Uniformization of Geodetic data for deformation analysis

Contribution to the research project:
Second phase of the long-term subsidence study in the Wadden Sea region (LTS2)

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Contents

Executive summary **5**

1 Introduction **7**

2 Use of double-difference (DD) data **11**
2.1 Definition of double-differences 11
2.2 Rationale behind the use of DD observations 11

3 Unified multi-format geodetic dataset **13**

4 CUPiDO: a tool to generate double-differences **15**
4.1 Reading the data 15
4.2 Constructing the SD2DD transformation 17
4.3 Transforming SDs to DDs 20
4.4 Construction of idealization noise covariance matrix 21
4.5 Creating the final output 24

5 Leveling data preparation **25**
5.1 Stochastic model 26
5.2 Adjustment and testing by Move3 27
5.3 Move3 to NetCDF conversion 28
5.4 Detection of outliers 29

6 GPS data preparation **31**
6.1 06-GPS Network and Processing 32
6.1.1 The monitoring network 32
6.1.2 GNSMART processing 35
6.1.3 Reference station coordinates 37
6.2 Generation of CUPiDO GPS dataset 38
6.2.1 Time-series analysis 40
6.2.2 Preparation of CUPIDO dataset 45
6.2.3 Cluster analysis and cluster stability detection 47
6.2.4 Cluster analysis: modeling the benchmark instabilities stochastically 49
6.2.5 Stochastic model 50
6.3 Platform GPS Surveys (1993 – 2004) 53
6.4 Discussion and recommendations 54

7 Conclusion **57**

References **59**

Appendix A Precision of hydrostatic leveling **61**

Appendix B Idealization noise components for geo-modelers 63
Appendix B.1 Further decomposition of idealization noise model . . . 64

Appendix C 2nd-order statistics for double-differences of random processes with fractional Brownian motion 65
Appendix C.1 Fractional Brownian motion 65
Appendix C.2 2nd-order statistics for double-differences (DDs) 65

Appendix D CUPiDO software 69

Appendix E lts2_insert_hydro_stoch_model processing output 71

Appendix F lts2_move3_to_netcdf processing output 91

Appendix G lts2_outlier_detection processing output 145

Appendix H lts2_plot_levelling_campaigns processing output 161

Appendix I lts2_visual_hydro_check processing output 177

Appendix J lts2_merge_lvl_gpsbaselines processing output 189

Appendix K lts2_gpscors processing output 217

Appendix L lts2_gps processing output 245

Appendix M lts2_rename_cors processing output 313

Appendix N lts2_seasonal_correction processing output 317

Appendix O lts2_gps_baselines processing output 321

Executive summary

This study proposes a new approach for the analysis and preparation of geodetic data for the use in geomechanical modeling. The approach is based on two main parts: uniformization of the data using a standardized data format, and the development of a conversion tool to construct double-difference observations.

This study is a follow-up of the project: "Research and Development Project for Geodetic Deformation Monitoring (Long-term study on anomalous time-dependent subsidence in the Wadden Sea region (LTS1))" [1]. The basic recommendations of that project are summarized as:

1. Do not combine/interpolate different geodetic datasets prior to geomechanical modeling, and introduce different geodetic data separately into the model.
2. Use the full covariance matrix of the geodetic data (comprises both measurement noise and idealization noise effects).
3. Use double-differences (DD) as an optimal interface between geodetic data and geomechanical modeling.
4. Use the proposed approach for detection and removal of only the most obvious outliers (blunders) from the geodetic data prior to the geomechanical modeling.

The objective of the current long-term study on anomalous time-dependent subsidence in the Wadden Sea region (LTS2) is to develop the required tools for preparation of the geodetic datasets based on the recommendations above. The methodology is developed for the analysis of GPS and leveling data[1].

The proposed approach is based on two main parts:

1. Generation of standardized datasets of single-difference (raw) geodetic measurements.
2. Development of a conversion tool to create double-difference displacements and the corresponding covariance matrices.

Although the study has been conducted in the framework of the LTS2 project for the subsidence analysis of the Ameland case, the proposed approach can be used for any deformation study using geodetic data. Therefore, this report has been written in a more generic sense as a stand-alone document[2] that describes the proposed methodology. However, the application of the proposed approach for the Ameland case is explained in detail.

[1] InSAR data has not been used for the LTS2 project due to the low density of InSAR measurement in the area of interest (Ameland). Therefore, all the algorithms of this study have been developed and applied only on GPS and leveling data (including hydrostatic leveling data). However, the generic methodology of the study can be extended to incorporate InSAR data and other geodetic data as well.

[2] The intention is to publish this report as an individual scientific paper.

1. Introduction

For many geophysical applications, geodetic data is used to estimate or constrain a model. A range of geodetic techniques is available to acquire these data, such as leveling, the Global Positioning System (GPS), and Interferometric Synthetic Aperture Radar (InSAR). These techniques have in common that measurements are acquired at certain locations, and that these measurements can be repeated over time. However, there are also many differences between the techniques. Typically, the measurement stations or benchmarks will not be the same. Furthermore, the spatial density varies strongly, see Figure 1. Leveling observations are made between fixed benchmarks founded in objects, which are typically hundreds of meters apart. GPS measurements are acquired, either continuously or campaign-based, at a limited number of stations. InSAR uses radar signal reflections of certain objects on the surface, with a spatial density of 100 to 10000 points per km^2.

Apart from the spatial distribution, the temporal density and coverage also differs per technique. Leveling campaigns are typically performed every 3-10 years, GPS receivers can provide a new measurement up to every 15 seconds, and the repeat cycle of SAR satellites ranges between 6 and 35 days. Also the directional sensitivity of the measurements varies. By leveling, height differences are measured (Up-direction), GPS provides 3D positions, and InSAR results in displacements in the radar Line-of-Sight, which is dependent on the heading of the satellite and the incidence angle of the signal at the surface. Apart from the differences in station or benchmark locations, measurement epochs, and sensitivity direction, the data may have different reference points and reference systems (geodetic datums), different accuracies, and different data formats. To conclude, the available geodetic datasets are strongly non-uniform.

Nevertheless, this non-uniformity also provides opportunities. Because of the complementary in spatial density and coverage of the measurements, in the temporal density and coverage, as well as in the direction sensitivity of the measurements (1D vertical, 3D or Line-of-Sight), it is attractive to combine the data for an integrated analysis or modeling. However, this integration is not straightforward. In previous work, often an interpolation is applied prior to geophysical modeling, for instance by Kriging [2] or least-squares prediction, to spatially or/and temporally collocate the measurements acquired by the various techniques.

For example, in [3, 4], leveling, GPS and InSAR data are integrated by Kriging-based collocation of linear deformation rates obtained by the different techniques. The use of linear rates is attractive, since the time-references are canceled. However, although for the slow tectonic motions studied in this paper the assumption of linearity may be valid, for many applications the non-linearity of the deformation signal should be preserved. In general, interpolation of geodetic data prior to geo-modeling has the disadvantage that it requires a-priori knowledge about the spatio-temporal smoothness of the deformation signal, and thereby it implicitly introduces constraints on the signal of interest. This is undesirable for the modeling, since subjective a-priori knowledge may result in a bias in the interpolated data, which can be propagated into the modeling. To avoid the potential bias, it is recommended not to interpolate the data, and instead to introduce different geodetic data sources (and their corresponding stochastic model or covariance matrices) separately into the modeling. This way, the data integration is

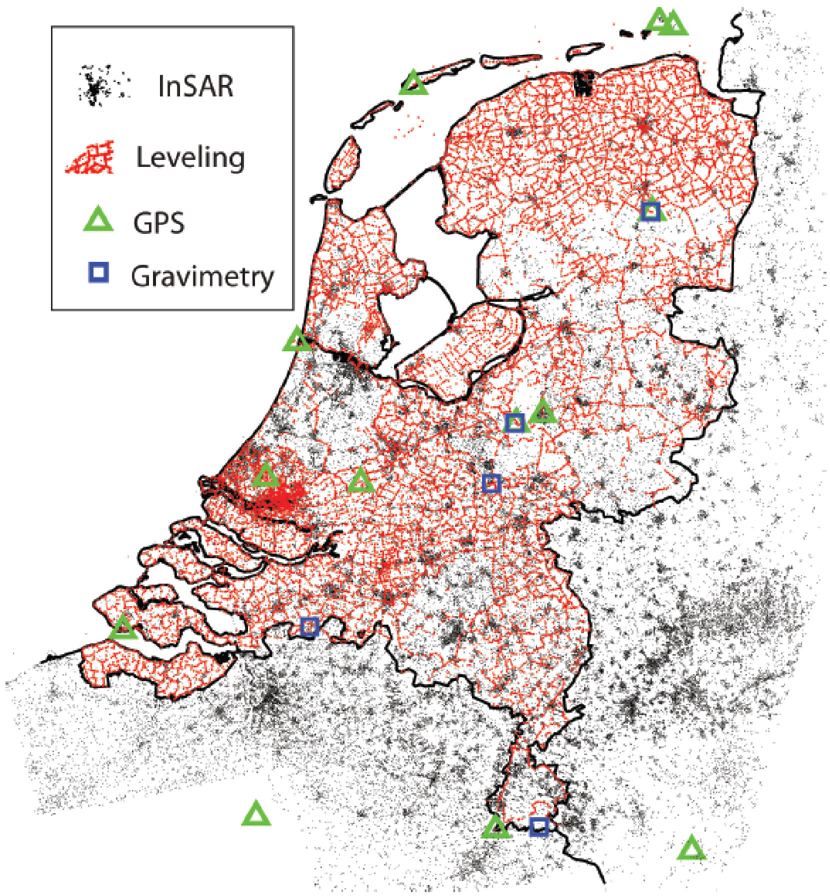

Figure 1: Example of distribution of geodetic benchmarks/stations over the Netherlands for various techniques.

applied implicitly in the model parameter space instead of in the observation space. To prepare different geodetic data with different properties for the modeling, we propose in this paper to use double-difference (DD) observations as the unified configuration for the geodetic data. The use of DD observations has some advantages, which are discussed in detail in Section 2. It should be noted that the concept of using DD observation for the modeling is already applied in various studies, for example in [5, 6, 7]. However, these studies were limited to the use of leveling or InSAR data only.

For an optimal use of all available geodetic data in modeling, including their stochastic properties, an additional step is required. In this contribution we present our approach to construct an optimal set of DD observations based on multi-technique datasets. The approach is based on a uniformization of the datasets and the generation of the optimal set of DD observations, including their covariance matrix[3]. In Section 2 the rationale behind the use of DD observations is discussed. Sections 3 and 4 present the developed approach, consisting of a uniform data format based on the NetCDF file format and the conversion tool to generate the DD observations. In Sections 5 and 6 the preparation of the leveling and GPS data for the Ameland region is described. The conclusions can be found in Section 7.

[3]At this stage, the implementation is based on leveling and GPS data only.

2. Use of double-difference (DD) data

2.1. Definition of double-differences

In our approach, the objective is to transform all the geodetic data in a so-called *double-difference* (DD) form[4]. With 'double-difference', we mean differences in both time and space. For example, in the case of height measurements, a DD observation shows the change in the height difference between two points at two epochs. Figure 2 shows the schematic definition of DD observations. In a mathematical form, a DD height observation y_{DD} is defined as:

$$y_{\mathrm{DD}} = \underbrace{(H^{T_{\mathrm{to}}}_{P_{\mathrm{to}}} - H^{T_{\mathrm{to}}}_{P_{\mathrm{from}}})}_{\Delta H^{T_{\mathrm{to}}}} - \underbrace{(H^{T_{\mathrm{from}}}_{P_{\mathrm{to}}} - H^{T_{\mathrm{from}}}_{P_{\mathrm{from}}})}_{\Delta H^{T_{\mathrm{from}}}}, \qquad (1)$$

where

- H^T_P denotes the height of the point P at epoch T,
- P_{to} and P_{from} denote two different stations or benchmarks,
- T_{to} and T_{from} denote two different epochs, and
- ΔH^T indicates the height difference (or spatial single-difference) between two points at epoch T.

Although the definition of Eq. (1) has been given for height measurements, hence in vertical or *Up*-direction, it can easily be used for other components (e.g., the *North*- and *East*-coordinates of GPS data, or Line-of-Sight measurements of InSAR).

2.2. Rationale behind the use of DD observations

The rationale behind the use of DD observations for deformation studies is as follows. First, regarding the differencing in the time domain, the models that are used in deformation modeling via inverse/forward problems are usually relative in time. In fact, the entity *deformation* is, by definition, relative in time.

Secondly, regarding the spatial differencing, most of the geodetic data (e.g., leveling, InSAR, baseline-GPS data) are inherently relative in space. For example, leveling data are measurements of height differences between benchmarks. Even after geodetic adjustment and the linking to a datum, the results show the spatially relative heights with respect to a chosen reference point or reference datum. In addition, the undifferenced or single-differenced geodetic measurements can simply be transformed to DDs (note that the inverse is not always possible), and therefore, the DD configuration can be used as a unified format for all different kinds of geodetic data.

Another advantage of using the DD configuration is that DD observations are invariant with respect to the selection of the reference datum. For example, changing the reference epoch or reference point in leveling networks does not have any effect on DD observations. This property creates the flexibility of directly using different geodetic

[4] It should be noted that one of the generic recommendations of the LTS1 geodetic project was that the final geodetic deliverables are double-difference (DD) (or spatio-temporal) observations [1].

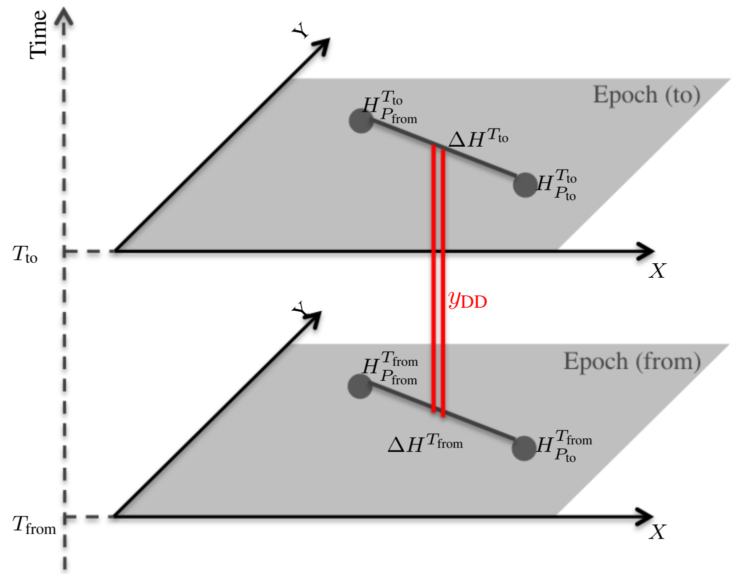

Figure 2: Schematic explanation of DD height observations (y_{DD}) between points P_{to} and P_{from}, and between epochs T_{to} and T_{from}. The X- and Y-axis indicate an arbitrary reference system.

datasets with different datums in deformation modeling without any need for further datum connection.

Furthermore, in case of deformation models that account only for localized mechanisms (for example reservoir/geomechanical models that are used for subsidence modeling), using the DD configuration has also the advantage of excluding the contribution of global/common deformation mechanisms from the geodetic data[5].

To generate the double-differences of geodetic observations and the associated covariance matrix, we developed a two-step approach. First, the original multi-format geodetic datasets are converted to a common NetCDF file format, see Section 3. Second, a tool is used to generate the optimal set of DD observations based on the NetCDF files. This tool is described in Section 4. The tool, named CUPiDO – Connecting Undifferenced Points in Deformation Observations – will be made publicly available.

[5]Note that, although the exclusion of global mechanisms is desirable for a local deformation modeling and can be considered as an advantage of using DD observations, this exclusion should be considered as a disadvantage of using DD measurements for studying global mechanisms themselves as it results in loss of information about the signal of interest.

3. Unified multi-format geodetic dataset

The first step of the approach is to convert the multi-format original datasets (leveling, GPS) to a common NetCDF format [8]. The NetCDF file format is a widely accepted standard for (scientific) datasets. The format has a number of attractive characteristics [9]. First, NetCDF files are self-describing, based on the metadata stored within the file. Second, the format is array-oriented, allowing to store a multitude of arrays within the same file. This array-oriented structure facilitates an efficient selection and appending of data. Third, the format is multi-platform (among which Linux, OSX, Windows), and is supported by a wide range of programming languages, such as C++, Python and Matlab, and applications.

In principle, all datasets can be inserted in a single NetCDF file. However, from a practical point of view, also multiple files, for instance one per measurement technique, can be created. The data is stored in spatial single-difference (SD) form. Together with the observations, also the associated covariance matrix describing the measurement noise is inserted.

The structure of the data in the NetCDF file is based on a schema with three categories: station data, project data, and observation data, see Table 1. The station data contains the names, coordinates and classes of the stations/benchmarks involved. Similarly, the project data contains the names, epochs and classes of the measurement projects/epochs. Using indices into these station data and epoch data arrays, the single-differences are specified. For example, the `stationFromIndex`, `stationToIndex` and `projectIndex`, refer to the two stations and epoch involved. The actual observation is stored in the `sdObs`[6] array, which has a correspond-

[6]Please note that sd in the variable names denotes 'single-difference', and should not be confused with 'standard deviation'.

Table 1: CUPiDO NetCDF data structure

Category	Variable name	Description
Station data	station_name	Name of station
	x	X-coordinate [m]
	y	Y-coordinate [m]
	station_class	Station class identifier [LEV|CORS|GPS|SYN_BM|INSAR]
Project data	project_name	Project name
	project_epoch	Project epoch, date number with respect to 1-1-1970
	project_class	Project class identifier [GPS|LEV[#]] with # the leveling order
Observations	stationFromIndex	Index of 'from' station (in Station data)
	stationToIndex	Index of 'to' station (in Station data)
	projectIndex	Index of project (in Project data)
	epoch	Epoch, date number of with respect to 1-1-1970
	sdObs	Observations [m]
	sdCov	Covariance matrix [m^2]
	sdObsFlag	Observation flag, e.g., ...
	sensitivity	Sensitivity matrix

ing covariance matrix with the measurement noise. An additional array is available to flag outliers. Here, a zero indicates a good observation, whereas any higher number indicates a certain type of outlier, which can be specified by the user. Finally, the sensitivity array contains unit vectors indicating the direction of sensitivity of the particular observation in North, East, and Up direction. For example, leveling observations are only sensitive to deformation in Up direction, resulting in a [0 0 1] vector. For GPS observations, the North, East and Up component can be inserted in the NetCDF file by specifying [1 0 0], [0 1 0] and [0 0 1], respectively.

The NetCDF file contains global attributes describing the origin of the data, creation date, and other information of interest. Furthermore, the NetCDF contains for each array a short description and the unit that is used. These attributes can be viewed not only with the CUPiDO tool, but with any NetCDF viewer or browser.

With all the datasets in the same NetCDF format, the conversion tool can be used to generate a consistent set of DD observations.

4. CUPiDO: a tool to generate double-differences

The main functionality of the CUPiDO tool is to construct a subset of DD observations based on the user's input such as the region of interest (ROI), the period of interest (POI), and the technique of interest (TOI). The associated measurement noise covariance matrix of DD measurements is also constructed by propagating the covariance matrix of the original spatial SDs to the final DD covariance matrix. In addition to the measurement noise covariance matrix, the CUPiDO tool also has the functionality to construct the covariance matrix of the so-called *idealization noise* components[7] (for more information on idealization noise, see Appendix B). Figure 3 depicts the generic concept of the CUPiDO tool, and Table 2 list the inputs and outputs of the tool.

The methodology that we implemented in the CUPiDO tool to construct a subset of double-differences based on the user inputs can be divided into five generic steps (see the symbolic algorithm in Figure 4):

1. Reading the required data.
2. Constructing a SD2DD transformation matrix that transforms the SD observations (stored in the NetCDF files) to DD observations.
3. Transforming the SDs and their covariance matrix to DD observations and the corresponding measurement-noise covariance matrix.
4. Constructing the idealization-noise covariance matrix.
5. Creating the final output.

In the following these steps are described in more details.

4.1. Reading the data

In this step, based on the user input the required data is extracted from the geodetic database. For every technique listed in the user input TOI, a subset of SD observations with project epoch within the period of interest (POI) is selected. The results will be a vector of selected SDs and their corresponding covariance matrix per technique. If $y_{\text{sd}}^{\text{gn}}$, $y_{\text{sd}}^{\text{ge}}$, $y_{\text{sd}}^{\text{gu}}$, and $y_{\text{sd}}^{\text{lev}}$ are the select SD vectors for the three GPS components and the leveling, respectively, the final vector of selected SDs is:

$$y_{\text{sd}} = \begin{bmatrix} y_{\text{sd}}^{\text{gn}} \\ y_{\text{sd}}^{\text{ge}} \\ y_{\text{sd}}^{\text{gu}} \\ y_{\text{sd}}^{\text{lev}} \end{bmatrix}, \tag{2}$$

[7] In the context of deformation modeling, the term noise not only comprises the uncertainty of the measurements itself but also it subsumes all signal (or deformation) components in geodetic observations that are not related to the signal of interest. Based on this definition, we encounter two different kinds of noise. One is the random error of the measurements themselves, called measurement noise, and another covers any other kind of deformation signal other than the signal of interest. The latter is denoted as *idealization noise*.

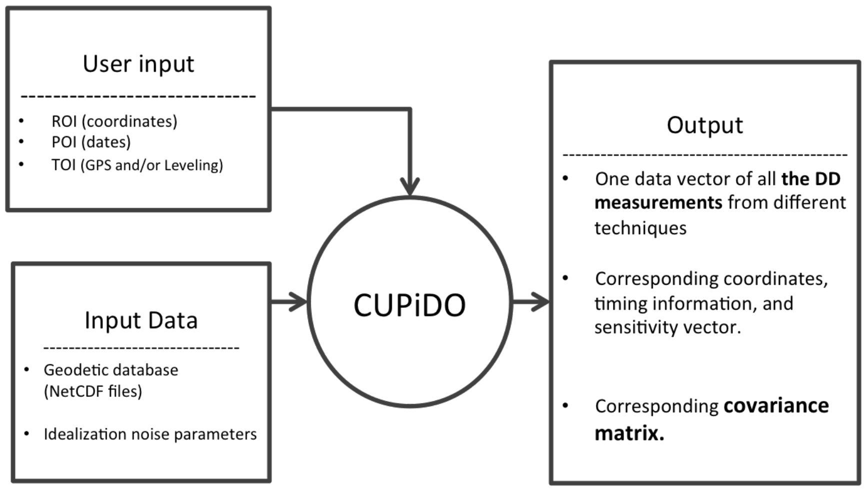

Figure 3: Generic concept of the CUPiDO tool.

Table 2: CUPiDO tool: overview of Inputs and Outputs

I/O	Description/Format
Input data:	
Leveling Data	NetCDF file with leveling data
GPS data	NetCDF file with GPS data
Noise parameters	CSV file with idealization precision model parameters
User input:	
POI	Period of interest: start and end dates
ROI	Region of interest: coordinates of a polygon of the area of interest
TOI	Techniques of interest:
	LEV = leveling
	GPS1D = GPS in Up-direction
	GPS3D = GPS in North-, East-, Up-direction
	or combination of above options (LEV+GPS1D or LEV+GPS3D)
Output:	
DD_OBS	$m \times 1$ vector of double-difference observations (m: number of constructed DDs)
DD_COV_MX	$m \times m$ Covariance matrix of double-difference observations
DD_TABLE	Table of double-differences with eight columns:
	1) name of 'from' station, 2) name 'to station'
	3) name of 'from' project, 4) name 'to project'
	5) North-sensitivity, 6) East-sensitivity, 7) UP-sensitivity
	8) Technique identifier (GPSN, GPSE, GPSU, or LEV)
BENCHMARKS	Table of used benchmarks with three columns:
	1) Benchmark name, 2) X-coordinate, 3) Y-coordinate
DATES	Table of used projects/epochs with two columns:
	1) name of the project, 2) dates (yyyymmdd)

and its corresponding covariance matrix will be:

$$\begin{bmatrix} Q_{y_{\text{sd}}^{\text{gn}}} & & & \\ & Q_{y_{\text{sd}}^{\text{ge}}} & & \\ & & Q_{y_{\text{sd}}^{\text{gu}}} & \\ & & & Q_{y_{\text{sd}}^{\text{lev}}} \end{bmatrix} \quad (3)$$

Hence, this results in a block-diagonal covariance matrix, since the measurements of different techniques are uncorrelated and the assumption is made that the North-, East-, and Up-components of the GPS measurements are uncorrelated as well.

Note that in this selection step, we do not apply any spatial subset selection based on the user's input ROI. The reason is that the SDs outside the ROI may still be useful for connecting two benchmarks inside the ROI. The selection in space will be handled in the next step during the construction of the SD2DD transformation.

CUPiDO tool implementation

Input:
User inputs: ROI, POI, and TOI
Geodetic datasets (NetCDF files)
Idealization noise parameters
begin
1. Reading the required SDs and their covariance matrix $\longrightarrow y_{\text{sd}}, Q_{\text{sd}}$
2. Constructing SD2DD transformation matrix $\longrightarrow S$
3. Transforming the SDs and their covariance matrix to DDs:
   $y_{\text{dd}} = Sy_{\text{sd}}$, and $Q_{e_{\text{dd}}} = SQ_{\text{sd}}S^T$
4. Constructing the idealization-noise covariance matrix $\longrightarrow Q_{i_{\text{dd}}}$
5. Creating the final output
   DD_OBS: y_{dd}
   DD_COV_MX: $Q_{\text{dd}} = Q_{e_{\text{dd}}} + Q_{i_{\text{dd}}}$
   DD_TABLE, BENCHMARKS, DATES

end

Figure 4: Symbolic algorithm for implementation of CUPiDO tool.

4.2. Constructing the SD2DD transformation

The objective of this step is to construct a transformation that creates a set of double-differences based on all the observations in the region and period of interest. The two criteria for the final set of DDs are

1. all the corresponding from/to-stations should be in the ROI.
2. all the corresponding from/to-projects should be within the POI.

The logic behind the designed algorithm is to keep the number of from-stations and from-projects as minimum as possible. For example, if it is possible to connect all the observations in the region and period of interest to a single from-station (or reference point) and a single from-project (or reference epoch), then the output set of DDs will all have the same from-station and from-project. It should be noted that, if the full covariance matrix of geodetic observations is used in the geomechanical modeling, it is possible to safely use a single reference point and reference epoch, and there is no need for using multiple references, as indicated in [1]. See [10] for more information.

This step is applied separately for each technique and directional component (i.e., three components of GPS and leveling). As a results, no cross-DD are constructed between different techniques[8].

The generic algorithm to construct the SD2DD transformation (per technique) can be summarized in the following steps (see Figure 5):

1. First, we select all the SDs whose from-stations or to-stations are located in the ROI. This selection forms a set of SDs denoted by $y_{\text{sd}}^{\text{sel}}$.
2. The set of all stations/benchmarks in the ROI are selected, forming a set denoted by $P_{\text{bm}}^{\text{sel}}$.
3. From all the stations in $P_{\text{bm}}^{\text{sel}}$, the station with the maximum number of connections to other stations is selected as a from-station.
4. Then a transformation is build to create all the possible DDs by connecting the SDs to the selected from-station in the previous step, following by the differencing in the time domain (see Figure 5 for more details).
5. If there are still SD observations in $y_{\text{sd}}^{\text{sel}}$ which remain disconnected to the current set of DDs, then steps 3 and 4 are repeated with a new from-station (unless all the stations in $P_{\text{bm}}^{\text{sel}}$ are already selected as the from-station in step 3).
6. The final SD2DD transformation matrix is constructed by integrating all the transformation matrices from the iteration:

$$S_{\text{sd2dd}} = \begin{bmatrix} S_{\text{sd2dd},1} \\ \vdots \\ S_{\text{sd2dd},i} \end{bmatrix}, \tag{4}$$

   where i is the total number of iterations.

The above algorithm results in an individual SD2DD transformation matrix for leveling and the three GPS components. If $S_{\text{sd2dd}}^{\text{gn}}$, $S_{\text{sd2dd}}^{\text{ge}}$, $S_{\text{sd2dd}}^{\text{gu}}$, and $S_{\text{sd2dd}}^{\text{lev}}$ denote the transformation matrices for the three GPS components and the leveling, the final SD2DD

[8]Note that the construction of cross-DDs between the GPS Up-component and the leveling data, in principle, is possible. However, a number of biases may be introduced by creating these DDs. First, especially when an odd number of GPS measurements is involved, the uncertainty in the geoid undulation will directly affect the DD. Second, differences in the tidal stage at the time of the measurements may introduce an additional offset. For instance, hydrostatic leveling measurements are always acquired at high tide. For the GPS measurements, this may not be accounted for. To avoid these potential biases, the combination of different techniques in a single DD has not been implemented in the current version of the CUPiDO tool.

Implementation of SD2DD transformation (per technique)

Input:
All the selected SDs (y_{sd})
Covariance matrix of the selected SDs (Q_{sd})
begin
1. Select SDs whose from-station or to-station are located in ROI $\longrightarrow y_{\text{sd}}^{\text{sel}}$
2. Select all the stations (contributed in $y_{\text{sd}}^{\text{sel}}$) that are located in ROI $\longrightarrow P_{\text{bm}}^{\text{sel}}$

- Set the iteration counter $i = 0$

begin

3. Set $i = i + 1$, and select a station in $P_{\text{bm}}^{\text{sel}}$ with the maximum number of connections to other stations $\longrightarrow R_i$ (selected as a from-station)

4. **begin**

for *every project/epoch in* y_{sd}^{sel} *($j = 1 \dots N$)* **do**
Construct the transformation to connect the corresponding SDs in $y_{\text{sd}}^{\text{sel}}$ to $R_k \longrightarrow S_{\text{sd2R},j}$ (not all the SDs can be connected)
end
- Construct final $S_{\text{sd2R}} = [S_{\text{sd2R},1}^T \dots S_{\text{sd2R},N}^T]^T$

for *every station in* P_{bm}^{sel} *($k = 1 \dots M$)* **do**
Construct the transformation to make DDs by differencing in time (for every point, the earliest project is used as the from-project) $\longrightarrow S_{\text{sdR2DD},k}$ (not all the SDs can be connected)
end
- Construct $S_{\text{sdR2dd}} = [S_{\text{sdR2dd},1}^T \dots S_{\text{sdR2dd},M}^T]^T$

- Construct final SD2DD transformation in the ith iteration
$\longrightarrow S_{\text{sd2dd},i} = S_{\text{sdR2dd}} S_{\text{sd2R}}$

end

5. **Until**
all SDs in $y_{\text{sd}}^{\text{sel}}$ are connected to one the from-point $R_1 \dots R_i$, or
all the stations in $P_{\text{bm}}^{\text{sel}}$ are checked as a from-point
Repeat steps 3 and 4

end

6. Construct the final SD2DD transformation $S_{\text{sd2dd}} = [S_{\text{sd2dd},1}^T \dots S_{\text{sd2dd},i}^T]^T$

end

Figure 5: Symbolic algorithm of construction of the SD2DD transformation.

transformation matrix is constructed as:

$$S = \begin{bmatrix} S^{\text{gn}}_{\text{sd2dd}} \\ S^{\text{ge}}_{\text{sd2dd}} \\ S^{\text{gu}}_{\text{sd2dd}} \\ S^{\text{lev}}_{\text{sd2dd}} \end{bmatrix} \tag{5}$$

The output transformation matrix S will be used in the next step to transform the SDs and their covariance matrix to the set of double-differences and its corresponding covariance matrix.

Note on potential linearly dependent DDs: The proposed algorithm does not guarantee that all the resulting DDs are linearly independent from each other. In other words the final S matrix may have linearly dependent rows (i.e., S will be rank-defect). This rank-deficiency will also results in singularities in any covariance matrix that is constructed by error propagation via S. This problem can cause a non-invertible covariance matrix. If the inverse of the covariance matrix is needed, the pseudo-inverse should be used [11, 12][9].

Note on the different implementation for GPS data: In the current implementation it is assumed that all the GPS single-differences in NetCDF files have a common from-station (i.e. the synthetic benchmark, see Section 6). As a consequence there is no need for any transformation in the spatial domain, and so the SD2DD transformation can easily be constructed by just accounting for differencing in the time domain. In the current implementation for the GPS data, we use a simpler version of the SD2DD construction, which does not apply step 3 (i.e. selection of the from-point) and do not apply any spatial transformation.

4.3. Transforming SDs to DDs

In this step the transformation matrix S is utilized to transform the SD observations in y_{sd} to the final set of DD observations y_{dd}:

$$y_{\text{dd}} = S y_{\text{sd}}. \tag{6}$$

Also the covariance matrix of the DD observations is constructed via linear error propagation:

$$Q_{e_{\text{dd}}} = S Q_{\text{sd}} S^T, \tag{7}$$

where $Q_{e_{\text{dd}}}$ is the DD covariance matrix. Note that with the subscript e in $Q_{e_{\text{dd}}}$, we indicate that this covariance matrix is associates to the measurement errors (e for 'errors'). In the next step of the CUPiDO algorithm, the idealization noise covariance matrix is constructed.

[9]In future versions of the CUPiDO tool, this problem can be solved by selection of a set of independent rows of S based on householder QR factorization of S [13]. In this way, the rows in S which create linearly dependent observations can be removed. As a result, the final S matrix will be of full row-rank.

4.4. Construction of idealization noise covariance matrix

In the context of deformation modeling, the term *idealization noise* is associated with deformation components in geodetic observations that are not related to the signal of interest. For example, for modeling of subsidence induced by deep gas production, the signal of interest is the deformation induced by deep mechanisms such as reservoir compaction or aquifer depletion. Therefore, the deformation caused by shallow sources (e.g., independent motion of individual benchmarks due to their structural instabilities, or shallow compaction of the Holocene layer) should be considered as noise and thus be described by the stochastic model (i.e., covariance matrix). See Appendix B for more information on the definition of idealization noise components.

The idealization noise model used in the CUPiDO tool is based on the model proposed in [1]. The model is based on random processes with fractional Brownian motion (see [14] and Appendix C). The model comprises two components: the spatio-temporally correlated noise component with the covariance matrix Q_{st}, and the temporally correlated noise component with the covariance matrix Q_t. In the following the computation of Q_{st} and Q_t is explained.

Spatio-temporally correlated idealization noise The model for spatio-temporally correlated idealization noise describes this component (here denoted by z) as a random process with fractional Brownian motion in the time domain, and correlated second-order stationary behavior in space. For such a random process, the second-order statistics (i.e., variance and covariances) are defined as:

$$\mathrm{D}\{\underline{z}_i^{t_1}\} = q_{ii}^{11} = \sigma_s^2 t_1^{p_s}, \tag{8}$$

and

$$\mathrm{C}\{\underline{z}_i^{t_1}, \underline{z}_j^{t_2}\} = q_{ij}^{t_1 t_2} = \frac{1}{2}\sigma_s^2 (t_1^{p_s} + t_2^{p_s} - \Delta t_{12}^{p_s}) e^{-\frac{h_{ij}}{L}}, \tag{9}$$

where

- z_i^t is the noise component of point i at epoch t
- t_1 and t_2 are two epochs
- $\mathrm{D}\{\underline{z}_i^{t_1}\}$ (symbolized by q_{ii}^{11}) is dispersion (variance) of $\underline{z}_i^{t_1}$
- $\mathrm{C}\{\underline{z}_i^{t_1}, \underline{z}_j^{t_2}\}$ (symbolized by q_{ij}^{12}) is the covariance between $\underline{z}_i^{t_1}$ and $\underline{z}_j^{t_2}$,
- h_{ij} is the distance between the two points,
- $\Delta t_{12} = |t1 - t2|$, and
- σ_s^2, L, and p_s are the three parameters of the noise model (variance, correlation length, and power index).

For such a random process with variance and covariances of Eqs. (8) and (9), the covariance between two double-differences $z_{ij}^{t_1 t_2}$, and $z_{kl}^{t_3 t_4}$ can be computed by error propagation as (see the proof in Appendix C, Eq. (C.7)):

$$\begin{aligned}
\mathrm{C}\{\underline{z}_{ij}^{t_1t_2}, \underline{z}_{kl}^{t_3t_4}\} = q_{ik}^{13} - q_{ik}^{14} - q_{ik}^{23} + q_{ik}^{24} \; ...\\
-q_{il}^{13} + q_{il}^{14} + q_{il}^{23} - q_{il}^{24} \; ...\\
-q_{jk}^{13} + q_{jk}^{14} + q_{jk}^{23} - q_{jk}^{24} \; ...\\
+q_{jl}^{13} - q_{jl}^{14} - q_{jl}^{23} + q_{jl}^{24}.
\end{aligned} \tag{10}$$

Note that if $i = k$, $j = l$, $t_1 = t_3$, and $t_2 = t_4$, then the Eq. (10) evaluates the variance of DD observation $z_{ij}^{t_1t_2}$, and it reduces to:

$$\begin{aligned}
\mathrm{C}\{\underline{z}_{ij}^{t_1t_2}, \underline{z}_{ij}^{t_1t_2}\} = \mathrm{D}\{\underline{z}_{ij}^{t_1t_2}\} = q_{ii}^{11} - 2q_{ii}^{12} + q_{ii}^{22} \; ...\\
-2q_{ij}^{11} - 2q_{ii}^{22} + 4q_{ij}^{12} ...\\
+q_{jj}^{11} - 2q_{jj}^{12} + q_{jj}^{22}
\end{aligned} \tag{11}$$

The q components in these equations are computed by Eqs. (8) and (9). The parameters of the idealization noise model (i.e., σ_s^2, L, and p_s) are given as one of the inputs of the CUPiDO tool (see Table 2).

By evaluating Eqs. (10) and (11) for all pairs of the constructed DD observations (results of Eq. (6)), all the elements of the spatio-temporal idealization covariance matrix Q_{st} are computed.

Temporally correlated idealization noise The temporally correlated noise component is described as a random process with fractional Brownian motion in the time domain but without correlation in the space domain. For such a random process, the second-order statistics (i.e., variance and covariances) are defined as:

$$\mathrm{D}\{\underline{z}_i^{t_1}\} = q_{ii}^{11} = \sigma_{t_i}^2 t_1^{p_{t_i}}, \tag{12}$$

and

$$\mathrm{C}\{\underline{z}_i^{t_1}, \underline{z}_j^{t_2}\} = \begin{cases} q_{ii}^{t_1t_2} = \frac{1}{2}\sigma_{t_i}^2 (t_1^{p_{t_i}} + t_2^{p_{t_i}} - \Delta t_{12}^{p_{t_i}}), & i = j \\ 0 & i \neq j \end{cases} \tag{13}$$

where $\sigma_{t_i}^2$ and p_{t_i} are the two model parameters for station i. Note that, in this model, different stations can have different model parameters. This option gives the flexibility to assign different temporally correlated behavior to different classes of benchmarks, based on their construction/material properties, or their foundation depth and geotechnical characteristics. For the Wadden sea region, for example, it is reasonable to discriminate between onshore and offshore benchmarks. The onshore benchmarks are usually located on the wall of buildings, whereas the offshore benchmarks have a deep foundation. Together with the difference between the geological/geotechnical characteristics of these two regions, the possibility to differentiate in benchmark behavior is desirable. In the CUPiDO software, the $\sigma_{t_i}^2$ and p_{t_i} for different classes of stations are given via the input CSV file of noise parameters (see Table 2). These classes can be specified by the creator of the NetCDF files. For the LTS2 project, the following classes are used: `DEFAULT` (in case no class is specified), `GPS&OFFSH`,

GPS&ONSH, LEV&OFFSH, LEV&ONSH, CORS&ONSH (for a Continuously Operating Reference Station (CORS)), CORS&OFFSH, SYNBM (for a synthetic benchmark) and UNUSED (in case a station is not used in a DD). Hence, in general a combination of the technique and onshore/offshore location of the station is used.

Similar to the spatio-temporal noise component, the double-difference variance/covariances of the temporally correlated noise components are computed using Eqs. (10) and (11), however with the q components evaluated by Eqs. (12) and (13). By evaluating variances and covariances for all the pairs of the constructed DD observations, all the elements of the temporal idealization covariance matrix Q_t are computed.

Finally, by having both Q_t and Q_{st} the final idealization noise covariance matrix is computed as:

$$Q_{i_{dd}} = Q_{st} + Q_t. \tag{14}$$

Note on the computation of Eqs. (10) **and** (11) **for DDs with a synthetic benchmark:**

For some DD observations, either the 'from-station' or 'to-station' is associated to the synthetic benchmark. The synthetic benchmark represents the reference network used in the processing of geodetic data (for more information on the synthetic benchmark, see Section 6). For example, in the current implementation, the 'from-station' of all the GPS observations is the synthetic benchmark. As the reference network is the average of a large number of benchmarks, the effect of the idealization noise will be significantly reduced. So in the current implementation, it is assumed that the synthetic benchmark is not affected by idealization noise. For computation of Q_{st}, all the components corresponding to the synthetic benchmark in Eqs. (10) and (11) are assigned to zero. For example, if $i =$ SYNBM, all the q components with an i in the subscript will be zero. For computation of Q_t the variance of the temporally correlated noise of the synthetic benchmark is assigned to zero (i.e., $\sigma_{t_i}^2 = 0$ if $i =$ SYNBM).

Note on the choice of idealization noise parameters:

The CUPiDO tool allows the construction of a full idealization noise covariance matrix based on the aforementioned analytical model. However, the parameters of the model (i.e., σ_s^2, L, p_s, σ_t^2, and p_t) should be chosen by the user/modeler and inserted via the input CSV-file of noise parameters. The choice for these parameters should be based on some a-priori knowledge about possible spatio-temporally correlated mechanisms (e.g., shallow compaction), and also the possible temporally correlated noise components (e.g., autonomous movements of individual benchmarks). Some estimates of these parameters have been given by [15] based on Variance Component Estimation (VCE) of leveling networks over the whole of the Netherlands. A similar VCE approach has been applied by [1, 10] on the onshore leveling networks in a stable area close to the Wadden sea region. For the temporally correlated noise of offshore benchmarks, a potential choice of the parameters σ_t^2, and p_t are those which have been estimated based on VCE of DD measurements between offshore benchmarks with a very short distance to each other (see Section 6.2.4).

4.5. Creating the final output

The main outputs of the CUPiDO tool are the vector of the constructed DD observation and its covariance matrix. The vector of DD observations (y_{dd}) is computed in step 3 by Eq. (6). This vector is assigned to the output vector DD_OBS.

The final covariance matrix of DD observations is computed as

$$Q_{\text{dd}} = Q_{e_{\text{dd}}} + Q_{i_{\text{dd}}}, \tag{15}$$

where $Q_{e_{\text{dd}}}$ and $Q_{i_{\text{dd}}}$ are the covariance matrices of the measurement noise computed by Eq. (7), and the idealization noise evaluated by Eq. (14), respectively. The covariance matrix Q_{dd} is assigned to the output array DD_COV_MX.

In addition to DD_OBS and DD_COV_MX, three other output arrays are constructed:

- DD_TABLE: including station names of the corresponding benchmarks, epoch information, and sensitivity vector of all the constructed DD observations.
- BENCHMARKS: including station name and coordinates of all the used stations.
- DATES: including the project ID and dates of all the used projects/epochs.

In the framework of the LTS2 project, the CUPiDO tool has been utilized to provide input data for the reservoir/geomechanical modeling of the subsidence induced by gas production in Ameland region. In the following section, we describe the specific setting/preparation of the used geodetic data for Ameland case.

5. Leveling data preparation

The available leveling data is either acquired by optical leveling, both onshore and offshore, or by hydrostatic leveling (offshore). The data is typically obtained within a measurement campaign, covering a time span of days to months. An overview of the 29 available leveling campaigns in the Ameland region is given in Table 3.

To make use of the original redundant network of measurements acquired in the campaigns, we applied a campaign-based data adjustment and testing scheme using the Move3 software [16] to detect and remove outliers in the data. The resulting adjusted single-difference observations and their covariance matrix are inserted in the CUPiDO NetCDF file. If possible, the optical and hydrostatic leveling observations are adjusted and tested simultaneously. Once the adjusted observations per project are inserted in

Table 3: Available 29 leveling campaigns. For different reasons, three campaigns are not used. Some campaigns consist partly out of hydrostatic observations, the other campaigns are only based on optical leveling measurements. The specified date is the average date of the campaign.

Project name	Date (average)	Hydrostatic part	Remark
aml1986	07-04-1986	Yes	Not used, observations also in 279H05.
279H05	24-06-1986	Yes	
279H08		Yes	Not used, observation dates unclear, observations also in 289W05.
279H09		Yes	Not used, two separate networks, observation dates unclear, observations also in 289W05.
289W05	03-11-1987	Yes	
289W16	01-10-1988		
289W20	01-02-1990		
289W26	01-02-1991		
289W34	18-01-1992		
279W22	16-05-1992	Yes	
332W02	01-02-1993		
344W01	23-12-1993	Yes	
289W37	02-02-1994		
342W04	23-01-1995		
342W05	12-01-1996		
342W10	10-01-1997		
aml1998	30-01-1998		
371W00	01-05-1998	Yes	
aml1999	10-02-1999		
aml2001	04-07-2001	Yes	
aml2003	02-02-2003		
AMEL0409	15-09-2004	Yes	Two separate networks.
aml2005	13-03-2005		
70604-001 (20060203 - 0917)	16-01-2006		
231-70812 (20070302 - 1420)	18-01-2007		
231-70604 (20080325 - 1152)	18-03-2008		
Ameland_2009	22-02-2009		
NAM_AM2011	01-02-2011		
NAM_AM2014	25-02-2014		

the NetCDF file, an additional outlier detection scheme is applied in the time domain to flag obvious remaining outliers in the data.

To obtain this result, a four-step procedure is followed:

1. Insertion of the stochastic model for hydrostatic leveling data in the Move3 files.
2. Re-running of Move3 for the campaigns with hydrostatic leveling data.
3. Writing of the Move3 results to the NetCDF file.
4. Detection of outliers in the time domain.

These steps are described in the next sections. A detailed overview of the data preparation can be found in Appendix E-Appendix J.

5.1. Stochastic model

For the 29 leveling campaigns covering the area and period of interest, the Move3 observation files are available. However, in these files no distinction in the stochastic model is made regarding the type of leveling measurement. Instead, a unique value of 1 $\text{mm}/\sqrt{\text{km}}$ is inserted. This standard value will allow the detection of outliers in the data during the testing process. Moreover, in case all leveling measurements are of the same type, the use of this unique value allows for an a-posteriori scaling of the covariance matrix, see Section 5.3. However, for campaigns with a combination of different types of leveling observations, this is not possible, and the proper stochastic model should be inserted before the adjustment and testing scheme.

Here, we distinguish three types of leveling observations: optical leveling (either onshore and offshore), hydrostatic leveling, and short optical leveling. These short optical leveling measurements, typically made over a distance of around 10 meters, are made to connect the hydrostatic leveling measurements to onshore or offshore benchmarks. Because of the short distance, the model applied to the general optical leveling measurements would result in a too optimistic standard deviation. Therefore, a separate model for these short distance observations is introduced.

The stochastic models applied are:

1. Optical leveling: $\sigma = 0.76\ \text{mm}/\sqrt{\text{km}}$.
2. Hydrostatic leveling: $\sigma = 0.25 \cdot V$ mm, where $V = 0.8 + 0.1 \cdot L$ is the Tolerance and L is the trajectory length in km [17], see Appendix A.
3. Short optical leveling: 0.1 mm.

The value of 0.76 $\text{mm}/\sqrt{\text{km}}$ is adopted based on the Overall Model Test of all onshore leveling networks and because this is the default value for second-order leveling campaigns of Rijkswaterstaat.

Unfortunately, the original database of measurements does not contain a classification to measurement type. Hence, the proper stochastic model per measurement cannot be selected directly. Instead, a classification based on contextual information is made. The selection of hydrostatic leveling observations is based on

1. the offshore location of observations. To determine the offshore observations, the topology of the benchmarks and the observations is used. Starting point is an onshore/offshore classification of the fixed benchmarks (the coordinates of

the temporary benchmarks do not seem sufficiently reliable, and are not considered). Starting at the offshore benchmarks, offshore observations are selected iteratively, until an onshore benchmark is reached.

2. the length of the observation trajectory. An offshore observation is assigned as a hydrostatic observation when the length of the trajectory is either exactly 1000 m, or longer or equal to 2000 m and is rounded to a multiple of 50 m. Hence, an observation of 4150 m is selected, an observation of 4153 m is not.

An example of the topology-based selection of offshore observations is shown in Figure 6, Left.

For the selection of the short optical leveling measurements, which can occur both offshore and onshore, a threshold based on the distance of the trajectory is used. This threshold is set at the distance for which the stochastic model for optical leveling also provides a standard deviation of 0.1 mm, so that a continuous model is obtained. Hence,

$$0.76\sqrt{L_{\text{thres}}} = 0.1 \text{ mm}, \tag{16}$$

which results in

$$L_{\text{thres}} = (\frac{0.1}{0.76})^2 \approx 17 \text{ m}. \tag{17}$$

An example of the resulting classification is shown in Figure 6, Right. Please note that the coordinates of the temporary benchmarks used for the hydrostatic levelings are not reliable. Temporary benchmarks are used, because the distance between two fixed (onshore) benchmarks may have been too long and therefore intermediate points are required (the maximum available tube length for a hydrostatic leveling was 12 km) and because the hydrostatic leveling observations cannot be connected directly to fixed (onshore) benchmarks, and optical connection measurements are required, which again requires an intermediate benchmark. Because the coordinates of these temporary benchmarks were not relevant and cumbersome to determine (particularly in the pre-GPS era), the coordinates are unreliable. Therefore, some classification results in Figure 6 appear to be erroneous. However, since the classification is based on the topology and not on the coordinates of these benchmarks, the classification is assumed to be sufficiently reliable.

Based on the classification, the Move3 observation files of 9 campaigns with hydrostatic leveling observations are updated accordingly, see Table 3. Campaign aml1986 was excluded in an earlier stage and is therefore not considered here. Note that the standard deviation of the hydrostatic leveling observations are evaluated based on the trajectory length and inserted in the Move3 file as a constant. The alternative, insertion of the original model $\sigma = 0.25 \cdot V = 0.2 + 0.025L$ mm is not possible, since Move3 cannot handle stochastic model parameters with 3 decimal numbers. The optical and short optical leveling models, 0.76 $mm\sqrt{\text{km}}$ and 0.1 mm respectively, are inserted directly.

5.2. Adjustment and testing by Move3

Based on the updated Move3 observation files, the combined optical/hydrostatic leveling campaigns are adjusted and tested. For the testing, a level of significance of

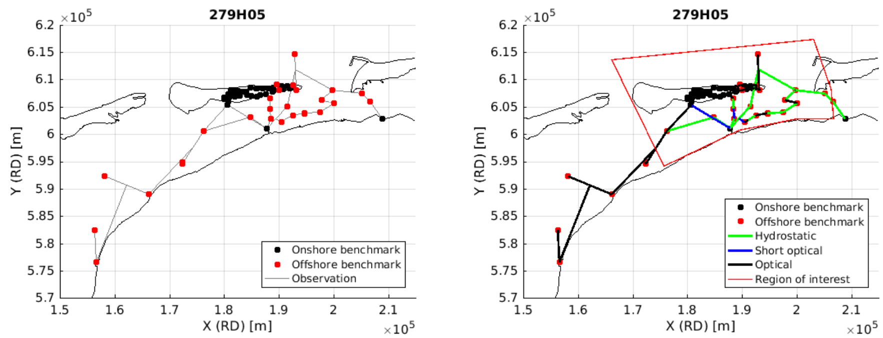

Figure 6: Example for campaign 279H05 of the classification of leveling observations based on the location of benchmarks, the topology of the benchmarks and observations, and the length of the observation trajectories. Left) Classification of onshore and offshore benchmarks. Right) Final classification in leveling type based on topology and observation trajectory length.

the one-dimensional test α_0 of 0.05 is applied, together with a power of the test γ of 0.8. For each campaign, the testing procedure (data-snooping) is applied until the Overall Model Test (OMT) is accepted [18]. In fact, in this testing step, we detect and remove gross observation errors that are detectable based on closed-loop conditions within one epoch, using standard geodetic testing techniques, i.e., the OMT and w-test [18]. The testing resulted per campaign in only a small number of removed observations and disconnected (and therefore removed) benchmarks. In case a campaign consisted of two separate networks, two individual Move3 runs are performed. In total, this resulted in 9 adjusted and tested combined optical/hydrostatic leveling campaigns, of which two campaigns consist of two separate networks. Because the observation dates of campaigns 279H08 and 279H09 appeared to be unclear, and the observations of these campaigns are also contained in the dataset of campaign 289W05, it was decided in consultation with the NAM to exclude these campaigns. As a result, the final dataset of leveling data used consists of 26 campaigns, see Table 3.

5.3. Move3 to NetCDF conversion

Once the leveling data is adjusted and tested per campaign, the adjusted height differences with respect to a reference benchmark and the corresponding covariance matrix is inserted in the CUPiDO NetCDF file. For the combined optical/hydrostatic leveling campaigns, the covariance matrix obtained in Section 5.2 can be inserted directly into the NetCDF file. For the optical-only campaigns, which where adjusted and tested previously using a generic stochastic model of $1\sqrt{\text{km}}$ mm for the standard deviation, an additional scaling is applied with a factor of 0.76 (see Section 5.1). Hence, the scaled covariance matrix Q_{scaled} becomes

$$Q_{\text{scaled}} = 0.76^2 Q_{\text{orig}}. \tag{18}$$

The format of the inserted data is described in Section 3. As discussed, arrays with unique station information and project information is inserted. As station class, either LEV&ONSH or LEV&OFFSH is indicated, referring to onshore or offshore leveling benchmarks. With indices into the station and project arrays, the single-differences are specified. Apart from the actual single-difference observations, and the associated covariance matrix, the sensitivity of the observation is specified. Since leveling is only sensitive in vertical direction, this translates to the vector [0 0 1] for each observation. The vector with observation flags is updated later, after the detection of obvious outliers in the data, see Section 5.4.

5.4. Detection of outliers

Based on the created NetCDF file with single-difference adjusted leveling observations, an additional testing scheme is applied to the time series per benchmark to detect and flag obvious outliers in the data. In this step, we test the individual time series of double-differences to detect gross (potentially human) errors that were not detectable based on the closed-loop conditions in the Move3 network adjustment. These kinds of errors are mainly induced by benchmark mis-identifications, that create discontinuities in the time series.

The testing is base on the residuals between the observations and a prognosis model. For the testing a level of significance for the one-dimensional test α_0 of 0.0005, a power of the test γ of 0.8, and a threshold for the OMT of 24 is applied. Because of these very relaxed settings, only very obvious outliers are detected and flagged. Smaller deviations are not flagged and should be evaluated by confronting the observations with the operational model [1].

In particular, three types of outliers are considered in the testing scheme [1]:

1. Identification errors: isolated observations that show an anomalous behavior within a double-difference time series. These errors are most likely due to benchmark mis-identification during a single leveling campaign. The detected identification errors are flagged with a 3 in the NetCDF file. Multiple identification errors per SD time series can be detected.
2. Disturbances: events that cause a step in the DD time series. These errors are most likely due to repeated benchmark mis-identification or a physical disturbance of the benchmark. The associated SD time series is split in two parts, the part before and after the event, by assigning a new benchmark name to the two parts. The new benchmark name is created by adding a suffix to the original benchmark name. The part before the event gets suffix 'a', while the part after gets suffix 'b'. In iterative scheme is applied to allow the detection of multiple events within a time series. Again, the same suffixes are applied. For example, in case of two detected events, the final benchmark names may be 00C03453aa, 00C03453ab, 00C03453b. The first observation after a detected event (now with benchmark name with suffix 'b') is duplicated in the dataset and assigned the benchmark name with suffix 'a', together with an identification error flag (3). This way, when using the CUPiDO conversion tool, a selection 'with outliers' is applied, the DD observations corresponding to the original time series are all constructed by the tool without loosing any information. In case of 'without outliers', the different benchmark numbers together with the identification error flag cause two separate time series, before and after the event.

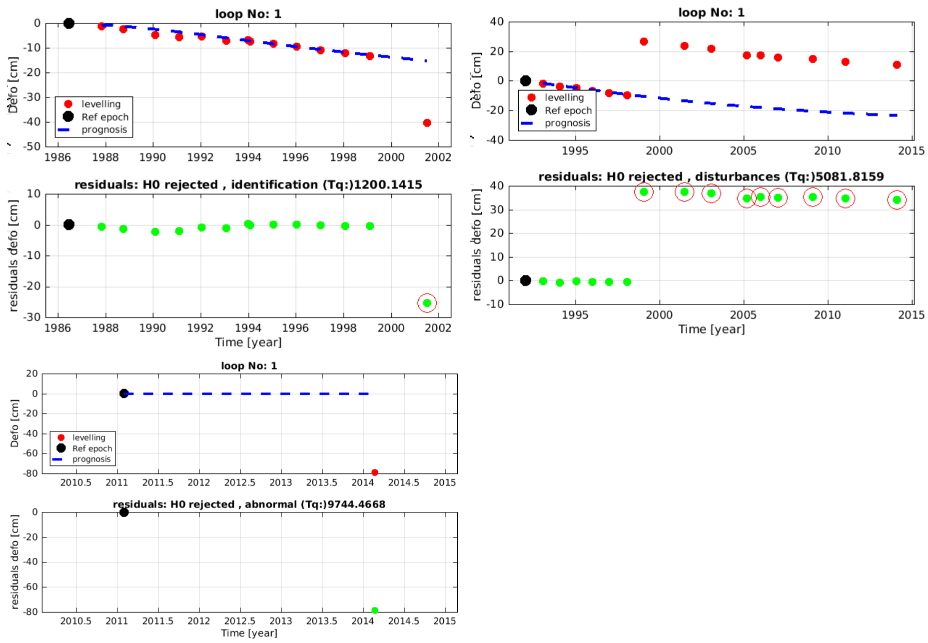

Figure 7: Top Left) Example of detected identification error in double-difference leveling time series (Top: observations vs. model, Bottom: Residuals.). Top Right) Example of detected disturbance (Top: observations vs. model, Bottom: Residuals.). Bottom Left) Example of detected abnormal behavior (Top: observations vs. model, Bottom: Residuals.

3. Abnormal behavior: observations associated to the time series which have extremely large deviations from the initial/assumed prognosis model. If an abnormal behavior is detected, the corresponding observations are flagged with the index 2, to indicate that these observations are outliers.

To enable testing for identification errors and disturbances, the number of observations in the time series should be sufficiently long. On contrary, for abnormal behaviors, even a single DD observation can be tested. Therefore, to test for identification errors and disturbances, only time series with at least three spatial SD observations were tested, while all the observations are tested for abnormal behavior. In total, 3 identification errors, 4 disturbances, and 2 abnormal behaviors are detected, resulting in 9 unique flagged SD observations in the NetCDF file. Examples of an identification and a disturbance are visualized in Figure 7.

Since in some cases the DD time series were too short to apply the testing scheme, an additional visual check is performed on the time series of the offshore benchmarks. This visual check did not result in any additional flagged observations.

6. GPS data preparation

The GPS data in the area of interest consist of GPS monitor station time series, GPS campaign measurements, and a few GPS baseline measurements.

The GPS surveys in the area of interest started in earnest in 2006 with the installation of continuously operating GPS monitor stations and yearly GPS campaigns. Before 2006, in 1993, 1997, 1998, 2000 and 2004, only occasional GPS baseline measurements to the platforms AWG-1, AME-2 and a few other points were undertaken.

In 2006 three continuously operating GPS monitor stations were installed in East-Ameland (AME1), Moddergat (MODD) and Anjum (ANJM), followed in 2014 by the installation of GPS monitor stations on the AWG-1 and AME-2 platforms (AWG1, AME2). Three of these stations, AME1, AME2 and AWG1 are in the area of interest. In 2014 also a new AGRS.NL station, located in Nes Ameland (AMEL), just outside the area of interest, went on-line and is processed as another monitor station. In 2006 the first GPS measurement campaign was organized in the area of interest, including over 70 points in the Wadden Sea, on the platforms, and onshore. The campaigns are repeated more or less every year. For the campaigns the same equipment is used as for the GPS monitor stations, collecting typically 5 days of observations per point. Four to five campaign points are observed simultaneously. After typically five days the equipment is relocated to another point. Campaigns can last up to one month, but some have been split over several shorter periods. Up to 2014 the platforms AWG-1 and AME-2 were included in the GPS campaigns, but in 2014 they became continuously operating GPS monitor stations. The data from both the GPS monitor stations and campaigns is processed by 06-GPS using the Geo++ GNSMART software [19].

Typical for the 06-GPS processing is that the GPS monitor station and campaign data is processed together. Therefore, the results for the GPS monitor stations and campaign data in the area of interest are very homogeneous and also share a common co-variance matrix. The 06-GPS processing includes also several continuously operating GPS stations from outside the area of interest, the so-called GPS reference stations, of which the coordinates are constrained to reference values. The GPS reference stations provide a stable reference frame for the stations in the area of interest. In order to represent the reference frame in the single-difference CUPiDO NetCDF files the concept of a so-called synthetic benchmark is introduced. The computed GPS positions are considered to be single differences with respect to the synthetic benchmark. The synthetic benchmark does not exist in reality and does not have a known location, only the assumption is made that there is no ground motion at this location and from a modeling point of view the synthetic benchmark is outside the area of interest.

The synthetic benchmark represents the cluster of GPS reference stations and coordinates that have been used for these reference stations. In the 06-GPS processing there have been occasional updates of the reference station coordinates and changes in the set of reference stations [20]. Because 06-GPS has analyzed each change in the reference station configuration with the aim to minimize the impact on the positions in the area of interest, it becomes possible to use a single synthetic benchmark for the full dataset. If not, a new synthetic benchmark should be introduced after each change in the reference station configuration or reference station coordinates [10].

For the older GPS baselines (Platform GPS Surveys) very little is known about the actual processing method that has been used. What could be gathered from the limited information is that three to four receivers were deployed on markers during a measurement period of several hours, and that pairs of receivers have been processed to form baselines, most likely using the Leica SKI software. Typical baselines are 3-4 km long, the longest baseline is 10.7 km, and all measured stations are in or close to the area of interest.

Considering the different processing strategies, and the different time periods, the 06-GPS and GPS baseline processing are considered to be completely independent, and therefore, two independent CUPiDO NetCDF files – one for each method – are created. The processing is described in different sections. We start with a description of the 06-GPS processing.

6.1. 06-GPS Network and Processing

Data from GPS reference stations, GPS monitor stations and GPS campaigns is processed by 06-GPS using the Geo++ GNSMART software [19]. In total 12 reference stations and 23 continuous monitor stations are in use by the end of 2014, of which 6 monitor stations are considered within this project, see Figure 8.

6.1.1. The monitoring network

The network started in May 2006 with six reference stations, in Borkum (0687), Ballum (BALL), Drachten (DRAC), Schiermonnikoog (SCHI), West-Terschelling (TERS) and Westerbork (WSRA), and three monitor stations, in East-Ameland (AME1), Anjum (ANJM) and Moddergat (MODD). The stations TERS in West-Terschelling and WSRA in Westerbork are part of the Dutch national GPS infrastructure (AGRS.NL) and the EUREF Permanent GPS Network (EPN). The station WSRA uses the same antenna as the IGS (International GNSS Service) station WSRT. In July 2010 two reference stations were added, in Emden (0647) and Veendam (VEEN), to bring the total of reference stations to eight. In March 2013 a new monitor station in the Groningen area has been added to the network, whereas the earlier introduced reference station VEEN is now considered a monitor station, thus increasing the number of monitor stations to five and reducing the number of reference stations to seven. October 2013 two monitor stations near 'De Wijk' were added, and in February and March 2014, twelve more monitor stations were added in Groningen. Also, five extra reference stations were added in October 2013, Makkum (MAKK), Urk (URK2), Beilen (BEIL), Nieuwleusen (NIEU) and Meppen (0683), while as of this date, reference station Emden (0647) is considered to be a monitor station due to subsidence of the station. This brings the number of monitor stations to 20 and the number of reference stations to 11. In September 2014, two monitor stations on platforms in the

[10] However, from a theoretical point, one could argue that every change in the reference station configuration should be accompanied by a change of synthetic benchmark, but considering the reference station check procedure done by 06-GPS, see Section 6.1.3, this is not necessary [20].

Figure 8: Network of GPS reference and continuous monitor stations (From [19]). The GPS reference stations are the green triangles, the GPS monitor stations are the purple circles. The AGRS.NL station AMEL in Nes Ameland is missing in this figure.

Noordzee (AME2, AWG1) were added to the network. In the same month, one extra reference station, in Leer (0645), was added. In June 2014 also a new AGRS.NL station, located in Nes Ameland (AMEL) just outside the gas-field, was added. The data from this station is processed as another monitor station by 06-GPS. This brings the final total to 12 reference stations and 23 continuous monitor stations, of which 6 monitor stations are processed within this project and three of which are in the main area of interest, see also Figure 8. For a full list of reference and monitor stations see [19] and [20].

For all permanent stations, except Borkum and AGRS stations Ameland, Terschelling and Westerbork, the same equipment is used: Topcon GB-1000 GNSS receivers with a Topcon CR-3 choke ring antenna. For the campaign measurements identical equipment is used as for the continuously observing stations. All antennas are also individually calibrated. For the GPS-processing raw observations per station are collected with an interval of 15 seconds. The first permanent stations have gathered data since May 2006, while all campaign stations only collect observations for a typical 5 days per point.

The first GPS campaign was organized in 2006. The campaigns are repeated more or less every year, but not every campaign point is observed every year. For the campaigns the same equipment is used as for the GPS monitor stations. Four to five cam-

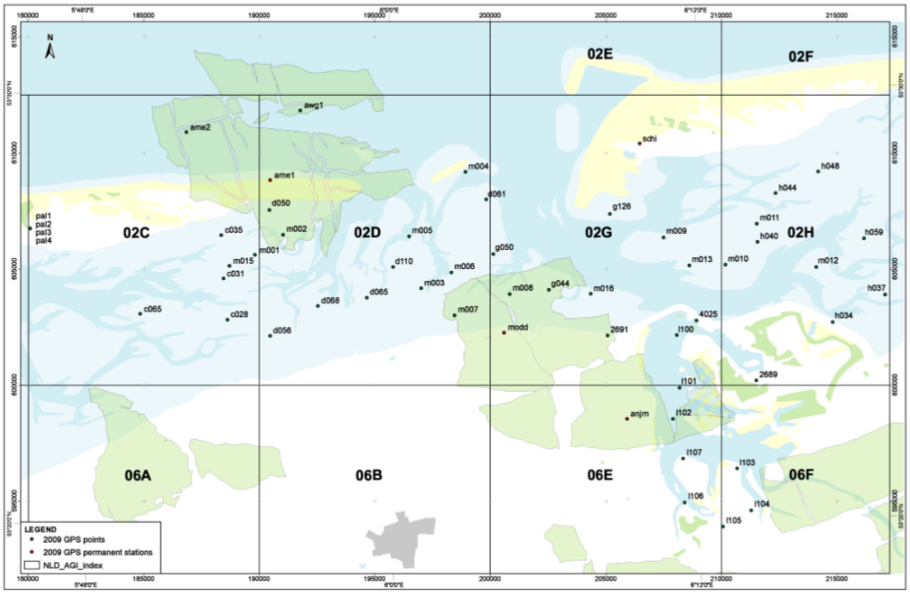

Figure 9: GPS continuous monitor stations and campaign points observed during the 2009 campaign (from [19]).

paign points are observed simultaneously. After typically five days of data has been collected, the equipment is relocated to another point. Campaigns can last up to one month, but some campaigns have been split over several shorter periods. As an example, Figure 9 gives an overview of the points observed during the 2009 campaign. For a full list of points and an overview of campaigns one should consult Appendix L. In total about 150 benchmarks, at just under 70 locations, have been observed during one or more GPS campaigns. Some of the benchmarks, mainly in the Wadden Sea area, are located in 40 clusters of typically three benchmarks each. Only one of these benchmarks is observed with GPS over a five day period. The other benchmarks in the cluster, are connected to the GPS benchmark by leveling. A typical benchmark in the Wadden Sea, and setup of the GPS receiver and antenna, is shown in Figure 10. The setup of the GPS antenna is such that only the height component is repeatable over time. The horizontal components cannot be used for monitoring.

Up to 2014 the platforms AWG-1 and AME-2 were included in the GPS campaigns, but in 2014 they became continuously operating GPS monitor stations (AWG1 and AME2). The continuously operating monitoring stations AWG1 and AME2 are not at the exact same location on the platforms, but they are connected to the campaign points by a local survey. The nature of the platforms is such that also only the height components can be used, and only after a correction for temperature related effects is applied. The procedure is explained in Section 6.2. The horizontal components of the platforms cannot be trusted for the monitoring of ground motions.

The focus of the monitoring is on the vertical component. Except for the GPS monitoring stations MODD, ANJM, AME1 and AMEL, the horizontal components

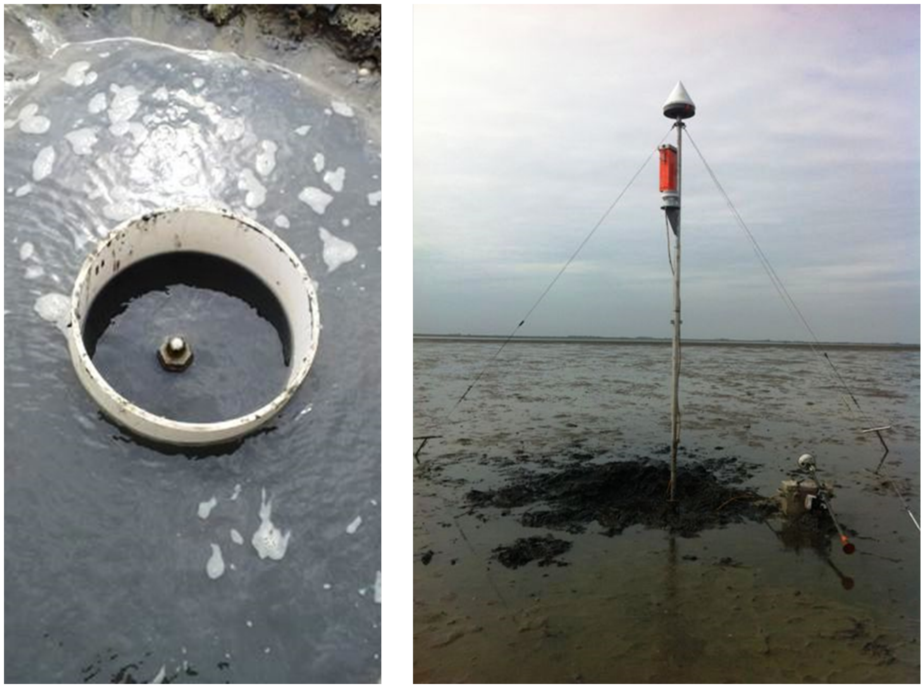

Figure 10: Typical GPS benchmark (left) and GPS measurement setup (right) in the Wadden Sea area (pictures courtesy NAM).

are not used.

6.1.2. GNSMART processing

The data from the GPS monitor and GPS campaign stations is post-processed by 06-GPS using the GNSMART software of the Geo++ GmbH company from Hannover, Germany. In 2005 positive tests were realized with this software package at the Anjum site where deliberate lowering of the GPS-antenna could be detected at the mm-level within a few days of observation time [21, 22]. The Geo++ software is able to deliver a highly accurate result for the combination of fixed GPS reference stations, dynamic GPS monitor stations (Anjum, AME-1 and Moddergat) and Wadden Sea stations in one single processing with optimal use of antenna calibration models and modeling of all error sources involved with GPS surveying.

GNSMART stands for GNSS State Monitoring and Representation Technique. A complete state space model (SSM) with millimeter-accuracy is implemented for the rigorous and simultaneous adjustment of GNSS observables, which is essential to resolve phase ambiguities, as well as to mitigate major GNSS error sources. To determine the (error) state of a GNSS system, GNSMART estimates the following state parameters:

- satellite clock synchronization error, satellite signal delays (group delays) and satellite orbit error (kinematic orbits)
- ionospheric signal propagation changes and tropospheric signal delays

- carrier phase ambiguities
- receiver clock synchronization error and receiver signal delays (group delays)
- receiver coordinates (fixed, dynamic or unknown)
- receiver multipath (optional [11])

For the receiver coordinates various models can be used in a single processing run: fixed coordinates for GPS reference stations, dynamic (filtered) for GPS monitor stations and unknown for campaign stations.

The state-space modeling of GNSMART applies beforehand corrections to the GNSS observations. The SSM model is prepared for the following corrections:

- satellite-receiver phase wind-up effect (satellite attitude)
- (absolute) satellite and receiver antenna PCV correction
- relativistic corrections
- site displacement effect (solid earth tide and pole tide included; ocean loading and atmospheric loading not included for the current network)
- higher order ionospheric correction (not included for current network)

For the current network GNSMART does not correct for loading effects and higher-order ionosphere. This was deemed unnecessary by 06-GPS because of the small size of the network [19][12].

The adjustment model is a Kalman filter for the simultaneous adjustment of all L1 and L2 observations. It results in one rigorous solution of all stations, fixed, dynamic or unknown, with all correlations known in one run. The adjustment uses IGS Ultra rapid Precise orbits [19]. The processing has to wait for the end of the survey campaign. Therefore, the Kalman filter is run in post-processing mode over periods of one and a half month, using all available reference, monitor and campaign stations for that period. Each period overlaps by half a month. The first half month is used for the Kalman filter to obtain a steady state and is not used for the final solution. Therefore, each run results in a one month final solution. The coordinates are computed with an interval of one hour.

The reference station coordinates in each run are kept fixed (not adjusted) using coordinates determined by a special procedure described in Section 6.1.3. For the monitor stations a dynamics model is used. Two options have been investigated by 06-GPS: the first uses dynamics of the coordinate residuals of 1mm/day, while the second uses dynamics of 1mm/hour. For the final processing a dynamics of the coordinate residuals of 1 mm/hour was selected [19].

The GPS campaign measurements are carried out with five GPS receivers simultaneously. This leads additionally to more redundancy in a simultaneous processing with

[11] Not clear if receiver multipath estimation is included in the processing, we assume it is not.

[12] This assumption is certainly true for atmospheric loading and higher order ionosphere, that the effect for atmospheric loading is negligible is confirmed by the analysis in Section 6.2.1. However, to us, it is not confirmed that ocean loading can be neglected. The variation in ocean loading is significant over the extend of the network and is predominately present for stations near the coast. It could be that this effect is absorbed by other parameters in the 06-GPS processing, e.g. troposphere delay could be a good candidate, but this is not confirmed.

the monitoring stations and will increase the reliability and accuracy. The observations on each point last for at least five days. In the processing the coordinates are assumed to be unknown (i.e. no dynamics are introduced [13]). Of the five days of observation, typically, only the last three days are used to obtain the final observed height by averaging the hourly height values over the last three days.

The 06-GPS processing results give the height of each ARP (Antenna Reference Point), which is the bottom of the antenna. The antenna height, the vertical distance between the marker and ARP, have been measured by a contractor. As every mast used has a different length, this must be monitored carefully during the project. The antenna height is subtracted from the computed height of the ARP to obtain the height of the actual benchmark.

Several benchmarks are located in clusters of typically three benchmarks. Only one of the benchmarks in a cluster is observed by GPS. The other benchmarks in the cluster are connected by leveling. Of the 70 campaign locations 40 are cluster locations, and the total number of benchmarks is about 150.

6.1.3. Reference station coordinates

In order to obtain reliable results it is necessary to have accurate and homogeneous coordinates for the reference stations. Discrepancies between the reference station coordinates, which will be fixed in the processing, should be as small as possible.

To compute the initial coordinates of the reference stations a complete month (July 2006) of data of all reference stations was evaluated by 06-GPS using the GNSMART software. Also the data of the AGRS.NL stations Terschelling and Westerbork were used. The coordinates of the AGRS.NL stations in Terschelling en Westerbork, and the station in Borkum, were fixed to values published in ETRS89 [20][14]. The coordinates of the other reference stations were computed.

Since 2006, 06-GPS processes GPS data of permanent monitor and campaign stations in a network with reference stations on a monthly basis (see Figure 8). The coordinates of these reference stations are kept fixed (standard deviation of 0.0 mm) to the previously computed values. The coordinates of the monitor stations get some freedom to move (using a dynamics model with a standard deviation of 1 mm/day). However, there is always the possibility that the positions of the reference stations change as well. This can be due to physical movements or due to instrumental changes.

To detect changes in the reference station coordinates the reference station coordinates should be checked periodically. In case movement is detected in one or more reference stations, the coordinates of the reference station should be updated. The reference station coordinates are checked once per year using the following procedure [20]:

a. Recalculation of all reference station coordinates using GNSMART by giving them

[13] We are not sure of this, it could be that some dynamics are introduced, but no–priori constraints. Should be checked with 06-GPS.

[14] We can't find a reference to where the values came from, they are in ETRS89, but also for ETRS89 different realizations exist. Also it is not clear how the plate velocity is handled w.r.t. to IGS precise orbits, which are in ITRF. We assume the orbits are translated into ETRS89 before processing, but we are not sure.

an a priori standard deviation of 1.0 mm for the horizontal position and 2.0 mm for the height.

b. Change the reference station coordinates for stations with a height deviation of more than 2.0 mm compared to the existing coordinates.
c. Process the network again with all reference stations fixed to the new coordinates, to be able to calculate the influence of the new reference station coordinates on the monitor stations.

The reference station coordinates have been checked every year from 2009 onwards. Each check involved the analysis of six weeks of data. Typically there are only a few reference stations for which the coordinates exceed the limits. For instance, in 2009 and 2011 two reference stations needed updates, but in 2010 no updates were needed. The influence of the change in reference station coordinates on the GPS monitor stations was always smaller than 1 mm, often even smaller than 0.5 mm, depending on the distance to the reference station for which the coordinates were changed.

6.2. Generation of CUPiDO GPS dataset

The CUPiDO GPS dataset is a NetCDF file with spatial single-differences and the covariance matrix describing the measurement precision. For geo-mechanical modeling the CUPiDO tool will add the idealization precision to the measurement precision. In order to create this dataset for the area of interest some specific actions are required

a. Read 06-GPS time series of the continuously operating GPS monitor stations, analyze the time series, remove systematic effects and outliers, and decimate the time series to one point per year for the CUPiDO dataset.
b. Preprocess GPS observations for the platforms AWG-1 and AME-2
    i. Correct both GPS monitor and campaign observations on the platforms for temperature related effects,
    ii. Refer GPS monitor stations AWG1 and AME2 to the campaign benchmarks AWG-1 and AME-2.
c. Read the GPS campaign observations and check the clusters for stability and outliers.
d. Refer the GPS observations to a *synthetic benchmark* to obtain single-difference observations, which is a requirement for the CUPiDO dataset.
e. Generate the co-variance matrix of the single-difference observations for the CUPiDO dataset.

The GPS monitor station time series have a data point every hour. This is simply too much data for the geomechanical modeling to handle. Therefore, the GPS monitor station time series must be downsampled to roughly one point per year. One point per year was selected because this matches the interval of the GPS campaigns and agreed upon with the modelers. Since the GPS monitor stations and GPS campaigns are processed together it was decided to select the data point for the GPS monitor stations around the time of the GPS campaigns, in order to maximize the correlation between the GPS monitor station and campaign data. In case a campaign was split over several sub-campaigns per year, then a data point for the monitor stations was created for every sub-campaign. The reference epoch for the monitor station data points is the average of the epochs of all observations in the (sub-)campaign.

The value for each decimated data point is computed following a time series analysis. The time series analysis is used to remove outliers from the data and station dependent systematic effects. The time series analysis is described in Section 6.2.1. Systematic station dependent effects that are removed are: i) annual- and semi-annual harmonics and ii) temperature related effects. The analysis showed (see Section 6.2.1) that these components are station dependent and must be removed, if possible, before the actual modeling. Especially, the two platform time series AWG1 and AME2 showed significant harmonics and temperature related effects, which were unlike the other stations (actually AWG1 and AME2, both platforms, showed similar behavior). Of course, this is only possible for the GPS monitor stations; this cannot be done for the GPS campaign observations which only span a period of five days, with one exception. The exception are the AWG-1 and AME-2 campaign observations, which are corrected for the periodic (harmonic) and temperature related effects estimated from the AWG1 and AME2 GPS monitor station data. The actual values that were computed for the GPS monitor stations consisted of the estimated trend (fitted spline function) plus the average of the residuals over a five day period, thus effectively removing the periodic (harmonic) signal and temperature effects. Atmospheric loading is removed as well, but this was only a very small and negligible effect.

The campaign observations are read from ascii files provided by NAM, that include the average of the last three days of observation, and corrected for the antenna height. The dataset provided by NAM contains a field to flag data. This flag is used to remove data from the CUPiDO output dataset. The script that creates the CUPiDO data includes an analysis of the clustered benchmarks. It is able to automatically flag outliers within a cluster, and, can be used to remove unstable clusters and and epochs with unstable benchmarks by manually setting flags in the input dataset. This outlier identification is assumption free and only based on intra-cluster stability, it is described in more detail in Section 6.2.3. Depending on the input options two different CUPiDO datasets may be generated:

i. CUPiDO NetCDF dataset with all cluster benchmarks included,
ii. CUPiDO NetCDF dataset with only one benchmark per cluster.

In both cases cluster outlier observations can be removed from the CUPiDO datasets depending on a input flag. At this point the CUPiDO dataset contains also the down-sampled observations from the GPS monitor stations and of course also the benchmarks that are not in a cluster. For the dataset that contains only one benchmark per cluster the observations are computed by least-squares using all available observations for a cluster (except outliers). It is possible, in this case, to have observations for a cluster point even if that point was not observed, had itself an outlier, or is not completely stable. Usually the benchmark in the cluster which has most observations and has the best stability is selected to represent the cluster in this case.

Finally, the covariance matrix is generated for the GPS observations in the CUPiDO dataset using one of the models selected by S. Williams [23]. These models include temporal and spatial correlation. For the campaign stations an additional setup noise is added for each occupation. Details are given in Section 6.2.5.

6.2.1. Time-series analysis

The processing of the continuously operating GNSS stations consists of two steps. In the first step the raw GNSS measurements are processed by 06-GPS resulting in raw time series. The second step consists of a time series analysis using in-house developed Matlab software. The raw time series are decomposed into components including a secular trend, temperature influence, atmospheric loading, harmonic components, jumps and noise components. From the individual components new products can be generated. For instance, for monitoring long term subsidence, one could decide to remove the harmonics, temperature effects, atmospheric loading and jumps to obtain a clean series, and sub-sample this series into one data point per year. This is effectively the approach taken for this study: the continuous station time series are sub-sampled to the epochs of the campaign measurements while removing all signals that are not related to long term ground motion, while for some platform stations the harmonic and temperature components are used to correct campaign measurements that were taken before the continuously operating stations were installed. The analysis is carried out for both the horizontal and vertical components, although, for the stations on platforms only the vertical components are retained for further analysis.

The raw time series from the 06-GPS processing contain a couple of effects

a. Long term surface movement.
b. Monument movement as result of the environmental conditions, residual Earth tides and ocean loading, atmospheric loading, ground water effects, etc.
   Tidal and atmospheric loading effects have not been modeled in the 06-GPS processing. Therefore, small residual effects with respect to the reference stations that were kept fixed, may remain. These residual effects, as well as effects of ground water fluctuations, and other motions of the monument, for instance, under the influence of temperature changes, may still be present in the raw time series.
c. Apparent motions, but no real motions, as the result of for instance unmodeled elevation and azimuth dependent antenna phase delays (can only be partly covered by antenna calibration), site multipath, and unmodeled atmosphere effects.
   The GPS processing, which include the estimation of rather correlated receiver clock, troposphere zenith delay and height parameters, is very sensitive to elevation dependent effects in the observations and models used by the processing. As result of the repeating GPS satellite constellation these effects can result into several harmonic effects in the time series.
d. Common mode signals.
   These are effects that are (more or less) the same for all stations, which can be due to the used reference frame, common atmosphere effects, or errors in the used satellite orbits and clocks. In case of the 06-GPS processing this will be most likely effects related to the reference stations and changes in the reference station configuration.
e. Jumps due to equipment changes.
f. Measurement noise.

To separate these effects a decomposition of the GPS time series is made. Each component of the time series Δ, with Δ either ΔN, ΔE, ΔU (North, East, Up), can be described by the following model

$$\begin{aligned}\Delta(t) &= s(t) + \Delta_{\text{AtmLd}}(P(t) - P_0) + \Delta_{\text{TempI}}(T(t) - T_0) + \\ &\quad \sum_i (a_{si} \sin 2\pi f_i t + a_{ci} \cos 2\pi f_i t) + \Delta_{\text{CM}}(t) + \sum_j \Gamma_{t_j}(t) + \epsilon\end{aligned}$$

with $s(t)$ the trend, Δ_{AtmLd} an atmospheric loading coefficient and Δ_{TempI} a temperature influence coefficient, a_{si} and a_{ci} harmonic coefficients, $\Delta_{\text{CM}}(t)$ a common mode signal that is the same for all stations, $\sum_j \Gamma_{t_j}(t)$ the cumulative effect of jumps, with $\Gamma_{t_j}(t < t_j) = 0$, and ϵ the residual noise, t time in decimal years and f_i frequency in cycles/year.

The trend model $s(t)$ can be a linear trend, higher order polynomial or spline function. In the current project a spline function is used. The spline consists of piecewise polynomials of order three with continuity in the first derivative (velocity) at the breakpoints. The length of each piecewise polynomial is about one year. For each coordinate component an atmospheric loading coefficient and a coefficient for station deformation under influence of temperature are estimated, using observed atmospheric pressure P and temperature T from the KNMI meteo station in Eelde. The harmonic terms that are estimated have periods of 1 cycle/year (annual) and 2 cycles/year (semi-annual). These periods are very common periods in GPS time series, but often not related to real motion. For each station several plots are made in order to assess the quality of the fits:

- Plot with raw time series, corrected for jumps, with the total fit, estimated trend and trend plus atmospheric loading.
- Plot with the estimated components (Temperature effect, harmonics, atmospheric loading).
- Plot with the residuals.

All plots include information on the reliability intervals (95%) from the estimated standard deviations and identify the equipment changes. These plots can be found in Appendix K.

Another useful way to present the results is shown in Figure 11 and 12. In Figure 11 all stations are plotted together in a single sub-plot, off-setting each time series by a certain amount on the y-axis. Each sub-plot contains a component of the decomposed time series, showing the raw height series in Figure 11a, the estimated harmonic components and temperature influence in Figure 11b, residuals in Figure 11c, and final series in Figure 11d consisting of the fitted trend including the unmodeled residuals. The unmodeled residuals are included with the trend because these may still contain a ground motion signal. Figure 12 shows the estimated parameters on a map of the GPS monitor stations. Figure 12a shows the estimated velocity component, computed from the spline fit at the center epoch, Figure 12b shows a representation of the estimated temperature influence parameter, while Figure 12c shows the estimated annual harmonic component, and Figure 12d shows the horizontal standard ellipse and vertical standard deviation as computed from the estimated covariance matrix of the residuals. The original plots, and many other plots and analysis results can be found in Appendix K.

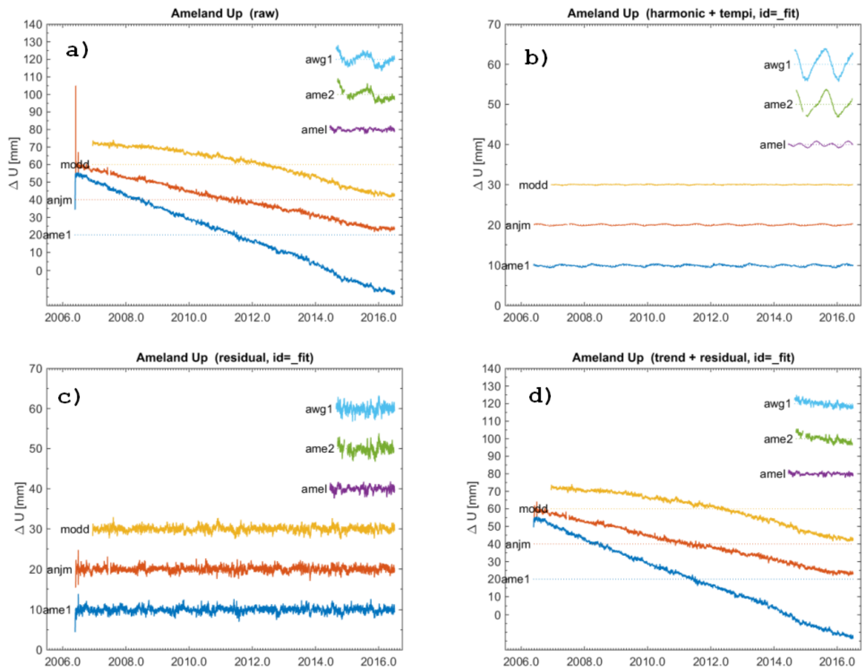

Figure 11: Height time series components for the GPS monitor stations: a) original time series, b) harmonic components and temperature influence, c) residual signal after fit, d) final time series consisting of estimated trend with residual signal.

The estimated harmonic components, plotted in Figure 11b and Figure 12c, may contain some part of the deformation signal. However, we believe that the estimated harmonic components and temperature influence are dominated by station dependent effects, and, therefore that it is better to remove these components from the final series, as we did. Adding a term for the temperature effect gives a significant improvement in the fit. This is especially the case for the platform stations AWG1 and AME2, which show significant harmonic components and temperature influences. The annual harmonics term and temperature coefficient can be estimated individually. Sometimes both terms amplify each other, in other cases the opposite may happen. The estimated atmospheric loading is only significant in the vertical component, and even then is was very small, so this can be ignored.

The time series analysis has been implemented in the Matlab script `lts2_gpscors.m`. It uses functions from the `tseries` toolbox, with supporting functions from the `crsutil` and `rdnaptrans` toolboxes.

The script first reads the hourly GPS positions (longitude, latitude and height) from the Excel files provided by the NAM and converts these into Matlab mat files, one file for each station, in the format required by the `tseries` toolbox. During the conversion several consistency checks are carried out: i) some parts of the dataset with invalid data need to be removed, and ii) detect and remove duplicate epochs. Periods

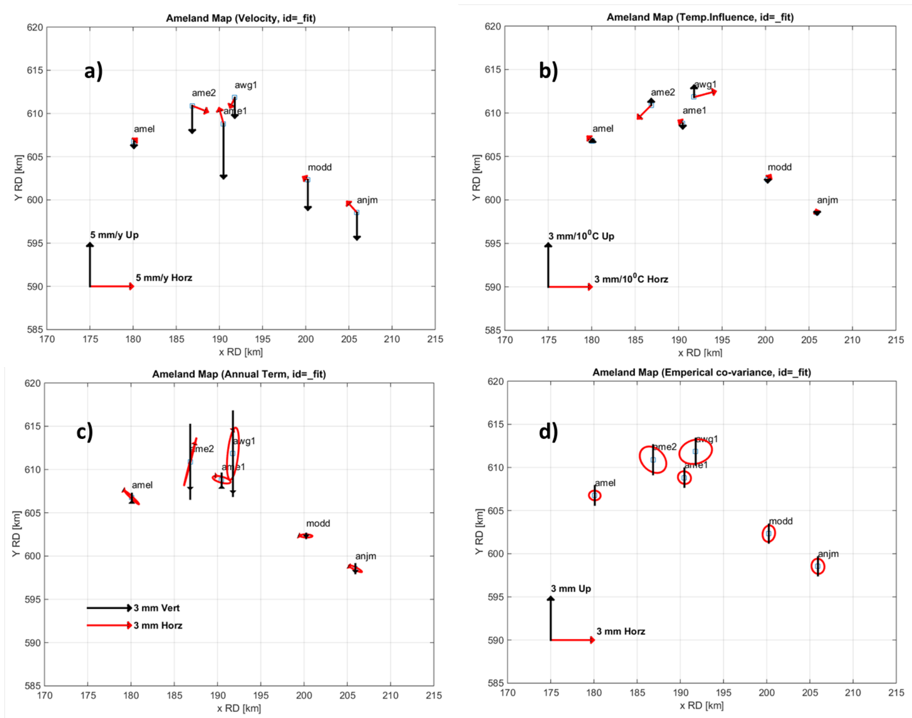

Figure 12: Map of the GPS monitor stations with representation of estimated parameters: a) velocity vector, b) temperature influence parameter, c) annual harmonic component, and d) covariance of the residuals.

with missing data are still included in the input dataset, just repeating the last computed position until new data is included. This is a byproduct of the Filter approach used by GNSMART, and this data must be removed from the time series. The GNSMART implementation is doing a good job, but it would be much better if this false data was not included in the first place. The next step is to read the temperature and air pressure data for the synoptic weather station Eelde. This data is available at the KNMI website `http://cdn.knmi.nl/knmi/map/page/klimatologie/gegevens/uurgegevens/uurgeg_280_2011-2020.zip`.

The GPS time series is decomposed into several components: trend, atmospheric loading, temperature Influence, annual and semi–annual harmonics and residuals (unmodeled effects). These components are estimated using the function `tseriesanalysis` from the `tseries` toolbox. The results are written to another set of Matlab mat file, `<ssss>_fit.mat`, with `<ssss>` the station name abbreviation. The trendmodel is selected automatically. For time series shorter than two years a linear fit is chosen, for time series over two years a spline fit is used. Meteo data from Eelde is used to estimate the temperature influence and loading effects. Data points with residuals larger than 4 mm in horizontal components and 6 mm in the vertical are removed using one or more iterations. Functions from the `tseries` toolbox are called to print and plot the results, such as for example Figure 11 and Figure 12.

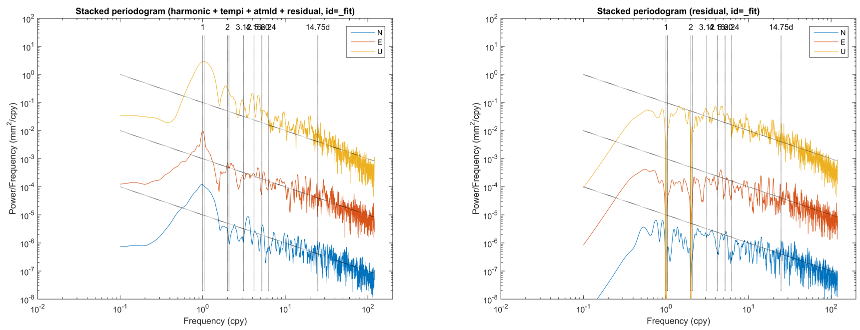

Figure 13: Lomb-Scargle periodogram for the 6 GPS monitor stations: detrended signal (left), residuals (right).

Functions from the `tseries` toolbox are also used to compute the Lomb-Scargle periodogram for several components, residual stack, and common mode of the parameters. The periodogram can be computed both for individual stations as well as all stations together (stacked periodogram). In the script we compute two periodograms: one of the detrended signal, and one for the residuals, see Figure 13. The computed residual stack is shown in Figure 14. There is some evidence of residual effects of changes in the network of reference and monitor changes, and changes in the reference station coordinates, for the horizontal components, but no effects are visible in the vertical components. The common mode of the estimated harmonic, temperature influence and loading parameters is computed, but are not significant (See Appendix K). In theory the residual stack and parameter common mode can be removed from the time series. However, this turns out to be not necessary or advisable for this dataset. For the residuals stack this is not advisable because there are too few stations, and, not necessary because the residuals stack does not contain a significant signal in the present case. Removing a common mode in the parameters is harmless, but this is not necessary because the analysis showed no significant common mode in the parameters.

The final results are written to both ascii and Excel files for use by other programs. Also written is a GPS point and observation file, with GPS monitor station data, in the format that NAM has defined for the campaign data. These files will be used by the `lts2_gpscamp.m` script to merge with campaign data, and compute the covariance matrix for all GPS data. To be able to create the GPS point and observation files the `lts2_gpscors.m` script needs a project file with the campaign name and campaign epochs, and the number of days (currently five days) to average the data. The actual values for the GPS observation file are computed from estimated trend (fitted spline function) for the monitor stations at the campaign epoch, and, average of the residuals are the fit over a five day period, thus effectively removing the period (harmonic) signal and temperature effects. The project file is created by copying the result from the campaign data analysis done by the `lts2_gpscamp.m` script.

The full output of the `lts2_gpscors.m` script is shown in Appendix K using Matlab's publish function.

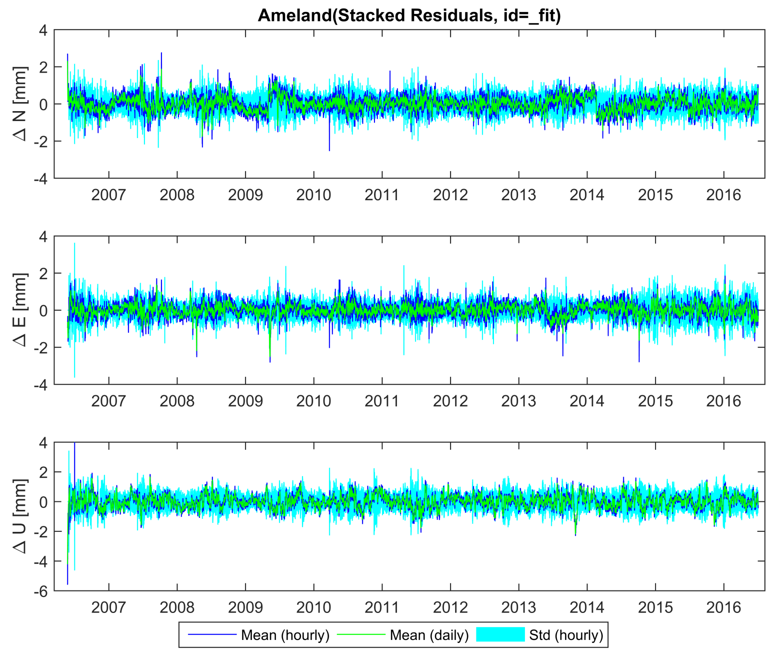

Figure 14: Residual stack of the 6 GPS monitor stations.

6.2.2. Preparation of CUPIDO dataset

The GPS CUPiDO NetCDF is created by the Matlab script `lts_gps.m` using two sets of GPS point and observations files as input. One set of GPS point and observations files contains the data for the GPS campaigns, and has been prepared by NAM, and the other set contains the data for the GPS monitor stations, created by the `lts2_gpscors.m` script that was described in the preceding section. The full output of the `lts_gps.m` script is given in Appendix L.

The GPS point and observation files are comma separated files with a single header line. The GPS point files contain the point name, RD coordinates and a cluster_id for each point. Points that belong to the same cluster have the same cluster_id. The GPS observation files contain for each observation the point name, project name, mean date of observation, the observation duration, the observation, and a flag. In case the GPS observation file concerns a campaign the observation is the observed benchmark height and the flag is used to indicate whether the observation should be used or not. In case the GPS observation file concerns GPS monitor stations the observation is either a height, East, or North component. The flag is then used to identify which component is given (3=Height, 2=East,1=North). The different usage is reflected in the header line.

Before the GPS point and observation files can be used by `lts_gps.m` several corrections need to be done:

1. The platform stations AWG1 and AME2 in the GPS point and observation files

for the GPS monitoring stations are renamed to the benchmark names AWG-1 and AME-2, and the observations are corrected for the eccentricity between the GPS monitor station and benchmarks that are used in the campaign dataset. Also the horizontal components of the platform stations are removed. This correction step is implemented in the `lts2_rename_cors.m` script. It generates new corrected GPS point and observation files. The full output is given in Appendix M.

2. The campaign observations for the platform stations AWG-1 and AME-2 have to be corrected for temperature effects. The harmonic and temperature corrections estimated from the time series analysis of the GPS monitor stations AWG1 and AME2 are applied to campaign observations AWG-1 and AME-2. This correction step is implemented in the `lts2_seasonal_correction.m` script. This script used meteo data from the KNMI station in Eelde. It generates a new GPS observation file with corrected data for AWG-1 and AME-2. The full output is given in Appendix N.

Figure 15 shows the seasonal corrections for the stations AWG-1 and AME-2.

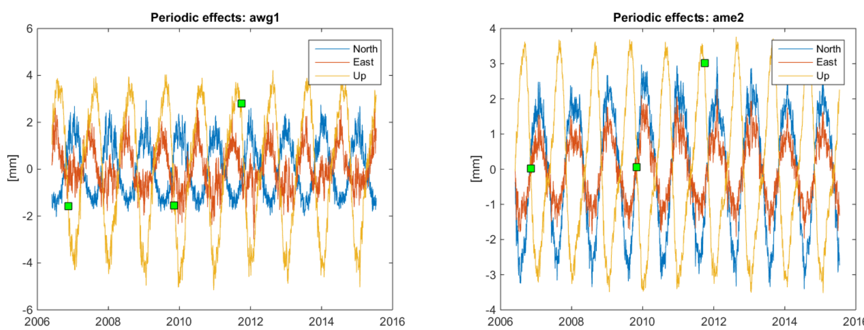

Figure 15: Seasonal corrections for the the platform stations AWG-1 and AME-2. The squares represent the campaign epochs (height only).

The Matlab script `lts_gps.m` creates the actual GPS CUPiDO NetCDF file(s) from the modified GPS point and observations files. This involves a number of steps:

1. Set up the configuration parameters and input files (USER INPUT), including the meta data for the NetCDF file.
2. Read the comma separated ascii GPS point and observation files and merge campaign and GPS monitor station data.
3. Compile project, point, cluster and observation statistics, and print some essential information.
4. Analyze the cluster data, provide statistics and remove outliers.
5. Compute the GPS covariance matrix for the GPS campaign and monitor station data.
6. Output NetCDF CUPiDO file, using single-differences with respect to a synthetic benchmark.
7. Perform consistency checks and plot various information.

It calls various functions in the `lts2` and `sdwil` toolboxes to do the main work. Depending on the input options two different CUPiDO datasets may be generated:

i. CUPiDO NetCDF dataset `lts2_allgps.nc` with all cluster benchmarks included,
ii. CUPiDO NetCDF dataset `lts2_allgps_cluster.nc` with only one benchmark per cluster.

The cluster analysis and outlier detection is described in Section 6.2.3. The model for the GPS covariance is based on the work of Simon Williams [23]. The actual model to be used and the key parameters are set in the input data section. The model is described in more detail in Section 6.2.5.

The full output of `lts2_gps`, for each of the two cluster options, is given in Appendix L.

6.2.3. Cluster analysis and cluster stability detection

Several of the benchmarks, mainly in the Wadden Sea area, are located in clusters of typically three benchmarks each. Only one of these benchmarks is observed with GPS during a campaign. The other benchmarks in the cluster are connected to the GPS benchmark by leveling. Figure 10 shows a typical GPS benchmark in the Wadden Sea with the GPS receiver and antenna. There are about 40 clusters with multiple benchmarks.

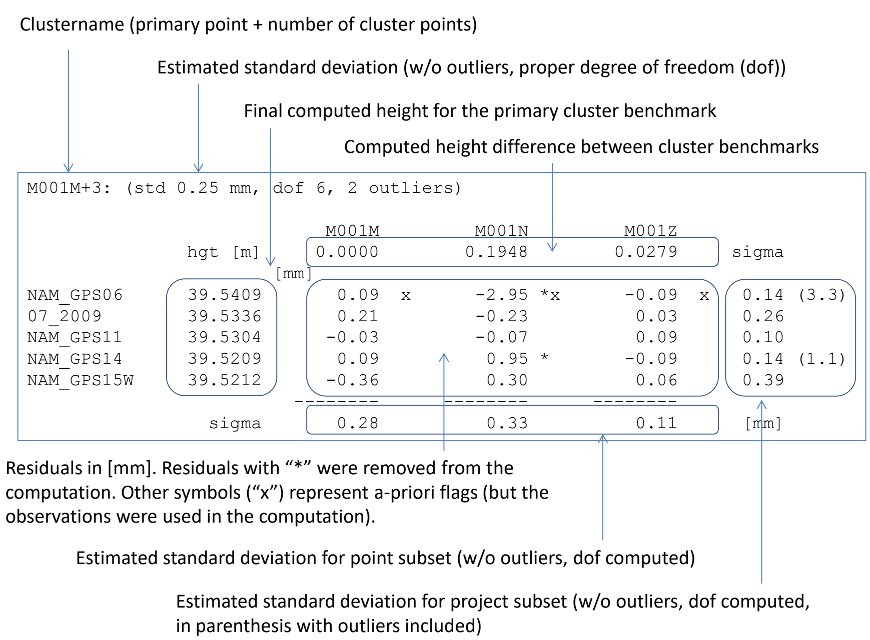

Figure 16: Example output of GPS cluster analysis for one cluster with explanation of the entries.

For each of the benchmarks in a cluster a height is given in the GPS observations files. Only one of these benchmarks in a cluster is observed by GPS, the heights for the other benchmarks are computed from the GPS observed benchmark using the leveling between the benchmarks. If double-differences are formed between the benchmarks in a cluster, using one benchmark and one epoch as reference, a direct measure for the differential height changes in the cluster is obtained. These double-differences can be used to detect outliers and investigate the stability of the individual benchmarks.

Instead of double-differences, in the software an undifferenced approach based on an iterative least–squares adjustment with outlier detection is used. The goal is

1. To be able to flag observations so that these can be removed from further processing.
2. To be able to use one benchmark per cluster that represents the complete cluster.

In the software there is the option to output all benchmarks for a cluster, or a single benchmark per cluster with an adjusted height computed from all available information in the cluster. In both cases outlier observations are removed from the CUPiDO datasets.

For each cluster an independent least–squares adjustment is used using only data from within the cluster. The heights given in the GPS observation file, for each benchmark in a cluster, are the observations. The unknown parameters in the adjustment are the heights of the primary cluster point for each campaign and the height difference between the cluster points. The height difference between the cluster points, as null–hypothesis, is assumed not to change: statistical testing is used to verify this assumption and to detect outliers. For example, for three points, and four campaigns, we have $4 + (3 - 1) = 6$ unknowns, and $4 * 3 = 12$ observations (if fully observed). It is not required that for every campaign that all points are observed. Even if the primary point has no observations, but the other points have, the height of the primary point can be estimated. Outliers are removed one by one. After an outlier is detected the least–squares adjustment is repeated without this outlier, but the residual is still computed, although the observation is not used in the adjustment or for computing the standard deviations (sigma's). This is repeated until all outliers are removed or until no redundancy is left.

An example output of the GPS cluster analysis, with some explanations, is shown in Figure 16. The results for the other clusters are given in Appendix L. The output is the same for both cluster processing options. The first line contains the name of the primary point + number of cluster points, the estimated standard deviation (outliers removed), the degree of freedom (number of observations minus number of unknowns) and the number of detected outliers. The second line contains the benchmark names in the cluster. The third line gives the estimated height difference between the benchmarks, the height difference for the primary benchmark is zero (this is the reference). What follows is one line per campaign, with the campaign name, adjusted height of the primary marker for that campaign, the least squares residuals and finally the estimated standard deviation for this campaign. Whenever an outlier is detected this is flagged by an $*$, the outlier is removed from the adjustment and is not used. The standard deviation is computed without outliers, in brackets, the standard deviation including outliers is given. An `x` indicates observations that have been flagged in the input GPS observation file. These are still used in the cluster analysis, but will be removed from the CUPiDO NetCDF file. The last line contains the estimated standard deviation for each point (outliers removed). When there is no redundancy anymore this is indicated in the output (not shown here in this example). If there is no redundancy left, the whole epoch is flagged and marked as `BAD EPOCH`; the last remaining observation for a epoch has residual zero, but this means nothing. The same applies for points, but here nothing special is printed, though the estimated standard deviation becomes a NaN. In case there is no redundancy from the start the message `NO REDUNDANCY` is printed.

The sigma's in Figure 16 are computed as

$$\sigma = \sqrt{\frac{\sum_i \hat{e}_i^2}{\sum_i r_i}}$$

with $\hat{e}_i$ the least squares residual and r_i $(0 \ldots 1)$ the redundancy number for each residual, computed from the covariance matrix of the residuals. The summation can be done over the residuals for one point, or for one campaign, or all residuals together (always without outliers). The degree of freedom (dof) is the number of observations, minus number of unknowns (points + campaigns 1), minus number of outliers. The threshold for the outlier detection can be set in the input; 0.4 mm is used as a default value.

Usually the first occurrence in the point list will be the primary point, except when there is another point with more observations. Other primary points can be selected by changing the order in the point list in the GPS point file.

As can be observed in Figure 16 and Appendix L, the 2006 M–points have already been flagged in the input dataset by NAM. These points also have most of the outliers. The observation flags from the input file are not removed, so observations that have been flagged in the input dataset will never be included in the CUPiDO output file. However, the user has the option to remove new outliers detected by this procedure, from the output CUPiDO NetCDF.

In general we advise for a human to go through the list with detected outliers and decide what to do, and then flag the observations in the input dataset (or NAM database). This could for instance include removing some suspect points from a few clusters.

6.2.4. Cluster analysis: modeling the benchmark instabilities stochastically

Independent motion of individual benchmarks with respect to their foundation layer can produce a displacement which is temporally correlated, but spatially not. The leveling observations between close benchmarks in the clusters that are described in the previous section, provide a unique dataset to analyze and assess the benchmarks temporal instabilities. As the benchmarks per cluster are very close to each other (i.e., the average distance within a cluster is around 10 m or 0.01 km), the effect of spatially correlated noise/signal components is negligible in DD observations. Besides, due to the short leveling lines, the effect of leveling measurement noise is also very small, e.g.,

$$\sigma = 0.76\sqrt{0.01} = 0.076 \text{ mm}, \tag{19}$$

if a typical model for the standard deviation would be used, see also Section 5.1. Therefore, the DD leveling observations per cluster can be assumed to describe mainly the temporally correlated component of the benchmark instability.

In order to model these instabilities as a stochastic process, we use the same model as the temporally correlated idealization noise component (see Section 4.4), which is based on random processes with fractional Brownian motion in the time domain. We first calculate the dissimilarities [24] for DD leveling observations as

$$\hat{\gamma}(\Delta t_{12}) = \frac{1}{2}\Big((h_{ri}^{t_1t_2} - h_{rj}^{t_1t_2})^2\Big) = \frac{1}{2}\Big((h_{ij}^{t_1t_2})^2\Big), \tag{20}$$

where $h_{ri}^{t_1t_2}$ is the DD measurement defined as $h_{ri}^{t_1t_2} = (h_i^{t_2} - h_r^{t_2}) - (h_i^{t_1} - h_r^{t_1})$. Note that the outliers that had been detected in clusters (see Section 6.2.3) were excluded from the dissimilarity calculation. The dissimilarities were averaged for different temporal intervals (bins), resulting in an experimental variogram.

For a random process with fractional Brownian motion, the expected variogram of double-differences is written as [10]:

$$\mathrm{E}\{\hat{\gamma}(\Delta t_{12})\} = \sigma_t^2 \Delta_{12}^{p_t}, \tag{21}$$

where σ_t^2 is the variance of the temporally correlated random process and p_t is the power component (see Appendix C for more information on fractional Brownian motion). We assign weights to the elements of the experimental variogram based on the number of dissimilarities per bin. Using the elements of the experimental variogram as observations, the two parameters σ_t^2 and p_t have been estimated by nonlinear least-squares fit to the model of Eq. (21) as:

$$\hat{\sigma}_t^2 = 0.07\ \mathrm{mm}^2/\mathrm{y}^{p_t}, \quad \hat{p}_t = 1.86. \tag{22}$$

Figure 17 shows the dissimilarities, experimental variogram and the fitted model. The colors in the figure indicate the number of dissimilarities per bin.

These estimated parameters can potentially be used as the parameters of the temporally correlated noise component of offshore benchmarks.

6.2.5. Stochastic model

The covariance matrix is generated in three parts, first for the Up component, then East, and finally North, and then re–assembled in the actual order of the observations. The assumption is that there is no correlation between the three components. The covariance matrix for each component is the sum of two parts

1. Covariance matrix generated according to one of the models proposed by Simon Williams [23]. This consists of both a temporal and spatial component. No distinction is made between campaign and monitor stations. There are two options:
   a. Assuming a common date for all observations within a project (campaign).
   b. Taking the actual date of the observation into account.

   The second option is more complex to implement, and in the presence of setup noise, does not give significantly different results. Therefore, it was decided, only to implement the first option.

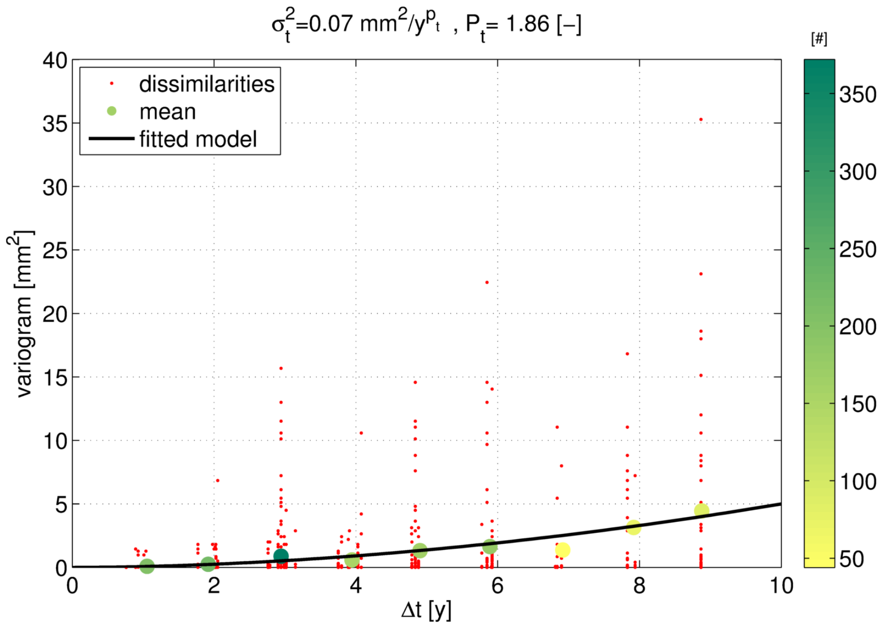

Figure 17: Calculated dissimilarities, experimental variogram and fitted variogram model. The colors indicate the number of dissimilarities per bin.

2. Covariance matrix with the setup noise, only for the campaign stations, and only for the height component. For the GPS monitor stations no setup noise is added. Again there are two options:
   a. Diagonal setup noise.
   b. Block diagonal setup noise for clusters in non reduced setup.

   In case the user decides to write all benchmarks in a cluster to the CUPiDO NetCDF file the height of the benchmarks in the same cluster will of course be heavily correlated because all are derived from the same GPS measurements. In this case of block diagonal covariance matrix must be used, which represents that a single point in the cluster has been observed with GPS with an appropriate setup noise, and that the others are connected using more precise leveling measurements. Typical values for the setup noise is 1.5 mm and 0.3 mm for the leveling between points in a cluster. In case the user decides only to output the primary point in a cluster a diagonal covariance matrix is used, as for the non-clustered campaign benchmarks.

All parameters can be specified in the input section of the `lts2_gps.m` script.

To compute the part of the covariance matrix without setup noise we use a simple algorithm. First, the temporal part of the GPS covariance matrix is computed for all possible epochs, taking into account that hourly samples have been averaged over several days, using the functions and models developed by Simon Williams [23]. Secondly, the spatial part of the GPS covariance matrix is computed using the locations of the benchmarks. For the spatial correlation we use the values proposed by Simon Williams [23], but as all parameters, these can be set in the scripts. Thirdly, the tem-

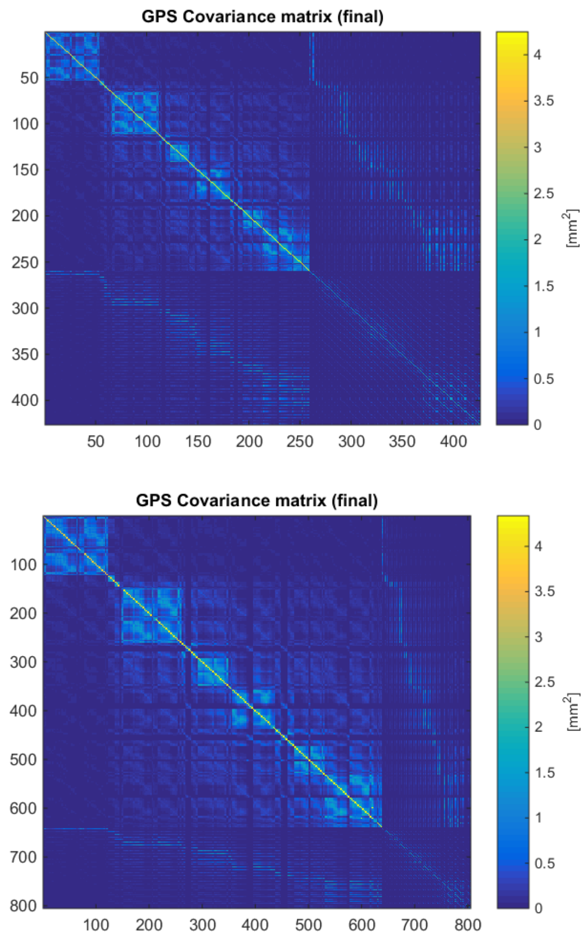

Figure 18: GPS covariance matrix with one benchmark per cluster (top) and with all benchmarks per cluster (bottom). The order of the points is campaign benchmarks followed by the GPS monitor stations. For the campaign benchmarks only the height component is included. For (some) monitor stations also the horizontal components are included, and there is no setup noise involved. The setup noise for the campaign stations is 1.5 mm. Simon Williams model number 6 was used the height, and model number 7 for the horizontal values, using the parameters proposed by Simon Williams [23]. Note that model 3 in [23] is the same as model 7.

poral and spatial parts are combined using a Kronecker product, resulting in a larger than needed covariance matrix. In the last step, only the elements of the covariance matrix for which there are observations are selected. Finally, the setup noise is added for the height component, and the height, East and North components are combined. The resulting covariance matrix is shown in Figure 18 for both cluster options.

6.3. Platform GPS Surveys (1993 – 2004)

GPS surveys to the platforms AWG1 and AME2 were undertaken in 1993, 1997, 1998, 2000 and 2004, involving also several markers onshore. For the older platform GPS Surveys very little is known about the actual processing method that has been used. What could be gathered from the limited information is that three to four receivers were deployed on a marker during a measurement period, and pairs of receivers have been processed to form baselines, possibly using the Leica SKI software. Typical baselines are 3–4 km, the longest baseline is 10.7 km, and all measured stations are in or close to the area of interest.

Taking into account the different processing strategy and the different time period, compared to the 06-GPS processing, which give completely independent results, and the fact that the GPS baseline measurement method is not used anymore in the area, it was decided to create a separate CUPiDO NetCDF dataset for the GPS baselines measured between 1993 and 2004. The baseline measurements are natural single-differences and can be directly used in a CUPiDO dataset. The synthetic benchmark construct, that was used for the 06-GPS processing, is not needed. The CUPiDO NetCDF dataset with GPS baseline data contains only the ellipsoidal height differences.

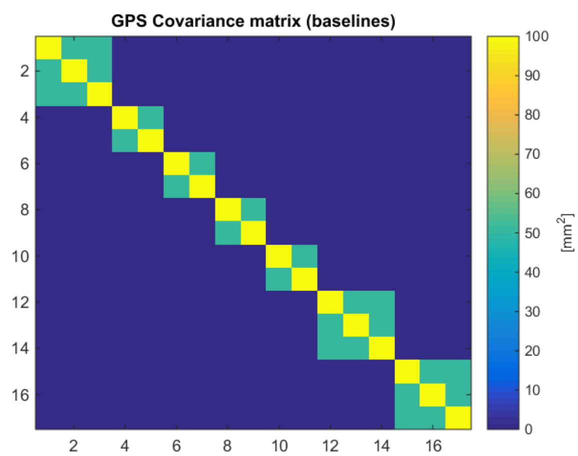

Figure 19: GPS baseline covariance matrix.

The Matlab script `lts2_gps_baselines.m` reads the Excel file with GPS baseline data provide by NAM, creates the appropriate covariance matrix, and writes the results to a CUPiDO NetCDF file. The script has two options for the covariance matrix. A simple diagonal matrix and an option that takes into account the correlations between simultaneously observed baselines. Simultaneously observed baselines often use a common receiver on one end of each baseline. This creates a strong correlation of 0.5 between the baselines. The standard deviation of the height differences is an input parameter. The current dataset was generated using the second option, taking correlations between baselines into account, with a conservative standard deviation of 10 mm for the height differences. The structure of the covariance matrix is shown in Figure 19. The output of the `lts2_gps_baselines.m` script is is given in Appendix O.

Using ellipsoidal height differences in the GPS baseline CUPiDO NetCDF file should as such not be a problem because the CUPiDO software does not form double-differences between two CUPiDO datasets. In this way, CUPiDO files with ellipsoidal height can be used together with CUPiDO files with leveled heights. However, because the initial CUPiDO has a limitation that only two files can be read, and we have three files (leveling, 06-GPS and GPS baselines), we merged the GPS baseline file with the leveling data file (merging with the 06-GPS files was not possible because CUPiDO applies a special treatment for the synthetic benchmark in the 06-GPS dataset). But this causes a problem with double-differences being formed between GPS and leveling data. For this reason, as a temporary measure, the GPS ellipsoidal heights were converted into orthometric height differences using corrections derived from a geoid. The next version of the CUPiDO software will be able to handle more than two datasets, which will resolve this particular problem.

6.4. Discussion and recommendations

In this section mainly the procedures for generating a GPS CUPiDO NetCDF dataset were described. The actual data is provided by the NAM, including an (initial) selection of outliers that should be removed from the data. The stochastic model was derived in a study by Simon Williams [23] and was taken over in this study without further analysis, except for the value of the setup noise, 1.5 mm, which was chosen in deliberation with the NAM.

The standard deviation of the resulting height of the GPS monitor stations is between 1.2 and 1.4 mm; setup noise and idealization precision are not included in these numbers. For the campaign stations a setup noise of 1.5 mm is added, resulting in standard deviations of 1.9 to 2.0 mm. Idealization precision will be added by the CUPiDO tool and is not further discussed here. The standard deviation of the temporal differences for the monitor stations is between 1.4 mm and 1.9 mm depending on the time interval between the measurements, and sometimes even smaller when two sub-campaigns are separated by a small amount in time. The standard deviation of the temporal differences of campaign stations is always between 2.6 and 2.9 mm on account of the setup noise.

Although the stochastic model for the GPS dataset was not a topic of analysis in the present study we would like to make a couple of remarks that could be useful for further studies.

The value chosen for the setup noise, 1.5 mm, is based on intuition and not based on experiments. It would be useful to verify this number by a controlled experiment.

The values chosen for the Simon Williams model are based on the analysis of three monitor stations. The same values are used for all stations, including those on the platforms, which have higher noise levels than the other stations, as can be observed from the time series analysis in this study. It would be useful to repeat the analysis of Simon Williams for the monitor stations on platforms and if necessary derive a different set of parameters for the stochastic model of this type of station.

The temporal component in the Simon Williams model assumes a start date when the benchmark was established. However, in the current implementation this start date is the same for all benchmarks. Ideally, although this is a small effect, the actual date a benchmark was build should be taken into account.

06-GPS has analyzed each change in the reference station configuration with the aim to minimize the impact on the positions in the area of interest. The influence of the change in reference station coordinates on the GPS monitor stations was always smaller than 1 mm, often even smaller than 0.5 mm, depending on the distance to the reference station for which the coordinates were changed. This led us to the conclusion to use a single synthetic benchmark for the full dataset. However, the stochastic model does not take the actual reference station changes into account at the epochs they occur[15]. Either we should introduce a new synthetic benchmark after each change in the reference station configuration or reference station coordinates, such that the dataset will be effectively split up in parts after each change in reference station configuration with it's own covariance matrix, or, these changes should be reflected in the covariance matrix by adding some sort of jump in the temporal covariance matrix after each reference station configuration change.

[15]Simon Williams did include two offsets in his parametric model for the horizontal data, [23], page 26.

7. Conclusion

We presented a new approach for the analysis of geodetic data. The approach is based on a uniformization of the data using a standardized data format and a conversion to double-difference observations. The implementation of the standardized data format is based on NetCDF file format, which is self-describing and provides a high degree of flexibility regarding data selection and data addition. The conversion tool generates an optimal set of DD observations, including the accompanying covariance matrix. This covariance matrix contains both the contribution of the measurement noise and idealization precision, which is based on user-defined models. Both a temporal model, e.g., describing benchmark instability, and a spatio-temporal model, e.g., representing shallow compaction, can be used. By using DD observations, the effect of different reference points and geodetic datums is eliminated. Hereby, the approach enables the integration of various techniques, such as leveling and GPS, as described here. However, the data acquired by other techniques can easily be included as well.

We also described, in detail, the procedures applied to the leveling and GPS data for the Ameland case. The procedure involves the detection of outliers in the data, which are flagged in the NetCDF files and transferred to the output of the conversion tool. This way, the user can decide whether or not the outliers are incorporated in the modeling.

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Appendix A. Precision of hydrostatic leveling

For hydrostatic leveling measurements, in practice the tolerance V [mm] is used to set the allowed deviation in the difference between the mean of both a set of forward and a set of backward hydrostatic leveling measurements [17]. Typically, a set of 5 measurements is used in both directions. The tolerance is dependent on the length of the tube L [km] used, and is set by

$$V = 0.8 + 0.1L. \tag{A.1}$$

Assuming this tolerance can be translated to a 95% confidence interval, the tolerance can also be expressed as a function of the standard deviation σ_m of a one-way mean hydrostatic leveling as

$$V = 1.96\sigma_m\sqrt{2}, \tag{A.2}$$

where the $\sqrt{2}$ accounts for the difference between the forward and backward leveling. Hence, the standard deviation of a mean hydrostatic leveling reads

$$\sigma_m = \frac{V}{1.96\sqrt{2}}. \tag{A.3}$$

The standard deviation σ_{mm} of the mean of a mean forward and a mean backward hydrostatic leveling is therefore

$$\sigma_{mm} = \frac{V}{1.96\sqrt{2}\sqrt{2}} \approx \frac{1}{4}V. \tag{A.4}$$

The associated values are summarized in Table A.4.

The hydrostatic leveling measurements are stored at Rijkswaterstaat in the same database as optical leveling measurements. For optical leveling measurements, the standard deviation is expressed in mm per square root kilometer (and transformed to the actual standard deviation based on the length of the leveled transect at a later stage). As the hydrostatic leveling measurements only form a small part of the total number of leveling measurements, this methodology is applied to the hydrostatic leveling measurements as well. As a result, the original standard deviations of the hydrostatic leveling measurements have to be transformed into a value per square root kilometer.

Therefore, assuming the one-way mean hydrostatic leveling measurements are stored in the HIS database of Rijkswaterstaat, the standard deviations σ_L in the database are

$$\sigma_L = \frac{\sigma_m}{\sqrt{L}}, \tag{A.5}$$

where L is expressed in km. Combining Equations (A.3) and (A.5), this leads to

$$\sigma_L = \frac{V}{1.96\sqrt{2}\sqrt{L}}. \tag{A.6}$$

Table A.4: Tolerances and standard deviation as a function of tube length (taken from [17]).

Tube length L [km]	Tolerance V [mm]	σ_{mm} ($\frac{1}{4}V$) [mm]	Tolerance B [mm]
2	1	0.25	1.8
4	1.2	0.30	1.8
6	1.4	0.35	1.8
8	1.6	0.40	1.8
10	1.8	0.45	1.8
12	2	0.50	1.8

Following the example in [17] and using the values in Table A.4, this translates for a tube with a length of 8 km into the standard deviation

$$\sigma_L = \frac{1.6}{1.96\sqrt{2}\sqrt{8}} = 0.204 \text{ mm}. \tag{A.7}$$

Similar, for a tube of 4 km, the standard deviation reads 0.216 mm.

Once inserted in the database, these values can be used in a common adjustment and testing scheme with the optical leveling measurements. To do so, the standard deviations per square root kilometer are translated into values per trajectory. Following again the numerical example in [17], the assumption is made that instead of the one-way mean measurements, the mean value between the mean forward and backward measurements is used. Therefore, the associated standard deviation is

$$\sigma_{mm} = \frac{\sigma_L}{\sqrt{2}}\sqrt{L}, \tag{A.8}$$

or expressed as variance,

$$\sigma_{mm}^2 = \frac{1}{2}L\sigma_L^2, \tag{A.9}$$

where again L is expressed in km. Continuing the example in [17], this leads to a variance of 0.167 mm^2 for a tube of 8 km and 0.094 mm^2 for a tube of 4 km. Note that, by combining Eqs. (A.6) and (A.8), you indeed obtain Eq. (A.4), that is

$$\sigma_{mm} = \frac{V}{1.96\sqrt{2}\sqrt{2}} \approx \frac{1}{4}V. \tag{A.10}$$

Appendix B. Idealization noise components for geo-modelers

For subsidence modeling, when identifying a deformation signal of interest, any other deformation caused by other sources should be considered as noise and their statistical properties should be described and included in the noise covariance matrix. Therefore, in the context of deformation modeling, the term noise not only comprises the the uncertainty of the measurements itself (Q_{e_1}) but also subsumes all signal (or deformation) components in geodetic observations that are not related to the signal of interest.

For example, for modeling of subsidence induced by deep gas production, the signal of interest is the deformation induced by deep mechanisms such as reservoir compaction or aquifer depletion. Therefore, the deformation caused by shallow sources should be considered as noise and thus be described by the stochastic model (i.e. covariance matrix). Based on this definition, we distinguish two different classes of noise components. One class is the random error of the measurements themselves, called *measurement noise*, and the other class covers any other kind of deformation signal rather than the signal of interest. We call the latter *idealization noise*. With this definition, the dispersion (variance and covariances) of the idealization noise components is the measure of idealization precision, and the dispersion of measurement noise is the measure of measurement precision.

To describe this concept in a mathematical form, we decompose the deformation vector d into two components

$$\underline{d} = d_M + \underline{d}_I, \tag{B.1}$$

where d_M is the true and unknown deformation signal of interest (deep source components), and $\underline{d}_I$ is the sum of all the other deformation signals (considered as idealization noise). Note that, in principle, the deformation d is a deterministic component. However for geo-modelers, in order to account for variability of other deformation sources, these sources are assumed to have stochastic behavior and therefore they are denoted by random vector $\underline{d}_I$. Consequently, the total deformation signal d is also described as a stochastic vector $\underline{d}$.

Let's $\underline{y}$ be the vector of geodetic deformation measurements, and consider the following standard functional model

$$\underline{y} = d + \underline{e} \tag{B.2}$$

where $\underline{e}$ denotes the random errors on the geodetic observations (i.e., the so-called measurement noise).
Inserting Eq. B.1 in Eq. B.2, we have

$$\underline{y} = d_M + \underline{d}_I + \underline{e}. \tag{B.3}$$

Assuming the functional model of $d_M = G(m)$ (where m is the vector of unknown model parameters) and zero-mean noise components, from a geo-modeling perspective, the mathematical model for the estimation of the model parameters m will be:

$$\mathrm{E}\{\underline{y}\} = d_M = G(m), \quad \mathrm{D}\{\underline{y}\} = Q_{d_I} + Q_e, \tag{B.4}$$

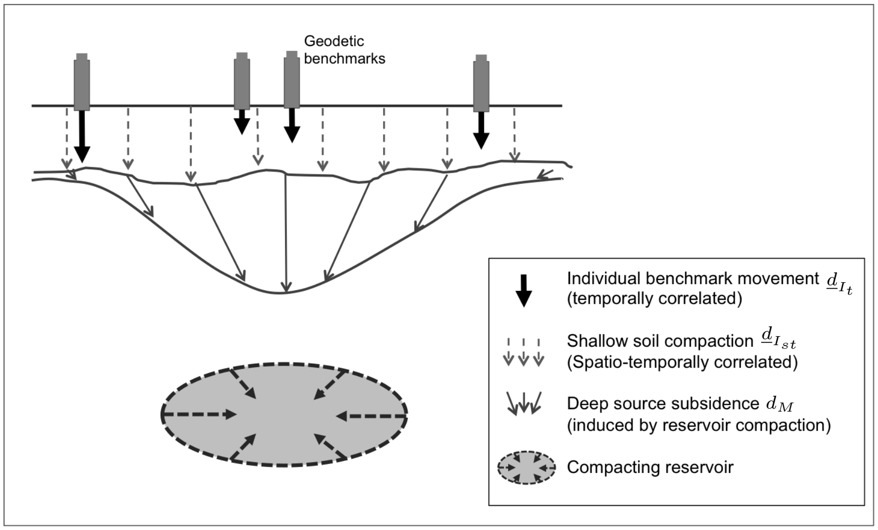


Figure B.20: Schematic visualization of the signal of interest (d_M) and different idealization noise components ($\underline{d}_{I_t}$ and $\underline{d}_{I_{st}}$).

where Q_{d_I} and Q_e are the covariance matrix of idealization noise and measurement noise, respectively. Note that Q_{d_I} can be further decomposed in different deformation components (see for example the next section and also Chapter 2 of [1]).

Appendix B.1. Further decomposition of idealization noise model

For geodetic data, the generic sources of idealization noise are deformation regimes such as (see Figure B.20):

- Independent motion of individual benchmarks with respect to the foundation layer due to for example structural instabilities. As the benchmark construction settings differ among all benchmarks, this autonomous deformation is assumed to be spatially uncorrelated. However, as deformation is developing in time, it is temporally correlated. Hence, the noise contribution of this regime is referred to as the *temporal component*, denoted as $\underline{d}_{I_t}$.
- Shallow compaction of the Holocene layer beneath benchmarks due to for example ground water level variation or soil compaction. These mechanisms are assumed to have dependencies in both space and time. Hence, the associated noise contribution is referred to as the *spatio-temporal component*, $\underline{d}_{I_{st}}$.

Therefore, the idealization noise components $\underline{d}_I$ can be written as summation of these two components (as $\underline{d}_I = \underline{d}_{I_t} + \underline{d}_{I_{st}}$), and so its covariance matrix is

$$\mathrm{D}\{\underline{d}_I\} = Q_{d_I} = Q_{d_{I_t}} + Q_{d_{I_{st}}}, \tag{B.5}$$

where $Q_{d_{I_t}}$ and $Q_{d_{I_{st}}}$ denote the covariance matrix of the temporal component $\underline{d}_{I_t}$ and the spatio-temporal component $\underline{d}_{I_{st}}$, respectively.

Appendix C. 2nd-order statistics for double-differences of random processes with fractional Brownian motion

Appendix C.1. Fractional Brownian motion

For a random process (or noise component) with a fractional Brownian motion, the variance increases with time. The variance/dispersion of such a process (hereafter denoted by $\underline{z}$) at point i and time t_1 is [14]:

$$D\{\underline{z}_i^{t_1}\} = \sigma^2 t_1^p, \tag{C.1}$$

where $0 < p < 2$ is a power index. The p exponent describes the smoothness of the resultant motion, with a higher value leading to a smoother motion.

Based on the definition of Eq.(C.1) and using the error propagation law, the covariance between $\underline{z}_i$ at two different times t_1 and t_2 is computed as [14]:

$$C\{\underline{z}_i^{t_1}, \underline{z}_i^{t_2}\} = \frac{1}{2}\sigma^2(t_1^p + t_2^p - \Delta t_{12}^p), \tag{C.2}$$

where $\Delta t_{12} = |t1 - t2|$.

Extension to a spatially correlated signal

Assuming a random process with a fractional Brownian motion in the time domain, but also with correlation and 2nd-order stationarity in the space domain, the model of Eq.(C.2) can be extended to the covariance between z at t_1 and t_2, and at two different locations i and j

$$C\{\underline{z}_i^{t_1}, \underline{z}_j^{t_2}\} = \frac{1}{2}\sigma^2(t_1^p + t_2^p - \Delta t_{12}^p)e^{-\frac{h_{ij}}{L}}, \tag{C.3}$$

where h_{ij} is the distance between the two points, and L is the spatial correlation length[16].

Using Eqs. (C.2) and (C.3), the 2nd-order statistics (i.e., variance and covariances) of the process z for different choices of i, j, t_1, and $t2$ can be evaluated. Table C.5 shows the overview of these 2nd-order statistics for both spatially correlated and spatially uncorrelated processes.

Appendix C.2. 2nd-order statistics for double-differences (DDs)

Using the linear error propagation law, the statistics of fractional Brownian processes (Table C.5) can be propagated to DD combinations.

[16]Note that there are, in general, different models to describe the spatially correlated signal. Here, as an example, we use the exponential covariance model $\sigma^2 e^{-h_{ij}/L}$.

Table C.5: Overview of the 2nd-order statistics for both spatially correlated and uncorrelated fractional Brownian processes.

Statistics	Symbol	Temporally non-stationary Spatially correlated (2nd-order stationary)	Temporally non-stationary Spatially uncorrelated ($L \to \epsilon$)
$\mathrm{D}\{\underline{z}_i^{t_1}\}$	q_{ii}^{11}	$\sigma^2 t_1^p$	$\sigma^2 t_1^p$
$\mathrm{C}\{\underline{z}_i^{t_1}, \underline{z}_j^{t_1}\}$	q_{ij}^{11}	$\sigma^2 t_1^p e^{-\frac{h_{ij}}{L}}$	0
$\mathrm{C}\{\underline{z}_i^{t_1}, \underline{z}_i^{t_2}\}$	q_{ii}^{12}	$\frac{1}{2}\sigma^2(t_1^p + t_2^p - \Delta t_{12}^p)$	$\frac{1}{2}\sigma^2(t_1^p + t_2^p - \Delta t_{12}^p)$
$\mathrm{C}\{\underline{z}_i^{t_1}, \underline{z}_j^{t_2}\}$	q_{ij}^{12}	$\frac{1}{2}\sigma^2(t_1^p + t_2^p - \Delta t_{12}^p)e^{-\frac{h_{ij}}{L}}$	0

For a general case, when we have two double-differences $\underline{z}_{ij}^{t_1t_2}$ and $\underline{z}_{kl}^{t_3t_4}$, the functional relationship between double-differences and un-differenced z components is written as

$$\begin{bmatrix} \underline{z}_{ij}^{t_1t_2} \\ \underline{z}_{kl}^{t_3t_4} \end{bmatrix} = \underbrace{\begin{bmatrix} 1 & -1 & -1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & -1 & -1 & 1 \end{bmatrix}}_{S} \underbrace{\begin{bmatrix} \underline{z}_i^{t_1} \\ \underline{z}_i^{t_2} \\ \underline{z}_j^{t_1} \\ \underline{z}_j^{t_2} \\ \underline{z}_k^{t_3} \\ \underline{z}_k^{t_4} \\ \underline{z}_l^{t_3} \\ \underline{z}_l^{t_4} \end{bmatrix}}_{Z}. \quad \text{(C.4)}$$

The dispersion of $\left[\underline{z}_{ij}^{t_1t_2}, \underline{z}_{kl}^{t_3t_4}\right]^T$ is computed by linear error propagation as

$$\mathrm{D}\{\begin{bmatrix} \underline{z}_{ij}^{t_1t_2} \\ \underline{z}_{kl}^{t_3t_4} \end{bmatrix}\} = \begin{bmatrix} \mathrm{D}\{\underline{z}_{ij}^{t_1t_2}\} & \mathrm{C}\{\underline{z}_{ij}^{t_1t_2}, \underline{z}_{kl}^{t_3t_4}\} \\ \mathrm{C}\{\underline{z}_{ij}^{t_1t_2}, \underline{z}_{kl}^{t_3t_4}\} & \mathrm{D}\{\underline{z}_{kl}^{t_3t_4}\} \end{bmatrix} = SQ_ZS^T, \quad \text{(C.5)}$$

where Q_Z is the covariance matrix of the vector Z

$$Q_Z = \mathrm{D}\{Z\} = \begin{bmatrix} q_{ii}^{11} & q_{ii}^{12} & q_{ij}^{11} & q_{ij}^{12} & q_{ik}^{13} & q_{ik}^{14} & q_{il}^{13} & q_{il}^{14} \\ & q_{ii}^{22} & q_{ij}^{12} & q_{ij}^{22} & q_{ik}^{23} & q_{ik}^{24} & q_{il}^{23} & q_{il}^{24} \\ & & q_{jj}^{11} & q_{jj}^{12} & q_{jk}^{13} & q_{jk}^{14} & q_{jl}^{13} & q_{jl}^{14} \\ & & & q_{jj}^{22} & q_{jk}^{23} & q_{jk}^{24} & q_{jl}^{23} & q_{jl}^{24} \\ & & & & q_{kk}^{33} & q_{kk}^{34} & q_{kl}^{33} & q_{kl}^{34} \\ & sym & & & & q_{kk}^{44} & q_{kl}^{34} & q_{kl}^{44} \\ & & & & & & q_{ll}^{33} & q_{ll}^{34} \\ & & & & & & & q_{ll}^{44} \end{bmatrix}. \quad \text{(C.6)}$$

By inserting Q_Z into Eq. (C.5), the $\mathrm{C}\{\underline{z}_{ij}^{t_1t_2}, \underline{z}_{kl}^{t_3t_4}\}$ is computed as

$$\begin{aligned}\mathrm{C}\{\underline{z}_{ij}^{t_1t_2}, \underline{z}_{kl}^{t_3t_4}\} = q_{ik}^{13} - q_{ik}^{14} - q_{ik}^{23} + q_{ik}^{24} \ \ldots \\ -q_{il}^{13} + q_{il}^{14} + q_{il}^{23} - q_{il}^{24} \ \ldots \\ -q_{jk}^{13} + q_{jk}^{14} + q_{jk}^{23} - q_{jk}^{24} \ \ldots \\ +q_{jl}^{13} - q_{jl}^{14} - q_{jl}^{23} + q_{jl}^{24}\end{aligned}. \tag{C.7}$$

By evaluation of Eq. (C.7) based on the equations in Table C.5, the 2nd-order statistics of double-difference measurements are derived as

$$\mathrm{D}\{\underline{z}_{ij}^{t_1t_2}\} = \mathrm{C}\{\underline{z}_{ij}^{t_1t_2}, \underline{z}_{ij}^{t_1t_2}\} = 2\sigma^2 \Delta t_{12}^p (1 - e^{-\frac{h_{ij}}{L}}), \tag{C.8}$$

and

$$\mathrm{C}\{\underline{z}_{ij}^{t_1t_2}, \underline{z}_{kl}^{t_3t_4}\} = \frac{1}{2}\sigma^2 \Big(\Delta t_{14}^p + \Delta t_{23}^p - \Delta t_{13}^p - \Delta t_{24}^p\Big)\Big(e^{-\frac{h_{ik}}{L}} + e^{-\frac{h_{jl}}{L}} - e^{-\frac{h_{il}}{L}} - e^{-\frac{h_{jk}}{L}}\Big). \tag{C.9}$$

Note that in case of a spatially uncorrelated signal (i.e., $L \to \epsilon$), the exponential component equals zero and Eq. (C.8) reduces to

$$\mathrm{D}\{\underline{z}_{ij}^{t_1t_2}\} = 2\sigma^2 \Delta t_{12}^p, \tag{C.10}$$

and the covariance components of Eq. (C.9) will be zero in a general case. Note that, if $h \neq 0$ the exponential components $e^{-h/\epsilon} = 0$, but when $h = 0$, then we get $e^{-h/\epsilon} = 1$. Therefor, for spatially uncorrelated signals, the covariance between DD combinations are zero only when the two DD measurements share no common benchmark. In other cases, there is a correlation induced by the common benchmark. For example if the two DDs share a same reference point, then $i = k$ and the covariance of Eq. (C.9) for spatially uncorrelated components (i.e., when $L = \epsilon$) is

$$\begin{aligned}\mathrm{C}\{\underline{z}_{ij}^{t_1t_2}, \underline{z}_{il}^{t_3t_4}\} &= \frac{1}{2}\sigma^2 \Big(\Delta t_{14}^p + \Delta t_{23}^p - \Delta t_{13}^p - \Delta t_{24}^p\Big)\Big(1 + 0 - 0 - 0\Big), \\ &= \frac{1}{2}\sigma^2 \Big(\Delta t_{14}^p + \Delta t_{23}^p - \Delta t_{13}^p - \Delta t_{24}^p\Big).\end{aligned} \tag{C.11}$$

Appendix D. CUPiDO software

The methodology described to handle geodetic observations for deformation analysis is implemented in the tool called 'CUPiDO'. The CUPiDO tool creates the optimal set of double-difference geodetic (GPS and leveling) measurements and its corresponding covariance matrix based on the user input: Period of interest (POI), Region of interest (ROI), and technique of interest (TOI).

The algorithm of the CUPiDO tool is explained in section 4. The overview of the inputs/outputs of the software is given in table 2.

The software is developed in Python and includes one main function and eight sub-functions:

1. *get_data.py* (main function)
   For the detailed description of Inputs/Outputs of the get_data.py, see the header of get_data.py.

2. *construct_sd2dd_transformation_gps.py*
   This sub-function constructs the single-to-double-difference transformation for both leveling and GPS data.

3. *construct_sd2dd_transformation.py*
   This sub-function constructs the single-to-double-difference transformation for both leveling and leveling data.

4. *construct_st_idealization_covmx.py*
   This sub-function constructs the covariance matrix associated with the spatio-temporally correlated component of idealization noise.

5. *construct_t_idealization_covmx.py*
   This sub-function constructs the covariance matrix associated with the temporally correlated component of idealization noise.

6. *csv_idealization_reading.py*
   This sub-function reads the idealization noise parameters from the database (see the header of 'get_data.py' for more info about the input database).

7. *csv_polygon_reading.py*
   This sub-function reads the polygon of the ROI.

8. *netcdf_reading.py*
   This sub-function reads the geodetic observations from the database (see the header of 'get_data.py' for more info about the input database).

9. *get_data_logging.py*
   This sub-function is used to write a log-file.

Appendix E. lts2_insert_hydro_stoch_model processing output

Contents lts2_insert_hydro_stoch_model.m

- Insert stochastic model hydrostatic levelling observations
- Input section (specify your project here)
- Set directories
- Load polygons from outline directory
- Loop over Move3 files
- Read .Obs file
- Read .tco file
- Link .Obs and .tco files
- Extract fixed benchmarks
- Select offshore benchmarks
- Select offshore observations
- Find index offshore observations
- Select observations
- Update stochastic model
- Write .Obs data

Insert stochastic model hydrostatic levelling observations

*Freek van Leijen, Delft University of Technology, 29 August 2016 *

This Matlab script reads Move3 files, detects hydrostatic and short optical levelling observations, and updates the stochastic models asociated with these observations. The stochastic model of the remaining optical levelling observations is also adapted, since a simple a-posteriori scaling afterwards (as applied to the campaigns without hydrostatic levelling observations) is no longer possible due to the different models used.

The following stochastic models are implemented:

1) hydrostatic levelling: std = 0.25 * V [mm], where for example the tolerance V = 0.8+0.1*L [mm], where L is the trajectory length in km. The standard deviation is evaluated here based on the trajectory length and inserted as a constant (c0) in the Move3 file, because Move3 cannot handle parameters with 3 decimal numbers (therefore, the alternative, c0 = 0.2 and c2 = 0.025 is not possible).

2) short optical levelling: e.g., 0.1 mm.

3) optical levelling: e.g., 0.76 mm/sqrt(km).

The inputs of the script are - dirIn: directory with Move3 .Obs and .tco files - dirOut: output directory for updated Move3 .Obs files - prj: list of campaigns with hydrostatic levelling observations to consider - tolerance_hydro1 tolerance for hydrostatic levelling, parameter 1 [mm] - tolerance_hydro2 tolerance for hydrostatic levelling, parameter 2 [mm] - std_optical standard deviation for optical levelling observations [mm/sqrt(km)] - std_short_optical standard deviation for short optical levelling observations [mm] - outlinedir directory with shorelines - roi region of interest (optional, plotting purposes only) - xminplot, xmaxplot, bounding box for plotting (optional, plotting yminplot, ymaxplot purposes only)

The outputs are - updated Move3 .Obs files (in dirOut) - various plots

This script uses functions from the `lts2` toolbox.

```
% (c) Freek van Leijen, Delft University of Technology, 2016.

% Created:    29 August 2016 by Freek van Leijen
% Modified:
%


clear all
close all

% Set path to required toolboxes
lts2toolboxdir=fullfile('../..','lts2toolbox');
addpath(fullfile(lts2toolboxdir,'lts2'));
```

Input section (specify your project here)

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Specify input and output directories
dirIn = 'move3_orig';
dirOut = 'move3_updated';

% Specify the campaigns to consider
prj = {'279H05','279H08','279H09','279W22','289W05','344W01',...
'371W00','AMEL0409','aml2001'};
Nprj = size(prj,2);

% Specify the stochastic model parameters
tolerance_hydro1 = 0.8; %mm
tolerance_hydro2 = 0.1; %mm
std_optical = 0.76; %mm/sqrt(km)
std_short_optical = 0.1; %mm
```

```
% Specify the directory with outlines
outlinedir = fullfile(lts2toolboxdir,'lts2','lts2outlines');

% Specify the region of interest (optional, plotting purposes only)
roi = ...
[175742.831700001 594117.445900001;...
166170.609099999 613572.102000002;...
203130.024099998 617294.633000001;...
206320.765000001 608165.568799999;...
206763.9234 602759.035700001;...
200027.914900001 602759.035700001;...
189436.427900001 600676.191;...
175742.831700001 594117.445900001];

% Specify the bounding box for plotting (optional, plotting purposes only)
xminplot = 150000;
xmaxplot = 215000;
yminplot = 570000;
ymaxplot = 620000;

% End input section (You should not have to change anything below this line.)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Set directories

```
if ~exist(dirIn,'dir')
  error(['The directory ' dirIn ' with original Move3 files does not exist.']);
end
if ~exist(dirOut,'dir')
  mkdir(dirOut);
end
```

Load polygons from outline directory

```
d=dir(fullfile(outlinedir,'*.coo'));
shoreline=[];
for k=1:numel(d)
   formatSpec = '%6f%f%[^\n\r]';
   filename=fullfile(outlinedir,d(k).name);
   fid=fopen(filename,'r');
   dataArray = textscan(fid, formatSpec, 'Delimiter', '', 'WhiteSpace', '',  'ReturnOnError', false);
```

```
   fclose(fid);
   shoreline=[ shoreline ; dataArray{:, 1} dataArray{:, 2} ; NaN NaN];
end
clear d
```

Loop over Move3 files

```
for w = 1:Nprj
```

```
  fprintf('Updating %s ....\n',char(prj(w)));
```

```
Updating 279H05 ....
```

```
Updating 279H08 ....
```

```
Updating 279H09 ....
```

```
Updating 279W22 ....
```

```
Updating 289W05 ....
```

```
Updating 344W01 ....
```

```
Updating 371W00 ....
```

```
Updating AMEL0409 ....
```

```
Updating aml2001 ....
```

Read .Obs file

```
fileIn = [dirIn '/' char(prj(w)) '.Obs'];
data = textread(fileIn,'%s');

dh = char(data(11:8:end-1));
p1 = data(12:8:end);
p2 = data(13:8:end);
hdf = data(14:8:end);
len = data(15:8:end);
c0 = str2num(char(data(16:8:end)));
c1 = str2num(char(data(17:8:end)));
c2 = str2num(char(data(18:8:end)));
N = size(dh,1);
```

Read .tco file

```
tcofile = [dirIn '/' char(prj(w)) '.tco'];
data2 = textread(tcofile,'%s');
```

Link .Obs and .tco files

Here, the id's in the .Obs file are linked to the benchmark coordinates in the .tco file with an index.

```
pnt = unique([p1;p2]);
Npnt = size(pnt,1);
x = nan(Npnt,1);
y = nan(Npnt,1);
id = cell(Npnt,1);
for v = 1:Npnt
  idx = strmatch(pnt(v),data2,'exact');

  if isempty(idx)
    error('Error: pntid could not be found in .tco file.');
  else
    id(v) = data2(idx);
    x(v) = str2num(char(data2(idx+1)));
    y(v) = str2num(char(data2(idx+2)));
  end
```

```
end

[~,p1idx] = ismember(p1,id);
[~,p2idx] = ismember(p2,id);
```

Extract fixed benchmarks

The selection of hydrostatic levelling observations is based on

1) offshore location of observations. To determine the offshore observations, the topology of the benchmarks and the observations is used. Starting point is an onshore/offshore classification of the fixed benchmarks (the coordinates of the temporary benchmarks do not seem sufficiently reliable, and are not considered). Starting at the offshore benchmarks, offshore observations are selected iteratively, until an onshore benchmark is reached.

2) length of the observation trajectory. An offshore observation is assigned as a hydrostatic observation when the length of the trajectory is either exactly 1000 m, or longer or equal to 2000 m and is rounded to a multiple of 50 m. Hence, an observation of 4150 m is selected, an observation of 4153 m is not.

First step is the selection of the fixed benchmarks by removing the temporary benchmarks.

```
pts = 1:length(id);
temp_pts = sort([strmatch('XXX',id);strmatch('PRI',id);strmatch('SEC',id)]);
pts(temp_pts) = [];
pnt_fixed = id(pts);
x_fixed = x(pts);
y_fixed = y(pts);
```

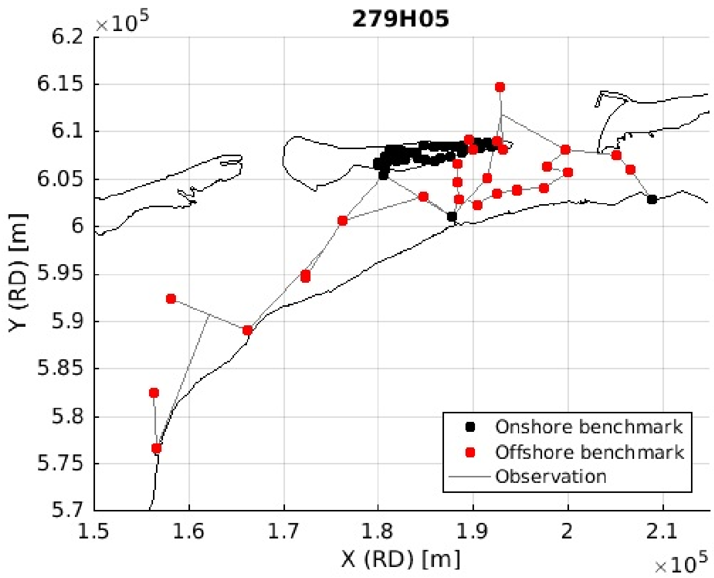
Select offshore benchmarks

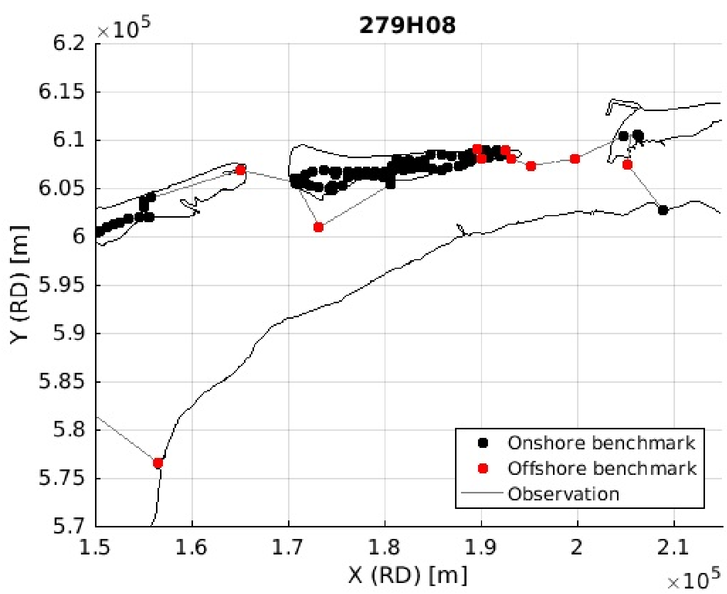
Polygons provided by the NAM are used to identify onshore benchmarks, and thereby also the offshore benchmarks. Please note that due to wrong coordinates of the temporary benchmarks, some connections look strange. This especially applies to campaign 344W01.

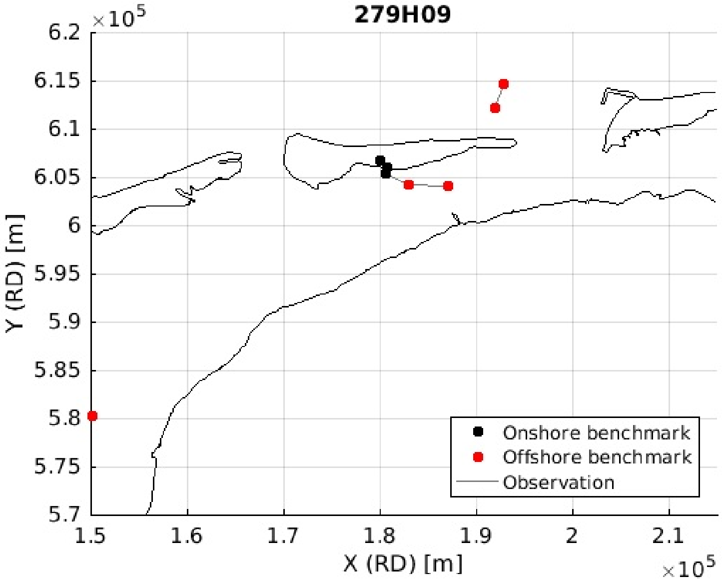
```
offshore = 1:length(x_fixed);
onshore = find(inpolygon(x_fixed,y_fixed,shoreline(:,1),shoreline(:,2)));
offshore(onshore) = [];

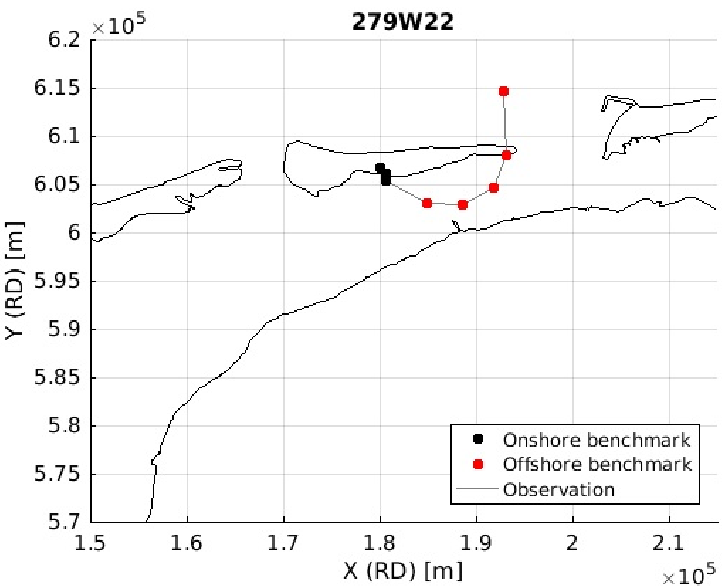
hh = NaN(6,1);
figure(w);hold on;
plot(shoreline(:,1),shoreline(:,2),'k')
h = plot([x(p1idx) x(p2idx)]',[y(p1idx) y(p2idx)]','color',[0.5 0.5 0.5]);
hh(3) = h(1);
h = plot(x_fixed,y_fixed,'k.','markersize',20);
```

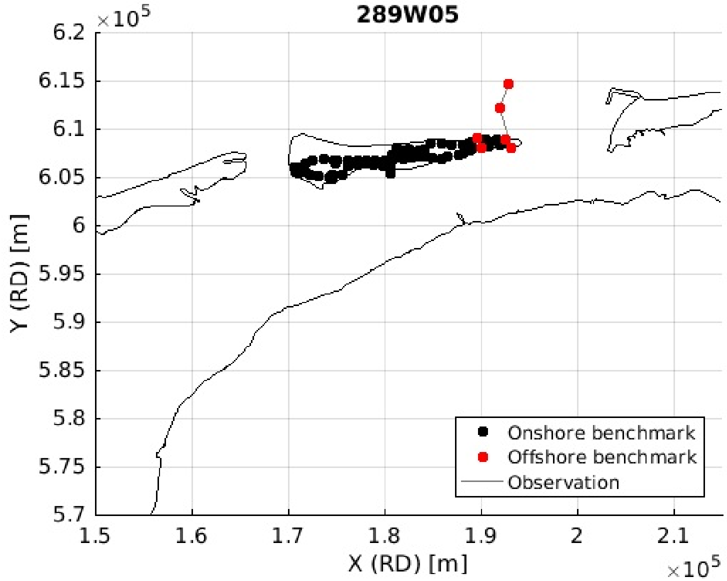
```
hh(1) = h(1);
h = plot(x_fixed(offshore),y_fixed(offshore),'r.','markersize',20);
hh(2) = h(1);
title(char(prj(w)));
xlabel('X (RD) [m]');
ylabel('Y (RD) [m]');
axis equal;
if exist('xminplot','var')
  if ~isempty(xminplot)
    set(gca,'xlim',[xminplot xmaxplot],'ylim',[yminplot ymaxplot]);
  end
end
grid on;
legend(hh(1:3),'Onshore benchmark','Offshore benchmark','Observation','Location','SouthEast');
```

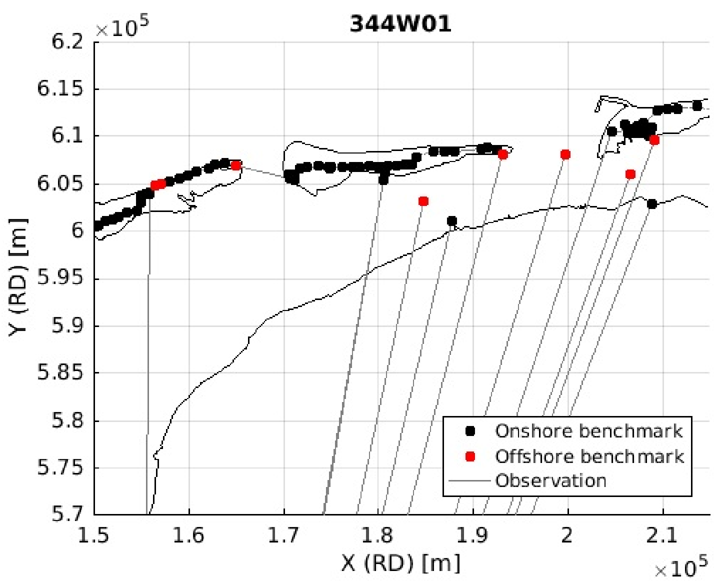


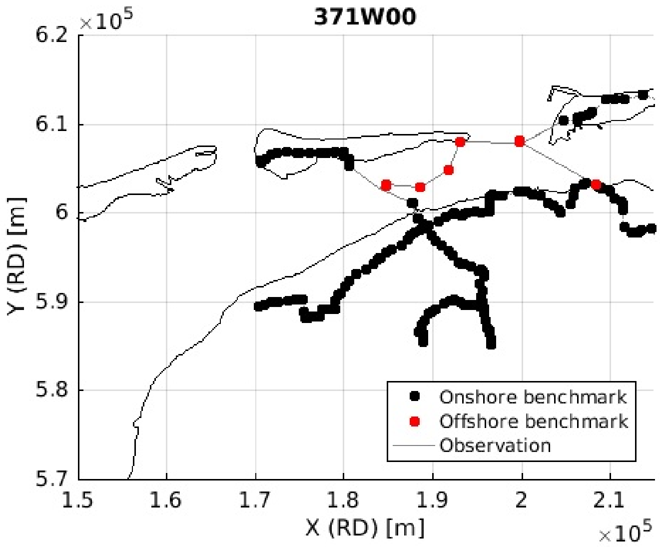


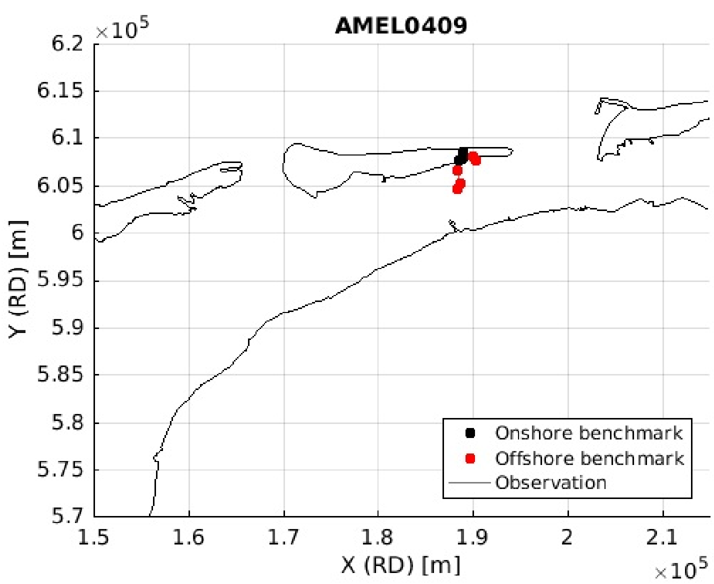

279H09
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Observation

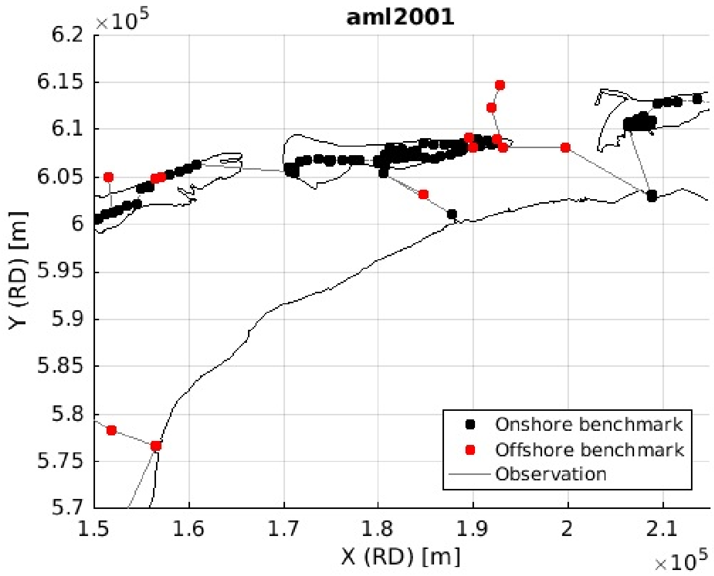

279W22
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Observation


289W05
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Observation


344W01
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Observation


371W00
×10^5
6.2
6.1
6
5.9
5.8
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Observation


AMEL0409
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Observation



Select offshore observations

An iterative search is applied to detect the offshore observations.

```
offshore_copy = offshore;
obs_ind = 1:length(p1);
obs_array = [];
while ~isempty(offshore_copy)

  pnt_con = pnt_fixed(offshore_copy(1));
  offshore_copy(1) = [];
  while ~isempty(pnt_con)
    obs1 = strmatch(pnt_con(1),p1(obs_ind));
    obs2 = strmatch(pnt_con(1),p2(obs_ind));
    pnt_con(1) = [];
```

```
    if ~isempty(obs1)
      dist1 = cellstr(num2str(hypot(x(p1idx(obs_ind(obs1)))-x(p2idx(obs_ind(obs1))),y(p1idx(obs_ind(obs1)))-y(p2idx(obs_ind(obs1)))),'
%10.3f'));
    else
      dist1 = cell(0,1);
    end
    if ~isempty(obs2)
      dist2 = cellstr(num2str(hypot(x(p1idx(obs_ind(obs2)))-x(p2idx(obs_ind(obs2))),y(p1idx(obs_ind(obs2)))-y(p2idx(obs_ind(obs2)))),'
%10.3f'));
    else
      dist2 = cell(0,1);
    end

    obs_array = [obs_array;...
                [p1(obs_ind(obs1)) p2(obs_ind(obs1)) len(obs_ind(obs1)) dist1];...
                [p1(obs_ind(obs2)) p2(obs_ind(obs2)) len(obs_ind(obs2)) dist2]];

    pnt_con = unique([pnt_con;p2(obs_ind(obs1));p1(obs_ind(obs2))]);

    land_idx = find(ismember(pnt_con,pnt_fixed(onshore)));
    pnt_con(land_idx) = [];
    offshore_idx = find(ismember(pnt_fixed(offshore_copy),pnt_con));
    offshore_copy(offshore_idx) = [];

    figure(w);
    h1 = plot([x(p1idx(obs_ind(obs1))) x(p2idx(obs_ind(obs1)))]',[y(p1idx(obs_ind(obs1))) y(p2idx(obs_ind(obs1)))]','r');
    h2 = plot([x(p1idx(obs_ind(obs2))) x(p2idx(obs_ind(obs2)))]',[y(p1idx(obs_ind(obs2))) y(p2idx(obs_ind(obs2)))]','r');

    if ~isempty(h1);
      hh(4) = h1(1);
    end
    if ~isempty(h2);
      hh(4) = h2(1);
    end

    [p1(obs_ind(obs1)) p2(obs_ind(obs1))];
    [p1(obs_ind(obs2)) p2(obs_ind(obs2))];

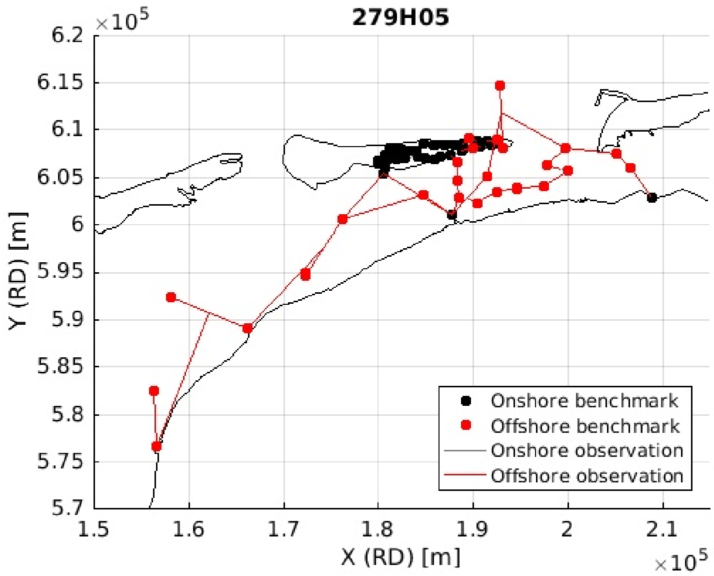
    [[x(p1idx(obs_ind(obs1))) x(p2idx(obs_ind(obs1)))] [y(p1idx(obs_ind(obs1))) y(p2idx(obs_ind(obs1)))]];
    [[x(p1idx(obs_ind(obs2))) x(p2idx(obs_ind(obs2)))] [y(p1idx(obs_ind(obs2))) y(p2idx(obs_ind(obs2)))]];

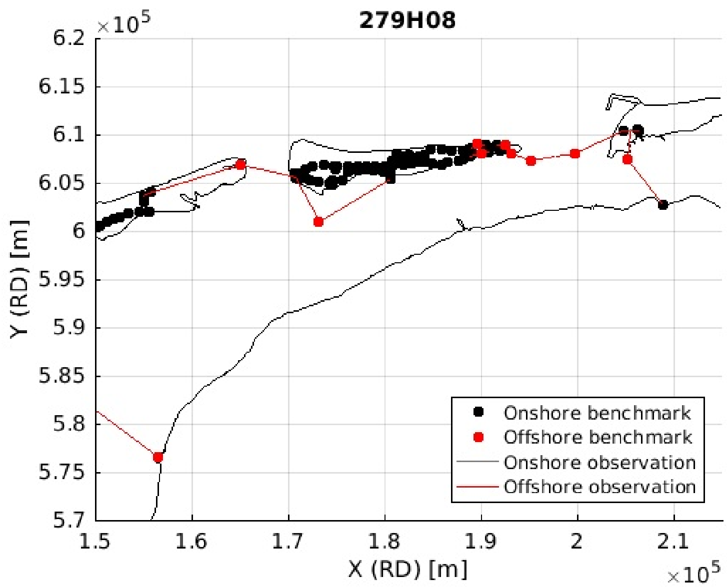
    len(obs_ind(obs1));
    len(obs_ind(obs2));
```

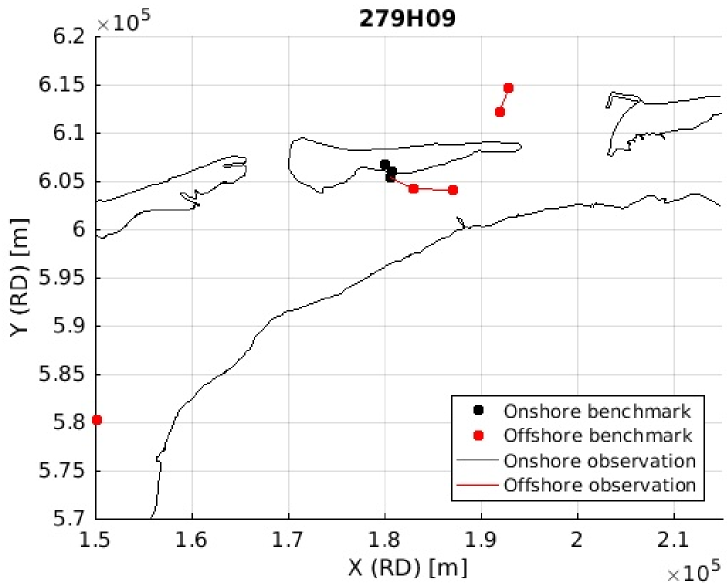
```
    obs_ind([obs1;obs2]) = [];

  end
end

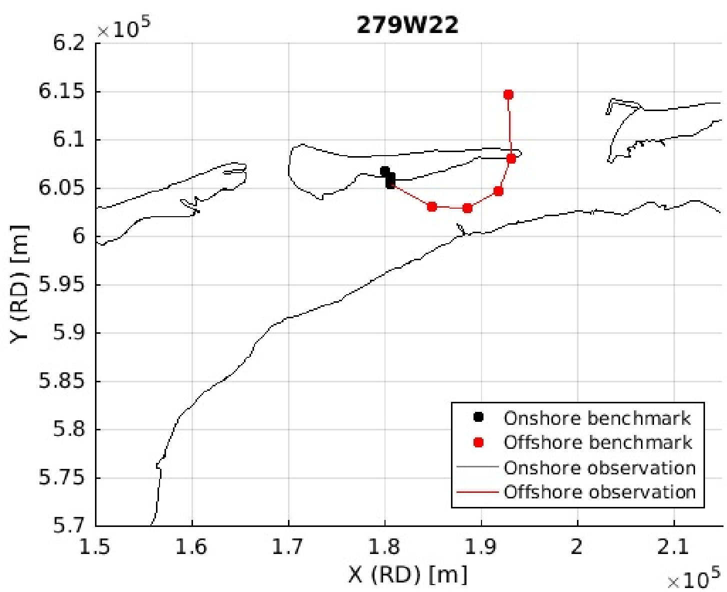
figure(w);
legend(hh(1:4),'Onshore benchmark','Offshore benchmark','Onshore observation','Offshore observation','Location','SouthEast');
hh(3:end) = NaN;
```



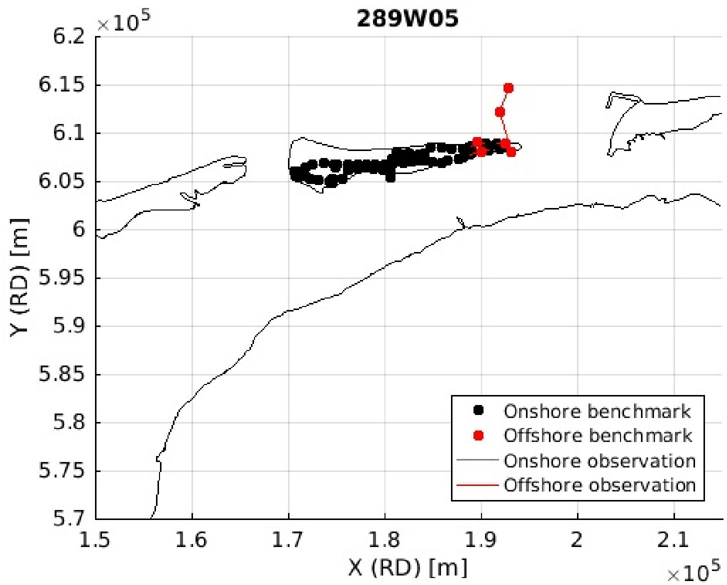


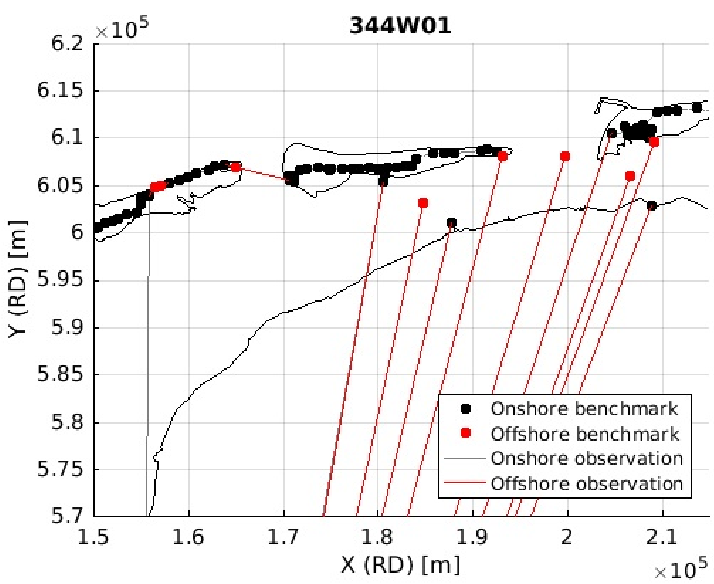


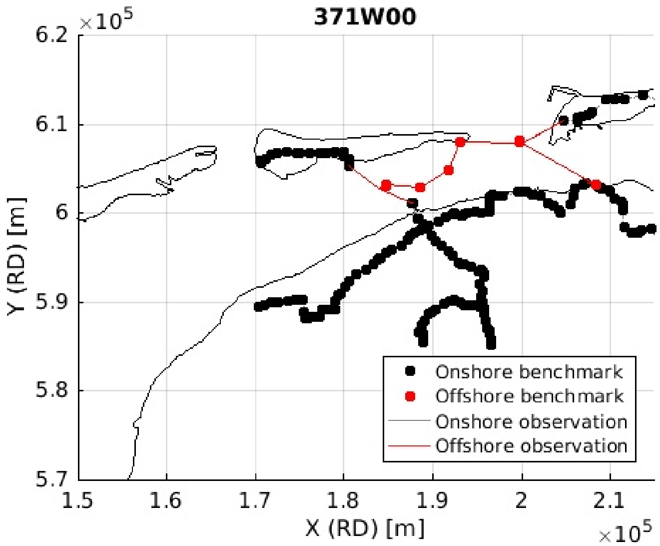
279H09
Y (RD) [m]
X (RD) [m]
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
1.5
1.6
1.7
1.8
1.9
2
2.1
Onshore benchmark
Offshore benchmark
Onshore observation
Offshore observation



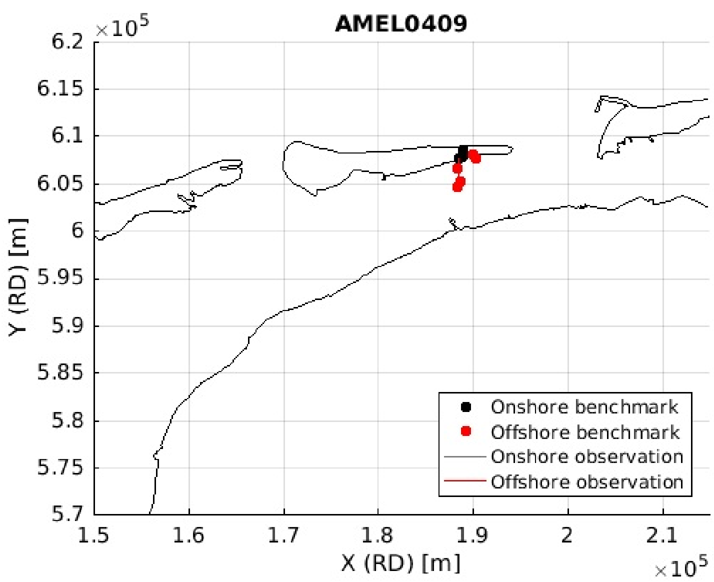
279W22
Y (RD) [m]
X (RD) [m]
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
1.5
1.6
1.7
1.8
1.9
2
2.1
Onshore benchmark
Offshore benchmark
Onshore observation
Offshore observation


289W05
Onshore benchmark
Offshore benchmark
Onshore observation
Offshore observation
X (RD) [m]
Y (RD) [m]

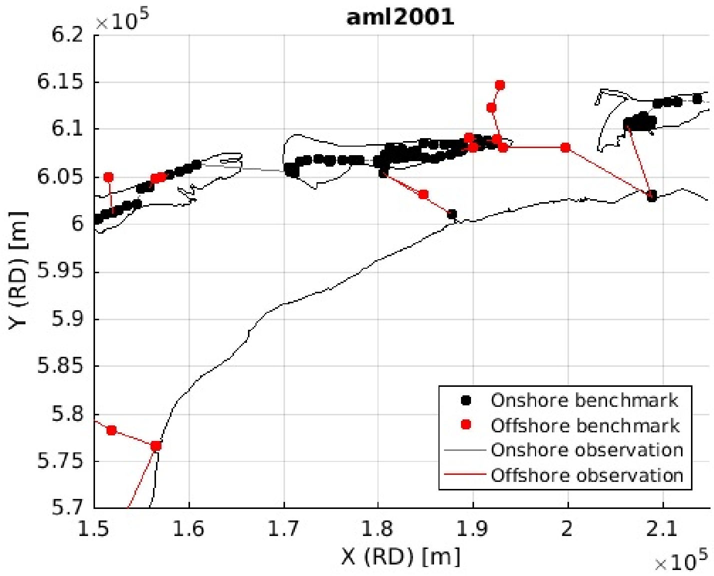

344W01
Onshore benchmark
Offshore benchmark
Onshore observation
Offshore observation
X (RD) [m]
Y (RD) [m]



371W00
×10^5
6.2
6.1
6
5.9
5.8
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Onshore observation
Offshore observation



AMEL0409
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Onshore observation
Offshore observation



Find index offshore observations

```
Noffshore = size(obs_array,1);
offshore_idx = [];
for v = 1:Noffshore
  idx1 = strmatch(obs_array(v,1),p1,'exact');
  idx2 = strmatch(obs_array(v,2),p2(idx1),'exact'); % can contain more than 1 observation
  offshore_idx = [offshore_idx;idx1(idx2)];
end
offshore_idx = unique(offshore_idx); %to avoid double indices
```

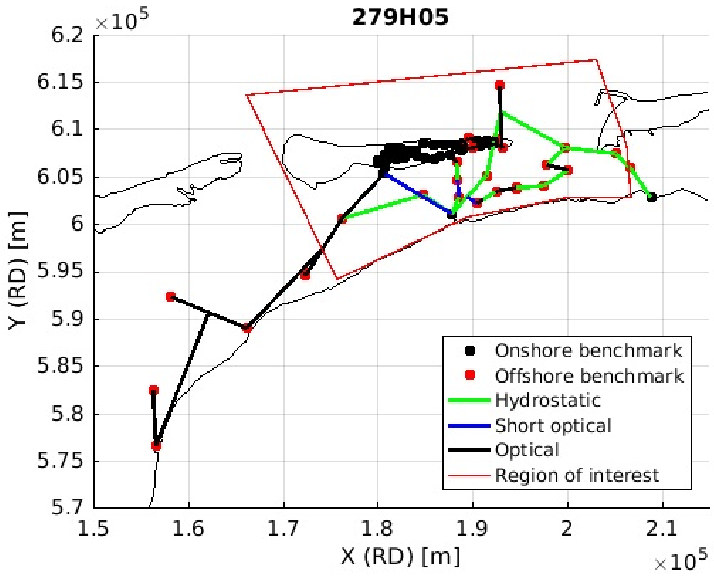
Select observations

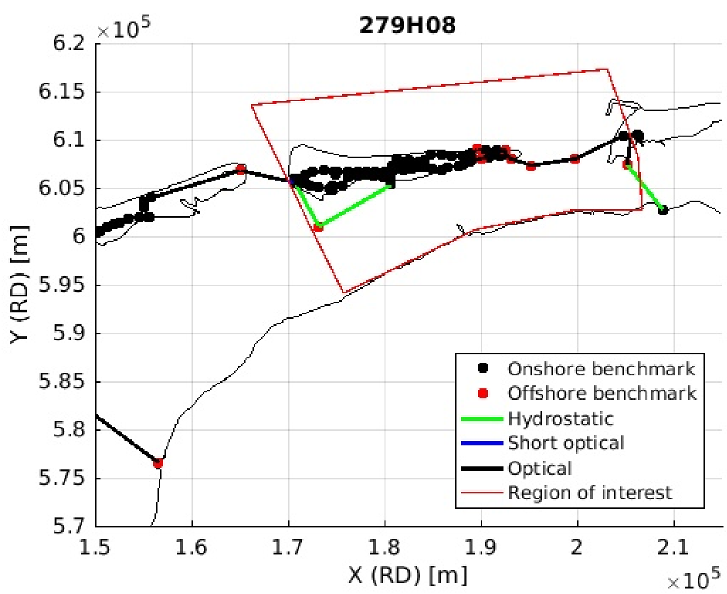
From the total set of observations, the hydrostatic observations and short optical levelling observations are selected. The short optical observations (onshore and offshore) are given a minimal standard deviation of e.g., 0.1 mm. Please note that due to wrong coordinates of the temporary benchmarks, some classifications look strange. This especially applies to campaign 344W01.

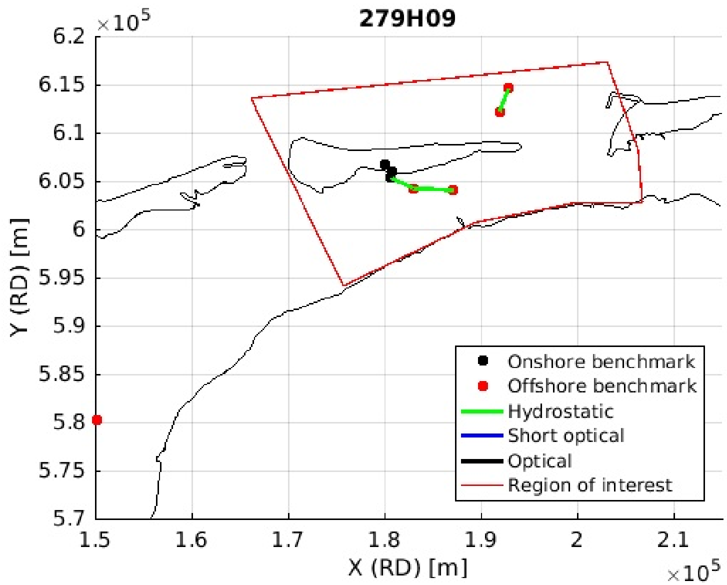
```
idx1 = find(str2num(char(len(offshore_idx)))==1000 | (str2num(char(len(offshore_idx)))>=2000 & rem(str2num(char(len(offshore_idx))),50
)==0));
Nidx1 = length(idx1);
idx2 = find(0.001*str2num(char(len))<(std_short_optical/std_optical)^2);
Nidx2 = length(idx2);
idx3 = setdiff(1:N,[offshore_idx(idx1);idx2]);
Nidx3 = length(idx3);

figure(w);
if ~isempty(idx1)
  h = plot([x(p1idx(offshore_idx(idx1))) x(p2idx(offshore_idx(idx1)))]',[y(p1idx(offshore_idx(idx1))) y(p2idx(offshore_idx(idx1)))]','
g','linewidth',2);
  hh(3) = h(1);
end
if ~isempty(idx2)
  h = plot([x(p1idx(idx2)) x(p2idx(idx2))]',[y(p1idx(idx2)) y(p2idx(idx2))]','b','linewidth',2);
  hh(4) = h(1);
end
if ~isempty(idx3)
  h = plot([x(p1idx(idx3)) x(p2idx(idx3))]',[y(p1idx(idx3)) y(p2idx(idx3))]','k','linewidth',2);
  hh(5) = h(1);
end

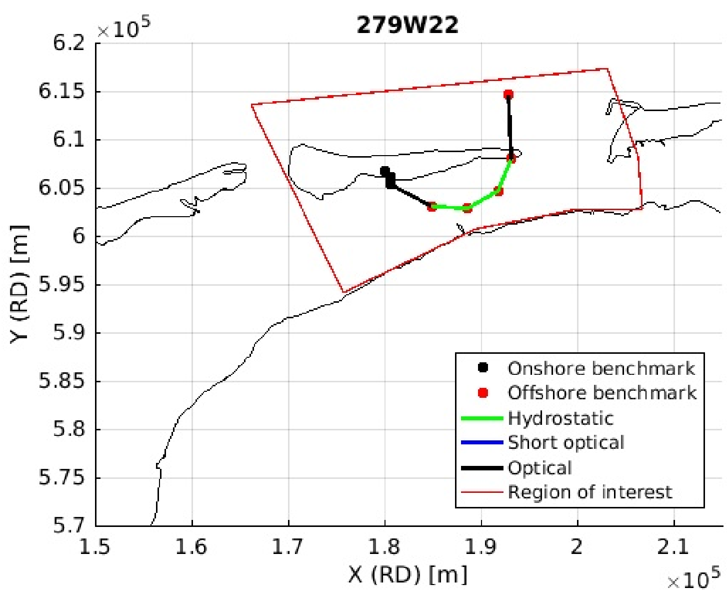
if exist('roi','var')
  if ~isempty(roi)
    h = plot(roi(:,1),roi(:,2),'r','Linewidth',1);
    hh(6) = h(1);
  end
end
legend_strings = {'Onshore benchmark','Offshore benchmark','Hydrostatic','Short optical','Optical','Region of interest'};
nanidx = find(~isnan(hh));
legend(hh(nanidx),legend_strings(nanidx),'Location','SouthEast');
```


279H05
Y (RD) [m]
X (RD) [m]
Onshore benchmark
Offshore benchmark
Hydrostatic
Short optical
Optical
Region of interest

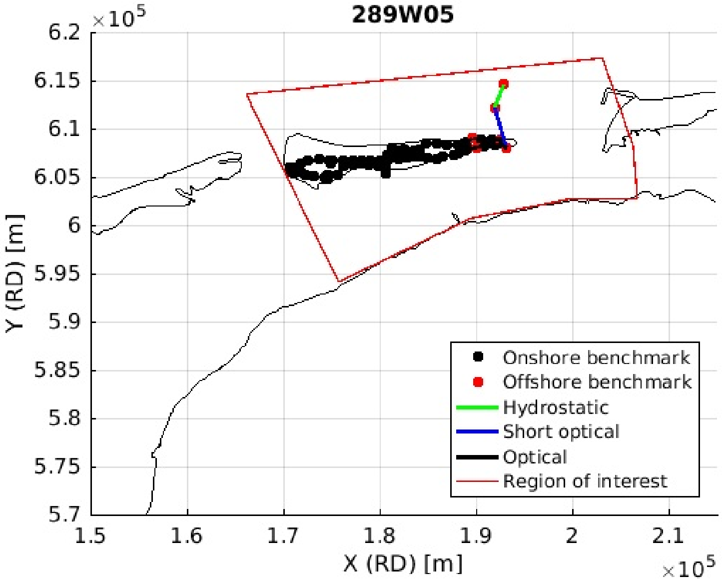

279H08
Y (RD) [m]
X (RD) [m]
Onshore benchmark
Offshore benchmark
Hydrostatic
Short optical
Optical
Region of interest

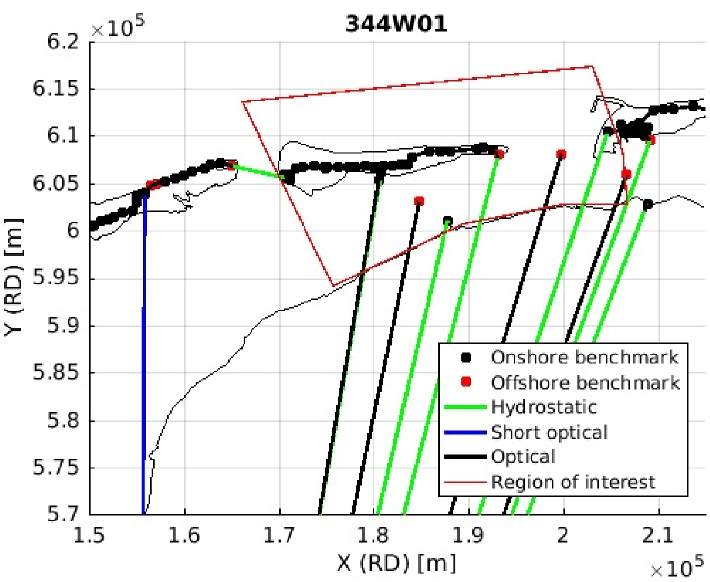


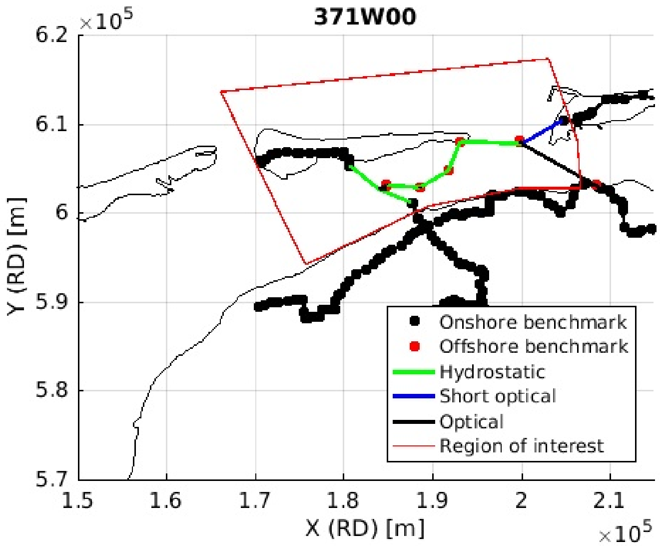
279H09
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Hydrostatic
Short optical
Optical
Region of interest

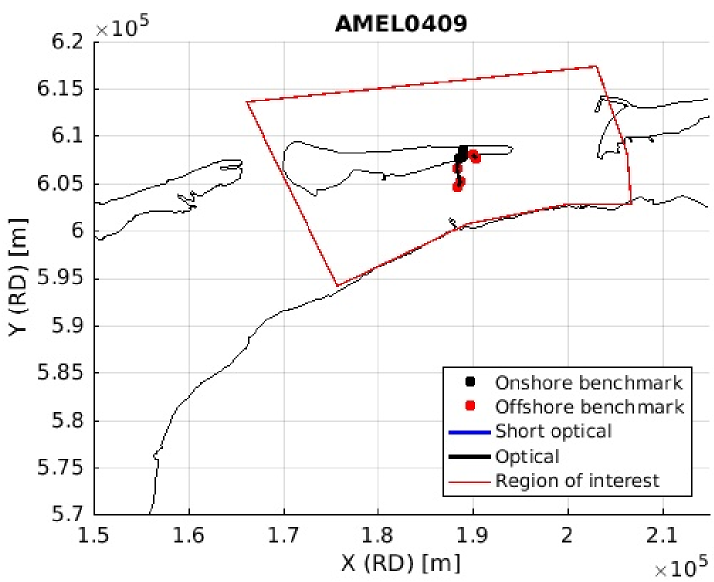


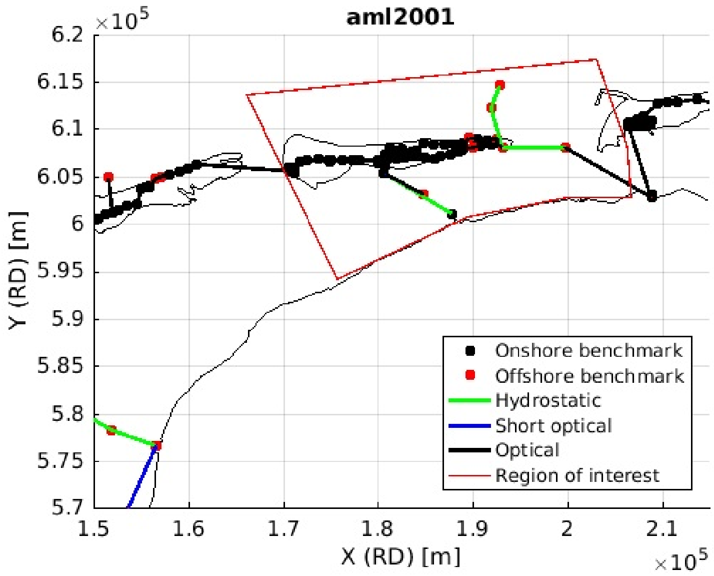
279W22
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Hydrostatic
Short optical
Optical
Region of interest


289W05
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Hydrostatic
Short optical
Optical
Region of interest


344W01
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Hydrostatic
Short optical
Optical
Region of interest


371W00
×10^5
6.2
6.1
6
5.9
5.8
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Hydrostatic
Short optical
Optical
Region of interest


AMEL0409
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Onshore benchmark
Offshore benchmark
Short optical
Optical
Region of interest



Update stochastic model

Update of the stochastic model:

1) hydrostatic levelling: std = 0.25 * V [mm], where for example the tolerance V = 0.8+0.1*L [mm], where L is the trajectory length in km. The standard deviation is evaluated here based on the trajectory length and inserted as a constant (c0) in the Move3 file, because Move3 cannot handle parameters with 3 decimal numbers (therefore, the alternative, c0 = 0.2 and c2 = 0.025 is not possible).

2) short optical levelling: e.g., 0.1 mm.

3) optical levelling: e.g., 0.76 mm/sqrt(km).

```
for v = 1:Nidx1
  c0(offshore_idx(idx1(v))) = 0.25*(tolerance_hydro1+tolerance_hydro2*...
                              (0.001*str2num(char(len(offshore_idx(idx1(v)))))));
```

```
  c1(offshore_idx(idx1(v))) = 0.00;
  c2(offshore_idx(idx1(v))) = 0.00;
end

for v = 1:Nidx2
  c0(idx2(v)) = std_short_optical;
  c1(idx2(v)) = 0.00;
  c2(idx2(v)) = 0.00;
end

for v = 1:Nidx3
  c1(idx3(v)) = std_optical;
end
```

Write .Obs data

```
fileOut = [dirOut '/' char(prj(w)) '.Obs'];
fid1 = fopen(fileOut,'w');

fprintf(fid1,'%s ',char(data(1)));
fprintf(fid1,'%s ',char(data(2)));
fprintf(fid1,'%s ',char(data(3)));
fprintf(fid1,'%s\n',char(data(4)));
fprintf(fid1,'%s\n',char(data(5)));
fprintf(fid1,'%s\n',char(data(6)));
fprintf(fid1,'%s\n',char(data(7)));
fprintf(fid1,'%s ',char(data(8)));
fprintf(fid1,'%s\n',char(data(9)));
fprintf(fid1,'%s\n',char(data(10)));
fprintf(fid1,'\n');

p1 = char(p1);
p2 = char(p2);
for v = 1:N
  fprintf(fid1,'%s   ',dh(v,:));
  fprintf(fid1,['%s' repmat(' ',1,8)],p1(v,:));
  fprintf(fid1,['%s' repmat(' ',1,8)],p2(v,:));

  hdf_str = char(hdf(v));
  if strmatch(hdf_str(end),'#')
    hdf_str(end) = [];
  end
  if strmatch(hdf_str(end),'#')
```

```
      fprintf(fid1,[repmat(' ',1,14-length(hdf_str)) '%s'],hdf_str);
    else
      fprintf(fid1,[repmat(' ',1,13-length(hdf_str)) '%s '],hdf_str);
    end

    fprintf(fid1,[repmat(' ',1,15-length(char(len(v,:)))) '%s'],char(len(v,:)));

    fprintf(fid1,'%15.2f',c0(v));
    fprintf(fid1,'%15.2f',c1(v));
    fprintf(fid1,'%15.2f\n',c2(v));

  end


  % Close file
  fprintf(fid1,'%s\n',char(data(end)));
  fclose(fid1);
```

```
end
```

Published with MATLAB® R2016b

Appendix F. lts2_move3_to_netcdf processing output

Contents lts2_move3_to_netcdf.m

- Write levellings campaigns (Move3 output) to NetCDF file
- Input section (specify your project here)
- Load polygons from outline directory
- Read project data
- Loop over Move3 files
- Read .var file
- Read .tco file
- Construct obs data
- Apply scale factor
- Get reference point
- Set reference height at zero
- Remove the reference point
- Remove temporary benchmarks
- Construct pnt data
- Select points inside area of interest
- Plot the final covariance matrix
- Create dataset
- Write netcdf file
- Update point class
- Get information about NetCDF file into structure finfo
- Read netcdf file for verification
- Test the data read from netcdf
- Done

Write levellings campaigns (Move3 output) to NetCDF file

*Freek van Leijen, Delft University of Technology, 5 September 2016 *

This Matlab script reads Move3 files in the specified input directory and writes the data to a NetCDF file.

The inputs of the script are - move3_dir: directory with Move3 .Obs and .tco files - overview_file: .csv file with information per campaign - outlinedir directory with

shorelines - xmin, xmax, bounding box to output to NetCDF file ymin, ymax - roi region of interest (optional, plotting purposes only) - xminplot, xmaxplot, bounding box for plotting (optional, plotting yminplot, ymaxplot purposes only) - netcdf_file Netcdf file name - globalattributes meta data for Netcdf file

The outputs are - Netcdf file with single difference levelling observations (including point class) - various plots

This script uses functions from the `lts2` toolbox.

```
% (c) Freek van Leijen, Delft University of Technology, 2016.

% Created:    5 September 2016 by Freek van Leijen
% Modified:   2 October 2016 by Freek van Leijen
%             - update with point class
%


clear all
close all

% Set path to required toolboxes
lts2toolboxdir = fullfile('../..','lts2toolbox');
addpath(genpath(fullfile(lts2toolboxdir,'lts2')));
```

Input section (specify your project here)

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Specify Move3 file directory and project overview file
move3_dir = './move3_final_results';
overview_file = 'lts2_lvl_prj_overview.csv';

% Specify the directory with outlines
outlinedir = fullfile(lts2toolboxdir,'lts2','lts2outlines');

% Specify the bounding box to output to NetCDF file
xmin = 150000;
xmax = 215000;
ymin = 570000;
ymax = 620000;

% Specify the region of interest (optional, plotting purposes only)
roi = ...
[175742.831700001 594117.445900001;...
```

```
166170.609099999 613572.102000002;...
203130.024099998 617294.633000001;...
206320.765000001 608165.568799999;...
206763.9234 602759.035700001;...
200027.914900001 602759.035700001;...
189436.427900001 600676.191;...
175742.831700001 594117.445900001];

% Specify the bounding box for plotting (optional, plotting purposes only)
xminplot = 150000;
xmaxplot = 215000;
yminplot = 570000;
ymaxplot = 620000;

% Define netcdf file name and global attributes

netcdf_file = 'lts2_alllevelling.nc';

globalattributes = { ...
      'title'        , 'LTS2 levelling dataset'  ; ...
      'institution'  , 'Delft University of Technology, Netherlands.' ; ...
      'source'       , 'Nederlandse Aardolie Maatschappij (NAM) height database.' ; ...
      'technique'    , 'Levelling' ; ...
      'history'      , ' ' ; ...
      'references'   , 'TU Delft, NAM LTS2 Report, 2016 (in preparation).' ; ...
      'comment'      , ' ' ; ...
      'Conventions'  , 'CF-1.6' ; ...
      'featureType'  , 'timeSeries' ; ...
      'email'        , 'f.j.vanleijen@tudelft.nl' ; ...
      'version'      , '1.0' ; ...
      'terms_for_use', 'These data can be used freely for research purposes provided that the following source is acknowledged: Nederlan
dse Aardolie Maatschappij (NAM).' ; ...
      'disclaimer'   , 'This data is made available in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the impli
ed warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.' ; ...
};

% End input section (You should not have to change anything below this line.)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Load polygons from outline directory

```
d=dir(fullfile(outlinedir,'*.coo'));
shoreline=[];
```

```
for k=1:numel(d)
   formatSpec = '%6f%f%[^\n\r]';
   filename=fullfile(outlinedir,d(k).name);
   fid=fopen(filename,'r');
   dataArray = textscan(fid, formatSpec, 'Delimiter', '', 'WhiteSpace', '',  'ReturnOnError', false);
   fclose(fid);
   shoreline=[ shoreline ; dataArray{:, 1} dataArray{:, 2} ; NaN NaN];
end
clear d
```

Read project data

```
display('Reading project data ...');

fid = fopen(overview_file,'r');
prjdata = textscan(fid,'%s%s%s%s%s','delimiter',',','headerlines',1);
fclose(fid);

prjfile = prjdata{1};
prjname = prjdata{2};
[prjname,prjidx1,prjidx2] = unique(prjname);
prjepoch = prjdata{3}(prjidx1);
prjepoch = datenum(prjepoch,'yyyymmdd');
prjclass = prjdata{4}(prjidx1);
prjscale = prjdata{5};
clear prjdata

Nprj = size(prjname,1);
Nfile = size(prjfile,1);
```

```
Reading project data ...
```

Loop over Move3 files

```
display('Reading observation data ...');
for w = 1:Nfile
```

Read .var file

```
varfile = [move3_dir '/' char(prjfile(w)) '.var'];
data = textread(varfile,'%s');
```

Read .tco file

```
tcofile = [move3_dir '/' char(prjfile(w)) '.tco'];
data2 = textread(tcofile,'%s');
```

Construct obs data

```
idx = strmatch('$',data);
obs(w).id = data(idx(3)+1:2:idx(4)-2);
obs(w).val = str2num(char(data(idx(3)+2:2:idx(4)-1)));
obs(w).N = size(obs(w).id,1);

temp = zeros(obs(w).N,obs(w).N);

count = 0;
for v = 1:obs(w).N
  temp(v,1:v) = str2num(char(data(idx(4)+count+1:idx(4)+count+v)));
  count = count + v;
end

if isempty(strmatch('$',data(idx(4)+count+1)));
  error(['Something went wrong while reading the data. The ' char(prjfile(w)) '.var file seems to be corrupt.']);
end

obs(w).cov = tril(temp) + tril(temp,-1)';
```

Apply scale factor

The campaigns with hydrostatic levelling observations are already based on the updated stochastic model (scale factor is 1). The campaigns without hydrostatic levelling observations need to be scale based on the standard deviation of e.g., 0.76 mm/sqrt(km) (scaling factors obtained from the project overview file).

```
obs(w).cov = obs(w).cov*(str2num(char(prjscale(w)))^2);
```

Get reference point

```
idx1 = find(sum(obs(w).cov,1)<1e-15);
if length(idx1)~=1
  error(['Could not find the reference point for project ' char(prjname(prjidx2(w))) '.']);
else
  ref_id = data(idx(3)+2*idx1-1);
end
```

Set reference height at zero

Sometimes the height of the reference point is not set to zero in Move3, therefore set to zero.

```
obs(w).val = obs(w).val-obs(w).val(idx1);
```

Remove the reference point

```
ref_idx = strmatch(ref_id,obs(w).id,'exact');
obs(w).id(ref_idx) = [];
obs(w).val(ref_idx) = [];
obs(w).cov(ref_idx,:) = [];
obs(w).cov(:,ref_idx) = [];
obs(w).N = size(obs(w).id,1);
obs(w).table = [repmat(ref_id,obs(w).N,1) obs(w).id];
```

Remove temporary benchmarks

Only the fixed benchmarks are written to the NetCDF file.

```
temp_pts = sort([strmatch('XXX',obs(w).id);strmatch('PRI',obs(w).id);strmatch('SEC',obs(w).id)]);
obs(w).id(temp_pts) = [];
obs(w).val(temp_pts) = [];
obs(w).cov(temp_pts,:) = [];
obs(w).cov(:,temp_pts) = [];
obs(w).N = size(obs(w).id,1);
obs(w).table(temp_pts,:) = [];
```

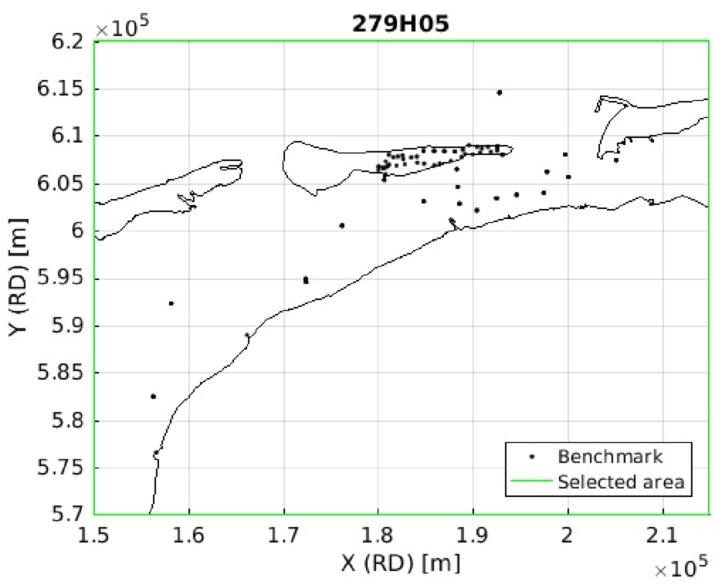
Construct pnt data

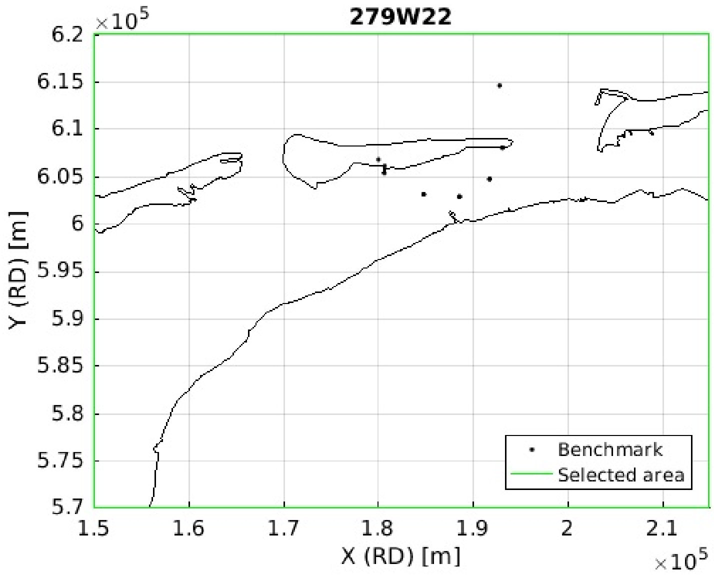
```
pnt(w).id = [ref_id;obs(w).id];
```

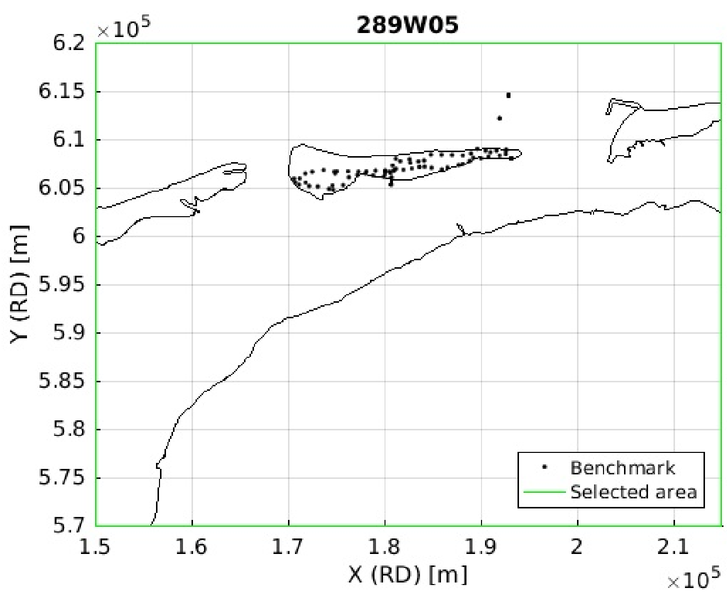
```
  pnt(w).N = size(pnt(w).id,1);
  pnt(w).x = nan(pnt(w).N,1);
  pnt(w).y = nan(pnt(w).N,1);
  for v = 1:pnt(w).N
    idx = strmatch(pnt(w).id(v),data2,'exact');

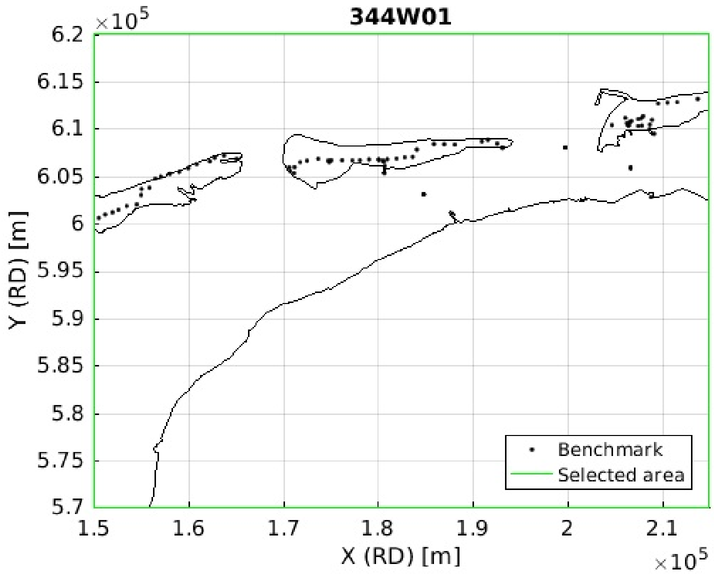
    if isempty(idx)
      error('Error: pntid could not be found in .tco file.');
    else
      pnt(w).x(v) = str2num(char(data2(idx+1)));
      pnt(w).y(v) = str2num(char(data2(idx+2)));
    end
  end

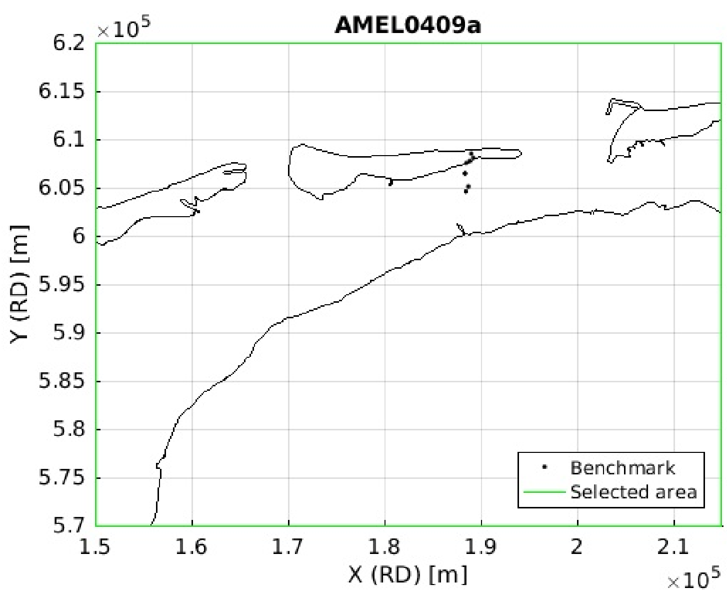
  hh = NaN(5,1);
  figure(2*w-1);hold on
  plot(shoreline(:,1),shoreline(:,2),'k')
  h = plot(pnt(w).x,pnt(w).y,'k.');
  hh(1) = h(1);
  h = plot([xmin xmax xmax xmin xmin]',[ymin ymin ymax ymax ymin]','g');
  hh(4) = h(1);
  title(char(prjfile(w)));
  xlabel('X (RD) [m]');
  ylabel('Y (RD) [m]');
  axis equal;
  if exist('xminplot','var')
    if ~isempty(xminplot)
      set(gca,'xlim',[xminplot xmaxplot],'ylim',[yminplot ymaxplot]);
    end
  end
  grid on;
  legend(hh([1 4]),'Benchmark','Selected area','Location','SouthEast');
```

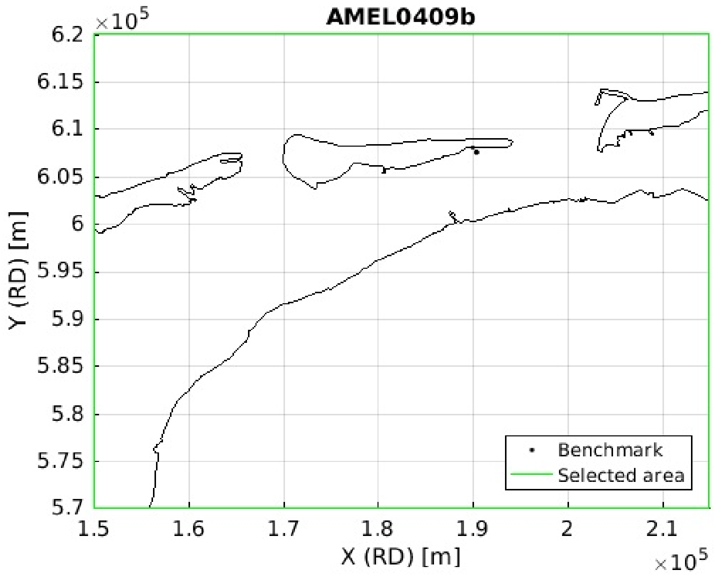


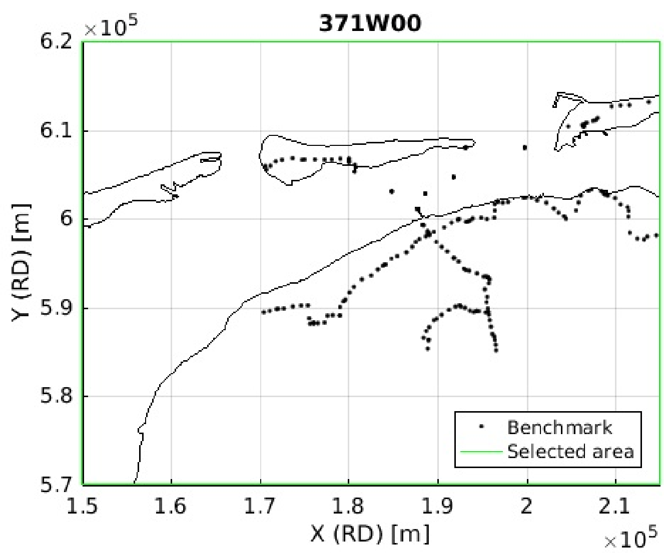

279W22
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
×10^5
X (RD) [m]
Benchmark
Selected area

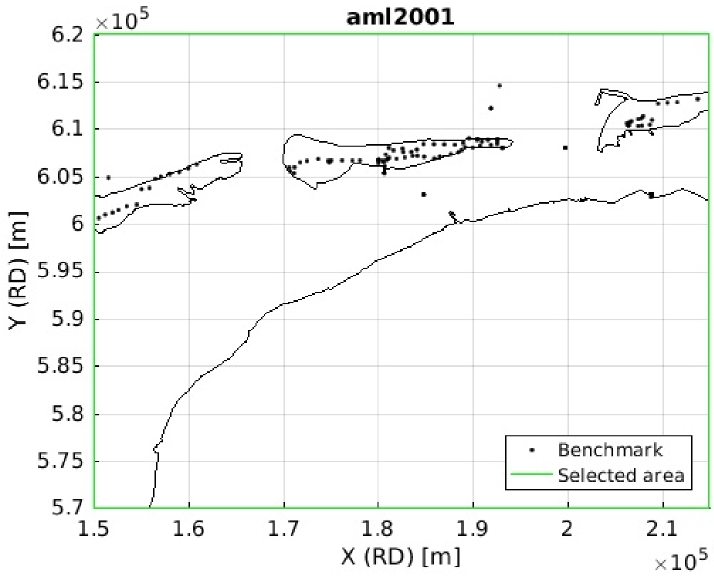

289W05
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
×10^5
X (RD) [m]
Benchmark
Selected area

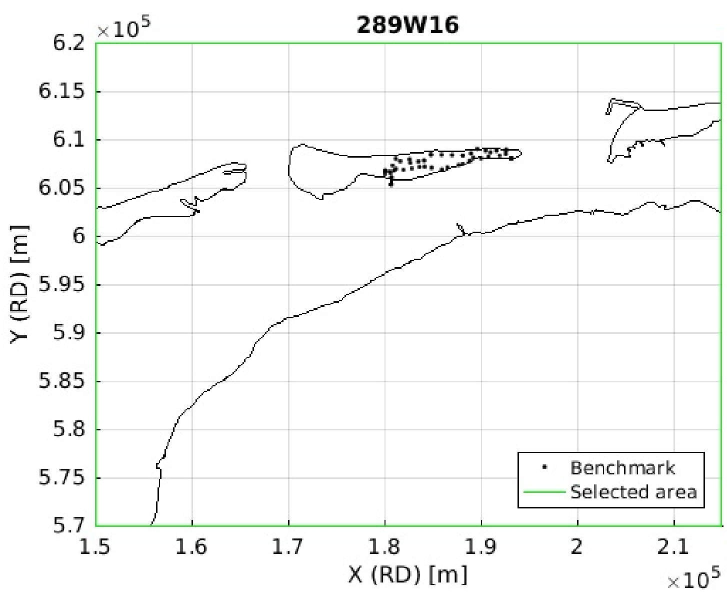

344W01
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area

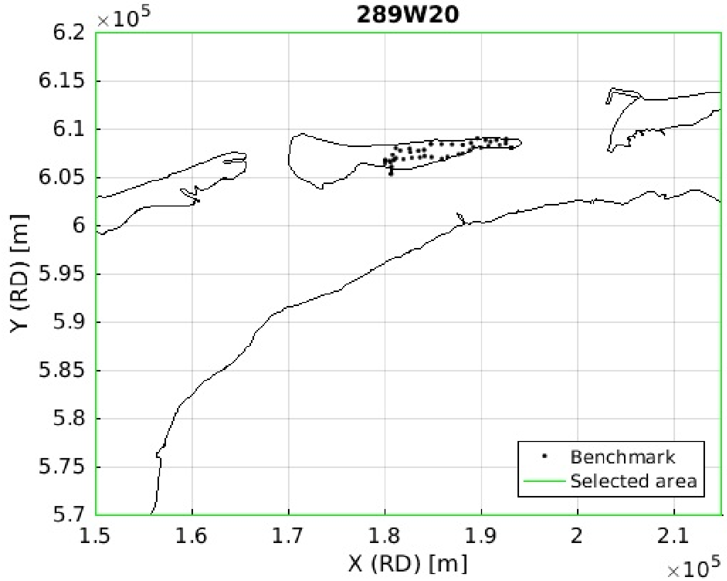

AMEL0409a
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area

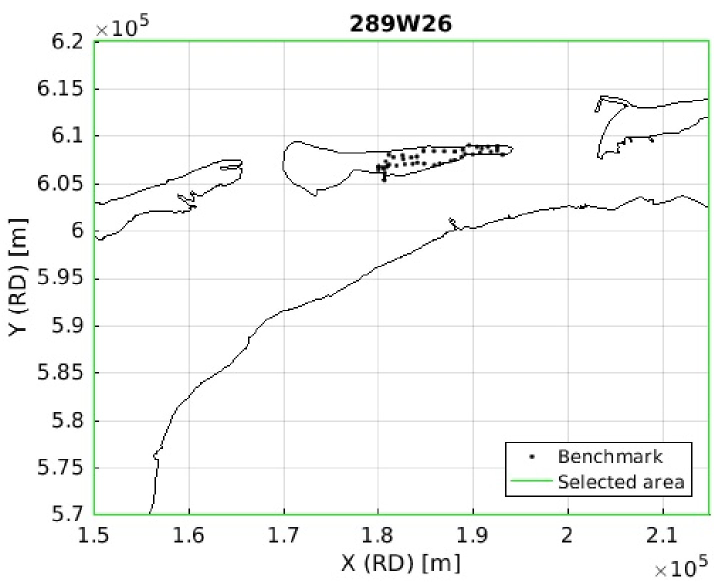

AMEL0409b
Y (RD) [m]
X (RD) [m]
Benchmark
Selected area

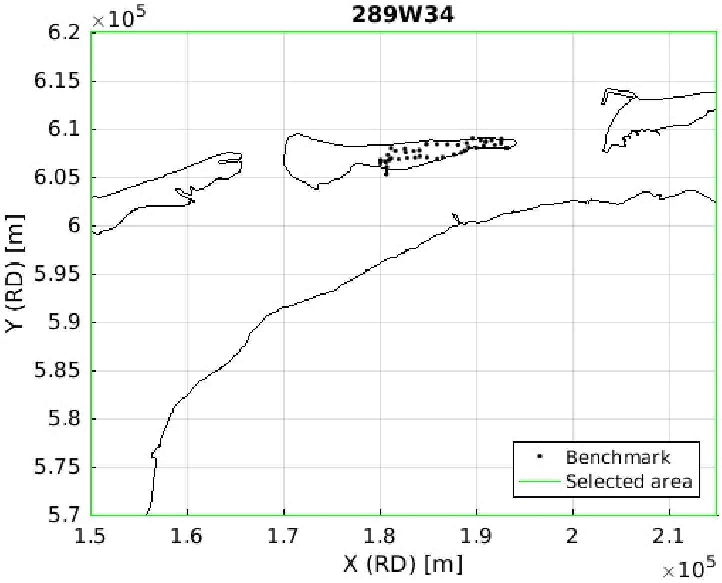

371W00
Y (RD) [m]
X (RD) [m]
Benchmark
Selected area

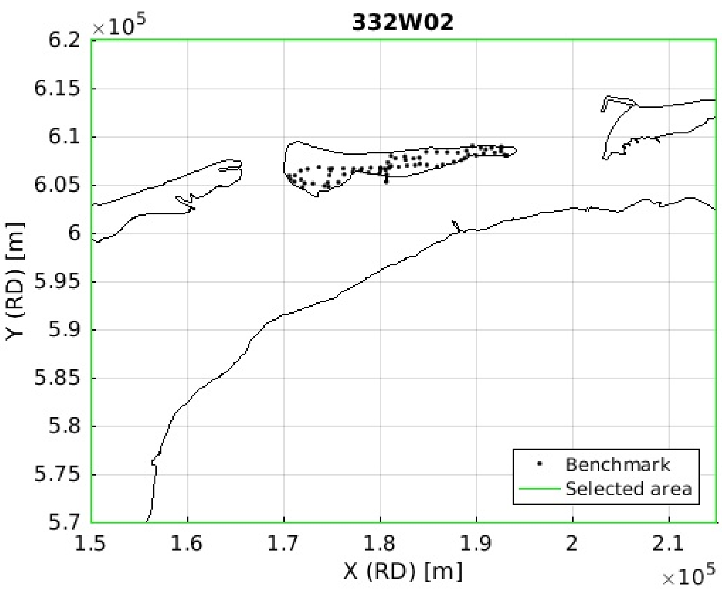

aml2001
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area

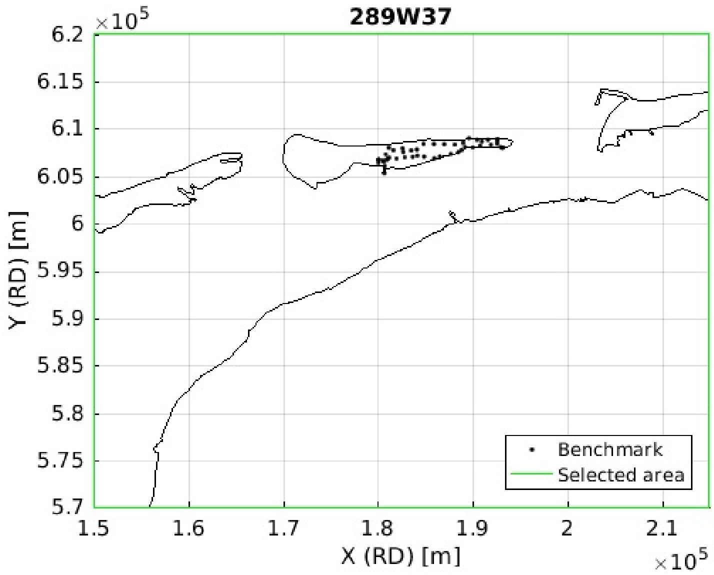

289W16
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area

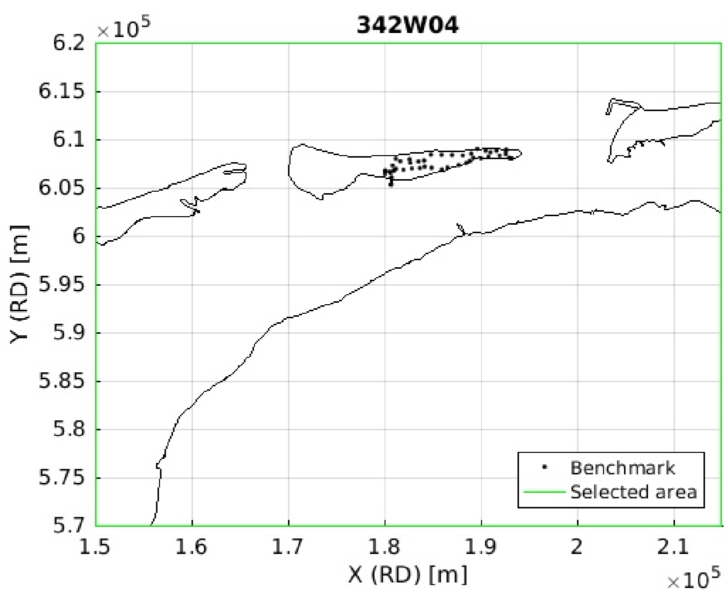

289W20
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area

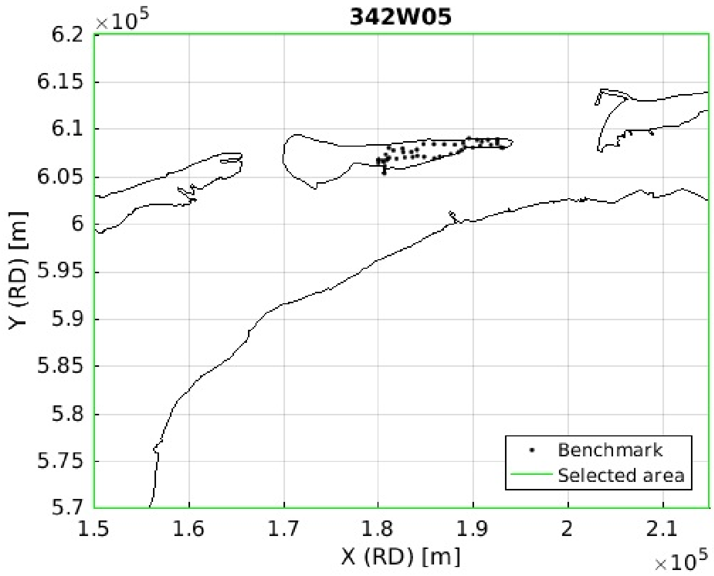

289W26
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area


289W34
Benchmark
Selected area
X (RD) [m]
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
×10^5
5.7
5.75
5.8
5.85
5.9
5.95
6
6.05
6.1
6.15
6.2
×10^5

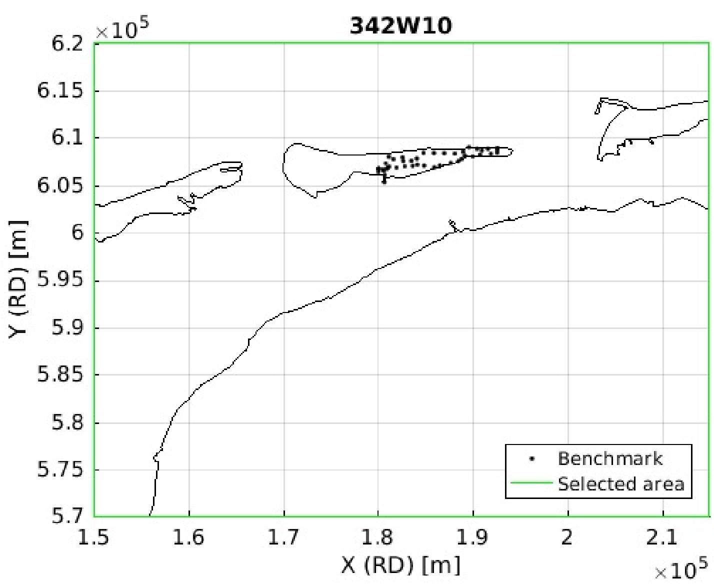

332W02
Benchmark
Selected area
X (RD) [m]
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
×10^5
5.7
5.75
5.8
5.85
5.9
5.95
6
6.05
6.1
6.15
6.2
×10^5


289W37
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
Benchmark
Selected area
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5

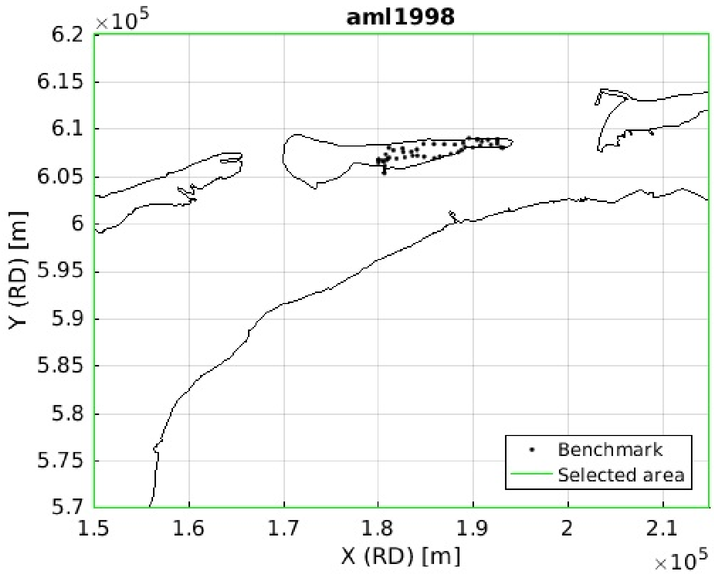

342W04
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
Benchmark
Selected area
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5

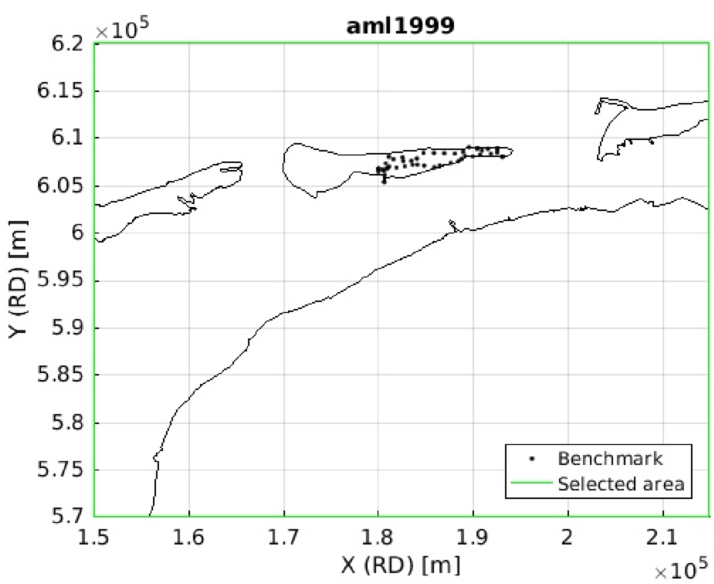


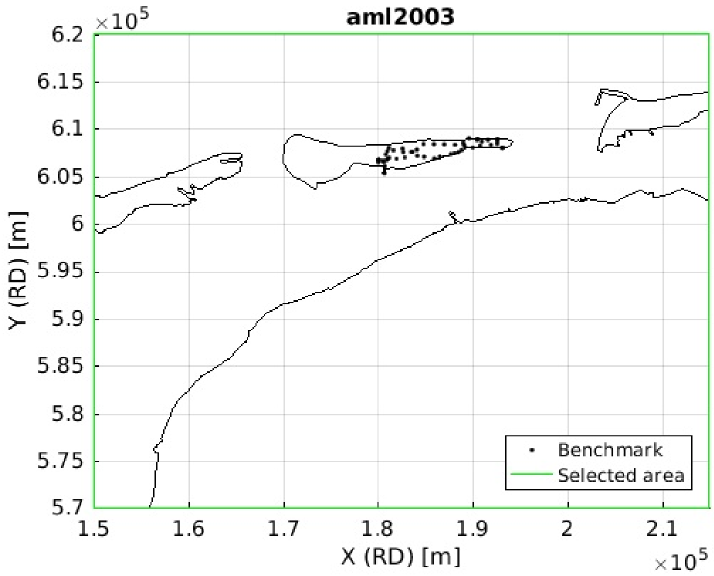
342W05
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area



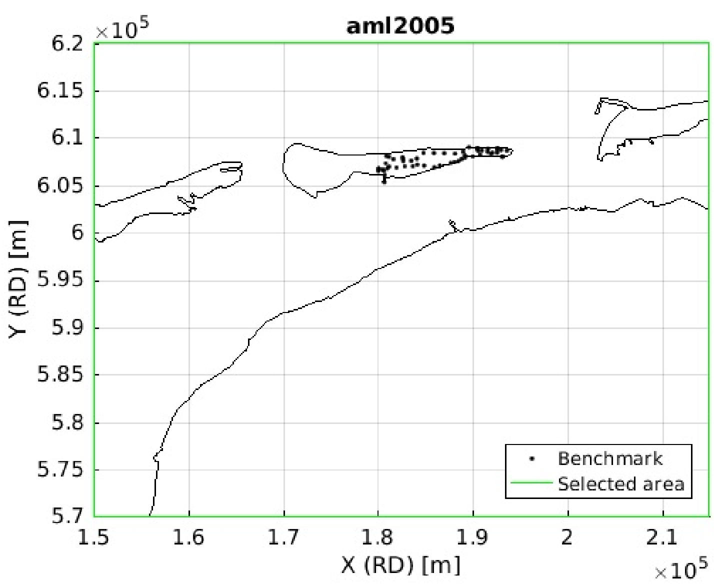
342W10
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area


aml1998
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area

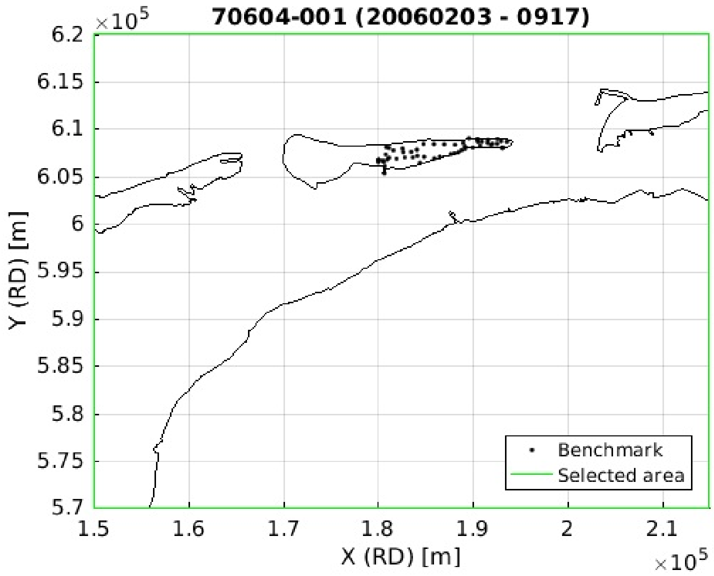

aml1999
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area

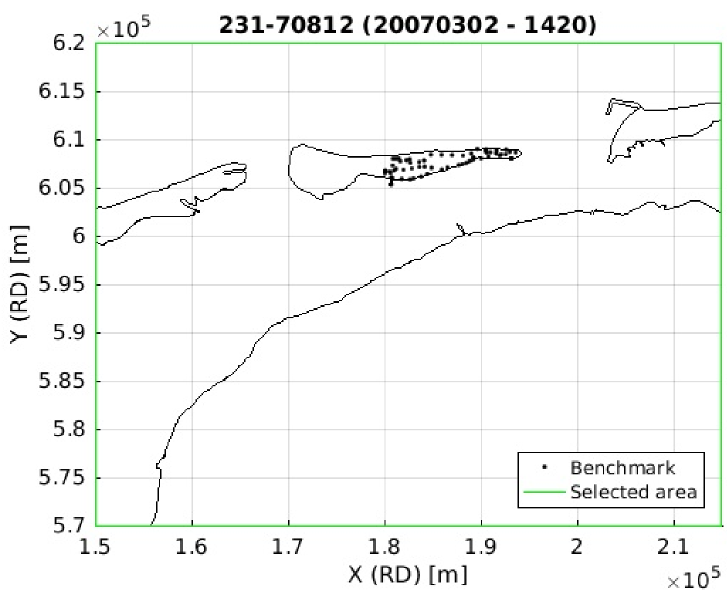


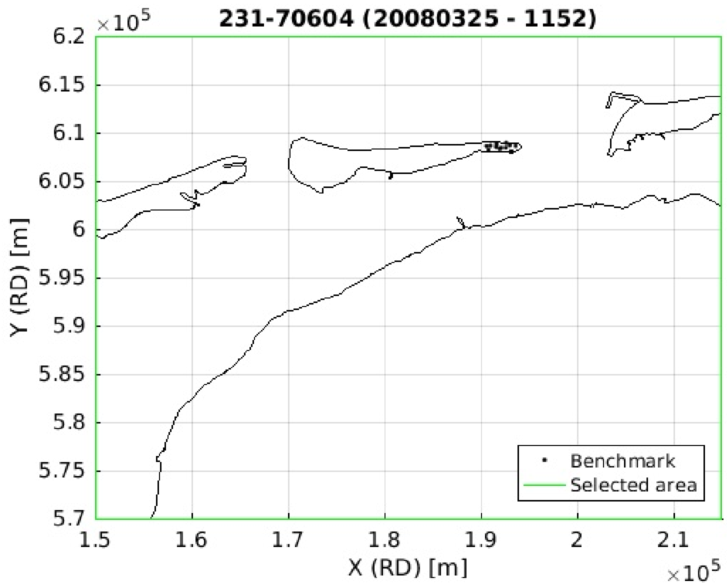
aml2003
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area

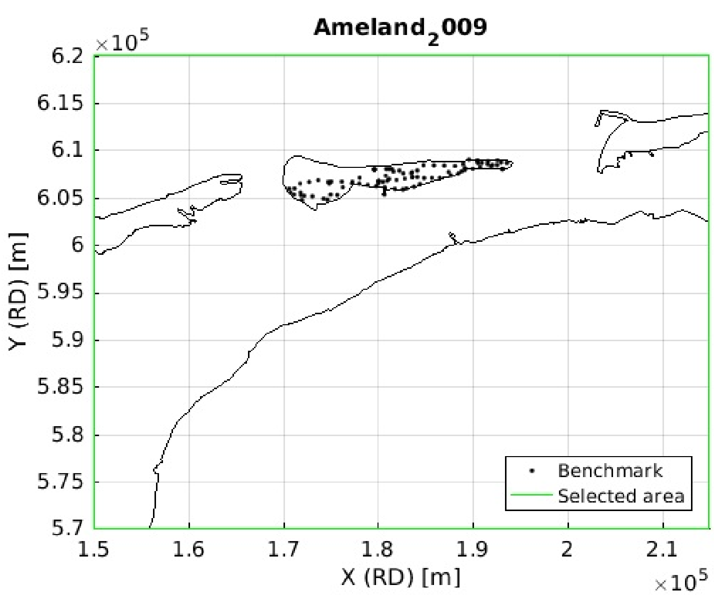


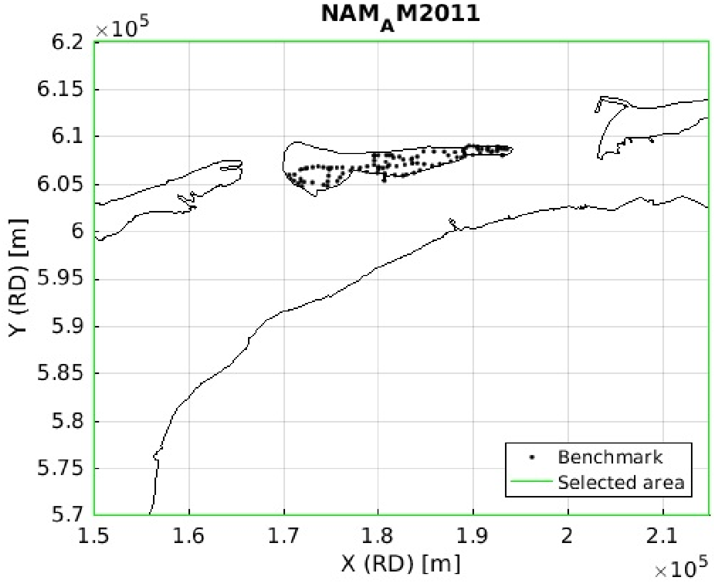
aml2005
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area

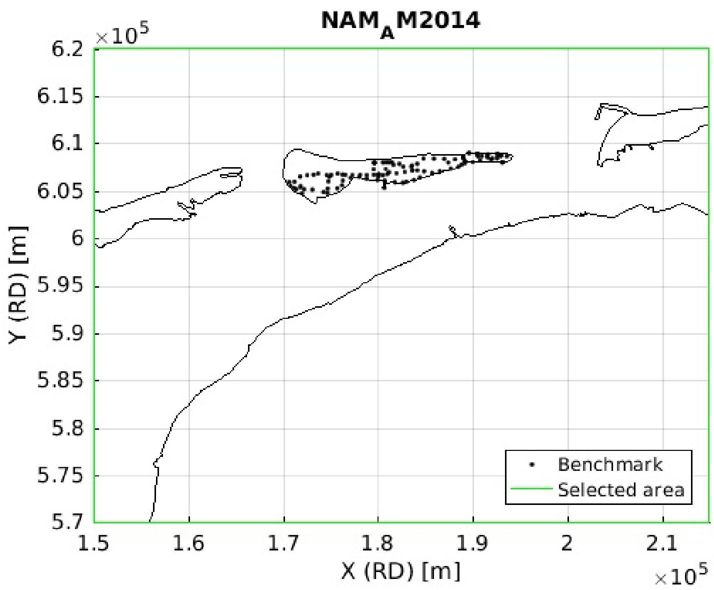

70604-001 (20060203 - 0917)
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area


231-70812 (20070302 - 1420)
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected area


231-70604 (20080325 - 1152)
Y (RD) [m]
X (RD) [m]
Benchmark
Selected area


Ameland_2009
Y (RD) [m]
X (RD) [m]
Benchmark
Selected area





Select points inside area of interest

```
aoi_idx = find(pnt(w).x>=xmin & pnt(w).x<=xmax & ...
               pnt(w).y>=ymin & pnt(w).y<=ymax);

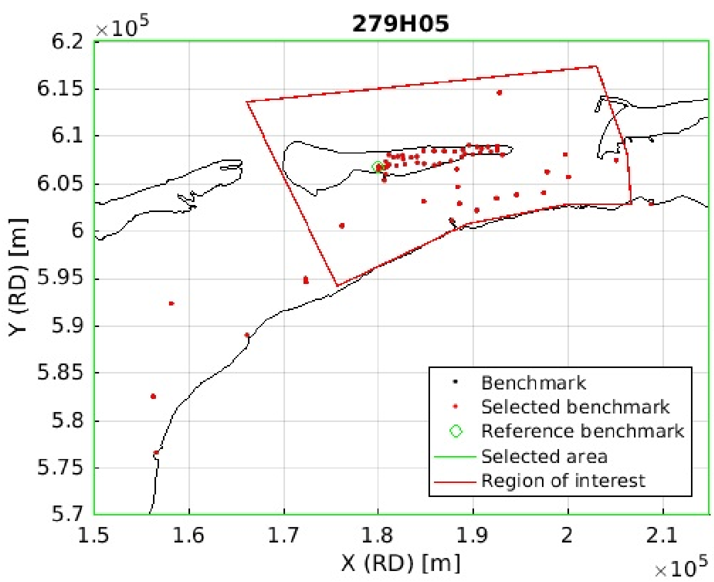
pnt(w).x = pnt(w).x(aoi_idx);
pnt(w).y = pnt(w).y(aoi_idx);
pnt(w).id = pnt(w).id(aoi_idx);
pnt(w).N = size(pnt(w).id,1);

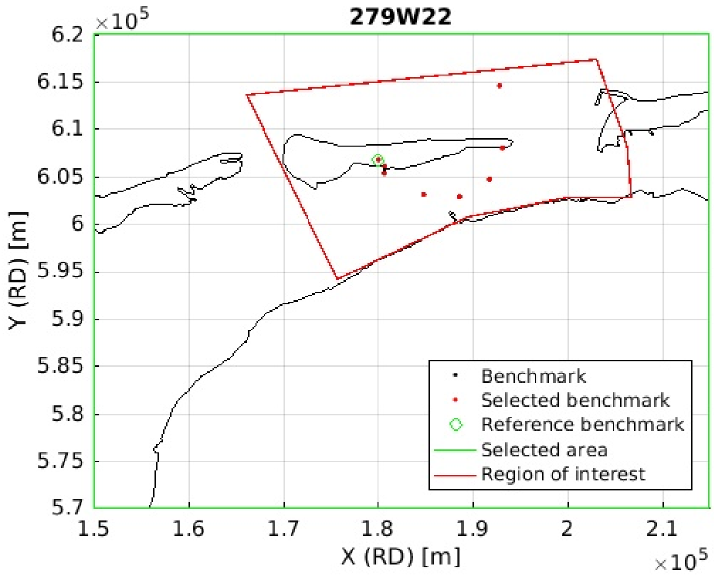
figure(2*w-1);hold on
h = plot(pnt(w).x,pnt(w).y,'r.');
hh(2) = h(1);
h = plot(pnt(w).x(1),pnt(w).y(1),'go');
hh(3) = h(1);
```

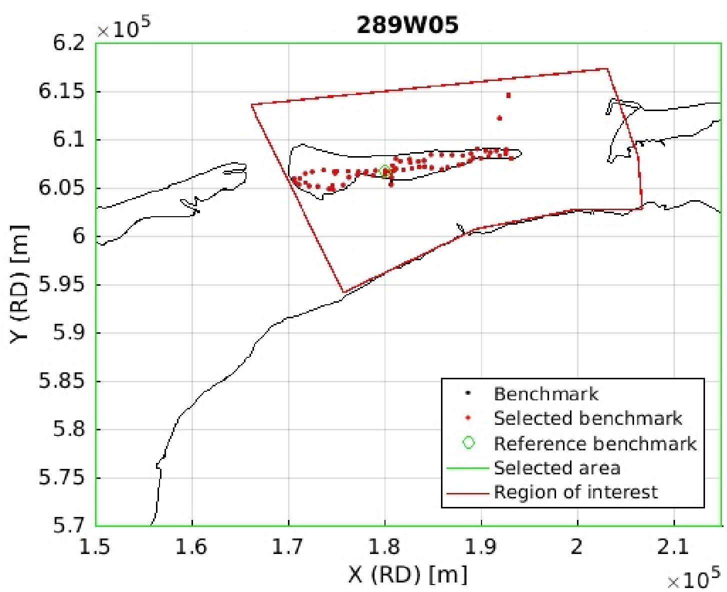
```
if exist('roi','var')
  if ~isempty(roi)
    h = plot(roi(:,1),roi(:,2),'r','Linewidth',1);
    hh(5) = h(1);
  end
end
legend_strings = {'Benchmark','Selected benchmark','Reference benchmark','Selected area','Region of interest'};
nanidx = find(~isnan(hh));
legend(hh(nanidx),legend_strings(nanidx),'Location','SouthEast');

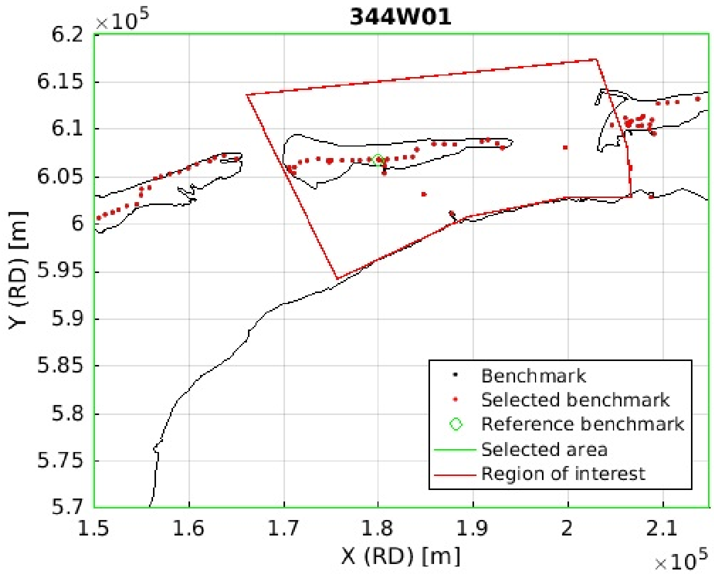
if isempty(find(aoi_idx==1))
  error('The reference points is outside the area of interest.');
else
  aoi_idx(1) = []; %remove reference point, not in obs
  aoi_idx = aoi_idx-1; % adapt index because of reference point
end

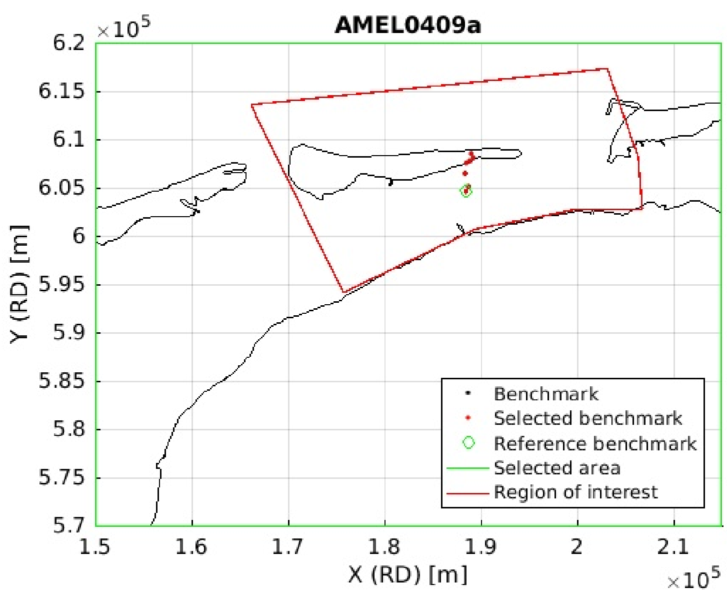
obs(w).id = obs(w).id(aoi_idx);
obs(w).val = obs(w).val(aoi_idx);
obs(w).cov = obs(w).cov(aoi_idx,:);
obs(w).cov = obs(w).cov(:,aoi_idx);
obs(w).N = size(obs(w).id,1);
obs(w).table = obs(w).table(aoi_idx,:);
```

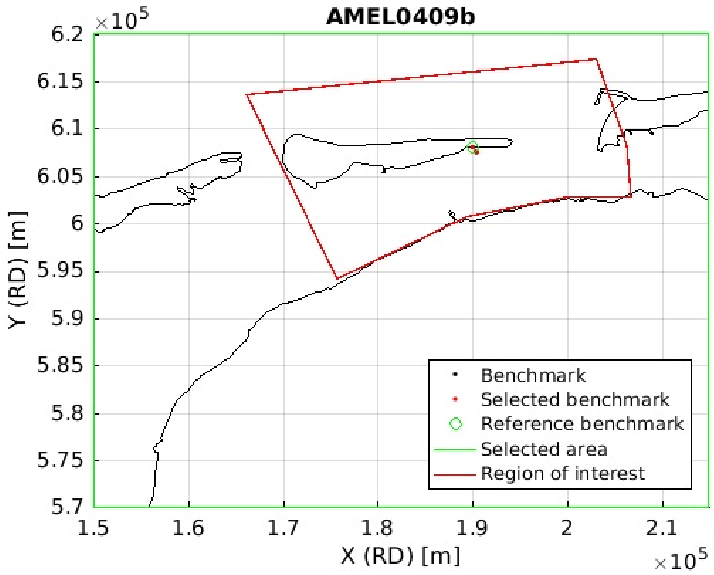


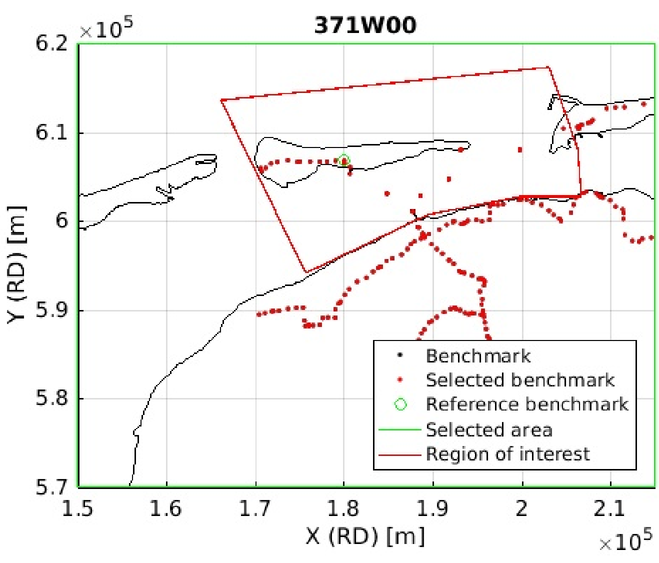

279W22
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest
Y (RD) [m]
X (RD) [m]
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
1.5
1.6
1.7
1.8
1.9
2
2.1

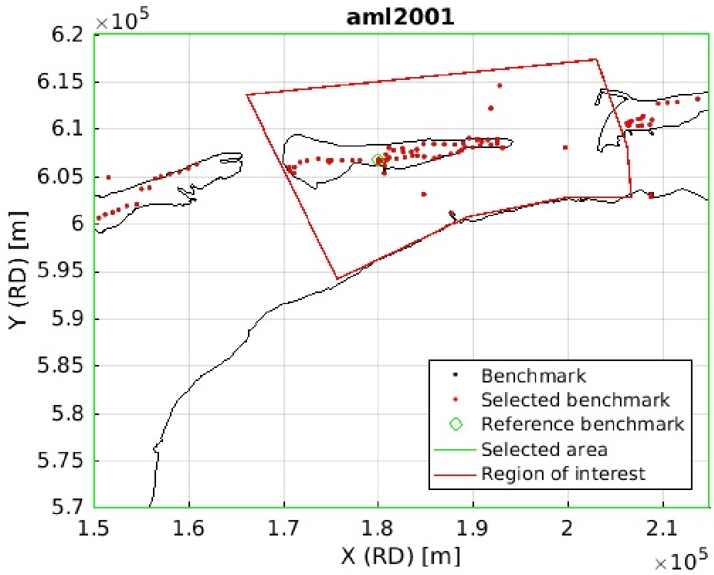

289W05
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest
Y (RD) [m]
X (RD) [m]
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
1.5
1.6
1.7
1.8
1.9
2
2.1

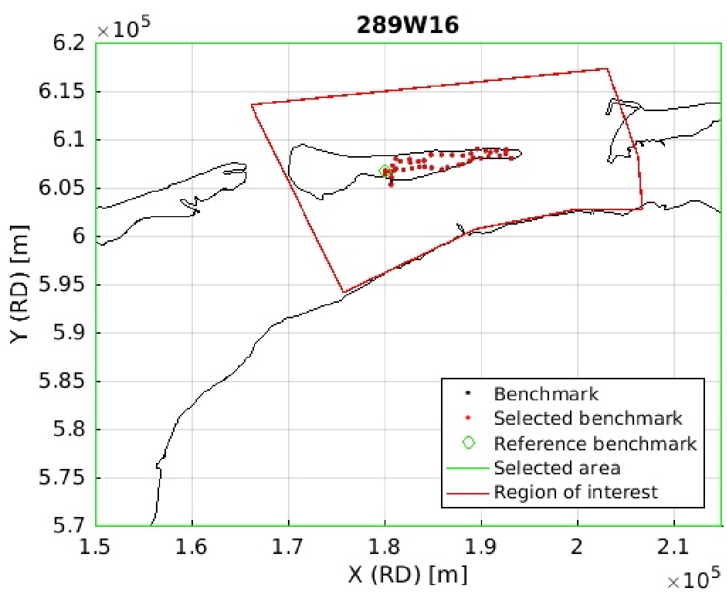

344W01
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

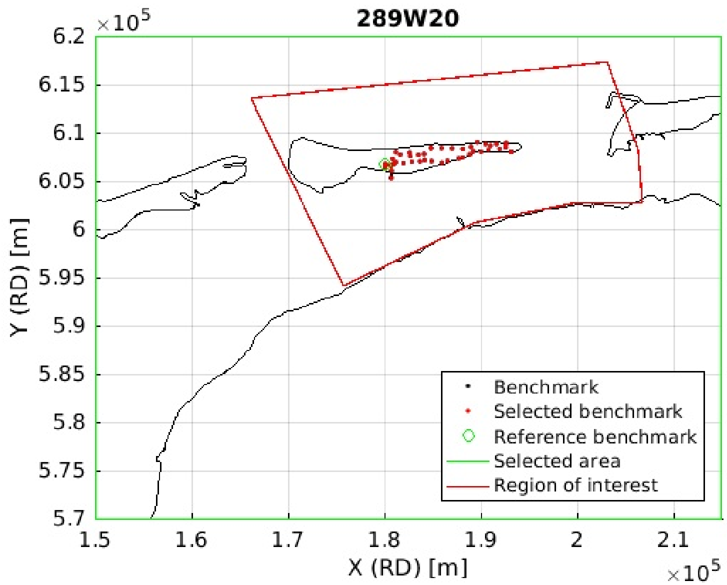

AMEL0409a
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

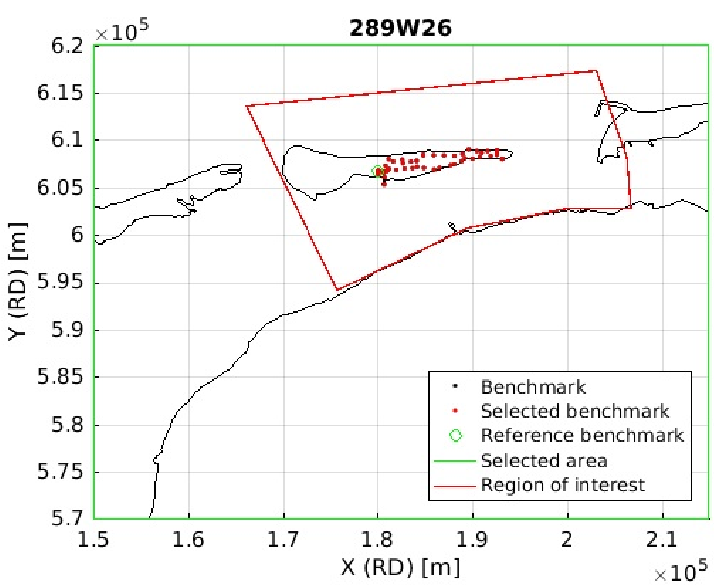

AMEL0409b
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

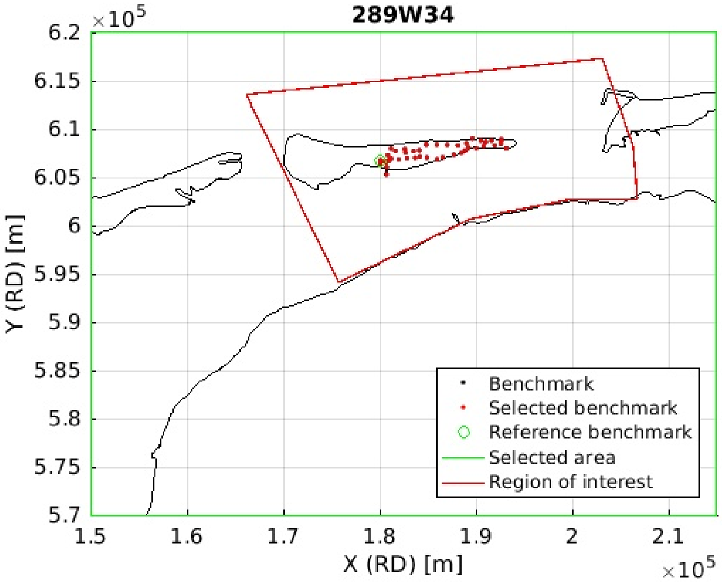

371W00
×10^5
6.2
6.1
6
5.9
5.8
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

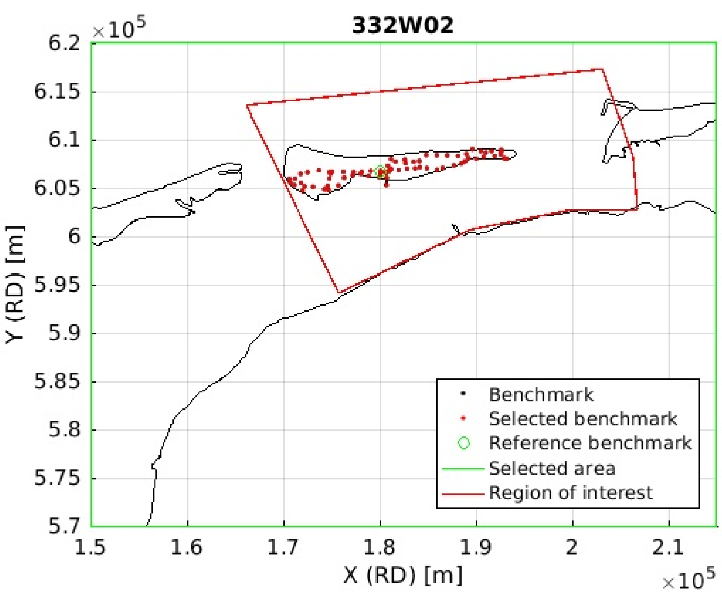

aml2001
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5

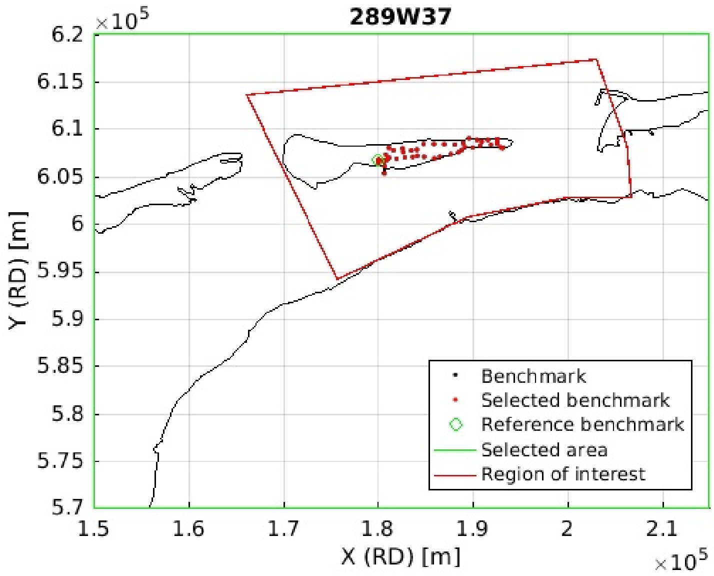

289W16
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5

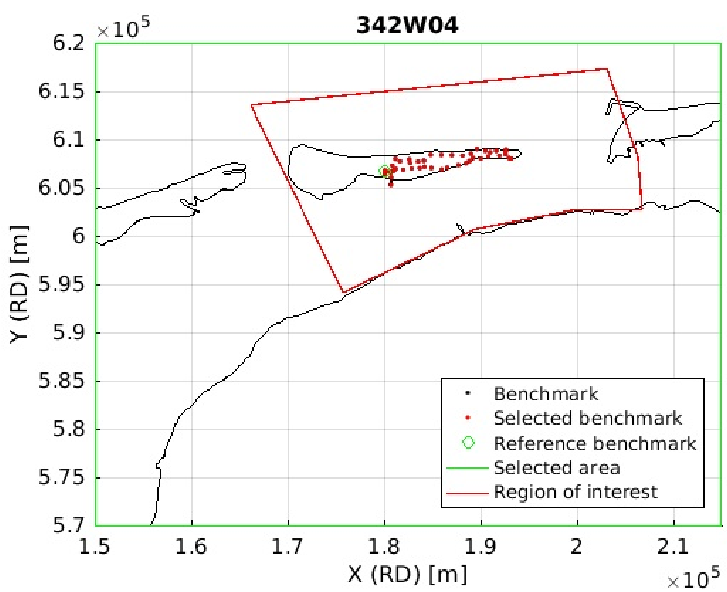

289W20
Y (RD) [m]
X (RD) [m]
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
1.5
1.6
1.7
1.8
1.9
2
2.1
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

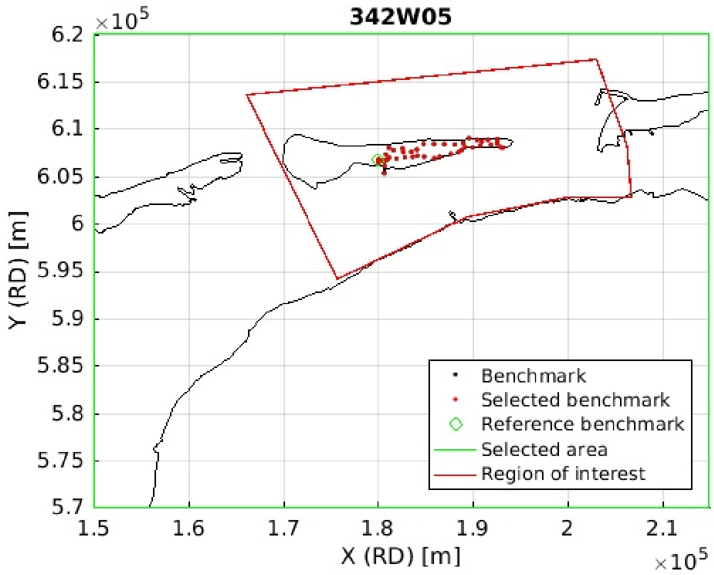

289W26
Y (RD) [m]
X (RD) [m]
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
1.5
1.6
1.7
1.8
1.9
2
2.1
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

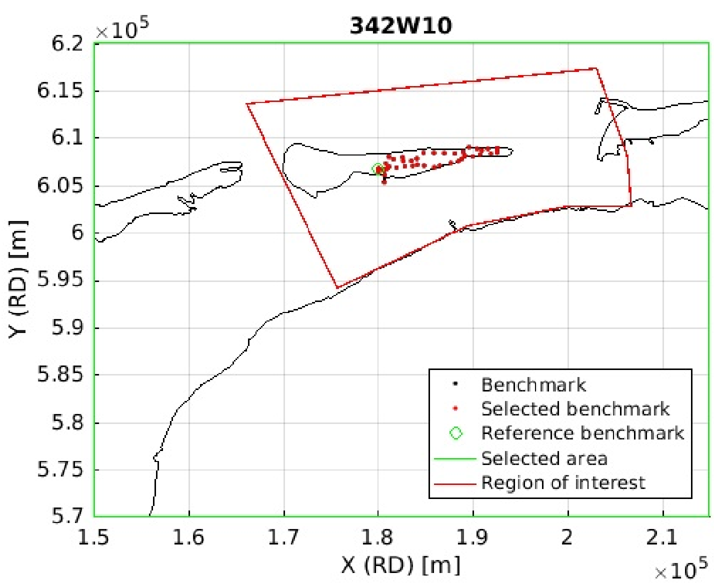

289W34
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

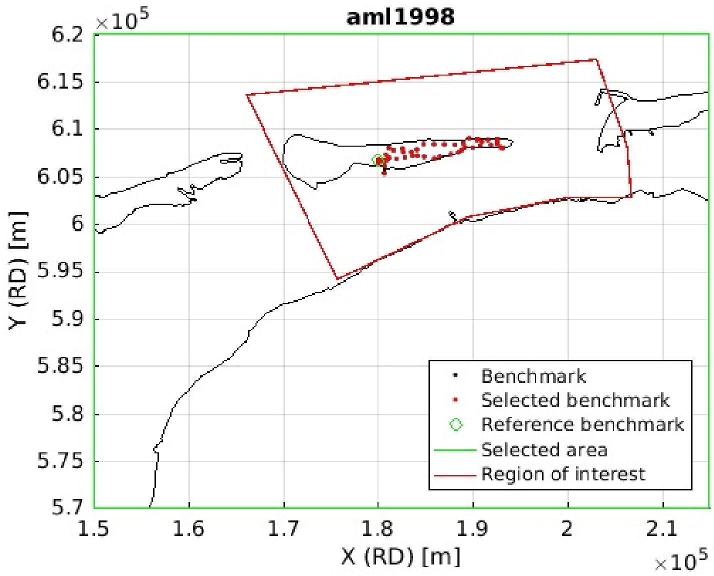

332W02
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

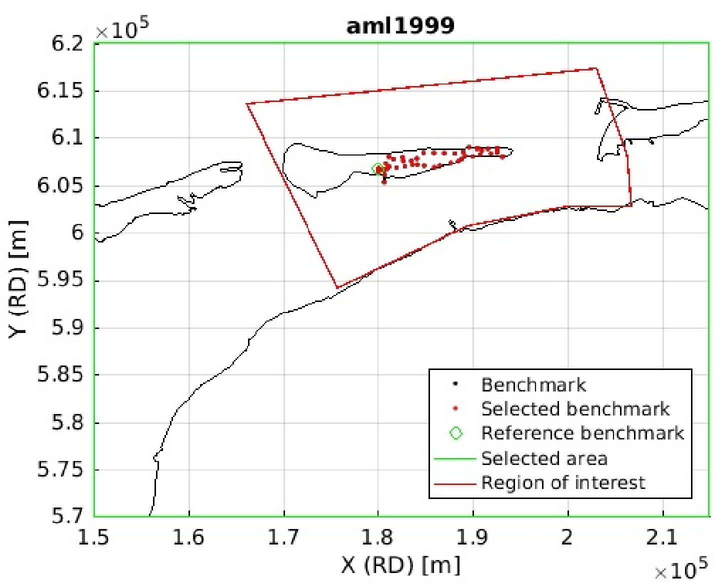

289W37
×10^5
Y (RD) [m]
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

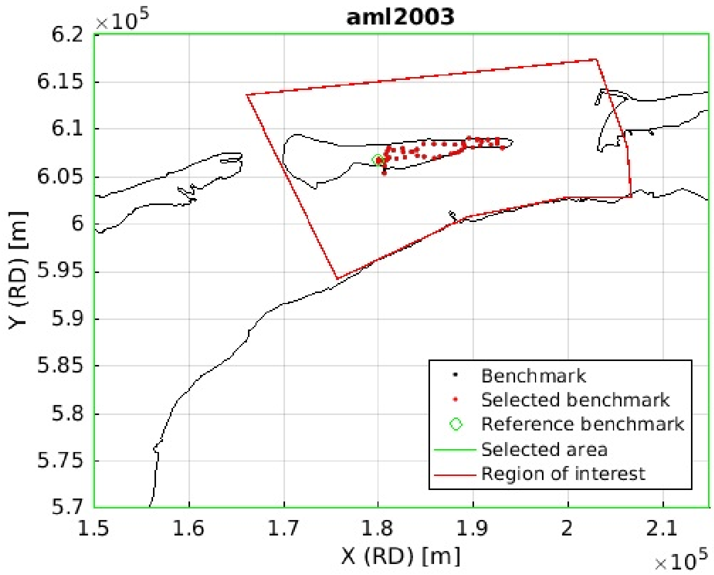

342W04
×10^5
Y (RD) [m]
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

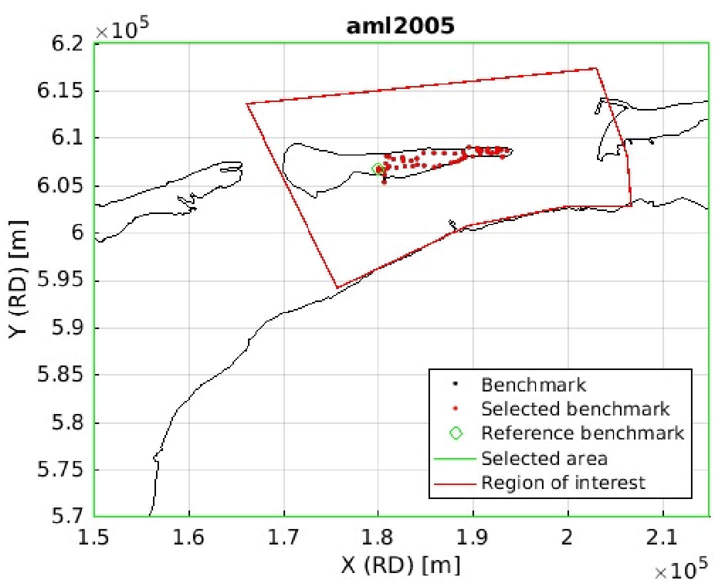

342W05
×10^5
Y (RD) [m]
X (RD) [m]
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
1.5
1.6
1.7
1.8
1.9
2
2.1
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

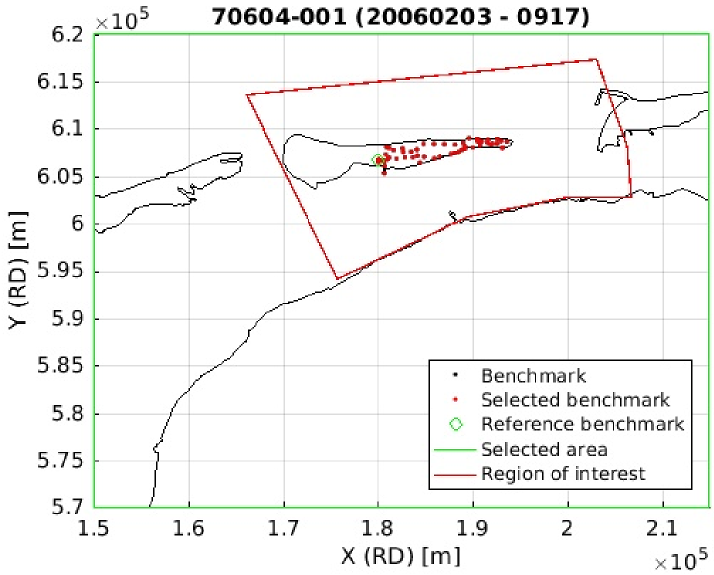

342W10
×10^5
Y (RD) [m]
X (RD) [m]
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
1.5
1.6
1.7
1.8
1.9
2
2.1
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

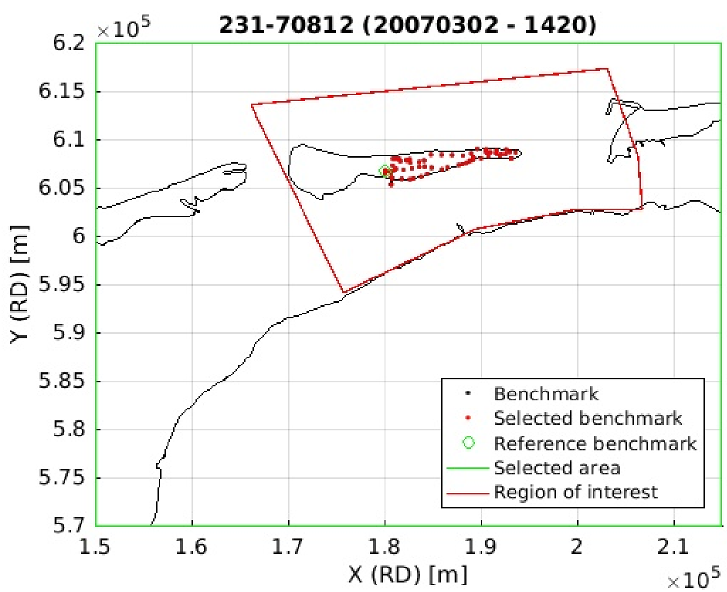

aml1998
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

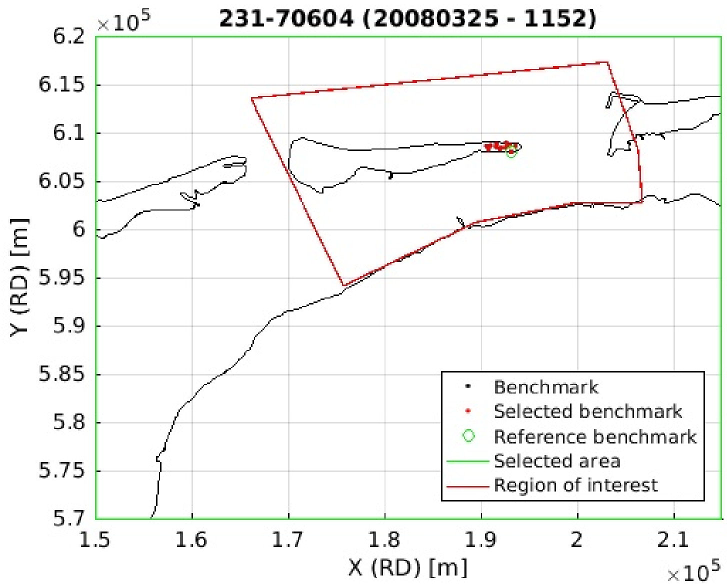

aml1999
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

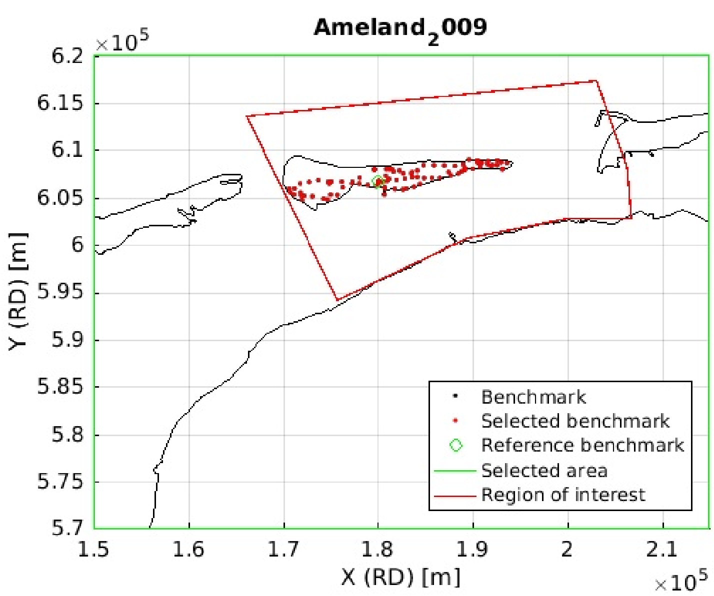

aml2003
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

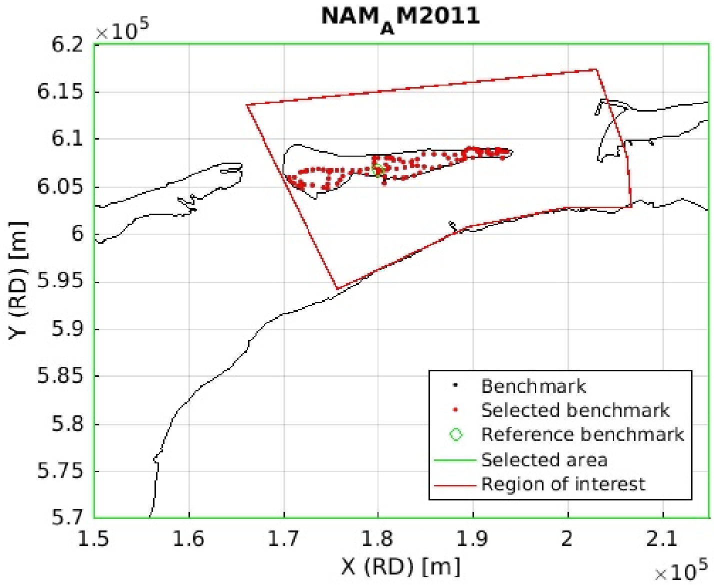

aml2005
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

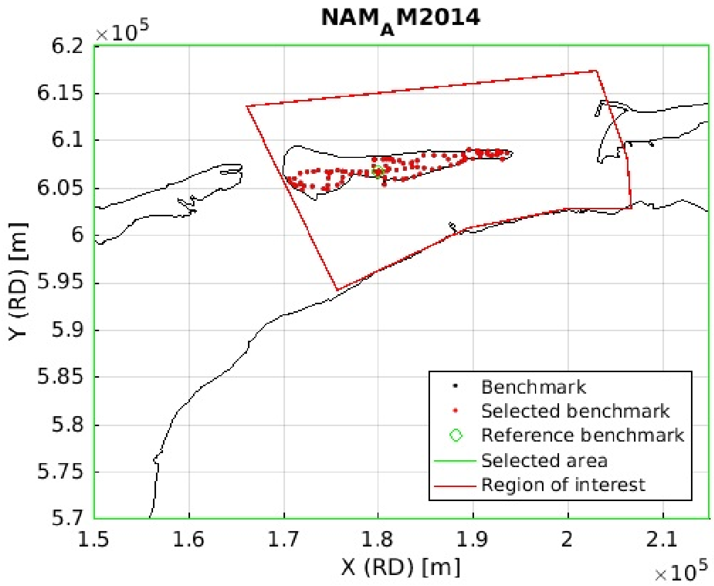

70604-001 (20060203 - 0917)
Y (RD) [m]
X (RD) [m]
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest


231-70812 (20070302 - 1420)
Y (RD) [m]
X (RD) [m]
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest


231-70604 (20080325 - 1152)
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

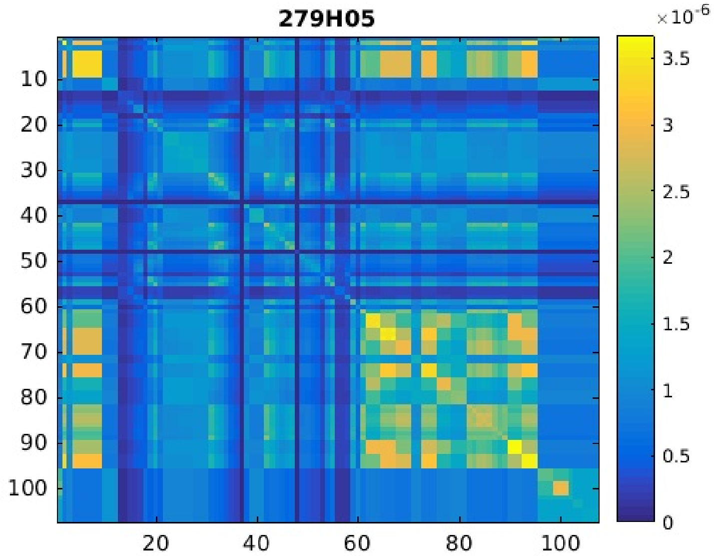

Ameland_2009
×10^5
6.2
6.15
6.1
6.05
6
5.95
5.9
5.85
5.8
5.75
5.7
Y (RD) [m]
1.5
1.6
1.7
1.8
1.9
2
2.1
X (RD) [m]
×10^5
Benchmark
Selected benchmark
Reference benchmark
Selected area
Region of interest

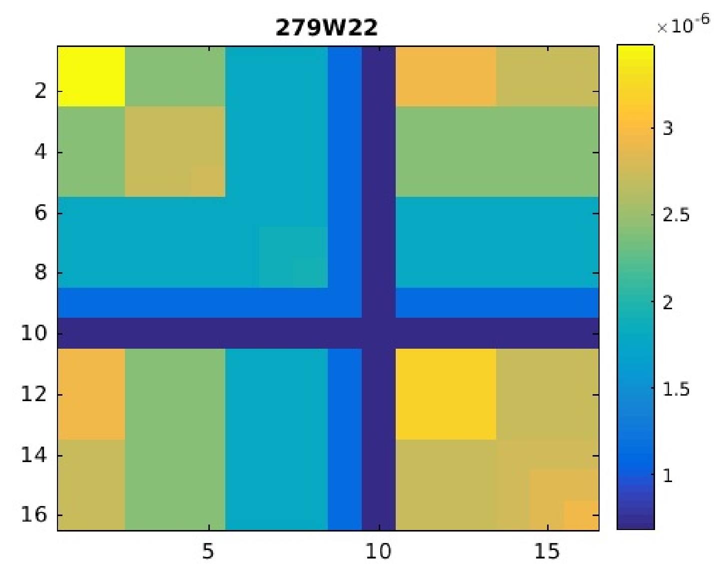


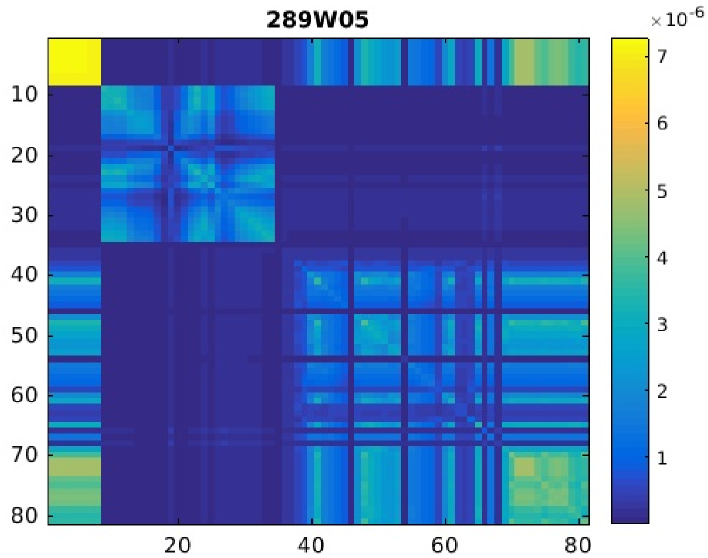


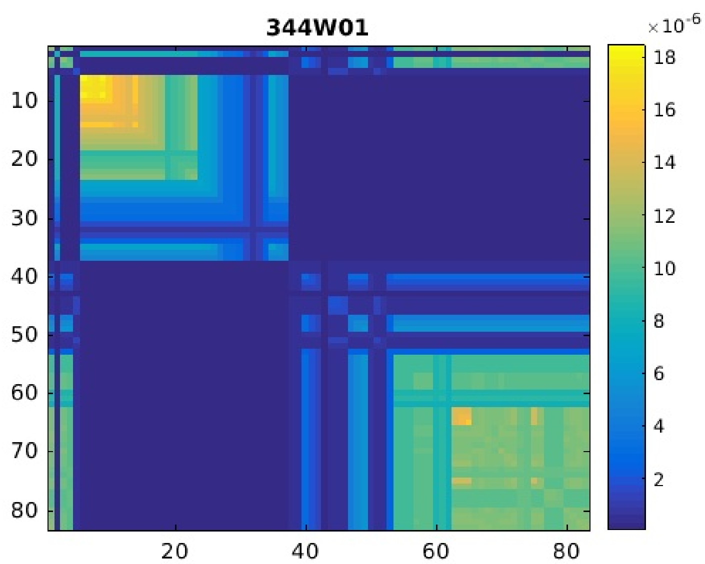
Plot the final covariance matrix

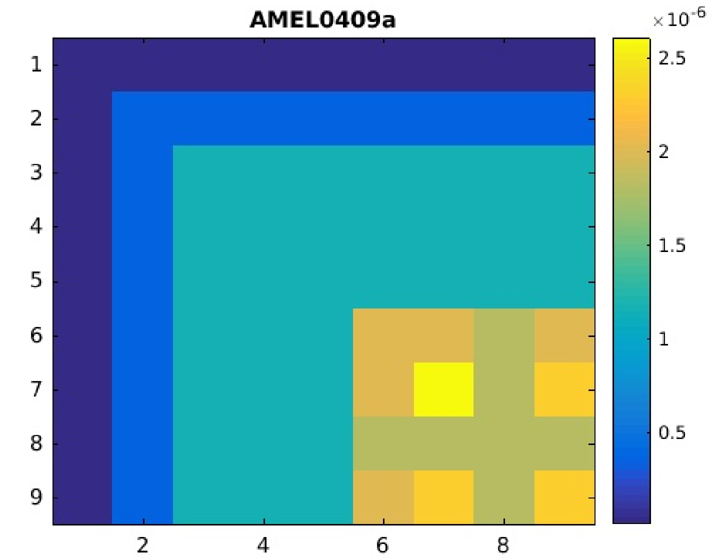
```
figure(2*w);imagesc(obs(w).cov);colorbar
title(char(prjfile(w)));
```

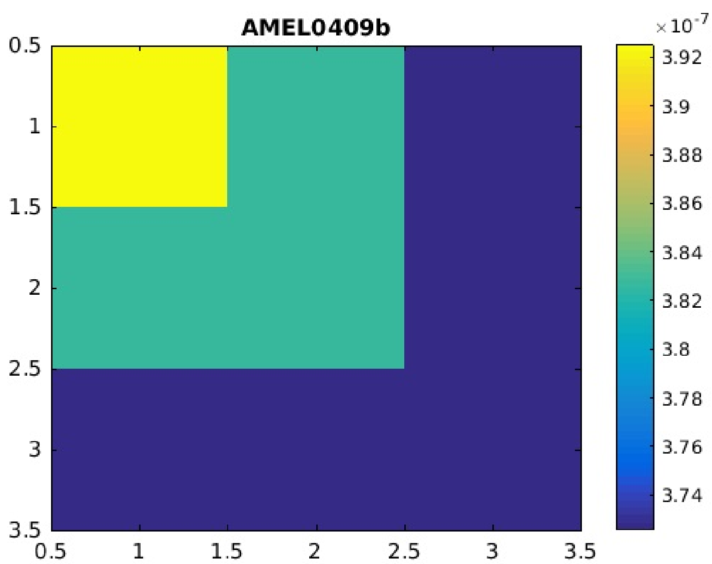

279H05
×10⁻⁶

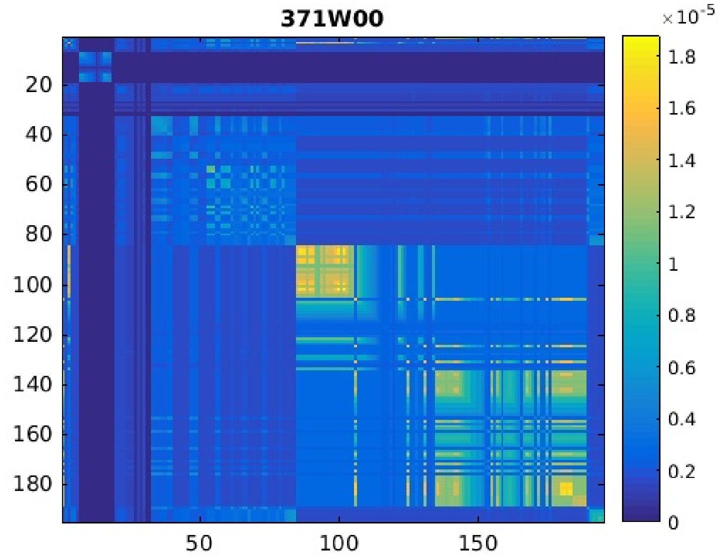

279W22
×10⁻⁶

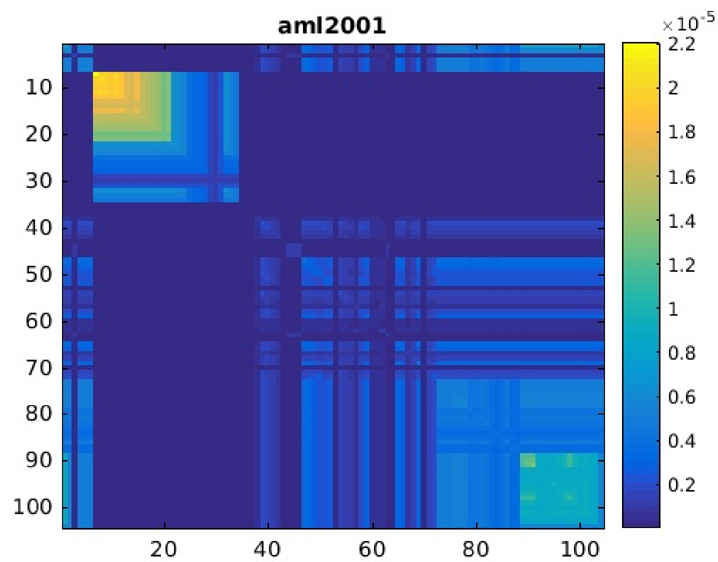

289W05
×10^-6
7
6
5
4
3
2
1
10
20
30
40
50
60
70
80
20
40
60
80

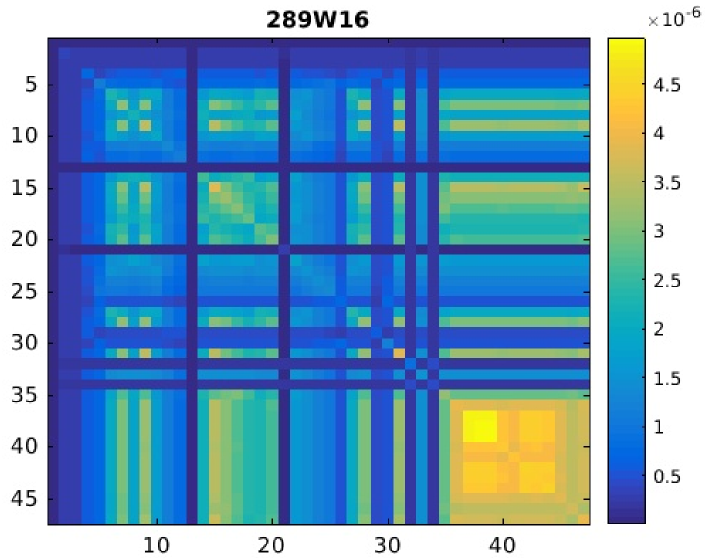

344W01
×10^-6
18
16
14
12
10
8
6
4
2
10
20
30
40
50
60
70
80
20
40
60
80

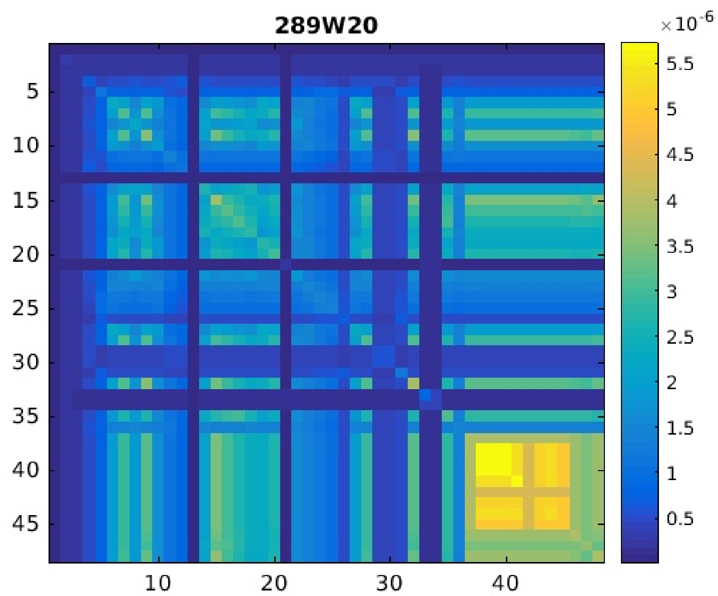

AMEL0409a
×10^-6
2.5
2
1.5
1
0.5
1
2
3
4
5
6
7
8
9
2
4
6
8

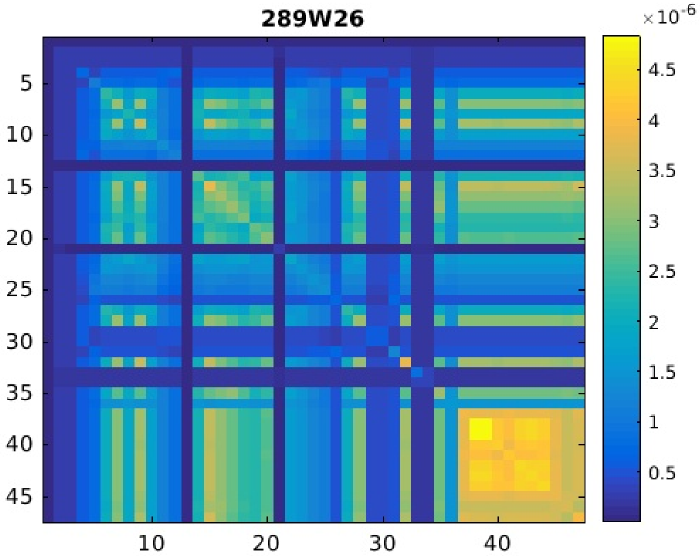

AMEL0409b
×10^-7
3.92
3.9
3.88
3.86
3.84
3.82
3.8
3.78
3.76
3.74
0.5
1
1.5
2
2.5
3
3.5
0.5
1
1.5
2
2.5
3
3.5

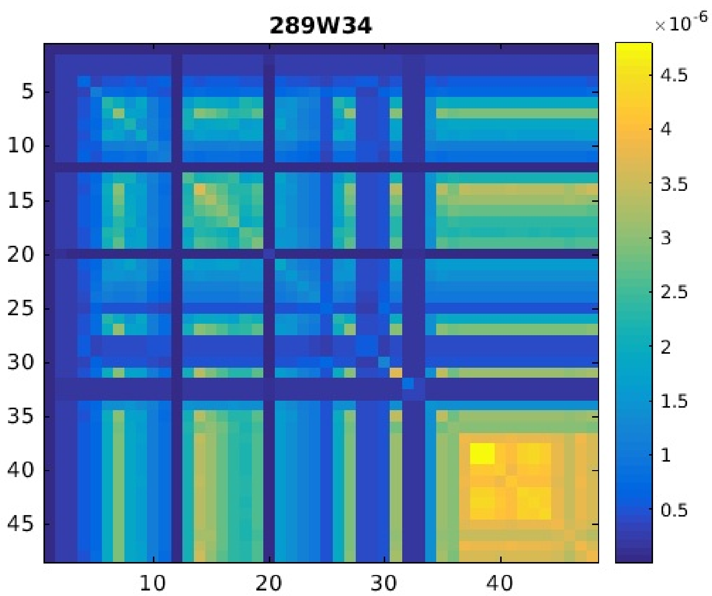

371W00
20
40
60
80
100
120
140
160
180
50
100
150
×10^-5
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0

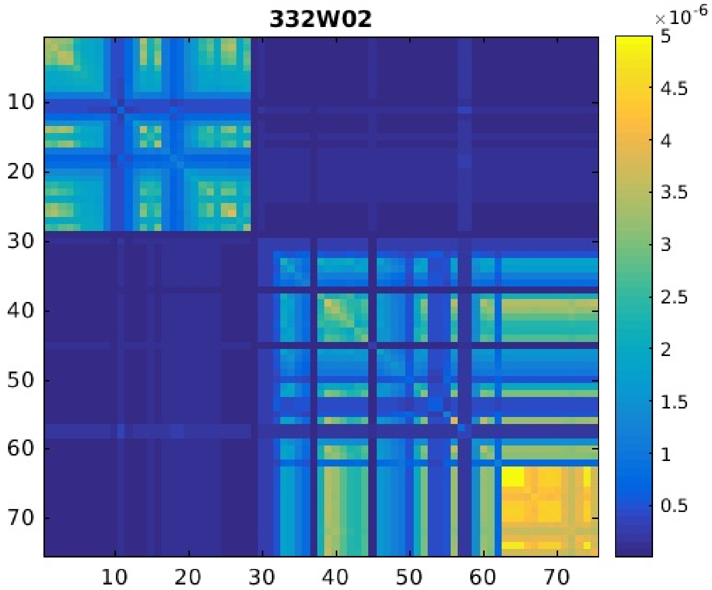

aml2001
10
20
30
40
50
60
70
80
90
100
20
40
60
80
100
×10^-5
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2

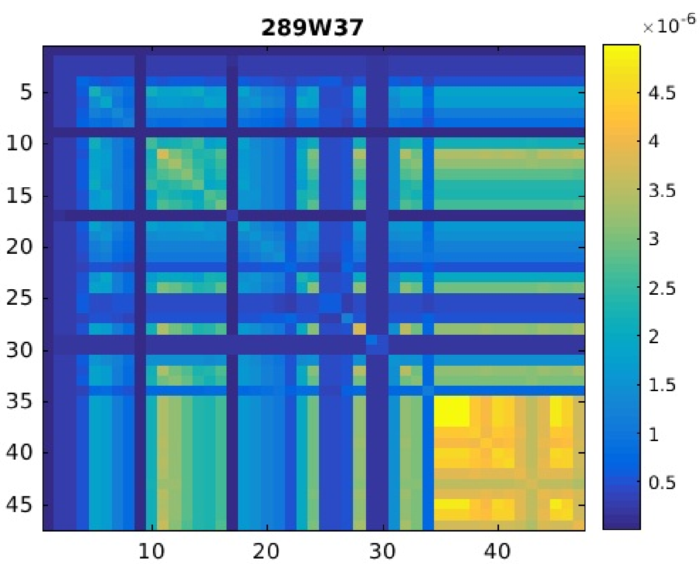

289W16
×10-6
4.5
4
3.5
3
2.5
2
1.5
1
0.5
5
10
15
20
25
30
35
40
45
10
20
30
40


289W20
×10-6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
5
10
15
20
25
30
35
40
45
10
20
30
40


289W26
×10^-6
4.5
4
3.5
3
2.5
2
1.5
1
0.5
5
10
15
20
25
30
35
40
45
10
20
30
40


289W34
×10^-6
4.5
4
3.5
3
2.5
2
1.5
1
0.5
5
10
15
20
25
30
35
40
45
10
20
30
40


332W02
×10^-6
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
10
20
30
40
50
60
70


289W37
×10^-6
4.5
4
3.5
3
2.5
2
1.5
1
0.5
5
10
15
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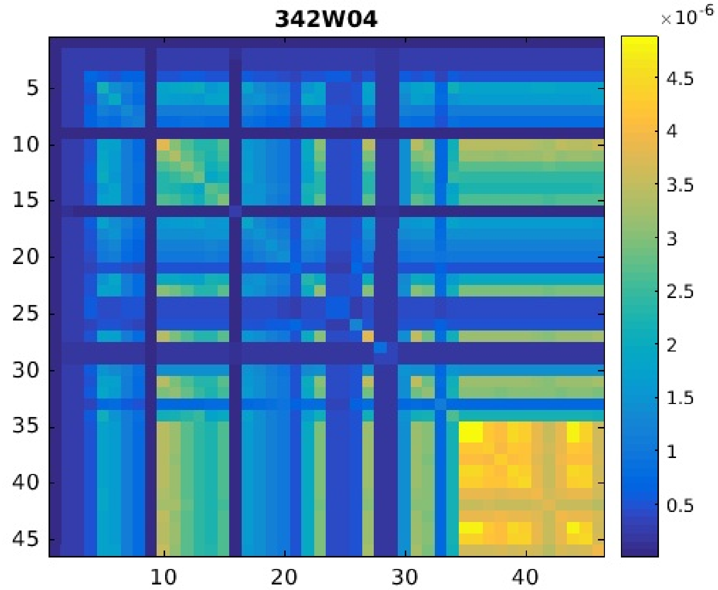
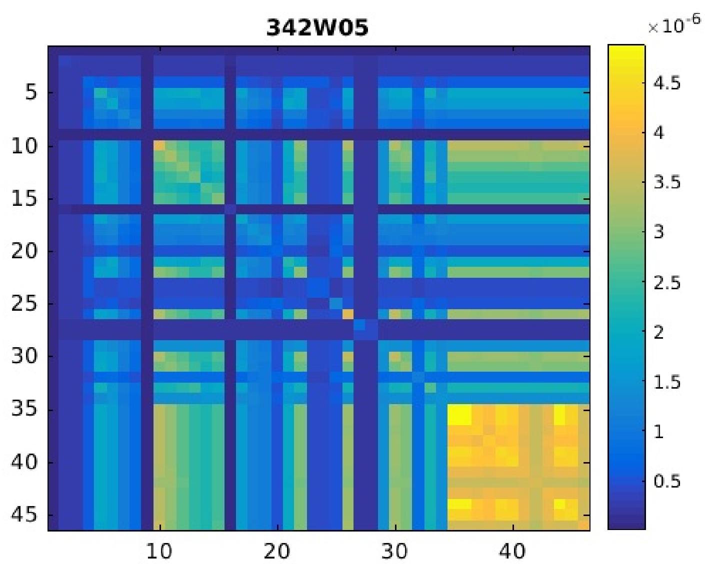
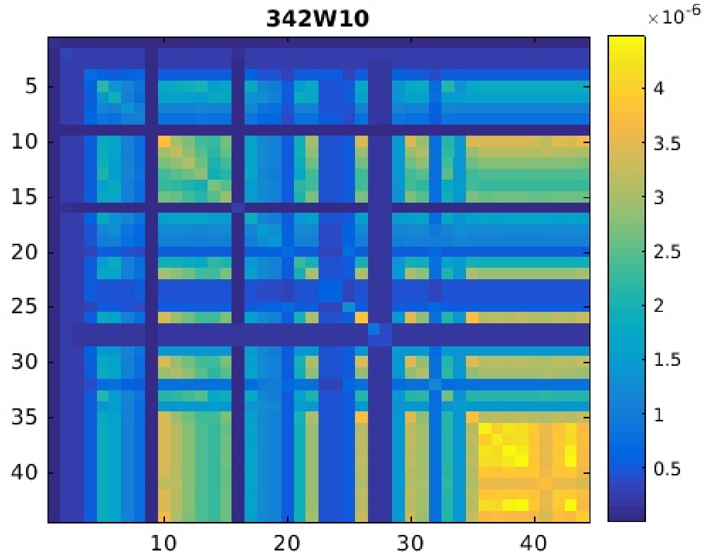
25
30
35
40
45

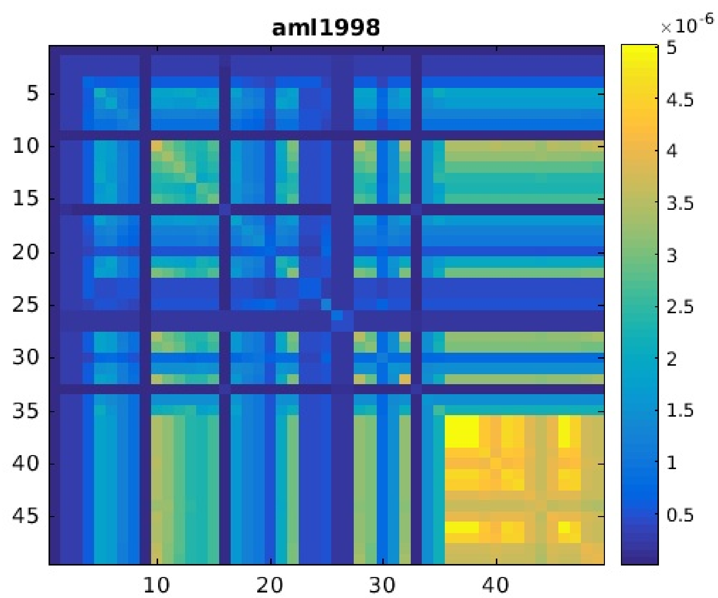


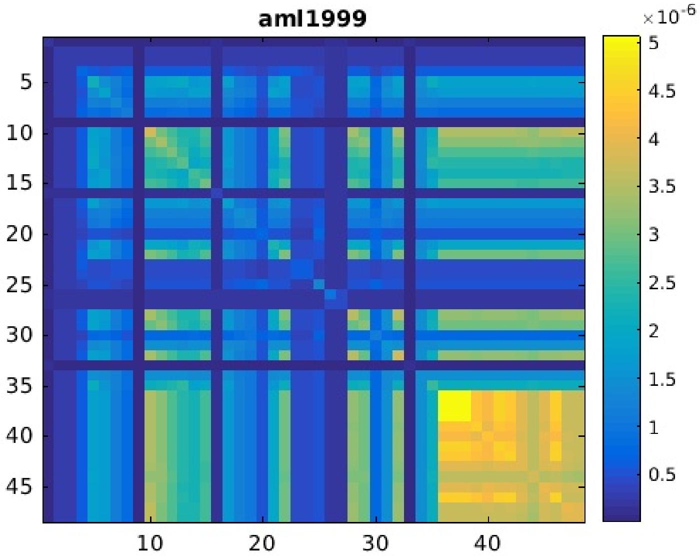
342W04
×10⁻⁶
4.5
4
3.5
3
2.5
2
1.5
1
0.5
5
10
15
20
25
30
35
40
45
10
20
30
40



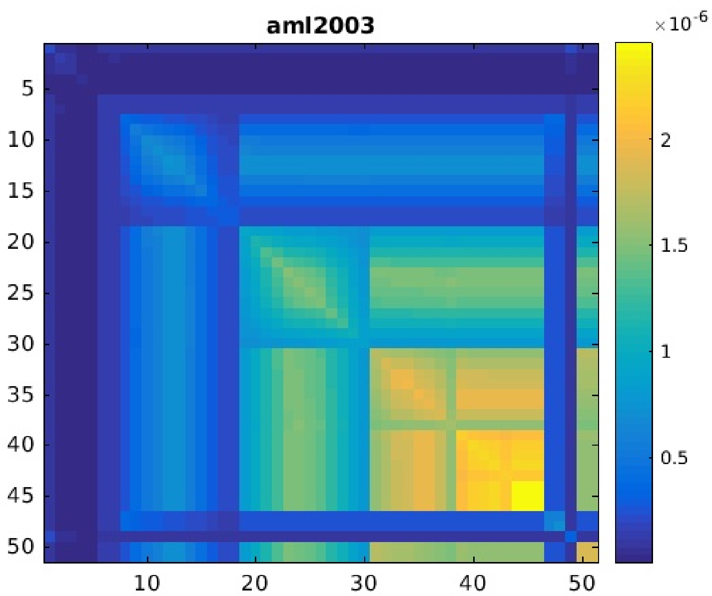
342W05
×10⁻⁶
4.5
4
3.5
3
2.5
2
1.5
1
0.5
5
10
15
20
25
30
35
40
45
10
20
30
40


342W10
5
10
15
20
25
30
35
40
10
20
30
40
×10-6
4
3.5
3
2.5
2
1.5
1
0.5

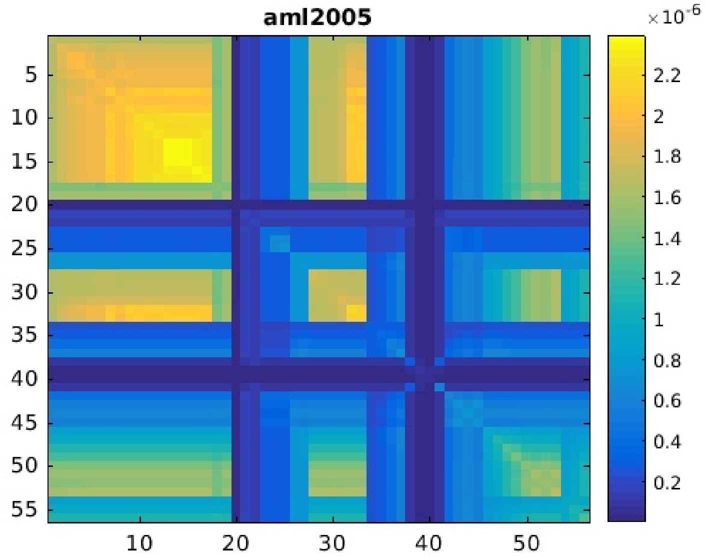

aml1998
5
10
15
20
25
30
35
40
45
10
20
30
40
×10-6
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5

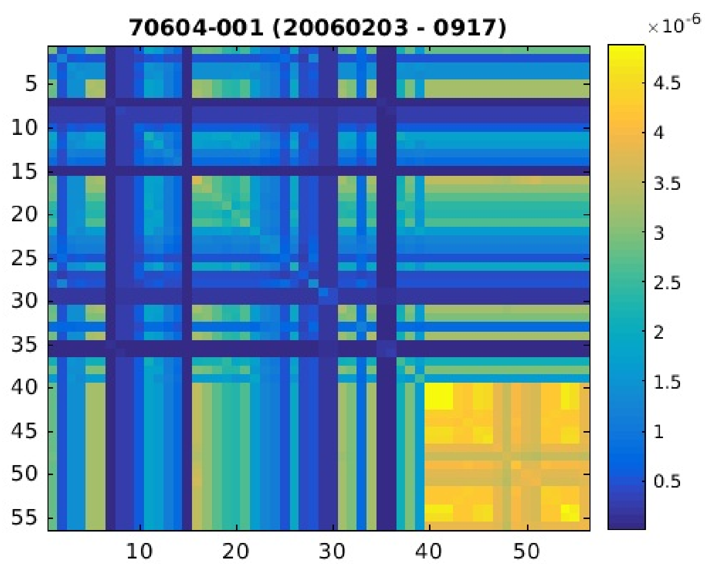


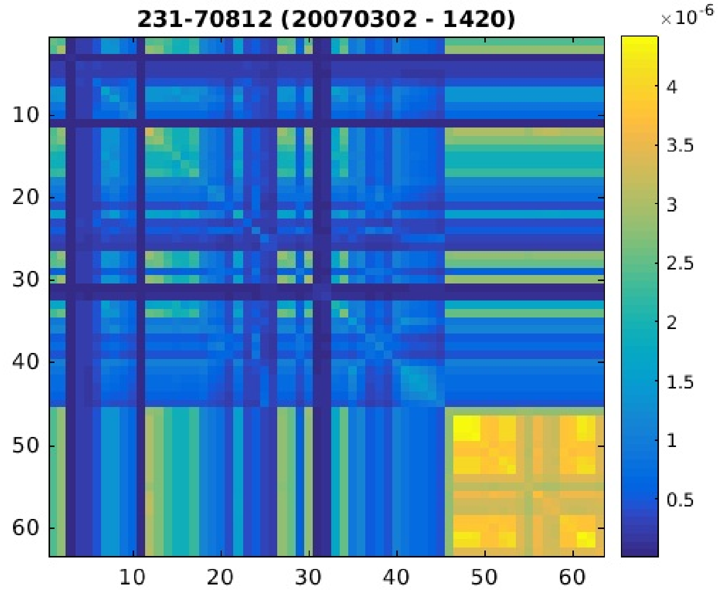
aml1999
×10^-6

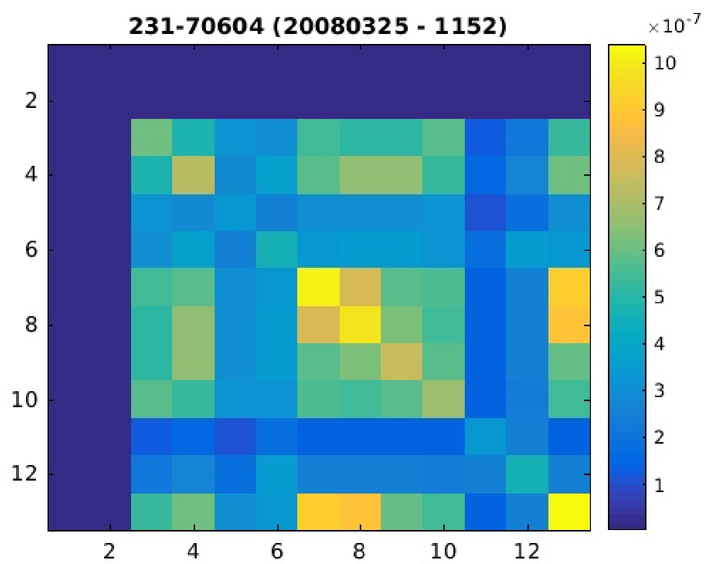


aml2003
×10^-6

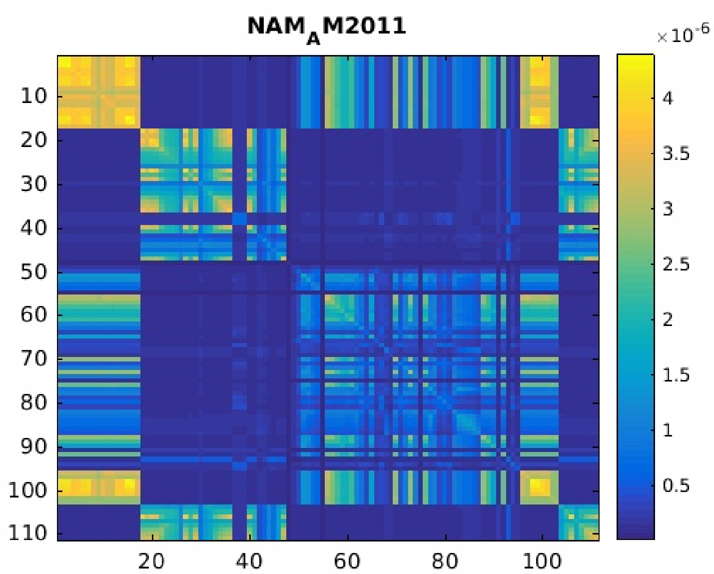

aml2005
×10^-6
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
5
10
15
20
25
30
35
40
45
50
55
10
20
30
40
50

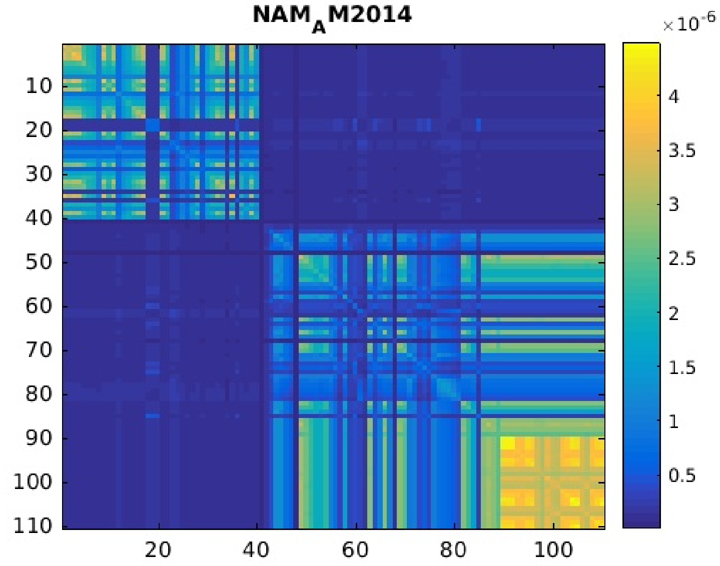

70604-001 (20060203 - 0917)
×10^-6
4.5
4
3.5
3
2.5
2
1.5
1
0.5
5
10
15
20
25
30
35
40
45
50
55
10
20
30
40
50


231-70812 (20070302 - 1420)
×10^-6
4
3.5
3
2.5
2
1.5
1
0.5
10
20
30
40
50
60
10
20
30
40
50
60


231-70604 (20080325 - 1152)
×10^-7
10
9
8
7
6
5
4
3
2
1
2
4
6
8
10
12
2
4
6
8
10
12


Ameland$_2$009
×10^{-6}
4
3.5
3
2.5
2
1.5
1
0.5
10
20
30
40
50
60
70
80
90
20
40
60
80


NAM$_A$M2011
×10^{-6}
4
3.5
3
2.5
2
1.5
1
0.5
10
20
30
40
50
60
70
80
90
100
110
20
40
60
80
100




```
end
```

```
Reading observation data ...
```

Create dataset

```
display('Creating dataset ...');

% Create sd data
Nobs = sum([obs.N]);
sdcov = zeros(Nobs,Nobs);
sdobs = zeros(Nobs,1);
```

```
count = 0;
for w = 1:Nfile
  sdobs(count+1:count+obs(w).N) = obs(w).val;
  sdcov(count+1:count+obs(w).N,count+1:count+obs(w).N) = obs(w).cov;
  count = count+obs(w).N;
end

% Create pnt data
Npnt = sum([pnt.N]);
temp_id = cell(Npnt,1);
temp_x = nan(Npnt,1);
temp_y = nan(Npnt,1);

count = 0;
for w = 1:Nfile
  temp_id(count+1:count+pnt(w).N) = pnt(w).id;
  temp_x(count+1:count+pnt(w).N) = pnt(w).x;
  temp_y(count+1:count+pnt(w).N) = pnt(w).y;
  count = count+pnt(w).N;
end

[pntname,idx1,idx2] = unique(temp_id);
Npnt = size(pntname,1);
pntcrd = [temp_x(idx1) temp_y(idx1)];
pntclass = repmat({'LEV'},Npnt,1);
pntclass = char(pntclass);

% Create obs table
obstable = NaN(Nobs,3);

count = 0;
for w = 1:Nfile
  for v = 1:obs(w).N
    idx1 = strmatch(obs(w).table(v,1),pntname);
    idx2 = strmatch(obs(w).table(v,2),pntname);

    if length(idx1)==1 & length(idx2)==1
      obstable(count+v,:) = [idx1 idx2 prjidx2(w)];
    else
      error(['Something went wrong while looking for pnt id ' ...
             char(obs(w).table(v,1)) ' or ' char(obs(w).table(v,2)) '.']);
    end
  end
  count = count+obs(w).N;
```

```
end
```

```
Creating dataset ...
```

Write netcdf file

```
display('Writing netcdf file ...');

writelts2netcdf(netcdf_file,globalattributes, ...
                pntname,pntcrd,pntclass, ...
                prjname,prjepoch,prjclass, ...
                obstable,sdobs,sdcov,0,[ 0 0 1]); %,epoch);
```

```
Writing netcdf file ...
Create NAM LTS2 netcdf schema ...
Write NAM LTS2 netcdf schema to file...
Write data to NAM LTS2 netcdf...
Done.
```

Update point class

```
updpntclasslts2netcdf(netcdf_file);
```

```
Benchmarks (432 points):

PNTNAME             X_RD         Y_RD    CLASS

0009994       188091.000   607436.000   LEV --> LEV&ONSH
0009995       180897.000   608072.000   LEV --> LEV&ONSH
0009996       183701.000   606988.000   LEV --> LEV&ONSH
0009997       183537.000   607578.000   LEV --> LEV&ONSH
0009998       189230.000   607893.000   LEV --> LEV&OFFSH
0009999       189232.000   608132.000   LEV --> LEV&ONSH
000A2050      195720.000   589520.000   LEV --> LEV&ONSH
000A2592      180070.000   606750.000   LEV --> LEV&ONSH
000A2594      206455.000   610345.000   LEV --> LEV&ONSH
000A2596      176070.000   588220.000   LEV --> LEV&ONSH


000A3526      165090.000   606800.000   LEV --> LEV&OFFSH
000A3532      204720.000   610380.000   LEV --> LEV&ONSH
000A4020      156610.000   576560.000   LEV --> LEV&OFFSH
000A4025      208860.000   602780.000   LEV --> LEV&ONSH
000A4070      187830.000   601050.000   LEV --> LEV&ONSH
000G0092      192880.000   614560.000   LEV --> LEV&OFFSH
000G0093      192880.000   614560.000   LEV --> LEV&OFFSH
000G0094      192880.000   614560.000   LEV --> LEV&OFFSH
000G0095      192880.000   614560.000   LEV --> LEV&OFFSH
000G0096      192880.000   614560.000   LEV --> LEV&OFFSH
000G0097      192880.000   614560.000   LEV --> LEV&OFFSH
000G0099      192880.000   614560.000   LEV --> LEV&OFFSH
000G0191      191950.000   612180.000   LEV --> LEV&OFFSH
000G0192      191960.000   612160.000   LEV --> LEV&OFFSH
000G0213      151570.000   604850.000   LEV --> LEV&OFFSH
001D0001      150560.000   600580.000   LEV --> LEV&ONSH
001D0002      152000.000   601180.000   LEV --> LEV&ONSH
001D0003      152630.000   601430.000   LEV --> LEV&ONSH
001D0012      151220.000   600940.000   LEV --> LEV&ONSH
001D0014      153500.000   601840.000   LEV --> LEV&ONSH
001D0015      155020.000   603010.000   LEV --> LEV&ONSH
001D0016      155070.000   603640.000   LEV --> LEV&ONSH
001D0021      155900.000   603780.000   LEV --> LEV&ONSH
001D0022      154580.000   602020.000   LEV --> LEV&ONSH
001D0023      156520.000   604720.000   LEV --> LEV&OFFSH
001D0024      157100.000   604940.000   LEV --> LEV&OFFSH
001D0025      158060.000   605220.000   LEV --> LEV&ONSH
001D0026      159040.000   605430.000   LEV --> LEV&ONSH
001G0005      163780.000   607160.000   LEV --> LEV&ONSH
001G0006      162800.000   606940.000   LEV --> LEV&ONSH
001G0007      162270.000   606560.000   LEV --> LEV&ONSH
001G0008      160900.000   606260.000   LEV --> LEV&ONSH
001G0009      160000.000   605850.000   LEV --> LEV&ONSH
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001H0005      171850.000   605520.000   LEV --> LEV&ONSH
001H0007      170640.000   605920.000   LEV --> LEV&ONSH
001H0009      171220.000   605950.000   LEV --> LEV&ONSH
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001H0012      174790.000   606640.000   LEV --> LEV&ONSH
001H0013      174900.000   606460.000   LEV --> LEV&ONSH
001H0014      175080.000   606680.000   LEV --> LEV&ONSH
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001H0017      179090.000   606760.000   LEV --> LEV&ONSH
001H0018      179970.000   606120.000   LEV --> LEV&ONSH
```

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001H0021	172530.000	606630.000	LEV --> LEV&ONSH
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001H0026	174700.000	604770.000	LEV --> LEV&ONSH
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001H0031	176230.000	600510.000	LEV --> LEV&OFFSH
001H0032	176230.000	600510.000	LEV --> LEV&OFFSH
001H0045	171810.000	606460.000	LEV --> LEV&ONSH
001H0046	177220.000	606300.000	LEV --> LEV&ONSH
001H0047	178840.000	606250.000	LEV --> LEV&ONSH
001H0048	178050.000	606460.000	LEV --> LEV&ONSH
001H0049	176320.000	606070.000	LEV --> LEV&ONSH
001H0050	175730.000	605250.000	LEV --> LEV&ONSH
001H0051	174620.000	605210.000	LEV --> LEV&ONSH
001H0052	174280.000	604870.000	LEV --> LEV&ONSH
001H0053	173110.000	605110.000	LEV --> LEV&ONSH
001H0054	172220.000	605160.000	LEV --> LEV&ONSH
001H0055	174600.000	605210.000	LEV --> LEV&ONSH
001H0056	172220.000	605160.000	LEV --> LEV&ONSH
001H0057	172010.000	604720.000	LEV --> LEV&ONSH
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001H0059	172530.000	606630.000	LEV --> LEV&ONSH
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001H0063	179640.000	607930.000	LEV --> LEV&ONSH
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001H0065	175024.000	605300.000	LEV --> LEV&ONSH
001H0066	179837.000	606193.000	LEV --> LEV&ONSH
001H0067	178943.000	606327.000	LEV --> LEV&ONSH
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002C0027	188625.391	602823.625	LEV --> LEV&OFFSH
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002C0033	188354.891	606473.500	LEV --> LEV&OFFSH
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002C0037	188980.000	608530.000	LEV --> LEV&ONSH
002C0038	187030.000	608380.000	LEV --> LEV&ONSH
002C0039	185980.000	608400.000	LEV --> LEV&ONSH
002C0040	184130.000	607800.000	LEV --> LEV&ONSH
002C0041	183650.000	607130.000	LEV --> LEV&ONSH
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002C0064	184855.312	603078.625	LEV --> LEV&OFFSH
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002C0095	180070.000	606380.000	LEV --> LEV&ONSH
002C0096	184180.000	607160.000	LEV --> LEV&ONSH

002C0097	183530.000	607710.000	LEV --> LEV&ONSH
002C0098	182690.000	607550.000	LEV --> LEV&ONSH
002C0099	182610.000	607920.000	LEV --> LEV&ONSH
002C0100	180850.000	607300.000	LEV --> LEV&ONSH
002C0101	184840.000	608410.000	LEV --> LEV&ONSH
002C0102	188130.000	608330.000	LEV --> LEV&ONSH
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002C0110	188120.000	607450.000	LEV --> LEV&ONSH
002C0111	183690.000	607020.000	LEV --> LEV&ONSH
002C0112	189010.000	608520.000	LEV --> LEV&ONSH
002C0113	188500.000	607540.000	LEV --> LEV&ONSH
002C0114	181640.000	607740.000	LEV --> LEV&ONSH
002C0116	185980.000	606870.000	LEV --> LEV&ONSH
002C0117	183550.000	607570.000	LEV --> LEV&ONSH
002C0120	187820.000	601020.000	LEV --> LEV&ONSH
002C0121	189220.000	608080.000	LEV --> LEV&ONSH
002C0122	180100.000	606650.000	LEV --> LEV&ONSH
002C0123	183680.000	607150.000	LEV --> LEV&ONSH
002C0124	180060.000	606460.000	LEV --> LEV&ONSH
002C0125	185980.000	606870.000	LEV --> LEV&ONSH
002C0127	180050.000	606440.000	LEV --> LEV&ONSH
002C0128	189220.000	608080.000	LEV --> LEV&ONSH
002C0129	188150.000	608320.000	LEV --> LEV&ONSH
002C0131	184450.000	606420.000	LEV --> LEV&ONSH
002C0133	183620.000	607650.000	LEV --> LEV&ONSH
002C0134	181480.000	608010.000	LEV --> LEV&ONSH
002C0135	182290.000	607830.000	LEV --> LEV&ONSH
002C0136	180890.000	607990.000	LEV --> LEV&ONSH
002C0137	183640.000	607130.000	LEV --> LEV&ONSH
002C0138	183820.000	606130.000	LEV --> LEV&ONSH
002C0139	183030.000	605950.000	LEV --> LEV&ONSH
002C0140	182650.000	605850.000	LEV --> LEV&ONSH
002C0141	181800.000	605900.000	LEV --> LEV&ONSH
002C0142	180790.000	605940.000	LEV --> LEV&ONSH
002C0143	189220.000	607900.000	LEV --> LEV&OFFSH
002C0144	187480.000	607683.000	LEV --> LEV&ONSH
002C0145	185730.000	607060.000	LEV --> LEV&ONSH
002C0146	180057.000	607983.000	LEV --> LEV&ONSH

002C0148	189063.000	608410.000	LEV --> LEV&ONSH
002C0149	189325.000	608765.000	LEV --> LEV&ONSH
002C0150	189168.000	608190.000	LEV --> LEV&ONSH
002C0151	188366.000	607771.000	LEV --> LEV&ONSH
002C0997	188105.000	607440.000	LEV --> LEV&ONSH
002C0998	189115.000	608300.000	LEV --> LEV&ONSH
002C0999	181015.000	607645.000	LEV --> LEV&ONSH
002C9993	182670.000	607770.000	LEV --> LEV&ONSH
002C9994	188091.000	607436.000	LEV --> LEV&ONSH
002C9995	180897.000	608072.000	LEV --> LEV&ONSH
002C9996	183701.000	606988.000	LEV --> LEV&ONSH
002C9997	183537.000	607578.000	LEV --> LEV&ONSH
002C9998	189230.000	607893.000	LEV --> LEV&OFFSH
002C9999	189232.000	608132.000	LEV --> LEV&ONSH
002D0007	196460.000	600910.000	LEV --> LEV&ONSH
002D0012	196810.000	601910.000	LEV --> LEV&ONSH
002D0013	196800.000	601950.000	LEV --> LEV&ONSH
002D0015	197960.000	601880.000	LEV --> LEV&ONSH
002D0019	199680.000	602330.000	LEV --> LEV&ONSH
002D0021	199940.000	602370.000	LEV --> LEV&ONSH
002D0023	191000.000	608660.000	LEV --> LEV&ONSH
002D0028	194940.000	600090.000	LEV --> LEV&ONSH
002D0029	193970.000	600020.000	LEV --> LEV&ONSH
002D0036	197520.000	603970.000	LEV --> LEV&OFFSH
002D0037	197520.000	603970.000	LEV --> LEV&OFFSH
002D0038	197520.000	603970.000	LEV --> LEV&OFFSH
002D0045	197880.000	606190.000	LEV --> LEV&OFFSH
002D0046	197880.000	606200.000	LEV --> LEV&OFFSH
002D0047	197880.000	606190.000	LEV --> LEV&OFFSH
002D0048	190431.453	607552.938	LEV --> LEV&OFFSH
002D0049	190432.625	607547.625	LEV --> LEV&OFFSH
002D0050	190433.156	607538.000	LEV --> LEV&OFFSH
002D0051	193170.000	608010.000	LEV --> LEV&OFFSH
002D0052	193180.000	608000.000	LEV --> LEV&OFFSH
002D0053	193160.000	608000.000	LEV --> LEV&OFFSH
002D0054	190472.750	602133.625	LEV --> LEV&OFFSH
002D0055	190473.266	602128.312	LEV --> LEV&OFFSH
002D0059	199818.562	608020.625	LEV --> LEV&OFFSH
002D0060	199818.172	608015.500	LEV --> LEV&OFFSH
002D0061	199816.922	608005.188	LEV --> LEV&OFFSH
002D0063	194665.750	603777.500	LEV --> LEV&OFFSH
002D0064	194666.016	603771.562	LEV --> LEV&OFFSH
002D0065	194666.500	603761.438	LEV --> LEV&OFFSH
002D0066	192539.516	603415.000	LEV --> LEV&OFFSH

002D0067	192540.484	603410.188	LEV --> LEV&OFFSH
002D0068	192543.391	603400.500	LEV --> LEV&OFFSH
002D0069	191950.000	608320.000	LEV --> LEV&ONSH
002D0070	191630.000	608830.000	LEV --> LEV&ONSH
002D0071	192620.000	608740.000	LEV --> LEV&ONSH
002D0072	192600.000	608440.000	LEV --> LEV&ONSH
002D0073	192640.000	608940.000	LEV --> LEV&OFFSH
002D0074	190790.000	608220.000	LEV --> LEV&ONSH
002D0075	190020.000	608030.000	LEV --> LEV&OFFSH
002D0076	191000.000	608660.000	LEV --> LEV&ONSH
002D0077	192960.000	608080.000	LEV --> LEV&ONSH
002D0078	192620.000	608740.000	LEV --> LEV&ONSH
002D0079	190500.000	608830.000	LEV --> LEV&ONSH
002D0080	196400.000	600100.000	LEV --> LEV&ONSH
002D0081	190550.000	608950.000	LEV --> LEV&ONSH
002D0086	197340.000	601810.000	LEV --> LEV&ONSH
002D0087	196450.000	601650.000	LEV --> LEV&ONSH
002D0088	191820.000	604680.000	LEV --> LEV&OFFSH
002D0089	191820.000	604680.000	LEV --> LEV&OFFSH
002D0090	191820.000	604680.000	LEV --> LEV&OFFSH
002D0095	191604.000	608535.000	LEV --> LEV&ONSH
002D0096	192116.000	608428.000	LEV --> LEV&ONSH
002D0099	193623.000	608650.000	LEV --> LEV&ONSH
002D0100	193025.000	608705.000	LEV --> LEV&ONSH
002D0101	190609.000	608627.000	LEV --> LEV&ONSH
002D0114	190095.000	608980.000	LEV --> LEV&OFFSH
002D0115	191617.000	608683.000	LEV --> LEV&ONSH
002D0116	192620.000	608690.000	LEV --> LEV&ONSH
002D0117	192833.000	608823.000	LEV --> LEV&ONSH
002D0118	193324.000	608678.000	LEV --> LEV&ONSH
002F0003	210590.000	612760.000	LEV --> LEV&ONSH
002F0004	211600.000	612800.000	LEV --> LEV&ONSH
002F0005	213780.000	613150.000	LEV --> LEV&ONSH
002G0014	200580.000	602360.000	LEV --> LEV&ONSH
002G0015	201210.000	602060.000	LEV --> LEV&ONSH
002G0019	206320.000	610580.000	LEV --> LEV&ONSH
002G0021	206800.000	610800.000	LEV --> LEV&ONSH
002G0022	207500.000	610300.000	LEV --> LEV&ONSH
002G0023	208720.000	610440.000	LEV --> LEV&ONSH
002G0025	206140.000	611140.000	LEV --> LEV&ONSH
002G0026	207500.000	611020.000	LEV --> LEV&ONSH
002G0027	208020.000	611340.000	LEV --> LEV&ONSH
002G0029	208690.000	609950.000	LEV --> LEV&ONSH
002G0030	205600.000	600930.000	LEV --> LEV&ONSH
002G0032	208410.000	603120.000	LEV --> LEV&OFFSH
002G0034	208820.000	602780.000	LEV --> LEV&ONSH
002G0036	207000.000	603140.000	LEV --> LEV&ONSH
002G0039	203630.000	600680.000	LEV --> LEV&ONSH
002G0040	204240.000	600280.000	LEV --> LEV&ONSH
002G0048	200137.703	605655.312	LEV --> LEV&OFFSH
002G0049	200137.797	605649.938	LEV --> LEV&OFFSH
002G0050	200137.656	605640.000	LEV --> LEV&OFFSH
002G0055	205190.000	607400.000	LEV --> LEV&OFFSH
002G0056	205190.000	607400.000	LEV --> LEV&OFFSH
002G0057	205190.000	607400.000	LEV --> LEV&OFFSH
002G0058	209990.000	602320.000	LEV --> LEV&ONSH
002G0059	209170.000	609480.000	LEV --> LEV&OFFSH
002G0062	209600.000	612660.000	LEV --> LEV&ONSH
002G0063	206110.000	602620.000	LEV --> LEV&ONSH
002G0065	207830.000	611100.000	LEV --> LEV&ONSH
002G0066	206700.000	605870.000	LEV --> LEV&OFFSH
002G0067	206700.000	605870.000	LEV --> LEV&OFFSH
002G0068	206700.000	605870.000	LEV --> LEV&OFFSH
002G0071	207900.000	610330.000	LEV --> LEV&ONSH
002G0072	208960.000	610940.000	LEV --> LEV&ONSH
002G0075	207360.000	603300.000	LEV --> LEV&ONSH
002G0076	202250.000	601800.000	LEV --> LEV&ONSH
002G0077	203100.000	601140.000	LEV --> LEV&ONSH
002G0081	208700.000	602840.000	LEV --> LEV&ONSH
002G0082	206580.000	610690.000	LEV --> LEV&ONSH
002G0083	206460.000	610351.000	LEV --> LEV&ONSH
002G0085	209150.000	602620.000	LEV --> LEV&ONSH
002G0094	205890.000	601820.000	LEV --> LEV&ONSH
002G0100	206460.000	610400.000	LEV --> LEV&ONSH
002G0105	208860.000	603050.000	LEV --> LEV&ONSH
002H0062	210600.000	601600.000	LEV --> LEV&ONSH
002H0063	211400.000	601300.000	LEV --> LEV&ONSH
002H0064	211520.000	600880.000	LEV --> LEV&ONSH
002H0065	211480.000	600220.000	LEV --> LEV&ONSH
005B0005	158190.000	592280.000	LEV --> LEV&OFFSH
005B0006	158190.000	592280.000	LEV --> LEV&OFFSH
005B0007	158190.000	592280.000	LEV --> LEV&OFFSH
005D0049	156320.000	582470.000	LEV --> LEV&OFFSH
005D0050	156320.000	582470.000	LEV --> LEV&OFFSH
005D0051	156320.000	582470.000	LEV --> LEV&OFFSH
005E0010	166200.000	588960.000	LEV --> LEV&OFFSH
005F0012	175580.000	588780.000	LEV --> LEV&ONSH
005F0016	171900.000	589810.000	LEV --> LEV&ONSH

005F0017	172100.000	589850.000	LEV --> LEV&ONSH
005F0018	172720.000	589880.000	LEV --> LEV&ONSH
005F0020	177630.000	589060.000	LEV --> LEV&ONSH
005F0023	173740.000	590100.000	LEV --> LEV&ONSH
005F0024	174670.000	590200.000	LEV --> LEV&ONSH
005F0030	179440.000	590670.000	LEV --> LEV&ONSH
005F0031	179640.000	590880.000	LEV --> LEV&ONSH
005F0051	177320.000	588280.000	LEV --> LEV&ONSH
005F0053	179010.000	589100.000	LEV --> LEV&ONSH
005F0054	175680.000	588160.000	LEV --> LEV&ONSH
005F0055	176540.000	588220.000	LEV --> LEV&ONSH
005F0070	172440.000	594530.000	LEV --> LEV&OFFSH
005F0071	172440.000	594530.000	LEV --> LEV&OFFSH
005F0092	176040.000	588260.000	LEV --> LEV&ONSH
005F0093	172370.000	594880.000	LEV --> LEV&OFFSH
005F0094	172370.000	594880.000	LEV --> LEV&OFFSH
005F0095	172370.000	594880.000	LEV --> LEV&OFFSH
005F0097	175440.000	590220.000	LEV --> LEV&ONSH
005F0100	170480.000	589460.000	LEV --> LEV&ONSH
005F0103	178230.000	589120.000	LEV --> LEV&ONSH
005F0106	171140.000	589600.000	LEV --> LEV&ONSH
005F0107	176100.000	588200.000	LEV --> LEV&ONSH
005F0108	179040.000	590040.000	LEV --> LEV&ONSH
005F0113	179020.000	589080.000	LEV --> LEV&ONSH
006A0005	189080.000	587780.000	LEV --> LEV&ONSH
006A0041	180610.000	592320.000	LEV --> LEV&ONSH
006A0050	182540.000	593590.000	LEV --> LEV&ONSH
006A0057	184050.000	594810.000	LEV --> LEV&ONSH
006A0063	184840.000	595500.000	LEV --> LEV&ONSH
006A0064	185480.000	595780.000	LEV --> LEV&ONSH
006A0069	186510.000	596200.000	LEV --> LEV&ONSH
006A0070	187180.000	596840.000	LEV --> LEV&ONSH
006A0073	187960.000	597700.000	LEV --> LEV&ONSH
006A0076	188920.000	598220.000	LEV --> LEV&ONSH
006A0077	188890.000	598620.000	LEV --> LEV&ONSH
006A0078	188930.000	598430.000	LEV --> LEV&ONSH
006A0079	188930.000	598430.000	LEV --> LEV&ONSH
006A0080	189120.000	598140.000	LEV --> LEV&ONSH
006A0082	188440.000	599250.000	LEV --> LEV&ONSH
006A0100	188700.000	598000.000	LEV --> LEV&ONSH
006A0114	180130.000	591680.000	LEV --> LEV&ONSH
006A0135	183310.000	594270.000	LEV --> LEV&ONSH
006A0154	187560.000	597370.000	LEV --> LEV&ONSH
006A0157	189600.000	588560.000	LEV --> LEV&ONSH

006A0160	189100.000	598330.000	LEV --> LEV&ONSH
006A0161	189610.000	598510.000	LEV --> LEV&ONSH
006A0162	189870.000	597380.000	LEV --> LEV&ONSH
006A0163	183850.000	594690.000	LEV --> LEV&ONSH
006A0164	184200.000	594850.000	LEV --> LEV&ONSH
006A0173	189920.000	588700.000	LEV --> LEV&ONSH
006A0200	188350.000	599300.000	LEV --> LEV&ONSH
006A0205	188350.000	599300.000	LEV --> LEV&ONSH
006A0206	181500.000	593150.000	LEV --> LEV&ONSH
006B0002	195900.000	588570.000	LEV --> LEV&ONSH
006B0003	190470.000	589160.000	LEV --> LEV&ONSH
006B0007	194700.000	589570.000	LEV --> LEV&ONSH
006B0008	195430.000	589440.000	LEV --> LEV&ONSH
006B0009	195680.000	589900.000	LEV --> LEV&ONSH
006B0010	195710.000	589510.000	LEV --> LEV&ONSH
006B0011	195790.000	589180.000	LEV --> LEV&ONSH
006B0016	192050.000	590090.000	LEV --> LEV&ONSH
006B0019	192480.000	590230.000	LEV --> LEV&ONSH
006B0020	195540.000	590590.000	LEV --> LEV&ONSH
006B0027	195330.000	592040.000	LEV --> LEV&ONSH
006B0036	195700.000	593360.000	LEV --> LEV&ONSH
006B0037	195710.000	593340.000	LEV --> LEV&ONSH
006B0046	193220.000	594190.000	LEV --> LEV&ONSH
006B0047	193580.000	594130.000	LEV --> LEV&ONSH
006B0060	191920.000	595580.000	LEV --> LEV&ONSH
006B0061	192380.000	595160.000	LEV --> LEV&ONSH
006B0072	191120.000	596310.000	LEV --> LEV&ONSH
006B0097	190770.000	599020.000	LEV --> LEV&ONSH
006B0102	193430.000	599670.000	LEV --> LEV&ONSH
006B0138	193110.000	589960.000	LEV --> LEV&ONSH
006B0197	190480.000	596830.000	LEV --> LEV&ONSH
006B0206	196040.000	587840.000	LEV --> LEV&ONSH
006B0207	195780.000	592740.000	LEV --> LEV&ONSH
006B0209	193680.000	599800.000	LEV --> LEV&ONSH
006B0228	195440.000	593500.000	LEV --> LEV&ONSH
006B0229	195680.000	593460.000	LEV --> LEV&ONSH
006B0231	195880.000	593160.000	LEV --> LEV&ONSH
006B0232	195200.000	593470.000	LEV --> LEV&ONSH
006B0234	192990.000	594370.000	LEV --> LEV&ONSH
006B0235	191800.000	595560.000	LEV --> LEV&ONSH
006B0237	193230.000	599640.000	LEV --> LEV&ONSH
006B0238	195700.000	593360.000	LEV --> LEV&ONSH
006B0240	192650.000	590090.000	LEV --> LEV&ONSH
006B0255	195610.000	591180.000	LEV --> LEV&ONSH

```
006B0264      194450.000   593840.000   LEV --> LEV&ONSH
006B0274      192410.000   599960.000   LEV --> LEV&ONSH
006B0281      194090.000   589490.000   LEV --> LEV&ONSH
006B0283      191600.000   599540.000   LEV --> LEV&ONSH
006B0284      192300.000   599870.000   LEV --> LEV&ONSH
006B0285      191300.000   589710.000   LEV --> LEV&ONSH
006B0286      195580.000   599950.000   LEV --> LEV&ONSH
006B0287      193660.000   589620.000   LEV --> LEV&ONSH
006B0302      194360.000   589560.000   LEV --> LEV&ONSH
006B0313      194420.000   589610.000   LEV --> LEV&ONSH
006C0119      188440.000   586580.000   LEV --> LEV&ONSH
006C0120      189000.000   586270.000   LEV --> LEV&ONSH
006C0129      188750.000   587350.000   LEV --> LEV&ONSH
006C0161      188910.000   585350.000   LEV --> LEV&ONSH
006C0164      189030.000   586400.000   LEV --> LEV&ONSH
006D0145      196460.000   586330.000   LEV --> LEV&ONSH
006D0161      196190.000   587010.000   LEV --> LEV&ONSH
006D0200      196570.000   585800.000   LEV --> LEV&ONSH
006D0203      196400.000   586720.000   LEV --> LEV&ONSH
006D0260      196610.000   585170.000   LEV --> LEV&ONSH
006E0118      204460.000   600000.000   LEV --> LEV&ONSH
006F0150      211650.000   598420.000   LEV --> LEV&ONSH
006F0151      213250.000   597660.000   LEV --> LEV&ONSH
006F0154      212490.000   597760.000   LEV --> LEV&ONSH
006F0158      214620.000   598120.000   LEV --> LEV&ONSH
006F0179      213620.000   597980.000   LEV --> LEV&ONSH

The netcdf_file lts2_alllevelling.nc will be updated.
```

Get information about NetCDF file into structure finfo

```
finfo=ncinfo(netcdf_file);
```

Read netcdf file for verification

```
% Read point data

pntname2=cellstr(ncread(netcdf_file,'station_name'));
pntcrd2(:,1)=ncread(netcdf_file,'x');
pntcrd2(:,2)=ncread(netcdf_file,'y');
pntclass2=cellstr(ncread(netcdf_file,'station_class'));
```

```
% Project data

prjname2=cellstr(ncread(netcdf_file,'project_name'));
prjepoch2=ncread(netcdf_file,'project_epoch')+datenum('1-Jan-1970 00:00:00');
prjclass2=cellstr(ncread(netcdf_file,'project_class'));

% Observations

%  obstable       observation table with index to from_point, to_point and project
%  epoch          array with epoch (Matlab date number)
%  sdobs          array with the observed height difference [m]
%  sdcov          covariance matrix [m]
%  sdobsflag      integer observation flag (default 0)
%  sensitivity    sensitivity matrix [0-1]

stationFromIndex=ncread(netcdf_file,'stationFromIndex');
stationToIndex=ncread(netcdf_file,'stationToIndex');
projectIndex=ncread(netcdf_file,'projectIndex');

sdobs2=ncread(netcdf_file,'sdObs');
sdcov2=ncread(netcdf_file,'sdCov');

epoch2=ncread(netcdf_file,'epoch')+datenum('1-Jan-1970 00:00:00');
sdobsflag2=ncread(netcdf_file,'sdObsFlag');
sensitivity2=ncread(netcdf_file,'sensitivity');

obstable2=[stationFromIndex stationToIndex projectIndex ];
```

Test the data read from netcdf

```
display('Checking netcdf file ...');

if all(strncmp(pntname2,pntname,8)) && ...
                all(all(abs(pntcrd2-pntcrd) < 1e-1)) && ...
                all(strncmp(pntclass2,pntclass,3))
   fprintf('Station data is ok.\n')
else
   fprintf('Station data is NOT ok!!!!\n')
   pntname2
   pntcrd2
   pntclass2
end
```

```
if all(strncmp(prjname2,prjname,8)) && ...
                all(abs(prjepoch2-prjepoch) < 1e-1) && ...
                all(strncmp(prjclass2,prjclass,3))
   fprintf('Project data is ok.\n')
else
   fprintf('Project data is NOT ok!!!!\n')
   prjname2
   datestr(prjepoch2)
   prjclass2
end

if  all(abs(sdobs2 - sdobs) < 1e-6 ) && ...
                all(all(abs(sdcov2 - sdcov) < 1e-6 )) && ...
                all(all(obstable2 == obstable))
   fprintf('Observation data is ok.\n')
else
   fprintf('Observation data is NOT ok!!!!\n')
   obstable2
   sdobs2
   sdcov2
end

display('Done.');
```

```
Checking netcdf file ...
Station data is ok.
Project data is ok.
Observation data is ok.
Done.
```

Done

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Appendix G. lts2_outlier_detection processing output

Contents lts2_outlier_detection.m

- Detect and flag outliers in levelling data
- Input section (specify your project here)
- Load polygons from outline directory
- Read the idealization noise parameters
- Read prognosis
- Read the netcdf data file
- Loop while no more disturbances are detected
- Split the data based on the from_point (common reference point)
- Make transformation from SDs to DDs with respect to the earliest refrence times
- Compute idealization cov_mx (spatio_temporal component)
- Compute idealization cov_mx (temporal component)
- Test SD timeseries
- Prognosis interpolation
- Apply the test
- Handle case 2 abnormal
- Handle case 3 identification error
- Handle case 4 disturbance
- Visualization
- Create overview flagged observations
- Update the global attributes of the new Netcdf file
- Write the results to the new Netcdf file

Detect and flag outliers in levelling data

*Sami Samiei Esfahany, Delft University of Technology, 5 September 2016 *

This Matlab script reads a Netcdf file with levelling data and applies a testing scheme to detect and flag outliers.

In particular, three types of outliers are considered: (based on the report: Samiei-Esfahany and Baehr(2015)*) - identification errors: isolated observations that show an anomalous behavior within a DD time series. The detected identification errors get flag 3. Multiple identification errors per SD can be detected. - disturbances: events that cause a step in the DD time series. The associated SD time series is split in two parts, the part before and after the event, by assigning a new benchmark name to the two parts. The new benchmark name is created by adding a suffix to the original benchmark name. The part before the event gets suffix 'a', while the part after gets suffix 'b'. In iterative scheme is applied to allow the detection of multiple events within a time series. Again, the same suffixes are applied. For example, in case of two detected events, the final benchmark names may be 00C03453aa, 00C03453ab, 00C03453b. The first observation after a detected event (now with benchmark name with suffix 'b') is duplicated in the dataset and assigned the benchmark name with suffix 'a', together with an identification error flag (3). This way, when a selection 'with outliers' is applied, the DD observations corresponding to the original time series are all constructed by the getdata tool without loosing any information. In case of 'without outliers', the different benchmark numbers together with the identification error flag cause two separate time series, before and after the event. - Abnormal behavior: observations associated to the time-series which have extremely large deviations from the initial/assumed prognosis model. If an abnormal behavior is detected, the corresponding observations are flagged with the index 2.

```
*Samiei-Esfahany, S. and H. Baehr (2015). Research and development
project for geodetic deformation monitoring, for longterm study on
anomalous time-dependent subsidence in the wadden sea region.
Technical report, Nederlanse Aardolie Maatschappij V.V., Assen,



Netherlands.
```

The inputs of the script are - csv_idealisation_precision: .csv file with idealization precision parameters - inprognosis: prognosis file - outlinedir: directory with outlines - minNobs_fortest: minimum number of observations to apply testing. The minimum number should be 4. - gam0: power of the test - alpha0: level of sifnificance for one dimensional test - OMT_th: overall model test threshold. (Theoretically should be 1, but it should be large (e.g., 20) to only detect blunders) - axLim: axis limits for visualization - netcdf_file: original Netcdf file - netcdf_file_new: new Netcdf file with flagged outliers - globalattributes_new: new or updated global attributes for new Netcdf file

The outputs are - Netcdf file with flagged outliers - Time series plots containing the detected outliers

This script uses functions from the `lts2|crsutil` toolbox.

```
% (c) Sami Samiei Esfahany, Delft University of Technology, 2016.

% Created:    12 October 2016 by Sami Samiei Esfahany
% Modified:   21 October 2016 by Freek van Leijen
%             - iterative testing to detect multiple disturbances
%             19 January 2017 by Sami Samiei Esfahany
%             - detection of abnormal behavior
%             - overview of detected outliers at end of testing scheme,
%               and not in every loop
%

clear all
close all

% Set path to required toolboxes
lts2toolboxdir = fullfile('../..','lts2toolbox');
addpath(fullfile(lts2toolboxdir,'lts2'));
addpath(fullfile(lts2toolboxdir,'crsutil'));
```

Input section (specify your project here)

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Specify .csv file with idealization precision parameters
csv_idealisation_precision = 'getdata_idealization_precision_26Oct2016.csv';

% Specify prognosis file
inprognosis = 'Ameland_BC_ZE-A1.69E-09L2-allROSL0-9-base-case-TD7-1986initial_nwregrid.csv';

% Specify the directory with outlines
outlinedir = fullfile(lts2toolboxdir,'lts2','lts2outlines');

% Specify minimum number of observations to apply testing
% Minimum should be 3 -- apply the test (for identification and disturbances) for timeseries with more than minNobs
minNobs_fortest = 4;

% Specify the power of the test
gam0 = 0.8;

% Specify the level of sifnificance for one dimensional test
alpha0 = 0.0005;
```

```
% Specify the overall model test threshold
% (Theoretically should be 1, but it should be large (e.g., 20) to only detect blunders)
OMT_th = 24;

% Specify the axis limits for visualization
axLim=[149.56 215.62 575.56 615.56]; %[km]

% Specify netcdf filenames
netcdf_file = '../lts2_move3_to_netcdf/lts2_alllevelling.nc';
netcdf_file_new = 'lts2_alllevelling_flaggedOutliers.nc';

% Specify new or updated global attributes for Netcdf file
globalattributes_new = { ...
    'title'        , 'LTS2 levelling dataset - flagged outliers'  ; ...
    'original_file',  netcdf_file ; ...
    'id_noise_file',  csv_idealisation_precision ; ...
    'outl_setting' , ['gam0:' num2str(gam0) ',  alpha0:' num2str(alpha0), ',  OMT_th:' num2str(OMT_th), ', minNobs_fortest:', num2str(minNobs_fortest)]; ...
    };

% End input section (You should not have to change anything below this line.)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

if minNobs_fortest<4
    error('minNobs_fortest should be at least equals 4.')
end
```

Load polygons from outline directory

```
d=dir(fullfile(outlinedir,'*.coo'));
shoreline=[];
for k=1:numel(d)
    formatSpec = '%6f%f%[^\n\r]';
    filename=fullfile(outlinedir,d(k).name);
    fid=fopen(filename,'r');
    dataArray = textscan(fid, formatSpec, 'Delimiter', '', 'WhiteSpace', '',  'ReturnOnError', false);
    fclose(fid);
    shoreline=[ shoreline ; dataArray{:, 1} dataArray{:, 2} ; NaN NaN];
end
clear d
```

Read the idealization noise parameters

```
data = textread(csv_idealisation_precision,'%s','delimiter',',');
ip.type = data(6:5:end);
ip.class = data(7:5:end);
ip.variance = data(8:5:end);
ip.range = data(9:5:end);
ip.power = data(10:5:end);
clear data
```

Read prognosis

```
Pdata=importdata(inprognosis,',',1);
prognos_def=-Pdata.data(:,3:end)*0.01;% *0.01 cm converts to meter
prognos_X=Pdata.data(:,1);
prognos_Y=Pdata.data(:,2);
PNepochs=size(prognos_def,2);
PNpnt=size(prognos_def,1);
Pepochsname=char(Pdata.textdata(3:end));
PTepoch0=str2num(Pepochsname(:,2:end));

Kconv=convhull(prognos_X,prognos_Y);
prognos_Xconv=prognos_X(Kconv);
prognos_Yconv=prognos_Y(Kconv);
```

Read the netcdf data file

```
lev = readlts2netcdf2struct(netcdf_file);
lev2=lev; % new database (the changes are applied on lev2)
```

Loop while no more disturbances are detected

```
global_disturbance_counter = 0;
disturbance_count = 1;
loop_count = 0;
plot_count = 0;

while disturbance_count~=0
```

```
    loop_count = loop_count+1;
    fprintf('Loop %d ...\n',loop_count);

    % Set disturbance and identification counter
    disturbance_count = 0;
    identification_count = 0;
    abnormal_count = 0;
    % Replace the old lev database with the updated version
    % (only effective from second iteration)
    lev = lev2;

    BM_all=[cellstr(lev.PointData.station_name) ...
        num2cell(lev.PointData.x) ...
        num2cell(lev.PointData.y) ...
        cellstr(lev.PointData.station_class)];

    DATES=[cellstr(lev.ProjectData.project_name) ...
        cellstr(datestr(lev.ProjectData.project_epoch,'yyyymmdd'))];
    temp=char(DATES(:,2));
    dates_decyear = ymd2dyear(datevec(datenum(temp,'yyyymmdd')));
```

```
Loop 1 ...
```

```
Loop 2 ...
```

Split the data based on the from_point (common reference point)

```
ref_points_ind=unique(lev.Observations.from_index);  % index of the from_points
Nref=length(ref_points_ind);

Nsd=length(lev.SDObs);
SD_table=[lev.Observations.from_index lev.Observations.to_index lev.Observations.project_index];

for iref=1:Nref
```

```
    refind=ref_points_ind(iref); % the index of the common reference point
    SDind=find(lev.Observations.from_index==refind);
    Sfrom_to_epoch=SD_table(SDind,:);
    ysd=lev.SDObs(SDind);
    Qsd=lev.SDCov(SDind,SDind);
```

Make transformation from SDs to DDs with respect to the earliest refrence times

```
    %(For testing, we need a timeseries with respect to a reference time)
    [SDuniq,indSD1,indSD2]=unique(Sfrom_to_epoch(:,1:2),'rows');
    Pind=[];
    STfromto=[];
    S_sdref2dd=[];
    for i=1:length(indSD1)  % indSD1 is the number of unique SDs

        ind=find(ismember(Sfrom_to_epoch(:,1:2),Sfrom_to_epoch(indSD1(i),1:2),'rows'));
        tempdates=Sfrom_to_epoch(ind,3);
        tempdates2=dates_decyear(Sfrom_to_epoch(ind,3));
        [datemin,minind]=min(tempdates2);  % find the reference time (earliest epoch)
        minind=minind(1);
        datemin=Sfrom_to_epoch(ind(minind),3);



        if length(ind)>=2    %if there are at least 2 epochs for this arc (indSD1)

            S=zeros(length(ind),size(Sfrom_to_epoch,1));
            for j=1:length(ind)
                S(j,ind(minind))=-1;
                S(j,ind(j))=1;
            end
            S(minind,:)=[];

            temp=[repmat(Sfrom_to_epoch(indSD1(i),1:2),length(ind)-1,1) ...
```

```
                repmat(datemin,length(ind)-1,1) ...
                tempdates(tempdates~=datemin)];
            STfromto=[STfromto;temp];
            S_sdref2dd=[S_sdref2dd;S];
            Pind=[Pind;i*ones(size(S,1),1)]; % index of the DDs for each to_point

        end
    end

    if ~isempty(Pind)
```

```
        % Propagation to make the DD vector and its cov matrix
        ydd0=S_sdref2dd*ysd;
        DD_ind_Tabale=STfromto;
```

Compute idealization cov_mx (spatio_temporal component)

```
        ind =find(strcmp(ip.type,'ST'));
        IdealNoiseParamS=[str2num(cell2mat(ip.variance(ind))) ...
            str2num(cell2mat(ip.range(ind))) ...
            str2num(cell2mat(ip.power(ind)))]; % I am really bad with this cell>str>num conversion
        ind =find(strcmp(ip.type,'T'));
        IdealNoiseParamT=[str2num(cell2mat(ip.variance(ind(1)))) ...
            eps ...
            str2num(cell2mat(ip.power(ind(1))))]; % here only the first ip 'T' model is selected: (ind(1))
        BMxy=cell2mat(BM_all(1:end,2:3));
        QidS=lts2_construct_st_idealization_covmx(IdealNoiseParamS,DD_ind_Tabale,BMxy,dates_decyear);
        QidS=QidS*1e-6;  % the QidS is in [mm^2], here we convert it to [m^2]
```

Compute idealization cov_mx (temporal component)

```
        [temp,i1]=ismember(BM_all(:,end),ip.class);
        i2=find(strcmp(ip.class,'DEFAULT'));
        i1(i1==0)=i2;
        BM_var=ip.variance(i1);
        BM_pow=ip.power(i1);
        BM_var=str2num(char(BM_var));
        BM_pow=str2num(char(BM_pow));
        QidT=lts2_construct_t_idealization_covmx(DD_ind_Tabale,BMxy,dates_decyear,BM_var,BM_pow);
        QidT=QidT*1e-6;  % the QidS is in [mm^2], here we convert it to [m^2]

        Qdd0=S_sdref2dd*Qsd*S_sdref2dd'+QidT+0*QidS; % final cov matrix
```

Test SD timeseries

```
        indSD1uniq=unique(Pind);
        test_flag = zeros(length(indSD1uniq),1);

        for i=1:length(indSD1uniq)
```

```
ind=find(Pind==indSD1uniq(i));
sdflag_ind=find(sum((S_sdref2dd(ind,:)),1)>0); % index of the used SDs in ysd
ref_sd_ind=find(sum((S_sdref2dd(ind,:)),1)<0); % index of the reference epoch in ysd
if length(ref_sd_ind)>1 | isempty(ref_sd_ind) % there should be only one reference in time for each arc
    errors('something goes wrong, look at the code')
end
ydd=ydd0(ind);  % observation vector
Qdd=Qdd0(ind,ind); % measurment covariance matrix
ddtable=STfromto(ind,:); % dd table

refepoch=decyear(datestr(lev.ProjectData.project_epoch( ...
    Sfrom_to_epoch(ref_sd_ind,3)),'yyyymmdd'),'yyyymmdd'); % ref time in decimal year
Btemp=decyear(datestr(lev.ProjectData.project_epoch( ...
    Sfrom_to_epoch(sdflag_ind,3)),'yyyymmdd'),'yyyymmdd')-refepoch; % dates for the timeseries
```

Prognosis interpolation

```
frX=double(lev.PointData.x(ddtable(1,1)));
frY=double(lev.PointData.y(ddtable(1,1)));
toX=double(lev.PointData.x(ddtable(1,2)));
toY=double(lev.PointData.y(ddtable(1,2)));
frEp=dates_decyear(ddtable(1,3));
toEp=dates_decyear(ddtable(:,4));

fr_def_ts0=zeros(PNepochs,1);
to_def_ts0=zeros(PNepochs,1);

% Interpolation in space
if  inpolygon(frX,frY,prognos_Xconv,prognos_Yconv);
    for j=1:PNepochs
        fr_def_ts0(j)=griddata(prognos_X,prognos_Y,prognos_def(:,j),frX,frY);
    end
end
if  inpolygon(toX,toY,prognos_Xconv,prognos_Yconv);
    for j=1:PNepochs
        to_def_ts0(j)=griddata(prognos_X,prognos_Y,prognos_def(:,j),toX,toY);
    end
end

% Interpolation in time
fr_def_ts=interp1(PTepoch0,fr_def_ts0,[refepoch;refepoch+Btemp],'spline','extrap');
to_def_ts=interp1(PTepoch0,to_def_ts0,[refepoch;refepoch+Btemp],'spline','extrap');
indtemp=find([refepoch;refepoch+Btemp]<min(PTepoch0));
fr_def_ts(indtemp)=0;
to_def_ts(indtemp)=0;

if ~isempty(find([refepoch;refepoch+Btemp]>max(PTepoch0)))
    warning('out-of-prognosis epochs')
end

yhat=(to_def_ts-to_def_ts(1))-(fr_def_ts-fr_def_ts(1)); % timeseries based on the prognosis
```

```
yhat=yhat(2:end);
```

Apply the test

```
%---- Reordering (IMPORTANT)
[Btemp2,indtemp]=sort(Btemp);
Btemp2=Btemp2+refepoch;
ydd=ydd(indtemp);
Qdd=Qdd(indtemp,indtemp);
yhat=yhat(indtemp);
%----

% testing
e0 = ydd-yhat;
e0_org=e0;
Tresults = lts2_outlier_testing(alpha0,gam0,e0,Qdd);
[tq_dist,ind_dist] = max(Tresults.dist_toetsq);
[tq_iden,ind_iden] = max(Tresults.iden_toetsq);
OMT_toetsq = Tresults.OMT_toetsq;

% select the most likely hypothesis
[temptest,test_flag(i)]=max([OMT_th OMT_toetsq tq_iden tq_dist]); % the first element is the threshold to accept OMT
temp=[NaN NaN ind_iden ind_dist];
error_index(i)=temp(test_flag(i));

% adapt the model for indentification/disturbance only if
% number of observations in the timeseries is larger than minNobs_fortest
if test_flag(i)>=3 & length(e0)<minNobs_fortest-1 % if identification/disturbance is detected but the number
  test_flag(i)=2;                          % of observations is smaller than minNobs_fortest-1 (-1 is because of the e0 is already DD)
end
```

Handle case 2 abnormal

```
if  test_flag(i)==2 %abnormal
 % Update lev2 database
    abnormal_count = abnormal_count + length(sdflag_ind)+1;
    lev2.Observations.sdObs_flag(SDind(sdflag_ind)) = 2;  % flagging the detected SDs
    lev2.Observations.sdObs_flag(SDind(ref_sd_ind)) = 2;  % flagging the detected SDs (reference epoch)
end
```

Handle case 3 identification error

```
clear iden_ind_vector  counter_iden
counter_iden=0;
if test_flag(i)==3  % if identification then iterate on identification testing

    e0_new_ind=[1:length(e0)]';
    ind_iden_wrt_org_y=ind_iden;
    iden_ind_vector=[ind_iden_wrt_org_y];
    while test_flag(i)==3
```

```
            e0_new_ind(ind_iden)=[];
            e0(ind_iden)=[];
            Qdd(ind_iden,:)=[];
            Qdd(:,ind_iden)=[];

            Tresults=lts2_outlier_testing(alpha0,gam0,e0,Qdd);
            [tq_dist,ind_dist]=max(Tresults.dist_toetsq);
            [tq_iden,ind_iden]=max(Tresults.iden_toetsq);
            OMT_toetsq=Tresults.OMT_toetsq;

            temptestlast=temptest;
            [temptest,test_flag(i)]=max([OMT_th OMT_toetsq tq_iden tq_dist]); % the first element is the threshold to accept OMT
            temp=[NaN NaN ind_iden ind_dist];
            error_index(i)=temp(test_flag(i));

            if ~isnan(error_index(i))
                ind_iden_wrt_org_y=e0_new_ind(error_index(i));
            else
                ind_iden_wrt_org_y=NaN;
            end
            iden_ind_vector=[iden_ind_vector;ind_iden_wrt_org_y];
            counter_iden=counter_iden+1;

        end

        % Update lev2 database
        identification_count = identification_count + counter_iden;
        out_index=indtemp(iden_ind_vector(1:counter_iden));
        outlier_SD_ind=SDind(sdflag_ind(out_index));
        lev2.Observations.sdObs_flag(outlier_SD_ind) = 3;  % flagging the detected SD

    end
```

Handle case 4 disturbance

```
    if  test_flag(i)==4 %disturbance
        global_disturbance_counter=global_disturbance_counter+1;
        disturbance_count = disturbance_count + 1;

        if counter_iden==0
            out_index=indtemp(error_index(i):end);
        else
            out_index=indtemp(iden_ind_vector(counter_iden+1):end);
        end

        outlier_SD_ind=SDind(sdflag_ind(out_index));

        BMto_name=unique(cellstr(lev.PointData.station_name(SD_table(outlier_SD_ind,2),:)));
        if length(BMto_name)>1
            error('BMto_name length');
        end
        BMto_name=char(BMto_name);
        BMto_name_new1=[BMto_name 'a'];
```

```
        BMto_name_new2=[BMto_name 'b'];

        if length(BMto_name_new1)>10
            error('The created benchmark name is too long for the current getdata tool.')
        end

        temp = cellstr(lev2.PointData.station_name);
        temp(SD_table(outlier_SD_ind(1),2)) = cellstr(BMto_name_new1);
        temp=char([temp;cellstr(BMto_name_new2)]);
        ind_newBM=size(temp,1); % always the last one

        % Add new benchmark to PointData
        lev2.PointData.station_name=temp;
        lev2.PointData.station_class=[lev2.PointData.station_class;...
            lev.PointData.station_class(SD_table(outlier_SD_ind(1),2),:)];

        lev2.PointData.x=[lev2.PointData.x;...
            lev.PointData.x(SD_table(outlier_SD_ind(1),2),:)];
        lev2.PointData.y=[lev2.PointData.y;...
            lev.PointData.y(SD_table(outlier_SD_ind(1),2),:)];

        % Update observations table
        lev2.Observations.to_index(outlier_SD_ind)=ind_newBM;

        % The first detected disturbance will be kept in
        % the observation table and it is flagged as
        % identification error
        lev2.Observations.to_index= ...
            [lev2.Observations.to_index; lev.Observations.to_index(outlier_SD_ind(1))];
        lev2.Observations.from_index= ...
            [lev2.Observations.from_index; lev.Observations.from_index(outlier_SD_ind(1))];
        lev2.Observations.epoch= ...
            [ lev2.Observations.epoch ; lev.Observations.epoch(outlier_SD_ind(1))];
        lev2.Observations.project_index= ...
            [lev2.Observations.project_index ; lev.Observations.project_index(outlier_SD_ind(1))];
        lev2.Observations.sdObs_flag= ...
            [lev2.Observations.sdObs_flag ; 3];
        lev2.Observations.sensitivity= ...
            [lev2.Observations.sensitivity ; lev.Observations.sensitivity(outlier_SD_ind(1),:)];

        lev2.SDObs = [lev2.SDObs; lev.SDObs(outlier_SD_ind(1))];
        lev2.SDCov = [lev2.SDCov lev2.SDCov(:,outlier_SD_ind(1));...
            [lev2.SDCov(outlier_SD_ind(1),:) ...
            lev2.SDCov(outlier_SD_ind(1),outlier_SD_ind(1))]];

        % Check on non-tested observations
        % Search of the whole dataset to find whether the disturbance-benchmark is used in any other
        % (perhaps not-tested) SD observation. If yes, the  form/to_index of these detected SDs
        % are updated accordingly (XXXXa and XXXXb before and after the disturbance event.)
        clear ind0 indtemp2 temp temp2 ind_outof_a ind_outof_b
        ind0=find(strcmp(cellstr(lev2.PointData.station_name),cellstr(BMto_name_new1)));
        indtemp2=find(lev2.Observations.to_index==ind0);


        temp=lev2.ProjectData.project_epoch(lev2.Observations.project_index(indtemp2),:);
```

```
        index_a=SDind(sdflag_ind((~ismember([1:length(sdflag_ind)]',out_index))));
        temp2=lev2.Observations.epoch([index_a;SDind(ref_sd_ind);outlier_SD_ind(1)]);
        ind_outof_a=find(temp>max(temp2));
        if ~isempty(ind_outof_a)
            lev2.Observations.to_index(indtemp2(ind_outof_a))=ind_newBM;
        end

        clear temp ind_outof_a indtemp3
        indtemp3=find(lev2.Observations.from_index==ind0);
        temp=lev2.ProjectData.project_epoch(lev2.Observations.project_index(indtemp3),:);
        ind_outof_a=find(temp>max(temp2));
        if ~isempty(ind_outof_a)
            lev2.Observations.from_index(indtemp2(ind_outof_a))=ind_newBM;
        end

    end
```

Visualization

```
    e0=e0_org;
    if test_flag(i)==3 | test_flag(i)==4 | test_flag(i)==2 | counter_iden>0
        plot_count = plot_count+1;
        g1=figure(200+plot_count);
        subplot(3,5,[1,2,6,7])

        hold on
        plot(frX/1000,frY/1000,'r.','markersize',40);grid on;
        plot(toX/1000,toY/1000,'b.','markersize',20);grid on;
        plot(shoreline(:,1)/1000,shoreline(:,2)/1000,'k','linewidth',2)
        axis equal
        axis(axLim)
        xlabel('X-RD');ylabel('Y-RD');
        legend('BMFrom','BMTo','land','Location','Southwest')
        fr_str=(lev.PointData.station_name(ddtable(1,1),:));
        to_str=(lev.PointData.station_name(ddtable(1,2),:));
        title(['FromBM: ' char(cellstr(fr_str)) ',   ToBM: ' char(cellstr(to_str))])


        subplot(3,5,[3,4,5])
        plot(Btemp2,ydd*100,'r.','markersize',30)
        hold on
        plot(refepoch,0,'k.','markersize',40)
        grid on
        plot([refepoch;Btemp2],[0;yhat*100],'b--','linewidth',3)
        xlim([refepoch-1 max(Btemp2)+1]);
        ylabel('Defo [cm]')
        legend('levelling','Ref epoch','prognosis','Location','Southwest')
        title(['loop No: ' num2str(loop_count)])
        hold off

        subplot(3,5,11:12);imagesc(Qdd*1e4); colorbar;
        title('cov-mx [cm^2]');
```

```
        subplot(3,5,[8,9,10])
        switch test_flag(i)
            case 1
                plot(Btemp2,e0*100,'g.','markersize',30);ylabel('residuals defo [cm]');xlabel('Time [year]');hold on
                plot(refepoch,0,'k.','markersize',40);
                xlim([refepoch-1 max(Btemp2)+1]);
                grid on;
                title(['residuals: H0 accepted , identification (Tq:)' num2str(temptestlast)]);
                plot(Btemp2(iden_ind_vector(1:counter_iden)),100*e0(iden_ind_vector(1:counter_iden)),'ro','markersize',20);

            case 2
                plot(Btemp2,e0*100,'g.','markersize',30);ylabel('residuals defo [cm]');xlabel('Time [year]');hold on
                plot(refepoch,0,'k.','markersize',40);
                xlim([refepoch-1 max(Btemp2)+1]);
                grid on;
                title(['residuals: H0 rejected , abnormal (Tq:)' num2str(temptest)]);

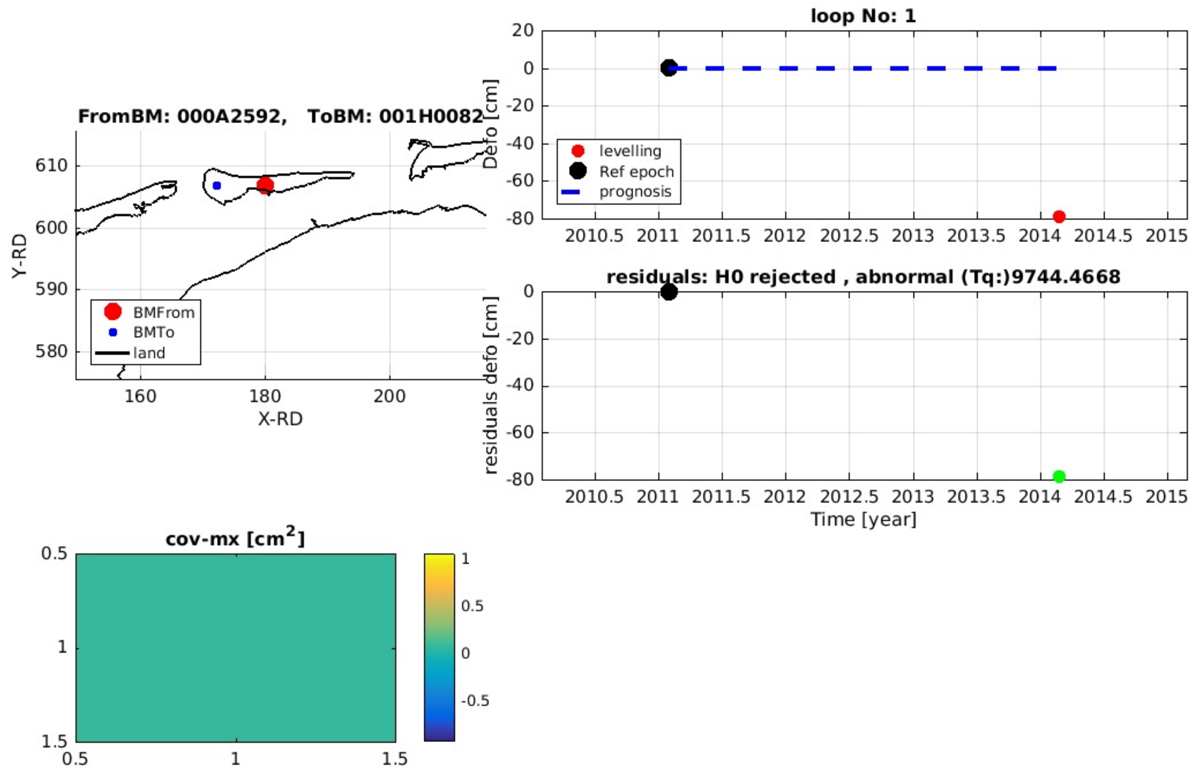

            case 3

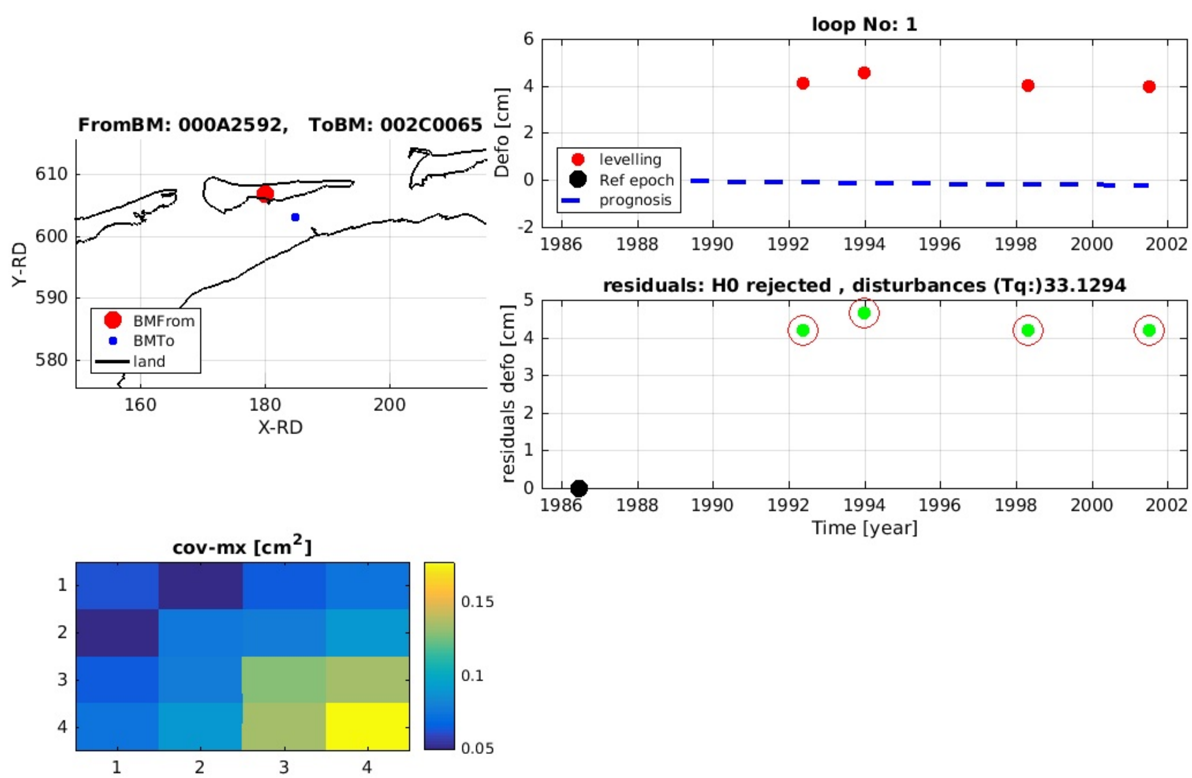
                plot(Btemp2,e0*100,'g.','markersize',30);ylabel('residuals defo [cm]');xlabel('Time [year]');hold on
                plot(Btemp2(error_index(i)),100*e0(error_index(i)),'ro','markersize',20);
                plot(refepoch,0,'k.','markersize',40);
                xlim([refepoch-1 max(Btemp2)+1]);
                grid on;
                title(['residuals: H0 rejected , identification (Tq:)' num2str(temptest)]);
                if counter_iden>0
                    plot(Btemp2(iden_ind_vector(1:counter_iden)),100*e0(iden_ind_vector(1:counter_iden)),'ro','markersize',20);
                end

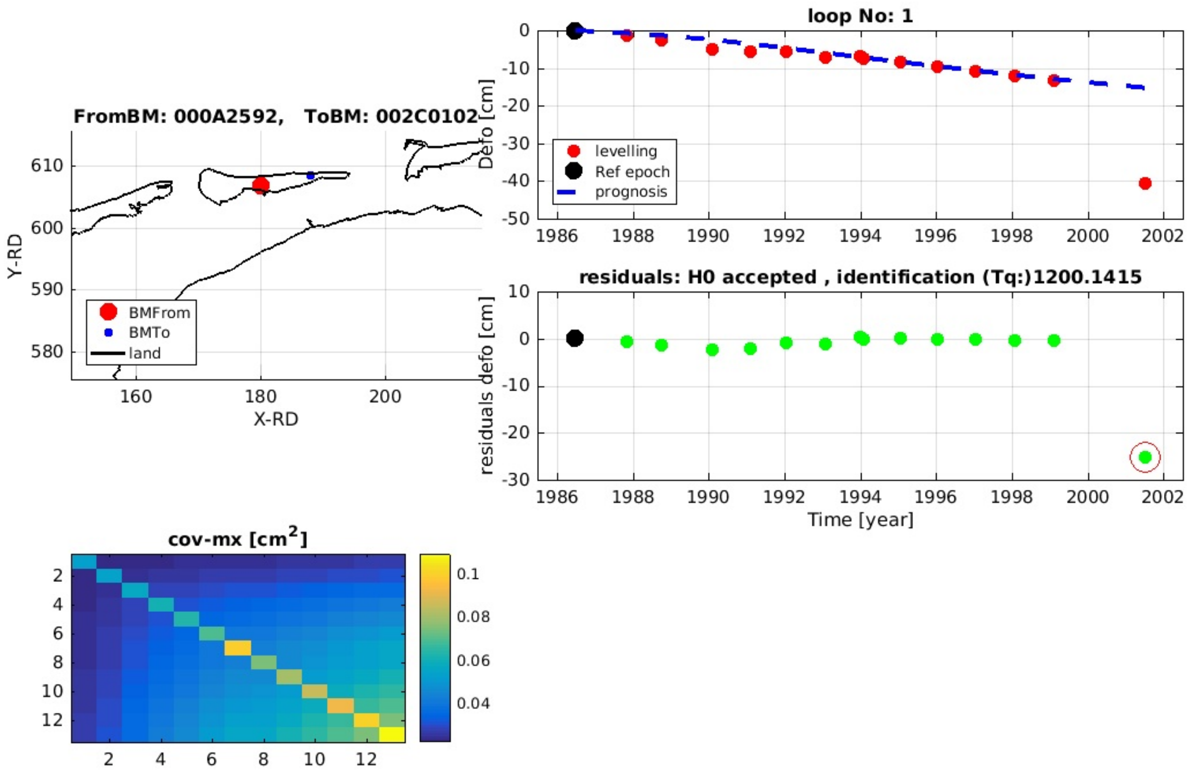
            case 4

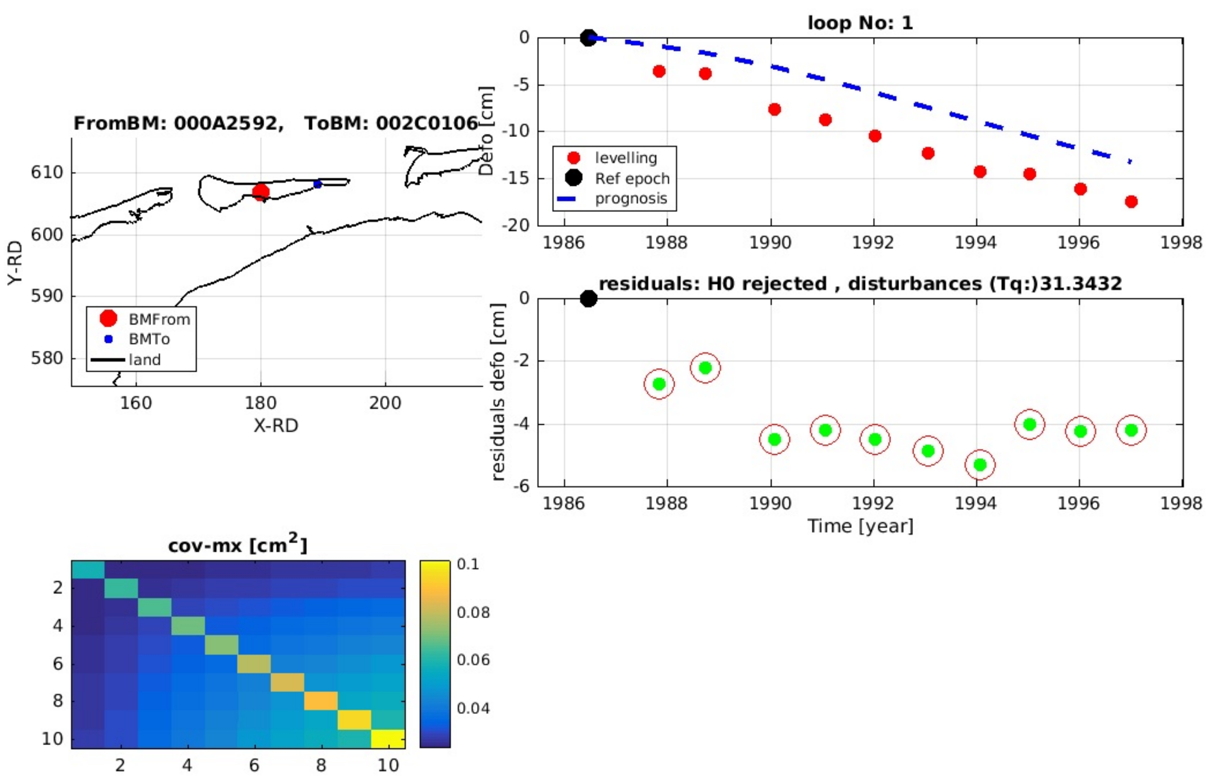
                plot(Btemp2,e0*100,'g.','markersize',30);ylabel('residuals defo [cm]');xlabel('Time [year]');hold on
                plot(Btemp2(error_index(i):end),100*e0(error_index(i):end),'ro','markersize',20);
                plot(refepoch,0,'k.','markersize',40);
                xlim([refepoch-1 max(Btemp2)+1]);
                grid on;
                title(['residuals: H0 rejected , disturbances (Tq:)' num2str(temptest)]);
                if counter_iden>0
                    plot(Btemp2(iden_ind_vector(1:counter_iden)),100*e0(iden_ind_vector(1:counter_iden)),'bo','markersize',30);
                end

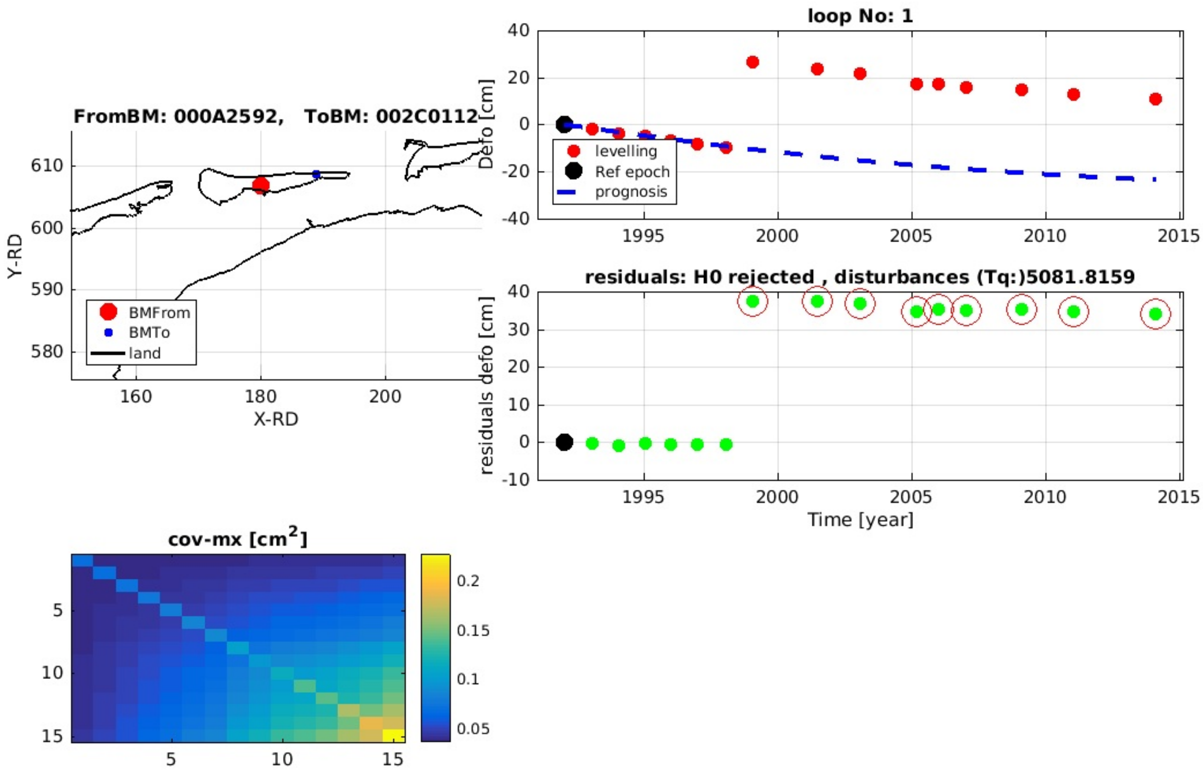
        end
        set(g1, 'Position', [440-440   378-370   2.7*560   1.8*420])
        hold off
    end
```

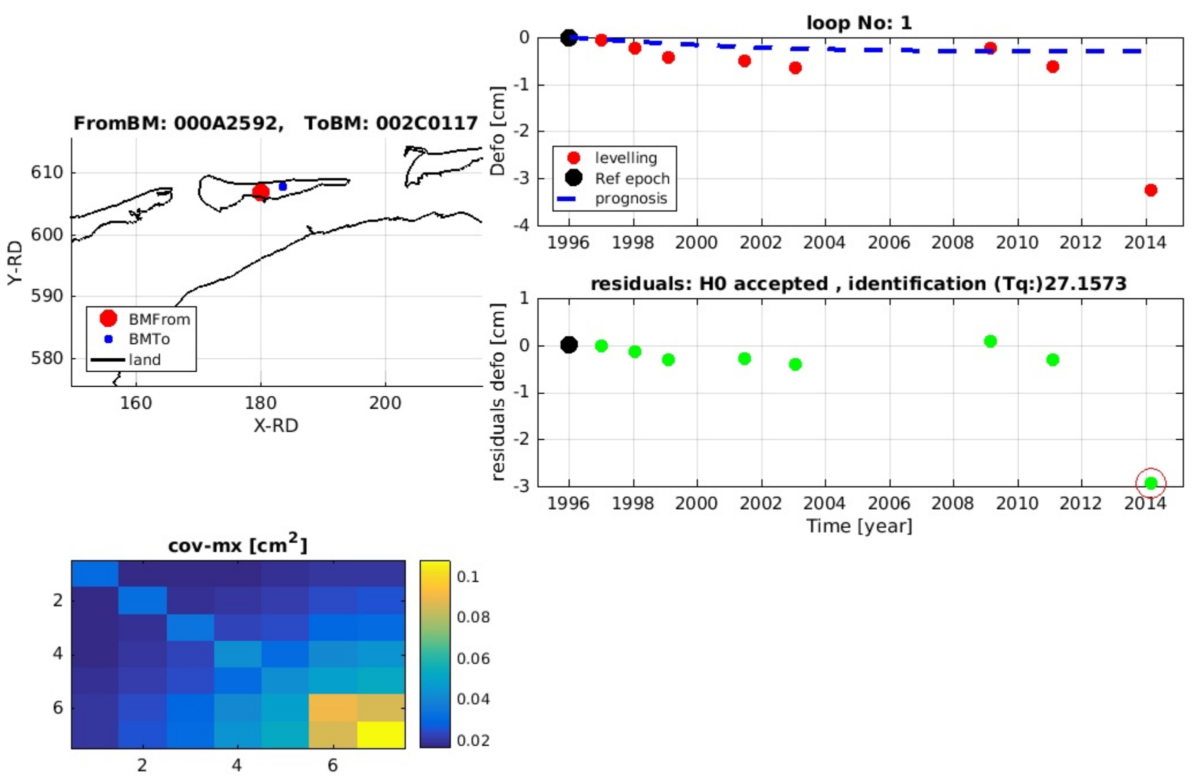

FromBM: 000A2592, ToBM: 001H0082
Y-RD
X-RD
BMFrom
BMTo
land
loop No: 1
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 rejected , abnormal (Tq:)9744.4668
residuals defo [cm]
Time [year]
cov-mx [cm^2]

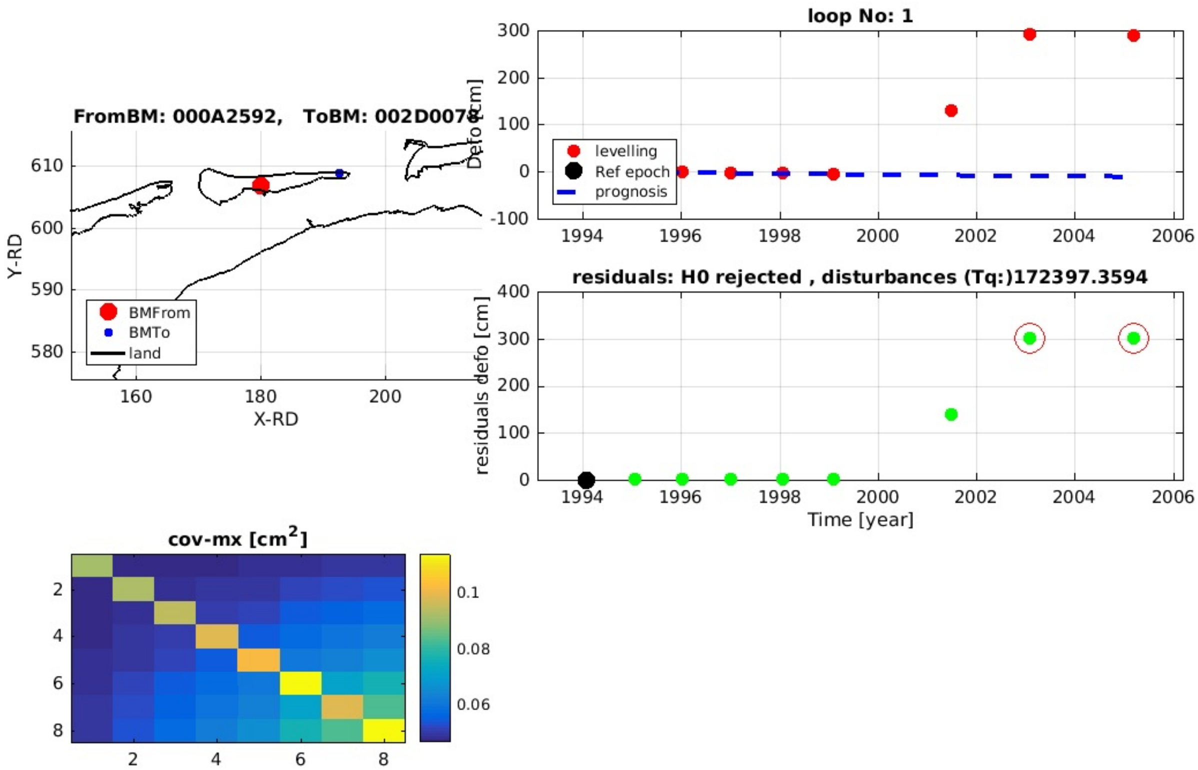

FromBM: 000A2592, ToBM: 002C0065
Y-RD
X-RD
BMFrom
BMTo
land
loop No: 1
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 rejected , disturbances (Tq:)33.1294
residuals defo [cm]
Time [year]
cov-mx [cm^2]

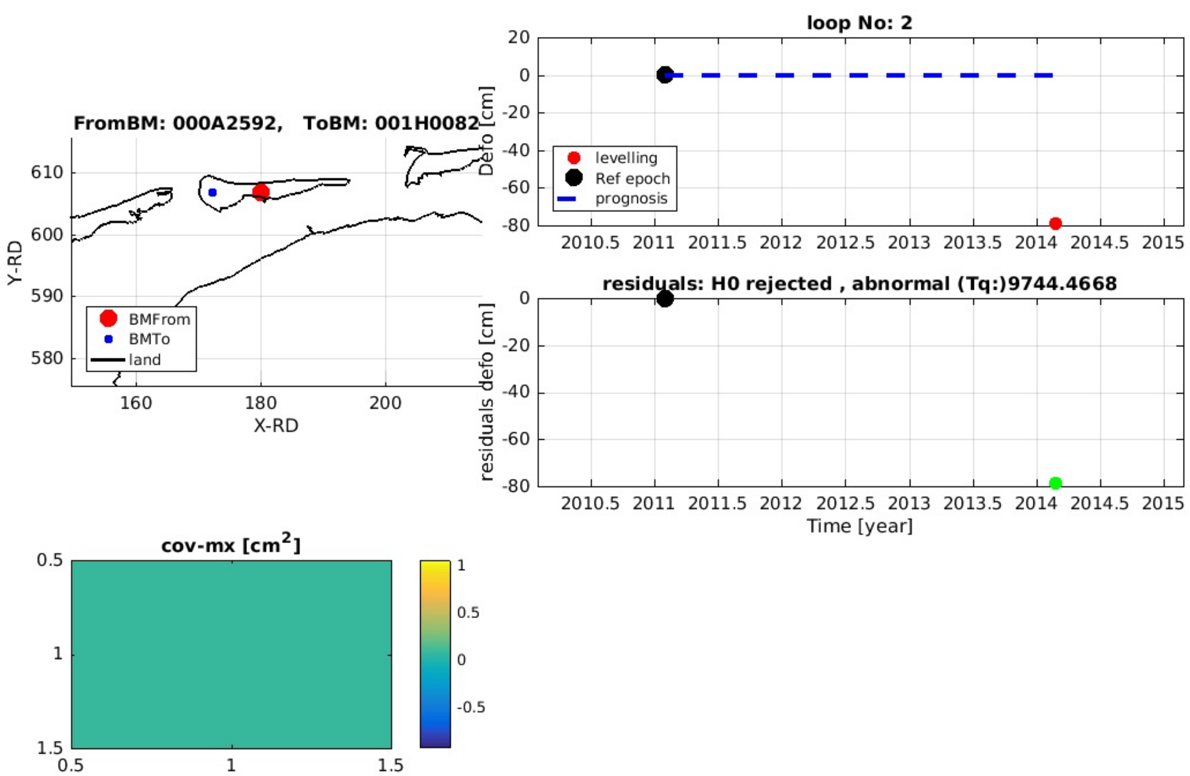

FromBM: 000A2592, ToBM: 002C0102
BMFrom
BMTo
land
Y-RD
X-RD
loop No: 1
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 accepted , identification (Tq:)1200.1415
residuals defo [cm]
Time [year]
cov-mx [cm^2]

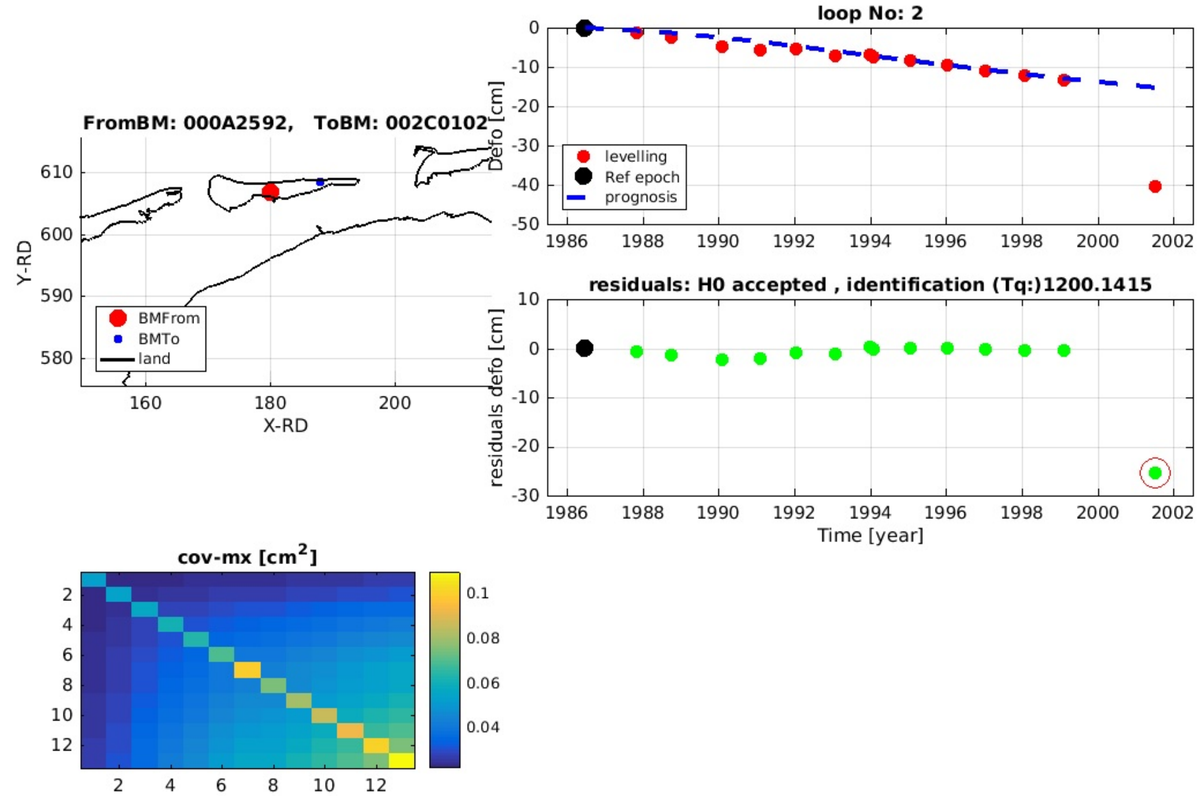

FromBM: 000A2592, ToBM: 002C0106
BMFrom
BMTo
land
Y-RD
X-RD
loop No: 1
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 rejected , disturbances (Tq:)31.3432
residuals defo [cm]
Time [year]
cov-mx [cm^2]

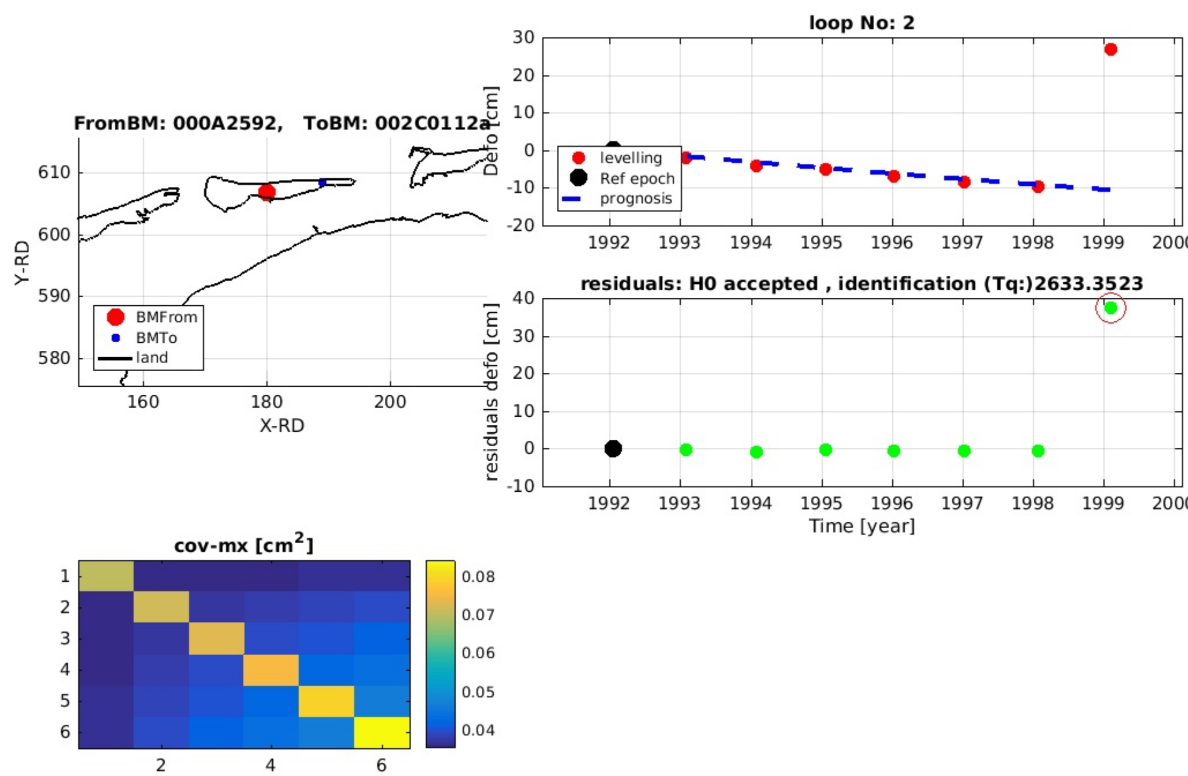

FromBM: 000A2592, ToBM: 002C0112
Y-RD
X-RD
BMFrom
BMTo
land
loop No: 1
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 rejected , disturbances (Tq:)5081.8159
residuals defo [cm]
Time [year]
cov-mx [cm2]

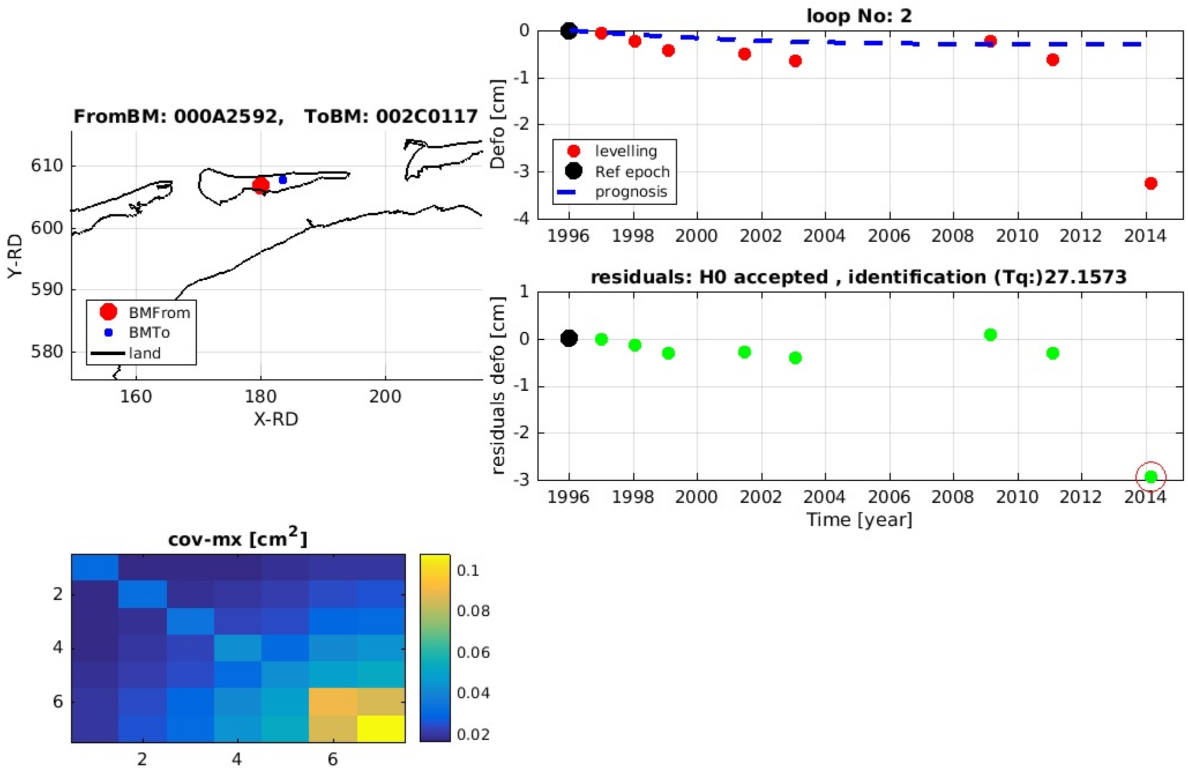

FromBM: 000A2592, ToBM: 002C0117
Y-RD
X-RD
BMFrom
BMTo
land
loop No: 1
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 accepted , identification (Tq:)27.1573
residuals defo [cm]
Time [year]
cov-mx [cm2]


FromBM: 000A2592, ToBM: 002D0078
Y-RD
X-RD
BMFrom
BMTo
land
loop No: 1
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 rejected , disturbances (Tq:)172397.3594
residuals defo [cm]
Time [year]
cov-mx [cm2]

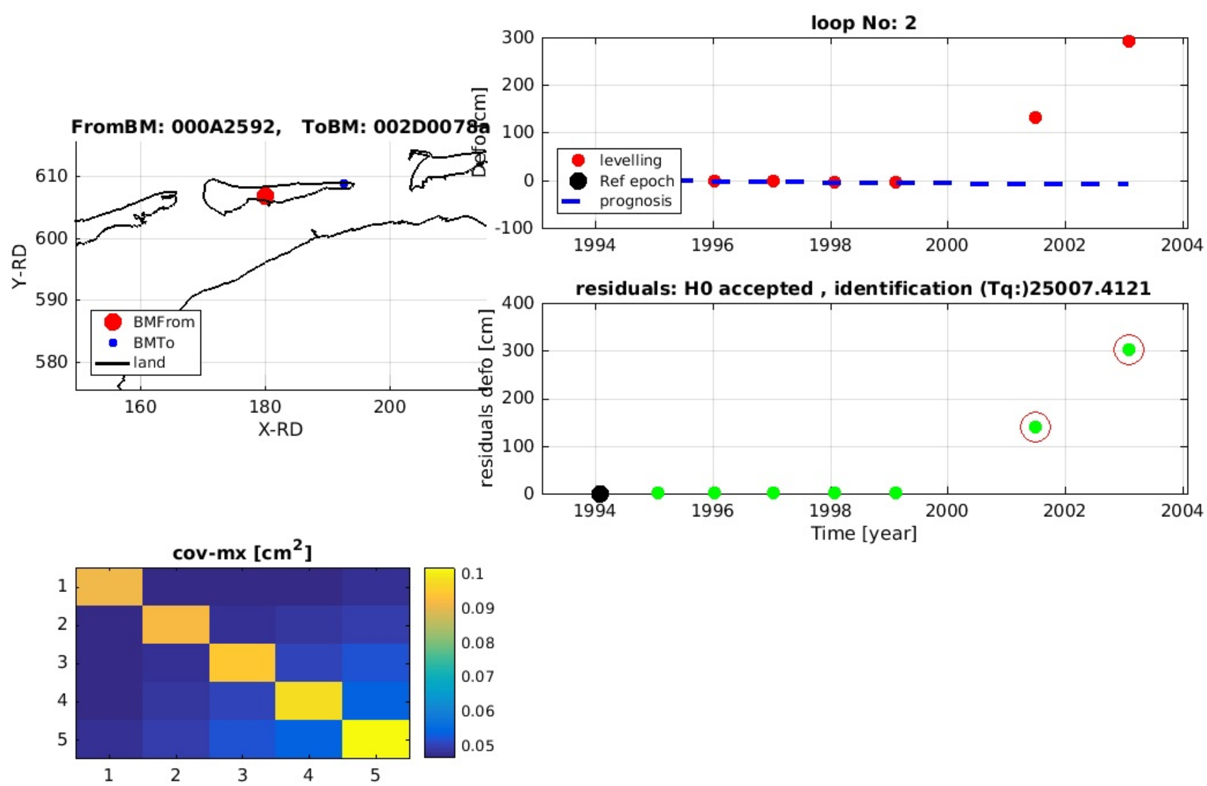

FromBM: 000A2592, ToBM: 001H0082
Y-RD
X-RD
BMFrom
BMTo
land
loop No: 2
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 rejected , abnormal (Tq:)9744.4668
residuals defo [cm]
Time [year]
cov-mx [cm2]


FromBM: 000A2592, ToBM: 002C0102
BMFrom
BMTo
land
Y-RD
X-RD
loop No: 2
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 accepted , identification (Tq:)1200.1415
residuals defo [cm]
Time [year]
cov-mx [cm^2]


FromBM: 000A2592, ToBM: 002C0112a
BMFrom
BMTo
land
Y-RD
X-RD
loop No: 2
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 accepted , identification (Tq:)2633.3523
residuals defo [cm]
Time [year]
cov-mx [cm^2]



FromBM: 000A2592,   ToBM: 002C0117
Y-RD
X-RD
BMFrom
BMTo
land
loop No: 2
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 accepted , identification (Tq:)27.1573
residuals defo [cm]
Time [year]
cov-mx [cm^2]



FromBM: 000A2592,   ToBM: 002D0078a
Y-RD
X-RD
BMFrom
BMTo
land
loop No: 2
Defo [cm]
levelling
Ref epoch
prognosis
residuals: H0 accepted , identification (Tq:)25007.4121
residuals defo [cm]
Time [year]
cov-mx [cm^2]


```
        end
```

```
      end
```

```
    end
```

```
end
```

Create overview flagged observations

```
(Please note that the total number of flagged observations listed here can
be larger than the number of identification errors given above. This is
because in case of a disturbance, the first observation after the disturbance
is flagged as identification error. However, because of the split of the time
series based on the new benchmark names, the remaining time series may be too
short to do a new test in the next loop. Therefore, these identification
are flagged in the database, but not detected anymore here (which is not a
problem).
```

```
total_num_disturbance_errors=global_disturbance_counter;
total_num_identification_errors=length(find(lev2.Observations.sdObs_flag==3))-total_num_disturbance_errors;
total_num_abnormal_errors=length(find(lev2.Observations.sdObs_flag==2));

fprintf('Overview of the total number of detected outliers \n');
fprintf('----------------------------------------------------------- \n');
fprintf('Total number of detected identification errors: %d\n',total_num_identification_errors);
fprintf('Total number of detected disturbances: %d\n',total_num_disturbance_errors);
fprintf('Total number of detected abnormal behavior: %d\n',total_num_abnormal_errors);
fprintf('\n');

flag_idx = find(lev2.Observations.sdObs_flag>0);
Nflag = length(flag_idx);
temp1 = lev2.PointData.station_name(lev2.Observations.from_index(flag_idx),:);
temp2 = lev2.PointData.station_name(lev2.Observations.to_index(flag_idx),:);
temp3 = lev2.ProjectData.project_name(lev2.Observations.project_index(flag_idx),:);
temp4 = datestr(lev2.ProjectData.project_epoch(lev2.Observations.project_index(flag_idx),:),'yyyymmdd');
temp5 = lev2.Observations.sdObs_flag(flag_idx);

fprintf('Flagged observations:\n');
fprintf('from_index  to_index  project_name  project_epoch  flag\n');
fprintf('----------------------------------------------------------- \n');
%fprintf('\n');
for k=1:Nflag
    fprintf('%s  %s  %s  %s  %d\n',temp1(k,:),temp2(k,:),temp3(k,:),temp4(k,:),temp5(k));
end
```

```
Overview of the total number of detected outliers
-----------------------------------------------------------
Total number of detected identification errors: 3
Total number of detected disturbances: 4
Total number of detected abnormal behavior: 2

Flagged observations:



from_index  to_index  project_name  project_epoch  flag
-----------------------------------------------------------
000A2592   002C0102   373W31      20010704  3
000A2592   002D0078a  373W31      20010704  3
000A2592   001H0082   NAM_AM2011  20110201  2
000A2592   001H0082   NAM_AM2014  20140225  2
000A2592   002C0117   NAM_AM2014  20140225  3
000A2592   002C0065a  279W22      19920516  3
000A2592   002C0106a  289W05      19871103  3
000A2592   002C0112a  aml1999     19990210  3
000A2592   002D0078a  aml2003     20030202  3
```

Update the global attributes of the new Netcdf file

```
finfo = ncinfo(netcdf_file);
attributes = {finfo.Attributes.Name}';

attr_idx = [];
for k = 1:size(globalattributes_new,1)
    str_idx = find(strcmpi(globalattributes_new(k,1),attributes));
    if isempty(str_idx)
        attr_idx = [attr_idx;k];
    elseif length(str_idx)==1
        finfo.Attributes(str_idx).Value = char(globalattributes_new(k,2));
    else
        error('Something went wrong while updating the global attributes of the Netcdf file.');
    end
end
globalattributes=[[{finfo.Attributes.Name}'; globalattributes_new(attr_idx,1)] ...
    [{finfo.Attributes.Value}'; globalattributes_new(attr_idx,2)]];
```

Write the results to the new Netcdf file

```
writelts2netcdf(netcdf_file_new,globalattributes, ...
    lev2.PointData.station_name, ...
    [lev2.PointData.x lev2.PointData.y], ...
    lev2.PointData.station_class, ...
    lev2.ProjectData.project_name,...
    lev2.ProjectData.project_epoch,...
    lev2.ProjectData.project_class, ...
    [lev2.Observations.from_index lev2.Observations.to_index lev2.Observations.project_index], ...
    lev2.SDObs, ...
    lev2.SDCov, ...
    lev2.Observations.sdObs_flag, ...
    lev2.Observations.sensitivity, ...
    lev2.Observations.epoch);
```

```
Create NAM LTS2 netcdf schema ...
Netcdf file lts2_alllevelling_flaggedOutliers.nc already exists, will be deleted first to recreate it.
Write NAM LTS2 netcdf schema to file...
```

```
Write data to NAM LTS2 netcdf...
Done.
```

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Appendix H. lts2_plot_levelling_campaigns processing output

Contents lts2_plot_levelling_campaigns.m

- Plot levelling campaigns for validation purposes
- Input section (specify your project here)
- Load polygons from outline directory
- Read the netcdf data file
- Visualization

Plot levelling campaigns for validation purposes

*Freek van Leijen, Delft University of Technology, 21 October 2016 *

This script uses functions from the `lts2` toolbox.

```
% (c) Freek van Leijen, Delft University of Technology, 2016.

% Created:    21 October 2016 by Freek van Leijen
% Modified:
%

clear all
close all

fullscreen=get(0,'Screensize');

% Set path to required toolboxes
lts2toolboxdir = fullfile('../..','lts2toolbox');
addpath(fullfile(lts2toolboxdir,'lts2'));
```

Input section (specify your project here)

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Specify the directory with outlines
outlinedir = fullfile(lts2toolboxdir,'lts2','lts2outlines');

% Specify netcdf filenames
netcdf_file = '../lts2_outlier_detection/lts2_alllevelling_flaggedOutliers.nc';

% Specify the bounding box for plotting (optional, plotting purposes only)
xminplot = 150000;
xmaxplot = 215000;
yminplot = 570000;
ymaxplot = 620000;

poly1_x = 1e5*[...
   1.900000000000000;...
   1.900000000000000;...
   1.975027412280702;...
   2.013514254385965;...
   2.045586622807018;...
   2.077658991228070;...
   2.074808114035088;...
   2.046299342105263;...
   2.032044956140351;...
   2.000000000000000;...
   1.900000000000000];

poly1_y = 1e5*[...
   6.200000000000000;...
   6.005592105263158;...
   6.026260964912280;...
   6.030537280701754;...
   6.026260964912280;...
   6.038377192982455;...
   6.083278508771929;...
   6.077576754385965;...
   6.069024122807019;...
   6.200000000000000;...
   6.200000000000000]

poly2_x = 1e5*[...
   1.900000000000000;...
   1.876672149122807;...
   1.846737938596491;...
   1.823930921052632;...
   1.815000000000000;...
   1.811101973684210;...
   1.794709429824561;...
   1.776178728070175;...
   1.746244517543860;...
   1.688514254385965;...
   1.637198464912281;...
   1.597998903508772;...
   1.500000000000000;...
   1.500000000000000;...
   1.569490131578947;...
   1.582319078947368;...
   1.632209429824561;...
   1.666419956140351;...
   1.723437500000000;...
   1.789007675438596;...
   1.868119517543860;...
   1.900000000000000;...
   1.900000000000000];

poly2_y = 1e5*[...
   6.078289473684211;...
   6.070449561403509;...
   6.061184210526315;...
   6.057620614035089;...
   6.057620614035089;...
   6.061896929824561;...
   6.059758771929824;...
   6.054769736842105;...
   6.034813596491229;...
   6.054057017543860;...
   6.039802631578947;...
   6.011293859649124;...
   5.983497807017544;...
   5.750000000000000;...
   5.750000000000000;...
   5.816721491228070;...
   5.858771929824561;...
   5.885855263157895;...
   5.927192982456140;...
   5.961403508771930;...
   5.998464912280701;...
   6.007730263157895;...
   6.078289473684211];


% End input section (You should not have to change anything below this line.)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
poly1_y =
   1.0e+05 *
    6.2000
    6.0056
    6.0263
    6.0305
    6.0263
    6.0384
    6.0833
    6.0776
    6.0690
```

```
    6.2000
    6.2000
```

Load polygons from outline directory

```
d=dir(fullfile(outlinedir,'*.coo'));
shoreline=[];
for k=1:numel(d)
    formatSpec = '%6f%f%[^\n\r]';
    filename=fullfile(outlinedir,d(k).name);
    fid=fopen(filename,'r');
    dataArray = textscan(fid, formatSpec, 'Delimiter', '', 'WhiteSpace', '',  'ReturnOnError', false);
    fclose(fid);
    shoreline=[ shoreline ; dataArray{:, 1} dataArray{:, 2} ; NaN NaN];
end
clear d
```

Read the netcdf data file

```
lev = readlts2netcdf2struct(netcdf_file);
```

Visualization

```
Nepoch = size(lev.ProjectData.project_name,1);

for w = 1:Nepoch

  epoch_idx = find(lev.Observations.project_index==w);
  flag_idx = find(lev.Observations.sdObs_flag(epoch_idx)>0);

  hh = NaN(2,1);
  figure(w);hold on
  set(gcf,'position',fullscreen);
  plot(0.001*shoreline(:,1),0.001*shoreline(:,2),'k')
  scatter(0.001*lev.PointData.x(lev.Observations.to_index(epoch_idx)),...
          0.001*lev.PointData.y(lev.Observations.to_index(epoch_idx)),...
          10,...
          lev.SDObs(lev.Observations.to_index(epoch_idx)),'filled');
  k = colorbar;
  set(get(k,'title'),'string','m','fontweight','normal','fontsize',12);

  h = plot(0.001*lev.PointData.x(unique(lev.Observations.from_index(epoch_idx))),...
           0.001*lev.PointData.y(unique(lev.Observations.from_index(epoch_idx))),...
           'k^','markersize',5,'linewidth',2);
  hh(1) = h(1);

  if ~isempty(flag_idx)
    h = plot(0.001*lev.PointData.x(lev.Observations.to_index(epoch_idx(flag_idx))),...
             0.001*lev.PointData.y(lev.Observations.to_index(epoch_idx(flag_idx))),...
             'ro','markersize',8,'linewidth',2);
    hh(2) = h(1);
  end

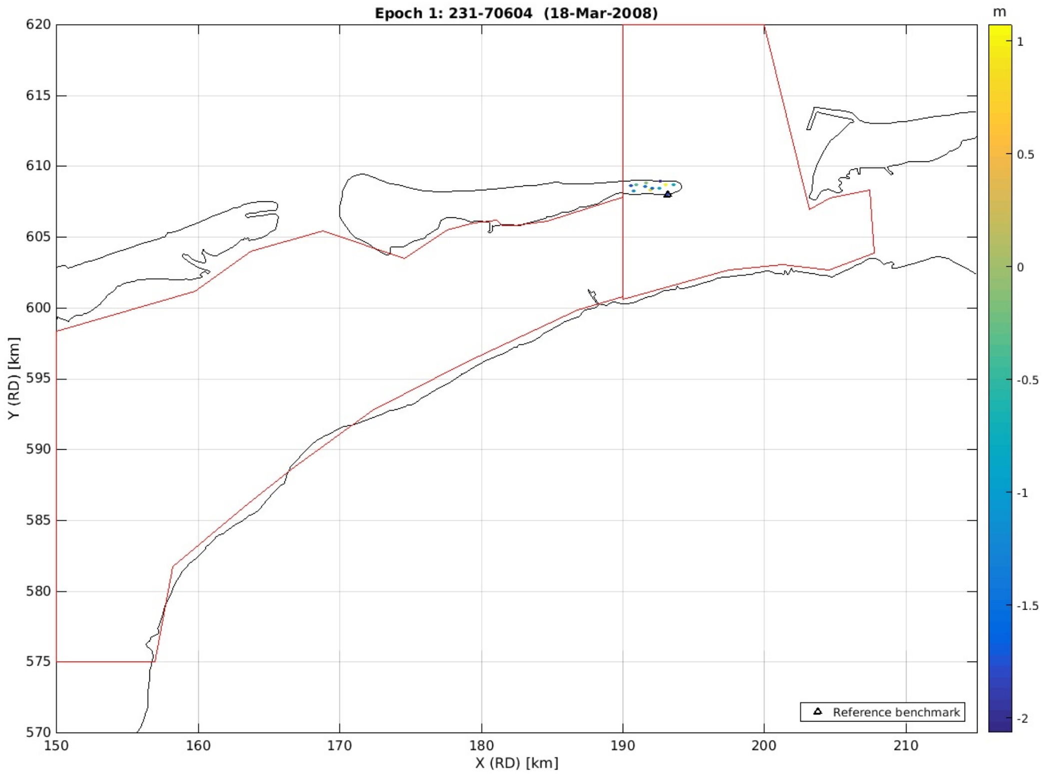
  plot(0.001*poly1_x,0.001*poly1_y,'r');
  plot(0.001*poly2_x,0.001*poly2_y,'r');

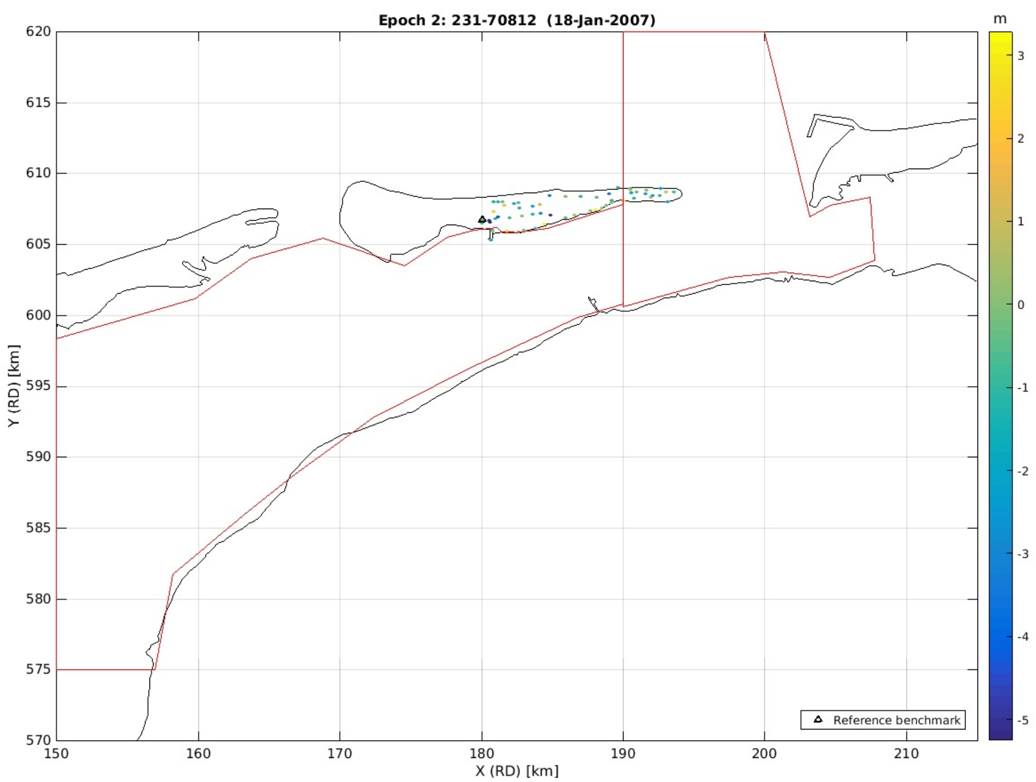
  title(['Epoch ' num2str(w) ': ' lev.ProjectData.project_name(w,:) ' (' ...
         datestr(lev.ProjectData.project_epoch(w),'dd-mmm-yyyy') ')']);
  xlabel('X (RD) [km]');
  ylabel('Y (RD) [km]');
  axis equal;
  if exist('xminplot','var')
    if ~isempty(xminplot)
      set(gca,'xlim',0.001*[xminplot xmaxplot],'ylim',0.001*[yminplot ymaxplot]);
    end
  end

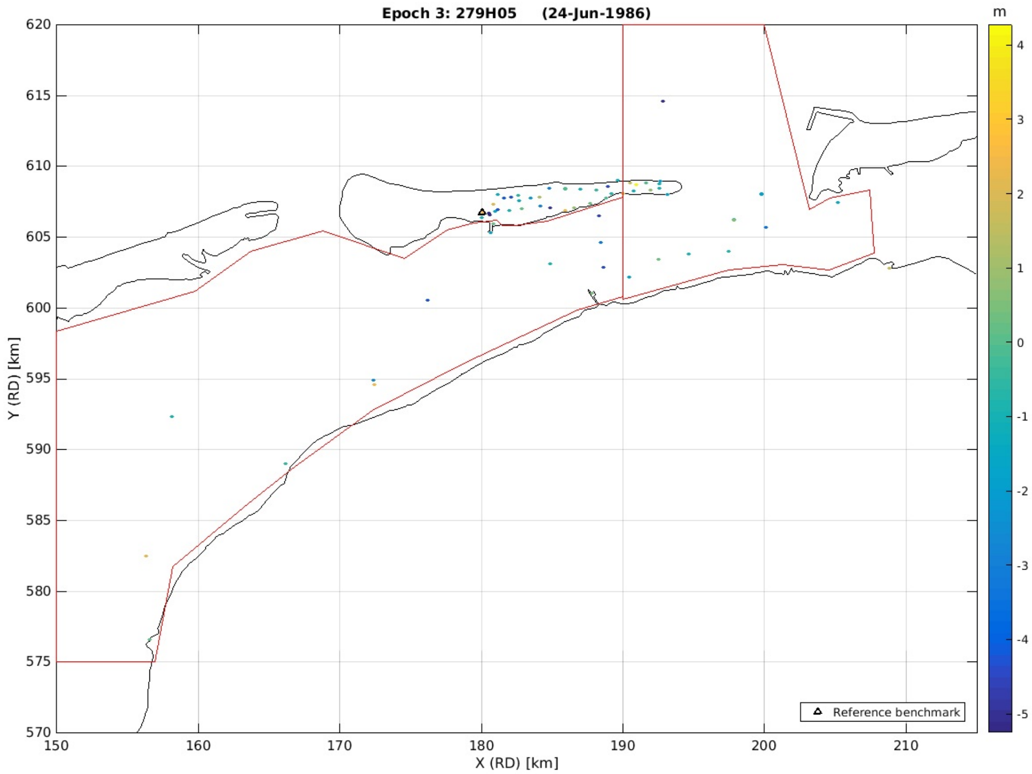
  legend_strings = {'Reference benchmark','Flagged outlier'};
  nanidx = find(~isnan(hh));
  legend(hh(nanidx),legend_strings(nanidx),'Location','SouthEast');

  box on;
  grid on;
  hold off;

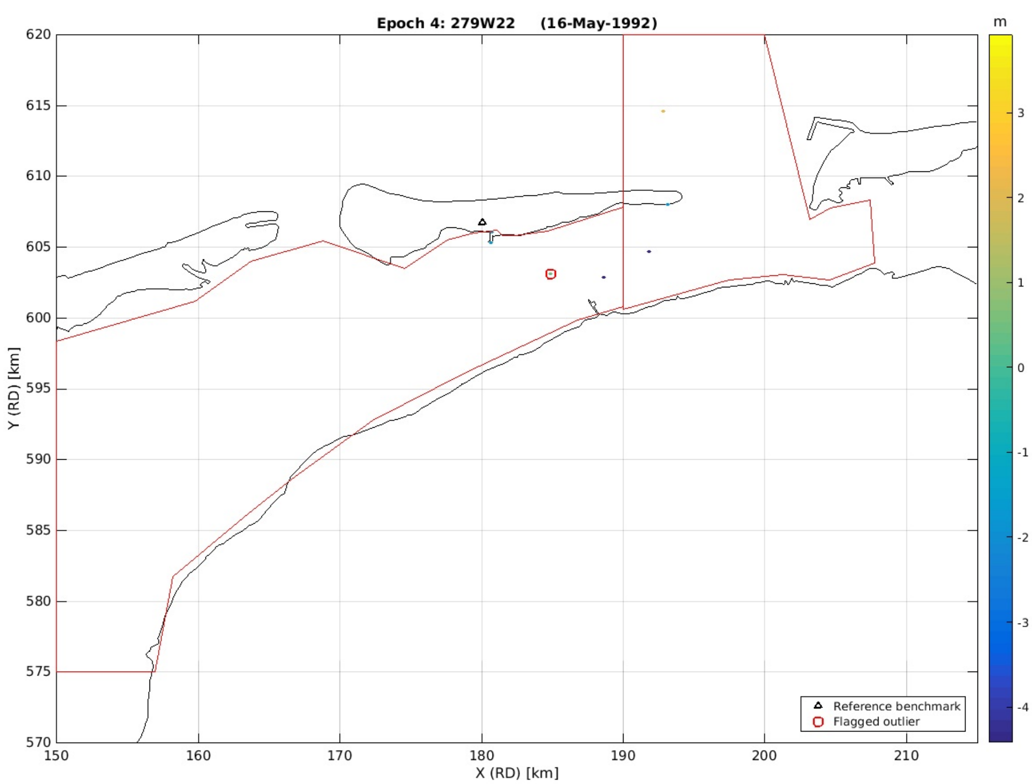
end
```


Epoch 1: 231-70604 (18-Mar-2008)
Y (RD) [km]
X (RD) [km]
m
Reference benchmark

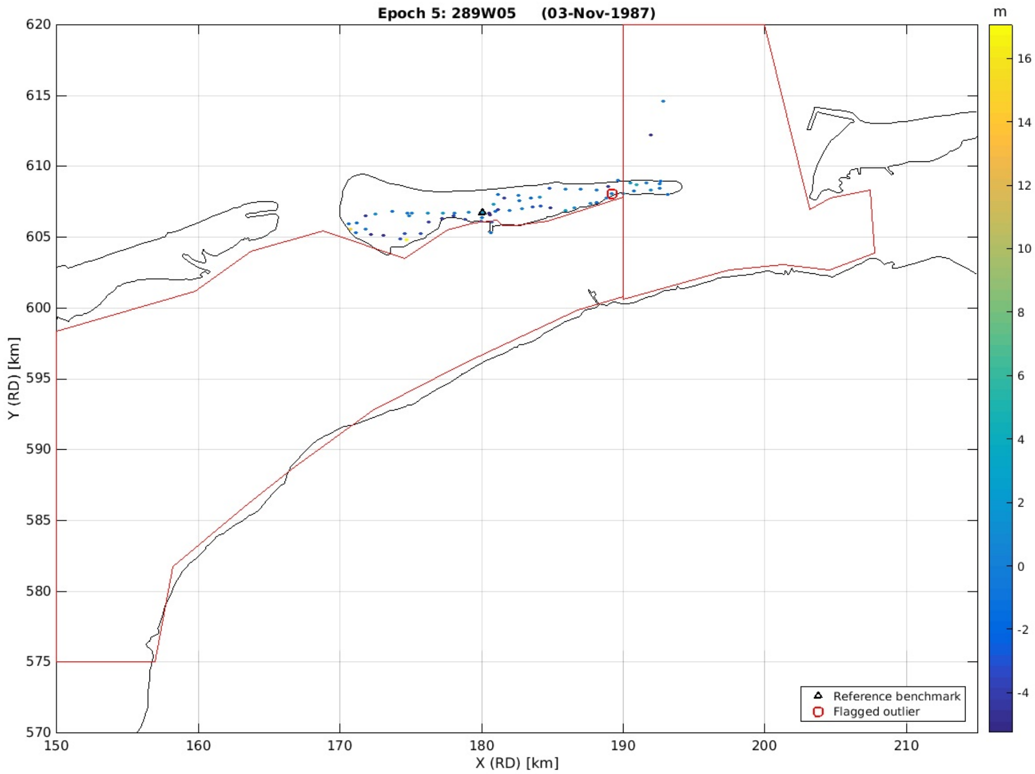

Epoch 2: 231-70812 (18-Jan-2007)
Y (RD) [km]
X (RD) [km]
m
Reference benchmark

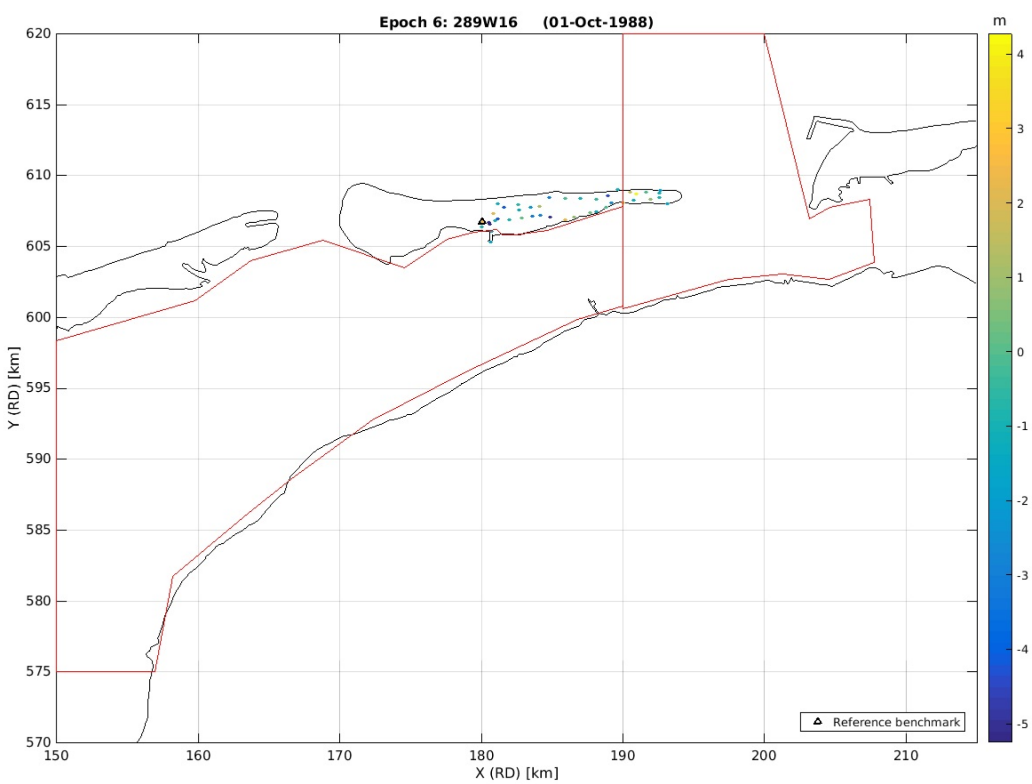


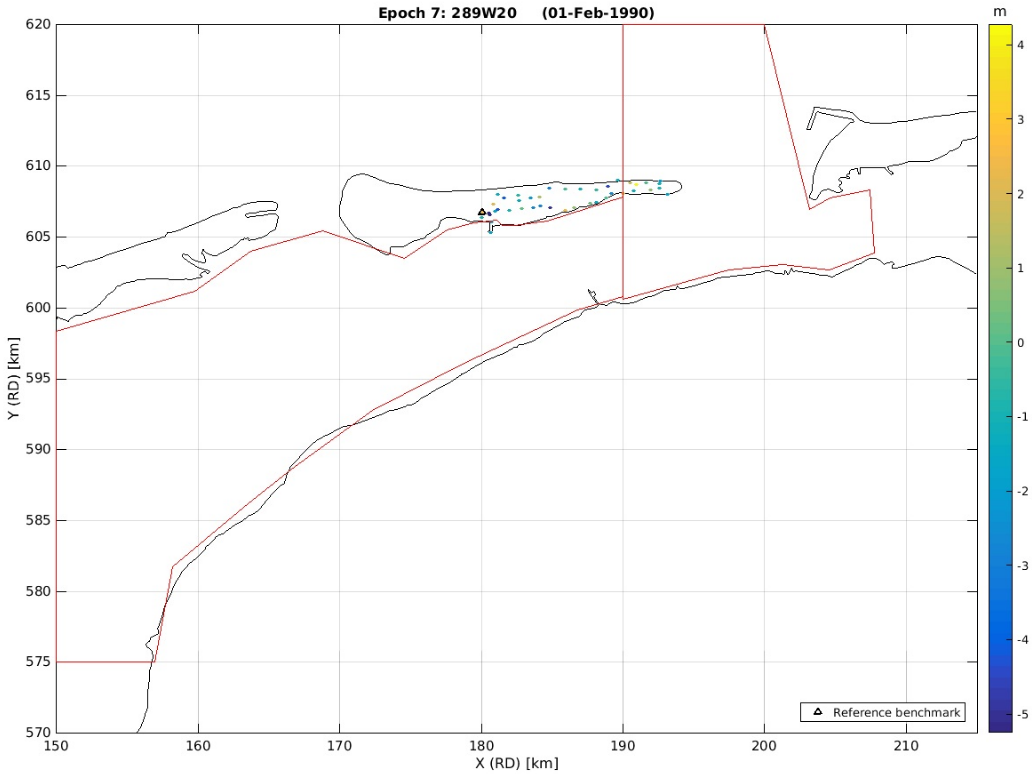
Epoch 3: 279H05 (24-Jun-1986)
m
Y (RD) [km]
X (RD) [km]
Reference benchmark



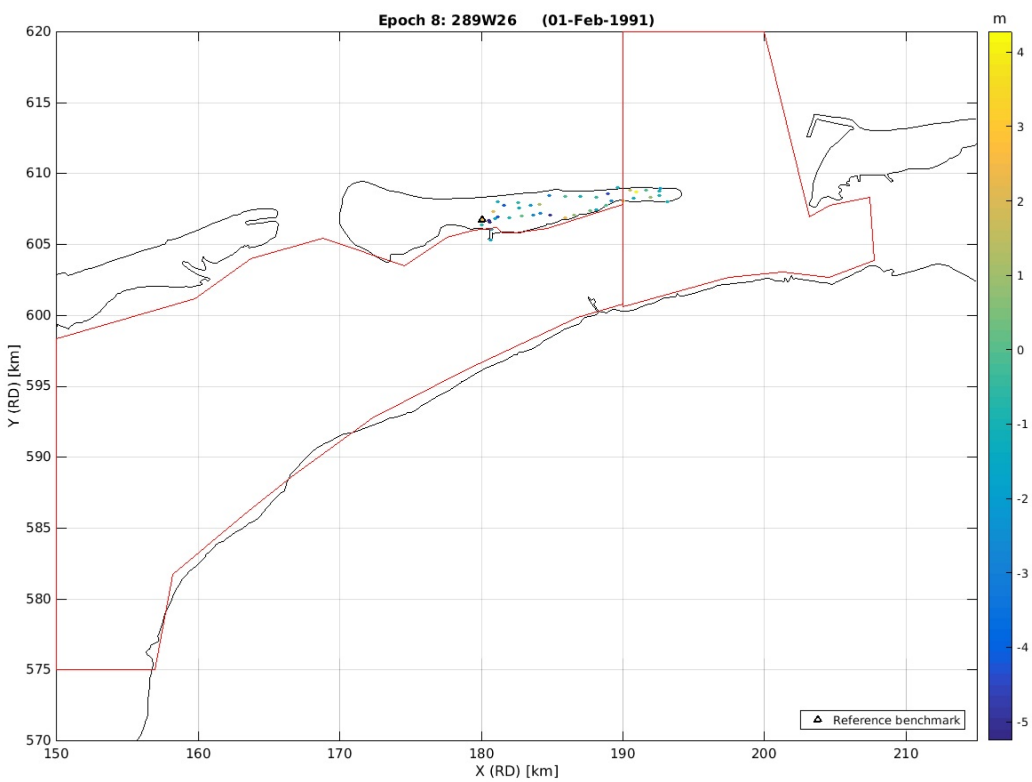
Epoch 4: 279W22 (16-May-1992)
m
Y (RD) [km]
X (RD) [km]
Reference benchmark
Flagged outlier


Epoch 5: 289W05 (03-Nov-1987)
Y (RD) [km]
X (RD) [km]
m
Reference benchmark
Flagged outlier

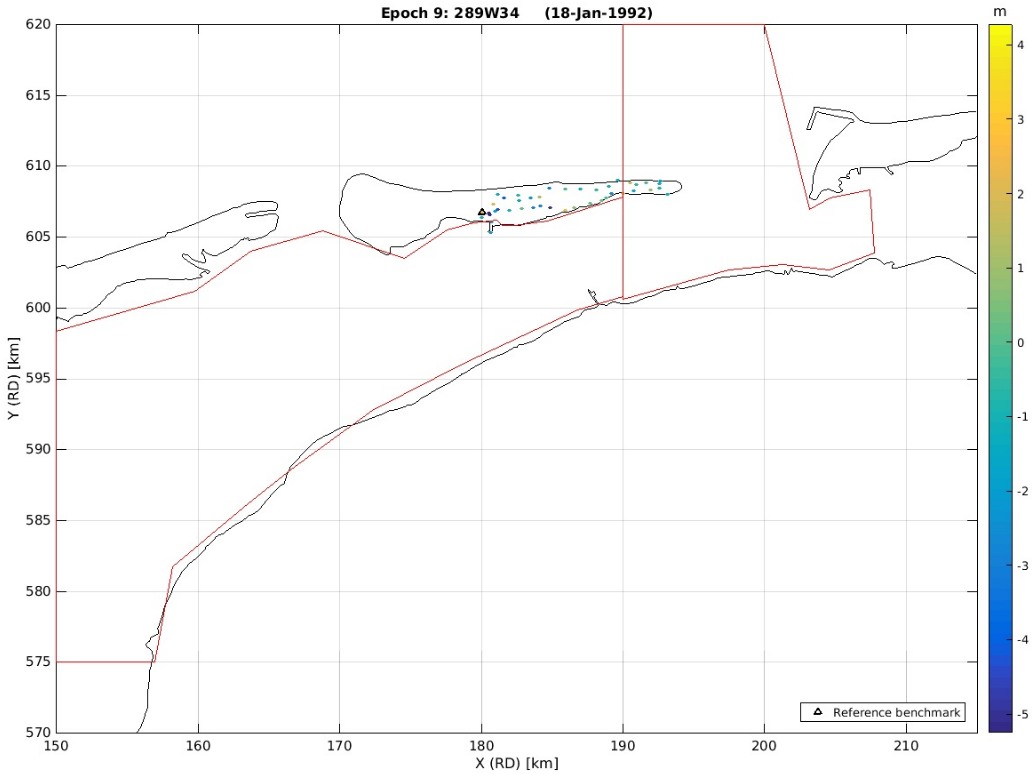

Epoch 6: 289W16 (01-Oct-1988)
Y (RD) [km]
X (RD) [km]
m
Reference benchmark



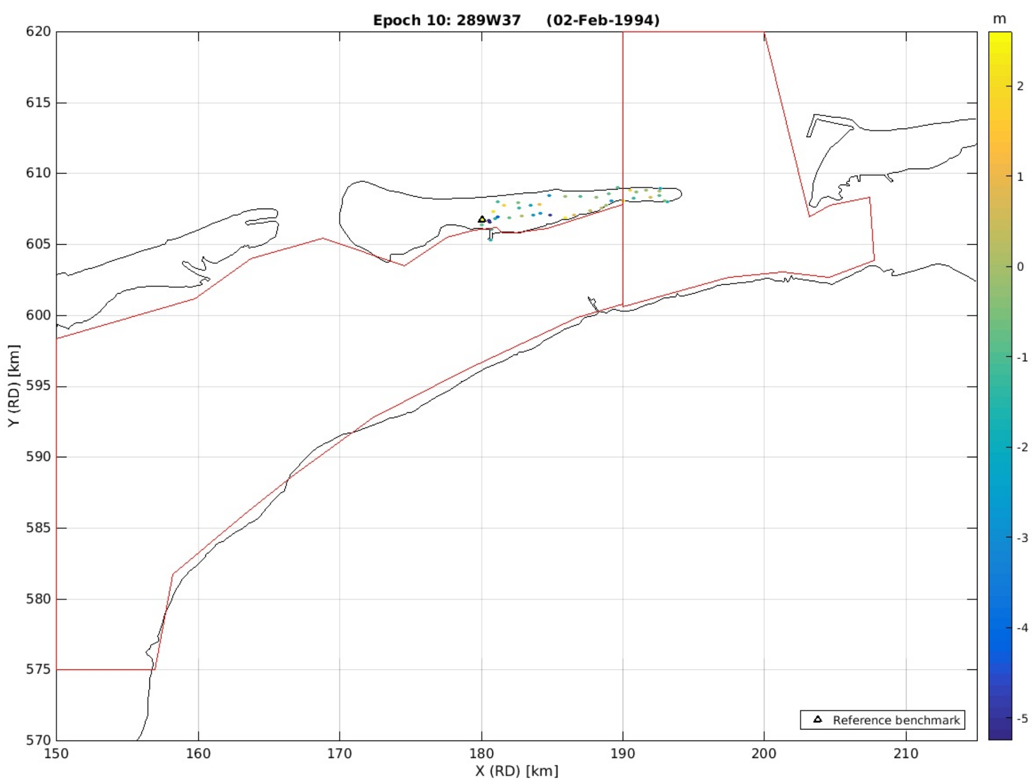
Epoch 7: 289W20 (01-Feb-1990)
m
Y (RD) [km]
X (RD) [km]
Reference benchmark



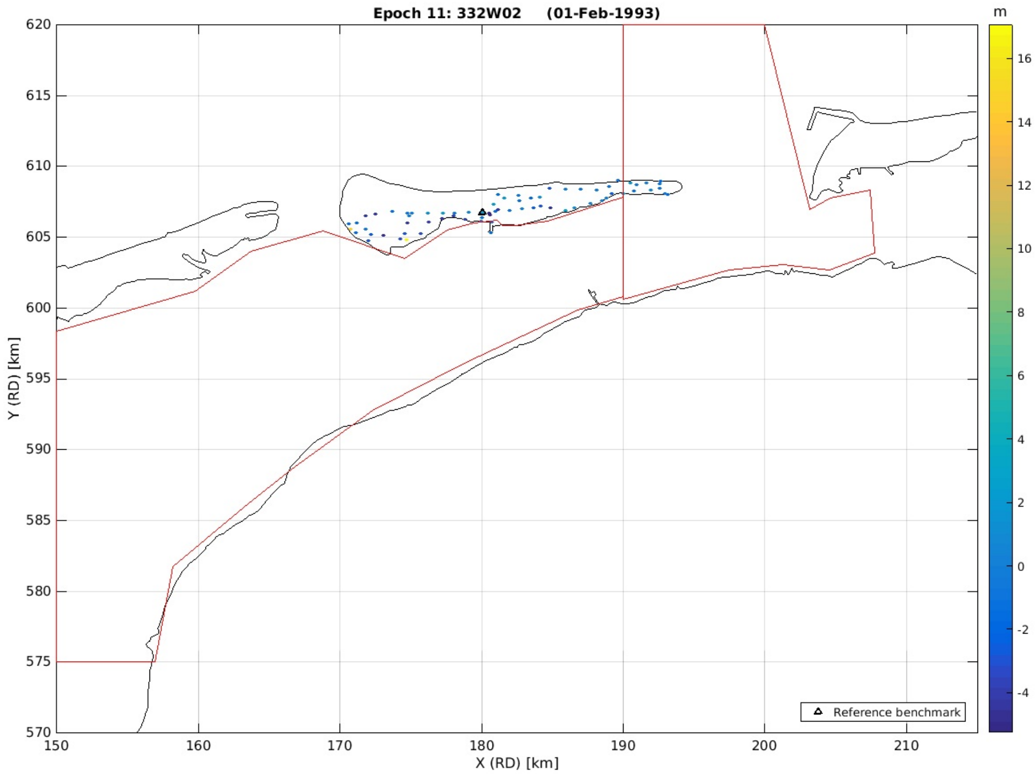
Epoch 8: 289W26 (01-Feb-1991)
m
Y (RD) [km]
X (RD) [km]
Reference benchmark

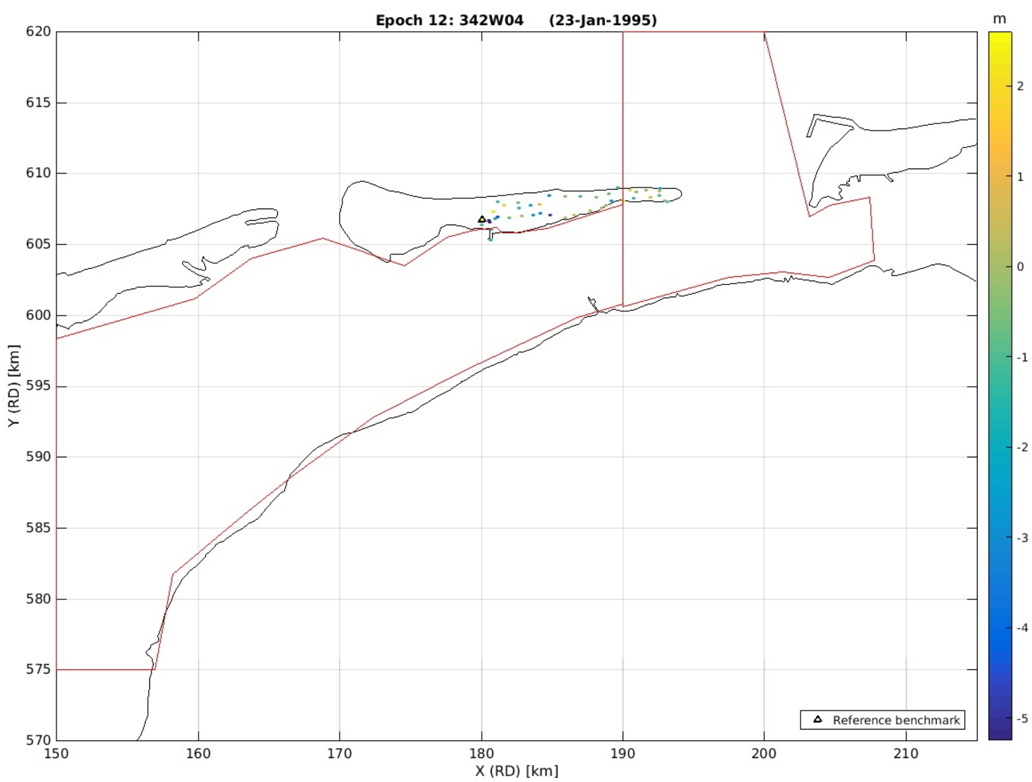


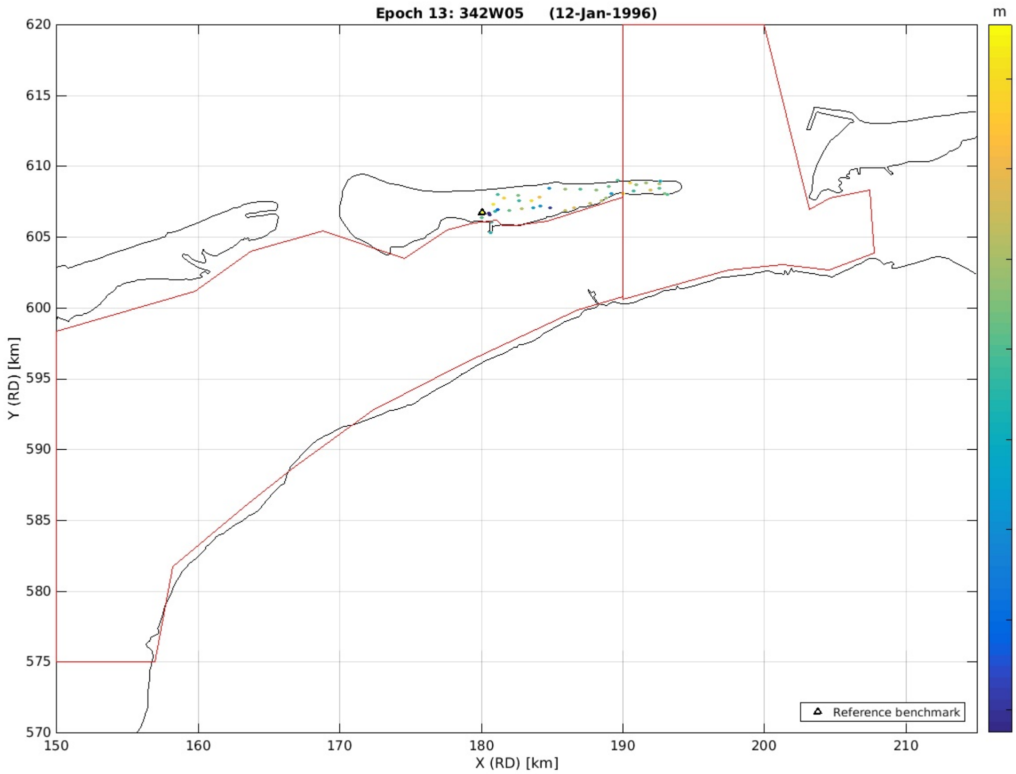
Epoch 9: 289W34 (18-Jan-1992)
m
Y (RD) [km]
X (RD) [km]
Reference benchmark



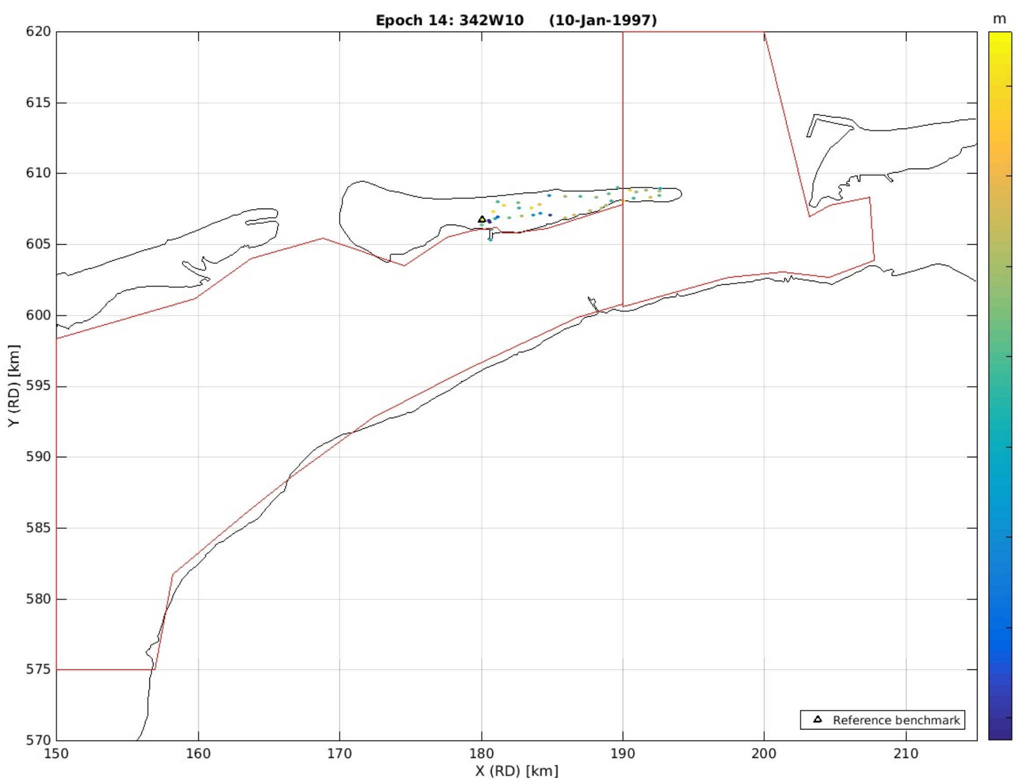
Epoch 10: 289W37 (02-Feb-1994)
m
Y (RD) [km]
X (RD) [km]
Reference benchmark


Epoch 11: 332W02 (01-Feb-1993)
m
Reference benchmark
X (RD) [km]
Y (RD) [km]
150
160
170
180
190
200
210
570
575
580
585
590
595
600
605
610
615
620
16
14
12
10
8
6
4
2
0
-2
-4

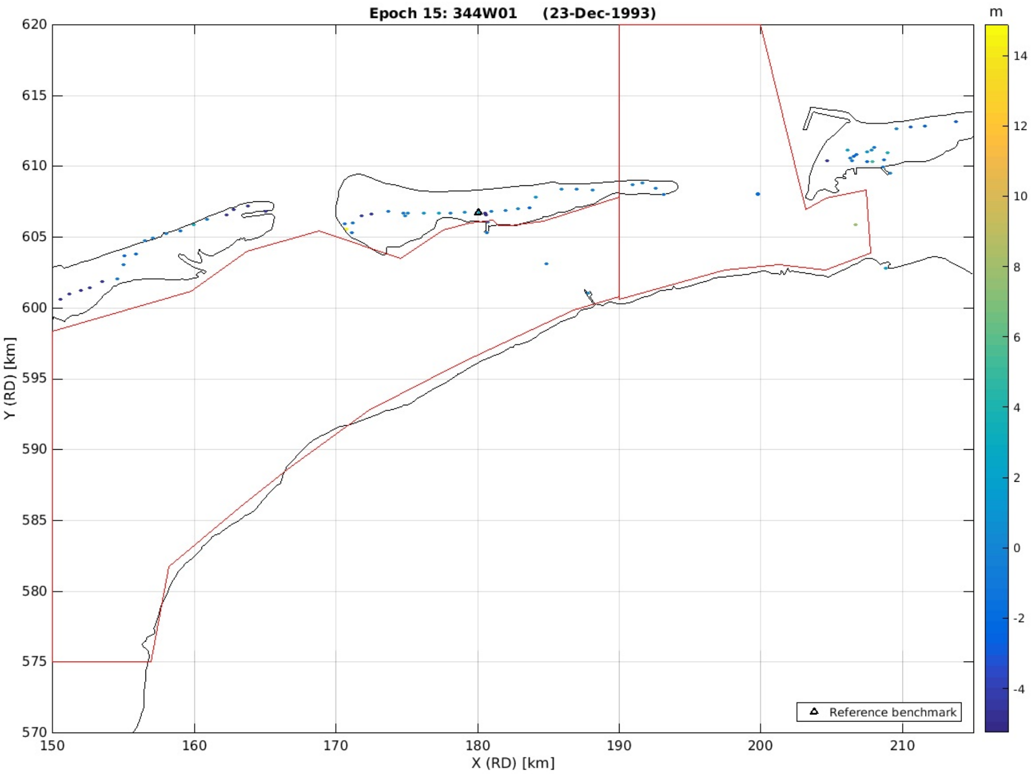

Epoch 12: 342W04 (23-Jan-1995)
m
Reference benchmark
X (RD) [km]
Y (RD) [km]
150
160
170
180
190
200
210
570
575
580
585
590
595
600
605
610
615
620
2
1
0
-1
-2
-3
-4
-5



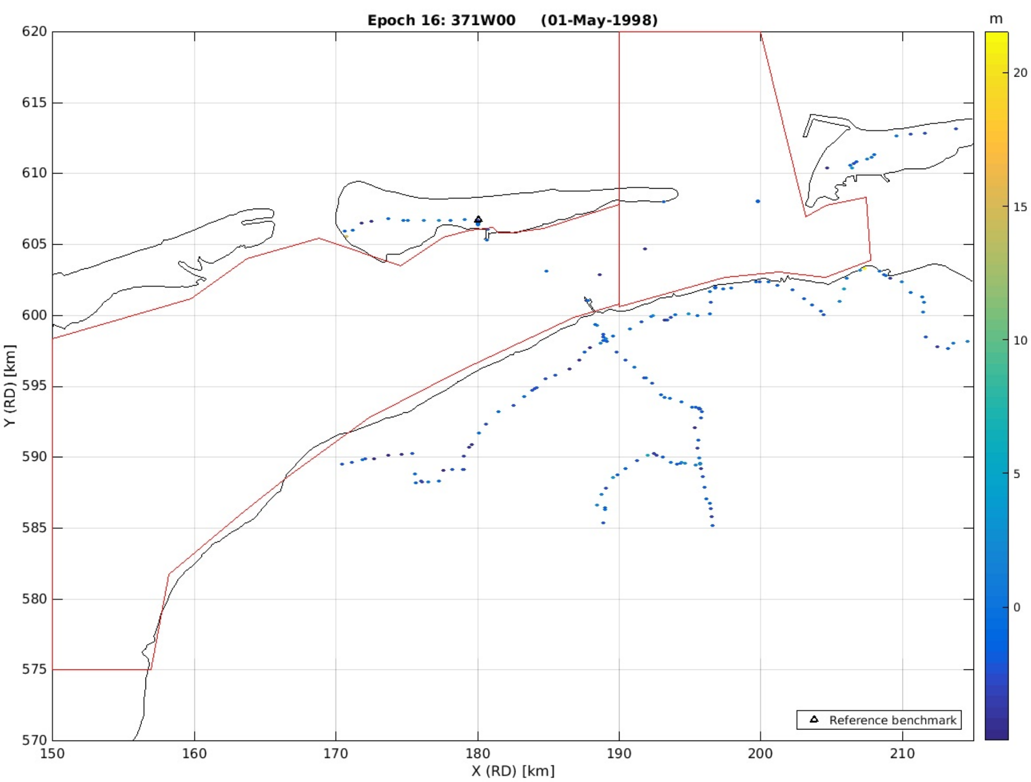
Epoch 13: 342W05 (12-Jan-1996)
Y (RD) [km]
X (RD) [km]
m
Reference benchmark



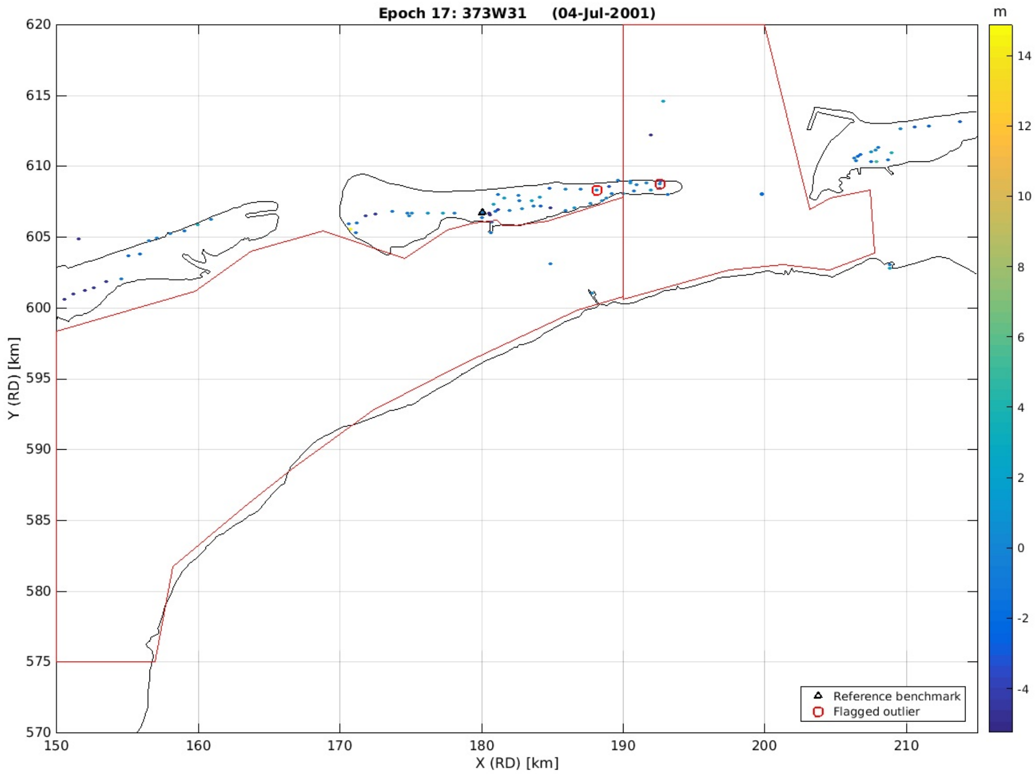
Epoch 14: 342W10 (10-Jan-1997)
Y (RD) [km]
X (RD) [km]
m
Reference benchmark

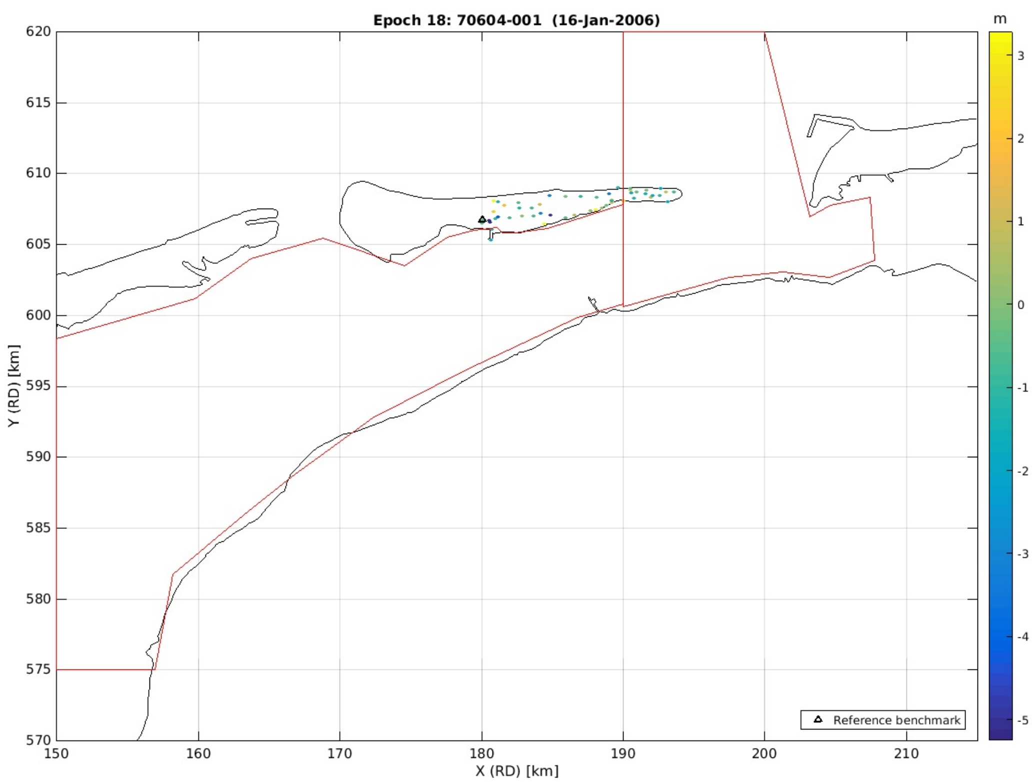


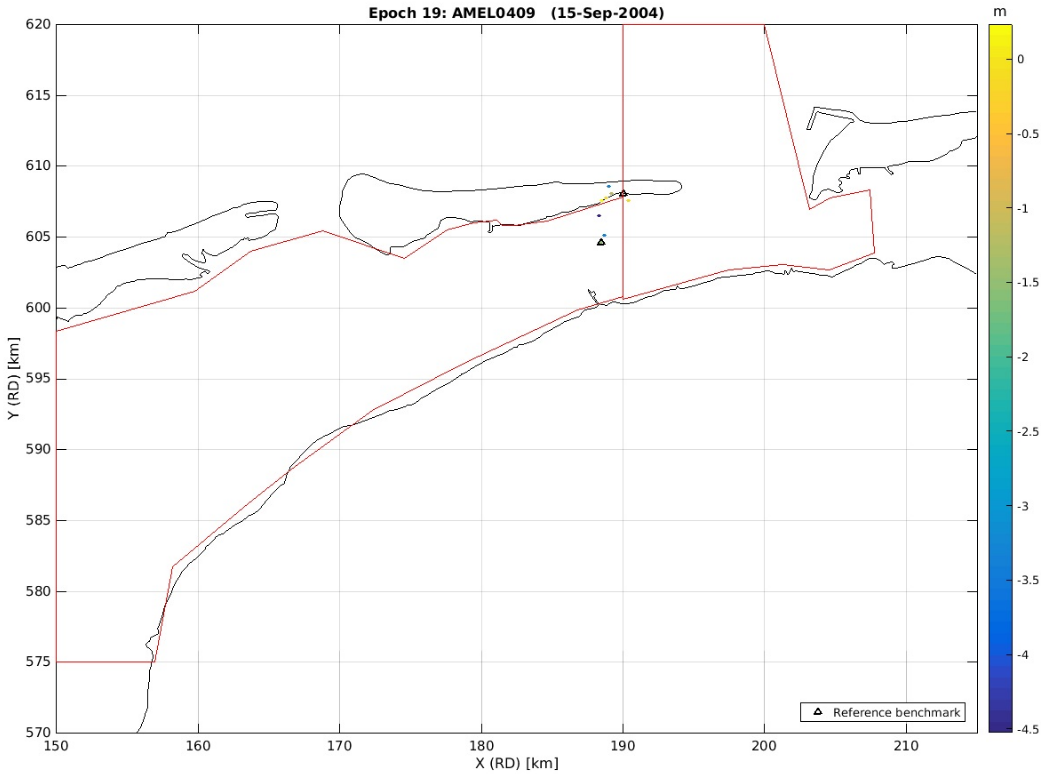
Epoch 15: 344W01 (23-Dec-1993)
m
Reference benchmark
X (RD) [km]
Y (RD) [km]

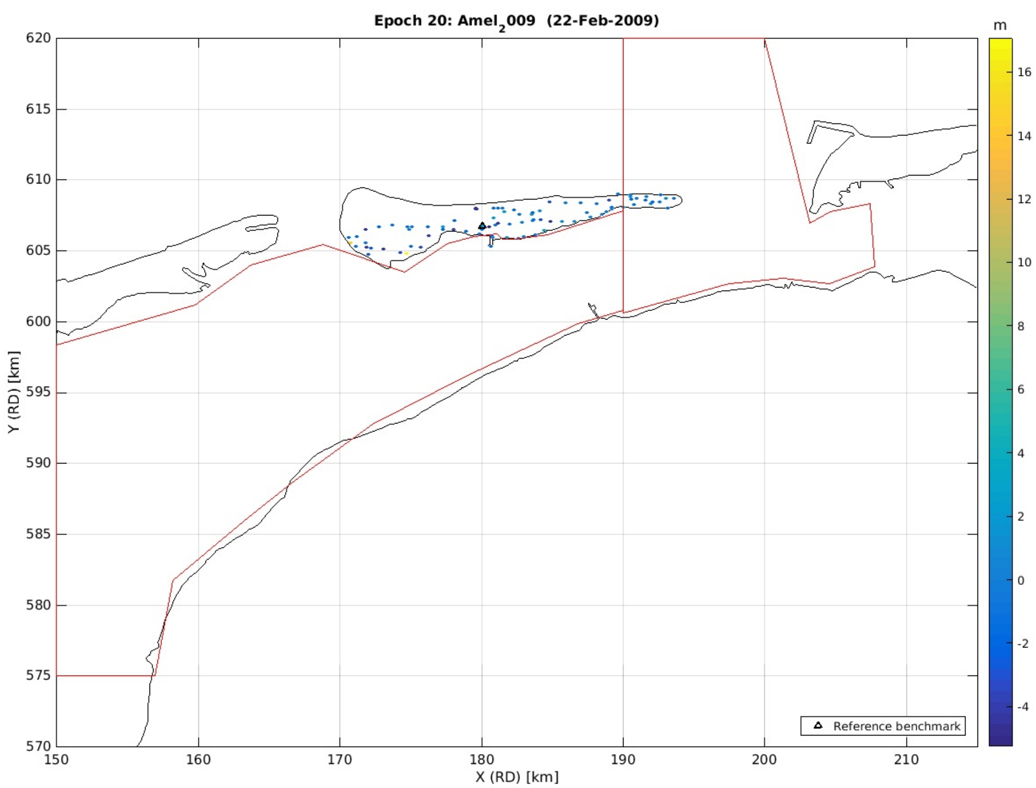


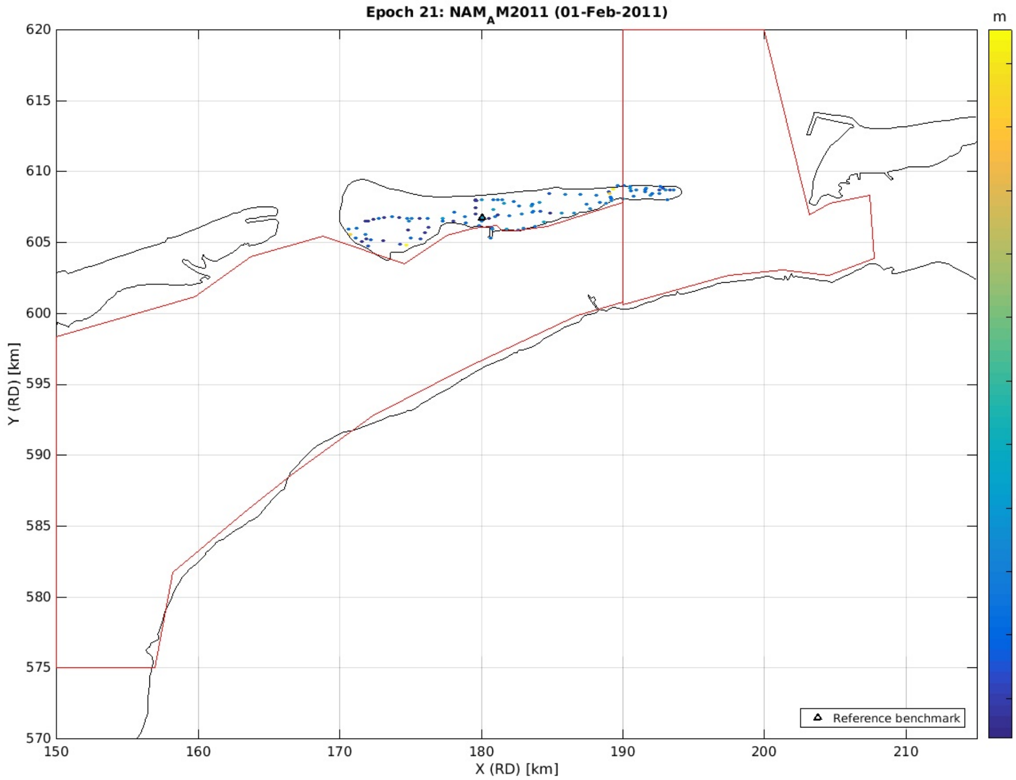
Epoch 16: 371W00 (01-May-1998)
m
Reference benchmark
X (RD) [km]
Y (RD) [km]

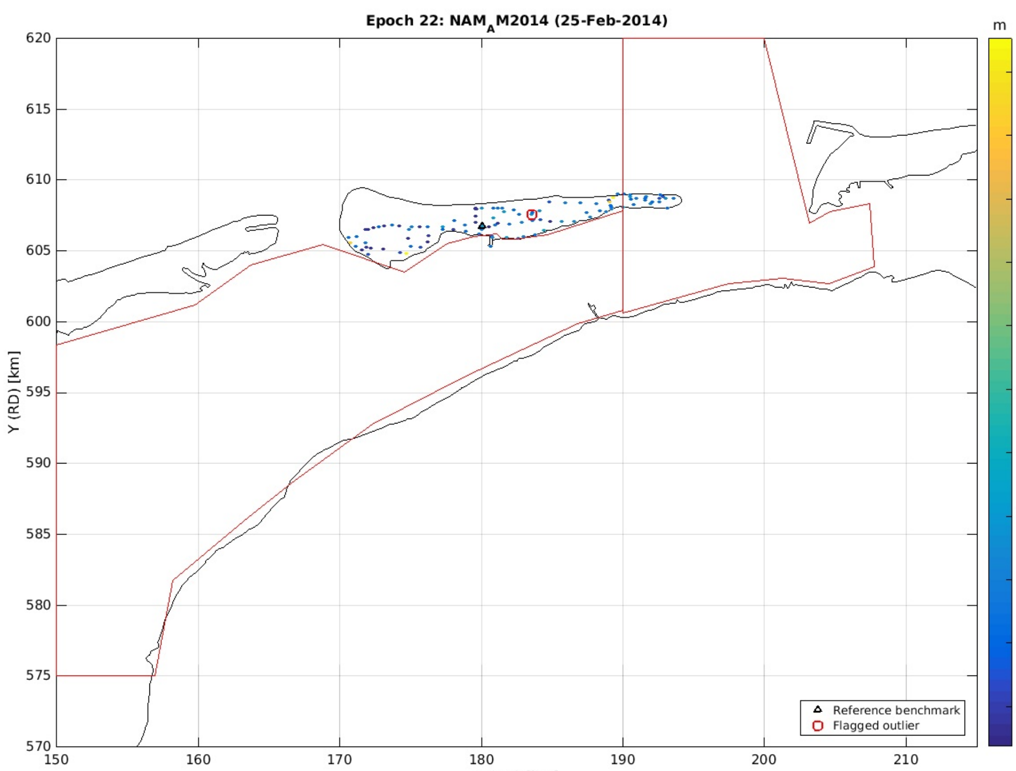

Epoch 17: 373W31 (04-Jul-2001)
Y (RD) [km]
X (RD) [km]
m
Reference benchmark
Flagged outlier

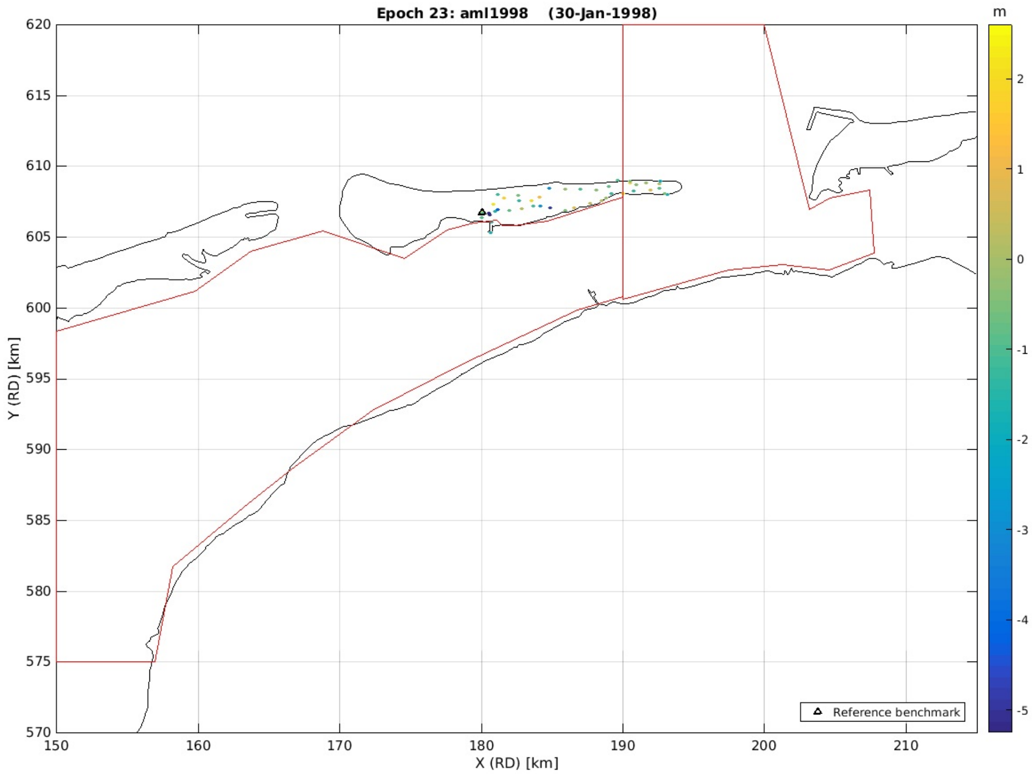

Epoch 18: 70604-001 (16-Jan-2006)
Y (RD) [km]
X (RD) [km]
m
Reference benchmark


Epoch 19: AMEL0409 (15-Sep-2004)
m
Y (RD) [km]
X (RD) [km]
Reference benchmark

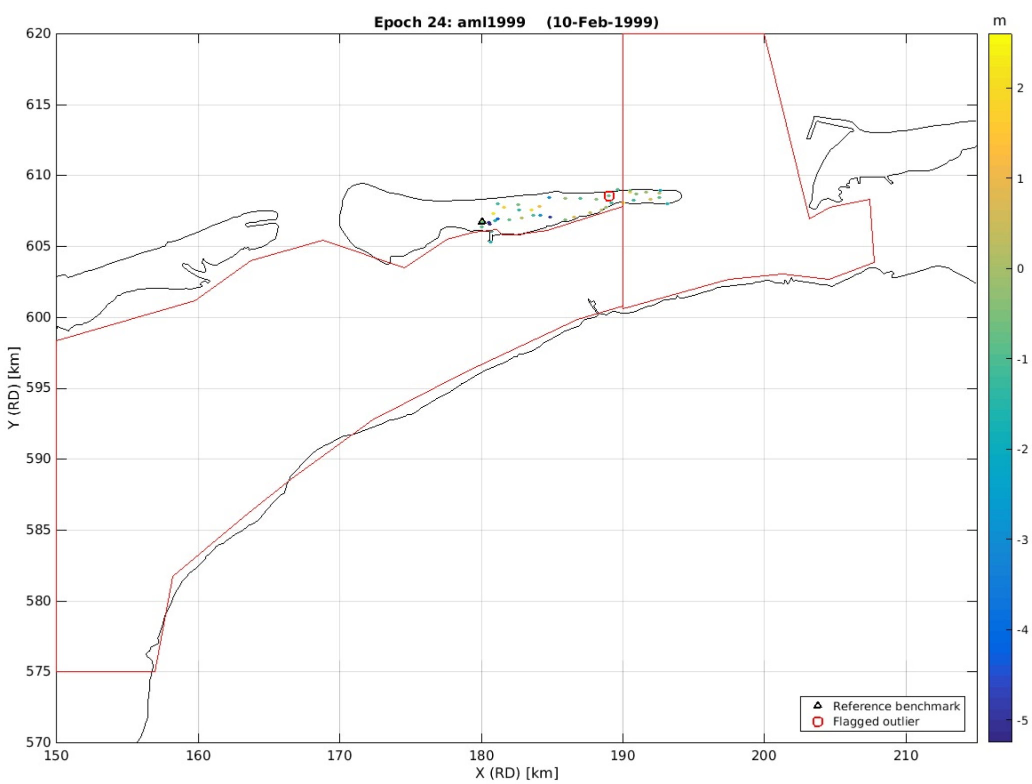

Epoch 20: Amel_2009 (22-Feb-2009)
m
Y (RD) [km]
X (RD) [km]
Reference benchmark


Epoch 21: NAM$_A$M2011 (01-Feb-2011)
m
Y (RD) [km]
X (RD) [km]
620
615
610
605
600
595
590
585
580
575
570
150
160
170
180
190
200
210
16
14
12
10
8
6
4
2
0
-2
-4
Reference benchmark

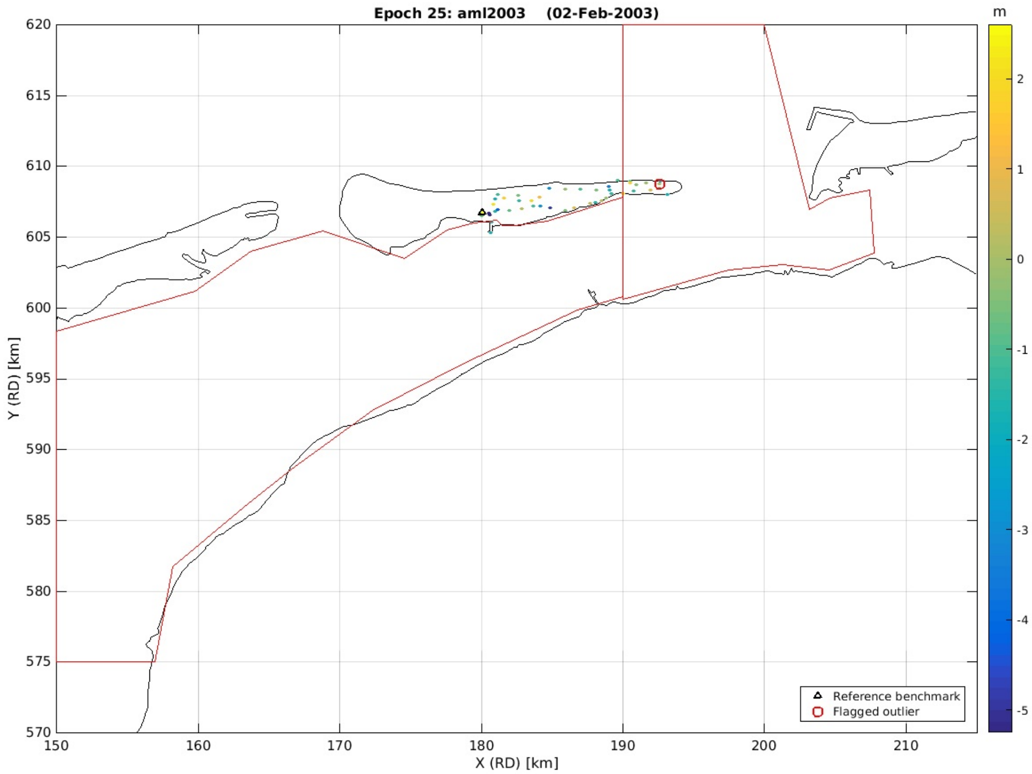

Epoch 22: NAM$_A$M2014 (25-Feb-2014)
m
Y (RD) [km]
X (RD) [km]
620
615
610
605
600
595
590
585
580
575
570
150
160
170
180
190
200
210
16
14
12
10
8
6
4
2
0
-2
-4
Reference benchmark
Flagged outlier

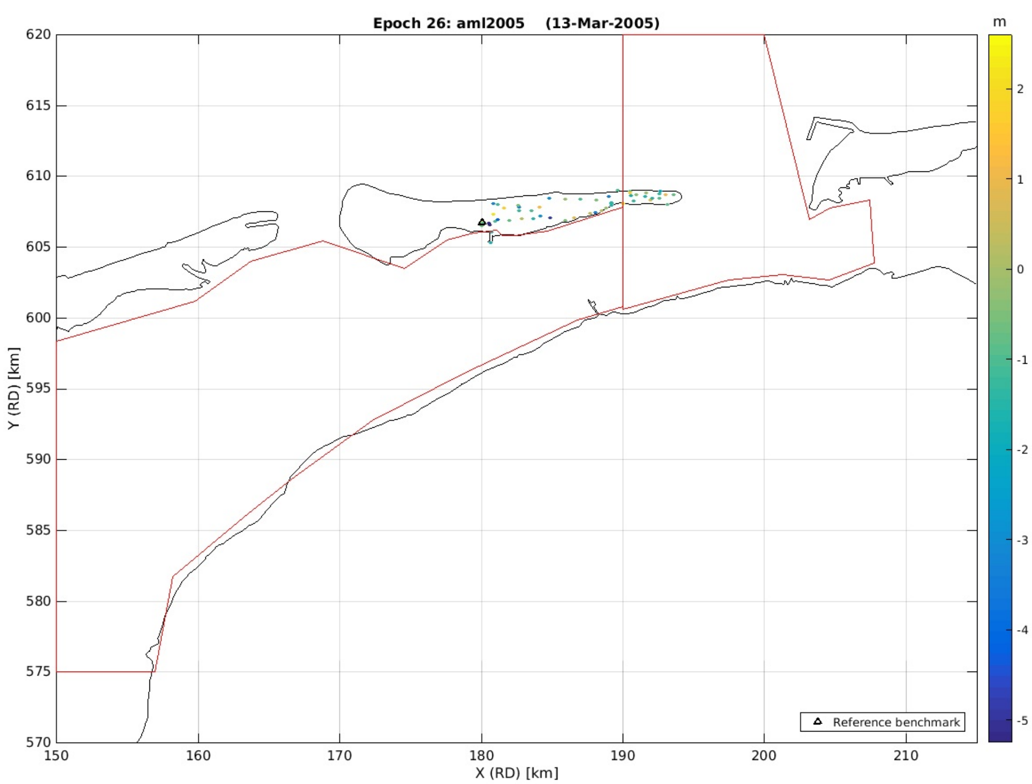


Epoch 23: aml1998 (30-Jan-1998)
Y (RD) [km]
X (RD) [km]
m
Reference benchmark



Epoch 24: aml1999 (10-Feb-1999)
Y (RD) [km]
X (RD) [km]
m
Reference benchmark
Flagged outlier


Epoch 25: aml2003 (02-Feb-2003)
m
Y (RD) [km]
X (RD) [km]
Reference benchmark
Flagged outlier


Epoch 26: aml2005 (13-Mar-2005)
m
Y (RD) [km]
X (RD) [km]
Reference benchmark

Appendix I. lts2_visual_hydro_check processing output

Contents lts2_visual_hydro_check.m

- Visual check of offshore (hydrostatic) levelling observations
- Input section (specify your project here)
- Load polygons from outline directory
- Read prognosis
- Load the .mat file
- Create index table
- Plot DD
- Plot timeseries
- Prognosis interpolation
- Plot DD

Visual check of offshore (hydrostatic) levelling observations

- Freek van Leijen, Delft University of Technology, 21 October 2016 *

This script uses functions from the `lts2` toolbox.

```
% (c) Freek van Leijen, Delft University of Technology, 2016.

% Created:    21 October 2016 by Freek van Leijen
% Modified:
%

clear all
close all

fullscreen=get(0,'Screensize');

% Set path to required toolboxes
lts2toolboxdir = fullfile('../..','lts2toolbox');
addpath(fullfile(lts2toolboxdir,'lts2'));
```

Input section (specify your project here)

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Specify the directory with outlines
outlinedir = fullfile(lts2toolboxdir,'lts2','lts2outlines');

% Specify .mat filenames
mat_file = {'lts2_ameland_poly1_with_outliers.mat','lts2_ameland_poly2_with_outliers.mat'};

% Specify prognosis file
inprognosis = 'Ameland_BC_ZE-A1.69E-09L2-allROSL0-9-base-case-TD7-1986initial_nwregrid.csv';

% Specify the bounding box for plotting (optional, plotting purposes only)
xminplot = 150000;
xmaxplot = 215000;
yminplot = 570000;
ymaxplot = 620000;

poly1_x = 1e5*[...
   1.900000000000000;...
   1.900000000000000;...
   1.975027412280702;...
   2.013514254385965;...
   2.045586622807018;...
   2.077658991228070;...
   2.074808114035088;...
   2.046299342105263;...
   2.032044956140351;...
   2.000000000000000;...
   1.900000000000000];

poly1_y = 1e5*[...
   6.200000000000000;...
   6.005592105263158;...
   6.026260964912280;...
   6.030537280701754;...
   6.026260964912280;...
   6.038377192982455;...
   6.083278508771929;...
   6.077576754385965;...
   6.069024122807019;...
   6.200000000000000;...
   6.200000000000000];

poly2_x = 1e5*[...
   1.900000000000000;...
   1.876672149122807;...
   1.846737938596491;...
   1.823930921052632;...
   1.815000000000000;...
   1.811101973684210;...
   1.794709429824561;...
   1.776178728070175;...
   1.746244517543860;...
   1.688514254385965;...
   1.637198464912281;...
   1.597998903508772;...
   1.500000000000000;...
   1.500000000000000;...
   1.569490131578947;...
   1.582319078947368;...
   1.632209429824561;...
   1.666419956140351;...
   1.723437500000000;...
   1.789007675438596;...
   1.868119517543860;...
   1.900000000000000;...
   1.900000000000000];

poly2_y = 1e5*[...
   6.078289473684211;...
   6.070449561403509;...
   6.061184210526315;...
   6.057620614035089;...
   6.057620614035089;...
   6.061896929824561;...
   6.059758771929824;...
   6.054769736842105;...
   6.034813596491229;...
   6.054057017543860;...
   6.039802631578947;...
   6.011293859649124;...
   5.983497807017544;...
   5.750000000000000;...
   5.750000000000000;...
   5.816721491228070;...
   5.858771929824561;...
   5.885855263157895;...
   5.927192982456140;...
   5.961403508771930;...
   5.998464912280701;...
   6.007730263157895;...
   6.078289473684211];


% End input section (You should not have to change anything below this line.)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Load polygons from outline directory

```
d=dir(fullfile(outlinedir,'*.coo'));
shoreline=[];
for k=1:numel(d)
    formatSpec = '%6f%f%[^\n\r]';
    filename=fullfile(outlinedir,d(k).name);
    fid=fopen(filename,'r');
    dataArray = textscan(fid, formatSpec, 'Delimiter', '', 'WhiteSpace', '',  'ReturnOnError', false);
    fclose(fid);
    shoreline=[ shoreline ; dataArray{:, 1} dataArray{:, 2} ; NaN NaN];
end
clear d
```

Read prognosis

```
Pdata=importdata(inprognosis,',',1);
prognos_def=-Pdata.data(:,3:end)*0.01;% *0.01 cm converts to meter
prognos_X=Pdata.data(:,1);
prognos_Y=Pdata.data(:,2);
PNepochs=size(prognos_def,2);
PNpnt=size(prognos_def,1);
Pepochsname=char(Pdata.textdata(3:end));
PTepoch0=str2num(Pepochsname(:,2:end));

Kconv=convhull(prognos_X,prognos_Y);
prognos_Xconv=prognos_X(Kconv);
prognos_Yconv=prognos_Y(Kconv);

count = 0;
for v = 1:length(mat_file)
```

Load the .mat file

```
  load(char(mat_file(v)));
  DD_TABLE(:,1:4)
```

```
ans =
    '002D0052'    '000G0092'     '279H05    '    '289W05    '
    '002D0052'    '000G0093'     '279W22    '    '289W05    '
    '002D0052'    '000G0094'     '279H05    '    '279W22    '
    '002D0052'    '000G0094'     '279H05    '    '289W05    '
    '002D0052'    '000G0094'     '279H05    '    '373W31    '
    '002D0052'    '000G0095'     '279H05    '    '289W05    '
    '002D0052'    '000G0096'     '279H05    '    '289W05    '
    '002D0052'    '000G0097'     '279H05    '    '289W05    '
    '002D0052'    '000G0191'     '289W05    '    '373W31    '
    '002D0052'    '000G0192'     '289W05    '    '373W31    '
    '002D0052'    '002D0023'     '279H05    '    '289W05    '
    '002D0052'    '002D0023'     '279H05    '    '289W16    '
    '002D0052'    '002D0023'     '279H05    '    '289W20    '
    '002D0052'    '002D0023'     '279H05    '    '289W26    '
    '002D0052'    '002D0023'     '279H05    '    '289W34    '
    '002D0052'    '002D0051'     '231-70604 '    '231-70812 '
    '002D0052'    '002D0051'     '231-70604 '    '279H05    '
    '002D0052'    '002D0051'     '231-70604 '    '279W22    '
    '002D0052'    '002D0051'     '231-70604 '    '289W05    '
    '002D0052'    '002D0051'     '231-70604 '    '289W16    '
    '002D0052'    '002D0051'     '231-70604 '    '289W20    '
    '002D0052'    '002D0051'     '231-70604 '    '289W26    '
    '002D0052'    '002D0051'     '231-70604 '    '289W34    '
    '002D0052'    '002D0051'     '231-70604 '    '289W37    '
    '002D0052'    '002D0051'     '231-70604 '    '332W02    '
    '002D0052'    '002D0051'     '231-70604 '    '342W04    '
    '002D0052'    '002D0051'     '231-70604 '    '342W05    '
    '002D0052'    '002D0051'     '231-70604 '    '344W01    '
    '002D0052'    '002D0051'     '231-70604 '    '371W00    '
    '002D0052'    '002D0051'     '231-70604 '    '373W31    '



    '002D0052'    '002D0051'     '231-70604 '    '70604-001 '
    '002D0052'    '002D0051'     '231-70604 '    'Amel_2009 '
    '002D0052'    '002D0051'     '231-70604 '    'NAM_AM2011'
    '002D0052'    '002D0051'     '231-70604 '    'NAM_AM2014'
    '002D0052'    '002D0051'     '231-70604 '    'aml1998   '
    '002D0052'    '002D0051'     '231-70604 '    'aml1999   '
    '002D0052'    '002D0051'     '231-70604 '    'aml2003   '
    '002D0052'    '002D0051'     '231-70604 '    'aml2005   '
    '002D0052'    '002D0053'     '231-70604 '    '231-70812 '
    '002D0052'    '002D0053'     '231-70604 '    '279H05    '
    '002D0052'    '002D0053'     '231-70604 '    '279W22    '
    '002D0052'    '002D0053'     '231-70604 '    '289W05    '
    '002D0052'    '002D0053'     '231-70604 '    '289W16    '
    '002D0052'    '002D0053'     '231-70604 '    '289W20    '
    '002D0052'    '002D0053'     '231-70604 '    '289W37    '
    '002D0052'    '002D0053'     '231-70604 '    '332W02    '
    '002D0052'    '002D0053'     '231-70604 '    '344W01    '
    '002D0052'    '002D0053'     '231-70604 '    '371W00    '
    '002D0052'    '002D0053'     '231-70604 '    '373W31    '
    '002D0052'    '002D0053'     '231-70604 '    '70604-001 '
    '002D0052'    '002D0053'     '231-70604 '    'Amel_2009 '
    '002D0052'    '002D0053'     '231-70604 '    'NAM_AM2011'
    '002D0052'    '002D0053'     '231-70604 '    'NAM_AM2014'
    '002D0052'    '002D0053'     '231-70604 '    'aml1998   '
    '002D0052'    '002D0053'     '231-70604 '    'aml1999   '
    '002D0052'    '002D0053'     '231-70604 '    'aml2003   '
    '002D0052'    '002D0053'     '231-70604 '    'aml2005   '
    '002D0052'    '002D0059'     '279H05    '    '344W01    '
    '002D0052'    '002D0059'     '279H05    '    '371W00    '
    '002D0052'    '002D0059'     '279H05    '    '373W31    '
    '002D0052'    '002D0060'     '279H05    '    '344W01    '
    '002D0052'    '002D0060'     '279H05    '    '371W00    '
    '002D0052'    '002D0060'     '279H05    '    '373W31    '
    '002D0052'    '002D0061'     '279H05    '    '344W01    '
    '002D0052'    '002D0061'     '279H05    '    '371W00    '
    '002D0052'    '002D0061'     '279H05    '    '373W31    '
    '002D0052'    '002D0069'     '231-70604 '    '231-70812 '
    '002D0052'    '002D0069'     '231-70604 '    '279H05    '
    '002D0052'    '002D0069'     '231-70604 '    '289W05    '
    '002D0052'    '002D0069'     '231-70604 '    '289W16    '
    '002D0052'    '002D0069'     '231-70604 '    '289W20    '
    '002D0052'    '002D0069'     '231-70604 '    '289W26    '
    '002D0052'    '002D0069'     '231-70604 '    '289W34    '
    '002D0052'    '002D0069'     '231-70604 '    '289W37    '
    '002D0052'    '002D0069'     '231-70604 '    '332W02    '
    '002D0052'    '002D0069'     '231-70604 '    '342W04    '
    '002D0052'    '002D0069'     '231-70604 '    '342W05    '
    '002D0052'    '002D0069'     '231-70604 '    '373W31    '
    '002D0052'    '002D0069'     '231-70604 '    '70604-001 '
    '002D0052'    '002D0069'     '231-70604 '    'Amel_2009 '
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    '002D0052'    '002D0069'     '231-70604 '    'aml1998   '
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    '002D0052'    '002D0069'     '231-70604 '    'aml2005   '
    '002D0052'    '002D0070'     '231-70604 '    '231-70812 '
    '002D0052'    '002D0070'     '231-70604 '    '279H05    '
    '002D0052'    '002D0070'     '231-70604 '    '289W05    '
    '002D0052'    '002D0070'     '231-70604 '    '289W16    '
    '002D0052'    '002D0070'     '231-70604 '    '289W20    '
    '002D0052'    '002D0070'     '231-70604 '    '289W26    '
    '002D0052'    '002D0070'     '231-70604 '    '289W34    '
    '002D0052'    '002D0070'     '231-70604 '    '289W37    '
    '002D0052'    '002D0070'     '231-70604 '    '332W02    '
    '002D0052'    '002D0070'     '231-70604 '    '342W04    '
    '002D0052'    '002D0070'     '231-70604 '    '342W05    '
    '002D0052'    '002D0070'     '231-70604 '    '344W01    '
    '002D0052'    '002D0070'     '231-70604 '    '373W31    '
    '002D0052'    '002D0070'     '231-70604 '    '70604-001 '
    '002D0052'    '002D0070'     '231-70604 '    'Amel_2009 '
```

```
'002D0052'   '002D0070'    '231-70604 '   'NAM_AM2011'
'002D0052'   '002D0070'    '231-70604 '   'NAM_AM2014'
'002D0052'   '002D0070'    '231-70604 '   'aml1998   '
'002D0052'   '002D0070'    '231-70604 '   'aml1999   '
'002D0052'   '002D0070'    '231-70604 '   'aml2003   '
'002D0052'   '002D0070'    '231-70604 '   'aml2005   '
'002D0052'   '002D0071'    '279H05    '   '289W05    '
'002D0052'   '002D0071'    '279H05    '   '289W16    '
'002D0052'   '002D0071'    '279H05    '   '289W20    '
'002D0052'   '002D0071'    '279H05    '   '289W26    '
'002D0052'   '002D0071'    '279H05    '   '289W34    '
'002D0052'   '002D0071'    '279H05    '   '332W02    '
'002D0052'   '002D0072'    '231-70604 '   '231-70812 '
'002D0052'   '002D0072'    '231-70604 '   '279H05    '
'002D0052'   '002D0072'    '231-70604 '   '289W05    '
'002D0052'   '002D0072'    '231-70604 '   '289W16    '
'002D0052'   '002D0072'    '231-70604 '   '289W20    '
'002D0052'   '002D0072'    '231-70604 '   '289W26    '
'002D0052'   '002D0072'    '231-70604 '   '289W34    '
'002D0052'   '002D0072'    '231-70604 '   '289W37    '
'002D0052'   '002D0072'    '231-70604 '   '332W02    '
'002D0052'   '002D0072'    '231-70604 '   '342W04    '
'002D0052'   '002D0072'    '231-70604 '   '342W05    '
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'002D0052'   '002D0073'    '231-70604 '   'Amel_2009 '
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'002D0052'   '002D0073'    '231-70604 '   'aml1998   '
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'002D0052'   '002D0073'    '231-70604 '   'aml2003   '
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'002D0052'   '002D0074'    '231-70604 '   '279H05    '
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'002D0052'   '002D0074'    '231-70604 '   '289W34    '
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'002D0052'   '002D0074'    '231-70604 '   'NAM_AM2014'
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'002D0052'   '002D0074'    '231-70604 '   'aml1999   '
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'002D0052'   '002D0075'    '231-70812 '   '289W20    '
'002D0052'   '002D0075'    '231-70812 '   '289W26    '
'002D0052'   '002D0075'    '231-70812 '   '289W34    '
'002D0052'   '002D0075'    '231-70812 '   '289W37    '
'002D0052'   '002D0075'    '231-70812 '   '332W02    '
'002D0052'   '002D0075'    '231-70812 '   '342W04    '
'002D0052'   '002D0075'    '231-70812 '   '342W05    '
'002D0052'   '002D0075'    '231-70812 '   '373W31    '
'002D0052'   '002D0075'    '231-70812 '   '70604-001 '
'002D0052'   '002D0075'    '231-70812 '   'Amel_2009 '
'002D0052'   '002D0075'    '231-70812 '   'NAM_AM2011'
'002D0052'   '002D0075'    '231-70812 '   'NAM_AM2014'
'002D0052'   '002D0075'    '231-70812 '   'aml1998   '
'002D0052'   '002D0075'    '231-70812 '   'aml1999   '
'002D0052'   '002D0075'    '231-70812 '   'aml2003   '
'002D0052'   '002D0075'    '231-70812 '   'aml2005   '
'002D0052'   '002D0076'    '231-70604 '   '231-70812 '
'002D0052'   '002D0076'    '231-70604 '   '289W34    '
'002D0052'   '002D0076'    '231-70604 '   '289W37    '
'002D0052'   '002D0076'    '231-70604 '   '332W02    '
'002D0052'   '002D0076'    '231-70604 '   '342W04    '
'002D0052'   '002D0076'    '231-70604 '   '342W05    '
'002D0052'   '002D0076'    '231-70604 '   '344W01    '
'002D0052'   '002D0076'    '231-70604 '   '373W31    '
'002D0052'   '002D0076'    '231-70604 '   '70604-001 '
'002D0052'   '002D0076'    '231-70604 '   'Amel_2009 '
'002D0052'   '002D0076'    '231-70604 '   'NAM_AM2011'
'002D0052'   '002D0076'    '231-70604 '   'NAM_AM2014'
'002D0052'   '002D0076'    '231-70604 '   'aml1998   '
'002D0052'   '002D0076'    '231-70604 '   'aml1999   '
'002D0052'   '002D0076'    '231-70604 '   'aml2003   '
'002D0052'   '002D0076'    '231-70604 '   'aml2005   '
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'002D0052'   '002D0079'    '231-70812 '   '289W26    '
'002D0052'   '002D0079'    '231-70812 '   '289W34    '
'002D0052'   '002D0079'    '231-70812 '   '289W37    '
'002D0052'   '002D0079'    '231-70812 '   '332W02    '
'002D0052'   '002D0079'    '231-70812 '   '342W04    '
'002D0052'   '002D0079'    '231-70812 '   '342W05    '
'002D0052'   '002D0079'    '231-70812 '   '373W31    '
'002D0052'   '002D0079'    '231-70812 '   '70604-001 '
'002D0052'   '002D0079'    '231-70812 '   'Amel_2009 '
'002D0052'   '002D0079'    '231-70812 '   'NAM_AM2011'
'002D0052'   '002D0079'    '231-70812 '   'NAM_AM2014'
'002D0052'   '002D0079'    '231-70812 '   'aml1998   '
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'002D0052'   '002D0079'    '231-70812 '   'aml2003   '
'002D0052'   '002D0079'    '231-70812 '   'aml2005   '
'002D0052'   '002D0081'    '231-70812 '   '373W31    '
'002D0052'   '002D0081'    '231-70812 '   '70604-001 '
'002D0052'   '002D0081'    '231-70812 '   'Amel_2009 '
'002D0052'   '002D0081'    '231-70812 '   'NAM_AM2011'
```

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    '002D0052'    '002D0081'     '231-70812 '    'aml1999   '
    '002D0052'    '002D0081'     '231-70812 '    'aml2003   '
    '002D0052'    '002D0081'     '231-70812 '    'aml2005   '
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    '002D0052'    '002D0089'     '279W22    '    '371W00    '
    '002D0052'    '002D0089'     '279W22    '    'NAM_GPS98B'
    '002D0052'    '002D0090'     '279W22    '    '371W00    '
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    '002D0052'    '002D0095'     '231-70604 '    'NAM_AM2014'
    '002D0052'    '002D0095'     '231-70604 '    'aml2005   '
    '002D0052'    '002D0096'     '231-70604 '    '231-70812 '
    '002D0052'    '002D0096'     '231-70604 '    '70604-001 '
    '002D0052'    '002D0096'     '231-70604 '    'Amel_2009 '
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    '002D0052'    '002D0096'     '231-70604 '    'NAM_AM2014'
    '002D0052'    '002D0096'     '231-70604 '    'aml2005   '
    '002D0052'    '002D0099'     '231-70604 '    '231-70812 '
    '002D0052'    '002D0099'     '231-70604 '    '70604-001 '
    '002D0052'    '002D0099'     '231-70604 '    'Amel_2009 '
    '002D0052'    '002D0099'     '231-70604 '    'NAM_AM2011'
    '002D0052'    '002D0099'     '231-70604 '    'NAM_AM2014'
    '002D0052'    '002D0099'     '231-70604 '    'aml2005   '
    '002D0052'    '002D0100'     '231-70604 '    '231-70812 '
    '002D0052'    '002D0100'     '231-70604 '    '70604-001 '
    '002D0052'    '002D0100'     '231-70604 '    'Amel_2009 '
    '002D0052'    '002D0100'     '231-70604 '    'NAM_AM2011'
    '002D0052'    '002D0100'     '231-70604 '    'NAM_AM2014'
    '002D0052'    '002D0100'     '231-70604 '    'aml2005   '
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    '002D0052'    '002D0101'     '231-70604 '    'NAM_AM2014'
    '002D0052'    '002D0101'     '231-70604 '    'aml2005   '
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    '002D0052'    '002D0115'     'NAM_AM2011'    'NAM_AM2014'
    '002D0052'    '002D0116'     'NAM_AM2011'    'NAM_AM2014'
    '002D0052'    '002D0117'     'NAM_AM2011'    'NAM_AM2014'
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    '002D0070'    '002D0073'     '231-70604 '    '342W10    '
    '002D0070'    '002D0074'     '231-70604 '    '342W10    '
    '002D0070'    '002D0075'     '231-70812 '    '342W10    '
    '002D0070'    '002D0076'     '231-70604 '    '342W10    '
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    '002D0070'    '002D0079'     '231-70812 '    '342W10    '
    '002D0081'    'AWG-1'        'NAM_GPS98C'    'NAM_GPS00 '
    '002D0081'    'AWG-1'        'NAM_GPS98C'    'NAM_GPS04A'


ans = 
    '002C0107'    '000A4070'     '279H05    '    '344W01    '
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    '002C0107'    '002C0026'     '279H05    '    '371W00    '
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    '002C0107'    '002C0109'     '231-70812 '    'aml2003   '
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    '002C0029'    '002C0033'     '279H05    '    'AMEL0409  '
    '002C0029'    '002C0034'     '279H05    '    'AMEL0409  '
    '002C0029'    '002C0035'     '279H05    '    'AMEL0409  '
```

Create index table

```
table_idx = NaN(size(DD_TABLE(:,1:4)));
[~,table_idx(:,1)] = ismember(DD_TABLE(:,1),BENCHMARKS(:,1));
[~,table_idx(:,2)] = ismember(DD_TABLE(:,2),BENCHMARKS(:,1));
[~,table_idx(:,3)] = ismember(DD_TABLE(:,3),DATES(:,1));
[~,table_idx(:,4)] = ismember(DD_TABLE(:,4),DATES(:,1));

unique_obs = unique(table_idx(:,1:2),'rows');
unique_from = unique(table_idx(:,1));
unique_to = unique(table_idx(:,2));
bm = cell2mat(BENCHMARKS(:,2:3));
```

Plot DD

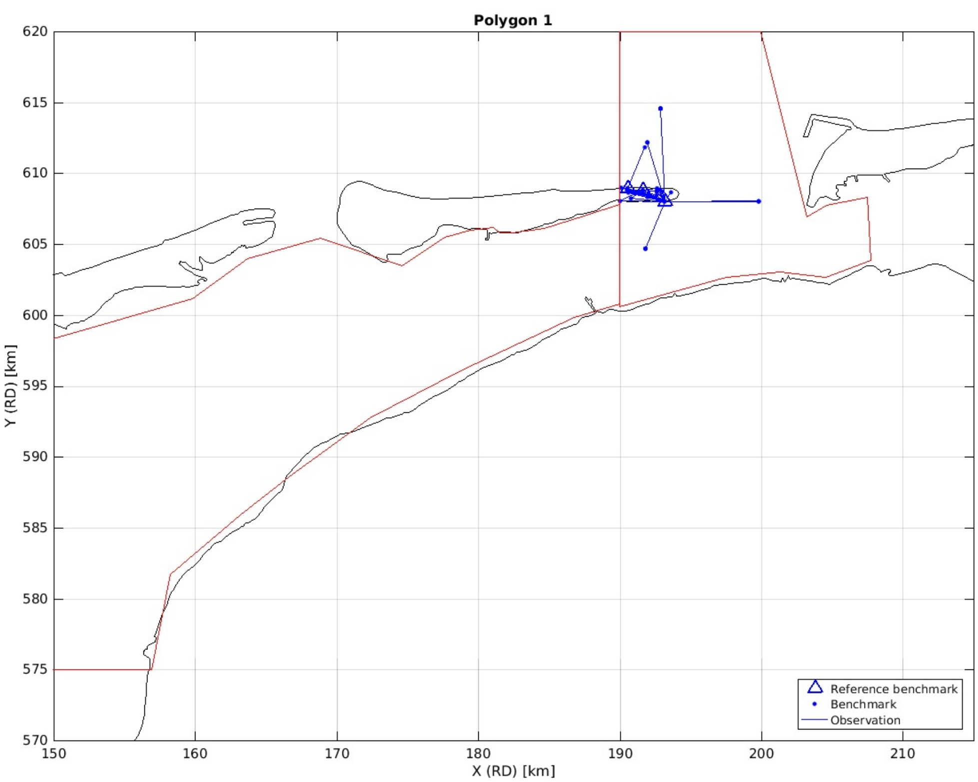
```
hh = NaN(3,1);
figure(v); hold on;
set(gcf,'position',fullscreen);
plot(0.001*shoreline(:,1),0.001*shoreline(:,2),'k')
h = plot(0.001*[bm(unique_obs(:,1),1) bm(unique_obs(:,2),1)]',...
     0.001*[bm(unique_obs(:,1),2) bm(unique_obs(:,2),2)]',...
     'b');
hh(3) = h(1);
h = plot(0.001*bm(unique_from,1),0.001*bm(unique_from,2),'b^',...
     'markersize',10,'linewidth',2);
hh(1) = h(1);
h = plot(0.001*bm(unique_to,1),0.001*bm(unique_to,2),'b.',...
     'markersize',10);
hh(2) = h(1);
plot(0.001*poly1_x,0.001*poly1_y,'r');
plot(0.001*poly2_x,0.001*poly2_y,'r');

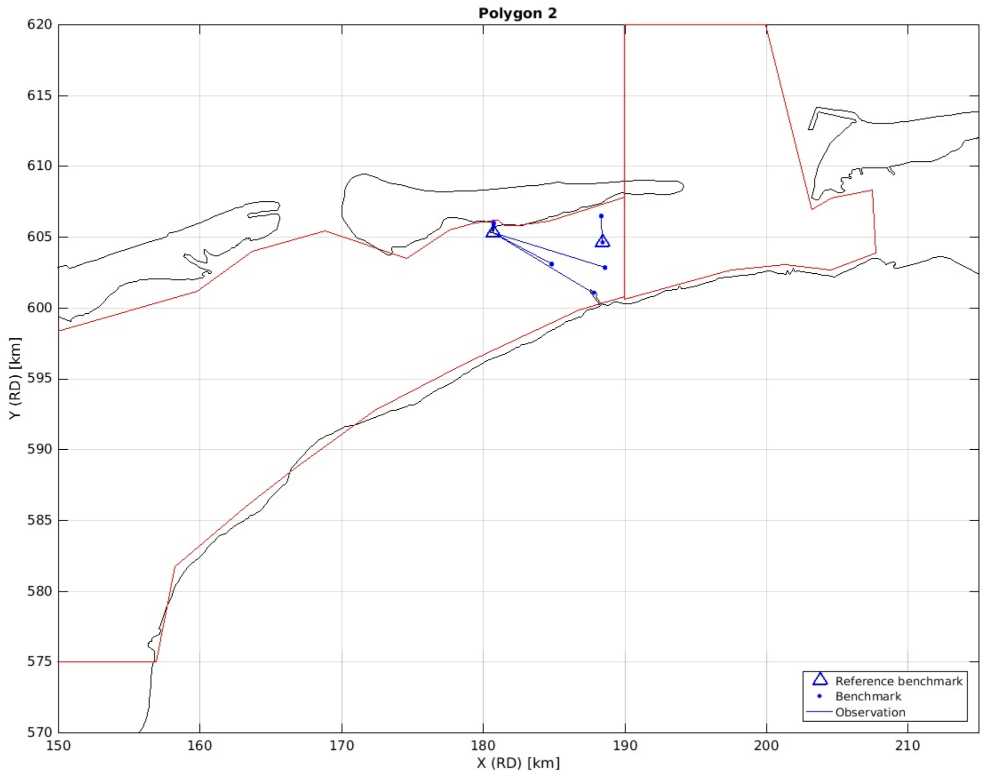
title(['Polygon ' num2str(v)]);
```

```
xlabel('X (RD) [km]');
ylabel('Y (RD) [km]');
axis equal;
if exist('xminplot','var')
  if ~isempty(xminplot)
    set(gca,'xlim',0.001*[xminplot xmaxplot],'ylim',0.001*[yminplot ymaxplot]);
  end
end

legend_strings = {'Reference benchmark','Benchmark','Observation'};
nanidx = find(~isnan(hh));
legend(hh(nanidx),legend_strings(nanidx),'Location','SouthEast');

box on;
grid on;
hold off;
```





Plot timeseries

```
  for w = 1:size(unique_obs)

    if isempty(find(inpolygon(bm(unique_obs(w,2),1),bm(unique_obs(w,2),2),...
              shoreline(:,1),shoreline(:,2))));

      tmp1 = find(table_idx(:,1)==unique_obs(w,1));
```

```
      tmp2 = find(table_idx(tmp1,2)==unique_obs(w,2));
      obs_idx = tmp1(tmp2);
      clear tmp1 tmp2

      if length(obs_idx)>=2
```

```
        count = count + 2;
```

Prognosis interpolation

```
        frX=double(bm(unique_obs(w,1),1));
        frY=double(bm(unique_obs(w,1),2));
        toX=double(bm(unique_obs(w,2),1));
        toY=double(bm(unique_obs(w,2),2));
        frEp=ymd2dyear(datevec(datenum(DATES(table_idx(obs_idx(1),3),2),'yyyymmdd')));
        toEp=ymd2dyear(datevec(datenum(DATES(table_idx(obs_idx,4),2),'yyyymmdd')));

        refepoch = frEp;
        Btemp = toEp-refepoch;

        fr_def_ts0=zeros(PNepochs,1);
        to_def_ts0=zeros(PNepochs,1);

        % Interpolation in space
        if  inpolygon(frX,frY,prognos_Xconv,prognos_Yconv);
          for j=1:PNepochs
            fr_def_ts0(j)=griddata(prognos_X,prognos_Y,prognos_def(:,j),frX,frY);
          end
        end
        if  inpolygon(toX,toY,prognos_Xconv,prognos_Yconv);
          for j=1:PNepochs
            to_def_ts0(j)=griddata(prognos_X,prognos_Y,prognos_def(:,j),toX,toY);
          end
        end

        % Interpolation in time
        fr_def_ts=interp1(PTepoch0,fr_def_ts0,[refepoch;refepoch+Btemp],'spline','extrap');
        to_def_ts=interp1(PTepoch0,to_def_ts0,[refepoch;refepoch+Btemp],'spline','extrap');
        indtemp=find([refepoch;refepoch+Btemp]<min(PTepoch0));
        fr_def_ts(indtemp)=0;
        to_def_ts(indtemp)=0;

        if ~isempty(find([refepoch;refepoch+Btemp]>max(PTepoch0)))
          warning('out-of-prognosis epochs')
        end

        yhat=(to_def_ts-to_def_ts(1))-(fr_def_ts-fr_def_ts(1)); % timeseries based on the prognosis
        yhat=yhat(2:end);
```

Plot DD

```
        hh = NaN(3,1);
        figure(2+count); hold on;
        plot(0.001*shoreline(:,1),0.001*shoreline(:,2),'k')
        h = plot(0.001*[bm(unique_obs(w,1),1) bm(unique_obs(w,2),1)]',...
             0.001*[bm(unique_obs(w,1),2) bm(unique_obs(w,2),2)]',...
             'b');
        hh(3) = h(1);
        h = plot(0.001*bm(unique_obs(w,1),1),0.001*bm(unique_obs(w,1),2),'b^',...
        'markersize',10,'linewidth',2);
        hh(1) = h(1);
        h = plot(0.001*bm(unique_obs(w,2),1),0.001*bm(unique_obs(w,2),2),'b.',...
           'markersize',10);
        hh(2) = h(1);
        plot(0.001*poly1_x,0.001*poly1_y,'r');
        plot(0.001*poly2_x,0.001*poly2_y,'r');
```

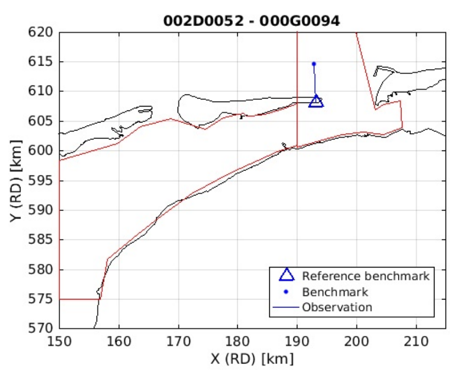
```
      title([char(BENCHMARKS(unique_obs(w,1),1)) ' - ' char(BENCHMARKS(unique_obs(w,2),1))]);
      xlabel('X (RD) [km]');
      ylabel('Y (RD) [km]');
      axis equal;
      if exist('xminplot','var')
        if ~isempty(xminplot)
          set(gca,'xlim',0.001*[xminplot xmaxplot],'ylim',0.001*[yminplot ymaxplot]);
        end
      end

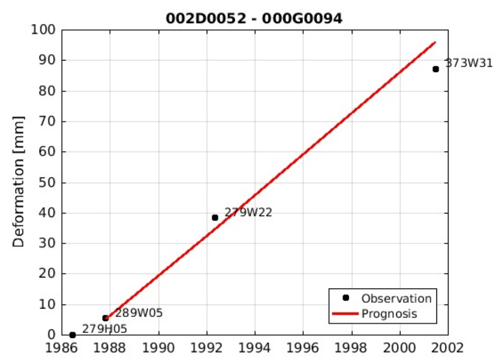
      legend_strings = {'Reference benchmark','Benchmark','Observation'};
      nanidx = find(~isnan(hh));
      legend(hh(nanidx),legend_strings(nanidx),'Location','SouthEast');

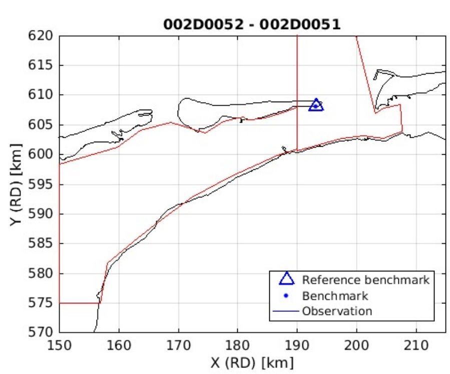
      box on;
      grid on;
      hold off;

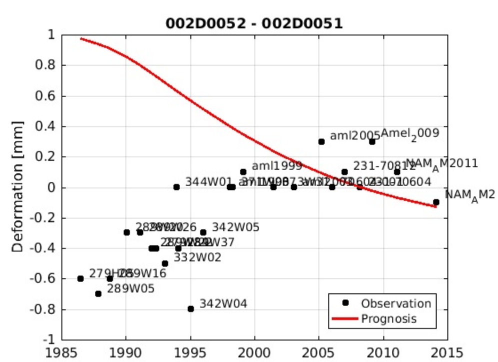
      [dates_sort,dates_idx] = sort(datenum(DATES(table_idx(obs_idx,4),2),'yyyymmdd'));
      hh = NaN(2,1);
      figure(2+count+1); hold on;
      plot(datenum(DATES(table_idx(obs_idx(1),3),2),'yyyymmdd'),0,'k.','markersize',20);
      h = plot(datenum(DATES(table_idx(obs_idx,4),2),'yyyymmdd'),1000*DD_OBS(obs_idx),'k.','markersize',20);
      hh(1) = h(1);
      h = plot(dates_sort,1000*yhat(dates_idx),'r','linewidth',2);
      hh(2) = h(1);
      title([char(BENCHMARKS(unique_obs(w,1),1)) ' - ' char(BENCHMARKS(unique_obs(w,2),1))]);
      xlim = get(gca,'xlim');
      xrange = xlim(2) - xlim(1);
      ylim = get(gca,'ylim');
      yrange = ylim(2) - ylim(1);
      text(datenum(DATES(table_idx(obs_idx(1),3),2),'yyyymmdd')+0.02*xrange,0+0.02*yrange,...
         char(DATES(table_idx(obs_idx(1),3),1)));
      text(datenum(DATES(table_idx(obs_idx,4),2),'yyyymmdd')+0.02*xrange,1000*DD_OBS(obs_idx)+0.02*yrange,...
         char(DATES(table_idx(obs_idx,4),1)));
      datetick;
      ylabel('Deformation [mm]');
      grid on;
      box on;

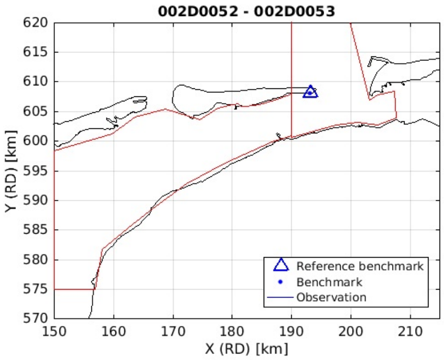
      legend_strings = {'Observation','Prognosis'};
      nanidx = find(~isnan(hh));
      legend(hh(nanidx),legend_strings(nanidx),'Location','SouthEast');
```

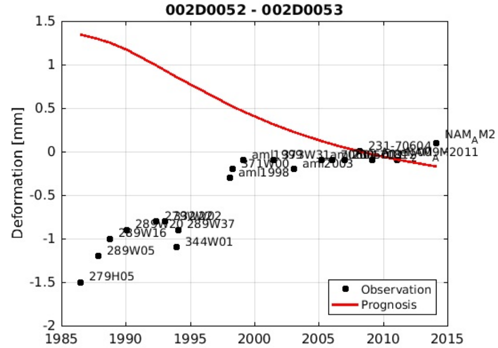


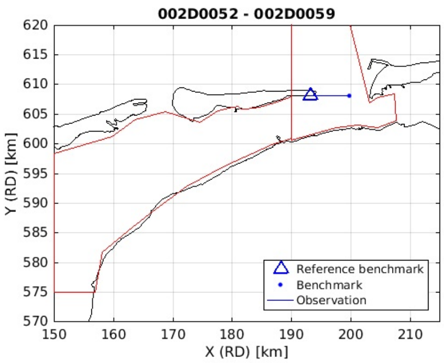


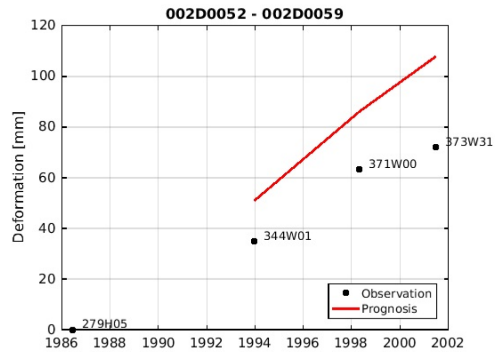


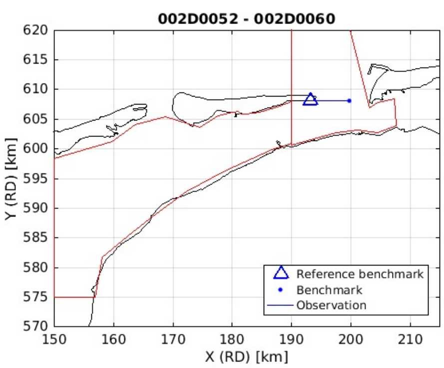


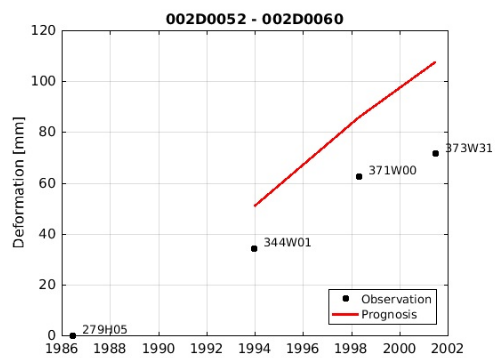

002D0052 - 002D0053
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

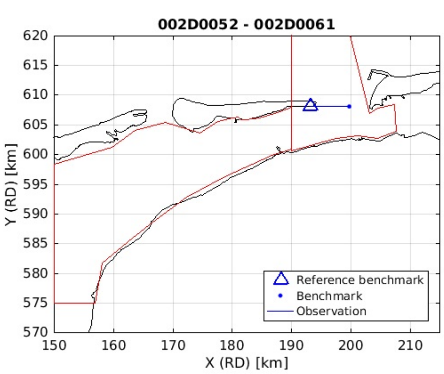

002D0052 - 002D0053
Deformation [mm]
279H05
289W05
289W16
289W37
344W01
371W00
aml1998
aml2003
NAM_A M2
Observation
Prognosis

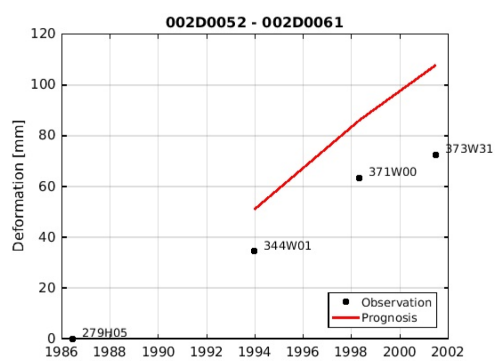

002D0052 - 002D0059
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

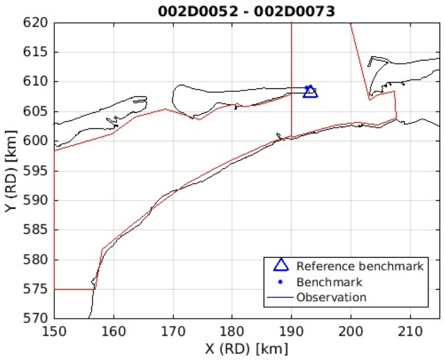

002D0052 - 002D0059
Deformation [mm]
279H05
344W01
371W00
373W31
Observation
Prognosis

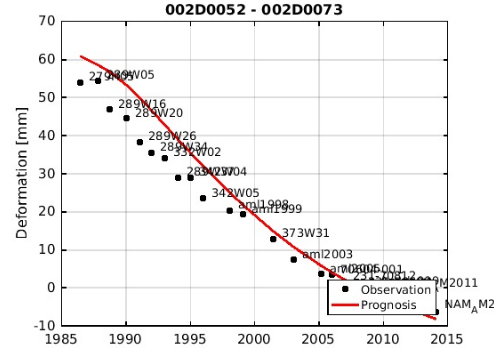

002D0052 - 002D0060
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

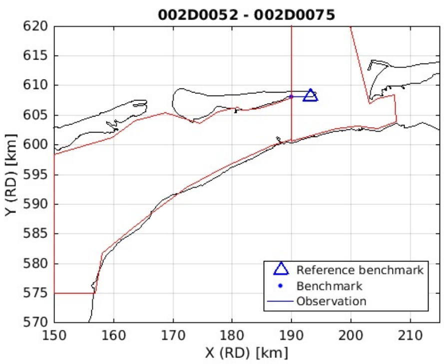

002D0052 - 002D0060
Deformation [mm]
279H05
344W01
371W00
373W31
Observation
Prognosis

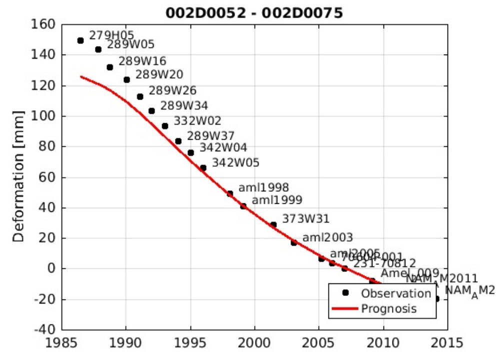

002D0052 - 002D0061
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

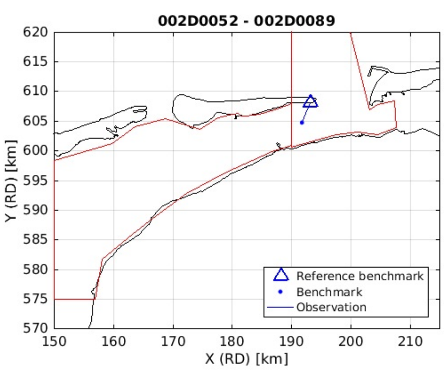

002D0052 - 002D0061
Deformation [mm]
279H05
344W01
371W00
373W31
Observation
Prognosis

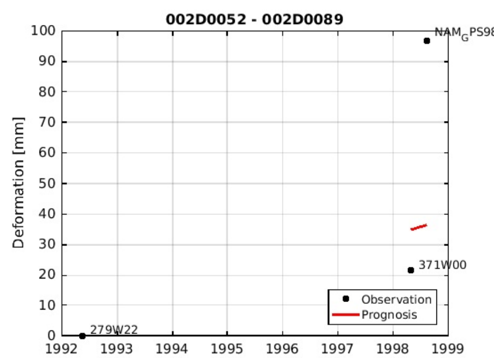

002D0052 - 002D0073
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

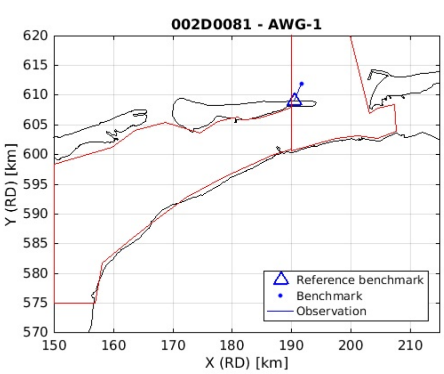

002D0052 - 002D0073
Deformation [mm]
289W05
289W16
289W20
289W26
289W34
332W02
342W04
342W05
aml1998
aml1999
373W31
aml2003
Observation
Prognosis

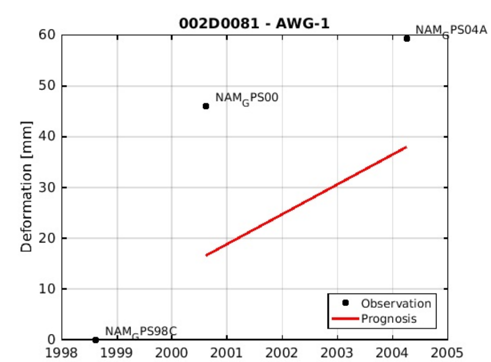

002D0052 - 002D0075
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

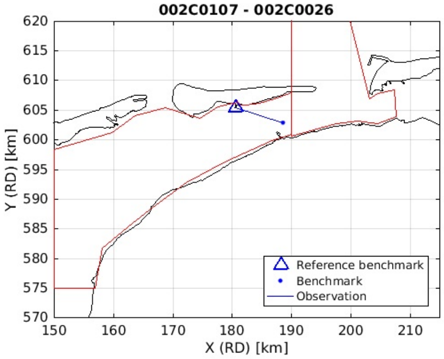

002D0052 - 002D0075
Deformation [mm]
279H05
289W05
289W16
289W20
289W26
289W34
332W02
289W37
342W04
342W05
aml1998
aml1999
373W31
aml2003
231-70812
Observation
Prognosis

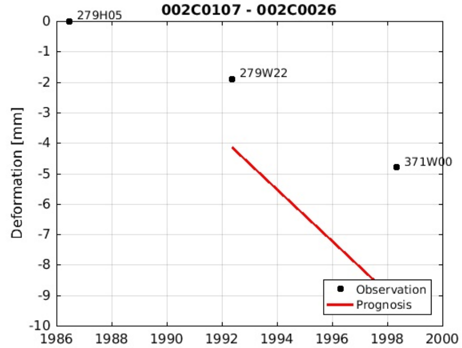

002D0052 - 002D0089
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

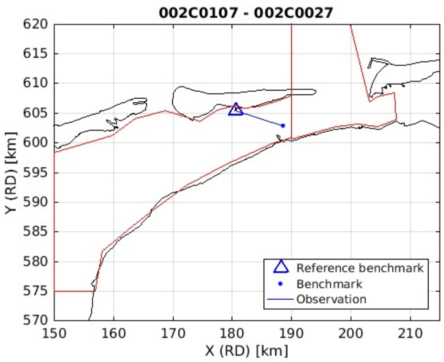

002D0052 - 002D0089
Deformation [mm]
371W00
279W22
Observation
Prognosis

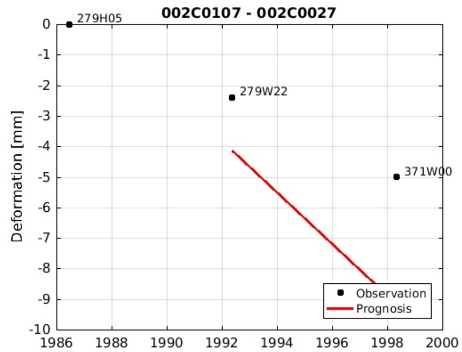

002D0081 - AWG-1
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

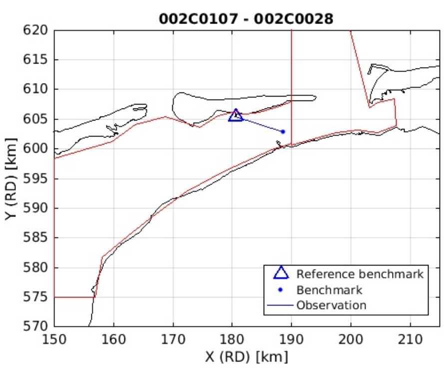

002D0081 - AWG-1
Deformation [mm]
NAM$_G$PS04A
NAM$_G$PS00
NAM$_G$PS98C
Observation
Prognosis

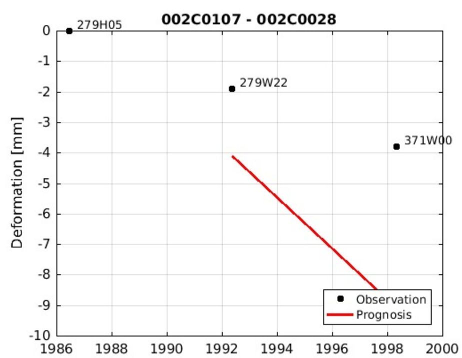

002C0107 - 002C0026
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

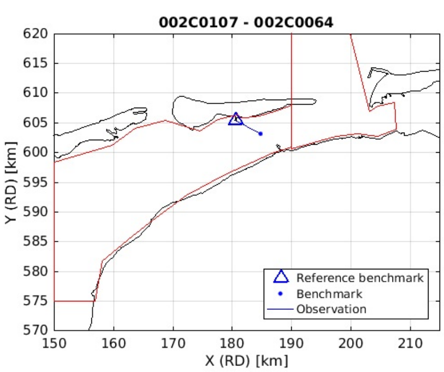

002C0107 - 002C0026
Deformation [mm]
279H05
279W22
371W00
Observation
Prognosis

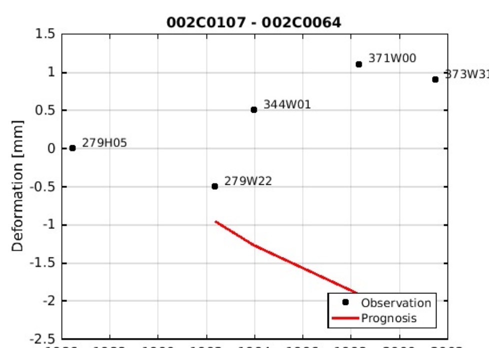

002C0107 - 002C0027
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

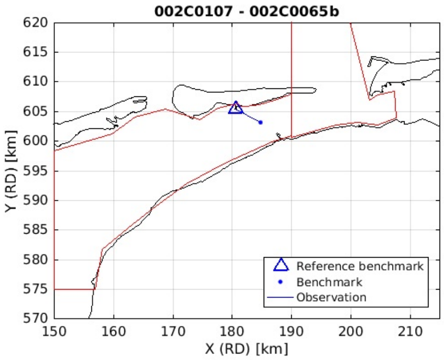

002C0107 - 002C0027
Deformation [mm]
279H05
279W22
371W00
Observation
Prognosis

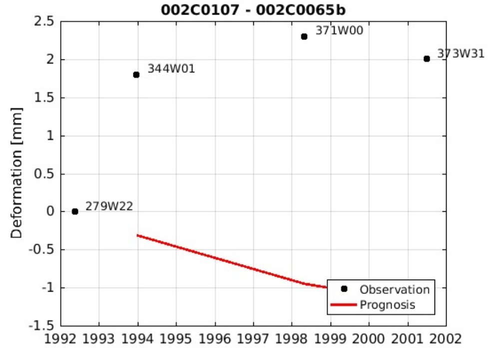

002C0107 - 002C0028
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation

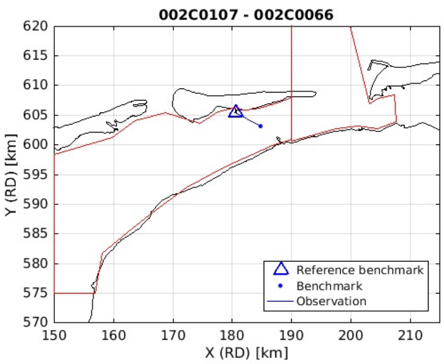

002C0107 - 002C0028
Deformation [mm]
279H05
279W22
371W00
Observation
Prognosis

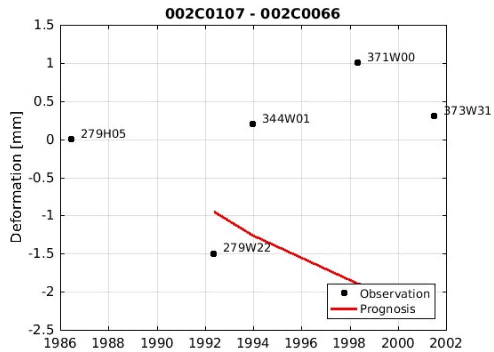

002C0107 - 002C0064
Y (RD) [km]
X (RD) [km]
Reference benchmark
Benchmark
Observation


002C0107 - 002C0064
Deformation [mm]
371W00
373W31
344W01
279H05
279W22
Observation
Prognosis










```
        end
      end
    end
```

```
end
```

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Appendix J. lts2_merge_lvl_gpsbaselines processing output

Contents lts2_merge_lvl_gpsbaselines.m

- Merge levelling and GPS baseline Netcdf files
- Specify input
- Merge files

Merge levelling and GPS baseline Netcdf files

*Freek van Leijen, Delft University of Technology, 17 October 2016 *

This Matlab script merges the levelling and GPS baseline Netcdf files. This temporary solution is applied because the current version of the getdata tool cannot handle more than 2 Netcdf files. Future versions of the getdata tool will be able to handle multiple files, and this merge will not be necessary anymore.

The inputs of the script are - netcdf_file_in1 levelling Netcdf filename - netcdf_file_in2 GPS baseline Netcdf filename - netcdf_file_out output Netcdf filename

The outputs are - merged Netcdf file

This script uses functions from the `lts2` toolbox.

```
% (c) Freek van Leijen, Delft University of Technology, 2016.

% Created:    17 October 2016 by Freek van Leijen
% Modified:
%


clear all
close all

% Set path to required toolboxes
lts2toolboxdir = fullfile('..','lts2toolbox');
addpath(genpath(fullfile(lts2toolboxdir,'lts2')));
```

Specify input

```
netcdf_file_in1 = '../lts2lvl/lts2_outlier_detection/lts2_alllevelling_flaggedOutliers.nc';
netcdf_file_in2 = '../lts2gpsbsl/lts2_gpsbaseline.nc';
netcdf_file_out = 'lts2_alllevelling_gpsbaseline.nc';
```

Merge files

```
mergelts2netcdf(netcdf_file_in1,netcdf_file_in2,netcdf_file_out);
```

```
Global Attributes:

title: LTS2 levelling dataset - flagged outliers
institution: Delft University of Technology, Netherlands.
source: Nederlandse Aardolie Maatschappij (NAM) height database.
technique: Levelling
history:
references: TU Delft, NAM LTS2 Report, 2016 (in preparation).
comment:   Merged from ../lts2lvl/lts2_outlier_detection/lts2_alllevelling_flaggedOutliers.nc and ../lts2gpsbsl/lts2_gpsbaseline.nc.
Conventions: CF-1.6
featureType: timeSeries
email: f.j.vanleijen@tudelft.nl
version: 1.0
terms_for_use: These data have been prepared for: Nederlandse Aardolie Maatschappij (NAM). Any use by third parties requires explicit ap
proval by NAM.
disclaimer: This data is made available in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty
of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
original_file: ../lts2_move3_to_netcdf/lts2_alllevelling.nc
id_noise_file: getdata_idealization_precision_26Oct2016.csv
outl_setting: gam0:0.8,  alpha0:0.0005,  OMT_th:24, minNobs_fortest:4


Some points have different coordinates

Benchmarks (440 points):

PNTNAME              X_RD         Y_RD    CLASS

0009994       188091.000   607436.000   LEV&ONSH
0009995       180897.000   608072.000   LEV&ONSH
0009996       183701.000   606988.000   LEV&ONSH
0009997       183537.000   607578.000   LEV&ONSH
0009998       189230.000   607893.000   LEV&OFFSH
0009999       189232.000   608132.000   LEV&ONSH
000A2050      195720.000   589520.000   LEV&ONSH
000A2592      180070.000   606750.000   LEV&ONSH
000A2594      206455.000   610345.000   LEV&ONSH
000A2596      176070.000   588220.000   LEV&ONSH
```

000A3526	165090.000	606800.000	LEV&OFFSH
000A3532	204720.000	610380.000	LEV&ONSH
000A4020	156610.000	576560.000	LEV&OFFSH
000A4025	208860.000	602780.000	LEV&ONSH
000A4070	187830.000	601050.000	LEV&ONSH
000G0092	192880.000	614560.000	LEV&OFFSH
000G0093	192880.000	614560.000	LEV&OFFSH
000G0094	192880.000	614560.000	LEV&OFFSH
000G0095	192880.000	614560.000	LEV&OFFSH
000G0096	192880.000	614560.000	LEV&OFFSH
000G0097	192880.000	614560.000	LEV&OFFSH
000G0099	192880.000	614560.000	LEV&OFFSH
000G0191	191950.000	612180.000	LEV&OFFSH
000G0192	191960.000	612160.000	LEV&OFFSH
000G0213	151570.000	604850.000	LEV&OFFSH
000G0391	186870.000	610910.000	GPS&OFFSH
001D0001	150560.000	600580.000	LEV&ONSH
001D0002	152000.000	601180.000	LEV&ONSH
001D0003	152630.000	601430.000	LEV&ONSH
001D0012	151220.000	600940.000	LEV&ONSH
001D0014	153500.000	601840.000	LEV&ONSH
001D0015	155020.000	603010.000	LEV&ONSH
001D0016	155070.000	603640.000	LEV&ONSH
001D0021	155900.000	603780.000	LEV&ONSH
001D0022	154580.000	602020.000	LEV&ONSH
001D0023	156520.000	604720.000	LEV&OFFSH
001D0024	157100.000	604940.000	LEV&OFFSH
001D0025	158060.000	605220.000	LEV&ONSH
001D0026	159040.000	605430.000	LEV&ONSH
001G0005	163780.000	607160.000	LEV&ONSH
001G0006	162800.000	606940.000	LEV&ONSH
001G0007	162270.000	606560.000	LEV&ONSH
001G0008	160900.000	606260.000	LEV&ONSH
001G0009	160000.000	605850.000	LEV&ONSH
001H0003	171160.000	605300.000	LEV&ONSH
001H0005	171850.000	605520.000	LEV&ONSH
001H0007	170640.000	605920.000	LEV&ONSH
001H0009	171220.000	605950.000	LEV&ONSH
001H0011	173710.000	606820.000	LEV&ONSH
001H0012	174790.000	606640.000	LEV&ONSH
001H0013	174900.000	606460.000	LEV&ONSH
001H0014	175080.000	606680.000	LEV&ONSH
001H0016	177320.000	606660.000	LEV&ONSH
001H0017	179090.000	606760.000	LEV&ONSH
001H0018	179970.000	606120.000	LEV&ONSH
001H0019	178130.000	606680.000	LEV&ONSH
001H0020	176230.000	606680.000	LEV&ONSH
001H0021	172530.000	606630.000	LEV&ONSH
001H0022	170750.000	605530.000	LEV&ONSH
001H0026	174700.000	604770.000	LEV&ONSH
001H0030	176230.000	600510.000	LEV&OFFSH
001H0031	176230.000	600510.000	LEV&OFFSH
001H0032	176230.000	600510.000	LEV&OFFSH
001H0045	171810.000	606460.000	LEV&ONSH
001H0046	177220.000	606300.000	LEV&ONSH
001H0047	178840.000	606250.000	LEV&ONSH
001H0048	178050.000	606460.000	LEV&ONSH
001H0049	176320.000	606070.000	LEV&ONSH
001H0050	175730.000	605250.000	LEV&ONSH
001H0051	174620.000	605210.000	LEV&ONSH
001H0052	174280.000	604870.000	LEV&ONSH
001H0053	173110.000	605110.000	LEV&ONSH
001H0054	172220.000	605160.000	LEV&ONSH
001H0055	174600.000	605210.000	LEV&ONSH
001H0056	172220.000	605160.000	LEV&ONSH
001H0057	172010.000	604720.000	LEV&ONSH
001H0058	174800.000	605980.000	LEV&ONSH
001H0059	172530.000	606630.000	LEV&ONSH
001H0061	179640.000	607980.000	LEV&ONSH
001H0062	179650.000	607930.000	LEV&ONSH
001H0063	179640.000	607930.000	LEV&ONSH
001H0064	171880.000	605230.000	LEV&ONSH
001H0065	175024.000	605300.000	LEV&ONSH
001H0066	179837.000	606193.000	LEV&ONSH
001H0067	178943.000	606327.000	LEV&ONSH
001H0068	177274.000	606489.000	LEV&ONSH
001H0069	178093.000	607083.000	LEV&ONSH
001H0070	176200.000	606670.000	LEV&ONSH
001H0071	172760.000	606640.000	LEV&ONSH
001H0072	178889.000	606825.000	LEV&ONSH
001H0073	175675.000	606695.000	LEV&ONSH
001H0074	174250.000	606730.000	LEV&ONSH
001H0075	171998.000	606508.000	LEV&ONSH
001H0076	173135.000	606735.000	LEV&ONSH
001H0077	176025.000	605660.000	LEV&ONSH
001H0078	179628.000	606961.000	LEV&ONSH
001H0079	171585.000	605010.000	LEV&ONSH
001H0080	179634.000	607445.000	LEV&ONSH

001H0081	174815.000	605835.000	LEV&ONSH
001H0082	172373.000	606603.000	LEV&ONSH
001H0083	172220.000	605150.000	LEV&ONSH
001H0084	176220.000	605580.000	LEV&ONSH
002C0001	180050.000	606700.000	LEV&ONSH
002C0002	180630.000	606520.000	LEV&ONSH
002C0003	180550.000	606650.000	LEV&ONSH
002C0006	181200.000	606940.000	LEV&ONSH
002C0009	181640.000	607740.000	LEV&ONSH
002C0010	182130.000	607810.000	LEV&ONSH
002C0016	180840.000	605930.000	LEV&ONSH
002C0018	184840.000	608410.000	LEV&ONSH
002C0019	188130.000	608320.000	LEV&ONSH
002C0020	187700.000	601050.000	LEV&ONSH
002C0023	184910.000	607050.000	LEV&ONSH
002C0026	188624.797	602828.875	LEV&OFFSH
002C0027	188625.391	602823.625	LEV&OFFSH
002C0028	188625.359	602813.688	LEV&OFFSH
002C0029	188454.516	604607.562	LEV&OFFSH
002C0030	188454.344	604602.562	LEV&OFFSH
002C0031	188454.344	604597.562	LEV&OFFSH
002C0032	188716.000	605113.000	LEV&OFFSH
002C0033	188354.891	606473.500	LEV&OFFSH
002C0034	188354.906	606468.438	LEV&OFFSH
002C0035	188355.812	606458.875	LEV&OFFSH
002C0037	188980.000	608530.000	LEV&ONSH
002C0038	187030.000	608380.000	LEV&ONSH
002C0039	185980.000	608400.000	LEV&ONSH
002C0040	184130.000	607800.000	LEV&ONSH
002C0041	183650.000	607130.000	LEV&ONSH
002C0042	182850.000	606980.000	LEV&ONSH
002C0043	181980.000	606850.000	LEV&ONSH
002C0045	180130.000	606730.000	LEV&ONSH
002C0047	185980.000	606870.000	LEV&ONSH
002C0064	184855.312	603078.625	LEV&OFFSH
002C0065a	184855.516	603073.500	LEV&OFFSH
002C0065b	184855.516	603073.500	LEV&OFFSH
002C0066	184854.906	603063.750	LEV&OFFSH
002C0082	189640.000	609010.000	LEV&OFFSH
002C0083	188850.000	607760.000	LEV&ONSH
002C0084	187710.000	607340.000	LEV&ONSH
002C0085	186550.000	607070.000	LEV&ONSH
002C0086	185940.000	608390.000	LEV&ONSH
002C0087	187020.000	608370.000	LEV&ONSH
002C0095	180070.000	606380.000	LEV&ONSH
002C0096	184180.000	607160.000	LEV&ONSH
002C0097	183530.000	607710.000	LEV&ONSH
002C0098	182690.000	607550.000	LEV&ONSH
002C0099	182610.000	607920.000	LEV&ONSH
002C0100	180850.000	607300.000	LEV&ONSH
002C0101	184840.000	608410.000	LEV&ONSH
002C0102	188130.000	608330.000	LEV&ONSH
002C0103	181010.000	606780.000	LEV&ONSH
002C0104	180980.000	606780.000	LEV&ONSH
002C0105	181180.000	607990.000	LEV&ONSH
002C0106	189220.000	608080.000	GPS&ONSH
002C0106a	189220.000	608080.000	LEV&ONSH
002C0106b	189220.000	608080.000	LEV&ONSH
002C0107	180700.000	605300.000	LEV&ONSH
002C0108	183650.000	607130.000	LEV&ONSH
002C0109	180730.000	606060.000	LEV&ONSH
002C0110	188120.000	607450.000	LEV&ONSH
002C0111	183690.000	607020.000	LEV&ONSH
002C0112a	189010.000	608520.000	LEV&ONSH
002C0112b	189010.000	608520.000	LEV&ONSH
002C0113	188500.000	607540.000	LEV&ONSH
002C0114	181640.000	607740.000	LEV&ONSH
002C0116	185980.000	606870.000	LEV&ONSH
002C0117	183550.000	607570.000	LEV&ONSH
002C0118	188050.000	600770.000	GPS&OFFSH
002C0120	187820.000	601020.000	LEV&ONSH
002C0121	189220.000	608080.000	LEV&ONSH
002C0122	180100.000	606650.000	LEV&ONSH
002C0123	183680.000	607150.000	LEV&ONSH
002C0124	180060.000	606460.000	LEV&ONSH
002C0125	185980.000	606870.000	LEV&ONSH
002C0127	180050.000	606440.000	LEV&ONSH
002C0128	189220.000	608080.000	LEV&ONSH
002C0129	188150.000	608320.000	LEV&ONSH
002C0131	184450.000	606420.000	LEV&ONSH
002C0133	183620.000	607650.000	LEV&ONSH
002C0134	181480.000	608010.000	LEV&ONSH
002C0135	182290.000	607830.000	LEV&ONSH
002C0136	180890.000	607990.000	LEV&ONSH
002C0137	183640.000	607130.000	LEV&ONSH
002C0138	183820.000	606130.000	LEV&ONSH
002C0139	183030.000	605950.000	LEV&ONSH
002C0140	182650.000	605850.000	LEV&ONSH

002C0141	181800.000	605900.000	LEV&ONSH
002C0142	180790.000	605940.000	LEV&ONSH
002C0143	189220.000	607900.000	LEV&OFFSH
002C0144	187480.000	607683.000	LEV&ONSH
002C0145	185730.000	607060.000	LEV&ONSH
002C0146	180057.000	607983.000	LEV&ONSH
002C0148	189063.000	608410.000	LEV&ONSH
002C0149	189325.000	608765.000	LEV&ONSH
002C0150	189168.000	608190.000	LEV&ONSH
002C0151	188366.000	607771.000	LEV&ONSH
002C0997	188105.000	607440.000	LEV&ONSH
002C0998	189115.000	608300.000	LEV&ONSH
002C0999	181015.000	607645.000	LEV&ONSH
002C9993	182670.000	607770.000	LEV&ONSH
002C9994	188091.000	607436.000	LEV&ONSH
002C9995	180897.000	608072.000	LEV&ONSH
002C9996	183701.000	606988.000	LEV&ONSH
002C9997	183537.000	607578.000	LEV&ONSH
002C9998	189230.000	607893.000	LEV&OFFSH
002C9999	189232.000	608132.000	LEV&ONSH
002D0007	196460.000	600910.000	LEV&ONSH
002D0012	196810.000	601910.000	LEV&ONSH
002D0013	196800.000	601950.000	LEV&ONSH
002D0015	197960.000	601880.000	LEV&ONSH
002D0019	199680.000	602330.000	LEV&ONSH
002D0021	199940.000	602370.000	LEV&ONSH
002D0023	191000.000	608660.000	LEV&ONSH
002D0028	194940.000	600090.000	LEV&ONSH
002D0029	193970.000	600020.000	LEV&ONSH
002D0036	197520.000	603970.000	LEV&OFFSH
002D0037	197520.000	603970.000	LEV&OFFSH
002D0038	197520.000	603970.000	LEV&OFFSH
002D0045	197880.000	606190.000	LEV&OFFSH
002D0046	197880.000	606200.000	LEV&OFFSH
002D0047	197880.000	606190.000	LEV&OFFSH
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002D0049	190432.625	607547.625	LEV&OFFSH
002D0050	190433.156	607538.000	LEV&OFFSH
002D0051	193170.000	608010.000	LEV&OFFSH
002D0052	193180.000	608000.000	LEV&OFFSH
002D0053	193160.000	608000.000	LEV&OFFSH
002D0054	190472.750	602133.625	LEV&OFFSH
002D0055	190473.266	602128.312	LEV&OFFSH
002D0059	199818.562	608020.625	LEV&OFFSH
002D0060	199818.172	608015.500	LEV&OFFSH
002D0061	199816.922	608005.188	LEV&OFFSH
002D0063	194665.750	603777.500	LEV&OFFSH
002D0064	194666.016	603771.562	LEV&OFFSH
002D0065	194666.500	603761.438	LEV&OFFSH
002D0066	192539.516	603415.000	LEV&OFFSH
002D0067	192540.484	603410.188	LEV&OFFSH
002D0068	192543.391	603400.500	LEV&OFFSH
002D0069	191950.000	608320.000	LEV&ONSH
002D0070	191630.000	608830.000	LEV&ONSH
002D0071	192620.000	608740.000	LEV&ONSH
002D0072	192600.000	608440.000	LEV&ONSH
002D0073	192640.000	608940.000	LEV&OFFSH
002D0074	190790.000	608220.000	LEV&ONSH
002D0075	190020.000	608030.000	LEV&OFFSH
002D0076	191000.000	608660.000	LEV&ONSH
002D0077	192960.000	608080.000	LEV&ONSH
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002D0078b	192620.000	608740.000	LEV&ONSH
002D0079	190500.000	608830.000	LEV&ONSH
002D0080	196400.000	600100.000	LEV&ONSH
002D0081	190550.000	608950.000	LEV&ONSH
002D0086	197340.000	601810.000	LEV&ONSH
002D0087	196450.000	601650.000	LEV&ONSH
002D0088	191820.000	604680.000	LEV&OFFSH
002D0089	191820.000	604680.000	LEV&OFFSH
002D0090	191820.000	604680.000	LEV&OFFSH
002D0095	191604.000	608535.000	LEV&ONSH
002D0096	192116.000	608428.000	LEV&ONSH
002D0099	193623.000	608650.000	LEV&ONSH
002D0100	193025.000	608705.000	LEV&ONSH
002D0101	190609.000	608627.000	LEV&ONSH
002D0114	190095.000	608980.000	LEV&OFFSH
002D0115	191617.000	608683.000	LEV&ONSH
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002D0118	193324.000	608678.000	LEV&ONSH
002F0003	210590.000	612760.000	LEV&ONSH
002F0004	211600.000	612800.000	LEV&ONSH
002F0005	213780.000	613150.000	LEV&ONSH
002G0014	200580.000	602360.000	LEV&ONSH
002G0015	201210.000	602060.000	LEV&ONSH
002G0019	206320.000	610580.000	LEV&ONSH
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002G0022	207500.000	610300.000	LEV&ONSH
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002G0029	208690.000	609950.000	LEV&ONSH
002G0030	205600.000	600930.000	LEV&ONSH
002G0032	208410.000	603120.000	LEV&OFFSH
002G0034	208820.000	602780.000	LEV&ONSH
002G0036	207000.000	603140.000	LEV&ONSH
002G0039	203630.000	600680.000	LEV&ONSH
002G0040	204240.000	600280.000	LEV&ONSH
002G0048	200137.703	605655.312	LEV&OFFSH
002G0049	200137.797	605649.938	LEV&OFFSH
002G0050	200137.656	605640.000	LEV&OFFSH
002G0055	205190.000	607400.000	LEV&OFFSH
002G0056	205190.000	607400.000	LEV&OFFSH
002G0057	205190.000	607400.000	LEV&OFFSH
002G0058	209990.000	602320.000	LEV&ONSH
002G0059	209170.000	609480.000	LEV&OFFSH
002G0062	209600.000	612660.000	LEV&ONSH
002G0063	206110.000	602620.000	LEV&ONSH
002G0065	207830.000	611100.000	LEV&ONSH
002G0066	206700.000	605870.000	LEV&OFFSH
002G0067	206700.000	605870.000	LEV&OFFSH
002G0068	206700.000	605870.000	LEV&OFFSH
002G0071	207900.000	610330.000	LEV&ONSH
002G0072	208960.000	610940.000	LEV&ONSH
002G0075	207360.000	603300.000	LEV&ONSH
002G0076	202250.000	601800.000	LEV&ONSH
002G0077	203100.000	601140.000	LEV&ONSH
002G0081	208700.000	602840.000	LEV&ONSH
002G0082	206580.000	610690.000	LEV&ONSH
002G0083	206460.000	610351.000	LEV&ONSH
002G0085	209150.000	602620.000	LEV&ONSH
002G0094	205890.000	601820.000	LEV&ONSH
002G0100	206460.000	610400.000	LEV&ONSH
002G0105	208860.000	603050.000	LEV&ONSH
002H0062	210600.000	601600.000	LEV&ONSH
002H0063	211400.000	601300.000	LEV&ONSH
002H0064	211520.000	600880.000	LEV&ONSH
002H0065	211480.000	600220.000	LEV&ONSH
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005B0006	158190.000	592280.000	LEV&OFFSH
005B0007	158190.000	592280.000	LEV&OFFSH
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005D0051	156320.000	582470.000	LEV&OFFSH
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005F0012	175580.000	588780.000	LEV&ONSH
005F0016	171900.000	589810.000	LEV&ONSH
005F0017	172100.000	589850.000	LEV&ONSH
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005F0023	173740.000	590100.000	LEV&ONSH
005F0024	174670.000	590200.000	LEV&ONSH
005F0030	179440.000	590670.000	LEV&ONSH
005F0031	179640.000	590880.000	LEV&ONSH
005F0051	177320.000	588280.000	LEV&ONSH
005F0053	179010.000	589100.000	LEV&ONSH
005F0054	175680.000	588160.000	LEV&ONSH
005F0055	176540.000	588220.000	LEV&ONSH
005F0070	172440.000	594530.000	LEV&OFFSH
005F0071	172440.000	594530.000	LEV&OFFSH
005F0092	176040.000	588260.000	LEV&ONSH
005F0093	172370.000	594880.000	LEV&OFFSH
005F0094	172370.000	594880.000	LEV&OFFSH
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005F0097	175440.000	590220.000	LEV&ONSH
005F0100	170480.000	589460.000	LEV&ONSH
005F0103	178230.000	589120.000	LEV&ONSH
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005F0108	179040.000	590040.000	LEV&ONSH
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006A0057	184050.000	594810.000	LEV&ONSH
006A0063	184840.000	595500.000	LEV&ONSH
006A0064	185480.000	595780.000	LEV&ONSH
006A0069	186510.000	596200.000	LEV&ONSH
006A0070	187180.000	596840.000	LEV&ONSH
006A0073	187960.000	597700.000	LEV&ONSH
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006A0078	188930.000	598430.000	LEV&ONSH
006A0079	188930.000	598430.000	LEV&ONSH

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006A0100      188700.000   598000.000   LEV&ONSH
006A0114      180130.000   591680.000   LEV&ONSH
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006A0154      187560.000   597370.000   LEV&ONSH
006A0157      189600.000   588560.000   LEV&ONSH
006A0160      189100.000   598330.000   LEV&ONSH
006A0161      189610.000   598510.000   LEV&ONSH
006A0162      189870.000   597380.000   LEV&ONSH
006A0163      183850.000   594690.000   LEV&ONSH
006A0164      184200.000   594850.000   LEV&ONSH
006A0173      189920.000   588700.000   LEV&ONSH
006A0200      188350.000   599300.000   LEV&ONSH
006A0205      188350.000   599300.000   LEV&ONSH
006A0206      181500.000   593150.000   LEV&ONSH
006B0002      195900.000   588570.000   LEV&ONSH
006B0003      190470.000   589160.000   LEV&ONSH
006B0007      194700.000   589570.000   LEV&ONSH
006B0008      195430.000   589440.000   LEV&ONSH
006B0009      195680.000   589900.000   LEV&ONSH
006B0010      195710.000   589510.000   LEV&ONSH
006B0011      195790.000   589180.000   LEV&ONSH
006B0016      192050.000   590090.000   LEV&ONSH
006B0019      192480.000   590230.000   LEV&ONSH
006B0020      195540.000   590590.000   LEV&ONSH
006B0027      195330.000   592040.000   LEV&ONSH
006B0036      195700.000   593360.000   LEV&ONSH
006B0037      195710.000   593340.000   LEV&ONSH
006B0046      193220.000   594190.000   LEV&ONSH
006B0047      193580.000   594130.000   LEV&ONSH
006B0060      191920.000   595580.000   LEV&ONSH
006B0061      192380.000   595160.000   LEV&ONSH
006B0072      191120.000   596310.000   LEV&ONSH
006B0097      190770.000   599020.000   LEV&ONSH
006B0102      193430.000   599670.000   LEV&ONSH
006B0138      193110.000   589960.000   LEV&ONSH
006B0197      190480.000   596830.000   LEV&ONSH
006B0206      196040.000   587840.000   LEV&ONSH
006B0207      195780.000   592740.000   LEV&ONSH
006B0209      193680.000   599800.000   LEV&ONSH
006B0228      195440.000   593500.000   LEV&ONSH
006B0229      195680.000   593460.000   LEV&ONSH
006B0231      195880.000   593160.000   LEV&ONSH


006B0232      195200.000   593470.000   LEV&ONSH
006B0234      192990.000   594370.000   LEV&ONSH
006B0235      191800.000   595560.000   LEV&ONSH
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Create NAM LTS2 netcdf schema ...
Write NAM LTS2 netcdf schema to file...
Write data to NAM LTS2 netcdf...
Done.


From       To         Project       Obs [m] StDev [mm] Flg   N E U  Date

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000A2592	002C0103	289W05	1.0757	0.77	0	0 0 1	1987-11-03 00:00
000A2592	002C0104	289W05	1.1709	0.76	0	0 0 1	1987-11-03 00:00
000A2592	002C0105	289W05	14.8857	1.10	0	0 0 1	1987-11-03 00:00
000A2592	002C0106b	289W05	17.0349	1.88	0	0 0 1	1987-11-03 00:00
000A2592	002C0107	289W05	-1.7244	0.93	0	0 0 1	1987-11-03 00:00
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000A2592	002D0051	289W05	-3.2189	2.20	0	0 0 1	1987-11-03 00:00
000A2592	002D0052	289W05	-3.3319	2.19	0	0 0 1	1987-11-03 00:00
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000A2592	002D0070	289W05	-1.0211	2.10	0	0 0 1	1987-11-03 00:00
000A2592	002D0071	289W05	-1.6213	2.10	0	0 0 1	1987-11-03 00:00
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000A2592	002D0079	289W05	-0.8528	2.05	0	0 0 1	1987-11-03 00:00
000A2592	000A2594	344W01	-1.4079	3.42	0	0 0 1	1993-12-23 00:00
000A2592	000A3526	344W01	-2.2526	2.89	0	0 0 1	1993-12-23 00:00
000A2592	000A3532	344W01	4.2773	3.37	0	0 0 1	1993-12-23 00:00
000A2592	000A4025	344W01	3.1976	3.26	0	0 0 1	1993-12-23 00:00
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000A2592	001H0011	344W01	-0.1795	2.03	0	0 0 1	1993-12-23 00:00
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000A2592	001H0013	344W01	0.8245	1.84	0	0 0 1	1993-12-23 00:00
000A2592	001H0014	344W01	-0.1410	1.77	0	0 0 1	1993-12-23 00:00
000A2592	001H0016	344W01	-1.0279	1.33	0	0 0 1	1993-12-23 00:00
000A2592	001H0017	344W01	-0.8861	0.84	0	0 0 1	1993-12-23 00:00
000A2592	001H0019	344W01	-2.0648	1.13	0	0 0 1	1993-12-23 00:00
000A2592	001H0020	344W01	-1.2299	1.56	0	0 0 1	1993-12-23 00:00
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000A2592	001H0045	344W01	-0.3687	2.34	0	0 0 1	1993-12-23 00:00
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000A2592	002C0002	344W01	0.2346	0.66	0	0 0 1	1993-12-23 00:00
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000A2592	002C0042	344W01	-0.6118	1.34	0	0 0 1	1993-12-23 00:00
000A2592	002C0043	344W01	-0.5234	1.12	0	0 0 1	1993-12-23 00:00
000A2592	002C0045	344W01	-0.2648	0.21	0	0 0 1	1993-12-23 00:00
000A2592	002C0064	344W01	-4.3373	1.34	0	0 0 1	1993-12-23 00:00
000A2592	002C0065b	344W01	-4.3099	1.33	0	0 0 1	1993-12-23 00:00
000A2592	002C0066	344W01	-4.4130	1.33	0	0 0 1	1993-12-23 00:00
000A2592	002C0086	344W01	-1.4727	2.09	0	0 0 1	1993-12-23 00:00
000A2592	002C0087	344W01	-1.5260	2.23	0	0 0 1	1993-12-23 00:00
000A2592	002C0102	344W01	-0.8028	2.37	0	0 0 1	1993-12-23 00:00
000A2592	002C0103	344W01	1.0748	0.82	0	0 0 1	1993-12-23 00:00
000A2592	002C0107	344W01	-1.7261	1.12	0	0 0 1	1993-12-23 00:00
000A2592	002C0109	344W01	-1.4968	0.88	0	0 0 1	1993-12-23 00:00
000A2592	002C0111	344W01	-1.5051	1.54	0	0 0 1	1993-12-23 00:00
000A2592	002D0051	344W01	-3.2515	3.13	0	0 0 1	1993-12-23 00:00
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000A2592	002D0059	344W01	-2.8623	3.27	0	0 0 1	1993-12-23 00:00
000A2592	002D0060	344W01	-2.6913	3.26	0	0 0 1	1993-12-23 00:00
000A2592	002D0061	344W01	-2.8351	3.27	0	0 0 1	1993-12-23 00:00
000A2592	002D0070	344W01	-1.1061	2.90	0	0 0 1	1993-12-23 00:00
000A2592	002D0072	344W01	-1.9201	3.04	0	0 0 1	1993-12-23 00:00

000A2592	002D0076	344W01	-1.0385	2.81	0	0	0	1	1993-12-23	00:00
000A2592	002F0003	344W01	-1.9114	3.77	0	0	0	1	1993-12-23	00:00
000A2592	002F0004	344W01	-2.2168	3.85	0	0	0	1	1993-12-23	00:00
000A2592	002F0005	344W01	-1.5413	4.02	0	0	0	1	1993-12-23	00:00
000A2592	002G0019	344W01	2.0617	3.40	0	0	0	1	1993-12-23	00:00
000A2592	002G0021	344W01	0.9794	3.39	0	0	0	1	1993-12-23	00:00
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000A2592	002G0026	344W01	-0.6294	3.41	0	0	0	1	1993-12-23	00:00
000A2592	002G0027	344W01	-0.4446	3.45	0	0	0	1	1993-12-23	00:00
000A2592	002G0029	344W01	2.1176	3.31	0	0	0	1	1993-12-23	00:00
000A2592	002G0059	344W01	-1.6818	3.26	0	0	0	1	1993-12-23	00:00
000A2592	002G0062	344W01	-1.9109	3.69	0	0	0	1	1993-12-23	00:00
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000A2592	002G0066	344W01	-3.3754	3.33	0	0	0	1	1993-12-23	00:00
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000A2592	002G0068	344W01	-3.5525	3.31	0	0	0	1	1993-12-23	00:00
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002C0029	002C0030	AMEL0409	0.0170	0.10	0	0	0	1	2004-09-15	00:00
002C0029	002C0032	AMEL0409	-0.2103	0.58	0	0	0	1	2004-09-15	00:00
002C0029	002C0033	AMEL0409	0.3186	1.07	0	0	0	1	2004-09-15	00:00
002C0029	002C0034	AMEL0409	0.2150	1.08	0	0	0	1	2004-09-15	00:00
002C0029	002C0035	AMEL0409	0.1573	1.08	0	0	0	1	2004-09-15	00:00
002C0029	002C0083	AMEL0409	7.9639	1.43	0	0	0	1	2004-09-15	00:00
002C0029	002C0112b	AMEL0409	4.8373	1.62	0	0	0	1	2004-09-15	00:00
002C0029	002C0113	AMEL0409	3.4651	1.34	0	0	0	1	2004-09-15	00:00
002C0029	002C0121	AMEL0409	21.5453	1.52	0	0	0	1	2004-09-15	00:00
002D0075	002D0048	AMEL0409	-1.9081	0.63	0	0	0	1	2004-09-15	00:00
002D0075	002D0049	AMEL0409	-1.9844	0.62	0	0	0	1	2004-09-15	00:00
002D0075	002D0050	AMEL0409	-1.9922	0.61	0	0	0	1	2004-09-15	00:00
000A2592	000A2050	371W00	-2.5442	3.41	0	0	0	1	1998-05-01	00:00
000A2592	000A2594	371W00	-1.4133	2.53	0	0	0	1	1998-05-01	00:00
000A2592	000A2596	371W00	-3.8059	3.78	0	0	0	1	1998-05-01	00:00
000A2592	000A3532	371W00	4.2689	2.30	0	0	0	1	1998-05-01	00:00
000A2592	000A4025	371W00	3.1939	1.82	0	0	0	1	1998-05-01	00:00
000A2592	000A4070	371W00	-0.8465	1.27	0	0	0	1	1998-05-01	00:00
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000A2592	001H0011	371W00	-0.1824	1.99	0	0	0	1	1998-05-01	00:00
000A2592	001H0012	371W00	0.3323	1.82	0	0	0	1	1998-05-01	00:00
000A2592	001H0014	371W00	-0.1436	1.77	0	0	0	1	1998-05-01	00:00
000A2592	001H0016	371W00	-1.0296	1.34	0	0	0	1	1998-05-01	00:00
000A2592	001H0017	371W00	-0.8931	0.85	0	0	0	1	1998-05-01	00:00
000A2592	001H0019	371W00	-2.0660	1.14	0	0	0	1	1998-05-01	00:00
000A2592	001H0020	371W00	-1.2318	1.56	0	0	0	1	1998-05-01	00:00
000A2592	001H0022	371W00	2.1421	2.55	0	0	0	1	1998-05-01	00:00
000A2592	001H0045	371W00	-0.3689	2.30	0	0	0	1	1998-05-01	00:00
000A2592	001H0059	371W00	-0.5298	2.16	0	0	0	1	1998-05-01	00:00
000A2592	002C0001	371W00	-0.7942	0.31	0	0	0	1	1998-05-01	00:00
000A2592	002C0020	371W00	-2.1267	1.29	0	0	0	1	1998-05-01	00:00
000A2592	002C0026	371W00	-4.9899	1.57	0	0	0	1	1998-05-01	00:00
000A2592	002C0027	371W00	-4.8978	1.57	0	0	0	1	1998-05-01	00:00
000A2592	002C0028	371W00	-4.8695	1.57	0	0	0	1	1998-05-01	00:00
000A2592	002C0064	371W00	-4.3426	1.31	0	0	0	1	1998-05-01	00:00
000A2592	002C0065b	371W00	-4.3153	1.31	0	0	0	1	1998-05-01	00:00
000A2592	002C0066	371W00	-4.4181	1.32	0	0	0	1	1998-05-01	00:00
000A2592	002C0095	371W00	-1.2143	0.58	0	0	0	1	1998-05-01	00:00
000A2592	002C0107	371W00	-1.7320	1.13	0	0	0	1	1998-05-01	00:00
000A2592	002C0109	371W00	-1.4993	0.90	0	0	0	1	1998-05-01	00:00
000A2592	002C0120	371W00	0.0447	1.28	0	0	0	1	1998-05-01	00:00
000A2592	002C0124	371W00	-0.8039	0.52	0	0	0	1	1998-05-01	00:00
000A2592	002C0127	371W00	2.4566	0.57	0	0	0	1	1998-05-01	00:00
000A2592	002D0007	371W00	-2.5389	2.44	0	0	0	1	1998-05-01	00:00
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000A2592	002D0015	371W00	-2.6701	2.50	0	0	0	1	1998-05-01	00:00
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000A2592	002D0021	371W00	-2.4040	2.51	0	0	0	1	1998-05-01	00:00
000A2592	002D0028	371W00	-2.2901	2.33	0	0	0	1	1998-05-01	00:00
000A2592	002D0029	371W00	-2.4340	2.27	0	0	0	1	1998-05-01	00:00
000A2592	002D0051	371W00	-3.2932	1.61	0	0	0	1	1998-05-01	00:00
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000A2592	002D0087	371W00	-2.1062	2.46	0	0	0	1	1998-05-01	00:00
000A2592	002D0088	371W00	-4.5342	1.59	0	0	0	1	1998-05-01	00:00
000A2592	002D0089	371W00	-4.5442	1.59	0	0	0	1	1998-05-01	00:00
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000A2592	002F0003	371W00	-1.9199	3.19	0	0	0	1	1998-05-01	00:00
000A2592	002F0004	371W00	-2.2255	3.29	0	0	0	1	1998-05-01	00:00

000A2592	002F0005	371W00	-1.5536	3.49	0	0	0	1	1998-05-01 00:00
000A2592	002G0014	371W00	-2.1764	2.51	0	0	0	1	1998-05-01 00:00
000A2592	002G0015	371W00	-1.9757	2.50	0	0	0	1	1998-05-01 00:00
000A2592	002G0019	371W00	2.0555	2.59	0	0	0	1	1998-05-01 00:00
000A2592	002G0021	371W00	0.9733	2.65	0	0	0	1	1998-05-01 00:00
000A2592	002G0026	371W00	-0.6365	2.75	0	0	0	1	1998-05-01 00:00
000A2592	002G0027	371W00	-0.4521	2.83	0	0	0	1	1998-05-01 00:00
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000A2592	002G0036	371W00	-1.2425	2.06	0	0	0	1	1998-05-01 00:00
000A2592	002G0039	371W00	-2.1430	2.42	0	0	0	1	1998-05-01 00:00
000A2592	002G0040	371W00	-2.2944	2.39	0	0	0	1	1998-05-01 00:00
000A2592	002G0058	371W00	-2.3970	2.06	0	0	0	1	1998-05-01 00:00
000A2592	002G0062	371W00	-1.9189	3.10	0	0	0	1	1998-05-01 00:00
000A2592	002G0063	371W00	-2.5959	2.14	0	0	0	1	1998-05-01 00:00
000A2592	002G0065	371W00	-1.3366	2.79	0	0	0	1	1998-05-01 00:00
000A2592	002G0075	371W00	-1.1105	2.02	0	0	0	1	1998-05-01 00:00
000A2592	002G0076	371W00	-2.1140	2.48	0	0	0	1	1998-05-01 00:00
000A2592	002G0077	371W00	-1.5986	2.45	0	0	0	1	1998-05-01 00:00
000A2592	002G0081	371W00	2.0246	1.85	0	0	0	1	1998-05-01 00:00
000A2592	002G0082	371W00	0.8316	2.62	0	0	0	1	1998-05-01 00:00
000A2592	002G0083	371W00	-0.0041	2.53	0	0	0	1	1998-05-01 00:00
000A2592	002G0085	371W00	2.2772	1.88	0	0	0	1	1998-05-01 00:00
000A2592	002G0094	371W00	-4.1478	2.21	0	0	0	1	1998-05-01 00:00
000A2592	002G0100	371W00	6.1369	2.54	0	0	0	1	1998-05-01 00:00
000A2592	002H0062	371W00	-3.3719	2.21	0	0	0	1	1998-05-01 00:00
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000A2592	005F0018	371W00	-0.4896	4.18	0	0	0	1	1998-05-01 00:00
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000A2592	005F0030	371W00	-2.4304	3.35	0	0	0	1	1998-05-01 00:00
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000A2592	006A0069	371W00	0.0639	2.31	0	0	0	1	1998-05-01 00:00
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000A2592	006A0073	371W00	-0.9582	1.97	0	0	0	1	1998-05-01 00:00
000A2592	006A0076	371W00	-0.3314	1.76	0	0	0	1	1998-05-01 00:00
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000A2592	006A0206	371W00	-1.7573	3.04	0	0	0	1	1998-05-01 00:00
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000A2592	006B0003	371W00	-3.2897	3.89	0	0	0	1	1998-05-01 00:00
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000A2592	006B0016	371W00	-0.3081	3.73	0	0	0	1	1998-05-01 00:00

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000A2592	006B0060	371W00	2.0817	2.38	0	0 0 1	1998-05-01 00:00
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000A2592	006B0240	371W00	-2.4689	3.67	0	0 0 1	1998-05-01 00:00
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000A2592	000A4070	373W31	-0.8442	1.09	0	0 0 1	2001-07-04 00:00
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000A2592	001D0003	373W31	-0.7094	4.39	0	0 0 1	2001-07-04 00:00
000A2592	001D0012	373W31	-2.1422	4.50	0	0 0 1	2001-07-04 00:00
000A2592	001D0014	373W31	-0.0189	4.33	0	0 0 1	2001-07-04 00:00
000A2592	001D0016	373W31	-0.8209	4.13	0	0 0 1	2001-07-04 00:00
000A2592	001D0021	373W31	-0.3505	4.06	0	0 0 1	2001-07-04 00:00
000A2592	001D0022	373W31	-0.1353	4.25	0	0 0 1	2001-07-04 00:00
000A2592	001D0023	373W31	-0.7183	3.96	0	0 0 1	2001-07-04 00:00
000A2592	001D0024	373W31	-1.0421	3.91	0	0 0 1	2001-07-04 00:00
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000A2592	001H0007	373W31	-0.8494	2.47	0	0 0 1	2001-07-04 00:00
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000A2592	001H0011	373W31	-0.1788	1.99	0	0 0 1	2001-07-04 00:00
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000A2592	001H0014	373W31	-0.1438	1.73	0	0 0 1	2001-07-04 00:00
000A2592	001H0016	373W31	-1.0305	1.28	0	0 0 1	2001-07-04 00:00
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000A2592	001H0022	373W31	2.1471	2.54	0	0 0 1	2001-07-04 00:00
000A2592	001H0045	373W31	-0.3631	2.29	0	0 0 1	2001-07-04 00:00
000A2592	001H0059	373W31	-0.5248	2.16	0	0 0 1	2001-07-04 00:00
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000A2592	002C0023	373W31	-0.1804	1.47	0	0	0	1	2001-07-04 00:00
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000A2592	002C0045	373W31	-0.2660	0.20	0	0	0	1	2001-07-04 00:00
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000A2592	002C0065b	373W31	-4.3156	1.12	0	0	0	1	2001-07-04 00:00
000A2592	002C0066	373W31	-4.4188	1.12	0	0	0	1	2001-07-04 00:00
000A2592	002C0082	373W31	-0.8017	1.96	0	0	0	1	2001-07-04 00:00
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000A2592	002C0098	373W31	-0.0658	1.21	0	0	0	1	2001-07-04 00:00
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000A2592	002C0102	373W31	-1.1397	1.77	3	0	0	1	2001-07-04 00:00
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000A2592	002C0107	373W31	-1.7320	0.91	0	0	0	1	2001-07-04 00:00
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000A2592	002C0117	373W31	0.0670	1.22	0	0	0	1	2001-07-04 00:00
000A2592	002C0121	373W31	16.6953	1.97	0	0	0	1	2001-07-04 00:00
000A2592	002C0122	373W31	-1.3579	0.42	0	0	0	1	2001-07-04 00:00
000A2592	002C0123	373W31	-0.7784	1.21	0	0	0	1	2001-07-04 00:00
000A2592	002C0125	373W31	-0.7508	1.61	0	0	0	1	2001-07-04 00:00
000A2592	002D0051	373W31	-3.3061	2.24	0	0	0	1	2001-07-04 00:00
000A2592	002D0052	373W31	-3.4198	2.24	0	0	0	1	2001-07-04 00:00
000A2592	002D0053	373W31	-3.3018	2.24	0	0	0	1	2001-07-04 00:00
000A2592	002D0059	373W31	-2.8797	2.34	0	0	0	1	2001-07-04 00:00
000A2592	002D0060	373W31	-2.7087	2.35	0	0	0	1	2001-07-04 00:00
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000A2592	002D0069	373W31	-1.6756	2.11	0	0	0	1	2001-07-04 00:00
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000A2592	002D0072	373W31	-1.9891	2.14	0	0	0	1	2001-07-04 00:00
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000A2592	002D0076	373W31	-1.1508	2.01	0	0	0	1	2001-07-04 00:00
000A2592	002D0078a	373W31	0.6510	2.14	3	0	0	1	2001-07-04 00:00
000A2592	002D0079	373W31	-1.0655	2.01	0	0	0	1	2001-07-04 00:00
000A2592	002D0081	373W31	0.3283	2.00	0	0	0	1	2001-07-04 00:00
000A2592	002F0003	373W31	-1.9141	3.45	0	0	0	1	2001-07-04 00:00
000A2592	002F0004	373W31	-2.2200	3.53	0	0	0	1	2001-07-04 00:00
000A2592	002F0005	373W31	-1.5485	3.72	0	0	0	1	2001-07-04 00:00
000A2592	002G0019	373W31	2.0552	2.95	0	0	0	1	2001-07-04 00:00
000A2592	002G0021	373W31	0.9745	3.00	0	0	0	1	2001-07-04 00:00
000A2592	002G0022	373W31	-1.1999	3.02	0	0	0	1	2001-07-04 00:00
000A2592	002G0023	373W31	-0.9418	3.07	0	0	0	1	2001-07-04 00:00
000A2592	002G0026	373W31	-0.6345	3.04	0	0	0	1	2001-07-04 00:00
000A2592	002G0027	373W31	-0.4492	3.12	0	0	0	1	2001-07-04 00:00
000A2592	002G0062	373W31	-1.9139	3.36	0	0	0	1	2001-07-04 00:00
000A2592	002G0065	373W31	-1.3338	3.08	0	0	0	1	2001-07-04 00:00
000A2592	002G0071	373W31	-1.1167	3.04	0	0	0	1	2001-07-04 00:00
000A2592	002G0072	373W31	-1.3031	3.07	0	0	0	1	2001-07-04 00:00
000A2592	002G0082	373W31	0.8317	2.98	0	0	0	1	2001-07-04 00:00
000A2592	002G0083	373W31	-0.0044	2.91	0	0	0	1	2001-07-04 00:00
000A2592	002G0105	373W31	0.4658	2.49	0	0	0	1	2001-07-04 00:00
000A2592	002C0001	289W16	-0.7918	0.28	0	0	0	1	1988-10-01 00:00
000A2592	002C0002	289W16	0.2342	0.57	0	0	0	1	1988-10-01 00:00
000A2592	002C0003	289W16	1.7369	0.52	0	0	0	1	1988-10-01 00:00
000A2592	002C0006	289W16	0.4248	0.85	0	0	0	1	1988-10-01 00:00
000A2592	002C0009	289W16	1.8824	1.06	0	0	0	1	1988-10-01 00:00
000A2592	002C0018	289W16	0.0766	1.53	0	0	0	1	1988-10-01 00:00
000A2592	002C0019	289W16	-0.6150	1.78	0	0	0	1	1988-10-01 00:00
000A2592	002C0023	289W16	-0.1561	1.48	0	0	0	1	1988-10-01 00:00
000A2592	002C0037	289W16	-1.2192	1.88	0	0	0	1	1988-10-01 00:00
000A2592	002C0040	289W16	-1.0646	1.39	0	0	0	1	1988-10-01 00:00
000A2592	002C0042	289W16	-0.6090	1.17	0	0	0	1	1988-10-01 00:00
000A2592	002C0043	289W16	-0.5222	1.05	0	0	0	1	1988-10-01 00:00
000A2592	002C0045	289W16	-0.2638	0.22	0	0	0	1	1988-10-01 00:00
000A2592	002C0047	289W16	-1.5236	1.62	0	0	0	1	1988-10-01 00:00
000A2592	002C0082	289W16	-0.5812	1.95	0	0	0	1	1988-10-01 00:00
000A2592	002C0083	289W16	3.2740	1.79	0	0	0	1	1988-10-01 00:00
000A2592	002C0084	289W16	-1.6924	1.76	0	0	0	1	1988-10-01 00:00
000A2592	002C0085	289W16	-0.3740	1.69	0	0	0	1	1988-10-01 00:00
000A2592	002C0086	289W16	-1.4445	1.66	0	0	0	1	1988-10-01 00:00

000A2592	002C0087	289W16	-1.4772	1.74	0	0	0	1	1988-10-01 00:00
000A2592	002C0095	289W16	-1.2130	0.50	0	0	0	1	1988-10-01 00:00
000A2592	002C0096	289W16	-0.9418	1.34	0	0	0	1	1988-10-01 00:00
000A2592	002C0097	289W16	-0.0815	1.23	0	0	0	1	1988-10-01 00:00
000A2592	002C0098	289W16	-0.0603	1.22	0	0	0	1	1988-10-01 00:00
000A2592	002C0099	289W16	2.1310	1.18	0	0	0	1	1988-10-01 00:00
000A2592	002C0100	289W16	0.3374	0.85	0	0	0	1	1988-10-01 00:00
000A2592	002C0101	289W16	-0.0814	1.53	0	0	0	1	1988-10-01 00:00
000A2592	002C0102	289W16	-0.7604	1.78	0	0	0	1	1988-10-01 00:00
000A2592	002C0103	289W16	1.0764	0.75	0	0	0	1	1988-10-01 00:00
000A2592	002C0105	289W16	14.8865	1.11	0	0	0	1	1988-10-01 00:00
000A2592	002C0106b	289W16	17.0325	1.97	0	0	0	1	1988-10-01 00:00
000A2592	002C0107	289W16	-1.7233	0.93	0	0	0	1	1988-10-01 00:00
000A2592	002C0108	289W16	-1.2505	1.22	0	0	0	1	1988-10-01 00:00
000A2592	002C0109	289W16	-1.4950	0.63	0	0	0	1	1988-10-01 00:00
000A2592	002C0110	289W16	-1.8105	1.77	0	0	0	1	1988-10-01 00:00
000A2592	002D0023	289W16	-1.7819	1.98	0	0	0	1	1988-10-01 00:00
000A2592	002D0051	289W16	-3.2210	2.20	0	0	0	1	1988-10-01 00:00
000A2592	002D0052	289W16	-3.3341	2.22	0	0	0	1	1988-10-01 00:00
000A2592	002D0053	289W16	-3.2170	2.23	0	0	0	1	1988-10-01 00:00
000A2592	002D0069	289W16	-1.5283	2.08	0	0	0	1	1988-10-01 00:00
000A2592	002D0070	289W16	-1.0319	2.07	0	0	0	1	1988-10-01 00:00
000A2592	002D0071	289W16	-1.6319	2.11	0	0	0	1	1988-10-01 00:00
000A2592	002D0072	289W16	-1.8737	2.11	0	0	0	1	1988-10-01 00:00
000A2592	002D0073	289W16	-2.1220	2.11	0	0	0	1	1988-10-01 00:00
000A2592	002D0074	289W16	-1.6210	1.96	0	0	0	1	1988-10-01 00:00
000A2592	002D0075	289W16	-1.9803	1.92	0	0	0	1	1988-10-01 00:00
000A2592	002D0079	289W16	-0.8663	1.98	0	0	0	1	1988-10-01 00:00
000A2592	002C0001	289W20	-0.7911	0.27	0	0	0	1	1990-02-01 00:00
000A2592	002C0002	289W20	0.2330	0.55	0	0	0	1	1990-02-01 00:00
000A2592	002C0003	289W20	1.7355	0.51	0	0	0	1	1990-02-01 00:00
000A2592	002C0006	289W20	0.4223	0.85	0	0	0	1	1990-02-01 00:00
000A2592	002C0009	289W20	1.8794	1.05	0	0	0	1	1990-02-01 00:00
000A2592	002C0018	289W20	0.0660	1.52	0	0	0	1	1990-02-01 00:00
000A2592	002C0019	289W20	-0.6383	1.76	0	0	0	1	1990-02-01 00:00
000A2592	002C0023	289W20	-0.1632	1.49	0	0	0	1	1990-02-01 00:00
000A2592	002C0037	289W20	-1.2498	1.87	0	0	0	1	1990-02-01 00:00
000A2592	002C0040	289W20	-1.0725	1.38	0	0	0	1	1990-02-01 00:00
000A2592	002C0042	289W20	-0.6119	1.16	0	0	0	1	1990-02-01 00:00
000A2592	002C0043	289W20	-0.5242	1.05	0	0	0	1	1990-02-01 00:00
000A2592	002C0045	289W20	-0.2650	0.22	0	0	0	1	1990-02-01 00:00
000A2592	002C0047	289W20	-1.5335	1.62	0	0	0	1	1990-02-01 00:00
000A2592	002C0082	289W20	-0.6162	1.95	0	0	0	1	1990-02-01 00:00
000A2592	002C0083	289W20	3.2503	1.78	0	0	0	1	1990-02-01 00:00
000A2592	002C0084	289W20	-1.7083	1.75	0	0	0	1	1990-02-01 00:00
000A2592	002C0085	289W20	-0.3861	1.69	0	0	0	1	1990-02-01 00:00
000A2592	002C0086	289W20	-1.4594	1.64	0	0	0	1	1990-02-01 00:00
000A2592	002C0087	289W20	-1.4947	1.72	0	0	0	1	1990-02-01 00:00
000A2592	002C0095	289W20	-1.2140	0.49	0	0	0	1	1990-02-01 00:00
000A2592	002C0096	289W20	-0.9466	1.36	0	0	0	1	1990-02-01 00:00
000A2592	002C0097	289W20	-0.0865	1.23	0	0	0	1	1990-02-01 00:00
000A2592	002C0098	289W20	-0.0636	1.21	0	0	0	1	1990-02-01 00:00
000A2592	002C0099	289W20	2.1277	1.17	0	0	0	1	1990-02-01 00:00
000A2592	002C0100	289W20	0.3355	0.84	0	0	0	1	1990-02-01 00:00
000A2592	002C0101	289W20	-0.0926	1.53	0	0	0	1	1990-02-01 00:00
000A2592	002C0102	289W20	-0.7838	1.77	0	0	0	1	1990-02-01 00:00
000A2592	002C0103	289W20	1.0748	0.74	0	0	0	1	1990-02-01 00:00
000A2592	002C0104	289W20	1.1700	0.75	0	0	0	1	1990-02-01 00:00
000A2592	002C0105	289W20	14.8848	1.10	0	0	0	1	1990-02-01 00:00
000A2592	002C0106b	289W20	16.9950	1.95	0	0	0	1	1990-02-01 00:00
000A2592	002C0107	289W20	-1.7284	0.92	0	0	0	1	1990-02-01 00:00
000A2592	002C0109	289W20	-1.4968	0.62	0	0	0	1	1990-02-01 00:00
000A2592	002C0110	289W20	-1.8291	1.76	0	0	0	1	1990-02-01 00:00
000A2592	002C0111	289W20	-1.5040	1.22	0	0	0	1	1990-02-01 00:00
000A2592	002D0023	289W20	-1.8141	1.98	0	0	0	1	1990-02-01 00:00
000A2592	002D0051	289W20	-3.2424	2.39	0	0	0	1	1990-02-01 00:00
000A2592	002D0052	289W20	-3.3558	2.39	0	0	0	1	1990-02-01 00:00
000A2592	002D0053	289W20	-3.2386	2.40	0	0	0	1	1990-02-01 00:00
000A2592	002D0069	289W20	-1.5556	2.39	0	0	0	1	1990-02-01 00:00
000A2592	002D0070	289W20	-1.0632	2.09	0	0	0	1	1990-02-01 00:00
000A2592	002D0071	289W20	-1.6565	2.26	0	0	0	1	1990-02-01 00:00
000A2592	002D0072	289W20	-1.8968	2.30	0	0	0	1	1990-02-01 00:00
000A2592	002D0073	289W20	-2.1460	2.24	0	0	0	1	1990-02-01 00:00
000A2592	002D0074	289W20	-1.6507	1.96	0	0	0	1	1990-02-01 00:00
000A2592	002D0075	289W20	-2.0104	1.91	0	0	0	1	1990-02-01 00:00
000A2592	002D0079	289W20	-0.8987	1.98	0	0	0	1	1990-02-01 00:00
000A2592	002C0001	289W26	-0.7921	0.28	0	0	0	1	1991-02-01 00:00
000A2592	002C0002	289W26	0.2348	0.55	0	0	0	1	1991-02-01 00:00
000A2592	002C0003	289W26	1.7361	0.51	0	0	0	1	1991-02-01 00:00
000A2592	002C0006	289W26	0.4237	0.87	0	0	0	1	1991-02-01 00:00
000A2592	002C0009	289W26	1.8804	1.06	0	0	0	1	1991-02-01 00:00
000A2592	002C0018	289W26	0.0711	1.54	0	0	0	1	1991-02-01 00:00
000A2592	002C0019	289W26	-0.6454	1.78	0	0	0	1	1991-02-01 00:00
000A2592	002C0023	289W26	-0.1614	1.50	0	0	0	1	1991-02-01 00:00
000A2592	002C0037	289W26	-1.2593	1.88	0	0	0	1	1991-02-01 00:00
000A2592	002C0040	289W26	-1.0690	1.40	0	0	0	1	1991-02-01 00:00
000A2592	002C0042	289W26	-0.6105	1.17	0	0	0	1	1991-02-01 00:00
000A2592	002C0043	289W26	-0.5232	1.07	0	0	0	1	1991-02-01 00:00

000A2592	002C0045	289W26	-0.2648	0.21	0	0	0	1	1991-02-01 00:00
000A2592	002C0047	289W26	-1.5322	1.63	0	0	0	1	1991-02-01 00:00
000A2592	002C0082	289W26	-0.6259	1.96	0	0	0	1	1991-02-01 00:00
000A2592	002C0083	289W26	3.2428	1.79	0	0	0	1	1991-02-01 00:00
000A2592	002C0084	289W26	-1.7114	1.77	0	0	0	1	1991-02-01 00:00
000A2592	002C0085	289W26	-0.3848	1.70	0	0	0	1	1991-02-01 00:00
000A2592	002C0086	289W26	-1.4562	1.66	0	0	0	1	1991-02-01 00:00
000A2592	002C0087	289W26	-1.4974	1.73	0	0	0	1	1991-02-01 00:00
000A2592	002C0095	289W26	-1.2142	0.49	0	0	0	1	1991-02-01 00:00
000A2592	002C0096	289W26	-0.9450	1.37	0	0	0	1	1991-02-01 00:00
000A2592	002C0097	289W26	-0.0847	1.25	0	0	0	1	1991-02-01 00:00
000A2592	002C0098	289W26	-0.0610	1.23	0	0	0	1	1991-02-01 00:00
000A2592	002C0099	289W26	2.1305	1.19	0	0	0	1	1991-02-01 00:00
000A2592	002C0100	289W26	0.3367	0.85	0	0	0	1	1991-02-01 00:00
000A2592	002C0101	289W26	-0.0876	1.53	0	0	0	1	1991-02-01 00:00
000A2592	002C0102	289W26	-0.7908	1.78	0	0	0	1	1991-02-01 00:00
000A2592	002C0103	289W26	1.0713	0.76	0	0	0	1	1991-02-01 00:00
000A2592	002C0104	289W26	1.1704	0.75	0	0	0	1	1991-02-01 00:00
000A2592	002C0105	289W26	14.8853	1.12	0	0	0	1	1991-02-01 00:00
000A2592	002C0106b	289W26	16.9844	1.96	0	0	0	1	1991-02-01 00:00
000A2592	002C0107	289W26	-1.7245	0.92	0	0	0	1	1991-02-01 00:00
000A2592	002C0109	289W26	-1.4957	0.62	0	0	0	1	1991-02-01 00:00
000A2592	002C0110	289W26	-1.8332	1.78	0	0	0	1	1991-02-01 00:00
000A2592	002C0111	289W26	-1.5024	1.23	0	0	0	1	1991-02-01 00:00
000A2592	002D0023	289W26	-1.8265	1.98	0	0	0	1	1991-02-01 00:00
000A2592	002D0051	289W26	-3.2416	2.20	0	0	0	1	1991-02-01 00:00
000A2592	002D0052	289W26	-3.3550	2.20	0	0	0	1	1991-02-01 00:00
000A2592	002D0069	289W26	-1.5636	2.08	0	0	0	1	1991-02-01 00:00
000A2592	002D0070	289W26	-1.0727	2.06	0	0	0	1	1991-02-01 00:00
000A2592	002D0071	289W26	-1.6612	2.10	0	0	0	1	1991-02-01 00:00
000A2592	002D0072	289W26	-1.9007	2.10	0	0	0	1	1991-02-01 00:00
000A2592	002D0073	289W26	-2.1514	2.10	0	0	0	1	1991-02-01 00:00
000A2592	002D0074	289W26	-1.6611	1.96	0	0	0	1	1991-02-01 00:00
000A2592	002D0075	289W26	-2.0205	1.92	0	0	0	1	1991-02-01 00:00
000A2592	002D0079	289W26	-0.9077	1.99	0	0	0	1	1991-02-01 00:00
000A2592	002C0001	289W34	-0.7930	0.27	0	0	0	1	1992-01-18 00:00
000A2592	002C0002	289W34	0.2339	0.54	0	0	0	1	1992-01-18 00:00
000A2592	002C0003	289W34	1.7348	0.51	0	0	0	1	1992-01-18 00:00
000A2592	002C0006	289W34	0.4222	0.84	0	0	0	1	1992-01-18 00:00
000A2592	002C0009	289W34	1.8799	1.05	0	0	0	1	1992-01-18 00:00
000A2592	002C0018	289W34	0.0662	1.52	0	0	0	1	1992-01-18 00:00
000A2592	002C0019	289W34	-0.6577	1.74	0	0	0	1	1992-01-18 00:00
000A2592	002C0023	289W34	-0.1641	1.48	0	0	0	1	1992-01-18 00:00
000A2592	002C0040	289W34	-1.0714	1.38	0	0	0	1	1992-01-18 00:00
000A2592	002C0042	289W34	-0.6109	1.16	0	0	0	1	1992-01-18 00:00
000A2592	002C0043	289W34	-0.5236	1.05	0	0	0	1	1992-01-18 00:00
000A2592	002C0045	289W34	-0.2653	0.21	0	0	0	1	1992-01-18 00:00
000A2592	002C0047	289W34	-1.5352	1.61	0	0	0	1	1992-01-18 00:00
000A2592	002C0082	289W34	-0.6473	1.93	0	0	0	1	1992-01-18 00:00
000A2592	002C0083	289W34	3.2293	1.80	0	0	0	1	1992-01-18 00:00
000A2592	002C0084	289W34	-1.7204	1.73	0	0	0	1	1992-01-18 00:00
000A2592	002C0085	289W34	-0.3885	1.67	0	0	0	1	1992-01-18 00:00
000A2592	002C0086	289W34	-1.4629	1.63	0	0	0	1	1992-01-18 00:00
000A2592	002C0087	289W34	-1.5072	1.70	0	0	0	1	1992-01-18 00:00
000A2592	002C0095	289W34	-1.2146	0.49	0	0	0	1	1992-01-18 00:00
000A2592	002C0096	289W34	-0.9473	1.35	0	0	0	1	1992-01-18 00:00
000A2592	002C0097	289W34	-0.0866	1.23	0	0	0	1	1992-01-18 00:00
000A2592	002C0098	289W34	-0.0629	1.21	0	0	0	1	1992-01-18 00:00
000A2592	002C0099	289W34	2.1278	1.17	0	0	0	1	1992-01-18 00:00
000A2592	002C0100	289W34	0.3350	0.83	0	0	0	1	1992-01-18 00:00
000A2592	002C0101	289W34	-0.0922	1.52	0	0	0	1	1992-01-18 00:00
000A2592	002C0102	289W34	-0.7897	1.74	0	0	0	1	1992-01-18 00:00
000A2592	002C0103	289W34	1.0747	0.74	0	0	0	1	1992-01-18 00:00
000A2592	002C0104	289W34	1.1708	0.75	0	0	0	1	1992-01-18 00:00
000A2592	002C0105	289W34	14.8839	1.10	0	0	0	1	1992-01-18 00:00
000A2592	002C0106b	289W34	16.9673	1.93	0	0	0	1	1992-01-18 00:00
000A2592	002C0107	289W34	-1.7261	0.92	0	0	0	1	1992-01-18 00:00
000A2592	002C0109	289W34	-1.4972	0.61	0	0	0	1	1992-01-18 00:00
000A2592	002C0111	289W34	-1.5047	1.22	0	0	0	1	1992-01-18 00:00
000A2592	002C0112a	289W34	-0.2232	1.85	0	0	0	1	1992-01-18 00:00
000A2592	002C0113	289W34	-1.2913	1.75	0	0	0	1	1992-01-18 00:00
000A2592	002D0023	289W34	-1.8436	1.97	0	0	0	1	1992-01-18 00:00
000A2592	002D0051	289W34	-3.2494	2.19	0	0	0	1	1992-01-18 00:00
000A2592	002D0052	289W34	-3.3627	2.19	0	0	0	1	1992-01-18 00:00
000A2592	002D0069	289W34	-1.5762	2.07	0	0	0	1	1992-01-18 00:00
000A2592	002D0070	289W34	-1.0876	2.04	0	0	0	1	1992-01-18 00:00
000A2592	002D0071	289W34	-1.6729	2.09	0	0	0	1	1992-01-18 00:00
000A2592	002D0072	289W34	-1.9113	2.09	0	0	0	1	1992-01-18 00:00
000A2592	002D0073	289W34	-2.1619	2.09	0	0	0	1	1992-01-18 00:00
000A2592	002D0074	289W34	-1.6775	1.96	0	0	0	1	1992-01-18 00:00
000A2592	002D0075	289W34	-2.0380	1.92	0	0	0	1	1992-01-18 00:00
000A2592	002D0076	289W34	-1.0137	1.97	0	0	0	1	1992-01-18 00:00
000A2592	002D0079	289W34	-0.9263	1.97	0	0	0	1	1992-01-18 00:00
000A2592	001H0003	332W02	-0.7242	1.89	0	0	0	1	1993-02-01 00:00
000A2592	001H0005	332W02	0.4313	1.86	0	0	0	1	1993-02-01 00:00
000A2592	001H0007	332W02	-0.8525	1.89	0	0	0	1	1993-02-01 00:00
000A2592	001H0009	332W02	-1.0323	1.87	0	0	0	1	1993-02-01 00:00
000A2592	001H0011	332W02	-0.1838	1.64	0	0	0	1	1993-02-01 00:00

000A2592	001H0012	332W02	0.3313	1.48	0	0	0	1	1993-02-01 00:00
000A2592	001H0013	332W02	0.8203	1.44	0	0	0	1	1993-02-01 00:00
000A2592	001H0014	332W02	-0.1452	1.42	0	0	0	1	1993-02-01 00:00
000A2592	001H0016	332W02	-1.0308	1.06	0	0	0	1	1993-02-01 00:00
000A2592	001H0017	332W02	-0.8836	0.77	0	0	0	1	1993-02-01 00:00
000A2592	001H0018	332W02	-2.8632	0.88	0	0	0	1	1993-02-01 00:00
000A2592	001H0019	332W02	-2.0672	0.97	0	0	0	1	1993-02-01 00:00
000A2592	001H0020	332W02	-1.2332	1.28	0	0	0	1	1993-02-01 00:00
000A2592	001H0022	332W02	2.1432	1.89	0	0	0	1	1993-02-01 00:00
000A2592	001H0026	332W02	-2.9846	1.57	0	0	0	1	1993-02-01 00:00
000A2592	001H0045	332W02	-0.3716	1.84	0	0	0	1	1993-02-01 00:00
000A2592	001H0046	332W02	-1.0382	1.09	0	0	0	1	1993-02-01 00:00
000A2592	001H0047	332W02	-1.6097	1.05	0	0	0	1	1993-02-01 00:00
000A2592	001H0048	332W02	-1.1884	1.09	0	0	0	1	1993-02-01 00:00
000A2592	001H0049	332W02	-0.6618	1.30	0	0	0	1	1993-02-01 00:00
000A2592	001H0050	332W02	-1.6231	1.42	0	0	0	1	1993-02-01 00:00
000A2592	001H0052	332W02	-1.5906	1.63	0	0	0	1	1993-02-01 00:00
000A2592	001H0053	332W02	-1.3491	1.76	0	0	0	1	1993-02-01 00:00
000A2592	001H0055	332W02	-3.0764	1.47	0	0	0	1	1993-02-01 00:00
000A2592	001H0056	332W02	-2.6046	1.83	0	0	0	1	1993-02-01 00:00
000A2592	001H0057	332W02	-1.9210	1.98	0	0	0	1	1993-02-01 00:00
000A2592	001H0058	332W02	-2.1338	1.46	0	0	0	1	1993-02-01 00:00
000A2592	001H0059	332W02	-0.5306	1.77	0	0	0	1	1993-02-01 00:00
000A2592	002C0001	332W02	-0.7937	0.28	0	0	0	1	1993-02-01 00:00
000A2592	002C0002	332W02	0.2330	0.55	0	0	0	1	1993-02-01 00:00
000A2592	002C0003	332W02	1.7339	0.51	0	0	0	1	1993-02-01 00:00
000A2592	002C0006	332W02	0.4229	0.86	0	0	0	1	1993-02-01 00:00
000A2592	002C0023	332W02	-0.1650	1.50	0	0	0	1	1993-02-01 00:00
000A2592	002C0040	332W02	-1.0746	1.40	0	0	0	1	1993-02-01 00:00
000A2592	002C0042	332W02	-0.6128	1.18	0	0	0	1	1993-02-01 00:00
000A2592	002C0043	332W02	-0.5247	1.06	0	0	0	1	1993-02-01 00:00
000A2592	002C0045	332W02	-0.2655	0.23	0	0	0	1	1993-02-01 00:00
000A2592	002C0047	332W02	-1.5379	1.64	0	0	0	1	1993-02-01 00:00
000A2592	002C0082	332W02	-0.6684	1.96	0	0	0	1	1993-02-01 00:00
000A2592	002C0083	332W02	3.2113	1.84	0	0	0	1	1993-02-01 00:00
000A2592	002C0084	332W02	-1.7286	1.77	0	0	0	1	1993-02-01 00:00
000A2592	002C0085	332W02	-0.3908	1.70	0	0	0	1	1993-02-01 00:00
000A2592	002C0086	332W02	-1.4697	1.65	0	0	0	1	1993-02-01 00:00
000A2592	002C0087	332W02	-1.5197	1.73	0	0	0	1	1993-02-01 00:00
000A2592	002C0095	332W02	-1.2148	0.50	0	0	0	1	1993-02-01 00:00
000A2592	002C0096	332W02	-0.9480	1.37	0	0	0	1	1993-02-01 00:00
000A2592	002C0097	332W02	-0.0876	1.24	0	0	0	1	1993-02-01 00:00
000A2592	002C0098	332W02	-0.0628	1.22	0	0	0	1	1993-02-01 00:00
000A2592	002C0099	332W02	2.1271	1.19	0	0	0	1	1993-02-01 00:00

000A2592	002C0100	332W02	0.3338	0.85	0	0	0	1	1993-02-01 00:00
000A2592	002C0101	332W02	-0.0966	1.54	0	0	0	1	1993-02-01 00:00
000A2592	002C0102	332W02	-0.8062	1.77	0	0	0	1	1993-02-01 00:00
000A2592	002C0103	332W02	1.0732	0.76	0	0	0	1	1993-02-01 00:00
000A2592	002C0104	332W02	1.1689	0.77	0	0	0	1	1993-02-01 00:00
000A2592	002C0105	332W02	14.8813	1.11	0	0	0	1	1993-02-01 00:00
000A2592	002C0106b	332W02	16.9480	1.96	0	0	0	1	1993-02-01 00:00
000A2592	002C0107	332W02	-1.7305	0.92	0	0	0	1	1993-02-01 00:00
000A2592	002C0109	332W02	-1.4982	0.61	0	0	0	1	1993-02-01 00:00
000A2592	002C0111	332W02	-1.5066	1.23	0	0	0	1	1993-02-01 00:00
000A2592	002C0112a	332W02	-0.2438	1.88	0	0	0	1	1993-02-01 00:00
000A2592	002C0113	332W02	-1.3067	1.78	0	0	0	1	1993-02-01 00:00
000A2592	002C0114	332W02	1.8840	1.06	0	0	0	1	1993-02-01 00:00
000A2592	002D0051	332W02	-3.2602	2.22	0	0	0	1	1993-02-01 00:00
000A2592	002D0052	332W02	-3.3734	2.23	0	0	0	1	1993-02-01 00:00
000A2592	002D0053	332W02	-3.2561	2.24	0	0	0	1	1993-02-01 00:00
000A2592	002D0069	332W02	-1.5917	2.10	0	0	0	1	1993-02-01 00:00
000A2592	002D0070	332W02	-1.1038	2.08	0	0	0	1	1993-02-01 00:00
000A2592	002D0071	332W02	-1.6866	2.13	0	0	0	1	1993-02-01 00:00
000A2592	002D0072	332W02	-1.9235	2.13	0	0	0	1	1993-02-01 00:00
000A2592	002D0073	332W02	-2.1740	2.13	0	0	0	1	1993-02-01 00:00
000A2592	002D0074	332W02	-1.6981	1.99	0	0	0	1	1993-02-01 00:00
000A2592	002D0075	332W02	-2.0586	1.95	0	0	0	1	1993-02-01 00:00
000A2592	002D0076	332W02	-1.0336	2.00	0	0	0	1	1993-02-01 00:00
000A2592	002D0077	332W02	-2.4507	2.19	0	0	0	1	1993-02-01 00:00
000A2592	002D0079	332W02	-0.9464	2.00	0	0	0	1	1993-02-01 00:00
000A2592	002C0001	289W37	-0.7926	0.27	0	0	0	1	1994-02-02 00:00
000A2592	002C0002	289W37	0.2342	0.56	0	0	0	1	1994-02-02 00:00
000A2592	002C0003	289W37	1.7347	0.52	0	0	0	1	1994-02-02 00:00
000A2592	002C0006	289W37	0.4221	0.86	0	0	0	1	1994-02-02 00:00
000A2592	002C0023	289W37	-0.1691	1.49	0	0	0	1	1994-02-02 00:00
000A2592	002C0040	289W37	-1.0775	1.40	0	0	0	1	1994-02-02 00:00
000A2592	002C0042	289W37	-0.6140	1.17	0	0	0	1	1994-02-02 00:00
000A2592	002C0043	289W37	-0.5258	1.06	0	0	0	1	1994-02-02 00:00
000A2592	002C0045	289W37	-0.2647	0.24	0	0	0	1	1994-02-02 00:00
000A2592	002C0047	289W37	-1.5428	1.63	0	0	0	1	1994-02-02 00:00
000A2592	002C0082	289W37	-0.6902	1.95	0	0	0	1	1994-02-02 00:00
000A2592	002C0083	289W37	3.1967	1.82	0	0	0	1	1994-02-02 00:00
000A2592	002C0084	289W37	-1.7404	1.75	0	0	0	1	1994-02-02 00:00
000A2592	002C0085	289W37	-0.3992	1.68	0	0	0	1	1994-02-02 00:00
000A2592	002C0086	289W37	-1.4760	1.65	0	0	0	1	1994-02-02 00:00
000A2592	002C0087	289W37	-1.5305	1.72	0	0	0	1	1994-02-02 00:00
000A2592	002C0095	289W37	-1.2131	0.51	0	0	0	1	1994-02-02 00:00
000A2592	002C0096	289W37	-0.9514	1.37	0	0	0	1	1994-02-02 00:00

000A2592	002C0097	289W37	-0.0904	1.24	0	0	0	1	1994-02-02 00:00
000A2592	002C0098	289W37	-0.0643	1.22	0	0	0	1	1994-02-02 00:00
000A2592	002C0099	289W37	2.1257	1.19	0	0	0	1	1994-02-02 00:00
000A2592	002C0100	289W37	0.3348	0.84	0	0	0	1	1994-02-02 00:00
000A2592	002C0101	289W37	-0.0998	1.53	0	0	0	1	1994-02-02 00:00
000A2592	002C0102	289W37	-0.8090	1.76	0	0	0	1	1994-02-02 00:00
000A2592	002C0103	289W37	1.0757	0.76	0	0	0	1	1994-02-02 00:00
000A2592	002C0104	289W37	1.1720	0.77	0	0	0	1	1994-02-02 00:00
000A2592	002C0105	289W37	14.8826	1.11	0	0	0	1	1994-02-02 00:00
000A2592	002C0106b	289W37	16.9283	1.95	0	0	0	1	1994-02-02 00:00
000A2592	002C0107	289W37	-1.7273	0.93	0	0	0	1	1994-02-02 00:00
000A2592	002C0109	289W37	-1.4975	0.63	0	0	0	1	1994-02-02 00:00
000A2592	002C0111	289W37	-1.5158	1.23	0	0	0	1	1994-02-02 00:00
000A2592	002C0112a	289W37	-0.2645	1.87	0	0	0	1	1994-02-02 00:00
000A2592	002C0113	289W37	-1.3183	1.77	0	0	0	1	1994-02-02 00:00
000A2592	002C0114	289W37	1.8850	1.06	0	0	0	1	1994-02-02 00:00
000A2592	002D0051	289W37	-3.2678	2.23	0	0	0	1	1994-02-02 00:00
000A2592	002D0052	289W37	-3.3811	2.23	0	0	0	1	1994-02-02 00:00
000A2592	002D0053	289W37	-3.2639	2.24	0	0	0	1	1994-02-02 00:00
000A2592	002D0069	289W37	-1.6054	2.11	0	0	0	1	1994-02-02 00:00
000A2592	002D0070	289W37	-1.1209	2.08	0	0	0	1	1994-02-02 00:00
000A2592	002D0072	289W37	-1.9353	2.13	0	0	0	1	1994-02-02 00:00
000A2592	002D0073	289W37	-2.1868	2.13	0	0	0	1	1994-02-02 00:00
000A2592	002D0074	289W37	-1.7141	1.99	0	0	0	1	1994-02-02 00:00
000A2592	002D0075	289W37	-2.0761	1.94	0	0	0	1	1994-02-02 00:00
000A2592	002D0076	289W37	-1.0528	2.00	0	0	0	1	1994-02-02 00:00
000A2592	002D0077	289W37	-2.4601	2.20	0	0	0	1	1994-02-02 00:00
000A2592	002D0078a	289W37	-0.6528	2.13	0	0	0	1	1994-02-02 00:00
000A2592	002D0079	289W37	-0.9648	1.99	0	0	0	1	1994-02-02 00:00
000A2592	002C0001	342W04	-0.7929	0.27	0	0	0	1	1995-01-23 00:00
000A2592	002C0002	342W04	0.2335	0.54	0	0	0	1	1995-01-23 00:00
000A2592	002C0003	342W04	1.7341	0.50	0	0	0	1	1995-01-23 00:00
000A2592	002C0006	342W04	0.4220	0.85	0	0	0	1	1995-01-23 00:00
000A2592	002C0023	342W04	-0.1688	1.49	0	0	0	1	1995-01-23 00:00
000A2592	002C0040	342W04	-1.0769	1.39	0	0	0	1	1995-01-23 00:00
000A2592	002C0042	342W04	-0.6122	1.16	0	0	0	1	1995-01-23 00:00
000A2592	002C0043	342W04	-0.5251	1.05	0	0	0	1	1995-01-23 00:00
000A2592	002C0045	342W04	-0.2651	0.20	0	0	0	1	1995-01-23 00:00
000A2592	002C0082	342W04	-0.7019	1.94	0	0	0	1	1995-01-23 00:00
000A2592	002C0083	342W04	3.1886	1.82	0	0	0	1	1995-01-23 00:00
000A2592	002C0084	342W04	-1.7432	1.74	0	0	0	1	1995-01-23 00:00
000A2592	002C0085	342W04	-0.4000	1.69	0	0	0	1	1995-01-23 00:00
000A2592	002C0086	342W04	-1.4788	1.64	0	0	0	1	1995-01-23 00:00
000A2592	002C0087	342W04	-1.5362	1.71	0	0	0	1	1995-01-23 00:00
000A2592	002C0095	342W04	-1.2150	0.49	0	0	0	1	1995-01-23 00:00
000A2592	002C0096	342W04	-0.9510	1.36	0	0	0	1	1995-01-23 00:00
000A2592	002C0097	342W04	-0.0895	1.23	0	0	0	1	1995-01-23 00:00
000A2592	002C0098	342W04	-0.0633	1.21	0	0	0	1	1995-01-23 00:00
000A2592	002C0099	342W04	2.1255	1.18	0	0	0	1	1995-01-23 00:00
000A2592	002C0100	342W04	0.3349	0.85	0	0	0	1	1995-01-23 00:00
000A2592	002C0101	342W04	-0.1001	1.53	0	0	0	1	1995-01-23 00:00
000A2592	002C0102	342W04	-0.8179	1.75	0	0	0	1	1995-01-23 00:00
000A2592	002C0103	342W04	1.0742	0.75	0	0	0	1	1995-01-23 00:00
000A2592	002C0104	342W04	1.1690	0.76	0	0	0	1	1995-01-23 00:00
000A2592	002C0105	342W04	14.8829	1.12	0	0	0	1	1995-01-23 00:00
000A2592	002C0106b	342W04	16.9267	1.96	0	0	0	1	1995-01-23 00:00
000A2592	002C0107	342W04	-1.7291	0.92	0	0	0	1	1995-01-23 00:00
000A2592	002C0109	342W04	-1.4980	0.61	0	0	0	1	1995-01-23 00:00
000A2592	002C0111	342W04	-1.5041	1.22	0	0	0	1	1995-01-23 00:00
000A2592	002C0112a	342W04	-0.2745	1.86	0	0	0	1	1995-01-23 00:00
000A2592	002C0113	342W04	-1.3242	1.76	0	0	0	1	1995-01-23 00:00
000A2592	002C0114	342W04	1.8850	1.06	0	0	0	1	1995-01-23 00:00
000A2592	002C0116	342W04	-0.5198	1.62	0	0	0	1	1995-01-23 00:00
000A2592	002D0051	342W04	-3.2706	2.21	0	0	0	1	1995-01-23 00:00
000A2592	002D0052	342W04	-3.3835	2.21	0	0	0	1	1995-01-23 00:00
000A2592	002D0069	342W04	-1.6114	2.09	0	0	0	1	1995-01-23 00:00
000A2592	002D0070	342W04	-1.1267	2.07	0	0	0	1	1995-01-23 00:00
000A2592	002D0072	342W04	-1.9381	2.11	0	0	0	1	1995-01-23 00:00
000A2592	002D0073	342W04	-2.1892	2.11	0	0	0	1	1995-01-23 00:00
000A2592	002D0074	342W04	-1.7236	1.98	0	0	0	1	1995-01-23 00:00
000A2592	002D0075	342W04	-2.0861	1.94	0	0	0	1	1995-01-23 00:00
000A2592	002D0076	342W04	-1.0622	1.99	0	0	0	1	1995-01-23 00:00
000A2592	002D0077	342W04	-2.4630	2.18	0	0	0	1	1995-01-23 00:00
000A2592	002D0078a	342W04	-0.6557	2.11	0	0	0	1	1995-01-23 00:00
000A2592	002D0079	342W04	-0.9757	1.99	0	0	0	1	1995-01-23 00:00
000A2592	002C0001	342W05	-0.7915	0.28	0	0	0	1	1996-01-12 00:00
000A2592	002C0002	342W05	0.2331	0.56	0	0	0	1	1996-01-12 00:00
000A2592	002C0003	342W05	1.7334	0.52	0	0	0	1	1996-01-12 00:00
000A2592	002C0006	342W05	0.4218	0.86	0	0	0	1	1996-01-12 00:00
000A2592	002C0023	342W05	-0.1718	1.49	0	0	0	1	1996-01-12 00:00
000A2592	002C0040	342W05	-1.0776	1.38	0	0	0	1	1996-01-12 00:00
000A2592	002C0042	342W05	-0.6141	1.16	0	0	0	1	1996-01-12 00:00
000A2592	002C0043	342W05	-0.5255	1.04	0	0	0	1	1996-01-12 00:00
000A2592	002C0045	342W05	-0.2650	0.22	0	0	0	1	1996-01-12 00:00
000A2592	002C0082	342W05	-0.7192	1.94	0	0	0	1	1996-01-12 00:00
000A2592	002C0083	342W05	3.1763	1.81	0	0	0	1	1996-01-12 00:00
000A2592	002C0084	342W05	-1.7526	1.74	0	0	0	1	1996-01-12 00:00
000A2592	002C0085	342W05	-0.4041	1.68	0	0	0	1	1996-01-12 00:00

000A2592	002C0086	342W05	-1.4829	1.63	0	0	0	1	1996-01-12 00:00
000A2592	002C0087	342W05	-1.5452	1.71	0	0	0	1	1996-01-12 00:00
000A2592	002C0095	342W05	-1.2148	0.50	0	0	0	1	1996-01-12 00:00
000A2592	002C0096	342W05	-0.9528	1.36	0	0	0	1	1996-01-12 00:00
000A2592	002C0098	342W05	-0.0641	1.22	0	0	0	1	1996-01-12 00:00
000A2592	002C0099	342W05	2.1260	1.19	0	0	0	1	1996-01-12 00:00
000A2592	002C0100	342W05	0.3349	0.87	0	0	0	1	1996-01-12 00:00
000A2592	002C0101	342W05	-0.1019	1.52	0	0	0	1	1996-01-12 00:00
000A2592	002C0102	342W05	-0.8304	1.74	0	0	0	1	1996-01-12 00:00
000A2592	002C0103	342W05	1.0756	0.75	0	0	0	1	1996-01-12 00:00
000A2592	002C0104	342W05	1.1706	0.77	0	0	0	1	1996-01-12 00:00
000A2592	002C0105	342W05	14.8838	1.14	0	0	0	1	1996-01-12 00:00
000A2592	002C0106b	342W05	16.9106	1.94	0	0	0	1	1996-01-12 00:00
000A2592	002C0107	342W05	-1.7286	0.93	0	0	0	1	1996-01-12 00:00
000A2592	002C0109	342W05	-1.4982	0.63	0	0	0	1	1996-01-12 00:00
000A2592	002C0111	342W05	-1.5152	1.22	0	0	0	1	1996-01-12 00:00
000A2592	002C0112a	342W05	-0.2916	1.86	0	0	0	1	1996-01-12 00:00
000A2592	002C0113	342W05	-1.3357	1.75	0	0	0	1	1996-01-12 00:00
000A2592	002C0114	342W05	1.8848	1.07	0	0	0	1	1996-01-12 00:00
000A2592	002C0116	342W05	-0.5199	1.61	0	0	0	1	1996-01-12 00:00
000A2592	002C0117	342W05	0.0721	1.23	0	0	0	1	1996-01-12 00:00
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000A2592	002D0069	342W05	-1.6221	2.08	0	0	0	1	1996-01-12 00:00
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000A2592	002D0073	342W05	-2.1981	2.11	0	0	0	1	1996-01-12 00:00
000A2592	002D0074	342W05	-1.7367	1.97	0	0	0	1	1996-01-12 00:00
000A2592	002D0075	342W05	-2.0995	1.93	0	0	0	1	1996-01-12 00:00
000A2592	002D0076	342W05	-1.0773	1.98	0	0	0	1	1996-01-12 00:00
000A2592	002D0077	342W05	-2.4665	2.18	0	0	0	1	1996-01-12 00:00
000A2592	002D0078a	342W05	-0.6652	2.11	0	0	0	1	1996-01-12 00:00
000A2592	002D0079	342W05	-0.9904	1.98	0	0	0	1	1996-01-12 00:00
000A2592	002C0001	342W10	-0.7934	0.27	0	0	0	1	1997-01-10 00:00
000A2592	002C0002	342W10	0.2334	0.55	0	0	0	1	1997-01-10 00:00
000A2592	002C0003	342W10	1.7327	0.52	0	0	0	1	1997-01-10 00:00
000A2592	002C0006	342W10	0.4214	0.86	0	0	0	1	1997-01-10 00:00
000A2592	002C0023	342W10	-0.1761	1.49	0	0	0	1	1997-01-10 00:00
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000A2592	002C0042	342W10	-0.6153	1.16	0	0	0	1	1997-01-10 00:00
000A2592	002C0043	342W10	-0.5263	1.04	0	0	0	1	1997-01-10 00:00
000A2592	002C0045	342W10	-0.2658	0.22	0	0	0	1	1997-01-10 00:00
000A2592	002C0082	342W10	-0.7363	1.94	0	0	0	1	1997-01-10 00:00
000A2592	002C0083	342W10	3.1611	1.82	0	0	0	1	1997-01-10 00:00
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000A2592	002C0085	342W10	-0.4116	1.69	0	0	0	1	1997-01-10 00:00
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000A2592	002C0087	342W10	-1.5537	1.71	0	0	0	1	1997-01-10 00:00
000A2592	002C0095	342W10	-1.2153	0.51	0	0	0	1	1997-01-10 00:00
000A2592	002C0096	342W10	-0.9560	1.36	0	0	0	1	1997-01-10 00:00
000A2592	002C0098	342W10	-0.0651	1.22	0	0	0	1	1997-01-10 00:00
000A2592	002C0099	342W10	2.1243	1.19	0	0	0	1	1997-01-10 00:00
000A2592	002C0100	342W10	0.3345	0.87	0	0	0	1	1997-01-10 00:00
000A2592	002C0101	342W10	-0.1050	1.52	0	0	0	1	1997-01-10 00:00
000A2592	002C0102	342W10	-0.8438	1.75	0	0	0	1	1997-01-10 00:00
000A2592	002C0103	342W10	1.0745	0.76	0	0	0	1	1997-01-10 00:00
000A2592	002C0104	342W10	1.1681	0.77	0	0	0	1	1997-01-10 00:00
000A2592	002C0105	342W10	14.8839	1.14	0	0	0	1	1997-01-10 00:00
000A2592	002C0106b	342W10	16.8970	1.95	0	0	0	1	1997-01-10 00:00
000A2592	002C0107	342W10	-1.7317	0.93	0	0	0	1	1997-01-10 00:00
000A2592	002C0109	342W10	-1.4986	0.62	0	0	0	1	1997-01-10 00:00
000A2592	002C0111	342W10	-1.5097	1.22	0	0	0	1	1997-01-10 00:00
000A2592	002C0112a	342W10	-0.3080	1.86	0	0	0	1	1997-01-10 00:00
000A2592	002C0113	342W10	-1.3489	1.76	0	0	0	1	1997-01-10 00:00
000A2592	002C0114	342W10	1.8847	1.07	0	0	0	1	1997-01-10 00:00
000A2592	002C0116	342W10	-0.5261	1.62	0	0	0	1	1997-01-10 00:00
000A2592	002C0117	342W10	0.0715	1.23	0	0	0	1	1997-01-10 00:00
000A2592	002C0121	342W10	16.7484	1.95	0	0	0	1	1997-01-10 00:00
000A2592	002D0069	342W10	-1.6345	2.09	0	0	0	1	1997-01-10 00:00
000A2592	002D0070	342W10	-1.1532	2.07	0	0	0	1	1997-01-10 00:00
000A2592	002D0072	342W10	-1.9567	2.11	0	0	0	1	1997-01-10 00:00
000A2592	002D0073	342W10	-2.2072	2.12	0	0	0	1	1997-01-10 00:00
000A2592	002D0074	342W10	-1.7530	1.98	0	0	0	1	1997-01-10 00:00
000A2592	002D0075	342W10	-2.1160	1.94	0	0	0	1	1997-01-10 00:00
000A2592	002D0076	342W10	-1.0931	1.99	0	0	0	1	1997-01-10 00:00
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000A2592	002D0079	342W10	-1.0059	1.99	0	0	0	1	1997-01-10 00:00
000A2592	002C0001	aml1998	-0.7931	0.28	0	0	0	1	1998-01-30 00:00
000A2592	002C0002	aml1998	0.2328	0.55	0	0	0	1	1998-01-30 00:00
000A2592	002C0003	aml1998	1.7311	0.52	0	0	0	1	1998-01-30 00:00
000A2592	002C0006	aml1998	0.4213	0.88	0	0	0	1	1998-01-30 00:00
000A2592	002C0023	aml1998	-0.1788	1.48	0	0	0	1	1998-01-30 00:00
000A2592	002C0040	aml1998	-1.0825	1.39	0	0	0	1	1998-01-30 00:00
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000A2592	002C0043	aml1998	-0.5282	1.08	0	0	0	1	1998-01-30 00:00
000A2592	002C0045	aml1998	-0.2658	0.21	0	0	0	1	1998-01-30 00:00
000A2592	002C0082	aml1998	-0.7554	1.95	0	0	0	1	1998-01-30 00:00
000A2592	002C0083	aml1998	3.1491	1.83	0	0	0	1	1998-01-30 00:00

000A2592	002C0084	aml1998	-1.7692	1.75	0	0	0	1	1998-01-30	00:00
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000A2592	002C0087	aml1998	-1.5639	1.72	0	0	0	1	1998-01-30	00:00
000A2592	002C0095	aml1998	-1.2151	0.53	0	0	0	1	1998-01-30	00:00
000A2592	002C0096	aml1998	-0.9580	1.35	0	0	0	1	1998-01-30	00:00
000A2592	002C0098	aml1998	-0.0676	1.22	0	0	0	1	1998-01-30	00:00
000A2592	002C0099	aml1998	2.1222	1.19	0	0	0	1	1998-01-30	00:00
000A2592	002C0100	aml1998	0.3340	0.87	0	0	0	1	1998-01-30	00:00
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000A2592	002C0102	aml1998	-0.8561	1.76	0	0	0	1	1998-01-30	00:00
000A2592	002C0103	aml1998	1.0732	0.76	0	0	0	1	1998-01-30	00:00
000A2592	002C0104	aml1998	1.1681	0.77	0	0	0	1	1998-01-30	00:00
000A2592	002C0105	aml1998	14.8834	1.12	0	0	0	1	1998-01-30	00:00
000A2592	002C0107	aml1998	-1.7312	0.95	0	0	0	1	1998-01-30	00:00
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000A2592	002C0112a	aml1998	-0.3204	1.87	0	0	0	1	1998-01-30	00:00
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000A2592	002C0114	aml1998	1.8841	1.08	0	0	0	1	1998-01-30	00:00
000A2592	002C0117	aml1998	0.0698	1.24	0	0	0	1	1998-01-30	00:00
000A2592	002C0121	aml1998	16.7341	1.96	0	0	0	1	1998-01-30	00:00
000A2592	002C0122	aml1998	-1.3579	0.44	0	0	0	1	1998-01-30	00:00
000A2592	002C0123	aml1998	-0.7738	1.23	0	0	0	1	1998-01-30	00:00
000A2592	002C0125	aml1998	-0.7416	1.62	0	0	0	1	1998-01-30	00:00
000A2592	002D0051	aml1998	-3.2894	2.24	0	0	0	1	1998-01-30	00:00
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000A2592	002D0070	aml1998	-1.1679	2.09	0	0	0	1	1998-01-30	00:00
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000A2592	002D0073	aml1998	-2.2174	2.14	0	0	0	1	1998-01-30	00:00
000A2592	002D0074	aml1998	-1.7685	1.99	0	0	0	1	1998-01-30	00:00
000A2592	002D0075	aml1998	-2.1321	1.96	0	0	0	1	1998-01-30	00:00
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000A2592	002D0077	aml1998	-2.4803	2.21	0	0	0	1	1998-01-30	00:00
000A2592	002D0078a	aml1998	-0.6874	2.14	0	0	0	1	1998-01-30	00:00
000A2592	002D0079	aml1998	-1.0254	2.00	0	0	0	1	1998-01-30	00:00
000A2592	002D0081	aml1998	0.3701	1.99	0	0	0	1	1998-01-30	00:00
000A2592	002C0001	aml1999	-0.7932	0.44	0	0	0	1	1999-02-10	00:00
000A2592	002C0002	aml1999	0.2324	0.56	0	0	0	1	1999-02-10	00:00
000A2592	002C0003	aml1999	1.7300	0.52	0	0	0	1	1999-02-10	00:00
000A2592	002C0006	aml1999	0.4204	0.87	0	0	0	1	1999-02-10	00:00
000A2592	002C0023	aml1999	-0.1788	1.47	0	0	0	1	1999-02-10	00:00
000A2592	002C0040	aml1999	-1.0835	1.38	0	0	0	1	1999-02-10	00:00
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000A2592	002C0045	aml1999	-0.2655	0.21	0	0	0	1	1999-02-10	00:00
000A2592	002C0082	aml1999	-0.7725	1.95	0	0	0	1	1999-02-10	00:00
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000A2592	002C0087	aml1999	-1.5711	1.71	0	0	0	1	1999-02-10	00:00
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000A2592	002C0098	aml1999	-0.0678	1.21	0	0	0	1	1999-02-10	00:00
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000A2592	002C0101	aml1999	-0.1105	1.52	0	0	0	1	1999-02-10	00:00
000A2592	002C0102	aml1999	-0.8673	1.76	0	0	0	1	1999-02-10	00:00
000A2592	002C0103	aml1999	1.0731	0.77	0	0	0	1	1999-02-10	00:00
000A2592	002C0104	aml1999	1.1684	0.75	0	0	0	1	1999-02-10	00:00
000A2592	002C0105	aml1999	14.8808	1.13	0	0	0	1	1999-02-10	00:00
000A2592	002C0107	aml1999	-1.7320	1.00	0	0	0	1	1999-02-10	00:00
000A2592	002C0109	aml1999	-1.4993	0.65	0	0	0	1	1999-02-10	00:00
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000A2592	002C0122	aml1999	-1.3578	0.31	0	0	0	1	1999-02-10	00:00
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000A2592	002D0081	aml1999	0.3548	1.99	0	0	0	1	1999-02-10	00:00
000A2592	002C0109	aml2003	-1.5017	0.44	0	0	0	1	2003-02-02	00:00
000A2592	002C0124	aml2003	-0.8040	0.35	0	0	0	1	2003-02-02	00:00

000A2592	002C0122	aml2003	-1.3584	0.29	0	0	0	1	2003-02-02 00:00
000A2592	002C0001	aml2003	-0.7946	0.20	0	0	0	1	2003-02-02 00:00
000A2592	002C0045	aml2003	-0.2663	0.15	0	0	0	1	2003-02-02 00:00
000A2592	002C0003	aml2003	1.7280	0.36	0	0	0	1	2003-02-02 00:00
000A2592	002C0002	aml2003	0.2334	0.39	0	0	0	1	2003-02-02 00:00
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000A2592	002C0114	aml2003	1.8829	0.75	0	0	0	1	2003-02-02 00:00
000A2592	002C0099	aml2003	2.1206	0.83	0	0	0	1	2003-02-02 00:00
000A2592	002C0098	aml2003	-0.0668	0.85	0	0	0	1	2003-02-02 00:00
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000A2592	002C0123	aml2003	-0.7803	0.85	0	0	0	1	2003-02-02 00:00
000A2592	002C0042	aml2003	-0.6191	0.82	0	0	0	1	2003-02-02 00:00
000A2592	002C0043	aml2003	-0.5291	0.75	0	0	0	1	2003-02-02 00:00
000A2592	002C0006	aml2003	0.4214	0.62	0	0	0	1	2003-02-02 00:00
000A2592	002C0103	aml2003	1.0716	0.54	0	0	0	1	2003-02-02 00:00
000A2592	002C0104	aml2003	1.1691	0.53	0	0	0	1	2003-02-02 00:00
000A2592	002C0040	aml2003	-1.0855	0.97	0	0	0	1	2003-02-02 00:00
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000A2592	002C0023	aml2003	-0.1812	1.04	0	0	0	1	2003-02-02 00:00
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000A2592	002C0082	aml2003	-0.8250	1.37	0	0	0	1	2003-02-02 00:00
000A2592	002D0081	aml2003	0.3058	1.40	0	0	0	1	2003-02-02 00:00
000A2592	002D0079	aml2003	-1.0846	1.40	0	0	0	1	2003-02-02 00:00
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000A2592	002D0072	aml2005	-2.0165	1.49	0	0	0	1	2005-03-13 00:00
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000A2592	002C0002	aml2005	0.2336	0.43	0	0	0	1	2005-03-13 00:00
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000A2592	002C0002	70604-001	0.2331	0.56	0	0	0	1	2006-01-16 00:00
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000A2592	002C0045	70604-001	-0.2662	0.22	0	0	0	1	2006-01-16 00:00
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000A2592	002C0101	70604-001	-0.1198	1.51	0	0	0	1	2006-01-16 00:00
000A2592	002C0103	70604-001	1.0738	0.75	0	0	0	1	2006-01-16 00:00
000A2592	002C0105	70604-001	14.8807	1.20	0	0	0	1	2006-01-16 00:00
000A2592	002C0107	70604-001	-1.7309	0.93	0	0	0	1	2006-01-16 00:00
000A2592	002C0109	70604-001	-1.5013	0.63	0	0	0	1	2006-01-16 00:00
000A2592	002C0112b	70604-001	-0.0526	1.82	0	0	0	1	2006-01-16 00:00
000A2592	002C0113	70604-001	-1.4132	1.74	0	0	0	1	2006-01-16 00:00
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000A2592	002C0124	70604-001	-0.8039	0.50	0	0	0	1	2006-01-16 00:00
000A2592	002C0125	70604-001	-0.7571	1.60	0	0	0	1	2006-01-16 00:00
000A2592	002C0129	70604-001	-0.3639	1.75	0	0	0	1	2006-01-16 00:00
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000A2592	002D0051	70604-001	-3.3230	2.20	0	0	0	1	2006-01-16 00:00
000A2592	002D0052	70604-001	-3.4367	2.20	0	0	0	1	2006-01-16 00:00
000A2592	002D0053	70604-001	-3.3187	2.19	0	0	0	1	2006-01-16 00:00
000A2592	002D0069	70604-001	-1.7053	2.08	0	0	0	1	2006-01-16 00:00
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000A2592	002D0072	70604-001	-2.0131	2.13	0	0	0	1	2006-01-16 00:00
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000A2592	002D0074	70604-001	-1.8481	1.98	0	0	0	1	2006-01-16 00:00
000A2592	002D0075	70604-001	-2.2112	1.92	0	0	0	1	2006-01-16 00:00
000A2592	002D0076	70604-001	-1.1984	2.04	0	0	0	1	2006-01-16 00:00
000A2592	002D0079	70604-001	-1.1131	1.99	0	0	0	1	2006-01-16 00:00
000A2592	002D0081	70604-001	0.2758	1.98	0	0	0	1	2006-01-16 00:00
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000A2592	0009999	231-70812	10.1874	1.71	0	0	0	1	2007-01-18 00:00
000A2592	002C0001	231-70812	-0.7950	0.27	0	0	0	1	2007-01-18 00:00
000A2592	002C0002	231-70812	0.2345	0.54	0	0	0	1	2007-01-18 00:00
000A2592	002C0003	231-70812	1.7270	0.50	0	0	0	1	2007-01-18 00:00
000A2592	002C0006	231-70812	0.4183	0.85	0	0	0	1	2007-01-18 00:00
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000A2592	002C0045	231-70812	-0.2660	0.21	0	0	0	1	2007-01-18 00:00
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000A2592	002C0122	231-70812	-1.3580	0.41	0	0	0	1	2007-01-18 00:00
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000A2592	002C0125	231-70812	-0.7618	1.42	0	0	0	1	2007-01-18 00:00
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000A2592	002C0133	231-70812	-0.3662	1.11	0	0	0	1	2007-01-18 00:00
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000A2592	002C0135	231-70812	0.4475	1.06	0	0	0	1	2007-01-18 00:00
000A2592	002C0136	231-70812	0.5216	0.98	0	0	0	1	2007-01-18 00:00
000A2592	002C0137	231-70812	-1.5373	1.07	0	0	0	1	2007-01-18 00:00
000A2592	002C0138	231-70812	-1.4522	1.24	0	0	0	1	2007-01-18 00:00
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000A2592	002D0069	231-70812	-1.7149	1.97	0	0	0	1	2007-01-18 00:00
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000A2592	002D0072	231-70812	-2.0224	2.02	0	0	0	1	2007-01-18 00:00
000A2592	002D0073	231-70812	-2.2776	2.04	0	0	0	1	2007-01-18 00:00
000A2592	002D0074	231-70812	-1.8582	1.86	0	0	0	1	2007-01-18 00:00
000A2592	002D0075	231-70812	-2.2228	1.80	0	0	0	1	2007-01-18 00:00
000A2592	002D0076	231-70812	-1.2089	1.93	0	0	0	1	2007-01-18 00:00
000A2592	002D0079	231-70812	-1.1254	1.87	0	0	0	1	2007-01-18 00:00
000A2592	002D0081	231-70812	0.2631	1.86	0	0	0	1	2007-01-18 00:00
000A2592	002D0095	231-70812	-1.5558	2.00	0	0	0	1	2007-01-18 00:00
000A2592	002D0096	231-70812	-1.9079	1.98	0	0	0	1	2007-01-18 00:00
000A2592	002D0099	231-70812	-2.2175	2.10	0	0	0	1	2007-01-18 00:00
000A2592	002D0100	231-70812	-2.1849	2.08	0	0	0	1	2007-01-18 00:00
000A2592	002D0101	231-70812	-1.6880	1.87	0	0	0	1	2007-01-18 00:00
002D0051	002D0052	231-70604	-0.1137	0.09	0	0	0	1	2008-03-18 00:00
002D0051	002D0053	231-70604	0.0044	0.13	0	0	0	1	2008-03-18 00:00
002D0051	002D0069	231-70604	1.6137	0.78	0	0	0	1	2008-03-18 00:00
002D0051	002D0070	231-70604	2.0754	0.85	0	0	0	1	2008-03-18 00:00
002D0051	002D0072	231-70604	1.3081	0.58	0	0	0	1	2008-03-18 00:00
002D0051	002D0073	231-70604	1.0517	0.68	0	0	0	1	2008-03-18 00:00
002D0051	002D0074	231-70604	1.4688	1.01	0	0	0	1	2008-03-18 00:00
002D0051	002D0076	231-70604	2.1169	1.00	0	0	0	1	2008-03-18 00:00
002D0051	002D0095	231-70604	1.7716	0.87	0	0	0	1	2008-03-18 00:00
002D0051	002D0096	231-70604	1.4200	0.82	0	0	0	1	2008-03-18 00:00
002D0051	002D0099	231-70604	1.1153	0.58	0	0	0	1	2008-03-18 00:00
002D0051	002D0100	231-70604	1.1449	0.68	0	0	0	1	2008-03-18 00:00
002D0051	002D0101	231-70604	1.6379	1.02	0	0	0	1	2008-03-18 00:00
000A2592	002D0051	Amel_2009	-3.3336	2.09	0	0	0	1	2009-02-22 00:00
000A2592	002D0052	Amel_2009	-3.4476	2.09	0	0	0	1	2009-02-22 00:00
000A2592	002D0053	Amel_2009	-3.3296	2.09	0	0	0	1	2009-02-22 00:00
000A2592	002D0069	Amel_2009	-1.7226	1.97	0	0	0	1	2009-02-22 00:00
000A2592	002D0070	Amel_2009	-1.2614	1.97	0	0	0	1	2009-02-22 00:00
000A2592	002D0072	Amel_2009	-2.0266	2.02	0	0	0	1	2009-02-22 00:00
000A2592	002D0073	Amel_2009	-2.2825	2.03	0	0	0	1	2009-02-22 00:00
000A2592	002D0074	Amel_2009	-1.8702	1.86	0	0	0	1	2009-02-22 00:00
000A2592	002D0075	Amel_2009	-2.2342	1.80	0	0	0	1	2009-02-22 00:00
000A2592	002D0076	Amel_2009	-1.2210	1.93	0	0	0	1	2009-02-22 00:00
000A2592	002D0079	Amel_2009	-1.1374	1.87	0	0	0	1	2009-02-22 00:00
000A2592	002D0081	Amel_2009	0.2496	1.86	0	0	0	1	2009-02-22 00:00
000A2592	002D0095	Amel_2009	-1.5649	1.99	0	0	0	1	2009-02-22 00:00
000A2592	002D0096	Amel_2009	-1.9155	1.98	0	0	0	1	2009-02-22 00:00
000A2592	002D0099	Amel_2009	-2.2167	2.10	0	0	0	1	2009-02-22 00:00
000A2592	002D0100	Amel_2009	-2.1883	2.07	0	0	0	1	2009-02-22 00:00
000A2592	002D0101	Amel_2009	-1.7001	1.87	0	0	0	1	2009-02-22 00:00
000A2592	001H0003	Amel_2009	-0.7218	2.03	0	0	0	1	2009-02-22 00:00
000A2592	001H0005	Amel_2009	0.4338	1.91	0	0	0	1	2009-02-22 00:00
000A2592	001H0007	Amel_2009	-0.8510	2.02	0	0	0	1	2009-02-22 00:00
000A2592	001H0009	Amel_2009	-1.0255	1.99	0	0	0	1	2009-02-22 00:00
000A2592	001H0011	Amel_2009	-0.1800	1.76	0	0	0	1	2009-02-22 00:00
000A2592	001H0012	Amel_2009	0.3357	1.62	0	0	0	1	2009-02-22 00:00
000A2592	001H0013	Amel_2009	0.8257	1.58	0	0	0	1	2009-02-22 00:00
000A2592	001H0014	Amel_2009	-0.1389	1.56	0	0	0	1	2009-02-22 00:00
000A2592	001H0016	Amel_2009	-1.0292	1.26	0	0	0	1	2009-02-22 00:00
000A2592	001H0022	Amel_2009	2.1447	2.04	0	0	0	1	2009-02-22 00:00

000A2592	001H0026	Amel_2009	-2.9773	1.70	0	0	0	1	2009-02-22 00:00
000A2592	001H0045	Amel_2009	-0.3630	1.90	0	0	0	1	2009-02-22 00:00
000A2592	001H0048	Amel_2009	-1.1865	1.19	0	0	0	1	2009-02-22 00:00
000A2592	001H0049	Amel_2009	-0.6558	1.46	0	0	0	1	2009-02-22 00:00
000A2592	001H0050	Amel_2009	-1.6166	1.57	0	0	0	1	2009-02-22 00:00
000A2592	001H0052	Amel_2009	-1.5891	1.76	0	0	0	1	2009-02-22 00:00
000A2592	001H0053	Amel_2009	-1.3428	1.86	0	0	0	1	2009-02-22 00:00
000A2592	001H0056	Amel_2009	-2.5956	1.89	0	0	0	1	2009-02-22 00:00
000A2592	001H0057	Amel_2009	-1.9174	1.97	0	0	0	1	2009-02-22 00:00
000A2592	001H0061	Amel_2009	0.5666	0.96	0	0	0	1	2009-02-22 00:00
000A2592	001H0062	Amel_2009	-0.2849	0.95	0	0	0	1	2009-02-22 00:00
000A2592	001H0063	Amel_2009	-0.4041	0.97	0	0	0	1	2009-02-22 00:00
000A2592	001H0064	Amel_2009	-2.1560	1.90	0	0	0	1	2009-02-22 00:00
000A2592	002C0001	Amel_2009	-0.7965	0.27	0	0	0	1	2009-02-22 00:00
000A2592	002C0003	Amel_2009	1.7262	0.51	0	0	0	1	2009-02-22 00:00
000A2592	002C0006	Amel_2009	0.4210	0.84	0	0	0	1	2009-02-22 00:00
000A2592	002C0023	Amel_2009	-0.1876	1.22	0	0	0	1	2009-02-22 00:00
000A2592	002C0040	Amel_2009	-1.0896	1.29	0	0	0	1	2009-02-22 00:00
000A2592	002C0042	Amel_2009	-0.6221	1.08	0	0	0	1	2009-02-22 00:00
000A2592	002C0043	Amel_2009	-0.5297	1.00	0	0	0	1	2009-02-22 00:00
000A2592	002C0045	Amel_2009	-0.2665	0.19	0	0	0	1	2009-02-22 00:00
000A2592	002C0082	Amel_2009	-0.8823	1.81	0	0	0	1	2009-02-22 00:00
000A2592	002C0083	Amel_2009	3.0641	1.67	0	0	0	1	2009-02-22 00:00
000A2592	002C0084	Amel_2009	-1.8204	1.54	0	0	0	1	2009-02-22 00:00
000A2592	002C0085	Amel_2009	-0.4401	1.48	0	0	0	1	2009-02-22 00:00
000A2592	002C0086	Amel_2009	-1.5264	1.51	0	0	0	1	2009-02-22 00:00
000A2592	002C0087	Amel_2009	-1.6237	1.54	0	0	0	1	2009-02-22 00:00
000A2592	002C0096	Amel_2009	-0.9647	1.17	0	0	0	1	2009-02-22 00:00
000A2592	002C0098	Amel_2009	-0.0681	1.12	0	0	0	1	2009-02-22 00:00
000A2592	002C0100	Amel_2009	0.3312	0.86	0	0	0	1	2009-02-22 00:00
000A2592	002C0101	Amel_2009	-0.1249	1.42	0	0	0	1	2009-02-22 00:00
000A2592	002C0103	Amel_2009	1.0739	0.74	0	0	0	1	2009-02-22 00:00
000A2592	002C0105	Amel_2009	14.8794	1.06	0	0	0	1	2009-02-22 00:00
000A2592	002C0107	Amel_2009	-1.7314	0.88	0	0	0	1	2009-02-22 00:00
000A2592	002C0109	Amel_2009	-1.5023	0.60	0	0	0	1	2009-02-22 00:00
000A2592	002C0112b	Amel_2009	-0.0770	1.70	0	0	0	1	2009-02-22 00:00
000A2592	002C0113	Amel_2009	-1.4304	1.61	0	0	0	1	2009-02-22 00:00
000A2592	002C0114	Amel_2009	1.8825	0.99	0	0	0	1	2009-02-22 00:00
000A2592	002C0117	Amel_2009	0.0698	1.11	0	0	0	1	2009-02-22 00:00
000A2592	002C0121	Amel_2009	16.6384	1.71	0	0	0	1	2009-02-22 00:00
000A2592	002C0123	Amel_2009	-0.7900	1.09	0	0	0	1	2009-02-22 00:00
000A2592	002C0124	Amel_2009	-0.8043	0.48	0	0	0	1	2009-02-22 00:00
000A2592	002C0128	Amel_2009	16.7847	1.71	0	0	0	1	2009-02-22 00:00
000A2592	002C0129	Amel_2009	-0.3830	1.62	0	0	0	1	2009-02-22 00:00
000A2592	002C0131	Amel_2009	-1.5659	1.29	0	0	0	1	2009-02-22 00:00
000A2592	002C0133	Amel_2009	-0.3649	1.14	0	0	0	1	2009-02-22 00:00
000A2592	002C0134	Amel_2009	0.5271	1.05	0	0	0	1	2009-02-22 00:00
000A2592	002C0135	Amel_2009	0.4480	1.08	0	0	0	1	2009-02-22 00:00
000A2592	002C0136	Amel_2009	0.5229	1.01	0	0	0	1	2009-02-22 00:00
000A2592	002C0137	Amel_2009	-1.5359	1.09	0	0	0	1	2009-02-22 00:00
000A2592	002C0138	Amel_2009	-1.4521	1.30	0	0	0	1	2009-02-22 00:00
000A2592	002C0139	Amel_2009	-1.7416	1.28	0	0	0	1	2009-02-22 00:00
000A2592	002C0140	Amel_2009	-1.4739	1.26	0	0	0	1	2009-02-22 00:00
000A2592	002C0141	Amel_2009	-1.4927	1.18	0	0	0	1	2009-02-22 00:00
000A2592	002C0142	Amel_2009	2.3008	1.04	0	0	0	1	2009-02-22 00:00
000A2592	002C0143	Amel_2009	-0.8499	1.70	0	0	0	1	2009-02-22 00:00
000A2592	001H0065	Amel_2009	-2.7391	1.61	0	0	0	1	2009-02-22 00:00
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000A2592	001H0066	Amel_2009	-1.6964	0.89	0	0	0	1	2009-02-22 00:00
000A2592	001H0067	Amel_2009	-1.3376	1.10	0	0	0	1	2009-02-22 00:00
000A2592	002C0144	Amel_2009	-2.0086	1.57	0	0	0	1	2009-02-22 00:00
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000A2592	001H0071	Amel_2009	-0.1782	1.86	0	0	0	1	2009-02-22 00:00
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000A2592	002D0070	NAM_AM2011	-1.2737	1.97	0	0	0	1	2011-02-01 00:00
000A2592	002D0072	NAM_AM2011	-2.0354	2.01	0	0	0	1	2011-02-01 00:00
000A2592	002D0073	NAM_AM2011	-2.2902	2.03	0	0	0	1	2011-02-01 00:00
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000A2592	002D0075	NAM_AM2011	-2.2447	1.80	0	0	0	1	2011-02-01 00:00
000A2592	002D0076	NAM_AM2011	-1.2345	1.92	0	0	0	1	2011-02-01 00:00
000A2592	002D0079	NAM_AM2011	-1.1498	1.88	0	0	0	1	2011-02-01 00:00
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000A2592	002D0096	NAM_AM2011	-1.9253	1.97	0	0	0	1	2011-02-01 00:00
000A2592	002D0099	NAM_AM2011	-2.2225	2.10	0	0	0	1	2011-02-01 00:00
000A2592	002D0100	NAM_AM2011	-2.1961	2.07	0	0	0	1	2011-02-01 00:00
000A2592	002D0101	NAM_AM2011	-1.7120	1.88	0	0	0	1	2011-02-01 00:00
000A2592	001H0003	NAM_AM2011	-0.7277	2.00	0	0	0	1	2011-02-01 00:00
000A2592	001H0005	NAM_AM2011	0.4262	1.87	0	0	0	1	2011-02-01 00:00
000A2592	001H0007	NAM_AM2011	-0.8581	2.00	0	0	0	1	2011-02-01 00:00
000A2592	001H0009	NAM_AM2011	-1.0311	1.97	0	0	0	1	2011-02-01 00:00
000A2592	001H0011	NAM_AM2011	-0.1854	1.70	0	0	0	1	2011-02-01 00:00
000A2592	001H0012	NAM_AM2011	0.3296	1.53	0	0	0	1	2011-02-01 00:00

000A2592	001H0013	NAM_AM2011	0.8209	1.48	0	0	0	1	2011-02-01 00:00
000A2592	001H0014	NAM_AM2011	-0.1432	1.46	0	0	0	1	2011-02-01 00:00
000A2592	001H0016	NAM_AM2011	-1.0308	1.08	0	0	0	1	2011-02-01 00:00
000A2592	001H0022	NAM_AM2011	2.1373	2.01	0	0	0	1	2011-02-01 00:00
000A2592	001H0026	NAM_AM2011	-2.9828	1.60	0	0	0	1	2011-02-01 00:00
000A2592	001H0045	NAM_AM2011	-0.3691	1.87	0	0	0	1	2011-02-01 00:00
000A2592	001H0048	NAM_AM2011	-1.1869	1.11	0	0	0	1	2011-02-01 00:00
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000A2592	001H0061	NAM_AM2011	0.5635	0.86	0	0	0	1	2011-02-01 00:00
000A2592	001H0062	NAM_AM2011	-0.2864	0.85	0	0	0	1	2011-02-01 00:00
000A2592	001H0063	NAM_AM2011	-0.4067	0.85	0	0	0	1	2011-02-01 00:00
000A2592	001H0064	NAM_AM2011	-2.1609	1.86	0	0	0	1	2011-02-01 00:00
000A2592	001H0065	NAM_AM2011	-2.7434	1.51	0	0	0	1	2011-02-01 00:00
000A2592	001H0066	NAM_AM2011	-1.6943	0.89	0	0	0	1	2011-02-01 00:00
000A2592	001H0067	NAM_AM2011	-1.3374	1.06	0	0	0	1	2011-02-01 00:00
000A2592	001H0068	NAM_AM2011	-1.0490	1.11	0	0	0	1	2011-02-01 00:00
000A2592	001H0069	NAM_AM2011	-1.6175	0.97	0	0	0	1	2011-02-01 00:00
000A2592	001H0070	NAM_AM2011	-0.9754	1.30	0	0	0	1	2011-02-01 00:00
000A2592	001H0071	NAM_AM2011	-0.1850	1.81	0	0	0	1	2011-02-01 00:00
000A2592	002C0001	NAM_AM2011	-0.7953	0.29	0	0	0	1	2011-02-01 00:00
000A2592	002C0003	NAM_AM2011	1.7259	0.49	0	0	0	1	2011-02-01 00:00
000A2592	002C0006	NAM_AM2011	0.4204	0.82	0	0	0	1	2011-02-01 00:00
000A2592	002C0023	NAM_AM2011	-0.1897	1.29	0	0	0	1	2011-02-01 00:00
000A2592	002C0040	NAM_AM2011	-1.0897	1.25	0	0	0	1	2011-02-01 00:00
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000A2592	002C0043	NAM_AM2011	-0.5305	0.99	0	0	0	1	2011-02-01 00:00
000A2592	002C0045	NAM_AM2011	-0.2669	0.20	0	0	0	1	2011-02-01 00:00
000A2592	002C0082	NAM_AM2011	-0.8988	1.82	0	0	0	1	2011-02-01 00:00
000A2592	002C0083	NAM_AM2011	3.0535	1.67	0	0	0	1	2011-02-01 00:00
000A2592	002C0084	NAM_AM2011	-1.8275	1.54	0	0	0	1	2011-02-01 00:00
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000A2592	002C0086	NAM_AM2011	-1.5336	1.49	0	0	0	1	2011-02-01 00:00
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000A2592	002C0098	NAM_AM2011	-0.0677	1.09	0	0	0	1	2011-02-01 00:00
000A2592	002C0100	NAM_AM2011	0.3328	0.76	0	0	0	1	2011-02-01 00:00
000A2592	002C0101	NAM_AM2011	-0.1280	1.38	0	0	0	1	2011-02-01 00:00
000A2592	002C0103	NAM_AM2011	1.0736	0.72	0	0	0	1	2011-02-01 00:00
000A2592	002C0105	NAM_AM2011	14.8798	0.90	0	0	0	1	2011-02-01 00:00
000A2592	002C0107	NAM_AM2011	-1.7337	0.92	0	0	0	1	2011-02-01 00:00
000A2592	002C0109	NAM_AM2011	-1.5011	0.59	0	0	0	1	2011-02-01 00:00
000A2592	002C0112b	NAM_AM2011	-0.0961	1.70	0	0	0	1	2011-02-01 00:00
000A2592	002C0114	NAM_AM2011	1.8840	0.89	0	0	0	1	2011-02-01 00:00
000A2592	002C0117	NAM_AM2011	0.0658	1.09	0	0	0	1	2011-02-01 00:00
000A2592	002C0121	NAM_AM2011	16.6256	1.71	0	0	0	1	2011-02-01 00:00
000A2592	002C0123	NAM_AM2011	-0.7874	1.07	0	0	0	1	2011-02-01 00:00
000A2592	002C0124	NAM_AM2011	-0.8040	0.49	0	0	0	1	2011-02-01 00:00
000A2592	002C0129	NAM_AM2011	-0.3964	1.62	0	0	0	1	2011-02-01 00:00
000A2592	002C0131	NAM_AM2011	-1.5657	1.23	0	0	0	1	2011-02-01 00:00
000A2592	002C0133	NAM_AM2011	-0.3650	1.09	0	0	0	1	2011-02-01 00:00
000A2592	002C0134	NAM_AM2011	0.5273	0.92	0	0	0	1	2011-02-01 00:00
000A2592	002C0135	NAM_AM2011	0.4484	1.01	0	0	0	1	2011-02-01 00:00
000A2592	002C0136	NAM_AM2011	0.5244	0.83	0	0	0	1	2011-02-01 00:00
000A2592	002C0137	NAM_AM2011	-1.5359	1.06	0	0	0	1	2011-02-01 00:00
000A2592	002C0138	NAM_AM2011	-1.4521	1.25	0	0	0	1	2011-02-01 00:00
000A2592	002C0139	NAM_AM2011	-1.7426	1.25	0	0	0	1	2011-02-01 00:00
000A2592	002C0140	NAM_AM2011	-1.4759	1.24	0	0	0	1	2011-02-01 00:00
000A2592	002C0141	NAM_AM2011	-1.4940	1.18	0	0	0	1	2011-02-01 00:00
000A2592	002C0142	NAM_AM2011	2.2971	1.06	0	0	0	1	2011-02-01 00:00
000A2592	002C0143	NAM_AM2011	-0.8650	1.70	0	0	0	1	2011-02-01 00:00
000A2592	002C0144	NAM_AM2011	-2.0177	1.56	0	0	0	1	2011-02-01 00:00
000A2592	002C0145	NAM_AM2011	2.2186	1.42	0	0	0	1	2011-02-01 00:00
000A2592	001H0078	NAM_AM2011	-2.2084	0.55	0	0	0	1	2011-02-01 00:00
000A2592	002C0151	NAM_AM2011	-1.7330	1.62	0	0	0	1	2011-02-01 00:00
000A2592	001H0072	NAM_AM2011	-0.7257	0.83	0	0	0	1	2011-02-01 00:00
000A2592	002C0146	NAM_AM2011	-0.0405	0.88	0	0	0	1	2011-02-01 00:00
000A2592	001H0080	NAM_AM2011	-0.4217	0.73	0	0	0	1	2011-02-01 00:00
000A2592	002D0114	NAM_AM2011	2.1680	1.87	0	0	0	1	2011-02-01 00:00
000A2592	002C0149	NAM_AM2011	-1.3542	1.81	0	0	0	1	2011-02-01 00:00
000A2592	002D0118	NAM_AM2011	-2.5547	2.10	0	0	0	1	2011-02-01 00:00
000A2592	002D0117	NAM_AM2011	-2.7761	2.07	0	0	0	1	2011-02-01 00:00
000A2592	002D0116	NAM_AM2011	0.7101	2.03	0	0	0	1	2011-02-01 00:00
000A2592	002D0115	NAM_AM2011	-0.1369	1.98	0	0	0	1	2011-02-01 00:00
000A2592	002C0148	NAM_AM2011	-0.6717	1.70	0	0	0	1	2011-02-01 00:00
000A2592	002C0150	NAM_AM2011	9.6235	1.71	0	0	0	1	2011-02-01 00:00
000A2592	001H0077	NAM_AM2011	-1.9786	1.40	0	0	0	1	2011-02-01 00:00
000A2592	001H0081	NAM_AM2011	-2.2276	1.51	0	0	0	1	2011-02-01 00:00
000A2592	001H0079	NAM_AM2011	-1.5340	1.99	0	0	0	1	2011-02-01 00:00
000A2592	001H0073	NAM_AM2011	-0.4395	1.39	0	0	0	1	2011-02-01 00:00
000A2592	001H0074	NAM_AM2011	-0.3280	1.56	0	0	0	1	2011-02-01 00:00
000A2592	001H0076	NAM_AM2011	0.5663	1.75	0	0	0	1	2011-02-01 00:00
000A2592	001H0082	NAM_AM2011	0.0492	1.83	2	0	0	1	2011-02-01 00:00
000A2592	001H0075	NAM_AM2011	-0.7408	1.87	0	0	0	1	2011-02-01 00:00

000A2592	001H0003	NAM_AM2014	-0.7263	1.94	0	0	0	1	2014-02-25	00:00
000A2592	001H0005	NAM_AM2014	0.4288	1.81	0	0	0	1	2014-02-25	00:00
000A2592	001H0007	NAM_AM2014	-0.8555	1.93	0	0	0	1	2014-02-25	00:00
000A2592	001H0009	NAM_AM2014	-1.0281	1.89	0	0	0	1	2014-02-25	00:00
000A2592	001H0011	NAM_AM2014	-0.1816	1.64	0	0	0	1	2014-02-25	00:00
000A2592	001H0013	NAM_AM2014	0.8250	1.46	0	0	0	1	2014-02-25	00:00
000A2592	001H0014	NAM_AM2014	-0.1401	1.44	0	0	0	1	2014-02-25	00:00
000A2592	001H0016	NAM_AM2014	-1.0272	1.06	0	0	0	1	2014-02-25	00:00
000A2592	001H0022	NAM_AM2014	2.1407	1.94	0	0	0	1	2014-02-25	00:00
000A2592	001H0026	NAM_AM2014	-2.9796	1.57	0	0	0	1	2014-02-25	00:00
000A2592	001H0045	NAM_AM2014	-0.3662	1.80	0	0	0	1	2014-02-25	00:00
000A2592	001H0048	NAM_AM2014	-1.1861	1.10	0	0	0	1	2014-02-25	00:00
000A2592	001H0049	NAM_AM2014	-0.6551	1.31	0	0	0	1	2014-02-25	00:00
000A2592	001H0050	NAM_AM2014	-1.6174	1.43	0	0	0	1	2014-02-25	00:00
000A2592	001H0052	NAM_AM2014	-1.5918	1.64	0	0	0	1	2014-02-25	00:00
000A2592	001H0053	NAM_AM2014	-1.3459	1.75	0	0	0	1	2014-02-25	00:00
000A2592	001H0057	NAM_AM2014	-1.9231	1.87	0	0	0	1	2014-02-25	00:00
000A2592	001H0061	NAM_AM2014	0.5661	0.84	0	0	0	1	2014-02-25	00:00
000A2592	001H0062	NAM_AM2014	-0.2839	0.84	0	0	0	1	2014-02-25	00:00
000A2592	001H0063	NAM_AM2014	-0.4045	0.83	0	0	0	1	2014-02-25	00:00
000A2592	001H0064	NAM_AM2014	-2.1606	1.80	0	0	0	1	2014-02-25	00:00
000A2592	001H0065	NAM_AM2014	-2.7406	1.48	0	0	0	1	2014-02-25	00:00
000A2592	001H0066	NAM_AM2014	-1.6959	0.88	0	0	0	1	2014-02-25	00:00
000A2592	001H0067	NAM_AM2014	-1.3379	1.05	0	0	0	1	2014-02-25	00:00
000A2592	001H0068	NAM_AM2014	-1.0458	1.09	0	0	0	1	2014-02-25	00:00
000A2592	001H0069	NAM_AM2014	-1.6139	0.96	0	0	0	1	2014-02-25	00:00
000A2592	001H0070	NAM_AM2014	-0.9743	1.28	0	0	0	1	2014-02-25	00:00
000A2592	001H0071	NAM_AM2014	-0.1802	1.76	0	0	0	1	2014-02-25	00:00
000A2592	001H0072	NAM_AM2014	-0.7222	0.82	0	0	0	1	2014-02-25	00:00
000A2592	001H0073	NAM_AM2014	-0.4365	1.37	0	0	0	1	2014-02-25	00:00
000A2592	001H0074	NAM_AM2014	-0.3236	1.51	0	0	0	1	2014-02-25	00:00
000A2592	001H0075	NAM_AM2014	-0.7378	1.80	0	0	0	1	2014-02-25	00:00
000A2592	001H0076	NAM_AM2014	0.5723	1.70	0	0	0	1	2014-02-25	00:00
000A2592	001H0078	NAM_AM2014	-2.2065	0.53	0	0	0	1	2014-02-25	00:00
000A2592	001H0079	NAM_AM2014	-1.5326	1.93	0	0	0	1	2014-02-25	00:00
000A2592	001H0080	NAM_AM2014	-0.4187	0.72	0	0	0	1	2014-02-25	00:00
000A2592	001H0081	NAM_AM2014	-2.2264	1.48	0	0	0	1	2014-02-25	00:00
000A2592	001H0082	NAM_AM2014	-0.7393	1.23	2	0	0	1	2014-02-25	00:00
000A2592	001H0083	NAM_AM2014	-2.3115	1.79	0	0	0	1	2014-02-25	00:00
000A2592	001H0084	NAM_AM2014	-1.9274	1.38	0	0	0	1	2014-02-25	00:00
000A2592	002C0001	NAM_AM2014	-0.7955	0.26	0	0	0	1	2014-02-25	00:00
000A2592	002C0003	NAM_AM2014	1.7249	0.49	0	0	0	1	2014-02-25	00:00
000A2592	002C0006	NAM_AM2014	0.4200	0.82	0	0	0	1	2014-02-25	00:00
000A2592	002C0023	NAM_AM2014	-0.1932	1.28	0	0	0	1	2014-02-25	00:00

000A2592	002C0040	NAM_AM2014	-1.0926	1.24	0	0	0	1	2014-02-25	00:00
000A2592	002C0042	NAM_AM2014	-0.6249	1.05	0	0	0	1	2014-02-25	00:00
000A2592	002C0043	NAM_AM2014	-0.5345	0.99	0	0	0	1	2014-02-25	00:00
000A2592	002C0045	NAM_AM2014	-0.2671	0.20	0	0	0	1	2014-02-25	00:00
000A2592	002C0082	NAM_AM2014	-0.9222	1.80	0	0	0	1	2014-02-25	00:00
000A2592	002C0083	NAM_AM2014	3.0362	1.65	0	0	0	1	2014-02-25	00:00
000A2592	002C0084	NAM_AM2014	-1.8387	1.54	0	0	0	1	2014-02-25	00:00
000A2592	002C0085	NAM_AM2014	-0.4494	1.49	0	0	0	1	2014-02-25	00:00
000A2592	002C0086	NAM_AM2014	-1.5397	1.48	0	0	0	1	2014-02-25	00:00
000A2592	002C0087	NAM_AM2014	-1.6459	1.53	0	0	0	1	2014-02-25	00:00
000A2592	002C0096	NAM_AM2014	-0.9681	1.12	0	0	0	1	2014-02-25	00:00
000A2592	002C0098	NAM_AM2014	-0.0693	1.08	0	0	0	1	2014-02-25	00:00
000A2592	002C0100	NAM_AM2014	0.3315	0.75	0	0	0	1	2014-02-25	00:00
000A2592	002C0101	NAM_AM2014	-0.1321	1.37	0	0	0	1	2014-02-25	00:00
000A2592	002C0103	NAM_AM2014	1.0728	0.72	0	0	0	1	2014-02-25	00:00
000A2592	002C0105	NAM_AM2014	14.8792	0.89	0	0	0	1	2014-02-25	00:00
000A2592	002C0107	NAM_AM2014	-1.7341	0.88	0	0	0	1	2014-02-25	00:00
000A2592	002C0109	NAM_AM2014	-1.5026	0.59	0	0	0	1	2014-02-25	00:00
000A2592	002C0112b	NAM_AM2014	-0.1175	1.69	0	0	0	1	2014-02-25	00:00
000A2592	002C0114	NAM_AM2014	1.8824	0.89	0	0	0	1	2014-02-25	00:00
000A2592	002C0117	NAM_AM2014	0.0396	1.09	3	0	0	1	2014-02-25	00:00
000A2592	002C0121	NAM_AM2014	16.6038	1.69	0	0	0	1	2014-02-25	00:00
000A2592	002C0123	NAM_AM2014	-0.7916	1.06	0	0	0	1	2014-02-25	00:00
000A2592	002C0124	NAM_AM2014	-0.8025	0.48	0	0	0	1	2014-02-25	00:00
000A2592	002C0128	NAM_AM2014	16.7494	1.69	0	0	0	1	2014-02-25	00:00
000A2592	002C0129	NAM_AM2014	-0.4156	1.61	0	0	0	1	2014-02-25	00:00
000A2592	002C0131	NAM_AM2014	-1.5686	1.22	0	0	0	1	2014-02-25	00:00
000A2592	002C0133	NAM_AM2014	-0.3668	1.08	0	0	0	1	2014-02-25	00:00
000A2592	002C0134	NAM_AM2014	0.5269	0.91	0	0	0	1	2014-02-25	00:00
000A2592	002C0135	NAM_AM2014	0.4468	1.01	0	0	0	1	2014-02-25	00:00
000A2592	002C0136	NAM_AM2014	0.5221	0.82	0	0	0	1	2014-02-25	00:00
000A2592	002C0137	NAM_AM2014	-1.5375	1.05	0	0	0	1	2014-02-25	00:00
000A2592	002C0138	NAM_AM2014	-1.4551	1.24	0	0	0	1	2014-02-25	00:00
000A2592	002C0139	NAM_AM2014	-1.7443	1.23	0	0	0	1	2014-02-25	00:00
000A2592	002C0140	NAM_AM2014	-1.4763	1.22	0	0	0	1	2014-02-25	00:00
000A2592	002C0141	NAM_AM2014	-1.4951	1.16	0	0	0	1	2014-02-25	00:00
000A2592	002C0142	NAM_AM2014	2.2958	1.02	0	0	0	1	2014-02-25	00:00
000A2592	002C0143	NAM_AM2014	-0.8925	1.68	0	0	0	1	2014-02-25	00:00
000A2592	002C0144	NAM_AM2014	-2.0300	1.55	0	0	0	1	2014-02-25	00:00
000A2592	002C0145	NAM_AM2014	2.2141	1.40	0	0	0	1	2014-02-25	00:00
000A2592	002C0146	NAM_AM2014	-0.0398	0.87	0	0	0	1	2014-02-25	00:00
000A2592	002C0148	NAM_AM2014	-0.6938	1.69	0	0	0	1	2014-02-25	00:00
000A2592	002C0149	NAM_AM2014	-1.3786	1.80	0	0	0	1	2014-02-25	00:00
000A2592	002C0150	NAM_AM2014	9.6019	1.70	0	0	0	1	2014-02-25	00:00

```
 000A2592   002C0151   NAM_AM2014    -1.7474       1.59   0   0 0 1  2014-02-25 00:00
 000A2592   002D0051   NAM_AM2014    -3.3520       2.10   0   0 0 1  2014-02-25 00:00
 000A2592   002D0052   NAM_AM2014    -3.4656       2.10   0   0 0 1  2014-02-25 00:00
 000A2592   002D0053   NAM_AM2014    -3.3474       2.10   0   0 0 1  2014-02-25 00:00
 000A2592   002D0069   NAM_AM2014    -1.7479       1.96   0   0 0 1  2014-02-25 00:00
 000A2592   002D0070   NAM_AM2014    -1.2930       1.96   0   0 0 1  2014-02-25 00:00
 000A2592   002D0072   NAM_AM2014    -2.0483       2.03   0   0 0 1  2014-02-25 00:00
 000A2592   002D0073   NAM_AM2014    -2.3066       2.04   0   0 0 1  2014-02-25 00:00
 000A2592   002D0074   NAM_AM2014    -1.9001       1.85   0   0 0 1  2014-02-25 00:00
 000A2592   002D0075   NAM_AM2014    -2.2634       1.79   0   0 0 1  2014-02-25 00:00
 000A2592   002D0076   NAM_AM2014    -1.2545       1.92   0   0 0 1  2014-02-25 00:00
 000A2592   002D0079   NAM_AM2014    -1.1716       1.86   0   0 0 1  2014-02-25 00:00
 000A2592   002D0081   NAM_AM2014     0.2114       1.86   0   0 0 1  2014-02-25 00:00
 000A2592   002D0095   NAM_AM2014    -1.5921       1.97   0   0 0 1  2014-02-25 00:00
 000A2592   002D0096   NAM_AM2014    -1.9396       1.98   0   0 0 1  2014-02-25 00:00
 000A2592   002D0099   NAM_AM2014    -2.2320       2.12   0   0 0 1  2014-02-25 00:00
 000A2592   002D0100   NAM_AM2014    -2.2084       2.10   0   0 0 1  2014-02-25 00:00
 000A2592   002D0101   NAM_AM2014    -1.7334       1.86   0   0 0 1  2014-02-25 00:00
 000A2592   002D0114   NAM_AM2014     2.1454       1.86   0   0 0 1  2014-02-25 00:00
 000A2592   002D0115   NAM_AM2014    -0.1556       1.97   0   0 0 1  2014-02-25 00:00
 000A2592   002D0116   NAM_AM2014     0.6923       2.04   0   0 0 1  2014-02-25 00:00
 000A2592   002D0117   NAM_AM2014    -2.7885       2.10   0   0 0 1  2014-02-25 00:00
 000A2592   002C0065a  279W22        -4.3142       1.37   3   0 0 1  1992-05-16 00:00
 000A2592   002C0106a  289W05        17.0349       1.88   3   0 0 1  1987-11-03 00:00
 000A2592   002C0112a  aml1999        0.0441       1.87   3   0 0 1  1999-02-10 00:00
 000A2592   002D0078a  aml2003        2.2697       1.50   3   0 0 1  2003-02-02 00:00
 002C0106   002C0102   NAM_GPS93    -17.7550      10.00   0   0 0 1  1993-06-15 12:00
 002C0106   000G0391   NAM_GPS93      8.5220      10.00   0   0 0 1  1993-06-15 12:00
 002C0106   AWG-1      NAM_GPS93     18.1840      10.00   0   0 0 1  1993-06-15 12:00
 002C0122   002D0081   NAM_GPS97      1.7310      10.00   0   0 0 1  1997-06-15 12:00
 002C0122   002C0118   NAM_GPS97     -0.5750      10.00   0   0 0 1  1997-06-15 12:00
 002C0122   002C0118   NAM_GPS98A    -0.5760      10.00   0   0 0 1  1998-08-15 12:00
 002C0122   002C0027   NAM_GPS98A    -3.5290      10.00   0   0 0 1  1998-08-15 12:00
 002D0089   002D0052   NAM_GPS98B     1.1290      10.00   0   0 0 1  1998-08-15 12:00
 002D0089   002C0027   NAM_GPS98B    -0.3560      10.00   0   0 0 1  1998-08-15 12:00
 002D0081   AWG-1      NAM_GPS98C    34.7200      10.00   0   0 0 1  1998-08-15 12:00
 002D0081   000G0391   NAM_GPS98C    25.0340      10.00   0   0 0 1  1998-08-15 12:00
 002D0081   002C0122   NAM_GPS00     -1.6950      10.00   0   0 0 1  2000-08-15 12:00
 002D0081   000G0391   NAM_GPS00     25.0580      10.00   0   0 0 1  2000-08-15 12:00
 002D0081   AWG-1      NAM_GPS00     34.7660      10.00   0   0 0 1  2000-08-15 12:00
 002D0081   AWG-1      NAM_GPS04A    34.7793      10.00   0   0 0 1  2004-04-06 12:00
 002D0081   000G0391   NAM_GPS04A    25.0793      10.00   0   0 0 1  2004-04-06 12:00
 002D0081   002C0121   NAM_GPS04A    16.3940      10.00   0   0 0 1  2004-04-06 12:00
```

Appendix K. lts2_gpscors processing output

Contents lts2_gpscors.m

- Analyze GPS CORS data Ameland
- Set stationlist and project name
- Import GPS data
- Meteo data
- GPS decomposition (fitting) - First iteration
- Print parameter summary
- Plot individual components
- Plot final corrected time series and removed component
- Plot maps
- GPS Periodogram - First iteration
- Common mode - Residual stack
- Common mode - Common mode of parameters
- GPS decomposition (fitting) - Second iteration [NOT NECESSARY]
- Final results
- Write GPS CORS point and observation files

Analyze GPS CORS data Ameland

*Hans van der Marel, Delft University of Technology, 29 August 2016 *

This Matlab script processes and analyzes GPS data acquired by the NAM for the monitoring of subsidence in Ameland and the Waddenzee.

The outputs are - text summaries and plots of the estimated parameters - plots of the time series and estimated components - corrected time series (mat, txt and excel files) - NAM GPS point and observation files (for lts2_gpscamp)

Inputs are - Excel file with 06-GPS results - NAM GPS project file

This script uses functions from the `tseries`, `rdnaptrans` and `crsutils` toolboxes.

```
% (c) Hans van der Marel, Delft University of Technology, 2016.

% Created:    29 August 2016 by Hans van der Marel
% Modified:   14 September 2016 by Hans van der Marel
%                - release 1.0

clear all
close all
clc

% Set path to required toolboxes

lts2toolboxdir=fullfile('..','lts2toolbox');

addpath(fullfile(lts2toolboxdir,'tseries'));
addpath(fullfile(lts2toolboxdir,'crsutil'));
addpath(fullfile(lts2toolboxdir,'rdnaptrans'));
```

Set stationlist and project name

```
projectname = 'Ameland';
stations = {'ame1' 'anjm' 'modd' 'amel' 'ame2' 'awg1' };
```

Import GPS data

Hourly GPS positions (longitude, latitude and height) computed by 06-GPS are given in one or more excel files. The excel files are imported using the function `namimportdata` (calls `namimportstation`), and are converted into Matlab mat files `ssss.mat`, with `ssss` the station name. This function calls `namnodata` to remove some parts of the file with invalid data. This is implemented in `lts2_importcorsdata` which can be called separately.

```
importGPS=false;
```

```
for k=1:numel(stations)
  importGPS=importGPS || ~exist([ stations{k} '.mat'],'file');
end
if importGPS
    % Import NAM data to mat files (Please note that you may have to change
    % the script lts2_importcorsdata)
    lts2_importcorsdata
    % Plot the data for a first inspection.
    tseriesplotcomponent(stations,'raw','',projectname,[10 10 20]);
end
```

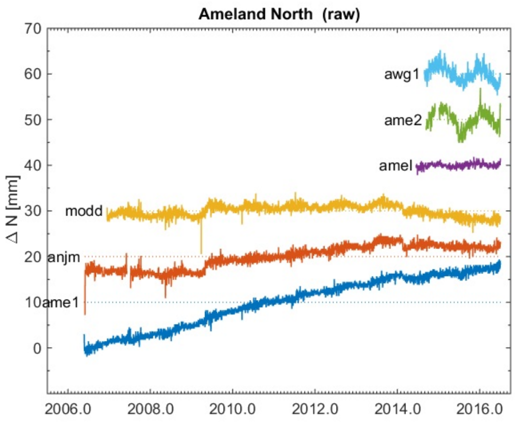
```
Importing ame1 ...
Found date inconsistencies:

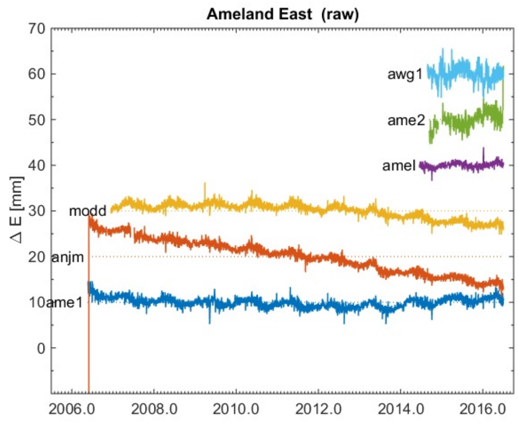
ans =

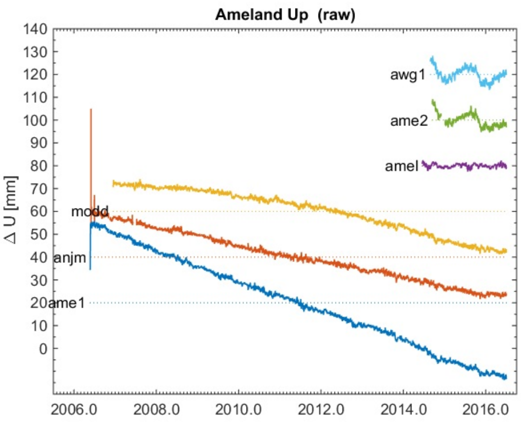
29-Jun-2008 23:00:00
30-Jun-2008 23:00:00
01-Jul-2008 23:00:00
02-Jul-2008 23:00:00
03-Jul-2008 23:00:00
04-Jul-2008 23:00:00
05-Jul-2008 23:00:00
06-Jul-2008 23:00:00
07-Jul-2008 23:00:00
08-Jul-2008 23:00:00
09-Jul-2008 23:00:00
10-Jul-2008 23:00:00
11-Jul-2008 23:00:00
12-Jul-2008 23:00:00
13-Jul-2008 23:00:00
14-Jul-2008 23:00:00
15-Jul-2008 23:00:00
16-Jul-2008 23:00:00
17-Jul-2008 23:00:00
18-Jul-2008 23:00:00
19-Jul-2008 23:00:00
20-Jul-2008 23:00:00
21-Jul-2008 23:00:00
22-Jul-2008 23:00:00

removed 04-Nov-2006 16:00:00 - 10-Nov-2006 13:00:00  (142 epochs)
removed 11-Nov-2006 08:00:00 - 14-Nov-2006 03:00:00  (67 epochs)
removed 05-May-2009 05:00:00 - 05-May-2009 22:00:00  (18 epochs)
removed 08-Aug-2010 03:00:00 - 09-Aug-2010 07:00:00  (29 epochs)
removed 22-Apr-2013 19:00:00 - 23-Apr-2013 20:00:00  (26 epochs)
removed 31-May-2013 04:00:00 - 01-Jun-2013 23:00:00  (44 epochs)
removed 18-Nov-2013 09:00:00 - 29-Nov-2013 14:00:00  (270 epochs)
removed 06-Mar-2016 17:00:00 - 10-Mar-2016 15:00:00  (95 epochs)
The data contains duplicate or decreasing epochs, remove...
2008-06-28 23:00:00  2008-06-28 23:00:00      -0.0067     0.0004     0.0184       -0.0067     0.0004     0.0184
2009-02-07 02:00:00  2009-02-07 02:00:00      -0.0054     0.0000     0.0158       -0.0054     0.0000     0.0158
2009-02-28 01:00:00  2009-02-28 01:00:00      -0.0048     0.0000     0.0156       -0.0048     0.0000     0.0156
Importing anjm ...
removed 21-Oct-2006 23:00:00 - 30-Oct-2006 08:00:00  (201 epochs)
removed 04-Nov-2006 20:00:00 - 11-Nov-2006 13:00:00  (162 epochs)
removed 12-Nov-2006 12:00:00 - 15-Nov-2006 04:00:00  (64 epochs)
removed 08-Jun-2007 08:00:00 - 10-Jul-2007 07:00:00  (767 epochs)
removed 05-Oct-2007 13:00:00 - 08-Oct-2007 11:00:00  (70 epochs)
removed 01-Jan-2008 21:00:00 - 02-Jan-2008 15:00:00  (19 epochs)
removed 16-Jan-2008 20:00:00 - 17-Jan-2008 16:00:00  (21 epochs)
removed 12-Feb-2011 21:00:00 - 13-Feb-2011 14:00:00  (18 epochs)
removed 22-Apr-2013 20:00:00 - 23-Apr-2013 18:00:00  (23 epochs)
removed 13-Jan-2014 22:00:00 - 14-Jan-2014 17:00:00  (20 epochs)
removed 14-Apr-2015 23:00:00 - 16-Apr-2015 01:00:00  (27 epochs)
The data contains duplicate or decreasing epochs, remove...
2008-11-16 11:00:00  2008-11-16 10:00:00      -0.0035     0.0024     0.0094       -0.0035     0.0024     0.0094
2009-02-07 02:00:00  2009-02-07 02:00:00      -0.0035     0.0022     0.0093       -0.0035     0.0022     0.0093
2009-02-28 01:00:00  2009-02-28 01:00:00      -0.0035     0.0032     0.0086       -0.0035     0.0032     0.0086
Importing modd ...
```

```
removed 01-Mar-2013 08:00:00 - 04-Mar-2013 12:00:00  (77 epochs)
removed 02-Jan-2016 23:00:00 - 09-Jan-2016 00:00:00  (146 epochs)
The data contains duplicate or decreasing epochs, remove...
2009-02-28 01:00:00  2009-02-28 01:00:00      -0.0014     0.0013     0.0093       -0.0014     0.0013     0.0093
2009-07-12 13:00:00  2009-07-12 12:00:00       0.0008     0.0011     0.0072        0.0008     0.0011     0.0072
Importing amel ...
removed 16-Nov-2014 08:00:00 - 17-Nov-2014 14:00:00  (31 epochs)
removed 23-Nov-2014 20:00:00 - 24-Nov-2014 16:00:00  (21 epochs)
removed 17-Dec-2014 00:00:00 - 17-Dec-2014 17:00:00  (18 epochs)
removed 22-Jan-2015 23:00:00 - 23-Jan-2015 21:00:00  (23 epochs)
removed 10-Feb-2015 22:00:00 - 11-Feb-2015 17:00:00  (20 epochs)
removed 04-Mar-2015 00:00:00 - 04-Mar-2015 17:00:00  (18 epochs)
removed 06-Mar-2015 00:00:00 - 06-Mar-2015 20:00:00  (21 epochs)
removed 21-Nov-2015 20:00:00 - 23-Nov-2015 07:00:00  (36 epochs)
removed 15-Jan-2016 00:00:00 - 16-Jan-2016 04:00:00  (29 epochs)
removed 19-Mar-2016 07:00:00 - 21-Mar-2016 11:00:00  (53 epochs)
Importing ame2 ...
removed 20-Mar-2016 20:00:00 - 21-Mar-2016 18:00:00  (23 epochs)
Importing awg1 ...
Done importing data.
```



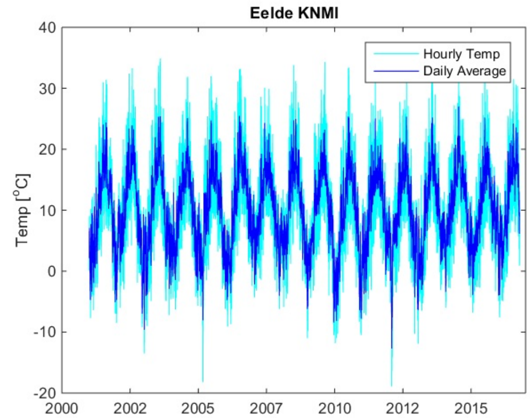


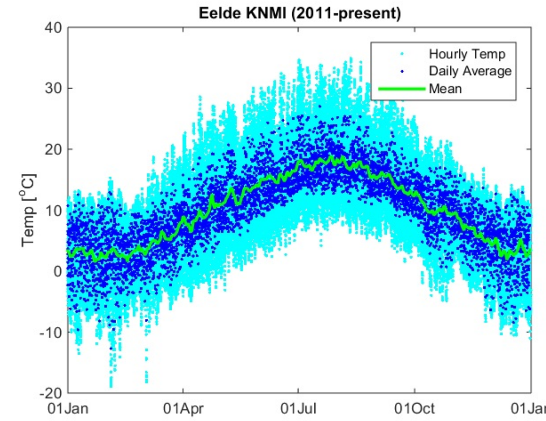


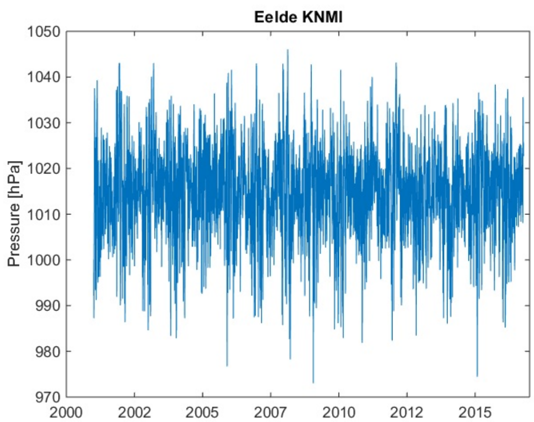
Meteo data

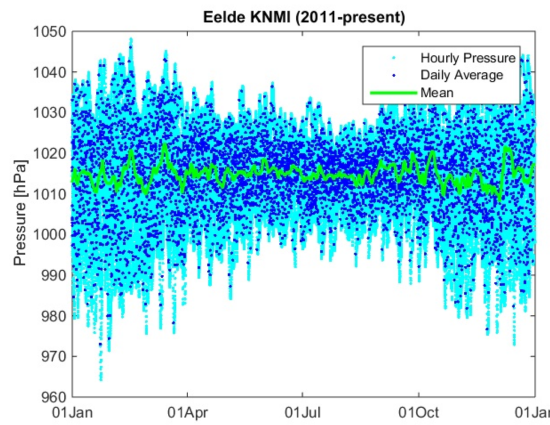
For the decomposition of the GPS signal we require temperature and air pressure data. This data is available at the KNMI website http://cdn.knmi.nl/knmi/map/page/klimatologie/gegevens/uurgegevens/uurgeg_280_2011-2020.zip We download data for * Eelde (280) * Hoorn Terschelling (251) * Lauwersoog (277) has no pressure data!! into the directory `./meteo`. The mean hourly and daily temperature and air pressure are computed using the function `getmeteo`. `getmeteo` saves the results in mat files |meteo_<STATIONNAME.mat| and plots the temperature and air pressure.

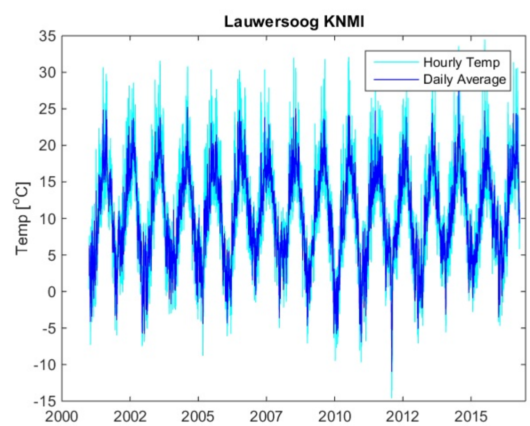
```
if ~exist('meteo_Eelde.mat','file')
  unzip('http://cdn.knmi.nl/knmi/map/page/klimatologie/gegevens/uurgegevens/uurgeg_280_2001-2010.zip','meteo');
  unzip('http://cdn.knmi.nl/knmi/map/page/klimatologie/gegevens/uurgegevens/uurgeg_277_2001-2010.zip','meteo');
  unzip('http://cdn.knmi.nl/knmi/map/page/klimatologie/gegevens/uurgegevens/uurgeg_251_2001-2010.zip','meteo');
  unzip('http://cdn.knmi.nl/knmi/map/page/klimatologie/gegevens/uurgegevens/uurgeg_280_2011-2020.zip','meteo');
  unzip('http://cdn.knmi.nl/knmi/map/page/klimatologie/gegevens/uurgegevens/uurgeg_277_2011-2020.zip','meteo');
  unzip('http://cdn.knmi.nl/knmi/map/page/klimatologie/gegevens/uurgegevens/uurgeg_251_2011-2020.zip','meteo');
  getmeteo('Eelde',{'meteo/uurgeg_280_2001-2010.txt';'meteo/uurgeg_280_2011-2020.txt'});
  getmeteo('Lauwersoog',{'meteo/uurgeg_277_2001-2010.txt';'meteo/uurgeg_277_2011-2020.txt'});
  getmeteo('Hoorn_Terschelling',{'meteo/uurgeg_251_2001-2010.txt';'meteo/uurgeg_251_2011-2020.txt'});
end
```

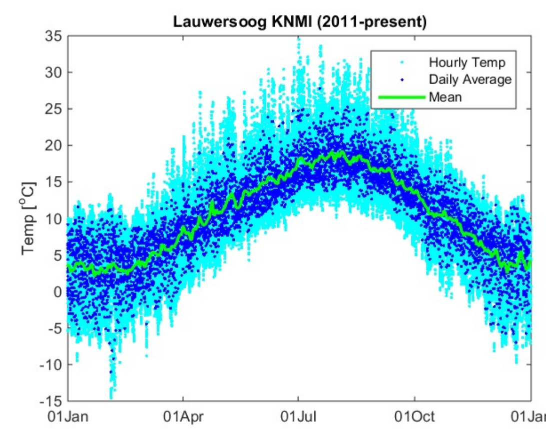

Eelde KNMI
Hourly Temp
Daily Average
Temp [°C]

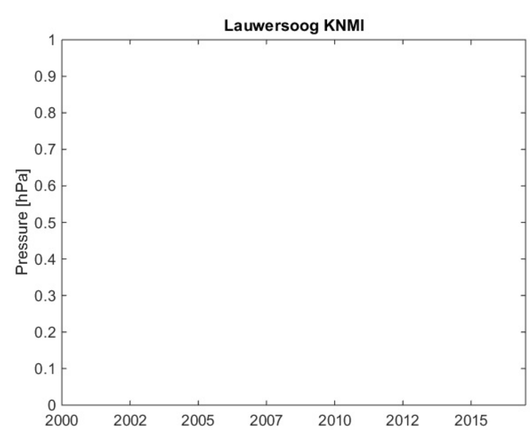

Eelde KNMI (2011-present)
Hourly Temp
Daily Average
Mean
Temp [°C]

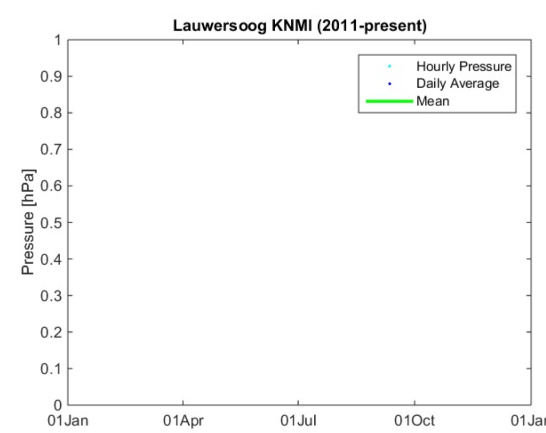

Eelde KNMI
Pressure [hPa]

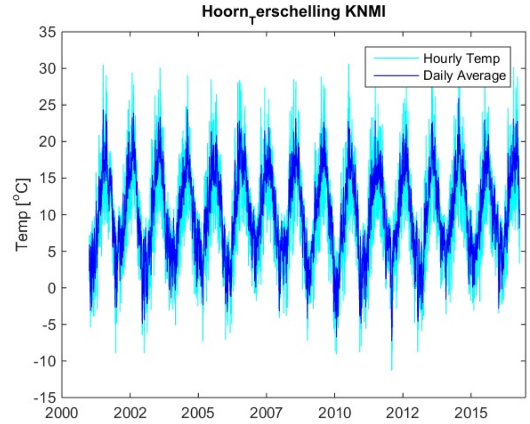

Eelde KNMI (2011-present)
Hourly Pressure
Daily Average
Mean
Pressure [hPa]

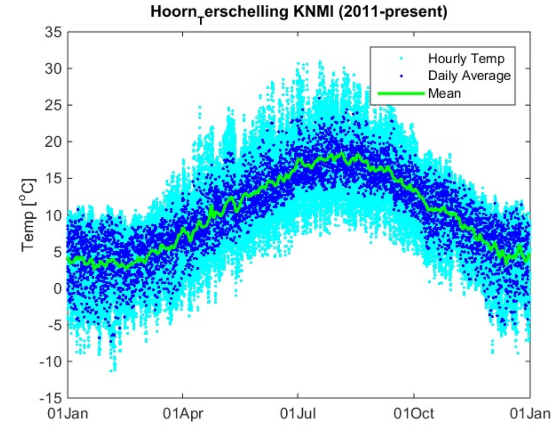

Lauwersoog KNMI
Hourly Temp
Daily Average
Temp [°C]

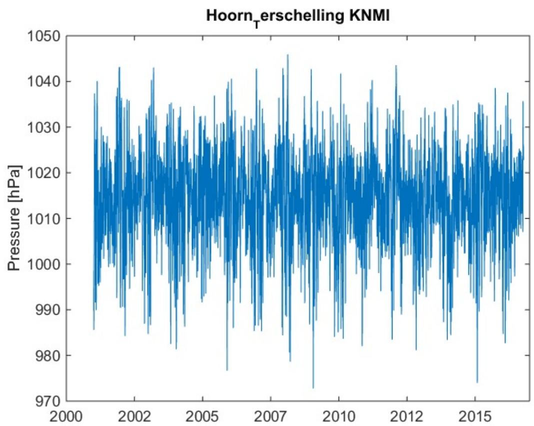

Lauwersoog KNMI (2011-present)
Hourly Temp
Daily Average
Mean
Temp [°C]

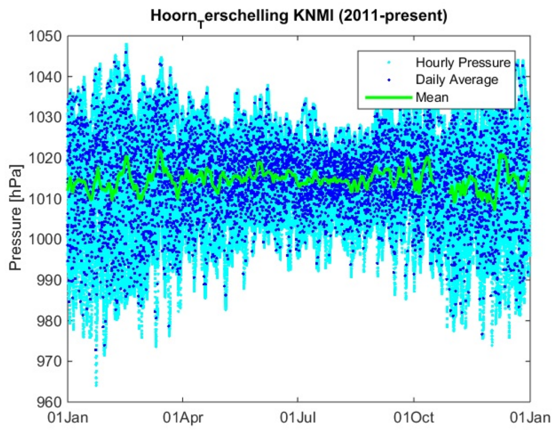

Lauwersoog KNMI
Pressure [hPa]


Lauwersoog KNMI (2011-present)
Hourly Pressure
Daily Average
Mean
Pressure [hPa]









GPS decomposition (fitting) - First iteration

The GPS timeseries is decomposed into several components: *trend* , *Atmospheric loading*, *Temperature Influence*, *Periodic components* and *Residuals* (unmodelled effects). These components are estimated using the function `tseriesanalysis`, which is called from the function `tseriesfit`. The results are written to a mat file `ssss_fit.mat` for each call of `tseriesfit`. Also for each call 3 plots are made and saved in tge directory `./plots`: `ssss_series.png`, `ssss_components.png` and `ssss_residuals.png`.

The trendmodel is selected automatically in `tseriesfit`. For time series shorter than two years a linear fit is chosen, for time series over two year a spline fit is used. Meteo data from Eelde is used to estimate the temperature influence and loading effects. Also any data points with residuals larger than 4 mm in horizontal components and 6 mm in the vertical will be removed.

```
for i=1:numel(stations)
   station=stations{i};
   %tseries=tseriesfit(station,'meteo','meteo_Eelde.mat','_fit');
   tseriesfit(station,'harmonic',[1 1/2],'meteo','meteo_Eelde.mat','maxresid',[4 4 6],'_fit');
end
```

```
Get meteo data...

Timeseries (2006.394 - 2016.502)

          s(1)   s(2)   s(3)   s(4)   s(5)   s(6)   s(7)   s(8)   s(9)  s(10)  s(11)  s(12)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
            mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude
        -10.65  -8.74  -7.56  -5.50  -1.75   0.04   1.90   3.66   5.50   5.78   6.94   8.04   0.00   0.19  -0.05   0.26  -0.01  -0.03   0.44   0.19
          0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.00   0.00   0.00   0.00   0.00   0.00
Longitude
          3.04   0.96   0.47  -0.23   0.01  -0.31  -0.98  -1.00  -0.92   0.60   0.75   0.50   0.00  -0.29   0.56  -0.25  -0.10  -0.01   0.47   0.22
          0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.00   0.01   0.00   0.00   0.00   0.00
Height
         34.95  31.84  23.12  16.59   9.26   3.24  -3.47  -9.56 -15.26 -25.65 -30.25 -32.87   0.07  -0.36   0.15  -0.40   0.06  -0.10   0.66   0.44
          0.02   0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.02   0.02   0.00   0.01   0.00   0.01   0.00   0.00


Remove outliers (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]):

 Epoch             North [mm]  East [mm]    Up [mm]    sN [mm]  sE [mm]  sU [mm]
     1 (2006.394)        -7.0        4.6       14.4        1.0      1.0      1.0
     2 (2006.394)        -7.0        3.5       18.4        1.0      1.0      1.0
     3 (2006.395)        -7.0        3.5       18.4        1.0      1.0      1.0
     4 (2006.395)        -7.0        3.5       18.3        1.0      1.0      1.0
     5 (2006.395)        -8.9        3.3       23.0        1.0      1.0      1.0
     6 (2006.395)        -9.5        3.3       26.3        1.0      1.0      1.0
     7 (2006.395)        -9.5        3.3       26.3        1.0      1.0      1.0
     8 (2006.395)        -9.2        2.8       26.9        1.0      1.0      1.0
     9 (2006.395)        -8.9        2.8       27.6        1.0      1.0      1.0
    10 (2006.395)        -8.9        2.8       28.6        1.0      1.0      1.0
    11 (2006.396)        -8.2        2.8       29.1        1.0      1.0      1.0
    12 (2006.396)        -8.2        2.6       28.9        1.0      1.0      1.0
 25684 (2009.353)        -2.4       -3.5       13.2        1.0      1.0      1.0
 25685 (2009.353)        -2.4       -3.7       13.3        1.0      1.0      1.0
 25686 (2009.354)        -2.7       -3.9       13.3        1.0      1.0      1.0
 25687 (2009.354)        -2.7       -4.1       13.4        1.0      1.0      1.0
 25688 (2009.354)        -3.0       -3.9       13.4        1.0      1.0      1.0
 25689 (2009.354)        -3.3       -3.9       13.4        1.0      1.0      1.0
 25690 (2009.354)        -3.3       -4.1       13.4        1.0      1.0      1.0
 25691 (2009.354)        -3.3       -4.2       13.4        1.0      1.0      1.0
 25692 (2009.354)        -3.3       -4.2       13.3        1.0      1.0      1.0
 25693 (2009.354)        -3.6       -4.2       13.3        1.0      1.0      1.0
 25694 (2009.354)        -3.6       -4.4       13.2        1.0      1.0      1.0
 25695 (2009.355)        -3.9       -4.4       13.3        1.0      1.0      1.0
 25696 (2009.355)        -3.9       -4.4       13.4        1.0      1.0      1.0
 25697 (2009.355)        -3.9       -4.6       13.3        1.0      1.0      1.0
 25698 (2009.355)        -3.9       -4.8       13.3        1.0      1.0      1.0
 25699 (2009.355)        -3.9       -4.8       13.2        1.0      1.0      1.0
 25700 (2009.355)        -3.9       -4.8       13.3        1.0      1.0      1.0
 25701 (2009.355)        -3.9       -4.8       13.4        1.0      1.0      1.0
 25702 (2009.355)        -3.9       -4.8       13.4        1.0      1.0      1.0
 25703 (2009.355)        -3.6       -4.6       13.4        1.0      1.0      1.0
 25704 (2009.356)        -3.6       -4.4       13.5        1.0      1.0      1.0
 25705 (2009.356)        -3.6       -4.2       13.5        1.0      1.0      1.0
 25706 (2009.356)        -3.9       -4.2       13.5        1.0      1.0      1.0
 25707 (2009.356)        -3.9       -4.2       13.5        1.0      1.0      1.0
 25708 (2009.356)        -4.2       -4.1       13.4        1.0      1.0      1.0
 25709 (2009.356)        -4.2       -4.2       13.5        1.0      1.0      1.0
 25710 (2009.356)        -4.5       -4.2       13.7        1.0      1.0      1.0
 25711 (2009.356)        -4.5       -4.2       13.6        1.0      1.0      1.0
```

```
 25712 (2009.356)         -4.5       -4.2       13.7       1.0      1.0      1.0
 25713 (2009.357)         -4.5       -4.1       13.9       1.0      1.0      1.0
 25714 (2009.357)         -4.5       -3.9       13.8       1.0      1.0      1.0
 25715 (2009.357)         -3.9       -4.2       13.6       1.0      1.0      1.0
 25716 (2009.357)         -3.9       -4.2       13.5       1.0      1.0      1.0
 25717 (2009.357)         -3.9       -4.2       13.4       1.0      1.0      1.0
 25718 (2009.357)         -3.6       -4.2       13.4       1.0      1.0      1.0
 25719 (2009.357)         -3.6       -4.2       13.3       1.0      1.0      1.0
 25720 (2009.357)         -3.6       -4.2       13.3       1.0      1.0      1.0
 25721 (2009.358)         -3.6       -4.2       13.4       1.0      1.0      1.0
 25722 (2009.358)         -3.6       -4.2       13.4       1.0      1.0      1.0
 25723 (2009.358)         -3.9       -4.1       13.5       1.0      1.0      1.0
 25724 (2009.358)         -3.6       -4.1       13.5       1.0      1.0      1.0
 25725 (2009.358)         -3.6       -4.1       13.6       1.0      1.0      1.0
 25726 (2009.358)         -3.6       -3.9       13.6       1.0      1.0      1.0
 25727 (2009.358)         -3.3       -3.9       13.5       1.0      1.0      1.0
 25728 (2009.358)         -3.3       -3.7       13.6       1.0      1.0      1.0
 25729 (2009.358)         -3.3       -3.5       13.6       1.0      1.0      1.0

Timeseries (2006.396 - 2016.502)

         s(1)   s(2)   s(3)   s(4)   s(5)   s(6)   s(7)   s(8)   s(9)  s(10)  s(11)  s(12)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
           mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude
       -10.67  -8.73  -7.56  -5.49  -1.75   0.04   1.90   3.66   5.50   5.78   6.94   8.04   0.00   0.19  -0.05   0.26  -0.01  -0.03   0.44   0.19
         0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.00   0.00   0.00   0.00   0.00   0.00
Longitude
         3.03   0.97   0.46  -0.21   0.02  -0.31  -0.98  -1.00  -0.92   0.60   0.76   0.49   0.01  -0.29   0.57  -0.26  -0.10  -0.01   0.45   0.21
         0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.00   0.00   0.00   0.00   0.00   0.00
Height
        35.05  31.78  23.13  16.58   9.26   3.24  -3.47  -9.56 -15.26 -25.65 -30.24 -32.88   0.07  -0.37   0.15  -0.40   0.06  -0.10   0.65   0.42
         0.02   0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.02   0.02   0.00   0.01   0.00   0.01   0.00   0.00


No outliers found (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]), continue...


                    North [mm]  East [mm]    Up [mm]
Emperical St.Dev.:       0.111      0.101      0.069
Formal St.Dev.:          1.000      1.000      1.000
Factor (Estimated):      0.111      0.101      0.069
Factor (Applied):        1.000      1.000      1.000




           Vframe  Vsite   +/- [mm/y]365d   183d    StdR   StdE   StdF [mm]
ame1  Lat    0.00   1.81   0.01      0.26   0.03    0.44   0.11   1.00     2006.40-2016.50
ame1  Lon    0.00  -0.51   0.01      0.62   0.10    0.45   0.10   1.00     2006.40-2016.50
ame1  Hgt    0.00  -6.34   0.01      0.43   0.11    0.65   0.07   1.00     2006.40-2016.50

ame1  PLH   53.46442857   5.92133508   48.1284    (   53 27 51.9428    5 55 16.8063    48.1284 )
save tseries fit to file ame1_fit.mat
Get meteo data...

Timeseries (2006.415 - 2016.502)

         s(1)   s(2)   s(3)   s(4)   s(5)   s(6)   s(7)   s(8)   s(9)  s(10)  s(11)  s(12)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
           mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude
        -3.20  -2.77  -3.78  -3.85  -0.19  -0.31   1.06   2.24   3.42   2.25   1.99   2.34  -0.01   0.20  -0.23   0.07   0.01   0.10   0.53   0.28
         0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.00   0.01   0.00   0.00   0.00   0.00
Longitude
         6.67   6.19   3.77   3.12   1.90   0.81  -0.27  -1.50  -3.75  -4.34  -5.78  -6.69   0.03  -0.06   0.33  -0.30  -0.05  -0.09   0.55   0.30
         0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.02   0.00   0.01   0.00   0.00   0.00   0.00
Height
        19.53  17.59  12.65  10.19   4.53   0.85  -1.94  -5.43  -8.72 -13.38 -17.06 -16.72  -0.01  -0.15  -0.04  -0.32   0.06   0.04   0.66   0.43
         0.02   0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.02   0.02   0.00   0.01   0.00   0.01   0.00   0.00


Remove outliers (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]):




 Epoch              North [mm]  East [mm]    Up [mm]    sN [mm]  sE [mm]  sU [mm]
     1 (2006.415)        -12.8      -85.2       64.8       1.0      1.0      1.0
   736 (2006.498)         -4.4        7.8       27.0       1.0      1.0      1.0
  8365 (2007.418)          0.8        5.0       15.6       1.0      1.0      1.0
 15791 (2008.367)         -8.4        3.7       11.1       1.0      1.0      1.0
 15792 (2008.367)         -8.4        3.9       11.1       1.0      1.0      1.0
 15793 (2008.367)         -8.4        3.9       11.0       1.0      1.0      1.0
 15794 (2008.367)         -8.7        3.7       10.8       1.0      1.0      1.0
 15795 (2008.367)         -8.7        3.9       10.9       1.0      1.0      1.0
 15796 (2008.367)         -9.0        3.7       11.0       1.0      1.0      1.0
 15797 (2008.367)         -9.0        3.5       11.1       1.0      1.0      1.0
 15798 (2008.367)         -8.4        3.3       10.7       1.0      1.0      1.0

Timeseries (2006.415 - 2016.502)

         s(1)   s(2)   s(3)   s(4)   s(5)   s(6)   s(7)   s(8)   s(9)  s(10)  s(11)  s(12)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
           mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude
        -3.19  -2.78  -3.78  -3.85  -0.19  -0.31   1.06   2.24   3.42   2.25   2.00   2.34  -0.01   0.20  -0.23   0.07   0.01   0.10   0.53   0.28
         0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.00   0.01   0.00   0.00   0.00   0.00
Longitude
         6.74   6.16   3.78   3.12   1.90   0.80  -0.27  -1.50  -3.75  -4.34  -5.78  -6.69   0.03  -0.07   0.33  -0.30  -0.05  -0.09   0.45   0.20
         0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.00   0.00   0.00   0.00   0.00   0.00
Height
        19.49  17.60  12.65  10.19   4.53   0.85  -1.94  -5.43  -8.72 -13.38 -17.06 -16.71  -0.01  -0.15  -0.04  -0.32   0.06   0.04   0.64   0.41
         0.02   0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.02   0.02   0.00   0.01   0.00   0.01   0.00   0.00


No outliers found (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]), continue...


                    North [mm]  East [mm]    Up [mm]
Emperical St.Dev.:       0.114      0.093      0.074
Formal St.Dev.:          1.000      1.000      1.000
Factor (Estimated):      0.114      0.093      0.074
Factor (Applied):        1.000      1.000      1.000




           Vframe  Vsite   +/- [mm/y]365d   183d    StdR   StdE   StdF [mm]
anjm  Lat    0.00   1.26   0.01      0.24   0.10    0.53   0.11   1.00     2006.41-2016.50
anjm  Lon    0.00  -1.15   0.01      0.45   0.10    0.45   0.09   1.00     2006.41-2016.50
anjm  Hgt    0.00  -3.14   0.01      0.32   0.07    0.64   0.07   1.00     2006.41-2016.50

anjm  PLH   53.37084495   6.15238647   45.2640    (   53 22 15.0418    6 09 08.5913    45.2640 )
save tseries fit to file anjm_fit.mat
Get meteo data...

Timeseries (2006.953 - 2016.502)

         s(1)   s(2)   s(3)   s(4)   s(5)   s(6)   s(7)   s(8)   s(9)  s(10)  s(11)  s(12)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
           mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude
        -0.71  -0.33  -1.40   0.02   1.06   0.69   0.88   1.49   0.85  -1.14  -1.87  -1.91   0.02   0.32  -0.10  -0.05  -0.04   0.03   0.57   0.33
         0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.02   0.02   0.00   0.01   0.00   0.01   0.00   0.00
Longitude
         1.10   1.09   1.05   1.48   1.25   1.10   0.43   0.22  -1.29  -2.31  -2.81  -3.60   0.02   0.20   0.24  -0.35  -0.11  -0.04   0.43   0.19
         0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.00   0.00   0.00   0.00   0.00   0.00
Height
        12.47  11.32  10.40   9.10   5.70   3.78   0.98  -3.66  -7.31 -13.65 -16.61 -17.67   0.01  -0.20  -0.10  -0.13   0.06   0.02   0.64   0.40
         0.02   0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.02   0.02   0.00   0.01   0.00   0.01   0.00   0.00


Remove outliers (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]):

 Epoch              North [mm]  East [mm]    Up [mm]    sN [mm]  sE [mm]  sU [mm]
 20019 (2009.239)         -9.4        6.3        9.6       1.0      1.0      1.0

Timeseries (2006.953 - 2016.502)
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         s(1)   s(2)   s(3)   s(4)   s(5)   s(6)   s(7)   s(8)   s(9)  s(10)  s(11)  s(12)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
           mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm     mm mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude
        -0.71  -0.33  -1.40   0.02   1.06   0.69   0.88   1.49   0.85  -1.14  -1.87  -1.91   0.02   0.32  -0.10  -0.05  -0.04   0.03   0.57   0.32
         0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.02   0.00   0.01   0.00   0.01   0.00   0.00
Longitude
         1.10   1.09   1.05   1.48   1.25   1.10   0.43   0.22  -1.29  -2.31  -2.81  -3.60   0.02   0.20   0.24  -0.35  -0.11  -0.04   0.43   0.19
         0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.00   0.00   0.00   0.00   0.00   0.00
Height
        12.47  11.32  10.40   9.10   5.70   3.78   0.98  -3.66  -7.31 -13.65 -16.61 -17.67   0.01  -0.20  -0.10  -0.13   0.06   0.02   0.64   0.40
         0.02   0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.02   0.02   0.00   0.01   0.00   0.01   0.00   0.00


No outliers found (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]), continue...


                    North [mm]  East [mm]    Up [mm]
Emperical St.Dev.:       0.120      0.095      0.068
Formal St.Dev.:          1.000      1.000      1.000
Factor (Estimated):      0.120      0.095      0.068
Factor (Applied):        1.000      1.000      1.000




           Vframe  Vsite   +/- [mm/y]365d   183d    StdR   StdE   StdF [mm]
modd  Lat    0.00   0.33   0.01      0.11   0.04    0.57   0.12   1.00     2006.95-2016.50
modd  Lon    0.00  -0.56   0.01      0.43   0.12    0.43   0.10   1.00     2006.95-2016.50
modd  Hgt    0.00  -3.48   0.01      0.16   0.06    0.64   0.07   1.00     2006.95-2016.50

modd  PLH   53.40535322   6.06749592   47.5542    (   53 24 19.2716    6 04 02.9853    47.5542 )
save tseries fit to file modd_fit.mat
Get meteo data...

Timeseries (2014.457 - 2016.502)

         s(1)   s(2)   s(3)   s(4)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
           mm     mm     mm     mm mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude
        -0.36   0.01   0.03   0.39  -0.03   0.33  -0.15   0.44   0.02   0.04   0.33   0.11
         0.01   0.01   0.01   0.01   0.00   0.01   0.01   0.01   0.00   0.00
Longitude
        -0.30  -0.10   0.20   0.04  -0.05  -0.35   0.26  -0.43  -0.07   0.10   0.41   0.17
         0.01   0.01   0.01   0.01   0.00   0.01   0.01   0.01   0.00   0.00
Height
         0.80  -0.62   0.43  -0.45   0.05   0.15   0.19  -0.20  -0.48  -0.29   0.66   0.43
         0.02   0.02   0.02   0.02   0.01   0.02   0.01   0.01   0.01   0.01


No outliers found (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]), continue...


                    North [mm]  East [mm]    Up [mm]
Emperical St.Dev.:       0.087      0.078      0.057
Formal St.Dev.:          1.000      1.000      1.000
Factor (Estimated):      0.087      0.078      0.057
Factor (Applied):        1.000      1.000      1.000




           Vframe  Vsite   +/- [mm/y]365d   183d    StdR   StdE   StdF [mm]
amel  Lat    0.00   0.35   0.01      0.46   0.04    0.33   0.09   1.00     2014.46-2016.50
amel  Lon    0.00   0.34   0.01      0.50   0.12    0.41   0.08   1.00     2014.46-2016.50
amel  Hgt    0.00  -0.76   0.02      0.28   0.56    0.66   0.06   1.00     2014.46-2016.50

amel  PLH   53.44646133   5.76489266   60.6355    (   53 26 47.2608    5 45 53.6136    60.6355 )
save tseries fit to file amel_fit.mat
Get meteo data...




Timeseries (2014.701 - 2016.502)

         p(0)   p(1)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
           mm   mm/y mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude
        -0.34  -0.61  -0.11  -0.99   0.82   1.30  -0.29  -0.02   1.01   1.02
         0.01   0.02   0.01   0.03   0.02   0.02   0.01   0.01
Longitude
         0.73   2.03  -0.11  -1.02   0.15   0.17  -0.02   0.18   1.22   1.48
         0.01   0.02   0.01   0.03   0.02   0.03   0.01   0.01
Height
        -0.98  -3.15   0.14   0.43  -1.66  -1.95   0.47  -0.78   1.02   1.05
         0.01   0.02   0.01   0.03   0.02   0.02   0.01   0.01


Remove outliers (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]):

 Epoch              North [mm]  East [mm]    Up [mm]    sN [mm]  sE [mm]  sU [mm]
  1998 (2015.028)          0.2        3.7       -2.2        1.0      1.0      1.0
  1999 (2015.028)         -0.1        3.7       -2.3        1.0      1.0      1.0
  2000 (2015.028)         -0.1        3.7       -2.3        1.0      1.0      1.0
  2001 (2015.028)         -0.1        3.7       -2.4        1.0      1.0      1.0
  2002 (2015.028)         -0.1        3.7       -2.4        1.0      1.0      1.0
  2003 (2015.028)         -0.1        3.7       -2.5        1.0      1.0      1.0
  2004 (2015.029)         -0.1        3.7       -2.5        1.0      1.0      1.0
  2005 (2015.029)         -0.1        3.7       -2.4        1.0      1.0      1.0
  2006 (2015.029)         -0.1        3.7       -2.4        1.0      1.0      1.0
 10427 (2016.017)          6.4        4.2       -1.9        1.0      1.0      1.0
 10428 (2016.017)          6.4        4.4       -1.9        1.0      1.0      1.0
 10429 (2016.017)          6.4        4.4       -2.0        1.0      1.0      1.0
 10430 (2016.017)          6.4        4.6       -1.9        1.0      1.0      1.0
 10431 (2016.017)          6.4        4.6       -1.8        1.0      1.0      1.0
 10432 (2016.017)          6.4        4.6       -1.7        1.0      1.0      1.0
 10433 (2016.017)          7.0        4.6       -1.6        1.0      1.0      1.0
 10434 (2016.017)          7.0        4.6       -1.5        1.0      1.0      1.0
 10435 (2016.018)          6.7        4.8       -1.6        1.0      1.0      1.0
 10436 (2016.018)          6.4        4.8       -1.7        1.0      1.0      1.0
 10437 (2016.018)          6.1        4.6       -1.7        1.0      1.0      1.0
 10438 (2016.018)          6.1        4.6       -1.7        1.0      1.0      1.0
 10439 (2016.018)          6.1        4.4       -1.7        1.0      1.0      1.0
 10440 (2016.018)          5.7        4.4       -1.7        1.0      1.0      1.0
 14471 (2016.492)         -1.7        5.3       -1.1        1.0      1.0      1.0
 14472 (2016.492)         -0.1        7.4       -0.8        1.0      1.0      1.0
 14473 (2016.492)          0.2        8.1       -0.9        1.0      1.0      1.0
 14474 (2016.492)          0.5        8.3       -1.3        1.0      1.0      1.0
 14475 (2016.492)          0.8        8.5       -1.3        1.0      1.0      1.0
 14476 (2016.492)          0.8        8.9       -1.1        1.0      1.0      1.0
 14477 (2016.492)          0.5        9.2       -1.6        1.0      1.0      1.0
 14478 (2016.492)          0.2        9.6       -1.4        1.0      1.0      1.0
 14479 (2016.492)          0.8        9.6       -1.3        1.0      1.0      1.0
 14480 (2016.493)          0.2       10.0       -0.8        1.0      1.0      1.0
 14481 (2016.493)          0.2       10.3       -0.9        1.0      1.0      1.0
 14482 (2016.493)          0.2       10.5       -1.3        1.0      1.0      1.0
 14483 (2016.493)          0.2       10.7       -1.3        1.0      1.0      1.0
 14484 (2016.493)          0.5       10.7       -1.3        1.0      1.0      1.0
 14485 (2016.493)          0.5       10.7       -1.4        1.0      1.0      1.0
 14486 (2016.493)          0.8       11.1       -1.5        1.0      1.0      1.0
 14487 (2016.493)          0.8       11.3       -1.7        1.0      1.0      1.0
 14488 (2016.493)          1.1       11.6       -1.4        1.0      1.0      1.0
 14489 (2016.494)          1.1       11.6       -1.3        1.0      1.0      1.0
 14490 (2016.494)          1.4       11.6       -1.3        1.0      1.0      1.0
 14491 (2016.494)          1.4       11.4       -1.3        1.0      1.0      1.0
 14492 (2016.494)          1.7       11.4       -1.3        1.0      1.0      1.0
 14493 (2016.494)          2.0       11.3       -1.3        1.0      1.0      1.0
 14494 (2016.494)          2.0       11.3       -1.4        1.0      1.0      1.0
 14495 (2016.494)          2.0       11.1       -1.5        1.0      1.0      1.0
 14496 (2016.494)          2.0       11.1       -1.3        1.0      1.0      1.0
 14497 (2016.495)          2.0       11.4       -1.4        1.0      1.0      1.0
 14498 (2016.495)          2.3       11.3       -1.6        1.0      1.0      1.0
 14499 (2016.495)          2.3       11.1       -1.7        1.0      1.0      1.0
 14500 (2016.495)          2.3       11.3       -1.5        1.0      1.0      1.0
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 14501 (2016.495)          2.3       11.1       -1.6       1.0      1.0      1.0
 14502 (2016.495)          2.3       11.3       -1.7       1.0      1.0      1.0
 14503 (2016.495)          2.0       11.1       -1.7       1.0      1.0      1.0
 14504 (2016.495)          2.0       11.3       -1.8       1.0      1.0      1.0
 14505 (2016.495)          2.0       11.4       -1.8       1.0      1.0      1.0
 14506 (2016.496)          2.0       11.4       -1.7       1.0      1.0      1.0
 14507 (2016.496)          2.0       11.4       -1.8       1.0      1.0      1.0
 14508 (2016.496)          2.0       11.3       -1.6       1.0      1.0      1.0
 14509 (2016.496)          2.0       11.3       -1.7       1.0      1.0      1.0
 14510 (2016.496)          2.0       11.3       -1.6       1.0      1.0      1.0
 14511 (2016.496)          2.0       11.1       -1.7       1.0      1.0      1.0
 14512 (2016.496)          2.0       11.1       -1.7       1.0      1.0      1.0
 14513 (2016.496)          2.0       11.1       -1.7       1.0      1.0      1.0
 14514 (2016.496)          2.0       11.1       -1.8       1.0      1.0      1.0
 14515 (2016.497)          2.3       11.1       -2.0       1.0      1.0      1.0
 14516 (2016.497)          2.7       11.1       -2.2       1.0      1.0      1.0
 14517 (2016.497)          3.0       10.9       -2.3       1.0      1.0      1.0
 14518 (2016.497)          3.3       10.5       -2.4       1.0      1.0      1.0
 14519 (2016.497)          3.3       10.5       -2.3       1.0      1.0      1.0
 14520 (2016.497)          3.3       10.5       -2.2       1.0      1.0      1.0
 14521 (2016.497)          3.3       10.5       -2.2       1.0      1.0      1.0
 14522 (2016.497)          3.3       10.5       -2.3       1.0      1.0      1.0
 14523 (2016.497)          3.3       10.5       -2.4       1.0      1.0      1.0
 14524 (2016.498)          3.6       10.7       -2.4       1.0      1.0      1.0
 14525 (2016.498)          3.3       10.7       -2.6       1.0      1.0      1.0
 14526 (2016.498)          3.3       10.9       -2.6       1.0      1.0      1.0
 14527 (2016.498)          3.3       10.9       -2.6       1.0      1.0      1.0
 14528 (2016.498)          3.3       10.9       -2.5       1.0      1.0      1.0
 14529 (2016.498)          3.3       10.9       -2.5       1.0      1.0      1.0
 14530 (2016.498)          3.3       10.9       -2.4       1.0      1.0      1.0
 14531 (2016.498)          3.6       10.7       -2.3       1.0      1.0      1.0
 14532 (2016.499)          3.3       10.9       -2.3       1.0      1.0      1.0
 14533 (2016.499)          3.3       10.7       -2.2       1.0      1.0      1.0
 14534 (2016.499)          3.3       10.5       -2.1       1.0      1.0      1.0
 14535 (2016.499)          3.3       10.7       -2.3       1.0      1.0      1.0
 14536 (2016.499)          3.3       10.9       -2.3       1.0      1.0      1.0
 14537 (2016.499)          3.3       10.9       -2.4       1.0      1.0      1.0
 14538 (2016.499)          3.0       10.9       -2.6       1.0      1.0      1.0
 14539 (2016.499)          3.0       10.9       -2.7       1.0      1.0      1.0
 14540 (2016.499)          3.3       10.9       -2.6       1.0      1.0      1.0
 14541 (2016.500)          3.3       10.9       -2.6       1.0      1.0      1.0
 14542 (2016.500)          3.3       10.7       -2.6       1.0      1.0      1.0
 14543 (2016.500)          3.6       10.9       -2.5       1.0      1.0      1.0
 14544 (2016.500)          3.3       10.7       -2.5       1.0      1.0      1.0
 14545 (2016.500)          3.6       10.7       -2.6       1.0      1.0      1.0
 14546 (2016.500)          3.3       10.9       -2.7       1.0      1.0      1.0
 14547 (2016.500)          3.3       10.7       -2.7       1.0      1.0      1.0
 14548 (2016.500)          3.3       10.7       -2.7       1.0      1.0      1.0
 14549 (2016.500)          3.3       10.5       -2.6       1.0      1.0      1.0
 14550 (2016.501)          3.3       10.5       -2.7       1.0      1.0      1.0
 14551 (2016.501)          3.3       10.5       -2.8       1.0      1.0      1.0
 14552 (2016.501)          3.0       10.5       -2.9       1.0      1.0      1.0
 14553 (2016.501)          3.0       10.5       -3.0       1.0      1.0      1.0
 14554 (2016.501)          3.0       10.5       -3.1       1.0      1.0      1.0
 14555 (2016.501)          2.7       10.5       -3.1       1.0      1.0      1.0
 14556 (2016.501)          2.7       10.5       -3.1       1.0      1.0      1.0
 14557 (2016.501)          2.7       10.7       -3.1       1.0      1.0      1.0
 14558 (2016.501)          2.7       10.7       -3.1       1.0      1.0      1.0
 14559 (2016.502)          2.7       10.9       -3.0       1.0      1.0      1.0
 14560 (2016.502)          2.7       11.4       -2.8       1.0      1.0      1.0
 14561 (2016.502)          2.7       11.8       -2.8       1.0      1.0      1.0
 14562 (2016.502)          2.7       11.8       -2.9       1.0      1.0      1.0
 14563 (2016.502)          2.7       11.8       -3.0       1.0      1.0      1.0
 14564 (2016.502)          3.0       11.6       -3.0       1.0      1.0      1.0
 14565 (2016.502)          3.0       11.4       -3.2       1.0      1.0      1.0

Timeseries (2014.701 - 2016.491)

         p(0)   p(1)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
           mm   mm/y mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude



        -0.42  -0.71  -0.09  -0.93   0.88   1.40  -0.31  -0.09   0.92   0.84
         0.01   0.02   0.01   0.03   0.01   0.02   0.01   0.01
Longitude
         0.56   1.84  -0.08  -0.93   0.25   0.35  -0.05   0.05   0.92   0.85
         0.01   0.02   0.01   0.03   0.01   0.02   0.01   0.01
Height
        -0.97  -3.14   0.14   0.43  -1.66  -1.96   0.47  -0.77   1.02   1.04
         0.01   0.02   0.01   0.03   0.02   0.02   0.01   0.01


Remove outliers (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]):

 Epoch              North [mm]  East [mm]    Up [mm]    sN [mm]  sE [mm]  sU [mm]
 10410 (2016.016)          6.1        3.5       -2.1       1.0      1.0      1.0
 10412 (2016.016)          6.1        3.7       -2.0       1.0      1.0      1.0
 10413 (2016.016)          6.1        3.7       -2.0       1.0      1.0      1.0
 10414 (2016.016)          6.1        3.9       -1.9       1.0      1.0      1.0
 10415 (2016.016)          6.1        3.9       -1.9       1.0      1.0      1.0
 10416 (2016.016)          6.1        4.1       -1.9       1.0      1.0      1.0
 10417 (2016.017)          6.1        4.1       -2.0       1.0      1.0      1.0

                    North [mm]  East [mm]    Up [mm]
Emperical St.Dev.:       0.114      0.119      0.077
Formal St.Dev.:          1.000      1.000      1.000
Factor (Estimated):      0.114      0.119      0.077
Factor (Applied):        1.000      1.000      1.000




           Vframe  Vsite   +/- [mm/y]365d   183d    StdR   StdE   StdF [mm]
ame2  Lat    0.00  -0.71   0.02      1.65   0.32    0.92   0.11   1.00     2014.70-2016.49
ame2  Lon    0.00   1.84   0.02      0.43   0.07    0.92   0.12   1.00     2014.70-2016.49
ame2  Hgt    0.00  -3.14   0.02      2.57   0.90    1.02   0.08   1.00     2014.70-2016.49

ame2  PLH   53.48329865   5.86684295   69.5413    (   53 28 59.8751    5 52 00.6346    69.5413 )
save tseries fit to file ame2_fit.mat
Get meteo data...

Timeseries (2014.657 - 2016.502)

         p(0)   p(1)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
           mm   mm/y mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude
        -0.62  -1.16  -0.33   0.39   0.41   1.75  -0.08   0.09   0.85   0.73
         0.01   0.01   0.01   0.02   0.01   0.02   0.01   0.01
Longitude
        -0.25  -0.58  -0.07   1.54   0.45   0.13   0.05   0.38   1.19   1.41
         0.01   0.02   0.01   0.03   0.02   0.02   0.01   0.01
Height
        -0.79  -2.32   0.30   0.79  -1.01  -2.77   0.30  -0.72   0.93   0.86
         0.01   0.02   0.01   0.03   0.01   0.02   0.01   0.01


Remove outliers (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]):

 Epoch              North [mm]  East [mm]    Up [mm]    sN [mm]  sE [mm]  sU [mm]
  2202 (2014.908)          3.0       -4.7        1.1       1.0      1.0      1.0
  2207 (2014.909)          3.0       -4.7        1.3       1.0      1.0      1.0
  2208 (2014.909)          3.0       -4.9        1.3       1.0      1.0      1.0
  2211 (2014.909)          3.3       -5.0        1.3       1.0      1.0      1.0
  2212 (2014.909)          3.3       -5.0        1.2       1.0      1.0      1.0
  2213 (2014.909)          3.3       -5.0        1.2       1.0      1.0      1.0
  2214 (2014.910)          3.7       -5.0        1.3       1.0      1.0      1.0
  2215 (2014.910)          3.7       -5.0        1.4       1.0      1.0      1.0
  2216 (2014.910)          3.7       -5.0        1.5       1.0      1.0      1.0
  2217 (2014.910)          3.7       -5.0        1.5       1.0      1.0      1.0
  2903 (2014.988)          1.8       -4.7       -2.1       1.0      1.0      1.0
  2904 (2014.988)          1.8       -5.0       -2.3       1.0      1.0      1.0
  2905 (2014.988)          2.1       -5.2       -2.3       1.0      1.0      1.0
  2906 (2014.988)          2.1       -5.2       -2.2       1.0      1.0      1.0
```

```
  2907 (2014.989)         2.1      -5.2      -2.1      1.0     1.0     1.0
  2908 (2014.989)         2.1      -5.2      -2.2      1.0     1.0     1.0
  2909 (2014.989)         2.1      -5.0      -2.1      1.0     1.0     1.0
  2910 (2014.989)         2.1      -5.0      -1.9      1.0     1.0     1.0
  2911 (2014.989)         2.1      -4.9      -1.9      1.0     1.0     1.0
  3236 (2015.026)         2.4       4.9      -2.9      1.0     1.0     1.0
  3237 (2015.026)         2.4       5.3      -3.0      1.0     1.0     1.0
  3238 (2015.026)         2.4       5.3      -3.1      1.0     1.0     1.0
  3239 (2015.026)         2.4       5.3      -3.1      1.0     1.0     1.0
  3240 (2015.027)         2.4       5.3      -3.1      1.0     1.0     1.0
  3241 (2015.027)         2.4       5.5      -3.2      1.0     1.0     1.0
  3242 (2015.027)         2.4       5.5      -3.3      1.0     1.0     1.0
  3243 (2015.027)         2.1       5.3      -3.5      1.0     1.0     1.0
  3244 (2015.027)         1.8       5.3      -3.5      1.0     1.0     1.0
  3245 (2015.027)         1.8       5.3      -3.5      1.0     1.0     1.0
  3246 (2015.027)         2.1       5.3      -3.5      1.0     1.0     1.0
  3247 (2015.027)         1.8       5.3      -3.6      1.0     1.0     1.0
  3248 (2015.027)         1.8       5.3      -3.6      1.0     1.0     1.0
  3249 (2015.028)         1.8       5.5      -3.6      1.0     1.0     1.0
  3250 (2015.028)         1.8       5.5      -3.7      1.0     1.0     1.0
  3251 (2015.028)         1.5       5.6      -3.8      1.0     1.0     1.0
  3252 (2015.028)         1.5       5.6      -4.0      1.0     1.0     1.0
  3253 (2015.028)         1.5       5.6      -4.1      1.0     1.0     1.0
  3254 (2015.028)         1.5       5.6      -4.2      1.0     1.0     1.0
  3255 (2015.028)         1.5       5.6      -4.3      1.0     1.0     1.0
  3256 (2015.028)         1.5       5.6      -4.3      1.0     1.0     1.0
  3257 (2015.029)         1.2       5.6      -4.3      1.0     1.0     1.0
  3258 (2015.029)         1.5       5.5      -4.4      1.0     1.0     1.0
  3259 (2015.029)         1.5       5.5      -4.5      1.0     1.0     1.0
  3260 (2015.029)         1.5       5.5      -4.6      1.0     1.0     1.0
  3261 (2015.029)         1.5       5.3      -4.5      1.0     1.0     1.0
  3262 (2015.029)         1.5       5.1      -4.4      1.0     1.0     1.0
  3263 (2015.029)         1.5       5.1      -4.4      1.0     1.0     1.0
  3264 (2015.029)         1.8       4.9      -4.3      1.0     1.0     1.0
  3265 (2015.029)         1.8       4.7      -4.3      1.0     1.0     1.0
  5148 (2015.244)         1.5       4.4      -1.2      1.0     1.0     1.0
  5149 (2015.244)         1.5       4.7      -1.3      1.0     1.0     1.0
  5150 (2015.244)         1.5       5.1      -1.4      1.0     1.0     1.0
  5151 (2015.245)         1.2       5.3      -1.3      1.0     1.0     1.0
  5152 (2015.245)         1.2       5.3      -1.3      1.0     1.0     1.0
  5153 (2015.245)         1.2       5.3      -1.4      1.0     1.0     1.0
  5154 (2015.245)         0.9       5.3      -1.5      1.0     1.0     1.0
  5155 (2015.245)         0.9       5.3      -1.6      1.0     1.0     1.0
  5156 (2015.245)         0.9       5.3      -1.7      1.0     1.0     1.0
  5157 (2015.245)         0.9       5.3      -1.9      1.0     1.0     1.0
  5158 (2015.245)         0.9       5.3      -1.9      1.0     1.0     1.0
  5159 (2015.245)         0.9       5.5      -2.0      1.0     1.0     1.0
  5160 (2015.246)         0.9       5.5      -2.0      1.0     1.0     1.0
  5161 (2015.246)         0.9       5.3      -2.0      1.0     1.0     1.0
  5162 (2015.246)         0.9       5.1      -2.0      1.0     1.0     1.0
  5163 (2015.246)         0.9       4.7      -2.1      1.0     1.0     1.0
  5164 (2015.246)         0.9       4.7      -2.3      1.0     1.0     1.0
  5165 (2015.246)         0.9       4.5      -2.4      1.0     1.0     1.0
  5166 (2015.246)         0.6       4.5      -2.4      1.0     1.0     1.0
  5167 (2015.246)         0.6       4.5      -2.3      1.0     1.0     1.0
  5168 (2015.247)         0.6       4.5      -2.5      1.0     1.0     1.0
  5169 (2015.247)         0.6       4.5      -2.6      1.0     1.0     1.0
  5170 (2015.247)         0.6       4.5      -2.6      1.0     1.0     1.0
  5171 (2015.247)         0.2       4.5      -2.6      1.0     1.0     1.0
  5172 (2015.247)         0.2       4.4      -2.7      1.0     1.0     1.0
  5173 (2015.247)         0.2       4.4      -2.7      1.0     1.0     1.0
  5174 (2015.247)         0.6       4.4      -2.8      1.0     1.0     1.0
  5175 (2015.247)         0.6       4.4      -2.8      1.0     1.0     1.0
  5176 (2015.247)         0.6       4.2      -2.7      1.0     1.0     1.0
  5177 (2015.248)         0.6       4.2      -2.8      1.0     1.0     1.0
  5178 (2015.248)         0.6       4.0      -2.8      1.0     1.0     1.0
  5179 (2015.248)         0.9       3.8      -2.8      1.0     1.0     1.0
  5180 (2015.248)         0.9       3.6      -2.7      1.0     1.0     1.0
  5181 (2015.248)         0.9       3.6      -2.8      1.0     1.0     1.0
 10739 (2015.882)         0.6       3.8      -4.8      1.0     1.0     1.0
 10740 (2015.882)         0.6       3.8      -4.8      1.0     1.0     1.0



 10741 (2015.882)         0.6       3.8      -4.9      1.0     1.0     1.0
 10742 (2015.882)         0.2       3.8      -5.1      1.0     1.0     1.0
 10997 (2015.911)         1.2       3.6      -4.2      1.0     1.0     1.0
 10998 (2015.912)         0.9       3.8      -4.2      1.0     1.0     1.0
 10999 (2015.912)         0.9       3.6      -4.2      1.0     1.0     1.0
 11807 (2016.004)         2.1      -4.9      -1.9      1.0     1.0     1.0
 11808 (2016.004)         2.4      -4.9      -1.9      1.0     1.0     1.0
 11809 (2016.021)         2.7      -5.4      -2.0      1.0     1.0     1.0
 12409 (2016.089)         1.8       3.4      -6.2      1.0     1.0     1.0
 12410 (2016.089)         1.8       3.4      -6.1      1.0     1.0     1.0
 12411 (2016.089)         1.5       3.4      -6.1      1.0     1.0     1.0
 12412 (2016.089)         1.2       3.4      -6.1      1.0     1.0     1.0

Timeseries (2014.657 - 2016.502)

         p(0)   p(1)  AtmLd  TempI s(365) c(365) s(183) c(183)    rms    omt
           mm   mm/y mm/kPa mm/daK     mm     mm     mm     mm     mm
Latitude
        -0.62  -1.16  -0.33   0.40   0.42   1.76  -0.07   0.09   0.86   0.73
         0.01   0.01   0.01   0.02   0.01   0.02   0.01   0.01
Longitude
        -0.25  -0.55  -0.05   1.49   0.40   0.10   0.04   0.39   1.13   1.28
         0.01   0.02   0.01   0.03   0.02   0.02   0.01   0.01
Height
        -0.78  -2.33   0.30   0.81  -0.99  -2.76   0.31  -0.72   0.92   0.84
         0.01   0.02   0.01   0.02   0.01   0.02   0.01   0.01

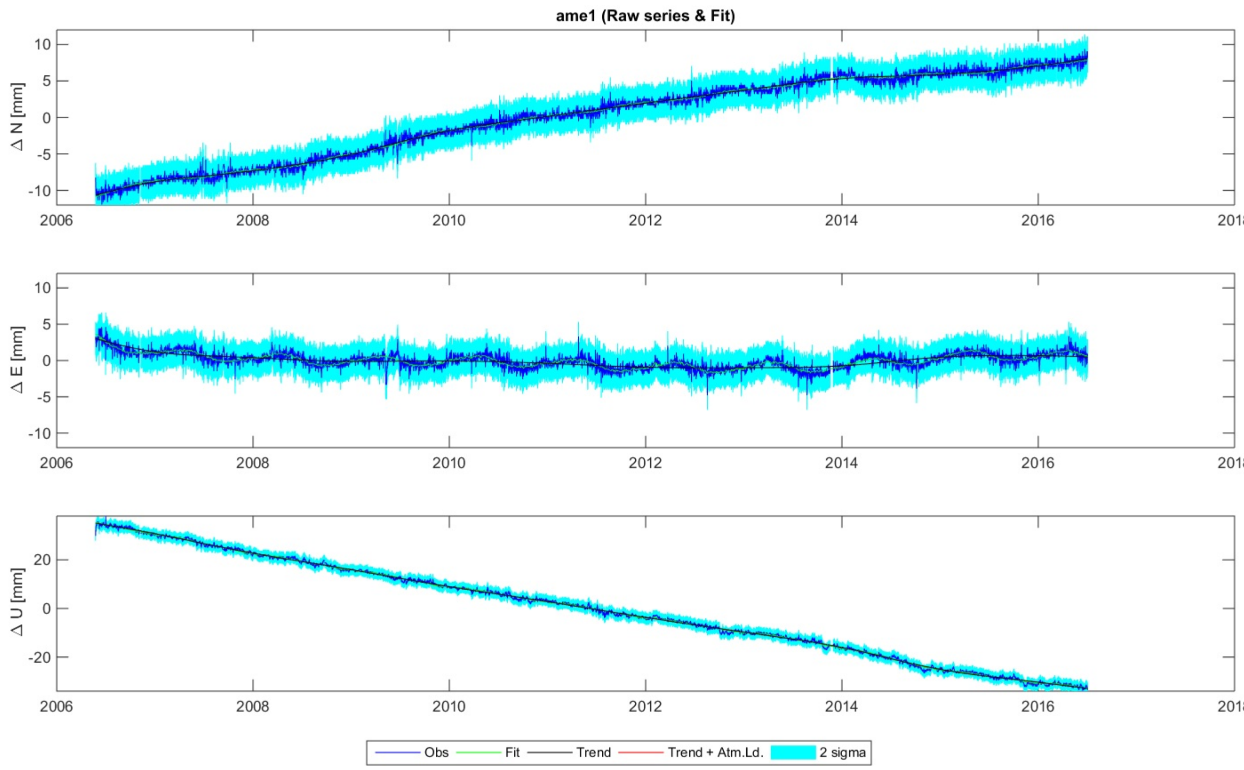

No outliers found (dN > 4.0 , dE > 4.0  dU > 6.0 [mm]), continue...

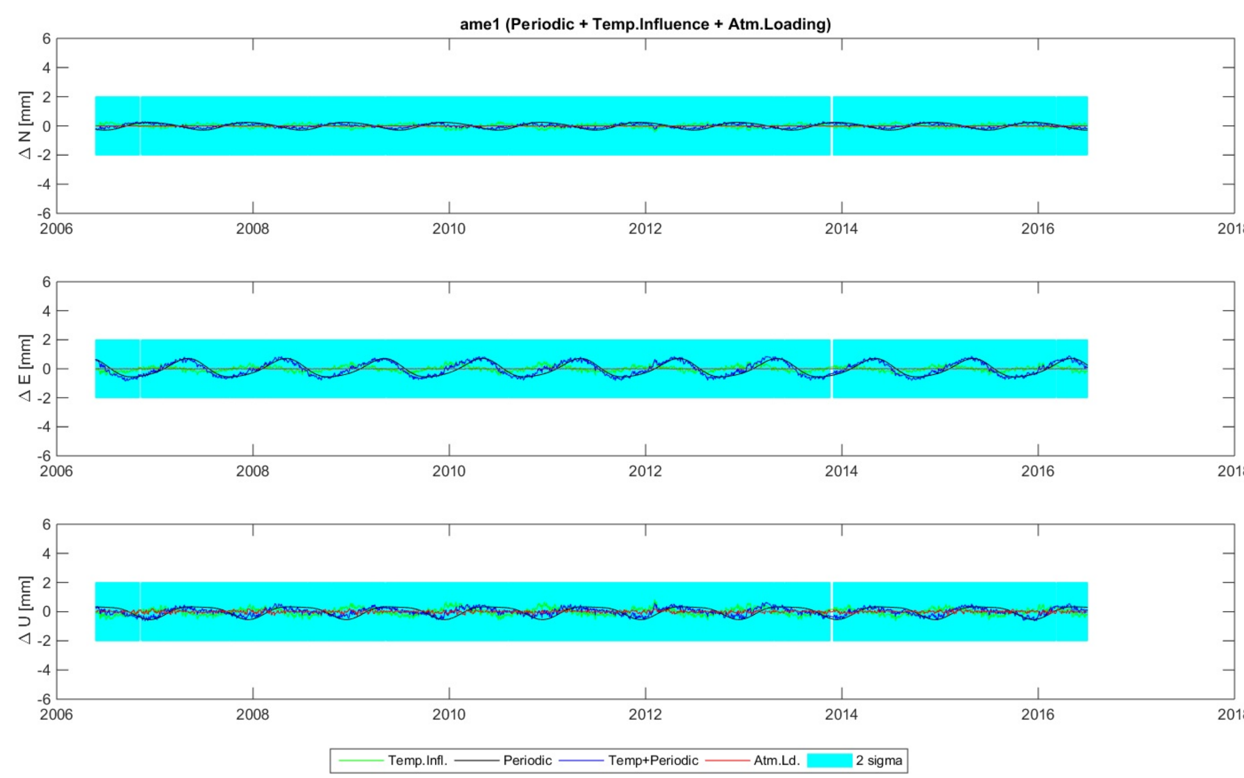

                    North [mm]  East [mm]    Up [mm]
Emperical St.Dev.:       0.115      0.113      0.074
Formal St.Dev.:          1.000      1.000      1.000
Factor (Estimated):      0.115      0.113      0.074
Factor (Applied):        1.000      1.000      1.000

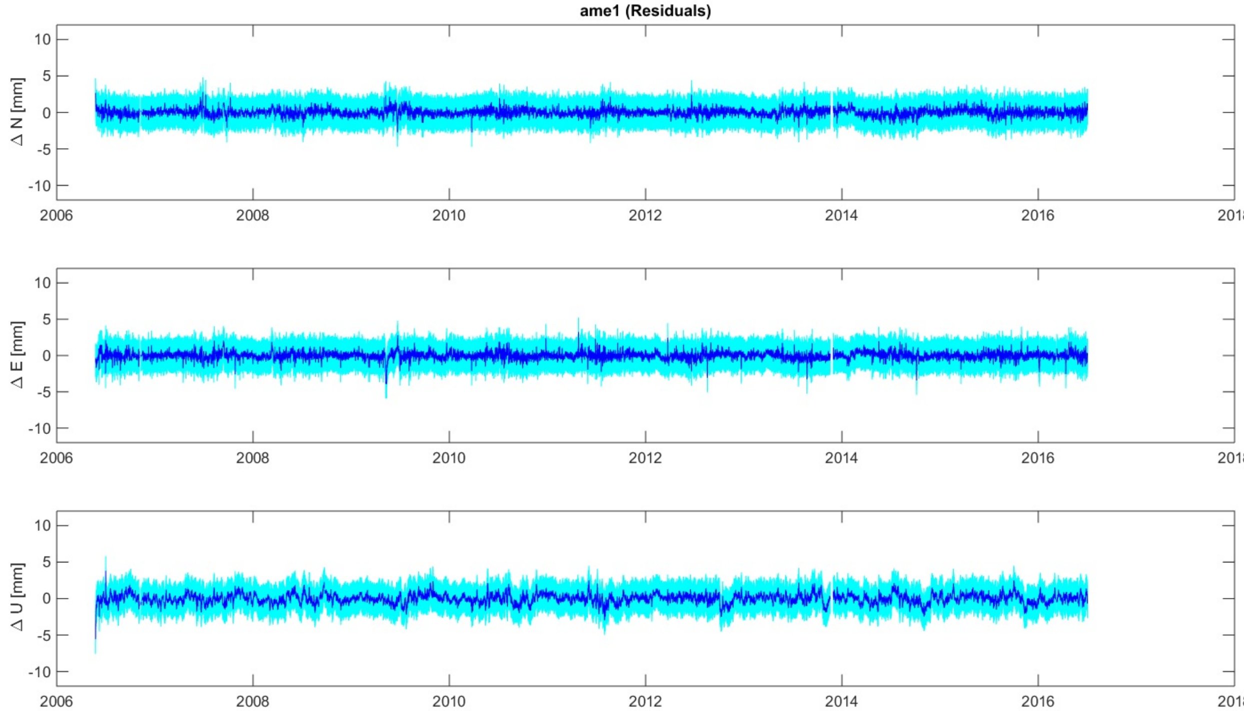


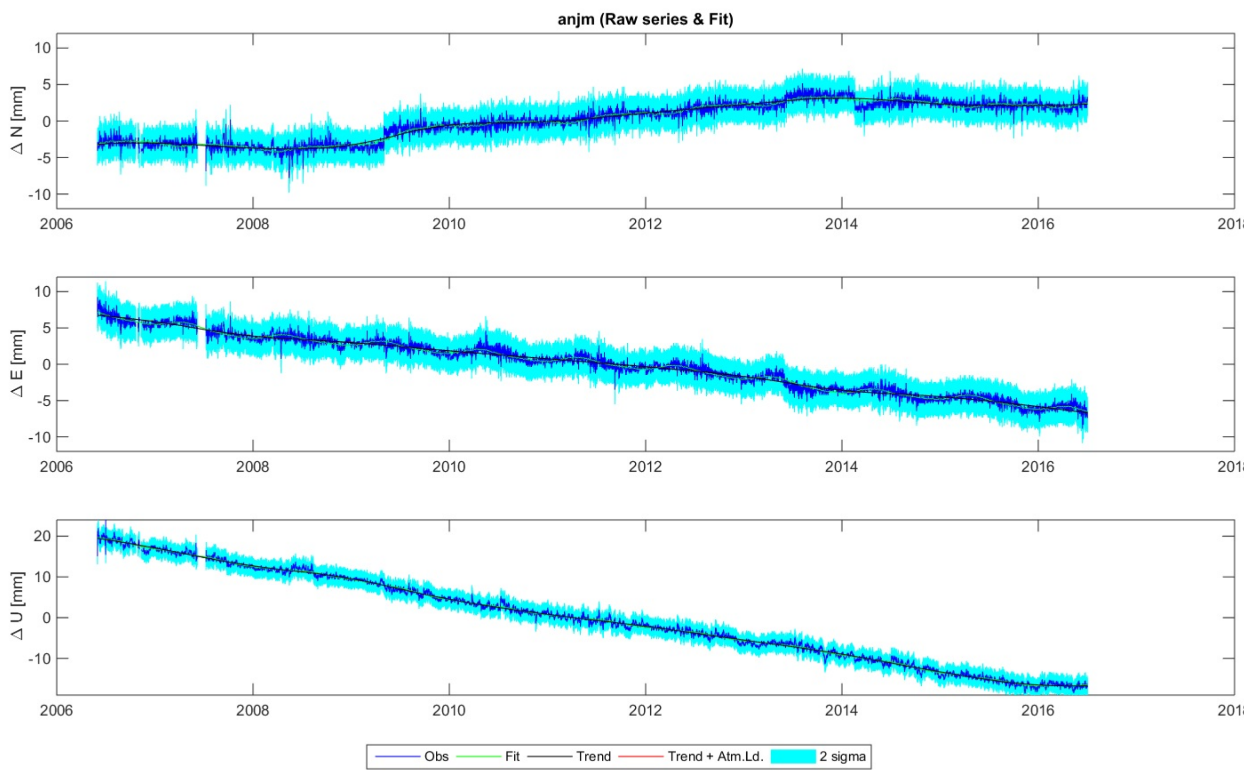

           Vframe  Vsite   +/- [mm/y]365d   183d    StdR   StdE   StdF [mm]
awg1  Lat    0.00  -1.16   0.01      1.80   0.12    0.86   0.12   1.00     2014.66-2016.50
awg1  Lon    0.00  -0.55   0.02      0.41   0.39    1.13   0.11   1.00     2014.66-2016.50
awg1  Hgt    0.00  -2.33   0.02      2.94   0.79    0.92   0.07   1.00     2014.66-2016.50

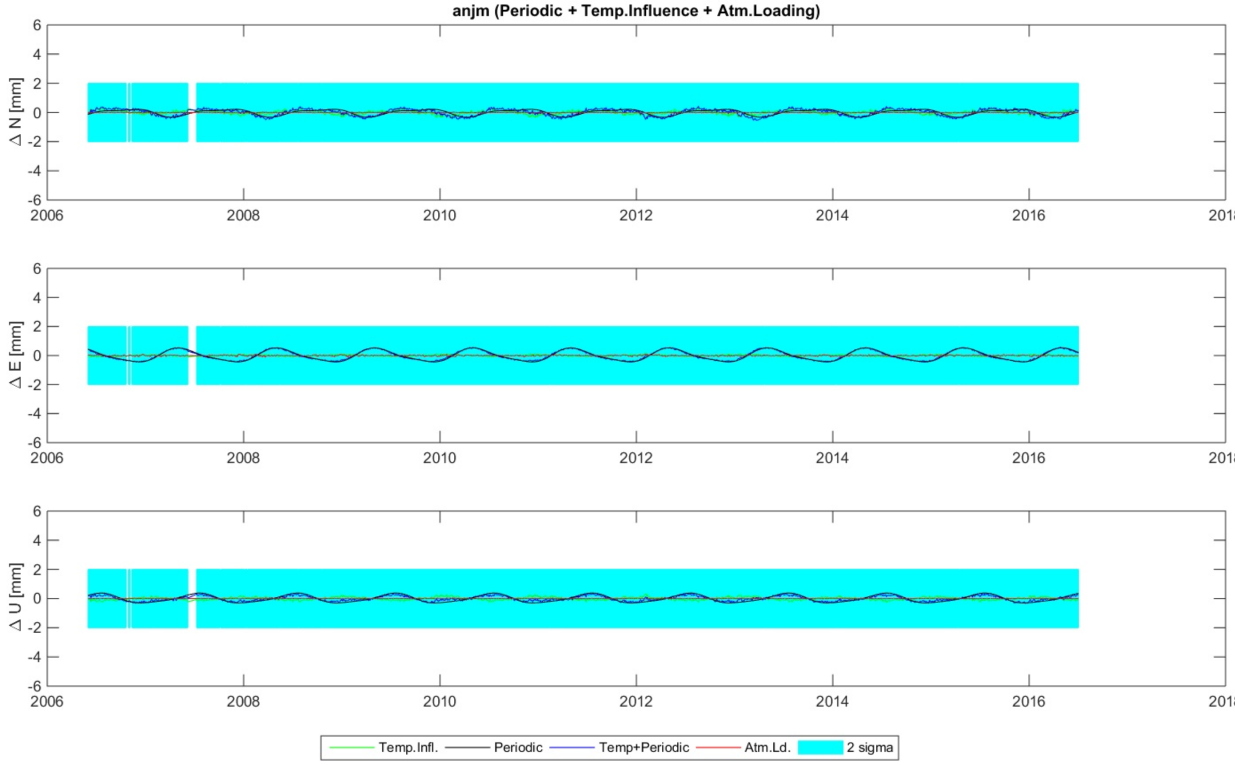
awg1  PLH   53.49134105   5.94131337   79.2036    (   53 29 28.8278    5 56 28.7281    79.2036 )
save tseries fit to file awg1_fit.mat
```

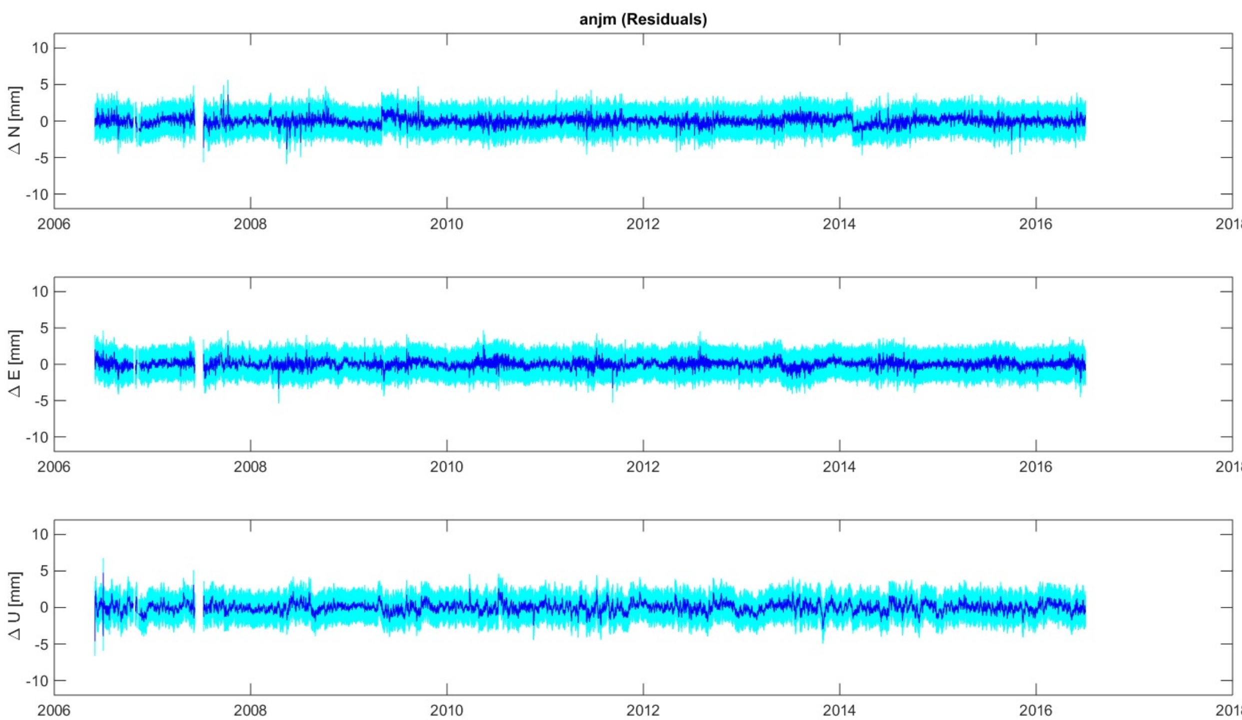

ame1 (Raw series & Fit)
Δ N [mm]
Δ E [mm]
Δ U [mm]
Obs
Fit
Trend
Trend + Atm.Ld.
2 sigma

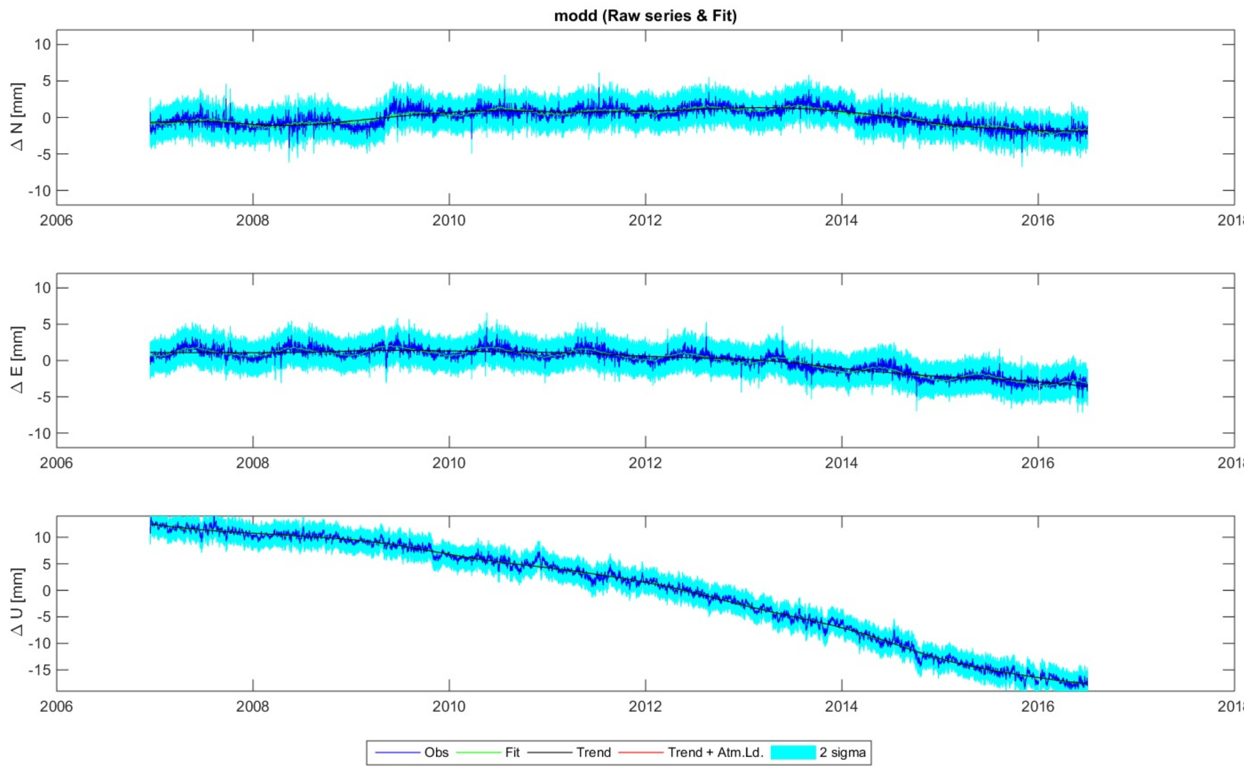

ame1 (Periodic + Temp.Influence + Atm.Loading)
Δ N [mm]
Δ E [mm]
Δ U [mm]
Temp.Infl.
Periodic
Temp+Periodic
Atm.Ld.
2 sigma

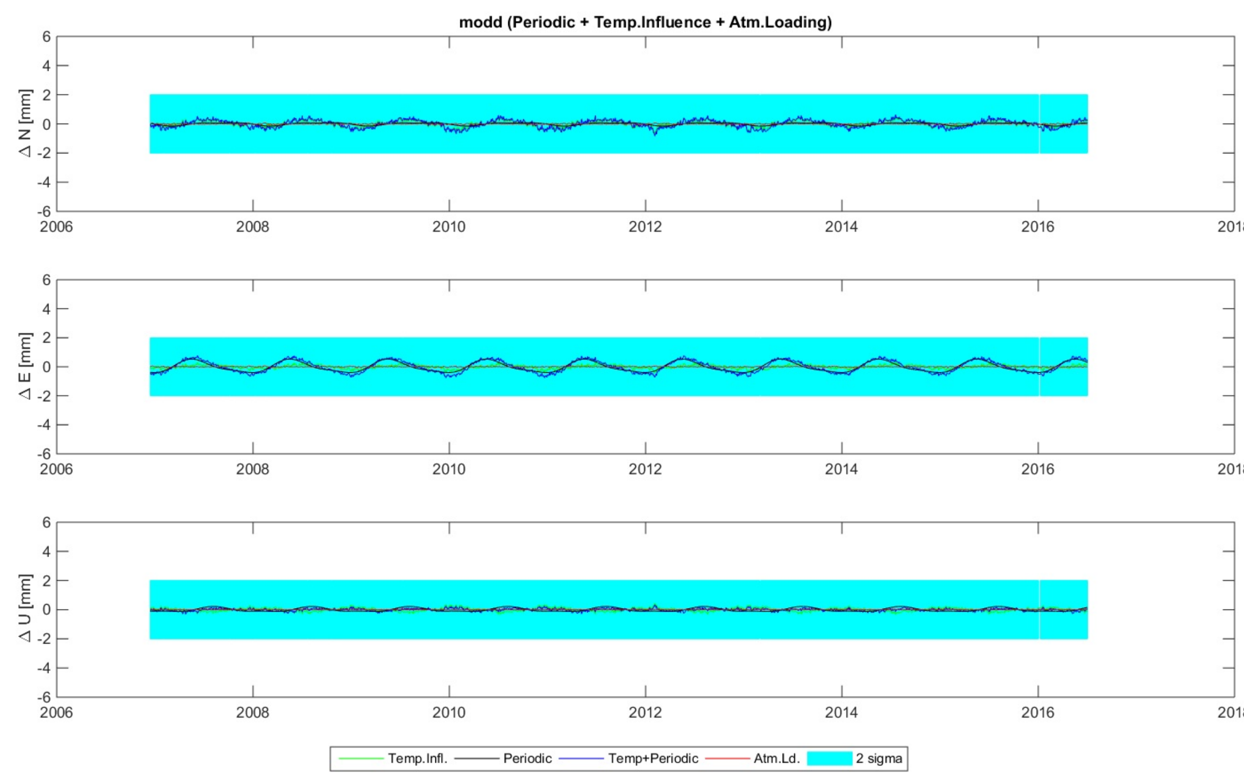

ame1 (Residuals)
Δ N [mm]
Δ E [mm]
Δ U [mm]
10
5
0
-5
-10
2006
2008
2010
2012
2014
2016
2018


anjm (Raw series & Fit)
Δ N [mm]
Δ E [mm]
Δ U [mm]
20
10
5
0
-5
-10
2006
2008
2010
2012
2014
2016
2018
Obs
Fit
Trend
Trend + Atm.Ld.
2 sigma

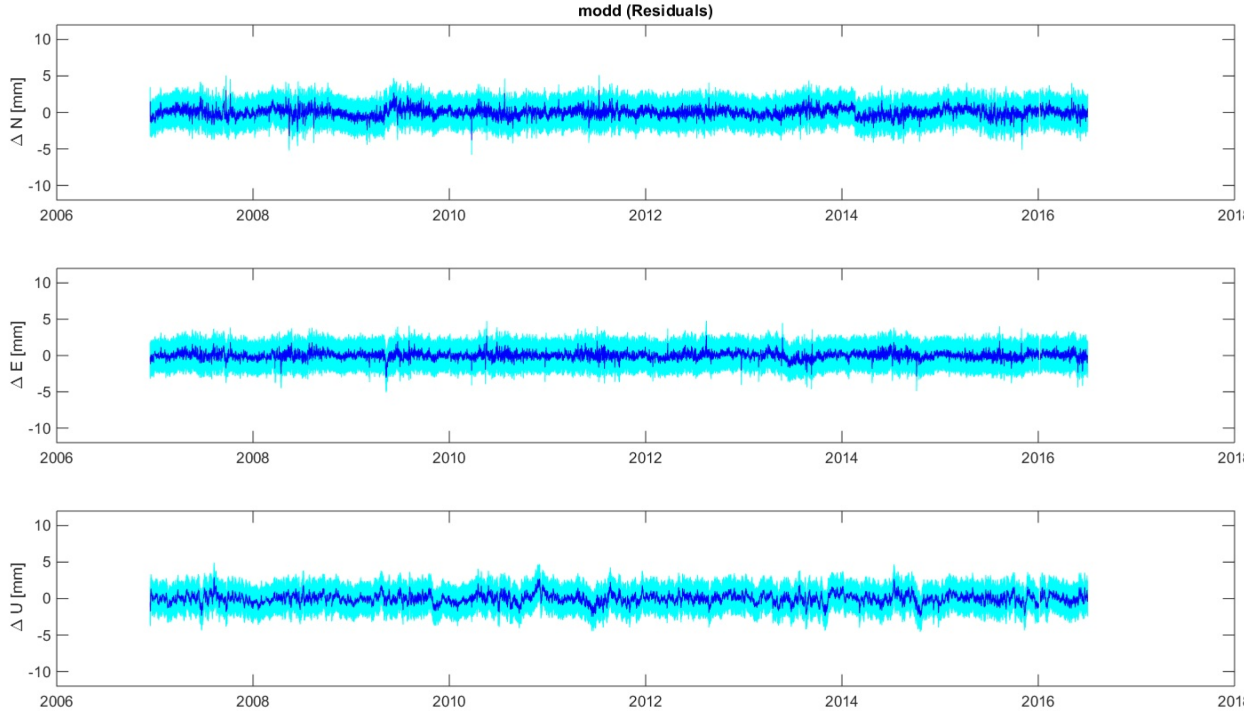

anjm (Periodic + Temp.Influence + Atm.Loading)
Δ N [mm]
Δ E [mm]
Δ U [mm]
Temp.Infl.
Periodic
Temp+Periodic
Atm.Ld.
2 sigma


anjm (Residuals)
Δ N [mm]
Δ E [mm]
Δ U [mm]

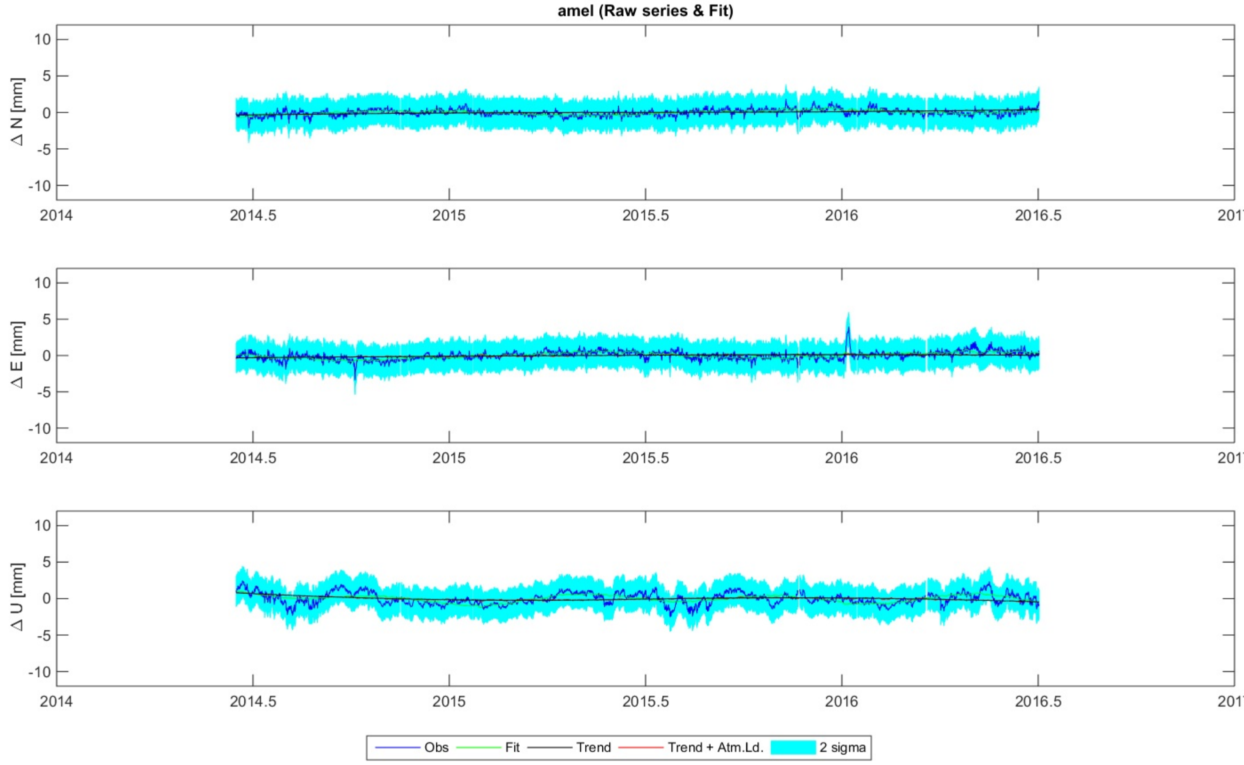

modd (Raw series & Fit)
Δ N [mm]
Δ E [mm]
Δ U [mm]
Obs
Fit
Trend
Trend + Atm.Ld.
2 sigma

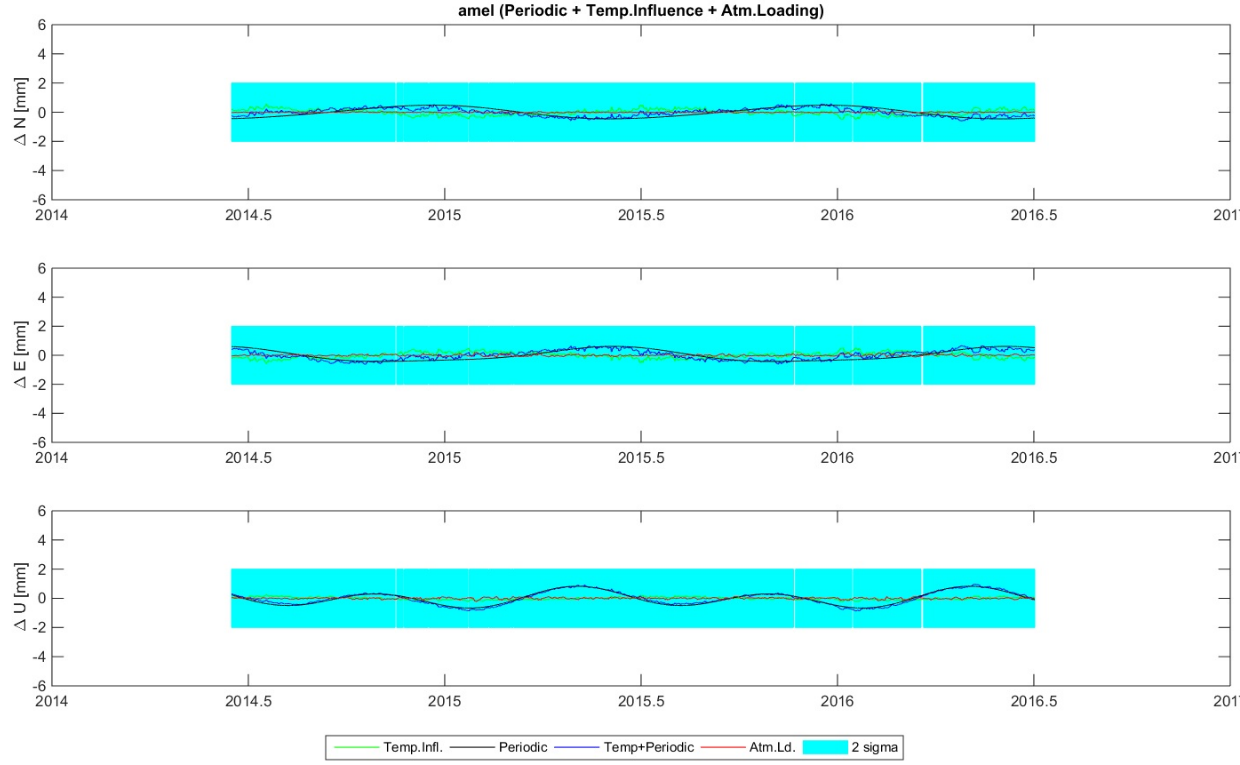

modd (Periodic + Temp.Influence + Atm.Loading)
Δ N [mm]
Δ E [mm]
Δ U [mm]
Temp.Infl.
Periodic
Temp+Periodic
Atm.Ld.
2 sigma

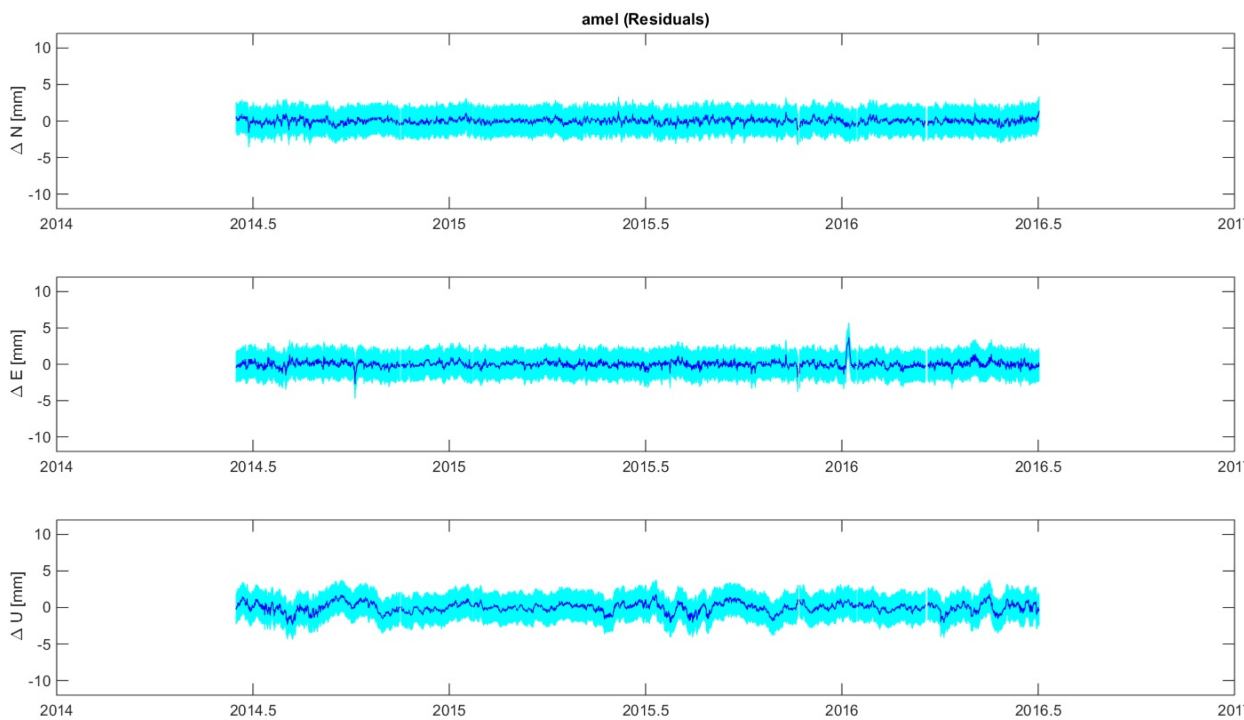
modd (Residuals)

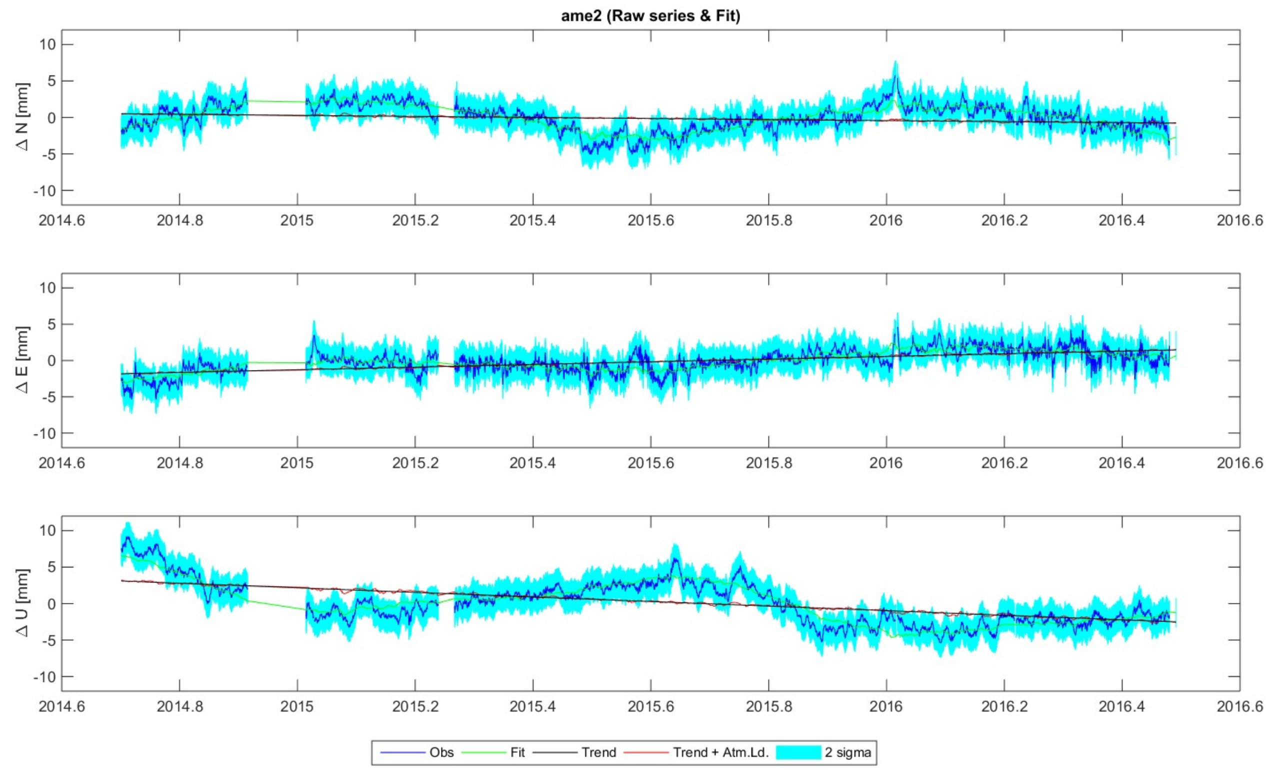


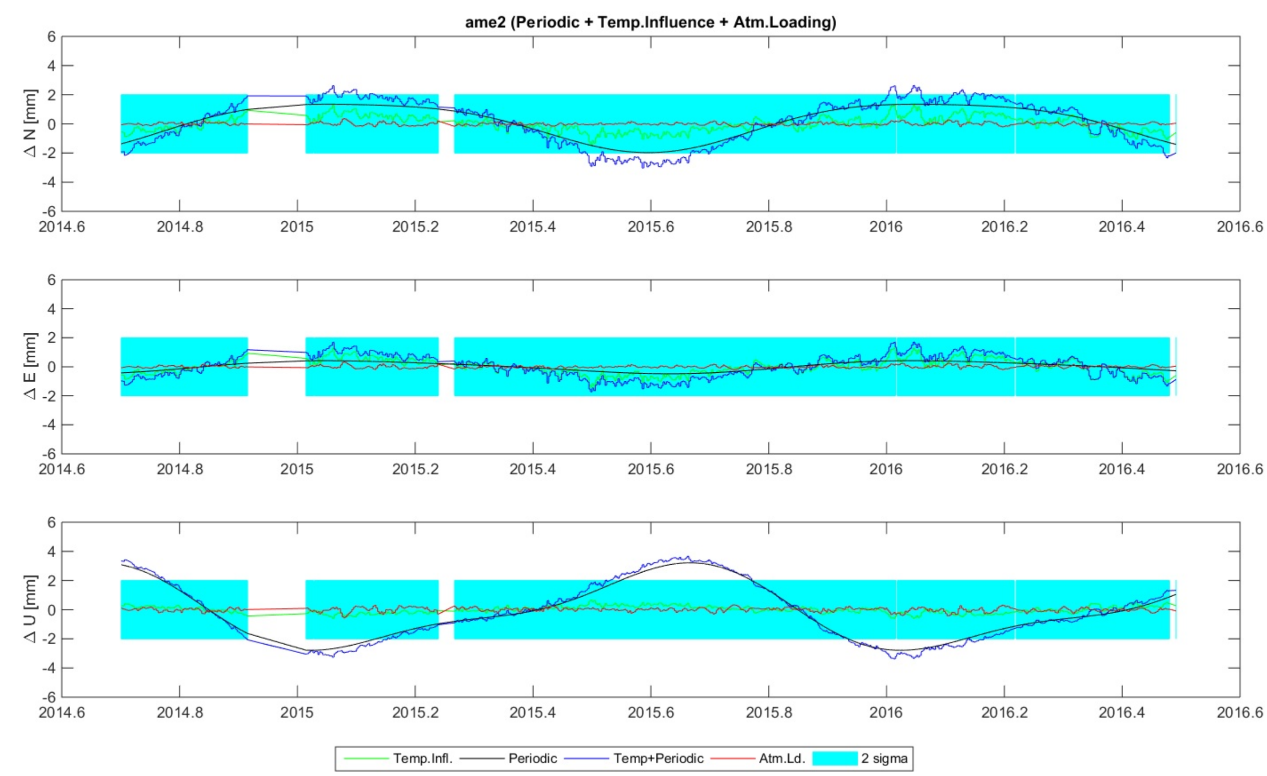
amel (Raw series & Fit)

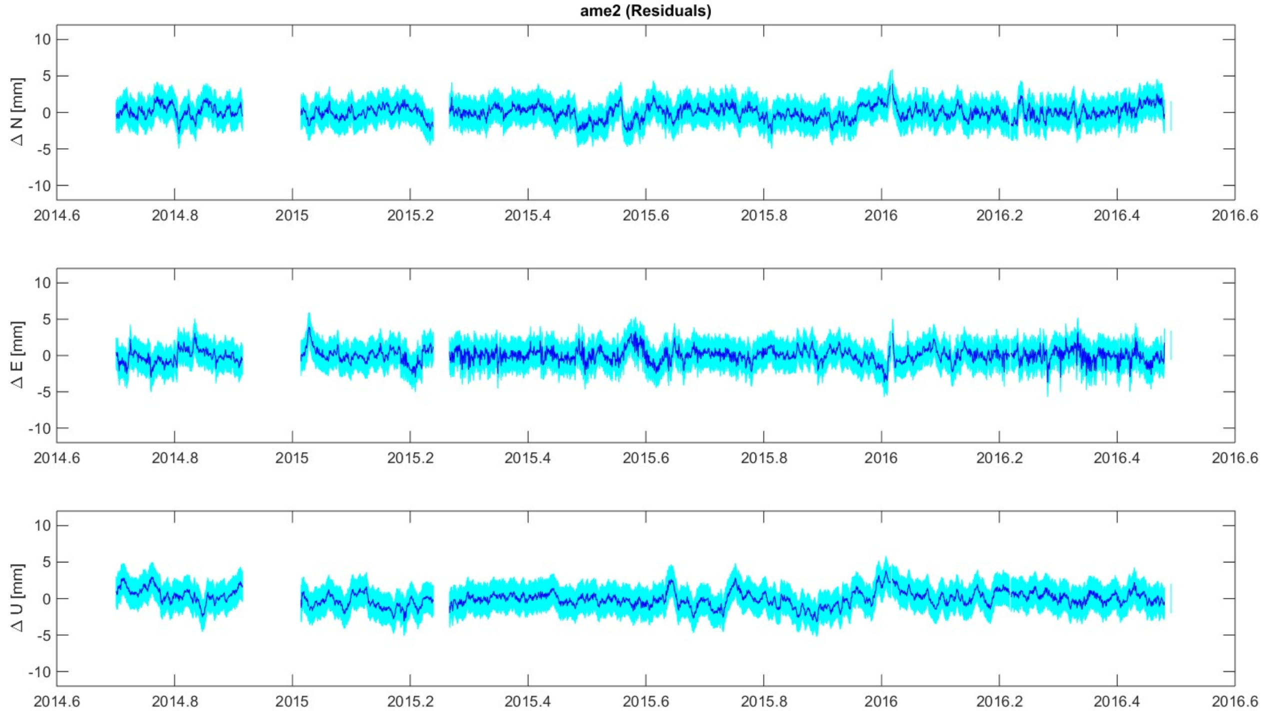


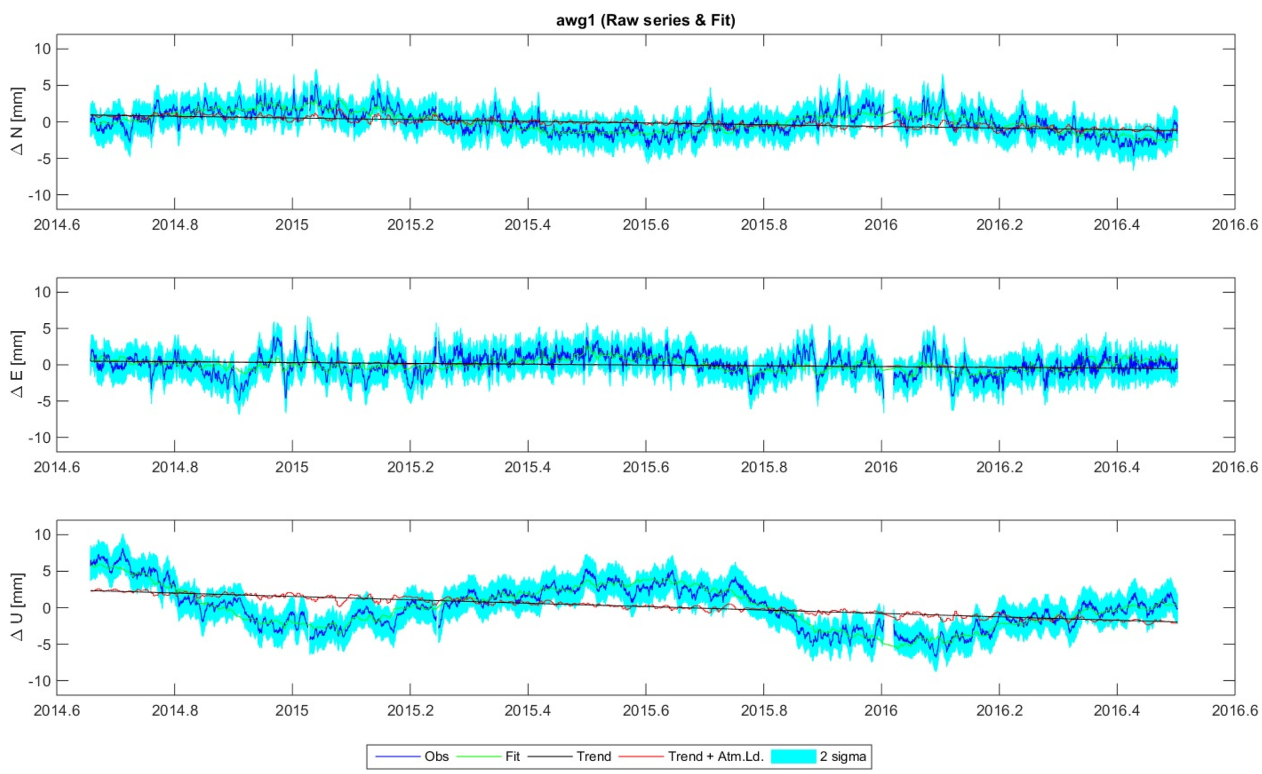

amel (Periodic + Temp.Influence + Atm.Loading)
Δ N [mm]
Δ E [mm]
Δ U [mm]
Temp.Infl.
Periodic
Temp+Periodic
Atm.Ld.
2 sigma

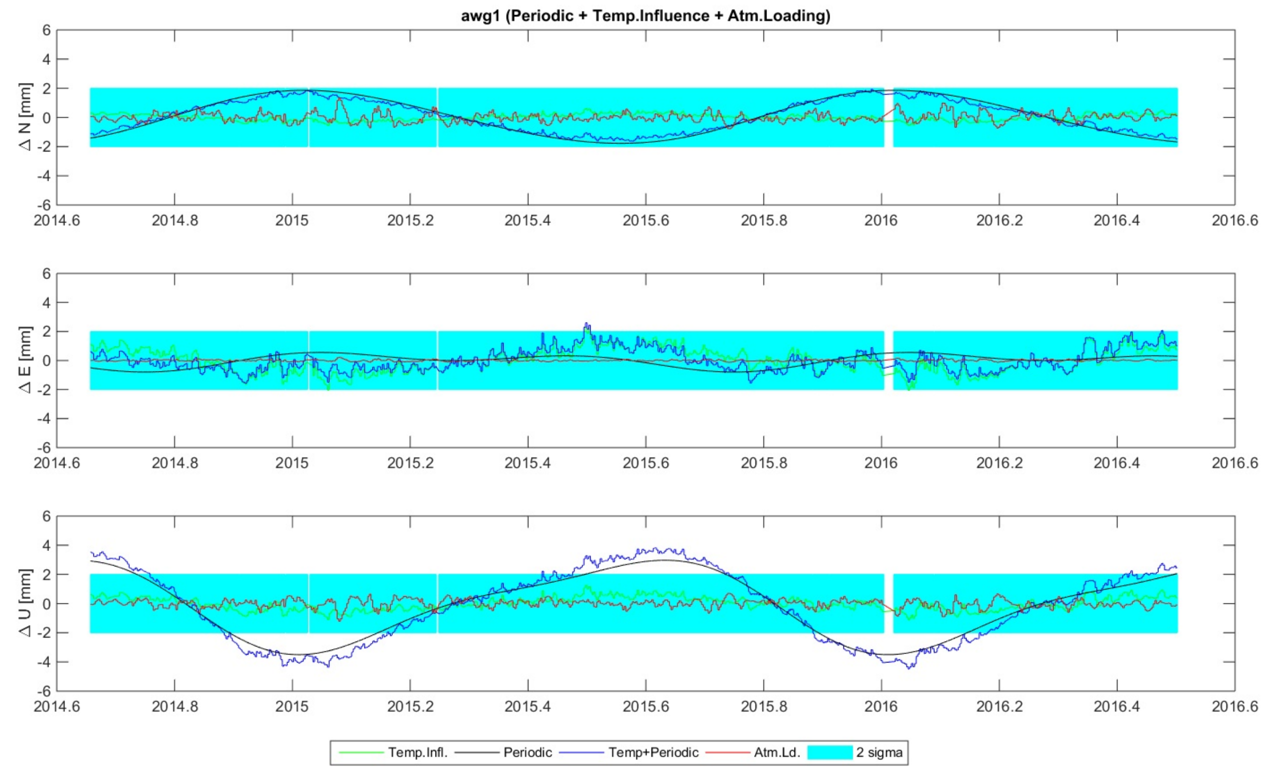

amel (Residuals)
Δ N [mm]
Δ E [mm]
Δ U [mm]

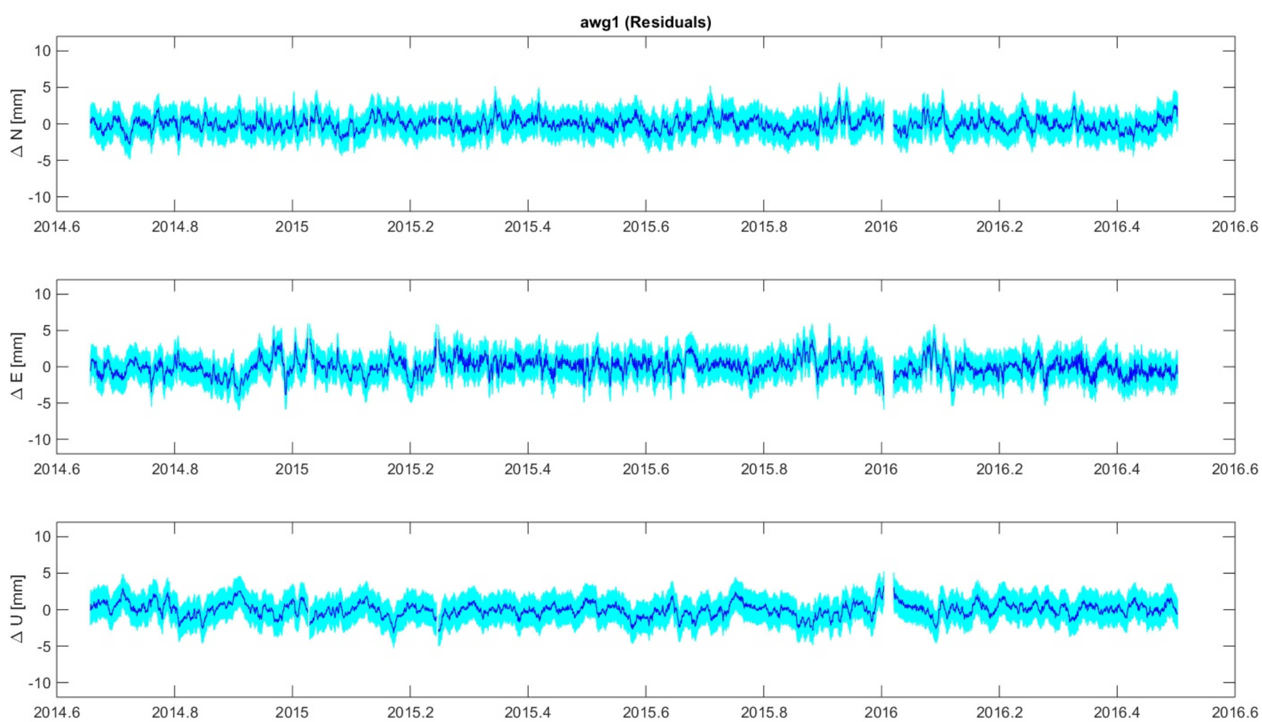

ame2 (Raw series & Fit)
Δ N [mm]
Δ E [mm]
Δ U [mm]
Obs
Fit
Trend
Trend + Atm.Ld.
2 sigma


ame2 (Periodic + Temp.Influence + Atm.Loading)
Δ N [mm]
Δ E [mm]
Δ U [mm]
Temp.Infl.
Periodic
Temp+Periodic
Atm.Ld.
2 sigma


ame2 (Residuals)
Δ N [mm]
Δ E [mm]
Δ U [mm]
10
5
0
-5
-10
2014.6
2014.8
2015
2015.2
2015.4
2015.6
2015.8
2016
2016.2
2016.4
2016.6


awg1 (Raw series & Fit)
Δ N [mm]
Δ E [mm]
Δ U [mm]
10
5
0
-5
-10
2014.6
2014.8
2015
2015.2
2015.4
2015.6
2015.8
2016
2016.2
2016.4
2016.6
Obs
Fit
Trend
Trend + Atm.Ld.
2 sigma





Print parameter summary

The function `tseriessummary` prints the values of the estimated parameters and their standard deviation, as well as results form the overall model test

```
tseriessummary(stations,'_fit')
```

```
             Vel1   Vel2     AtmLd  TempI     365d   183d     StdF   StdE   StdR      OMT
             mm/y   mm/y    mm/kPa mm/daK       mm     mm       mm     mm     mm

ame1  Lat    0.00   1.81      0.00   0.19     0.26   0.03     1.00   0.11   0.44     0.19
ame1  Lon    0.00  -0.51      0.01  -0.29     0.62   0.10     1.00   0.10   0.45     0.21
```

```
ame1  Rad    0.00  -6.34      0.07  -0.37     0.43   0.11     1.00   0.07   0.65     0.42

anjm  Lat    0.00   1.26     -0.01   0.20     0.24   0.10     1.00   0.11   0.53     0.28
anjm  Lon    0.00  -1.15      0.03  -0.07     0.45   0.10     1.00   0.09   0.45     0.20
anjm  Rad    0.00  -3.14     -0.01  -0.15     0.32   0.07     1.00   0.07   0.64     0.41

modd  Lat    0.00   0.33      0.02   0.32     0.11   0.04     1.00   0.12   0.57     0.32
modd  Lon    0.00  -0.56      0.02   0.20     0.43   0.12     1.00   0.10   0.43     0.19
modd  Rad    0.00  -3.48      0.01  -0.20     0.16   0.06     1.00   0.07   0.64     0.40

amel  Lat    0.00   0.35     -0.03   0.33     0.46   0.04     1.00   0.09   0.33     0.11
amel  Lon    0.00   0.34     -0.05  -0.35     0.50   0.12     1.00   0.08   0.41     0.17
amel  Rad    0.00  -0.76      0.05   0.15     0.28   0.56     1.00   0.06   0.66     0.43

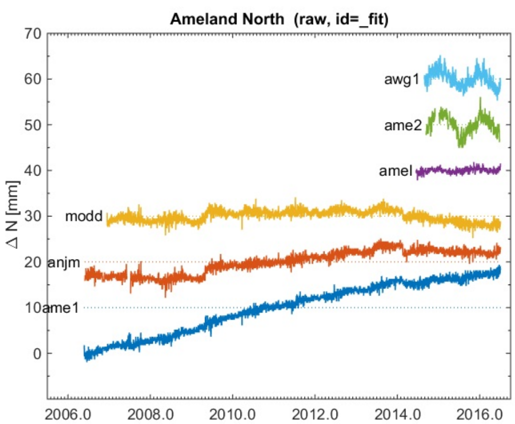
ame2  Lat    0.00  -0.71     -0.09  -0.93     1.65   0.32     1.00   0.12   0.92     0.84
ame2  Lon    0.00   1.84     -0.08  -0.93     0.43   0.07     1.00   0.12   0.92     0.85
ame2  Rad    0.00  -3.14      0.14   0.43     2.57   0.90     1.00   0.08   1.02     1.04

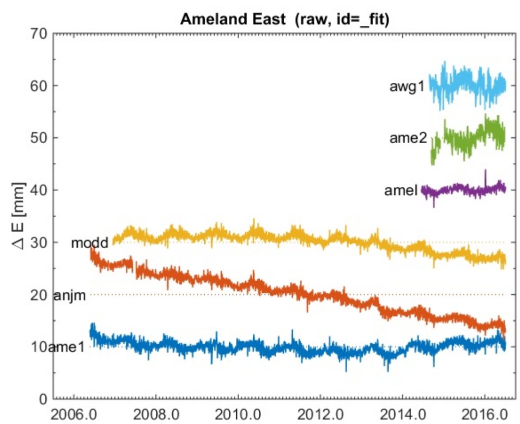
awg1  Lat    0.00  -1.16     -0.33   0.40     1.80   0.12     1.00   0.12   0.86     0.73
awg1  Lon    0.00  -0.55     -0.05   1.49     0.41   0.39     1.00   0.12   1.13     1.28
awg1  Rad    0.00  -2.33      0.30   0.81     2.94   0.79     1.00   0.08   0.92     0.84
```

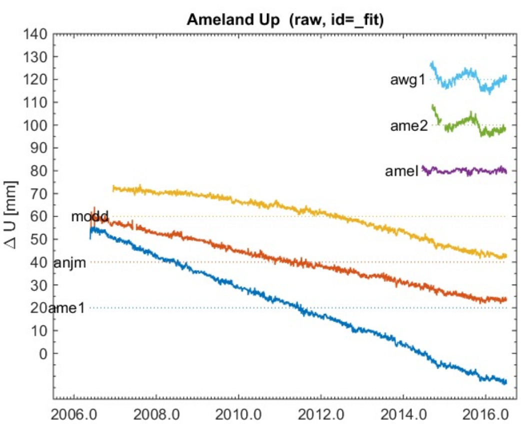
Plot individual components

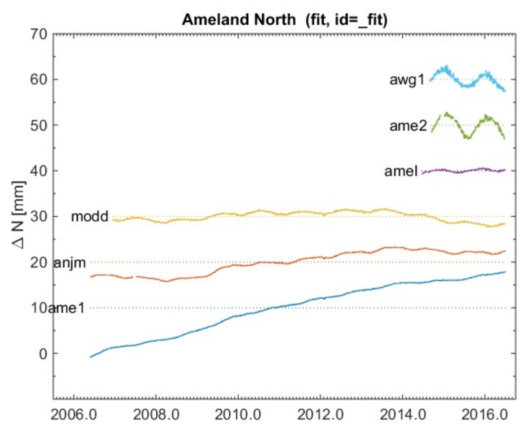
The results from the decomposition are also be plotted component by component, using a single plot for all stations. We use for this the function `tseriesplotcomponent`. The plots are saved in `./plots` under the name `all_*.png`.

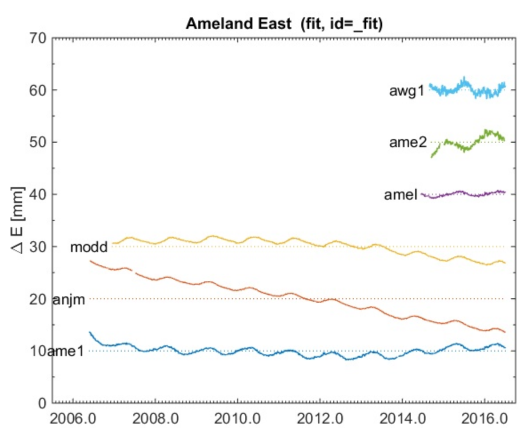
```
tseriesplotcomponent(stations,'raw','_fit',projectname,[10 10 20]);
tseriesplotcomponent(stations,'fit','_fit',projectname,[10 10 20]);
tseriesplotcomponent(stations,'trend','_fit',projectname,[10 10 20]);
tseriesplotcomponent(stations,'atmld','_fit',projectname,5);
tseriesplotcomponent(stations,'tempi','_fit',projectname,10);
tseriesplotcomponent(stations,'harmonic','_fit',projectname,10);
tseriesplotcomponent(stations,{'harmonic' 'tempi'},'_fit',projectname,10);
tseriesplotcomponent(stations,'residual','_fit',projectname,10);
```

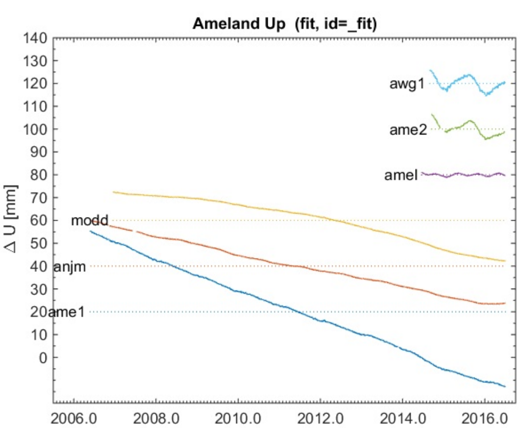


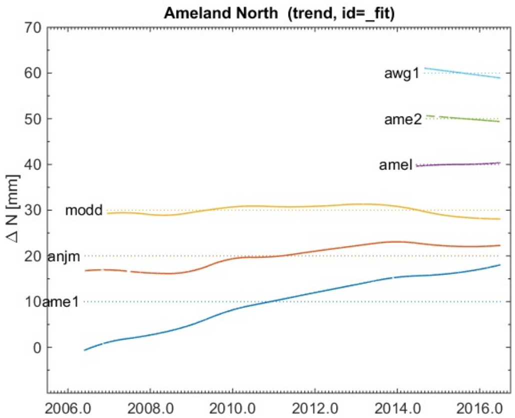


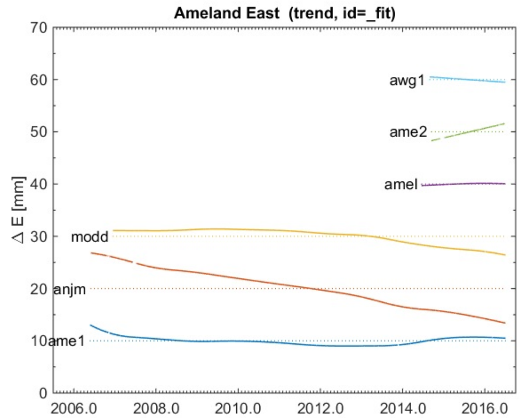


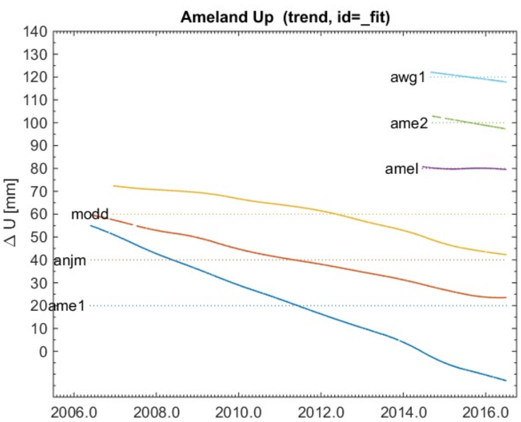


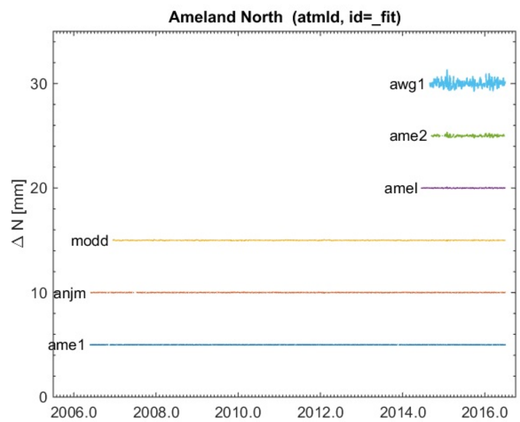


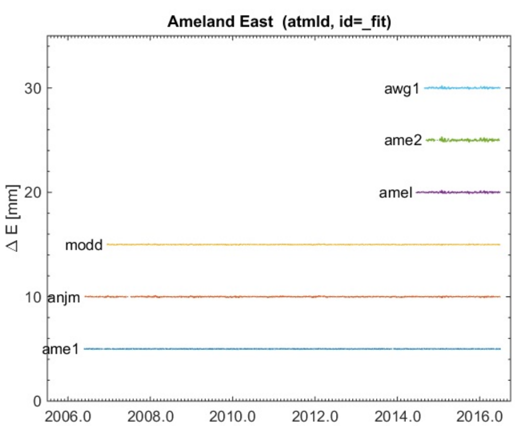


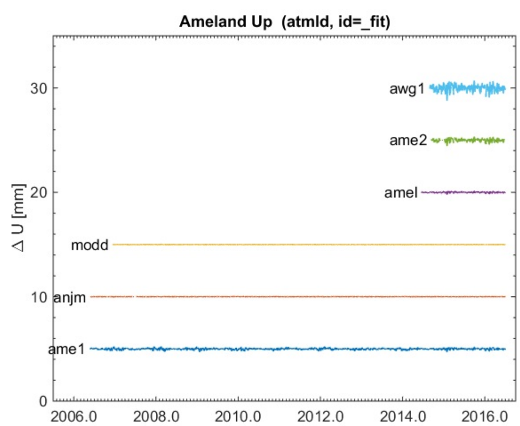

Ameland North (trend, id=_fit)
Δ N [mm]
awg1
ame2
amel
modd
anjm
ame1
2006.0 2008.0 2010.0 2012.0 2014.0 2016.0

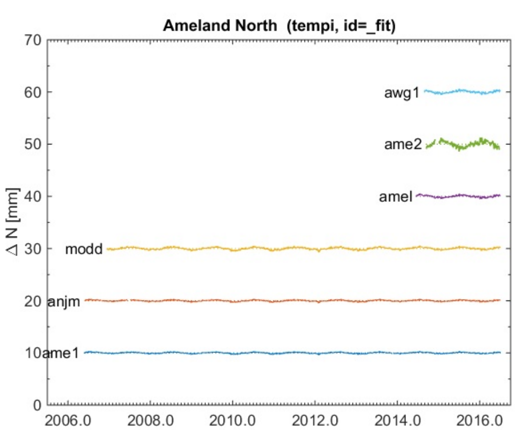

Ameland East (trend, id=_fit)
Δ E [mm]
awg1
ame2
amel
modd
anjm
ame1
2006.0 2008.0 2010.0 2012.0 2014.0 2016.0

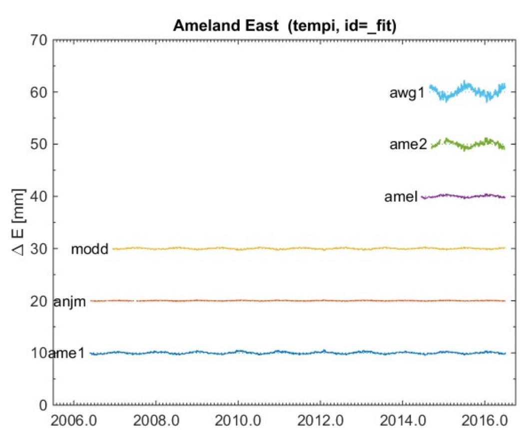

Ameland Up (trend, id=_fit)
Δ U [mm]
awg1
ame2
amel
modd
anjm
ame1
2006.0 2008.0 2010.0 2012.0 2014.0 2016.0

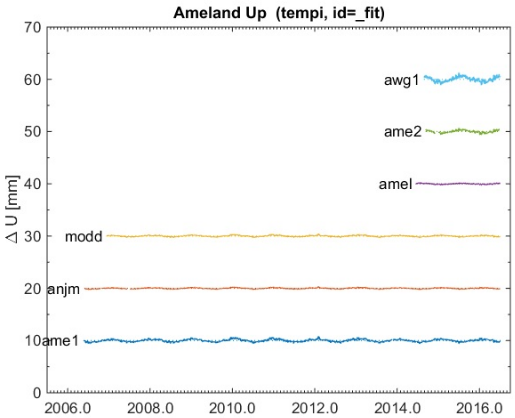

Ameland North (atmld, id=_fit)
Δ N [mm]
awg1
ame2
amel
modd
anjm
ame1
2006.0 2008.0 2010.0 2012.0 2014.0 2016.0

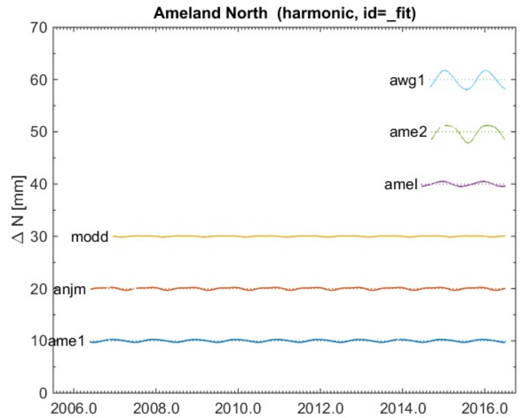

Ameland East (atmld, id=_fit)
Δ E [mm]
awg1
ame2
amel
modd
anjm
ame1
2006.0 2008.0 2010.0 2012.0 2014.0 2016.0

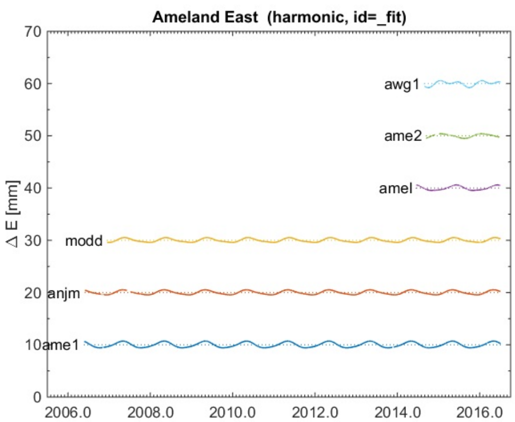

Ameland Up (atmld, id=_fit)
Δ U [mm]
awg1
ame2
amel
modd
anjm
ame1
2006.0 2008.0 2010.0 2012.0 2014.0 2016.0

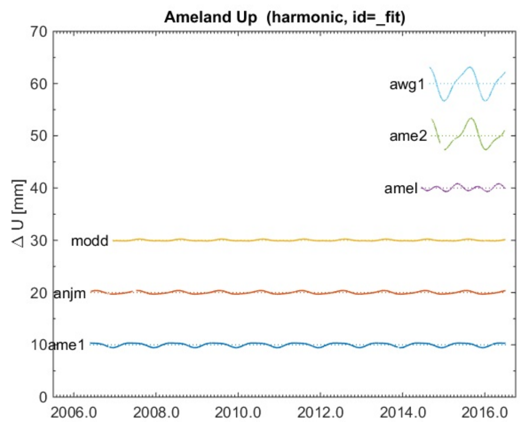

Ameland North (tempi, id=_fit)
Δ N [mm]
awg1
ame2
amel
modd
anjm
ame1
2006.0 2008.0 2010.0 2012.0 2014.0 2016.0

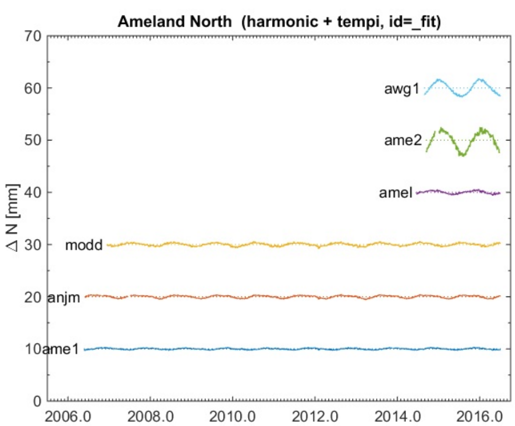

Ameland East (tempi, id=_fit)
Δ E [mm]
awg1
ame2
amel
modd
anjm
ame1
2006.0 2008.0 2010.0 2012.0 2014.0 2016.0

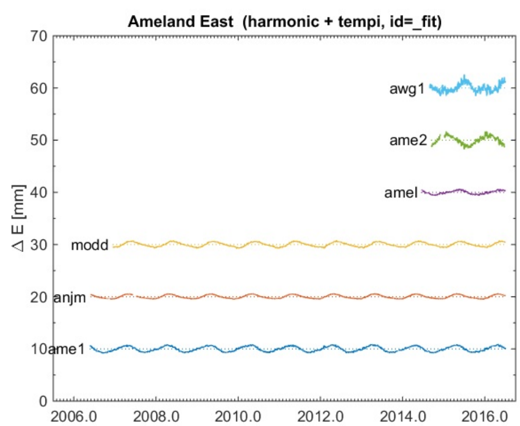

Ameland Up (tempi, id=_fit)
Δ U [mm]
awg1
ame2
amel
modd
anjm
ame1
0
10
20
30
40
50
60
70
2006.0
2008.0
2010.0
2012.0
2014.0
2016.0

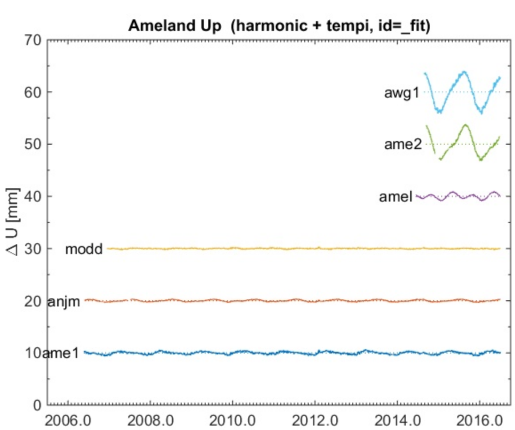

Ameland North (harmonic, id=_fit)
Δ N [mm]
awg1
ame2
amel
modd
anjm
ame1
0
10
20
30
40
50
60
70
2006.0
2008.0
2010.0
2012.0
2014.0
2016.0

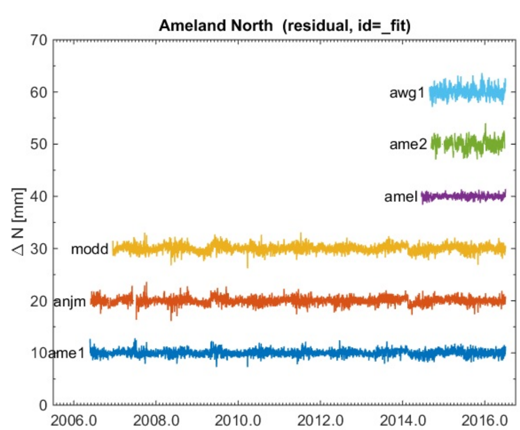

Ameland East (harmonic, id=_fit)
Δ E [mm]
awg1
ame2
amel
modd
anjm
ame1
0
10
20
30
40
50
60
70
2006.0
2008.0
2010.0
2012.0
2014.0
2016.0

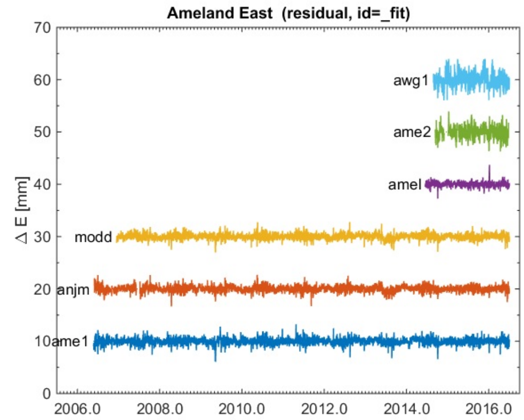

Ameland Up (harmonic, id=_fit)
Δ U [mm]
awg1
ame2
amel
modd
anjm
ame1
0
10
20
30
40
50
60
70
2006.0
2008.0
2010.0
2012.0
2014.0
2016.0

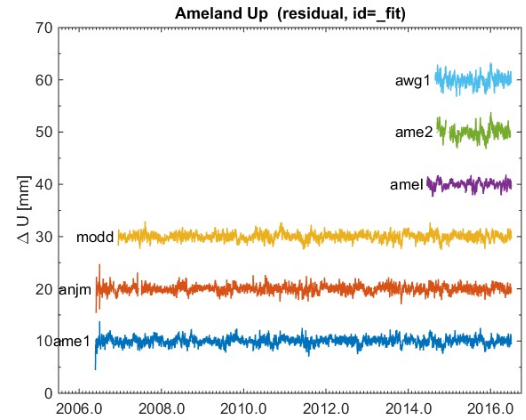

Ameland North (harmonic + tempi, id=_fit)
Δ N [mm]
awg1
ame2
amel
modd
anjm
ame1
0
10
20
30
40
50
60
70
2006.0
2008.0
2010.0
2012.0
2014.0
2016.0


Ameland East (harmonic + tempi, id=_fit)
Δ E [mm]
awg1
ame2
amel
modd
anjm
ame1
0
10
20
30
40
50
60
70
2006.0
2008.0
2010.0
2012.0
2014.0
2016.0


Ameland Up (harmonic + tempi, id=_fit)
Δ U [mm]
awg1
ame2
amel
modd
anjm
ame1
0
10
20
30
40
50
60
70
2006.0
2008.0
2010.0
2012.0
2014.0
2016.0


Ameland North (residual, id=_fit)
Δ N [mm]
awg1
ame2
amel
modd
anjm
ame1
0
10
20
30
40
50
60
70
2006.0
2008.0
2010.0
2012.0
2014.0
2016.0

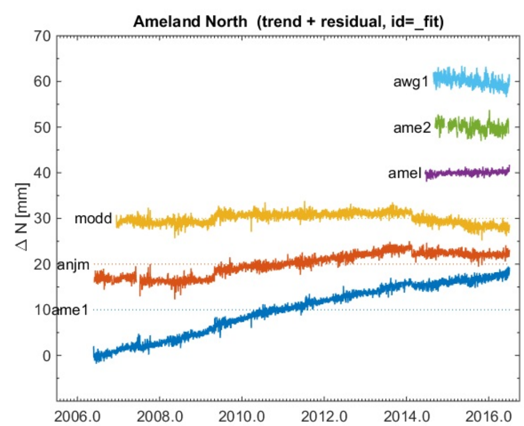


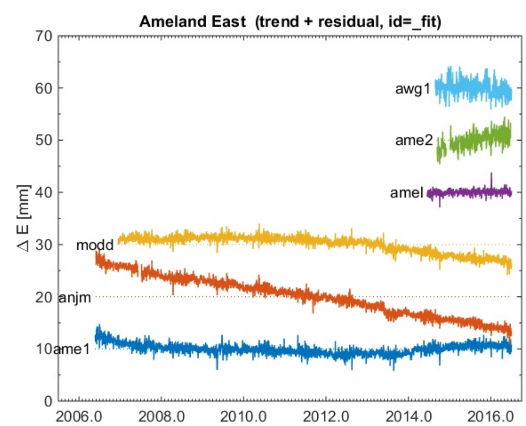


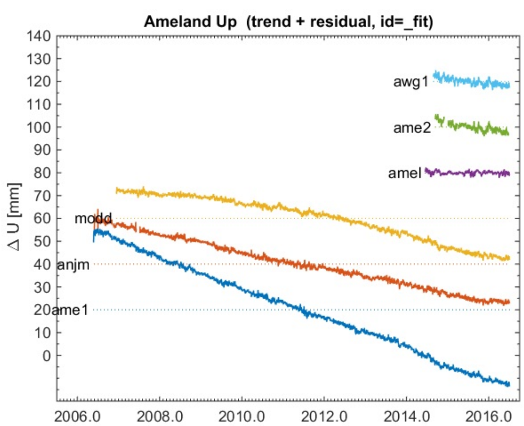
Plot final corrected time series and removed component

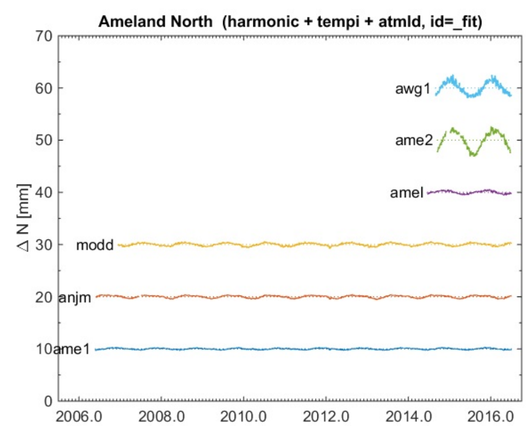
Two final (most important?) plots are made * the final corrected time series consisting of the estimated trend and residuals * the harmonic, temperature influence and loading components that have been removed from the original series

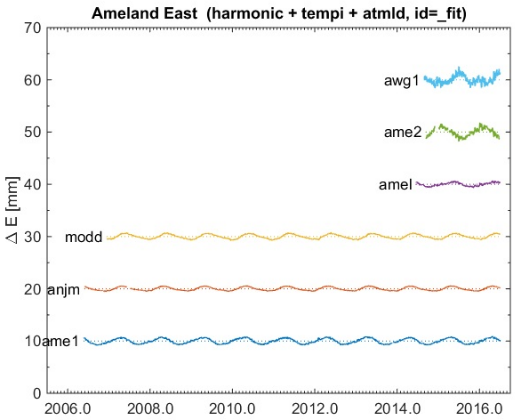
```
tseriesplotcomponent(stations,{'trend','residual'},'_fit',projectname,[10 10 20]);
tseriesplotcomponent(stations,{'harmonic','tempi','atmld'},'_fit',projectname,10);
```

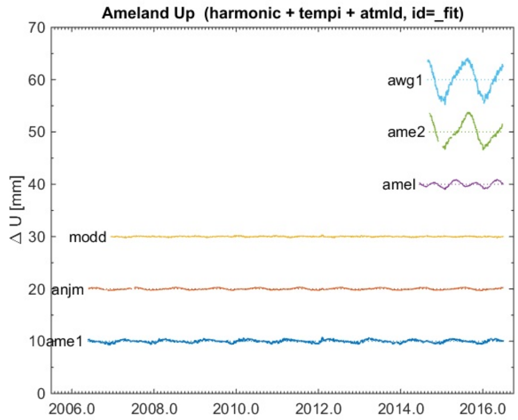












Plot maps

The function `tseriesplotmap` plots the location of the stations together with a representation of the estimated parameters in map format. The plots are saved in `./plots` under the name `map_*.png`.

```
tseriesplotmap(stations,'Annual','_fit',projectname);
%tseriesplotmap(stations,'AnnualP','_fit',projectname);
%tseriesplotmap(stations,'AnnualA','_fit',projectname);
tseriesplotmap(stations,'Tempi','_fit',projectname);
tseriesplotmap(stations,'Velocity','_fit',projectname);
tseriesplotmap(stations,'Cov','_fit',projectname);
```

```
      Lat [deg]  Lon [deg]  hght [m]
ame1  53.464429   5.921335   48.128
anjm  53.370845   6.152386   45.264
modd  53.405353   6.067496   47.554
amel  53.446461   5.764893   60.636
ame2  53.483299   5.866843   69.541
awg1  53.491341   5.941313   79.204

         X-RD [m]     Y-RD [m]   NAP [m]
ame1    190474.980   608822.481    7.543
anjm    205931.143   598546.043    4.647
modd    200244.561   602329.796    6.950
amel    180095.066   606756.931   19.893
ame2    186841.780   610897.175   28.951
awg1    191778.768   611827.827   38.679

      Lat [deg]  Lon [deg]  hght [m]
ame1  53.464429   5.921335   48.128
anjm  53.370845   6.152386   45.264
modd  53.405353   6.067496   47.554
amel  53.446461   5.764893   60.636
ame2  53.483299   5.866843   69.541
awg1  53.491341   5.941313   79.204

         X-RD [m]     Y-RD [m]   NAP [m]



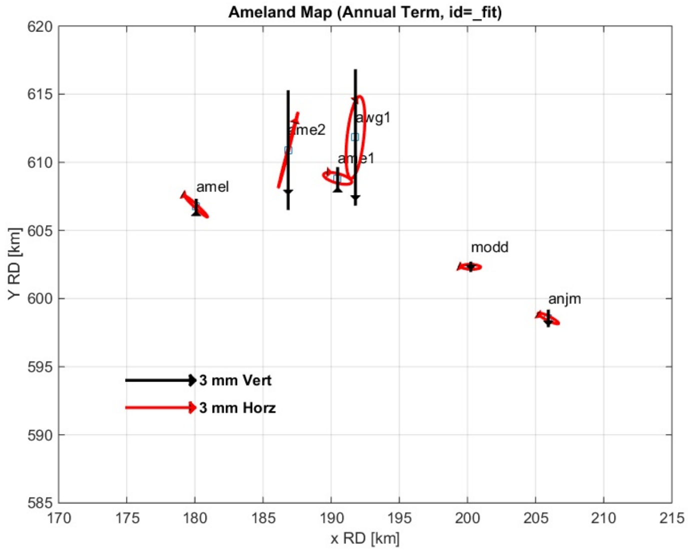
ame1    190474.980   608822.481    7.543
anjm    205931.143   598546.043    4.647
modd    200244.561   602329.796    6.950
amel    180095.066   606756.931   19.893
ame2    186841.780   610897.175   28.951
awg1    191778.768   611827.827   38.679

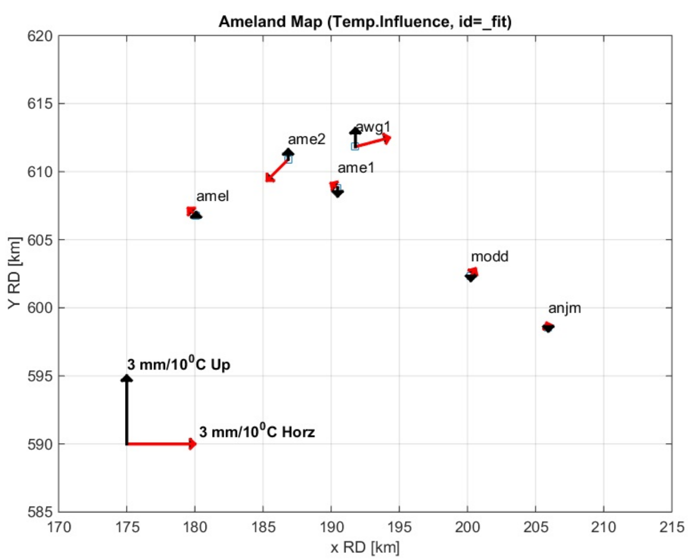
      Lat [deg]  Lon [deg]  hght [m]
ame1  53.464429   5.921335   48.128
anjm  53.370845   6.152386   45.264
modd  53.405353   6.067496   47.554
amel  53.446461   5.764893   60.636
ame2  53.483299   5.866843   69.541
awg1  53.491341   5.941313   79.204

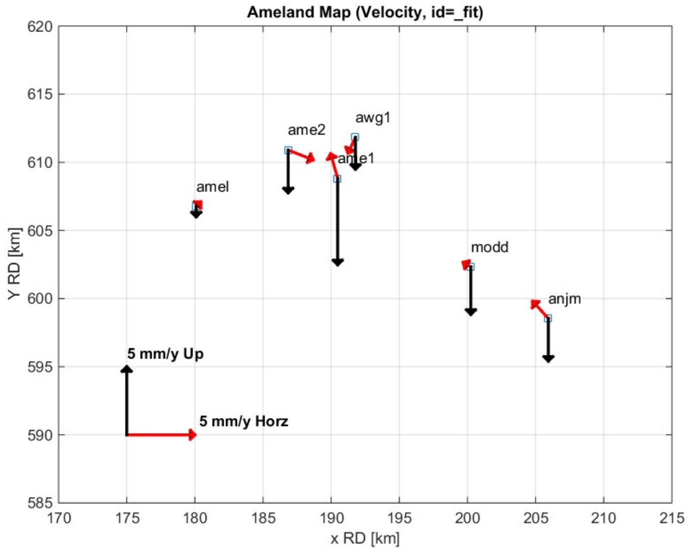
         X-RD [m]     Y-RD [m]   NAP [m]
ame1    190474.980   608822.481    7.543
anjm    205931.143   598546.043    4.647
modd    200244.561   602329.796    6.950
amel    180095.066   606756.931   19.893
ame2    186841.780   610897.175   28.951
awg1    191778.768   611827.827   38.679

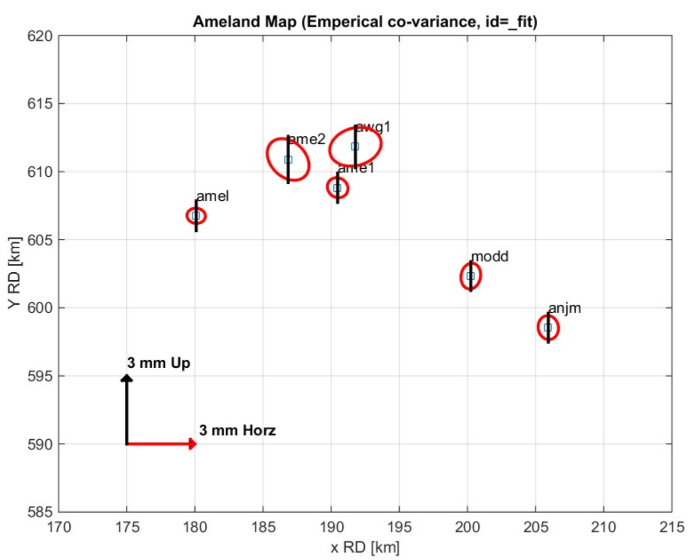
      Lat [deg]  Lon [deg]  hght [m]
ame1  53.464429   5.921335   48.128
anjm  53.370845   6.152386   45.264
modd  53.405353   6.067496   47.554
amel  53.446461   5.764893   60.636
ame2  53.483299   5.866843   69.541
awg1  53.491341   5.941313   79.204

         X-RD [m]     Y-RD [m]   NAP [m]
ame1    190474.980   608822.481    7.543
anjm    205931.143   598546.043    4.647
modd    200244.561   602329.796    6.950
amel    180095.066   606756.931   19.893
ame2    186841.780   610897.175   28.951
awg1    191778.768   611827.827   38.679
```


Ameland Map (Annual Term, id=_fit)
Y RD [km]
x RD [km]
ame2
awg1
ame1
amel
modd
anjm
3 mm Vert
3 mm Horz


Ameland Map (Temp.Influence, id=_fit)
Y RD [km]
x RD [km]
ame2
awg1
ame1
amel
modd
anjm
3 mm/10^{0}C Up
3 mm/10^{0}C Horz

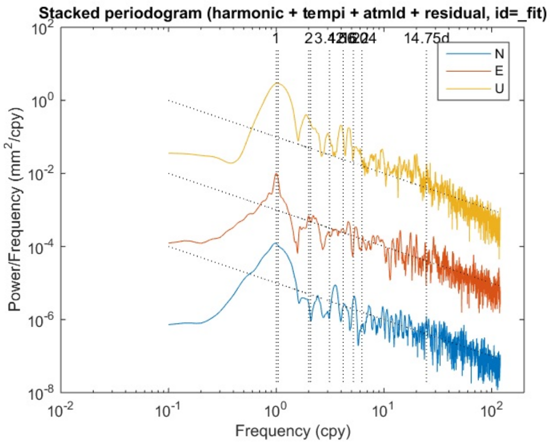


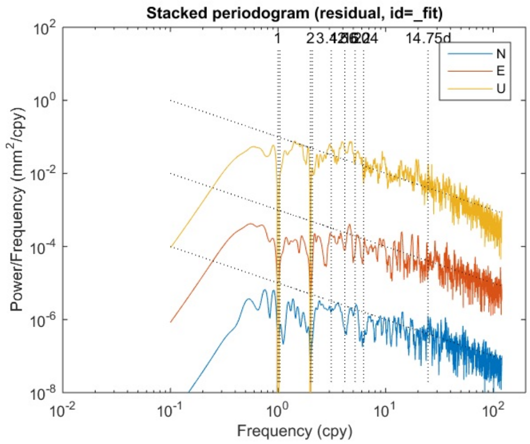


GPS Periodogram - First iteration

The Matlab function `tseriesperiodogram.m` computes the Lomb-Scargle periodogram for several components. The periodogram can be computed both for individual stations as well as all stations together (stacked periodogram). In this script we compute two periodograms: one of the detrended signal, and one for the residuals. This may take some time.

```
%tseriesperiodogram(stations,'tempi','_fit');
tseriesperiodogram(stations,{'harmonic','tempi','atmld','residual'},'_fit');
tseriesperiodogram(stations,'residual','_fit');
```

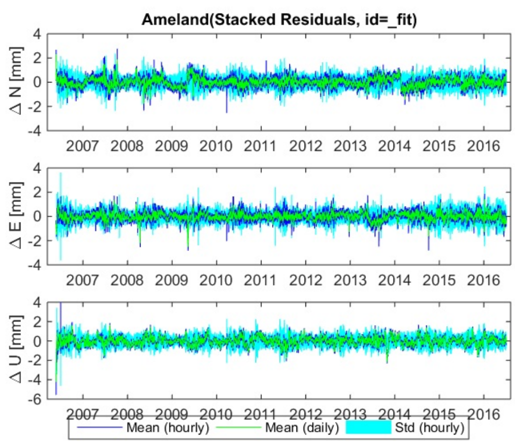


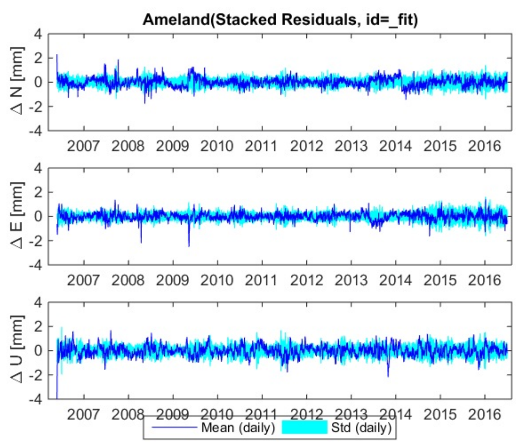


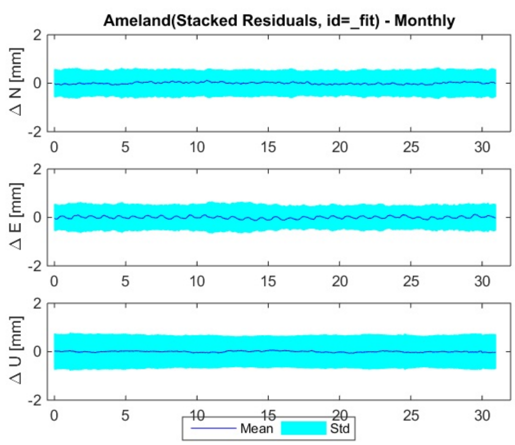
Common mode - Residual stack

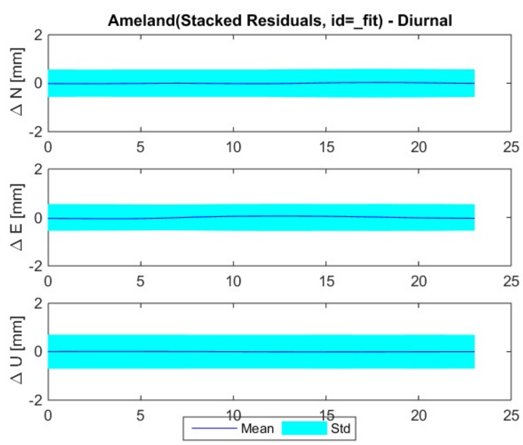
The function `tseriesresidualstack` computes and plots a residual stack from the timeseries. The residual stack is saved to the mat file rstack_ID.mat. The plots are saved in `./plots` under the name `rstack*.png`.

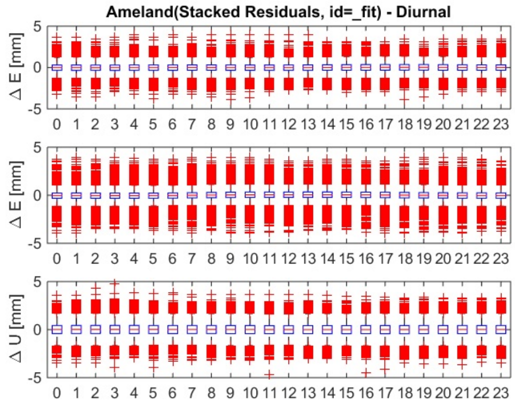
```
tseriesresidualstack(stations,'_fit',projectname);
```











Common mode - Common mode of parameters

The function `tseriescmfit` computes the common mode of the estimated harmonic, temperature influence and loading parameters.

```
cm=tseriescmfit(stations,'_fit');
```

```
Lat
         AtmLd   TempI  s(365)  c(365)  s(183)  c(183)
ame1      0.00    0.19   -0.05    0.26   -0.01   -0.03
anjm     -0.01    0.20   -0.23    0.07    0.01    0.10
modd      0.02    0.32   -0.10   -0.05   -0.04    0.03
amel     -0.03    0.33   -0.15    0.44    0.02    0.04
ame2     -0.09   -0.93    0.88    1.40   -0.31   -0.09
awg1     -0.33    0.40    0.42    1.76   -0.07    0.09

         -0.02    0.25   -0.03    0.28   -0.00    0.03

Lon
         AtmLd   TempI  s(365)  c(365)  s(183)  c(183)
ame1      0.01   -0.29    0.57   -0.26   -0.10   -0.01
anjm      0.03   -0.07    0.33   -0.30   -0.05   -0.09
modd      0.02    0.20    0.24   -0.35   -0.11   -0.04
amel     -0.05   -0.35    0.26   -0.43   -0.07    0.10
ame2     -0.08   -0.93    0.25    0.35   -0.05    0.05
awg1     -0.05    1.49    0.40    0.10    0.04    0.39

          0.00   -0.02    0.38   -0.24   -0.07   -0.01

Rad
         AtmLd   TempI  s(365)  c(365)  s(183)  c(183)
ame1      0.07   -0.37    0.15   -0.40    0.06   -0.10
anjm     -0.01   -0.15   -0.04   -0.32    0.06    0.04
modd      0.01   -0.20   -0.10   -0.13    0.06    0.02
amel      0.05    0.15    0.19   -0.20   -0.48   -0.29
ame2      0.14    0.43   -1.66   -1.96    0.47   -0.77
awg1      0.30    0.81   -0.99   -2.76    0.31   -0.72




          0.05   -0.22   -0.15   -0.52    0.02   -0.10
```

GPS decomposition (fitting) - Second iteration [NOT NECESSARY]

The residual stack and parameter common mode can be removed from the time series and the time series fit can be repeated a second time. However, this is NOT NECESSARY and NOT ADVISABLE for this dataset. For the residuals stack this is not advisable because there are too few stations. Not necessary because the residuals stack does not contain a significant signal in the present case. Removing a common mode in the parameters is harmless, but this is not necessary because the analysis showed hardly any common mode in the parameters.

Below, we show the implementation for the second iteration, but this is stricly not necessary. We don't use these results.

```
doseconditer=false;
if doseconditer

for i=1:numel(stations)
  station=stations{i};
  tseries=tseriesfit(station,'harmonic',[1 1/2],'meteo','meteo_Eelde.mat','rstack','rstack_fit','maxresid',[4 4 6],'_fit2');
  % tseries=tseriesfit(station,'harmonic',[1 1/2],'meteo','meteo_Eelde.mat','rstack','rstack_fit.mat','cm',cm,'maxresid',[4 4 6],'_fit2');
end

% print summary

tseriessummary(stations,'_fit2')

% Plot several of the estimated components

tseriesplotcomponent(stations,{'trend','residual'},'_fit2',projectname,[10 10 20]);
tseriesplotcomponent(stations,'trend','_fit2',projectname,[10 10 20]);
tseriesplotcomponent(stations,{'harmonic' 'tempi'},'_fit2',projectname,10);
tseriesplotcomponent(stations,'residual','_fit2',projectname,10);

% Plot maps

tseriesplotmap(stations,'Annual','_fit2',projectname);
tseriesplotmap(stations,'Tempi','_fit2',projectname);
tseriesplotmap(stations,'Velocity','_fit2',projectname);
tseriesplotmap(stations,'Cov','_fit2',projectname);

end
```

Final results

Make final plots of corrected timeseries and write corrected series to ascii and excel files.

```
%%%%sodmtseriesfinalplot -> tseriesplot
tseriesxlswrite(stations,{'trend' 'residual'},'_fit');
tseriestxtwrite(stations,{'trend' 'residual'},'_fit');
```

```
Warning: Added specified worksheet.
Warning: Added specified worksheet.
Warning: Added specified worksheet.
Warning: Added specified worksheet.
Warning: Added specified worksheet.
Warning: Added specified worksheet.
```

Write GPS CORS point and observation files

The script `lts2_gpscamp` will merge the GPS CORS and campaign data, and compute the covariance matrix for the GPS data. This script needs a GPS point file and observation file with samples from the time series. To specify the samples, a input file is needed with the campaign name and campaign epochs. This file can be created using cut and paste from campaign data analysis (`lts2_gpscamp` output)

```
projectfile='namprojects.csv';  % create this file using an editor and the output of |lts2_gpscamp|
basename='gpscors';             % basename of the GPS point and observation files
duration=5.0;                   % duration in days for the samples

% read file with project data
```

```
fid = fopen(projectfile,'r');
data = textscan(fid, '%s%s%[^\n\r]', Inf, 'Delimiter', ',', 'HeaderLines', 1, 'ReturnOnError', false);
fclose(fid);

prjnames = data{:, 1};
meandate = datenum(data{:, 2},'yyyy-mm-dd');

% Write GPS point and observation files, using the corrected time series
% from the first iteration

lts2_exportcorsdata(stations,{'trend' 'residual'},'_fit',prjnames,meandate,duration,basename)

% [End of Document]
```

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Appendix L. lts2_gps processing output

Contents lts2_gps_noreducecluster.m

- NAM LTS2 main GPS script
- Set up the configuration parameters and input files (USER INPUT)
- Load the GPS data
- Analyze the cluster data
- Select output mode: all benchmarks or only one per cluster
- Make GPS covariance matrix
- Output netcdf
- update point class
- Text output
- Plot output
- Idem, sorted on distance to AWG1
- Idem, sorted on distance to AWG1, flagged data removed
- Plot covariances
- End of script

NAM LTS2 main GPS script

```
This script is the main script for preparing the GPS data for the NAM
LTS2 project. It does the following:

- reads the comma separated ascii input files with GPS campaign data
  generated from the NAM database
- reads the comma separated ascii input files with GPS CORS observations
  computed by |lts2_gpscors.m| script for the analysis of GPS CORS timeseries
- sort out the projects
- sort out the point clusters
- print point, project and cluster statistics
- computes the GPS covariance matrix for the GPS campaign and CORS data
- output the netcdf interface format
- do some printing and plotting for checking purposes

It calls various functions to do the main work.

See also GPSGETPNTDATA, GPSGETOBSDATA, GPSPRJSTATS, GPSPNTSTATS,
GPSCLUSTERSTATS, GPSCOV1, GPSTEMPORALCOV, GPSSPATIALCOV, GPSSETUPCOV,


WRITELTS2NETCDF and LTS2_GPSCORS.

(c) Hans van der Marel, Delft University of Technology, 2016.
```

```
%   Created:    10 August 2016 by Hans van der Marel
%   Modified:   26 August 2016 by Hans van der Marel
%                  - split into functions
%                  - added CORS data and other components
%                  - added netcdf output
%                  - all configuration parameters moved to config
%               14 September 2016 by Hans van der Marel
%                  - minor bug fixing following testing with CORS data and
%                    other components
%                  - added printing and plotting of observations and
%                    covariances for sensibility checks
%                  - make all point and project names uppercase
%                  - implemented new covariance matrix options
%               14 October 2016 by Hans van der Marel
%                  - added call to updpntclasslts2netcdf (instead of
%                    running as seperate script)
%                9 November 2016 by Hans van der Marel
%                  - modified terms of use

clear all
close all
clc

% Set path to required toolboxes

lts2toolboxdir=fullfile('..','lts2toolbox');

addpath(fullfile(lts2toolboxdir,'lts2'));
addpath(fullfile(lts2toolboxdir,'sdwil'));
```

Set up the configuration parameters and input files (USER INPUT)

```
% Input files

campaignonly=false;     % make this true if you want to analyze only campaign data
if campaignonly
  config.gpspntfiles={'gpscampaigns_pnt.csv'};          % gps point input file(s)
  config.gpscampobsfiles={'gpscampaigns_obs_alt.csv'};  % gps campaign observation file(s)
```

```
  config.gpscorsobsfiles={};                            % gps CORS observation file(s)
else
  config.gpspntfiles={'gpscampaigns_pnt.csv','gpscors_pnt_renamed.csv'};   % gps point input file(s)
  config.gpscampobsfiles={'gpscampaigns_obs_seasonal_corrected.csv'};  % gps campaign observation file(s)
  config.gpscorsobsfiles={'gpscors_obs_renamed.csv'};   % gps CORS observation file(s)
end

% Main output options

config.reducecluster=false;                              % if true, redundant cluster benchmarks will be removed from the observatiosns
config.updateflags=true;                                 % if true, update observations flags with results from single difference analys
is

% Parameters for cluster analysis

config.clusteranalysis.maxres=0.0004;                    % observations with residuals > maxres will be flagged
config.clusteranalysis.maxiter=7;                        % maximum number of iterations for outlier detection

% Parameters for the up co-variance matrix

config.gpscov(3).SWmodel=6;         % Simon Williams model number for temporal covariance
config.gpscov(3).rho=0.0887;        % Exponential decay [1/km] for spatial correlation
config.gpscov(3).setupnoise=0.0015; % Setup standard deviation [m] for campaign stations
config.gpscov(3).setuplevellingnoise=0.0003; % Standard deviation for the levelling between cluster benchmarks
config.gpscov(3).doplots=false;     % Plotting for debugging purposes

% Parameters for the east co-variance matrix

config.gpscov(2).SWmodel=7;         % Simon Williams model number for temporal covariance
config.gpscov(2).rho=0.1291;        % Exponential decay [1/km] for spatial correlation
config.gpscov(2).doplots=false;     % Plotting for debugging purposes

% Parameters for the north co-variance matrix

config.gpscov(1).SWmodel=7;         % Simon Williams model number for temporal covariance
config.gpscov(1).rho=0.0827;        % Exponential decay [1/km] for spatial correlation
config.gpscov(1).doplots=false;     % Plotting for debugging purposes

% Covariance computation method

config.covcompmethod='common_project_date';
config.ignoreclustercorrelation=false;

% Output netcdf file and global netcdf attributes
```

```
if config.reducecluster
   netcdf_file='lts2_allgps_cluster.nc';
else
   netcdf_file='lts2_allgps.nc';
end
globalattributes = { ...
  'title'        , 'GPS height differences for the NAM LTS2 project.'  ; ...
  'institution'  , 'Delft University of Technology, Netherlands.' ; ...
  'source'       , 'Nederlandse Aardolie Maatschappij (NAM) GPS height database.' ; ...
  'technique'    , 'GPS' ; ...
  'history'      , ' ' ; ...
  'references'   , 'TU Delft, NAM LTS2 Report, 2016 (in preparation).' ; ...
  'comment'      , ' ' ; ...
  'Conventions'  , 'CF-1.6' ; ...
  'featureType'  , 'timeSeries' ; ...
  'email'        , 'h.vandermarel@tudelft.nl' ; ...
  'version'      , '1.0' ; ...
  'terms_for_use', 'These data have been prepared for: Nederlandse Aardolie Maatschappij (NAM). Any use by third parties requires explic
it approval by NAM.' ; ...
  'disclaimer'   , 'This data is made available in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied w
arranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.' ; ...
};


% END OF USER INPUT (no further changes should be necessary)
```

Load the GPS data

```
The GPS campaign data is loaded

- Reads the ascii point and observation files
- Convert meandate and duration to Matlab datenumbers, with start and stop
- Makes project data and print a table with project data
- Computes observation indices to the point and project data arrays
- Analyze the point data and print a table with point data
- Analyze the point clusters and print two tables with cluster information

Observation variables:

numobs         number of observations (scalar)

obsindex(:,1)  index to pntnames and pntdata
```

```
obsindex(:,2)  index to prjnames and prjstats *)

obs(:)         the observations (height)

obsstats(:,1)  observation start date (Matlab date number)
obsstats(:,2)  observation end date (Matlab date number)
obsstats(:,3)  mean epoch (Matlab date number)
obsstats(:,4)  observation duration (days)
obsstats(:,5)  observation flag (0=reliable, 1,2,...=unreliable)
obsstats(:,6)  CORS station indicator (1=CORS, 0=campaign)
obsstats(:,7)  observed component (1=North, 2=East, 3=Up)

The number of rows (leading dimension) is the number of observations numobs

Project variables:

numprj         number of projects (scalar)

prjname(:)     cell array with the project name

prjstats(:,1)  project start date (Matlab date number)
prjstats(:,2)  project end date (Matlab date number)
prjstats(:,3)  mean epoch (Matlab date number)
prjstats(:,4)  mean observation duration (days)
prjstats(:,5)  number of observations in the project
prjstats(:,6)  number of useful observations in project (as set by use flag)

The number of rows (leading dimension) is the number of projects numprj

Point variables:

numpnt         number of points (scalar)

pntname(:)     cell array with the point name

pntcrd(:,1)    array with x-coordinate in Rijksdriehoekstelsel [m]
pntcrd(:,2)    array with y-coordinate in Rijksdriehoekstelsel [m]

cluster_id(:)  point cluster id

pntstats(:,1)  First observation for this point (Matlab date number)


pntstats(:,2)  Last observation for this point (Matlab date number)
pntstats(:,3)  mean epoch of observation (Matlab date number)
pntstats(:,4)  mean observation duration (days)
pntstats(:,5)  number of observations for the point
pntstats(:,6)  number of useful observations for the point (as set by use flag)

The number of rows (leading dimension) is the number of points numpnt

Cluster variables:

numcluster         number of point clusters (scalar)
maxclusterpnts     maximum number of points per cluster (scalar, is computed)

clustername(:)     cell array with the cluster name
clusterpntadm(:,1) number of points per cluster
clusterpntadm(:,1:maxclusterpnts)   index to pntname and pntstats, or NaN

clustercoord(:,1)  RD x-coordinate of the cluster
clustercoord(:,2)  RD y-coordinate of the cluster

clusterstats(:,1)  First observation for this cluster (Matlab date number)
clusterstats(:,2)  Last observation for this cluster (Matlab date number)
clusterstats(:,3)  mean epoch of observation (Matlab date number)
clusterstats(:,4)  mean observation duration for the cluster points (days)
clusterstats(:,5)  number of projects for the cluster (with at least one
                   point of the cluster observed)
clusterstats(:,6)  number of observations for the cluster (all points included)
clusterstats(:,7)  number of useful observations for the cluster (as set by use flag)

The number of rows (leading dimension) is the number of clusters numcluster
```

```
% Read ascii point files

[pntname,pntcrd,cluster_id] = gpsgetpntdata(config.gpspntfiles);

% Read ascii observation files and compute observations statistics

[pntname_obs,prjname_obs,obs,obsstats] = ...
     gpsgetobsdata(config.gpscampobsfiles,config.gpscorsobsfiles);

% Make project data
```

```
[prjname,prjstats,prjclass]=gpsprjstats(prjname_obs,obsstats);

% Analyze the point data

[pntstats,pntclass]=gpspntstats(pntname,pntname_obs,obsstats);

% Compute observation indexes

obsindex(:,1)=mkindex(pntname_obs,pntname);
obsindex(:,2)=mkindex(prjname_obs,prjname);


% Compute cluster names, index, statistics and coordinates

[clustername,clusterstats,clusterpntadm]=gpsclusterstats(pntname,cluster_id,...
       obsindex,obsstats);
clustercrd=pntcrd(clusterpntadm(:,2),:);  % coordinates of first point in cluster

% Count the point, projects, observations and clusters

numobs=size(obsindex,1);
numpnt=numel(pntname);
numprj=numel(prjname);
numcluster=numel(clustername);
```

```
We have duplicates in the point files...
gpscors_pnt_renamed.csv: AME-2 186841.780 610897.175 (186842.964 610897.745)
gpscors_pnt_renamed.csv: AWG-1 191778.768 611827.827 (191779.000 611828.000)

Project statistics (17 projects):

PRJNAME           START         END  MEAN_EPOCH #DAYS   MEAN  NUMOBS   USE  CLASS
                                                     _OBSTIME
NAM_GPS06    2006-05-28  2006-11-17  2006-07-17   173    3.8     128    83  GPS&CORS
NAM_GPS07    2007-06-13  2007-07-09  2007-06-21    26    5.5      19    19  GPS&CORS
NAM_GPS08A   2008-08-01  2008-08-07  2008-08-04     6    3.8      18    18  GPS&CORS
NAM_GPS08B   2008-10-16  2008-10-24  2008-10-20     8    5.0      12    12  GPS&CORS
07_2009      2009-05-08  2009-11-30  2009-06-26   206    5.3     122   122  GPS&CORS
NAM_GPS10    2010-07-29  2010-09-01  2010-08-13    34    3.8      40    40  GPS&CORS
NAM_GPS11    2011-05-05  2011-06-03  2011-05-18    29    4.1      66    66  GPS&CORS
NAM_GPS11L   2011-09-16  2011-09-29  2011-09-23    13    4.6      15    15  GPS&CORS
NAM_GPS11P   2011-09-25  2011-10-03  2011-09-29     8    5.1      11    11  GPS&CORS
NAM_GPS12W   2012-05-05  2012-06-10  2012-05-21    36    4.5      81    81  GPS&CORS


NAM_GPS12L   2012-06-15  2012-06-28  2012-06-20    13    4.2      17    17  GPS&CORS
NAM_GPS13    2013-05-09  2013-05-26  2013-05-17    17    3.6      45    45  GPS&CORS
NAM_GPS14    2014-04-30  2014-05-27  2014-05-13    27    3.3      67    67  GPS&CORS
NAM_GPS15W   2015-05-03  2015-06-23  2015-05-27    51    3.8     105   105  GPS&CORS
NAM_GPS15L   2015-06-26  2015-07-09  2015-07-01    13    4.4      22    22  GPS&CORS
NAM_GPS15O   2015-07-01  2015-07-21  2015-07-09    20    4.4      23    23  GPS&CORS
NAM_TMP16    2016-04-28  2016-05-04  2016-05-01     6    5.0      14    14  CORS


Benchmark statistics (154 points):

PNTNAME       FIRST_OBS    LAST_OBS  MEAN_EPOCH #YEAR   MEAN  NUMOBS   USE  CLASS
                                                     _OBSTIME
000A2592     2006-06-08  2015-07-21  2010-08-24   9.1    7.9       6     6  GPS
000A2632     2008-10-18  2008-10-23  2008-10-20   0.0    4.1       1     1  GPS
000A2683     2011-09-24  2015-07-06  2013-08-15   3.8    3.6       2     2  GPS
000A2686     2006-07-20  2015-07-07  2011-01-12   9.0    3.5       2     2  GPS
000A2687     2011-09-24  2015-07-16  2013-08-20   3.8    3.3       2     2  GPS
000A2688     2008-10-17  2015-07-13  2012-01-06   6.7    4.4       3     3  GPS
000A2689     2006-06-28  2015-07-06  2010-10-20   9.0    8.7       4     4  GPS
000A2691     2006-07-13  2015-07-16  2010-11-17   9.0    4.2       4     4  GPS
000A4025     2006-07-27  2015-07-06  2010-11-08   8.9    3.4       4     4  GPS
000A5025     2015-07-01  2015-07-06  2015-07-03   0.0    3.5       1     1  GPS
002C0026     2006-06-07  2014-05-20  2010-05-22   8.0    3.2       4     4  GPS
002C0027     2006-06-07  2014-05-20  2010-05-22   8.0    3.2       4     4  GPS
002C0028     2006-06-07  2014-05-20  2010-05-22   8.0    3.2       4     4  GPS
002C0029     2006-05-31  2014-05-25  2010-06-05   8.0    3.7       7     7  GPS
002C0030     2006-05-31  2014-05-25  2010-06-05   8.0    3.7       7     7  GPS
002C0031     2006-05-31  2014-05-25  2010-06-05   8.0    3.7       7     7  GPS
002C0033     2006-06-02  2015-06-18  2011-02-14   9.0    4.0       7     7  GPS
002C0034     2006-06-02  2015-06-18  2011-02-14   9.0    4.0       7     7  GPS
002C0035     2006-06-02  2015-06-18  2011-02-14   9.0    4.0       7     7  GPS
002C0064     2006-05-28  2014-05-27  2010-05-18   8.0    3.5       4     4  GPS
002C0065     2006-05-28  2014-05-27  2010-05-18   8.0    3.5       4     4  GPS
002C0066     2006-05-28  2014-05-27  2010-05-18   8.0    3.5       4     4  GPS
002D0048     2006-06-10  2015-06-15  2010-10-02   9.0    3.5       6     6  GPS
002D0049     2006-06-10  2015-06-15  2010-10-02   9.0    3.5       6     6  GPS
002D0050     2006-06-10  2014-05-21  2009-10-24   7.9    3.2       5     5  GPS
002D0054     2006-06-20  2011-05-28  2009-01-31   4.9    3.4       3     3  GPS
002D0055     2006-06-20  2011-05-28  2009-01-31   4.9    3.4       3     3  GPS
002D0056     2006-06-20  2011-05-28  2009-01-31   4.9    3.4       3     3  GPS
002D0059     2006-06-23  2015-06-01  2010-12-09   8.9    4.4       4     4  GPS
002D0060     2006-06-23  2015-06-01  2010-12-09   8.9    4.4       4     4  GPS
002D0061     2006-06-23  2015-06-01  2010-12-09   8.9    4.4       4     4  GPS
```

002D0066	2006-06-12	2015-06-06	2011-03-20	9.0	4.2	5	5	GPS
002D0067	2006-06-12	2015-06-06	2011-03-20	9.0	4.2	5	5	GPS
002D0068	2006-06-12	2015-06-06	2011-03-20	9.0	4.2	5	5	GPS
002D0079								
002D0102	2006-06-15	2015-05-25	2011-05-25	8.9	4.2	5	5	GPS
002D0103	2006-06-15	2015-05-25	2011-05-25	8.9	4.2	5	5	GPS
002D0104	2006-06-15	2015-05-25	2011-05-25	8.9	4.2	5	5	GPS
002D0105	2006-06-05	2006-06-10	2006-06-07	0.0	4.2	1	1	GPS
002D0106	2006-06-05	2006-06-10	2006-06-07	0.0	4.2	1	1	GPS
002D0107	2006-06-05	2006-06-10	2006-06-07	0.0	4.2	1	1	GPS
002D0108	2006-06-16	2015-06-04	2011-06-05	9.0	3.3	5	5	GPS
002D0109	2006-06-16	2015-06-04	2011-06-05	9.0	3.3	5	5	GPS
002D0110	2006-06-16	2015-06-04	2011-06-05	9.0	3.3	5	5	GPS
002G0042	2006-06-28	2015-05-29	2011-03-16	8.9	2.9	8	8	GPS
002G0043	2006-06-28	2015-05-29	2011-03-16	8.9	2.9	8	8	GPS
002G0044	2006-06-28	2015-05-29	2011-03-16	8.9	2.9	8	8	GPS
002G0048	2006-07-02	2014-05-07	2010-09-02	7.8	3.9	4	4	GPS
002G0049	2006-07-02	2014-05-07	2010-09-02	7.8	3.9	4	4	GPS
002G0050	2006-07-02	2014-05-07	2010-09-02	7.8	3.9	4	4	GPS
002G0124	2006-07-12	2015-05-23	2010-12-06	8.9	4.8	4	4	GPS
002G0125	2006-07-12	2015-05-23	2010-12-06	8.9	4.8	4	4	GPS
002G0126	2006-07-12	2015-05-23	2010-12-06	8.9	4.8	4	4	GPS
002H0032	2006-08-03	2015-05-26	2010-12-23	8.8	3.7	4	4	GPS
002H0033	2006-08-03	2015-05-26	2010-12-23	8.8	3.7	4	4	GPS
002H0034	2006-08-03	2015-05-26	2010-12-23	8.8	3.7	4	4	GPS
002H0035	2006-08-10	2015-05-20	2010-12-23	8.8	4.3	4	4	GPS
002H0036	2006-08-10	2015-05-20	2010-12-23	8.8	4.3	4	4	GPS
002H0037	2006-08-10	2015-05-20	2010-12-23	8.8	4.3	4	4	GPS
002H0038	2006-07-06	2015-05-27	2010-12-15	8.9	3.7	4	4	GPS
002H0039	2006-07-06	2015-05-27	2010-12-15	8.9	3.7	4	4	GPS
002H0040	2006-07-06	2015-05-27	2010-12-15	8.9	3.7	4	4	GPS
002H0042	2006-06-30	2015-05-11	2010-12-13	8.9	3.4	4	4	GPS
002H0043	2006-06-30	2015-05-11	2010-12-13	8.9	3.4	4	4	GPS
002H0044	2006-06-30	2015-05-11	2010-12-13	8.9	3.4	4	4	GPS
002H0048	2006-08-13	2006-08-20	2006-08-17	0.0	5.8	1	1	GPS
002H0048M	2012-05-07	2015-05-10	2013-11-07	3.0	3.6	2	2	GPS
002H0048N	2012-05-07	2015-05-10	2013-11-07	3.0	3.6	2	2	GPS
002H0048Z	2012-05-07	2015-05-10	2013-11-07	3.0	3.6	2	2	GPS
002H0057	2006-07-04	2015-05-15	2010-12-19	8.9	5.4	4	4	GPS
002H0058	2006-07-04	2015-05-15	2010-12-19	8.9	5.4	4	4	GPS
002H0059	2006-07-04	2015-05-15	2010-12-19	8.9	5.4	4	4	GPS
003C0122	2010-08-17	2015-05-29	2013-03-26	4.8	3.3	5	5	GPS
003C0123	2010-08-17	2015-05-29	2013-03-26	4.8	3.3	5	5	GPS
003C0124	2010-08-17	2015-05-29	2013-03-26	4.8	3.3	5	5	GPS
003D0138	2010-08-19	2015-06-23	2012-12-23	4.8	5.0	4	4	GPS
003D0139	2010-08-19	2015-06-23	2012-12-23	4.8	5.0	4	4	GPS
003D0140	2010-08-19	2015-06-23	2012-12-23	4.8	5.0	4	4	GPS
003G0187	2010-08-21	2013-05-16	2012-02-19	2.7	3.8	3	3	GPS
003G0188	2010-08-21	2013-05-16	2012-02-19	2.7	3.8	3	3	GPS
003G0189	2010-08-21	2013-05-16	2012-02-19	2.7	3.8	3	3	GPS
003G0196	2010-08-27	2013-05-20	2012-02-22	2.7	3.0	3	3	GPS
003G0197	2010-08-27	2013-05-20	2012-02-22	2.7	3.0	3	3	GPS
003G0198	2010-08-27	2013-05-20	2012-02-22	2.7	3.0	3	3	GPS
006B0021	2008-10-16	2008-10-22	2008-10-19	0.0	5.0	1	1	GPS
006E0193								
006E0216								
006E0239								
AME-2	2006-10-30	2016-05-04	2013-01-10	9.5	12.8	7	7	GPS&CORS
AWG-1	2006-11-12	2016-05-04	2013-01-11	9.5	11.9	7	7	GPS&CORS
GRK1	2006-09-24	2006-09-29	2006-09-27	0.0	4.6	1	1	GPS
GRK2	2006-09-24	2006-09-29	2006-09-27	0.0	4.5	1	1	GPS
GRK3	2006-09-24	2006-09-28	2006-09-26	0.0	3.1	1	1	GPS
GRK4	2006-09-24	2006-09-30	2006-09-27	0.0	4.4	1	1	GPS
L100	2006-09-07	2015-06-30	2011-01-23	8.8	3.3	4	4	GPS
L101	2006-09-07	2015-07-01	2011-01-24	8.8	3.2	4	4	GPS
L102	2006-09-15	2015-07-01	2011-01-27	8.8	3.4	4	4	GPS
L103	2006-08-31	2015-06-30	2011-01-23	8.8	3.5	4	4	GPS
L104	2006-09-16	2015-07-09	2011-02-02	8.8	4.4	4	4	GPS
L105	2006-09-09	2015-07-09	2011-01-31	8.8	4.3	4	4	GPS
L106	2006-09-06	2015-07-02	2011-01-26	8.8	3.5	4	4	GPS
L107	2006-08-31	2015-07-02	2011-01-24	8.8	3.1	4	4	GPS
M001M	2006-08-07	2015-06-12	2011-06-06	8.8	2.8	5	4	GPS
M001N	2006-08-07	2015-06-12	2011-06-06	8.8	2.8	5	4	GPS
M001Z	2006-08-07	2015-06-12	2011-06-06	8.8	2.8	5	4	GPS
M002M	2006-08-06	2015-06-13	2010-09-29	8.9	4.0	7	6	GPS
M002N	2006-08-06	2015-06-13	2010-09-29	8.9	4.0	7	6	GPS
M002Z	2006-08-06	2015-06-13	2010-09-29	8.9	4.0	7	6	GPS
M003M	2006-07-28	2015-05-16	2011-07-31	8.8	4.2	6	5	GPS
M003N	2006-07-28	2015-05-16	2011-07-31	8.8	4.2	6	5	GPS
M003Z	2006-07-28	2015-05-16	2011-07-31	8.8	4.2	6	5	GPS
M004M	2006-06-22	2015-05-31	2010-12-16	8.9	6.2	4	3	GPS
M004N	2006-06-22	2015-05-31	2010-12-16	8.9	6.2	4	3	GPS
M004Z	2006-06-22	2015-05-31	2010-12-16	8.9	6.2	4	3	GPS
M005M	2006-07-24	2015-05-28	2011-06-09	8.8	3.3	5	4	GPS
M005N	2006-07-24	2015-05-28	2011-06-09	8.8	3.3	5	4	GPS
M005Z	2006-07-24	2015-05-28	2011-06-09	8.8	3.3	5	4	GPS
M006M	2006-07-30	2015-05-15	2011-01-18	8.8	3.1	5	4	GPS
M006N	2006-07-30	2015-05-15	2011-01-18	8.8	3.1	5	4	GPS

M006Z	2006-07-30	2015-05-15	2011-01-18	8.8	3.1	5	4	GPS
M007M	2006-07-22	2015-06-21	2011-09-20	8.9	3.7	8	7	GPS
M007N	2006-07-22	2015-06-21	2011-09-20	8.9	3.7	8	7	GPS
M007Z	2006-07-22	2015-06-21	2011-09-20	8.9	3.7	8	7	GPS
M008M	2006-07-18	2015-06-21	2011-05-12	8.9	3.8	9	8	GPS
M008N	2006-07-18	2015-06-21	2011-05-12	8.9	3.8	9	8	GPS
M008Z	2006-07-18	2014-05-09	2010-11-06	7.8	3.9	8	7	GPS
M009M	2006-07-14	2015-05-09	2011-09-05	8.8	3.0	8	7	GPS
M009N	2006-07-14	2015-05-09	2011-09-05	8.8	3.0	8	7	GPS
M009Z	2006-07-14	2015-05-09	2011-09-05	8.8	3.0	8	7	GPS
M010M	2006-07-08	2015-05-22	2010-12-13	8.9	5.5	4	3	GPS
M010N	2006-07-08	2015-05-22	2010-12-13	8.9	5.5	4	3	GPS
M010Z	2006-07-08	2015-05-22	2010-12-13	8.9	5.5	4	3	GPS
M011M	2006-07-26	2015-05-17	2011-06-14	8.8	3.6	5	4	GPS
M011N	2006-07-26	2015-05-17	2011-06-14	8.8	3.6	5	4	GPS
M011Z	2006-07-26	2015-05-17	2011-06-14	8.8	3.6	5	4	GPS
M012M	2006-07-16	2015-05-12	2010-12-15	8.8	2.9	4	3	GPS
M012N	2006-07-16	2015-05-12	2010-12-15	8.8	2.9	4	3	GPS
M012Z	2006-07-16	2015-05-12	2010-12-15	8.8	2.9	4	3	GPS
M013M	2006-07-10	2015-05-08	2010-12-02	8.8	3.9	4	3	GPS
M013N	2006-07-10	2015-05-08	2010-12-02	8.8	3.9	4	3	GPS
M013Z	2006-07-10	2015-05-08	2010-12-02	8.8	3.9	4	3	GPS
M015M	2006-07-20	2015-06-12	2011-06-03	8.9	3.7	5	4	GPS
M015N	2006-07-20	2015-06-12	2011-06-03	8.9	3.7	5	4	GPS
M015Z	2006-07-20	2015-06-12	2011-06-03	8.9	3.7	5	4	GPS
M016M	2006-08-14	2014-05-08	2010-04-14	7.7	3.3	5	4	GPS
M016N	2006-08-14	2014-05-08	2010-04-14	7.7	3.3	5	4	GPS
M016Z	2006-08-14	2014-05-08	2010-04-14	7.7	3.3	5	4	GPS
M017M	2015-06-17	2015-06-21	2015-06-19	0.0	3.1	1	1	GPS
M017N	2015-06-17	2015-06-21	2015-06-19	0.0	3.1	1	1	GPS
M017Z	2015-06-17	2015-06-21	2015-06-19	0.0	3.1	1	1	GPS
AME1	2006-07-14	2016-05-04	2011-11-12	9.8	5.0	51	51	CORS
ANJM	2006-07-14	2016-05-04	2012-02-21	9.8	5.0	48	48	CORS
MODD	2007-06-18	2016-05-04	2012-03-13	8.9	5.0	48	48	CORS
AMEL	2015-05-24	2016-05-04	2015-09-09	0.9	5.0	12	12	CORS

Cluster composition: (71 clusters, 40 with multiples, ## is the number of observations per point)

CID	CLUSTERNAME	#PNT	PNTNAME (##)	PNTNAME (##) ...				
1	002C0026+3	3	002C0026 (4)	002C0027 (4)	002C0028 (4)			
2	002C0029+3	3	002C0029 (7)	002C0030 (7)	002C0031 (7)			
3	002C0033+3	3	002C0033 (7)	002C0034 (7)	002C0035 (7)			
4	002C0064+3	3	002C0064 (4)	002C0065 (4)	002C0066 (4)			
5	002D0048+3	3	002D0048 (6)	002D0049 (6)	002D0050 (5)			
6	002D0054+3	3	002D0054 (3)	002D0055 (3)	002D0056 (3)			
7	002D0059+3	3	002D0059 (4)	002D0060 (4)	002D0061 (4)			
8	002D0066+3	3	002D0066 (5)	002D0067 (5)	002D0068 (5)			
9	002D0102+3	3	002D0102 (5)	002D0103 (5)	002D0104 (5)			
10	002D0105+3	3	002D0105 (1)	002D0106 (1)	002D0107 (1)			
11	002D0108+3	3	002D0108 (5)	002D0109 (5)	002D0110 (5)			
12	002G0042+3	3	002G0042 (8)	002G0043 (8)	002G0044 (8)			
13	002G0048+3	3	002G0048 (4)	002G0049 (4)	002G0050 (4)			
14	002G0124+3	3	002G0124 (4)	002G0125 (4)	002G0126 (4)			
15	002H0032+3	3	002H0032 (4)	002H0033 (4)	002H0034 (4)			
16	002H0035+3	3	002H0035 (4)	002H0036 (4)	002H0037 (4)			
17	002H0038+3	3	002H0038 (4)	002H0039 (4)	002H0040 (4)			
18	002H0042+3	3	002H0042 (4)	002H0043 (4)	002H0044 (4)			
19	002H0048M+4	4	002H0048M (2)	002H0048N (2)	002H0048Z (2)	002H0048 (1)		
20	002H0057+3	3	002H0057 (4)	002H0058 (4)	002H0059 (4)			
21	003C0122+3	3	003C0122 (5)	003C0123 (5)	003C0124 (5)			
22	003D0138+3	3	003D0138 (4)	003D0139 (4)	003D0140 (4)			
23	003G0187+3	3	003G0187 (3)	003G0188 (3)	003G0189 (3)			
24	003G0196+3	3	003G0196 (3)	003G0197 (3)	003G0198 (3)			
25	M001M+3	3	M001M (5)	M001N (5)	M001Z (5)			
26	M002M+3	3	M002M (7)	M002N (7)	M002Z (7)			
27	M003M+3	3	M003M (6)	M003N (6)	M003Z (6)			
28	M004M+3	3	M004M (4)	M004N (4)	M004Z (4)			
29	M005M+3	3	M005M (5)	M005N (5)	M005Z (5)			
30	M006M+3	3	M006M (5)	M006N (5)	M006Z (5)			
31	M007M+3	3	M007M (8)	M007N (8)	M007Z (8)			
32	M008M+6	6	M008M (9)	M008N (9)	M008Z (8)	M017M (1)	M017N (1)	M017Z (1)
33	M009M+3	3	M009M (8)	M009N (8)	M009Z (8)			
34	M010M+3	3	M010M (4)	M010N (4)	M010Z (4)			
35	M011M+3	3	M011M (5)	M011N (5)	M011Z (5)			
36	M012M+3	3	M012M (4)	M012N (4)	M012Z (4)			
37	M013M+3	3	M013M (4)	M013N (4)	M013Z (4)			
38	M015M+3	3	M015M (5)	M015N (5)	M015Z (5)			
39	M016M+3	3	M016M (5)	M016N (5)	M016Z (5)			
40	000A4025+2	2	000A4025 (4)	000A5025 (1)				

Cluster benchmarks statistics (71 cluster benchmarks):

CID	CLUSTERNAME	FIRST_OBS	LAST_OBS	MEAN_EPOCH	#YEAR	MEAN _OBSTIME	NUMPRJ	NUMOBS	USE
1	002C0026+3	2006-06-07	2014-05-20	2010-05-22	8.0	3.2	4	12	12

```
  2 002C0029+3    2006-05-31  2014-05-25  2010-06-05   8.0    3.7       7      21    21
  3 002C0033+3    2006-06-02  2015-06-18  2011-02-14   9.0    4.0       7      21    21
  4 002C0064+3    2006-05-28  2014-05-27  2010-05-18   8.0    3.5       4      12    12
  5 002D0048+3    2006-06-10  2015-06-15  2010-06-23   9.0    3.4       6      17    17
  6 002D0054+3    2006-06-20  2011-05-28  2009-01-31   4.9    3.4       3       9     9
  7 002D0059+3    2006-06-23  2015-06-01  2010-12-09   8.9    4.4       4      12    12
  8 002D0066+3    2006-06-12  2015-06-06  2011-03-20   9.0    4.2       5      15    15
  9 002D0102+3    2006-06-15  2015-05-25  2011-05-25   8.9    4.2       5      15    15
 10 002D0105+3    2006-06-05  2006-06-10  2006-06-07   0.0    4.2       1       3     3
 11 002D0108+3    2006-06-16  2015-06-04  2011-06-05   9.0    3.3       5      15    15
 12 002G0042+3    2006-06-28  2015-05-29  2011-03-16   8.9    2.9       8      24    24
 13 002G0048+3    2006-07-02  2014-05-07  2010-09-02   7.8    3.9       4      12    12
 14 002G0124+3    2006-07-12  2015-05-23  2010-12-06   8.9    4.8       4      12    12
 15 002H0032+3    2006-08-03  2015-05-26  2010-12-23   8.8    3.7       4      12    12
 16 002H0035+3    2006-08-10  2015-05-20  2010-12-23   8.8    4.3       4      12    12
 17 002H0038+3    2006-07-06  2015-05-27  2010-12-15   8.9    3.7       4      12    12
 18 002H0042+3    2006-06-30  2015-05-11  2010-12-13   8.9    3.4       4      12    12
 19 002H0048M+4   2006-08-13  2015-05-10  2012-10-26   8.7    3.9       3       7     7
 20 002H0057+3    2006-07-04  2015-05-15  2010-12-19   8.9    5.4       4      12    12
 21 003C0122+3    2010-08-17  2015-05-29  2013-03-26   4.8    3.3       5      15    15
 22 003D0138+3    2010-08-19  2015-06-23  2012-12-23   4.8    5.0       4      12    12
 23 003G0187+3    2010-08-21  2013-05-16  2012-02-19   2.7    3.8       3       9     9
 24 003G0196+3    2010-08-27  2013-05-20  2012-02-22   2.7    3.0       3       9     9
 25 M001M+3       2006-08-07  2015-06-12  2011-06-06   8.8    2.8       5      15    12
 26 M002M+3       2006-08-06  2015-06-13  2010-09-29   8.9    4.0       7      21    18
 27 M003M+3       2006-07-28  2015-05-16  2011-07-31   8.8    4.2       6      18    15
 28 M004M+3       2006-06-22  2015-05-31  2010-12-16   8.9    6.2       4      12     9
 29 M005M+3       2006-07-24  2015-05-28  2011-06-09   8.8    3.3       5      15    12
 30 M006M+3       2006-07-30  2015-05-15  2011-01-18   8.8    3.1       5      15    12
 31 M007M+3       2006-07-22  2015-06-21  2011-09-20   8.9    3.7       8      24    21
 32 M008M+6       2006-07-18  2015-06-21  2011-08-23   8.9    3.8       9      29    26
 33 M009M+3       2006-07-14  2015-05-09  2011-09-05   8.8    3.0       8      24    21
 34 M010M+3       2006-07-08  2015-05-22  2010-12-13   8.9    5.5       4      12     9
 35 M011M+3       2006-07-26  2015-05-17  2011-06-14   8.8    3.6       5      15    12
 36 M012M+3       2006-07-16  2015-05-12  2010-12-15   8.8    2.9       4      12     9
 37 M013M+3       2006-07-10  2015-05-08  2010-12-02   8.8    4.0       4      12     9
 38 M015M+3       2006-07-20  2015-06-12  2011-06-03   8.9    3.7       5      15    12
 39 M016M+3       2006-08-14  2014-05-08  2010-04-14   7.7    3.3       5      15    12
 40 000A4025+2    2006-07-27  2015-07-06  2011-10-14   8.9    3.4       4       5     5
 41 000A2592      2006-06-08  2015-07-21  2010-08-24   9.1    7.9       6       6     6
 42 000A2632      2008-10-18  2008-10-23  2008-10-20   0.0    4.1       1       1     1
 43 000A2683      2011-09-24  2015-07-06  2013-08-15   3.8    3.6       2       2     2
 44 000A2686      2006-07-20  2015-07-07  2011-01-12   9.0    3.5       2       2     2
 45 000A2687      2011-09-24  2015-07-16  2013-08-20   3.8    3.3       2       2     2


 46 000A2688      2008-10-17  2015-07-13  2012-01-06   6.7    4.4       3       3     3
 47 000A2689      2006-06-28  2015-07-06  2010-10-20   9.0    8.7       4       4     4
 48 000A2691      2006-07-13  2015-07-16  2010-11-17   9.0    4.2       4       4     4
 49 002D0079
 50 006B0021      2008-10-16  2008-10-22  2008-10-19   0.0    5.0       1       1     1
 51 006E0193
 52 006E0216
 53 006E0239
 54 AME-2         2006-10-30  2016-05-04  2013-01-10   9.5   12.8       7       7     7
 55 AWG-1         2006-11-12  2016-05-04  2013-01-11   9.5   11.9       7       7     7
 56 GRK1          2006-09-24  2006-09-29  2006-09-27   0.0    4.6       1       1     1
 57 GRK2          2006-09-24  2006-09-29  2006-09-27   0.0    4.5       1       1     1
 58 GRK3          2006-09-24  2006-09-28  2006-09-26   0.0    3.1       1       1     1
 59 GRK4          2006-09-24  2006-09-30  2006-09-27   0.0    4.4       1       1     1
 60 L100          2006-09-07  2015-06-30  2011-01-23   8.8    3.3       4       4     4
 61 L101          2006-09-07  2015-07-01  2011-01-24   8.8    3.2       4       4     4
 62 L102          2006-09-15  2015-07-01  2011-01-27   8.8    3.4       4       4     4
 63 L103          2006-08-31  2015-06-30  2011-01-23   8.8    3.5       4       4     4
 64 L104          2006-09-16  2015-07-09  2011-02-02   8.8    4.4       4       4     4
 65 L105          2006-09-09  2015-07-09  2011-01-31   8.8    4.3       4       4     4
 66 L106          2006-09-06  2015-07-02  2011-01-26   8.8    3.5       4       4     4
 67 L107          2006-08-31  2015-07-02  2011-01-24   8.8    3.1       4       4     4
 68 AME1          2006-07-14  2016-05-04  2011-11-12   9.8    5.0      17      51    51
 69 ANJM          2006-07-14  2016-05-04  2012-02-21   9.8    5.0      16      48    48
 70 MODD          2007-06-18  2016-05-04  2012-03-13   8.9    5.0      16      48    48
 71 AMEL          2015-05-24  2016-05-04  2015-09-09   0.9    5.0       4      12    12
```

Analyze the cluster data

```
% Compute cluster observation administration

[clusterobsadm,obsindex]=gpsclusterobsadm(clusterpntadm,obsindex);

% Print double difference observations

gpsclusterprtobs(pntname,prjname,clustername,clusterpntadm,clusterobsadm,obs)

% Zero difference analysis using LSQ adjustment and outlier detection, flag observations

[obsstats2,clusterobs]=gpsclusteranalysis(pntname,prjname,clustername,clusterpntadm,clusterobsadm,obs,obsstats,config.clusteranalysis);

% Cluster observation statistics
```

```
clusterobsstats=gpsclusterobsstats(clusterobsadm,obsstats2);
```

```
Cluster Double Differences [mm]:

002C0026+3:
             002C0026   002C0027   002C0028
NAM_GPS06        0.00      -0.07       0.20
07_2009          0.00      -0.08      -0.10
NAM_GPS11        0.00       0.02      -0.10
NAM_GPS14        0.00       0.13       0.00

002C0029+3:
             002C0029   002C0030   002C0031
NAM_GPS06        0.00       1.09       0.04
NAM_GPS07        0.00      -0.31      -0.16
07_2009          0.00      -0.21      -0.16
NAM_GPS10        0.00      -0.11       0.04
NAM_GPS11        0.00      -0.11       0.04
NAM_GPS13        0.00      -0.21       0.04
NAM_GPS14        0.00      -0.11       0.14

002C0033+3:
             002C0033   002C0034   002C0035
NAM_GPS06        0.00       0.10       0.06
NAM_GPS07        0.00      -0.20      -0.14
07_2009          0.00      -0.00      -0.04
NAM_GPS11        0.00      -0.00       0.06
NAM_GPS13        0.00       0.10      -0.04
NAM_GPS14        0.00      -0.00       0.16
NAM_GPS15W       0.00      -0.00      -0.04

002C0064+3:
             002C0064   002C0065   002C0066
NAM_GPS06        0.00      -0.02      -0.02
07_2009          0.00       0.18       0.07
NAM_GPS11        0.00       0.07       0.07
NAM_GPS14        0.00      -0.23      -0.13

002D0048+3:
             002D0048   002D0049   002D0050
NAM_GPS06        0.00      -0.00      -0.20
NAM_GPS07        0.00      -0.30      -0.00


07_2009          0.00      -0.20      -0.10
NAM_GPS11        0.00       0.00       0.10
NAM_GPS14        0.00       0.20       0.20
NAM_GPS15W       0.00       0.30        NaN

002D0054+3:
             002D0054   002D0055   002D0056
NAM_GPS06        0.00      -0.10      -0.70
07_2009          0.00       0.30       0.60
NAM_GPS11        0.00      -0.20       0.10

002D0059+3:
             002D0059   002D0060   002D0061
NAM_GPS06        0.00       0.13       0.05
07_2009          0.00       0.02       0.05
NAM_GPS12W       0.00       0.02       0.15
NAM_GPS15W       0.00      -0.18      -0.25

002D0066+3:
             002D0066   002D0067   002D0068
NAM_GPS06        0.00      -1.26      -1.60
07_2009          0.00      -0.16      -0.30
NAM_GPS11        0.00       0.04       0.00
NAM_GPS13        0.00       0.04       0.30
NAM_GPS15W       0.00       1.34       1.60

002D0102+3:
             002D0102   002D0103   002D0104
NAM_GPS06        0.00      -0.60      -0.18
07_2009          0.00      -0.40      -0.48
NAM_GPS11        0.00      -0.10      -0.38
NAM_GPS14        0.00       0.50       0.32
NAM_GPS15W       0.00       0.60       0.72

002D0108+3:
             002D0108   002D0109   002D0110
NAM_GPS06        0.00       3.64       1.64
07_2009          0.00      -1.46       0.84
NAM_GPS11        0.00      -1.16       0.54
NAM_GPS14        0.00      -0.56      -1.66
NAM_GPS15W       0.00      -0.46      -1.36

002G0042+3:
             002G0042   002G0043   002G0044
```

NAM_GPS06	0.00	0.05	0.26
NAM_GPS08A	0.00	0.15	0.16
07_2009	0.00	0.05	-0.04
NAM_GPS10	0.00	0.05	0.06
NAM_GPS11	0.00	-0.05	-0.04
NAM_GPS13	0.00	-0.05	-0.04
NAM_GPS14	0.00	-0.25	-0.14
NAM_GPS15W	0.00	0.05	-0.24

002G0048+3:

	002G0048	002G0049	002G0050
NAM_GPS06	0.00	-0.45	-1.05
07_2009	0.00	0.85	0.05
NAM_GPS12W	0.00	0.15	0.55
NAM_GPS14	0.00	-0.55	0.45

002G0124+3:

	002G0124	002G0125	002G0126
NAM_GPS06	0.00	2.72	-0.15
07_2009	0.00	-0.48	0.15
NAM_GPS12W	0.00	-0.77	0.05
NAM_GPS15W	0.00	-1.47	-0.05

002H0032+3:

	002H0032	002H0033	002H0034
NAM_GPS06	0.00	0.15	0.75
07_2009	0.00	0.15	-0.05
NAM_GPS12W	0.00	-0.25	-0.35
NAM_GPS15W	0.00	-0.05	-0.35

002H0035+3:

	002H0035	002H0036	002H0037
NAM_GPS06	0.00	0.85	-0.27
07_2009	0.00	-0.55	-0.27
NAM_GPS12W	0.00	-0.25	0.33
NAM_GPS15W	0.00	-0.05	0.22

002H0038+3:

	002H0038	002H0039	002H0040
NAM_GPS06	0.00	0.20	0.70
07_2009	0.00	-0.20	-0.40
NAM_GPS12W	0.00	-0.20	-0.30
NAM_GPS15W	0.00	0.20	0.00

002H0042+3:

	002H0042	002H0043	002H0044
NAM_GPS06	0.00	-0.17	0.00
07_2009	0.00	0.02	0.00
NAM_GPS12W	0.00	0.12	0.00
NAM_GPS15W	0.00	0.03	0.00

002H0048M+4:

	002H0048M	002H0048N	002H0048Z	002H0048
NAM_GPS06	NaN	NaN	NaN	NaN
NAM_GPS12W	0.00	-0.20	-0.10	NaN
NAM_GPS15W	0.00	0.20	0.10	NaN

002H0057+3:

	002H0057	002H0058	002H0059
NAM_GPS06	0.00	-0.05	-0.07
07_2009	0.00	0.15	0.13
NAM_GPS12W	0.00	-0.05	-0.08
NAM_GPS15W	0.00	-0.05	0.03

003C0122+3:

	003C0122	003C0123	003C0124
NAM_GPS10	0.00	0.10	0.32
NAM_GPS12W	0.00	0.00	0.12
NAM_GPS13	0.00	0.20	0.12
NAM_GPS14	0.00	-0.00	-0.08
NAM_GPS15W	0.00	-0.30	-0.48

003D0138+3:

	003D0138	003D0139	003D0140
NAM_GPS10	0.00	-0.12	-0.05
NAM_GPS12W	0.00	0.08	0.05
NAM_GPS13	0.00	-0.03	-0.05
NAM_GPS15W	0.00	0.08	0.05

003G0187+3:

	003G0187	003G0188	003G0189
NAM_GPS10	0.00	1.00	1.20
NAM_GPS12W	0.00	-0.50	-0.70
NAM_GPS13	0.00	-0.50	-0.50

003G0196+3:

	003G0196	003G0197	003G0198
NAM_GPS10	0.00	-0.07	-0.13

NAM_GPS12W	0.00	0.03	0.17
NAM_GPS13	0.00	0.03	-0.03

M001M+3:

	M001M	M001N	M001Z
NAM_GPS06	0.00	-2.64	-0.18
07_2009	0.00	-0.04	-0.18
NAM_GPS11	0.00	0.36	0.12
NAM_GPS14	0.00	1.26	-0.18
NAM_GPS15W	0.00	1.06	0.42

M002M+3:

	M002M	M002N	M002Z
NAM_GPS06	0.00	1.97	7.11
NAM_GPS07	0.00	0.37	1.21
07_2009	0.00	-0.23	-0.59
NAM_GPS10	0.00	-0.33	-1.19
NAM_GPS11	0.00	-0.43	-1.19
NAM_GPS14	0.00	-0.83	-2.79
NAM_GPS15W	0.00	-0.53	-2.59

M003M+3:

	M003M	M003N	M003Z
NAM_GPS06	0.00	-0.05	4.37
07_2009	0.00	-0.35	-0.13
NAM_GPS11	0.00	-0.45	-0.33
NAM_GPS12W	0.00	-0.45	-0.73
NAM_GPS14	0.00	1.45	-1.43
NAM_GPS15W	0.00	-0.15	-1.73

M004M+3:

	M004M	M004N	M004Z
NAM_GPS06	0.00	-8.27	-4.22
07_2009	0.00	0.12	-1.13
NAM_GPS12W	0.00	2.53	1.18
NAM_GPS15W	0.00	5.63	4.17

M005M+3:

	M005M	M005N	M005Z
NAM_GPS06	0.00	3.46	-2.02
07_2009	0.00	-0.34	0.58
NAM_GPS11	0.00	-0.44	0.68
NAM_GPS14	0.00	-1.24	0.38
NAM_GPS15W	0.00	-1.44	0.38

M006M+3:

	M006M	M006N	M006Z
NAM_GPS06	0.00	0.76	3.52
07_2009	0.00	-0.14	0.22
NAM_GPS11	0.00	-0.14	-0.68
NAM_GPS12W	0.00	-0.14	-1.08
NAM_GPS15W	0.00	-0.34	-1.98

M007M+3:

	M007M	M007N	M007Z
NAM_GPS06	0.00	7.01	2.86
07_2009	0.00	-0.09	0.16
NAM_GPS10	0.00	-0.29	-0.04
NAM_GPS11	0.00	-0.49	-0.24
NAM_GPS12W	0.00	-0.99	-0.34
NAM_GPS13	0.00	-1.09	-0.44
NAM_GPS14	0.00	-1.79	-0.84
NAM_GPS15W	0.00	-2.29	-1.14

M008M+6:

	M008M	M008N	M008Z	M017M	M017N	M017Z
NAM_GPS06	0.00	37.43	7.16	NaN	NaN	NaN
NAM_GPS08A	0.00	-2.37	-0.04	NaN	NaN	NaN
07_2009	0.00	-4.07	-0.24	NaN	NaN	NaN
NAM_GPS10	0.00	-4.27	-0.34	NaN	NaN	NaN
NAM_GPS11	0.00	-4.37	-0.64	NaN	NaN	NaN
NAM_GPS12W	0.00	-4.57	-2.04	NaN	NaN	NaN
NAM_GPS13	0.00	-4.87	-2.34	NaN	NaN	NaN
NAM_GPS14	0.00	-4.97	-1.54	NaN	NaN	NaN
NAM_GPS15W	0.00	-7.97	NaN	0.00	0.00	0.00

M009M+3:

	M009M	M009N	M009Z
NAM_GPS06	0.00	4.01	-0.34
07_2009	0.00	-0.59	-0.44
NAM_GPS10	0.00	-0.59	-0.14
NAM_GPS11	0.00	-0.49	0.06
NAM_GPS12W	0.00	-0.39	0.16
NAM_GPS13	0.00	-0.69	0.06
NAM_GPS14	0.00	-0.69	0.26
NAM_GPS15W	0.00	-0.59	0.36

M010M+3:

```
                M010M      M010N      M010Z
NAM_GPS06        0.00      -1.28       0.65
07_2009          0.00       0.52      -0.25
NAM_GPS12W       0.00       0.33      -0.25
NAM_GPS15W       0.00       0.43      -0.15

M011M+3:
                M011M      M011N      M011Z
NAM_GPS06        0.00       1.10       6.40
07_2009          0.00      -0.50      -0.70
NAM_GPS12W       0.00      -0.10      -1.20
NAM_GPS13        0.00      -0.20      -1.40
NAM_GPS15W       0.00      -0.30      -3.10

M012M+3:
                M012M      M012N      M012Z
NAM_GPS06        0.00      -1.42      -5.95
07_2009          0.00       1.28       1.15
NAM_GPS12W       0.00       0.28       1.85
NAM_GPS15W       0.00      -0.13       2.95

M013M+3:
                M013M      M013N      M013Z
NAM_GPS06        0.00       8.12       4.57
07_2009          0.00      -1.17      -0.22
NAM_GPS12W       0.00      -3.08      -2.12
NAM_GPS15W       0.00      -3.88      -2.23

M015M+3:
                M015M      M015N      M015Z
NAM_GPS06        0.00      -4.56      -8.70
07_2009          0.00       1.04       1.20
NAM_GPS11        0.00       0.84       1.60
NAM_GPS14        0.00       1.24       2.80
NAM_GPS15W       0.00       1.44       3.10

M016M+3:
                M016M      M016N      M016Z
NAM_GPS06        0.00       0.82      -2.78
NAM_GPS08A       0.00      -0.18       0.92
07_2009          0.00      -0.08       0.72
NAM_GPS12W       0.00      -0.28       0.42
NAM_GPS14        0.00      -0.28       0.72



000A4025+2:
             000A4025   000A5025
NAM_GPS06        0.00        NaN
07_2009          0.00        NaN
NAM_GPS11L       0.00        NaN
NAM_GPS15O       0.00       0.00


Cluster Zero Difference Residuals [mm]:

Outlier detection parameters:
- Maximum residual:       0.4 [mm]
- Maximum iterations:     7

Newly detected outliers are flagged with "*", other symbols represent a-priori flags.

002C0026+3: (std 0.10 mm, dof 6)

                        002C0026      002C0027      002C0028
              hgt [m]     0.0000        0.0922        0.1200     sigma
                      [mm]
NAM_GPS06      39.4816      -0.04         -0.12          0.16      0.16
07_2009        39.4848       0.06         -0.02         -0.04      0.06
NAM_GPS11      39.4840       0.03          0.05         -0.07      0.08
NAM_GPS14      39.4831      -0.04          0.08         -0.04      0.08
                        --------      --------      --------
                sigma       0.06          0.11          0.13      [mm]

002C0029+3: (std 0.07 mm, dof 11, 1 outlier)

                        002C0029      002C0030      002C0031
              hgt [m]     0.0000        0.0157        0.0736     sigma
                      [mm]
NAM_GPS06      39.5697      -0.02          1.24 *        0.02      0.03 (1.3)
NAM_GPS07      39.5672       0.10         -0.04         -0.06      0.09
07_2009        39.5664       0.06          0.03         -0.09      0.09
NAM_GPS10      39.5665      -0.04          0.03          0.01      0.04
NAM_GPS11      39.5682      -0.04          0.03          0.01      0.04
NAM_GPS13      39.5656      -0.00         -0.04          0.04      0.04
NAM_GPS14      39.5659      -0.07         -0.01          0.07      0.08
                        --------      --------      --------
                sigma       0.07          0.04          0.07      [mm]

002C0033+3: (std 0.07 mm, dof 12)
```

		002C0033	002C0034	002C0035	
	hgt [m]	0.0000	-0.1034	-0.1620	sigma
	[mm]				
NAM_GPS06	39.8506	-0.05	0.05	0.00	0.05
NAM_GPS07	39.8467	0.11	-0.09	-0.03	0.11
07_2009	39.8425	0.01	0.01	-0.03	0.03
NAM_GPS11	39.8379	-0.02	-0.02	0.04	0.04
NAM_GPS13	39.8353	-0.02	0.08	-0.06	0.08
NAM_GPS14	39.8313	-0.05	-0.05	0.10	0.10
NAM_GPS15W	39.8260	0.01	0.01	-0.03	0.03
	sigma	0.07	0.07	0.07	[mm]

002C0064+3: (std 0.09 mm, dof 6)

		002C0064	002C0065	002C0066	
	hgt [m]	0.0000	0.0273	-0.0756	sigma
	[mm]				
NAM_GPS06	40.1763	0.02	-0.01	-0.01	0.02
07_2009	40.1760	-0.08	0.09	-0.01	0.10
NAM_GPS11	40.1772	-0.05	0.03	0.03	0.05
NAM_GPS14	40.1812	0.12	-0.11	-0.01	0.13
	sigma	0.11	0.10	0.02	[mm]

002D0048+3: (std 0.14 mm, dof 9)

		002D0048	002D0049	002D0050	
	hgt [m]	0.0000	-0.0759	-0.0837	sigma
	[mm]				
NAM_GPS06	40.2410	0.08	0.08	-0.15	0.15
NAM_GPS07	40.2353	0.11	-0.19	0.08	0.18
07_2009	40.2248	0.11	-0.09	-0.02	0.11
NAM_GPS11	40.2172	-0.02	-0.02	0.05	0.04
NAM_GPS14	40.2036	-0.12	0.08	0.05	0.12
NAM_GPS15W	40.1968	-0.15	0.15	NaN	0.23
	sigma	0.15	0.16	0.11	[mm]

002D0054+3: (std 0.17 mm, dof 3, 1 outlier)

		002D0054	002D0055	002D0056	
	hgt [m]	0.0000	0.0916	0.0915	sigma
	[mm]				
NAM_GPS06	39.5756	0.05	-0.05	-0.97 *	0.09 (1.2)
07_2009	39.5739	-0.19	0.11	0.08	0.22
NAM_GPS11	39.5732	0.14	-0.06	-0.08	0.16
	sigma	0.23	0.12	0.14	[mm]

002D0059+3: (std 0.10 mm, dof 6)

		002D0059	002D0060	002D0061	
	hgt [m]	0.0000	0.1706	0.0274	sigma
	[mm]				
NAM_GPS06	41.4059	-0.06	0.07	-0.01	0.07
07_2009	41.4061	-0.02	0.00	0.03	0.03
NAM_GPS12W	41.4039	-0.06	-0.03	0.09	0.09
NAM_GPS15W	41.4020	0.14	-0.03	-0.11	0.15
	sigma	0.12	0.06	0.10	[mm]

002D0066+3: (std 0.18 mm, dof 6, 2 outliers)

		002D0066	002D0067	002D0068	
	hgt [m]	0.0000	-0.1533	-0.1514	sigma
	[mm]				
NAM_GPS06	40.0017	1.42 *	0.17	-0.17	0.27 (1.6)
07_2009	40.0000	0.14	-0.00	-0.14	0.17
NAM_GPS11	39.9989	-0.02	0.03	-0.01	0.03
NAM_GPS13	39.9955	-0.12	-0.07	0.19	0.20
NAM_GPS15W	39.9934	-1.48 *	-0.13	0.13	0.21 (1.7)
	sigma	0.16	0.15	0.21	[mm]

002D0102+3: (std 0.26 mm, dof 7, 1 outlier)

		002D0102	002D0103	002D0104	
	hgt [m]	0.0000	0.1359	0.1120	sigma
	[mm]				
NAM_GPS06	39.4434	0.15	-0.28	0.14	0.28
07_2009	39.4420	0.18	-0.05	-0.13	0.19
NAM_GPS11	39.4406	0.05	0.12	-0.16	0.17
NAM_GPS14	39.4292	-0.38	0.28	0.10	0.39
NAM_GPS15W	39.4290	-0.82 *	-0.06	0.06	0.09 (0.9)
	sigma	0.32	0.27	0.18	[mm]

002D0108+3: (std 0.35 mm, dof 5, 3 outliers)

		002D0108	002D0109	002D0110	
	hgt [m]	0.0000	-0.1202	-0.0306	sigma
		[mm]			
NAM_GPS06	40.1795	-0.26	4.22 *	0.26	0.44 (5.1)
07_2009	40.1724	0.30	-0.32	0.02	0.37
NAM_GPS11	40.1696	0.30	-0.02	-0.28	0.35
NAM_GPS14	40.1614	-0.14	0.14	-2.92 *	0.23 (3.4)
NAM_GPS15W	40.1589	-0.19	0.19	-2.67 *	0.31 (3.1)
		--------	--------	--------	
	sigma	0.38	0.31	0.35	[mm]

002G0042+3: (std 0.10 mm, dof 14)

		002G0042	002G0043	002G0044	
	hgt [m]	0.0000	0.0188	0.0490	sigma
		[mm]			
NAM_GPS06	40.0280	-0.10	-0.05	0.16	0.15
NAM_GPS08A	40.0270	-0.10	0.05	0.06	0.10
07_2009	40.0234	-0.00	0.05	-0.04	0.05
NAM_GPS10	40.0205	-0.04	0.01	0.03	0.04
NAM_GPS11	40.0216	0.03	-0.02	-0.01	0.03
NAM_GPS13	40.0146	0.03	-0.02	-0.01	0.03
NAM_GPS14	40.0104	0.13	-0.12	-0.01	0.13
NAM_GPS15W	40.0075	0.06	0.11	-0.17	0.16
		--------	--------	--------	
	sigma	0.10	0.09	0.11	[mm]

002G0048+3: (std 0.24 mm, dof 4, 2 outliers)

		002G0048	002G0049	002G0050	
	hgt [m]	0.0000	-0.0054	-0.1022	sigma
		[mm]			
NAM_GPS06	39.7759	0.06	-0.06	-1.32 *	0.10 (1.6)
07_2009	39.7731	0.14	1.32 *	-0.14	0.24 (1.6)
NAM_GPS12W	39.7679	-0.23	0.25	-0.01	0.30
NAM_GPS14	39.7657	0.03	-0.19	0.15	0.21
		--------	--------	--------	
	sigma	0.22	0.29	0.19	[mm]

002G0124+3: (std 0.25 mm, dof 5, 1 outlier)

		002G0124	002G0125	002G0126	
	hgt [m]	0.0000	-0.1104	-0.0973	sigma
		[mm]			
NAM_GPS06	40.7112	0.08	3.73 *	-0.07	0.12 (4.3)
07_2009	40.7061	-0.20	0.26	-0.05	0.28
NAM_GPS12W	40.7035	-0.07	0.09	-0.02	0.10
NAM_GPS15W	40.7029	0.20	-0.34	0.15	0.36
		--------	--------	--------	
	sigma	0.22	0.38	0.13	[mm]

002H0032+3: (std 0.12 mm, dof 5, 1 outlier)

		002H0032	002H0033	002H0034	
	hgt [m]	0.0000	0.0174	-0.0241	sigma
		[mm]			
NAM_GPS06	39.6040	-0.08	0.07	0.90 *	0.12 (1.0)
07_2009	39.6042	-0.11	0.04	0.07	0.11
NAM_GPS12W	39.6034	0.12	-0.13	0.00	0.15
NAM_GPS15W	39.6004	0.06	0.01	-0.07	0.07
		--------	--------	--------	
	sigma	0.14	0.11	0.08	[mm]

002H0035+3: (std 0.19 mm, dof 5, 1 outlier)

		002H0035	002H0036	002H0037	
	hgt [m]	0.0000	0.0271	-0.0082	sigma
		[mm]			
NAM_GPS06	39.8571	0.14	1.32 *	-0.14	0.22 (1.5)
07_2009	39.8600	0.17	-0.06	-0.11	0.17
NAM_GPS12W	39.8591	-0.13	-0.06	0.19	0.20
NAM_GPS15W	39.8566	-0.17	0.11	0.06	0.18
		--------	--------	--------	
	sigma	0.22	0.12	0.20	[mm]

002H0038+3: (std 0.14 mm, dof 5, 1 outlier)

		002H0038	002H0039	002H0040	
	hgt [m]	0.0000	0.0078	0.0326	sigma
		[mm]			
NAM_GPS06	40.4548	-0.10	0.10	0.80 *	0.16 (0.9)
07_2009	40.4537	0.13	-0.07	-0.07	0.14
NAM_GPS12W	40.4523	0.10	-0.10	-0.00	0.12
NAM_GPS15W	40.4489	-0.13	0.07	0.07	0.14
		--------	--------	--------	

```
                 sigma       0.17          0.13          0.08      [mm]

002H0042+3: (std 0.07 mm, dof 6)

                         002H0042      002H0043      002H0044
               hgt [m]     0.0000        0.0142        0.0916     sigma
                       [mm]
NAM_GPS06      39.6247       0.06         -0.12          0.06      0.12
07_2009        39.6268      -0.01          0.02         -0.01      0.02
NAM_GPS12W     39.6265      -0.04          0.08         -0.04      0.08
NAM_GPS15W     39.6241      -0.01          0.02         -0.01      0.02
                         --------      --------      --------
                 sigma       0.05          0.10          0.05      [mm]

warning: 002H0048M+4, numiter=1, matrix singular, regularize...
002H0048M+4: (std 0.20 mm, dof 2)

                        002H0048M     002H0048N     002H0048Z      002H0048
               hgt [m]     0.0000        0.0085       -0.1179        0.1094     sigma
                       [mm]
NAM_GPS06      39.6868        NaN           NaN           NaN          0.00                NO REDUNDANCY
NAM_GPS12W     39.7982       0.10         -0.10          0.00           NaN      0.14
NAM_GPS15W     39.7980      -0.10          0.10          0.00           NaN      0.14
                         --------      --------      --------      --------
                 sigma       0.17          0.17          0.00           NaN      [mm]

002H0057+3: (std 0.06 mm, dof 6)

                         002H0057      002H0058      002H0059
               hgt [m]     0.0000        0.0391        0.1202     sigma
                       [mm]
NAM_GPS06      39.9418       0.04         -0.01         -0.03      0.04
07_2009        39.9424      -0.09          0.06          0.03      0.09
NAM_GPS12W     39.9453       0.04         -0.01         -0.03      0.04
NAM_GPS15W     39.9413       0.01         -0.04          0.03      0.04
                         --------      --------      --------
                 sigma       0.08          0.05          0.05      [mm]

003C0122+3: (std 0.16 mm, dof 8)

                         003C0122      003C0123      003C0124
               hgt [m]     0.0000       -0.0158        0.0327     sigma
                       [mm]
NAM_GPS10      40.1431      -0.14         -0.04          0.18      0.18



NAM_GPS12W     40.1470      -0.04         -0.04          0.08      0.08
NAM_GPS13      40.1431      -0.11          0.09          0.01      0.11
NAM_GPS14      40.1452       0.03          0.03         -0.05      0.05
NAM_GPS15W     40.1461       0.26         -0.04         -0.22      0.27
                         --------      --------      --------
                 sigma       0.19          0.07          0.18      [mm]

003D0138+3: (std 0.05 mm, dof 6)

                         003D0138      003D0139      003D0140
               hgt [m]     0.0000        0.1140        0.1067     sigma
                       [mm]
NAM_GPS10      40.1784       0.06         -0.07          0.01      0.07
NAM_GPS12W     40.1781      -0.04          0.03          0.01      0.04
NAM_GPS13      40.1743       0.03          0.00         -0.02      0.03
NAM_GPS15W     40.1767      -0.04          0.03          0.01      0.04
                         --------      --------      --------
                 sigma       0.06          0.06          0.02      [mm]

003G0187+3: (std 0.12 mm, dof 3, 1 outlier)

                         003G0187      003G0188      003G0189
               hgt [m]     0.0000       -0.0118        0.0770     sigma
                       [mm]
NAM_GPS10      39.6443      -1.65 *       -0.10          0.10      0.17 (2.0)
NAM_GPS12W     39.6368       0.03          0.08         -0.12      0.14
NAM_GPS13      39.6349      -0.03          0.02          0.02      0.04
                         --------      --------      --------
                 sigma       0.06          0.12          0.14      [mm]

003G0196+3: (std 0.08 mm, dof 4)

                         003G0196      003G0197      003G0198
               hgt [m]     0.0000        0.0358        0.0516     sigma
                       [mm]
NAM_GPS10      39.7177       0.07          0.00         -0.07      0.08
NAM_GPS12W     39.7155      -0.07         -0.03          0.10      0.11
NAM_GPS13      39.7126       0.00          0.03         -0.03      0.04
                         --------      --------      --------
                 sigma       0.08          0.04          0.11      [mm]

M001M+3: (std 0.25 mm, dof 6, 2 outliers)

                            M001M         M001N         M001Z
```

```
              hgt [m]     0.0000        0.1948        0.0279     sigma
                      [mm]
NAM_GPS06      39.5409       0.09  x      -2.95 *x      -0.09  x   0.14 (3.3)
07_2009        39.5336       0.21         -0.23          0.03      0.26
NAM_GPS11      39.5304      -0.03         -0.07          0.09      0.10
NAM_GPS14      39.5209       0.09          0.95 *       -0.09      0.14 (1.1)
NAM_GPS15W     39.5212      -0.36          0.30          0.06      0.39
                        --------      --------      --------
                sigma       0.28          0.33          0.11      [mm]


warning: maximum number of iterations for outlier detection exceeded.
M002M+3: (std 0.33 mm, dof 6, 6 outliers)

                            M002M         M002N         M002Z
              hgt [m]     0.0000       -0.1637       -0.1490     sigma
                      [mm]
NAM_GPS06      39.7079       0.00  x       2.12 *x       8.47 *x             BAD EPOCH
NAM_GPS07      39.7012      -0.26          0.26          2.31 *    0.41 (2.6)
07_2009        39.6962       0.04         -0.04          0.81 *    0.06 (0.9)
NAM_GPS10      39.6926       0.00         -0.17          0.17      0.20
NAM_GPS11      39.6923       0.04         -0.24          0.21      0.27
NAM_GPS14      39.6835       1.05 *        0.38         -0.38      0.64 (1.4)
NAM_GPS15W     39.6813       0.19         -0.19         -1.04 *    0.30 (1.2)
                        --------      --------      --------
                sigma       0.22          0.36          0.42      [mm]

M003M+3: (std 0.17 mm, dof 6, 4 outliers)

                            M003M         M003N         M003Z
              hgt [m]     0.0000       -0.0492       -0.1048     sigma
                      [mm]
NAM_GPS06      40.3959      -0.12  x       0.12  x       4.58 *x   0.19 (5.1)
07_2009        40.3865      -0.05         -0.11          0.16      0.16
NAM_GPS11      40.3813       0.05         -0.11          0.06      0.11
NAM_GPS12W     40.3794       0.19          0.03         -0.21      0.23
NAM_GPS14      40.3741       0.00          1.74 *       -1.10 *             BAD EPOCH
NAM_GPS15W     40.3701      -0.07          0.07         -1.47 *    0.11 (1.6)
                        --------      --------      --------
                sigma       0.16          0.14          0.23      [mm]

M004M+3: (std 0.07 mm, dof 2, 4 outliers)

                            M004M         M004N         M004Z



              hgt [m]     0.0000        0.2292        0.1269     sigma
                      [mm]
NAM_GPS06      40.6548      10.80 *x       0.00  x       5.40 *x             BAD EPOCH
07_2009        40.6548       2.35 *       -0.05          0.05      0.09 (2.9)
NAM_GPS12W     40.6523       0.00          0.00          0.00      0.00
NAM_GPS15W     40.6494      -3.05 *        0.05         -0.05      0.09 (3.7)
                        --------      --------      --------
                sigma        NaN          0.07          0.07      [mm]

M005M+3: (std 0.29 mm, dof 6, 2 outliers)

                            M005M         M005N         M005Z
              hgt [m]     0.0000       -0.0478       -0.1233     sigma
                      [mm]
NAM_GPS06      40.6763       2.52 *x       6.85 *x      -0.00  x             BAD EPOCH
07_2009        40.6710      -0.20          0.32         -0.12      0.33
NAM_GPS11      40.6672      -0.20          0.22         -0.02      0.25
NAM_GPS14      40.6619       0.17         -0.21          0.04      0.22
NAM_GPS15W     40.6584       0.23         -0.34          0.11      0.35
                        --------      --------      --------
                sigma       0.28          0.40          0.12      [mm]

M006M+3: (std 0.29 mm, dof 5, 3 outliers)

                            M006M         M006N         M006Z
              hgt [m]     0.0000        0.0044       -0.0795     sigma
                      [mm]
NAM_GPS06      39.8741      -0.38  x       0.38  x       3.95 *x   0.60 (4.5)
07_2009        39.8707       0.07         -0.07          1.10 *    0.11 (1.2)
NAM_GPS11      39.8659       0.00         -0.14          0.13      0.17
NAM_GPS12W     39.8638       0.14         -0.00         -0.13      0.17
NAM_GPS15W     39.8553       0.17         -0.17         -1.00 *    0.27 (1.1)
                        --------      --------      --------
                sigma       0.30          0.30          0.23      [mm]

M007M+3: (std 0.26 mm, dof 10, 4 outliers)

                            M007M         M007N         M007Z
              hgt [m]     0.0000       -0.1264       -0.1250     sigma
                      [mm]
NAM_GPS06      40.1203      -2.95 *x       4.74 *x       0.00  x             BAD EPOCH
07_2009        40.1139      -0.28          0.31         -0.03      0.33
NAM_GPS10      40.1113      -0.15          0.24         -0.10      0.23
NAM_GPS11      40.1070      -0.01          0.18         -0.16      0.19
```

```
NAM_GPS12W     40.1021       0.19         -0.12         -0.06      0.18
NAM_GPS13      40.1011       0.25         -0.16         -0.10      0.24
NAM_GPS14      40.0924       0.93 *       -0.18          0.18      0.27 (1.0)
NAM_GPS15W     40.0883       1.33 *       -0.28          0.28      0.43 (1.5)
                          --------      --------      --------
                 sigma       0.27          0.30          0.21      [mm]


warning: maximum number of iterations for outlier detection exceeded.
M008M+6: (std 0.38 mm, dof 9, 6 outliers)

                            M008M         M008N         M008Z         M017M         M017N         M017Z
               hgt [m]     0.0000        0.0343        0.0833        0.2603        0.2127        0.1814     sigma
                       [mm]
NAM_GPS06      39.9686       0.00  x      41.85 *x       8.07 *x        NaN           NaN           NaN                BAD EPOCH
NAM_GPS08A     39.9687      -1.46 *        0.59         -0.59 *         NaN           NaN           NaN                BAD EPOCH
07_2009        39.9657      -0.34          0.01          0.33           NaN           NaN           NaN      0.37
NAM_GPS10      39.9616      -0.24         -0.09          0.33           NaN           NaN           NaN      0.33
NAM_GPS11      39.9616      -0.11         -0.06          0.16           NaN           NaN           NaN      0.16
NAM_GPS12W     39.9577       0.07         -0.07         -1.05 *         NaN           NaN           NaN      0.11 (1.2)
NAM_GPS13      39.9542       0.22         -0.22         -1.20 *         NaN           NaN           NaN      0.35 (1.4)
NAM_GPS14      39.9523       0.39         -0.16         -0.24           NaN           NaN           NaN      0.38
NAM_GPS15W     39.9440       0.00         -3.55 *         NaN          0.00          0.00          0.00                NO REDUNDANCY
                          --------      --------      --------      --------      --------      --------
                 sigma       0.36          0.36          0.38           NaN           NaN           NaN      [mm]

M009M+3: (std 0.17 mm, dof 13, 1 outlier)

                            M009M         M009N         M009Z
               hgt [m]     0.0000       -0.0999        0.0066     sigma
                       [mm]
NAM_GPS06      40.2341       0.17  x       4.78 *x      -0.17  x   0.26 (5.1)
07_2009        40.2286       0.14          0.15         -0.29      0.27
NAM_GPS10      40.2279       0.04          0.05         -0.09      0.09
NAM_GPS11      40.2268      -0.06          0.05          0.01      0.06
NAM_GPS12W     40.2290      -0.12          0.09          0.04      0.12
NAM_GPS13      40.2248       0.01         -0.08          0.07      0.08
NAM_GPS14      40.2238      -0.06         -0.15          0.21      0.20
NAM_GPS15W     40.2246      -0.12         -0.11          0.24      0.22
                          --------      --------      --------
                 sigma       0.14          0.14          0.23      [mm]

M010M+3: (std 0.24 mm, dof 5, 1 outlier)



                            M010M         M010N         M010Z
               hgt [m]     0.0000        0.0318        0.0655     sigma
                       [mm]
NAM_GPS06      39.8403      -0.32  x      -2.13 *x       0.32  x   0.53 (2.5)
07_2009        39.8343       0.09          0.08         -0.16      0.17
NAM_GPS12W     39.8323       0.15         -0.06         -0.10      0.16
NAM_GPS15W     39.8271       0.09         -0.02         -0.06      0.09
                          --------      --------      --------
                 sigma       0.28          0.08          0.28      [mm]

M011M+3: (std 0.25 mm, dof 5, 3 outliers)

                            M011M         M011N         M011Z
               hgt [m]     0.0000       -0.0590       -0.1066     sigma
                       [mm]
NAM_GPS06      40.6190      -1.38 *x      -0.00  x       6.13 *x             BAD EPOCH
07_2009        40.6191      -0.06         -0.28          0.34      0.38
NAM_GPS12W     40.6166      -0.03          0.15         -0.12      0.16
NAM_GPS13      40.6167       0.07          0.15         -0.22      0.23
NAM_GPS15W     40.6120       0.01         -0.01         -1.98 *    0.02 (2.3)
                          --------      --------      --------
                 sigma       0.07          0.26          0.37      [mm]

M012M+3: (std 0.26 mm, dof 2, 4 outliers)

                            M012M         M012N         M012Z
               hgt [m]     0.0000       -0.0643       -0.0363     sigma
                       [mm]
NAM_GPS06      40.2159       1.42 *x       0.00  x      -6.00 *x             BAD EPOCH
07_2009        40.2020       0.16          1.44 *       -0.16      0.31 (2.0)
NAM_GPS12W     40.2038      -0.22          0.06          0.16      0.29
NAM_GPS15W     40.1999       0.06         -0.06          1.54 *    0.12 (2.1)
                          --------      --------      --------
                 sigma       0.29          0.12          0.31      [mm]

M013M+3: (std 0.28 mm, dof 3, 3 outliers)

                            M013M         M013N         M013Z
               hgt [m]     0.0000       -0.0573       -0.1625     sigma
                       [mm]
NAM_GPS06      39.4610      -6.81 *x       4.73 *x       0.00  x             BAD EPOCH
07_2009        39.4543      -2.12 *        0.12         -0.12      0.20 (2.6)
NAM_GPS12W     39.4539      -0.15          0.19         -0.04      0.23
NAM_GPS15W     39.4508       0.15         -0.31          0.16      0.35
```

```
                    --------      --------      --------
             sigma       0.26          0.35          0.19      [mm]

M015M+3: (std 0.17 mm, dof 4, 4 outliers)

                       M015M         M015N         M015Z
           hgt [m]     0.0000        0.1063       -0.1442     sigma
                   [mm]
NAM_GPS06      39.7988      11.55 *x       5.85 *x       0.00  x             BAD EPOCH
07_2009        39.7978       0.05         -0.05         -1.60 *    0.08 (1.8)
NAM_GPS11      39.7918       0.15         -0.15         -1.10 *    0.24 (1.3)
NAM_GPS14      39.7877      -0.02          0.08         -0.07      0.10
NAM_GPS15W     39.7851      -0.18          0.12          0.07      0.20
                    --------      --------      --------
             sigma       0.19          0.17          0.12      [mm]

M016M+3: (std 0.12 mm, dof 6, 2 outliers)

                       M016M         M016N         M016Z
           hgt [m]     0.0000        0.0623       -0.0448     sigma
                   [mm]
NAM_GPS06      40.2454       0.00  x       1.02 *x      -3.47 *x             BAD EPOCH
NAM_GPS08A     40.2409      -0.08         -0.06          0.14      0.14
07_2009        40.2395      -0.05          0.08         -0.02      0.08
NAM_GPS12W     40.2330       0.12          0.04         -0.16      0.16
NAM_GPS14      40.2296       0.02         -0.06          0.04      0.06
                    --------      --------      --------
             sigma       0.11          0.08          0.15      [mm]

000A4025+2: (std NaN mm, dof 0)

                    000A4025      000A5025
           hgt [m]     0.0000       -0.4728     sigma
                   [mm]
NAM_GPS06      47.4881       0.00           NaN                NO REDUNDANCY
07_2009        47.4873       0.00           NaN                NO REDUNDANCY
NAM_GPS11L     47.4868       0.00           NaN                NO REDUNDANCY
NAM_GPS150     47.4856       0.00          0.00                NO REDUNDANCY
                    --------      --------
             sigma        NaN           NaN      [mm]
```

Select output mode: all benchmarks or only one per cluster

```
if config.reducecluster

   % Use only one benchmark per cluster with the adjusted height, updated
   % flags used by default.

   fprintf('\n\nRemove observations and benchmarks for clusters, leaving only one\n unique benchmarks per cluster with LSQ adjusted height measurements.\n')
   fprintf('\nObservations flags are recomputed using both the a-priori flags and\n results from the cluster analysis.\n\n')

   % rename old observations and replace by cluster observations

   obsindex_orig=obsindex;
   obsstats_orig=obsstats;
   obs_orig=obs;

   obsindex=clusterobsadm(:,1:2);
   obsstats=clusterobsstats;
   obs=clusterobs(:,1);

   % remove cluster observations with format st.dev. larger than 1 cm

   irem=find(clusterobs(:,2)>.01);     % remove cluster observations with formal st.dev. larger than 1 cm
   obs(irem,:)=[];
   obsindex(irem,:)=[];
   obsstats(irem,:)=[];

   % rename old point data and replace by cluster data

   pntname_orig=pntname;
   pntcrd_orig=pntcrd;
   pntstats_orig=pntstats;

   pntname=pntname(clusterpntadm(:,2));     % don't use clustername, but name of first point (clustername is too long for netcdf)
   pntcrd=pntcrd(clusterpntadm(:,2),:);     % coordinates of first point in cluster
   pntclass=pntclass(clusterpntadm(:,2),:);
   pntstats=clusterstats(:,[ 1:4 6:7]);     % clusterstats has one more column, is removed

   % update the counts

   numobs=size(obsindex,1);
   numpnt=numel(pntname);

   fprintf('Number of observations %d -> %d\n',numel(obs_orig),numobs)
   fprintf('Number of benchmarks %d -> %d \n\n',numel(pntname_orig),numpnt)
```

```
elseif config.updateflags

   fprintf('\n\nUpdate observations flags using results from the cluster analysis.\n\n')

   % Use updated flags from cluster analysis

   obsstats_orig=obsstats;
   obsstats=obsstats2;

end
```

```
Update observations flags using results from the cluster analysis.
```

Make GPS covariance matrix

```
tmjd=prjstats(:,3) - 678942;       % mean project epoch in MJD
tyear=(tmjd-51544.5)./365.25+2000; % mean project epoch in years
ndays=prjstats(:,4);               % number of days of observations

cov1=zeros(numobs,numobs);
for component=3:-1:1
    idx=find( obsstats(:,7) == component );  % find observed component (1=North, 2=East, 3=Up)
    if isempty(idx), continue;, end
    % Make GPS covariance matrix w/o setup noise
    switch config.covcompmethod
        case 'common_project_date'
           % All points with common date for each campaign observation
           cov1(idx,idx)=gpscov1(obsindex(idx,:),pntcrd,tyear,round(mean(ndays)),config.gpscov(component));
        case 'obs_date'
            error(['unsupported co-variance computation method, use "common_project_date" instead.' covmethod ])
        otherwise
            error(['unknown co-variance computation method, check input.' covmethod ])
    end
end

figure('Name','GPSCov');
imagesc(cov1.*1e6); hc=colorbar;ylabel(hc,'[mm^2]')
title('GPS Covariance matrix (w/o setup noise)')
```

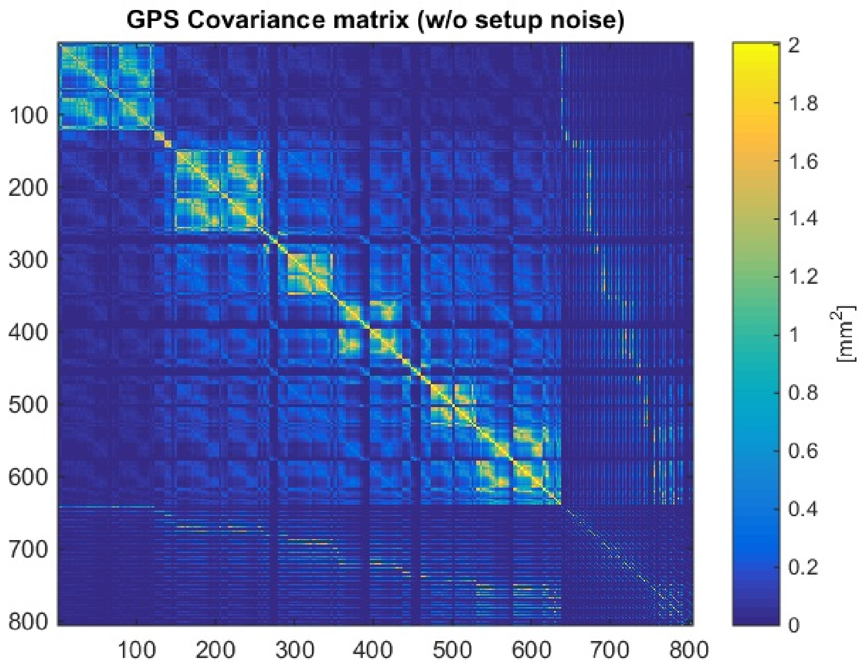
```
% Add setup noise, only for the height component, and only for campaign stations

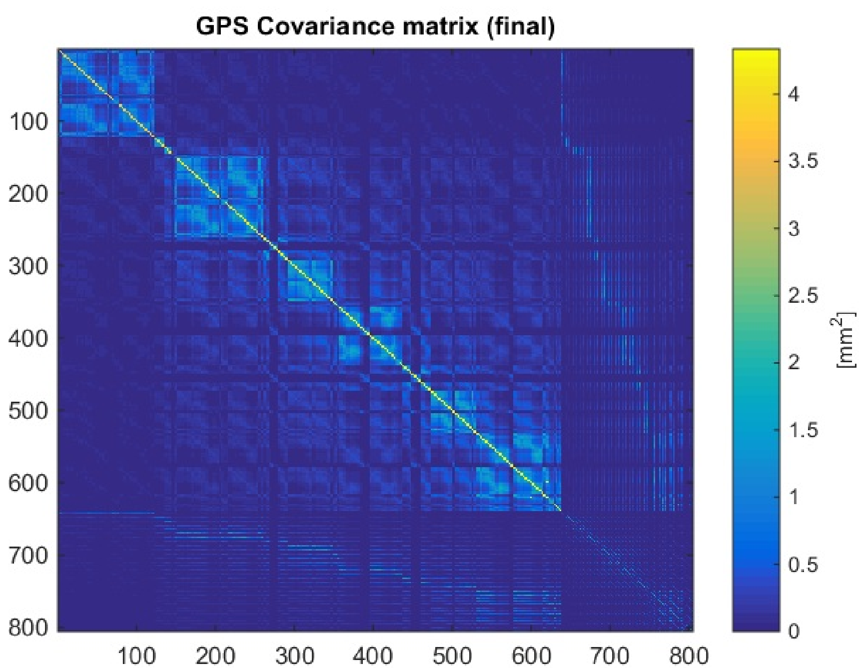
component=3;
cov2=zeros(numobs,numobs);
if config.reducecluster || config.ignoreclustercorrelation
   % add diagonal setup noise for reduced clusters
   idxobsk=find( obsstats(:,6) == 0 & obsstats(:,7) == component);
   nobsk=numel(idxobsk);
   if nobsk > 0
      cov2(idxobsk,idxobsk)=cov2(idxobsk,idxobsk) + ...
            eye(nobsk,nobsk)*config.gpscov(component).setupnoise.^2 ;
   end
else
   % add block diagonal setup noise for clusters in non reduced setup
   idxcluster=find( clusterobsstats(:,6) == 0 & clusterobsstats(:,7) == component);
   for k=1:numel(idxcluster)
      idxobsk=clusterobsadm(k,find(~isnan(clusterobsadm(k,4:end)))+3);
      nobsk=numel(idxobsk);
      cov2(idxobsk,idxobsk)=cov2(idxobsk,idxobsk) + ...
          ones(nobsk,nobsk)*config.gpscov(component).setupnoise.^2 + ...
          eye(nobsk,nobsk)*config.gpscov(component).setuplevellingnoise.^2;
   end
end

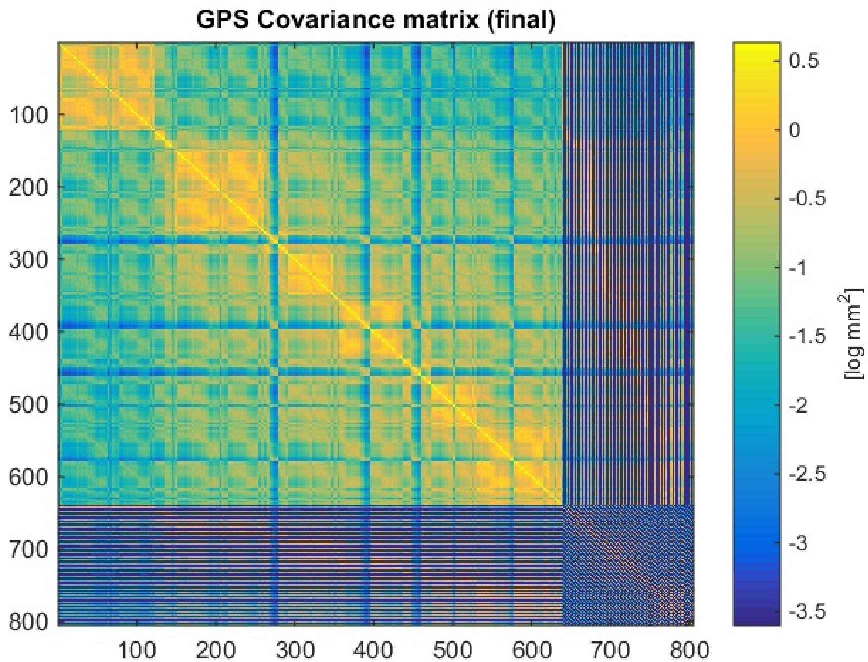
cov2=cov1+cov2;

figure('Name','GPSfinalCov');
imagesc(cov2.*1e6); hc=colorbar;ylabel(hc,'[mm^2]')
title('GPS Covariance matrix (final)')

figure('Name','GPSfinalCov (log)');
imagesc(log10(abs(cov2.*1e6))); hc=colorbar;ylabel(hc,'[log mm^2]')
title('GPS Covariance matrix (final)')
```


GPS Covariance matrix (w/o setup noise)
100
200
300
400
500
600
700
800
100
200
300
400
500
600
700
800
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
[mm2]


GPS Covariance matrix (final)
100
200
300
400
500
600
700
800
100
200
300
400
500
600
700
800
4
3.5
3
2.5
2
1.5
1
0.5
0
[mm2]



Output netcdf

```
% Add synthetic benchmark SYN_BM to end of point data arrays

pntname{end+1}='SYN_BM';
pntcrd(end+1,1:2)=[NaN NaN];
%pntcrd(end+1,1:2)=[0 0];
pntclass{end+1}='SYN_BM';
cluster_id(end+1)=0;

% Prepare the single (spatial) differences (wrt SYN_BM)
```

```
prjepoch=prjstats(:,3);

sdobstable= [  (numpnt+1)*ones(numobs,1)   obsindex(:,1) obsindex(:,2) ];
sdobs=obs;
sdcov=cov2;

sdobsflag=obsstats(:,5);
sensitivity=zeros(numobs,3);
sensitivity(sub2ind([numobs,3],[1:numobs]',obsstats(:,7)))=ones(numobs,1);
epoch=obsstats(:,3);

% write netcdf

writelts2netcdf(netcdf_file,globalattributes, ...
                pntname,pntcrd,pntclass, ...
                prjname,prjepoch,prjclass, ...
                sdobstable,sdobs,sdcov,sdobsflag,sensitivity,epoch)
```

```
Create NAM LTS2 netcdf schema ...
Netcdf file lts2_allgps.nc already exists, will be deleted first to recreate it.
Write NAM LTS2 netcdf schema to file...
Write data to NAM LTS2 netcdf...
Done.
```

update point class

```
updpntclasslts2netcdf(netcdf_file);
```

```
Warning: pntclass length exceeded, take evasive action GPS&CORS&OFFSH -> CORS&OFFSH
Warning: pntclass length exceeded, take evasive action GPS&CORS&OFFSH -> CORS&OFFSH

Benchmarks (155 points):

PNTNAME             X_RD          Y_RD    CLASS

000A2592      180070.000   606750.000    GPS --> GPS&ONSH
000A2632      216190.000   588660.000    GPS --> GPS&ONSH
000A2683      214920.000   594120.000    GPS --> GPS&ONSH
000A2686      201440.000   601650.000    GPS --> GPS&ONSH
```

000A2687	207460.000	592600.000	GPS --> GPS&ONSH
000A2688	216130.000	601040.000	GPS --> GPS&ONSH
000A2689	211540.000	600330.000	GPS --> GPS&ONSH
000A2691	205070.000	602130.000	GPS --> GPS&ONSH
000A4025	208860.000	602780.000	GPS --> GPS&ONSH
000A5025	208850.000	602790.000	GPS --> GPS&ONSH
002C0026	188624.906	602829.000	GPS --> GPS&OFFSH
002C0027	188625.516	602823.750	GPS --> GPS&OFFSH
002C0028	188625.438	602813.750	GPS --> GPS&OFFSH
002C0029	188454.516	604607.563	GPS --> GPS&OFFSH
002C0030	188454.453	604602.688	GPS --> GPS&OFFSH
002C0031	188454.297	604597.375	GPS --> GPS&OFFSH
002C0033	188355.016	606473.625	GPS --> GPS&OFFSH
002C0034	188355.031	606468.563	GPS --> GPS&OFFSH
002C0035	188355.906	606459.000	GPS --> GPS&OFFSH
002C0064	184855.422	603078.750	GPS --> GPS&OFFSH
002C0065	184855.422	603078.750	GPS --> GPS&OFFSH
002C0066	184855.063	603063.375	GPS --> GPS&OFFSH
002D0048	190431.453	607552.938	GPS --> GPS&OFFSH
002D0049	190432.625	607547.625	GPS --> GPS&OFFSH
002D0050	190433.156	607538.000	GPS --> GPS&OFFSH
002D0054	190472.875	602133.750	GPS --> GPS&OFFSH
002D0055	190473.391	602128.438	GPS --> GPS&OFFSH
002D0056	190473.438	602117.813	GPS --> GPS&OFFSH
002D0059	199818.563	608020.625	GPS --> GPS&OFFSH
002D0060	199818.453	608015.625	GPS --> GPS&OFFSH
002D0061	199816.922	608005.188	GPS --> GPS&OFFSH
002D0066	192539.516	603415.000	GPS --> GPS&OFFSH
002D0067	192540.484	603410.188	GPS --> GPS&OFFSH
002D0068	192543.391	603400.500	GPS --> GPS&OFFSH
002D0079	190500.000	608830.000	UNUSED
002D0102	194665.750	603777.500	GPS --> GPS&OFFSH
002D0103	194666.203	603771.563	GPS --> GPS&OFFSH
002D0104	194666.656	603761.438	GPS --> GPS&OFFSH
002D0105	191525.844	605371.313	GPS --> GPS&OFFSH
002D0106	191528.563	605367.000	GPS --> GPS&OFFSH
002D0107	191533.609	605358.188	GPS --> GPS&OFFSH
002D0108	195800.406	605104.813	GPS --> GPS&OFFSH
002D0109	195799.578	605099.938	GPS --> GPS&OFFSH
002D0110	195800.031	605089.750	GPS --> GPS&OFFSH
002G0042	202536.609	604116.125	GPS --> GPS&OFFSH
002G0043	202536.891	604110.688	GPS --> GPS&OFFSH
002G0044	202537.469	604100.125	GPS --> GPS&OFFSH
002G0048	200137.703	605655.313	GPS --> GPS&OFFSH
002G0049	200137.797	605649.938	GPS --> GPS&OFFSH
002G0050	200137.938	605640.250	GPS --> GPS&OFFSH
002G0124	205180.000	607390.000	GPS --> GPS&OFFSH
002G0125	205180.000	607380.000	GPS --> GPS&OFFSH
002G0126	205180.000	607360.000	GPS --> GPS&OFFSH
002H0032	214816.016	602736.125	GPS --> GPS&OFFSH
002H0033	214815.453	602731.188	GPS --> GPS&OFFSH
002H0034	214815.500	602720.563	GPS --> GPS&OFFSH
002H0035	217078.219	603911.063	GPS --> GPS&OFFSH
002H0036	217079.000	603905.750	GPS --> GPS&OFFSH
002H0037	217079.844	603895.500	GPS --> GPS&OFFSH
002H0038	211559.609	606175.563	GPS --> GPS&OFFSH
002H0039	211561.109	606170.625	GPS --> GPS&OFFSH
002H0040	211562.766	606165.875	GPS --> GPS&OFFSH
002H0042	212350.109	608280.875	GPS --> GPS&OFFSH
002H0043	212349.938	608275.688	GPS --> GPS&OFFSH
002H0044	212349.234	608265.688	GPS --> GPS&OFFSH
002H0048	214192.047	609217.438	GPS --> GPS&OFFSH
002H0048M	214192.016	609212.688	GPS --> GPS&OFFSH
002H0048N	214192.047	609217.438	GPS --> GPS&OFFSH
002H0048Z	214191.922	609202.313	GPS --> GPS&OFFSH
002H0057	216171.141	606338.063	GPS --> GPS&OFFSH
002H0058	216169.438	606333.438	GPS --> GPS&OFFSH
002H0059	216166.516	606324.938	GPS --> GPS&OFFSH
003C0122	227224.984	607639.625	GPS --> GPS&OFFSH
003C0123	227225.375	607634.500	GPS --> GPS&OFFSH
003C0124	227226.125	607625.000	GPS --> GPS&OFFSH
003D0138	235065.719	609432.188	GPS --> GPS&OFFSH
003D0139	235065.844	609427.250	GPS --> GPS&OFFSH
003D0140	235065.000	609416.688	GPS --> GPS&OFFSH
003G0187	247508.203	610468.750	GPS --> GPS&OFFSH
003G0188	247507.922	610463.750	GPS --> GPS&OFFSH
003G0189	247507.281	610453.813	GPS --> GPS&OFFSH
003G0196	243854.656	611562.813	GPS --> GPS&OFFSH
003G0197	243856.000	611558.000	GPS --> GPS&OFFSH
003G0198	243858.875	611548.313	GPS --> GPS&OFFSH
006B0021	198930.000	590320.000	GPS --> GPS&ONSH
006E0193	205330.000	598560.000	UNUSED
006E0216	205380.000	598440.000	UNUSED
006E0239	205355.000	598500.000	UNUSED
AME-2	186842.969	610897.750	GPS&CORS --> CORS&OFFSH
AWG-1	191779.000	611828.000	GPS&CORS --> CORS&OFFSH
GRK1	216356.281	588654.250	GPS --> GPS&ONSH
GRK2	216356.188	588662.188	GPS --> GPS&ONSH

```
GRK3          216356.094   588670.250   GPS --> GPS&ONSH
GRK4          216356.016   588678.250   GPS --> GPS&ONSH
L100          208080.016   602147.813   GPS --> GPS&ONSH
L101          208197.813   599877.938   GPS --> GPS&ONSH
L102          207909.219   598551.625   GPS --> GPS&ONSH
L103          210682.906   596425.000   GPS --> GPS&ONSH
L104          211295.344   594605.188   GPS --> GPS&ONSH
L105          210076.063   593900.938   GPS --> GPS&ONSH
L106          208413.813   594932.250   GPS --> GPS&ONSH
L107          208345.578   596834.000   GPS --> GPS&ONSH
M001M         189813.125   605613.813   GPS --> GPS&OFFSH
M001N         189811.234   605618.500   GPS --> GPS&OFFSH
M001Z         189816.219   605603.938   GPS --> GPS&OFFSH
M002M         191025.109   606484.000   GPS --> GPS&OFFSH
M002N         191022.953   606488.563   GPS --> GPS&OFFSH
M002Z         191025.703   606473.750   GPS --> GPS&OFFSH
M003M         197017.828   604177.188   GPS --> GPS&OFFSH
M003N         197016.734   604181.750   GPS --> GPS&OFFSH
M003Z         197020.047   604166.625   GPS --> GPS&OFFSH
M004M         198928.672   609200.688   GPS --> GPS&OFFSH
M004N         198929.078   609205.688   GPS --> GPS&OFFSH
M004Z         198927.938   609190.625   GPS --> GPS&OFFSH
M005M         196483.891   606410.813   GPS --> GPS&OFFSH
M005N         196483.344   606415.750   GPS --> GPS&OFFSH
M005Z         196485.016   606399.875   GPS --> GPS&OFFSH
M006M         198322.391   604850.563   GPS --> GPS&OFFSH
M006N         198321.641   604855.938   GPS --> GPS&OFFSH
M006Z         198322.781   604840.563   GPS --> GPS&OFFSH
M007M         198456.875   603016.563   GPS --> GPS&OFFSH
M007N         198456.563   603022.063   GPS --> GPS&OFFSH
M007Z         198457.375   603006.313   GPS --> GPS&OFFSH
M008M         200842.516   603928.563   GPS --> GPS&OFFSH
M008N         200843.406   603933.688   GPS --> GPS&OFFSH
M008Z         200841.297   603918.500   GPS --> GPS&OFFSH
M009M         207493.375   606364.250   GPS --> GPS&OFFSH
M009N         207492.516   606369.375   GPS --> GPS&OFFSH
M009Z         207494.969   606354.375   GPS --> GPS&OFFSH
M010M         210169.000   605201.188   GPS --> GPS&OFFSH
M010N         210167.531   605235.938   GPS --> GPS&OFFSH
M010Z         210171.953   605191.438   GPS --> GPS&OFFSH
M011M         211529.906   606960.000   GPS --> GPS&OFFSH
M011N         211529.813   606965.063   GPS --> GPS&OFFSH
M011Z         211529.906   606949.875   GPS --> GPS&OFFSH
M012M         214107.453   605091.750   GPS --> GPS&OFFSH


M012N         214107.094   605096.938   GPS --> GPS&OFFSH
M012Z         214108.531   605081.563   GPS --> GPS&OFFSH
M013M         208614.281   605166.438   GPS --> GPS&OFFSH
M013N         208613.719   605171.250   GPS --> GPS&OFFSH
M013Z         208614.188   605155.875   GPS --> GPS&OFFSH
M015M         188715.375   605150.688   GPS --> GPS&OFFSH
M015N         188715.375   605155.688   GPS --> GPS&OFFSH
M015Z         188715.375   605140.688   GPS --> GPS&OFFSH
M016M         204340.375   603946.063   GPS --> GPS&OFFSH
M016N         204340.250   603950.063   GPS --> GPS&OFFSH
M016Z         204339.922   603934.438   GPS --> GPS&OFFSH
M017M         200746.516   603937.375   GPS --> GPS&OFFSH
M017N         200745.563   603941.875   GPS --> GPS&OFFSH
M017Z         200747.531   603933.500   GPS --> GPS&OFFSH
AME1          190474.984   608822.500   CORS --> CORS&ONSH
ANJM          205931.141   598546.063   CORS --> CORS&ONSH
MODD          200244.563   602329.813   CORS --> CORS&ONSH
AMEL          180095.063   606756.938   CORS --> CORS&ONSH
SYN_BM               NaN          NaN   SYN_BM

The netcdf_file lts2_allgps.nc will be updated.
```

Text output

```
fprintf('\n\nFrom       To         Project       Obs [m] StDev [mm] Flg   N E U  Date\n\n')
for k=1:size(sdobstable,1)
   fprintf('%-10s %-10s %-10s %10.4f %10.2f  %2d  %2d%2d%2d  %s\n',...
       pntname{sdobstable(k,1)},pntname{sdobstable(k,2)},prjname{sdobstable(k,3)},...
       sdobs(k),sqrt(sdcov(k,k))*1000,sdobsflag(k),sensitivity(k,:),datestr(epoch(k),'yyyy-mm-dd HH:MM'))
end
```

```
From       To         Project       Obs [m] StDev [mm] Flg   N E U  Date

SYN_BM     000A2592   NAM_GPS06     44.5020       1.96   0   0 0 1  2006-06-15 13:58
SYN_BM     000A2686   NAM_GPS06     40.4799       1.96   0   0 0 1  2006-07-22 10:59
SYN_BM     000A2689   NAM_GPS06     39.7409       1.96   0   0 0 1  2006-07-01 22:52
SYN_BM     000A2691   NAM_GPS06     41.4449       1.96   0   0 0 1  2006-07-15 12:31
SYN_BM     000A4025   NAM_GPS06     47.4881       1.96   0   0 0 1  2006-07-28 15:38
SYN_BM     002C0026   NAM_GPS06     39.4816       1.96   0   0 0 1  2006-06-09 11:49
SYN_BM     002C0027   NAM_GPS06     39.5737       1.96   0   0 0 1  2006-06-09 11:49
SYN_BM     002C0028   NAM_GPS06     39.6018       1.96   0   0 0 1  2006-06-09 11:49
```

SYN_BM	002C0029	NAM_GPS06	39.5697	1.96	0	0 0 1	2006-06-02 12:26
SYN_BM	002C0030	NAM_GPS06	39.5867	1.96	2	0 0 1	2006-06-02 12:26
SYN_BM	002C0031	NAM_GPS06	39.6433	1.96	0	0 0 1	2006-06-02 12:26
SYN_BM	002C0033	NAM_GPS06	39.8505	1.96	0	0 0 1	2006-06-04 08:41
SYN_BM	002C0034	NAM_GPS06	39.7472	1.96	0	0 0 1	2006-06-04 08:41
SYN_BM	002C0035	NAM_GPS06	39.6886	1.96	0	0 0 1	2006-06-04 08:41
SYN_BM	002C0064	NAM_GPS06	40.1763	1.96	0	0 0 1	2006-05-30 22:04
SYN_BM	002C0065	NAM_GPS06	40.2036	1.96	0	0 0 1	2006-05-30 22:04
SYN_BM	002C0066	NAM_GPS06	40.1007	1.96	0	0 0 1	2006-05-30 22:04
SYN_BM	002D0048	NAM_GPS06	40.2411	1.96	0	0 0 1	2006-06-12 01:12
SYN_BM	002D0049	NAM_GPS06	40.1652	1.96	0	0 0 1	2006-06-12 01:12
SYN_BM	002D0050	NAM_GPS06	40.1572	1.96	0	0 0 1	2006-06-12 01:12
SYN_BM	002D0054	NAM_GPS06	39.5757	1.96	0	0 0 1	2006-06-21 23:02
SYN_BM	002D0055	NAM_GPS06	39.6672	1.96	0	0 0 1	2006-06-21 23:02
SYN_BM	002D0056	NAM_GPS06	39.6662	1.96	2	0 0 1	2006-06-21 23:02
SYN_BM	002D0059	NAM_GPS06	41.4058	1.96	0	0 0 1	2006-06-25 12:08
SYN_BM	002D0060	NAM_GPS06	41.5765	1.96	0	0 0 1	2006-06-25 12:08
SYN_BM	002D0061	NAM_GPS06	41.4332	1.96	0	0 0 1	2006-06-25 12:08
SYN_BM	002D0066	NAM_GPS06	40.0031	1.96	2	0 0 1	2006-06-14 03:12
SYN_BM	002D0067	NAM_GPS06	39.8486	1.96	0	0 0 1	2006-06-14 03:12
SYN_BM	002D0068	NAM_GPS06	39.8501	1.96	0	0 0 1	2006-06-14 03:12
SYN_BM	002D0102	NAM_GPS06	39.4436	1.96	0	0 0 1	2006-06-16 07:51
SYN_BM	002D0103	NAM_GPS06	39.5791	1.96	0	0 0 1	2006-06-16 07:51
SYN_BM	002D0104	NAM_GPS06	39.5556	1.96	0	0 0 1	2006-06-16 07:51
SYN_BM	002D0105	NAM_GPS06	39.5467	1.96	0	0 0 1	2006-06-07 10:02
SYN_BM	002D0106	NAM_GPS06	39.4651	1.96	0	0 0 1	2006-06-07 10:02
SYN_BM	002D0107	NAM_GPS06	39.4397	1.96	0	0 0 1	2006-06-07 10:02
SYN_BM	002D0108	NAM_GPS06	40.1792	1.96	0	0 0 1	2006-06-17 23:49
SYN_BM	002D0109	NAM_GPS06	40.0635	1.96	2	0 0 1	2006-06-17 23:49
SYN_BM	002D0110	NAM_GPS06	40.1491	1.96	0	0 0 1	2006-06-17 23:49
SYN_BM	002G0042	NAM_GPS06	40.0279	1.96	0	0 0 1	2006-06-29 11:13
SYN_BM	002G0043	NAM_GPS06	40.0467	1.96	0	0 0 1	2006-06-29 11:13
SYN_BM	002G0044	NAM_GPS06	40.0772	1.96	0	0 0 1	2006-06-29 11:13
SYN_BM	002G0048	NAM_GPS06	39.7760	1.96	0	0 0 1	2006-07-03 19:19
SYN_BM	002G0049	NAM_GPS06	39.7705	1.96	0	0 0 1	2006-07-03 19:19
SYN_BM	002G0050	NAM_GPS06	39.6724	1.96	2	0 0 1	2006-07-03 19:19
SYN_BM	002G0124	NAM_GPS06	40.7113	1.96	0	0 0 1	2006-07-13 20:32
SYN_BM	002G0125	NAM_GPS06	40.6046	1.96	2	0 0 1	2006-07-13 20:32
SYN_BM	002G0126	NAM_GPS06	40.6139	1.96	0	0 0 1	2006-07-13 20:32
SYN_BM	002H0032	NAM_GPS06	39.6039	1.96	0	0 0 1	2006-08-05 09:23
SYN_BM	002H0033	NAM_GPS06	39.6214	1.96	0	0 0 1	2006-08-05 09:23
SYN_BM	002H0034	NAM_GPS06	39.5808	1.96	2	0 0 1	2006-08-05 09:23
SYN_BM	002H0035	NAM_GPS06	39.8572	1.96	0	0 0 1	2006-08-13 17:40
SYN_BM	002H0036	NAM_GPS06	39.8855	1.96	2	0 0 1	2006-08-13 17:40
SYN_BM	002H0037	NAM_GPS06	39.8487	1.96	0	0 0 1	2006-08-13 17:40
SYN_BM	002H0038	NAM_GPS06	40.4547	1.96	0	0 0 1	2006-07-07 21:50
SYN_BM	002H0039	NAM_GPS06	40.4627	1.96	0	0 0 1	2006-07-07 21:50
SYN_BM	002H0040	NAM_GPS06	40.4882	1.96	2	0 0 1	2006-07-07 21:50
SYN_BM	002H0042	NAM_GPS06	39.6248	1.96	0	0 0 1	2006-07-02 00:28
SYN_BM	002H0043	NAM_GPS06	39.6388	1.96	0	0 0 1	2006-07-02 00:28
SYN_BM	002H0044	NAM_GPS06	39.7164	1.96	0	0 0 1	2006-07-02 00:28
SYN_BM	002H0048	NAM_GPS06	39.7962	1.96	0	0 0 1	2006-08-16 14:15
SYN_BM	002H0057	NAM_GPS06	39.9418	1.96	0	0 0 1	2006-07-05 20:37
SYN_BM	002H0058	NAM_GPS06	39.9808	1.96	0	0 0 1	2006-07-05 20:37
SYN_BM	002H0059	NAM_GPS06	40.0619	1.96	0	0 0 1	2006-07-05 20:37
SYN_BM	AME-2	NAM_GPS06	69.7026	1.96	0	0 0 1	2006-11-07 11:25
SYN_BM	AWG-1	NAM_GPS06	79.3302	1.96	0	0 0 1	2006-11-14 11:33
SYN_BM	GRK1	NAM_GPS06	42.0622	1.96	0	0 0 1	2006-09-26 16:44
SYN_BM	GRK2	NAM_GPS06	42.0606	1.96	0	0 0 1	2006-09-26 17:36
SYN_BM	GRK3	NAM_GPS06	42.0617	1.96	0	0 0 1	2006-09-26 03:43
SYN_BM	GRK4	NAM_GPS06	42.0644	1.96	0	0 0 1	2006-09-26 19:42
SYN_BM	L100	NAM_GPS06	39.8652	1.96	0	0 0 1	2006-09-09 07:33
SYN_BM	L101	NAM_GPS06	39.8720	1.96	0	0 0 1	2006-09-09 09:51
SYN_BM	L102	NAM_GPS06	39.9065	1.96	0	0 0 1	2006-09-17 20:16
SYN_BM	L103	NAM_GPS06	39.7952	1.96	0	0 0 1	2006-09-02 10:40
SYN_BM	L104	NAM_GPS06	40.9892	1.96	0	0 0 1	2006-09-18 10:11
SYN_BM	L105	NAM_GPS06	40.8844	1.96	0	0 0 1	2006-09-11 20:32
SYN_BM	L106	NAM_GPS06	39.6761	1.96	0	0 0 1	2006-09-08 20:49
SYN_BM	L107	NAM_GPS06	39.7506	1.96	0	0 0 1	2006-09-02 10:03
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SYN_BM	M001N	NAM_GPS06	39.7328	1.96	3	0 0 1	2006-08-09 01:14
SYN_BM	M001Z	NAM_GPS06	39.5687	1.96	1	0 0 1	2006-08-09 01:14
SYN_BM	M002M	NAM_GPS06	39.7079	1.96	1	0 0 1	2006-08-08 00:05
SYN_BM	M002N	NAM_GPS06	39.5463	1.96	3	0 0 1	2006-08-08 00:05
SYN_BM	M002Z	NAM_GPS06	39.5674	1.96	3	0 0 1	2006-08-08 00:05
SYN_BM	M003M	NAM_GPS06	40.3958	1.96	1	0 0 1	2006-07-31 10:37
SYN_BM	M003N	NAM_GPS06	40.3468	1.96	1	0 0 1	2006-07-31 10:37
SYN_BM	M003Z	NAM_GPS06	40.2957	1.96	3	0 0 1	2006-07-31 10:37
SYN_BM	M004M	NAM_GPS06	40.6656	1.96	3	0 0 1	2006-06-24 22:46
SYN_BM	M004N	NAM_GPS06	40.8840	1.96	1	0 0 1	2006-06-24 22:46
SYN_BM	M004Z	NAM_GPS06	40.7871	1.96	3	0 0 1	2006-06-24 22:46
SYN_BM	M005M	NAM_GPS06	40.6788	1.96	3	0 0 1	2006-07-25 23:44
SYN_BM	M005N	NAM_GPS06	40.6353	1.96	3	0 0 1	2006-07-25 23:44
SYN_BM	M005Z	NAM_GPS06	40.5530	1.96	3	0 0 1	2006-07-25 23:44
SYN_BM	M006M	NAM_GPS06	39.8737	1.96	1	0 0 1	2006-07-31 18:54
SYN_BM	M006N	NAM_GPS06	39.8789	1.96	1	0 0 1	2006-07-31 18:54
SYN_BM	M006Z	NAM_GPS06	39.7985	1.96	3	0 0 1	2006-07-31 18:54
SYN_BM	M007M	NAM_GPS06	40.1174	1.96	3	0 0 1	2006-07-24 00:05

SYN_BM	M007N	NAM_GPS06	39.9987	1.96	3	0	0	1	2006-07-24 00:05
SYN_BM	M007Z	NAM_GPS06	39.9953	1.96	3	0	0	1	2006-07-24 00:05
SYN_BM	M008M	NAM_GPS06	39.9686	1.96	1	0	0	1	2006-07-19 19:53
SYN_BM	M008N	NAM_GPS06	40.0448	1.96	3	0	0	1	2006-07-19 19:53
SYN_BM	M008Z	NAM_GPS06	40.0600	1.96	3	0	0	1	2006-07-19 19:53
SYN_BM	M009M	NAM_GPS06	40.2343	1.96	1	0	0	1	2006-07-15 22:36
SYN_BM	M009N	NAM_GPS06	40.1390	1.96	3	0	0	1	2006-07-15 22:36
SYN_BM	M009Z	NAM_GPS06	40.2406	1.96	1	0	0	1	2006-07-15 22:36
SYN_BM	M010M	NAM_GPS06	39.8400	1.96	1	0	0	1	2006-07-10 00:12
SYN_BM	M010N	NAM_GPS06	39.8700	1.96	3	0	0	1	2006-07-10 00:12
SYN_BM	M010Z	NAM_GPS06	39.9062	1.96	1	0	0	1	2006-07-10 00:12
SYN_BM	M011M	NAM_GPS06	40.6176	1.96	3	0	0	1	2006-07-27 21:23
SYN_BM	M011N	NAM_GPS06	40.5600	1.96	1	0	0	1	2006-07-27 21:23
SYN_BM	M011Z	NAM_GPS06	40.5185	1.96	3	0	0	1	2006-07-27 21:23
SYN_BM	M012M	NAM_GPS06	40.2173	1.96	3	0	0	1	2006-07-18 00:45
SYN_BM	M012N	NAM_GPS06	40.1516	1.96	1	0	0	1	2006-07-18 00:45
SYN_BM	M012Z	NAM_GPS06	40.1736	1.96	3	0	0	1	2006-07-18 00:45
SYN_BM	M013M	NAM_GPS06	39.4542	1.96	3	0	0	1	2006-07-12 02:27
SYN_BM	M013N	NAM_GPS06	39.4084	1.96	3	0	0	1	2006-07-12 02:27
SYN_BM	M013Z	NAM_GPS06	39.2985	1.96	3	0	0	1	2006-07-12 02:27
SYN_BM	M015M	NAM_GPS06	39.8103	1.96	3	0	0	1	2006-07-21 23:09
SYN_BM	M015N	NAM_GPS06	39.9109	1.96	3	0	0	1	2006-07-21 23:09
SYN_BM	M015Z	NAM_GPS06	39.6546	1.96	3	0	0	1	2006-07-21 23:09
SYN_BM	M016M	NAM_GPS06	40.2454	1.96	1	0	0	1	2006-08-16 00:33
SYN_BM	M016N	NAM_GPS06	40.3087	1.96	3	0	0	1	2006-08-16 00:33
SYN_BM	M016Z	NAM_GPS06	40.1971	1.96	3	0	0	1	2006-08-16 00:33
SYN_BM	000A2592	NAM_GPS07	44.5043	2.01	0	0	0	1	2007-07-05 13:50
SYN_BM	002C0029	NAM_GPS07	39.5673	2.01	0	0	0	1	2007-06-29 13:30
SYN_BM	002C0030	NAM_GPS07	39.5829	2.01	0	0	0	1	2007-06-29 13:30
SYN_BM	002C0031	NAM_GPS07	39.6407	2.01	0	0	0	1	2007-06-29 13:30
SYN_BM	002C0033	NAM_GPS07	39.8468	2.01	0	0	0	1	2007-06-16 13:22
SYN_BM	002C0034	NAM_GPS07	39.7432	2.01	0	0	0	1	2007-06-16 13:22
SYN_BM	002C0035	NAM_GPS07	39.6847	2.01	0	0	0	1	2007-06-16 13:22
SYN_BM	002D0048	NAM_GPS07	40.2354	2.01	0	0	0	1	2007-06-17 10:02
SYN_BM	002D0049	NAM_GPS07	40.1592	2.01	0	0	0	1	2007-06-17 10:02
SYN_BM	002D0050	NAM_GPS07	40.1517	2.01	0	0	0	1	2007-06-17 10:02
SYN_BM	M002M	NAM_GPS07	39.7009	2.01	0	0	0	1	2007-06-17 17:15
SYN_BM	M002N	NAM_GPS07	39.5377	2.01	0	0	0	1	2007-06-17 17:15
SYN_BM	M002Z	NAM_GPS07	39.5545	2.01	2	0	0	1	2007-06-17 17:15
SYN_BM	002G0042	NAM_GPS08A	40.0269	2.04	0	0	0	1	2008-08-03 21:23
SYN_BM	002G0043	NAM_GPS08A	40.0458	2.04	0	0	0	1	2008-08-03 21:23
SYN_BM	002G0044	NAM_GPS08A	40.0761	2.04	0	0	0	1	2008-08-03 21:23
SYN_BM	M008M	NAM_GPS08A	39.9672	2.04	2	0	0	1	2008-08-02 21:15
SYN_BM	M008N	NAM_GPS08A	40.0036	2.04	0	0	0	1	2008-08-02 21:15
SYN_BM	M008Z	NAM_GPS08A	40.0514	2.04	2	0	0	1	2008-08-02 21:15
SYN_BM	M016M	NAM_GPS08A	40.2408	2.04	0	0	0	1	2008-08-04 22:32
SYN_BM	M016N	NAM_GPS08A	40.3031	2.04	0	0	0	1	2008-08-04 22:32
SYN_BM	M016Z	NAM_GPS08A	40.1962	2.04	0	0	0	1	2008-08-04 22:32
SYN_BM	000A2632	NAM_GPS08B	40.6130	2.04	0	0	0	1	2008-10-20 10:34
SYN_BM	000A2688	NAM_GPS08B	46.1002	2.04	0	0	0	1	2008-10-20 09:31
SYN_BM	006B0021	NAM_GPS08B	45.6618	2.04	0	0	0	1	2008-10-18 23:45
SYN_BM	000A2592	07_2009	44.5036	2.05	0	0	0	1	2009-05-20 23:00
SYN_BM	000A2689	07_2009	39.7419	2.05	0	0	0	1	2009-06-25 09:47
SYN_BM	000A2691	07_2009	41.4383	2.05	0	0	0	1	2009-09-21 08:56
SYN_BM	000A4025	07_2009	47.4873	2.05	0	0	0	1	2009-08-08 09:53
SYN_BM	002C0026	07_2009	39.4849	2.05	0	0	0	1	2009-05-15 12:42
SYN_BM	002C0027	07_2009	39.5770	2.05	0	0	0	1	2009-05-15 12:42
SYN_BM	002C0028	07_2009	39.6048	2.05	0	0	0	1	2009-05-15 12:42
SYN_BM	002C0029	07_2009	39.5665	2.05	0	0	0	1	2009-05-17 14:07
SYN_BM	002C0030	07_2009	39.5822	2.05	0	0	0	1	2009-05-17 14:07
SYN_BM	002C0031	07_2009	39.6399	2.05	0	0	0	1	2009-05-17 14:07
SYN_BM	002C0033	07_2009	39.8425	2.05	0	0	0	1	2009-05-21 23:24
SYN_BM	002C0034	07_2009	39.7391	2.05	0	0	0	1	2009-05-21 23:24
SYN_BM	002C0035	07_2009	39.6805	2.05	0	0	0	1	2009-05-21 23:24
SYN_BM	002C0064	07_2009	40.1759	2.05	0	0	0	1	2009-05-09 07:27
SYN_BM	002C0065	07_2009	40.2034	2.05	0	0	0	1	2009-05-09 07:27
SYN_BM	002C0066	07_2009	40.1004	2.05	0	0	0	1	2009-05-09 07:27
SYN_BM	002D0048	07_2009	40.2249	2.05	0	0	0	1	2009-05-23 23:58
SYN_BM	002D0049	07_2009	40.1488	2.05	0	0	0	1	2009-05-23 23:58
SYN_BM	002D0050	07_2009	40.1411	2.05	0	0	0	1	2009-05-23 23:58
SYN_BM	002D0054	07_2009	39.5737	2.05	0	0	0	1	2009-05-19 22:11
SYN_BM	002D0055	07_2009	39.6656	2.05	0	0	0	1	2009-05-19 22:11
SYN_BM	002D0056	07_2009	39.6655	2.05	0	0	0	1	2009-05-19 22:11
SYN_BM	002D0059	07_2009	41.4061	2.05	0	0	0	1	2009-06-22 11:57
SYN_BM	002D0060	07_2009	41.5767	2.05	0	0	0	1	2009-06-22 11:57
SYN_BM	002D0061	07_2009	41.4335	2.05	0	0	0	1	2009-06-22 11:57
SYN_BM	002D0066	07_2009	40.0001	2.05	0	0	0	1	2009-06-13 11:48
SYN_BM	002D0067	07_2009	39.8467	2.05	0	0	0	1	2009-06-13 11:48
SYN_BM	002D0068	07_2009	39.8484	2.05	0	0	0	1	2009-06-13 11:48
SYN_BM	002D0102	07_2009	39.4422	2.05	0	0	0	1	2009-06-02 16:00
SYN_BM	002D0103	07_2009	39.5779	2.05	0	0	0	1	2009-06-02 16:00
SYN_BM	002D0104	07_2009	39.5539	2.05	0	0	0	1	2009-06-02 16:00
SYN_BM	002D0108	07_2009	40.1727	2.05	0	0	0	1	2009-07-03 21:54
SYN_BM	002D0109	07_2009	40.0519	2.05	0	0	0	1	2009-07-03 21:54
SYN_BM	002D0110	07_2009	40.1418	2.05	0	0	0	1	2009-07-03 21:54
SYN_BM	002G0042	07_2009	40.0234	2.05	0	0	0	1	2009-06-18 21:22
SYN_BM	002G0043	07_2009	40.0422	2.05	0	0	0	1	2009-06-18 21:22
SYN_BM	002G0044	07_2009	40.0724	2.05	0	0	0	1	2009-06-18 21:22

SYN_BM	002G0048	07_2009	39.7732	2.05	0	0 0 1	2009-06-16 19:57
SYN_BM	002G0049	07_2009	39.7690	2.05	2	0 0 1	2009-06-16 19:57
SYN_BM	002G0050	07_2009	39.6707	2.05	0	0 0 1	2009-06-16 19:57
SYN_BM	002G0124	07_2009	40.7059	2.05	0	0 0 1	2009-06-06 22:35
SYN_BM	002G0125	07_2009	40.5960	2.05	0	0 0 1	2009-06-06 22:35
SYN_BM	002G0126	07_2009	40.6088	2.05	0	0 0 1	2009-06-06 22:35
SYN_BM	002H0032	07_2009	39.6041	2.05	0	0 0 1	2009-07-24 14:54
SYN_BM	002H0033	07_2009	39.6216	2.05	0	0 0 1	2009-07-24 14:54
SYN_BM	002H0034	07_2009	39.5802	2.05	0	0 0 1	2009-07-24 14:54
SYN_BM	002H0035	07_2009	39.8602	2.05	0	0 0 1	2009-07-22 00:25
SYN_BM	002H0036	07_2009	39.8871	2.05	0	0 0 1	2009-07-22 00:25
SYN_BM	002H0037	07_2009	39.8517	2.05	0	0 0 1	2009-07-22 00:25
SYN_BM	002H0038	07_2009	40.4538	2.05	0	0 0 1	2009-06-29 10:40
SYN_BM	002H0039	07_2009	40.4614	2.05	0	0 0 1	2009-06-29 10:40
SYN_BM	002H0040	07_2009	40.4862	2.05	0	0 0 1	2009-06-29 10:40
SYN_BM	002H0042	07_2009	39.6268	2.05	0	0 0 1	2009-08-04 00:05
SYN_BM	002H0043	07_2009	39.6410	2.05	0	0 0 1	2009-08-04 00:05
SYN_BM	002H0044	07_2009	39.7184	2.05	0	0 0 1	2009-08-04 00:05
SYN_BM	002H0057	07_2009	39.9423	2.05	0	0 0 1	2009-07-30 03:57
SYN_BM	002H0058	07_2009	39.9815	2.05	0	0 0 1	2009-07-30 03:57
SYN_BM	002H0059	07_2009	40.0626	2.05	0	0 0 1	2009-07-30 03:57
SYN_BM	AME-2	07_2009	69.6900	2.05	0	0 0 1	2009-11-02 18:12
SYN_BM	AWG-1	07_2009	79.3216	2.05	0	0 0 1	2009-11-03 12:06
SYN_BM	L100	07_2009	39.8640	2.05	0	0 0 1	2009-08-09 23:42
SYN_BM	L101	07_2009	39.8648	2.05	0	0 0 1	2009-08-10 20:20
SYN_BM	L102	07_2009	39.8973	2.05	0	0 0 1	2009-08-15 22:10
SYN_BM	L103	07_2009	39.7872	2.05	0	0 0 1	2009-08-15 08:35
SYN_BM	L104	07_2009	40.9802	2.05	0	0 0 1	2009-08-23 22:01
SYN_BM	L105	07_2009	40.8816	2.05	0	0 0 1	2009-08-23 22:24
SYN_BM	L106	07_2009	39.6734	2.05	0	0 0 1	2009-08-16 20:55
SYN_BM	L107	07_2009	39.7486	2.05	0	0 0 1	2009-08-16 22:55
SYN_BM	M001M	07_2009	39.5338	2.05	0	0 0 1	2009-05-10 15:20
SYN_BM	M001N	07_2009	39.7282	2.05	0	0 0 1	2009-05-10 15:20
SYN_BM	M001Z	07_2009	39.5615	2.05	0	0 0 1	2009-05-10 15:20
SYN_BM	M002M	07_2009	39.6962	2.05	0	0 0 1	2009-05-27 03:58
SYN_BM	M002N	07_2009	39.5324	2.05	0	0 0 1	2009-05-27 03:58
SYN_BM	M002Z	07_2009	39.5480	2.05	2	0 0 1	2009-05-27 03:58
SYN_BM	M003M	07_2009	40.3865	2.05	0	0 0 1	2009-05-29 04:35
SYN_BM	M003N	07_2009	40.3372	2.05	0	0 0 1	2009-05-29 04:35
SYN_BM	M003Z	07_2009	40.2819	2.05	0	0 0 1	2009-05-29 04:35
SYN_BM	M004M	07_2009	40.6572	2.05	2	0 0 1	2009-07-12 22:52
SYN_BM	M004N	07_2009	40.8840	2.05	0	0 0 1	2009-07-12 22:52
SYN_BM	M004Z	07_2009	40.7818	2.05	0	0 0 1	2009-07-12 22:52
SYN_BM	M005M	07_2009	40.6708	2.05	0	0 0 1	2009-06-20 21:28
SYN_BM	M005N	07_2009	40.6235	2.05	0	0 0 1	2009-06-20 21:28
SYN_BM	M005Z	07_2009	40.5476	2.05	0	0 0 1	2009-06-20 21:28
SYN_BM	M006M	07_2009	39.8708	2.05	0	0 0 1	2009-06-27 04:32
SYN_BM	M006N	07_2009	39.8751	2.05	0	0 0 1	2009-06-27 04:32
SYN_BM	M006Z	07_2009	39.7923	2.05	2	0 0 1	2009-06-27 04:32
SYN_BM	M007M	07_2009	40.1136	2.05	0	0 0 1	2009-07-06 00:31
SYN_BM	M007N	07_2009	39.9878	2.05	0	0 0 1	2009-07-06 00:31
SYN_BM	M007Z	07_2009	39.9888	2.05	0	0 0 1	2009-07-06 00:31
SYN_BM	M008M	07_2009	39.9654	2.05	0	0 0 1	2009-07-01 14:12
SYN_BM	M008N	07_2009	40.0001	2.05	0	0 0 1	2009-07-01 14:12
SYN_BM	M008Z	07_2009	40.0494	2.05	0	0 0 1	2009-07-01 14:12
SYN_BM	M009M	07_2009	40.2287	2.05	0	0 0 1	2009-06-25 02:14
SYN_BM	M009N	07_2009	40.1288	2.05	0	0 0 1	2009-06-25 02:14
SYN_BM	M009Z	07_2009	40.2349	2.05	0	0 0 1	2009-06-25 02:14
SYN_BM	M010M	07_2009	39.8344	2.05	0	0 0 1	2009-07-10 14:15
SYN_BM	M010N	07_2009	39.8662	2.05	0	0 0 1	2009-07-10 14:15
SYN_BM	M010Z	07_2009	39.8997	2.05	0	0 0 1	2009-07-10 14:15
SYN_BM	M011M	07_2009	40.6190	2.05	0	0 0 1	2009-08-01 21:32
SYN_BM	M011N	07_2009	40.5598	2.05	0	0 0 1	2009-08-01 21:32
SYN_BM	M011Z	07_2009	40.5128	2.05	0	0 0 1	2009-08-01 21:32
SYN_BM	M012M	07_2009	40.2022	2.05	0	0 0 1	2009-07-19 22:07
SYN_BM	M012N	07_2009	40.1392	2.05	2	0 0 1	2009-07-19 22:07
SYN_BM	M012Z	07_2009	40.1656	2.05	0	0 0 1	2009-07-19 22:07
SYN_BM	M013M	07_2009	39.4522	2.05	2	0 0 1	2009-06-11 10:21
SYN_BM	M013N	07_2009	39.3971	2.05	0	0 0 1	2009-06-11 10:21
SYN_BM	M013Z	07_2009	39.2917	2.05	0	0 0 1	2009-06-11 10:21
SYN_BM	M015M	07_2009	39.7979	2.05	0	0 0 1	2009-05-13 04:57
SYN_BM	M015N	07_2009	39.9041	2.05	0	0 0 1	2009-05-13 04:57
SYN_BM	M015Z	07_2009	39.6521	2.05	2	0 0 1	2009-05-13 04:57
SYN_BM	M016M	07_2009	40.2395	2.05	0	0 0 1	2009-06-04 23:38
SYN_BM	M016N	07_2009	40.3019	2.05	0	0 0 1	2009-06-04 23:38
SYN_BM	M016Z	07_2009	40.1947	2.05	0	0 0 1	2009-06-04 23:38
SYN_BM	000A2592	NAM_GPS10	44.5036	2.06	0	0 0 1	2010-07-31 03:10
SYN_BM	002C0029	NAM_GPS10	39.5665	2.06	0	0 0 1	2010-07-31 18:33
SYN_BM	002C0030	NAM_GPS10	39.5823	2.06	0	0 0 1	2010-07-31 18:33
SYN_BM	002C0031	NAM_GPS10	39.6401	2.06	0	0 0 1	2010-07-31 18:33
SYN_BM	002G0042	NAM_GPS10	40.0205	2.06	0	0 0 1	2010-08-08 23:35
SYN_BM	002G0043	NAM_GPS10	40.0393	2.06	0	0 0 1	2010-08-08 23:35
SYN_BM	002G0044	NAM_GPS10	40.0696	2.06	0	0 0 1	2010-08-08 23:35
SYN_BM	003C0122	NAM_GPS10	40.1430	2.06	0	0 0 1	2010-08-18 20:05
SYN_BM	003C0123	NAM_GPS10	40.1273	2.06	0	0 0 1	2010-08-18 20:05
SYN_BM	003C0124	NAM_GPS10	40.1760	2.06	0	0 0 1	2010-08-18 20:05
SYN_BM	003D0138	NAM_GPS10	40.1785	2.06	0	0 0 1	2010-08-21 03:38
SYN_BM	003D0139	NAM_GPS10	40.2924	2.06	0	0 0 1	2010-08-21 03:38

SYN_BM	003D0140	NAM_GPS10	40.2851	2.06	0	0 0 1	2010-08-21 03:38
SYN_BM	003G0187	NAM_GPS10	39.6426	2.06	2	0 0 1	2010-08-23 19:39
SYN_BM	003G0188	NAM_GPS10	39.6323	2.06	0	0 0 1	2010-08-23 19:39
SYN_BM	003G0189	NAM_GPS10	39.7213	2.06	0	0 0 1	2010-08-23 19:39
SYN_BM	003G0196	NAM_GPS10	39.7178	2.06	0	0 0 1	2010-08-29 10:51
SYN_BM	003G0197	NAM_GPS10	39.7535	2.06	0	0 0 1	2010-08-29 10:51
SYN_BM	003G0198	NAM_GPS10	39.7693	2.06	0	0 0 1	2010-08-29 10:51
SYN_BM	M002M	NAM_GPS10	39.6926	2.06	0	0 0 1	2010-08-01 18:12
SYN_BM	M002N	NAM_GPS10	39.5287	2.06	0	0 0 1	2010-08-01 18:12
SYN_BM	M002Z	NAM_GPS10	39.5438	2.06	0	0 0 1	2010-08-01 18:12
SYN_BM	M007M	NAM_GPS10	40.1112	2.06	0	0 0 1	2010-08-10 00:33
SYN_BM	M007N	NAM_GPS10	39.9852	2.06	0	0 0 1	2010-08-10 00:33
SYN_BM	M007Z	NAM_GPS10	39.9862	2.06	0	0 0 1	2010-08-10 00:33
SYN_BM	M008M	NAM_GPS10	39.9614	2.06	0	0 0 1	2010-08-07 22:38
SYN_BM	M008N	NAM_GPS10	39.9959	2.06	0	0 0 1	2010-08-07 22:38
SYN_BM	M008Z	NAM_GPS10	40.0453	2.06	0	0 0 1	2010-08-07 22:38
SYN_BM	M009M	NAM_GPS10	40.2279	2.06	0	0 0 1	2010-08-16 12:08
SYN_BM	M009N	NAM_GPS10	40.1280	2.06	0	0 0 1	2010-08-16 12:08
SYN_BM	M009Z	NAM_GPS10	40.2344	2.06	0	0 0 1	2010-08-16 12:08
SYN_BM	002C0026	NAM_GPS11	39.4840	2.06	0	0 0 1	2011-05-13 12:03
SYN_BM	002C0027	NAM_GPS11	39.5762	2.06	0	0 0 1	2011-05-13 12:03
SYN_BM	002C0028	NAM_GPS11	39.6039	2.06	0	0 0 1	2011-05-13 12:03
SYN_BM	002C0029	NAM_GPS11	39.5682	2.06	0	0 0 1	2011-05-09 18:55
SYN_BM	002C0030	NAM_GPS11	39.5840	2.06	0	0 0 1	2011-05-09 18:55
SYN_BM	002C0031	NAM_GPS11	39.6418	2.06	0	0 0 1	2011-05-09 18:55
SYN_BM	002C0033	NAM_GPS11	39.8379	2.06	0	0 0 1	2011-05-08 18:23
SYN_BM	002C0034	NAM_GPS11	39.7345	2.06	0	0 0 1	2011-05-08 18:23
SYN_BM	002C0035	NAM_GPS11	39.6760	2.06	0	0 0 1	2011-05-08 18:23
SYN_BM	002C0064	NAM_GPS11	40.1772	2.06	0	0 0 1	2011-05-07 23:06
SYN_BM	002C0065	NAM_GPS11	40.2046	2.06	0	0 0 1	2011-05-07 23:06
SYN_BM	002C0066	NAM_GPS11	40.1017	2.06	0	0 0 1	2011-05-07 23:06
SYN_BM	002D0048	NAM_GPS11	40.2172	2.06	0	0 0 1	2011-05-20 03:24
SYN_BM	002D0049	NAM_GPS11	40.1413	2.06	0	0 0 1	2011-05-20 03:24
SYN_BM	002D0050	NAM_GPS11	40.1336	2.06	0	0 0 1	2011-05-20 03:24
SYN_BM	002D0054	NAM_GPS11	39.5733	2.06	0	0 0 1	2011-05-25 05:44
SYN_BM	002D0055	NAM_GPS11	39.6647	2.06	0	0 0 1	2011-05-25 05:44
SYN_BM	002D0056	NAM_GPS11	39.6646	2.06	0	0 0 1	2011-05-25 05:44
SYN_BM	002D0066	NAM_GPS11	39.9989	2.06	0	0 0 1	2011-05-17 03:15
SYN_BM	002D0067	NAM_GPS11	39.8457	2.06	0	0 0 1	2011-05-17 03:15
SYN_BM	002D0068	NAM_GPS11	39.8475	2.06	0	0 0 1	2011-05-17 03:15
SYN_BM	002D0102	NAM_GPS11	39.4407	2.06	0	0 0 1	2011-05-14 09:28
SYN_BM	002D0103	NAM_GPS11	39.5767	2.06	0	0 0 1	2011-05-14 09:28
SYN_BM	002D0104	NAM_GPS11	39.5525	2.06	0	0 0 1	2011-05-14 09:28
SYN_BM	002D0108	NAM_GPS11	40.1699	2.06	0	0 0 1	2011-05-24 00:48
SYN_BM	002D0109	NAM_GPS11	40.0494	2.06	0	0 0 1	2011-05-24 00:48
SYN_BM	002D0110	NAM_GPS11	40.1387	2.06	0	0 0 1	2011-05-24 00:48
SYN_BM	002G0042	NAM_GPS11	40.0216	2.06	0	0 0 1	2011-05-06 22:03
SYN_BM	002G0043	NAM_GPS11	40.0403	2.06	0	0 0 1	2011-05-06 22:03
SYN_BM	002G0044	NAM_GPS11	40.0706	2.06	0	0 0 1	2011-05-06 22:03
SYN_BM	M001M	NAM_GPS11	39.5304	2.06	0	0 0 1	2011-05-12 08:01
SYN_BM	M001N	NAM_GPS11	39.7252	2.06	0	0 0 1	2011-05-12 08:01
SYN_BM	M001Z	NAM_GPS11	39.5584	2.06	0	0 0 1	2011-05-12 08:01
SYN_BM	M002M	NAM_GPS11	39.6923	2.06	0	0 0 1	2011-05-12 02:50
SYN_BM	M002N	NAM_GPS11	39.5283	2.06	0	0 0 1	2011-05-12 02:50
SYN_BM	M002Z	NAM_GPS11	39.5435	2.06	0	0 0 1	2011-05-12 02:50
SYN_BM	M003M	NAM_GPS11	40.3814	2.06	0	0 0 1	2011-05-18 23:57
SYN_BM	M003N	NAM_GPS11	40.3320	2.06	0	0 0 1	2011-05-18 23:57
SYN_BM	M003Z	NAM_GPS11	40.2766	2.06	0	0 0 1	2011-05-18 23:57
SYN_BM	M005M	NAM_GPS11	40.6670	2.06	0	0 0 1	2011-05-26 14:06
SYN_BM	M005N	NAM_GPS11	40.6196	2.06	0	0 0 1	2011-05-26 14:06
SYN_BM	M005Z	NAM_GPS11	40.5439	2.06	0	0 0 1	2011-05-26 14:06
SYN_BM	M006M	NAM_GPS11	39.8659	2.06	0	0 0 1	2011-05-31 07:35
SYN_BM	M006N	NAM_GPS11	39.8702	2.06	0	0 0 1	2011-05-31 07:35
SYN_BM	M006Z	NAM_GPS11	39.7865	2.06	0	0 0 1	2011-05-31 07:35
SYN_BM	M007M	NAM_GPS11	40.1070	2.06	0	0 0 1	2011-05-30 09:34
SYN_BM	M007N	NAM_GPS11	39.9808	2.06	0	0 0 1	2011-05-30 09:34
SYN_BM	M007Z	NAM_GPS11	39.9818	2.06	0	0 0 1	2011-05-30 09:34
SYN_BM	M008M	NAM_GPS11	39.9615	2.06	0	0 0 1	2011-05-28 10:31
SYN_BM	M008N	NAM_GPS11	39.9959	2.06	0	0 0 1	2011-05-28 10:31
SYN_BM	M008Z	NAM_GPS11	40.0451	2.06	0	0 0 1	2011-05-28 10:31
SYN_BM	M009M	NAM_GPS11	40.2267	2.06	0	0 0 1	2011-05-22 04:39
SYN_BM	M009N	NAM_GPS11	40.1269	2.06	0	0 0 1	2011-05-22 04:39
SYN_BM	M009Z	NAM_GPS11	40.2334	2.06	0	0 0 1	2011-05-22 04:39
SYN_BM	M015M	NAM_GPS11	39.7920	2.06	0	0 0 1	2011-05-10 13:48
SYN_BM	M015N	NAM_GPS11	39.8980	2.06	0	0 0 1	2011-05-10 13:48
SYN_BM	M015Z	NAM_GPS11	39.6466	2.06	2	0 0 1	2011-05-10 13:48
SYN_BM	000A2683	NAM_GPS11L	46.1854	2.07	0	0 0 1	2011-09-26 09:23
SYN_BM	000A2687	NAM_GPS11L	40.6483	2.07	0	0 0 1	2011-09-26 05:49
SYN_BM	000A2688	NAM_GPS11L	46.0944	2.07	0	0 0 1	2011-09-18 07:54
SYN_BM	000A2689	NAM_GPS11L	39.7439	2.07	0	0 0 1	2011-09-18 22:43
SYN_BM	000A2691	NAM_GPS11L	41.4339	2.07	0	0 0 1	2011-09-19 09:28
SYN_BM	000A4025	NAM_GPS11L	47.4868	2.07	0	0 0 1	2011-09-26 11:46
SYN_BM	AME-2	NAM_GPS11P	69.6813	2.07	0	0 0 1	2011-09-29 10:46
SYN_BM	AWG-1	NAM_GPS11P	79.3154	2.07	0	0 0 1	2011-09-28 21:36
SYN_BM	002D0059	NAM_GPS12W	41.4038	2.07	0	0 0 1	2012-05-20 12:52
SYN_BM	002D0060	NAM_GPS12W	41.5744	2.07	0	0 0 1	2012-05-20 12:52
SYN_BM	002D0061	NAM_GPS12W	41.4313	2.07	0	0 0 1	2012-05-20 12:52
SYN_BM	002G0048	NAM_GPS12W	39.7677	2.07	0	0 0 1	2012-05-15 10:02

SYN_BM	002G0049	NAM_GPS12W	39.7628	2.07	0	0	0	1	2012-05-15 10:02
SYN_BM	002G0050	NAM_GPS12W	39.6657	2.07	0	0	0	1	2012-05-15 10:02
SYN_BM	002G0124	NAM_GPS12W	40.7034	2.07	0	0	0	1	2012-05-17 00:19
SYN_BM	002G0125	NAM_GPS12W	40.5932	2.07	0	0	0	1	2012-05-17 00:19
SYN_BM	002G0126	NAM_GPS12W	40.6062	2.07	0	0	0	1	2012-05-17 00:19
SYN_BM	002H0032	NAM_GPS12W	39.6035	2.07	0	0	0	1	2012-05-10 04:20
SYN_BM	002H0033	NAM_GPS12W	39.6206	2.07	0	0	0	1	2012-05-10 04:20
SYN_BM	002H0034	NAM_GPS12W	39.5793	2.07	0	0	0	1	2012-05-10 04:20
SYN_BM	002H0035	NAM_GPS12W	39.8590	2.07	0	0	0	1	2012-05-11 01:26
SYN_BM	002H0036	NAM_GPS12W	39.8862	2.07	0	0	0	1	2012-05-11 01:26
SYN_BM	002H0037	NAM_GPS12W	39.8511	2.07	0	0	0	1	2012-05-11 01:26
SYN_BM	002H0038	NAM_GPS12W	40.4524	2.07	0	0	0	1	2012-06-01 23:32
SYN_BM	002H0039	NAM_GPS12W	40.4600	2.07	0	0	0	1	2012-06-01 23:32
SYN_BM	002H0040	NAM_GPS12W	40.4849	2.07	0	0	0	1	2012-06-01 23:32
SYN_BM	002H0042	NAM_GPS12W	39.6265	2.07	0	0	0	1	2012-05-08 03:08
SYN_BM	002H0043	NAM_GPS12W	39.6408	2.07	0	0	0	1	2012-05-08 03:08
SYN_BM	002H0044	NAM_GPS12W	39.7181	2.07	0	0	0	1	2012-05-08 03:08
SYN_BM	002H0048M	NAM_GPS12W	39.7983	2.07	0	0	0	1	2012-05-09 04:36
SYN_BM	002H0048N	NAM_GPS12W	39.8066	2.07	0	0	0	1	2012-05-09 04:36
SYN_BM	002H0048Z	NAM_GPS12W	39.6803	2.07	0	0	0	1	2012-05-09 04:36
SYN_BM	002H0057	NAM_GPS12W	39.9453	2.07	0	0	0	1	2012-05-29 13:50
SYN_BM	002H0058	NAM_GPS12W	39.9843	2.07	0	0	0	1	2012-05-29 13:50
SYN_BM	002H0059	NAM_GPS12W	40.0654	2.07	0	0	0	1	2012-05-29 13:50
SYN_BM	003C0122	NAM_GPS12W	40.1470	2.07	0	0	0	1	2012-05-29 10:23
SYN_BM	003C0123	NAM_GPS12W	40.1312	2.07	0	0	0	1	2012-05-29 10:23
SYN_BM	003C0124	NAM_GPS12W	40.1798	2.07	0	0	0	1	2012-05-29 10:23
SYN_BM	003D0138	NAM_GPS12W	40.1781	2.07	0	0	0	1	2012-06-01 11:06
SYN_BM	003D0139	NAM_GPS12W	40.2922	2.07	0	0	0	1	2012-06-01 11:06
SYN_BM	003D0140	NAM_GPS12W	40.2848	2.07	0	0	0	1	2012-06-01 11:06
SYN_BM	003G0187	NAM_GPS12W	39.6368	2.07	0	0	0	1	2012-05-22 07:04
SYN_BM	003G0188	NAM_GPS12W	39.6250	2.07	0	0	0	1	2012-05-22 07:04
SYN_BM	003G0189	NAM_GPS12W	39.7136	2.07	0	0	0	1	2012-05-22 07:04
SYN_BM	003G0196	NAM_GPS12W	39.7154	2.07	0	0	0	1	2012-05-23 04:22
SYN_BM	003G0197	NAM_GPS12W	39.7512	2.07	0	0	0	1	2012-05-23 04:22
SYN_BM	003G0198	NAM_GPS12W	39.7672	2.07	0	0	0	1	2012-05-23 04:22
SYN_BM	M003M	NAM_GPS12W	40.3796	2.07	0	0	0	1	2012-05-26 04:32
SYN_BM	M003N	NAM_GPS12W	40.3302	2.07	0	0	0	1	2012-05-26 04:32
SYN_BM	M003Z	NAM_GPS12W	40.2744	2.07	0	0	0	1	2012-05-26 04:32
SYN_BM	M004M	NAM_GPS12W	40.6523	2.07	0	0	0	1	2012-05-28 13:46
SYN_BM	M004N	NAM_GPS12W	40.8815	2.07	0	0	0	1	2012-05-28 13:46
SYN_BM	M004Z	NAM_GPS12W	40.7792	2.07	0	0	0	1	2012-05-28 13:46
SYN_BM	M006M	NAM_GPS12W	39.8639	2.07	0	0	0	1	2012-05-24 09:36
SYN_BM	M006N	NAM_GPS12W	39.8682	2.07	0	0	0	1	2012-05-24 09:36
SYN_BM	M006Z	NAM_GPS12W	39.7841	2.07	0	0	0	1	2012-05-24 09:36
SYN_BM	M007M	NAM_GPS12W	40.1023	2.07	0	0	0	1	2012-06-06 22:17
SYN_BM	M007N	NAM_GPS12W	39.9756	2.07	0	0	0	1	2012-06-06 22:17
SYN_BM	M007Z	NAM_GPS12W	39.9770	2.07	0	0	0	1	2012-06-06 22:17
SYN_BM	M008M	NAM_GPS12W	39.9578	2.07	0	0	0	1	2012-05-31 17:18
SYN_BM	M008N	NAM_GPS12W	39.9920	2.07	0	0	0	1	2012-05-31 17:18
SYN_BM	M008Z	NAM_GPS12W	40.0400	2.07	2	0	0	1	2012-05-31 17:18
SYN_BM	M009M	NAM_GPS12W	40.2289	2.07	0	0	0	1	2012-05-06 18:47
SYN_BM	M009N	NAM_GPS12W	40.1292	2.07	0	0	0	1	2012-05-06 18:47
SYN_BM	M009Z	NAM_GPS12W	40.2357	2.07	0	0	0	1	2012-05-06 18:47
SYN_BM	M010M	NAM_GPS12W	39.8325	2.07	0	0	0	1	2012-05-14 15:22
SYN_BM	M010N	NAM_GPS12W	39.8641	2.07	0	0	0	1	2012-05-14 15:22
SYN_BM	M010Z	NAM_GPS12W	39.8978	2.07	0	0	0	1	2012-05-14 15:22
SYN_BM	M011M	NAM_GPS12W	40.6166	2.07	0	0	0	1	2012-05-07 01:36
SYN_BM	M011N	NAM_GPS12W	40.5578	2.07	0	0	0	1	2012-05-07 01:36
SYN_BM	M011Z	NAM_GPS12W	40.5099	2.07	0	0	0	1	2012-05-07 01:36
SYN_BM	M012M	NAM_GPS12W	40.2036	2.07	0	0	0	1	2012-05-15 21:07
SYN_BM	M012N	NAM_GPS12W	40.1396	2.07	0	0	0	1	2012-05-15 21:07
SYN_BM	M012Z	NAM_GPS12W	40.1677	2.07	0	0	0	1	2012-05-15 21:07
SYN_BM	M013M	NAM_GPS12W	39.4538	2.07	0	0	0	1	2012-05-11 14:36
SYN_BM	M013N	NAM_GPS12W	39.3968	2.07	0	0	0	1	2012-05-11 14:36
SYN_BM	M013Z	NAM_GPS12W	39.2914	2.07	0	0	0	1	2012-05-11 14:36
SYN_BM	M016M	NAM_GPS12W	40.2331	2.07	0	0	0	1	2012-06-08 04:21
SYN_BM	M016N	NAM_GPS12W	40.2953	2.07	0	0	0	1	2012-06-08 04:21
SYN_BM	M016Z	NAM_GPS12W	40.1880	2.07	0	0	0	1	2012-06-08 04:21
SYN_BM	L100	NAM_GPS12L	39.8625	2.07	0	0	0	1	2012-06-16 23:46
SYN_BM	L101	NAM_GPS12L	39.8611	2.07	0	0	0	1	2012-06-17 00:04
SYN_BM	L102	NAM_GPS12L	39.8898	2.07	0	0	0	1	2012-06-17 23:40
SYN_BM	L103	NAM_GPS12L	39.7831	2.07	0	0	0	1	2012-06-17 20:48
SYN_BM	L104	NAM_GPS12L	40.9749	2.07	0	0	0	1	2012-06-25 09:55
SYN_BM	L105	NAM_GPS12L	40.8794	2.07	0	0	0	1	2012-06-25 11:29
SYN_BM	L106	NAM_GPS12L	39.6727	2.07	0	0	0	1	2012-06-18 20:50
SYN_BM	L107	NAM_GPS12L	39.7448	2.07	0	0	0	1	2012-06-17 22:21
SYN_BM	002C0029	NAM_GPS13	39.5656	2.07	0	0	0	1	2013-05-11 16:59
SYN_BM	002C0030	NAM_GPS13	39.5813	2.07	0	0	0	1	2013-05-11 16:59
SYN_BM	002C0031	NAM_GPS13	39.6392	2.07	0	0	0	1	2013-05-11 16:59
SYN_BM	002C0033	NAM_GPS13	39.8353	2.07	0	0	0	1	2013-05-22 18:28
SYN_BM	002C0034	NAM_GPS13	39.7320	2.07	0	0	0	1	2013-05-22 18:28
SYN_BM	002C0035	NAM_GPS13	39.6733	2.07	0	0	0	1	2013-05-22 18:28
SYN_BM	002D0066	NAM_GPS13	39.9954	2.07	0	0	0	1	2013-05-17 19:45
SYN_BM	002D0067	NAM_GPS13	39.8422	2.07	0	0	0	1	2013-05-17 19:45
SYN_BM	002D0068	NAM_GPS13	39.8443	2.07	0	0	0	1	2013-05-17 19:45
SYN_BM	002G0042	NAM_GPS13	40.0146	2.07	0	0	0	1	2013-05-15 04:33
SYN_BM	002G0043	NAM_GPS13	40.0333	2.07	0	0	0	1	2013-05-15 04:33
SYN_BM	002G0044	NAM_GPS13	40.0636	2.07	0	0	0	1	2013-05-15 04:33

SYN_BM	003C0122	NAM_GPS13	40.1430	2.07	0	0	0	1	2013-05-14	04:41
SYN_BM	003C0123	NAM_GPS13	40.1274	2.07	0	0	0	1	2013-05-14	04:41
SYN_BM	003C0124	NAM_GPS13	40.1758	2.07	0	0	0	1	2013-05-14	04:41
SYN_BM	003D0138	NAM_GPS13	40.1743	2.07	0	0	0	1	2013-05-19	21:55
SYN_BM	003D0139	NAM_GPS13	40.2883	2.07	0	0	0	1	2013-05-19	21:55
SYN_BM	003D0140	NAM_GPS13	40.2809	2.07	0	0	0	1	2013-05-19	21:55
SYN_BM	003G0187	NAM_GPS13	39.6349	2.07	0	0	0	1	2013-05-14	04:33
SYN_BM	003G0188	NAM_GPS13	39.6231	2.07	0	0	0	1	2013-05-14	04:33
SYN_BM	003G0189	NAM_GPS13	39.7119	2.07	0	0	0	1	2013-05-14	04:33
SYN_BM	003G0196	NAM_GPS13	39.7126	2.07	0	0	0	1	2013-05-18	20:36
SYN_BM	003G0197	NAM_GPS13	39.7484	2.07	0	0	0	1	2013-05-18	20:36
SYN_BM	003G0198	NAM_GPS13	39.7642	2.07	0	0	0	1	2013-05-18	20:36
SYN_BM	M007M	NAM_GPS13	40.1014	2.07	0	0	0	1	2013-05-21	22:19
SYN_BM	M007N	NAM_GPS13	39.9746	2.07	0	0	0	1	2013-05-21	22:19
SYN_BM	M007Z	NAM_GPS13	39.9760	2.07	0	0	0	1	2013-05-21	22:19
SYN_BM	M008M	NAM_GPS13	39.9544	2.07	0	0	0	1	2013-05-15	23:49
SYN_BM	M008N	NAM_GPS13	39.9883	2.07	0	0	0	1	2013-05-15	23:49
SYN_BM	M008Z	NAM_GPS13	40.0363	2.07	2	0	0	1	2013-05-15	23:49
SYN_BM	M009M	NAM_GPS13	40.2248	2.07	0	0	0	1	2013-05-11	02:08
SYN_BM	M009N	NAM_GPS13	40.1248	2.07	0	0	0	1	2013-05-11	02:08
SYN_BM	M009Z	NAM_GPS13	40.2315	2.07	0	0	0	1	2013-05-11	02:08
SYN_BM	M011M	NAM_GPS13	40.6168	2.07	0	0	0	1	2013-05-16	22:04
SYN_BM	M011N	NAM_GPS13	40.5579	2.07	0	0	0	1	2013-05-16	22:04
SYN_BM	M011Z	NAM_GPS13	40.5099	2.07	0	0	0	1	2013-05-16	22:04
SYN_BM	000A2592	NAM_GPS14	44.5035	2.08	0	0	0	1	2014-05-25	12:20
SYN_BM	002C0026	NAM_GPS14	39.4831	2.08	0	0	0	1	2014-05-17	10:43
SYN_BM	002C0027	NAM_GPS14	39.5754	2.08	0	0	0	1	2014-05-17	10:43
SYN_BM	002C0028	NAM_GPS14	39.6031	2.08	0	0	0	1	2014-05-17	10:43
SYN_BM	002C0029	NAM_GPS14	39.5658	2.08	0	0	0	1	2014-05-22	14:48
SYN_BM	002C0030	NAM_GPS14	39.5816	2.08	0	0	0	1	2014-05-22	14:48
SYN_BM	002C0031	NAM_GPS14	39.6395	2.08	0	0	0	1	2014-05-22	14:48
SYN_BM	002C0033	NAM_GPS14	39.8312	2.08	0	0	0	1	2014-05-21	20:38
SYN_BM	002C0034	NAM_GPS14	39.7278	2.08	0	0	0	1	2014-05-21	20:38
SYN_BM	002C0035	NAM_GPS14	39.6694	2.08	0	0	0	1	2014-05-21	20:38
SYN_BM	002C0064	NAM_GPS14	40.1813	2.08	0	0	0	1	2014-05-24	15:54
SYN_BM	002C0065	NAM_GPS14	40.2084	2.08	0	0	0	1	2014-05-24	15:54
SYN_BM	002C0066	NAM_GPS14	40.1056	2.08	0	0	0	1	2014-05-24	15:54
SYN_BM	002D0048	NAM_GPS14	40.2035	2.08	0	0	0	1	2014-05-18	23:12
SYN_BM	002D0049	NAM_GPS14	40.1278	2.08	0	0	0	1	2014-05-18	23:12
SYN_BM	002D0050	NAM_GPS14	40.1200	2.08	0	0	0	1	2014-05-18	23:12
SYN_BM	002D0102	NAM_GPS14	39.4288	2.08	0	0	0	1	2014-05-03	16:50
SYN_BM	002D0103	NAM_GPS14	39.5654	2.08	0	0	0	1	2014-05-03	16:50
SYN_BM	002D0104	NAM_GPS14	39.5413	2.08	0	0	0	1	2014-05-03	16:50
SYN_BM	002D0108	NAM_GPS14	40.1613	2.08	0	0	0	1	2014-05-09	00:19
SYN_BM	002D0109	NAM_GPS14	40.0414	2.08	0	0	0	1	2014-05-09	00:19
SYN_BM	002D0110	NAM_GPS14	40.1279	2.08	2	0	0	1	2014-05-09	00:19
SYN_BM	002G0042	NAM_GPS14	40.0105	2.08	0	0	0	1	2014-05-14	17:10
SYN_BM	002G0043	NAM_GPS14	40.0290	2.08	0	0	0	1	2014-05-14	17:10
SYN_BM	002G0044	NAM_GPS14	40.0594	2.08	0	0	0	1	2014-05-14	17:10
SYN_BM	002G0048	NAM_GPS14	39.7657	2.08	0	0	0	1	2014-05-05	05:28
SYN_BM	002G0049	NAM_GPS14	39.7601	2.08	0	0	0	1	2014-05-05	05:28
SYN_BM	002G0050	NAM_GPS14	39.6636	2.08	0	0	0	1	2014-05-05	05:28
SYN_BM	003C0122	NAM_GPS14	40.1452	2.08	0	0	0	1	2014-05-10	23:43
SYN_BM	003C0123	NAM_GPS14	40.1294	2.08	0	0	0	1	2014-05-10	23:43
SYN_BM	003C0124	NAM_GPS14	40.1778	2.08	0	0	0	1	2014-05-10	23:43
SYN_BM	M001M	NAM_GPS14	39.5210	2.08	0	0	0	1	2014-05-19	16:41
SYN_BM	M001N	NAM_GPS14	39.7167	2.08	2	0	0	1	2014-05-19	16:41
SYN_BM	M001Z	NAM_GPS14	39.5487	2.08	0	0	0	1	2014-05-19	16:41
SYN_BM	M002M	NAM_GPS14	39.6846	2.08	2	0	0	1	2014-05-08	10:44
SYN_BM	M002N	NAM_GPS14	39.5202	2.08	0	0	0	1	2014-05-08	10:44
SYN_BM	M002Z	NAM_GPS14	39.5342	2.08	0	0	0	1	2014-05-08	10:44
SYN_BM	M003M	NAM_GPS14	40.3741	2.08	0	0	0	1	2014-05-02	22:30
SYN_BM	M003N	NAM_GPS14	40.3266	2.08	2	0	0	1	2014-05-02	22:30
SYN_BM	M003Z	NAM_GPS14	40.2682	2.08	2	0	0	1	2014-05-02	22:30
SYN_BM	M005M	NAM_GPS14	40.6621	2.08	0	0	0	1	2014-05-07	11:49
SYN_BM	M005N	NAM_GPS14	40.6139	2.08	0	0	0	1	2014-05-07	11:49
SYN_BM	M005Z	NAM_GPS14	40.5387	2.08	0	0	0	1	2014-05-07	11:49
SYN_BM	M007M	NAM_GPS14	40.0933	2.08	2	0	0	1	2014-05-13	05:54
SYN_BM	M007N	NAM_GPS14	39.9658	2.08	0	0	0	1	2014-05-13	05:54
SYN_BM	M007Z	NAM_GPS14	39.9675	2.08	0	0	0	1	2014-05-13	05:54
SYN_BM	M008M	NAM_GPS14	39.9527	2.08	0	0	0	1	2014-05-06	06:09
SYN_BM	M008N	NAM_GPS14	39.9865	2.08	0	0	0	1	2014-05-06	06:09
SYN_BM	M008Z	NAM_GPS14	40.0354	2.08	0	0	0	1	2014-05-06	06:09
SYN_BM	M009M	NAM_GPS14	40.2237	2.08	0	0	0	1	2014-05-01	22:22
SYN_BM	M009N	NAM_GPS14	40.1237	2.08	0	0	0	1	2014-05-01	22:22
SYN_BM	M009Z	NAM_GPS14	40.2306	2.08	0	0	0	1	2014-05-01	22:22
SYN_BM	M015M	NAM_GPS14	39.7877	2.08	0	0	0	1	2014-05-23	02:03
SYN_BM	M015N	NAM_GPS14	39.8941	2.08	0	0	0	1	2014-05-23	02:03
SYN_BM	M015Z	NAM_GPS14	39.6435	2.08	0	0	0	1	2014-05-23	02:03
SYN_BM	M016M	NAM_GPS14	40.2296	2.08	0	0	0	1	2014-05-06	00:03
SYN_BM	M016N	NAM_GPS14	40.2918	2.08	0	0	0	1	2014-05-06	00:03
SYN_BM	M016Z	NAM_GPS14	40.1848	2.08	0	0	0	1	2014-05-06	00:03
SYN_BM	002C0033	NAM_GPS15W	39.8260	2.08	0	0	0	1	2015-06-16	03:07
SYN_BM	002C0034	NAM_GPS15W	39.7226	2.08	0	0	0	1	2015-06-16	03:07
SYN_BM	002C0035	NAM_GPS15W	39.6640	2.08	0	0	0	1	2015-06-16	03:07
SYN_BM	002D0048	NAM_GPS15W	40.1966	2.08	0	0	0	1	2015-06-11	17:55
SYN_BM	002D0049	NAM_GPS15W	40.1210	2.08	0	0	0	1	2015-06-11	17:55
SYN_BM	002D0059	NAM_GPS15W	41.4021	2.08	0	0	0	1	2015-05-29	23:45

SYN_BM	002D0060	NAM_GPS15W	41.5725	2.08	0	0 0 1	2015-05-29 23:45
SYN_BM	002D0061	NAM_GPS15W	41.4292	2.08	0	0 0 1	2015-05-29 23:45
SYN_BM	002D0066	NAM_GPS15W	39.9919	2.08	2	0 0 1	2015-06-04 05:58
SYN_BM	002D0067	NAM_GPS15W	39.8400	2.08	0	0 0 1	2015-06-04 05:58
SYN_BM	002D0068	NAM_GPS15W	39.8421	2.08	0	0 0 1	2015-06-04 05:58
SYN_BM	002D0102	NAM_GPS15W	39.4282	2.08	2	0 0 1	2015-05-22 11:15
SYN_BM	002D0103	NAM_GPS15W	39.5649	2.08	0	0 0 1	2015-05-22 11:15
SYN_BM	002D0104	NAM_GPS15W	39.5411	2.08	0	0 0 1	2015-05-22 11:15
SYN_BM	002D0108	NAM_GPS15W	40.1587	2.08	0	0 0 1	2015-06-02 03:22
SYN_BM	002D0109	NAM_GPS15W	40.0389	2.08	0	0 0 1	2015-06-02 03:22
SYN_BM	002D0110	NAM_GPS15W	40.1256	2.08	2	0 0 1	2015-06-02 03:22
SYN_BM	002G0042	NAM_GPS15W	40.0076	2.08	0	0 0 1	2015-05-25 22:02
SYN_BM	002G0043	NAM_GPS15W	40.0264	2.08	0	0 0 1	2015-05-25 22:02
SYN_BM	002G0044	NAM_GPS15W	40.0564	2.08	0	0 0 1	2015-05-25 22:02
SYN_BM	002G0124	NAM_GPS15W	40.7031	2.08	0	0 0 1	2015-05-20 12:53
SYN_BM	002G0125	NAM_GPS15W	40.5922	2.08	0	0 0 1	2015-05-20 12:53
SYN_BM	002G0126	NAM_GPS15W	40.6058	2.08	0	0 0 1	2015-05-20 12:53
SYN_BM	002H0032	NAM_GPS15W	39.6005	2.08	0	0 0 1	2015-05-23 18:34
SYN_BM	002H0033	NAM_GPS15W	39.6178	2.08	0	0 0 1	2015-05-23 18:34
SYN_BM	002H0034	NAM_GPS15W	39.5763	2.08	0	0 0 1	2015-05-23 18:34
SYN_BM	002H0035	NAM_GPS15W	39.8564	2.08	0	0 0 1	2015-05-17 11:28
SYN_BM	002H0036	NAM_GPS15W	39.8838	2.08	0	0 0 1	2015-05-17 11:28
SYN_BM	002H0037	NAM_GPS15W	39.8484	2.08	0	0 0 1	2015-05-17 11:28
SYN_BM	002H0038	NAM_GPS15W	40.4488	2.08	0	0 0 1	2015-05-24 09:51
SYN_BM	002H0039	NAM_GPS15W	40.4568	2.08	0	0 0 1	2015-05-24 09:51
SYN_BM	002H0040	NAM_GPS15W	40.4816	2.08	0	0 0 1	2015-05-24 09:51
SYN_BM	002H0042	NAM_GPS15W	39.6241	2.08	0	0 0 1	2015-05-08 10:57
SYN_BM	002H0043	NAM_GPS15W	39.6383	2.08	0	0 0 1	2015-05-08 10:57
SYN_BM	002H0044	NAM_GPS15W	39.7157	2.08	0	0 0 1	2015-05-08 10:57
SYN_BM	002H0048M	NAM_GPS15W	39.7979	2.08	0	0 0 1	2015-05-07 18:44
SYN_BM	002H0048N	NAM_GPS15W	39.8066	2.08	0	0 0 1	2015-05-07 18:44
SYN_BM	002H0048Z	NAM_GPS15W	39.6801	2.08	0	0 0 1	2015-05-07 18:44
SYN_BM	002H0057	NAM_GPS15W	39.9413	2.08	0	0 0 1	2015-05-12 05:20
SYN_BM	002H0058	NAM_GPS15W	39.9803	2.08	0	0 0 1	2015-05-12 05:20
SYN_BM	002H0059	NAM_GPS15W	40.0615	2.08	0	0 0 1	2015-05-12 05:20
SYN_BM	003C0122	NAM_GPS15W	40.1464	2.08	0	0 0 1	2015-05-26 19:20
SYN_BM	003C0123	NAM_GPS15W	40.1303	2.08	0	0 0 1	2015-05-26 19:20
SYN_BM	003C0124	NAM_GPS15W	40.1786	2.08	0	0 0 1	2015-05-26 19:20
SYN_BM	003D0138	NAM_GPS15W	40.1767	2.08	0	0 0 1	2015-06-20 23:22
SYN_BM	003D0139	NAM_GPS15W	40.2908	2.08	0	0 0 1	2015-06-20 23:22
SYN_BM	003D0140	NAM_GPS15W	40.2834	2.08	0	0 0 1	2015-06-20 23:22
SYN_BM	M001M	NAM_GPS15W	39.5208	2.08	0	0 0 1	2015-06-09 12:54
SYN_BM	M001N	NAM_GPS15W	39.7163	2.08	0	0 0 1	2015-06-09 12:54
SYN_BM	M001Z	NAM_GPS15W	39.5491	2.08	0	0 0 1	2015-06-09 12:54

SYN_BM	M002M	NAM_GPS15W	39.6815	2.08	0	0 0 1	2015-06-11 07:26
SYN_BM	M002N	NAM_GPS15W	39.5174	2.08	0	0 0 1	2015-06-11 07:26
SYN_BM	M002Z	NAM_GPS15W	39.5313	2.08	2	0 0 1	2015-06-11 07:26
SYN_BM	M003M	NAM_GPS15W	40.3700	2.08	0	0 0 1	2015-05-13 13:24
SYN_BM	M003N	NAM_GPS15W	40.3209	2.08	0	0 0 1	2015-05-13 13:24
SYN_BM	M003Z	NAM_GPS15W	40.2638	2.08	2	0 0 1	2015-05-13 13:24
SYN_BM	M004M	NAM_GPS15W	40.6464	2.08	2	0 0 1	2015-05-28 14:09
SYN_BM	M004N	NAM_GPS15W	40.8787	2.08	0	0 0 1	2015-05-28 14:09
SYN_BM	M004Z	NAM_GPS15W	40.7763	2.08	0	0 0 1	2015-05-28 14:09
SYN_BM	M005M	NAM_GPS15W	40.6586	2.08	0	0 0 1	2015-05-26 17:53
SYN_BM	M005N	NAM_GPS15W	40.6102	2.08	0	0 0 1	2015-05-26 17:53
SYN_BM	M005Z	NAM_GPS15W	40.5352	2.08	0	0 0 1	2015-05-26 17:53
SYN_BM	M006M	NAM_GPS15W	39.8555	2.08	0	0 0 1	2015-05-12 16:56
SYN_BM	M006N	NAM_GPS15W	39.8596	2.08	0	0 0 1	2015-05-12 16:56
SYN_BM	M006Z	NAM_GPS15W	39.7748	2.08	2	0 0 1	2015-05-12 16:56
SYN_BM	M007M	NAM_GPS15W	40.0896	2.08	2	0 0 1	2015-06-19 10:15
SYN_BM	M007N	NAM_GPS15W	39.9616	2.08	0	0 0 1	2015-06-19 10:15
SYN_BM	M007Z	NAM_GPS15W	39.9635	2.08	0	0 0 1	2015-06-19 10:15
SYN_BM	M008M	NAM_GPS15W	39.9440	2.08	0	0 0 1	2015-06-19 02:05
SYN_BM	M008N	NAM_GPS15W	39.9748	2.08	2	0 0 1	2015-06-19 02:05
SYN_BM	M009M	NAM_GPS15W	40.2245	2.08	0	0 0 1	2015-05-06 07:04
SYN_BM	M009N	NAM_GPS15W	40.1246	2.08	0	0 0 1	2015-05-06 07:04
SYN_BM	M009Z	NAM_GPS15W	40.2315	2.08	0	0 0 1	2015-05-06 07:04
SYN_BM	M010M	NAM_GPS15W	39.8272	2.08	0	0 0 1	2015-05-19 08:39
SYN_BM	M010N	NAM_GPS15W	39.8589	2.08	0	0 0 1	2015-05-19 08:39
SYN_BM	M010Z	NAM_GPS15W	39.8926	2.08	0	0 0 1	2015-05-19 08:39
SYN_BM	M011M	NAM_GPS15W	40.6120	2.08	0	0 0 1	2015-05-14 12:05
SYN_BM	M011N	NAM_GPS15W	40.5530	2.08	0	0 0 1	2015-05-14 12:05
SYN_BM	M011Z	NAM_GPS15W	40.5034	2.08	2	0 0 1	2015-05-14 12:05
SYN_BM	M012M	NAM_GPS15W	40.2000	2.08	0	0 0 1	2015-05-10 12:11
SYN_BM	M012N	NAM_GPS15W	40.1356	2.08	0	0 0 1	2015-05-10 12:11
SYN_BM	M012Z	NAM_GPS15W	40.1652	2.08	2	0 0 1	2015-05-10 12:11
SYN_BM	M013M	NAM_GPS15W	39.4510	2.08	0	0 0 1	2015-05-05 14:01
SYN_BM	M013N	NAM_GPS15W	39.3932	2.08	0	0 0 1	2015-05-05 14:01
SYN_BM	M013Z	NAM_GPS15W	39.2885	2.08	0	0 0 1	2015-05-05 14:01
SYN_BM	M015M	NAM_GPS15W	39.7849	2.08	0	0 0 1	2015-06-10 02:14
SYN_BM	M015N	NAM_GPS15W	39.8915	2.08	0	0 0 1	2015-06-10 02:14
SYN_BM	M015Z	NAM_GPS15W	39.6410	2.08	0	0 0 1	2015-06-10 02:14
SYN_BM	M017M	NAM_GPS15W	40.2043	2.08	0	0 0 1	2015-06-19 02:05
SYN_BM	M017N	NAM_GPS15W	40.1567	2.08	0	0 0 1	2015-06-19 02:05
SYN_BM	M017Z	NAM_GPS15W	40.1254	2.08	0	0 0 1	2015-06-19 02:05
SYN_BM	L100	NAM_GPS15L	39.8588	2.08	0	0 0 1	2015-06-27 20:55
SYN_BM	L101	NAM_GPS15L	39.8535	2.08	0	0 0 1	2015-06-28 20:47
SYN_BM	L102	NAM_GPS15L	39.8824	2.08	0	0 0 1	2015-06-28 22:03

SYN_BM	L103	NAM_GPS15L	39.7804	2.08	0	0 0 1	2015-06-27 21:13
SYN_BM	L104	NAM_GPS15L	40.9689	2.08	0	0 0 1	2015-07-06 13:25
SYN_BM	L105	NAM_GPS15L	40.8718	2.08	0	0 0 1	2015-07-06 06:47
SYN_BM	L106	NAM_GPS15L	39.6692	2.08	0	0 0 1	2015-06-29 20:52
SYN_BM	L107	NAM_GPS15L	39.7416	2.08	0	0 0 1	2015-06-29 22:50
SYN_BM	000A2592	NAM_GPS15O	44.5024	2.08	0	0 0 1	2015-07-17 20:53
SYN_BM	000A2683	NAM_GPS15O	46.1793	2.08	0	0 0 1	2015-07-04 05:59
SYN_BM	000A2686	NAM_GPS15O	40.4518	2.08	0	0 0 1	2015-07-05 00:41
SYN_BM	000A2687	NAM_GPS15O	40.6388	2.08	0	0 0 1	2015-07-13 21:31
SYN_BM	000A2688	NAM_GPS15O	46.0897	2.08	0	0 0 1	2015-07-11 05:48
SYN_BM	000A2689	NAM_GPS15O	39.7397	2.08	0	0 0 1	2015-07-04 03:39
SYN_BM	000A2691	NAM_GPS15O	41.4273	2.08	0	0 0 1	2015-07-13 23:36
SYN_BM	000A4025	NAM_GPS15O	47.4856	2.08	0	0 0 1	2015-07-03 07:39
SYN_BM	000A5025	NAM_GPS15O	47.0128	2.08	0	0 0 1	2015-07-03 07:39
SYN_BM	AME1	NAM_GPS06	48.1627	1.22	0	0 0 1	2006-07-17 00:00
SYN_BM	AME1	NAM_GPS06	0.0027	0.84	0	0 1 0	2006-07-17 00:00
SYN_BM	AME1	NAM_GPS06	-0.0100	0.84	0	1 0 0	2006-07-17 00:00
SYN_BM	ANJM	NAM_GPS06	45.2827	1.22	0	0 0 1	2006-07-17 00:00
SYN_BM	ANJM	NAM_GPS06	0.0065	0.84	0	0 1 0	2006-07-17 00:00
SYN_BM	ANJM	NAM_GPS06	-0.0033	0.84	0	1 0 0	2006-07-17 00:00
SYN_BM	AME1	NAM_GPS07	48.1546	1.31	0	0 0 1	2007-06-21 00:00
SYN_BM	AME1	NAM_GPS07	0.0007	0.87	0	0 1 0	2007-06-21 00:00
SYN_BM	AME1	NAM_GPS07	-0.0070	0.87	0	1 0 0	2007-06-21 00:00
SYN_BM	MODD	NAM_GPS07	47.5643	1.31	0	0 0 1	2007-06-21 00:00
SYN_BM	MODD	NAM_GPS07	0.0012	0.87	0	0 1 0	2007-06-21 00:00
SYN_BM	MODD	NAM_GPS07	0.0006	0.87	0	1 0 0	2007-06-21 00:00
SYN_BM	AME1	NAM_GPS08A	48.1470	1.34	0	0 0 1	2008-08-04 00:00
SYN_BM	AME1	NAM_GPS08A	0.0002	0.89	0	0 1 0	2008-08-04 00:00
SYN_BM	AME1	NAM_GPS08A	-0.0059	0.89	0	1 0 0	2008-08-04 00:00
SYN_BM	ANJM	NAM_GPS08A	45.2757	1.34	0	0 0 1	2008-08-04 00:00
SYN_BM	ANJM	NAM_GPS08A	0.0033	0.89	0	0 1 0	2008-08-04 00:00
SYN_BM	ANJM	NAM_GPS08A	-0.0033	0.89	0	1 0 0	2008-08-04 00:00
SYN_BM	MODD	NAM_GPS08A	47.5640	1.34	0	0 0 1	2008-08-04 00:00
SYN_BM	MODD	NAM_GPS08A	0.0016	0.89	0	0 1 0	2008-08-04 00:00
SYN_BM	MODD	NAM_GPS08A	-0.0005	0.89	0	1 0 0	2008-08-04 00:00
SYN_BM	AME1	NAM_GPS08B	48.1459	1.35	0	0 0 1	2008-10-19 23:51
SYN_BM	AME1	NAM_GPS08B	0.0001	0.89	0	0 1 0	2008-10-19 23:51
SYN_BM	AME1	NAM_GPS08B	-0.0055	0.89	0	1 0 0	2008-10-19 23:51
SYN_BM	ANJM	NAM_GPS08B	45.2744	1.35	0	0 0 1	2008-10-19 23:51
SYN_BM	ANJM	NAM_GPS08B	0.0034	0.89	0	0 1 0	2008-10-19 23:51
SYN_BM	ANJM	NAM_GPS08B	-0.0034	0.89	0	1 0 0	2008-10-19 23:51
SYN_BM	MODD	NAM_GPS08B	47.5638	1.35	0	0 0 1	2008-10-19 23:51
SYN_BM	MODD	NAM_GPS08B	0.0015	0.89	0	0 1 0	2008-10-19 23:51
SYN_BM	MODD	NAM_GPS08B	-0.0006	0.89	0	1 0 0	2008-10-19 23:51

SYN_BM	AME1	07_2009	48.1408	1.36	0	0 0 1	2009-06-26 00:00
SYN_BM	AME1	07_2009	0.0007	0.89	0	0 1 0	2009-06-26 00:00
SYN_BM	AME1	07_2009	-0.0035	0.89	0	1 0 0	2009-06-26 00:00
SYN_BM	ANJM	07_2009	45.2710	1.36	0	0 0 1	2009-06-26 00:00
SYN_BM	ANJM	07_2009	0.0029	0.89	0	0 1 0	2009-06-26 00:00
SYN_BM	ANJM	07_2009	-0.0013	0.89	0	1 0 0	2009-06-26 00:00
SYN_BM	MODD	07_2009	47.5633	1.36	0	0 0 1	2009-06-26 00:00
SYN_BM	MODD	07_2009	0.0016	0.89	0	0 1 0	2009-06-26 00:00
SYN_BM	MODD	07_2009	0.0006	0.89	0	1 0 0	2009-06-26 00:00
SYN_BM	AME1	NAM_GPS10	48.1345	1.38	0	0 0 1	2010-08-13 00:00
SYN_BM	AME1	NAM_GPS10	-0.0001	0.90	0	0 1 0	2010-08-13 00:00
SYN_BM	AME1	NAM_GPS10	-0.0007	0.90	0	1 0 0	2010-08-13 00:00
SYN_BM	ANJM	NAM_GPS10	45.2662	1.38	0	0 0 1	2010-08-13 00:00
SYN_BM	ANJM	NAM_GPS10	0.0014	0.90	0	0 1 0	2010-08-13 00:00
SYN_BM	ANJM	NAM_GPS10	-0.0003	0.90	0	1 0 0	2010-08-13 00:00
SYN_BM	MODD	NAM_GPS10	47.5596	1.38	0	0 0 1	2010-08-13 00:00
SYN_BM	MODD	NAM_GPS10	0.0014	0.90	0	0 1 0	2010-08-13 00:00
SYN_BM	MODD	NAM_GPS10	0.0003	0.90	0	1 0 0	2010-08-13 00:00
SYN_BM	AME1	NAM_GPS11	48.1286	1.39	0	0 0 1	2011-05-18 00:00
SYN_BM	AME1	NAM_GPS11	-0.0005	0.90	0	0 1 0	2011-05-18 00:00
SYN_BM	AME1	NAM_GPS11	0.0010	0.90	0	1 0 0	2011-05-18 00:00
SYN_BM	ANJM	NAM_GPS11	45.2643	1.39	0	0 0 1	2011-05-18 00:00
SYN_BM	ANJM	NAM_GPS11	0.0007	0.90	0	0 1 0	2011-05-18 00:00
SYN_BM	ANJM	NAM_GPS11	0.0006	0.90	0	1 0 0	2011-05-18 00:00
SYN_BM	MODD	NAM_GPS11	47.5574	1.39	0	0 0 1	2011-05-18 00:00
SYN_BM	MODD	NAM_GPS11	0.0010	0.90	0	0 1 0	2011-05-18 00:00
SYN_BM	MODD	NAM_GPS11	0.0006	0.90	0	1 0 0	2011-05-18 00:00
SYN_BM	AME1	NAM_GPS11L	48.1257	1.39	0	0 0 1	2011-09-23 00:00
SYN_BM	AME1	NAM_GPS11L	-0.0009	0.90	0	0 1 0	2011-09-23 00:00
SYN_BM	AME1	NAM_GPS11L	0.0015	0.90	0	1 0 0	2011-09-23 00:00
SYN_BM	ANJM	NAM_GPS11L	45.2623	1.39	0	0 0 1	2011-09-23 00:00
SYN_BM	ANJM	NAM_GPS11L	-0.0006	0.90	0	0 1 0	2011-09-23 00:00
SYN_BM	ANJM	NAM_GPS11L	0.0005	0.90	0	1 0 0	2011-09-23 00:00
SYN_BM	MODD	NAM_GPS11L	47.5570	1.39	0	0 0 1	2011-09-23 00:00
SYN_BM	MODD	NAM_GPS11L	0.0002	0.90	0	0 1 0	2011-09-23 00:00
SYN_BM	MODD	NAM_GPS11L	0.0004	0.90	0	1 0 0	2011-09-23 00:00
SYN_BM	AME1	NAM_GPS11P	48.1257	1.39	0	0 0 1	2011-09-29 00:00
SYN_BM	AME1	NAM_GPS11P	-0.0008	0.90	0	0 1 0	2011-09-29 00:00
SYN_BM	AME1	NAM_GPS11P	0.0014	0.90	0	1 0 0	2011-09-29 00:00
SYN_BM	ANJM	NAM_GPS11P	45.2630	1.39	0	0 0 1	2011-09-29 00:00
SYN_BM	ANJM	NAM_GPS11P	-0.0004	0.90	0	0 1 0	2011-09-29 00:00
SYN_BM	ANJM	NAM_GPS11P	0.0007	0.90	0	1 0 0	2011-09-29 00:00
SYN_BM	MODD	NAM_GPS11P	47.5570	1.39	0	0 0 1	2011-09-29 00:00
SYN_BM	MODD	NAM_GPS11P	0.0007	0.90	0	0 1 0	2011-09-29 00:00

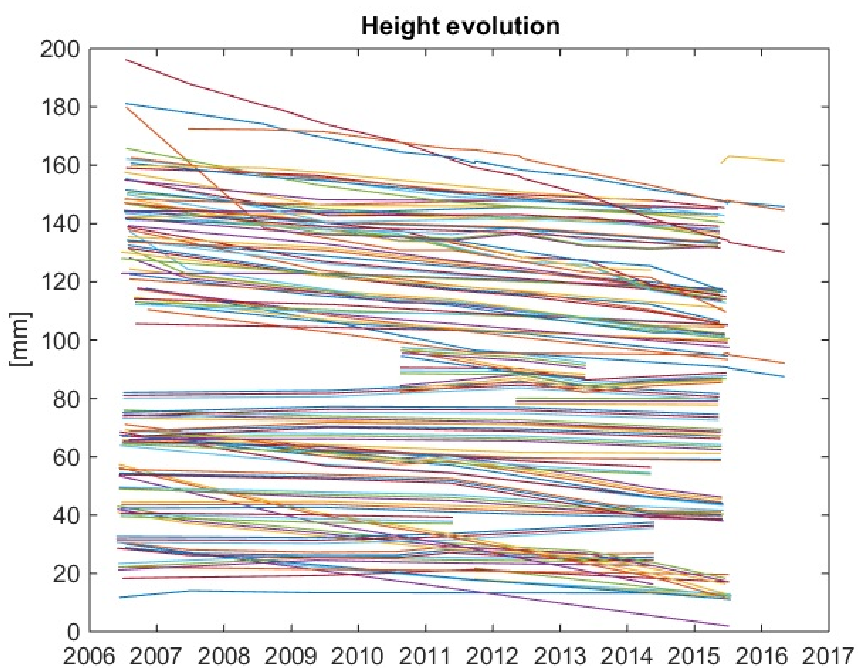
SYN_BM	MODD	NAM_GPS11P	0.0007	0.90	0	1 0 0	2011-09-29 00:00
SYN_BM	AME1	NAM_GPS12W	48.1228	1.39	0	0 0 1	2012-05-21 00:00
SYN_BM	AME1	NAM_GPS12W	-0.0008	0.91	0	0 1 0	2012-05-21 00:00
SYN_BM	AME1	NAM_GPS12W	0.0025	0.91	0	1 0 0	2012-05-21 00:00
SYN_BM	ANJM	NAM_GPS12W	45.2601	1.39	0	0 0 1	2012-05-21 00:00
SYN_BM	ANJM	NAM_GPS12W	-0.0007	0.91	0	0 1 0	2012-05-21 00:00
SYN_BM	ANJM	NAM_GPS12W	0.0012	0.91	0	1 0 0	2012-05-21 00:00
SYN_BM	MODD	NAM_GPS12W	47.5549	1.39	0	0 0 1	2012-05-21 00:00
SYN_BM	MODD	NAM_GPS12W	0.0008	0.91	0	0 1 0	2012-05-21 00:00
SYN_BM	MODD	NAM_GPS12W	0.0009	0.91	0	1 0 0	2012-05-21 00:00
SYN_BM	AME1	NAM_GPS12L	48.1219	1.39	0	0 0 1	2012-06-20 00:00
SYN_BM	AME1	NAM_GPS12L	-0.0011	0.91	0	0 1 0	2012-06-20 00:00
SYN_BM	AME1	NAM_GPS12L	0.0034	0.91	0	1 0 0	2012-06-20 00:00
SYN_BM	ANJM	NAM_GPS12L	45.2598	1.39	0	0 0 1	2012-06-20 00:00
SYN_BM	ANJM	NAM_GPS12L	-0.0007	0.91	0	0 1 0	2012-06-20 00:00
SYN_BM	ANJM	NAM_GPS12L	0.0014	0.91	0	1 0 0	2012-06-20 00:00
SYN_BM	MODD	NAM_GPS12L	47.5539	1.39	0	0 0 1	2012-06-20 00:00
SYN_BM	MODD	NAM_GPS12L	0.0008	0.91	0	0 1 0	2012-06-20 00:00
SYN_BM	MODD	NAM_GPS12L	0.0011	0.91	0	1 0 0	2012-06-20 00:00
SYN_BM	AME1	NAM_GPS13	48.1164	1.40	0	0 0 1	2013-05-17 00:00
SYN_BM	AME1	NAM_GPS13	-0.0010	0.91	0	0 1 0	2013-05-17 00:00
SYN_BM	AME1	NAM_GPS13	0.0043	0.91	0	1 0 0	2013-05-17 00:00
SYN_BM	ANJM	NAM_GPS13	45.2575	1.40	0	0 0 1	2013-05-17 00:00
SYN_BM	ANJM	NAM_GPS13	-0.0018	0.91	0	0 1 0	2013-05-17 00:00
SYN_BM	ANJM	NAM_GPS13	0.0026	0.91	0	1 0 0	2013-05-17 00:00
SYN_BM	MODD	NAM_GPS13	47.5493	1.40	0	0 0 1	2013-05-17 00:00
SYN_BM	MODD	NAM_GPS13	-0.0002	0.91	0	0 1 0	2013-05-17 00:00
SYN_BM	MODD	NAM_GPS13	0.0005	0.91	0	1 0 0	2013-05-17 00:00
SYN_BM	AME1	NAM_GPS14	48.1082	1.41	0	0 0 1	2014-05-13 00:00
SYN_BM	AME1	NAM_GPS14	-0.0003	0.91	0	0 1 0	2014-05-13 00:00
SYN_BM	AME1	NAM_GPS14	0.0057	0.91	0	1 0 0	2014-05-13 00:00
SYN_BM	ANJM	NAM_GPS14	45.2533	1.41	0	0 0 1	2014-05-13 00:00
SYN_BM	ANJM	NAM_GPS14	-0.0038	0.91	0	0 1 0	2014-05-13 00:00
SYN_BM	ANJM	NAM_GPS14	0.0030	0.91	0	1 0 0	2014-05-13 00:00
SYN_BM	MODD	NAM_GPS14	47.5448	1.41	0	0 0 1	2014-05-13 00:00
SYN_BM	MODD	NAM_GPS14	-0.0016	0.91	0	0 1 0	2014-05-13 00:00
SYN_BM	MODD	NAM_GPS14	0.0001	0.91	0	1 0 0	2014-05-13 00:00
SYN_BM	AME1	NAM_GPS15W	48.1013	1.41	0	0 0 1	2015-05-27 00:00
SYN_BM	AME1	NAM_GPS15W	0.0004	0.91	0	0 1 0	2015-05-27 00:00
SYN_BM	AME1	NAM_GPS15W	0.0066	0.91	0	1 0 0	2015-05-27 00:00
SYN_BM	ANJM	NAM_GPS15W	45.2495	1.41	0	0 0 1	2015-05-27 00:00
SYN_BM	ANJM	NAM_GPS15W	-0.0052	0.91	0	0 1 0	2015-05-27 00:00
SYN_BM	ANJM	NAM_GPS15W	0.0024	0.91	0	1 0 0	2015-05-27 00:00
SYN_BM	MODD	NAM_GPS15W	47.5393	1.41	0	0 0 1	2015-05-27 00:00
SYN_BM	MODD	NAM_GPS15W	-0.0028	0.91	0	0 1 0	2015-05-27 00:00
SYN_BM	MODD	NAM_GPS15W	-0.0009	0.91	0	1 0 0	2015-05-27 00:00
SYN_BM	AMEL	NAM_GPS15W	60.6342	1.41	0	0 0 1	2015-05-27 00:00
SYN_BM	AMEL	NAM_GPS15W	0.0001	0.91	0	0 1 0	2015-05-27 00:00
SYN_BM	AMEL	NAM_GPS15W	0.0000	0.91	0	1 0 0	2015-05-27 00:00
SYN_BM	AME-2	NAM_GPS15W	69.6757	1.41	0	0 0 1	2015-05-27 00:00
SYN_BM	AWG-1	NAM_GPS15W	79.3147	1.41	0	0 0 1	2015-05-27 00:00
SYN_BM	AME1	NAM_GPS15L	48.1008	1.41	0	0 0 1	2015-07-01 00:00
SYN_BM	AME1	NAM_GPS15L	0.0010	0.91	0	0 1 0	2015-07-01 00:00
SYN_BM	AME1	NAM_GPS15L	0.0060	0.91	0	1 0 0	2015-07-01 00:00
SYN_BM	ANJM	NAM_GPS15L	45.2485	1.41	0	0 0 1	2015-07-01 00:00
SYN_BM	ANJM	NAM_GPS15L	-0.0049	0.91	0	0 1 0	2015-07-01 00:00
SYN_BM	ANJM	NAM_GPS15L	0.0019	0.91	0	1 0 0	2015-07-01 00:00
SYN_BM	MODD	NAM_GPS15L	47.5396	1.41	0	0 0 1	2015-07-01 00:00
SYN_BM	MODD	NAM_GPS15L	-0.0023	0.91	0	0 1 0	2015-07-01 00:00
SYN_BM	MODD	NAM_GPS15L	-0.0023	0.91	0	1 0 0	2015-07-01 00:00
SYN_BM	AMEL	NAM_GPS15L	60.6360	1.41	0	0 0 1	2015-07-01 00:00
SYN_BM	AMEL	NAM_GPS15L	-0.0003	0.91	0	0 1 0	2015-07-01 00:00
SYN_BM	AMEL	NAM_GPS15L	0.0000	0.91	0	1 0 0	2015-07-01 00:00
SYN_BM	AME-2	NAM_GPS15L	69.6755	1.41	0	0 0 1	2015-07-01 00:00
SYN_BM	AWG-1	NAM_GPS15L	79.3154	1.41	0	0 0 1	2015-07-01 00:00
SYN_BM	AME1	NAM_GPS15O	48.1001	1.41	0	0 0 1	2015-07-09 00:00
SYN_BM	AME1	NAM_GPS15O	0.0008	0.91	0	0 1 0	2015-07-09 00:00
SYN_BM	AME1	NAM_GPS15O	0.0064	0.91	0	1 0 0	2015-07-09 00:00
SYN_BM	ANJM	NAM_GPS15O	45.2491	1.41	0	0 0 1	2015-07-09 00:00
SYN_BM	ANJM	NAM_GPS15O	-0.0048	0.91	0	0 1 0	2015-07-09 00:00
SYN_BM	ANJM	NAM_GPS15O	0.0020	0.91	0	1 0 0	2015-07-09 00:00
SYN_BM	MODD	NAM_GPS15O	47.5395	1.41	0	0 0 1	2015-07-09 00:00
SYN_BM	MODD	NAM_GPS15O	-0.0026	0.91	0	0 1 0	2015-07-09 00:00
SYN_BM	MODD	NAM_GPS15O	-0.0019	0.91	0	1 0 0	2015-07-09 00:00
SYN_BM	AMEL	NAM_GPS15O	60.6364	1.41	0	0 0 1	2015-07-09 00:00
SYN_BM	AMEL	NAM_GPS15O	0.0000	0.91	0	0 1 0	2015-07-09 00:00
SYN_BM	AMEL	NAM_GPS15O	0.0002	0.91	0	1 0 0	2015-07-09 00:00
SYN_BM	AME-2	NAM_GPS15O	69.6752	1.41	0	0 0 1	2015-07-09 00:00
SYN_BM	AWG-1	NAM_GPS15O	79.3147	1.41	0	0 0 1	2015-07-09 00:00
SYN_BM	AME1	NAM_TMP16	48.0968	1.42	0	0 0 1	2016-05-01 00:00
SYN_BM	AME1	NAM_TMP16	0.0011	0.92	0	0 1 0	2016-05-01 00:00
SYN_BM	AME1	NAM_TMP16	0.0076	0.92	0	1 0 0	2016-05-01 00:00
SYN_BM	ANJM	NAM_TMP16	45.2474	1.42	0	0 0 1	2016-05-01 00:00
SYN_BM	ANJM	NAM_TMP16	-0.0063	0.92	0	0 1 0	2016-05-01 00:00
SYN_BM	ANJM	NAM_TMP16	0.0020	0.92	0	1 0 0	2016-05-01 00:00
SYN_BM	MODD	NAM_TMP16	47.5363	1.42	0	0 0 1	2016-05-01 00:00
SYN_BM	MODD	NAM_TMP16	-0.0033	0.92	0	0 1 0	2016-05-01 00:00
SYN_BM	MODD	NAM_TMP16	-0.0021	0.92	0	1 0 0	2016-05-01 00:00

```
SYN_BM      AMEL        NAM_TMP16     60.6348       1.42   0    0 0 1  2016-05-01 00:00
SYN_BM      AMEL        NAM_TMP16      0.0006       0.92   0    0 1 0  2016-05-01 00:00
SYN_BM      AMEL        NAM_TMP16      0.0001       0.92   0    1 0 0  2016-05-01 00:00
SYN_BM      AME-2       NAM_TMP16     69.6723       1.42   0    0 0 1  2016-05-01 00:00
SYN_BM      AWG-1       NAM_TMP16     79.3119       1.42   0    0 0 1  2016-05-01 00:00
```

Plot output

```
pnts=unique(sdobstable(:,2));

figure;
for k=1:numel(pnts)
   idx=find( sdobstable(:,2)==pnts(k) & sensitivity(:,3));
   plot(epoch(idx),(sdobs(idx)-mean(sdobs(idx)))*1000+k+12)
   hold on
end
title('Height evolution')
datetick('x')
ylabel('[mm]')
```

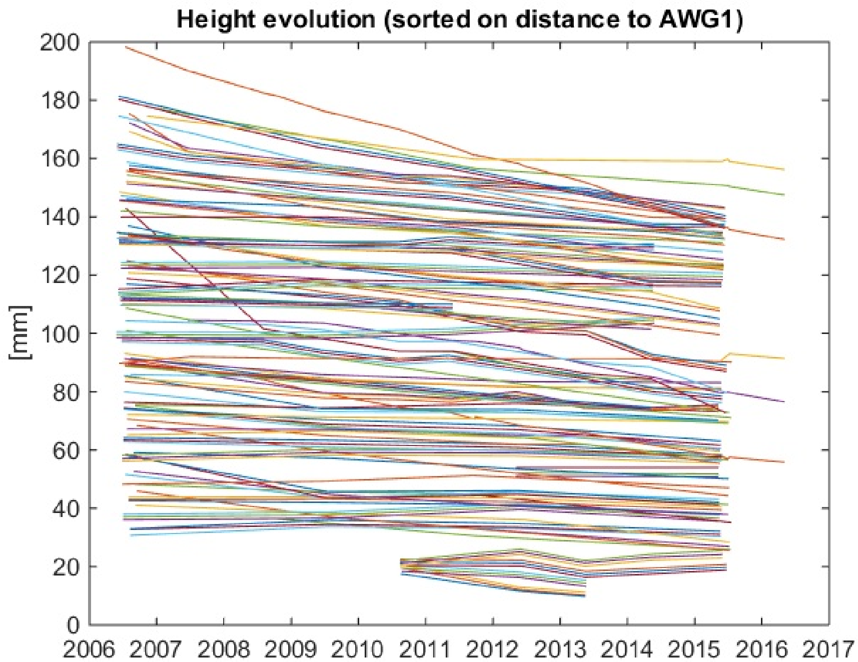


Idem, sorted on distance to AWG1

```
AWG1=[191778.768 611827.827];
dist=sqrt((pntcrd(pnts,1)-AWG1(1)).^2+(pntcrd(pnts,2)-AWG1(2)).^2);
[~,isrt]=sort(dist,'descend');
pnts=pnts(isrt);

figure;
for k=1:numel(pnts)
   idx=find( sdobstable(:,2)==pnts(k) & sensitivity(:,3));
   plot(epoch(idx),(sdobs(idx)-mean(sdobs(idx)))*1000+k+12)
```

```
   hold on
end
title('Height evolution (sorted on distance to AWG1)')
datetick('x')
ylabel('[mm]')
```



Idem, sorted on distance to AWG1, flagged data removed

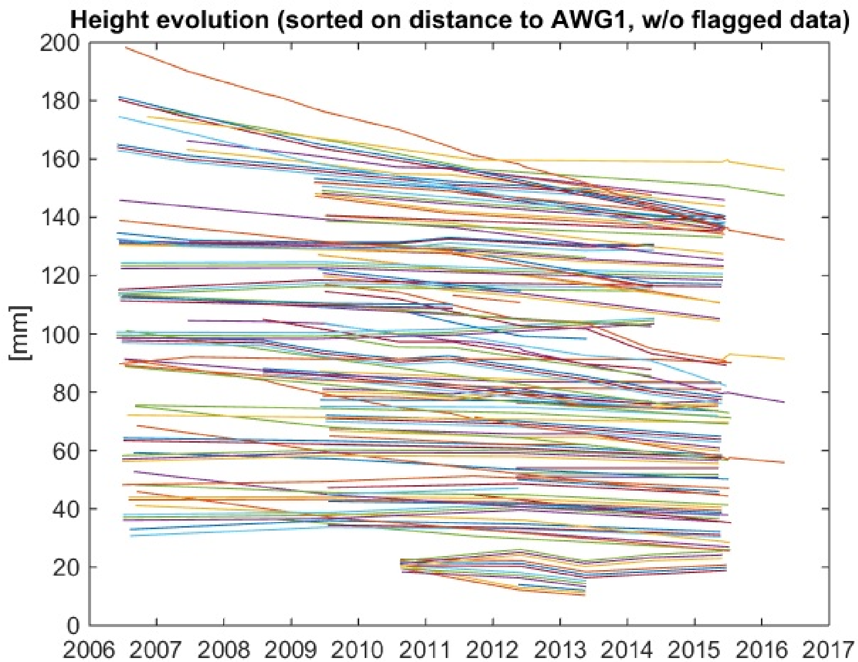
```
idx=(sdobsflag==0);
sdobstable2=sdobstable(idx,:);
```

```
sdobs2=sdobs(idx);
sensitivity2=sensitivity(idx,:);
epoch2=epoch(idx);

pnts=unique(sdobstable2(:,2));

AWG1=[191778.768 611827.827];
dist=sqrt((pntcrd(pnts,1)-AWG1(1)).^2+(pntcrd(pnts,2)-AWG1(2)).^2);
[~,isrt]=sort(dist,'descend');
pnts=pnts(isrt);

figure;
for k=1:numel(pnts)
   idx=find( sdobstable2(:,2)==pnts(k) & sensitivity2(:,3));
   plot(epoch2(idx),(sdobs2(idx)-mean(sdobs2(idx)))*1000+k+12)
   hold on
end
title('Height evolution (sorted on distance to AWG1, w/o flagged data)')
datetick('x')
ylabel('[mm]')
```

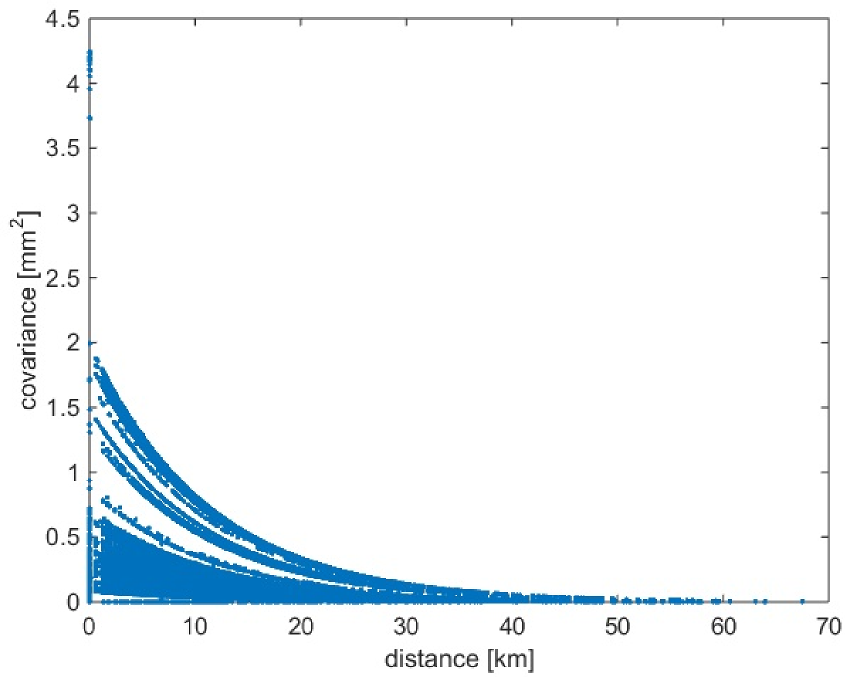


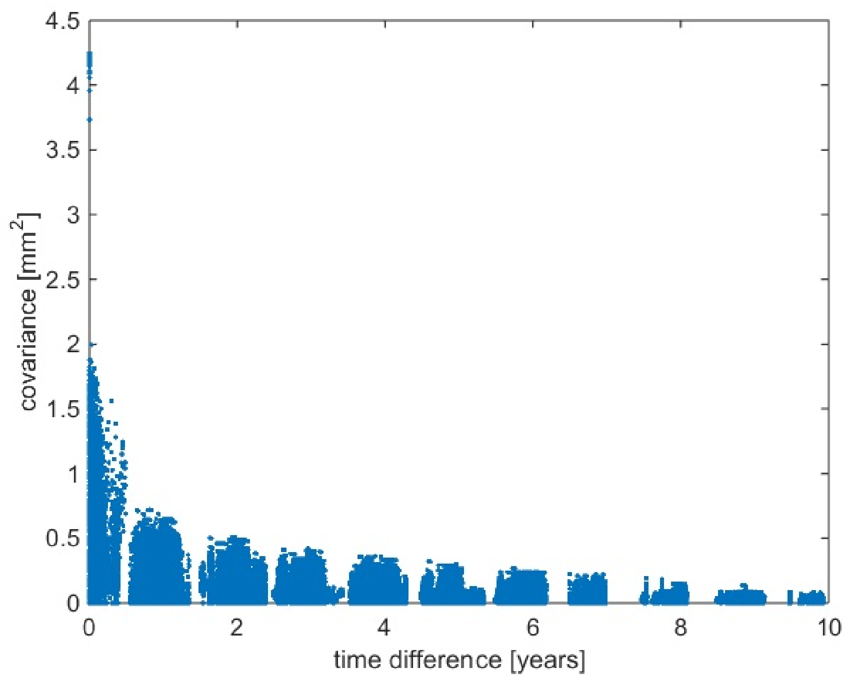
Plot covariances

```
numobs=size(sdcov,1);
distvec=zeros(numobs*(numobs-1)/2,1);
timevec=zeros(numobs*(numobs-1)/2,1);
covvec=zeros(numobs*(numobs-1)/2,1);
kk=0;
for k=1:numobs
    for l=1:k-1
      kk=kk+1;
      pntk=sdobstable(k,2);
      pntl=sdobstable(l,2);
      distvec(kk,1)=sqrt((pntcrd(pntl,1)-pntcrd(pntk,1)).^2+(pntcrd(pntl,2)-pntcrd(pntk,2)).^2);
      timevec(kk,1)=abs(epoch(l)-epoch(k));
      covvec(kk,1)=sdcov(k,l);
    end
end
```

```
figure;
plot(distvec./1000,covvec.*1e6,'.')
ylabel('covariance [mm^2]')
xlabel('distance [km]')

figure;
plot(timevec./365,covvec.*1e6,'.')
ylabel('covariance [mm^2]')
xlabel('time difference [years]')
```

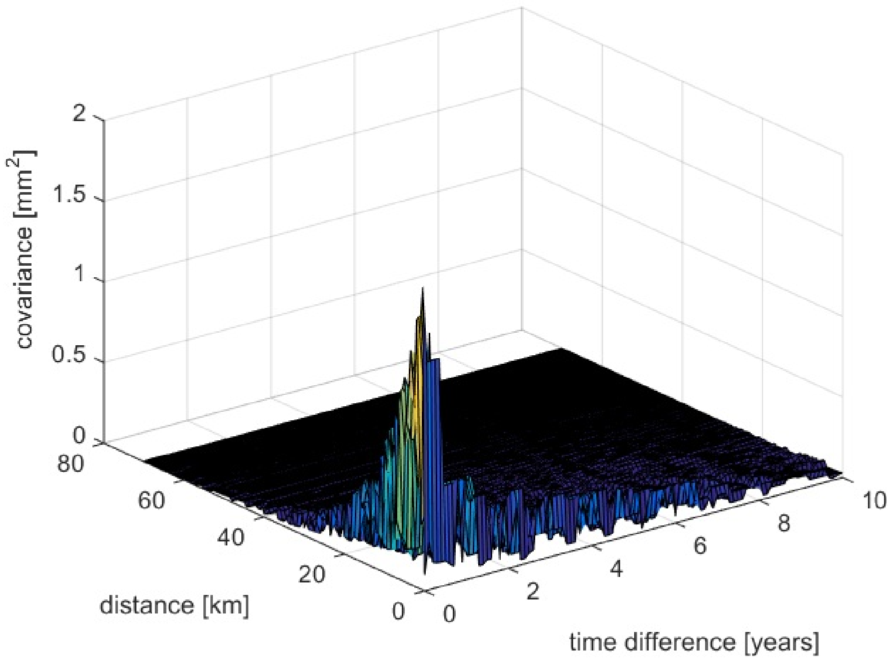





```
figure
[xi,yi] = meshgrid(0:.1:10, 0:.5:70);
zi = griddata(timevec./365,distvec./1000,covvec.*1e6,xi,yi,'nearest');
surf(xi,yi,zi);
xlabel('time difference [years]')
ylabel('distance [km]')
zlabel('covariance [mm^2]')
```

```
Warning: Duplicate data points have been detected and removed - corresponding
```

```
values have been averaged.
```



End of script

```
fprintf('lts2_gps.m done\n');
```

```
lts2_gps.m done
```

Published with MATLAB® R2014b

Contents lts2_gps_reducecluster.m

- NAM LTS2 main GPS script
- Set up the configuration parameters and input files (USER INPUT)
- Load the GPS data
- Analyze the cluster data
- Select output mode: all benchmarks or only one per cluster
- Make GPS covariance matrix
- Output netcdf
- update point class
- Text output
- Plot output
- Idem, sorted on distance to AWG1
- Idem, sorted on distance to AWG1, flagged data removed
- Plot covariances
- End of script

NAM LTS2 main GPS script

```
This script is the main script for preparing the GPS data for the NAM
LTS2 project. It does the following:

- reads the comma separated ascii input files with GPS campaign data
  generated from the NAM database
- reads the comma separated ascii input files with GPS CORS observations
  computed by |lts2_gpscors.m| script for the analysis of GPS CORS timeseries
- sort out the projects
- sort out the point clusters
- print point, project and cluster statistics
- computes the GPS covariance matrix for the GPS campaign and CORS data
- output the netcdf interface format
- do some printing and plotting for checking purposes

It calls various functions to do the main work.

See also GPSGETPNTDATA, GPSGETOBSDATA, GPSPRJSTATS, GPSPNTSTATS,
GPSCLUSTERSTATS, GPSCOV1, GPSTEMPORALCOV, GPSSPATIALCOV, GPSSETUPCOV,


WRITELTS2NETCDF and LTS2_GPSCORS.

(c) Hans van der Marel, Delft University of Technology, 2016.
```

```
%   Created:    10 August 2016 by Hans van der Marel
%   Modified:   26 August 2016 by Hans van der Marel
%                  - split into functions
%                  - added CORS data and other components
%                  - added netcdf output
%                  - all configuration parameters moved to config
%               14 September 2016 by Hans van der Marel
%                  - minor bug fixing following testing with CORS data and
%                    other components
%                  - added printing and plotting of observations and
%                    covariances for sensibility checks
%                  - make all point and project names uppercase
%                  - implemented new covariance matrix options
%               14 October 2016 by Hans van der Marel
%                  - added call to updpntclasslts2netcdf (instead of
%                    running as seperate script)
%                9 November 2016 by Hans van der Marel
%                  - modified terms of use

clear all
close all
clc

% Set path to required toolboxes

lts2toolboxdir=fullfile('..','lts2toolbox');

addpath(fullfile(lts2toolboxdir,'lts2'));
addpath(fullfile(lts2toolboxdir,'sdwil'));
```

Set up the configuration parameters and input files (USER INPUT)

```
% Input files

campaignonly=false;     % make this true if you want to analyze only campaign data
if campaignonly
  config.gpspntfiles={'gpscampaigns_pnt.csv'};          % gps point input file(s)
  config.gpscampobsfiles={'gpscampaigns_obs_alt.csv'};  % gps campaign observation file(s)
```

```
  config.gpscorsobsfiles={};                            % gps CORS observation file(s)
else
  config.gpspntfiles={'gpscampaigns_pnt.csv','gpscors_pnt_renamed.csv'};   % gps point input file(s)
  config.gpscampobsfiles={'gpscampaigns_obs_seasonal_corrected.csv'};  % gps campaign observation file(s)
  config.gpscorsobsfiles={'gpscors_obs_renamed.csv'};   % gps CORS observation file(s)
end

% Main output options

config.reducecluster=true;                              % if true, redundant cluster benchmarks will be removed from the observatiosns
config.updateflags=true;                                % if true, update observations flags with results from single difference analys
is

% Parameters for cluster analysis

config.clusteranalysis.maxres=0.0004;                   % observations with residuals > maxres will be flagged
config.clusteranalysis.maxiter=7;                       % maximum number of iterations for outlier detection

% Parameters for the up co-variance matrix

config.gpscov(3).SWmodel=6;         % Simon Williams model number for temporal covariance
config.gpscov(3).rho=0.0887;        % Exponential decay [1/km] for spatial correlation
config.gpscov(3).setupnoise=0.0015; % Setup standard deviation [m] for campaign stations
config.gpscov(3).setuplevellingnoise=0.0003; % Standard deviation for the levelling between cluster benchmarks
config.gpscov(3).doplots=false;     % Plotting for debugging purposes

% Parameters for the east co-variance matrix

config.gpscov(2).SWmodel=7;         % Simon Williams model number for temporal covariance
config.gpscov(2).rho=0.1291;        % Exponential decay [1/km] for spatial correlation
config.gpscov(2).doplots=false;     % Plotting for debugging purposes

% Parameters for the north co-variance matrix

config.gpscov(1).SWmodel=7;         % Simon Williams model number for temporal covariance
config.gpscov(1).rho=0.0827;        % Exponential decay [1/km] for spatial correlation
config.gpscov(1).doplots=false;     % Plotting for debugging purposes

% Covariance computation method

config.covcompmethod='common_project_date';
config.ignoreclustercorrelation=false;

% Output netcdf file and global netcdf attributes
```

```
if config.reducecluster
   netcdf_file='lts2_allgps_cluster.nc';
else
   netcdf_file='lts2_allgps.nc';
end
globalattributes = { ...
  'title'        , 'GPS height differences for the NAM LTS2 project.'  ; ...
  'institution'  , 'Delft University of Technology, Netherlands.' ; ...
  'source'       , 'Nederlandse Aardolie Maatschappij (NAM) GPS height database.' ; ...
  'technique'    , 'GPS' ; ...
  'history'      , ' ' ; ...
  'references'   , 'TU Delft, NAM LTS2 Report, 2016 (in preparation).' ; ...
  'comment'      , ' ' ; ...
  'Conventions'  , 'CF-1.6' ; ...
  'featureType'  , 'timeSeries' ; ...
  'email'        , 'h.vandermarel@tudelft.nl' ; ...
  'version'      , '1.0' ; ...
  'terms_for_use', 'These data have been prepared for: Nederlandse Aardolie Maatschappij (NAM). Any use by third parties requires explic
it approval by NAM.' ; ...
  'disclaimer'   , 'This data is made available in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied w
arranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.' ; ...
};


% END OF USER INPUT (no further changes should be necessary)
```

Load the GPS data

```
The GPS campaign data is loaded

- Reads the ascii point and observation files
- Convert meandate and duration to Matlab datenumbers, with start and stop
- Makes project data and print a table with project data
- Computes observation indices to the point and project data arrays
- Analyze the point data and print a table with point data
- Analyze the point clusters and print two tables with cluster information

Observation variables:

numobs         number of observations (scalar)

obsindex(:,1)  index to pntnames and pntdata
```

```
obsindex(:,2)  index to prjnames and prjstats *)

obs(:)         the observations (height)

obsstats(:,1)  observation start date (Matlab date number)
obsstats(:,2)  observation end date (Matlab date number)
obsstats(:,3)  mean epoch (Matlab date number)
obsstats(:,4)  observation duration (days)
obsstats(:,5)  observation flag (0=reliable, 1,2,...=unreliable)
obsstats(:,6)  CORS station indicator (1=CORS, 0=campaign)
obsstats(:,7)  observed component (1=North, 2=East, 3=Up)

The number of rows (leading dimension) is the number of observations numobs

Project variables:

numprj         number of projects (scalar)

prjname(:)     cell array with the project name

prjstats(:,1)  project start date (Matlab date number)
prjstats(:,2)  project end date (Matlab date number)
prjstats(:,3)  mean epoch (Matlab date number)
prjstats(:,4)  mean observation duration (days)
prjstats(:,5)  number of observations in the project
prjstats(:,6)  number of useful observations in project (as set by use flag)

The number of rows (leading dimension) is the number of projects numprj

Point variables:

numpnt         number of points (scalar)

pntname(:)     cell array with the point name

pntcrd(:,1)    array with x-coordinate in Rijksdriehoekstelsel [m]
pntcrd(:,2)    array with y-coordinate in Rijksdriehoekstelsel [m]

cluster_id(:)  point cluster id

pntstats(:,1)  First observation for this point (Matlab date number)


pntstats(:,2)  Last observation for this point (Matlab date number)
pntstats(:,3)  mean epoch of observation (Matlab date number)
pntstats(:,4)  mean observation duration (days)
pntstats(:,5)  number of observations for the point
pntstats(:,6)  number of useful observations for the point (as set by use flag)

The number of rows (leading dimension) is the number of points numpnt

Cluster variables:

numcluster         number of point clusters (scalar)
maxclusterpnts     maximum number of points per cluster (scalar, is computed)

clustername(:)     cell array with the cluster name
clusterpntadm(:,1) number of points per cluster
clusterpntadm(:,1:maxclusterpnts)   index to pntname and pntstats, or NaN

clustercoord(:,1)  RD x-coordinate of the cluster
clustercoord(:,2)  RD y-coordinate of the cluster

clusterstats(:,1)  First observation for this cluster (Matlab date number)
clusterstats(:,2)  Last observation for this cluster (Matlab date number)
clusterstats(:,3)  mean epoch of observation (Matlab date number)
clusterstats(:,4)  mean observation duration for the cluster points (days)
clusterstats(:,5)  number of projects for the cluster (with at least one
                   point of the cluster observed)
clusterstats(:,6)  number of observations for the cluster (all points included)
clusterstats(:,7)  number of useful observations for the cluster (as set by use flag)

The number of rows (leading dimension) is the number of clusters numcluster
```

```
% Read ascii point files

[pntname,pntcrd,cluster_id] = gpsgetpntdata(config.gpspntfiles);

% Read ascii observation files and compute observations statistics

[pntname_obs,prjname_obs,obs,obsstats] = ...
     gpsgetobsdata(config.gpscampobsfiles,config.gpscorsobsfiles);

% Make project data
```

```
[prjname,prjstats,prjclass]=gpsprjstats(prjname_obs,obsstats);

% Analyze the point data

[pntstats,pntclass]=gpspntstats(pntname,pntname_obs,obsstats);

% Compute observation indexes

obsindex(:,1)=mkindex(pntname_obs,pntname);
obsindex(:,2)=mkindex(prjname_obs,prjname);


% Compute cluster names, index, statistics and coordinates

[clustername,clusterstats,clusterpntadm]=gpsclusterstats(pntname,cluster_id,...
       obsindex,obsstats);
clustercrd=pntcrd(clusterpntadm(:,2),:);  % coordinates of first point in cluster

% Count the point, projects, observations and clusters

numobs=size(obsindex,1);
numpnt=numel(pntname);
numprj=numel(prjname);
numcluster=numel(clustername);
```

```
We have duplicates in the point files...
gpscors_pnt_renamed.csv: AME-2 186841.780 610897.175 (186842.964 610897.745)
gpscors_pnt_renamed.csv: AWG-1 191778.768 611827.827 (191779.000 611828.000)

Project statistics (17 projects):

PRJNAME           START         END  MEAN_EPOCH #DAYS   MEAN  NUMOBS   USE  CLASS
                                                     _OBSTIME
NAM_GPS06    2006-05-28  2006-11-17  2006-07-17   173    3.8     128    83  GPS&CORS
NAM_GPS07    2007-06-13  2007-07-09  2007-06-21    26    5.5      19    19  GPS&CORS
NAM_GPS08A   2008-08-01  2008-08-07  2008-08-04     6    3.8      18    18  GPS&CORS
NAM_GPS08B   2008-10-16  2008-10-24  2008-10-20     8    5.0      12    12  GPS&CORS
07_2009      2009-05-08  2009-11-30  2009-06-26   206    5.3     122   122  GPS&CORS
NAM_GPS10    2010-07-29  2010-09-01  2010-08-13    34    3.8      40    40  GPS&CORS
NAM_GPS11    2011-05-05  2011-06-03  2011-05-18    29    4.1      66    66  GPS&CORS
NAM_GPS11L   2011-09-16  2011-09-29  2011-09-23    13    4.6      15    15  GPS&CORS
NAM_GPS11P   2011-09-25  2011-10-03  2011-09-29     8    5.1      11    11  GPS&CORS
NAM_GPS12W   2012-05-05  2012-06-10  2012-05-21    36    4.5      81    81  GPS&CORS


NAM_GPS12L   2012-06-15  2012-06-28  2012-06-20    13    4.2      17    17  GPS&CORS
NAM_GPS13    2013-05-09  2013-05-26  2013-05-17    17    3.6      45    45  GPS&CORS
NAM_GPS14    2014-04-30  2014-05-27  2014-05-13    27    3.3      67    67  GPS&CORS
NAM_GPS15W   2015-05-03  2015-06-23  2015-05-27    51    3.8     105   105  GPS&CORS
NAM_GPS15L   2015-06-26  2015-07-09  2015-07-01    13    4.4      22    22  GPS&CORS
NAM_GPS15O   2015-07-01  2015-07-21  2015-07-09    20    4.4      23    23  GPS&CORS
NAM_TMP16    2016-04-28  2016-05-04  2016-05-01     6    5.0      14    14  CORS


Benchmark statistics (154 points):

PNTNAME       FIRST_OBS    LAST_OBS  MEAN_EPOCH #YEAR   MEAN  NUMOBS   USE  CLASS
                                                     _OBSTIME
000A2592     2006-06-08  2015-07-21  2010-08-24   9.1    7.9       6     6  GPS
000A2632     2008-10-18  2008-10-23  2008-10-20   0.0    4.1       1     1  GPS
000A2683     2011-09-24  2015-07-06  2013-08-15   3.8    3.6       2     2  GPS
000A2686     2006-07-20  2015-07-07  2011-01-12   9.0    3.5       2     2  GPS
000A2687     2011-09-24  2015-07-16  2013-08-20   3.8    3.3       2     2  GPS
000A2688     2008-10-17  2015-07-13  2012-01-06   6.7    4.4       3     3  GPS
000A2689     2006-06-28  2015-07-06  2010-10-20   9.0    8.7       4     4  GPS
000A2691     2006-07-13  2015-07-16  2010-11-17   9.0    4.2       4     4  GPS
000A4025     2006-07-27  2015-07-06  2010-11-08   8.9    3.4       4     4  GPS
000A5025     2015-07-01  2015-07-06  2015-07-03   0.0    3.5       1     1  GPS
002C0026     2006-06-07  2014-05-20  2010-05-22   8.0    3.2       4     4  GPS
002C0027     2006-06-07  2014-05-20  2010-05-22   8.0    3.2       4     4  GPS
002C0028     2006-06-07  2014-05-20  2010-05-22   8.0    3.2       4     4  GPS
002C0029     2006-05-31  2014-05-25  2010-06-05   8.0    3.7       7     7  GPS
002C0030     2006-05-31  2014-05-25  2010-06-05   8.0    3.7       7     7  GPS
002C0031     2006-05-31  2014-05-25  2010-06-05   8.0    3.7       7     7  GPS
002C0033     2006-06-02  2015-06-18  2011-02-14   9.0    4.0       7     7  GPS
002C0034     2006-06-02  2015-06-18  2011-02-14   9.0    4.0       7     7  GPS
002C0035     2006-06-02  2015-06-18  2011-02-14   9.0    4.0       7     7  GPS
002C0064     2006-05-28  2014-05-27  2010-05-18   8.0    3.5       4     4  GPS
002C0065     2006-05-28  2014-05-27  2010-05-18   8.0    3.5       4     4  GPS
002C0066     2006-05-28  2014-05-27  2010-05-18   8.0    3.5       4     4  GPS
002D0048     2006-06-10  2015-06-15  2010-10-02   9.0    3.5       6     6  GPS
002D0049     2006-06-10  2015-06-15  2010-10-02   9.0    3.5       6     6  GPS
002D0050     2006-06-10  2014-05-21  2009-10-24   7.9    3.2       5     5  GPS
002D0054     2006-06-20  2011-05-28  2009-01-31   4.9    3.4       3     3  GPS
002D0055     2006-06-20  2011-05-28  2009-01-31   4.9    3.4       3     3  GPS
002D0056     2006-06-20  2011-05-28  2009-01-31   4.9    3.4       3     3  GPS
002D0059     2006-06-23  2015-06-01  2010-12-09   8.9    4.4       4     4  GPS
002D0060     2006-06-23  2015-06-01  2010-12-09   8.9    4.4       4     4  GPS
002D0061     2006-06-23  2015-06-01  2010-12-09   8.9    4.4       4     4  GPS
```

002D0066	2006-06-12	2015-06-06	2011-03-20	9.0	4.2	5	5	GPS
002D0067	2006-06-12	2015-06-06	2011-03-20	9.0	4.2	5	5	GPS
002D0068	2006-06-12	2015-06-06	2011-03-20	9.0	4.2	5	5	GPS
002D0079								
002D0102	2006-06-15	2015-05-25	2011-05-25	8.9	4.2	5	5	GPS
002D0103	2006-06-15	2015-05-25	2011-05-25	8.9	4.2	5	5	GPS
002D0104	2006-06-15	2015-05-25	2011-05-25	8.9	4.2	5	5	GPS
002D0105	2006-06-05	2006-06-10	2006-06-07	0.0	4.2	1	1	GPS
002D0106	2006-06-05	2006-06-10	2006-06-07	0.0	4.2	1	1	GPS
002D0107	2006-06-05	2006-06-10	2006-06-07	0.0	4.2	1	1	GPS
002D0108	2006-06-16	2015-06-04	2011-06-05	9.0	3.3	5	5	GPS
002D0109	2006-06-16	2015-06-04	2011-06-05	9.0	3.3	5	5	GPS
002D0110	2006-06-16	2015-06-04	2011-06-05	9.0	3.3	5	5	GPS
002G0042	2006-06-28	2015-05-29	2011-03-16	8.9	2.9	8	8	GPS
002G0043	2006-06-28	2015-05-29	2011-03-16	8.9	2.9	8	8	GPS
002G0044	2006-06-28	2015-05-29	2011-03-16	8.9	2.9	8	8	GPS
002G0048	2006-07-02	2014-05-07	2010-09-02	7.8	3.9	4	4	GPS
002G0049	2006-07-02	2014-05-07	2010-09-02	7.8	3.9	4	4	GPS
002G0050	2006-07-02	2014-05-07	2010-09-02	7.8	3.9	4	4	GPS
002G0124	2006-07-12	2015-05-23	2010-12-06	8.9	4.8	4	4	GPS
002G0125	2006-07-12	2015-05-23	2010-12-06	8.9	4.8	4	4	GPS
002G0126	2006-07-12	2015-05-23	2010-12-06	8.9	4.8	4	4	GPS
002H0032	2006-08-03	2015-05-26	2010-12-23	8.8	3.7	4	4	GPS
002H0033	2006-08-03	2015-05-26	2010-12-23	8.8	3.7	4	4	GPS
002H0034	2006-08-03	2015-05-26	2010-12-23	8.8	3.7	4	4	GPS
002H0035	2006-08-10	2015-05-20	2010-12-23	8.8	4.3	4	4	GPS
002H0036	2006-08-10	2015-05-20	2010-12-23	8.8	4.3	4	4	GPS
002H0037	2006-08-10	2015-05-20	2010-12-23	8.8	4.3	4	4	GPS
002H0038	2006-07-06	2015-05-27	2010-12-15	8.9	3.7	4	4	GPS
002H0039	2006-07-06	2015-05-27	2010-12-15	8.9	3.7	4	4	GPS
002H0040	2006-07-06	2015-05-27	2010-12-15	8.9	3.7	4	4	GPS
002H0042	2006-06-30	2015-05-11	2010-12-13	8.9	3.4	4	4	GPS
002H0043	2006-06-30	2015-05-11	2010-12-13	8.9	3.4	4	4	GPS
002H0044	2006-06-30	2015-05-11	2010-12-13	8.9	3.4	4	4	GPS
002H0048	2006-08-13	2006-08-20	2006-08-17	0.0	5.8	1	1	GPS
002H0048M	2012-05-07	2015-05-10	2013-11-07	3.0	3.6	2	2	GPS
002H0048N	2012-05-07	2015-05-10	2013-11-07	3.0	3.6	2	2	GPS
002H0048Z	2012-05-07	2015-05-10	2013-11-07	3.0	3.6	2	2	GPS
002H0057	2006-07-04	2015-05-15	2010-12-19	8.9	5.4	4	4	GPS
002H0058	2006-07-04	2015-05-15	2010-12-19	8.9	5.4	4	4	GPS
002H0059	2006-07-04	2015-05-15	2010-12-19	8.9	5.4	4	4	GPS
003C0122	2010-08-17	2015-05-29	2013-03-26	4.8	3.3	5	5	GPS
003C0123	2010-08-17	2015-05-29	2013-03-26	4.8	3.3	5	5	GPS
003C0124	2010-08-17	2015-05-29	2013-03-26	4.8	3.3	5	5	GPS
003D0138	2010-08-19	2015-06-23	2012-12-23	4.8	5.0	4	4	GPS
003D0139	2010-08-19	2015-06-23	2012-12-23	4.8	5.0	4	4	GPS
003D0140	2010-08-19	2015-06-23	2012-12-23	4.8	5.0	4	4	GPS
003G0187	2010-08-21	2013-05-16	2012-02-19	2.7	3.8	3	3	GPS
003G0188	2010-08-21	2013-05-16	2012-02-19	2.7	3.8	3	3	GPS
003G0189	2010-08-21	2013-05-16	2012-02-19	2.7	3.8	3	3	GPS
003G0196	2010-08-27	2013-05-20	2012-02-22	2.7	3.0	3	3	GPS
003G0197	2010-08-27	2013-05-20	2012-02-22	2.7	3.0	3	3	GPS
003G0198	2010-08-27	2013-05-20	2012-02-22	2.7	3.0	3	3	GPS
006B0021	2008-10-16	2008-10-22	2008-10-19	0.0	5.0	1	1	GPS
006E0193								
006E0216								
006E0239								
AME-2	2006-10-30	2016-05-04	2013-01-10	9.5	12.8	7	7	GPS&CORS
AWG-1	2006-11-12	2016-05-04	2013-01-11	9.5	11.9	7	7	GPS&CORS
GRK1	2006-09-24	2006-09-29	2006-09-27	0.0	4.6	1	1	GPS
GRK2	2006-09-24	2006-09-29	2006-09-27	0.0	4.5	1	1	GPS
GRK3	2006-09-24	2006-09-28	2006-09-26	0.0	3.1	1	1	GPS
GRK4	2006-09-24	2006-09-30	2006-09-27	0.0	4.4	1	1	GPS
L100	2006-09-07	2015-06-30	2011-01-23	8.8	3.3	4	4	GPS
L101	2006-09-07	2015-07-01	2011-01-24	8.8	3.2	4	4	GPS
L102	2006-09-15	2015-07-01	2011-01-27	8.8	3.4	4	4	GPS
L103	2006-08-31	2015-06-30	2011-01-23	8.8	3.5	4	4	GPS
L104	2006-09-16	2015-07-09	2011-02-02	8.8	4.4	4	4	GPS
L105	2006-09-09	2015-07-09	2011-01-31	8.8	4.3	4	4	GPS
L106	2006-09-06	2015-07-02	2011-01-26	8.8	3.5	4	4	GPS
L107	2006-08-31	2015-07-02	2011-01-24	8.8	3.1	4	4	GPS
M001M	2006-08-07	2015-06-12	2011-06-06	8.8	2.8	5	4	GPS
M001N	2006-08-07	2015-06-12	2011-06-06	8.8	2.8	5	4	GPS
M001Z	2006-08-07	2015-06-12	2011-06-06	8.8	2.8	5	4	GPS
M002M	2006-08-06	2015-06-13	2010-09-29	8.9	4.0	7	6	GPS
M002N	2006-08-06	2015-06-13	2010-09-29	8.9	4.0	7	6	GPS
M002Z	2006-08-06	2015-06-13	2010-09-29	8.9	4.0	7	6	GPS
M003M	2006-07-28	2015-05-16	2011-07-31	8.8	4.2	6	5	GPS
M003N	2006-07-28	2015-05-16	2011-07-31	8.8	4.2	6	5	GPS
M003Z	2006-07-28	2015-05-16	2011-07-31	8.8	4.2	6	5	GPS
M004M	2006-06-22	2015-05-31	2010-12-16	8.9	6.2	4	3	GPS
M004N	2006-06-22	2015-05-31	2010-12-16	8.9	6.2	4	3	GPS
M004Z	2006-06-22	2015-05-31	2010-12-16	8.9	6.2	4	3	GPS
M005M	2006-07-24	2015-05-28	2011-06-09	8.8	3.3	5	4	GPS
M005N	2006-07-24	2015-05-28	2011-06-09	8.8	3.3	5	4	GPS
M005Z	2006-07-24	2015-05-28	2011-06-09	8.8	3.3	5	4	GPS
M006M	2006-07-30	2015-05-15	2011-01-18	8.8	3.1	5	4	GPS
M006N	2006-07-30	2015-05-15	2011-01-18	8.8	3.1	5	4	GPS

M006Z	2006-07-30	2015-05-15	2011-01-18	8.8	3.1	5	4	GPS
M007M	2006-07-22	2015-06-21	2011-09-20	8.9	3.7	8	7	GPS
M007N	2006-07-22	2015-06-21	2011-09-20	8.9	3.7	8	7	GPS
M007Z	2006-07-22	2015-06-21	2011-09-20	8.9	3.7	8	7	GPS
M008M	2006-07-18	2015-06-21	2011-05-12	8.9	3.8	9	8	GPS
M008N	2006-07-18	2015-06-21	2011-05-12	8.9	3.8	9	8	GPS
M008Z	2006-07-18	2014-05-09	2010-11-06	7.8	3.9	8	7	GPS
M009M	2006-07-14	2015-05-09	2011-09-05	8.8	3.0	8	7	GPS
M009N	2006-07-14	2015-05-09	2011-09-05	8.8	3.0	8	7	GPS
M009Z	2006-07-14	2015-05-09	2011-09-05	8.8	3.0	8	7	GPS
M010M	2006-07-08	2015-05-22	2010-12-13	8.9	5.5	4	3	GPS
M010N	2006-07-08	2015-05-22	2010-12-13	8.9	5.5	4	3	GPS
M010Z	2006-07-08	2015-05-22	2010-12-13	8.9	5.5	4	3	GPS
M011M	2006-07-26	2015-05-17	2011-06-14	8.8	3.6	5	4	GPS
M011N	2006-07-26	2015-05-17	2011-06-14	8.8	3.6	5	4	GPS
M011Z	2006-07-26	2015-05-17	2011-06-14	8.8	3.6	5	4	GPS
M012M	2006-07-16	2015-05-12	2010-12-15	8.8	2.9	4	3	GPS
M012N	2006-07-16	2015-05-12	2010-12-15	8.8	2.9	4	3	GPS
M012Z	2006-07-16	2015-05-12	2010-12-15	8.8	2.9	4	3	GPS
M013M	2006-07-10	2015-05-08	2010-12-02	8.8	3.9	4	3	GPS
M013N	2006-07-10	2015-05-08	2010-12-02	8.8	3.9	4	3	GPS
M013Z	2006-07-10	2015-05-08	2010-12-02	8.8	3.9	4	3	GPS
M015M	2006-07-20	2015-06-12	2011-06-03	8.9	3.7	5	4	GPS
M015N	2006-07-20	2015-06-12	2011-06-03	8.9	3.7	5	4	GPS
M015Z	2006-07-20	2015-06-12	2011-06-03	8.9	3.7	5	4	GPS
M016M	2006-08-14	2014-05-08	2010-04-14	7.7	3.3	5	4	GPS
M016N	2006-08-14	2014-05-08	2010-04-14	7.7	3.3	5	4	GPS
M016Z	2006-08-14	2014-05-08	2010-04-14	7.7	3.3	5	4	GPS
M017M	2015-06-17	2015-06-21	2015-06-19	0.0	3.1	1	1	GPS
M017N	2015-06-17	2015-06-21	2015-06-19	0.0	3.1	1	1	GPS
M017Z	2015-06-17	2015-06-21	2015-06-19	0.0	3.1	1	1	GPS
AME1	2006-07-14	2016-05-04	2011-11-12	9.8	5.0	51	51	CORS
ANJM	2006-07-14	2016-05-04	2012-02-21	9.8	5.0	48	48	CORS
MODD	2007-06-18	2016-05-04	2012-03-13	8.9	5.0	48	48	CORS
AMEL	2015-05-24	2016-05-04	2015-09-09	0.9	5.0	12	12	CORS

Cluster composition: (71 clusters, 40 with multiples, ## is the number of observations per point)

CID	CLUSTERNAME	#PNT	PNTNAME (##)	PNTNAME (##) ...				
1	002C0026+3	3	002C0026 (4)	002C0027 (4)	002C0028 (4)			
2	002C0029+3	3	002C0029 (7)	002C0030 (7)	002C0031 (7)			
3	002C0033+3	3	002C0033 (7)	002C0034 (7)	002C0035 (7)			
4	002C0064+3	3	002C0064 (4)	002C0065 (4)	002C0066 (4)			
5	002D0048+3	3	002D0048 (6)	002D0049 (6)	002D0050 (5)			
6	002D0054+3	3	002D0054 (3)	002D0055 (3)	002D0056 (3)			
7	002D0059+3	3	002D0059 (4)	002D0060 (4)	002D0061 (4)			
8	002D0066+3	3	002D0066 (5)	002D0067 (5)	002D0068 (5)			
9	002D0102+3	3	002D0102 (5)	002D0103 (5)	002D0104 (5)			
10	002D0105+3	3	002D0105 (1)	002D0106 (1)	002D0107 (1)			
11	002D0108+3	3	002D0108 (5)	002D0109 (5)	002D0110 (5)			
12	002G0042+3	3	002G0042 (8)	002G0043 (8)	002G0044 (8)			
13	002G0048+3	3	002G0048 (4)	002G0049 (4)	002G0050 (4)			
14	002G0124+3	3	002G0124 (4)	002G0125 (4)	002G0126 (4)			
15	002H0032+3	3	002H0032 (4)	002H0033 (4)	002H0034 (4)			
16	002H0035+3	3	002H0035 (4)	002H0036 (4)	002H0037 (4)			
17	002H0038+3	3	002H0038 (4)	002H0039 (4)	002H0040 (4)			
18	002H0042+3	3	002H0042 (4)	002H0043 (4)	002H0044 (4)			
19	002H0048M+4	4	002H0048M (2)	002H0048N (2)	002H0048Z (2)	002H0048 (1)		
20	002H0057+3	3	002H0057 (4)	002H0058 (4)	002H0059 (4)			
21	003C0122+3	3	003C0122 (5)	003C0123 (5)	003C0124 (5)			
22	003D0138+3	3	003D0138 (4)	003D0139 (4)	003D0140 (4)			
23	003G0187+3	3	003G0187 (3)	003G0188 (3)	003G0189 (3)			
24	003G0196+3	3	003G0196 (3)	003G0197 (3)	003G0198 (3)			
25	M001M+3	3	M001M (5)	M001N (5)	M001Z (5)			
26	M002M+3	3	M002M (7)	M002N (7)	M002Z (7)			
27	M003M+3	3	M003M (6)	M003N (6)	M003Z (6)			
28	M004M+3	3	M004M (4)	M004N (4)	M004Z (4)			
29	M005M+3	3	M005M (5)	M005N (5)	M005Z (5)			
30	M006M+3	3	M006M (5)	M006N (5)	M006Z (5)			
31	M007M+3	3	M007M (8)	M007N (8)	M007Z (8)			
32	M008M+6	6	M008M (9)	M008N (9)	M008Z (8)	M017M (1)	M017N (1)	M017Z (1)
33	M009M+3	3	M009M (8)	M009N (8)	M009Z (8)			
34	M010M+3	3	M010M (4)	M010N (4)	M010Z (4)			
35	M011M+3	3	M011M (5)	M011N (5)	M011Z (5)			
36	M012M+3	3	M012M (4)	M012N (4)	M012Z (4)			
37	M013M+3	3	M013M (4)	M013N (4)	M013Z (4)			
38	M015M+3	3	M015M (5)	M015N (5)	M015Z (5)			
39	M016M+3	3	M016M (5)	M016N (5)	M016Z (5)			
40	000A4025+2	2	000A4025 (4)	000A5025 (1)				

Cluster benchmarks statistics (71 cluster benchmarks):

CID	CLUSTERNAME	FIRST_OBS	LAST_OBS	MEAN_EPOCH	#YEAR	MEAN _OBSTIME	NUMPRJ	NUMOBS	USE
1	002C0026+3	2006-06-07	2014-05-20	2010-05-22	8.0	3.2	4	12	12

```
  2 002C0029+3    2006-05-31  2014-05-25  2010-06-05   8.0    3.7       7      21    21
  3 002C0033+3    2006-06-02  2015-06-18  2011-02-14   9.0    4.0       7      21    21
  4 002C0064+3    2006-05-28  2014-05-27  2010-05-18   8.0    3.5       4      12    12
  5 002D0048+3    2006-06-10  2015-06-15  2010-06-23   9.0    3.4       6      17    17
  6 002D0054+3    2006-06-20  2011-05-28  2009-01-31   4.9    3.4       3       9     9
  7 002D0059+3    2006-06-23  2015-06-01  2010-12-09   8.9    4.4       4      12    12
  8 002D0066+3    2006-06-12  2015-06-06  2011-03-20   9.0    4.2       5      15    15
  9 002D0102+3    2006-06-15  2015-05-25  2011-05-25   8.9    4.2       5      15    15
 10 002D0105+3    2006-06-05  2006-06-10  2006-06-07   0.0    4.2       1       3     3
 11 002D0108+3    2006-06-16  2015-06-04  2011-06-05   9.0    3.3       5      15    15
 12 002G0042+3    2006-06-28  2015-05-29  2011-03-16   8.9    2.9       8      24    24
 13 002G0048+3    2006-07-02  2014-05-07  2010-09-02   7.8    3.9       4      12    12
 14 002G0124+3    2006-07-12  2015-05-23  2010-12-06   8.9    4.8       4      12    12
 15 002H0032+3    2006-08-03  2015-05-26  2010-12-23   8.8    3.7       4      12    12
 16 002H0035+3    2006-08-10  2015-05-20  2010-12-23   8.8    4.3       4      12    12
 17 002H0038+3    2006-07-06  2015-05-27  2010-12-15   8.9    3.7       4      12    12
 18 002H0042+3    2006-06-30  2015-05-11  2010-12-13   8.9    3.4       4      12    12
 19 002H0048M+4   2006-08-13  2015-05-10  2012-10-26   8.7    3.9       3       7     7
 20 002H0057+3    2006-07-04  2015-05-15  2010-12-19   8.9    5.4       4      12    12
 21 003C0122+3    2010-08-17  2015-05-29  2013-03-26   4.8    3.3       5      15    15
 22 003D0138+3    2010-08-19  2015-06-23  2012-12-23   4.8    5.0       4      12    12
 23 003G0187+3    2010-08-21  2013-05-16  2012-02-19   2.7    3.8       3       9     9
 24 003G0196+3    2010-08-27  2013-05-20  2012-02-22   2.7    3.0       3       9     9
 25 M001M+3       2006-08-07  2015-06-12  2011-06-06   8.8    2.8       5      15    12
 26 M002M+3       2006-08-06  2015-06-13  2010-09-29   8.9    4.0       7      21    18
 27 M003M+3       2006-07-28  2015-05-16  2011-07-31   8.8    4.2       6      18    15
 28 M004M+3       2006-06-22  2015-05-31  2010-12-16   8.9    6.2       4      12     9
 29 M005M+3       2006-07-24  2015-05-28  2011-06-09   8.8    3.3       5      15    12
 30 M006M+3       2006-07-30  2015-05-15  2011-01-18   8.8    3.1       5      15    12
 31 M007M+3       2006-07-22  2015-06-21  2011-09-20   8.9    3.7       8      24    21
 32 M008M+6       2006-07-18  2015-06-21  2011-08-23   8.9    3.8       9      29    26
 33 M009M+3       2006-07-14  2015-05-09  2011-09-05   8.8    3.0       8      24    21
 34 M010M+3       2006-07-08  2015-05-22  2010-12-13   8.9    5.5       4      12     9
 35 M011M+3       2006-07-26  2015-05-17  2011-06-14   8.8    3.6       5      15    12
 36 M012M+3       2006-07-16  2015-05-12  2010-12-15   8.8    2.9       4      12     9
 37 M013M+3       2006-07-10  2015-05-08  2010-12-02   8.8    4.0       4      12     9
 38 M015M+3       2006-07-20  2015-06-12  2011-06-03   8.9    3.7       5      15    12
 39 M016M+3       2006-08-14  2014-05-08  2010-04-14   7.7    3.3       5      15    12
 40 000A4025+2    2006-07-27  2015-07-06  2011-10-14   8.9    3.4       4       5     5
 41 000A2592      2006-06-08  2015-07-21  2010-08-24   9.1    7.9       6       6     6
 42 000A2632      2008-10-18  2008-10-23  2008-10-20   0.0    4.1       1       1     1
 43 000A2683      2011-09-24  2015-07-06  2013-08-15   3.8    3.6       2       2     2
 44 000A2686      2006-07-20  2015-07-07  2011-01-12   9.0    3.5       2       2     2
 45 000A2687      2011-09-24  2015-07-16  2013-08-20   3.8    3.3       2       2     2


 46 000A2688      2008-10-17  2015-07-13  2012-01-06   6.7    4.4       3       3     3
 47 000A2689      2006-06-28  2015-07-06  2010-10-20   9.0    8.7       4       4     4
 48 000A2691      2006-07-13  2015-07-16  2010-11-17   9.0    4.2       4       4     4
 49 002D0079
 50 006B0021      2008-10-16  2008-10-22  2008-10-19   0.0    5.0       1       1     1
 51 006E0193
 52 006E0216
 53 006E0239
 54 AME-2         2006-10-30  2016-05-04  2013-01-10   9.5   12.8       7       7     7
 55 AWG-1         2006-11-12  2016-05-04  2013-01-11   9.5   11.9       7       7     7
 56 GRK1          2006-09-24  2006-09-29  2006-09-27   0.0    4.6       1       1     1
 57 GRK2          2006-09-24  2006-09-29  2006-09-27   0.0    4.5       1       1     1
 58 GRK3          2006-09-24  2006-09-28  2006-09-26   0.0    3.1       1       1     1
 59 GRK4          2006-09-24  2006-09-30  2006-09-27   0.0    4.4       1       1     1
 60 L100          2006-09-07  2015-06-30  2011-01-23   8.8    3.3       4       4     4
 61 L101          2006-09-07  2015-07-01  2011-01-24   8.8    3.2       4       4     4
 62 L102          2006-09-15  2015-07-01  2011-01-27   8.8    3.4       4       4     4
 63 L103          2006-08-31  2015-06-30  2011-01-23   8.8    3.5       4       4     4
 64 L104          2006-09-16  2015-07-09  2011-02-02   8.8    4.4       4       4     4
 65 L105          2006-09-09  2015-07-09  2011-01-31   8.8    4.3       4       4     4
 66 L106          2006-09-06  2015-07-02  2011-01-26   8.8    3.5       4       4     4
 67 L107          2006-08-31  2015-07-02  2011-01-24   8.8    3.1       4       4     4
 68 AME1          2006-07-14  2016-05-04  2011-11-12   9.8    5.0      17      51    51
 69 ANJM          2006-07-14  2016-05-04  2012-02-21   9.8    5.0      16      48    48
 70 MODD          2007-06-18  2016-05-04  2012-03-13   8.9    5.0      16      48    48
 71 AMEL          2015-05-24  2016-05-04  2015-09-09   0.9    5.0       4      12    12
```

Analyze the cluster data

```
% Compute cluster observation administration

[clusterobsadm,obsindex]=gpsclusterobsadm(clusterpntadm,obsindex);

% Print double difference observations

gpsclusterprtobs(pntname,prjname,clustername,clusterpntadm,clusterobsadm,obs)

% Zero difference analysis using LSQ adjustment and outlier detection, flag observations

[obsstats2,clusterobs]=gpsclusteranalysis(pntname,prjname,clustername,clusterpntadm,clusterobsadm,obs,obsstats,config.clusteranalysis);

% Cluster observation statistics
```

```
clusterobsstats=gpsclusterobsstats(clusterobsadm,obsstats2);
```

```
Cluster Double Differences [mm]:

002C0026+3:
             002C0026   002C0027   002C0028
NAM_GPS06        0.00      -0.07       0.20
07_2009          0.00      -0.08      -0.10
NAM_GPS11        0.00       0.02      -0.10
NAM_GPS14        0.00       0.13       0.00

002C0029+3:
             002C0029   002C0030   002C0031
NAM_GPS06        0.00       1.09       0.04
NAM_GPS07        0.00      -0.31      -0.16
07_2009          0.00      -0.21      -0.16
NAM_GPS10        0.00      -0.11       0.04
NAM_GPS11        0.00      -0.11       0.04
NAM_GPS13        0.00      -0.21       0.04
NAM_GPS14        0.00      -0.11       0.14

002C0033+3:
             002C0033   002C0034   002C0035
NAM_GPS06        0.00       0.10       0.06
NAM_GPS07        0.00      -0.20      -0.14
07_2009          0.00      -0.00      -0.04
NAM_GPS11        0.00      -0.00       0.06
NAM_GPS13        0.00       0.10      -0.04
NAM_GPS14        0.00      -0.00       0.16
NAM_GPS15W       0.00      -0.00      -0.04

002C0064+3:
             002C0064   002C0065   002C0066
NAM_GPS06        0.00      -0.02      -0.02
07_2009          0.00       0.18       0.07
NAM_GPS11        0.00       0.07       0.07
NAM_GPS14        0.00      -0.23      -0.13

002D0048+3:
             002D0048   002D0049   002D0050
NAM_GPS06        0.00      -0.00      -0.20
NAM_GPS07        0.00      -0.30      -0.00


07_2009          0.00      -0.20      -0.10
NAM_GPS11        0.00       0.00       0.10
NAM_GPS14        0.00       0.20       0.20
NAM_GPS15W       0.00       0.30        NaN

002D0054+3:
             002D0054   002D0055   002D0056
NAM_GPS06        0.00      -0.10      -0.70
07_2009          0.00       0.30       0.60
NAM_GPS11        0.00      -0.20       0.10

002D0059+3:
             002D0059   002D0060   002D0061
NAM_GPS06        0.00       0.13       0.05
07_2009          0.00       0.02       0.05
NAM_GPS12W       0.00       0.02       0.15
NAM_GPS15W       0.00      -0.18      -0.25

002D0066+3:
             002D0066   002D0067   002D0068
NAM_GPS06        0.00      -1.26      -1.60
07_2009          0.00      -0.16      -0.30
NAM_GPS11        0.00       0.04       0.00
NAM_GPS13        0.00       0.04       0.30
NAM_GPS15W       0.00       1.34       1.60

002D0102+3:
             002D0102   002D0103   002D0104
NAM_GPS06        0.00      -0.60      -0.18
07_2009          0.00      -0.40      -0.48
NAM_GPS11        0.00      -0.10      -0.38
NAM_GPS14        0.00       0.50       0.32
NAM_GPS15W       0.00       0.60       0.72

002D0108+3:
             002D0108   002D0109   002D0110
NAM_GPS06        0.00       3.64       1.64
07_2009          0.00      -1.46       0.84
NAM_GPS11        0.00      -1.16       0.54
NAM_GPS14        0.00      -0.56      -1.66
NAM_GPS15W       0.00      -0.46      -1.36

002G0042+3:
             002G0042   002G0043   002G0044
```

NAM_GPS06	0.00	0.05	0.26
NAM_GPS08A	0.00	0.15	0.16
07_2009	0.00	0.05	-0.04
NAM_GPS10	0.00	0.05	0.06
NAM_GPS11	0.00	-0.05	-0.04
NAM_GPS13	0.00	-0.05	-0.04
NAM_GPS14	0.00	-0.25	-0.14
NAM_GPS15W	0.00	0.05	-0.24

002G0048+3:

	002G0048	002G0049	002G0050
NAM_GPS06	0.00	-0.45	-1.05
07_2009	0.00	0.85	0.05
NAM_GPS12W	0.00	0.15	0.55
NAM_GPS14	0.00	-0.55	0.45

002G0124+3:

	002G0124	002G0125	002G0126
NAM_GPS06	0.00	2.72	-0.15
07_2009	0.00	-0.48	0.15
NAM_GPS12W	0.00	-0.77	0.05
NAM_GPS15W	0.00	-1.47	-0.05

002H0032+3:

	002H0032	002H0033	002H0034
NAM_GPS06	0.00	0.15	0.75
07_2009	0.00	0.15	-0.05
NAM_GPS12W	0.00	-0.25	-0.35
NAM_GPS15W	0.00	-0.05	-0.35

002H0035+3:

	002H0035	002H0036	002H0037
NAM_GPS06	0.00	0.85	-0.27
07_2009	0.00	-0.55	-0.27
NAM_GPS12W	0.00	-0.25	0.33
NAM_GPS15W	0.00	-0.05	0.22

002H0038+3:

	002H0038	002H0039	002H0040
NAM_GPS06	0.00	0.20	0.70
07_2009	0.00	-0.20	-0.40
NAM_GPS12W	0.00	-0.20	-0.30
NAM_GPS15W	0.00	0.20	0.00

002H0042+3:

	002H0042	002H0043	002H0044
NAM_GPS06	0.00	-0.17	0.00
07_2009	0.00	0.02	0.00
NAM_GPS12W	0.00	0.12	0.00
NAM_GPS15W	0.00	0.03	0.00

002H0048M+4:

	002H0048M	002H0048N	002H0048Z	002H0048
NAM_GPS06	NaN	NaN	NaN	NaN
NAM_GPS12W	0.00	-0.20	-0.10	NaN
NAM_GPS15W	0.00	0.20	0.10	NaN

002H0057+3:

	002H0057	002H0058	002H0059
NAM_GPS06	0.00	-0.05	-0.07
07_2009	0.00	0.15	0.13
NAM_GPS12W	0.00	-0.05	-0.08
NAM_GPS15W	0.00	-0.05	0.03

003C0122+3:

	003C0122	003C0123	003C0124
NAM_GPS10	0.00	0.10	0.32
NAM_GPS12W	0.00	0.00	0.12
NAM_GPS13	0.00	0.20	0.12
NAM_GPS14	0.00	-0.00	-0.08
NAM_GPS15W	0.00	-0.30	-0.48

003D0138+3:

	003D0138	003D0139	003D0140
NAM_GPS10	0.00	-0.12	-0.05
NAM_GPS12W	0.00	0.08	0.05
NAM_GPS13	0.00	-0.03	-0.05
NAM_GPS15W	0.00	0.08	0.05

003G0187+3:

	003G0187	003G0188	003G0189
NAM_GPS10	0.00	1.00	1.20
NAM_GPS12W	0.00	-0.50	-0.70
NAM_GPS13	0.00	-0.50	-0.50

003G0196+3:

	003G0196	003G0197	003G0198
NAM_GPS10	0.00	-0.07	-0.13

NAM_GPS12W	0.00	0.03	0.17
NAM_GPS13	0.00	0.03	-0.03

M001M+3:

	M001M	M001N	M001Z
NAM_GPS06	0.00	-2.64	-0.18
07_2009	0.00	-0.04	-0.18
NAM_GPS11	0.00	0.36	0.12
NAM_GPS14	0.00	1.26	-0.18
NAM_GPS15W	0.00	1.06	0.42

M002M+3:

	M002M	M002N	M002Z
NAM_GPS06	0.00	1.97	7.11
NAM_GPS07	0.00	0.37	1.21
07_2009	0.00	-0.23	-0.59
NAM_GPS10	0.00	-0.33	-1.19
NAM_GPS11	0.00	-0.43	-1.19
NAM_GPS14	0.00	-0.83	-2.79
NAM_GPS15W	0.00	-0.53	-2.59

M003M+3:

	M003M	M003N	M003Z
NAM_GPS06	0.00	-0.05	4.37
07_2009	0.00	-0.35	-0.13
NAM_GPS11	0.00	-0.45	-0.33
NAM_GPS12W	0.00	-0.45	-0.73
NAM_GPS14	0.00	1.45	-1.43
NAM_GPS15W	0.00	-0.15	-1.73

M004M+3:

	M004M	M004N	M004Z
NAM_GPS06	0.00	-8.27	-4.22
07_2009	0.00	0.12	-1.13
NAM_GPS12W	0.00	2.53	1.18
NAM_GPS15W	0.00	5.63	4.17

M005M+3:

	M005M	M005N	M005Z
NAM_GPS06	0.00	3.46	-2.02
07_2009	0.00	-0.34	0.58
NAM_GPS11	0.00	-0.44	0.68
NAM_GPS14	0.00	-1.24	0.38
NAM_GPS15W	0.00	-1.44	0.38

M006M+3:

	M006M	M006N	M006Z
NAM_GPS06	0.00	0.76	3.52
07_2009	0.00	-0.14	0.22
NAM_GPS11	0.00	-0.14	-0.68
NAM_GPS12W	0.00	-0.14	-1.08
NAM_GPS15W	0.00	-0.34	-1.98

M007M+3:

	M007M	M007N	M007Z
NAM_GPS06	0.00	7.01	2.86
07_2009	0.00	-0.09	0.16
NAM_GPS10	0.00	-0.29	-0.04
NAM_GPS11	0.00	-0.49	-0.24
NAM_GPS12W	0.00	-0.99	-0.34
NAM_GPS13	0.00	-1.09	-0.44
NAM_GPS14	0.00	-1.79	-0.84
NAM_GPS15W	0.00	-2.29	-1.14

M008M+6:

	M008M	M008N	M008Z	M017M	M017N	M017Z
NAM_GPS06	0.00	37.43	7.16	NaN	NaN	NaN
NAM_GPS08A	0.00	-2.37	-0.04	NaN	NaN	NaN
07_2009	0.00	-4.07	-0.24	NaN	NaN	NaN
NAM_GPS10	0.00	-4.27	-0.34	NaN	NaN	NaN
NAM_GPS11	0.00	-4.37	-0.64	NaN	NaN	NaN
NAM_GPS12W	0.00	-4.57	-2.04	NaN	NaN	NaN
NAM_GPS13	0.00	-4.87	-2.34	NaN	NaN	NaN
NAM_GPS14	0.00	-4.97	-1.54	NaN	NaN	NaN
NAM_GPS15W	0.00	-7.97	NaN	0.00	0.00	0.00

M009M+3:

	M009M	M009N	M009Z
NAM_GPS06	0.00	4.01	-0.34
07_2009	0.00	-0.59	-0.44
NAM_GPS10	0.00	-0.59	-0.14
NAM_GPS11	0.00	-0.49	0.06
NAM_GPS12W	0.00	-0.39	0.16
NAM_GPS13	0.00	-0.69	0.06
NAM_GPS14	0.00	-0.69	0.26
NAM_GPS15W	0.00	-0.59	0.36

M010M+3:

	M010M	M010N	M010Z
NAM_GPS06	0.00	-1.28	0.65
07_2009	0.00	0.52	-0.25
NAM_GPS12W	0.00	0.33	-0.25
NAM_GPS15W	0.00	0.43	-0.15

M011M+3:

	M011M	M011N	M011Z
NAM_GPS06	0.00	1.10	6.40
07_2009	0.00	-0.50	-0.70
NAM_GPS12W	0.00	-0.10	-1.20
NAM_GPS13	0.00	-0.20	-1.40
NAM_GPS15W	0.00	-0.30	-3.10

M012M+3:

	M012M	M012N	M012Z
NAM_GPS06	0.00	-1.42	-5.95
07_2009	0.00	1.28	1.15
NAM_GPS12W	0.00	0.28	1.85
NAM_GPS15W	0.00	-0.13	2.95

M013M+3:

	M013M	M013N	M013Z
NAM_GPS06	0.00	8.12	4.57
07_2009	0.00	-1.17	-0.22
NAM_GPS12W	0.00	-3.08	-2.12
NAM_GPS15W	0.00	-3.88	-2.23

M015M+3:

	M015M	M015N	M015Z
NAM_GPS06	0.00	-4.56	-8.70
07_2009	0.00	1.04	1.20
NAM_GPS11	0.00	0.84	1.60
NAM_GPS14	0.00	1.24	2.80
NAM_GPS15W	0.00	1.44	3.10

M016M+3:

	M016M	M016N	M016Z
NAM_GPS06	0.00	0.82	-2.78
NAM_GPS08A	0.00	-0.18	0.92
07_2009	0.00	-0.08	0.72
NAM_GPS12W	0.00	-0.28	0.42
NAM_GPS14	0.00	-0.28	0.72

000A4025+2:

	000A4025	000A5025
NAM_GPS06	0.00	NaN
07_2009	0.00	NaN
NAM_GPS11L	0.00	NaN
NAM_GPS15O	0.00	0.00

Cluster Zero Difference Residuals [mm]:

Outlier detection parameters:
- Maximum residual: 0.4 [mm]
- Maximum iterations: 7

Newly detected outliers are flagged with "*", other symbols represent a-priori flags.

002C0026+3: (std 0.10 mm, dof 6)

		002C0026	002C0027	002C0028	
	hgt [m]	0.0000	0.0922	0.1200	sigma
	[mm]				
NAM_GPS06	39.4816	-0.04	-0.12	0.16	0.16
07_2009	39.4848	0.06	-0.02	-0.04	0.06
NAM_GPS11	39.4840	0.03	0.05	-0.07	0.08
NAM_GPS14	39.4831	-0.04	0.08	-0.04	0.08
		--------	--------	--------	
	sigma	0.06	0.11	0.13	[mm]

002C0029+3: (std 0.07 mm, dof 11, 1 outlier)

		002C0029	002C0030	002C0031	
	hgt [m]	0.0000	0.0157	0.0736	sigma
	[mm]				
NAM_GPS06	39.5697	-0.02	1.24 *	0.02	0.03 (1.3)
NAM_GPS07	39.5672	0.10	-0.04	-0.06	0.09
07_2009	39.5664	0.06	0.03	-0.09	0.09
NAM_GPS10	39.5665	-0.04	0.03	0.01	0.04
NAM_GPS11	39.5682	-0.04	0.03	0.01	0.04
NAM_GPS13	39.5656	-0.00	-0.04	0.04	0.04
NAM_GPS14	39.5659	-0.07	-0.01	0.07	0.08
		--------	--------	--------	
	sigma	0.07	0.04	0.07	[mm]

002C0033+3: (std 0.07 mm, dof 12)

		002C0033	002C0034	002C0035	
	hgt [m]	0.0000	-0.1034	-0.1620	sigma
	[mm]				
NAM_GPS06	39.8506	-0.05	0.05	0.00	0.05
NAM_GPS07	39.8467	0.11	-0.09	-0.03	0.11
07_2009	39.8425	0.01	0.01	-0.03	0.03
NAM_GPS11	39.8379	-0.02	-0.02	0.04	0.04
NAM_GPS13	39.8353	-0.02	0.08	-0.06	0.08
NAM_GPS14	39.8313	-0.05	-0.05	0.10	0.10
NAM_GPS15W	39.8260	0.01	0.01	-0.03	0.03
		--------	--------	--------	
	sigma	0.07	0.07	0.07	[mm]

002C0064+3: (std 0.09 mm, dof 6)

		002C0064	002C0065	002C0066	
	hgt [m]	0.0000	0.0273	-0.0756	sigma
	[mm]				
NAM_GPS06	40.1763	0.02	-0.01	-0.01	0.02
07_2009	40.1760	-0.08	0.09	-0.01	0.10
NAM_GPS11	40.1772	-0.05	0.03	0.03	0.05
NAM_GPS14	40.1812	0.12	-0.11	-0.01	0.13
		--------	--------	--------	
	sigma	0.11	0.10	0.02	[mm]

002D0048+3: (std 0.14 mm, dof 9)

		002D0048	002D0049	002D0050	
	hgt [m]	0.0000	-0.0759	-0.0837	sigma
	[mm]				
NAM_GPS06	40.2410	0.08	0.08	-0.15	0.15
NAM_GPS07	40.2353	0.11	-0.19	0.08	0.18
07_2009	40.2248	0.11	-0.09	-0.02	0.11
NAM_GPS11	40.2172	-0.02	-0.02	0.05	0.04
NAM_GPS14	40.2036	-0.12	0.08	0.05	0.12
NAM_GPS15W	40.1968	-0.15	0.15	NaN	0.23
		--------	--------	--------	
	sigma	0.15	0.16	0.11	[mm]

002D0054+3: (std 0.17 mm, dof 3, 1 outlier)

		002D0054	002D0055	002D0056	
	hgt [m]	0.0000	0.0916	0.0915	sigma
	[mm]				
NAM_GPS06	39.5756	0.05	-0.05	-0.97 *	0.09 (1.2)
07_2009	39.5739	-0.19	0.11	0.08	0.22
NAM_GPS11	39.5732	0.14	-0.06	-0.08	0.16
		--------	--------	--------	
	sigma	0.23	0.12	0.14	[mm]

002D0059+3: (std 0.10 mm, dof 6)

		002D0059	002D0060	002D0061	
	hgt [m]	0.0000	0.1706	0.0274	sigma
	[mm]				
NAM_GPS06	41.4059	-0.06	0.07	-0.01	0.07
07_2009	41.4061	-0.02	0.00	0.03	0.03
NAM_GPS12W	41.4039	-0.06	-0.03	0.09	0.09
NAM_GPS15W	41.4020	0.14	-0.03	-0.11	0.15
		--------	--------	--------	
	sigma	0.12	0.06	0.10	[mm]

002D0066+3: (std 0.18 mm, dof 6, 2 outliers)

		002D0066	002D0067	002D0068	
	hgt [m]	0.0000	-0.1533	-0.1514	sigma
	[mm]				
NAM_GPS06	40.0017	1.42 *	0.17	-0.17	0.27 (1.6)
07_2009	40.0000	0.14	-0.00	-0.14	0.17
NAM_GPS11	39.9989	-0.02	0.03	-0.01	0.03
NAM_GPS13	39.9955	-0.12	-0.07	0.19	0.20
NAM_GPS15W	39.9934	-1.48 *	-0.13	0.13	0.21 (1.7)
		--------	--------	--------	
	sigma	0.16	0.15	0.21	[mm]

002D0102+3: (std 0.26 mm, dof 7, 1 outlier)

		002D0102	002D0103	002D0104	
	hgt [m]	0.0000	0.1359	0.1120	sigma
	[mm]				
NAM_GPS06	39.4434	0.15	-0.28	0.14	0.28
07_2009	39.4420	0.18	-0.05	-0.13	0.19
NAM_GPS11	39.4406	0.05	0.12	-0.16	0.17
NAM_GPS14	39.4292	-0.38	0.28	0.10	0.39
NAM_GPS15W	39.4290	-0.82 *	-0.06	0.06	0.09 (0.9)
		--------	--------	--------	
	sigma	0.32	0.27	0.18	[mm]

002D0108+3: (std 0.35 mm, dof 5, 3 outliers)

	002D0108	002D0109	002D0110	
hgt [m]	0.0000	-0.1202	-0.0306	sigma
	[mm]			
NAM_GPS06 40.1795	-0.26	4.22 *	0.26	0.44 (5.1)
07_2009 40.1724	0.30	-0.32	0.02	0.37
NAM_GPS11 40.1696	0.30	-0.02	-0.28	0.35
NAM_GPS14 40.1614	-0.14	0.14	-2.92 *	0.23 (3.4)
NAM_GPS15W 40.1589	-0.19	0.19	-2.67 *	0.31 (3.1)
	--------	--------	--------	
sigma	0.38	0.31	0.35	[mm]

002G0042+3: (std 0.10 mm, dof 14)

	002G0042	002G0043	002G0044	
hgt [m]	0.0000	0.0188	0.0490	sigma
	[mm]			
NAM_GPS06 40.0280	-0.10	-0.05	0.16	0.15
NAM_GPS08A 40.0270	-0.10	0.05	0.06	0.10
07_2009 40.0234	-0.00	0.05	-0.04	0.05
NAM_GPS10 40.0205	-0.04	0.01	0.03	0.04
NAM_GPS11 40.0216	0.03	-0.02	-0.01	0.03
NAM_GPS13 40.0146	0.03	-0.02	-0.01	0.03
NAM_GPS14 40.0104	0.13	-0.12	-0.01	0.13
NAM_GPS15W 40.0075	0.06	0.11	-0.17	0.16
	--------	--------	--------	
sigma	0.10	0.09	0.11	[mm]

002G0048+3: (std 0.24 mm, dof 4, 2 outliers)

	002G0048	002G0049	002G0050	
hgt [m]	0.0000	-0.0054	-0.1022	sigma
	[mm]			
NAM_GPS06 39.7759	0.06	-0.06	-1.32 *	0.10 (1.6)
07_2009 39.7731	0.14	1.32 *	-0.14	0.24 (1.6)
NAM_GPS12W 39.7679	-0.23	0.25	-0.01	0.30
NAM_GPS14 39.7657	0.03	-0.19	0.15	0.21
	--------	--------	--------	
sigma	0.22	0.29	0.19	[mm]

002G0124+3: (std 0.25 mm, dof 5, 1 outlier)

	002G0124	002G0125	002G0126	
hgt [m]	0.0000	-0.1104	-0.0973	sigma
	[mm]			
NAM_GPS06 40.7112	0.08	3.73 *	-0.07	0.12 (4.3)
07_2009 40.7061	-0.20	0.26	-0.05	0.28
NAM_GPS12W 40.7035	-0.07	0.09	-0.02	0.10
NAM_GPS15W 40.7029	0.20	-0.34	0.15	0.36
	--------	--------	--------	
sigma	0.22	0.38	0.13	[mm]

002H0032+3: (std 0.12 mm, dof 5, 1 outlier)

	002H0032	002H0033	002H0034	
hgt [m]	0.0000	0.0174	-0.0241	sigma
	[mm]			
NAM_GPS06 39.6040	-0.08	0.07	0.90 *	0.12 (1.0)
07_2009 39.6042	-0.11	0.04	0.07	0.11
NAM_GPS12W 39.6034	0.12	-0.13	0.00	0.15
NAM_GPS15W 39.6004	0.06	0.01	-0.07	0.07
	--------	--------	--------	
sigma	0.14	0.11	0.08	[mm]

002H0035+3: (std 0.19 mm, dof 5, 1 outlier)

	002H0035	002H0036	002H0037	
hgt [m]	0.0000	0.0271	-0.0082	sigma
	[mm]			
NAM_GPS06 39.8571	0.14	1.32 *	-0.14	0.22 (1.5)
07_2009 39.8600	0.17	-0.06	-0.11	0.17
NAM_GPS12W 39.8591	-0.13	-0.06	0.19	0.20
NAM_GPS15W 39.8566	-0.17	0.11	0.06	0.18
	--------	--------	--------	
sigma	0.22	0.12	0.20	[mm]

002H0038+3: (std 0.14 mm, dof 5, 1 outlier)

	002H0038	002H0039	002H0040	
hgt [m]	0.0000	0.0078	0.0326	sigma
	[mm]			
NAM_GPS06 40.4548	-0.10	0.10	0.80 *	0.16 (0.9)
07_2009 40.4537	0.13	-0.07	-0.07	0.14
NAM_GPS12W 40.4523	0.10	-0.10	-0.00	0.12
NAM_GPS15W 40.4489	-0.13	0.07	0.07	0.14
	--------	--------	--------	

```
                 sigma       0.17          0.13          0.08      [mm]

002H0042+3: (std 0.07 mm, dof 6)

                         002H0042      002H0043      002H0044
               hgt [m]     0.0000        0.0142        0.0916     sigma
                       [mm]
NAM_GPS06      39.6247       0.06         -0.12          0.06      0.12
07_2009        39.6268      -0.01          0.02         -0.01      0.02
NAM_GPS12W     39.6265      -0.04          0.08         -0.04      0.08
NAM_GPS15W     39.6241      -0.01          0.02         -0.01      0.02
                         --------      --------      --------
                 sigma       0.05          0.10          0.05      [mm]

warning: 002H0048M+4, numiter=1, matrix singular, regularize...
002H0048M+4: (std 0.20 mm, dof 2)

                        002H0048M     002H0048N     002H0048Z      002H0048
               hgt [m]     0.0000        0.0085       -0.1179        0.1094     sigma
                       [mm]
NAM_GPS06      39.6868        NaN           NaN           NaN          0.00                NO REDUNDANCY
NAM_GPS12W     39.7982       0.10         -0.10          0.00           NaN      0.14
NAM_GPS15W     39.7980      -0.10          0.10          0.00           NaN      0.14
                         --------      --------      --------      --------
                 sigma       0.17          0.17          0.00           NaN      [mm]

002H0057+3: (std 0.06 mm, dof 6)

                         002H0057      002H0058      002H0059
               hgt [m]     0.0000        0.0391        0.1202     sigma
                       [mm]
NAM_GPS06      39.9418       0.04         -0.01         -0.03      0.04
07_2009        39.9424      -0.09          0.06          0.03      0.09
NAM_GPS12W     39.9453       0.04         -0.01         -0.03      0.04
NAM_GPS15W     39.9413       0.01         -0.04          0.03      0.04
                         --------      --------      --------
                 sigma       0.08          0.05          0.05      [mm]

003C0122+3: (std 0.16 mm, dof 8)

                         003C0122      003C0123      003C0124
               hgt [m]     0.0000       -0.0158        0.0327     sigma
                       [mm]
NAM_GPS10      40.1431      -0.14         -0.04          0.18      0.18



NAM_GPS12W     40.1470      -0.04         -0.04          0.08      0.08
NAM_GPS13      40.1431      -0.11          0.09          0.01      0.11
NAM_GPS14      40.1452       0.03          0.03         -0.05      0.05
NAM_GPS15W     40.1461       0.26         -0.04         -0.22      0.27
                         --------      --------      --------
                 sigma       0.19          0.07          0.18      [mm]

003D0138+3: (std 0.05 mm, dof 6)

                         003D0138      003D0139      003D0140
               hgt [m]     0.0000        0.1140        0.1067     sigma
                       [mm]
NAM_GPS10      40.1784       0.06         -0.07          0.01      0.07
NAM_GPS12W     40.1781      -0.04          0.03          0.01      0.04
NAM_GPS13      40.1743       0.03          0.00         -0.02      0.03
NAM_GPS15W     40.1767      -0.04          0.03          0.01      0.04
                         --------      --------      --------
                 sigma       0.06          0.06          0.02      [mm]

003G0187+3: (std 0.12 mm, dof 3, 1 outlier)

                         003G0187      003G0188      003G0189
               hgt [m]     0.0000       -0.0118        0.0770     sigma
                       [mm]
NAM_GPS10      39.6443      -1.65 *       -0.10          0.10      0.17 (2.0)
NAM_GPS12W     39.6368       0.03          0.08         -0.12      0.14
NAM_GPS13      39.6349      -0.03          0.02          0.02      0.04
                         --------      --------      --------
                 sigma       0.06          0.12          0.14      [mm]

003G0196+3: (std 0.08 mm, dof 4)

                         003G0196      003G0197      003G0198
               hgt [m]     0.0000        0.0358        0.0516     sigma
                       [mm]
NAM_GPS10      39.7177       0.07          0.00         -0.07      0.08
NAM_GPS12W     39.7155      -0.07         -0.03          0.10      0.11
NAM_GPS13      39.7126       0.00          0.03         -0.03      0.04
                         --------      --------      --------
                 sigma       0.08          0.04          0.11      [mm]

M001M+3: (std 0.25 mm, dof 6, 2 outliers)

                            M001M         M001N         M001Z
```

```
               hgt [m]     0.0000        0.1948        0.0279     sigma
                       [mm]
NAM_GPS06      39.5409       0.09  x      -2.95 *x      -0.09  x   0.14 (3.3)
07_2009        39.5336       0.21         -0.23          0.03      0.26
NAM_GPS11      39.5304      -0.03         -0.07          0.09      0.10
NAM_GPS14      39.5209       0.09          0.95 *       -0.09      0.14 (1.1)
NAM_GPS15W     39.5212      -0.36          0.30          0.06      0.39
                         --------      --------      --------
                 sigma       0.28          0.33          0.11      [mm]


warning: maximum number of iterations for outlier detection exceeded.
M002M+3: (std 0.33 mm, dof 6, 6 outliers)

                            M002M         M002N         M002Z
               hgt [m]     0.0000       -0.1637       -0.1490     sigma
                       [mm]
NAM_GPS06      39.7079       0.00  x       2.12 *x       8.47 *x             BAD EPOCH
NAM_GPS07      39.7012      -0.26          0.26          2.31 *    0.41 (2.6)
07_2009        39.6962       0.04         -0.04          0.81 *    0.06 (0.9)
NAM_GPS10      39.6926       0.00         -0.17          0.17      0.20
NAM_GPS11      39.6923       0.04         -0.24          0.21      0.27
NAM_GPS14      39.6835       1.05 *        0.38         -0.38      0.64 (1.4)
NAM_GPS15W     39.6813       0.19         -0.19         -1.04 *    0.30 (1.2)
                         --------      --------      --------
                 sigma       0.22          0.36          0.42      [mm]

M003M+3: (std 0.17 mm, dof 6, 4 outliers)

                            M003M         M003N         M003Z
               hgt [m]     0.0000       -0.0492       -0.1048     sigma
                       [mm]
NAM_GPS06      40.3959      -0.12  x       0.12  x       4.58 *x   0.19 (5.1)
07_2009        40.3865      -0.05         -0.11          0.16      0.16
NAM_GPS11      40.3813       0.05         -0.11          0.06      0.11
NAM_GPS12W     40.3794       0.19          0.03         -0.21      0.23
NAM_GPS14      40.3741       0.00          1.74 *       -1.10 *             BAD EPOCH
NAM_GPS15W     40.3701      -0.07          0.07         -1.47 *    0.11 (1.6)
                         --------      --------      --------
                 sigma       0.16          0.14          0.23      [mm]

M004M+3: (std 0.07 mm, dof 2, 4 outliers)

                            M004M         M004N         M004Z



               hgt [m]     0.0000        0.2292        0.1269     sigma
                       [mm]
NAM_GPS06      40.6548      10.80 *x       0.00  x       5.40 *x             BAD EPOCH
07_2009        40.6548       2.35 *       -0.05          0.05      0.09 (2.9)
NAM_GPS12W     40.6523       0.00          0.00          0.00      0.00
NAM_GPS15W     40.6494      -3.05 *        0.05         -0.05      0.09 (3.7)
                         --------      --------      --------
                 sigma        NaN          0.07          0.07      [mm]

M005M+3: (std 0.29 mm, dof 6, 2 outliers)

                            M005M         M005N         M005Z
               hgt [m]     0.0000       -0.0478       -0.1233     sigma
                       [mm]
NAM_GPS06      40.6763       2.52 *x       6.85 *x      -0.00  x             BAD EPOCH
07_2009        40.6710      -0.20          0.32         -0.12      0.33
NAM_GPS11      40.6672      -0.20          0.22         -0.02      0.25
NAM_GPS14      40.6619       0.17         -0.21          0.04      0.22
NAM_GPS15W     40.6584       0.23         -0.34          0.11      0.35
                         --------      --------      --------
                 sigma       0.28          0.40          0.12      [mm]

M006M+3: (std 0.29 mm, dof 5, 3 outliers)

                            M006M         M006N         M006Z
               hgt [m]     0.0000        0.0044       -0.0795     sigma
                       [mm]
NAM_GPS06      39.8741      -0.38  x       0.38  x       3.95 *x   0.60 (4.5)
07_2009        39.8707       0.07         -0.07          1.10 *    0.11 (1.2)
NAM_GPS11      39.8659       0.00         -0.14          0.13      0.17
NAM_GPS12W     39.8638       0.14         -0.00         -0.13      0.17
NAM_GPS15W     39.8553       0.17         -0.17         -1.00 *    0.27 (1.1)
                         --------      --------      --------
                 sigma       0.30          0.30          0.23      [mm]

M007M+3: (std 0.26 mm, dof 10, 4 outliers)

                            M007M         M007N         M007Z
               hgt [m]     0.0000       -0.1264       -0.1250     sigma
                       [mm]
NAM_GPS06      40.1203      -2.95 *x       4.74 *x       0.00  x             BAD EPOCH
07_2009        40.1139      -0.28          0.31         -0.03      0.33
NAM_GPS10      40.1113      -0.15          0.24         -0.10      0.23
NAM_GPS11      40.1070      -0.01          0.18         -0.16      0.19
```

```
NAM_GPS12W     40.1021       0.19         -0.12         -0.06      0.18
NAM_GPS13      40.1011       0.25         -0.16         -0.10      0.24
NAM_GPS14      40.0924       0.93 *       -0.18          0.18      0.27 (1.0)
NAM_GPS15W     40.0883       1.33 *       -0.28          0.28      0.43 (1.5)
                          --------      --------      --------
                 sigma       0.27          0.30          0.21      [mm]


warning: maximum number of iterations for outlier detection exceeded.
M008M+6: (std 0.38 mm, dof 9, 6 outliers)

                            M008M         M008N         M008Z         M017M         M017N         M017Z
               hgt [m]     0.0000        0.0343        0.0833        0.2603        0.2127        0.1814     sigma
                       [mm]
NAM_GPS06      39.9686       0.00  x      41.85 *x       8.07 *x        NaN           NaN           NaN                BAD EPOCH
NAM_GPS08A     39.9687      -1.46 *        0.59         -0.59 *         NaN           NaN           NaN                BAD EPOCH
07_2009        39.9657      -0.34          0.01          0.33           NaN           NaN           NaN      0.37
NAM_GPS10      39.9616      -0.24         -0.09          0.33           NaN           NaN           NaN      0.33
NAM_GPS11      39.9616      -0.11         -0.06          0.16           NaN           NaN           NaN      0.16
NAM_GPS12W     39.9577       0.07         -0.07         -1.05 *         NaN           NaN           NaN      0.11 (1.2)
NAM_GPS13      39.9542       0.22         -0.22         -1.20 *         NaN           NaN           NaN      0.35 (1.4)
NAM_GPS14      39.9523       0.39         -0.16         -0.24           NaN           NaN           NaN      0.38
NAM_GPS15W     39.9440       0.00         -3.55 *         NaN          0.00          0.00          0.00                NO REDUNDANCY
                          --------      --------      --------      --------      --------      --------
                 sigma       0.36          0.36          0.38           NaN           NaN           NaN      [mm]

M009M+3: (std 0.17 mm, dof 13, 1 outlier)

                            M009M         M009N         M009Z
               hgt [m]     0.0000       -0.0999        0.0066     sigma
                       [mm]
NAM_GPS06      40.2341       0.17  x       4.78 *x      -0.17  x   0.26 (5.1)
07_2009        40.2286       0.14          0.15         -0.29      0.27
NAM_GPS10      40.2279       0.04          0.05         -0.09      0.09
NAM_GPS11      40.2268      -0.06          0.05          0.01      0.06
NAM_GPS12W     40.2290      -0.12          0.09          0.04      0.12
NAM_GPS13      40.2248       0.01         -0.08          0.07      0.08
NAM_GPS14      40.2238      -0.06         -0.15          0.21      0.20
NAM_GPS15W     40.2246      -0.12         -0.11          0.24      0.22
                          --------      --------      --------
                 sigma       0.14          0.14          0.23      [mm]

M010M+3: (std 0.24 mm, dof 5, 1 outlier)




                            M010M         M010N         M010Z
               hgt [m]     0.0000        0.0318        0.0655     sigma
                       [mm]
NAM_GPS06      39.8403      -0.32  x      -2.13 *x       0.32  x   0.53 (2.5)
07_2009        39.8343       0.09          0.08         -0.16      0.17
NAM_GPS12W     39.8323       0.15         -0.06         -0.10      0.16
NAM_GPS15W     39.8271       0.09         -0.02         -0.06      0.09
                          --------      --------      --------
                 sigma       0.28          0.08          0.28      [mm]

M011M+3: (std 0.25 mm, dof 5, 3 outliers)

                            M011M         M011N         M011Z
               hgt [m]     0.0000       -0.0590       -0.1066     sigma
                       [mm]
NAM_GPS06      40.6190      -1.38 *x      -0.00  x       6.13 *x            BAD EPOCH
07_2009        40.6191      -0.06         -0.28          0.34      0.38
NAM_GPS12W     40.6166      -0.03          0.15         -0.12      0.16
NAM_GPS13      40.6167       0.07          0.15         -0.22      0.23
NAM_GPS15W     40.6120       0.01         -0.01         -1.98 *    0.02 (2.3)
                          --------      --------      --------
                 sigma       0.07          0.26          0.37      [mm]

M012M+3: (std 0.26 mm, dof 2, 4 outliers)

                            M012M         M012N         M012Z
               hgt [m]     0.0000       -0.0643       -0.0363     sigma
                       [mm]
NAM_GPS06      40.2159       1.42 *x       0.00  x      -6.00 *x            BAD EPOCH
07_2009        40.2020       0.16          1.44 *       -0.16      0.31 (2.0)
NAM_GPS12W     40.2038      -0.22          0.06          0.16      0.29
NAM_GPS15W     40.1999       0.06         -0.06          1.54 *    0.12 (2.1)
                          --------      --------      --------
                 sigma       0.29          0.12          0.31      [mm]

M013M+3: (std 0.28 mm, dof 3, 3 outliers)

                            M013M         M013N         M013Z
               hgt [m]     0.0000       -0.0573       -0.1625     sigma
                       [mm]
NAM_GPS06      39.4610      -6.81 *x       4.73 *x       0.00  x            BAD EPOCH
07_2009        39.4543      -2.12 *        0.12         -0.12      0.20 (2.6)
NAM_GPS12W     39.4539      -0.15          0.19         -0.04      0.23
NAM_GPS15W     39.4508       0.15         -0.31          0.16      0.35
```

```
                    --------      --------      --------
                sigma       0.26          0.35          0.19      [mm]

M015M+3: (std 0.17 mm, dof 4, 4 outliers)

                           M015M         M015N         M015Z
              hgt [m]     0.0000        0.1063       -0.1442     sigma
                      [mm]
NAM_GPS06      39.7988      11.55 *x       5.85 *x       0.00  x              BAD EPOCH
07_2009        39.7978       0.05         -0.05         -1.60 *    0.08 (1.8)
NAM_GPS11      39.7918       0.15         -0.15         -1.10 *    0.24 (1.3)
NAM_GPS14      39.7877      -0.02          0.08         -0.07      0.10
NAM_GPS15W     39.7851      -0.18          0.12          0.07      0.20
                    --------      --------      --------
                sigma       0.19          0.17          0.12      [mm]

M016M+3: (std 0.12 mm, dof 6, 2 outliers)

                           M016M         M016N         M016Z
              hgt [m]     0.0000        0.0623       -0.0448     sigma
                      [mm]
NAM_GPS06      40.2454       0.00  x       1.02 *x      -3.47 *x              BAD EPOCH
NAM_GPS08A     40.2409      -0.08         -0.06          0.14      0.14
07_2009        40.2395      -0.05          0.08         -0.02      0.08
NAM_GPS12W     40.2330       0.12          0.04         -0.16      0.16
NAM_GPS14      40.2296       0.02         -0.06          0.04      0.06
                    --------      --------      --------
                sigma       0.11          0.08          0.15      [mm]

000A4025+2: (std NaN mm, dof 0)

                        000A4025      000A5025
              hgt [m]     0.0000       -0.4728     sigma
                      [mm]
NAM_GPS06      47.4881       0.00           NaN               NO REDUNDANCY
07_2009        47.4873       0.00           NaN               NO REDUNDANCY
NAM_GPS11L     47.4868       0.00           NaN               NO REDUNDANCY
NAM_GPS15O     47.4856       0.00          0.00               NO REDUNDANCY
                    --------      --------
                sigma        NaN           NaN      [mm]
```

Select output mode: all benchmarks or only one per cluster

```
if config.reducecluster

   % Use only one benchmark per cluster with the adjusted height, updated
   % flags used by default.

   fprintf('\n\nRemove observations and benchmarks for clusters, leaving only one\n unique benchmarks per cluster with LSQ adjusted heig
ht measurements.\n')
   fprintf('\nObservations flags are recomputed using both the a-priori flags and\n results from the cluster analysis.\n\n')

   % rename old observations and replace by cluster observations

   obsindex_orig=obsindex;
   obsstats_orig=obsstats;
   obs_orig=obs;

   obsindex=clusterobsadm(:,1:2);
   obsstats=clusterobsstats;
   obs=clusterobs(:,1);

   % remove cluster observations with format st.dev. larger than 1 cm

   irem=find(clusterobs(:,2)>.01);     % remove cluster observations with formal st.dev. larger than 1 cm
   obs(irem,:)=[];
   obsindex(irem,:)=[];
   obsstats(irem,:)=[];

   % rename old point data and replace by cluster data

   pntname_orig=pntname;
   pntcrd_orig=pntcrd;
   pntstats_orig=pntstats;

   pntname=pntname(clusterpntadm(:,2));     % don't use clustername, but name of first point (clustername is too long for netcdf)
   pntcrd=pntcrd(clusterpntadm(:,2),:);     % coordinates of first point in cluster
   pntclass=pntclass(clusterpntadm(:,2),:);
   pntstats=clusterstats(:,[ 1:4 6:7]);     % clusterstats has one more column, is removed

   % update the counts

   numobs=size(obsindex,1);
   numpnt=numel(pntname);

   fprintf('Number of observations %d -> %d\n',numel(obs_orig),numobs)
   fprintf('Number of benchmarks %d -> %d \n\n',numel(pntname_orig),numpnt)
```

```
elseif config.updateflags

   fprintf('\n\nUpdate observations flags using results from the cluster analysis.\n\n')

   % Use updated flags from cluster analysis

   obsstats_orig=obsstats;
   obsstats=obsstats2;

end
```

```
Remove observations and benchmarks for clusters, leaving only one
 unique benchmarks per cluster with LSQ adjusted height measurements.

Observations flags are recomputed using both the a-priori flags and
 results from the cluster analysis.

Number of observations 805 -> 426
Number of benchmarks 154 -> 71
```

Make GPS covariance matrix

```
tmjd=prjstats(:,3) - 678942;       % mean project epoch in MJD
tyear=(tmjd-51544.5)./365.25+2000; % mean project epoch in years
ndays=prjstats(:,4);               % number of days of observations

cov1=zeros(numobs,numobs);
for component=3:-1:1
    idx=find( obsstats(:,7) == component );  % find observed component (1=North, 2=East, 3=Up)
    if isempty(idx), continue;, end
    % Make GPS covariance matrix w/o setup noise
    switch config.covcompmethod
        case 'common_project_date'
           % All points with common date for each campaign observation
           cov1(idx,idx)=gpscov1(obsindex(idx,:),pntcrd,tyear,round(mean(ndays)),config.gpscov(component));
        case 'obs_date'
            error(['unsupported co-variance computation method, use "common_project_date" instead.' covmethod ])
        otherwise
            error(['unknown co-variance computation method, check input.' covmethod ])
    end
end

figure('Name','GPSCov');
imagesc(cov1.*1e6); hc=colorbar;ylabel(hc,'[mm^2]')
title('GPS Covariance matrix (w/o setup noise)')

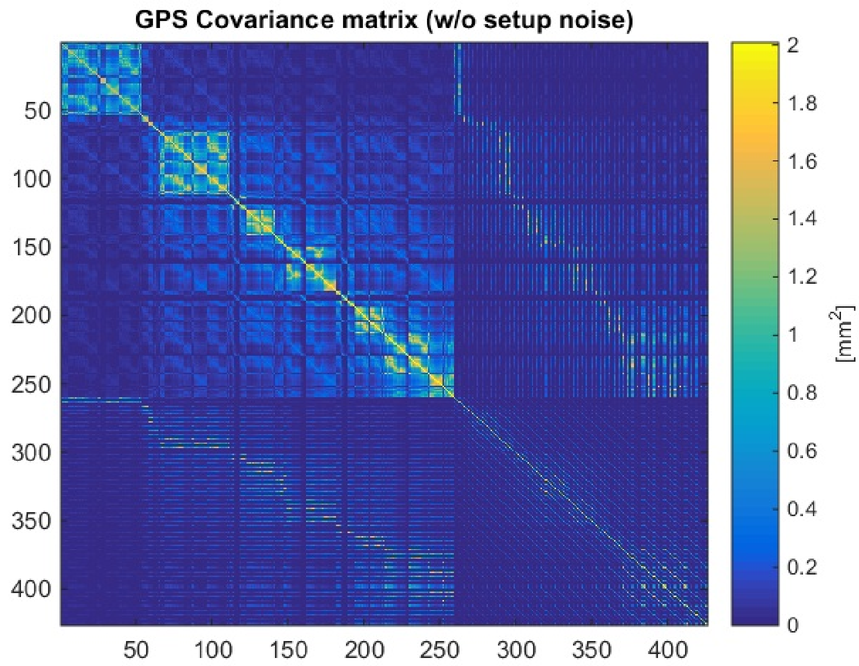
% Add setup noise, only for the height component, and only for campaign stations

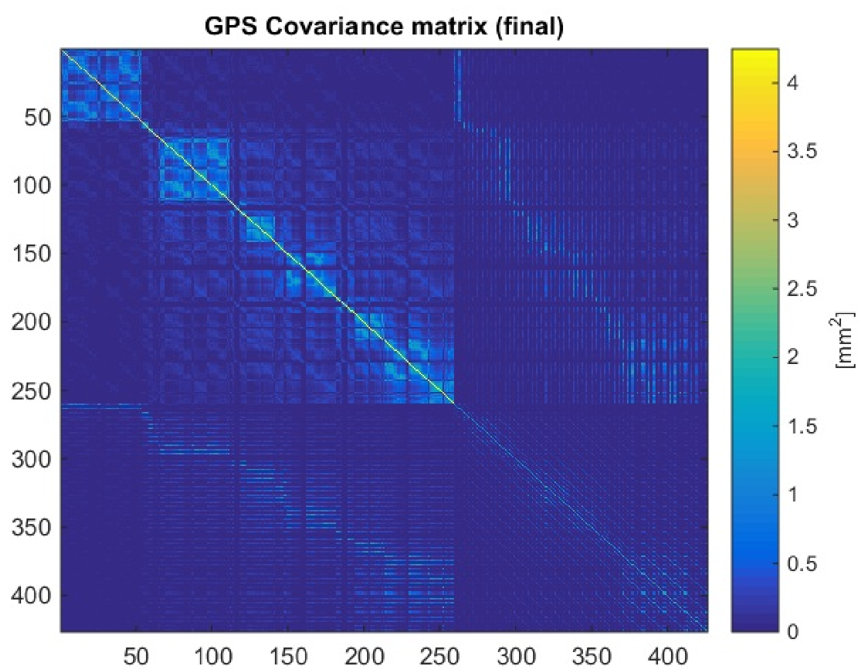
component=3;
cov2=zeros(numobs,numobs);
if config.reducecluster || config.ignoreclustercorrelation
   % add diagonal setup noise for reduced clusters
   idxobsk=find( obsstats(:,6) == 0 & obsstats(:,7) == component);
   nobsk=numel(idxobsk);
   if nobsk > 0
      cov2(idxobsk,idxobsk)=cov2(idxobsk,idxobsk) + ...
            eye(nobsk,nobsk)*config.gpscov(component).setupnoise.^2 ;
   end
else
   % add block diagonal setup noise for clusters in non reduced setup
   idxcluster=find( clusterobsstats(:,6) == 0 & clusterobsstats(:,7) == component);
   for k=1:numel(idxcluster)
      idxobsk=clusterobsadm(k,find(~isnan(clusterobsadm(k,4:end)))+3);
      nobsk=numel(idxobsk);
      cov2(idxobsk,idxobsk)=cov2(idxobsk,idxobsk) + ...
          ones(nobsk,nobsk)*config.gpscov(component).setupnoise.^2 + ...
          eye(nobsk,nobsk)*config.gpscov(component).setuplevellingnoise.^2;
   end
end

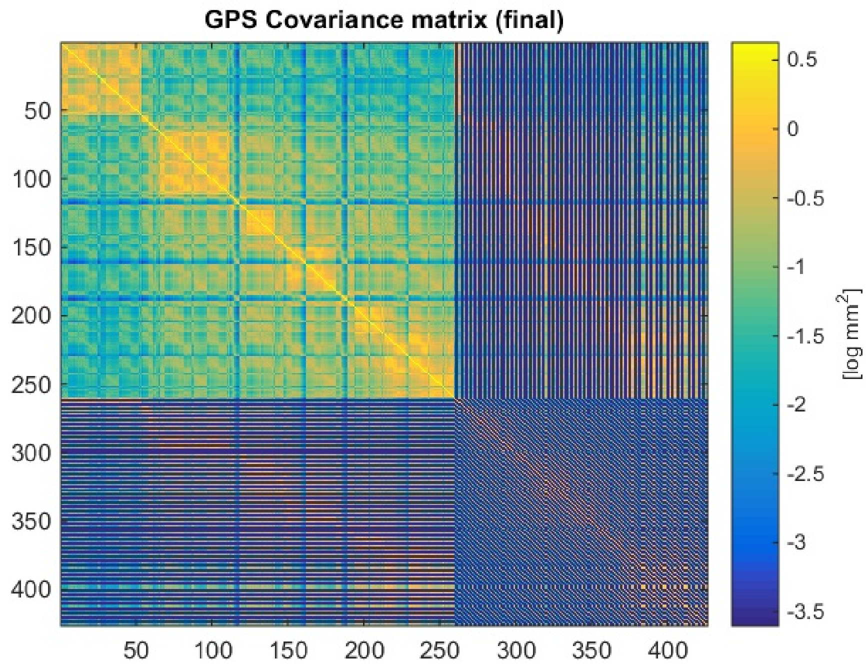
cov2=cov1+cov2;

figure('Name','GPSfinalCov');
imagesc(cov2.*1e6); hc=colorbar;ylabel(hc,'[mm^2]')
title('GPS Covariance matrix (final)')

figure('Name','GPSfinalCov (log)');
imagesc(log10(abs(cov2.*1e6))); hc=colorbar;ylabel(hc,'[log mm^2]')
title('GPS Covariance matrix (final)')
```


GPS Covariance matrix (w/o setup noise)
[mm2]
50
100
150
200
250
300
350
400
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2


GPS Covariance matrix (final)
[mm2]
50
100
150
200
250
300
350
400
0
0.5
1
1.5
2
2.5
3
3.5
4



Output netcdf

```
% Add synthetic benchmark SYN_BM to end of point data arrays

pntname{end+1}='SYN_BM';
pntcrd(end+1,1:2)=[NaN NaN];
%pntcrd(end+1,1:2)=[0 0];
pntclass{end+1}='SYN_BM';
cluster_id(end+1)=0;

% Prepare the single (spatial) differences (wrt SYN_BM)
```

```
prjepoch=prjstats(:,3);

sdobstable= [  (numpnt+1)*ones(numobs,1)   obsindex(:,1) obsindex(:,2) ];
sdobs=obs;
sdcov=cov2;

sdobsflag=obsstats(:,5);
sensitivity=zeros(numobs,3);
sensitivity(sub2ind([numobs,3],[1:numobs]',obsstats(:,7)))=ones(numobs,1);
epoch=obsstats(:,3);

% write netcdf

writelts2netcdf(netcdf_file,globalattributes, ...
                pntname,pntcrd,pntclass, ...
                prjname,prjepoch,prjclass, ...
                sdobstable,sdobs,sdcov,sdobsflag,sensitivity,epoch)
```

```
Create NAM LTS2 netcdf schema ...
Netcdf file lts2_allgps_cluster.nc already exists, will be deleted first to recreate it.
Write NAM LTS2 netcdf schema to file...
Write data to NAM LTS2 netcdf...
Done.
```

update point class

```
updpntclasslts2netcdf(netcdf_file);
```

```
Warning: pntclass length exceeded, take evasive action GPS&CORS&OFFSH -> CORS&OFFSH
Warning: pntclass length exceeded, take evasive action GPS&CORS&OFFSH -> CORS&OFFSH

Benchmarks (72 points):

PNTNAME             X_RD         Y_RD    CLASS

002C0026      188624.906   602829.000    GPS --> GPS&OFFSH
002C0029      188454.516   604607.563    GPS --> GPS&OFFSH
002C0033      188355.016   606473.625    GPS --> GPS&OFFSH
002C0064      184855.422   603078.750    GPS --> GPS&OFFSH
```

```
002D0048      190431.453   607552.938   GPS --> GPS&OFFSH
002D0054      190472.875   602133.750   GPS --> GPS&OFFSH
002D0059      199818.563   608020.625   GPS --> GPS&OFFSH
002D0066      192539.516   603415.000   GPS --> GPS&OFFSH
002D0102      194665.750   603777.500   GPS --> GPS&OFFSH
002D0105      191525.844   605371.313   GPS --> GPS&OFFSH
002D0108      195800.406   605104.813   GPS --> GPS&OFFSH
002G0042      202536.609   604116.125   GPS --> GPS&OFFSH
002G0048      200137.703   605655.313   GPS --> GPS&OFFSH
002G0124      205180.000   607390.000   GPS --> GPS&OFFSH
002H0032      214816.016   602736.125   GPS --> GPS&OFFSH
002H0035      217078.219   603911.063   GPS --> GPS&OFFSH
002H0038      211559.609   606175.563   GPS --> GPS&OFFSH
002H0042      212350.109   608280.875   GPS --> GPS&OFFSH
002H0048M     214192.016   609212.688   GPS --> GPS&OFFSH
002H0057      216171.141   606338.063   GPS --> GPS&OFFSH
003C0122      227224.984   607639.625   GPS --> GPS&OFFSH
003D0138      235065.719   609432.188   GPS --> GPS&OFFSH
003G0187      247508.203   610468.750   GPS --> GPS&OFFSH
003G0196      243854.656   611562.813   GPS --> GPS&OFFSH
M001M         189813.125   605613.813   GPS --> GPS&OFFSH
M002M         191025.109   606484.000   GPS --> GPS&OFFSH
M003M         197017.828   604177.188   GPS --> GPS&OFFSH
M004M         198928.672   609200.688   GPS --> GPS&OFFSH
M005M         196483.891   606410.813   GPS --> GPS&OFFSH
M006M         198322.391   604850.563   GPS --> GPS&OFFSH
M007M         198456.875   603016.563   GPS --> GPS&OFFSH
M008M         200842.516   603928.563   GPS --> GPS&OFFSH
M009M         207493.375   606364.250   GPS --> GPS&OFFSH
M010M         210169.000   605201.188   GPS --> GPS&OFFSH
M011M         211529.906   606960.000   GPS --> GPS&OFFSH
M012M         214107.453   605091.750   GPS --> GPS&OFFSH
M013M         208614.281   605166.438   GPS --> GPS&OFFSH
M015M         188715.375   605150.688   GPS --> GPS&OFFSH
M016M         204340.375   603946.063   GPS --> GPS&OFFSH
000A4025      208860.000   602780.000   GPS --> GPS&ONSH
000A2592      180070.000   606750.000   GPS --> GPS&ONSH
000A2632      216190.000   588660.000   GPS --> GPS&ONSH
000A2683      214920.000   594120.000   GPS --> GPS&ONSH
000A2686      201440.000   601650.000   GPS --> GPS&ONSH
000A2687      207460.000   592600.000   GPS --> GPS&ONSH
000A2688      216130.000   601040.000   GPS --> GPS&ONSH
000A2689      211540.000   600330.000   GPS --> GPS&ONSH
000A2691      205070.000   602130.000   GPS --> GPS&ONSH


002D0079      190500.000   608830.000   UNUSED
006B0021      198930.000   590320.000   GPS --> GPS&ONSH
006E0193      205330.000   598560.000   UNUSED
006E0216      205380.000   598440.000   UNUSED
006E0239      205355.000   598500.000   UNUSED
AME-2         186842.969   610897.750   GPS&CORS --> CORS&OFFSH
AWG-1         191779.000   611828.000   GPS&CORS --> CORS&OFFSH
GRK1          216356.281   588654.250   GPS --> GPS&ONSH
GRK2          216356.188   588662.188   GPS --> GPS&ONSH
GRK3          216356.094   588670.250   GPS --> GPS&ONSH
GRK4          216356.016   588678.250   GPS --> GPS&ONSH
L100          208080.016   602147.813   GPS --> GPS&ONSH
L101          208197.813   599877.938   GPS --> GPS&ONSH
L102          207909.219   598551.625   GPS --> GPS&ONSH
L103          210682.906   596425.000   GPS --> GPS&ONSH
L104          211295.344   594605.188   GPS --> GPS&ONSH
L105          210076.063   593900.938   GPS --> GPS&ONSH
L106          208413.813   594932.250   GPS --> GPS&ONSH
L107          208345.578   596834.000   GPS --> GPS&ONSH
AME1          190474.984   608822.500   CORS --> CORS&ONSH
ANJM          205931.141   598546.063   CORS --> CORS&ONSH
MODD          200244.563   602329.813   CORS --> CORS&ONSH
AMEL          180095.063   606756.938   CORS --> CORS&ONSH
SYN_BM               NaN          NaN   SYN_BM

The netcdf_file lts2_allgps_cluster.nc will be updated.
```

Text output

```
fprintf('\n\nFrom       To         Project       Obs [m] StDev [mm] Flg   N E U  Date\n\n')
for k=1:size(sdobstable,1)
   fprintf('%-10s %-10s %-10s %10.4f %10.2f  %2d  %2d%2d%2d  %s\n',...
       pntname{sdobstable(k,1)},pntname{sdobstable(k,2)},prjname{sdobstable(k,3)},...
       sdobs(k),sqrt(sdcov(k,k))*1000,sdobsflag(k),sensitivity(k,:),datestr(epoch(k),'yyyy-mm-dd HH:MM'))
end
```

```
From       To         Project       Obs [m] StDev [mm] Flg   N E U  Date

SYN_BM     000A2592   NAM_GPS06     44.5020       1.93   0   0 0 1  2006-06-15 13:58
SYN_BM     000A2686   NAM_GPS06     40.4799       1.93   0   0 0 1  2006-07-22 10:59
SYN_BM     000A2689   NAM_GPS06     39.7409       1.93   0   0 0 1  2006-07-01 22:52
```

SYN_BM	000A2691	NAM_GPS06	41.4449	1.93	0	0	0	1	2006-07-15	12:31
SYN_BM	000A4025	NAM_GPS06	47.4881	1.93	0	0	0	1	2006-07-28	15:38
SYN_BM	002C0026	NAM_GPS06	39.4816	1.93	0	0	0	1	2006-06-09	11:49
SYN_BM	002C0029	NAM_GPS06	39.5697	1.93	0	0	0	1	2006-06-02	12:26
SYN_BM	002C0033	NAM_GPS06	39.8506	1.93	0	0	0	1	2006-06-04	08:41
SYN_BM	002C0064	NAM_GPS06	40.1763	1.93	0	0	0	1	2006-05-30	22:04
SYN_BM	002D0048	NAM_GPS06	40.2410	1.93	0	0	0	1	2006-06-12	01:12
SYN_BM	002D0054	NAM_GPS06	39.5756	1.93	0	0	0	1	2006-06-21	23:02
SYN_BM	002D0059	NAM_GPS06	41.4059	1.93	0	0	0	1	2006-06-25	12:08
SYN_BM	002D0066	NAM_GPS06	40.0017	1.93	0	0	0	1	2006-06-14	03:12
SYN_BM	002D0102	NAM_GPS06	39.4434	1.93	0	0	0	1	2006-06-16	07:51
SYN_BM	002D0105	NAM_GPS06	39.5467	1.93	0	0	0	1	2006-06-07	10:02
SYN_BM	002D0108	NAM_GPS06	40.1795	1.93	0	0	0	1	2006-06-17	23:49
SYN_BM	002G0042	NAM_GPS06	40.0280	1.93	0	0	0	1	2006-06-29	11:13
SYN_BM	002G0048	NAM_GPS06	39.7759	1.93	0	0	0	1	2006-07-03	19:19
SYN_BM	002G0124	NAM_GPS06	40.7112	1.93	0	0	0	1	2006-07-13	20:32
SYN_BM	002H0032	NAM_GPS06	39.6040	1.93	0	0	0	1	2006-08-05	09:23
SYN_BM	002H0035	NAM_GPS06	39.8571	1.93	0	0	0	1	2006-08-13	17:40
SYN_BM	002H0038	NAM_GPS06	40.4548	1.93	0	0	0	1	2006-07-07	21:50
SYN_BM	002H0042	NAM_GPS06	39.6247	1.93	0	0	0	1	2006-07-02	00:28
SYN_BM	002H0057	NAM_GPS06	39.9418	1.93	0	0	0	1	2006-07-05	20:37
SYN_BM	AME-2	NAM_GPS06	69.7026	1.93	0	0	0	1	2006-11-07	11:25
SYN_BM	AWG-1	NAM_GPS06	79.3302	1.93	0	0	0	1	2006-11-14	11:33
SYN_BM	GRK1	NAM_GPS06	42.0622	1.93	0	0	0	1	2006-09-26	16:44
SYN_BM	GRK2	NAM_GPS06	42.0606	1.93	0	0	0	1	2006-09-26	17:36
SYN_BM	GRK3	NAM_GPS06	42.0617	1.93	0	0	0	1	2006-09-26	03:43
SYN_BM	GRK4	NAM_GPS06	42.0644	1.93	0	0	0	1	2006-09-26	19:42
SYN_BM	L100	NAM_GPS06	39.8652	1.93	0	0	0	1	2006-09-09	07:33
SYN_BM	L101	NAM_GPS06	39.8720	1.93	0	0	0	1	2006-09-09	09:51
SYN_BM	L102	NAM_GPS06	39.9065	1.93	0	0	0	1	2006-09-17	20:16
SYN_BM	L103	NAM_GPS06	39.7952	1.93	0	0	0	1	2006-09-02	10:40
SYN_BM	L104	NAM_GPS06	40.9892	1.93	0	0	0	1	2006-09-18	10:11
SYN_BM	L105	NAM_GPS06	40.8844	1.93	0	0	0	1	2006-09-11	20:32
SYN_BM	L106	NAM_GPS06	39.6761	1.93	0	0	0	1	2006-09-08	20:49
SYN_BM	L107	NAM_GPS06	39.7506	1.93	0	0	0	1	2006-09-02	10:03
SYN_BM	M001M	NAM_GPS06	39.5409	1.93	1	0	0	1	2006-08-09	01:14
SYN_BM	M002M	NAM_GPS06	39.7079	1.93	1	0	0	1	2006-08-08	00:05
SYN_BM	M003M	NAM_GPS06	40.3959	1.93	1	0	0	1	2006-07-31	10:37
SYN_BM	M004M	NAM_GPS06	40.6548	1.93	1	0	0	1	2006-06-24	22:46
SYN_BM	M005M	NAM_GPS06	40.6763	1.93	3	0	0	1	2006-07-25	23:44
SYN_BM	M006M	NAM_GPS06	39.8741	1.93	1	0	0	1	2006-07-31	18:54
SYN_BM	M007M	NAM_GPS06	40.1203	1.93	3	0	0	1	2006-07-24	00:05
SYN_BM	M008M	NAM_GPS06	39.9686	1.93	1	0	0	1	2006-07-19	19:53
SYN_BM	M009M	NAM_GPS06	40.2341	1.93	1	0	0	1	2006-07-15	22:36
SYN_BM	M010M	NAM_GPS06	39.8403	1.93	1	0	0	1	2006-07-10	00:12
SYN_BM	M011M	NAM_GPS06	40.6190	1.93	1	0	0	1	2006-07-27	21:23
SYN_BM	M012M	NAM_GPS06	40.2159	1.93	1	0	0	1	2006-07-18	00:45
SYN_BM	M013M	NAM_GPS06	39.4610	1.93	3	0	0	1	2006-07-12	02:27
SYN_BM	M015M	NAM_GPS06	39.7988	1.93	3	0	0	1	2006-07-21	23:09
SYN_BM	M016M	NAM_GPS06	40.2454	1.93	1	0	0	1	2006-08-16	00:33
SYN_BM	000A2592	NAM_GPS07	44.5043	1.99	0	0	0	1	2007-07-05	13:50
SYN_BM	002C0029	NAM_GPS07	39.5672	1.99	0	0	0	1	2007-06-29	13:30
SYN_BM	002C0033	NAM_GPS07	39.8467	1.99	0	0	0	1	2007-06-16	13:22
SYN_BM	002D0048	NAM_GPS07	40.2353	1.99	0	0	0	1	2007-06-17	10:02
SYN_BM	M002M	NAM_GPS07	39.7012	1.99	0	0	0	1	2007-06-17	17:15
SYN_BM	002G0042	NAM_GPS08A	40.0270	2.01	0	0	0	1	2008-08-03	21:23
SYN_BM	M008M	NAM_GPS08A	39.9687	2.01	0	0	0	1	2008-08-02	21:15
SYN_BM	M016M	NAM_GPS08A	40.2409	2.01	0	0	0	1	2008-08-04	22:32
SYN_BM	000A2632	NAM_GPS08B	40.6130	2.02	0	0	0	1	2008-10-20	10:34
SYN_BM	000A2688	NAM_GPS08B	46.1002	2.02	0	0	0	1	2008-10-20	09:31
SYN_BM	006B0021	NAM_GPS08B	45.6618	2.02	0	0	0	1	2008-10-18	23:45
SYN_BM	000A2592	07_2009	44.5036	2.03	0	0	0	1	2009-05-20	23:00
SYN_BM	000A2689	07_2009	39.7419	2.03	0	0	0	1	2009-06-25	09:47
SYN_BM	000A2691	07_2009	41.4383	2.03	0	0	0	1	2009-09-21	08:56
SYN_BM	000A4025	07_2009	47.4873	2.03	0	0	0	1	2009-08-08	09:53
SYN_BM	002C0026	07_2009	39.4848	2.03	0	0	0	1	2009-05-15	12:42
SYN_BM	002C0029	07_2009	39.5664	2.03	0	0	0	1	2009-05-17	14:07
SYN_BM	002C0033	07_2009	39.8425	2.03	0	0	0	1	2009-05-21	23:24
SYN_BM	002C0064	07_2009	40.1760	2.03	0	0	0	1	2009-05-09	07:27
SYN_BM	002D0048	07_2009	40.2248	2.03	0	0	0	1	2009-05-23	23:58
SYN_BM	002D0054	07_2009	39.5739	2.03	0	0	0	1	2009-05-19	22:11
SYN_BM	002D0059	07_2009	41.4061	2.03	0	0	0	1	2009-06-22	11:57
SYN_BM	002D0066	07_2009	40.0000	2.03	0	0	0	1	2009-06-13	11:48
SYN_BM	002D0102	07_2009	39.4420	2.03	0	0	0	1	2009-06-02	16:00
SYN_BM	002D0108	07_2009	40.1724	2.03	0	0	0	1	2009-07-03	21:54
SYN_BM	002G0042	07_2009	40.0234	2.03	0	0	0	1	2009-06-18	21:22
SYN_BM	002G0048	07_2009	39.7731	2.03	0	0	0	1	2009-06-16	19:57
SYN_BM	002G0124	07_2009	40.7061	2.03	0	0	0	1	2009-06-06	22:35
SYN_BM	002H0032	07_2009	39.6042	2.03	0	0	0	1	2009-07-24	14:54
SYN_BM	002H0035	07_2009	39.8600	2.03	0	0	0	1	2009-07-22	00:25
SYN_BM	002H0038	07_2009	40.4537	2.03	0	0	0	1	2009-06-29	10:40
SYN_BM	002H0042	07_2009	39.6268	2.03	0	0	0	1	2009-08-04	00:05
SYN_BM	002H0057	07_2009	39.9424	2.03	0	0	0	1	2009-07-30	03:57
SYN_BM	AME-2	07_2009	69.6900	2.03	0	0	0	1	2009-11-02	18:12
SYN_BM	AWG-1	07_2009	79.3216	2.03	0	0	0	1	2009-11-03	12:06
SYN_BM	L100	07_2009	39.8640	2.03	0	0	0	1	2009-08-09	23:42
SYN_BM	L101	07_2009	39.8648	2.03	0	0	0	1	2009-08-10	20:20
SYN_BM	L102	07_2009	39.8973	2.03	0	0	0	1	2009-08-15	22:10

SYN_BM	L103	07_2009	39.7872	2.03	0	0	0	1	2009-08-15 08:35
SYN_BM	L104	07_2009	40.9802	2.03	0	0	0	1	2009-08-23 22:01
SYN_BM	L105	07_2009	40.8816	2.03	0	0	0	1	2009-08-23 22:24
SYN_BM	L106	07_2009	39.6734	2.03	0	0	0	1	2009-08-16 20:55
SYN_BM	L107	07_2009	39.7486	2.03	0	0	0	1	2009-08-16 22:55
SYN_BM	M001M	07_2009	39.5336	2.03	0	0	0	1	2009-05-10 15:20
SYN_BM	M002M	07_2009	39.6962	2.03	0	0	0	1	2009-05-27 03:58
SYN_BM	M003M	07_2009	40.3865	2.03	0	0	0	1	2009-05-29 04:35
SYN_BM	M004M	07_2009	40.6548	2.03	0	0	0	1	2009-07-12 22:52
SYN_BM	M005M	07_2009	40.6710	2.03	0	0	0	1	2009-06-20 21:28
SYN_BM	M006M	07_2009	39.8707	2.03	0	0	0	1	2009-06-27 04:32
SYN_BM	M007M	07_2009	40.1139	2.03	0	0	0	1	2009-07-06 00:31
SYN_BM	M008M	07_2009	39.9657	2.03	0	0	0	1	2009-07-01 14:12
SYN_BM	M009M	07_2009	40.2286	2.03	0	0	0	1	2009-06-25 02:14
SYN_BM	M010M	07_2009	39.8343	2.03	0	0	0	1	2009-07-10 14:15
SYN_BM	M011M	07_2009	40.6191	2.03	0	0	0	1	2009-08-01 21:32
SYN_BM	M012M	07_2009	40.2020	2.03	0	0	0	1	2009-07-19 22:07
SYN_BM	M013M	07_2009	39.4543	2.03	0	0	0	1	2009-06-11 10:21
SYN_BM	M015M	07_2009	39.7978	2.03	0	0	0	1	2009-05-13 04:57
SYN_BM	M016M	07_2009	40.2395	2.03	0	0	0	1	2009-06-04 23:38
SYN_BM	000A2592	NAM_GPS10	44.5036	2.04	0	0	0	1	2010-07-31 03:10
SYN_BM	002C0029	NAM_GPS10	39.5665	2.04	0	0	0	1	2010-07-31 18:33
SYN_BM	002G0042	NAM_GPS10	40.0205	2.04	0	0	0	1	2010-08-08 23:35
SYN_BM	003C0122	NAM_GPS10	40.1431	2.04	0	0	0	1	2010-08-18 20:05
SYN_BM	003D0138	NAM_GPS10	40.1784	2.04	0	0	0	1	2010-08-21 03:38
SYN_BM	003G0187	NAM_GPS10	39.6443	2.04	0	0	0	1	2010-08-23 19:39
SYN_BM	003G0196	NAM_GPS10	39.7177	2.04	0	0	0	1	2010-08-29 10:51
SYN_BM	M002M	NAM_GPS10	39.6926	2.04	0	0	0	1	2010-08-01 18:12
SYN_BM	M007M	NAM_GPS10	40.1113	2.04	0	0	0	1	2010-08-10 00:33
SYN_BM	M008M	NAM_GPS10	39.9616	2.04	0	0	0	1	2010-08-07 22:38
SYN_BM	M009M	NAM_GPS10	40.2279	2.04	0	0	0	1	2010-08-16 12:08
SYN_BM	002C0026	NAM_GPS11	39.4840	2.04	0	0	0	1	2011-05-13 12:03
SYN_BM	002C0029	NAM_GPS11	39.5682	2.04	0	0	0	1	2011-05-09 18:55
SYN_BM	002C0033	NAM_GPS11	39.8379	2.04	0	0	0	1	2011-05-08 18:23
SYN_BM	002C0064	NAM_GPS11	40.1772	2.04	0	0	0	1	2011-05-07 23:06
SYN_BM	002D0048	NAM_GPS11	40.2172	2.04	0	0	0	1	2011-05-20 03:24
SYN_BM	002D0054	NAM_GPS11	39.5732	2.04	0	0	0	1	2011-05-25 05:44
SYN_BM	002D0066	NAM_GPS11	39.9989	2.04	0	0	0	1	2011-05-17 03:15
SYN_BM	002D0102	NAM_GPS11	39.4406	2.04	0	0	0	1	2011-05-14 09:28
SYN_BM	002D0108	NAM_GPS11	40.1696	2.04	0	0	0	1	2011-05-24 00:48
SYN_BM	002G0042	NAM_GPS11	40.0216	2.04	0	0	0	1	2011-05-06 22:03
SYN_BM	M001M	NAM_GPS11	39.5304	2.04	0	0	0	1	2011-05-12 08:01
SYN_BM	M002M	NAM_GPS11	39.6923	2.04	0	0	0	1	2011-05-12 02:50
SYN_BM	M003M	NAM_GPS11	40.3813	2.04	0	0	0	1	2011-05-18 23:57
SYN_BM	M005M	NAM_GPS11	40.6672	2.04	0	0	0	1	2011-05-26 14:06
SYN_BM	M006M	NAM_GPS11	39.8659	2.04	0	0	0	1	2011-05-31 07:35
SYN_BM	M007M	NAM_GPS11	40.1070	2.04	0	0	0	1	2011-05-30 09:34
SYN_BM	M008M	NAM_GPS11	39.9616	2.04	0	0	0	1	2011-05-28 10:31
SYN_BM	M009M	NAM_GPS11	40.2268	2.04	0	0	0	1	2011-05-22 04:39
SYN_BM	M015M	NAM_GPS11	39.7918	2.04	0	0	0	1	2011-05-10 13:48
SYN_BM	000A2683	NAM_GPS11L	46.1854	2.04	0	0	0	1	2011-09-26 09:23
SYN_BM	000A2687	NAM_GPS11L	40.6483	2.04	0	0	0	1	2011-09-26 05:49
SYN_BM	000A2688	NAM_GPS11L	46.0944	2.04	0	0	0	1	2011-09-18 07:54
SYN_BM	000A2689	NAM_GPS11L	39.7439	2.04	0	0	0	1	2011-09-18 22:43
SYN_BM	000A2691	NAM_GPS11L	41.4339	2.04	0	0	0	1	2011-09-19 09:28
SYN_BM	000A4025	NAM_GPS11L	47.4868	2.04	0	0	0	1	2011-09-26 11:46
SYN_BM	AME-2	NAM_GPS11P	69.6813	2.04	0	0	0	1	2011-09-29 10:46
SYN_BM	AWG-1	NAM_GPS11P	79.3154	2.04	0	0	0	1	2011-09-28 21:36
SYN_BM	002D0059	NAM_GPS12W	41.4039	2.05	0	0	0	1	2012-05-20 12:52
SYN_BM	002G0048	NAM_GPS12W	39.7679	2.05	0	0	0	1	2012-05-15 10:02
SYN_BM	002G0124	NAM_GPS12W	40.7035	2.05	0	0	0	1	2012-05-17 00:19
SYN_BM	002H0032	NAM_GPS12W	39.6034	2.05	0	0	0	1	2012-05-10 04:20
SYN_BM	002H0035	NAM_GPS12W	39.8591	2.05	0	0	0	1	2012-05-11 01:26
SYN_BM	002H0038	NAM_GPS12W	40.4523	2.05	0	0	0	1	2012-06-01 23:32
SYN_BM	002H0042	NAM_GPS12W	39.6265	2.05	0	0	0	1	2012-05-08 03:08
SYN_BM	002H0048M	NAM_GPS12W	39.7982	2.05	0	0	0	1	2012-05-09 04:36
SYN_BM	002H0057	NAM_GPS12W	39.9453	2.05	0	0	0	1	2012-05-29 13:50
SYN_BM	003C0122	NAM_GPS12W	40.1470	2.05	0	0	0	1	2012-05-29 10:23
SYN_BM	003D0138	NAM_GPS12W	40.1781	2.05	0	0	0	1	2012-06-01 11:06
SYN_BM	003G0187	NAM_GPS12W	39.6368	2.05	0	0	0	1	2012-05-22 07:04
SYN_BM	003G0196	NAM_GPS12W	39.7155	2.05	0	0	0	1	2012-05-23 04:22
SYN_BM	M003M	NAM_GPS12W	40.3794	2.05	0	0	0	1	2012-05-26 04:32
SYN_BM	M004M	NAM_GPS12W	40.6523	2.05	0	0	0	1	2012-05-28 13:46
SYN_BM	M006M	NAM_GPS12W	39.8638	2.05	0	0	0	1	2012-05-24 09:36
SYN_BM	M007M	NAM_GPS12W	40.1021	2.05	0	0	0	1	2012-06-06 22:17
SYN_BM	M008M	NAM_GPS12W	39.9577	2.05	0	0	0	1	2012-05-31 17:18
SYN_BM	M009M	NAM_GPS12W	40.2290	2.05	0	0	0	1	2012-05-06 18:47
SYN_BM	M010M	NAM_GPS12W	39.8323	2.05	0	0	0	1	2012-05-14 15:22
SYN_BM	M011M	NAM_GPS12W	40.6166	2.05	0	0	0	1	2012-05-07 01:36
SYN_BM	M012M	NAM_GPS12W	40.2038	2.05	0	0	0	1	2012-05-15 21:07
SYN_BM	M013M	NAM_GPS12W	39.4539	2.05	0	0	0	1	2012-05-11 14:36
SYN_BM	M016M	NAM_GPS12W	40.2330	2.05	0	0	0	1	2012-06-08 04:21
SYN_BM	L100	NAM_GPS12L	39.8625	2.05	0	0	0	1	2012-06-16 23:46
SYN_BM	L101	NAM_GPS12L	39.8611	2.05	0	0	0	1	2012-06-17 00:04
SYN_BM	L102	NAM_GPS12L	39.8898	2.05	0	0	0	1	2012-06-17 23:40
SYN_BM	L103	NAM_GPS12L	39.7831	2.05	0	0	0	1	2012-06-17 20:48
SYN_BM	L104	NAM_GPS12L	40.9749	2.05	0	0	0	1	2012-06-25 09:55
SYN_BM	L105	NAM_GPS12L	40.8794	2.05	0	0	0	1	2012-06-25 11:29

SYN_BM	L106	NAM_GPS12L	39.6727	2.05	0	0	0	1	2012-06-18	20:50
SYN_BM	L107	NAM_GPS12L	39.7448	2.05	0	0	0	1	2012-06-17	22:21
SYN_BM	002C0029	NAM_GPS13	39.5656	2.05	0	0	0	1	2013-05-11	16:59
SYN_BM	002C0033	NAM_GPS13	39.8353	2.05	0	0	0	1	2013-05-22	18:28
SYN_BM	002D0066	NAM_GPS13	39.9955	2.05	0	0	0	1	2013-05-17	19:45
SYN_BM	002G0042	NAM_GPS13	40.0146	2.05	0	0	0	1	2013-05-15	04:33
SYN_BM	003C0122	NAM_GPS13	40.1431	2.05	0	0	0	1	2013-05-14	04:41
SYN_BM	003D0138	NAM_GPS13	40.1743	2.05	0	0	0	1	2013-05-19	21:55
SYN_BM	003G0187	NAM_GPS13	39.6349	2.05	0	0	0	1	2013-05-14	04:33
SYN_BM	003G0196	NAM_GPS13	39.7126	2.05	0	0	0	1	2013-05-18	20:36
SYN_BM	M007M	NAM_GPS13	40.1011	2.05	0	0	0	1	2013-05-21	22:19
SYN_BM	M008M	NAM_GPS13	39.9542	2.05	0	0	0	1	2013-05-15	23:49
SYN_BM	M009M	NAM_GPS13	40.2248	2.05	0	0	0	1	2013-05-11	02:08
SYN_BM	M011M	NAM_GPS13	40.6167	2.05	0	0	0	1	2013-05-16	22:04
SYN_BM	000A2592	NAM_GPS14	44.5035	2.06	0	0	0	1	2014-05-25	12:20
SYN_BM	002C0026	NAM_GPS14	39.4831	2.06	0	0	0	1	2014-05-17	10:43
SYN_BM	002C0029	NAM_GPS14	39.5659	2.06	0	0	0	1	2014-05-22	14:48
SYN_BM	002C0033	NAM_GPS14	39.8313	2.06	0	0	0	1	2014-05-21	20:38
SYN_BM	002C0064	NAM_GPS14	40.1812	2.06	0	0	0	1	2014-05-24	15:54
SYN_BM	002D0048	NAM_GPS14	40.2036	2.06	0	0	0	1	2014-05-18	23:12
SYN_BM	002D0102	NAM_GPS14	39.4292	2.06	0	0	0	1	2014-05-03	16:50
SYN_BM	002D0108	NAM_GPS14	40.1614	2.06	0	0	0	1	2014-05-09	00:19
SYN_BM	002G0042	NAM_GPS14	40.0104	2.06	0	0	0	1	2014-05-14	17:10
SYN_BM	002G0048	NAM_GPS14	39.7657	2.06	0	0	0	1	2014-05-05	05:28
SYN_BM	003C0122	NAM_GPS14	40.1452	2.06	0	0	0	1	2014-05-10	23:43
SYN_BM	M001M	NAM_GPS14	39.5209	2.06	0	0	0	1	2014-05-19	16:41
SYN_BM	M002M	NAM_GPS14	39.6835	2.06	0	0	0	1	2014-05-08	10:44
SYN_BM	M003M	NAM_GPS14	40.3741	2.06	0	0	0	1	2014-05-02	22:30
SYN_BM	M005M	NAM_GPS14	40.6619	2.06	0	0	0	1	2014-05-07	11:49
SYN_BM	M007M	NAM_GPS14	40.0924	2.06	0	0	0	1	2014-05-13	05:54
SYN_BM	M008M	NAM_GPS14	39.9523	2.06	0	0	0	1	2014-05-06	06:09
SYN_BM	M009M	NAM_GPS14	40.2238	2.06	0	0	0	1	2014-05-01	22:22
SYN_BM	M015M	NAM_GPS14	39.7877	2.06	0	0	0	1	2014-05-23	02:03
SYN_BM	M016M	NAM_GPS14	40.2296	2.06	0	0	0	1	2014-05-06	00:03
SYN_BM	002C0033	NAM_GPS15W	39.8260	2.06	0	0	0	1	2015-06-16	03:07
SYN_BM	002D0048	NAM_GPS15W	40.1968	2.06	0	0	0	1	2015-06-11	17:55
SYN_BM	002D0059	NAM_GPS15W	41.4020	2.06	0	0	0	1	2015-05-29	23:45
SYN_BM	002D0066	NAM_GPS15W	39.9934	2.06	0	0	0	1	2015-06-04	05:58
SYN_BM	002D0102	NAM_GPS15W	39.4290	2.06	0	0	0	1	2015-05-22	11:15
SYN_BM	002D0108	NAM_GPS15W	40.1589	2.06	0	0	0	1	2015-06-02	03:22
SYN_BM	002G0042	NAM_GPS15W	40.0075	2.06	0	0	0	1	2015-05-25	22:02
SYN_BM	002G0124	NAM_GPS15W	40.7029	2.06	0	0	0	1	2015-05-20	12:53
SYN_BM	002H0032	NAM_GPS15W	39.6004	2.06	0	0	0	1	2015-05-23	18:34
SYN_BM	002H0035	NAM_GPS15W	39.8566	2.06	0	0	0	1	2015-05-17	11:28
SYN_BM	002H0038	NAM_GPS15W	40.4489	2.06	0	0	0	1	2015-05-24	09:51
SYN_BM	002H0042	NAM_GPS15W	39.6241	2.06	0	0	0	1	2015-05-08	10:57
SYN_BM	002H0048M	NAM_GPS15W	39.7980	2.06	0	0	0	1	2015-05-07	18:44
SYN_BM	002H0057	NAM_GPS15W	39.9413	2.06	0	0	0	1	2015-05-12	05:20
SYN_BM	003C0122	NAM_GPS15W	40.1461	2.06	0	0	0	1	2015-05-26	19:20
SYN_BM	003D0138	NAM_GPS15W	40.1767	2.06	0	0	0	1	2015-06-20	23:22
SYN_BM	M001M	NAM_GPS15W	39.5212	2.06	0	0	0	1	2015-06-09	12:54
SYN_BM	M002M	NAM_GPS15W	39.6813	2.06	0	0	0	1	2015-06-11	07:26
SYN_BM	M003M	NAM_GPS15W	40.3701	2.06	0	0	0	1	2015-05-13	13:24
SYN_BM	M004M	NAM_GPS15W	40.6494	2.06	0	0	0	1	2015-05-28	14:09
SYN_BM	M005M	NAM_GPS15W	40.6584	2.06	0	0	0	1	2015-05-26	17:53
SYN_BM	M006M	NAM_GPS15W	39.8553	2.06	0	0	0	1	2015-05-12	16:56
SYN_BM	M007M	NAM_GPS15W	40.0883	2.06	0	0	0	1	2015-06-19	10:15
SYN_BM	M008M	NAM_GPS15W	39.9440	2.06	0	0	0	1	2015-06-19	02:05
SYN_BM	M009M	NAM_GPS15W	40.2246	2.06	0	0	0	1	2015-05-06	07:04
SYN_BM	M010M	NAM_GPS15W	39.8271	2.06	0	0	0	1	2015-05-19	08:39
SYN_BM	M011M	NAM_GPS15W	40.6120	2.06	0	0	0	1	2015-05-14	12:05
SYN_BM	M012M	NAM_GPS15W	40.1999	2.06	0	0	0	1	2015-05-10	12:11
SYN_BM	M013M	NAM_GPS15W	39.4508	2.06	0	0	0	1	2015-05-05	14:01
SYN_BM	M015M	NAM_GPS15W	39.7851	2.06	0	0	0	1	2015-06-10	02:14
SYN_BM	L100	NAM_GPS15L	39.8588	2.06	0	0	0	1	2015-06-27	20:55
SYN_BM	L101	NAM_GPS15L	39.8535	2.06	0	0	0	1	2015-06-28	20:47
SYN_BM	L102	NAM_GPS15L	39.8824	2.06	0	0	0	1	2015-06-28	22:03
SYN_BM	L103	NAM_GPS15L	39.7804	2.06	0	0	0	1	2015-06-27	21:13
SYN_BM	L104	NAM_GPS15L	40.9689	2.06	0	0	0	1	2015-07-06	13:25
SYN_BM	L105	NAM_GPS15L	40.8718	2.06	0	0	0	1	2015-07-06	06:47
SYN_BM	L106	NAM_GPS15L	39.6692	2.06	0	0	0	1	2015-06-29	20:52
SYN_BM	L107	NAM_GPS15L	39.7416	2.06	0	0	0	1	2015-06-29	22:50
SYN_BM	000A2592	NAM_GPS15O	44.5024	2.06	0	0	0	1	2015-07-17	20:53
SYN_BM	000A2683	NAM_GPS15O	46.1793	2.06	0	0	0	1	2015-07-04	05:59
SYN_BM	000A2686	NAM_GPS15O	40.4518	2.06	0	0	0	1	2015-07-05	00:41
SYN_BM	000A2687	NAM_GPS15O	40.6388	2.06	0	0	0	1	2015-07-13	21:31
SYN_BM	000A2688	NAM_GPS15O	46.0897	2.06	0	0	0	1	2015-07-11	05:48
SYN_BM	000A2689	NAM_GPS15O	39.7397	2.06	0	0	0	1	2015-07-04	03:39
SYN_BM	000A2691	NAM_GPS15O	41.4273	2.06	0	0	0	1	2015-07-13	23:36
SYN_BM	000A4025	NAM_GPS15O	47.4856	2.06	0	0	0	1	2015-07-03	07:39
SYN_BM	AME1	NAM_GPS06	48.1627	1.22	0	0	0	1	2006-07-17	00:00
SYN_BM	AME1	NAM_GPS06	0.0027	0.84	0	0	1	0	2006-07-17	00:00
SYN_BM	AME1	NAM_GPS06	-0.0100	0.84	0	1	0	0	2006-07-17	00:00
SYN_BM	ANJM	NAM_GPS06	45.2827	1.22	0	0	0	1	2006-07-17	00:00
SYN_BM	ANJM	NAM_GPS06	0.0065	0.84	0	0	1	0	2006-07-17	00:00
SYN_BM	ANJM	NAM_GPS06	-0.0033	0.84	0	1	0	0	2006-07-17	00:00
SYN_BM	AME1	NAM_GPS07	48.1546	1.31	0	0	0	1	2007-06-21	00:00
SYN_BM	AME1	NAM_GPS07	0.0007	0.87	0	0	1	0	2007-06-21	00:00

SYN_BM	AME1	NAM_GPS07	-0.0070	0.87	0	1 0 0	2007-06-21 00:00
SYN_BM	MODD	NAM_GPS07	47.5643	1.31	0	0 0 1	2007-06-21 00:00
SYN_BM	MODD	NAM_GPS07	0.0012	0.87	0	0 1 0	2007-06-21 00:00
SYN_BM	MODD	NAM_GPS07	0.0006	0.87	0	1 0 0	2007-06-21 00:00
SYN_BM	AME1	NAM_GPS08A	48.1470	1.34	0	0 0 1	2008-08-04 00:00
SYN_BM	AME1	NAM_GPS08A	0.0002	0.89	0	0 1 0	2008-08-04 00:00
SYN_BM	AME1	NAM_GPS08A	-0.0059	0.89	0	1 0 0	2008-08-04 00:00
SYN_BM	ANJM	NAM_GPS08A	45.2757	1.34	0	0 0 1	2008-08-04 00:00
SYN_BM	ANJM	NAM_GPS08A	0.0033	0.89	0	0 1 0	2008-08-04 00:00
SYN_BM	ANJM	NAM_GPS08A	-0.0033	0.89	0	1 0 0	2008-08-04 00:00
SYN_BM	MODD	NAM_GPS08A	47.5640	1.34	0	0 0 1	2008-08-04 00:00
SYN_BM	MODD	NAM_GPS08A	0.0016	0.89	0	0 1 0	2008-08-04 00:00
SYN_BM	MODD	NAM_GPS08A	-0.0005	0.89	0	1 0 0	2008-08-04 00:00
SYN_BM	AME1	NAM_GPS08B	48.1459	1.35	0	0 0 1	2008-10-19 23:51
SYN_BM	AME1	NAM_GPS08B	0.0001	0.89	0	0 1 0	2008-10-19 23:51
SYN_BM	AME1	NAM_GPS08B	-0.0055	0.89	0	1 0 0	2008-10-19 23:51
SYN_BM	ANJM	NAM_GPS08B	45.2744	1.35	0	0 0 1	2008-10-19 23:51
SYN_BM	ANJM	NAM_GPS08B	0.0034	0.89	0	0 1 0	2008-10-19 23:51
SYN_BM	ANJM	NAM_GPS08B	-0.0034	0.89	0	1 0 0	2008-10-19 23:51
SYN_BM	MODD	NAM_GPS08B	47.5638	1.35	0	0 0 1	2008-10-19 23:51
SYN_BM	MODD	NAM_GPS08B	0.0015	0.89	0	0 1 0	2008-10-19 23:51
SYN_BM	MODD	NAM_GPS08B	-0.0006	0.89	0	1 0 0	2008-10-19 23:51
SYN_BM	AME1	07_2009	48.1408	1.36	0	0 0 1	2009-06-26 00:00
SYN_BM	AME1	07_2009	0.0007	0.89	0	0 1 0	2009-06-26 00:00
SYN_BM	AME1	07_2009	-0.0035	0.89	0	1 0 0	2009-06-26 00:00
SYN_BM	ANJM	07_2009	45.2710	1.36	0	0 0 1	2009-06-26 00:00
SYN_BM	ANJM	07_2009	0.0029	0.89	0	0 1 0	2009-06-26 00:00
SYN_BM	ANJM	07_2009	-0.0013	0.89	0	1 0 0	2009-06-26 00:00
SYN_BM	MODD	07_2009	47.5633	1.36	0	0 0 1	2009-06-26 00:00
SYN_BM	MODD	07_2009	0.0016	0.89	0	0 1 0	2009-06-26 00:00
SYN_BM	MODD	07_2009	0.0006	0.89	0	1 0 0	2009-06-26 00:00
SYN_BM	AME1	NAM_GPS10	48.1345	1.38	0	0 0 1	2010-08-13 00:00
SYN_BM	AME1	NAM_GPS10	-0.0001	0.90	0	0 1 0	2010-08-13 00:00
SYN_BM	AME1	NAM_GPS10	-0.0007	0.90	0	1 0 0	2010-08-13 00:00
SYN_BM	ANJM	NAM_GPS10	45.2662	1.38	0	0 0 1	2010-08-13 00:00
SYN_BM	ANJM	NAM_GPS10	0.0014	0.90	0	0 1 0	2010-08-13 00:00
SYN_BM	ANJM	NAM_GPS10	-0.0003	0.90	0	1 0 0	2010-08-13 00:00
SYN_BM	MODD	NAM_GPS10	47.5596	1.38	0	0 0 1	2010-08-13 00:00
SYN_BM	MODD	NAM_GPS10	0.0014	0.90	0	0 1 0	2010-08-13 00:00
SYN_BM	MODD	NAM_GPS10	0.0003	0.90	0	1 0 0	2010-08-13 00:00
SYN_BM	AME1	NAM_GPS11	48.1286	1.39	0	0 0 1	2011-05-18 00:00
SYN_BM	AME1	NAM_GPS11	-0.0005	0.90	0	0 1 0	2011-05-18 00:00
SYN_BM	AME1	NAM_GPS11	0.0010	0.90	0	1 0 0	2011-05-18 00:00
SYN_BM	ANJM	NAM_GPS11	45.2643	1.39	0	0 0 1	2011-05-18 00:00
SYN_BM	ANJM	NAM_GPS11	0.0007	0.90	0	0 1 0	2011-05-18 00:00
SYN_BM	ANJM	NAM_GPS11	0.0006	0.90	0	1 0 0	2011-05-18 00:00
SYN_BM	MODD	NAM_GPS11	47.5574	1.39	0	0 0 1	2011-05-18 00:00
SYN_BM	MODD	NAM_GPS11	0.0010	0.90	0	0 1 0	2011-05-18 00:00
SYN_BM	MODD	NAM_GPS11	0.0006	0.90	0	1 0 0	2011-05-18 00:00
SYN_BM	AME1	NAM_GPS11L	48.1257	1.39	0	0 0 1	2011-09-23 00:00
SYN_BM	AME1	NAM_GPS11L	-0.0009	0.90	0	0 1 0	2011-09-23 00:00
SYN_BM	AME1	NAM_GPS11L	0.0015	0.90	0	1 0 0	2011-09-23 00:00
SYN_BM	ANJM	NAM_GPS11L	45.2623	1.39	0	0 0 1	2011-09-23 00:00
SYN_BM	ANJM	NAM_GPS11L	-0.0006	0.90	0	0 1 0	2011-09-23 00:00
SYN_BM	ANJM	NAM_GPS11L	0.0005	0.90	0	1 0 0	2011-09-23 00:00
SYN_BM	MODD	NAM_GPS11L	47.5570	1.39	0	0 0 1	2011-09-23 00:00
SYN_BM	MODD	NAM_GPS11L	0.0002	0.90	0	0 1 0	2011-09-23 00:00
SYN_BM	MODD	NAM_GPS11L	0.0004	0.90	0	1 0 0	2011-09-23 00:00
SYN_BM	AME1	NAM_GPS11P	48.1257	1.39	0	0 0 1	2011-09-29 00:00
SYN_BM	AME1	NAM_GPS11P	-0.0008	0.90	0	0 1 0	2011-09-29 00:00
SYN_BM	AME1	NAM_GPS11P	0.0014	0.90	0	1 0 0	2011-09-29 00:00
SYN_BM	ANJM	NAM_GPS11P	45.2630	1.39	0	0 0 1	2011-09-29 00:00
SYN_BM	ANJM	NAM_GPS11P	-0.0004	0.90	0	0 1 0	2011-09-29 00:00
SYN_BM	ANJM	NAM_GPS11P	0.0007	0.90	0	1 0 0	2011-09-29 00:00
SYN_BM	MODD	NAM_GPS11P	47.5570	1.39	0	0 0 1	2011-09-29 00:00
SYN_BM	MODD	NAM_GPS11P	0.0007	0.90	0	0 1 0	2011-09-29 00:00
SYN_BM	MODD	NAM_GPS11P	0.0007	0.90	0	1 0 0	2011-09-29 00:00
SYN_BM	AME1	NAM_GPS12W	48.1228	1.39	0	0 0 1	2012-05-21 00:00
SYN_BM	AME1	NAM_GPS12W	-0.0008	0.91	0	0 1 0	2012-05-21 00:00
SYN_BM	AME1	NAM_GPS12W	0.0025	0.91	0	1 0 0	2012-05-21 00:00
SYN_BM	ANJM	NAM_GPS12W	45.2601	1.39	0	0 0 1	2012-05-21 00:00
SYN_BM	ANJM	NAM_GPS12W	-0.0007	0.91	0	0 1 0	2012-05-21 00:00
SYN_BM	ANJM	NAM_GPS12W	0.0012	0.91	0	1 0 0	2012-05-21 00:00
SYN_BM	MODD	NAM_GPS12W	47.5549	1.39	0	0 0 1	2012-05-21 00:00
SYN_BM	MODD	NAM_GPS12W	0.0008	0.91	0	0 1 0	2012-05-21 00:00
SYN_BM	MODD	NAM_GPS12W	0.0009	0.91	0	1 0 0	2012-05-21 00:00
SYN_BM	AME1	NAM_GPS12L	48.1219	1.39	0	0 0 1	2012-06-20 00:00
SYN_BM	AME1	NAM_GPS12L	-0.0011	0.91	0	0 1 0	2012-06-20 00:00
SYN_BM	AME1	NAM_GPS12L	0.0034	0.91	0	1 0 0	2012-06-20 00:00
SYN_BM	ANJM	NAM_GPS12L	45.2598	1.39	0	0 0 1	2012-06-20 00:00
SYN_BM	ANJM	NAM_GPS12L	-0.0007	0.91	0	0 1 0	2012-06-20 00:00
SYN_BM	ANJM	NAM_GPS12L	0.0014	0.91	0	1 0 0	2012-06-20 00:00
SYN_BM	MODD	NAM_GPS12L	47.5539	1.39	0	0 0 1	2012-06-20 00:00
SYN_BM	MODD	NAM_GPS12L	0.0008	0.91	0	0 1 0	2012-06-20 00:00
SYN_BM	MODD	NAM_GPS12L	0.0011	0.91	0	1 0 0	2012-06-20 00:00
SYN_BM	AME1	NAM_GPS13	48.1164	1.40	0	0 0 1	2013-05-17 00:00
SYN_BM	AME1	NAM_GPS13	-0.0010	0.91	0	0 1 0	2013-05-17 00:00
SYN_BM	AME1	NAM_GPS13	0.0043	0.91	0	1 0 0	2013-05-17 00:00

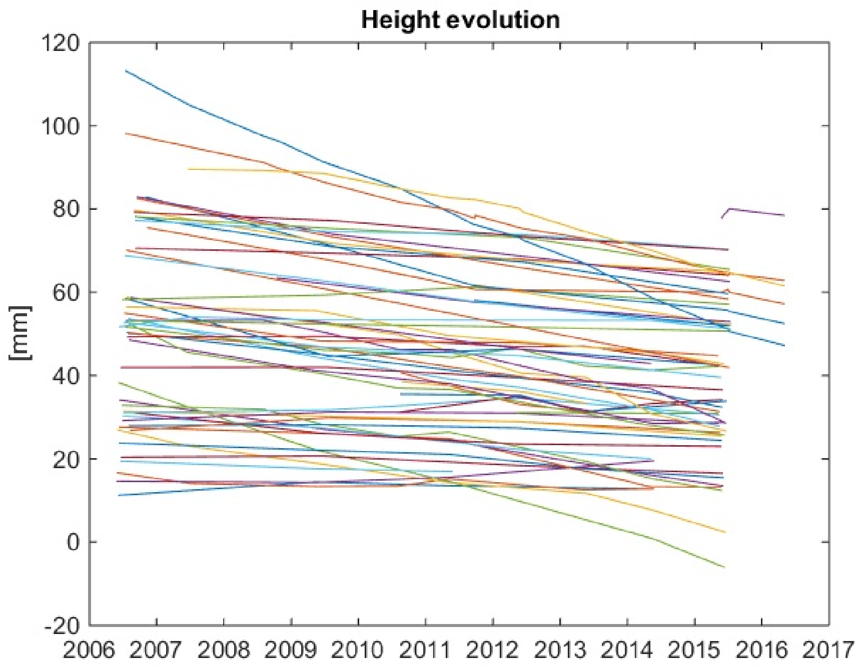
```
SYN_BM     ANJM       NAM_GPS13     45.2575       1.40   0    0 0 1  2013-05-17 00:00
SYN_BM     ANJM       NAM_GPS13     -0.0018       0.91   0    0 1 0  2013-05-17 00:00
SYN_BM     ANJM       NAM_GPS13      0.0026       0.91   0    1 0 0  2013-05-17 00:00
SYN_BM     MODD       NAM_GPS13     47.5493       1.40   0    0 0 1  2013-05-17 00:00
SYN_BM     MODD       NAM_GPS13     -0.0002       0.91   0    0 1 0  2013-05-17 00:00
SYN_BM     MODD       NAM_GPS13      0.0005       0.91   0    1 0 0  2013-05-17 00:00
SYN_BM     AME1       NAM_GPS14     48.1082       1.41   0    0 0 1  2014-05-13 00:00
SYN_BM     AME1       NAM_GPS14     -0.0003       0.91   0    0 1 0  2014-05-13 00:00
SYN_BM     AME1       NAM_GPS14      0.0057       0.91   0    1 0 0  2014-05-13 00:00
SYN_BM     ANJM       NAM_GPS14     45.2533       1.41   0    0 0 1  2014-05-13 00:00
SYN_BM     ANJM       NAM_GPS14     -0.0038       0.91   0    0 1 0  2014-05-13 00:00
SYN_BM     ANJM       NAM_GPS14      0.0030       0.91   0    1 0 0  2014-05-13 00:00
SYN_BM     MODD       NAM_GPS14     47.5448       1.41   0    0 0 1  2014-05-13 00:00
SYN_BM     MODD       NAM_GPS14     -0.0016       0.91   0    0 1 0  2014-05-13 00:00
SYN_BM     MODD       NAM_GPS14      0.0001       0.91   0    1 0 0  2014-05-13 00:00
SYN_BM     AME1       NAM_GPS15W    48.1013       1.41   0    0 0 1  2015-05-27 00:00
SYN_BM     AME1       NAM_GPS15W     0.0004       0.91   0    0 1 0  2015-05-27 00:00
SYN_BM     AME1       NAM_GPS15W     0.0066       0.91   0    1 0 0  2015-05-27 00:00
SYN_BM     ANJM       NAM_GPS15W    45.2495       1.41   0    0 0 1  2015-05-27 00:00
SYN_BM     ANJM       NAM_GPS15W    -0.0052       0.91   0    0 1 0  2015-05-27 00:00
SYN_BM     ANJM       NAM_GPS15W     0.0024       0.91   0    1 0 0  2015-05-27 00:00
SYN_BM     MODD       NAM_GPS15W    47.5393       1.41   0    0 0 1  2015-05-27 00:00
SYN_BM     MODD       NAM_GPS15W    -0.0028       0.91   0    0 1 0  2015-05-27 00:00
SYN_BM     MODD       NAM_GPS15W    -0.0009       0.91   0    1 0 0  2015-05-27 00:00
SYN_BM     AMEL       NAM_GPS15W    60.6342       1.41   0    0 0 1  2015-05-27 00:00
SYN_BM     AMEL       NAM_GPS15W     0.0001       0.91   0    0 1 0  2015-05-27 00:00
SYN_BM     AMEL       NAM_GPS15W     0.0000       0.91   0    1 0 0  2015-05-27 00:00
SYN_BM     AME-2      NAM_GPS15W    69.6757       1.41   0    0 0 1  2015-05-27 00:00
SYN_BM     AWG-1      NAM_GPS15W    79.3147       1.41   0    0 0 1  2015-05-27 00:00
SYN_BM     AME1       NAM_GPS15L    48.1008       1.41   0    0 0 1  2015-07-01 00:00
SYN_BM     AME1       NAM_GPS15L     0.0010       0.91   0    0 1 0  2015-07-01 00:00
SYN_BM     AME1       NAM_GPS15L     0.0060       0.91   0    1 0 0  2015-07-01 00:00
SYN_BM     ANJM       NAM_GPS15L    45.2485       1.41   0    0 0 1  2015-07-01 00:00
SYN_BM     ANJM       NAM_GPS15L    -0.0049       0.91   0    0 1 0  2015-07-01 00:00
SYN_BM     ANJM       NAM_GPS15L     0.0019       0.91   0    1 0 0  2015-07-01 00:00
SYN_BM     MODD       NAM_GPS15L    47.5396       1.41   0    0 0 1  2015-07-01 00:00
SYN_BM     MODD       NAM_GPS15L    -0.0023       0.91   0    0 1 0  2015-07-01 00:00
SYN_BM     MODD       NAM_GPS15L    -0.0023       0.91   0    1 0 0  2015-07-01 00:00
SYN_BM     AMEL       NAM_GPS15L    60.6360       1.41   0    0 0 1  2015-07-01 00:00
SYN_BM     AMEL       NAM_GPS15L    -0.0003       0.91   0    0 1 0  2015-07-01 00:00
SYN_BM     AMEL       NAM_GPS15L     0.0000       0.91   0    1 0 0  2015-07-01 00:00
SYN_BM     AME-2      NAM_GPS15L    69.6755       1.41   0    0 0 1  2015-07-01 00:00
SYN_BM     AWG-1      NAM_GPS15L    79.3154       1.41   0    0 0 1  2015-07-01 00:00
SYN_BM     AME1       NAM_GPS15O    48.1001       1.41   0    0 0 1  2015-07-09 00:00


SYN_BM     AME1       NAM_GPS15O     0.0008       0.91   0    0 1 0  2015-07-09 00:00
SYN_BM     AME1       NAM_GPS15O     0.0064       0.91   0    1 0 0  2015-07-09 00:00
SYN_BM     ANJM       NAM_GPS15O    45.2491       1.41   0    0 0 1  2015-07-09 00:00
SYN_BM     ANJM       NAM_GPS15O    -0.0048       0.91   0    0 1 0  2015-07-09 00:00
SYN_BM     ANJM       NAM_GPS15O     0.0020       0.91   0    1 0 0  2015-07-09 00:00
SYN_BM     MODD       NAM_GPS15O    47.5395       1.41   0    0 0 1  2015-07-09 00:00
SYN_BM     MODD       NAM_GPS15O    -0.0026       0.91   0    0 1 0  2015-07-09 00:00
SYN_BM     MODD       NAM_GPS15O    -0.0019       0.91   0    1 0 0  2015-07-09 00:00
SYN_BM     AMEL       NAM_GPS15O    60.6364       1.41   0    0 0 1  2015-07-09 00:00
SYN_BM     AMEL       NAM_GPS15O     0.0000       0.91   0    0 1 0  2015-07-09 00:00
SYN_BM     AMEL       NAM_GPS15O     0.0002       0.91   0    1 0 0  2015-07-09 00:00
SYN_BM     AME-2      NAM_GPS15O    69.6752       1.41   0    0 0 1  2015-07-09 00:00
SYN_BM     AWG-1      NAM_GPS15O    79.3147       1.41   0    0 0 1  2015-07-09 00:00
SYN_BM     AME1       NAM_TMP16     48.0968       1.42   0    0 0 1  2016-05-01 00:00
SYN_BM     AME1       NAM_TMP16      0.0011       0.92   0    0 1 0  2016-05-01 00:00
SYN_BM     AME1       NAM_TMP16      0.0076       0.92   0    1 0 0  2016-05-01 00:00
SYN_BM     ANJM       NAM_TMP16     45.2474       1.42   0    0 0 1  2016-05-01 00:00
SYN_BM     ANJM       NAM_TMP16     -0.0063       0.92   0    0 1 0  2016-05-01 00:00
SYN_BM     ANJM       NAM_TMP16      0.0020       0.92   0    1 0 0  2016-05-01 00:00
SYN_BM     MODD       NAM_TMP16     47.5363       1.42   0    0 0 1  2016-05-01 00:00
SYN_BM     MODD       NAM_TMP16     -0.0033       0.92   0    0 1 0  2016-05-01 00:00
SYN_BM     MODD       NAM_TMP16     -0.0021       0.92   0    1 0 0  2016-05-01 00:00
SYN_BM     AMEL       NAM_TMP16     60.6348       1.42   0    0 0 1  2016-05-01 00:00
SYN_BM     AMEL       NAM_TMP16      0.0006       0.92   0    0 1 0  2016-05-01 00:00
SYN_BM     AMEL       NAM_TMP16      0.0001       0.92   0    1 0 0  2016-05-01 00:00
SYN_BM     AME-2      NAM_TMP16     69.6723       1.42   0    0 0 1  2016-05-01 00:00
SYN_BM     AWG-1      NAM_TMP16     79.3119       1.42   0    0 0 1  2016-05-01 00:00
```

Plot output

```
pnts=unique(sdobstable(:,2));

figure;
for k=1:numel(pnts)
   idx=find( sdobstable(:,2)==pnts(k) & sensitivity(:,3));
   plot(epoch(idx),(sdobs(idx)-mean(sdobs(idx)))*1000+k+12)
   hold on
end
title('Height evolution')
datetick('x')
ylabel('[mm]')
```

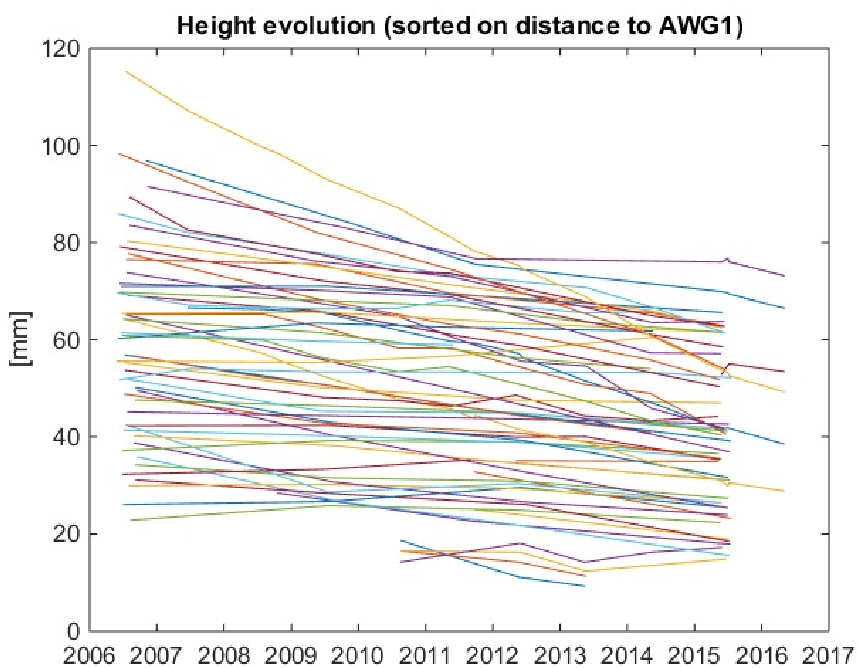


Idem, sorted on distance to AWG1

```
AWG1=[191778.768 611827.827];
dist=sqrt((pntcrd(pnts,1)-AWG1(1)).^2+(pntcrd(pnts,2)-AWG1(2)).^2);
[~,isrt]=sort(dist,'descend');
pnts=pnts(isrt);

figure;
for k=1:numel(pnts)
   idx=find( sdobstable(:,2)==pnts(k) & sensitivity(:,3));
   plot(epoch(idx),(sdobs(idx)-mean(sdobs(idx)))*1000+k+12)
```

```
   hold on
end
title('Height evolution (sorted on distance to AWG1)')
datetick('x')
ylabel('[mm]')
```



Idem, sorted on distance to AWG1, flagged data removed

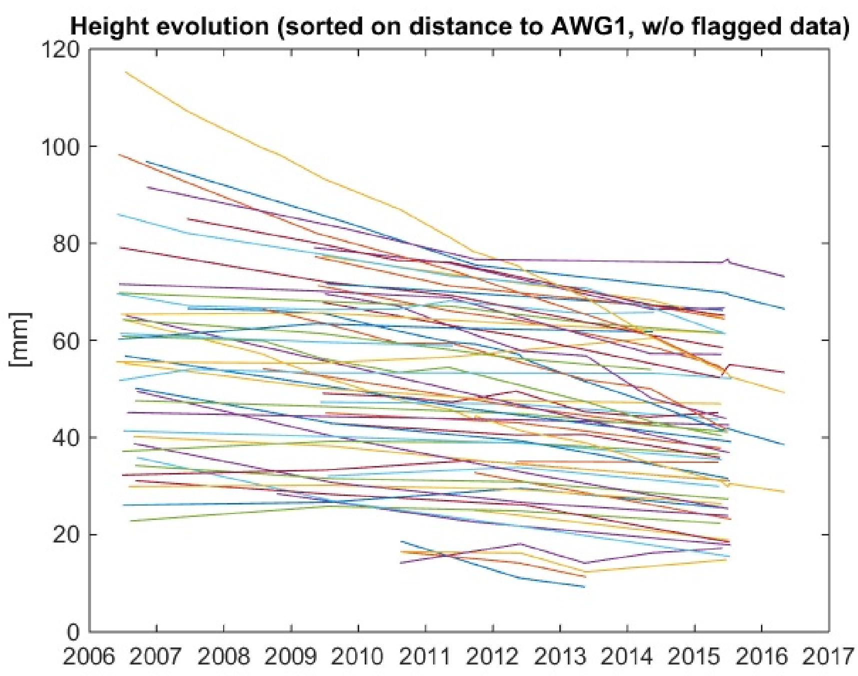
```
idx=(sdobsflag==0);
sdobstable2=sdobstable(idx,:);
```

```
sdobs2=sdobs(idx);
sensitivity2=sensitivity(idx,:);
epoch2=epoch(idx);

pnts=unique(sdobstable2(:,2));

AWG1=[191778.768 611827.827];
dist=sqrt((pntcrd(pnts,1)-AWG1(1)).^2+(pntcrd(pnts,2)-AWG1(2)).^2);
[~,isrt]=sort(dist,'descend');
pnts=pnts(isrt);

figure;
for k=1:numel(pnts)
   idx=find( sdobstable2(:,2)==pnts(k) & sensitivity2(:,3));
   plot(epoch2(idx),(sdobs2(idx)-mean(sdobs2(idx)))*1000+k+12)
   hold on
end
title('Height evolution (sorted on distance to AWG1, w/o flagged data)')
datetick('x')
ylabel('[mm]')
```



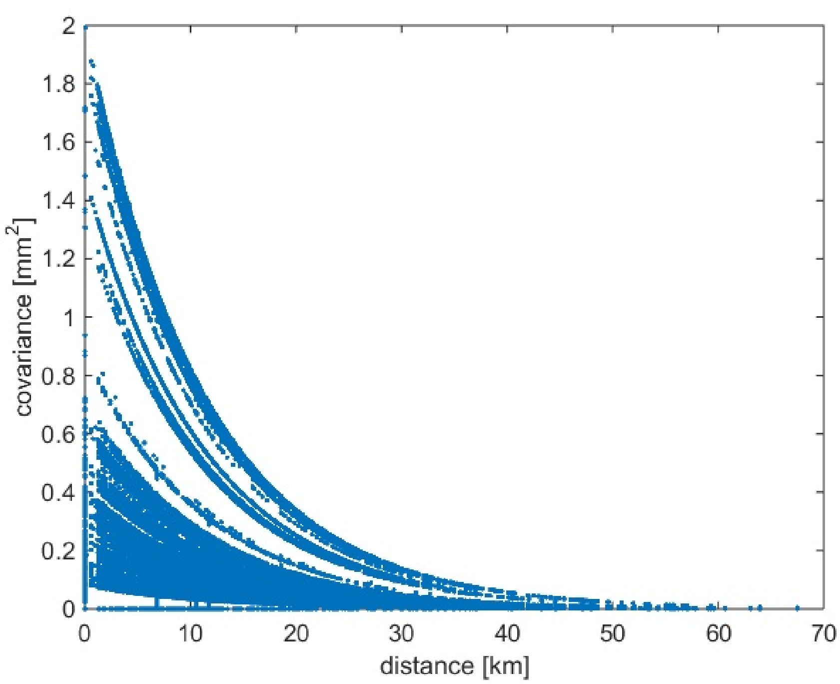
Plot covariances

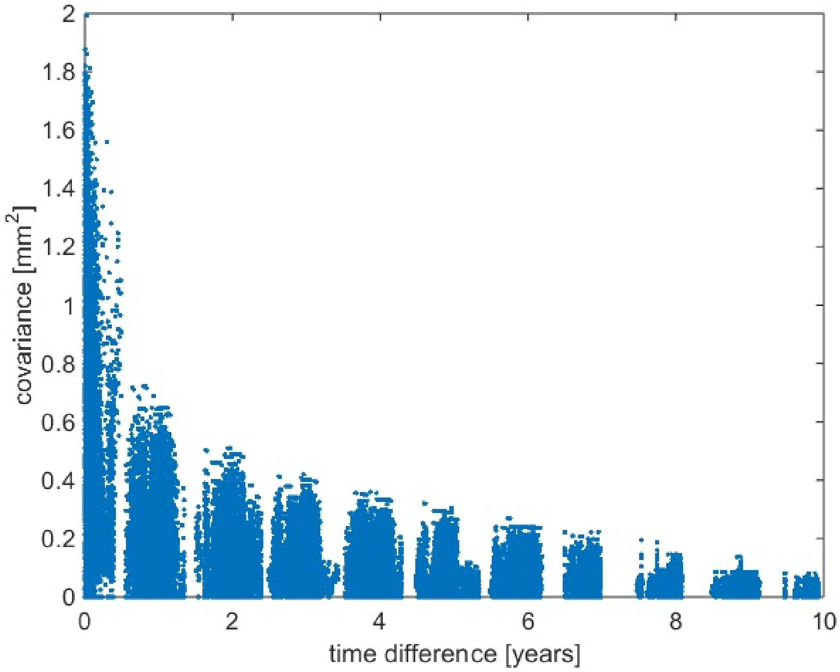
```
numobs=size(sdcov,1);
distvec=zeros(numobs*(numobs-1)/2,1);
timevec=zeros(numobs*(numobs-1)/2,1);
covvec=zeros(numobs*(numobs-1)/2,1);
kk=0;
for k=1:numobs
    for l=1:k-1
      kk=kk+1;
      pntk=sdobstable(k,2);
```

```
        pntl=sdobstable(l,2);
        distvec(kk,1)=sqrt((pntcrd(pntl,1)-pntcrd(pntk,1)).^2+(pntcrd(pntl,2)-pntcrd(pntk,2)).^2);
        timevec(kk,1)=abs(epoch(l)-epoch(k));
        covvec(kk,1)=sdcov(k,l);
    end
end
```

```
figure;
plot(distvec./1000,covvec.*1e6,'.')
ylabel('covariance [mm^2]')
xlabel('distance [km]')

figure;
plot(timevec./365,covvec.*1e6,'.')
ylabel('covariance [mm^2]')
xlabel('time difference [years]')
```

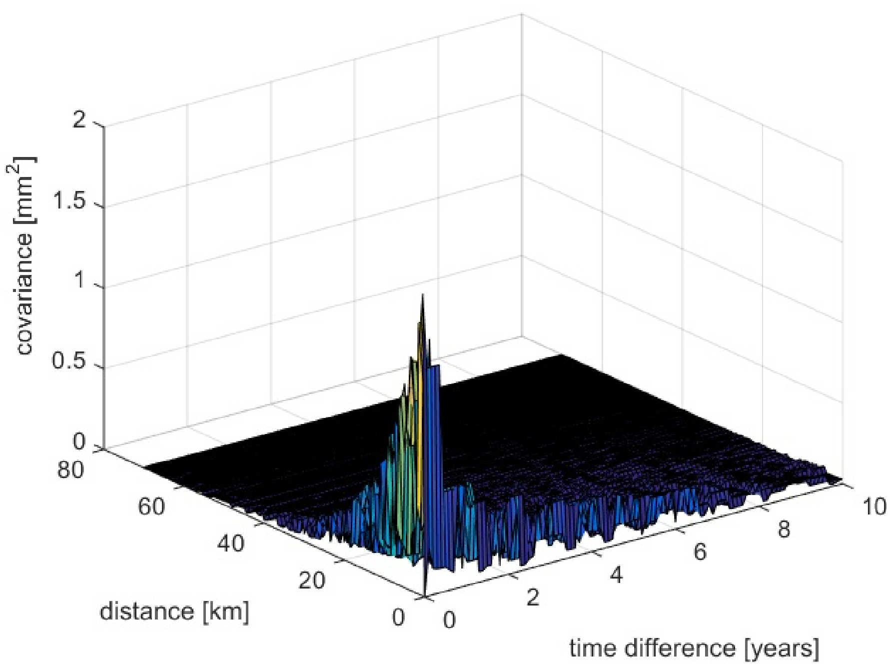





```
figure
[xi,yi] = meshgrid(0:.1:10, 0:.5:70);
zi = griddata(timevec./365,distvec./1000,covvec.*1e6,xi,yi,'nearest');
surf(xi,yi,zi);
xlabel('time difference [years]')
ylabel('distance [km]')
zlabel('covariance [mm^2]')
```

```
Warning: Duplicate data points have been detected and removed - corresponding

values have been averaged.
```



End of script

```
fprintf('lts2_gps.m done\n');
```

```
lts2_gps.m done
```

Appendix M. lts2_rename_cors processing output

Contents lts2_rename_cors.m

- Rename points and apply height corrections to gps point and observation files
- User input
- Read GPS point file using textscan
- Write updated GPS point file
- Read the observation file using textscan
- Remove GPS observations
- Rename the stations and apply antenna height change
- Write updated GPS observation file

Rename points and apply height corrections to gps point and observation files

```
This short script renames some points in the GPS CORS files to their
campaign name and applies an offset to the CORS data for the height of
the GPS ARP above the benchmark.

References:
- AWG1_AM2_GPS_ARP_Benchmark_difference.txt
- see also report AWG1_AME2_GPS_Installation_8312-0054-019-001.pdf

See also LTS2_GPSCORS and LTS2_GPS.
```

```
%   (c) Hans van der Marel, Delft University of Technology, 2016.

%   Created:    21 September 2016 by Hans van der Marel
%   Modified:   20 October 2016 by Hans van der Marel
%                - added code to remove selected components of CORS data
```

User input

The height correction in the translation table is the height of the ARP above (!) the (campaign) benchmark. Negative values mean the ARP is below the benchmark (see the reference documents). Since we correct the CORS data, this value must be substracted from the height observations, which is actually what is done in the code.

```
posfileold='../lts2cors/gpscors_pnt.csv';
obsfileold='../lts2cors/gpscors_obs.csv';
```

```
posfilenew='gpscors_pnt_renamed.csv';
obsfilenew='gpscors_obs_renamed.csv';

gpstranslate= { 'AWG1'  'AWG-1'  -0.1106   ; ...
                'AME2'  'AME-2'  -0.1335   ; ...
              };

gpsremove=    { 'AWG1' [ true true false ] ; ...
                'AME2' [ true true false ] ; ...
              };
```

Read GPS point file using textscan

```
fid = fopen(posfileold,'r');
posheader=fgetl(fid);
data = textscan(fid, '%s%f%f%f%[^\n\r]', Inf, 'Delimiter', ',', 'HeaderLines', 0, 'ReturnOnError', false);
fclose(fid);

pntname = data{:, 1};
pntcrd = [ data{:, 2} data{:, 3}];
cluster_id = data{:, 4};
```

Write updated GPS point file

```
for k=1:size(gpstranslate,1)
  pntname=strrep(pntname,gpstranslate{k,1},gpstranslate{k,2});
end

fid=fopen(posfilenew,'w');
fprintf(fid,'%s\n',posheader);
for k=1:numel(pntname)
  fprintf(fid,'%s,%.3f,%.3f,%d\n',pntname{k},pntcrd(k,1:2),cluster_id(k));
end
fclose(fid);
```

Read the observation file using textscan

```
fid = fopen(obsfileold,'r');
obsheader=fgetl(fid);
```

```
data = textscan(fid, '%s%s%s%f%f%f%[^\n\r]', Inf, 'Delimiter', ',', 'HeaderLines', 0, 'ReturnOnError', false);
fclose(fid);

pntname_obs = data{:, 1};
prjname_obs = data{:, 2};
meandate = data{:, 3};
duration = data{:, 4};
height = data{:, 5};
use = data{:, 6};

iscorsfile=~isempty(strfind(obsheader,'COMPONENT'));
```

Remove GPS observations

```
lremove=false(size(height));
for k=1:size(gpsremove,1)
  if iscorsfile
     lcomp=gpsremove{k,2};
     idx=ismember(pntname_obs,gpsremove{k,1}) & lcomp(use)';
  else
     idx=ismember(pntname_obs,gpsremove{k,1});
  end
  lremove(idx)=true;
end

pntname_obs(lremove)=[];
prjname_obs(lremove)=[];
meandate(lremove)=[];
duration(lremove) = [];
height(lremove) = [];
use(lremove) = [];
```

Rename the stations and apply antenna height change

```
for k=1:size(gpstranslate,1)
  if iscorsfile
     idx=ismember(pntname_obs,gpstranslate{k,1}) & use == 3;
  else
     idx=ismember(pntname_obs,gpstranslate{k,1});
  end
  height(idx)=height(idx) - gpstranslate{k,3};  % Minus sign !!
  pntname_obs=strrep(pntname_obs,gpstranslate{k,1},gpstranslate{k,2});

end
```

Write updated GPS observation file

```
fid=fopen(obsfilenew,'w');
fprintf(fid,'%s\n',obsheader);
for k=1:numel(pntname_obs)
   fprintf(fid,'%s,%s,%s,%.1f,%.4f,%d\n',pntname_obs{k},prjname_obs{k},meandate{k},duration(k),height(k),use(k));
end
fclose(fid);
```

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Appendix N. lts2_seasonal_correction processing output

Contents lts2_seasonal_correction.m

- Apply seasonal height correction to selected stations in GPS campaigns
- User input
- Read the observation file using textscan
- Apply seaonal correction to the stations in seasonalcorrection
- Write updated GPS observation file

Apply seasonal height correction to selected stations in GPS campaigns

```
This short script appplies a seasonal height correctcion, derived
from GPS CORS analysis, to co-located campaign stations.

This script is typically run in conjunction with LTS_RENAME_CORS,
which renames some CORS stations to their nearby campaign equivalent
and applies a height offset to the CORS station.

See also LTS2_RENAME_CORS, LTS2_GPSCORS and LTS2_GPS.
```

```
%   (c) Hans van der Marel, Delft University of Technology, 2016.

%   Created:    21 September 2016 by Hans van der Marel
%   Modified:   10 October 2016 by Hans van der Marel
%                  - isolated code to a dedicated script which updates
%                    the files (run once)

% Set path to required toolboxes

lts2toolboxdir=fullfile('..','lts2toolbox');

addpath(fullfile(lts2toolboxdir,'tseries'));
```

User input

The table SEASONALCORRECTION provides the co-located campaign station name (that should be corrected), the name of the TSERIES mat file with results of the CORS timeseries analysis, and name of the meteo matlab file.

The mat files from the timeseries analysis are assumed to be in the in the directory GPSCORSDIR.

Further, the names of the input and output campaign observation files need to be specified.

```
obsfileold='gpscampaigns_obs_alt.csv';
obsfilenew='gpscampaigns_obs_seasonal_corrected.csv';

gpscorsdir='../lts2cors';

seasonalcorrection= { 'AWG-1'  'awg1_fit.mat'  'meteo_Eelde.mat'  ; ...
                      'AME-2'  'ame2_fit.mat'  'meteo_Eelde.mat'  ; ...
                    };

doplot=true;
```

Read the observation file using textscan

```
fid = fopen(obsfileold,'r');
obsheader=fgetl(fid);
data = textscan(fid, '%s%s%s%s%f%f%f%[^\n\r]', Inf, 'Delimiter', ',', 'HeaderLines', 0, 'ReturnOnError', false);
fclose(fid);

iscorsfile=~isempty(strfind(obsheader,'COMPONENT'));

pntname_obs = data{:, 1};
prjname_obs = data{:, 2};
meandate = data{:, 3};
duration = data{:, 4};
height = data{:, 5};
use = data{:, 6};
```

Apply seaonal correction to the stations in seasonalcorrection

```
for k=1:size(seasonalcorrection,1)
    pntnamek=seasonalcorrection{k,1};
    tseriesfile=fullfile(gpscorsdir,seasonalcorrection{k,2});
    meteofile=fullfile(gpscorsdir,seasonalcorrection{k,3});
    fprintf('\nApply seasonal corrections to %s using tseries object %s and meteo data %s.\n',...
        pntnamek,tseriesfile,meteofile);
    % find all observations
    if iscorsfile
      idx=ismember(pntname_obs,pntnamek) & use == 3;
    else
```

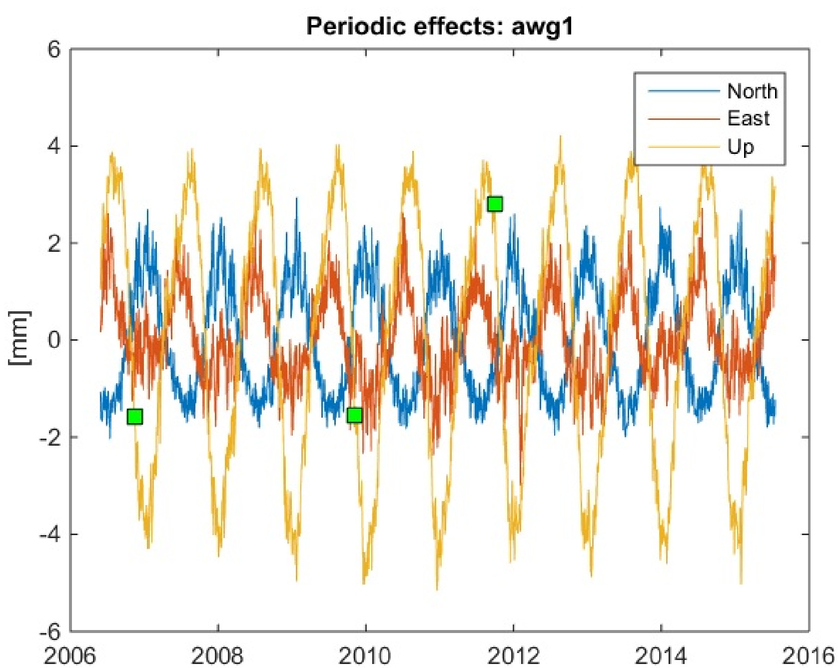
```
        idx=ismember(pntname_obs,pntnamek);
    end
    epochk=datenum(meandate(idx),'yyyy-mm-dd HH:MM');
    yeark=ymd2dyear(datevec(epochk));
    % compute the seasonal correction
    load(tseriesfile); % this loads the tseries structure
    correction=tseriescmeval2(tseries,yeark,meteofile);
    fprintf('\nPntname    Date        Year    Correction [mm]\n')
    for l=1:numel(yeark)
        fprintf('%s   %s   %8.3f   %7.2f\n',pntnamek,datestr(epochk(l),'yyyy-mm-dd'),yeark(l),correction(l,3)*1000)
    end
    % apply seasonal correction
    height(idx)=height(idx) - correction(:,3);
    % plot
    if doplot
        epoch=datenum(meandate,'yyyy-mm-dd HH:MM');
        range=ymd2dyear(datevec([ min(epoch) ; max(epoch) ]));
        tseriescmeval2(tseries,range(1):1/365:range(2),meteofile);
        hold on
        plot(yeark,correction(:,3)*1000,'s','MarkerEdgeColor','k',...
                       'MarkerFaceColor','g',...
                       'MarkerSize',8)
    end
end
```

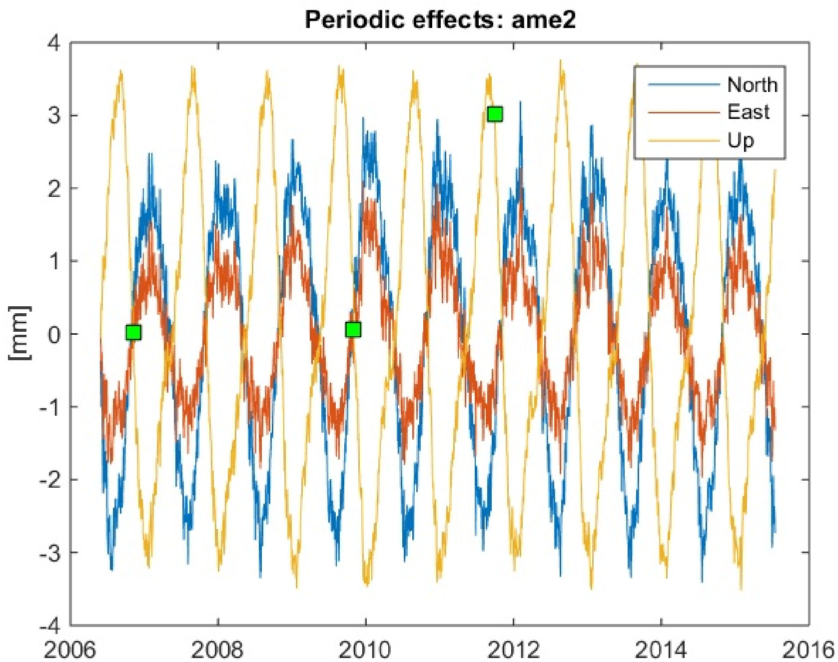
```
Apply seasonal corrections to AWG-1 using tseries object ..\lts2cors\awg1_fit.mat and meteo data ..\lts2cors\meteo_Eelde.mat.

Pntname    Date        Year    Correction [mm]
AWG-1   2006-11-14   2006.869     -1.58
AWG-1   2009-11-03   2009.840     -1.54
AWG-1   2011-09-28   2011.741      2.80

Apply seasonal corrections to AME-2 using tseries object ..\lts2cors\ame2_fit.mat and meteo data ..\lts2cors\meteo_Eelde.mat.

Pntname    Date        Year    Correction [mm]
AME-2   2006-11-07   2006.850      0.02
AME-2   2009-11-02   2009.838      0.06
AME-2   2011-09-29   2011.743      3.03
```





Write updated GPS observation file

```
fid=fopen(obsfilenew,'w');
fprintf(fid,'%s\n',obsheader);
for k=1:numel(pntname_obs)
   fprintf(fid,'%s,%s,%s,%.1f,%.4f,%d\n',pntname_obs{k},prjname_obs{k},meandate{k},duration(k),height(k),use(k));
end
fclose(fid);
```

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Appendix O. lts2_gps_baselines processing output

Contents lts2_gps_baselines.m

- NAM LTS2 script to create netcdf file with 1993-2004 GPS baseline data
- Set up the configuration parameters and input files (USER INPUT)
- Load the GPS data
- Make the station list and class
- Make project list and class
- Make sd observation table and other parameters
- Co-variance matrix
- Text output
- write netcdf
- update point class
- Done

NAM LTS2 script to create netcdf file with 1993-2004 GPS baseline data

```
This script read the old GPS baseline data from the period 1993 until
2004 from an excel file, creates the appropriate covariance matrix,
and saves the results to a netcdf file.

(c) Hans van der Marel, Delft University of Technology, 2016.
```

```
%   Created:    30 September 2016 by Hans van der Marel
%   Modified:   12 October 2016 by Hans van der Marel
%                  - added addpath to lts2toolbox
%                  - added point class update
%                9 November 2016 by Hans van der Marel
%                  - modified terms of use
%               25 January 2017 by Freek van Leijen
%                  - inclusion of geoid undulation
%                  - made Linux compatible
clear all
close all
clc

% Set path to required toolboxes

lts2toolboxdir=fullfile('..','lts2toolbox');
```

```
addpath(fullfile(lts2toolboxdir,'lts2'));
```

Set up the configuration parameters and input files (USER INPUT)

```
% Input files

config.gpsbaselines='GPS_Data_Ameland_1993_2004_incl_Geoid.xlsx';   % gps baselines

% Covariance matrix computation

%config.gpsbaselinecov='diag';       % make diagonal matrix with values from file
config.gpsbaselinecov='bsl';        % introduce baseline correlation and use specified value for st.dev.
config.gpsbslstdev=10;              % st.dev. in [mm], only for baseline option

% Output netcdf file and global netcdf attributes

netcdf_file='lts2_gpsbaseline.nc';
globalattributes = { ...
  'title'        , 'GPS Data Ameland 1993 to 2004.'  ; ...
  'institution'  , 'Delft University of Technology, Netherlands.' ; ...
  'source'       , 'Nederlandse Aardolie Maatschappij (NAM) GPS height database.' ; ...
  'technique'    , 'GPS' ; ...
  'history'      , ' ' ; ...
  'references'   , 'TU Delft, NAM LTS2 Report, 2016 (in preparation).' ; ...
  'comment'      , ' ' ; ...
  'Conventions'  , 'CF-1.6' ; ...
  'featureType'  , 'timeSeries' ; ...
  'email'        , 'h.vandermarel@tudelft.nl' ; ...
  'version'      , '1.0' ; ...
  'terms_for_use', 'These data have been prepared for: Nederlandse Aardolie Maatschappij (NAM). Any use by third parties requires explic
it approval by NAM.' ; ...
  'disclaimer'   , 'This data is made available in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied w
arranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.' ; ...
};


% END OF USER INPUT (no further changes should be necessary)
```

Load the GPS data

```
The GPS baseline data is loaded
```

```
[NUM,TXT,RAW]=xlsread(config.gpsbaselines);

prj=RAW(2:end,1);
obsdate=cell2mat(RAW(2:end,2));
pntfrom=RAW(2:end,3);
pntto=RAW(2:end,4);
hgt=cell2mat(RAW(2:end,16));
len=cell2mat(RAW(2:end,6));
sd=cell2mat(RAW(2:end,7));
pntcrdfrom=cell2mat(RAW(2:end,8:9));
pntcrdto=cell2mat(RAW(2:end,10:11));

pntfrom=strrep(pntfrom,'3047','');
pntto=strrep(pntto,'3047','');

% check for date format (Matlab on Linux @NAM imports as Excel serial date,
% which is a different behaviour than on Windows @TUD.)]
if obsdate(1)<1e5
    obsdate = cellstr(datestr(obsdate+datenum(1899,12,30),'dd/mm/yyyy HH:MM:SS'));
end
```

Make the station list and class

```
[pntname,ia,ib]=unique([pntfrom;pntto]);
pnttmp=[pntcrdfrom;pntcrdto];
pntcrd=pnttmp(ia,:);
pntclass=repmat({'GPS'},numel(pntname),1);

% Check the coordiantes

if ~isempty(find(abs(pntcrd(ib,:)-pnttmp)>0.5))
    fprintf('Points have different coordinates\n')
end
```

Make project list and class

```
[prjname,ia,ib]=unique(prj);
prjdate=obsdate(ia);
prjepoch=datenum(prjdate,'dd/mm/yyyy HH:MM:SS');

[prjepoch,ia]=sort(prjepoch);
```

```
prjname=prjname(ia);
prjdate=prjdate(ia);
prjclass=repmat({'GPSBL'},numel(prjname),1);
```

Make sd observation table and other parameters

```
% Compute observation indexes

sdobstable(:,1)=mkindex(pntfrom,pntname);
sdobstable(:,2)=mkindex(pntto,pntname);
sdobstable(:,3)=mkindex(prj,prjname);

% Observations, flags and sensitivity

numobs=size(hgt,1);

sdobs=hgt;
sdobsflag=zeros(numobs,1);
sensitivity=[ zeros(numobs,2) ones(numobs,1)];

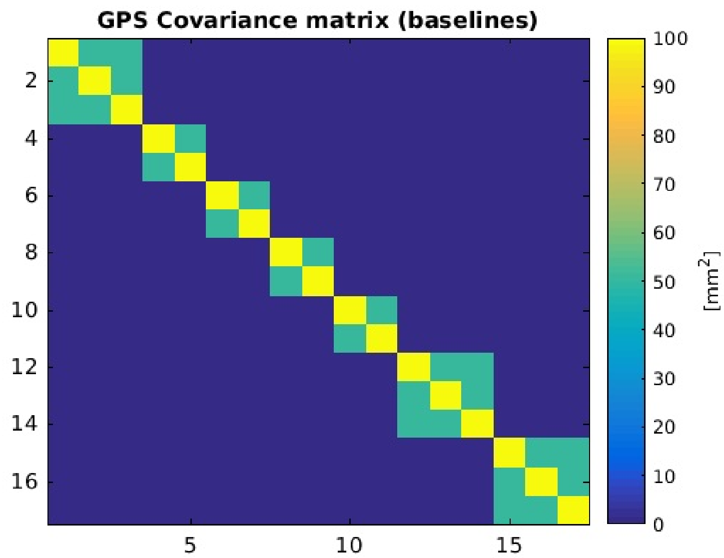
% Observation epoch

epoch=datenum(obsdate,'dd/mm/yyyy HH:MM:SS');
```

Co-variance matrix

```
switch config.gpsbaselinecov
    case 'diag'
       %  Co-variance matrix is diagonal with st.dev. from file
       sdcov=diag((sd./1000).^2);
    case 'bsl'
       %  Co-variance matrix includes correlations due to baseline formation
       sd2=0.5*(config.gpsbslstdev./1000).^2;
       sdcov=zeros(numobs,numobs);
       for k=1:numel(prjname)
          idx=find(sdobstable(:,3)==k);
          np=size(idx,1);
          sdcov(idx,idx)=(ones(np,np)+eye(np,np)).*sd2;
       end
    otherwise
       error('Illegal covariance matrix option.')
end
```

```
figure('Name','GPSBaselineCov');
imagesc(sdcov.*1e6); hc=colorbar;ylabel(hc,'[mm^2]')
title('GPS Covariance matrix (baselines)')
```



Text output

```
fprintf('\n\nFrom       To         Project       Obs [m] StDev [mm] Flg   N E U  Date\n\n')
for k=1:size(sdobstable,1)
   fprintf('%-10s %-10s %-10s %10.4f %10.2f  %2d  %2d%2d%2d  %s\n',...
       pntname{sdobstable(k,1)},pntname{sdobstable(k,2)},prjname{sdobstable(k,3)},...
       sdobs(k),sqrt(sdcov(k,k))*1000,sdobsflag(k),sensitivity(k,:),datestr(epoch(k),'yyyy-mm-dd HH:MM'))
end
```

```
From       To         Project       Obs [m] StDev [mm] Flg   N E U  Date

002C0106   002C0102   NAM_GPS93    -17.7550      10.00   0   0 0 1  1993-06-15 12:00
002C0106   000G0391   NAM_GPS93      8.5220      10.00   0   0 0 1  1993-06-15 12:00
002C0106   AWG-1      NAM_GPS93     18.1840      10.00   0   0 0 1  1993-06-15 12:00
002C0122   002D0081   NAM_GPS97      1.7310      10.00   0   0 0 1  1997-06-15 12:00
002C0122   002C0118   NAM_GPS97     -0.5750      10.00   0   0 0 1  1997-06-15 12:00
002C0122   002C0118   NAM_GPS98A    -0.5760      10.00   0   0 0 1  1998-08-15 12:00
002C0122   002C0027   NAM_GPS98A    -3.5290      10.00   0   0 0 1  1998-08-15 12:00
002D0089   002D0052   NAM_GPS98B     1.1290      10.00   0   0 0 1  1998-08-15 12:00
002D0089   002C0027   NAM_GPS98B    -0.3560      10.00   0   0 0 1  1998-08-15 12:00
002D0081   AWG-1      NAM_GPS98C    34.7200      10.00   0   0 0 1  1998-08-15 12:00
002D0081   000G0391   NAM_GPS98C    25.0340      10.00   0   0 0 1  1998-08-15 12:00
002D0081   002C0122   NAM_GPS00     -1.6950      10.00   0   0 0 1  2000-08-15 12:00
002D0081   000G0391   NAM_GPS00     25.0580      10.00   0   0 0 1  2000-08-15 12:00
002D0081   AWG-1      NAM_GPS00     34.7660      10.00   0   0 0 1  2000-08-15 12:00
002D0081   AWG-1      NAM_GPS04A    34.7793      10.00   0   0 0 1  2004-04-06 12:00
002D0081   000G0391   NAM_GPS04A    25.0793      10.00   0   0 0 1  2004-04-06 12:00
002D0081   002C0121   NAM_GPS04A    16.3940      10.00   0   0 0 1  2004-04-06 12:00
```

write netcdf

```
writelts2netcdf(netcdf_file,globalattributes, ...
                pntname,pntcrd,pntclass, ...
                prjname,prjepoch,prjclass, ...
                sdobstable,sdobs,sdcov,sdobsflag,sensitivity,epoch)
```

```
Create NAM LTS2 netcdf schema ...
Write NAM LTS2 netcdf schema to file...
Write data to NAM LTS2 netcdf...
Done.
```

update point class

```
updpntclasslts2netcdf(netcdf_file);
```

```
Benchmarks (11 points):
```

```
PNTNAME              X_RD         Y_RD   CLASS

000G0391      186870.000   610910.000   GPS --> GPS&OFFSH
002C0027      188625.516   602823.750   GPS --> GPS&OFFSH
002C0102      188130.000   608330.000   GPS --> GPS&ONSH
002C0106      189220.000   608080.000   GPS --> GPS&ONSH
002C0118      188050.000   600770.000   GPS --> GPS&OFFSH
002C0121      189220.000   608080.000   GPS --> GPS&ONSH
002C0122      180100.000   606650.000   GPS --> GPS&ONSH
002D0052      193180.000   608000.000   GPS --> GPS&OFFSH
002D0081      190542.312   608928.375   GPS --> GPS&ONSH
002D0089      191820.000   604680.000   GPS --> GPS&OFFSH
AWG-1         191779.000   611828.000   GPS --> GPS&OFFSH

The netcdf_file lts2_gpsbaseline.nc will be updated.
```

Done

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