TOPCON

Delta Watch v3.4

Deformation Monitoring

User's Manual

Delta Watch v3.4 Deformation Monitoring User's Manual

Part Number 1041256-01

User manual

Delta Watch

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Content

1 Why Delta Watch?

Delta Watch is a universal software for the evaluation of deformation measurements on:

- Buildings
- Infrastructure facilities such as rail tracks, bridges, tunnels
- Machinery
- Other structures such as slide slopes

Delta Watch can evaluate the observations of geodetic deformation networks consisting of fixed points[1] and object points[2] for this purpose.

The points can be measured in different ways:

- Fully automatic measurement with a total station[3] or GNSS[4] sensors
- Manual measurement with one total station, even from different positions
- Manual levelling

Optionally, manual and fully automatic observations of geodetic total stations, GNSS receiver data and manual levelling can be processed.

In addition, the evaluated results of a number of geotechnical sensors, such as tilt sensors, inclinometers or thermometers, can be visualised within the software.

The measurement results can be evaluated automatically at freely definable intervals. Several measurement cycles of an observation network are jointly balanced and condensed into one epoch. Epochs can be displayed both in tabular and in graphical form, and can be documented in many different ways.

Independently of the evaluations, you can define limit values for your measurement results. On reaching the limit values, alarm messages are generated which can be sent to predefined e-mail distribution lists.

Delta Live!

Delta Watch is supplemented by Delta Live!. Delta Live! provides web-based visualisation of the measurement results.

> **Important:** This documentation only describes the configuration of Delta Live! in Delta Watch, however not the use of Delta Live!. See its separate documentation for the use of Delta Live!.

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[1] A fixed point is a point whose position is expected to remain unchanged.
[2] An object point is a point whose position may change.
[3] Electronic tachymeters (total stations) measure horizontal and vertical directions and distances to discrete targets. The electro-optical distance measurement is carried out by means of automatic target detection to optical prisms or reflectorless to correspondingly suitable surfaces.
[4] A Global Navigation Satellite System (GNSS) is a satellite-based positioning system (e.g. GPS, GALILEO or GLONASS).

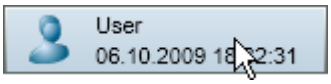
2 General Functions

Login to Delta Watch

Start Delta Watch by double clicking on the program symbol or use the Windows Start Menu.

> **Caution:** Delta Watch always starts with the last logged in user and logs him in automatically. After the initial installation, you will automatically be logged in as Administrator with full permissions for all modules. Therefore, you should create a standard user for security reasons who has no or at least severely restricted rights (see „User Management“ on page 51).

To log in as another user or as the standard user, click on the displayed user in the lower left corner of the program window.

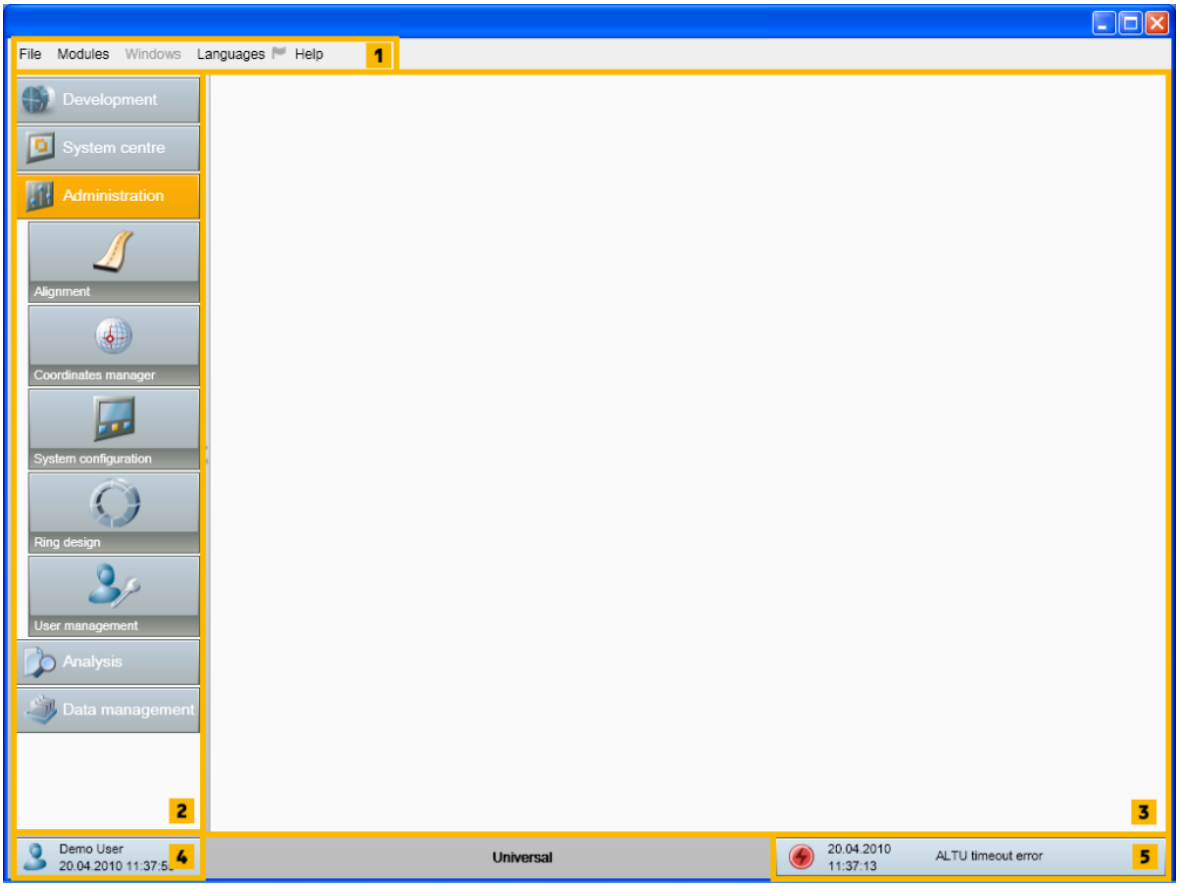


Enter the login details for a different user.

*Annotation: If you have already defined a standard user, you can quickly and easily change to this user by selecting the **STANDARD USER** button.*

All active modules are then closed and Delta Watch restarts with the required user. If there are any unsaved modifications in the program, you will be prompted to save them.

Program window and operator elements



Menu bar [1]

The menu bar contains general functions and information about the currently opened module.

- Languages: Lists the available display languages for Delta Watch.

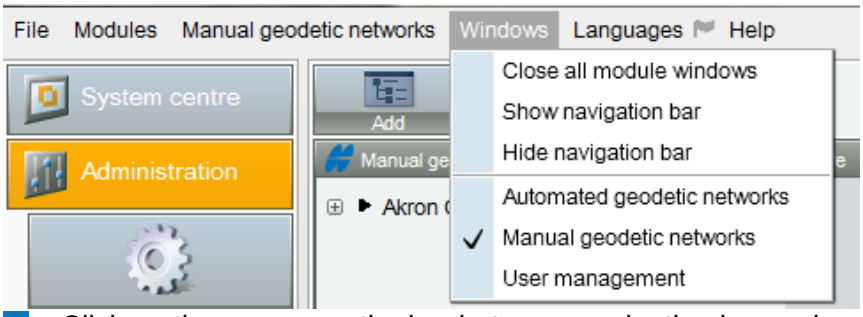
Annotation: Contents are not always completely translated. The English term is displayed if a translation is missing.

- Help: In addition to the access to the online version of this manual**,** tools for troubleshooting are provided in this menu.
- **EXTENSIVE LOGGIN**G
- **ABOUT DELTA** WATCH: Displays the program version and licence details.
- **DATABASE BACKUP**: Saves a copy of your database locally or in the network.
- **SAVE DIAGNOSTIC INFORMATION**

Navigation bar [2]

The navigation bar provides the functionalities of Delta Watch within module groups and modules. A module group or module can be opened by clicking on it.

- The currently active module is preceded by a vertical bar for identification.
- The button of an active module has a yellow background. An alternative display of the opened modules can be found in the menu bar under WINDOWS. The currently displayed module is identified by a tick.



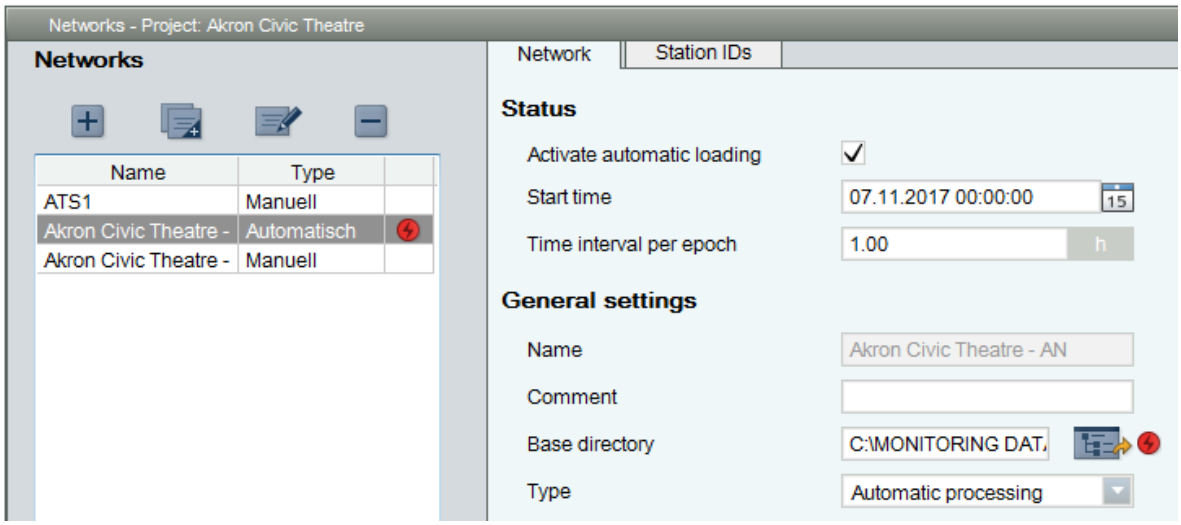
- Click on the arrows on the bar between navigation bar and work area to show or hide the navigation bar.

Tip: Is a module missing? Check the scope of your licence (see „Licence Management“ on page 96).

Work area, secondary menu and submodules [3]	The module content is displayed in this area after opening. If the module has a menu of its own, this is displayed in the upper left corner. Annotation: Note that some buttons only work if certain conditions are met. For example, you can only copy users after they have been created. A few modules have additional submodules. These are made available to you in an additional column in the work area.
User name [4]	Here you can see with which user you are logged in, and the time in the time zone of your project.
Messages [5]	Messages are displayed here, e.g. the successful processing of an epoch. Double click in this area to open the message window where you can scroll through all messages to date.

Indication of errors and problems

Delta Watch informs you with a red dot about incorrect configurations or missing information. Position the mouse cursor over the dot to display additional information.



Multiple selection

If you would like to select a larger number of entries, e.g. in a points list, Delta Watch provides two options for a simplified selection.

- Common selection of several points: Press and hold the CTRL key while you are clicking on the desired entries.
- Selection of a larger contiguous area: Click on the first entry. Then press and hold the Shift key and click on the last entry.

Logout from Delta Watch

Select **FILE > CLOSE** in the menu to logout from Delta Watch. All active modules are then automatically closed and Delta Watch is terminated. If there are any unsaved modifications in the program**,** you will be prompted to save them.

3 System Centre

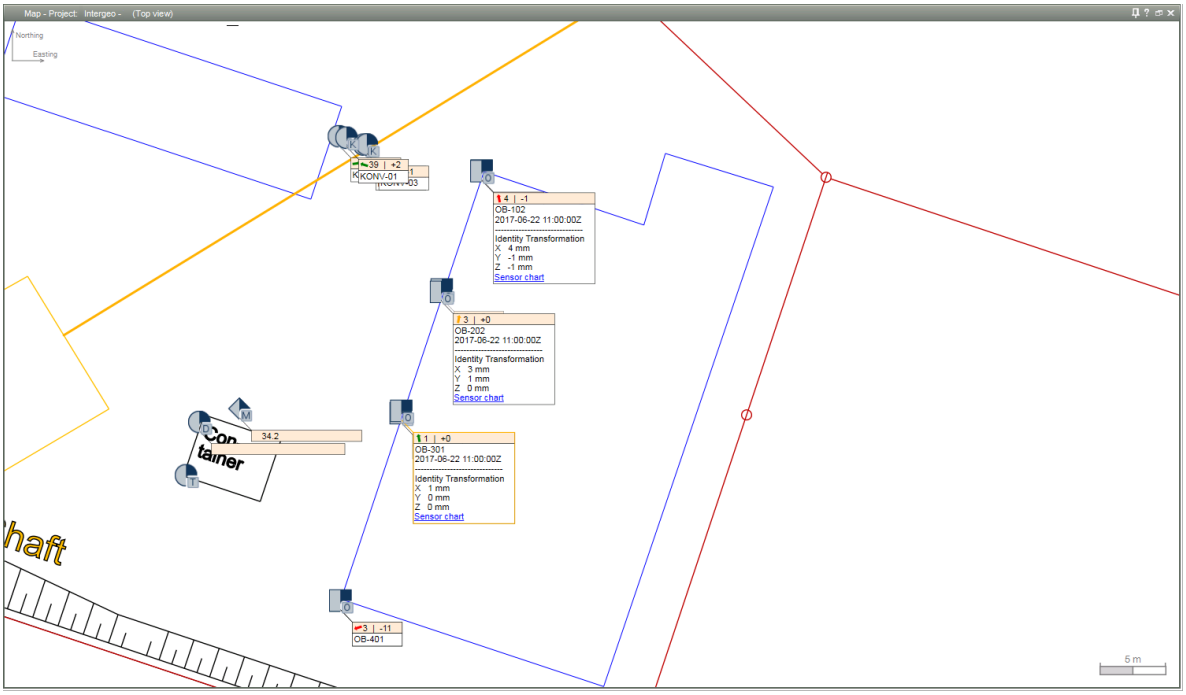
3.1 Map

The fixed and object points of your project are shown on a map in the **MAP** module. In the map window**,** you can continuously zoom in and out as well as move the section with the mouse. The various map views can be set under **SYSTEM CONFIGURATION > MAP > VIEW CONFIGURATION**.

Use the **REPORT** button in the secondary menu to save or print the displayed map section.

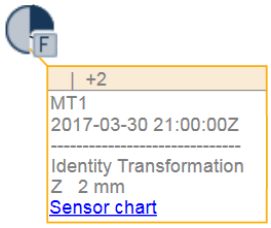
*Tip: There can be a lot of sensors in large construction projects. If you are looking for a specific sensor and its values**,** you can do this quickly via **SYSTEM CENTRE > MAP > SEARCH SENSOR**.*

General configuration settings for the map are made in the **ADMINISTRATION > SYSTEM CONFIGURATION > MAP** module.



Point Symbols

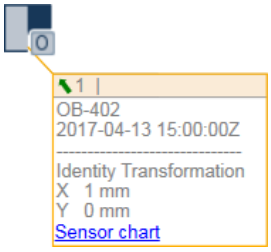
The fixed and object points in the map are displayed as symbols. Points show additional values when you click on the associated symbol info field. Click again to minimise the measured value display again.



1D Sensor

The Z displacement is displayed in the header of the info field (here +2 mm).

The point name, the date of the current epoch, the transformation used and the displacement value in the Z direction are displayed.

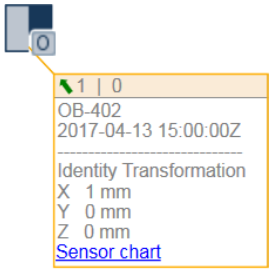


2D Sensor

The modification is displayed as a horizontal direction vector (here 1 mm). The value stands for the length of the vector, i.e. the horizontal displacement in the direction of the vector.

The arrow is displayed in the colours green, yellow or red according to the respective alarm level (see „Limit monitoring“ on page 37).

The point name, the date of the displayed measurement, the transformation used and the displacement in 2D coordinates (here X and Y) are displayed. You can select whether the delta value or the absolute value is displayed in the system configuration.

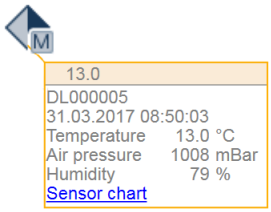


3D Sensor

The modification is displayed as a horizontal direction vector. The value (here 1 mm) stands for the length of the vector, i.e. the horizontal displacement in the direction of the vector. In addition, the displacement in Z direction is displayed as a value (here 0 mm).

The arrow is displayed in the colours green, yellow or red according to the respective alarm level.

The point name, the date of the displayed measurement, the transformation used and the displacement in 2D coordinates and Z direction (here X, Y and Z) are displayed. You can select whether the delta value or the absolute value is displayed in the system configuration.



Geotechnical sensor

This example shows a meteorological sensor.

Modify point symbol graphic

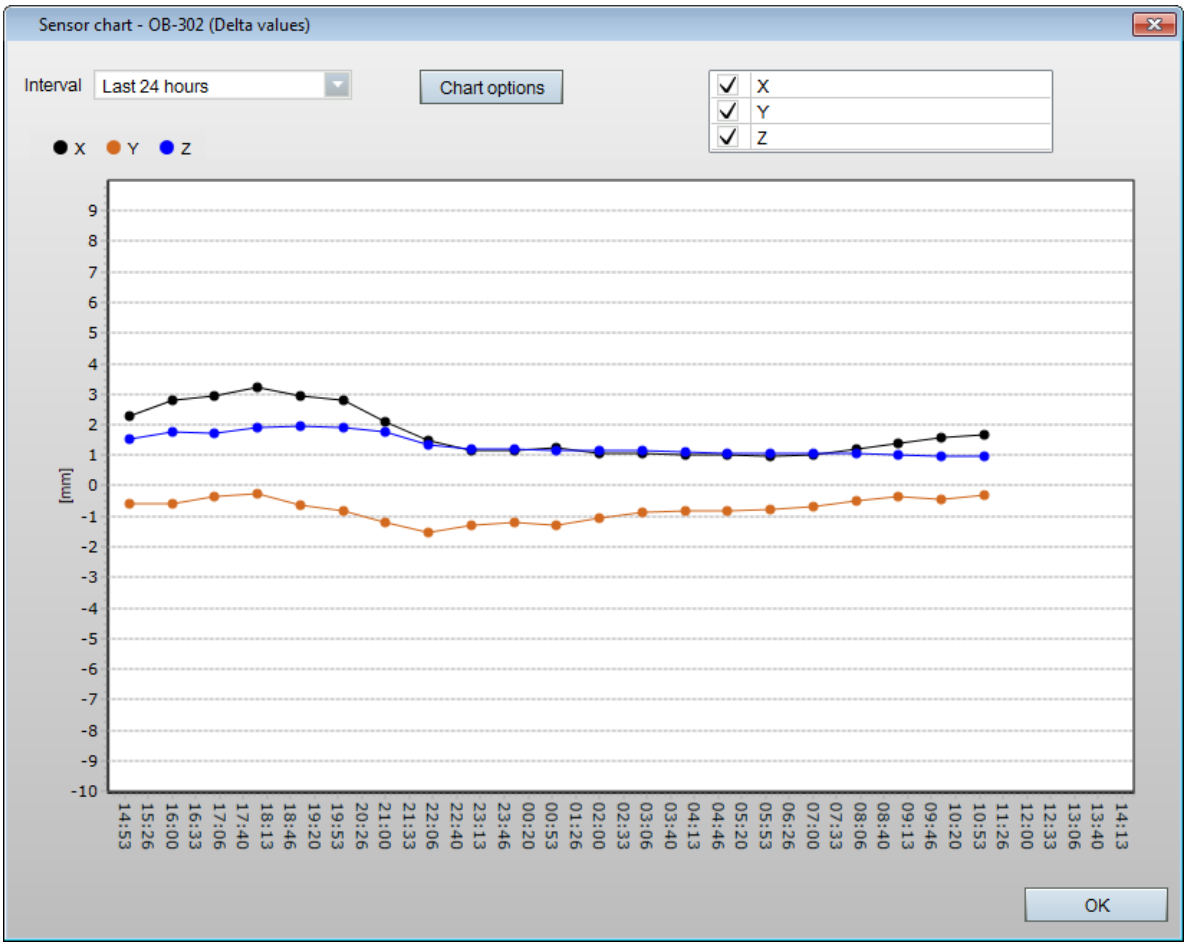
Proceed as follows to modify the graphical display of a point symbol:

1. Open **ADMINISTRATION > POINT AND LIMIT MANAGEMENT > POINT TYPE** in the navigation bar.
2. Select the desired point type and then click on the "Edit" symbol.
3. Select a graphic from the list.

Sensor charts

You can display a chart for the sensor with the measured values over time. You can configure the time period, the axes and the scaling for the chart.

Click on the link in the info field to display a chart.



4 Administration

Important: Changes that you make in the **ADMINISTRATION** module group are not accepted and activated until after clicking on the **APPLY** button.

4.1 System Configuration

You make the general configurations for your Delta Watch system in the **SYSTEM CONFIGURATION**. With a few exceptions**,** these settings apply globally to all projects in your installation.

The following settings are only applicable within a project:

- Map View: **ADMINISTRATION > SYSTEM CONFIGURATION > MAP > VIEW CONFIGURATIO**N

Units and decimal places

Define the units and decimal places for the individual modules.

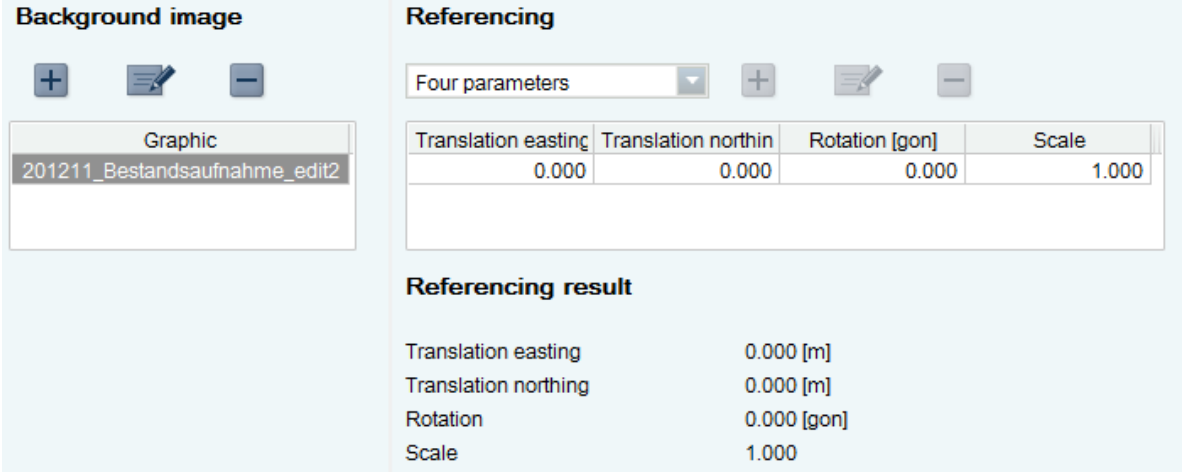
Annotation: Delta Watch always calculates internally with all decimal places for the highest possible accuracy.

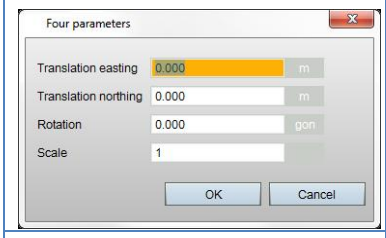
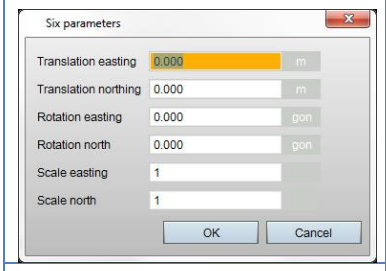
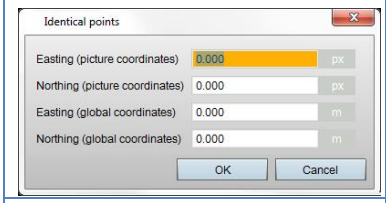
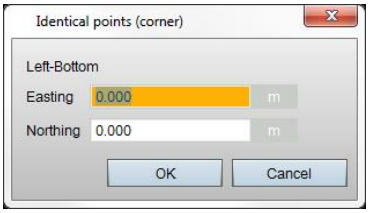
Settings that have been made under **DATE AND TIME** are applicable for the entire Delta Watch system. They are used as defaults for all other date and time settings that can be made under the Charts**,** Automatic Reports and Sensor Fields submodules.

Map

Each Delta Watch project can integrate graphics**,** usually maps or aerial photographs**,** for better visualisation. You reach the Map module via **ADMINISTRATION > SYSTEM CONFIGURATION > MAP**.

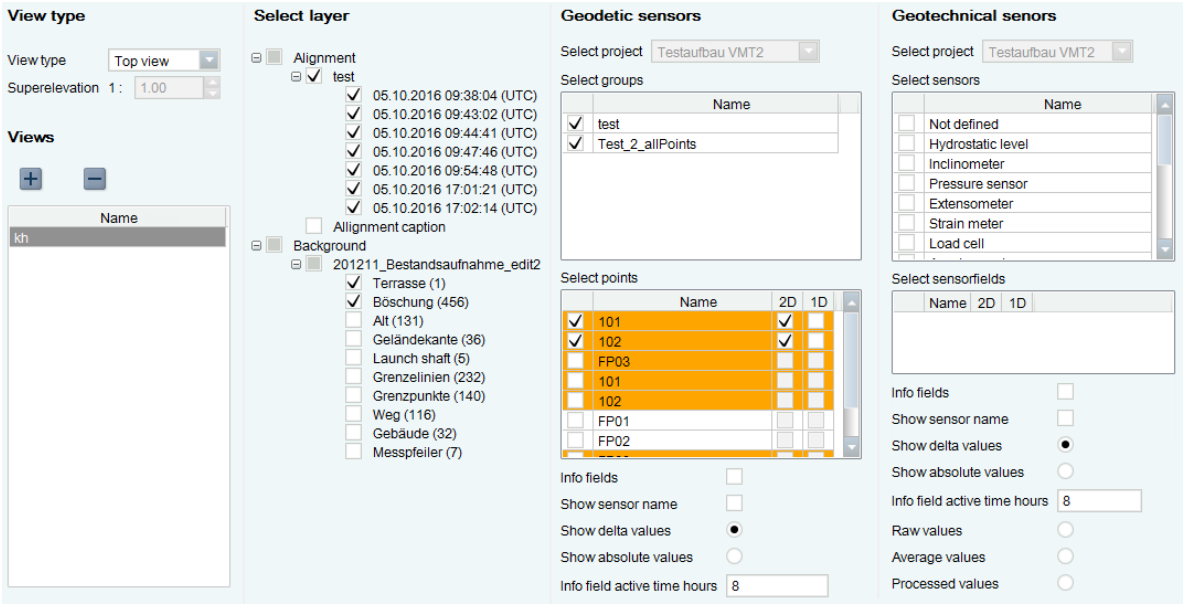
Each map background image must be georeferenced using various parameters, such as scale or easting / northing shift. Several options are available for this purpose.



Parameter	Meaning
	**Four parameters**: 4 parameters are used for this type of referencing. This corresponds to a similarity transformation with 2 control points, 2 translations, 1 rotation, 1 scale.
	**Six parameters**: 6 parameters are used for this type of referencing. This corresponds to an affine transformation with 3 control points, 2 translations, 2 rotations, 2 scales.
	**Identical points**: Any number of points can be added for referencing using identical points. In this case, both the image and global coordinates must be entered for an identical point.
	**Identical points (corners)**: Enter the coordinates of the image corners for referencing via the image corners: ■ Top right ■ Bottom left

Create map views

You configure the defined views under **ADMINISTRATION > SYSTEM CONFIGURATION > MAP > VIEW CONFIGURATION**. Each view has its own parameter set.



*Annotation: You can apply a view using the **VIEWS** button under **SYSTEM CENTRE > MAP**.*

Layers

If you have referenced multiple maps or images and added them to a view**,** you can change the sequence. The layer at the top of the tree view is drawn first. All other layers are drawn above it**,** so they might cover the layers below.

1. If not already done**,** open **ADMINISTRATION > SYSTEM CONFIGURATION > MAP > VIEW CONFIGURATIO**N
2. Click on the **VIEWS** button and select Sort.
3. Select a layer and move this up or down.
4. Click on the **VIEWS** button and select Tree View to return to the normal view.

> **Important:** You can import DWG drawing files with the layers defined there. However, the layers within the DWG cannot be moved.

*Annotation: Activating the **BROWSER** checkbox makes the view visible in Delta Live**!**.*

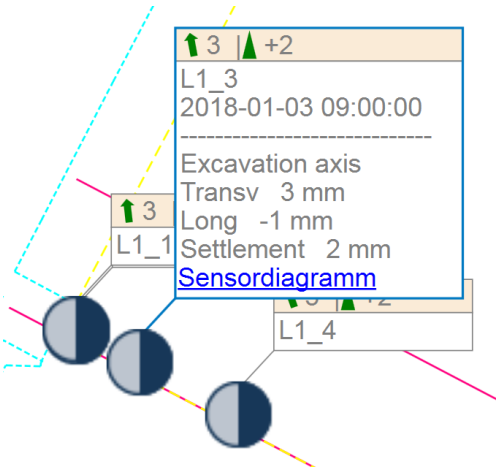
Configuration of the Info field

The appearance of the information fields for geotechnical or geodetic sensors can be adjusted in many ways.

Proceed as follow to adjust an Info field:

1. If not already done, open **ADMINISTRATION > SYSTEM CONFIGURATION > MAP > VIEW CONFIGURATION**
2. Select a view. The areas **SELECT POINTS** (geodetic sensors) and **SELECT SENSOR FIELDS** (geotechnical sensors) are populated with points if these are created.
3. You control the display of the X, Y and Z coordinates (dimensions) in the Info field by setting markers in the **2D** and **1D** columns:
   - 2D: X and Y coordinates are displayed
   - 1D: Z coordinate is displayed
   - 2D and 1D: X, Y and Z coordinates are displayed

   These coordinates and their designation can also be transformed (see „Transformation of coordinates“ on page 54).



4. Make further settings:

Parameter	Meaning
Info fields	Switches the display of the Info field on or off.
Show delta values	The difference to a reference value defined in the global point list is displayed.
Show absolute values	Absolute coordinate components are displayed.
Do not show values	Sensor values are not displayed.
Info field active time in hours	After this time, the absence of current sensor data is indicated by a colour change of the frame from black to grey.
Raw values / average values / adjusted values	Only for geotechnical sensors.

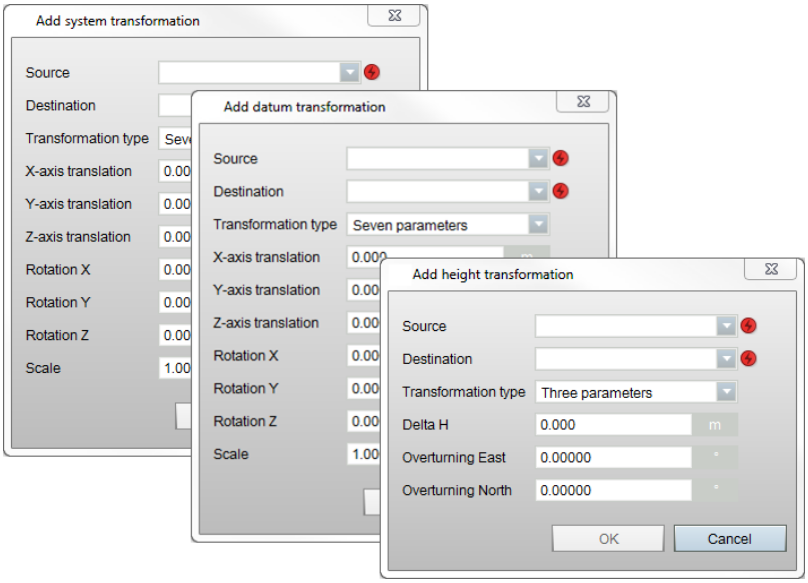
Right clicking on a point opens a context menu in which further setting options are available.

Parameter	Meaning
Status	Activate or deactivate the point Inactive points are not displayed on the map. You can apply these options collectively to all points.
Dimension	Activate or deactivate all 1D and/or 2D coordinates.
Orientation	Select where the info field is displayed on the point. The possibilities are based on the standard divisions of a compass rose: north, north-east, east, etc.

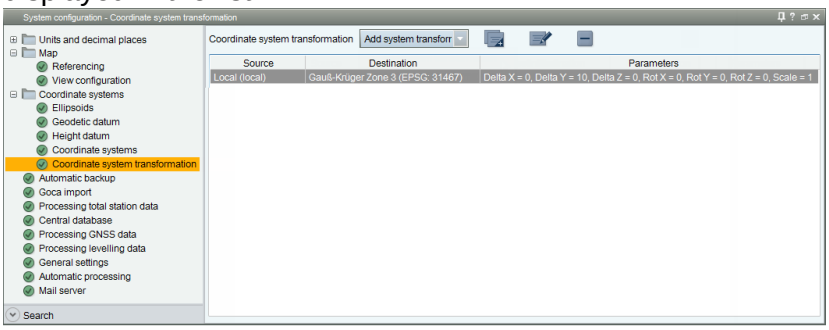
Coordinate systems

Ellipsoids	Define or select the reference ellipsoid.
Geodetic datum	Define or select the geodetic datum of your project coordinate system.
Elevation datum	Define or select the elevation datum of your project coordinate system.
Coordinate systems	Define or select the coordinate system (consisting of: EPSG[5] code, geodetic datum, elevation datum and projection). You can also configure a local coordinate system.
Coordinate system transformations	The coordinate system transformation distinguishes between several transformation types: ■ System transformation ■ Datum transformation ■ Elevation transformation Created transformations can be selected in other modules. Proceed as follows to perform a coordinate system transformation: 1. If not already done, open **ADMINISTRATION > SYSTEM CONFIGURATION > COORDINATE SYSTEMS > COORDINATE SYSTEM TRANSFORMATIO**N 2. Select the transformation type. The appropriate configuration window opens:

[5]The EPSG code is a system of globally unique, 4- to 5-digit code numbers (SRIDs) for coordinate reference systems and other geodetic datasets, such as reference ellipsoids or projections.

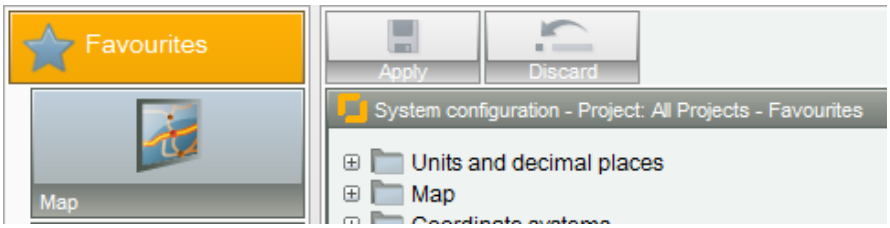


3. Select source and target coordinate systems.
4. Specify the parameters. After saving, the transformation is displayed in the list.



Further setting options in the system configuration

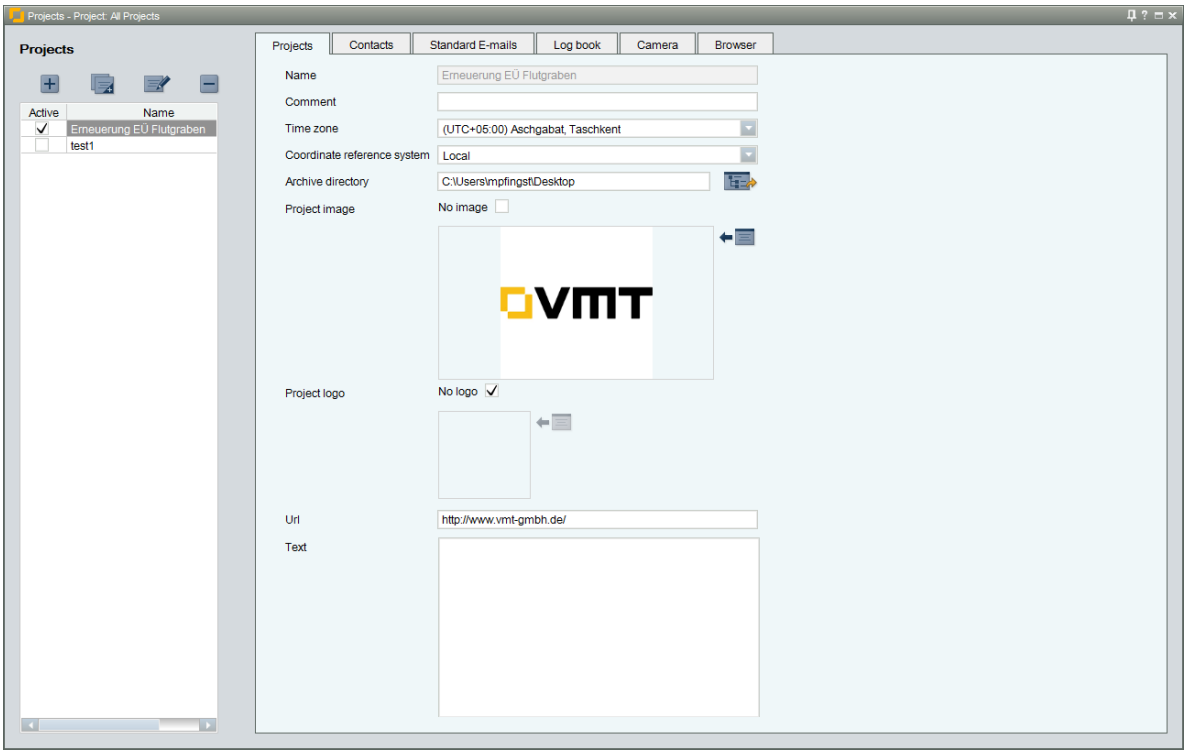
Background image	Import of background images. These can be used in other Delta Watch modules.
Automatic backup	All data from the deformation monitoring are backed up at freely definable intervals and can be restored if required. The restore can be performed using the Delta Watch utilities. *Tip: You can also initiate a manual backup. To do this, select Help > Database backup in the menu.*
Preparation of total station data	Default values for the preparation of total station data.
Preparation of GNSS data	Default values for the preparation of GNSS data.
Preparation of levelling data	Default values for the preparation of levelling data.
General settings	Notes:

	Activation of a confirmation request before closing the program. In the case of a crash of Delta Watch, a crash report is transmitted. The automatic import also searches through subdirectories.
Favourites	Compile your own module group from all available modules. This is displayed at the top of the navigation bar after saving. 
Automatic processing	You can configure the behaviour for automatic XML import and export - for example, overwriting existing XML files or the procedure for import errors.
Mail server	Enter the server data for sending e-mails. You can test the settings made using the **SEND TEST MAIL** button.

4.2 Projects

A project is the clear compilation of measuring points. Changing between projects is only possible here.

*Tip: Create its own project for each jobsite or section in order to structure associated data. The maximum number of projects is determined by your licence (see „*Licence Management*“ on page 96).*



Time zone	Time zone of the project. All times are converted accordingly.
Coordinate reference system	The selection is possible from all coordinate systems that have been created in **ADMINISTRATION > SYSTEM CONFIGURATION > COORDINATE SYSTEMS > COORDINATE SYSTEMS**. The selected system is used as default for all geodetic networks in the project.
Archive directory	Subdirectory in which already processed data are stored as compressed files.
Project image	Display of a project image. Only used in Delta Live**!.**
Project logo	Display of a project logo. Only used in Delta Live**!.**
URL	Display of a website. Only used in Delta Live**!.**
Text	Display of a text. Only used in Delta Live**!.**

Create project

Proceed as follows to create a project:

1. If not already done, open **ADMINISTRATION > PROJECTS**.
2. Click on the "Add" symbol.
3. Enter the name and confirm the input.

   The new project is displayed in the project selection.

Active project

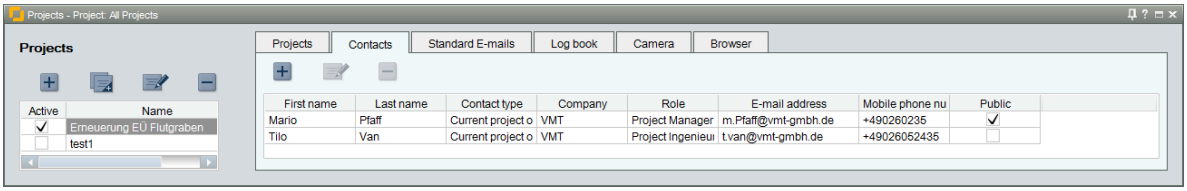
In Delta Watch, only one project can be active and its data available at a time. For your information, the project name is displayed in the title bar of all non-general modules. The active project will be loaded automatically when restarting.

Annotation: Irrespective of the active project, sensor data are always processed in the background - even if they do not belong to the active project.

Create e-mail contacts

Delta Watch can automatically inform about certain events, e.g. the reaching of a limit value, via e-mail. The possible recipients for these e-mails are created centrally on the **CONTACTS** tab.

A created contact can be limited to the currently active project or can be used for all projects of your Delta Watch installation.

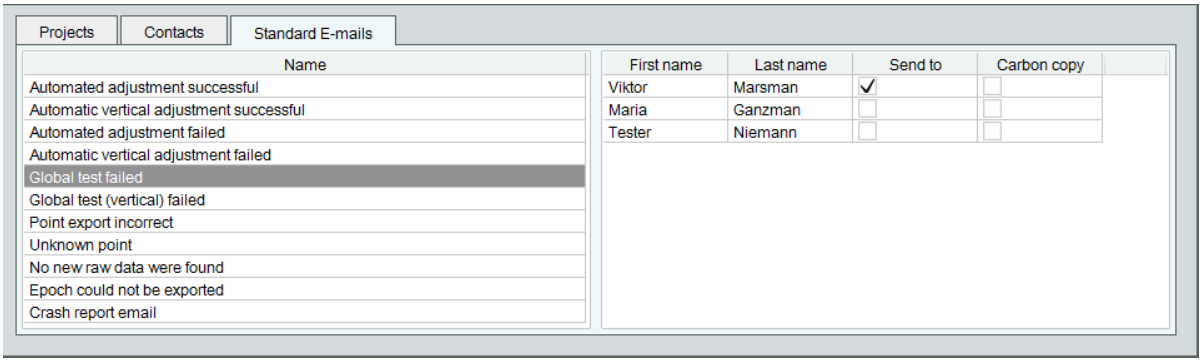


*Tip: If you enable the **PUBLIC** field, Delta Live! displays these contacts.*

Define e-mail recipients for standard events

Standard messages are stored in Delta Watch for certain events, such as the absence of data.

You can define which contacts should be notified via e-mail for these standard events. You can select from all enabled contacts for this project as recipients or as copy recipients on the **STANDARD E-MAILS** tab.



Log

You can document and track project activities in the log. You can enable individual users to access different entries.

> **Important:** The log can be reached via Delta Live!. For this reason, check carefully which entries are made accessible for which user groups.

Camera

Webcams can be configured here. These are only shown in Delta Live**!**.

Browser

Under **BROWSER**, you can define which modules are generally visible in Delta Live**!**.

You can also define the submodules of the Delta Live! **SENSOR FIELD** module.

In project management modules of Delta Watch, you can define under which submodule the respective sensor field is displayed.

4.3 Point and limit value management

In point and limit value management, you perform the basic point management of your geodetic and geotechnical deformation network and manage your geotechnical sensors centrally.

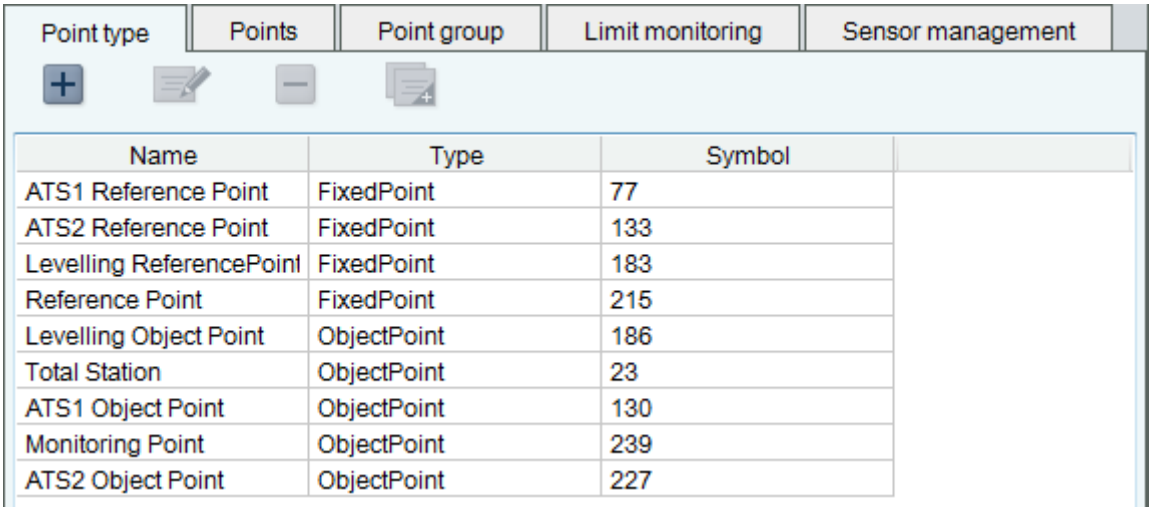
- Sort your fixed and object points using freely definable point types.
- Points can be grouped and managed in point groups.
- In limit monitoring, you define threshold values, for which a notification is sent by e-mail when they are reached.

4.3.1 Point types

You can define point types to distinguish and group points and mark them with a specific symbol in the map display. Possible applications for point types are e.g.:

- Differentiation of manually and automatically measured points
- Identification of fixed and object points
- Points with certain commonalities, e.g. all prisms

Each point must be assigned such a point type on the POINTS tab.



Name	Type	Symbol
ATS1 Reference Point	FixedPoint	77
ATS2 Reference Point	FixedPoint	133
Levelling ReferencePoint	FixedPoint	183
Reference Point	FixedPoint	215
Levelling Object Point	ObjectPoint	186
Total Station	ObjectPoint	23
ATS1 Object Point	ObjectPoint	130
Monitoring Point	ObjectPoint	239
ATS2 Object Point	ObjectPoint	227

Create point type

Proceed as follows to add a point type:

1. If not already done, open **ADMINISTRATION > POINT AND LIMIT MONITORING > TAB: POINT TYPE**.
2. Click on the "Add" symbol.
3. Specify a name for the point type and specify whether it is a fixed or object point.
4. Select a symbol graphic for the representation in the map module.

Annotation: The symbol graphics are predefined and cannot be changed.

4.3.2 Points

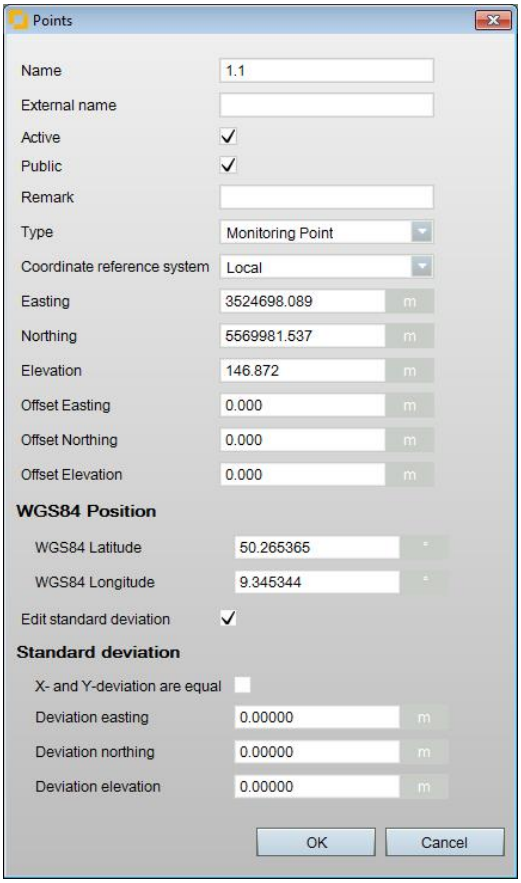
Create and edit points

You can create and edit the points of your project on the **POINTS** tab. In addition to a manual input, point data can also be imported from a file.

Proceed as follows to create a new point:

1. If not already done, open **ADMINISTRATION > POINT AND LIMIT MONITORING > TAB**: **POINTS**.

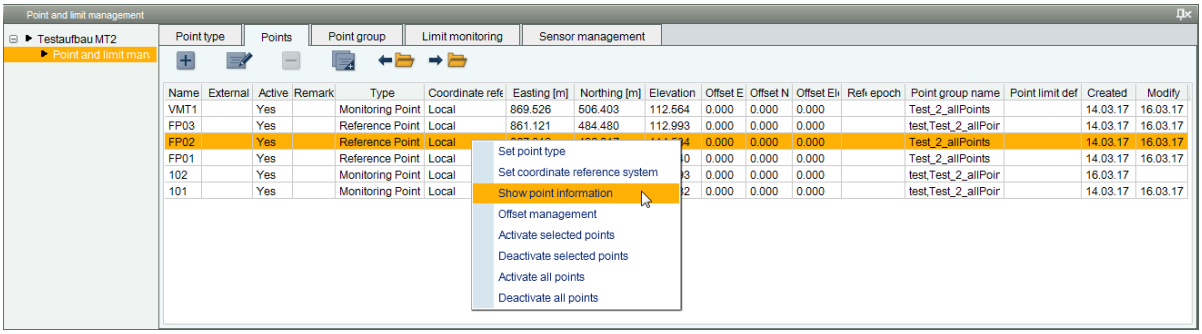
2. Click on the "Add" symbol to enter the relevant entries for the new point.



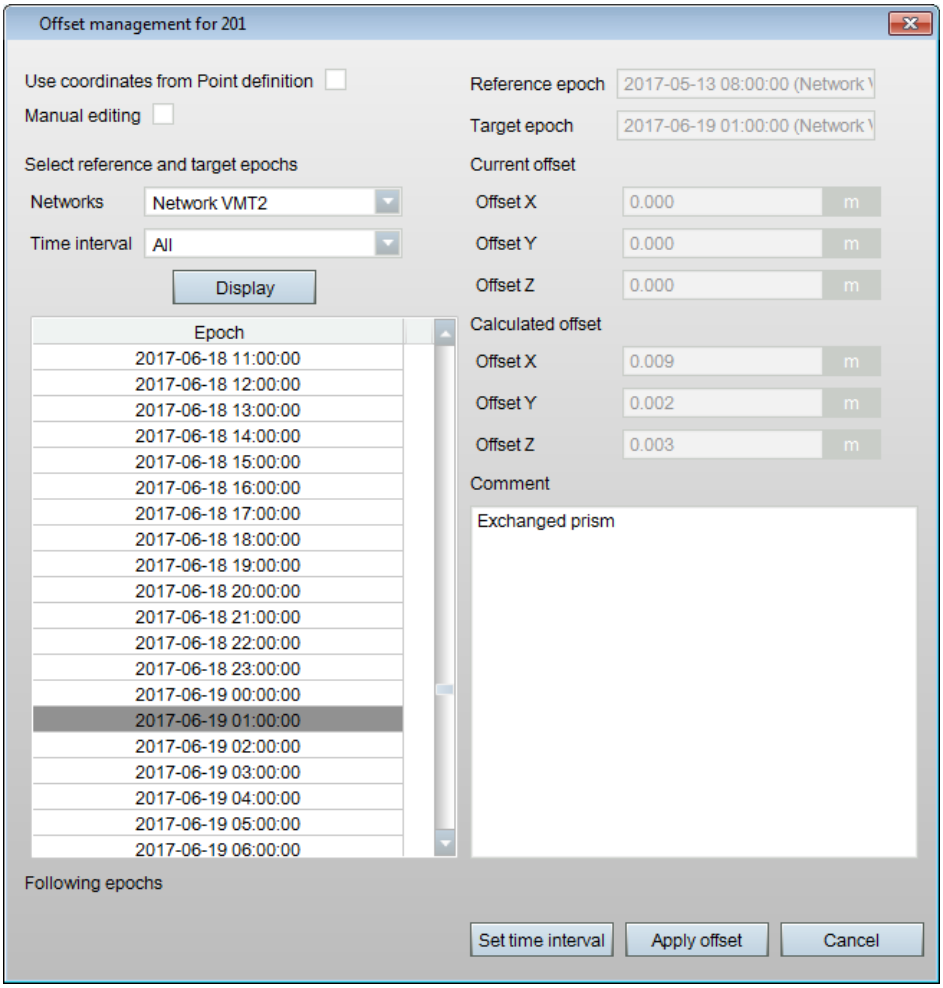
*Annotation: **WGS84** coordinates must be entered if you want to display points in Delta Live! on a map.*

To edit the data of a point at a later time, open the dialogue by double clicking on its row.

Alternatively, you can right click on the row to open the context menu. There are various options available in the context menu:



Set point type	Assigns a point type to the point.
Show point information	The networks and epochs in which the point has been measured are displayed here.
Offset management	Input of the offset. For example, this is necessary if you offset the sensor or it has been manipulated. **Important:** For reasons of traceability, a comment must always be entered for any offset input. There are various possibilities for calculating the offset. ■ By selecting any reference and target epoch (normal case). ■ By selecting the coordinates (reference epoch) from point and limit management and any target epoch. The option **USE COORDINATES FROM POINT DEFINITION** must be activated for this. ■ By manual input of the X, Y and Z components of the offset.



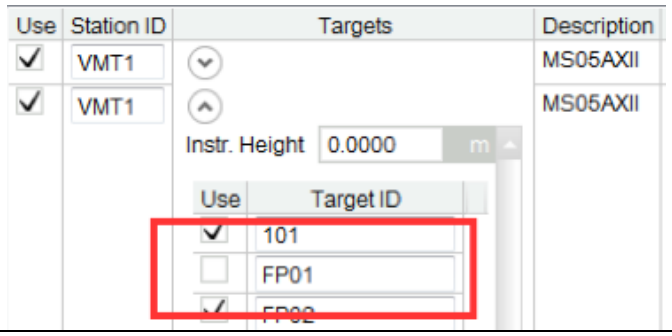
The offset can be applied to the following periods:

- for all following epochs
- from a specified point in time
- for a specified period

Status

The status of a point determines whether it is included in the total number according to your licence. Only active points are included in the calculation (see „Licence Management“ on page 96).

A deactivated point is not calculated and is identified accordingly in the **EPOCHS > TOTAL STATION** data module.



Public

Manages the visibility of individual or all points.

Initial measurement

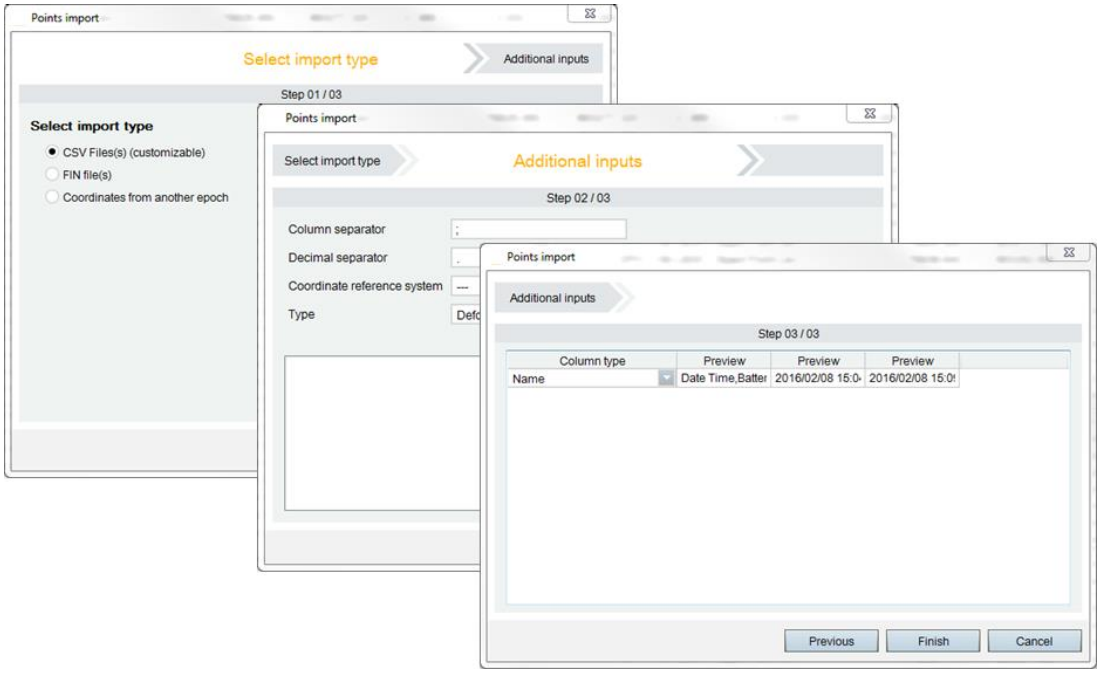
The coordinates in the point list, including any existing offset, correspond to the initial measurement. Points can be added (e.g. when extending the network) or changed (e.g. for structural reasons).

Import points

Proceed as follows to import multiple points from a file:

1. If not already done, open **ADMINISTRATION > POINT AND LIMIT MONITORING > TAB**: **POINTS**.

2. Click on the **IMPORT** button.

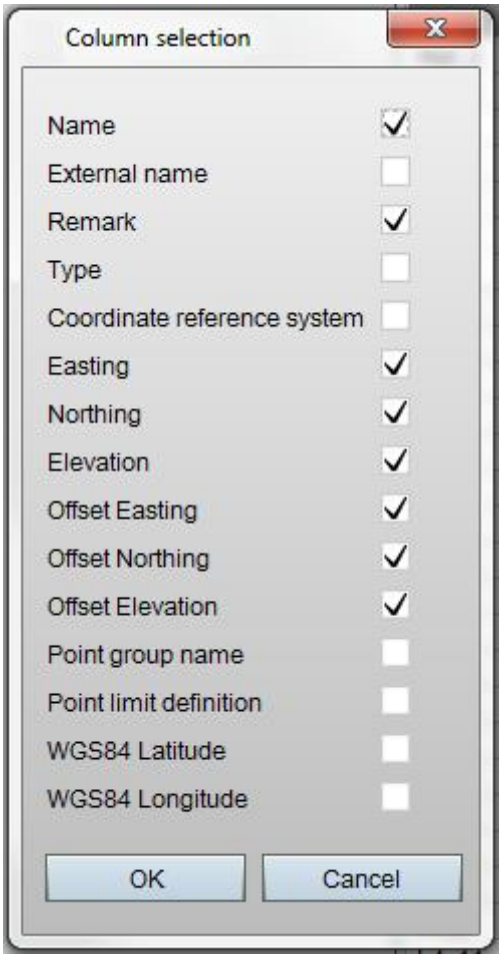


3. Follow the dialogue.

Export points

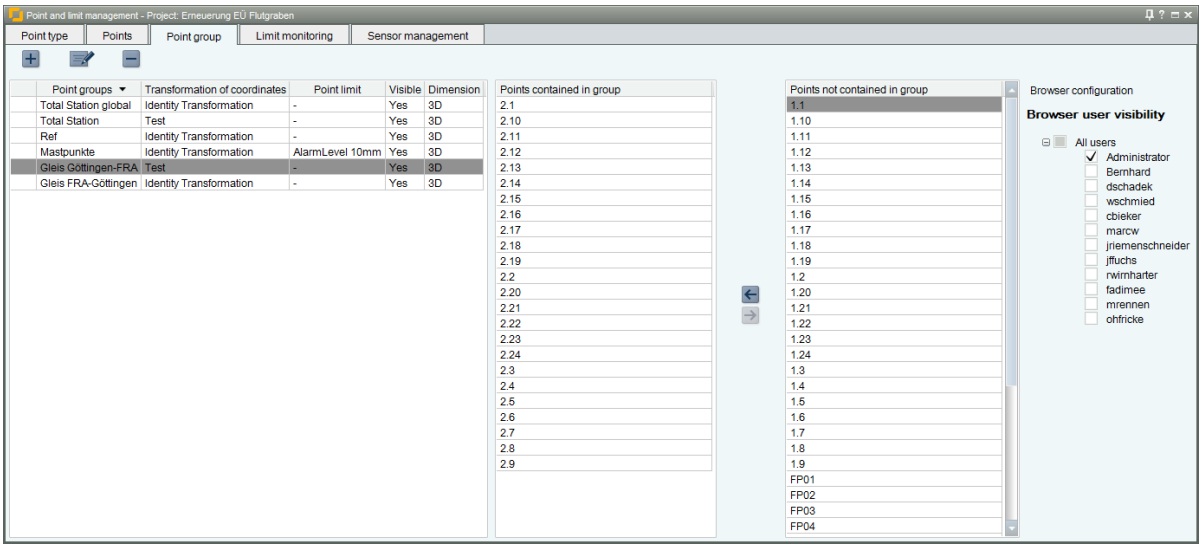
Proceed as follows to export one or more points:

1. If not already done, open **ADMINISTRATION > POINT AND LIMIT MONITORING > TAB**: **POINTS**.
2. Click on the "Export" symbol.
3. Select the columns that you would like to export.



4.3.3 Point groups

You can use point groups to group together any number of points. This enables you later to specifically display the points of this group and to use the points in other Delta Watch modules or in Delta Live!.



Create point group

Proceed as follows to create a point group and to assign your points:

1. If not already done, open **ADMINISTRATION > POINT AND LIMIT MONITORING > TAB**: **POINT GROUP**.
2. Click on the **ADD** button and enter a name.
3. In the **POINTS NOT CONTAINED IN GROUP** column, select all entries that you would like to add to your newly created point group.
4. Use the arrow button to move the points to the **POINTS CONTAINED IN GROUP** column.

Assign transformation of coordinates to point groups

You can apply **TRANSFORMATION OF COORDINATES** to point groups. In this case, all coordinates within the group are converted according to the set transformation (see „Transformation of coordinates“ on page 54 and „Limit monitoring“ on page 36**)**.

Proceed as follows to assign a transformation to your point groups.

1. If not already done, open the **ADMINISTRATION > POINT AND LIMIT MONITORING > POINT GROUP TAB**.
2. Click with the right mouse button on the point group to which you want to assign a transformation, and then select **SET TRANSFORMATION** in the context menu.
3. Select the transformation to be applied from the list.

Assign limit values to point groups

Certain values of point groups can be monitored by Delta Watch. If these limit values are exceeded or undercut, a previously defined group of persons can be informed by e-mail (see „Limit monitoring“ on page 37**)**.

Proceed as follows to assign limit values to your point groups.

1. If not already done, open the **ADMINISTRATION > POINT AND LIMIT MONITORING > POINT GROUP TAB**.
2. Click with the right mouse button on the point group which you want to monitor and then select **SET LIMIT VALUE** in the context menu.
3. Select the limit value definition to be applied from the list.

Set point groups visible

If a point group is set visible, this can be used everywhere in Delta Watch or Delta Live**!**.

Proceed as follows to set your point groups visible:

1. If not already done, open the **ADMINISTRATION > POINT AND LIMIT MONITORING > POINT GROUP TAB**.
2. Click with the right mouse button on the point group which you want to make visible and then select **VISIBLE** in the context menu.
3. Select one of the provided options.

Add dimension to point groups

A dimension can be assigned to a point group, depending on whether the coordinates are three-dimensional or one-dimensional. Various Delta Watch modules and Delta Live! react to this setting.

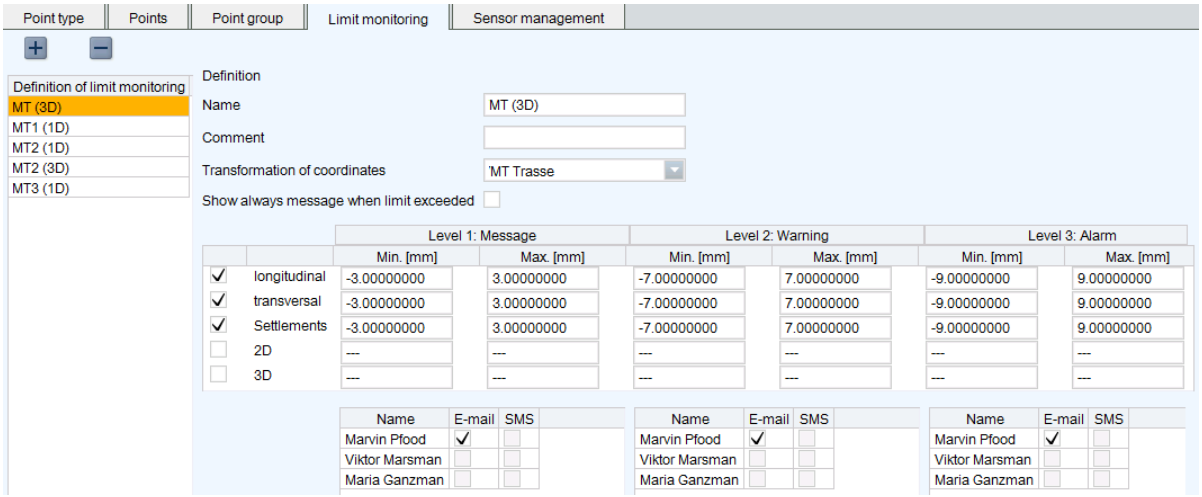
Proceed as follows to select a dimension:

1. If not already done, open the **ADMINISTRATION > POINT AND LIMIT MONITORING > POINT GROUP TAB**.
2. Select the point group that you would like to assign a dimension to.
3. Click on the '' Edit'' symbol and then select **3D** for three-dimensional or **1D** for one-dimensional coordinates from the list that is displayed.

4.3.4 Limit monitoring

Delta Watch enables you to monitor certain point values for undershoots and overshoots. The following values can be monitored:

- X-value: position displacement
- Y-value: transverse displacement
- Z-value: settlement / uplift
- 2D: position displacement in X-Y direction
- 3D: total spatial displacement



Create limit values

Proceed as follows to create a new limit value definition:

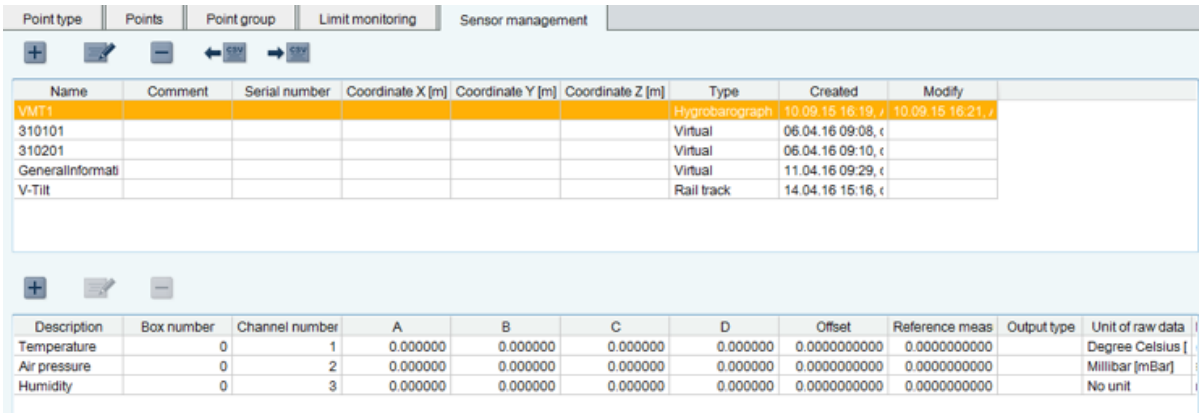
1. If not already done, open **ADMINISTRATION > POINT AND LIMIT MONITORING > TAB**: **LIMIT MONITORING**.
2. Click on the **ADD** button and enter a name for your new limit value definition.
3. Click on the created limit value definition in the overview list and edit the parameters:

Parameter	Meaning
Transformation of coordinates	Select a transformation of coordinates from the list (see „Transformation of coordinates“ on page 54**).**
Always report when exceeded	Defines whether an alarm is triggered for each epoch exceeding the limit value or only for the first epoch.Annotation: This can be required if the value alternates around the limit value in successive epochs. Proceed as follows to reset the one-time limit value notification: 1. If not already done, open **ADMINISTRATION > AUTOMATIC GEODETIC NETWORKS**. 2. Select the network whose notification you would like to reset. 3. Click on the new "Reset limit value notification" button that is displayed in the secondary menu.
Level	Delta Watch uses three levels to show different priorities in limit value management. ■ Level 1 – Message ■ Level 2 – Warning ■ Level 3 – Alarm *Tip: For information about how to change the units and decimal places for the entered limit values, see* „Administration“ *on page 17.*
Recipients	Contacts can be defined for each limit value level who are informed by e-mail when the limit value is reached (see „Projects“ on page 25**).**

Behaviour of the system when the limit value is exceeded

When a limit value is exceeded, Delta Watch behaves as follows:

- When an epoch of an automatic network has been evaluated, Delta Watch then checks all calculated point group points for which a limit value has been created.
- If the value is exceeded, an entry is made in the message window.
- If contacts are stored for the level, the corresponding e-mail template from the standard e-mails is sent (see „Projects“ on page 25).
  - Message limit values exceeded
  - Warning limit values exceeded
  - Alarm limit values exceeded
- There is always only one message generated for the highest level. For example, if Level 3 is exceeded, only one single message is generated although Levels 1 and 2 have also been exceeded.

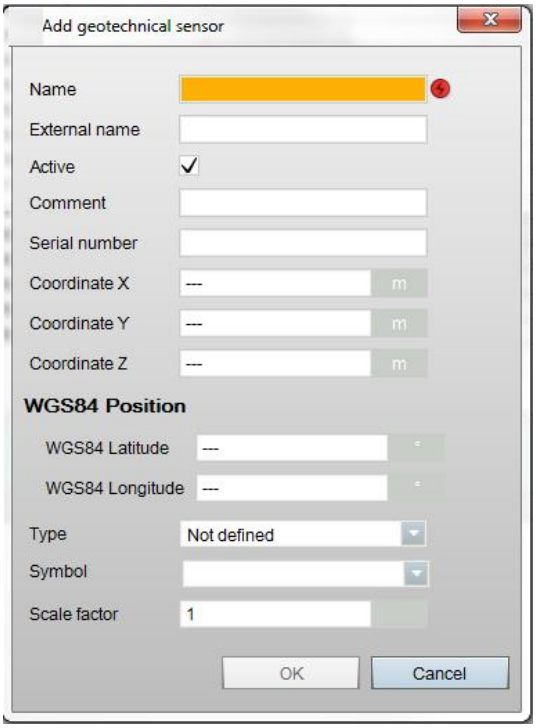


4.3.5 Sensor management

Create and configure sensors

Proceed as follows to create a sensor:

1. If not already done, open **ADMINISTRATION > POINT AND LIMIT MONITORING > TAB**: **SENSOR MANAGEMENT**.
2. Click on the **ADD** button and enter a name.
3. Fill in the remaining parameters.



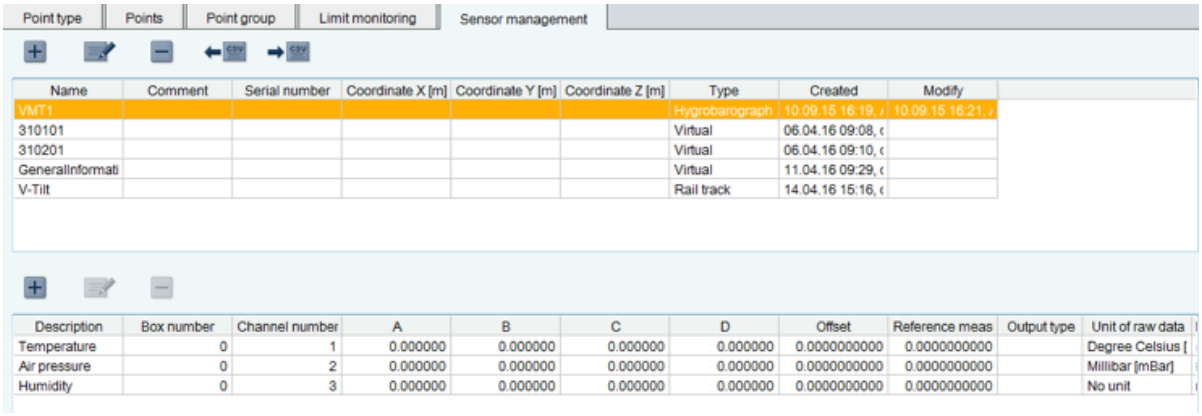
Annotation: WGS84 coordinates must be entered if you would like to display sensors in Delta Live! on a map.

Create and configure sensor channels

Each sensor can record different types of information and forward them separately via channels, e.g.:

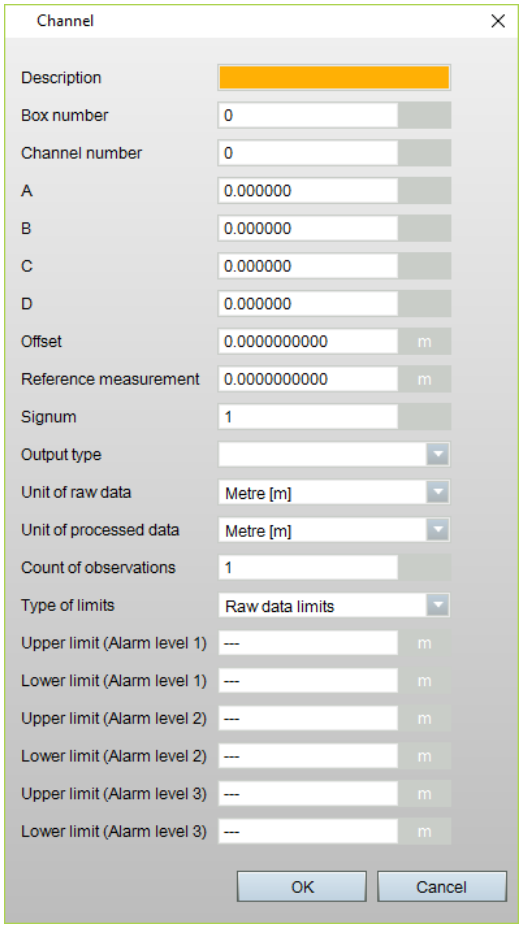
- for a hygrobarograph: temperature, air pressure, air humidity
- for an inclinometer, the respective depths

Each sensor channel can be configured with limit values. The allocation follows the same principles as described in „Limit monitoring“ on page 37 and is done in the parametrisation of the sensor channel.



Proceed as follows to assign channels to a sensor:

1. If not already done, open **ADMINISTRATION > POINT AND LIMIT MONITORING > TAB**: **SENSOR MANAGEMENT**.
2. Select the sensor that you would like to configure in the upper window. In the lower window, you can see channels that have already been created, if there are any.
3. Click on the "Add" symbol in the lower window.
4. Add all parameters of the sensor channel.



4.4 Networks

Networks are used to group sensors together. Delta Watch distinguishes between manual and automatic networks.

- **Manual networks**: The complete evaluation of the measured values is carried out by the user himself. There is no automated calculation.
- **Automatic networks**: The import of the measured values and the configuration of the network adjustment up to the checking of stored limit values are completely automated.

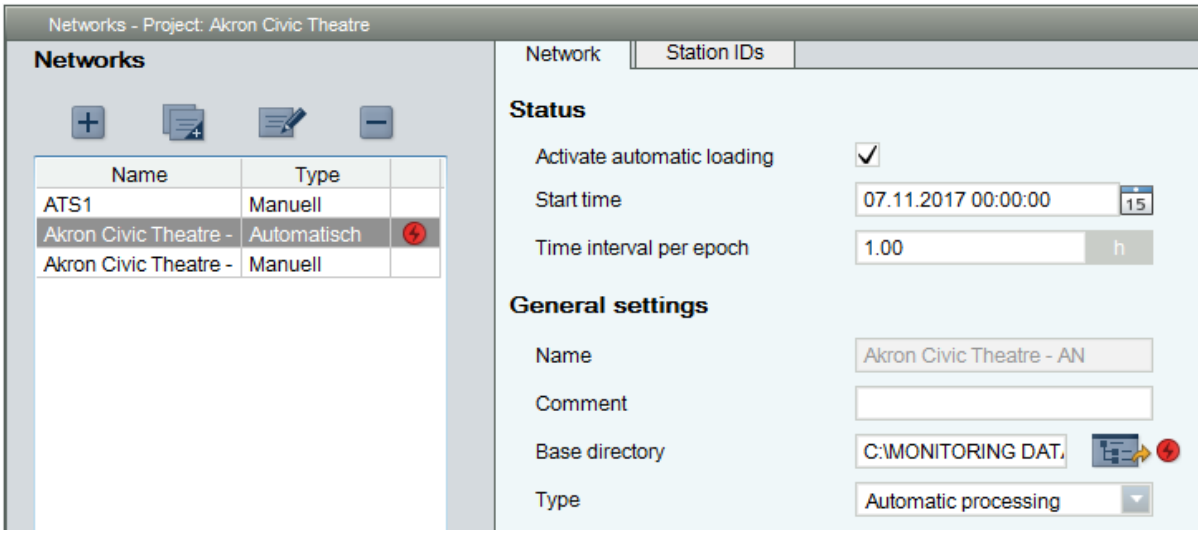
Create and edit network

Proceed as follows to create a network:

1. If not already done, open **ADMINISTRATION > NETWORKS**.
2. Click on the "Add" symbol.
3. Specify the name and type.

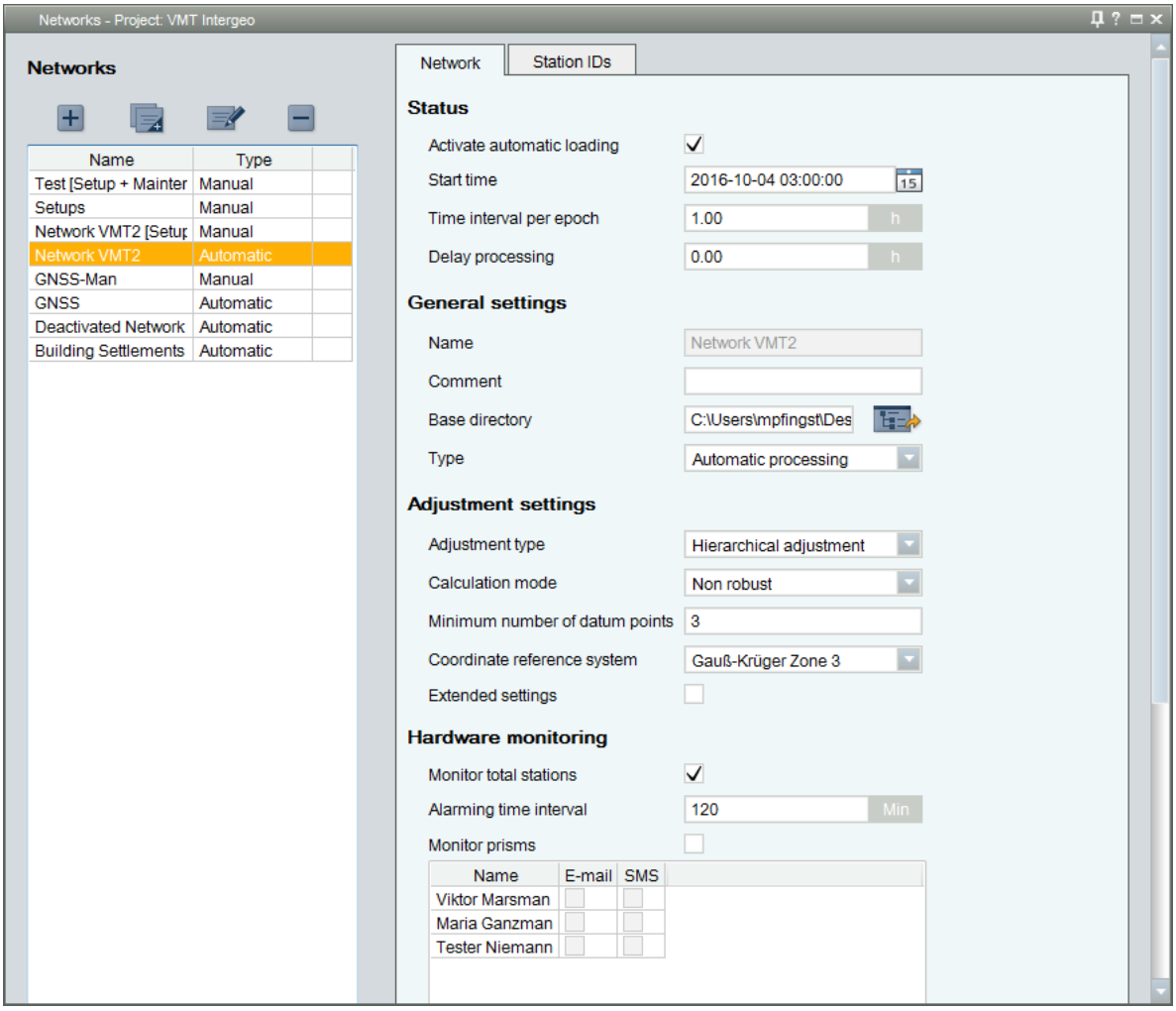
The network you have created is automatically assigned to the currently active project (see also „Projects“ on page 25).

Select the entry in the network overview to configure your network. The details of your network are displayed. The settings made here are applicable for all epochs of this network.



Automatic geodetic networks

If you have selected the "Automatic" type for the system, measurement data are automatically imported from the specified base directory according to a basic configuration and compressed to epochs with the default adjustment settings.



Hardware monitoring

You can monitor the activity of your total stations and prisms in automatic networks.

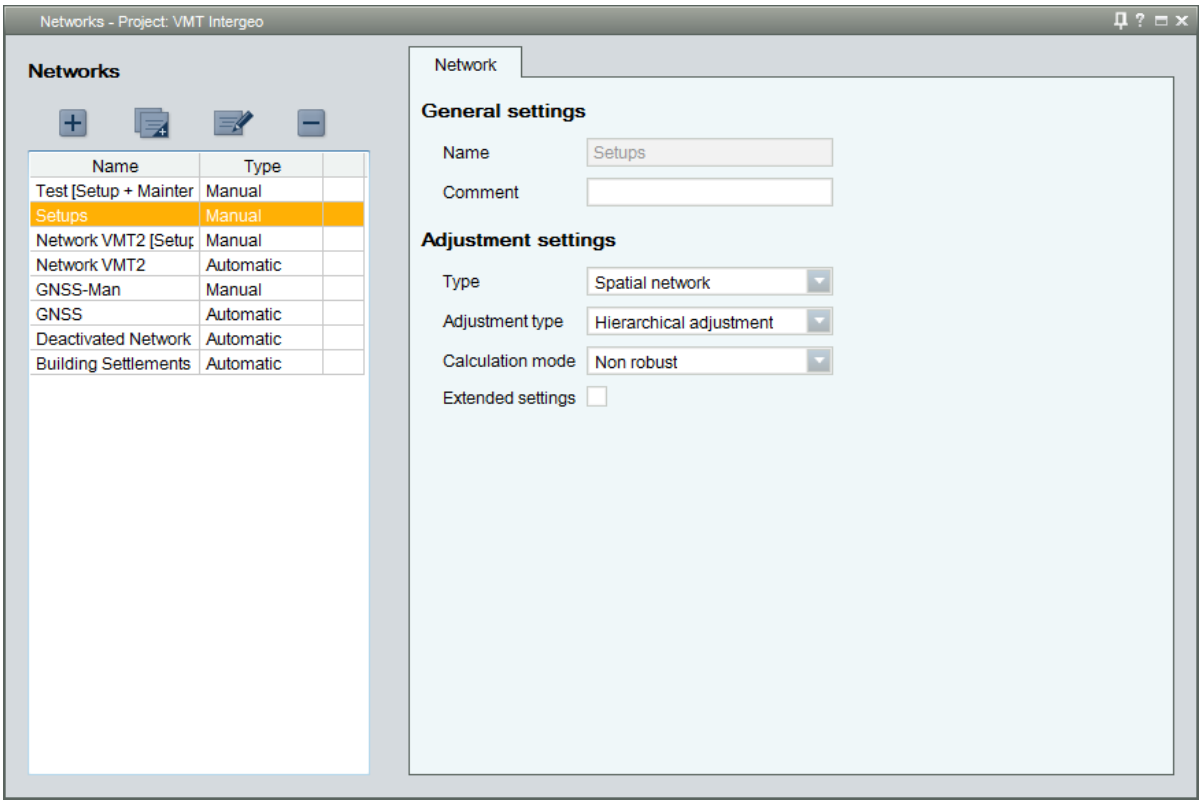
Proceed as follows to monitor your hardware:

> Select the hardware types that you want to monitor.

The additional field **ACTIVATION PERIOD** is displayed. The alarming time interval corresponds to the time without activity after which an alarm will be triggered.

*Tip: Select the alarming value so that it is a multiple of the **TIME INTERVAL PER EPOCH** value.*

The e-mail recipients selected here receive notifications from the hardware monitoring (see also „Projects“ on page 25**)**.



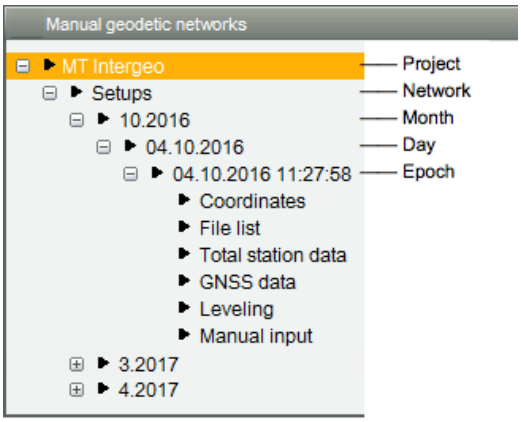
Manual geodetic networks

Measurement data are added per epoch, as described in „Epochs“ on page 45.

4.5 Epochs

An epoch is a freely definable time period in which raw data can be evaluated. Multiple observations in the same network are balanced together. There are various possibilities to fill an epoch with data:

- manual input
- manual import from a file (gka, dat or gsi format)
- automatic import of automatically imported data into the total station (e.g. via Delta Link)
- automatic or manual import of GNSS baselines or RINEX raw data



Create and edit epochs

> **Important:** The epochs are created automatically in automatic networks. Manual creation of epochs is only possible in manual networks.

Proceed as follows to create an epoch:

1. If not already done, open **ADMINISTRATION > EPOCHS**.
2. Select a network and a time interval.
3. Click on the **SHOW** button.
4. Existing epochs are listed hierarchically sorted.
5. Click on the "Add" symbol.
6. Specify the name and starting time point of the epoch.
7. The epoch is added to the project tree.

To continue editing the epoch, select the entry and expand it using the preceding node.

General configuration

- Comment: Any text.
- Coordinate reference system: defines the coordinate reference system for the epoch. Only a coordinate reference system that is created in the system configuration can be selected.

  Annotation: A global system must be selected for GNSS observations.

- Time stamp: time of the measurement. The epoch is sorted in the project tree based on this time (sorted chronologically by date).

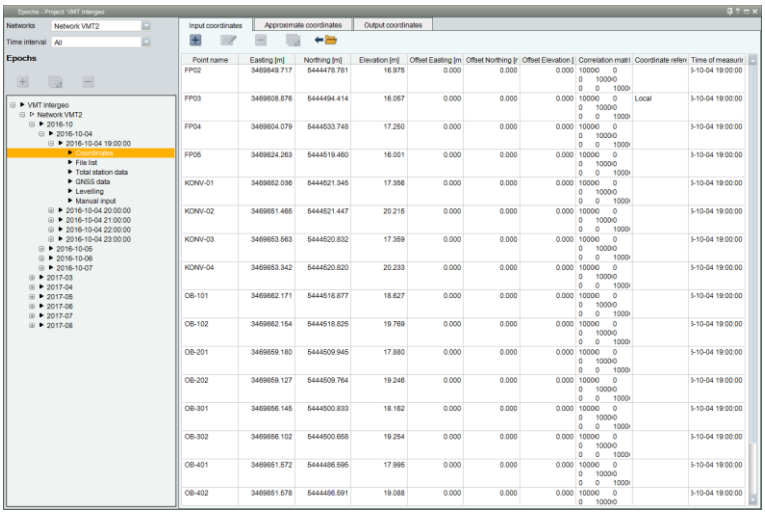
Annotation: The time stamp cannot be changed in automatic networks.

Coordinates

A distinction is made between input coordinates, approximate coordinates and calculated coordinates:

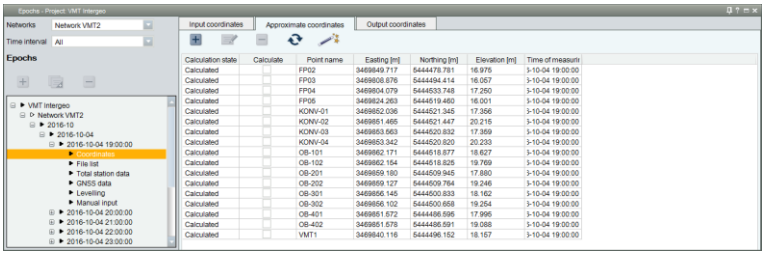
- Input coordinates

  Here you can read in known coordinates, for example, fixed points that have been measured.



- Approximate coordinates

  Approximate coordinates are required for the determination of new points in the course of network adjustment. They can be calculated before the adjustment based on the measurements.

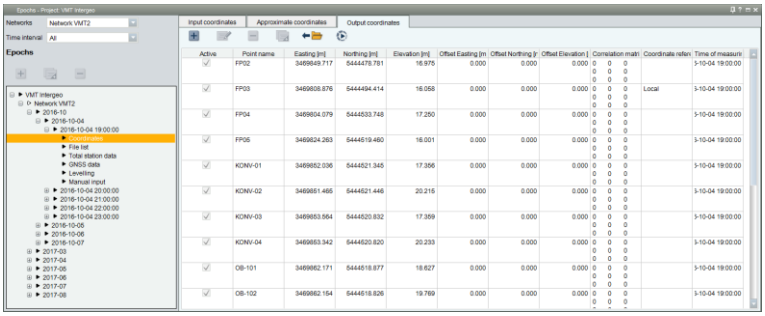


The system has already selected the points that should be calculated.

- Click on the "Update" symbol to start the calculation.
- Click on "Apply" when all approximate coordinates have been calculated.

■ Calculated coordinates

Here are the coordinates that have been created in the course of the adjustment. You can delete or deactivate incorrect points. Deactivated coordinates are no longer displayed in the charts and monitoring reports.



Write calculated coordinates to global point list

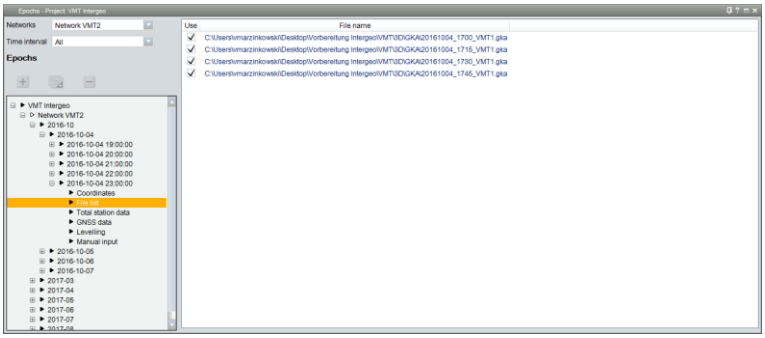
Proceed as follows to transfer the coordinates with point type and coordinate system to the global point list:

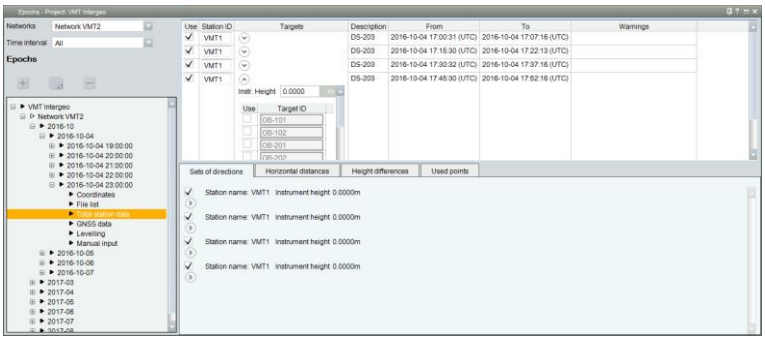
1. Select the rows in the table view with the coordinates to be imported.
2. Click on the selected set of coordinates with the right mouse button.
3. Select **WRITE COORDINATES TO POINT DEFINITION** in the context menu.

The transferred reference system corresponds to the one selected in the compensation calculation.

File list

All files that have been used for the calculation of this epoch are displayed here. The files are archived in the archive directory (see „Projects“ on page 25) and can be copied back to the base directory via **RESTORE FILE**.

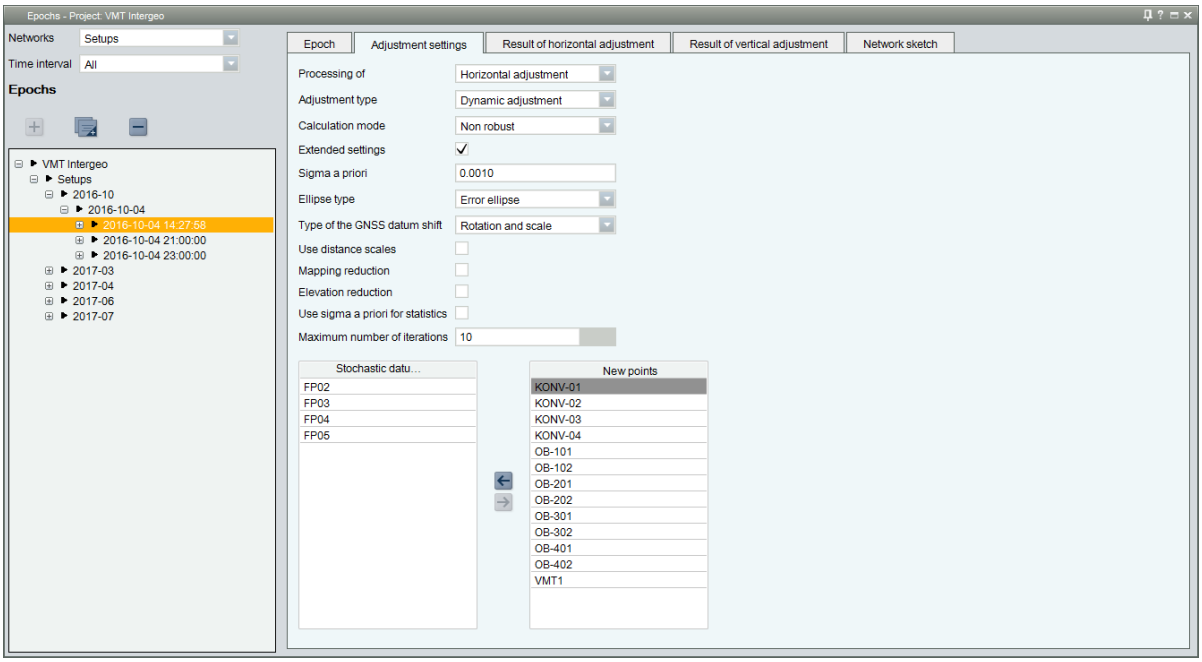


Total station data	Here you can import and edit measured values from one or more total stations.  The quality of the data is checked during the import. Variations from the epoch settings are displayed in the message window.
GNSS data	Here you can import and edit GNSS baselines (see „GNSS Array“ on page 71).
Levelling	You can import and edit measurements from levelling – also multiple levelling lines in parallel.
Manual input	Datasets can be manually completed here.

Adjustments

Observations of an epoch are evaluated using network adjustment. In doing so, the data for multiple measurements are evaluated and optimised statistically.

- Horizontal and vertical adjustment are performed separately.
- Based on the result, you can estimate the quality of the measurement.



Guideline: Make an adjustment manually

Typically, proceed as follows for adjustments:

1. If not already done, open **ADMINISTRATION > EPOCHS**. Select a network, click on the **SHOW** button and the select the previously selected network again in the tree view that opens. The "Add" symbol becomes active.

2. A new epoch is created after you have allocated a name and possibly adjusted the time stamp. Open the node before the epoch and click on **TOTAL STATION DATA** to read in data using the **LOAD MEASUREMENT DATA** button.

3. Change to **COORDINATES > APPROXIMATE COORDINATES** and let these be calculated.

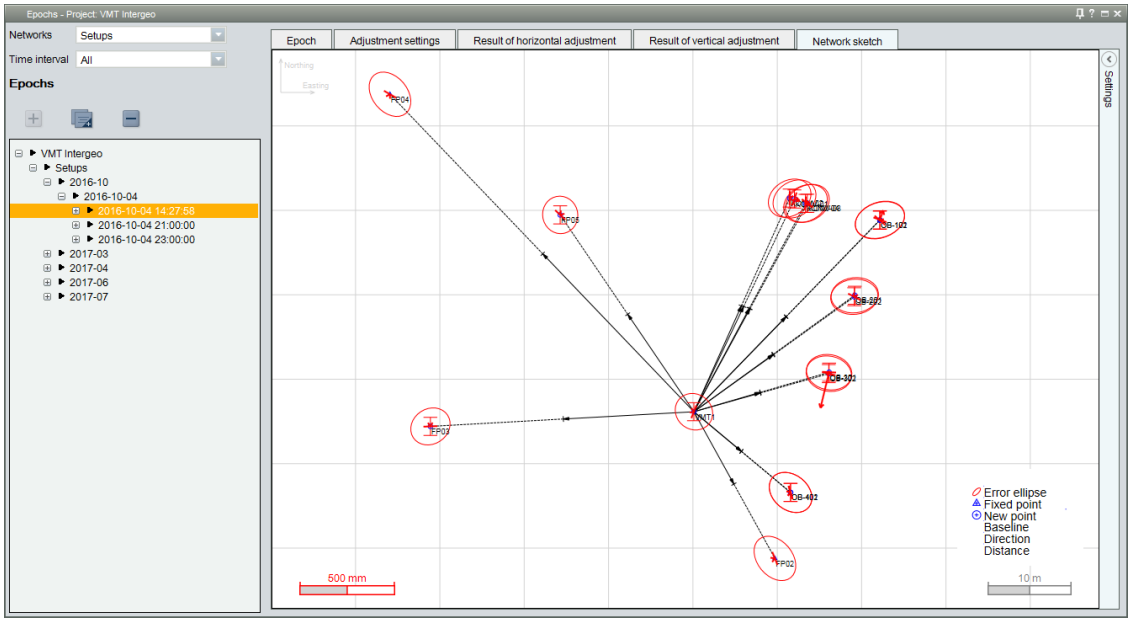
4. Return to the Epoch module and change to the **ADJUSTMENT SETTINGS** tab. After deciding on a horizontal or vertical adjustment, select the type of adjustment (Hierarchical adjustment, Dynamic adjustment or Free adjustment**).** Further fields are now displayed below depending on the selected type.

   *Annotation: If you are adjusting **3D** coordinates, you must perform both adjustment types one after the other.*

5. Move the points to the **FIXED POINT** or **NEW POINT** column. Fill in the other fields as necessary. Click on the **CALCULATE ADJUSTMENT** button. The system informs you that the adjustment has taken place.

6. Change to the **RESULT OF HORIZONTAL ADJUSTMENT** or **RESULT OF VERTICAL ADJUSTMENT** tab. If the results are not good, you can search for the cause in the **ADJUSTED OBSERVATIONS** Incorrect observations can be excluded from the evaluation.

7. Change to the **NETWORK SKETCH** tab. The scale of the deltas and the error ellipse (depending on the set magnification) can be seen at the bottom left. The scale of the network sketch is shown at the bottom right (depending on the set zoom level**)**.



You can zoom into or pan the network sketch. Select the relevant commands for this or keep the left mouse button pressed and zoom in and out using the mouse wheel.

Further configurations can be accessed via **SETTINGS** in the upper right corner. You can change various settings on the display palette. Changes are applied immediately and for all epochs of a network.

4.6 User Management

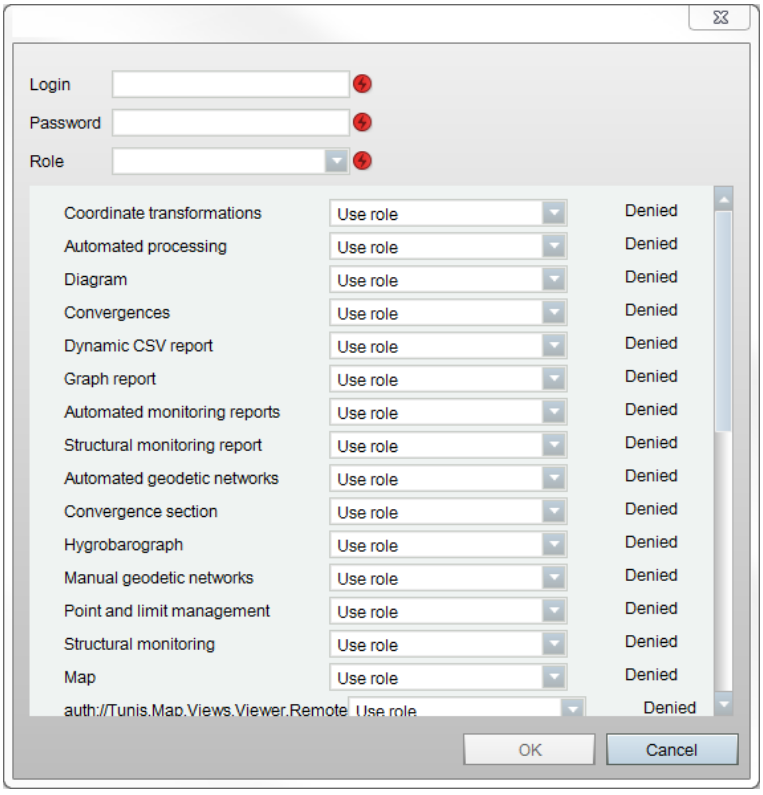
The **USER MANAGEMENT** module is used for the organisation of the users of Delta Watch. Using roles, you can control access rights down to the last detail and thus adapt Delta Watch precisely to your needs.

Add, edit and copy users

Proceed as follows to add, edit or copy a user:

1. If not already done, open **ADMINISTRATION > USER MANAGEMENT**.
2. Click on the symbol for the respective action.
3. Fill in the fields in the respective dialogue.

Annotation: The dialogue is the same for all three actions.



Tip: By default, the access options for the individual modules of Delta Watch are determined by the selected role. However, you can assign read and write permissions individually for each module.

Define standard users

Delta Watch always starts with the last logged in user and logs him in automatically. Therefore, you should create a standard user who has no or at least severely restricted rights to prevent unauthorised use.

Proceed as follows to make an already created user the standard user:

1. Select the user.
2. Click on the "Set standard user" symbol.

Delete users

Existing users can simply be removed from the list.

Annotation: The Administrator cannot be deleted.

Proceed as follows to delete a user:

1. Select the user that you would like to delete.
2. Click on the "Delete user" symbol.

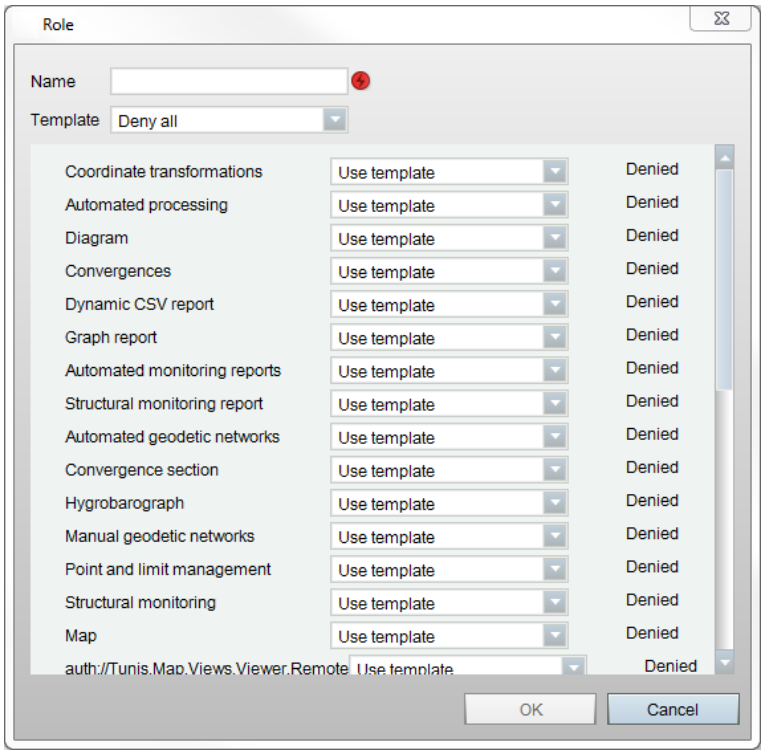
The deletion of the user must still be confirmed before it is performed.

Add, edit and copy user role

Proceed as follows to add, edit or copy a role:

1. Click on the symbol for the respective action.
2. Fill in the fields in the respective dialogue.

Annotation: The dialogue is the same for all three actions.



You can find the three standard access types under **TEMPLAT**E

- Deny all
- Read all
- Full access

The configurable individual authorisations, e.g. **ADMINISTRATION**: **ALIGNMENT** or **DYNAMIC CSV REPORT**, are assigned this value by default.

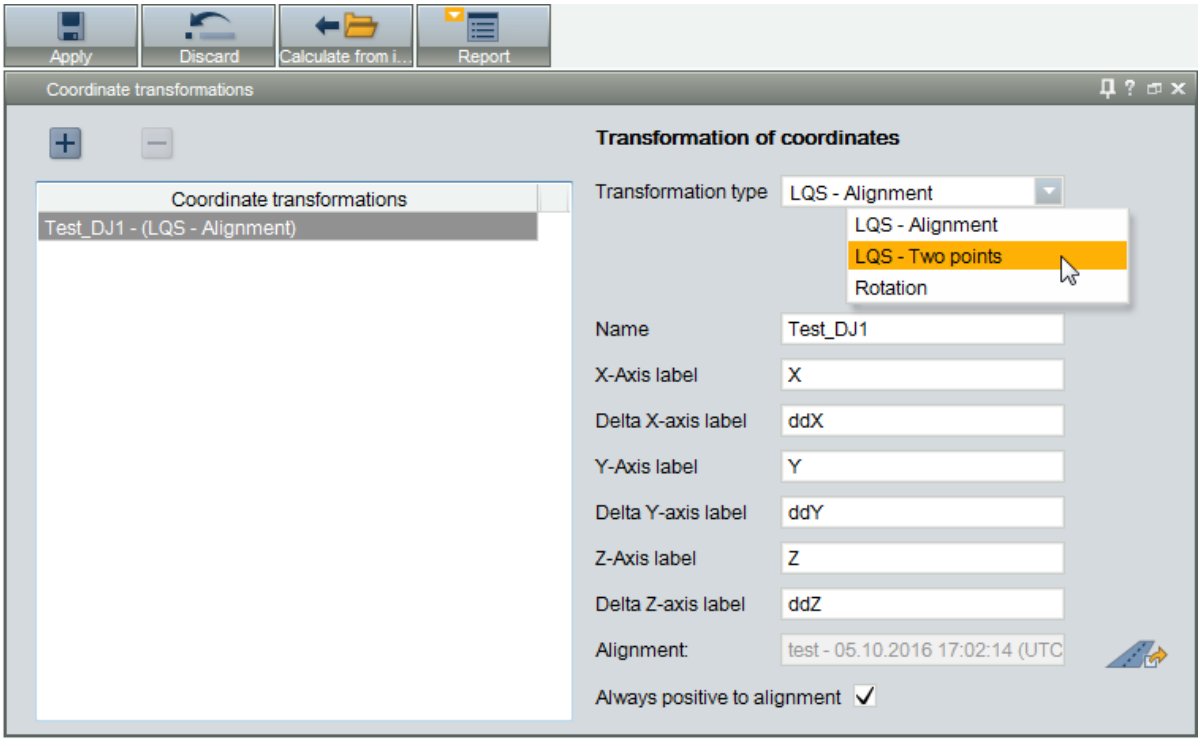
All individual authorisations can be adjusted individually:

Parameter	Meaning
Denied	No access. The module or function is not displayed
Read only	The user can view the module or function but cannot make definitions or configurations.
Full access	The module or function is completely accessible to the user.

4.7 Transformation of coordinates

You can convert the coordinates of a point to another coordinates system using a transformation of coordinates. For example, this can be useful to visualise the measurement results in relation to the local conditions.

Tip: A created transformation of coordinates can also be used by other modules.



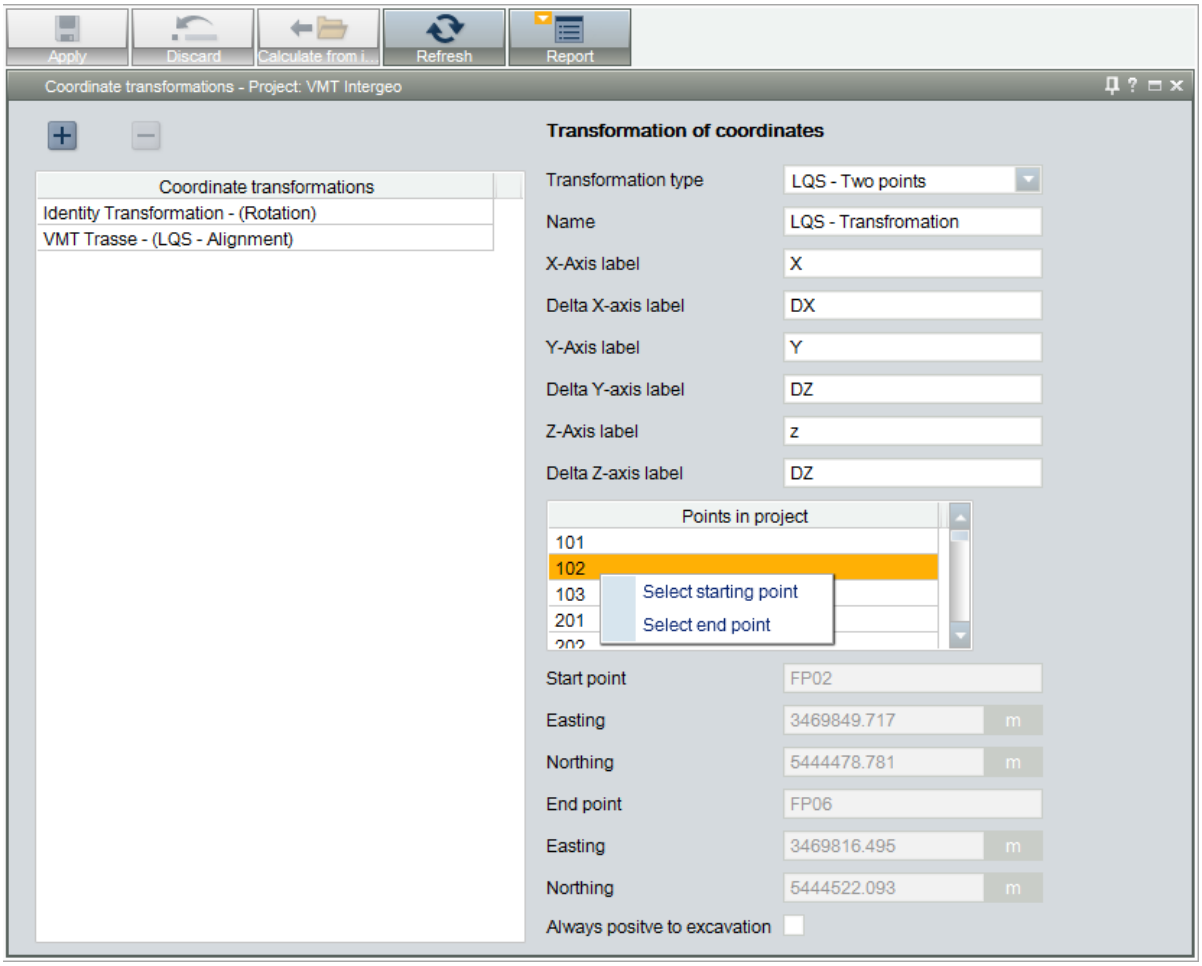
Create transformation of coordinates

Proceed as follows to create a transformation of coordinates:

1. If not already done, open **ADMINISTRATION > TRANSFORMATION OF COORDINATES**.
2. Click on the "Add" symbol.
3. Select the transformation type.
4. Specify a name for the transformation and the axes.
5. Add the required parameters.

LQS – Two Points Transformation

Local transformations of coordinates are used to project the coordinates differences that arise from the respective epochs in relation to the relevant reference epochs to local coordinates axes. The shifts are then calculated longitudinally and transversely to the local coordinate axes.



1. If not already done, open **ADMINISTRATION > TRANSFORMATION OF COORDINATES**.
2. Click on the "Add" symbol.
3. Select **LQS** Two points as transformation type.
4. Name the transformation and the axes.
5. Click on the starting point in the point list and specify it as starting point in the context menu.
6. Click on the end point in the point list and specify it as end point in the context menu.

5 Project Management

Measured values, structured according to sensor types, can be viewed and evaluated in the **PROJECT MANAGEMENT** module group.

> **Important:** Their type must be set correctly in the **ADMINISTRATION > POINT AND LIMIT VALUE MANAGEMENT > SENSOR MANAGEMENT TAB** to display sensor values of external hardware in the relevant modules.

Change time interval for data display

The data of the last 24 hours are always displayed by default when calling modules within the project management. In order to define this time interval individually, each module has a date and time selector.

> **Important:** When you close a project management module, its settings are reset to their initial values.

Notifications when limit values are exceeded

Some modules provide you with the option of sending notification e-mails when limit values are exceeded.

To be able to send notifications:

1. Create e-mail contacts: **ADMINISTRATION > PROJECTS > CONTACT TAB**.
2. Define limit values for each desired channel of the relevant sensor: **ADMINISTRATION > POINT AND LIMIT VALUE MANAGEMENT > SENSOR MANAGEMENT TAB > AREA**: **CHANNE**L
3. Add recipient and limit value in the project management module in the **NOTIFICATION CONFIGURATION** area.

Browser Settings

In each project management module, you can make settings on an extra tab, which are mainly used for displaying the respective measured values in Delta Live**!**.

WGS84 Position

WGS84 coordinates must be added if the sensor field should be marked in a map in the **OVERVIEW** module (see „Overview“ on page 74**)**.

Units and decimal places

Modifications made here to the units and decimal places apply exclusively to the relevant sensor field (if you would like to modify the settings for all sensor fields, you must do this in the System Configuration (see „System Configuration“ on page 18**)**.

*Annotation: The modifications are applicable for this sensor field both in Delta Watch as well as in Delta Live**!**.*

Time and date

Modifications made here to the units and decimal places apply exclusively to the relevant sensor field (if you would like to modify the settings for all sensor fields, you must do this in the System Configuration (see „System Configuration“ on page 18**)**.

*Annotation: The modifications are applicable for this sensor field both in Delta Watch as well as in Delta Live**!**.*

Browser User Visibility

Here you can set which users have access to the sensor field via Delta Live**!**.

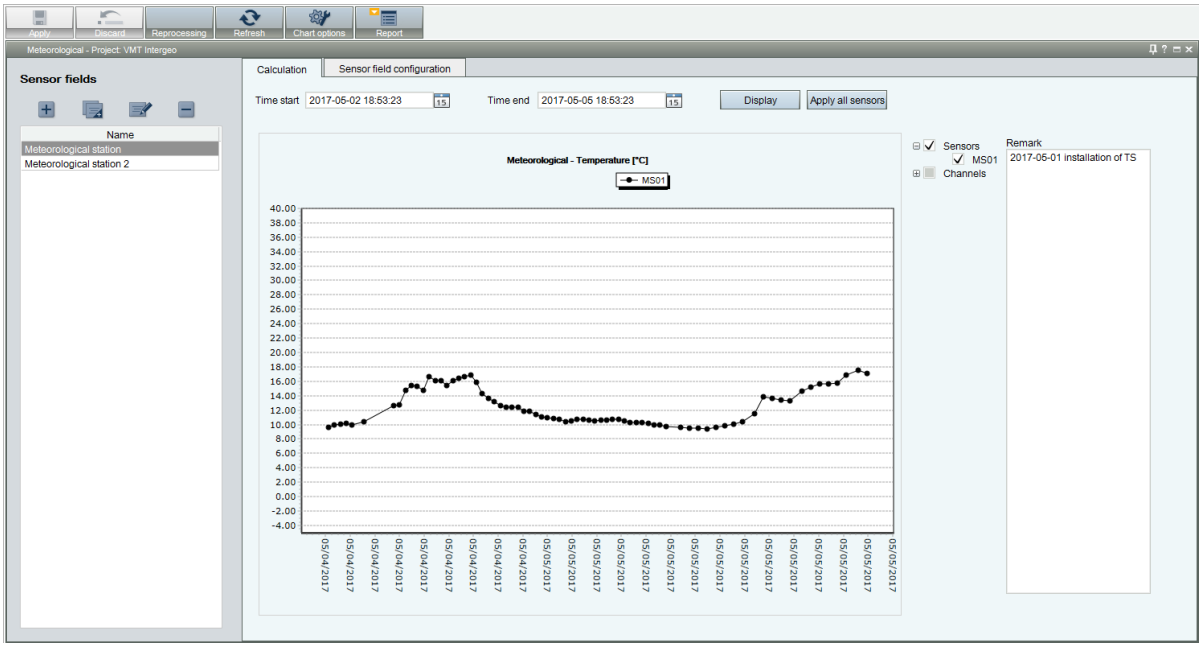
Browser Menu Settings

You can set the submenu to which this sensor field is assigned here.

*Annotation: You can add and change the individual submenus under **ADMINISTRATION > PROJECTS > TAB**: **BROWSER**.*

5.1 Meteorology

In the **METEOROLOGY** module, you can display the data of your meteorological sensors and create reports from them.



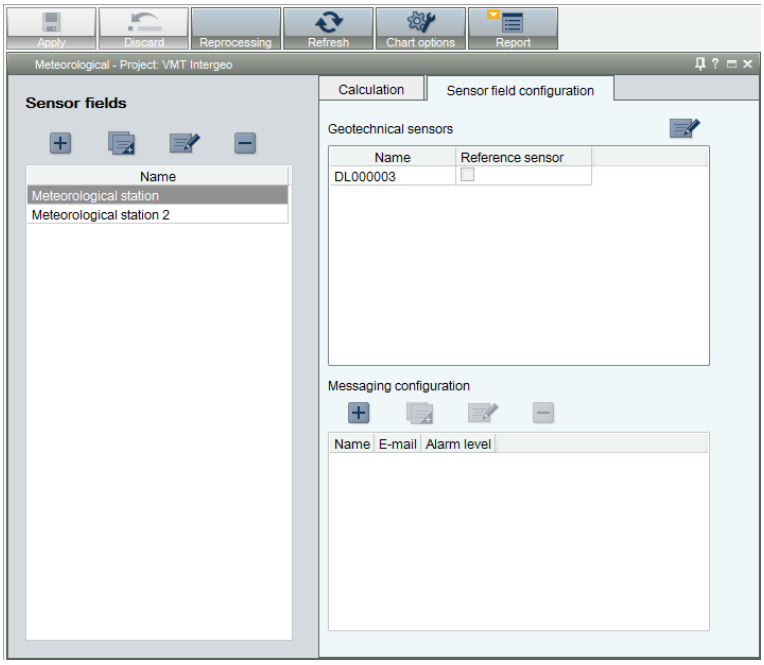
Display meteorological chart

You can display sensor values of a certain period as a chart on the **CALCULATION** tab.

1. If not already done, open **PROJECT MANAGEMENT > METEOROLOGY**.
2. In the **SENSOR FIELDS** area, add a sensor or select one from the list.
3. Define the time period.
4. Select the sensors and channels to be displayed.
5. Click on **SHOW** to create the chart.

Configure meteorological sensor

You can specify which sensors will be used in this module on the **SENSOR FIELD CONFIGURATION** tab.

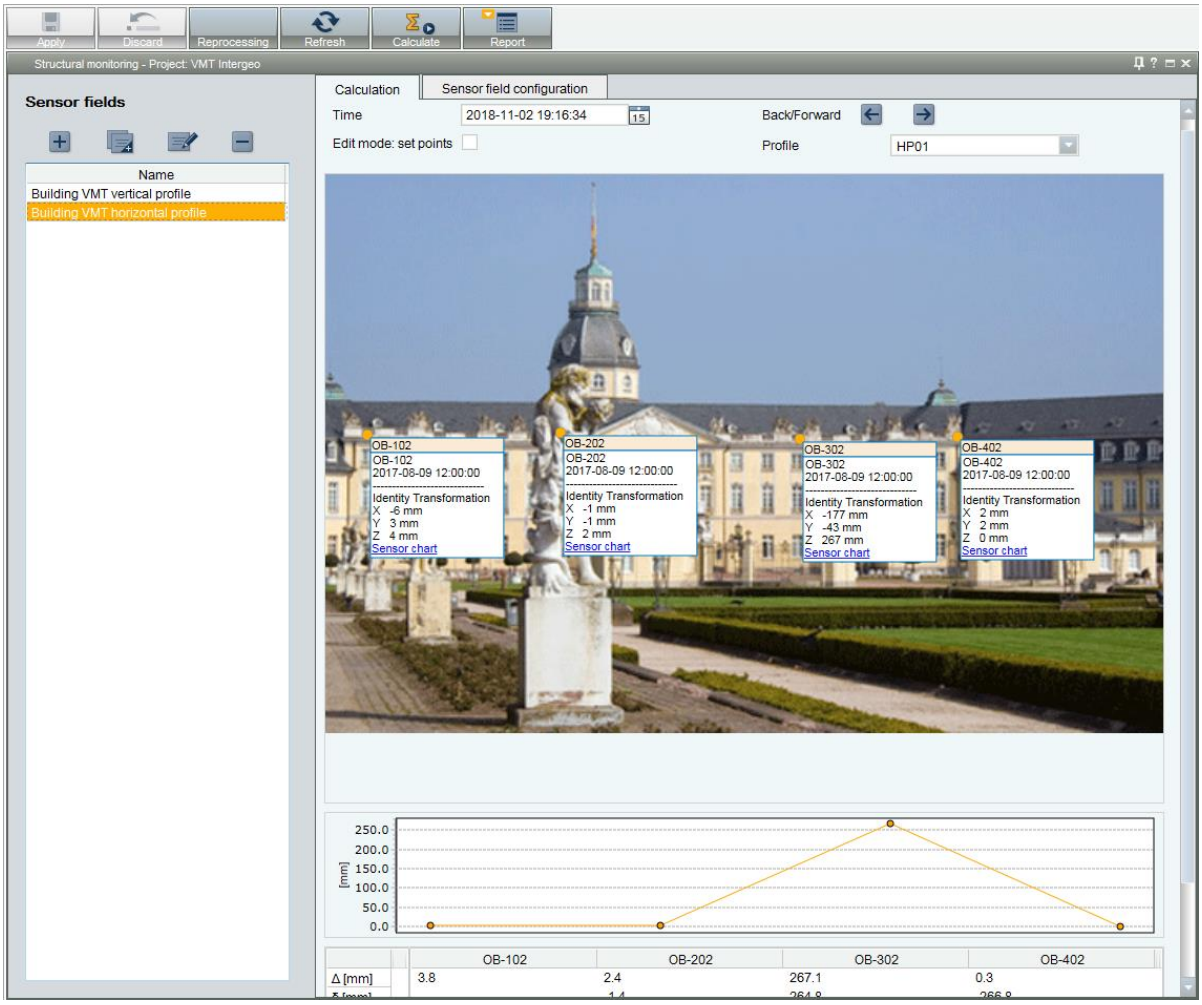


*Annotation: You can set options for the graphical display of a meteorological sensor in the secondary menu under **CHART OPTIONS**.*

5.2 Structural monitoring

The **STRUCTURAL MONITORING** module can be used to evaluate parameters that are relevant for monitoring buildings and structures.

- Measuring points and their values can be displayed at a freely selectable time.
- Measuring points can be displayed in a graph, in a chart or as a table of values.



Set points

You can set the points in the graphic manually. The graphic is only used as a visualisation aid.

Proceed as follows to set and change a point:

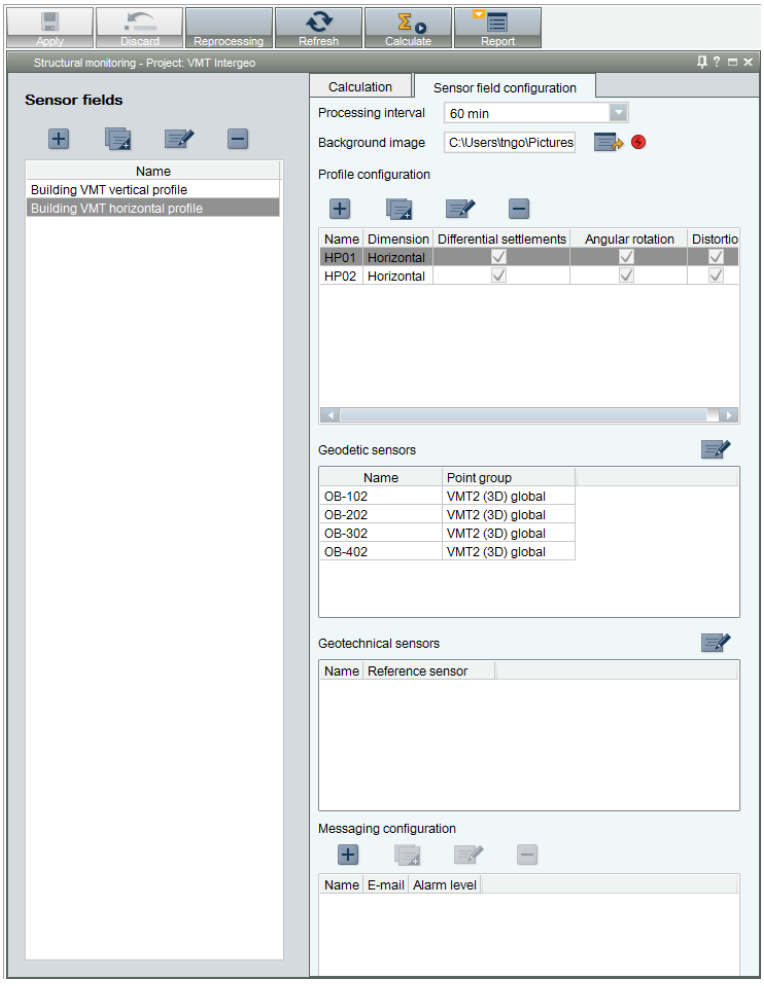
1. Select **EDIT MODE**: **SET POINTS**.
2. Select a point and drag this to the desired position while keeping the left mouse button pressed.

Configure representation

With the preselection of a profile, only the sensors combined there are displayed as graph and table. The background graphic always shows all sensors.

You can specify which sensors will be evaluated at which intervals on the **SENSOR FIELD CONFIGURATION** tab.

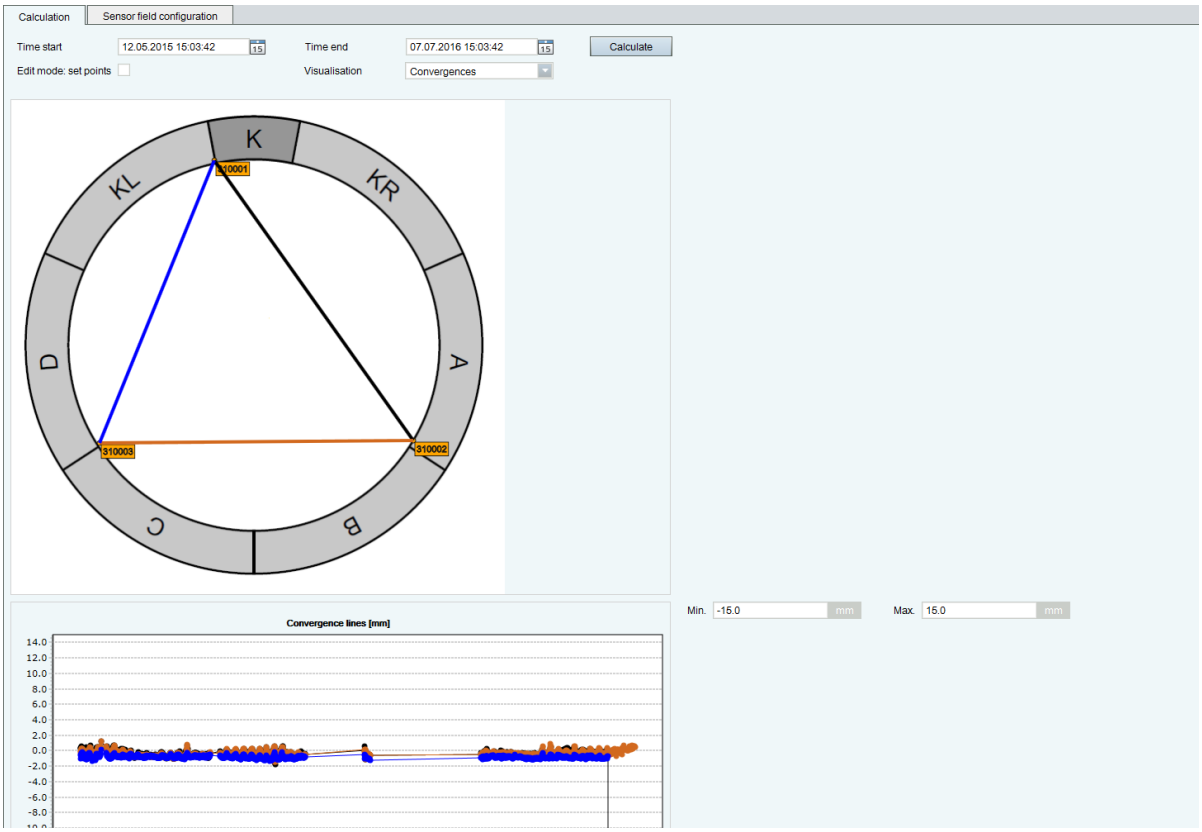
Parameter	Meaning
Processing interval	Interval in which calculations are performed.
Background image	File name and path of the background image.
Profile configuration	Parameters to be calculated (settlement difference, angular rotation and/or distortion).
Geodetic / geotechnical sensors	Available sensors are created in the Point and limit value management module (see„Sensor management“ on page 40.



Convergence Section

The display of the deformation, e.g. of tunnel profiles, can be managed in the **CONVERGENCE SECTION** module. Beyond the representation of absolute movements, drifts between the observed prisms can be defined. Their stretching or contraction can provide information about recent convergence movements.

- The shift in the points can be displayed in absolute terms.
- The change in the convergence lines indicates the shift of defined points relative to each other.
- Furthermore, geotechnical sensors can be displayed (e.g. temperature, air pressure, air humidity**)**.



The measurement results can be visualised as displacement, convergence or as vectors.

- Displacement
  - Vertical displacement
  - Transverse displacement
  - Longitudinal displacement
  - Construction phases
- Convergence measurement
  - Convergence lines

- Construction phases

- Vectors
  - Changes are displayed as direction vectors in the image

Set points

You can set the points in the graphic manually. The graphic is only used as a visualisation aid.

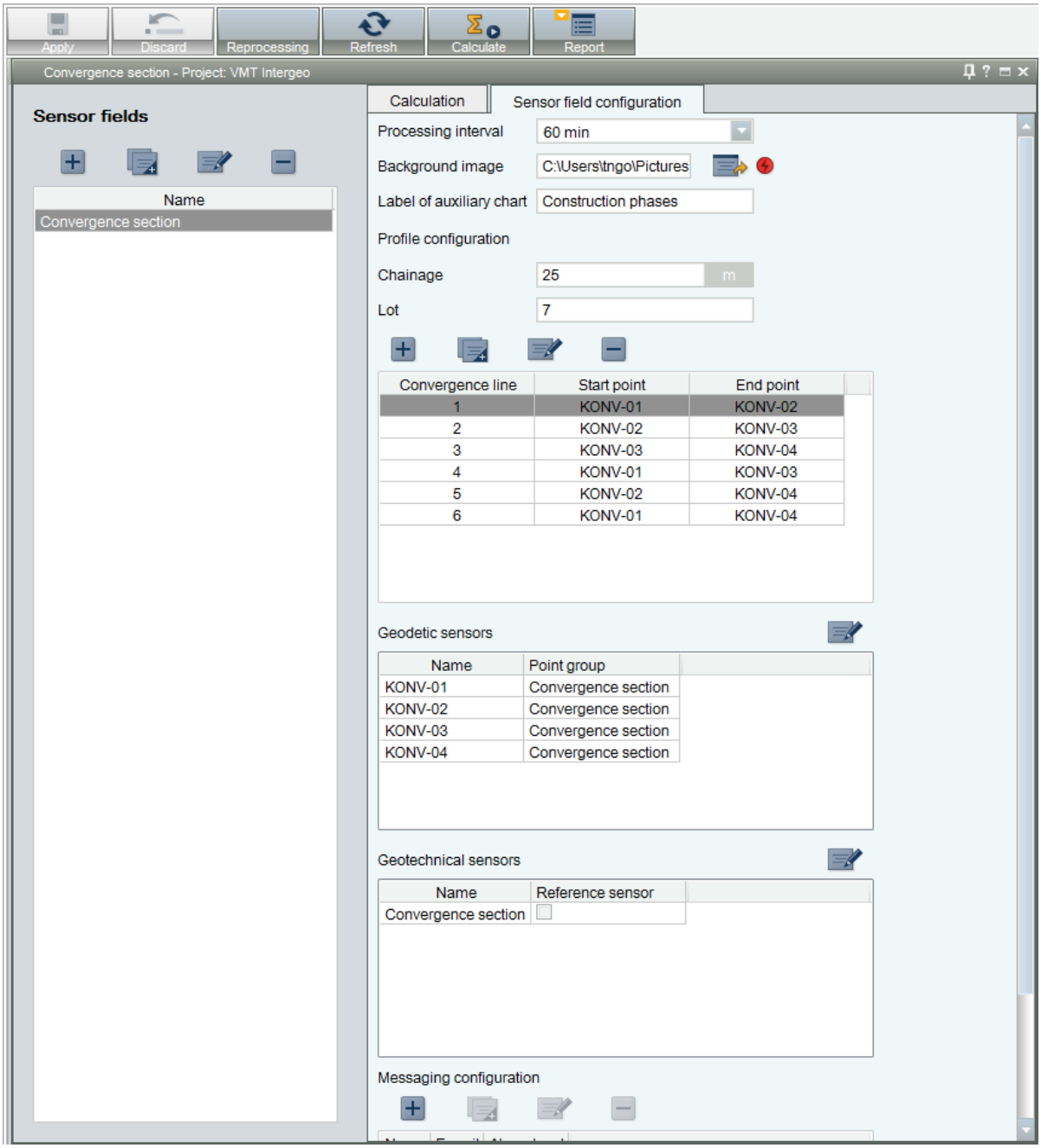
Proceed as follows to set and change a point:

1. Select **EDIT MODE**: **SET POINTS**.
2. Select a point and drag this to the desired position while keeping the left mouse button pressed.

Configure convergence section

You can specify which sensors should be evaluated in the **SENSOR FIELD CONFIGURATION** tab. The convergence lines are defined by their start and end points.

Parameter	Meaning
Processing interval	Specifies how often the calculation should be performed.
Background image	File name of the background image.
Profile configuration	Parameters to be calculated (settlement difference, angular rotation and/or distortion).
Chainage	Metre value from tunnel exit where the calculation is made (as information in the report).
Lot	Tunnel section (as information in the report).
Convergence lines	Specify the convergence lines. Specify the respective start and end points.
Geodetic sensors	You can specify which sensors are displayed here. The available sensors are defined in the Administration > Point and limit management module.
Geotechnical sensors	You can specify which geotechnical sensors are also displayed here.They are displayed below the convergence tables in a "Construction Phase" graphic.


Apply
Discard
Reprocessing
Refresh
Calculate
Report
Convergence section - Project: VMT Intergeo
Sensor fields
Name
Convergence section
Calculation
Sensor field configuration
Processing interval
60 min
Background image
C:\Users\tngo\Pictures
Label of auxiliary chart
Construction phases
Profile configuration
Chainage
25
m
Lot
7
Convergence line
Start point
End point
1
KONV-01
KONV-02
2
KONV-02
KONV-03
3
KONV-03
KONV-04
4
KONV-01
KONV-03
5
KONV-02
KONV-04
6
KONV-01
KONV-04
Geodetic sensors
Name
Point group
KONV-01
Convergence section
KONV-02
Convergence section
KONV-03
Convergence section
KONV-04
Convergence section
Geotechnical sensors
Name
Reference sensor
Convergence section
Messaging configuration

5.3 Rail Track

The rail track monitoring of Delta Watch takes over additional processing of the recorded coordinates in your geodetic network. The following calculations can be performed:

- Determination of the cant between a pair of prisms located on parallel rails of a rail track.
- Short or long twist between successive pairs of prisms (directly or at longer intervals) on the parallel rails of a rail track.
- Short and long settlement difference between two points, measured at different distances. Optionally, the results can be converted into another network.

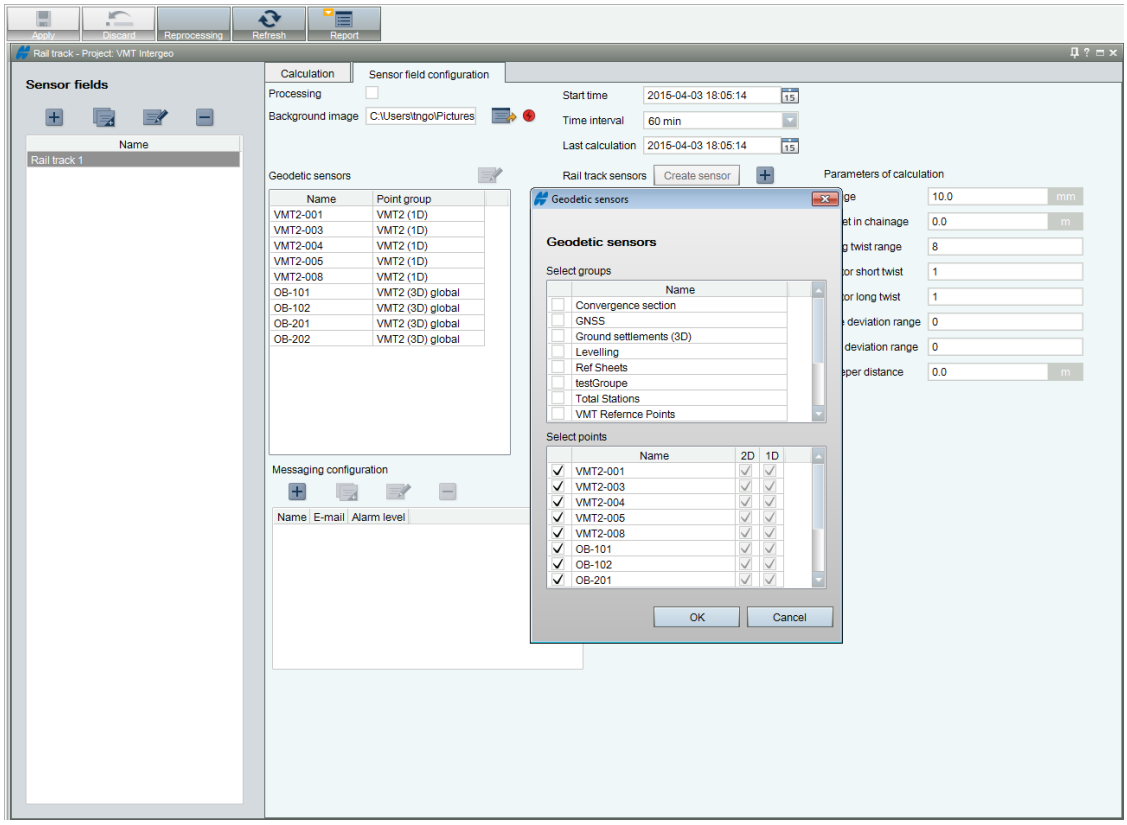
Requirements for the rail track monitoring

- An already configured automatic geodetic network.
- All monitoring points of the alignment are already configured with the final prism elevation offsets.
- Point groups have already been configured and all alignment monitoring points have been assigned.
- Optional: You have defined a map view that shows the local situation (see „System Configuration“ on page 18**)**.

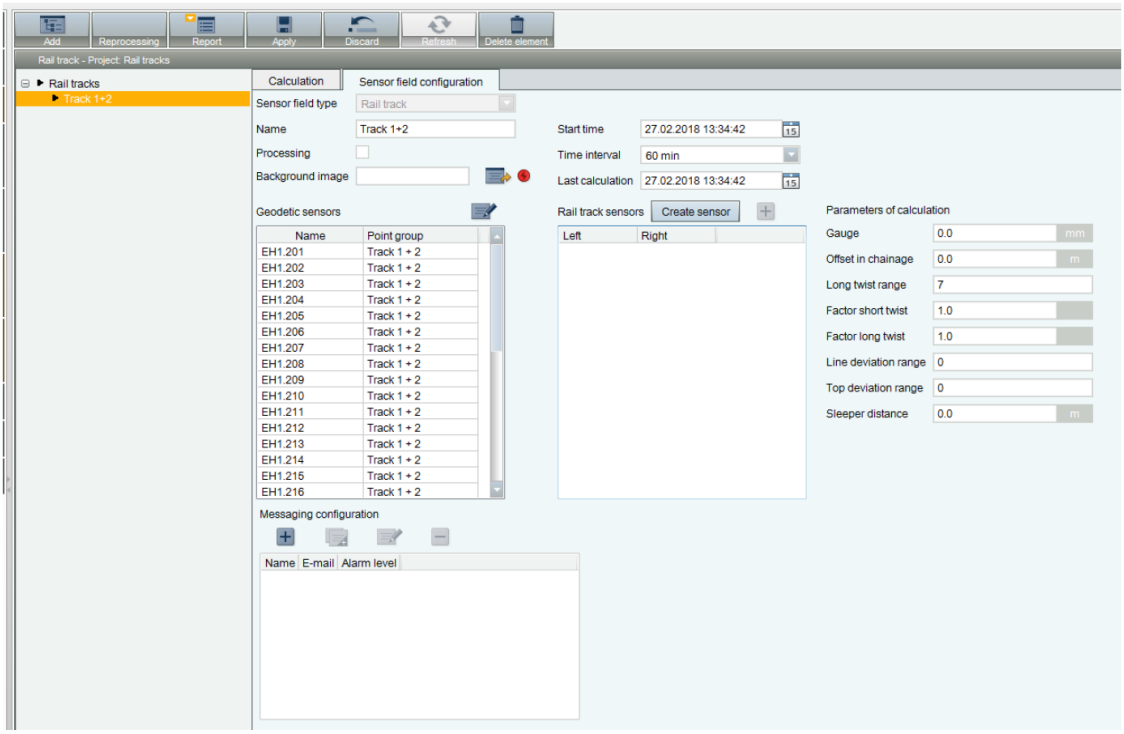
Create rail track sensor

Proceed as follows to create a rail track sensor:

1. If not already done, open **PROJECT MANAGEMENT > RAIL TRACK**.
2. Click on the "Add" button and enter a name for the new sensor field.
3. For the further editing, select the just created sensor field from the list and then change to the **SENSOR FIELD CONFIGURATION** tab.



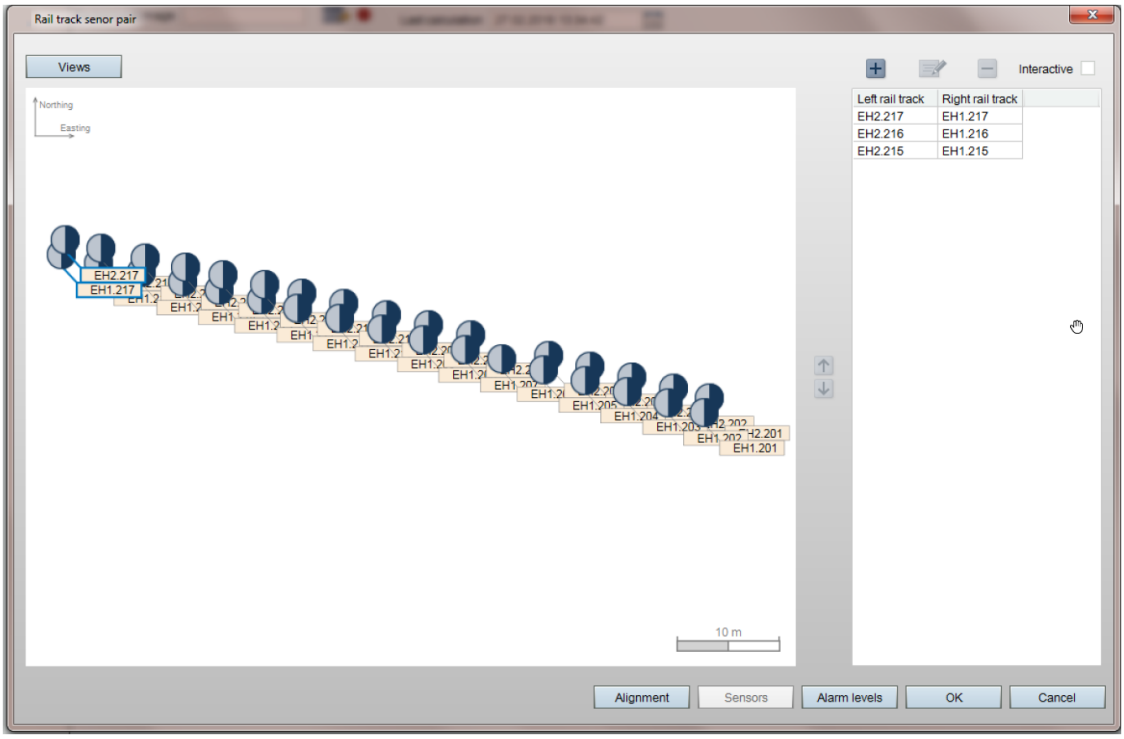
4. Click above the **GEODETIC SENSORS** list field on the "Edit" symbol and make a selection from the point groups and the individual sensors included there.



5. Create virtual sensors by clicking on the **CREATE SENSOR** button above the **RAIL TRACK SENSORS** list field.

You will be informed via a notification window when the creation is completed.

Create point pairs



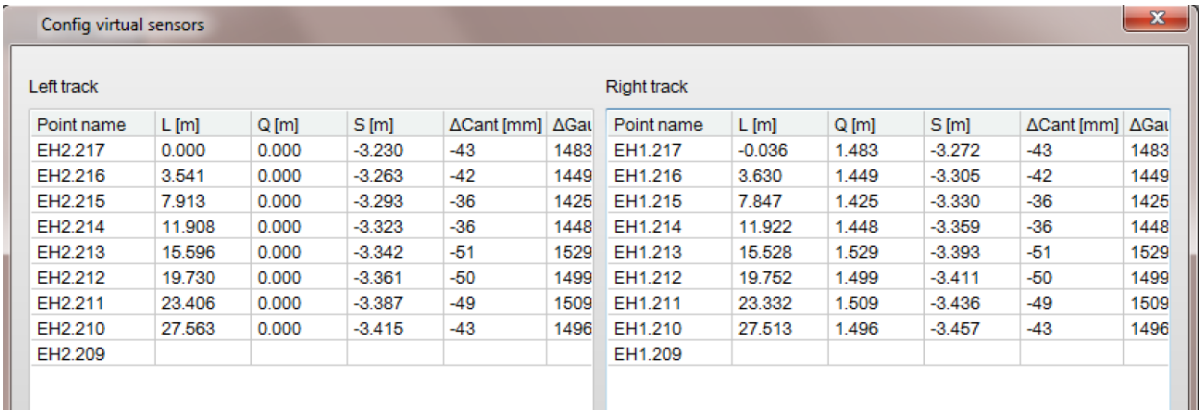
Proceed as follows to create a point pair:

1. Click on the "Add" symbol above the **RAIL TRACK SENSORS** list field.
2. Click on the "Add" symbol in the window that now opens. Select a sensor for the left and right tracks in the list fields.

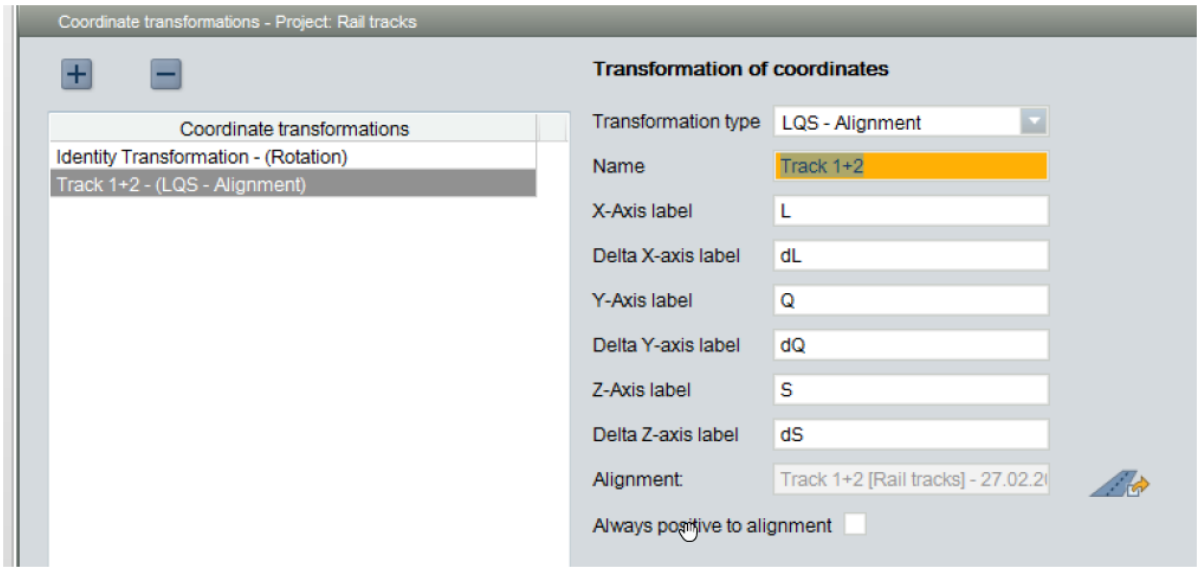
   *Tip: Alternatively to the list field selection, you can also make pairings using the displayed map. To do this, select the **INTERACTIVE** checkbox and then click one after the other on the information fields of the two desired points on the map.*
3. Create a reference system via the **ALIGNMENT** button.

*Annotation: The alignment starts with the first and ends with the last point on the left track. The points on the right track are calculated by the system into the generated reference system. The generated alignment is saved by the system under **ADMINISTRATION > TRANSFORMATION OF COORDINATES** and can be displayed in the map.*

You can check the point definitions via the **SENSORS** button.



Caution: If the sensor field is deleted, the alignment and the transformation of coordinates are also deleted if the alignment is not used in another module.

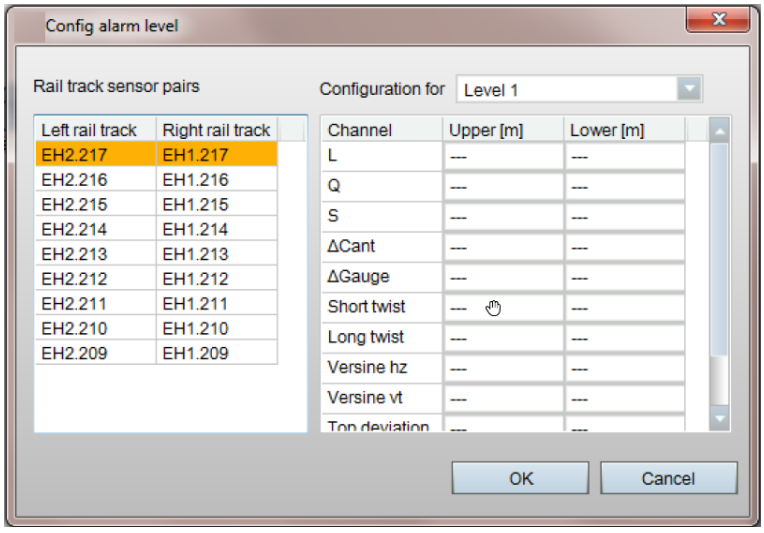


Define limit values

As in other Delta Watch modules, you can define limit values where an alarm is triggered if they are exceeded.

Proceed as follows to create limit values for rail track sensors:

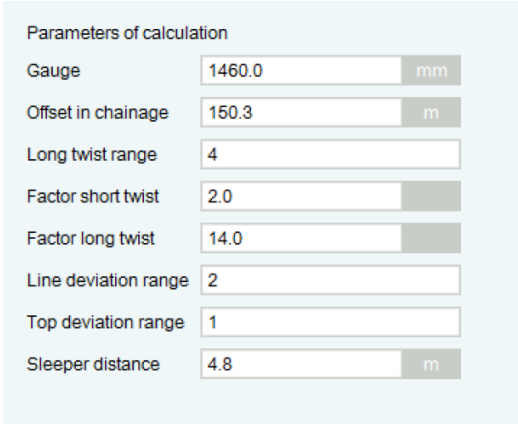
1. If not already done, open **PROJECT MANAGEMENT > RAIL TRACK > TAB**: **SENSOR FIELD CONFIGURATION**.
2. Click on the "Add" symbol above the **RAIL TRACK SENSORS** list field.
3. Click on the **ALARM LEVEL** button in the window that now opens.
4. Enter an upper and lower value for the channels where you want to be notified if they exceed or fall below these limit values.



Tip: To enter alarm values for several sensor pairs at the same time, select the desired entries in the list with a mouse click while pressing and holding the CTRL key.

Configure calculation parameters

In order to complete the configuration for the track geometry, the calculation parameters in the **SENSOR FIELD CONFIGURATION** tab must be adjusted.



Parameter	Meaning
Gauge	Distance between the left and right deviation.
Offset in chainage	All calculations are made on the local reference system. An offset can be entered here if a special chainage point is required for a transformation.
Long twist range	The number of prisms that are taken into account for the calculation of the long twist range. Short twists are always calculated between adjacent prisms.
Factor short / long twist	The twist is calculated as the difference (in cant) between pairs of prisms. The factor allows the calculation over a longer distance.

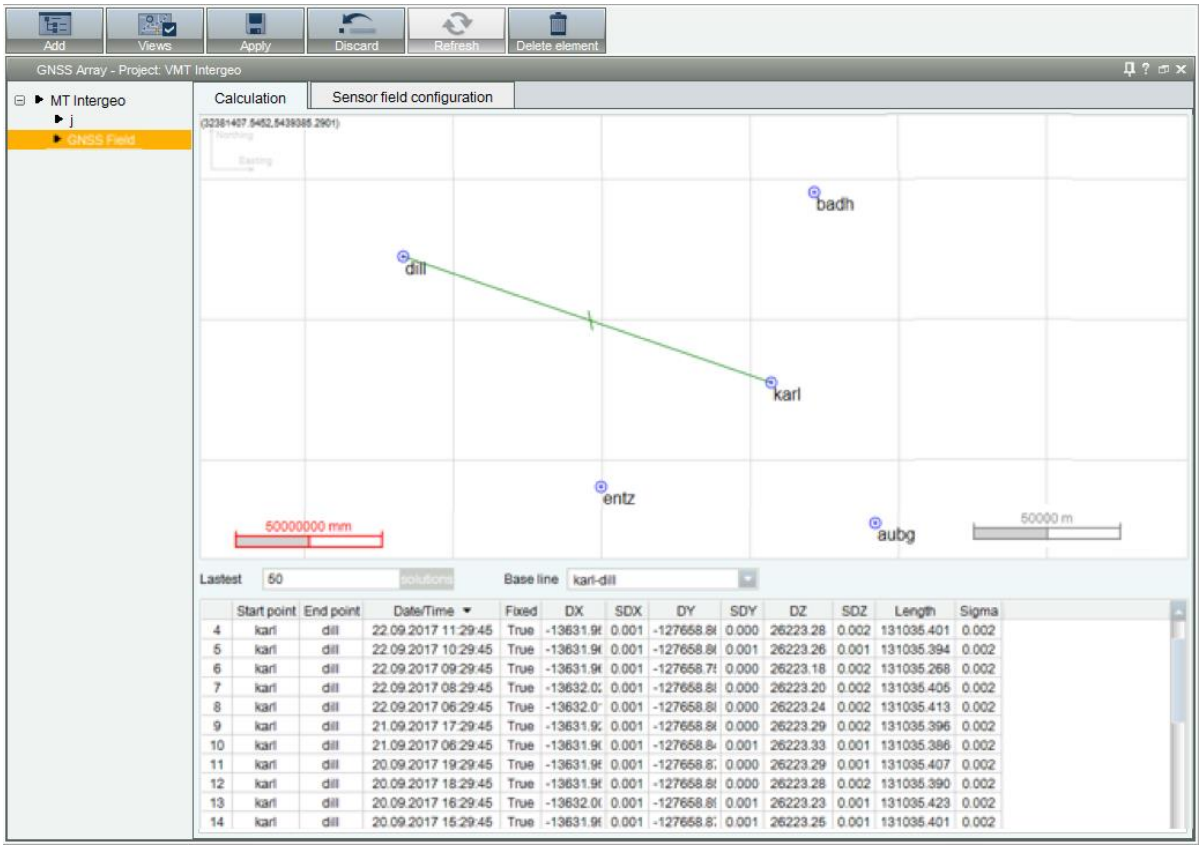
Parameter	Meaning
Short / long settlement difference range	The settlement difference range is calculated as an adjustment between prisms on the same track. This parameter specifies which prisms are taken into account.Example: "1" takes the next prism on the alignment. "2" skips the next prism.
Sleeper distance	Only used for information in the report.

5.4 GNSS Array

In the GNSS **ARRAY** module you can calculate baselines with GNSS sensors, which can be used in the adjustment calculation in the Networks module (see „Networks“ on page 42**)**.

GNSS Array Calculation

You can view the sensors in the map and the last baseline components in the **CALCULATION** tab.



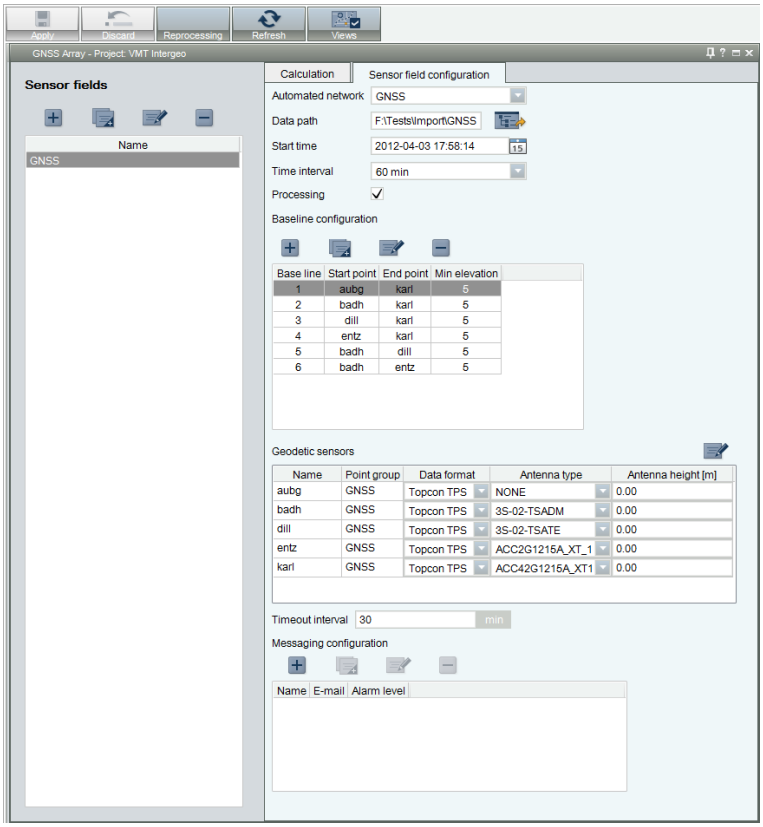
Move the mouse cursor over the map to change the scale of the displayed map. Use the mouse wheel to enlarge or reduce the section. Further options are available via the context menu.

To view a baseline in detail, select the baseline from the **BASELINE** drop-down list. The baseline is made visible in the map by a green line and the calculated values of the baseline are displayed in the table.

The base lines configured here can be used for adjustment of the geodetic network.

Configure GNSS module

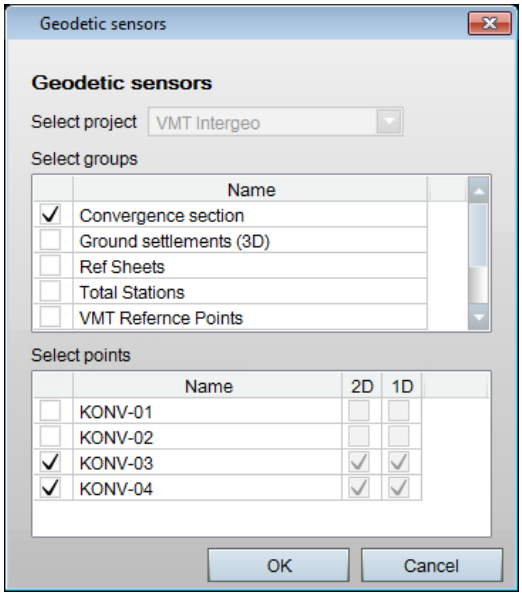
You can specify which sensors will be evaluated in the **SENSOR FIELD CONFIGURATION** tab.



Geodetic sensors

Proceed as follows to add geodetic sensors:

1. Click on the "Edit" symbol in the **GEODETIC SENSORS** area.
2. The lists of groups and points are displayed.



3. Select the groups and points that you want to take over.
4. Specify the data for the sensors in the list:

Parameter	Meaning
Data format	The GNSS sensors log the raw data and send them in **RINEX**[6] format to a local directory or network directory for further processing. You must specify for each sensor whether **RINEX2** or **RINEX3** is used.
Antenna type	The antenna type must be assigned to each sensor. Calibration data are available for the different antenna types, which are defined in the Hardware > GNSS Antenna module.
Antenna height	The zero point of the GNSS antenna (Antenna Reference Point) is at the base of the antenna. If the antenna should be positioned higher than the measuring point (e.g. because the base is shadowed**),** a height can be entered.

Specify baselines

You must specify the baselines that should be included for the evaluation.

The absolute accuracy of GNSS sensors is relatively imprecise (about 1 m). The relative accuracy (difference between two sensors) is only a few mm if the sensors are close together (< 100 m). High accuracy for the measurement of fixed points to measuring points can be achieved in this way. You must define the vectors for this that will be evaluated for the measurement.

Proceed as follows to specify baselines:

1. Click on the "Add" symbol in the BASELINE CONFIGURATION section.
2. Fill in the fields.

Parameter	Meaning
Starting point	Starting point of the baseline
End point	End point of the baseline
Min. Elevation	Specify a minimum elevation angle. Satellite signals from higher elevation angles travel a shorter path through the atmosphere and can therefore be considered as more accurate. Therefore, signals from elevations not smaller than 10° - 15° are generally used for the horizontal components of the coordinates. However, with regard to the vertical components, higher elevation angles reduce the quality of the signal incidence configuration for point determination. The accuracy of the elevations determined by GNSS is therefore generally assumed to be 2 - 3 times worse than that of the horizontal components. In individual cases it can therefore be desirable to reduce the elevation filter to up to 5°. The accuracy is greater for a large angle.

The baseline is shown in the table.

[6]The Receiver Independent Exchange Format (RINEX) is a receiver-independent data storage and exchange format. It is used for GPS or nowadays general GNSS raw data, in particular for pseudorange measurements from code or carrier phase observations and satellite ephemeris. The provision of these data allows a subsequent re-evaluation, usually to determine position solutions of higher accuracy.

5.5 Overview

You can create individual views with the **OVERVIEW** module. Background images for Delta Live! are linked with different sensors.

Set points

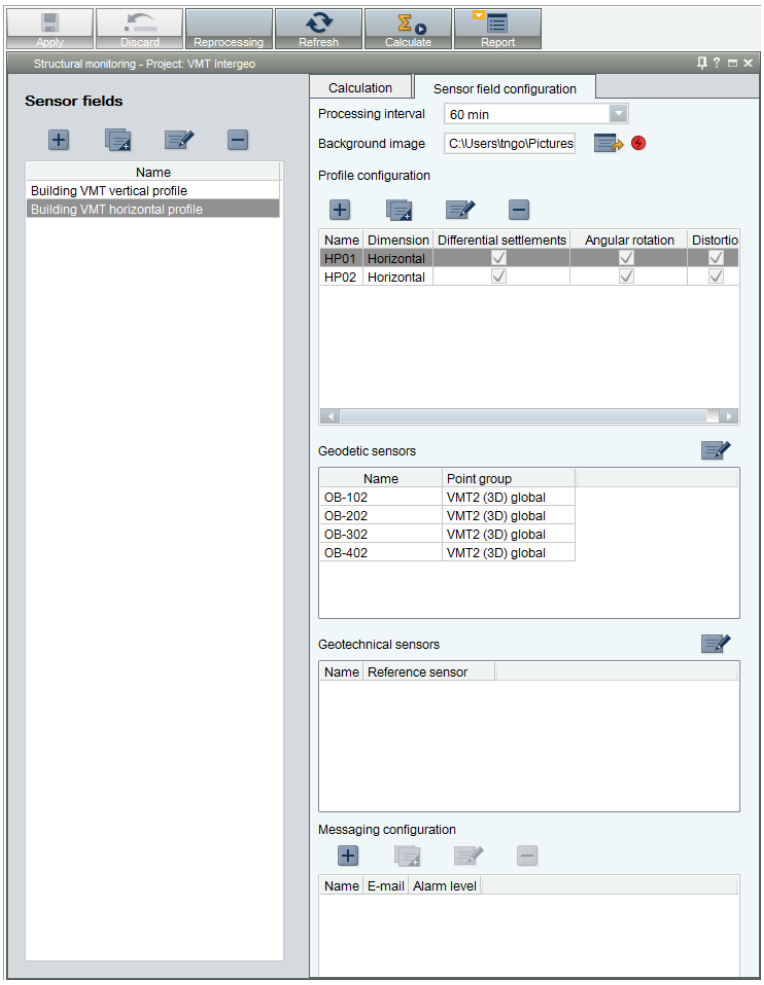
You can manually set and move the points in the graphic:

1. Select **EDIT MODE**: **SET POINTS**.
2. Select a sensor and drag this to the desired position while keeping the left mouse button pressed.

Configure representation

You can define which geodetic and geotechnical sensors and which sensor fields should be linked to the background image on the **SENSOR FIELD CONFIGURATION** tab.

Parameter	Meaning
Background image	File name of the background image.
Geodetic / geotechnical sensors	Available sensors are created in the Point and limit value management module in the „Sensor management“ on page 40.
Sensor Fields	You can select all configurable fields here.

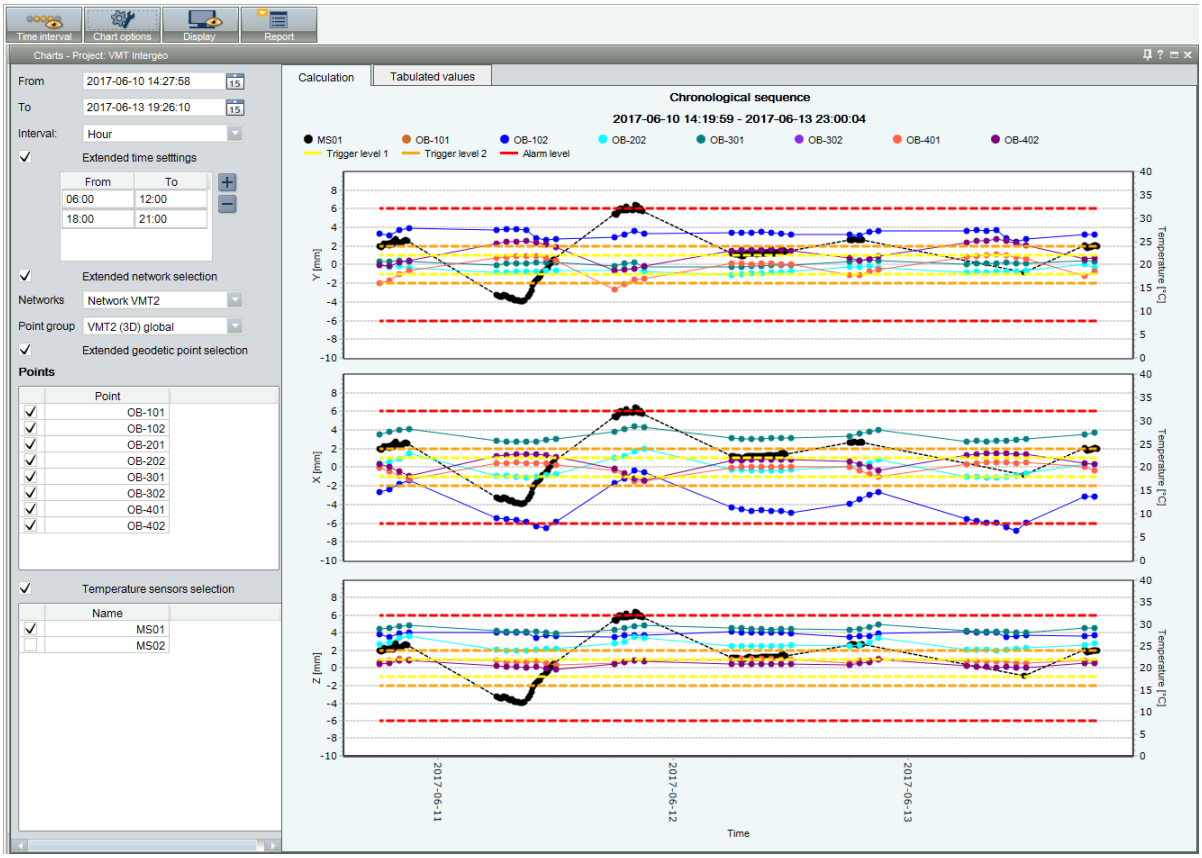

Apply
Discard
Reprocessing
Refresh
Calculate
Report
Structural monitoring - Project: VMT Intergeo
Sensor fields
Name
Building VMT vertical profile
Building VMT horizontal profile
Calculation
Sensor field configuration
Processing interval
60 min
Background image
C:\Users\tngo\Pictures
Profile configuration
Name
Dimension
Differential settlements
Angular rotation
Distortio
HP01
Horizontal
HP02
Horizontal
Geodetic sensors
Name
Point group
OB-102
VMT2 (3D) global
OB-202
VMT2 (3D) global
OB-302
VMT2 (3D) global
OB-402
VMT2 (3D) global
Geotechnical sensors
Name
Reference sensor
Messaging configuration
Name
E-mail
Alarm level

6 Analysis

6.1 Charts

The measurement results can be displayed graphically in the **CHARTS** module. Geodetic and meteorological sensors are used.

- The data of the last 24 hours are always displayed when the module is called up.
- The period to be displayed is freely adjustable.
- In addition to the chart display, the values can also be displayed in a table.



Configure charts

> **Important:** Changes made must always be confirmed with the SHOW button for them to be displayed.

Global chart settings can be made in the secondary menu using the **CHART SETTINGS** button:

Parameter	Meaning
Min/Max	Defines the minimum and maximum values for axes and temperature sensor.
Limits	You can specify whether the trigger level and alarm level are displayed in the chart as a line (limit values**).**

Parameter	Meaning
View	Display symbols for measured values: The measuring point is shown as a symbol (otherwise only the line is shown**)**. Automatic chart update: If this option is selected, the point values (for the opened module) are constantly updated with new measured values. Use external names: Use of the external name defined in Points (see „Points“ on page 30**).**

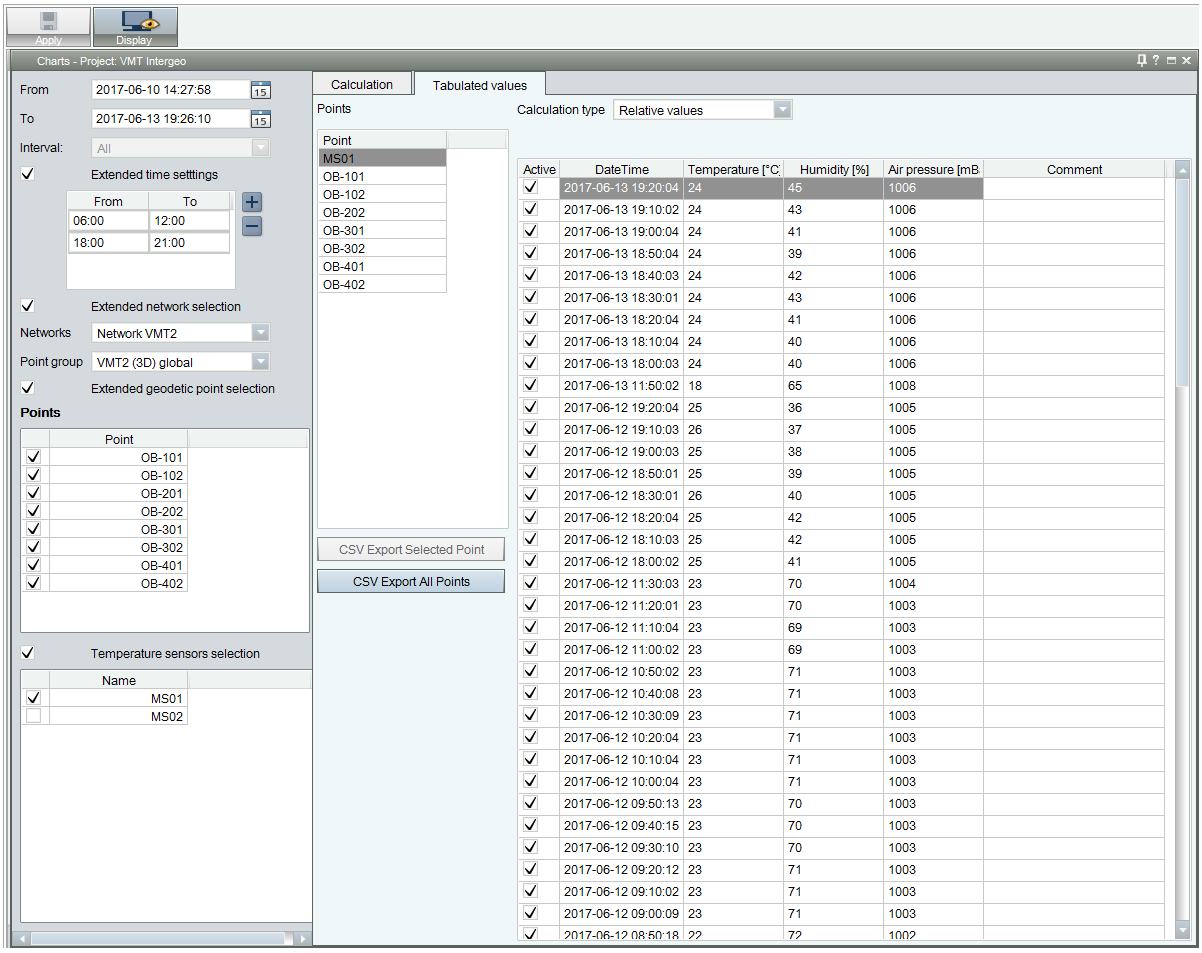
You make detailed settings for the current chart on the **CALCULATION** tab.

Parameter	Meaning
From... To ...	Specifies the time period to display in the chart and table.
Interval	Groups data in specified time units, e.g. days or weeks.
Advanced time settings	By specifying one or more From **...** To time pairs, you can restrict the display to the time intervals included in each case.
Advanced network selection	Only shows the point data that have also been measured in the networks.
Point group	The specification of a point group is required so that a chart can be drawn. Depending on which dimension is assigned to a point group (see „Point groups“ on page 35**),** 3 charts or only one chart will be drawn.
Advanced geodetic point selection	Specifies which points will be displayed. All points will be displayed if no marker is set. You can restrict the display by deselecting points in the Points list.
Temperature sensor selection	You can select a temperature sensor, which is displayed as an additional line in the chart and with its values in the table.In addition, a scale for the temperature is displayed to the right of the chart.

Show tabulated values

The measured values are displayed numerically on the **TABULATED VALUES** tab.

- The display is only available for **INTERVAL**: **ALL**. When you change to the **TABULATED VALUES** tab, the system automatically changes to the full view and displays a corresponding message.
- Values can be displayed as absolute or relative values using the **CALCULATION TYPE** field.


Apply
Display
Charts - Project: VMT Intergeo
From 2017-06-10 14:27:58
To 2017-06-13 19:26:10
Interval: All
Extended time setttings
From To
06:00 12:00
18:00 21:00
Extended network selection
Networks Network VMT2
Point group VMT2 (3D) global
Extended geodetic point selection
Points
Point
OB-101
OB-102
OB-201
OB-202
OB-301
OB-302
OB-401
OB-402
Temperature sensors selection
Name
MS01
MS02
Calculation
Tabulated values
Points
Point
MS01
OB-101
OB-102
OB-202
OB-301
OB-302
OB-401
OB-402
CSV Export Selected Point
CSV Export All Points
Calculation type Relative values
Active DateTime Temperature [°C Humidity [%] Air pressure [mB Comment
2017-06-13 19:20:04 24 45 1006
2017-06-13 19:10:02 24 43 1006
2017-06-13 19:00:04 24 41 1006
2017-06-13 18:50:04 24 39 1006
2017-06-13 18:40:03 24 42 1006
2017-06-13 18:30:01 24 43 1006
2017-06-13 18:20:04 24 41 1006
2017-06-13 18:10:04 24 40 1006
2017-06-13 18:00:03 24 40 1006
2017-06-13 11:50:02 18 65 1008
2017-06-12 19:20:04 25 36 1005
2017-06-12 19:10:03 26 37 1005
2017-06-12 19:00:03 25 38 1005
2017-06-12 18:50:01 25 39 1005
2017-06-12 18:30:01 26 40 1005
2017-06-12 18:20:04 25 42 1005
2017-06-12 18:10:03 25 42 1005
2017-06-12 18:00:02 25 41 1005
2017-06-12 11:30:03 23 70 1004
2017-06-12 11:20:01 23 70 1003
2017-06-12 11:10:04 23 69 1003
2017-06-12 11:00:02 23 69 1003
2017-06-12 10:50:02 23 71 1003
2017-06-12 10:40:08 23 71 1003
2017-06-12 10:30:09 23 71 1003
2017-06-12 10:20:04 23 71 1003
2017-06-12 10:10:04 23 71 1003
2017-06-12 10:00:04 23 71 1003
2017-06-12 09:50:13 23 70 1003
2017-06-12 09:40:15 23 70 1003
2017-06-12 09:30:10 23 70 1003
2017-06-12 09:20:12 23 71 1003
2017-06-12 09:10:02 23 71 1003
2017-06-12 09:00:09 23 71 1003
2017-06-12 08:50:18 22 72 1002

6.2 Reports

Use reports to document your work in a tamper-proof manner and to be able to provide your customers with information at any time. Reports can be output to the printer or as a **PDF** file for cross-platform distribution.

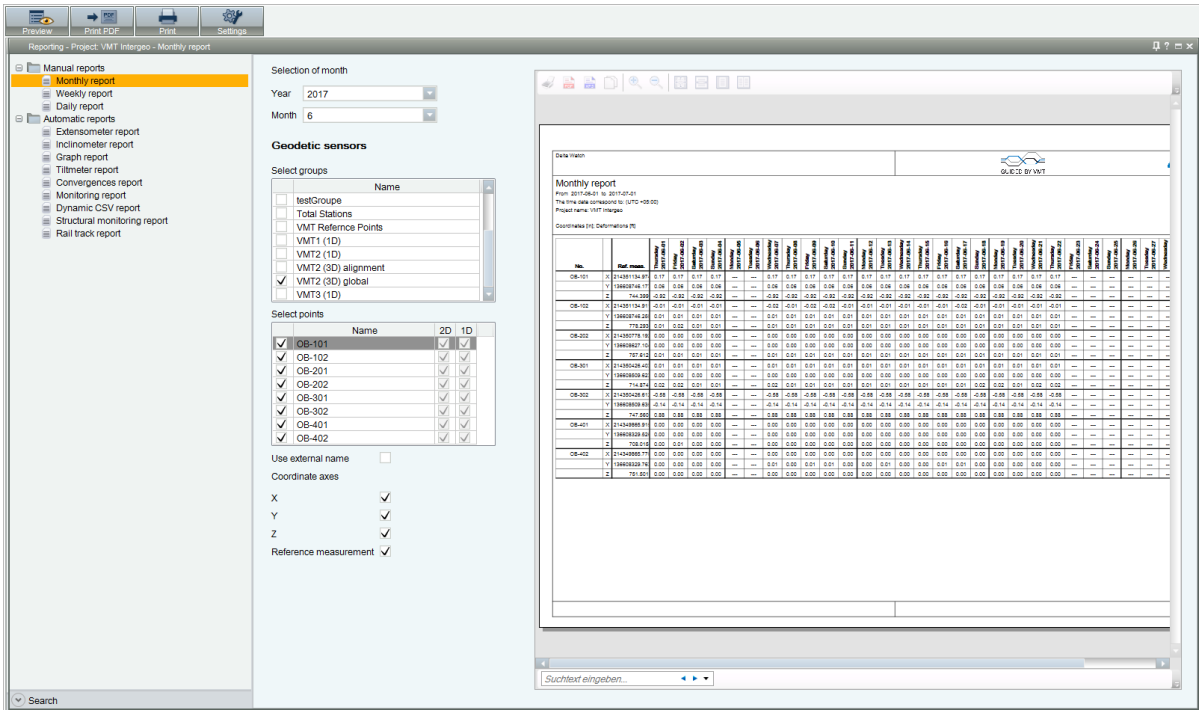
Specify number of decimal places

You can set the units and number of decimal places globally for the various report types using **SETTINGS** in the secondary navigation.

Configure manual reports

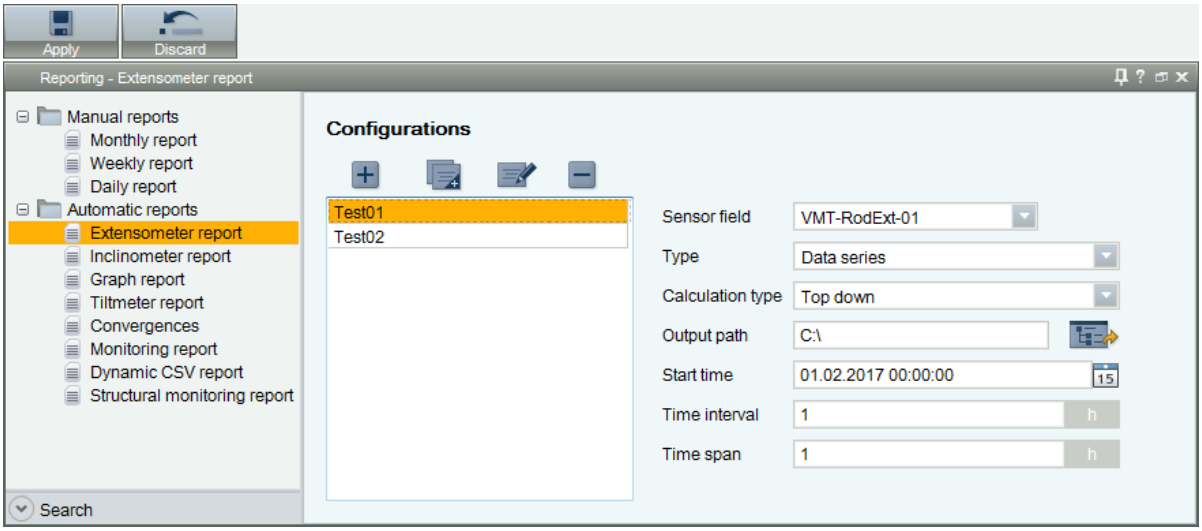
Create manual reports for evaluations of any points over fixed periods of time:

- Month
- Week
- Day



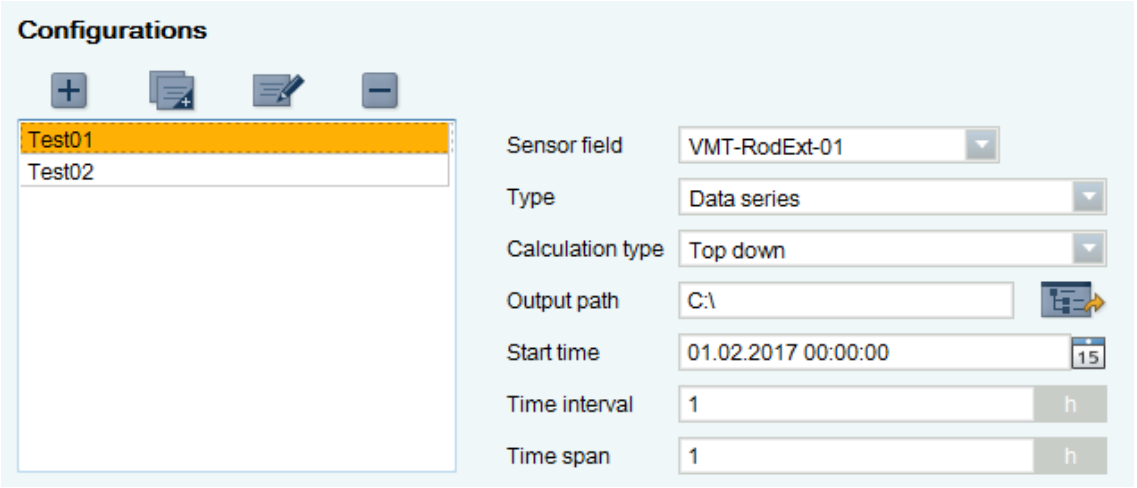
Configure automatic reports

Automatic reports are created as **PDF** files at regular intervals after a one-time configuration of Delta Watch and are stored locally or on a network drive.



Proceed as follows to create an automatic report:

1. Select the required report type.
2. Click on the "Add" symbol.
3. Enter a name for the report and its parameters.

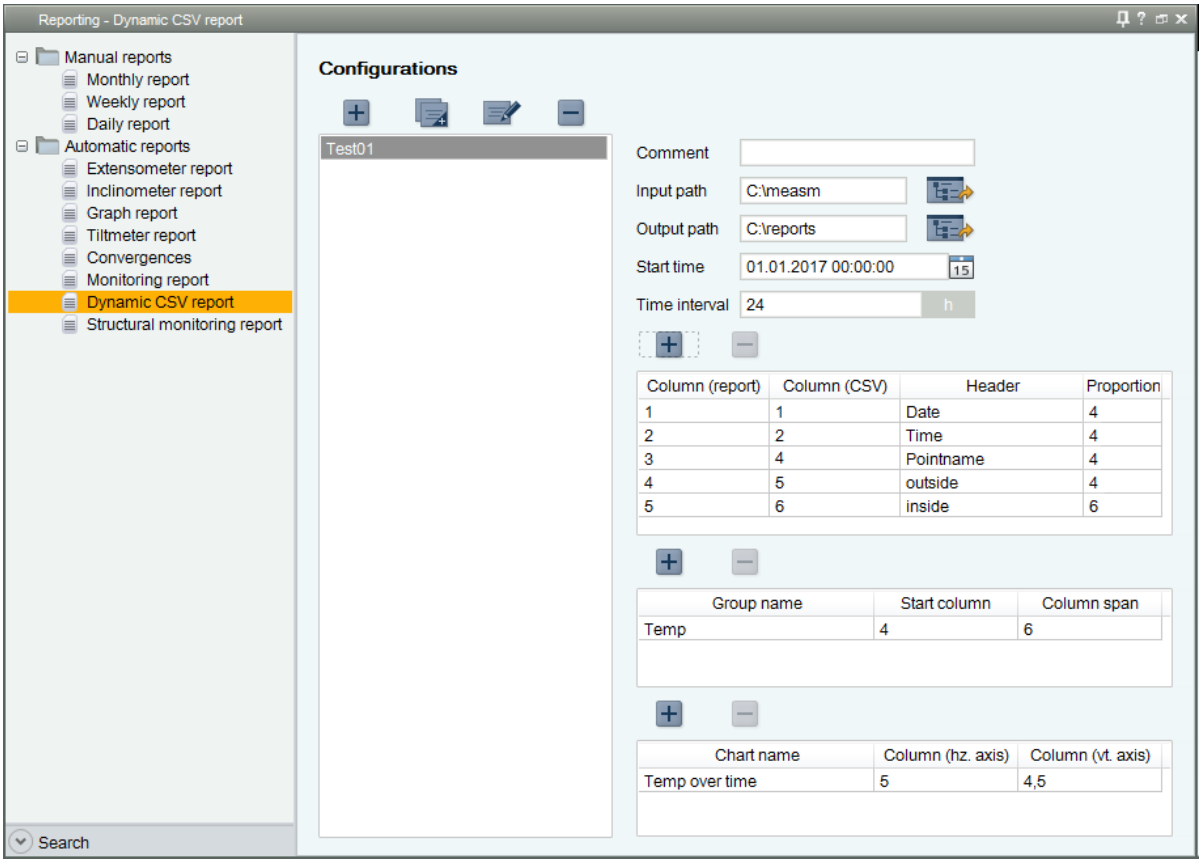


Parameter	Meaning
Sensor field, Type and Calculation type	The possible values depend on the selection of the sensor.
Output path	Location at which the PDF file is saved.
Start time	The time at which the system starts creating the reports.
Time interval	Time period, after which the next report is created.
Time span	Time period covered by the report.

Use data from external sources for reports

The report types described above use data stored in the Delta Watch database. Using the report type **DYNAMIC CSV REPORT**, reports can also be created from external data.

> **Important:** The data to be read in must be provided as comma separated values (CSV file) at a location in your network.



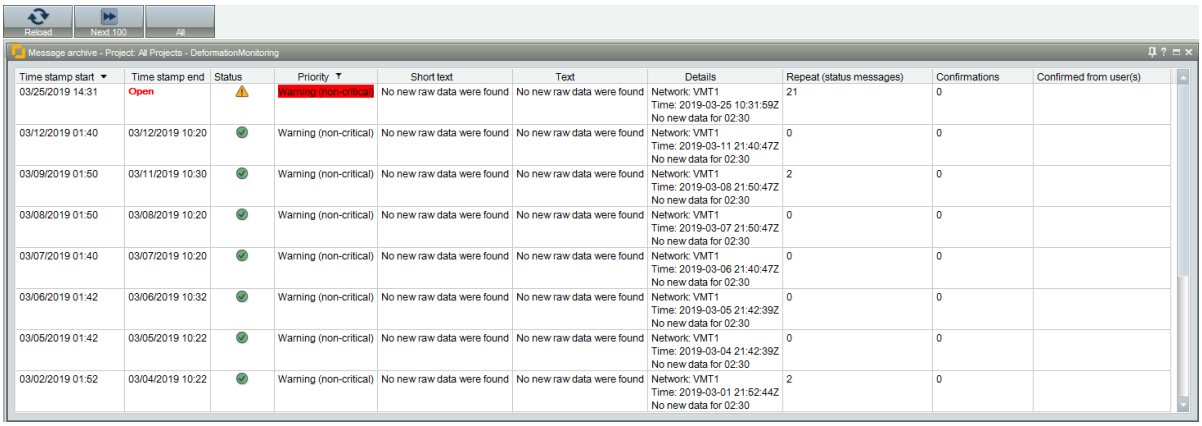
Proceed as follows to create a dynamic **CSV** report:

1. Select **DYNAMIC CSV REPORT** in the list and enter the general parameters on the right.
2. In the columns section, allocate the columns of the **CSV** file to the report columns. To do this, use the numeric position of each column.
3. In the group section, you can combine columns under one designation. To do this, enter the numeric position of the start column and the number of columns to be included.
4. The chart section enables you to draw a chart using column values. To do this, allocate the numeric position to the horizontal or vertical axis of the chart.

6.3 Message Archive

Delta Watch outputs messages for errors or warnings and stores these in the message archive.

- The messages are shown in a table, starting with the most recent entry.
- The most recent 100 messages are shown the first time the list is called up. A scroll symbol is shown in the secondary navigation if more than 100 messages exist.



Time stamp start	Time stamp end	Status	Priority	Short text	Text	Details	Repeat (status messages)	Confirmations	Confirmed from user(s)
03/25/2019 14:31	Open		Warning (non-critical)	No new raw data were found	No new raw data were found	Network: VMT1 Time: 2019-03-25 10:31:59Z No new data for 02:30	21	0	
03/12/2019 01:40	03/12/2019 10:20		Warning (non-critical)	No new raw data were found	No new raw data were found	Network: VMT1 Time: 2019-03-11 21:40:47Z No new data for 02:30	0	0	
03/09/2019 01:50	03/11/2019 10:30		Warning (non-critical)	No new raw data were found	No new raw data were found	Network: VMT1 Time: 2019-03-08 21:50:47Z No new data for 02:30	2	0	
03/08/2019 01:50	03/08/2019 10:20		Warning (non-critical)	No new raw data were found	No new raw data were found	Network: VMT1 Time: 2019-03-07 21:50:47Z No new data for 02:30	0	0	
03/07/2019 01:40	03/07/2019 10:20		Warning (non-critical)	No new raw data were found	No new raw data were found	Network: VMT1 Time: 2019-03-06 21:40:47Z No new data for 02:30	0	0	
03/06/2019 01:42	03/06/2019 10:32		Warning (non-critical)	No new raw data were found	No new raw data were found	Network: VMT1 Time: 2019-03-05 21:42:39Z No new data for 02:30	0	0	
03/05/2019 01:42	03/05/2019 10:22		Warning (non-critical)	No new raw data were found	No new raw data were found	Network: VMT1 Time: 2019-03-04 21:42:39Z No new data for 02:30	0	0	
03/02/2019 01:52	03/04/2019 10:22		Warning (non-critical)	No new raw data were found	No new raw data were found	Network: VMT1 Time: 2019-03-01 21:52:44Z No new data for 02:30	2	0	

Use message archive

The messages are sorted chronologically by default.
Currently pending messages, i.e. without a terminating time stamp, are displayed at the top of the table with an empty time stamp end and their current status. This gives you an immediate overview of whether or not there is a need for action.

- Click on a column header to sort the list in ascending order of the column contents.
- Click again on the same column header to sort in descending order.
- By default, a filter is set in the **PRIORITY** column that sorts the messages by their priority. You can set additional filters as required in order to create user-specific views. To do this, click with the right mouse button in the column header for which you would like to set a filter and then enter the filter parameters.

7 Interfaces

You can transfer data to external systems using the interface functionalities of Delta Watch. You can use **CSV** exports or the **RESTful API** with direct database communication for this.

The connection to Delta Live! is also configured here.

7.1 Import and Export

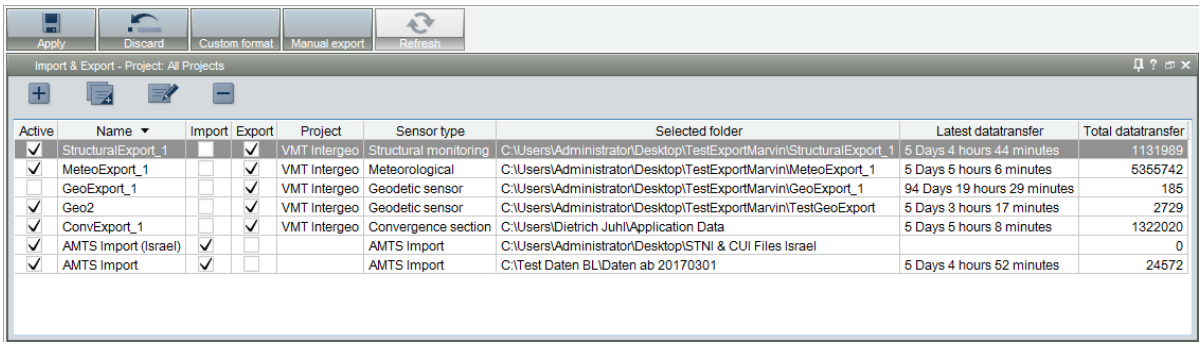
All imports and exports can be defined centrally in the **IMPORT & EXPORT** module. You see in the overview how long ago the last data transfer was and how many data transfers in total have been performed.

Import

- Sensors and data loggers (e.g. Delta Link) store the data as a file at a specified location on the device or in the construction site network.
- Imports read this file into the database at specified intervals.

Export

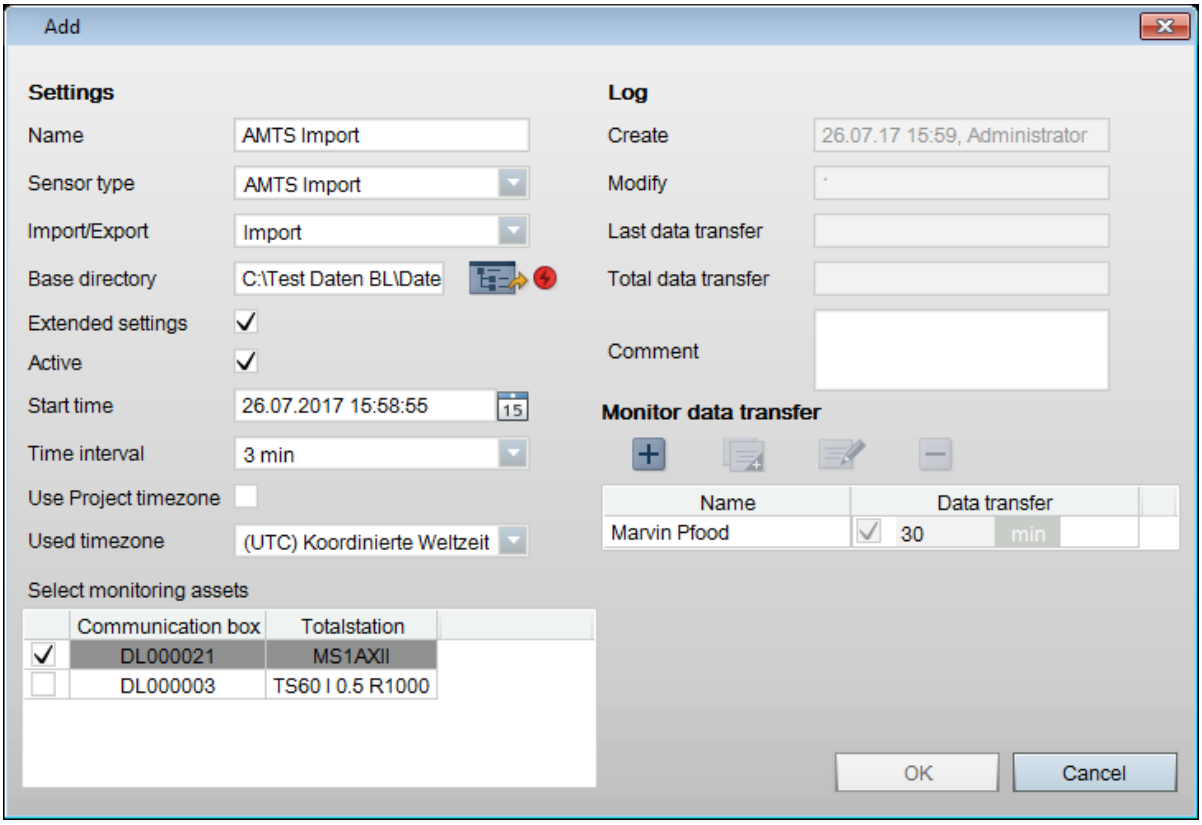
- Exports to other information systems can be managed centrally.
- In doing so, the predefined export formats can be used or also own or customer-specific formats can be created and used.



Active	Name	Import	Export	Project	Sensor type	Selected folder	Latest datatransfer	Total datatransfer
✓	StructuralExport_1		✓	VMT Intergeo	Structural monitoring	C:\Users\Administrator\Desktop\TestExportMarvin\StructuralExport_1	5 Days 4 hours 44 minutes	1131989
✓	MeteoExport_1		✓	VMT Intergeo	Meteorological	C:\Users\Administrator\Desktop\TestExportMarvin\MeteoExport_1	5 Days 5 hours 6 minutes	5355742
	GeoExport_1		✓	VMT Intergeo	Geodetic sensor	C:\Users\Administrator\Desktop\TestExportMarvin\GeoExport_1	94 Days 19 hours 29 minutes	185
✓	Geo2		✓	VMT Intergeo	Geodetic sensor	C:\Users\Administrator\Desktop\TestExportMarvin\TestGeoExport	5 Days 3 hours 17 minutes	2729
✓	ConvExport_1		✓	VMT Intergeo	Convergence section	C:\Users\Dietrich Juhl\Application Data	5 Days 5 hours 8 minutes	1322020
✓	AMTS Import (Israel)	✓			AMTS Import	C:\Users\Administrator\Desktop\STNI & CUI Files Israel		0
✓	AMTS Import	✓			AMTS Import	C:\Test Daten BL\Daten ab 20170301	5 Days 4 hours 52 minutes	24572

Create import or export

Click on the "Add" symbol to define an import or export.



Parameter	Meaning
Sensor type	Select a sensor type, e.g. Geodetic sensor. The possible selection depends on the desired operation (import or export**).**
Import / Export	Select the operation.
Export directory	Specifies the directory in which the export data are stored.
Time interval	Sets the time for the delay between each import or export action.
Extended settings	Shows additional options.
Active	Remove the tick to pause this import or export.
Export type / import type	Specifies the file format for import or export.
Select project	Specifies the project for this action.
Select groups	Selects the point groups, depending on the sensor type, for the export.Annotation: This field is not available for an import operation.
Log	This area is not populated with data until after the first use.
Monitor data transfer	Specify the e-mail recipients here who will be informed about data transfers (see „Projects“ on page 25**).**The alarm interval specifies the time period after which recipients are informed if a transfer fails.

Perform export manually

You can perform a manual export at any time interval from a defined export of the list.

1. Select an export in the list.

   Annotation: You can also generate an export without its default settings. In this case, skip this step.

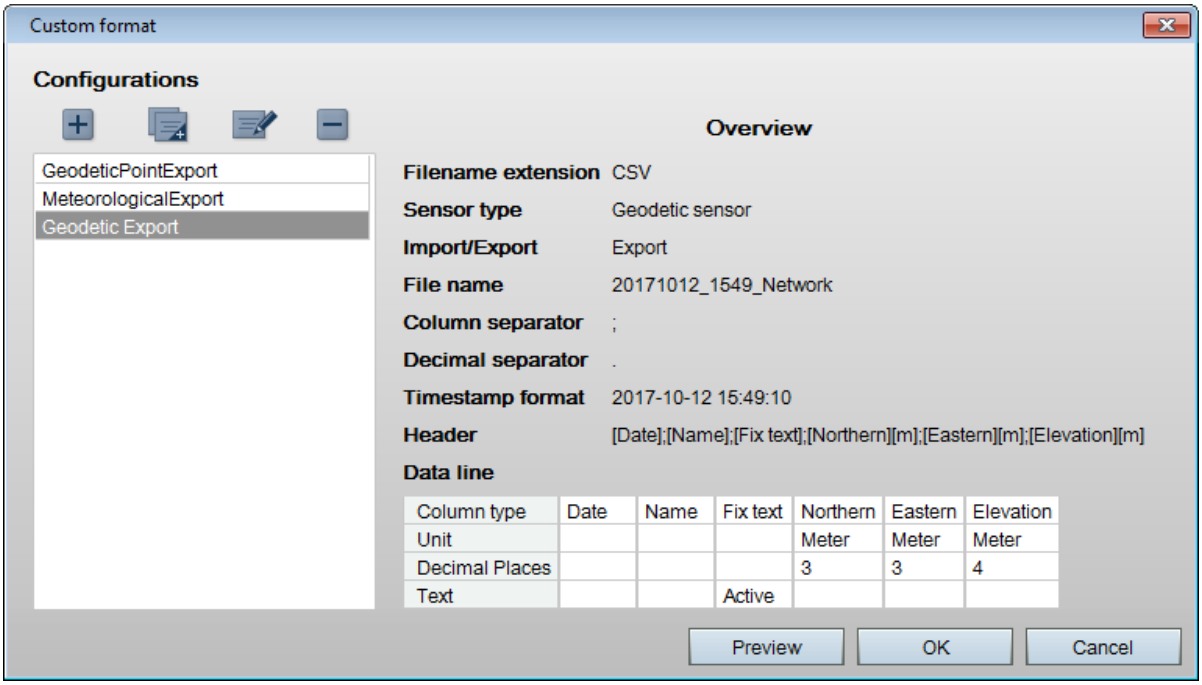
2. Click on the **MANUAL EXPORT** button.

3. Specify the details for the export and then confirm with **OK**.

The export is saved as **CSV** file in the export directory.

Create your own format for import and export

You can define your own formats to be used during import or export. This applies to general settings, such as decimal separators, and global settings, such as the time format or data type of a column. You can access this functionality using the **CUSTOMER FORMAT** symbol in the secondary navigation.

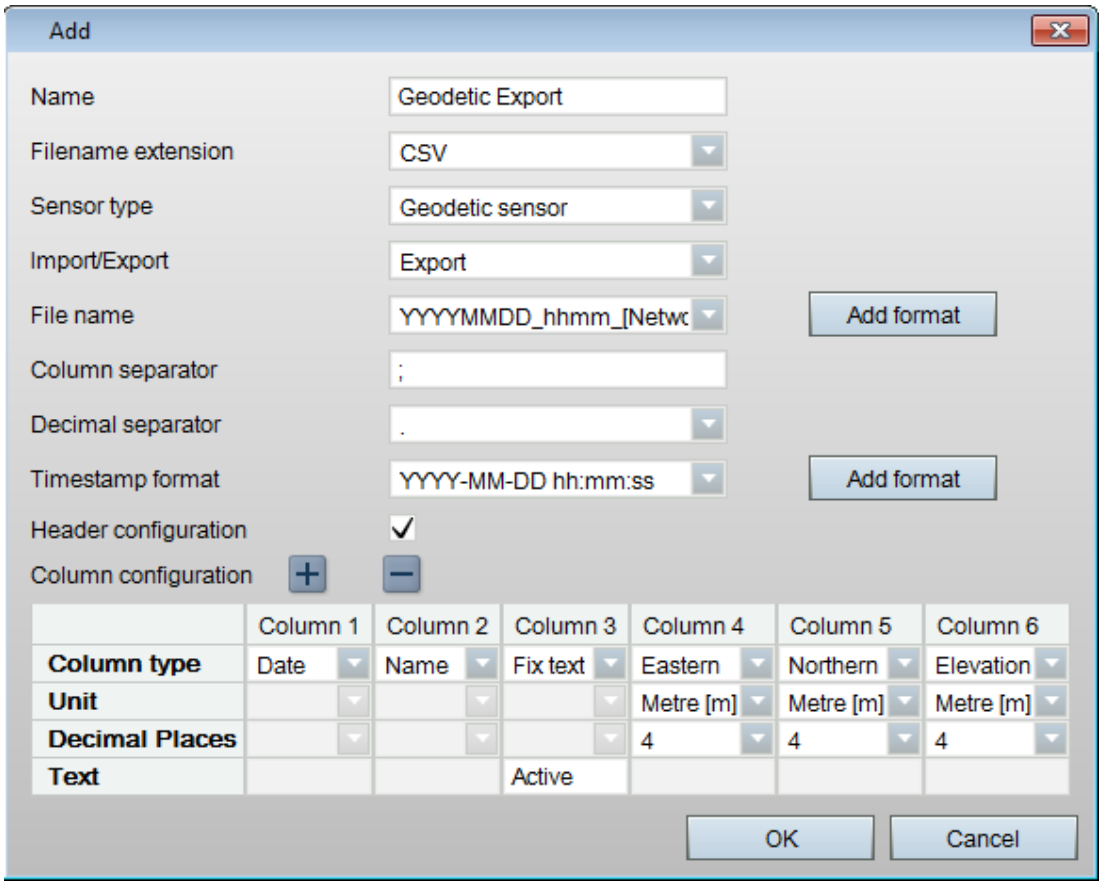


Annotation: Predefined formats cannot be edited or deleted. Formats in use cannot be deleted.

Proceed as follows to create a new format:

1. Click on the "Add" symbol.

   The **ADD** window opens.

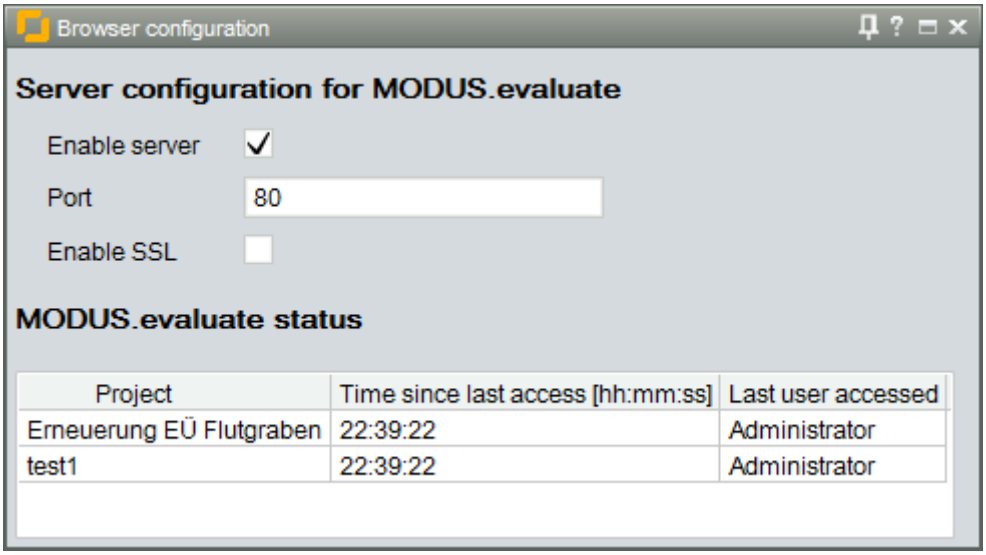


2. Set the parameters as required.
3. Specify the columns by selecting type, unit and the number of decimal places (if applicable**)**.
4. Specify the text if necessary. By selecting the column type Fixed text, it is possible to enter a free text in the field provided for this purpose. This is then written to the corresponding column of the **CSV** file.
5. If necessary, add more columns via the "Add" symbol.

7.2 Browser Settings

In this module, you make the required settings to be able to use Delta Live**!**.

Delta Live! communicates directly with the database of Delta Watch. In doing so, Delta Live! uses the **RESTful API** of Delta Watch. This is a programming interface that uses **HTTP** requests (**GET, PUT, POST** and **DELETE**) to access data. The **RESTful API** can also be controlled by other systems.



Configure Delta Watch for Delta Live!

To be able to use Delta Live**!**:

1. Open **ADMINISTRATION > INTERFACE > BROWSER SETTINGS** in Delta Watch.
2. Activate the server by enabling the relevant checkbox.
3. Select a suitable port.

   *Annotation: There are no specifications or restrictions for the port selection on the part of Delta Watch or Delta Live**!**. (Example: port 80. If in doubt, contact your system administrator for assistance in selecting a suitable port**)**.*
4. We recommend that you enable **SSL** encryption.

   After activation, a selection window opens and you can select the certificate file there.

Without **SSL** encryption, Delta Live! can be reached via **localhost:port number/app1**. With **SSL** encryption via the specified domain.

Order and import SSL certificate

To order an **SSL** certificate, you need:

- a customer account with a domain provider
- a customer account with a certificate provider

1. Think about a suitable domain name under which Delta Live! should be accessible, for example: modus-demo.vmt-gmbh.de.
2. Create a **CSR** (Certificate Signing Request) via the certification service. This service is installed on every Windows server. The certificate request must contain the previously considered domain name as Common Name. If necessary, contact your system administrator for assistance.

   You will receive a **CSR** file after completion of the request.
3. You can now use the **CSR** file to request a publicly verified certificate from a certificate provider.

   After your order and the processing by the provider, you will receive the certificate by e-mail or via your customer account with the provider.
4. Import the received certificate on the Windows server via the certification service. If necessary, contact your system administrator for assistance.
5. Select the imported certificate from the **CERTIFICATION** list in Delta Watch.

> **Important:** Remember to renew the certificate in good time before it expires if the project is running longer than the period requested for the certificate.

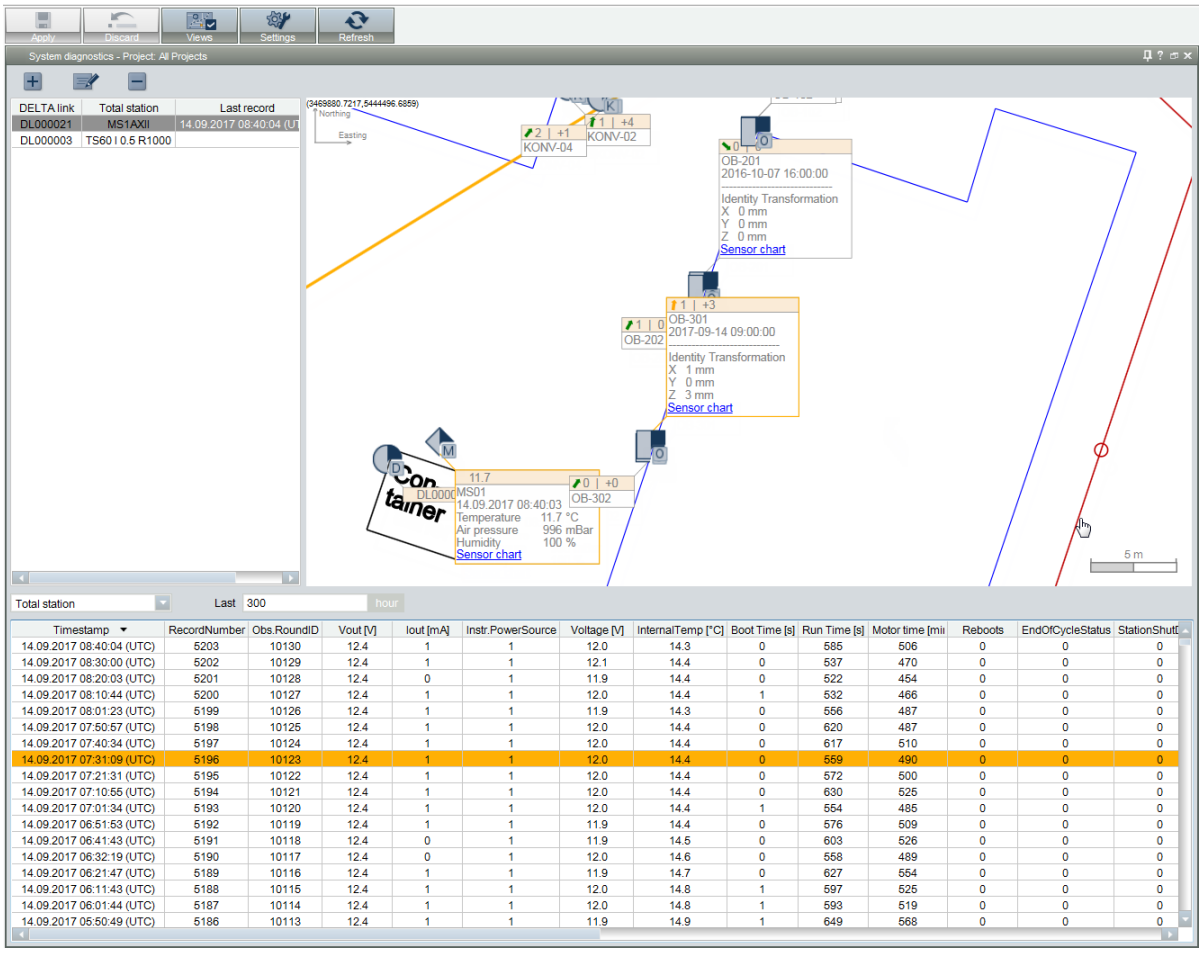
Delta Live! Status

In this area of the module window, you can see which user was the last to access the Delta Watch database via Delta Live**!**.

8 Hardware

8.1 System Diagnostics

You can display the technical values of the connected communication boxes and total stations in the **SYSTEM DIAGNOSTICS** module.



Communication box and total station – Assignment

At the top left of the work area, you can see the existing pairing consisting of Delta Link and total station. You can add new pairs in the table and edit or delete existing entries.

Proceed as follows to add a new pairing:

1. If not already done, open **ADMINISTRATION > POINT AND LIMIT MONITORING > TAB**: **SENSOR MANAGEMENT**.
2. Create one entry each with the type Delta Link and total station.

   > **Caution:** Ensure that the correct serial number is entered. This is mandatory for retrieving the system data.

3. Change to **HARDWARE > SYSTEM DIAGNOSTICS**.
4. Click on the "Add" symbol.
5. Create a Delta Link–total station pair.

6. Change to **INTERFACES > IMPORT & EXPORT**.
7. Click on the "Add" symbol.
8. Create an import with the sensor type **AMTS** Import. Select the hardware pair you just created.

> **Caution:** This sensor type is only available if the value Import is selected in the **IMPORT/EXPORT** field.

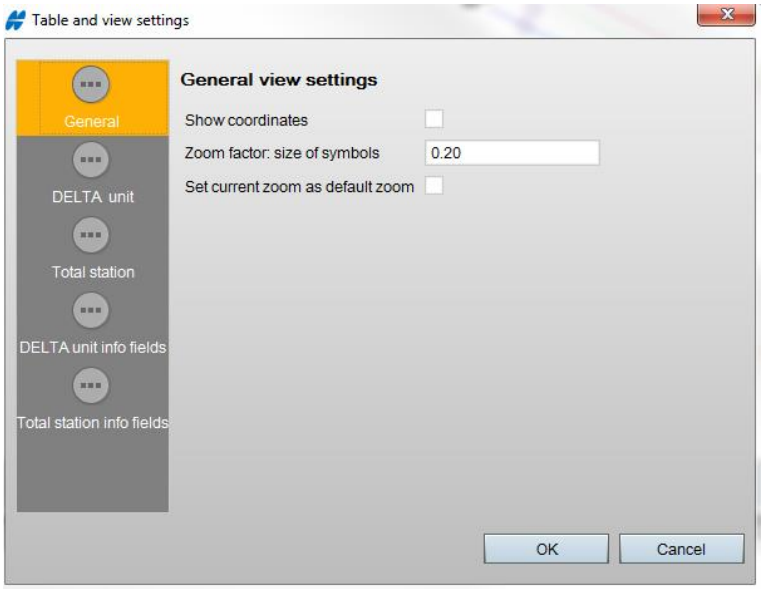
Representation on map and technical details

In the map, you can see the selected pairing between communication box and total station as well as the monitored points. The displayed items can be selected in the **VIEW CONFIGURATION** (see „System Configuration“ on page 18**)**.

The technical values, such as voltage, temperature and running time, can be found in the lower part of the table. You can select whether you want to display the values of the communication box or those of the total station. The system displays all data records that occurred in the period that was entered in the **LAST** field.

Communication box and total station – Settings

Further configuration options are available via the **SETTINGS** button in the secondary navigation.

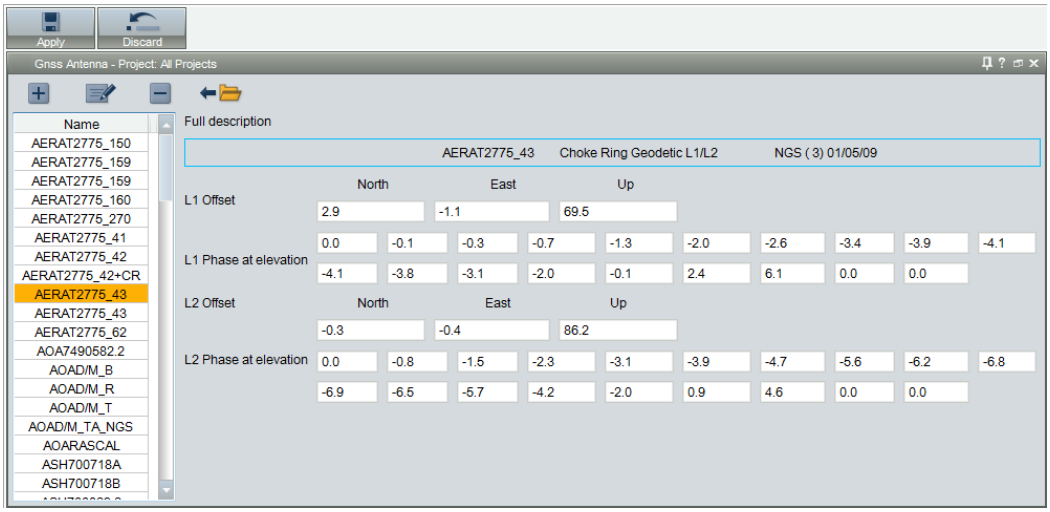


Parameter	Meaning
General	Make settings here for the representation in the map.
Delta Link	Specify the contacts who should be notified by e-mail when Delta Link alarm values are exceeded. The alarm values are assigned in Sensor Management to the individual channels (Administration > Point and limit value management > Sensor management).

Parameter	Meaning
Total station	Specify the contacts who should be notified by e-mail when total station alarm values are exceeded. The alarm values are assigned in Sensor Management to the individual channels (**ADMINISTRATION > POINT AND LIMIT VALUE MANAGEMENT > SENSOR MANAGEMENT**).
Delta Link Info field	Specify the data to be displayed for the Info field of Delta Link.
Total station Info field	Specify the data to be displayed for the Info field of the total station.

8.2 GNSS Antenna

Different GNSS antennas can be used in the Delta Watch system. Calibration values can be loaded from a **PCV** file or manually entered for each antenna type.



Import calibration values

Proceed as follows to import the calibration values for an antenna type from a **PCV** file:

1. If not already done, open **ADMINISTRATION > HARDWARE > GNSS ANTENNA**
2. Click on the "Import" symbol. The file selection window is displayed.
3. Select a **PCV** file.

The file is now imported and the imported antenna type is displayed in the list.

Input calibration values manually

Proceed as follows to manually create an antenna type and its calibration values:

1. Click on the "Add" symbol.
2. Input the basic values of the antenna. These can be found in the report of the calibration software.
3. Enter the values.

   The antenna type is now created and is displayed in the list.
4. Enter the calibration values (see next section**)**.

Display and edit calibration values

Proceed as follows to display and edit the calibration values of an antenna type:

1. Select the antenna type in the list.

   The calibration values are displayed.
2. Edit the values.

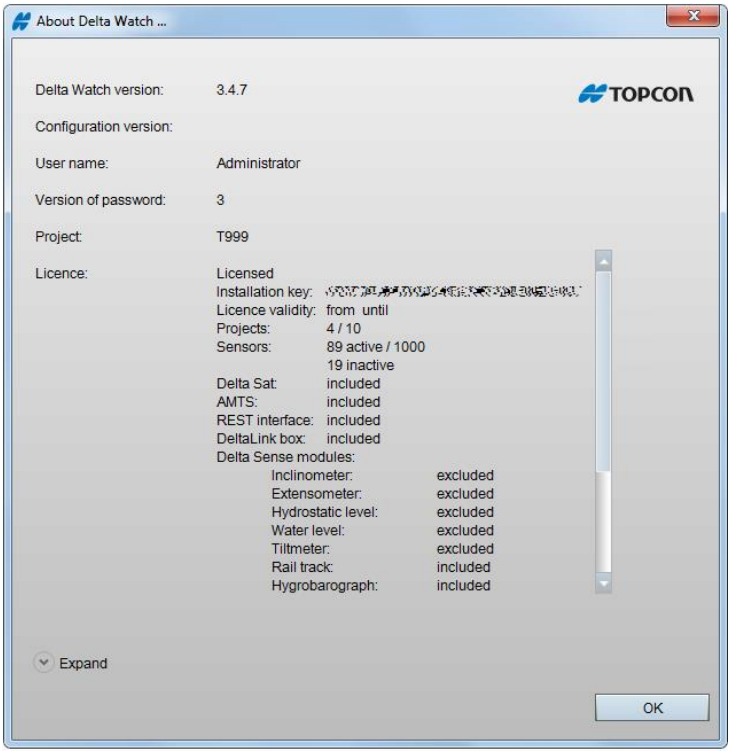
9 Licence Management

Your licence for Delta Watch is defined by a maximum number of projects and points. Information about the scope of your licence can be found in the menu bar at **HELP > ABOUT DELTA WATCH**.

Tip: If you are missing any modules, you can also check here whether your scope of delivery of Delta Watch includes an activation of these modules at all.

You can influence both limiting factors by deactivating projects or deactivating points and thus removing them from the calculation for the total number of points.

- Activation and deactivation of projects: **ADMINISTRATION > PROJECTS**
- Activation and deactivation of points: **ADMINISTRATION > POINT AND LIMIT VALUE MANAGEMENT > POINTS**



10 System Requirements

Minimum system requirements:

- Operating system: 64-bit, Windows 7 or later
- Installation of .**NET** Framework 4.7 or higher
- **CPU**: Dual Core **CPU** with 3 GHz
- Random access memory 4 **GB RAM**
- Hard disk space: 20 **GB** free space (dependent on size of the project)

Recommended system requirements:

- Operating system: 64-bit, Windows 7 or later
- Installation of .**NET** Framework 4.7 or higher
- **CPU**: Quad Core **I7 CPU** with 4 GHz
- Random access memory 8 **GB RAM**
- Hard disk space: 150 **GB** free space (dependent on size of the project)

Recommended system requirements for Amazon Web Services:

- Model: **C4**.2xlarge
- vCPU: 8
- Random access memory 15 **GB RAM**
- Hard disk space: **EBS**
- **EBS** bandwidth: 1,**000**

11 Glossary

A

API

Application programming interface

C

CSV

The CSV file format stands for "comma separated values" and describes the structure of a text file for storing or exchanging simply structured data.

E

EPSG

The EPSG code is a system of globally unique, 4- to 5-digit code numbers (SRIDs) for coordinate reference systems and other geodetic datasets, such as reference ellipsoids or projections.

F

Festpunkt

A fixed point is a point whose position is expected to remain unchanged.

G

GNSS

A Global Navigation Satellite System (GNSS) is a satellite-based positioning system (e.g. GPS, GALILEO or GLONASS).

K

Koordinatentransformation

In a coordinate transformation, the coordinates of a point in a coordinate system are used to calculate its coordinates in another coordinate system.

O

Objektpunkt

An object point is a point whose position may change.

R

RESTful

A RESTful API (API=Application Programming Interface) is a programming interface that uses HTTP requests to access data through GET, PUT, POST, and DELETE.

RINEX-Format

The Receiver Independent Exchange Format (RINEX) is a receiver-independent data storage and exchange format. It is used for GPS or nowadays general GNSS raw data, in particular for pseudorange measurements from code or carrier phase observations and satellite ephemeris. The provision of these data allows a subsequent re-evaluation, usually to determine position solutions of higher accuracy.

T

Totalstation

Electronic tachymeters (total stations) measure horizontal and vertical directions and distances to discrete targets. The electro-optical distance measurement is carried out by means of automatic target detection to optical prisms or reflectorless to correspondingly suitable surfaces.

www.topconpositioning.com