Trimble 4D Control Web User Manual

Version 5.0

Note to the reader:

Many of the screenshots embedded in this document were taken from Trimble 4D Control Web version 4.6. Trimble 4D Control Web has received substantial styling and theming updates for version 5.0, but in many cases the general underlying functionality has remained unchanged.

1. Introduction

Trimble 4D Control is a comprehensive structural integrity monitoring solution which offers a high level of compatibility and delivers unparalleled details and information with complete sensor management that enables you to customize and add instruments, sensors and functionality as your project needs to change and expand. Trimble 4D Control can handle the challenge of complex monitoring projects with tools to create visual results for rigorous analysis and alerting.

A Trimble 4D Control installation lets you detect displacement or movement in natural structures or manmade structures. It provides the data you need to understand the speed, direction and magnitude of any motion. The T4D Control suite is the core of your monitoring project. It controls the measurements, manages and analyzes the data, and provides decision support.

Getting started is easy with scalable monitoring solutions from Trimble. Trimble 4D Control provides analysis and management tools to help you start small and grow. As your expertise in monitoring increases, you can easily expand from post-processed deformation monitoring campaigns all the way to real-time systems that manage your projects and alert the operator of significant motion events.

Typical applications includes

- **Mining** – Trimble monitoring solutions can be used in open pit and underground mines for monitoring high walls, tunnels, subsidence and stockpiles.
- **Construction** – Monitor motion in buildings and structures adjacent to construction sites. You can monitor cut and fill slopes and incomplete structures.
- **Engineering** – Track the motion of dams, bridges, buildings and other manmade structures.
- **Transportation** – Monitor transportation structures, cut and fill slopes and railways. You

can also monitor structures close to transportation corridors during construction and operation.

- **Utilities** – Monitor pipelines, transmission structures, production and storage facilities.
- **Tunneling** – Monitor new and existing tunnels for deformation. Monitor for surface subsidence above tunneling projects.
- **Geotechnical** – Monitor dams and levees, landslides, landfills, subsidence, faults and natural structures.

This document represents a support manual for the web interface of the T4D Control suite.

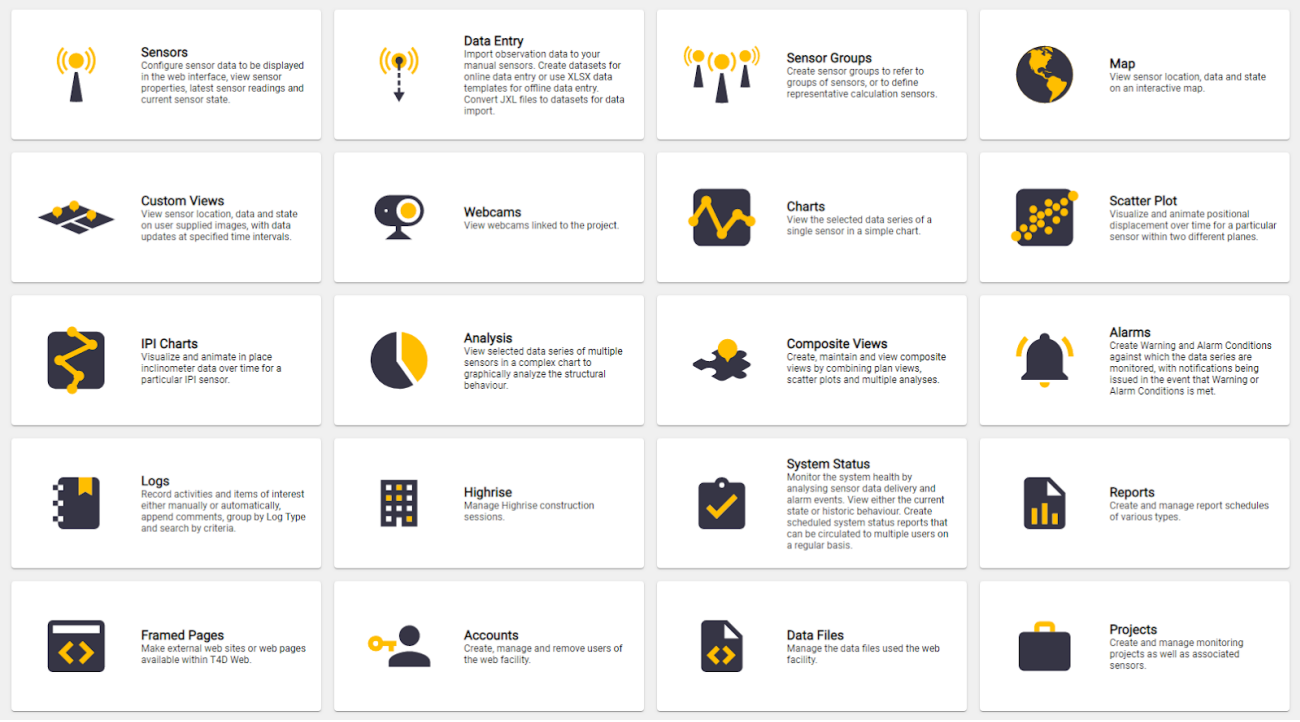
1.1. Target Users

The majority of users will most likely not have permission to access all areas of the web interface and therefore not need all the information explained in this manual. User permissions will be explained in the Accounts section. User permissions are highly customizable on Trimble 4D Control and can differ from one installation to another. This manual contains all the support material for a user with full administrator access.

Note: Trimble 4D Control security is automatically enforced both in the browser and on the server side. Users with limited permissions will just not see all the functionality discussed in this manual. The manual can therefore be freely distributed as required.

2. Overview and Terminology

The functionality of Trimble 4D Control is exposed by means of different *Areas*.
The visibility of these areas depends on the Trimble 4D Control Server *Modules* installed (e.g. Highrise), the permissions of the current logged in user and the sensors contained by the current selected project.



With reference to the above *Areas*, we will now discuss the *Core Entities*, *Core Functionality* and *Core Concepts* used by Trimble 4D Control Web:

2.1. Core Entities

This section introduces the core entities you will interact with in Trimble 4D Control.

2.1.1. Sensors

A sensor designates a particular location and associated description where measurements are taken. Typically a sensor may be a hardware device taking automated measurements, or a device where manual measurements are regularly taken. A sensor can also designate only a beacon of which measurements are taken, such as a Total Station Measurement or a field collector collecting data with a portable device at the particular beacon.

2.1.2. Observations

The term *observation* is used for a temporal measurement taken at a Sensor. Observations are either automatically received and stored by the Trimble 4D Control Server, or they are manually entered using Trimble 4D Control Web.

Each observation has a timestamp (or *epoch*) and measured values. The values are stored in the database in a standard *unit of measure* and converted to the preferred *unit of measure* for display.

2.1.3. Analysis

An *analysis* is a visualization that displays particular observations from particular sensors. Each analysis type provides specialized charting and controls to obtain useful analysis information from observations.

Real time observations can also be fed into an analysis for monitoring purposes.

2.1.4. Alarm Definitions

An *alarm definition* consists of one or more *alarm condition*. Each *alarm condition* is essentially an expression that gets evaluated against observation values from specified sensors. These expressions determines when *attention*, *warning* or *alarm* events will be triggered.

A number of *recipients* can be associated with each *alarm definition*. These recipients will be notified whenever the *alarm definition* triggers an event.

In addition, *alarm definitions* can be configured in such a way that events have to be *acknowledged* by duly authorized users. Alarm *events* that are not acknowledged within the required time period will be *escalated* to the a 2nd and 3rd set of *recipients*.

The colour of each sensor icon will be green (Ok), blue (Attention), yellow (Warning) or red (Alarm), based on

- The most severe *current* state of all alarm conditions associated with the sensor.
- The most severe evaluation result of that particular sensor within the context of an event that has not yet been *acknowledged*. (Applies only if acknowledgement is enabled).

2.1.5. Logs

A *log* is a text message and an optional image that describes an events that occurred at a particular point in time.

The system automatically creates logs for some events such as alarm state changes.
Users can comment on existing logs or create new logs for new events such as seismic events, accident events and blasting events.

2.1.7. Custom Views

A *custom view* is an image on which you can place icons for particular sensors.
The image can be a schematic plan or a photo of the physical location of the sensor.
The sensor icons allow you to visualise the latest observation or simple observation charts.

2.1.8. Map

The *map* shows your sensors as icons on a geographic terrain either from standard map providers or from your own geo-referenced terrain photos.

2.1.9. Webcams

A *webcam* is a configuration to receive a video feed from a video camera. This is useful to monitor remote areas.

Preconfiguring the webcams enables you to view video feeds in Trimble 4D Control Web.
You can also configure your *alarm definitions* to attach video clips to email notifications covering alarm events.

2.1.10. Reports

A *report* is a schedule to generate and email a document containing information about the system or from particular sensors. The report recipients will receive the report according the the configured daily, weekly or monthly report schedule.

A report integrates with other areas of Trimble 4D Control to automatically generate particular charts or extract information already configured.

2.1.11. Projects

A project is a collection of entities in Trimble 4D Control. All the entities above are inside the scope of a monitoring project. A project is useful to segregate different monitoring sites or periods under the same monitoring division.

2.1.12. Users

Each user can be configured with permissions according to a the role performed by the person.
A user can also hold some private entities in a project only visible to that user.

User access can be granted or restricted on a per-project basis.

2.3. Core Functionality

This section describes the core functionality provided by Trimble 4D Control. Some of the functionality is driven by the system and others by the user.

2.3.1. Automatic Sensors and Measurement Feeds

A sensor is created either as an *automatic sensor* or a *manual sensor.* An *automatic sensor* is connected to a *measurement feed* received by Trimble 4D Control Server. Observations are automatically created as the measurements are received on the feed. More than one *automatic sensor* can be connected to the same *measurement feed*.

Observations for a *manual sensor* can only be created by importing measurements from template files or by entering measurements manually.

2.3.2. Alarm Evaluation

Trimble 4D Control periodically evaluates alarm definitions against the incoming stream of observations.

The alarm evaluation process entails, generating alarm state changes (or alarm events), escalating second and third notifications and sending notifications.

2.3.3. Automated Event Logs

The system automatically creates logs for alarm state changes. Logs are also created automatically if users enable or disable an alarm, acknowledge an event or manually add observations to a sensor.

2.3.4. System Status Monitoring

The system status functionality displays a dashboard page containing general health of the Trimble 4D Control system. This includes sensor data flow health, alarm states and unacknowledged events.

2.3.5. Charting and Analysis

The charting and analysis functionality provides specialized charting capability to visualize and analyse observations from sensors. Many of these charts can receive real time observations for monitoring purposes.

2.3.6. Terrain Visualization

The terrain visualization functionality visualizes the position and placement of sensors using geographic maps, custom georeferenced terrain images, photos or real time video feeds.

2.4. Core Concepts

This section explains core concepts used by the functionality in Trimble 4D Control.

2.4.1. Data Value Columns

A *data value column* represents a single value measurement. Typical *data value columns* are Distance, Temperature and Wind Speed.

Note: This term is sometimes used interchangeably with a "*data type component*" or "*observation component*".

2.4.2. Data Types

A *data type* is a set of *data value columns* that represents readings that are normally measured together. For example the data type **Terrestrial Displacement** has readings for *Delta Northing (dN)*, *Delta Easting (dE)* and *Delta Height (dH)*, etc. Many *data types* only have a single *data value column*, for example the data type **Temperature** only has a data value column *Temperature*, because there is only one reading value for temperature.

Data types with positional or displacement *data value columns* are called **positional data types**.

2.4.3. Sensor Types

The *sensor type* of a sensor determines the *data types* associated with the particular sensor. For example a **Water Level Gauge** has the data types *Temperature* and *Water Depth*, while an **Inclinometer** has the data types *Temperature* and *Tilt*. Although the sensor type of a sensor determines all the possible data types associated with the sensor, in Trimble 4D Control, you can choose a combination of the available data types to be associated with a particular sensor.

For example you can choose to associate only the data type *Water Depth* with a particular sensor of sensor type **Water Level Gauge**.

2.4.4. Sensor Groups and Group Sensors

A *sensor group* is a user defined collection of sensors. Each sensor group is configured with a *data type* that is common amongst the sensors belonging to that group. A sensor may belong to more than one *sensor group*.

A sensor group based on a *positional data type*, allows you to create a *Group Sensor* linked to that sensor group. Trimble 4D Control Server will automatically calculate representative observations for the *Group Sensor* from the sensors in the particular sensor group.

2.4.5. Summarized Data Sets (Data Type Reductions)

Viewing or analysing sensor observations over a long time period may involve an overwhelming amount of data points. Trimble 4D Control provides a solution to this by automatically storing the observations as the *raw readings* (or *every epoch*) together with *summarized data sets*.

A *summarized data set* could be calculated as a value per second, a value per minute, a value per hour or a value per day. A *summarized data set* effectively allows a reduced view of observations.

The most common *reduction method* is to take a moving average of the *raw readings*. The *reduction method* for velocities are different: In this case the last calculated *velocity* value within the time period is used as the *representative* or *summarized* value.

2.4.6. Observations and Velocities

Trimble 4D Control automatically calculates and stores the velocity of observations of *positional data types*. The *summarized data sets* of velocities are also calculated and stored.

A typical velocity unit of measure is for example meters per day. The velocity values are calculated over a time intervals of 3 Hours or 1 Day. It is important to note that the unit in which you express velocities are independent from the time interval over which the velocity was calculated.

2.4.7. Observations and Absolute vs Relative Measurements

An *absolute measurement* is simply the raw reading measured on a sensor.

A *reference measurement* is a previous *absolute measurement* made at some previous point in time (called the *reference date*).

A *relative measurement* is the difference between the *absolute measurement* and the *reference measurement*.

Relative measurements are useful to monitor structural changes with respect to some fixed measurement in the past, or a moving reference date at a fixed time period into the past (e.g. the absolute measurement 7 days ago).

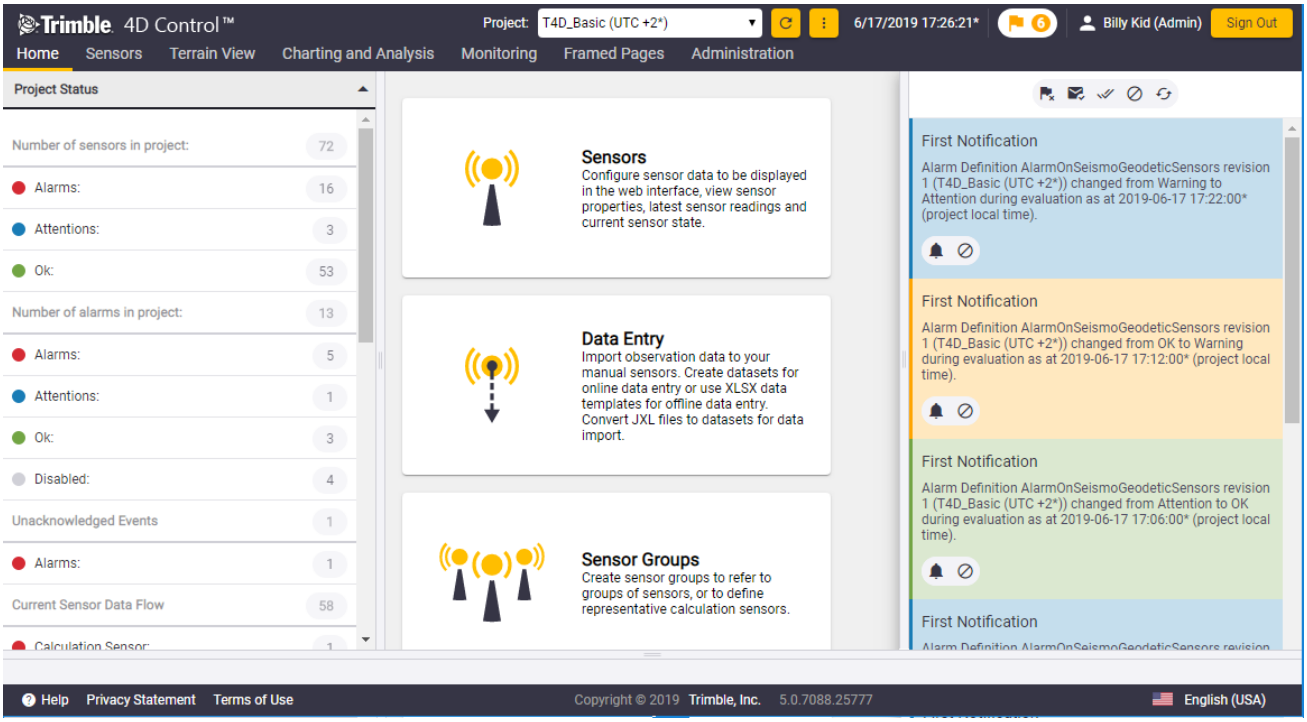
2.4.8. Data Source Mode of a Sensor: Auto or Manual

Sensors in Trimble 4D Control can either receive observations from an automatic readings feed or you can manually add readings to a sensor. The *Data Source Mode* is only selectable on creation of a sensor and determines whether a sensor is an **Automatic Sensor** or a **Manual Sensor**.

3. Navigation

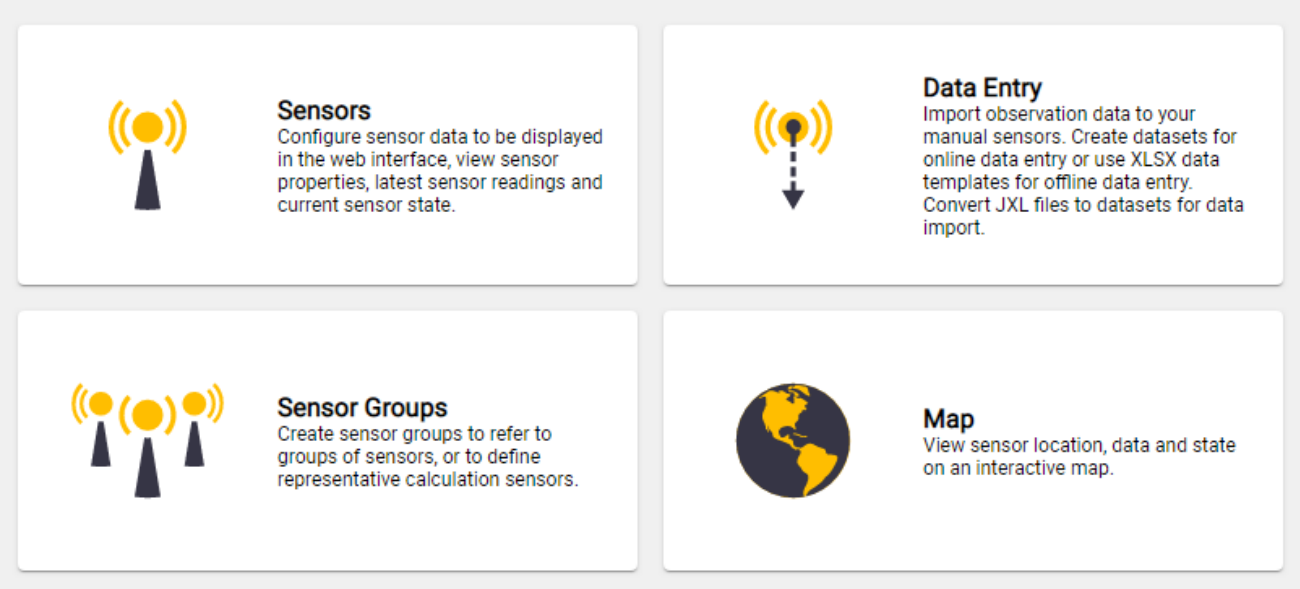
When you log into The Trimble 4D Control Web Interface, the first page you see is the **Home Page**.

The Trimble 4D Control Web Interface can be navigated either via the icons with pictures on the Home Page or via the main menu at the top of the pages. Below is a typical display of the Trimble 4D Control Web interface. Note the different control areas: status bar, main menu, left panel (containing the project status), content panel (containing the Home Page content), and the notification right panel. Below we will present the areas used for navigation.



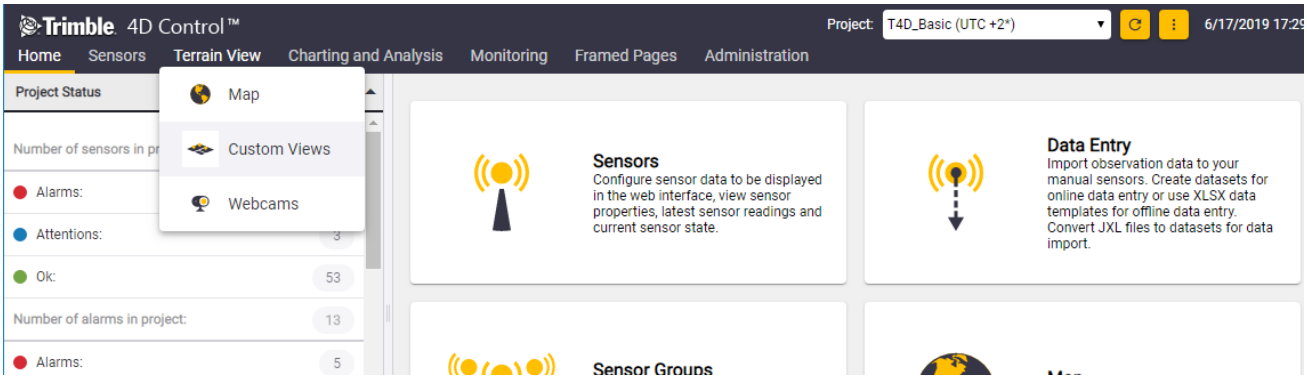
3.1. Home Page

Here you will see icons which navigate you through the rest of the site areas; each with a short description of what functionality is available in the particular area.



3.2. Main Menu

The Trimble 4D Control Web Interface can also be navigated via the main horizontal menu at the top of the Page.

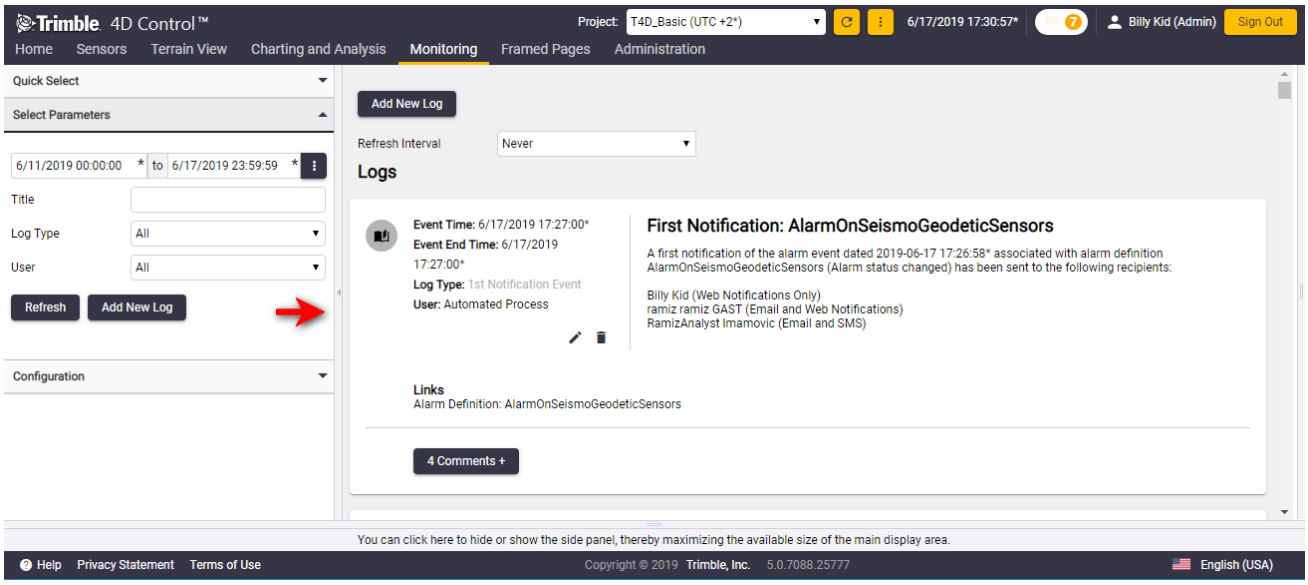


The Trimble 4D Control Web Interface can also be navigated via the main horizontal menu at the top of the Page.

You can hover over each menu entry to see the chile menu items.

3.3. Page Control Panel

Every Trimble 4D Control Web Interface page has a **Control Panel** in the left panel.
Consider the example in the figure below. In the **Control Panel** there are bar tabs with additional options (Quick Select, Select Parameters and Configuration). These bar tabs may differ from **Page** to Page. The **Control Panel** can be hidden by clicking the panel collapse arrow (indicated by the red arrow).

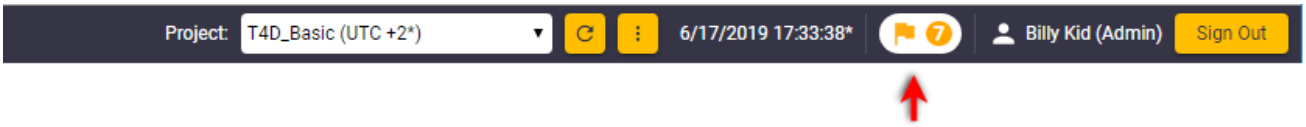


NB: If you do not see all tabs in the Navigation Bar or Control Panel, keep in mind that the visible tabs are dependent on the role of the logged in User. Administrators have more options available than Analysts etc. If you do not see all the options, it is most likely because your user does not have access to the functionality on these tabs.

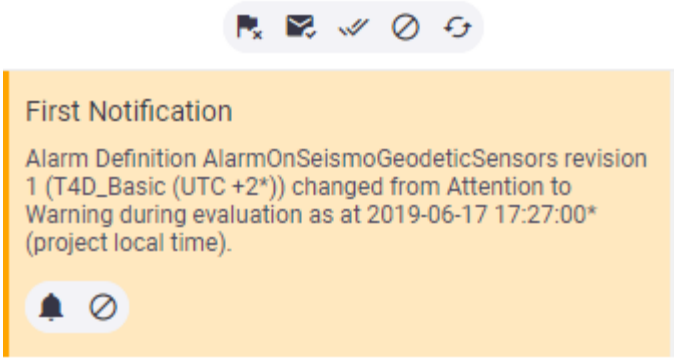
3.4. Web Notifications Panel

The **Web Notifications Panel** is displayed on the right. Normally this panel is not visible. You can open or close the web notifications panel by clicking the flag icon on the main menu next to where you user name is displayed.

The web notifications panel is usually displayed over the content area of the page you are viewing, so the intention of the web notification panel is not for it to be kept open.

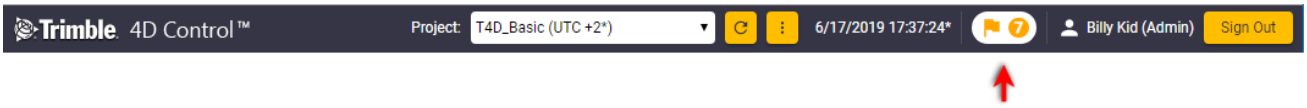


The web notifications panel shows alarms and events to the currently logged in user. You can click on the buttons presented by the web notifications panel to acknowledge or navigate to event related information.



3.5. Select a Project

To select a project, use the **Projects Drop-down** menu found above the main menu.



The time displayed adjacent to the project is the Project Local Time. This is the time at the physical site being monitored. Please note that you need to configure the daylight savings setting (see the Time Zone Settings and Daylight Savings section) for the project time to take daylight savings into account.

4. Project Configuration

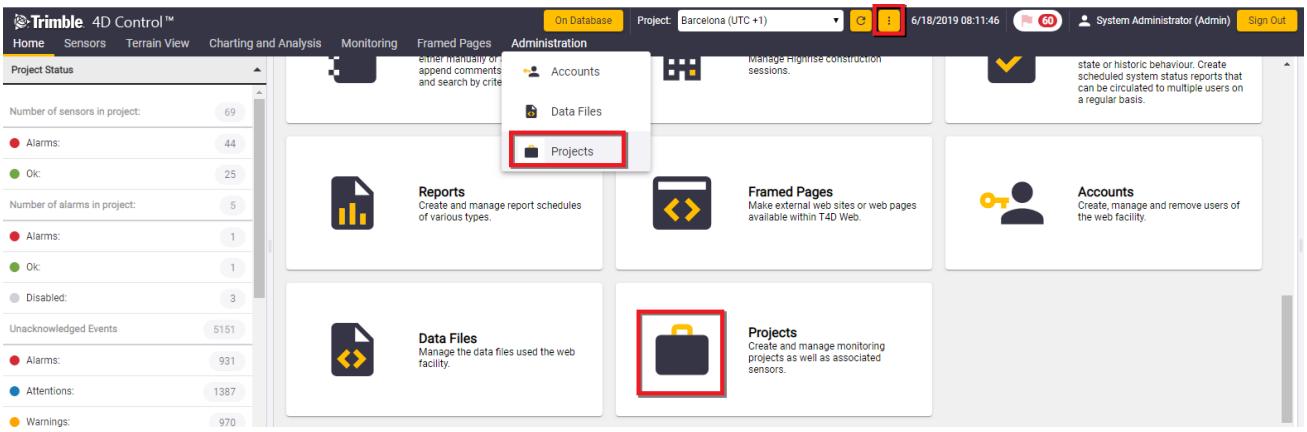
4.1. T4D Web Admin Area

In previous version of T4D Web, administrative users made use of the **T4D Desktop Application** to configure Projects and the Sensors belonging to these projects.

The **T4D Desktop Application** has been discontinued as of version 4.6. The functionality previously provided by the **T4D Desktop Application** can now be accessed in a new **T4D Web Admin Area**.

4.1.1. Navigating to the Admin Area

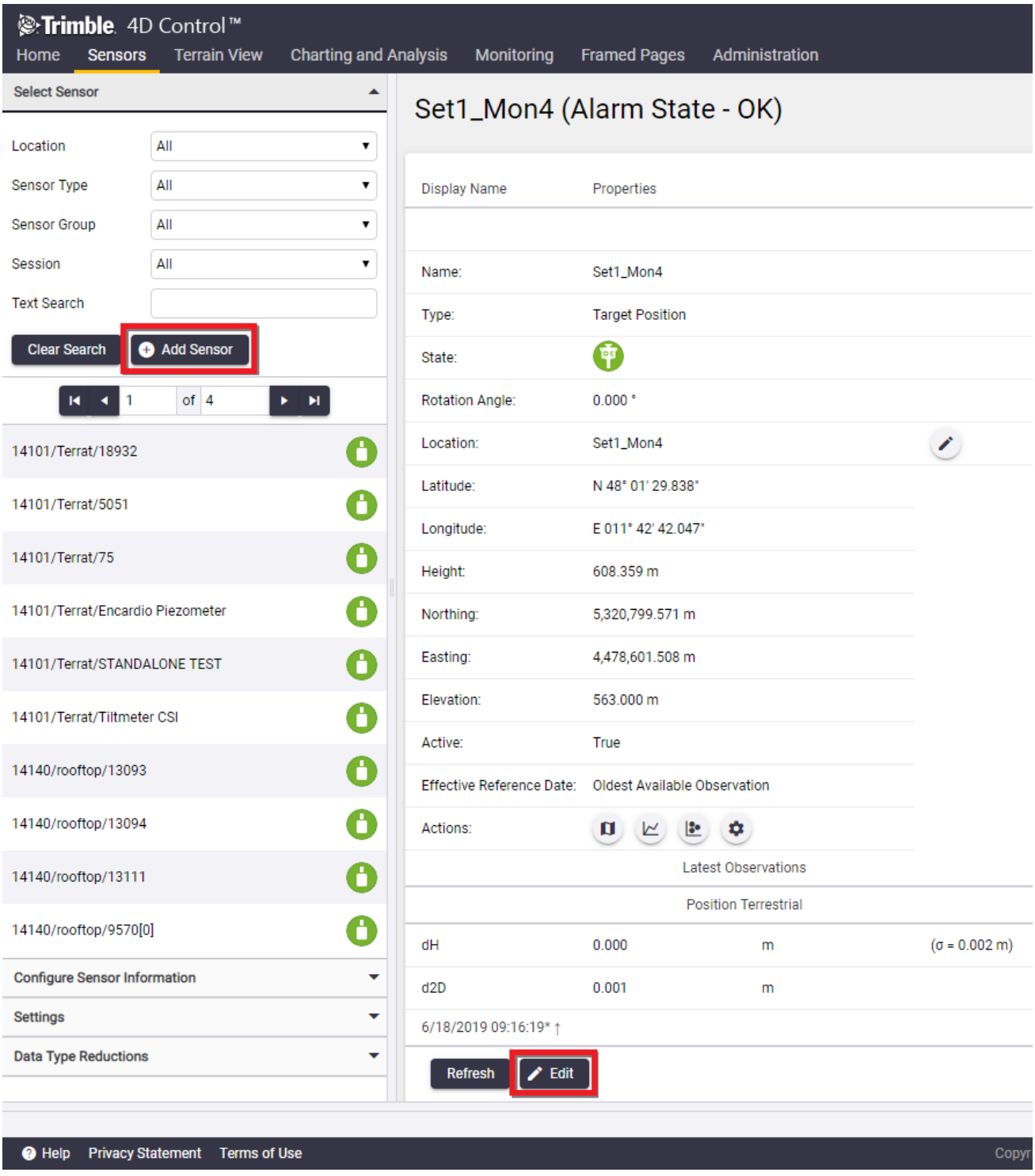
Users with sufficient rights can access this admin area via a number of links and buttons available in T4D Web:



To navigate to the Admin area click on:

- The "…" button next to the **Projects Drop-down**
- The **Projects menu item** under the **Administration** menu
- **The Projects** from the **Home Page**

Two additional navigation buttons are available on the **Sensors** page:

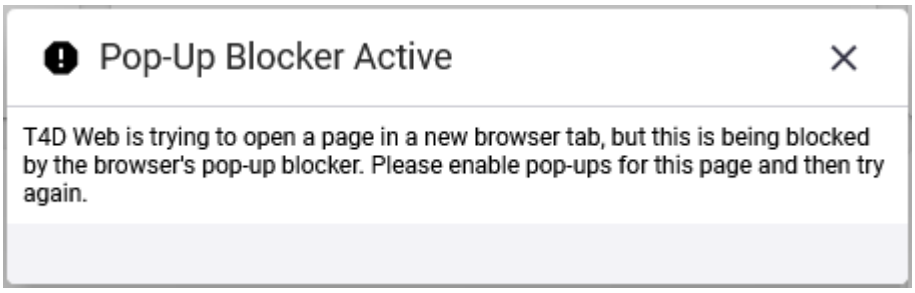


The **Add Sensor** button in the **Sensor Search** panel will navigate directly to the **Add Sensor** page in the admin area. The **Edit** button on the **View Sensor** page will navigate directly to the **Edit Sensor** page in the admin area.

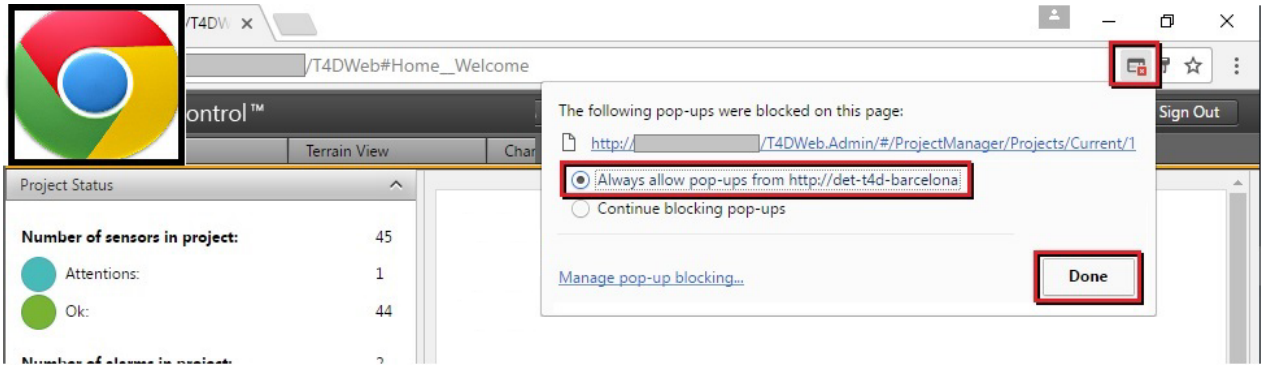
4.1.2. Popup Blocker

The admin area will open in a separate browser tab. Some browsers may block this action the first time that you attempt this.

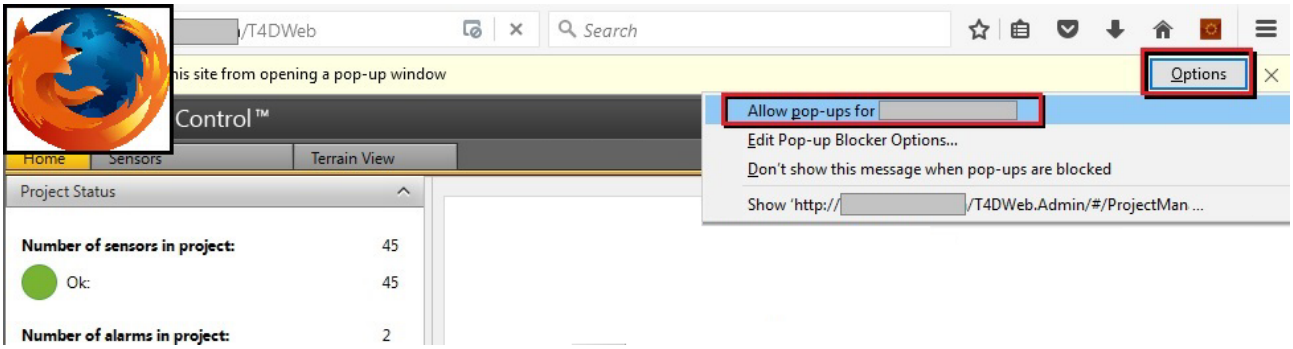
T4D Web will detect when a popup blocker is active and show the following error message:



The exact steps for allowing Popups depends on the browser you are using. The following images shows how to allow Popups in Google Chrome and Mozilla Firefox respectively.



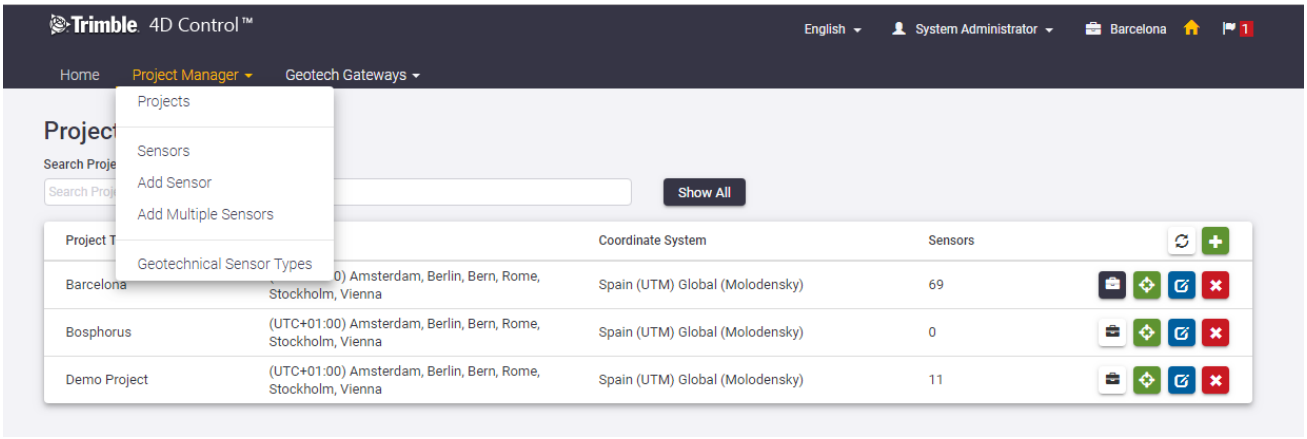
In Google Chrome, click on the button on the right side of the address bar and select the option as above. You only have to do this once.



In Mozilla Firefox, click on the Options button of the warning message and select the option as above. You only have to do this once.

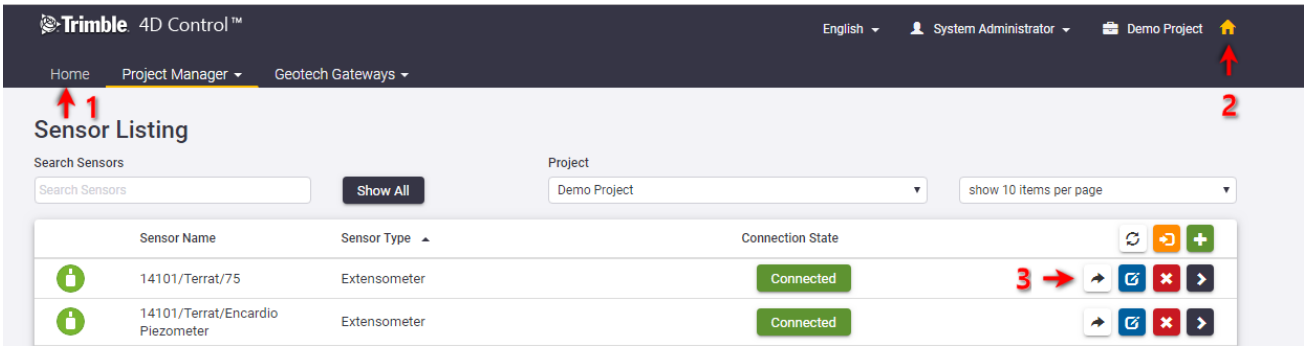
4.1.3. Navigating within the T4D Web Admin Area

The admin area has a main menu with entries for **Home**, **Project Manager** and **Geotech Gateways**. Find below a description of the menu items available under **Project Manager**:



- **Projects**: Navigates to the a page listing all projects in the system where you can Add, Edit or Delete Projects.
- **Sensors:** Navigates to a page listing all the sensors in the current project where you can Add, Edit and Delete Sensors within the current project.
- **Add Sensor:** Navigates to a page where you can add a single sensor to the current project.
- **Add Multiple Sensors:** Navigates to a page designed to easily add multiple sensors as a bulk operation.
- **Geotechnical Sensor Types**: Navigates to a page where you can define a new Geotechnical Sensor Type.

4.1.4. Navigating back to T4D Web



Once you are done configuring your project and sensors you can navigate away out of the Admin Area by clicking on either of the **Home** buttons indicated above or a **View Sensor** button on the **Sensor Listing** page.

The Admin Area will always be opened in a new browser tab so you may choose to simply click on the original browser tab once you are done configuring your projects and sensors.

4.1.5. Sign Out

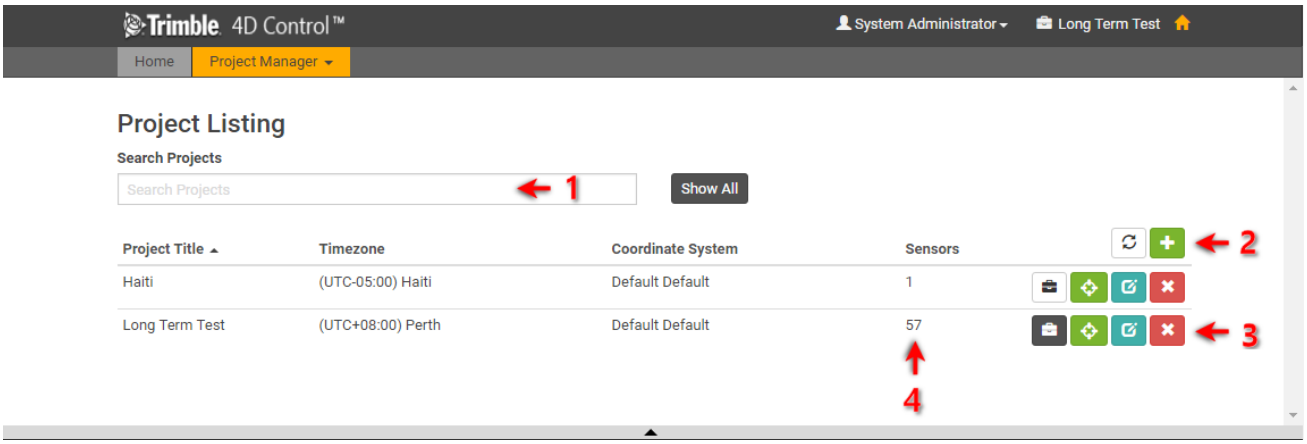
You can sign out from T4D Web from within the Admin Area.

Simply click on the user name displayed in the top bar and then click on **Sign Out**.

4.2. Project Administration

4.2.1. Project Listing

The **Project Listing** page will show a list of all existing Projects available in your T4D Installation. If you are using a brand new installation, then this list will be empty.



The above picture highlights a number of actions that you can take from this page:

1. You can search for a specific **Project** by name by typing in the **Search Projects** field.
2. There are two buttons in the header row:

    a. The **Refresh Projects** button can be used to refresh the project listing.

    b. The **Add Project** button can be used to add a new **Project**.

3. There are four buttons next to each **Project**:

    a. The Set **Current Project** button can be used to set the current project. The current project will be displayed in the top bar of the Admin Area.

    b. The **Coordinate System** button can be used to update the Project Coordinate System from T4D Server.

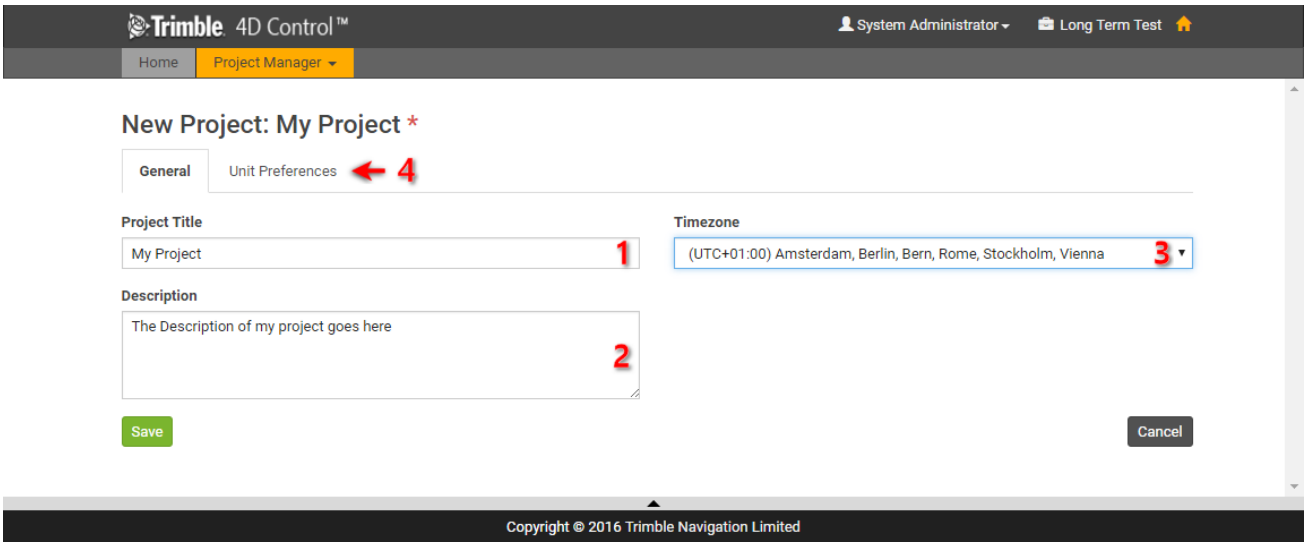
c. The **Edit Project** button can be used to edit a particular project. 

d. The **Delete Project** button can be used to delete a particular project. 

4. If you click on the sensor count for a specific project, then that project will be set as the current project and you will be navigated to the **Sensor Listing** page.

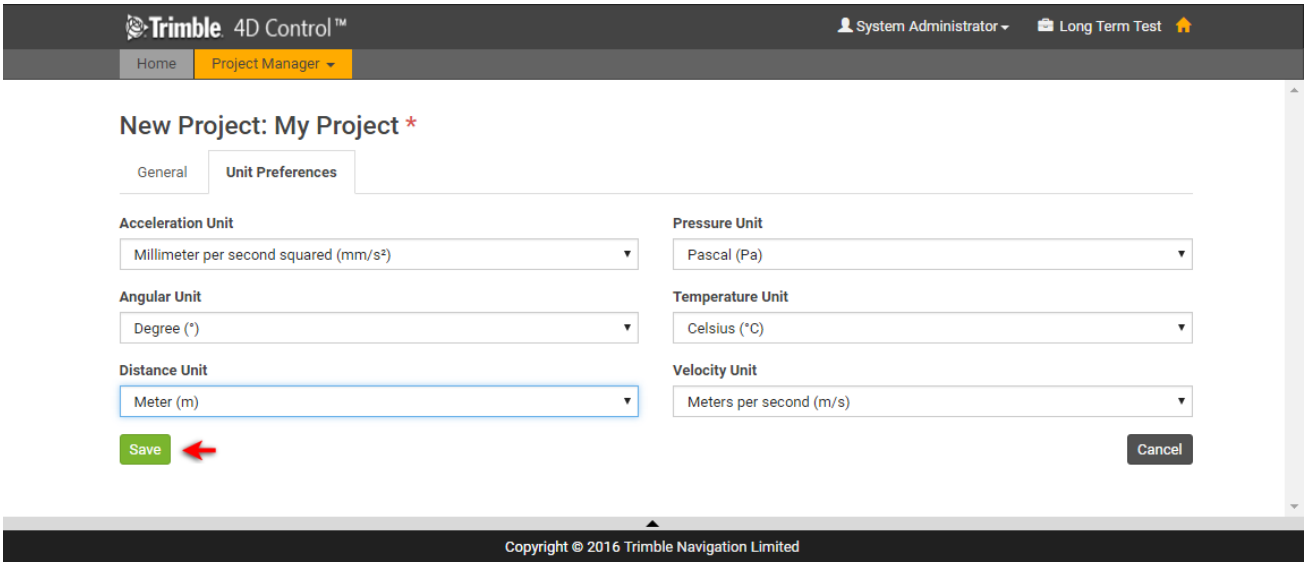
4.2.2. Add Project

To add a new project, click on the green **+** button in the header row of the **Project Listing** page. This will navigate you to the **Add Project** page.



On the **Add Project** page you can:

1. Specify a **Project Title** (required).
2. Add a **Description** (optional).
3. Select a **Timezone** (required).
4. Go to the **Unit Preferences** tab to configure display units.



Once you are satisfied with all the values you can click on the **Save** button. Alternatively, you can click on the **Cancel** button.

Note that the newly created **Project** will automatically be set as the new **Current Project**.

4.2.3. Edit Project

To edit a project, simply click on the **Edit** button (**pencil** icon) next to the relevant **Project** in the **Project Listing** page.

This will navigate you to the **Edit Project** page, which is similar to the **Add Project** page described above.

4.2.4. Delete Project

Any **Project** can be deleted by clicking on the red **Delete** button (**x** icon) next to the relevant project.

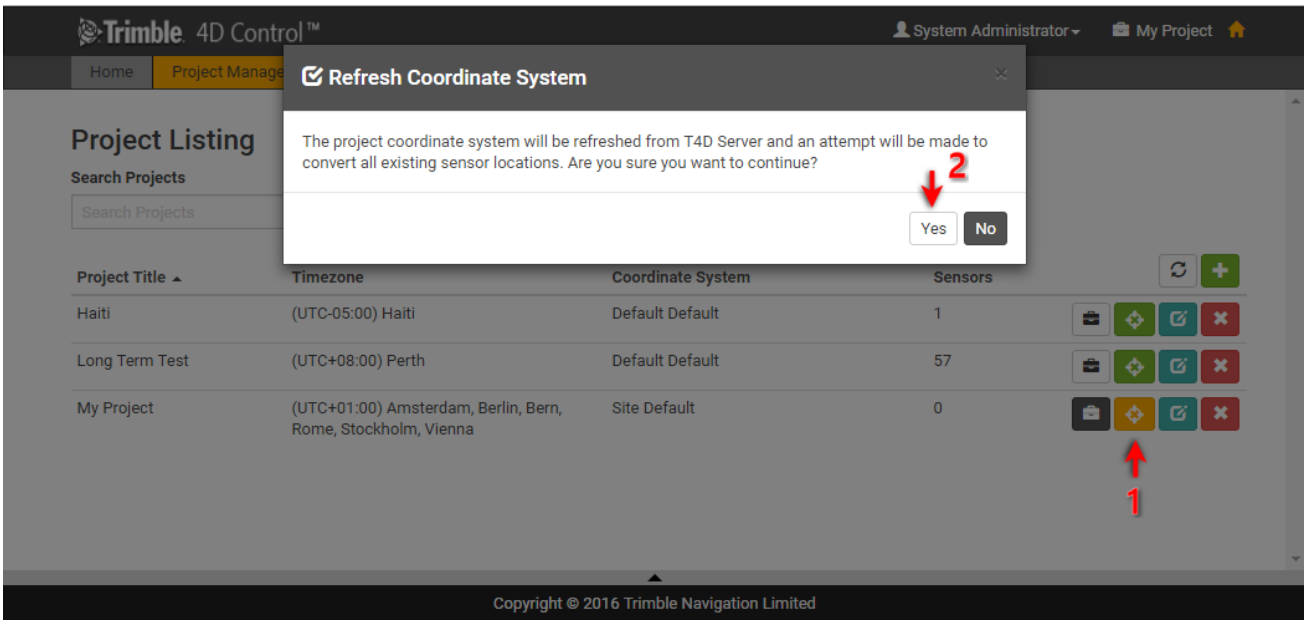
4.2.5. Update Coordinate System from Trimble 4D Control Server

In previous version of **Trimble 4D Control**, it was required to configure the **Project Coordinate System** in the **T4D Desktop** application.

This is no longer required in version 4.6. When a new **Project** is created then the **Coordinate System Definition** is read from **Trimble 4D Server** and applied to the new **Project.** If the **Coordinate System Definition** in Trimble 4D Server is changed after the creation of a **Project** then the **Project Coordinate System Definition** may have to be updated.

The **crosshair** button next to each **Project** in the **Project Listing** page will give an indication of whether or not the **Project Coordinate System** matches that of **T4D Server:**

- A green icon indicates that everything is OK. No action is required and clicking on the button will have no effect. 
- A gray icon indicates that the **Coordinate System Definition** in **T4D Server** could not be retrieved for comparison purposes. This may indicate a problem. Click on the **refresh** button to refresh the **Project Listing** page. If the icon remains grey then contact your Systems Administrator or Trimble Infrastructure support. 
- A yellow icon indicated that the **Project Coordinate System Definition** does not match that of the **Coordinate System Definition** in **T4D Server.** This will have to be rectified before more **Sensors** are added to the **Project.** 



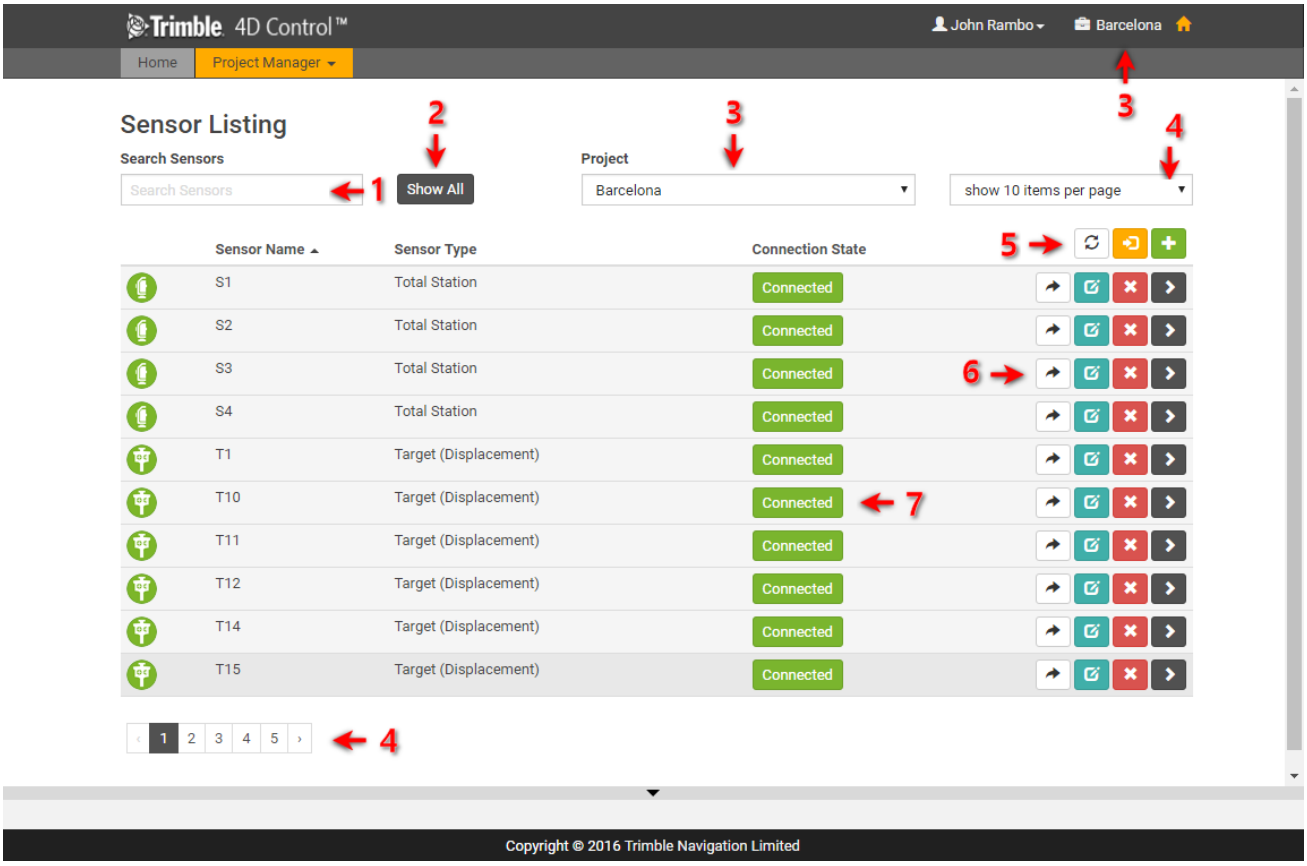
To update the **Project Coordinate System Definition**, simply click on the yellow **Coordinate System** button. You will be prompted for confirmation. Simply click on **Yes.**

The **Project Coordinate System Definition** will be updated and **T4D Web** will update all existing **Sensor Locations** accordingly.

4.3. Sensor Administration

4.3.1. Sensor Listing

You can navigate to the **Sensor Listing** page clicking on **Project Manager** > **Sensors** in the menu.



The **Sensor Listing** page will show a list of all the existing **Sensors** in the current **Project**. The above figure highlights the most important controls on the **Sensor Listing** page:

1. The **Search Sensors** field can be used to search for specific sensors.
2. The **Show All** button will clear the **Search Sensors** field in order to show all the sensors available in the current **Project**.
3. The **Project** drop-down can be used to switch between **Projects.** This has the exact same effect as clicking on the **Set Current Project** button on the **Project Listing** page.
4. Some **Projects** may contain large numbers of sensors and so the **Sensors** on this page may be paginated. You can change the page size using the drop-down on the top right of the page and you can switch between pages by making use of the paginator control on the bottom left of the page.
5. There are three button in the header row of the **Sensor Listing** page:

    a. The **Refresh** button can be used to refresh the current **Sensor Listing.**

b. The **Import** or **Bulk Add** button can be used to import multiple **Prisms** into the **Project.**

c. The **Add Sensor** button can be used to add a new **Sensor** to the **Project.**

6. Within each row of the **Sensor Listing** page, a number of buttons are available the interact specifically with the **Sensor** listed in that row:

a. The **View Sensor** button will navigate out of the admin area to the **View Sensor** page in T4D Web. You can open the **View Sensor** page in a new browser window by holding down the *Ctrl* key when clicking on this button.

b. The **Edit Sensor** button will navigate you to the **Edit Sensor** page.

c. The **Delete Sensor** button can be used to delete the **Sensor** from the **Project.**

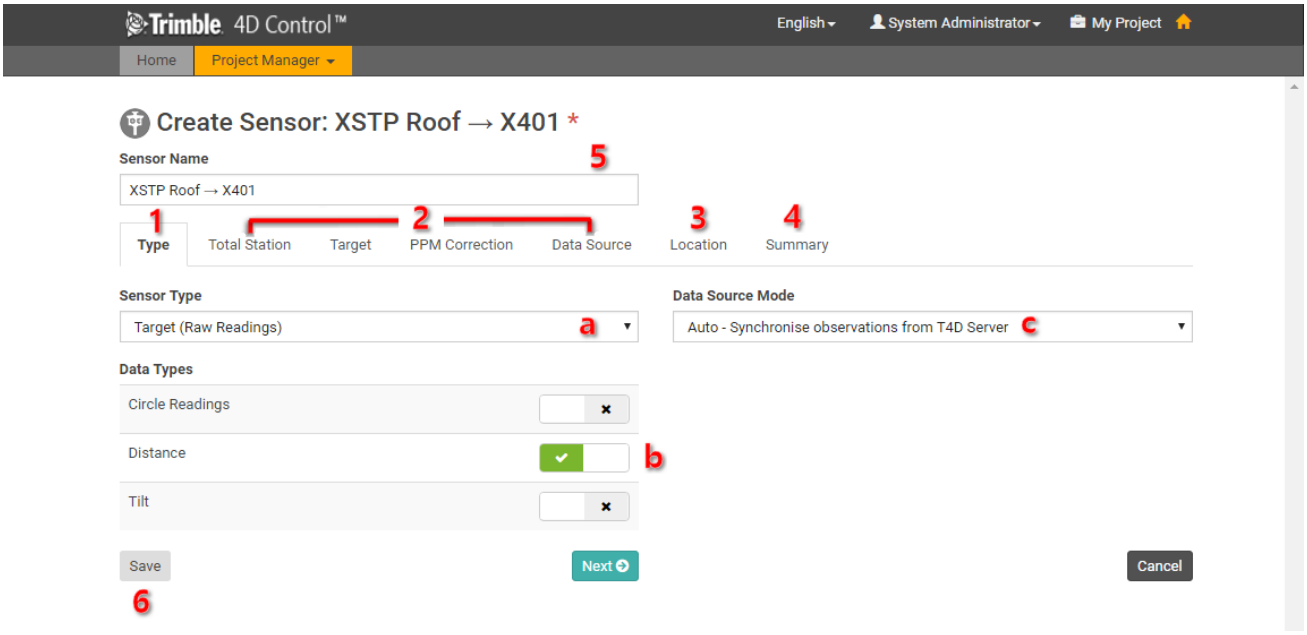
d. The **Expand Details** button can be used to view all the **Data Sources** connected to the sensor.

7. The **Connection State** of the sensor will appear next each sensor. You can **disconnect** sensors by clicking on this button. The **Sensor Icon** will change to grey and dataflow will stop. To reconnect the **Sensor** simply click on the **Connection State** button again.

4.3.3. Add Sensor

4.3.3.1. Overview

To add a new **Sensor** to the **Project**, click on the green **Add Sensor** button described above, or click on the **Add Sensor** menu item under **Project Manager**.



T4D supports a large variety of **Sensor Types** and the workflow for defining a new **Sensor** is slightly different for each of these. In general though, the steps are very similar:

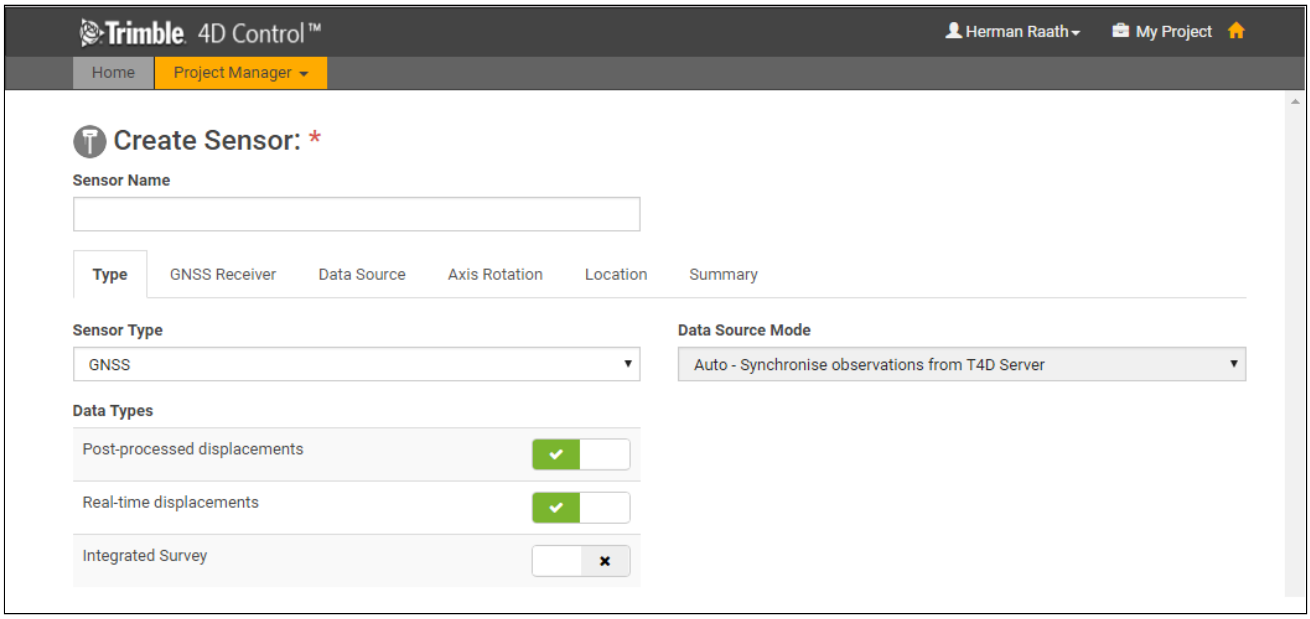
1. On the **Type** tab:
    a. Specify a **Sensor Type**.
    b. Link one or more **Data Type**.
    c. Set the **Data Source Mode** as *Auto* or *Manual* (see Data Source Mode of a Sensor)
2. Fill in all the **Sensor Type** specific tabs.
3. Specify or verify the **Location**
4. Review the **Summary**
5. Specify a **Sensor Name** (or use the suggested default.)
6. Click on the **Save** button.

You can navigate between tabs by clicking on the tab titles or by clicking on the **Next** and **Back** buttons.

Some Tabs may remain inactive until prerequisite fields on preceding tabs have been populated. If any of the Tab titles turn red, then this is an indication that there is an input validation error on that particular tab.

4.3.3.2. GNSS Receivers

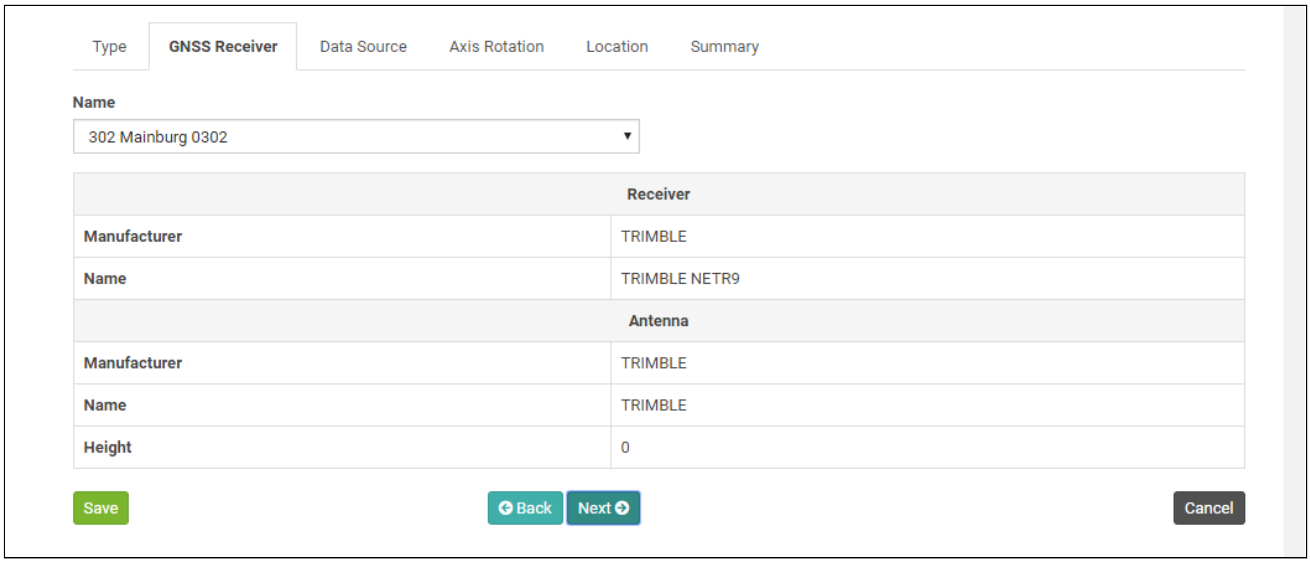
To add a **GNSS Receiver** to the **Project** simply click on the **Add Sensor** menu item or click on green “Plus” button on the **Sensor Listing** pager.



On the **Type** tab, select the **GNSS** sensor type and link the appropriate **Data Types** to the new sensor.

(Note that only the **Type** tab will be visible when the page loads. The subsequent tabs will appear as soon as a **Data Type** is linked to the sensor).

You can proceed to the the next tab by clicking on it, or by clicking in the **Next** button.

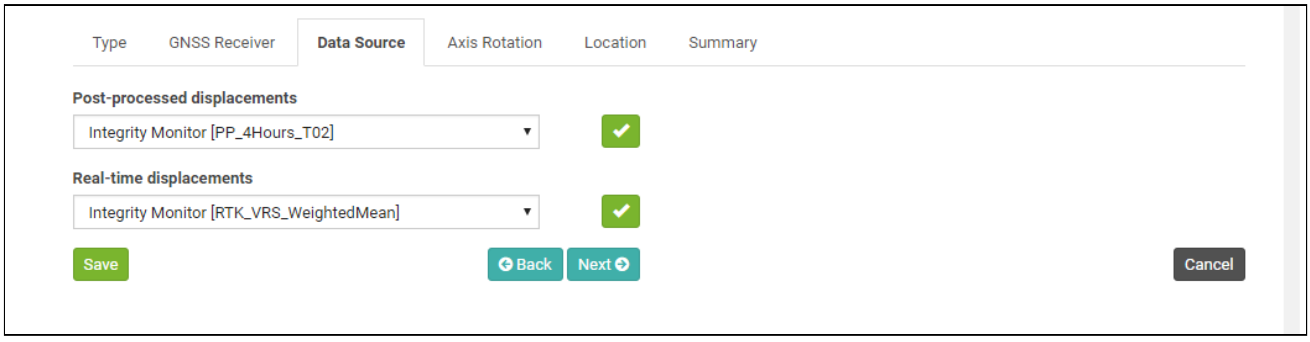


The drop down at the top of the **GNSS Receiver** tab, will contain all the receivers configured in **T4D Server**.

Simply select the receiver which you would like to add to the **Project**.

If you have not entered a **Name** yet (at the very top of the page), then the name will be defaulted to the selected **GNSS Receiver**. You can still edit the name if you wish to.

Proceed to the **Data Source** tab.

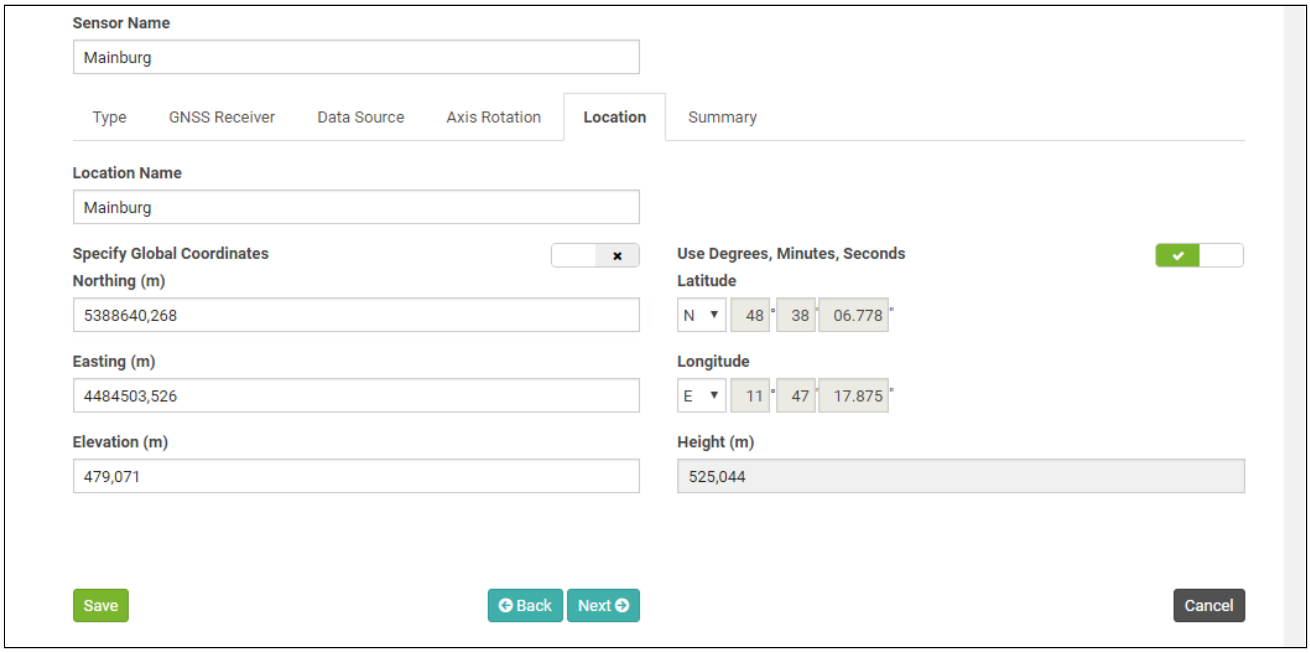


Next you will need to select a Data Source for each Data Type that you have associated with the new GNSS Receiver. Upon selection, the Data Source will be validated. You should see a green "check" icon momentarily.

Note: You must link a valid **Data Source** for each associated **Data Type** in order to add the **GNSS Receiver** to the **Project**. If there are no valid options available for a particular **Data Type** then you either need to resolve this in **T4D Server** or you need to unlink that particular **Data Type** on the first tab.

The next tab can be used to define the **Axis Rotation** of the **GNSS Receiver**. This is covered in a separate section.

Click on the **Next** button and proceed to the **Location** tab.



The **Coordinates** of the **GNSS Receiver** will be imported from **T4D Server**. In general it should not be required to edit these.

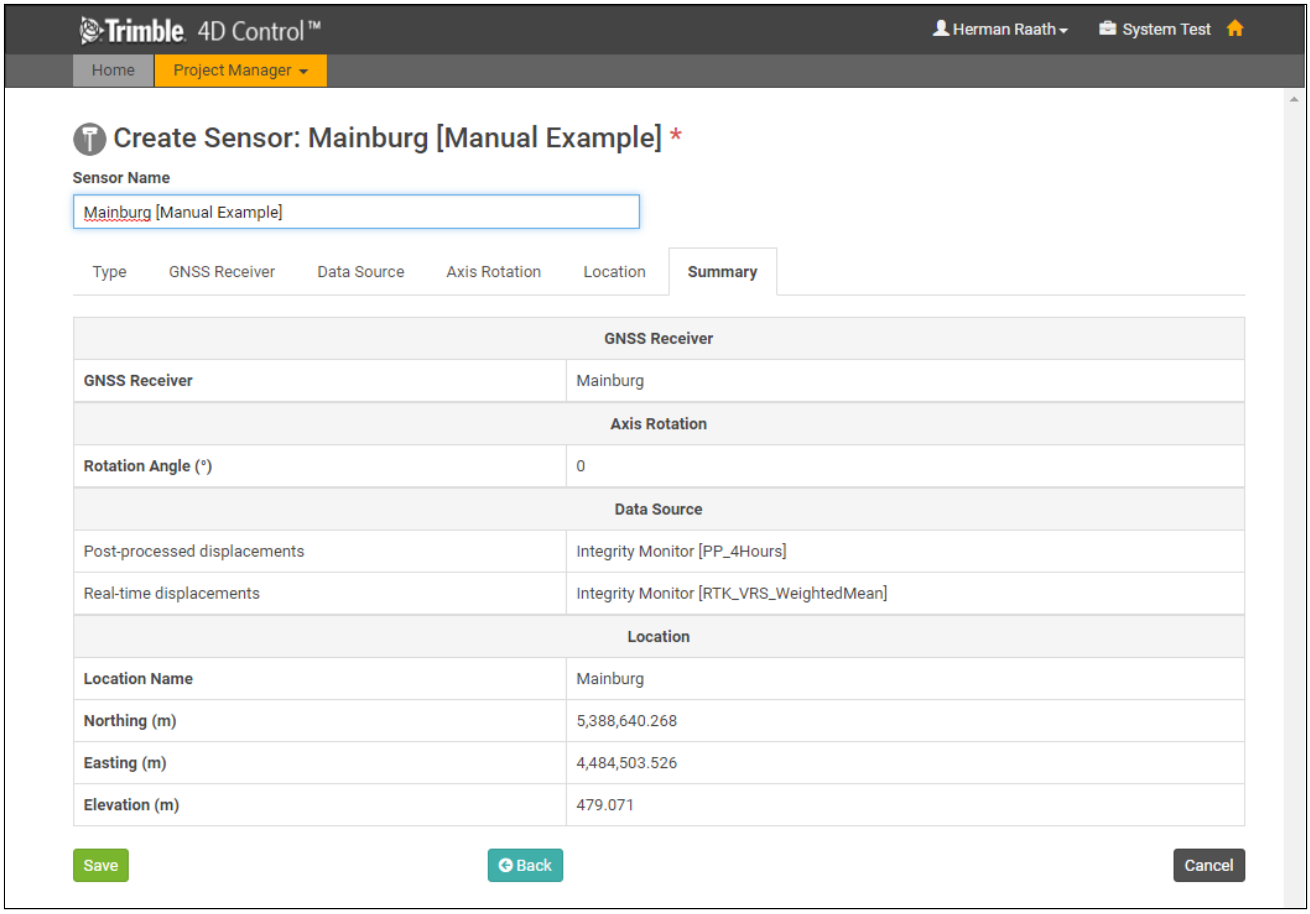
You can however change the **Location Name** or edit the **Coordinates** if required. The **Grid Coordinates** will appear on the left hand side of the page. If you are not using a **Local Coordinate System**, then the **Global Coordinates** will appear on the right hand side.

If you edit the **Grid Coordinates** then the **Global Coordinates** will update accordingly.

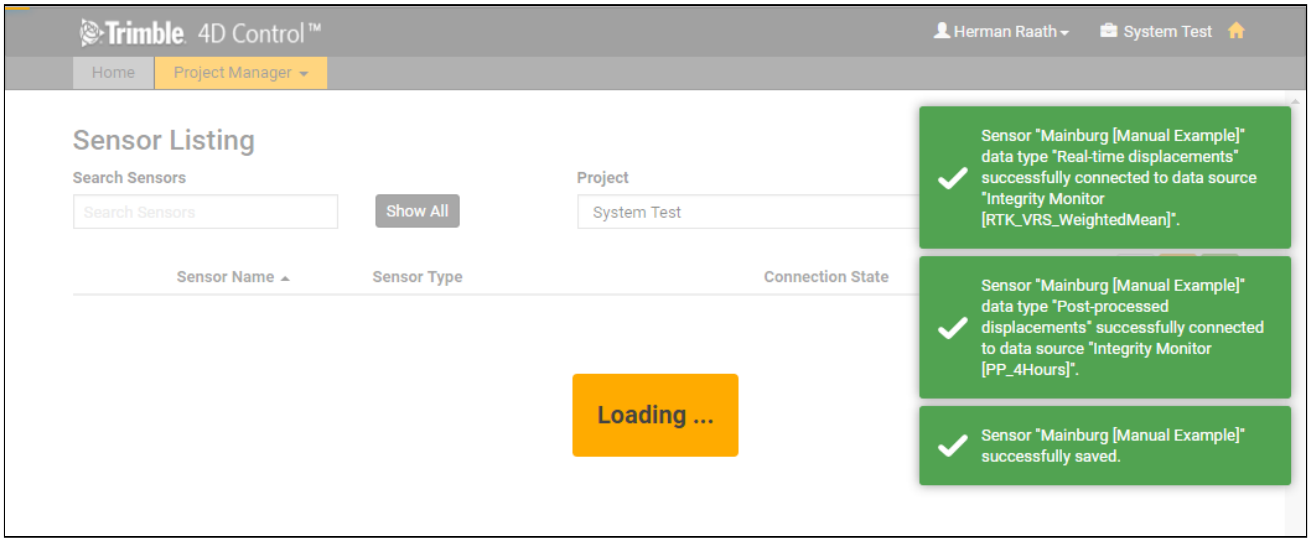
Alternatively you can click on the **Specify Global Coordinates** toggle. This will disable the **Grid Coordinate** fields and enable the **Global Coordinate** fields. If you edit the **Global Coordinates** then the **Grid Coordinates** will be updated automatically.

Global Coordinates can be entered either in **Degrees, Minutes and Seconds** or in **Decimal Degrees**. Simply toggle the switch above the **Global Coordinate** fields to switch between entry modes.

Click on the **Next** button to proceed to the **Summary** tab.



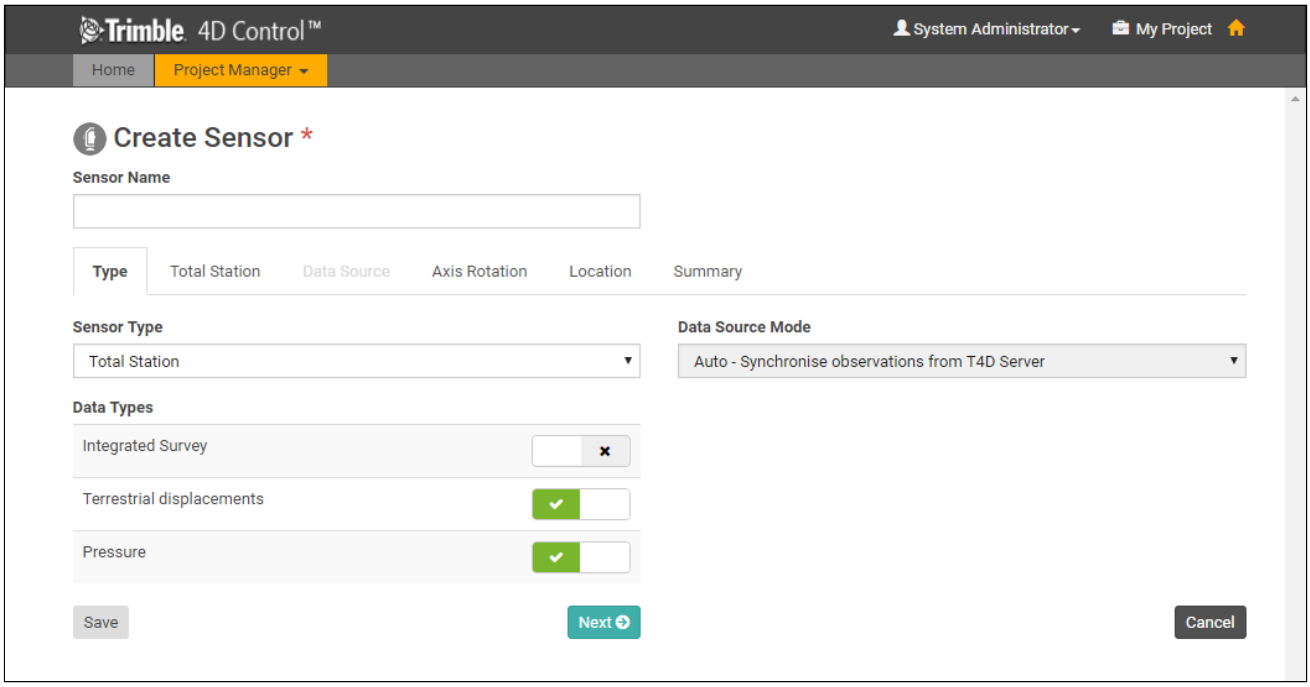
The **Summary** page presents an overview of the sensor configuration. Verify that all the settings are correct and optionally edit the name. Finally click on the **Save** button.



The **GNSS Receiver** will be added to the **Project** and **Connected** to all the selected **Data Sources**.

4.3.3.3. Total Stations

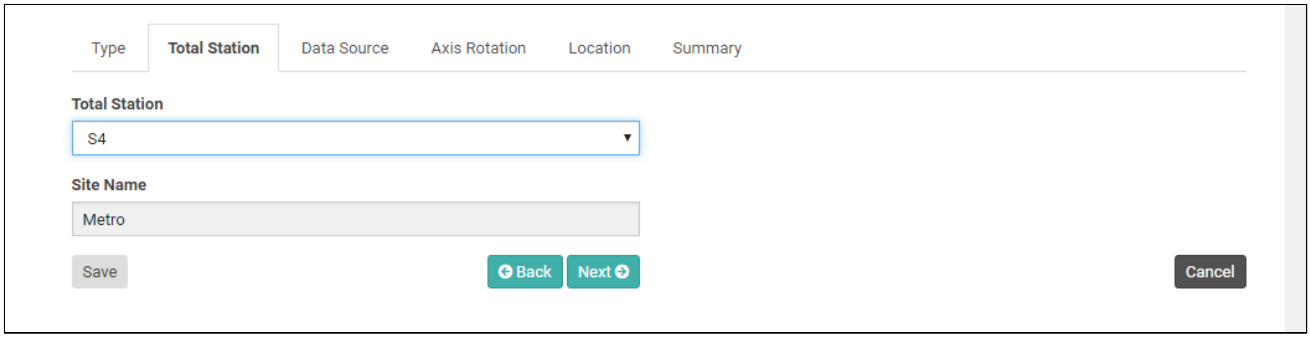
To add a **Total Station** to the **Project** simply click on the **Add Sensor** menu item or click on green "Plus" button on the **Sensor Listing** pager.



On the **Type** tab, select the **Total Station** sensor type and link the appropriate **Data Types** to the new sensor.

(Note that only the **Type** tab will be visible when the page loads. The subsequent tabs will appear as soon as a **Data Type** is linked to the sensor).

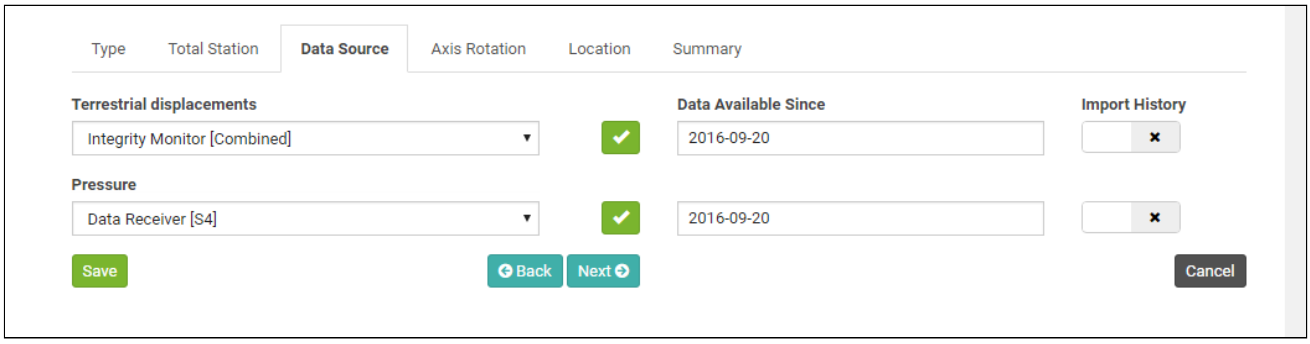
You can proceed to the the next tab by clicking on it, or by clicking in the **Next** button.



All the **Total Station** instruments configured in **T4D Server** will be listed on the **Total Station** tab. Select the **Total Station** which you would like to add to the **Project**.

If the **Name** field at the top of the page is still blank, then it will be defaulted to the name of the selected **Total Station**.

Click on the **Next** button to proceed to the **Data Source** tab.



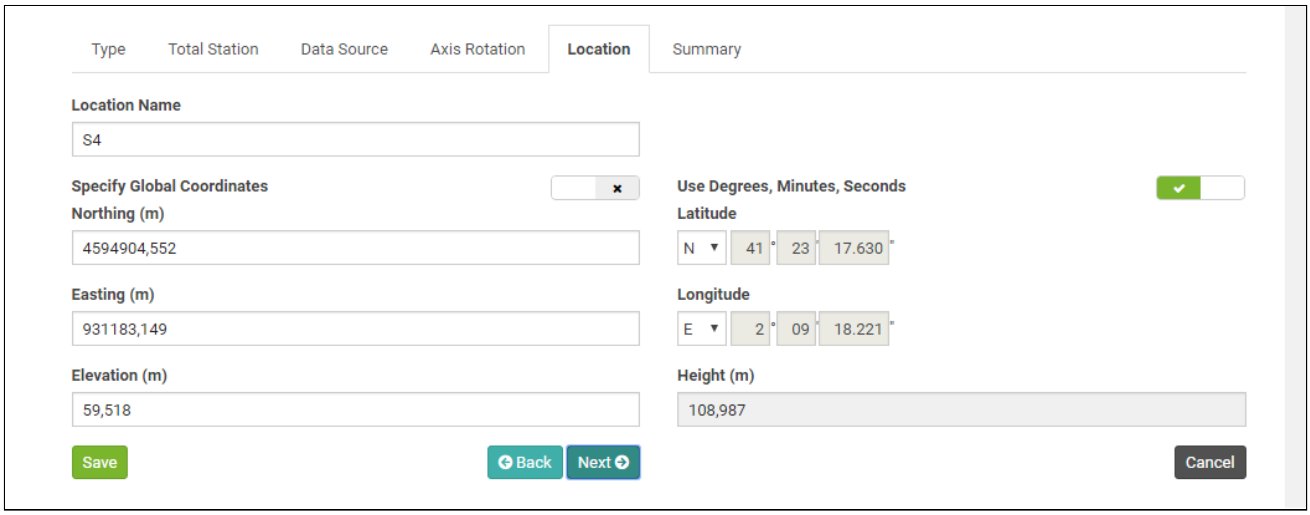
Next you will need to select a Data Source for each Data Type that you have associated with the new Total Station. Upon selection, the Data Source will be validated. You should see a green "check" icon momentarily.

Note I: You must link a valid **Data Source** for each associated **Data Type** in order to add the **Total Station** to the **Project**. If there are no valid options available for a particular **Data Type** then you either need to resolve this in **T4D Server** or you need to unlink that particular **Data Type** on the first tab.

Note II: Historic **Terrestrial Displacement** and **Pressure** data can optionally be imported when the **Total Station** is added to the **Project**. Historic data import will be covered in a later section.

The next tab can be used to define the **Axis Rotation** of the **GNSS Receiver**. This is covered in a separate section.

Click on the **Next** button and proceed to the **Location** tab.



The **Coordinates** of the **Total Station** will be imported from **T4D Server**. In general it should not be required to edit these.

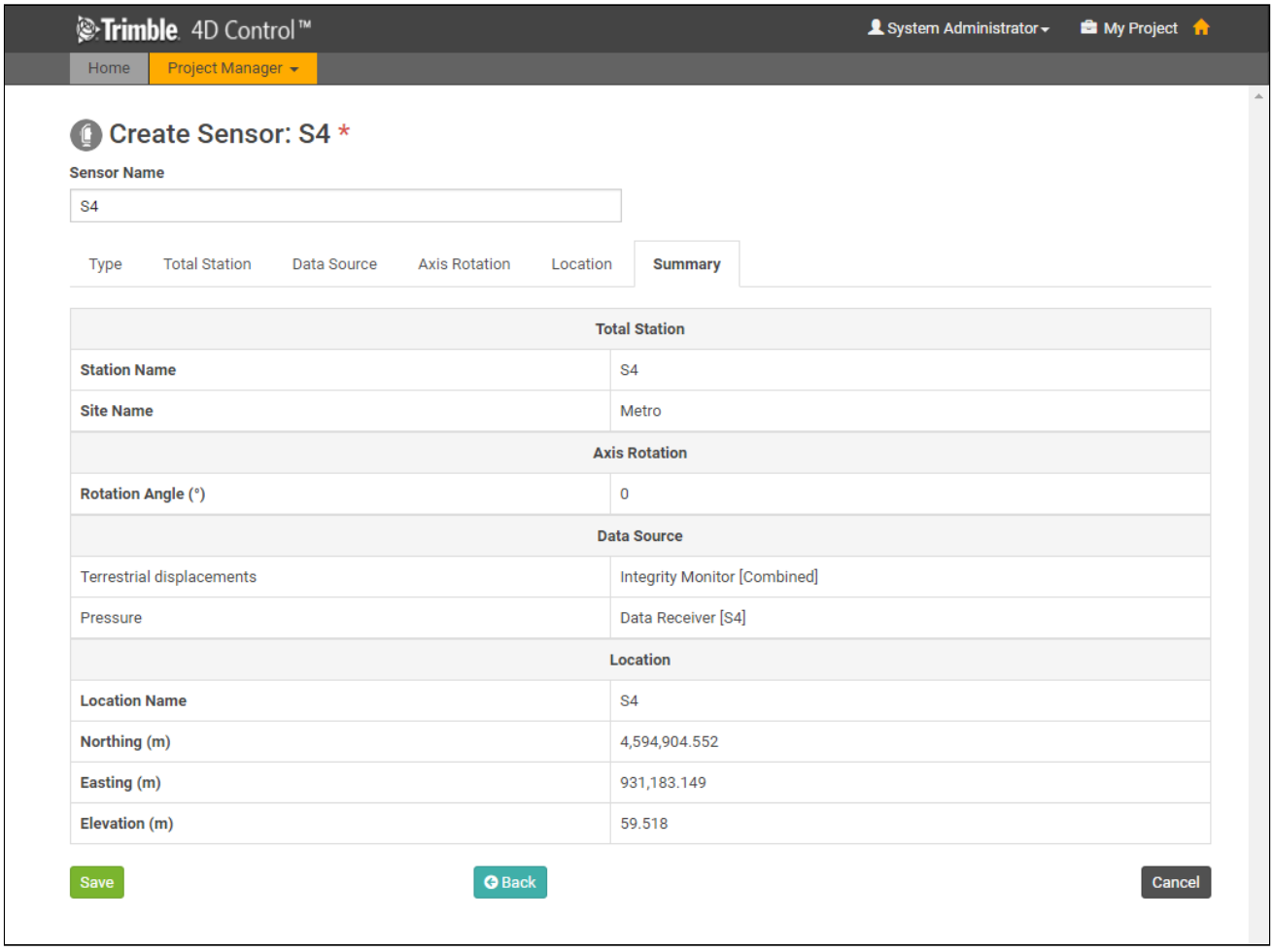
You can however change the **Location Name** or edit the **Coordinates** if required. The **Grid Coordinates** will appear on the left hand side of the page. If you are not using a **Local Coordinate System**, then the **Global Coordinates** will appear on the right hand side.

If you edit the **Grid Coordinates** then the **Global Coordinates** will update accordingly.

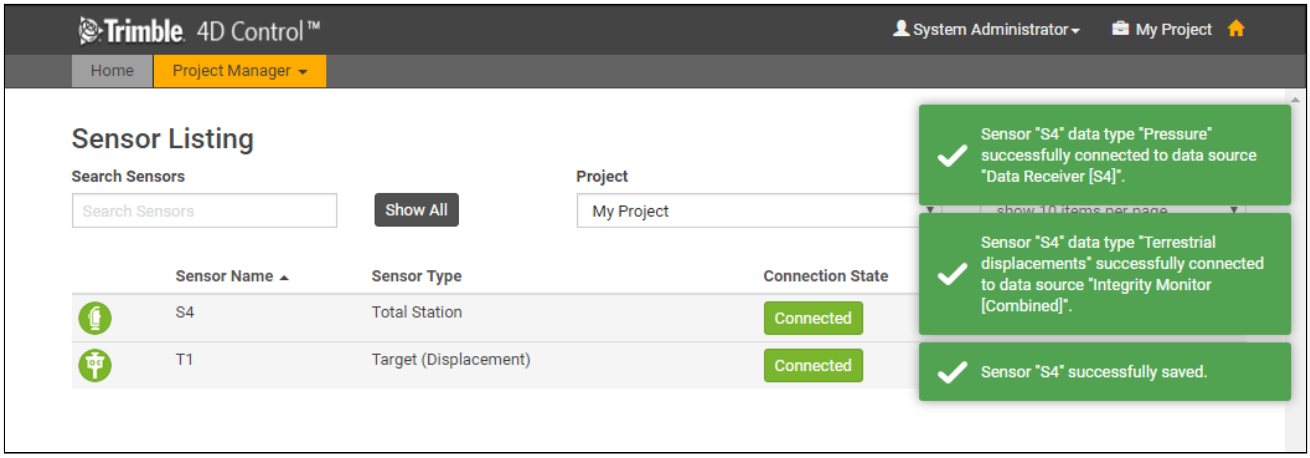
Alternatively you can click on the **Specify Global Coordinates** toggle. This will disable the **Grid Coordinate** fields and enable the **Global Coordinate** fields. If you edit the **Global Coordinates** then the **Grid Coordinates** will be updated automatically.

Global Coordinates can be entered either in **Degrees, Minutes and Seconds** or in **Decimal Degrees**. Simply toggle the switch above the **Global Coordinate** fields to switch between entry modes.

Click on the **Next** button to proceed to the **Summary** tab.



The **Summary** page presents an overview of the sensor configuration. Verify that all the settings are correct and optionally edit the name. Finally click on the **Save** button.



The **GNSS Receiver** will be added to the **Project** and **Connected** to all the selected **Data Sources**.

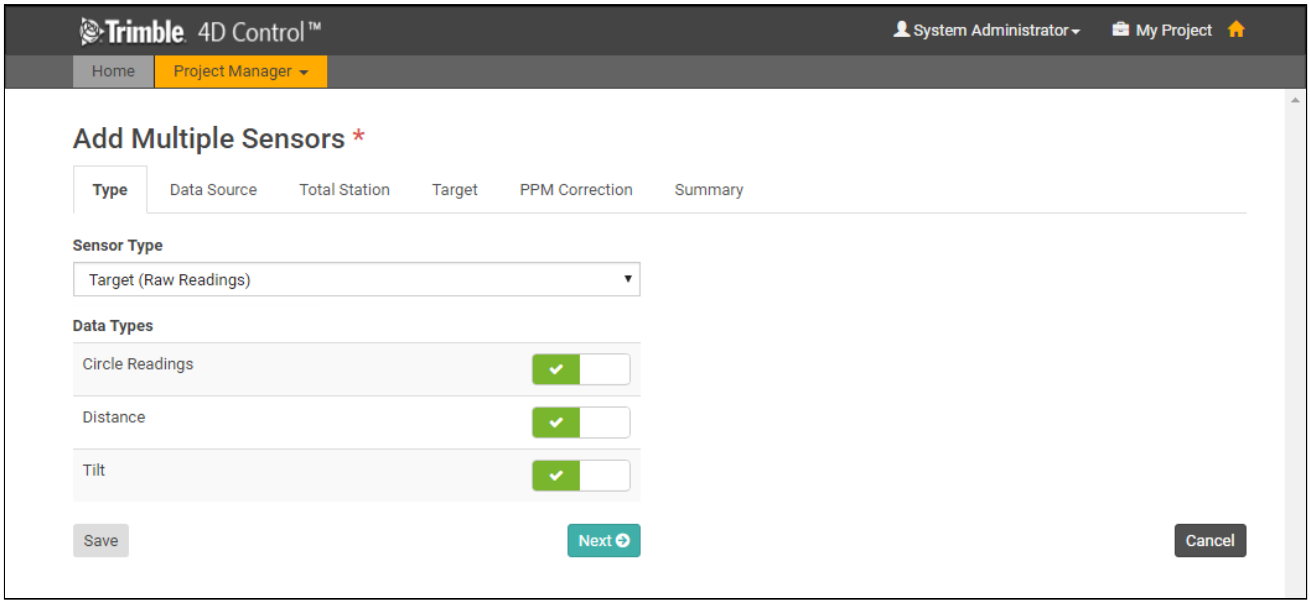
4.3.3.4. Target (Raw Readings)

The **Target (Raw Readings)** or (**"Target Raw"**) sensor type represents the measurement made by one **Total Station** instrument on a specific **Target** or **Prism**.

The actual displacement of the **Prism** is treated as a separate **Sensor Type** - namely **Target Displacements**.

This section covers the process for adding **Target (Raw Readings)** sensors to a **Project**. This can be done one by one, but the preferred approach with prism data is to add sensor in bulk.

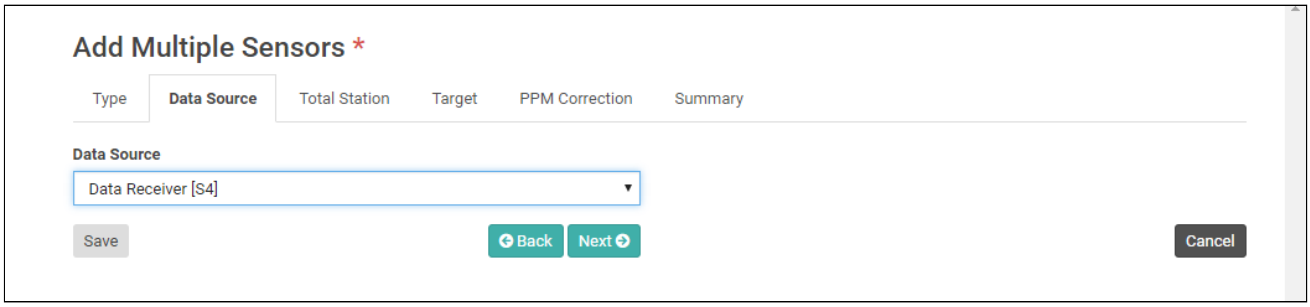
To begin this process, click on the **Add Multiple Sensors** menu item.



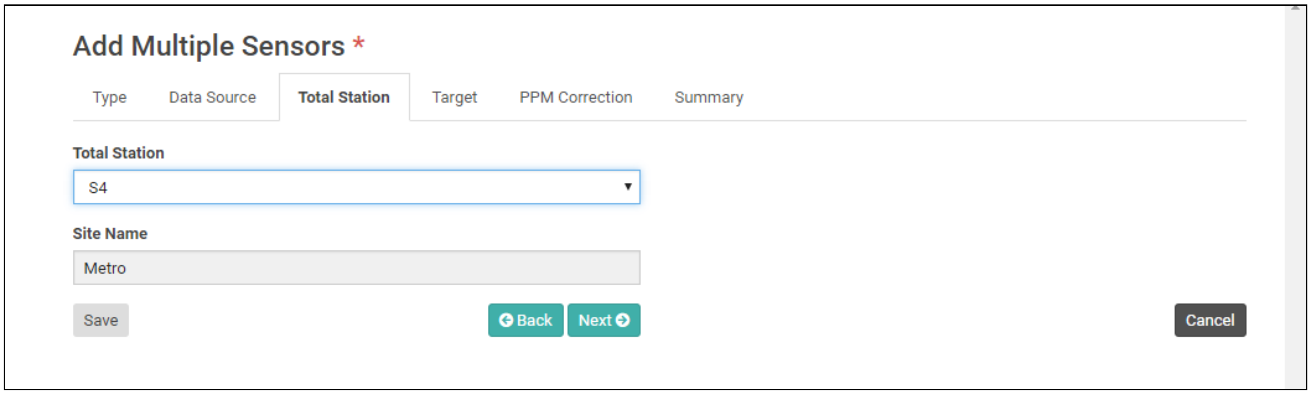
On the **Type** tab, select the **Target (Raw Readings)** sensor type and link the appropriate **Data Types**.

(Note that only the **Type** tab will be visible when the page loads. The subsequent tabs will appear as soon as a **Data Type** is linked to the sensor).

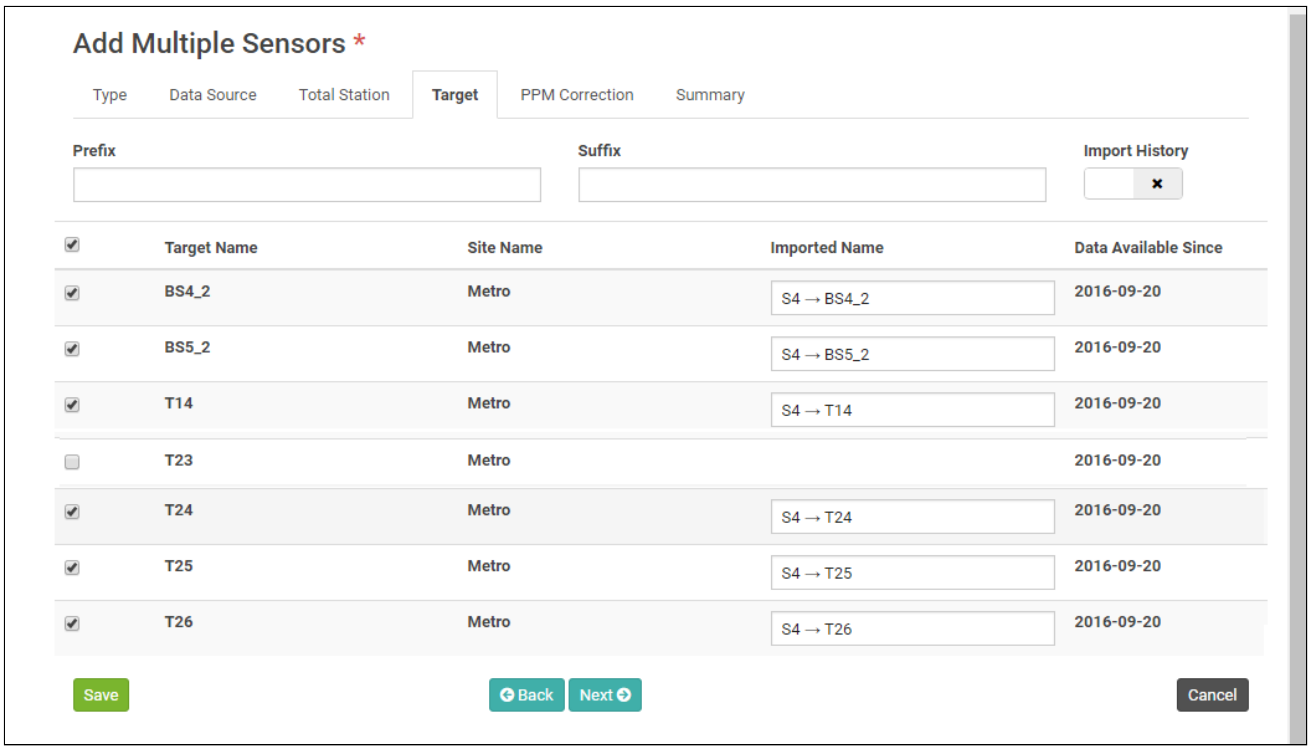
You can proceed to the the next tab by clicking on it, or by clicking in the **Next** button.



The drop down on the **Data Source** tab will contain a list of all the raw measurement modules in **T4D Server**. Select the appropriate options and click on the **Next** button.



The drop down on the **Total Station** tab will list the available **Total Stations** pre-filtered according to the selected **Data Source**. Choose one and click on the **Next** button.



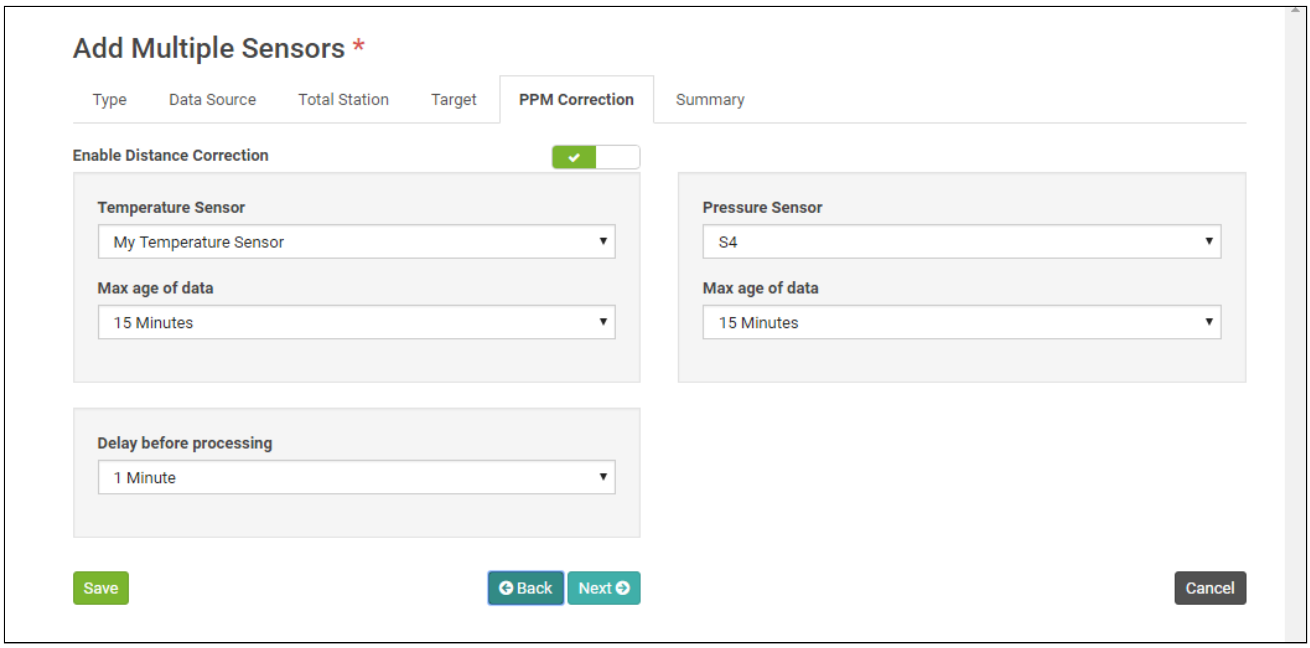
The **Target** tab consists of grid or table showing all the **targets** (or **prisms**) associated with the selected **Data Source** and total station.

By default, all the **targets** will be selected and a default sensor name will be suggested based on the conversion "**[Total Station Name] -> [Target Name]**".

You can select or deselect the individual **targets** that should be imported. You can also edit each sensor name individually, or specify a **Prefix** and/or **Suffix** to be added to the auto-generated names.

Additionally you have the option to import historic observation data (if available). Historic data import will be covered in a later section.

Click on the **Next** button to proceed to the **PPM Correction** tab.



Parts Per Million (PPM) Correction can be applied to distance measurements. The **PPM Correction** tab will be available if the **Distance** data type was selected on the **Type** tab and will contain configuration fields for **PPM Correction**.

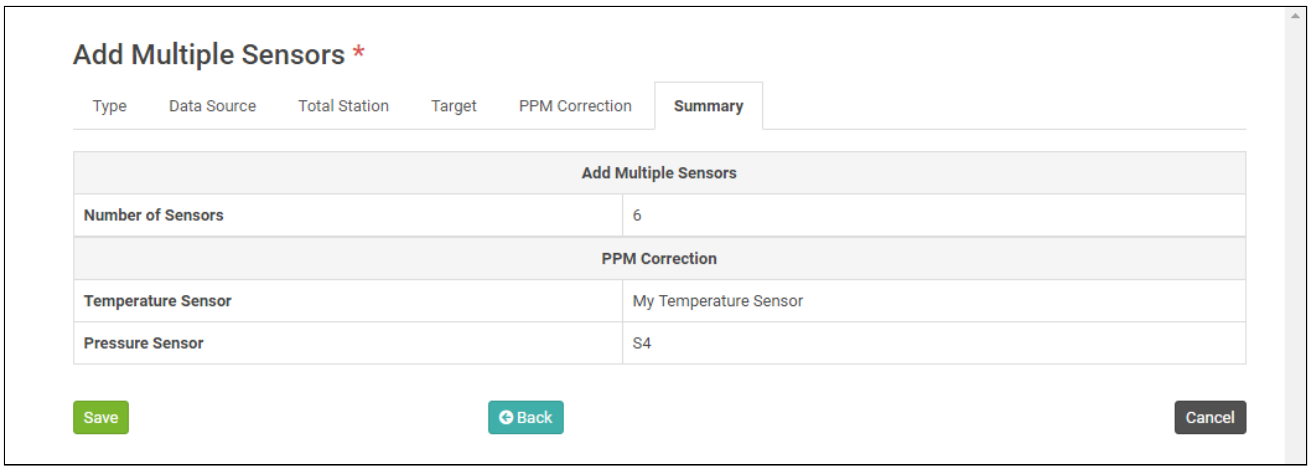
You have the option to skip **PPM Correction**. To do this, simply switch off the **Enable PPM Correction** toggle.

It is important to note that a **Temperature** and **Pressure** data must already be available in the **Project** in order to enable **PPM Correction**. **Temperature** data can come either from a **Papouch Sensor** or from a **Geotechnical Sensor**. **Pressure** data can come either from a **Total Station** or from a **Geotechnical Sensor**.

When the distance measurement data becomes available, **T4D** will look for the most recent observations from the specified **Temperature** and **Pressure** sensors. If the age of these observations is less than the specified **Max data age**, then corrections will be applied.

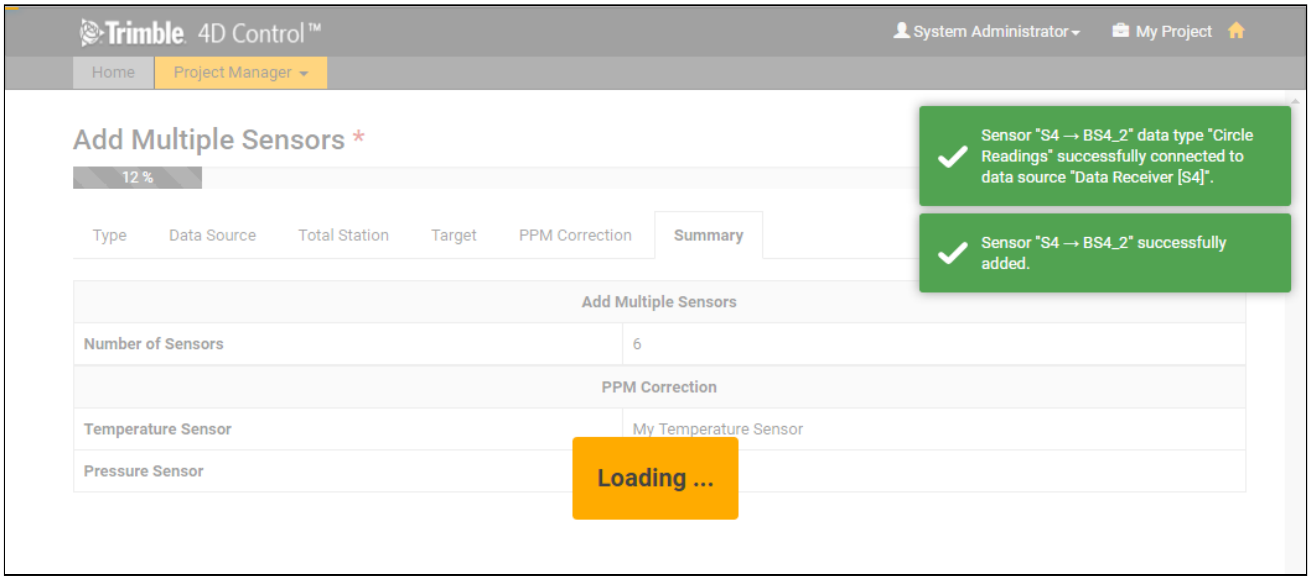
The **Delay before processing** setting can be used to delay the above process. If you are concerned about the difference in data latency from the different data sources then you can consider increasing this value.

Click on the **Next** button to continue to the **Summary** tab.



The **Summary** tab will contain a brief overview of the the number of targets to be added to the **Project** and the **Temperature** and **Pressure** data sources selected for **PPM Correction** (if applicable).

Review these settings can click on the **Save** button.



A progress bar will appear at the top of the page. The **Target (Raw Readings)** sensors will be created and connected to all the selected **Data Sources**.

NB: It is important to keep your browser open and to remain on the current page until the process completes.

When all the sensors have been created and and connected then you will be navigated back to the **Sensor Listing** page.

4.3.3.5. Target (Raw Readings) Trimble Access

The process for adding **Target (Raw Readings) Trimble Access** sensors to the **Project** is essentially the same as the above.

That main difference is that you do not need to provide **PPM Correction** settings. Instead the instrument operator must provide a **Temperature** value in the **Trimble Access** software before starting the survey. The **Pressure** value from the **Total Station** will be used and these two values will be applied for **PPM Correction**.

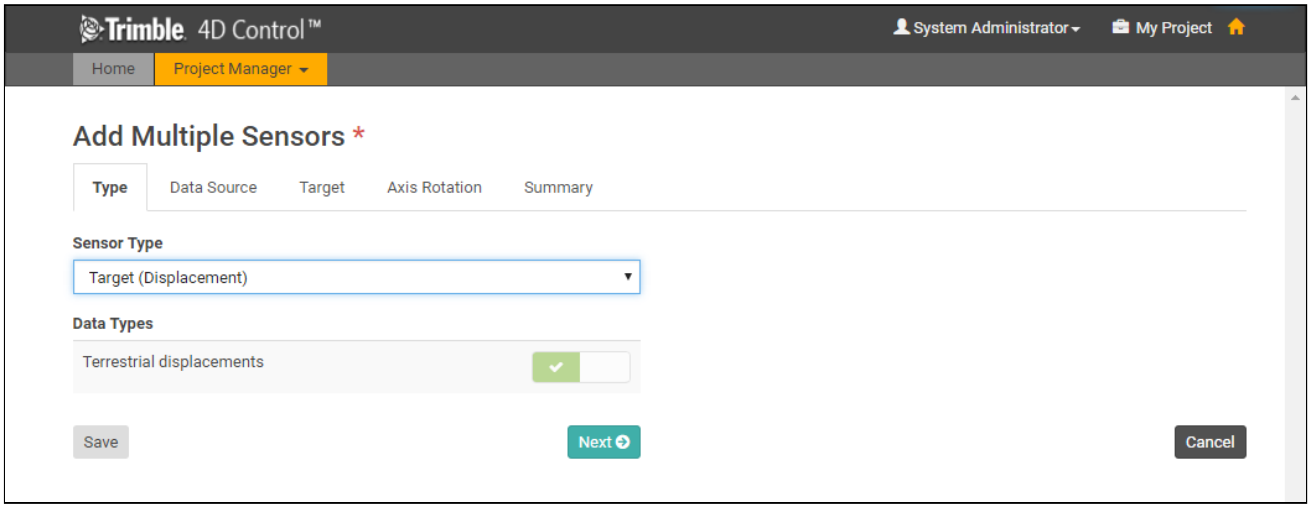
4.3.3.6. Target Displacements

The **Target (Displacement)** sensor type represents the change in **Coordinates** of a specific prism over time.

The raw measurements made from a **Total Station** onto the **prism** are recorded against a separate **Sensor Type** - namely **Target (Raw Readings)**.

This section covers the process for adding **Target (Displacement)** sensors to a **Project**. This can be done one by one, but the preferred approach with prism data is to add sensor in bulk.

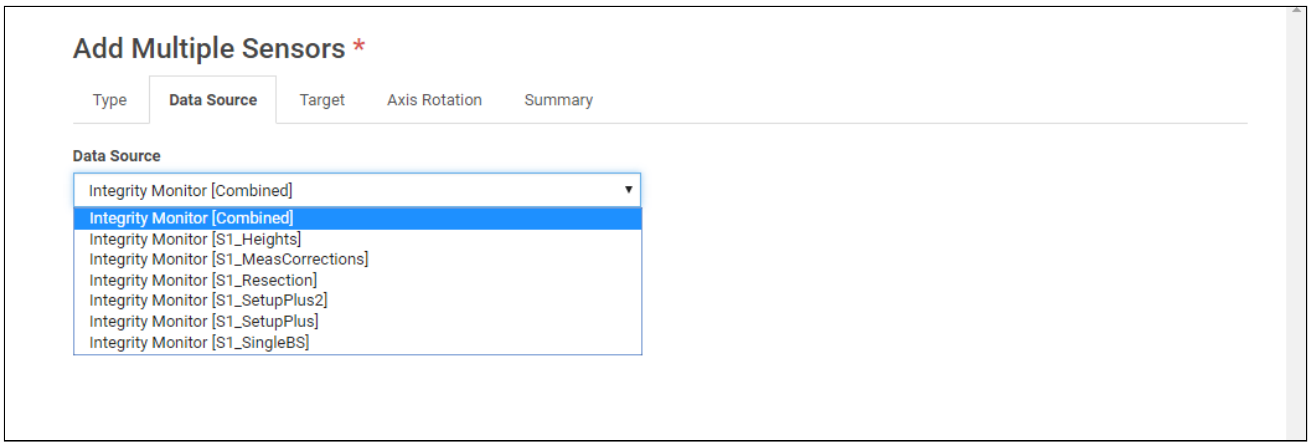
To begin this process, click on the **Add Multiple Sensors** menu item.



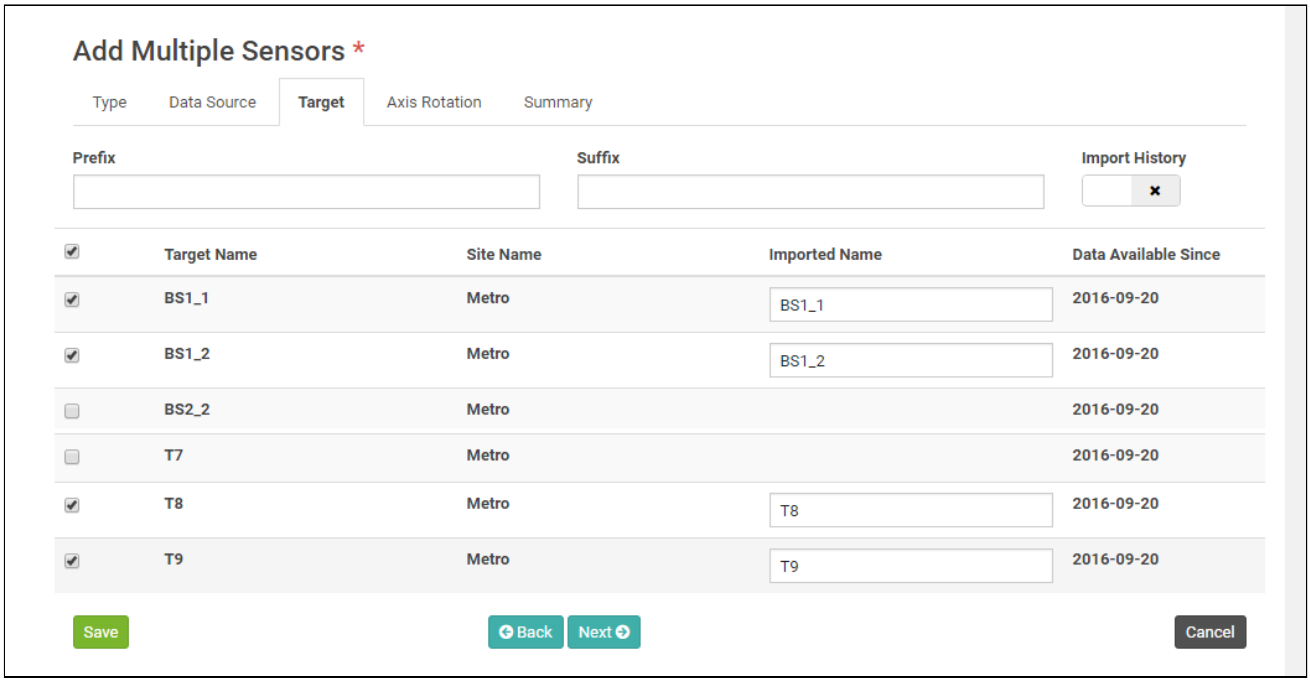
On the **Type** tab, select the **Target (Displacement)** sensor type. The **Terrestrial displacements** data type will be selected automatically.

(Note: If you need to link the **Integrated Survey** data type with a prism, then you can not use the **Add Multiple Sensors** workflow. Click on **Add Sensor** instead).

You can proceed to the the next tab by clicking on it, or by clicking in the **Next** button.



The drop down on the **Data Source** tab will contain a list of all the position modules in **T4D Server**. Select the appropriate options and click on the **Next** button.



The **Target** tab consists of grid or table showing all the **targets** (or **prisms**) associated with the selected **Data Source.**

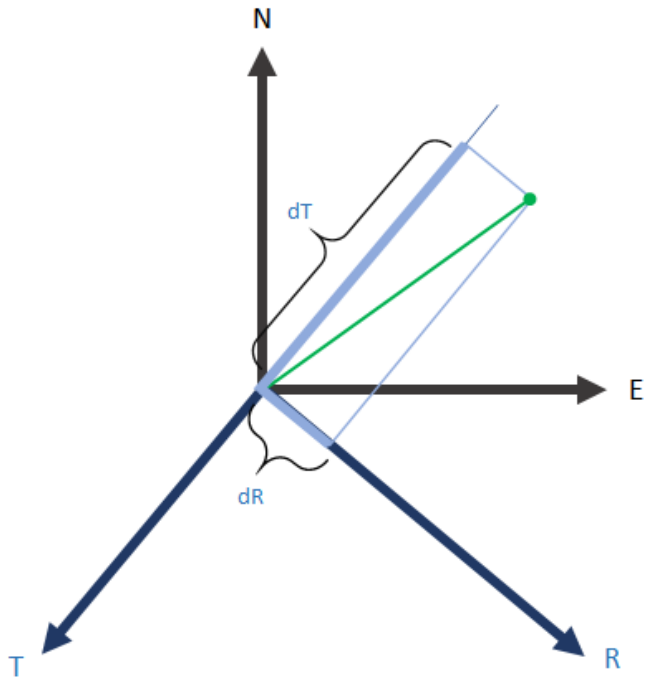
By default, all the **targets** will be selected and a default sensor name will be suggested based on the **Target Name**.

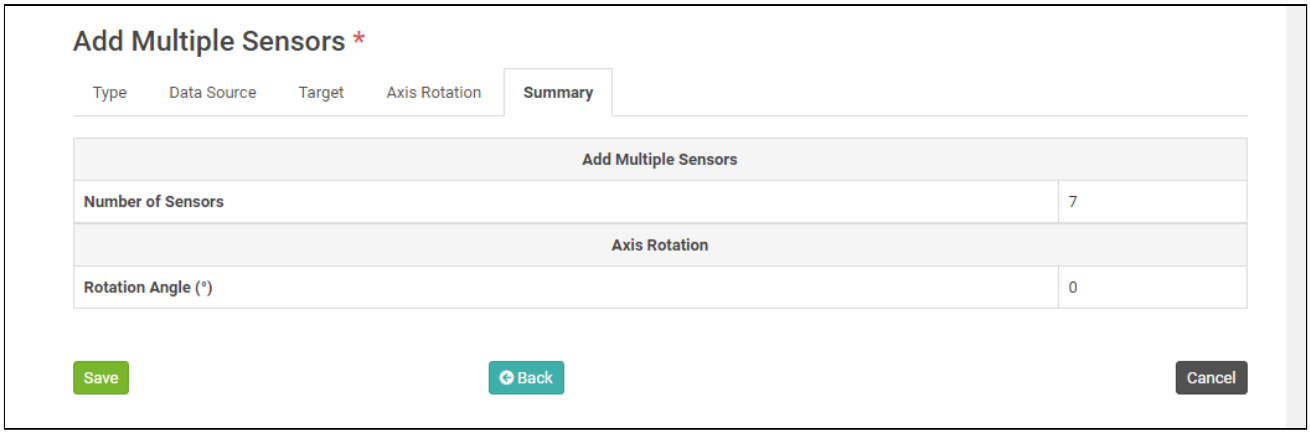
You can select or deselect the individual **targets** that should be imported. You can also edit each sensor name individually, or specify a **Prefix** and/or **Suffix** to be added to the auto-generated names.

Additionally you have the option to import historic observation data (if available). Historic data import will be covered in a later section.

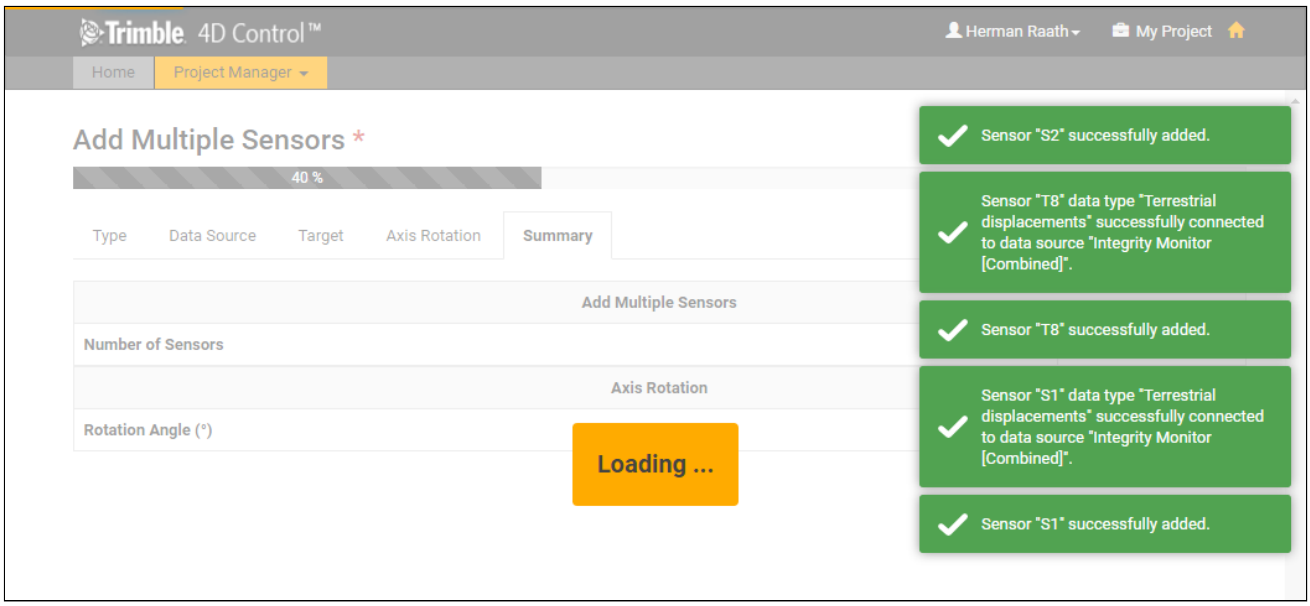
The **Rotation Angle** of the targets can be configured on the next tab. **Axis Rotation** is covered in a later section.

Click on the **Next** button to proceed to the **Summary** tab.





Review the details on the **Summary** tab and then click on the **Save** button.



A progress bar will appear at the top of the page. The **Target (Displacement)** sensors will be created and connected to the selected **Data Source**.

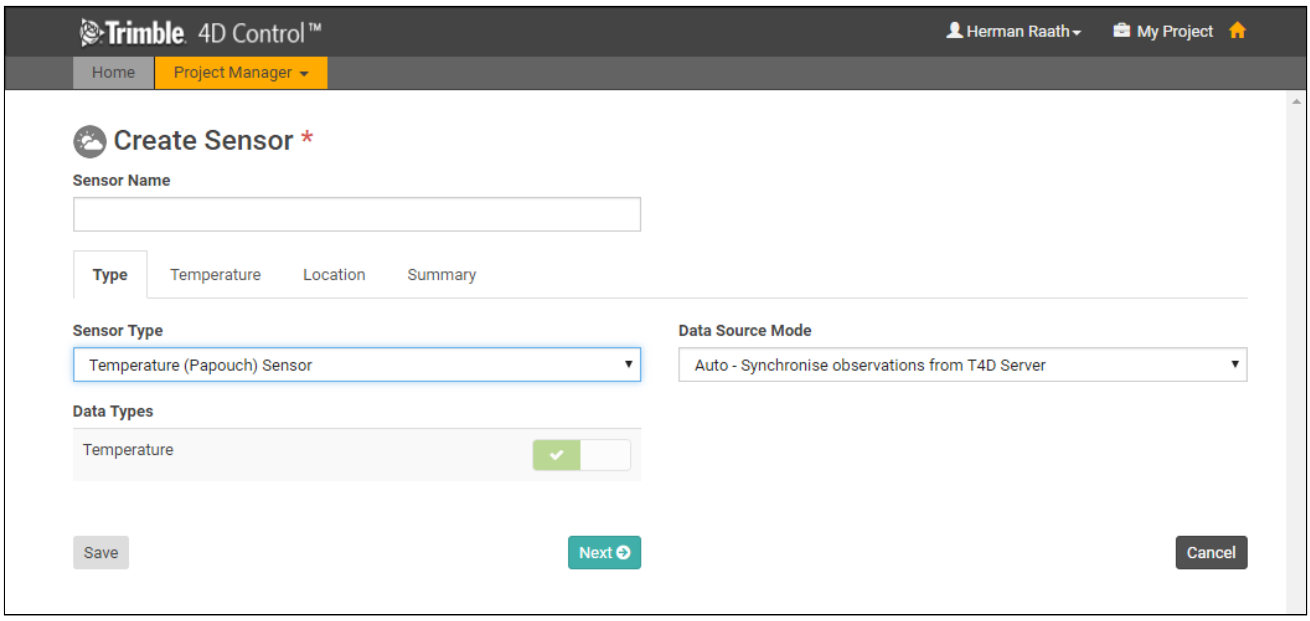
NB: It is important to keep your browser open and to remain on the current page until the process completes.

When all the sensors have been created and and connected then you will be navigated back to the **Sensor Listing** page.

4.3.3.7. Papouch Temperature Sensor

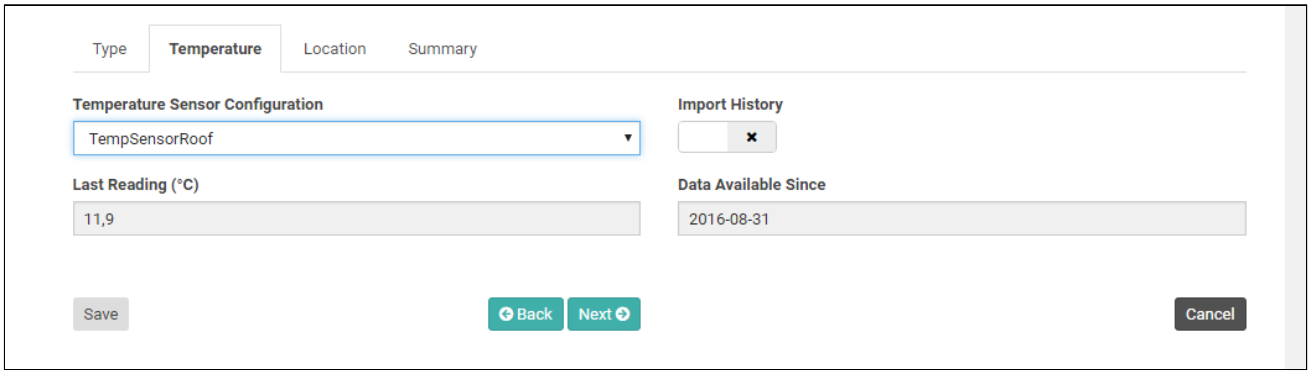
T4D Server natively supports **Papouch Temperature Sensors** and data from these sensors can be synchronised to a monitoring **Project**. If you are interested in **Temperature** readings obtained by a **Data Logger** then refer to the section on **Geotechnical Sensors**.

Click on the **Add Sensor** menu item to begin with the process of adding a **Papouch Temperature Sensor** to the **Project**.



On the **Type** tab, pick the **Temperature (Papouch) Sensor** option. This sensor type supports only one **Data Type** (**Temperature**). The **Data Type** will be linked automatically.

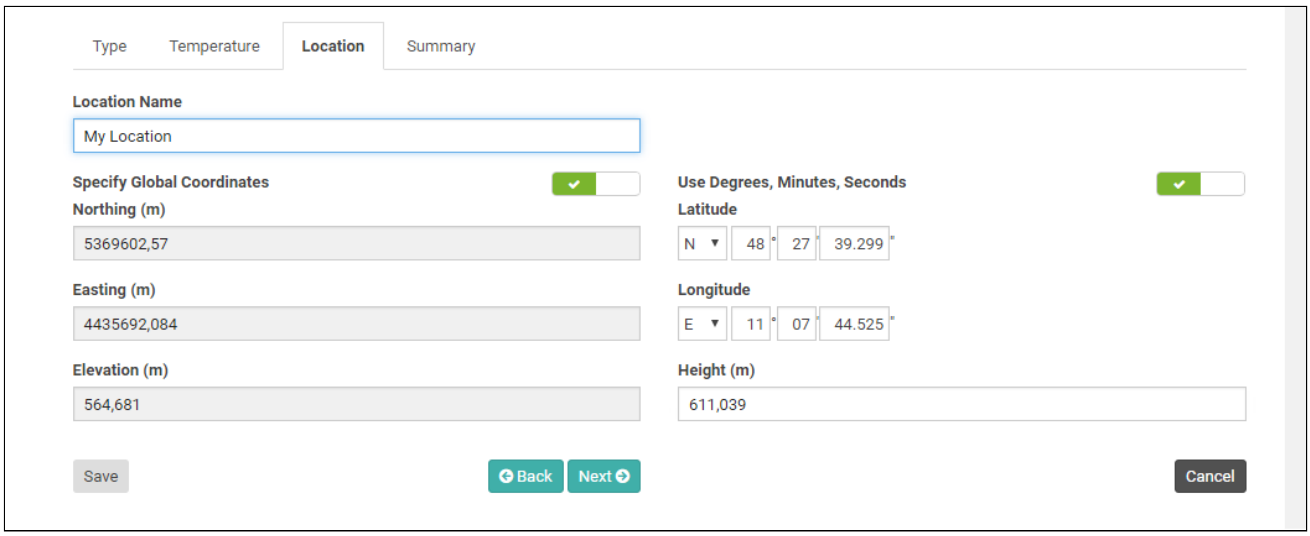
Click on the **Next** button to continue to the **Temperature** tab.



All the **Temperature Sensors** configured in **T4D Server** will be listed in the **Temperature Sensor Configuration** drop down.
When you select a temperature sensor the **Last Reading** value will be populated.

The **Papouch Temperature Sensor** support historic data import. This will be covered in a later section.

Click on the **Next** button to proceed to the **Location** tab.



On the **Location** tab, you will need to specify a **Location Name** and the **Coordinates** of the **Location** of the sensor.

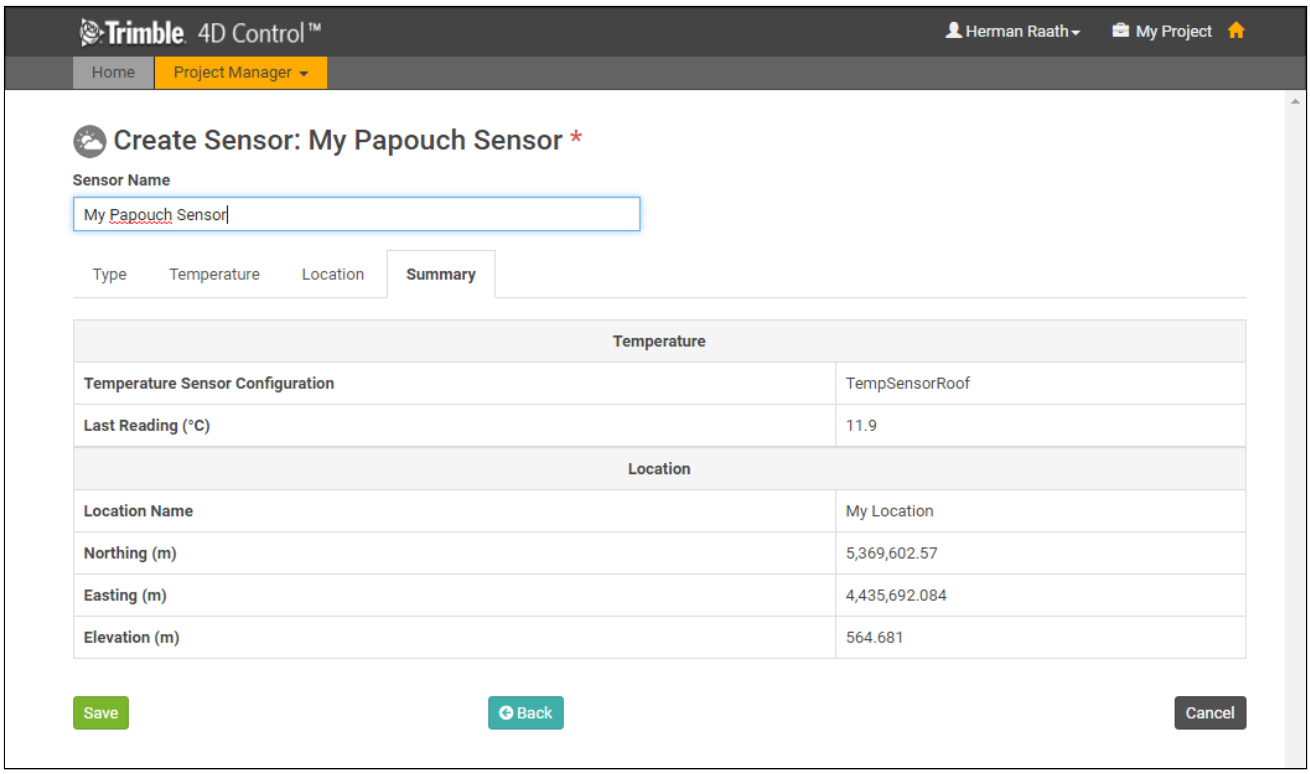
If you already have other **Locations** defined in the **Project** then there will be an option to select an existing **Location.**

Grid Coordinates will appear on the left hand side of the page and **Global Coordinates** (if applicable) will appear on the right hand side.

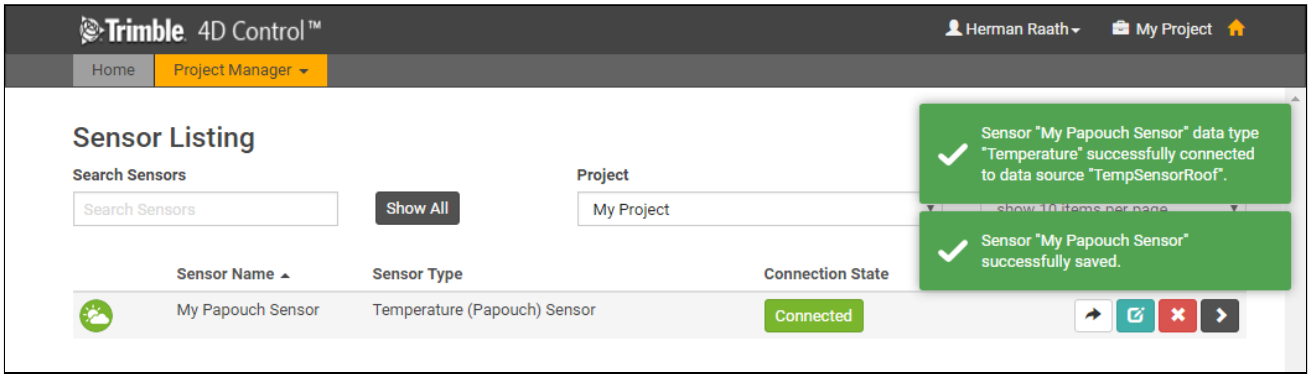
You can switch between specifying either **Grid** or **Global Coordinates** using the **Specify Global Coordinates** toggle switch. **Global Coordinates** can either be specified in **Degrees, Minutes and Seconds** or in **Decimal Degrees**. The toggle switch above the **Global Coordinates** can be used to switch between these two entry modes.

If you choose to specify **Grid Coordinates** then the **Global Coordinates** will be updated automatically. Conversely, if you choose to specify **Global Coordinates** then the **Grid Coordinates** will be updated automatically.

Click on the **Next** button to proceed to the **Summary** tab.



Review the details on the **Summary** tab. Enter a **Sensor Name** and click on the **Save** button.



The **Papuch Temperature Sensor** will be added to the project and connected to the **Data Source**.

4.3.3.8. Geotechnical Sensors

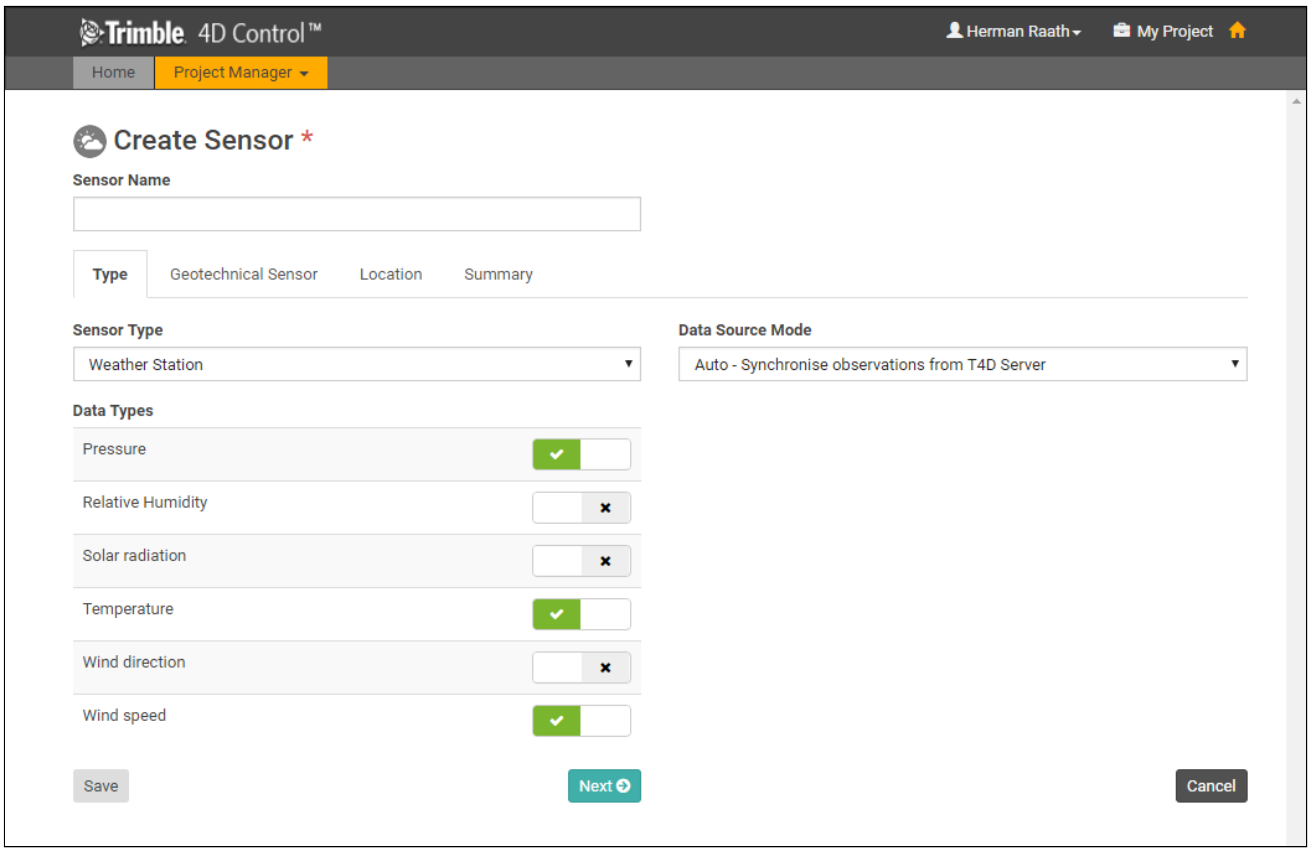
Trimble 4D Control supports a variety of **Geotechnical Sensors**. Before adding **Geotechnical Sensors** to a **Project**, it will be required to configure **Data Logger(s)** in **T4D Server**. For details on how to configure a **Data Logger** in T4D Server, please refer to the T4D Server help files.

The following Geotechnical Sensor Types are supported by default:

- Crack meters
- Data Loggers
- Earth Pressure Cells
- Extensometers
- Hygrometers
- Inclinometers
- Load Cells
- Piezometers
- Rain Gauges
- Soil Moisture Content Sensors
- Strain Gauges
- Tiltmeters
- Water Level Gauges
- Weather Stations

It is also possible to define additional **Geotechnical Sensor Types**.

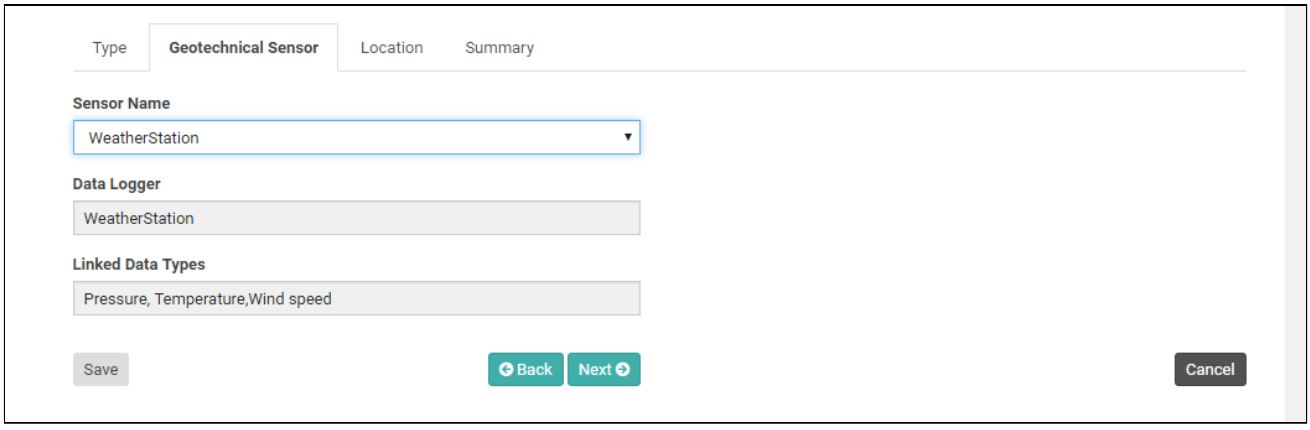
Do add a new **Geotechnical Sensor** to the **Project** click on **Add Sensor**.



On the **Type** tab, select one of the **Geotechnical Sensor Types** listed above and select the **Data Types** that should be linked to the **Geotechnical Sensor**.

(Note that only the **Type** tab will be visible when the page loads. The subsequent tabs will appear as soon as a **Data Type** is linked to the sensor).

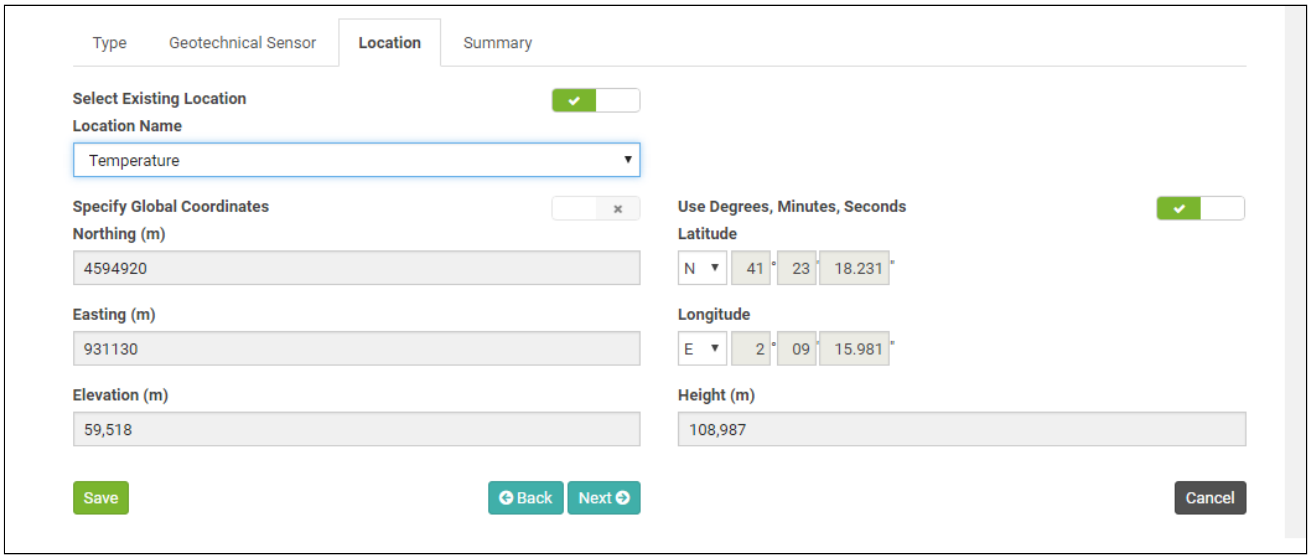
Click on the **Next** button to proceed.



The drop down at the top of the **Geotechnical Sensor** tab will list all the **Geotechnical Sensors** configured in **T4D Server** but filtered according to the selected data types.

If you have not specified a sensor name before this point, then the sensor name will default to the selected entry. Details of the **Data Logger** module and the linked data types will be displayed in the remaining two fields on the tab.

Click on the **Next** button to proceed to the **Location** tab.



On the **Location** tab, you will need to specify a **Location Name** and the **Coordinates** of the **Location** of the sensor.

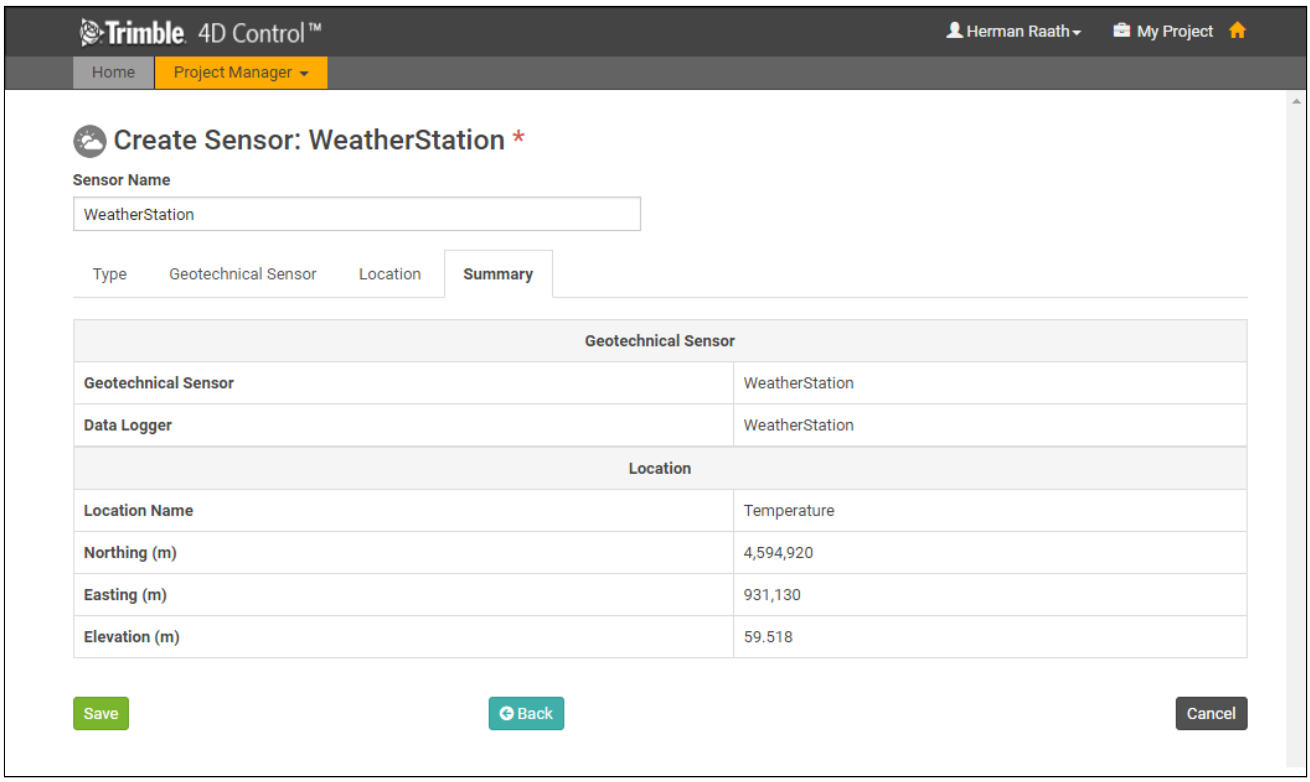
If you already have other **Locations** defined in the **Project** then there will be an option to select an existing **Location.**

Grid Coordinates will appear on the left hand side of the page and **Global Coordinates** (if applicable) will appear on the right hand side.

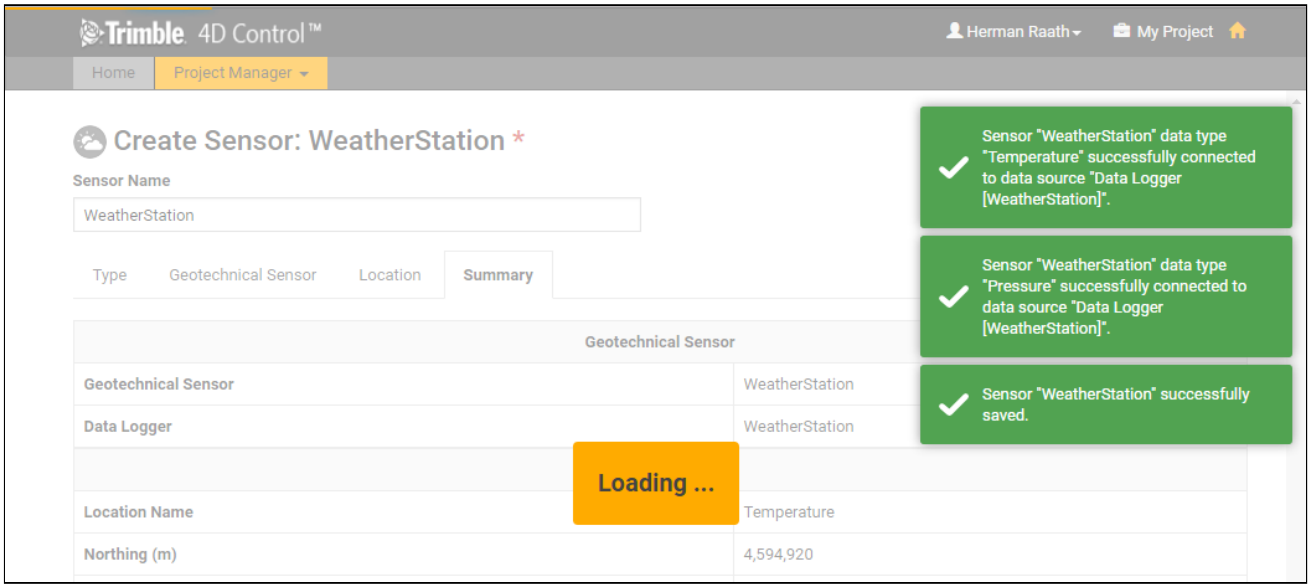
You can switch between specifying either **Grid** or **Global Coordinates** using the **Specify Global Coordinates** toggle switch. **Global Coordinates** can either be specified in **Degrees, Minutes and Seconds** or in **Decimal Degrees**. The toggle switch above the **Global Coordinates** can be used to switch between these two entry modes.

If you choose to specify **Grid Coordinates** then the **Global Coordinates** will be updated automatically. Conversely, if you choose to specify **Global Coordinates** then the **Grid Coordinates** will be updated automatically.

Click on the **Next** button to proceed to the **Summary** tab.



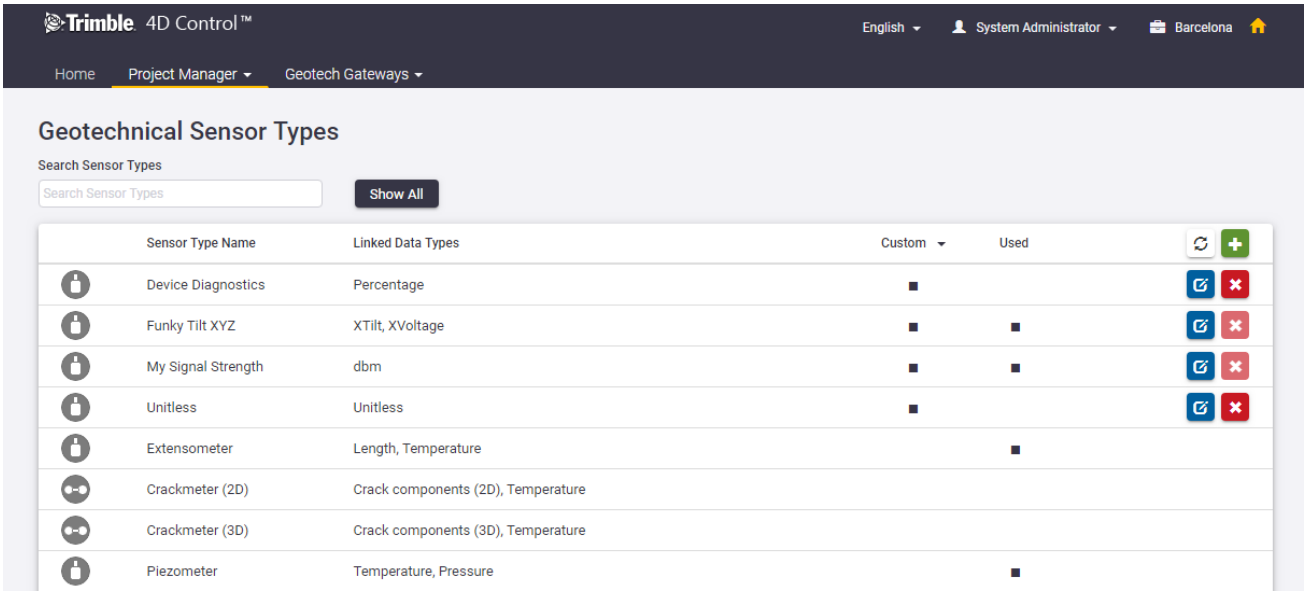
Review the details on the **Summary** tab and optionally specify a new name for the sensor. When you are satisfied that everything is correct, then you can proceed to click on the **Save** button.



The **Geotechnical Sensor** will be added to the **Project** and connected to the specified data sources.

4.3.3.9. Custom Geotechnical Sensor Types

To define a new **Geotechnical Sensor Type** click on **Project Manager > Geotechnical Sensor Types** in the menu.



A list of the existing **Geotechnical** sensor types will appear. In each item in the list there will be a clear indication on whether or not the sensor type is a **Custom** sensor type and whether or not it has ever been **Used**.

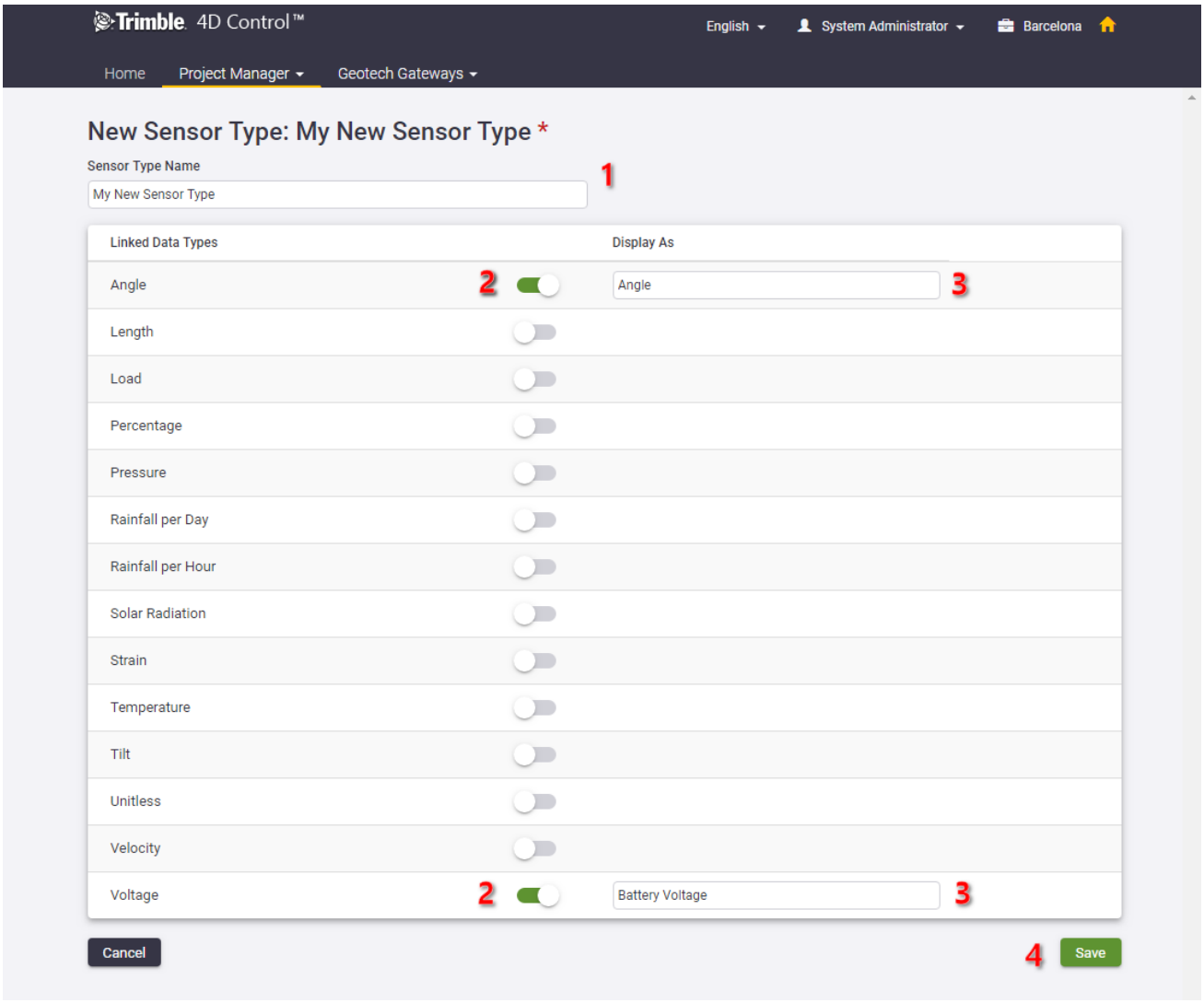
By default the, list will be sorted to display **Custom** sensor types at the top of the list.

Only **Custom** sensor types that have never been **Used**, can be deleted and only **Custom** sensor types can be edited.

To define a new **Custom Geotechnical**sensor type, simply click on the "+" button.

The steps defining a custom geotechnical sensor type are as follows:

1. Specify a name for the new **Sensor Type**.
2. Select the **Data Types** to be associated with the **Sensor Type**.
3. Optionally specify a **Display Type** (or alias) to be used for each linked **Data Type**.
4. Click on the **Save** button.

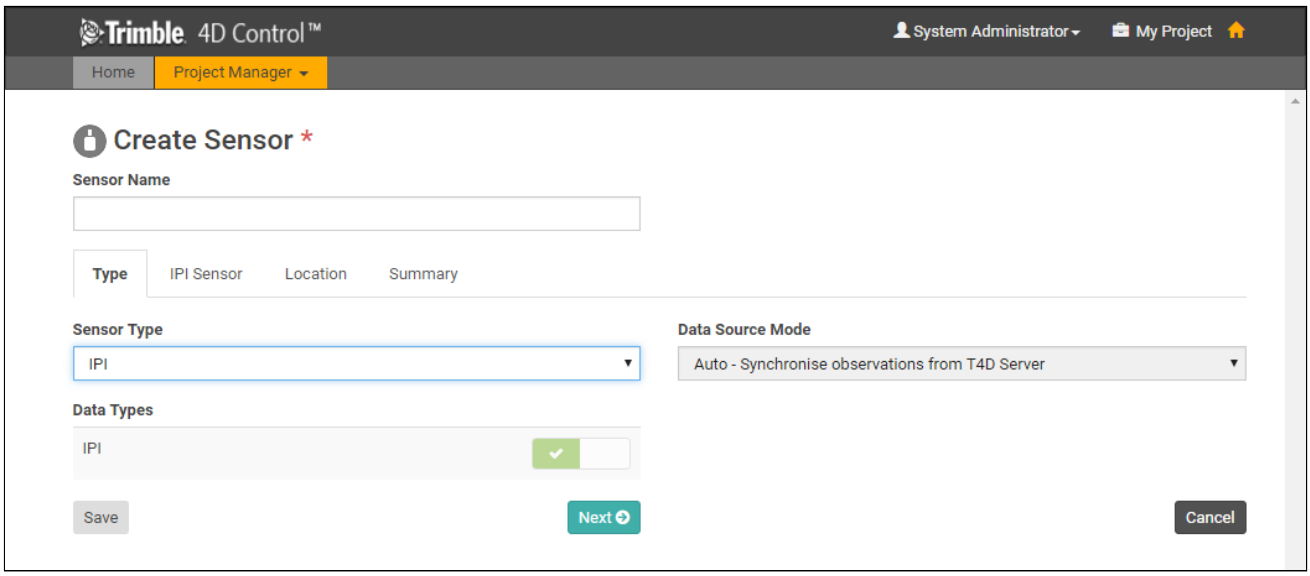


The new **Geotechnical Sensor Type** will be created. This new sensor type will be available from the **Sensor Type** drop down on the **Add Sensor** page.

4.3.3.10. In-Place Inclinometer Arrays

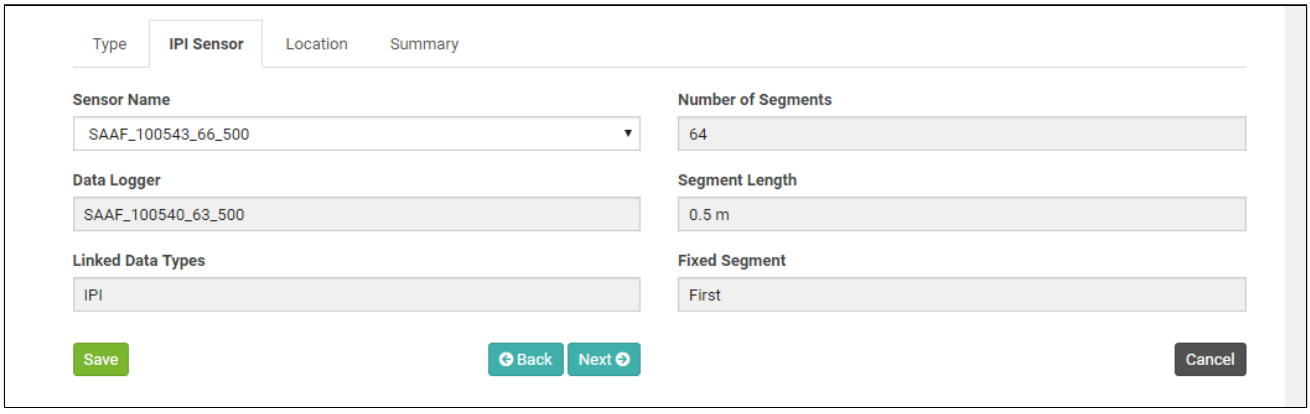
As of version 4.6, **Trimble 4D Control** natively supports **In-Place Inclinometer Arrays** (called an **IPI** for short). Once you have config an **IPI** in **T4D Server** you can add it to the **Project.**

Click on the **Add Sensor** menu item.



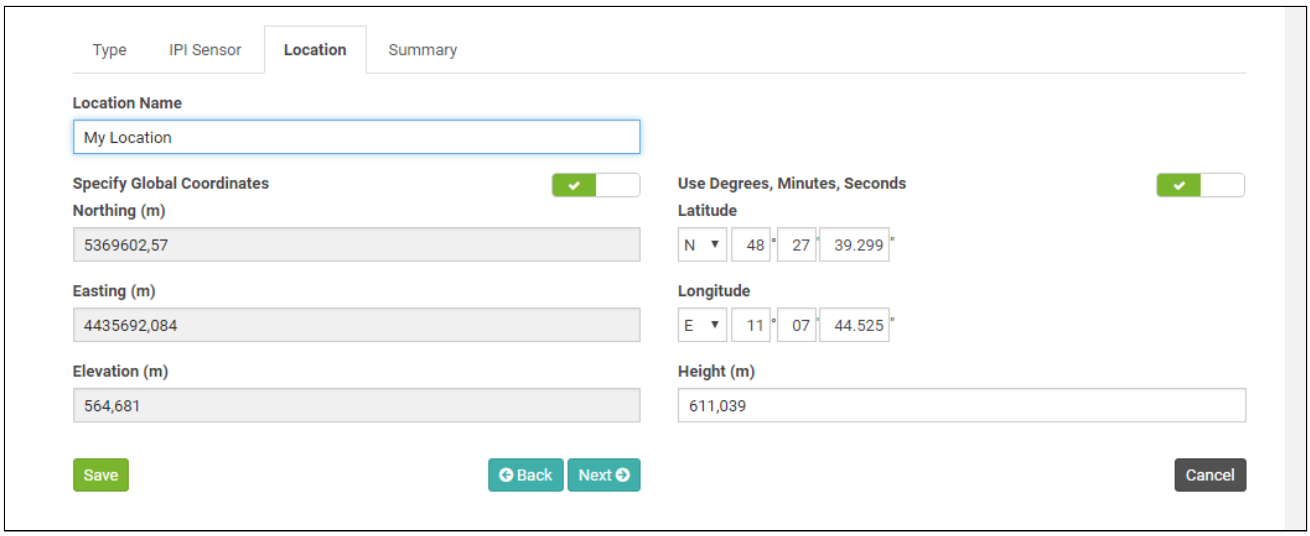
On the **Type** tab select the **IPI** sensor type. This sensor type is associated only with the **IPI Data Type** which will be linked automatically.

Click on the **Next** to proceed.



The drop down at the top of the **IPI Sensor** tab will list all all the **IPI** arrays that have been configured in **T4D Server**. The sensor name will be defaulted to the selection and the remaining fields will display additional information on the selected **IPI**.

Click on the **Next** button to proceed to the **Location** tab.



On the **Location** tab, you will need to specify a **Location Name** and the **Coordinates** of the **Location** of the sensor.

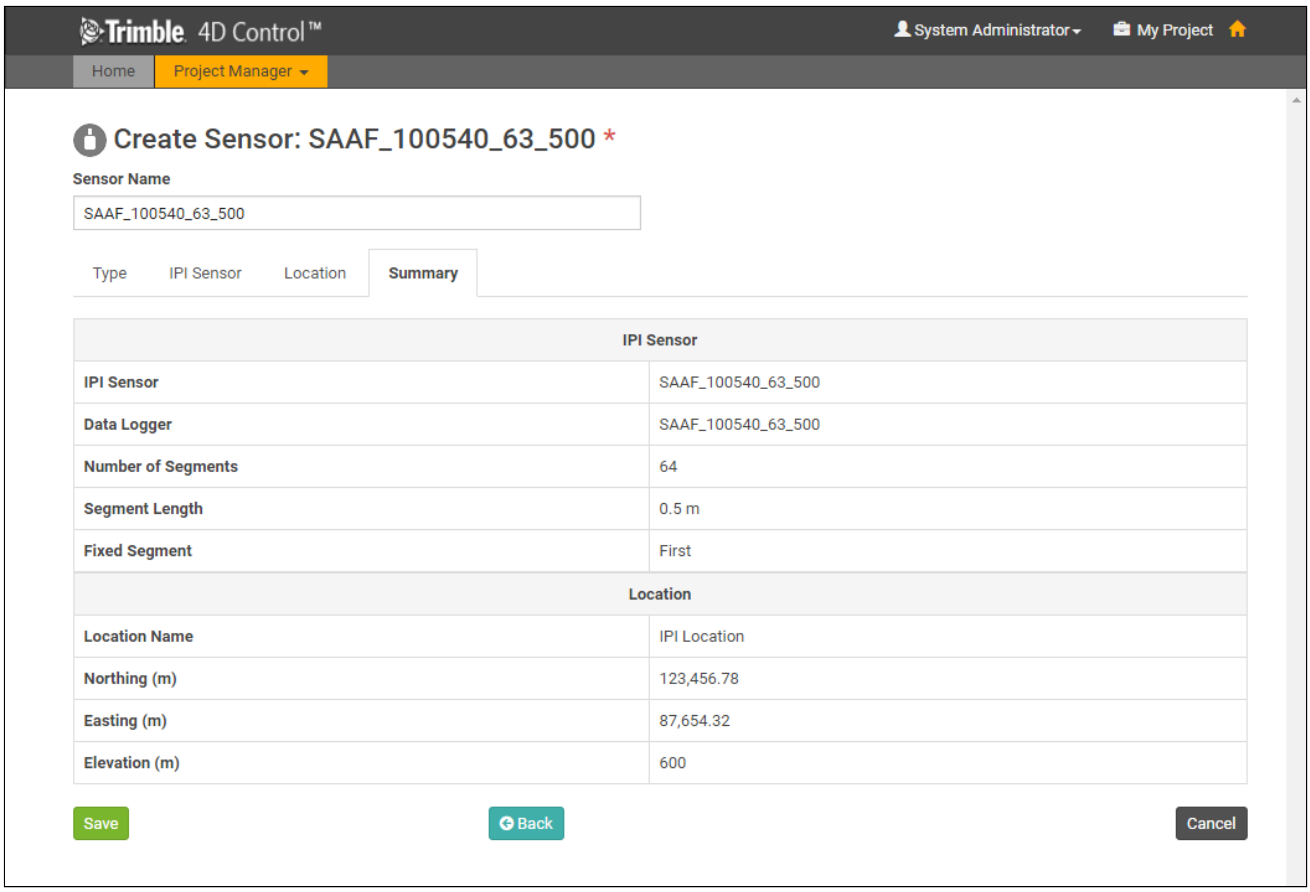
If you already have other **Locations** defined in the **Project** then there will be an option to select an existing **Location.**

Grid Coordinates will appear on the left hand side of the page and **Global Coordinates** (if applicable) will appear on the right hand side.

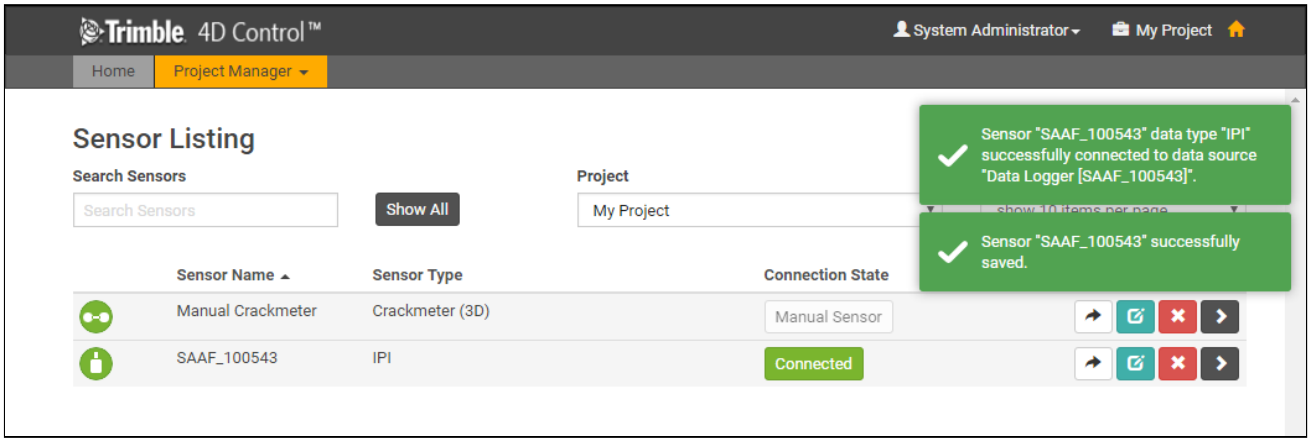
You can switch between specifying either **Grid** or **Global Coordinates** using the **Specify Global Coordinates** toggle switch. **Global Coordinates** can either be specified in **Degrees, Minutes and Seconds** or in **Decimal Degrees**. The toggle switch above the **Global Coordinates** can be used to switch between these two entry modes.

If you choose to specify **Grid Coordinates** then the **Global Coordinates** will be updated automatically. Conversely, if you choose to specify **Global Coordinates** then the **Grid Coordinates** will be updated automatically.

Click on the **Next** button to proceed to the **Summary** tab.



Review the details on the **Summary** tab and click on the **Save** button.

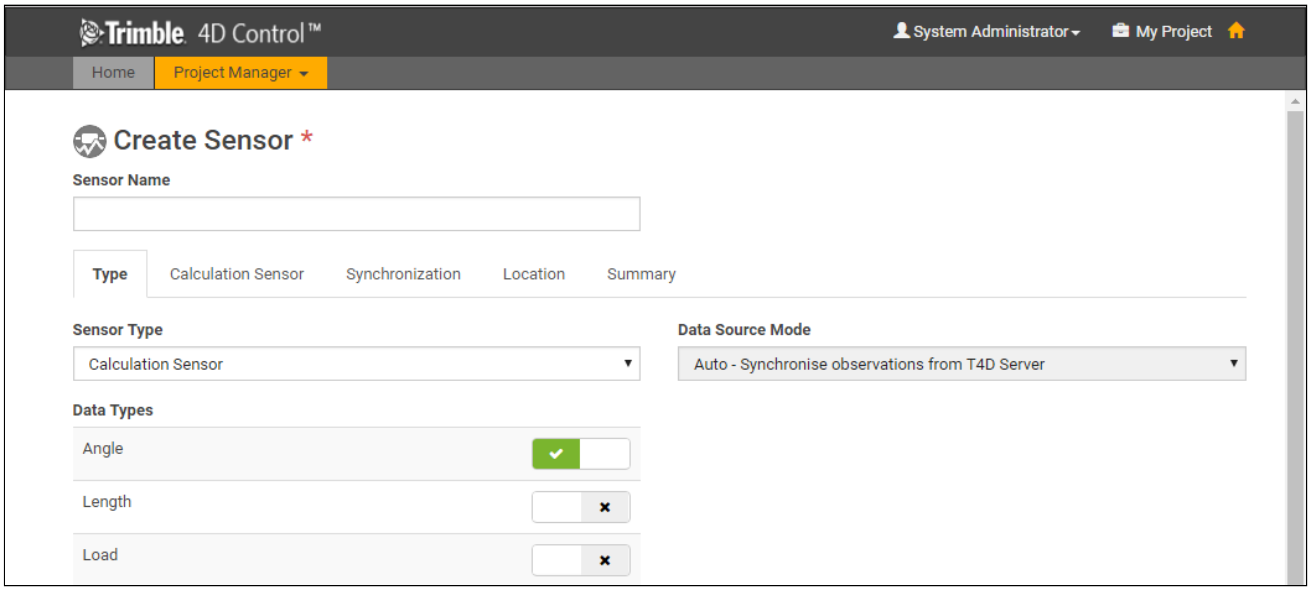


The **IPI** sensor will be added to the **Project** and linked to the selected **Data Source**.

4.3.3.11. Calculation Sensors

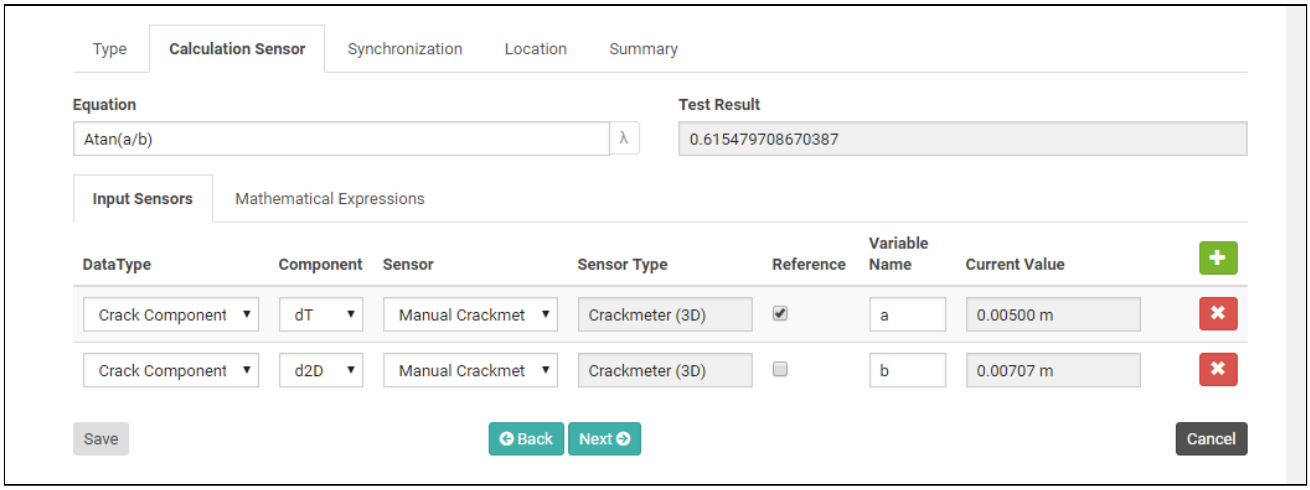
Calculation Sensors can be used to produce a calculated scalar data stream based on the inputs of one or more sensors.

To define a new **Calculation Sensor**, click on the **Add Sensor** menu item.



On the **Type** tab select the **Calculation** sensor type and pick an output **Data Type**. Take note that a **Calculation Sensor** can only be linked to a single output **Data Type**.

Click on the **Next** button to proceed to the **Calculation Sensor** tab.



The **Calculation Sensor** tab allows you to configure complex calculations.

You can go ahead and type the **Equation** of the calculation you have in mind. A list of supported expressions and operations can be found on the **Mathematical Expressions** sub tab.

If the project already contains other calculation sensors, then you can quickly re-use the **Equations** from there by clicking on the **λ** button.

The **Input Sensor** sub tab contains a grid where any number of input sensors can be defined. Click on the green **plus** button to add an input.

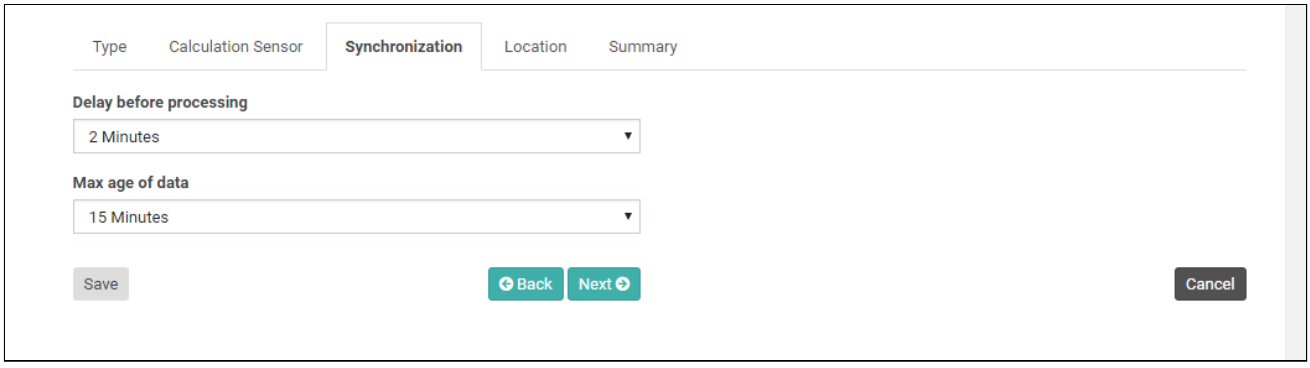
When you choose a **Data Type** then the **Component** and **Sensor** drop downs will be populated accordingly. When you choose a **Sensor** then the **Sensor Type** field will be populated and the **Current Value** will be extracted from the database.

By default, the **Variable Names** associated with each input will be designated as “a”, “b”, “c”, “d” etc. These variable can however changed to match the variable names as they appear in the **Equation** at the top of the page.

Each time that you change either the equation or any of the inputs, an attempt will be made to calculate a **Test Result**. This attempt must succeed before you will be allowed to add the **Sensor**.

NB: It is important to understand the the **Current Value,** the actual **Calculation** and the **Test Result** will be in terms of **SI Units**. In the example above, the **Test Result** value is in **Radians.** However, once the sensor has been configured the output data stream will be presented in the display unit selected for the project.

One of the inputs must be set as the **Reference** input. This input, along with the settings on the next tab will determine **when** the calculation will take place. Click on the **Next** button to continue to the **Synchronization** tab.



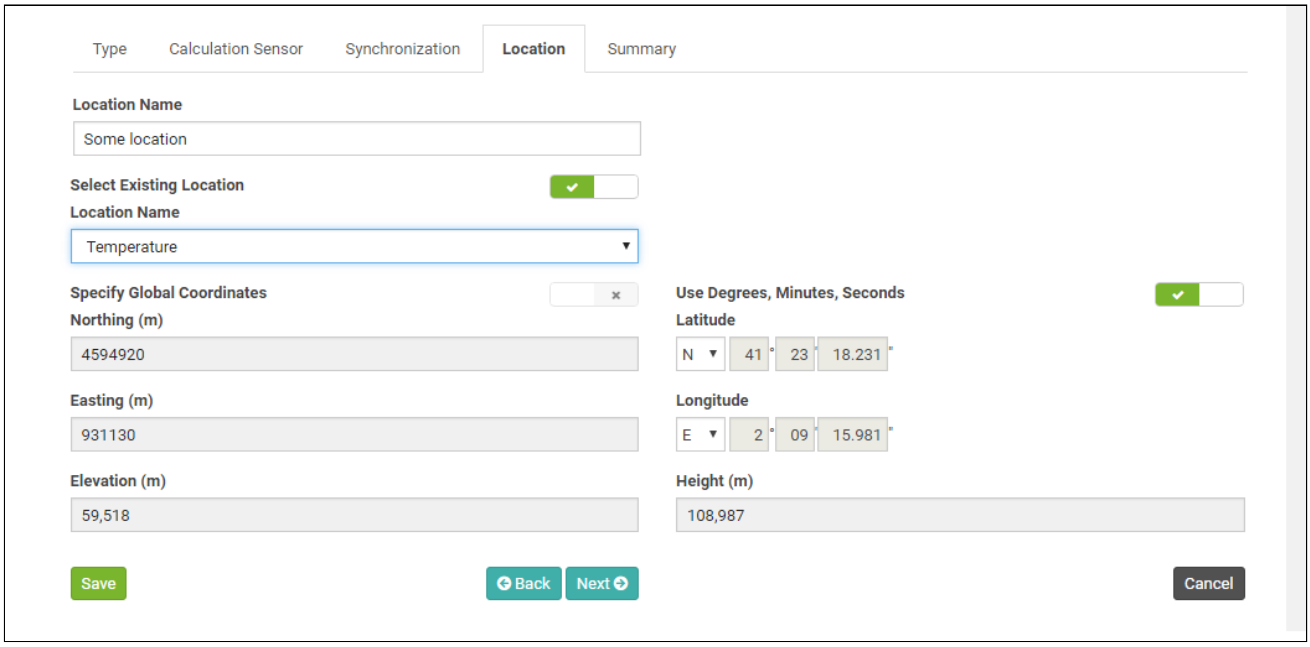
Calculation Sensors can accept inputs from different sensors and these sensors may deliver data at different intervals and with various degrees of latency. This can complicate the logic with regards to **when** and **with what** to calculate a new output.

The **Delay before processing** value applies to the **Input Sensor** that has been flagged as the **Reference.** When a new observation from the **Reference Input Sensor** becomes available, then **T4D** will wait for the specified **Delay** time before attempting a calculation.

When the above **Delay** expires, **T4D** will look for the latest available observation from all other **Input Sensors**. If observations can be found for all these sensors, and if none of these observations are older than the **Max age of data**, then the calculation will be perform and an output will be generated.

The timestamp on the output will correspond with the timestamp of the observation that came from the **Reference Input Sensor**.

Click on the **Next** button to proceed to the **Location** tab.



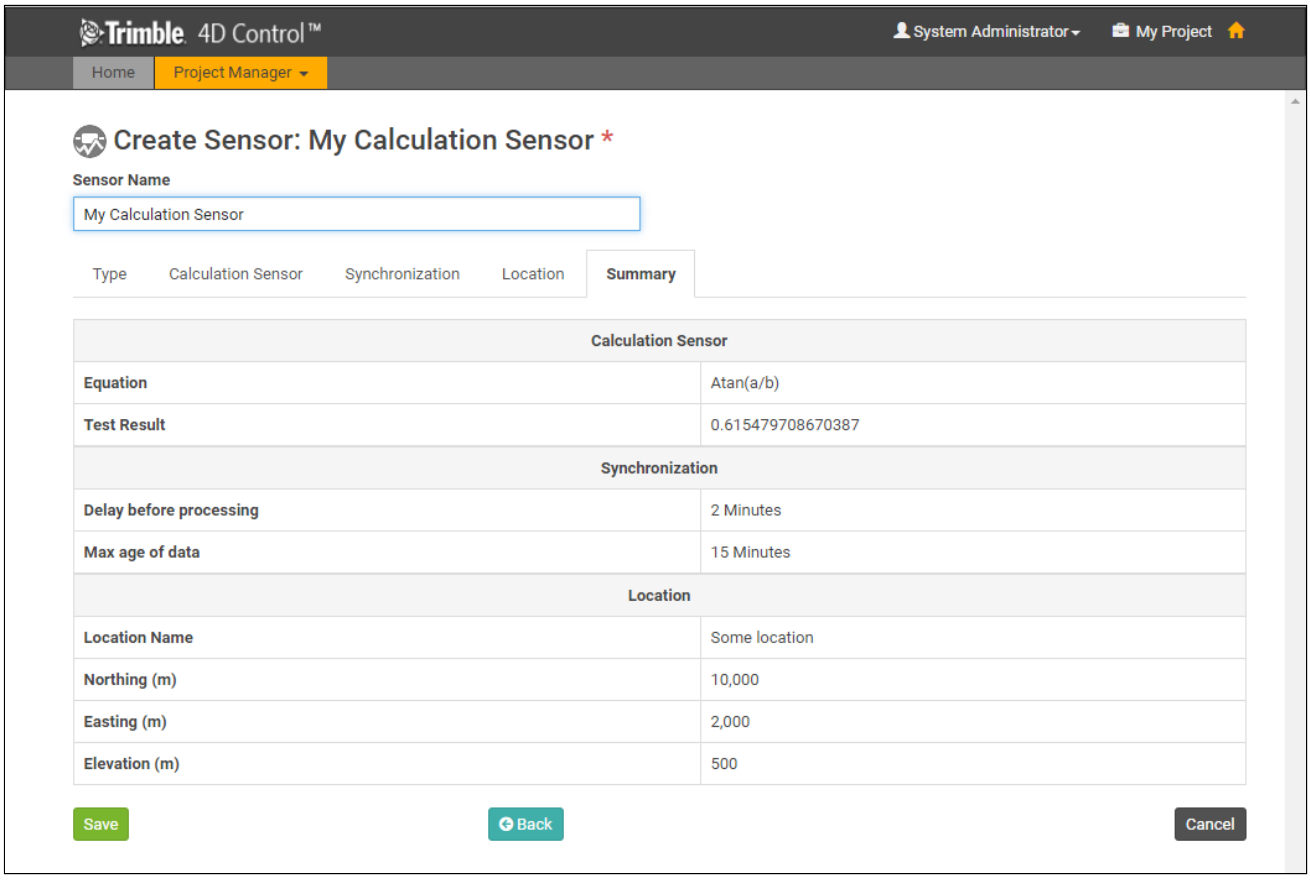
On the **Location** tab, you will need to either specify a **Location Name** and the **Coordinates** of the **Location** of the sensor or select an existing **Location**.

Grid Coordinates will appear on the left hand side of the page and **Global Coordinates** (if applicable) will appear on the right hand side.

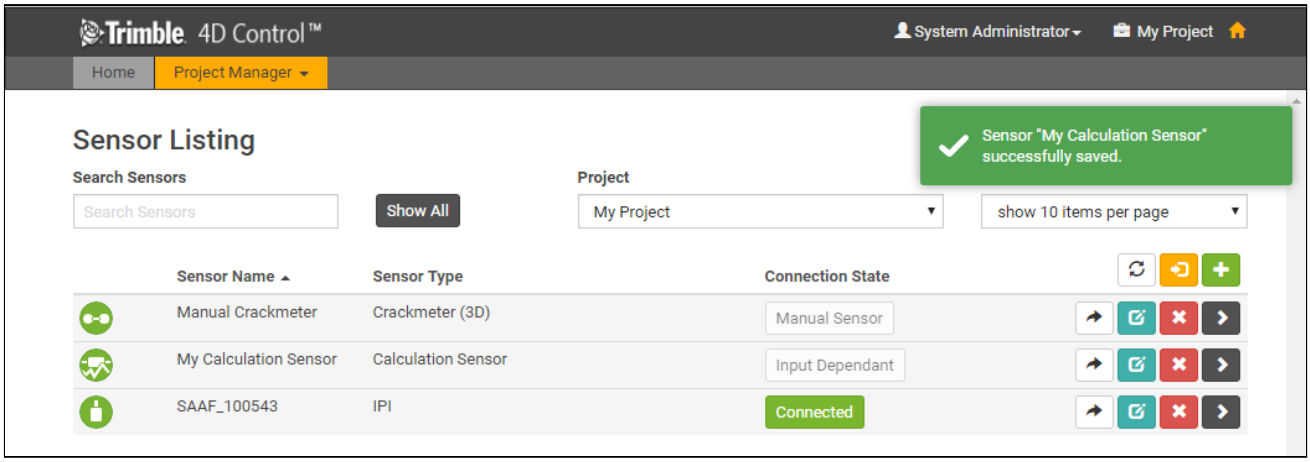
You can switch between specifying either **Grid** or **Global Coordinates** using the **Specify Global Coordinates** toggle switch. **Global Coordinates** can either be specified in **Degrees, Minutes and Seconds** or in **Decimal Degrees**. The toggle switch above the **Global Coordinates** can be used to switch between these two entry modes.

If you choose to specify **Grid Coordinates** then the **Global Coordinates** will be updated automatically. Conversely, if you choose to specify **Global Coordinates** then the **Grid Coordinates** will be updated automatically.

Click on the **Next** button to proceed to the **Summary** tab.



Verify that the details on the **Summary** tab is correct. Specify a name for the **Calculation Sensor** and click on the **Save** button.



The **Calculation Sensor** will be created and you will be navigated back to the **Sensor Listing** tab.

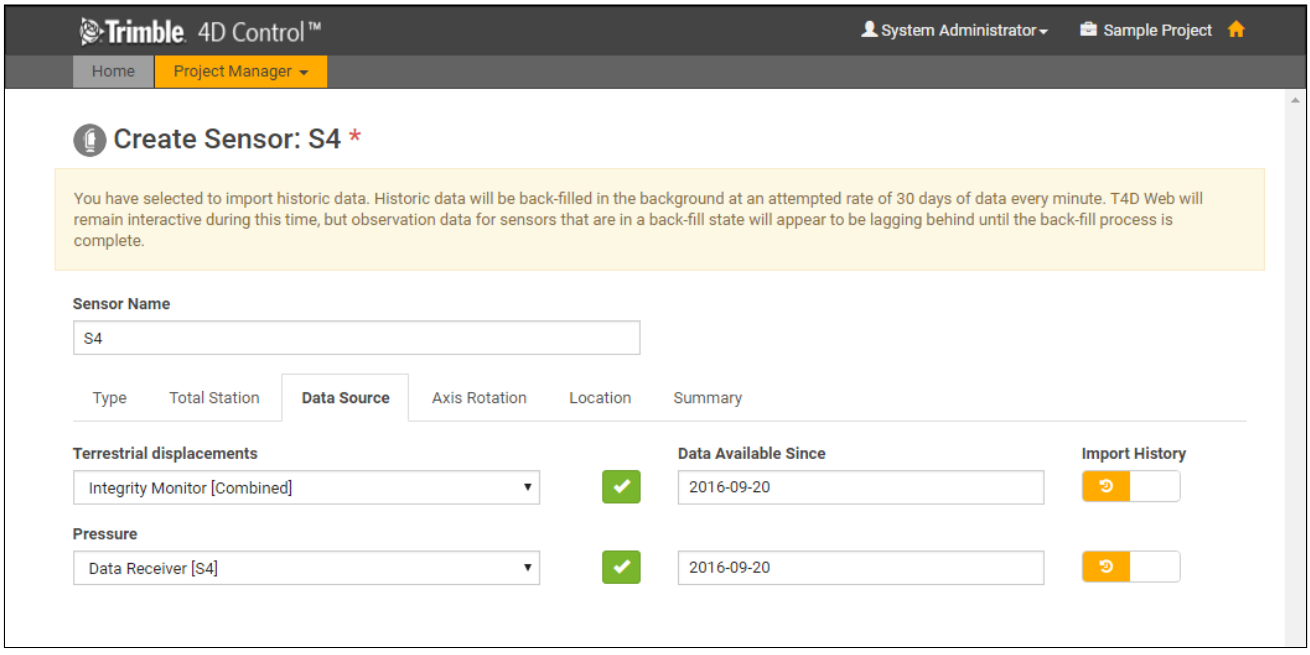
4.3.6. Historic Data Import

As of version 4.6 users have the option to import historic observation data that may be available in **T4D Server** when a sensor is added to the **Project**.

This functionality is restricted to the following **Sensor Types**:

- Papouch Temperature Sensors
- Total Stations
- Target (Raw Measurements)
- Target (Displacement)

Historic **Integrated Survey** data can not be imported.

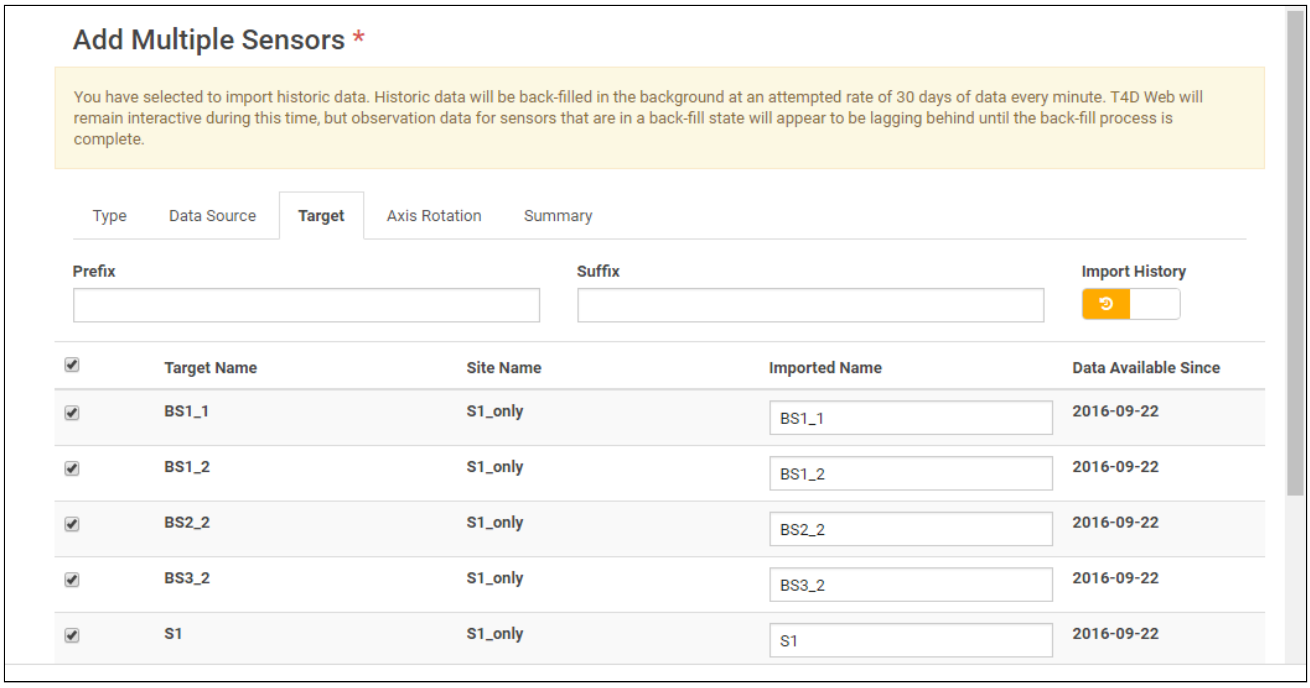


When you select a **Data Source** during the **Add Sensor** workflow, then the UTC date of the oldest available observation in **T4D server** will be displayed.

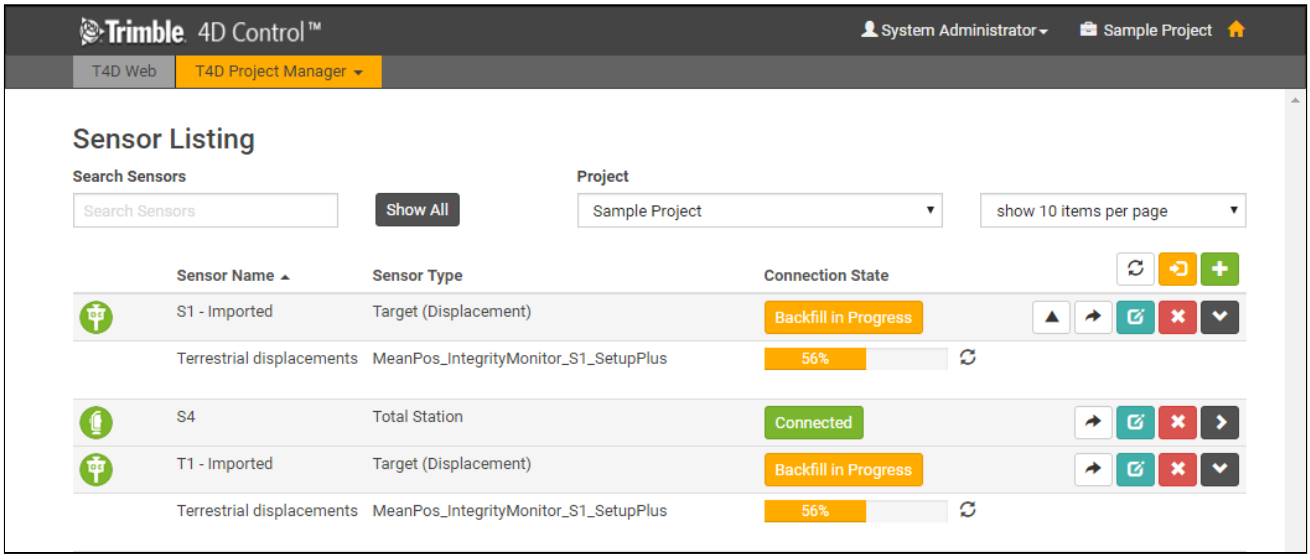
To import the historic data simply switch on the **Import History** toggle switch next to the appropriate **Data Source**.

The process is slightly different in the **Add Multiple Sensors** workflow. In this case the oldest available observation date is shown next to each target. A single **Import History** toggle switch will appear at the top left of the page.

If you choose to enable the this switch then historic observation data will be imported for all the selected targets.



When the sensor is added to the project it will show a connection state of **Backfill in Progress** - provided that there is more than 30 days' historic data to import.



If you expand a sensor that is in **Backfill** then you will be confronted with a progress bar next to each of the linked **Data Types**.

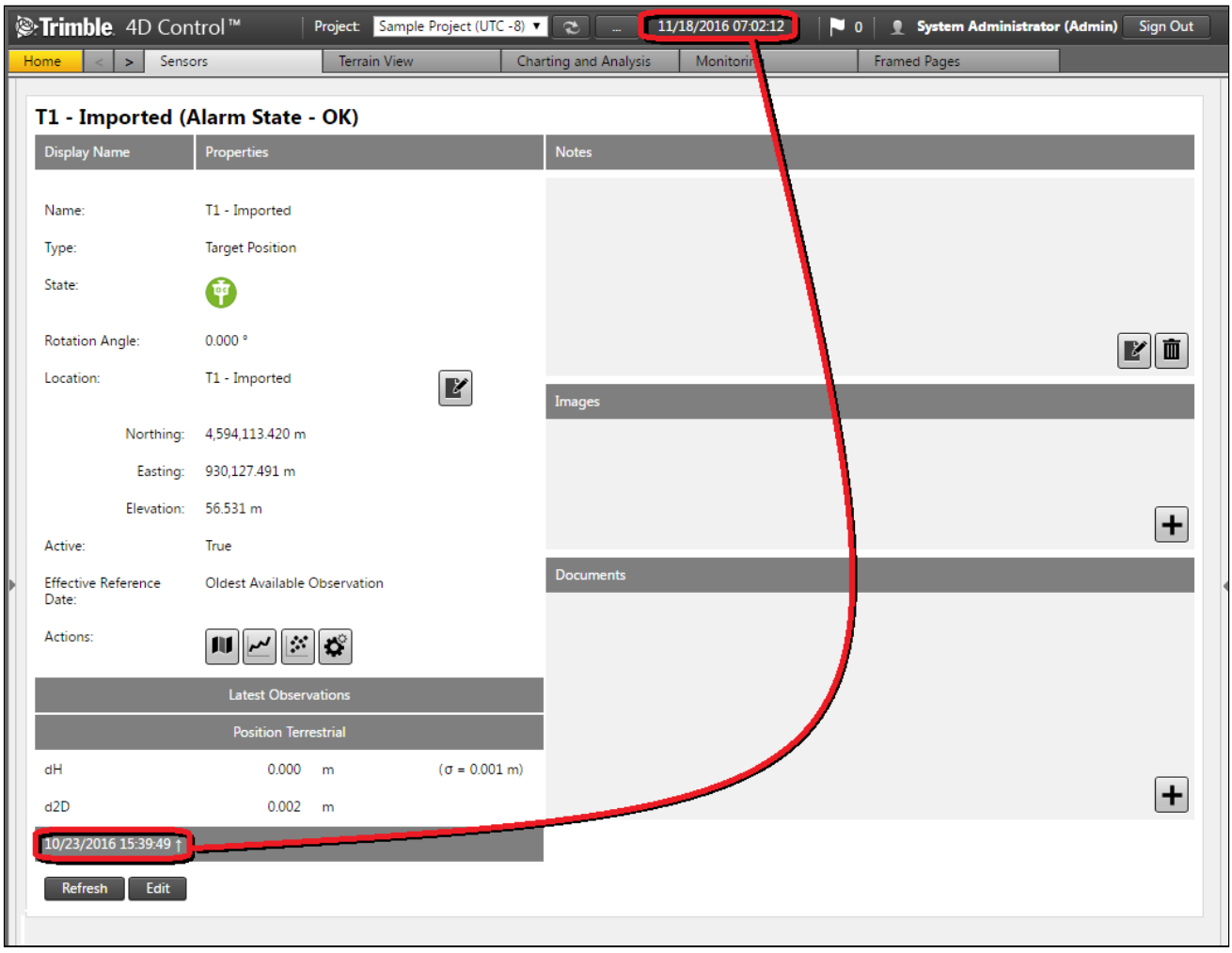
The backfill progress can be refreshed by clicking on the refresh icon next to any of the progress bars or by collapsing and expanding the row or refresh the entire sensor listing page.

Eventually the **Connection State** will change to **Connected.**

It is important to keep a few things in mind as far as the backfill is concerned:

1. There is a slight performance cost to determining the progress of the backfill process. As such the update is only done once every 2 minutes - regardless of how often you click the refresh button next to the progress bar. The progress shown in the progress bar will therefore lag behind reality.

2. The actual backfill process is throttled in order restrict load on the system. Historic data will be imported at an attempted rate of 30 days' worth of data per minute. During this time you can continue to use **T4D Web**, but you need to keep in mind that the observation data for these sensor may appear to be old.



3. The **Sensor Data Flow** health indicators may turn red while the backfill is in process. This is due to the fact that the latest available observations for the sensors in the backfill state will appear to be too old. The health indicators will turn back to green when the backfill is complete.

4. If you have a no data alarm configured on an alarm condition that is linked to **All Sensors of a specific Sensor Type**, then an unintentional **No Data Alarm** event may be triggered. The **No Data Alarm** condition will automatically clear when the backfill process is complete.

5. If you need to import historic data for a very large number of **Targets** then it would be advisable to do so in batches of 50 **Targets** or less.

6. **NB:** If you wish to import historic **Slope Distance** data with **PPM Correction**, then you should ensure that the relevant **Temperature** and **Pressure** data is imported first. In reality you do not need to wait for the **Temperature and Pressure** data backfill to complete - a substantial "head start" would be sufficient. As a rule of thumb you can start the backfill process for **Temperature** (Papouch sensor) and **Pressure** (Total Station) and then wait for +/- 10 minutes because starting the backfill process for **Slope Distance** observations.

4.3.7. Rotation Angles

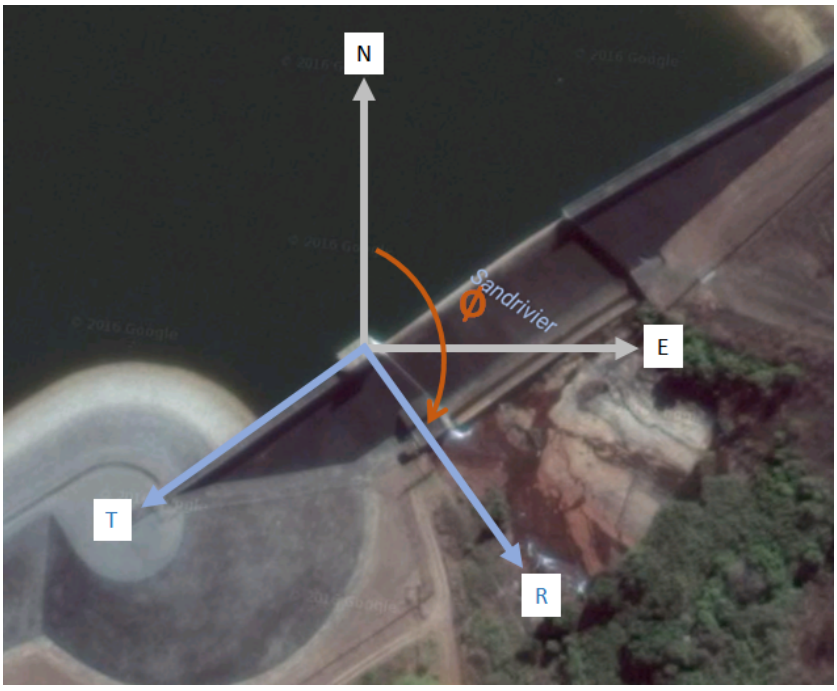
4.3.7.1. Terminology

GNSS Receivers and **Target Displacement** sensors produce an observation time series of displacements broken down into **Northing**, **Easting** and **Height** components.

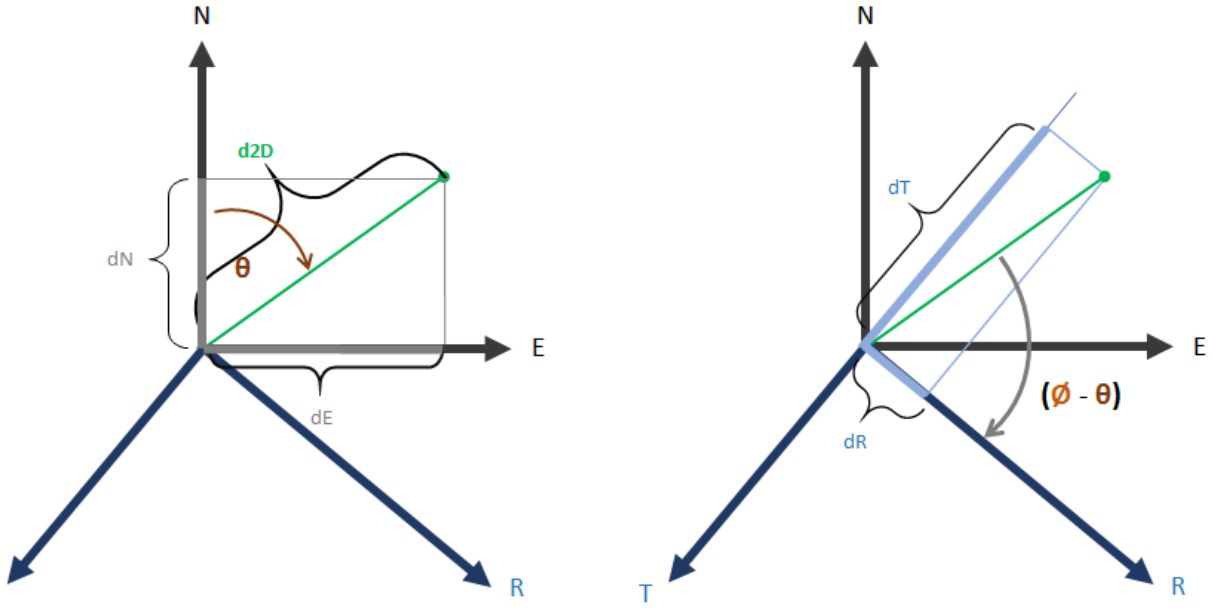
The structure that is being monitored may not align with the direction of **Northing** and or **Easting** as defined in the **Coordinate System** used. **Rotation Angles** can be used to configure these sensors so that planar component of the displacement is broken down into **Radial** and **Tangential** components as well.

The following image depicts a typical example of how the **Radial/Tangential** axis pair might be configured. During configuration the user specifies a rotation angle (**Ø**), which is angle from the **Northing** axis to the **Radial** axis - measured in a clockwise direction.

In this case the **Rotation Angle** is configured so that the bearing of the positive **Radial** axis corresponds with the *downstream* direction of the dam structure.



The diagrams below show the mathematical relationship between the displacement components in the **Northing** and **Easting** directions and the displacement components in the **Radial** and **Tangential** components.



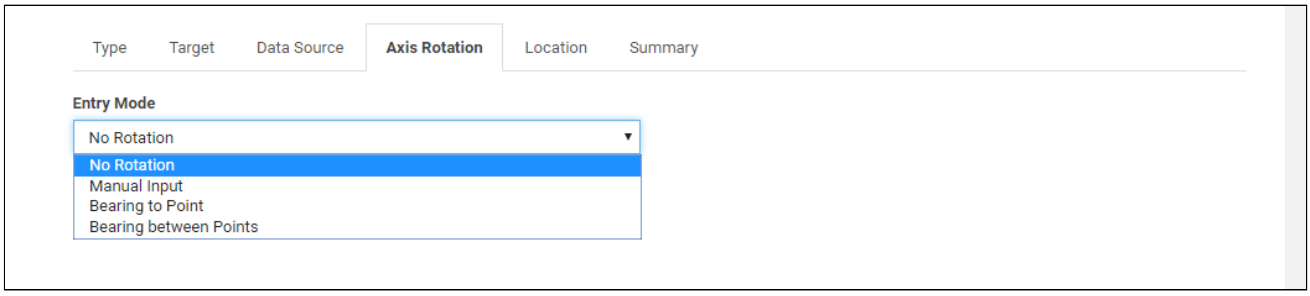
Let us assume a hypothetical example where the **Rotation Angle** (Ø) between the **Northing** axis and the **Radial** axis is ***120°*** and where a prism is displaced by ***3 mm*** in the **Northing** direction and ***4 mm*** **Easting** direction.

Given the above, the following will hold:

Symbol	Symbol	Calculation
Axis Rotation	***Ø***	User Defined = ***120°***
Planar Displacement Magnitude	***d2D***	***d2D*** = $\sqrt{(dN^2 + dE^2)}$ = $\sqrt{(3^2 + 4^2)}$ = ***5 mm***
Azimuth of the Displacement	***θ***	***θ*** = *ArcTan(dE/dN)* = *ArcTan(4/3)* = ***53.13°***
Northing Displacement	***dN***	***dN*** = ***d2D***.*Cos(**θ**)* = ***5***.*Cos(**53.13°**)* = ***3 mm***
Easting Displacement	***dE***	***dE*** = ***d2D***.*Sin(**θ**)* = ***5***.*Sin(**53.13°**)* = ***4 mm***
Radial Displacement	***dR***	***dR*** = ***d2D***.*Cos(**Ø - θ**)* = ***5***.*Cos(**120° - 53.13°**)* = ***1.964 mm***
Tangential Displacement	***dT***	***dT*** = ***d2D***.*Cos(**Ø - θ + 90°**)* = ***d2D***.*Sin(**θ - Ø**)* = ***5***.*Sin(**53.13° - 120°**)* = ***- 4.598 mm***

4.3.7.2. Configuration

Where applicable, the **Add Sensor** page will contain an **Axis Rotation** tab. The input fields on this tab is used to configure the bearing of the **Radial** axis (and by implication the bearing of the **Tangential** axis) as described above.

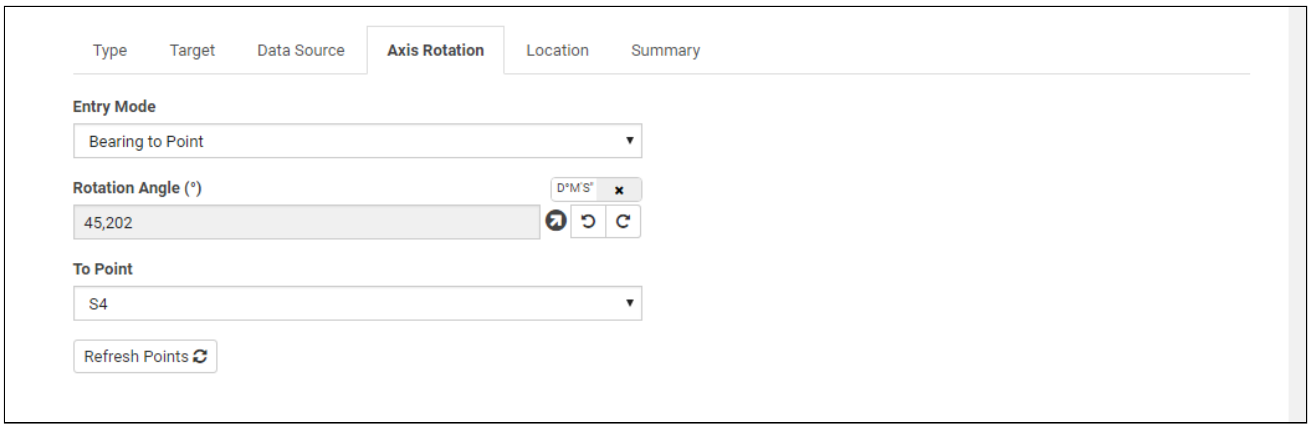


There are four different modes that can be used to define the **Rotation Angle**. The **No Rotation** option simply applies a rotation angle of zero degrees. In this case the direction of the **Radial** axis will coincide with the **Northing** axis and the direction of the **Tangential** axis will coincide with the direction of the **Easting** axis.

The **Manual Input** mode allows for manual entry of the rotation angle. The **Angular Unit Preference** as defined in the **Project Unit Preferences** applies. If the **Angular Unit Preference** is set to **degrees** then toggle switch denoted with **D°M'S"** will appear above this **Rotation Angle** field. This toggle switch can be used to switch between **Decimal Degrees** and **Degrees, Minutes and Seconds**.

The arrow icon next to the **Rotation Angle** field depicts the direction of the **Radial** axis. The reference orientation for this depiction is such that the **Northing** axis points up and the **Easting** axis points right. This holds regardless of the true orientation of the **Coordinate System**.

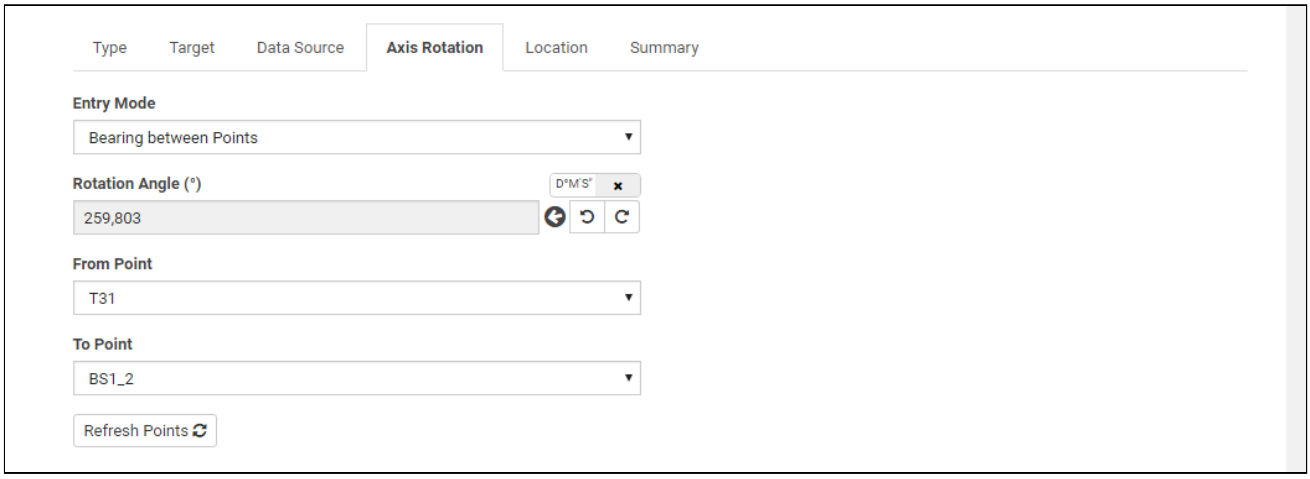
There are two utility buttons for rotation the the current rotation angle by 90 degrees in the CCW and CW directions.



The **Bearing to Point** entry mode can be used to calculate **Rotation Angle** so that the **Radial** axis will coincide with a line drawn from the **Coordinate** of the sensor that is being configured to the specified **Point**.

The **To Point** drop down will contain all **Total Stations**, **Prisms** and **GNSS Receivers** configured in **T4D Server**.

Note: You can still click on the **Rotate CCW** and **Rotate CW** utility buttons. The rotation angle will be adjusted accordingly and the **Entry Mode** will be switched back to **Manual Input**.



The **Bearing between Points** entry mode can be used to calculate a **Rotation Angle** so that the bearing of the **Radial** axis will correspond with the bearing of a line drawn between to the specified **Points**.

The **From Point** and **To Point** drop downs will contain all the **Total Stations**, **Prisms** and **GNSS Receivers** configured in **T4D Server**.

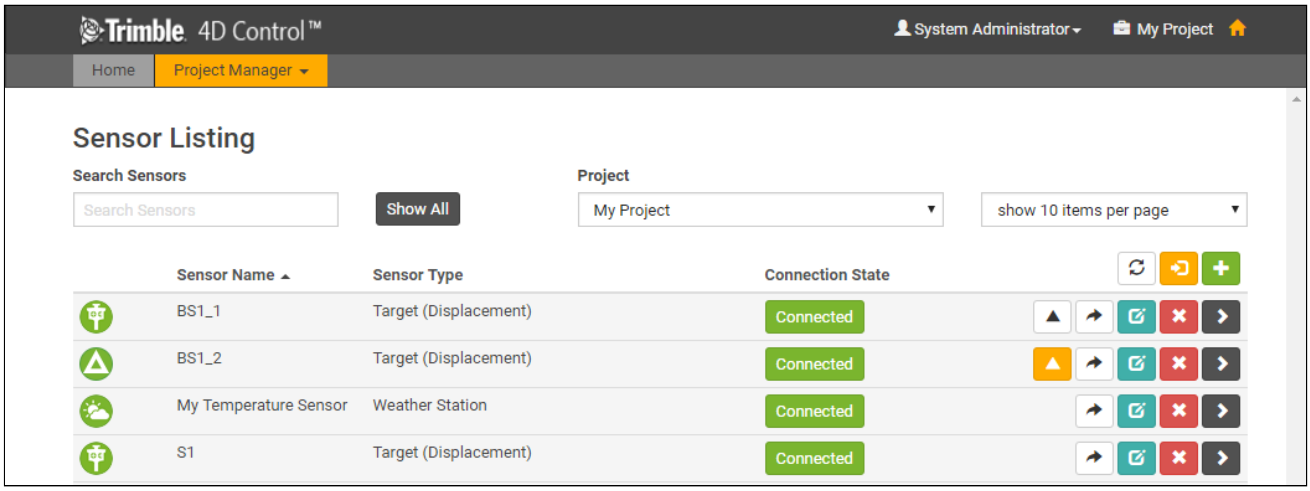
Note: You can still click on the **Rotate CCW** and **Rotate CW** utility buttons. The rotation angle will be adjusted accordingly and the **Entry Mode** will be switched back to **Manual Input**.

4.3.8. Edit Sensor

Some of the sensor configuration properties can be edited after the sensor has been created. To edit a sensor, simply click on the **Edit** button (**pencil** icon) next to the appropriate sensor in the sensor listing page.

4.3.9. Control Point Indicators

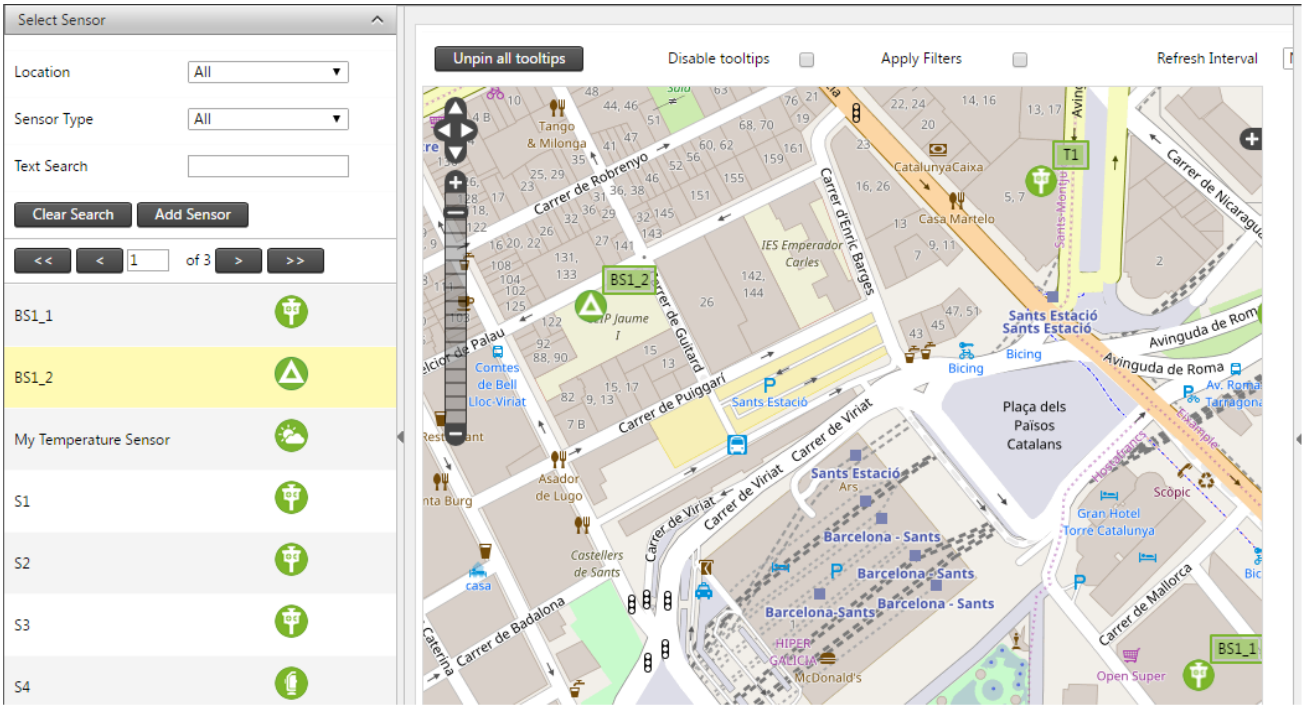
As of version 4.6, users have the option of changing the display icon on **Control Points** so that these are clearly displayed as such in **T4D Web**. This can be particularly useful on the **Maps** page.



If a target is defined as **Fixed** in any of the round measurements in **T4D Server** then a triangle icons will appear next to it on the **Sensor Listing** page.

If you click on this button then it will be highlighted to indicate the sensor has been designated as a **Control Point** for display purposes.

At the same time the sensor icon will change to a triangle. The same icon will be used all over **T4D Web**.



5. Geotechnical Gateways

5.1. Overview

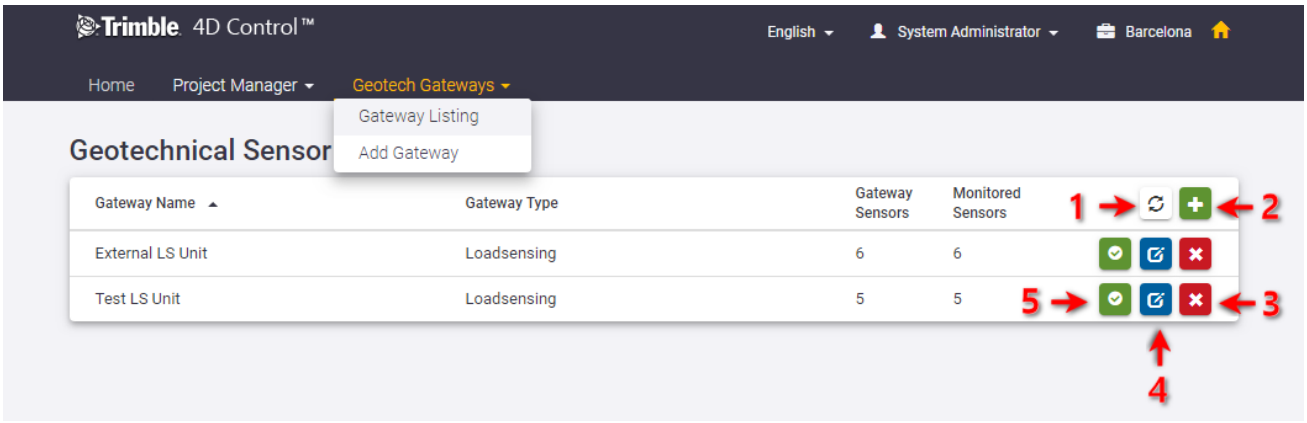
Trimble 4D Control has offered **Geotechnical Sensor** support via imported csv files since version 4.0. Version 5.0 extends this existing functionality by offering the capability to synchronize Geotechnical sensor data directly from 3rd party Geotechnical platforms such as Loadsensing.

This functionality makes it easy to monitor large numbers of **Geotechnical** sensors in a Trimble 4D Control monitoring project.

5.2. Geotechnical Gateway Configuration

5.3. Gateway Listing

To manage **Geotechnical Gateways**, click on **Geotechnical Gateways > Gateway Listing** in the main menu.



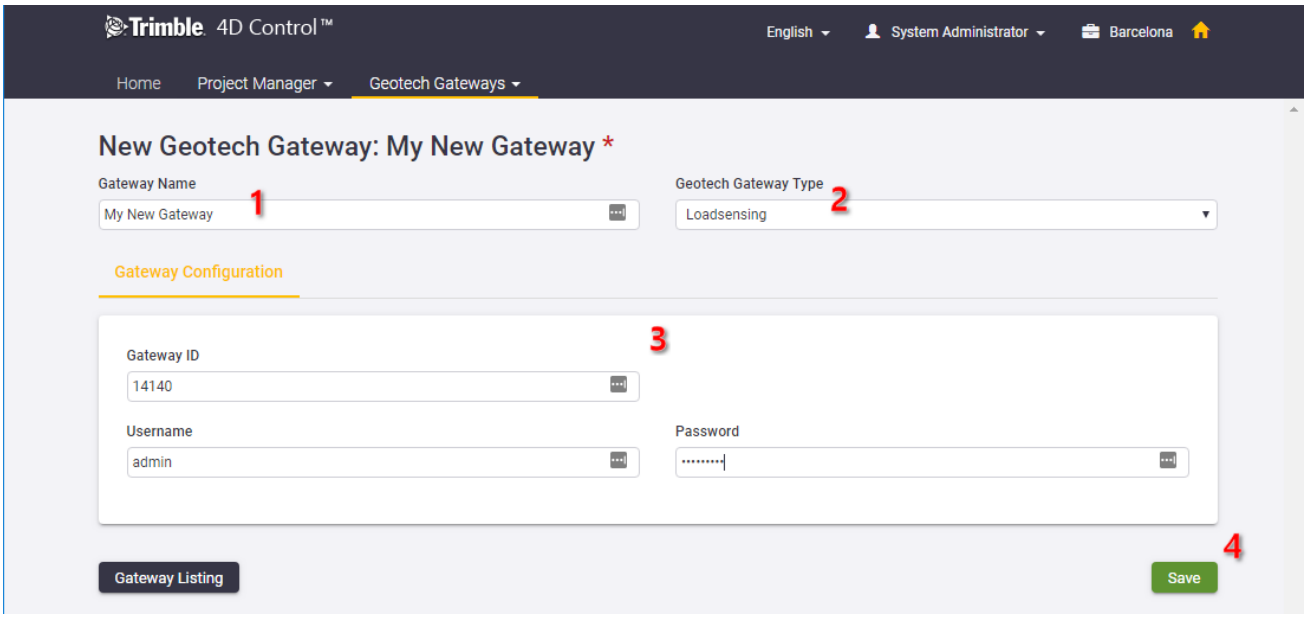
A list of previously configured Geotechnical Gateways will appear. From this list it is possible to:

1. Refresh the list of Geotechnical Gateways
2. Add a new Geotechnical Gateway
3. Delete an existing Geotechnical Gateway
4. View and Edit and existing Geotechnical Gateway
5. View sync information on the Geotechnical Gateway

5.3.1. Add Geotechnical Gateway

To define a new Geotechnical Gateway, click on the "+" button (nr 2 above).

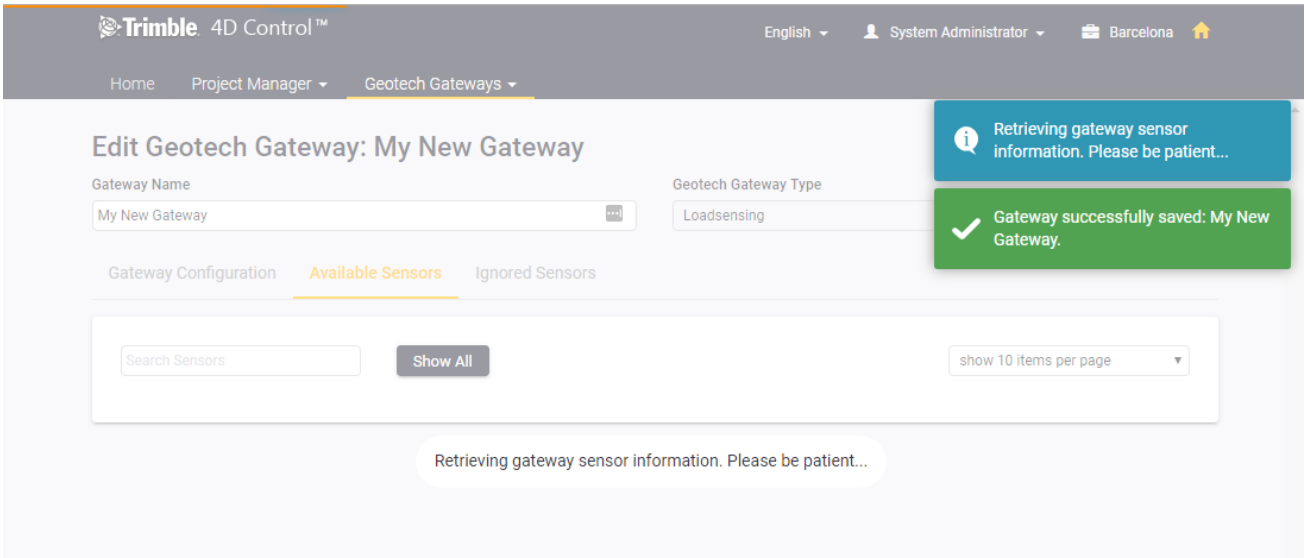
5.3.1.1. Specify Connection Details



On the “New Geotech Gateway” screen, specify the following details:

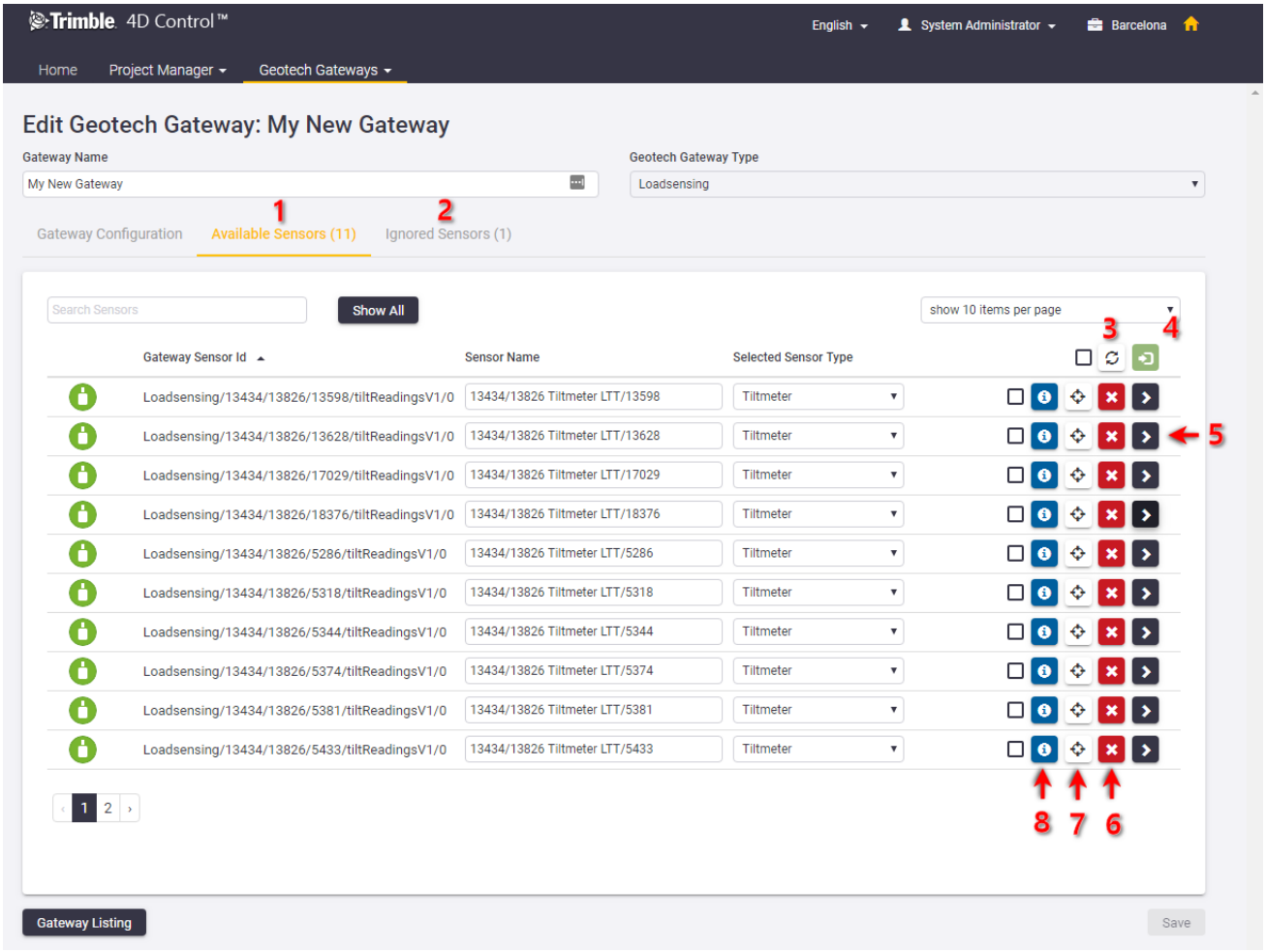
1. A user defined name for the Geotech Gateway
2. The Gateway Type (currently only Loadsensing is supported)
3. The Credentials required to connect to the Gateway
4. Then click on the “Save” button to continue

Trimble 4D Control Admin Web will first verify that the specified credentials are correct and subsequently begin to scan the Gateway to find sensors connected to the Gateway.



5.3.1.2. Gateway Sensors Administration

Once the initial scan of the Gateway has completed, two additional tabs will appear.



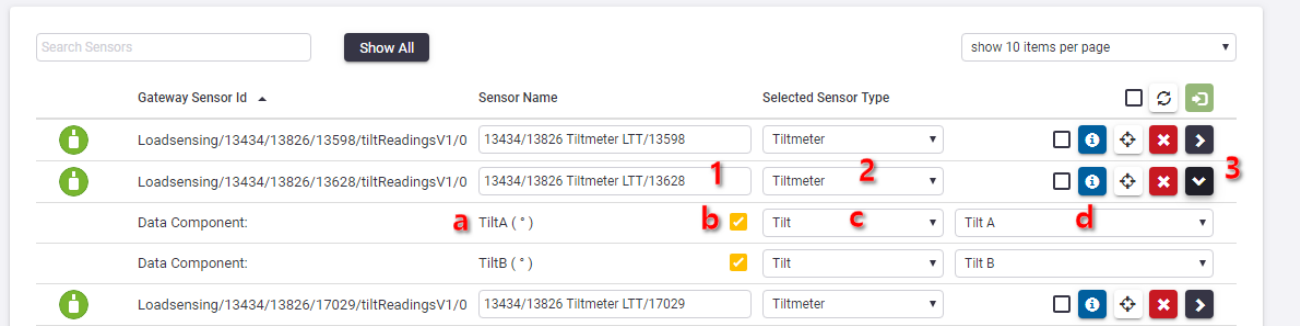
It is important to understand that the sensors in the screen above have not yet been created as sensors in T4D. This page only shows the sensors that are ***available*** on the Geotech Gateway.

From this screen it is possible to:

1. View the list of **Gateway Sensors** which could be automatically matched with T4D **Sensor Types** and **Data Types** ("Available Sensors")
2. View the list of **Gateway Sensors** which could not be automatically matched with T4D **Sensor Types** and **Data Types**.
3. Rescan the **Gateway** to refresh the list of available **Gateway Sensors**.
4. Import selected Gateway Sensors to the current **Monitoring Project**.
5. Expand the details section of a **Gateway Sensor** to view and optionally edit the **Data Type(s)** associated with the readings delivered by the **Gateway Sensor**.
6. Optionally flag the **Gateway Sensor** as ignored (this will move the Gateway Sensor from the "Available Sensors" tab to the "Ignored Sensors" tab)
7. Optionally specify the **Location Coordinates** of the sensors.

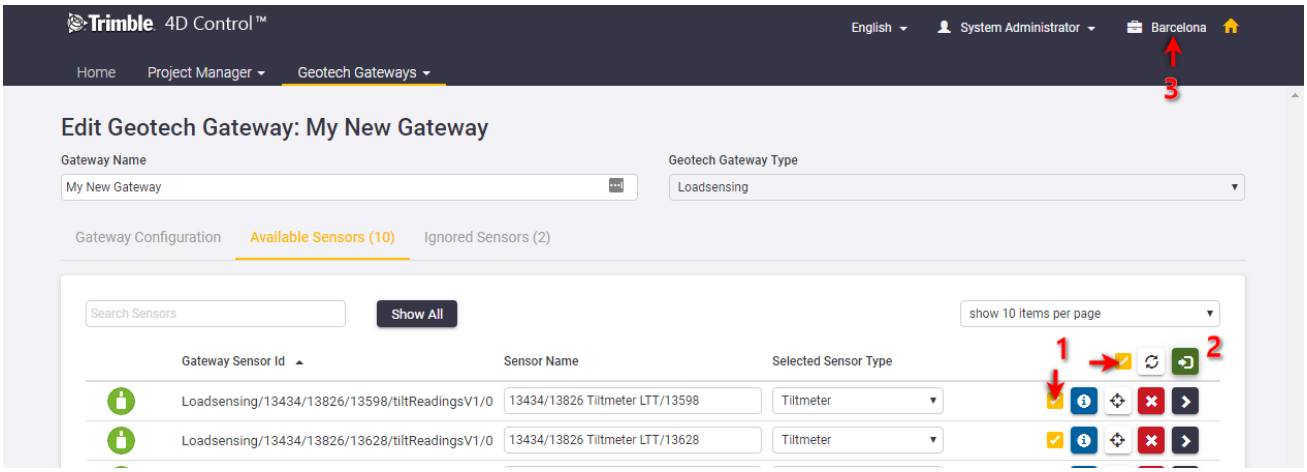
8. View information on
    a. The **Monitoring Projects** from where the Gateway Sensor is being monitored.
    b. Details on when last data for the sensor was synchronized.

On each entry on the list of available **Gateway Sensors**it is possible to refine the auto-detected settings as follows:



1. Optionally change the auto-detected **Sensor Name**
2. Optionally changes the auto-detected **Sensor Type**
3. Expand the details of the sensor to:
    a. View a list of **Data Components** delivered by the **Gateway Sensor**.
    b. Choose whether or not the component is of interest
    c. Change the auto-detected T4D **Data Type** (will be required if the auto-detected **Sensor Type** was changed in 2 above).
    d. Select the relevant **Data Type Component** (only required if the selected data type has more than one component).

5.3.1.3. Import Gateway Sensors to Monitoring Project



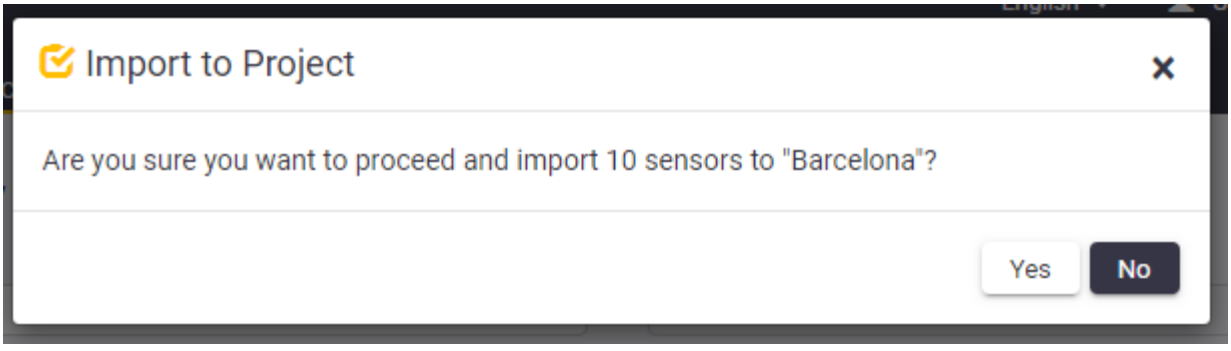
Once you are satisfied that the **Sensor Type** and **Data Type** on each sensor is correct then it is possible to proceed with importing the **Gateway Sensors** into a **Monitoring Project** by doing the following:

1. Select the **Gateway Sensors that should be imported.**
2. **Click on the Import** button
3. Keep in mind that the **Gateway Sensors** will be imported to the current **Monitoring Project**.

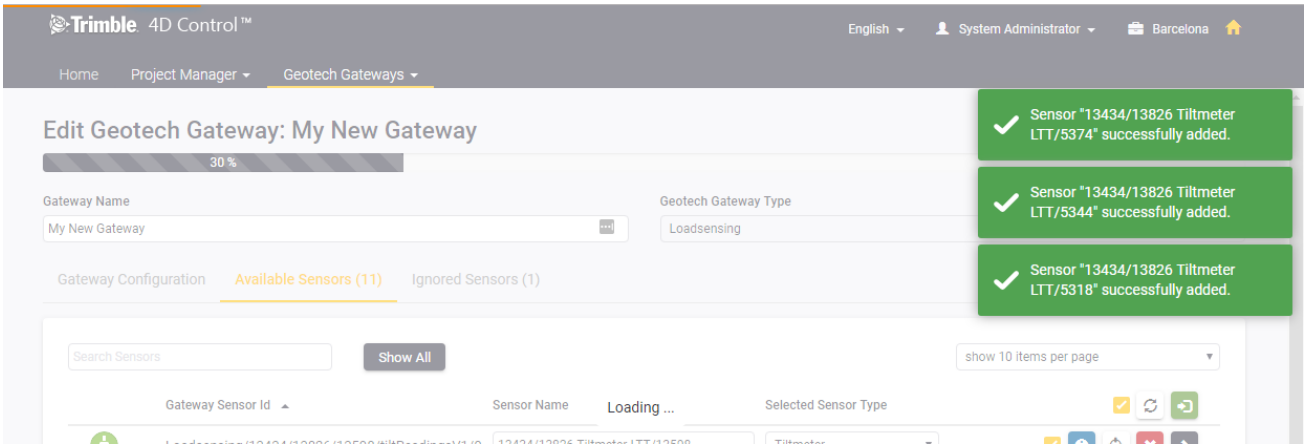
Note: If a checkbox next to one of the sensors is inactive, then it could imply one of to things:

- The **Sensor Type and/**or **Data Types** on the **Gateway Sensor** are not configured.
- The **Gateway Sensor** has already been imported to the current **Monitoring Project**.

After clicking on the **Import** button, you will be presented with a confirmation dialog:



Click on “Yes” to proceed. You will be presented with a progress bar and a notification each time that a **Gateway Sensor** was added to the current **Monitoring Project**.

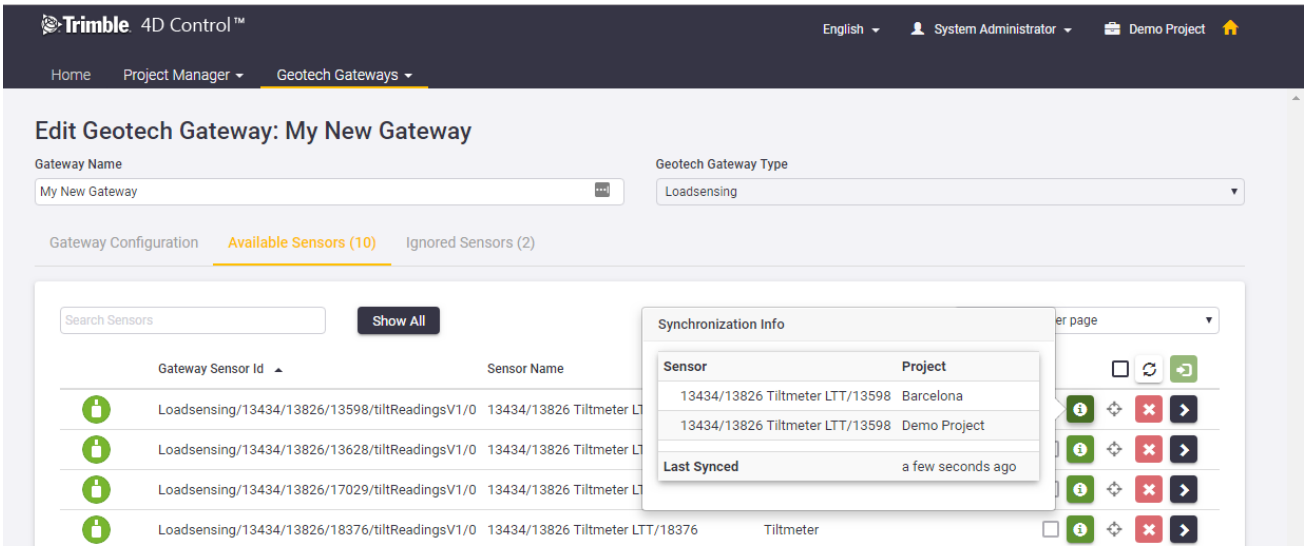


The importation process may take a few minutes - depending on the number of selected **Gateway Sensors.**

Note: It is important to keep the browser window open and to remain on this page until the Import is complete.

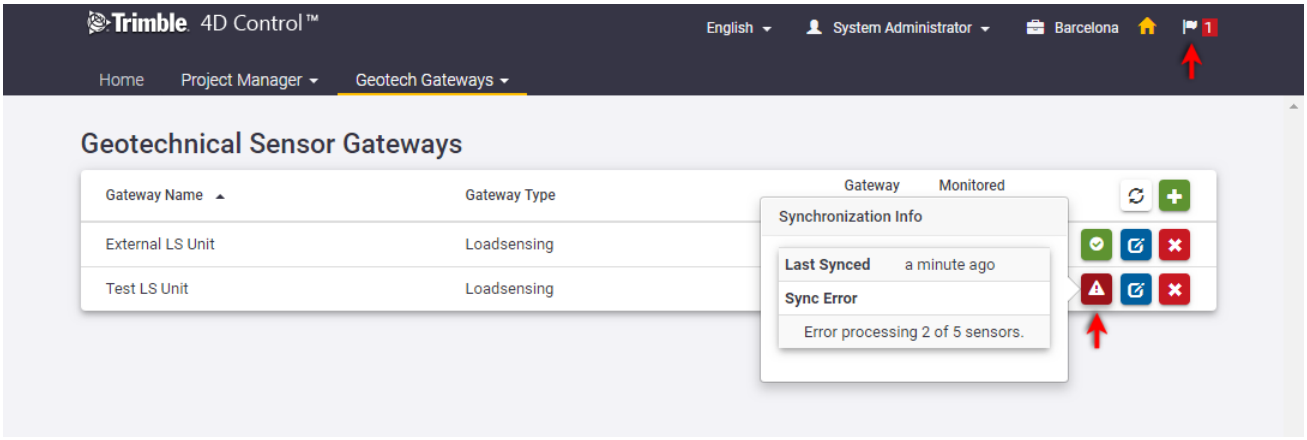
5.3.1.4. Synchronization Information

To view details on the sync-state of a **Gateway Sensor**, simply click on the info button.



From time to time it may happen that the synchronization process encounters transient issues which temporarily block synchronization from taking place. If there were any errors during the last sync attempt, then a notification will appear on the top right corner.

Additional information on the error will be available on the affected **Geotech Gateway** in the **Gateway Listing** page, and on the affected **Gateway Sensor(s)** on the Edit Gateway page.

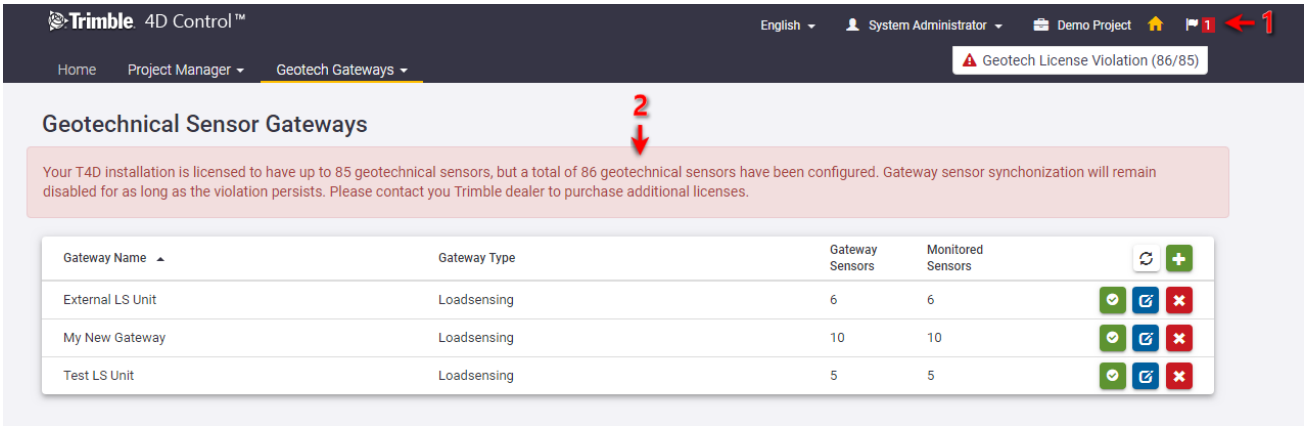


5.4. Licensing

Geotechnical Gateway Sensors consumer from the "Geotech Sensor" license counter. The usage is counted when a sensor appears under the "Available Sensors" tab on the **Geotech Gateway** edit page.

The usage is counted only once - regardless of the number of **Monitoring Projects** into which the sensor has been imported.

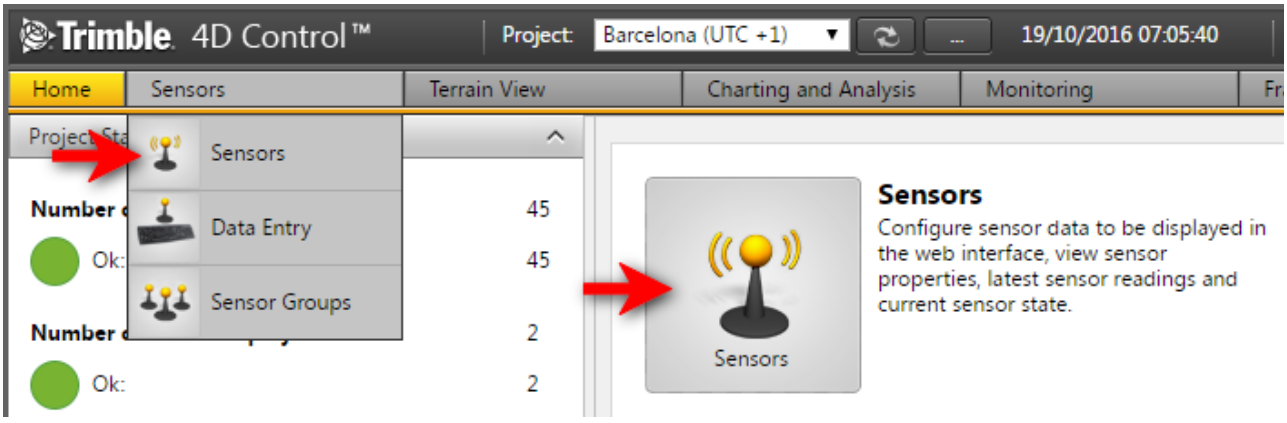
If the license counter is exceeded, then synchronization from all Geotech Gateway Sensors will be suspended until the license violation has been resolved:



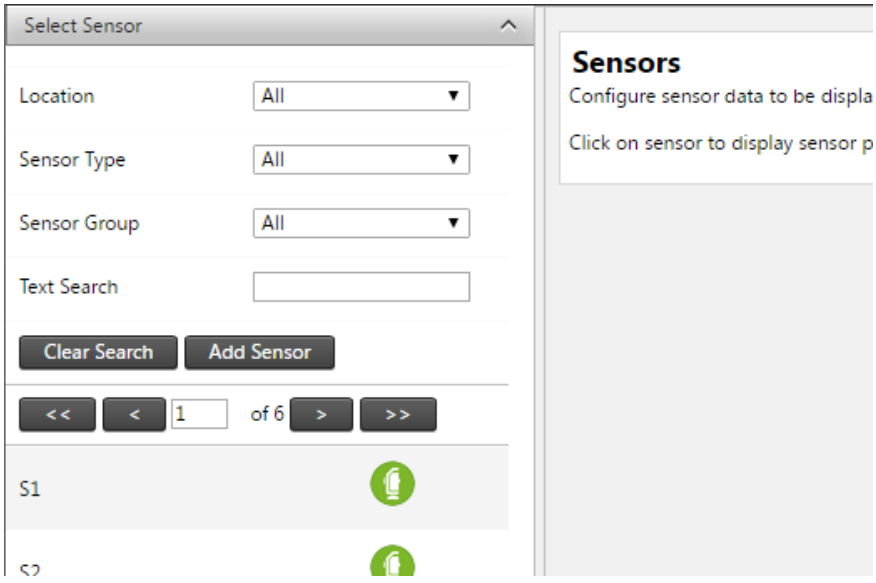
6. 6.Sensors

A sensor in Trimble 4D Control designates a location and related information to measurements taken at the particular location. Typically a sensor may be a hardware device taking automated measurements, or a device where manual measurements are regularly taken. A sensor can also designate only a beacon of which measurements are taken, such as a *Prism* measured by a *Total Station* or a field collector collecting data with a portable device at the particular beacon. We use the term *observation* for data measurement of a sensor.

6.1. Display Sensor Properties and Latest Readings



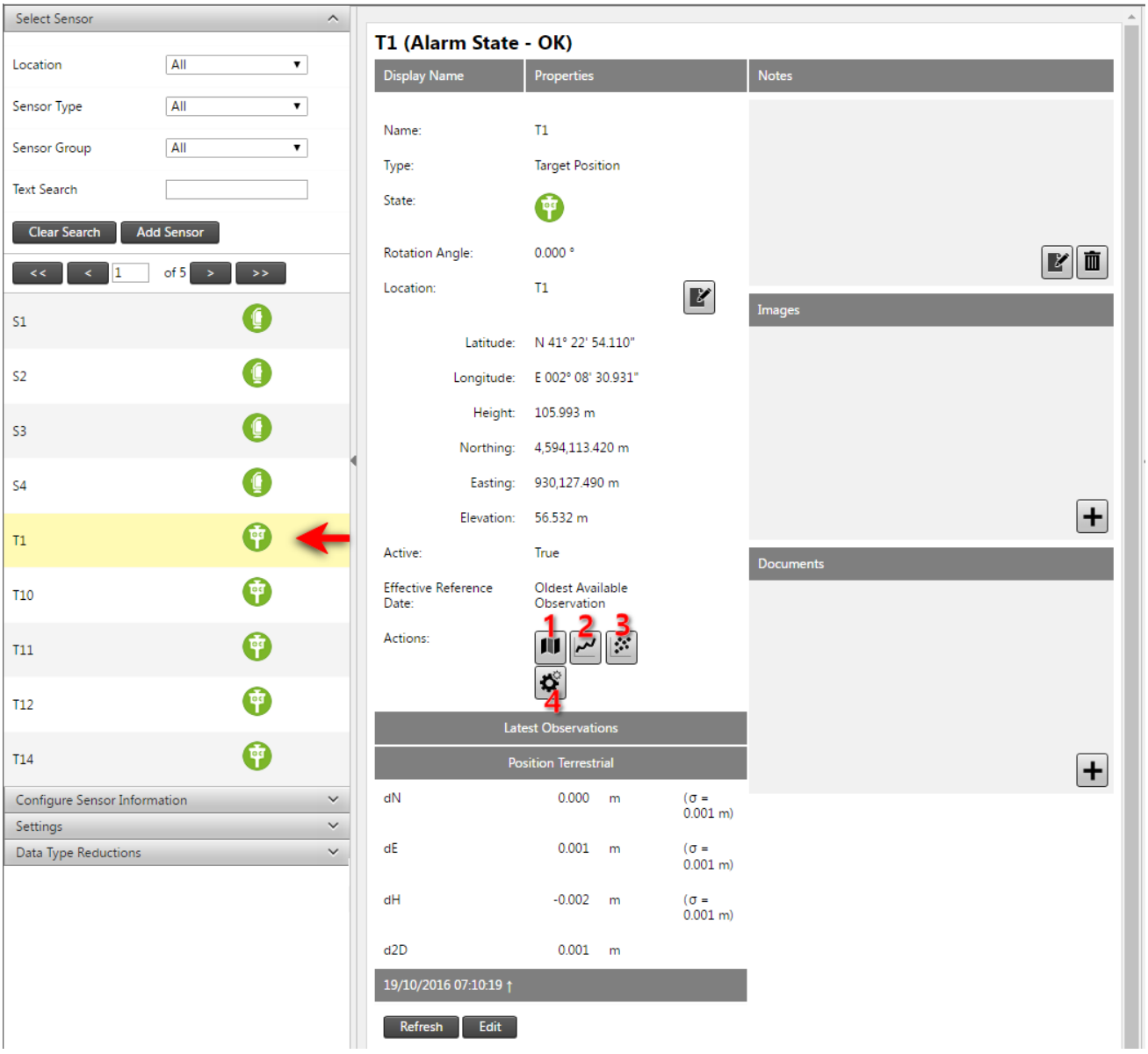
Step 1: Navigate to the Sensors area by clicking Sensors Icon on the Home Page or by hovering the mouse over the Sensors top menu item and then clicking Sensors in the dropdown menu (as illustrated).



Step 2: Choose your sensor. The available sensors are listed in the area below the search filter controls. The sensors can be filtered by any of the options:

- **Location:** the physical location of the sensor.

- **Sensor Type:** the type of the sensor.
- **Sensor Group:** the sensor group to which the sensor belongs.
- **Text Search:** a search term on the sensor name.



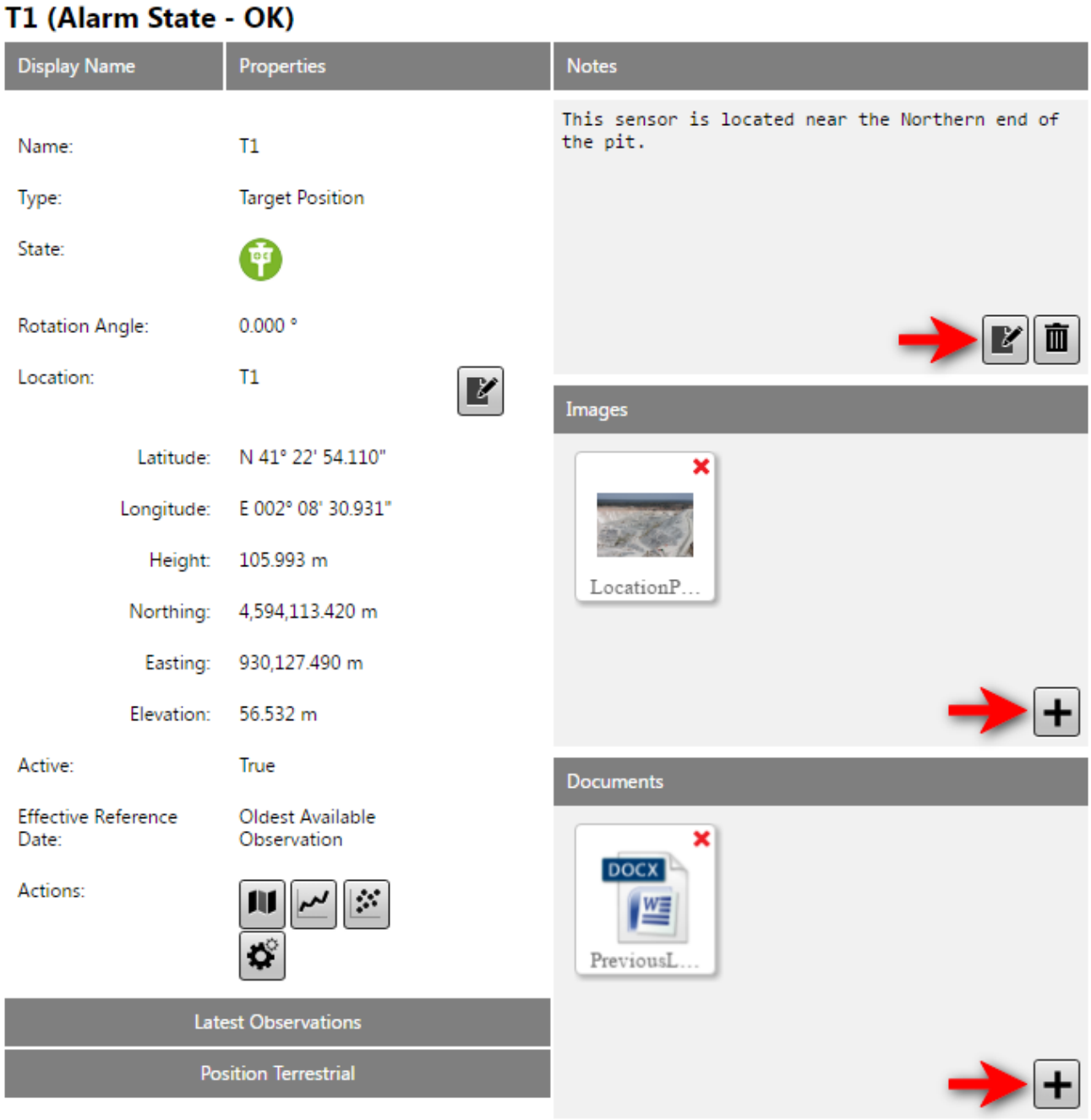
Step 3: Click on any listed Sensor Icon for information about the Sensor to be displayed. The right hand pane will display the Sensor Properties of the selected Sensor.

On the Sensor properties page you can navigate to other sensor information pages by clicking on any of the action buttons.

To view a Map of the selected sensor, select Map View button (1). To view a chart, select the Chart button (2). To view the Scatter Plot, select the dotted button (3). Lastly to configure the reference date, select the Configuration button (4). The buttons available on the sensor properties page depends on the Sensor Type of the sensor.

6.2. Sensor Notes and Documents

Sensors can individually be associated with additional information. Additional information includes notes, images and documents associated with the Sensor.

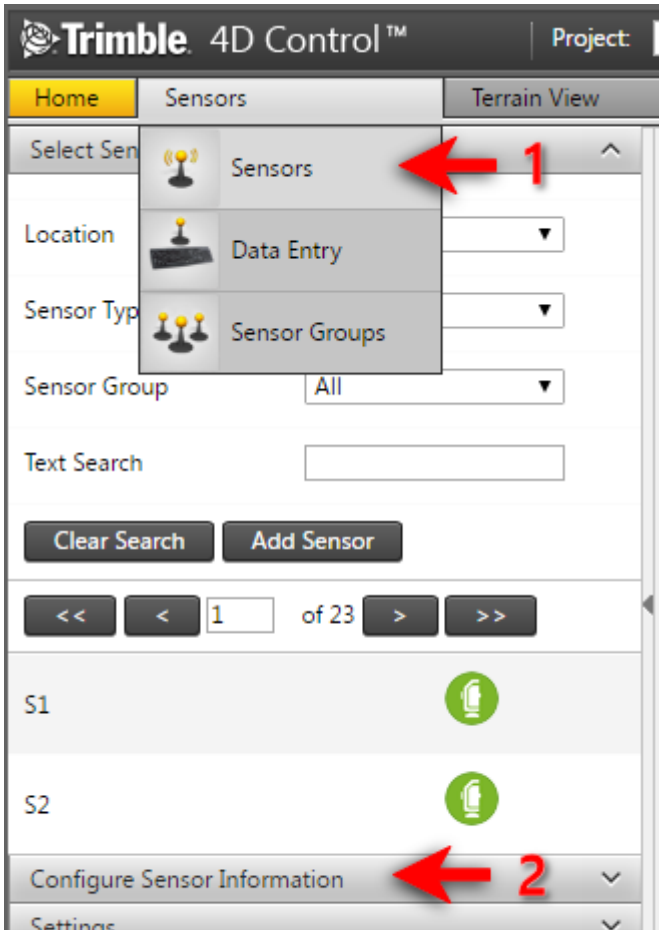


Use the buttons above to associate additional information with your sensors.

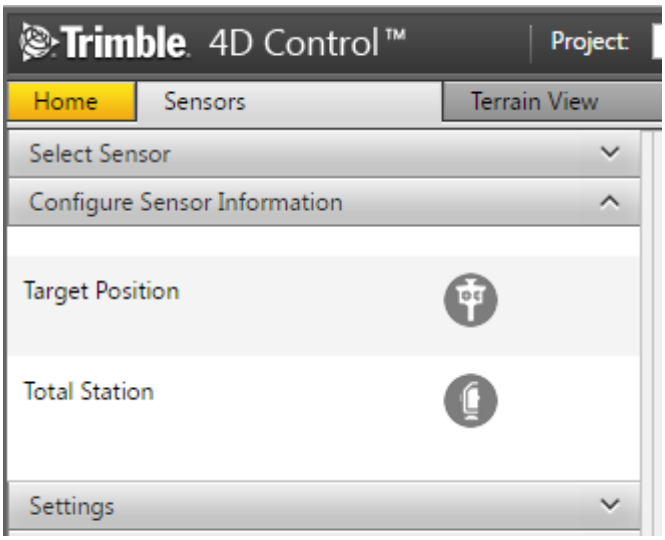
6.3. Configure Sensor Information

The information displayed by Sensors, Map, Custom Views and Chart pages are controlled by the configuration settings under the Configure Sensor Information section. Here the display settings are configured per Sensor Type.

To configure your Sensor information, follow these steps:



Step 1: Navigate to the Sensors area via the Sensors Menu (1) or Sensors Button on the Home Page. In the left window, select the Configure Sensor Information bar (2).



Step 2: Select the Sensor Type you wish to configure by clicking on the name or the Sensor Type Icon.

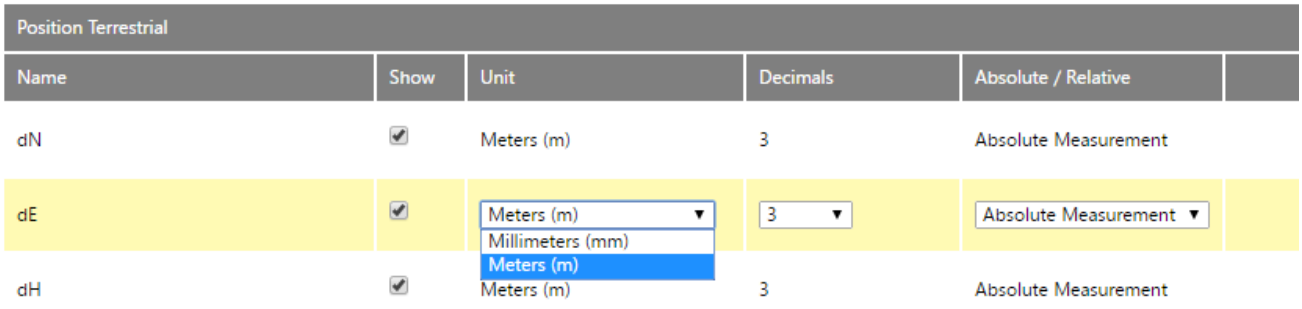
Display Column Configuration - Target Position

Notes:
The following settings configures how sensors are displayed on the Sensors, Map, Custom Views and Charts pages.

Position GNSS Integrated Survey					
Name	Show	Unit	Decimals	Absolute / Relative	
dN	☐	Meters (m)	3	Absolute Measurement	
dE	☐	Meters (m)	3	Absolute Measurement	
dH	☑	Meters (m)	3	Absolute Measurement	
d2D	☑	Meters (m)	3	Absolute Measurement	
d3D	☐	Meters (m)	3	Absolute Measurement	
dTangential	☐	Meters (m)	3	Absolute Measurement	
dRadial	☐	Meters (m)	3	Absolute Measurement	

Position Terrestrial					
Name	Show	Unit	Decimals	Absolute / Relative	
dN	☑	Meters (m)	3	Absolute Measurement	
dE	☑	Meters (m)	3	Absolute Measurement	
dH	☑	Meters (m)	3	Absolute Measurement	
d2D	☑	Meters (m)	3	Absolute Measurement	
d3D	☐	Meters (m)	3	Absolute Measurement	
dTangential	☐	Meters (m)	3	Absolute Measurement	
dRadial	☐	Meters (m)	3	Absolute Measurement	

Step 3: On the details view above you can configure information to be displayed about your selected Sensor Type. Click any cell in on a row to change the particular Sensor Type Information:

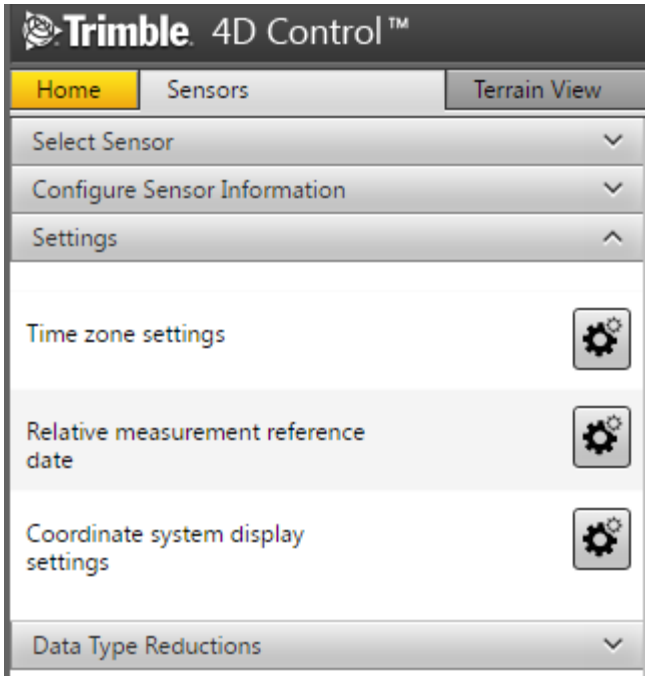


Step 5: You can change any of the following information of a *Data Type Column*:

- **Show:** Indicates to show this *Data Type Column* for sensors of this particular Sensor Type. If show is not selected, then the *Data Type Column* will not be shown.
- **Unit:** The available Units will depend on the Project Unit Settings configured in the T4D Admin Area.
- **Absolute/Relative:** *Absolute Reading* will show the actual value measured. A *Relative Reading* will be denoted by a small delta (Δ) and depicts the change or difference between the actual reading and a reference reading.

6.4. Sensor Settings

Under Sensor settings you can change the way the *Reference Date* is used in *Relative Measurements* or change the way the *Coordinate System Display* for the current project. Below we describe the different settings:

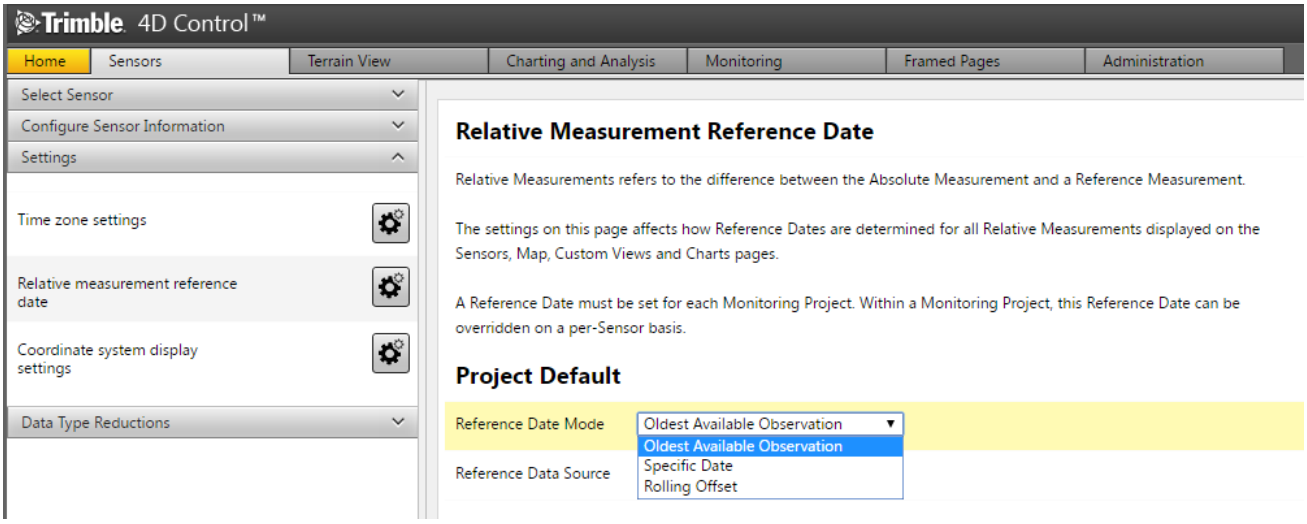


6.4.1. Time Zone Settings and Daylight Savings

Time zone information can be configured on the current project to take into account the difference of summer time and winter time. If the daylight saving time feature is enabled an asterisk (*) is shown whenever daylight savings time applies to any date time information displayed. This applies to the current project time, charts, scatter plots, alarm notifications or any other applicable time related information. The asterisk indicates that a particular date or time is displayed in terms of the configured daylight saving time.

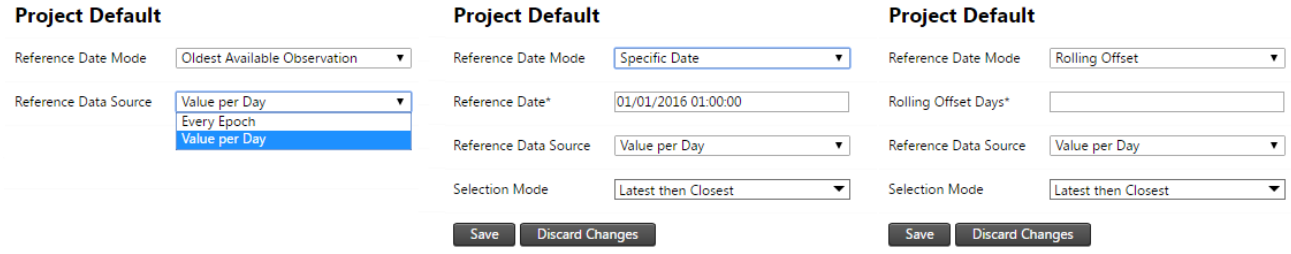
6.4.2. Relative Measurements Reference Date Settings

Select the Project Default Reference Date Mode as either Oldest Available Observation, Specific Date or Rolling Offset Days:



NB: Relative Measurements refers to the difference between the Absolute Measurement and a Reference Measurement.

The *Reference Measurement* will be the observation closest to the *Reference Date*. You can configure the *Reference Data Source* from which to select the reference value. This can either be the raw observation values or a **summarized source** available for the sensor (typically *Summarized per Day*).



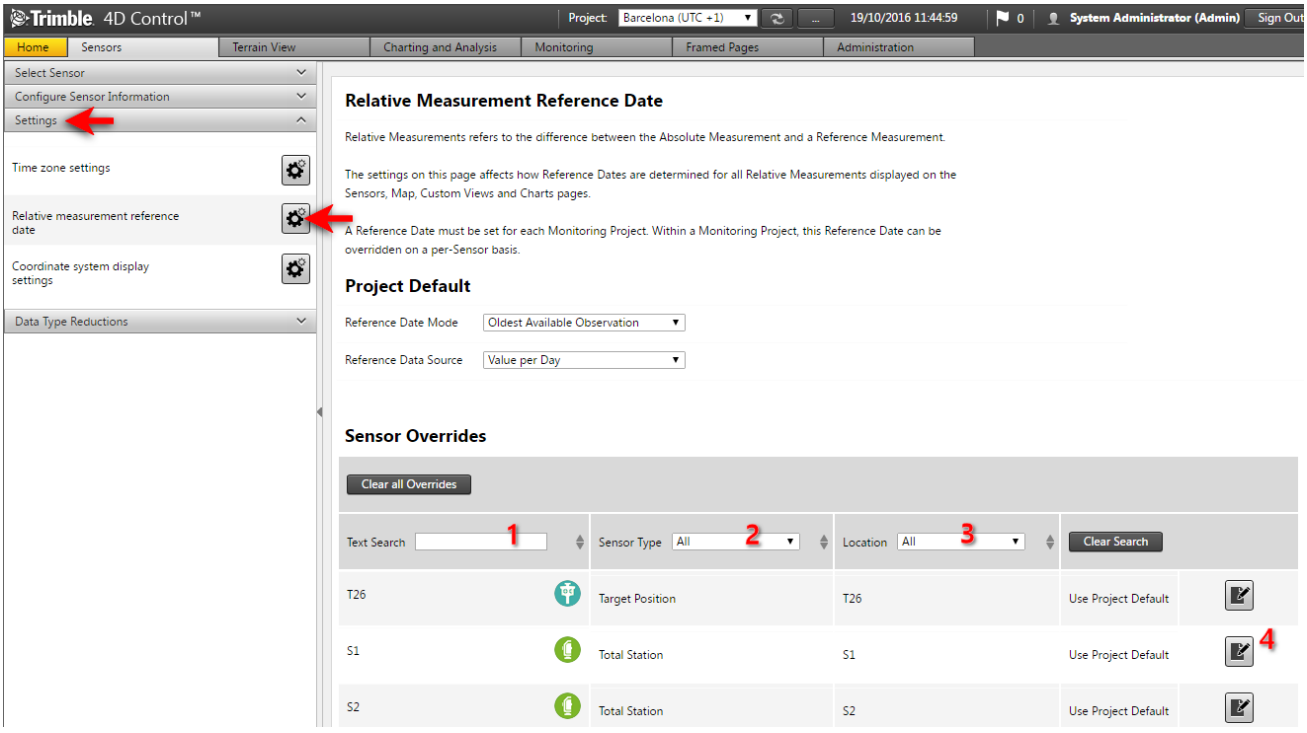
You can configure how the reference value is selected from the discrete set of values in the reference data source by setting the *Selection Mode*. Typically this setting determines a preference for closest values before or after the *Reference Date*.

The settings on this page affects how *Reference Dates* are determined for all *Relative Measurements* displayed on the Sensor Details, Maps, Custom Views and Charts pages.

A Reference Date must be set for each Project. The next section will show how this Reference Date can be overridden on a per-Sensor basis within a Project.

6.4.3. Sensor Reference Date Overrides

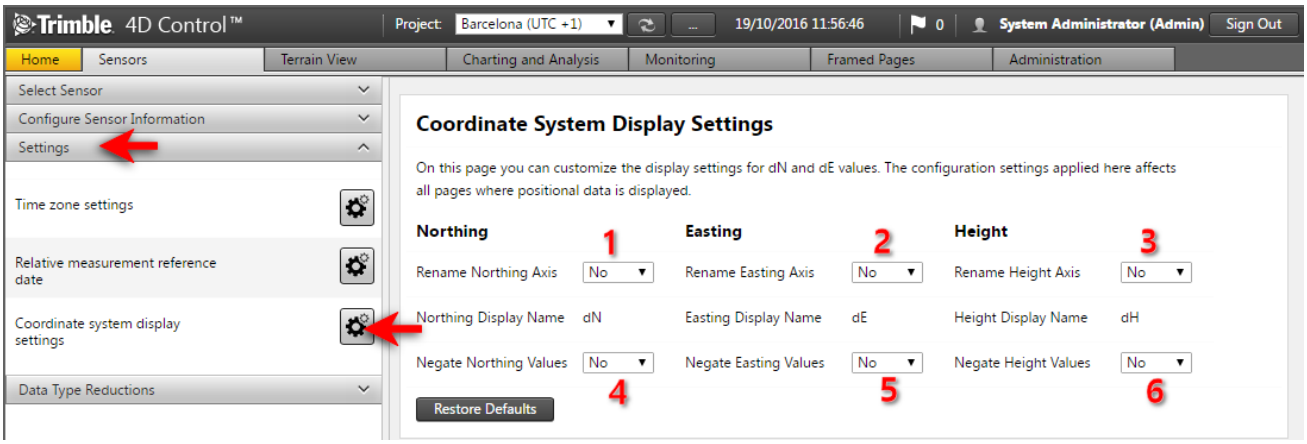
The per-Sensor Reference Date set in this section with override the default Reference Date set for the particular Project.



Navigate to the *Relative Measurement Reference Date* area. From here you can navigate the *Sensor Overrides* table to override the Project Default Reference Date for any listed Sensor.
Find the particular sensor you wish to override using the filter fields Text Search (1), Sensor Type (2), Location (3), then click on the particular sensor's Edit button (4).
For each Sensor you can either use the Project Default, Oldest Available Observation, Specific Date or Rolling Offset Days as the Reference Date Setting.

6.4.4. Sensor Reference Date Overrides

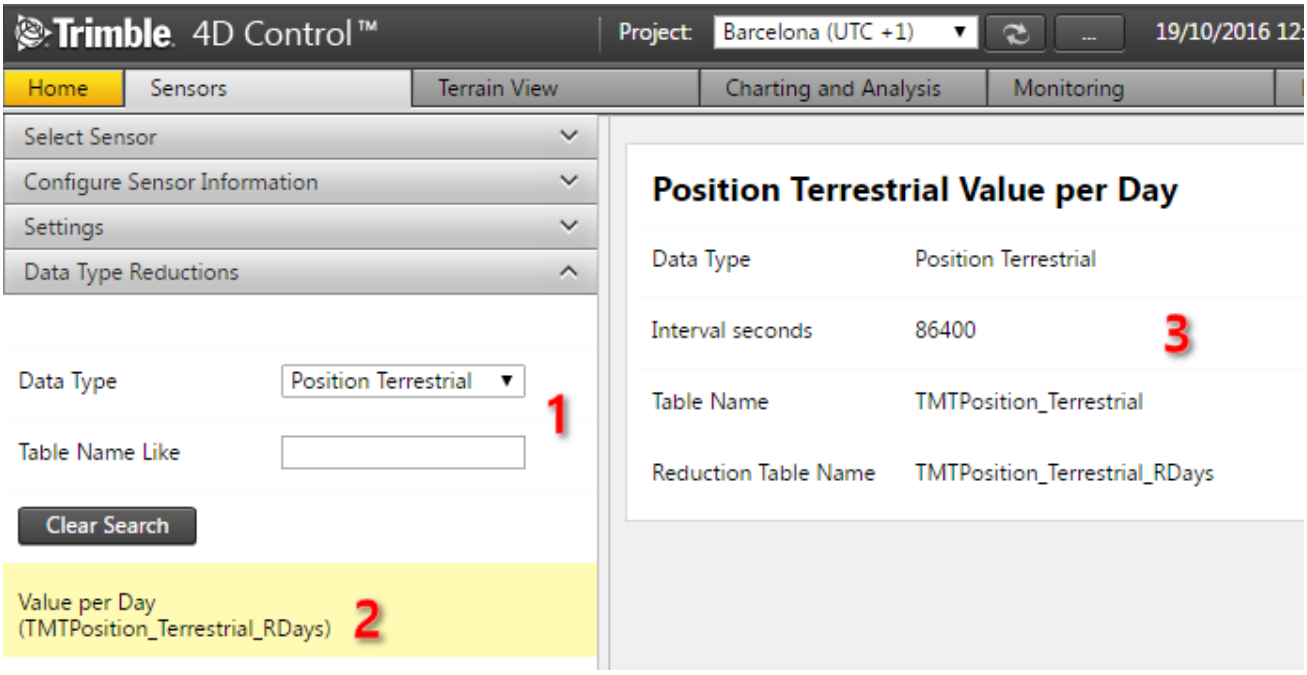
Use the coordinate system display settings for the current project.



Navigate to the *Coordinate system display settings area*. From here you can specify if the Northing Axis (1), Easting Axis (2), or Height Axis (3) should be renamed, or whether the Northing (4), Easting (5), or Height (6) Measurement Values should be multiplied by minus one (inverting the particular axis).

6.5. Data Type Reductions

Navigate to the *Data Type Reductions area*. Here you can view the different reduction or summary sets that are available for the various data types in the system. Please note this is a read-only section and therefore only provide information.



You can filter the list of available reductions or summary sets by either selecting a data type or by typing the name of reduction table (1).

Then click on any of the items (2) in the list to view the corresponding information (3).

7. Data Entry

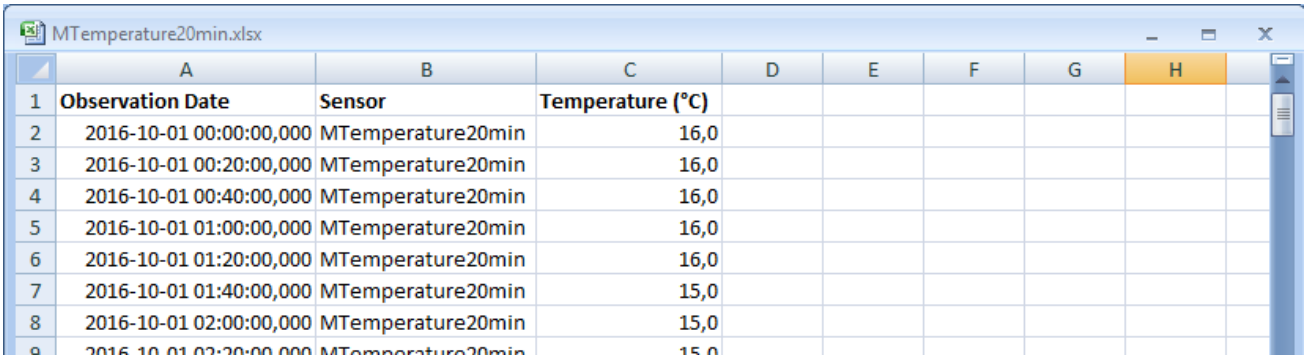
The *Data Entry* area is used to manually add readings to sensors.

Data Entry is only applicable to **Manual Sensors**. A **Manual Sensors** is created when the *Data Source Mode* is set to **Manual** on sensor creation (see Add Sensor). The *Data Source Mode* is only selectable on creation of a sensor. **Manual Sensors** can be created for only some *Sensor Types*.

7.1. Overview

The capturing of readings using *Data Entry* involves interim steps. Typically the user would manually enter sensor readings, verify correctness and finally apply the readings to the sensor.

Data Entry provides two methods to manually enter sensor readings:

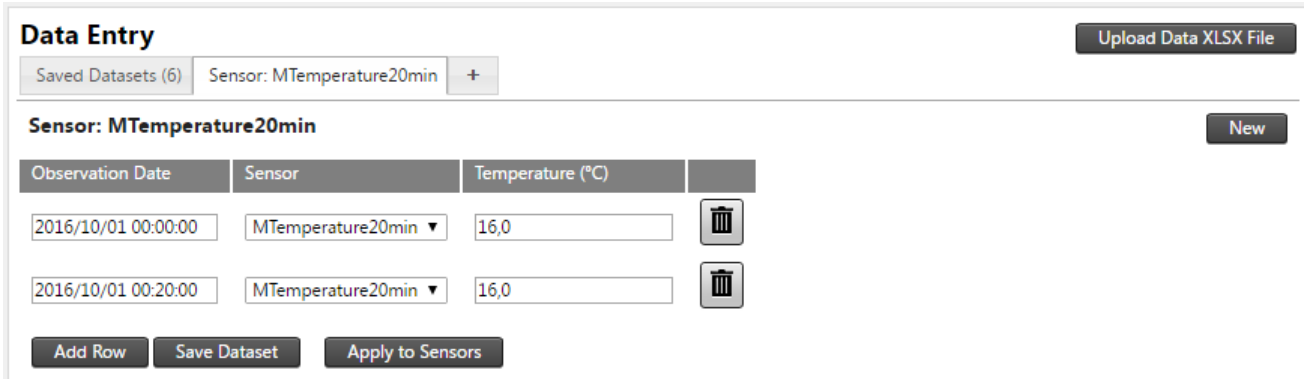

MTemperature20min.xlsx

	A	B	C	D	E	F	G	H
1	Observation Date	Sensor	Temperature (°C)					
2	2016-10-01 00:00:00,000	MTemperature20min	16,0					
3	2016-10-01 00:20:00,000	MTemperature20min	16,0					
4	2016-10-01 00:40:00,000	MTemperature20min	16,0					
5	2016-10-01 01:00:00,000	MTemperature20min	16,0					
6	2016-10-01 01:20:00,000	MTemperature20min	16,0					
7	2016-10-01 01:40:00,000	MTemperature20min	15,0					
8	2016-10-01 02:00:00,000	MTemperature20min	15,0					

The first method is a *Data XLSX File* which is a spreadsheet that provides a structured form to enter readings. Each *Data XLSX File* is a template for entering readings for a particular *Sensor* or readings for sensors of a particular *Sensor Type*. A *Data XLSX File* is useful to capture readings offline at remote locations.

A *Data XLS File* cannot directly be used to apply sensor readings to *sensors* defined in your project; You can edit *Data XLSX Files* and upload it to Trimble 4D Control to become *Datasets*.

A *Dataset* is an online repository which stores captured readings for a particular *Sensor* or readings for sensors of a particular *Sensor Type*.



Editing *Datasets* online is the second method of enter sensor readings manually.

Data XLSX Files can be uploaded to Trimble 4D Control to become *Datasets*, and *Datasets* can be downloaded from Trimble 4D Control as *Data XLSX Files*.

Finally the readings in a *Dataset* can be applied to sensors in your project by clicking on the **Apply to Sensors** button.

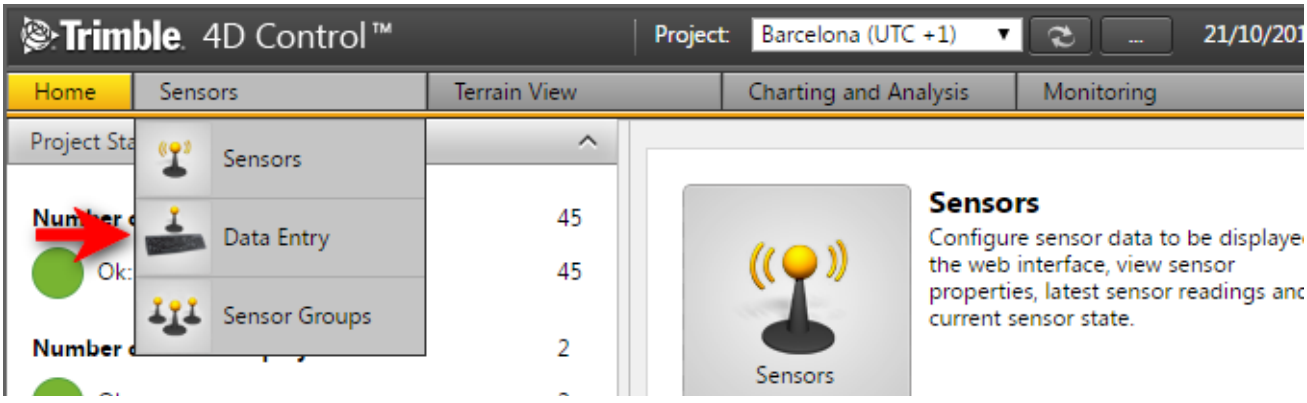
7.2. Sensor Template Data Entry

This section describes how to enter readings for a particular sensor.

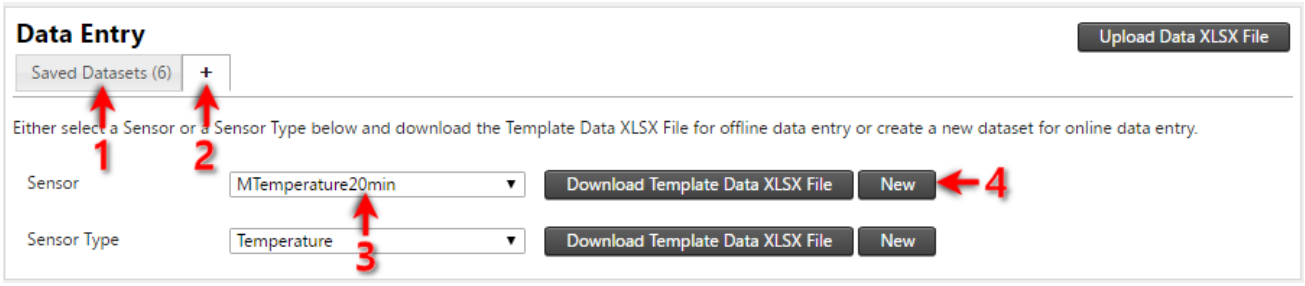
We will create a *Dataset* and enter a few sensor readings. Then for demonstration purpose we will export the *Dataset* to a *Data XLSX Files*, add more readings using *Excel* and upload the completed *Data XLSX File* to create a new completed *Dataset*. Finally we will view the completed *Dataset* and apply the readings to our sensor.

There are two methods to create a new *Dataset* for Sensor Data Entry.

7.2.1. Method 1: Add Dataset from Data Entry area



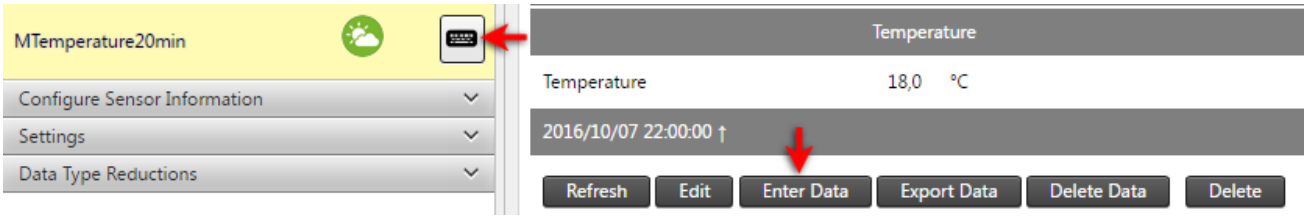
Navigate to the *Data Entry* area via the Menu under *Sensors* or from the *Home Page*.



The *Data Entry* area will appear as a tabbed view. The tab called **Saved Datasets** (1) lists all the Datasets saved online. We will discuss this later.

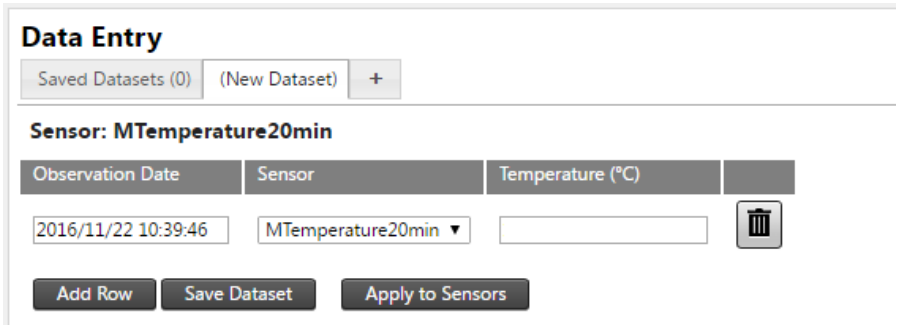
The tab marked + (2) shows options to either download *Data XLSX Files* or create a new *Dataset* for a particular *Sensor* or sensors of particular *Sensor Type*. For now select a manual sensor (3) in the sensors dropdown and click on the **New** (4) button to create a new *Dataset*.

7.2.2. Method 2: Add Dataset from Sensor List or Sensor Details page



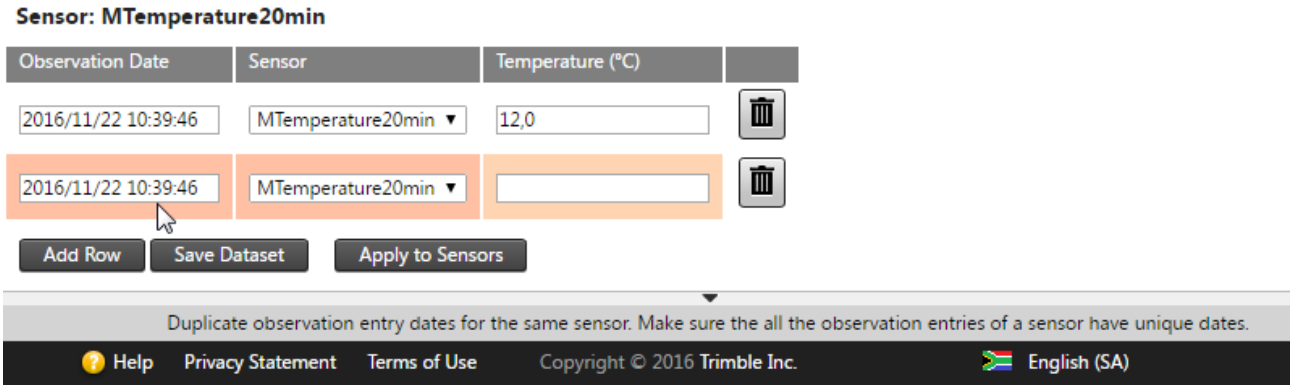
A new *Dataset* for a particular *Sensor* can also be created by moving your mouse over a manual sensor in the sensor list of the *Sensors* area or by clicking on the **Enter Data** button of the sensor details view.

7.2.3. Dataset for a particular Sensor



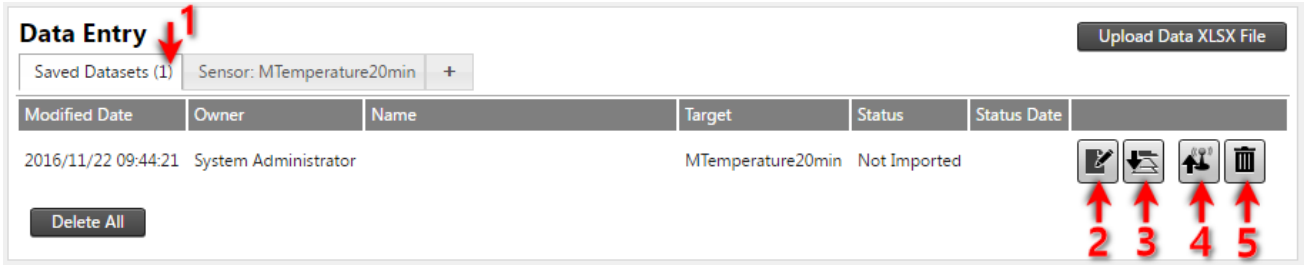
A new *Dataset* appears in the *Data Entry* area tabbed view as a tab called **(New Dataset)**. The online *Dataset* editor allows you to specify observation dates and enter readings for the particular *observation dates*.

Click on the **Add Row** button or simply press *TAB* on the last reading field in the *Dataset row* to add another row to your *Dataset*. You can also remove a *Dataset row* by clicking on the **Delete** icon next to the row.



Notice that some cells may be marked with *validation warnings*. You can view particular *validation warnings* by hovering over the cell. Once you fixed all the *validation warnings* in a *Dataset* you can click on the **Save Dataset** button to save your *Dataset* online.

You could also have applied the readings to your sensor immediately by clicking on the **Apply to Sensors** button. This would will apply the readings to your sensor and direct you to the Sensor details page. If you do not save a *Dataset* before clicking on the **Apply to Sensors** button, then the new *Dataset* you created will not be saved online. If you do not plan to use the *Dataset* again, it is not necessary to save a *Dataset* during data entry.



After saving your *Dataset*, click on the **Saved Datasets** (1) tab to view your saved *Dataset*. Here you have the options to click on any one of the action icons:

- **Edit** icon to edit the *Dataset*,
- **Download** icon to download the *Dataset* as a *Data XLSX Files*,
- **Apply to Sensors** icon to apply the readings captured in the *Dataset* to the sensor
- **Delete** icon to delete the *Dataset*.

7.2.4. Data XLSX File for a particular Sensor

We continue from the previous section and demonstrate data entry using a *Data XLSX Files*.

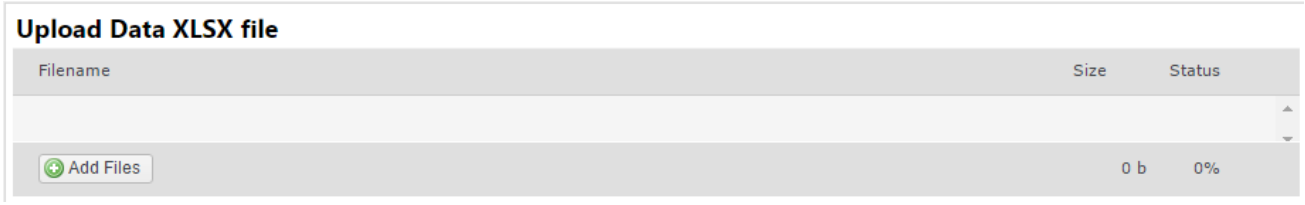
On the the **Saved Datasets** (1) tab, click the **Download** icon of your *Dataset* to download the *Dataset* as a *Data XLSX File*.

TestProject_MTemperature20min_2016-11-22_12_34_25.xlsx

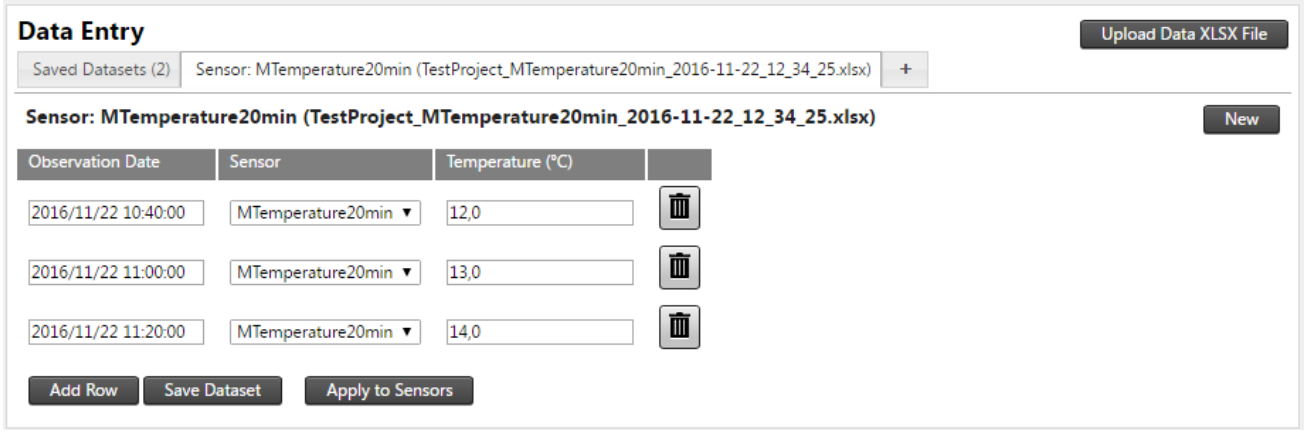
	A	B	C	D	E	F	G
1	**Observation Date**	**Sensor**	**Temperature (°C)**				
2	2016-11-22 10:40:00.000	MTemperature20min	12.0				
3	2016-11-22 11:00:00.000	MTemperature20min	13.0				
4	2016-11-22 11:20:00.000	MTemperature20min	14.0				
5							
6							

Open the *Data XLSX File* to change or enter additional readings. You can also send the *Data XLSX File* to someone else to capture readings.
Remember to save your *Data XLSX File* after making changes.

Once you have captured readings in your *Data XLSX File* you can upload your readings by navigating to the *Data Entry* area and clicking on the **Upload Data XLSX File** button.



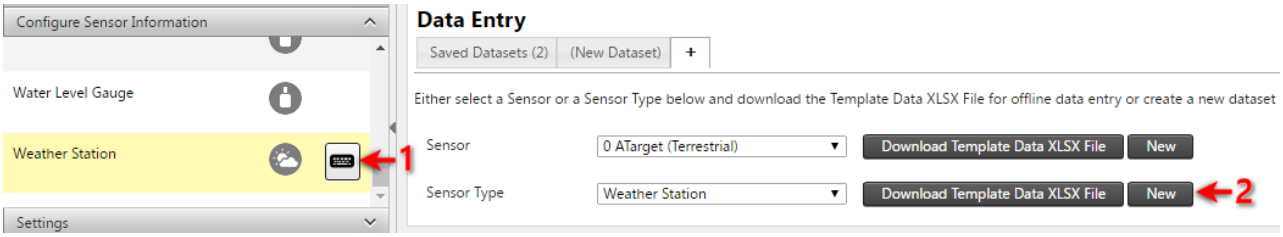
Either drag your *Data XLSX File* onto the upload area or click the **Add Files** button to upload your *Data XLSX File*.



The readings in your *Data XLSX File* will now appear as a *Dataset* in T4D Control Web and you can proceed to edit the readings online or apply the readings to sensors.

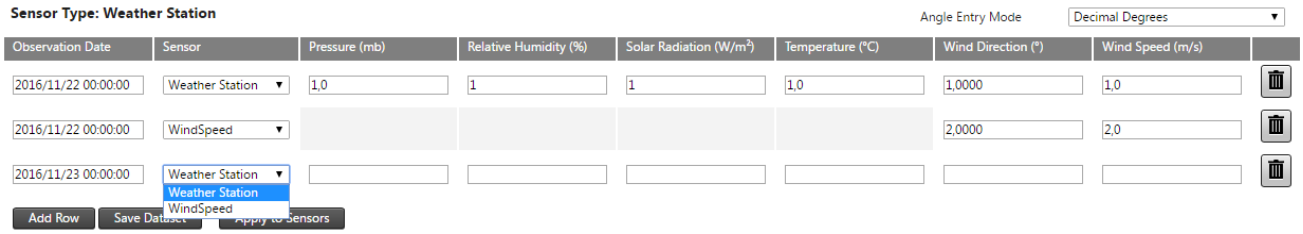
7.3. Sensor Type Template Data Entry

If you wish to capture readings for multiple sensors of a particular *Sensor Type* you may want to use a *Dataset* or *Data XLSX File* for sensors of a particular *Sensor Type*.



Create a new *Dataset* for a sensors of a particular *Sensor Type* by:

1. Moving your mouse over a listed *Sensor Type* under the *Configure Sensor Information* bar and clicking on the **Data Entry** icon (1), OR
2. Selecting a *Sensor Type* and clicking on the **New** (2) button at the *Data Entry* area on the tab marked +



In the online editor of a *Dataset* for sensors of a particular *Sensor Type* you can add readings for any manual sensor of that *Sensor Type*. The *Data Types* that are not associated with particular sensors of a *Sensor Type* will simply not have input boxes in the *Dataset*.

Similar to *Sensor Template Data Entry* in the previous section, for *Sensor Type Template Data Entry* you can also export the *Dataset* a *Data XLSX File* and upload the *Data XLSX File* to create a *Dataset*.

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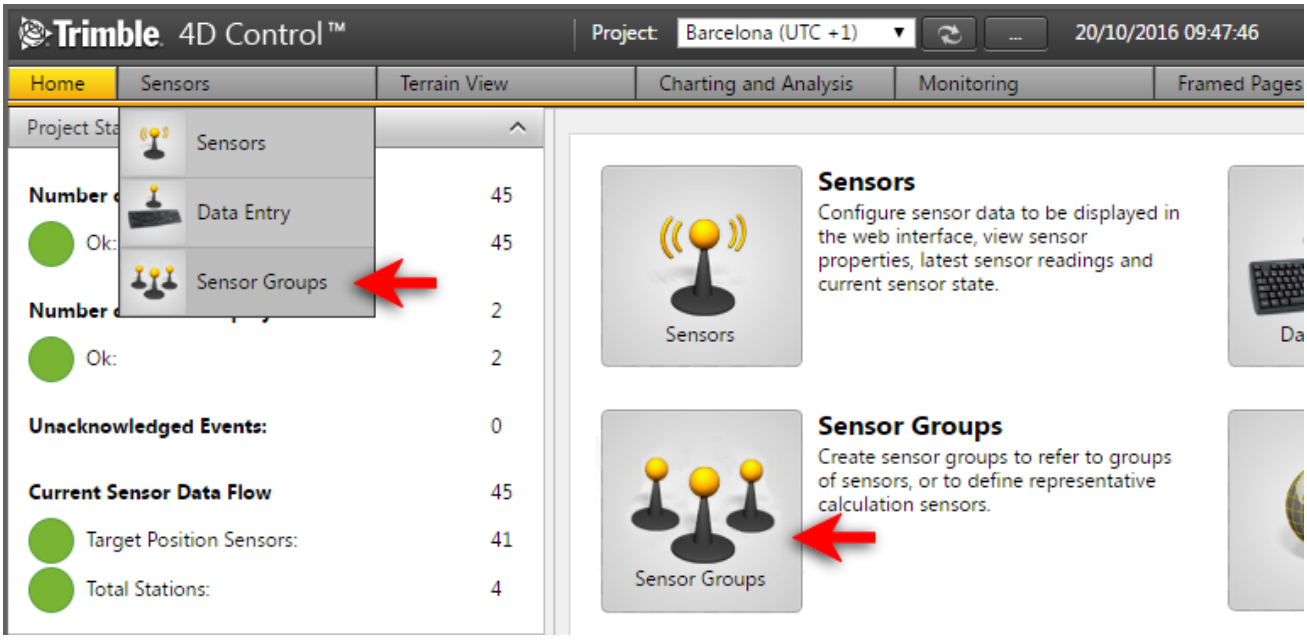
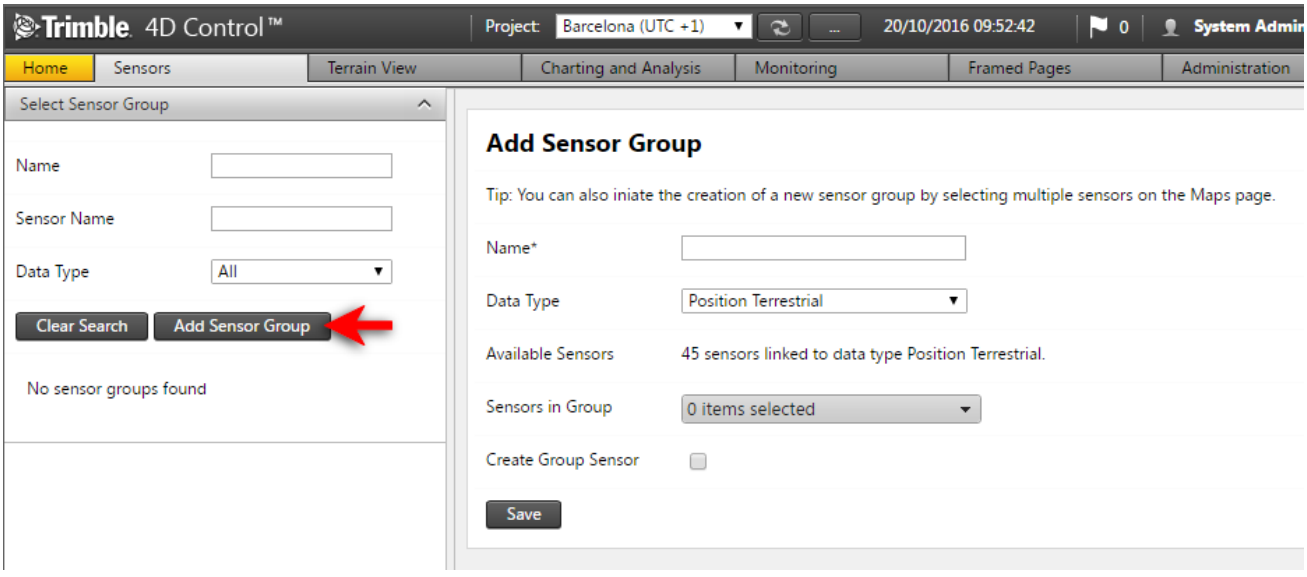
8. Sensor Groups

Sensor groups are used to refer to a collections of sensors when defining *Analysis* or *Alarms*.
A representative sensor can also be created using sensor groups.



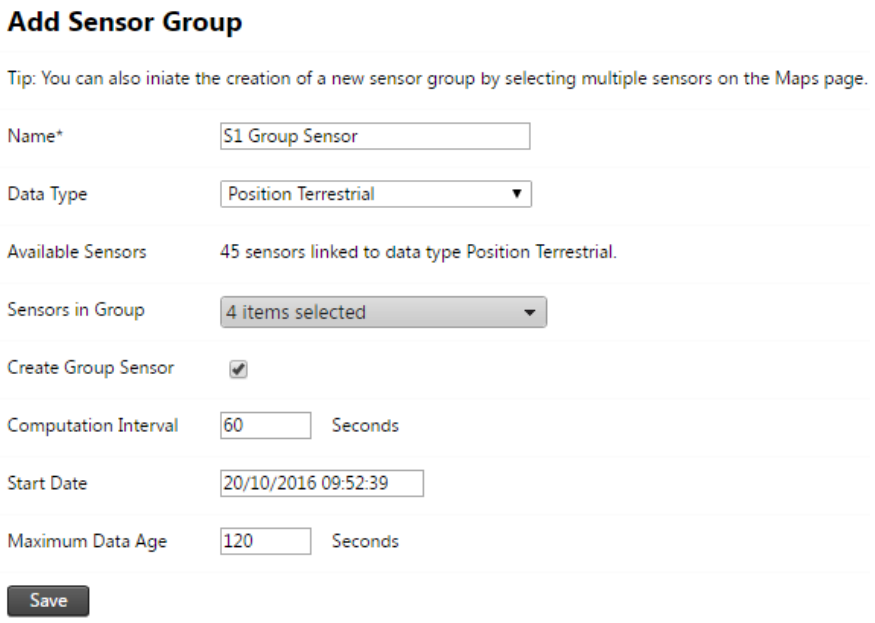
Navigate to the Sensor Groups area from the *Menu* under *Sensors*,or from the *Home Page*.

8.1. Add Sensor Group



Step 1: On the Sensor Group Page, click on Add Sensor Group
Complete information on the right. The fields are as follows:

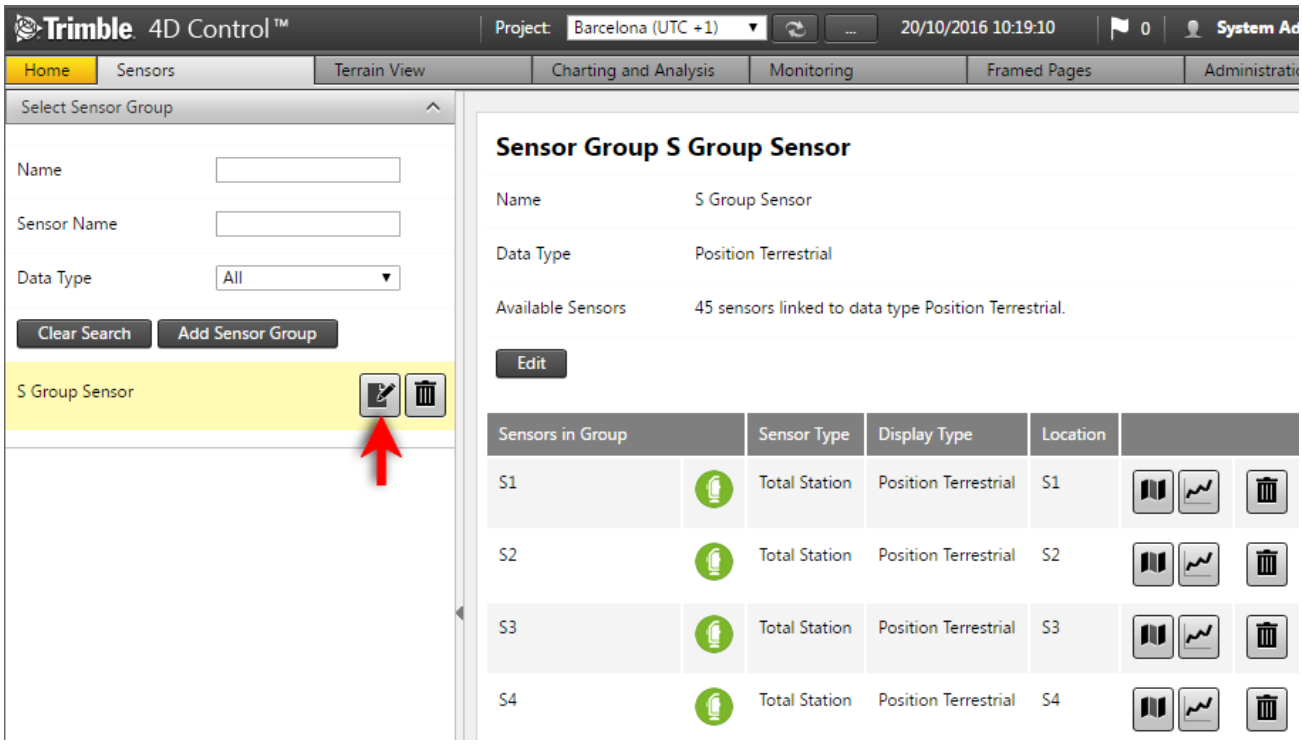
- **Name:** Any unique name by which to identify the group.
- **Data Type:** The *Data Type* of the sensor group. Only sensor with the particular selected Data Type will be allowed to be associated with this Sensor Group.
- **Available Sensors:** For convenience the number of sensors in the Project with the selected Data Type are displayed here.
- **Sensors in Group:** Here you can select the individual sensors that should belong to your new Sensor Group. Keep in mind that only sensor with the particular Data Type will be allowed to be associated with your new Sensor Group.
- **Create Group Sensor:** This option is only available for Sensor Groups with Positional Data Types. Select this option if you wish to create a representative **Group Sensor** for the sensors in this group. A new Sensor will be created and the observations of the new sensor will be calculated as a representative observation of all the sensors in the group.



- **Computational Interval:** Specify an interval at which observations for the group sensor is sampled from the sensors in the sensor group.
- **Start Date:** Specify a start date from when observations for the group sensor should be calculated.
- **Maximum Data Age:** Specify the maximum age of observations to be included in calculations for the group sensor.

Step 2: Click the Save button to create the Sensor Group (and Group Sensor if applicable).

8.2. Manage Sensor Group



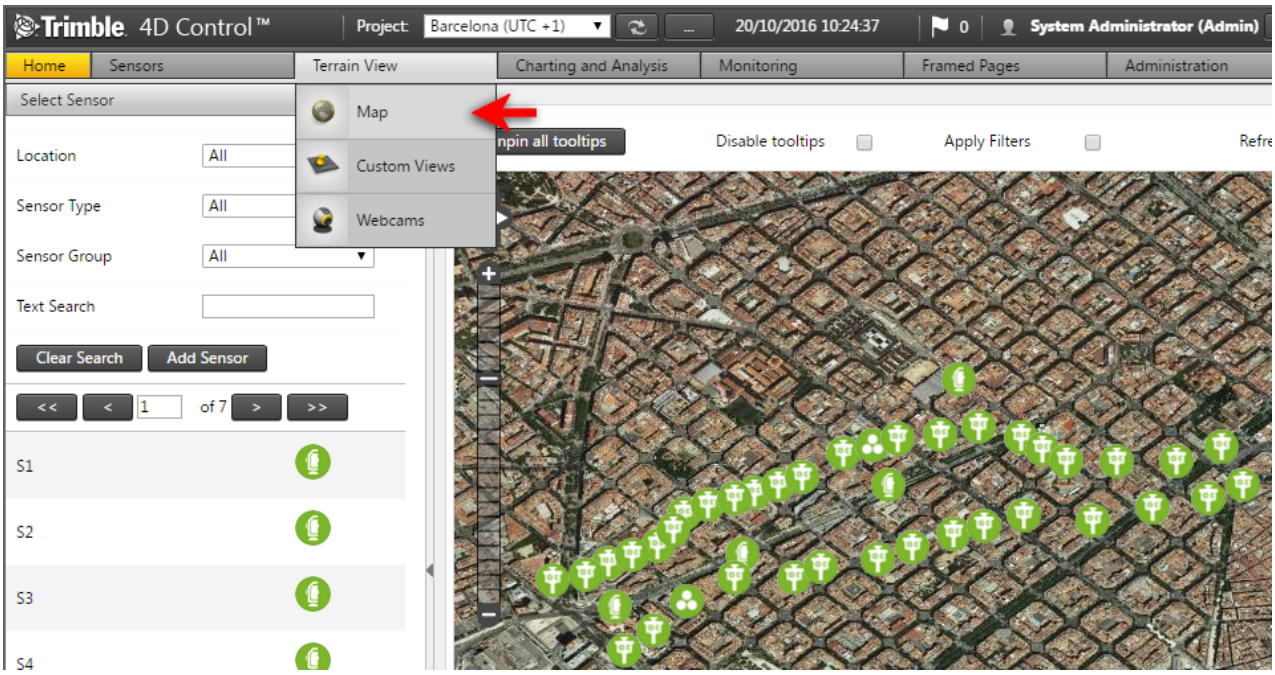
The sensor group can be viewed by simply clicking on its name in the list of sensor groups in the left panel.

The sensor group view shows the configuration of the sensor group. Simply click the Edit button to modify and/or maintain some of these fields. From here you can also navigate to informational pages for the sensors in the sensor group or remove sensors from the Sensor Group.

The Sensor Group can be deleted by clicking on the trash can icon in the list of the left hand pane.

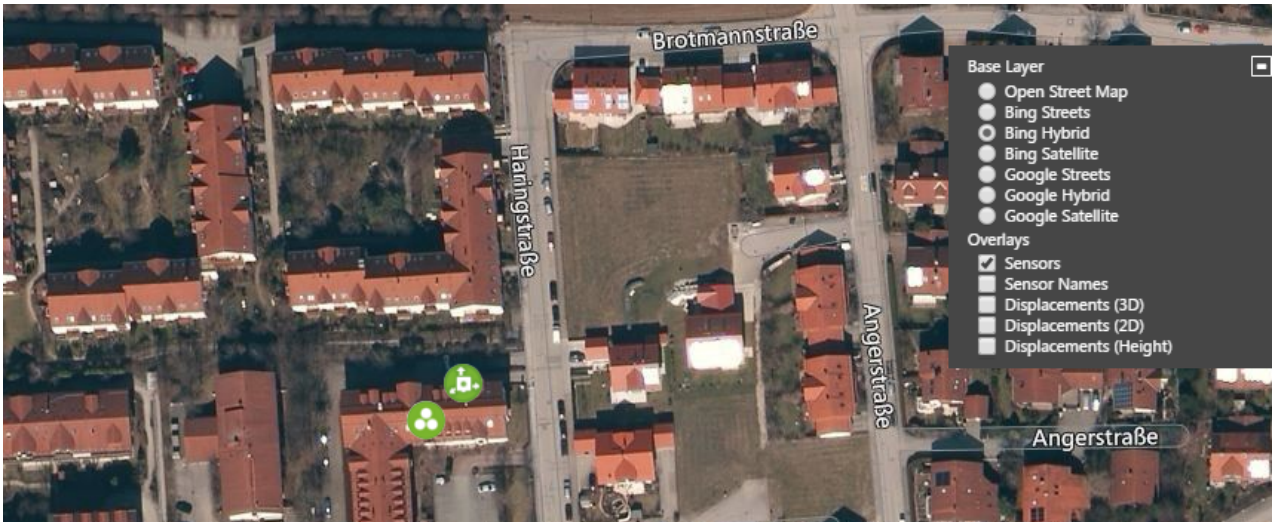
9. Maps

The *Maps* area shows your sensors as icons on a geographic terrain either from standard map providers or from your own geo-referenced terrain photos.



Navigate to the Maps area by hovering the mouse over the *Terrain View* top menu item and then clicking on Maps in the dropdown menu. Alternatively simply click on Map Icon on the Home Page. **Note that the maps page is unavailable for Projects that are configured on a local coordinate system only.**

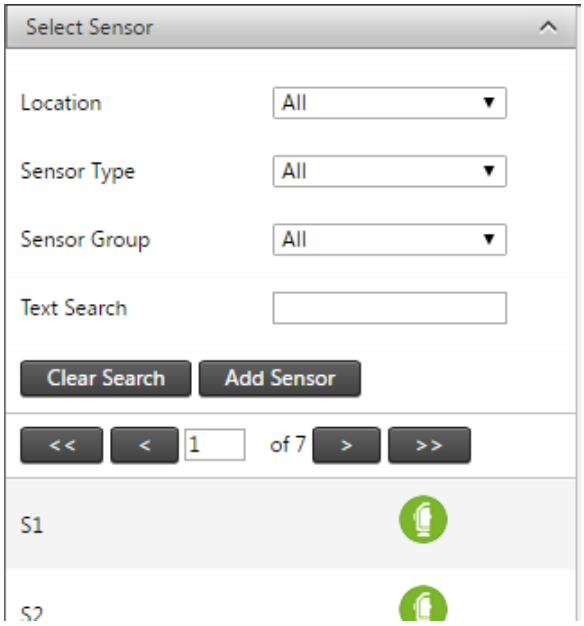
On the Maps Page you can click and drag on the map using the left mouse button to pan the map area in different directions. Use the mouse wheel to zoom in or out.



The settings at the top right of the map area can be used to hide and show available layers (we will discuss this later in this manual).

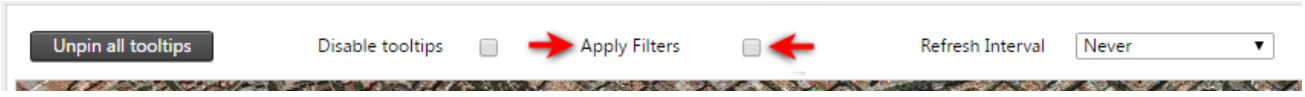
9.1. Select Sensors

Upon opening the Map Page, all the available sensors on the map will be plotted by default. To select a sensor, click on any of the listed sensors (shown in the blue box). The map will navigate directly to the position of the sensor.



You can filter the sensors shown in the sensor list by using the options above. These options are:

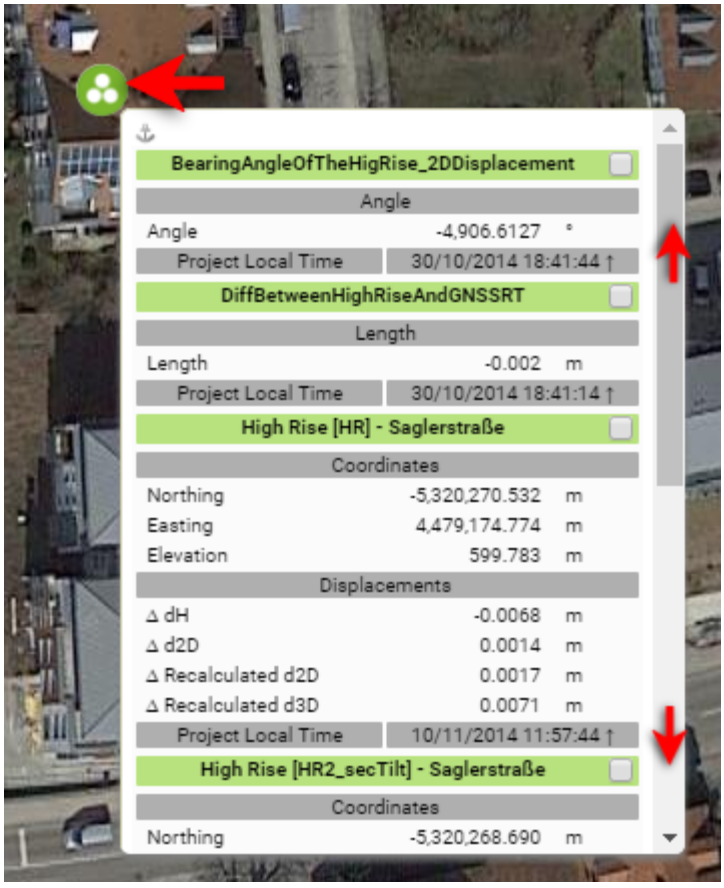
- Sensor location: sensors at a marked location.
- Sensor type: sensors of a specific Sensor Type, e.g. Total Station.
- Sensor group: sensors associated with a Sensor Group.
- Text search: Enter text to filter by sensor name.



You can apply the same filter also to the sensors shown on the Map by selecting the option on the bar above the Map.

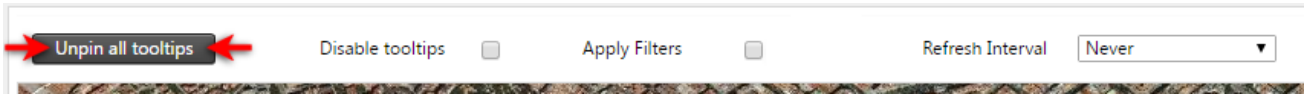
9.2. Sensor Nodes

To display more information about any of the sensor nodes on the map, simply hover the cursor over the node on the map.

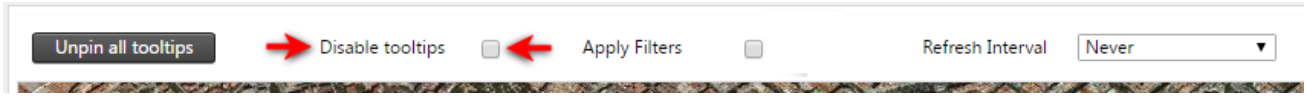


Sensors that are clumped up too close to each other (depending on how far the map is zoomed out) are collectively shown by a special icon as illustrated above.

To keep the tooltip (pop-up) information visible, click on the node instead of just hovering over it. An anchor will appear next to the node to show that it will not disappear when the mouse cursor moves away. Simply click on the anchor to close the tooltip.



Click on the Unpin all tooltips buttons to easily clear all “anchored” pop-ups.

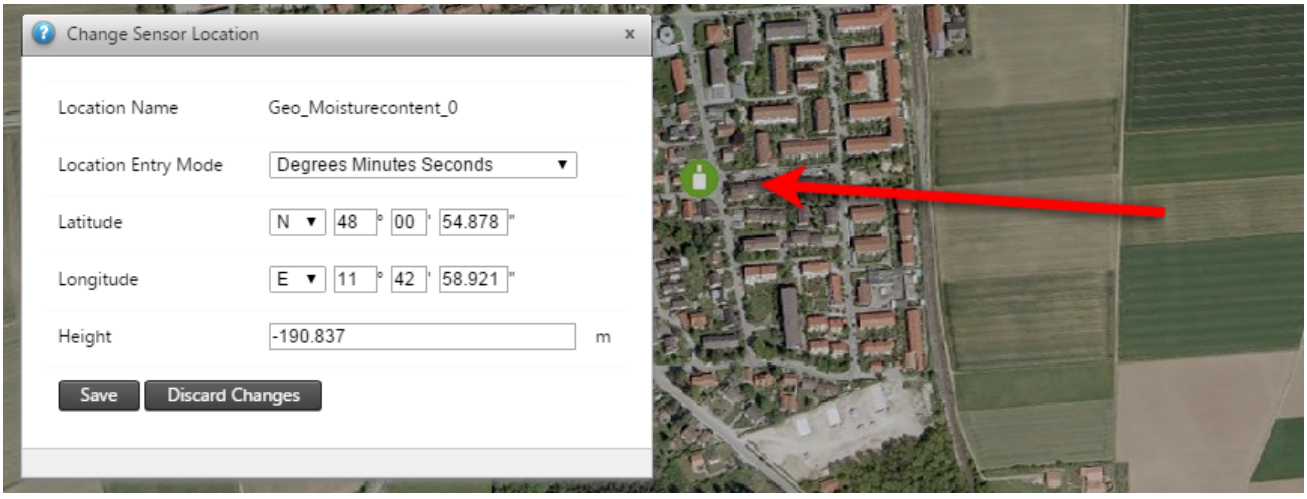


Disable the auto tooltips (pop-ups) simply by checking the *Disable tooltips* box at the area above the map. Clicking on a node will still provide the tooltip but hovering over nodes will not show any tooltip. This is useful if there are many icons on the screen triggering too many pop-ups.

9.3. Move Sensor to Change Sensor Location

You can use the map to change the location of a sensor. You cannot use this feature to move sensors that are clumped up too close to each other (depending on how far the map is zoomed out).

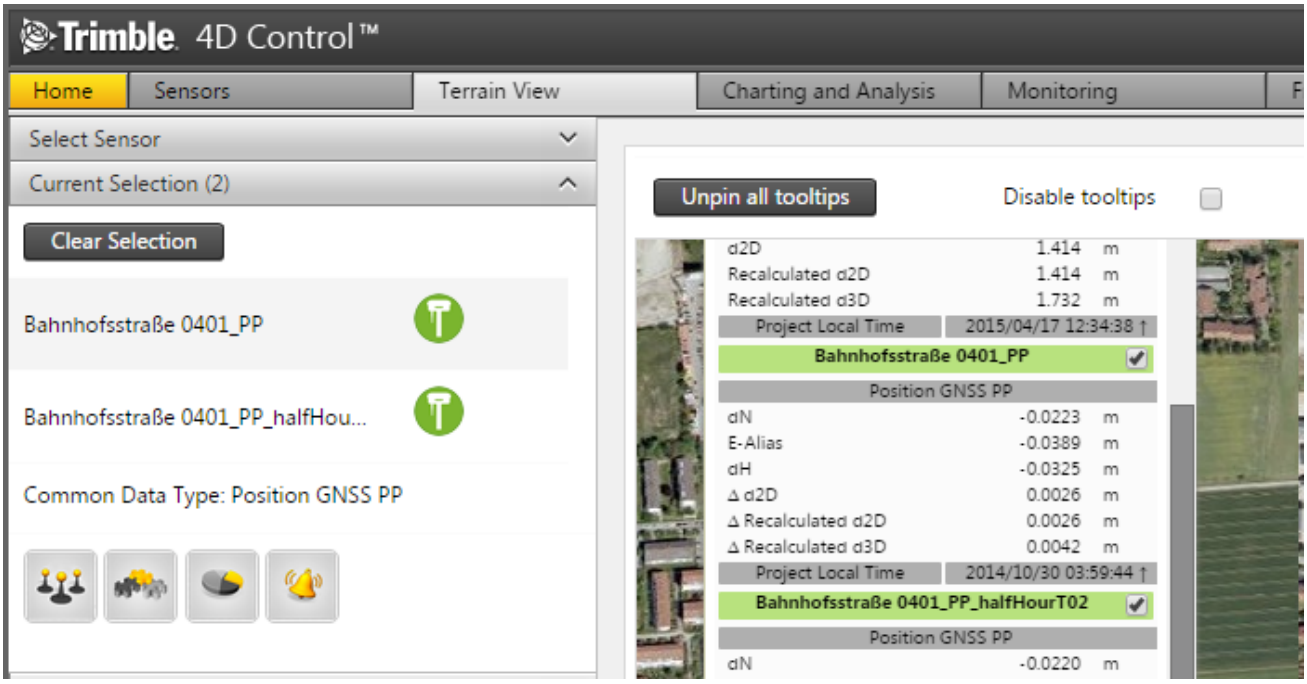
Simply hover your mouse cursor over a sensor and notice the mouse cursor change into a *move cursor*. Click and drag the sensor to a new location on the map. When you have dragged the sensor to the new location on the map, simply release the mouse button. The *Change Sensor Location* dialog will then appear:



The *Change Sensor Location* will show the new map coordinates where you have dragged the sensor. You can also edit these values. Confirm the change of sensor location by clicking the *Save* button or discard the change of sensor location by clicking *Discard Changes*.

9.4. Map Kick Start and Lasso Tool

You can use the map to kick-start creating a Sensor Group, Composite View, Analysis or an Alarm in Trimble 4D Control Web.

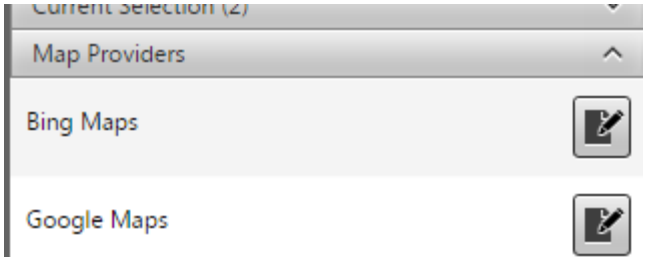


Next to each sensor's name on the tooltip (pop-up) is an option to select that sensor.
When you select a Sensors, it will be added to the *Current Selection* section visible in the left hand pane. The *Current Selection* panel shows a list of sensors you selected and also the common Data Types. The kick-start buttons will appear below the list of selected sensors. These may differ depending on the sensors selected. You can click on any of these buttons to start creating either a Sensor Group, Composite View, Analysis or an Alarm.

You can also use the *Lasso Tool* to select sensors on the map.

Hold down the *Ctrl* key and click to create the corners of a polygon enclosing the sensors you wish to select. Release the *Ctrl* key to select the sensors.

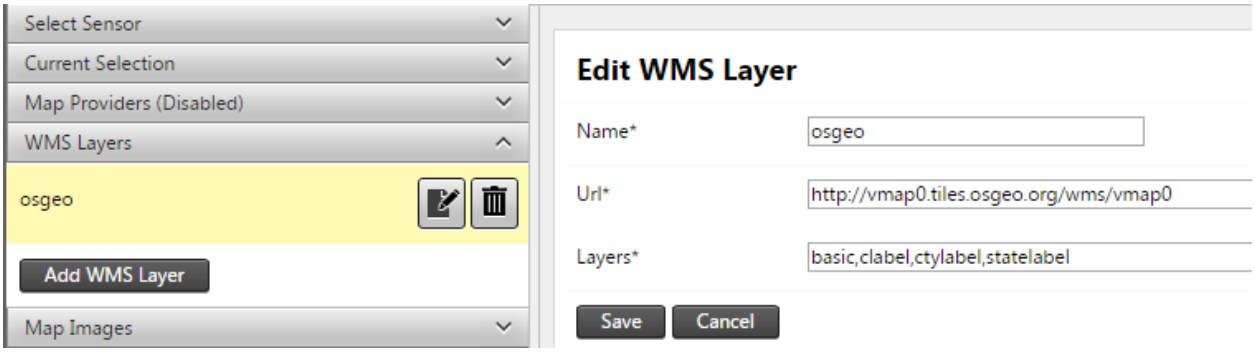
9.5. Map Providers



By default Trimble 4D Control Web has some pre-configured free map providers, however the free map providers may not offer sufficient content. In addition to the free map providers you can utilize the map providers Bing Maps or Google Maps. By selecting the *Map Providers* panel you can configure your license for these map providers. The interface will provide you with instructions on how to acquire a key for each of these.

9.6. WMS Layers

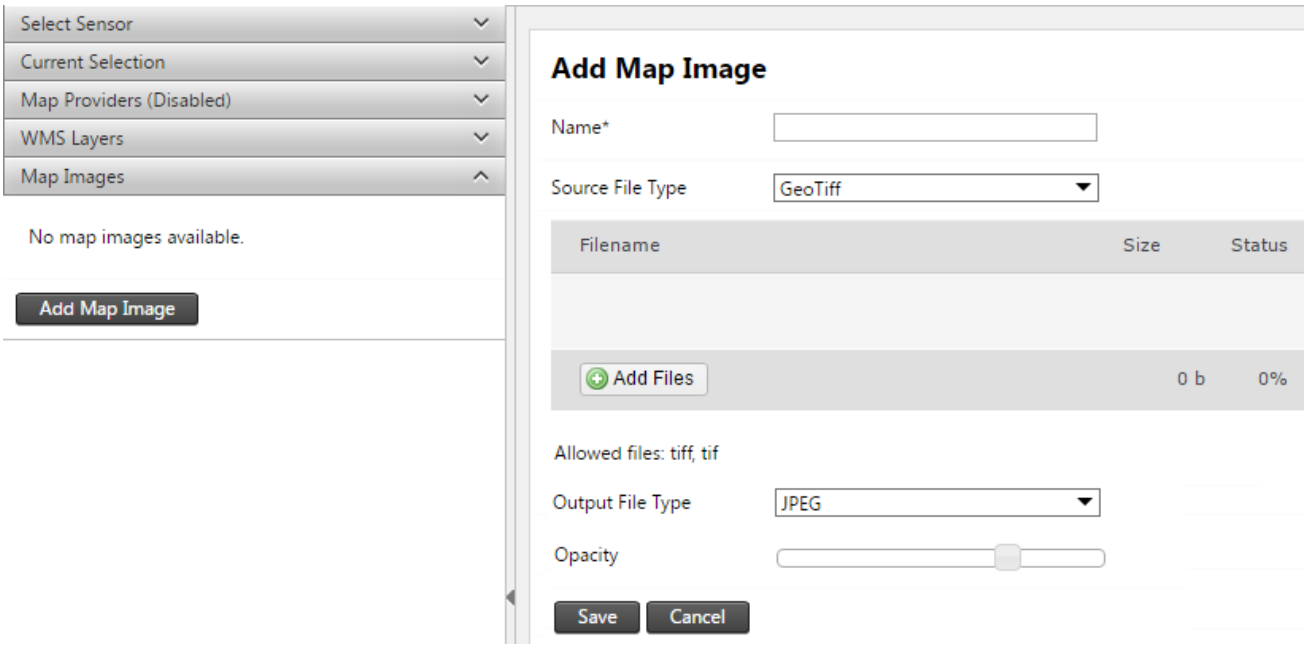
A Web Map Service (WMS) is a standard protocol for serving georeferenced map images which a map server generates using data from a GIS database. In Trimble 4D Control you can use WMS Layers on your map instead of using Map Providers.



Navigate to the *WMS Layers* tab in the *Map* area and enter your WMS map service name, location and the layers you require. Click the **Save** button.

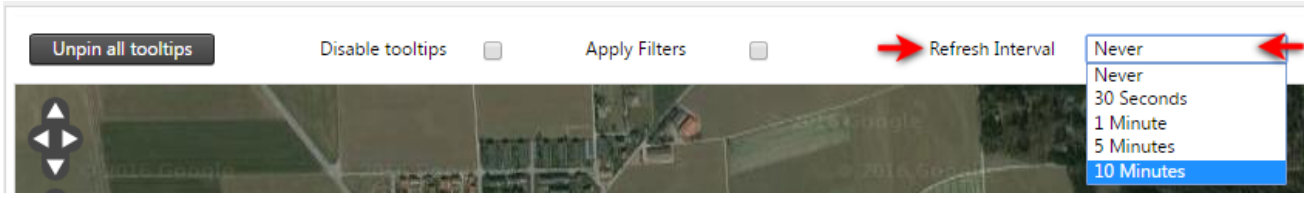
The WMS Layer will now be available as a Base Layer on the Map.

9.7. Map Images



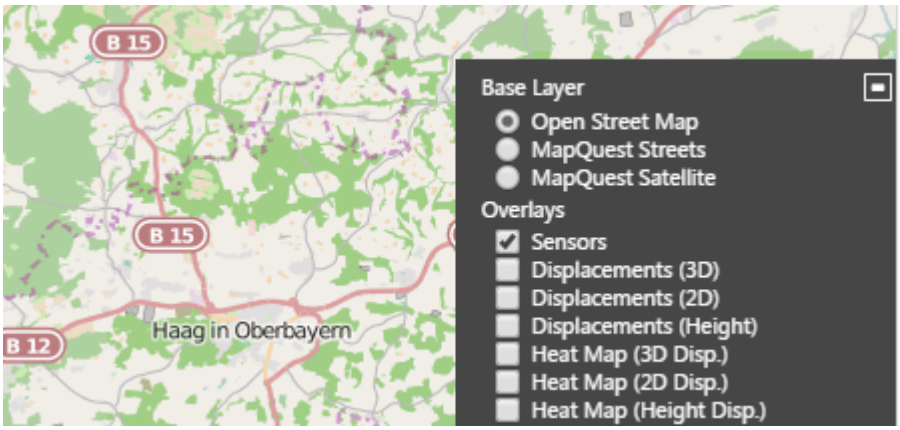
You can add your own images as a layer overlaying the map. Select the *Map Images* bar to start adding a map image. You can add GeoTiff images or other images. If your image is not geo-referenced, you will be required to specify a map extent onto which your image must be projected.

9.8. Map Refresh Timer



Select a time interval from the dropdown menu to refresh die map view.
The time selected will cause the map to refresh, for example every 30 seconds.

9.9. Sensors Map Overlay



On the right hand side of the map there are options of overlays to enable on the map. Among these is an overlayer called *Sensors* which displays the icons of the sensors at the projected sensor location on the geographic map.

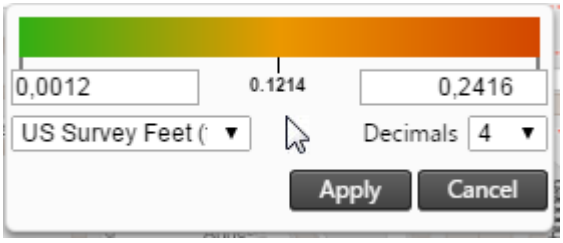
9.10. Sensor Names Map Overlay

On the right hand side of the map there are options of overlays to enable on the map. Select the *Sensors Names* overlay to display the names of sensors on the map. The sensor name labels may be grouped together depending on the map zoom level.

9.11. Displacement Vector Map Overlay

In addition to the sensor overlay you can show the displacement of sensors visualized as a *displacement vector layer*. The displacements shown is colour coded to indicate the severity of the displacement according to a colour scale.

A legend of the color scale is also included to the left (which will only appear if a displacement overlay is enabled).



You can edit any of the following display parameters on the legend:

- **Minimum displacement threshold:** any displacement below this threshold will not be shown.
- **Maximum displacement threshold:** any displacement above this threshold will appear in a red colour and be a maximum length/size.
- **Unit of Measure:** change your unit of measure (if multiple ones are available for the particular metric)
- **Decimals:** the number of decimals to be used when displacement values are displayed.

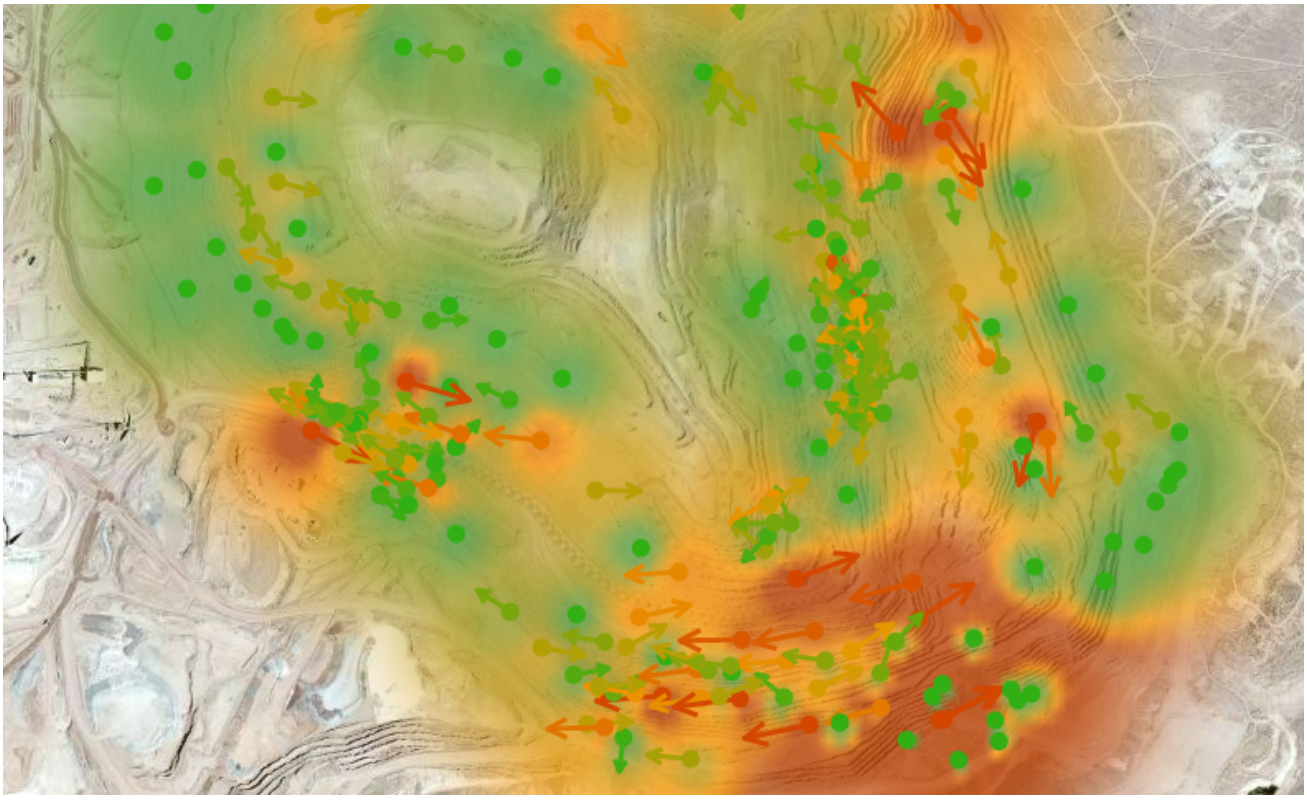
A sensor that measures Height (in the map above for example the orange bar) shows the direction of the displacement by use of a bar pointing up or down and the severity of the displacement as the length and the colour of the bar.

A sensor that measures 2D (in map above for example the green arrow) shows the direction of the displacement by use of an arrow and the severity of the displacement as the length and colour of the arrow.

A sensor that measures 3D will use both the Height and 2D measurements to calculate a circle around the sensor and show the severity as the radius and colour of the circle. The direction of 3D displacements are not visualized here. The radius of the circle is equal to the 3D displacement vector length.

9.12. Displacement Heat Map Overlay

In addition to the displacement vector layer, you can enable the **Displacement Heat Map Overlay** which visualizes the various vector displacement layers an interpolated colour maps.

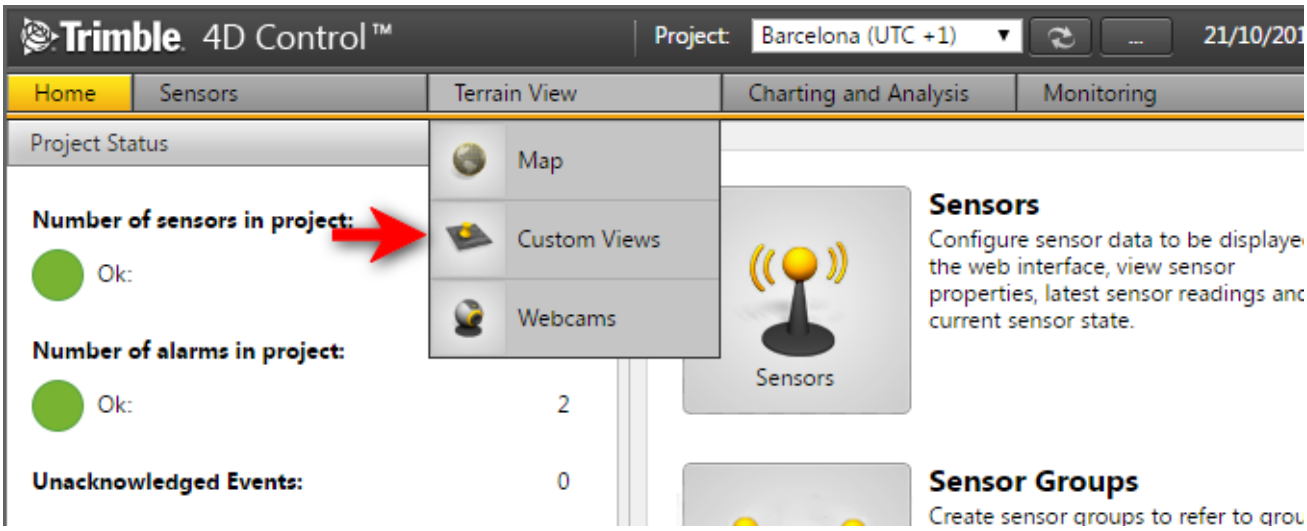


The colour map is colour coded with the same colour scale as the vector displacement layer.

10. Custom Views

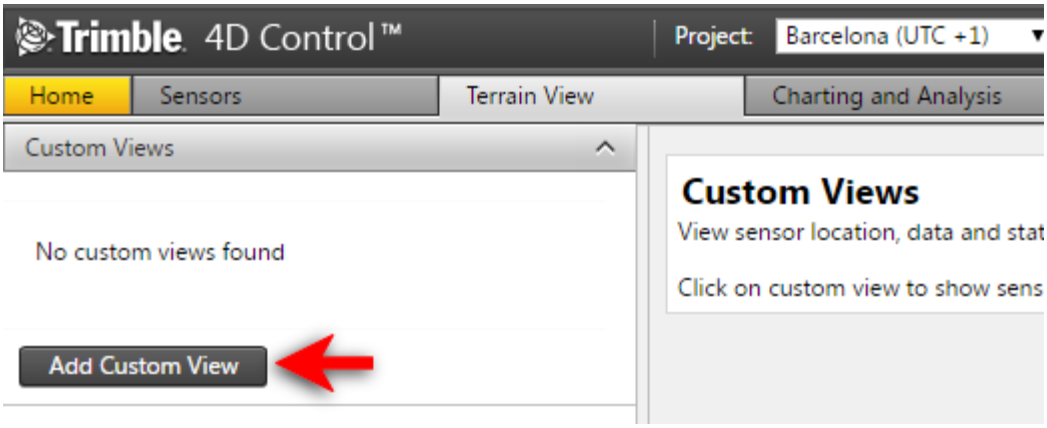
A Custom View allows sensors to be placed on a picture for context visualization. It can be a schematic plan (e.g. a blue print) of a building/site/structure or even the actual photo of the location of the sensor or the sensor itself (as will be illustrated in the example later in this section).

The Custom Views also provides the ability to show a Chart or Scatter plot in a tooltip.
The Custom Views page can be accessed from the Terrain View main menu.

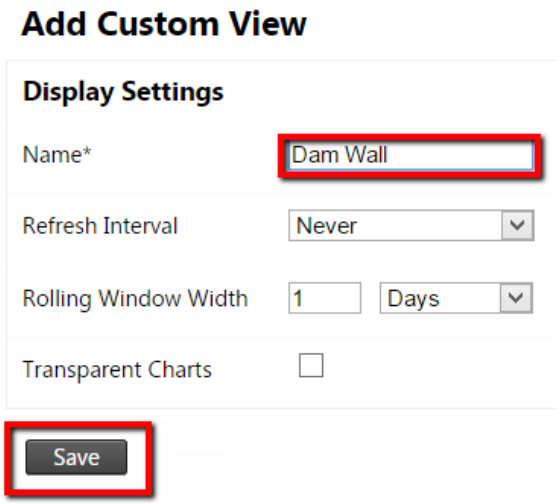


Navigate to Custom View from the *Menu* under *Terrain View* or from the *Home Page*.

10.1. Add a Custom View

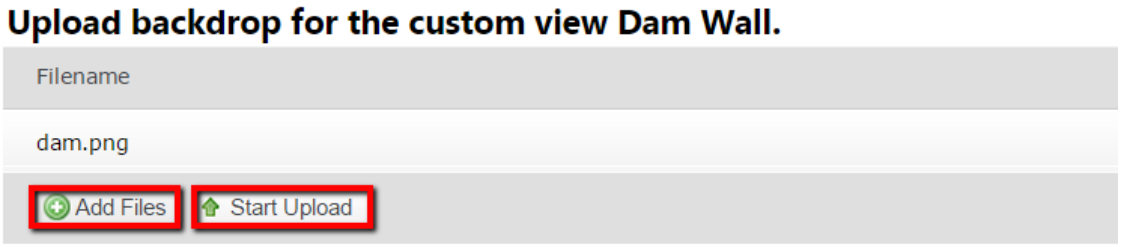


Step 1: Navigate to Custom Views, then click on the *Add Custom View* button.



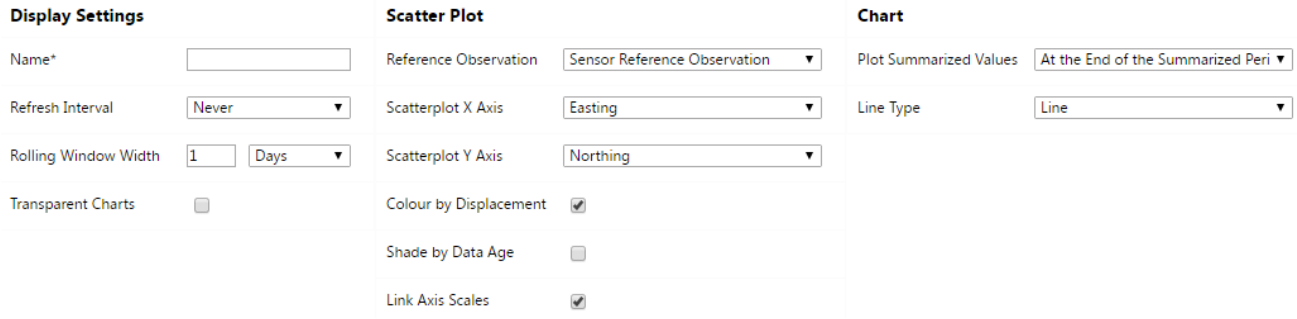
Step 2: Enter a name for your Custom view. For now please ignore all the other options and click the Save button. We will discuss these settings later.

Step 3: Click the Upload Image button. 



Step 4: Click the Add Files button, select a file from your computer and then click the Start Upload button.

Your Custom View will now be created and you can start adding sensor, which will be discussed in the next section. Below is a description of the other settings available when adding a Custom View:



Display Settings:

- **Refresh Interval:** Specify the interval by which data should be refreshed. (Same effect as with Maps that are refreshed.)
- **Rolling Window Width:** Specify the time window which will determine the date range used by custom view charts. The effective date range will change on a continuous basis.
- **Transparent Charts:** Transparency allows tooltips to be both visible and not obscure the custom view background image.

Scatter Plot:

- **Reference Observation:** In Trimble 4D Control Web scatter plots always plot relative positions, which is the difference between and actual position and a reference position. You can either use the reference date of the selected sensor to obtain a reference position, use the first observation in the result set or use the average of the observation values within the result set.
- **Scatter plot X Axis:** Select the dimension to plot against the X axis of the scatter plot.
- **Scatter plot Y Axis:** Select the dimension to plot against the Y axis of the scatter plot.
- **Colour by Displacement:** When this option is enabled, dots on the scatter plot will be colored green, yellow or red depending on the distance from the reference measurement. If this option is disabled, all dots will be blue.
- **Shade by Data Age:** When this option is enabled, a degree of transparency will be applied to each dot on the scatter plot. The latest observation will be solid and the oldest observation will be almost completely transparent. The use of this setting is only effective when you do not have multiple observations plotted on top of each other.
- **Link Axis Scales:** When this option is enabled, the two chart surfaces will be scaled identically. When this option is disabled, the scale of each chart surface will be optimized for the data that appears on that chart only.

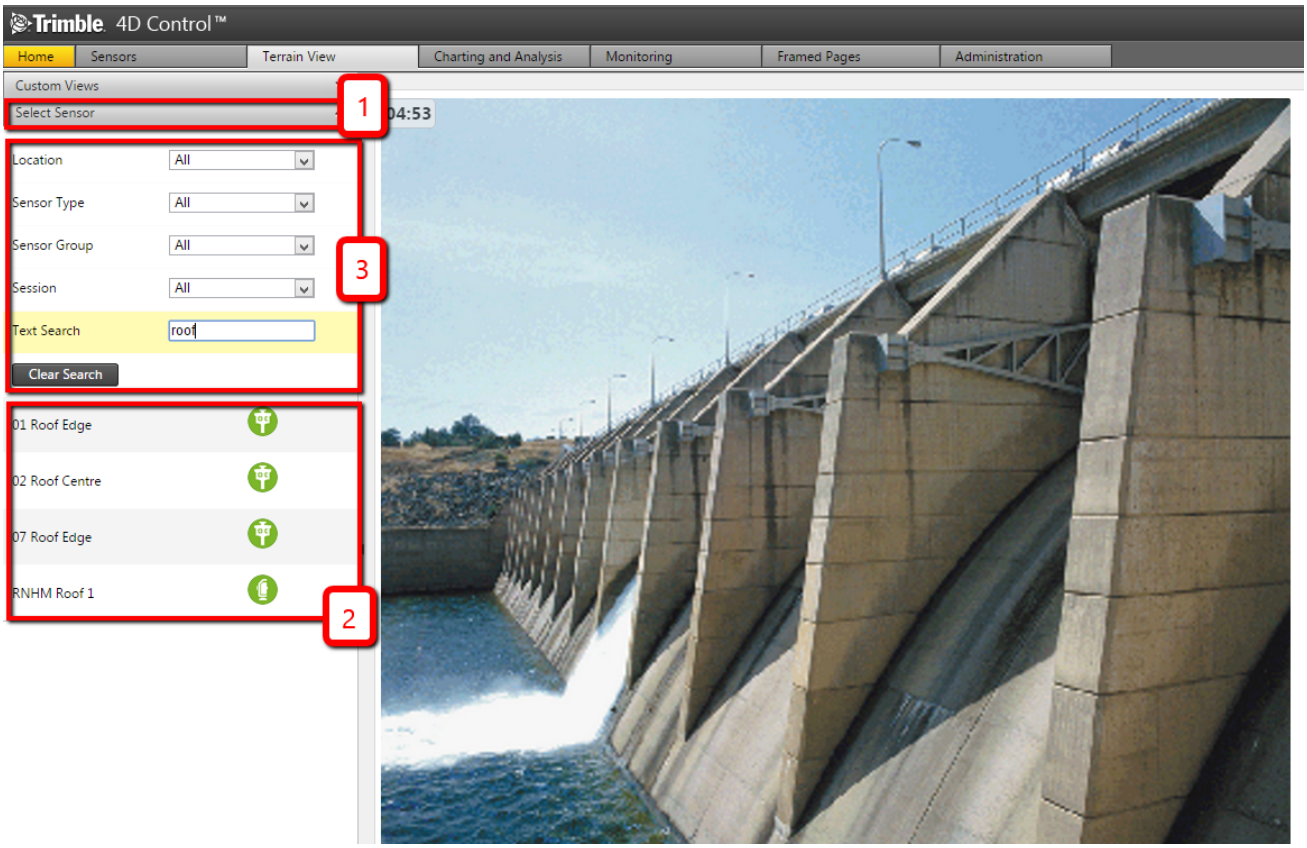
Chart:

- **Plot Summarized Values:** This option has an effect on the time value (or x axis value) against which summarized values will be plotted. Each node in a summarized series typically reflect the average observation value over a period (such as 1 hour or 1 day). By adjusting this option, you can plot summarized values either at the beginning, in the middle or at the end of the time period over which the data was summarized.
- **Line Type:** This option controls how the data will be represented on the chart surface.

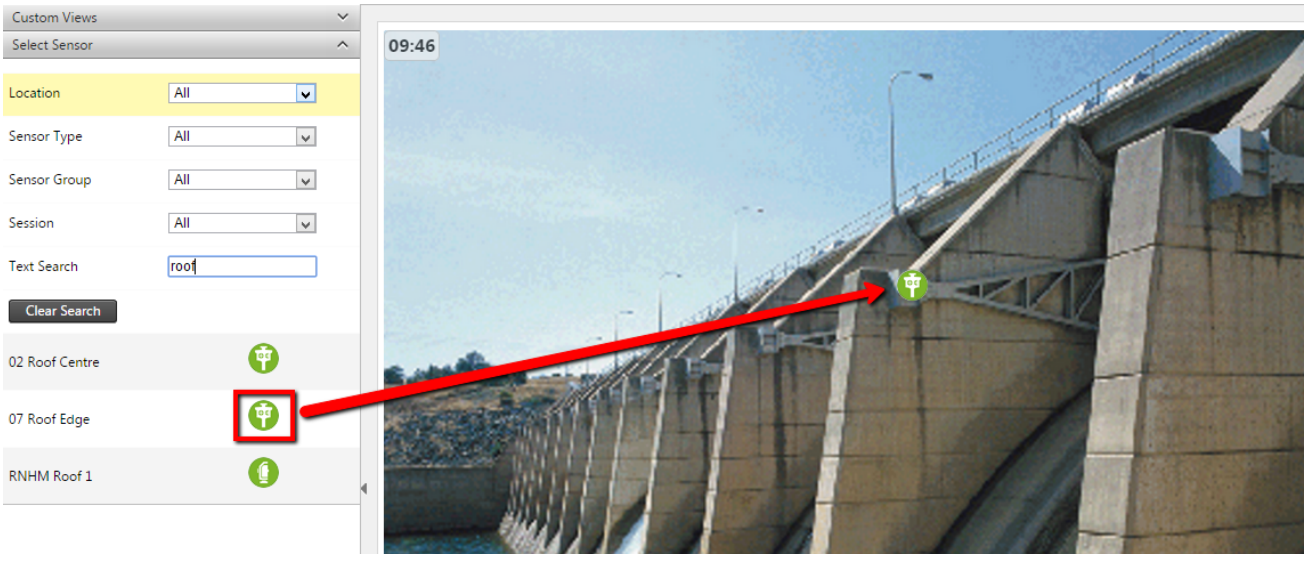
10.2. Add and Remove Custom View Sensors

The following section will guide you through the process of adding and removing sensors to a Custom View.

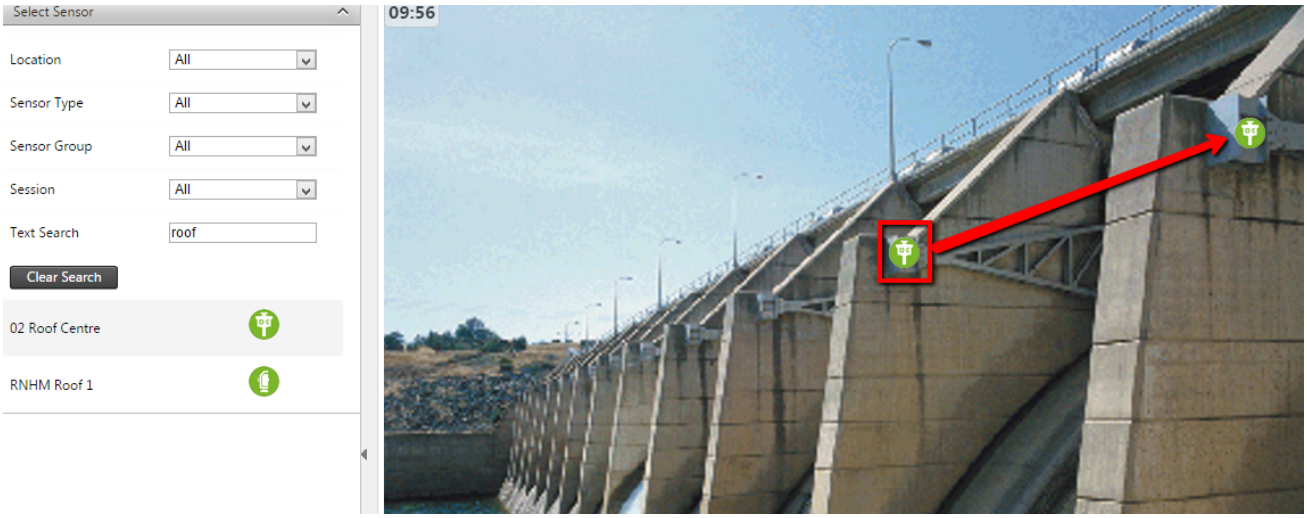
Important: This section does not explain how to create a new sensor that was handled in the section on Sensors.



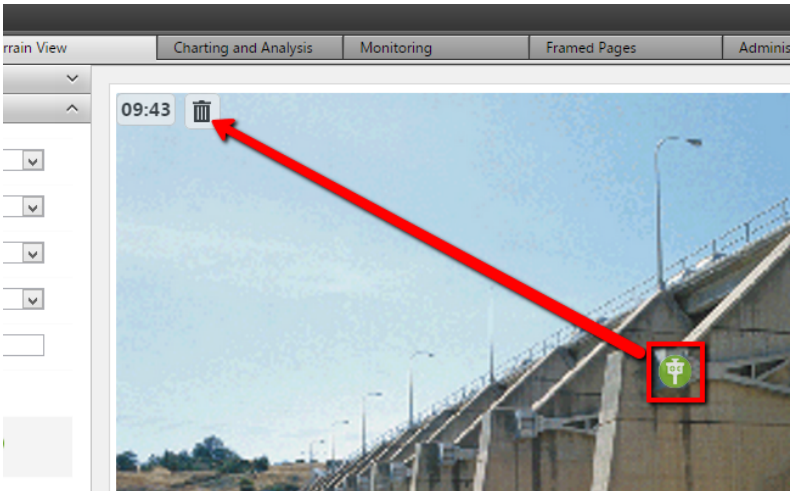
Step 1: Make sure you have selected the Custom View you want to work with and then click on the Select Sensor sub-section (1). Here (2) you can add any of the available sensors to the Custom View. As before if there are many sensors, you can make use of the filters (3) to show only specific sensors.



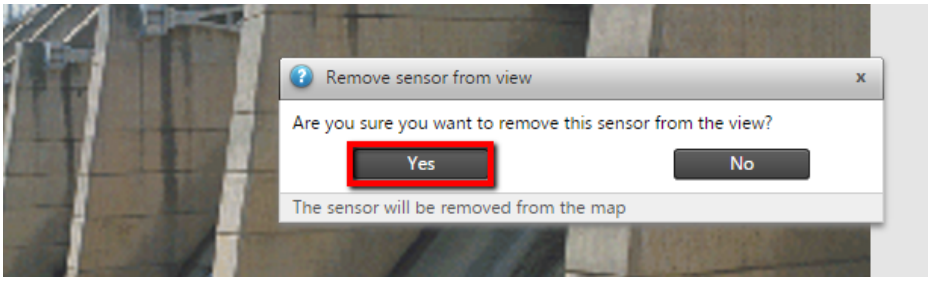
Step 2: To add a sensor, click on the sensor icon and without letting go of the mouse button, drag it onto the image.



Step 3: If you are not happy with the placement of the icon, simply drag it to a new location on the image.



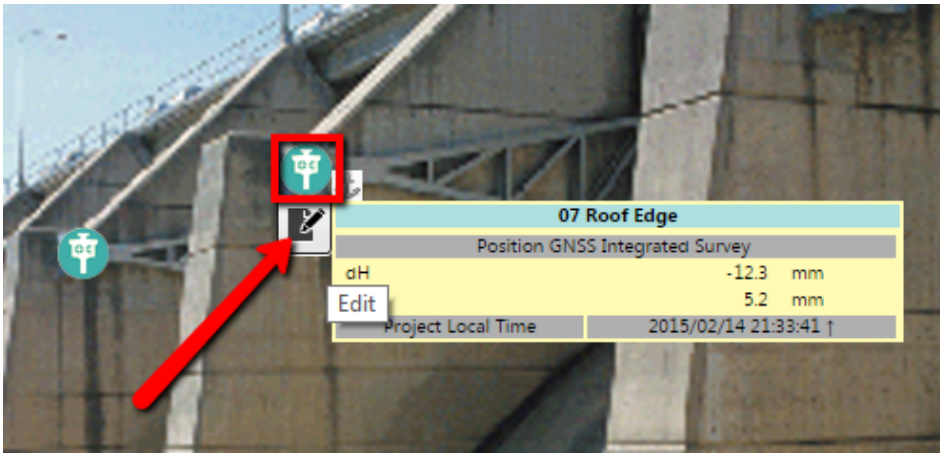
Step 4: To remove a sensor from the view, click on the sensor on the image and without letting go of the mouse button, drag the sensor to the trash can icon that will appear in the upper left-hand corner of the Custom View backdrop.



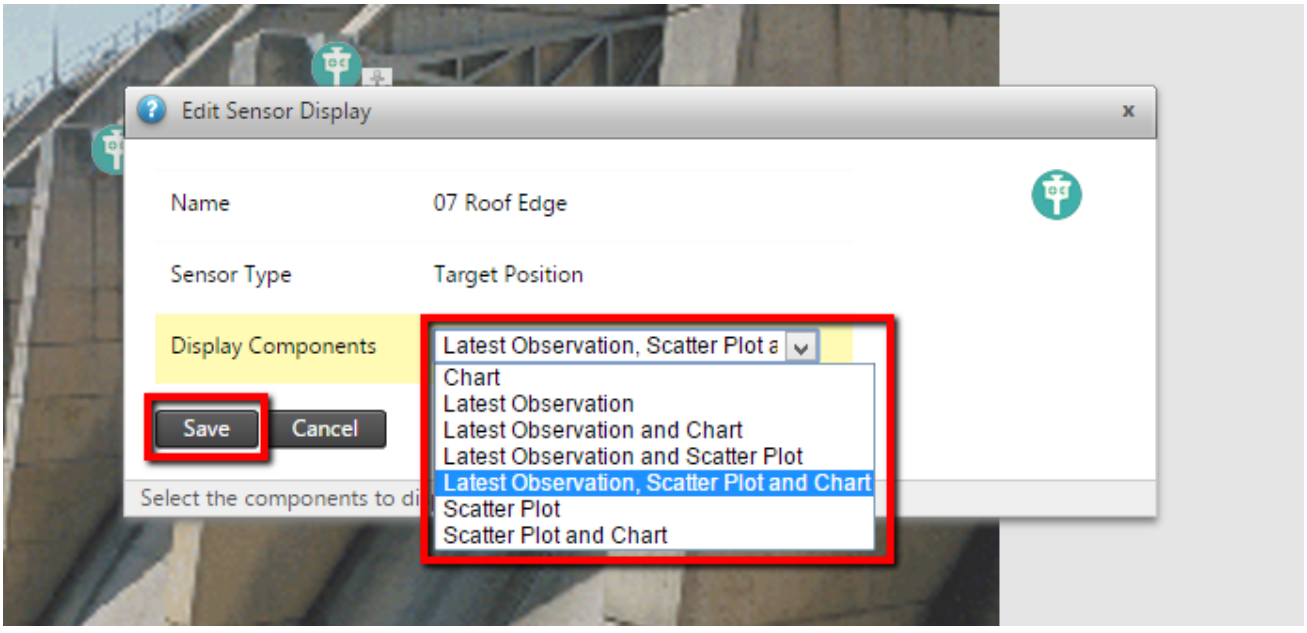
Please note that this will not delete the sensor, it will only remove the sensor from the current Custom View. To add the sensor to the Custom View again, simply drag it onto the image again.

10.3. Custom View Tooltips

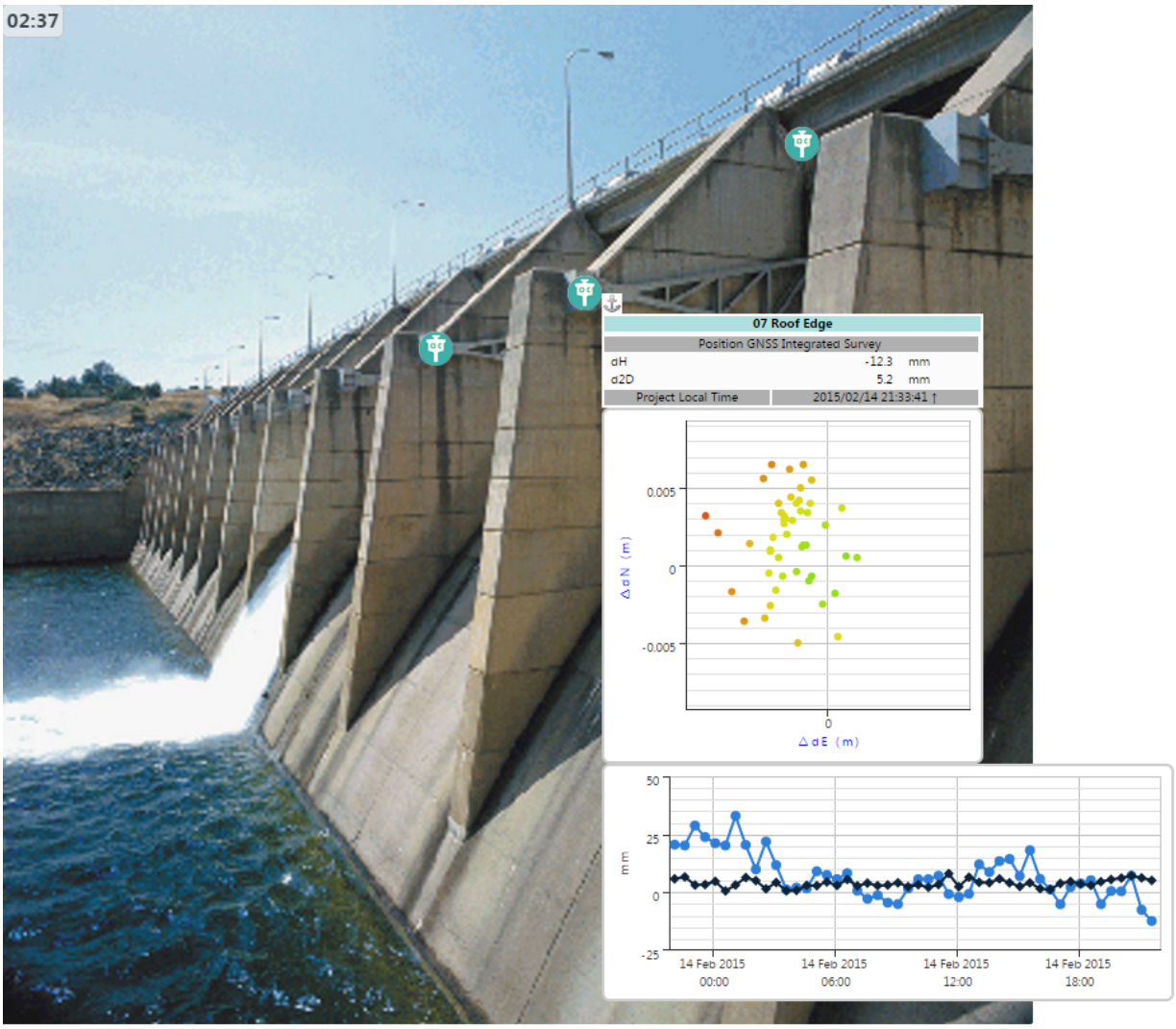
The tooltips (pop-ups) of sensors on Custom Views can provide up to three display components called *Latest observations* (same as in the Maps section), *Chart* and *Scatter plot*.



You can enable these display components by clicking on the Edit icon that appears when you hover the mouse cursor over the sensor icon.



Select the specific option, or combination of options to be displayed in tooltip of the sensor on the on the Custom View.

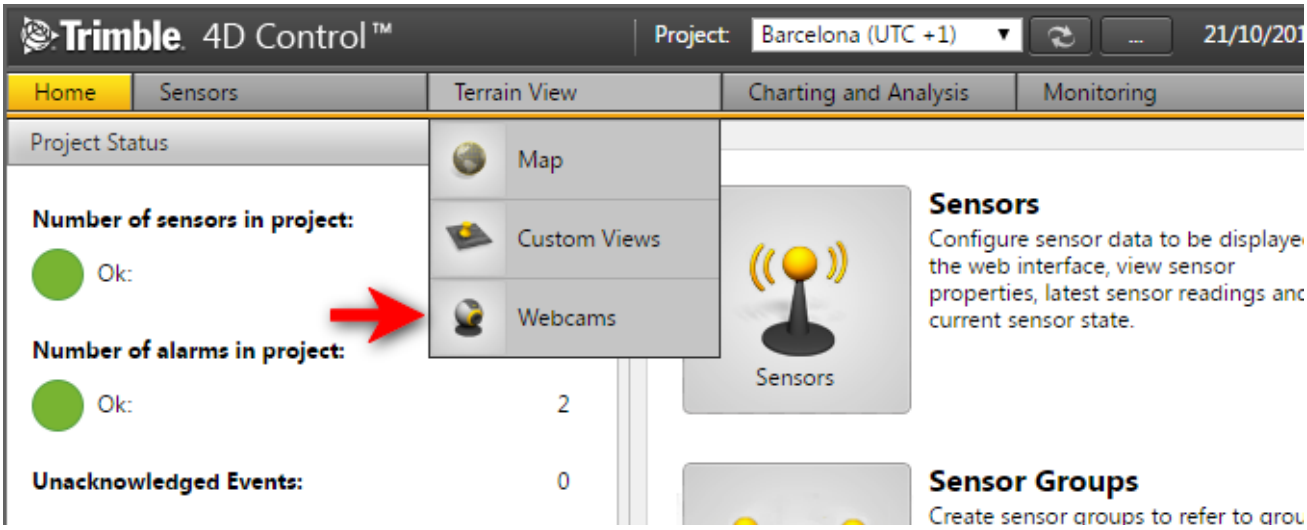


The sensor tooltip will then display the configured components. You can click on a sensor to anchor the tooltip to stay in place. In the example above all three components were configured: latest observations, chart and scatter plot.

11. Webcams

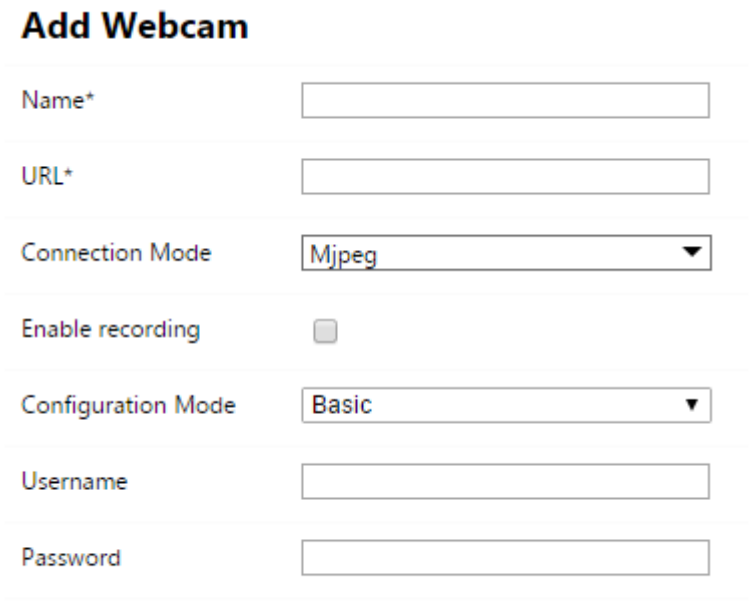
Some monitoring sites have cameras installed on site – e.g. for instance to monitor certain areas that are very remote. Some of these cameras support web cam technology, by outputting its video to an URL. The Webcam pages makes it useful to list such cameras in the T4D web interface.

11.1. Configure a Webcam



Navigate to the Webcam area via the Menu under *Terrain View* or from the *Home Page*.

You will be presented with the Webcam configuration page.

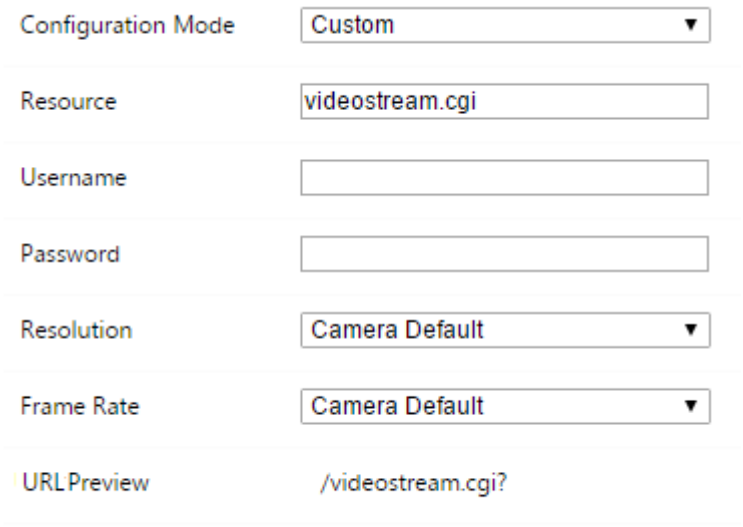


You can fill in the different parameters for the webcam. Below we explain the different parameters:

- **Name:** the display name of the webcam.
- **URL:** the location where the webcam feed can be accessed.
- **Connection Mode:** this can be FirmWare UI if you only want to view the webcam in the Trimble 4D Control interface, or set to Mjpeg if you wish to record information from the webcam.
- **Enable recording:** enable this setting if you wish to include video recorded from the webcam in alarm notifications. After you have setup the recording webcam, will then be able to add the webcam to an alarm definition (see section 14.5.4 on page 118). A short video clip covering the time period around the alarm event will then be attached to any alarm notification email sent to users.
- **Configuration mode:** you can set this option to determine the details level of parameters you wish to configure to control recording of the webcam video. Normally users will configure the Custom configuration mode to have more control over the webcam video recording.
- **Username:** the username to access the webcam UI or HTTP video stream.
- **Password:** the password to access the webcam UI or HTTP video stream.

11.1.1. Custom Configuration Mode

You may need to consult your webcam manual for configuration modes other than Basic.

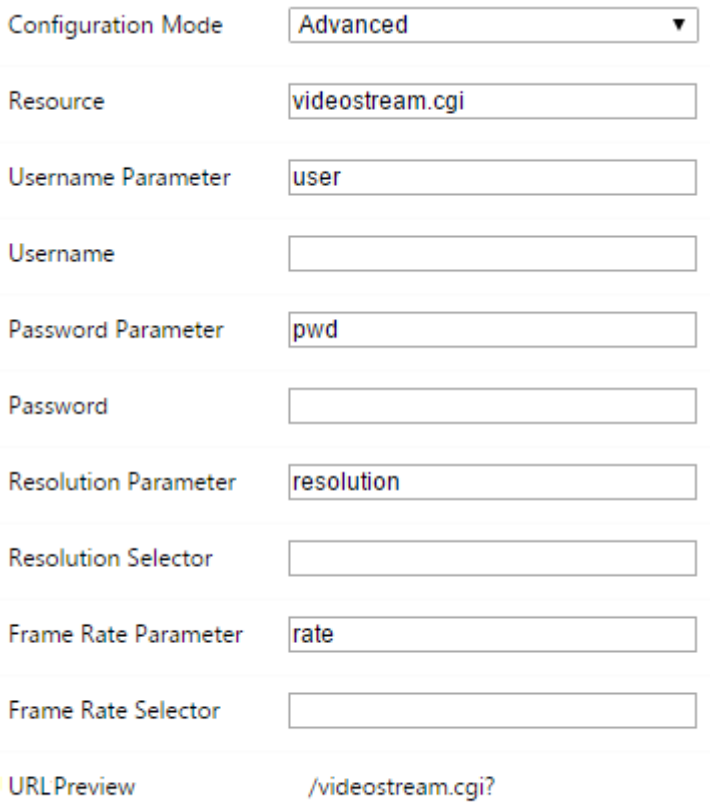


Above is a description of the additional available parameters if you select the configuration mode as *Custom*:

- **Resource:** the resource part in the web camera's URL for the video stream. This is typically something like "videostream.cgi" or "video.mjpeg".
- **Username:** the username to access the webcam UI or HTTP video stream.
- **Password:** the password to access the webcam UI or HTTP video stream.
- **Resolution:** the video pixel Width x Height dimension that should be used
- **Frame Rate:** the video frames per second that should be used. In order to preserve system resources we recommend setting the lowest feasible frame rate for your purposes.
- **URL Preview:** this is the webcam HTTP URL that will be used. It is created according to the preceding parameters you have configured. A typical URL Preview is: `http://webcamserver:8080/videostream.cgi?resolution=1&rate=11`

11.1.2. Advanced Configuration Mode

We recommend using the Advanced configuration mode only if the Basic and Custom configuration modes are insufficient to configure recording of your webcam video.



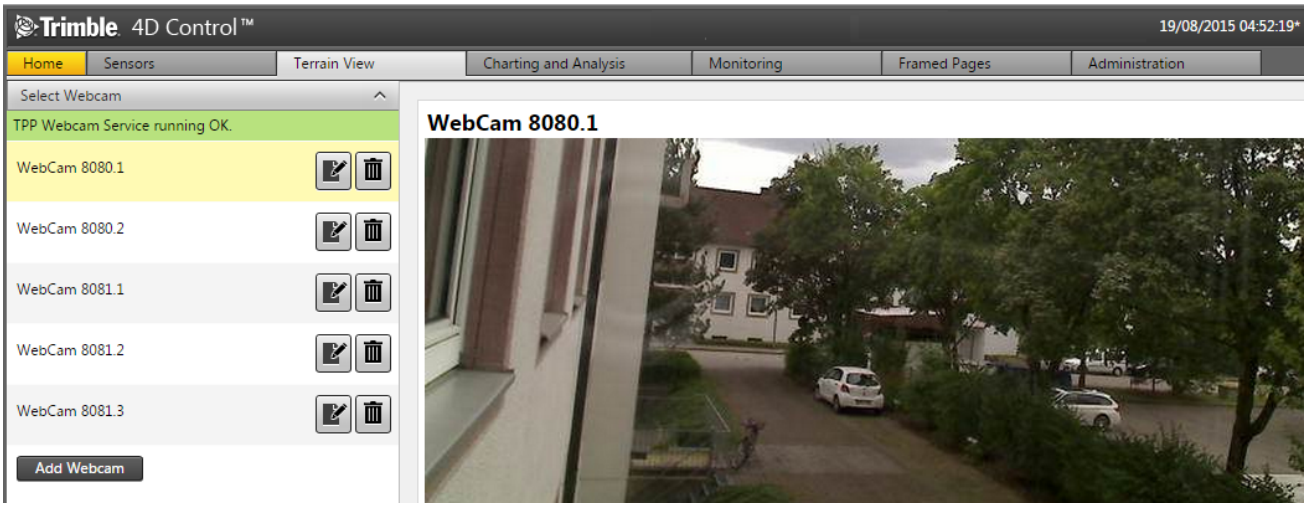
Below is a description of the additional available parameters if you select the Configuration mode as Advanced.

- **Resource:** the resource part in the web camera's URL for the video stream. This is typically something like "videostream.cgi" or "video.mjpeg".
- **Username Parameter:** specify the parameter name used in the URL for the username.
- Username: the username to access the webcam UI or HTTP video stream.
- **Password Parameter:** specify the parameter name used in the URL for the password.
- Password: the password to access the webcam UI or HTTP video stream.
- **Resolution Parameter:** specify the parameter name used in the URL for the resolution.
- **Resolution:** the video pixel Width x Height dimension that should be used
- **Frame Rate Parameter:** specify the parameter name used in the URL for the frame rate.
- **Frame Rate:** the video frames per second that should be used.
- **URL Preview:** this is the webcam HTTP URL that will be used. It is created according to the preceding parameters you have configured.

Click Save after configuring the webcam parameters.

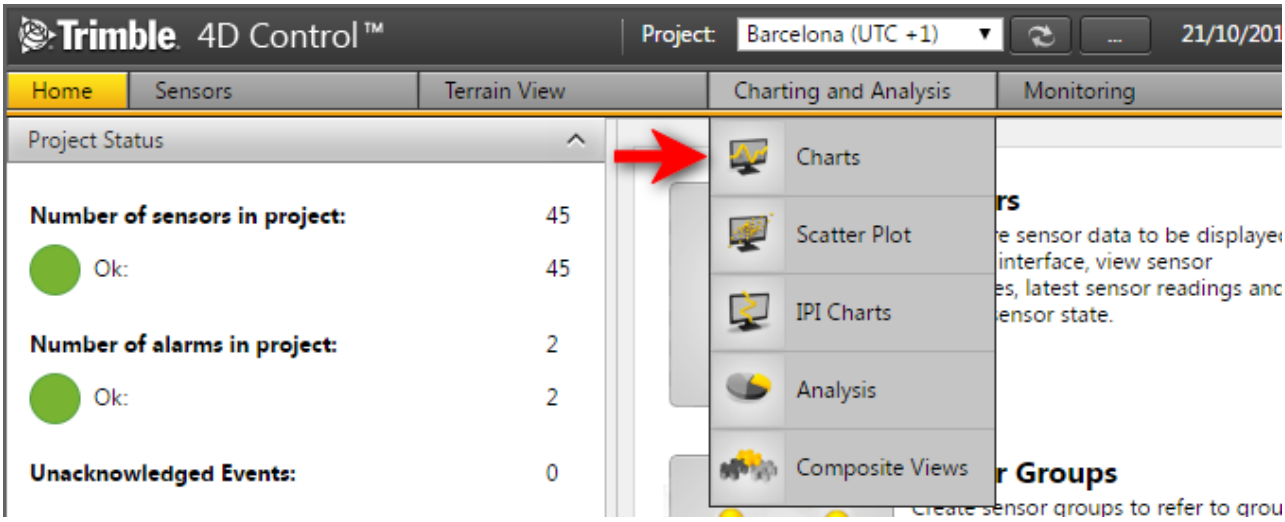
11.2. View a Webcam

If you select a Webcam on the left-hand panel, it will show the webcam video in the right-hand window pane of the Webcam Page.

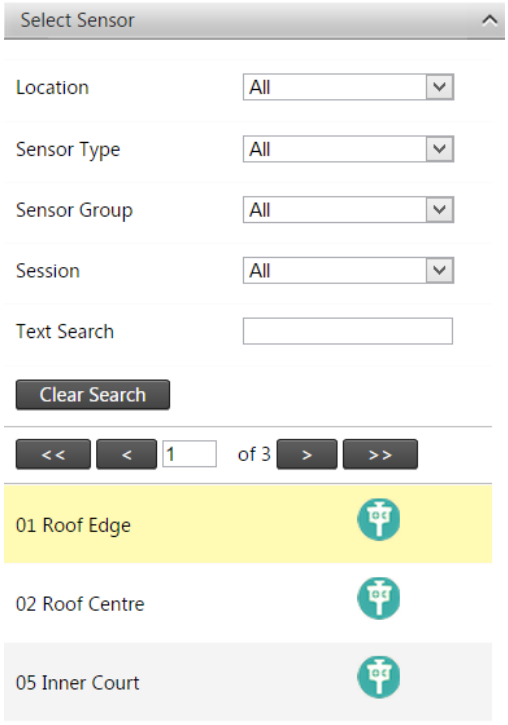


12. Charts

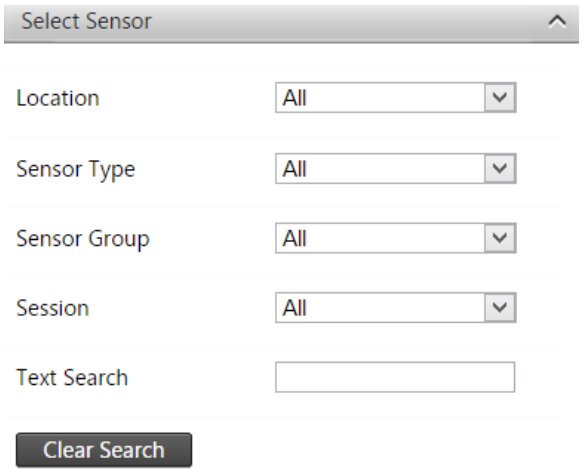
Charts are used to visualize observations of sensors. Charts are useful to obtain a high level overview of the observations on a sensor and to drill down into particular observation time intervals for a closer inspection of the observations.



Navigate to the Charts area via the Menu under *Charting and Analysis* or from the *Home Page*.

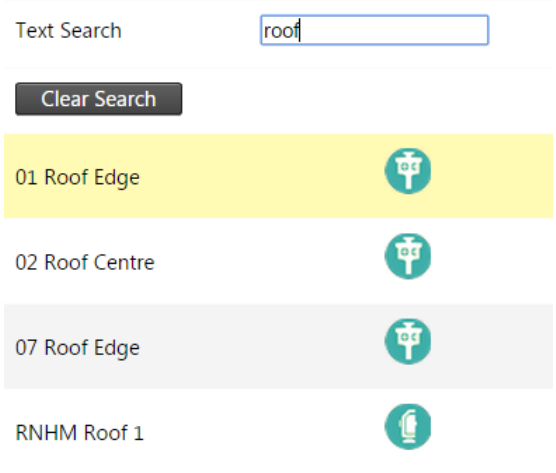


In the charts pages, all sensors in the project will automatically be listed in the left sidebar navigation.



The sensors displayed on the left sidebar navigation can be filtered via the filtering options:

- **Location:** Depending on the available list of sensors, this dropdown list will be pre-populated with the locations of those sensors. By clicking on the dropdown list and selecting a location, the available sensors at the bottom of the section will refresh. Note that when selecting an entry in the dropdown field, the charts in the main content section will not change until selecting a new sensor at the bottom of the sidebar navigation section.
- **Sensor Type:** The sensor type allows one to filter the map on the right hand side according to the sensor selected. Note that clicking on one of the sensors in the dropdown, filters the sensors to display only the available sensors of the chosen type.
- **Sensor Group:** The group you have allocated the sensor to belong to.
- **Sensor Session:** The specific session linked to the sensor (only applicable if the Highrise module is installed).
- **Text Search:** By typing the name or partial name of the desired sensor into the field provided and pushing enter, the system will perform a real-time search of the available sensors by that name.

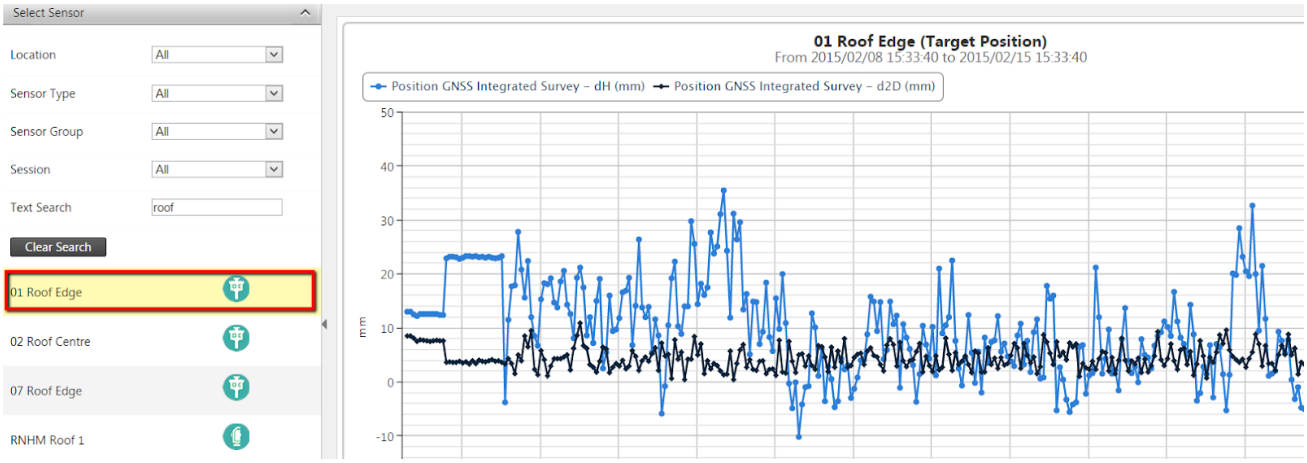


Click the Clear Search button to clear all search fields, thus resetting the page to display all sensors in the project.

By clicking on any one of the sensors in the sensors list, the sensor data is displayed on the right.

12.1. Using Charts

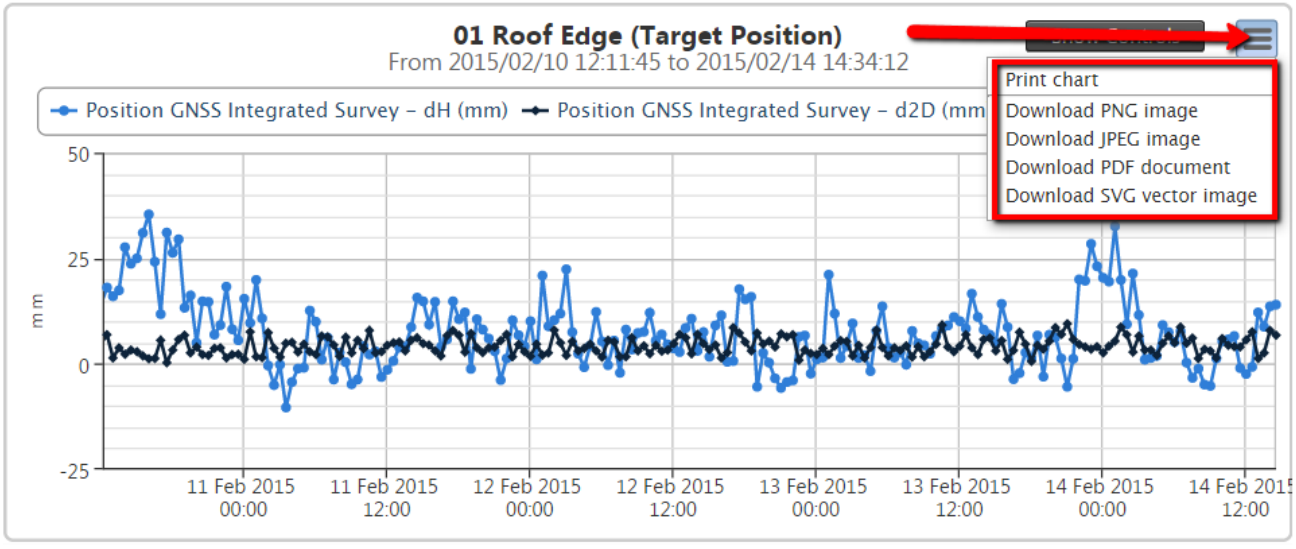
This section describes how you can navigate, customize and export a Chart.



Navigate to Charts in Trimble 4D Control Web and click on a sensor in the list.

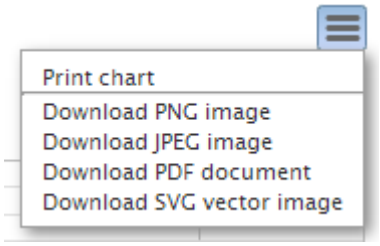
Clicking on the items in the legend of the chart, will show/hide that series in the chart.

12.1.1. Print Chart



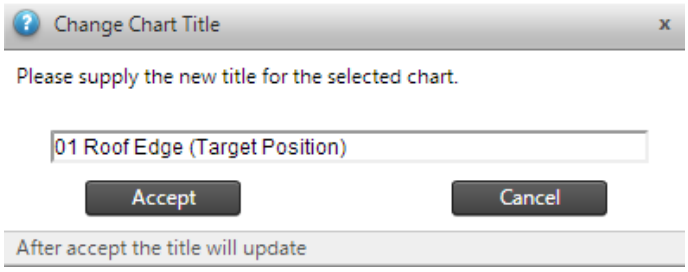
Click on the button in the top right-hand corner of the chart and select *Print chart* to print the chart that is currently displayed on screen. Note that the printing result may vary between browsers / printers.

12.1.2. Save Chart Image



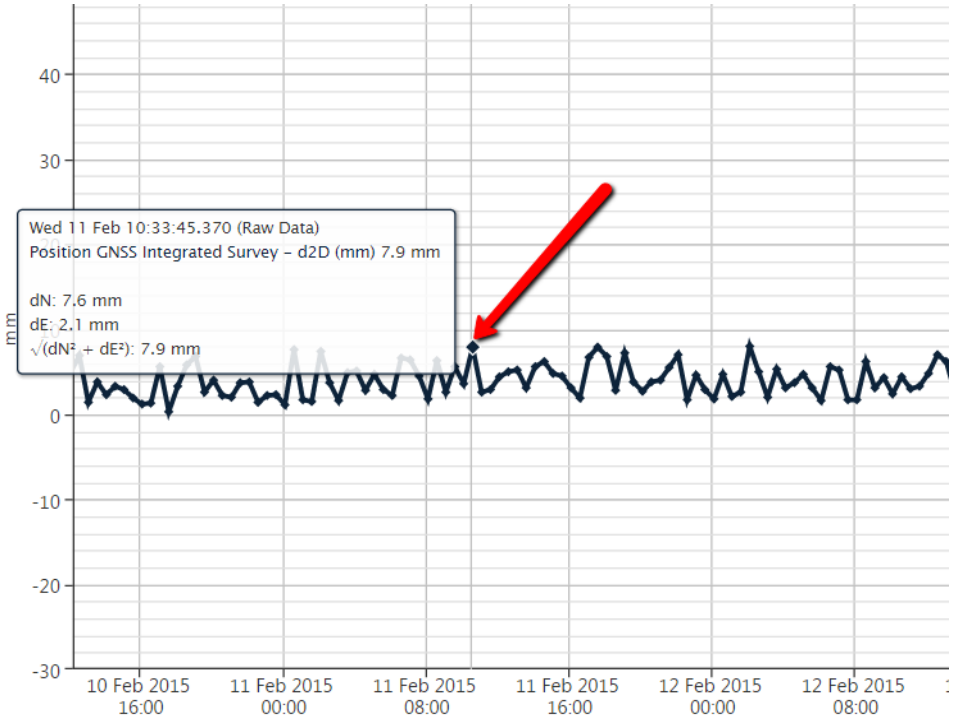
Click on the Button in the top right-hand corner of the chart (same as above), then select any of the options below *Print chart* to download the current chart displayed as PNG, JPEG, PDF or SVG.

12.1.3. Change the Chart Heading



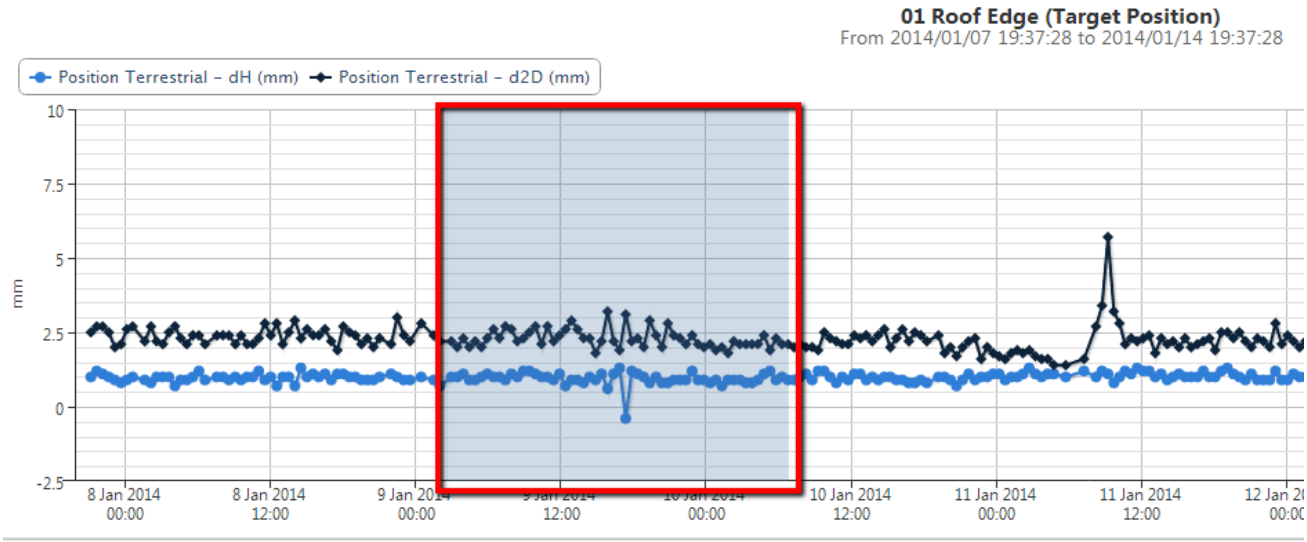
Click on the chart heading. A pop-up will appear prompting you to enter a new name for the Chart. Click *Accept* to apply the new chart heading.

12.1.4. Display Chart Point Information



Hover the mouse cursor over the points of a chart series to display a tooltip containing the *Chart Point Information*.

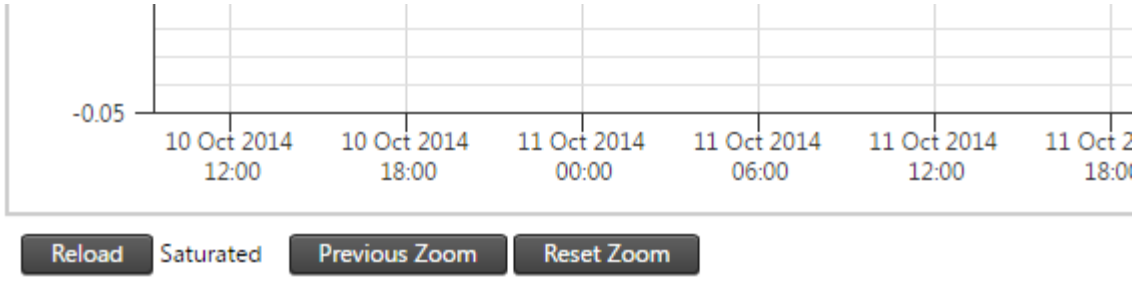
12.1.5. Zoom into a Chart Section



Each chart series in the chart view will display either **Raw Data** or one of the **Summarized Data Sets** (per minute, per hour etc.), depending on the data density. This provides the best view on the data for the particular date range.

Zoom into a certain area on the chart by clicking on the chart and selecting the area which should be zoomed into (as indicated above). Once you release the left mouse button, the chat will reload to zoom into the selected area. Please note that the chart may load more data from the database.

The *Zoom Status* will update as you zoom in and out of the chart. The status may vary between **unzoomed**, **zoomed** and **saturated**. The *Zoom Status* status is indicated on the bottom left of the chart next to the *Reload* button. The zoom status **saturated** occurs when the chart is zoomed in to such an extent that no additional data can be retrieved from the database. Usually this happens after you zoomed in repeatedly and when all series in the chart is already displaying **Raw Data**.
Attempts to Zoom further while in a **saturated** *Zoom Status*, will lead to the chart being panned either left or right, without narrowing the date range.

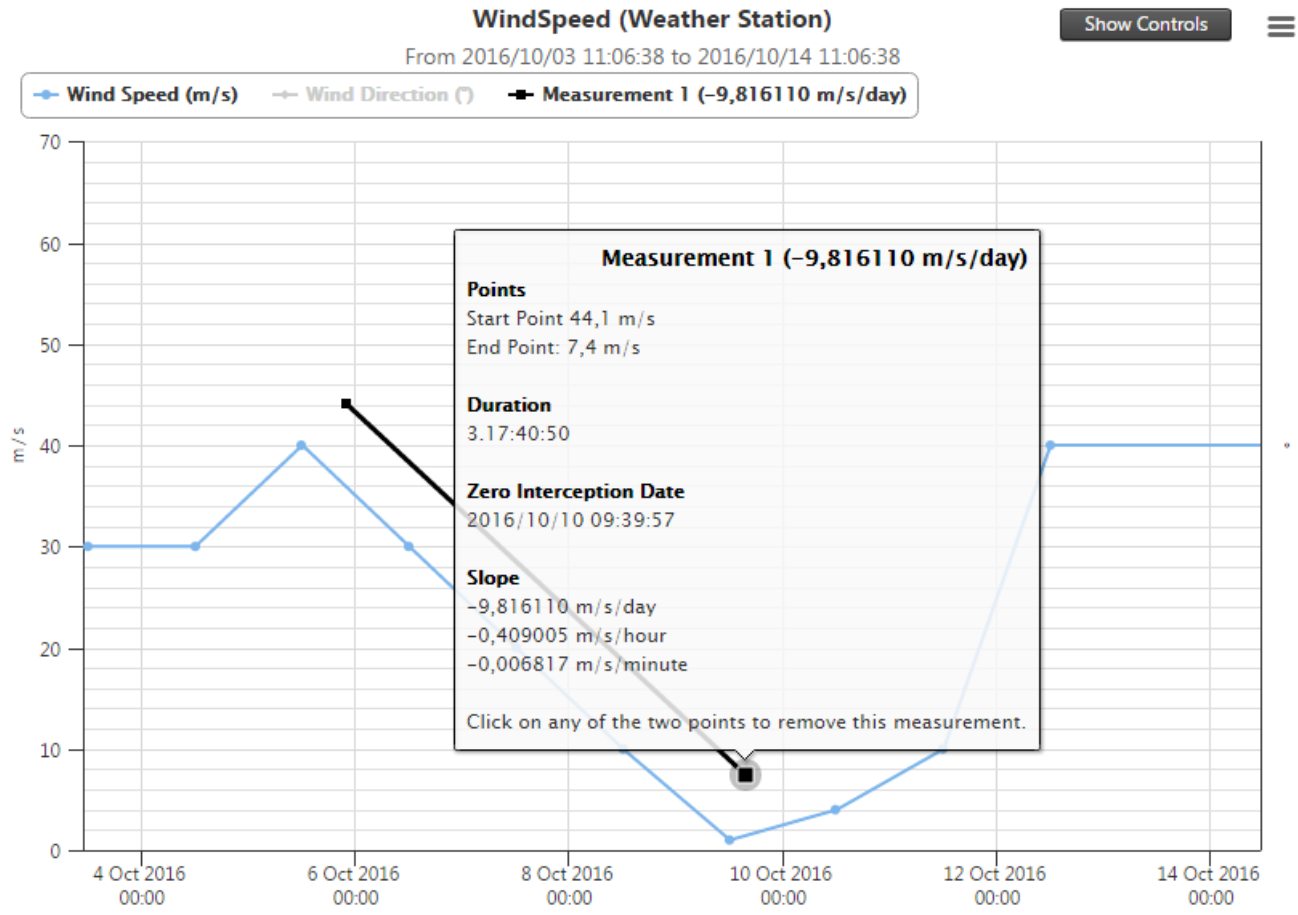


Click the *Previous Zoom* button to go to a previous zoom range, or you can click on the *Reset Zoom* button to zoom out completely. The current *Zoom Range* as well as the stored *Previous Zoom* ranges are maintained when you select a different Sensor.

If the chart series become horizontally too flat when you zoom in, then you can adjust the *Y Axis Scaling*. (see the section below).

12.1.6. Freehand Measurements

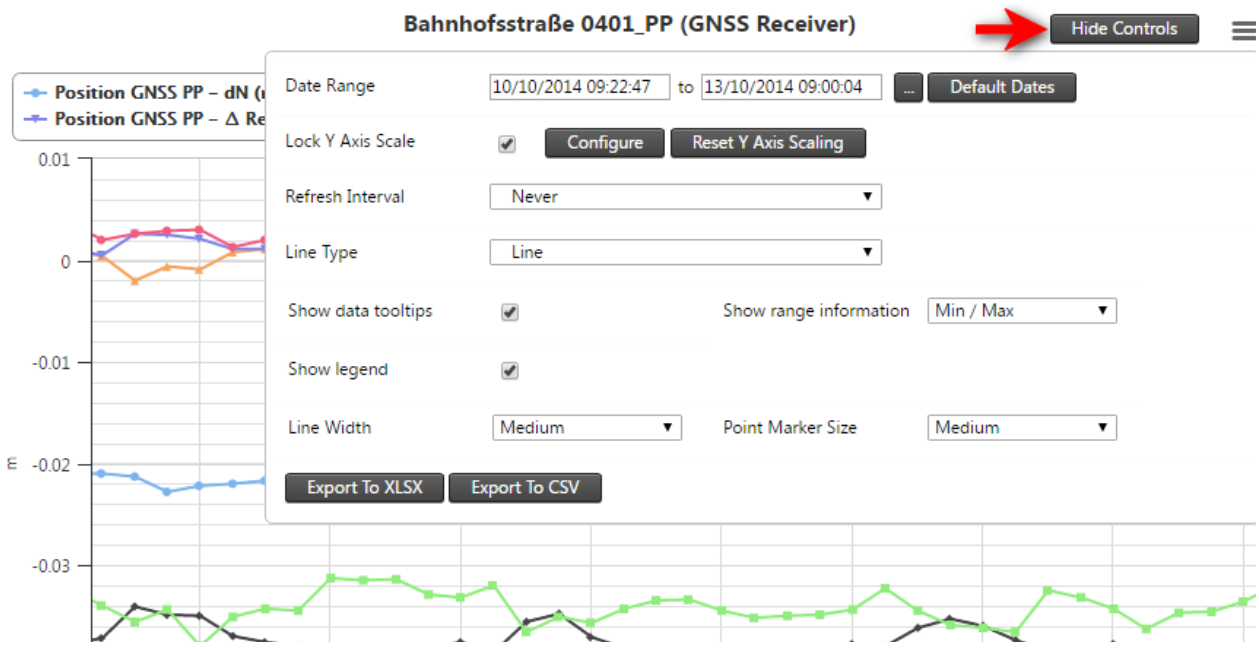
You can draw your own line to measure the slope between two points on the chart surface by holding down the C*trl* key and clicking on any position on the chart. Continue holding the *Ctrl* key and move your mouse to another position on the chart and click on the position to create the measurement line.



A line *Measurement* (1) with useful details will appear as a new chart series.

Note: When the chart contains more than one y-axis, then the Freehand Measurements are always done in terms of the *primary* y-axis (y-axis on the left).

12.2. Chart Settings



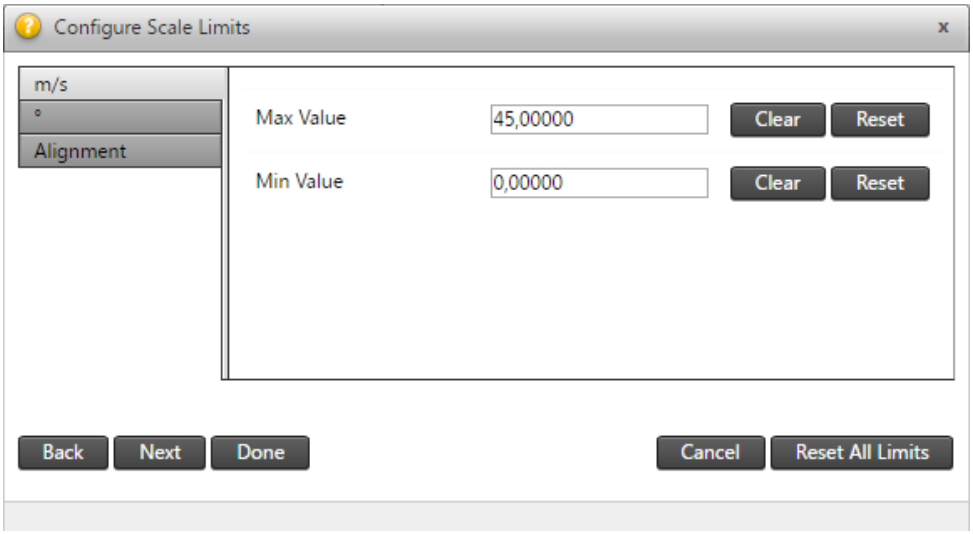
Click the *Show Controls* button on the top right of the chart to show the Chart Settings (the button label will change to *Hide Controls*).

12.2.1. Lock Y Axis Scale

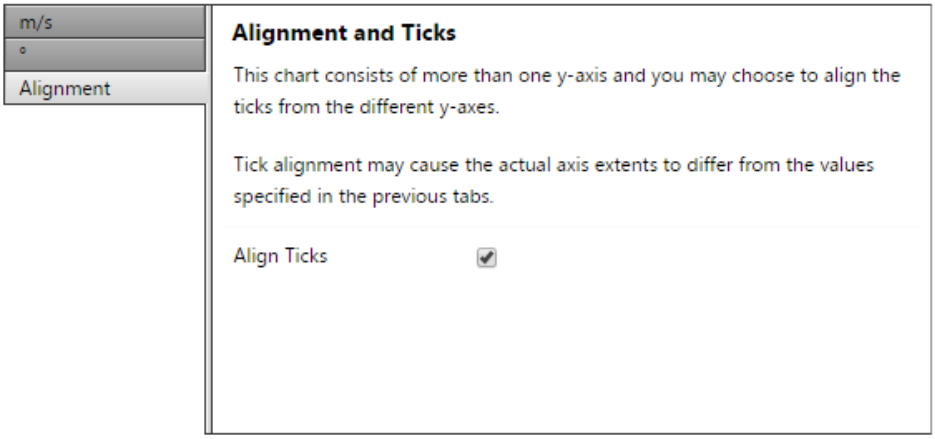
The Lock Y Axis Scale can be used to calibrate the Y axis scale based on the current chart. When the box is checked the y scale will be remembered between zoom operations on the same sensor chart. When unchecked the y scale will recalibrate with each zoom operation.

12.2.2. Configure Y Axis Scale

Click on the *Configure* button to show the *Configure Scale Limits* dialog.



A tab will be shown for each Y axis in your *Chart*. You can specify min and max values for each Y axis. Once these values are set the *Max* and *Min* values are guaranteed to be shown on the particular Y axis.



The *Alignment* tab offers you the option to align the tick marks of the different Y axis. If this option is enabled, the actual minimum and maximum y-axis values may differ from the configured minimum and maximum Y axis values. This is because the charting will need to adjust the axes to ensure that the tick lines of the individual axes line up.

If you disable the *Align Ticks* option, then for aesthetic purposes the horizontal tick lines will not be shown on the chart.

12.2.3. Date Range

This setting adjusts the time frame of the chart displayed underneath. The default setting when loading a new sensor is data from the past week. If you want to change the time frame, click on the [...] button which will present a pop-up with various settings. Inside this pop-up, the settings include:

- **Quick Selections:** today, yesterday, this week, last week, this month or last month).
- **Custom Selection:** set a custom time frame by clicking on the input fields.
- **Session:** where a current session in the system can be selected if needed (only applicable if the Highrise module is installed).

Clicking on the *Default Dates* button will cause the chart to automatically select a date range, based on the most recent data available for the selected sensor. This action will clear all stored zoom range and reset the *Zoom Status* to **unzoomed**.

If a custom time frame is selected, click on the *Reload* button to activate the changes.

12.2.4. Refresh Interval

You can select an interval by which the data on the chart should be refreshed. This allows the system to periodically refresh the data displayed on the chart. In order to change the default refresh interval, click on the dropdown menu and select your desired interval.

12.2.5. Line Type

The options to view the chart either by area, dots, lines, spline or area spline.

12.2.6. Show Data Tooltips

The options to view the chart either by area, dots, lines, spline or area spline.

12.2.7. Show Range Information

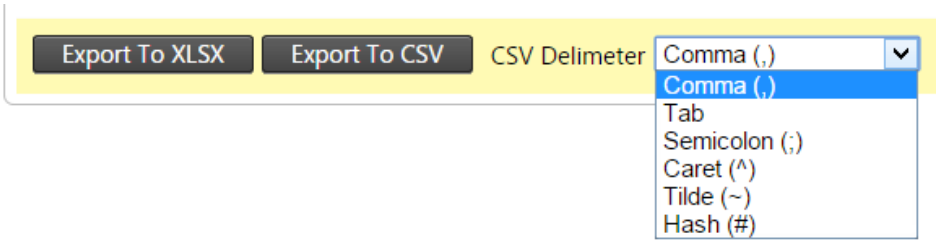
Some series have more data values that are available although only the moving averages are plotted in the graph. If these additional data are available this option can be used to plot certain range related information to get an idea of spread of the data. The options available are the standard deviation (1 sigma), more deviations (2 and 3 sigma) or the absolute minimum and maximum extreme points.

12.2.8. Line With and Pointer Size

These options simply modify the graph line and data points' size to be displayed.

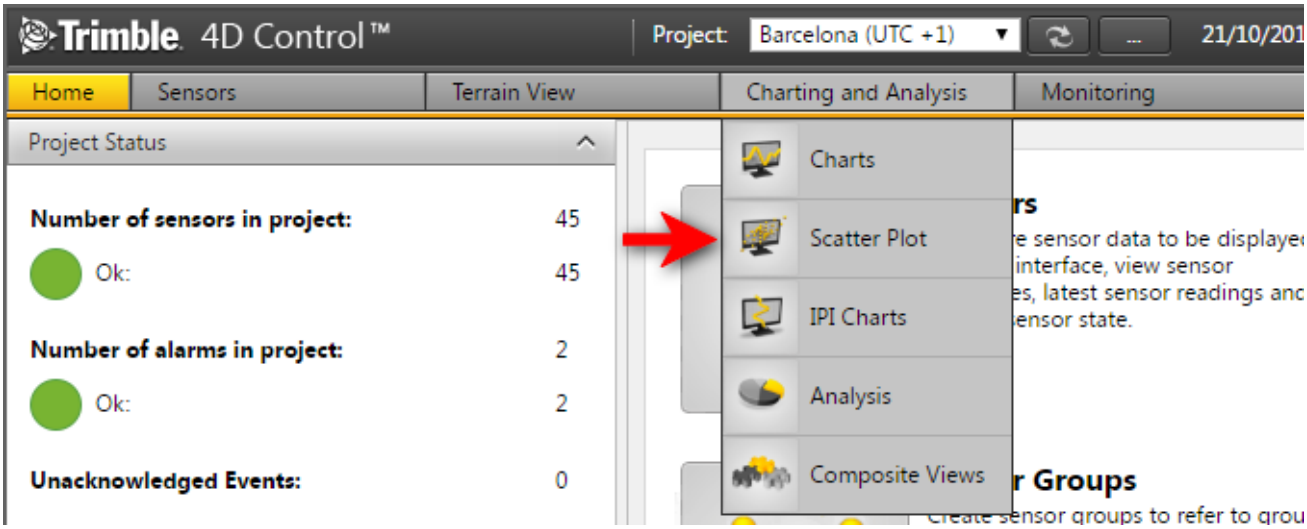
12.2.9. Export

Click on the *Export* buttons to download the raw data of the chart.
Hover the mouse over the *Export To CSV* button and then carefully move with the mouse to the right in order to select a specific *delimiter* to be used by the CSV file.

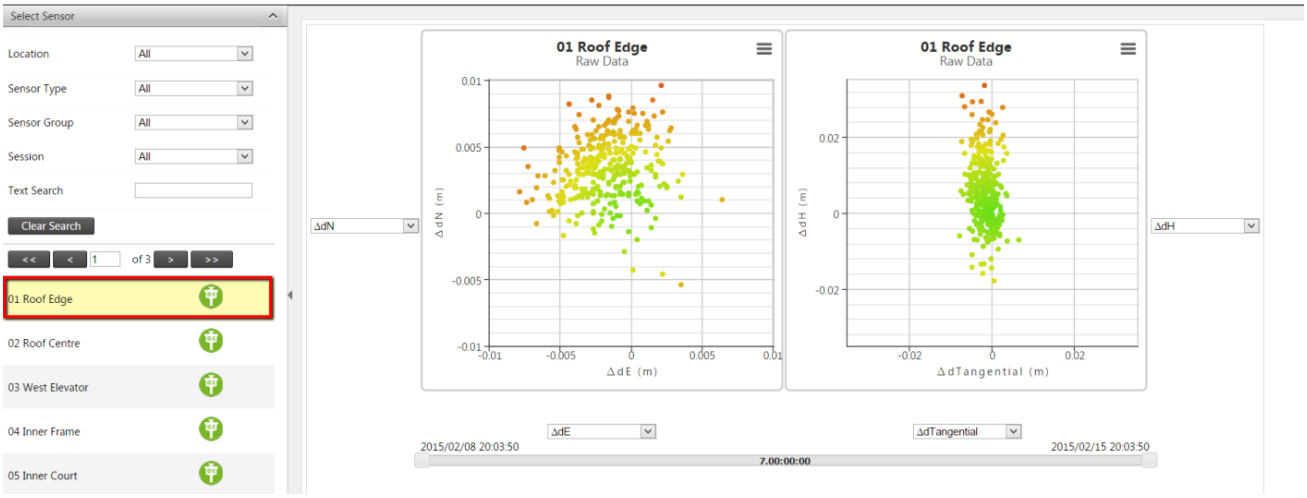


13. Scatter plot

Scatter plot is used to visualize changes in positional observations. The plotted X and Y axis can be adjusted to visualize movement in the various planes. For convenience the Trimble 4D Control scatter plot shows two scatter plot charts next to each other in order to visualize the movement in two planes side-by-side.



Navigate to the Scatter plot area via the Menu under *Charting and Analysis* or from the *Home Page*.

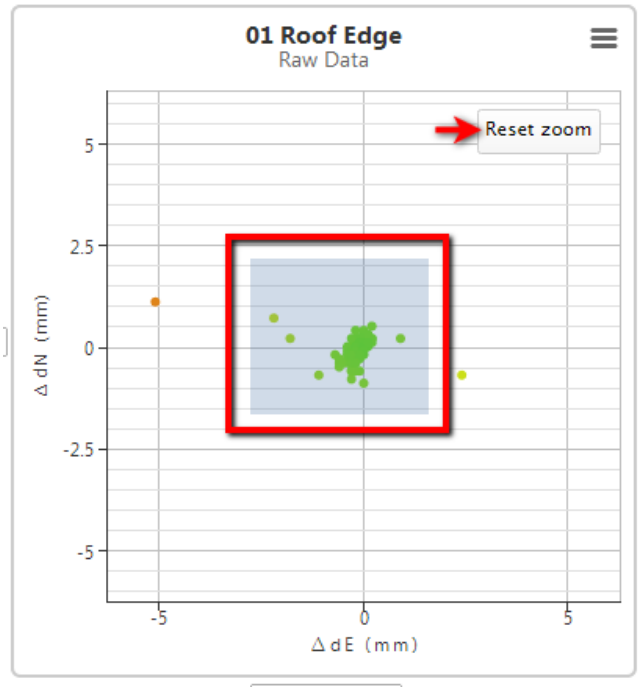


The sensors available for scatter plots will be listed on the left sidebar navigation. These are sensors with *Positional Data Types*. You can filter the list of sensors shown using the filter controls similar to with Charts. Click on one of the listed sensors to view the scatter plot.

13.1. Using Scatter plot

Scatte plot and Charts have similar controls and behaviour (see Using Charts). In this section we only review the scatter plot specific controls and behaviour.

13.1.1. Zoom into a Scatter plot area

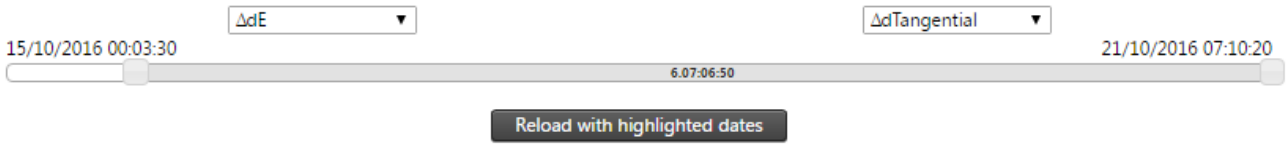


Click on the chart and drag an area to zoom into that area. The chart may reload to zoom into the selected area. If you have zoomed into an area a *Reset Zoom* button. Click the *Reset Zoom* button if you wish to reset the zoom level.

13.1.2. Date Range Slider

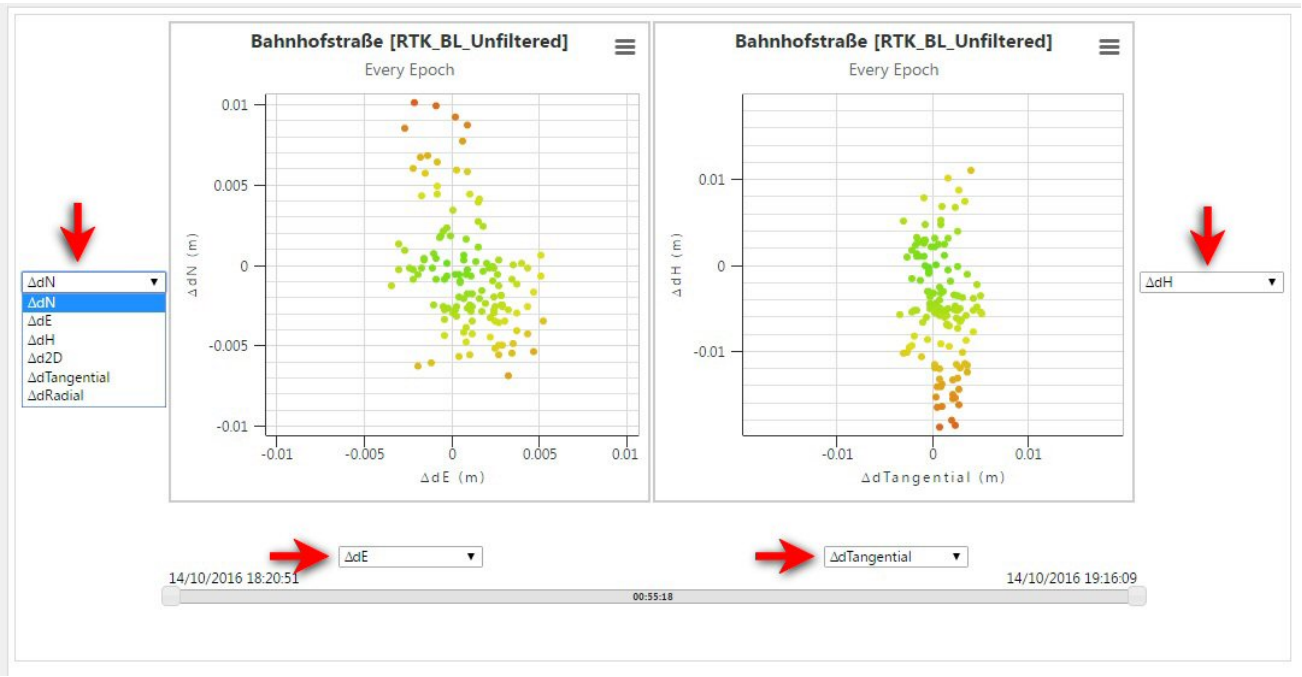
The *Date Range Slider* is located directly below the X axis drop downs. The date range can be narrowed by dragging either one of the slider handles (initially located at the start and end of the slider). Both slider handles of the date range slider can be moved together simultaneously by dragging the area between the two ends.

The total duration between the slider handles is displayed by on the slider itself.



A *Reload with highlighted dates* button will appear when the when the date range is narrowed. Click this button to set the start and end date and reload the scatter plot for the new date range. This may cause the scatter plot to display a more fine grained *summarized data* or *raw data*.

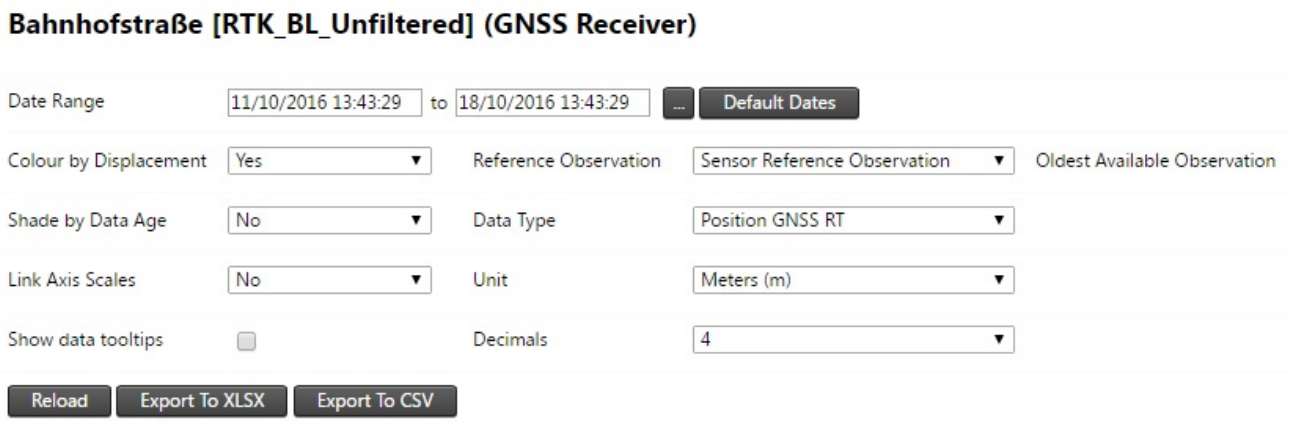
13.1.3. Y Axis and X Axis selection



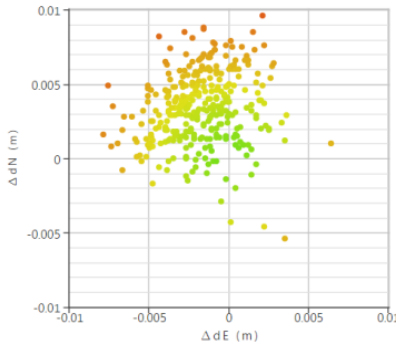
Use the **axes dropdowns** to select the dimension to plot against for the X axis and Y axis.

13.2. Scatter Plot Settings

Scatter plot and Charts have similar settings (see Chart Settings). This section only reviews the scatter plot specific settings. Scatter Plot settings are located below the two scatter charts.

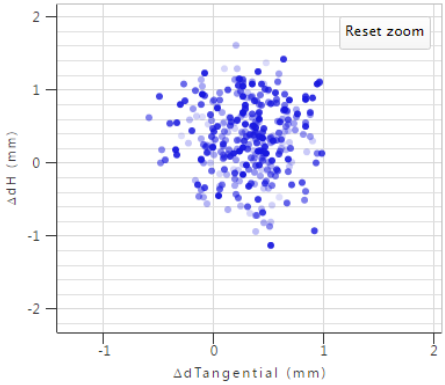


13.2.1. Color by Displacement



When *Color by Displacement* is enabled, dots on the scatter plot are colored on a gradient scale from green to yellow to red depending on the distance measured. This reflects the severity of the displacement. If *Color by Displacement* is disabled all the scatter plot dots will be blue.

13.2.2. Shade by Data Age



When enabled, a degree of transparency will be applied to each dot. The latest observation will be solid and the oldest completely transparent. This setting is only effective if you do not have multiple observations plotted on top of each other.

13.2.3. Link Axis Scales

When *Link Axis Scales* is enabled, the two scatter charts will scale identically on the initial load of the scatter charts. When *Link Axis Scales* are disabled, the scale of each scatter chart will be optimized for the data that appears on that scatter chart only. Please take note that the scatter chart scales will not remain identical if you zoom into an area on either scatter chart.

13.2.4. Show data Tooltips

Use this checkbox to enable or disable the tooltips containing observation information (shows as you move the mouse cursor over the plot points on the chart).

13.2.5. Reference Observations

Scatter plots always plots relative positions, this differs between actual and reference positions. You can either use reference dates of the selected sensor to obtain a reference position or use the first observation.

13.2.6. Data Type

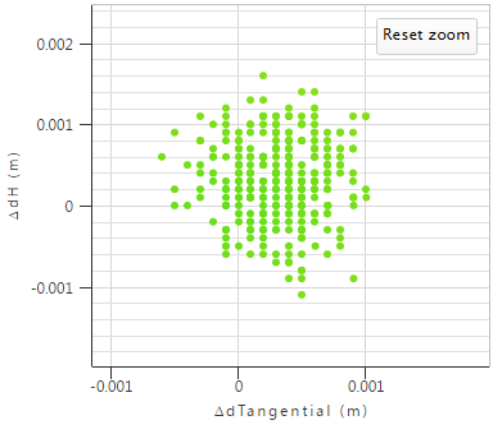
If the selected sensor is linked to more than one *positional data type*, then the user will be able to select any of these data types from the dropdown.

13.2.7. Unit

Select the unit in which displacements are displayed on the scatter plot.

13.2.8. Decimals

Select the number of decimals to be used to display displacements on the scatter plot.



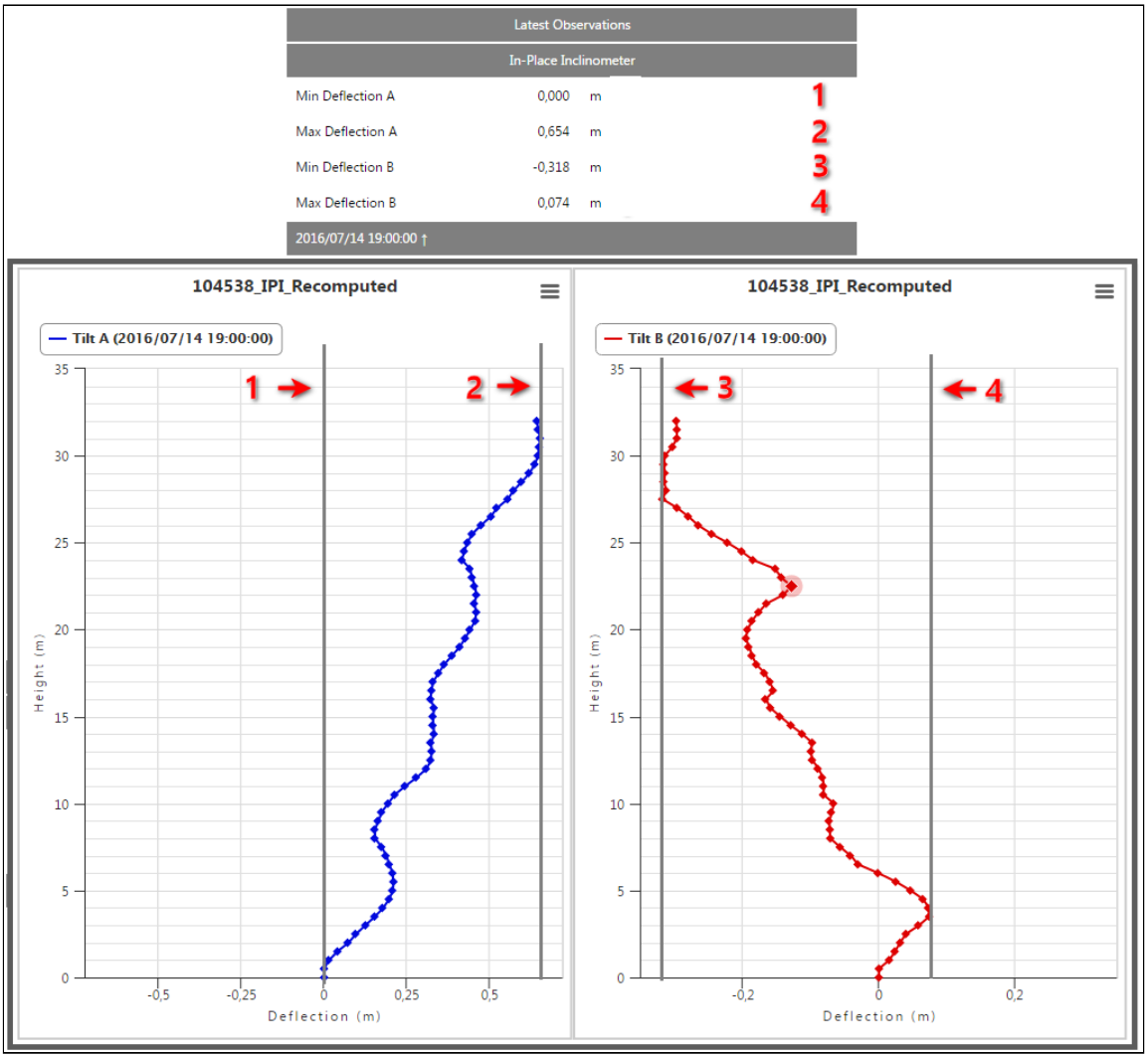
Please note that the number of decimals may affect the accuracy of the scatter plot. In the example above, the number of decimals are set to 4. Note that all the displacements are grouped in intervals of `0.0001` (maximum 4 decimal accuracy) between the displacements `0` and `0.001`.

14. IPI Sensors and Charts

As of version 4.6, **Trimble 4D Control** offers native support for In-Place Inclinometers (*IPI Sensor*) as a special sensor type.

In order to use the functionality for the new *IPI* sensor type you need to configure an *IPI Sensor* in **Trimble 4D Control Server** and add the sensor to the **Project** as described in the *Project Configuration* section for In-Place Inclinometer Arrays.

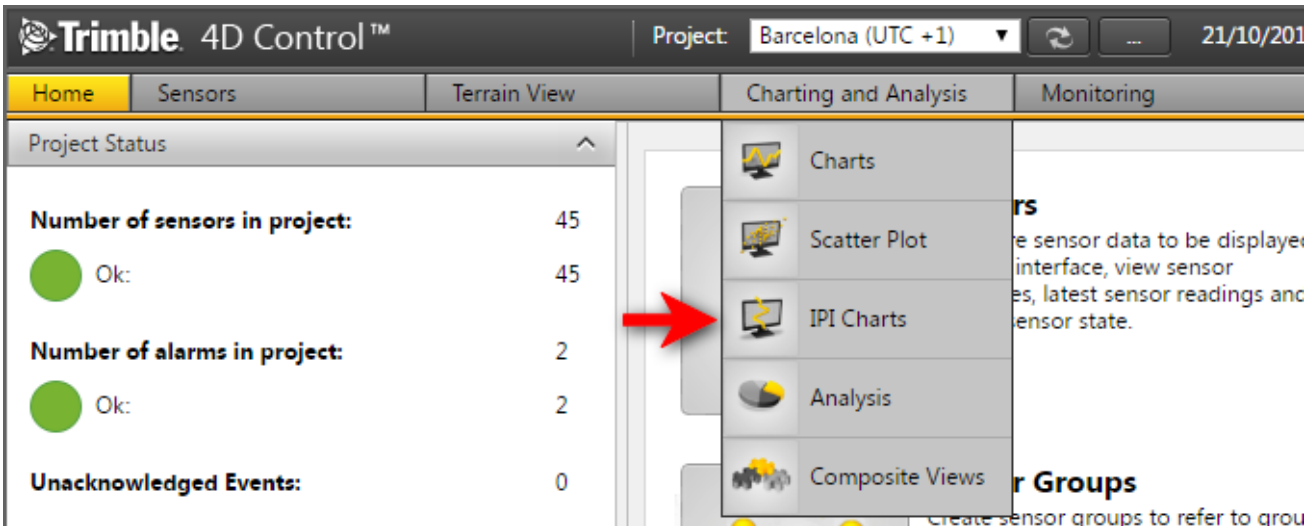
IPI Sensors are associated with a new **In-Place Inclinometer** data type. This data type contains components for **Min** deflection and **Max** deflection values in the **A** and **B** planes. **IPI** chains of an *IPI Sensor* can also be visualized in detail by a special type of chart called an **IPI Chart.**



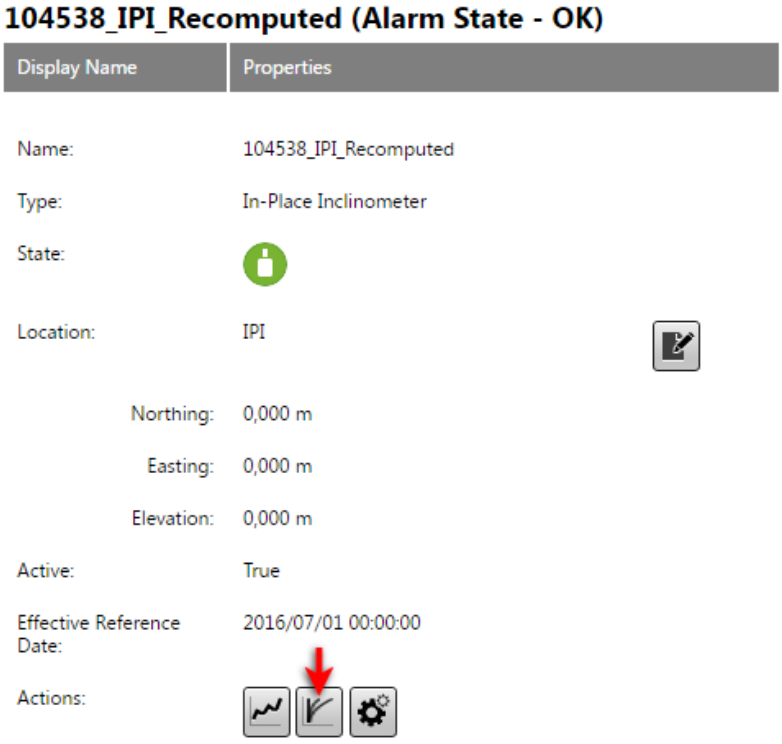
The figure above shows the relation between the components available on the **In-Place Inclinometer** data type and the corresponding **IPI Chart** plot. The components of the **In-Place Inclinometer** data type can be monitored with standard alarming functionality.

The main menu entry for the **IPI Charts** section can be found under **Charting and Analysis.**

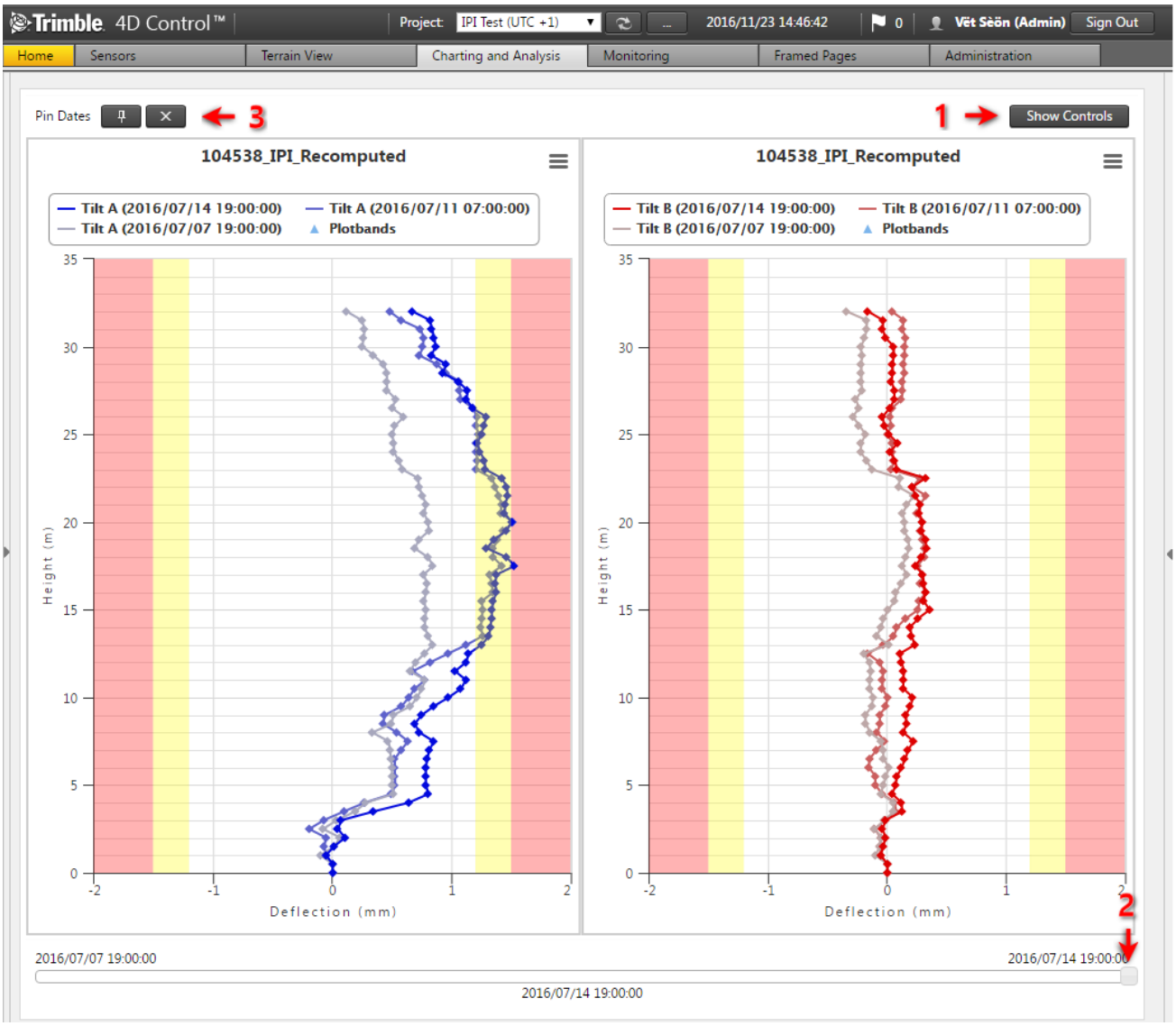
14.1. View IPI Chart



Navigate to the *IPI Chart* area via the Menu under *Charting and Analysis* or from the *Home Page*.



You can also navigate to the *IPI Chart* area by clicking on the **IPI Chart** button that is available when an **IPI Sensor** is viewed on the **View Sensor** page.



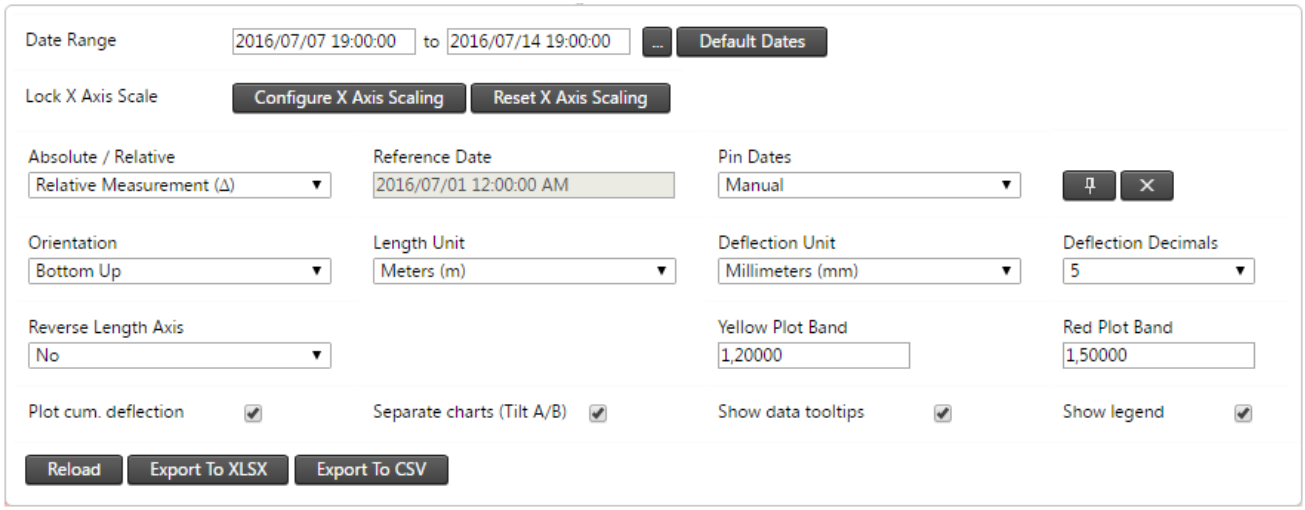
The picture above shows a **Relative** plot of an **IPI** chain in a **Bottom Up** orientation. A number of controls are available on this view:

1. The **Show Controls** button can be used to expand a controls area (see below).
2. The **date slider** at the bottom of the page can be used to animate the state of the primary series over time. Simply click and drag this slider to set the data and time that should be depicted by the primary series.
3. The **Pin Dates** controls will be visible if the current **Pin Date Mode** is set to **Manual**.

14.5. IPI Chart Settings

The collapsable **Controls Area** contains controls that can be used to adjust the presentation of the **IPI Chart**.

All settings (except for the **Date Range**) are persisted against each individual **IPI Chain** - provided that the user has **Edit** permissions on the **IPI Page**.



14.5.1. Date Range

The **Date Range** controls on the **IPI Chart** works exactly the same as in all other charting areas (e.g. Charts, Scatter plot and Analysis).

14.5.2. Lock Axis Scale

The **Lock Axis Scale** controls can be used to adjust the **Deflection** scale. This might either be the X or the Y axis of the Chart(s) depending on the **IPI Chart Orientation**.

Click on **Configure X (or Y) Axis Scaling** to set up the scale extents. Click on **Reset X (or Y) Axis Scaling** to remove the extent presets.

14.5.3. Absolute / Relative

IPI Charts can be plot either in **Absolute** or **Relative** mode. An **Absolute IPI Chart** simply plots the **IPI** chain with actual tilt and deflection values.

A **Relative IPI** chart plots the difference between the actual tilt and deflection values at a given time vs a reference point in time. **Relative IPI Charts make us of** the **Reference Date** defined for the **Project** or for a specific **Sensor**.

14.5.4. Pin Dates

By default the **IPI Chart** will load with only a single series - known as the **active** series. This series is tied to the date slider at the bottom of the page and will change to reflect the state of the **IPI Chain** as the slider is dragged left or right.

Additional **Pinned** series can be added to the **IPI Chart**. A number of automatic **Pin Date Modes** are available. These are:

- Every Hour
- Every Day
- Every Week
- Every Month
- Every Three Months
- Every Six Months
- Every Year

Alternatively you may set the **Pin Date Mode** to **Manual**. To pin a specific date, simply drag the time slider at the bottom of the page and click on the **Pin** icon. This state will remain pinned even if the time slider is dragged to a different time.

Manual Pin Dates can be cleared by click on the **Cross** icon (next to the **Pin** icon).

14.5.5. Orientation & Reverse Length Axis

IPI Charts can be rendered with 4 different orientations:

- Bottom Up
- Top Down
- Left to Right
- Right to Left

By default the fixed end of the **IPI Chain** will coincide with the zero mark on the **Length** axis. However, the scaling of the **Length** axis can be revered by enabling the **Reverse Length Axis** setting.

Note: The labels on the form controls refer to a **Length** axis. The actual label of this axis on the chart surface will be denoted as either **Depth**, **Height** or **Distance** - depending on the **Orientation**.

14.5.6. Deflection and Length Units

The preferred units for the **Deflection Axis** and the **Length Axis** can be set separately. The available options will depend on the linear **Unit Preference** as set on the **Project**.

Note: The labels on the form controls refer to a **Length** axis. The actual label of this axis on the chart surface will be denoted as either **Depth**, **Height** or **Distance** - depending on the **Orientation**.

14.5.7. Deflection Decimals

The number of decimals used for plotting deflection values can be adjusted. This setting will also apply to values shown in the tool tips.

14.5.8. Yellow & Red Blot Bands

The **Yellow Plot Band** and **Red Plot Band** values can be used to render plot bands against the **Deflection** axis. These plot bands can be cleared by clearing the values or by setting it to zero.

14.5.9. Plot Cumulative Deflection

By default, the **IPI Chart** will plot the cumulative displacement - obtained by adding the displacement at each node up to a particular node. The **Plot cum displacements** checkbox can be deselected to plot the individual node displacements only.

14.5.10. Separate Charts

The **IPI Chart** will plot deflection in the **A** and **B** planes onto separate surfaces. To plot the chains on the same charting surface simply deselect the **Separate charts (Tilt A/B)** checkbox at the bottom of the page.

14.5.11. Show Data Tooltips

Tooltips can be enabled or disabled via the **Show data tooltips** checkbox.

14.5.12. Show Legend

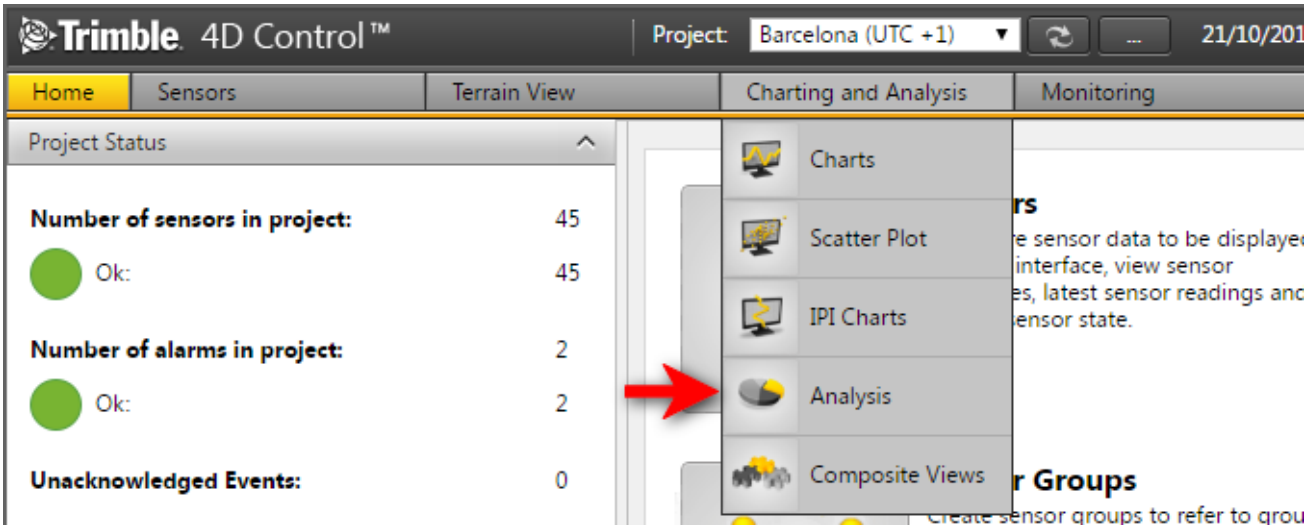
You can show or hide the chart legend(s) by selecting or deselecting the **Show legend** checkbox.

14.5.13. Export

IPI data can be exported to Excel or CSV format by making use of the **Export** buttons at the bottom of the controls area.

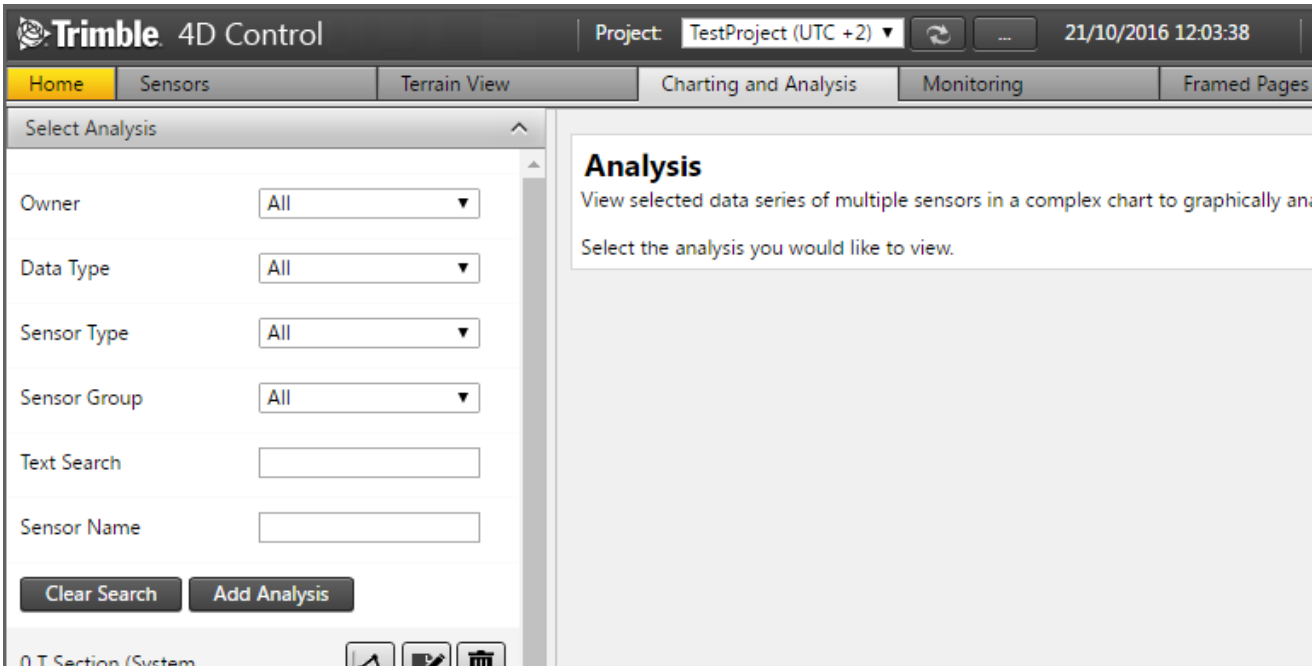
15. Analysis

The Analysis section allows you to visualize observations from different sensors. Each analysis type provides specialized charting and controls to obtain useful analysis information from sensor observations. The analysis types that are designed to analyze specific sensor or data types will only become available for selection if you have a sensor in your project that satisfies the requirements for that analysis type.



Navigate to the Analysis area via the Menu under *Charting and Analysis* or from the *Home Page*.

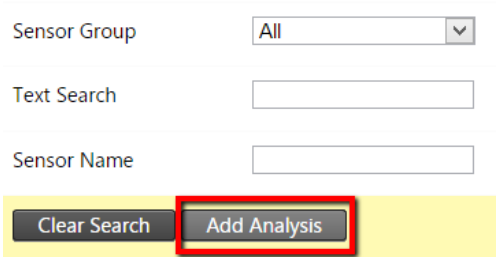
15.1. View Analysis



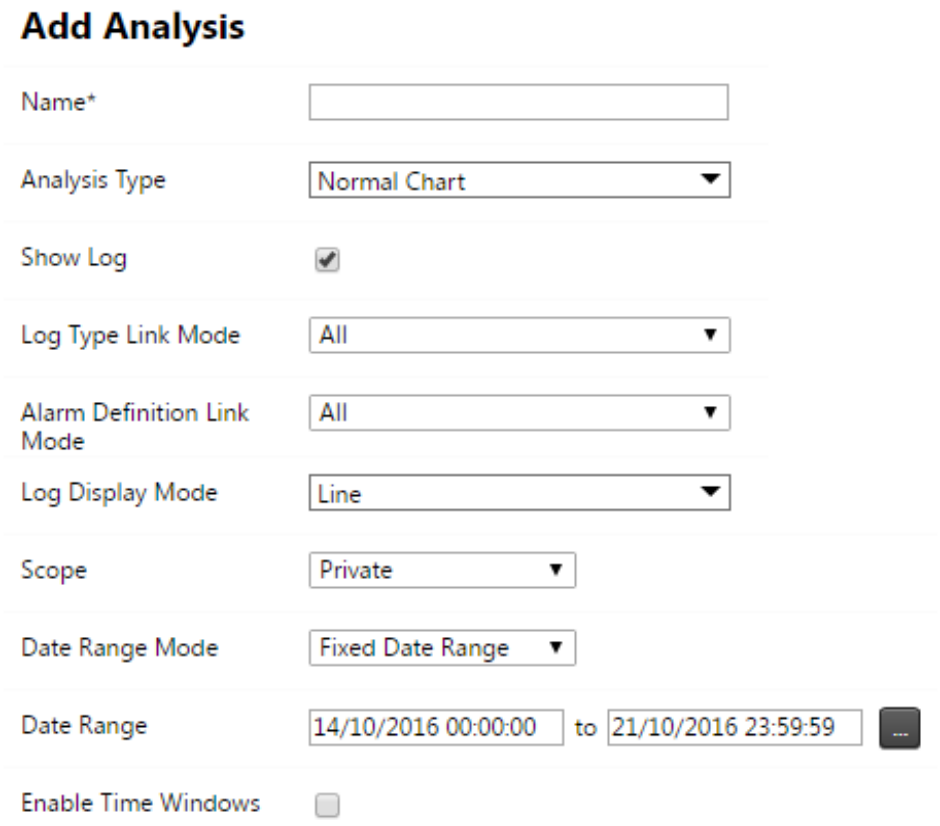
In the analysis section you can filter the analyses shown with the following controls:

- **Owner:** Every analysis is owned by a user. Set this filter to only show analyses owned by a particular user. Note that *Private* analyses are visible to the owner only.
- **Data Type:** show only analyses that has a series of the particular *Data Type*.
- **Sensor Type:** show only analyses that have a series from particular *Sensor Type*.
- **Sensor Group:** show only analyses that have a series from particular *Sensor Group*.
- **Text Search:** show only analyses where the search text matches the analysis name.
- **Sensor Name:** show only analyses where the search text matches the sensor name of any of its analysis series.

15.2. Add an Analysis



Step 1: Navigate to the Analysis area and click the *Add Analysis* button.



Step 2: Configure the basic *Analysis Settings* of the new analysis:

- **Name:** Specify a name for the analysis. Analysis names must be unique within a project.

- **Analysis Types:** Select the analysis according to the specialized charting and controls you wish to use:
    - **Normal Chart Analysis Type:** Plot analysis data on a chart surface with time denoted on the x-axis of the chart. This analysis type includes rich functionality such as regression and point exclusion.
    - **Comparative Bar Chart Analysis Type:** Compare one or more values from similar sensors visually and use a date slider to visualize changes overtime.
    - **Windrose Analysis Type:** Visualize the change in wind direction and speed.
    - **Tabular Analysis Type:** Visualize observation data in a tabular format. Use a date slider to visualize changes over time.
    - **Tiltmeter Array Analysis Type:** Visualize the cumulative tilt as measured by an array of tilt meters. (Also see **IPI Charts**).
    - **Cross Section** Analysis Type: Visualizes a single *data type component* from various sensors relative to the actual distance between the sensor locations.
    - **Heat Map Analysis Type:** Generate geo-referenced interpolated image visualising particular sensor observation values.
    - **High Frequency Analysis**: Available only in projects with High Frequency sensors such as *Accelerometers*. Optimized for plotting high frequency data.
- **Reference Date:** This date is used to determine reference measurements for series configured to display relative measurements. Note that this date is in terms of project local time.
- **Show log:** Log entries that fall within the analysis date range can be visualized on the analysis charts surface by enabling this option.
- **Scope:** You can make the analysis visible to other users by marking it as public. A private analysis can only be accessed by the user that created it.
- **Date Range Mode:** The date range of an analysis can be determined either by specifying a start and an end date, or by specifying the rolling time window width.
    - **Fixed date range:** Use these date and time inputs to specify the analysis date range in terms or project local time.
    - **Rolling Window:** Specify the time window which will determine the analysis date range. The effective analysis date range will change on a continuous basis. Note: Window widths of less than 1 minute may be affected by data latency.
- **Enable Time Windows:** Enable time windows if you only want to show observations in a particular time interval per day. If the To Time of Day is less than the From Time of Day then the interval wraps around midnight starting at the To Time of Day and ending on the From Time of Day of the next day. Only observations inside this daily interval will appear on the analysis chart.
- **Log Type Link Mode:** Specify the log type link mode.
- **Alarm Definition Link Mode:** Specify the alarm definition link mode.
- **Log Display Mode:** Choose how logs are displayed on the chart.
    - **Line:** Logs are represented with separate coloured line for each log type.
    - **Dots:** Logs are represented with separate coloured dotted lines for each log type.
    - **Icon:** Logs are represented with their respected icons.
    - **Area:** Logs are represented with plot bands in the log type colour for each log type.

Step 3: For now please select a **Normal Chart Analysis Type** and click the Save button.

Proceed to the next section to configure the analysis.

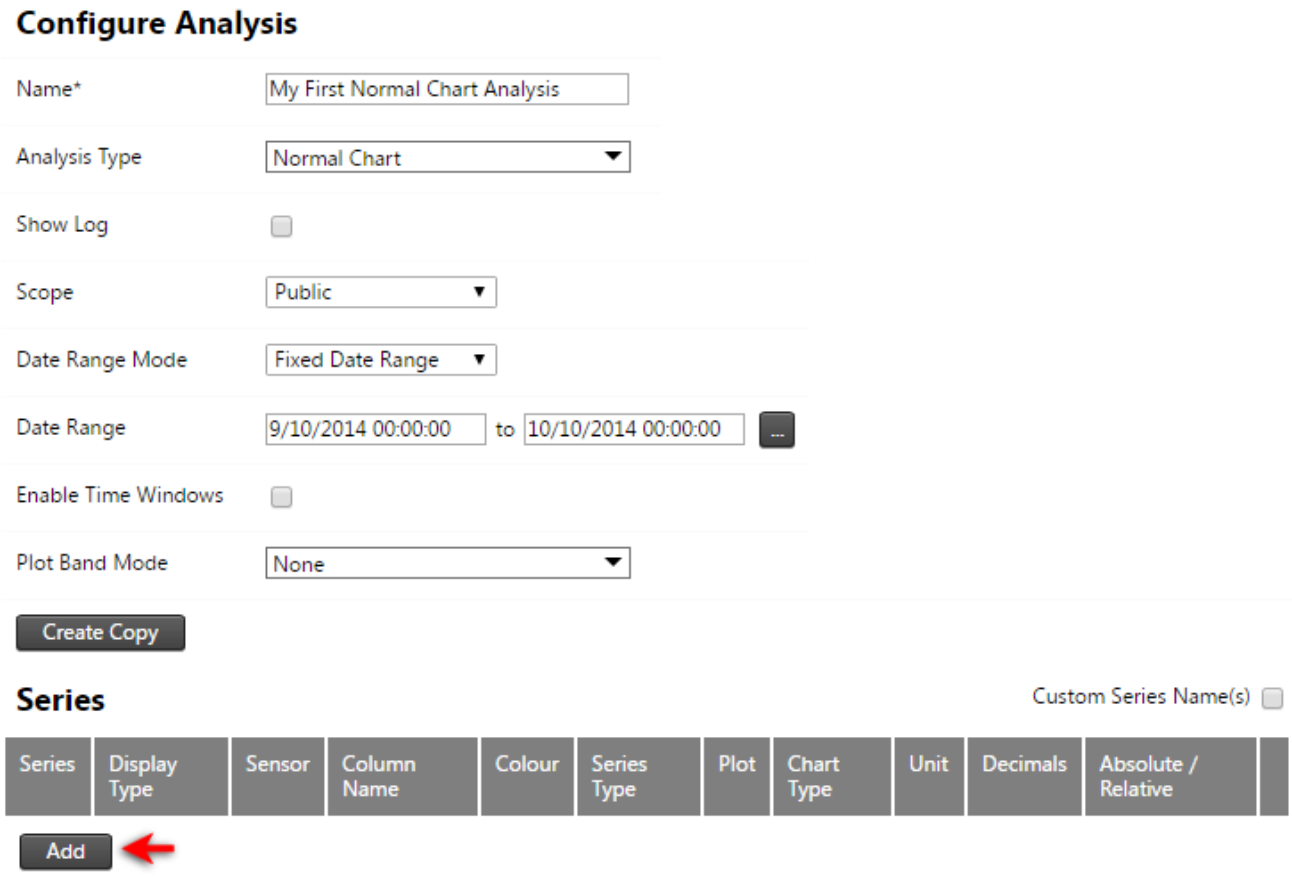
15.3. Normal Chart Analysis

This section guides you through the steps to configure your analysis. Configuring the different analysis types are all very similar. In this section we focus only on configuring an *Analysis* of the *Normal Chart Analysis Type* (referred to a *Normal Chart Analysis*). This will serve as example how to configure the different analysis types. The other analysis-type-specific settings will be covered in later sections.

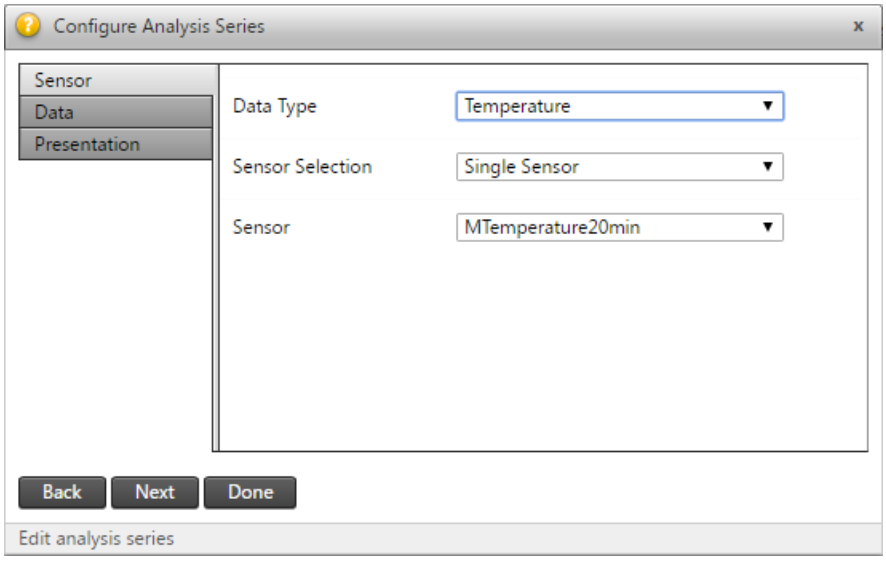
The analysis settings consists of two areas; the *Analysis Series Settings* and the *Analysis Settings*. We already covered most of the *Analysis Settings* configuration in the previous section (see Add an Analysis). We will now proceed to discuss configuration of the *Analysis Series Settings* and the rest of the *Analysis Settings*

15.3.1. Analysis Series Settings

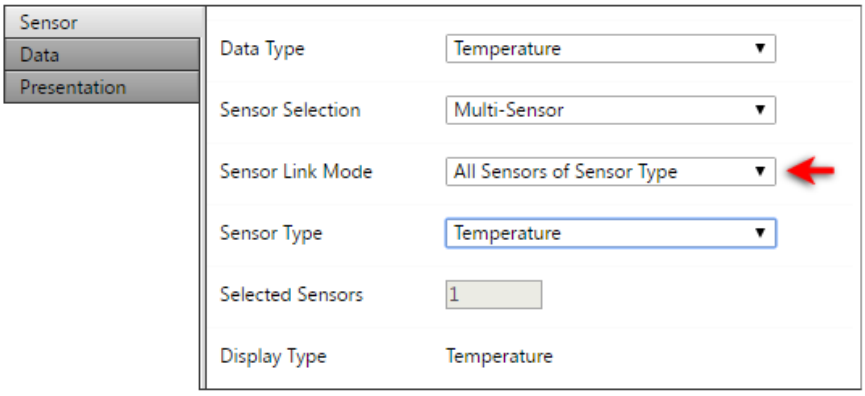
An **Analysis Series** links the data of a *Sensor Data Value Column* to an *Analysis*. The analysis then charts and offers controls to analyse the data provided by the Analysis Series. Below are the steps to configure *Analysis Series* for your Analysis:



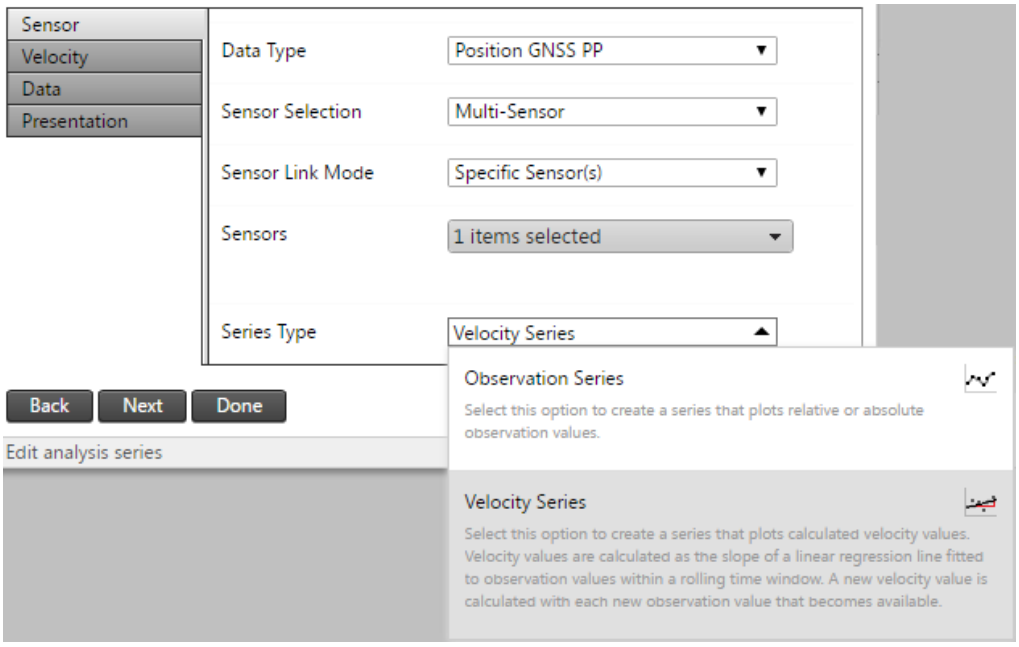
Step 1: On your newly created *Normal Chart Analysis*. Click on the *Add* button at the bottom of the Series table.



Step 2: On the *Configure Analysis Series* Window select the *Data Type* of the series you wish to include in your analysis. Notice the tabs on the left (Sensor, Data & Presentation). You can navigate between the tabs by clicking on the tab labels or by clicking the *Next* and *Back* buttons at the bottom.

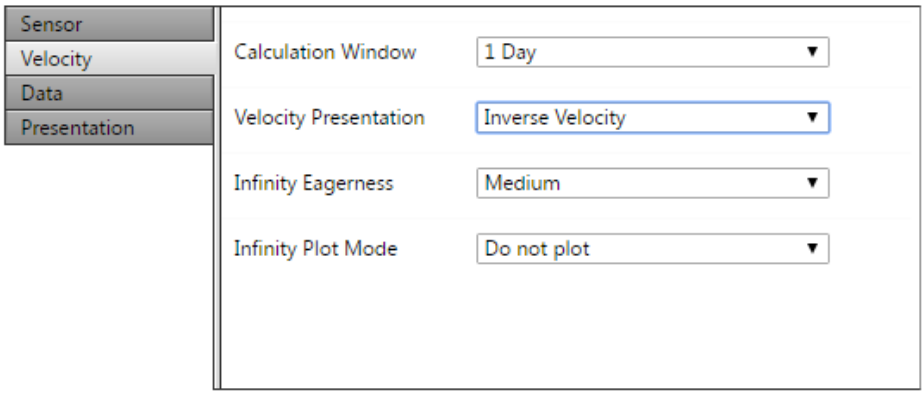


Step 3: You can configure multiple *Analysis Series* to be added to your *Analysis* by changing the *Sensor Selection* to **Multi-Sensor**; a selectable *Sensor Link Mode* will then appear. The *Sensor Link Mode* allows you to link your *Analysis* to either specific sensors, all sensors of a particular *Sensor Type* or all sensors of a particular *Sensor Group* (see Sensor Groups). In the example above we selected Sensor Type link mode and we only have one sensor of *Sensor Type* **Temperature**.
Click *Next* to proceed to the *Data* tab.



If you selected a *Positional Data Type* (as "Position GNSS PP" above), then you will have an additional option to select the **Series Type** for this analysis series. You can choose to either show the *Analysis Series* as positional observations or the velocities calculated from the positional observations.

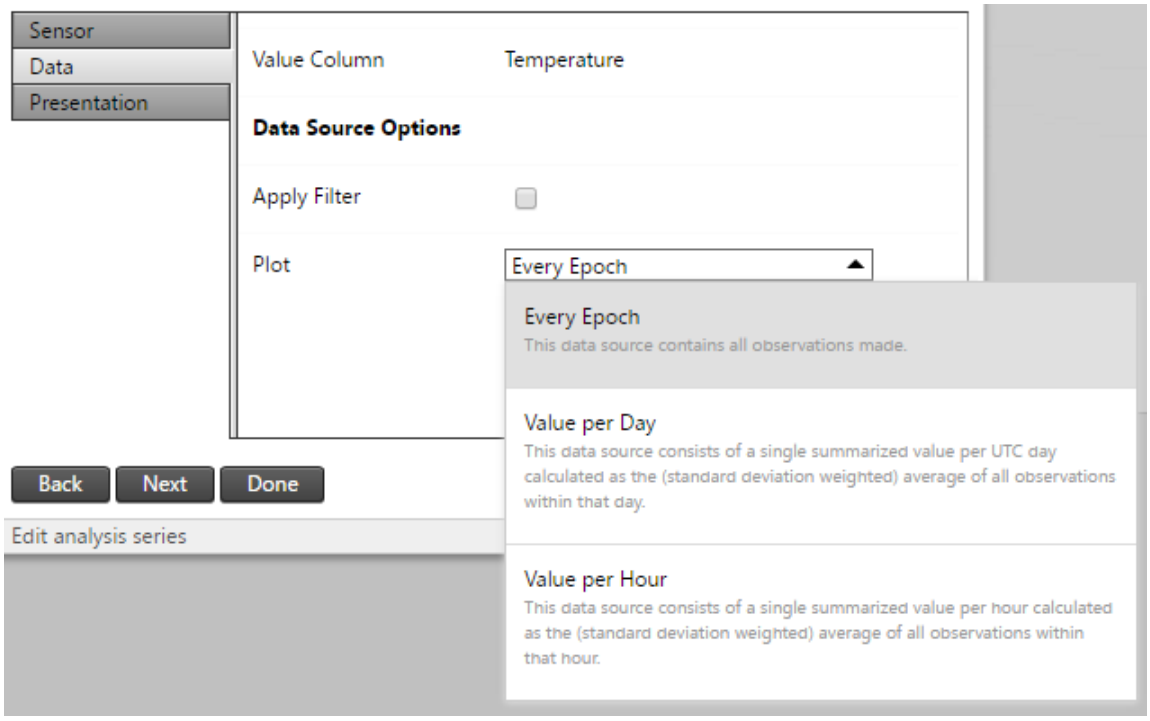
Step 4: If you selected a *Positional Data Type* and *Velocity Series* as the **Series Type**, then a *Velocity* tab will appear in the dialog.



Here you can complete the following fields:

- **Calculation Window**: Specify the width of the rolling time window over which a linear regression line should be fitted in order to calculate the velocity to be monitored.
- **Velocity Presentation**: Specify whether the velocity should be presented as *Velocity* (v) or *Inverse Velocity* ($1/v$).
- **Infinity Eagerness**: Applicable for *Inverse Velocity*. This property controls how soon infinity is assumed when a value close to zero is inverted.
- **Infinity Plot Mode**: Applicable for *Inverse Velocity*. This property controls the manner in which infinity is plotted.

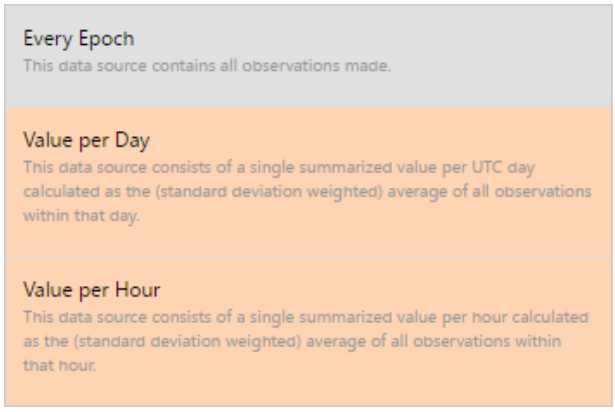
Step 5: If there are more than one *Data Value Column* associated with your selected *Data Type* then you will be able to select a *Data Value Column* to be used on the *Data* tab.



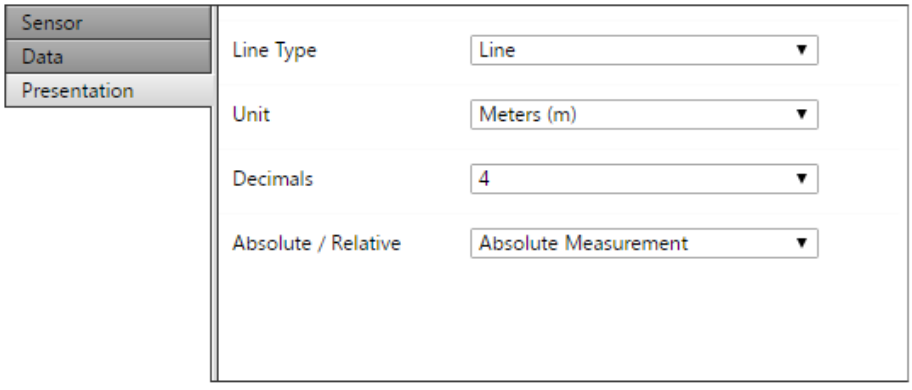
Our example above only has one *Data Value Column* available, so there is not selection to be made here.

Next you can configure the **Plot** setting which determines the **Summarized Data Sets** (per minute, per hour etc.) to plotted for the *Analysis Series*:

- **Every Epoch:** consists of all the observations received from the sensor.
- **Value per Day:** consists of a single summarized value per UTC day calculated as the (standard deviation weighted) average of all the observations within that UTC day.
- **Value per Hour**: consists of a single summarized value per hour calculated as the (standard deviation weighted) average of all the observations within that hour.
- **Value per Minute:** consists of a single summarized value per minute calculated as the (standard deviation weighted) average of all the observations within that minute. The *Value per Minute Summarized Data Set* is only available for high frequency sensors.



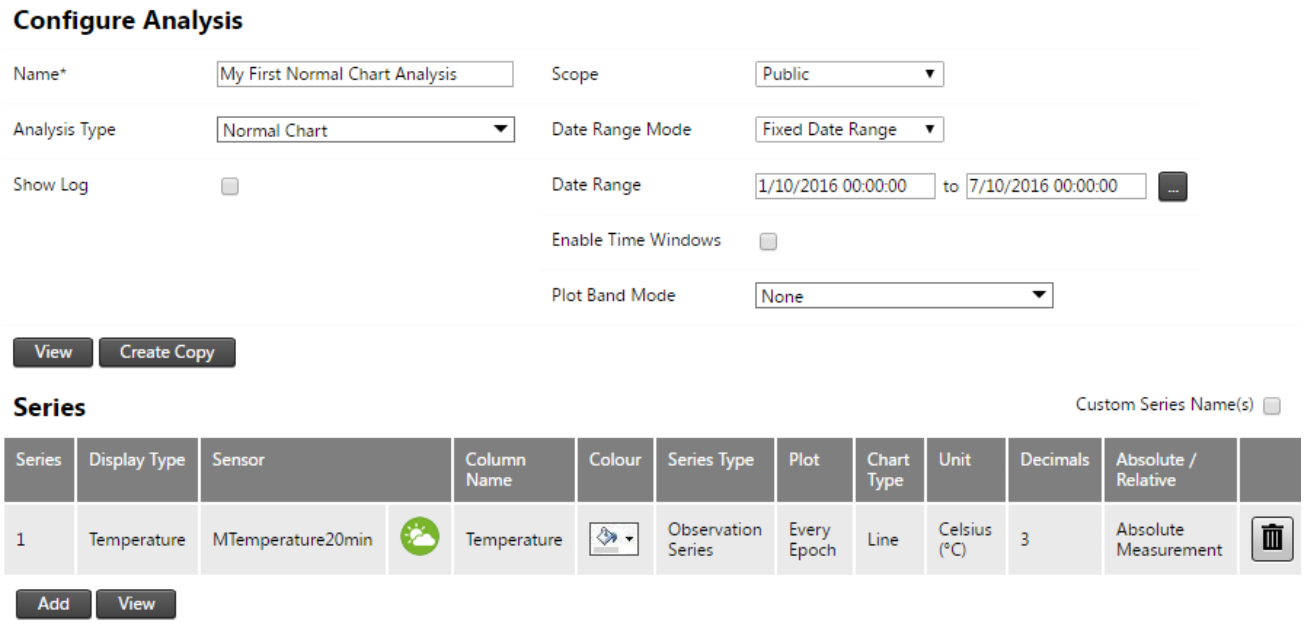
Note that the **Summarized Data Sets** available for selection depends on the particular *Data Value Column*. If you see some **Summarized Data Sets** marked with a warning color it means that there are no observations available for these **Summarized Data Sets** in the *Analysis Date Range*. You can automatically hide these by selecting the **Apply Filter** option above the **Plot** settings (see previous picture above).
Click *Next* to proceed to the *Presentations* tab.



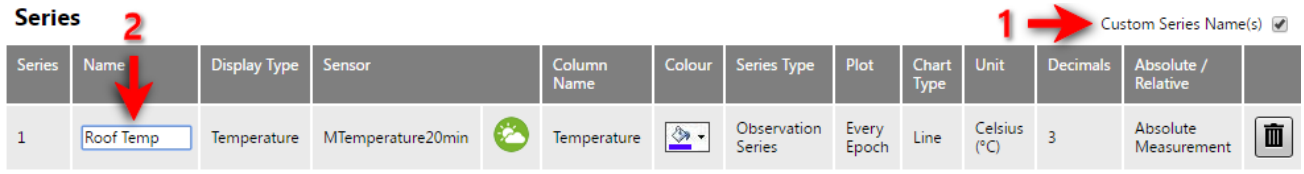
Step 6: On the *Presentation* tab you can select various presentation parameters:

- **Line Type**: the plot type to use for the series; area, dots, lines, spline or area spline.
- **Unit**: the unit in which to plot observations from the *Data Value Column(s)*.
- **Decimal**: the number of decimals to use when plotting observations from the *Data Value Column(s)*.
- **Absolute/Relative**: *Absolute Reading* will show the actual value measured. A *Relative Reading* will be denoted by a small delta (Δ) and depicts the change or difference between the actual reading and a reference reading.

Click the *Done* button to save your *Analysis Series Settings*.



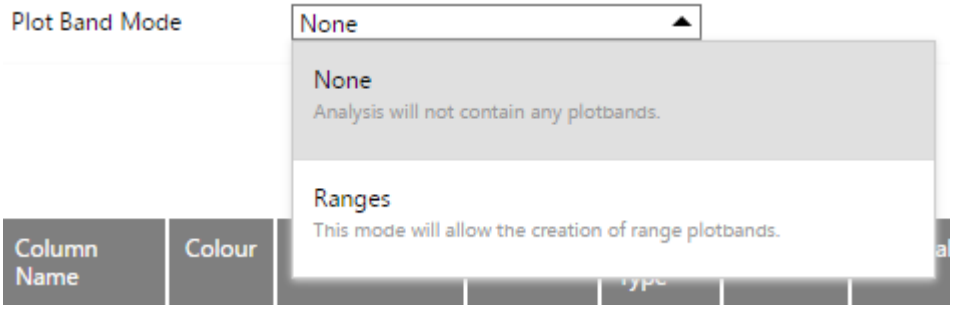
The created *Analysis Series* will now appear at the below the Analysis Settings. You can now set the *plot color* of the series by clicking on the color selector. You can also remove the series by using the *Delete* button on the far right of the *Analysis Series*.



The name of an *Analysis Series* is by default the name of the *Sensor*. You can change this by selecting the option *Custom Series Name(s)* on the top right of the *Series* table (1) and then clicking on the *Name* column (2) of a listed *Analysis Series*. Enter a name in the text box (2). Apply the name to the *Analysis Series* by clicking anywhere outside the custom name text box.

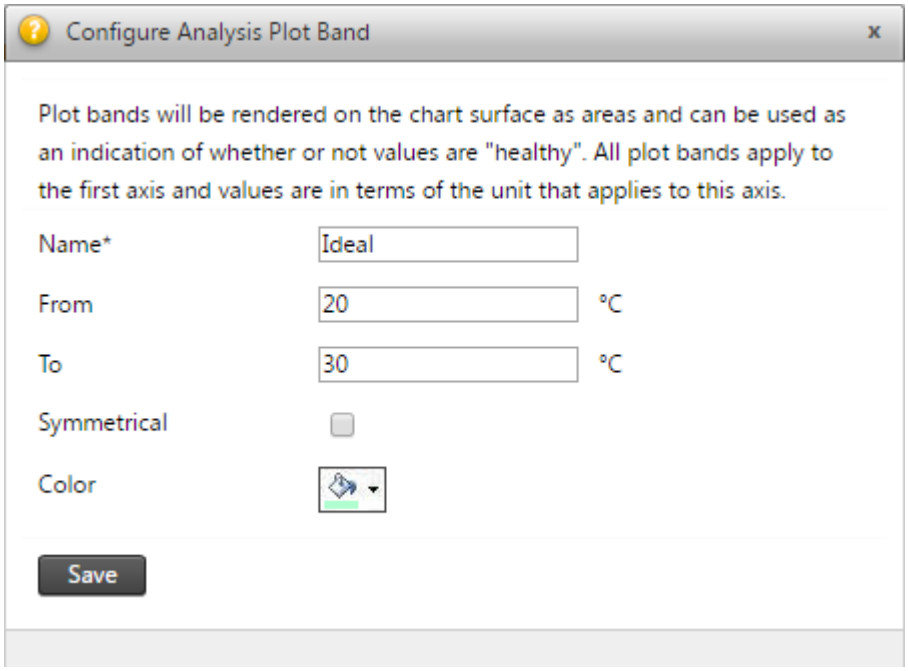
15.3.2. Analysis Series Plot Band Settings

You can configure *Plot Bands* on your Analysis in order to colorize the analysis chart background surface in particular *Ranges* (for Y-axis values e.g. between 20°C and 30°C). Some *Analysis Types* also allows configuring *Plot Bands* in particular *Zones* (for X-axis values) (see TODO: REF XSection/Tilt section).



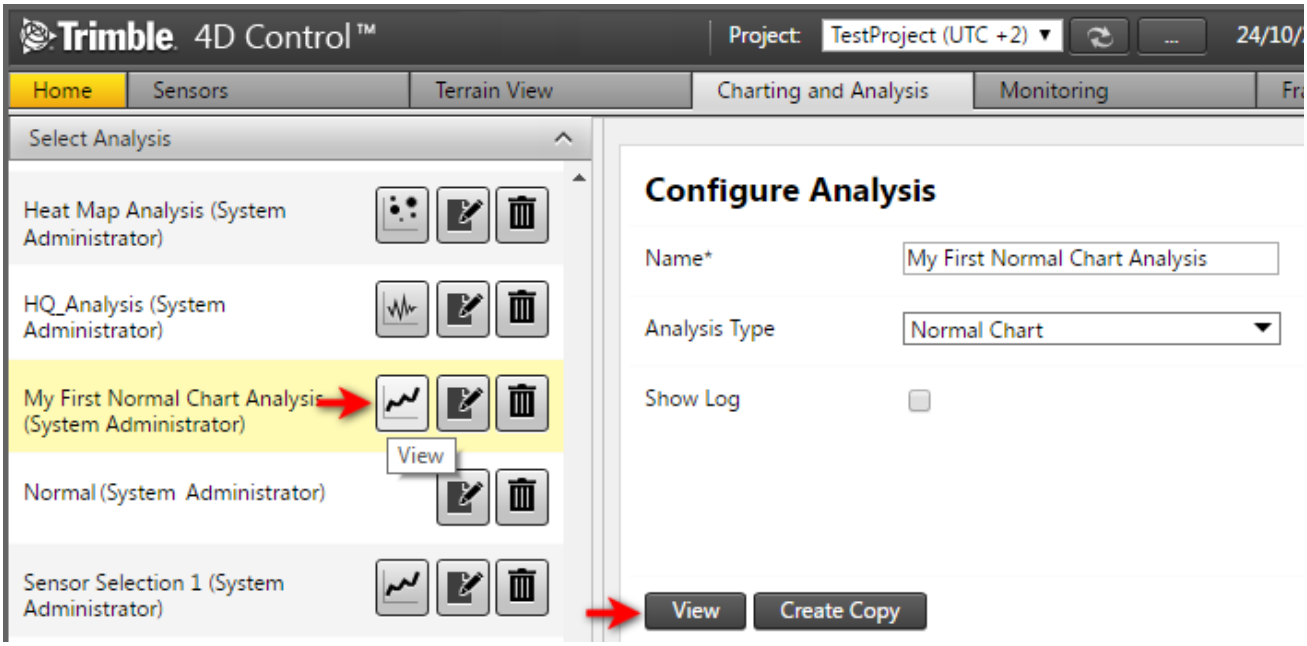
On the *Analysis Settings* page change the *Plot Band Mode* setting to **Ranges**.

Click the *Save* button to apply the the *Plot Band Mode* selection.



The *Configure Analysis Plot Band dialog* will appear. Enter a name for your *Plot Band* and specify the **From** and **To** values. Select the **Symmetrical** option if you want another plot band symmetrical over the X-axis (e.g. if your plot band is between 20°C and 30°C then the symmetrical plot band will be between -30°C and -20°C). Click *Save* to apply the *Plot Band* values.
We see this *Plot Band* drawn on the analysis chart background surface later in the next section.

15.3.3. Analysis View

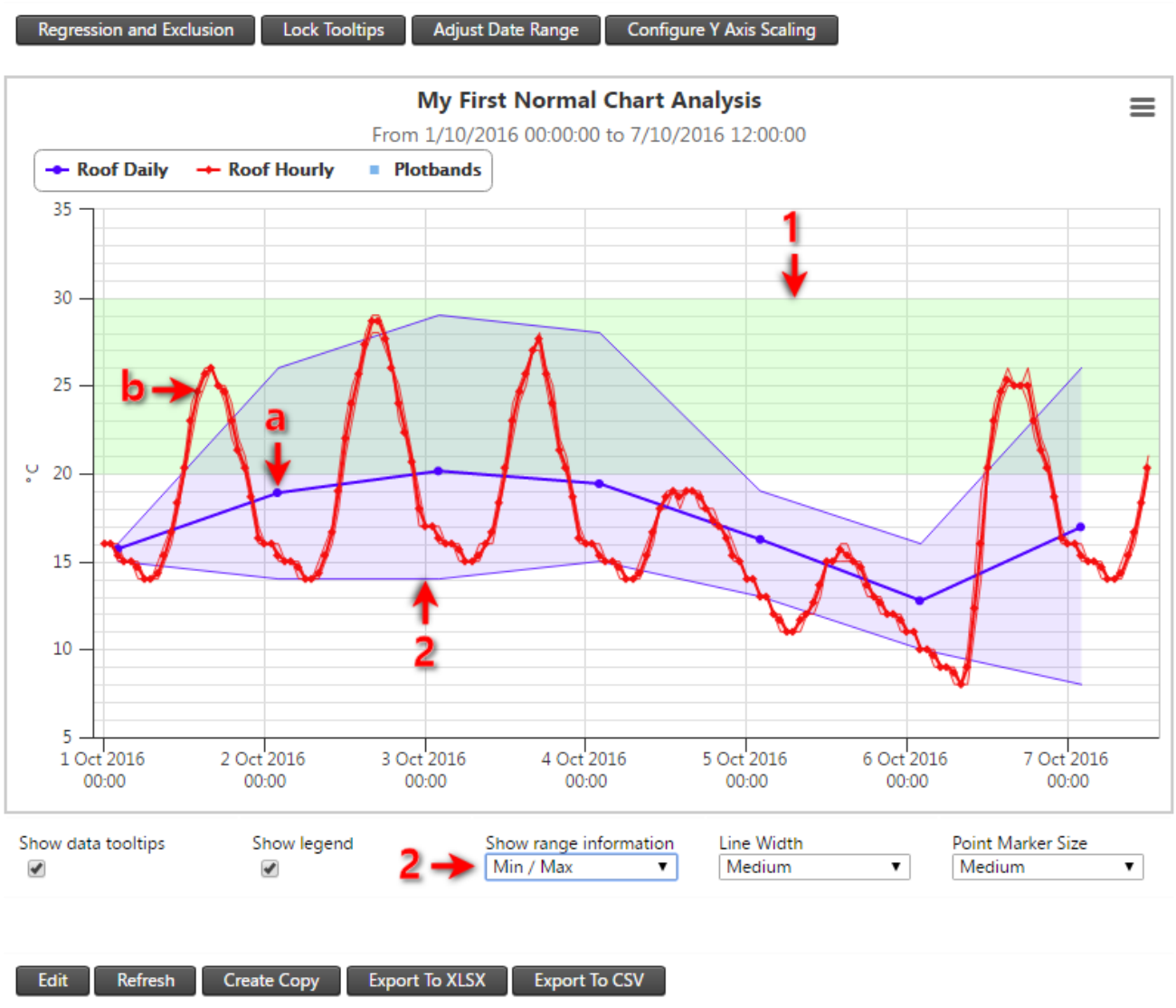


Click on the Analysis Icon in the Analysis list on the left or on the *View* button to view the analysis.

Below we discuss the features specific to the *Normal Chart Analysis* and some general *Analysis* features. We will not discuss the general charting feature here that was already presented in the Charts section.

Series	Name	Display Type	Sensor		Column Name	Colour	Series Type	Plot	Ch Ty
1 a	Roof Daily	Temperature	MTemperature20min		Temperature		Observation Series	Value per Day	Li
2 b	Roof Hourly	Temperature	MTemperature20min		Temperature		Observation Series	Value per Hour	Li

The analysis shown below has two *Analysis Series*, each from the same *Sensor Data Value Column*. The raw sensor measurements are temperature reading every 20 minutes. The *Analysis Series (a)* is configured to be a *Value per Day Summarized Data Set* and the *Analysis Series (b)* is configured to be a *Value per Hour Summarized Data Set*. The same observations will therefore be shown in this analysis but from different **Summarized Data Sets.**



On the Analysis View, we see the blue *Analysis Series (a)* and red *Analysis Series (b)* plotted on the same graph. Notice the plot band (1) on the chart background surface that we previously configured in the Analysis Series Plot Band Settings section.

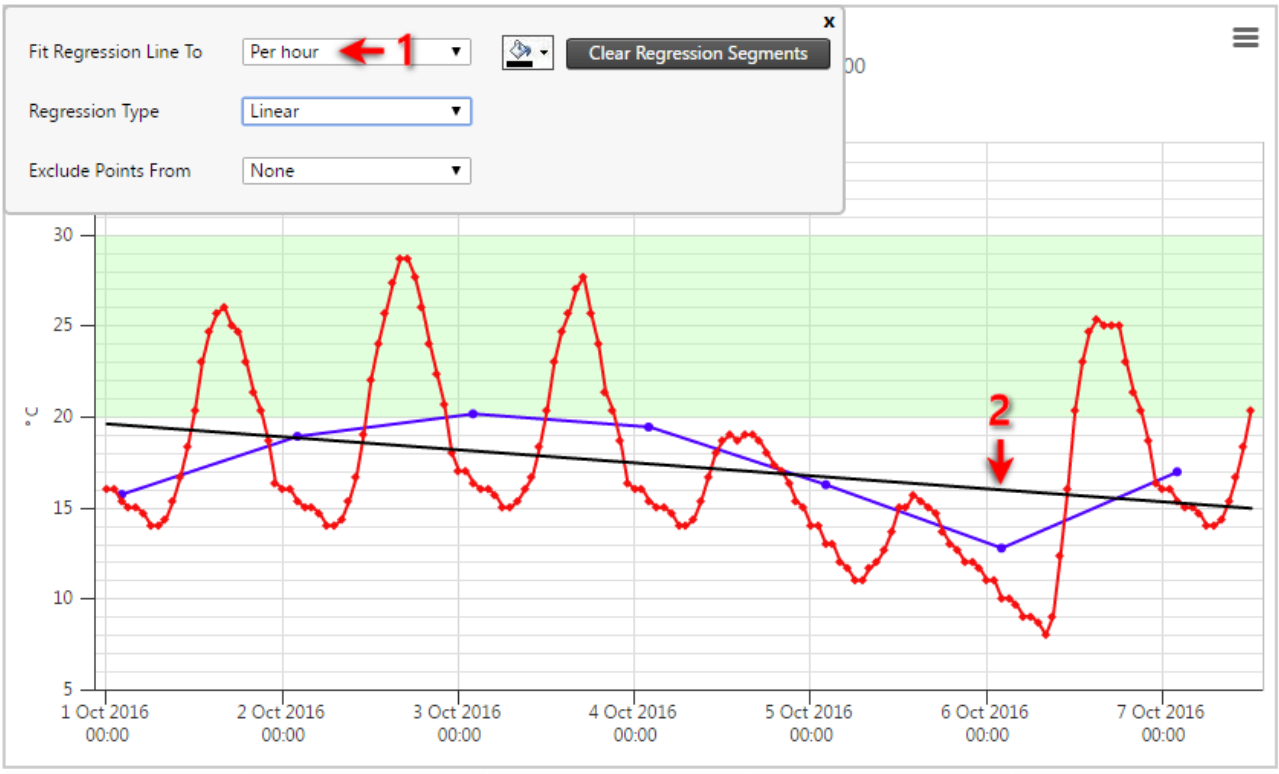
The **Show range information** (2) is set as *Min/Max* by default; the available settings for **Show range information** are *Disabled, Min/Max* and various other standard deviation options.

Also notice that *Analysis Series (a)* (*Value per Day Summarized Data Set*) is plotted 2 hours after midnight on each day. This is because our example project has a timezone of UTC+2 and the *Value per Day Summarized* is calculated per UTC day and also shown at the end of each UTC day.

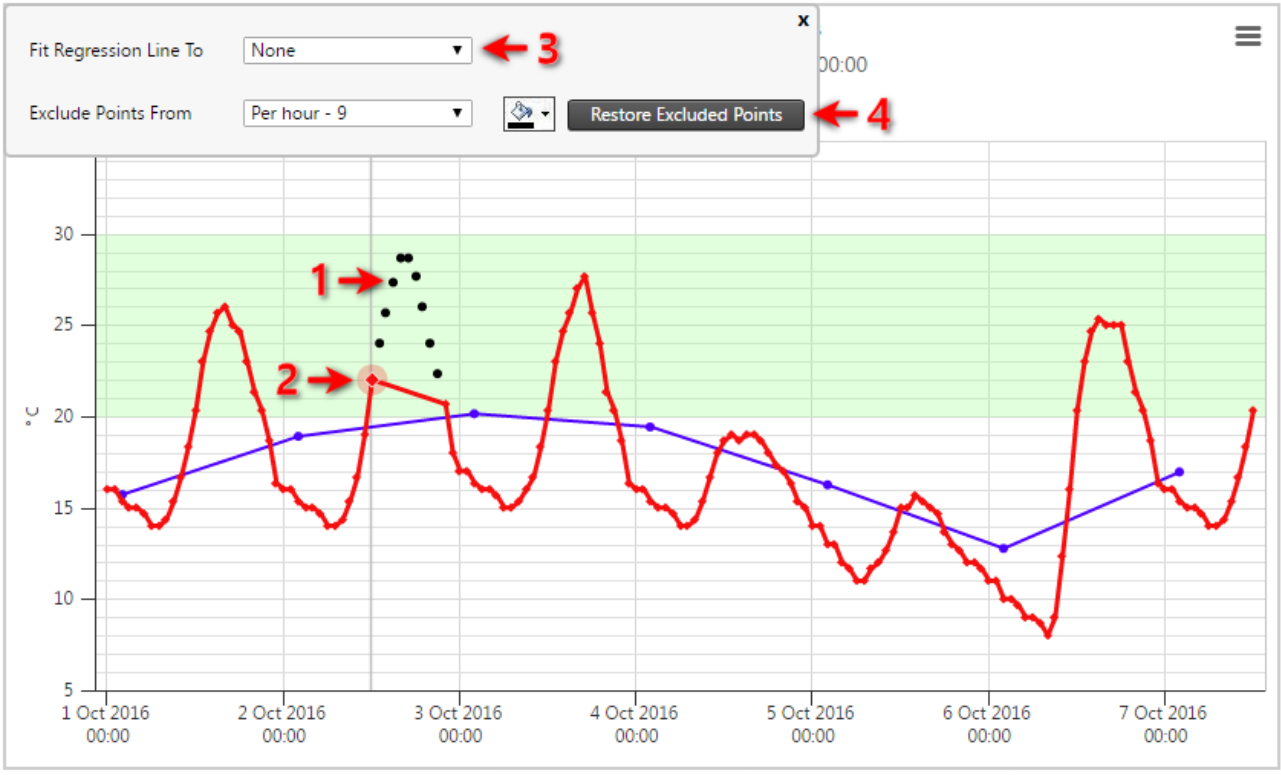
We will now discuss the **Regression and Exclusions** functionality on the *Normal Chart Analysis*.

15.3.4. Regression and Exclusions

Click on the *Regression and Exclusions* button at the top of the *Normal Chart Analysis*.



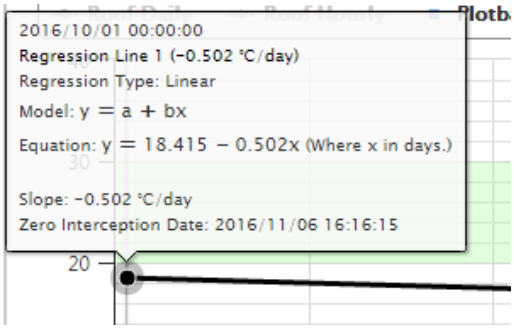
Select the analysis series (1) to which you wish to fit the regression line. The regression line will then appear on the chart (2). The default **Regression Type** is set to *Linear*, you can change this to various other regression types.



Select an *Analysis Series* for **Exclude Points From** to exclude points from an *Analysis Series*. The

Fit Regression Line To will automatically show no regression line. This is to avoid clutter while selecting exclusion points. Now, click on the points you wish to exclude (2). In the example above we already excluded some points (1). The points you exclude will automatically be remembered for this analysis.

Once you are finished excluding points you may select **Fit Regression Line To** (3) to show the regression line you previously selected again. You will notice that the excluded points will neither be displayed nor be used by the the regression fit. Point exclusion is useful if some points on the series are outliers or incorrect measurements.



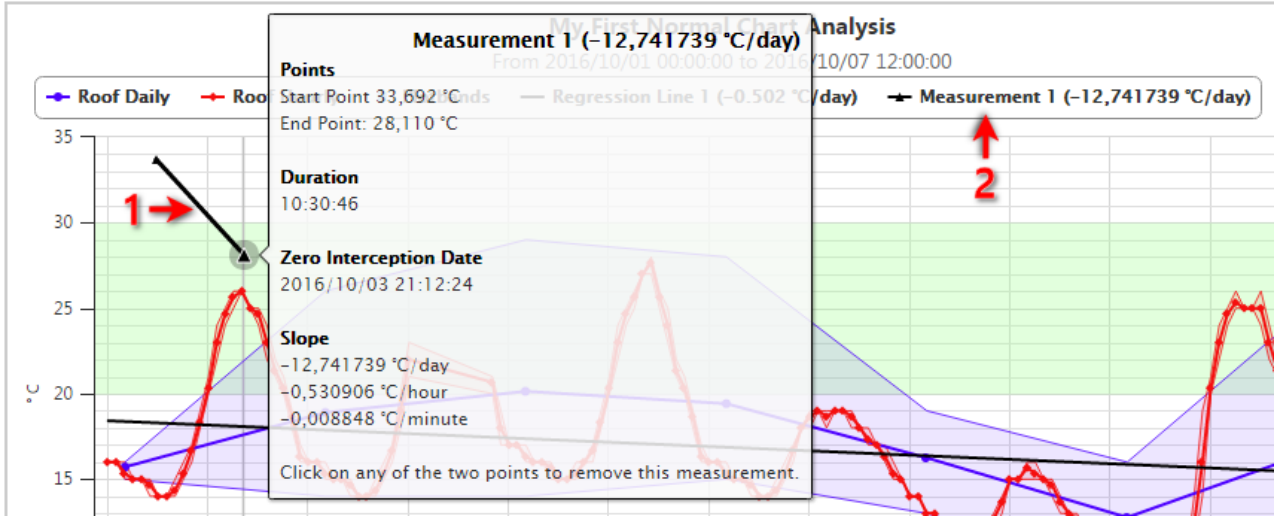
Move the mouse cursor over the regression line to see a tooltip displaying the:

- **Regression Equation:** The equation of the regression curve on the chart area.
- **Slope:** The slope of the regression line. Only applicable if the regression fit is Linear.
- **Zero Interception Date:** The date at which the regression line will intercept the zero line (y=0). This is also only applicable if the regression fit is Linear.

Click on the *Restore Excluded Points* (4) button the restore the points you excluded from a particular analysis series.

15.3.5. Freehand Measurements

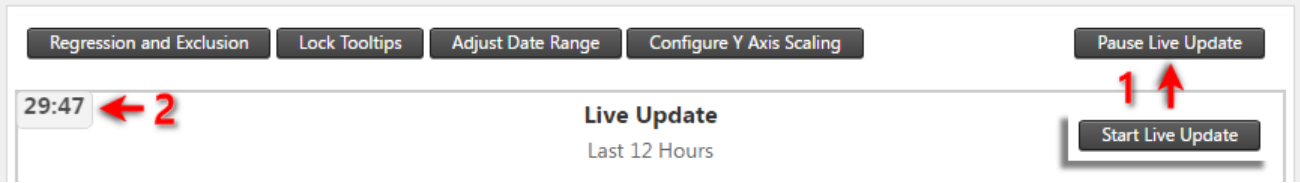
You can draw your own line to measure the slope between two points on the chart surface by holding down the *Ctrl* key and clicking on any position on the chart. Continue holding the *Ctrl* key and move your mouse to another position on the chart and click on the position to create the measurement line.



A line *Measurement* (1) with useful details will appear as a new chart series (2).

15.3.6. Live Update

If your analysis is configured to use data range mode of *Rolling Window*, or if you defined a future *Analysis End Date*, then the **Live Update** feature will be enabled on the analysis.



Click on the *Start Live Update* button on the top right hand corner of the *Analysis View*. The button will change to a *Pause Live Update* button. An *update counter* will start and be shown on the top left corner of the analysis chart. The particular update interval will automatically be determined by the system according to the data frequency of the plotted analysis series.
ure).

15.3.7. Matched Data Series Concept

The **Matched Data Series** feature on the Normal Analysis type was specifically requested by the mining industry. The reason for creating a **Matched Data Series** is to fit a regression line and analyze the behaviour of a rock body over a period that is longer than the life of any particular sensor. Of course this will only make sense if the two different sensors are installed in roughly the same region.

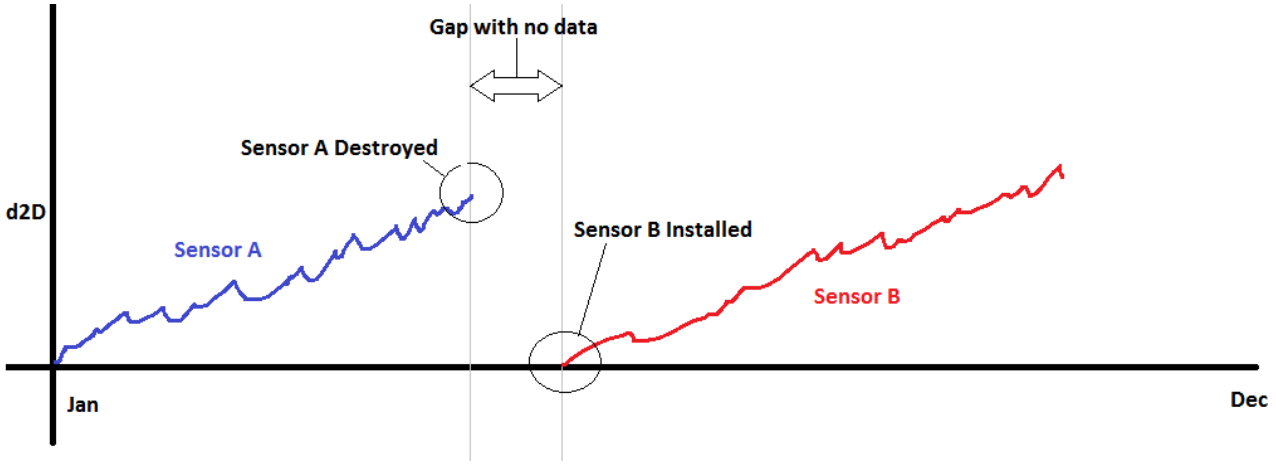
This functionality is seen as a historical analysis and is only available in **fixed date ranged mode**. Make sure your analysis is not configured to use a **rolling window** date range mode.

The functionality only becomes available if you have multiple series with the same Data Type, Value Column (or component) and Reduction. Typically you need to create an analysis with multiple Sensors of the same *Sensor Type*.

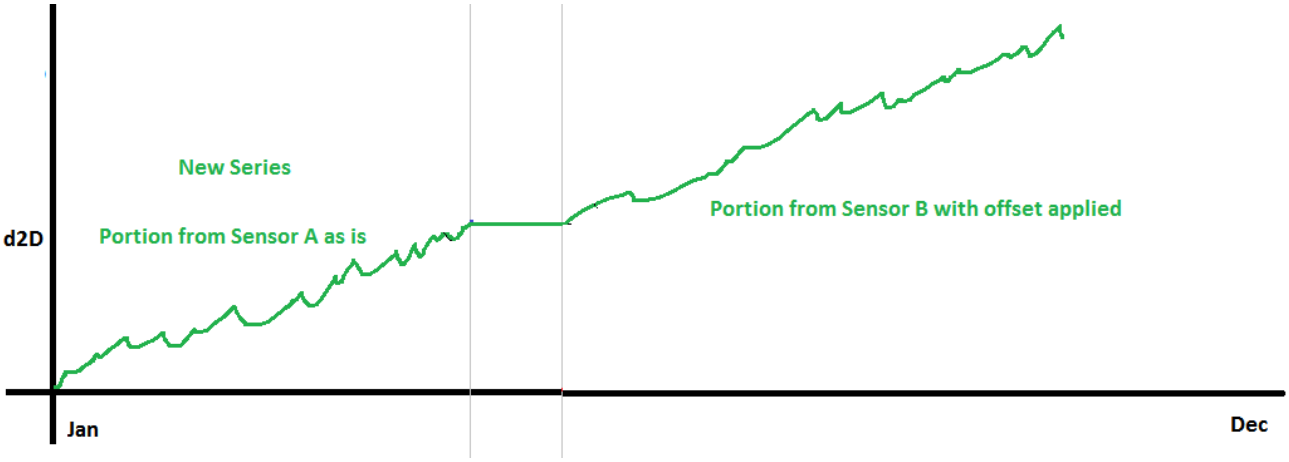
We will present an example setup of a **Matched Data Series** in a following section, but first we will describe the two matched data series cases at a conceptual level:

Case 1: Decommissioned before new Installation:

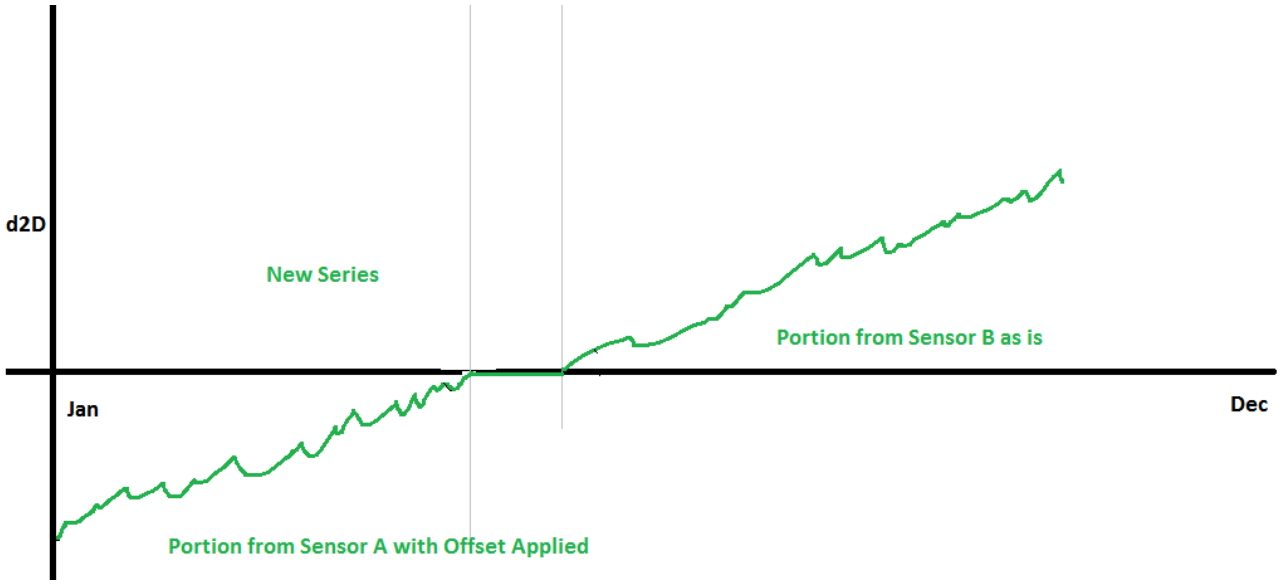
Sensor A existed at a location and was decommissioned before a *Sensor B* was installed at the same location. The analyst wants to get an understanding of how the ground moved over the entire period and the period in question is longer than the lifetime of either sensors.
For setup reasons, *Sensor A* and *Sensor B* may have yielded displacement values that are not the same: for example it may have been that both sensors started at a displacement of zero.



The matched data series feature should enable the analyst to create a new series by joining the series of *Sensor A* and *Sensor B* together. In doing so, one of the two series will be kept fixed (not shifted up or down) and an offset will be applied to the other series (shifted up or down). These options will be demonstrated below.



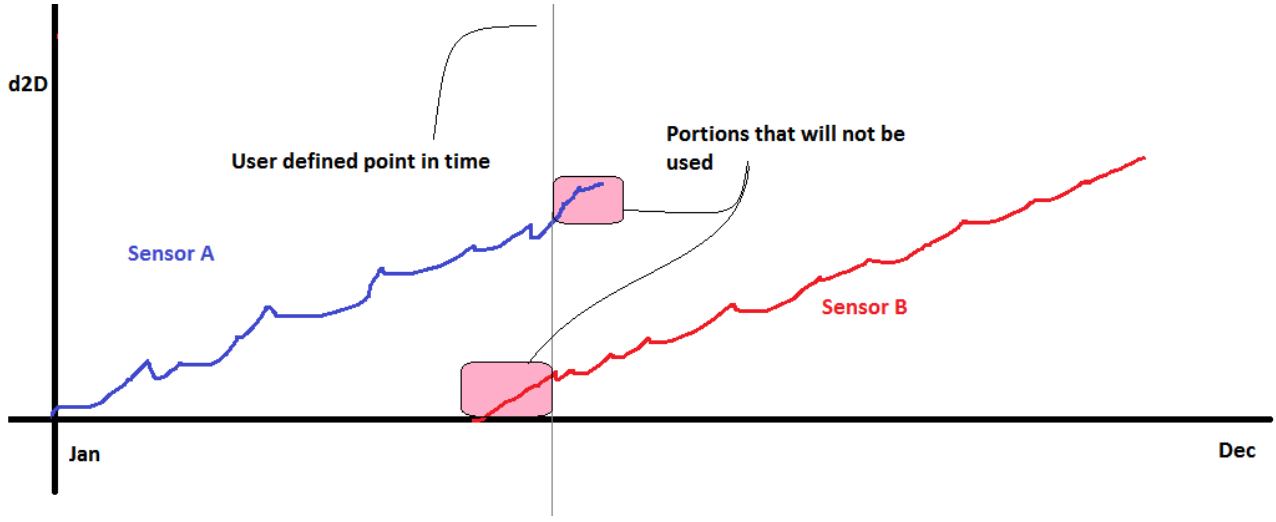
The series of *Sensor A* was fixed in the option above. Note that the series of *Sensor B* was shifted up. A regression line can now be fit to the new series.



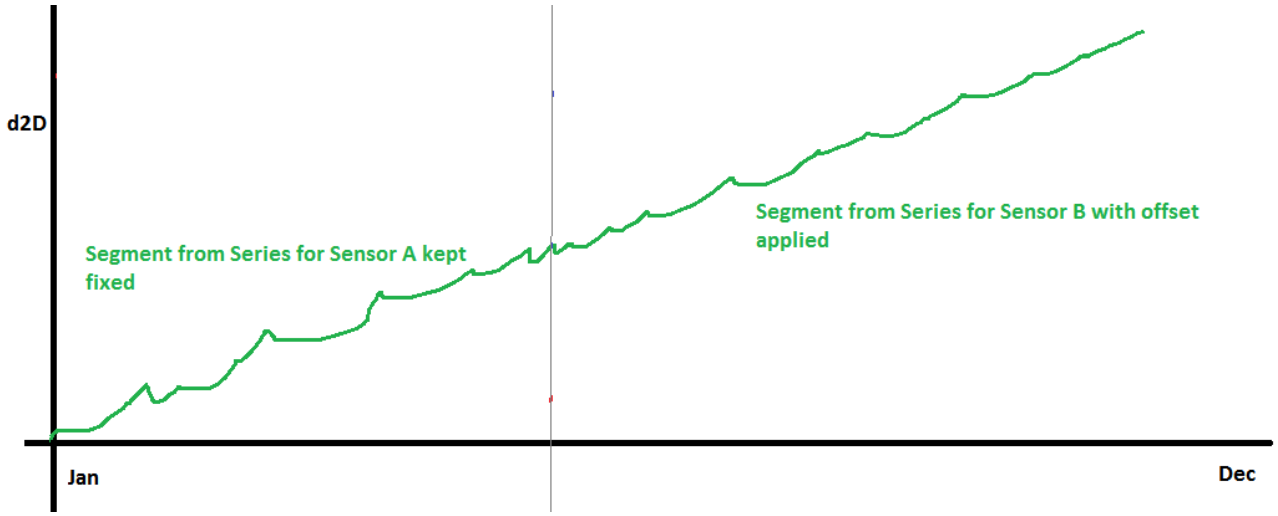
The series of *Sensor B* was fixed in the option above. Note that the series of *Sensor A* was shifted down. A regression line can now be fit to the new series.

<u>Case 2: Decomissioned after new Installation:</u>

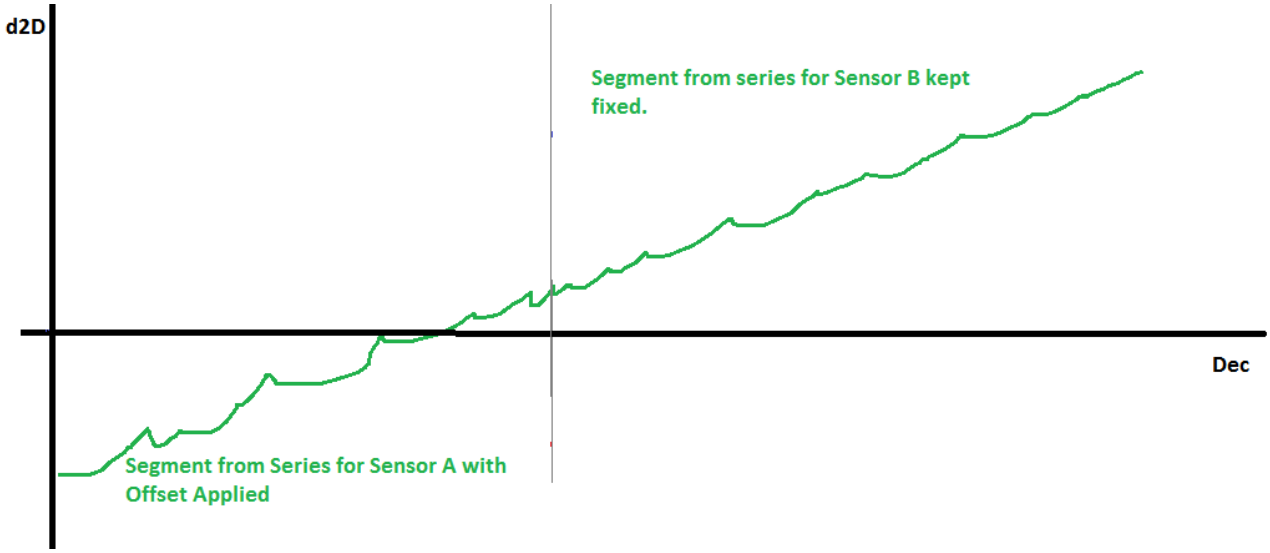
Sensor A existed at a location and a *Sensor B* was installed at the same location before *Sensor A* was decommissioned. The analyst wants to merge the series from *Sensor A* with *Sensor B* in order to fit a regression line and analyze the behaviour of the rock body. To do this, the analyst needs to specify the point in time that should be used for intersection purposes.



The matched data series feature should enable the analyst to create a new series by joining the series of *Sensor A* and *Sensor B* together. In doing so, one of the two series will be kept fixed (not shifted up or down) and an offset will be applied to the other series (shifted up or down).



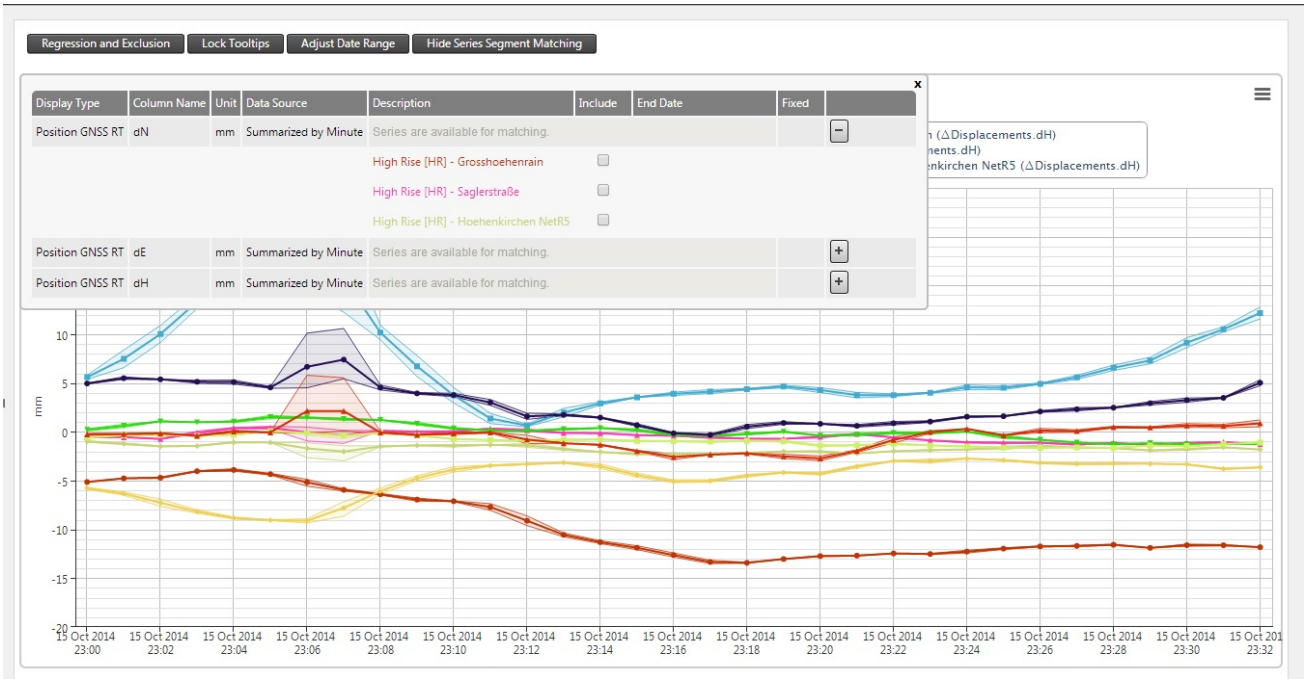
The series of *Sensor A* was fixed in the option above. Note that the series of *Sensor B* was shifted up. A regression line can now be fit to the new series.



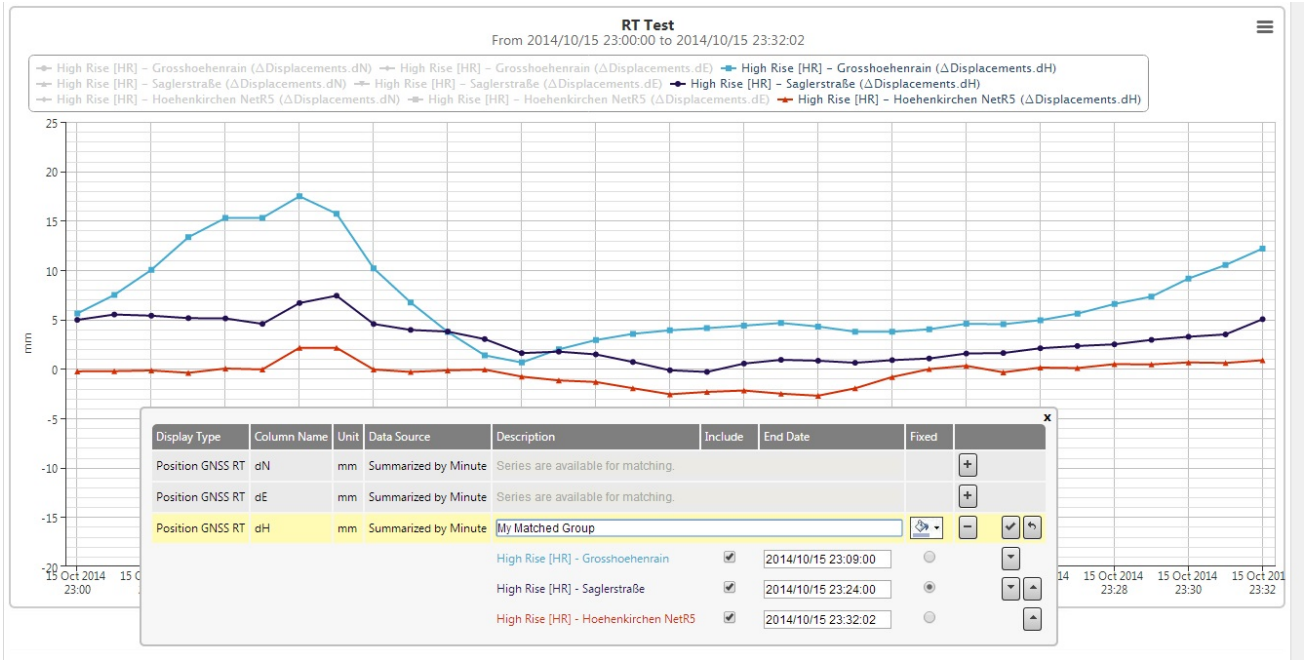
The series of *Sensor B* was fixed in the option above. Note that the series of *Sensor A* was shifted down. A regression line can now be fit to the new series.

15.3.8. Matched Data Series Example

In this section we present an exhaustive example configuration of matching three series segments. Although in this example all three sensors have data over the entire period, the configuration can be applied in a similar fashion if some sensors only have partial data. The example configuration is more complicated that



Click on the **Show Series Segment Matching** button to expand the configuration grid.
Note that you can click and drag the expanded grid control in order to view the analysis chart area behind it. The grid will contain expandable groups. Each group contains series that could potentially be matched together. (You cannot merge dN with dE for instance).

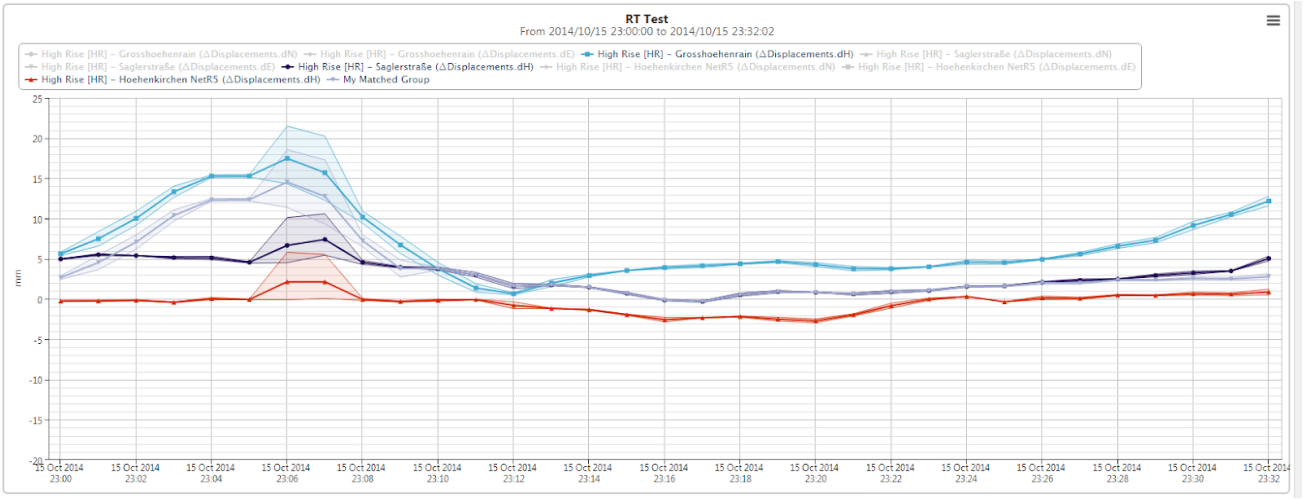


Expand the group you want to work with and pick two or more series. As soon as you pick the 2nd series, all other series which are not candidates to be matched will become temporarily hidden on the analysis chart area. You can now specify a new name for the calculated series, or simply use the suggested name. You can also specify a colour for the new series that will be created. Use the up and down arrows to indicate the order in which segments should be taken from each series. In our example above the order is the *light blue* series, *purple* series and *red* series. Indicate which one of the series should be fixed (the first segment will be fixed by default).

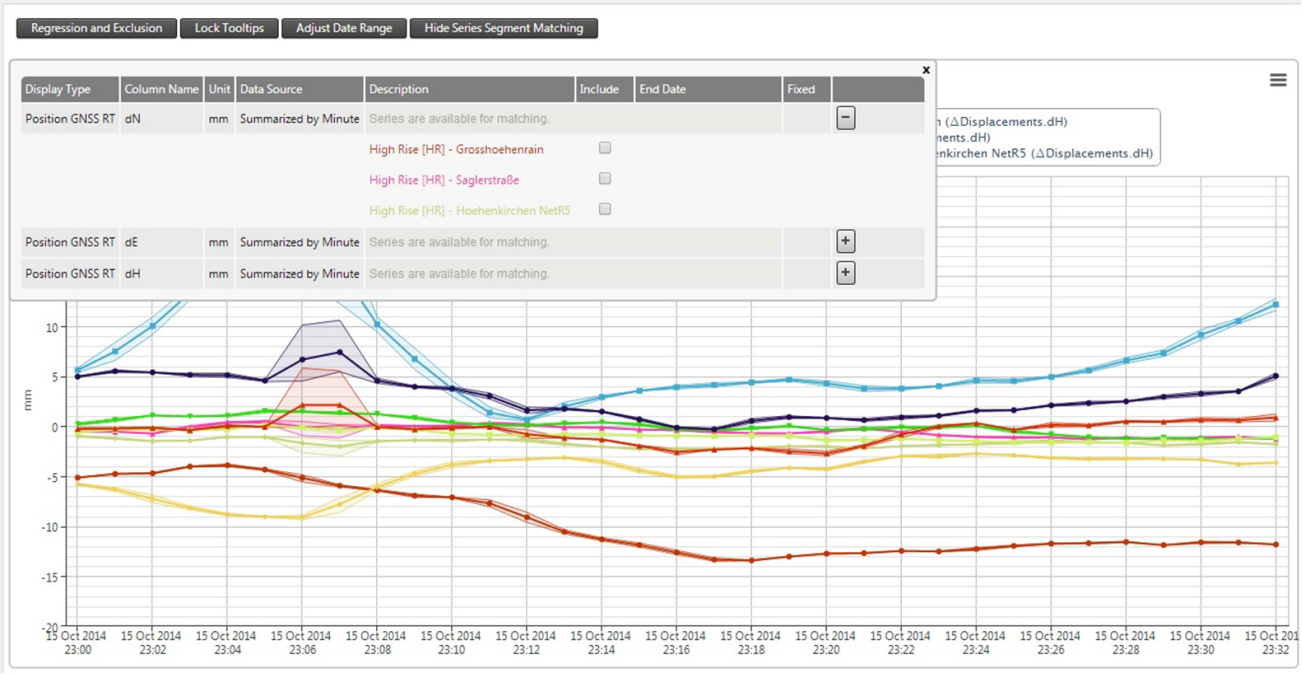
For each series, indicate the end date for the segment. This is the point up to which data will be taken from that series to create a series segment. Normally this date would be the date of the last available observation in that series. You can do this by entering the date or by clicking on a particular point on the series on the chart surface. Note that the end date for the one segment also serves as the start date for the segment taken from the next series. When you are matching more than two series segments, then you need to ensure that the end dates for each segment is in the same sequence as the series themselves.

For the series order in this example (*light blue* series, *purple* series and *red* series), we must ensure that the end date for the *light blue* series segment is before the end dates of the other series segments. We also need to ensure that the end date for the *purple* series is before the end date of the *red* series. You will be presented with a validation error message if this is not the case.

You can now click on the  button to save the newly created matched series group.



As seen above, the calculated series was added to the analysis.

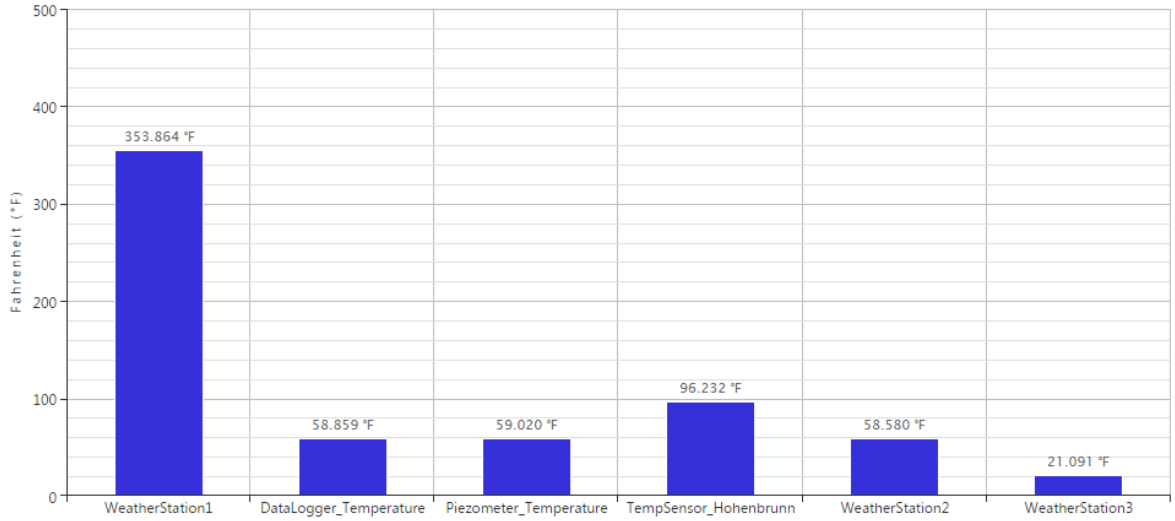


Above we inspect the tooltips of the calculated series. You will note that an offset may be applicable. In our example the *purple* series was kept fixed and has an offset of zero. You can now fit a regression line to the calculated series, open the matched series configuration grid again to create other matched series segments (e.g. for dE or dN) or change the settings of an existing matched series.

It is important to note that if you edit the analysis and change certain aspects of either the analysis or the series (e.g. Data Type, Sensor, Reduction, Value Column etc) then the matched groups may automatically be removed.

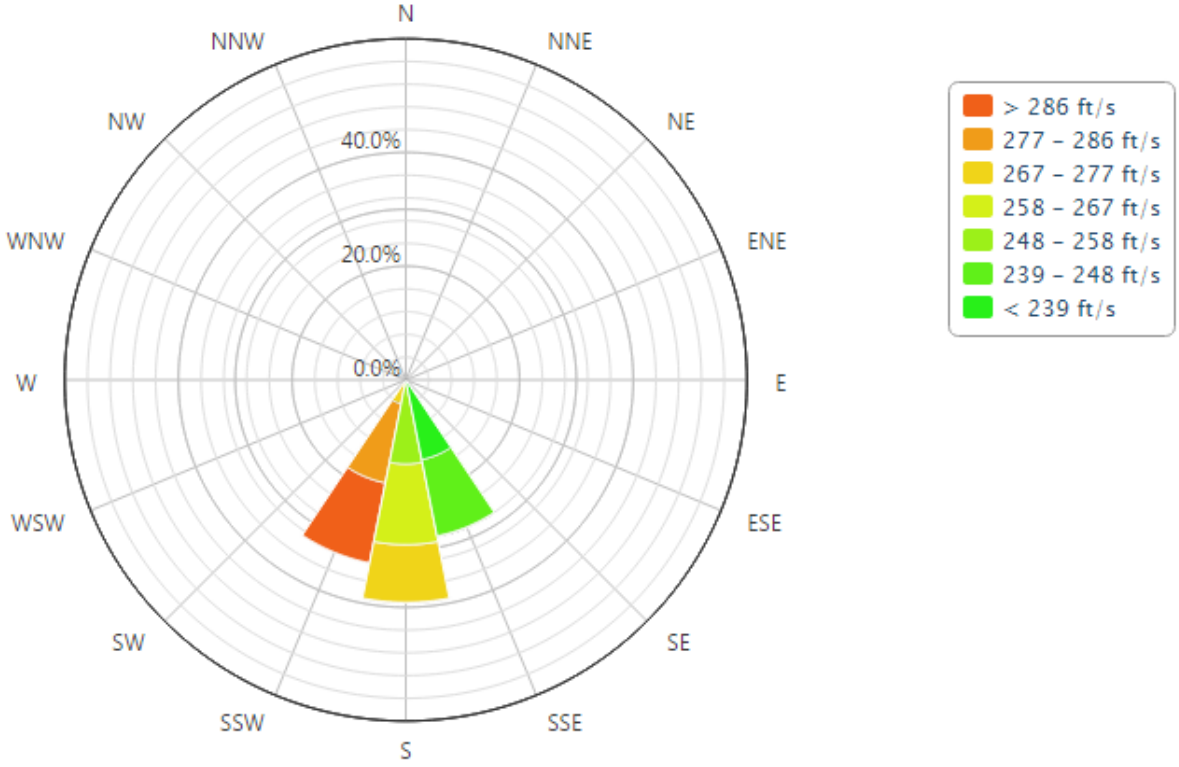
15.4. Comparative Bar Analysis

A Comparative Bar analysis shows a data type component from multiple sensors on a bar chart for comparison. You require sensors with a common *Data Type Value Column* to be able to create a Comparative Bar analysis.



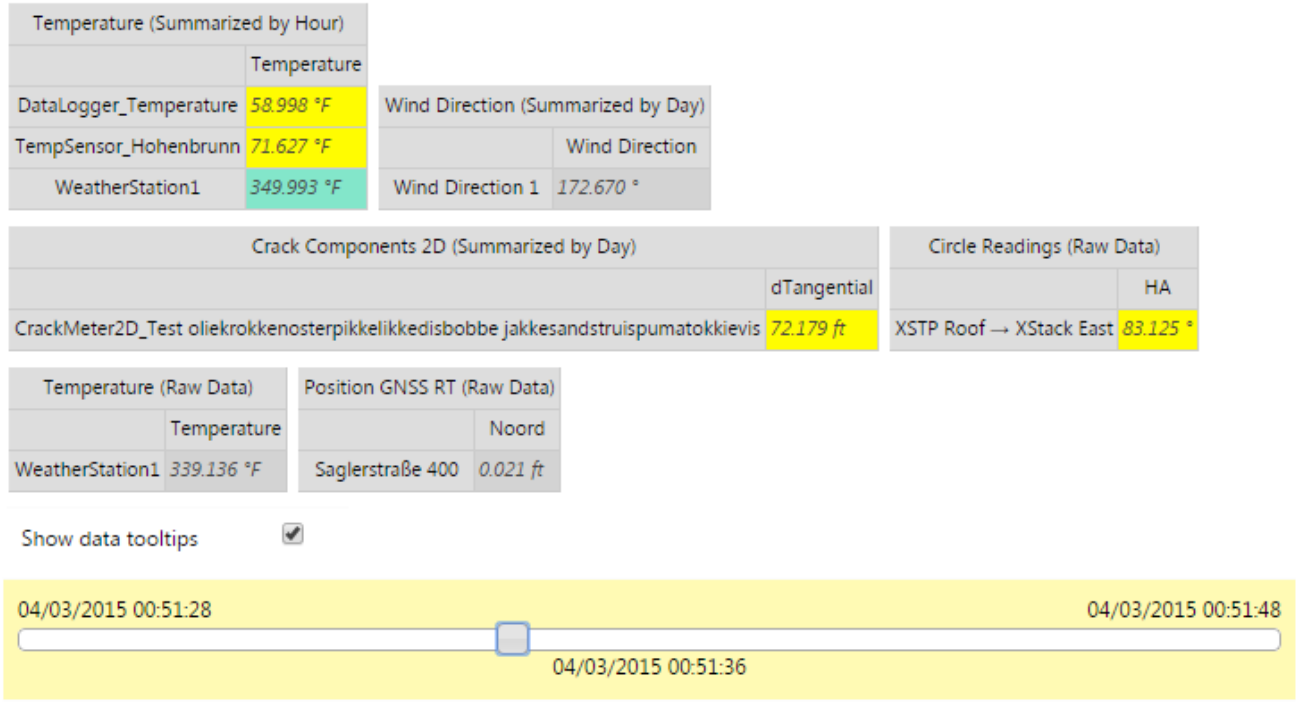
15.5. Windrose Analysis

A Windrose analysis shows a diagram depicting the wind direction and wind speed over a particular period of time. This is helpful to determine the predominant wind direction and speed over particular periods. You require at least one sensor with data types **Wind Direction** and **Wind Speed** to be able to create a Windrose analysis.



15.6. Tabular Analysis

A tabular analysis groups data type components of different sensors together in tables and shows the various measurements on a single page. This is helpful to correlate observations between different sensors.



Use the date slider bar to scroll through the observation time period to visualize the observation changes over time.

15.7. Tiltmeter Array Analysis

Tiltmeter array visualizes the tilt measured by an array of tiltmeters. You require at least one sensor with the **Tilt** data type to be able to create a Tiltmeter Array Analysis.

The *IPI Charts* facility supersedes the functionality available on the *Tiltmeter Array Analysis*. Please refer to the IPI Charts section for information about the various settings for *Tiltmeter Array Analysis*.

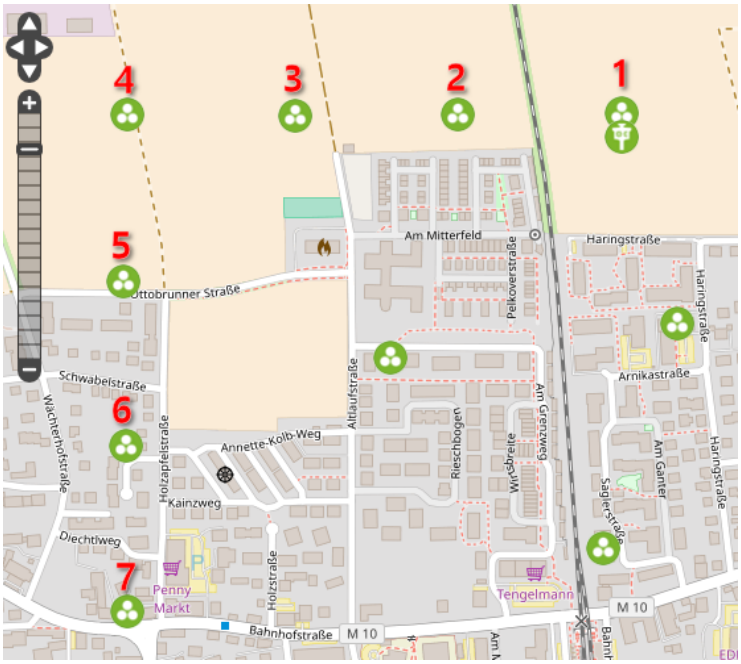
IMPORTANT: If you make extensive use of tiltmeter arrays, we recommend that you define *IPI Sensors* and use the *IPI Charts* functionality instead of *Tiltmeter Array Analysis*. The *IPI Charts* functionality is performance optimized for visualising larger arrays of tiltmeters. Use *Tiltmeter Array Analysis* only if you have historic tiltmeter, short tiltmeter arrays or tiltmeter arrays with infrequent readings.

15.8. Cross Section Analysis

The *Cross Section Analysis* chart plots particular observation values from different sensors opposed to a distance axis. There is no restriction on the value columns that can be plotted on a *Cross Section Analysis*.

A *Cross Section Analysis* is very similar to a non-cumulative *Tiltmeter Array Analysis* plotted on the same chart. The distance between sensor observations on the distance axis can either be a user defined distance or the distance between the sensors automatically calculated from the sensor locations.

The *Cross Section Analysis* above plots the dN, dH and d2D observations against the distance between the seven position sensors (the *Segment Length Mode* was selected as *Calculated NE*). The locations of the seven position sensors are indicated on the map below. Moving the date slider on the *Cross Section Analysis* will show how dN, dH and d2D on the different sensors vary over time.



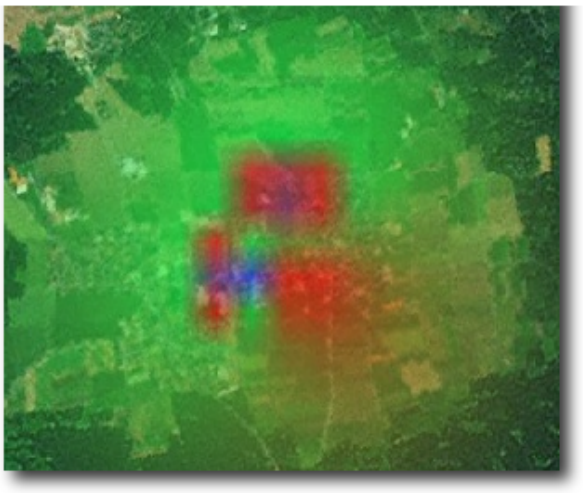
15.9. Heat Map Analysis

Heat Map Analysis allows you to display custom Heat Maps on the maps view using arbitrary data types. You can for instance create a Heat Map based on a length Data Type of sensors and define Colour Stops for interpolation purposes.

Colour Stops

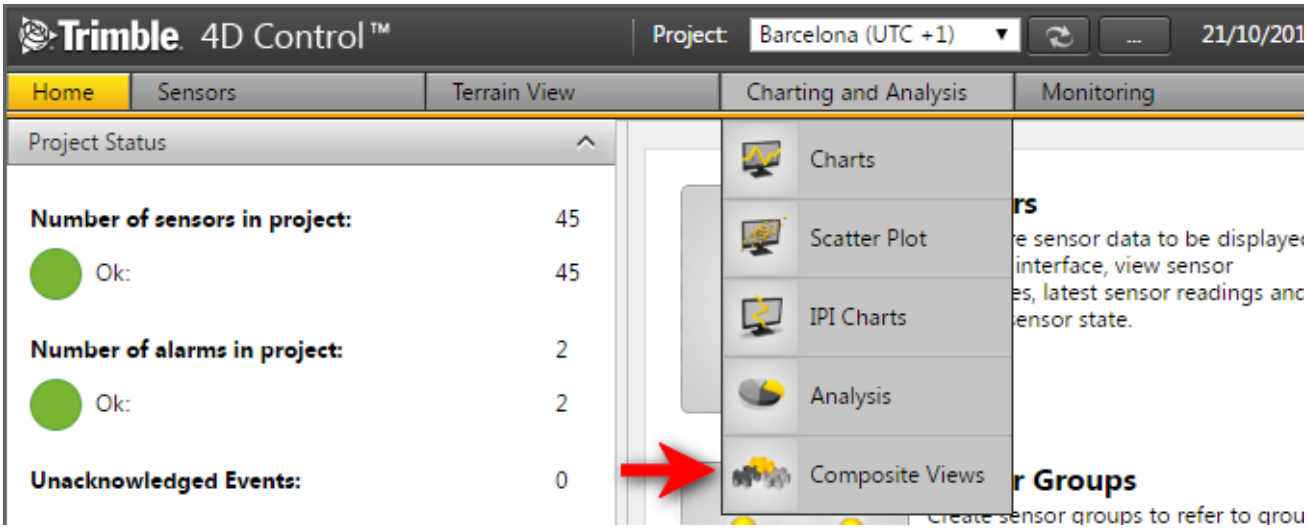
Colour Stop	Name	From	To	Color	
3	High	20 m	30 m		
2	Medium	10 m	20 m		
1	Low	0 m	10 m		

Add | Delete All | View



16. Composite View

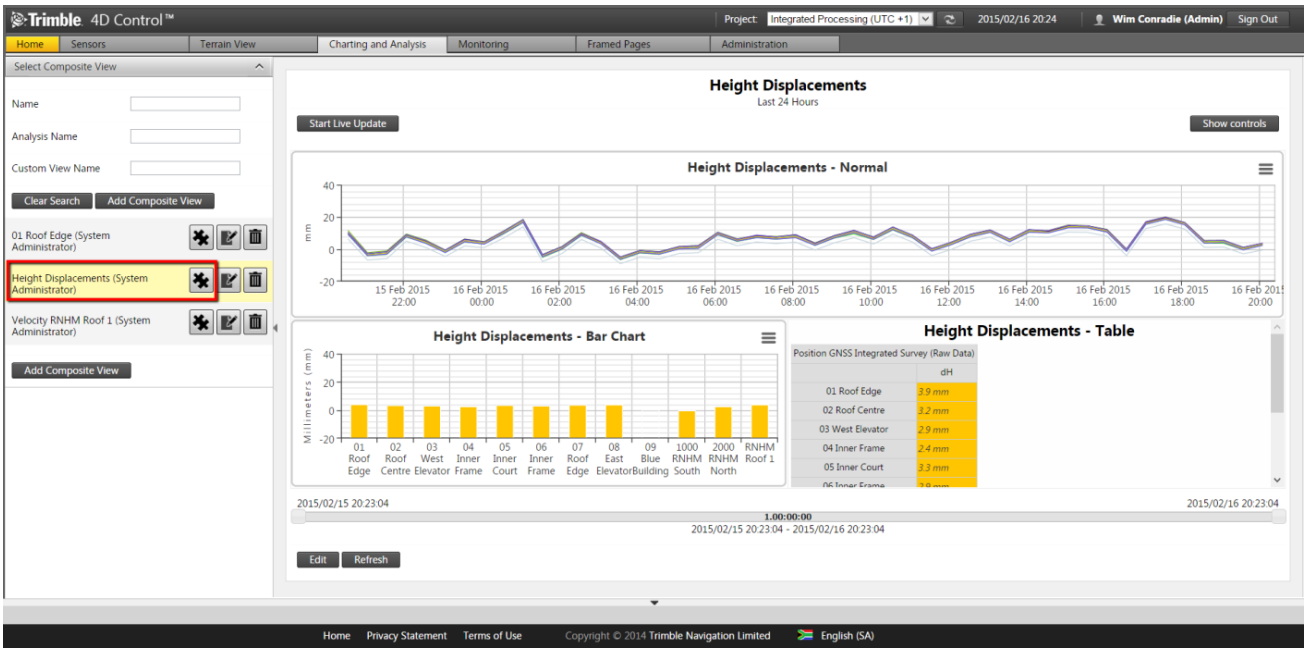
A Composite View provides the ability to display data visualization components in smaller **panes** all on one page as a dashboard view. The dashboard view is useful in control room like environment where there are large monitors that requires multiple charts/analyses/etc. on a single monitor.



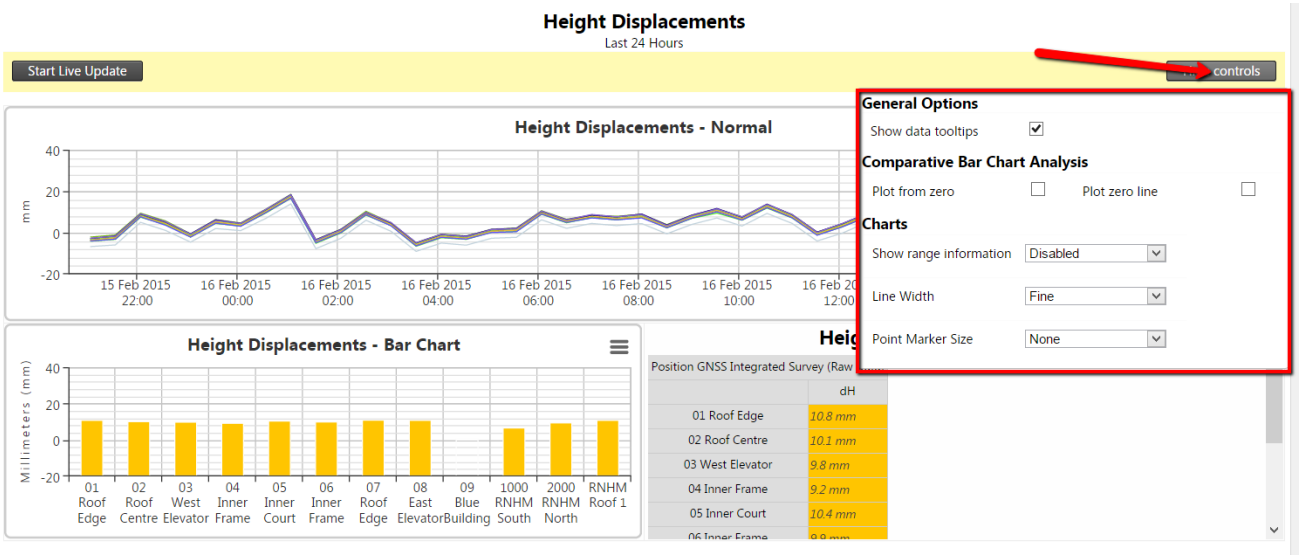
Navigate to the Composite View area via the Menu under *Charting and Analysis* or from the *Home Page*.

16.1. View a Composite View

Composite views can be filtered by die options on the left hand side.

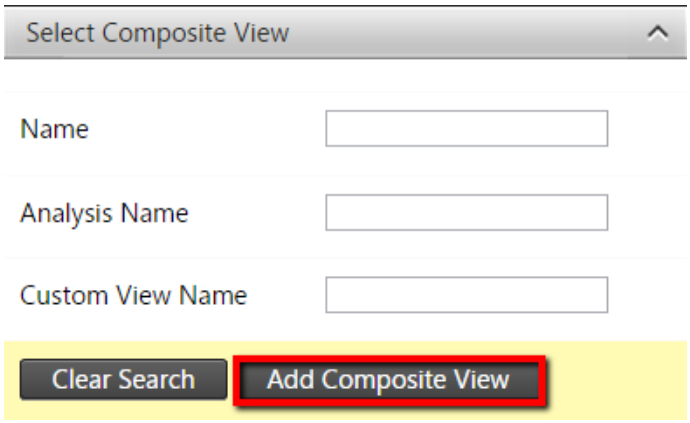


To view a composite view simply click on the composite view in any of the area. The resulting view will be displayed on the right hand side main page.

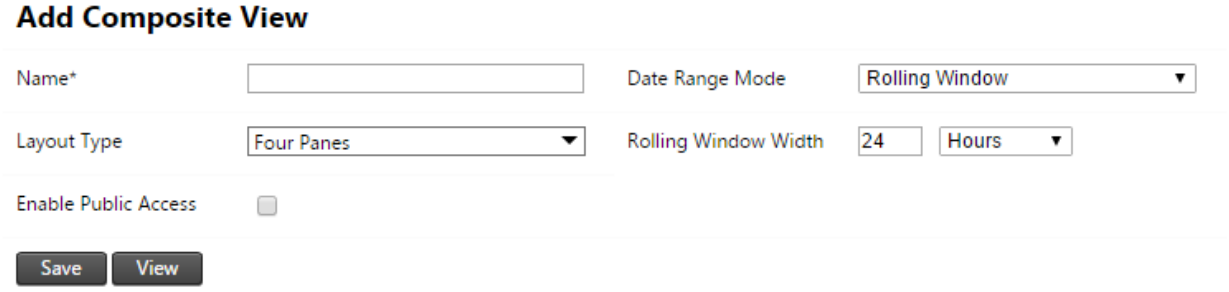


Most of the view settings for the different components in the Composite View are available. Some settings that affect multiple graphs are available vai the *Show Controls* button on the top right.

16.2. Create a Composite View



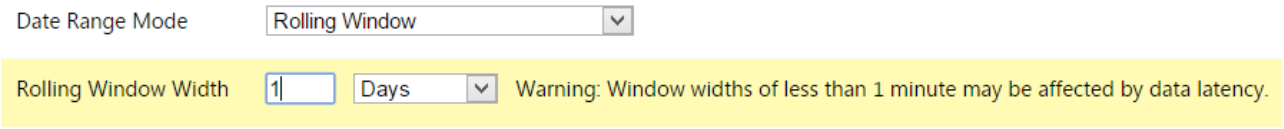
Step 1: Click on the Add Composite View button in the left hand side.



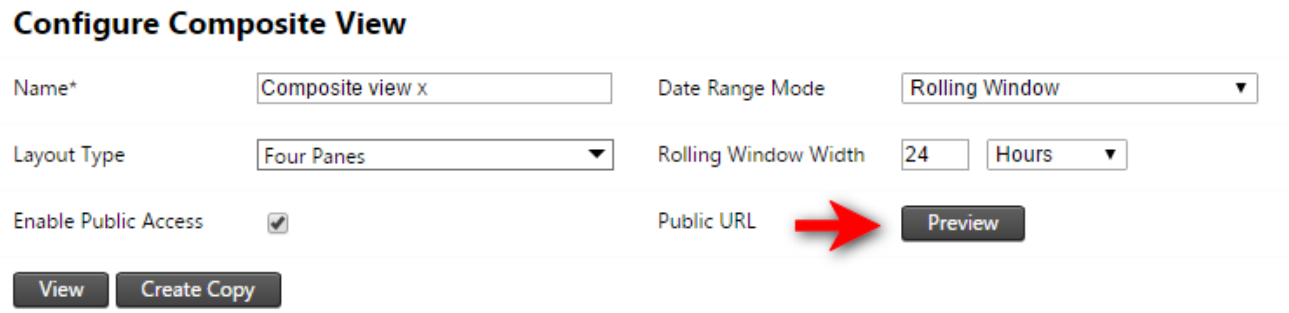
Step 2: Complete the necessary information:

- **Name**: specify an unique name in the project for the composite view.

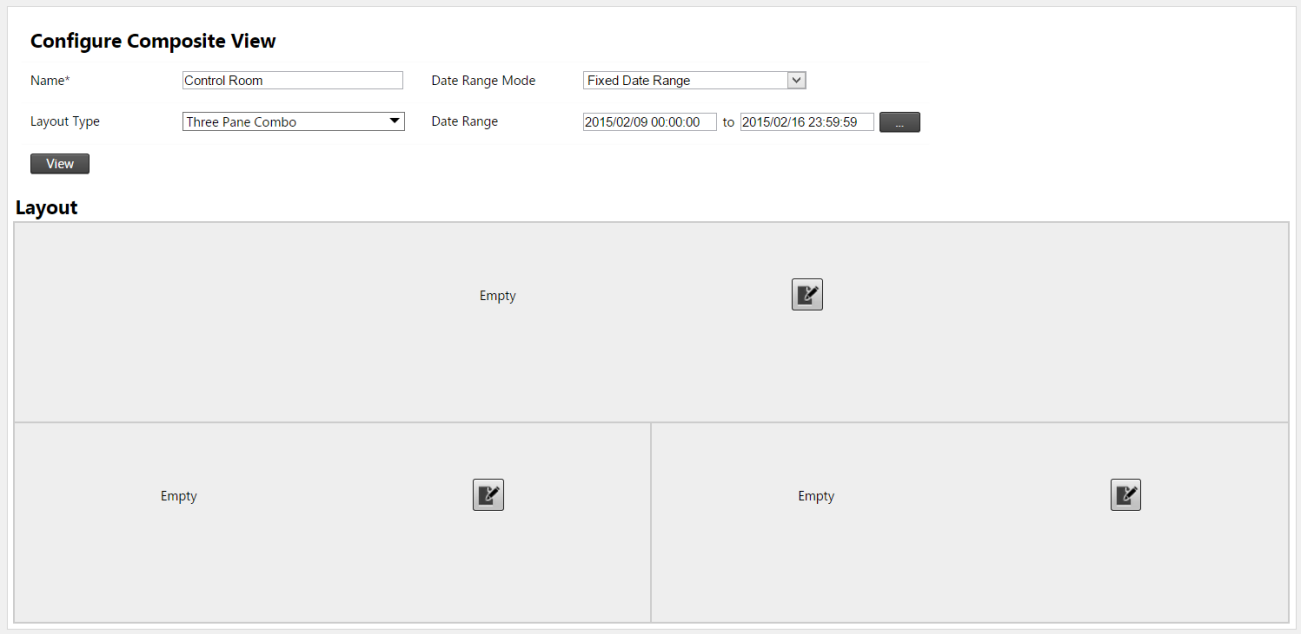
- **Date Range Mode**: The date range of an analysis can be determined either by specifying a start and an end date, or by specifying the rolling time window width.
    - *Fixed date range*: Use these date and time inputs to specify the analysis date range in terms or project local time.
    - *Rolling Window*: Specify the time window which will determine the analysis date range. The effective analysis date range will change on a continuous basis. Note: Window widths of less than 1 minute may be affected by data latency.



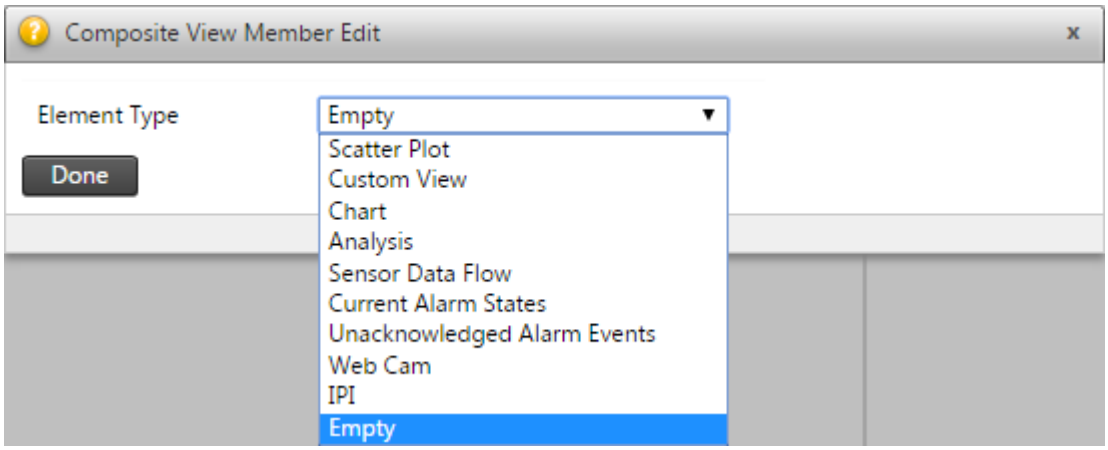
- **Enable Public Access**: You can select this option to make your composite view publicly accessible. This means that anyone with the particular public URL of the composite view will be able to view the composite view without having to log into Trimble 4D Control. Once saved, you can preview the public URL of your composite view by clicking on the Preview button. You can then copy and distribute the public URL.



When you configured all the settings click the *Save* button.

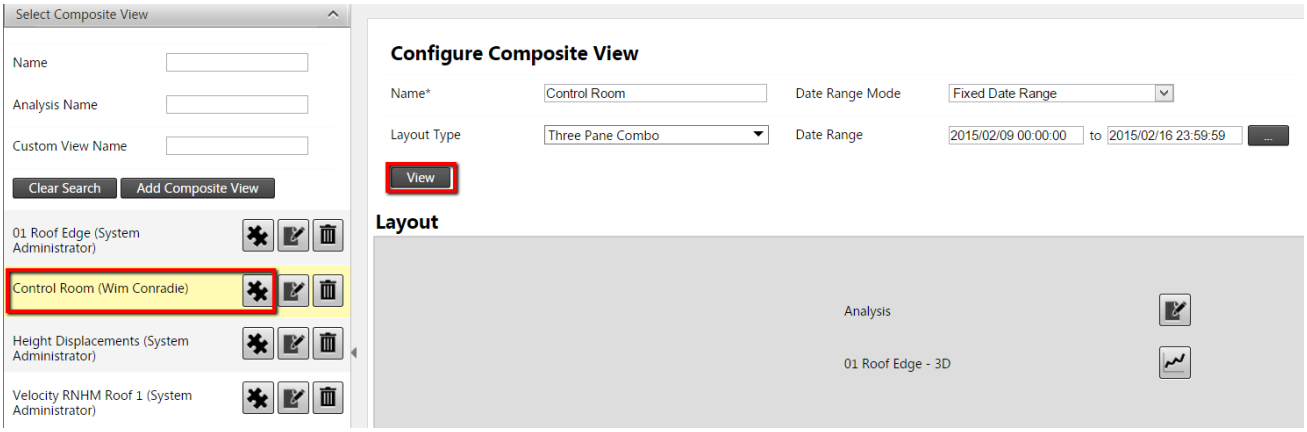


Step 3: A newly created composite view with the chosen layout will now be displayed.



Step 4: Add a view or graph to any pane by clicking the *Edit* icon on the specific pane and select an option from the dropdown list. Based on the option selected additional options will appear related to the specific view or graph. Refer to the relevant section in this manual for details on the specific componet settings. Click the *Done* button to save the component to the particular pane.

Step 5: Complete all the other panes in the composite view. It is not mandatory to fill all panes. Every time a pane is saved with content, a related icon to the view or graph will be displayed below the edit icon. You can click on the icon to go directly to that individual view or graph.

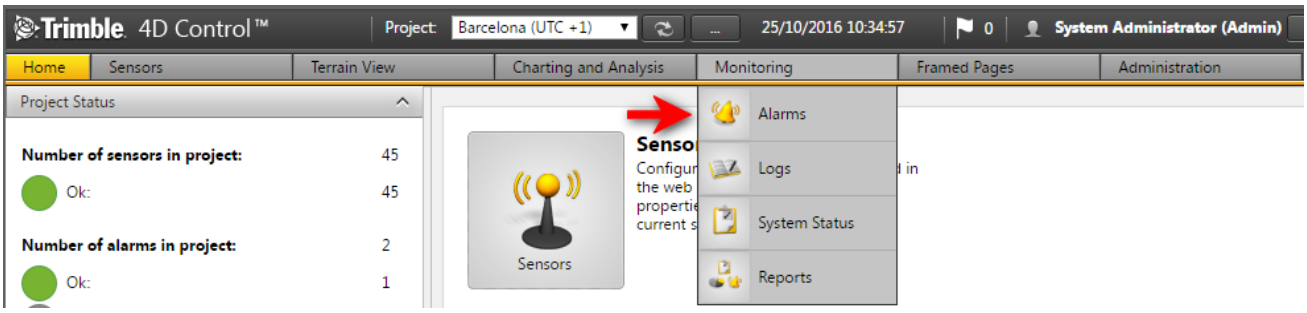


Step 6: Once all required panes are completed, simply click the View button or the composite view in the left hand side list (as shown earlier).

17. Alarms

This section shows you how to setup *Alarm Definitions* to monitor data flows from your Sensors.

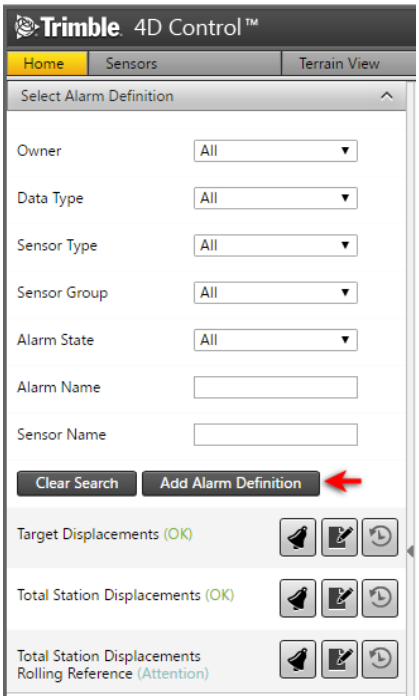
Every *alarm definition* consists of one or more *alarm condition*. *Alarm conditions* are expressions that are evaluated against the observation values from specified sensors. These conditions determine when the alarm is triggered and in which state the alarm is. A triggered alarm can dispatch notification events describing the conditions that triggered the alarm. Notifications can be escalated according to preset rules.



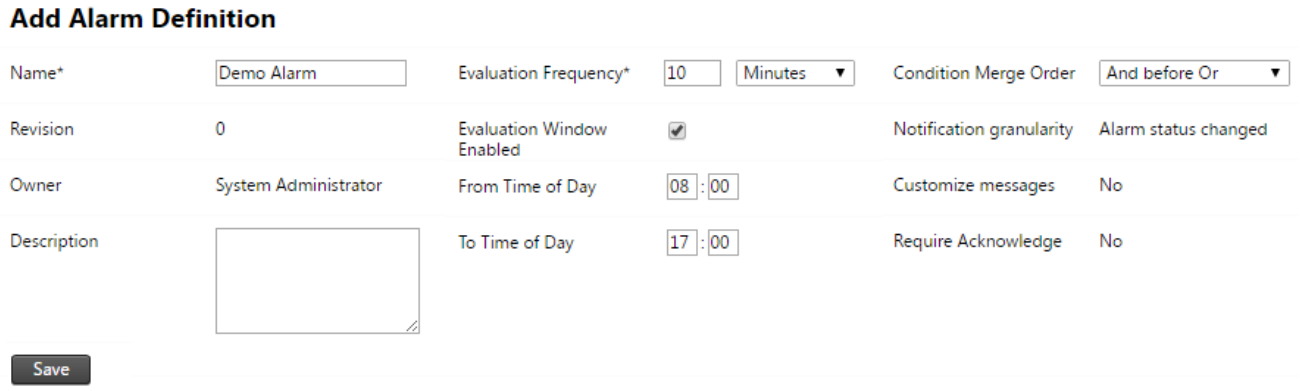
Navigate to the *Alarms* area via the Menu under *Monitoring* or from the *Home Page*.

17.1. Add a Basic Alarm

In the *Alarms* section you can search for existing alarms using the filters provided. Changing the search filters will automatically update the *Alarms* in the list below.



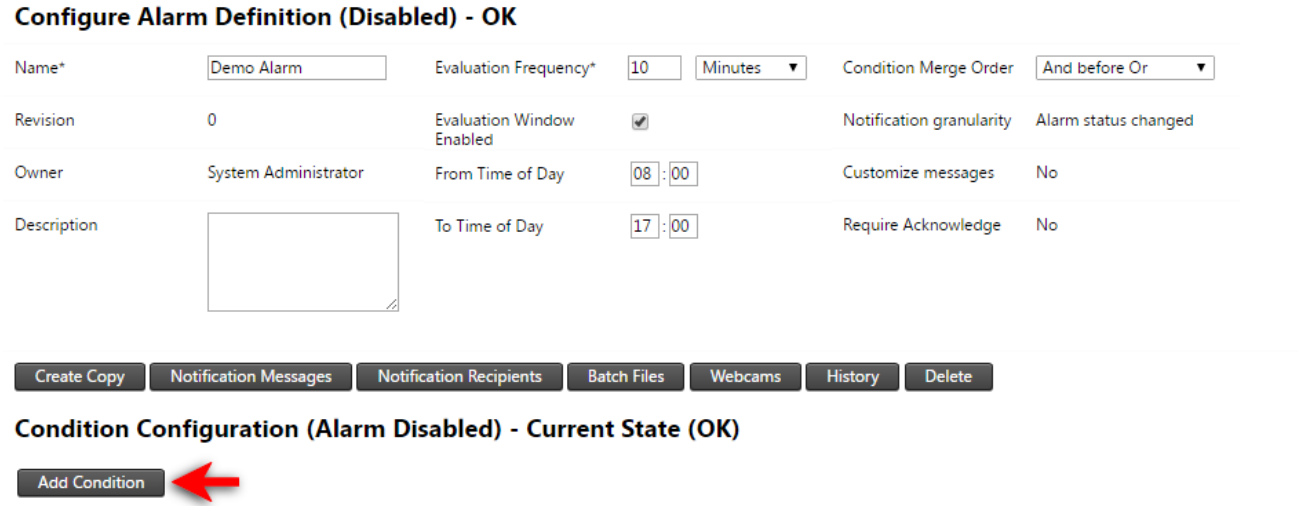
Step 1: Click on the *Add Alarm Definition* button to add a new *Alarm*.



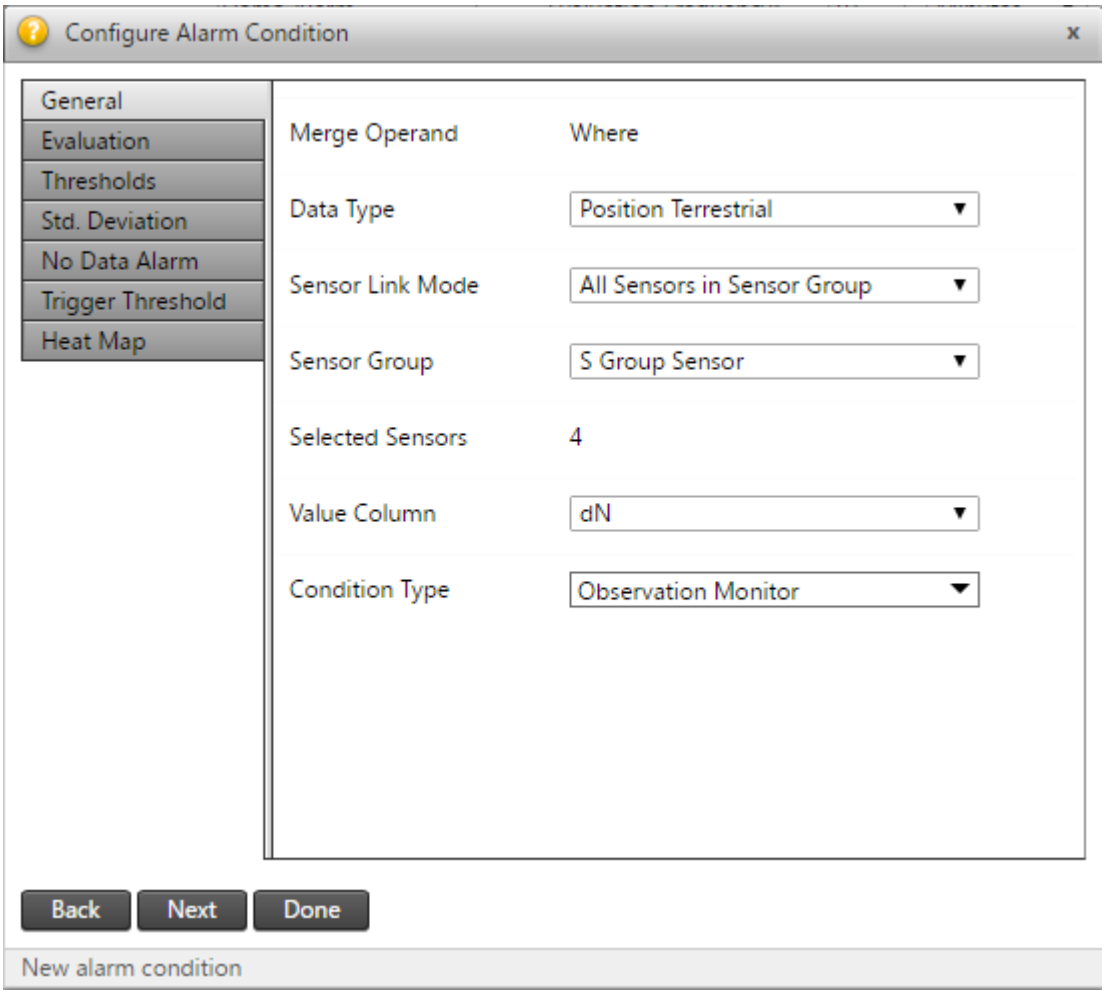
The *Add Alarm Definition* page will display the following editable fields:

- **Name**: A name for the alarm that is unique in the *Project*.
- **Description**: A custom description of the alarm.
- **Evaluation Frequency**: The rate at which the alarm checks whether or not the conditions for the alarm are satisfied.
- **Evaluation Window Enabled**: Enable an evaluation time window if you want your alarm to only evaluate observations in a particular time interval per day. If the To Time of Day is less than the From Time of Day then the interval wraps around midnight starting at the To Time of Day and ending on the From Time of Day of the next day. Only observations inside this daily interval will be evaluated by the alarm, any observations outside this time interval will be ignored by the alarm.
- **Condition Merge Order**: This option will determine how the statuses of individual alarm conditions belonging to this alarm definition are rolled up in order to determine a state for the alarm definition.

Enter appropriate field values and click the *Save* button to create an *Alarm Definition*.

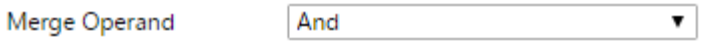


Step 2: Click on the *Add Condition* button.



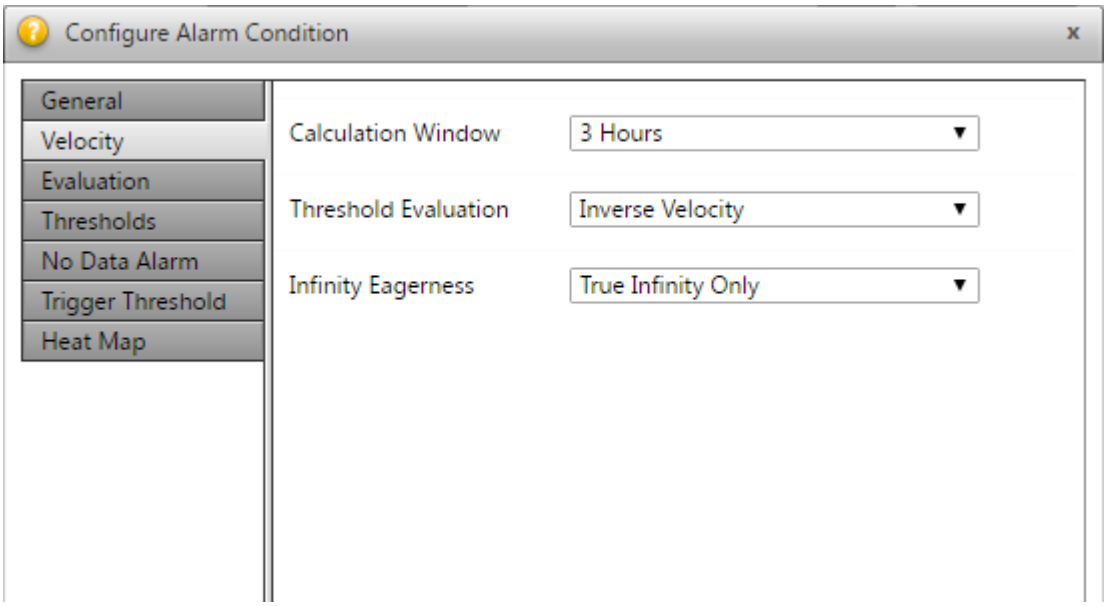
Step 3: The *Add Alarm Condition* dialog will show the *General* tab. Complete the fields:

- **Merge Operand**: The merge operand controls how condition evaluation results will be rolled up to determine an alarm evaluation result. For the first condition it is not applicable but any additional conditions can be concatenated via the logical Boolean operators *AND* or *OR*.



- **Data Type**: The *Data Type* which you wish to monitor with this *Alarm Condition*.
- **Sensor Link Mode**: The Sensor Link Mode allows you to link your *Alarm Condition* to either specific sensors, all sensors of a particular Sensor Type or all sensors of a particular Sensor Group (see Sensor Groups). In the example above we selected *All Sensors in Sensor Group* link mode and we selected the **Sensor Group** "S Group Sensor" with 4 **Selected Sensors**.
- **Value Column**: The *Value Column* which you wish to monitor with this *Alarm Condition*.
- **Condition Type**: The Condition Type can either by the *Observation* (default) or the *Velocity* calculated from the Observations. You can only monitor velocities if you selected a *Positional Data Type* for the *Alarm Condition*. Velocity values are calculated as the slope of a linear regression line fitted to observation values within a rolling time window. A new velocity value is calculated with each new observation value that becomes available.

Click *Next* to continue to the next tab.

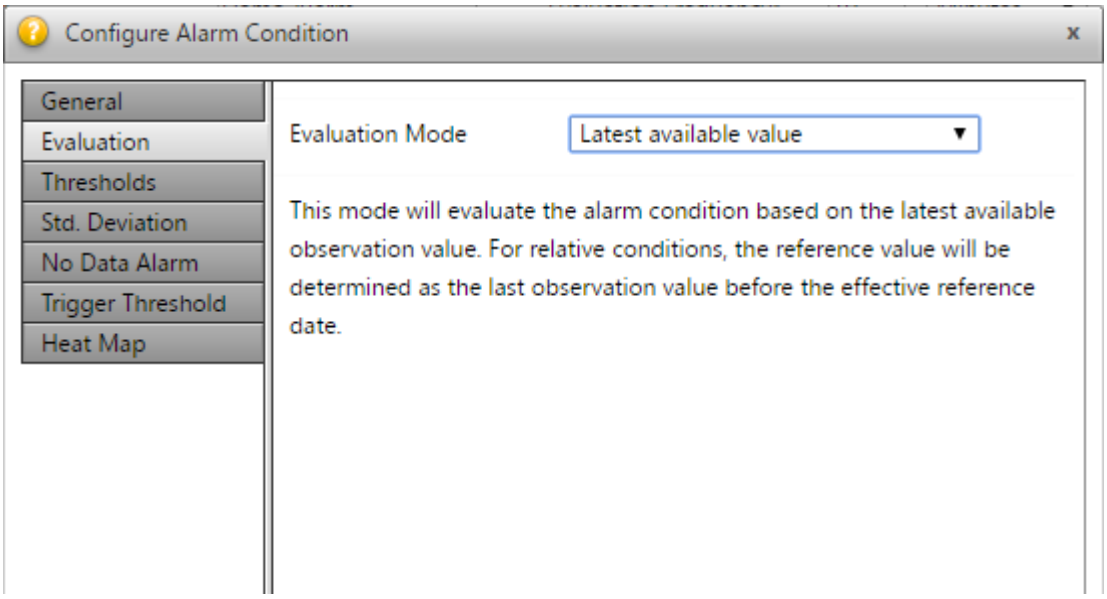


Velocity Step: If you selected the **Observation Type** as *Velocity* in the previous tab, then an additional tab called *Velocity* will be available. The configuration on this tab determines how the velocity is calculated and presented.

Complete the fields:

- **Calculation Window**: Specify the width of the rolling time window over which a linear regression line should be fitted in order to calculate the velocity to be monitored.
- **Threshold Evaluation**: Specify whether the alarm condition thresholds should be configured in terms of *Velocity* (`v`) or *Inverse Velocity* (`1/v`).
- **Infinity Eagerness**: Applicable for *Inverse Velocity*. This property controls how soon infinity is assumed when a value close to zero is inverted.

Click *Next* to continue to the next tab.



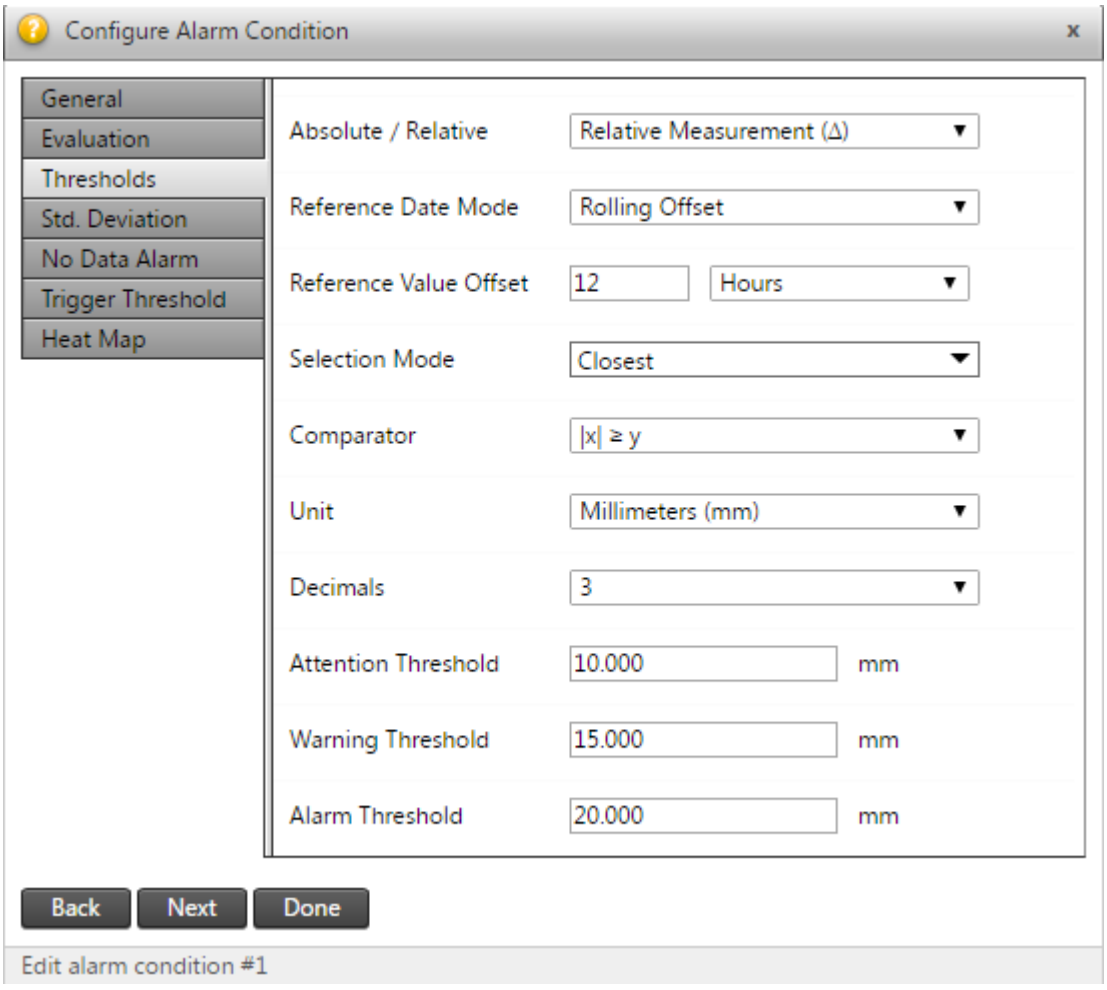
Step 4: On the *Evaluation* tab select the **Evaluation Mode**:

- *Latest available value:* Evaluate the latest available observation for the *Sensor(s)*. In this Evaluation Mode using relative values, the Reference Value is the last observation value before the *Effective Reference Date*.
- *Average of X latest values:* This mode will evaluate the alarm condition based on the average value of the last X number of observations. For relative conditions, the reference value will be determined as the average of the last X observation values before the effective reference date.
- *Peak (any)*: This mode will evaluate the alarm condition based on the most severe peak value (high or low) that occurred since the previous evaluation. For relative conditions, the reference value will be determined as the average of the last X observation values before the effective reference date.
- *Peak (local maximum)*: This mode will evaluate the alarm condition based on the highest value that occurred since the previous evaluation. For relative conditions, the reference value will be determined as the average of the last X observation values before the effective reference date.
- *Peak (local minimum)*: This mode will evaluate the alarm condition based on the lowest value that occurred since the previous evaluation. For relative conditions, the reference value will be determined as the average of the last X observation values before the effective reference date.

In the last four Evaluation Modes listed above, if using relative values, the reference value will be determined as the average of the last X observation values before the effective reference date.

The Peak Evaluation modes are useful for monitoring sensors with observation frequency higher than than one observation per minute, such as ***accelerometers***.

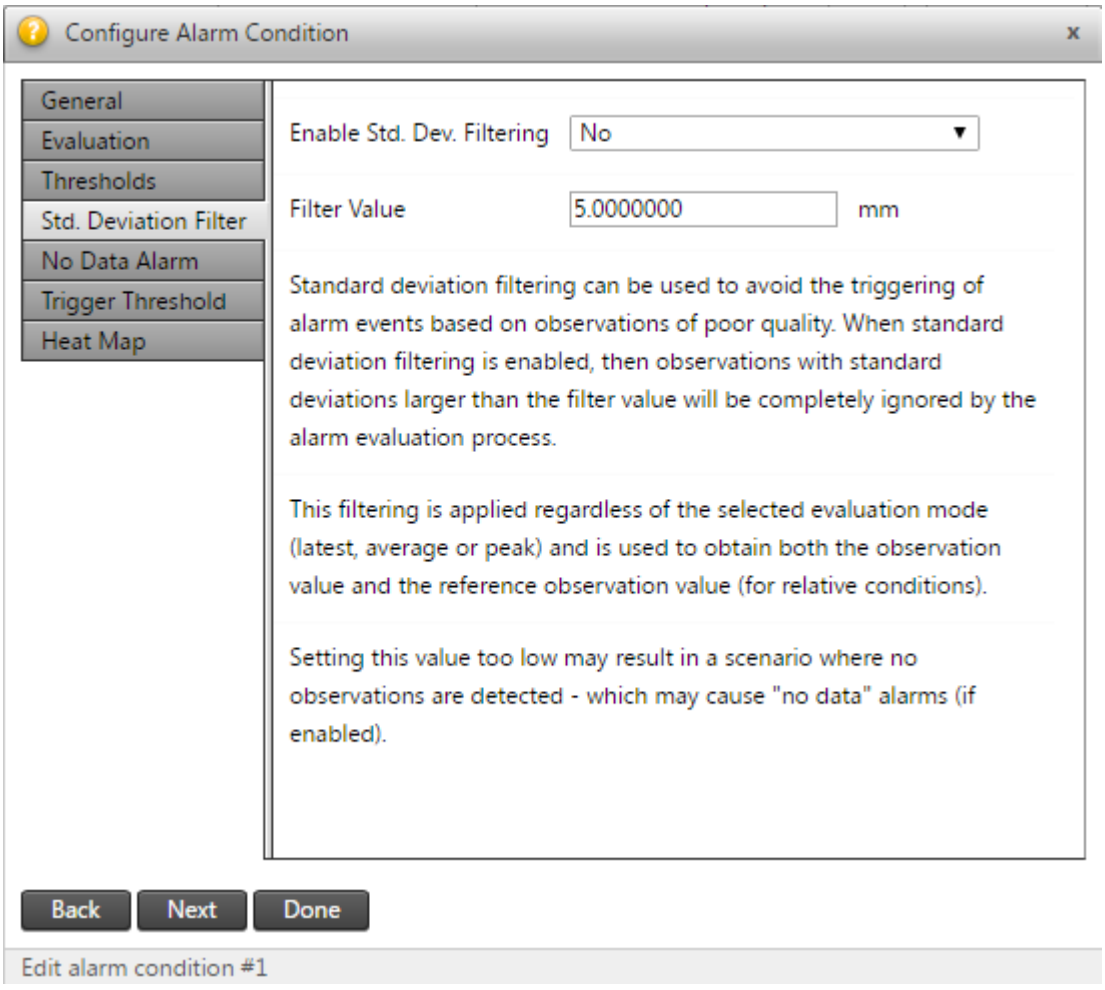
Click *Next* to continue to the next tab.



Step 5: On the *Thresholds* tab complete the fields:

- **Absolute / Relative**: Monitor absolute or relative measurements.
- **Reference Date Mode:** If relative measurements were selected in the previous option, you can specify the reference date mode as *Rolling Offset* or *Specific Date* here.
- **Reference Value Offset:** If *Rolling Offset* was selected for *Reference Date Mode* in the previous option then you can set the reference date offset here.
- **Reference Date:** If *Specific Date* was selected for *Reference Date Mode*, then you can enter the fixed Reference Date here.
- **Selection Mode:** If relative measurements were selected, then you can choose how the reference value is selected here.
- **Comparator:** Specify the comparator that should be used to evaluate the alarm condition. Here X denotes the measurement that might trigger the alarm and Y denotes the threshold or specific value with which X is compared.
- **Unit:** The unit used to define thresholds for the *Alarm Condition*.
- **Decimals:** The number of decimals used to define thresholds for the *Alarm Condition*.
- **Thresholds:** These specify the three states that the condition can trigger, starting at Attention, then Warning and finally Alarm.

Click *Next* to continue to the next tab.



Step 6: The settings on the *Standard Deviation Filter* tab allows you to configure the *Alarm Condition* to not trigger the alarm on poor quality observations.

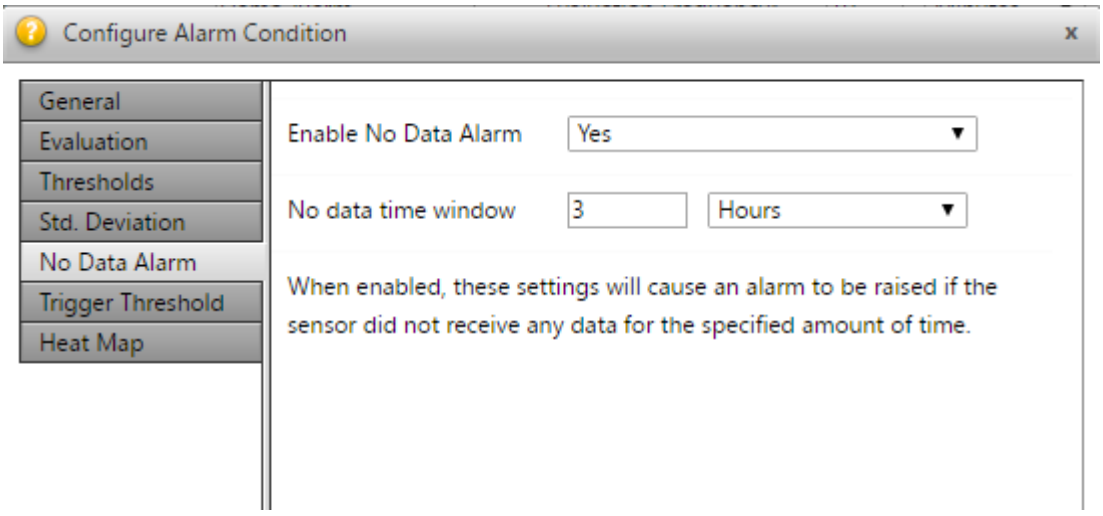
When standard deviation filtering is enabled observations with standard deviations larger than the filter value will be ignored by the alarm evaluation process. This filtering is applied regardless of the selected evaluation mode (latest, average or peak) and is used to obtain both the observation value and the reference observation value (for relative conditions).

Setting this value too low may result in a scenario where no observations are detected - which may cause a configured *No Data* Alarm to trigger (discussed in the next Step below).

The available fields are:

- **Enable Std. Dev. Filtering**: Specify whether standard deviation filtering should be enabled.
- **Filter Value:** Observations with standard deviations larger than this value will be ignored by the evaluation of this *Alarm Condition*.

Click *Next* to continue to the next tab.

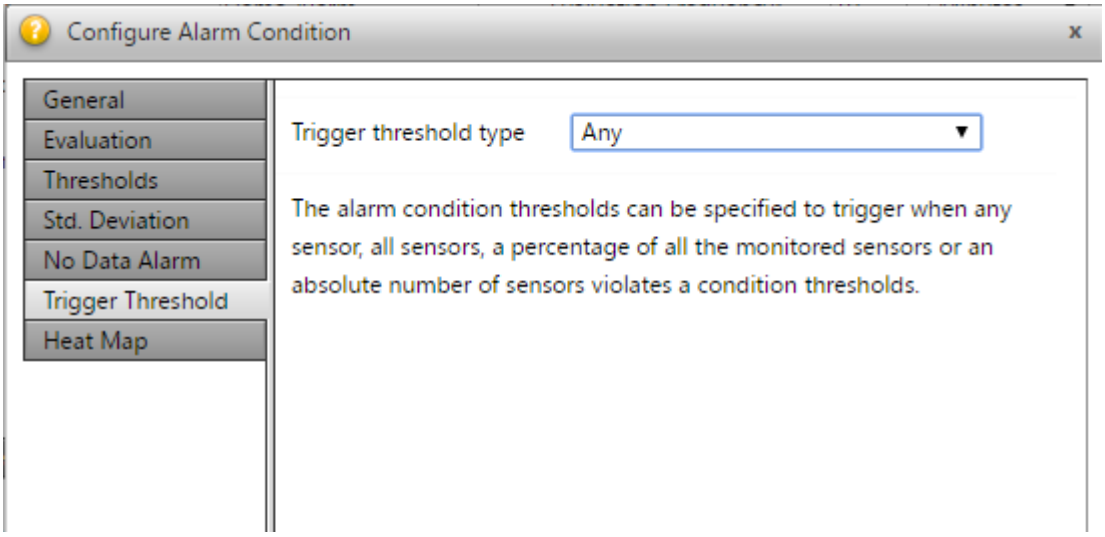


Step 7: The *No Data Alarm* tab allows you to enable a *No Data Alarm* to be raised if the sensor did not receive any data for the specified period of time. Complete the fields as required:

The available fields are:

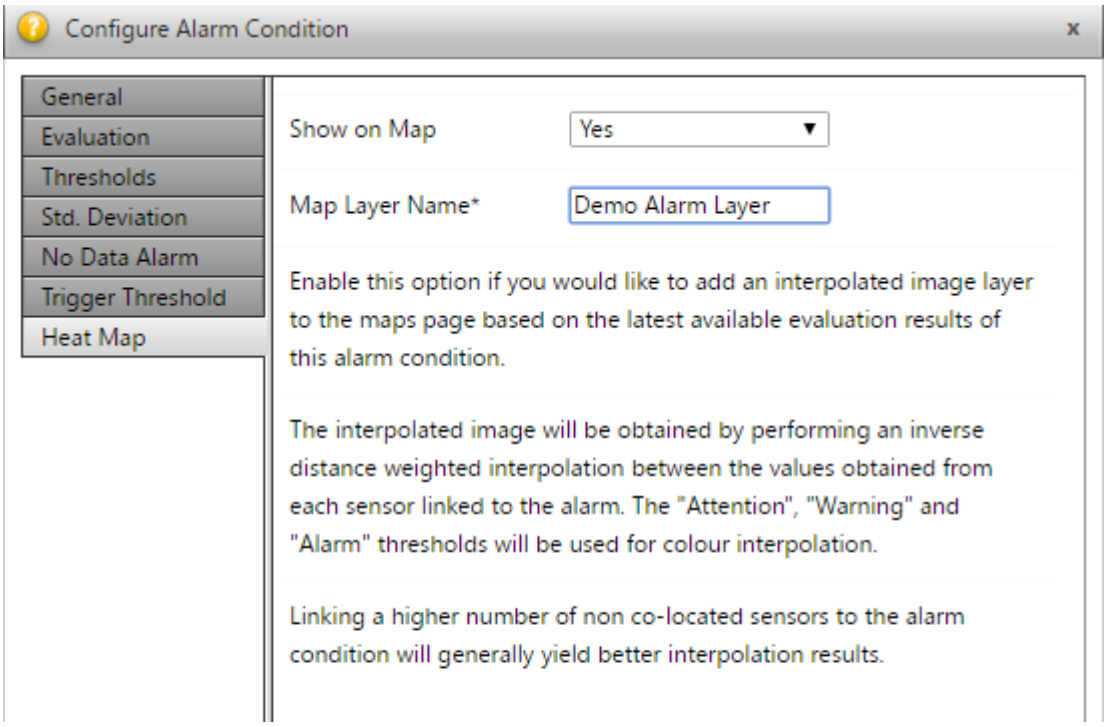
- **Enable No Data Alarm**: Specify whether a no data alarm should be triggered.
- **No data time window:** If no observations are found for this this window of time, then a *No Data Alarm* is triggered.

Click *Next* to continue to the next tab.



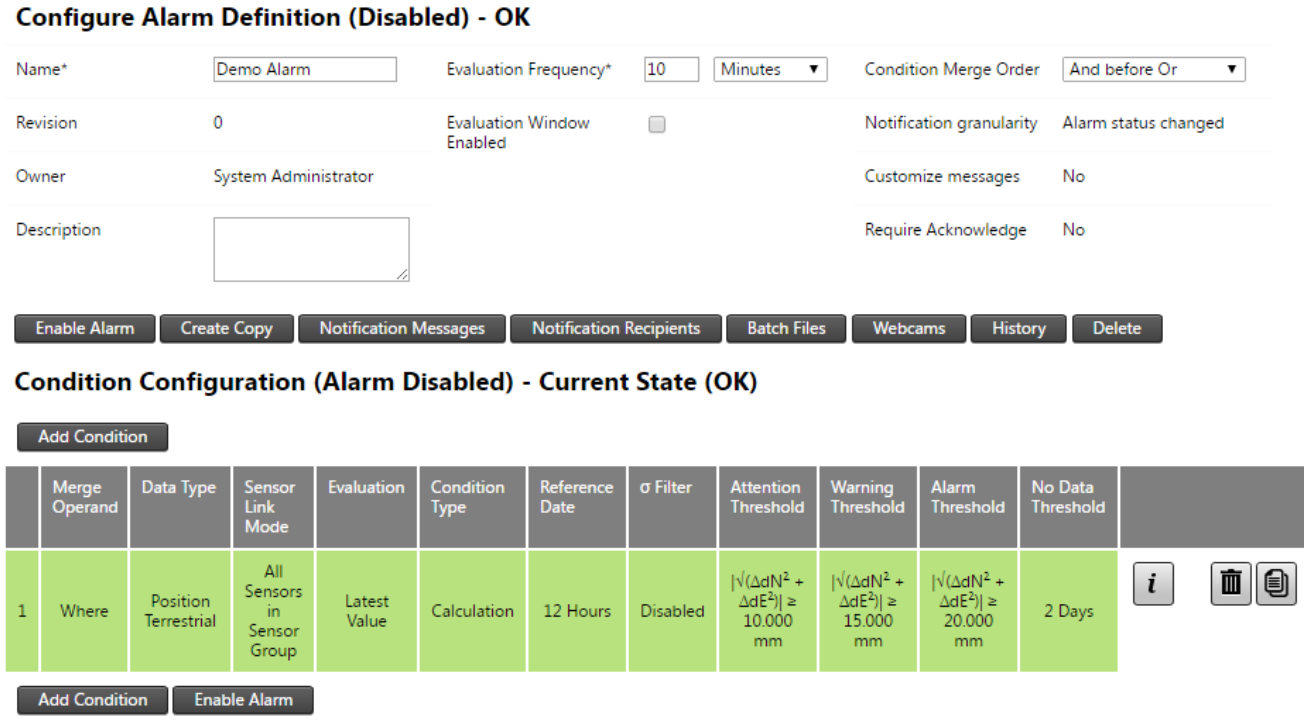
Step 8: The *Trigger Threshold* tab allows you to configure the alarm condition thresholds to trigger when A*ny* monitored sensor, A*ll* monitored sensors, a *Percentage* of the monitored sensors or an absolute *Number* of the monitored sensors violates the condition threshold.

Click *Next* to continue to the next tab.



Step 9: The *Heat Map* tab allows you to configure a *Map Layer* that represents the particular *Alarm Condition*.

Click *Done* to complete your *Alarm Condition* configuration.



The *Alarm Condition* should now appear in a table at the bottom of your *Alarm Definition*.

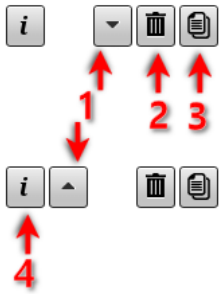
17.2. Configure Alarm Conditions

The *Alarm Conditions* of an *Alarm Definition* are listed in a table at the bottom of an *Alarm Definition*. You can edit an *Alarm Condition* by clicking on the relevant table row.

Condition Configuration (Alarm Disabled) - Current State (Alarm)

Add Condition

	Merge Operand	Data Type	Sensor Link Mode	Evaluation	Condition Type	Reference Date	σ Filter	Attention Threshold	Warning Threshold	Alarm Threshold	No Data Threshold	
1	Where	Position Terrestrial	All Sensors in Sensor Group	Latest Value	Calculation	12 Hours	Disabled	$\lvert\sqrt{(\Delta dN^2 + \Delta dE^2)}\rvert \geq$ 10.000 mm	$\lvert\sqrt{(\Delta dN^2 + \Delta dE^2)}\rvert \geq$ 15.000 mm	$\lvert\sqrt{(\Delta dN^2 + \Delta dE^2)}\rvert \geq$ 20.000 mm	2 Days	
	Or											
2		Position Terrestrial Velocity (Calculated over 3 hours.)	All Sensors in Sensor Group	Latest Value	Calculation		Disabled	$\lvert\sqrt{(dN^2 + dE^2 + dH^2)}\rvert \geq$ 5.000 mm/day	$\lvert\sqrt{(dN^2 + dE^2 + dH^2)}\rvert \geq$ 10.000 mm/day	$\lvert\sqrt{(dN^2 + dE^2 + dH^2)}\rvert \geq$ 15.000 mm/day	Disabled	



Alarm conditions of an *Alarm Definition* are joined using **AND** or **OR** to make up the *Alarm Condition Expression*.

You can change the order of the *Alarm Conditions* in the *Alarm Condition Expression* by using the *Up* and *Down* icons (1). Use the *Delete* icon (2) to remove an *Alarm Condition* or the *Copy* icon (3) to create a copy of the particular *Alarm Condition*.

Each *Alarm Condition* evaluates data from a set of *Sensors*. Click on the *Information* icon (4) next to an *Alarm Condition* to expand the list if sensors evaluated by the particular *Alarm Condition*.

The next section describes how the *Alarm* **Alarm State** is calculated.

17.3. How Alarm Conditions are Evaluated

In the previous section we created *Alarm Conditions* for our *Alarm Definition*.
This section explains how the *Alarm* **Alarm State** is determined using the *Alarm Conditions*.

An **Alarm State** (Okay, Attention, Warning or Alarm) is designated at three levels:

1. **Alarm Definition Level:** The *Alarm Definition Level* **Alarm State** is calculated using the *Alarm Condition Expression*.
2. **Alarm Condition Level:** The *Alarm Condition Level* **Alarm State** is calculated according to the Sensors associated with that *Alarm Condition* using the configured **Trigger threshold type.**
3. **Sensor Level:** The *Sensor Level* **Alarm State** is calculated according to the *Alarm Condition* thresholds evaluated against the sensor data.

If multiple alarm severities are triggered on a particular level, then that level is assigned the most severe **Alarm State.**

	Merge Operand	Data Type	Sensor Link Mode	Evaluation	Condition Type	Reference Date	σ Filter	Attention Threshold	Warning Threshold	Alarm Threshold	No Data Threshold
1	Where	Position Terrestrial	All Sensors in Sensor Group	Latest Value	Calculation	12 Hours	Disabled	$\lvert\sqrt{(\Delta dN^2 + \Delta dE^2)}\rvert \geq 10.000$ mm	$\lvert\sqrt{(\Delta dN^2 + \Delta dE^2)}\rvert \geq 15.000$ mm	$\lvert\sqrt{(\Delta dN^2 + \Delta dE^2)}\rvert \geq 20.000$ mm	2 Days
	Or										
2		Position Terrestrial Velocity (Calculated over 3 hours.)	All Sensors in Sensor Group	Latest Value	Calculation		Disabled	$\lvert\sqrt{(dN^2 + dE^2 + dH^2)}\rvert \geq 5.000$ mm/day	$\lvert\sqrt{(dN^2 + dE^2 + dH^2)}\rvert \geq 10.000$ mm/day	$\lvert\sqrt{(dN^2 + dE^2 + dH^2)}\rvert \geq 15.000$ mm/day	Disabled
	S3 (Position Terrestrial Velocity)				17.990 mm/day (11/10/2016 06:37:00)			|17.990| ≥ 5.000	|17.990| ≥ 10.000	|17.990| ≥ 15.000	-
	S4 (Position Terrestrial Velocity)				5.793 mm/day (11/10/2016 06:37:00)			|5.793| ≥ 5.000	|5.793| ≥ 10.000	|5.793| ≥ 15.000	-
	S1 (Position Terrestrial Velocity)				5.687 mm/day (11/10/2016 06:37:00)			|5.687| ≥ 5.000	|5.687| ≥ 10.000	|5.687| ≥ 15.000	-
	S2 (Position Terrestrial Velocity)				4.636 mm/day (11/10/2016 06:37:00)			|4.636| ≥ 5.000	|4.636| ≥ 10.000	|4.636| ≥ 15.000	-

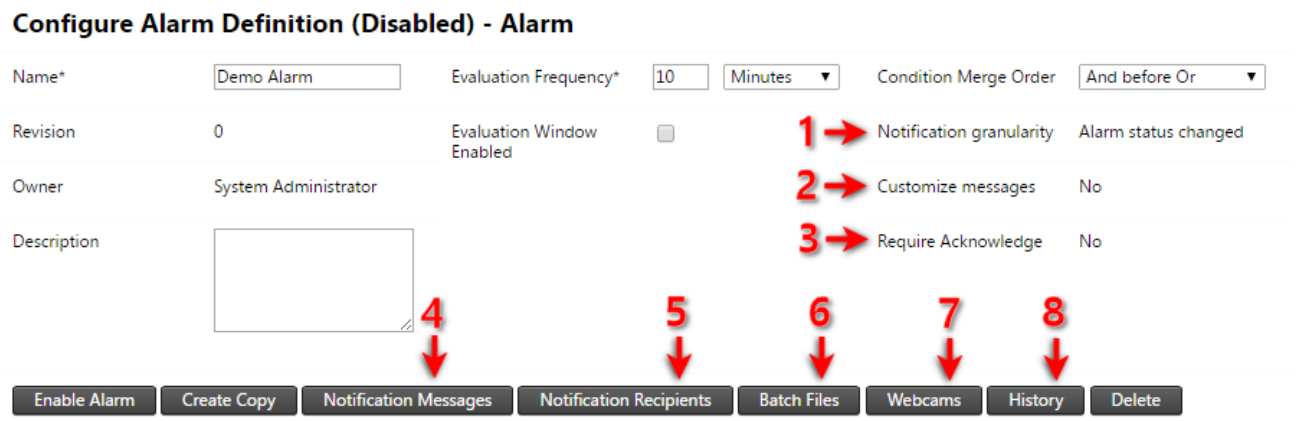
In the example above, under the second *Alarm Condition* the Sensor "S3" exceeds the **Alarm Threshold** (`|17.990| ≥ 15.000`). The *Sensor Level* **Alarm State** for this particular sensor is therefore *Alarm*.

In the example above, the second *Alarm Condition* **Alarm State** is *Alarm*, because the **Trigger threshold type** is set to *Any* and the worst *Sensor Level* **Alarm State** is *Alarm* from Sensor "S3". (Notice that Sensors "S4" and "S1" have the *Sensor Level* **Alarm State** of *Attention*, which is less severe than *Alarm*).

In the example above, the *Alarm* **Alarm State** is *Alarm*, because the *Alarm Condition Expression* evaluates to *Alarm*: *[Alarm Condition 1]* OR [*Alarm Condition 2*] (`OK OR ALARM = ALARM`)

17.4. Configure an Alarm

This section describes additional configuration options on an *Alarm Definition*.



Additional alarm configuration options are available on an *Alarm Definition* with configured **Alarm Conditions**. This section only shows you how to start configuring either of the additional configuration options, we will discuss how the configure each option in subsequent sections.

Click on either one of the labels **Notification granularity** (1), **Customize messages** (2) or the button **Notification Messages** (4) to bring up the **Notification Message Settings** dialog.

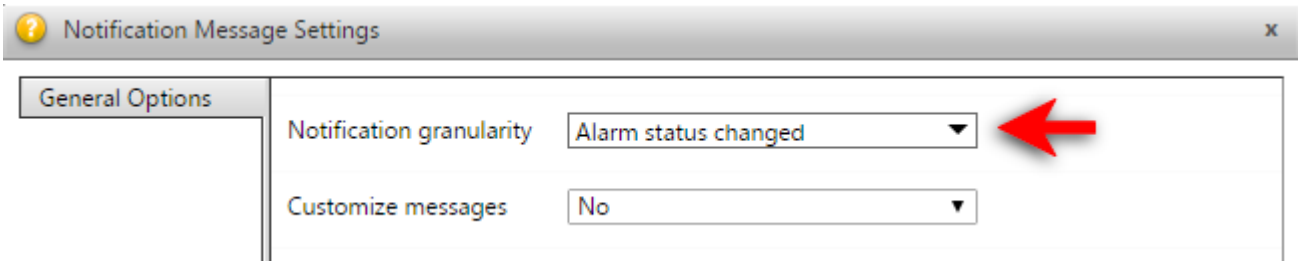
Click on **Require Acknowledge** (3) label or the **Notification Recipients** (5) button to bring up the **Notification Recipients** dialog and configure when which users should receive notification events from this *Alarm*.

Click on the **Batch Files** (6) button to configure batch files to be executed when alarm events occur.

Click on the **Webcams** (7) button to configure which webcam(s) information should be included in notification events from this *Alarm*.

Click on the **History** (8) button to view *Alarm Event History* of this *Alarm*.

17.4.1. Notification Granularity



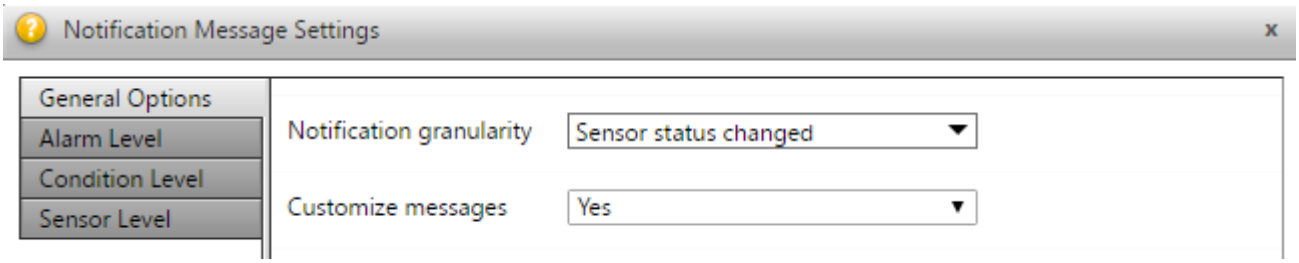
The *Notification granularity* determines when an alarm Notification is sent.

There are three levels of *Notification granularity* which corresponds to the three levels where an **Alarm State** is designated (see How Alarm Conditions are Evaluated):

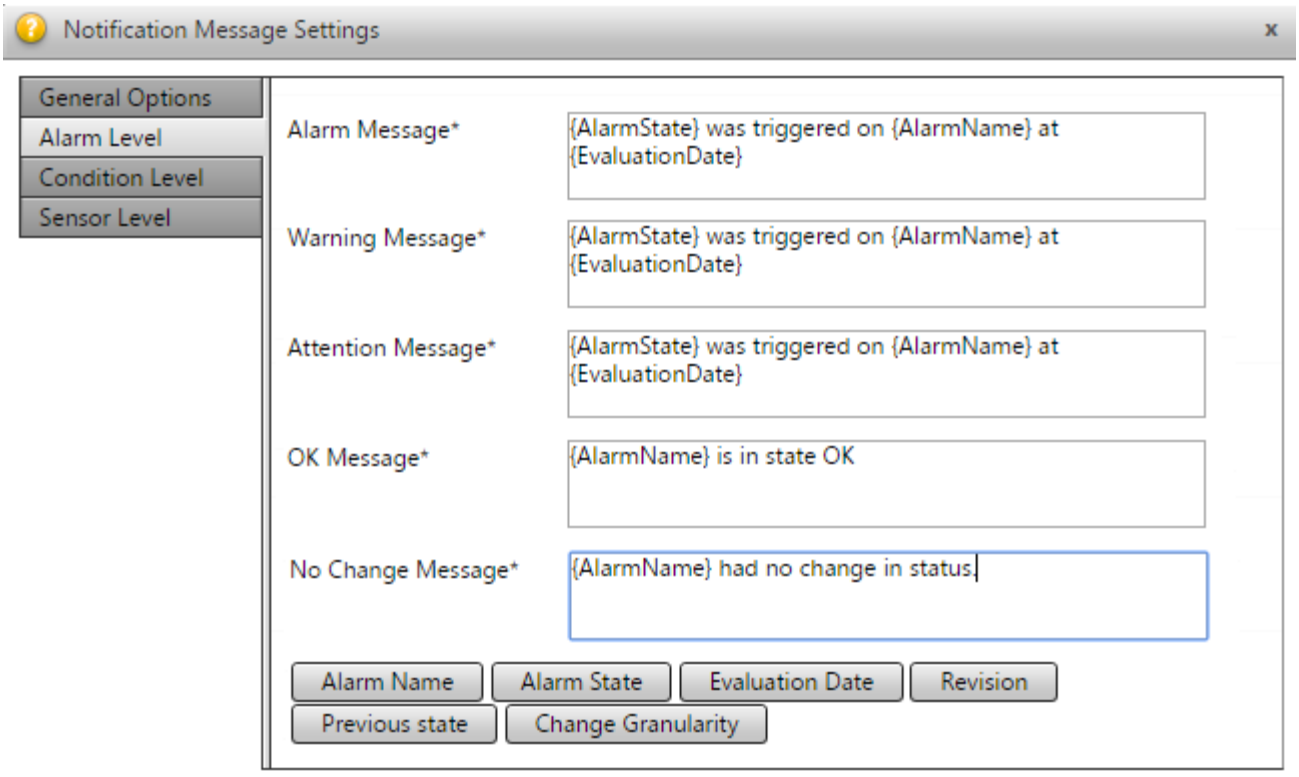
- **Alarm status changed**: Send a notification when the status of an *Alarm* changes.
- **Condition status changed**: Send a notification when the status of an *Alarm* or the status of an *Alarm Condition* changes.
- **Sensor status changed**: Send a notification when the status of an *Alarm*, the status of an *Alarm Condition* or the status of a *Sensor* changes.

17.4.2. Customize Messages

Generally it is not necessary to make changes to the Alarm Notification messages, because the application automatically builds up detailed messages for Alarm Notifications.



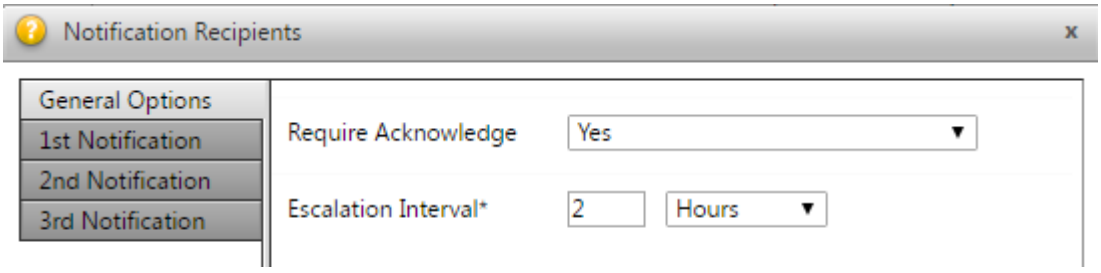
You can however customize the alarm notification messages. The exact messages sent in the notification can be customized per **Alarm State** level. One or more of these Notification Message Customization tabs will appear depending on the *Notification granularity* you selected.



At each level, different *Tags* are available. These tags can be used to embed contextual data into the custom message. When a notification is generated, a resulting message will be built up based on the evaluation of alarm definition, the evaluation of each of its conditions and the evaluation

of each sensor linked to a condition. Hover your mouse cursor over each tag to identify what information the tag will insert in your custom message.

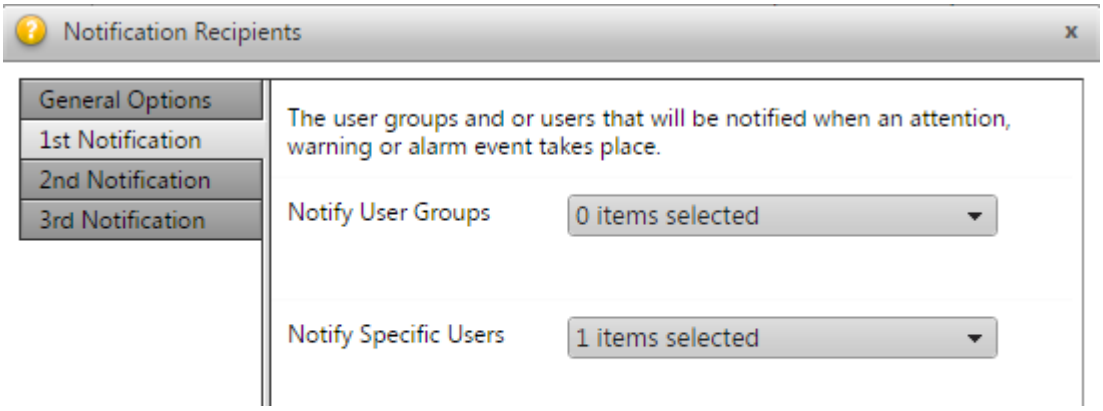
17.4.3. Enable Require Acknowledge



On the **Notification Recipients** dialog you can set *Require Acknowledge* to *Yes* for *Alarm Notifications* to require acknowledgement. If the Alarm is triggered, then a first notification message is sent immediately. If the Alarm is not acknowledged by a recipient of the first notification before the *Escalation Interval* expired, a second notification message is sent. Similarly,
if the Alarm is not acknowledged by a recipient of the second notification before the *Escalation Interval* expired, a third notification message is sent.

It is important to note that alarms that requires acknowledgements will peg the alarm state of the sensors triggering the alarm at the particular alarm level until a user acknowledged the alarm notification.

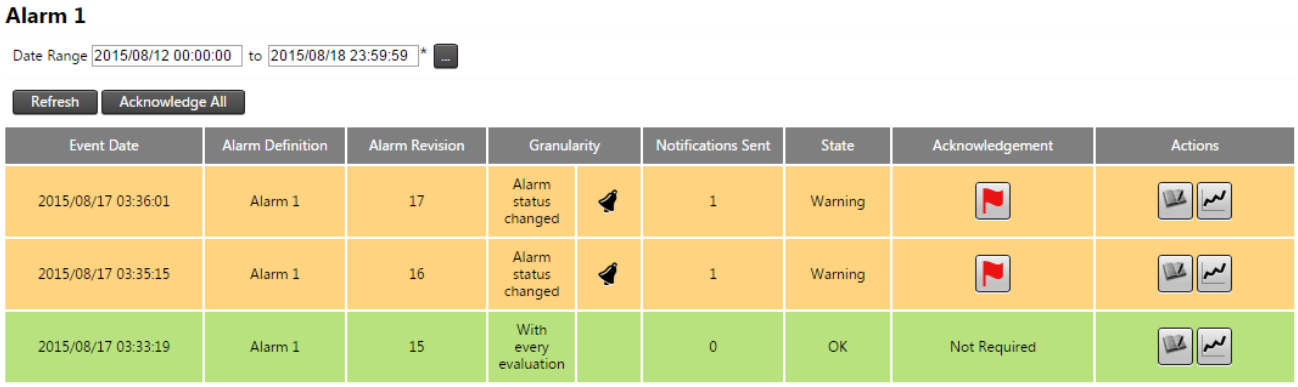
17.4.4. Manage Notification Recipients



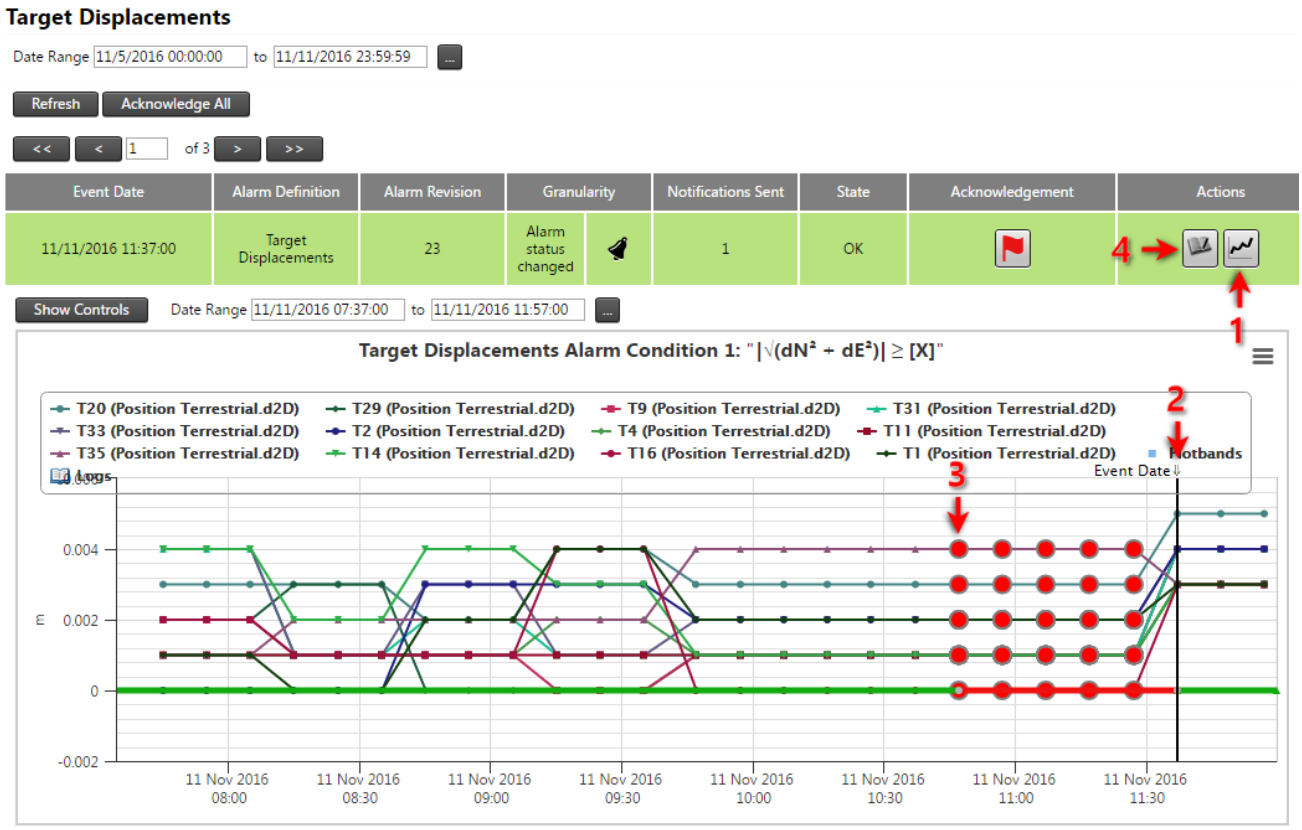
You can configure the recipients of *Alarm Notifications* by selecting a Group of Users (all users in a specific Role) or individual users.

17.4.5. Alarm History and Alarm Charts

You can view the Alarm Event History by clicking on the *History* button next to the *Webcams* button.



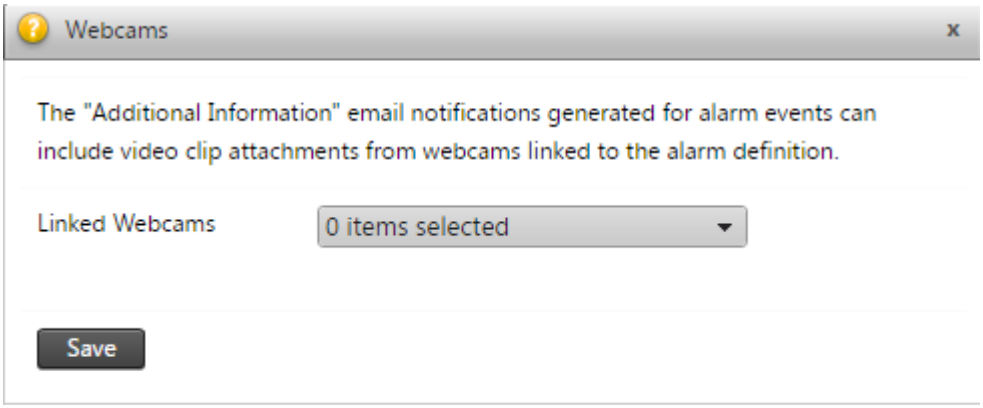
Here you can view all the alarm events of the particular alarm. You can also acknowledge alarm notifications or view who acknowledged an alarm notification.



Click on the *Chart* (1) icon to expand the *Alarm Charts* for a particular *Alarm Notification*. An *Alarm Chart* is shown for each *Alarm Condition* (example above has only one condition). Each *Alarm Chart* shows the data readings from the *Sensors* associated with the particular *Alarm Condition*. The moment in time when the particular Alarm *Event* happened is indicated by a vertical line (2) over the *Alarm Chart*. Any *No Data readings* are shown as large red plots vertices (3) on a chart series.

Click on the *Logs* (4) icon to open and view the associated Log entry for the *Alarm Notification*.

17.4.6. Attach video clips from Webcams

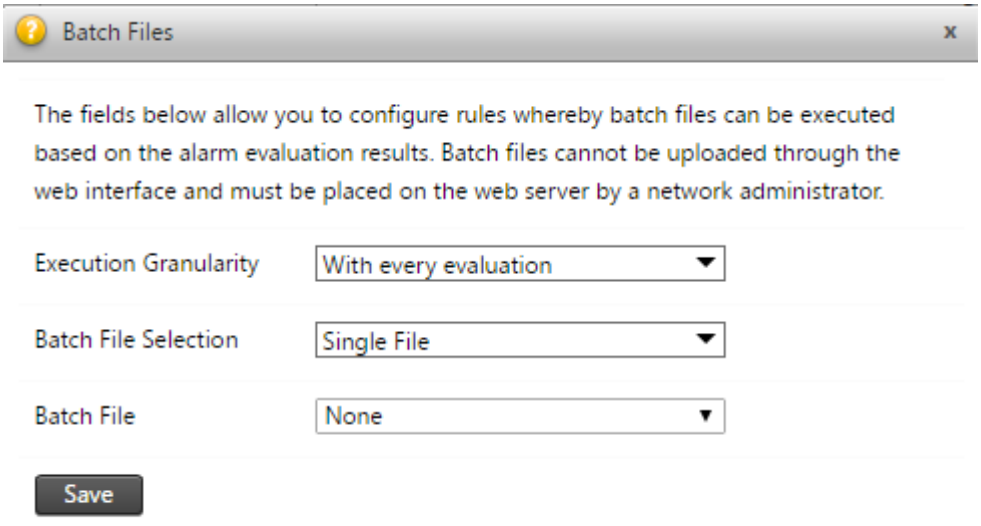


One or more video-capable webcams can be linked to an alarm definition. When an alarm event is triggered an additional notification email is sent and includes a video clip attachment. This clip originates from the associated webcam and covers the period before and after the event occurred.

Next to the video clip an alarm chart is also attached to the email. The alarm chart illustrates the most relevant sensors observations involved in triggering the alarm together with other information relevant to the alarm. Typical illustrations are alarm events, notifications events and attention, warning and alarm thresholds.

17.4.7. Batch Files

You can create custom *Batch Files* to be executed on alarm events. These batch files can receive information about alarms and trigger events or record data in external systems.



The following fields can be configured:

- **Execution Granularity:** This setting determines when the batch file should be executed. The value available are *With every evaluation*, *Alarm status changed*, *Condition status changes*, *sensor status changed*.

- **Batch File Selection:** Determines if a *Single* batch file or a *State Specific* batch file should be executed. For the *State Specific* batch file setting, you can configure a batch file to be executed for each **Alarm State** (Okay, Attention, Warning or Alarm).
- **Batch File:** select the batch file to be execute on alarm events. Trimble 4D Control Web will show you a list of all the batch files found in the `/Executables` folder on the server.

Batch files are executed with as the local user **IUSR** and with a standard set of batch file parameters described in a file under `/Executables/README.txt`

17.5. Enable and Disable Alarms

An alarm needs to be *Enabled* to start monitoring sensor data flows and send *Alarm Notification*.

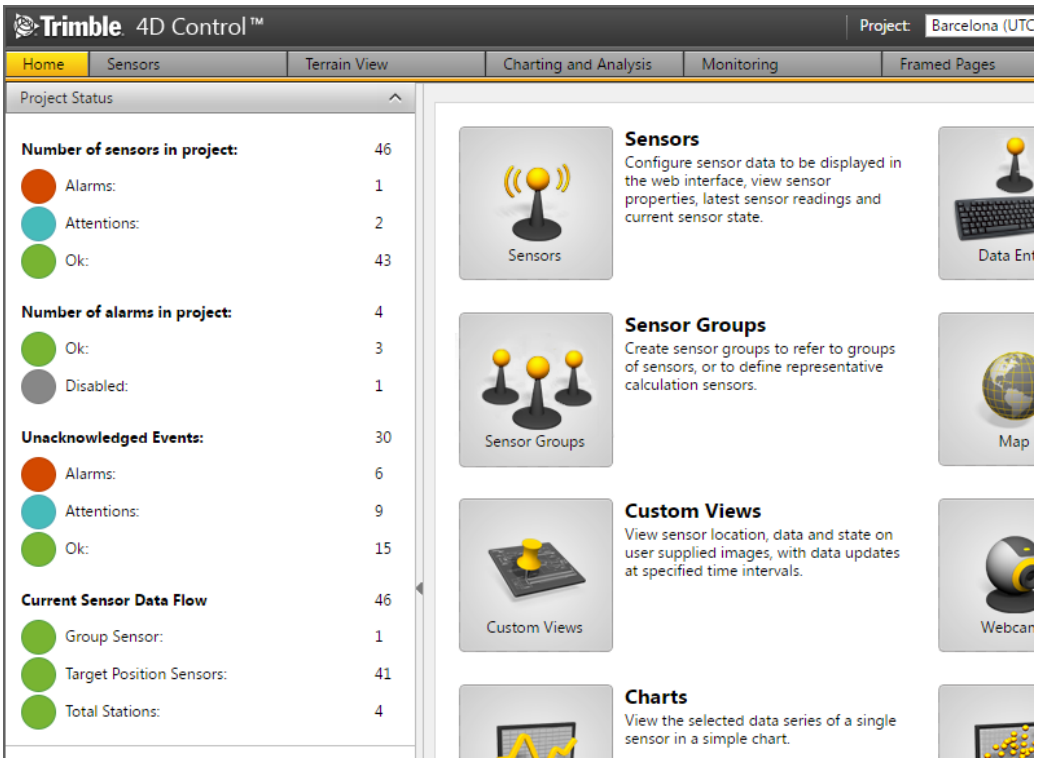
You can **Enable** an *Alarm* by clicking on the *Enable Alarm* icon next the the alarm name in the alarm list, or by clicking on the *Enable* button on the alarm edit window. An enabled *Alarm* cannot be edited. If you wish to change the details of an enabled *Alarm* you would need to first disable the *Alarm*.

You can **Disable** an *Alarm* by clicking on the *Alarm* icon next the the alarm name in the alarm list, or by clicking on the *Disable For Edit* button on the alarm edit window.

17.6. Managing Alarm Notifications

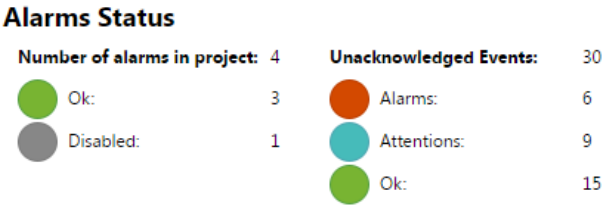
This section explains how to interpret *Alarm* and *Alarm Condition* statuses and possible user workflows of how to investigate the cause of an *Alarm Notification*.

The number of unacknowledged events can potentially increase if actual events are not investigated and acknowledged. A well maintained project should have zero or very few unacknowledged events.



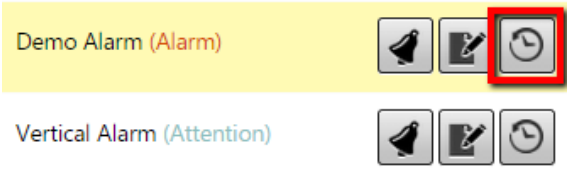
A summary of alarm states is displayed on the Home page. Click either on *Number of sensors in project*, *Number of alarms in project* or *Unacknowledged Events* to navigate to the **Alarms Overview Page**.

Notice the *Current Sensor Data Flow* display. This is discussed later in the System Status section.



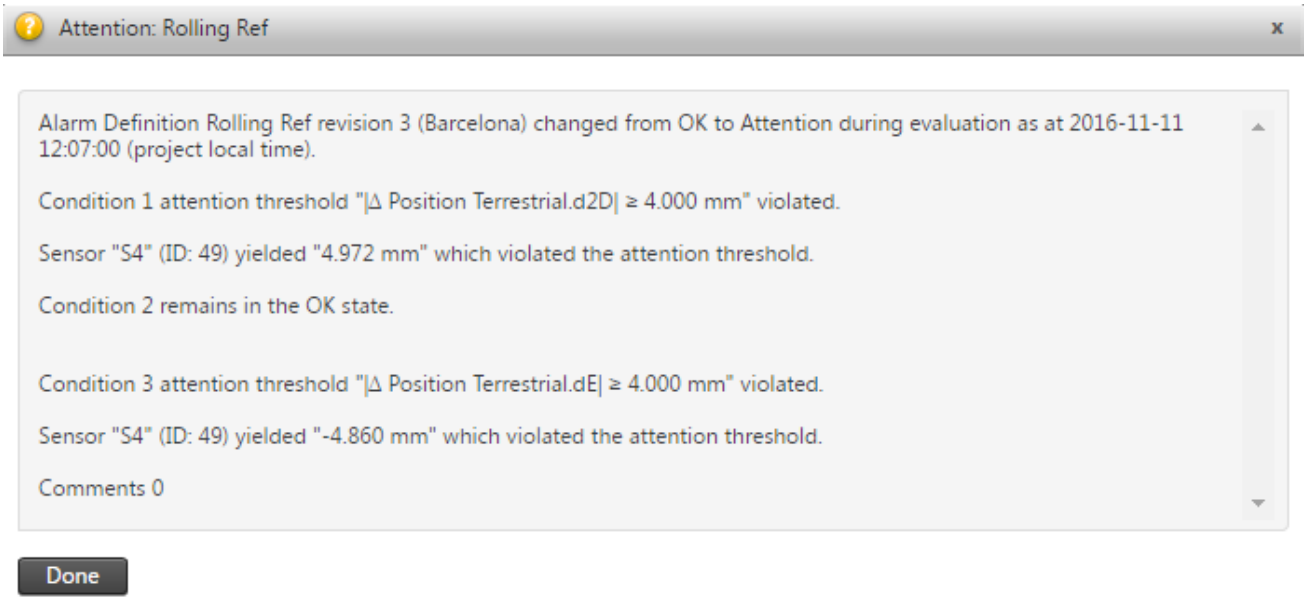
The **Alarms Overview Page** is also the default landing page when you navigate to Alarms from the *Main menu*. This page shows a list of unacknowledged events. If you are in charge of responding

to an alarm that triggered, you can click on the *Flag* icon of a listed *Alarm Notification* to acknowledge that you have responded to the alarm event. Normally the person reviewing the cause of an alarm event would also log additional comments in the relevant Log entry (discussed in the Logs section). Acknowledging an alarm event will also automatically add a Log entry. An acknowledged event will disappear from the list.



If you want to review past or active alarm events on a particular *Alarm*, you can navigate to the particular *Alarm* the list of alarms on the left hand side and click on the *History* icon. Or you can click on the name of the *Alarm* and click on the *History* button on the alarm edit page.

From the **Alarms Overview Page** you can also have a peek at the log event generated by a particular Alarm Notification by clicking on the *Log* icon.



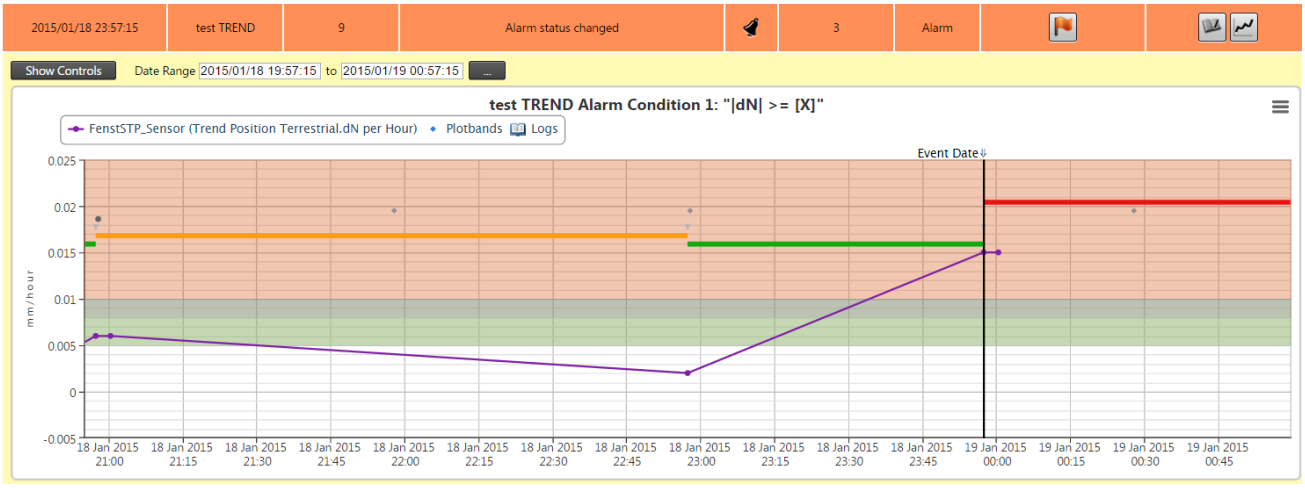
A pop-up will show the log details about the event. If notifications settings were activated when the particular *Alarm Event* occurred, then you should also have received and email or SMS with this text.

For more detailed analysis it might be necessary to review the graphs that led to the trigger of the event:

Click on the *Chart* icon to show the *Alarm Charts* for the particular *Alarm Event* (see section Alarm History and Alarm Charts). We now explain the *Alarm Charts* in more detail.

17.6.1. Alarm Charts

Alarm Charts provide visual information about an Alarm event and could assist in analysing the cause of the event.



The purple line in the *Alarm Chart* above indicates the effective sensor readings.
The vertical black line indicates when the event has happened.

The horizontal lines (orange => green =>red) indicate the change in alarm states. Normally it should be all green (which is the OK state), but for this example we used very sensitive (low) thresholds to trigger the states.

The starting point of each line is where the event happened that triggered the state. Note that the red line starts from the vertical black line, which is the time where the event happened that we are inspecting.

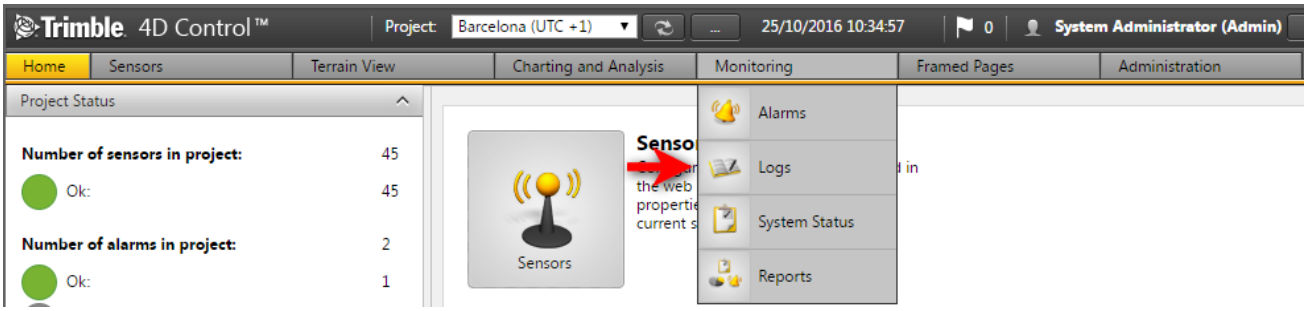
The dots on the graph at the event changes indicate the first, second and final notifications that were sent out (depending on the configuration and/or escalations that happened). Move your mouse cursor over the points to display pop-ups containing more information.

The white area on the graph indicates the OK state for the effective sensor readings. The *Attention*, *Warning* and *Alarm* colored *Plotband* areas on the chart indicates where the particular *Alarm Condition* would evaluate to the appropriate **Alarm State**.

18. Logs

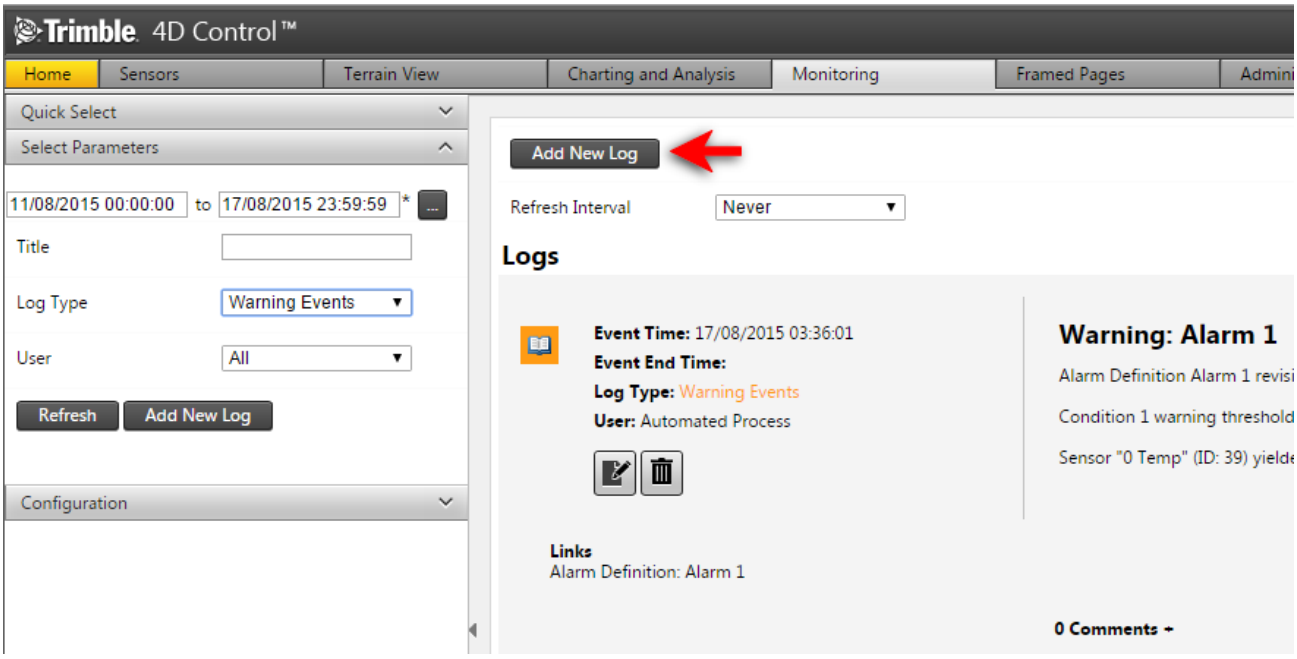
The Logs section shows information on events (or log entries), such as alarms, projects, hardware events, seismic events, accident events and blasting events.

Alarm events (see Alarms) automatically creates log entries. Other events are manually entered into the system. Users can discuss log entries online by adding comments and file attachments.

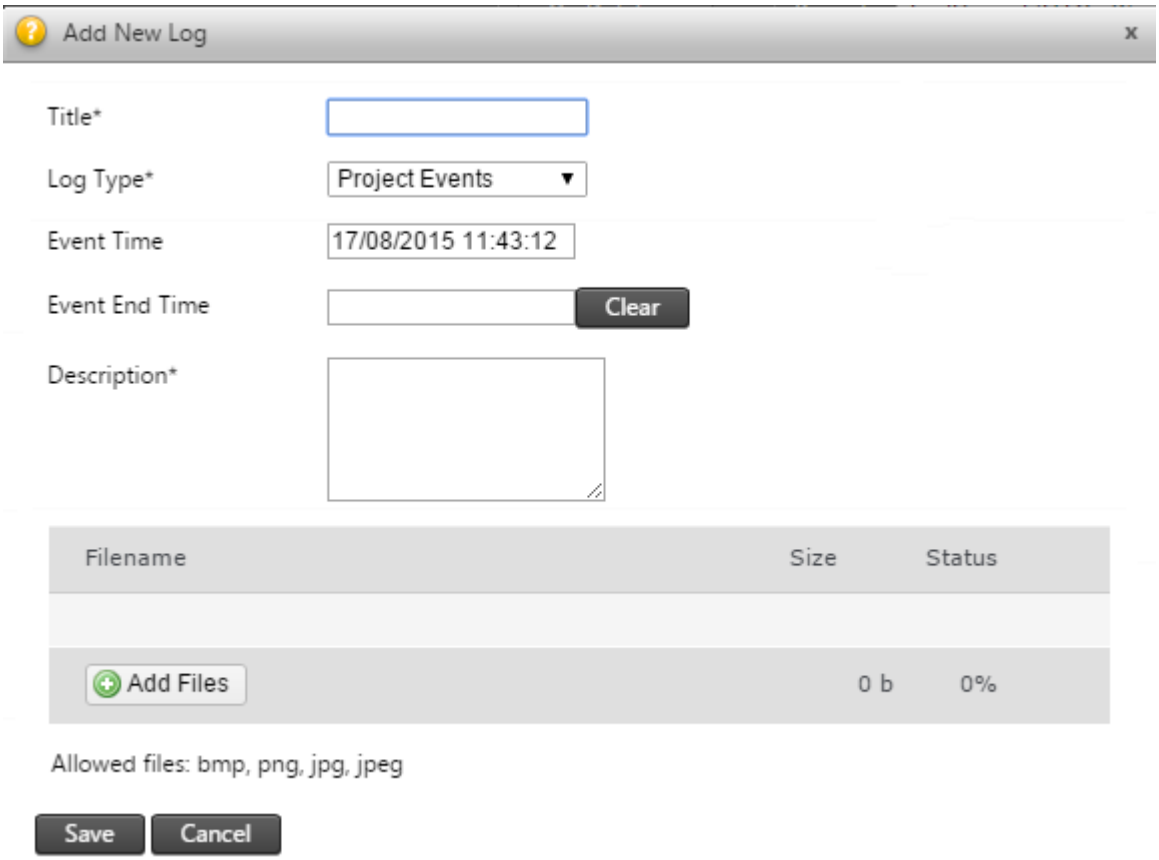


Navigate to the *Logs* area via the Menu under *Monitoring* or from the *Home Page*.

18.1. Add a Log Entry



Step 1: Navigate to the default log landing page and Click the *Add New Log* button.



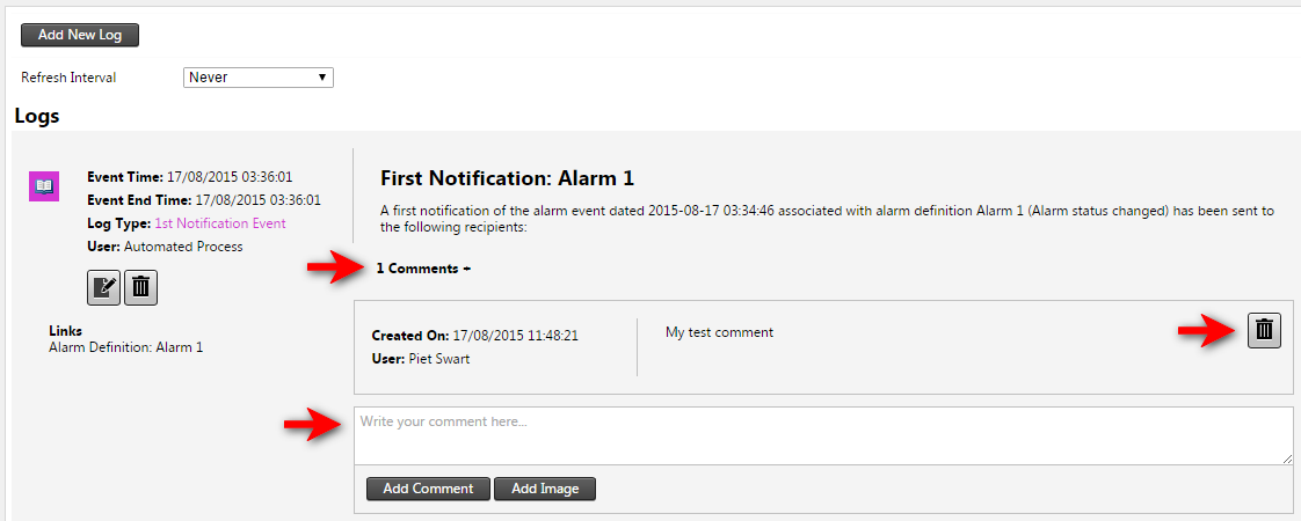
Step 2: The *Add New Log* dialog will appear. Complete the necessary fields as required:

- **Title:** Name of the event.
- **Log Type:** The type of event. We will later show how you can create additional *Log Types*.
- **Event Time:** The date and time the event happened.
- **Event End Time:** The date and time it ended for the log entry. This field is optional.
- **Description:** An explanation of what happened.
- **Image File:** You can attach an image to a log event.

Click the *Save* button to create the new *Log Entry*. The new *Log Entry* will appear in the logs.

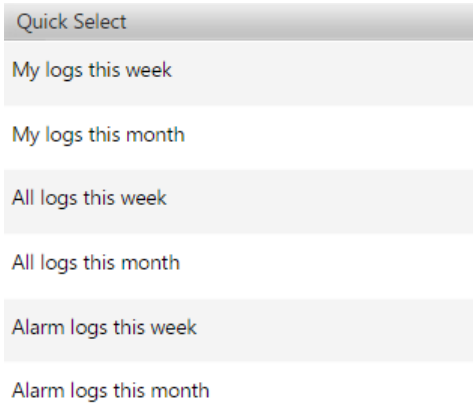
18.2. Add a Log Entry

Multiple *Comments* can be added to a *Log Entry*. You can also add an image to be displayed with your comment.

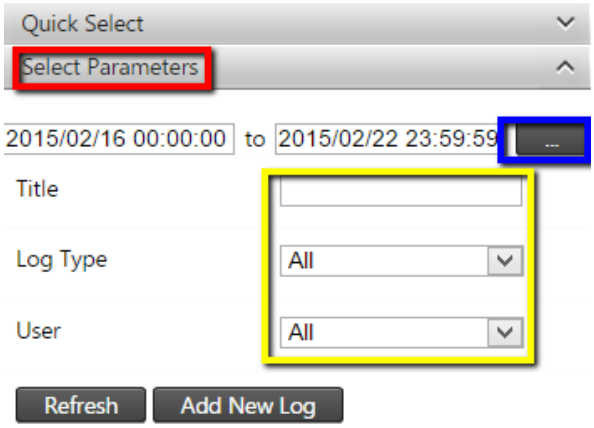


Click on the Comments area below each log entry to read or add comments to the *Log Entry*. Click the *Delete* icon to delete a *Log Entry* or a *Comment*.

18.3. View Log Entries



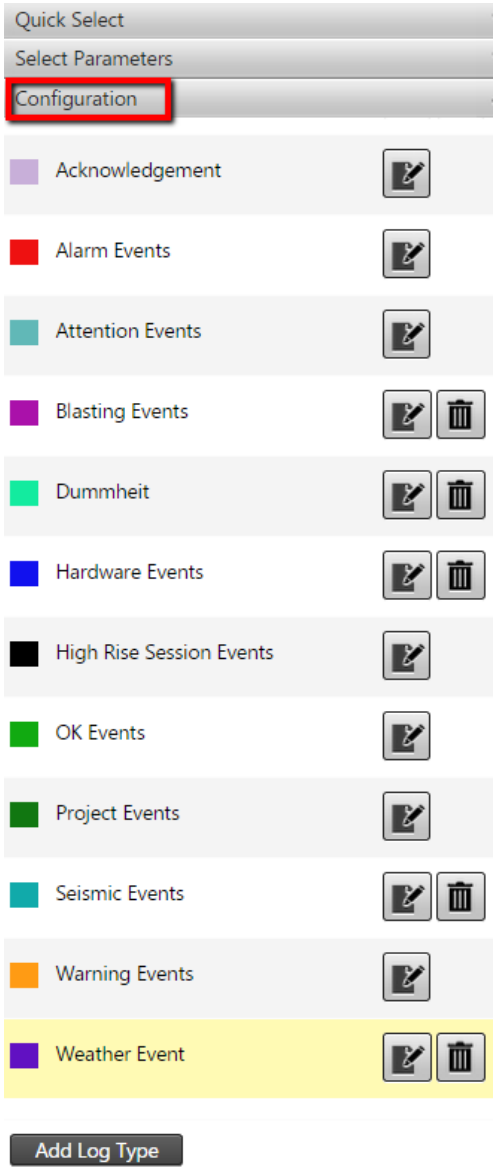
Step 1: Navigate to the default log landing page and select the *Quick Select* bar. Find the logs you wish to view by selecting the timeframe in which the *Log Entry* would have been created.



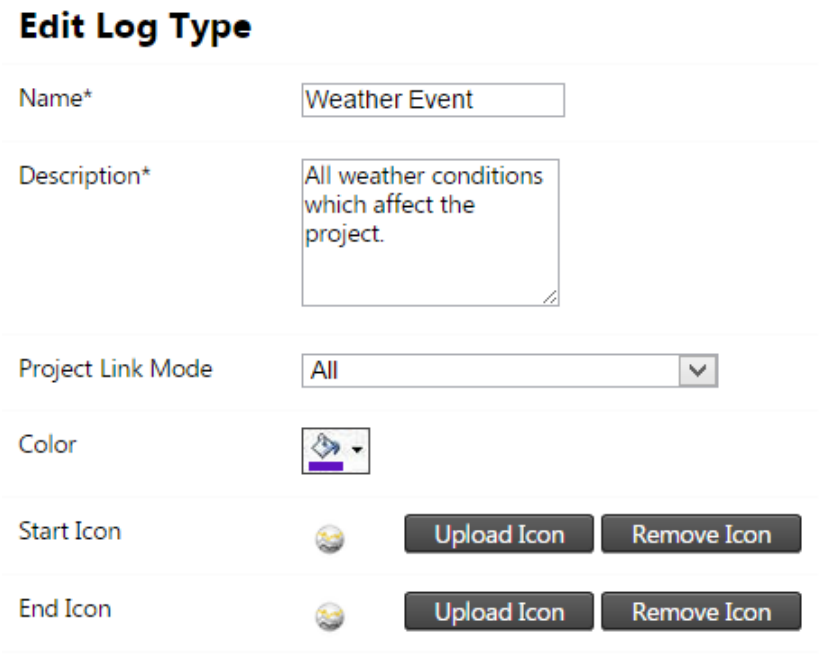
Step 2: Alternatively select the *Select Parameters* bar on the left pane, select the timeframe in which the *Log Entry* would have been created and enter filter parameters for the Log Entries.

Step 3: Finally click the Refresh button to update the log entries in the list view.

18.4. Log Types



Step 1: Select the Configuration bar in the left pane to display a list of *Log Types*.
Step 2: Click on the name of a *Log Type* to view details about the log type. Click on the *Edit*-icon to to edit the *Log Type* or the trash can icon to delete the log type. Some log types cannot be deleted.

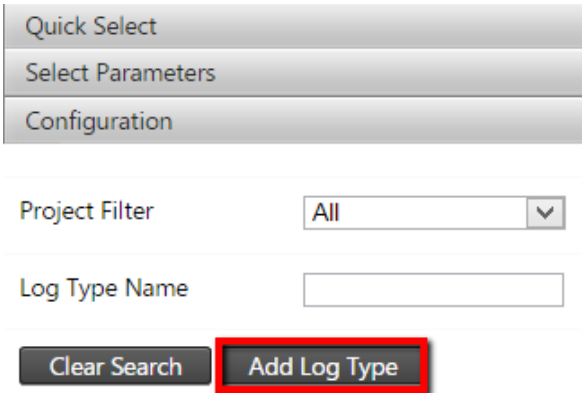


Step 3: Editing a *Log Type* will preset the setting above.
Update the necessary fields as required:

- **Name**: The display name for the log type.
- **Description**: Specify a description for the log type.
- **Project Link Mode:** The default option is all projects, but you can also specify here which projects this log type may only be available for if it should not be available for all projects.
- **Color**: The log type colour that will be used to represent the log on analysis charts.
- **Start Icon**: The log type icon that will be used to represent the start of a log on analysis charts.
- **End Icon**: The log type icon that will be used to represent the end of a log on analysis charts.

Click the Save button. Some *System Log Types* will offer only limited editing options.

18.4.1. Add a new Log Type

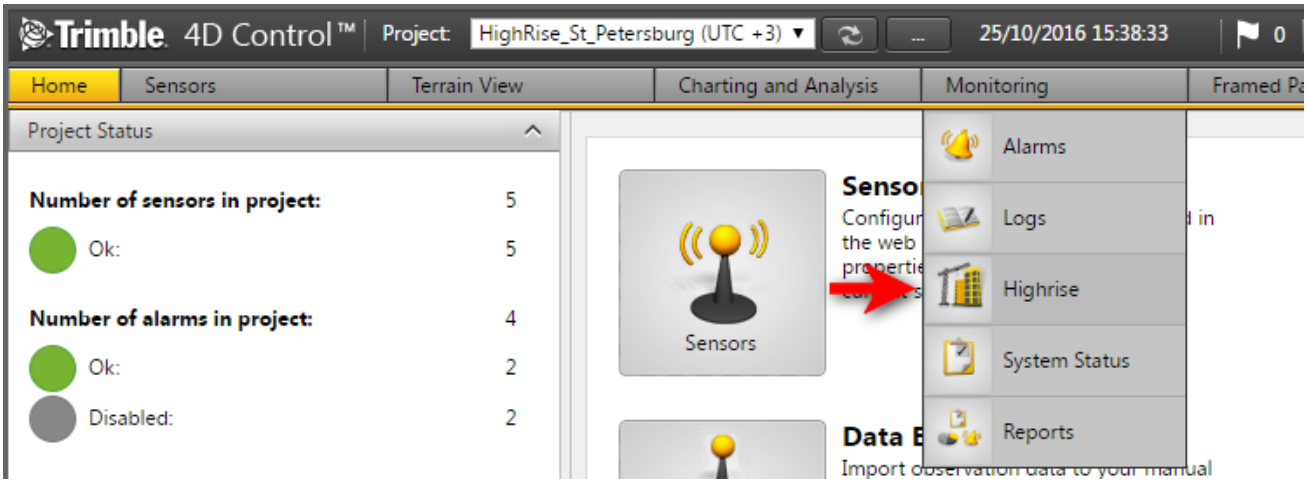


Step 1: Click the Add Log Type button at the top or at the bottom of the log type list.

Step 2: Enter the necessary fields as required which would the same as previously discussed. Click the Save button and your Log Type will be added to the list.

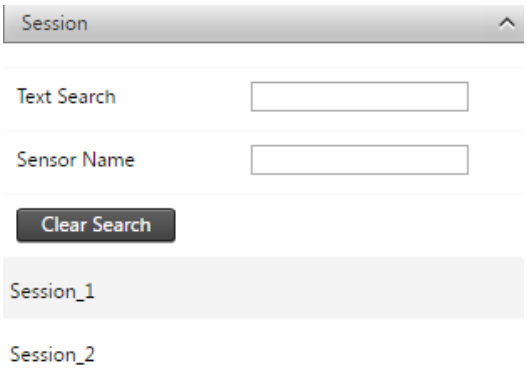
19. Highrise

Highrise is used to manage Highrise construction sessions.
It is a specialized module that if acquired will be accompanied by the necessary personal training.
Highrise is a licensed module in Trimble 4D Control and is not visible in Trimble 4D Control Web if it is not licensed on your system.

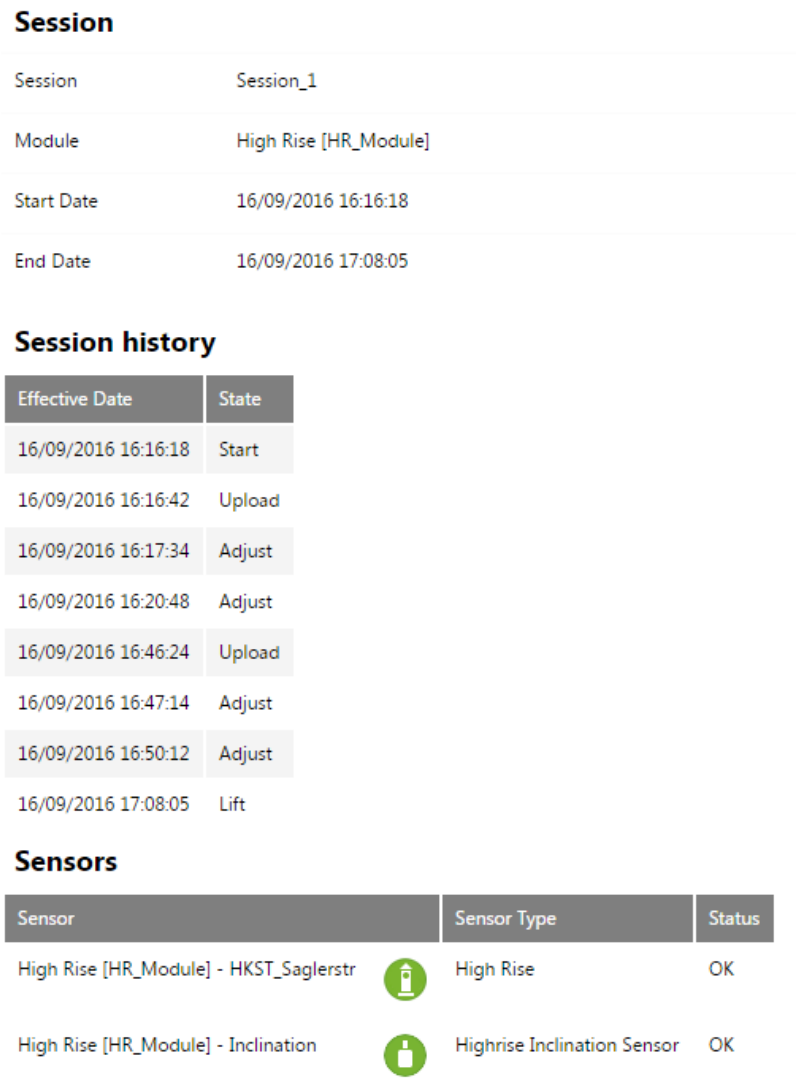


Navigate to the *Highrise* area via the Menu under *Monitoring* or from the *Home Page*.

19.1. View Sessions



Step 1: Navigate to the *Highrise* section and use the filters on the left side pane to search for the sessions. Click on a *Session* in the list below to display information about the *Session*.



Session

Session	Session_1
Module	High Rise [HR_Module]
Start Date	16/09/2016 16:16:18
End Date	16/09/2016 17:08:05

Session history

Effective Date	State
16/09/2016 16:16:18	Start
16/09/2016 16:16:42	Upload
16/09/2016 16:17:34	Adjust
16/09/2016 16:20:48	Adjust
16/09/2016 16:46:24	Upload
16/09/2016 16:47:14	Adjust
16/09/2016 16:50:12	Adjust
16/09/2016 17:08:05	Lift

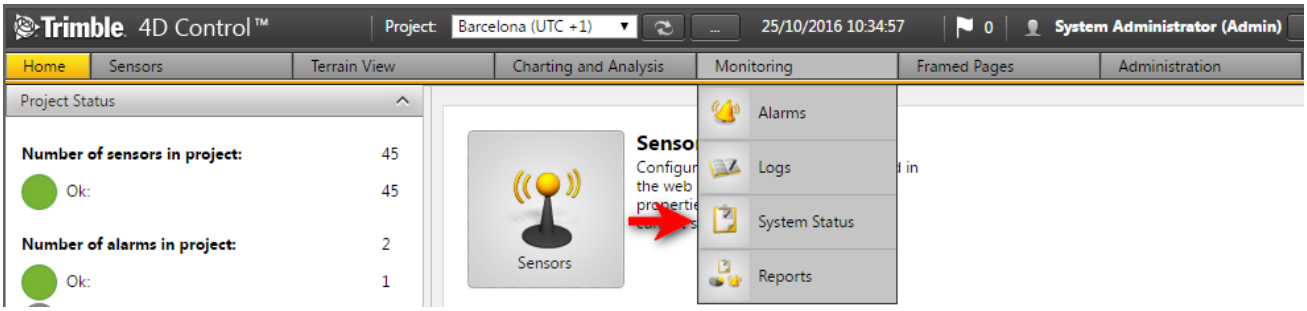
Sensors

Sensor	Sensor Type	Status
High Rise [HR_Module] - HKST_Saglerstr	High Rise	OK
High Rise [HR_Module] - Inclination	Highrise Inclination Sensor	OK

Step 2: The session details will be displayed on the right hand side.

20. System Status

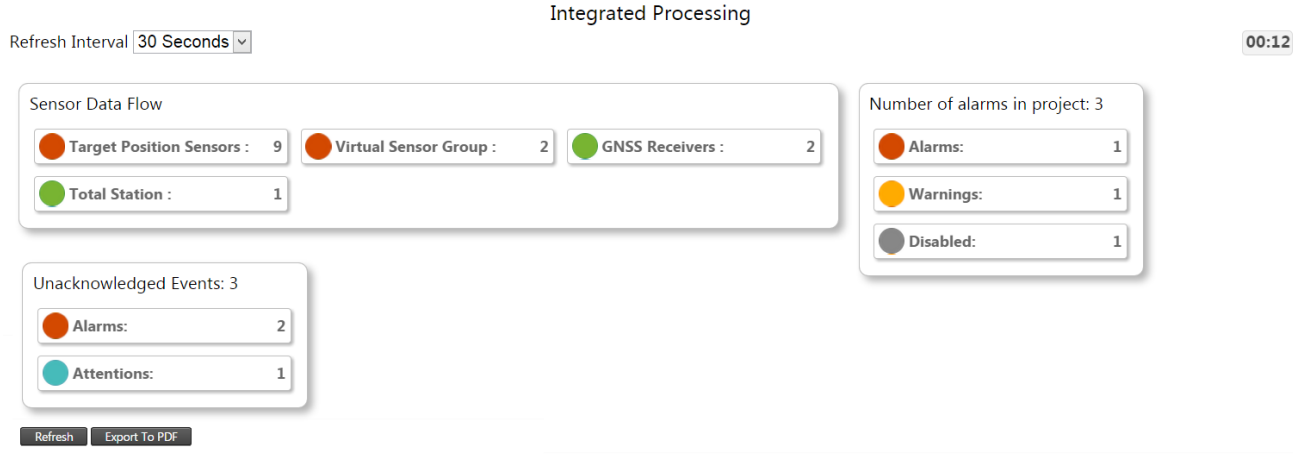
The System Status section brings useful top level reporting within the T4D system together as well as provide means to link back to the respective sections in the system for more detailed drill down queries. It also provides the tools to generate detailed reports and notifications.



Navigate to the System Status area via the Menu under *Monitoring* or from the *Home Page*.

20.1. Overview Dashboard

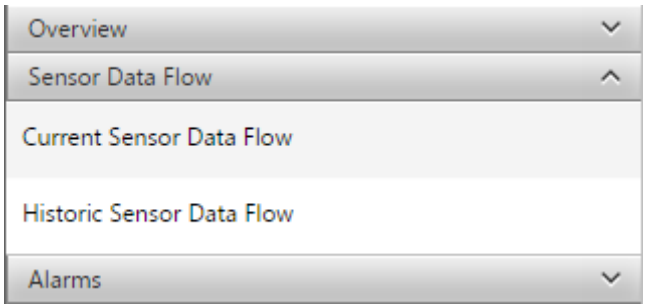
The *System Status* overview displays a dashboard page containing general overview information of the Trimble 4D Control system.



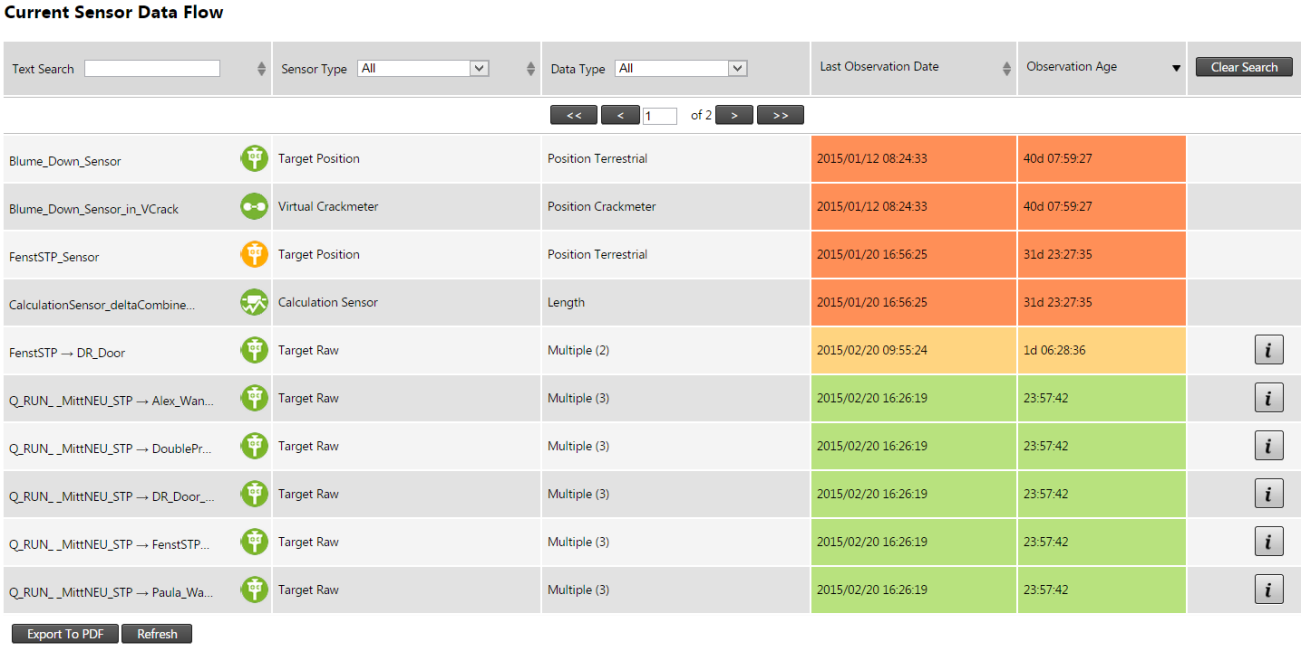
Click on any of the dashboard item to navigate to the respective *System Status* details area. These areas are **Sensor Data Flow**, **Number of Alarms**, and **Unacknowledged Events.**

The *Overview Dashboard* will automatically refresh according to the **Refresh Interval** chosen on the top left selection control. You can also refresh the *Overview Dashboard* by clicking on the *Refresh* button. Click on the *Export To PDF* button to save the *Overview Dashboard* view to a PDF file.

20.2. Sensor Data Flow Status



The *Sensor Data Flow* area is located in a tab on the *System Status* section. The sensor data flow area is used to analyze the performance and age on the latest available observations for each sensor. This is useful to see that data is being delivered correctly for each sensor.

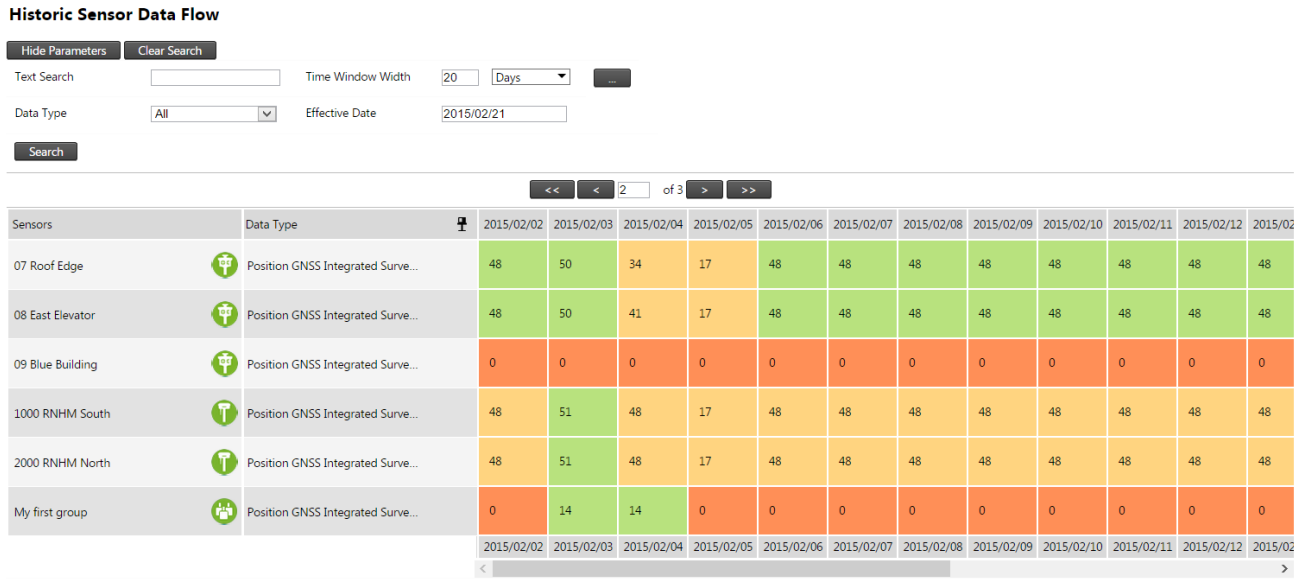


Click on the *Current Sensor Data Flow* option. The page will show a table. Notice the filters at the top of each column to assist with quickly navigating to sensors in case the project has many sensors.

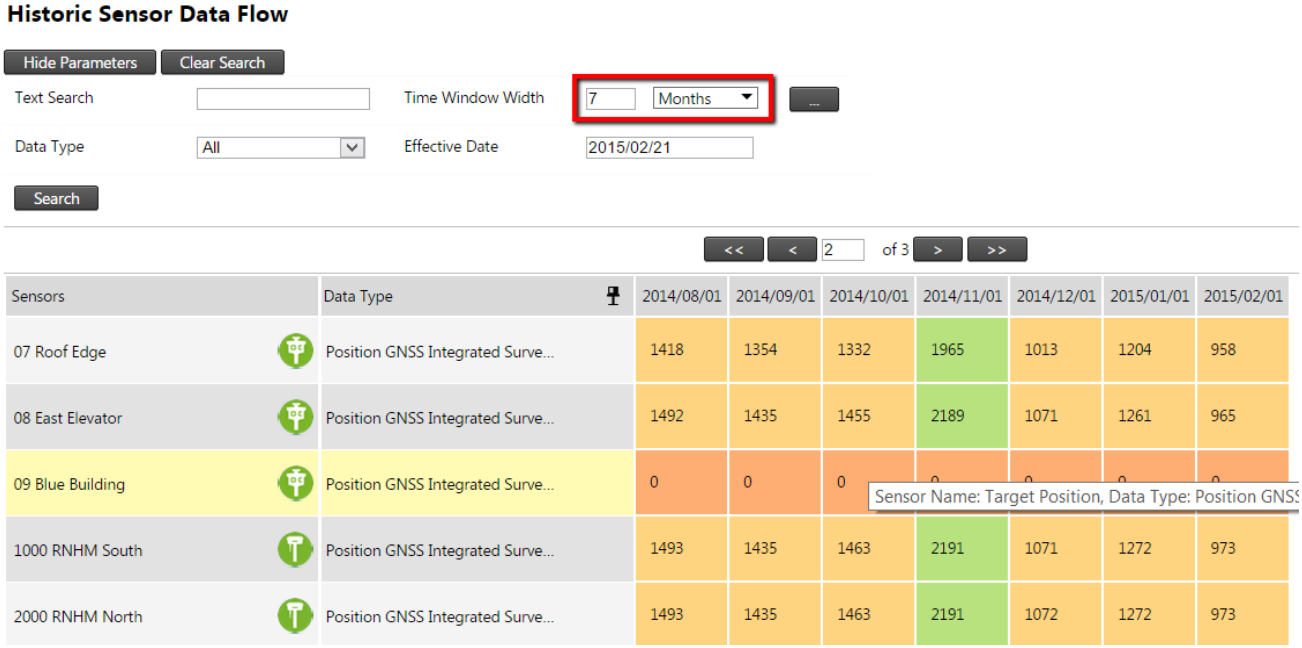
A color-code is applied to each Sensor *Data Type* with the following meanings:

- **Green**: Data delivery appears to be healthy.
- **Orange**: Data delivery appears to be delayed.
- **Red**: Data delivery appears to have stopped.

Click on the *Historic Sensor Data Flow* option to view the past data availability on sensors in your project.

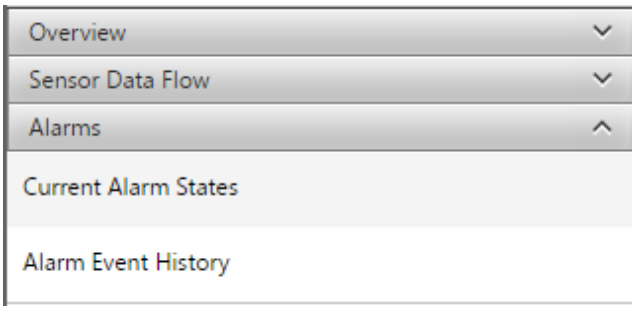


In the example above the sensor history are displayed for the past 20 days. Each cell represents a specific day for a specific sensor and the total observations that day. As can be seen the healthy green cells have more readings than the orange cells, which again have more than the red cells provided no observations. Use the pin icon on the *Data Type* column heading to keep the Sensor details fixed when you scroll through the columns to the right.

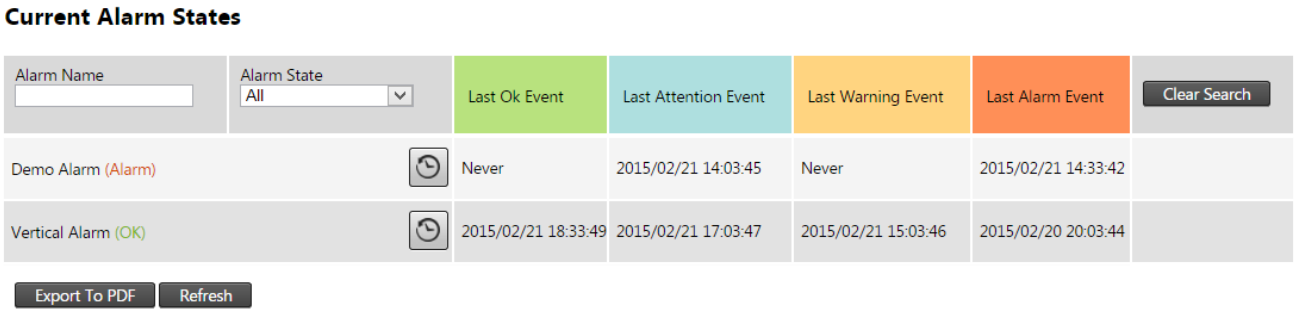


The **20 day** time window can be changed. In the example above we change it to 7 months.

20.3. Alarms Status

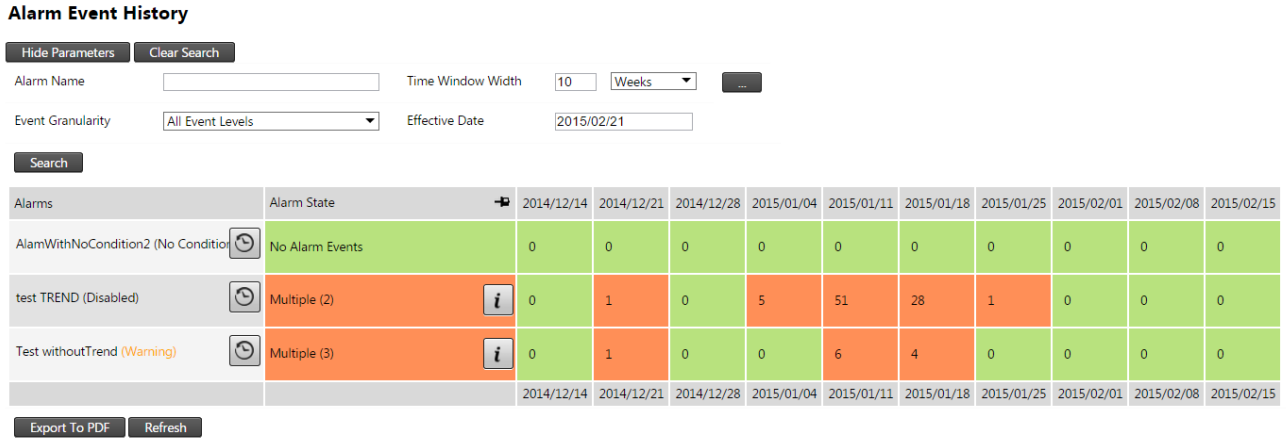


Click on the *Alarms* tab to view the status of alarms and alarm events.

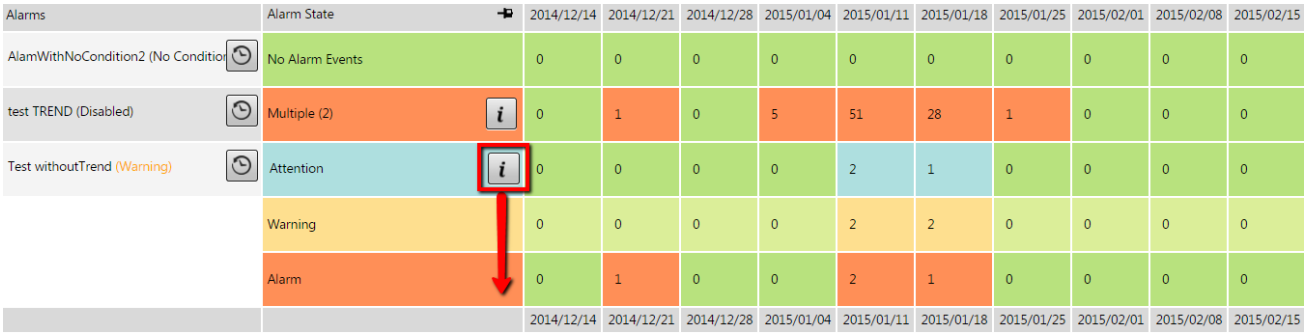


Click on the *Current Alarm States* option. As with sensor data flow, the *Current Alarm States* page shows active data. The current state is shown in brackets next to the alarm's name. To drill deeper you can click on the clock icon (to the right of the alarm name and current state) to go the *Alarm History* (see Alarm History and Alarm Charts).
The other columns in the table indicate the last time was that the four different alarm states triggered. Click on the *Export To PDF* button to export a report containing the Current Alarm States.

Click on the *Alarm Event History* option to view Alarm Events.



The example above displays the alarm history for the past 10 weeks. Notice that most of the alarm events occurred roughly 5-6 weeks ago. Notice that if multiple alarm states were triggered on a particular *Alarm* then the only the color of the alarm row is shown with the worst alarm state for events under that alarm.



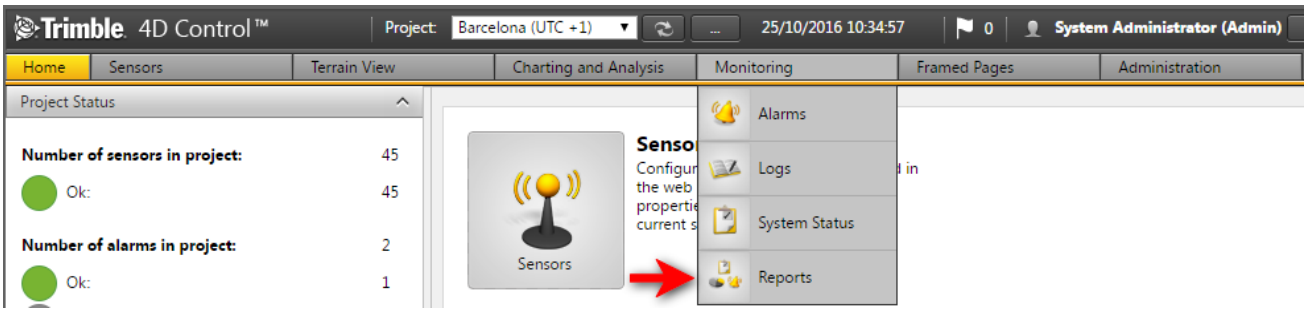
Alarms	Alarm State	2014/12/14	2014/12/21	2014/12/28	2015/01/04	2015/01/11	2015/01/18	2015/01/25	2015/02/01	2015/02/08	2015/02/15
AlamWithNoCondition2 (No Condition)	No Alarm Events	0	0	0	0	0	0	0	0	0	0
test TREND (Disabled)	Multiple (2)	0	1	0	5	51	28	1	0	0	0
Test withoutTrend (Warning)	Attention	0	0	0	0	2	1	0	0	0	0
	Warning	0	0	0	0	2	2	0	0	0	0
	Alarm	0	1	0	0	2	1	0	0	0	0
		2014/12/14	2014/12/21	2014/12/28	2015/01/04	2015/01/11	2015/01/18	2015/01/25	2015/02/01	2015/02/08	2015/02/15

Click on the *Information* icon to expand the different states that was triggered by of a particular *Alarm*. Click on the *Clock* icon to navigate to the alarm history page (see Alarm History and Alarm Charts).

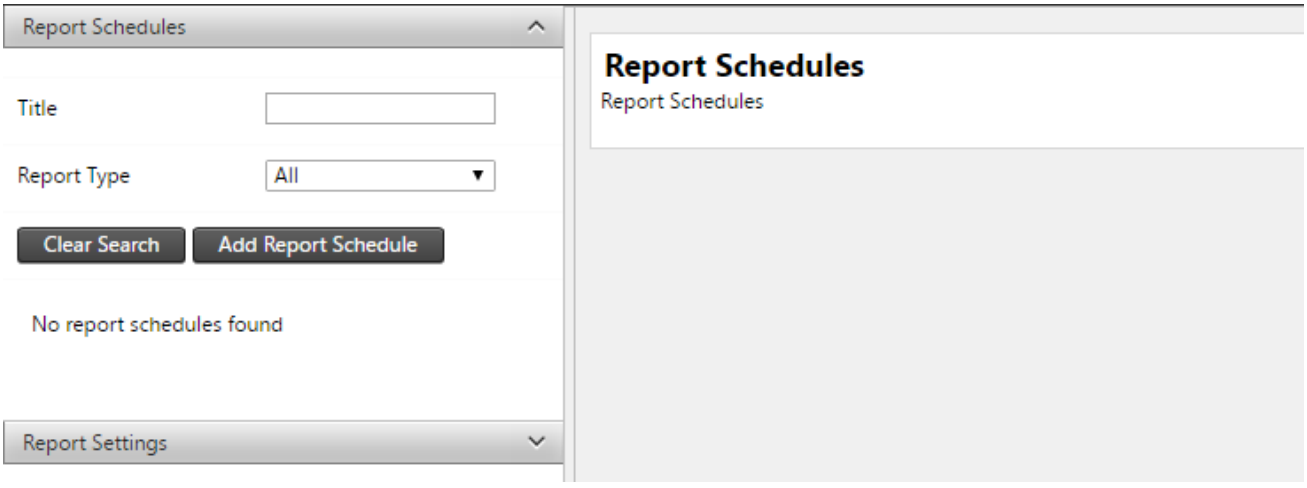
21. Report Schedules

The *Report Schedule* area allows you to schedule reports to be generated and emailed to particular recipients. These reports contain information about the Trimble 4D Control system or information about particular sensors. The report recipients will receive the report according the the configured daily, weekly or monthly report schedule.

Reports are integrated with different areas of Trimble 4D Control to automatically generate particular charts or extract information already configured in Trimble 4D Control.



Navigate to the *Report Schedule* area via the Menu under *Monitoring* or from the *Home Page*.

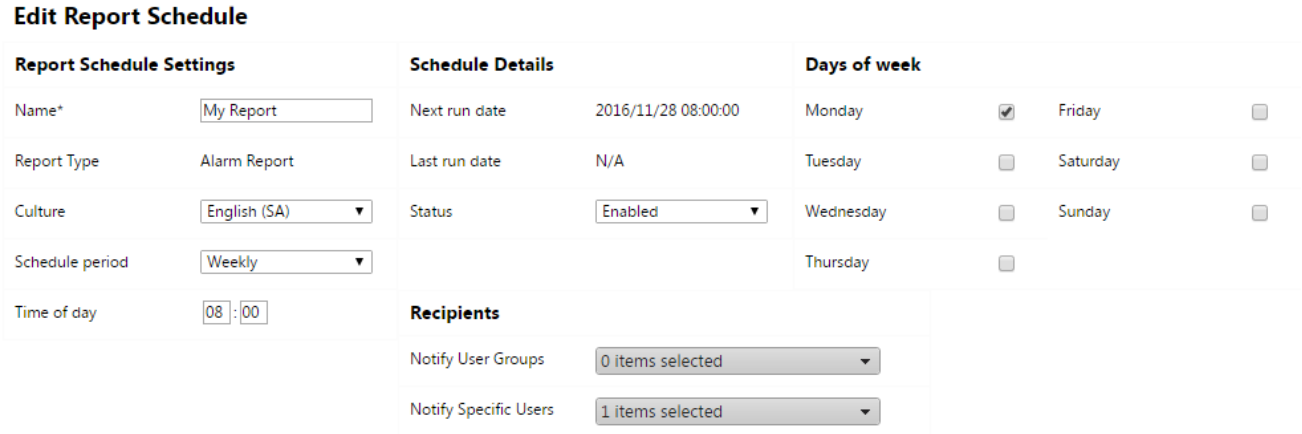


On the left side of the *Report Schedule* area is a list of report schedules with filter controls:

- **Title:** Text search on the title of the reports.
- **Report Type:** The type of the report to show in the list. We will discuss the different report types later in this section.

21.1. Report Schedule General Settings

In this section we describe the basic *Report Schedule* settings that is common on *Report Schedules* of all Report Types. In the *Report Schedule* area, click on the **Add Report Schedule** button, select an *Alarm Report* and click on the **Create** button.



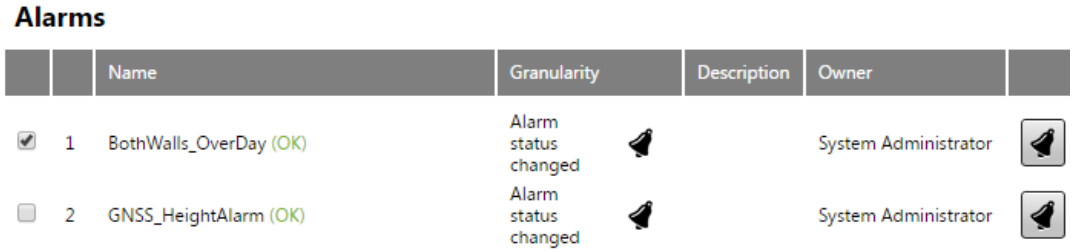
We now discuss the various *Report Schedule* general settings:

- **Name:** A custom name by which to identify the *Report* generated by this *Report Schedule*.
- **Report Type:** The type of *Report* to be generated by the *Report Schedule*.
- **Culture:** The culture in which the *Report* should be generated.
- **Schedule period:** The period on which the *Report Schedule* should generate a *Report*. The values are *Hourly, Daily, Weekly* and *Monthly*. Depending on this selection, other controls may appear on the *Report Schedule settings* page.
- **Day of month:** The day of the month on which the *Report* should be generated. This setting is only available if a **Schedule period** of *Monthly* is selected.
- **Time of day:** The time of day at which the *Report* should be generated. This setting is only available if a **Schedule period** of *Weekly* is selected
- **Days of week:** The day(s) of the week on which the *Report* should be generated.
- **Next run date**: The date and time at which the *Report Schedule* will generate the next *Report*. The *next run date* will automatically be calculated according to the **Schedule period** and related settings.
- **Last run date:** The date and time at which the *Report Schedule* was last generated.
- **Status:** Setting to disable or enable the *Report Schedule*. This is useful if you wish to temporarily disable generation of a *Report*.
- **Notify User Groups:** The recipient *User Roles* to which the *Report* should be sent.
- **Notify Specific Groups:** The recipient *Users* to which the *Report* should be sent.
- **Time Window Width:** Some reports may have a field called *Time Window Width*. The period over which the report content should span, typically the last 24 hours, or the last 7 days. This setting is only applicable to some reports. The *Report Time Period* determines the time span of data that should be included in the *Report*.
- **Show Latest Data Only:** Some reports may also have the option *Show Latest Data Only*, which if selected will only include the latest data values in the generated *Report*.

In the following sections we discuss the settings of each *Report Type*.

21.2. Alarm Report

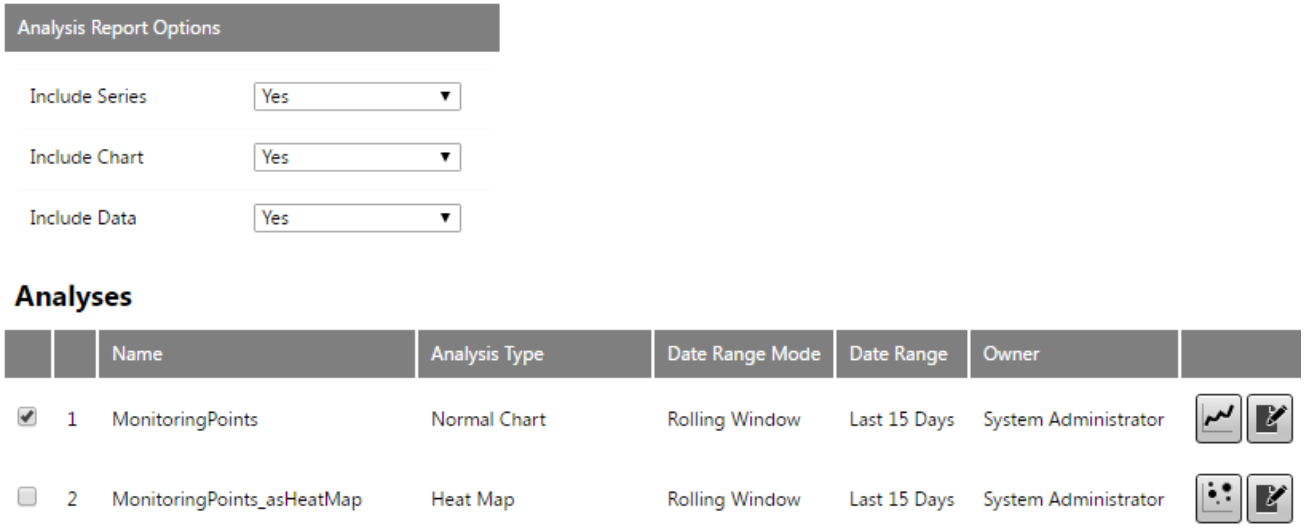
In the *Report Schedule* area to add a new *Alarm Report*, click on the **Add Report Schedule** button, select *Alarm Report* and click on the **Create** button.



Below the *Report General Settings* section you will see a list of all the *Alarms* in your project. From the list, select the *Alarms* to be included in your *Alarm Report*.

21.3. Analysis Report

In the *Report Schedule* area to add a new *Analysis Report*, click on the **Add Report Schedule** button, select *Analysis Report* and click on the **Create** button.



Below the *Report General Settings* section you will see the *Analysis Report Options* and a list of all the *Analyses* in your project. Configure the *Analysis Report Options* as follows:

- **Include Series:** Indicates if analysis series should be shown in the analysis report.
- **Include Chart:** Indicates if analysis charts should be shown in the analysis report.
- **Include Data:** Indicates if a table of the analysis data points should be shown in the analysis report.

From the list of analyses, select the *Analyses* to be included in your *Alarm Report*.

21.4. Highrise Sessions Report

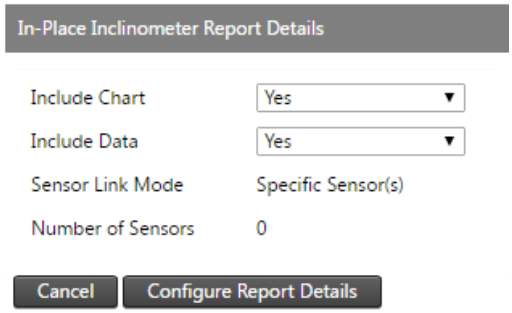
In the *Report Schedule* area to add a new *Analysis Report*, click on the **Add Report Schedule** button, select *Highrise Report* and click on the **Create** button.

The *Highrise Report Options* are below the *Report General Settings* section. The **Time Window Width** setting here is the period over which the report content should span, typically the last 24 hours, or the last 7 days.

The *Report Time Period* determines the time span of data that should be included in the *Report*.

21.5. In-Place Inclinometer Report

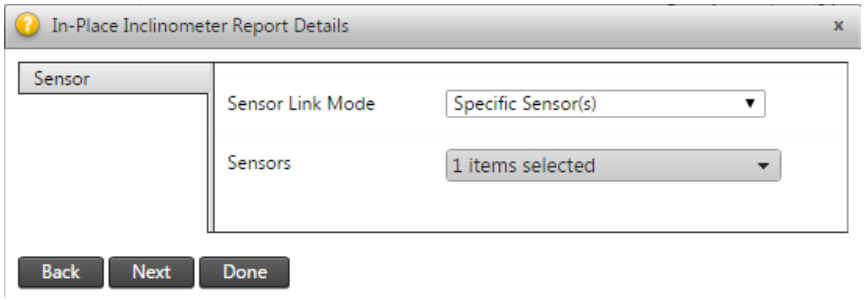
In the *Report Schedule* area to add a new *IPI Report*, click on the **Add Report Schedule** button, select *IPI Report* and click on the **Create** button.



The *In-Place Inclinometer Report Details* are below the *Report General Settings* section. Configure the *n-Place Inclinometer Report Details* as follows:

- **Include Chart:** Indicates if *IPI Chart* should be shown in the report.
- **Include Data:** Indicates if a table of the IPI data points should be shown in the report.
- **Sensor Linke Mode:** This is the sensor link mode selected. Below we will discuss how to configure this.
- **Number of Sensors:** This is the number of *Sensors* that is included in the report.

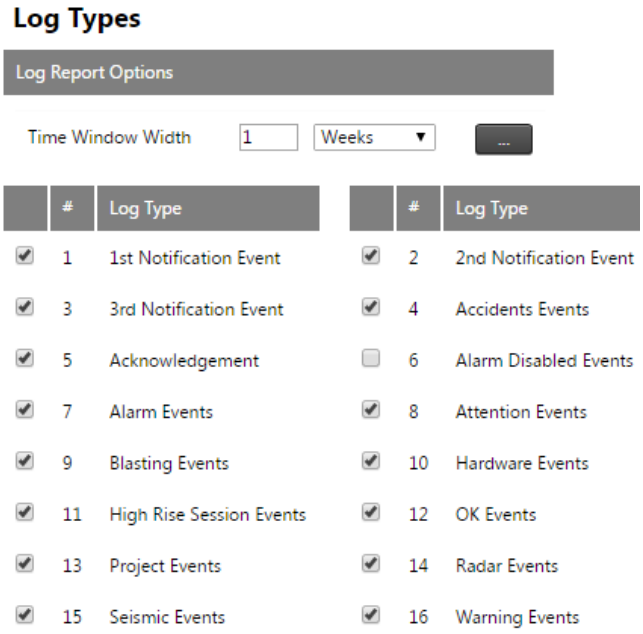
Click on the **Configure Report Details** button to configure more *In-Place Inclinometer Report Details*.



The *In-Place Inclinometer Report Details* dialog provides the option to select the IPI *Sensors* you wish to include in your report. The *Sensor Link Mode* allows you to include to either specific sensors, all sensors of a particular *Sensor Type* or all sensors of a particular *Sensor Group* (see Sensor Groups). In the example above we selected Specific Sensor link mode and we selected one sensor to be included in the report.
Click *Done* to apply your changes.

21.6. Log Report

In the *Report Schedule* area to add a new *Log Report*, click on the **Add Report Schedule** button, select *Log Report* and click on the **Create** button.



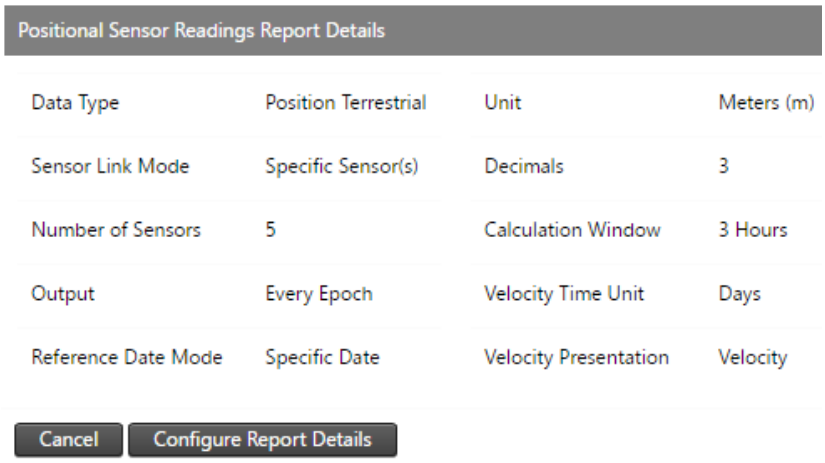
The *Log Report Options* are below the *Report General Settings* section. The **Time Window Width** setting here is the period over which the report content should span, typically the last 7 days, or the last 2 weeks.

You will also see a list of *Log Types*. You can select from this list to determine the *Log Type* of the *Logs* you wish to include in your report.

21.7. Positional Sensor Readings Report

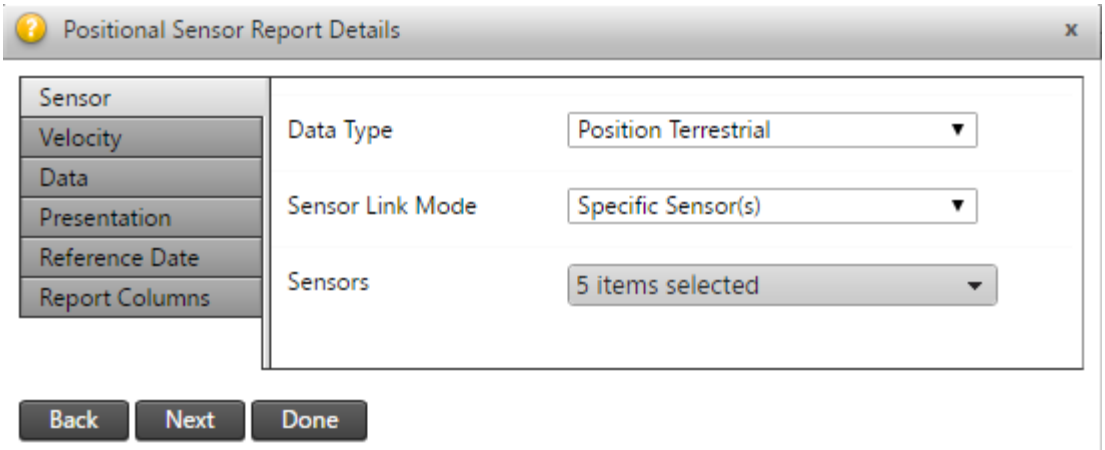
In the *Report Schedule* area to add a new *Positional Sensor Render Report (PSR)*, click on the **Add Report Schedule** button, select *PSR Report* and click on the **Create** button.

The *PSR Report* is an Excel File export containing readings of *Sensors* with *Positional Data Types*. The report also calculate and presents the sensor's resultant position by adding the originally measured sensor location to the the measured change in the position according to the readings.



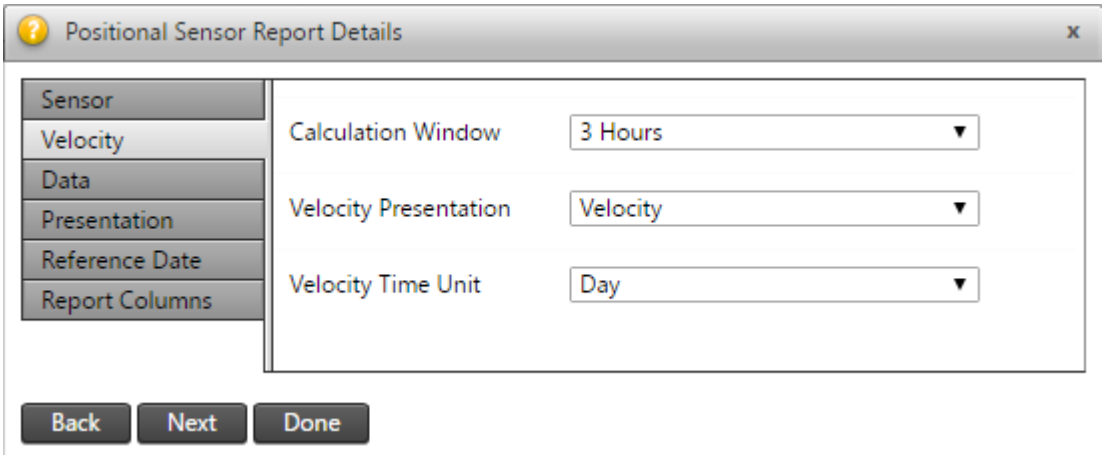
The *PSR Report Details* are below the *Report General Settings* section. You can edit the listed settings by clicking on the particular setting. This will open the *PSR Report Details* dialog where you can edit the settings. You can also click on the **Configure Report Details** button to open the *PSR Report Details* dialog. The following steps will guide you through configuring your *PSR Report*.

Step 1: The first tab on the *PSR Report Details* dialog shows allows you to select a *Positional Data Type* and the relevant sensors associated with that *Positional Data Type* to be included in the report.



The *Sensor Link Mode* allows you to include to either specific sensors, all sensors of a particular *Sensor Type* or all sensors of a particular *Sensor Group* (see Sensor Groups). In the example above we selected Specific Sensor link mode and we selected five sensors to be included in the report. Click *Next* to proceed.

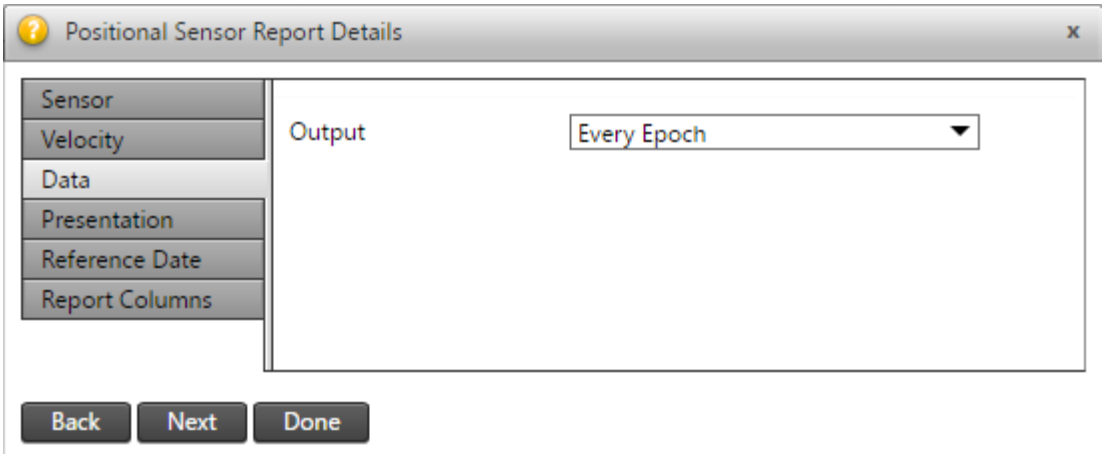
Step 2: Configure the *Velocity* settings. The *Velocity* settings tab will only be visible for *Data Types* where *Velocity* is applicable.



The settings are as follows:

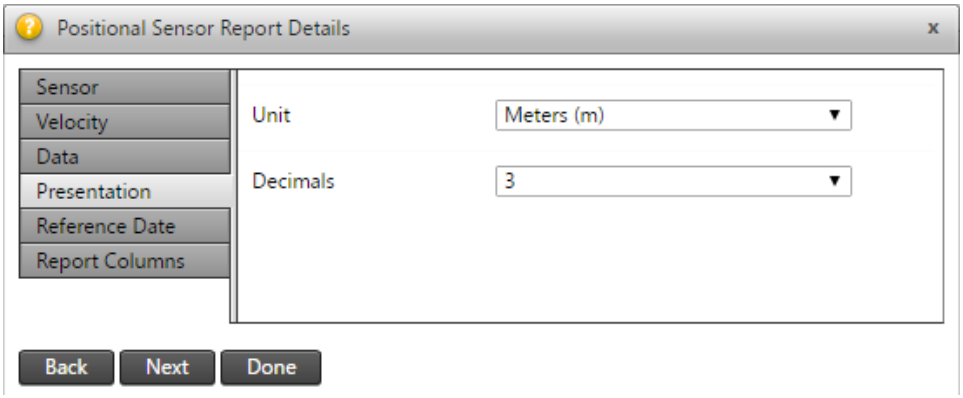
- **Calculation Window**: Specify the width of the rolling time window over which a linear regression line should be fitted in order to calculate the velocity to be monitored.
- **Velocity Presentation**: Specify whether the velocity should be presented as *Velocity* (v) or *Inverse Velocity* ($1/v$).
- **Velocity Time Unit:** The time unit in which the velocity should be presented. These are *Per Hour* or *Per Day*.

Step 3: Select the type of data to be used for the report.



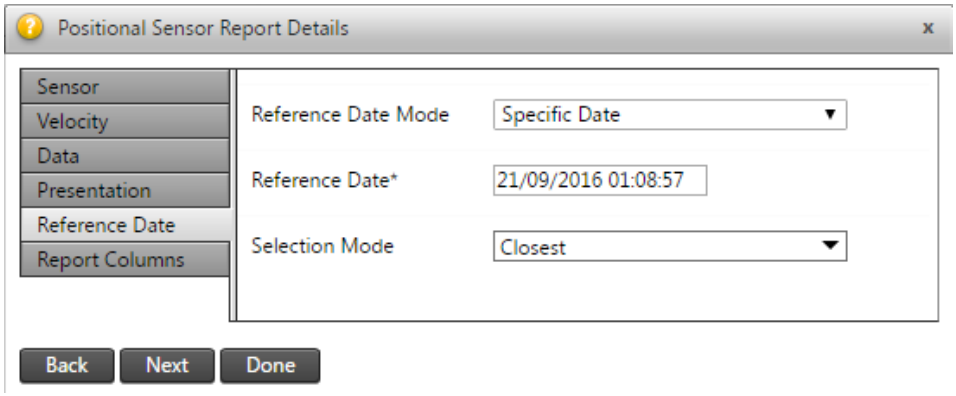
- **Output**: Specify which *Summarized Data Set* to be used to generate the *Positional Sensors Readings Report* (see section Summarized Data Sets). *Every Epoch* refers to the unsummarized readings.

Step 4: Configure presentation of the positional readings.



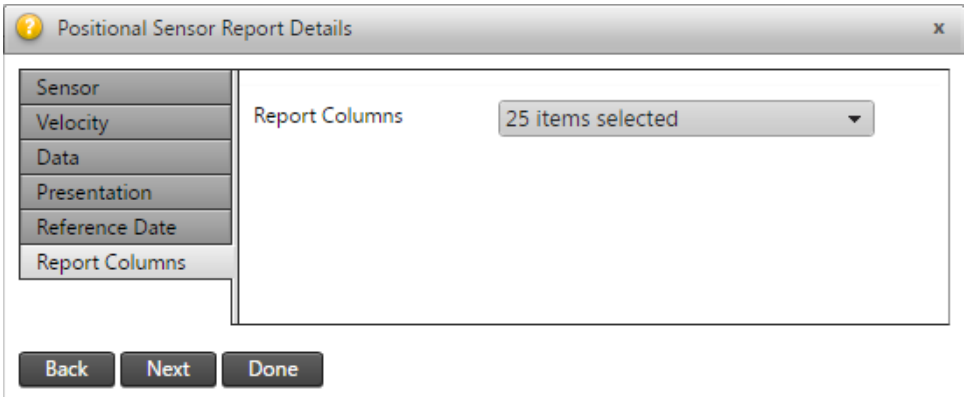
- **Unit**: the unit in which to present the *Positional Readings*.
- **Decimal**: the number of decimals to use for *Positional Readings*.

Step 5: Configure the reference date to be used by the Relative Measurements.



- **Reference Date Mode:** Specifies to use either a *Rolling Offset* or *Specific Date*.
- **Reference Value Offset:** If *Rolling Offset* was selected for *Reference Date Mode* in the previous option then you can set the reference date offset here.
- **Reference Date:** If *Specific Date* was selected for *Reference Date Mode*, then you can enter the fixed Reference Date here.
- **Selection Mode:** Choose how the reference value is selected here. This setting determines a preference for closest values before or after the *Reference Date*.

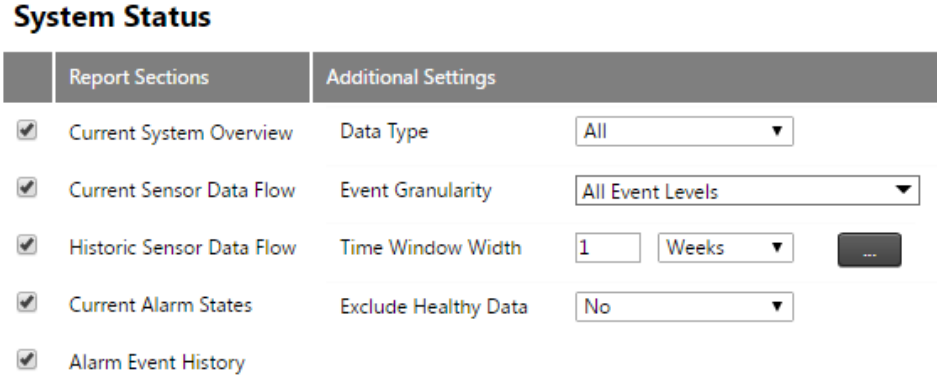
Step 6: Configure the columns to include in the *PSR Report*.



- **Report Columns:** Choose columns related to the sensor (*Sensor Name*, *Sensor Alarm State*), the sensor readings (Delta Northing, Delta Easting, …), or the resultant sensor position at a particular point in time (Northing, Easting, …).

21.8. System Status Report

In the *Report Schedule* area to add a new *System Report Report*, click on the **Add Report Schedule** button, select an *System Status Report* and click on the **Create** button.



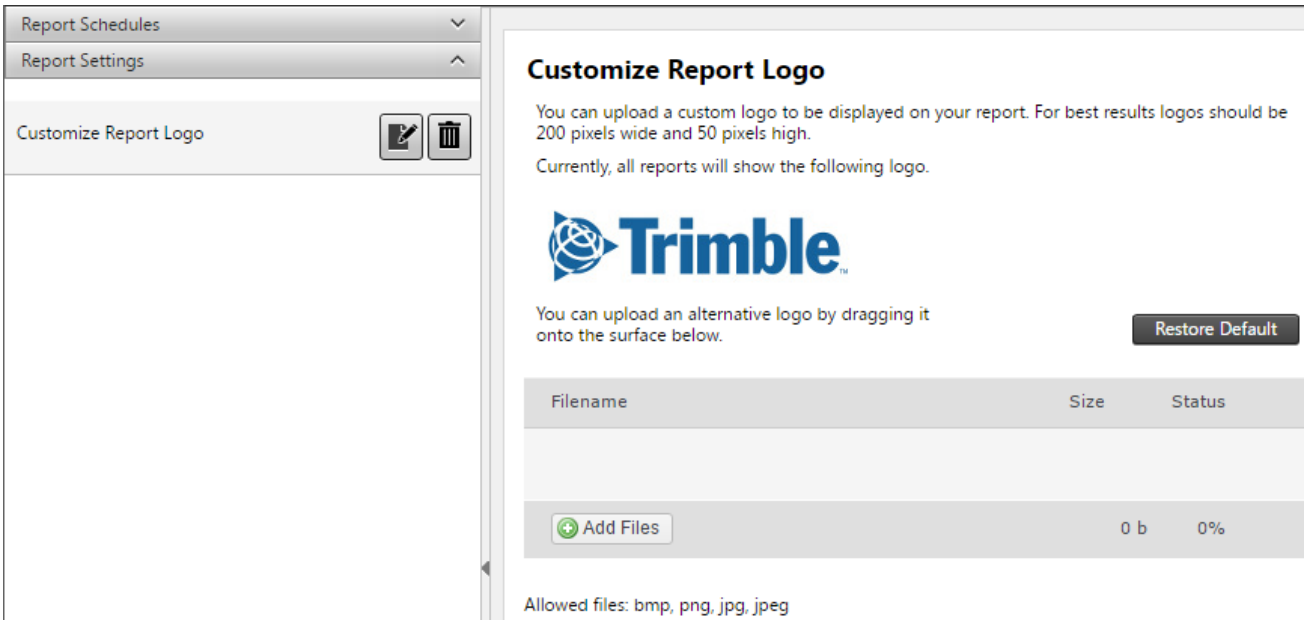
Below the *Report General Settings* section you will see the *System Status Report Options*. You can include different *System Status* reporting in your *System Status Report* by selecting the appropriate setting. These *System Status* report sections correspond to the different System Status areas discussed in the System Status section.

- **Current System Overview:** Shows a synopsis of the system health.
- **Current Sensor Data Flow:** Shows health information about readings received for sensors.
- **Historic Sensor Data Flow:** Shows health information about readings received for sensors in the past.
- **Current Alarm Status:** Shows information about the alarms in your project.
- **Alarm Event History:** Shows historic information about alarm events.

The *Additional Settings* on the right hand side are related to the particular *System Status* report sections you selected. The settings available will change depending on which *System Status* report sections you select. We describe these fields below:

- **Data Type:** Use this field if you only wish your *Report* to only include system status information about *Sensors* associated with a particular *Data Type*.
- **Time Windows Width:** This setting here is similar to the **Report Time Period** described previously. This is the period over which the report content should span, typically the last 24 hours, or the last 7 days.
- **Exclude Health Data:** Enable this option to exclude healthy data from your *System Status Report*. This is useful if you want to make unhealthy status more prominent.
- **Event Granularity:** If you selected the *Alarm Event History System Status* report section, then you can specify the Alarm Event Granularity here.

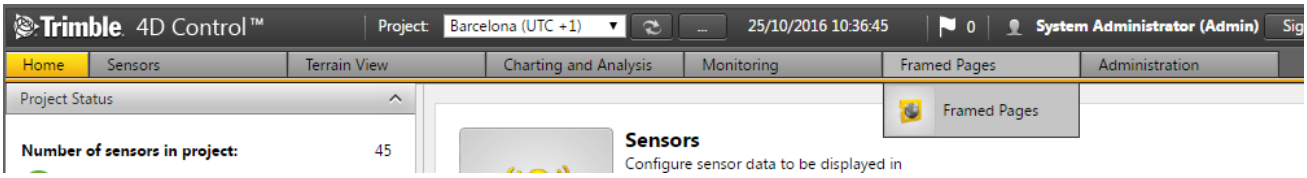
21.9. Customize Report Logo



In the *Report Schedule* area, navigate to the *Report Settings* bar and click on the *Customize Report Logo* item. Here you can click on the *Add Files* button and select a local image file or drag a local image file onto the uploads area to use as the *Report Logo* image. The optimal image resolution is 200 pixels width by 50 pixels height.

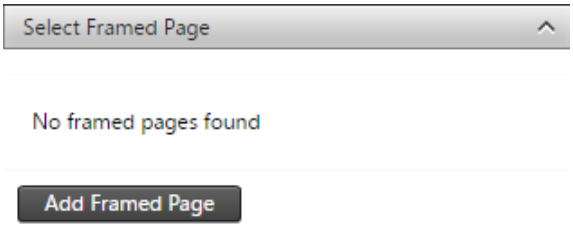
22. Framed Pages

Framed pages offers functionality to show external websites inside Trimble 4D Control accessible via the main menu. This is useful if certain internal web pages are important to the monitoring team using Trimble 4D Control.

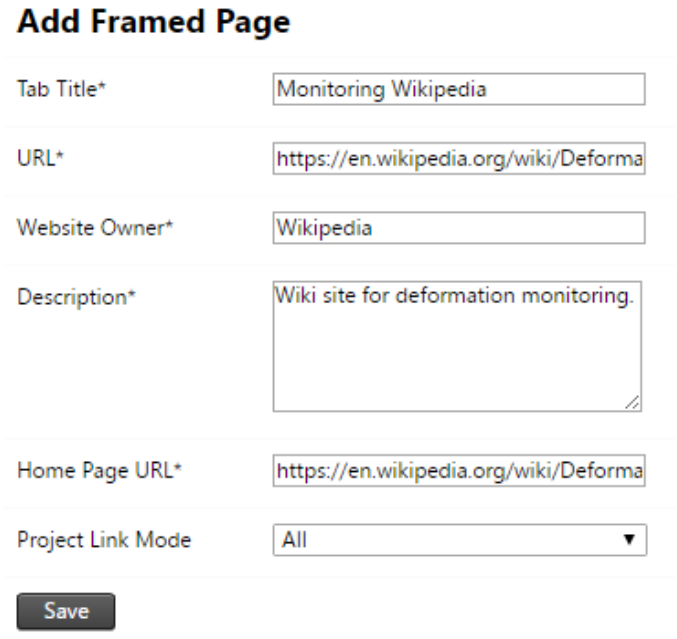


Navigate to the *Framed Page* area via the Menu under *Framed Pages* or from the *Home Page*.

22.1. Add a Framed Page



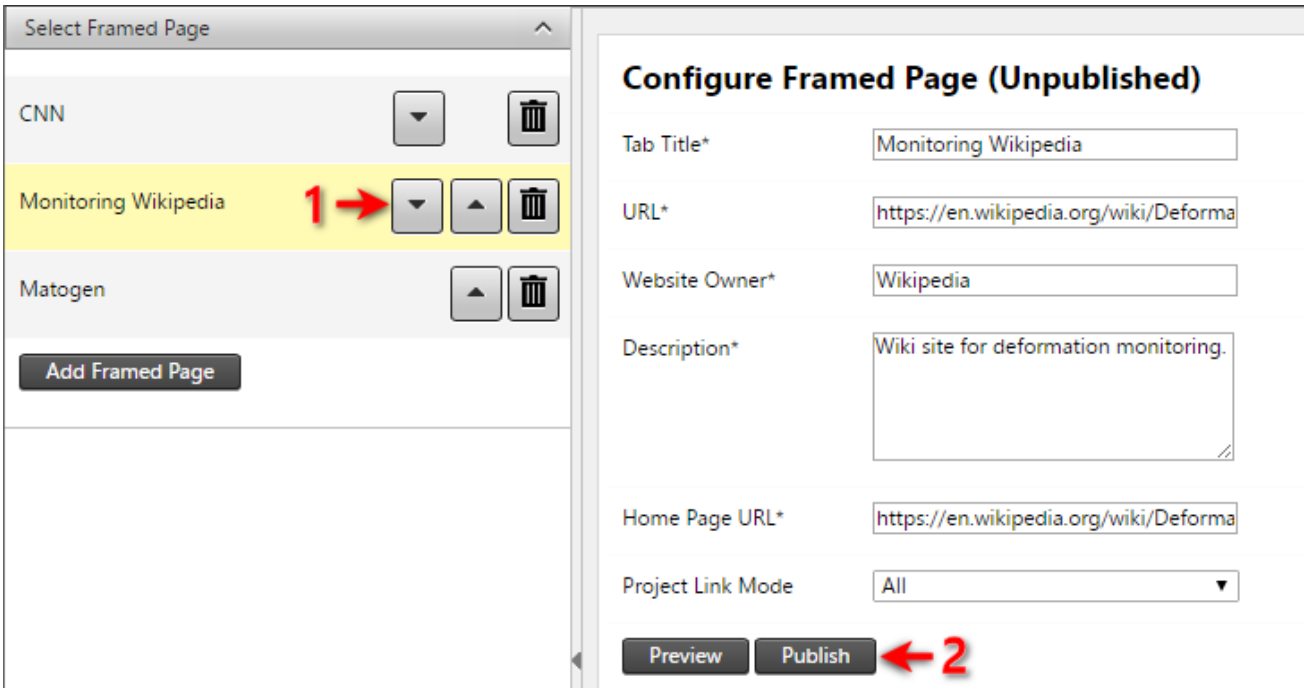
Step 1: Navigate to the *Framed Page* area and click on the *Add Framed Page* button.



Step 2: Complete the form and click *Save* to save your new framed page. You can edit these settings later. The settings are:

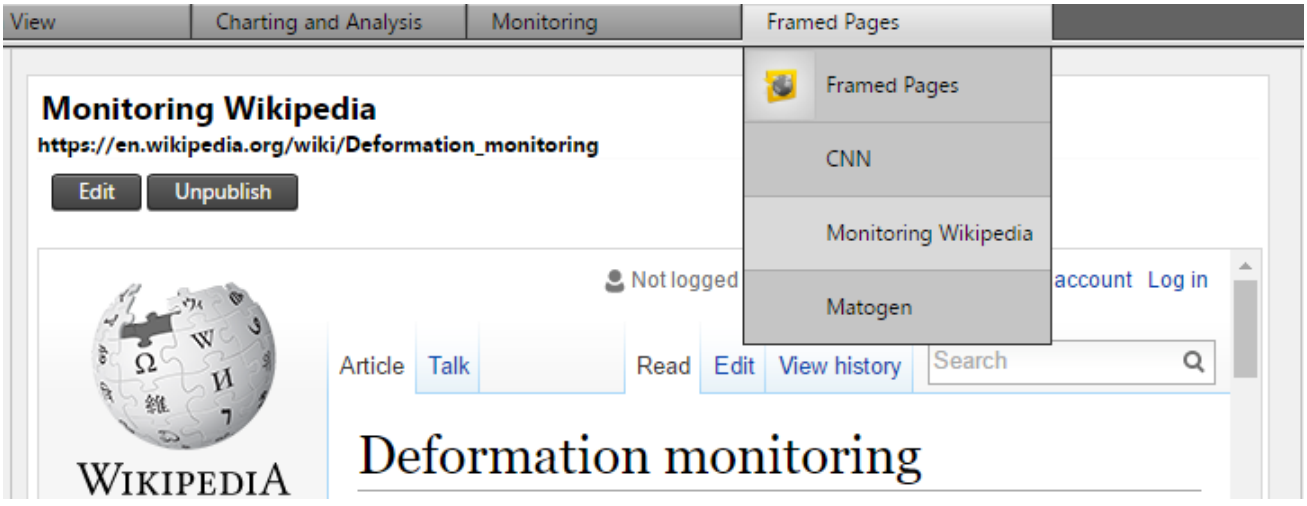
- **Tab Title**: This is the name of the *Framed Page* that appears under the *Framed Pages* drop-down menu.

- **URL**: The URL to the particular website to display inside the framed page. Keep in mind that some websites does not allow being displayed in an **iframe**. If a website disallows being displayed as a *Framed Page* then the framed page will appear blank.
- **Website Owner**: The owner of the website.
- **Description**: A description of the framed page to be displayed below the page.
- **Home Page URL**: A home page link to be accessible from a link below the page.
- **Project Link Mode**: Determines in which projects the *Framed Page* should be visible. The particular framed page will only be visible when a user selected one these projects as the current project in Trimble 4D Control Web.



Step 3: You should now see your framed page in the list on the left. Click on the *Up* and *Down* buttons (1) to change the order in which the framed pages should appear in the *Framed Pages* drop-down menu.

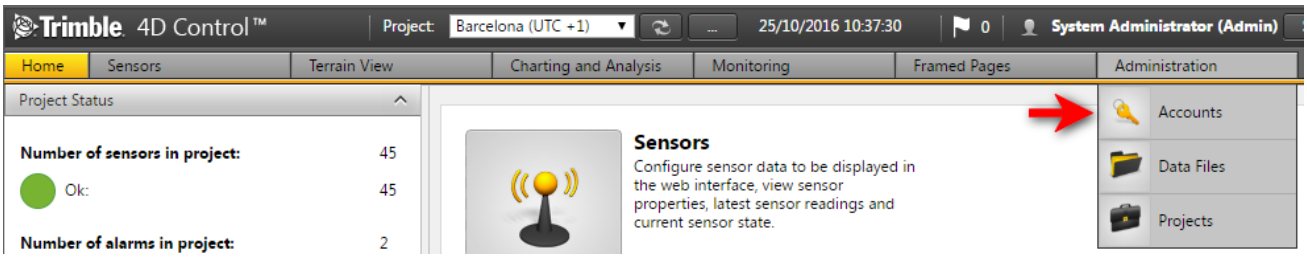
Step 4: Your *Framed Page* is not visible on the *Framed Pages* drop-down menu unless you **Publish** it. Click on the *Publish* button to publish the framed page.



Your *Framed Page* should now be visible on the *Framed Pages* drop-down menu.

23. Accounts

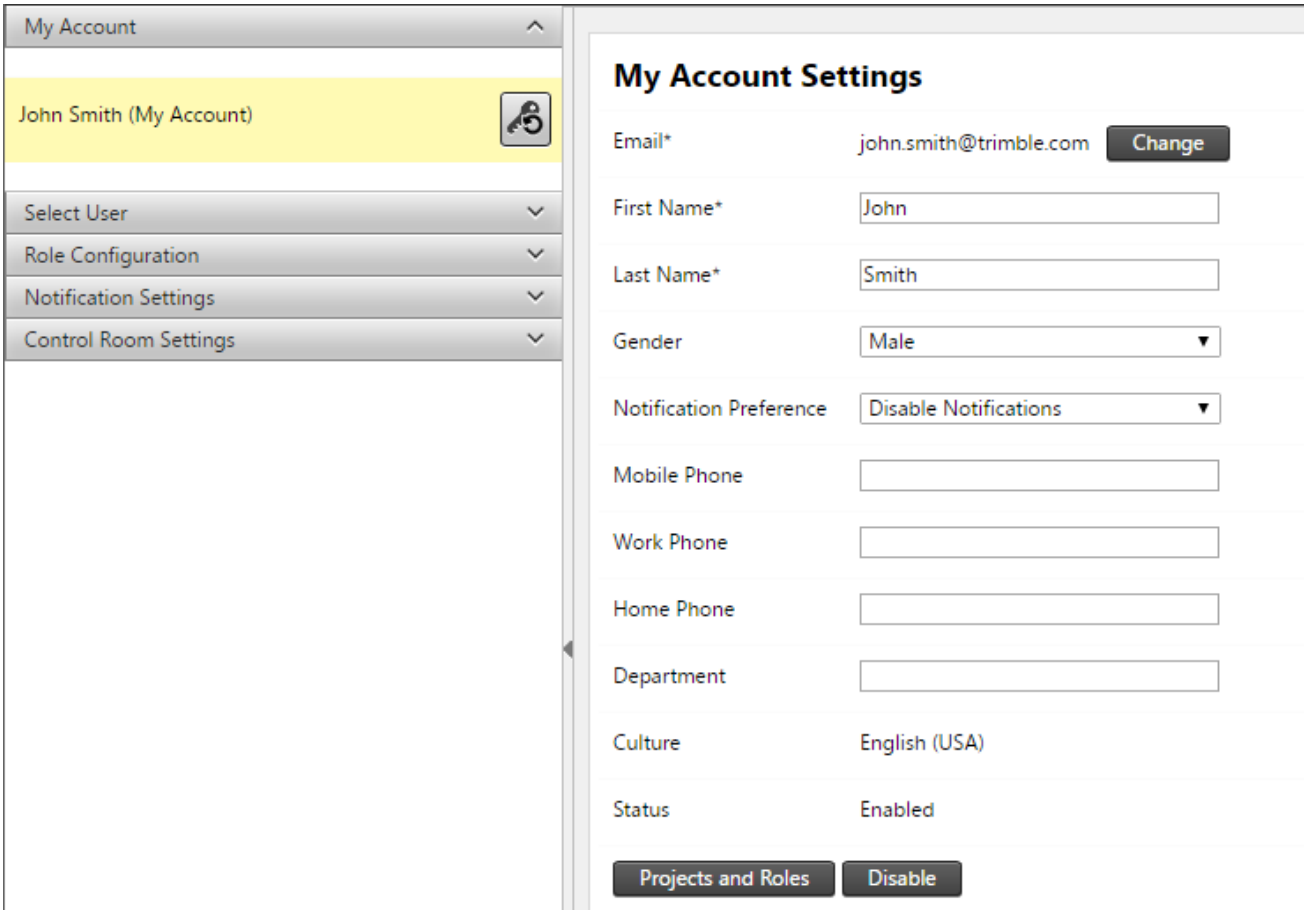
The *Accounts* section allows the user to change their account details. In addition, admin users can set user permissions, add, delete or change passwords for other user accounts.



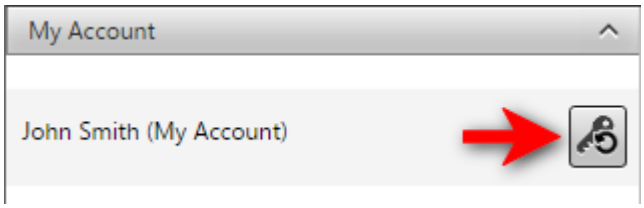
Navigate to the *Accounts* area via the Menu under *Administration* or from the *Home Page*.

23.1. My Account Settings

On the *Accounts* section the *My Account* tab on the left pane will show your username. Click on the username to view your account details.



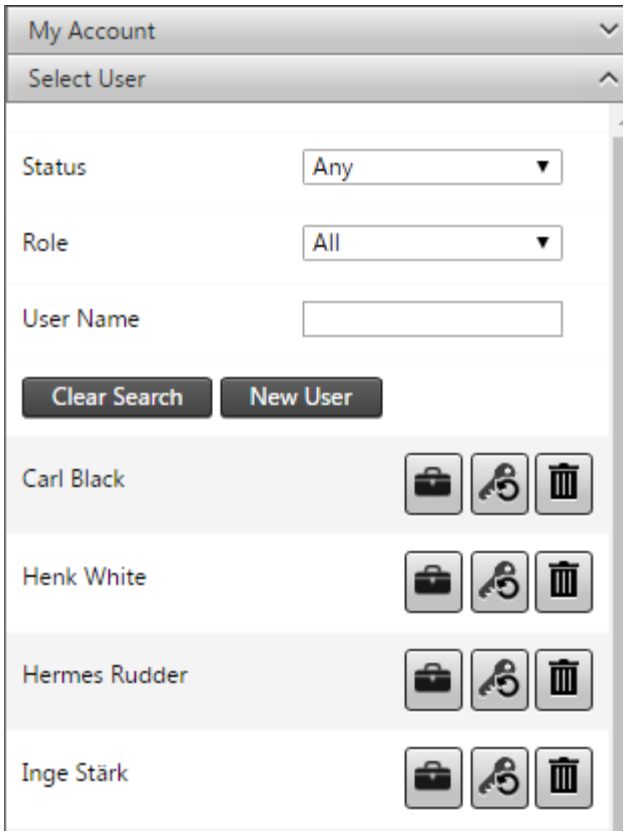
You can edit these and click on the “Save” button to apply the changes.



You can also change your password by clicking on the *Key* icon. A prompt will ask you to enter your current password, a new password and a confirmation of your new password. On the prompt page, click the *Apply* button to change your password.

23.2. Manage User Accounts Settings

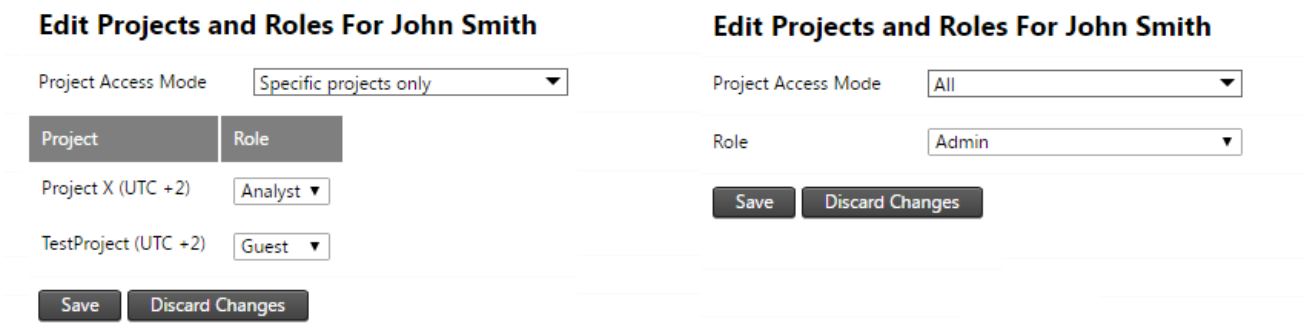
If you have the necessary system privileges you can access the *Select User* tab where you can manage the account settings of other users.



You can filter the user accounts shown in the list of users by using the filter controls.
The user list will automatically update as you populate the filter fields.
Click on the *New User* button to create a new users. (**Important: before creating a user you need to ensure that the system emails are working.** See Email Server Configuration)

Next to each user account are icons to manage the particular user account:

- **Briefcase Icon**: change the *User Roles* assigned to the user.
- **Key Icon**: reset the user's password. An email will be sent to the user containing a new temporary password.
- **Delete Icon**: delete the user account.



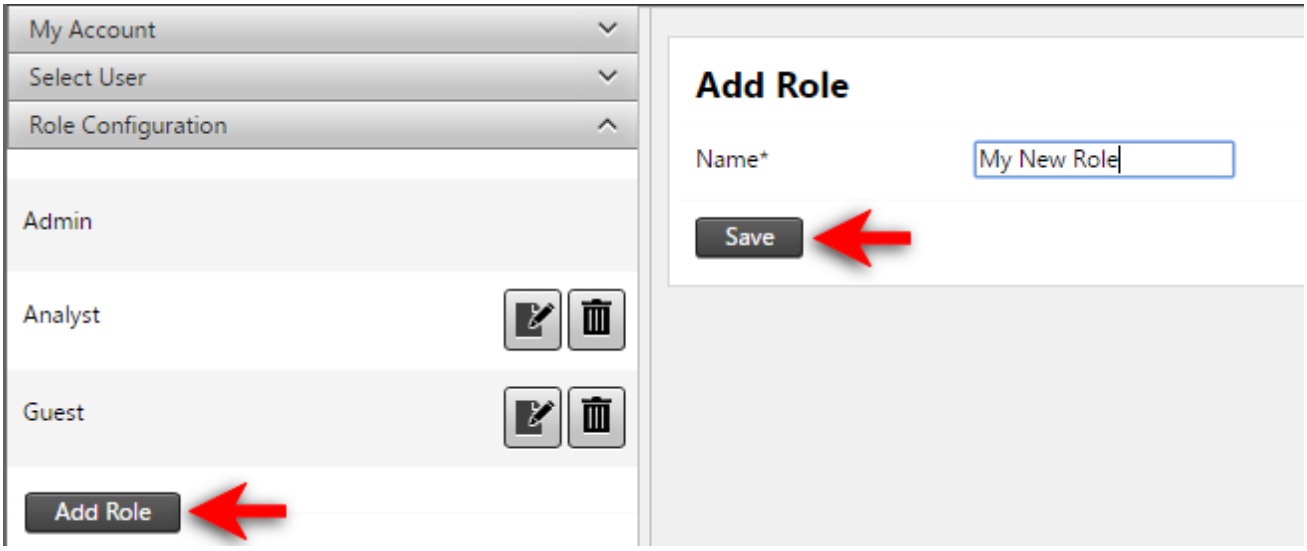
If the Click on the *Briefcase icon* next to a listed user account the *User Roles* assigned to that particular user will be displayed. *User Roles* can be assigned to a user according to the **Project Access Mode** setting; this can be set to either one of the following:

- **Specific projects**: a *User Role* is specified for the user for each project in the system. The user will not have access to any new projects added to the system.
- **All**: a single *User Role* is assigned to all projects. The user will automatically have the same *User Role* configuration on any new projects added to the system.

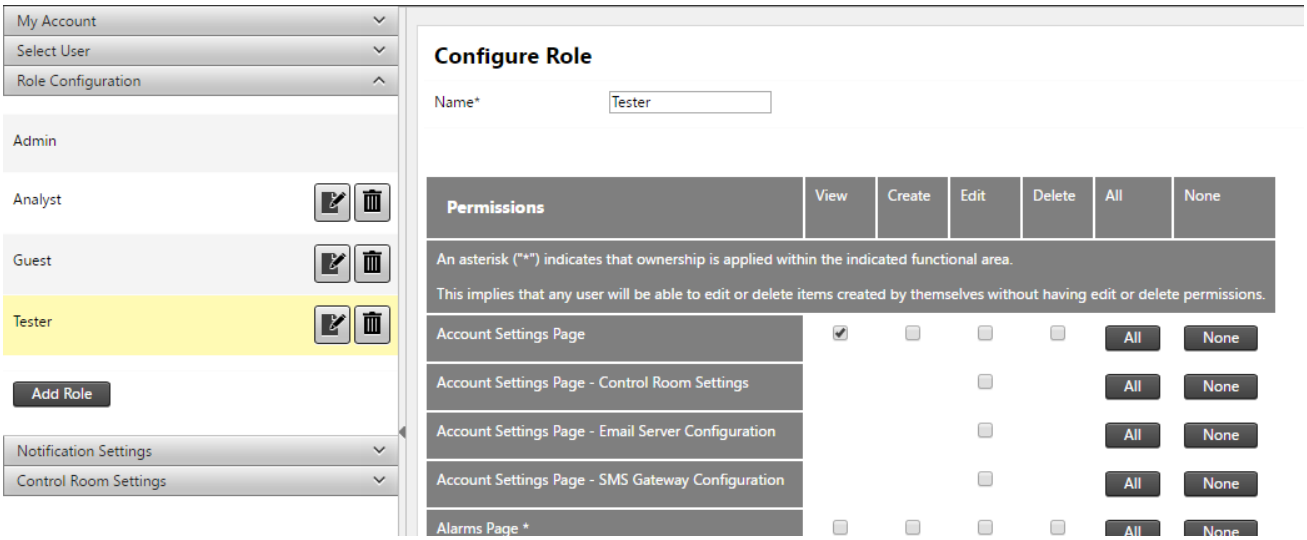
Click on the *Save* button to save the *User Roles* assigned to the user account.

23.3. Role Configuration

If you have the necessary system privileges you can access the *Role Configuration* tab where you can edit or create new *User Roles*.



You can add a new *User Role* by clicking on the *Add Role* button, entering a unique name for your new *User Role* and clicking on the *Save* button.



Configure a *User Role* by selecting the allowable permissions from the list available. Note that some permissions are required by others; for example if the *View* permission is configurable on a particular *User Role* then assigning *Edit* permissions to that role will automatically assign *View* permissions also.

If you change the permissions of a *User Role* a *Save* button will appear. Click on the *Save* button to apply your changes to the *User Role*.

Use the *Delete* icons to delete *User Roles*. You can only delete a *User Role* if the user role is not assigned to any user accounts. First disassociate the particular *User Role* from all user accounts before deleting it.

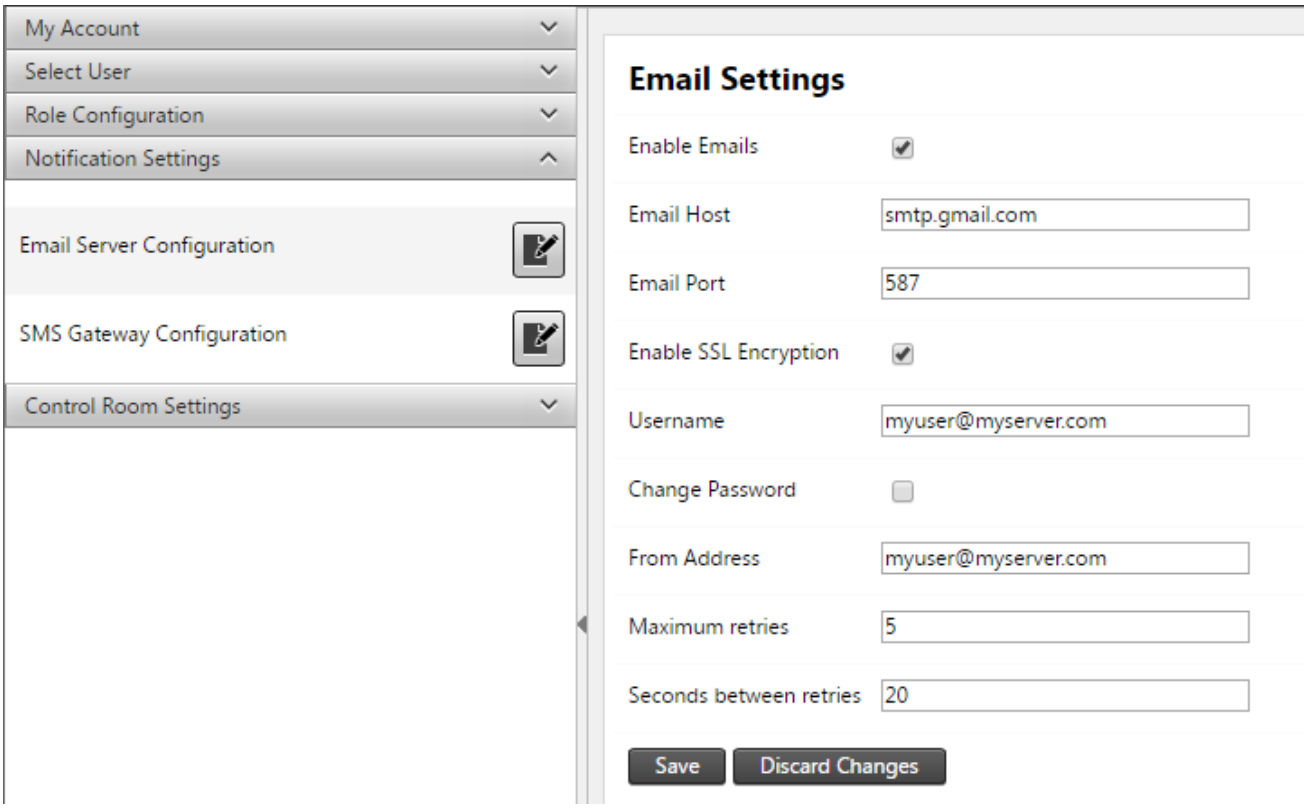
23.4. Notification Settings

If you have the necessary system privileges you can access the *Notification Settings* tab where you can edit the Email Server and SMS Gateway configurations used to send messages to users.

23.4.1. Email Server Configuration

Email sending is required by Trimble 4D Control for a variety of cases. Some of these are new user account notifications, user account password resets, *Alarm Notifications* (see Alarms) and Scheduled Reports.

A new Trimble 4D Control installation will have a blank Email Server Configuration.

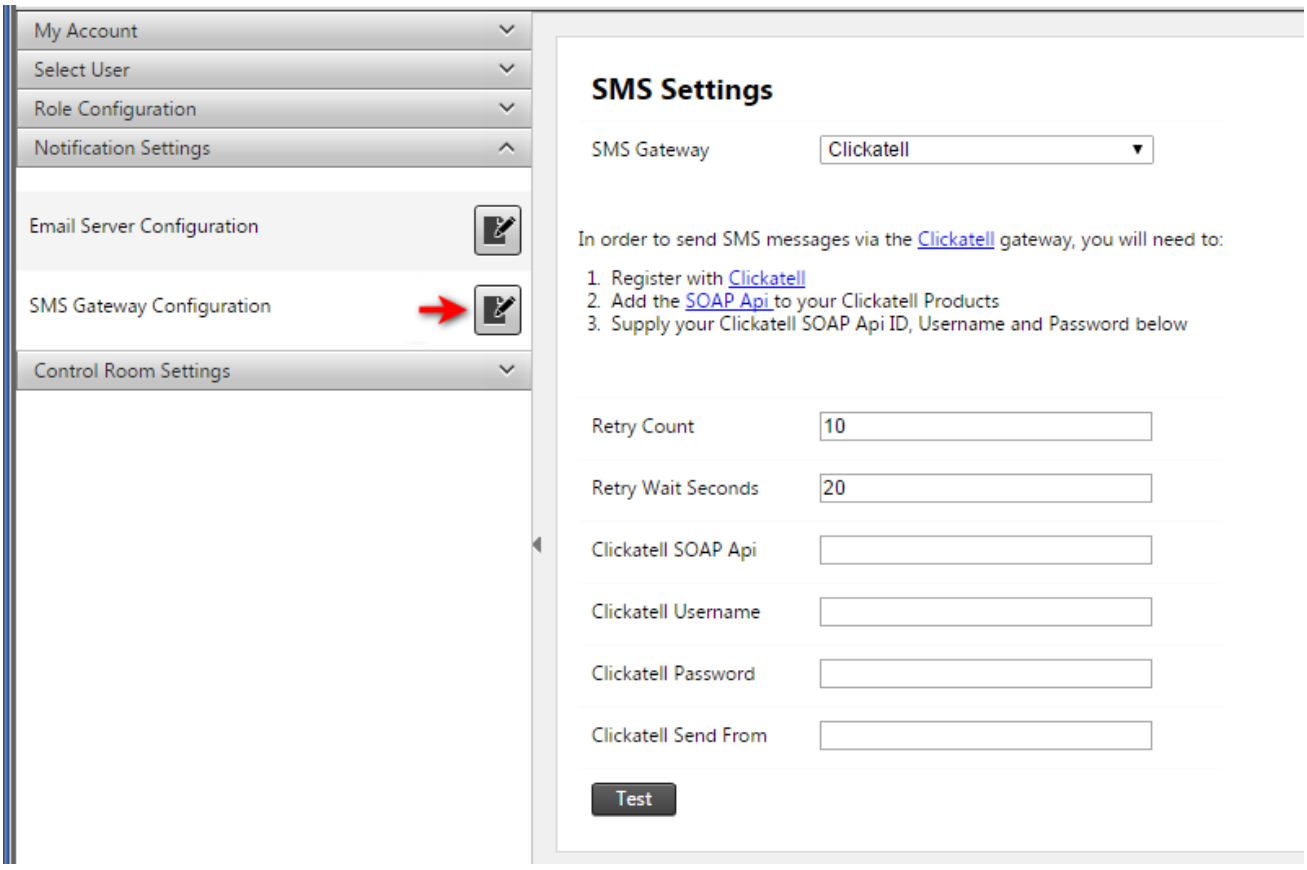


Edit the *Email Server Configuration* by clicking on the *Edit* icon. The settings are as follow:

- **Enable Emails**: you can disable emails using this setting.
- **Email Host**: the SMTP address of the mail server.
- **Enable SSL Encryption**: the port on which to send emails using SMTP.
- **Username**: the email account username. Some providers require a full email address here.
- **Change Password**: check this option if you wish to change the email account password.
- **Password**: this field will become visible if you check the *Change Password* option above.
- **From Address**: the from address to appear in the outgoing emails. Usually this is the same as your email account address.
- **Maximum retries**: if email sending failed for some intermittent reason, then Trimble 4D Control will retry sending the email this number of tries.
- **Seconds between retries**: if email sending failed for some intermittent reason, then Trimble 4D Control will wait for this configured period before retry sending the particular email.

Click on the *Save* button to apply your changes.
Click on the *Test* button to send a test Email to verify that your *Email Server Configuration* is correct.

23.4.2. SMS Gateway Configuration



Edit the *SMS Gateway Configuration* by clicking on the *Edit* icon. The settings are as follow:

- **SMS Gateway**: you can either Disable SMS notification with this settings or select the *Clickatell SMS Gateway. **NB**: Please register at Clickatell (www.clickatell.com) to obtain account details for the SMS sending functionality.*
- **Retry Count**: if SMS sending failed for some intermittent reason, then Trimble 4D Control will retry sending the SMS this number of tries.
- **Retry Wait Seconds**: if SMS sending failed for some intermittent reason, then Trimble 4D Control will wait for this configured period before retry sending the particular SMSl.
- **Clickatell SOAP Api**: the API address you obtained from Clickatell.
- **Clickatell Username**: the username you obtained from Clickatell.
- **Clickatell Password**: the passwordyou obtained from Clickatell.
- **Clickatell Send From**: the send from you obtained from Clickatell.

Click on the *Save* button to apply your changes.
Click on the *Test* button to send a test SMS to verify that your *SMS Gateway Configuration* is correct.

23.5. Control Room Settings

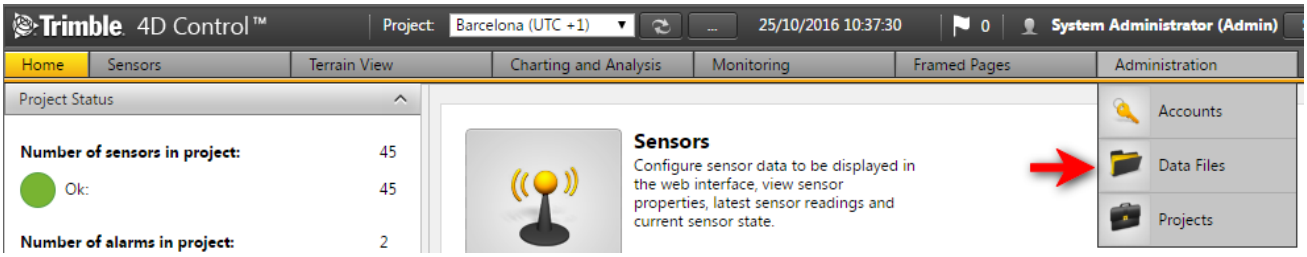
Open the *Control Room Settings* tab on the left hand side pane. Here you can enable *Seamless Transfer* from *T4D Control Room Web* if your installation is licensed to enable remote monitoring from *T4D Control Room Web*.

Users who access *T4D Control Room Web* may request to be redirected to a specific Trimble 4D Control installation (see the T4D *Control Room Web* section on Installations). If a user uses the same username (or email) to log into both Trimble 4D Control and *Trimble 4D Control Room*, then it is possible to accept "proof of identity" from *T4D Control Room Web*. When this settings is enabled, such users will not have to specify a username and password to log into Trimble 4D Control.

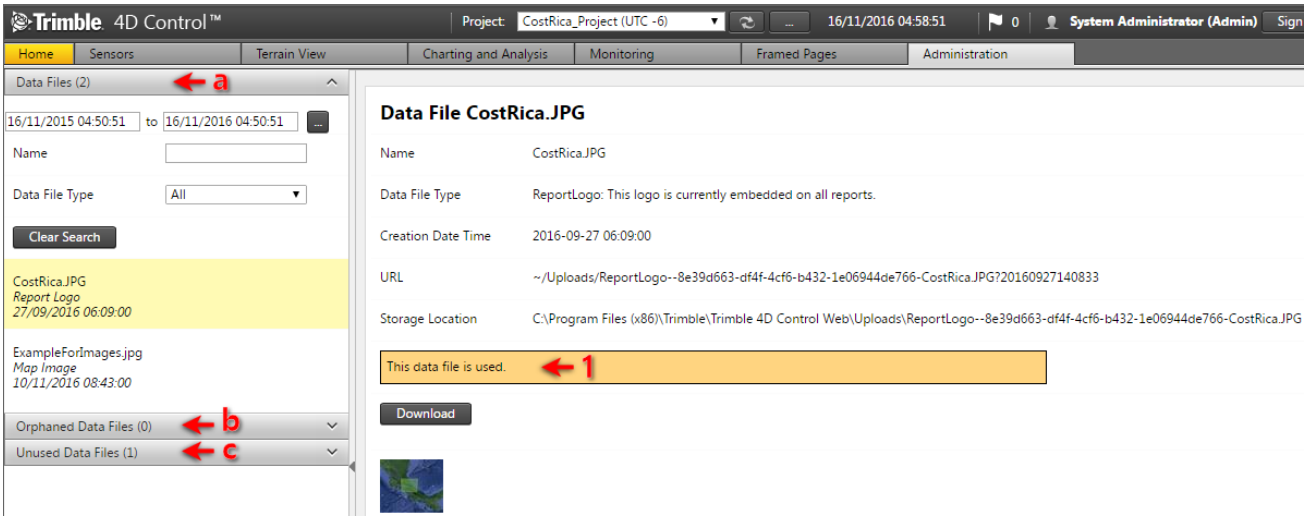
For security reasons this form of seamless transfer will not work for users logged on as **admin**.

24. Manage Data Files

The *Manage Data Files* area is used by system administrators of Trimble 4D Control to manage the files uploaded to Trimble 4D Control Web. Data file are occasionally uploaded by users for *Custom View* background images, *geo-referenced images* for the *map* or *Sensor Documents*. Although the entities associated with the data files are stored in the *Monitoring Database* the physical files themselves are stored on the local disk of the machine hosting Trimble 4D Control Web.



Navigate to the *Data Files* area via the Menu under *Administration* or from the *Home Page*.



The *Manage Data Files* area has three tabs on the left. The *Data Files* tab (a) shows you all the data files that are associated with entities in the *Monitoring Database*. Here you can filter and view information about each *data file* in the system. A message (1) indicates the status of each data file.

The *Orphaned Data Files* (b) tab shows *data files* that are referenced by entities according to the *Monitoring Database*, however their physical files does not exist on the local disk of the machine hosting Trimble 4D Control Web. This could be due to a faulty upgrade of Trimble 4D Control or the folder on the local disk of the machine hosting Trimble 4D Control Web has been moved.

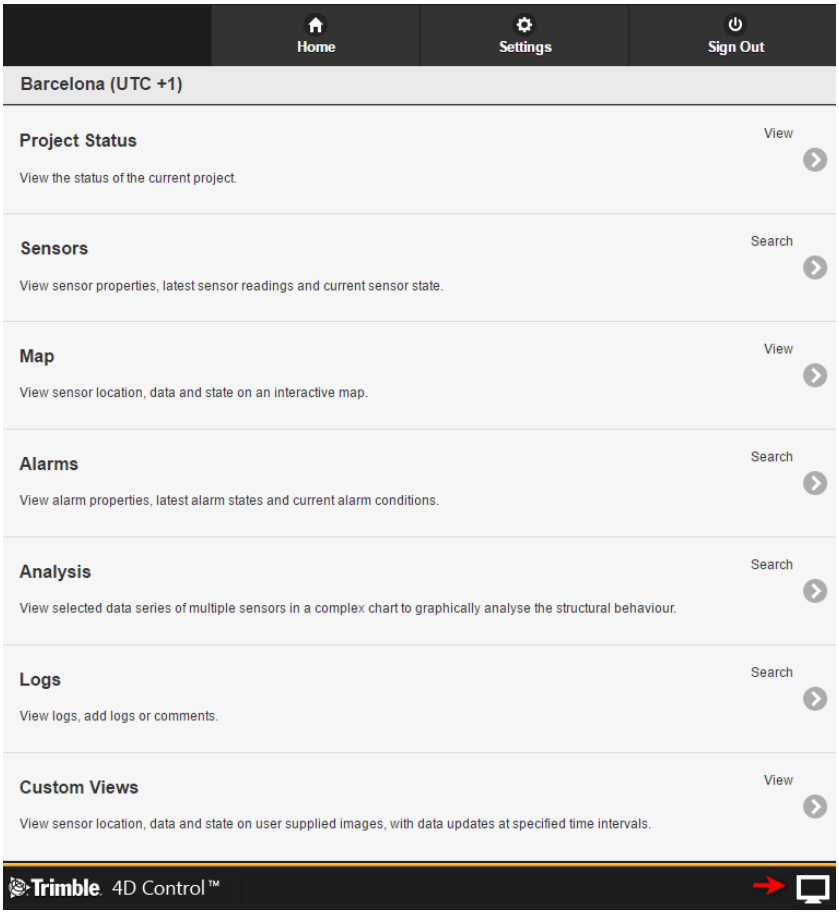
The *Unused Data Files* (c) tab shows *data files* that are not associated with entities in the *Monitoring Database*. Typically these are background images or map images that once were associated with entities in the *Monitoring Database*, but those entities have been deleted since.

25. Mobile View

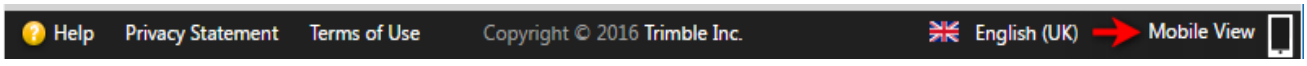
Trimble 4D Control Web suite provides a separate *Mobile View* for devices with a small screen size.

The mobile view only offers a subset of the functionality available in the *Desktop View*. The intention of the *Mobile View* is to offer users a task-orientated slimmed down interface to perform tasks typical for users that only have mobile access to Trimble 4D Control Web.

Trimble 4D Control Web will automatically detect if you are using a mobile device and serve the *Mobile View* to your mobile browser. You can also manually switch between the *Mobile View* and the regular *Desktop View*:



When you are in the *Mobile View*, click on the *Desktop* icon on the bottom right to switch back to the *Desktop View*.



A *Mobile* icon will appear on the bottom right of the Trimble 4D Control Web status bar, if your browser window is not wide enough for the regular *Desktop View*. Click on this *Mobile* icon to switch to the Mobile View.

26. Trimble 4D Control Room

Trimble 4D Control Room is a stand alone web application providing a centralized overview of multiple Trimble 4D Control installations.

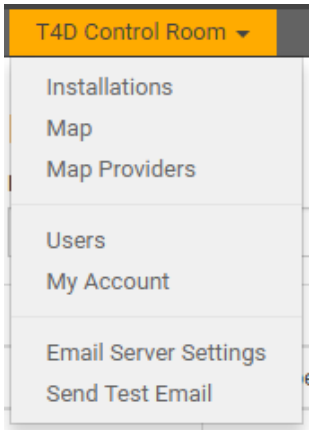
The main purpose of Trimble 4D Control Room is to provide summarized health information from various Trimble 4D Control installations and a way for the user to seamlessly access all installations.

26.1. Introduction

Trimble 4D Control Room is a web based application. All local data and configurable settings of Control Room is stored on local configuration files in the Control Room application folder. Control Room therefore does not require SQL Server.

The following areas allows configuration and viewing of the entities in Control Room:

- **Installations:** Information and connection details to the T4D Control Web installations.
- **Map:** Settings for a map on which the *Installations* are displayed.
- **Users:** Information about the users that are allowed to log on and use Control Room.
- **Email:** Email settings to be used for notifications sent by Control Room.



Areas where you can view and configure these entities can be accessed from the Control Room main menu. The next few sections will discuss these areas.

26.2. Installations

From the T4D Control Room menu option select *Installations* to view the I*nstallations List* area.

In our example above we already configured a number of T4D Control Web installations.

Click on the *expand* (4) icon to show the monitored projects listed under each installation. In our example above the "Perth" Trimble 4D Control installation has two configured projects called the "Long Term Test" and "Purple Line".

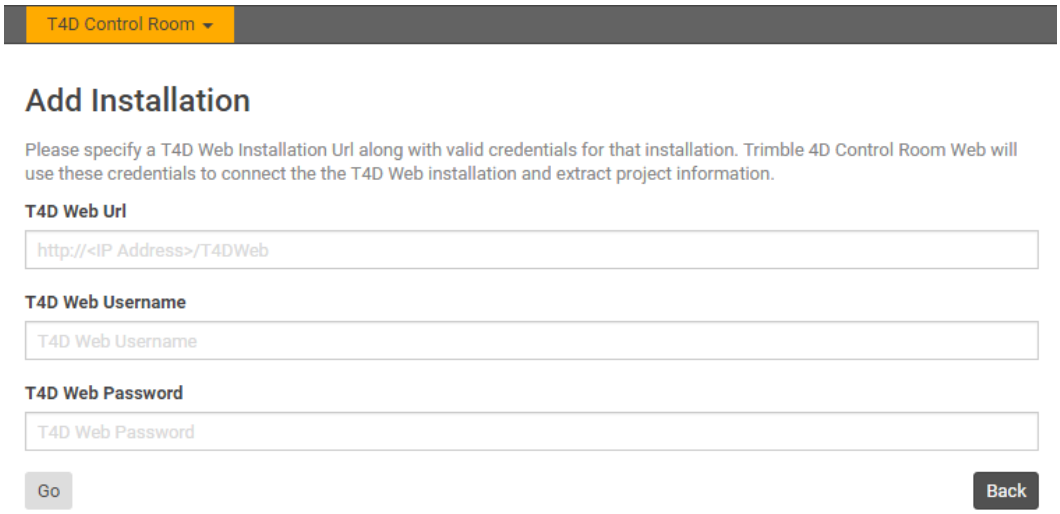
Projects of the various Trimble 4D Control Web installations will indicate the health of their **Data Flow** (1), **Current Alarms** (2) and **Active Events** (3).

- **Data Flow**: This indicator reflects the color of the worst health status of sensor data flows in the monitored project.
- **Current Alarms**: This indicator shows the worst alarm state of alarms in the monitored project.
- **Active Events**: This indicator shows the worst alarm state of unacknowledged events in the monitored project.

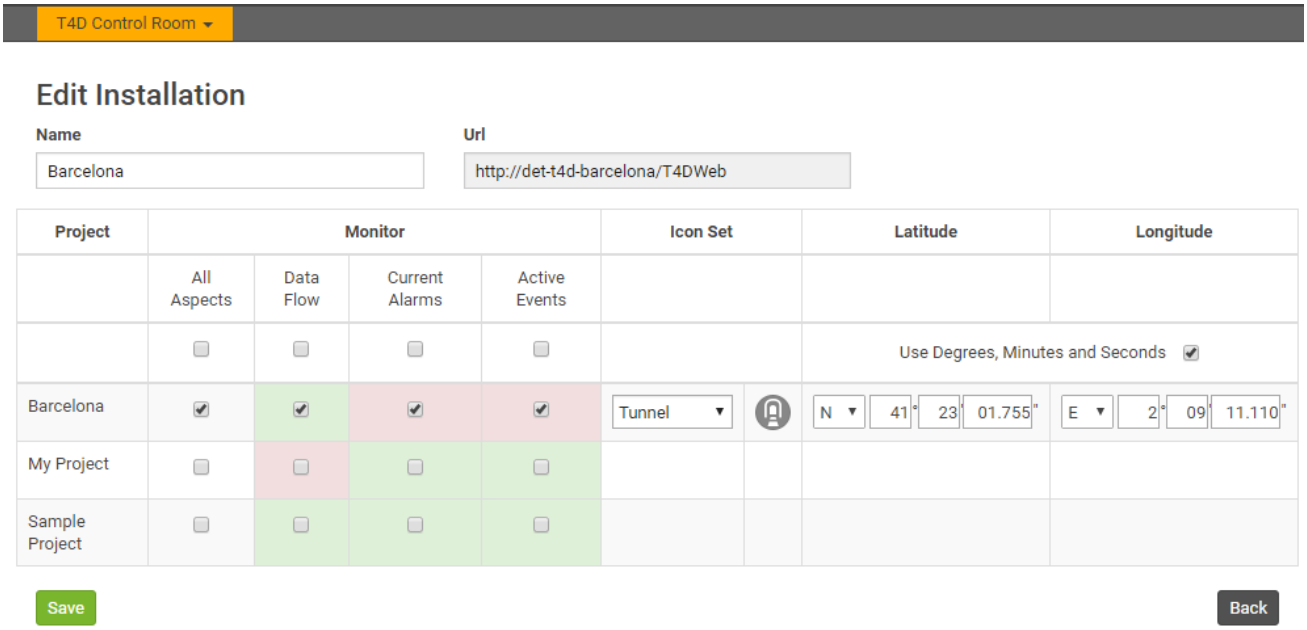
Clicking on the *Home* (5) icon of a particular *Installation* will open the particular Trimble 4D Control Web installation in a new browser tab. Depending on your user configuration and the particular Trimble 4D Control installation settings (see Control Room Settings) a you may be required to enter login credentials to login to the particular Trimble 4D Control installation.

T4D Control Room Web periodically refreshes the health indicators of each project in each *Installation*. The staleness of the health indicators are displayed below the list of monitored projects (6) of each *Installation*.

Click on the *Add* (7) icon to add a new *Installation*.



The *Add Installation* page will require you to enter the Trimble 4D Control Web URL and the login credentials of an administrator user on the particular installation. Please note that for security reasons you cannot use the built-in "admin" user to connect to an installation. Complete the required fields and click the *GO* button to add the installation.



You will be directed to the *Edit Installation* page. Here you can select the particular health indicators from each project that you wish to monitor. We discussed in the installation health indicators in the previous section.

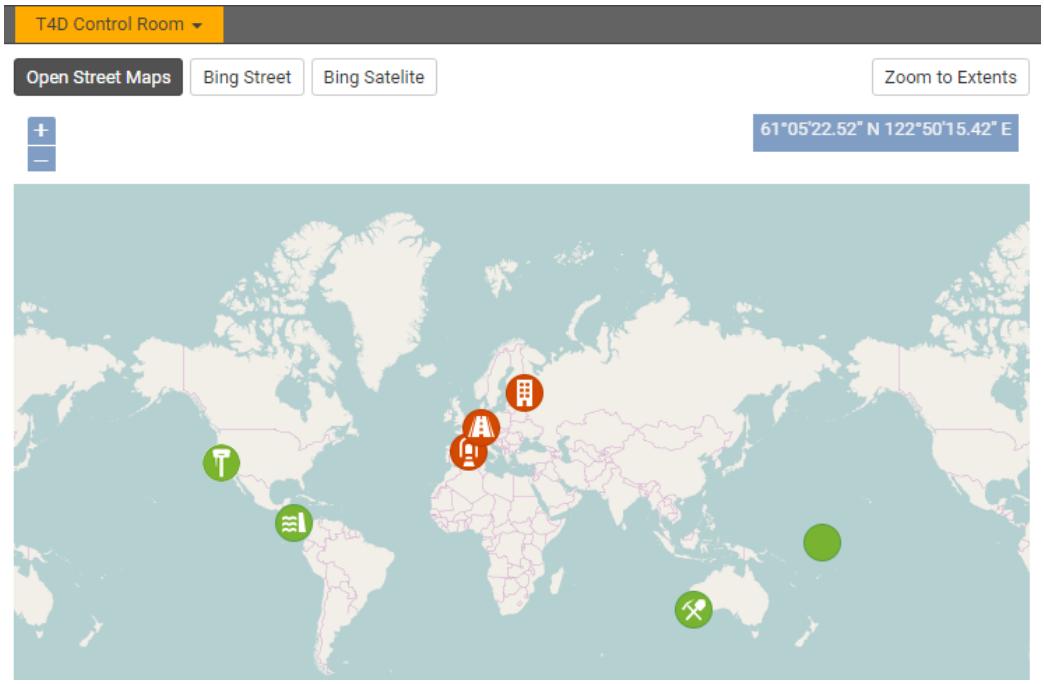
You can also associate an icon that represents the particular Trimble 4D Control installation and the representative geographic location of the project.

You can also change the **Name** of your installation.

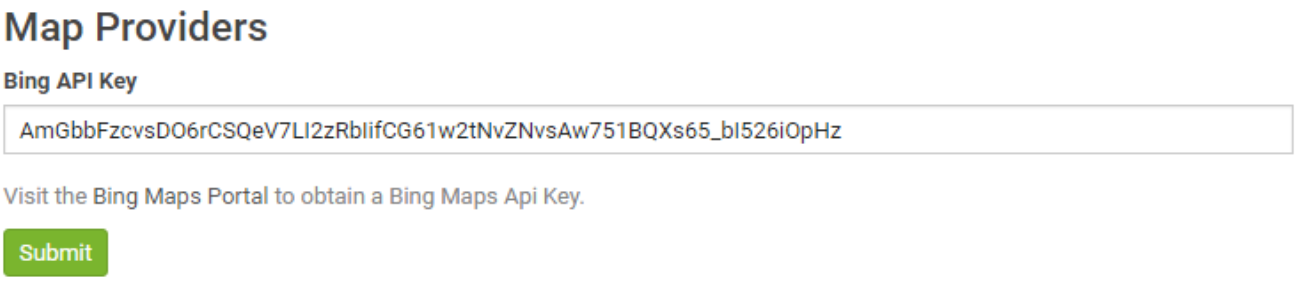
Once you are done, click the *Save* button to save your *Installation* settings. You can always get back to an installation's *Edit Installation* page by clicking on the *Edit* icon next to a particular *Installation* on *Installation List*.

26.3. Map

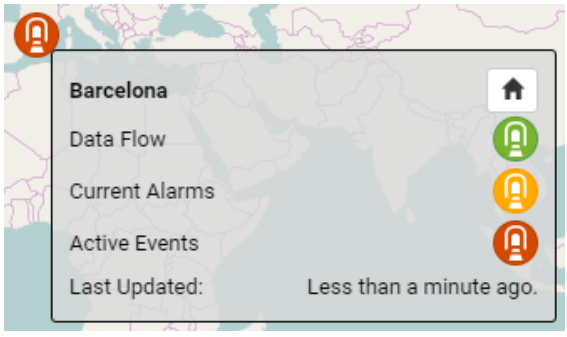
The *Map* area is useful to see a geographic overview of your Trimble 4D Control installations.



You can select different map providers by using the selectors at the top.



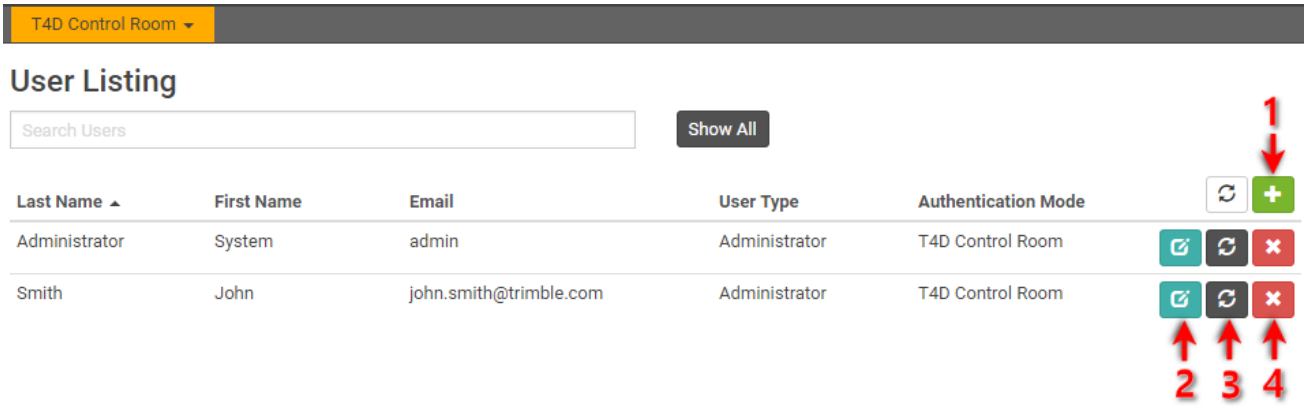
Navigate to the *Map Providers* area from the main menu to configure a Bing API Key required to use Bing Maps.



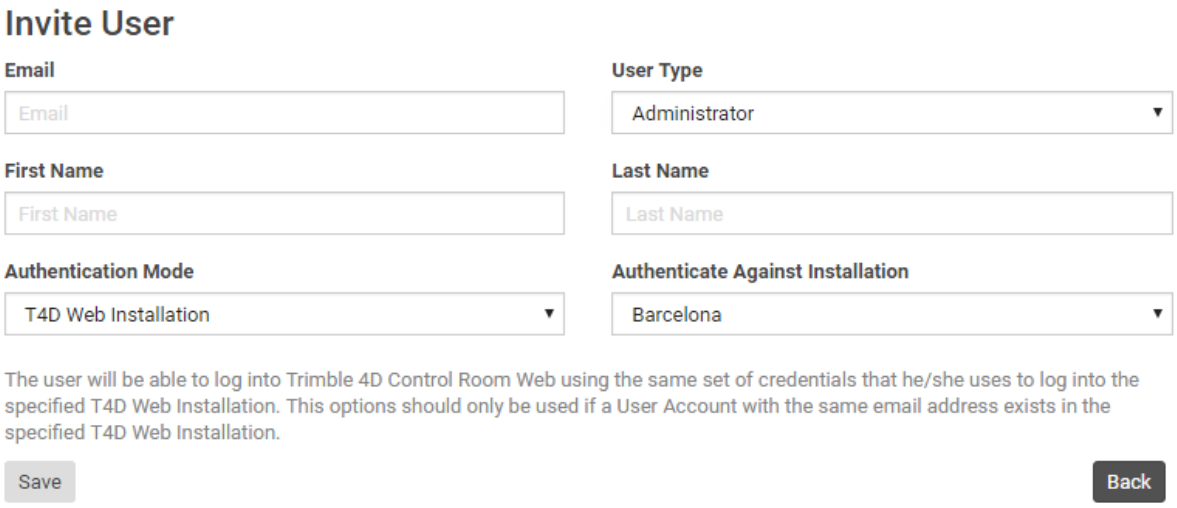
On the *Map* area, move your mouse cursor over an *Installation* icon to view the health information of the particular *Installation*.

26.4. Users

The *User* area presents a list of all the users in T4D Control Room Web.
Here you can add (1), edit (2), reset the password (3) or remove (4) users.



Click on the *Add* (1) icon to add a new user.



Fill in the user's email address, name and specify the user type.

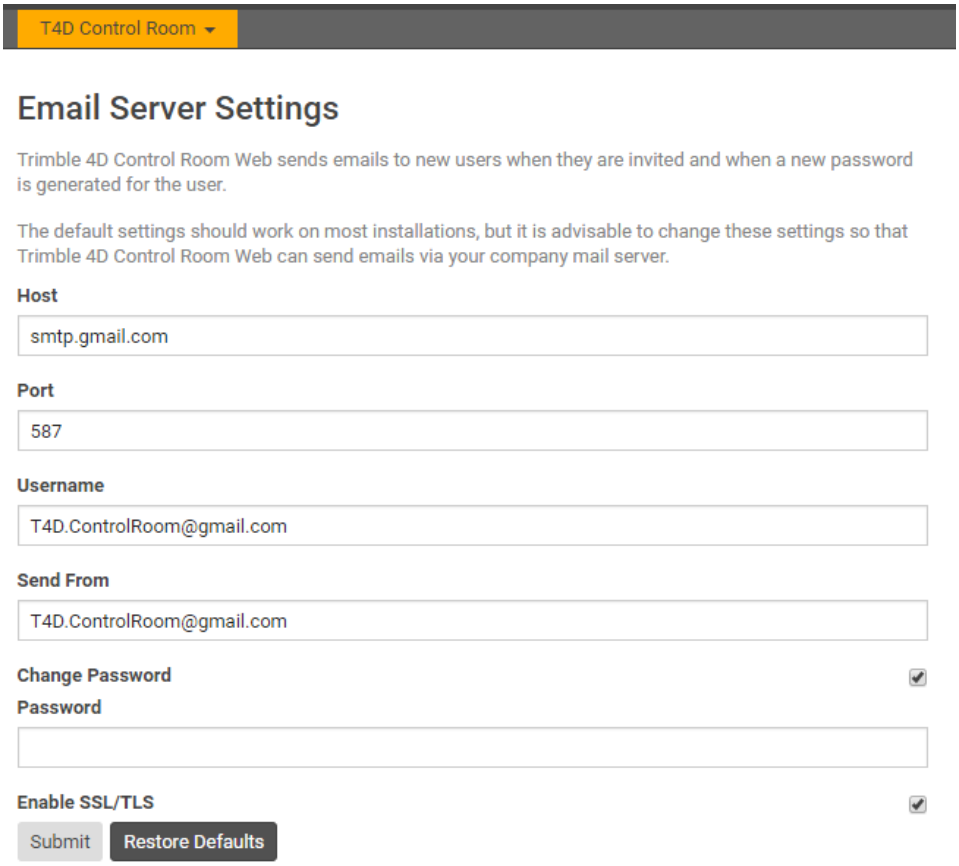
Users can be configured with an *Authentication Mode* of **T4D Control Room** or **T4D Web Installation**. The user credentials of

The credentials of a user with authentication mode **T4D Control Room** are encrypted and stored locally on the machine hosting T4D Control Room Web. When a user with authentication mode **T4D Control Room** logs into T4D Control Room Web, then authentication for the particular user happens against the credentials stored locally.

The credentials of **T4D Web Installation Users** are not stored locally. When a user with authentication mode **T4D Web Installation** logs into T4D Control Room Web, T4D Control Room Web makes a call to the particular *Installation* to authenticate the user before allowing the user access to T4D Control Room Web.

26.5. Email Server Settings

The *Email* area allows you to configure the email server credentials to be used to send emails to new users when they are invited to T4D Control Room Web, or to email new passwords to users on password reset.



The settings are as follows:

- **Host**: The SMTP server address.
- **Port**: The SMTP port.
- **Username**: The email username to be used for sending emails.
- **Send From**: The *from email address* to be used for sending emails.
- **Change Password**: Select this if you wish to change the password.
- **Password**: The email account password.
- **Enable SSL/TLS**: Select this if you wish to enable encrypted email sending.

Once you configured these settings, click the *Submit* button.

Use the *Send Test Email* area to send a test email in order to test your configured email server settings.

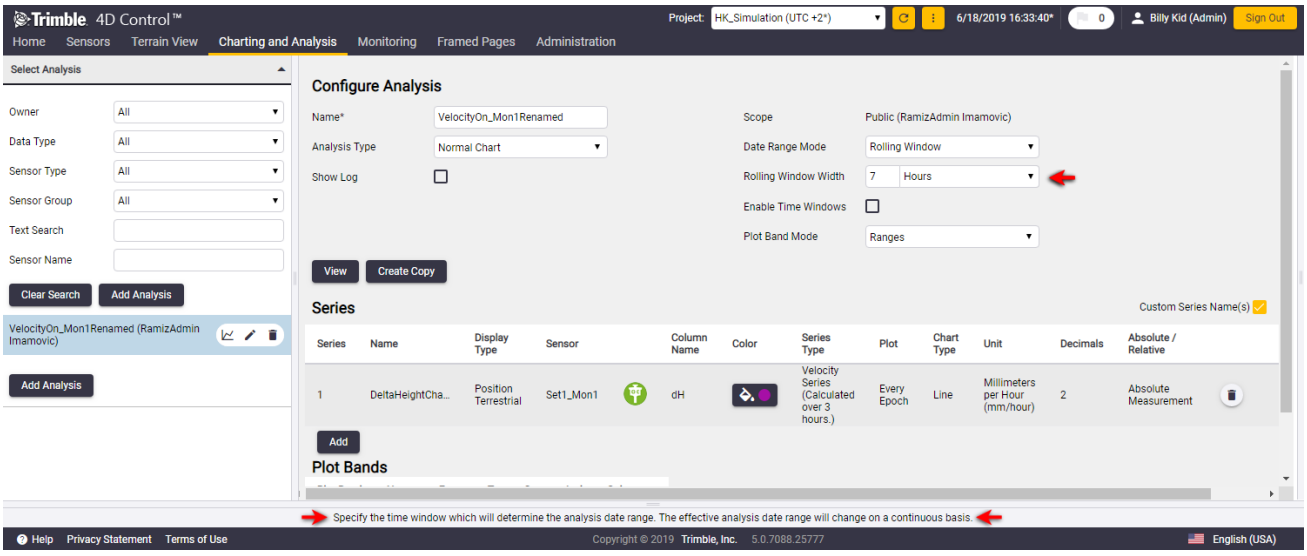
27. Further Reading

For Trimble 4D Control Server installation information please refer to our installation guide at:
http://help.web.t4d.trimble.com/version5.0/web

For Trimble 4D Control Web installation information please refer to our installation guide at:
http://setup-guide.web.t4d.trimble.com/version5.0/web

For Monitoring Infrastructure information please refer to the Trimble website at:
http://www.trimble.com/infrastructure/monitoring.aspx

There are quite a few details that we have not covered in this manual, nonetheless the user can explore the functionality of Trimble 4D Control Web by means of the **context sensitive help** provided on almost all interface controls of Trimble 4D Control Web:



Context sensitive help will appear at the bottom of the page whenever the user hovers the mouse cursor over an interface control.