



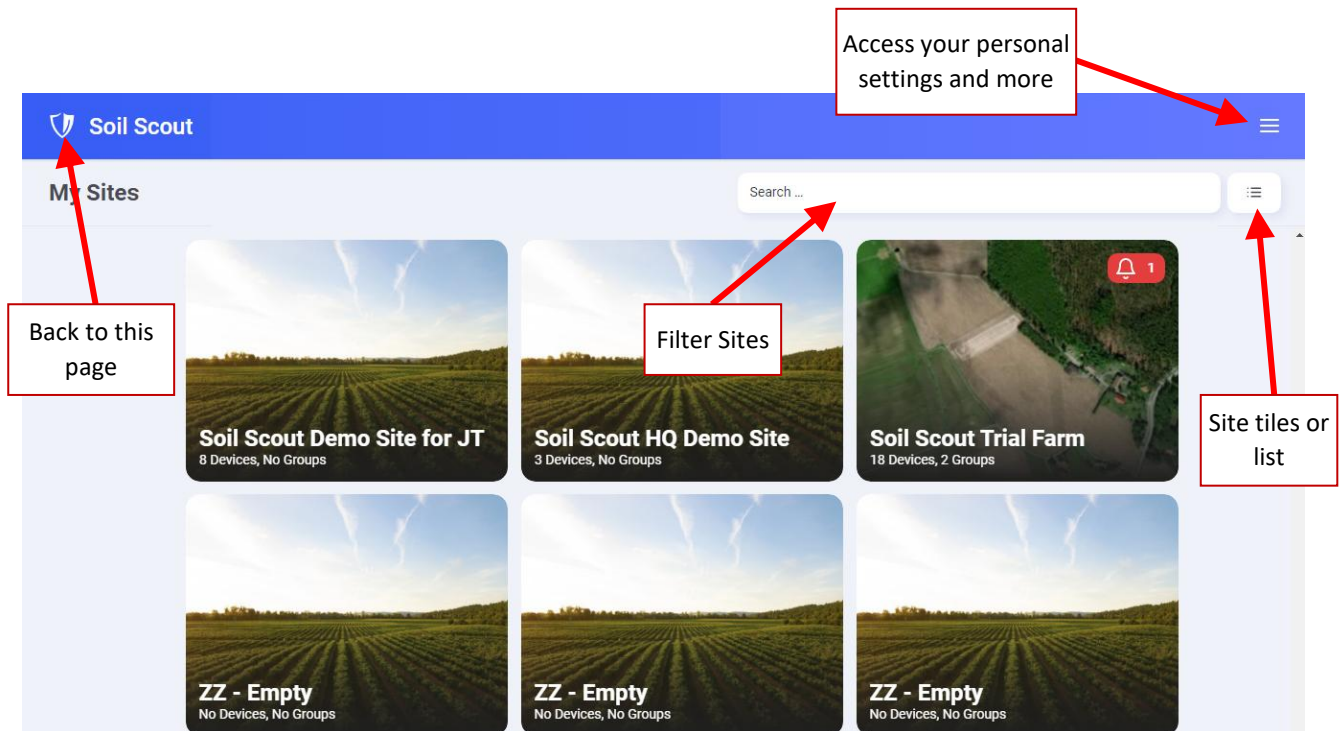
# Soil Scout Hub User Manual

Online Monitoring Service | 10 Jan 2023

## 1. Welcome Page (Site List)

The Welcome or home screen shows a list of all Sites that you have permission to view or edit, each represented as a tile. This top-level view provides a summary of devices on the Site, as well as whether there are any Alerts requiring attention. The number of triggered Alerts are presented in red.

Click on the Site that you wish to access.









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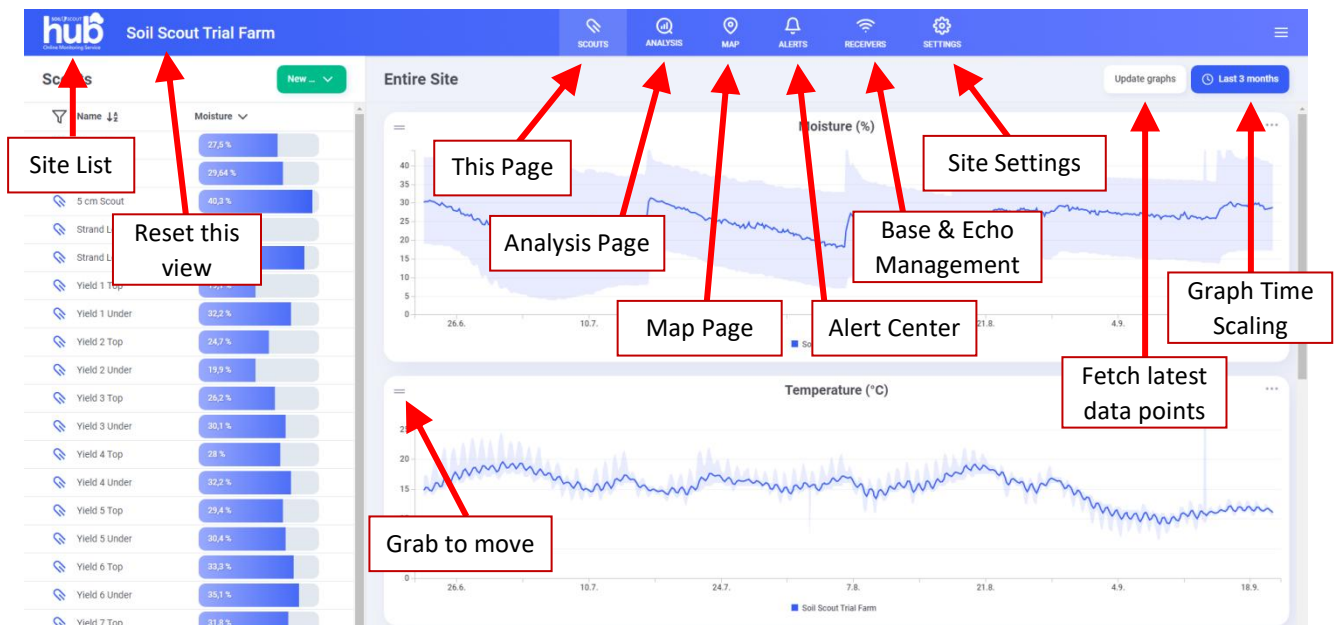
## 2. Site View (Main Page)


This page presents all the main information regarding your soil measurements. The top bar contains quick access to all core functionalities.

The Device List on the left presents both sensor groups  and individual sensors  with general information.

The sensor list can be  filtered and sorted  by name or measurement values. The measurement bars can be configured to show moisture, temperature or salinity.

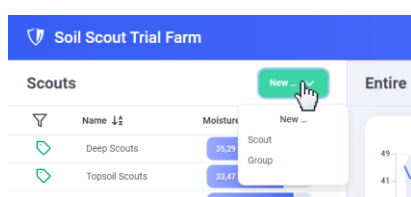
A red bell  stands for ongoing Alerts. The sensor has reached a thresholds that you have defined for a Scout Group. The bell is a link to the according Alert rule page.



When hovering the mouse hand cursor on a list item, the pen book  symbol will appear to the right. The pen book button will take you to the **Properties** of this Scout / Group / Device.



The **New** button is for adding new **Devices** to your site or creating new **Groups**, which are the basis for comparing different areas, depths, etc. as well as for creating automated Alerts.





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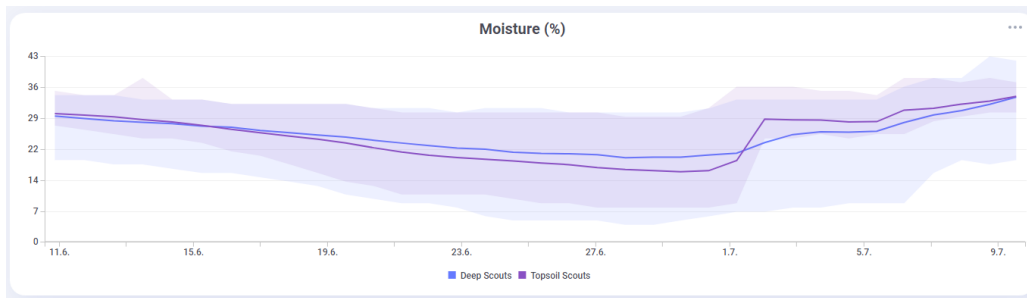
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## 3. Viewing Graphs

The **Entire Site** graph is a plot of *all devices* on the device list. The solid line is the moving average, while the shaded tube represents the min and max values.

More importantly, when you select one or more **Groups** for comparison by clicking their select boxes  on the left, you will see a similar compilation of tubes, which enables a convenient method to compare selected areas or depths with each other.

The three dots **...** in the upper right hand corner contains graph specific options, such as revealing Alert rule lines, exporting data, hiding this graph and more. Alert rules will appear as dashed lines. Downloading the *Comma Separated Values* (csv file) will export all visible data (without down filtering) to your preferred spread sheet software. The first line contains information on the contents of each column.



*This example comparing two Scout Groups (Deep Scouts & Topsoil Scouts) shows that 1.7. rain has quickly wetted the topsoil and diminished variability, while deep soil reacted several days later and less dramatically.*

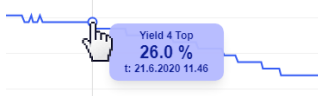
Selecting different time spans from the time scale menu will bring up different data sets. Dragging on the graph will allow for zooming in, while clicking on *Reset zoom* will bring you back out.

*The database contains a large amount of data, but to give you a smooth browsing experience, only a filtered set of data is being downloaded depending on the time span and zoom level.*

Hovering the mouse hand tool on the graph line legend will enable to highlight individual lines in the graph, clicking on them will toggle them on and off.



All formatting, such as the tool tip date and time units, automatically uses regional settings of your browser.



The Salinity graph extrapolates *what the Electrical Conductivity (EC) would be if the soil was saturated wet*. Would you rather see the momentary raw EC without extrapolation, you can choose "Bulk conductivity" in the Salinity graph options **...** menu. More detailed information on the Salinity and EC with interpretation guidelines can be acquired from Soil Scout.

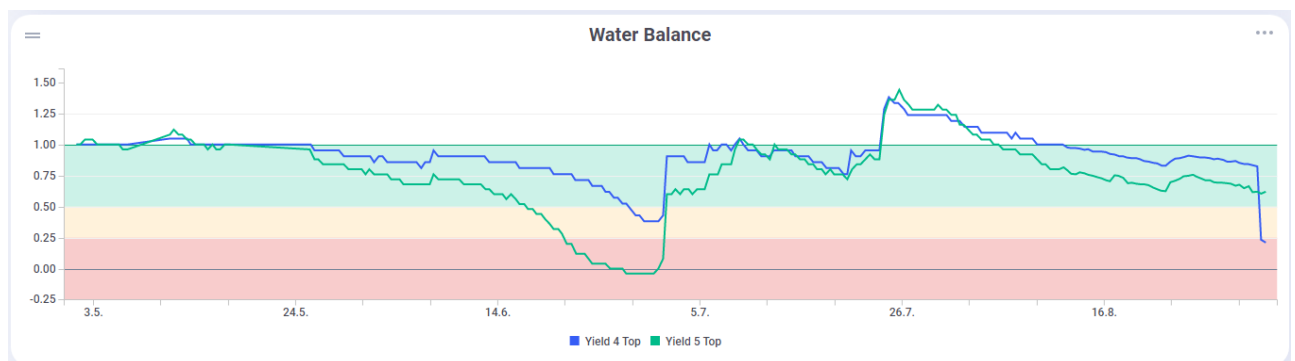


## 4. Water Balance Graph

While the **Moisture (%)** graph presents the volumetric water content, the **Water Balance** graph indicates plant water availability, based on Scout specific *Field Capacity* (FC) and *Wilting Point* (WP) settings. The simple principle is, that *Water Balance* equals to 1, when soil moisture is at FC and plenty of water is readily available for plants. On the other hand, *Water Balance* is 0 when soil moisture has reached WP, and plants are at risk of wilting permanently.

The Irrigation Threshold is usually considered halfway, at Water Balance 0.50. Above this limit (the green zone) plant growth is not severely limited by water availability. Below the Irrigation Threshold (the yellow zone) growth starts to decline. Agronomically, this means that the crop may not be able to fully benefit from additional inputs such as fertilizer, unless water availability improves by rain or irrigation.

In other words, the purpose of the Water Balance graph is to enable comparison of moisture data from locations with varying water holding capacities on a uniform agronomical scale.



In this example the mid summer completely dried up the location "Yield 5" topsoil down to Wilting Point 0.00, while "Yield 4" had a better water holding capacity and plant water availability was almost not endangered at all. The location "Yield 5" would have needed more water on June 17th.

When creating a New Scout Device, the dialogue will suggest soil type specific default values for FC and WP. You can adjust these values any time later in the *Edit Device Properties* [📄](#) page. You may have accurate FC values from a soil laboratory report, but you can in fact also identify your Scout specific FC value by observing the moisture data by following this procedure:

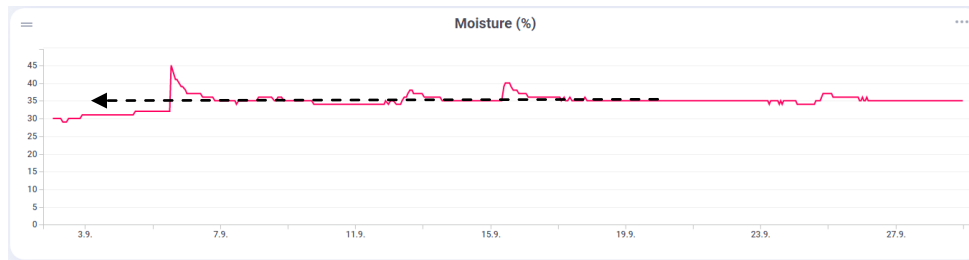
With your local knowledge, zoom the Scout Moisture Graph to a moment, where you know the soil has been properly wetted, over irrigated or received heavy rain. You will observe, that every time after such a wetting event, the moisture will settle down to a certain moisture level. This water holding level is the Scout specific Field Capacity, as the moisture declination is caused by drainage and/or percolation.

In some cases, for example in the absence of natural rains, you might consider causing the over watering situation artificially, for example pouring lots of water on the installed sensor or performing one excessive irrigation event. Another option is to pick soil samples next to the sensors and have them analysed for water holding properties.



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The graph above shows moisture from a Scout during Autumn rains, and the soil gets saturated repeatedly. One day after each rain event the moisture declination stops at 35 %, which represents the location specific water holding capacity, the Field Capacity.



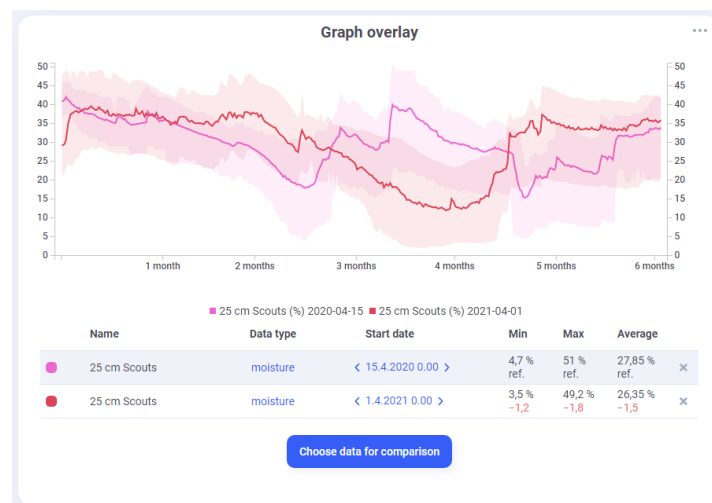
You can also adjust the Scout specific Irrigation Threshold, but then a Water Balance Graph with Scouts at different Irrigation Threshold levels will **not be able** to show the colour zones.



## 5. Analysis Page

The graphs on the Site View (main page) can show data from selected devices, but they are all in the same time axis. The **Analysis** page is a tool for comparing any data graphs from different times. As an example, you can plot soil moisture from several growing seasons on top of each other to analyze the seasonal differences. You can also plot any parameters, such as temperature and salinity into the same graph. In addition, you can save the created Analysis and it will be visible for other users of the same Site.

A typical Analysis would be to compare two (or more) growing seasons with each other. Below is an example, where two seasons of data from the Group "25 cm Scouts" is plotted. Note, that the 2020 season has been set to start on April 15th, while 2021 season is beginning April 1st. This way the two graphs are synchronized based on growth stage rather than calendar. During 2021 it was easy to observe, that the early season had favourable moisture, but from the third month drought hit hard compared to the late season rains in the previous season.



This Analysis example is showing two moisture graphs from the Group "25 cm Scouts" from two seasons beginning at different dates.

The Analysis can have as many graphs you wish, but too many will make the graph unclear. You can hide and show graph lines by clicking their legends.

The graph lines are live, which means that an unfinished line will extend as data accumulates, and every time you open a particular Analysis the "ongoing season" graph will have grown longer.

To create an Analysis, click [New analysis](#) and give the analysis a familiar name which will also be understood by your colleagues. Add data to the graph by clicking [Choose data for comparison](#) and choosing the Scouts and/or Groups you wish to add. You can choose the same data multiple times, if you wish to have several graphs from the same source but different times.

When the graphs appear in the plot, you can change the Data Type (moisture, temperature...) and the Start Date of each line. Also the time span, [12 months](#) by default, can be changed and will be saved with the Analysis.




If you wish to make copies of the Analysis with modified settings, just click [Save As...](#) and type in a new name for the new Analysis.



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## 6. Map Page


The Map interface is built on the [ArcGIS API for JavaScript](#) library. The symbols for Scout , Base  and Echo Repeater  are similar to their corresponding symbols in the Device List.

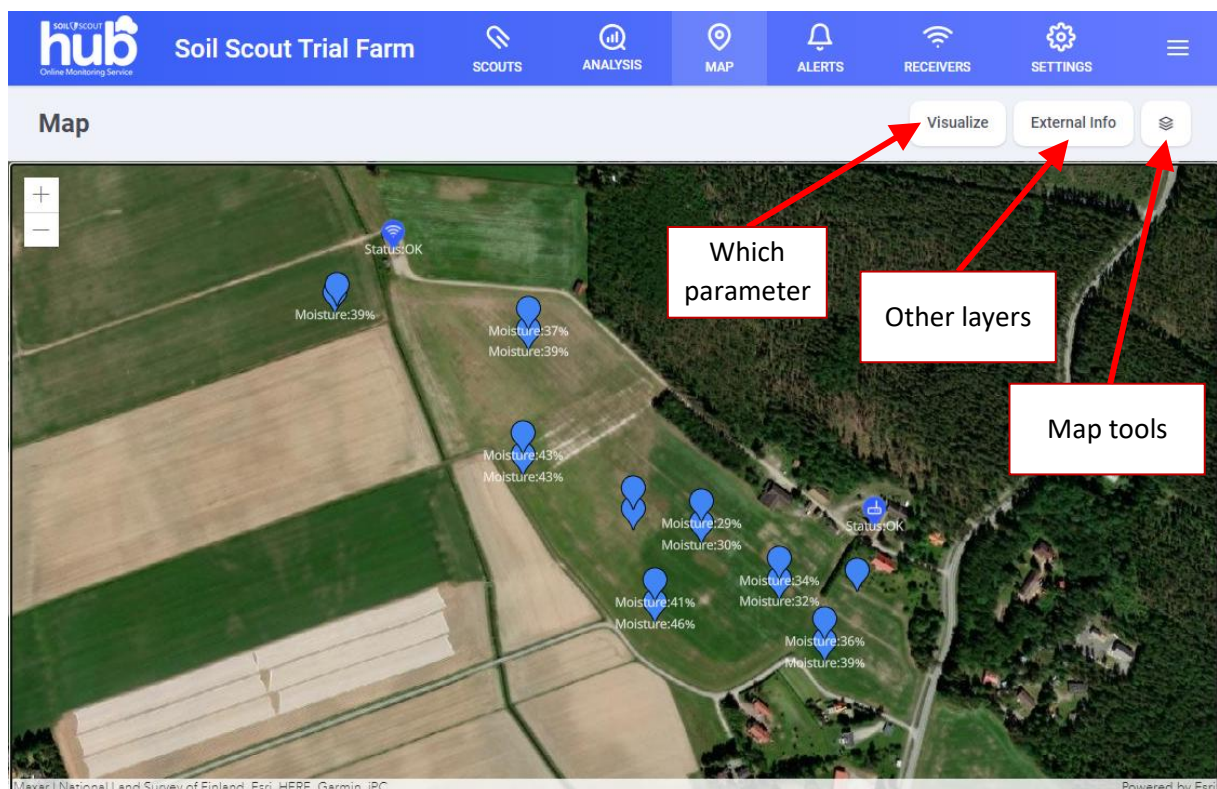
If a device has not connected for 2 hours, the symbol becomes yellow (**Waiting**).

When a device has not connected for 12 hours, the symbol becomes red (**Not connected**).

The Visualize menu lets you select which soil parameter you wish to evaluate on the map. Moisture colours are defined based on water balance, temperature on a scale from blue (cold) to red (hot).

External info contains a selection of other data sources, such as a satellite biomass map.

The Map Widgets menu  will allow you to enable Find and Measurement tools, as well as to customize the map imagery.




Clicking on the symbols will pop up an measurement information text box.



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## 7. Alerts

The automatic Alert system enables you to set predefined measurement value conditions, which will trigger the Alert  and send an according notification email, if desired. The Alert can only target a Group, but you can create a group of one Scout.

Once configured and saved, the Alert will start monitoring for measurements that will trigger the Alarm. When the defined Alarm is no longer relevant for you, you can turn the *Enabled* switch off for later use.

When an Alert has triggered, it will keep the red bell on the Tool Bar until it has been acknowledged by a user. The red bell remains on the Device List as long as the triggering condition remains true. All triggering events are logged into the *Notification History*.

The screenshot displays the 'Alert Properties' configuration interface. The top navigation bar includes 'Soil Scout Trial Farm' and icons for SCOUTS, MAP, ALERTS, RECEIVERS, and SETTINGS. The main interface is divided into two sections: 'Alerts' on the left and 'Alert Properties' on the right. The 'Alerts' section shows a table with one entry 'TestRule' and a 'New alert' button. The 'Alert Properties' section contains the following fields: Name (TestRule), Enabled (toggle), Group (Deep Scouts), Conditions (Temperature), Moisture (%) (Should stay inside range, 25-40), Email frequency (Only the first time a Scout violates this rule), and Email addresses (johannes.tiusanen@soilscout.com). A 'Save' button is located at the bottom of the 'Alert Properties' panel.

*In this example the rule "TestRule" will start monitoring that Scouts in the "Deep Scouts" group stay inside the desired moisture range 25-40%. If a measurement value outside the range is received, the email recipient will get notified. When a second group member triggers the condition, a new email will not be sent.*





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## 8. Add New Device / Edit Device properties

Creating a New Scout or clicking on the pen book  symbol the device list will open a new window with device specific properties.

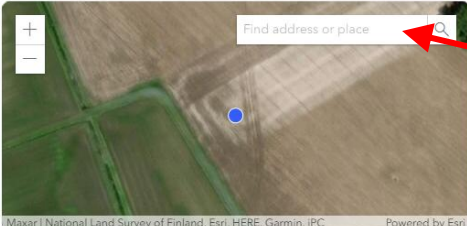


**Name \*** Yield 1 Top

**Serial number** 14917

**Soil spec.** Soil type: Loam, Soil dry bulk density: 1,4

**Latitude:** 61.474344, **Longitude:** 21.889887

**Location**  Find address or place

**Depth (cm)** 15

**Groups** Topsoil Scouts x

**Save**

Give the Scout a friendly and informative name, which also makes sense in the alphabetical Device list.

Scout serial number is the 5-digit ID number on the device, such as "15678".

Select which soil type your sensor will be installed in. The system will suggest a dry bulk density, which is required for the Salinity extrapolation. Feel free to put in a more exact value, in case you have one.


Choose a location from the map. This is essential to both using the Map Page as well as communicating with Soil Scout representatives. If you have recorded in-field coordinates, type them into the *Find box*.


The preferred coordinate format is degree decimals, such as 61.474344, 21.889887.

If you enter coordinates in some other format (such as 61°28'27.6"N 21°53'23.6"E), make sure that the conversion occurs accurately.

Depth/Height is important for later reference.

You can include the new Scout into groups when creating or edit it later.

On the *Receivers Page*  you can create New Base or Echo in a similar manner. The key difference is, that the Base has a 15-digit IMEI number like "357890123456789", while Echo repeaters have a 5-digit serial number, such as "57890".

 Whilst coordinates and depth/height are optional fields, we strongly recommend that you measure these as accurately as possible and enter the appropriate information in case need to find the Scouts later. When cm-accuracy satellite equipment is not available, best practice installation of Scouts includes using above ground sight lines and distances to fixed objects to compensate for the fact that typical GPS has a significant margin of error.



## Miscellaneous Notes

**Soil moisture** is always stated as the volumetric moisture fraction, i.e. a value 25% means that there is 2,5 decilitres (or 250 grams) of water in one litre of wet soil.

**Time stamps** are presented in the time zone of your browsing device. However, the CSV export uses Greenwich Mean Time (GMT) zone Coordinated Universal Time (UTC) time format, such as "2020-08-03T14:20:22.970198Z"

**Salinity** is a Hillhorst (2000) equation extrapolation of what the Electrical Conductivity (EC) would be if the soil was saturated wet. When soil is dry, the extrapolation is inaccurate. The accuracy is approximately as follows: Good = moisture > 40 %; Intermediate = moisture 25-40 %; Inaccurate = moisture < 25 %.

**Backups** of the server and databases are saved periodically, but any changes you make in the online configuration (coordinates, soil types, etc.) will take effect immediately and are irreversible.

**Soil type** is saved for each measurement data point according to the present Device Properties. If you change soil type later, it will influence future measurements, but will not recalculate old ones.

**Read only user** level will keep some of the mentioned features hidden for such users.

**On mobile devices** with narrow screens, Device list and Graphs are not presented simultaneously. Also some comparison features cannot be used due to excessive complexity.

Would like to get notified by email **when Base Station goes offline**, you can set the *Base Status email notification* in your Site Settings.



*The information in this document has been provided in good faith and is accurate to the best of our knowledge at the time of writing. Any errors or omissions are unintended. New features and aesthetic styling of the service is an ongoing process, and this guide may occasionally be outdated.*