TAHMO WEATHER STATION

All you need to know about TAHMO weather station

Contents

TAHMO weather station is a 4 in one weather station. Data is available on the server side and amen. TAHMO station has two components; a data logger and a sensor suit (ATMOS 41).

1 ATMOS 41

The ATMOS 41 All-in-One Weather Station is designed for continuous monitoring of environmental variables, including all standard weather measurements. The ATMOS 41 measures the following:

- Solar radiation
- Precipitation
- Air temperature
- Barometric pressure
- Vapor pressure
- Relative humidity
- Wind speed
- Wind direction
- Maximum wind gust
- Lightning strikes
- Lightning distance
- Tilt

All sensors are integrated into a single, small form-factor unit, requiring minimal installation effort. A robust, no moving parts design that prevents errors because of wear or fouling make the weather station ideal for long-term, remote installations.

1.1 MEASUREMENT SPECIFICATIONS

Solar Radiation

- Range 0–1750 W/m2
- Resolution 1 W/m2
- Accuracy ±5% of measurement typical

Precipitation

- Range 0–400 mm/h
- Resolution 0.017 mm
- Accuracy ±5% of measurement from 0 to 50 mm/h

Vapor Pressure

- Range 0–47 kPa
- Resolution 0.01 kPa
- Accuracy Varies with temperature and humidity, ±0.2 kPa typical below 40 °C

Relative Humidity

- Range 0–100% RH (0.00–1.00)
- Resolution 0.1% RH
- Accuracy Varies with temperature and humidity, ±3% RH typical

Air Temperature

- Range –50 to 60 °C
- Resolution 0.1 °C
- Accuracy ±0.6 °C

Humidity Sensor Temperature

- Range –40 to 50 °C
- Resolution 0.1 °C
- Accuracy ±1.0 °C

Barometric Pressure

- Range 50–110 kPa
- Resolution 0.01 kPa
- Accuracy ±0.1 kPa from –10 to 50 °C
  ±0.5 kPa from –40 to 60 °C

Horizontal Wind Speed

- Range 0–30 m/s
- Resolution 0.01 m/s
- Accuracy The greater of 0.3 m/s or 3% of measurement

Wind Gust

- Range 0–30 m/s
- Resolution 0.01 m/s
- Accuracy The greater of 0.3 m/s or 3% of measurement

Wind Direction

- Range 0°–359°
- Resolution 1°
- Accuracy ±5°

Tilt

- Range –90° to 90°
- Resolution 0.1°
- Accuracy ±1°

Lightning Strike

- Range 0–65,535 strikes
- Resolution 1 strike
- Accuracy Variable with distance, >25% detection at <10 km typical

Lightning Average Distance

- Range 0–40 km
- Resolution 3 km
- Accuracy Variable

1.2 SENSORS

1.2.1 PYRANOMETER – Solar Radiation Sensor

Solar radiation is measured by a pyranometer that is integrated into the lip of rain gauge funnel.

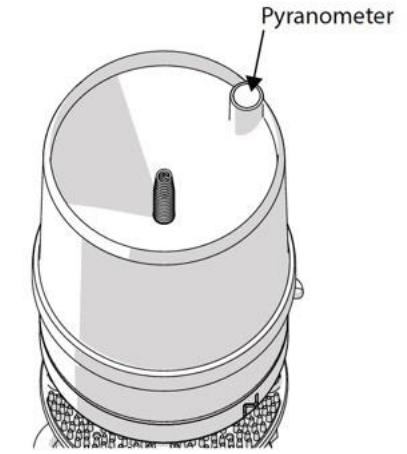


Figure 1 Pyranometer

1.2.2 RAINGAUGE – Precipitation sensor

The ATMOS 41 contains a 9.31-cm diameter rain gauge. During rain events, the flared hole (Figure 2) forms the rain into drops that pass by the drip counter. The spring (Figure 2) acts as a filter to keep out large particles but still allows enough flow so water does not back up. Gold pins (Figure 2) measure each drop of rain. Because the flared hole forms a drop of a known size, the ATMOS 41 counts the drops and calculate the water volume. As the rain intensity increases, the drops become smaller, but the ATMOS 41 firmware contains an algorithm to automatically compensate for drop size as the rain increases.

When powered on, the ATMOS 41 counts water drops continuously and adds each drop to an accumulated total. When queried, the ATMOS 41 outputs the total rainfall (in millimetres) that has accumulated since the last query. Precipitation maximum intensity calculation is capped at 280 mm/h, available from METER data loggers and software.

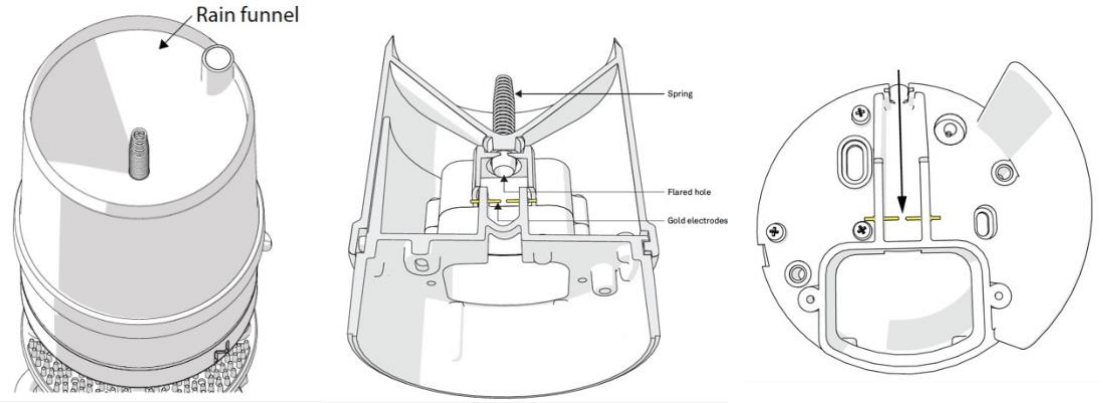


Figure 2 Rain gauge

1.2.3 WIND SENSOR – Wind and Gust Sensor

The space underneath the rain gauge is where the ATMOS 41 measures wind speed. Ultrasonic signals emitted from transducers at right angles to each other bounce off the porous sintered glass plate (Figure 3) and back up to the opposite sensor. The speed of sound is affected by the wind, and the wind speed is calculated by measuring differences in the time it takes for sound to travel back and forth between sensors (Section 3.10.1). When powered on, the ATMOS 41 measures the wind speed and direction once every 10 s and records the instantaneous wind vector components. When queried, the ATMOS 41 outputs the average of the instantaneous measurements since the last query for wind speed and direction and the maximum instantaneous wind speed value for wind gust.

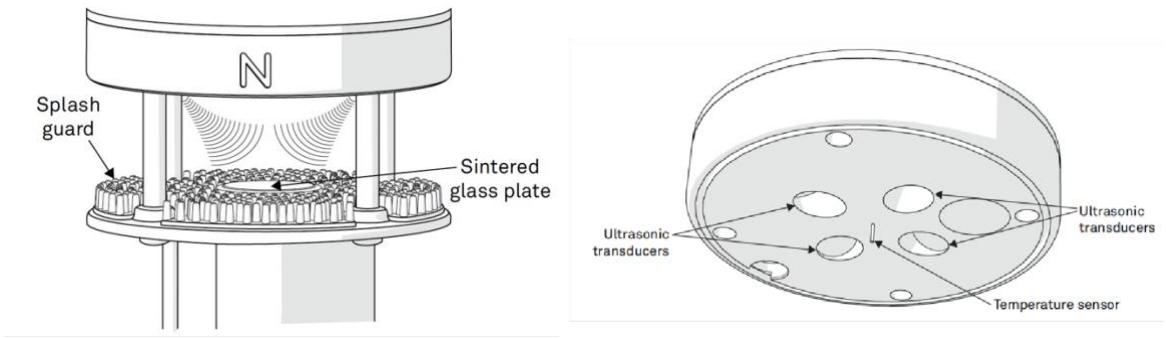


Figure 3 Anemometer

1.2.4 VAPOR PRESSURE/RELATIVE HUMIDITY SENSOR

The vapor pressure sensor (Figure 4) on the ATMOS 41 is located behind the circular Teflon screen in the same housing as the sonic transducers. The Teflon screen protects the sensor from liquid water and dust while allowing water vapor to freely pass to the sensor and equilibrate with air vapor pressure. The sensor

measures relative humidity and temperature in addition to computing vapor pressure.

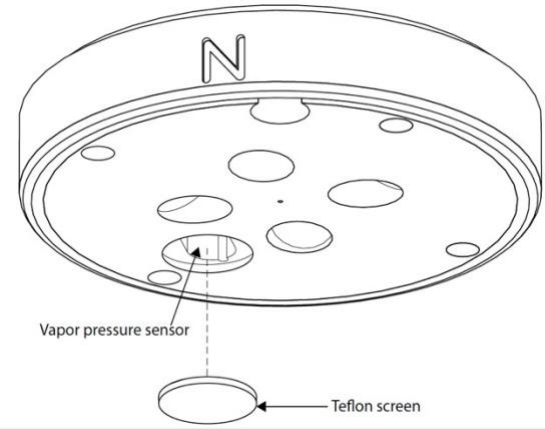


Figure 4 Vapor Pressure sensor

1.2.5 TEMPERATURE SENSOR

The ATMOS 41 temperature measurement (Figure 5) is made in the centre of the anemometer area where a small stainless-steel needle containing a tiny temperature sensor (thermistor) extends from the middle of the four sonic transducers in the centre of the anemometer. Unlike most air temperature measurements, the weather station sensor is not covered with ouvered plates to protect from solar heating. Instead, it sits in open air, susceptible to solar heating of the instrument body. However, the ATMOS 41 calculates the air temperature accurately because solar radiation and the wind speed are known. These are the two main parameters that determine the error between measured air temperature and the actual air temperature. Therefore, it is possible to solve the energy balance to get what the actual temperature should be based on the solar load of the body and the convective cooling of that temperature sensor.

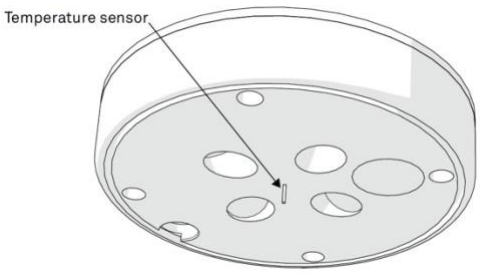
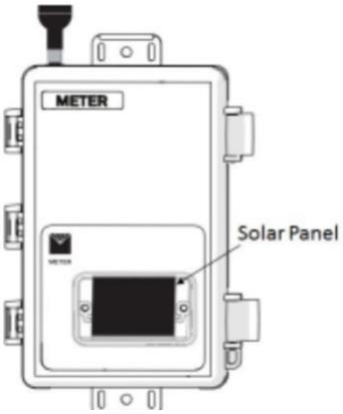


Figure 5 Temperature Sensor

1.2.6 CLEANING CHECKLIST

You should check your station every month to verify there are no obstructions. You will need to bring a chair/stool to reach the station, a damp cloth, and paperclip or stick.

Go to location of TAHMO station. Set up the chair or stool securely so that you can reach the top of the weather station. Complete the following three tasks:



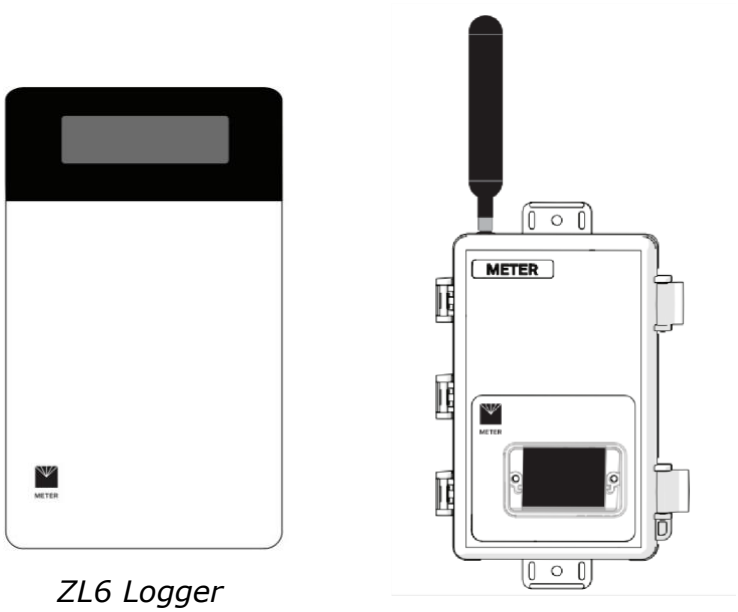
1. Wipe off the solar panel on the data logger box using the cloth.
2. Wipe off any dust from the solar sensor using the cloth. The solar sensor is located on the side of the rain funnel and is a small circle.
3. Remove any leaves, bugs, or bird droppings from the rain funnel using the cloth. The rain funnel is located on the top of the weather station. If the rain funnel is very dirty or if you cannot see into the funnel you can remove the top of the rain funnel by pressing down and twisting it off counterclockwise. Carefully disconnect the wire and continue cleaning. You can use a paperclip or piece of grass to remove any twigs from the spring. You can remove the metal spring in the center of the rain funnel in order to remove any pieces blocking the funnel. Re-secure the metal spring by gentry pressing and turning the spring into the funnel hole. When you replace the funnel onto the weather station, plug back in the wires then align the funnel by pressing down and twisting clockwise.
4. Remember to close and lock the gate when you leave.

If you have any concern about your station or having problem cleaning the station please contact your TAHMO country representative for help or email: info@tahmo.org.

Cleaning Video: https://www.youtube.com/watch?v=n9KGaUHkUP0

2 DATA LOGGER

As at 2020, TAHMO uses two types of loggers; EM60G and ZL6



ZL6 Logger

EM60G

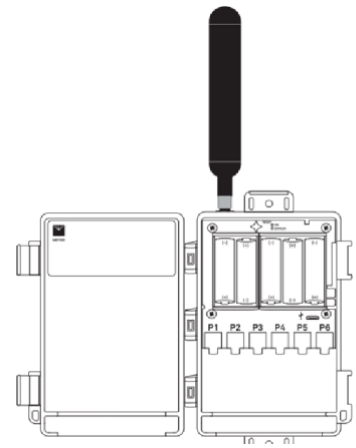
Figure 6 : EM60 and ZL6 Logger

Both loggers perform well in the field, but ZL6 has a few additional features compared to EM60G.

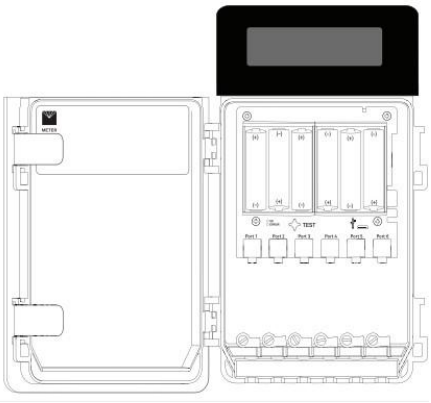
The logger serves the following purpose

1. Data storage – data captured by sensors (e.g. ATMOS 41) is stored on the logger. Data memory is non-volatile flash; removing the batteries or rebooting the logger will not stored sensor measurement data.
2. Telemetry – When properly configured[1], the logger transmits data stored in the logger to an online platform. Configurations done to the logger includes:
    a. Setting upload times and frequency of data upload an online server/platform
    b. Setting frequency of recording data from the sensors
    c. Data configurations for SIM cards/cellular communication
3. GPS receiver – The logger has built in receiver that provides the latitude, longitude and altitude of the logger.
4. Timekeeping – The logger keeps track of time using Universal time coordinated (UTC) seconds. It synchronizes time using either computer software, cellular network or GPS receiver.
5. Powering the logger – The logger uses rechargeable batteries. The batteries are recharged by solar cells.

[1] Consult a certified TAHMO technician on how to do configurations.



EM60G Interior



ZL6 interior

Figure 7 Logger interior

2.1 Test Button

Pressing the test button will initiate SELF TEST sequence. Self-test takes approximately 6 sec to complete. The following actions are part of self-test sequence:

1. Reboot the logger – Internal software restarts. Both status light will stay lit during reboot.
2. Perform basic functionality testing on internal system and evaluate the amount of charge in the battery
3. Autodetect the connected sensors
4. Start the embedded GPS receiver to obtain a current time and location fix. The process takes up to 15 minutes to complete
5. Establish internet connection over the cellular network and attempt to communicate with the server.

After completing the self-tests, the logger will indicate success or failure by lighting either the red or green status light.

- A solid green light (for approximately 20 s), indicates that the internal tests passed, and if applicable, there is successful communication over the cellular network.
- A solid red light indicates an internal error in the logger, which may include
    - Corrupt logger firmware
    - Low batteries
    - Unsuccessful logger communication

4 TAHMO Station Overview platform

TAHMO Station Overview is an open platform that provides status of stations that sends data to TAHMO platform.

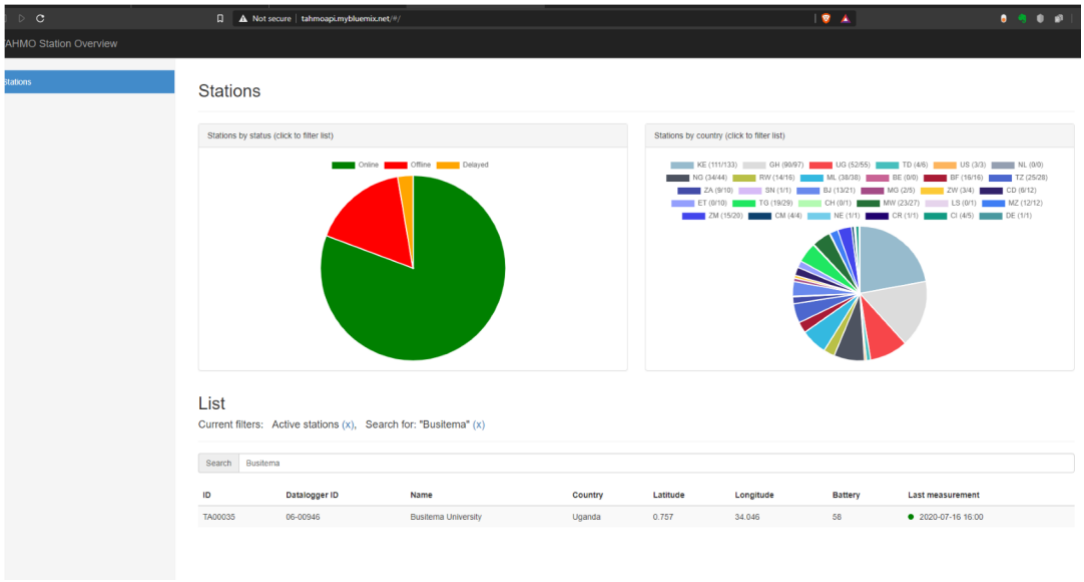


Figure 8 Tahmo station overview platform

The platform is useful especially when monitoring the battery charge level of stations.

To check overview of your station

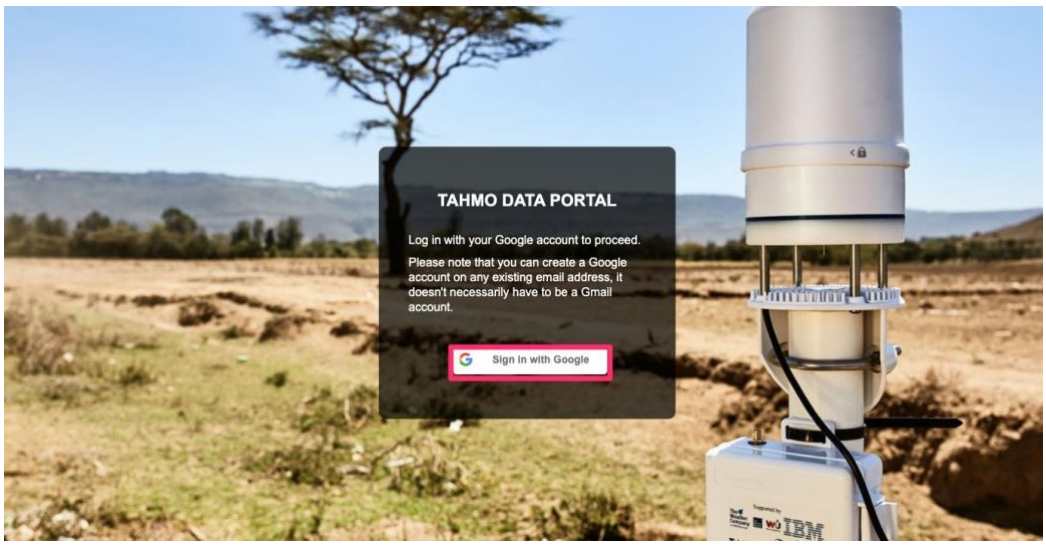
1. Go to http://tahmoapi.mybluemix.net/
2. On the search button, enter your site name or logger ID or Station ID
3. The following information will be available for you to view:
   The following information is available"
   a. Station metadata – station ID, Datalogger ID, site name, country installed and GPS location of the site (latitude and longitude)
   b. Battery status – This is found on the column battery. The number represents the percentage battery of the station at the time of data upload.
   c. Station status – A colored dot on column "last measurement" shows the status of the station. The column also shows the time and date when data was last uploaded to the online.

Green	Station is online. The station uploads data to the server
Orange	Delayed. The station has stayed a few hours uploading the data. It could be that the station is configured to upload few times in a day, or it may be having a serious issue that occurred in recent time.
Red	Offline – The station has not uploaded data for more than 1 day. In this case investigate the reasons which could be either battery drained, SIM card not working or the station vandalized.

5 Data Access via TAHMO portal

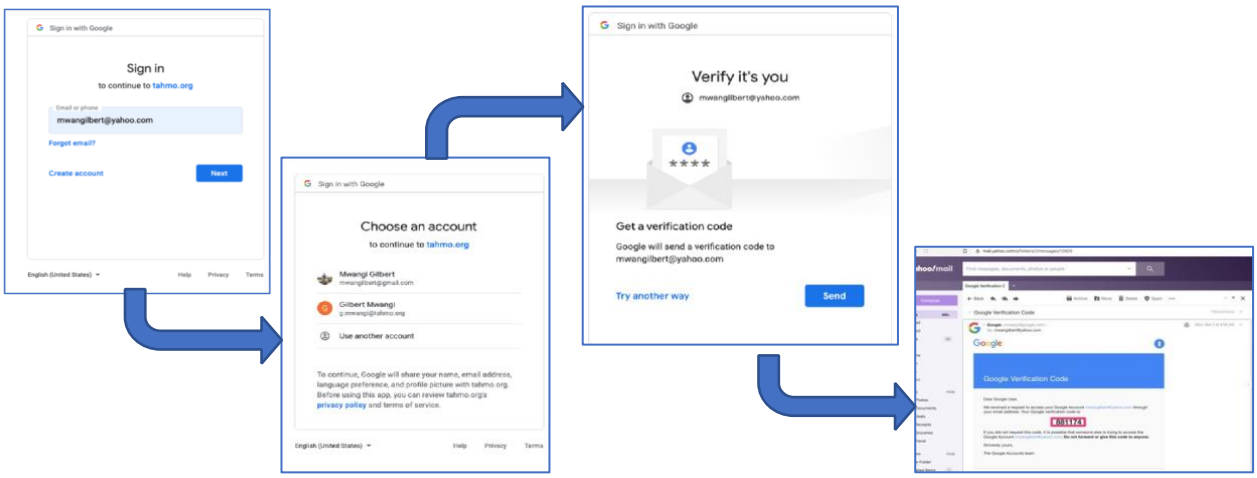
Last Updated: 11 NOVEMBER 2021

1. Go to portal.tahmo.org, click sign in with Google.

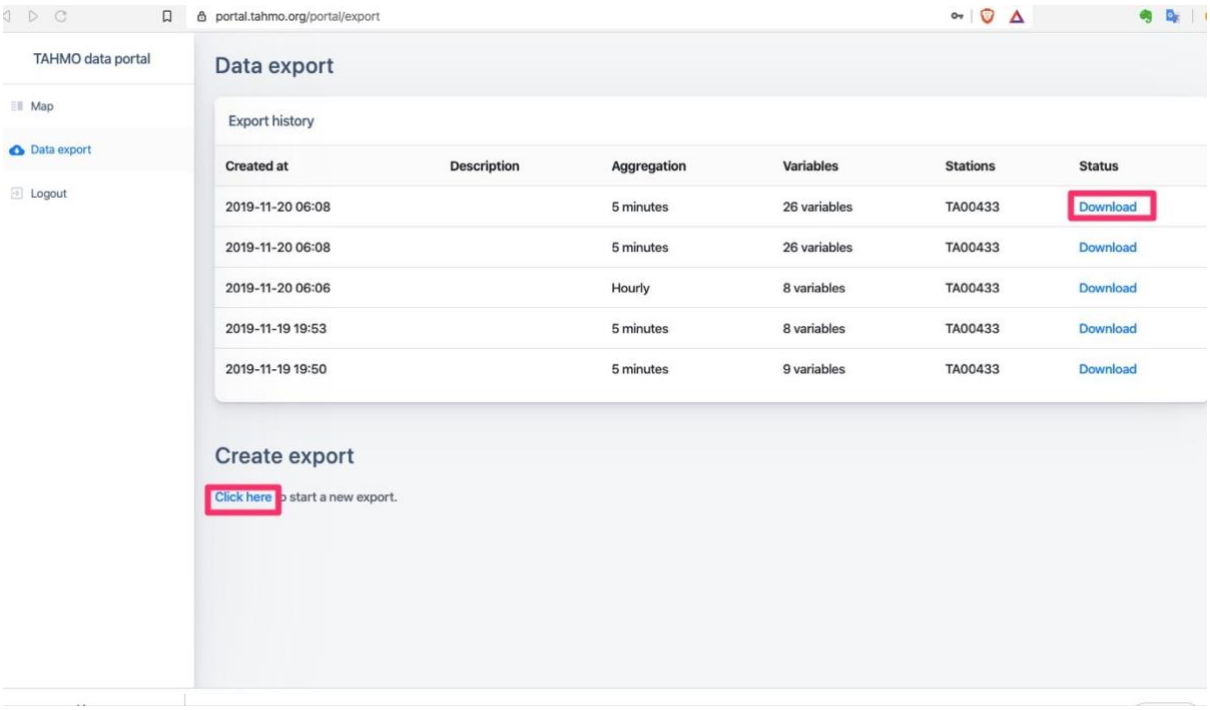


2. You will have to use email address shared to us (TAHMO) while logging in through google.
   - If this email address is not listed within your google accounts yet, please click on "Use another account" and follow the steps. Enter the email
   - A verification code will be sent to your email account to allow you log in via google account.
   - Enter the verification code

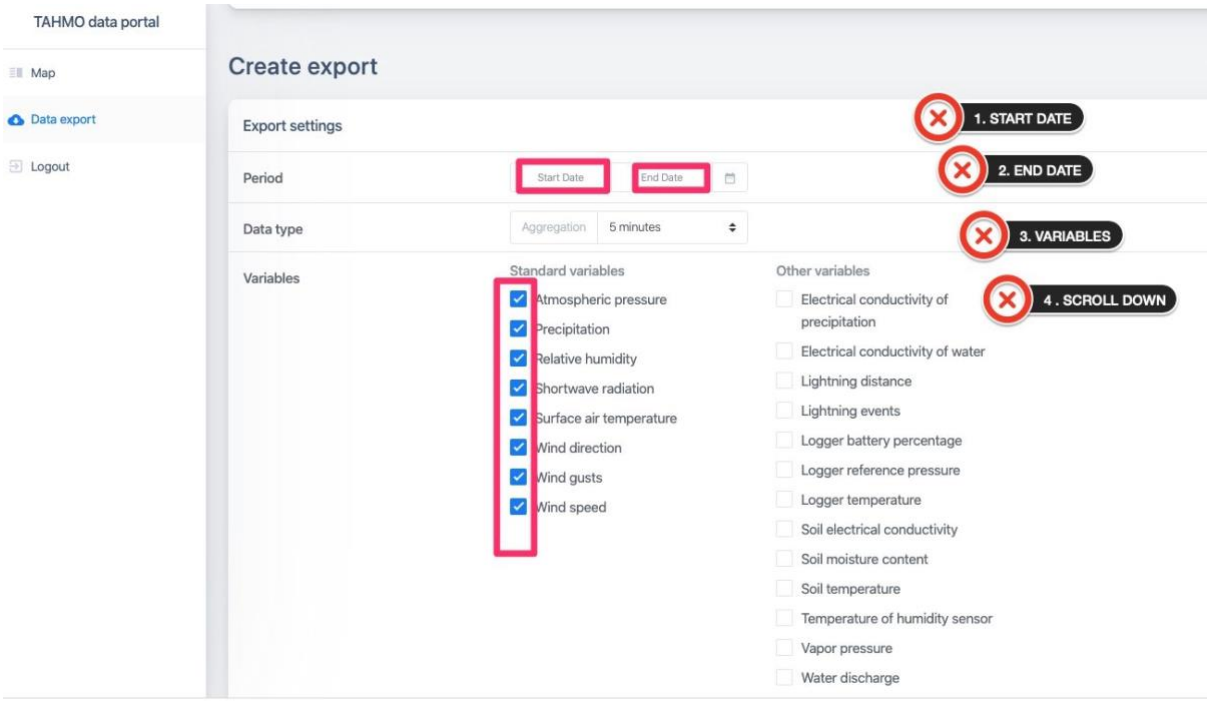
3. Once Logged in click “Data export”



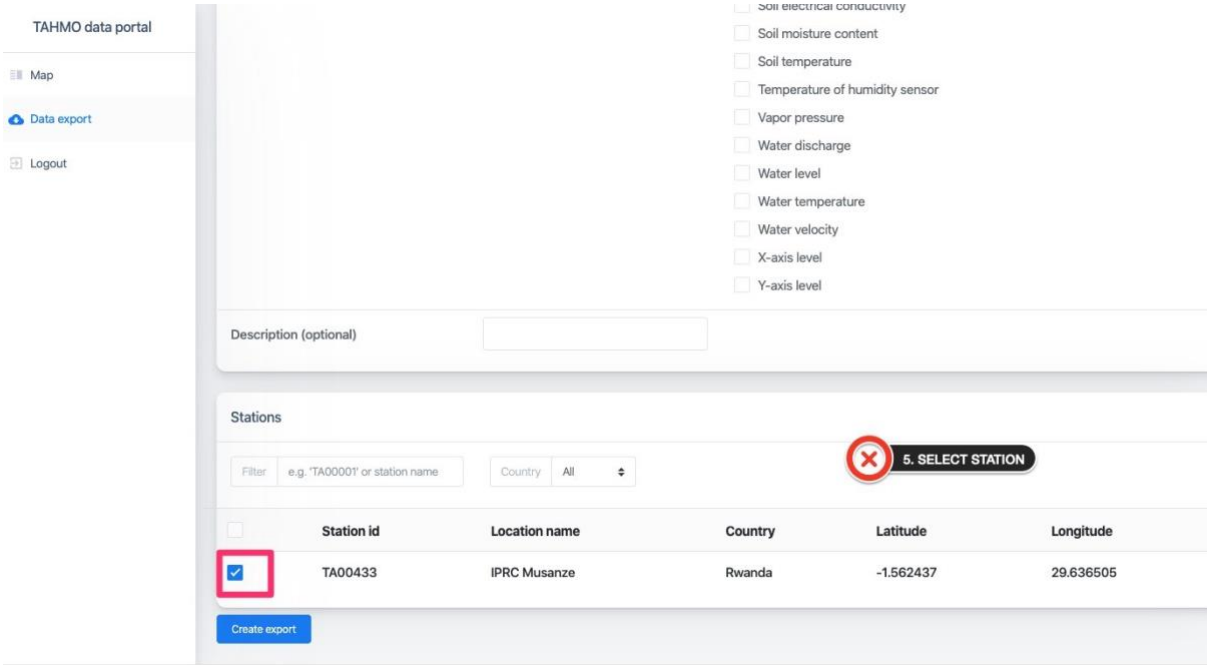
4. Select “Click here” to start a new export



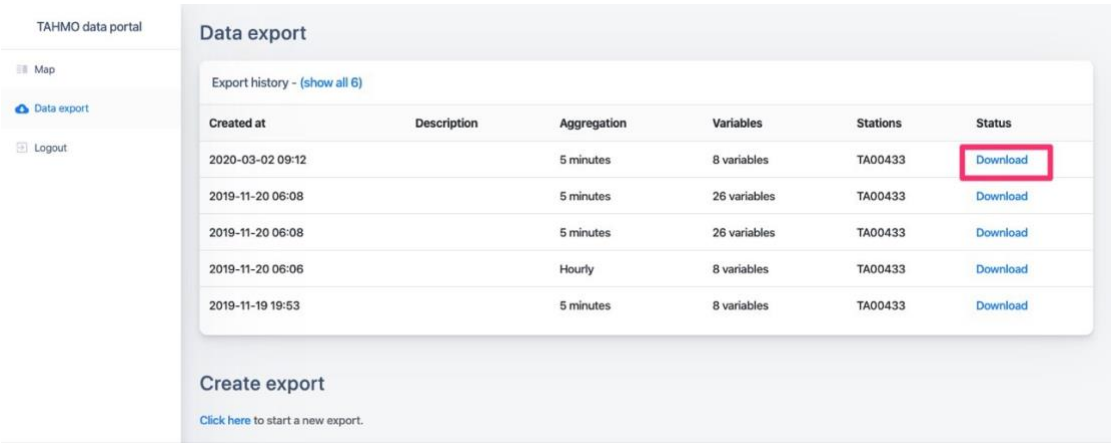
5. Enter start date, End date, aggregation and select the valuables of data you want to download.



6. Scroll down on the same page and select the station(s)
7. Click Create Export



8. A new export will be listed under export history.



- Click "Download". You will see a zip folder with metadata and data in csv file.

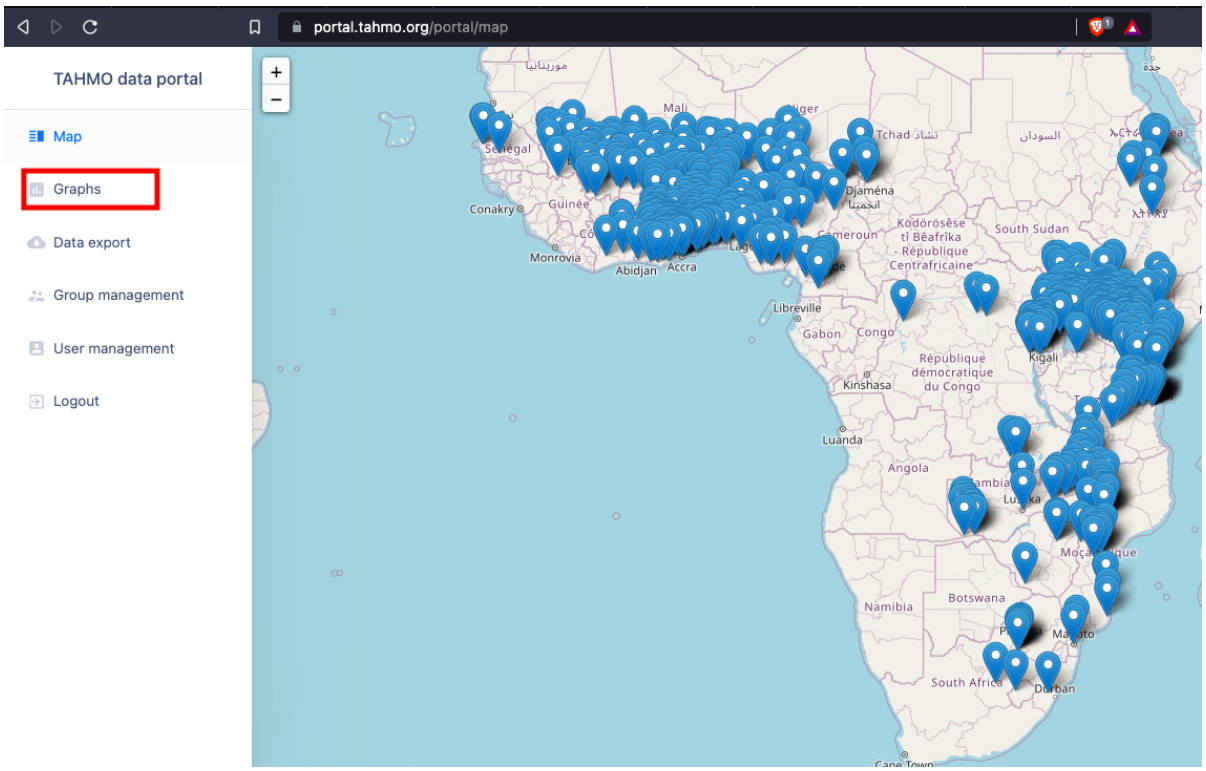
➢ You can also check a video for data access on the link here: https://www.youtube.com/watch?v=wXI2Fy7wbhc

NOTES:

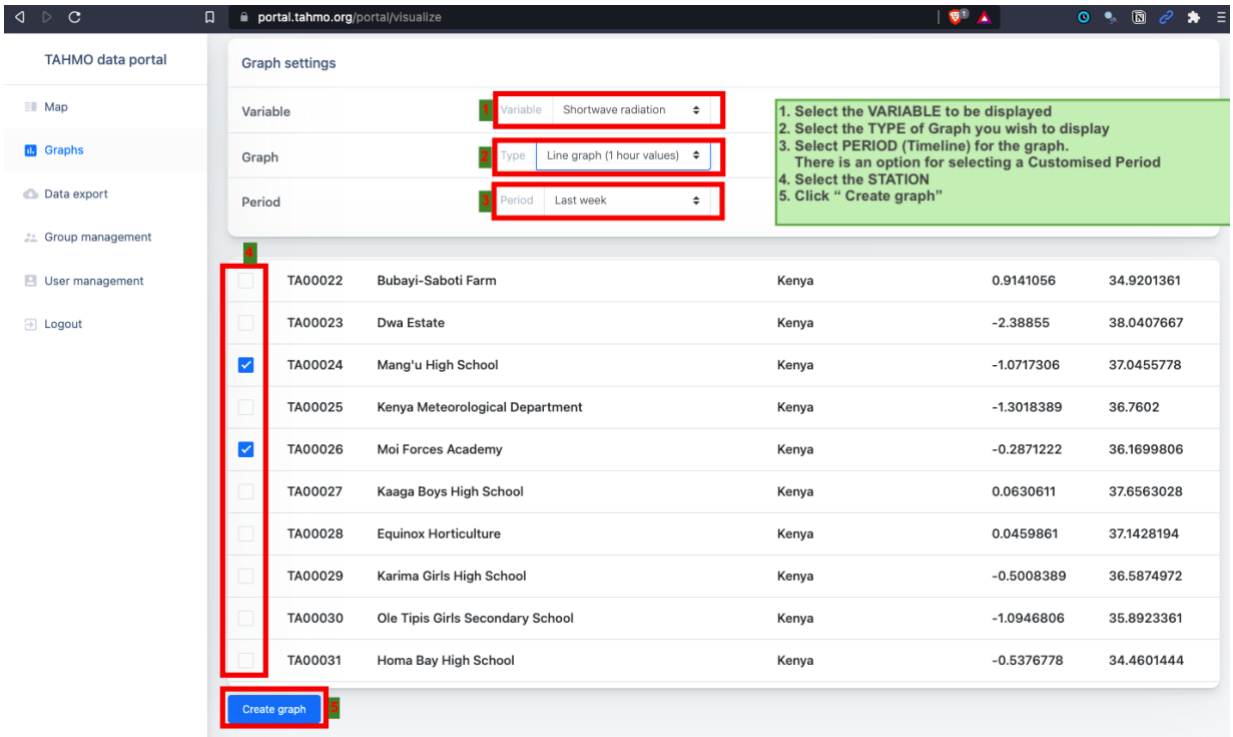
1. Data timestamp is in UTC time (0 GMT). You may want to convert it to your local time. See the video on how to do the conversion: https://www.youtube.com/watch?v=xpIzGj1CSoY#t=1m48s

5.1 GRAPHS

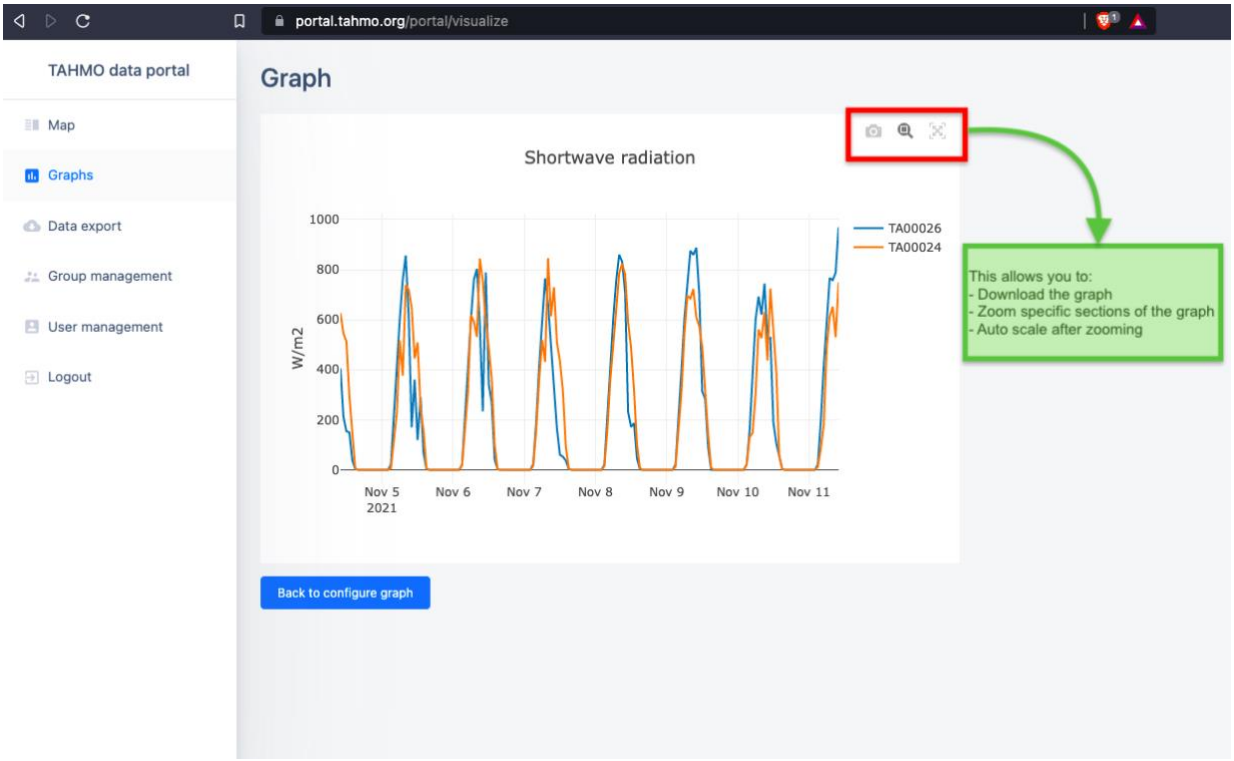
1. When logged in select “Graphs”



2. Select VARIABLE, GRAPH TYPE, Period and STATIONS, then click “ Create Graph”



3. A graph will be generated as shown below. You can download and zoom to specific points of the graph.



If you have any challenges using tahmo data portal contact your country representative or email us: info@tahmo.org

6 Troubleshooting

Problem	Possible Solution
Poor measurements of some parameters	Clean the station[2]. For some measurements, TAHMO data quality team will flag the issue when the readings captured are unrealistic. For some measurements the issue may not be identified. It is recommended you clean the station at least once a month. If the sensor is cleaned and you still observe unrealistic data, request your country director to replace the faulty sensor.
Battery draining too fast[3]	Battery faulty: If the batteries have stayed for long, they may drain out charge/discharge cycle. The solar panel of the logger may be faulty in which case the logger may need to be replaced.
Sensor measurement data does not seem to be correct	Switch the sensor to a known working port and scan again. If the problem follows the sensor, then the sensor may be damaged. Many issues affect the quality of the sensor measurement. Please see the sensor user manual for troubleshooting.
Cellular uploads stopped working	Check batteries
Logger does not seem to be working correctly or reliably	Check logger batteries. Replace alkaline batteries if close to 0%. Recharge NiMH batteries if close to 0%.

[2] See 1.2.6 CLEANING CHECKLIST

[3] See TAHMO Station Overview platform

Red ERROR light and/ or green OK light are always on	See section

Not reading any rain or not measuring rain accurately	Remove any debris from rain gauge funnel. Check the cleaning guide. The ATMOS 41 must be within approximately ±2 degrees of dead level (0, 0) in both the X and Y directions to accurately measure rainfall. If not within this range, drops from the flared hole can miss the gold electrodes entirely. Use the internal level measurements that are available in the ATMOS 41 data stream to confirm that the ATMOS 41 is level.
Water not flowing through raingauge	Check spring, screen, and the outflow to ensure there is no lodged debris.
No Temperature reading	Check the temperature needle to be sure it is not pushed in (pushing in the temperature sensor will break the thermistor wires and stop measurement). Do not to abuse the temperature sensor needle when cleaning, because its very delicate lead wires can be easily damaged.
No pyranometer reading	Make sure the pyranometer plug (Figure 1Figure *1* Pyranometer) is plugged in. ***NOTE: BE CAREFUL TO UNPLUG THE PYRANOMETER CONNECTOR INSIDE THE FUNNEL BEFORE FULLY REMOVING THE FUNNEL.***
No wind speed data	Check anemometer pathway to make sure there is no debris blocking the path of the sonic transducer measurement (between transducers and acoustic mirror on base). Check the sonic transducers for water build-up; if there is moisture, take a dry cloth and dab it away. Check to see that the sintered glass plate (Figure 3) is not dirty. Clean by flushing with water and dry with a dry cloth. Be sure the ATMOS 41 is level.
ATMOS 41 not responding	Check sensor cable and stereo plug connector integrity. Try a different port on the data logger

VIDEO LINKS

1. TAHMO data portal: Data access: https://www.youtube.com/watch?v=wXI2Fy7wbhc
2. Converting UTC time to Local time https://www.youtube.com/watch?v=xpIzGj1CSoY#t=1m48s
3. Cleaning TAHMO weather station: https://www.youtube.com/watch?v=n9KGaUHkUP0