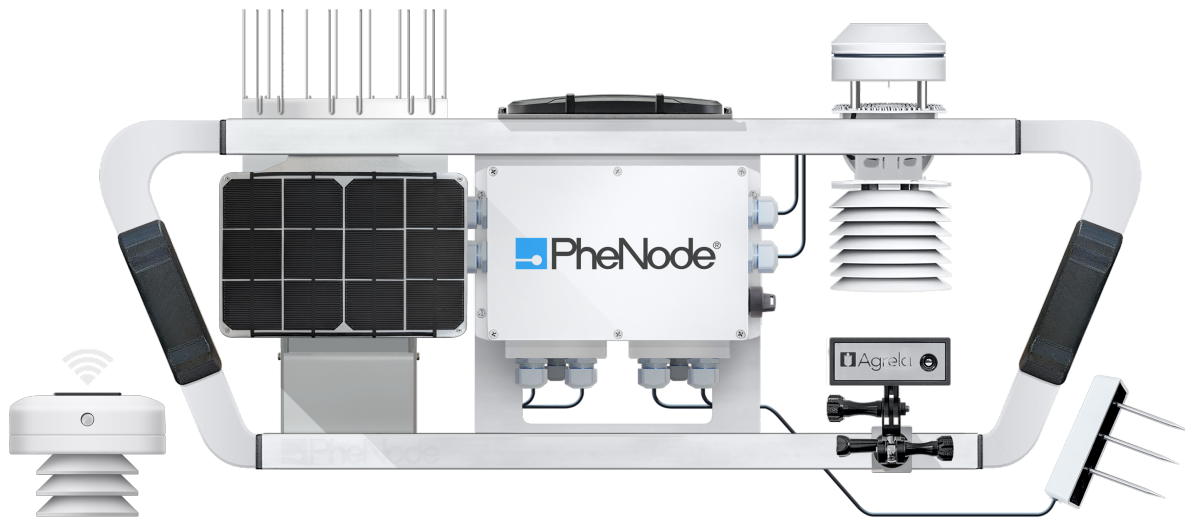# Installation and User Instructions

PheNode

Premium Environmental Data Collection Platform

Version 1.1

(PH01-523)

January 2024 Version 1.1

Agrela Ecosystems

DISCLAIMER

Agrela Ecosystems makes no representations or warranties with respect to this manual and, to the maximum extent permitted by law, expressly limits its liability for breach of any warranty that may be implied to the replacement of this manual with another. Furthermore, Agrela Ecosystems reserves the right to revise this publication at any time without incurring an obligation to notify any person of the revision.

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Agrela Ecosystems nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information that is contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer shall perform repairs to components unless otherwise explicitly stated or communicated by Agrela Ecosystems. Failure to observe this information can result in injury or equipment damage.

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Agrela Ecosystems

Product modifications

Year	Type	Modifications
2024		Integrated METER Atmos 41

Table 1. Product modifications

Document revisions

Date	Version Number	Document Changes
January 2024	1.1	API Documentation, GUI update

Table 2. Document revisions

Table of Contents

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1 Preface

1.1 Description of the user

This document is intended for PheNode owners and operators as well as any user who may need to assemble, disassemble, deploy, install, or relocate PheNode in any indoor or outdoor environment.

1.2 Explanation of Safety Warnings

⚠WARNING
Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.

⚠CAUTION
Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

NOTICE
Indicates information considered important, but not hazard-related.

1.3 Retaining Instructions

- Read and understand this manual and its safety instructions before using this product. Failure to do so can result in injury.
- Follow all the instructions. This will avoid fire, electric shocks or other hazards that may result in damage to property and/or severe or fatal injuries.
- The product shall only be used by persons who have fully read and understand the contents of this user manual.
- Ensure that each person who uses the product has read these warnings and instructions and follows them.
- Keep all safety information and instructions for future reference and pass them on to subsequent users of the product.
- The manufacturer is not liable for cases of material damage or personal injury caused by incorrect handling or non-compliance with the safety instructions. In such cases, the warranty will be voided.

1.4 Obtaining documentation and information

1.4.1 Internet
The latest version of the documentation is available at the following address:
https://www.agrelaeco.com/support

1.4.2 Supplementary information
Besides these user instructions, the following documentation is available:
- User manuals for third party sensors and components can be found by following the links in Section 2.1.

1.4.3 Company Website: https://www.agrelaeco.com

1.4.4 Ordering documentation
Documentation, user instructions and technical information can be obtained by sending a document request to info@agrelaeco.com.

1.4.5 Other languages
Currently, this manual is only available in English.

1.4.6 Documentation Feedback
If you are reading Agrela product documentation on the internet, any comments can be submitted on the website on the Contact page. Comments can also be sent to info@agrelaeco.com. We appreciate your comments.

1.4.7 Support and service
For other questions, information, technical assistance or ordering user instructions, please contact support@agrelaeco.com

2 Description of the product

2.1 Intended use

The PheNode is intended to be used as an environmental sensor station in indoor or outdoor environments, much as a weather station would be used. Following these instructions to ensure proper installation of PheNode is essential to its safe and intended use. Following these instructions is essential to achieve optimum performance and measurement accuracy with your PheNode.

By purchasing a PheNode, the User agrees ***not to***:

- use the PheNode as surveillance equipment whereby the user installs or uses the PheNode in a manner that is collecting personal or sensitive data of individuals, persons, or organizations;
- infringe on the personal rights of any individual or entity, including using any information obtained from the PheNode in order to harass, abuse, or harm another person;
- circumvent, disable, or otherwise interfere with security-related features of the PheNode;
- attempt to bypass any measures of the software designed to prevent or restrict access to the User dashboard;
- decipher, decompile, disassemble, or reverse engineer any of the PheNode software or firmware in order to host the PheNode database on a different server, network or cloud platform in any way not intended unless otherwise stated in this manual;
- make improper use of our support and maintenance Services or submit false reports of sensor or component malfunctions;
- use the PheNode in a manner inconsistent with any applicable laws or regulations (i.e. FCC regulations);
- force integration of new or different sensors, peripheral components, or third-party components of any kind outside what is established and agreed upon within these Terms or outside the physical, electrical, and software capabilities of the PheNode.

PheNode is strictly designed and intended to be used for collecting the data and images of environmental conditions in locations owned or operated by the user or their associated organizations.

Unless any new, additional, or requested components or sensors not listed below are integrated into PheNode by Agrela for the User, PheNode shall only be used with the following sensors, accessories, and components:

- AGRELA Imaging Sensor (See Section 8.1.3)
- AGRELA Wireless Sensors (See Section 9)
- METER GROUP Atmos 14 Sensor (https://www.metergroup.com/en/meter-environment/products/atmos-14/atmos-14-tech-specs)
- METER GROUP Atmos 22 Sensor (https://www.metergroup.com/en/meter-environment/products/atmos-22/atmos-22-tech-specs)
- METER GROUP TEROS 12 Sensor (https://www.metergroup.com/en/meter-environment/products/teros-12/teros-12-tech-specs)
- METER GROUP Teros 21 Sensor (https://www.metergroup.com/en/meter-environment/products/teros-21/teros-21-tech-specs)
- METER GROUP Atmos 41 Sensor (https://www.metergroup.com/en/meter-environment/products/atmos-41/atmos-41-tech-specs)
- PRONAMIC RAIN-O-MATIC Sensor (https://pronamic.com/Files/Images/datasheets/DatasheetProfessional.pdf)
- VOLTAIC SYSTEMS 6V Solar Panels (https://voltaicsystems.com/6-volt-solar-panels/)
- TAOGLAS 5-in-1 Antenna MA275.LBICG.002 (https://www.mouser.com/datasheet/2/398/MA275.LBICG.002-1839627.pdf)

Any additional sensor integrations, system modifications or use cases that are not listed in this manual must be approved by Agrela or the user risks voiding their warranty, even if the user has purchased a PheNode Service Subscription. For more information on PheNode Service Subscriptions, visit: https://www.agrelaeco.com/terms-of-service.

2.2 Geographical restrictions

If you are unsure whether PheNode can operate in your state/country or connect to your regional cellular networks, contact an Agrela associate to learn more about PheNode's geographical restrictions.

2.3 System overview

PheNode is a flexible, environmental sensor platform with a mechanical framework that can be reconfigured for a variety of applications. The PheNode Sensor Frame (Figure 1) rests on top of the PheNode tower structure (Figure 2) or can affix to any pole with an outer diameter of 1.5"- 2.5". The Sensor Frame is where many of the PheNode environmental sensors are mounted, and its design allows for the expansion of additional sensors and components.

PRONAMIC
Rain-o-matic Professional:
Rainfall

METER ATMOS 22:
Windspeed/Direction/Gust

METER ATMOS 14:
Temperature, Humidity,
Air Pressure, Vapor Pressure

METER TEROS 12:
Soil Moisture, Soil
Temperature, Salinity

AGRELA WIRELESS SENSOR
• Measures Temperature, Humidity, Air Pressure, Air Quality, LUX
• Plug in up to (2) TEROS 12 soil probes
• Rechargeable
• Small solar panel for longer battery life
• Communicates via LoRaWAN (1km) or Bluetooth (300ft)
• GPS

AGRELA IMAGING MODULE:
5MP, autofocus, compact / lightweight,
compatible with many action camera
extension arm mounts

Figure 1. PheNode Sensor Frame

Wireless communications:

LoRa · Cellular · WiFi · Bluetooth · GPS

Rainfall

Solar powered for outdoor applications, 12VDC plug-in for indoor applications

Additional connectors for custom sensor integrations (SDI-12, RS-485)

Aluminum Tower Structure
- (3) 24" Tower sections
- 4 Leg base

Wireless Sensors (Bluetooth, LoRa, GPS)
Range: up to 1km
Measures: Temperature, Humidity, Air Pressure, Air Quality, LUX

PheNode

Wind Speed
Wind Direction
Gust

Air Temperature
Relative Humidity
Air Pressure
Vapor Pressure

5MP RGB Camera

Eye screws for secure guy wire connections

Add Agrela Wireless Sensors to the tower structure for vertical measurement gradients

Soil Moisture
Soil Temperature
Electrical Conductivity

Add TEROS 21 for water potential measurements

Add TEROS 12 to wireless sensors for soil measurements

Figure 2. PheNode General System Components

2.4 Technical data

Parameter	Unit
Device name	PheNode
Designation	PH01-523
Tools Needed, *Recommended*	Hex key set (Metric), *adjustable wrench, hand sledge, compass*
Input	6V1A (Solar), 12V 1A (Plug-in adapter)
Output	4.2V
Weight: Control box, Assembled sensor frame with sensor suite, tower structure, cabling and ground stakes, complete system	2.5 lbs.	16lbs.	17lbs.	9.5lbs.	34.9lbs.
Chemical composition	Structural components are primarily aluminum. Electronics are comprised of common PCB materials. Sensors are comprised of various materials including plastics and metals.
Performance data	Any diagnostic data collected by PheNode will be available to the user on the "Download Data" screen of the PheNode GUI
Optimal operation temperature range, relative humidity	32°F to +113 °F, 30 - 70%

Table 3. Technical data

2.5 Product compliance

This product complies with all relevant regulations. The product is in conformity with the following relevant product safety standards:

- USA: FCC Part 15b
  - o This device complies with Part 15b of the FCC Rules. Operation is subject to the following conditions:
    - 1. This device may not cause harmful interference.
    - 2. This device must accept any interference received, including interference that may cause undesired operation.
  - o PheNode contains the following radio modules, listed by their FCC identification numbers:
    - XMR2020BG95M1
    - QOQWFM200
    - 2ALPH-E22900T30S
    - XPYNINAB30
  - o Changes or modifications to PheNode modules or antennas not expressly approved by Agrela Ecosystems, Inc. could void FCC compliance and thus the user's authority to operate the equipment.

2.6 Product elements
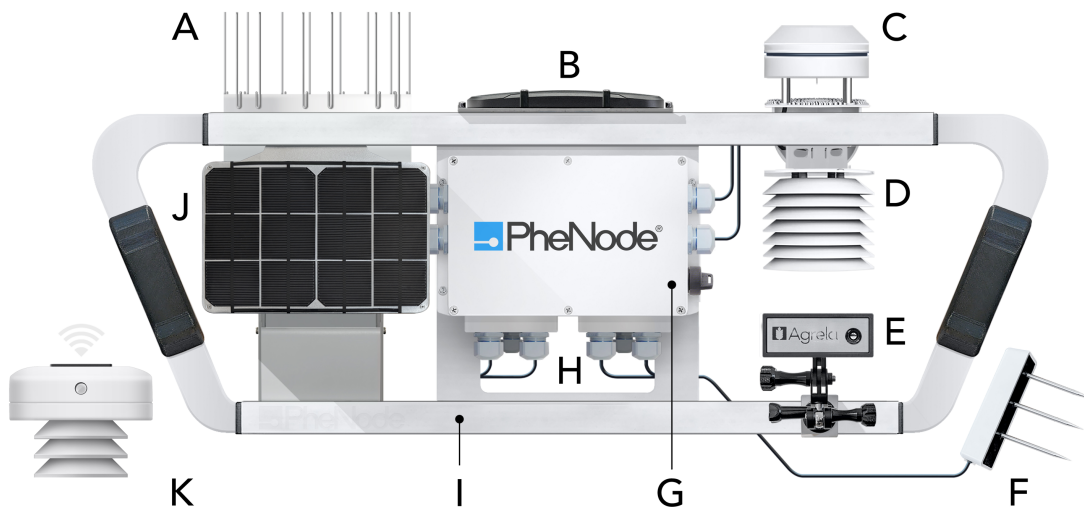
Figure 3. PheNode elements

A. Rain sensor: Pronamic Rain-o-matic
B. 5 Band Antenna (WiFi, Bluetooth, Cellular, LoRaWAN, GPS)
C. Wind sensor: METER Atmos 22
D. Ambient air sensor: METER Atmos 14
E. Agrela Imaging module: 5MP, autofocus
F. Soil sensor: METER Teros 12
G. PheNode Control Box
H. Sensor connectors
I. Sensor frame
J. Solar panel: Voltaic Systems 6V panels
K. Agrela wireless sensor

2.7 Understanding the user interface

The user can view sensor and imaging data, set device and data download preferences, and more through the PheNode graphic user interface (GUI). (See Section 6 for more information.)
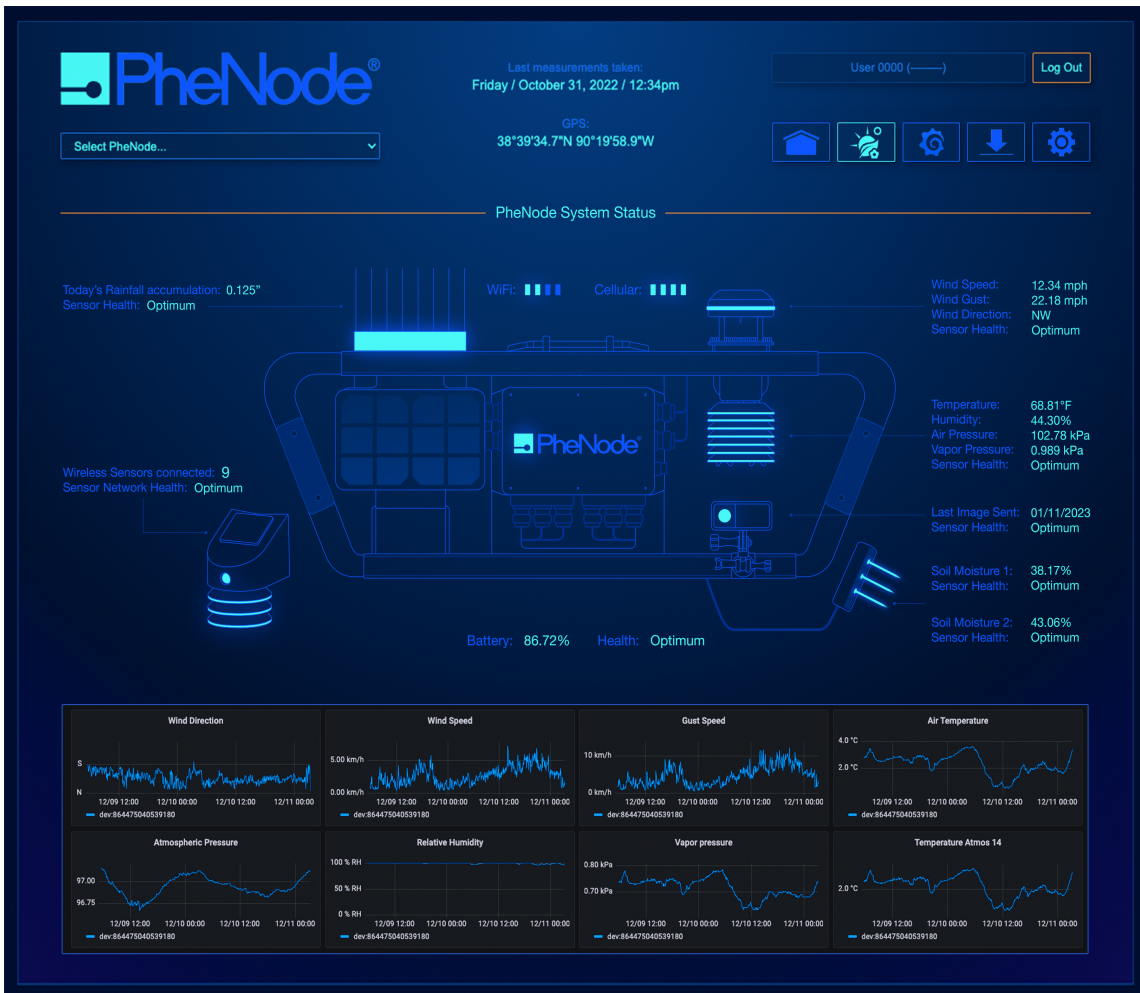
Figure 4. PheNode GUI

2.8 Operating panels

The key switch on the side of the Control Box is how the User will turn on and off PheNode.

Figure 5. Key Switch

3 Safety instructions

⚠CAUTION

READ AND UNDERSTAND THIS MANUAL AND ITS SAFETY INSTRUCTIONS BEFORE USING THIS PRODUCT. FAILURE TO DO SO CAN RESULT IN INJURY.

3.1 How to use the products Safely

3.1.1 Technical life span
- PheNode's technical lifespan regarding any/all integrated 3rd party components are limited to the availability of these components. Agrela cannot guarantee the availability of 3rd party components and sensors but will make a reasonable effort to maintain PheNode's inherent flexibility to accommodate replacements of any 3rd party components/sensors that are no longer commercially available.
- **To maximize the life of the lithium-ion batteries, and to avoid any potential battery-related hazard, it is strongly recommended that PheNode primarily operate in environments between 32°F to 113°F.**
- For a user to maximize the longevity of their PheNode(s), Agrela strongly recommends subscribing to the PheNode Service Subscription to keep their device current and fully operational.

3.1.2 Safety information related to the use of PheNode in residential areas
- The User is urged to place bright fluorescent flags next to any ground stake, guy wire, or other hardware component attached to PheNode that may not be immediately visible to any passers-by and can be considered a tripping hazard.
- Although PheNode's structure is comprised of aluminum and can withstand extreme weather conditions, Agrela strongly advises that no one climb, hang from, jump from, or swing from PheNode. Any activities not stated in this product manual are not recommended and may cause injury.

3.1.3 Personal protective equipment

- When installing PheNode on a sunny day, it is recommended that the installer wear sunglasses to protect their eyes from the bright sunlight reflecting off the solar panels.
- Agrela also recommends the user wear gloves to protect their hands when installing PheNode guy wires, ground stakes, and soil probes.

3.1.4 Product limitations and restrictions

- See section 2.1.

3.1.5 Installation safety information

- See section 5.2.
- Only follow installation instructions that are provided by Agrela in this manual.
- Contact Agrela if any components are disconnected, damaged, or missing upon arrival.
- Although not required, Agrela strongly recommends PheNode be installed and/or serviced with two users at any time to ensure materials and components are being handled safely.

3.1.6 Safety information regarding electronic components

- Do not pull on or place an unnecessary amount of force on sensor or solar power cables. Do not hang any items from sensor or solar power cables. Contact Agrela for assistance if cables become disconnected.
- Unless instructed in this manual, User is advised not to plug in any devices, objects, or components not listed in this manual into any connector on the product.

3.1.7 Maintenance safety information

- The rain sensor will need to be inspected periodically to ensure debris has not collected in the bucket and is blocking the intake of water into the sensor. See Section 10.1.1.2 for more information.
- The User may wipe down or clean the PheNode structure using a cloth dampened with water or a mild cleaning solution. It is advised that the User not climb the structure to clean components that are higher up on the PheNode, and instead safely lay down PheNode onto a box or similar item as suggested in the installation section of this manual or use a ladder safely to reach the top of PheNode.

- **Do not open the Control Box and attempt to modify, alter, disassemble the electronics, or remove or install new batteries.**

3.1.8 Service and repair safety information

- WARNING! Do not attempt to open, modify, or repair the product. Alterations to the product and technical modifications are not permitted. The User must contact Agrela before servicing the internal electrical components inside the Control Box to not void the warranty.
- In the event a User must open the Control Box for repairs, maintenance, or upgrades with approval from an Agrela associate, it is strongly recommended that an anti-static wrist strap be worn to prevent any damage to the PheNode electronics by way of any errant static electricity.

3.1.9 Safe disposal

- If the User no longer wants to keep their PheNode, or wishes to dispose of it, please contact Agrela. Agrela will advise on best disposal standards and practices.
- Agrela strongly advises Users not to dispose of their PheNode's Lithium-Ion batteries in any manner either not stated in this manual, or that is recommended by the Environmental Protection Agency (EPA). **Lithium-ion batteries and devices containing these batteries should NOT go in household garbage or recycling bins. Lithium-ion batteries SHOULD be taken to separate recycling or household hazardous waste collection points. To prevent fires, tape battery terminals and/or place lithium-ion batteries in separate plastic bags.** For more information, visit: https://www.epa.gov/recycle/used-lithium-ion-batteries
- PheNode electronics should NOT be placed in garbage or recycling bins. Agrela STRONGLY urges Users to follow EPA guidelines for electronics disposal/donation/recycling: https://www.epa.gov/recycle/electronics-donation-and-recycling

3.2 Labels

3.2.1 Explanation of safety information on the packaging and product

Symbol	Meaning
UN3481 Label	Lithium-ion batteries contained in or packed with the equipment, installed / integrated at the source.
Warranty Decal	Inside the Control Box cover. Removal of this decal will void the warranty.
FCC Compliance (Label)	See FCC statement on Control Box cover

Table 4. Product labeling

3.3 Potential health consequences

⚠ WARNING

This device uses lithium-ion batteries. Keep away from children. Do not disassemble and do not dispose of in fire. Inaccurate handling of lithium-ion and lithium-ion polymer rechargeable battery may cause leakage, heat, smoke, an explosion, or fire. This could cause deterioration of performance or failure.

3.4 Data protection

To protect stored data:
1. **Do not attempt to extract the SD card inside this product's Control Box without first contacting Agrela.** All sensor, imaging, and system data collected by PheNode remains on the SD card until either (a) the SD card's storage capacity is full and PheNode will begin overwriting the oldest data on the SD card, or (b) the user manually deletes the data while the SD card is plugged into a PC, or any other device that can read/write to SD cards. Instructions on how to remove data safely and manually from PheNode is available upon request at support.agrelaeco.com.
2. **A user's PheNode collected data will always be available to the user.** In the event of a user cancelling their PheNode Service Subscription, any data collected by their PheNode before the subscription cancelation will still be available upon request.

4 Setting up your PheNode account

4.1 Access and manage your PheNode account

4.1.1 Logging into your account

Upon purchasing a PheNode Service Subscription, the User will receive an email with a link to their PheNode Graphic User Interface (GUI) accessible through a web browser (Agrela recommends using Google Chrome or Safari web browsers).

1. **To access your PheNode online account:** Click on the link in the email sent to you by Agrela to access your PheNode account.
2. Login using the temporary username and password provided in the email. Navigate to the "Settings Screen" of the PheNode GUI (*Figure 6*)
3. Click on "Manage Account". (*Figure 6*) This will open a new tab in your browser and take you to "Keycloak Account Management".
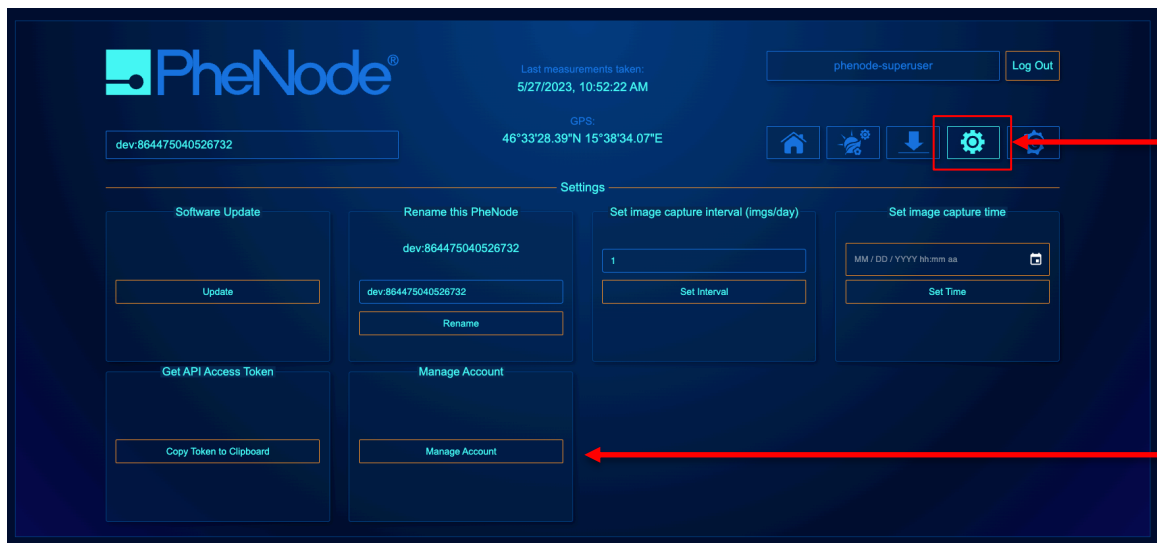
Figure 6. Settings Screen in the PheNode GUI. Red arrows point to the "Settings Screen" button and the "Manage Account" link.

4. Under "Account Security", click "Signing In" (*Figure 7)*
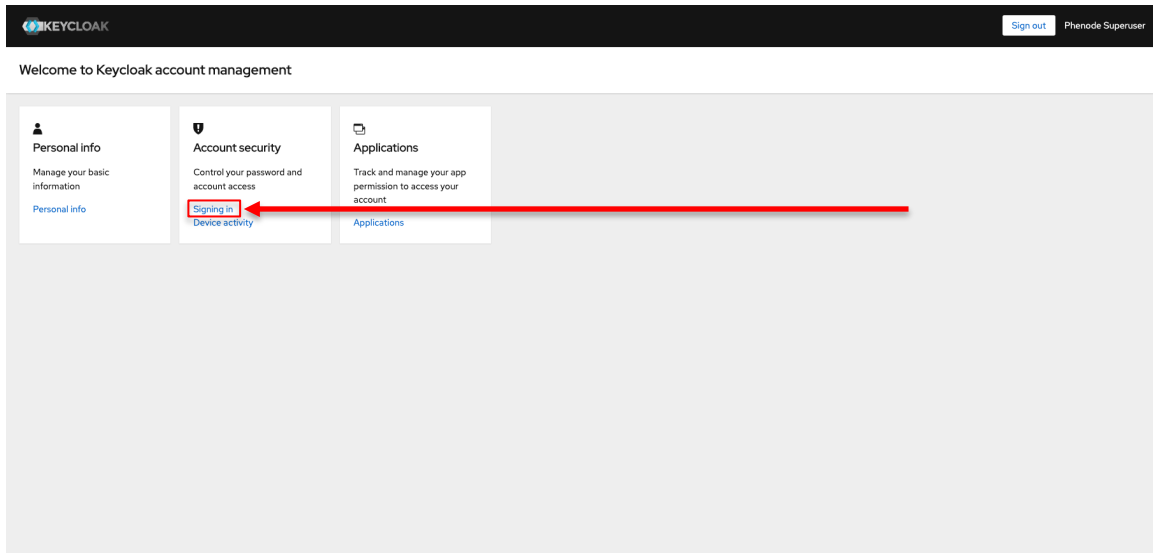
Figure 7. Keycloak account management screen

5. Click on "Update"
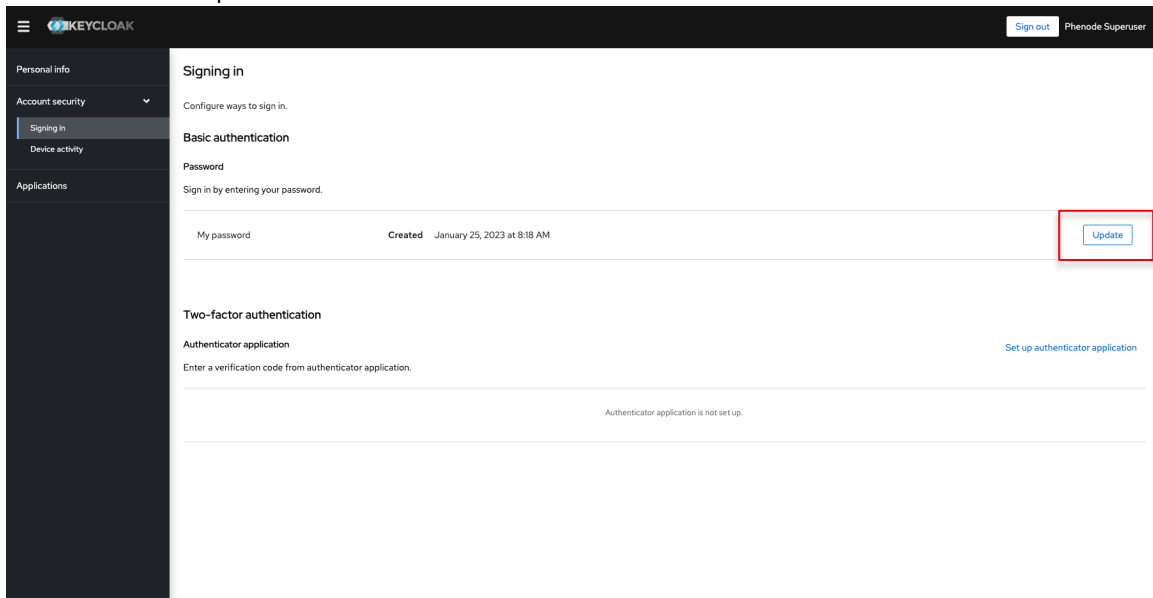
Figure 8. Keycloak "Signing In" screen

6. Enter a new Password, and save. The User may now login with their new login credentials.
7. If you would like to change the email or name of user associated with the account, navigate to the "Personal Info" section of Keycloak. (Figure 8)
8. Change the user's email and name, then save.

You cannot change the username of the account, only the name of the user associated with the account.
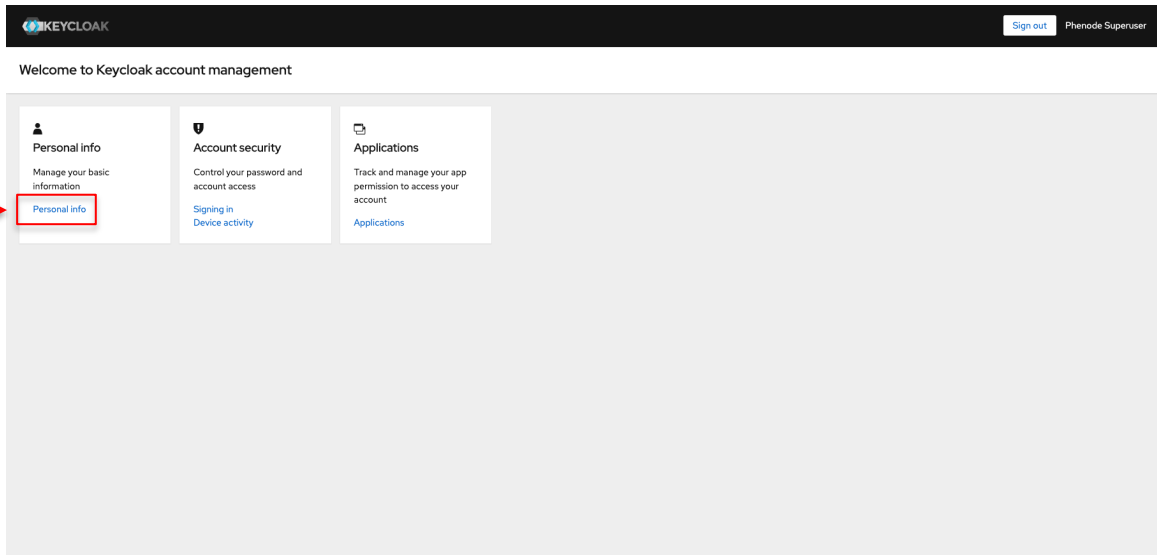
Figure 9. Keycloak - Editing personal info

For more information about the PheNode GUI, See *Section 6.*

5 Preparation

5.1 How to transport and store the product

⚠CAUTION

PheNode ships with twelve (12) 18650 Lithium-Ion batteries. Handle with care.

5.1.1 Packaging

The complete PheNode system ships in two (2) boxes. The Sensor Frame, Control Box, Sensors, and solar panels ship in a box that is 40"L x 24"W x 18"D. The tower structure ships in a box that is 36"L x 10"W x 10"H.

5.1.2 Lifting, handling, and transporting the product

PheNode box and contents total weight is 45lbs. Although not necessary, it is recommended two persons lift, handle, and transport the PheNode box to better avoid injury.

To lift the product safely:
1. Stand with a wide base of support (feet at shoulder width). ...
2. Squat down, bending at the hips and knees only. ...
3. Keep your back as straight as you can while bending.
4. Firmly grasp the handle on the top end of the box ...
5. Slowly lift by straightening your hips and knees (not your back). ...
6. Hold the box as close to your body as possible.
7. Maintain good posture as you walk.

To handle the product safely:
1. Do not drop the box, especially from heights above 3'.
2. Do not lift the box alone if you feel you cannot safely lift 50lbs..
3. Set it on its bottom end or bottom face when not in transport.

To transport the product safely:
1. When shipping PheNode with lithium-ion batteries still contained in the device, do not ship the PheNode without applying a UN3481 decal to the box it is packed in.
2. Agrela will not be responsible for any damages, or any other issues caused by Users shipping PheNode in their own packaging.

3. Users should always try to use the original packaging when transporting PheNode.
4. Agrela recommends two persons transport the PheNode in its packaging when needed to be carried by hand.
5. Agrela recommends two persons transport PheNode when uninstalling and moving PheNode to a new location in the field.

5.1.3 Storing the product
To store the product safely:
1. Repackage the PheNode as it was originally packaged (See section 5.1.5).
2. Agrela recommends PheNode be stored in a cool, dry place between 55°F - 72°F.
3. Do not stack any other boxes or items on top of the PheNode packaging.
4. Do not stack the PheNode packaging on top of any other box or item.

5.1.4   Storing the product during intervals in normal use
If the User does not wish to repackage the device due to regular intermittent use, follow these steps:
1. Place the PheNode, with the sensor frame and tower structure fully assembled, standing up on level ground away from any other items that may fall onto the PheNode. Do not hang anything from the PheNode structure, nor place the assembled PheNode on top of any other item or object. Disconnect solar panel cables to allow the batteries to discharge safely. Set the key switch in to the "Off" position.
2. Unless safely deployed/installed in a way that strictly follows the contents of this manual, do not keep PheNode plugged in unattended for any extended period.

5.1.5 Repacking the product
It is recommended to keep and store your original packaging after unboxing PheNode. The PheNode packaging was designed to protect the product in transit and while in storage.

To repack the product:
1. First, make sure the PheNode's key switch is in the "Off" position (Figure 5).

2. Next, unplug solar panels from the Control Box.
3. Disconnect the soil probe cables from the Control Box.

4. Loosen the pole clamp wingnuts and remove the Sensor Frame from the pole structure.
5. Lay the Sensor Frame back side down on a soft surface.
6. Disconnect all sensors plugged into the bottom of the Control Box. Set sensors and solar panels aside on loose packing material.
7. Return the Camera Module to a position that rests on the same plane as the Sensor Frame and lock the camera arm in place.
8. Lay the sensor frame face down (on the Control Box) on something soft like foam or cardboard.
9. Remove the handles from each side of the Sensor Frame and place the fasteners in a small plastic bag.
10. Place the tool kit, sensor frame handles, solar panels, hardware bag, and any booklets/manuals in the lower layer of the box.
11. Lay a thick layer of packing material in the box on top of the accessories.
12. Lay the Sensor Frame down flat in the box, Control Box facing upward, on top of the accessories layer.
13. Place another layer of packing material on top of the Sensor Frame.
14. Wrap all sensors and solar panels and place in the box on top of the Sensor Frame layer.
15. Fill the rest of the box with packing material until all components are firm and do not easily move around when the box is jostled.
16. Close the box and secure the flaps with packing tape.
17. Disassemble the tower structure by removing the three (3) hex bolts from the top pole section first and place them in a plastic bag.
18. Slide the top pole section off the middle pole section and set to the side.
19. Next, disconnect the middle pole section from the lower pole section by removing the three (3) hex bolts and place them in a plastic bag.
20. Slide the middle pole section off the bottom pole section and set to the side.
21. Disconnect the legs from the leg base collar by unscrewing the two (2) hex bolts from where the leg rests against the base collar.
22. Rewrap each pole section with the small sheets of foam or a similar material.
23. Wrap all three (3) pipe sections together with bubble wrap, and place inside the bottom of the long box.
24. Wrap the four (4) legs individually with foam sheets or a similar material.
25. Wrap all four (4) legs together with bubble wrap and place alongside the wrapped pole sections in the box.
26. Wrap all seven (7) ground stakes together in foam sheets, or similar material, and place inside the box.

27. Roll up all three (3) guy wires together, and secure them with zip ties, twist ties, or similar.
28. Place all loose fasteners in a bag.
29. Place the bagged fasteners, rolled up guy wires, turnbuckles, and carabiners into the box.
30. Use any available soft packing material inside the box to firm-in all components and close the box flaps.
31. Secure the box flaps with packing tape.

5.2 How to assemble PheNode

⚠CAUTION

Installation of the product shall only be done by persons who have read and understood the perceived risks and hazards that could occur during the construction, installation, and use of PheNode.

5.2.1 Unpacking and constructing PheNode

If the User wishes to keep soil cabling tidy, see Section 5.2.8 before proceeding with the steps below.

1. Remove the pole section with the grey collar fastened to one end (Figure 10) from the long rectangular box.

Figure 10. Bottom pole section

2. Fasten the (4) four legs to the base collar with the hex screws provided (Figure 11).

Figure 11. Attaching legs onto the base collar

Figure 12. Middle pole section combined with base assembly

Figure 13. Securing pole fasteners

3. Slide the middle pole section down onto the base assembly as shown (Figure 12) and secure with hex screws (Figure 13).
4. Pull the sensor frame with sensors out of the larger box.
5. Gently lay the sensor frame face down onto something soft like packing material or foam.
6. Make sure the wingnuts on the long bolts are loosened enough to slide the pole clamps back a few inches, then slide the top pole section through the pole clamps on the back of the sensor frame until the plastic cap on top of the pole section is against the sensor frame hood (Figure 14).
7. Tighten the wingnuts on the long bolts until the pole clamps are quite tight against the pole.
8. Lift the sensor frame and top pole section assembly onto the middle pole section. The back of the sensor frame should be facing the same direction as the cable gland on the top pole section (Figure 15).
9. Secure the pole section with three (3) hex bolts.

Sensor frame hood
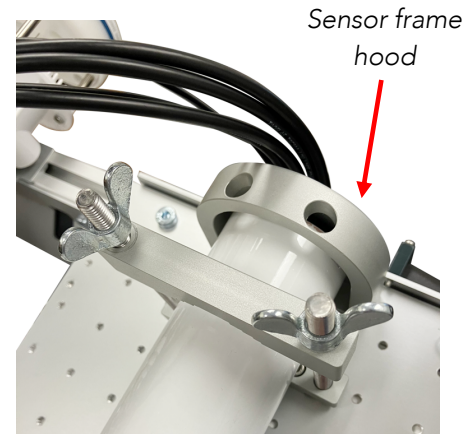
Figure 14. Top pole section inserted through pole clamp

Back of sensor frame
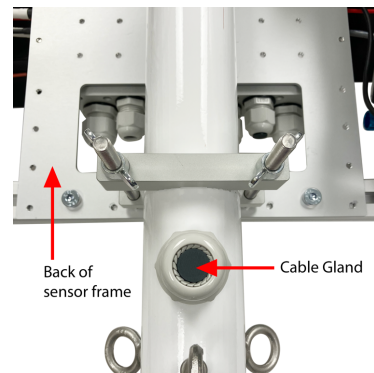
Cable Gland

Figure 15. Cable gland and mounting plate

5.2.2 Minimum space required

PheNode fully assembled with its tower structure will need 16 square feet (4' x 4') of space if no guy wires are connected. When guy wires are required, PheNode will need roughly 100 square feet, or a 10' x 10' area. (Figure 16).
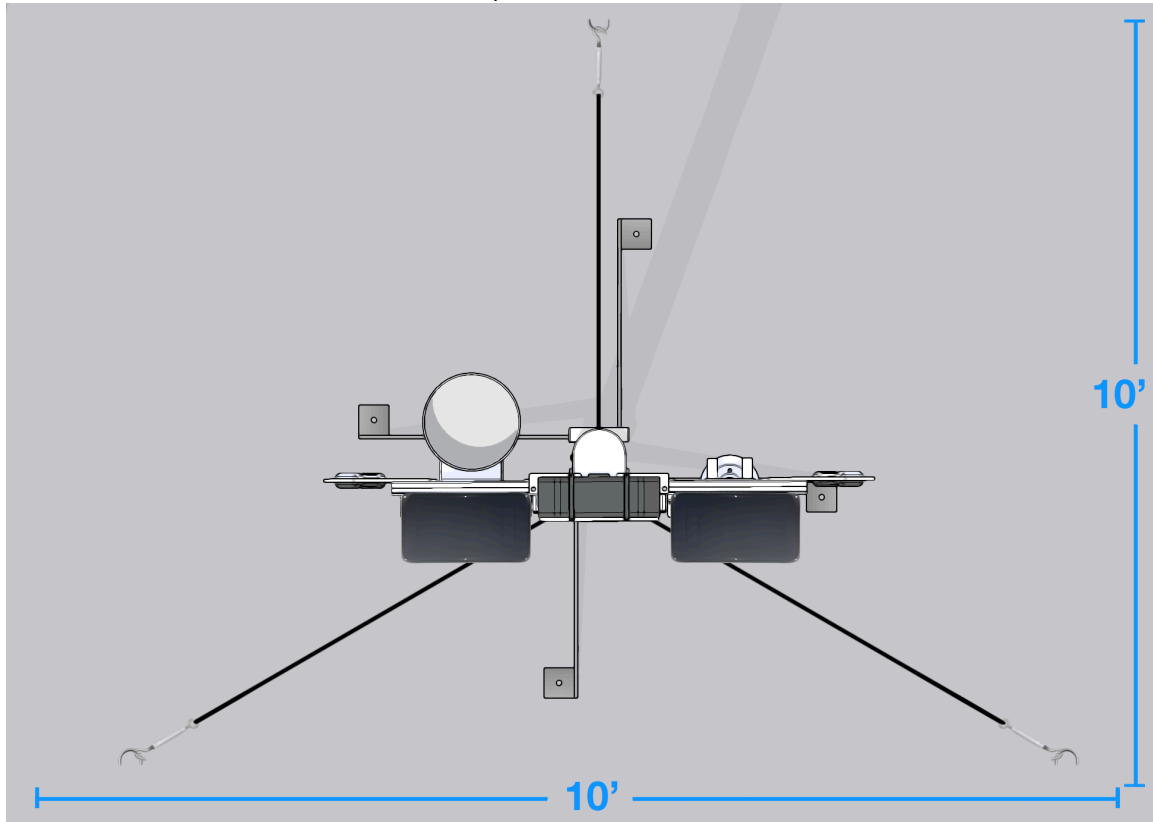
Figure 16. PheNode area requirements from above.

5.2.3 Layout plan

For optimum sensor measurements and overall product performance, Agrela recommends the following steps be taken:

1. PheNode should be installed on ground that is reasonably level.
2. Install PheNode out of the path of heavy machinery, pedestrians, or any other situation where PheNode could be an obstruction that could possibly lead to any injuries to people or damage to property and equipment.
3. Check to ensure PheNode is not installed near any object or building that could obstruct wireless communication to and from the device.
4. Do not position the camera to take images of personal property or individuals that are not associated with the User or organization who purchased the PheNode.

5. Check to ensure PheNode's solar panels are facing south for maximum solar power generation, and that no object or building is obstructing the southern sky.
6. If the user wishes to organize their sensor suite on the sensor frame in a different configuration, the User should take care as to not obstruct any sensor in a way that could compromise or diminish its measurement capabilities.

Check to ensure no utilities or infrastructure of any kind may be under the area in which the User intends to install their PheNode. The ground below the PheNode should be able to safely accommodate the full length of the ground stakes provided without obstruction of any kind.

⚠CAUTION

5.2.4 Conditions for assembly
PheNode can be deployed in any condition, but it is recommended that weather conditions be mild and without strong winds or precipitation. The User should be able to see the ground in its entirety without snow cover or excessive muddy conditions to ensure the PheNode is level and on firm ground before securing the system with ground stakes and guy wires.
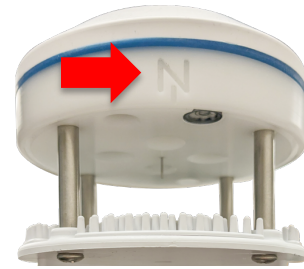
Figure 17. "North" mark on wind sensor

5.2.5 Installation of PheNode
Required tools:

- M3, M4, M5, M6 Hex Wrenches (Included)
- Hand Sledge (Not included)
- Compass (Analog or digital) - Strongly recommended for optimum measurements (Not included)
- Level - Strongly recommended but not required (Not included)

To install the PheNode:
1. After PheNode is fully assembled (Section 5.2.1), station the PheNode in a location that complies with the recommendations and requirements of Sections 5.2.3, 5.2.4, and 5.2.5).
2. *In the northern hemisphere, face the solar panels toward the south and the "N" on the wind sensor (Figure 17) should face north. In the southern hemisphere, face the solar panels toward the north and the "N" on the wind*

sensor should still face north. *For optimum measurements, use true north rather than magnetic north.*

3. Position the camera module to take images at the desired object of interest.
4. Hammer ground stakes into the "foot holes" of the Tower structure until the hook on the ground stake is touching the metal of the PheNode "foot" (Figure 18) and both sides of the ground stake hook are below the ground surface.
5. Attach the carabiner end of the guy wires to the eye bolts on the top tower section just below the sensor frame (Figure 19) and screw the nut on the carabiner until it closes the gap between the threading and the nut.
6. Pull the guy wires away from the PheNode and against the ground until the guy wire is taut.
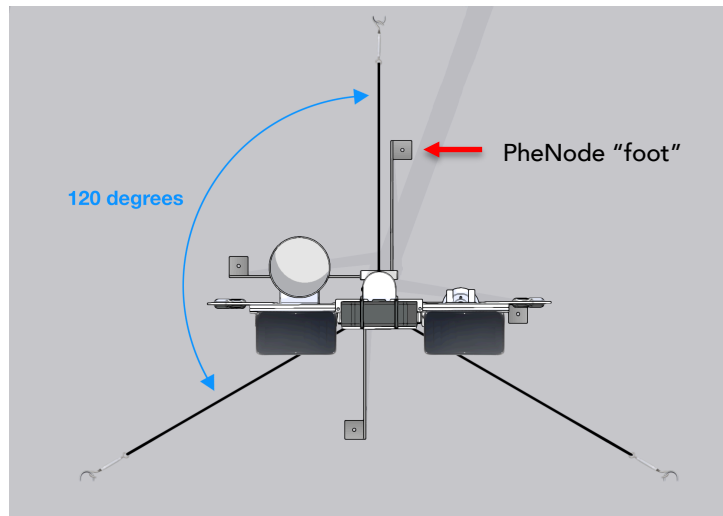
Figure 18. Guy wire positioning from above

Mark the spot where the hook end of the turnbuckle is touching the ground. (CHECK TO ENSURE THE TURNBUCKLE IS LOOSENED ENOUGH THAT AT LEAST 3" OF THREADING IS EXPOSED ON EITHER SIDE) All guy wires should be roughly 120 degrees away from one another (Figure 18). Eye screws on the tower structure are already 120 degrees from one another and should be used as a guide.

7. Hammer the J-hook ground stake into the ground until there is only about 1" of space left between the hook and the ground.
8. Slide the hook end of the turnbuckle around the J Hook.
9. To secure the guy wire hammer the remaining J hook into the ground until both sides of the hook are below the ground surface.
10. Tighten the guy wire by twisting the turnbuckle.

Figure 19. Attaching the guy wire carabiner to the tower structure eye screw

11. For soil probe installation, dig a hole to the desired depth near PheNode that the cable length can accommodate.

12. **Push the spikes of the soil probe into the wall of the dug hole. Do not back fill the soil into the hole until the PheNode is turned on and the User confirms the soil probe is reporting measurements properly.** The user is advised not to place the soil probe at the bottom of the hole and back fill soil on top. This will produce inaccurate measurements as the soil conditions in this case would not be representative of the surrounding, undisturbed soil. For optimum measurements, always push the soil probe spikes into undisturbed/least disturbed soil, such as the wall of the dug hole. (If the User wishes to run the soil probes cable(s) up through the tower structure to keep them better protected, see Section 5.2.6 below.)

13. Attach cable protector to the soil probe cable (Figure 20) whereby roughly 8" of the cable is buried under the ground level and roughly 24" is above the ground line. If multiple soil probes are being used with a single PheNode in a single hole, Agrela recommends the user run both soil probe cables into the same cable protector. If the user prefers to bury all excessive cable slack in the dug hole, Agrela advises the installer to use caution when unearthing the soil probe at a later date as damaging the soil probe cable with a shovel, or metal tool of any kind, could render the soil probes unusable.

Figure 20. Cable protector on soil probe cable

14. Insert the key into the key switch and turn the switch to the "On" position.

15. Login to your PheNode account (Section 4) and check to make sure your PheNode is connected to the cloud and reporting values. The User should see sensor values being reported as well as a timestamp that confirms that a measurement was just recently taken.

16. Back fill the soil probe hole with the removed soil and firm it in.

5.2.6 Hiding soil probe cables in the tower structure

Follow the steps below to run soil cables through the tower structure **before** the top tower section and sensor frame is fastened to the middle pipe section.

1. Before inserting your soil probe cables into the bottom pipe section, be sure to leave enough cable length for your soil probes to reach the desired depth in the soil.
2. Lay the tower base, bottom pipe section, and middle pipe section assembly on its side on the ground.
3. Insert the soil probe connector end into the bottom of the bottom pipe section, turn the tower base assembly upside down and let the connector slide downward, up through the bottom and middle pipe section.
4. Once the connector is out of the top of the middle pipe section, pull all the remaining cable slack through.
5. Lay the top pipe section and sensor frame assembly down gently on the PheNode cardboard shipping box and remove the cable gland from the back of the top pipe section by unscrewing it.
6. Manually feed the soil probe cable (connector end) up the top pipe section until the connector reaches the cable gland hole.
7. Pull the connector through the cable gland hole along with all the soil probe cable slack.
8. Unscrew the cable gland cap from the cable gland and pull the connector end of the soil probe cable first through the cable gland threading, next through the cable gland rubber plug, and finally through the cable gland cap.
9. Screw the cable gland threaded piece back onto the back of the top pipe section. Then, cap back on the cable gland cap, but keep it loose.
10. Connect the top pipe section and sensor frame assembly with the tower base, bottom pipe section, and middle pipe section assembly and secure the fasteners.
11. Remove the cable gland cap on the bottom of the Control Box labeled "SDI-12 5" and "SDI-12 6".
12. Push the soil probe connector into one of the stereo jacks, then tighten the cable gland until the cap closes in around the soil probe cable.
13. Now that the cable gland on the Control Box is tight, push excess cable slack into the cable gland on the back of the top pipe section, then tighten the cable gland cap.
14. Now finish the soil probe installation as outlined in Section 5.2.6.

5.2.7 Indoor installation

PheNode can be used indoors with the tower structure. If the user prefers to mount the sensor frame to an existing indoor structure instead, Agrela advises the installer to use caution.

To install PheNode indoors:

1. Make sure the solar panels are disconnected from the Control Box.
2. Once the PheNode is safely stationed in the desired location, insert the barrel plug of the 12VDC wall adapter into the "DC IN" connector on the bottom of the PheNode Control Box.
3. Next, plug the adapter end into a 120V wall outlet, and make sure it is protected from water.
4. Enter your WiFi credentials on the "Settings Screen" of the GUI to connect PheNode to the nearest network if WiFi is available. If no WiFi is available, PheNode will try to connect via cellular connection.
5. Turn the PheNode key switch to the "On" position.
6. Log into your PheNode GUI to check if sensor measurements are being sent and received.
7. See section for troubleshooting if PheNode is not sending data to the cloud.

6 Using the Graphic User Interface (GUI)

6.1 How to use the GUI

6.1.1 Logging in
Go to www.phenode-link.com, and login with the temporary username and password given to you by Agrela. Or if you have changed your username and password, always use those credentials to login.

6.1.2 Navigation
At the top of every screen in the GUI is the navigation section.
In the upper left under the PheNode logo is the drop-down menu where you can select all PheNodes connected to the account that you are logged into. Selecting a PheNode from this drop-down menu will take you to the "System Status" screen.

In the middle of the navigation section of the GUI you will find a timestamp of the last measurement taken from the PheNode selected, and below this are the GPS coordinates of the selected PheNode.

In the upper right is the name of the user who logged into the account, the "log Out" button which logs you out of the account, and the screen navigation buttons. The buttons from left to right are:

1. Fleet screen (Home)
2. System Status screen
3. Download Data screen
4. Settings screen
5. Grafana outbound link (Full screen Grafana viewing)

6.1.3 Fleet Screen (Figure 21)
After logging in, the default screen you will see is the "Fleet" screen. On this screen, users will see an overview of all PheNodes in their "fleet" that are connected to the account that was logged into. The overview contains the latest measurements of the following information:
- Name of PheNode
- Date and time of last measurement taken
- Overall health of the PheNode
- Temperature

- Humidity
- Rainfall accumulation from that day
- Wind Speed
- Current battery charge
- GPS coordinates

The user may either click on a PheNode from the list or select a PheNode from the drop-down menu in the upper right side of the screen.

Figure 21. Fleet Screen

6.1.4 **System Status Screen** (Figure 22)

The System Status screen is where you can view the latest measurements from the selected PheNode as well as data visualization panels at the bottom of the screen, powered by Grafana, whereby each sensor measurement above is visualized on a graph below.

Adjacent to the PheNode diagram are the latest sensor measurements as well a general health indicator of each sensor. Here you will find an error message in red text if a sensor is malfunctioning. Click on "See Images" to view the images taken from the Agrela Camera module in its on screen.

Down below is a Grafana module where you can view the measurements from each sensor connected to the Control Box, as well as the images taken from the Agrela Camera Module and the location of the PheNode based on its GPS coordinates. Click on the name of each panel for more visualization options such

as "view" where you can view the individual graph in full screen. Click on the arrow in the upper left to return to the GUI.
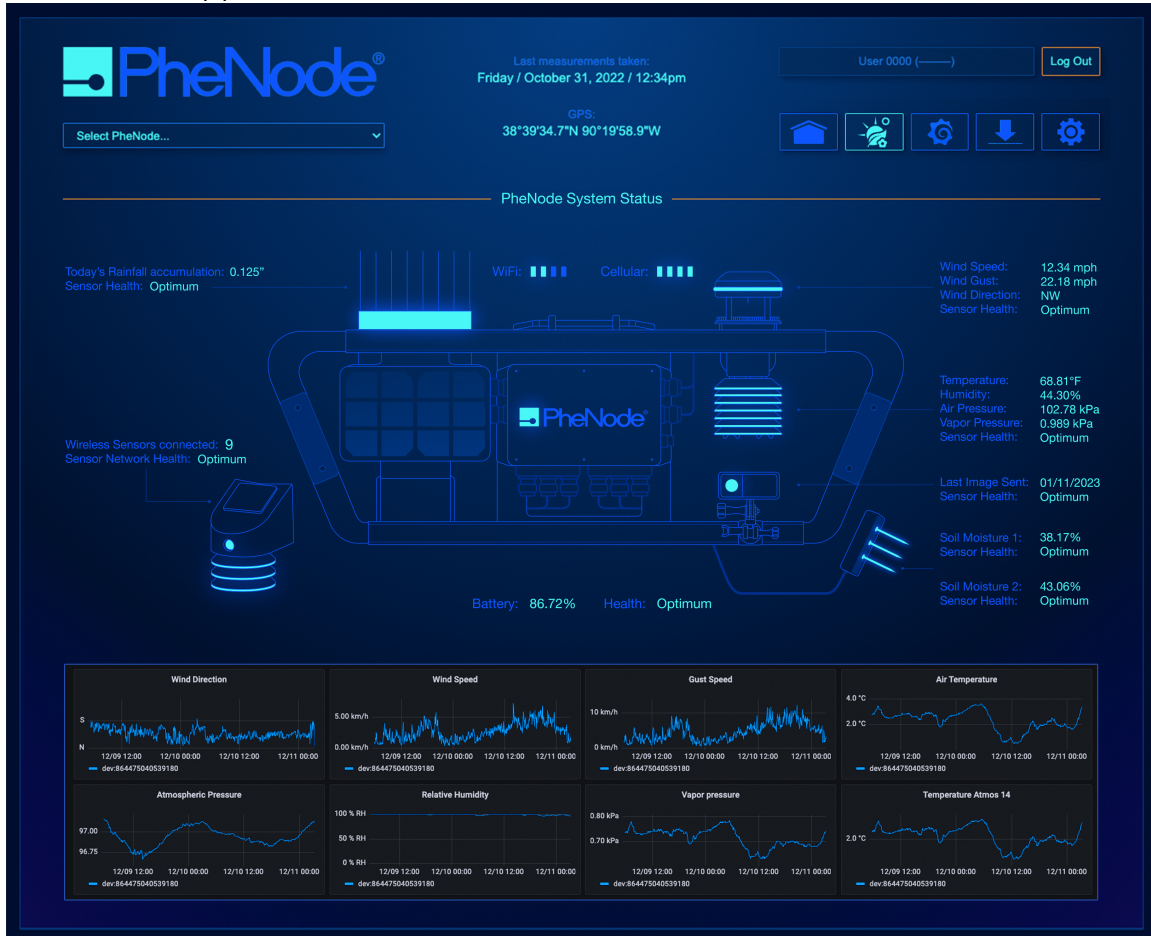
Figure 22. System Status Screen

6.1.5 **Wireless Sensor Screen** (Figure 23)
This is where you will view the data from your wireless sensors. To view the current measurements of a single connected wireless sensor in your fleet, select a sensor from the drop-down menu at the center of the screen below the orange header line. The current measurements (GPS coordinates, temperature, humidity, air pressure, air quality, battery charge and measurements from connected soil probes) will populate to either side of the wireless sensor graphic.

Below the Wireless Sensor graphic, you can rename the selected sensor. This will change the name of the sensor as it appears in the drop-down menu, as well as the downloaded .csv file (.csv files for Wireless sensor data can be found on the Data Download Screen).

Down below is a Grafana module where you can view the individual measurements from each wireless sensor connected to PheNode, as well as the

location of the sensor based on its GPS coordinates. Click on the name of each panel for more visualization options such as "view" where you can view the individual graph in full screen. Click on the arrow in the upper left to return to the GUI.
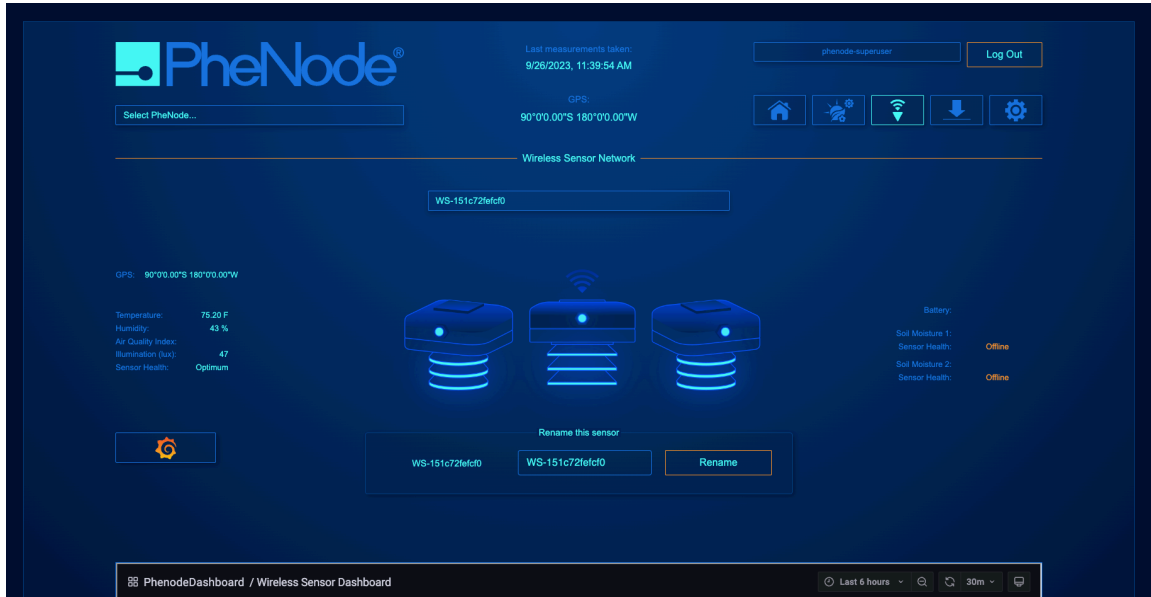
Figure 23. Wireless Sensor Screen

6.1.6 **Data Download Screen** (Figure 24)

This is where you will download PheNode-collected data, wireless sensor data, diagnostic data and imaging files. Enter a "start date" and "end date" in the appropriate fields to download data files that will only contain data or images from your specified time range. Data files will be in .csv format. Images will be jpegs bundled into a .zip file.
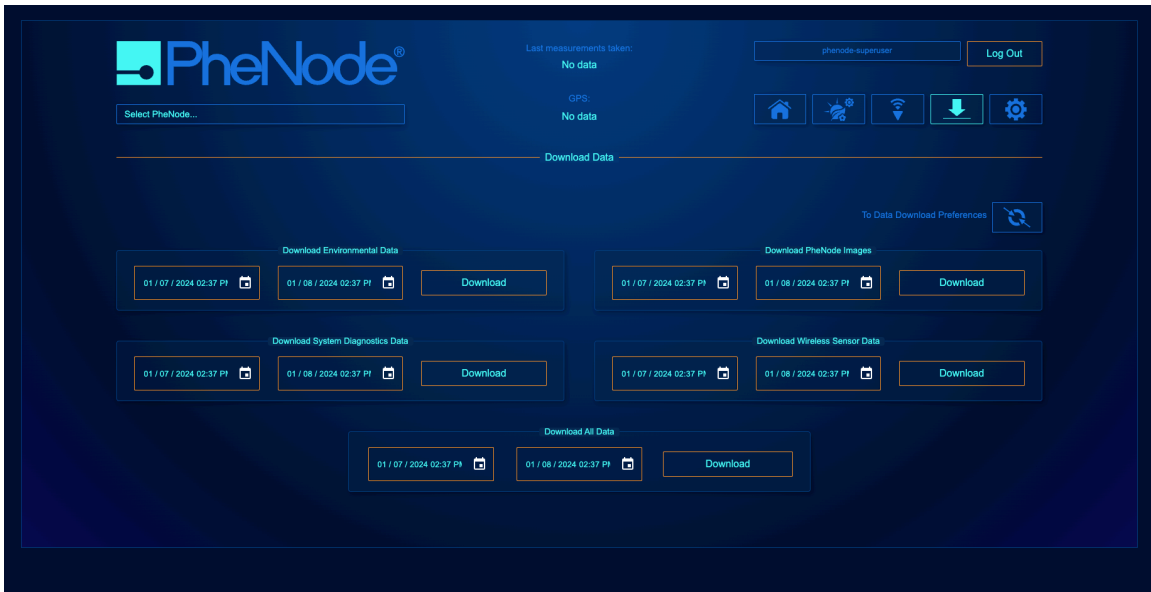
Figure 24. Data Download Screen

6.1.7 **Data Download Preferences Screen** (Figure 25)

The Data Download Preferences screen is where you can set your .csv download preferences such as replacing hyphens, Zeros, error values, and blank cells with several options, setting the desired number of decimal places for measurement values, and adjust your timestamps with your desired time zone rather than the default UTC setting.
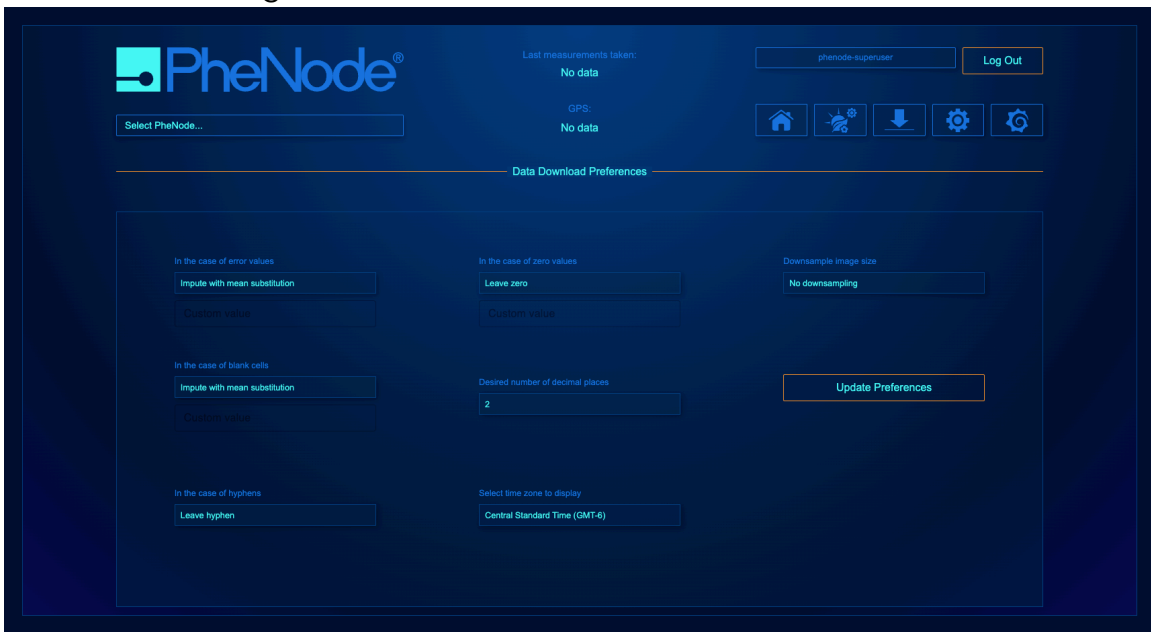
Figure 25. Data Download Preferences Screen

6.1.8 **Settings Screen** (Figure 26)

The Settings screen is where you can initiate a software update, rename your PheNodes, eneter your WiFi credentials, *set the image capture interval of your PheNode (images per day), set the image capture time of your PheNode's imager, copy the access token in order to access PheNode's API, and create sub-user accounts.

*The current version of PheNode can only support 1-3 images per day when on cellular. Additional options will become available as new software updates are released at a later date.
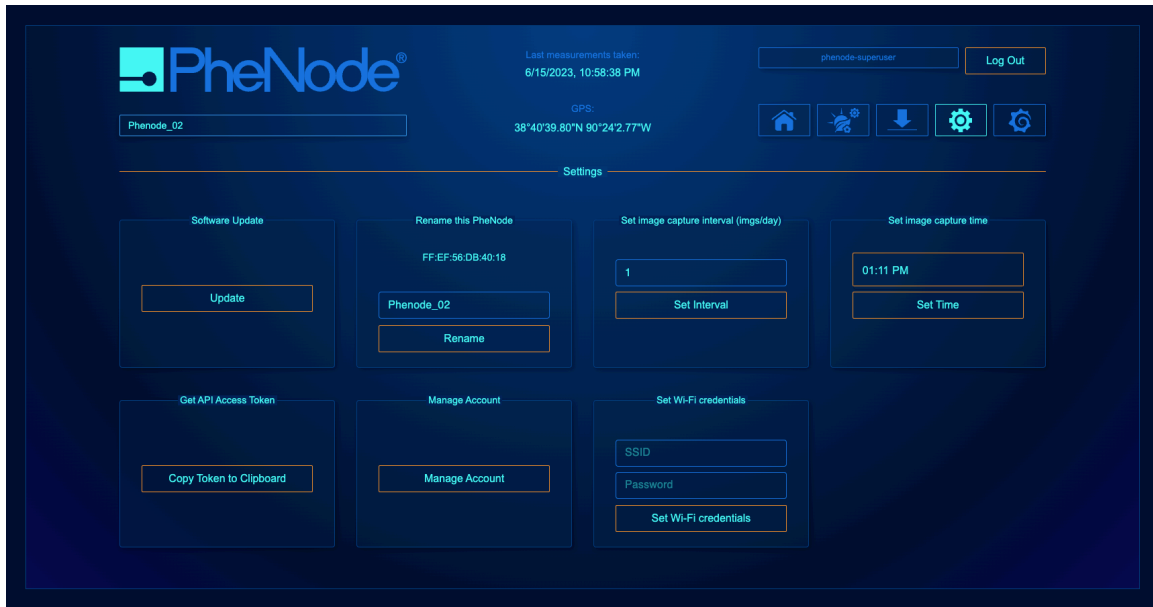
Figure 26. Settings Screen

6.1.9 **Grafana Screen** (Figure 27)

If you would like to view the Grafana data visualization interface in its own webpage, click the fifth screen navigation button in the navigation section of the PheNode GUI. This will open up Grafana in your browser. Click the back arrow in your browser navigation controls to navigate back to the PheNode GUI.

Figure 27. Grafana web application

7 API Access

7.1 API Usage

The application exposes a REST API that can be used to retrieve device data. The API is secured using KeyCloak. To use the API you need to obtain an access token from KeyCloak. The access token is used to authenticate the user when making requests to the API. To obtain the access token login to your account and navigate to the Settings screen. There you will find a Copy Token to Clipboard button. Click it and paste the token into your application.

Alternatively, you can use the curl command to obtain the token:

```
curl --data
 "username=<username>&password=<password>&grant_type=password&client_id=<client_id>"
 https://<your_domain>:8443/realms/<realm>/protocol/openid-connect/token
```

Copy the token from the access_token field in the response and use it in your application.

7.2 API Routes

NOTE: In the example below, only the api_url field is specified, please note the port must be included as well! Generally, the {{api_url}} would be https://phenode-link.com:2537.

The API exposes the following routes:
- {{api_url}}/devices/{{deviceLabel}}/sensor-data/:from/:to? - Get device sensor information. Specify the deviceLabel (device name on the portal), and the :from parameter in UTC time format. The :to parameter is optional.

Example usage:

```
curl -X POST -i <api_url>/devices/<device_label>/sensor-data/2023-04-
10T16:52:21Z/2023-04-17T16:52:21Z -H "Authorization: Bearer <your_token>"
```

- {{api_url}}/devices/{{deviceLabel}}/health-data/:from/:to? - Get device health information. The parameters are the same as for the sensor data route.

Response:

```
{
    "success": true,
    "csvLines": [...]
}
```

Example usage:

```
curl -X POST -i <api_url>/devices/<device_label>/health-data/2023-04-01T16:52:21Z -H "Authorization: Bearer <your_token>"
```

Note: This query does not specify the end time. In that case all data from the starting point up until the moment of the query will be retrieved

- {{api_url}}/devices/{{deviceLabel}}/all-data/:from/:to? - Get all device information. The parameters are the same as for the sensor data route.

Response:

```
{
    "success": true,
    "csvLines": [...]
}
```

Example usage:

```
curl -X POST -i <api_url>/devices/<device_label>/all-data/2023-04-01T16:52:21Z -H "Authorization: Bearer <your_token>" --output <filename>.zip
```

Response:

```
Zip archive saved to the specified file (--output)
```

- {{api_url}}/devices/{{deviceLabel}}/images/download/:from?/:to? - Get device images in a zip file. The parameters are the same as for the sensor data route.

Example usage:

```
curl -X POST -i <api_url>/devices/<device_label>/images/download/2023-04-
01T16:52:21Z -H "Authorization: Bearer <your_token>" --output
<filename>.zip
```

Response:

```
Zip archive saved to the specified file (--output)
```

7.3 CSV Response

The sensor-data and health-data responses are JSON formatted and contain the following fields:

```
{
    "success": true,
    "csvLines": []
}
```

If the query returned data the csvLines field will contain an array of strings. Each string represents a line in the CSV file. The first line contains the column names.

The following lines contain the data:

```
"csvLines": [
    "Time,Growing Degree Days,Air Temperature Primary (°C),Air Temperature
Primary (F),Relative Humidity (%),Atmospheric Pressure (kPa),Vapor Pressure
(kPa),Rain Bucket Capacity (mL),Rain Bucket Tips per Minute,Calculated Fallen
Rain (mm),Wind Speed (m/s),Wind Direction (°),Wind Gust (m/s),North Wind
Speed (m/s),East Wind Speed (m/s),Air Temperature Secondary (°C),Air
Temperature Secondary (F),Calibrated Counts VWC 1,Soil Moisture 1
(VWC),Electrical Conductivity 1 (dS/m),Soil Temperature 1 (°C),Soil
```

```
Temperature 1 (F),Calibrated Counts VWC 2,Soil Moisture 2 (VWC),Electrical
Conductivity 2 (dS/m),Soil Temperature 2 (°C),Soil Temperature 2 (F),Battery 1
Voltage (mV),Battery 2 Voltage (mV),Latitude,Longitude,X Orientation,Y
Orientation",
    "2023-05-28T15:02:24.077Z,,24,76,0,98,1,4,0,0,1,294,3,0,-
1,25,78,,,,,,,,,,646,4171,46.5578875,15.642796875,1,-1",
    "2023-05-28T15:12:20.440Z,,24,75,0,98,1,4,0,0,1,192,2,-1,-
0,25,77,,,,,,,,,,661,4171,46.5578875,15.642796875,1,-1",
    "2023-05-28T15:22:16.937Z,,24,74,0,98,1,4,0,0,1,268,3,-0,-
1,24,76,,,,,,,,,,682,4169,46.5578875,15.642796875,1,-1",
    "2023-05-28T15:32:24.265Z,,24,74,0,98,1,4,0,0,1,293,2,0,-
1,24,75,,,,,,,,,,708,4174,46.5578875,15.642796875,1,-1",
    "2023-05-28T15:42:20.413Z,,23,74,0,98,1,4,0,0,1,212,2,-1,-
0,24,75,,,,,,,,,,739,4178,46.554676,15.615316,1,-1",
    "2023-05-28T15:52:19.533Z,,23,74,0,98,1,4,0,0,1,204,2,-1,-
0,24,74,,,,,,,,,,772,4176,46.5578875,15.642796875,1,-1",
    "2023-05-28T16:02:24.128Z,,23,74,0,98,1,4,0,0,1,275,2,0,-
1,24,74,,,,,,,,,,809,4176,46.5578875,15.642796875,1,-1"
]
```

Use this data to create a CSV file or import it into a database.

8 PheNode Operation/Use

8.1 How to use the product

8.1.1 Operational environment
PheNode is designed to operate in all seasons and environments and performance is optimal whereby windspeed does not exceed a sustained 67mph and temperatures are between 32°F to +113°F.

8.1.2 Operation
Once the PheNode is powered on and connected to the cloud, it will take measurements automatically and report the collected data to the cloud once per hour, 24 hours a day. There is no need for the intervention of the User, or an operator of any kind, at any time unless the device experiences a malfunction that requires a user's attention (See Section 8 "Troubleshooting and Repair").

8.1.3 Camera Module
The Agrela Camera Module operates automatically once the system is on and does not require physical user intervention in any way. If the user wishes to change the settings of the Camera Module, such as a sampling interval, this can be done within the GUI on the Settings Screen.

8.1.4 Starting/Stopping the product's operation (Figure 5)
1. To power on PheNode, insert the key into the key switch on the left side of the box, and turn the key to the "On" position.
2. To turn off PheNode, turn the key switch to the "Off" position.

8.1.5 Checks before using PheNode
1. Have all cables been properly connected and are undamaged?
2. Are all cable glands closed tightly around the cables inserted into them to prevent water/humidity ingress?
3. Ensure nothing sounds "loose" and rattling around inside of the Control Box. If a "rattling" sound is heard, this could be loose cables or batteries, in which case PheNode should not be used. **Please contact Agrela if any "rattling" sounds are heard inside the PheNode Control Box when the Control Box is moved.**
4. Have the solar panel cables been properly connected and are the solar panels facing South for maximum solar power generation?
5. Is the arrow on the side of the wind sensor pointing North?

6. Are all enclosures closed tightly, and all sensors fastened securely to the sensor frame?
7. Are the Guy wires and ground stakes correctly installed?
8. If PheNode is being used indoors, check to make sure the appropriate Agrela-provided power adapter is correctly plugged in to a 120v power outlet and the other end of the cable is properly plugged into the Control Box, and ensure PheNode is securely mounted/positioned to avoid any potential injuries.

9 Wireless Sensors Operation/Use

9.1 Operating the Wireless Sensor

9.1.1 Deploying the Wireless Sensor

Upon purchasing your wireless sensors, Agrela will contact you for guidance on how many sensors to connect to each PheNode on your account. Agrela will connect your wireless sensors to their respective PheNode, and Agrela will mark/label each wireless sensor accordingly.

Figure 28. Agrela Wireless Sensor

9.1.2 Set Up

If you have purchased soil probes to be used with your Agrela Wireless Sensors, connect them to the desired sensor before turning on the Wireless Sensor. Soil probes can be connected to either cable gland on the bottom of the enclosure. To do this, follow these steps:

1. Unscrew the cap to one of the cable glands.
2. Push the soil probe stereo plug through the cable gland cap.
3. Plug the stereo plug into the stereo connector inside the cable gland.
4. Reconnect the cable gland cap by screwing it back onto the cable gland threading.
5. Continue to screw the cable gland cap on until the gland has closed firmly around the soil probe cable.
6. Repeat these steps with the other cable gland if an additional soil probe needs to be connected.

NOTE: Only METER Teros 12 soil probes with stereo connectors can be connected to Agrela Wireless Sensors at this time.

9.1.3 Powering on/off the Wireless Sensor

1. To power on/off the Wireless Sensor, find the toggle switch on the bottom of the enclosure. Note the "On" / "Off" engravings near each side of the toggle switch. The Wireless Sensor will automatically connect to the appropriate PheNode during the PheNode's next measurement cycle when the switch has been pressed to the "On" position.

9.1.4 Checks before using Agrela Wireless Sensors

1. Have all soil probe cables been properly connected and are undamaged?
2. Ensure nothing sounds "loose" and rattling around inside. If a "rattling" sound is heard, this could be loose batteries, in which case the Wireless Sensor should not be used. **Please contact Agrela if a "rattling" sound is heard inside the Wireless Sensor enclosure.**
3. When a Wireless Sensor is secured to a structure with zip ties, fasteners, etc., check to ensure the Wireless Sensor is securely fastened and at least 12"(inches) off of the ground to help prevent the ingress of any excess water that be flowing over the ground surface during extreme rain events.
4. Don't forget to use cable protector around each soil probe cable connected to a wireless sensor before completing installation.

9.2 What to do in emergency and exceptional situations

⚠WARNING

9.2.1 Exceptional Situations
In case of a battery fire:

1. Do not approach PheNode and keep as much distance from PheNode as possible as Lithium-Ion fires release toxic gas and breathing this gas should be avoided.
2. Do not attempt to put out the fire. Lithium-Ion fires are difficult to extinguish and should be handled by emergency services.
3. Call 911 and report the fire.
4. If the fire is at risk of spreading to nearby objects or infrastructure, exit the building, structure, or area of fire and seek a safe space.
5. Notify all nearby persons of the fire and to avoid the area until emergency services arrive.

9.3 Protection and security

9.3.1 Data protection

Agrela Privacy Policy:
https://www.agrelaeco.com/privacy-policy

Agrela Terms of Service:
https://www.agrelaeco.com/terms-of-service

9.3.2 Preventing unauthorized access

To prevent unauthorized access:
1. Never share your passwords with any individuals, organizations, or online forums without the explicit intention of sharing your PheNode-collected data, account data, and possibly personal data.
2. If you suspect your login credentials have been compromised, change your username and password immediately. If you believe an unauthorized user has locked you out of your account, contact Agrela immediately.

10 Maintenance

⚠CAUTION

The PheNode shall only be maintained by a qualified and trained person. See below for exceptions and procedures.

10.1 How to maintain the product

⚠CAUTION

DO NOT ATTEMPT TO REPLACE BATTERIES IN THE PHENODE CONTROL BOX. REPLACING BATTERIES REQUIRES THE OPENING OF THE CONTROL BOX AND A SIGNIFICANT AMOUNT OF ELECTRONICS DISASSEMBLY. ALWAYS CONTACT AN AGRELA ASSOCIATE IN THE EVENT OF A BATTERY NEEDING TO BE REPLACED.

10.1.1 Replacing Sensors

How to replace a sensor:
1. Always contact an Agrela associate for instructions on how to replace a sensor.
2. Do not attempt to remove a malfunctioning sensor without instruction from an Agrela associate.

10.1.2 Sensor maintenance

How to service the rain bucket sensor:
At a minimum of once per year, Users should clean all debris out of their rain sensor bucket.

1. Before cleaning their rain sensor, Users should remove the bird spikes from the rim of the bucket attachment as well as the leaf grid, to prevent injury.
2. Remove the bucket attachment by pulling upward on the large bucket component while gently rocking it side-to-side.
3. Check the mechanical components inside the rain sensor housing to ensure rainfall is being measured accurately. Agrela advises to User not to use any water or cleaning solutions to wipe down the inner components/mechanics of the rain sensor.
4. Replace the rain sensor components in reverse order of above steps.

10.1.3 Sensor calibration

Every 24-36 months, Agrela recommends all sensors are serviced for recalibration if sensor measurements are appearing to drift. Contact Agrela to learn more about its Sensor Recalibration Services.

10.1.4 Planned maintenance

Maintenance tasks shall be done according to the following plan:

Task	Frequency
Replace the batteries	Once the charge capacity has dramatically diminished (Always contact Agrela before replacing the batteries)
Recalibrate all sensors	Every 24-36 months. Contact Agrela associate for more information.
Clean the Rain Sensor	1x-2x per year

Table 5. Planned maintenance

10.2 How to inspect the product

10.2.1 Weekly inspection tasks

Task	Action
Data Check	Check the data visualization (Grafana) to ensure there aren't any lapses in sensor measurements.
System Components and Sensors Check	View the "System Status" screen on the GUI for any errors or warnings regarding component or sensor malfunctions. Malfunctioning sensors and components will report an error message in red text next to the "Health" parameters.
PheNode System Check	View the "My Fleet" screen on the GUI for any error messages. Malfunctioning PheNodes will report

	an error message in red text next to the "Health" parameter.

Table 6. Weekly tasks

10.3 Replacing product labeling

Do not attempt to remove or replace any labeling on PheNode as it may void the warranty of the product, or affect the regulatory markings intended to communicate Federal compliance. AGRELA WILL NOT BE RESPONSIBLE FOR ANY REPRECUSSIONS OR DAMAGES RESULTING FROM THE REMOVAL OR ALTERATION OF LABELS OR MARKINGS.

11 Troubleshooting and repair

11.1 How to identify and solve problems

11.1.1 Troubleshooting and repair by non-skilled persons

⚠CAUTION

Always contact an Agrela associate before attempting a PheNode repair of any kind.

Error	Cause	Solution
PheNode not reporting measurements to the cloud outdoors…	Poor cellular signal	Try moving PheNode to different areas that may be able to get a signal
PheNode not reporting measurements to the cloud indoors…	Poor WiFi network signal or credentials entered incorrectly…	Check to ensure your WiFi network credentials were entered correctly, or try moving PheNode to different areas that may be able to get a signal.
PheNode still not reporting measurements at all…	Low power	If outdoors, are the solar panels exposed to direct sunlight? If PheNode is still not reporting measurement values to the cloud, try plugging the Control Box into a wall outlet to charge the batteries while the key switch is turned to "On". If measurements are still not reporting, contact Agrela.

Certain sensors are not reporting, but others are…	Sensors not plugged in properly	Contact an Agrela associate for instructions on how to correctly plug in a sensor to the Control Box.
PheNode keeps running out of power when installed outdoors…	Solar panels not plugged in all the way	Plug the solar panel cables into the solar panels cable protectors all the way until you hear a "snapping" sound. Note: it can be quite difficult to plug these cables in all the way.
PheNode not holding charge/turning on/other power issues…	Batteries may not be installed, or installed correctly	Contact Agrela for more information.

Table 7. Troubleshooting

11.2 Frequently asked questions

Question	Answer

Table 8. Frequently asked questions

11.4 How to repair the product

In the event of a repair, contact an Agrela associate in order to determine the nature and scope of work required. Do not attempt any repairs or part replacements without the guidance of a qualified Agrela associate. Failing to do so could result in the void of a product warranty.

11.4.1.1   Equipment

The following equipment is needed for reparation tasks:

Task	Tools
Sensor removal for recalibration services	Hex key set Adjustable wrench for cable gland removal
Control Box removal for repair/replacement	Hex key set Adjustable wrench for cable gland removal

Table 9. Equipment needed for repairs

11.4.1.2   Removing a sensor for recalibration services

NOTICE

WHEN DISCONNECTING AND REMOVING SENSORS FROM THE PHENODE FOR REPAIR OR RECALIBRATION SERVICES, DO NOT ATTEMPT ANY METHODS OR FOLLOW INSTRUCTIONS NOT STATED IN THIS MANUAL OR ANY INSTRUCTIONS GIVEN BY AN AGRELA ASSOCIATE.

To disconnect a sensor:
1. Make sure the PheNode is uninstalled and in a dry, covered structure before performing the following steps.
2. Use an adjustable wrench to remove the cable gland cap on the Control Box that corresponds to the sensor being removed. (Sensor names are etched into the Control Box near all connectors.
3. Once the cable gland cap is removed, pull the cable from the terminal. If the end of the cable has a stereo plug, gently pull on the plug while also gently applying force in the opposite direction to the stereo connector until the stereo plug is removed.
4. When all sensor wires/cables are successfully unplugged from their respective connectors, screw the cable gland caps back onto the Control Box and tighten until the cable gland cap is closed. If the cable gland cap doesn't close all the way, plug the end with a plastic cap or any non-conductive component that fits into the cable gland cap hole and allows the cap to close tightly around the object, creating a seal.
5. Unscrew the sensor(s) from its respective mount with the corresponding hex key.
6. Leave the screws in the mount as to not lose them.
7. Package and return all sensors and components to Agrela as advised.
8. Contact Agrela for any lost components, hardware, or fasteners that need replacing.

11.4.1.3   Replacement of Control Box

To replace the Control Box:
1. Disconnect all sensors from their respective connectors on the Control Box as outlined in the previous section.
2. Unscrew all antenna wires from the Control Box.
3. Open the Control Box cover by unscrewing the six (6) screws.

4. With a small flathead screwdriver, unscrew all wires from sensors that are plugged into screw terminals.
5. Loosen the cable glands to all the sensors that are connected to screw terminals inside the Control Box unscrewing the cable gland caps. Gently remove the cables from the Control Box by pulling them out through the cable glands.
6. Reconnect all cable gland caps to the Control Box.
7. Once all sensors and components connected to the Control Box are disconnected, unscrew the control box from the mounting plate by removing the four (4) screws on the Control Box flanges with the correct hex key.
8. Package and return the Control Box to Agrela as instructed by an Agrela associate.
9. Leave the partially disassembled PheNode in a protected area until new components are replaced and the system is ready for deployment.

11.5 Modification of PheNode sensor configuration

To modify the sensor configuration:
1. Make sure cable lengths of sensors to be moved are long enough to accommodate a new location on the sensor frame.
2. Once moving the sensor to a new location, make sure the sensor connector is not compromised in a way that might be pulling on the respective sensor connector or any other electronics.
3. Make sure not to block solar panels in a way that prevent PheNode from collecting solar charge.
4. Make sure the "N" (north) arrow on the wind sensor is always facing North.
5. Make sure any new sensor attachments are not blocking or preventing the measurements of other sensors, such as something large blocking the path of the wind sensor preventing a wind measurement from any given direction, or anything that may be blocking rainfall for the rain bucket sensor.

11.6 Testing the product

To do a test:
1. Place the sensor frame on a flat surface near an electrical outlet.
2. Plug in the adapter as outlined in section 5.2.7.
3. Log into the PheNode GUI, and enter the WiFi credentials needed to connect to a nearby, available network.
4. Next, adjust the data download options on the "Data Download Preferences" screen in the GUI to any settings that are different than the default settings.
5. Turn the PheNode key switch to the "On" position. Wait 2 minutes for the PheNode sensor measurement processing loop to complete and send a measurement to the cloud.
6. View the sensor measurements in the GUI.
7. Download the sensor data and confirm the downloaded .csv file reflects the data download preferences that were set prior to the PheNode reporting the data to the cloud.
8. If all sensor measurements and GUI adjustments are correct, the test is complete.
9. For any errors, issues, or malfunctions, see Section 8 for all troubleshooting advice.

12 Disposal

If the user wishes to dispose of their device, please contact an Agrela associate first as there may be disposal options available to the user. In the event of there being no disposal options available for the user, follow the below directions.

12.1 How to disassemble the product

To disassemble the product:
Follow the disassembly instructions from Section 5.1.5.

12.2 How to recycle parts

To recycle the Control Box, Sensor Frame, Tower Structure, and other components:

1. Disconnect all electrical components from the sensor frame and tower structure.
2. Open the Control Box and remove all electronics. Separate out all metal components from inside the Control Box that may be recyclable.
3. Remove all fasteners, batteries and screws from the Control Box, Sensor Frame and Tower Structure.
4. Remove all metal from the guy wires (turnbuckles, carabiners).
5. Search online for metal recycling services near you.
6. Inquire about all metal components you wish to recycle (including fasteners, ground stakes, and electronical component mounts).
7. Deliver all components to the appropriate facility for recycling.
8. After recycling all metal components, search online for electronics recycling services near you.
9. Inquire about the components you wish to recycle and recycle what you can (Note: there can often be fees for recycling electronic components).
10. Deliver all electrical components to the appropriate facility for recycling.
11. Once all electrical components are recycled, search online for lithium-ion battery recycling.
12. Deliver lithium-ion batteries to the appropriate facility for recycling.

Appendix A. Supplied accessories, consumables and spare parts

For ordering accessories, consumables and/or spare parts, please contact support@agrelaeco.com.

Supplied accessories

Name
Guy wires (3)
Ground stakes (7)
Hex key tool set (1)
Key for key switch (2)
Atmos 14 Sensor (1)
Atmos 22 Sensor (1)
Teros 12 sensor (1)
Pronamic Rain-o-matic sensor (1)
Taoglas 5-Band antenna
Agrela 5MP imager
Agrela Wireless Sensor
Agrela PheNode Control Box

Table 10. Supplied accessories

Spare/replacement parts

Name	Article Number
Hex bolts (3)	
M5 Square Nuts (2)	
M5 Hex Bolts (2)	

Table 11. Spare parts

Appendix B. Related documentation

Document Title	Location	Author
METER Atmos 14 User Manual	http://library.metergroup.com/Manuals/20867_ATMOS14_Gen2_Manual_Web.pdf	METER Group, Inc.
METER Atmos 22 User Manual	http://library.metergroup.com/Manuals/20419_ATMOS22_Manual_Web.pdf	METER Group, Inc.
METER Teros 12 User Manual	http://publications.metergroup.com/Manuals/20587_TEROS11-12_Manual_Web.pdf	METER Group, Inc.
Pronamic Rain-o-matic Professional Rain Sensor	https://pronamic.com/Files/Images/datasheets/DatasheetProfessional.pdf	Pronamic

Table 12. Related documentation

13 FCC Compliance Statement and Advisory Instructions

This product has been tested and found to comply with the limits for an intentional radiator operating in the 2450Mhz ISM band, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This product generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this product does cause harmful interference to radio or television reception, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the product and receiver.
- Connect the product to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the party responsible for compliance may void the user's authority to operate the product. Where shielded interface cables have been provided with the product, specified additional components or accessories elsewhere defined to be used with the installation of the product, they shall be used in order to ensure compliance with FCC regulations.

FCC Radiation Exposure Statement

- This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.
- This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.

14 License agreement and warranty

LICENSE AGREEMENT AND LIMITED WARRANTY LANGUAGE

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