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Summary	The deliverable C4.1 describes the project's web platform, a Center of GHGs Monitoring and Management (CMM) system. This report is an "Interactive guide" for the CMM web-GIS platform.



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Extended Summary

The deliverable C4.1 describes the design and development of the ClimaMED project's web platform, that is related to Action C4 – Operational Center development. Action C4 aims to develop a “Center of GHGs Monitoring and Management” (CMM) system, which allow national, regional and local Authorities as well as farmers' associations/cooperatives to estimate, map, monitor and report GHGs emissions about their territories.

The deliverable represents a user guide based on the identification and analysis of user and system requirements in order to provide specific solutions for the functional specifications of the architectural components of the CMM platform. The requirements capturing process identified crucial aspects of user and system needs in order to successfully address the expectations for the central monitoring and management of GHGs emissions and SOC stock changes.

1. Introduction

The purpose of this deliverable is to briefly describe the use of the project's web platform, and to provide details on the system's structure, functionalities and user actions.

CMM is a tool designed and developed in the framework of the ClimaMED project (LIFE17 CCM/GR/000087) aiming to enhance local authorities, stakeholders or other interested parties to screen GHGs emissions from cultivated areas, identify potential risky conditions and proceed to detailed and continuous monitoring of these areas. The CMM web application combines the usability of Microsoft .NET framework with the stability and flexibility of JavaScript and Google Maps API. It features a rich web-interface, and through the Bootstrap framework provides integration from phones to tablets to desktop platforms.

The CMM platform is designed, developed and currently hosted at a dedicated cloud server of FORTH, allowing users of national, regional and local Authorities as well as farmers' associations/cooperatives to estimate, map, monitor and report GHGs emissions about their territories. In the framework of the project, current active users are the ones of the project consortium, and especially MINAGRIC, however in the future, users could be any monitoring authority or farmer/producer or farmers' association/cooperative that are willing to use the methodologies of the project and the CMM platform to measure and monitor GHGs emissions at their area or territory.

The CMM web-GIS platform was launched at December of 2021 (beta version), while the final version was deployed at November 2024, and it is available at:

<https://cmm.life-climamed.eu>

The CMM system is capable of storing information coming from heterogeneous data input sources, i.e. receive and store data coming from the telemetric infrastructure (Action C3) and integrates various functional components to process data input and calculate GHGs emissions and SOC stock changes. Currently, CMM users are able to view, monitor and manage information coming from the telemetric infrastructure (CoreIoT API), and in particular data from installed weather stations, IoT and LiDAR devices (Figure 1).

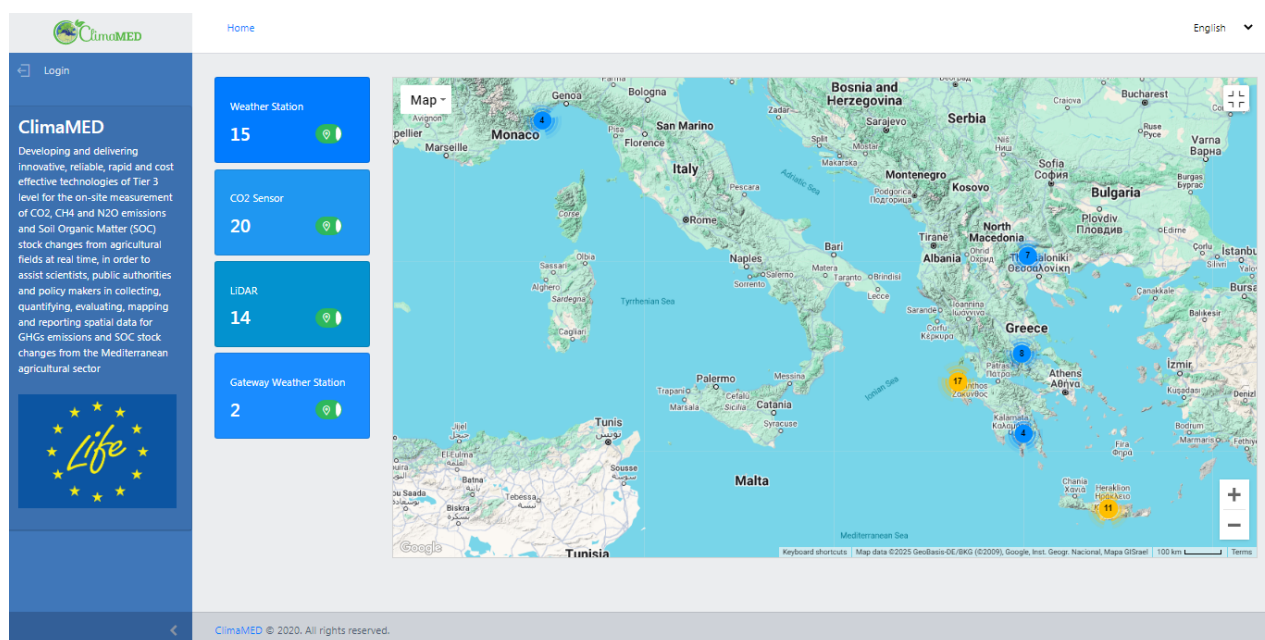


Figure 1. ClimaMED project CMM platform

In the following sections, "how-to" information regarding the CMM platform dashboard and IoT devices or LiDAR measurements display and management is provided for authenticated users. This document, the CMM User Guide, describes how to use the system from a user's viewpoint.

2. User login

To login to the CMMT, point the browser to the following URL:

<https://cmm.life-climamed.eu/login>

The CMM login screen will appear when the connection succeeded, as shown in Figure 2. The login credentials can be obtained by the CMM system administrator. These by default consist of:

- A username
- A password

As a security measure, all characters are displayed as dots, when the password is entered. Click “Login” to log in to the CMM system.

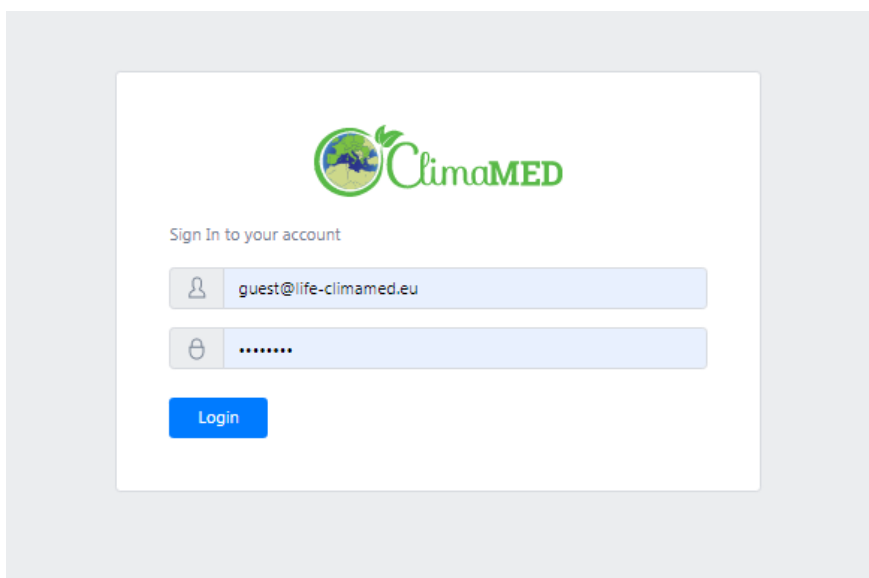


Figure 2. CMM Login

Video Tutorial: <https://vimeo.com/1053326306/66cc235c7f>

3. Platform dashboard

The CMM user, after logging in, is presented with the “dashboard” main view, as illustrated in Figure 3 below. CMM main view functionalities can be divided into two main menus:

Main menu (Sidebar) [1]: Depending on the action selected in the respective menu, the main content of the corresponding page is shown. For example, when the “LiDARs” menu has been selected, information regarding LiDARs devices that are associated with the CMM user are shown; when the “Cultivations” sub-menu (under Settings) has been selected, the respective view area of available cultivation data (crop types, cultivation period, etc.) is shown.

Quick menu (Top) [2]: The “quick menu” contains links to few basic functions of the CMM system; “Users” menu, redirects the authorized user (manager or administrator role) to the main page where CRUD (Create, Update, Delete) operation actions, are possible. The user icon on the right of this menu, provides access to the user “Profile” and “Logout” actions.

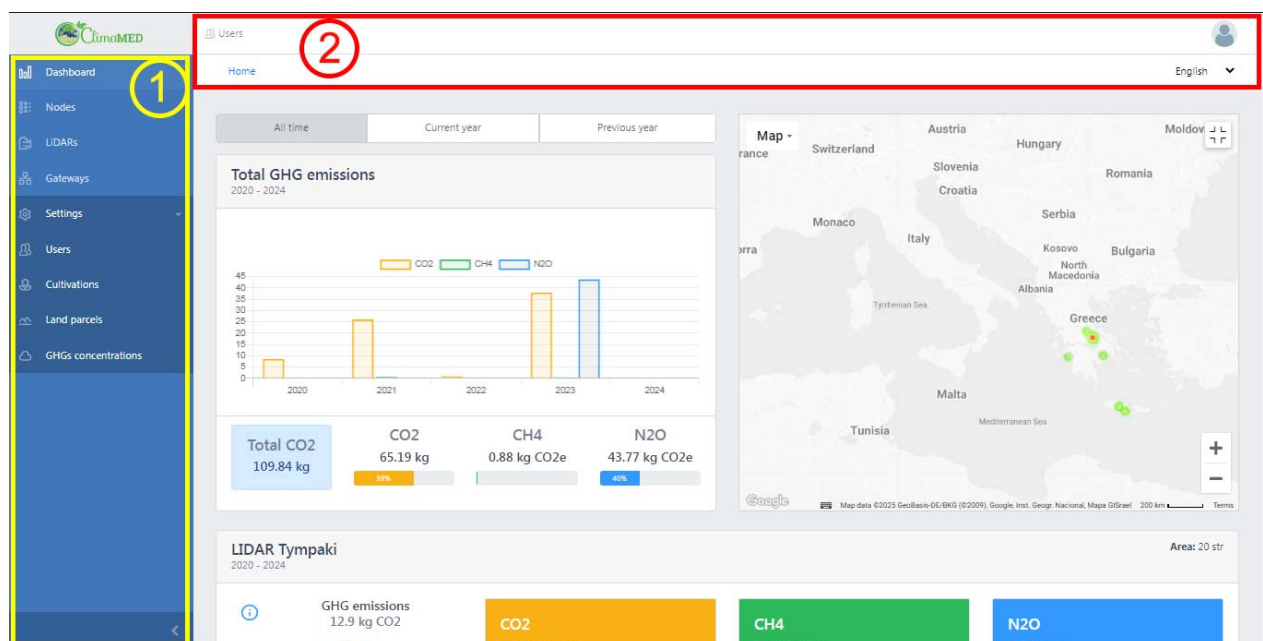


Figure 3. CMM dashboard for monitoring GHGs emissions of user associated agricultural areas

At the main dashboard view the CMM user is presented with specific information regarding GHGs emissions, such as “Total GHG emissions” per year, or per GHG type (in Kg) of measurement data recorded by all associated LiDAR devices within an interactive chart, as shown in Figure 4.

Note

Logging out from the CMM system can be done by selecting on the “**Logout**” action in the top right corner of the “**Quick menu**”.

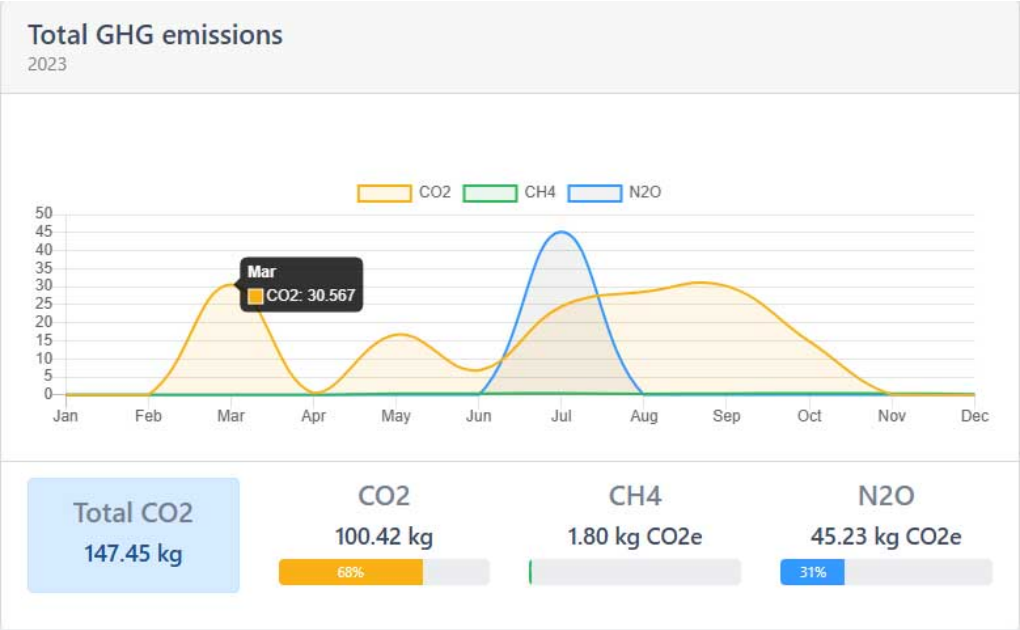


Figure 4. CMM dashboard interactive chart for monitoring GHGs emissions per period and type

Moreover, within the dashboard view, the user is able to intuitively monitor GHGs emissions per agricultural field / land parcel (LiDAR device) through an interactive web map, with a green to red color scheme depicting low to high emission areas, respectively (Figure 5).

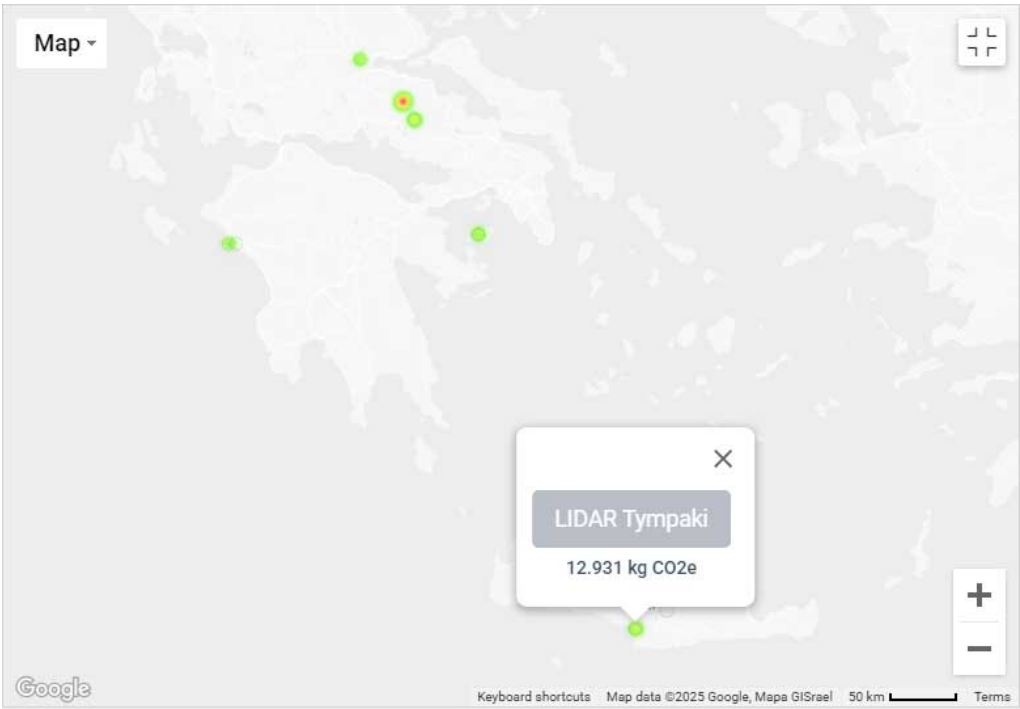


Figure 5. CMM dashboard interactive map for spatiotemporal monitoring of GHGs emissions

Detailed information regarding GHGs emissions per agricultural field / land parcel (LiDAR device) associated with the CMM user is also displayed at the lower area of the dashboard view, along with emissions for each GHG type and contribution of CO₂ (kg) of each agricultural area (corresponding LiDAR device) to the Total GHGs Emissions for the time period selected, e.g. current or previous year (Figure 6).

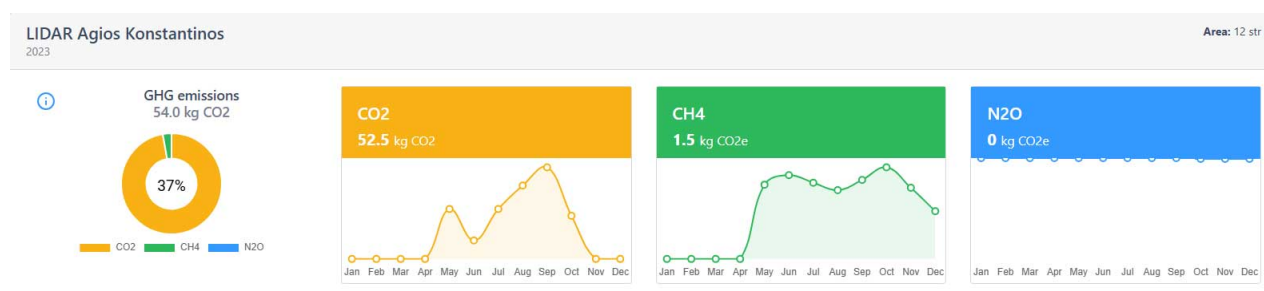


Figure 6. CMM dashboard interactive chart for detailed GHG emissions per area (LiDAR device)

Video Tutorial: <https://vimeo.com/1053326337>

Note

The CMM system is currently available in **Greek** and **English**. The preferred language can be set and changed anytime from the language button on the **"Quick menu"**.

4. IoT devices (nodes)

The specific view allows the CMM user to have an overview of the available IoT devices, that is, the "nodes" in the IoT Telemetry network of the ClimaMED project. Such devices can be meteorological stations installed at fields, CO₂ sensors, etc.

4.1 Overview

The CMM system is able to provide information regarding the available IoT devices (nodes) to its users. Such action can be triggered by selecting the **"Nodes"** submenu at the **Main menu (Sidebar) [1]**. Available IoT devices associated to the CMM user are displayed in a table / List view and within an interactive map, as illustrated in Figure 7 below.

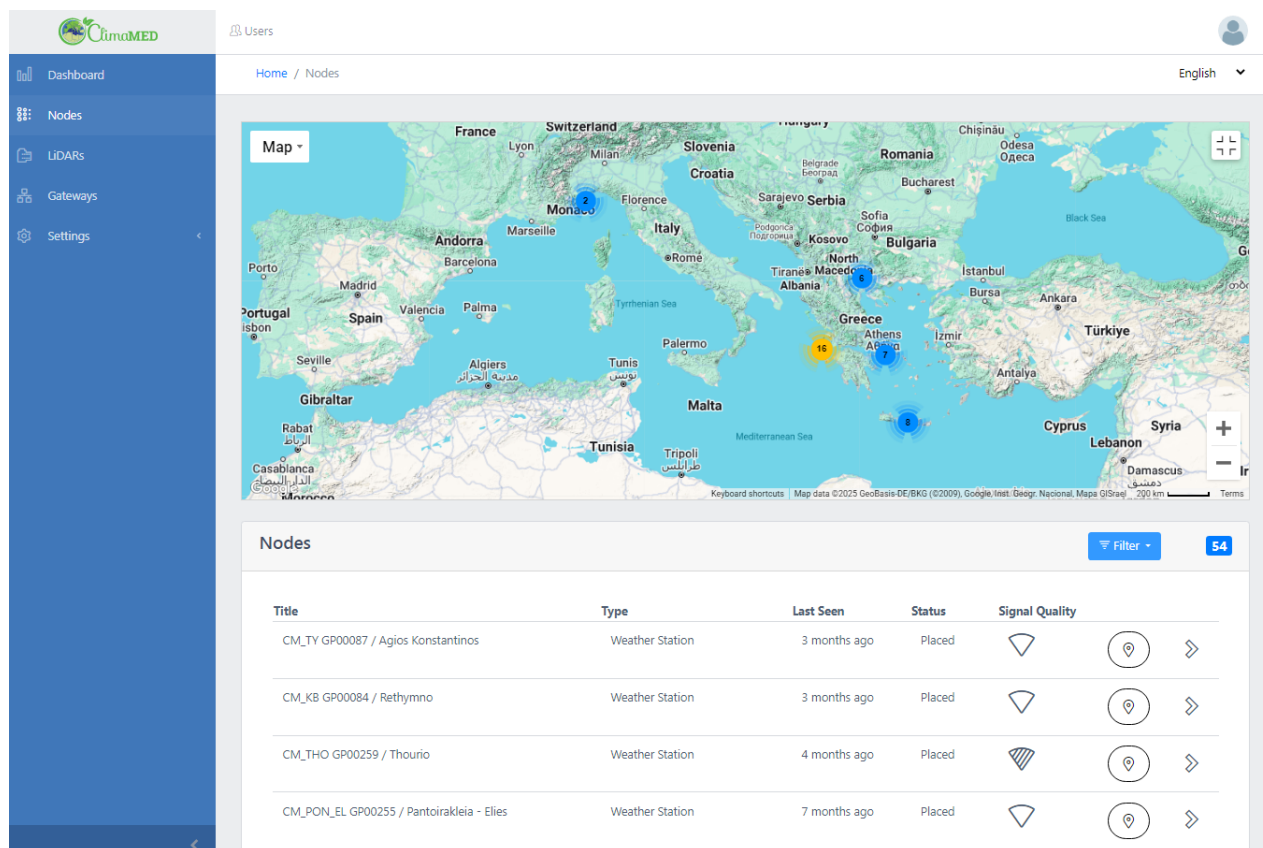


Figure 7. CMM nodes main view

At the top of the Nodes main view, an interactive map is provided, with all available devices associated with the logged in CMM user displayed as markers. The user is able to

select a marker  and retrieve the last recorded values of the specific IoT device (node) as displayed in Figure 8 below. The user is also able to filter out available IoT devices at the Table / List view, by selecting the corresponding devices type checkbox in the Filtering list provided at the header (top area) of the Table view, as shown in Figure 9 below.

CM_TY GP00087 / Agios Konstantinos

3 months ago [View](#)

Factor	Accuracy	Value
Air Humidity	±3% RH	88.73
Air Temperature	±0.01 °C	14.73
CH4 LEL	±0.1%	-
Counter		24456.00
Dew Point Temp		12.88
RainFall	±1 mm	-
Soil Humidity	±3%	-
Soil Temperature	±1°C	-55.00
Solar Radiation	3%	218.64
Wind Direction	±1°	174.65
Wind Speed	±1 m/s	19.98

Figure 8. Nodes popup information window with last recorded values of the selected marker (node) in the interactive map.

[Filter](#)

☒	Weather Station	15
☐	CO2 Sensor	22
☒	Gateway Weather Station	2
☒	LoRa Tractor Button	2
☒	Actuator Weather Station	1

Figure 9. Nodes filtering in the Table view

4.2 Measurements

The CMM user is able to view detailed temporal information, i.e. measurements and recorded values through time of a specific node (IoT device), by selecting its corresponding “row” in the Table / List view. The “Measurements” view of a corresponding node is illustrated at Figure 10 below.

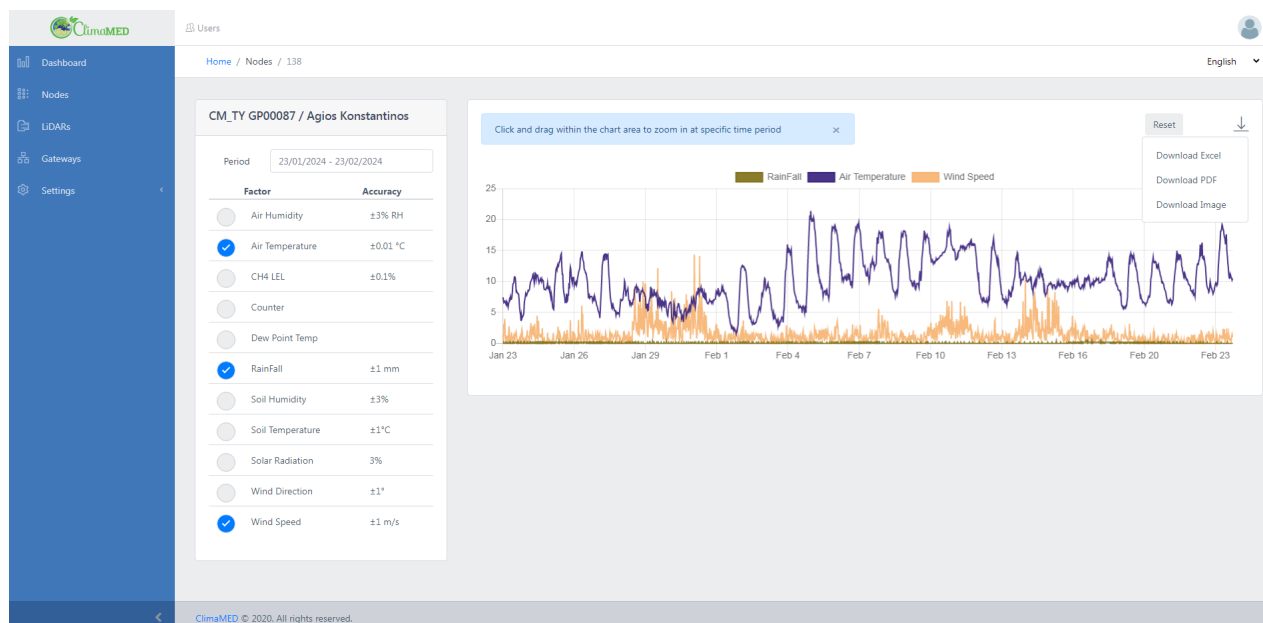


Figure 10. Nodes measurements view (detailed information)

The CMM user is able to select on the left side of the content area, the “time period” and the Node “factor” needed. As such, recorded values (measurements) for the specified time period and factors are displayed on the interactive chart available on the right of the content area.

Finally, the user is able to download node measurements for his/her own use by selecting

corresponding button  at the top right of the interactive chart area. Node measurements can be downloaded either as an Excel, PDF or Image file.

Note

Node measurements displayed in the interactive chart are available for **download** in different formats, such as an **Excel** , **PDF**  or **Image**  File.

Video Tutorial: <https://vimeo.com/1053326370>

5. LiDAR devices

The specific view allows the CMM user to have an overview of the available LiDAR devices, that is, the “LiDARs” in the IoT Telemetry network of the ClimaMED project.

5.1 Overview

The CMM system is able to provide information regarding the available LiDAR devices to its users. Such action can be triggered by selecting the “**LiDARs**” submenu at the **Main menu (Sidebar) [1]**. Available LiDAR devices associated to the CMM user are displayed in a table / List view as well as within an interactive map, as illustrated in Figure 11 below.

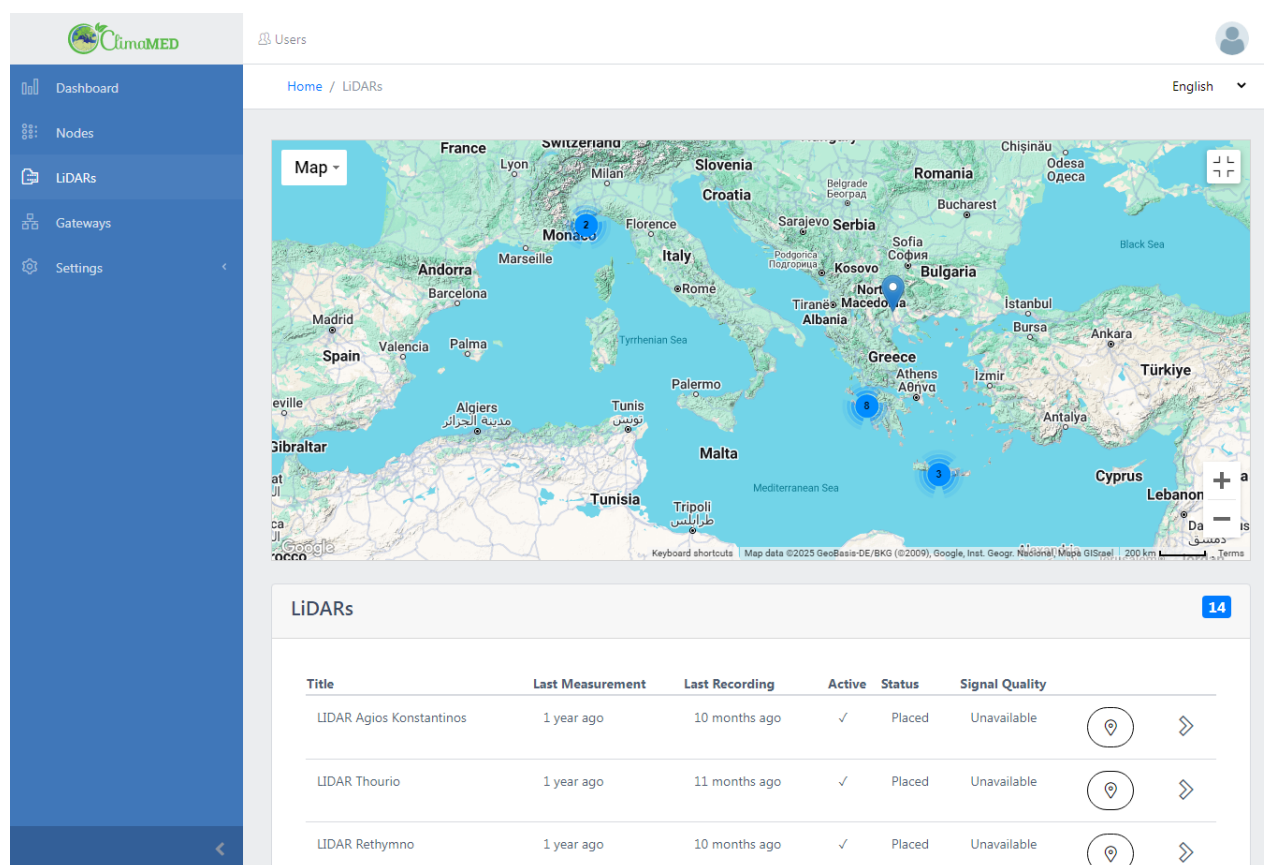


Figure 11. CMM LiDARs main view

At the top of the LiDARs main view, an interactive map is provided, with all available devices associated with the logged in CMM user displayed as markers. The user is able to

select a marker  and get with the last recorded values of the specific LiDAR device as displayed in Figure 12 below.

LIDAR Agios Konstantinos			
View			
Factor	Accuracy	Value (kg)	Date
CO2	0.414	0.564	1 year ago
CH4	0.969	0	1 year ago

Figure 12. LiDARs popup information window with last recorded GHG values of the selected marker (LiDAR) in the interactive map.

5.2 GHGs emissions

The CMM user is able to view detailed temporal information on GHG emissions, i.e. measurements and recorded values through time of a specific LiDAR (device), by selecting its corresponding “row” in the Table / List view. The “GHGs emissions” view of a corresponding LiDAR is illustrated at Figure 13 below.

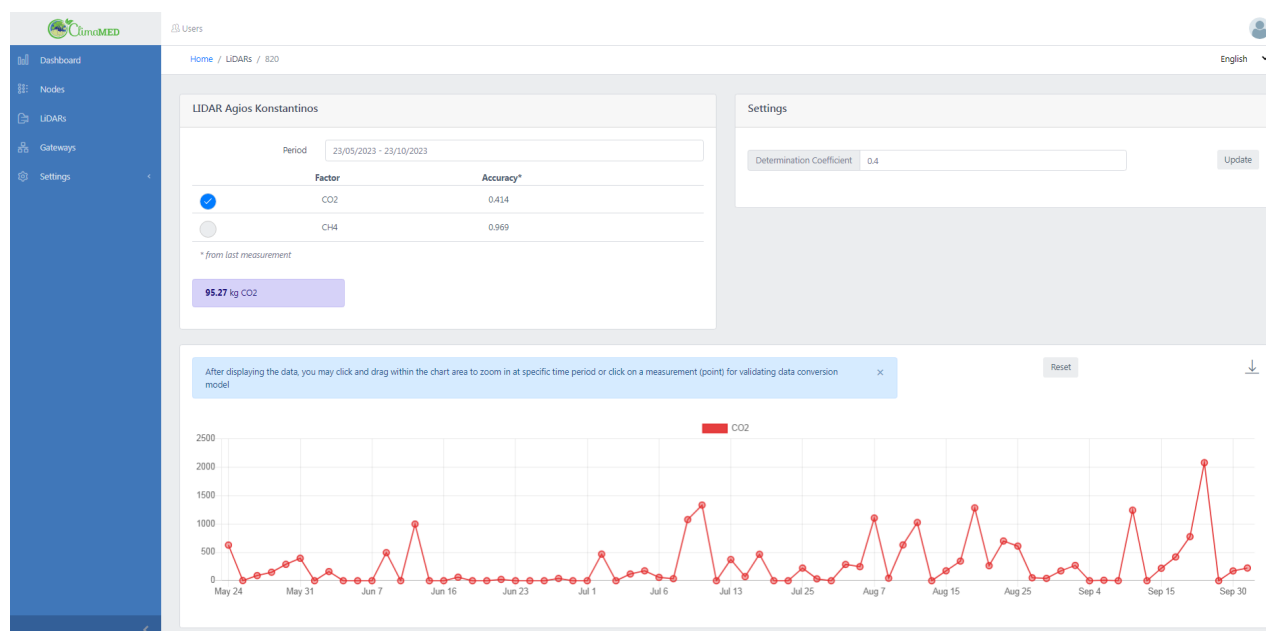


Figure 13. LiDARs GHGs emissions view (detailed information)

The CMM user is able to select on the top left side of the content area, the “time period” and the “GHG” type (factor) available. As such, recorded GHG values (measurements)

for the specified time period are displayed on the interactive chart available at the bottom of the content area.

Finally, the user is able to download node measurements for his/her own use by selecting

corresponding button  at the top right of the interactive chart area. Node measurements can be downloaded either as an Excel, PDF or Image file.

Note

LiDAR measurements displayed in the interactive chart are available for **download** in different formats, such as an **Excel** , **PDF**  or **Image**  File.

Video Tutorial: <https://vimeo.com/1053326457>

5.3 Validation

The user is able to define the display of measurements for a LiDAR node, that are above an accuracy threshold. This threshold corresponds to the "Determination Coefficient" (R-squared error) of the measurement data model during the conversion of raw data to ppm. In other words, it represents the proportion of the observed variation in the model that can be explained by measurement data, thus a higher value corresponds to a "better fit" of raw data to ppm. However, a high value does not necessarily mean a valid measurement.

The above threshold (Determination Coefficient) can be defined by the CMM user with role "Manager" or "Administrator" at the "Settings" area located at the top right of the content area of the LiDAR's GHG's emissions view (Figure 13). The CMM user is also able to view information on the measurement data model (conversion of raw to ppm) for each and every measurement by selecting the corresponding data point on the interactive chart area. Upon selection a modal with information regarding the measurement data model are presented to the user, as illustrated in Figure 14.

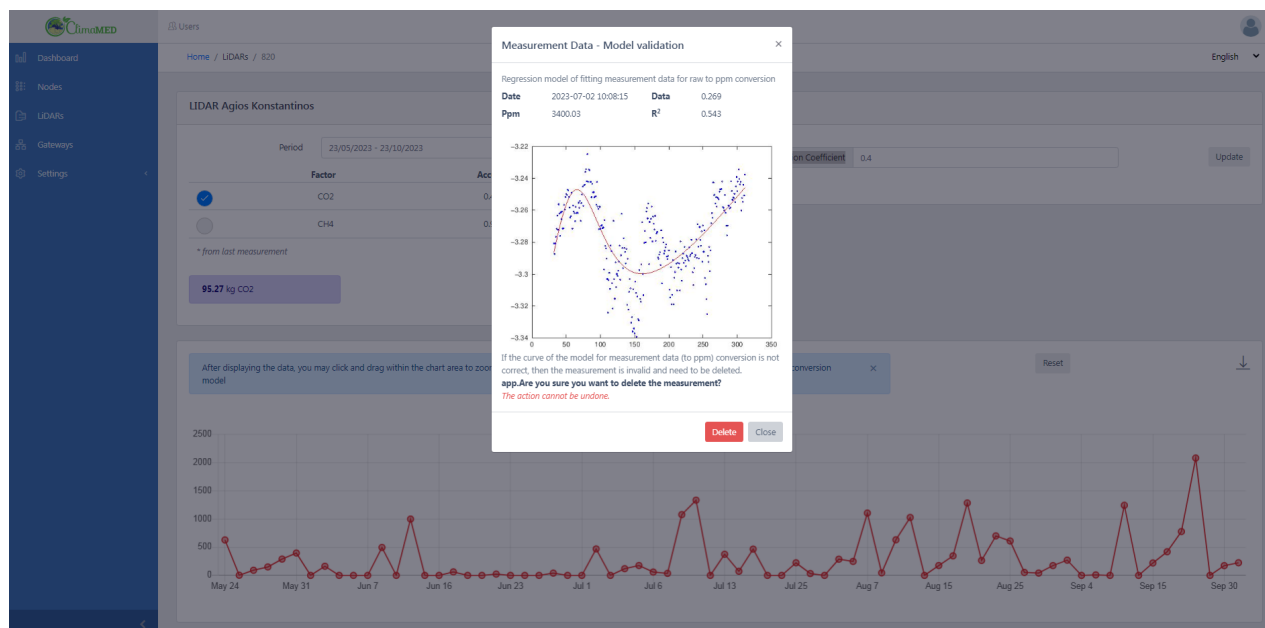


Figure 14. Modal window displaying LiDAR data model information to be cross-validated by experts

Such information includes the R-Squared value or the plot of the model "fitting". The authorized user (expert) based on the displayed information can decide if the corresponding measurement (converted ppm data) is not valid, and in such a case, remove the measurement from the database.

When the invalid measurement is removed by the expert, the interactive chart is automatically updated and another measurement can be selected for cross-validation. Usually, "peaks" on the GHG measurement data curve (extremely high values) are most likely not reliable (invalid) measurement data. Valid data models are shown in Figure 15 below.

Video Tutorial: <https://vimeo.com/1053326457>

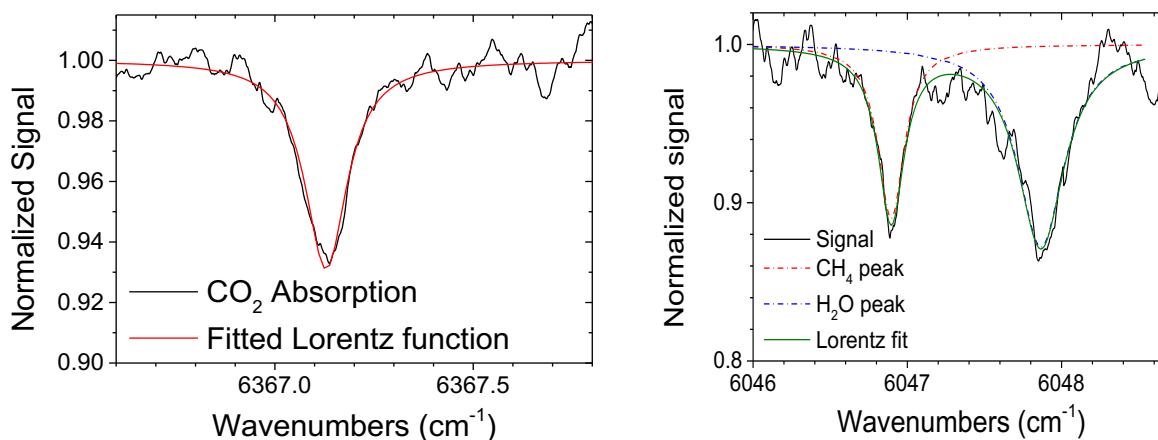


Figure 15. Valid CO₂ (on the left) and CH₄ (on the right) measurement models (conversion from raw to ppm).

6. Gateway devices

The specific view allows the CMM user to have an overview of the available Gateway devices that provide access for all Node devices in a specific area or territory through the IoT Telemetry network of the ClimaMED project.

6.1 Overview

The CMM system is able to provide information regarding the available Gateway devices to its authorized users (Manager role). Such action can be triggered by selecting the "**Gateways**" submenu at the **Main menu (Sidebar)** [1]. Available Gateway devices are displayed in a table / List view as well as within an interactive map, as illustrated in Figure 16 below.

At the top of the Gateways main view, an interactive map is provided, with all available devices displayed as markers. The user is able to select a marker and get with the last recorded values of the specific Gateway device.

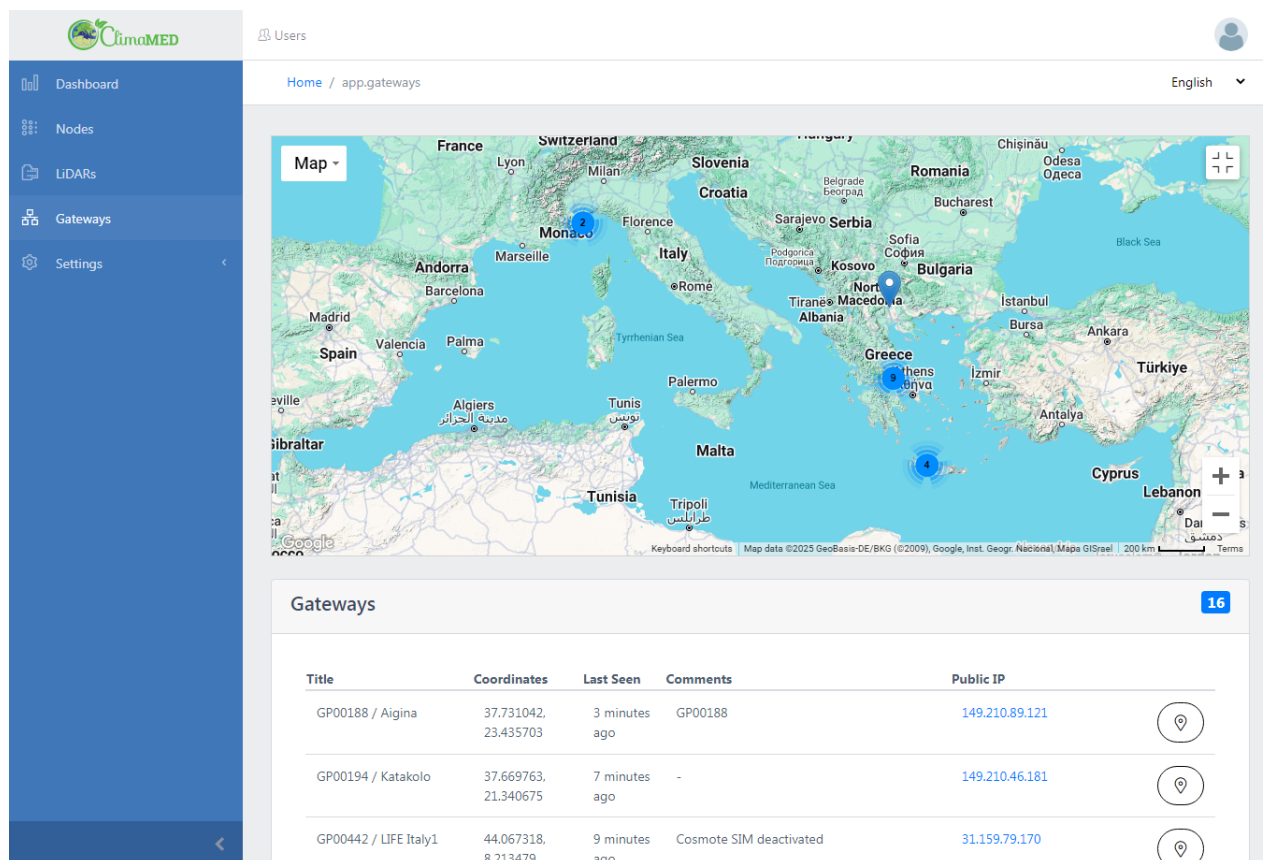


Figure 16. CMM Gateways main view

Video Tutorial: <https://vimeo.com/1053326513>

7. Settings

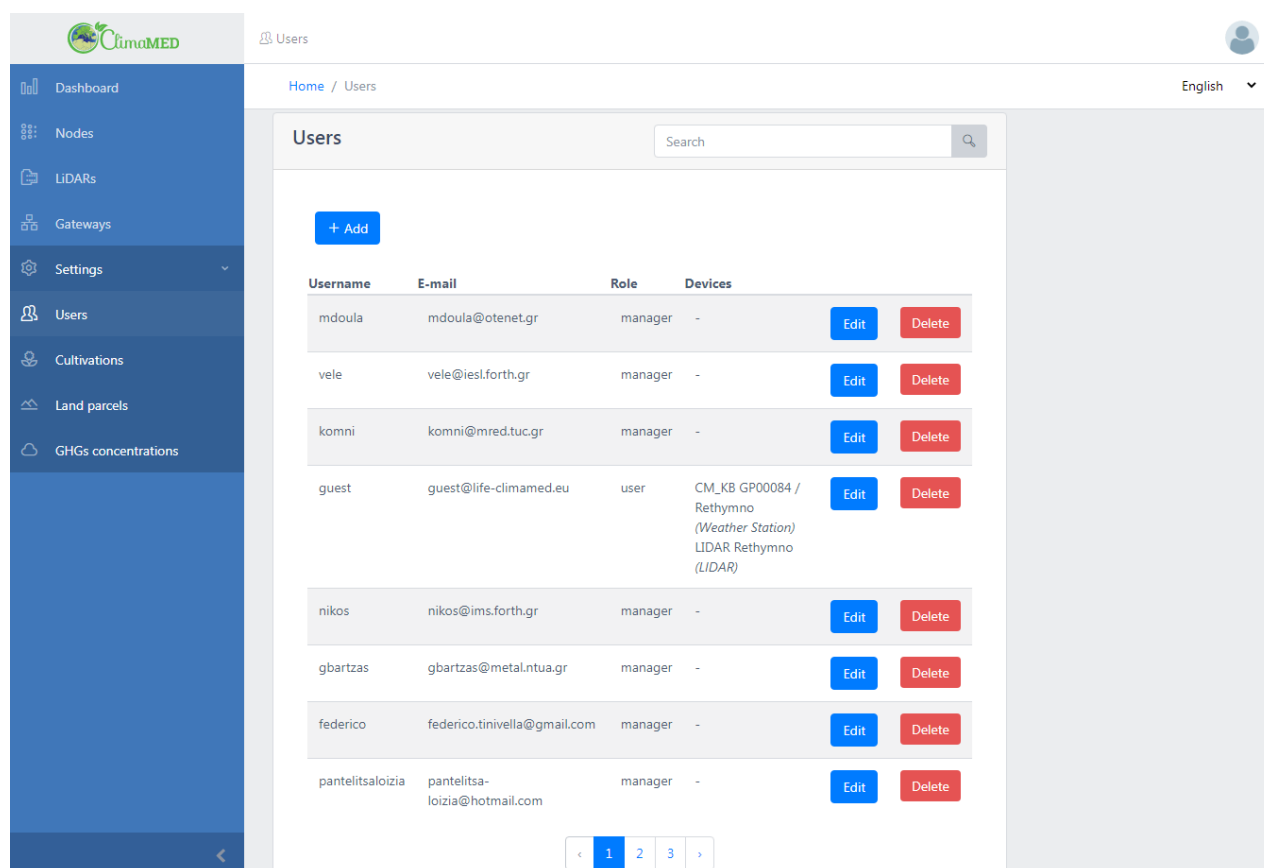
The CMM user is also able to have an overview of available information regarding the platform Users, supported cultivation types and cultivation periods, agricultural land parcels associated with LiDAR devices and background GHG emissions values needed for calculating Total Mean GHG emissions per year. Such information can be provided by the CMM platform by selecting the corresponding item under the “**Settings**” submenu (Figure 3) at the **Main menu (Sidebar)** [1].

7.1 User management

One of the important features of CMM is the ability to control how and what users can access. CMM allows the setup of three different types of users or user “Roles”:

- **Administrator:** CMM administrators are able to have the overall supervision of the system, such as CRUD operations on users, as well as make system configuration changes.
- **Manager:** CMM managers are able to make CRUD operations on users (with no Administrator role) and partial system configuration, such as GHG Measurement validation.
- **User:** CMM simple users are able to only view associated data and devices.

The **Users** menu item under the **Settings** submenu provides information regarding CMM platform users, as illustrated in Figure 17 below.



The screenshot shows the CMM Users main view. The sidebar on the left contains the following menu items: Dashboard, Nodes, LiDARs, Gateways, Settings, Users, Cultivations, Land parcels, and GHGs concentrations. The main content area is titled 'Users' and includes a search bar. Below the search bar is a '+ Add' button. The table below lists the users:

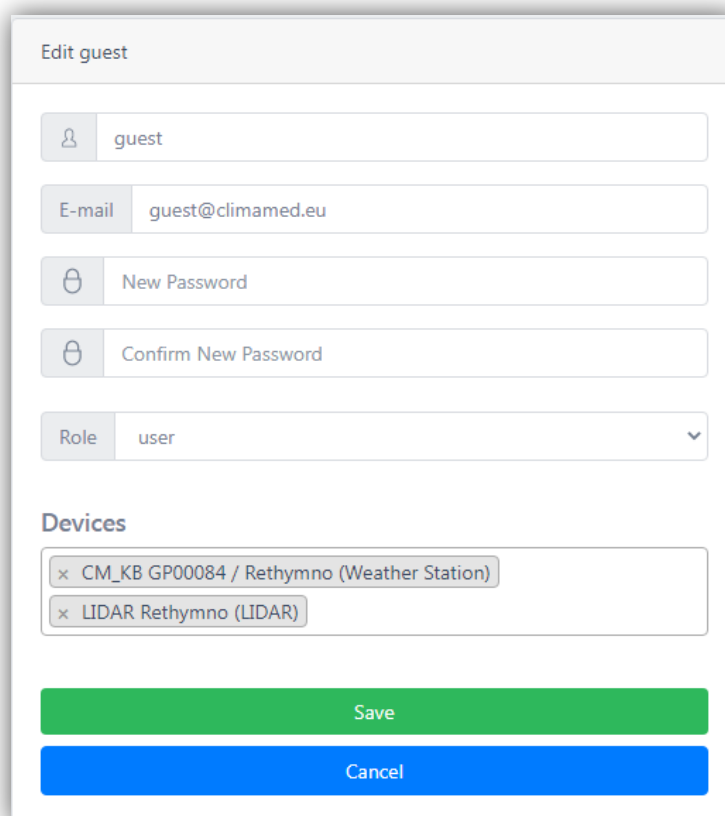
Username	E-mail	Role	Devices	Edit	Delete
mdoula	mdoula@otenet.gr	manager	-	Edit	Delete
vele	vele@iesl.forth.gr	manager	-	Edit	Delete
komni	komni@med.tuc.gr	manager	-	Edit	Delete
guest	guest@life-climamed.eu	user	CM_KB GP00084 / Rethymno (Weather Station) LiDAR Rethymno (LiDAR)	Edit	Delete
nikos	nikos@ims.forth.gr	manager	-	Edit	Delete
gbartzas	gbartzas@metal.ntua.gr	manager	-	Edit	Delete
federico	federico.tinivella@gmail.com	manager	-	Edit	Delete
pantelitsaloizia	pantelitsa-loizia@hotmail.com	manager	-	Edit	Delete

At the bottom of the table, there is a pagination control showing page 1 of 3.

Figure 17. CMM Users main view

A Table / List view of available users is provided to the authorized CMM user, with the ability to Add, Edit or Delete a User entry by selecting the corresponding action button. As such, CRUD operations on users, role & devices assignment is available, as illustrated in Figure 18.

Moreover, at the top right area of the main view, a **Search** area box is provided for quickly finding specific users for management actions.



The image shows a modal window titled "Edit guest". It contains several input fields: a username field with "guest", an email field with "guest@climamed.eu", a "New Password" field, and a "Confirm New Password" field. Below these is a "Role" dropdown menu currently set to "user". Under the "Devices" section, there are two tags: "CM_KB GP00084 / Rethymno (Weather Station)" and "LIDAR Rethymno (LIDAR)". At the bottom are "Save" and "Cancel" buttons.

Figure 18. CMM modal window for User management

Video Tutorial: <https://vimeo.com/1053326544>

7.2 Cultivations

The **Cultivations** menu item under the **Settings** submenu provides information regarding CMM platform cultivations, as illustrated in Figure 19 below.

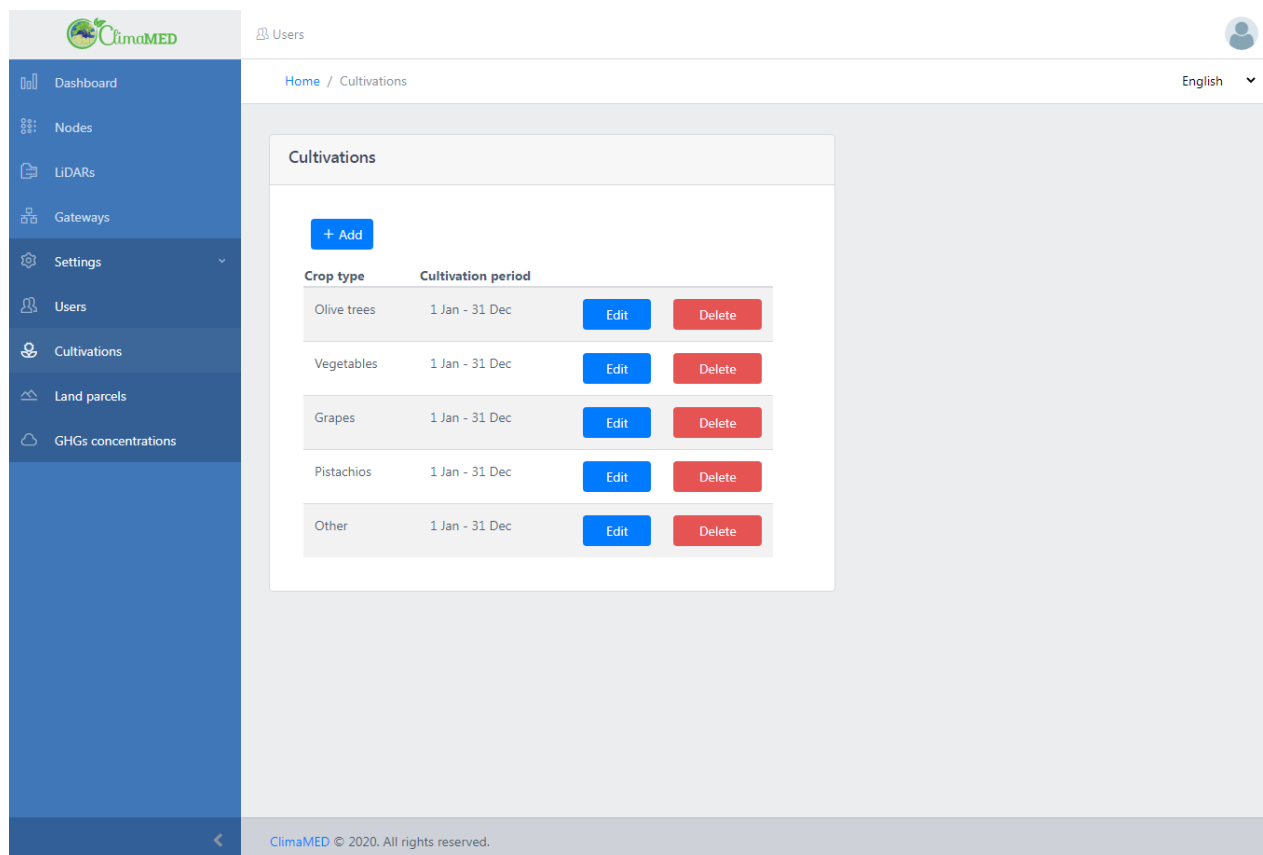


Figure 19. CMM Cultivations main view

A Table / List view of available cultivations is provided to the authorized CMM user, with the ability to Add, Edit or Delete a Cultivation entry by selecting the corresponding action button. As such, CRUD operations on cultivations, crop type and cultivation period assignment is available, as illustrated in Figure 20 below.

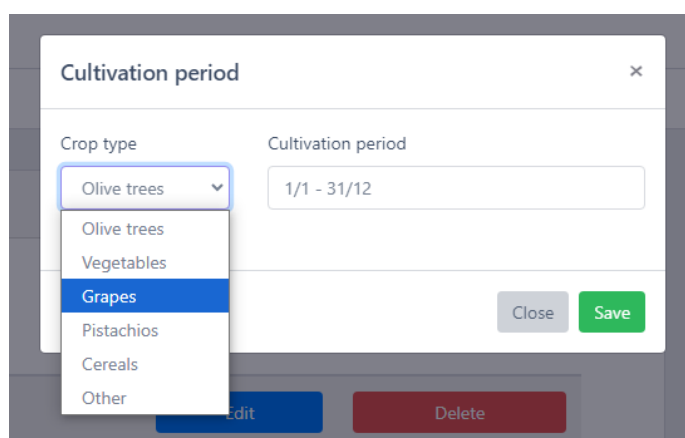
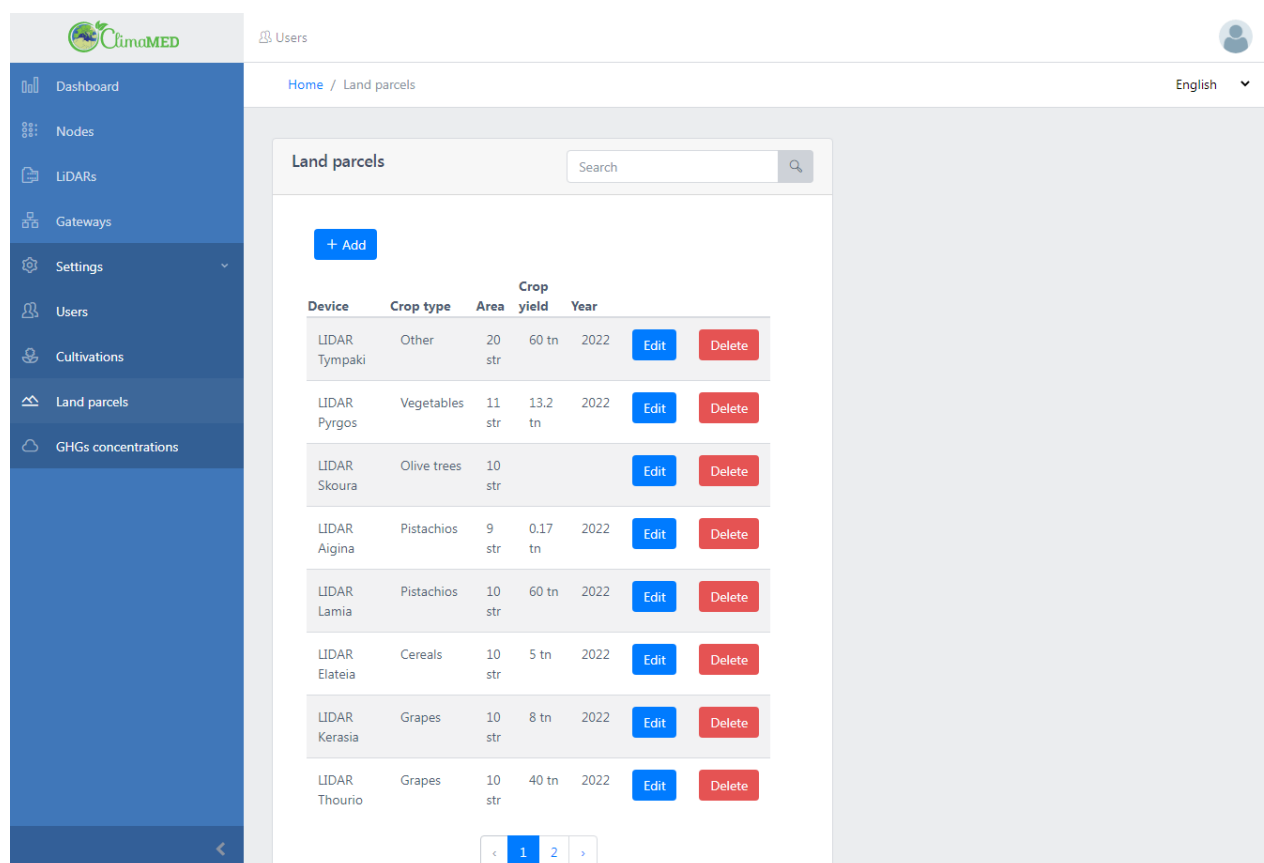


Figure 20. CMM modal window for Cultivation management

Video Tutorial: <https://vimeo.com/1053326570>

7.3 Land parcels

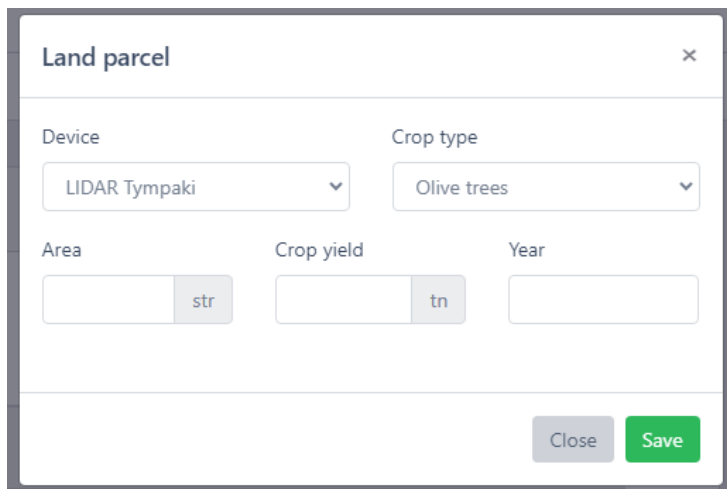
The **Land parcels** menu item under the **Settings** submenu provides information regarding CMM platform agricultural fields, as illustrated in Figure 21 below.



Device	Crop type	Area	Crop yield	Year		
LIDAR Tympaki	Other	20 str	60 tn	2022	Edit	Delete
LIDAR Pyrgos	Vegetables	11 str	13.2 tn	2022	Edit	Delete
LIDAR Skoura	Olive trees	10 str			Edit	Delete
LIDAR Aigina	Pistachios	9 str	0.17 tn	2022	Edit	Delete
LIDAR Lamia	Pistachios	10 str	60 tn	2022	Edit	Delete
LIDAR Elateia	Cereals	10 str	5 tn	2022	Edit	Delete
LIDAR Kerasia	Grapes	10 str	8 tn	2022	Edit	Delete
LIDAR Thourio	Grapes	10 str	40 tn	2022	Edit	Delete

Figure 21. CMM Land parcels main view

A Table / List view of available land parcels is provided to the authorized CMM user, with the ability to Add, Edit or Delete a Land parcel entry by selecting the corresponding action button. As such, CRUD operations on land parcels' crop type, area and yield per year is available, as illustrated in Figure 22 below.



The image shows a modal window titled "Land parcel" with a close button (X) in the top right corner. The window contains several input fields and buttons:

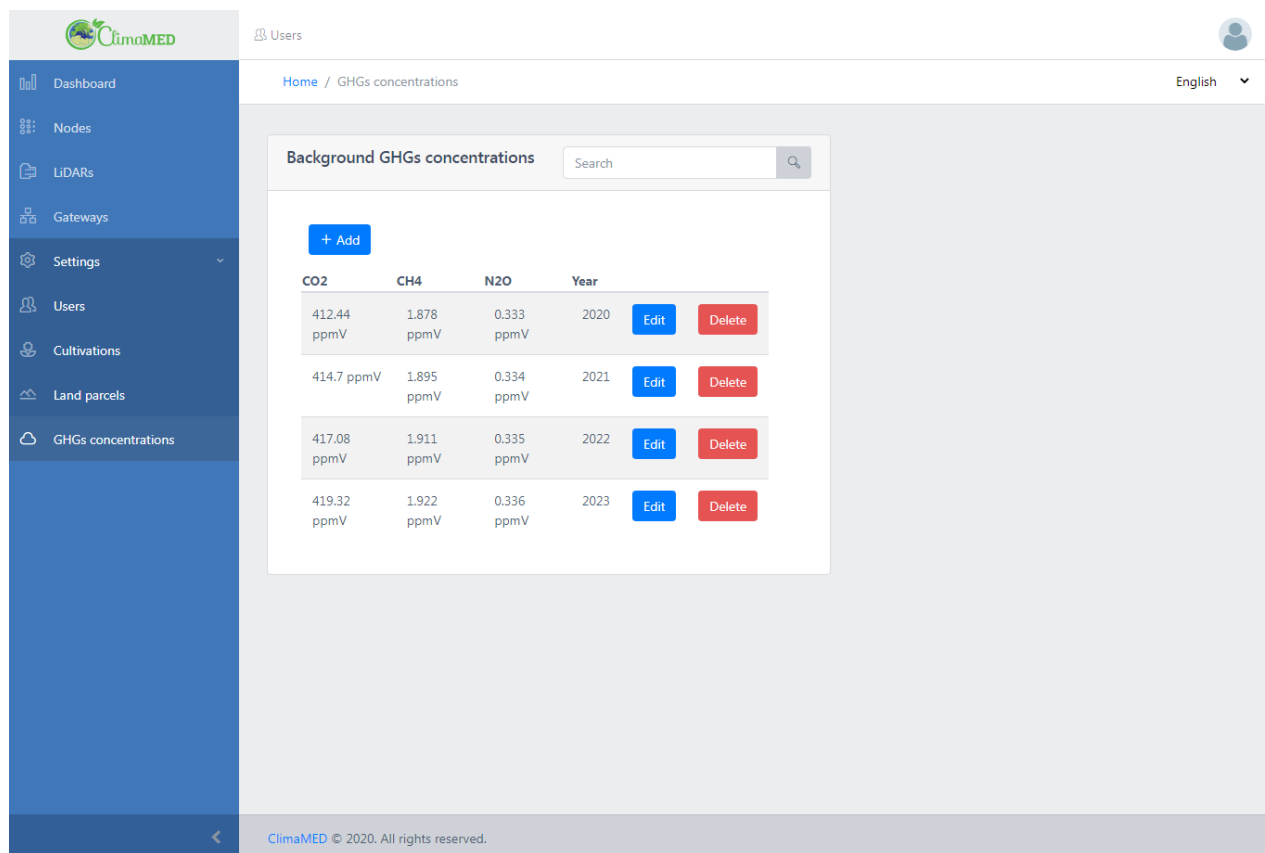
- Device:** A dropdown menu with "LIDAR Tympaki" selected.
- Crop type:** A dropdown menu with "Olive trees" selected.
- Area:** A text input field followed by a unit selector button labeled "str".
- Crop yield:** A text input field followed by a unit selector button labeled "tn".
- Year:** A text input field.
- Buttons:** "Close" (grey) and "Save" (green) buttons at the bottom right.

Figure 22. CMM modal window for Land parcel management

Video Tutorial: <https://vimeo.com/1053326627>

7.4 GHG concentrations

The **GHG concentrations** menu item under the **Settings** submenu provides information regarding CMM platform background (BG) GHG emissions needed by the system for calculation, as illustrated in Figure 23 below.



Background GHGs concentrations

Search

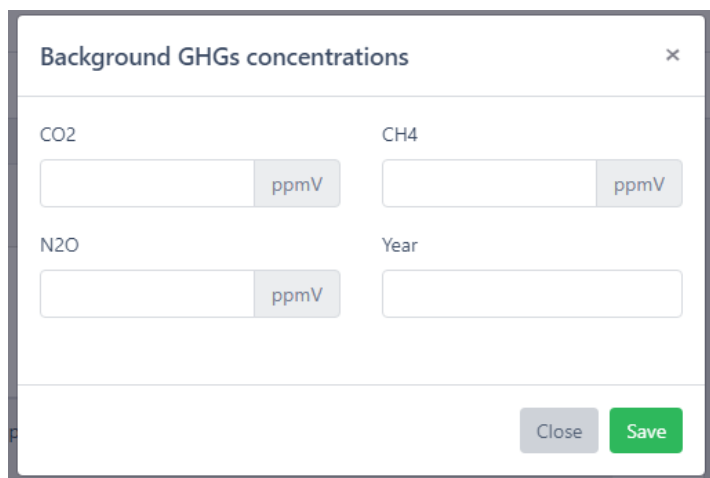
+ Add

CO2	CH4	N2O	Year		
412.44 ppmV	1.878 ppmV	0.333 ppmV	2020	Edit	Delete
414.7 ppmV	1.895 ppmV	0.334 ppmV	2021	Edit	Delete
417.08 ppmV	1.911 ppmV	0.335 ppmV	2022	Edit	Delete
419.32 ppmV	1.922 ppmV	0.336 ppmV	2023	Edit	Delete

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Figure 23. CMM GHG concentrations main view

A Table / List view of available GHG concentrations for a cultivation period (year) is provided to the authorized CMM user, with the ability to Add, Edit or Delete a BG GHG emissions entry by selecting the corresponding action button. As such, CRUD operations on BG GHG emission values per gas type and year is available, as illustrated in Figure 24.



The image shows a modal window titled "Background GHGs concentrations" with a close button (X) in the top right corner. The window contains four input fields arranged in a 2x2 grid. The top-left field is labeled "CO2" and has a "ppmV" unit button to its right. The top-right field is labeled "CH4" and also has a "ppmV" unit button to its right. The bottom-left field is labeled "N2O" and has a "ppmV" unit button to its right. The bottom-right field is labeled "Year" and does not have a unit button. At the bottom right of the modal, there are two buttons: a grey "Close" button and a green "Save" button.

Figure 24. CMM modal window for GHG concentrations management

Video Tutorial: <https://vimeo.com/1053326684>

8. Providing feedback

For any support inquiries or feedback, you may contact the development team at <https://life-climamed.eu/contact> using "SUPPORT" as subject title.