

# Decision making tools for reduction of GHGs emission from agricultural sector and monitoring soil organic carbon stocks

M.K.Doula, A. Hliaoutakis, N.S. Papadopoulos, N. Papadopoulos, A. Sarris, E. Karasali,

M. Velegrakis, K.Komnitsas, N. Tsotsolas, A.A. Zorpas, K. Lourantos



The establishment of data management and monitoring centers by exploiting GIS-based web apps for mapping GHGs emissions and Soil Organic Carbon (SOC) stock changes which allow the easy and visualized assessment of temporal variation of GHGs emission as well as of SOC, even at field level and therefore enhance and support the role of the authorities at national and also at European level.



# Imagine something like that...

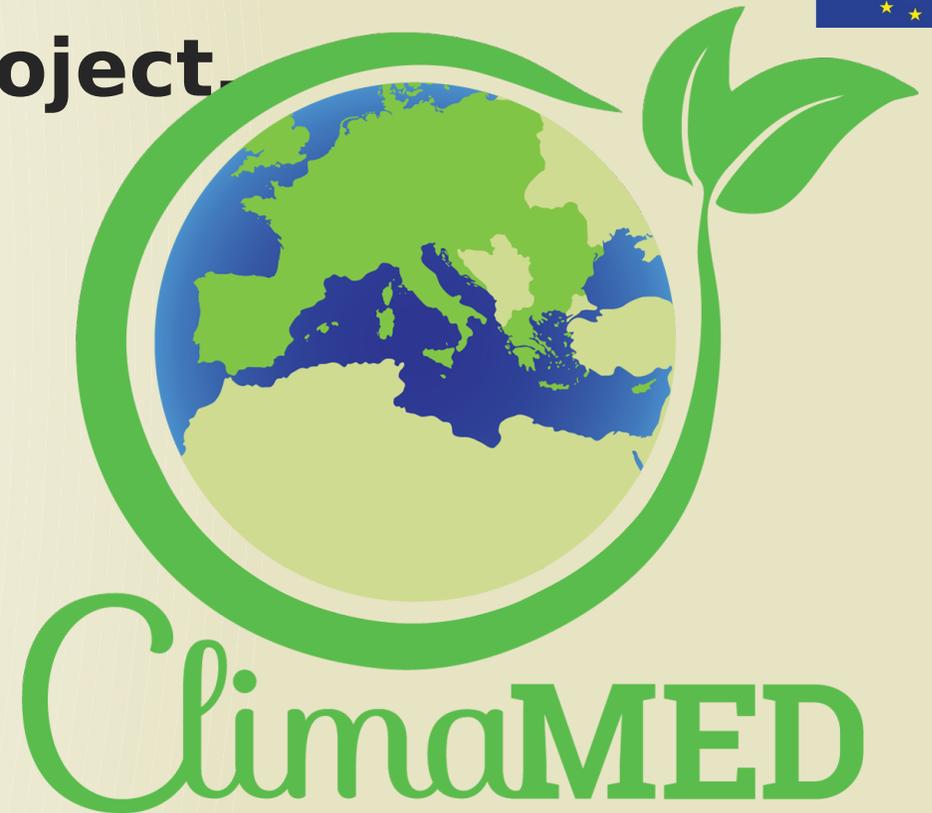
- Spatial data and GHG emissions at field level
- Real time measurements of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O
- Storing and management of data crucial for policy development (field practices, energy use, natural sources use, soil quality, etc.)
- A platform that enables recording of emissions from agricultural sector and reporting based on a Tier3 method for GHGs and Soil Organic Carbon Stock changes



## **This is LIFE ClimaMED project.**

**“Innovative technologies for climate change mitigation by Mediterranean agricultural sector”**

Development of a GIS-based Web platform (Center of GHGs Monitoring and Management-CMM) for collecting, processing and spatially mapping GHGs and SOC data from cultivated fields at national level

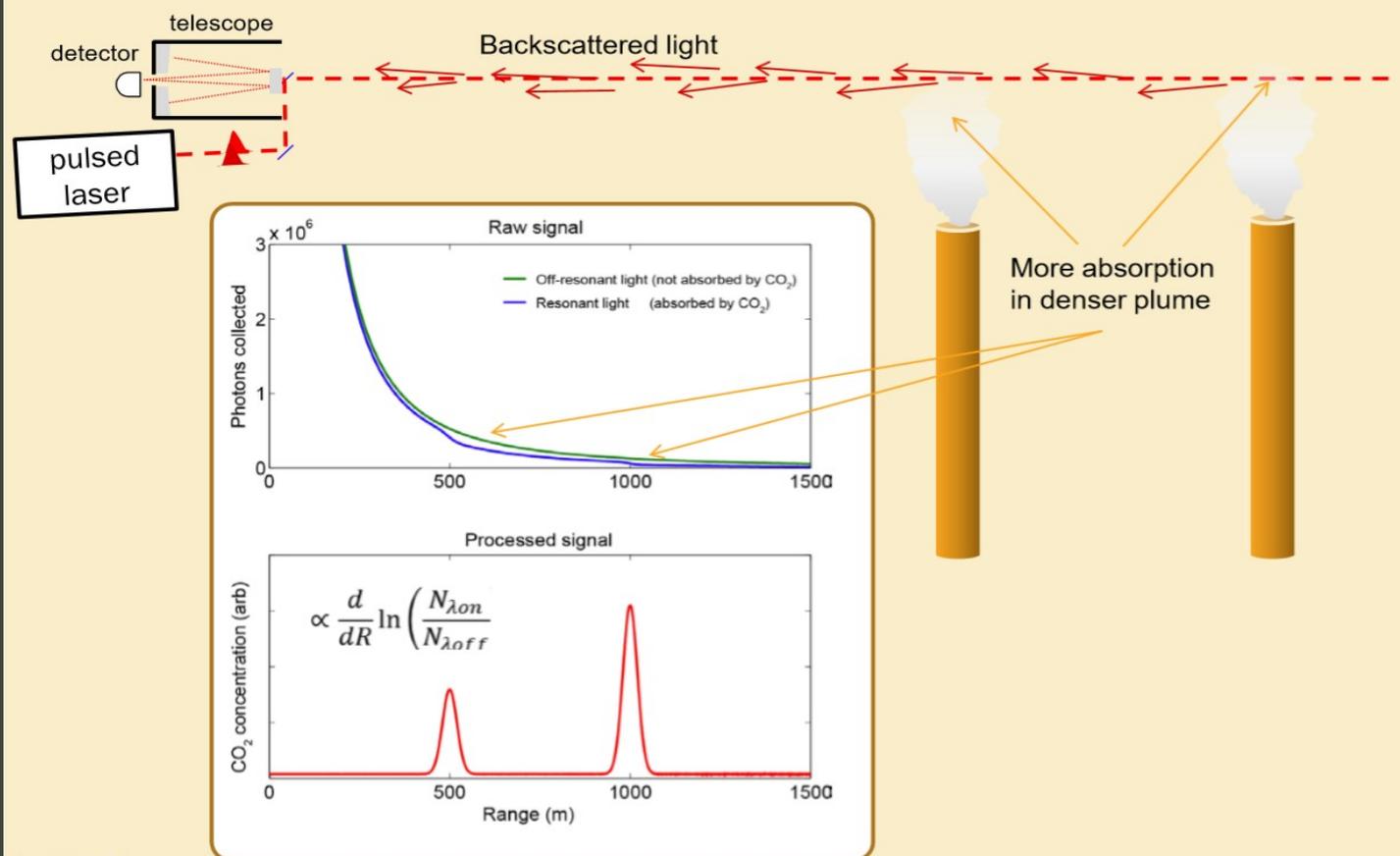


### **Tier3 methodology....How????**

**By developing an innovative methodology for GHGs measurement using LIDAR technology**

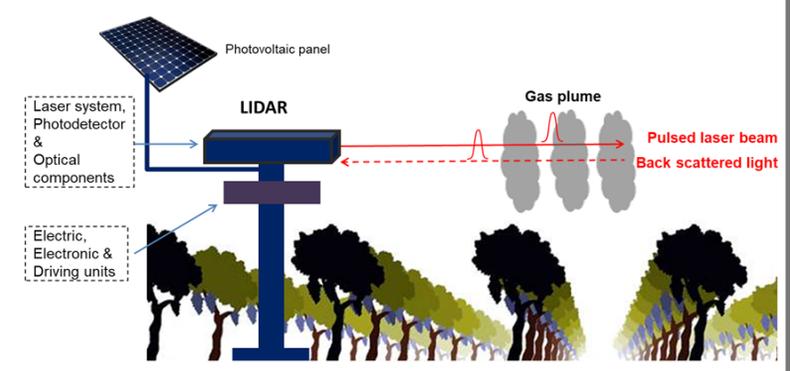
# LIDAR=Light Detection And Ranging-a technology that has been used for GHGs quantification in the past

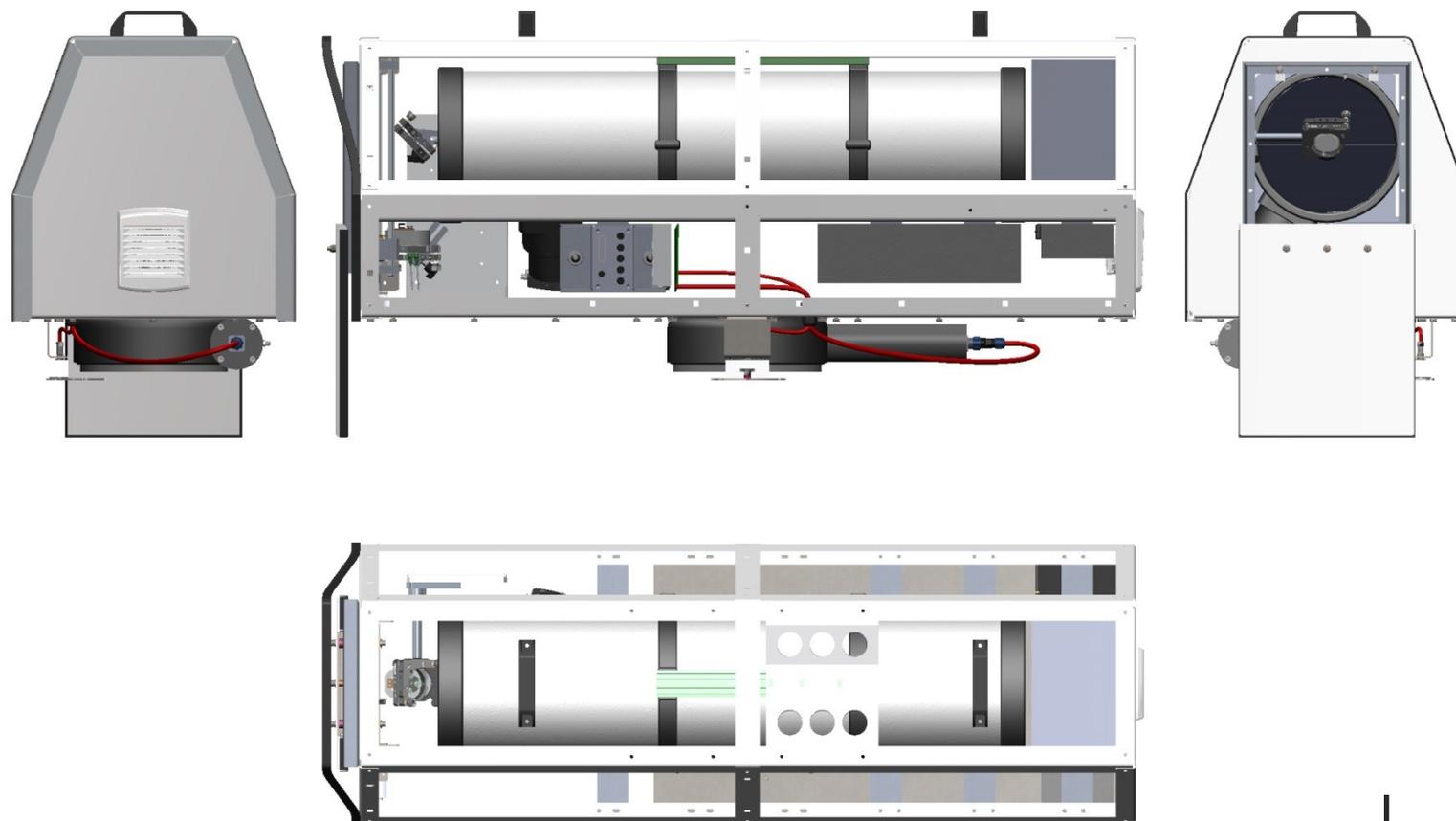
## DIFFERENTIAL ABSORPTION LIDAR (DIAL) CARTOON

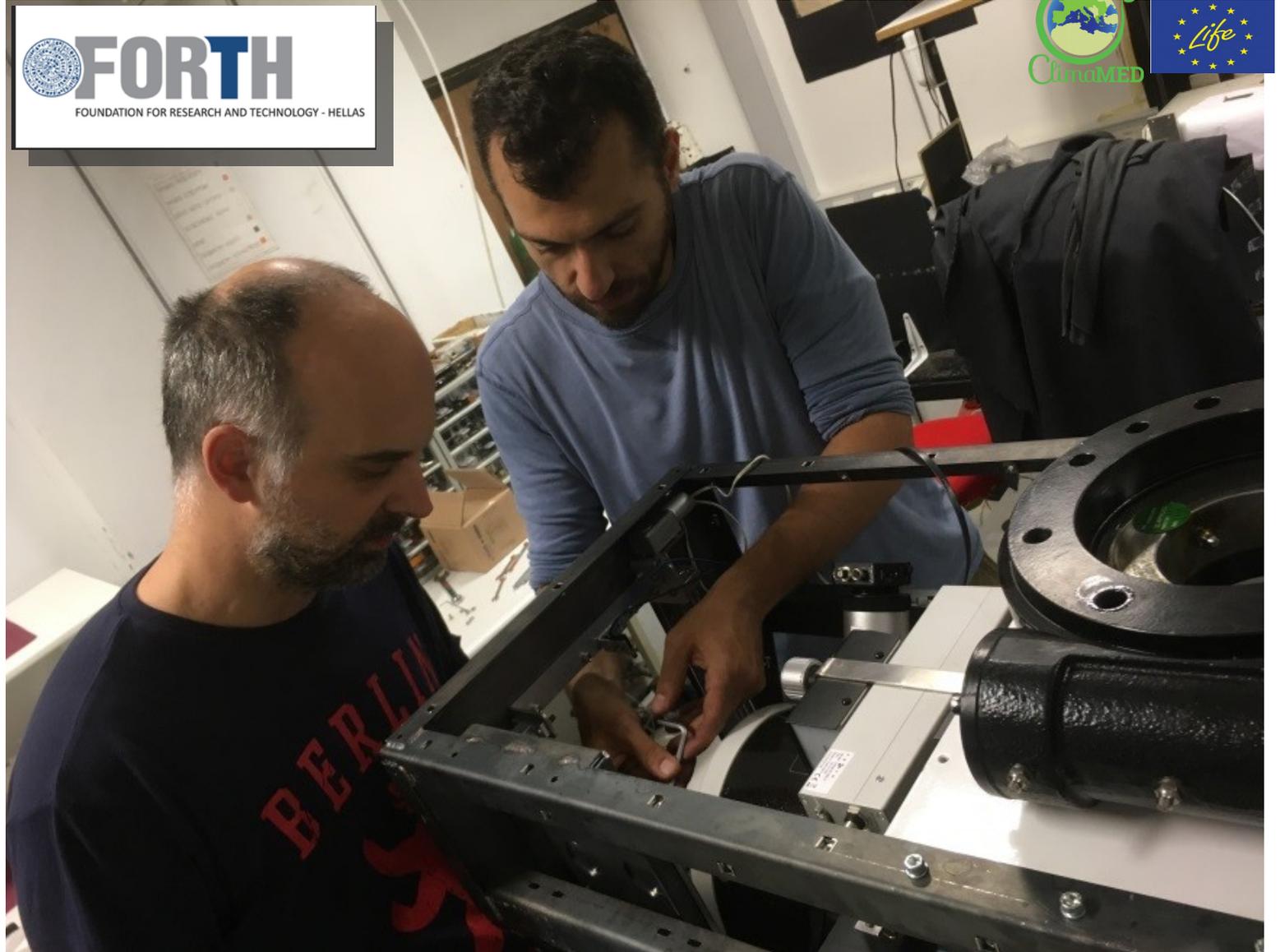
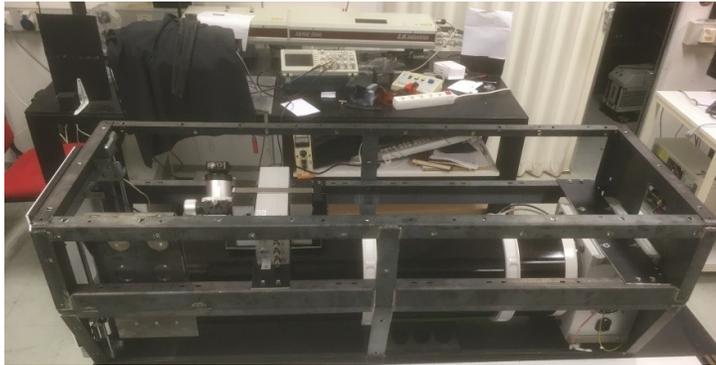


## LIDAR device

- The wavelength region selected is in the infrared region (1.5-2.5 μm) appropriate for measuring the three gases. This spectral region is selected also for some additional reasons such as eye safety, not disturbing birds and animals
- Three pulsed lasers emitting at infrared wavelength region (1.6 μm for CO<sub>2</sub>, 1.7 μm for CH<sub>4</sub> and 2.3 μm for N<sub>2</sub>O) were merged in a device

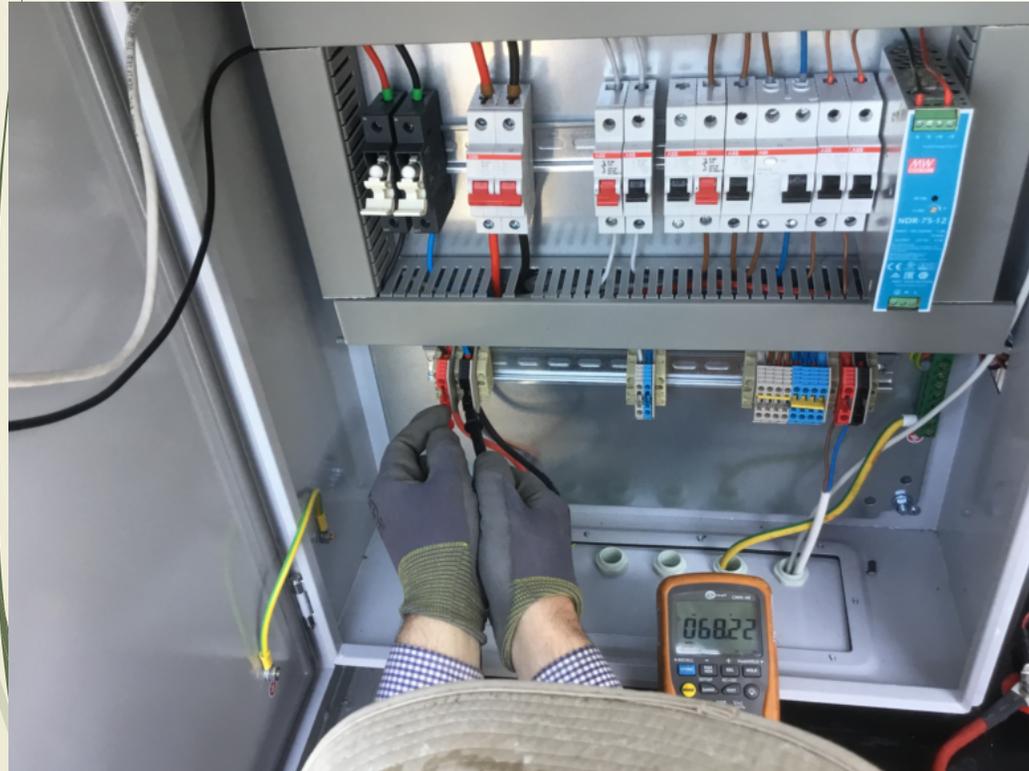








# Autonomous photovoltaic system

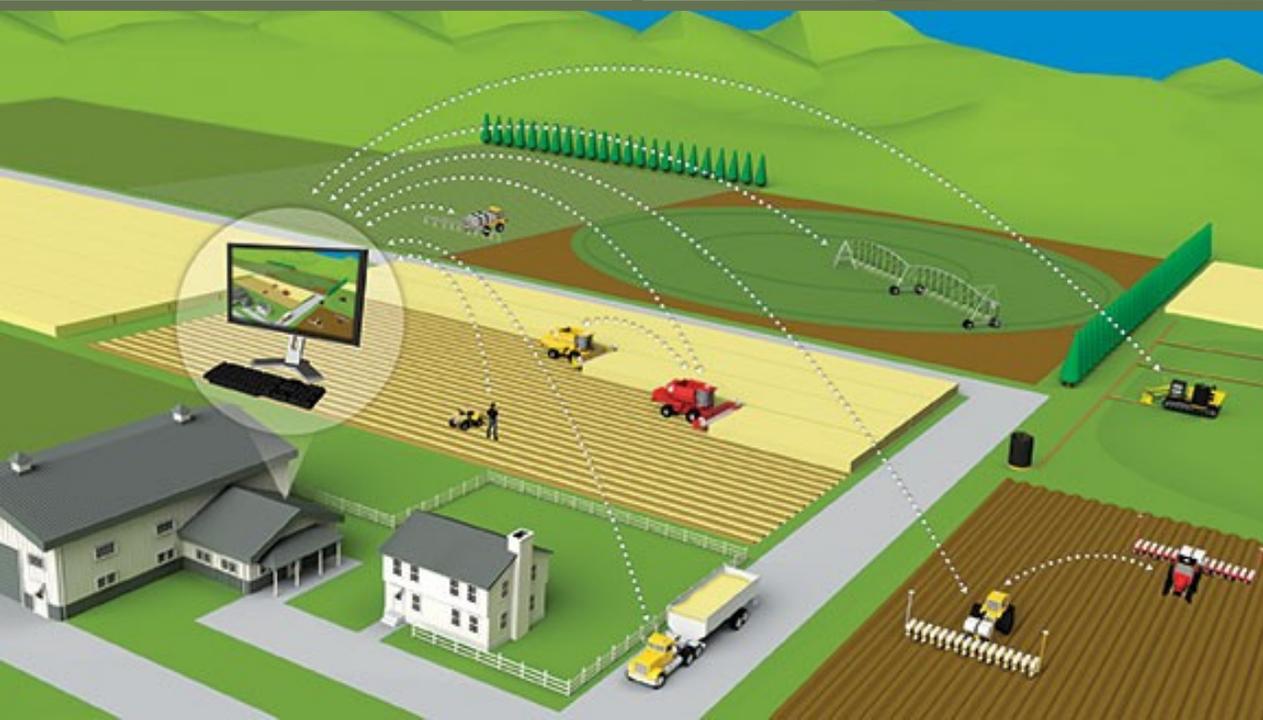


# Meteorological station



-05-27 20:42:20 - To: 2019-05-28 09:21:27

Satellite



# The pilot network consisting of 15 fields in Greece

Different cases, e.g. organic farming, intensive cultivation, animals in field, organic material spreading on soils, manure management in fields



MAP OF GREECE  
WWW.in2greece.com



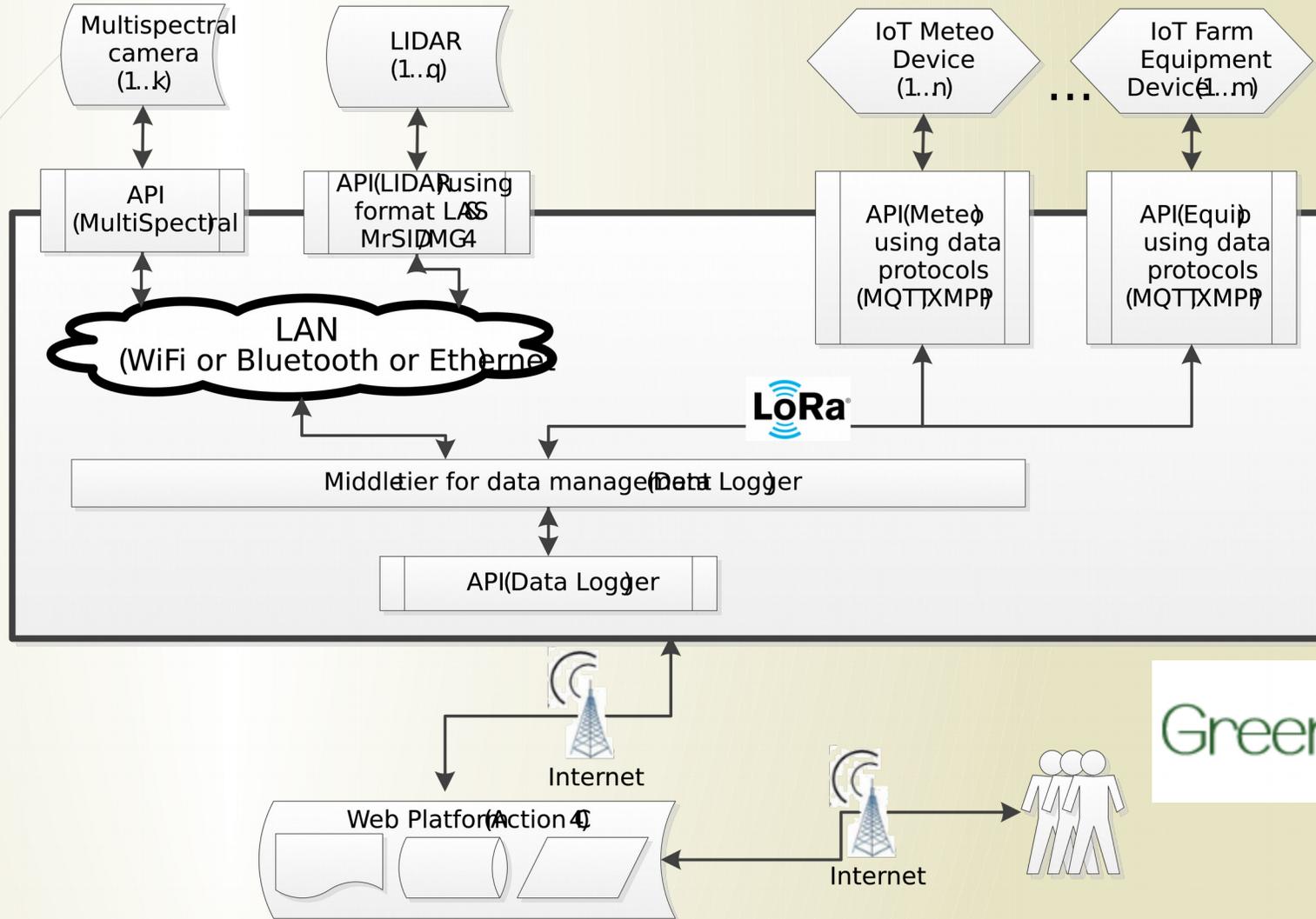
- O: Olive trees
- P: Pistachio trees
- V: Vegetables
- C: Cereals
- G: Grapes



# Telemetry



Telemetry Infrastructure for IoT LIDARs, Optical Fiber devices & Multispectral cameras







MAP OF GREECE  
WWW.in2greece.com

The equation that provides the changes in SOC stocks is

$$\Delta \text{SOC} = \text{NEE} + \text{CH}_4\text{-C} + C_{\text{HARV-MAN}} \quad (1) \text{ (modified)}$$

where

-NEE is the Net Ecosystem Exchange = GPP - RE, which reflects the difference of CO<sub>2</sub> amounts between Gross Primary Production (GPP = the CO<sub>2</sub> uptake by the photosynthesis of vegetation) and Ecosystem Respiration (RE = sum of autotrophic respiration due to plant respiration and of heterotrophic one which is the sum of respiration by animals, fungi and bacteria).

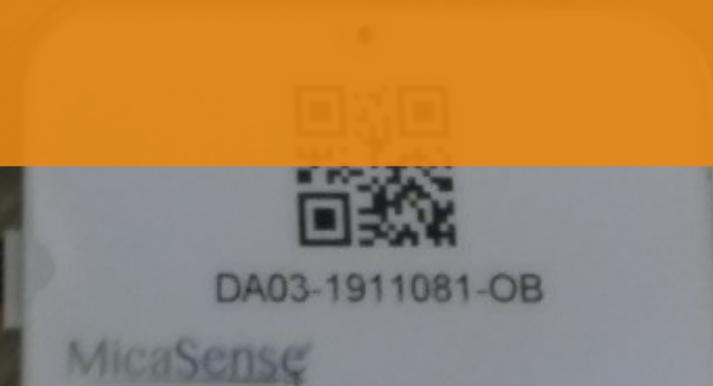
GPP and RE can be estimated by **using meteorological data** (air and soil temperature, PAR = photon flux density of the photosynthetic active radiation and indexes as for example Normalized Difference Vegetation Index-(NDVI, Enhanced Vegetation Index-EVI,, Leaf Area Index -LAI, Fraction of Photosynthetically Active Radiation absorbed by plant canopies-FPAR.....)

-CH<sub>4</sub>-C is the carbon removal from soil due to CH<sub>4</sub> emissions (measured by the **LIDAR devices**)

-C<sub>HARV-MAN</sub> is the C difference between the C removal due to harvest and C addition



# Multispectral VIS/IR camera



**To be  
continued...**

**Maria K. Doula**

Benaki Phytopathological Institute

