



SWRI

Soil and Water Resources Institute



JÜLICH

FORSCHUNGSZENTRUM



ATLAS

AGRICULTURAL INTEROPERABILITY
AND ANALYSIS SYSTEM

Development of irrigation management services based on integration of innovative soil moisture monitoring and hydrological modelling

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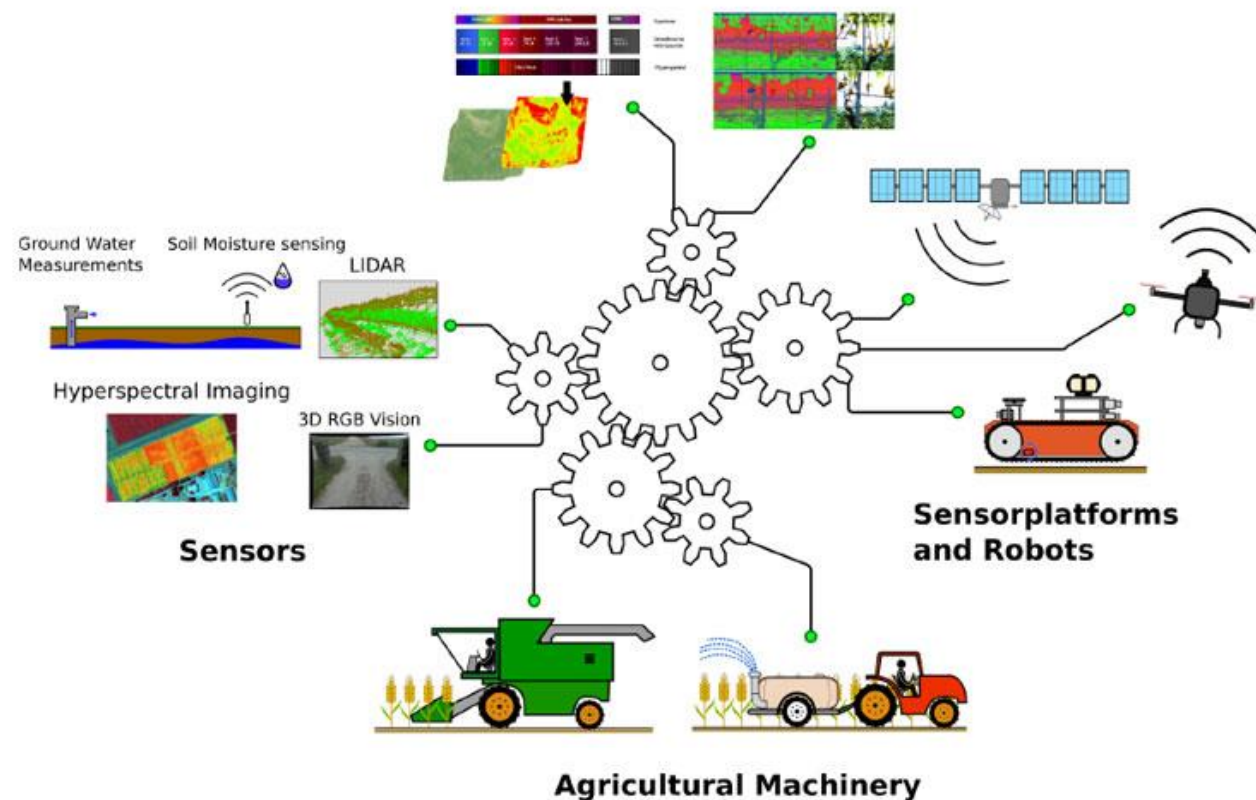


The ATLAS Project



The goal of **ATLAS** is to achieve a **new level of interoperability of agricultural machines, sensors and data services** and enable **farmers** to have **full control over their data** and decide which data is shared with whom in which place.

Data Processing and Analysis Services



- Services**
1. Crop Monitoring Data Collection
 - 2. Irrigation oriented services**
 3. Vehicle Fleet Navigation
 4. Livestock monitoring services tools





Irrigation management services



DATA FROM SENSORS

1. Soil moisture/FDR Technology
2. Soil moisture/Cosmic Ray Neutron Probes
3. Groundwater level
4. Groundwater abstractions
5. Atmospheric forcing
6. Sap flow



HYDROLOGIC MODELING

1. Modeling on the plot scale:



Irrigation scheduling

2. Modeling on the watershed scale:



Water availability for irrigation



PILOT IMPLEMENTATION

- 1 Country (Greece)
- 1 pilot watershed (Agia, central Greece)
- 2 Pilot areas (central and north Greece)
- 5 Pilot fields (vineyards and orchards)





Sensors and instrumentation

Soil Moisture

Groundwater



SoilNet Units

- Frequency Domain Reflectometry (**FDR**)
- **6 sensors per unit** installed in couples in three depths
- **Matrix potential sensors** in more than half of the units installed
- Data transmission with **NB-IoT technology**



Cosmic Ray Neutron System

- **Typical count rate per hour: 2300**
- **Gadolinium** neutron shield (efficiency > 90 %)
- Data transmission with **4G/NB-IoT technology**



Groundwater level and CTD

- DIVER Mini, Micro and CTD
- **Groundwater level monitoring in 15 minutes interval**
- **Electrical Conductivity** is also monitored in selected gw well (CTD).
- **Telemetry Units (3G)** are installed in selected gw wells



Groundwater abstractions

- **Tangential water meters** with pulse outputs
- Each water meter is connected to a **radio peripheral unit** and data is transmitted using **LoRaWAN** and **Ethernet**.



Sensors and instrumentation

Climate Stations



Typical Setup

- **Precipitation** (piezoelectrical and tipping bucket)
- **Wind** speed and direction
- Air **humidity**
- **Solar radiation**
- Air **temperature**
- Atmospheric **pressure**
- Data transmission through **3G technology**



Additional sensors

- **High precision precipitation gauge** using weight-based technology
- **Ultrasonic sensor** for the continuous and non-contact recording of **snow depth**
- Data transmission through **3G technology**

Sap Flow

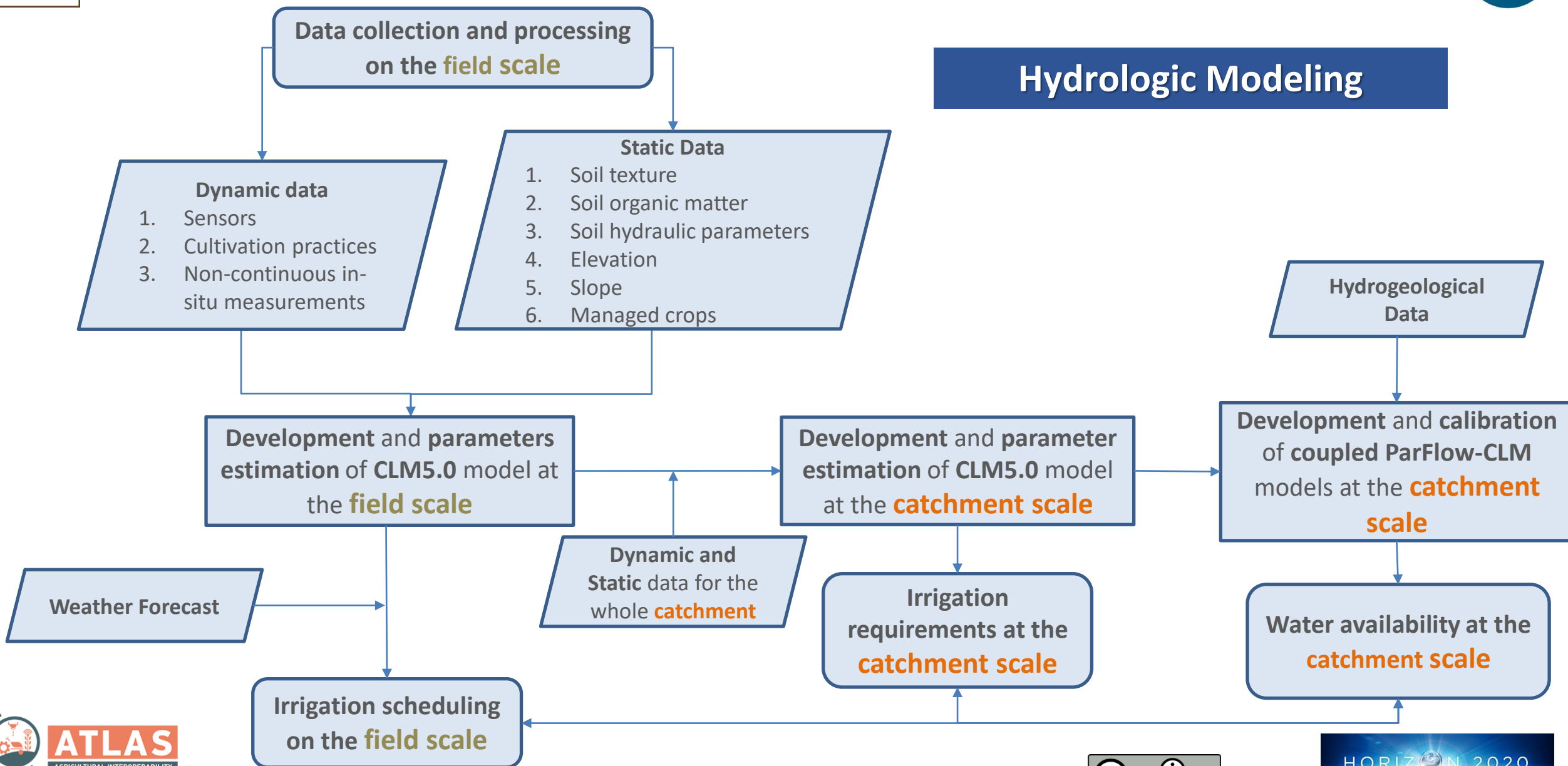


Sap flow monitoring system

- **Sap flow measurements in selected apple trees** using the Heat Ratio Method (HRM) principle able to measure **zero flow and reverse sap flow rates**.
- **Manual data collection.**

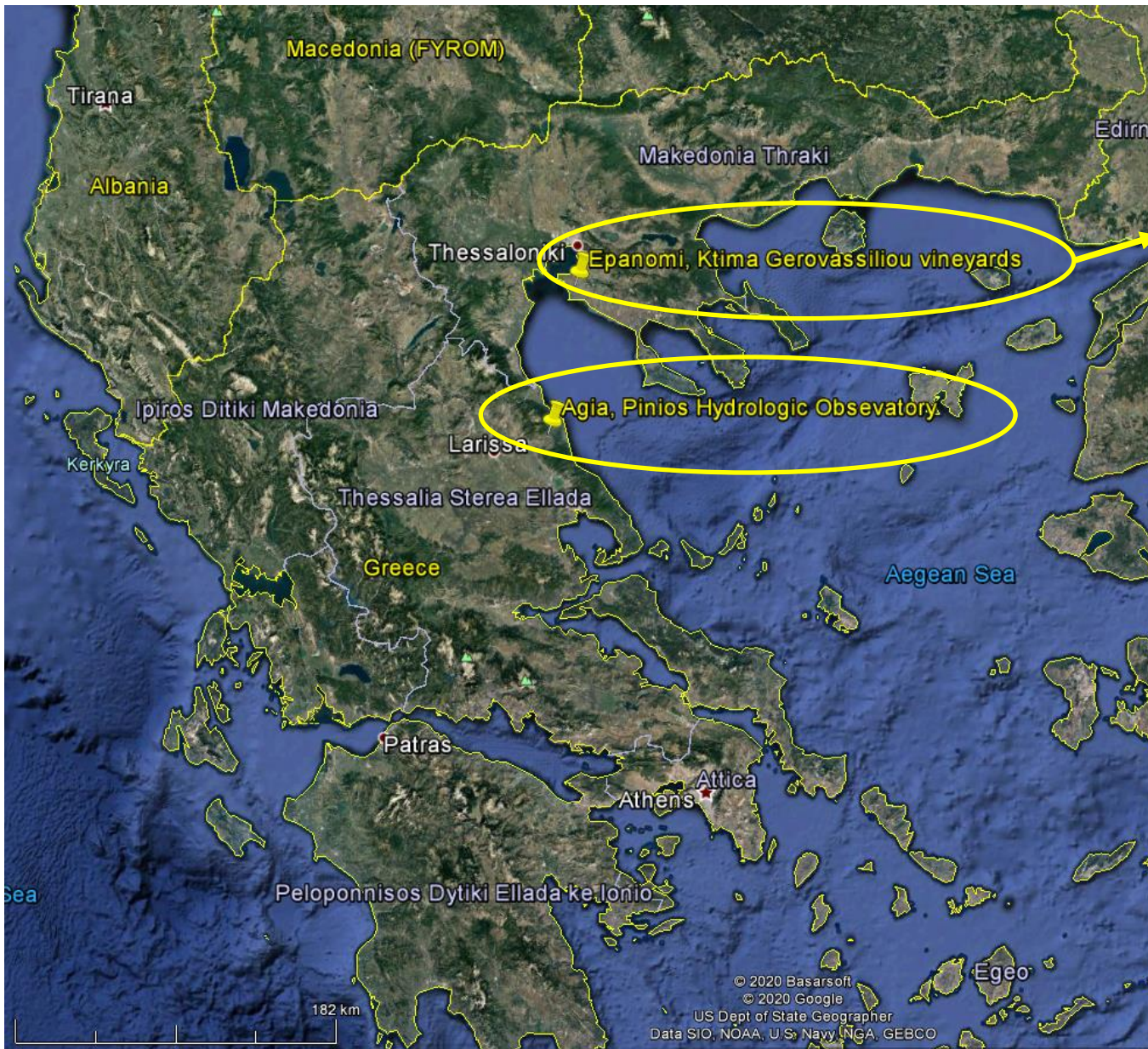


Hydrologic Modeling



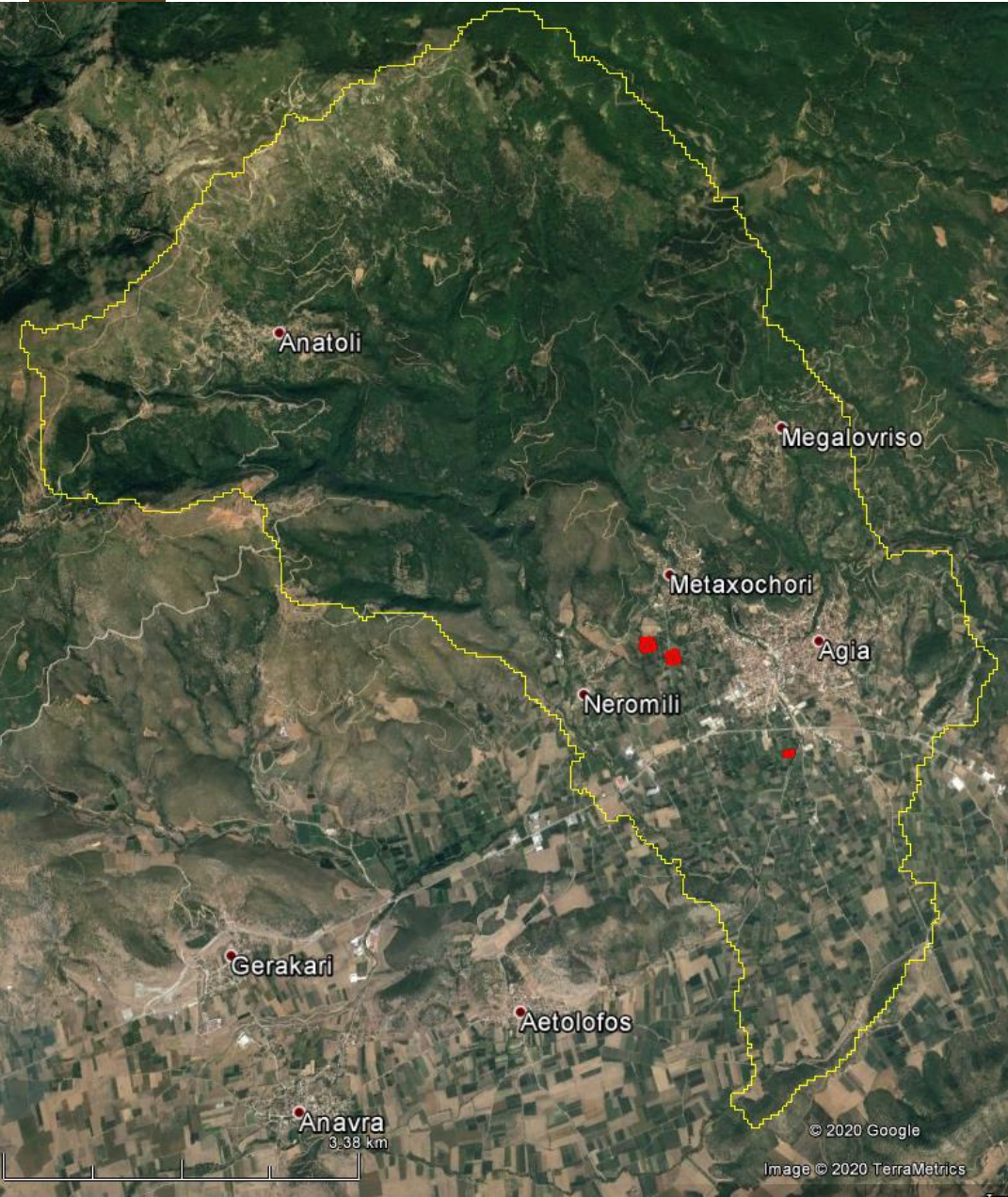


Pilot implementation



- ### Pilot area 2
- Ktima Gerovassiliou vineyards
 - 70 ha of grapes of several varieties
 - 2 pilot fields

- ### Pilot area 1
- Agia, Pinios Hydrologic Observatory
 - Pilot basin area: 44 km²
 - 3 pilot plots on apple orchards



Pinios Hydrologic Observatory (PHO)

- Established on **2015** and ran by:
 - Hellenic Agricultural Organization, Soil and Water Resources Institute
 - Forschungszentrum Jülich, Agrosphere Institute (IBG-3)
- Part of **Long-Term Ecosystem Research** monitoring network (GR-LTER)

Instrumentation in PHO

- Fully equipped precipit. and climate stations
- Groundwater level, EC and abstractions
- SoilNet clusters (soil moisture profilers)
- Cosmic Ray Neutron Probe
- Surface runoff monitor radar & doppler



Pilot implementation: *Pilot area 1*



Field S10



Field S09



- SoilNet node
- Soilnet + SapFlow
- ◆ CRNP
- Experim. Plot
- Control plot

Sensors' setup in pilot fields *Fields S9 and S10*

- **Apple orchards**
- Divided each in **2 control** and **2 pilot parts**.
- **Telemetric irrigation monitoring** in each part
- **12 SoilNet units per pilot field including FDR Soil moisture sensors + Soil water potential sensors**
- **1 x Cosmic-Ray Neutron Probe** in each field
- **6 sap flow sensors** in S10
- **1 climate station** in one of the two pilot fields

Plots T1

- **Apple orchard**
- Divided each in **1 control** and **1 pilot part**.
- **Telemetric irrigation monitoring** in each part
- **6 SoilNet units** equipped with **FDR Soil moisture sensors**

Preparatory works

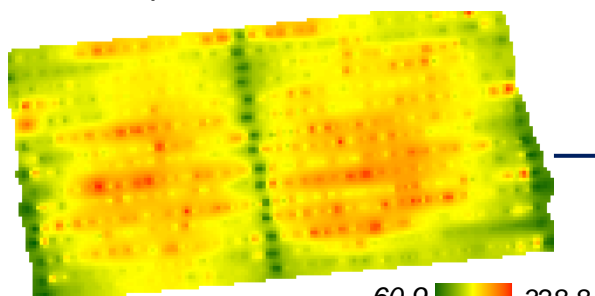
- **Soil bulk electrical conductivity** monitoring with Eletro-Magnetic Induction (EMI) technology
- **Soil sampling survey** for determination of soil texture and hydraulic properties.



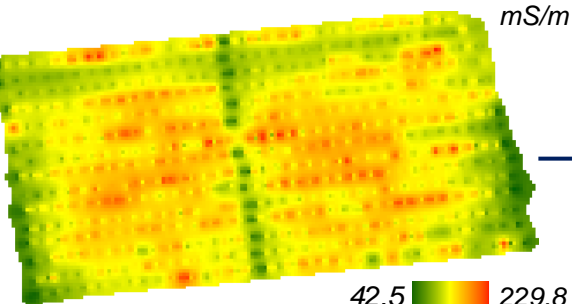


Electromagnetic induction EMI mapping and zonation

ECa map of HCP 1m

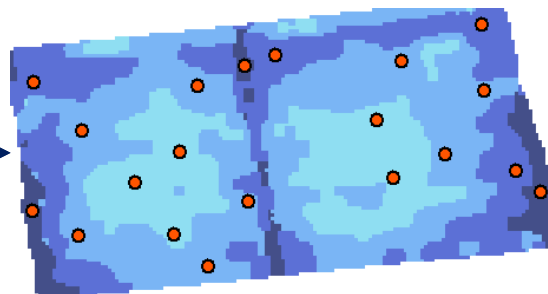


60.9  328.8
mS/m



42.5  229.8
mS/m

ECa maps are generalized using clustering algorithms



EMI-based zones used to select sampling and instrument locations

Sensors' setup in pilot fields

- **2 pilot vineyards**
- **1 for white and 1 for red variety**
- Divided each in 1 **control** and 1 **pilot part**.
- **Telemetric irrigation monitoring** in each part
- **6 SoilNet units** equipped with **FDR Soil moisture** sensors

Preparatory works

- Soil bulk **electrical conductivity** monitoring with Eletro-Magnetic Induction (**EMI**) technology
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Thank you!



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