

Open/Big Data and Citizen Science for Managing the Water, Energy, Food, and Environment (WEFE) Nexus

ISPRA, Rome – 31 May 2019

A Critical Zone Observatory in southern Italy to enhance understanding the complex interactions between Mediterranean climate and Earth's processes

Nunzio Romano

with contributions from: P. Nasta, M. Palladino, B. Sica, et al.

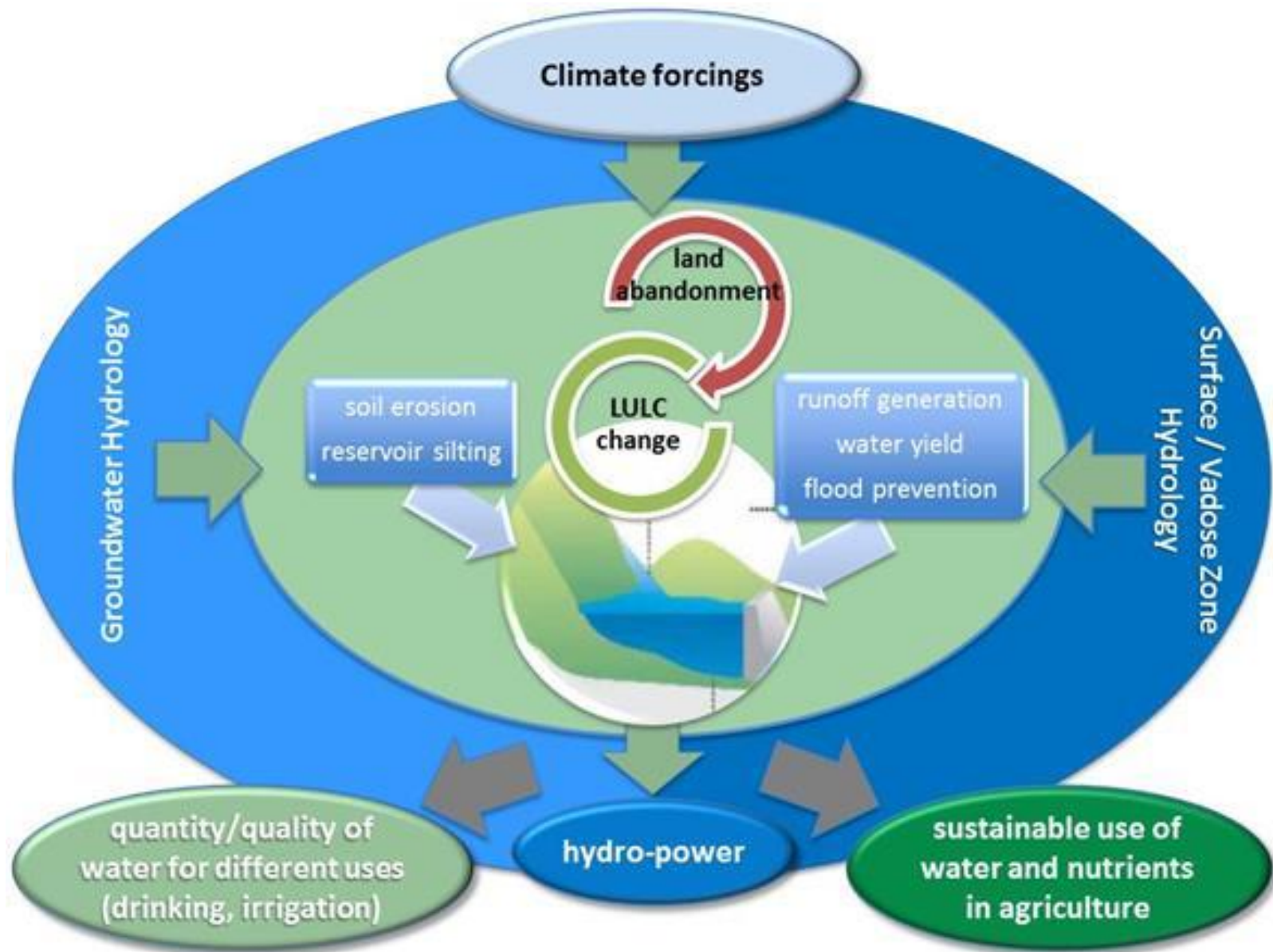


¹ *Interdepartmental Research Center "Environment"*

² *Division: Agricultural, Forest and Biosystems Engineering*

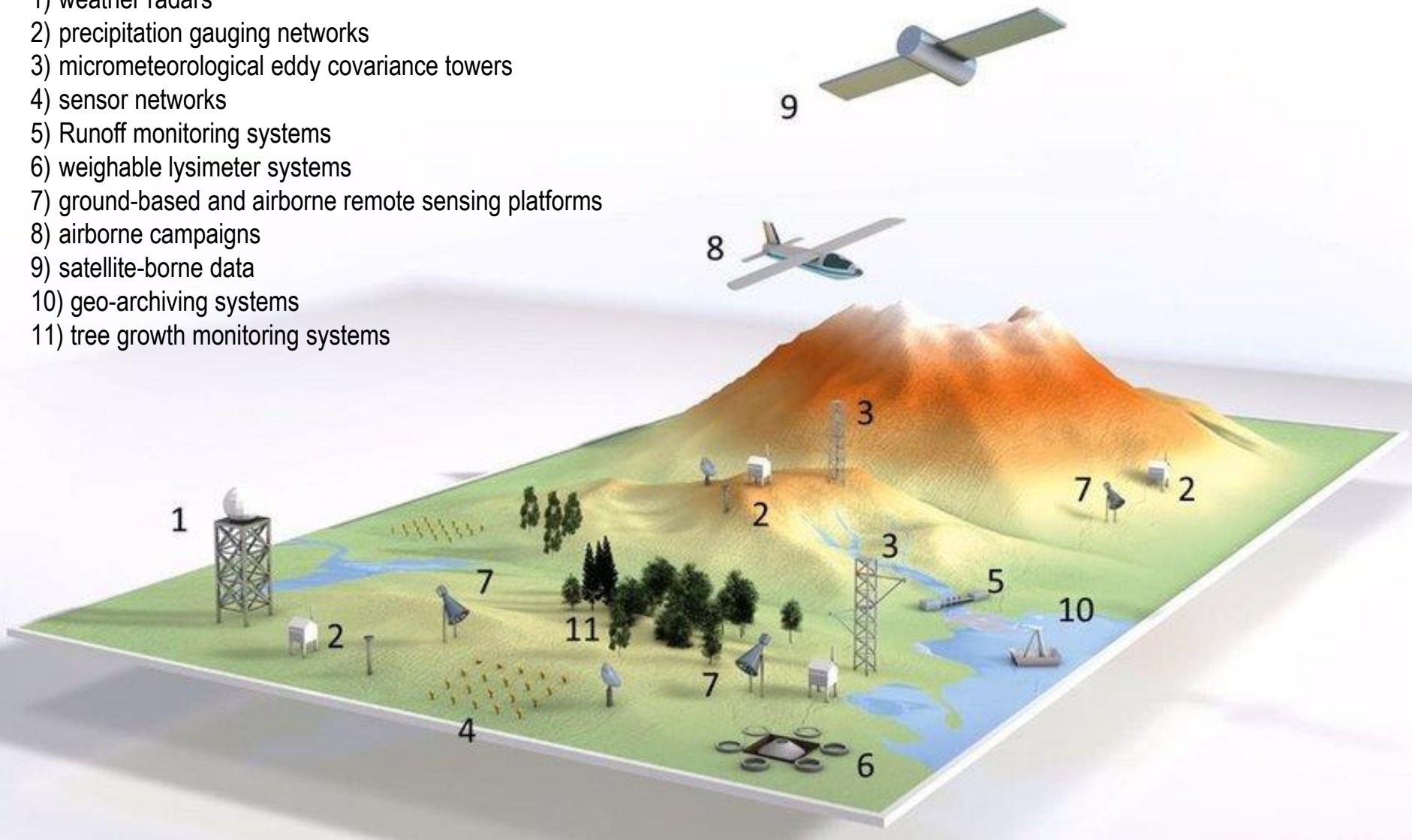
University of Napoli Federico II - Italy





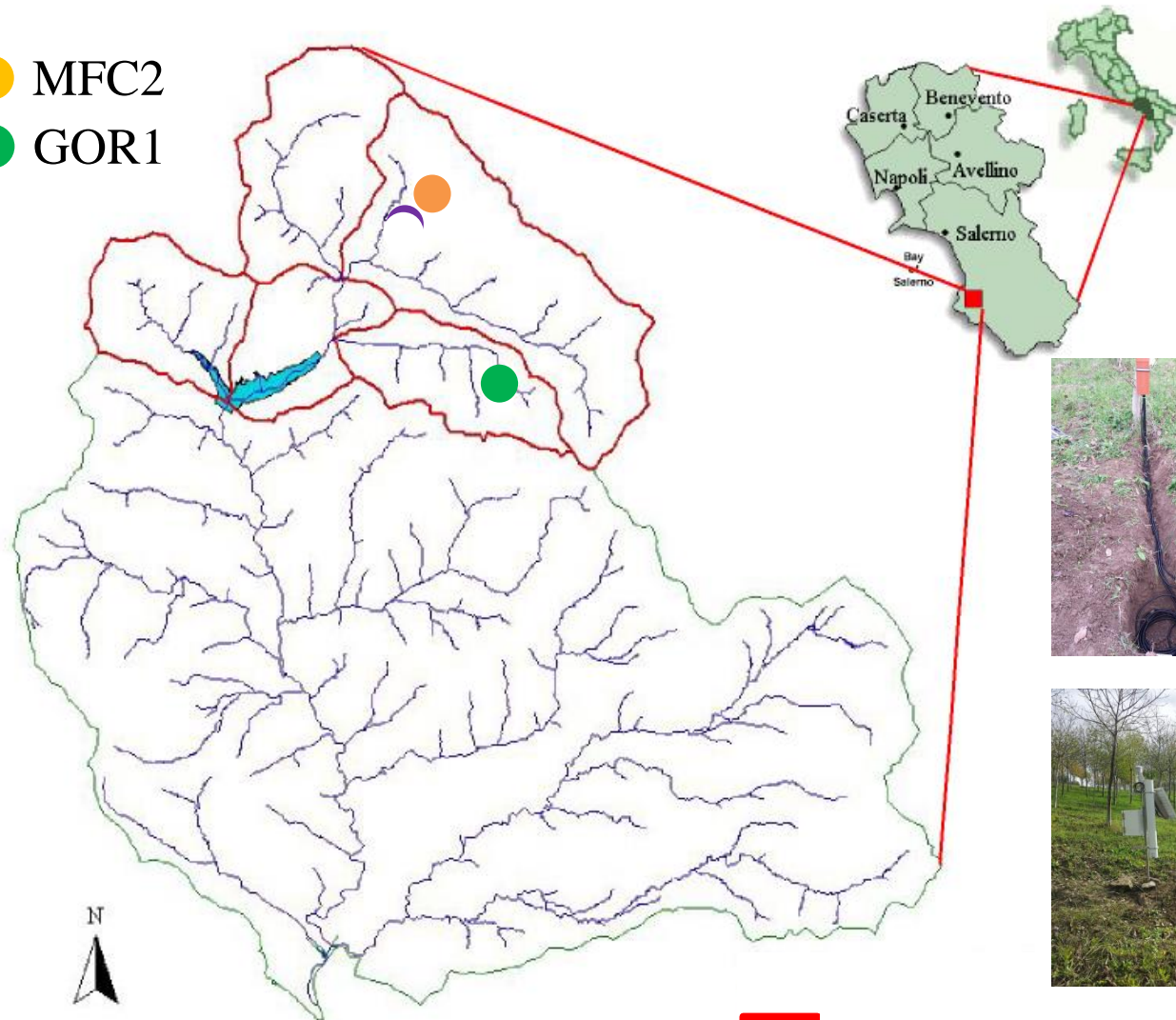
Critical Zone Observatory

- 1) weather radars
- 2) precipitation gauging networks
- 3) micrometeorological eddy covariance towers
- 4) sensor networks
- 5) Runoff monitoring systems
- 6) weighable lysimeter systems
- 7) ground-based and airborne remote sensing platforms
- 8) airborne campaigns
- 9) satellite-borne data
- 10) geo-archiving systems
- 11) tree growth monitoring systems



courtesy of "Tereno.net"

- MFC2
- GOR1



Weather station



SoilNet wireless sensor network

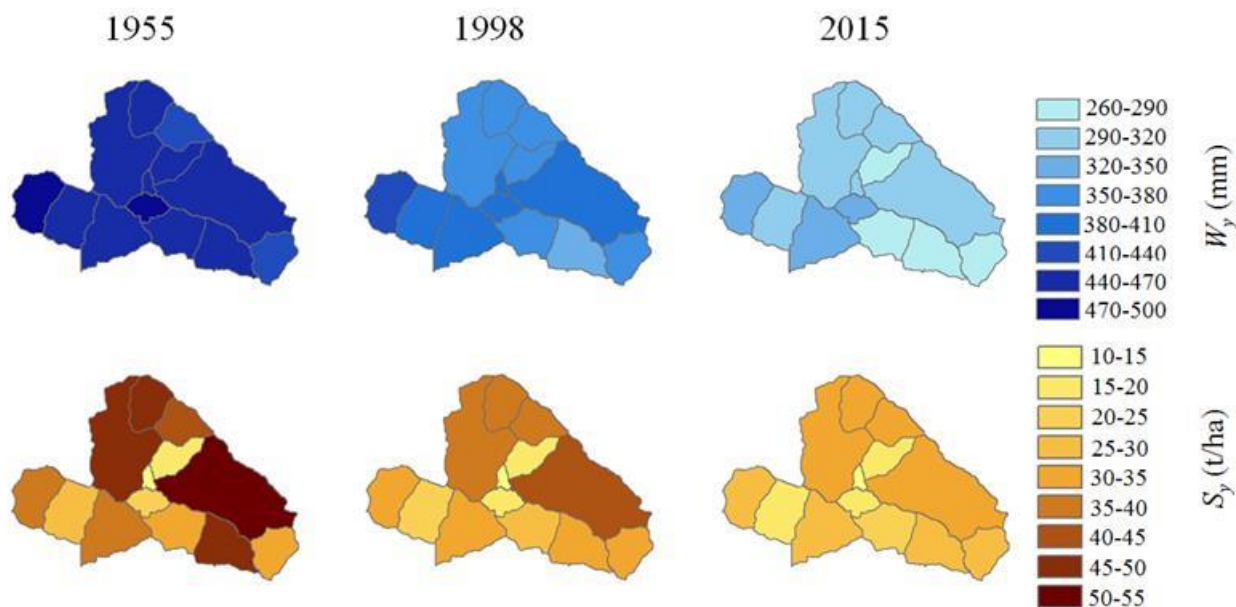
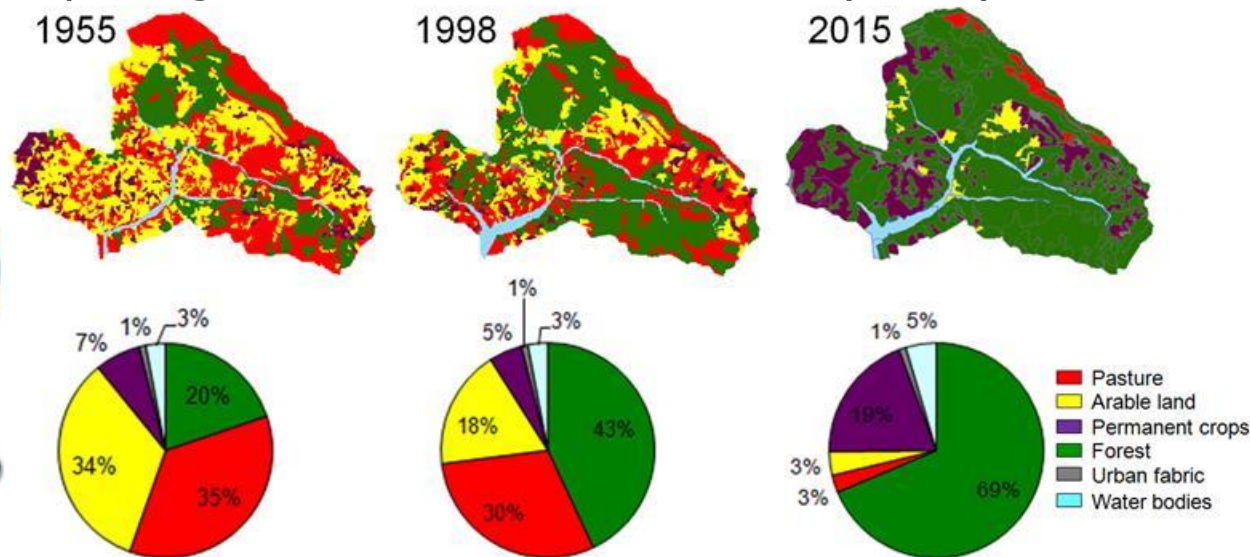
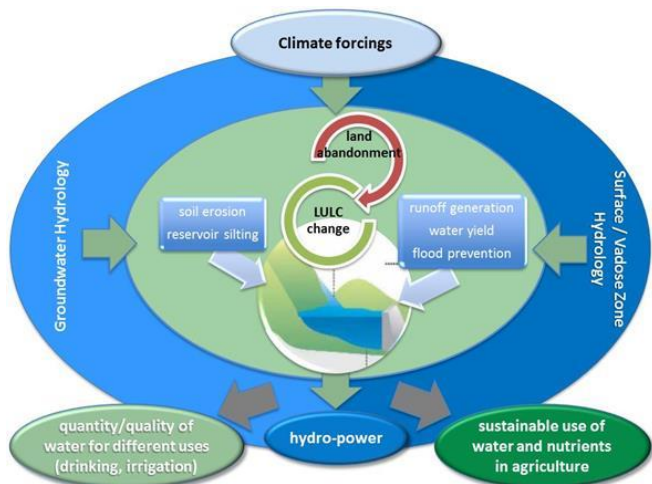


Cosmic Ray Sensor Probe (Hydroinnova)



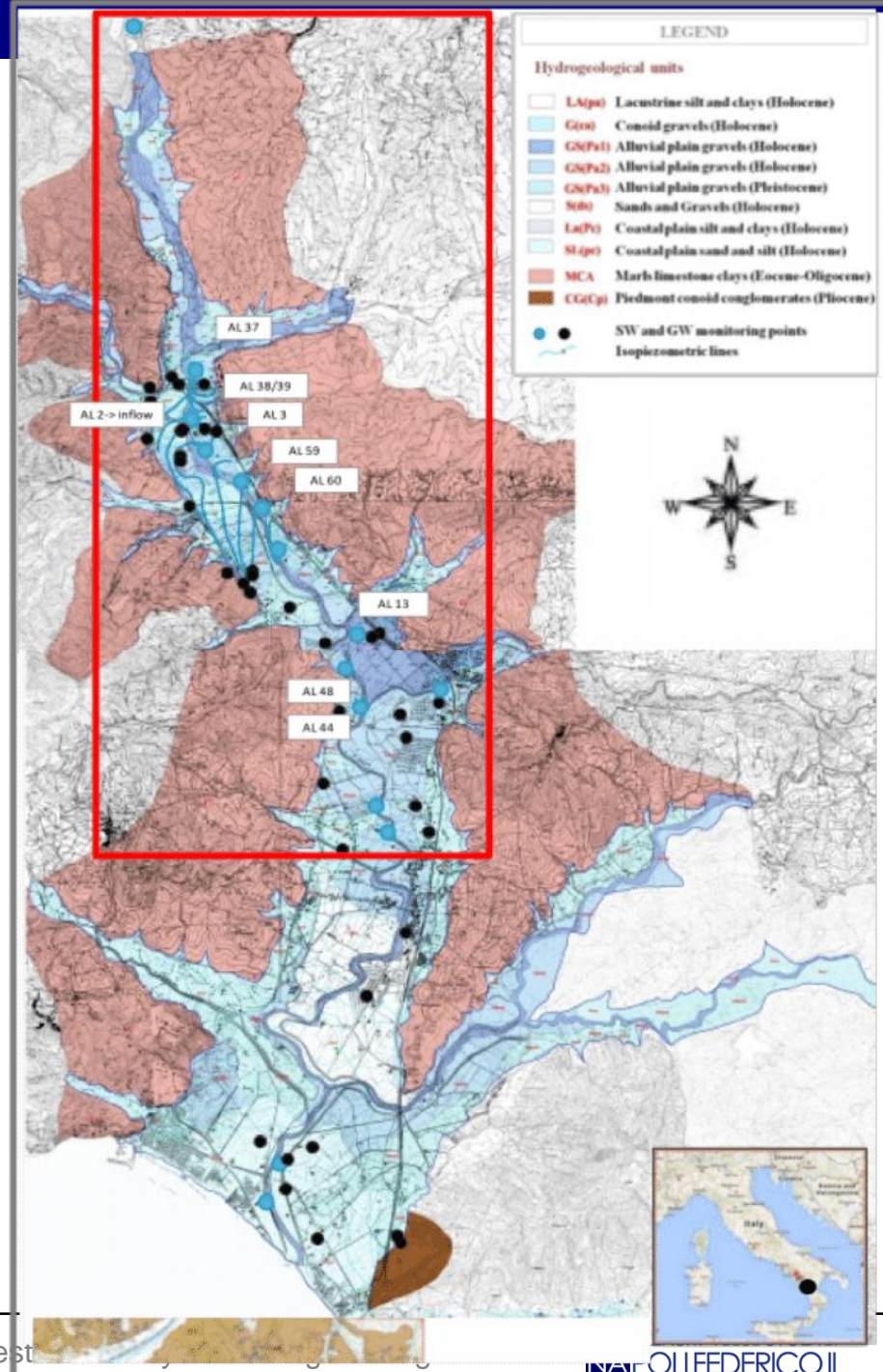
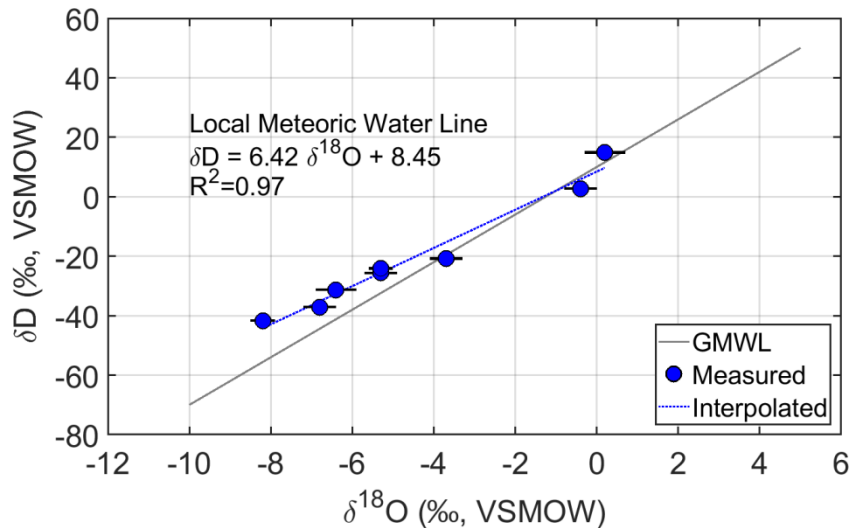
- Upper Alento River Catchment (101 km²)
- Lower Alento River Catchment (308 km²)
- Water reservoir

Upper Alento River Catchment – Impact of landuse change on the hydrological ecosystem services by using Soil Water Assessment Tool (SWAT)

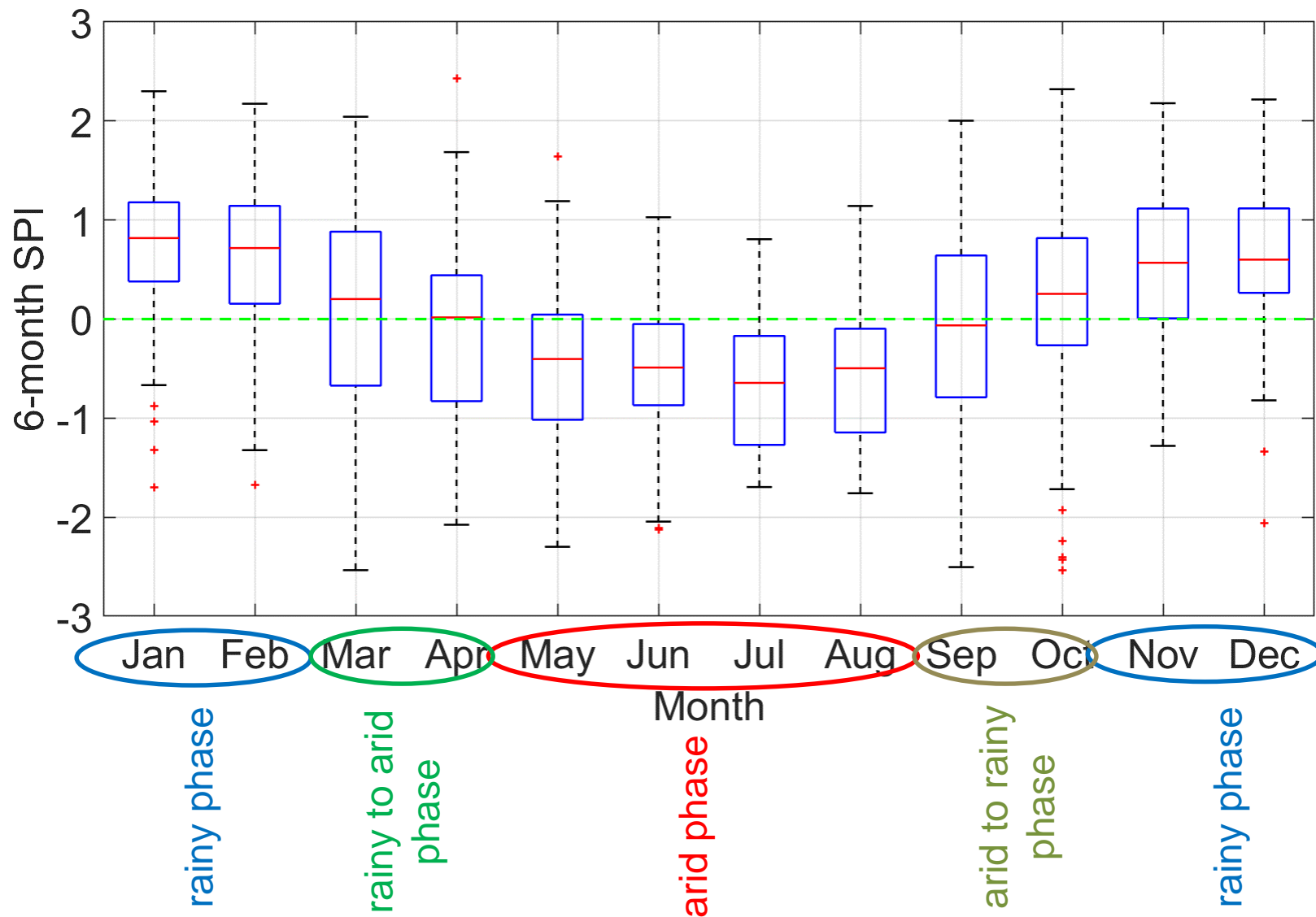


Isotopic measurements in the Lower Alento River catchment (LARC)

Hydrogeologic map + isotopic obs. points



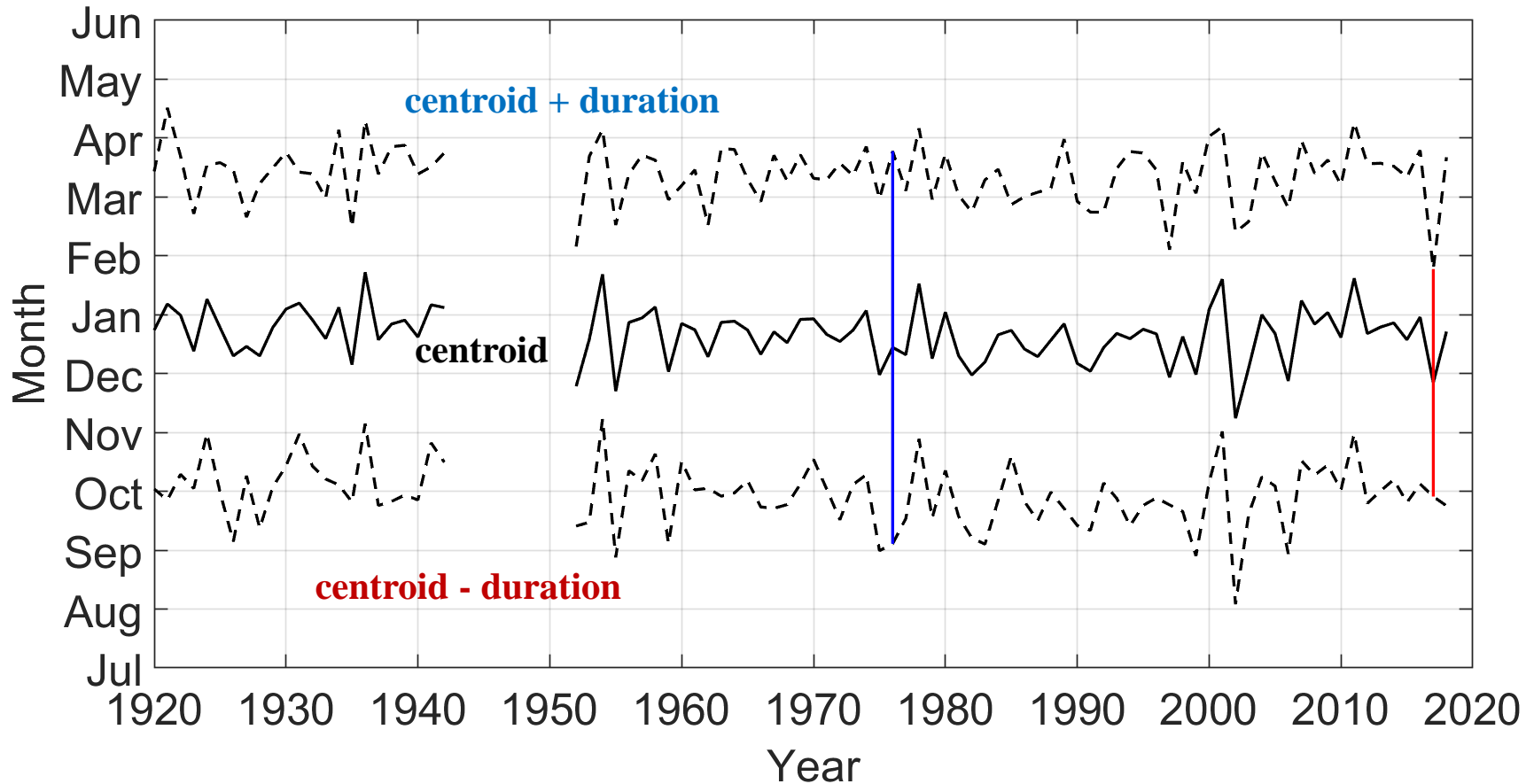
On characterizing the Mediterranean seasonality Presence of two transition phases

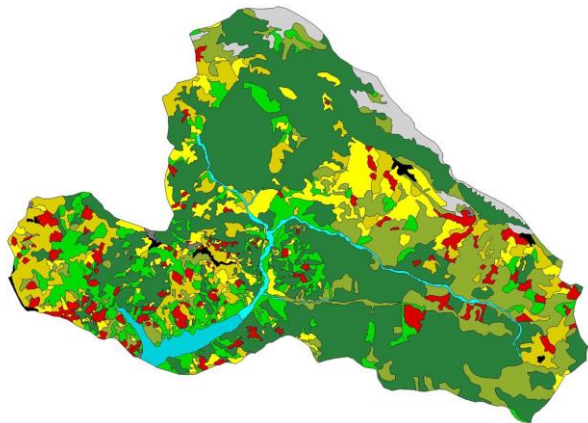


Characterization of the rainy periods (Feng et al., 2013)

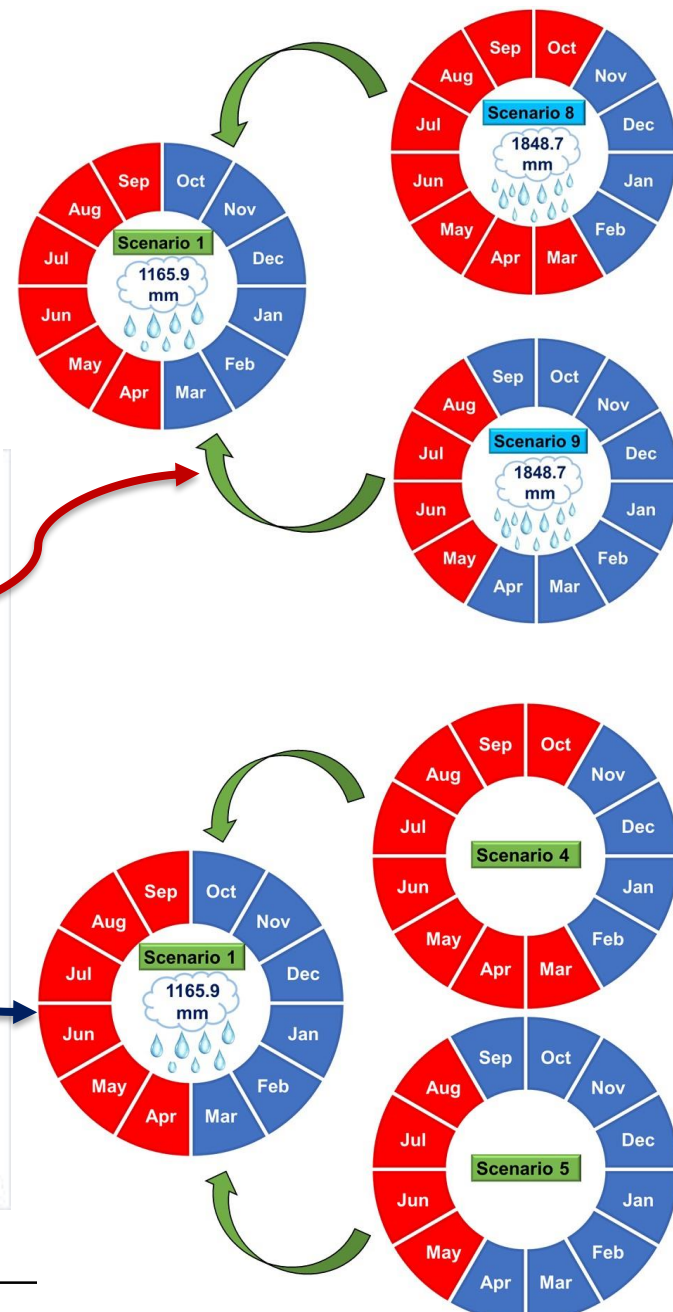
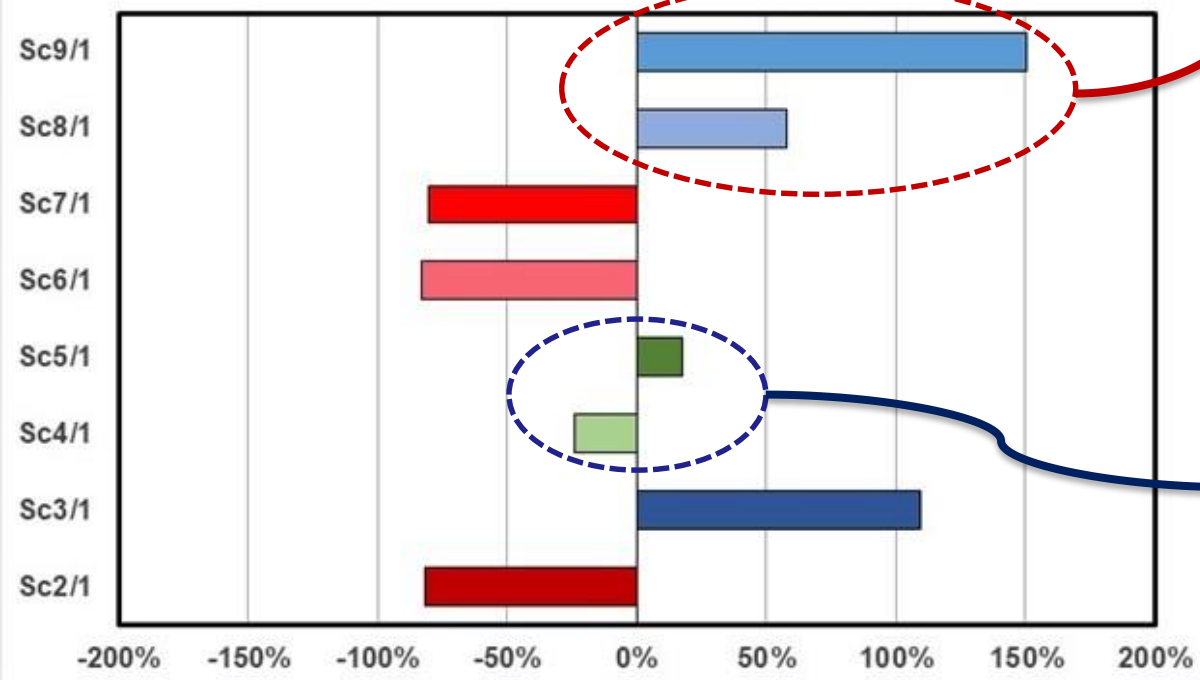
blue vertical line = maximum length (in 1976)

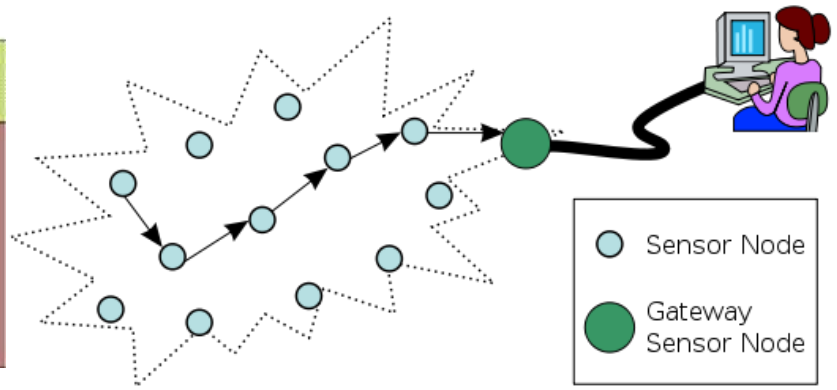
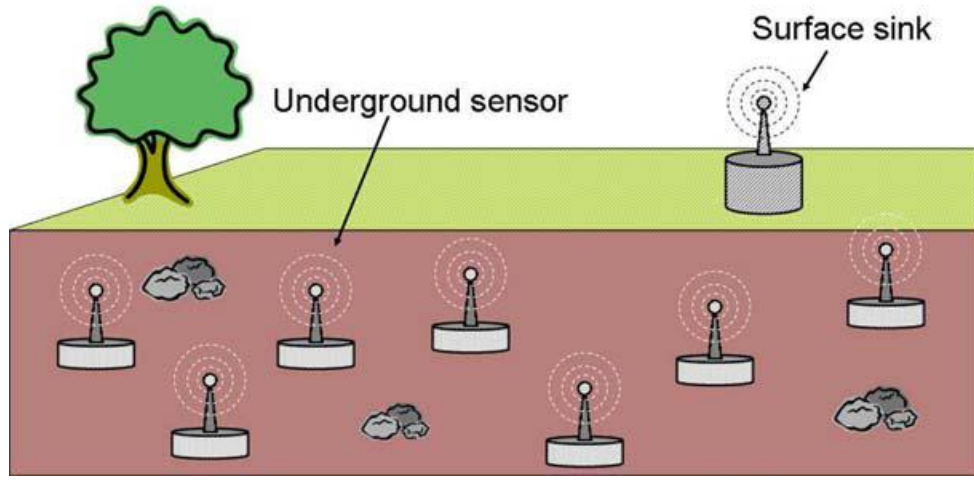
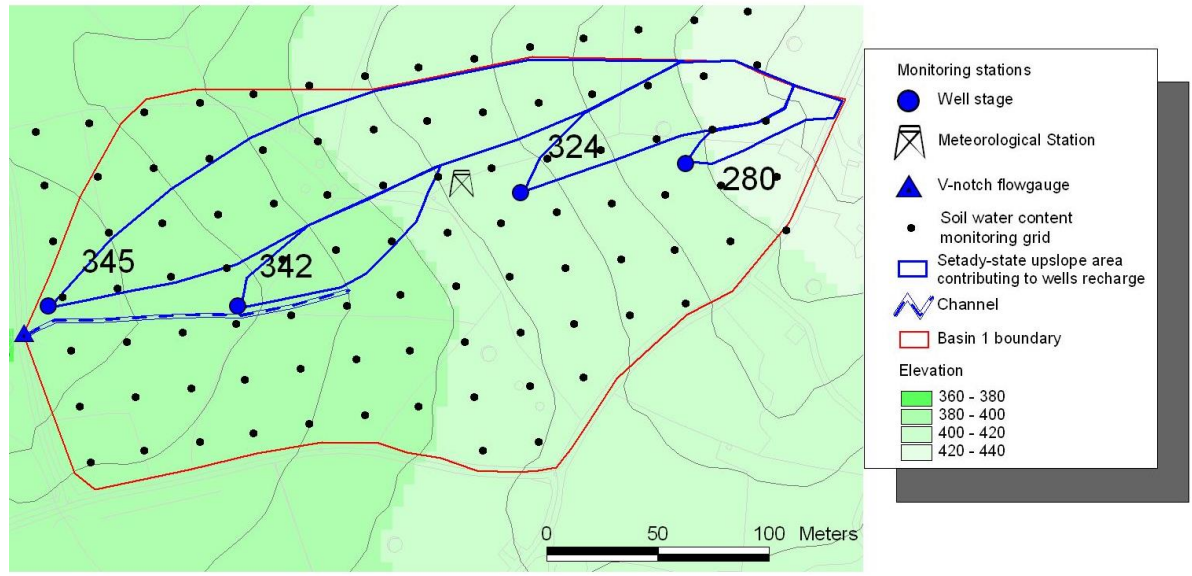
red vertical line = minimum length (in 2017)





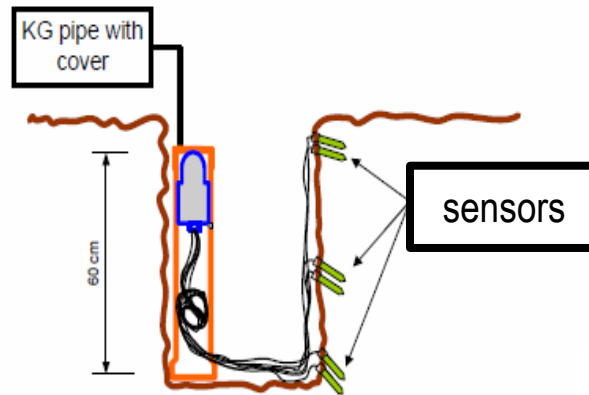
Percentage change in annual water yield, W_y





Romano et al., VZJ 2018

Sensor Unit (GS3 and MPS-6 probes)

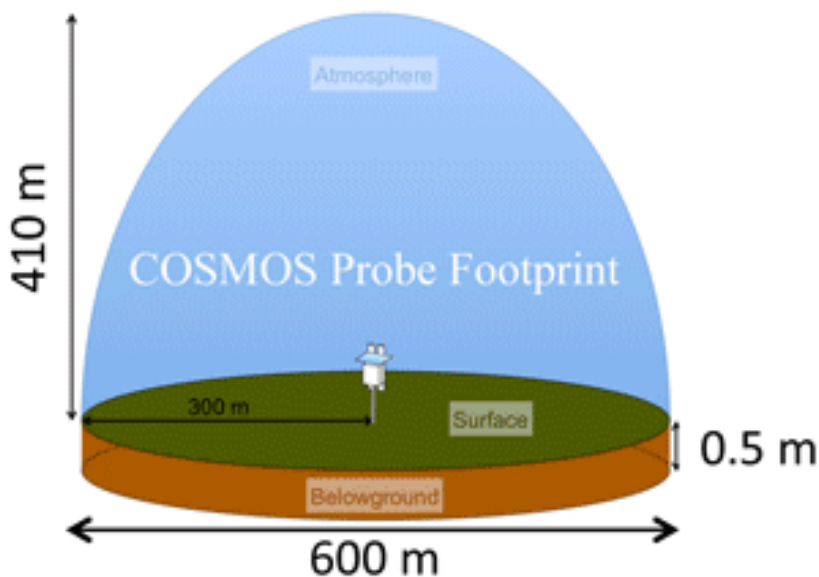


Router Unit

Coordinator Unit

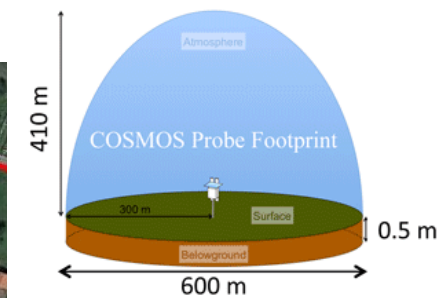
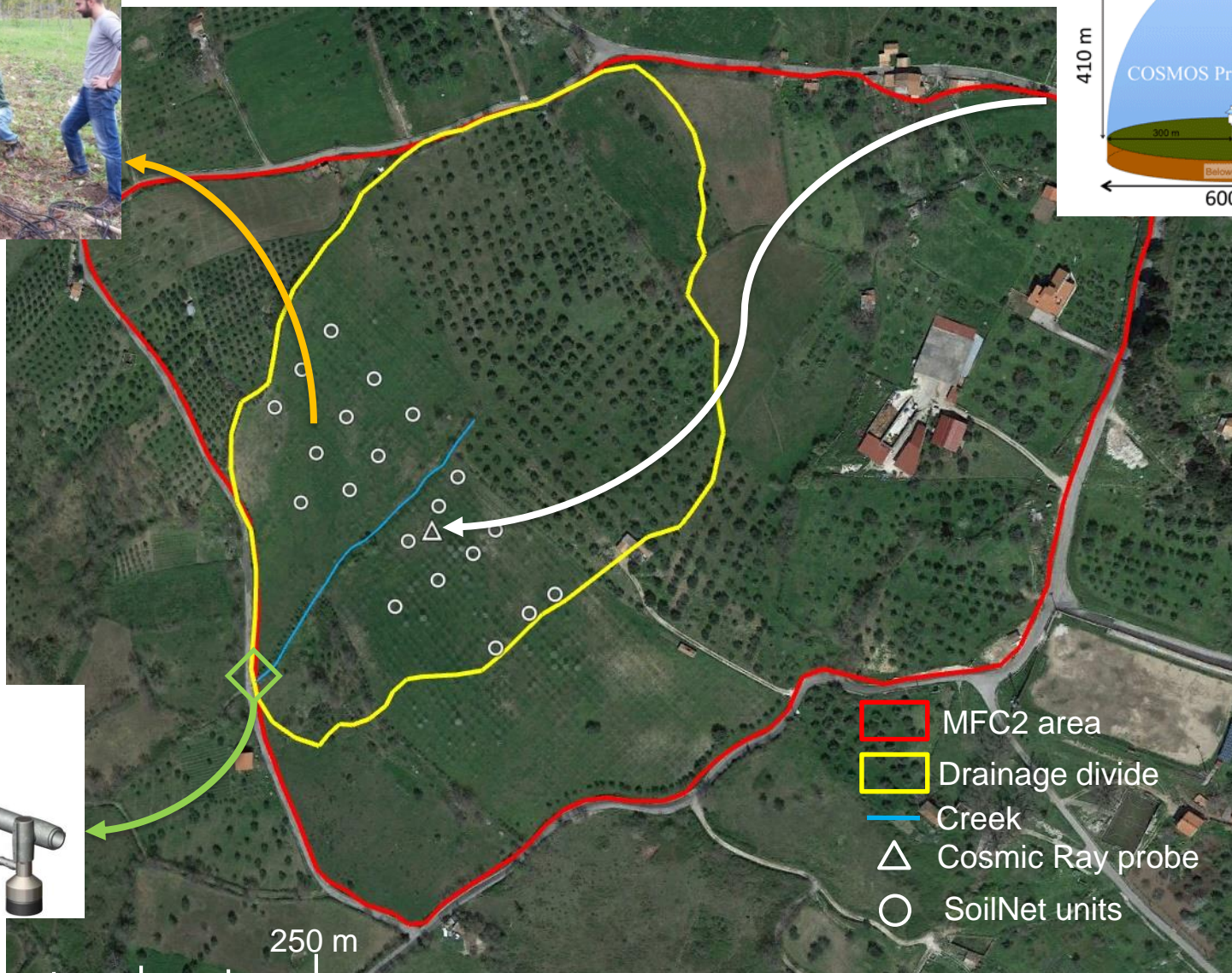


The CRNP measures an average soil moisture value over a circular footprint, whose radius varies between approximately 150 m and 300 m depending on the site conditions.



max footprint:
about 28 hectares!

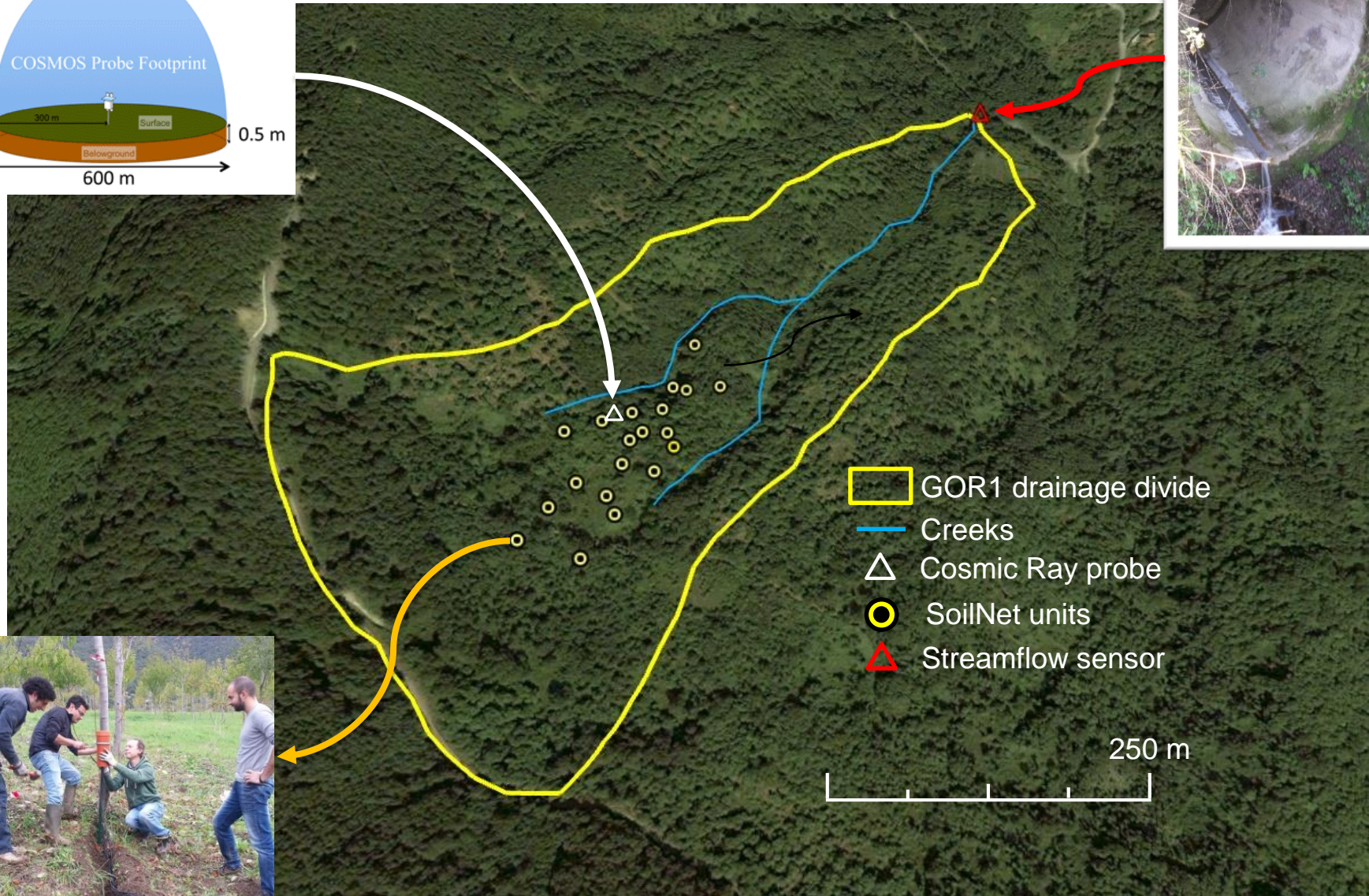
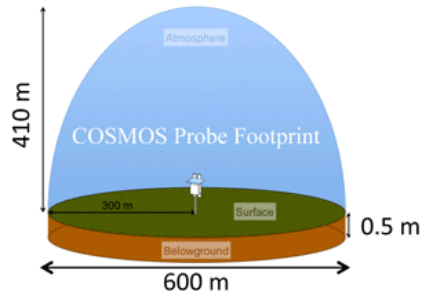




- █ MFC2 area
- █ Drainage divide
- █ Creek
- △ Cosmic Ray probe
- SoilNet units

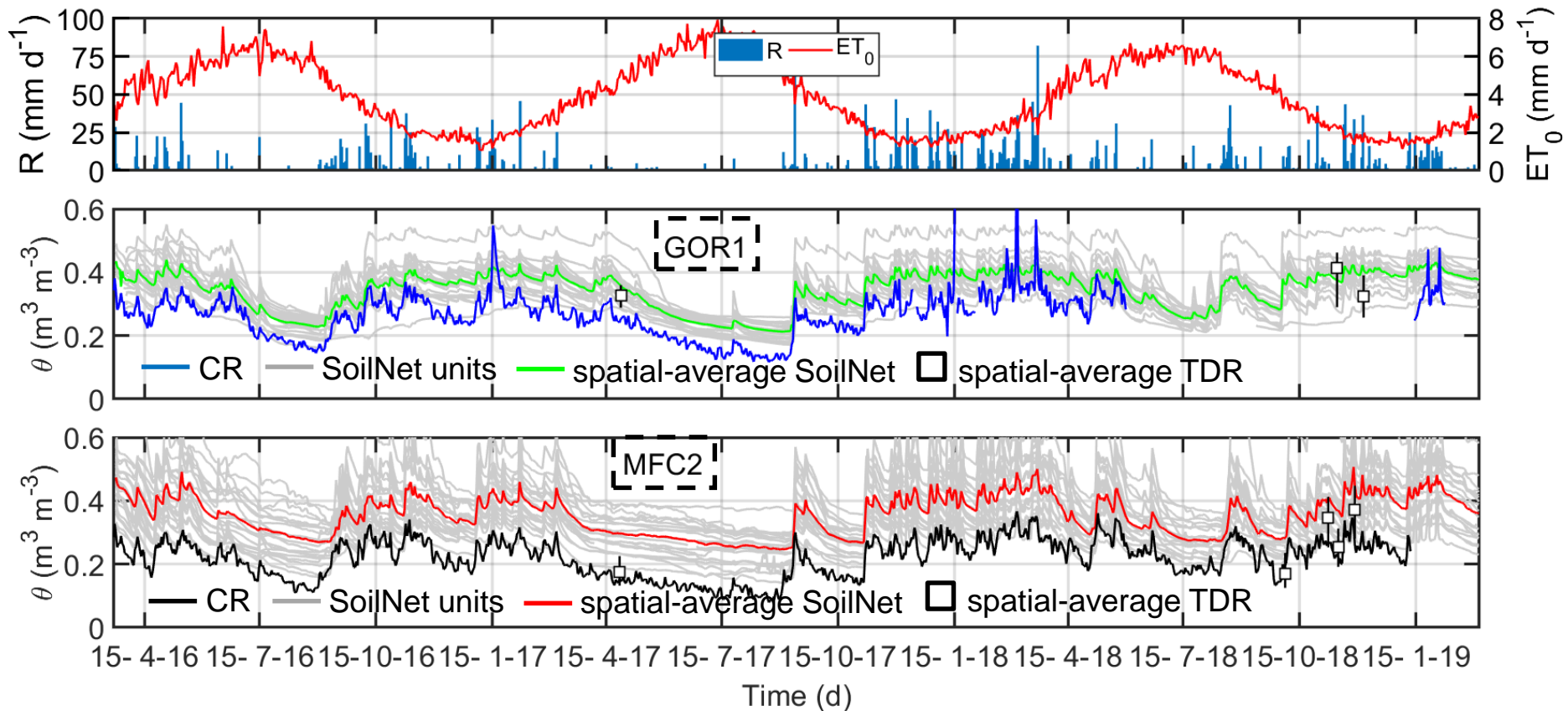
Romano et al., VZJ 2018

monitoring systems at GOR1 sub-catchment



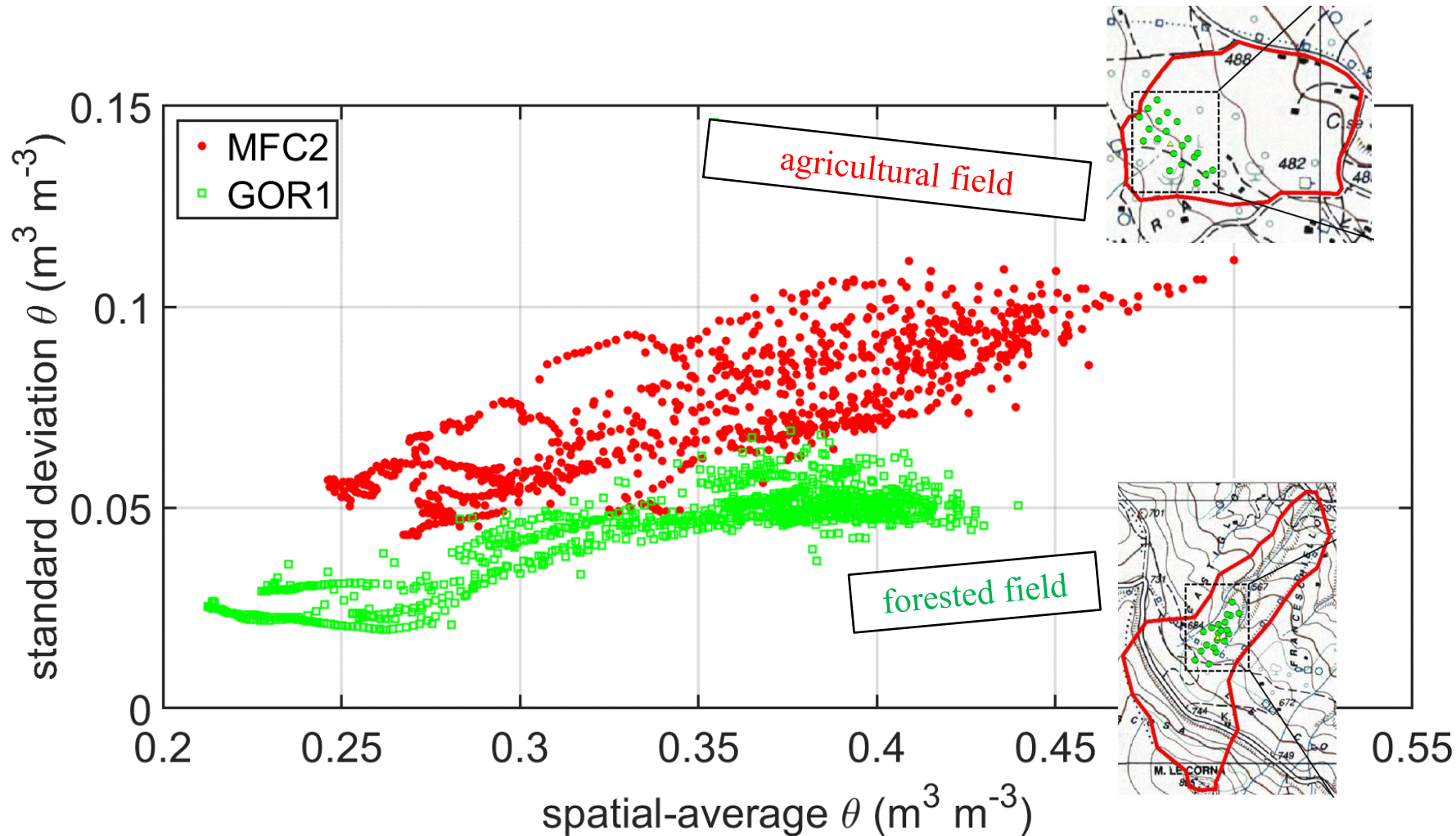
Romano et al., VZJ 2018

Soil moisture (SM) measurements by TDR, sensor net, and cosmic-ray probe at **GOR1** and **MFC2** sub-catchments.



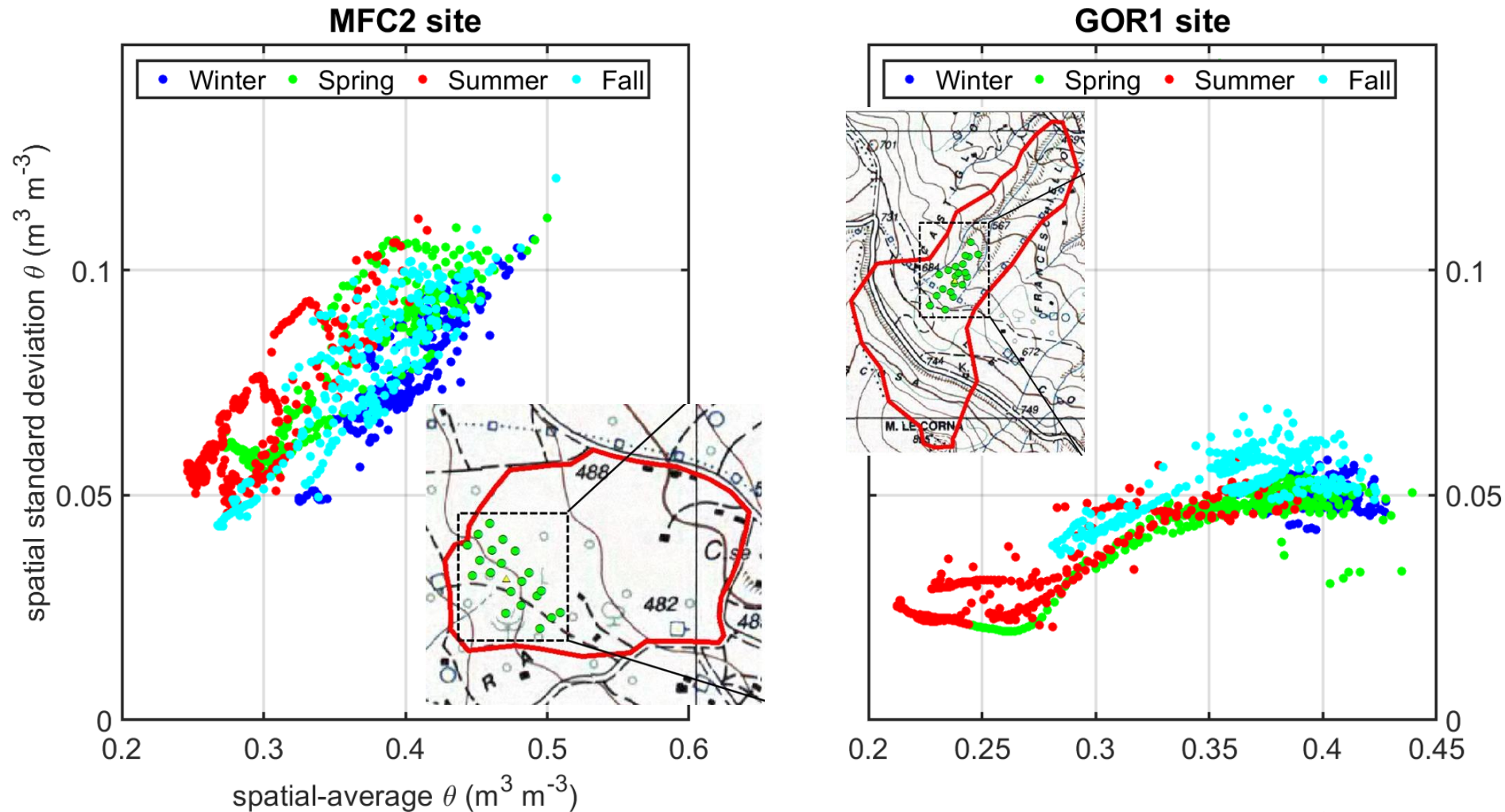
Romano et al., VZJ 2018

Relationship between spatial-average and standard deviation of soil moisture at **MFC2** and **GOR1** sub-catchments



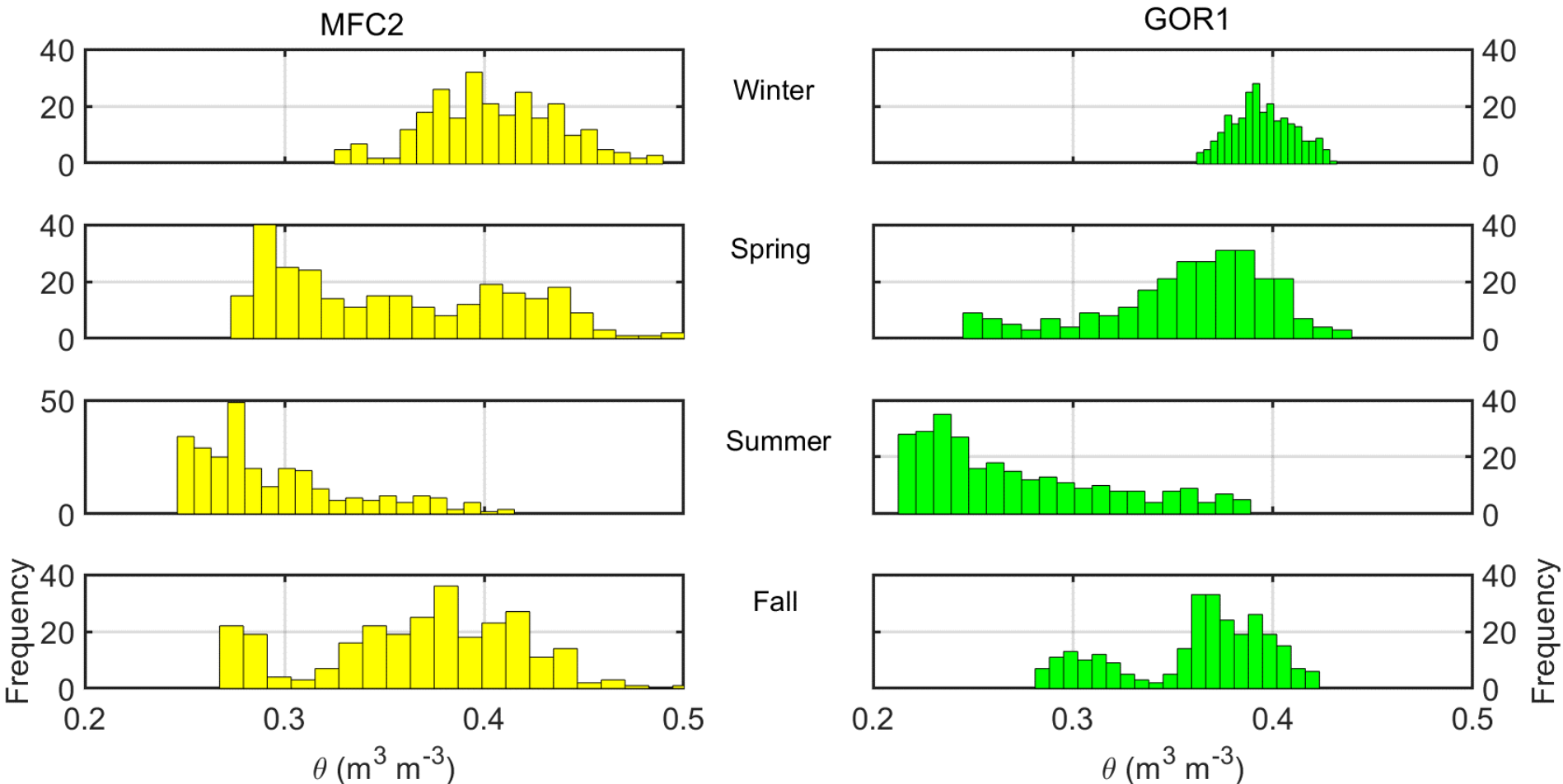
Romano et al., VZJ 2018

Seasonal relationship between spatial-average and standard deviation soil moisture (sensor net) at MFC2 and GOR1



Romano et al., VZJ 2018

Comparisons among seasonal PDFs of spatial-average soil moisture at **MFC2** and **GOR1** sub-catchments



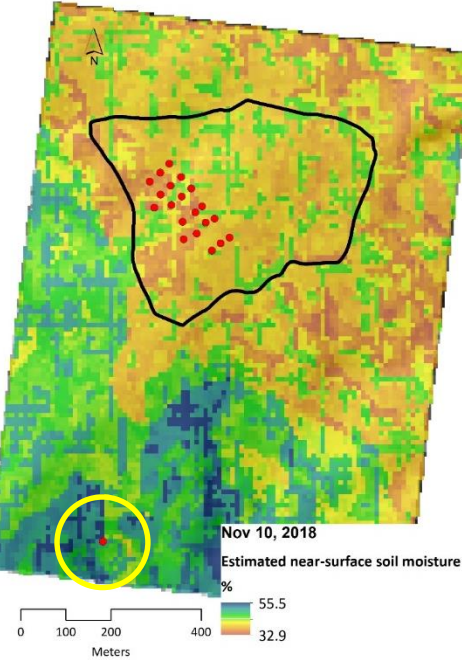
Romano et al., VZJ 2018

Nov 10, 2018

Nov 16, 2018

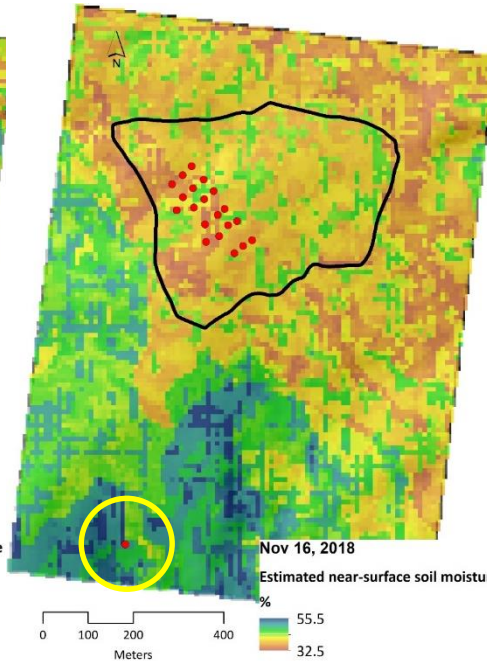
Nov 22, 2018

Nov 28, 2018



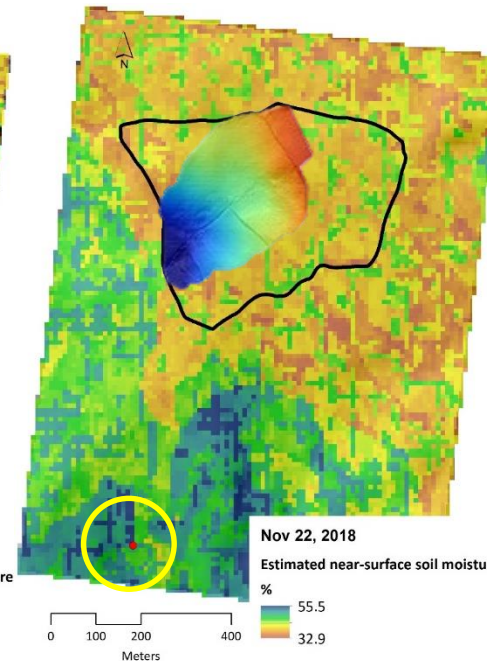
Nov 10, 2018
Estimated near-surface soil moisture %
55.5
32.9

Average = 41.99%, Std dev. = 4.39%



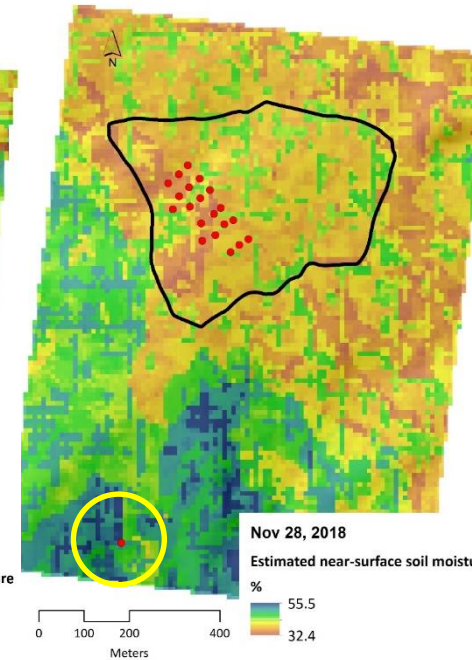
Nov 16, 2018
Estimated near-surface soil moisture %
55.5
32.5

Average = 41.61%, Std dev. = 4.54%



Nov 22, 2018
Estimated near-surface soil moisture %
55.5
32.9




Average = 41.96%, Std dev. = 4.42%



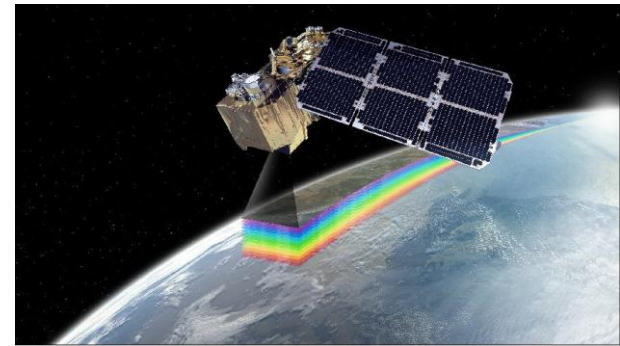
Nov 28, 2018
Estimated near-surface soil moisture %
55.5
32.4

Average = 41.60%, Std dev. = 4.63%

- High spatial-temporal near-surface soil moisture mapping (~ 5 cm) → time series
- Shown are estimated soil moisture maps for four different sensor dates (each at satellite overpass in the morning, **ascending** (e.g., S1A_a44, S1B_a44,): **04:51:01 pm – 05:04:48 pm**)
- The observation period refers to the soil moisture field campaign by the Master student
- Mapping algorithm is **random forest**. Please consider that analysis is **not final**
- Spatial resolution is 10 m (based on SAR C-band, Sentinel-1)

-  MFC2 catchment
-  Agriturismo Tre Morene (Luigi's place)
-  Soil moisture monitoring plots

- To continue field surveys with additional soil sampling and isotopic campaigns (soil and vegetation).
- Installing ground-based sensor-networks in other parts of the Alento River Basin
- Visible and near infrared spectroscopy (from UASs) for developing PTFs.
- Integrating ground-based (wireless sensor networks, cosmic-ray probes) with remote-based (Sentinel 1-2) measurements of soil moisture.
- Sharing our dataset to compare the Alento observatory with other observatories across Europe.





Water JPI

Site1. Twente, NL
Temperate, Dry Winter, Hot Summer
Site2. Zala, HU
Cold, Humid, Warm Summer
Site3. Alento, IT
Temperate, Dry Hot Summer
Site4. Corleto, IT
Temperate, Dry Warm Summer
Site5. Barranco del Carraixet, ES
Arid, Steppe, Cold
Site6. Haogen, IL
Arid, Dry Hot Summer

