

A novel combined approach for bridging scales in spatiotemporal soil moisture monitoring applying metrological principles

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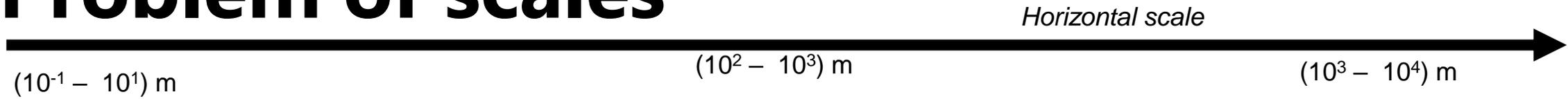


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Problem of scales



Point-scale *in situ* measurements



[<https://soilsensor.com>]

- Invasive, affected by immediate surrounding
- Sensor networks → maintenance & repair costs

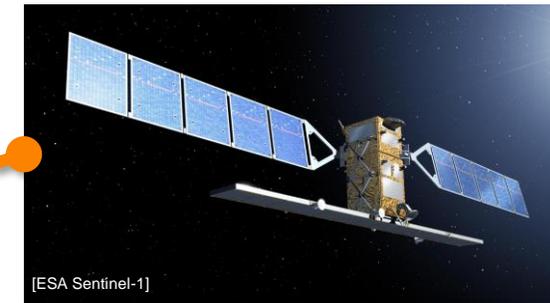
→ Need for harmonization of methods

→ Need for metrological transfer standards

Cosmic-ray neutron sensing (CRNS)



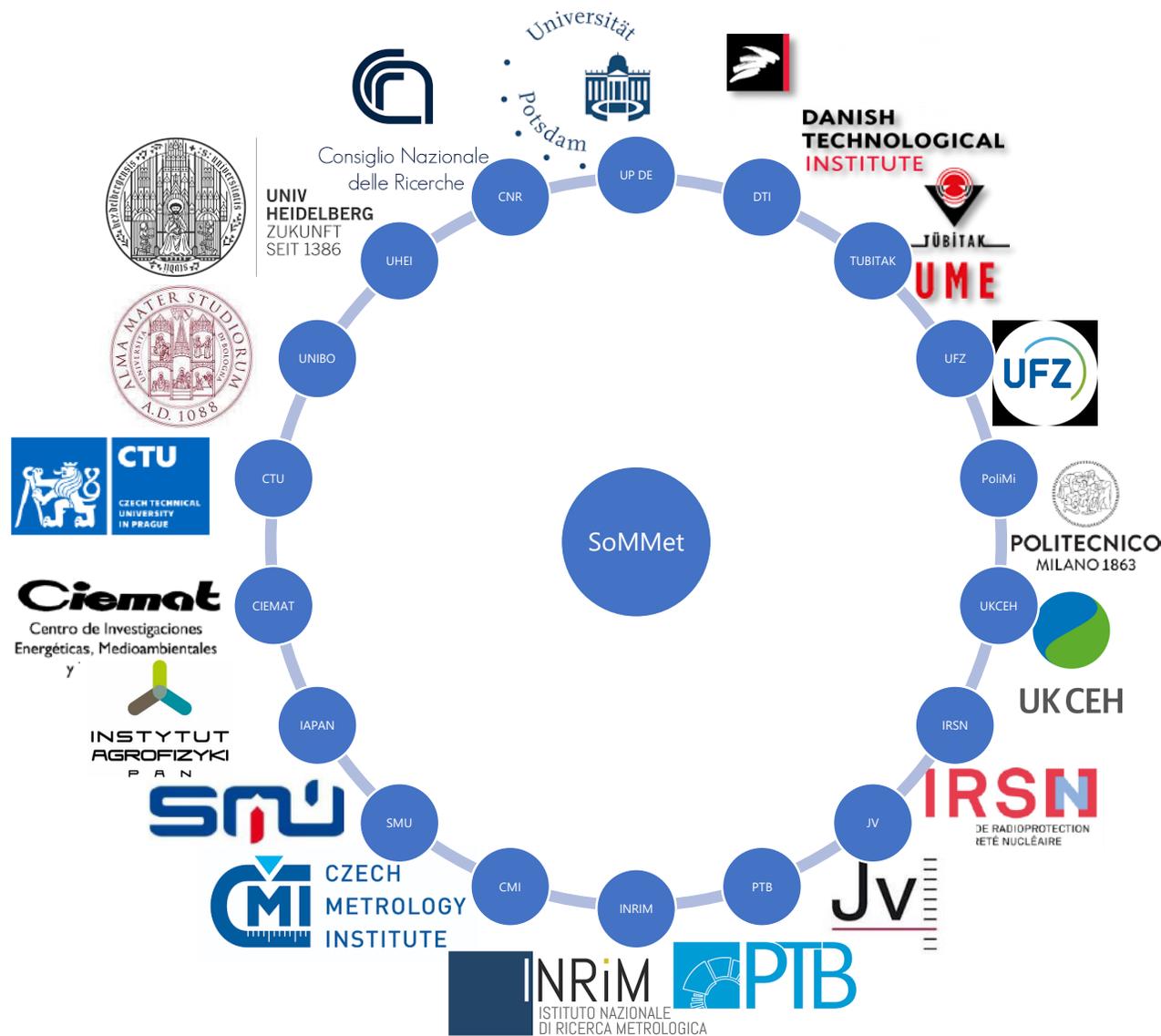
Satellite remote sensing



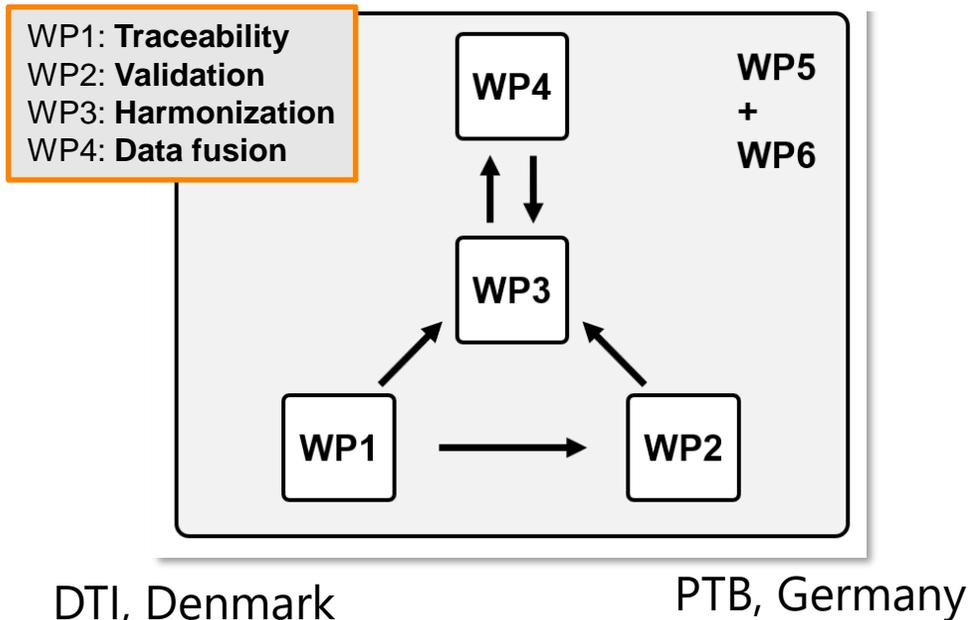
- Only topmost soil layer (5 cm)
 - Validation practices based on point-scale data
- Need for effective, representative ground-based methods

SoMMet

„...develop novel metrological tools and establish a **metrological foundation** for soil moisture measurements on **multiple lateral scales**, ranging from decimetre to kilometre, ensuring the **traceability** and **harmonisation** of the various soil moisture measurement methods.“



Metrological principles



• Traceability chain

- Primary and secondary transfer standard for point scale calibration
- Traceability across scales from the lab to the outdoors

• Metrology of neutron radiation

- Response function modelling
- Validation of multiple CRNS probes in the lab (neutron fields)
- Validation with Bonner Spheres (outdoors)

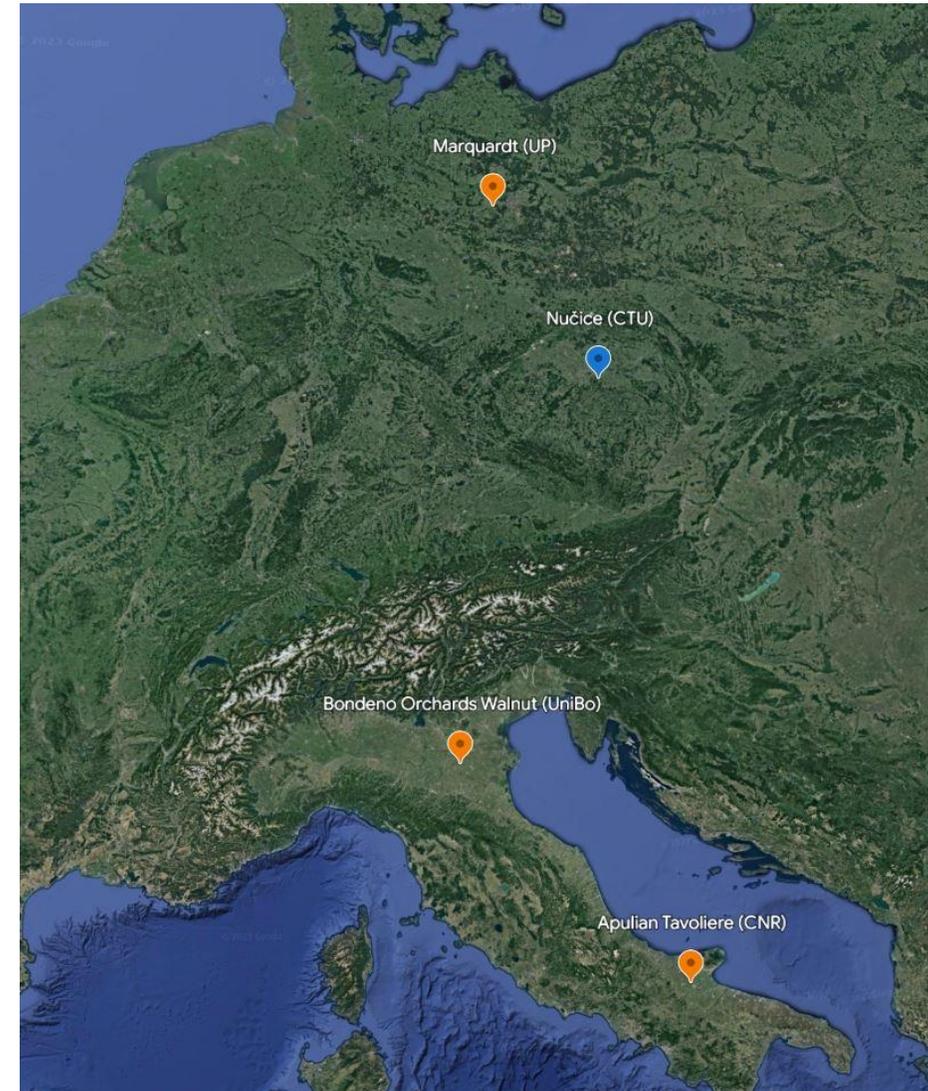
→ Improvements in CRNS usage

- Metrologically traceable calibration
 - Standardised estimates of uncertainty
- Comparability of CRNS



Test sites in SoMMet

- Three high level test sites:
 - Marquardt
 - Bondeno Orchards
 - Apulian Tavoliere
- Three measurement scales
- North-south gradient



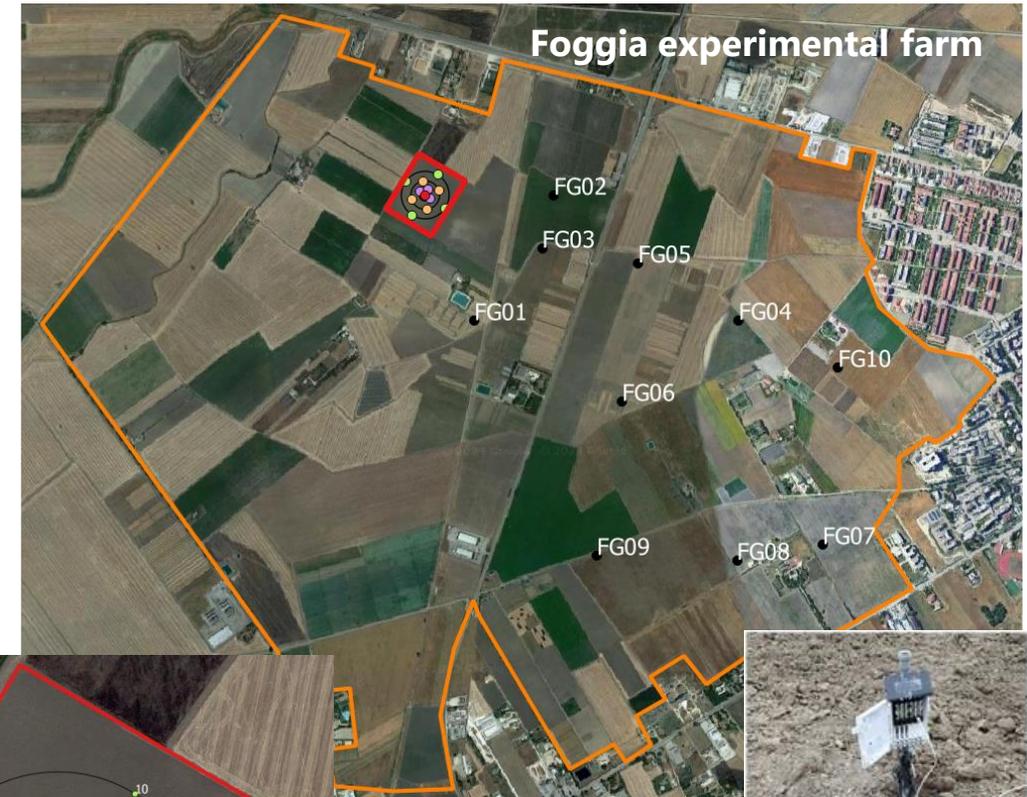
Apulian Tavoliere

General site info:

- Experimental Farm
- Durum wheat/tomatoes
- Extend: $\sim 3\text{km}^2$ (flat)
- Clay loam

- 530mm mean precipitation
- 15.8°C mean temperature

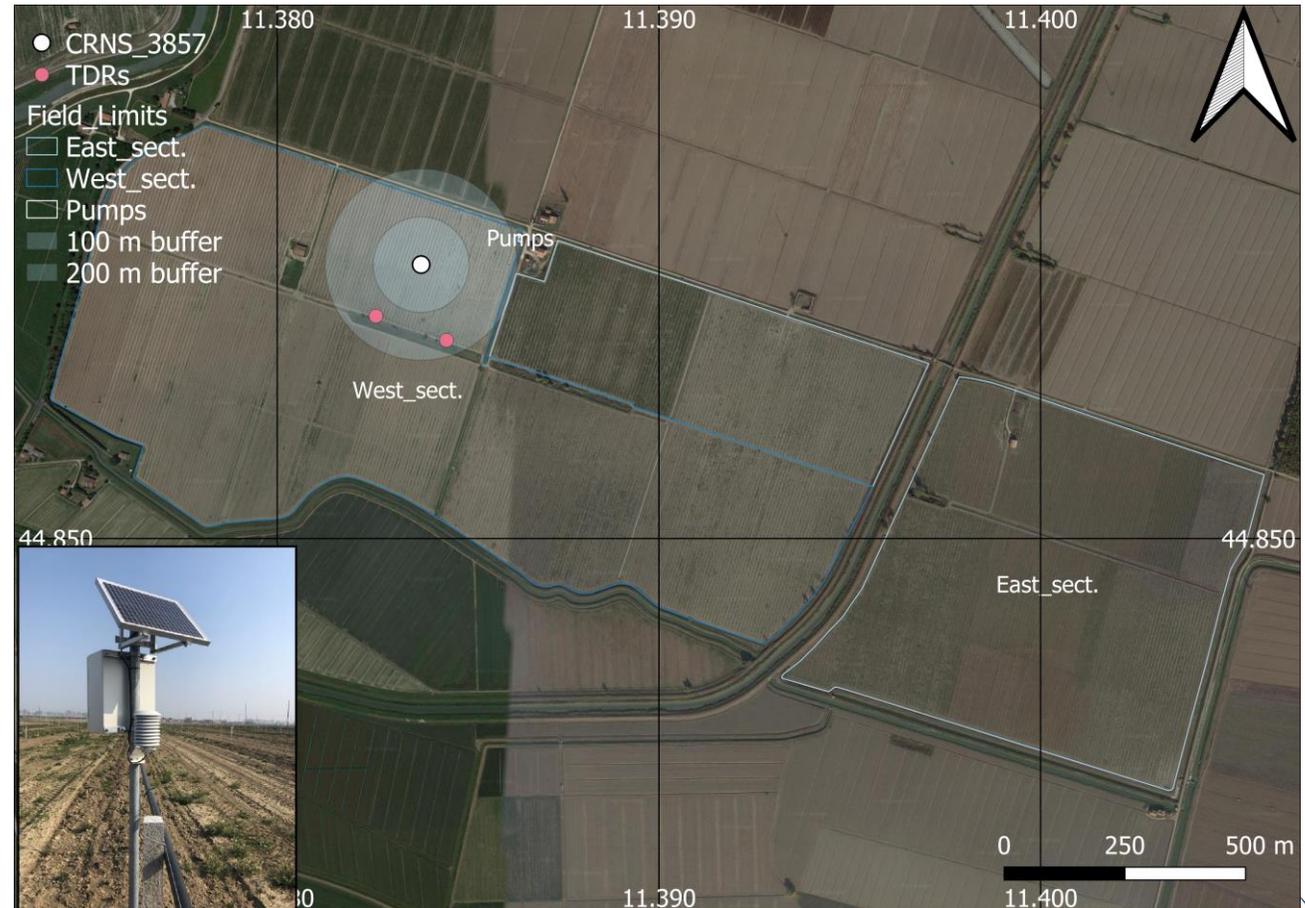
- 13 point scale sensors
- 1 CRNS (with multiple energy spectra)
- Well established remote sensing site



Bondeno Walnut Orchards

General site info:

- Irrigated walnut orchard
- Extend: $\sim 1.5\text{km}^2$ (flat)
- Clay loam
- 600mm mean precipitation
- 14°C mean temperature
- 1 CRNS and a few point scale sensors
- Regular manual TDR surveys



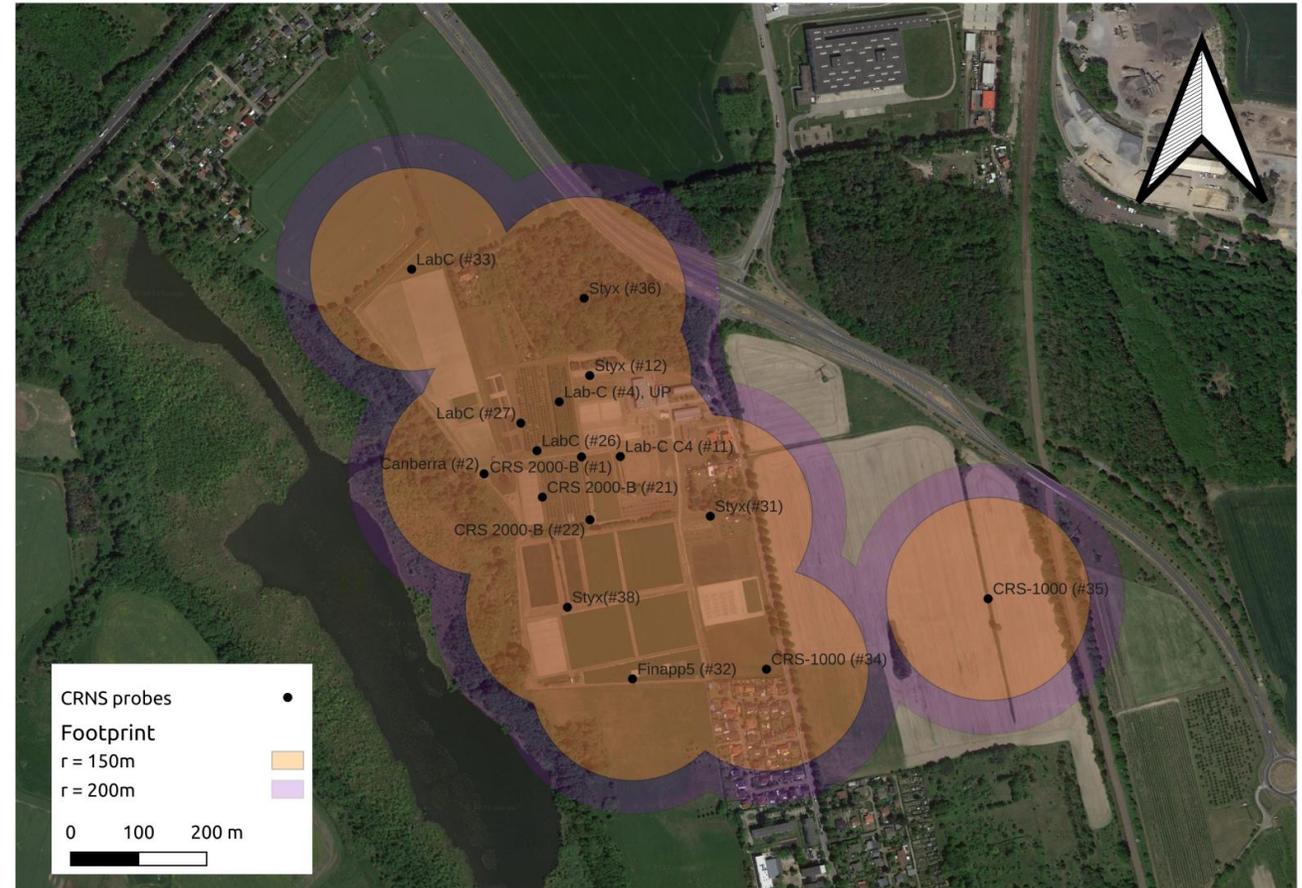
Marquardt

General site info:

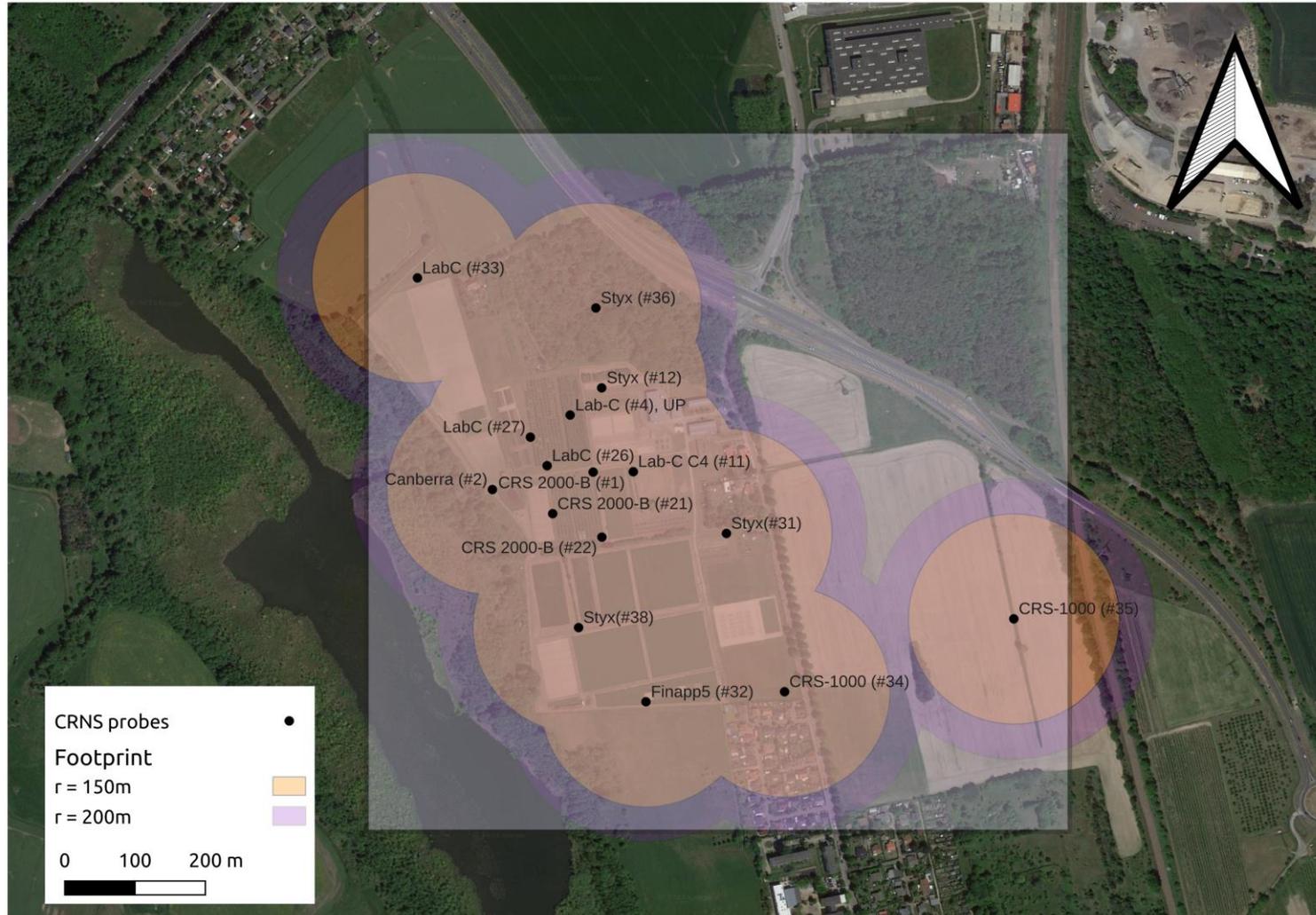
- Agricultural research site
- mixed land use
- Extend: $\sim 0.6\text{km}^2$ (slightly sloped)
- Loamy sand

- 580mm mean precipitation
- 10°C mean temperature

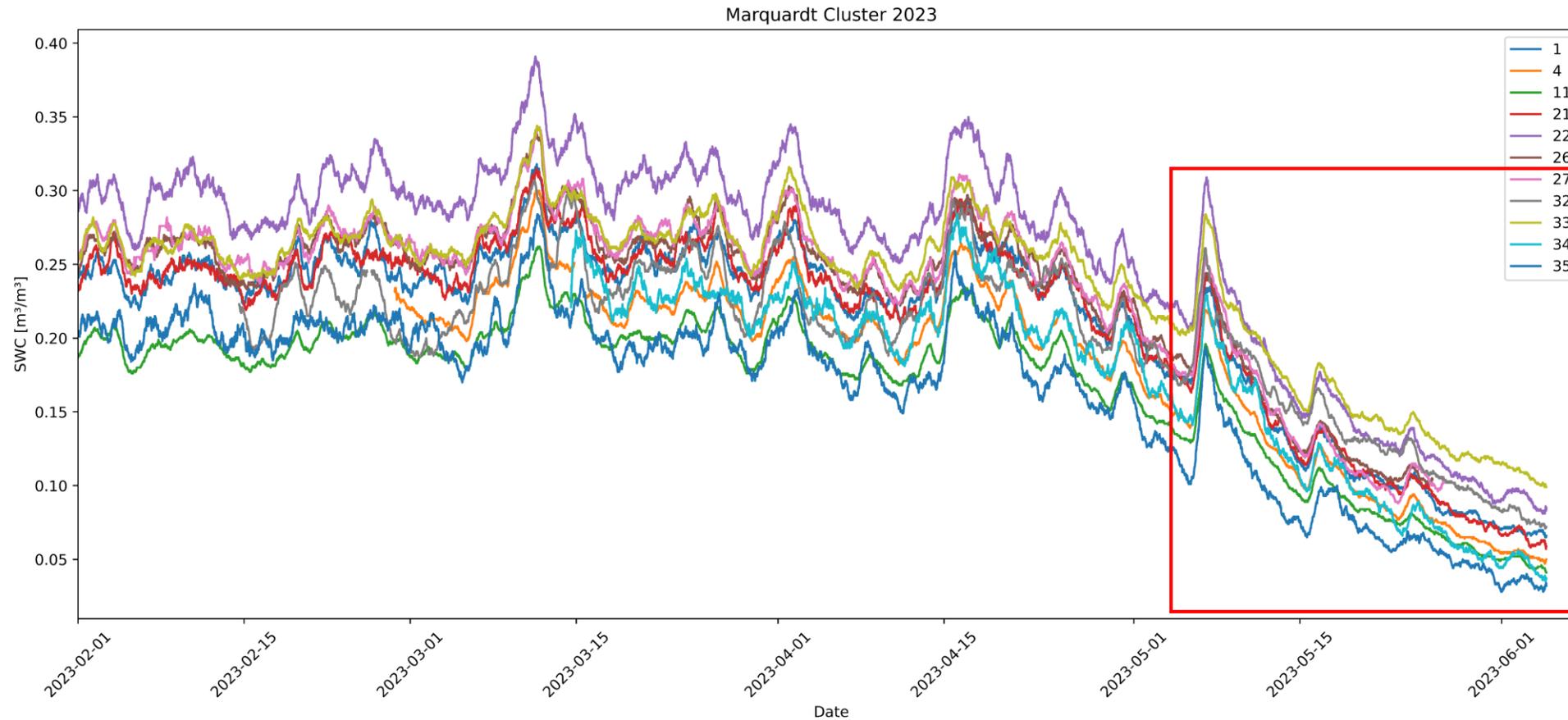
- 15 CRNS
- 27 point scale profiles (10 – 200cm)



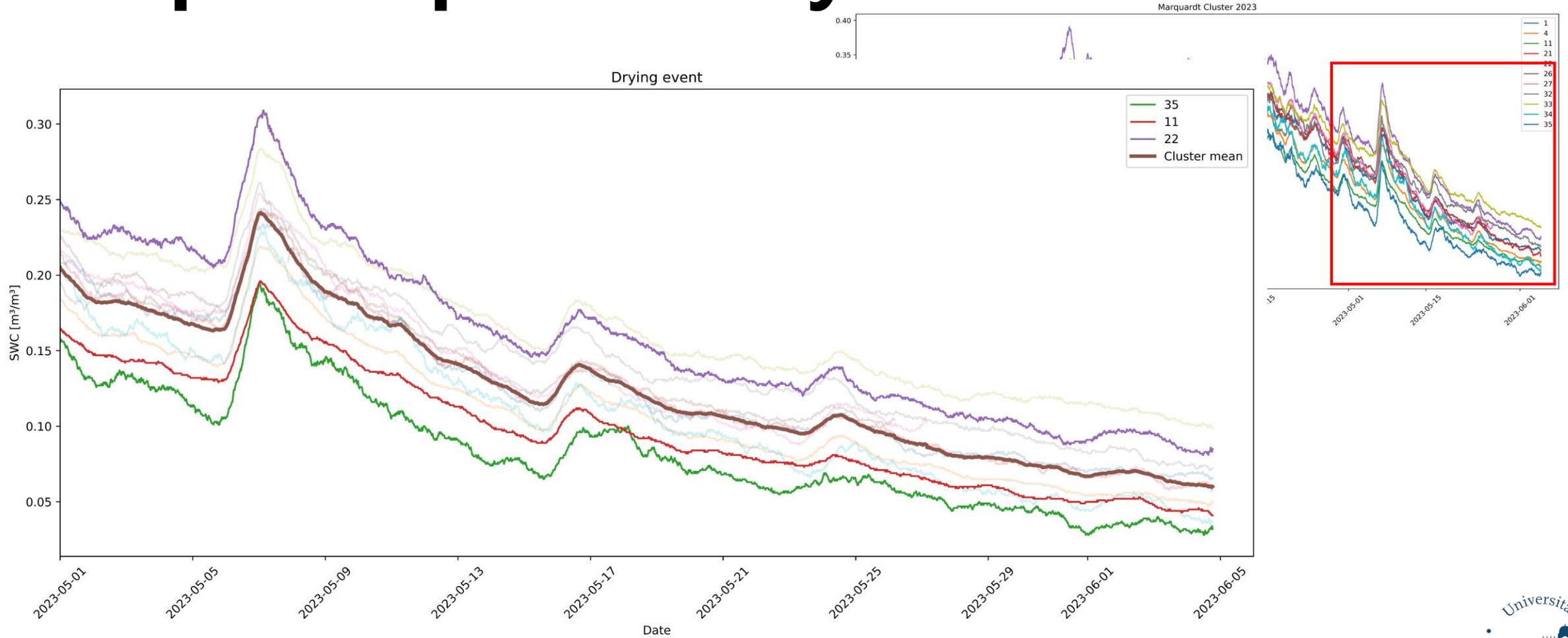
Marquardt's new cluster design



Marquardt: preliminary results



Marquardt: preliminary results



Thank you!

- Follow the project progress at: **sommet-project.eu**

