

Metrology for multi-scale monitoring of soil moisture

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Introduction

Soil moisture is an Essential Climate Variable (ECV), and a key resource influencing agriculture, forestry, groundwater recharge, weather, climate, and greenhouse gas emissions. Several soil moisture observation systems exist on multiple scales, **but they need to be harmonised**.

Needs for metrology

- Need for reliable, intercomparable and interoperable soil moisture data across different horizontal and temporal scales, models, and communities → Traceable data with reliable uncertainties!

Point scale (sensors)

- Need for harmonisation of measurement methods
- Need for traceable transfer standards

Intermediate scale (CRNS)

- Need for metrology foundation for the cosmic-ray neutron sensing method (CRNS)
 - Metrology of neutron radiation
 - Metrology of temperature and moisture

Large scale (remote sensing)

- Need for effective, representative ground-based methods

Project SoMMet: Soil Moisture Metrology (2022 – 2025)

- Interdisciplinary team, 9 NMI/DI's and 9 research institutions
- Novel methodology for calibration of point-scale soil moisture measurement devices
- New traceability scheme and validation practices for CRNS method
- Good practice guides: calibration practices in outdoor field conditions, harmonisation and data fusion of soil moisture on multiple scales

Calibration establishes traceability which in turn improves comparability of different methods across scales.

Point-scale *in situ* measurements



[<https://soilsensor.com>]

(10⁻¹ – 10¹) m

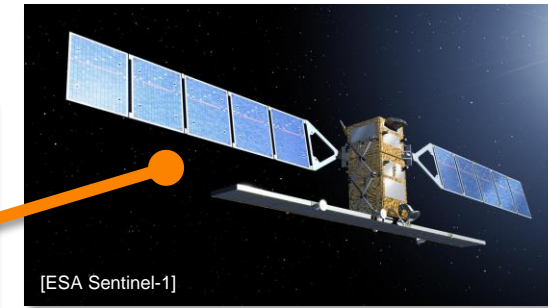
Cosmic-ray neutron sensing



[M. Schrön, PhD Thesis Uni Potsdam]

(10² – 10³) m

Satellite remote sensing



[ESA Sentinel-1]

(10³ – 10⁴) m

Impacts and opportunities

- Improved performance, interoperability and increased uptake of soil moisture measurement devices
- Increased use of soil moisture data for monitoring and modelling, thanks to their better understood uncertainties
- Collaboration with other projects, networks, manufacturers, researchers dealing with soil moisture observations

The project **21GRD08 SoMMet** has received funding from the European Partnership on Metrology, co-financed by the European Union's Horizon Europe Research and Innovation Programme and by the Participating States.