



L'INRiM a Matera:

Ricerca metrologica
e servizi per il territorio

Methods for Measuring Soil Moisture

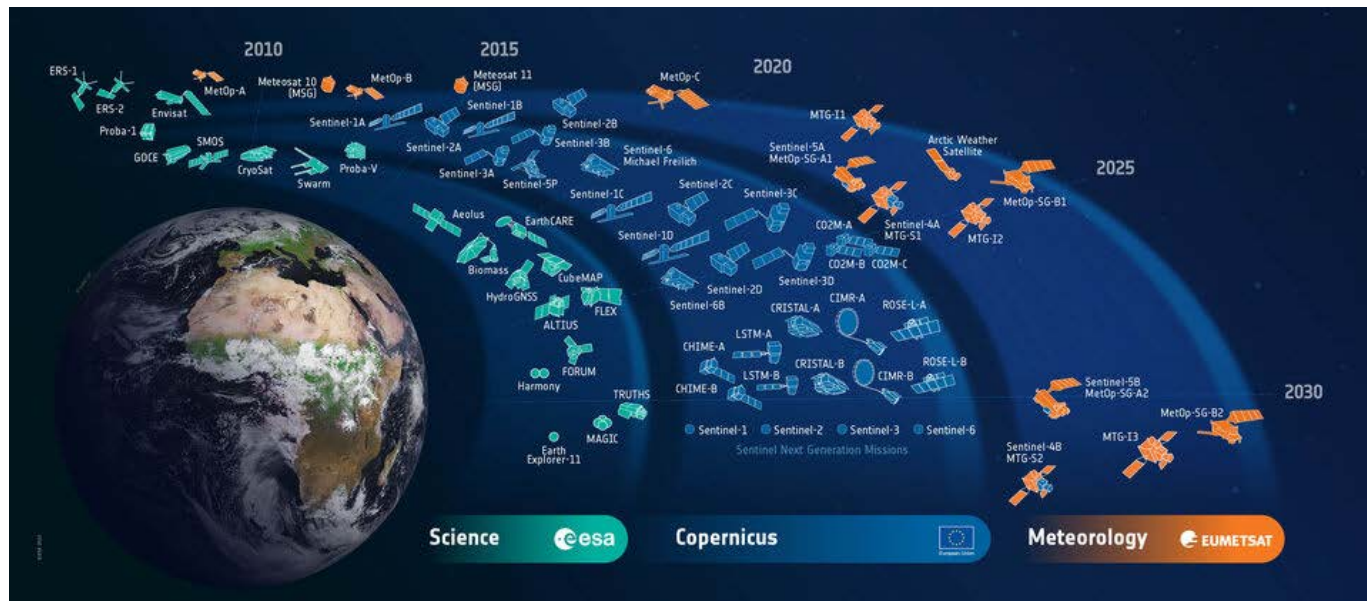
Anna Balenzano

Consiglio Nazionale delle Ricerche (CNR)
Istituto per il Rilevamento Elettromagnetico
dell'Ambiente (IREA), Bari



I dati di Osservazione della Terra (OT)

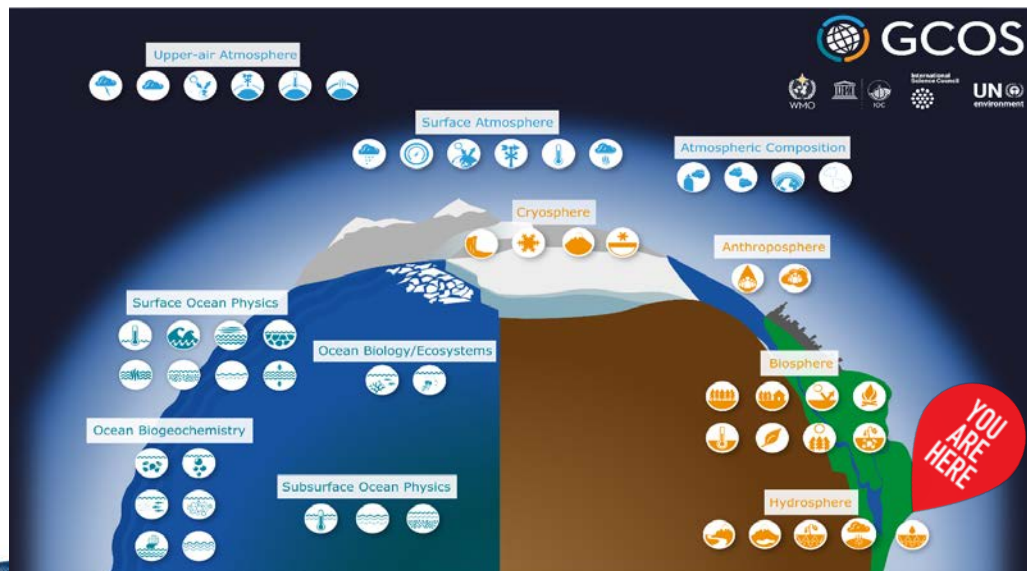
I dati **OT** sono acquisiti dalle costellazioni di satelliti orbitanti intorno la Terra



Le missioni OT dell'Agenzia Spaziale Europea (ESA)

Il monitoraggio ambientale con i dati OT

Variabili climatiche essenziali



I dati **OT** sono utilizzati per misurare le **variabili climatiche essenziali**.

Tra quelle relative alla **idrosfera** vi è:

☐ l'umidità del suolo (SM) 

CREDIT

WMO Global Climate Observing System

Umidità del suolo

Che cos'è?

Quantità di acqua presente nei pori del terreno [m^3/m^3].



Perché è importante?

Controlla lo scambio di acqua e energia tra la superficie terrestre e l'atmosfera, è fondamentale per il benessere delle piante (sicurezza idrica e alimentare), gioca un ruolo importante negli eventi estremi (inondazioni, siccità), ecc.



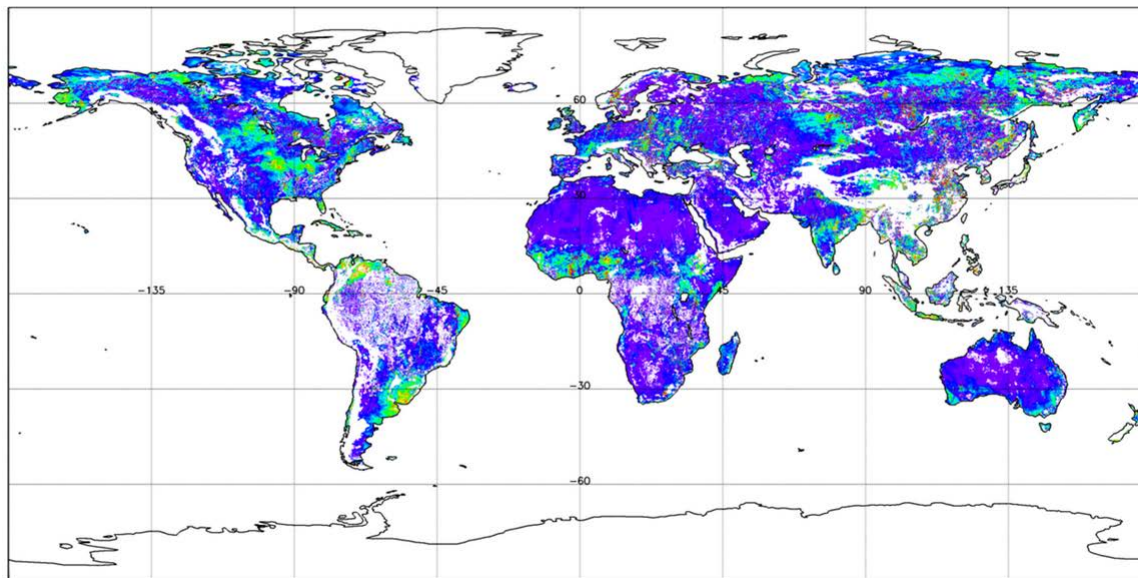
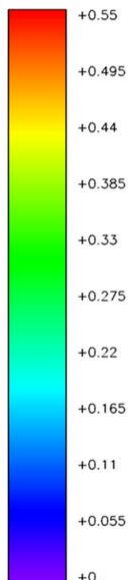
Prima mappa globale di SM dalla missione ESA SMOS



MIR_SMUDP2 - Soil_Moisture (m³m⁻³) - 20100620T001100 - 20100623T004816

Cylindrical projection - 87 product(s) - Generated on 20100624T193111

Orbits: All - Fill value: -999.0



SMOS Global Mapping Tool v2.4

20-23/06/2010

CREDIT

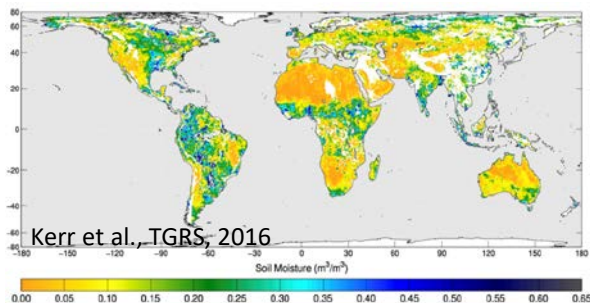
ESA - Cesium

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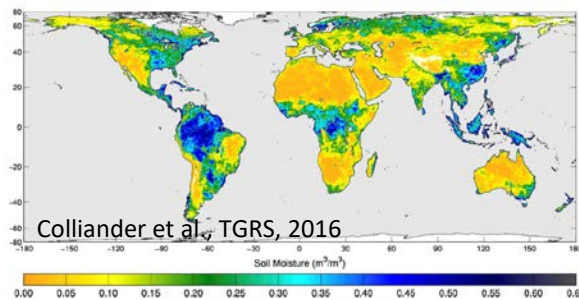


Prodotti SM operativi globali (@25-40km)

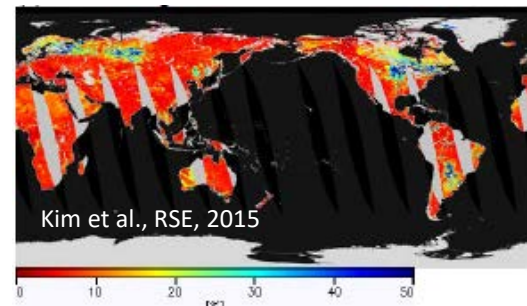
ESA/SMOS SM, 1-7/06/2015



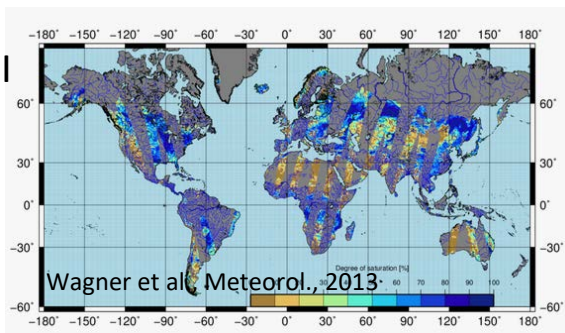
NASA/SMAP SM, 1-7/06/2015



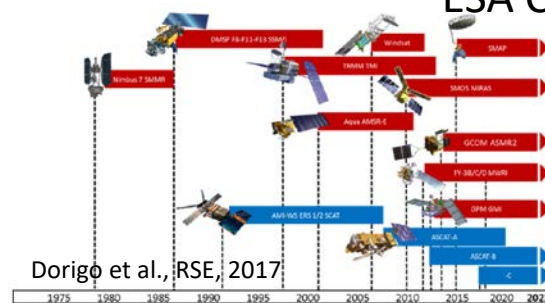
JAXA/AMRS2 SM on 20/05/13



EUMETSAT/ASCAT SWI
on 3/3/19

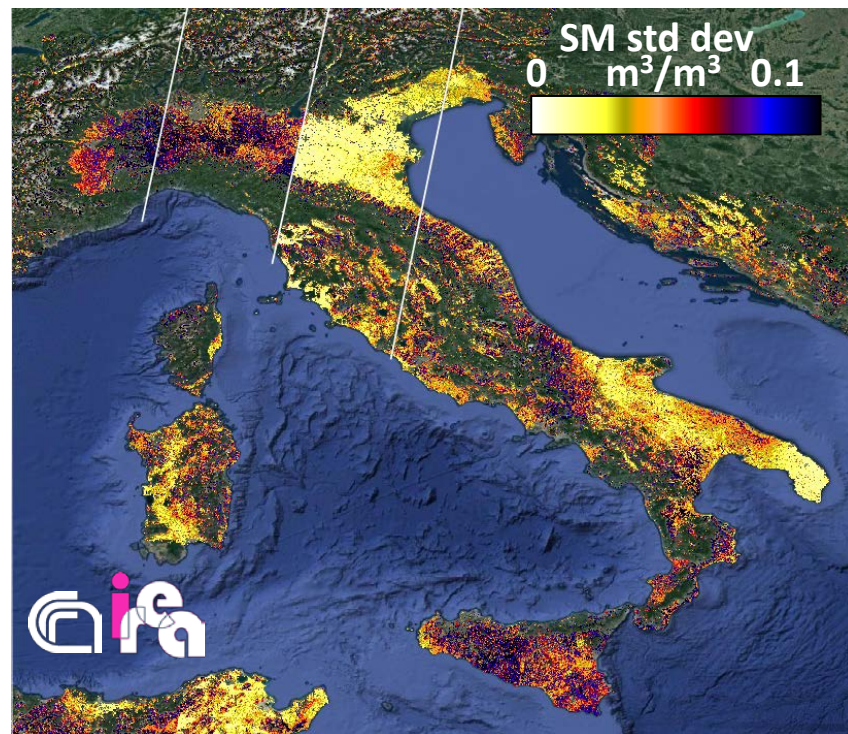
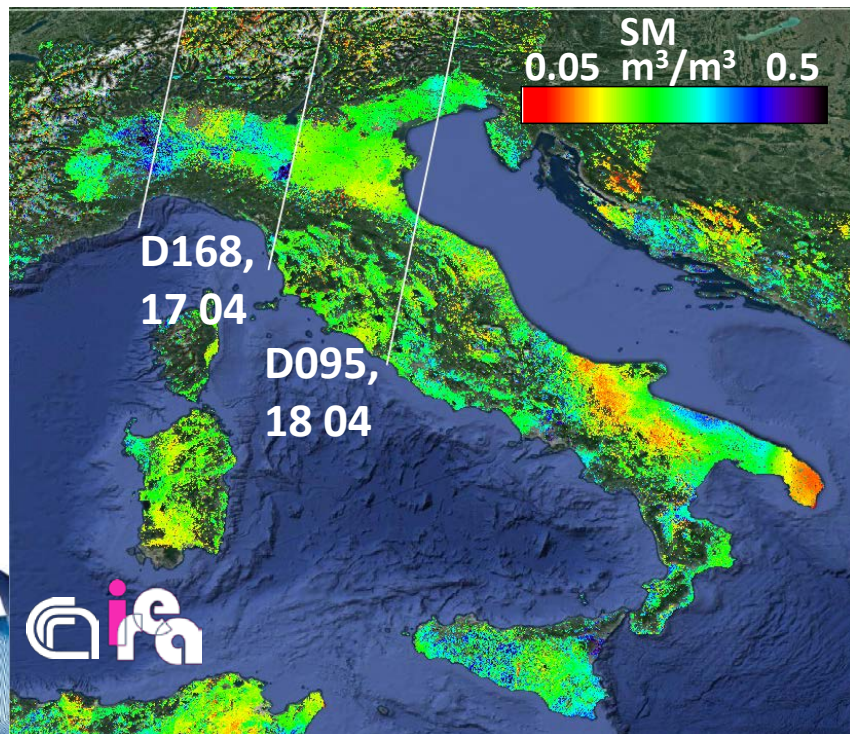


ESA CCI SM



ESA CCI soil moisture v02.1 product utilizes 5 active and 12 passive microwave sensors

SM da Copernicus SAR Sentinel-1 (@1km)



SM media e dev. st. nel periodo 14-19/04/2018

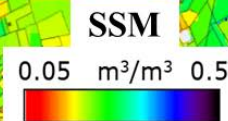
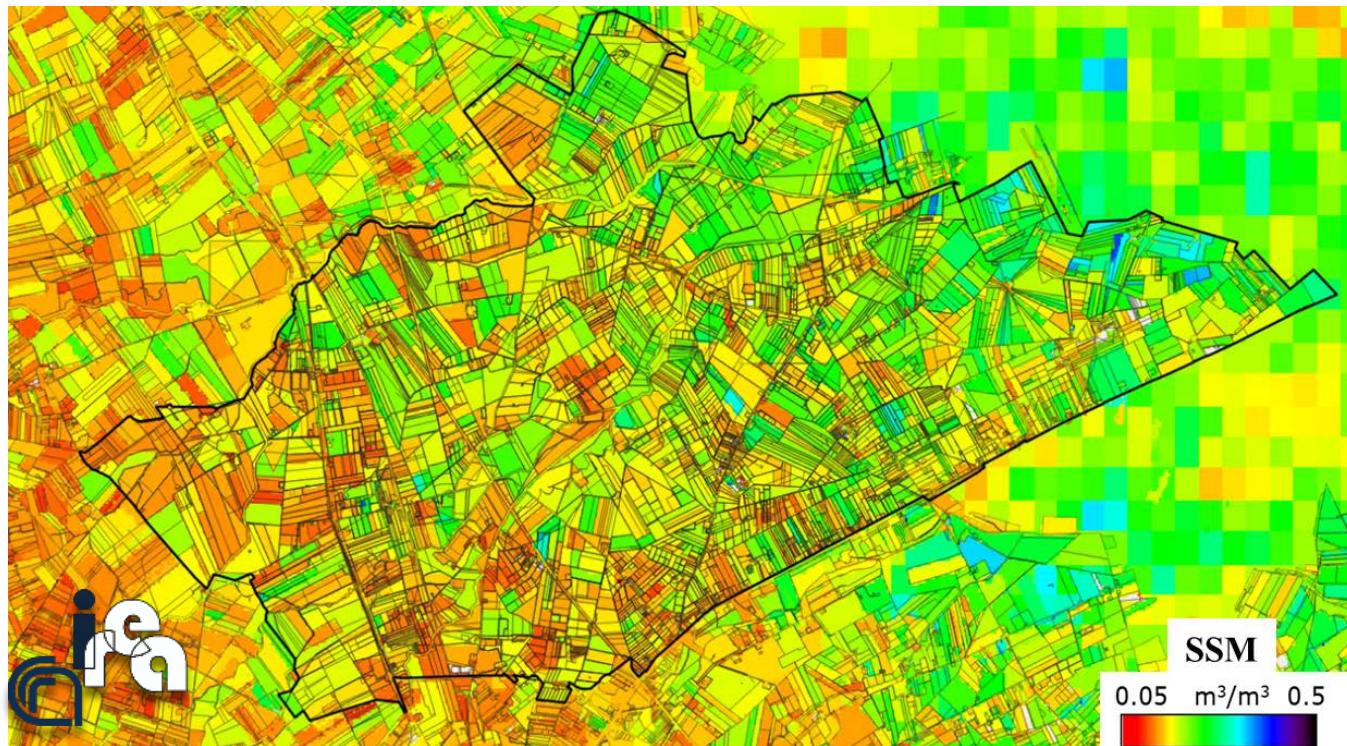
SM da Copernicus Sentinel-1&2 (@0.1km)



**Tavoliere
Pugliese**

140km²

2400 campi



SM del 14/03/2023 nel distretto irriguo servito da CBC (limiti dei campi in nero)

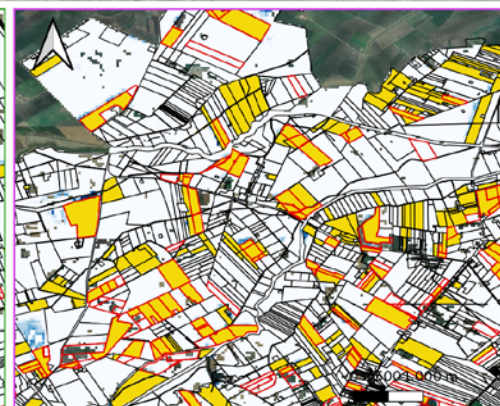


Es. applicazione: identificazione aree irrigate

**Identificazione
precoce** delle aree
irrigate prima dello
sviluppo vegetativo



Agenzia Spaziale Italiana



Aree irrigate derivate da SM del 01/05/2023.



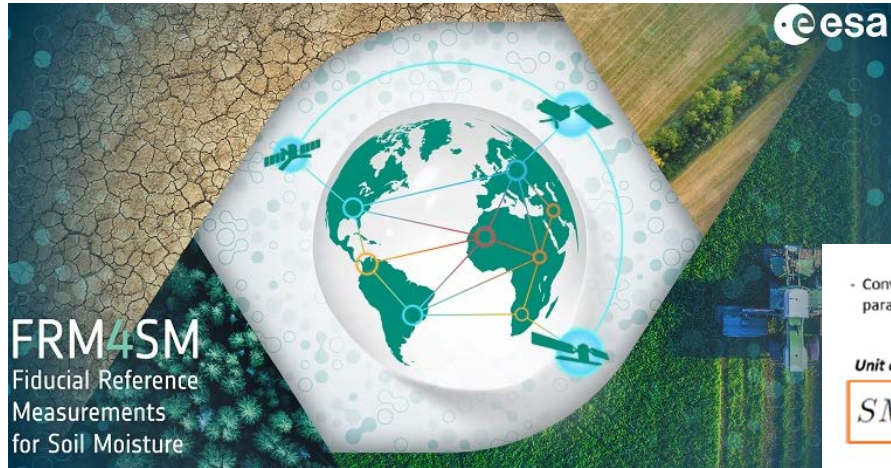
Metrology in OT



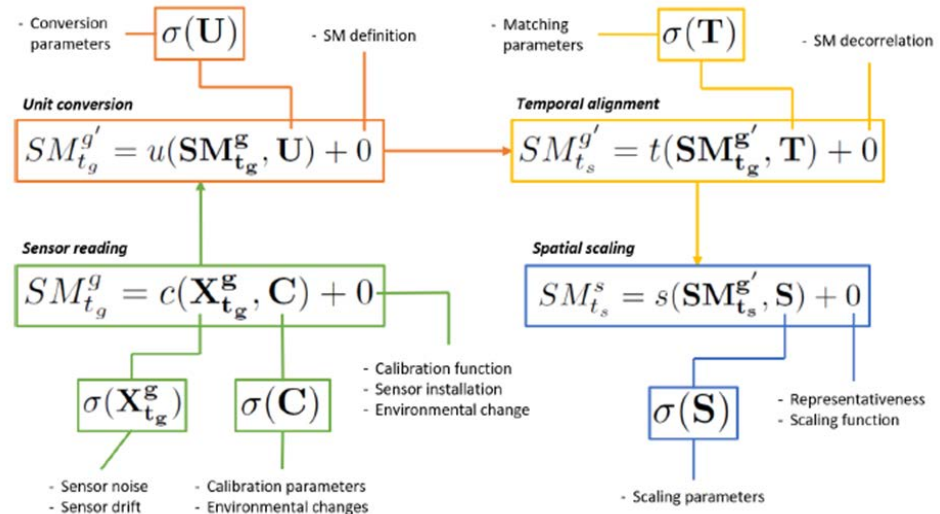
Group on Earth Observations/Committee on Earth Observation Satellites



Fiducial Reference Measurements for SM



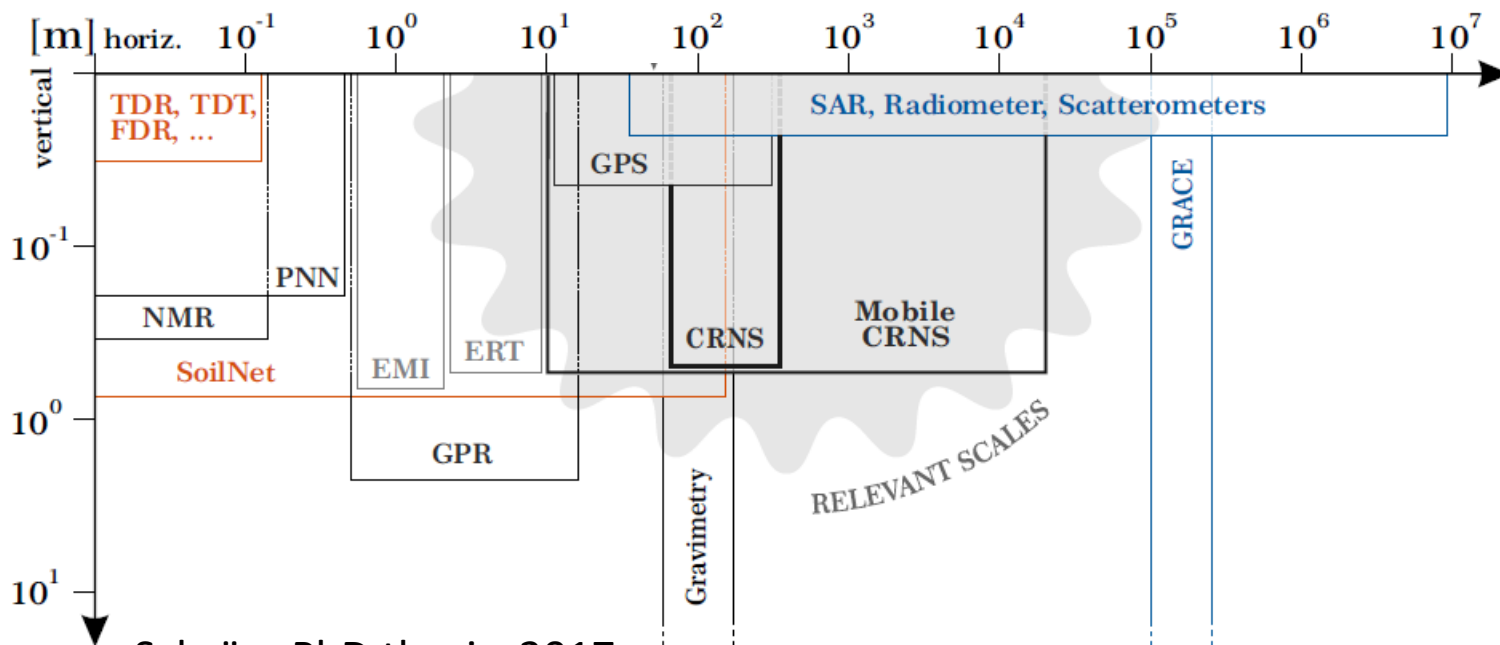
Measurand: average water content within a satellite footprint at the time of satellite passages



Himmelbauer et al., 2023

Methods of measuring

Scales of soil moisture measurements



Schrön, PhD thesis, 2017



SoMMet project: Metrology for multi-scale monitoring of soil moisture

PROJECT PARTNERS:



Coordination, Lead WP6



Lead WP1



Lead WP5



Lead WP4



Justervesenet

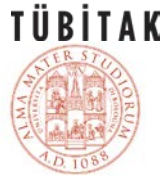


Lead WP2



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Lead WP3



POLITECNICO
MILANO 1863



UK Centre for
Ecology & Hy



INSTITUTE OF
AGROPHYSICS
PAS

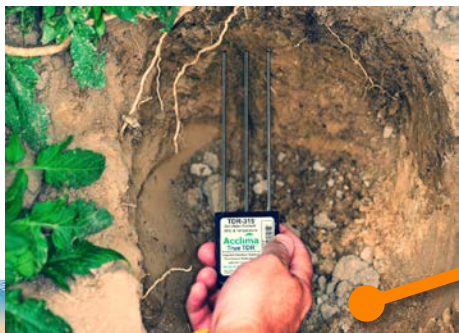


www.sommet-project.eu

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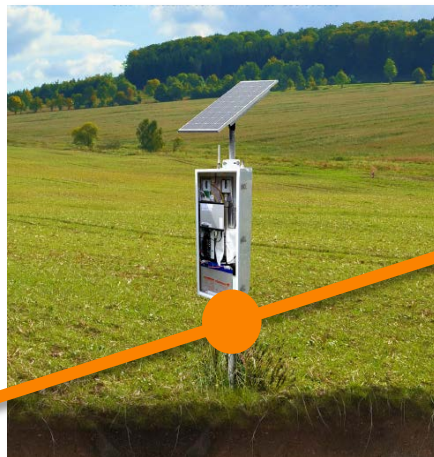
Harmonizing SM at different scales

Point scale sensor



$(10^{-1} - 10^1) \text{ m}$

Cosmic Ray
Neutron Sensor



$(10^2 - 10^3) \text{ m}$

Satellite Remote sensing



$(10^3 - 10^4) \text{ m}$



European Partnership

Co-funded by the
European Union

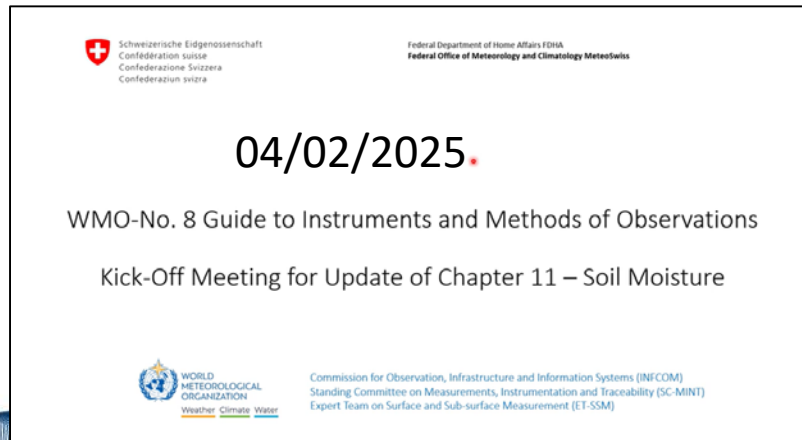
**METROLOGY
PARTNERSHIP**



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 from by the Participating States

Summary

- EO data allow for global monitoring of SM on the Earth's surface.



- The scientific and applicative interest lies in enhancing the ability to address small-scale surface SM heterogeneity and sub-daily variability.
- Collaboration among the various SM communities is needed to obtain high-quality measurements that are consistent and based on metrological standards.
- 4 Feb. 2025: KO meeting to update WMO-No. Guide 8, chapter 11- SM.



GRAZIE PER L'ATTENZIONE