The International Soil Moisture Network (ISMN): an introduction to data production for climate change sciences

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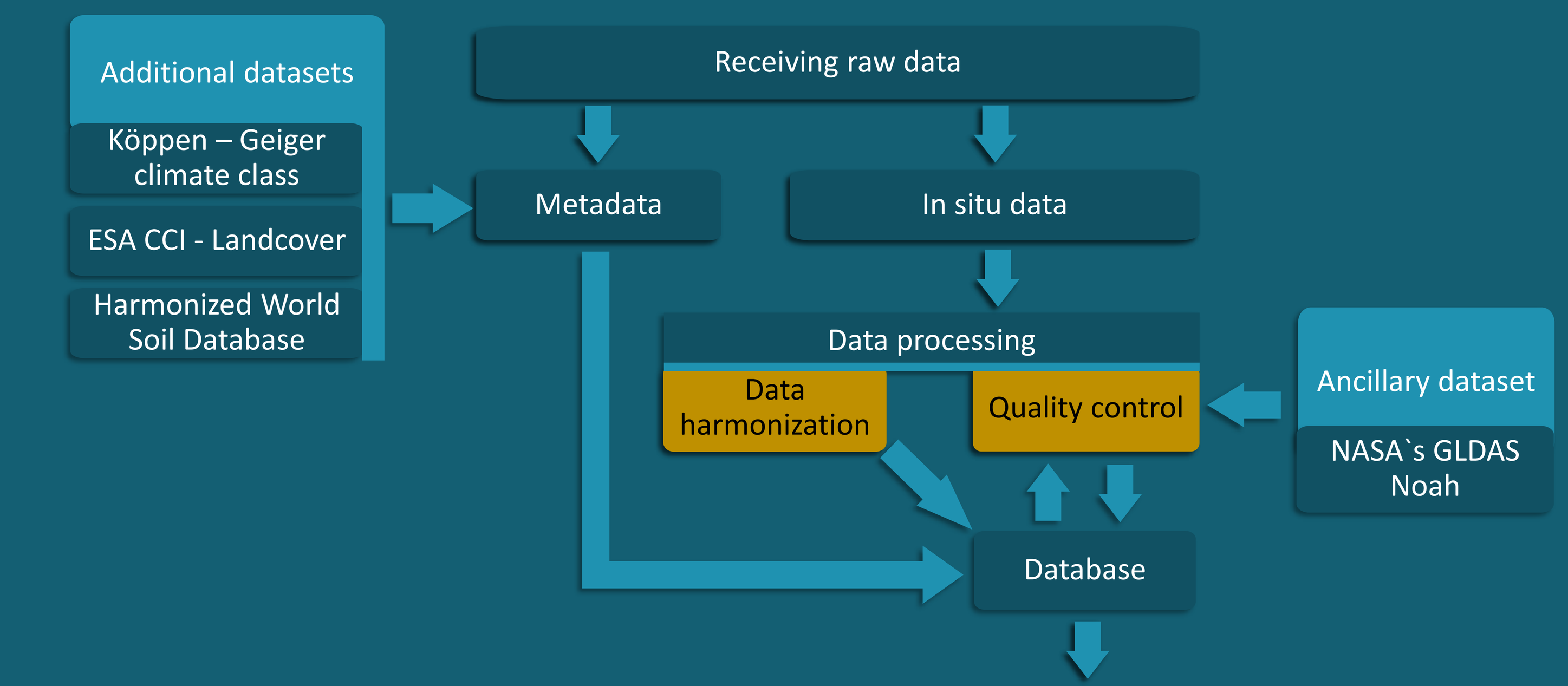
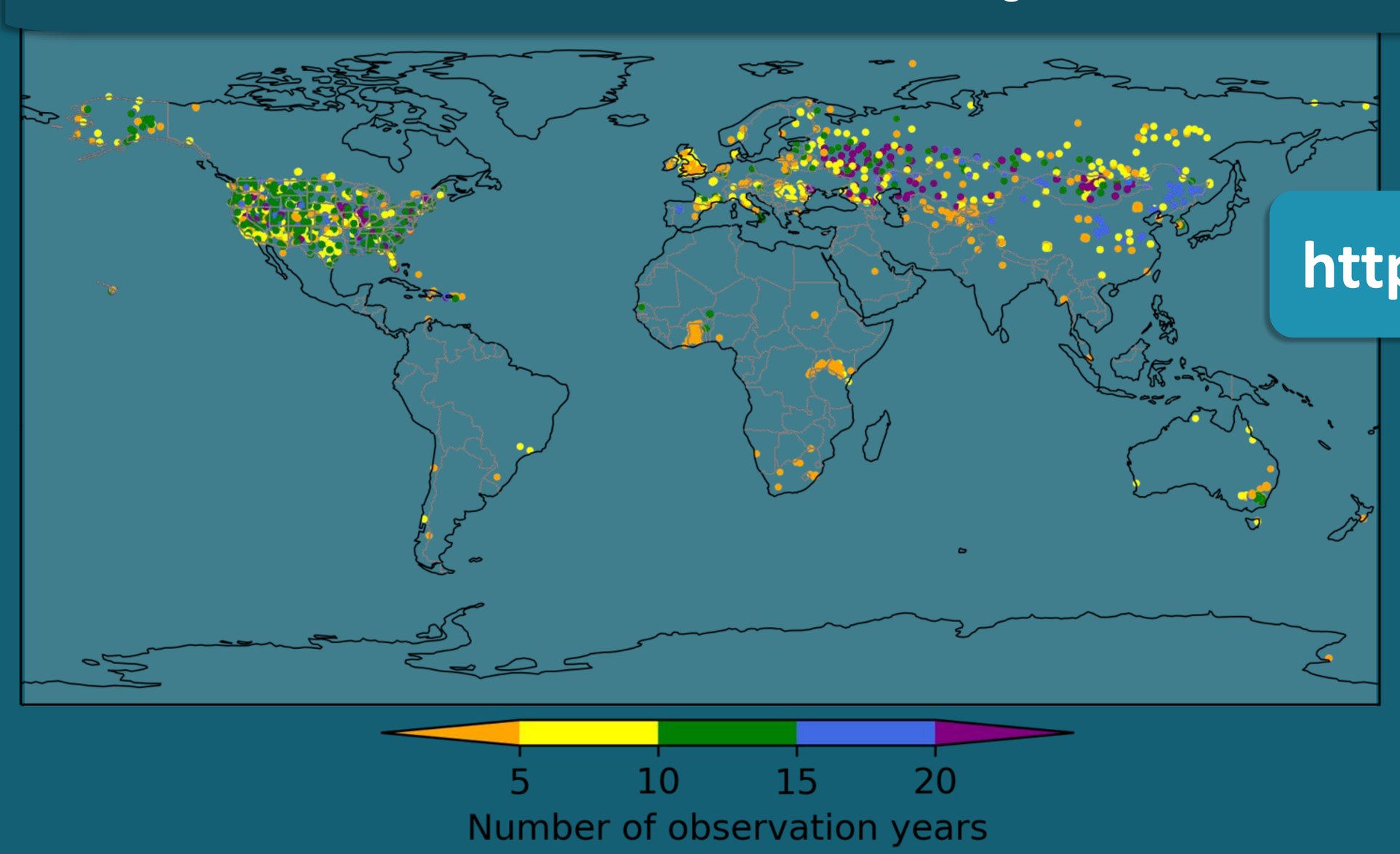
The International Soil Moisture Network (ISMN)

Established and developed at TU Wien in 2009, the ISMN collects in situ (on ground) soil moisture data on a global scale (surface and subsurface), **HARMONIZES** the data (units and sampling rates), applies **QUALITY CONTROL** and distributes the data via a web interface for FREE.





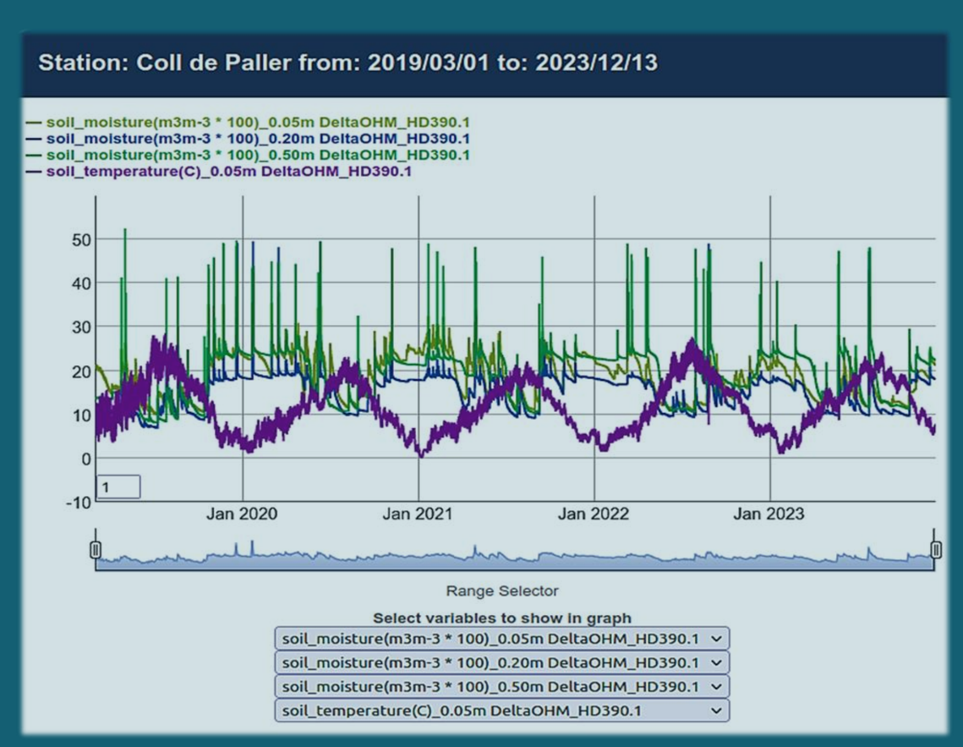


Figure 1: *ISMN methodology for data production and the visualized data viewer on the accessible webportal.*

ISMN data availability

80 contributing networks sharing data on a **voluntary basis** (global scale). ½ yearly statistical reports are issued per network to help acquire further funding for data production.

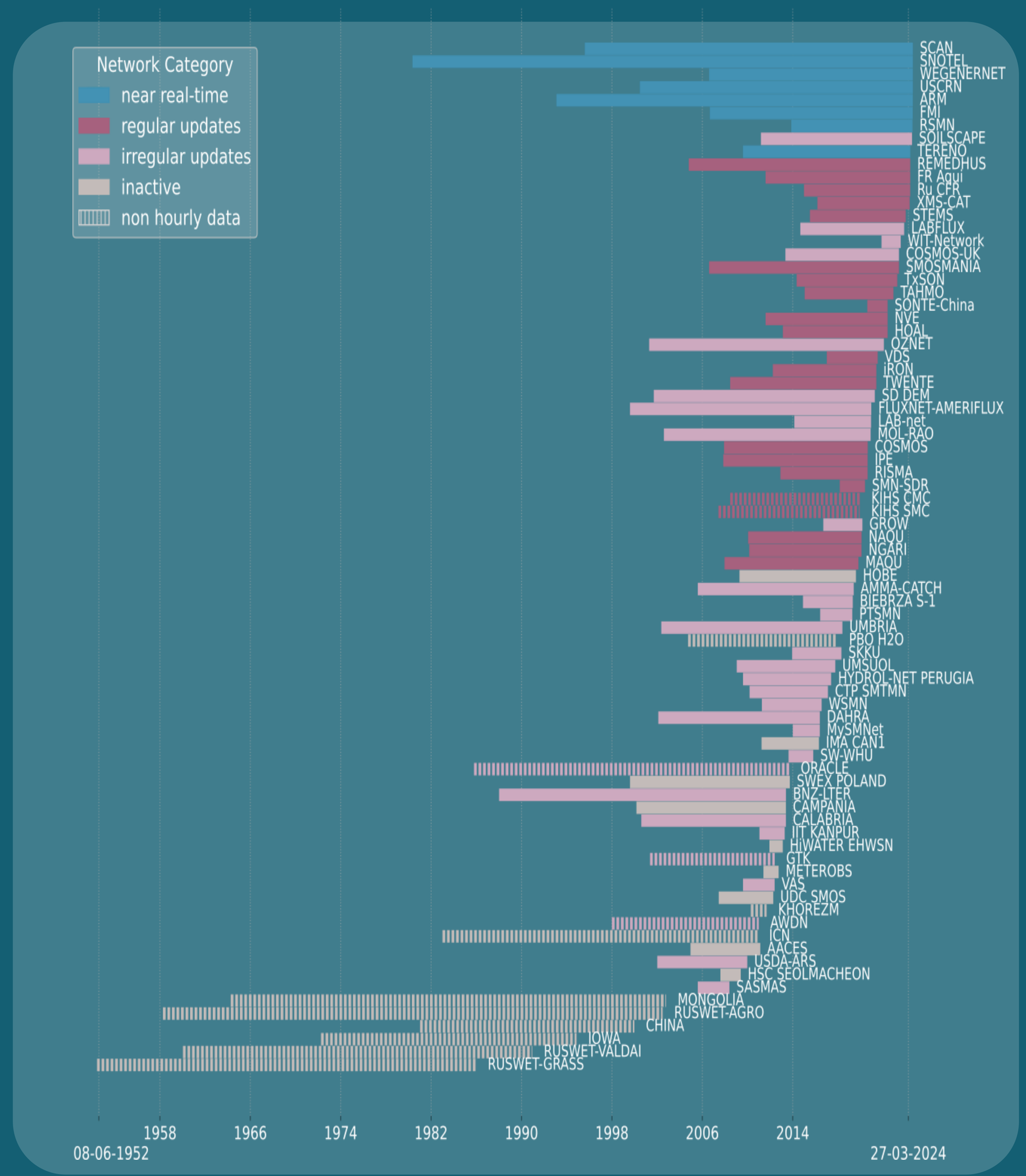
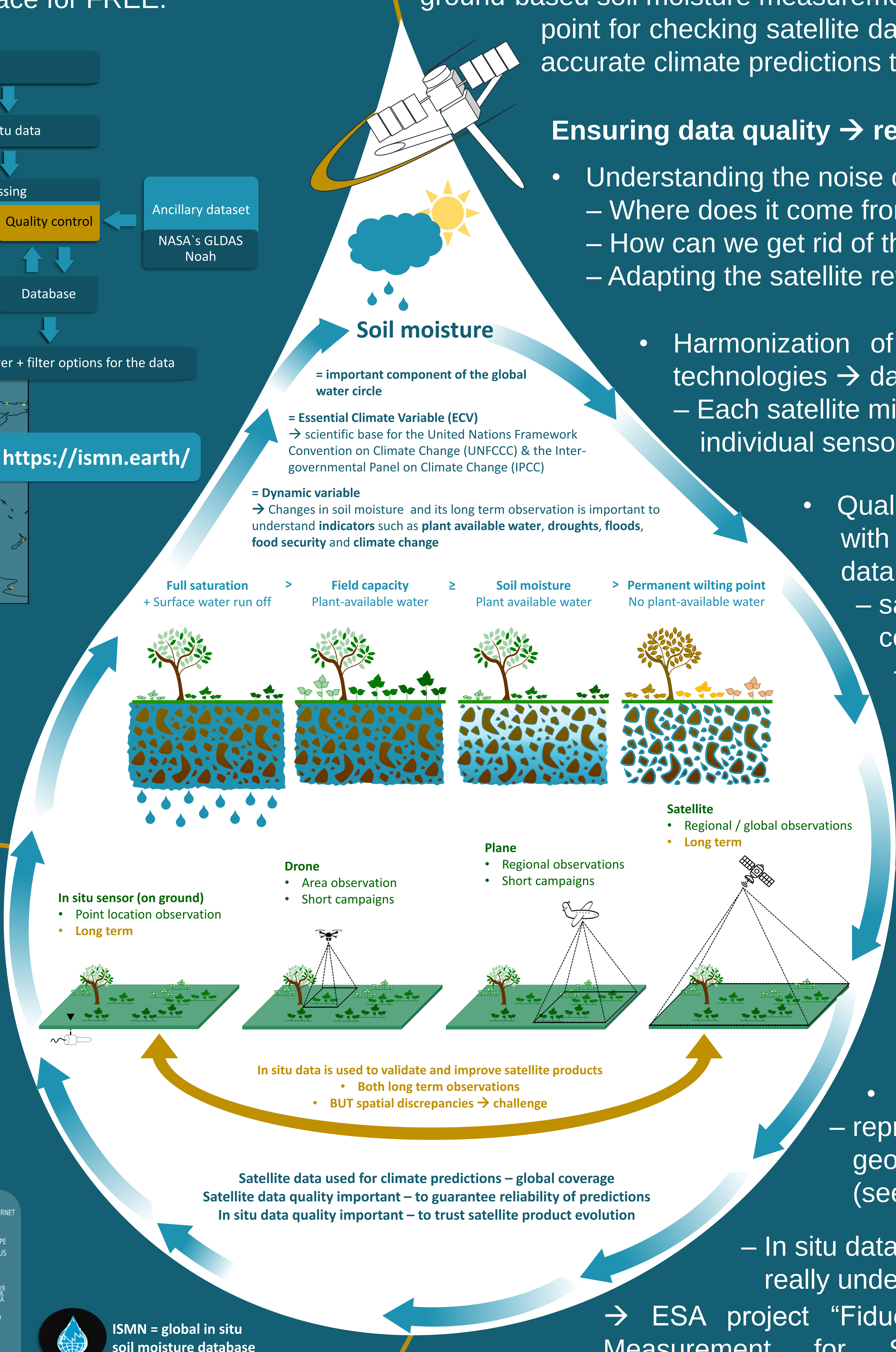


Figure 2: *Time series availability per integrated network (status March 2024).*

- **ISMN = global in situ soil moisture database**
- **Soil moisture + 7 additional variables** integrate able in the DB
- **80 networks** participate (status April 2024)
- **~ 3000 stations** with several depths **integrated** (status April 2024)
- Time series available from **1952** up **to near real time** (see figure 2)
- **Daily updates** of near real time networks (hourly data)



Satellites – the basis for climate predictions

Satellites are crucial for understanding climate change by giving us a global view of our planet's data. To ensure the accuracy of this information, we need to validate it with real-world data. That's where the International Soil Moisture Network (ISMN) comes in. It provides reliable ground-based soil moisture measurements, acting as a trusted reference point for checking satellite data. This helps scientists make more accurate climate predictions that we can rely on.

Ensuring data quality → reliability of prediction models

- Understanding the noise of the satellite observation (figure 3)
  – Where does it come from ?
  – How can we get rid of that ?
  – Adapting the satellite retrieval algorithm
- Harmonization of satellite sensor technologies → data comparability
  – Each satellite mission uses individual sensors techniques
- Quality assessment with reliable reference data
  – same temporal coverage
  – long term availability for climate predictions
  – global availability representing all geophysical conditions (e.g., climate classes, land cover types, etc.)

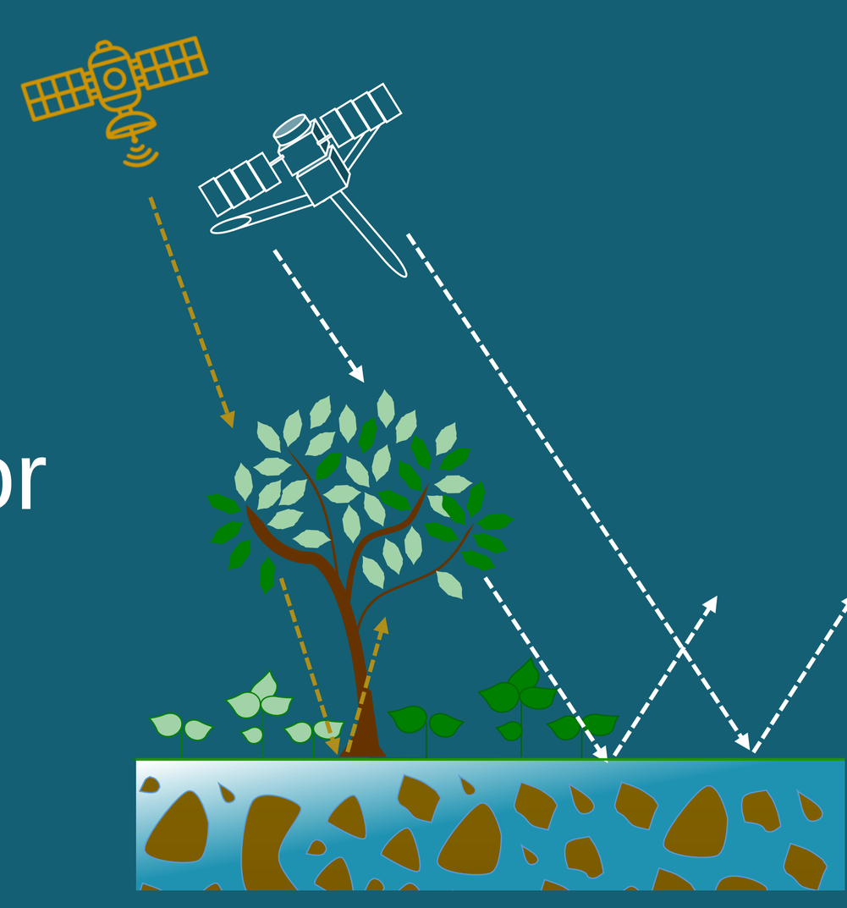


Figure 3: *Vegetation water content is an error source for soil moisture retrieval. Furthermore, the harmonization of different sensors techniques is important for data comparability.*

Challenges with the reference data (= in situ)

- Spatial discrepancies
  – single point versus km
- Data coverage
  – representation of geophysical condition (see figure 4)
  – In situ data uncertainty not really understood yet

→ ESA project “Fiducial Reference Measurement for Soil Moisture (FRM4SM) tackling this problem – TUW heavily involved

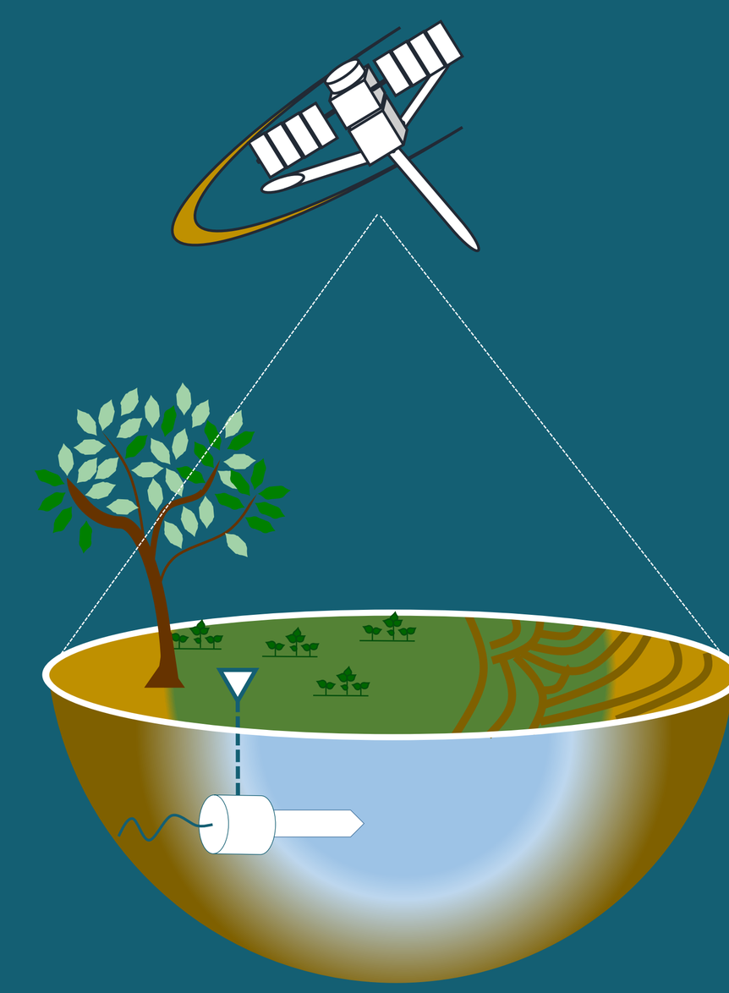


Figure 4: *Spatial discrepancies and differences in the representation of geo-physical conditions makes the comparison of in situ data with satellite data quite challenging. This figure shows as an example an in situ station installed in grassland and wetter conditions but the satellite sees more in comparison.*

Challenge - recognition for data production

The productions of in situ (satellite) data is not as well financed as one would hope even though most of the climate prediction models are built upon them:

- No long term financial support for ISMN network partners
- Governmental networks not shared with the global scientific community
- ISMN had to be moved from TU Wien Austria, to Germany for long term financial support – loss of global expert role for TUW / Austria

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