The International Soil Moisture Network (ISMN): an open-source data hosting facility in support of hydrological research

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https://ismn.geo.tuwien.ac.at

Overview

1) The International Soil Moisture Network (ISMN)

2) Future focus

3) Provider example: GROW citizen science project

4) User examples – ISMN data used for quality assurance of satellite based products/services

1) The International Soil Moisture Network (ISMN)

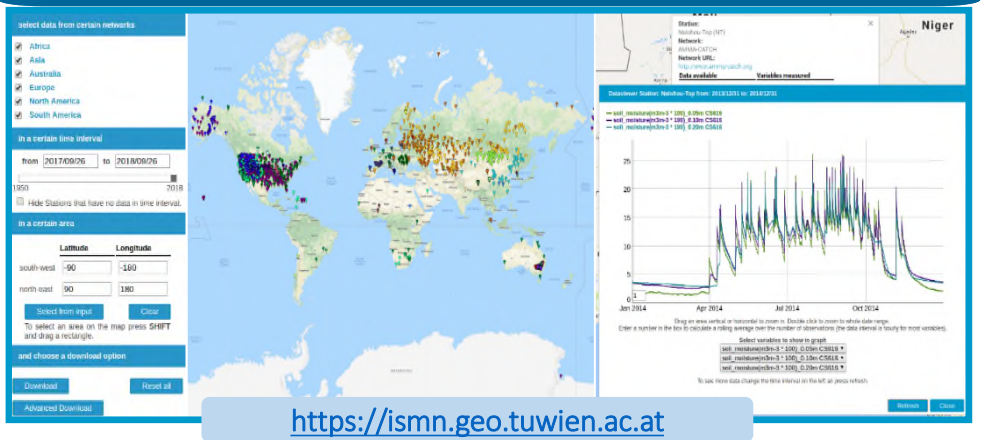
ISMN = a global **in situ** (surface and subsurface) **soil moisture** database

- established in 2009 with international cooperation (ESA, WCRP GEWEX, CEOS, GTN-H)

Data collection → Data harmonization → Quality control → Database storage

Metadata

Data portal



https://ismn.geo.tuwien.ac.at

- **Easy and FREE access** to the data
- **Surface and Subsurface** measurements
- **Harmonization of in situ data** for a meaningful comparison
- **Quality control** for reliability and accuracy
- **Long time series** for climate trend detection
- **Availability on a global scale**
- **Communication tool** for provider and user

Data Collection → Data Harmonization → Quality Control → Database Storage → Data Portal

In situ data + metadata

Soil moisture + 7 additional variables integrated in the DB (see Figure 1)

63 networks participate (status May 2020)

>2600 stations with several depths **integrated** (status February 2020)

Time series available from **1952** up **to near real time** (see graph)

Daily update of **6 NRT networks** → **~950 stations** (status May 2020)

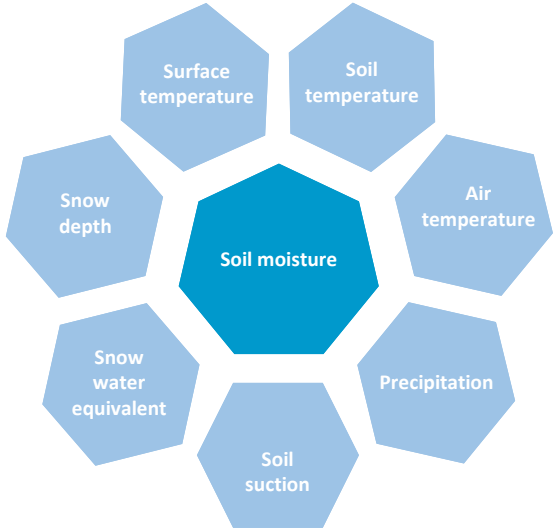
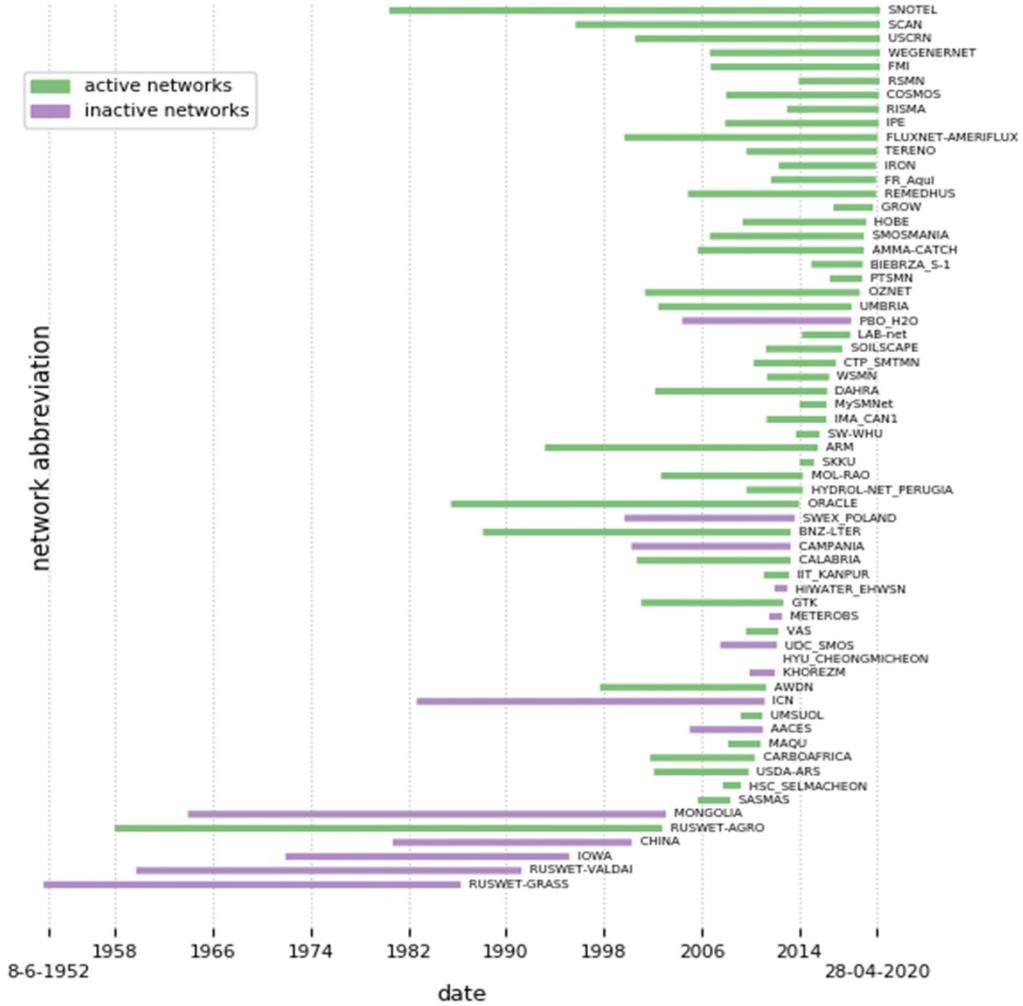


Figure 1: *8 in situ variables can be implemented in the database (per station and depth).*

Graph: *Temporal coverage of ISMN networks.*



Data transformed from provider format to ISMN standard

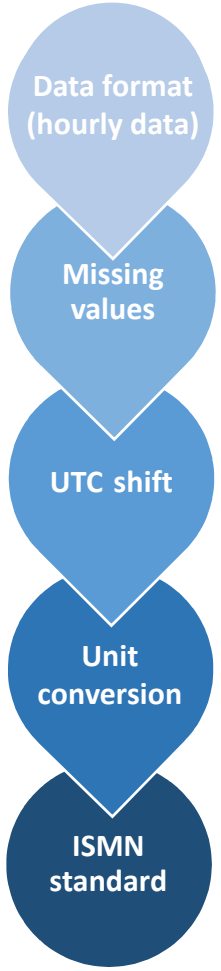
PROVIDER format

every network provider has its own system

- data access (http, ftp, E-Mail)
- data format
- etc.

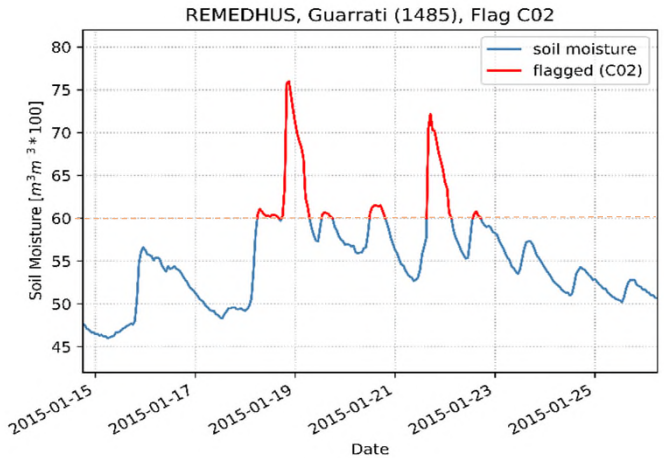
ISMN standard

- unified data format
- hourly data
- UTC
- same units

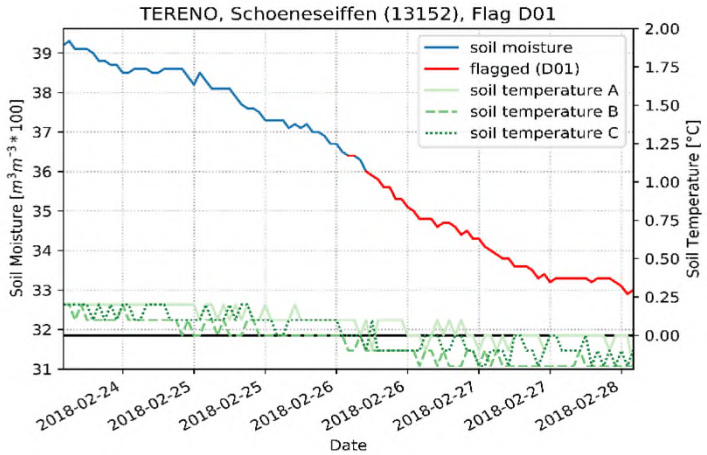


3 ISMN flagging methods: data is flagged not erased

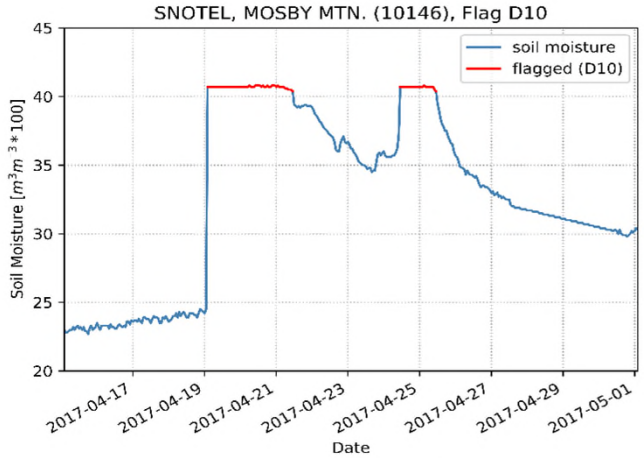
1) Geophysical Dynamic Range
- thresholds for all variables checked



2) Geophysical Consistency
- soil temperature/precipitation checked to flag soil moisture



3) Spectrum– Based Approach
- detection of data spikes and plateaus



Flag category	Flag values	Definition
C	C01 - C03	Threshold based flags for all variables used in the ISMN (soil moisture, soil temperature, temperature air, etc.)
D	D01 - D10	Questionable /dubious
M		Parameter value missing OR derived parameter can not be computed
G		Good

- Keeping original flags from provider (rarely applied)
- ISMN quality flags added to each measurement (CEOP standards)
- For a more detailed overview of the ISMN flags : Flag list

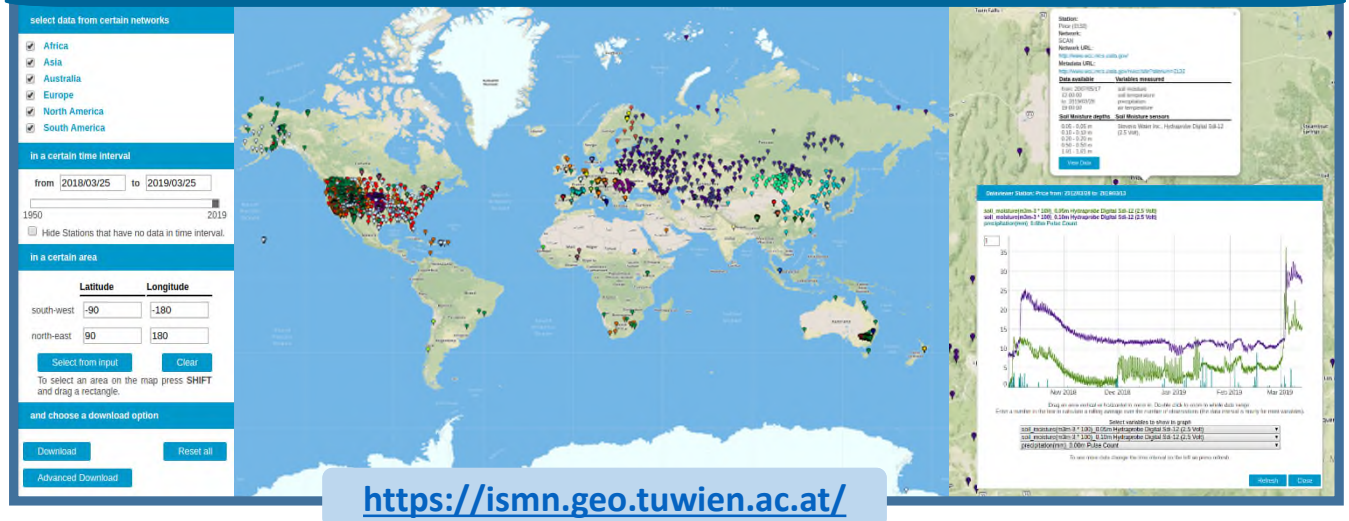
Dorigo, W.A. , Xaver, A. Vreugdenhil, M. Gruber, A., Hegyiová, A. Sanchis-Dufau, A.D., Zamojski, D. , Cordes, C., Wagner, W., and Drusch, M. (2013). Global Automated Quality Control of In Situ Soil Moisture data from the International Soil Moisture Network. Vadose Zone Journal, 12, 3, doi:10.2136/vzj2012.0097

Data Collection → Data Harmonization → Quality Control → Database Storage → Data Portal

- **Database storage : metadata + data time series + ISMN flags (+ provider flags (rarely sent))**

- **Data extraction** from data portal : https://ismn.geo.tuwien.ac.at/
- **Data reader + metadata extraction** package on gitHub: https://github.com/TUW-GEO/ismn

Data access FOR FREE via a web interface



https://ismn.geo.tuwien.ac.at/

Data access and download for free

~ 10 000 datasets stored in DB

> 3200 registered users

~ 1100 Peer reviewed publications making use of ISMN data (status January 2020)

1) ISMN: data provider and user community

Provider support:

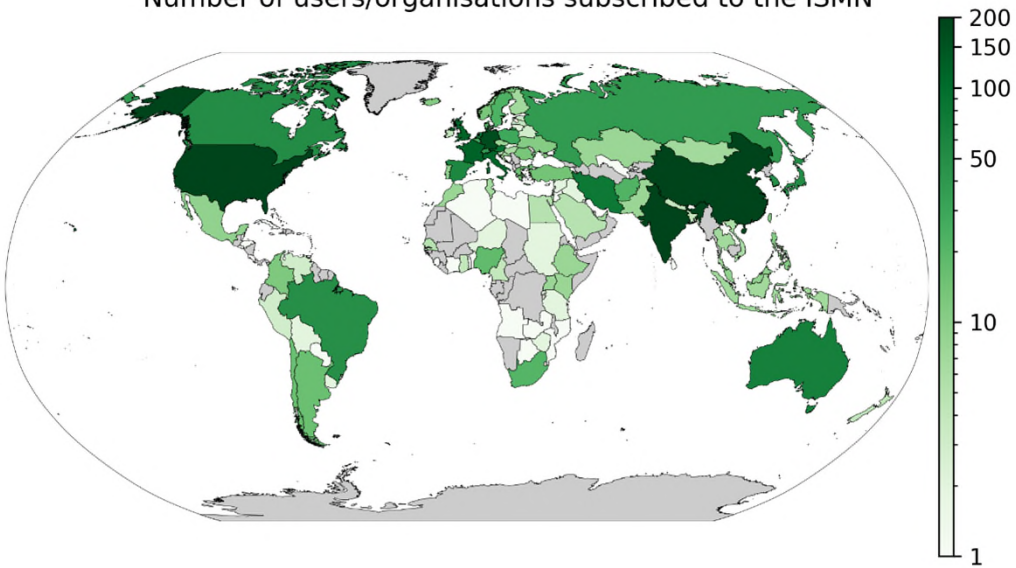
½ yearly provider reports sent (statistical data for each network: e.g. how many downloads of their data, flagging statistic, etc.)

Citing policy:
ISMN **AND** individual networks MUST BE cited

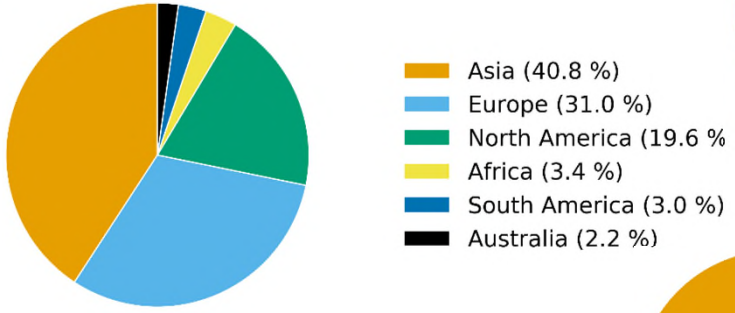
User community:

½ yearly newsletter sent to user (Information about: ISMN, updates, new networks, publications, workshop participation, etc.)

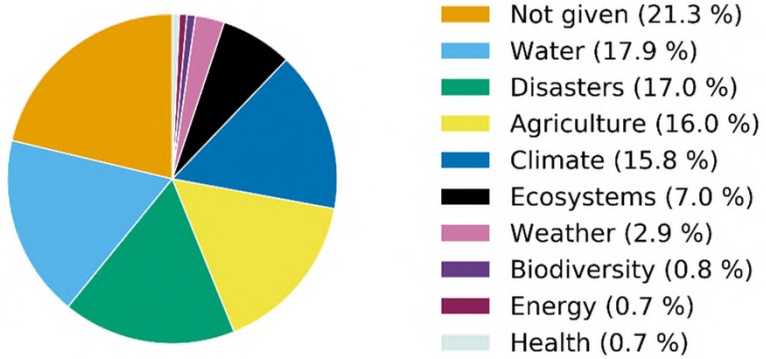
Number of users/organisations subscribed to the ISMN



Continental distribution of ISMN users:

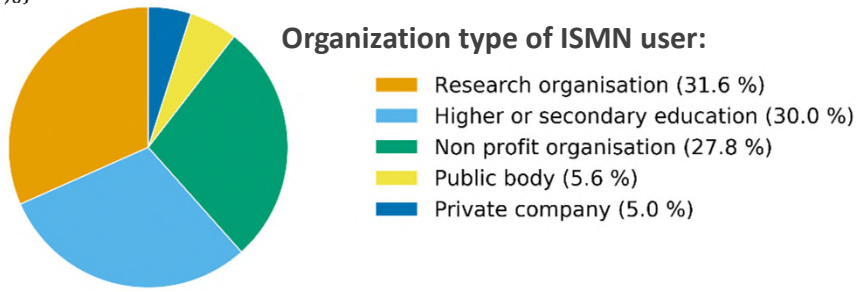


Usage area of ISMN data by users:



Not given … before statistics where recorded

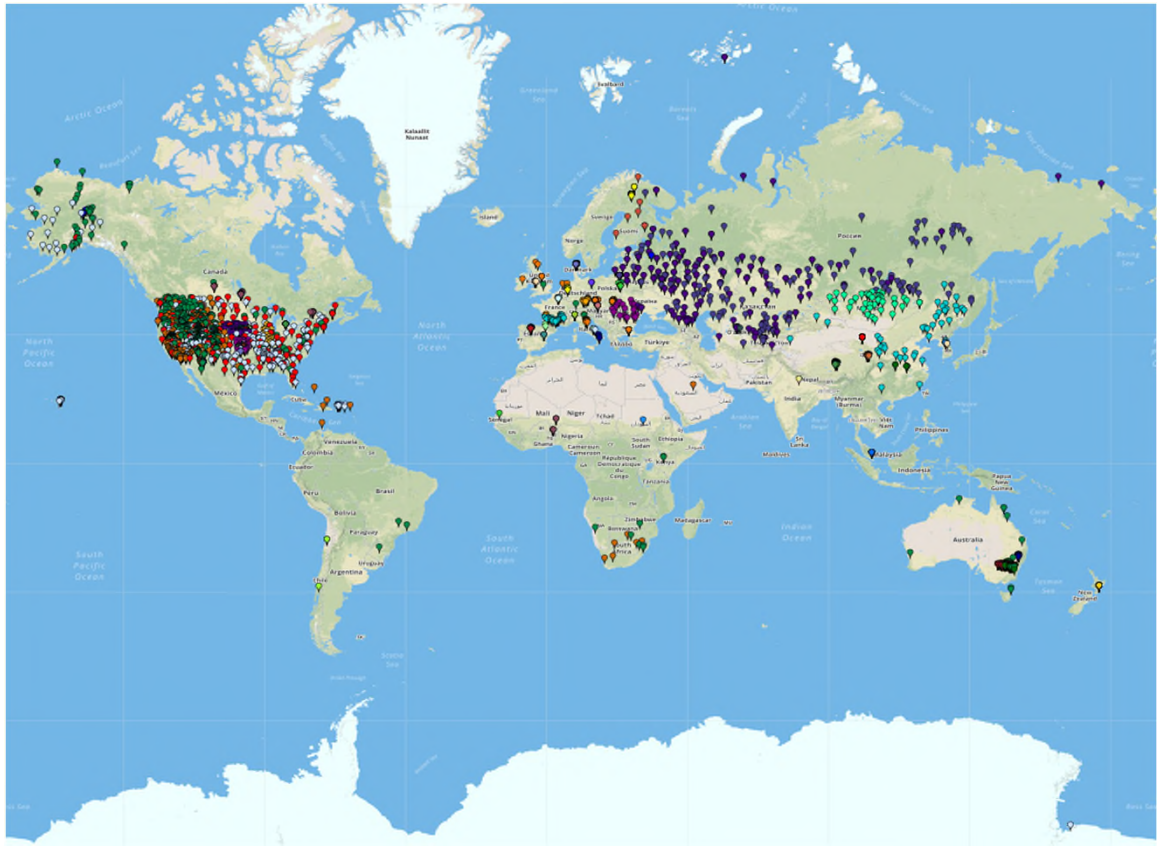
Organization type of ISMN user:



Graphs (status 02/2020): *User statistics recorded in respect of the European General Protection Regulation.*

2) ISMN: Future focus

Outlook:



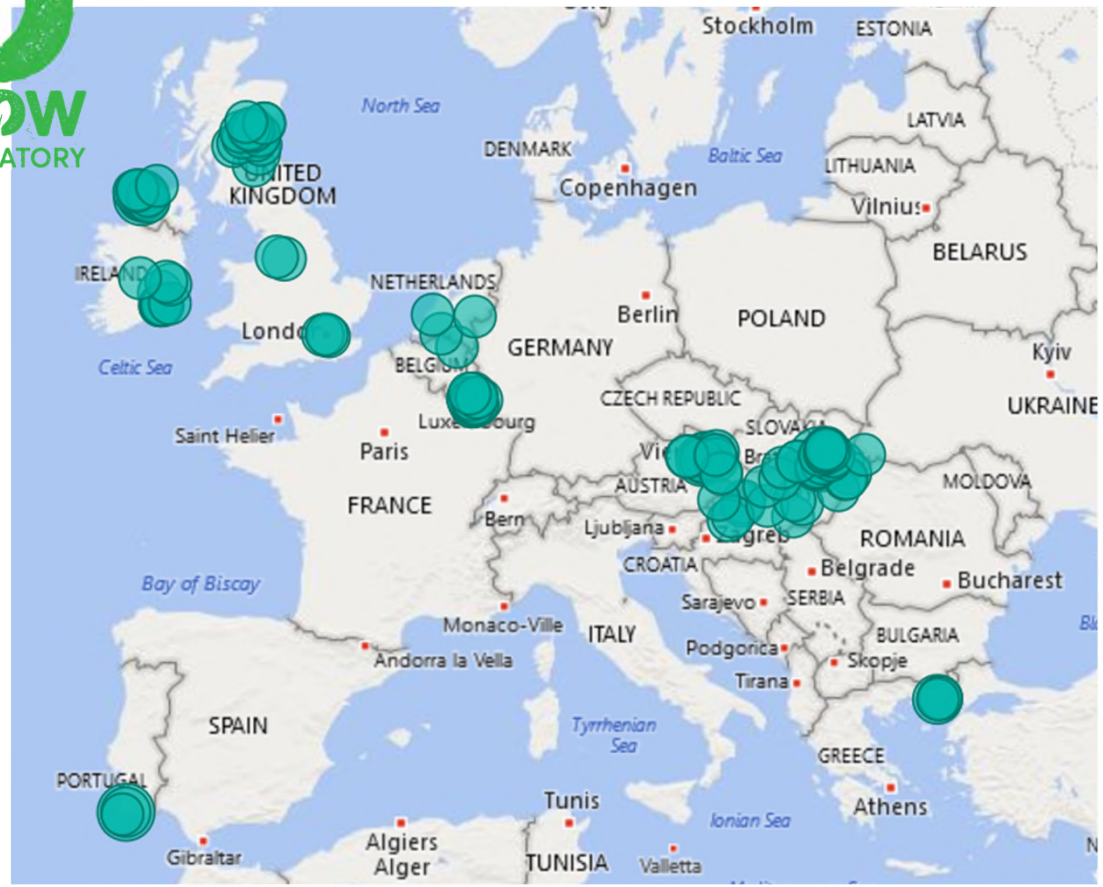
Picture 2 : All available stations within ISMN on a global scale (status 04/2020).

- Searching/Investigation of ideas for filling the gaps especially in the southern hemisphere (see picture 2)
  - Citizen science project could be one solution (please see next slide)
  - Ideas are always welcome!

- ISMN is working towards full traceability
  → from data collection on site to data download at ISMN platform (Fiducial Reference Measurements System)

❑ DOI for download is planned
  - Full traceability of data processes/changes etc.

3) Provider example: GROW citizen science project 1/2



Citizen science and satellite validation?

- **GROW observatory project (H2020)**
  - **3 year project:** ended October 2019 (data updates possible)
- **Flower power low cost sensors**
  - **15´000** soil moisture sensors
  - distributed **across Europe** to
    - Scientists and
    - Citizens (farmers, gardeners, etc.)

ISMN : 151 stations of GROW network integrated

For more information on about the Grow project : Angelika Xaver et. al.: https://doi.org/10.5194/gi-2019-38

4) User examples – ISMN data used for quality assurance of satellite based products/services :

Climate Change Initiative (CCI): soil moisture

EGU: Towards long-term satellite root-zone soil moisture: 40-year Soil Water Index dataset from ESA CCI COMBINED Soil Moisture product.
Wednesday May 6th: 8:30 – 10:15 : HS6.3: Remote sensing of soil moisture

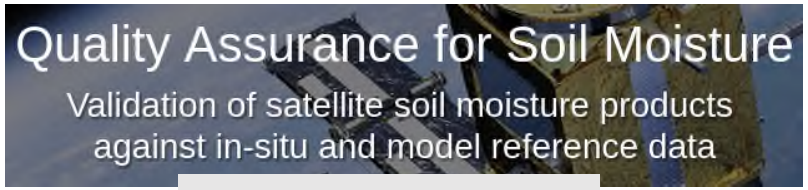
Copernicus Climate Change Service (C3S) soil moisture

EGU: ESA CCI and C3S Soil Moisture: latest product updates and climate assessment.
Wednesday May 6th: 8:30 – 10:15 : HS6.3: Remote sensing of soil moisture

Global Land Service

Soil Water Index (Copernicus Global Land Service)

https://land.copernicus.eu/global/products/ssm



https://qa4sm.eodc.eu/

EGU: QA4SM: Development of a traceable online satellite soil moisture validation system
Wednesday May 6th: 8:30 – 10:15 : HS6.3: Remote sensing of soil moisture

The ISMN is also the only in-situ soil moisture partner with the Global Terrestrial Network Hydrology (GTN-H) = a joint project of the World Meteorological Organization (WMO) and the Global Climate Observing System (GCOS)

Please contact us if you want to know more!

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