The International Soil Moisture Network (ISMN): Status update

GCOS Austria - Online

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Overview

- The International Soil Moisture Network (ISMN)
  - Short Introduction
  - Status update
  - User statistics
  - New ISMN paper currently under review
  - ISMN data usage
  - Continued operations
  - Conclusion and outlook

Short introduction

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

- Established in 2009
- International cooperation (ESA, GCOS, WCRP GEWEX, CEOS, etc.)
- Funded by ESA ever since : SMOS, Ideas+, **QA4EO CCN**

Idea: Reliable and consistent insitu datasets ⇒ crucial for validation of satellite soil moisture products

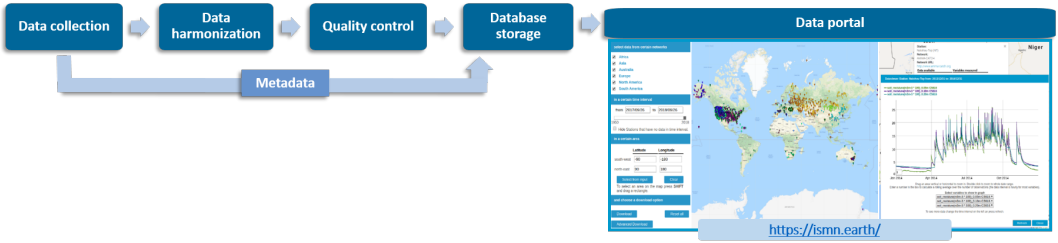

Figure 1: Diagram of workflow of the ISMN.

ISMN: Overview

- **In situ data + metadata**
- **Soil moisture + 7 additional variables** integrated in the DB
- **72 networks** participate (status October 2021)
- **2879 stations** with several depths **integrated** (status October 2021)
- Time series available from **1952** up **to near real time**
- **Daily update** of 7 **NRT networks** → **~ 1000 stations** (status October 2021)

Figure: *Two different examples of in situ sensors (left hand side – professional sensor in several depths; right hand side – low cost sensor in red circle next to professional sensor) .*

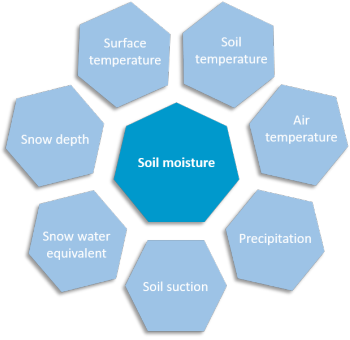

Figure: *8 in situ variables can be implemented in the database (per station and depth).*

User statistics status July 2021 (>3000 active users)

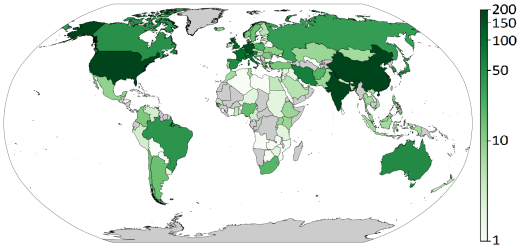

Figure 2: ISMN users per country.

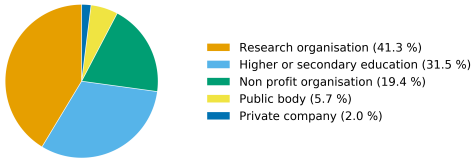

Figure 4: Statistics of organisations using ISMN data.

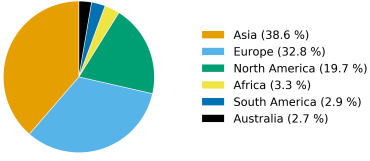

Figure 3: ISMN users per continent.

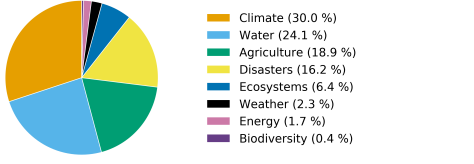

Figure 5: Beneficial areas of ISMN data usage.

The International Soil Moisture Network: serving Earth system science for over a decade

https://doi.org/10.5194/hess-2021-2
Preprint. Discussion started: 28 January 2021

Hydrology and Earth System Sciences
Discussions

The International Soil Moisture Network: serving Earth system science for over a decade

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⇒ 10 years of the ISMN

⇒ HESS paper – currently under review!

⇒ Content:

- Overview of ISMN
- Quality control
- Impact of the ISMN on Earth system sciences (Literature overview of studies making use of ISMN data)
- Challenges and opportunities
- Recent developments (since 2013 paper)
- Summarize current shortcomings and future needs

Figure 6: New paper currently under review: (Dorigo et.al. 2021).

ISMN data used for scientific studies/ services/ applications/ products

Purpose	%
Satellite Validation	55.7
Model development and validation	16.2
Meteorological applications	7.5
Drought monitoring	3.8
Other applications	16.8

Satellite Validation:

- ESA CCI Soil Moisture, C3S, GCLS, HSAF, QA4SM, etc.

Model development and validation:

- NASA´s GLDAS Noah, ECMWF (ERA5, ERA-Interim, ERA-Land), MERRA2, LDAS-Monde, etc.

Meteorological applications:

- TESSEL, Weather Research and Forecasting Model (WRF), ECMWF (ERA5, ERA-Interim, ERA-Land), etc.

Drought monitoring:

- SP(E)I, PDSI, European Drought Observatory etc.

Other applications:

- validation of hybrid observation based products, assessment of the impact of assimilating satellite observations into land surface models, etc.

ISMN - Continued operations

ISMN: Funding

- **Operations funded until April 30^{th} 2022** – ESAs Quality Assurance for Earth Observation (QA4EO CCN) programme
- **Long term funding for ISMN secured: ISMN operation transferred from Austria to Germany**
  - Together with ESA - search for funding solutions
  - Three years of negotiations
  - Finalized January 2021
  - Long Term Funding by the German Federal Ministry of Transport and Digital Infrastructure (BMVI)
  - **Technical operational host = German Federal Institute of Hydrology (BafG)**
  - **Provider contact = International Center for Water Resources and Climate Change (ICWRGC)** - connected to UNESCO and WMO
  - Transfer: May 2021 $\Rightarrow$ December 2022
  - TU Wien effort for transfer is funded by BMVI and ESA
- TU Wien involved in scientific development of the ISMN
  - **current ESA project: Fiducial Reference Measurement for Soil Moisture (FRM4SM)** (to find protocolls and procedures for space borne microwave radiometer retrieved soil moisture products, error propagation from insitu to satellite data, etc.)
  - FRM4SM project phase: May 1^{st} 2021 - April 30^{th} 2023

Conclusion and outlook

Conclusion and outlook

- ISMN is a TU Wien success story
- From a student project to a globally recognised source of trustworthy insitu soil moisture data
- 5 new networks included this year (with a near real time network in Africa THAMO)
- Long Term funding could be secured
- In the midst transferring the ISMN to Bafg - Germany
- Further scientific developments can be expected within the FRM4SM ESA project (TU Wien partner with Applied Science, Software and Technologie (AWST - Vienna, Austria) GmbH and the Center for Spacial and Biosphere Studies (CESBIO - Toulouse, France)

Thank you for your attention!

ISMN: https://ismn.earth

CLIMERS: climers.geo.tuwien.ac.at

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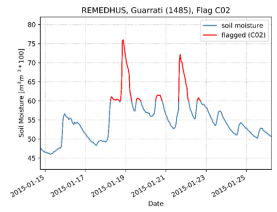
AMENDMENTS

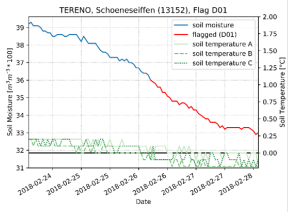
ISMN: Data is quality checked and flags are added

3 ISMN flagging methods developed at TU Wien (Dorigo et.al. 2013)

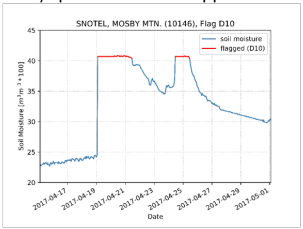
1) Geophysical Dynamic Range



2) Geophysical Consistency



3) Spectrum– Based Approach



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 flags from provider (rarely provided)
- quality flag added to each measurement (CEOP standards)