ESA CCI Soil Moisture: Current Status and Future Direction

European Space Agency

1 ESA CCI Soil Moisture

The ESA CCI soil moisture product (http://www.esa-soilmoisture-cci.org) is a multi-decadal global satellite observed soil moisture dataset combining various single-sensor active and passive microwave soil moisture products into three harmonised products: ACTIVE, PASSIVE and COMBINED. The product is continually updated with new scientific advancements.

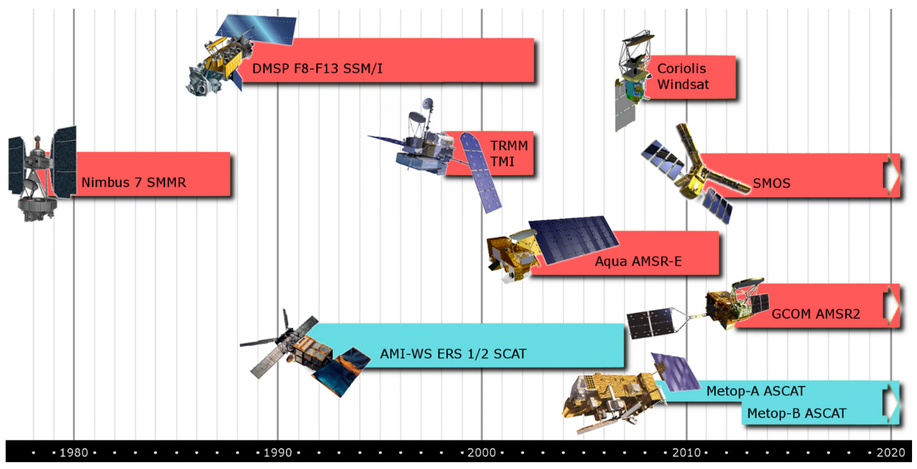


Figure 1: *Timelines of sensors used in the production of ESA CCI SM v04.7 dataset. Red lines indicate passive sensors, active sensors are in blue.*

2 Data Processing and Quality Assurance

The product is compared against in situ measurements from the International Soil Moisture Network (ISMN; https://ismn.geo.tuwien.ac.at; Dorigo et al. 2011) as well as modelled ERA5-Land data.

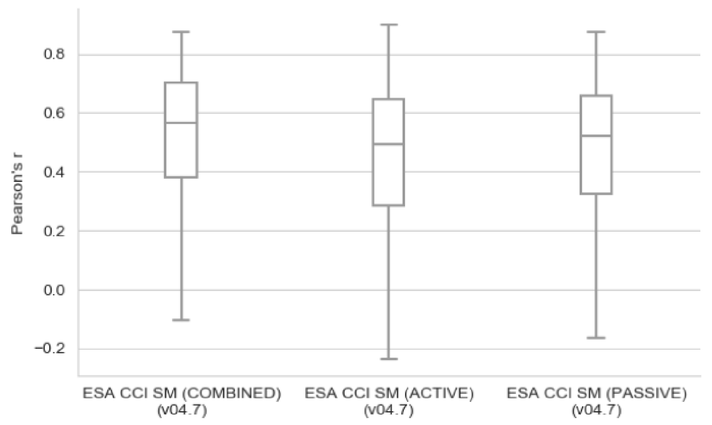


Figure 2: *Intercomparison of Pearson's r with the in situ ISMN measurements (created with QA4SM.eu).*

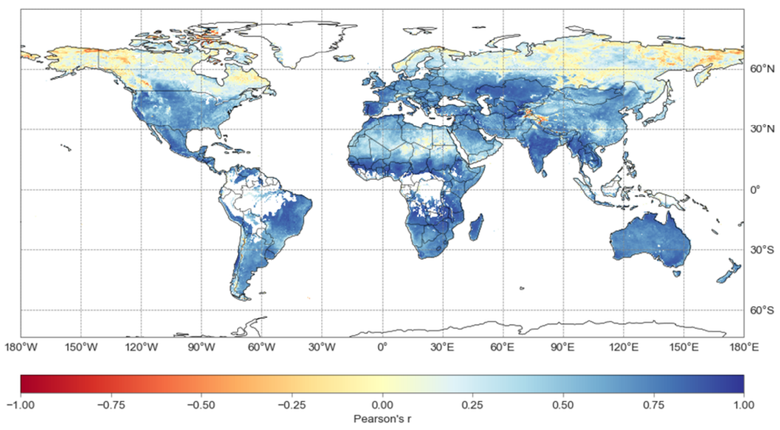


Figure 3: *Correlation of the gridded soil moisture COMBINED v04.7 product with the ERA5-Land data (created with QA4SM.eu).*

Quality Assurance for Soil Moisture
Validation of satellite soil moisture products against in-situ and model reference data

Customized validation of the products against both in situ and modelled data can also be freely performed by the users with the qa4sm.eu platform (www.qa4sm.eu).

3 Current Status

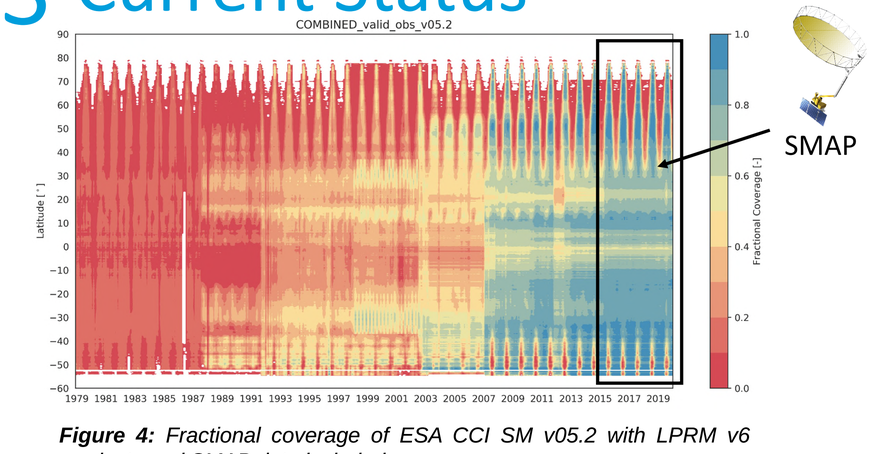


Figure 4: *Fractional coverage of ESA CCI SM v05.2 with LPRM v6 products and SMAP data included.*

The latest available version of the ESA CCI SM dataset (v04.7) utilizes data from 7 passive and 4 active sensors and provides data from 1978 up to the end of 2019. This dataset is featured in the recently published BAMS State of the Climate 2019 report (Fig. 5; Preimesberger et al. 2020a).

The next version of the dataset (v05.2) is expected to be released to the public in Q3/2020) and it features:

- Inclusion of SMAP radiometer data
- Bias correction of AMSR2 in the PASSIVE product
- Improved Level 2 passive products

Release version	Period covered	Release date
V05.2	1978 – 2019	Q3/2020
V6	1978 – 2020	Q1/2021
V7	1978 – 2021	Q1/2022

4 Outreach

- 8000+ registered data users
- Data used in the BAMS as well as the European State of the Climate reports each year (Fig. 5)

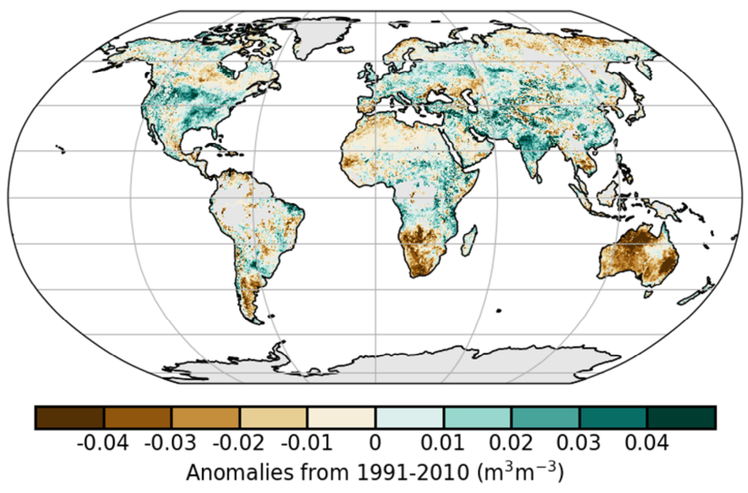
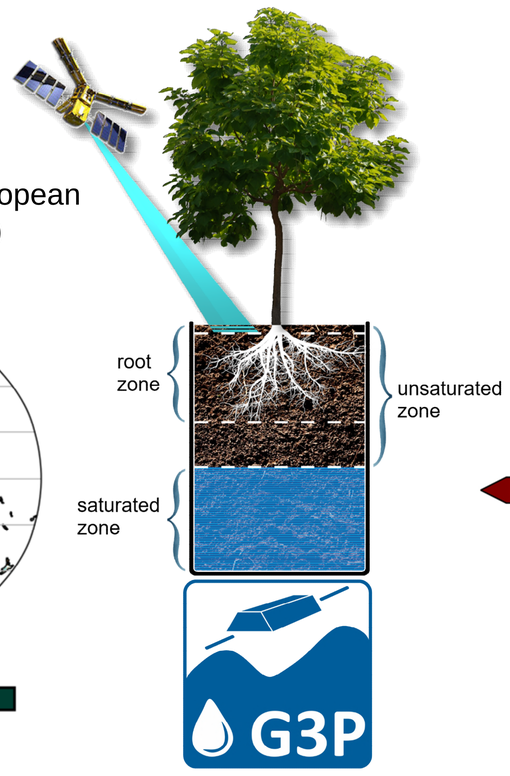


Figure 5: *Average ESA CCI SM anomalies for 2019 (base period: 1991-2010). Reproduced from Preimesberger et al. 2020a.*

Copernicus Europe's eyes on Earth

Climate Change Service climate.copernicus.eu

ESA CCI SM is also available as an operational product in near real time via the Copernicus Climate Change Service (C3S) Data Store (https://cds.climate.copernicus.eu).



Dataset used in novel cross-ECV project: Global Gravity-based Groundwater Product (www.g3p.eu). Where root-zone soil moisture conditions are approximated from ESA CCI SM by means of Soil Water Index (Wagner et al. 1999, Albergel et al. 2008).

5 Research and Development

ESA CCI SM v6 (planned release Q1/2021):

- Correcting structural breaks occurring at sensor changes (Fig. 6; Preimesberger et al. 2020b)
- Bridging the scaling gap between AMSRE and AMSR2 with Feng-Yun 3B data (Fig. 7)
- Inclusion of an experimental ASCAT dataset corrected for its wetting trend
- Improved flagging strategy for frozen soils and snow
- Improved intercalibration of Level 2 passive sensors

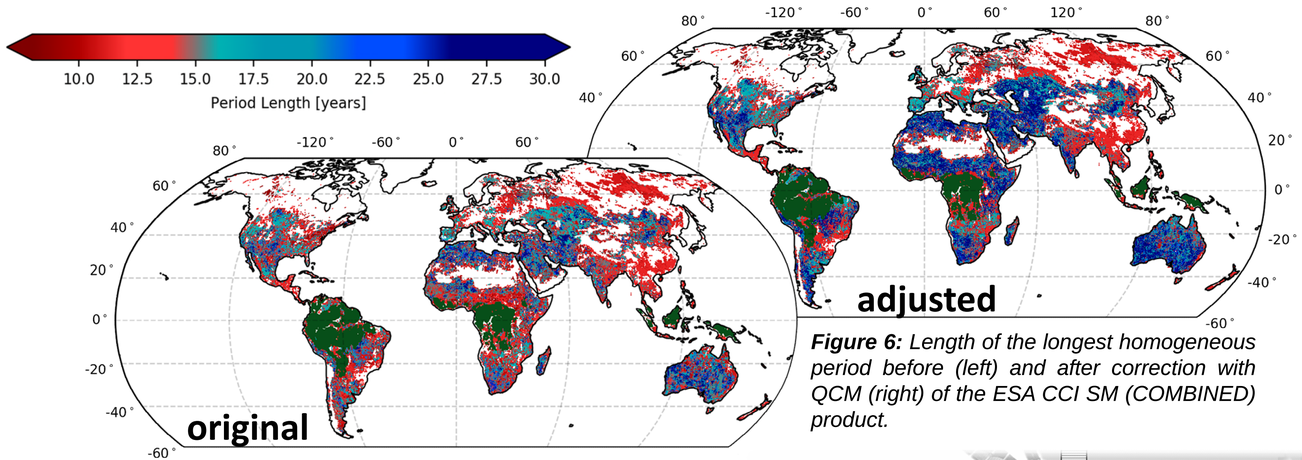


Figure 6: *Length of the longest homogeneous period before (left) and after correction with QCM (right) of the ESA CCI SM (COMBINED) product.*

ESA CCI SM beyond v6:

- Independence from Land Surface Models (LSMs) by using L-band as scaling reference
- Creation of a root-zone soil moisture product (RZSM)
- Inclusion of Metop-C data
- Global gap-filled soil moisture product
- and many more…

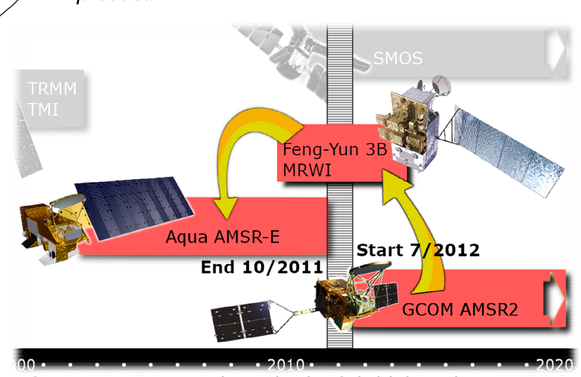


Figure 7: *Proposed method of bridging the AMSRE-AMSR2 scaling gap.*

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ESA CCI SM dataset utilizes and benefits from ASCAT soil moisture products developed by the EUMETSAT H-SAF team.

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