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45 years of global satellite soil moisture for hydrological and climate applications

Wouter Dorigo[1], Pietro Stradiotti[1], Wolfgang Preimesberger[1], Alexander Gruber[1], Maud Formanek[1], Thomas Frederikse[2], Robin Van der Schalie[2], Nemesio Rodriguez-Fernandez[3], and Martin Hirschi[4]

[1]TU Wien, Climate and Environmental Remote Sensing, Department of Geodesy and Geoinformation, Vienna, Austria (wouter.dorigo@tuwien.ac.at)

[2]Planet Labs, Haarlem, Netherlands

[3]Cesbio, Toulouse, France

[4]ETH Zurich, Switzerland

ESA CCI Soil Moisture (SM) is a long-term global Climate Data Record of water content stored in the surface soil layer, derived from satellite observations in the microwave domain. To make it suitable for long-term analyses in climate and hydrological applications, ESA CCI SM merges observations from a total of 19 satellite microwave radiometers and scatterometers into harmonized records covering a 45 year period (from 1978 onwards). Within the Copernicus Climate Change Service (C3S), the soil moisture data records are extended every ten days to provide input data for time-critical applications like monitoring or data assimilation.

The data sets have been widely used to study the water, energy, and carbon cycles over land, understand land surface-atmosphere hydrological feedbacks, assess the impact of climate change on the occurrence of climatic extremes, and for the evaluation and improvement of model simulations. ESA CCI SM has been the main input for assessing global soil moisture conditions as presented in the BAMS “State of the Climate” reports for more than 10 years, while C3S has been used in the yearly “European State of the Climate” reports for several years now

In this presentation we give an overview of the methodology and characteristics of the ESA CCI SM and C3S products with a focus on recent scientific developments, intended to make the data analysis-ready for climate and hydrological studies, such as filling spatial and temporal gaps, providing estimates of root-zone soil moisture, and making the dataset entirely independent of any model data. We show how both ESA CCI and C3S have been used in recent years to monitor dry and wet spells, and to gain deeper understanding of the Earth system.

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