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A soil moisture climatology based on five years of SMOS data

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Soil moisture observations are expected to play an important role in monitoring global climate trends. However, measuring soil moisture remains challenging because of its high spatial and temporal variability. Point-scale in situ measurements are scarce and remote sensing is the only practical means for obtaining regional- and global-scale soil moisture estimates. The ESA SMOS mission, launched in 2009, is measuring the Earth's surface soil moisture at daily time scales with an unprecedented level of accuracy. Yet, incorporating these soil moisture observations to land surface models is complex since it is usually represented as an index of water content in the soil using different hydrological schemes and different physical approaches of the soil-water interaction. In this context, it has become important to characterize the climatological differences between models, satellite estimates, and ground-based measurements of soil moisture.

This study investigates the temporal dynamics of soil moisture and its anomalies based on three main data sources: SMOS, in situ observations, and the land surface reanalysis ERA-Interim. The analysis includes the determination of mean annual conditions, trends and anomalies for modeled and satellite-based soil moisture estimates. Their spatial coherence and relationships through precipitation and evaporation are also analyzed to improve understanding of global water cycle dynamics. Ground-based estimates are used as a benchmark in four target regions representative of arid, semi-arid, sub-humid and humid climates across global land biomes.

Results show that, despite still being a short data set, SMOS data provide coherent and reliable variability patterns at both seasonal and inter-annual scales. This work is an important support to all land data assimilation projects that are using remote sensing products to initialize forecast systems.