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Global comparison of soil moisture variations as derived from remote sensing, satellite gravimetry, and hydrological modeling

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On local scales soil moisture products are most commonly validated with the help of in-situ measurements, taken at different depth of the soil. On global scales this validation is not possible due to the lack of comprehensive in-situ networks. Therefore global validation is usually done through the inter-comparison of different soil moisture products from space observation systems and hydrological models.

From satellite gravimetry the total change in continental water storage (TWS) can be derived, which comprises changes in surface water, ground water, snow water and soil moisture. The compartment soil moisture serves as interface between precipitation (one main driver of the hydrological cycle) and the compartment groundwater. Furthermore it covers the entire continental area in contrast to surface water, which rather appears in point-like (lakes) or line-like (rivers) features. Therefore total continental water storage is an independently derived global data set, which can be related to soil moisture variations.

This study focuses on the comparison of conventional soil moisture products from satellite remote sensing and hydrological models in combination with information on total water storage as derived from the satellite gravimetry mission GRACE. The remote sensing products stem from the passive sensors AMSR-E onboard Aqua (NASA) and the active sensor ASCAT onboard MetOp (EUMETSAT). The hydrological model used is the WaterGAP Global Hydrology Model (WGHM).

First the two remote sensing soil moisture products from AMSR-E and ASCAT are compared on daily scale, whereby the soil water index (SWI) is applied to both data sets. Then all four data sets are compared in monthly time intervals. To make the soil moisture products compatible with GRACE they first have to be expressed in spherical harmonics and smoothed accordingly (e.g. by a 300km Gaussian filter). Then they will be expressed on a 1° global grid. Afterwards the spatial and temporal agreement between all data is analyzed.

Results will highlight the correlations between all four data sets. Thereby regions with high and low data agreement can be identified. Specifically the integration of GRACE data will show if and where total water storage shows a similar variation as soil moisture. On the basis of the results the feasibility of integrating gravimetry data for the global validation of soil moisture products will be discussed.