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# Joint analysis of remotely sensed soil moisture and water storage variations from satellite gravimetry

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Information on water storage changes in the soil can be obtained on a global scale from different types of satellite observations. While active or passive microwave remote sensing is limited to investigating the upper few centimeters of the soil, satellite gravimetry is sensitive to variations in the full column of terrestrial water storage (TWS) but cannot distinguish between storage variations occurring in different soil depths. Jointly analyzing both data types promises interesting insights into the underlying hydrological dynamics and may enable a better process understanding of water storage change in the subsurface.

In this study, we aim at investigating the global relationship of (1) several satellite soil moisture (SM) products and (2) non-standard daily TWS data from the GRACE and GRACE-FO satellite gravimetry missions on different time scales. We decompose the data sets into different temporal frequencies from seasonal to sub-monthly signals and carry out the comparison with respect to spatial patterns and temporal variability. Level-3 (Surface SM up to 5 cm depth) and Level-4 (Root-Zone SM up to 1 m depth) data sets of the SMOS and SMAP missions as well as the ESA CCI data set are used in this investigation.
Since a direct comparison of the absolute values is not possible due to the different integration depths of the two data sets (SM and TWS), we will analyze their relationship using Pearson's pairwise correlation coefficient. Furthermore, a time-shift analysis is carried out by means of cross-correlation to identify time lags between SM and TWS data sets that indicate differences in the temporal dynamics of SM storage change in varying depth layers.