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Disentangling soil moisture and vegetation effects on the ASCAT backscatter-incidence angle relationship

Isabella Greimeister-Pfeil[1,2], Wolfgang Wagner[1,2], Raphael Quast[1], Sebastian Hahn[1], Susan Steele-Dunne[3], and Mariette Vreugdenhil[1,2]

[1]Department of Geodesy and Geoinformation, TU Wien, Vienna, Austria (isabella.pfeil@geo.tuwien.ac.at)
[2]Centre for Water Resource Systems, TU Wien, Vienna, Austria
[3]Faculty of Civil Engineering and Geosciences, Delft University of Technology (TU Delft), Delft, the Netherlands

Microwave scatterometers provide global and frequent observations of the Earth's surface. In particular, C-Band scatterometers are sensitive to the moisture content of the soil and vegetation in the sensor footprint, and can therefore be used for the retrieval of soil moisture (SM) and vegetation optical depth (VOD).

To model the vegetation component in the signal, and subsequently retrieve VOD, the slope (σ') of the backscatter dependence on the incidence angle of the observation is exploited. This is possible because σ' is related to the water content and structure of the canopy. Early studies moreover showed that SM effects on σ' are weak and can, in a first approximation, be neglected. However, short-term dynamics in σ' have raised questions about the validity of this assumption.

In this study, we investigate a potential SM effect on σ' time series derived from the Advanced Scatterometer (ASCAT) by exploring relationships between σ', SM, and leaf area index. We carry out the analysis over six study regions in Portugal, Austria, and Russia with different climate, land cover and vegetation cycles.

Spearman correlations between short-term anomalies of σ' and SM are stronger than between σ' and LAI, indicating that SM does have an effect on σ'. The analysis of daily σ' values, as opposed to the smoothed σ' that is used in retrieval algorithms, shows SM effects even more clearly: SM increases correspond to decreases of σ', even during periods of vegetation growth, which are typically characterized by increasing σ' values. Thus, we conclude that there is a SM signal in σ' time series on top of the vegetation signal. Over sparse vegetation, the SM effect may be as large as 20% of the seasonal, vegetation-induced variation of σ', whereas it is smaller over dense vegetation. Moreover, the short-term dynamics in σ' time series might be caused by water on the canopy, i.e., interception or dew, to some extent. Further work is needed to confirm this hypothesis. For the retrieval of SM from ASCAT observations, these results confirm the use of a

long-term average σ’ climatology instead of dynamic σ’ time series to correct for vegetation effects.