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Data Fusion Approaches to Close the Spatial and Temporal Scale Gaps between MetOp-ASCAT and Sentinel-1 Soil Moisture Observations

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Earth observation (EO), and more specifically, spaceborne radar remote sensing had made much progress toward its high potential to retrieve Soil Moisture (SM) at different scales. Yet, for a single sensing system there always exists a trade-off between spatial and temporal resolution of the observations: While scatterometer-derived SM products can well describe temporal soil moisture dynamics, they lack of spatial details. They do not facilitate analysis of local hydrological patterns, such as effects from convectional rains and topography and thus miss the requirements of many users. Contrary, SM products from Synthetic Aperture Radar (SAR) sensors can resolve dynamics at this level. However, they observe individual locations less frequently and are thus not suitable for acquisition of short-term variations.

To overcome these spatial and temporal scale gaps, data fusion of C-Band scatterometer and SAR radar observations is the method of choice, yielding a high-resolution, high-frequency soil profile wetness product called SCAT-SAR Soil Water Index (SWI). Benefiting from the input's either high temporal or spatial resolution, respectively, this 500m-sampling product bears great potential for operational use, even at local scale.

In this study, different approaches to fuse MetOp ASCAT scatterometer data (12.5km and almost-daily sampling) with SAR data from the new Sentinel-1 (10m and 3-6-day sampling) are examined. Methods entailed in the fusion process comprise spatial resampling, spatial correlation analysis, data matching, temporal matching and filtering as well as signal-to-noise estimation. Different sets of methods for data fusion are employed for SM derivation. The results are evaluated against alone-standing ASCAT and Sentinel-1 SM data, as well as against in-situ measurements at the Hydrological Open Air Laboratory (HOAL) in Petzenkirchen, Lower Austria.