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A new method for downscaling coarse scale ASCAT soil moisture using Sentinel-1: Preliminary results

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Numerous global soil moisture (SM) data sets derived from spaceborne sensors are operationally available at the moment. However, many SM data sets are typically not suitable for regional hydrological and agricultural applications, due to their coarse spatial resolution or temporal revisit rate. The launch of Sentinel-1 (S-1) provides a new opportunity to monitor SM with an unprecedented spatial resolution. Unfortunately, the constellation of S-1 has a nominal global coverage of landmass of 6 days (12 days with a single satellite), which is insufficient for many of the above mentioned applications. Therefore, it seems essential to develop an appropriate disaggregation scheme to benefit from the high temporal revisit time of ASCAT on-board the series of Metop satellites and the high spatial resolution of S-1.

In this study we demonstrate a new, promising directional resampling method. The underlying concept is based on temporal stability of SM: In the temporal domain SM measured at specific locations is correlated to the mean SM content of neighbouring areas, where neighbours with similar physical properties (like soil texture, land cover and terrain) show a higher coherence to the local SM than others (Wagner et al. 2008). Assuming that backscatter is linearly related to SM, high-resolution S-1 backscatter data from a local pixel (500 m) is related to surrounded aggregated (12.5 km) pixels. This results in multiple correlation coefficients for each local pixel, providing information about directional dependencies. The correlation coefficients are then used to downscale coarse scale ASCAT SM by calculating a directional-weighted average for each local pixel. First results over Europe reveal realistic and robust SM pattern in combination with a clear benefit of the additional high resolution information from S-1. This novel downscaled SM dataset could serve as input for regional to local applications like flood detection, drought monitoring or other applications that require a high spatial as well as temporal resolution. Moreover, the parameters of the directional resampling approach provide insight into spatial SM or rainfall relationships.

Wagner, W., Pathe, C., Doubkova, M., Sabel, D., Bartsch, A., Hasenauer, S., Blöschl, G., Scipal, K., Martínez-Fernández, J. & Löw, A. (2008). Temporal stability of soil moisture and radar backscatter observed by the Advanced Synthetic Aperture Radar (ASAR). Sensors, 8(2), 1174-1197.