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From ASCAT to Sentinel-1: Soil Moisture Monitoring using European C-Band Radars

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The Advanced Scatterometer (ASCAT) is a C-Band radar instrument flown on board of the series of three METOP satellites. Albeit not operating in one of the more favorable longer wavelength ranges (S, L or P-band) as the dedicated Soil Moisture and Ocean Salinity (SMOS) and Soil Moisture Active Passive (SMAP) missions, it is one of main microwave sensors used for monitoring of soil moisture on a global scale. Its attractiveness for soil moisture monitoring applications stems from its operational status, high radiometric accuracy and stability, short revisit time, multiple viewing directions and long heritage (Wagner et al. 2013). From an application perspective, its main limitation is its spatial resolution of about 25 km, which does not allow resolving soil moisture patterns driven by smaller-scale hydrometeorological processes (e.g. convective precipitation, runoff patterns, etc.) that are themselves related to highly variable land surface characteristics (soil characteristics, topography, vegetation cover, etc.). Fortunately, the technique of aperture synthesis allows to significantly improve the spatial resolution of spaceborne radar instruments up to the meter scale. Yet, past Synthetic Aperture Radar (SAR) missions had not yet been designed to achieve a short revisit time required for soil moisture monitoring. This has only changed recently with the development and launch of SMAP (Entekhabi et al. 2010) and Sentinel-1 (Hornacek et al. 2012). Unfortunately, the SMAP radar failed only after a few months of operations, which leaves Sentinel-1 as the only currently operational SAR mission capable of delivering high-resolution radar observations with a revisit time of about three days for Europe, about weekly for most crop growing regions worldwide, and about bi-weekly to monthly over the rest of the land surface area. Like ASCAT, Sentinel-1 acquires C-band backscatter data in VV polarization over land. Therefore, for the interpretation of both ASCAT and Sentinel-1 backscatter observation, the same physical processes and geophysical variables (e.g. vegetation optical depth, surface roughness, soil volume scattering, etc.) need to be considered. The difference lies mainly in the scaling, i.e. how prominently the different variables influence the C-band data at the different spatial (25 km versus 20 m) and temporal (daily versus 3-30 days repeat coverage) scales. Therefore, while the general properties of soil moisture retrievals schemes used for ASCAT and Sentinel-1 can be the same, the details of the algorithm and parameterization will be different. This presentation will review similarities and differences of soil moisture retrieval approaches used for ASCAT and Sentinel-1, with a focus on the change detection method developed by TU Wien. Some first comparisons of ASCAT and Sentinel-1 soil moisture data over Europe will also be shown.

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