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Soil moisture retrieval from Sentinel-1 satellite data

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Reliable up-to-date information on the current water availability and models to evaluate management scenarios are indispensable for skilful water management. The Sentinel-1 radar satellite programme provides an opportunity to monitor water availability (as surface soil moisture) from space on an operational basis at unprecedented fine spatial and temporal resolutions. However, the influences of soil roughness and vegetation cover complicate the retrieval of soil moisture states from radar data. In this contribution, we investigate the sensitivity of Sentinel-1 radar backscatter to soil moisture states and vegetation conditions. The analyses are based on 105 Sentinel-1 images in the period from October 2014 to January 2016 covering the Twente region in the Netherlands. This area is almost flat and has a heterogeneous landscape, including agricultural (mainly grass, cereal and corn), forested and urban land covers. In-situ measurements at 5 cm depth collected from the Twente soil moisture monitoring network are used as reference. This network consists of twenty measurement stations (most of them at agricultural fields) distributed across an area of 50 km $\times$ 40 km. The Normalized Difference Vegetation Index (NDVI) derived from optical images is adopted as proxy to represent seasonal variability in vegetation conditions.

The results from this sensitivity study provide insight into the potential capability of Sentinel-1 data for the estimation of soil moisture states and they will facilitate the further development of operational retrieval methods. An operationally applicable soil moisture retrieval method requires an algorithm that is usable without the need for area specific model calibration with detailed field information (regarding roughness and vegetation). Because it is not yet clear which method provides the most reliable soil moisture retrievals from Sentinel-1 data, multiple soil moisture retrieval methods will be studied in which the fine spatiotemporal resolution and the dual-polarized information of Sentinel-1 are utilized. Three candidate algorithms are presented at the conference, which are a data-driven algorithm, inversion of a radar scattering model and downscaling of coarser resolution soil moisture products. The research is part of the OWAS1S project (Optimizing Water Availability with Sentinel-1 Satellites), which stands for integration of the freely available global Sentinel-1 data and local knowledge on soil physical processes, to optimize water management of regional water systems and to develop value-added products for agriculture.