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1km Soil Moisture from Downsampled Sentinel-1 SAR Data: Harnessing Assets and Overcoming Obstacles.

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Radars onboard Earth observing satellites allow estimating Surface Soil Moisture (SSM) regularly and globally. The use of coarse-scale measurements from active or passive radars for SSM retrieval is well established and in operational use. Thanks to the Sentinel-1 mission, launched in 2014 and deploying Synthetic Aperture Radars (SAR), high-resolution radar imagery is routinely available at the scale of 20 meters, with a high revisit frequency of 3-6 days and with unprecedented radiometric accuracy.

However, the direct exploitation of high-resolution SAR data for SSM retrieval is complicated by several problems: Small-scaled contributions to the radar backscatter from individual ground features often obscure the soil moisture signal, rendering common algorithms insensitive to SSM. Furthermore, the influence of vegetation dynamics on the radar signal is less understood than in the coarse-scale case, leading to biases during the vegetation period. Finally, the large data volumes of high-resolution remote sensing data present a great load on hardware systems. Consequently, a spatial resampling of the high-resolution SAR data to a 500 meters sampling is done, allowing the exploitation of information at 10 meter sampling, but reducing effectively the inherent uncertainties. The thereof retrieved 1km SSM product aims to describe the soil moisture dynamics at medium scale with high quality.

We adopted the TU-Wien Change Detection algorithm to the Sentinel-1 data, which was already successfully used for retrieving SSM from ERS-1/2 and Envisat-ASAR observations. The adoption entails a new method for SAR image resampling, including a masking for pixels that do not carry soil moisture signals, preventing them to spread during downsampling. Furthermore, the observation angle between the radar sensors and the ground is treated in a different way, as Sentinel-1 sensors observe from fixed orbit paths (in contrast to other radar sensors). Here, a regression model is developed that successfully estimates the dependency of radar backscatter to observation angle with statistical parameters from the Sentinel-1 SAR time series archive.

We present the Sentinel-1 1km-SSM product generated by the adopted change detection algorithm. The dataset covers the European continent and holds data from October 2014 ongoing. In addition to a validation of the SSM product, the statistical SAR parameters used during SSM retrieval are examined.