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Estimation of soil moisture from Sentinel data

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The present project presents the technical implementation, testing and validation of a soil moisture retrieval algorithm in Python using C-band Sentinel-1 data at high incidence angle (42°). The retrieval algorithm is based on the alpha approximation, first developed by [Balenzano et al. 2011]. The alpha approximation utilizes the dense temporal coverage of the Sentinel-1 mission, assuming that changes in backscatter between subsequent acquisitions are only due to variations in soil moisture, such that vegetation and roughness can be neglected. The area used for testing the algorithm was chosen to be the region surrounding the Foulum test center for agricultural studies in Denmark, due to the availability of time series from 2018 of in situ soil moisture measurements to be used for validation. Masking of too densely vegetated areas have been performed using the cross-polarized component of the SAR backscatter, which have been validated using NDVI maps.

Auxiliary data, including land cover maps and parcel borders enable the computation of backscatter field means, significantly reducing the impact of speckle noise and thus decreasing uncertainty of the estimated soil moisture. Consequently, the results have field scale resolution (i.e. 0.1 km). The permittivity to soil moisture inversion is performed using a polynomial model by [Hallikainen et al. 1985], where a soil texture map provide the information necessary to obtain precise results.

Further work will aim toward applying a change detection algorithm in order to detect sudden temporal changes in vegetation and surface roughness, as the alpha approximation is inherently sensitive to such sudden changes.

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