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Using Envisat ASAR Global Mode data for Surface Soil Moisture Retrieval over Oklahoma (USA) using a change detection approach

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Soil moisture as a key element in global cycles of water, energy and carbon has been is in the focus of the active remote sensing community for more than three decades now. Due to technical and methodological constraints, operational soil moisture retrieval from conventional strip-map mode SAR data still is not available. Experiences with temporal high resolution scatterometer data revealed the potential of change detection techniques for soil moisture retrieval. Advanced SAR sensors like the Envisat ASAR also offer data acquired in ScanSAR mode at medium spatial and temporal resolutions.

In the presented study, a comprehensive archive of Envisat ASAR Global Mode data acquired over Oklahoma (USA) is used for adapting a change detection soil moisture retrieval algorithm originally developed for ERS-1/2 scatterometer data. Radar backscatter time-series measurements are used to define two location specific reference values: the dry reference characterizes radar backscatter at dry soil conditions at wilting level and the wet reference characterizes radar backscatter at wet soil moisture conditions at field capacity. Individual radar backscatter measurements are scaled between the dry and the wet reference, giving relative surface soil moisture ranging between 0% and 100%.

For validation, in-situ soil moisture measurements from the Oklahoma Mesonet and well established ERS-1/2 scatterometer derived relative surface soil moisture data have been used. Good agreement between ASAR GM relative surface soil moisture and both in-situ soil moisture measurements and ERS-1/2 scatterometer derived soil moisture was observed. The direct comparison of the results shows that the surface soil moisture extracted from ERS-1/2 scatterometer data performs slightly better than the data derived from ASAR GM. As the main source of error, the noise of the ASAR GM data with a value of 1.2 dB has been identified which is relatively high when compared to radiometric resolution of at least 0.3 dB of the ERS scatterometer. Nevertheless, the ASAR GM data offer surface soil moisture data with much more details than the ERS-1/2 scatterometer data and still keeping the capability of the scatterometer data to map temporal surface soil moisture trends. The validation also showed that operational use of ASAR GM data for soil moisture retrieval using change detection techniques is possible.