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Use of dense temporal series of C-band SAR data for soil moisture retrieval over agricultural sites

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Information about the spatial and temporal distribution of volumetric soil moisture content (mv) at the regional scale and high spatial resolution (100-1000m) is of great importance for a number of land applications, such as for instance flood monitoring and crop yield forecast. Over the last decades, Synthetic Aperture Radar (SAR) systems have widely demonstrated their high sensitivity to mv and therefore they have raised large expectations concerning their capability in providing mv maps at high spatial resolution. However, up to date no operational algorithm for mv retrieval from SAR data is yet available. One of the reasons that have mainly hindered the use of SAR space mission data in operational applications is the long revisit time, which hampers services requiring information with a higher frequency (e.g. weekly or bi-weekly).
The availability of dense temporal series of SAR acquisitions of the near future generation of SAR systems with a short revisit cycle, such as the European Sentinel-1 costellation, will make possible the development of operational algorithms that will be beneficial to the management of renewable resources. Indeed, one of the most promising approaches for improving the reliability of mv retrieval from SAR data is the use of temporal changes of backscatter. The rational of this method is that the temporal scale characteristic of mv changes is in the order of few days whereas the temporal changes of the other surface parameters affecting the radar backscatter (e.g. surface roughness, canopy structure, vegetation biomass) usually occur at longer temporal scales (e.g. few weeks). Based on this approach, a soil moisture retrieval algorithm has recently been developed and tested over a data set collected by the E-SAR airborne system [1]. It has been for instance observed that at C-band the retrieval of mv can be reliable only over crops whose backscatter is not dominated by the volume scattering. As a consequence, a previous classification step is required.

In this context, the objective of this paper is to present the developed soil moisture retrieval and to extend its assessment to a longer temporal series of C-band ASAR data acquired from February to August 2006 in the framework of the European Space Agency AgriSAR'06 campaign over a German agricultural site (DEMMIN). In order to have the most accurate estimate of soil moisture maps of the DEMMIN test site in coincidence with the ASAR acquisitions, calibrated soil moisture maps over a grid of 100m have been produced by a spatially distributed hydrologic model following the procedure in [2]. This requirement is extremely important to assess the accuracy of the retrieval algorithm on a wide area because the soil moisture fast changes in time and space.

The study illustrates the methodology used and provides an assessment of the algorithm applicability to C-band SAR data, by comparing the ASAR-derived soil moisture maps over the DEMMIN site with the hydrologically modelled soil moisture maps.

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