On the retrieval of soil moisture content over agricultural sites using L band SAR data

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Abstract

Soil moisture content is a parameter of major importance for land applications at both watershed and regional scale such as hydrology and agriculture. In the past, a vast number of experimental and theoretical studies relating radar measurements to soil and vegetation parameters have been conducted. Such studies have widely demonstrated the sensitivity of Synthetic Aperture Radar (SAR) measurements to soil moisture content and vegetation biomass. The inverse problem of retrieving soil and vegetation parameters from the observed radar response of the surface has been also widely investigated. The most promising algorithms use change detection techniques applied to multi-temporal SAR data. A priori information on surface parameters is also required in order to improve the robustness and the accuracy of retrieval algorithm. Based on this approach, previous works [e.g. Mattia et al., TGARS, vol. 44, n. 4, April 2006] demonstrated the feasibility of retrieving, from C-band SAR data, superficial soil moisture content, over sparse vegetated fields, with an accuracy of approximately 5%. However, an important limitation of currently available C-band space-borne SAR systems is that, in presence of well developed agricultural crops, they are usually not able to retrieve soil moisture values with sufficient accuracy. In this respect, the higher penetration of L-band SAR signal into the canopy, with respect to shorter wavelengths such as C- or X-bands, is expected to highly improve the SAR capability to monitor soil moisture on a quasi-continuous temporal basis.

In this context, the main objective of this study is to illustrate a soil moisture retrieval algorithm using L-band SAR data and appropriately assimilating a priori information on surface parameters. As a preliminary step, a sensitive study of L-band SAR data to soil moisture content over agricultural fields as a function of crop structure and crop biomass is presented.

The experimental data analysed in the study encompass in situ measurements and L-band SAR data acquired during three experimental campaigns, namely Little Washita (USA, 1994); Barrax (Spain, 2003) and Agrisar06 (Germany, 2006). This work was supported in part by the European Space Agency (ESA), European Space Research and Technology Centre (ESTEC), under Contract 19558/06/NL/HE.