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Improved characterization of land surface processes by means of synergistically coupled land surface and microwave backscattering models

A. Loew, W. Mauser

Department of Earth and Environmental Sciences, University of Munich, Germany
(a.loew@lmu.de / Fax: ++49-89-2180-6675)

Microwave remote sensing has proven its capabilities to provide valuable informations about the landsurface in the last decades. New sensor generations as e.g. ENVISAT ASAR are capable to gather frequent informations with an high information content. To make use of these multiple imaging capabilities, sophisticated parameter inversion and assimilation strategies have to be applied.

The paper presents a synergistic approach, coupling a landsurface process model with microwave backscattering models. It enables the realistic simulation of SAR images of various imaging geometries, based on bio- and geophysical input parameters. An interface between the models allows the direct assimilation of remote sensing data into the landsurface process model by comparison with SAR imagery.

A new microwave backscattering model for vegetated areas was developed. It enables the separation of the soil and vegetation contributions to the backscattering coefficient, which is crucial to obtain reliable simulation results for different imaging geometries. It is shown, that the vegetation influence on the signal can be directly derived from ENVISAT ASAR alternating polarization data. It is shown that it is dependant on plant biophysical variables.

To enable spatially distributed simulation of the SAR backscattering coefficient, an interface to a process oriented landsurface model is proposed, which provides the necessary input variables for the backscattering model. It is shown, that this coupled modelling approach leads to promising and accurate estimates of the backscattering coefficient. The methodology was validated, using 17 ENVISAT ASAR alternating

polarization datasets for a heterogeneous testsite in the alpine foreland ($\sim$450 km^2). Comparisons between the simulated and observed backscattering coefficients revealed a mean deviation of 0.3 dB with an appropriate standard deviation of 2.8 dB. The remaining residues were analysed by a detailed field based analysis. It turned out that most deviations result from imprecise input parameter sets, provided by the landsurface model. These can be identified and improved with help of the remote sensing informations. An outline for the inversion and improved derivation of surface soil moisture, using the coupled modelling approach is given.

The developed models allow the accurate prediction of the SAR backscattering coefficient. The various soil and vegetation scattering contributions can be separated. The direct interface to a physical based landsurface process model, allows the spatially distributed modelling of the backscattering coefficient and the direct assimilation of remote sensing data into a landsurface process model. The proposed models and inversion strategies are therefore reliable tools which can be used for sophisticated practice oriented problem solutions in a manifold manner.