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Soil moisture retrieval from C- and L-band SAR using modeled effective roughness

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Soil moisture retrieval from Synthetic Aperture Radar (SAR) using state-of-the-art backscattering models is not yet fully operational at the present, mainly due to difficulties involved in the parameterization of soil surface roughness. Field measurements of roughness parameters, such as the Root Mean Square (RMS) height and the correlation length, generally display a non-stationary and scale dependent behaviour and are also affected by the processing techniques applied. As a consequence, input of these measurements to backscattering models often yields poor soil moisture retrieval results.

Recently, an increasing interest has been drawn to the use of calibrated or effective roughness parameters, as they circumvent issues known to the parameterization of field measured roughness. This paper analyzes effective roughness parameters derived from C- and L-band SAR observations over a large number of agricultural seedbed sites in Europe and shows that parameters may largely differ between SAR acquisitions, as they are related to the observed backscattering coefficients. Therefore, a statistical model is developed that allows the estimation of effective roughness parameters from remote backscattering observations. Subsequently, these can be propagated through the Integral Equation Model (IEM) for soil moisture retrieval.

The paper demonstrates that statistical models allow for a precise estimation of roughness parameters at both SAR frequencies. To the contrary, soil moisture retrieval results show to be accurate only at L-band. In case of C-band, the retrieval appears to be largely affected even by small roughness parameterization errors. Hence, the use of L-band is recommended for further studies on the retrieval of surface parameters from SAR.