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On the derivation of soil surface roughness from multi parametric PolSAR data and its potential for hydrological modeling

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Abstract. The potential of multi parametric polarimetric SAR (PolSAR) data for soil surface roughness estimation is investigated and its potential for hydrological modeling is evaluated. The study utilizes microwave backscatter collected from the DEMMIN test site in the North East of Germany during the AgriSAR 2006 campaign using fully polarimetric L-band E-SAR data. In addition to various measurements of soil physical properties, soil surface roughness was measured extensively using photogrammetric image matching techniques for ground truthing. The resulting micro-DSMs are analyzed to correlate a soil surface roughness index to three well established polarimetric roughness estimators. Good results are obtained for $Re_{[\rho RRLL]}$ vs. RMS Height for areas with a polarimetric alpha angel $\alpha<40°$, which is thus used to produce multi temporal roughness data of the test site. The proposed roughness inversion scheme showed sufficiently accurate results (RMSE=0.1) to allow for a first order assessment of soil-hydrological parameters (soil porosity, void ratio), which are crucial for the initialization and operation of hydrological surface models. While uncertainties remain, the dependency of soil bulk density parameters from surface roughness can be shown and thus highlights the potential of the retrieval approach for hydrological model applications.

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