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Benchmarking of L-band soil microwave emission models

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A first step before assimilating Soil Moisture and ocean Salinity (SMOS) L-band brightness temperatures (Tb) over land is to couple land surface models (LSM) to microwave emission models. In this study, the ISBA LSM is coupled to the Community Microwave Emission Model (CMEM). Simulations of Tb are performed over a 3-yr period (2003-2005) for a bare soil field in southwestern France, at the SMOSREX experimental site. Both ISBA and CMEM present several options for the representation of the soil moisture and soil temperature profiles. Simplified 2-layer simulations are compared with more detailed multilayer simulations. In the 2-layer simulations, the soil is divided in two layers (a thin surface layer and a bulk reservoir), and Fresnel laws are used in CMEM to model the smooth surface emissivity. In the multilayer simulations, the ISBA soil diffusion scheme is used (with 11 soil layers represented) together with the Wilheit (1978) option of CMEM. The Tb simulations are compared to the Tb ground observations available for the SMOSREX site, at H and V polarizations and at different angles and the impact of soil roughness is assessed. It is shown that Tb values derived from the more complex multilayer simulations correlate better to the observations than Tb derived from the 2-layer model. This is partly due to a better representation of the soil moisture profile. However, taking surface soil moisture into account in the calculation of soil roughness is needed to represent the seasonal trend of Tb produced by the multilayer model. Finally, the multilayer model is used to investigate the L-band sampling depth for contrasting soil texture profiles. For the SMOSREX soil texture, it is found that Tb is mainly driven by the top 15 cm soil layer. However, from May to October, a significant part of the signal originates from deeper soil layers, and an accuracy of ± 0.1 K can be achieved by representing a multilayer soil profile from the surface to a depth of 35 cm.