Validation of SMOS Brightness Temperatures During the HOBE Airborne Campaign, Western Denmark

The Soil Moisture and Ocean Salinity (SMOS) mission delivers global surface soil moisture fields at high temporal resolution which is of major relevance for water management and climate predictions. Between April 26 and May 9, 2010, an airborne campaign with the L-band radiometer EMIRAD-2 was carried out within one SMOS pixel (44 km × 44 km) in the Skjern River Catchment, Denmark. Concurrently, ground sampling was conducted within three 2 km × 2 km patches (EMIRAD footprint size) of differing land cover. By means of this data set, the objective of this study is to present the validation of SMOS L1C brightness temperatures $T_{\text{B}}$ of the selected node. Data is stepwise compared from point via EMIRAD to SMOS scale. From ground soil moisture samples, $T_{\text{B}}$'s are pointwise estimated through the L-band microwave emission of the biosphere model using land cover specific model settings. These $T_{\text{B}}$'s are patchwise averaged and compared with EMIRAD $T_{\text{B}}$'s. A simple uncertainty assessment by means of a set of model runs with the most influencing parameters varied within a most likely interval results in a considerable spread of $T_{\text{B}}$'s (5–20 K). However, for each land cover class, a combination of parameters could be selected to bring modeled and EMIRAD data in good agreement. Thereby, replacing the Dobson dielectric mixing model with the Mironov model decreases the overall RMSE from 11.5 K to 3.8 K. Similarly, EMIRAD data averaged at SMOS scale and corresponding SMOS $T_{\text{B}}$'s show good accordance on the single day where comparison is not prevented by strong radio-frequency interference (RFI) (May 2, avg. $\text{RMSE} = 9.7 \text{K}$). While the advantages of solid data sets of high spatial coverage and density throughout spatial scales for SMOS validation could be clearly demonstrated, small temporal variability in soil moisture conditions and RFI contamination throughout the campaign limited the extent of the validation work. Further attempts over longer time frames are planned by means of soil moisture network data as well as studies on the impacts of organic layers under natural vegetation and higher open water fractions at surrounding grid nodes.

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