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Simulation of SMOS brightness temperature observations over the Upper Mississippi basin, USA

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The Soil Moisture and Ocean Salinity (SMOS) satellite mission is routinely providing multi-angular observations of brightness temperature (TB) at both horizontal and vertical polarization and with a high acquisition frequency (~3 day repeat period) at the global scale. The assimilation of such data into a hydrologic model may largely improve the skill of operational flood forecasts through an improved estimation of soil moisture and temperature. To accommodate for the direct assimilation of SMOS brightness temperature data, the hydrologic model has been coupled with a radiative transfer model (RTM).

The flood forecast model selected for this study is the Variable Infiltration Capacity (VIC) land surface model. The latter model has been coupled with the Community Microwave Emission Model (CMEM) in order to simulate multi-angular Top Of Atmosphere (TOA) TBs over the Upper Mississippi basin, USA. A comparison between SMOS TB observations from 2010-2011 and simulations with literature based RTM parameters reveals basin average biases over the Upper Mississippi of up to 30 K. Therefore, multi-angular SMOS observations from the year 2010 have been used to calibrate a number of RTM parameters, which are related to the description of surface roughness and vegetation optical depth, for the different land cover types present in the basin. After calibration, the basin average TB bias decreases to approximately 0-5 K, depending on the polarization and ascending/descending track of the satellite. Furthermore, the spatial patterns in TB show a large correspondence with the presence of different land cover types. Therefore, it can be concluded that the calibration of the RTM parameters is an efficient means for removing bias between SMOS observations and model simulations, being a necessary step prior to data assimilation.