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Where are the peatlands? Comparing two global peatland maps through L-band brightness temperature simulations

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Mapping the global peatland distribution is important for embedding peatland processes into Earth System Models. Peatland maps are typically compiled from nation-specific soil or ecosystem maps or based on machine learning tools trained on such data. Here, we evaluate the performance of a land surface model with two different peatland map inputs in providing critical land surface estimates (soil moisture, temperature) to a Radiative Transfer Model (RTM) for L-band brightness temperature (Tb). We hypothesize that an improved performance of the land surface model in Tb space indicates a better spatial peatland distribution input within the footprint of Tb observations (~40 km).

We employ the NASA Catchment Land Surface Model (CLSM) with a recently added module for peatland hydrology (PEATCLSM modules). We run this model at a 9-km EASEv2 resolution over the Northern Hemisphere for two soil maps that differ in their peatland distributions. The applied soil distributions are: (MAP1) a combination of the Harmonized World Soil Database and the State Soil Geographic Database, also used to generate the Soil Moisture Active Passive (SMAP) Level-4 soil moisture product, and (MAP2) a hybrid of HWSD-STATSGO and the 'PEATMAP' product, which is mainly compiled from national peatland maps. MAP2 indicates ~30 % more peatland area over the Northern Hemisphere. For both peat distributions, CLSM is run and parameters of the RTM are calibrated with 10 years of multi-angular L-band Tb observations from the Soil Moisture and Ocean Salinity SMOS mission. Afterwards, CLSM is run together with the calibrated RTM within a data assimilation system, with and without (open-loop) assimilating SMAP Tb observations, for the period 2015-2020. Our results demonstrate that Tb misfits (in both the open-loop and assimilation runs) are reduced in the areas with the largest differences in peat distribution, thus indicating a basic validity of assuming a peatland-like hydrological dynamics for the larger peat extent of MAP2. Results will be discussed in the context of how peatlands are defined in global peatland maps and the question of what is typically modeled as a peatland in Earth System Models. We propose the evaluation of future releases of peatland maps in Tb space as a tool to evaluate their suitability for implementation into Earth System Models.