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Towards an improved soil moisture retrieval for organic-rich soils from SMOS passive microwave L-band observations

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From the passive L-band microwave radiometer onboard the Soil Moisture and Ocean Salinity (SMOS) space mission global surface soil moisture data is retrieved every 2 - 3 days. Thus far, the empirical L-band Microwave Emission of the Biosphere (L-MEB) radiative transfer model applied in the SMOS soil moisture retrieval algorithm is exclusively calibrated over test sites in dry and temperate climate zones. Furthermore, the included dielectric mixing model relating soil moisture to relative permittivity accounts only for mineral soils. However, soil moisture monitoring over the higher Northern latitudes is crucial since these regions are especially sensitive to climate change. A considerable positive feedback is expected if thawing of these extremely organic soils supports carbon decomposition and release to the atmosphere. Due to differing structural characteristics and thus varying bound water fractions, the relative permittivity of organic material is lower than that of the most mineral soils at a given water content. This assumption was verified by means of L-band relative permittivity laboratory measurements of organic and mineral substrates from various sites in Denmark, Finland, Scotland and Siberia using a resonant cavity. Based on these data, a simple empirical dielectric model for organic soils was derived and implemented in the SMOS Soil Moisture Level 2 Prototype Processor (SML2PP). Unfortunately, the current SMOS retrieved soil moisture product seems to show unrealistically low values compared to in situ soil moisture data collected from organic surface layers in North America, Europe and the Tibetan Plateau so that the impact of the dielectric model for organic soils cannot really be tested. A simplified SMOS processing scheme yielding higher soil moisture levels has recently been proposed and is presently under investigation. Furthermore, recalibration of the model parameters accounting for vegetation and roughness effects that were thus far only evaluated using the default dielectric model for mineral soils is ongoing for the "organic" L-MEB version. Additionally, in order to decide where a soil moisture retrieval using the "organic" dielectric model should be triggered, information on soil organic matter content in the soil surface layer has to be considered in the retrieval algorithm. For this purpose, SoilGrids (www.soilgrids.org) providing soil organic carbon content (SOCC) in g/kg is under study. A SOCC threshold based on the relation between the SoilGrids' SOCC and the presence of organic soil surface layers (relevant to alter the microwave L-band emissions from the land surface) in the SoilGrids' source soil profile information has to be established. In this communication, we present the current status of the above outlined studies with the objective to advance towards an improved soil moisture retrieval for organic-rich soils from SMOS passive microwave L-band observations.