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Estimating soil moisture at various depths from near surface ESA CCI Soil Moisture

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Soil moisture drought is a natural, reoccurring phenomenon that can affect any part of the land. It consists one of the most challenging problems for the modern agriculture as it directly affects the water, energy and food security nexus. Remote sensed soil moisture products have been proved to be valuable tools for the study of the soil moisture droughts. The European Space Agency (ESA), through the Climate Change Initiative (CCI) is currently providing nearly 4 decades of global satellite observed, fully homogenized soil moisture (SM) data for the uppermost soil layer. This data is valuable as it consists one of the most complete in time and space observed soil moisture dataset available. One of the main limitations that ESA CCI SM exhibits is the limited depth at which the soil moisture is estimated (limited to approximately 5cm of soil). In this work we use the ESA CCI SM data to estimate the Soil Water Index (SWI) at the global scale, which can serve as a soil moisture approximation for different depths. The SWI is a simple index that simulates the infiltration process. It utilizes an infiltration parameter T, which is related to the hydraulic characteristics. In this work, the T parameter is calibrated and validated at point scale based on soil moisture measurements of the International Soil Moisture Network (ISMN) and the FluxNet2015 (Tier 1) datasets. The regionalization of the T parameter at global scale is performed by linking T to physical soil descriptors using multilinear regression. Physical soil descriptors were obtained from the Soil Grids 250m dataset, i.e. bulk density, sand/silt/clay fractions, soil organic carbon and coarse fragments. The result of this operation is an SWI dataset for a series of different depths between 0 and 1m. This dataset can be used for the systematic evaluation of global hydrological models on their ability to simulate the soil water.