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Assessment of SMOS soil moisture considering the heterogeneity of geophysical parameters within the footprint

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Evaluating the uncertainties of satellite soil moisture (as SMOS or SMAP) is crucial for enhancing our comprehension of climate mechanisms, such as the water cycle or the energy balance. The commonly used method is to evaluate the agreement between the satellite data and a reference, which are often ground measurements. However, the measurand in the present case is soil moisture at the satellite footprint scale, which means a much larger spatial and temporal scale than the in situ one. Various methods are employed to address these scale mismatches, such as multiple spatial sampling with in situ measurements within the satellite footprint (dense networks with strategic location installation) or the probes' classification with representativeness indicators (based on triple collocation analysis, for example). Within ESA's Fiducial Reference Measurement for Soil Moisture project (FRM4SM), we propose to investigate the level of heterogeneity within the SMOS satellite footprint due to its influence on the complexity of the retrieval model and also its influence on the scale mismatch with the reference. To do so, various indices are developed to i) quantify the footprint heterogeneity in terms of the spatial distribution of hydro-geophysical parameters, and ii) analyse the impact on the retrieval quality. We present the analysis using indices of diversity of surface conditions (Shannon and Gini indices), and indices based on the level of similarities of hydro-geophysical conditions between the probes' environment and the satellite footprint. Results show that even though the Shannon index is not significantly related to the soil moisture retrieval performances, the index based on the similarities of surface conditions better correlates with the retrieval performances.