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# Utility of Coarse and Downscaled Soil Moisture Observations at C- and L-Band in Hydrological Simulations

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Current microwave soil moisture ($\theta$) products, including AMSR-E, are based on sensors operating at C-band. Retrieval performance at this frequency degrades as vegetation increases. New satellite missions specifically dedicated to $\theta$ sensing, including SMOS and SMAP, are expected to produce more accurate estimates, as they utilize L-band sensors that are less sensitive to vegetation. Assessing the enhancement of L-band $\theta$ products in terms of their utility for hydrologic forecasting is thus important to support new spaceborne missions. In this study, we pursue this objective by using $\theta$ data from the SMEX04 experiment in Sonora (Mexico), including: L- and C-band data from airborne sensors in a 75 x 50 km$^2$ area (800-m resolution) and ground data from an elevation transect in the Sierra Los Locos (SLL) basin. We first calibrate a multifractal downscaling model in two frameworks mimicking disaggregation of: (1) AMSR-E (from 25.6 to 0.8 km), and (2) SMAP (from 12.8 to 0.8 km) products using C- and L-band aircraft $\theta$ data, respectively. We show that, due to the higher accuracy of the L-band sensor, the ensemble of $\theta$ fields disaggregated in the SMAP framework is able to reproduce, with significant improvement, the $\theta$ variability (a) within the satellite footprint; (b) at basin scale, and (c) along the transect. The utility of C- and L-band $\theta$ products for hydrological simulations is then tested through simple data assimilation experiments using a distributed model focused on the SLL basin. Results reveal that the model prognostic capability is considerably enhanced when L-band $\theta$ fields are assimilated. The advantages of ingesting an ensemble of downscaled $\theta$ data consist of: (i) the capability for the model to simulate soil moisture in distributed fashion, which is prevented by assimilating the single coarse satellite estimate; and (ii) the possibility to produce an ensemble of hydrological simulations accounting for predictive uncertainty. This study yields insights into the added value of new satellite missions based on L-band sensors.