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Calibration of a Model for Satellite Soil Moisture Downscaling in Different Climatic Regions

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Spatially-distributed soil moisture (θ) estimates are currently provided by satellite-borne passive remote sensors at scales of 25-50 km. The direct use of these coarse θ measurements can introduce biases in the simulation of water and energy fluxes in land-surface models, due to the strong non-linearity of the processes involved. As a result, operational algorithms are required to downscale satellite measurements. In this work, we present results of a calibration effort for a soil moisture multifractal downscaling model, based on a log-Poisson generator dependent on two parameters (i.e., c and β). The downscaling approach was first tested using the aircraft (800-m) θ estimates collected during the Southern Great Plains experiment in 1997 (SGP97). The model was applied from the coarse scale of 25.6 km (approximately a satellite footprint) to the fine scale of 800 m. Results showed that β parameter can be considered as constant across the region, while c parameter can be related to coarse-scale predictors including a dynamic component (the spatial mean soil moisture) and a stationary component accounting for static features (i.e. topography, soil texture, vegetation). In a second phase of the study, we showed preliminary results aimed at extending the validity of our calibration approach to θ data collected in areas with different climate as compared to SGP97. In particular, we used the datasets of (i) the Soil Moisture Experiment in 2002 (SMEX02) collected in an area with moderate to heavy water content in Iowa, and (ii) SMEX04, conducted in arid regions in Arizona and Sonora (Mexico). The final goal of the study is to furnish a robust operational relation able to characterize, with minimal computational demand, the sub-grid variability within satellite estimates in different regions, for use in land-surface models and data assimilation systems.