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On the calibration of an evaporation-based disaggregation method of SMOS soil moisture data

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High resolution (HR) soil moisture estimates are needed by a range of agricultural and hydrological applications, considering it's one of the drivers of evaporation, infiltration and runoff. Since the resolution of current remote sensing estimates (tens of kilometres) is insufficient for the majority of these applications, different downscaling techniques are used to improve the resolution. Amongst the existing methodologies, DISPATCH (DISaggregation based on a Physical And Theoretical scale CHange) has been proven to accurately improve the resolution of SMOS (Soil Moisture Ocean Salinity) soil moisture data, by using a soil evaporative efficiency (SEE) model. SEE can be derived from remotely sensed land surface temperature (LST) and normalized difference vegetation index (NDVI) data. DISPATCH uses two different SEE models: a temperature-based LST-driven model, and a soil moisture-based SMOS-driven model. This study aims at improving the robustness of the soil moisture-based SEE model, by testing different calibrations and models. Two SM-based SEE models, one linear and one nonlinear, are tested, each being calibrated from remote sensing data on a daily and on a multi-date basis. The approaches were implemented over two mixed dry and irrigated areas in Catalonia, Spain, and over a dry area in Morocco. When looking at the two models in the daily calibration mode, the linear model performs better. Over the two areas in Spain, the correlation coefficients obtained with the linear model are 0.63 and 0.18 as opposed to 0.13 and -0.08, respectively. In Morocco, the correlation coefficients are

roughly similar, 0.32 (linear mode) and 0.31 (nonlinear mode). The slopes of linear regression are also improved in the linear case, 0.44 and 0.88, as opposed to -0.14 and 0.11, for the Spanish sites. However, the best results were obtained in the case of the nonlinear model with an annual calibration. When comparing the linear and nonlinear models in the annual calibration mode, correlation coefficients are improved when using the nonlinear mode, from 0.13 and -0.08 to 0.78 and to 0.47 (Spanish site), and from 0.25 to 0.33 (Moroccan site). The slopes of linear regression are also improved, from 0.11 to 0.88, -0.14 to 1.15 (Spain) and from 0.53 to 0.74 (Morocco). The root mean square difference is generally low, ranging from 0.03 to 0.17 m3/m3. Considering several studies that report a strong nonlinear behaviour of the SEE with respect to SM, the nonlinear SM-based model in DISPATCH, combined with a multi-date calibration, is proven to give a significantly better performance, enhancing the robustness of the derived HR SM products.