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Reducing measurement scale mismatch to improve surface energy flux estimation

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Soil moisture importantly controls land surface processes such as energy and water partitioning. A good understanding of these controls is needed especially when recognizing the challenges in providing accurate hyper-resolution hydrometeorological simulations at sub-kilometre scales. Soil moisture controlling factors can, however, differ at distinct scales. In addition, some parameters in land surface models are still often prescribed based on observations obtained at another scale not necessarily employed by such models (e.g., soil properties obtained from lab samples used in regional simulations). To minimize such effects, parameters can be constrained with local data from Eddy-Covariance (EC) towers (i.e. latent and sensible heat fluxes) and Point Scale (PS) soil moisture observations (e.g., TDR). However, measurement scales represented by EC and PS still differ substantially. Here we use the fact that Cosmic-Ray Neutron Sensors (CRNS) estimate soil moisture at horizontal footprint similar to that of EC fluxes to help answer the following question: Does reduced observation scale mismatch yield better soil moisture - surface fluxes representation in land surface models?

To answer this question we analysed soil moisture and surface fluxes measurements from twelve COSMOS-Ameriflux sites in the USA characterized by distinct climate, soils and vegetation types. We calibrated model parameters of the Joint UK Land Environment Simulator (JULES) against PS and CRNS soil moisture data, respectively. We analysed the improvement in soil moisture estimation compared to uncalibrated model simulations and then evaluated the degree of improvement in surface fluxes before and after calibration experiments.

Preliminary results suggest that a more accurate representation of soil moisture dynamics is achieved when calibrating against observed soil moisture and further improvement obtained with CRNS relative to PS. However, our results also suggest that a more accurate representation of soil moisture in the model, under reduced scale mismatch, did not necessarily translate to improvements in surface heat fluxes.