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Will assimilating measured soil moisture into land surface models make them miscalculate surface fluxes?

Rafael Rosolem (1), W. James Shuttleworth (1), Tim Hoar (2), Avelino Arellano (3), Jeffrey Anderson (2), Xubin Zeng (3), Trenton Franz (1), and Marek Zreda (1)

(1) Department of Hydrology and Water Resources, University of Arizona, Tucson, USA (rosolem@email.arizona.edu), (2) Institute for Mathematics Applied to Geosciences (IMAGe), National Center for Atmospheric Research (NCAR), Boulder, CO, (3) Department of Atmospheric Sciences, University of Arizona, Tucson, USA

Improvements in numerical weather and short-term climate predictions rely on the ability of land surface models to successfully translate the more accurate soil moisture state (obtained for instance through data assimilation) into more realistic surface energy fluxes (i.e. sensible and latent heat densities). This assumption may not be achieved due to poorly defined model parameters, for example. Data assimilation experiments with synthetic observations have shown the importance of model calibration to successfully reduce undesired biases between model and observations. A similar approach is used here to estimate root zone soil moisture status from actual cosmic-ray neutron measurements made by the COsmic-ray Soil Moisture Observing System (COSMOS). Cosmic-ray sensors provide intermediate scale root zone soil moisture (approximately 300-400 m radius, and depths varying from 10 to 70 cm), filling the gap between traditional point-scale methods and large-scale satellite remote sensing. Soil moisture profiles from the Noah land surface model are converted to equivalent site-specific neutron counts through the COsmic-ray Interaction Code (COSMIC). The results from the data assimilation of cosmic-ray neutrons are compared with and without prior calibration of key parameters in the Noah model. The calibration is performed using only soil moisture measurements from an independent network of sensors distributed within the same footprint as the cosmic-ray sensor for a semi-arid site in Southwestern USA. A Multi-Algorithm, Genetically Adaptive Multi-objective method (AMALGAM) is used for minimizing the individual model errors associated to the mean-squared-error components (i.e. uncertainties in the signal mean, signal variability, and system dynamics, respectively). The resulting surface energy fluxes from both cases are compared with in-situ flux tower measurements.