Initializing Numerical Weather Prediction Models with Model-derived and Satellite-Based Soil Moisture Data

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Modeling studies suggest that soil moisture plays an increasingly important role in planetary boundary layer (PBL) evolution through the local land-atmosphere coupling (LoCo) process chain (Santanello et al, 2011). Latent heat flux relative maxima, co-located with soil moisture relative maxima, alter the surface energy budget. The surface energy budget is a crucial component in determining the state of the PBL, and, therefore the local heterogeneity in soil moisture also becomes a crucial component. To accurately account for antecedent soil moisture variability, this study uses offline Land Information System (LIS) "spin-ups" with varying meteorological forcing quality and varying greenness vegetation fraction (GVF). The offline LIS simulations were then used to initialize short-term NASA Unified Weather Research and Forecasting (NU-WRF) forecasts through the coupled LIS-WRF framework. A comparison is made between the LIS spin-ups, Soil Moisture Active Passive (SMAP) satellite data, and in situ soil moisture probes to define any biases that may be present in the seasonality of the LIS runs, and to address the ability of SMAP to convey soil moisture data that follow proximal observations. The LIS-WRF simulations followed observations more closely when using the LIS spin-up with the best-available meteorological forcing and GVF than when compared to the control run that was initialized by operational standards. This serves as an early step in using offline spin-ups to initialize forecast models, and it suggests that there is potential to use this method to improve operational NWP forecasts.