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A modeling and observational framework for diagnosing local land-atmosphere coupling on diurnal time scales

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Land-atmosphere interactions play a critical role in determining the diurnal evolution of planetary boundary layer (PBL) temperature and moisture states. The degree of coupling between the land surface and PBL must be represented accurately in models, but remains largely unexplored and undiagnosed due to the complex interactions and feedbacks present across a range of scales. Further, uncoupled systems or experiments (e.g., PILPS) may lead to inaccurate water and energy cycle process understanding by neglecting feedback processes such as entrainment. In this study, a framework for diagnosing local land-atmosphere coupling is presented using a coupled mesoscale model with a suite of PBL and land surface model (LSM) options along with observations during field experiments in the U. S. Southern Great Plains. Specifically, the Weather Research and Forecasting (WRF) model has been coupled to NASA's Land Information System (LIS), which provides a flexible and high-resolution representation and initialization of land surface physics and states. Within this framework, the land surface energy balance and mixed layer equilibrium established by each PBL-LSM pair are evaluated in terms of the diurnal temperature and humidity evolution. Results show how these variables are sensitive to and, in fact, integrative of the dominant processes involved in local coupling, which are then quantified and evaluated through the use of mixing diagrams. The results presented here provide a potential pathway to study factors controlling local land-atmosphere coupling (LoCo) using the

LIS-WRF system, which will serve as the foundation for future experiments to evaluate coupled modeling efforts within the community.