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State estimation and predictability in the planetary boundary layer

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Results from experiments assimilating real near-surface temperature, wind, and moisture observatons into a simple model are presented. A single column model with soil, surface-layer, and PBL parameterization schemes that are the same as in the Weather Research and Forecast (WRF) model is used to estimate PBL profiles with an ensemble filter. Surface observations over the southern great plains of North America are assimilated during the spring and early summer period of 2003. To strictly quantify the utility of the observations for determining PBL profiles in the ensemble filter framework, only climatological information is provided for initialization and forcing. Analysis skill, measured against rawinsondes for an independent verification, is compared against climatology to quantify the influence of the observations. Sensitivity to parameterization schemes, and to prescribed values of observation error variance, is examined. Temporal propagation of skillful analyses is also assessed, separating the effects of good prior state estimates from the impact of assimilation at night when covariance is weak. Results show that accurate profiles of temperature, mixing ratio, and winds are estimated with the column model and ensemble filter assimilating only surface observations. Results are largely insensitive to choice of parameterization scheme and specified observation error variance. The effects of using different parameterization schemes within the column model depend on whether assimilation is included, showing the importance of evaluating models within assimilation systems. At night, skillful estimates are possible because the influence of the observations from the previous day is temporally propagated, and atmospheric dynamics in the residual layer operate on slow time scales during the experimental period. Ongoing work to understand the roles of parameter estimation and stochastic models in PBL analysis and forecasting will also described.