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A simulation of a high-temperature event using different land surface schemes

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Using a series of forecast lead times, from short-range to medium-range, and four land surface schemes (LSSs) (i.e. SLAB, NOAH, RUC, and PX) in the Weather Research and Forecasting Model (WRF) Version 3, we designed simulations for the high-temperature event of 23 July 2003 in East China. The sensitivities of short- and medium-range simulations to the LSSs systematically varied with the lead times. Generally, the model reproduced the short-range high-temperature distribution. Furthermore, the simulated weather was sensitive to the LSSs. The LSS-induced sensitivity was higher in the medium range than in the short range. Additionally, the LSS performances were complex, i.e. the PX errors apparently increased in the medium range (longer than 6 days), RUC produced the maximum errors, and SLAB and NOAH had approximately equivalent errors that slightly increased. Further sensitivity simulations reveal that the WRF modeling system assigns relatively low initial soil moisture for RUC, and that soil moisture initialization plays an important role that is comparable to the LSS choice in the simulations. Additionally, an LSS-induced negative feedback between surface air temperature (SAT) and atmospheric circulation in the lower atmosphere was found in the medium range. These sensitivities were mainly caused by the LSS-induced differences in surface sensible heat flux and by errors associated with the lead times. Using the equation for SAT change, further diagnostic analysis reveals the LSS deficiencies in simulating surface fluxes and physical processes that modify the SAT, and indicates main reasons for these deficiencies. These results have implications for model improvement and applications.