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LES of the atmospheric boundary layer diurnal cycle with the Lagrangian scale-dependent subgrid-scale model VIJAYANT KUMAR, Johns Hopkins University, JAN KLEISSL, New Mexico Tech and UCSD, CHARLES MENEVEAU, Johns Hopkins University, MARC PARLANGE, EPFL, Switzerland — Accurately simulating the turbulent structure of the diurnal cycle of the atmospheric boundary layer (ABL) is a critical test for large-eddy simulation (LES). Extreme disparities in the nature of turbulence between unstable, day-time ABL and stably stratified, night-time ABL present a challenge for subgrid-scale models. The Lagrangian scale-dependent (LASD) subgrid-scale model has been recently shown to produce accurate results in flows over heterogeneous surfaces in the neutral boundary layer. In order to evaluate the performance of the LASD model in simulations of ABL flows spanning a wide range of stabilities, a diurnal cycle of the ABL is simulated using the time series of surface heat flux from the HATS experiment (Horst et al. 2004, Kleissl et al. 2004) as the surface boundary condition. Good results are obtained over the entire daily cycle, highlighting the adaptability of the LASD model to disparate flow conditions. Profiles of several flow variables plotted as a function of the surface-layer stability parameter show "hysteretic" behavior, whereas when plotted as a function of the local Obukhov length, they show no "hysteresis." This confirms the validity of Nieuwstadt's local scaling hypothesis for the entire stability regime of the diurnal cycle. Research funded by the National Science Foundation (WCR-0233464).

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