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Nonequilibrium Response of the Daytime Atmospheric Boundary Layer to Mesoscale Forcing JAMES BRASSEUR, BAJALI JAYARAMAN, Penn State, SUE HAUPT, JARED LEE, NCAR — The essential turbulence structure of the daytime atmospheric boundary layer (ABL) is driven by interactions between shear and buoyancy. A relatively strong inversion layer "lid" typically confines the ABL turbulence, whose height grows during the day with increasing surface heat flux (Q_0) to $\sim$ 1-2 km before collapsing with Q_0 towards the day's end. The 3D "microscale" ABL turbulence is forced largely in the horizontal by winds above the capping inversion at the "mesoscale" at the O(100) km scale. Whereas the "canonical" ABL is in equilibrium and quasi-stationary, quasi-2D weather dynamics at the mesoscale is typically nonstationary at sub-diurnal time scales. We study the consequences of nonstationarity in the quasi-2D mesoscale forcing in horizontal winds and solar heating on the dynamics of ABL turbulence and especially on the potential for significant deviations from the canonical equilibrium state. We apply high-fidelity LES of the dry cloudless ABL over Kansas in July forced at the mesoscale (WRF) with statistical homogeneity in the horizontal. We find significant deviations from equilibrium that appear in a variety of interesting ways. One of the more interesting results is that the changes in mesoscale wind direction at the diurnal time scale can destabilize the ABL and sometimes cause a transition in ABL eddy structure that are normally associated with increased surface heating. Supported by DOE. Computer resources by the Penn State ICS.

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