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Evening Transition of the Atmospheric Boundary Layer (ABL)
H.J.S. FERNANDO, University of Notre Dame — Laboratory experiments and theoretical studies were conducted to understand the decay of convective turbulence, with applications to evening transition of ABL over flat terrain. Either a linearly stratified or a homogeneous fluid was used. Initial convection was established with a steady heat flux at the bottom, which was then subjected to gradual cooling. The convection starts to decay with decreasing heat flux, and in stratified runs convective turbulence strongly interacts with the stratification aloft, thus changing the decay behavior substantially depending on the bulk Richardson number. Surprisingly, the turbulence modification during decay is realized by the adjustments occurring in the u-component rather than the w-component as expected. It is shown that stratification near the bottom surface and strong buoyancy effects in the proximity of entraining inversion suppress vertical motions therein to the extent that horizontal layering and a "jet-like" flow structure form. Enhanced dissipation in these layers leads to rapid decay of turbulent kinetic energy, after a time of about $t = (3\text{-}4)t*$, where $t*$ is the convective time scale at the onset of cooling. Oscillations of velocity and temperature fluctuations, development of layering, influence of overlying stratification and lack of agreement with previous numerical modeling were some of the salient features of experimental results.

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