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DNS of stably stratified Ekman flow with surface cooling S. M. IMAN GOHARI, PhD Student, SUTANU SARKAR, Professor — Direct numerical simulations of stably stratified Ekman flow are performed to study turbulence in an atmospheric boundary layer under surface cooling. Stability, classified by the normalized Monin-Obukhov (MO) length scale, is varied by imposing a range of cooling fluxes at the surface to mimic ground radiative cooling. The subsequent flow stability, measured by the MO length scale and bulk Richardson number, changes significantly as the flow evolves. We find considerable qualitative differences when a neutrally stratified Ekman flow is exposed to a constant surface cooling rather than a constant temperature, i.e. changes in the veering angle, super-gesotrophic velocity, surface shear velocity and the boundary layer height. Under strongly stable condition, the transient evolution shows the presence of intermittent turbulent patches. These patches contain small-scale, inclined hairpin structures that are organized into near-surface streaks. A low-level jet forms at steady state and the high-shear region between the surface and the low level jet is found to play a vital role in promoting turbulence. Our simplified setup is sufficient to observe turbulence collapse, intermittency and the low-level jet formation, indicating the applicability of this model to atmospheric problems.

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