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Direct Numerical Simulations of Turbulent Ekman Layers with Increasing Static Stability: Modifications to the Bulk Structure and Second-Order Statistics[1] STIMIT SHAH, ELIE BOU-ZEID, Princeton University — Turbulent Ekman layers, with increasing static stability and Reynolds number, are studied using Direct Numerical Simulations. The highest stability under which continuous turbulence can be sustained is shown to be Reynolds number dependent. The highest Reynolds number flow displays a well-developed inertial range and a logarithmic layer, which is found to obey the Monin-Obukhov similarity theory under non-neutral conditions. The analyses then focus on the budgets of turbulent kinetic energy (TKE), vertical velocity variance, momentum and buoyancy fluxes, and temperature variance. Results indicate that, due to imposed stability, there is damping of vertical motions that leads to a reduction in the turbulent transport of Reynolds stress towards the wall. This reduced transport results in lower production of TKE, which is shown to be more significant than direct buoyant destruction in reducing TKE levels in stable conditions. The reduction in the vertical velocity variance results in significant drops in the production terms in the other second order budgets we study as well. Building on these findings, we conclude by illustrating that the vertical velocity variance is a better parameter to base vertical eddy-diffusivity and viscosity models on than the full TKE.

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