Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Probing the effect of buoyancy on second-order statistics in stably-stratified boundary layers[1] ELIE BOU-ZEID, STIMIT SHAH, Princeton University — Statically-stable turbulent boundary layer flows are particularly challenging due to the potential breakdown of Kolmogorov's theory and to the emergence of laminar regions, gravity waves, and other complicating flow patterns. To develop a more fundamental understanding of how buoyancy influences turbulence in such flows, direct numerical simulations and large eddy simulations of turbulent boundary layers with rotation are performed. Under the highest stabilities, global intermittency (the almost compete decay of turbulence and then its regeneration) is observed, but could be the result of initial and boundary conditions rather than flow dynamics. Under more moderate stabilities, continuous turbulence is maintained, but it is significantly damped compared to neutral flows. This reduction of the TKE under stable conditions is very well known; however, here we show that it is mainly triggered by reduced mechanical production associated with reduced transport of Reynolds stresses from aloft toward the surface, rather than by direct destruction of TKE by buoyancy. This raises questions about the suitability of some conventional stability parameters, such as the flux Richardson number, in describing the influence of buoyancy in such flows.

[1]supported by NSF-PDM under AGS-1026636

Elie Bou-Zeid
Princeton University

Date submitted: 28 Jul 2014 Electronic form version 1.4