Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

The role of stability in modulating the structure and transport efficiency of turbulence in the atmospheric surface layer DAN LI, ELIE BOU-ZEID, Princeton University — A vast body of literature has emerged over the last few decades on the topology, dynamics, and role of coherent structures in turbulent boundary layer flows. The applicability of this knowledge to geophysical flows is problematic due to the often-dominant role of buoyancy. Here we aim to investigate the effect of buoyancy on coherent turbulent structures, with a focus on the ties between these structures and turbulent transport. The results confirm that the topology of the coherent structures is very sensitive to stability. The findings point to a gradual transformation of the structures from hairpin vortices (or horizontal rolls) to thermals, as the upward buoyancy flux increases. More importantly, this change induces a decorrelation of the momentum and scalar fluxes in the surface layer and significant change in the relative efficiencies of momentum and scalar transport. Scalars are transported much more efficiently under unstable conditions. These findings provide a better framework for including the effect of stability in turbulent transport models and open the way for more advanced models based on a better understanding of turbulent scale-interactions under different stabilities.

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Date submitted: 30 Jul 2011 Electronic form version 1.4