Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

**Characterization of wind-shear effects on the entrainment zone in convective boundary layers** ARMIN HAGHSHENAS, JUAN PEDRO MELLADO, Max Planck Institute for Meteorology, Hamburg, Germany — Direct numerical simulations and dimensional analysis are used to investigate wind-shear effects on a convective boundary layer (CBL) that grows into a linearly stratified atmosphere. Consistent with the literature, we observe that strong wind shear enhances entrainment and thickens the entrainment zone. In addition, we show that under a weak wind-shear condition, the entrainment zone is characterized by a convective-layer thickness, $(\Delta z_i)_c$, which is a constant fraction of the CBL depth. But as the wind shear increases, shear production starts to dominate turbulent transport across the entrainment zone, and as a result, the characteristic length scale in that region changes to a shear-layer thickness, $(\Delta z_i)_s$. We associate this length scale to the asymptotic depth of a stably stratified shear layer. We find that the dependence of wind-shear effects on surface buoyancy flux, buoyancy stratification, wind velocity, and the CBL depth can be expressed just by one dimensionless variable, $(\Delta z_i)_s/(\Delta z_i)_c$. Shear effects are observed only if this variable, which can be easily measured in the atmosphere, is larger than one. We also show that the observed dependence varies linearly when it is expressed in terms of the inverse of a bulk Richardson number.

Armin Haghshenas
Max Planck Institute for Meteorology, Hamburg, Germany

Date submitted: 16 Nov 2017 Electronic form version 1.4