

Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Shear effects in the evaporatively driven cloud-top mixing layer

JUAN PEDRO MELLADO, Max Planck Institute for Meteorology — A stably stratified shear layer destabilized locally by moist convection is studied using direct numerical simulations as a model to investigate the role of evaporative cooling at the top of stratocumulus clouds in the presence of vertical mean shear. Velocity and time scales are obtained from the study of the vertical structure. It is found that, overlapping with the background shear layer that has been often documented in the cloud-free cases, with a thickness $(1/3)(\Delta u)^2/\Delta b$, where Δu and Δb are the velocity and buoyancy increments across the cloud top, the system develops a turbulence layer that is dominated by free convection inside the cloud and by shear production inside the relatively thin overlap region. As turbulence intensifies, the turbulence layer encroaches upwards into the background shear layer and defines thereby the entrainment velocity. This encroachment is well characterized by the penetration length formed with the in-cloud convective velocity and the buoyancy frequency inside the background shear layer. Consistently, the turbulence intensity inside the overlap region follows a mixed scaling combining the background mean shear and the in-cloud convective velocity.

Juan Pedro Mellado
Max Planck Institute for Meteorology

Date submitted: 12 Jul 2013

Electronic form version 1.4