Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

The evaporatively driven cloud-top mixing layer JUAN PEDRO MELLADO, Max Planck Institute for Meteorology — Turbulent mixing caused by the local evaporative cooling at the top cloud-boundary of stratocumuli will be discussed. This research is motivated by the lack of a complete understanding of several phenomena in that important region, which translates into an unacceptable variability of order one in current models, including those employed in climate research. The cloud-top mixing layer is a simplified surrogate to investigate, locally, particular aspects of the fluid dynamics at the boundary between the stratocumulus clouds and the upper cloud-free air. In this work, direct numerical simulations have been used to study latent heat effects. The problem is the following: When the cloud mixes with the upper cloud-free layer, relatively warm and dry, evaporation tends to cool the mixture and, if strong enough, the buoyancy reversal instability develops. This instability leads to a turbulent convection layer growing next to the upper boundary of the cloud, which is, in several aspects, similar to free convection below a cold horizontal surface. In particular, results show an approximately self-preserving behavior that is characterized by the molecular buoyancy flux at the inversion base, fact that helps to explain the difficulties found when doing large-eddy simulations of this problem using classical subgrid closures.

Juan Pedro Mellado
Max Planck Institute for Meteorology

Date submitted: 06 Aug 2010 Electronic form version 1.4