Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

On the relevance of droplet sedimentation in stratocumulus-top mixing JUAN PEDRO MELLADO, Max Planck Institute for Meteorology, ALBERTO DE LOZAR, German Weather Service — The interaction between droplet sedimentation, turbulent mixing, evaporative cooling, and radiative cooling at the top of stratocumulus clouds has been studied using direct numerical simulations. This interaction is important to determine the mixing rate of the cloud and dry air above it, which eventually determines the cloud lifetime. By investigating the entrainment-rate equation, which is an analytical relationship between the contributions to cloud-top entrainment from the phenomena indicated above, we have found that the reduction of entrainment velocity by droplet sedimentation can be 2 to 3 times larger than previously conjectured. The reason is twofold. First, the reduction of evaporative cooling as droplets fall out of the inversion is stronger than previously observed in large-eddy simulations, where excessive mixing by turbulence models and numerical artifacts may have partially masked this effect of sedimentation on entrainment. Second, there is a non-negligible direct contribution from mass loading, as falling droplets leave behind more buoyant air in the inversion. This contribution is proportional to the fifth moment of the droplet-size distribution, which provides further evidence for the need to better understand the evolution of the droplet-size distribution.

Juan Pedro Mellado
Max Planck Institute for Meteorology

Date submitted: 13 Jul 2017 Electronic form version 1.4