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ENTRAINMENT AND MIXING AND THEIR EFFECTS ON CLOUD DROPLET SIZE DISTRIBUTIONS OF THE STRATOCUMULUS CLOUDS OBSERVED DURING VOCALS

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ABSTRACT

Cloud droplet size distribution is determined by several factors. Cloud condensation nuclei distribution and updraft velocity may determine the droplet size distribution of an adiabatic cloud parcel. However, adiabaticity cannot be maintained in most clouds due to entrainment and mixing of the clear air, which then affect the cloud droplet size distribution. How the entrained clear air mixes with cloudy air has been of great interest for the last several decades due to its crucial implication on the warm rain initiation problem. Basically, two mixing mechanisms have been proposed. Homogeneous mixing postulates that turbulent mixing of the clear and cloudy air is so fast that all droplets in the mixed parcel experience the same degree of evaporation. The opposite is the case when mixing is inhomogeneous, where droplets in some portion of the cloudy air completely evaporate while the droplets in the remaining portion experience no evaporation. As such, cloud droplet size distribution can differ depending on how mixing proceeds, and therefore the evolution of cloud droplet size distribution after mixing will also differ. In this study we analyze the cloud microphysics data obtained from the G-1 aircraft during the VOCALS field experiment conducted in October–November, 2008, off the coast of Chile over the southeastern Pacific. Three different mixing diagrams are used as a tool to examine the mixing mechanism. In most cases, comparison of the estimated time scales of turbulent mixing and evaporation suggests that inhomogeneous mixing is dominantly favored. However, what is shown in the mixing diagrams often deviates from what is expected from inhomogeneous mixing. Non-uniform updraft velocities and further evolution of droplet size distribution after mixing can be suggested as a possible reason for such deviation. Furthermore, examination of high-resolution data often suggests that mixing proceeds homogeneously in the parcels where severe entrainment occurs. Detailed analysis will be shown at the meeting.