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Cloud Microphysics Affected by Dry Air Entrained from above Cloud Top in Stratocumulus

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Fog is quite similar to low-level clouds, especially for stratocumulus. Both of them occur in the low troposphere and they are affected by dry air entrained from above the cloud top. Different turbulent entrainment-mixing processes are critical to cloud-related processes which have been studied with many conceptual models based on the relationship between cloud droplet size and cloud number concentration. However, few studies focus on the vertical evolutions of entrainment mixing mechanisms. To fill this gap, the stratocumulus clouds observed during the Physics of Stratocumulus Top (POST) project are analyzed to improve the understanding of the entrainment-mixing processes in the stratocumulus top region. Based on the sawtooth flight pattern, the cloud data are studied for each 1m as the height interval, which ensures the high vertical resolution. In 3 non-drizzling cases, there is a tendency for entrainment mixing to change from homogeneous to extremely inhomogeneous. First, microphysics analysis shows that homogeneous mixing degree (i.e., how much of mixing is homogeneous) decreases with the increasing height. Second, dynamics analysis shows that Damkohler number (the ratio of mixing time scale of dry air to evaporation time scale of droplets) increases with the increasing height. The reason is that the size of entrained dry air is large near cloud top. When the dry air goes deep into the cloud, the size of dry air decreases and relative humidity of dry air increases. The smaller dry air size and higher relative humidity cause more homogeneous mixing in the middle of cloud than near cloud top.