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A method for obtaining high time and spatial resolution convective cloud top data for the TTL

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Convective systems in the tropics have a maximum in the cloud top altitude distribution of about 13.5 km. However, there is a significant tail to this distribution -- a few percent reach the cold point tropopause (CPT) at 16.5 km, and there has been clear evidence of convective mass deposited as high as 19 km in the tropics.

The region between 13.5 km and the cold point tropopause is transitional, between the free tropical troposphere where convective mixing dominates, and the stratosphere where slow upward ascent dominates. In this region (the Tropical Tropopause Layer), convective injection, slow ascent, and mixing from midlatitudes all have similar time scales. So, even though only a few percent of convective systems reach the CPT, convection is important.

Space Based Lidar and cloud radar measurements have yielded information about long term average statistical distributions of cloud altitude as a function of location. However, we also need time-dependent cloud top altitude and cloud top potential temperature information, primarily to understand the water vapor and TTL cloud distributions. This is because the effect of convection depends on the local temperature, and on the subsequent temperature history. Time dependent cloud top information is also needed to understand short-lived tracers because cross-isentropic flow is time and space dependent.

This paper presents a method of obtaining time and space dependent convective cloud top theta (and altitude) information using 3-hourly geostationary brightness temperature data, coupled with global 3 -hourly rainfall estimates and temperature analyses. We explore different mixing algorithms to obtain the most reasonable agreement with near-simultaneous observations by cloudsat and calipso. Observations of short-lived tracers from ATTREX, coupled with short-term trajectories are used to test the method's accuracy. An important caveat is the ambiguity of evaluating convective cloud top altitudes under from combined cloudsat and calipso measurements.