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Tropical deep convection measured with A-train satellites

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Stratospheric water vapor plays an important role in chemical and radiative effects such as ozone depletion, stratospheric temperature, and surface climate. Most of the stratospheric water vapor is transported from the tropical troposphere to a higher latitude in the stratosphere through the tropical tropopause layer. There are two hypotheses on the effect of an overshooting, a cloud intrusion through its level of neutral buoyancy above a deep convection, on the stratospheric water vapor. One of them suggests that overshooting dehydrates the stratosphere, while the other proposes that overshooting rehydrates the stratospshere. The main reasons for this contradiction are insufficient information on (1) the size of the ice particles in an overshooting cloud and (2) entrain stratospheric air into the overshooting one; thus, the actual role of an overshooting is not well understood.

The data we analyze are the space-borne imager MODIS and infrared sounder AIRS, the space-borne lidar CALIOP, the space-borne cloud radar CloudSat, and space-borne microwave limb sounder MLS installed on Aqua, CALIPSO, CloudSat, and Aura, respectively. The orbits of the all satellites are the same and the maximum time lag is about 15 min.

MODIS measured four deep convections, whose brightness temperatures of 11 um channel were 190 K, in a cloud cluster of which diameter was 28.6 km. CloudSat and CALIOP measured one of them, the mode radius above the potential temperature of 380 K, estimated with AIRS, retrieved as 23.0 um. Thus, ice particles would be drift longer than the lifetime of the deep convection. However, MLS showed the stratospheric air over the convection was dryer than other latitudes though its horizontal resolution, observation time, and single profile precision are 210 km, 8 min after MODIS, CALIOP and CloudSat measurements, and 25 % in RHi, respectively.

We will discuss comprehensive data observed with the satellites.