Impact of Overshooting Deep Convection on the Stratospheric Water Vapor: an A-Train Satellite View

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The effect of overshooting deep convection (ODC) on the lower stratospheric humidity has been an unsettled subject. While the detrainment of extremely cold and dry air from convective cores may dehydrate the Tropical Tropopause layer (TTL), the convectively lofted ice crystals may moisten the TTL and the lower stratosphere. We seek to quantify the impact of ODC on the stratospheric water vapor by analyzing combined A-Train observations from Aura MLS, CloudSat/CALIPSO, Aqua AIRS and MODIS. CloudSat and CALIPSO reveal internal vertical structure of ODC while AIRS and MODIS provide a wide coverage of ODC in horizontal space. By matching ODC measurements from the active and passive sensors and identify statistical relationships between convective detrainment height and infrared bright temperature, we will establish a 3-dimensional ODC database with sufficient spatial and temporal coverage. The Aura MLS observed water vapor, temperature, ice water content and relative humidity profiles in the upper troposphere and lower stratosphere (UTLS) will be examined in relation to the ODC occurrence with the aid of Lagrangian trajectory calculations driven by reanalysis meteorological fields. We will compare the properties of stratospheric air parcels with and without ODC influence. Our preliminary results show that tropical ODC acts as an "express way" to moisten the lower stratosphere, although the rarity of ODC makes its impact on the annual mean stratospheric water vapor concentration rather small.