

Title (300 characters)

Influence of Deep Convection on Cirrus and Water Vapor Concentration in the Upper Troposphere and Lower Stratosphere

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Abstract (2000 characters)

It is well known that stratospheric humidity is primarily controlled by freeze drying (ice crystal growth and sedimentation) of air ascending across the cold tropical tropopause. However, the suggestion of an important source of water vapor from deep convection that extends above the tropical tropopause has persisted. There exists much anecdotal evidence of direct convective hydration of the lower stratosphere based on measurements from high-altitude aircraft campaigns, but quantifying the impact of deep convection on the overall budget of stratospheric water vapor has proven challenging.

The role of convection on the humidity of the upper troposphere and lower stratosphere (UTLS) is investigated in simulations of cirrus clouds along trajectories launched from given potential temperature level surfaces. The one-dimensional (vertical) cloud model tracks individual ice crystals through their lifecycles, beginning with nucleation or detrainment from convection, followed by deposition growth, sedimentation and sublimation. Convective influence of the parcels is diagnosed by tracing the trajectories through time-dependent fields of convective cloud-top height adjusted to match the CloudSAT and CALIPSO statistics. Model simulations of UTLS water vapor and cloud fields are evaluated and constrained by comparison with MLS and CALIPSO measurements.

The simulation results indicate that the overall impact of convection on water vapor near the tropical tropopause is 10-15%, while the impact on lower stratospheric humidity is no more than a few percent. Ice crystals detrained from deep convection have relatively small effect. The general implications for the importance of deep convection on UTLS humidity and cirrus cloud fraction will be discussed.