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Cloud top characteristics of deep convective storms in extratropical regions and cross-tropopause exchange

P. Wang

Department of Atmospheric and Oceanic Sciences, University of Wisconsin-Madison, Wisconsin, USA

It is increasingly clear that deep convective storms play an important role in transporting chemical species from the troposphere to the stratosphere. Recent cloud resolving model studies demonstrate that the deep convection-induced gravity wave breaking can cause water substance, other trace gases and aerosol particles to penetrate the tropopause and enter the stratosphere. These model-based conclusions have been supported by satellite and ground-ground based observations. We will review these findings in this paper.

In addition, our recent model studies indicate that the upper level wind shear influences greatly the cloud top characteristics of thunderstorms. Cloud top structure of storms in strong shear environment looks very different from those in weakly sheared environment. Many of these characteristics have been observed in satellite infrared imagery previously. This indicates that the model can be used to interpret cloud top dynamics and microphysics from satellite observed imagery. Since the cross-tropopause transport of chemical species is influenced by the wind shear environment, this new understanding can be used as a potential tool to retrieve information of chemical transport between the troposphere and stratosphere from satellite data.