Geophysical Research Abstracts, Vol. 8, 04677, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04677

Impact of clouds on the radiation budget of the tropical tropopause layer

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Most of the troposphere to stratosphere transport (TST) takes place in the tropical tropopause layer (TTL), but the detailed process, how air enters from the TTL into the lower stratosphere, is yet not well understood. Thus the radiative heating budget of the TTL, which primarily determines the vertical motion outside of convective systems, is subject of recent research.
For the cloudless sky case Gettelman et al. (2004) found radiative cooling below and heating above an altitude of about 15 km corresponding to 125 hPa, and 360 K potential temperature. Corti et al. (2005) pointed out that clouds have mainly three effects on the radiation budget in the TTL: For clouds underneath longwave cooling is enhanced, as upwelling infrared radiation is partly absorbed, but shortwave heating is also slightly increased, as radiation reflected by clouds contributes to solar radiative heating. The third effect is in situ heating by high cirrus clouds. As the latter effect dominates, Corti concluded that clouds lower the mean level of zero net radiative heating compared to the cloudless case.
Here we present further results on the impact of water and ice clouds on the radiation budget in the TTL. First the influences of atmospheric composition, temperature, and pressure profiles as well as surface properties on the radiation budget are compared to the effect of clouds. Furthermore the sensitivity of the budget concerning cloud type, geometry, and microphysics is quantified.
References:
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Gettelman, A. et al., 2004: Radiation balance of the tropical tropopause layer, in Journal of Geophysical Research, Vol. 109, D07103