Geophysical Research Abstracts
Vol. 18, EGU2016-10701, 2016
EGU General Assembly 2016

Radiative-dynamical and microphysical processes of thin cirrus clouds controlling humidity of air entering the stratosphere

Tra Dinh (1) and Stephan Fueglistaler (1,2)

(1) Program in Atmospheric and Oceanic Sciences, Princeton University, Princeton, United States, (2) Princeton University, Geosciences, Princeton, United States (stf@princeton.edu)

Thin cirrus clouds in the tropical tropopause layer (TTL) are of great interest due to their role in the control of water vapor and temperature in the TTL. Previous research on TTL cirrus clouds has focussed mainly on microphysical processes, specifically the ice nucleation mechanism and dehydration efficiency.
Here, we use a cloud resolving model to analyse the sensitivity of TTL cirrus characteristics and impacts with respect to microphysical and radiative processes. A steady-state TTL cirrus cloud field is obtained in the model forced with dynamical conditions typical for the TTL (2-dimensional setup with a Kelvin-wave temperature perturbation). Our model results show that the dehydration efficiency (as given by
the domain average relative humidity in the layer of cloud occurrence) is relatively insensitive to the ice nucleation mechanism, i.e. homogeneous versus heterogeneous nucleation. Rather, TTL cirrus affect the water vapor entering the stratosphere via an indirect effect associated with the cloud radiative heating and dynamics. Resolving the cloud radiative heating and the radiatively induced circulations approximately doubles the domain average ice mass. The cloud radiative heating is proportional to the domain average ice mass, and the observed increase in domain average ice mass induces a domain average temperature increase of a few Kelvin. The corresponding increase in water vapor entering the stratosphere is estimated to be about 30 to 40%.