Microphysical, radiative and dynamical impacts of thin cirrus clouds on humidity in the tropical tropopause layer and lower stratosphere

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Cloud-resolving numerical simulations are carried out to study how in situ formed cirrus affect the humidity in the tropical tropopause layer and lower stratosphere. Cloud-induced impacts on the specific humidity are evaluated separately in terms of (i) the dehydration efficiency and (ii) the increase in the saturation mixing ratio associated with cloud radiatively induced temperature adjustment.

The numerical results show that the dehydration efficiency of cirrus clouds, which is measured by the domain average relative humidity, varies within 100±15% in all model configurations (with/without heterogeneous ice nucleation, and with/without cloud radiative heating and cloud dynamics).

A larger impact on the specific humidity comes from temperature increase (of a few Kelvins) induced by cloud heating. The latter is found to scale approximately linearly with the domain average ice mass. Resolving the cloud radiatively induced circulations approximately doubles the domain average ice mass and associated cloud-induced temperature change.

References

Dinh, T., and Fueglistaler, S., *Geophys. Res. Lett.,* **2014**, 41, 6949-6955, doi:10.1002/2014GL061289.