Atmos. Chem. Phys. Discuss., 8, S1627–S1629, 2008
www.atmos-chem-phys-discuss.net/8/S1627/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The roles of convection, extratropical mixing, and in-situ freeze-drying in the tropical tropopause layer" *by* W. G. Read et al.

Anonymous Referee #4

Received and published: 14 April 2008

This paper addresses an important topic for the scientific community. It uses a conceptual 2D-model to investigate transport mechanisma in the TTL and the respective effects on the water budget. In particular the role of different transport mechanisms with respect to the formation of ice is investigated. The model is initialized and compared to state of the art satellite observations using different platforms. The choice of tracers (CO, H_2O, HDO,$H_2{}^{18}O$) highly constrain the interpretation of the results, especially the interplay between extratropical mixing, convection and freeze-drying. Thus, it allows valuable conclusions on the processes leading to the water vapor mixing ratios and in particular the HDO values as observed. The manuscript highlights the role of extratropical mixing to explain the model results.
The paper is well written and the initialization of the model is described in detail.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

Each Figure is carefully discussed assessing uncertainties and possible alternative explanations. Some weakness arise from the fact that the saesonal behaviour is addressed, but only speculated on, which should be considered in the discussion of the respective results.
I recommend the paper for publication with only minor changes.

General: Since a conceptual 2D-model can surely not describe all parameters explicitly, some aspects and the relation to the real atmosphere should be discussed a bit deeper. In particular the seasonality of the extratropical inmixing could be addressed with more care. How do the seasonal cycles of the lowermost stratospheric background affect the results? One might expect seasonal variations of the strengths, the location and the background composition, which is brought in. Despite being low lowermost stratospheric CO is not constant throughout the year and could vary by 50Similarly the seasonal effect of large scale tropospheric circulation patterns, namely the monsoon could be addressed shortly since they also puts some uncertainty on the initialization as well as the interpretation, e.g. for boreal summer, which is speculated on.

p.3968/69: CO-modelling, maybe also of importance for the discussion of CO p3976 or 3977,l.3: How sensitive is the model CO to changes of OH, which in turn depend on available H2O, which is calculated? The mean profiles of the loss and production rates might differ significantly from local spatial and temporal scales.
p.3970,l.20/21: Which radii are assumed for the major modes of ice and what are the associated velocities or residence times in the TTL?
p3975,l.19-27 (and associated conclusions): Are there any in-situ measurements available, which support the interpretation of the MLS data or at least other satellite platforms (ACE, AIRS)?
p.3976.: Please clarify: Why does the absence of extratropical mixing steepens the

ACPD
8, S1627–S1629, 2008

Interactive Comment

vertical CO-gradient? That would be only the case when only tropospheric air masses are involved. If air from the lowermost stratosphere were mixed in, which happens (e.g. Tuck et al. 2003) this would reduce CO-mixing ratios in the TTL and thus steepen the vertical gradient rather than flattening.

A. F. Tuck, S. J. Hovde, K. K. Kelly, M. J. Mahoney, M. H. Proffitt, E. C. Richard and T. L. Thompson, Exchange between the upper tropical troposphere and the lower stratosphere studied with aircraft observations, J. Geophys. Res.,108, D23, Art. No. 4734, doi:10.1029/2003JD003399 [2003]).

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 3961, 2008.