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Interactive comment

Interactive comment on "Impact of convectively lofted ice on the seasonal cycle of tropical lower stratospheric water vapor" *by* Xun Wang et al.

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1. "Above 370K, this model may have trajectories that never experienced a true cold point, but the biggest problem is below that level: in this model, anything below 370K is populated only by descending pathways - and none have just directly come up from the troposphere (which can be expected to be at local saturation, and hence much moister). This most certainly biases the results strongly... This paper tackles an important problem, but the authors need to demonstrate that their results are not unduly influenced by the initialization - which should be done in the troposphere and not at the tropopause..."

This is a good point. We have re-run the model with parcels initialized at 360 K. While

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some quantitative details of the plots have changed, the trajectory model is still unable to simulate the seasonal cycle in the NH subtropics when water vapor is influenced only by temperature.

Fig. 1 shows the trajectory models initialized at 360 K. It still shows smaller seasonal oscillation in the NH subtropics and smaller north-south asymmetry in the seasonal cycle compared to the MLS data. The figure also shows that adding the cloud model (Schoeberl et al., 2014) does not improve agreement.

We also did three test runs using ERAi, MERRA2, and GEOSCCM meteorology where we initialized the parcels above the local level of zero heating rate but not above the tropopause (Fig. 2). These runs agree closely with those initialized at 360 K.

In the revised version of the paper, we will replace all of the runs with those that initialize the parcels at 360 K.

Minor comments:

The reviewer asked: “Further - are the authors really initializing the trajectories in the extratropical stratosphere up to 60 degrees latitude with 200 ppmv as stated in the text?” The answer is, yes, we initialize parcels well into mid-latitudes. The reason these parcels do not impact the 100-hPa water values is that most of these mid- and high-latitude parcels are descending, so they never reach 100 hPa. Any that do ascend are immediately dehydrated by cold temperatures, so their water vapor values are set by TTL temperatures by the time they get to 100 hPa. We will add a statement to the paper discussing this.

Reference

Schoeberl, M. R., Dessler, A. E., Wang, T., Avery, M. A. and Jensen, E. J.: Cloud formation, convection, and stratospheric dehydration, Earth Sp. Sci., 1(1), 1–17, doi:10.1002/2014EA000014, 2014.

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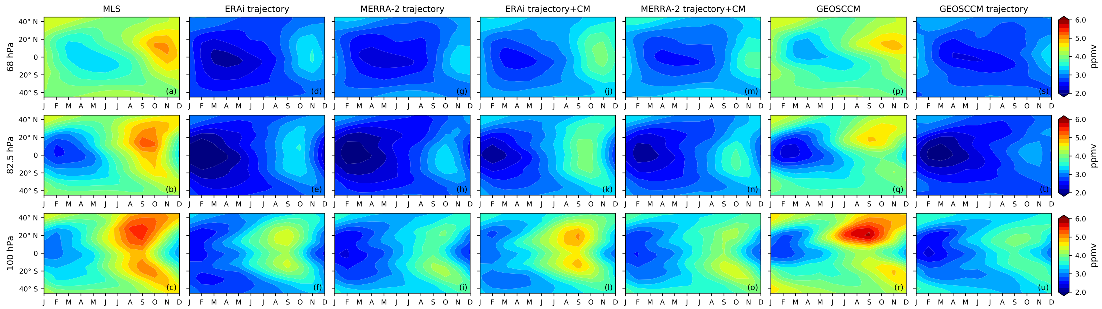

Fig. 1. Zonal mean water vapor seasonal cycle at 100, 82, and 68 hPa from MLS and trajectory models. The trajectory models are initialized at 360 K. We used the averaging kernels for all modeled water vapor.

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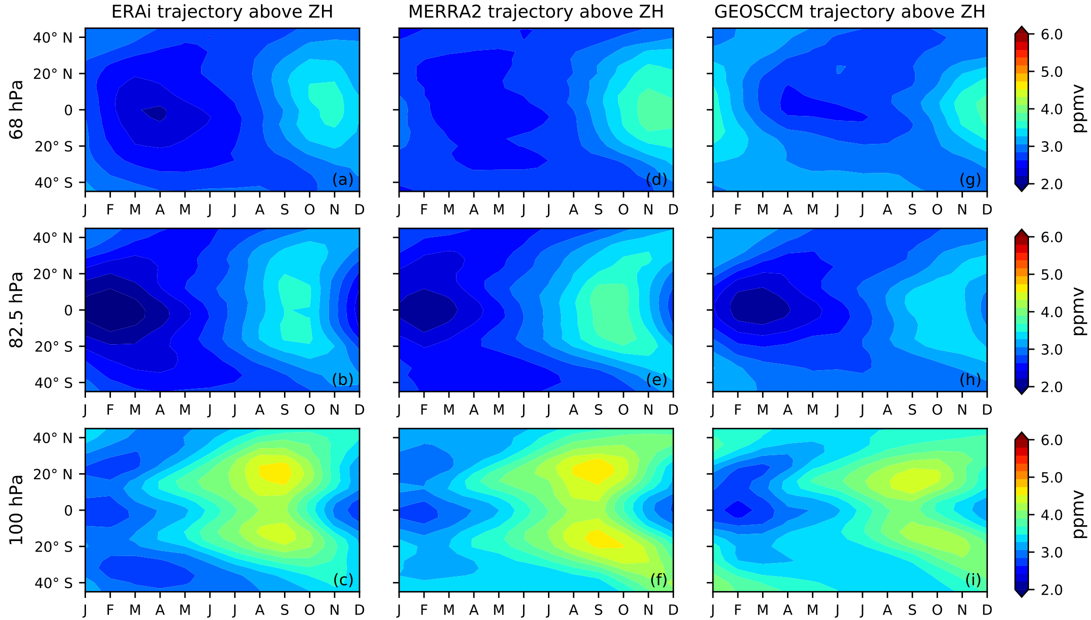

Fig. 2. Zonal mean water vapor seasonal cycle at 100, 82, and 68 hPa from ERAi, MERRA2, and GEOSCCM trajectory models. The trajectory models are initialized at local levels above zero heating rate.

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