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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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The processes that control the water budget of the TTL, and ultimately the stratosphere, remain remarkably uncertain despite much progress in observational data and numerical modeling. In particular, the moistening from ice detrained from deep convection remains poorly quantified. Wang et al. address the problem with a trajectory model, and compare the results to observations. If I understand the paper correctly, the logic is as follows: The GEOSCCM model reproduces the Microwave Limb Sounder observations in particular also during the boreal summer months well. On the other hand, the trajectory model that employs only advection and condensation (with instantaneous removal of condensate) is biased compared to the GEOSCCM water vapor field, and hence is also biased compared to MLS. Similarly, if the model is driven with renalysis

data, the patterns look similar to those obtained when driven with GEOSCCM. Applying a simple cloud model along the trajectories does not really improve the spatial pattern - the model simply increases water vapor everywhere, rather than fixing the spatial biases. I assume the cloud model is similar to that of Fueglistaler and Baker (2007, Atmos.Chem. Phys.), and as such results should be treated with caution since such a model can only serve as explorative tool - there are many poorly constrained parameters and showing results for only one configuration (which must have been tuned towards an unspecified target) may cause some concern. However, having worked with such models myself, I concur with the authors that such a model will change water vapor mixing ratios evenly, but not amplify spatial patternsn. (Figure 5b from Fueglistaler et al. (2013, J. Geophys. Res.) may be of interest to the authors, as it addresses the same problem with a similar model.) Thus, the case for convective moistening made by Wang et al. based on the spatial pattern (e.g. their Figures 1, 2 and 5) is quite convincing. However, I am very concerned whether their results are not unduly influenced - or even artefact - of the way they initialize their trajectory model. According to the paper:

"... and 60deg latitude, with initial water vapor mixing ratio of 200 parts per million by volume (ppmv). The initialization level is at 370 K potential temperature, which is above the average level of zero heating (∼355-360 K) (Fueglistaler et al., 2009) but below the tropical tropopause (∼380 K)."

If the initiation level is indeed 370K (and this is not a typo), then the model is essentially initialised with the driest possible state in the colder regions (over the cold Western Pacific, the tropopause is around 370K), and it is trivial that the model has a dry bias below that level - which is a problem particularly for the 100hPa level. (I should add that the display of data on pressure levels - necessary for MSL - makes it very difficult for the reader to understand whether the model is initialized above or below that pressure level.) Abover 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. Further - are the authors really initializing the trajectories in the extratropical stratosphere up to 60 degrees latitude with 200ppmv as stated in the text? This seems dramatically off - I am puzzled how this would produce the (reasonably looking) patterns shown in Figure 5?

The serious concerns with the initialization preclude further discussion of the results since the quantitative numbers for convective moistening may be strongly affected. 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. Major revisions are therefore inevitable, unfortunately.

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