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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impact of overshooting deep convection on local transport and mixing in the tropical upper troposphere/lower stratosphere (UTLS)" *by* W. Frey et al.

Anonymous Referee #3

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General comments:

This study investigates the mass transport in deep convection from a Hector storm observed during a research flight of the SCOUT-O3 campaign. In particular, this study focuses on the downward transport at cloud scale from the stratosphere into the upper tropical troposphere. The bulk of the investigation is conducted using a high-resolution simulation in WRF. Downward cloud-scale transport has not been studied extensively and is important for understanding the budget of chemical species in the UTLS, and, ultimately, for constraining the global convective transport models. The authors state this article is the first cloud-scale modeling study on downward convective transport

in the tropics, and I am not aware of any studies that would discount this claim. This study also looks at the hydration and dehydration effects around tropical deep convection, which are understandably very sensitive to model details. However, the approach of using passive proxy water vapor tracers to better understand the response of the microphysics is an innovative and valuable approach. I appreciated the authors' honesty in not being able to draw general conclusions about hydration/dehydration from this study (pg. 1064, first paragraph); I still found the water vapor analysis a good attempt at starting to disentangle the many processes that contribute to the water vapor budget. Finally, the tie-in of these model results to the aircraft observations helps give confidence to the simulated findings. I would also like to applaud the figures included, which were really useful in helping convey the findings (e.g., Figure 6 is great). Overall, the study presents a thorough and interesting investigation of tropical convective transport processes in the UTLS.

Specific Comments:

page 1050, line 29: "...the Thompson scheme produced the smallest Hector." This sensitivity discussion is great, as information on sensitivities is helpful to the community. So, I don't find anything wrong with your discussion, but I recommend some added clarification. First, what do you mean by "smallest"? I infer from the following sentence that "smaller" refers to the depth and magnitude of the convective turrets. Are there additional "smaller" traits, or is that the extent of what you meant to convey? You also mention that NSSL performed "slightly better" than the Morrison scheme. Can you be more specific about what fields in particular were "better"?

Figures 7-11, 13-14: As stated in "General Comments", I think you've done a great job with the figures in this article, but I need some clarification on the figures that use potential temperature as an axis. Some sort of interpolation to potential temperature surface would need to be performed, as the potential temperature surfaces are not planar when the storm is active (figure 12). You need to explain how this was done, as the method of interpolation would impact your results. Also, gravity waves, particu-

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larly near the overshooting tops, often cause near vertical isentropes (figure 12). How did you deal with these vertical isentropes when converting to potential temperature coordinates?

Figure 11: Are you able to show any later times? The storm is still active at 6:00, and this figure shows there are still some changes in the tracer perturbation fields from 6:30 to 7:00. At what time is the transport profile fixed? I.e., at what time are there no longer parcels with positive/negative buoyancy?

page 1062, lines 25-26: The sentence that begins with "However, this moistening. . ." reads very oddly. Having a "however" and a "but" in the same sentence left me confused about what you were trying to say here.

Technical Corrections:

page 1046, line 24: ". . .cloud turrets were performed, which. . ."

page 1048, line 6: I think there is an extra "the" in this sentence. "Therefore, 3 arcseconds. . ."

page 1054, line 18: ". . .model identifies mixing, Fig. 12 shows. . ."

page 1066, line 11: ". . .altitude of the layer. . ."?

page 1066,line 12: ". . .can actually lead to both hydration and. . ." (no comma)

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 1041, 2015.