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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of convection on the upper-tropospheric composition (water vapor/ozone) over a subtropical site (Réunion Island, 21.1° S–55.5° E) in the Indian Ocean" *by* Damien Héron et al.

Anonymous Referee #2

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The authors present a 3-year analysis of relative humidity (RH) and ozone in the upper troposphere at a tropical location removed from frequent deep convection. It is convincingly shown that convection is likely responsible for significant reduction in upper troposphere ozone and enhancement in RH. The analyses are well described and will make a useful contribution to the literature. However, before it is suitable for publication, a few outstanding issues should be resolved.

Major Comments:

1. The RH data used comes from daily radiosonde measurements. The standard instruments used in radiosondes have long been known to suffer from significant dry biases in the upper troposphere and stratosphere due to instrument limitations and icing in supercooled liquid clouds (e.g., Miloshevich et al. 2004). No mention is given in the article on the quality of the RH measurements in the radiosonde data used and whether or not a correction has been applied to these data to account for known sources of dry bias. This is an important issue because it impacts much of the analysis presented.

2. The use of a trajectory model to track air mass history and identify boundary layer sources of air associated with convection is a good approach to analysis, but the accuracy of the parameterized sub grid-scale motions along the trajectories is not well demonstrated. How well does the parameterized convection match actual convection in this region? The reliability of this approach is fundamental to the analysis and arguments presented in the paper and an assessment should be provided. The lack of agreement in RTLT and DCCO for the case study included in the paper (i.e., Figure 8) is particularly concerning as it suggests the parameterized convection fails to represent much of that observed (at least for the week shown). The only element of the paper acknowledging this potential issue (lines 299-305) is, in my opinion, insufficient.

3. There is a missed opportunity to put case study of tropical cyclones into broader context. Previous work on the impact of tropical cyclones on upper troposphere and lower stratosphere water vapor and ozone is not acknowledged and would help in the authors' interpretation and argumentation here (e.g., Ray & Rosenlof, 2007; Zhan & Wang, 2012). Moreover, I do not find the impact of tropical cyclones on upper troposphere RH to be convincing in the paper, likely related to my concerns outlined in #2 above.

Specific Comments:

Lines 134-135: "lower upper-tropospheric ozone values observed" is a bit confusing

phrasing. Suggest rephrasing to “lower observed ozone values in the upper troposphere”

Line 144: suggest revising “the day” and “the latitude” to “day” and “latitude”

Line 183: “affected by several three tropical cyclone events” Which is it – several or three?

Lines 194-195: Why is a threshold of 50% chosen? What is the sensitivity to this choice?

Lines 219-221: This statement doesn’t seem appropriate. What if the responsible convection is land-based? One should expect a higher ozone mixing ratio in the boundary layer in that case. It seems reasonable that many/most convective sources for air in the upper troposphere at Reunion island would be land-based (e.g., look at Figure 3!).

Line 221: comma should be a period

Lines 343-346: as presented, this seems anecdotal and based on a single case. It would be more convincing to show a map of the FLEXPART convective sources (i.e., locations of most recent position in the lower troposphere) for matches with the RH profiles. It would help to better answer the question of importance of differences in boundary layer sources and mixing to impacting the upper troposphere ozone observed.

References: Miloshevich et al. 2004: Development and Validation of a Time-Lag Correction for Vaisala Radiosonde Humidity Measurements, J. Atmos. Oceanic Technol., 21, 1305–1327

Ray & Rosenlof, 2007: Hydration of the upper troposphere by tropical cyclones, J. Geophys. Res., 112, D12311, doi:10.1029/2006JD008009

Zhan & Wang, 2012: Contribution of tropical cyclones to stratosphere-troposphere exchange over the northwest Pacific: Estimation based on AIRS satellite retrievals and ERA-Interim data, J. Geophys. Res., 117, D12112, doi:10.1029/2012JD017494

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