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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global Atmospheric Chemistry – Which Air Matters" *by* Michael J. Prather et al.

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I am writing to note the submission by Prather et al., to examine probability distribution functions weighted by chemical reactivity, seems to be a promising complement to other approaches being developed to *quantify* differences in the representation of OH and CH4 lifetime within CCMs and CTMs.

The community eagerly awaits the data from ATom, and the approach outlined in the submitted paper will likely advance our understanding of not only why models differ in their treatment of OH and CH4 lifetime, but which models might actually be closer to the truth.

At the same time, I am sympathetic to the comment of the reviewer who stated:

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-Sect. 5 seems to suggest that the NASA A Tom missions are unique in providing high-frequency measurements across the Pacific and Atlantic Oceans. Such measurements have been made since decades, which is a great asset to the atmospheric chemistry community and in particular modelers (probably underused), and it should be mentioned that these datasets can also be applied in the presented methodology. The focus on the NASA A Tom missions in the manuscript are distinctive, which does not do justice to the more general applications of the method.

For instance, the recently completed CONTRAST campaign is in the long-line of missions that have reported publicly available, high-frequency measurements in remote regions of the troposphere.

Should this paper proceed, Prather et al. might want to cite the usefulness of chemical fingerprinting via use of emission ratios as well as trajectory-based analyses for typing filaments to specific source regions, such as recently published by Anderson et al. (Nature Communications, 2016 http://www.nature.com/articles/ncomms10267) as another, complimentary means to look at this type of measurements.

Finally, the use of the CTM/CCMs in the A-run mode is a fascinating idea. Perhaps this will break the log-jam the community presently faces, driven by the difficulty in separating differences between OH precursors and chemical mechanism, with regards to model differences in OH and CH4 lifetime. At the same time should the editor decide that this paper will proceed, Prather et al. might want to note another new, recently published, promising approach: the use of neural networks (NNs) trained using archived, model output to simulated the chemical mechanism of each global model (i.e., Nicely et al., JGR, 2017 http://onlinelibrary.wiley.com/doi/10.1002/2016JD026239/full)

Personally, I hope this paper does proceed because I think the use of NNs (which require groups to archive specific quantities) versus special, new runs such as the A-run mode (which require groups to "disable processes that connect and mix air parcels" (line 318) will be a ripe discussion point among modelers at future meetings such as

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the CCMI meeting being held 13-15 June 2017 in Toulouse, France.

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