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Interactive comment

Interactive comment on "On the sources and sinks of atmospheric VOCs: An integrated analysis of recent aircraft campaigns over North America" *by* Xin Chen et al.

Anonymous Referee #1

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Chen et al. provide an overview of VOC budgets as observed in a set of aircraft campaigns and as modeled by GEOS-Chem. The model shows a dominance of biogenic VOC emissions in terms of magnitude and reactivity, and anthropogenic VOCs in terms of VOC loading. Model skill is variable, and the authors highlight the importance of discrepancies caused by a small subset of VOCs. They show discrepancies in the FT are linked to an underestimate of BL ventilation. Overall, the paper is well written and the results are suitable for publication in ACP. I have only a few remarks, below:

Major and Minor Comments:

1.) A predictable concern is that a single model year (2013) is directly compared to

observations spanning from 2010 to 2014. This may disproportionately influence anthropogenic VOCs comparisons, as California is largely sampled in 2010, and DC is sampled in 2011. It needs to be shown that interannual variability in emissions and meteorology is unlikely to affect the overall magnitude and spatial pattern in biases shown here.

2.) Observed VOC-loading is operationally defined by aircraft payload (section 5.1). The authors note that this is typically more comprehensive in the summer-time, BVOC-centric campaigns. Are there any biases that are expected to persist in a certain dataset? This information may be extractable from Table S1, but it should be directly stated. Similarly, are there any points where VOC loading as measured by each aircraft can be compared?

3.) What are the BOVOC/AOVOC tracer sources (section 7)? Are they formed from the oxidation of some VOC precursor with a specific lifetime? A more detailed explanation of the model setup is needed.

4.) Yu et al. (2018) also diagnose weak PBL ventilation – this cited in the conclusions but perhaps should be specifically discussed in section 6. Is the error associated with using off-line meteorology enough to drive the model errors observed here?

Specific Remarks:

1.) Page 3, line 118: "The model simulation includes extensive new developments related to atmospheric VOCs..." Can you clarify what developments are new in this work? "Latest" may be more appropriate than "new".

2.) Page 5 line 180: "... implemented into GEOS-Chem as described by Hu et al. (2015) with updated $0.25° \times 0.3125°$ distributions of plant functional types and base emission factors". Please clarify the source of the updated plant functional types and base emission factors if different than Hu et. al (2015).

3.) Figure 2: Please label fluxes to indicate net directionality.

Reference: Yu, K., Keller, C. A., Jacob, D. J., Molod, A. M., Eastham, S. D., and Long, M. S.: Errors and improvements in the use of archived meteorological data for chemical transport modeling: an analysis using GEOS-Chem v11-01 driven by GEOS-5 meteorology, Geosci. Model Dev., 11, 305-319, https://doi.org/10.5194/gmd-11-305-2018, 2018.

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