

## ***Interactive comment on “Exploring the vertical profile of atmospheric organic aerosol: comparing 17 aircraft field campaigns with a global model” by C. L. Heald et al.***

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We thank the reviewer for their comments that have helped to clarify the manuscript. We quote specific comments below and supply responses (marked by \*\*). A track changes pdf was also attached to the Response to Review #1.

"The paper provides clear motivation and good background information for compiling 17 datasets globally. However, in order to carry out the full objective, specifically, (from page 25374 line 25) “: : to consistently investigate OA loading into a global model”, the most up-to-date global model must be considered. If the paper does not consider the most recent developments in the GEOS-Chem Model, including Pye and

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Seinfeld 2010, then the study is incomplete. The main recommendation is to include the potential additional source of organic aerosol from semi-volatile and intermediate volatility compounds, as discussed in Pye and Seinfeld 2010."

\*\*We appreciate the reviewer's point here, but there were both scientific and practical reasons that the S/IVOC sources from Pye and Seinfeld were not included in the manuscript. First, the option to include this additional source has not yet been included in a standard GEOS-Chem release. This is envisioned for a future release (v9.1.3, likely early 2012), thus it is not possible to include this in our simulations. Second, the implementation of S/IVOC is highly uncertain, as e.g. the SOA yield from IVOC is about 30% in Pye and Seinfeld and near 200% in the alternative parameterization of Grieshop et al. (ACP 2009). Pye and Seinfeld demonstrate that inclusion of this source can actually degrade model performance, thus it is not empirically clear that this addition, as it exists in GEOS-Chem, is a “model improvement” (although certainly it is a development of interest which should be further investigated). Finally, to be clear, because of this, we specifically do not describe our simulations as the most “up-to-date”, but simply indicate that it is a baseline, and that these kinds of potential additional sources should be considered in the interpretation of the results.

"Comment 1: Page 25380 Line 28: 2 degrees by 2.5 degrees horizontal resolution seems too coarse to compare to aircraft data. Please discuss and justify. A recommendation is to run a nested simulation, for example North America at 0.5 degrees latitude by 0.667 degrees longitude, and compare this model result to all available campaign data from that domain to see the impact of higher model resolution."

\*\*Our objective was to be uniform with our comparisons over space and time, however we agree that higher resolution simulations would be valuable to the interpretation of individual campaigns. We have added some discussion of this to the Conclusions.

"Comment 2: Page 25383 line 2: Why is the median the “best” test of model performance? Explain more clearly why."

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\*\*We have clarified in text.

"Comment 3: Page 25383 Line 21: "The ratio of POA to SOA in polluted regions for the model is larger than 1, which contrasts with ratios much smaller than 1 in observations in aged polluted air: : : This suggests that SOA in the polluted regions in the model may be underestimated" – Can this be due to POA being treated as non-volatile. It is recommended to run a case like Pye and Seinfeld 2010 to see the impact of SV-POA."

\*\*This is a good point. Yes, it is possible that POA is too high due to being treated as non-volatile, and that SOA could include missing material oxidized from S/IVOC. We have clarified the text. Regarding an additional simulation, see comment above.

"Comment 4: Page 25386 Line: 28: "note here that the observations have been averaged to the model spatial resolution". Please clarify exactly how averaging was carried out."

\*\*We have clarified in Section 2.

"Comment 5: Please explain the vertical structure of the model better."

\*\*We have added the details on the vertical resolution of the model to Section 3.

"Comment 6: Page 25393 Line 9: Please clarify why 5% fragmentation was used."

\*\*We have clarified in the text.

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 25371, 2011.