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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Gas and aerosol carbon in California: comparison of measurements and model predictions in Pasadena and Bakersfield" *by* K. R. Baker et al.

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REVIEWER: The Baker et al. manuscript presents a comparison of gaseous and particulate organic carbon measurements and model predictions for the 2010 CalNex campaign. Simulation results from specific time periods and grid cells are analyzed to facilitate comparison with measurements.

The presentation quality of the paper could be improved. There: omissions of important/relevant literature, poorly organized sections, and many grammatical errors.

Specific examples follow under the technical and editorial comments.

Technical: The authors do not present sufficient evidence to support the assertion that reasonable predictions of VOCs and OH radical and underpredictions of SOC suggest error in parameterization of semi-volatile gases. The sensitivity simulation in which the concentrations of lumped oxidation products are increased by a factor of 4 only addresses one of the many limitations/uncertainties in the CMAQ model approach. While the sensitivity study is instructive, its importance should not be overstated. A more comprehensive sensitivity analysis of other limitations/uncertainties (likely beyond the scope of this manuscript) would be required to make such a statement. The authors refer to other limitations briefly throughout the manuscript.

AUTHORS : We agree with the reviewer that we only explore some of the many possible uncertainties with OA model performance in California. We also agree other notable uncertainties that need to be explored require a large amount of detail and work and are best as follow-up projects. We plan to submit a manuscript to ACP in the near future that examines treating POA as semi volatile with the VBS approach and a second follow up manuscript examining uncertainties in IVOC emissions on SOA production in this area. We feel these manuscripts in totality will still not be able to fully address the range of issues that could be contributing to model performance but provide a strong basis for understanding the best future directions for future CMAQ and emission inventory improvements.

REVIEWER : I am somewhat surprised that the authors did not further discuss the likely modeling implications of treating POA as non-volatile, particularly when comparing primary and secondary OC fractions. There have been several published studies suggesting that allowing evaporation and subsequent oxidation/partitioning of POA produces modeled primary to secondary OC ratios that are in better agreement with AMS measurements. I think this is a significant oversight/omission given the focus on underprediction of SOC. In the conclusions the authors do suggest this possibility, but it is not satisfactorily addressed in section 2.2.

AUTHORS : The reviewer is correct that treatment of POA as semi-volatile would result in more SOA and thus a relative mix of SOA/POA in this area that better matched AMS estimates of SOA/POA. We do not explore semi-volatile treatment of POA in this manuscript because we have a follow-up manuscript in preparation that should be submitted to ACP in the near future where we apply CMAQ with semi-volatile treatment for POA for this same period and area and compare with AMS based measurements. A great deal of complexity is involved with treating POA as semi-volatile, which includes some estimate of IVOC emissions. We felt the scope of that work is complex enough to necessitate an entire subsequent manuscript. This issue will be addressed in detail in a separate ACP submission.

REVIEWER : How do the modeling results compare with those presented by Fast et al. (ACP, 2014), in which aerosol precursors over California were modeling during CalNex using WRF-Chem)?

AUTHORS : We appreciate the reviewer noting the (Fast et al., 2014) manuscript describing modeling of the CALNEX period using a different modeling system that includes WRF-CHEM and an episodic emission inventory developed by California Air Resources Board for the ARCTAS field campaign in 2008. (Fast et al., 2014) show large under predictions of SOA mass at both Pasadena and Bakersfield. Primary OC is overestimated at Bakersfield and both over and underestimated at Pasadena depending on the time of day. Modeled total OA at Bakersfield is comparable to AMS measurements and largely under predicted at Pasadena compared to AMS measurements. The under prediction at Pasadena is most notable during peak events that are not captured by the modeling system. Text has been added to the manuscript providing results from (Fast et al., 2014) as context for some of the model performance features shown in this work. Revised manuscript text follows.

A modeling study for the same time period using different emissions, photochemical transport model, and SOA treatment also show underestimated OA and SOA at Pasadena and underestimated SOA but comparable OA at the Bakersfield location

(Fast et al., 2014).

REVIEWER : Editorial: Throughout the paper there are grammatical errors. It is recommended that the authors read carefully for such errors, some examples are noted below. It is suggested that the authors consider introducing the CMAQ model (2.2 Model Background) prior to discussing model application (2.1).

AUTHORS: We agree with the reviewer and have moved the section describing the model itself to be before the section describing the model application in the revised version of the manuscript. We have also carefully reviewed the manuscript for grammatical errors and made revisions where appropriate.

REFERENCES

Fast, J., Allan, J., Bahreini, R., Craven, J., Emmons, L., Ferrare, R., Hayes, P., Hodzic, A., Holloway, J., and Hostetler, C.: Modeling regional aerosol and aerosol precursor variability over California and its sensitivity to emissions and long-range transport during the 2010 CalNex and CARES campaigns, Atmospheric Chemistry and Physics, 14, 10013-10060, 2014.

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