**Atmospheric
Chemistry
and Physics**
Discussions

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Interactive comment on "Long-term particulate matter modeling for health effects studies in California – Part 1: Model performance on temporal and spatial variations" *by* J. Hu et al.

Anonymous Referee #1

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This paper presents results from a 9-year model simulation of air quality in California that includes chemically-resolved PM2.5 concentrations. Model predictions are compared to published field observations and generally show excellent agreement, both in capturing seasonal trends and absolute concentrations of several atmospherically relevant gas- and particle-phase species as well as total PM2.5. These results are of great importance as the adverse health effects of particulate matter have been shown to depend not just on mass loading, but on particle size and composition. The availability of accurate long-term, large-scale model predictions will help fill the significant spatial and temporal gaps in ambient particle measurements, and aid efforts to cor-

relate aerosol-related health effects with specific particle-phase species. This work is novel as it combines long-term modeling over a large area with high-spatial resolution in the most populated areas, and full particle size and component resolution. The results are clearly presented, and address a relevant question within the scope of ACP. It is recommended that this manuscript be accepted and published after consideration of several comments.

General comments/questions:

1) Can the spatial and/or temporal variation in the sulfate bias say anything as to it's source? It's stated that one possible contributor is the missing DMS from the ocean. However, in figure 9e, the model does a pretty good job along the coast except for a few sites in southern California, where anthropogenic sources would be expected to dominate sulfate formation.

2) On a related note, under conditions of low background particle concentration, nucleation from gas-phase sulfuric acid can be an important source of seed aerosol particles. Is this process included in the model? If so, is any correlation observed between the low sulfate bias and low PM2.5 bias generally in cleaner areas? If it is not included, could this account for some of the observed low sulfate bias? (Fig. 9e appears to show a small, constant under-prediction of sulfate over inland northern California and along the eastern border where aerosol mass is low to start with.)

3) The general finding that longer averaging times improves model performance is useful, especially as it relates to removing the effects of random measurement errors. However, would the 'smoothing out' of actual variations in PM2.5 concentrations affect the correlation of model results with health effects in epidemiological studies since short-term PM exposure is known to cause health issues? (Pope III, C. A., and D. W. Dockery. 2006 and references therein).

Specific comments/questions:

Page 21009, lines 2-4. Could the model not also be greatly over- and under-predicting moderate actual concentrations, as long as it did so with approximately equal frequency or over-predict consistently in certain areas and under-predict in others?

Page 21012, lines 24-29. 'OM' has not yet been defined. Also, on page 21001 line 17, 'OC' is defined as 'organic compounds,' however it appears to be used in this paragraph (and in Fig. 5?) to refer to organic carbon, while 'OM' is used to refer to the total organic mass. If 'OC' does refer to organic carbon throughout the text and figures, the discussion of this conversion should be moved up, maybe to the methods section. If not, a different abbreviation should be used for organic carbon.

Page 21024, line 16. If the bias is also driven by missing DMS emissions, this should be changed from SO2 to more general sulfur emissions.

Page 21032, Figure 5. The text in the figure is too small to be read easily. I would recommend splitting this into multiple figures. Also, labels (a) - (h) should be defined in the figure caption.

Page 21035, Figure 8. Units for concentrations and inverse wind speeds in brackets should be indicated in figure caption.

Minor editorial comments

Page 21000, line 4. Is the intended phrase to use "state-of-the-science," ? Page 21003, line 21. 'hpa' should be 'hPa' Page 21014, line 3. Extra period at the end of the sentence Page 21023, line 5. 'atmosphere' is misspelled Page 21035, Figure 8. The legend for 1/u [0,4] and the black dot to its right could be closer.

Pope III, C. A., and D. W. Dockery. 2006. "Health Effects of Fine Particulate Air Pollution: Lines That Connect." Journal of the Air & Waste Management Association 56 (6): 709–42.

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