Responses to reviewer

The authors have put in considerable effort for their revisions, and for the most part I am satisfied with their changes. The one point on which I still feel additional work is necessary is on the issue of PM2.5 speciation.

I understand the problem of data availability, and in my original review I was not suggesting that the authors create robust longterm speciated measurements where none exist. What I do (still) expect to see, however, is some significant discussion of this issue and how spatiotemporal patterns of PM2.5 speciation may affect the analyses and projections performed here. While we do lack much of the data necessary for a fully robust speciated analysis as performed in this manuscript, we are not completely blind with respect to how different types of PM2.5 precursors vary regionally, and much work has already explored differences in their expected behavior under varying ambient conditions. As just one example, Tai et al., 2010 (already cited in the manuscript) explore ways in which PM2.5 from sulfate and nitrate differ both in spatial distributions as well as their respective response to meteorology. Considering the significance of these differences, and the availabilitiy of previous studies like this one that have addressed them, I find it hard to accept the lack of meaningful discussion on the topic in this manuscript.

Furthermore, modern climate and chemical transport models (including CESM and the CAM4 atmospheric component) provide this speciation as gridded output, further supporting analysis on the model side. While full validation against observations may be outside the scope of this work, at the very least this output could aid in the interpretation of the model results themselves. Why has this not been done with the model output used here?

With this point addressed, I would feel comfortable giving full support for publication in ACP.

Response:

We would like to thank the reviewer for the constructive comments about the manuscript and we agree, and add the following text to the paper in lines 379-390 (at the end of Discussion section):

$PM_{2.5}$ generally consists of multiple different aerosols each with different sources and variability; for example, the most important in the US are sulfate, organic matter, elemental carbon, nitrate, ammonium and desert dust. The different $PM_{2.5}$ components respond to meteorological variables differently. The sulfate fraction of $PM_{2.5}$ is predicted to be higher due to faster SO_2 oxidation under a warmer climate while the nitrate and organic fraction lower due to volatility (Dawson et al., 2007; Kleeman, 2008; Tai et al., 2010). Increased temperatures can lead up to higher biogenic emissions of $PM_{2.5}$ precursors including agricultural ammonia, soil NO_x, and volatile organic compounds (Pinder et al., 2004; Bertram et al., 2005; Guenther et al., 2006; Riddick et al., 2016). Aqueous-phase sulfate and ammonium nitrate production increase with higher relative humidity (Liao et al., 2006; Dawson et al., 2007). Wildfires are an important source of black and organic carbon and they can increase or decrease depending on the local changes in climate and land use (Park et al., 2007; Spracklen et al., 2009; Kloster et al., 2012). Future exploration of the different components of aerosols and how each

responds to climate could provide more information about the effect on each type, but for these simulations, only $PM_{2.5}$ was output and thus is not available for this study.

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