

## ***Interactive comment on “Quantifying population exposure to airborne particulate matter during extreme events in California due to climate change” by A. Mahmud et al.***

**Anonymous Referee #1**

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The manuscript “Quantifying population exposure to airborne particulate matter during extreme events in California due to climate change” by Mahmud et al. is a concise, focused analysis of model estimated changes to particulate concentrations in three Californian air sheds. While previous studies have explored the impacts of climate on aerosol pollution more broadly, analysis at this level of detail on these regions of California is new. Also, treatment with a source-specific modeling approach is new, even though this aspect is perhaps not highlighted as much as it could be. Overall, this is a good manuscript that would benefit from additional attention to the literature, strengthened statistical arguments, further discussion of how climate impacts are isolated from other changes, and an assessment of model performance. Following these

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suggestions, the article will be publishable in ACP.

### **1 Major comments**

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- Introduction: Only one other study is discussed in the context of investigating the impact of climate change on particulate concentrations. There are many others – Dawson 2007, Kleeman 2007, Pye 2009, to name a few. Thorough discussion of the literature should be presented.
- 5885.22: Why are mobile source emissions impacted by variations in meteorological conditions? Overall, it's not clear to what extent changes in meteorology are being decoupled from changes in emissions. I would have thought, from the introduction, that only changes to biogenic, soil or lightning emissions (i.e., natural processes) would be affected by climate alone, and that all of the anthropogenic emissions would be fixed. This would be consistent with the attempt to minimize “confounding factors,” such as changes to population. This could use clarification.
- 5886: To what extent does the model reproduce observed variability in 3 year average PM<sub>2.5</sub> concentrations by species? Some assessment of the forward model performance relative to observations needs to be included, either directly or via discussion of previous work.
- 5889.7: I'm not sure that “statistically identical to zero” is entirely correct here. It is possible for two statistics to have overlapping CI's but be statistically different at a particular level of significance. Was the mean determined to be statistically different than zero? At what level of significance?

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- If the largest differences seen between the present and future climate cases were in the extreme events, did the authors consider the relevance of their work with regards to acute health effects? This would seem to me like a natural impact to explore, or at least mention.
- The investigation of differences in the upper 1% of the distributions is bothersome for a few reasons. First, the plot referred to by the text doesn't even show the part of the histograms being compared here. Also, this plot S3 would appear to be central to a large portion of the results. The manuscript is very short at present – I suggest including this figure in the main text. Lastly, it's not clear to me to what extent a single percentile between two distributions with this much variability can be explained. What statistical test can be done to determine if the difference between these extreme values are statistically significant? Is it arbitrary to focus only on the 99th percentile, i.e., couldn't the authors similarly have compared the differences between the histograms at the bin around  $11 \mu\text{g}/\text{m}^3$ ?
- Throughout, the authors invoke the notion of increased stagnation as governing the differences in the present vs future climate. Was that really the only difference? Did changes in temperature, precipitation or deposition really have no impact? If not, why were these factors noticed in other studies in the literature but not this manuscript?
- 5891.21: This is probably related to me not understanding clearly which emissions are fixed, and which emissions are affected by climate change, but why is there such a large decrease in  $\text{SO}_4^{-2}$  here?

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## 2 Minor comments

- 5882.14: This paragraph of the abstract seems to be missing on overall topic sentence, and thus the reader assumes the first sentence to be an overview, but really the following discussion focuses not on the lack of changes in the mean mass concentrations but rather the estimates of significant changes to the composition.
- 5883: “2.3” seems like a rather precise factor to be conjoined with the approximation symbol  $\sim$ .
- 5883.21: remove “trapping”
- 5886.27: What are the units of  $C_i$ ? Are the volumes of each of the grid boxes the same, i.e., the height of the first model layer is fixed? If not, summing up concentrations in this manner would not be appropriate.
- 5886.12: The modifications mentioned here to wet deposition schemes and sea salt emissions need to be explained further (or were these part of the Mahmud 2010 updates? It wasn't clear).
- 5887: A figure showing this distribution would be helpful.
- 5888: It's not clear to me why the y-axis on Fig 2 is set to  $\pm 50$  given that the scale of the results is much narrower.
- 5890.3: Have GCM and RCM been defined?

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 5881, 2012.

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