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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantification of impact of climate uncertainty on regional air quality" *by* K.-J. Liao et al.

Anonymous Referee #1

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The paper attempts to estimate the uncertainty of the effects of future climate change on air quality in the US. This is an interesting question both methodologically and also from a policy design point of view. The authors choose one future emissions scenario (the IPCC A1B), one GCM (the GISS) and rely on a single set of simulations for 2050. These choices limit severely both the potential uncertainty and variability in the problem. The authors introduce an original approach (at least in this air quality context) for the development of extreme meteorological scenarios. While this is a rather limited quantification of the impact of climate uncertainty on air quality in the US, the paper still makes a significant contribution to the problem of future air quality in a changing climate. However, the methodology needs to be presented clearly and the limitations of both the methods and the conclusions should be analyzed.

Major issues:

(1) The authors have chosen as a basis for their uncertainty estimation the IPCC A1B scenario. Some discussion of the dependence of their results (taking into account both the global climate and US emission changes) on this choice is necessary.

(2) The paper is based on the simulation of a single year (more precisely a few months in a single year). Given the variability of meteorology these results can be misleading even if the objective is just the calculation of the uncertainty. Some additional analysis is necessary to address this point.

(3) I think that the technique used for the estimation of the uncertainty is one of the major contributions of the paper and should be described in more detail. Unfortunately, even the additional information in the Supplementary Material is not sufficient. It is not clear how the authors calculate the different percentiles of the three-dimensional (y, z, m) fields. Also how do they deal with both the temperature and relative humidity fields? What do they do with the rest of the meteorological variables?

Last but not least, it is not clear (at least to me) what exactly do these extreme meteorological fields capture and what they do not capture? For example, do they include the possibility of very wet summers or winters in a specific region? How about major changes in mixing heights?

(4) Is the difference between the PM and ozone sensitivities just due to the respective averaging periods (8-hr versus annual average)? Some analysis of the sensitivity of the daily maxima PM concentrations would be quite helpful, especially considering the tightening of the daily average $PM_{2.5}$ standard in the US.

(5) Change in regional precipitation is always one of the most uncertain variables in such modeling exercises. How do the current predictions compare to others in the literature? How extreme are the extreme scenarios?

(6) The extreme scenario appears to result in predictions of both increases and de-

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creases in 4th MDA-8hr ozone. Are all the major urban areas characterized by increases? Is this uniformity real or just a consequence of how this extreme scenario was constructed?

(7) The paper focuses on total $PM_{2.5}$ changes and just mentions that these changes are dominated by sulfate and nitrate changes. Some additional information about the predicted changes in the major $PM_{2.5}$ components (sulfate, nitrate, primary and secondary organics, and dust) is necessary.

(8) The paper concludes that the impact of climate uncertainties may be substantial in some urban areas. However, there is very little discussion of specific urban areas (and corresponding uncertainties) in the paper.

Other Comments:

(9) Some additional information about the IGSM model is necessary (version number?). Also, how is the Emissions Predictions and Policy Analysis (EPPA) module used? Are its results consistent with those of the IPCC A1B scenario for the US?

(10) Abstract: Which areas are most responsive to climate change? Why?

(11) The table with the emissions in the supplement is not sufficient. The emissions of biogenic and anthropogenic VOCs as well as those of primary PM2.5 should be added to the table. Also a column with the current emissions would be helpful. Finally, the units (per grid) are rather confusing. How about just the emissions in the domain or subdomain per year?

(12) The absolute humidity entries in Table 1 are confusing. They are all given in percent.

(13) Figure 3 is discussed before Figure 2. Their order should probably be switched.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 7781, 2008.

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