Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Health and Economic Impacts of Ozone Pollution in China: a provincial level analysis" *by* Yang Xie et al.

Anonymous Referee #1

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This paper combines different types of models to estimate the current burden of ozone on public health and economic impacts in Chinese provinces, as well as the benefits of more stringent policies in the future. Overall, the study is interesting, adds value to the literature since most similar papers have focused on PM2.5 in China and not ozone, and the broad and multi-disciplinary range of impacts addressed is impressive. The general approach has been used by many other studies to estimate future air pollution-related health and economic impacts of emission policies, and this paper goes farther with the CGE model integration. Each model applied is generally established and widely used. I focused my review on the air quality modeling and health impact assessment.

Major issues:

1. The health impact assessment methods were confusing and unclear. More detail and rationale behind several of the data inputs could improve this part of the paper quite a bit. There could also be some inappropriate assumptions or aspects of the methods, though it is hard to tell without clear descriptions of the methods. Specific comments on the health impacts aspect:

1a. It was very confusing whether and where PM2.5 impacts were included. The paper focuses on ozone, the results section appears to be ozone health impacts only, but the conclusions anad abstract compare ozone health impacts to PM2.5 impacts. The methods section in the Supplemental material jumble ozone and PM2.5 together. Please clarify whether PM2.5 health impacts used to compare against the ozone impacts were original calculations done by the authors, or drawn from somewhere else. Are the PM2.5 health impacts included in the numbers given in the results and abstract sections?

1b. Line 93: Was SSP2 used to project future population, but not baseline disease rates? Please clarify, and if so, explain why. What was the source of baseline disease rates? What year are they from? Were they province-specific or national? Were they age specific? These choices can have really substantial influence on results and, in the case of this paper, could affect conclusions about the province-level results/rankings. Disease rates differ dramatically throughout China, so province-level rates should be used if possible. Also, both disease rates and age structure might change dramatically through 2030, with potentially substantial results.

1c. Clarify whether a log-linear or linear function was used. What is the evidence behind this choice?

1d. Is total mortality all-cause mortality or non-accidental mortality?

1e. What ages were calculated for each health endpoint? Where health impact calculations age specific? Was population age structure projected to the future?

1f. Discuss methods for calculating uncertainty, different sources of quantified and unquantified uncertainties – either in methods, health section, discussion, appendix, or preferably in at least two of these places. Line 384-385 is not sufficient.

1g. Table A1 – The sources list health impact assessments, sometimes for PM2.5 and not ozone, instead of the primary source of concentration=response functions. There should be a lot more information provided with this table, including the primary CRF source, the age it applies to, what ozone metric (e.g. 8-hr, 24-hr, seasonal avg, annual avg?), the concentration change it applies to, etc.

2 The air quality modeling portion of the study was also not entirely described, and some of the inadequately described assumptions and methods could have substantial influence on results. Specific questions on the air quality modeling methods:

2a. Does natural background include transport from other countries? What about wildfires and farmland, both of which may not be natural? The paper should discuss where the impacts from these sources are in the results, and how that might influence the province-level conclusions.

2b. Lines 101-102: How big of an impact would it have if meteorology was projected to 2030?

2c. Lines 101-102: About how many grid boxes per province? Are concentration results simple averages of the gridboxes within each province

Additional specific comments:

3. Abstract makes statements beyond the content and certainty presented in the paper. For ex. "will" on lines 27 and 29 might better reflect the amount of certainty this paper provides if written instead as "could be". Clarify in these lines whether these values are specific to ozone health impacts. Lines 32-34 seem to be beyond the scope of the paper.

4. Section 3.1 should summarize how much NOx and VOC emissions change by sce-

nario, to help interpret some of the ozone concentration results in the coming sections. This information is currently in the Appendix figures, but should be summarized in the main text.

5. Lines 192-202: suggest providing some indication of how many of the provinces with the highest ozone levels fall into each of these three categories. And how many of them might be most affected by the portion of what is called natural, that is actually from international transport of air pollution, wildfires, and farmland. These may not be natural.

6. Line 201: "a lot". . . by how much specifically?

7. Figure 3: shift x-axis labels to line up with tick points

8. Line 2014: "opportunities to obtain ozone-related diseases, premature death and payment. . ." is strange wording and should be revised

9. Line 235: 61.2% seems off. Is this calculated by dividing 140,100/491,000?

10. Lines 238 and 242: 4-5% and 1-2% of what? Clarify what these percentages represent.

11. Figure 4: How were different morbidity endpoints added together to get the results in the 2nd row? Is this equating all cases of different morbidity endpoints, so that the total number of cases is the cases of asthma + the cases of respiratory hospital admission + cases of cough, etc.?

12. Line 297: why does VSL change by scenario?

13. Line 342: Can forest burning and farmland really be considered natural?

14. Line 352: except in the cases where you found ozone increases. . .

15. Line 356-357: There are health effects below the WHO guideline. There is a large body of epidemiological literature on this. For example, see EPA PM National Ambient

Air Quality Standards Regulatory Impact Assessments. Suggest removing.

16. Line 362: Odd to introduce PM mortality results for the first time in the Discussion. Perhaps this should be woven into the health results section or left out completely since no methods information has been given to describe what was done to calculate that (e.g. shape of concentration-response function, epidemiological studies used, age ranges included)

17. Line 363-364: what about cardiovascular impacts?

18. Line 366: What does "2.3 times per capita per year" mean? Does this mean 2.3 cases per capita per year?

19. Line 376: "On the other hand" seems unnecessary since this line agrees with the last.

20. Figure 6: What is changing in the inputs underlying the results in this figure? Just concentrations? What about population, disease rates, etc.? Please clarify.

21. Figure 6: Clarify that the color legend at the bottom applies only to the bottom panel – e.g. by drawing a darker line between the 3rd and 4th rows. I was scratching my head about why there was so much asthma mortality in the top panels, because asthma is gray in the bottom panel.

22. Section 6.1: see major comment on health impact assessment above.

23. Lines 428-442 are perplexing. Many of these variables are not in the equations.

24. Line 426: Why is Ir all cause? Is this because only all-cause mortality for ozone exposure was calculated? If cause-specific mortality is calculated, the baseline disease rate should be cause-specific too.

25. Lines 445-449: So is this work lost due to death, or morbidity? This whole section is vague and confusing and should be revised.

26. Line 448: Only 4% of chronic mortality is aged between 15-65 years? That seems really low. Can provide some data to back this up? Need a source.

27. Line 784 is repetitive

28. Line 788: missing section reference