

Interactive
Comment

Interactive comment on “The impact of China’s vehicle emissions on regional air quality in 2000 and 2020: a scenario analysis” by E. Saikawa et al.

Anonymous Referee #2

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1 Overview

This manuscript by Saikawa et al. explores the potential impacts of vehicle emissions regulations in China on regional surface O_3 and $PM_{2.5}$ concentrations. Emission inventories for vehicles are constructed considering business as usual vs Euro-3 compliant scenarios. Emissions from other sectors and for global emissions are taken from the REAS PFC and IPCC A2 scenarios, respectively. The WRF-Chem regional CTM is applied using chemical boundary conditions from the global MOZART model. The modeling framework is assessed through comparison of O_3 and $PM_{2.5}$ estimates to observations. The authors examine the impacts of the different emissions scenarios in terms of monthly average surface concentrations and their cummalitive probabilities at

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various concentration levels. They find that vehicle emissions regulations would lead to improved air quality for China and the region, relative to no vehicle emissions regulations. The article is generally clear and well written. I think the significance could be enhanced by refocusing some of the analysis and presentation. I have some suggestions along these lines, and a few corrections or points of clarification. It is suitable for publication in ACP after addressing these issues.

2 Comments

1. There are a few areas in which results may be presented with a different emphasis or focus to enhance the significance of this work.
 - The main conclusion is, presently, that if vehicle emissions in China were regulated, air quality in China would be improved. This may seem somewhat obvious, particularly after having established that the projected increases in vehicle emissions are occurring at a much more substantial rate than those for the other emissions sectors (i.e., total CO emissions less than double, yet vehicle CO emissions increase by a factor of 7 for the BAU case). It seems that much of the effort for this work went into constructing the emissions inventories themselves, and thus the latter aspect alone is one of the more fundamental conclusions of the manuscript.
 - The air quality metrics used for assessing O₃ and PM_{2.5} (monthly averages) aren't inline with any of the metrics actually used for policy. Recasting the findings in terms of quantities such as exceedences, or the maximum running 8-hour average O₃ concentrations, would greatly improve the relevancy of this work and possibly lead to altered conclusions, as small changes to concentrations can lead to large changes in the frequency of exceedences

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- above a threshold. For example, the WHO targets cited on page 13160, line 21-24, could be explicitly evaluated.
- The discussion/quantification of the impact of the emissions regulations in China on regional air quality could be expanded beyond the one paragraph on page 13161.
 - From a policy point of view, it seems that one of the most interesting questions is to what extent could vehicle emissions reductions alone achieve air quality standards in China. This is only briefly mentioned in the conclusions. The implications of this work for considering the most effective way to achieve air quality goals could be considered.
2. Does WRF-Chem include feedbacks of aerosol concentrations on the gas-phase chemistry via heterogeneous chemistry and/or photolysis rates?
 3. p13146, 4: It wasn't entirely clear to me which species are regulated, as Table 1 implies it would be NO_x , PM, CO and HC, yet here we see distinctions for BC and OC.
 4. 13162,4: Formation of nitrate aerosol is often limited by availability of excess NH_4 . Was that constant for these simulations, or was nitrate uptake really enhanced by increased NO_x emissions?
 5. The figures are not always easily legible (specifically, captions and labels on Fig 2, 4, though all are a bit small). Suggest using larger fonts, making better use of white space on plots for placement of labels, legends, within the plot space. Also, visible country borders for the geo-spatial model results would be appreciated.
 6. What assumptions are made about the sulfur content of fuel, and this sulfur content being constant or changing in the various scenarios?

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3 Technical corrections

- 13151, 14: observed -- > included
- 13151, 20: lateral boundary -- > lateral chemical boundary
- 13155, 3: relative to what?
- 13159, 3: in excess -- > an excess
- 13162, 4: In summary

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