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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Projections of air pollutant emissions and its impacts on regional air quality in China in 2020" *by* J. Xing et al.

**Anonymous Referee #2**

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## 1 Overview

The goals of this work represent an important contribution to understanding air quality in China. These goals include developing scenarios of air pollutant emissions that are based on real policy options and using a chemical transport model to understand the air quality implications of these scenarios. However, in the present form, this manuscript does not sufficiently achieve these goals, largely because the analysis is very difficult to understand. The results are presented coherently in Figures 6, 7, and 8. But the text is very confusing. I agree with all of the points made by the other designated reviewer and by the comments from Dr. Z. Lui. I have listed additional comments to be addressed by the authors below.



In its current form, I do not think that this manuscript is fit to be published in *Atmospheric Chemistry and Physics*, unless the authors make substantial improvements, especially by re-writing the results and conclusions sections. If the authors elect to make these improvements, I am willing to review it again.

## 2 Major Comments

- An important contribution of this research is the development of scenarios that reflect real policy options for controlling air pollution in China. However, the method is not described in sufficient detail. First, why is logistic regression selected for forecasting fuel consumption, as in Figure 1? If the forecast variable is fuel consumption in units of energy, a logistic function seems like a poor fit. But if the forecast variable is fraction of industrial sector using a specific process, then logistic regression is a reasonable tool. Please be more specific. Second, to what extent are the scenarios different from the "official Chinese Industrial Forecast", listed as one of the data sources? Can you be more specific about how these data sources are used? Third, these questions are not addressed in the referenced reports by Amman et al. Is there a better source? There are two reports by Amman et al. published in 2008 listed in the references section; please make the citations unambiguous.
- For the scenario generation, is the economic growth assumed to be equal across all Provinces? It is not clear from Table 2. Are the data sources described in Section 2.1 at the Province or the National level? It would be good to include a few sentences clarifying the extent to which your estimates capture regional differences in growth and application of abatement technologies.
- Hong Kong and Macao are not part of the scenarios. Yet the Pearl River Delta is a featured area for the analysis of the concentration changes. Do the emissions in

Hong Kong and Macao impact this region? What was assumed for the emissions in Hong Kong and Macao?

- The CMAQ modeling experiment description is confusing, starting on page 26906, line 14 with "Except for the 2005 emissions and four...". These sentences are critically important as they describe the emission scenarios that make up this modeling experiment. Yet these sentences are very difficult to understand. Please re-write. After reading it several times, I gather that the 25 simulations include

  - 1 control study based on 2005 emissions
  - 4 future scenarios meant to represent hypothetical 2020 emissions
  - 20 additional scenarios, where one pollutant is set to the scenario level and the rest are held at the 2005 level, but I'm not sure about this last one. Please explain more explicitly.

- The notation describing the results is confusing in part because a "concentration response" is not defined. For example, page 26906, line 27: "NO2 concentration responses are 0.9~1 in NCP" Is this a mean, quartile, or the absolute range of the response? Is the response the ratio of one scenario to another? Also, please use the *en dash* (–) to denote a range, rather than the tilde (~). I suggest defining notation and a response in the start of this section and use it throughout.

- "Concentration responses of SO2 and NO2 to the changes of SO2 and NOx emissions present near-linear relationship ... NO2 concentrations present slightly non-linear relationships with NO2 emission changes. The ratio of emission changes to NO2 concentration responses are 0.9~1 in NCP, and 1~1.5 in YRD and PRD." It seems the first sentence states that $SO_2$ and $NO_2$ concentrations change nearly linearly with emissions. Then, the later sentence states that NO2 is slightly not



linear, and then the calculated ratios are as large as 1.5. Is this non-linear behavior? The NOx concentration and lifetime depends on OH, and there are strong feedbacks of NOx onto OH, so one would expect to find many cases where the NO2 concentration does not scale linearly with a change in NOx emissions.

- The ozone changes reported in Section 3.3 are difficult to understand, because it is unclear which scenario is being described. For example, the second sentence begins with "Due to the increase of future NMVOC ...", but the control scenarios have large decreases in NMVOC. I suggest that the reader should be directed to Figure 6 to read the results from the different scenarios, and then this section should focus in more detail on determining if ozone in these regions / seasons is more sensitive to NMVOC or NOx emission reductions.

- The PM2.5 section is also difficult to understand, in part because it is not clear what a "concentration response" is. Sentences such as "PM2.5 concentration responses to the decrease of PM emissions are 1.5~1.8 in January" are hard to interpret. Also, I don't know what this sentence means: "Sensitivity of PM2.5 concentration to SO2 emissions is larger in July with scale as 3, lower in January with the scale as 10". I advise the authors to re-write this section, letting Figure 7 show the change in PM2.5 for each scenario and species, and then using the text to explain what emissions source reductions can lead to the largest changes in PM2.5.

- The interpretation of the deposition section is also very confusing. For example, page 26910, line 15 "impacts from NOx emissions are relative small, with a scale of 5..." It is not clear what scale refers to. Also, the magnitude of the changes are pretty similar to the ammonia emission changes, so why the conclusion that NOx is relatively small? This analysis doesn't inform if the $NH_3$ is more or less effective than $NO_x$ controls. Rather, it compares two scenarios, each of which have different relative changes in $NO_x$ and $NH_3$ emissions.

- Given that I had such a difficult time interpreting the results, I'm not sure what to make of the conclusions. But I suggest that the authors focus on what air quality problems are likely to persist despite substantial emission controls, and what emission sources and sectors could be targeted to mitigate those air quality problems.
- For Figure 4, I suggest changing the scale such that all ratios less than one are in shades of green and all greater than one are in shades of red / orange.
- For Figures 6, 7, and 8: please define "response" in the caption and relevant parts of the text as the percent change relative to the 2005 scenarios.

## 3 Editorial Comments

This manuscript contains many editorial errors, too numerous to list here. I strongly recommend a thorough editorial review.

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