

Interactive comment on “Chemical composition of ambient PM_{2.5} over China and relationship to precursor emissions during 2005–2012” by Guannan Geng et al.

Anonymous Referee #1

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I think it is an important work adding to the discussion of the PM pollution in China. Indeed understanding of the past trends and chemical speciation is an important element of the work towards future strategy or evaluation of that strategy to reduce the PM exposure in China. Below are a number of comments and few questions that I hope are helpful to the authors and could potentially increase the value of the paper for several readers.

There is a lot of focus on high concentration areas and on the typical three regions for China. This is pretty common in many papers and there are good reasons for that. However, as Figure 1 shows, there are several stations in the range of 50-100 $\mu\text{g}/\text{m}^3$ for which the model seem to underestimate the concentrations and these are in

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the 'other' areas where possibly large population lives to and so for the overall health impact assessment it might be very important. I think this deserves more discussion in the text and possibly this is something that can be highlighted for further work.

The paper does not address the possible issues associated with changing aerosol load on satellite retrievals affecting potentially the trend analysis as well as the absolute comparison. The SI mentions issue of 'anomalies' in post 2007 period where less valid readings from OMI exist. I think this deserves a mention in the main paper and a short discussion of what it means for the error over time. I think some of that discussion can be added to the section 3.2.

Line 58-64: I think these two sentences should be reformulated. I do not believe that 'disparities in pollution characteristics' are the reason. It is the nature of air pollution that it does not know the borders and a mix of substances forms, travels over long distances making development of a comprehensive regional or national air quality strategy difficult, requiring knowledge of many different elements and measurements are essential factor. But only in combination with models (both CTM and remote sensing data) full understanding of the close and far sources on specific location can be understood and consequently managed.

Line 68-69: This sentence (conclusion) follows on the previous statements which to my mind do not fully characterize the complexity of the problem or the existing approaches. One has to consider that a lot of tools (CTMs) used in China were originally developed elsewhere where situation was different in many respects, including different level of pollutant concentrations, often existing networks of monitors with long time series, staff and laboratories with long term experience, existence of agencies monitoring pollution sources, etc. Obviously taking a set of tools from that context and trying to apply to China, or several Asian regions for that matter, will face challenges and the authors name a few. This sentence (line 68-69) reads a bit like the 'other' methods are disqualified to provide insight; I'd suggest to think of a more modest statement highlighting the additional approaches and analysis that can help to alleviate the issues and improve

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understanding the pm2.5 problem in china in the past years.

More specific comments:

TITLE

Suggest replacing 'Chemical compositions' with 'Chemical composition'

ABSTRACT

Line 17: 'other correction factors'...I am not sure this is the best formulation; this is not informative. Suggest to reformulate

Line 23: Suggest replacing 'dominated' with 'dominating'

INTRODUCTION

Line 36: replace 'a mixture of complex materials from ...' with 'a complex mixture originating from ..'

Line 41-43: It is not only 'direct' effects that are relevant and when mentioning BC, I would also add the reference to the 'Bounding BC study' by Bond et al. (2013) published in JGR. Consider rewriting the sentence; for example: 'Several components (e.g., sulfate, BC, OC) have significant impact on the global energy budget and consequently contribute to climate change (IPCC, 2013; Bond et al., 2013).

Line 43-44: This sentence shall be reformulated and I would focus on stressing on the role pm2,5 plays in haze formation as well as affecting visibility rather than public attention since currently also health issues attract attention. If you want to add a historical perspective then it should be a more comprehensive.

Line 54-55: 'cloud help design future plans' should be changed to 'could help design future control policies'

Line 56: add 'concentrations' after pm2.5

Line 95: Suggest replacing 'dominated' with 'dominating'

Line 97: suggest deleting 'figure out'

METHODOLOGY

Line 107: 'randomly distributed over time...'? A rather strange statement and I do not understand what the authors are trying to communicate here

Line 142: maybe modify to "...due to missing AOD data" Figure 1 and S1: I think it would be useful to see how the Figure S1 looks like when the points are shown with the same colour scale as in Figure 1 where regional allocation is indicated. From the Figure 1 it appears that there is pretty consistent about factor 2 underestimation for the low to moderate (well, in fact an average of 50-100 ug is not moderate but it is relative to 100-200 yg) concentrations in 'other' regions (yellow dots). I think this deserves few words of discussion in the text as there might be significant number of people leaving in these areas.

RESULTS

Line 259: Many readers might be interested about the possibly reasons for the overestimation of BC. Since this is a non-reactive species, does it mean that the emission are overestimated in bottom-up inventories or there are issues with the transport-deposition in the model?

Line 271: The first few lines of this section highlight the findings but are these really so new? I think a number of other papers have shown similar trends in emissions so this work compares the consistency of those estimates, at least in terms of emission trends. A couple of references can be added.

Line 278: Only vehicles are the cause? The level of control of SO₂ and NO_x has been different and only recently the power sector is asked to mitigate NO_x while SO₂ was longer on the agenda.

Line 280: Is S content the only reason? I thought that there has been also different requirements with respect to the emission standards for power and industrial sources

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across provinces with Western Provinces having slower pace in introducing strict standards.

Line 359: This statement reads like it would be a fact but in fact it is an estimate and even if the total value appear to fit the overall satellite trends there are several uncertainties. I think that here and in other discussion in this section one needs to stress that these are estimates and also that a real confirmation might come from the CMS (cont monitoring systems) if such data will be available.

Line 362: It might be useful to highlight in this section of the paper how policies outside of the three focus regions affected the total emissions in China. TO give an example; Figure 10 shows for example for SO₂ a larger change due to EF (power and total) in China as in any other three focus regions so I believe the contribution has to come from elsewhere.

Line 387: Linking to one of my earlier comments; this section could include also a word about the potential impact of changing aerosol load on the satellite retrievals

CONCLUSIONS

In general some repletion here of the discussion in chapter 4 so it could be shortened a bit. However, the issues I mentioned in the beginning of the review about the regions outside the three focus regions could be highlighted here as a possible area of further work.

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