

## ***Interactive comment on “Increased inorganic aerosol fraction contributes to air pollution and haze in China” by Yonghong Wang et al.***

**Anonymous Referee #1**

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This paper analyses long-term trends in visibility across China and explores if there is any evidence for aerosol hygroscopicity contributing during haze events using satellite data and ground level measurements of aerosol composition. Overall, visibility has decreased in during periods of high humidity in areas of Chin that experience high levels of haze. The satellite datasets revealed corresponding long-term trends of increasing concentrations of NO<sub>2</sub> and SO<sub>2</sub>, while measurements from one campaign with an aerosol mass spectrometer showed higher fraction of inorganic species. The authors conclude from these two datasets that an increased fraction of sulphates and nitrates may be contributing to increased haze levels as indicted by the decreasing visibility.

While I commend the authors for producing a sharp and focused paper, I feel at times some necessary and important details were lacking that made it hard to understand

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the methods and the how the different conclusions were reached (for details see the specific comments below). In my opinion, a bit more in-depth analysis is needed in to link the different sections/datasets. For example, does the observed increase inorganic aerosol fraction correspond to what was observed by the satellite data for that period? Finally, I was not sure what the new or novel findings in this paper compared to previous works in the literature as there have been a number of papers showing the role of inorganic aerosols in haze events (including papers cited by the authors, such as Pan et al., 2016). Perhaps the authors could more clearly state what is new. The paper is reasonably well written and the figures clear and appropriate.

Specific comments

1. The last paragraph of the introduction, in my opinion is normally the aims and objectives of the paper not a summary of the conclusions.
2. Page 4, line 80: The authors state that they use the ratio,  $R_i$ , to infer the long term trends in aerosol hygroscopicity but do not mention how or why this ratio gives this information. I think more information is needed.
3. Page 5, line 103. What time series? Fig 1 is a map of average visibility in different locations. Please refer to the reader to actual figure.
4. Page 5, line 108: The authors state that the “enhancement factor due to hygroscopicity is within expected values” yet I do not see where these enhancement factors numbers are given (which figure/Table?) or how they are calculated from the  $R_i$ ? please give some more information as I cant see how you can
5. Paragraph starting page 6, line 124: In this paragraph, the authors compared their results with other work. To help the reader, it would help I think to state what techniques the different papers used (i.e. modelling, satellite data?) as this will affect
6. Page 7, line 149: Not sure what you mean by a constant trend?
7. Page 7 Line 153-4: What do you mean by the aerosol precursor to NO<sub>2</sub>? And was the study by Xing et al also over the same period as this work? And was the data from Xing et al also satellite data?
8. Page 7, line 158 and 162: Can you really call NO<sub>2</sub> and SO<sub>2</sub> satellite data as ‘surface observations’ or ‘ground-based observations’? Or are you referring to something else?
9. Page 7, line 159: what mod-

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elling results are you referring to? Please give more details on the actual findings and outputs from the model. For example what time period are you referring to? And how much did it increase by? 10. Section 3.3: I realise that you may not have had access to in-situ measurements of aerosol composition from other locations but I still think you need to comment on how representative Beijing is for the rest of China 11. Page 8, line 174: These are not really big increases in % mass fractions (2%-7%). Firstly, are these statistically significant differences between low and high visibility? And if so, are these small increases really going to have a large impact on aerosol hygroscopicity and therefore visibility? The nitrate fraction only increased by 2%. What was the RH doing during these measurements? Can you based on the composition data calculate the change in aerosol hygroscopicity from low to high visibility? 12. Page 8, Line 177: Does the satellite data also show an increase in NO<sub>2</sub> and SO<sub>2</sub> during this period (as these are precursors)? 13. Figure 1: need to label the key 14. Figures 2,3,4: need to label the y axis 15. Figure 5: need to label the x axis. Also are these the mean values plotted for each visibility bin? If so I think you should give a indication of the variability (i.e. standard deviation). 16. Figure 6: Not sure what this adds to paper, I didn't quite see how the findings from this paper added to current understanding?

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