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Interactive comment on “Characterization of submicron aerosols during a serious pollution month in Beijing (2013) using an aerodyne high-resolution aerosol mass spectrometer” by J. K. Zhang et al.

Anonymous Referee #1

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This manuscript discusses PM concentrations, chemistry, and sources in Beijing, China during the winter of 2013 when unprecedented concentrations of PM were observed. Measurements were made using a high resolution aerosol mass spectrometer (HR-AMS) to probe size-resolved chemical composition of non-refractory material with high time resolution and to determine degrees of chemical aging. This article provides necessary measurements of an extreme PM event and is recommended for publication after major revision is made to the manuscript.

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My main concern is that this manuscript has the potential to be a very high impact paper; however, in its current state the manuscript does not provide a clear interpretation of the chemical composition and sources of PM. The abstract for example, focuses on overall trends, which are interesting, but really don't give the reader a clear view of what caused the largest spikes in PM during their sampling period. Buried within the results section, the authors describe high contributions of COA and meteorological conditions where emissions from coal fired power plants contributed to elevated PM concentrations; this should be highlighted in the abstract. A reorganization of the manuscript is strongly suggested with the results clearly shown for different conditions/periods; as it stands, the paper is either divided into periods, diurnal trends, or differences in air masses, which makes it hard to follow. Another issue is that the main periods described (I,II,III) in the manuscript represent a very small portion of the main figures and it is nearly impossible to see the different trends described throughout the manuscript. Either the figures or the periods need to be changed. Lastly, the conclusions section is a reiteration of the abstract and as such needs to be revised. My specific comments can be found below:

Abstract:

Were differences in PMF factors seen between high PM vs lower PM events? How are the sources different based on meteorological conditions and back-trajectories?

Page 19010, Line 8: State the range to show that PM was variable.

Page 19010, Line 22-23: What sources likely contributed to PM coming from WNW during this elevated PM event?

Introduction:

The introduction is too long. The latter half feels like a review of the AMS, which is not the purpose of this paper. I suggest focusing instead on previous work highlighting known sources of PM in China and seasonal trends in this PM. Most of paragraphs 3

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and 4 can be condensed or deleted entirely to improve the flow.

Experimental:

The authors never really introduce the different periods they talk about. I suggest introducing the different periods mentioned throughout the manuscript and how they are divided (e.g., how high was the PM, what was the air mass back-trajectory from, what were the meteorological conditions?). This could be shown in a table for clarity.

Also, the paper currently divides the data into periods I-III then later divides the data by air mass back-trajectory; I suggest divvying up the data in one, consistent way and to use this naming scheme either by period or back trajectory consistently throughout the manuscript.

AMS Data Analysis:

This can be considerably shortened by putting details, such as different factor solutions that are not used in this paper, in the supporting material.

Results:

Section 3.1:

Clearly define all the periods before you start to describe pollution events. As written it is hard to follow.

Figure 1: The figures are small and very hard to read. I recommend blowing them up and making the numbers/axes bold. The periods are such a small portion of the figure and it is very hard to see the trends that are being described. Where are the NO_x measurements described?

Page 19019, Line 5: How high was the PM?

Page 19019, Lines 12-17: Why are the TEOM measurements mentioned if they aren't used?

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Page 19019, Line 18: How did the meteorology change between accumulation and “clean up”?

Page 19019, Paragraph starting on Line 18: Did the air masses come from different places during the different periods?

Page 19019, Line 27: Cite previous work showing that humidity enhances nitrate and sulfate.

Page 19020, Section starting on Line 15: I don't follow any of this discussion of black carbon. Black carbon was not measured and as such speculation of its contribution should not be included.

Page 19021, Lines 9-16: What did you find and where do you think this mode is coming from? I don't see how the Alfarra study applies to different conditions in a different city.

Section 3.2:

Page 19022, Line 14: I don't understand how nitrate was determined to be all from traffic.

Section 3.3:

Page 19024, Lines 10-14: What does this slope/anti-correlation mean?

Page 19024, Lines 14-16: How are we to interpret these contributions of different elements?

Section 3.4:

Paragraph starting on Page 19024, Line 26: This much detail about divvying up the OOA is unnecessary, just state that this wasn't done.

Page 19026, Line 20: Cooking is also a large contributor to other regions as well.

Page 19027, Sentence ending on line 5: I'm not sure how to interpret the O/C and OM/OC of NOA for the dataset.

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Page 19027, Line 8: Please specify the ions used so we can also see them in the mass spectra.

Page 19027, Line 16: How were these concentrations arrived at?

Page 19028, Sentence ending on Line 6: In addition to citing other papers, it is also important to state where you think the observed NOA is coming from. It is also surprising that given the different source contributions (e.g. amines, urea, PAN) that they all show the same pattern.

Page 19028, Lines 7-9: I thought OOA was higher than HOA from Figure 5.

Section 3.5:

This whole section needs some polish with the observed differences in source and composition clearly laid out for the different trajectories. In general, I feel like the periods described throughout the manuscript should perhaps be arranged by air mass trajectory otherwise describing periods I-III particularly in Section 3.1 and then these new clusters in Section 3.5 are quite confusing to follow. I also suggest moving this section up in the manuscript to link chemistry with sources and meteorology.

Page 19029, Lines 12-16: HYSPLIT has been used MUCH more extensively than this. Also, these two studies seem to be used for a lot of interpretation throughout the manuscript.

Page 19030, Lines 8-12: A coal-fired power plant source of PM would also explain your elevated sulfate during the major PM events.

Page 19030, Line 13: What industrial sources are around Beijing?

Page 19030, Lines 17-19: This sentence is very confusing. So the air masses have emissions from cities that are not high in nitrates? I would think traffic emissions would produce a lot of nitrate.

Page 19030, Lines 23-27: What is this rotation and how is it supposed to explain

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Discussion Paper



changes in chemistry?

Page 19031, Lines 1-13: This paragraph seems unnecessary, especially if the same periods are used to describe the chemistry, PM, and meteorology.

Conclusions:

This is pretty much the abstract verbatim. Briefly summarize your findings then discuss the implications. What were the major sources during those high PM events? What sources should we be thinking about regulating? Are they hazardous to human health based on their composition?

Figures:

Figure 1: The temporal mainly shows data that doesn't fall within the main periods (I, II, III) discussed throughout the manuscript. Either enhance those periods or divide up the periods differently. This applies for most of the figures showing a temporal for all the data.

Figure 8: Could the resolution of the map be changed to show different regions a bit clearer? It would also be helpful to mark major cities, sources such as power plants, etc.

Technical Details:

Throughout the manuscript, change "tow" to "two"

Page 19010, Line 10: Change "increasing fraction of the NR-PM1 load as NR-PM1 loading increased" to "increasing fraction of NR-PM1 as the mass conc of PM1 increased"

Page 19011, Line 11: Delete "Meanwhile"

Page 19011, Line 25: Change "compositions" to "composition"

Page 19015, Line 23: The word should be "deconvolute"

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[Printer-friendly Version](#)

[Interactive Discussion](#)

[Discussion Paper](#)



Page 19021, Line 9: Delete “the” before “decreasing size”

Page 19026, Line 28: After “despite” add “the fact that”

Page 19026, Line 29: Delete “the” after “As”

Page 19027, Line 1: Change “more resemble” to “are more similar”

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 19009, 2013.

ACPD

13, C5060–C5066, 2013

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