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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Formation and characteristics of secondary aerosols in an industrialized environment during cold seasons" *by* Yangzhou Wu et al.

Anonymous Referee #2

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The authors measured PM1 using an Aerodyne high resolution AMS at a suburban site in China during February-March 2015. The PMF analysis was applied on the dataset to get different organic factors, which was already reported in their previous publication. The focus in this paper is to demonstrate that moisture plays a key role to enhance both nitrate and sulfate formations, mostly based on the correlation analysis with RH and Ox (O3+NO2). It was also demonstrated that the OA factor with the highest oxidation degree was mainly driven by aqueous-phase processing, while the other two SOA factors were mainly governed by photochemical processing. Although the conclusions are interesting, I have big concerns with the method to draw them with the following reasons. I would recommend a rejection to this paper.

1. The high RH and Ox are not effective indicators for aerosol aqueous reactions and photochemical processing, respectively. RH might not be closely related to aerosol water content and Ox might not be proportional to the OH radical in the air, which is more important in photochemical reactions. The current discussion fails in discussing this uncertainty.

2. When correlating RH and Ox with the aerosol species, other influencing factors must be well controlled. It is dangerous to draw a conclusion with only univariate regression. Since NOx and SO2 have quite different water solubility, it is strange that their secondary formation can respond similarly to RH. The reason could be the weather conditions. In my opinion, the high RH was likely to represent unfavorable dispersion weather conditions or a warm southerly air mass. On the other hand, the high Ox only occurs at noon while low RH mostly occurs at noon due to the diurnal variation of sunshine and the boundary layer (you will see this in the case study in Figure 12). Therefore, the real controlling factors could be the atmospheric mixing conditions rather than RH or Ox itself. How would it be when plotting BC in Figure 4c or 4d? If the similar results are obtained, one cannot say that RH promotes secondary formation.

3. Generally, RH and Ox are quite local factors, while sulfate has been proven to be mostly regional. Thus, their correlation could be a result of different air mass, which is not well analyzed in this paper.

Other comments:

1. Line 151: Are all RIEs were calibrated? Can you show the values of the RIEs for different species?

2. Line 212-214: Please add the references.

3. Section 3.1: Please provide more detailed information about different components, such as the diurnal patterns, because sulfate and nitrate in this study seemed to be very similar based on Figures 2-4.

4. Lines 241-242 and Figure 4: Actually, the trends of sulfate and nitrate also increase with the increase of Ox. So, you cannot conclude“these results highlight a more significant role of moisture in enhancing the formation of both sulfate and nitrate than that of photochemical processing.”

5. Section 3.3.1: Is possible that IOA mixed with BBOA? The evidences provided are not convincing. Most of m/z 60 in BBOA arises from different molecules that fragment in a similar way as levoglucosan in the AMS, not only levoglucosan, and BBOA can be transported thousands of kilometers far. It is strange that BBOA cannot be identified in this region in the cold season.

6. Why don’t discuss the effects of other meteorological factors such as wind speed and direction?

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