

## ***Interactive comment on “Year-round observations of water-soluble ionic species and trace metals in Sapporo aerosols: implication for significant contributions from terrestrial biological sources in Northeast Asia” by C. M. Pavuluri et al.***

**Anonymous Referee #1**

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General comments: The measurement of aerosol during the whole year is important especially over East Asia, due to the lack of such continuous monitoring. Owing to the rapid economic growth of East Asian countries, the atmospheric aerosols increase not only over East Asia, but also the outflow region. In fact, transpacific air pollution sometimes arrives at the west coast of the United States. Sapporo is the one of the suitable place to monitor the amount of the outflow from East Asia and Siberia, as mentioned by the authors. Therefore, the in-situ observations are useful as well as satellite observations and aerosol-transport models. One of the most important ionic species among

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inorganic compounds is sulfate, which is often the most abundant in the atmosphere. Therefore, I (and probably most readers) like to expect the authors to show what is the major source of the sulfate compounds at Sapporo. Unfortunately, I did not find clear answers from the current manuscript, even though I found several independent suggestions. This is the first major comment. I recommend that the authors divide the results into those for the abundant compounds and for the other trace metals. Second, the main conclusions in this study come from the results using the factor analysis, i.e., “varimax rotated factor analysis”, as mentioned in the manuscript. However, I cannot find any description of the analysis including a range of the uncertainties. Therefore, I am not convinced the conclusions from the manuscript. I strongly recommend the author to describe the method of the factor analysis in detail in the manuscript. Third, although the authors showed the correlations among various species, each point used in this analysis represents 13-18 days mean value. In Fig. 4, for example, although the authors showed the correlation coefficients in each season, the number of the points in each season is small, with the value of 8 (autumn), 3 (winter), 5 (spring), and 5 (summer). I feel that the time resolution is too coarse to investigate the seasonal variation of the sources. The results during 13-18 days probably include different air masses; therefore at least the authors explain the reason and the validity of the use in the manuscript. Basically, the authors often suggest very important conclusions, but some of them are unclear for the readers. In conclusion, I cannot recommend publishing the manuscript in the current form.

Specific comments: 1. P6590, L20-21: This statement is interesting, but I cannot find clear evidence in the manuscript.

2. P6602, L8-12: Although the Sapporo and the ocean are not so far, is the depletion of Cl<sup>-</sup> through formation during the transport from the ocean?

3. P6602, L19-24: This description should be moved to section 2. In addition, more explanation should be inserted, as mentioned in my general comments. Especially, please explain the meaning of the values in Table 2 and clarify the uncertainties of

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secondary species including SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, and NH<sub>4</sub><sup>+</sup>.

4. P6605, L1-14: The anthropogenic species shown here are secondary aerosols. However, I think a factor analysis generally includes a large uncertainty especially for the secondary aerosols. Originally, how confident does this result? This comment is related to the above comment #3.

5. P6607, L15-18: The correlation coefficients in winter and summer are very low. The values are ranging from 0.05 to 0.12. Statistically, these values represent no relation.

6. P6610, L15-16: More evidence is needed. To understand the transport, why does the authors analyze the air mass in detail?

7. P6622, Fig. 2: For me, the variation of the SO<sub>4</sub><sup>2-</sup> is smaller than that of the MSA, even though the authors stated the similarity of the variation.

Technical comments: 1. P6589, Title: The term 'ionic' can include organic compounds, but they are not treated in this study. Therefore, the term 'ionic' may be suitable. The terms like 'inorganic' will be better.

2. P6590, L13: Table 3 shows 32.47%, which is about 32%.

3. P6590, L20-21: This study only analyzes inorganic aerosols, therefore the term 'Sapporo inorganic aerosols' rather than 'Sapporo aerosols' is preferred.

4. P6624, Fig. 4: If the authors like to add some of r<sup>2</sup> value in the panels, please make a table to show the all of r<sup>2</sup>. The randomness to show the r<sup>2</sup> value in the panels is not good.

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