

Spatial and seasonal variability of PM_{2.5} acidity at two Chinese megacities: insights into the formation of secondary inorganic aerosols

General review:

This paper shows the reasonable analysis and valuable results for aerosol acidity using the continuous field observation for more than one year in two megacities in northern and southwestern China. It can help better understand the formation and its effecting factors of secondary inorganic aerosols in different cities and different seasons.

Some questions, suggestions and recommendations as the below:

1. Page 10, First paragraph

The authors write ‘Concentrations of SO_4^{-2} for all the sites were higher at Chongqing than at Beijing, whereas NO_3^- showed the opposite spatial pattern with higher concentrations at Beijing than at Chongqing.’ It is true if only looking at the concentration. But the PM_{2.5} concentration is also higher at Chongqing than at Beijing. From the data showed in Table 1, the proportion of SO_4^{-2} for MY of Beijing is similar to that of BB in Chongqing rural site, which is not lower than Chongqing. Please give some explanation for this and it should be better using the species proportion.

2. Page 11, Last line.

‘(<10 %; urban: 0.016-0.17, rural: 0.15)’, the value of 0.016 may be 0.16, please check and correct it .

3. Page 12, Last paragraph & Page 13, First Paragraph:

The authors list some study results in different cities (Table 2) , and conclude that there is no consistent pattern in inter-annual trends. Maybe it is true. But the aerosol sampling time, sites, sampling methods and even laboratory analysis and meteorological conditions may have differences in each study, which would result in big errors among each study. To some extent, the comparison of this is weak or unnecessary to reveal some scientific knowledge in the related studies. Here is one suggestion: conducting more than 3 years sample and analysis in same sites and using the same method to find some trends in inter-annual and more complete understand of .

4. Page 15, Last paragraph

It seems no enough reason choosing the RH to partly explain the inter-annual variation of PM_{2.5} acidity. Could the authors give more reasons or explain the function of RH in the formation of PM_{2.5} acidity.

5. Page 16 ,Third Paragraph

The reference of Mu et al., 2008 can not be found in this paper.

Fig. 3b and Fig. 3c have no value of coordinate axis, please add them.

6. Page 18: Asian desert dust

It is not enough to discuss the detailed dust event's influence on PM 2.5 acidity using the seasonal average results. It need to select several processes of dust event days and non-dust event days to further investigate the aerosol species' proportion or differences among dust and non-dust days. Then hope give the believable and concrete explanation of dust influence on aerosol acidity .

7. Page 18, Third Paragraph

It seems that the Caption of Fig. 6a is inconsistent with the analysis in this paragraph. For example, the paper text shows that 'the Ca²⁺ concentration at Beijing was 23.8% to 30.6% higher in the spring of 2006 than of 2005', but when using (2005-2006) /2006 as list in the figure caption, it will be the opposite description, namely, the Ca²⁺ concentration at Beijing was higher in 2005. Please check and give the reasonable explanation. Why do the author use the different calculation expression for Beijing and Chongqing? It causes much difficulty to understand.

8. Page 19, First paragraph:

Why the difference of NO₃⁻ /SO₄²⁻ is so much at TH and MY in Beijing? The explanation of this paper is not enough. It need add further study and explanation , as well as to explain the different aerosol acidity between TH and MY.

9. Page16-17:

In Fig. 4, authors select air mass trajectory at 500m, but the aerosol sample conducted near surface. It should be better when using lower layer trajectory.

10. Page 20, **Wet deposition**

Why only discuss the wet deposition of NH₄⁺? How about the deposition of NO₃⁻ and SO₄²⁻? This also influences the aerosol acidity. Although the precipitation is much less in northern cities than that in southern cities, it also plays important role in aerosol and its species deposition. How does the Wet deposition play in the formation of aerosol acidity in summer when the precipitation occurs frequently.

11. Please check the caption and denotation in Fig.7 (b) .