

Comments to ACP-2019-60

General comments

The manuscript describes the evolution of aerosol size-segregated particle number concentration during winter 2018 in Beijing. The data is separated in two different sets: days when haze is observed, and days with new particle formation (NPF) events. Additionally, the particle size distribution is separated into different modes according to the particle diameter: cluster, nucleation, Aitken and accumulation modes. Trace gases concentrations are used to establish the origin of the aerosol observed and induce a primary or secondary origin of the particles observed in each mode.

The topic of this paper is within the scope of this journal and the dataset used is interesting because particles in a wide size range, including very small particles (1.5 to 1000 nm) are measured. However, I believe that with such an interesting dataset one could expect a more comprehensive study. For example, it would be nice to see the evolution of condensation sinks during NPF and haze days, or calculate growth rates for each mode during NPF days. Additionally, the statistical data analysis is very simplistic, and the authors should reconsider analyzing the data with a different approach. The only statistical tools used for relating trace gases with the different modes are correlation coefficients. Assuming that the processes involved in the formation of the different modes is linear is a big oversimplification. The authors should improve the data analysis or discuss the limitations of the methodology they use.

In general, the manuscript is poorly written. There are grammar mistakes and the language is not fluent. This makes it difficult to follow some parts of the manuscript. The authors should have the paper proof-read and edited by a competent English speaker before publishing it.

Most of the discussions are very short and do not provide much more information than what is presented in the tables or figures.

The figures are good in general. The scales on figures 5 and 6 could be improved, and there are a few technical mistakes and information missing in the figure captions (see comments below).

Specific comments

Table 1: It would be useful for the reader if the authors mention in the text the number of days classified as NPF and haze.

I don't see the definition of the modes. Also, which instrumentation did you use to calculate the different modes number concentrations? There are overlapping size ranges for nucleation and Aitken modes in the instrumentation you described.

Section 2.2: Please include the time resolution of the data you use. I could not find this information for the PSD system and trace gases. How did you merge the data when the different instruments have different time resolutions? It is important that you describe this procedure carefully.

Line 181: "In general, there were no overlap between NPF and haze periods". Did you look for NPF events during haze days? If haze and NPF are not 100% mutually excluding it would be interesting to describe these episodes. If they are, then change your sentence to make it clear that there was never an overlap. Also, did you determine haze days or did the China Meteorological Administration do this? If the authors did the classification, they should include the instrumentation used.

Lines 222-228: The authors should also talk about O₃ here. I only see information for SO₂, CO and NO_x.

Lines 232-233: NPF does not favor clean environments. In any case, clean environments favor NPF.

Lines 247-251: "NO_x and CO are important precursors of O₃ in Chinese urban areas. Based on our data, O₃, on the other hand, started to increase [...] after the levels of NO_x and CO started to decrease". Your wording is confusing. It feels like you are suggesting that NO_x and CO are not precursors of O₃. Please reword.

Lines 280-284: I don't see Aitken mode concentrations being similar to NO_x evolutions before 9:00. See my comment on Figure 6 below.

Lines 295-297: Did you measure meteorological parameters or is this a general statement? If it is a general statement change "the wind was" for "the wind is...".

Line 301: It would be interesting to see the graphs for CS instead of giving only a daily value.

Section 3.3: In line 318 the authors state “In this section, we use CO, SO₂, NO_x and O₃ as tracers”, but there are no comments whatsoever regarding CO or O₃ in this section.

Line 337: Looking at the figure, it doesn't seem to me that SO₂ and cluster and nucleation mode concentrations are correlated, especially for NPF days. What are the correlation coefficients for NPF days and haze days separately? (see also comment for Table 2).

Lines 400-402: Please elaborate and comment on the correlation with the other modes. PM_{2.5} is also highly correlated with cluster mode but this is not discussed. Consider showing the correlations in an additional figure.

Conclusion: This section is written as a summary. The conclusion should reflect the significance of the results presented in this paper compared with existing observations, and give a message beyond summarizing what has already been said in the previous sections.

Line 415-416: I do not see in the text where this is discussed (secondary sources contribution to the Aitken mode during haze days).

Table 2: I think this table would be more useful if the authors separate the data for haze days and NPF days. Also, what do you mean by “all the data are in log scale”? Please reword. You are showing correlation coefficients here, which are not represented in any scale.

Figures 1, 2, 3, 4: Are these daily averages? Please specify the data you used to make the plot.

Figures 5 and 6: Please specify the time resolution of the data you are showing, and reword “and they are the median data from midnight to midnight”.

Figure 5: The scale in the upper left graph is different to the others. If you decide to use the same scale, change it to match the others. If it is not important for you that the graphs have the same scale, change the other scales (especially SO₂ and O₃) so that the variations can be seen more clearly.

Figure 6: The scales used here do not allow to see changes in the Aitken and accumulation modes. I would suggest changing the scales on the lower graphs. It is hard to see the changes you mention in the discussion.

Technical comments

Line 93-94: “... complicating the story even further”. I would suggest using a different language.

Line 153: Please change the verb tense: measures -> measured.

Lines 169 and 175: Correct the references format.

Line 213-214: Check the Aitken and accumulation median concentrations. Are they exactly the same?

Line 300: Change “maybe” for “may be”.

Line 305: Delete “in” between “increase” and “during”.

Line 311: Add in: “... SO₂ participated in the formation...”

Line 386: “resulting in an increase...”

Figure 2: Switch “left” and “right” in the figure caption.

Figure 3: Please change the label: OtherS -> Others.