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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Elucidating the pollution characteristics of nitrate, sulfate and ammonium in $PM_{2.5}$ in Chengdu, southwest China based on long-term observations" *by* Liuwei Kong et al.

Anonymous Referee #2

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Comments on "Elucidating the pollution characteristics of 1 nitrate, sulfate and ammonium in PM2.5 in Chengdu, southwest China based on long-term observations" by Kong et al.

This paper presented an overview of air pollution in Chengdu, southwest China based on study, a three-year observations of gas and particulate pollutants. Probably due to the special topography, the data from this site shows special characteristics of pollutants, different from most other polluted regions in China, e.g., North China plain and Pearl River Delta etc. Thermodynamic models and trajectory analysis have also been applied to analyze aerosol pH, partitioning of inorganic semi-volatile species and the

contribution of potential source regions. Overall, I think that the datasets are very interesting and valuable, and authors have tried to give a comprehensive overview and analysis of the mechanisms beyond. However, there is still much room for improvement. I would suggest the authors to carefully consider my comments/suggestions in their revision before its final publication in ACP.

Major concern: 1. Meteorological parameters and PM compositions show distinct diurnal variations compared to other regions such as NCP, PRD and YRD. Though chemistry is in this game, I guess that the special topography may play a dominant role in these features, which is missing from this submission. I'd suggest the authors to add these discussions. 2. QA/QC. Quality assurance and control is essential for multi-year analysis. Maybe I overlooked it and I didn't find a description to assure the data quality. QA/QC would give the readers more confidence in your data and analysis, e.g., the extremely high NH3 in the winter of 2017. 3. To avoid jump between text and SI, the authors could consider moving some SI parts into the main text. For example, gas phase NH3 that frequently used and discussed is missing from the main text.

Minor comments: Abstract: Line 21 "a long-term observational experiment was conducted from January 1, 2015 to December 31, 2017" Three years measurements are longer than a campaign-based experiment but I won't call it "long-term".

Line 27 "Seasonal and diurnal variations have obvious characteristics, winter still has a high NSA concentration and emission intensity, and the concentration during the day was higher than that at night. " This is unusual; is it because of the valley topography?

Line 34 "The ammonia-rich environment became increasingly obvious in the atmosphere of Chengdu" It is not clear what you want to say. Do you mean that you see an increase in NH3 concentration or partition rate?

Page 3 line 69 "For example, photochemistry may affect the formation of NSA at high solar radiation, and the homogeneous reaction may dominate the formation of NSA in high relative humidity" I think you mean "heterogeneous" instead of homogeneous ?

Page 3 line 82 “The characteristics of higher concentrations proportion of nitrate, sulfate and ammonium in PM2.5 were also found in other polluted areas in China, such as Beijing-Tianjin-Hebei, the Yangtze River Delta, the Pearl River Delta, the Fenwei Plain, “ You may not use “other” since you also refer to Beijing Tianjin-Hebei.

Page 5 line 123, Sect 2.1 According to the high NO concentrations, the site could be quite close to adjacent sources. This should be mentioned in the site description.

Page 7 line 154 “Temperature (T), relative humidity (RH) and the total concentrations (i.e., gas + aerosol) of Na+, SO42−, NH3, NO3 −, Cl-, 155 Ca2+, K+ and Mg2+ were input into the ISORROPIA-II thermodynamic mode” Do you have HCl, and HNO3 measured? I don’t see it in your instrument list. You may need to do a back calculation to check the modelled value and see if you may retrieve these information iterative model calculations. You may need to calculate the uncertainties or bias due to these missing data in your model input.

Page 7 line 159 “The simulated data and observed data were compared and analysed. Simultaneously, the aerosol water content (AWC) and pH of aerosols were calculated. The sensitivity of the interaction between aerosol chemical components (NSA) was analysed (Ding et al., 161 2019;Fountoukis et al., 2009). Could you show a comparison between the modelled and measured gas phase NH3, HCl and HNO3? This result can be used to check the reliability and performance of thermodynamic models.

Page 8 line 178 “the conditional probability function (CPF) was introduced the R Programming Language.” Complete the sentence.

Figure 2, why both fractional contribution of both organic and inorganic decrease at high PM2.5 concentrations? What’s the other compositions that are increasing?

Page 9 line 216 “The annual average mass concentration of NSA also changed significantly, and the difference was large. The Mann-Whitney U test showed that the variation in NO3 - was nonsignificant ($p > 0.05$), and SO4 2- and NH4 + had obvious

significance from 2015 to 2017 ($p < 0.05$), indicating that NO3 - had not decreased significantly, and there was an increase in 2017 compared to 2015.” Here, you could further discuss the reasons why the concentration SO2 and sulfate decease more than that of NOx and nitrate.

Page 12, line 283 “ This also shows that the implementation of air pollution reduction measures should increase the emission reduction intensity in terms of NOx and NH3 emissions, especially the implementation of autumn and winter air pollution prevention and control action.” You were talking about high NH3 in 2017 and then taking to NOx? I am missing a link here. Also I’d like to see an explanation about the high NH3 concentration up to 60 ppb. This is very high for a monthly average. What’s the pH under this condition?

Page 13 line 293 “Sulfate has a significant downward trend in all seasons from 2015 to 2017, especially in winter. This downward trend was due to implementation of the Air Pollution 294 Prevention and Control Action Plan” Such discussion should be put in Sect 3.1.

Page 15 line 325 “As shown in Fig. S4, from 9:00 to 11:00 a.m., the concentrations of SO2, NOx, NH3, CO and other gases increased significantly, indicating that the primary emission of pollutants was relatively strong. At this time, higher RH (Fig S5) also provides favourable conditions for the formation of secondary aerosols and promotes the accumulation of NSA” But the RH in Fig. S5 is decreasing in contrast to an increase in aerosol concentrations?

Sect. 3.4.1 In general, it is true that the emissions of multi-pollutant may come from the same kinds of sources. But you cannot draw such a conclusion based on correlation studies. Because the variation of most pollutants, especially those of long-lifetime, is strongly influenced by the boundary layer developments, and may show a similar diurnal variation in spite of different origins (sources).

Page 20 Line 430 “Figure 7 shows the variation characteristics of NSA chemical con-

versions and meteorological conditions with increasing RH. SOR and NOR increased with increasing RH, suggesting that SO2 and NO2 were more likely to produce sulfate and nitrate under higher RH conditions. In Fig. 7, how did you do the calculation, classifying the data according to RH or you keep all input the same but change RH only? In the former case, the apparent correlation with RH may not represent the real causation as chemical compositions and other parameters may change also change.

Sect 3.5.2 I understand that the authors adopted this approach based on a published study. This approach, however, is subject to several problems, e.g., neglecting the dilution of pollution in the course of transport which may overestimate the contribution of distant sources, or the endpoint is not necessary at the ground level, or why 24 hour (aerosols have a longer lifetime) etc. If you still want to keep this part, please explicitly include these caveats in the text to avoid misinterpretation of this result.

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