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Comment on acp-2021-455

Anonymous Referee #1

Referee comment on "Long-term trends and drivers of aerosol pH in eastern China" by Min Zhou et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-455-RC1, 2021

Review of "Long-term trends and drivers of aerosol pH in eastern China" by M. Zhou et al.

This study presents the results of nine years of hourly gas and particle composition measurements in Shanghai, China. Trends in aerosol pH over the measurement period are examined, as are the factors driving variability in aerosol pH. The measurement period includes a major reduction in some emissions due to a nationwide regulation, so the resulting effects on aerosol pH can be examined. Further, aerosol pH over the next 30 years is modeled under three future emissions scenarios. Overall, the results are novel and add important insight to the growing body of work characterizing aerosol pH, including drivers and trends. The writing is mostly clear, though specific areas for improvement are noted below. I recommend the manuscript for publication after the following issues are addressed:

Major Comments

- The estimates $ALWC_o$ seem unreasonably small (lines 120 - 127)? How was organic aerosol measured? Was it $PM_{2.5}$ as well, or was it PM_1?
- I found the convention used in Figures 1b, 3, and 5 very confusing. The pie charts below each figure are useful and seem straightforward to interpret, but the bar charts need substantial editing. For example, in Figure 1b, the effect of NVCs on the pH trends changes signs with time. Ultimately, using Fig. S6, I was able to deduce that the positive value associated with NVCs for 2011-2013 meant that NVCs had gone up, and the negative value associated with NVCs for 2013 – 2015 meant that NVCs had gone down. However, it took far too much time to interpret and is still not easily understandable even after spending much time on it. The convention used by Tao and Murphy (2021) is much clearer – I suggest edits to follow their approach.
- Discussion about the limited effects of future emissions control measures on haze pollution (e.g., line 35-36, 298-299) is just wrong. Although the partitioning of NH_3 and HNO_3 may shift towards the particulate phase in the future, it does not mean their total PM concentration has increased. If the total concentration (i.e., NH_3 + NH_4^+) decreased enough, then a shift in partitioning towards the particle phase could still occur with a decrease in the aerosol NH_4^+ This discussion would be much better with associated predictions of the $PM_{2.5}$, NH_4^+, SO_4^{2-}, and NO_3^- aerosol concentrations.

- The Conclusions section needs substantial revision. A brief recap is ok, but Section 4 is mostly redundant with the prior section. Rather than just reiterating what has already been said, more discussion of the significance of the work is warranted.
- Finally, the entire manuscript needs to be edited for language consistency – specifically, verb tenses change within and between paragraphs. There are too many instances to list here.

Technical/Minor Comments

- Line 25: define all acronyms on their first use (e.g., NVCs, YRD)
- Line 28-29: sentence needs grammatical editing.
- Line 39: suggest deleting "studies"
- Line 44-45: cite also Tilgner et al. (2021) in this group.
- Line 73: cite also Vasilakos et al. (2018) and Nenes et al. (2020)
- Line 77: "composition" should be singular
- Line 78: suggest changing "characterizing" to "characterize"
- Line 96: change "to be" to "were"
- Line 96: "calibration" is not the right term here – LiBr is used as an internal standard
- Line 102: due to unmeasured species (organic acid ions, carbonate) – it is quite possible to measure the aerosol inorganic composition accurately and not achieve an ion balance. Given what we know about organic acid concentrations, it is actually surprising that such a balance is observed.
- Line 104: cite also Stieger et al. (2018)
- Line 106: suggest deleting "techniques"
- Line 107: give the instrument(s) used to measure T and RH
- Line 128: cite also Battaglia Jr., et al. (2019)
- Line 237-238: the diurnal behavior of aerosol pH is not just consistent with Beijing, but is far more consistent (qualitatively) with many other locations like the SE USA (Guo et al., 2015), eastern US (Battaglia et al., 2017), Chicago (Battaglia et al., 2017), which shows the important influences of T and RH on aerosol pH.
- Line 274: "active actions" should be changed
- Line 284: comma needed before "respectively"

References

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