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Comment on acp-2021-368

Anonymous Referee #2

Referee comment on "Urban aerosol chemistry at a land–water transition site during summer – Part 2: Aerosol pH and liquid water content" by Michael A. Battaglia Jr. et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-368-RC2, 2021

Review of "Urban aerosol chemistry at a land-water transition site during summer – Part 2: Aerosol pH and liquid water content "

[acp-2021-368] by Michael A. Battaglia et al.

This study characterized the aerosol pH at a unique land-water transition site and systematically investigated the effects of temperature, aerosol liquid water, and composition on aerosol pH predictions. It is important and contributes to a more comprehensive understanding of the aerosol pH and its controlling factors in diverse environments.

The problems with the current study are detailed in below and the author may need to address before the MS can be accepted by ACP.

Major:

1. Given the poor performance of ISORROPIA for NH_3 partitioning predictions (pH dependent) in this study, Eq. 1-Eq. 3 was used to calculate aerosol pH, and the pH calculated from these equations was significantly different from the ISORROPIA-predicted aerosol pH. However, these equations are for ideal conditions (without considering ion activity coefficients), and the non-ideality in aerosols can introduce deviations from the ideal conditions. Zheng et al. (https://doi.org/10.5194/acp-2021-55) has recently

introduced a non-ideality correction factor for using these equations to calculate aerosol pH, and the aerosol pH calculated from the non-ideality corrected equations agreed well with the pH value determined by ISORROPIA.

Therefore, I suggest the authors to use the non-ideality corrected equations (either with non-ideality correction factor or with the related ion activity coefficients) to calculate aerosol pH and then compare with ISORROPIA predicted pH.

2. Fig. 4, shows the relationship between aerosol pH and factors such as temperature, aerosol liquid water and total NH_3. It seems that the influence of one factor on pH can also be affected by other factors. Is it possible to vary one factor with fixed other factors to investigate the influence of one factor?

Minor:

1. In Fig. S4, it would be better to use the same y scale when comparing pH values determined from different methods.

2. Line 228-240: "The result shown in Fig. 4b is somewhat surprising because NH_3 partitioning was quite sensitive to ALWC (Fig. 5); the relatively invariant aerosol pH is unexpected given the increase in NH_3 uptake in the presence of ALW." A discussion of this surprising result would be useful. (The following discussion in the ms about the dry deposition is not very relevant to this result).

3. Line 296-298: ISORROPIA didn't give good NH_3 partitioning predictions in this study and the different chemical compositions of the coarse- and fine-mode particles were used to explain it. I think the explanation is reasonable, however, I was still wondering what result you will get with E-AIM calculations. If the E-AIM also fails to predict NH_3 partitioning here, this explanation would be more solid since E-AIM also assumes an internally mixed aerosol distribution.