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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol pH and liquid water content determine when particulate matter is sensitive to ammonia and nitrate availability" *by* Athanasios Nenes et al.

Anonymous Referee #2

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The manuscript "Aerosol pH and liquid water content determine when particulate matter is sensitive to ammonia and nitrate availability" by Nenes and co-workers presents a thermodynamically consistent framework to assess the sensitivity of aerosol particulate matter (PM) to NH3 and HNO3 availability. The framework uses temperature, aerosol pH and liquid water content as main parameters to infer four regimes identified as 1) HNO3 sensitive (total nitrate reduction is effective to reducing PM); 2) NH3 sensitive (NH3 reduction is effective to reducing PM); 3) NH3 and HNO3 sensitive (both NOx and NH3 reductions are effective in reducing PM) and 4) a regime where neither NH3 nor HNO3 is important for PM levels. This latter regime is perhaps the most interesting aspect of the paper as, to my knowledge, it is the first time it has been pointed out.

The manuscript presents results that are of interest to the scientific community, it is well written and overall the concepts are expressed with clarity.

The main criticism I have is that while the authors explain well when this framework works well, they don't clarify when it is necessary to pay extra care at using it e.g., temperature below 273 K? Low aerosol water content? And in what instances aerosol pH and/or water content calculations are less reliable (as those quantities cannot be measured directly). Additionally, a mention on how the presence of an organic fraction in the aerosol mass could affect the pH and aerosol water content would help to guide the reader towards better use of this framework. I think that adding a sentence or two addressing the possible pitfalls that could occur in using this framework in the wrong domain would be of great help to the readers.

Minor comments

page 1 line 23: the four regimes are named in a different way here than in the main text. The naming used in the abstract is somehow confusing as "NH3-dominated" and "HNO3-dominated" does not immediately tell if the regime name refers to the aerosol phase, gas phase or total (aerosol+gas) therefore the reader could have a hard time to understand if the "NH3-dominated" regime is the same or the opposite than the "NH3 sensitive" regime. I recommend harmonizing the name of the four regimes and adopt in the abstract the same clearer nomenclature used at page7 lines 9 to 15 in the main text.

page 1 line 24: "... neither NH3 and HNO3 ..." maybe "... neither ... nor "?

page 6 line 3: "... the e(NO3-) is nearly 1 and almost all nitrate (NO3_T) is in the gas phase (HNO3)" This sentence is confusing. If the fraction of total nitrate in the aerosol phase is near 1 how can it be that almost all nitrate (NO3_T) is in the gas phase?

Table 1: indicating the units in the header (not only in the caption) would be useful to the reader

Figure 5: indicating the temperature ranges for each data set would be useful to the reader

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