Comments for "egusphere-2025-527: The influence of ammonia emissions on the size-resolved global atmospheric aerosol composition and acidity" by Wang et al. (2025)

Wang et al. presents a comprehensive investigation of how ammonia (NH_3) emissions affect size-resolved aerosol composition and acidity on a global scale. Using the EMAC atmospheric chemistry-climate model with three different ammonia emission schemes, the authors analyze the complex interactions between ammonium, sulfate and nitrate in different sizes, geographic regions, and chemical environments. Research advances our understanding of atmospheric aerosol dynamics and has significant implications for air quality management and climate modeling. I recommend publication after addressing the following comments.

Research questions and modeling approach lack clarity

The Introduction provides a comprehensive overview of aerosol emission trends and how PM2.5 components respond to different clean air policies. It also notes that these responses vary depending on particle size ranges. However, the progress in modeling this size-resolved response is not clearly presented. The intended model for use in this work and its suitability are not well explained, and the scientific question lacks clarity. The authors are encouraged to clearly articulate the rationale for selecting the model, i.e., why EMAC is appropriate for this question?

The role of organic aerosols in affecting aerosol pH

Although the main goal of this work is to study the size-resolved SNA and pH response to different ammonium emission inventories, it would be beneficial to include some discussions on the role of organics in influencing these outcomes. As significant components of aerosol particles with diverse hygroscopic properties, organic aerosols can absorb water and impact both aerosol liquid water content and pH. Including a discussion on how organics might alter the size-resolved response would strengthen the analysis.

For example, the reported 104% increase in NH_4^+in response to an 18% rise in ammonia emissions could not solely from interactions with sulfate and nitrate, but may partly result from reactions between ammonia and organic acids (e.g., forming ammonium oxalate). These processes can influence pH, especially in the 0–1 um range. Neglecting the role of organics risks overattributing observed effects to SNA alone.

Minor comments:

Line 170: The cases are not clearly defined in the texts that describe Table 1. What are noNH3 and Meta cases? You can briefly introduce why you conduct these two cases here. Is Top-Dep case using the Top-down scheme?

Line 207: The symbols and Italic fonts used in the texts and equations throughout the paper, such as $E_{\mathrm{NH_3,mod}}$ do not follow standard scientific writing conventions. For guidance, you may refer to this document.:https://iupac.org/wp-content/uploads/2016/01/ICTNS-On-the-use-of-italic-and-roman-fonts-for-symbols-in-scientific-text.pdf

Line 217: Remove the dot after number 74.

Line 230: Using lighter background colors in Figure 1(a) would improve clarity and make the hotspots easier to distinguish.

Line 235 and 245: Since these are comparative descriptions rather than time series trends, I'll avoid using "increase" and instead opt for terms like "overestimate" or "biases".

Line 295: references for IPCC(2023)?

Line 351: Typos in this paragraph. Change SO_4^- to SO_4^{2-}.

line 505: References for the statement:“high-latitude marine aerosols are more acidic ...”?

Line 538: Table 9?

Line 539: It would be better to provide more context for the motivation of conducting the noNH3 case earlier in the text-when introducing the cases in Table 1—rather than introducing it abruptly here.

Line 556: Since the effects of different ammonia emission scheme are a crucial aspect of this research, and the title is ”The Influence of Ammonia Emissions...,” it would be more appropriate to move the sentences discussing the importance of the ammonia emission inventory and its effects earlier.

Line 605: The figure captions for Figure 7 and Figure 8 are almost the same. You can change the caption of figure 8 to “The same as figure 7, but for the difference between Top-Dep case and base case. ”