Authors' Response to comments of the Executive Editor

Thank you for revising the manuscript. The reviewers agree that only minor issues remain to be addressed, especially regarding the figures (see Report 1) and the correction factors (see Report 2).

We thank the Executive Editor and the anonymous reviewers for the thorough review and detailed feedback. To address the concerns regarding the clarity of the figures, we have improved them accordingly (i.e., corrected time abscissa for Fig. 2-6d, fixed truncated y-axis for Fig. 8 and more descriptive caption). Additionally, we have added a supplement that shows Figures 2-6 with a real time axis instead of data point number. To further enhance the clarity and quality of our manuscript, we have addressed all other comments (in blue) regarding typesetting and additional comments.

Eq. (1): Please typeset "tAnions" and "tCations" in roman font (non-italic using \mathrm).
Eq. (2): Chemical elements in roman font.
Eq. (3): Italic K_\mathrm w, T, T_0, A_T, but roman K (Kelvin) and "where"

All fixed accordingly.

Eqs. (4), (8) etc.: Preferably use single-letter variables with subscripts rather than multi-letter variables to avoid confusion with products. Also consider the suggestion of referee 2 to use a more meaningful notation. For common multi-letter acronyms in other equations (e.g. LWC), please use roman font.

To use a more meaningful notation and to avoid multi-letter variables for our correction factors (YN, XN), we have replaced throughout the text the chemical domain dependent factor, YN, by K_D. Accordingly, we have replaced the composition dependent factor, XN, which depends on the degree of neutralization of the given aerosol composition, by F_N.

Eqs. (9): Roman pH, LWC, H, subscripts

Fixed accordingly.

In their AC, the authors clarified several issues and they added extra explanations/improved some unclear formulations in the paper which should improve the quality of the publication. There are still some suggestions before the paper can be recommended for final publication:

1. Regarding the recommendation to make a clearer outline of the improvements introduced in EQSAM4Clim-v12, the authors provide a good formulation in their AC (i.e. "EQSAM4Clim-v12 introduces a refined parameterization that separates aerosol, cloud, and precipitation pH, addressing a limitation of previous versions. This enhancement allows for more accurate representation of pH variations across different atmospheric conditions. The role of the XN correction factors can have a strong local impact in improving model performance").
Still, this has not been made transparent in the paper. First two sentences are only included in Results and Evaluation, while e.g. Abstract mentions only "aerosol acidity" (even though diagnosing pH of cloud and precipitation are among the main improvements).
The role of XN/YN correction factors are not mentioned either in Abstract or Conclusions (only in the technical description Sec. 2.2.1). I think it'd be relevant to mention calibration against E-AIM and introduction of the correction factors in Conclusion.

We have revised the conclusion accordingly by: *"Using a range of diverse case studies we have performed box model calculations with the results being compared and calibrated against E-AIM, upon introducing domain and neutralization dependent correction factors, i.e., KD, and FN, respectively. The comparison against the E-AIM reference model calculations covers a range of seasons and scenarios ranging from forest measurements to maritime seaboard measurements."*

2. Regarding XN scaling and YN correction factors, I wonder if it'd make it easier to follow the section if the authors could give a name to XN factor, reflecting its physical meaning (associated with non-ideal solution/neutralization??). It'd also help to emphasize XN scaling by 10 in footnotes to Table 1.

Further, the explanation of the origin of YN/XN ("The correction factors have been iteratively derived by comparing the diagnostic pH output of EQSAM4Clim-v12 with the reference pH computations of E-AIM for these five cases...") comes much later and in different section than where YN/XN are introduced (which means the given values appear kind of random).

We have renamed the correction factors to be more meaningful (as mentioned already above), however, we retain from adding *scaling by 10* in footnotes to Table 1 as this would lead to a duplication of text. Also, we find the note about the origin of the correction factors in the results section more appropriate, as otherwise the different cases used would not have been introduced.

3. Regarding the importance of modelling aerosol water pH, the authors gave a good explanation in their AC, whereas just one short general sentence ("The pH of aerosols controls their impact on climate and human health.") - which is OK, but the section with technical details of EQSAM4Clim-v12 doesn't seem to be the most appropriate place - perhaps could be moved to Introduction?

Given the scope and style of this technical manuscript we prefer to keep it as is.