

Author Responses to Reviewer Comments

<https://doi.org/10.5194/egusphere-2025-5587>, 'Modelling the deep convective transport of trace gases (CO, NH₃ and SO₂) from the planetary boundary layer to the Asian summer monsoon anticyclone' by J. Ma et al.

The referee comments are written in this font style and color.

The author answers are written in this font style and color, with the page and line numbers referring to the revised manuscript.

Changes in the revised manuscript are written in red.

Overall Thoughts: *The authors have addressed my primary concern in the original manuscript, which was to include comparisons between the model simulation and available observations. I believe the manuscript should be accepted for publication after considering the few points below.*

We thank the anonymous referee for reading our responses and revised manuscript carefully and providing additional constructive comments. Below are our point-by-point responses to referee's comments in detail.

Recommendation: *Minor revision*

Remaining comments:

- *The inclusion of remote sensing observations to evaluate the performance of model convection and trace gases is very beneficial. I think the authors should add some additional road-mapping comments to clarify that despite that the observed and simulated trace gas distributions not being in agreement with each other, the analysis of simulated convective transport is still useful to present. There is a short mention of this in the final concluding paragraph, but otherwise it seems to me that the new Section 3.3 does not cause any updated tone in the surrounding sections.*

As suggested, we have added the following paragraph at the end of Sect. 3.3 of the revised manuscript (Page 9, Line 18-27) :

Being an insoluble trace gas, CO is generally considered as a good tracer to investigate the dynamic processes associated with the ASMA (e.g., Randel and Park, 2006; Park et al., 2007; Park et al., 2008). The above comparisons have demonstrated that EMAC could well reproduce the CO regional distribution within the ASMA observed by satellite, strengthening our confidence to do in-depth analyses of simulated convective transport of trace gases to the ASMA, as presented in Sect. 3.4. In addition to CO, deep convective transport of NH₃ and SO₂ will also be investigated

although simulated regional distributions of these two soluble trace gases are not in good agreement with those from observations. We are concerned about whether deep convective transport could explain the simulated regional distributions of these three trace gases within the ASMA. The analyses presented in the following subsection not only can testify inherent consistency of physical processes considered in the model, but also might provide useful information for improving satellite retrievals of these trace gases.

- *In Figure 3, I believe the NH₃ and SO₂ colorbars should be the same between observations and models for a fair comparison. I recognize however that this may not look great and could obscure some important details, so if the authors insist on keeping it as-is, I suggest adding some explicit mention in the caption and/or text that the colorbars are different to make sure the reader is not fooled.*

We have added the following sentence in the text of the revised manuscript (Page 8, Line 10-11):

Note that different color-bar scales are used between the models and observations.

- *The Smith et al. (2025b) citation should be updated since it's now been published in 2026, see <https://doi.org/10.1029/2025GL118851>*

Done (Page 25, Line 21-24):

Smith, W. P., Tilmes, S., Gaubert, B., Granier, C., Zhu, Y., Eppers, O., Koellner, F., Brauner, P., Rollins, A., Waxman, E., Schill, G., Gurganus, C., Huey, L. G., Tanner, D., Lee, Y.-R., and Bekemeier, C.: Reduction of global sulfate aerosol concentration and corresponding radiative effects from recent Chinese SO₂ emission reduction. *Geophysical Research Letters*, 53, e2025GL118851. <https://doi.org/10.1029/2025GL118851>, 2025b.

- *I suggest removing “T63L90” from the first sentence of the conclusions, this is specific jargon to EMAC and isn't digestible for a broader audience without scrolling back up. If there is something important to mention about the configuration (e.g., resolution), I suggest repeating it again here.*

Removed (Page 13, Line 6).

In addition, we have made an additional change by adding the following information to Sect. 2 ‘Model description and setup’ (Page 5 Line 34 - Page 6, Line 2).

The Quasi Biennial Oscillation (QBO) was also nudged to observations compiled by the Free University of Berlin and Karlsruhe Institute of Technology (see <https://www.atmohub.kit.edu/english/807.php>, last access: 17 December 2025), as done in the work of Brühl et al. (2025).

Many thanks!