

Editor decision: Publish subject to minor revisions (review by editor)

Dear authors,

Please find enclosed a further referee report on the revised version of your manuscript. Although the referee suggest publication of the manuscript as is, I still have some minor revision I would like to ask you to consider before the manuscript can also be accepted from my side.

Comment	<p>P1, L11: What do you mean with informed? Is that really the right term? Do you mean "assimilated"?</p> <p>P1, L12: Same here in "GEMS-informed". Further, why is it always "our" Bayesian inversion? Isn't this just a "Bayesian inversion", thus shouldn't it rather read "the" or "a".</p>
Response	<p>The NO_x emissions used for the simulations were the top-down estimates derived from the Bayesian inverse modeling using GEMS observation data. As you pointed out, the term 'informed' seems to not clearly deliver this nuance. We have revised the manuscript accordingly.</p>
Changes made	<p>L11: "...NO_x emissions adjusted by the Geostationary..."</p> <p>L12: "After the Bayesian inversion..."</p> <p>L122: "...top-down constraints during the Bayesian inversion..."</p> <p>L153: "...the Bayesian inversion..."</p> <p>L347: ".....which the Bayesian inversion..."</p>

Comment	<p>P1, L13-15: The sentence with the emission increases is not clear. Do you refer here to results from an earlier study? To what compared did you derive an underestimation with the model? Please rephrase the sentence and provide a clear statement.</p>
Response	<p>Thanks for pointing it out and we agree that the sentence was not clear. We have rephrased the sentence accordingly.</p>
Changes made	<p>L14: "After the Bayesian inversion, the inventoried NO_x emissions increased by 50% in Korea and 33% in China compared to the a priori estimates..."</p>

Comment	<p>P3, L95 and further occasions throughout the text: emissions inventory -> emission inventory</p> <p>P6, L186: emissions inventories -> emission inventories</p>
Response	<p>We have revised our manuscript accordingly for consistency.</p>

Comment	P1-5: The introduction is with almost four pages to long. The topic if your study is not that complicated that it justifies such a long introduction. Please shorten to 2-3 pages.
Response	We acknowledge that our introduction was lengthy. We have made it more concise while retaining key literature, ensuring the length remains within three pages.
Changes made	<p>L46-48: “However, the Siberian High’s stable nature can also induce significant ... pollutants to accumulate locally near their sources (Zhang et al., 2007; Zhai et al., 2024).”</p> <p>L64-72: “Yang et al. (2021) conducted source apportionment of ozone concentrations during ... Similarly, Xian et al. (2024a)’s source apportionment study ... while the rest was driven by local precursor emissions.”</p> <p>L83-84: “This was primarily driven by secondary inorganic aerosols ... contributing up to 51% and 70% of the total PM_{2.5} mass, respectively.”</p> <p>L87-90: “Gu et al. (2024) assessed the health impacts ... while transboundary air pollution accounted for up to 13% and 40%.</p> <p>L128-136: “Beyond these satellite-based studies, several others successfully performed source apportionment ... the primary contributor, accounting for up to 68% of PM_{2.5} concentrations.”</p>

Comment	<p>P5, L149: Rename "Materials and Methods" to "Data and Methods"</p> <p>P5, L150: You actually do not provide here any model description, rather the simulation set-up is described. Thus, this section should be renamed to "Model simulations"</p> <p>P5, L153 and throughout the manuscript: "Figure" and "Section" are abbreviated in the text as "Fig." and "Sect." unless they appear at the begin of the sentence (see ACP manuscript preparation guidelines).</p>
Response	Thank you for pointing these out. We have renamed the sections and adjusted abbreviations as suggested.

Comment	P6, L183: "During discussions for Korea....." please rephrase the sentence part.
Response	We have rephrased the sentence for better clarity.
Changes made	L 161-163: "In our discussion of Korea (later in Sect. 3), we focused on the SMA, the country's economic hub, where dense traffic activity contributes to severe air pollution, as highlighted in the small panel of Fig. 1, which illustrates its geographic extent."

Comment	P7, L193: movement -> transport P7, L203: This section should be renamed to " Emission inventories". P8, L237: CB6 -> CB06 (to be consistent with the writing of CB05)
Response	We have revised our manuscript as suggested accordingly.

Comment	P25, Figure 7 title: Adjust font size for "across". P25, Figure 7 and Figure 7 caption: What is ANO3? I guess you mean "HNO3"?
Response	Thanks for pointing it out. Earlier we used CMAQ's output variable name ANO3 (aerosol nitrate) but now replaced it with NO ₃ ⁻ for better clarity.

Comment	Reference list: In the author lists "&" should be replaced by "and" P30, L600: All author names should be listed.
Response	We have corrected the format in the reference list.