

Dear Dr. Western,

We thank you for the positive assessment and for accepting the manuscript subject to technical corrections. We have addressed every point below. All changes are shown as tracked changes in the revised manuscript and the two supplements. Our point-by-point responses follow, and all corresponding changes are shown as tracked changes in the revised files.

Technical corrections

1. Figures, throughout: colour-blind-friendly palettes; unbold figure captions.

As the editor requested, the affected figures have been redrawn with a colour-blind-safe qualitative palette, and where multiple series are overlaid, each series is additionally distinguished by marker and/or line style so that it is separable without relying on colour. We also verified the palette by simulating each figure's colours under protanopia, deuteranopia, and tritanopia, and under their milder (anomalous-trichromatic) forms in the supplement figures, confirming that all series remain distinguishable. All figure captions have been changed to non-bold (regular) weight.

2. Line 24 and throughout: 'in situ' and other common Latin phrases should not be in italics.

Common Latin phrases such as 'in situ' are now set in non-italic type throughout the manuscript.

3. Line 26: spell out VPRM and FINN in full.

We spelled out VPRM and FINN in the manuscript as the "Vegetation Photosynthesis and Respiration Model," and as the "Fire Inventory from the National Center for Atmospheric Research," at first occurrence as the editor noted.

4. Line 99: OSSE needs to be spelled out in full in this occurrence.

We spelled out OSSE as "Observing System Simulation Experiments (OSSEs)" in the first occurrence.

5. *Figure 1: the caption needs expanding.*

The Figure 1 caption has been expanded to clarify that the red rectangle (marked d01) is the single WRF-Chem computational domain, that d01 denotes domain 1 in the WRF naming convention (indicating no nested domains), and that the surrounding map is provided only as geographic context and is not part of the simulated area.

6. *Line 160: spell out PREPBUFR in full at first occurrence.*

We revised the texts as the editor requested. The revised sentence is “The assimilated data include continuous in situ CO₂ and CH₄ concentrations, together with standard global upper-air and surface meteorological observations from the National Centers for Environmental Prediction (NCEP) provided in the prepared Binary Universal Form for the Representation of meteorological data (PREPBUFR) format”.

7. *Equation 1 and throughout: equations should be properly punctuated; no colon before an equation; subscripts should not be italicised unless they are a variable.*

We carefully checked equations and revised them as the editor mentioned. The colon introducing a single displayed equation has been removed, and terminal punctuation (a comma or period, as the sentence grammar requires) has been added at the end of the displayed equations. Descriptive (non-variable) subscripts such as met, chem, flux, meas, repr, and sfc are now set upright, while genuine variable subscripts (e.g., the ensemble-member index *i*) remain italic.

8. *Line 214: the subscript should not be in italics.*

We corrected the relevant subscript by setting it in upright type as the editor noted.

9. *Line 232: move the reference for the Gaspari-Cohn polynomial to line 232.*

We moved the reference as requested. The citation "(Gaspari and Cohn, 1999)" now appears immediately after "Gaspari-Cohn polynomial," at the point where the method is introduced.

10. *Line 259: CTL needs to be spelled out in full in this occurrence.*

We spelled out CTL as a control known-truth retrieval (CTL) as the editor requested.

11. *Line 443: why is the AMY value given to one decimal place, where others are given to the nearest ppm/ppb?*

As the editor noted, the AMY value has been rounded consistently with the other values in the text. Table 1 retains one-decimal precision for the CO₂ statistics to preserve numerical detail, whereas the running text now uses rounded values consistently.

Additional proactive refinements

While addressing the points above, we also made a few minor refinements to further improve clarity and consistency. In particular, we spelled out additional acronyms at first occurrence (for example, the Emissions Database for Global Atmospheric Research, EDGAR), harmonized the typographic formatting of chemical-species subscripts (CO₂ and CH₄) across the text, and made small consistency edits to terminology and formatting. These refinements do not change any result or conclusion and are likewise shown as tracked changes.

Code and data availability (Open Access Policy)

We have revised the Code and Data Availability section to comply with GMD's code and data policy. The model code, processed datasets, model outputs, and configuration files generated for this study are archived in persistent public repositories with permanent DOIs and are accessible without an "available upon request" restriction. For third-party datasets, we now provide the original persistent sources and access conditions, and where redistribution is permitted, we additionally provide static archived copies through Zenodo.

We believe these revisions fully address the technical corrections. We appreciate your constructive support and insight throughout the revision stages.

Yours sincerely,

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