

Dear Editorial team,

We thank you for considering our revised manuscript for publication, and the reviewers for their constructive feedback, which has helped us improve the manuscript.

Please find below a summary of the main revisions made to the manuscript in response to the comments and suggestions received during the Open Discussion phase. A detailed point-by-point response to all comments (RC1 and RC2) was previously uploaded as a PDF during the discussion phase (<https://doi.org/10.5194/egusphere-2024-4064-AC3> and <https://doi.org/10.5194/egusphere-2024-4064-AC4>)

Summary of Main Revisions:

1. Recomputed the SHAP values analysis using grouped features, addressing the suggestion from CC1.
2. Revised the Emulator Explainability results and discussion sections to reflect the updated SHAP analysis and the interpretations introduced in point 3.
3. Integrated suggestions from RC1 and RC2 by interpreting SHAP values in the context of previously published LPJ-GUESS model sensitivity studies.
4. Added clarification on the limitations of the emulation framework in Section 5.4 (Emulator Application), in response to RC1's comments.
5. Removed the statement regarding neural network extrapolation and added a note in Section 5.4 to address related comments from both CC1 and RC1.
6. Implemented several minor corrections and clarifications based on feedback from RC1 and CC1.
7. Addressed the technical editor's suggestions (CE1) concerning the code and data availability statement.

Items Not Changed:

1. We did not include a residual analysis, as suggested by CC1. We believe that the combination of three evaluation metrics (NRMSE, R^2 , and Relative Bias), along with trajectory plots and spatial error maps, provides a sufficiently comprehensive assessment of emulator performance for the intended application. Moreover, adding an additional analysis would significantly increase the number of figures and potentially exceed the manuscript's word and space limits.
2. Regarding the use of factorial LPJ-GUESS simulations to evaluate emulation performance: as explained in detail in our response to RC2, this approach is not viable for our framework. Additional justification has been added to the manuscript in the Emulator Performance section.

We hope the revised version meets the expectations for publication.

Best regards,

Carolina Natel de Moura, on behalf of all co-authors.