

Response to Topical Editor:

Dear Kazumi Ozaki and coauthors,

Thank you for your extensive revisions and response. All but one response fully addresses what the reviewers have asked for, so after a minor revision to the response to this one point I would be pleased to accept this manuscript.

The comment I would like you to look at again is:

Line 291-292: Neglecting the inorganic carbon cycle is an interesting choice that merits more discussion. To be clear, I understand the reasoning behind this simplification – carbon cycle feedbacks are uncertain and introduce more unconstrained complexity to an already complex model. However, changes in inorganic carbon cycling have been proposed as drivers of atmospheric oxygenation (e.g. Williams et al. 2019; Nature Communications), and the ^{13}C record provides a useful sanity check on any proposed oxygenation story. Neglecting the inorganic carbon cycle also means climate feedbacks are absent, which prevents the model from exploring the coevolution of life and the environment in many deep time contexts. More discussion of these limitations would be helpful in preventing misapplications or misunderstandings of the model.

Your text change (“Although we ignore the inorganic carbon cycle here for clarity and in order to simplify interpretation of model results, the full coupling of the inorganic carbon cycle within CANOPS-GRB is an important topic for future work.”) does not constitute a discussion of the limitations as the reviewer has suggested. I agree with the reviewer that this discussion is necessary.

I look forward to seeing this minor amendment to the manuscript.

We are most grateful to the Topical Editor for their handling of our manuscript and for the helpful comment on the revised manuscript. Based on the comment above, we have revised the text to more clearly explain the limitations of the model (Line 302-309): “Atmospheric CO_2 , dissolved inorganic carbon (DIC), and dissolved organic carbon (DOC) are not explicitly modelled in the current version of the model, and the full coupling of the inorganic carbon cycle within CANOPS-GRB is left as an important topic for future work. Neglecting the inorganic carbon cycle means that there are no climatic feedbacks in the system, and because of this simplification, the CANOPS-GRB model cannot be applied to problems such as those in which the Earth’s climate and redox states of the ocean-atmosphere system are closely related each other or to validate model predictions based on geologic records (such as $\delta^{13}\text{C}$), but this allows us to avoid introducing the additional complexities and uncertainties in the model.”

We hope that our explanations and revisions are satisfactory and that the revised version of our paper is now suitable for publication in the *Geoscientific Model Development*.