

Clim. Past Discuss., referee comment RC2
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Comment on cp-2022-46

Anonymous Referee #2

Referee comment on "Impact of iron fertilisation on atmospheric CO₂ during the last glaciation" by Himadri Saini et al., Clim. Past Discuss.,
<https://doi.org/10.5194/cp-2022-46-RC2>, 2022

Comment for "Impact of iron fertilisation on atmospheric CO₂ during the last glaciation"

Saini and co-author present nice modeling study of glacial carbon changes at 70 ka BP. The authors investigate, using a range of factorial analyses, the impacts of iron input and increased efficiency of biological pump in the glacial ocean. They simulate an upper limit for the CO₂ decrease due to iron fertilization of 21 ppm. The manuscript is concise and well written. Figures and tables are illustrative and support the conclusions. I recommend publication of the manuscript after minor revision.

I have one concern that require revision. The author showed that an exponential decay response of CO₂ decrease to iron input to the Southern Ocean (SO) is due to the saturation of the biological pump. I agree with this conclusion, but some descriptions of the reason why the efficiency of the biological pump saturates in response to iron inputs are missing. As a result of the saturation of the increase in EP/NPP in the SO in response to the iron input, has the efficiency of the biological pump also saturated? For example, please add figures for changes in EP/NPP in SO in response to iron inputs in SO to Figure 4 and describe the nonlinear response of the ecosystem to changes in iron inputs.

It would also be important to add a similar figure for changes in nutrient concentrations to show changes in nutrient cycling with iron fertilization. In the case of large iron flux (e.g. $\lambda_{\text{bre}}50\%-47S$), does the ecosystem response saturate due to nitrogen depletion instead of iron? I think these descriptions would be useful to the reader.

Minor comments

L174-175: It is interesting result that even though the two iron deposition patterns are very different, the effect on CO₂ lowering is almost the same for the two patterns. Please add an explanation as to why the Weddell Sea convection would result in smaller changes in CO₂ for the different iron deposition patterns.

L286-287 Where is this information described in the method? I couldn't figure it out, so please let me know.