

Interactive comment on “Response of the carbon cycle to the different orbital configurations of the last 9 interglacials” by Nathaëlle Bouttes et al.

Anonymous Referee #1

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This is a well-conceived study about an interesting and relevant topic. The methodology is sound, and the fact that the authors' model could not reproduce the observed changes in CO₂ before and after the Mid-Bruhnes event (MBE) should not prevent it from being published.

However, this manuscript needs a background section describing in more detail the previous studies that have addressed this question and the hypotheses that have been proposed (e.g., by Yin and Berger and Kohler). At the end of the manuscript the authors should revisit these hypotheses. Do the new model results presented support either hypothesis (ie, that stronger or weaker overturning explains the change in CO₂)? More background information about the ice sheet model used would also be helpful. What sea level is simulated for each interglacial?

C1

In the results section, it would be useful to have a more specific comparison of the proxy and model SST changes. The authors have a very nice table summarizing proxy SST observations, but it isn't clear how well the model agrees with the data. I can't tell in the figures how large the model SST changes are. How much beyond -0.6 C does the dark blue color go? Simply listing the global mean SST change as well as values for the North Atlantic and Southern Ocean would be helpful.

In their discussion, the authors suggest that the reason that the model did not reproduce large enough CO₂ changes could be related to a shortcoming in how it simulates bottom water formation. Additionally, the authors identify mismatches between proxy and simulated vegetation changes. They should provide more information related to these potential problems. How well does the model simulate the Holocene or pre-industrial with respect to atm CO₂ level, overturning and vegetation? Can the authors suggest more specific solutions to address these shortcomings? Are there additional simulations, such as sensitivity tests, that the authors could propose (or run) to gain more insights?

Lastly, I think the manuscript has too many figures. Several figures could be combined to make it easier to compare the different simulation scenarios. For example, Figure 4 could have 3 columns, one each for the OC, OVC, and OVIC simulations (thus, combining figures 4, 13, and 16). Similarly, results from figures 12 and 15 could be placed side-by-side.

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C2