



Interactive comment on “Evaluating seasonal sea-ice cover over the Southern Ocean from the Last Glacial Maximum” by Ryan A. Green et al.

Anonymous Referee #3

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Green et al., propose some interesting insights related to seasonal changes in sea-ice cover during the LGM using PMIP3 and LOVECLIM simulations, in particular in relation to wind stress and surface ocean temperatures. While simulations are generally coherent with paleo reconstructions for LGM winter sea-ice cover, simulated glacial summer sea-ice cover differs widely between models and between models and (arguably limited) proxy-based reconstructions.

While study is certainly relevant, it lacks some context, I feel. To me, the main outcome of the present study relates to the conclusion that the seasonal contrast in sea-ice cover is reduced today compared to the LGM. While clearly interesting, this finding should be placed into a broader context and outline how increased sea-ice dynamics

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would affect ocean circulation and more generally carbon and nutrient biogeochemistry during the LGM. Furthermore, it remains unclear why reconstructing summer sea-ice extent is relevant, in particular for air-sea gas exchange and deep water production, which to a large degree occur in winter.

I certainly support publication of the present study in *Climate of the Past*, provided some additional contextualization can be provided.

General comment

I'm certainly not a modeling expert, but the reason underlying the poor representation of the glacial summer sea-ice extent should be clarified. In particular, I don't quite understand why the distribution of mean summer SST during the LGM is generally coherent between models while summer sea-ice extent is not. Maybe this aspect could be clarified further at least for non-specialized readers.

Detailed comments

I. 15-27. Since the MS is focusing on seasonal contrasts in sea-ice extent, it may be relevant to briefly explain how seasonality affects the main processes outlined in this section today. For example, does a positive SAM phase affect both the winter and summer sea-ice extent linearly?

I. 27-30. The statement is misleading. I believe the Southern Ocean has accounted for about 40% of the global OCEANIC uptake of anthropogenic CO₂.

I. 44. Could you briefly explain why records of summer sea-ice extent are generally more poorly constrained?

I. 110 – incomplete sentence

I. 161-163 & 168-169 – how does the relationship between SST and sea-ice cover equate for the winter months as a comparison?

I. 203 – how does this value compare with modern SSI extent?

I. 321-323 – assuming that most of the mixing occurs during the winter, I'm not too sure to understand how increased sea-ice melt during the spring-summer could enhance nutrient utilization (and by inference carbon drawdown)?

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