

Clim. Past Discuss., referee comment RC1
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Comment on cp-2021-102

Anonymous Referee #1

Referee comment on "Reconstructing Antarctic winter sea-ice extent during Marine Isotope Stage 5e" by Matthew Chadwick et al., Clim. Past Discuss.,
<https://doi.org/10.5194/cp-2021-102-RC1>, 2021

I commend the authors for the scale and complexity of this work, which reflects an incredible amount of work from start to finish. The overall aim of this project, to evaluate palaeoceanographic conditions (winter sea ice and SST) during MIS 5e, in comparison to average modern conditions, is well conceived and of broad scale interest. This time period presents an appropriate test case for comparison, in terms of understanding/ anticipating near future conditions of the Southern Ocean, and the ramifications on an array of variables, ranging from changes in bottom water formation to ecosystem scale changes. For this reason, I found the introduction and conclusion to be especially useful and aimed toward wide audience, including those with less specific interest in the details of the diatom work. The data are well-illustrated and clear, easy to follow; thanks for the common x-axis scaling.

Specific comments:

1. I realize that the authors are limited by the cores available, that are suitable for this study – core length and time scale covered, resolution, and diatom preservation. In terms of future work, identification of key missing pieces might be helpful, with a very limited ability to truly evaluate the Indian Ocean sector of the Southern Ocean, with no cores reflecting almost this entire sector, which is about half of the studied area. The two cores analyzed reflect only the edge of this sector and are relatively high latitude. Given that, it is difficult to make substantive conclusions about this sector. This is just an observation, not a criticism. However, it might be a good idea to re-frame the term “Indian Ocean sector” which really isn’t well-addressed geographically.

2. I appreciate the reluctance to overinterpret, especially when the environmental controls on some species, or species groups, is more complicated than temperature and/or sea ice. The authors allude to this for example, in noting the unusual abundance of *Fragilariopsis separanda*, for example, on page 9-10 (lines 193-203). This impacts their statistical analysis and interpretation, yet clearly reflects something different. Thanks to the authors for pointing this out – yet one more species to re-evaluate. And despite the very common use of *F. curta* + *F. cylindrus* as a sea ice indicator, their differing distribution in the

modern ocean suggests that the story is more complex. How confident are the authors in suggesting that *F. cylindrus* is associated with sea ice meltwater? I suggest adding reference to several older papers, that might strengthen this association:

Kang, S.-H., Fryxell, G.A., 1992, *Fragilariopsis cylindrus* (Grunow) Krieger: The most abundant diatom in water column assemblages of Antarctic marginal ice-edge zones, *Polar Biology*, 12, 6-7, 609-627.

Kang, S.-H., Fryxell, G.A., 1993, Phytoplankton in the Weddell Sea, Antarctica: composition, abundance and distribution in water-column assemblages of the marginal ice-edge zone during austral autumn, *Marine Biology*, 116, 335-352.

Kang, S.-H., Fryxell, G.A., Roelke, D.L., 1993, *Fragilariopsis cylindrus* compared with other species of the diatom family Bacillariaceae in Antarctic marginal ice edge zones, *Nova Hedwigia*, 106, 335-352.

3. Table 2: are the +/- values overly precise, especially given bioturbation? In lines 140-142, the age uncertainty is widened, given the thickness of the sample interval (which pretty narrow, only 0.5 cm).

4. How does this paper compare to the Chadwick et al. paper that is in review? Without seeing both it is difficult to evaluate the unique contributions of each.

5. Line 275 – Interesting comment regarding the abundance of *Chaetoceros* resting spores in TPC290, such that the analog is closer to modern day Antarctic Peninsula. Lines 302-309, another reference to higher *Chaetoceros*, this time in core ELT17-9. I wonder if this might be associated with earlier timing of sea ice breakout in the spring, a longer open water season with a stronger spring bloom signal? Or upwelling? Or both?

6. Lines 383-391, discussion of changing ecosystem due to sea ice changes in the Weddell Sea sector: Consider references to:

Moline et al. 2004, Alteration of the food web along the Antarctic Peninsula in response to a warming trend. *Global Change Biology*. 10. 1973-1980 and Mendes et al., 2018, New insights on the dominance of cryptophytes in Antarctic coastal waters: A case study in Gerlache Strait. *DSR II*, 149, 161-170.

I realize that both these papers are from the western side of the Antarctic Peninsula but note the impact of meltwater and a warming ocean on primary producers and impacts that cascade through the food web.

7. Line 395 - remove parenthesis since this is an important consideration. In general, if it's important enough to be stated, no parentheses necessary.