

The Cryosphere Discuss., author comment AC2
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Reply on RC2

Dieter R. Tetzner et al.

Author comment on "Regional variability of diatoms in ice cores from the Antarctic Peninsula and Ellsworth Land, Antarctica" by Dieter R. Tetzner et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-160-AC2>, 2021

Dear Editor,

We appreciate all the comments and suggestions made by the Anonymous Referee. We thank for his/her time and consideration. Please find to follow, a list of all points raised and our responses to each item.

Reviewers comment #1

Figure 5 and MSA: It is mentioned in the methods that the ROIC ice core was dated using the annual cycles of major ion concentrations, and MSA is used in Figure 5c to identify the austral summer based on the maxima of MSA. As this study crosses multiple disciplines, not every reader will know what MSA is and understand its use here. MSA should be introduced earlier on in the manuscript (only mention is line 129) as to what it is, how it is interpreted at this site, and what the maximum represents.

Response #1:

Revised as suggested. Details about MSA and how it can be interpreted are now included in the methods section.

"The MSA is the oxidized product of DMS, an organic sulphur compound from marine biogenic emissions. Measurements of MSA were used to estimate the temporality of the ROIC ice core. The MSA record was used as it has demonstrated to present a clear seasonal cycle in Antarctic ice cores, with a sharp austral summer maximum and a broad winter trough (Abram et al., 2013)."

Reviewers comment #2

This may be a missed opportunity in the discussion for ROIC site, as MSA can be an indicator of winter sea ice extent or summer primary productivity (i.e., Thomas et al., 2019 as cited; Abram et al., 2013), and the relative timing of the MSA peak to the diatom peaks could add an interesting aspect to the discussion.

Response #2:

The link between MSA and diatoms in ice cores is not straightforward. Despite MSA being an indicator of primary productivity, this does not necessarily imply a direct relationship between the concentration of MSA and the diatom abundance in ice cores. To date, there is uncertainty on the amount of DMS (turned into MSA after oxidized) produced by each diatom species. We acknowledge that exploring the relationship between MSA and diatom abundance could provide interesting insights but it is beyond the scope of this research article. We hope to explore the relationship between MSA and ice core diatom assemblages in subsequent work.

Reviewers comment #3

Line 331/376: The text emphasizes the 'dominance' of marine diatoms in the record, when they are just over 58% (line 307) in some instances. The authors also state they cannot "rule out minor contributions from exposed sediments in fresh/brackish-water bodies." in line 341. Given that in some instances marine diatoms only make a little over half the assemblages I suggest the authors rephrase these sentences as 'dominance' could overemphasize the marine contribution. The same could be said about 'minor' minimizing contributions from fresh/brackish water bodies.

Response #3:

Marine diatoms account for at least 58% of the main diatom assemblage preserved in ice cores presented in this work. We have modified the introduction and discussion sections,

accounting for the potential inputs from non-marine sources. We have also revised the text to better acknowledge the contribution of “non- marine” taxa. Finally, we amended our description of the Antarctic marine taxa as ‘prevalent’ within the diatom assemblage rather than ‘dominant’ throughout the whole manuscript.

Example: *"Whilst the SO is the principal source of diatom to ice cores in this region, we cannot rule-out contributions from exposed diatom-bearing sediments (most reported from sites within the distally located Transantarctic Mountains (Barrett, 2013)) and fresh/brackish-water bodies. Antarctic non-marine water bodies could potentially contribute with diatoms to the ice core record."*

Reviewers comment #4

Line 344: SSIZ and POOZ are used to describe ‘seasonal sea ice zone’ and ‘permanently open ocean zone’ with a reference to section 2. However, neither of these acronyms are used or defined in section 2. SSIZ is defined in the caption of Figure 1. POOZ isn’t mentioned until the caption in Table 3. As these acronyms are used extensively in the discussion, they should be defined and described in main text in section 2 and not just in the captions.

Response #4:

We have modified section 2.1 to define and describe the SSIZ and POOZ as suggested.

Reviewers comment #5

Section 5.2 Inter-annual variability: This section provides some interesting insights, but the assessment of changing environmental conditions influencing diatom concentrations could be strengthened (from line 413 onwards). First off, regarding the decadal variability. Why were these subsets chosen? As they differ between sites, they seem arbitrary. The

discussion could instead focus on the overall increasing trend, rather than the differences between the subsets, particularly as the discussion of the changes in atmospheric circulation and sea ice dynamics is only regarding 'recent decades' and not these specific periods. However, since these data were subdivided, it would strengthen the discussion to be more specific about the trends in environmental conditions over each decade analysed. For example in Line 423: Regarding the 'recent decrease in the area of the ABS SSIZ mentioned in Parkinson, 2019– the overall trend is negative, but there has been a slight increasing trend since ~2010. This would then perhaps suggest an increase in the distance of the SSIZ relative to the 1999-2008 period. While data for the specific decades analysed may not be readily available for all environmental conditions mentioned in the text, the authors should make improvements where possible.

Response #5:

Similar points were raised by Prof. V. Jones in her Reviewers comment #9. We have modified the Discussion section of the manuscript to incorporate them.

"Our reason to analyse temporal changes in the assemblages and on the diatom concentration was to assess the consistency of the diatom record in response to recent environmental changes in the region. In particular, to determine if there were shorter-term shifts in the diatom concentrations caused by changes in certain diatom species or if there was a general shift in all diatom species that shape the main assemblage. We decided to assess this at a decadal timeframe to reduce the potential imprints of interannual variability. We did not discuss specific changes in climate/sea ice during the assessed decades because trends in both, wind strengthening and sea ice retreat, have been sustained over the last decades.

We acknowledge we did not specify that wind and sea ice trends have been sustained over time or refer to the different timing of the decadal subsets across the sites. To address this comment, we have modified the manuscript, specifying our reasons to analyse the dataset in decadal subsets (Methods – Section 3.2 – 6th paragraph), we have clarified that recent trends have been sustained over the last decades (Discussion – Section 5.2 – 5th paragraph) and we specified the timeframes considered when comparing recent changes in the diatom concentration (Discussion – Section 5.2 – 4th paragraph)."

Reviewers comment #6

Abstract, line 16: "yield a novel wind paleoenvironmental proxy" – suggest 'paleoenvironmental proxy' as authors acknowledge other environmental factors may influence diatom content in ice cores such as sea ice extent.

Response #6:

Modified as suggested

Reviewers comment #7

Line 28: "over long distances" – if possible, be more specific here (ex: over XX kms)

Response #7:

Revised as suggested. Now we specify that diatom transport distances can range from some kilometres to intercontinental scales.

Reviewers comment #8

Line 44: "ocean" is capitalized

Response #8:

Modified as suggested

Reviewers comment #9

Figure 1: SSIE and PSIE are difficult to read/see in the main figure – perhaps outline these in white (but keep them filled in with color) to make them stand out more?

Response #9:

Modified as suggested

Reviewers comment #10

Coastal polynyas: The transect in Figure 1 identifies coastal polynyas as a feature in this area. There are several in this region, yet no mention of coastal polynyas is made in the text or how polynya variability may impact these records.

Response #10:

This paper aims to determine the regional and temporal variability of diatom records preserved in ice cores from the AP and EL regions. Results presented in this paper allow us to broadly outline diatom sources and suggest potential processes driving the variability of the record. We agree polynyas in this region could potentially contribute diatoms to ice core sites and have included this in the discussion section of our revised manuscript.

Reviewers comment #11

Lines 89 and 95: "XXth century"

Response #11:

Modified as suggested

Reviewers comment #12

Table 1 caption: When describing SIE – perhaps refer to section 3.3 which provides the source of the data. The caption does an excellent job of explaining how these distances were calculated but does not identify the source of the data which is presented later.

Response #12:

Modified as suggested

Reviewers comment #13

Figures 2-5, Part C: The color used for SIDI can be hard to differentiate from the total diatom concentration (particularly with a printed version)– an alternate color or line marker may be more suitable. However, this is up to the author and editor's discretion.

Response #13:

Modified as suggested