Climate of the Past Discussions

Clim. Past Discuss., author comment AC1
https://doi.org/10.5194/cp-2021-107-AC1, 2021

Reply on RC1

Jacob Jones et al.

Author comment on "Sea ice changes in the southwest Pacific sector of the Southern Ocean during the last 140□000 years" by Jacob Jones et al., Clim. Past Discuss., https://doi.org/10.5194/cp-2021-107-AC1, 2021

RC1 (Dr. Diana Krawczyk): We thank you for your time in reviewing our manuscript – your comments have been extremely helpful in the further development of our manuscript, and we sincerely appreciate your positive feedback.

Because of the number of co-authors working on this project, we have opted to create a comment tracking table for ease of discussion and in-text references to other related comments. We have copied and numbered each comment received in your review and have provided our collective response to each.

Please feel free to follow up for any required clarity.

Sincerely,

Jacob Jones

Comment	Comment	Author's Response
RC1-1	Methods, section 2.1 – it's not entirely clear which cores are recalculated for SIC and which for SST as part of this study; I think all the cores should be mentioned in the methods and clarified which are analysed from the scratch and which have had their results recalculated; and	Agreed – we will add all cores to methods and provide more clarity around which cores provide what information, and where this information was collected from.

	which are jut cited. Caption to Figure 1 is confusing in this matter.	For reference: TAN96 => new data both for SSST and WSIC SO136 => WSIC recalculated through augmented modern database (249 analogs vs 195 analogs in Crosta 2004) E27-23 => Published data (Ferry et al., 2015)
RC1-2	Results – what is missing here is the figure and description for the results of the recalculated core SO136-111; it is a part of this study and needs to be described.	Agreed – we will include a description of the recalculated SO136-111 results.
RC1-3	Discussion, section 4.1 – this part belongs to Results, not in Discussion and the sentences that do belong to Discussion should just briefly describe the past conditions and trends for SIC and SST, e.g., line 276-278 and 282-283 so I suggest restructuring. And please provide time intervals for the periods you describe in text. Also, there is first mention of the core E27-23,	Agreed – we will restructure this section to fit into Results and will provide time intervals described in text. E27-23 is not recalculated within this study, but a citation (Ferry et al., 2015) will be provided.

	which was not mentioned in Methods or Results and if it is a part of recalculation then it should be properly described. Otherwise, please provide a citation for this core.	
RC1-4	l. 26 – what quantitative technique was used to reconstruct SIC and SST? Transfer function? Please clarify	We used a diatom-based transfer function. We will update the language and clarify accordingly.
RC1-5	l. 30 – please provide percentage info for the SIC (consolidated)	Generally, 0-15% open ocean; 15-40% unconsolidated sea ice; >40% consolidated sea ice (Armand et al., 2005 and references therein). We will clarify the text to something like: "Following the modern concept (Armand et al., 2005 and references therein), we find that winter sea ice was consolidated (wSIC = >40%) over the core site …"

RC1-6	Abstract overall – seems like there might be too much detail regarding the past conditions, could be simplified and generalized a bit, e.g. SST values could be mentioned only for the minimum and maximum values and otherwise just refer to trends	Agreed – we will rework to remove excess details (e.g., lat/long coordinates and water depth) and align with other comments regarding the Abstract (e.g., RC1-23, 24).
RC1-7	l. 51 – what does it mean 'dynamically linked'?	We use the term 'dynamic' in the convention sense to describe a "force that controls or influences a process of growth, change, interaction or activity" (from Merriam-Webster). We therefore describe the link between sea ice and carbon sequestration as being 'dynamically' linked because each factor exerts some force or influence over the other.
RC1-8	l. 66 – either 23 to 19 ka or 23.000 to 19.000, please use consistent time scale; also, is it BP?	Yes – ages are presented in BP. We will update and standardize to 'ka BP' throughout.

RC1-9	l. 64-84 – are there any other proxies providing information on reconstructed oceanic variability in the region? Such as foraminifera etc? Would be nice to mention	Yes - there are other proxy reconstructions from the region that provide information on oceanic variability (dust, nitrogen, temperature, etc.), but not many foraminifera reconstructions. However, these proxies don't necessary look at sea ice variability or capture it in the same capacity as do the use of diatoms and transfer functions. We've kept this paragraph and paper primarily focused on sea ice, and while we acknowledge and appreciate the reviewer's suggestion to include other key proxy reconstructions from the region, we feel as though discussing additional proxies from the region may detract from the tightly focused narrative. It is also worth mentioning that forthcoming submissions from Chadwick et al. and Kohfeld et al., which will be submitted to this special issue, will address some of the larger topics concerning regional oceanic variability and reconstructions from the region and will supplement this manuscript.
RC1-10	l. 88-92 – this belongs to methods; introduction should	After some consideration, the co-authors have agreed that

	mainly state general information on the materials studied	the text provided on lines 88-92 would likely be useful to readers who skip the methods section and only quickly read the paper. We will remove unnecessary information (e.g., latitude & longitude, water depth) to streamline the reading, but believe the additional references to SO136-111 and E27-23 should remain; however, we are open to further discussion on this topic.
RC1-11	l. 196-206 – this part belongs to Results section	The text provided in the manuscript on line 196 may be slightly misleading – our analysis did not establish these taxonomic groups, as these have been used in other publications and are established methods (e.g., Crosta et al., 2004, Ghadi et al., 2020). We will therefore change the wording to something like: "Based on previously established taxonomic groups, diatoms were grouped into one of three categories based on temperature preference and sea ice tolerance: …"
RC1-12	l. 201 – what is the sea ice	The highest abundances of

	concentration range for this group?	the diatom species composing this group in the modern sediments are found at WSI greater than 60-70% (Zielinski and Gersonde, 1997; Armand et al., 2005; Esper et al., 2010). They are therefore all suited to record past changes in WSI (Esper et al., 2014).
RC1-13	Table 1 – just curious, did you identify any Thalassiosira antarctica var. antarctica? Its northern equivalent is pretty common in the Arctic and sub-Arctic region	Only a few specimens of Thalassiosira antarctica var antarctica form 2 (warm variety; Taylor et al., 2002) were found, and they were generally identified during glacial periods. TAN => up to 1% of the total diatom assemblages SO136 => up to ~2% of the total diatom assemblages E27-23 => up to 1.5% of the total diatom assemblages
RC1-14	l. 212 – why did you choose this period only? Is the present-day diatom succession limited to January-March? Please clarify	January-March is mentioned only for the SST. In the Southern Ocean, diatom production is restricted to the sunlit period (spring to fall). Production starts earlier in the SAZ-POOZ than in the Sea Ice Zone, which is

especially late in the coastal zone due to high sea-ice cover (Nelson et al., 2001; Arrigo et al., 2004; Grigorov et al., 2014).

Although there is a succession in diatom production from spring to fall (Grigorov et al., 2014) and that spring production may exceed summer production in some regions (Fiala et al., 2002), most of the export occurs during the summer months (Fiala et al., 1998; Kopczynska et al., 1998; Fischer et al., 2002; Armand et al., 2008; Grigorov et al., 2014; Rigual-Hernandez et al., 2015).

For these reasons, summer SST is generally a better explanatory variable than spring or annual one (Esper et al., 2014).

We will add additional clarity (not to this degree) to the manuscript to resolve any confusion.

RC1-15

l. 227-228 – it would be nice to consider other quantitative, transfer function tests at some point, such as ML (MLRC) and WA-PLS to show that MAT is indeed the best choice.

Other transfer functions have been tested using the modern diatom database used here (Ferry et al., 2015) and using another modern diatom database (Esper et al., 2014).

In Esper et al. (2014), MAT

		performed better in term of R2 and RMSEP. Though the G-IG patterns were reconstructed with both IKM and MAT, the latter reconstructed more variable sea ice at the multi-millennial timescale as IKM is known to smooth down records due to its approach (regression and paleo-environmental equation; Esper et al., 2014). Conversely, GAM and MAT provided similar results in core SO136-111 (Ferry et al., 2015). Finally, it is worth noting that MAT provides SST and WSI reconstructions that are in agreement with other type of SST and WSI reconstructions (Gersonde et al., 2005; Civel et al., 2021), other downcore proxies and, more globally, Southern Ocean paleoclimate at any timescales (Crosta et al., 2004; Nair et al., 2019; Ghadi et al., 2020; Orme et al., 2020; Crosta et al., 2021; Shukla et al., 2021). This topic will also be discussed in the forthcoming Kohfeld et al. manuscript, which will be submitted to the same special issue.
RC1-16	l. 242 – which periods specifically? Looks like MIS 1, 4 and 5	We will update wording to something like:

		"The Sub-Antarctic Zone (SAZ) group had relatively low abundances, with higher values occurring generally during the warmer interstadial periods MIS 1 and 5, and briefly during MIS 4 at 67 ka."'
RC1-17	l. 289 – I can't find the description of cores MD06 in Discussion	We will rework the Methods & Results section to include a description of all cores that were used in the manuscript that were not already introduced (in line with comment RC1-21). The cores that will be introduced for the %AAIW calculation include: [1] MD06-2990; [2] MD06-2989; and [3] MD97-2120 From Pahanke & Zahn (2005) & Ronge et al. (2015). In addition, the following cores are used in Discussion 4.3 for the SST gradient:

		[1] SO136-GC3; [2] FR1/94-GC3; [3] ODP1119; [4] Q200; and [5] DSDP594. We will add a sentence in the manuscript that points to these cores (and references) so that all cores used in this analysis are included within the text and cited.
RC1-18	l. 308 – please clarify that you mean explanation no. 3	Noted - we will rearrange the numbering as follows and update lines 305-307 accordingly: [1] Different statistical applications; [2] lateral sediment redistribution; [3] differences in laboratory protocols;

		[4] differences in diatom identification/counting methodology; and [5] selective diatom dissolution; We will then correct the numbering in the appendices but leave the wording from lines 308-327 as is.
RC1-19	l. 308-330 – I suggest to put this text in a separate sub-chapter as it stands out of the description of past conditions	We initially had this section broken out as its own sub-chapter (as suggested), but after reading and having discussions around the chapter's flow, we decided to embed part of the discussion within the text and append the non-essential part of the discussion. We are open to reworking this section and separate it into a sub-chapter if the reviewer feels this is important; however, in our own writing/re-writing exercises we have found the current state of the manuscript to have the best reading flow.
RC1-20	l. 462 – reference for the core is needed here	Noted - we will add the Pahnke & Zahn (2005) reference for core MD97-2120.

RC1-21	l. 528 – again, if these two cores are a key element of Discussion and overall conclusions, then we need more info in Methods and Results	Noted - we will include a description of these cores in previous sections. See response to RC1-17 for more information.
RC1-22	l. 549-556 – perhaps this part fits better to Introduction	We agree that the current reading of this paragraph would fit better within the Introduction. We would like to keep these ideas at the end of the paper, so we will rework the paragraph to read more as a conclusion. We will change the text to read something like: "In conclusion, this paper has focused exclusively on sea ice as a driver of physical change…" and "We recognize that these processes may not act independently, and as such, have contributed new data to help advance our collective understanding…"

RC1-23	l. 29 - coordinates etc should be removed from Abstract, too much detail	Agreed - coordinates and water depth have been removed from the Abstract.
RC1-24	l. 36 – '…coolest values, respectively…'	Agreed – Line 36 now reads: "WSIC and SSSTs reached their maximum concentrations and coolest values, respectively, by 24.5 ka…"
RC1-25	l. 38 – SSST – too many S or sSSTs	This was a typing error and should have been "sSST"; however, based on other comments, we are updating all "sSST" to "SSST" throughout the manuscript.
RC1-26	l. 87 – SSSTs – should it be singular?	Yes – SSST should be singular. The text currently reads: "SSSTs and wSIC are estimated by applying the Modern Analogue Technique …"

		We will change the wording to: "SSST and WSIC estimates are produced by applying the Modern Analog Technique …"
RC1-27	l. 114 – 'published cores providing recalculated sea ice extent data'?	Only SO136-111 has been recalculated for this study. We will update the language to: "… and additional published cores providing sea-ice extent data".
RC1-28	Figure 1 – please add abbreviations SSI and WSI in legend	Agreed – we will update Figure 1 accordingly.