

Clim. Past Discuss., referee comment RC1
<https://doi.org/10.5194/cp-2021-59-RC1>, 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on cp-2021-59

Anonymous Referee #1

Referee comment on "Holocene palaeoceanography of the Northeast Greenland shelf" by Teodora Pados-Dibattista et al., *Clim. Past Discuss.*,
<https://doi.org/10.5194/cp-2021-59-RC1>, 2021

Review of "Holocene paleoceanography of the Northeast Greenland shelf" by Teodora Pados-Dibattista, Christof Pearce, Henrieka Detlef1, Jørgen Brendtsen, Marit-Solveig Seidenkrantz.

This manuscript is an interesting contribution to a number of ongoing international efforts to investigate the region of and off NE Greenland. This region is of particular importance for the Greenland Ice Sheet because it holds the NE Greenland Ice Stream, which accounts for a large part of the ice export from the ice sheet. The manuscript builds on established foraminiferal, isotopic and sediment-chemical data sets from a long sediment core obtained on the NE Greenland shelf which allow to reconstruct environmental change in this area at high temporal resolution and in great detail. The results are novel, the data interpretation is well-founded and in general I am in favor of a publication of this data set in *Climate of the Past*. However, I have two major concerns which should be addressed by the authors before publication is possible:

(1) The age model is based on a calibration which uses the Marine20 data set of Heaton et al. (2020, *Radiocarbon*). In this paper, Heaton et al. explicitly state already in the abstract (and in detail in the text) that the Marine20 data set "is not suitable for calibration in polar regions". Accordingly, Pados-Dibattista et al. need to find alternative ways of calibrating their radiocarbon data. They may think of using the IntCal20 data set and a suitable local reservoir correction. Proposed corrections have been published by e.g.,

Tauber, H., Funder, S., 1975. ^{14}C content of recent molluscs from Scoresby Sund, central East Greenland. *Grønlands Geol. Unders. Rapp.* 75, 95–99.

Mangerud, J., Bondevik, S., Gulliksen, S., Hufthammer, A.K., Høisæter, T., 2006. Marine ^{14}C reservoir ages for 19th century whales and molluscs from the North Atlantic. *Quat. Sci. Rev.* 25, 3228–3245.

Coulthard, R.D., Furze, M.F.A., Pienkowski, A.J., Nixon, F.C., England, J.E., 2010. New marine ΔR values for Arctic Canada. *Quat. Geochronol.* 5 (4), 419–434).

(2) The Discussion chapter needs to be reorganized. Currently, in its first part it consists of several subchapters (6.1-6.2) discussing Holocene environmental change on the NE Greenland shelf as derived from own data. This text is mostly fine, but more comparisons should be made with the paper of Zehnich et al. (2020) which contains (among other data) benthic isotopic data sets of higher temporal resolution than the ones of Pados-Dibattista et al. In the present manuscript the second part of the Discussion chapter holds two subchapters (6.3 and 6.4) which present a review of published knowledge concerning larger-scale Holocene climatic and environmental connections in and around the research area. What is missing is the combination of both parts. The authors need to show how their own results relate to larger scale developments and how they may improve our understanding of these developments.

Minor and more specific comments and proposed corrections (general and by line numbers):

Check the entire manuscript for consistency:

- sea ice vs. sea-ice

- West Spitzbergen Current vs. West Spitsbergen Current

Be consistent with using either British or American spelling (grey/gray, colour/color, -ise/-ize)

9: stable isotope and

14: iceberg

26-27: The reader might want to know why the "societal and environmental relevance of this sea-ice reduction" is particularly important for Greenland...

34: meltwater

35: budget and stratification, and it influences

36: Indicate Northeast Greenland ice stream on the map! Later you use "Northeast Greenland Ice Stream". Be consistent with capital letters!

39ff: Is it necessary to mention all the site numbers and citations in the figure caption if they reappear in the Discussion anyway? I guess something like "Locations of cores discussed in the text are indicated" would be enough...

51: Moossen

55/56: "the returning branch of the West Spitzbergen Current" - if you mean the RAC, then call it RAC!

57: freshwater (check also in the entire manuscript!)

58: affects

63: Better: demanding an improved...

65-69: You should either be more specific in explaining the features connected with the NAO or delete this paragraph and introduce NAO later. As it reads now, it is very general and details (e.g., NAO+ and NAO-) need to be introduced later, anyway (e.g., "a redistribution of atmospheric mass" - what kind?; shifts from one phase to another" - what kind of "phases"?)

76: most of the Holocene

82: of the NE

83: better "neighbored banks"? The banks are not really surrounding the troughs!

87: Johannessen (check also in ref list!)

88-89: In your Fig. 2a, waters with $S < 32$ only reach down to 150 m!

90: Atlantic sources

93-94: From Fig. 1 I cannot see that the RAC runs along the Greenland coast.

99: modulates the glaciers' basal

101-102: Make two sentences!

102: Start sentence with "Today, ..."

103: Polar Front lie east... Start new sentence with "However, ..."

105-107: Make two sentences!

108: increases in size

108-110: Make two sentences!

113 vs. 120: Why are coordinates of the core site differing in detail?

117: Temperatures (WOA) from which season?

117: this transect

140: top sediment loss?

155: are shown

159: the 100-1000 μm fraction

167: bulk sample

169: intervals

170: The official silt size is 2-63 microns. Are you sure that you used a 60 micron mesh?

176: Clearly describe what is shown in this figure, from left to right!

185: Better: below the lowest radiocarbon-dated sample

186-187: Give a cross-reference to chapter 4.4 for the reworked species.

191: ... and focus on the last 9.4 ka.

200: lowest radiocarbon-dated level

203: insert reference to Fig. 3

203-204: I agree that there is mostly a good visual correlation (maybe you should calculate correlation coefficients?), but I do not see a "trend" to either higher or lower values. If it is there, it is weakly developed.

206: For me this "steady increase" is hard to see.

207: I think the variability in Ca/Fe between the core base and c. 340 cm is more than just a "slightly stronger fluctuation". The amplitude is orders of magnitude higher than in the rest of the core!

212-218: Be more specific and clearly distinguish between modern and extinct species!

229 and 236: I do not think that it makes sense to give an average percentage in the entire core for the total agglutinated or total calcareous species, especially if (as you write) the relative proportion is changing from the core base to the top. I ask you to calculate %agglutinated of all benthics for each sample and add this record to Fig. 5, also because you refer several times to the aggl/calc ratio later in the text.

230: Start new sentence with "However, ..."

238: Again, I cannot see a "steadily decreasing trend towards the top of the core". Values are relatively high near the core base, around 6.5 ka, and near the top. In between they are lower. No trend is visible...

244: Arctic

245: Why is there a period (.) behind the Roman letters for the ecozones? Looks strange...

245-246: It is more common to say "horizontal" and "vertical" axes.

257: Once "on average" is enough...

294: A trend means that values are changing in one direction, i.e., they become higher or

lower. If values are mostly the same, then there is no trend. One would rather say that values remain constant (within a certain range).

298: Wouldn't "cluster" be the proper term?

308: in our interpretation

313: and in fjords

315: I suggest to label the panels/records (a) to (i) and give these labels in the figure caption together with the description of the individual panels/records. This will make it easier for the reader to identify certain records.

325-326: How can the bottom waters in these troughs be distinguished?

327: but may also be present due to...

328: shelf break

334-337: Kapp København is a location, not a deposit. Where are such places with Pliocene/early Pleistocene sediments? I cannot find anything on the map (Fig. 1). Is it likely that sediments were transported to your site, and how? Writing that "the breakup and significant retreat of a nearby glacier caused reworking of older sediments" is too general and the example (Seidenkrantz et al. 2019) is from far in the south...

340: What is the evidence that this was a "cold interval"? You should avoid introducing such a-priori statements before you discuss your own (and published) paleoclimatic evidence.

344: "would have characterised" ... if...?

340-348: Stratification and water masses on the NE Greenland shelf are also discussed by Zehnich et al. (2020). You should compare the results - here and in the other subchapters of the discussion.

343: Here you say that the area was heavily sea ice covered. Later (l.349 and in the discussion of the Syring et al. 2020 results) you state that planktic foraminifers were abundant and productivity was high. At first sight this sounds contradictory and needs a proper discussion. I am aware that this discussion comes when the relation to the ice margin is discussed, but you may from the beginning say that the results are only apparently contradictory.

348: A reference is needed when certain elements are ascribed to sources.

348: I cannot see that the d18O values are particularly low in this section. A potential influence of temperature changes on d18O should be discussed. There is evidence for an enhanced advection of Atlantic Water to the NE Greenland margin (Bauch et al., 2001). As shown in several papers on the W Svalbard margin, this advected AW was relatively warm, even when compared to today, and likely it was still relatively warm when it reached the NE Greenland margin as the RAC. Accordingly, there may be a temperature influence on the isotopic signal. Moreover, how would meltwater (near the surface) influence the d18O of benthic organisms? In any case, you should compare your isotope results (both d18O and d13C) to the isotope data sets of Zehnich et al. (2020).

356ff: Try to find better arguments for a linkage of your event with the 8.2 ka event. Can you derive information on the nature of these sediments from the X-ray photos? What about grain sizes? Wouldn't more icebergs leave traces by IRD-rich sediments?

357ff: Long sentence. Split into two!

374: appeared around 8 ka BP in the record, after a long absence

378: This refers to the previous sentence and should not start a new paragraph.

384ff: Core numbers are not necessary here and in many other places when references are given. Müller et al. discuss sea ice coverage and bioproduction, but temperatures only in a semiquantitative way. Werner et al. (2013, 2016) are more appropriate references for near-surface temperatures off W Svalbard and should be used here and in other subchapters of the discussion. They show that strongest AW advection started c. 10.8 ka. On the other hand, Risebrobakken et al. (2011) showed that highest SSTs came only c. 9 ka. Since there is a strong influence of AW at the NE Greenland shelf sea floor, the timing of AW and temperature maxima should be discussed with reference to results from the E Fram Strait. Is there a discrepancy? Can you speculate why? One may also ask whether results from SE Greenland are suitable for comparisons. The Nordic Seas are much wider than the Fram Strait and the heat distribution by AW works in a different way there.

403: Foster Bugt is not on the map in Fig. 1.

402-406: Okay, this is interesting information. What kind of conclusion can you draw?

412: <1

414-415: Theoretically, high d18O could also result from stronger AW influence. You should build your arguments on a combination of proxy interpretations. Example: Since the forams point at low bottom water temperatures, we interpret the high d18O value as indicative of...

420: 4.2 ka

427: What can you conclude from the literature information?

432: from ... to ...

433: Atlantic Water

437 to previous times

444: Several papers show that there was a cooling trend after c. 5 ka. However, there is also evidence for some warming in the last 2 ka (e.g., Sarnthein et al., 2003; Werner et al., 2013; Telesinski et al. 2014a,b; Zehnich et al. 2020). Is this expressed in your data? If not, can you speculate why?

474: Syring et al., 2020b

501: Also Werner et al., 2013, 2016; Consolaro et al., 2018

523: Hillaire

539: started to resemble

542: Freshening is usually strongest near the sea surface and would thus increase (and not reduce) stratification...

543: and to a (near) perennial

545: What is "possible sea-ice cover"?

780: Sarnthein

Fig 1: Orange lettering is difficult to read on greenish background (insert map)