Climate of the Past Discussions

Clim. Past Discuss., referee comment RC2
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Comment on cp-2021-59

Anonymous Referee #2

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-RC2, 2021

Comments to a manuscript by Pados-Dibattista and colleagues

The paper by Pados-Dibattista et al presents new data from a remote site at the northeastern Greenland shelf aiming to reconstruct variability of climate and ocean conditions during the Holocene. The topic is within the scope of the journal and the presented data are new and results are very interesting. The paper is generally well written but has some aspects in the results and the discussion (see below) which need to be improved before the final publication. I recommend publication after major revisions given that authors can address the criticism detailed below.

Major comments:

- During the review I counted about 30 (!) abbreviations present in the paper and was often struggling with finding what those mean throughout the text. I suggest to the authors to make it easier for the reader, compile a list of all abbreviations used in the paper and present it in the beginning or alternatively at the end of the paper. This will facilitate finding them all in one place if needed.
- Results section regarding foraminiferal analysis needs to be re-written starting with presenting a general information about foraminifera (this is present for planktonic but currently is missing for benthic ones). Such info shall include which benthic species were dominant (e.g. >10%), accessory (e.g. 5-10%) and rare (e.g. <5%). Then go into details regarding how many were calcareous vs how many were agglutinated and so on. The authors often write “the most abundant species” but it is unclear what they mean by those – dominant or accessory? This should be clarified. The authors shall also add figures with absolute abundances because relative abundances can sometimes be misleading as they are usually not normalized per sample weight or sample volume. There are some sort of graphs present in the appendices, and although those look a bit different they still have % instead of ind/g – if those are supposed to represent ind/g they shall be moved to the general text and be present alongside with % data instead

of appendices.

- The authors should run some kind of multivariate statistics to strengthen their visual ecozone subdivision. A simple cluster analysis combined with PCA or Factor analysis would help here to verify if changes in the assemblages are significant enough to define ecozones. For instance, in results (p10, line 53) the authors define ecozone II based on appearance of *bulloides* in the record. This species, however, is present in very low abundances (<1%) and it is important to show with statistical analyses that its presence makes significant changes in the assemblages.
- All ecozones are labelled in a strange manner e.g. "345-310 cm or 9.4-8.2 ka" – this should be changed to "310-345 cm or 8.2-9.4 ka" to make it more logical. Similar changes should be made all over in the text where authors refer to time periods or core intervals.
- In addition to age, core depth should be added to all foram graphs to make it easier to follow the text and connection to the age model. Also the width of the horizontal axis for the abundance data needs to be adjusted based on high (wide axis) or low (narrow axis) numbers – now all x-axis on graphs have the same width, but different range values, which makes it misleading for the reader.
- Section 5 (p11, lines 96-113) is way too long and contains a lot of text which belongs to the discussion. Here the authors shall only keep information about foram groupings they used for interpretation later– like suggested below. All remaining information including interpretation shall be moved to the discussion. A much shorter section 5 can include the following: Atlantic Water group includes x, y, z species (Refs); Chilled Atlantic Water group - x, y, z species (Refs); Arctic Water group ….S feylingi….Some agglutinated species have been described in connection with particular water masses (refs) and we use those to reconstruct….
- Section 6.2.1 (p13) shall be removed from the discussion as the authors say in the methods (p6, lines 190-19) that this section was not considered in the interpretation.
- My last major point is about the discussion section, where the authors present their own data (section 6.2) separately from other studies (sections 6.3 and 6.4), which both shall be intertwined. So, the discussion needs to be rewritten.

Minor comments:

Abstract:

P1, Line 9: "We carried out benthic foraminiferal…" - This sentence jumps a bit abrupt from one topic to another. Start instead by saying "In order to reconstruct the variability of the East Greenland Current and general paleoceanographic conditions in the area during the Holocene, we carried out benthic foraminiferal assemblage, stable isotope- and sedimentological analyses etc…"

Introduction:

P1, Line 25: "According to model simulations, the Arctic Ocean may become seasonally ice-free as early as 2040-2050 (Stroeve 25 et al., 2012). However, despite the extreme societal and environmental relevance of this sea-ice reduction…" – please add a sentence

or two explaining what these “extreme societal and environmental” implications are, and then introduce to the public the lack of knowledge on the topic.

Regional setting

P3, lines 83-85: Please remove abbreviations 79NG and ZI as those are only relevant of figure caption to Fig.1. Also please mark all “abbreviated” features (SS, ZI, 79NG, NQIB) on the Figure 1 with the arrows to better indicate their position on the map.

P3, line 85: Please spell out 79NG and ZI.

Methods:

P5, lines 148-150: “A minimum of 300 benthic specimens were identified for each sample, except for four samples (10-11 cm, 15-16 cm, 30-31 cm, 195-196 cm). These four samples contained only between 242-296 specimens. These data were, therefore, treated with some caution…” – I suggest authors removing the part about samples where 300 ind count was not reached. It is a well-known fact now that despite 300 ind/ sample is a standard procedure (e.g. Murray, 2006) counting individuals less than that can still produce statistically significant results (see e.g. Fatela & Taborda, 2002. Mar. Micropal. 45, 169-174).

P5, line 157: “..was restricted by the number of available, clearly identifiable tests…” – what does this mean? Not corroded and well preserved individuals? Please explain.

Results:

P6, line 174: “The sediment of the lowest 40 cm of the core is much coarser…” - it was mentioned in the methods that the authors did IRD analysis but that one is completely forgotten in the results and the discussion. Please add this information there.

P6, Figure 3: Please mark all available 14C dates close to the timescale.

P8, line 210: Please change the title to “Foraminiferal analysis” instead of “Foraminiferal content”

P8, line 211: Please change the title to "Redeposited core section 345-410 cm with Plio/Pleistocene Foraminifera" –Also I suggest the authors to swap the places for sections 4.4.1 and 4.4.2 and focus first on the core part which shows the main results. Then you can mention that the core base contains x,y,z forams, is likely redeposited, and is therefore excluded from interpretation.

P8, line 219: Please change to "The Holocene core section 0-345 cm". Also consider swapping places with section 4.4.1 to present your most important findings first.

P8, line 223 – p9, line 239: This section needs to be re-written.

- Start with presenting foram concentrations as range (x-y) with an average z. Do this for both planktonics and benthics (calcareous and agglutinated separately). As it looks now, sometimes ranges are given but averages are missing, or the other way around. Please be consistent and present both all the time.
- Continue by telling which species were dominant, accessory and rare for each foram group (planktonics and benthics). Here, try to be consistent with spelling out species names fully every time they appear for the first time in a new section.

P8, line 230: "…from this point..." – which point? Please specify.

P8, line 232: "..the most abundant.." – what does this mean? Dominant? Accessory? If so what range and averages this species has?

P8, line 233-234: "…representing on average 42 % and 16 % (respectively) of the benthic agglutinated assemblage, and 27.5 % and 10.5 % of the total benthic assemblage. " – information about their percentage within the agglutinated assemblage is irrelevant, please remove it and keep only % of the entire assemblage.

P8, line 236: "The most abundant.." – see comment above

P8, line 237: Spell out *C. reniforme* and *E. clavatum*,

P9, lines 242-243, Figure 5 caption: "The depicted species were chosen in order to show changes in the environment." – this is vague and unclear. I assume those are changes in water masses such as…., if yes please specify. Also please add core depth in cm to this graph, adjust axis width so it reflects the abundances visually and add a graph with

respective changes for absolute abundances of those species.

P9, lines 247-249: "..ecozones that were defined by visual interpretation of the species abundances" – please add here "within 0-345 cm core depth".

P9, line 250: please change the title to "Ecozone I. (310-345 cm; ca. 8.2-9.4 ka BP)". Do similar changes with swopping the ages and core depths so they appear in right order everywhere in the text.

P9, line 254: add "(unshown)" after the "agglutinated/calcareous ratio"

P9, line 256-258: "The benthic calcareous assemblage is dominated by *C. reniforme* (relative abundance on average 14 %), followed by *S. horvathi* (on average 12 %), *E. clavatum* (on average 11 %) and *C. neoteretis* (on average 9 %)." – where there any important accessory species?

P10, line 259: see my comment above regarding swopping the ages and core depths

P10, line 267:"..species *Adercotryma glomerata* significantly increases from 310 cm…" – based on figure 6 I cannot see any "significant" increase in *A glomerata* no matter how hard I try! So, I suggest to the authors to tone down this by removing word "significant" or to adjust the scale on *A glomerata* graph so it shows only 0-15% range with occasional peaks shown by axis break.

P10: Figure 6 – please add core depth and adjust axis width so it reflects the abundances visually. Also add a graph with respective changes for absolute abundances of those species.

P10, line 273: see my comment above regarding swopping the ages and core depths

P10, lines 275: "rises dramatically" – an increase from 1 to 7 % is not a dramatic increase. Please tone this statement down or change to "comes back to higher numbers".

P10, lines 276-277: please add "Being present in abundances below 2% in ecozones I and II" to "Epistominella arctica increases…" Also remove "while the relative abundances of *A. glomerata* decrease" – as this is not visible from the Fig 6 as it looks now!

P10, line 278: see my comment above regarding swopping the ages and core depths in the title.

P10, line 279: please remove word "drastic". There are several instances in the record where calcareous benthics decrease but those are not mentioned.

P10, line 280: "…and increased relative abundances of *E. arctica* and *Stainforthia feylingi*." -Based on fig 5, *S. feylingi*has abundances quite similar to zones I and II but is not mentioned at all in the description of those.

P11, line 282: "..agglutinated species *A. glomerata* shows a drastic peak at the beginning of this ecozone." – not just *A glomerata* but also *R. fusiformis* does the same and is worth mentioning here. Please add.

P11, line 283: "..*Spiroplectammina biformis* increase significantly compared to the previous interval." – please consider changing to "*Spiroplectammina biformis* starts to increase as compared to the previous ecozones.

P11, line 284: see my comment above regarding swopping the ages and core depths in the title.

P 11, line 288: "..*Saccamina difflugiformis* shows a steep rise unique to this interval" – this species again has been present in other ecozones as well but is completely ignored in the description of those. Why?

P11, lines 296-313: This section needs to be completely rewritten and moved to the methods (see suggestion below). Note that all information containing interpretation needs to be moved to the discussion. You may want to keep the following information (copy pasted from the MS) and move that to the Methods rather than keeping this in the results:

"In order to be able to describe the changes in water masses over time on the NE Greenland shelf, we place selected benthic calcareous foraminifera species into groupings that are based on environmental preferences of the species (Table A2 in appendices). *The Atlantic Water group* includes *C. neoteretis* and *P. bulloides* (e.g., Mackensen and Hald, 1988; Seidenkrantz 1995; Rytter et al., 2002; Jennings et al., 2004; 300 Jennings et al., 2011; Cage et al., 2021). *The chilled Atlantic Water group* includes *I. norcrossi* and *M. barleeanum* (e.g., Slubowska-Woldengen et al., 2007; Perner et al., 2011; Perner et al.,

2015; Cage et al., 2021). *The Arctic Water group* includes *S. horvathi* and *E. arctica* (e.g., Green, 1960; Lagoe, 1979; Wollenburg and Mackensen, 305 1998; Jennings et al, 2020). *Stainforthia feylingi* is used here as a sea-ice edge indicator species that tolerates unstable conditions (Knudsen and Seidenkrantz, 1994; Seidenkrantz, 2013); its increase may refer to the location of a sea-ice margin at the study site. Moreover, we use in the interpretation the abundances of the agglutinated species *A. glomerata*, *T. earlandi*, *T. torquata*, *S. biformis* and *S. difflugiformis*, as those have been linked to specific water masses in the Arctic (e.g., Hald and Korsun, 1997; Jennings and Helgadottir, 1994; Korsun and Hald, 2000; Lloyd 2006; Perner et al., 2012; Perner et al., 2015, Wangner et al., 2018).

Discussion:

P12, lines 324-325: Please change: "the temperature profile" to "CTD profile", "not exceeding" to "below" and "closer in character to that" to "closer in character to the water"

P13, line 326: please change "the site" to "our study site" and "but may also be due to wind-driven upwelling" to "but may also be present due to wind-driven upwelling

P13, lines 332-338: This section needs to be removed – see my major comment 7.

P13, line 339: please change "9.4-8.2" to 8.2-9.4"

P13, line 340: Before jumping into the discussion, you need to lead to it first based on what your data show. E.g. start with saying something like " The AMS 14C dating places this core interval into the early Holocene, which based on our data and previous studies (Refs) is suggested to be dominated by colder climate conditions over the study site. This cold interval was characterized by…."

P13, line 342: "Atlantic water indicator species" – please add "such as" and list those. Also change "points to" to "suggests".

P13, line 349: please change "was also characterised" to "was also likely characterised"

P13, line 350: please add "and" between "foraminifera" and "the presence of E. arctica"

P14, line 370: please change “8.2-6.2” to “6.2-8.2”

P14, lines 373-375: “*C. neoteretis* and *A. glomerata* had their highest relative abundances during this interval…and *P. bulloides* appeared in the record after a long absence around 8 ka BP (Figs. 5 and 6), suggesting highly stable bottom waters (Rytter et al., 2002).” “ - please spell out *C. neoteretis* fully or change to “Species C. neoteretis” (this applies to all species names at the start of a new sentence, as it is not correct to start a new sentence with an abbreviation). Also abundances of *A. glomerata* in zone II are not much higher than in zone 5, associated with Neoglaciation, so please change the statement about its highest abundances. As for *P. bulloides* – see my comment regarding its abundances <1%. The authors should discuss this and run a multivariate statistical analysis to see if this assemblage change is significant or not and add a discussion regarding this in the text.

P14, line 388: “..on the ME and SE Greenland shelf…” – what does abbreviation ME stands for? Please explain.

P14, line 391: please change “6.2-4.2” to “4.2-6.2” in the title

P15, line 407: please change “4.2-3.2” to “3.2-4.2” in the title

P15, line 431: please change “3.2-0.3” to “0.3-3.2”

Sections 6.3 and 6.4: This sections solely focus on findings of the others instead of putting own data into perspective of other studies. I suggest to move these sections to the introduction where they more naturally belong in their present form, otherwise the authors shall make an effort in answering the question how their own data fit into other studies they give an overview to herein. Go back to your aim. What are your data telling you about dynamics of the water masses you aimed to reconstruct? E.g. was EGC weaker or stronger? What does this mean for AMOC and climate in the Arctic (based on other studies)? What are future implications of those changes (again based on other studies)? As for now the authors treat their own data separately from other studies and this makes the last two sections look a bit off place giving a feeling that those shall be moved to the introduction or included in a review paper on the topic.

Conclusions:

This section contains too much information in its present form and is difficult to read due to its bullet-point structure. I suggest condensing conclusions, to present the most essential findings, again linking back to the hypothesis, aim and motivation of the study.