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Climate of the Past Discussions

CPD

Interactive comment

Interactive comment on "Holocene dynamics in the Bering Strait inflow to the Arctic and the Beaufort Gyre circulation based on sedimentary records from the Chukchi Sea" *by* Masanobu Yamamoto et al.

Masanobu Yamamoto et al.

myama@ees.hokudai.ac.jp

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Reply to the interactive comment of anonymous referee #1 on "Holocene dynamics in the Bering Strait inflow to the Arctic and the Beaufort Gyre circulation based on sedimentary records from the Chukchi Sea" by Masanobu Yamamoto et al.

We thank anonymous referee #1 for his/her helpful comments on our manuscript. Below is our reply to the main comments.

Comment: This paper deals with sediment cores from the Chukchi Sea and uses XRD

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mineralogy to study variability of the Beaufort Gyre and Pacific inflow into the Arctic Ocean during the Holocene. This submission is a revised version of an earlier manuscript published in Climate of the Past Discussions. One of the main comments on the original manuscript was the over-interpretation of results and linkage to Atlantic teleconnections. This component is toned down here, which has improved the manuscript. Several other reviewers' comments from the original remain, however, unaddressed so some are repeated here. This study provides a wealth of new data and new insights on the Chukchi Sea in the Holocene. I can recommend publication of this manuscript, provided the authors address the following comments and suggestions for revision.

Reply: Thank you for recognizing the significance of our paper. We will revise it according to your suggestions.

Comment: Problems with C/I and (C+K)/I as proxies for Bering Strait inflow: - how solid is this proxy, if it does not show any difference (in core 5JPC, Figure 3B) between the Holocene and the last glacial when the strait was closed? - The records from the three cores show very little agreement for these proxies. Again, what does this mean for the proxy? It does not seem a convincing record of Bering inflow.

Reply: Indeed, two samples near the bottom (1600 cm) of core 5JPC have the same CK/I and C/I ratios as those of Holocene sediments. However, glacial/deglacial depositional and circulation environments were very different from the Holocene, as exemplified by abundant detrital carbonates with the Laurentide provenance. Likewise, under environments non-analogous to the Holocene, clay minerals may have had a different provenance, with chlorite possibly transported from a source other than the Bering Sea. Some intervals in the deglacial unit in 05JPC are characterized by high abundance of kaolinite and terrestrial soil organic matter (branched GDGTs), probably delivered from inland North America by deglacial discharge (Suzuki et al., AGU fall meeting 2016). Chlorite may have also been delivered from areas affected by the Laurentide glaciation this period. The bottom line is that glacial/deglacial records cannot be used for characterizing Holocene conditions. In comparison, the spatial distribution of clay minerals in surface sediments suggests that the Bering Strait inflow provides a major contribution of chlorite-rich sediments under modern settings. As depositional conditions in the Chukchi Sea do not appear to have changed principally in the Holocene, there is enough reason to apply the modern-type provenance pattern to understanding Holocene changes in the Bering Strait inflow. We also recognize somewhat different patterns of C/I and CK/I among the three cores investigated. We are assuming that such a difference can be attributed to variable sediment focusing at different water depth and redistribution of the Bering Strait water between different branches after passing Bering Strait (lines 435-450). Further studies using more cores, e.g., from a depth transect, are required to clarify this issue.

Comment: Page 9. Lines 206-210. The top of core 01A-GC is assumed to be of modern age, because the authors write that sterols and IP25 show a decreasing trend in the top 10 cm (Stein et al 2017). This is a very poor indicator of recovery of the top sediments. Looking at the data in Stein et al 2017, the statement is not even accurate. The variability in the top 10 cm is of the same order of magnitude as deeper in the core. I suggest that this is removed (lines 206-210) and that it is acknowledged that the core top age is uncertain. There are no Pb210 dates, or a surface core to correlate with. There should be a table with radiocarbon dates and paleointensity datums (depth, age, reference). It would summarize the information spread out over pages 9-10 and shown in Figure 3. I suggest bringing back Table 1 from the original submission, adding the magnetic datums, and addressing the original reviewer comments to this version.

Reply: We agree that the core top in ARA 01-GC may not represent the modern age due to some sediment loss in the coring process. This is indicated by the absence of oxidized brown sediment at the core top, as opposed to a multi-corer collected at the same site. Nevertheless, we believe that the top of 01-GC is close to the sediment surface based on the biomarker distribution. Fig. 1 (below) shows the concentration profile of IP25 and brassicasterol (Stein et al., 2017). We suppose that the downward

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decrease in concentrations of both compounds in the top 10 cm indicates their degradation with burial. A similar extent of brassicasterol concentration decrease occurs also in some of the deeper intervals, but is unique for the upper ∼200 cm, while the IP25 decrease at the top is unique for the entire record. We will provide according explanations to this part and indicate that the core-top age is uncertain. We will also bring back Table 1 with the paleomagnetic datums.

Comment: Divide section 3 in subsections: e.g. 3.1 Coring and Sampling, 3.2 Chronology, 3.3 XRD Mineralogy

Reply: We will divide section 3 into subsections as suggested.

Comment: Figure 2 - From Panel E, one can see that there should be a data point with a CK/I ratio around 2.0 at about 63_N. This is not visible in Panel B. Check this carefully, as there may be others? - At some sites, there are too many data points for this type of plot. An example: In Panel A, at the Mackenzie delta there are a lot of yellow dots, but they are covering up green ones as well. Either, make inserts for those areas, or make the dots smaller? - Panel E. The regression lines in CK/I and C/I vs latitude do not extend further south than 65N. Correct this or explain why.

Reply: The symbol of the sample having a CK/I of 2.0 in the Yukon River estuary is hidden by another sample in Fig. 2B. We will make an enlarged map for Yukon and Mackenzie River estuary area and put it in either Fig 2 or supplementary material. The regression lines show the trend for the Chukchi Sea. This suffices to show a northward decrease of the ratios north of Bering Strait. The Bering Sea sediments do not show a systematic trend, probably reflecting multiple sources of chlorite, such as the Yukon River, Aleutian Island, etc. We will add according explanations.

Comment: Figure 3. What do the crosses represent? Radiocarbon dates, paleointensity datums? Please specify. Add them all to a table (perhaps supplementary).

Reply: Crosses represent radiocarbon dates in 01-GC and 5JPC and paleointensity datums in 06JPC. We will specify that in the caption and add this information in a table.

Comment: Figure 3. Rather than showing "D" for dolomite rich layers, please show the actual dolomite data. Also, add to the methods how dolomite was quantified (lines 250-260), and add the data to the supplementary tables.

Reply: Dolomite intensity will be shown in Figure 3, and the method will be added to the text. The data will be presented in a supplementary table.

Comment: Figure 3B. Please make it possible to distinguish between samples from the piston core vs trigger core by using different symbols.

Reply: We will show different symbols or colors.

Comment: Figure 4B. Same comment. Around 4000 cal yrs BP, there seem to be two data points for the same age. Is one JPC and one TC? The difference in their C/I values are large. Does this illustrate the uncertainty of the method?

Reply: Both samples were derived from core 5JPC (392 and 398 cm). The difference in the values is larger than the analytical error. We assume that this difference could be related to a high-amplitude fluctuation that was observed at the same stratigraphic level in core 01-GC. We will add an according explanation.

Comment: Page 22 line 515. Correct "brassicasterol".

Reply: This will be corrected.

Comment: Page 23 line 538. Add citation to Jakobsson et al 2017 Climate of the Past (this same special issue).

Reply: Jakobsson et al. (2017) will be cited.

Interactive comment on Clim. Past Discuss., https://doi.org/10.5194/cp-2017-58, 2017.

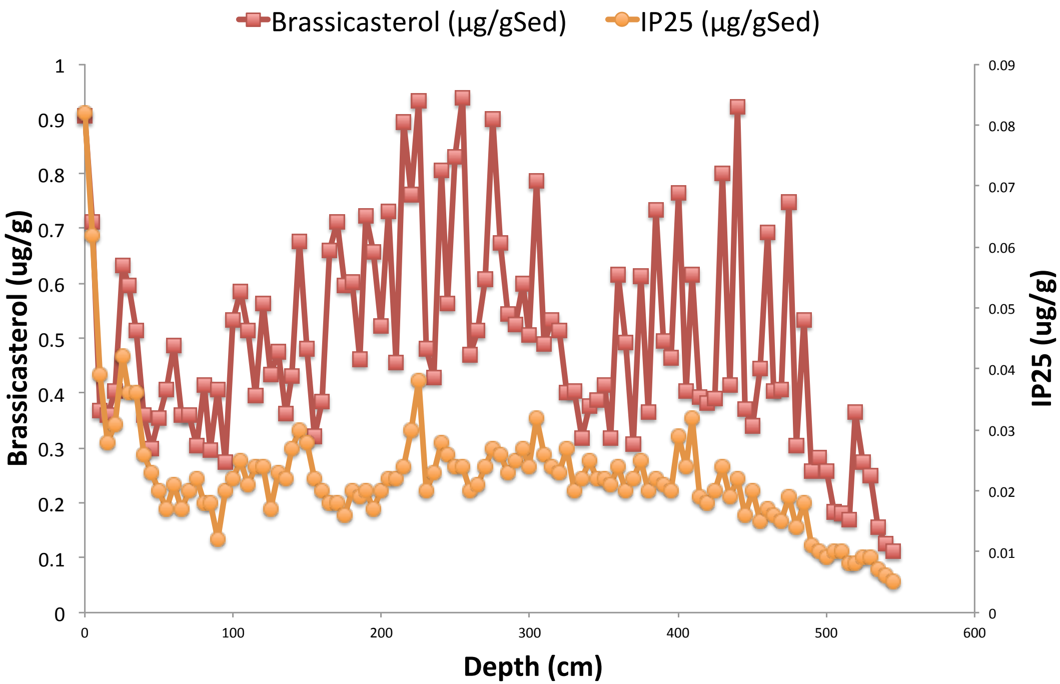

Fig. 1. Concentrations of IP25 and brassicasterol in sediments from core ARA02B 01A-GC (Stein et al., 2017)

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