Clim. Past Discuss.,
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Climate of the Past Discussions

Interactive comment on "Influence of the North Atlantic subpolar gyre circulation on the 4.2 ka BP event" *by* B. Jalali et al.

Anonymous Referee #2

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General comments

In the manuscript "Influence of the North Atlantic subpolar gyre circulation on the 4.2 ka BP event" by B. Jalali et al. reconstruct the behavior of the North Atlantic subpolar gyre during the 4.2 event. The authors present new alkenone reconstructions obtained from two marine sediment cores west of Iceland as well as pollen data from a sediment core the Gulf of Lyon and compare it to a compilation of marine and terrestrial datasets from the North Atlantic region and to a modeling study. This new compilation adds vulnerable information on the 4.2 event and confirm an already postulated concept of a weakening of the STG during the 4.2 event and thereby fits well within the scope of CP. The manuscript is well written, well structured and it is easy to follow the argumentation of the authors. Nevertheless, the report of the scientific methods is partially unprecise.

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Error estimates on the alkenone and pollen records are entirely missing, in the figures as well as in the methods chapter (also see detailed comments). Thus, it is difficult to evaluate of the significance of the presented changes in SST and pollen composition. As the changes in SST during the 4.2 event of 1.5 °C (MD99-2275) barely exceeds the error of the measurement, these definitely need to be addressed. The age models of the two different cores are based on two different methods and use different 14C calibration curves. As the discussion and conclusion of the manuscript severely rely on a robust stratigraphy, age models should be based on the same calibration and age model calculation method. For the latter I suggest to use a Bayesian age model approach, as already is done for core MD99-2275. Additionally, core KSGC-31 should be better included into the introduction and the method section. An age model description or reference to the age model as well as a short description of the coring position is entirely missing in the method section. Thus, it remains unclear which data is new and which data has already been published by Jalali et al., (2016). Furthermore, references to already published alkenone data of core MD95-2015 (Marchal et al, 2002) and its discussion (e.g. Leduc et al., 2010) are missing.

The results and discussion chapter focus on the spatial extension strength of the SPG during the 4.2 event, including a short discussion on its driving mechanism. The authors describe a cold/warm dipole in the North Atlantic. They argue that this pattern originates from a wintertime atmospheric blocking that is induced by a weak subpolar gyre circulation. The description of the data is very short and oversimplified. Information about observed ranges of change as temperature amplitudes in the 4.2 event and % of AMOC reduction are mostly missing. This makes it difficult to assess the significance of the described changes and thus the reliability of the entire discussion. Regardless the uncertainty, the description of this circulation pattern matches with the dataset, yet seasonality of the different proxy records should be considered, as already pointed out by Eduardo Moreno-Chamarro. High solar activity and absence of major volcanic activity is assumed to be the driver of the observed climate patterns. Here the authors highly rely on the cited modeling studies. The connection between solar activity

and changes in the atmospheric circulation need to be better explained to the reader. Furthermore, the influence of volcanic activity is only mentioned in the conclusion.

I suggest to partially rewrite the abstract, methods and results and discussion chapters under consideration of the points mentioned above as well as the specific comments.

Specific comments

Please include core KSGC-31 into the introduction and add the missing information to the age methods section.

Introduction Line 55ff. Please include a reconstructed change in the position of the Subtropical Gyre and the westerly wind belt, at the onset of the 4.2 event (Repschläger et al. 2017). The North Atlantic oscillation (NAO) severely influences the modern climate variability in the North Atlantic region. Though NAO typically is changing on interannual time scales which is not preserved in the presented datasets, previous research also refers to more NAO+ and NAO- like phases during the Holocene with a relative NAO- mode during the 4.2 event (Wassenburg et al., 2016). The relation of these modes to the strength of the SPG might add an important point to the discussion.

Methods section Line 80-90: Please add the core position and age model of core KSGC-31 to the description.

Line 97: At the latitude of the coring positions (58 and 66°N), a contribution of the 37:4 component on the alkenones is likely. Thus, the assumption that the proportion of the 37:4 component is neglectable and can be excluded from the temperature calibrations might be violated. Therefore, the use of the Uk'37 index might lead to an overestimation of the reconstructed temperatures. This becomes evident, when comparing the modern SST of 5°C (annual mean temperature) to 8°C (august SST) at the position of core MD99-2275 with core reconstructed top data that indicate temperatures of 9.5°C. I suggest to provide information on the percentage of the 37:4 component and discuss the potential use of the Uk37 index. A comparison of the core top data with the modern

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hydrography under consideration of the blooming season of the coccolithophores could help on this discussion. This discussion also can partially be put in the supplementary information.

Line 98: Please state how the data of core MD95-2015 relate to the published record in Marchal et al., (2002).

Line 202 to 205 Changes of 1°C at 4100 and 4300 hardly exceeds error of measurement.

Line 221 to 249 Add Wassenburg et al., 2016 to discussion.

259 to 260 Though solar activity was discussed in the manuscript, volcanic activities are so far not included into the manuscript.

Technical corrections

Line 14/15: Add resolution of records (e.g. years/centennial scale)

Line 73: “unprecedented high-resolution” Please add resolution of records (e.g. years/centennial scale).

Line 104 to 108: Please revise, parts of the information seem to be duplicated

Line 110: “Populus, Salix... In marine” replace "..."

Line 111ff: Please be more precise about the use of the different Pollen as environmental indicators.

Line 120-121: Please add a more details to the SST data description including SST values in °C.

Line 124 Replace “several” by number of cores and refer to figure 1.

Line 138: “Similar temperature pattern” not clear similar or the same pattern please rephrase sentence.

Line 137-138: “As earlier stressed....” here the reference in you text is not clear, maybe replace by “As emphasized in the introduction”

Line 208: “Pollen data at this site also indicate. . .” Please replace at this site by site number.

Figure 1 Line 528/29 “marine core KSGC-31 (Jalali et al., 2016; this study)” please provide additional information about the core throughout the manuscript

Figure 2 add error bars Line 539 “1σ uncertainty for the 14C dates” Do you mean calibrated 14C ages?

References

Marchal, O., et al., 2002. Apparent long-term cooling of the sea surface in the northeast Atlantic and Mediterranean during the Holocene. Quaternary Science Reviews 21, 455–483 Repschläger, J., D. Garbe-Schönberg, M. Weinelt, and R. Schneider (2017), Holocene evolution of the North Atlantic subsurface transport, Clim. Past, 13(4), 333-344. Wassenburg, J. A., et al. (2016), Reorganization of the North Atlantic Oscillation during early Holocene deglaciation, Nature Geosci, 9(8), 602-605.

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