

Interactive comment on “Multi-decadal to-century NAO-like marine climate oscillations across the Denmark Strait ($\sim 66^\circ$ N) over the last 2000 cal yr BP” by J. T. Andrews and A. E. Jennings

Anonymous Referee #1

Received and published: 2 September 2013

No doubt, the manuscript deals with a very interesting topic: variations of the NAO system during the last 2000 years. High-resolution marine records of climatic changes in the Denmark Strait area are compared with published NAO, AMOC and arctic summer temperature data. The authors base their reconstruction on marine sediment cores from areas West and East of the Denmark Strait. The study sites are strategically well placed. They record past property changes of the different surface water masses influencing the study area. This site placement is adequate for a reconstruction of past changes in the NAO system. The inferences of this study could be more than of local

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interest. Thus, the manuscript is potentially suitable for publication in *Climate of the Past*. However, the manuscript needs a major revision, a substantial re-writing before publication.

The authors aim to study “Multi-decadal to century NAO-like marine climatic oscillations . . .”. Hence, their reconstructions need to be supported by robust high-resolution chronological control. However, this is the major weakness of the manuscript and the authors basically acknowledge this problem in the “Cores, chronology, and methods” and in the “Conclusion” sections. Clearly, the authors seem to have high-resolution, high-quality cores but the chronological control of many of them is not adequate with regard to the aims and focus of the manuscript. I suggest that the presentation of the sediment data versus age should be limited to sites where a high-quality chronology is available. Thus, for example, presentation/discussion of data from cores BS1191-K7 and K8 against age is not suitable based on the age model presented. The data from poorly dated cores should be presented versus depth - perhaps include the depth positions of the few AMS14C dates available. Alternatively, the authors should discuss millennial time scale changes only. Age model uncertainties surely account for some of the record discrepancies obvious from e.g. Figures 6 and 9.

In general, the approach for the establishment of the core chronologies is not entirely clear to me. Why do the authors reject AMS14C based chronologies in certain cases (e.g. from Alonso-Garcia in press) but use those in this manuscript? Table 2 should indicate which radiocarbon and Pb / Cs dates are available from which cores (provide reference when published elsewhere). Which cores have been dated using radionuclides? Have the authors taken any AMS 14C shell dates from sections of cores overlapping with the Pb/Cs dated time interval? This could help refining the chronology as Pb/Cs profiles also have their “problems”. What is the author’s proof of an intact sediment surface at the various sites? This proof is needed when discussing results at multi-decadal scale. The authors do not present error bars which might be useful e.g. in Figure 11C.

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The authors discuss their results in a wider context using the cold events from Waner et al. and Kaufman's summer temperature estimates etc. I notice an important difference between Kaufman's and the authors calcite/quartz/IRD etc. data: the appearance and the amplitude of the signal of the last 100 years (MoWP warming) in the context of the longer term, 2000 years, perspective (e.g. Fig. 10). The authors could address this discrepancy in the paper.

The data presentation must be improved in line with the discussion, and the number of figures reduced. The climatically interesting MoWP, LIA, MCA, DA, RWP periods could be either marked in all figures or only in the summarizing 1-2 key figures. Perhaps include the Kaufman temperature and AMOC records in the present Figure 12, and mark those climatic episodes. This would make the summary figure or figures (perhaps one figure showing last 2000 years and one presenting the last 800 years or so) more informative and would surely trigger some very interesting discussion on the linkages between these records in the main text. Alternatively, the authors should discuss their records in terms of NAO only (e.g. calcite is discussed in relation to climate episodes but not to NAO). In any case, there is some streamlining needed. At the moment the authors jump between the time spans presented making it difficult to follow the arguments.

Suggestions re Figure presentation: 1) Merge Figures 1 and 2 in a way that a reader can see which sites are influenced by which water masses; 2) Figure 4 caption: "weight 3) Figure 5: It is not clear to me which data set is presented from BS1191-K14 and which from JM96-1210GGC. Are there any data shown from K14? If not, delete the radiocarbon dates in Table 2; 4) Figure 9: I guess that this figure is supposed to display the spatial differences. If so, I suggest to use only ONE representative record from the respective area. Label this curve e.g. "NW-Iceland" instead of using core labels. Use one diagram for one parameter, thus present the different core data versus the same x- and y-axis. Focus on the different baseline level in this figure as record details e.g. for core 2322 are shown in Figures 8 and 11-12 anyway; 5) Figure 10-12 could be merged

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(as suggested above)

The authors raised the question as to whether there are any significant periodicities in either the 19B/2322 calcite or quartz data. Why do they present an answer only for a site from West of Denmark Strait? The manuscript's title mentions "... across the Denmark Strait...!"

The authors mention the "NAO paradox", what are their conclusions in this regard? In general, the Conclusion section is a bit weak. I miss a clear take home message. The last paragraph actually leaves the reader with an impression that none of the core results presented are based on a solid age control – rephrase as this is surely not the case.

Minor issues: Please check the references. There are quite a few mentioned in the main text body which are not listed under "references".

Explain "Storis" under point 2 "The oceanographic ...".

Interactive comment on Clim. Past Discuss., 9, 3871, 2013.

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