

## ***Interactive comment on “Is there evidence for a 4.2 ka BP event in the northern North Atlantic region?” by Raymond Bradley and Jostein Bakke***

### **Anonymous Referee #1**

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### Summary and major suggestions

This manuscript addresses an important and interesting central question – whether there is evidence for a prominent “4.2 ka event” in paleoceanographic and terrestrial paleoclimate records from the northern North Atlantic regions directly affected by the North Atlantic Current and East Greenland Current (excluding Iceland, which is covered in a parallel submission by other authors). This paper can make a valuable contribution, but it will benefit from some major additions:

1. It should be made clear exactly what records are considered in this study, and (if they are a subset of published records) why these records were chosen. For example, section 2 begins with “we consider a transect of sediment cores,” but what sediment cores are referred to here, and why are these cores in particular singled out? Is the

“transect” a list of all available records the authors could find from the region? Or a subset of published records selected for some specific reason?

Choice of sites used in all parts of this study should be clearly explained (and justified if the study is assessing a subset of published records), preferably (for clarity) in a short “Methods” section (which is currently lacking from the paper).

Site locations should be added to Figure 1. Optionally, a table listing all sites, locations, proxies, and original publications would be useful.

2. In my opinion, all of the datasets described here should be shown in the paper’s figures. (As an example, Fig. 4 is a nice way to visualize a large number of glacier reconstructions; although it is unclear whether that figure is updated with records obtained since 2009.)

It would also be useful to include a statistical summary/ analysis of the data, as an objective test for a 4.2 ka event.

Very few of the data used to support the paper’s main conclusion are shown, and there is no particular methodology of site selection or analysis described. Thus, with the information provided, it is impossible for readers to evaluate or appreciate the evidence. I personally trust the authors’ expert knowledge of records from the region – but that alone is not a strong enough basis for their conclusions to be published in COP.

3. The goal of this study is to assess whether a 4.2 ka event is a coherent feature of Holocene climate in the study region. Yet most of the text actually summarizes multi-millennial climate trends through the Holocene, and only relatively short sections of text discuss/evaluate evidence for 4.2 ka events in various regions. In the first part of section 2, for example, lines 55-84 summarize multi-millennial Holocene trends, then lines 85-94 assess higher-frequency events and conclude there is no 4.2 ka event. Same for lines 96-118 (which review multi-millennial trends) vs. lines 119-124 (which evaluate evidence for/against a 4.2 ka event). Given the goal of this study, I would

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expect to see relatively more extensive discussion of high-frequency events, and the evidence for/against a prominent, coherent 4.2 ka event. If statistical analyses are added as suggested above, that will help flesh out the discussion.

#### Minor comments

What convention is used to subdivide early from middle from late Holocene? e.g., the Abstract refers to the period 8-6 ka BP as part of the early Holocene, though in many subdivisions this would be considered part of the middle Holocene.

Depending on the desired geographic scope of this analysis, additional terrestrial records that could be included from east Greenland include Levy et al 2013 QSR (Bregne ice cap) and Lowell et al. 2013 QSR (Istorvet ice cap). Neither is ideal to capture subtle climate changes ~4.2 ka, but these records may help make the authors' point about idiosyncratic glaciation thresholds for individual glaciers/catchments.

Line 19: It appears this paper is to be part of a special issue focused on the 4.2 ka event, so I understand why there is not an introduction to the broader (global/hemispheric) significance/question of the 4.2 ka event. Nonetheless, it would be helpful for future readers (who may read this paper on its own) if the Introduction began with at least a couple of sentences of background on the 4.2 ka event more broadly, rather than beginning by discussing Bond events, to clarify why testing for climate shifts at 4.2 ka (vs. shifts correlating with other Bond events) is of particular interest.

Line 37: The Geirsdottir review of Icelandic records appears to be published (or nearly). These findings from Iceland seem highly relevant to the current study and should be briefly summarized and discussed somewhere (Section 3.3?).

Line 75: "in all cases" SST cooling specifically? Meaning all published studies? Or cores in Fig. 2?

163: Omit extra comma after "at"

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Line 181: Why compare the coldest and warmest 20-year periods of the Vinther record, rather than stick to describing millennial-scale changes? Comparing the warmest and coldest millennia would seem more consistent with the rest of the discussion of multi-millennial scale changes. As currently written (e.g. followed immediately by the phrase “Superimposed on the long-term temperature decline. . .”) 4.9 C comes across as an estimate of the long-term, multi-millennial temperature change inferred from the Vinther reconstruction (for which it would be a major overestimate).

Line 249: The concluding sentence states that “Although a few records do show a distinct anomaly around 4.2 ka BP (associated with a glacial advance) . . . we interpret it as a local signal of overall climatic deterioration that characterized the late Holocene.” Is this consistently the onset of (subsequently more-or-less continuous) glaciation, as opposed to a transient, short-term glacial advance? If the former, which is what I gather from the previous discussion, then stating that more clearly here would strengthen this final assertion of the paper.

Fig 1. Locations of study sites mentioned in the text should be shown in this figure.

Fig. 2. Why are data plotted only from these sites?

Fig 3. It would be useful to see Kobashi et al. 2017 also plotted, given the different sub-millennial variability in that record.

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