

Clim. Past Discuss., referee comment RC1  
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## Comment on cp-2021-103

Anonymous Referee #1

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Referee comment on "Abrupt climate changes and the astronomical theory: are they related?" by Denis-Didier Rousseau et al., Clim. Past Discuss.,  
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In this manuscript, Rousseau and colleagues present a small review of millennial scale variability in the North Atlantic, with a particular focus on DO events. They use recurrence plots to determine the main transition times in the past 3 million years, and also to link millennial scale variability in the last glacial period to Bond cycles.

The review section is unexpected in CP, but could make sense as a contribution for this special issue. I have no major comments on that section and will leave this to the editor. On the research side, the use of recurrence plots to identify specific transition is an interesting approach. The advances presented are not very substantial when compared to standard CP papers; in my second major comment I suggest some aspect that could be fleshed out a bit. My main problem with this manuscript is the seemingly arbitrary way in which the transitions in the recurrence plots are determined (see major comment below). I wonder if the results are robust against small changes in parameter selection. I would like to see a sensitivity analysis before I recommend publication of this manuscript.

### Major comments:

- The choice of transition in the recurrence plots is not explained or justified. In line 166 and 167, the authors refer to Eckmann et al., 1987 and Marwan et al., 2013 to determine "sufficiently close". That is not acceptable, as a publication should include all necessary information to replicate the results. The authors should explain in detail what choices they made to produce the red lines in the recurrence plots. An emblematic example of this problem is Figure 4. Looking at the recurrence plot in figure 4b I see no justification for the line at 32 kaBP, it seems very arbitrary. The same goes for the line at 78 kaBP; between 70 and 78 kaBP there seem to be three more transitions that could reasonably have been drawn. The question arises about the sensitivity of the results to small variations in the parameters of the algorithm chosen to identify

transitions. An uncertainty/sensitivity analysis needs to be added for each RP.

- The sentence in line 305 is unclear. Are the authors defining new GIs based on the recurrence plot? If so how are they defined? If instead they are talking about the GI numbers in Figure 4a, which ones do they mean? There are several numbers in each interval defined by the red lines. I think the authors may have missed an opportunity to make a clear contribution here. This paragraph is the only one of the chapter that appears to be more than a review, and the relationship between GI duration and sea-level is very interesting. A scatter plot of sea-level (or sea-level trend) vs. GI duration would make their point much clearer and add a bit more results to this chapter.

### **Minor comments:**

Lines 12-13: "relatively" used twice in one sentence

Line 16: "constant" is the wrong word here since these are periodic variations. Maybe "regular"?

Line 98: It is unclear what "those" stands for in the second part of the sentence. I imagine it must refer to the shorter periodicities mentioned in the first part? Please clarify.

Line 99: I'm not sure "affected" is the right word here. Maybe something like "the frequency of abrupt changes is in part modulated by..."

Line 131-132: As I understand this sentence, it now says that during the late Pliocene the ice sheets over Greenland and Scandinavia were larger than during the Quaternary. That is not the message of the Naafs et al. 2013 paper. Please clarify.

Line 141-143: Yes, but Barker's record starts at 800 kaBP without any information about the occurrence of millennial scale variability before that. I think it is important to make clear that we don't know if millennial-scale variability (i.e. DO events) started during the MPR or not.

Line 154-155: This sentence is too vague, as ice sheet extent was very large also during MIS6 and LGM. It also doesn't convey much important information. I suggest rephrasing it or deleting it.

Line 184: I think it would be helpful to explain in one or two sentences what a “drift topology” is here, with deeper insights being referred to Marwan et al.

Line 186: Please refer to Figure 2a at the end of this sentence already.

Line 196-197: This sentence seems unnecessarily complicated. I suggest “Our analysis further identifies the steps at 0.9 Ma, 1.25 Ma, and 2.75 Ma (with 1.25 step also noticed in the  $\delta^{18}O$ ).”

Line 204: The sea-level change increased since the value of the change is not higher

Lines 208-211: That is only true for the glacial maxima. The glacials themselves have all kind of different orbital configurations due to their long duration.

Line 221: You could reference Figure 2 here since it’s the same plot.

Lines 224-225: Not every cold period is a Heinrich Event.

Line 261: In the text above, the “canonical” DOs were those described by Dansgaard.

Line 333: “event” is included in HE. Please provide a definition separating HEs from regular IRD events.

Line 350: “prevailed” may not be the best word choice here. How about “existed”?

Line 354-355: It’s not clear what “these results” refers to here. I’m guessing the authors mean the relationship between sea-level and GI duration? Please clarify.

Line 368-373: This mechanism was already posited by Shaffer et al. in 2004 (<https://doi.org/10.1029/2004GL020968>)

Figure 1: In paleoclimatic sciences and in this manuscript as well for most of the figures,

the "Age" scale on the x-axis increases in values towards the right. I would advise the authors to either flip the figure around to make it consistent with the rest of the figures, or to use "time" instead as an x-axis with negative numbers if you want to keep the present on the right side.

Figures 5 and 6: x-axis has again been reversed, please flip the figure around or use "time" with negative numbers.

Table 2: "Last" is already included "LGM".