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Climate of the Past Discussions

Interactive comment on "Regional seesaw between North Atlantic and Nordic Seas during the last glacial abrupt climate events" *by* Mélanie Wary et al.

Anonymous Referee #2

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Wary et al present an interesting compilation of (and new) sea surface temperature, salinity, sea ice cover reconstructions from the Norwegian Sea and northern North Atlantic based on dinocyst analyses for Marine Isotope Stage 3 as well as an ensemble of freshwater hosing experiments run under preindustrial boundary conditions. The paper is well written and data are very well presented and adds to the debate about the stadial/interstadial evolution of the Nordic Seas circulation during the last glacial and its role in the abrupt climate change. However, the paper needs moderate/major revisions before it could be accepted for publication.

1- First of all the authors need to elaborate on how summer SST up to 14 °C in the Norwegian Sea during stadials compare with other previous reconstructions. In this

regard, the following points need further discussion:

- The authors stated 'Furthermore, the few direct but qualitative sea-ice reconstructions based on lipid biomarker analyses (Müller and Stein, 2014; Hoff et al., 2016) yielded contrasting results'. Looking at Figure 4 in Hoff et al 2016, it does not seem that those two studies are at odd. In contrary, the sea ice cover records in Müller and Stein, 2014 and Hoff et al., 2016 seem for me to correlate well. I think it is critical to discuss why sea ice cover reconstructions in the southern Norwegian Sea in this study (dinocyst-based) and in Hoff et al., 2016 (lipid biomarker- based) significantly differ. I suggest you plot IP25, brassicasterol- and dinosterol concentration (not the PBIP25 and PDIP25 indexes) with your dinocyst-based data and see if you can reconcile between them or at least make the apparent disagreement between the two results clear, so future investigations may take it further.

- The authors may need to explain why the %subpolar planktic foraminifera (e.g., T. quinqueloba and G. bulloides) did not increase during stadials if summer SST was that high in the Norwegian Sea. I think the conditions at the average calcification depth of N. pachyderma may be best recorded in the isotopic and elemental composition of its shells, whereas the % N. pachyderma is also controlled by the abundance of other planktic species. For example, Mg/Ca in N. pachyderma shows different pattern from % N. pachyderma for Heinrich Stadial 1, also in the southern Norwegian Sea (Ezat et al., 2016).

- Notably, the reconstructed summer temperatures during glacial stadials in the southern Norwegian Sea in this study are similar to or even higher than modern temperatures. It is not plausible that we ignore an observation just because it does not fit with what we may expect. However, more discussion needed regards the temperature at the source of these water, were the stadial temperatures at lower latitudes higher than modern? In addition, the inflowing water may have had to mix with more cold polar water than in the modern case in its way to the Nordic seas.

2- It is important to clearly clarify in the methods (in section 2.2) what new data have been generated in this study and what have been used from previous studies. I think most of the dinocyst analyses from cores MD95-2009, MD95-2010 and MD99-2285 are already published, or? I may have just missed the referring to previous studies, so I hope this comment does annoy the authors if that is the case. Related to this, I would suggest removing the word 'Surprisingly' from the following sentence "Surprisingly, the three Norwegian Sea cores record higher SST and shorter SIC durations during the cold North Atlantic GS, and lower SST and longer SIC durations during the warm North Atlantic GI." This is not a surprise as previous dinocyst- based studies have already showed this stadial/interstadial SST pattern in the Norwegian Sea (e.g., Eynaud et al., 2002; Wary et al., 2016).

3- Line 139-144: Weakening of the subpolar gyre has been employed to explain relative warming in the eastern Nordic Seas under interglacial conditions for example during late Eemian (e.g., Born et al., 2011). However, a key difference here (in addition to many others), is the likely significant suppression of deep water formation in the Nordic Seas during MIS3 stadials, which has an impact of the inflowing surface water. So, adding more lines of discussions here is merited.

4- Lines 193–203: I think the discussion that enhanced contribution of moisture from the Norwegian Sea towards Greenland (inferred from SST reconstructions) may played a role in the increase in the deuterium excess recorded in Greenland ice cores during stadials.....has discussed in Wary et al. 2016. If so, please summarize and add Wary et al., 2016 as a reference.

5- Minor issues:

- Please make sure that Müller and Stein, 2014 is included in the reference list.

- Supporting Information (Line 8): the authors may consider the use of shallow subsurface reservoir age estimates from the northern North Atlantic (e.g., Stern and Lisiecki, 2013; Thornalley et al., 2011) and from the Norwegian Sea (Ezat et al., 2016; Thornal-

ley et al., 2015) to correct for past changes in reservoir ages.

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