We thank Moreno-Chamarro for his time and effort to review our manuscript and for his highly helpful comments and encouragement.

Moreno-Chamarro (Referee)

General comments:

Based on two new relatively high resolution SST records from the eastern subpolar gyre and off North Iceland, the authors document and discuss changes in the subpolar gyre between 4400–4100 years BP, this is during the 4.2 ka BP event. The dipole pattern that the authors identified in these SST records, combined with other paleoclimatic records from the North Atlantic and the Euro-Mediterranean regions, leads the author to suggest that those years were characterized by a weak gyre circulation, potentially connected to atmospheric blocked regimes. With these two new available records documenting changes in the oceanic conditions during the 4.2 ka BP event, the authors go a step forward with respect to previous works and discuss changes in the oceanic circulation that could have driven climate changes in the Nordic and Barents seas and the Mediterranean region. I find the paper overall well written and illustrated, as well as insightful, as it applies newly developed ideas for the LIA into the 4.2 ka BP event. The authors also do a very detailed compilation of other available proxies in the region and interpret them in a very reasonable way. I therefore recommend the publication of this manuscript, although I encourage the authors to address the following comments before that:

L44 – Are this changes mostly seen in summer or winter?.

The season recorded depends on the archive and proxy used, Most of those we cite register winter, i.e. the oxygen isotope records of stalagmites from Spannagel and Jeita caves has been attributed to the winter season (e.i. Fohlmeister et al., 2013; Cheng et al., 2015); others do not specify such as Ruan et al., (2016) for the speleothem oxygen isotope records of Gueldaman Cave in North Algeria. However, Zanchetta et al. (2016) highlighted that the dry conditions seen in the speleothem records from Renella Cave in Italy are linked to summer.

In the marine sediments, Jalali et al. (2016) showed that alkenones SSTs in the NW Mediterranean reflect annual mean with a bias towards late winter/early spring the season of production of alkenones in the G. of Lion.

However, as concluded by Magny et al. (2013) or Bini et al. (2019; this issue), the climate deterioration during the 4.2 event shows a highly heterogynous seasonality in the Mediterranean, but contrasting trends between Southern and Northern Mediterranean have been highlithed by Magny et al 2013.

L50 – Evidence (remove s).

Done

L51 – Berkelhammer (capital B).

Done

L55 – North America.

Done

L128 – Add comma between overflow and a. (In general, many commas are lacking throughout the text).

Done

L144 – Regression here is confusing. Weakening would be better.

Done

L143/145 – Moreno-Chamarro et al. [2017] find that the simulated weakening of the gyre during the LIA centuries starts during a solar maximum and a period of relatively high volcanic activity in the late 15th century; however, they do not attribute the weak gyre to such a solar maximum. In fact, a similar simulation with the MPI-ESM model and driven only by changes in the solar forcing [Moreno-Chamarro et al., 2016] is unable to reproduce the climate anomalies that full-forcing simulations show during the LIA. Moffa-Sanchez et al. [2014a] argued, in contrast, that a weakening in solar activity can lead to a weak gyre via persistent atmospheric blocking conditions during the past millennium, but this is not supported by simulations with the MPI-ESM model in Moreno-Chamarro et al. [2016; 2017]. I suggest the authors restate their conclusions about the role of the solar forcing. Besides, could they discuss other potential triggers, like volcanism during the LIA?

This part of the discussion has been shortened and summarized (second paragraph of section III.1) by stating that the role of external forcing is still not fully understood. We did not discuss more other triggers for the LIA climate, as our focus here is on the 4.2 event. We instead report on the transient modeling experiments (notably Yan and Liu 2019 this issue and Ning et al. 2019 this issue) that evidence the role of internal variability and insolation.

L154 – A _ is missing.

Done

L166 – You could better cite here other works that have studied the particular dynamics of the SPG [for example, Langehaug et al., 2012; Born et al., 2014].

Added in the revised manuscript.

L168 – Replace “trending” for “trend”.

Done

L168/170 – Replace “are suggestive of” for “suggest”.

Done

L173 – interval “was/is” a long-standing.

Done

L175 – Model results in Moreno-Chamarro et al. [2017] show a weak gyre associated with a salinity decrease in the Labrador Sea, not an increase. This does not exactly agree with the salinity reconstructions shown in Fig. 3g in the manuscript. In fact, colder and saltier ocean surface conditions in the Labrador Sea would lead to an increase in density that would, in turn, reinforce the oceanic deep mixing and eventually the SPG strength [e.g., Born et al., 2014]. I suggest few potential reasons: the first one is that the model does not correctly capture the pattern of changes in temperature and salinity in the Labrador Sea for a weak SPG; however, Moffa-Sanchez et al [2014b] find colder/fresher surface conditions in the Labrador Sea associated with a weak SPG during the LIA, in agreement with Moreno-Chamarro et al. [2017]'s results. Second, the fingerprint of SPG changes on the temperature and salinity in the Labrador Sea might have changed over the past 4000 years, although this might need to be proved. Finally, the proxy might not be fully reliable: this particular reconstructions has particularly low temporal resolution and presents a period of high salinity between 3600 and 2600 yr BP that does not differ much from values during the 4.2 ka BP event. I encourage the authors to discuss these results in the revised manuscript.

It is indeed possible that the model does not capture the Labrador Sea surface properties. (Barrier et al. PO 2015). Moffa-Sanchez et al [2014b] in fact report colder surface waters in the Labrador Sea associated with a weak SPG during the LIA. Indeed, they show that their d18O is correlated with temperature rather than salinity. They do not show any salinity or sea ice proxy data. Instead they refer to Massé et al. (2008) and Sha et al. (2016) (off North Iceland, MD99-2275) to suggest that the LIA experienced more sea ice that could account for the freshening of Labrador Sea through the EGC. So evidence for its strong freshening is not supported by their data although this is likely. We conclude on this issue that the LIA forcing and the role of sea ice might have been likely different from those of the 4.2 event. We now refer to modeling experiments now published in this special issue (Yan and Liu, 2019; Ning et al., 2019). These studies suggest a prevailing role of internal variability and insolation. Interestingly enough they stress the double-peak structure detected in these transient simulations that share resemblance with the proxy data (also seen in Klus et al., 2017; Holocene transient simulation with insolation only).

Note that the salinity decrease actually started 5300 year ago, even though it is a low-resolution record this trend is consistent with other data from Denmark Strait also mentioned in the discussion (Andresen et al., 2012) suggesting lower sea ice conditions and weaker influence of the EGC, as compared to the LIA.

L185 – Nordic "and" Barents seas.

Done

L201/205 – Split into two sentences.

Done

L205 – "in this area", which one?.

Gulf of Lion. We added it in the revised version

L207 – Are these changes mostly in summer? Winter? Year mean?.

As demonstrated by Sicre et al. (2016), the SST signal in the GoL reflects primarily annual mean SSTs as a result of convection induced by the Mistral winds blowing all year round but more strongly during winter. Alkenones SSTs are here biased to late winter/early spring (see Sicre et al., 2016).

Paragraph starting in L208: I suggest the authors discuss the seasonality of these pollen records. The increase in atmospheric blockings in the models is mostly in winter, and the associated precipitation anomalies were not discussed. I would like to see whether the reconstructed changes in precipitation in are expected mostly in winter or summer.

We now use different pollen taxa that allow discussing trend only. It remains difficult to discuss seasonality as the climate quantification (Temperature, Precipitation) have not been performed on the results.

L216 – (“>”750 mm).

Done

L218 – Add an “a” before “Mediterranean precipitation regime”.

Done

L222 – Add an “a” before “different picture”. Also, different with respect to what exactly?.

Done. This sentence means that precipitation does not change homogenously at the three sites during the 4.2 ka event. It has been reformulated.

L233 – Replace “share resemblance with” for “resemble”.

Done

L241 – “under sustained solar activity”. See my comment above about the connection between a weak gyre and the solar variability.

This has been changed in the revised version (see answer above) - the role of solar/volcanism during the LIA is unclear.

L255 – characterizes.

Done

L256 and 257 – Replace “subpolar gyre” for “SPG”.

Done

L259 – Here the high solar activity is again discussed.

This is now revised; See above