I thank the authors for considering my previous comments. While I find the results of this manuscript very interesting, I believe the authors ought to further improve the description and explanation of their results. For example, while NA-SST stands for North Atlantic sea surface temperatures, the authors defined the variable called "SST index" as a diagnostic of the SST variability over the North Atlantic region, which includes the anomalization and detrending of subtracted SSTs over two defined regions. Yet, in the discussion of the results, the authors frequently use simply "SST" or "NA-SST" while implying SST index (by the way, in the text of the manuscript it is SST index, while in Figures it is SST_index). The same issue persists for SLP and SLP index. I would highly appreciate it if the authors revised this issue. Maybe it is worth revising the naming of the variables used for the causal graphs as listed in Table 1? Perhaps there is no need to define an additional SST index and instead define NA-SST as the anomalized detrended monthly data of subtracted SSTs over two defined regions?

Further issues.

Abstract.

L2. The authors state that the analysis is done for 1908-2008. The next sentence in **L2-3** starts with "We find …" → this gives the impression that the results are related to the entire period. While in **L6-7** the authors clarify that this result is representative only for the 51-year period from 1958 to 2008. I recommend simplifying the sentence, e.g. "We find that in ERA-20C reanalysis the causal link from … to.. was evident/robust for the period 1958-2008 with an estimated causal effect expressed by … However, this causal connection was not evident/detected from the analysis of the entire period".

L4. In my opinion, **L4** reads very hard for an introduction; the reader is introduced to the NA-SST term, which further develops into the SST index. If the authors decide to keep both definitions, maybe the following makes it more clear: "NA-SST gradient in spring (expressed by SST index)…."

L6. "only evident during the **late** period from 1958 to 2008".

L7. How did the authors come up to a 45-year-long period? Why not randomly sampled 51 year-long period (like 1958-2008) to intercompare the strength of specific causal links based on timeseries of identical length?

L11-15. It is not clear which period of time the authors are talking about: full period (1908-2008) or a 51-year period (1958-2008)? Or all simulations have different analyzed period?

L15. Do authors mean "SST index"? Same in **L16**.

Introduction

L28-30. I recommend that this sentence is moved to ~L58, in order to keep the continuity of the introduction.

L70: The sentence in **L58** starts in a similar way. I recommend to unite the sentences from L28, L58 and L70 into one paragraph.

Section 2.1.

It is not clear from the text what the analysed periods for different MPI-ESM-MR simulations are (pre-industrial, historical, MR-30).

Section 2.2.

L118. by subtracting the average NA-SSTs or NA-SST anomalies?

L120. Isnt it the same as in L 106-107?

L125. Is it really just a second step? The first step was in **L111** to define a reference EA index. Then SST index seems to be ignored, and no "step" was given for it. And the second step is the analysis of the impact of NA-SST on temperature.

L131. I recommend the authors to be cautious here: NA-SST is not the index/variable as well as SLP. According to the authors notation SLP stands for the general definition of the sea level pressure, while SLP_ind represents the analysed variable. Therefore, the use of NA-SST definition here might also be also confusing.

 Section 2.3.

L136. This part of the sentence could also perfectly fit to Abstract or Introduction.

L140. A note for the authors: they are partial correlations if the user chose partial correlation (ParCorr) as conditional independence test. I recommend to reformulate the sentence as follows: "This method/algorithm is based on iterative conditional independence testing among …"

L168. From the description it is not clear why did authors choose "parcorr"?

Section 2.4.

L172. Why is it necessary to exclude 6 random years from each iteration?

Side note: Tigramite has also the methodology for the bootstrap aggregation, see tutorial here https://github.com/jakobrunge/tigramite/blob/master/tutorials/causal_discovery/tigramite_tutorial _bootstrap_aggregation.ipynb

Section 3.1

L191. Large-scale cyclonic conditions where?

Section 3.2

L195-196. There is already the statement in Sect. 2.2 L117-118. Instead I suggest the following: "As explained in Sect.2.2, spring extratropical North Atlantic SSTs are represented via SST index, following the methodology of Osso et al.."

L203 NA-SST or SST index? Here and below the authors use NA-SST. It is important to differentiate…

L206-207 Repetition from L105-107.

L207 "Correlation maps in Fig.2a-f"

L208 summer SLP **index**?

L213. If there is further interesting material, it could be added to the Supplements.

L214. NA-SST anomalies or SST index?

L217 Typo? No need of full stop.

L219 Figure 2d-f depicts significant correlation between the AM SST….

Given the order of the explanation, I would move panels d-f after regression maps (and regression maps move up as panels d-f).

L224-224. The definition of the $T2m_{CE}$ is already provided in Section2.2 L126, however the coordinates of central Europe slightly differ. Please, correct this.

L230. Is it correct to state here "spring extratropical SST" or rather "SST index"?

L233. '… in ERA-20C , as defined is Sect. 2.1?2.2?' Please, make sure that methodology section clearly states the periods that were analysed by different simulations and includes the definition of "early" and "late" periods.

L237. Please, stay consistent: $T2m_{CE}$ (as in the text) or T2m_CE as in causal graph (Fig. 3a, Table 1)

L239-240. Shouldn't this information be stated in Sect. 2.3 instead of Results section?

Fig 3. Is there a typo in panel (b) with node "EAP"? It would be very useful if the authors would plot the nodes in panels (a) and (b) at the same position (implying that EA, SST_ind, and SLP_ind are plotted at the same position on both panels). This is easily done in Tigramite in plot_graph function using keyword **node_pos.**

Caption Fig 3. Circle → node? Typo "time tag" → "time lag"

L243. $\beta_{SST \rightarrow EA}$ --> $\beta_{SST\_ind \rightarrow EA}$, same L245, L246, L253, L275.

L246. Can you really expect that the link SST → $T2m_{CE}$ is mediated via EA? It would be a mediator if the authors observe the link EA → $T2m_{CE}$. Contrary, there is no causal link from EA to $T2m_{CE}$, so how does EA mediate it?

L248. From the manuscript it follows that in order to avoid non-stationarity, the authors split the analysis to early and late periods. Yet in this sentence, the authors claim that since the full timeseries is nonstationary, they do not find a significant causal link in early period. It is not clear why they then found significant links in the late period.

L250. SLP index? Also in L256.

L261. Remove redundant full stop.

L262. How did authors find it out? Higher correlations?

L263-264. Do authors refer to just historical simulations?

Figure 5. There is no panels *g, h, i* as explained in the caption.

L272. From the text/Methodology it is not clear if pi-control, historical, and MR-30 are the same length as analysed ERA-20C data. Are the EA phases in agreement between the model and ERA-20C? If not, that all could contribute to the reasons why the direction of the link is different in comparison to the reanalysis.

Section 3.5

L313. I believe it should be β_{SST_ind} as well as in the caption of Fig.7 and L321, L322.

L319. This already explained in Sect 2.2. I recommend avoid duplication and rather refer the reader to Sect.2.2.

L321. ".. that are able to reproduce …"?

Conclusions.

L377. 1902→ 1908?

L387. "..detected in ERA-20C during the late period".