Referee 1

Our responses to your comments are marked in *italic* below.

The manuscript "Atmospheric teleconnections between the Arctic and the Baltic Sea region as simulated by CESM1-LE" by Jakobson and Jakobson examines North Atlantic sea ice teleconnections to the Baltic Sea through the large-scale atmospheric pathways described by the Arctic Oscillation, North Atlantic Oscillation, and Barents Oscillation. The authors examine stationary (pre-industrial) versus modern climate forcing (RCP8.5 scenario) in their model simulations in an attempt to understanding natural versus anthropogenic forcing on these Arctic-Baltic physical connections.

Key findings are that Svalbard and Greenland Sea regions two-meter air temperature and surface pressure exhibit the strongest correlative relationships with the Baltic region climate, namely in winter due to stronger forcing by the modes of variability (NAO and AO) relative to the summer season. Under continued climate change from greenhouse gas emissions, the authors note that the end-of-century projections suggest these Arctic-Baltic relationships will remain rather consistent through time despite continued Arctic warming and sea ice loss.

The topic of Arctic change linkages with northern European climate is one that continues to receive much attention. That said, the authors could do a better job of **reviewing this work to date**, and bringing attention to what value is **added by their new analysis and modeling approach.** The methods, especially the ridge regression approach, could be more clearly defined and the results could be much more clearly stated. Moreover, the paper is difficult to follow due to **numerous grammatical errors and redundancies in uncommon acronyms**. The paper may benefit from English editing services. Several remarks along these lines are made by manuscript line number (L) in the comments that follow.

Major comments:

L105: Are the correlative results sensitive to changes in the Baltic and Arctic marginal seas domains? Did you test for this? Why were these geographic areas selected? More details are needed to provide some context for results. Citing previous literature that has used these or similar domains may help in this regard.

Thank you for the comment. We added to the text that these domains were selected from regions where the correlations with TA were stronger, not from previous literature. Initially, we checked that, indeed – when we selected IA at a smaller region from a high correlation area, then the correlation was higher than from the case when we increased the region so that lower correlation areas were also included.

L155: While the correlative approaches are defined in Section 2, the Ridge Regression approach is not clearly described. What does it entail and why is it used? Readers will generally be familiar with correlation techniques, but less so with this specific regression method. It should be described in detail, including with justification for why it was selected

in lieu of a simple parametric test (i.e., linear regression) as are used in the correlation analyses.

The Ridge Regression was selected to mitigate the problem of multicollinearity in linear regression, as supposedly there are strong correlations between different regions' parameters. We added a sentence with a citation to the Ridge Regression: "Ridge regression (Saleh et al., 2019) is a multiple-regression method developed for cases when there is strong correlation between input parameters."

Minor comments and corrections:

L8: Suggest removing "measured and"

The correction has been made.

L15: What is meant by "local factors"? Please be more specific.

We replaced it with "local meteorological factors" (likewise Iguchi et al., 2018; Chen et al., 2017 used the term), which means that the global circulation influence is smaller.

L16: Suggest revise to "NAO and AO climate indices"

The correction has been made.

L48: By "permanent" do you mean "seasonal" or "ephemeral" snow cover? Please clarify.

The article we referenced used "permanent", but you are correct; „seasonal" is more precise.

L53: Suggest substituting "knowing" for "studying" or similar word choice

According to another referee's suggestions, we removed this paragraph.

L75: reanalyzes ◊ reanalyses

We chose the British English variant.

L76: Suggest substituting "search" for "examine" or similar word choice

The correction has been made.

L83: Suggest substituting "completes" for "concludes" or similar word choice

It has been reworded.

L98: Once these climate variables are defined, they do not need to redefined (e.g., L143, L192-193, etc) through the paper. Also, suggest using typical acronyms such as SLP for sea-level pressure and SIC for sea-ice concentration as they will make it easier for readers to follow results.

Corrected. We initially used the same acronyms the CESM model used, but we agree that typical acronyms are easier to follow.

L102: Are the NAO, BO, and AO definitions adopted or adapted from previous studies? If so, the studies should be cited. If not, then some explanation should be used for modifying data and domains used to define these indices.

The definitions are given L102 – L103. „NAO is defined as EOF–1 of seasonal SLP anomalies for 20–80N, 80W–40E, BO as EOF–2 of seasonal SLP anomalies for 30–90N, 90W–90E, and AO as EOF–1 of seasonal geopotential anomalies for 20–90N."

L107: Change "above" to "north of"

The correction has been made.

L126: Change "supposedly not" to "less"

The correction has been made.

L137-138: Please reword this sentence as the second half of it is confusing.

We reworded the sentence: "The climatic variables of separate areas are usually dependent, but the strength of the correlation depends on the distance and concrete variable."

L161: Add "and" before "seasonally"

The correction has been made.

L178: "then 0.82 = 64%" – it is very difficult to follow what is meant here. Are you referencing squared correlations initially then their explained variance? Please clarify.

We reworded the sentence: "As correlation square is the measure of the proportion of variance explained, then ..."

L199: "positive correlation" involving what? More specifics are needed to make results easier to follow.

We reworded the sentence: "Positive correlations between T2m in the TA and SIC in winter (DJF) show simultaneously a remarkable weakening in the North Pole region but significant strengthening in the Davis Strait and Hudson Bay region."

L209: "earlier average month is confusing as worded" – please revise.

We reworded the sentence: "...we studied the connections between earlier months (November for DJF, etc) average values of different parameters ...".

L224: What is meant by "self-consistent"

We agree, the expression is confusing. We reworded the sentence: „The advantage of this study is the length of the stationary 1800-year-long CESM-LE control database"

L225: r=0.046 is a pretty weak threshold for a physical relationship given that a random relationship could arise ~5% of the time. Why mention this threshold?

A random relationship could arise ~5% of the time, which is mostly a quite good rule of thumb for measured climate data and is statistically accurate when the sample size is 78. For our case, the sample size is 1800, and a random relationship could arise only ~0.2% of the time.

L228-231: Should some sort of teleconnection hypothesis be revisited in the introduction then touched upon here? This seems like a strange place to comment that the present study does not confirm the long-proposed linkage between sea ice around Greenland and European climate.

We moved the paragraph to the introduction and added newer references:

Zhuo, W., Yao, Y., Luo, D., Simmonds, I., Huang, F. 2023. The key atmospheric drivers linking regional Arctic amplification with East Asian cold extremes, Atmospheric Research, Volume 283, 2023, 106557, ISSN 0169-8095, https://doi.org/10.1016/j.atmosres.2022.106557.

Deng, K., Yang, S., Ting, M., Lin, A., &Wang, Z. (2018). An intensified mode of variability modulating the summer heatwaves in eastern Europe and Northern China.Geophysical Research Letters,45,11,361–11,369. https://doi.org/10.1029/2018GL079836

L252: This sentence is confusing, please reword.

We reworded the sentence to „Barents Oscillation (BO) is related to natural variability (the variation that humans do not cause) of Arctic surface air temperature (SAT) through meridional flow and zonal wind anomalies (Chen et al. 2013)."

L275: Change to "will significantly decrease"

The correction has been made.

L278: T2m and SLP from what Arctic region are best connected with Baltic climate?

We added, "and the most important Arctic regions are Greenland and Svalbard".