

Interactive comment on “The contributions of the leading modes of the North Pacific sea surface temperature variability to the Arctic sea ice depletion in recent decades” by Lejiang Yu et al.

Lejiang Yu et al.

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Received and published: 8 July 2019

Specific comments I am critical to the arguments presented in the section Mechanisms:
1) Line 173-175: Based on Figs. 8a and 9a it is claimed that “the global warming mode resemble the global warming mode of NAO and AO. I couldn’t see this from the figures, and the lack of connection is also consistent with no general trend in the AO and NAO indices over the last decades. 2) Line 175-178: It is here claimed that an anticyclone in the Bering sea in summer brings warm air into the Arctic causing ice melt. The reader is lead to Fig. 11a for the warming pattern, but I couldn’t find it. Most of the section continues with discussing patterns in the regression plots that are difficult or

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not possible to see. The choice of variables may not be appropriate for studying the physical processes relevant for the coupling between the EOF modes and the Arctic sea ice. Here are two suggestions: i) Temperature anomalies are not appropriate when investigating effect of advection over sea ice in summer, since convergence of energy associated with the advection often goes directly into sea-ice melt rather than warming. More appropriate variables would be the surface energy budget, and water vapour and clouds, where the later two are coupled to the changes of the greenhouse effect over sea ice. Also the greenhouse effect in itself can be estimated, as the difference between outgoing longwave radiation at the top of the atmosphere and the surface. ii) Apply lagged regression with a daily resolution in order to study cause and effect between variables.

Response: Following the suggestion, we have added analyses of the variables that are appropriate for studying physical processes relevant for coupling between the EOF modes and the Arctic sea ice. These variables include surface net solar radiation, downward longwave radiation, and total column water vapor and the results are discussed in a new section (3.2.2.) with three new figures (Figures 12-14). We have also estimated the greenhouse effect based on the difference between outgoing longwave radiation at the top of the atmosphere and the surface, which are significantly correlated with the time coefficients of the warming modes for summer and autumn with the correlation coefficients of -0.35 and -0.60, respectively. The result are shown below (Figures 1s) but not in the manuscript.

Note that PDO variability may not cause sea-ice variability even though the two appear related as shown by the regressions. Another process may cause both warming of the North Pacific and melting of the Arctic sea ice at the same time.

Response: To acknowledge this, we have added a following paragraph to the end of the paper Before ending, a word of caution about the PDO mode is in order here. A statistically significant connection between the PDO mode and the Arctic sea ice variability found in this analysis does not necessarily lead to the conclusion that PDO

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causes the Arctic sea ice loss unless confirmed by modeling studies focusing on the underlying physical mechanisms. It is possible that another process may cause both the warming of the North Pacific and the melting of the Arctic sea ice at the same time.

Small suggestions and typos: Line 25: “The” in front of “Arctic”, move “sea ice” to after “decrease in”. Changed

Line 26-29: This sentence is difficult to read and should be reformulated. Reformulated

Line 48: “decline” -> “declining”. Changed

Line 69: Comma after “forcings”. Added

Line 79-82: This sentence also needs a reformation. Reformed

Line 125: “corrected” -> “correlated”. Changed

Line 135: What are the units of the numbers mentioned in this line? The time series of the first two EOF modes is standardized. There is no unit.

Line 150: “The” in front of “sea ice”, “shows” with “s” Added

Line 153: “sharper” -> “stronger/larger” Changed

Line 156: “into” -> “onto”, and many other places. Changed

Line 160: “also” before “be”. Changed

Fig 7.: The colour scaling is not so well chosen, I suggest to let the scale goes from -1 to 1. Changed

Fig. 8-11: What is the reason why these figures are shown upside down relative to Fig. 7? Figures 4-7 has been modified to be consistent with Figures 8-11 in the geographical location.

Please also note the supplement to this comment:

<https://www.the-cryosphere-discuss.net/tc-2019-38/tc-2019-38-AC1-supplement.zip>

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-38>, 2019.

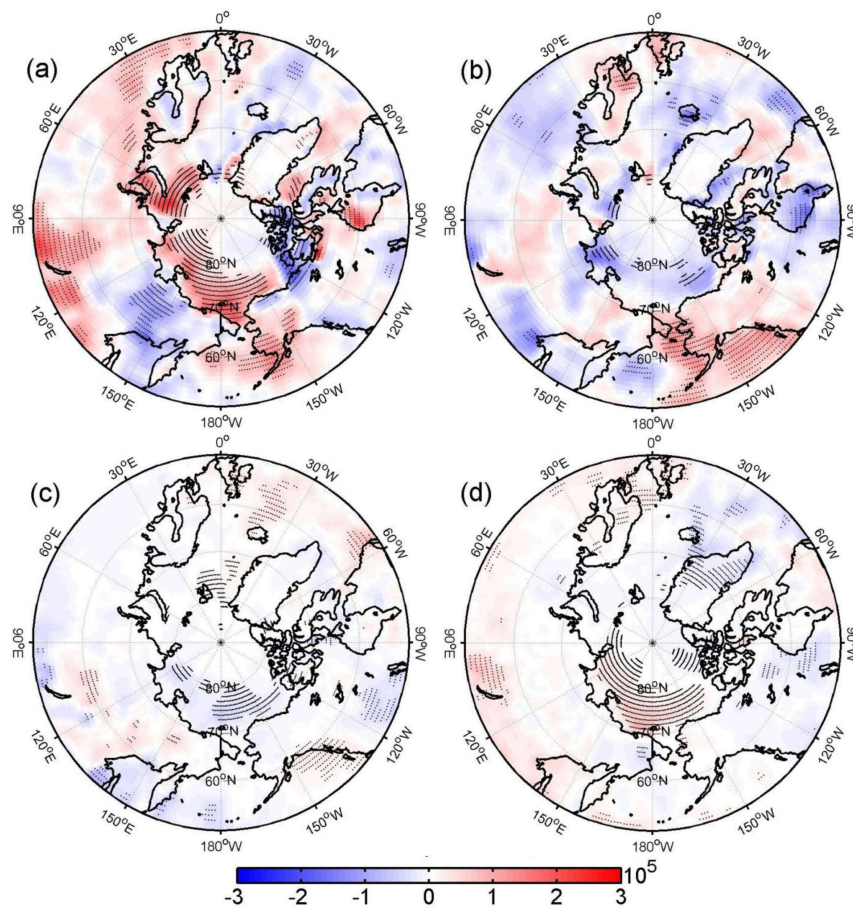
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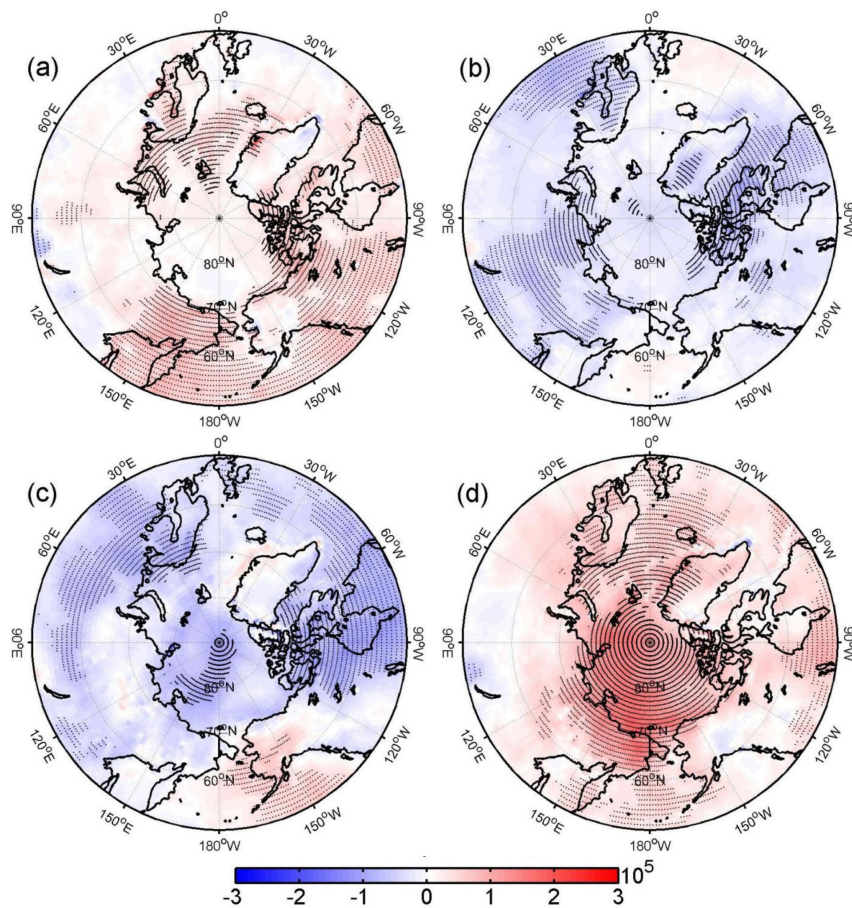
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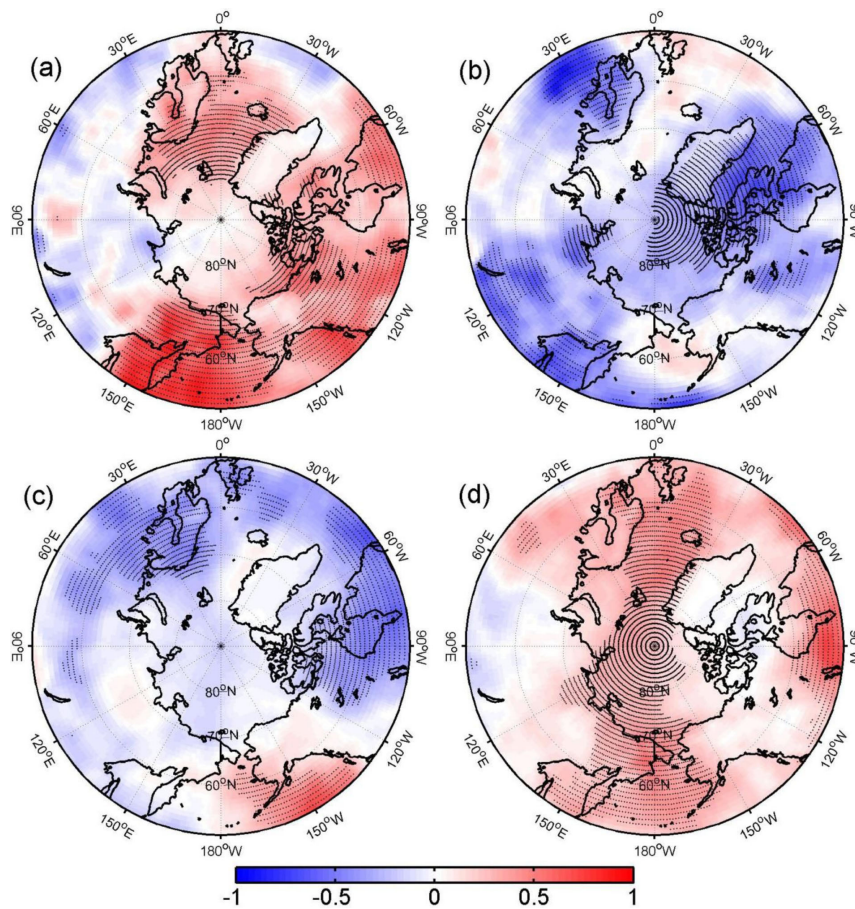
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**Fig. 1.**

**Fig. 2.**

**Fig. 3.**

The difference between domain-averaged outgoing longwave radiation north of 70°N at the top of the atmosphere and the surface for summer (a) and autumn (b)

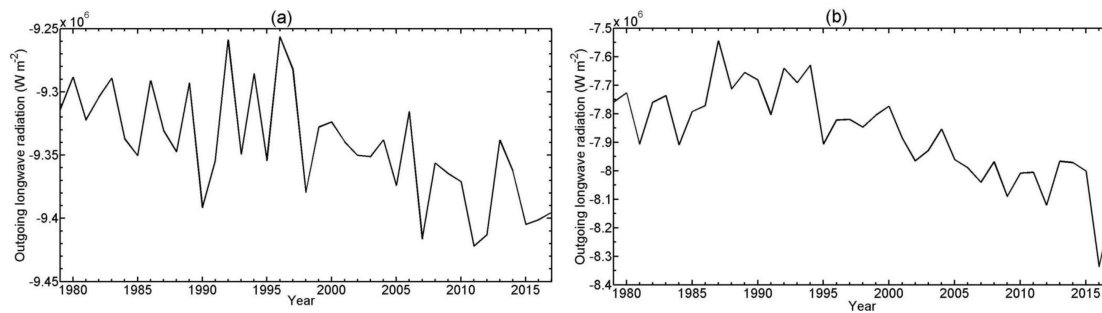


Fig. 4.

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