



Interactive comment on “Where can the Arctic oscillation be reconstructed? Towards a reconstruction of climate modes based on stable teleconnections” by G. Lohmann et al.

Anonymous Referee #1

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General comments

The paper addresses the issue of stable teleconnections that are needed for a reliable reconstruction of the Arctic Oscillation. This is a problem of great importance for the paleo- and recent climate scientific community and certainly lies within the scope of CP. The basic approach of this study is to analyze the spatial distribution of correlations between observed climate variables and an AO index. Regions with significant correlations and no changes of sign in running correlations are considered as stable. A similar approach is then applied to correlations between proxy data/index reconstructions and SSTs. Finally, the information from various stable sites or data sources are combined with the help of an EOF analysis of the respective time series. To the best of my knowledge such a concept has not been used in previous studies. I therefore

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consider the paper as of scientific relevance. There are, however, a number of critical points that have to be addressed. The scientific methods are not always clearly outlined. For example, what is the statistical significance of a 31-yr running correlation time series after the application of an 11-yr running mean? Why should this procedure be conducted in the first place? Why are all the proxies only correlated with SST and not with other climate variables? Is there a way to quantify the agreement between an AO index-SST and a proxy-SST correlation? This is only done qualitatively in this study. Consequently some of the results are not as convincing as they could be. This criticism is further elaborated in the specific comments below. Moreover, the title seems fairly long and contains the words “reconstructed” and “reconstruction”. Maybe a more concise title could be found. The abstract is very short and does not really provide a sufficiently clear summary of the method to determine stable teleconnections (see specific comments). The overall structure of the paper is not always logical and adequate, the presentation is not always clear, and the language could be improved (see specific and technical corrections). I think the number of figures could be reduced substantially by combining the spatial distribution of the correlations with the “change of sign” analysis (see specific comments). In conclusion, a major revision of the manuscript is needed before full acceptance.

Specific comments

1) Abstract: The abstract is too short and does not provide all necessary information. Describe the problem addressed, the method, and the main results and conclusions. Maybe you could use parts of the General comments as a suggestion for improvement. Sentences 2-4 contain some redundancies; sentences 2 and 4 even start with the same words.

2) P18, line 19: To which phase of the AO do the “milder winters etc.” belong? What characterizes the two phases? This information is also needed to understand P20, line 1. Please also define the phases of the NAO and the PNA before you interrelate the different phenomena. What is meant by “the AO includes the NAO”? This section is a

little confusing for a reader, who is not familiar with these variability patterns.

3) P20, line 11: “A second problem”, what is the first problem here? Maybe it is better to explain general issues of reconstructions first and then state how this paper is going to address these problems.

4) P20, line 15: You can’t say that the AO has “its origin” in winter; this is only the season when it is strongest.

5) P21, line 2: Write “Ě this EOF explains 21% of the total winter-to-winter variance” to make clear that you use January/February means and not individual months for the analysis. The paragraph should end after this sentence, since the SST information belongs to the following para.

6) P21, lines 10-15: There are two sentences stating that the period after 1900 is used. Remove this redundancy. Moreover, for Figs. 11-18 you do in fact use SST data from before 1900. Please clarify.

7) P21, lines 18-23: State the period, for which the Pacific Basin SST fields are available. I don’t understand the sentence with “Ě are provided along with Ěproxy types.” Without knowing much about the following analysis it is almost impossible for the reader to guess what you are implying here.

8) P21-23, last para of section 2 and section 3.1: This is a critical part of the paper. You start explaining your method at the end of section 2, but with very little detail. Then you introduce Fig. 2, explain your method in more detail with the help of Fig. 3, and then return to your results using Figs. 2 and 4. That is not a very clear or logical structure. I suggest giving a detailed description of the method first and then presenting the results. There are also a number of question/comments I have concerning the method: - Why did you detrend the data? Did you detrend both the AO index and the observations? Did you remove significant trends or were the changes minor anyway? - Why do you have to normalize data before the correlation calculation? Isn’t there a

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standard deviation term in the denominator of the formula for the correlation coefficient anyway? - The application of an 11-yr running mean to a 31-yr running correlation time series seems a strange concept to me. What is the statistical significance of such a variable? It is certainly not the same as for a 31-yr correlation. Use a larger window, if you want smooth curves. Or simply redefine your criteria for a stable teleconnection by requiring: (a) a significant correlation over the entire period and (b) that the 31-yr running correlation is not allowed to fall under the 90% significance value for more than X% of the time. I think the latter is a much more important point than a change of sign between -0.0001 and +0.0001. Moreover, you don't really discuss the number of changes provided in Fig. 2b, but concentrate on the zero regions, which are almost identical with regions of significant correlations in most of your plots. Therefore I think you should try to find one simple definition of stability.

9) Figures: Following 8) I would re-organize the figures in the following way: Plot only significant correlations (90 or 95%) in color. Use grey shading for regions without data to distinguish them from regions with insignificant correlations. Border regions of stable teleconnections according to your new definition with a thick black line. This way you could also discuss regions that have a significant, but unstable correlation, which is a potential pitfall for climate reconstructions. With omitting the "change of sign" plots you could then have the winter plot as panel (a) and the spring plot as panel (b). You should also move the legend a little closer to the actual plot. You might have to enlarge the figures a little bit.

10) P 22, line 13: Be more precise with your geographical terms. It is the North Atlantic to the south of Greenland and not "southwestern Greenland". On P23, line 13 it is the North Pacific to the south and southwest of Alaska and not the "western coast of North America". Check throughout the manuscript!

11) P23, line 15: Describe the "tri-polar SST structure" or at least give a reference.

12) P23, lines 22-23: Explain the part stating with "due to lagged \dot{E} ". Why does that

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work for the Atlantic and not for the Pacific?

13) P23, lines 25-26: Add “winter during” after “map for”. In what respect are the correlations over land and water “consistent”? Do you mean that there are no breaks or discontinuities along the coasts?

14) P24, lines 8-14: Here you introduce a new aspect and new part of your method. The same idea is then applied to precipitation (P25, line 1-3), to which you dedicate one single sentence. I would move both parts (and the respective figures) to section 3.5 to make clear that this is a next step in the analysis.

15) P25, lines 5-9: It is slightly inconsistent to introduce the climate data in section 2 and the proxy data here. Maybe you could move this paragraph to section 2, too.

16) P25-26, section 3.4: With presenting Figs. 11-14 you enter a new part of the analysis. Before, you correlated climate variables with the AO index and now you correlate proxy data with SST. You also consider a different time period. This new step is not introduced very well. Make clear that the reader understands, what you are showing and why. Why do you correlate with SST and not with temperatures over land or precipitation? How do you make the connection with the AO? As I understand it you only qualitatively compare your correlation maps with Fig. 2. Eventually, you should ask yourself, if there are more quantitative ways to show agreement between the different correlation maps. I would also combine Figs. 11-14 to one four-panel figure.

17) P25, lines 24-27: The sentence starting with “The SST correlation \check{E} ” is not clear to me. Advection from where to where, and what exactly is the role of the storm tracks here? Please clarify.

18) P 26, lines 13-15: Please explain the relation between the uncertain seasonality and the teleconnection pattern. This seems very vague and “provides for” is an odd expression here.

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19) P26-27, section 3.5: I think this section needs to be re-organized. In my view the SST reconstruction and Fig. 16 belong to section 3.4, where other proxy data are analyzed. Fig. 16 should then be the fifth panel of the respective figure (see 16)). I wonder why correlations in the box (160-120W, 0-15N) are so far from 1. Do you have an explanation for that? Maybe you should draw a box in the figure to point to this aspect. Section 3.5 should start with introducing the idea of combining information from different stable sources to one more reliable reconstruction of the AO /NAO with the help of an EOF analysis. You should then present the examples shown in Figs. 7, 10, and 17. Finally, you should compare the resulting correlation map (Fig. 18) with a prior reconstruction (Fig. 15) and discuss the progress made. These two figures should be combined to one, too. This is the core result of this study and should be presented that way (also in section 5).

20) P28, lines 23-25: I don't understand the sentence starting with "The increased \check{E} ". Please clarify.

21) P28-29, section 4.1: Some of the discussion is already contained in section 3. For example, the sentence on P29, lines 1-2 is the exact repetition of P24, lines 19-20. Please remove all the discussion from section 3 and integrate it in 4.1. I think this part would be easier to digest for the reader, if it directly followed section 3.3.

22) P29, lines 2-6: This sentence is hard to understand. What is a PP index? What exactly are the differences between AO-like and NAO-like? Before, you seem to consider the two as almost equivalent. Can you give references for the results mentioned?

23) P29, lines 23-24: It is very hard to understand this sentence. What are the mechanisms that relate the mixed layer, atmospheric dynamics and the winter signal?

24) P29, section 4.2: This section is so short, that it could be easily integrated in section 3. Parts of it are a repetition of information given in section 3 anyway.

25) P30, section 4.3: I'm not sure if I understand the function of this subsection. The

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first paragraph, in my view, contains reference to other work that motivates the present study and should therefore be moved to section 1. The second paragraph provides arguments why the study is restricted to instrumental records. I consider that part of the method and would move it to the data section 2.

26) P31, section 4.4: Again, I am a little confused by the function of this subsection in the structure of the paper. To me, lines 2-11 contain background information that should be moved to section 1. Lines 11-21 I consider conclusions from the presented work that belong to the final section. The last paragraph directly refers to Figs. 17 and 18 and should be attached to section 3.5. In conclusion I would suggest the following restructuring of the paper: 1 Introduction; 2 Data (as before) 3 Instrumental Records (sections 3.1, 3.2, 3.3, 4.1, 4.2) 4 Proxies (3.4) 5 Reconstructions (3.5) 6 Conclusions

27) P33, line 3: Do you mean spring or summer?

28) P32-33, section 5: Again I am not very happy with the structure of this section. Lines 3-17 sound like a literature overview to me and therefore belong to section 1. The same holds for P33, lines 7-11. Maybe the basic motivation could be summarized here, but not in all that detail. Make sure that this section contains in a concise way the motivation, the approach, the data, the main results and conclusions, as well as an outlook. For example, I am missing a statement whether or not this paper made substantial progress in improving the quality and reliability of the AO reconstruction.

Technical corrections

1) Decide whether you want to use the British (A, B and C) or the American (A, B, and C) comma rule for enumerations. This is not consistent in the current version (e.g., p18, line 12 vs. 18). The same holds for commas after “e.g.” and “i.e.”. There should always be a comma before the relative pronoun “which”.

2) P18, line 24: I prefer “Azores High” and “Icelandic Low”.

3) P19, lines 6-8: You use the word “record(s)” three times. Reword!

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- 4) P19, lines 15-18: You repeat “reconstruction(s)”. Replace “be” with “are”. “common intervals of overlap” is redundant. Reformulate this sentence.
- 5) P19, lines 21-22: Write “ \dot{E} using a backward \dot{E} as recently applied by \dot{E} temperature in the North Atlantic/European area.”
- 6) P19, line 24: Write “ \dot{E} between the NAO and SLP in the Northern Hemisphere Pacific sector during \dot{E} ” I would always use NAO with an article. The same is true for the AO. Please check throughout the manuscript.
- 7) P20, line 4: “ \dot{E} and for corals in connection with the El Niño \dot{E} ”
- 8) P20, lines 6-7: Move “is required” to the end of the sentence.
- 9) P20, lines 17-18: “with respect”.
- 10) P20, line 20: Write “ a running correlation analysis” or “running correlation analyses”.
- 11) P20, line 22: You have already defined the abbreviation “AO”; so don’t use “Arctic Oscillation” again. Check throughout manuscript for this and other abbreviations (e.g., p20, line 26). In section 2 you introduce “ST” for “surface air temperature”, but then you don’t use it again.
- 12) P20, lines 19-24: This paragraph is quite heavy on passive and uses “are presented” three times in a row. Try a more variable writing style.
- 13) P20, lines 26-27: Don’t start two sentences in a row with “The AO index”. There are numerous other sentences, where you repeat words. That is bad style and should be changed.
- 14) P21, line 9: You can apply an analysis to a dataset, but not the other way around. Change throughout manuscript (e.g., P25, line 22).
- 15) P21, line 12: “terrestrial” sounds to me as belonging to the planet Earth; maybe

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“over land” is better. Change throughout manuscript.

16) P21, line 16: You can say “another definition” and then it is only one and you don’t need “e.g.” or you have various alternative definitions and then you give an example. Correct “January” here.

17) P24, line 16-18: “The correlation \check{E} shows a large area \check{E} of \check{E} correlation” is an odd formulation.

18) P24, line 20: Rimbu et al., 2001a or b?

19) P25, line 9: “ \check{E} and combined tree ring \check{E} ”

20) P25, line 25: “Atlantic”

21) P25, line 27: “storm tracks”

22) P26, line 3: “shows”

23) P26, line 11: “over the western Pacific Ocean”

24) P26, line 13: “at some points”

25) P26, line 22: “ \check{E} features with the corresponding \check{E} ”

26) P26, lines 23-25: Strange sentence, please reword. What is GISP2?

27) P27, line 4: “ \check{E} independent, but share \check{E} ”

28) P27, lines 19-23: This is a very long and somewhat confusing sentence. Reformulate.

29) Figure 17: It is very hard to see something here. Make (a) a full-width time series and then put (b) and (c) underneath it.

30) P27, line 14: Usually it is latitude first. Check throughout manuscript.

31) P30, line 17: “are consistent”

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- 32) P30, line 23: “Ě seem sensitive to Ě”
- 33) P31, line 16: wrong hyphenation of paleoclimatic.
- 34) P31, line 27: “An improved Ě”
- 35) P32, line 1: “Ě is currently not available.”
- 36) P32, line 6: Replace “high” with “positive”.
- 37) P32, line 13: Chronological order for references. Check throughout paper.
- 38) P32, line 17: “Here we use a systematic approach for reconstructing Ě”
- 39) P32, line 18: “running correlations”
- 40) P32, line 22: “ Ě purposes, but Ě”
- 41) P33, line 9: “Ěmay not be Ě”
- 42) P33, line 24: “information”

Interactive comment on Climate of the Past Discussions, 1, 17, 2005.

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