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# *Interactive comment on* "Abrupt transitions in Arctic open water area" *by* M. A. Goldstein et al.

**M. A. Goldstein et al.**

Amanda_Lynch@brown.edu

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A full response to major and minor comments by the reviewer is attached in a PDF.

What follows is a response to the major comments by Reviewer 2.

We appreciate the comments by Anonymous Referee #2, who has highlighted important areas with additional detail would clarify the work. Since we acknowledge Anonymous Referee #2 has not read the review by and response to Anonymous Referee #1, and hence there is some repetition in our response here to our previously posted response, due to similar recommendations being made. That said, Anonymous Referee #2 has highlighted important areas with additional detail would clarify the work. In the response below, we address each of the main comments by Anonymous Referee #2, and where noted added additional detail to the revised paper.

Main Comments



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1. As noted in the response to Anonymous Referee #1, we apologize for the brevity of the description of the exploratory phase of the analysis. We have documented in the revised text the three methods that were used to identify statistically significant breakpoints in the timeseries described in section 2, as follows:

* We split the record into sub-periods of three years' duration and ranked the differences in the moving averages.

* Using the top ranked differences for non-overlapping time periods, we tested a series of models for significance. The equations are provided in the attachment.

* In our revision, we implemented the breakpoint detection approach suggested by Rodionov (2004) as an additional check on our results.

As suggested by the referee, we have added these equations and a more detailed description of the analysis process to the Method description, and we agree that this makes the results much easier to follow. As is evident, it was a nested series of decisions that was required to fully convince us fully that a shift in the mean was the appropriate model for the open water time series over a simple linear trend.

2. The self-organizing map is an unsupervised classification technique based on neural networks. There is an extensive literature on this approach, which does not vary appreciably from application to application. Since this classification approach is analyzed in great detail in Lynch et al. [2016] and is not the main focus of the paper, and is analyzed in great detail in Lynch et al. [2016] and hence we chose not to describe the process in great detail in this publication. However, Lynch et al. [2016] was not included in our original reference list. We apologize for this omission and have corrected it in the revised manuscript. In addition, we have provided some more detail regarding the technique, as follows:

"The allocation is achieved by minimizing the Euclidean distance between a vector representing the sea level pressure matrix and the vector representing that node. Af-





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ter each allocation, the entire array of nodes is adjusted to maximize the Euclidean distance between nodes. A 5x4 array was selected to provide a balance between a practical minimum of nodes and a desirable maximum of variability represented, as described in Lynch et al. [2016]."

Further, we have tried to clarify the clause that the referee found confusing as follows: "In this analysis, summer daily sea level pressure anomalies (that is, the differences between a July, August or September day and the entire period average for July, August and September)..."

We have now also added the following to the reference list: Lynch, A.H., M.C. Serreze, E.N. Cassano, A.D. Crawford and J. Stroeve, 2016: Linkages between Arctic summer circulation regimes and regional sea ice anomalies. J. Geophys. Res. 121 (13), 7868-7880. DOI: 10.1002/2016JD025164.

3. Because the third regression has two degrees of freedom, the referee is correct in noting that using r2 alone would result in the selection of the model that has the most free parameters. Hence the use of an adjusted correlation coefficient was required to account for the increase in explanatory variables. Since adjusted r2 adjusts for the number of predictors in the model, it is smaller than r2 alone and can become negative. While r2 is a measure of fit, the adjusted r2 is a measure of the suitability of alternative models.

Please also note the supplement to this comment:
http://www.the-cryosphere-discuss.net/tc-2016-108/tc-2016-108-AC2-supplement.pdf

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