

## ***Interactive comment on “Recent summer Arctic atmospheric circulation anomalies in a historical perspective” by A. Belleflamme et al.***

**Anonymous Referee #1**

Received and published: 6 October 2014

Review of ‘Recent summer Arctic atmospheric circulation anomalies in a historical perspective’ (tc-2014-122) by Belleflamme et al.

Recommendation: Accept with moderate revision

Many climate trends are presently apparent in the Arctic, particularly in summer. There is much research being directed at identifying the causes and implications of the trends, and what they may mean for the climatological future of the basin. A sizeable proportion of the research has been undertaken with data compiled since the late 1970s, as this was the period when satellite technology meant that, for the first time, comprehensive (in both space and time) observations were possible. Given this relatively brief period the question naturally arises as to how typical has been the last few decades, and to what extent have some of the extremes we see over that period been present in the

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‘pre-satellite’ era. One of the nice aspects of this paper is that it attempts to put the variability of summer Arctic atmospheric circulation in a broader temporal context by using ‘reanalysis’ data back to 1871.

Another very valuable aspect of his study is that it identifies its circulation types by making use of daily data. Often studies will use averages taken over one month or longer; a major shortcoming of making deductions from these is that most of the physics involves nonlinear characteristics (e.g., wind stress on the ocean or ice) and the associated covariances are not captured by the averages. Important perspectives are revealed in this connection, particularly with respect to decadal changes in sea ice coverage.

Page 4824, Line 26: Cite papers in the order of their year of publication. (Also at page 4825, line 9; page 4826, line 1-2, page 4837, line 4, ...)

page 4825, line 10: Also cite here the recent update of Simmonds (2015) - Comparing and contrasting the behaviour of Arctic and Antarctic sea ice over the 35-year period 1979-2013. Ann. of Glaciol., 56(69), 18-28, doi: 10.3189/2014AoG69A909.

page 4825, line 10: ‘SIC’ is almost always used to mean ‘sea ice concentration’. To be consistent with convention (and to avoid potential confusion) I suggest using the usual sea ice extent (SIE) or sea ice area (SIA) throughout the paper.

page 4826, line 16-17: The ERA-40 data set is valuable in that it extends to 1958, but it also contained a number of bugs. These bugs necessitated the running of ERA-Interim. While I have no great problem with the use of ERA-40 here, the authors should refer to the paper by Screen et al. (2011: Erroneous Arctic temperature trends in the ERA-40 reanalysis: A closer look. J. Climate, 24, 2620-2627), to make sure that the reader is alerted to the potential problems.

page 4828, line 9-11: I think it is valuable in this analysis that the authors have identified their synoptic patterns at both SLP and z500. However, there are some additional issues with the identification at the 500 level. On page 244 of their paper Fettweis, X.,

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E. Hanna, C. Lang, A. Belleflamme, M. Erpicum and H. Gallée, 2013: Important role of the mid-tropospheric atmospheric circulation in the recent surface melt increase over the Greenland ice sheet. *The Cryosphere*, 7, 241-248, doi: 10.5194/tc-7-241-2013 describe the procedure employed when they applied the CTC to z500 in evaluating the similarity between two days. They used an additional component to the similarity index which was based on the distance between the two surfaces (not picked up by spatial correlation) which makes some allowance for changes in the thickness pattern. The authors should make clear whether this procedure was applied in the present case, as the identified patterns will be sensitive to this.

page 4828, line 10: 'no more' is too strong here. I suggest replace with 'much less' or 'minimal'.

page 4828, line 25- : I like the approach of conducting 20,000 random classifications with a view to quantifying the uncertainty.

page 4830, line 7 : Change 'to the detriment' to 'as the expense'

page 4830, line 16 : Also refer here to Ballinger, T. J., and S. C. Sheridan, 2014: Associations between circulation pattern frequencies and sea ice minima in the western Arctic. *International Journal of Climatology*, 34, 1385-1394, doi: 10.1002/joc.3767. Change 'join the findings of' to 'are similar to those found by'.

page 4830, line 20: Change 'both' to 'over the record'.

page 4832, line 10: Change 'turning' to 'being'.

Page 4836, Conclusions: The CTC approach is powerful and the use is appropriate here. However, the authors should make some brief comments on how the results might compare with other methods of synoptic classification that are commonly used, such as 'Self Organising Maps' - Hope et al., 2014: A comparison of automated methods of front recognition for climate studies: A case study in southwest Western Australia. *Mon. Wea. Rev.*, 142, 343-363. Some words to indicate the advantages or

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otherwise of CTC would be very helpful here (or at some other relevant part of the paper).

page 4836, line 1-4: An important part of this research is the introduction of the consideration of sea ice trends and how they can be related to changes in \*DAILY\* synoptics. Very valuable to emphasise this message in the paper by here by referring to the very relevant studies of Simmonds et al., 2009: Extraordinary September Arctic sea ice reductions and their relationships with storm behavior over 1979-2008. *Geophys. Res. Lett.*, 36, L19715, and Screen and co-authors 2011: Dramatic interannual changes of perennial Arctic sea ice linked to abnormal summer storm activity. *J. Geophys. Res.*, 116, doi: 10.1029/2011JD015847.

page 4838, line 4: Here also cite study of Parkinson, C. L., 2014: Spatially mapped reductions in the length of the Arctic sea ice season. *Geophysical Research Letters*, 41, 4316-4322, doi: 10.1002/2014gl060434.

#### References:

After each reference there is one or more four-digit numbers. I don't know what these are. Please delete.

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Interactive comment on *The Cryosphere Discuss.*, 8, 4823, 2014.

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