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

We want to thank the reviewer for his constructive and useful remarks and suggestions. The remarks needing more important changes to the text are answered below (in blue). The language specific comments will be changed in the final manuscript according to the reviewer's propositions, and the proposed additional references will be added.

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.

Thanks for the suggestion. We will use sea ice extent (SIE) in the whole paper. The correlations between the circulation type frequencies and SIE in Section *4.3.2. Sea ice extent* are now as follows :

Type	SLP	Z500
1	0.50	0.56
2	-0.46	-0.17
3	0.47	-0.06
4	-0.52	-0.08
5	0.17	-0.56
6	0.24	-0.02
2 + 4	-0.65	/

Note that this does not change the main conclusions of this section.

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 ERAInterim. 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.

We propose to add : « It should be noted that ERA-40 is known to have significant biases in its vertical temperature profile (Screen and Simmonds, 2011), which is used in the geopotential height calculation. However, the impact of these biases on our Z500-based results should be limited, since the most problematic year (i.e. 1997) is not included in the ERA-40 period considered here. »

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., 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.

We propose to add at page 4828, line 6 : « Thus, in contrary to Fettweis et al. (2011, 2013), who used the Euclidean distance as similarity index and Z500 to take into account the influence of the temperature on the upper level circulation, we used the Spearman rank correlation and SLP to focus exclusively on the circulation pattern. » and to change page 4828, line 9 to : « For comparison, the same procedure was done using Z500, ... »

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

We propose to add in the introduction (page 4826, line 2) : « While a wide range of classifications has been developed to study the atmospheric circulation (e.g. leader-algorithm approaches (Fettweis et al., 2011), principal component analyses (Huth, 2000), optimization algorithms (Philipp et al., 2007) including self-organising maps (Hope et al., 2014)), no method can be considered as being overall better than the others (Philipp et al., 2010). Thus, we use our CTC that has been developed for the Arctic region and especially for Greenland (Fettweis et al., 2011). This CTC has already been used to compare reanalysis datasets and General Circulation Model outputs over Greenland with the aim of detecting circulation changes (Belleflamme et al., 2013) and to analyse temperature related flow analogues over the Greenland ice sheet (Fettweis et al., 2013).

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.

We propose to add : « Further, Simmonds and Keay (2009) and Screen et al. (2011) have shown that SIE in September is lower in years characterised by a weaker than normal summertime Arctic cyclonic activity, which induces a higher average SLP over the region. »

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

These are the page numbers where the references are cited. They have been added by the editor/type-setter.