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

Anonymous Referee #2

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General

This is an interesting paper that presents new and original results of changes in air-circulation patterns over Greenland based on the Twentieth Centurey Reanalysis dataset. The novelty of the study is it extends back to 1870, so puts the recent (2007-2012) circulation anomalies in a long-term climatic context. The analysis effectively builds on and generally links well to previous work. However, before it can be published, quite a few points of clarification and, in places, improvements to the clarity of the written English are needed. Once these are satisfactorily addressed, I would be happy to see this paper published.

Specific

Abstract, p.4824, line 13: what do you mean "largely exceed"? - be more specific. p.4824, l.15, "linked TO the North Atlantic Oscillation". p.4824, l.24: "favouring warm southerly air advection over WEST Greenland". The east of the country quite often experiences different/opposite conditions in this secnario, e.g. in summer 2012. p.4825, l.6 "summer...AO has decreased over the same period" - add reference Hanna et al. (2014): Hanna, E., T.E. Cropper, P.D. Jones, A.A. Scaife, R. Allan (2014) Recent seasonal asymmetric changes in the NAO (a marked summer decline and increased winter variability) and associated changes in the AO and Greenland Blocking Index. Int. J. Climatol., doi: 10.1002/joc.4157. p.4825, l.9: "Finally, these circulation anomalies have been IMPLICATED IN..." p.4825, l.17 "We have put the recent (2007-2012) summertime atmospheric circulation anomalies..." - justify choice of period and why the two more recent (2013, 2014) summers are not included here. p.4825, l.20: "to DISTINGUISH the main circulation types". p.4825, l.21: add comma before "as done by". p.4826, l.4 "TO daily SLP and Z500 fields". p.4826, l.17: "1958-1978 USED TO EXTEND ERA-Interim" p.4827, l.6 "strongly depends on the amount of available station data" (or the number of stations?) - rewrite to clarify. p.4827, l.8: Clarify that apart from MSLP, 20CR data does also include SST and sea-ice as boundary conditions. p.4827, l.14: "interpolated TO a regular grid". p.4827, l.15: "Our integration domain HAS A SIZE OF 5000x5000 km and covers...". p.4827, l.19: "normslised difference between the SLP measured in the Azores (Ponta Delgada) and Iceland (Reykjavik)." p.4827, l.26: I am not clear how the reference day was chosen. p.4828, ll.2-4: Rephrase the sentence explaining the reference day, as this doesn't currently make sense. p.4828, l.4: "The KEY FEATURE (or MAIN ASPECT) of using correlation-based similarity indices...". p.4828, l.8: "we only considered oceanic pixels WHEN PERFORMING the SLP-based classification." p.4828, l.17: "as IMPLEMENTED by Belleflamme et al. (2013)". p.4828, l.23: "which is common to all THESE reanalyses, as THE reference dataset." p.4828, l.27 - why 20,000 classifications? How was this determined? Why not use e.g. 10,000? p.4829, l.8: Why were 6 circulation types retained? Why not e.g. 5 or 7? p.4829, l.11 "the six obtained circulation types" - how do these differ-

ent types relate to physical climate forcings and different polar jet stream patterns? p.4829, l.13: "DURING 1980-2012. On the OTHER HAND, Type 2..." p.4829, l.18: spell out full form "respectively"; don't use "resp.". p.4829, l.20 "Type 6 contains days that are too different from the other types" - how is "too different" defined? p.4829, l.22: "Despite the DIFFERENCE BETWEEN the SLP and Z500-based circulation types, six types...". p.4829, l.24: "This depression is located FURTHER TO THE EAST in Type 2". p.4830, l.15: "The frequencies of Type 2 and Type 4 ARE ALMOST TWICE AS LARGE DURING 2007-2012 compared WITH the 1871-2013 average." p.4831, l.13 "However, the 2013 summer shows opposite extremes" - what about the 2014 summer? p.4832, l.10: "before 1940, AT A LEVEL OF around 7-11%". p.4833, l.9 "is MORE rather related to". p.4833, l.10: "the standard deviation of the SLP spread than to its average, which" - does "which" here refer to the average? p.4834, l.6: Unclear what "these types" refers to - is it Types 1 & 2 or Types 3, 5 & 6? Also, since, according to p.4833, adding the spread gives more Type 2 only and not more Type 1, I'm not clear why "Adding the spread to the detriment of these types has much more impact on the frequency distribution than subtracting the spread." p.4834, l.20: "The association of negative NAO phases with high frequencies OF Types 2 and 4, which is even more evident" - how much more evident? Give increase in correlation coefficient? p.4835, l.22 "Type 5 combines the Beaufort SEa High and the Greenland High" - Figure 1 seems to show LOW SLP anomaly over Greenland for Type 5? p.4836, ll.1-4 "Overland et al. (2012) nshowed that summers [with Arctic] high pressure...are marked by enhanced SIC loss". It would be worth briefly adding mention of the Arctic Dipole anomaly pattern at this point. p.4836, l.6: "We HAVE used an automatic...". p.4836, l.26: "This shows the IMPORTANCE OF ACCOUNTING FOR the spread of the 20CRv2 data...". p.4837, l.8: "These PREVIOUS anomalies"? p.4837, l.11 "...so they could SIMPLY be an exceptionally strong deviance..." p.4837, l.17 "which contrasts [2013] with the strong positive anomaly of the preceding summers." - actually the year to year variation in the summer Greenland Blocking Index value was greatest between 2012 and 2013, in the NCEP/NCAR Reanalysis record back to 1948, cf. Hanna et al. 2014b,

updated analysis: Hanna, E., Fettweis, X., Mernild, S. H., Cappelen, J., Ribergaard, M. H., Shuman, C. A., Steffen, K., Wood, L. and Mote, T. L. (2014), Atmospheric and oceanic climate forcing of the exceptional Greenland ice sheet surface melt in summer 2012. Int. J. Climatol., 34: 1022–1037. doi: 10.1002/joc.3743. p.4837, l.19 "likely TO HAVE BEEN much colder than now." p.4837, l.20 "Our findings CORROBROATE those of...who FOUND THAT the Beaufort Sea High...". p.4837, l.25 "the OBSERVED negative NAO trend (HANNA ET AL. 2014)." p.4837, l.27: "who suggest that RECENTLY MORE FREQUENT Beaufort Sea High and Greenland high PRESSURE SYSTEMS might be part...". Figure 2 caption needs clarification/expansion

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