

## ***Interactive comment on “Rapid Wastage of the Hazen Plateau Ice Caps, Northeastern Ellesmere Island, Nunavut, Canada” by Mark C. Serreze et al.***

### **Anonymous Referee #1**

Received and published: 5 October 2016

This paper documents the near demise of 4 small ice caps in NE Ellesmere Island - ice caps that have a >50 year history of study. The paper is of some interest because of this long history, but it could be made more interesting if more effort were made to place the results in a broader regional context.

Specifically, there is no mention at all of the work of Gabriel Wolken, who used trim-line mapping to document the pattern of post Little Ice Age glacier retreat across the Queen Elizabeth Islands and interpret observed patterns in terms of past climate dynamics (The Holocene 18 (4), 615-628 and 629-641, 2008). Nor is there mention of the chapter on this region in the GLIMS book (edited by Jeff Kargel and others; Global Land Ice Measurements from Space, pp 205-228 (Springer, 2014)), which provides a sub-regional breakdown of post 1950's ice retreat across the area as a function of initial ice cap/glacier size. Many small ice caps have disappeared from this region in the

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past 60 years, but this would not be obvious from reading the submitted manuscript).

Equally, there is no reference to the 4 in situ mass balance time series from the area which provide a nice picture of the short term variability in climate-mass balance linkages that would help with the interpretation of the results presented here - or of the regional ice mass change time series from GRACE, which would do the same thing. The relevant data are published annually in the Arctic section of the BAMS “State of the Climate” report and are readily available (as are the mass balance time series from WGMS). Nor is any comparison with ice core records from the region, which would also help to provide longer term context for the work (e.g. Fisher et al., 2012, Global and Planetary Change 84, 3-7).

As a result, the paper seems somewhat disconnected from what is already known about post LIA and recent glacier change in the region and its drivers. I think this issue has to be addressed if the paper is to pass the “significance” test for publication in The Cryosphere. The paper does nicely document the history of these specific ice caps in more detail than would be possible for most others in the same region (hence good for originality) , and the detail is sufficient to allow reasonably sophisticated comparison of ice cap retreat rates and patterns with other climate and mass balance indicators for the region - but this is not really attempted (hence fair for scientific quality and significance). This leaves the paper with a rather anecdotal feel. I think this needs to be changed before I could recommend publication in this journal.

The paper is however quite readable (good for presentation quality) although I do suggest below quite a number of detailed edits that would make it more readable.

Specific Points (keyed by line number):

71-74: Specify uncertainties associated with the ice cap area estimates - important to know how large these are relative to the observed changes

77: what is the range of surface elevations covered by this transect and how does it

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compare with the total elevation range of the ice cap?

85-86: this statement seems like unnecessary speculation, given that the comparison is with the behaviour of a single studied ice cap.

91: Why assume the 1982 melt season ended by the end of August ? Evidence for this claim? Climate data?

92-94: an annual mean MB value for a given time interval might be more useful than a period mean and, if there is a stake line, it would be useful to say something about how the annual balance varies with elevation.

96: decreased in area (rather than shrunk in area)

103: Is -0.49 the annual value or a period mean? Not clear

104: inferred by Hattersley-Smith. . .

106-107: Treats temperature and mass balance as interchangeable terms - not justified, so talk about temperature as that is what the data relate to (or present a quantitative relationship that justifies inferring MB from T

109: 1982/83 balance of the Simmons. . . .

116-117: annual balances of both ice caps were negative in all years, ranging from. . .

120: The larger and smaller. . . .of their 1959 areas respectively, while the Murray. . . .had shrunk to 70%. . . . .their 1957 areas

123: inserted allowed us to make a minimum estimate (-1.10 m w.e.) of the mass loss. . .

125-128: given the measurement approach, I think some assessment of the associated errors is warranted.

129: . . .studies, and the results from. . . .

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131: maximum, and likely to have formed

133: in the first couple. . . .

134-135: On the basis of a mapped lichen tramline, Braun et al. (2004) speculate that

135-138: Here the authors should make reference to Wolken's study (The Holocene) of lichen trimlines in the QEI; I'd also like to see a tabulation of all the available surface mass balance measurements and the time periods they represent.

143: List all the known positive balance years so we can see how many there have been

147: Note there are GRACE mass balance time series for the QEI (see the Arctic section of successive annual BAMS "State of the Climate" reports) and for the Russian Arctic, Svalbard, and Alaska, so you could make broader scale Arctic comparisons with your data time series.

152: areas (in km<sup>2</sup>) from all..

157: of the Murray

162: 2016, the Murray. . . . .in 1959. By sharp contrast, . . . . .only 0.15 km<sup>2</sup>

168: reductions in. . . . .area are striking

170: is shown in Figure 3, based on outlines from 1959, 2001, and 2016.

177: Note that none of these studies discuss glacier area changes, and you don't reference the one that does (paper in the GLIMS book)

197: is it meaningful to make comparisons with pan-Arctic means given the scale of this study?

200-203: Sharp et al (2011) provide evidence that would support this assumption (i.e. that 850 hPa and surface air temperatures show similar patterns)

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216: Arctic discussed by...

231: as the warmest in the record.

236: anomalous warming 237: is most strongly... 241: stands out how? 242: make it clear that these LST results relate to ice covered surfaces only

245-257: Do these specific years stand out as anomalous in the long term surface mass balance records from elsewhere in the QEI (White Glacier, Meighen Ice Cap, Melville South Ice Cap, Devon ice Cap) ? Why not discuss these data?

248: likely reflects... 251-252: Be careful here, MODIS data suggest that this assertion would not hold everywhere in the QEI 254: when there was an especially.....in field observations) 258-59: related to their limited thickness 266-268: note that MODIS albedo data do provide support for this hypothesis in restricted areas of the QEI 280: Do you have any specific information on what plant taxa have been exposed by the retreat of these ice caps?

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