tc-2016-171 Response to final editor reviews (12-12-2016)

We thank the scientific editor for his thoughtful and thorough final review of our paper. We have revised the manuscript to address your review comments (see below). Throughout this response to review document your (editor review) comments are provided in regular, non-italic font text, our response comments are provided in italic text (as here), and any changes to the revised manuscript text are provided in quotation marks and italic, blue font text. Along with this response to referee review document, we will upload to the The Cryosphere website a revised manuscript file with marked-up changes (text edits provided in italic, blue font text, as in this document), and a non-marked-up, final revised manuscript file (all text in black non-italic font).

We hope these final revisions will be sufficient to warrant acceptance for publication in The Cryosphere.

Thanks again, and on behalf of the authors,
Nick Barrand

Editor Decision: Publish subject to minor revisions (Editor review) (21 Dec 2016) by Dr. Etienne Berthier. Comments to the Author:

L13-14. Both reviewers and I agreed that the link between climate fluctuations and mass balance is currently not really demonstrated. "appear" suggest this in the abstract but I also ask you to add a statement clarifying that this link is based on very thin data and need further work: "However, further measurements and analysis are required to fully understand the mass balance sensitivity of Labrador glaciers". (feel free to use a different wording but this is the idea)

The manuscript text in the abstract is amended to read: 'Glacier mass balances appear to be controlled by variations in winter precipitation and, increasingly, by strong summer and autumn atmospheric warming since the early-1990s, though further observations are required to fully understand mass balance sensitivities.'.

The manuscript conclusion is also now amended to read: 'These findings suggested that Labrador glacier mass trends may be controlled by variability in winter precipitation, and increasingly by strong summer and autumn atmospheric warming since the early-1990s, though further observations are required to confirm these linkages.'.

L44. "w.e." not defined

Text amended to read: '…water equivalent (w.e.).'

L45. Glacier missing here I think after "Superguksoak"

Text amended to read: 'Superguksoak Glacier…'.

L48. 1986a? Check the correct call for the Rogerson-1986 references.

Text amended to read: '(Rogerson, 1986b)'.

L200. Currently authors used a constant density of 918 kg/m3 to convert volume to mass. No error is associated to this choice and the use of this value has not been justified. Such a pure ice density (I though pure ice density was 917 kg/m3 but maybe I am wrong here) would be only justified if NO firn was present over the glaciers during ALL surveys. Is it the case? Otherwise a lower density should be applied as justified by Huss, M.: Density assumptions for converting geodetic glacier volume change to mass change, The Cryosphere, 7(3), 877–887, doi:10.5194/tc-7-877-2013, 2013. In all cases, an uncertainty should be added.

Field geodetic surveys in 2008 and 2009 took place over mostly bare glacier ice with very little or no snow or firn present (AAR = 0, see earlier response to review comments). However, we cannot be completely certain of no change in the firn density profile (Sorge's Law). Also, we cannot be certain that the 2005 DEM and 2011 geodetic surveys were collected from snow and firn-free ice conditions (or that the density-depth profile was time invariant between these surveys). For these reasons, and based on the editor's recommendation, we have recalculated 2005-2008, 2008-2009 and 2009-2011 geodetic mass balances based on the lower 'wide range of conditions' density conversion of Huss (2013) (850 +/- 60 kg m^3). This approach also has the advantage of introducing an error term to the volume-mass conversion, which we now incorporate into our total error budget. The manuscript text of this section is now amended to read: 'Volume changes were converted to geodetic mass balances in water equivalent units (m yr^{-1} w.e.) by dividing by the glacier area, assuming an ice density of 850 ± 60 kg m^{-3} (Huss, 2013), and in the case of 2005-2008 and 2009-2011 measurements, dividing by the time between epochs.'.

These recalculations have the result of producing slightly less negative mass balances, with slightly larger uncertainties. Each of these amended values are now included in the manuscript text (in Sections 3.2 onwards) and in a replotted Figure 7 - adjustments that do not alter the conclusions of the manuscript.

L271. "with the largest changes": authors should write "thinning" here. Otherwise the positive values in the parenthesis that follow could be misinterpreted as a thickening...

To differentiate between simply 'thinning' and 'the largest changes' (i.e. the greatest thinning), the text is amended here to read: '…with substantial thinning (\sim 4 m yr^{-1})…'.

L290. authors can skip geodetic but not "mass" here.

The word 'geodetic' has now been deleted.

L358. The use of "preceding" here and also earlier (L328) ambiguous. A mass balance year is made of an accumulation season followed by an ablation season. Thus, the "preceding" accumulation season could be mis-interpreted as the one from the previous mass balance year. Avoid such ambiguity.

At line 328 (former), the words 'the preceding years' are deleted.
At line 359 (formed), the word 'preceding' is now deleted.

L388. Delete (Figure 4). No need to call a figure in the conclusion

Reference to Figure is now deleted from conclusions section '(Figure 4)'.

L391. Your acceleration in the thinning rate and the very negative mass balances after 2005 are in line with the findings of Papasodoro et al. for the nearby (300 km further north) Terra

Nivae ice cap (http://www.the-cryosphere.net/9/1535/2015/). You may thus compare yours and their value. It would give a more regional scope to your conclusions.

We thank for the editor for bringing this study to our attention. We include the following text at lines 303-305 (in Section 3.2): 'This strongly negative post-2005 mass balance is similar in magnitude to that measured at nearby Terra Nivea ice cap on southern Baffin Island (Papasodoro et al., 2015).'.

We also include the following text in the conclusions section: '…being the most negative mass balance yet recorded at this or any other glacier in Labrador, and similar in magnitude to that measured at neaby Terra Nivea ice cap.'.

Legend of Figure 2. "base stations" (space missing I think)

Text amended to read: '…base stations…'.

Non-public comments to the Author:
Nick and co-authors,
No Christmas gift sorry. No yet. Just a small effort and this should work.
Etienne

Thanks again for your time and efforts reviewing this manuscript, Etienne.
Nick