The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2017-236-SC2, 2018

Interactive comment on "Subglacial drainage patterns of Devon Island, Canada: Detailed comparison of river and tunnel valleys" *by* Anna Grau Galofre et al.

A. Grau Galofre

agraugal@eos.ubc.ca

Received and published: 15 January 2018

We would like to thank Martin Margold for his thorough and constructive review. We believe that his suggestions, in particular considering submarginal and purely lateral meltwater channels in our channel characterization, will greatly enrich this manuscript.

It is likely that a number of channels in Devon are in fact lateral meltwater channels, so we believe that Dr. Margold raises a good point in advising the consideration of these drainage systems in our study. From the literature suggested in his comment (in particular Kleman et al. 1992, Greenwood et al. 2007, and Syverson and Mickelson 2009), it appears that a good test to distinguish between subglacial and lateral meltwa-

ter channels would be to delineate the channels we visited over a hillshade map with contour lines, where the reader can compare the overall direction of the channels under study with the topographic gradient. We will produce this map, which will motivate the characterization of subglacial vs. lateral meltwater channels.

The overall direction of the channels visited in the field roughly follows the topographic gradients, and we do not see examples of systems of channels subparallel to contour lines. Other morphological and geometrical aspects, such as the length scales (1-1.5Km long, several meters wide), anabranching patterns, presence of potholes, and perpendicular direction to the inferred retreating ice sheet margins (see fig.1 in the manuscript and Dyke 1999), are also suggestive of subglacial drainage (Sugden 1991, Greenwood 2007).

However, we do see examples of lateral meltwater channels from aerial imagery. Along deeply incised canyons, there are examples of channels incised on the side walls parallel to the canyon floor, in occasions forming series of nested channels. The morphology of these channels is consistent with a similar formation process to those investigated in Syverson and Mickelson 2009. There is a particular example in figure 2 panel (d) that follows the contour line along a valley, which is more in agreement with a lateral meltwater channel than a subglacial channel. We will remove this panel from the figure for consistency, but we will also consider adding an additional panel comparing subglacial and lateral meltwater channels to illustrate the discussion between these landforms Dr. Margold suggested.

In addition to making the distinction between lateral and subglacial channels, we will re-estate the motivation for this study to make it more specific to our results, and we will dedicate a subsection describing the details of the channel morphology (see response to Dr. Livingstone), both for subglacial and fluvial channels. There is an overall lack of remote sensing characterization of subglacial landforms, which this manuscript addresses at high resolution. In particular, the kinematic mobile (referring to its portability) LiDAR methodology introduced is new (see Kukko et al. 2012) and gives an insight into the interior of the channels that DEMs and photogrammetry products cannot achieve, which is particularly relevant at detecting the presence/absence of inner channels or even potholes (Sugden 1991). These are, we believe, relevant additions to the body of data regarding subglacial landforms that motivate this study.

The last general point raised by Dr. Margold would be to include a discussion regarding the possible mechanism of formation, the length of operation, and the discharge accommodated by the channels identified. Although these aspects are indeed beyond the scope of the manuscript, and they will in fact be the direct focus of another study that is now in preparation, we can add a short paragraph in the discussion listing possible mechanisms and relevant references.

References

Dyke, A., 1999. Last glacial maximum and deglaciation of Devon Island, Arctic Canada: support for an Innuitian Ice Sheet. Quaternary Science Reviews, 18(3), pp. 393-420.

Greenwood, S.L., Clark, C.D. and Hughes, A.L., 2007. Formalising an inversion methodology for reconstructing ice-sheet retreat patterns from meltwater channels: application to the British Ice Sheet. Journal of Quaternary Science, 22(6), pp.637-645.

Kleman, J., 1992. The palimpsest glacial landscape in northwestern Sweden. Late Weichselian deglaciation landforms and traces of older west-centered ice sheets. Geografiska Annaler. Series A. Physical Geography, pp. 305-325.

Kukko, A., Kaartinen, H., Hyyppä, J., & Chen, Y., 2012. Multiplatform mobile laser scanning: Usability and performance. Sensors, 12(9), pp. 11712-11733.

Sugden, D. E., Denton, G. H., & Marchant, D. R., 1991. Subglacial meltwater channel systems and ice sheet overriding, Asgard Range, Antarctica. Geografiska Annaler. Series A. Physical Geography, pp. 109-121.

Syverson, K.M. and Mickelson, D.M., 2009. Origin and significance of lateral meltwater channels formed along a temperate glacier margin, Glacier Bay, Alaska. Boreas, 38(1),

pp.132-145.

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2017-236, 2017.