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Comment on egusphere-2022-1220

Anna L.C. Hughes (Referee)

Referee comment on "Differential impact of isolated topographic bumps on ice sheet flow and subglacial processes" by Marion A. McKenzie et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-1220-RC1, 2023

Differential impact of isolated topographic bumps on glacial ice flow and subglacial processes
McKenzie et al. Submission to The Cyrosphere

General comments:
This paper presents a morphometric analysis of a dataset of subglacial bedforms of the Cordilleran Ice Sheet to assess the influence of isolated changes in subglacial topographic relief on ice flow. The bedform dataset, was generated by semi-automatic mapping from Digital Elevation Models, the methods of which are summarised here and presented by the authors in cited papers published elsewhere. For this study nine sites within Puget Lowland were selected that capture isolated topographic highs of variable area and height in both crystalline and volcanic bedrock, with between 125 and 1013 bedforms at each site examined. The authors classify bedforms within 100 feet of each bump as being upstream, downstream or on top of each bump and use this to examine variations in the morphometry of bedforms, focussing on their elongation ratio and surface relief. Despite the relatively small sample size this dataset and analysis provides new data on the potential role of subglacial topography on landform morphometry.

The authors explain the morphometry by invoking explanations related to changes in lithology and thus sediment availability, as well as subglacial pressure and meltwater changes. Perhaps the most interesting finding is that bump volume appears to control the downstream bedform orientation, with bump volumes of 4.5 km^3 or less showing a persistent downstream legacy on bedform orientation (and thus ice flow organisation). Though this threshold is defined by only two sites with bumps >4.5 km^3. Further studies from a greater range of glaciated environments and ice flow settings are needed to explore this finding further.

I found this short paper to be well written. The description of the analysis and results are comprehensive and clear. Figures are high quality, although see comments below.

Specific comments:

Methods: The vertical and horizontal resoltuion of the DEMs used as the basis for bedform mapping needs to be added.

Figure 1: The colour choices in this figure for both the background elevation data and the

mapping mean that there is little contrast between the two, and the mapping is hard to see (especially the green bedforms appearing on the lowest topography. I suggest modifying the colour schemes to improve this. The elevation scale for each of the panels in A) also varies. In order to compare across sites it would be preferable to use a single colour scale for elevation in each panel. There should also be a space between the value and the unit in the labels. The study area panel is very dark. For those unfamiliar with the region there should be inclusion of a small inset to show the wider context of the location within the area covered by the Cordilleran Ice Sheet. The area comparisons in (B) is a very useful figure, but would be easier to follow if the lines connecting the labels to the graduated circles were thinner, and the colours of the text boxes were the same as the circles, especially as this same colour scheme is continued throughout the other figures to identify each site. It is unclear what the volume values are pertaining to in the labels. Is this of the area, the bump, or the bedforms?

Figure 2: Include in the legend the site codes as used in Fig 1 as well as the names, or add site names to the labelling in Figure 1A.

I would recommend acceptance of the paper with corrections as specified under specific comments.