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The Cryosphere Discussions
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Interactive comment on "Permafrost thaw couples slopes with downstream systems and effects propagate through Arctic drainage networks" *by* Steven V. Kokelj et al.

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General Comments The manuscript "Permafrost thaw couples slopes with downstream systems and effects propagate through Arctic drainage networks." provides a comprehensive overview of the extent and effects of mass wasting processing in NW Canada on its associated drainage networks across different scales. It analyzes different scales from local watersheds to the entire study area of ca. 1 Mkm^2. The authors used numerous methodologies and data sources were applied for each specific scale and target objective. The authors did a great job. This manuscript is of high quality and very comprehensive with a lot of detail and only needs minor corrections. Here are some general

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remarks. Detailed comments are stated below. The analysis of many different aspects, with a plethora of datasets in different scales, makes it sometimes hard to follow. I think it is generally very hard to find the balance between details and the overall story. Perhaps minor improvements, such as adding a table of datasets (see detailed comments) will help the readers to understand the scale, objective and significance of the specific analyses. The quality of figures ranges from very good to "room for improvement". Please check detailed comments. Geospatial datasets (Shapefiles or KML) of e.g. the slumps, and perhaps other features as well, would be a helpful addition for readers to easily find the locations and cross-check with other data sources. Overall this manuscript will be a great contribution to the permafrost science community.

Specific Comments Title: The title is rather complicated, particularly reading it for the first time 175: It would be good to somehow provide the exact number, especially since you do that in the abstract. 201 ff: You used several different datasets, but it is rather hard to follow this part with text only. I suggest to add a table with basic methodologies and datasets and its related objectives. This will help to keep better track of used methods and spatial scales. 238: Could you provide a little bit more information who exactly digitized the slumps (how many different people, people with field experience, etc.). I personally find it very challenging to consistently digitize thaw slumps, and even more so with several people. 258: I think it would make a great supplementary figure to show some examples (e.g. cross sections) of the reconstruction for selected sites. It looks like you provided this in Figure 3e, but did not reference it in the text. 267: Which Sentinel exactly. I suppose you mean Sentinel-2. 366: "decade": Do you have exact initiation ages or is it rather an estimate? If the former I suggest using a more precise values (year) otherwise it's also fine to leave decade. 369: see decades 369: I suggest writing "2" as a word, as a few words later. 376 Table 1: Please use either negative values without direction (W) or positive values with direction for longitudes. E.g. -135.7555° OR 135.7555°W 381: Figure 2: It would be nice to somehow make a more efficient use of this figure in the next version in case this will be a full page figure, as there is a large blank space on the right. Of course I understand that this version of the manuscript is

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still a preprint. Figure 2h: This plot is somehow hard to understand at the first glace. X-Label: is not initially clear, which distance you mean. I suggest extending it to “Distance from <location>” (fill with your reference location). The same (to a lesser extent) applies to the Y-Label. I suggest using “Thickness of sediment accumulation” or so. 425 Figure 3: a-c: I suggest using a more appropriate colorbar and visual scaling with a distinct break at 0 (zero). E.g. greenish/blueish colors for accumulation and orange/reddish colors for erosion. (e.g. https://colorbrewer2.org/#type=diverging&scheme=RdBu&n=9 or something similar) a-d: What is the source and timing of the hillshade? e: (very gentle) gridlines may help to better read the proportions of the plot. However, I am not sure if this add too much information to this plot. The intersection of “(e)” and the lines may need some improvement. 434: Please specify what exactly you mean with thaw-slump indices. Volume, area, . . .? (I found them in 443). I suggest using them here. 434 ff: You are providing slump related statistics, but it is unclear which total area you analyzed with this dataset or how many features/slumps you detected. At least I cannot find them here in this paragraph. 465: I suggest using “Scatter plots” instead of only “Scatter” (if you mean scatter plots)

543 Figure5: a Inset: The numbers are hard to read especially in the dark grey part. The order in 1986 is reversed (2 bottom) compared to the other years. Technically you could include the same information into the large bars, though the focus shifts to absolute numbers rather than relative to 100%. b-c/d-e: As the information from b & c as well as d & e are highly correlated, using only area or volume might be appropriate. However, this is a “soft” recommendation, but might be ok if you leave it. Perhaps shifting f to position d makes sense to have area and volume in one column.

551 Figure 6: Please check the numbering (a-c) of the insets. The main map does not have a letter. There are duplicate b and c. Main map: Just out of curiosity, which projection is it? The maps seems to be slightly rotated (clock-wise). The grid shows the rotation but the north arrow does not. Please adapt the north arrow, as I suppose the rotation was made to fit the watershed into the figure. I like the accumulated scar

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area visualization.

567: Sentinel-2? 596 Figure 7: The data itself are very interesting but the visualization should be improved. I suggest using colors instead of black and white only. Furthermore please make sure that data is not occluded, particularly in a, b and d. Using colors and semi-transparent markers should help. Is a/b already semi-transparent and the grey part the intersection area? If yes, using colors will help to better see that this might be the intersecting area, as this color is not visible in the legend. Perhaps, you could remove the fill color for the bars at all and use only edge colors. b/c: These plots look good, but it's quite challenging to understand what they mean. Particularly c it is not clear to me what the Cumulative disturbance in relation to the catchment area means. I see that there are changes over time (Peel), but the specific data behind it are puzzling to me.

641 Figure 8: Awesome Figure What does NHN mean in the legend?

859: I think it will help to have a list of publically available datasets in this section have a direct and comprehensive overview of these datasets instead of crawling through the text and references. Access to your datasets, e.g. delineated thaw slumps or aggregated spatial statistics, will be of great benefit to other researchers, particularly for large scale remote sensing and model applications.

Supplement Figure S1: I suggest using colors for nicer visualization. Please add (a,b,c) to each subplot. A horizontal alignment of plots would be nice, even if the plot size needs to be slightly reduced. Figure S3 iii: Here it would be great if you'd add an arrow/marker to the slide. With a lot of experience it's possible to find it, but without it can be hard. Please mention (and visually indicate) the dam/blockage. 384: bottom of Table S3: Perhaps it is rather nitpicky, but using ISO format of dates would be nicer (e.g. 1986_07_07 –> 1986-07-07) 444ff: Perhaps you should cite https://jstnbraaten.shinyapps.io/snazzy-ee-ts-gif/ as well, which is the second step to create these animations.

Technical Comments Supplement 381 Table S3 caption: typo in: "... could free Landsat ..."

Please also note the supplement to this comment:
https://tc.copernicus.org/preprints/tc-2020-218/tc-2020-218-RC2-supplement.pdf

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