

**Review of “Brief communication: Hydrologic connectivity of a tidewater glacier characterized with Sentinel-2 satellite images – a case study of Nordenskiöldbreen, Svalbard” (tc-2022-54) by Jan Kavan & Vincent Haagmans**

**Summary**

The authors lay out the issue that field measurement of glacier hydrology is difficult, yet significant computing & remote sensing expertise is often needed to ingest the large volumes of freely available satellite data. The authors therefore ask the question, “can one, without expert knowledge of processing remote sensing data, use Sentinel-2 imagery to study a subject as dynamic as the hydrological system of a tidewater glacier?” The authors manually digitize Sentinel imagery to characterize the areal extent of sea ice, supraglacial lakes, and sediment plumes as they evolve over the melt season of several years. The authors demonstrate that Sentinel is a useful tool for glacier hydrology surveillance, but don’t really ask or answer any science questions that advance the field other than “how do these things vary?”. I don’t see any serious flaws in the study, but think the study generally illustrates something that is already well-known (i.e., that satellite data, and particularly high spatial & temporal resolution data, is useful for glacier research). The study could be strengthened by framing their research around a process-based question about glacier hydrology. However, that is something of a value judgement/opinion, and think the manuscript could be publishable after addressing the following major & minor comments, constituting what I think are “minor revisions”.

**Major Comments**

- 1) In Section 2, you lay out a lot of background on previous work conducted on Nordenskiöldbreen, but never state “why this glacier”. Why is this your study site? Are there reasons to expect that this is a better/worse site for a Sentinel case study than any other Svalbard glacier (or global glacier, for that matter)?
- 2) On L96 you state that “the areal extents of sea ice, sediment-laden meltwater plumes, and selected supraglacial lakes were quantified using Sentinel- 2 satellite false-color images” but give no criteria for how you are going to define these features? What image interpretation cues are you using to say something is sea ice vs. icebergs, do you consider frozen supraglacial lakes, etc.?
- 3) Use of transition words like “furthermore” sometime seem out of place/incorrect. “Furthermore” implies that you’re building on a previous argument, but “additionally” seems like a better transition word (you’re often just adding more information, not necessarily “building a case”) > for example L78.

**Minor Comments**

L24: Need a citation to support that subglacial discharge is generally the primary mechanism for meltwater export.

L43: Perhaps worth noting that the tidewater glaciers disproportionately contribute to Svalbard glacier area/mass flux/mass loss (if true).

L45: O’Neel et al. (2015) would be a good reference to support this statement > doi: 10.1093/biosci/biv027

L53: Svalbard glaciers are retreating significantly faster than other Northern Hemisphere glaciers? If so, “faster” is missing from this sentence.

L63: Unclear > your evidence that the glacier is partly land terminating is that there’s no crevasses? Can you not just see land in the images? There are other ways to get crevasse free ice.

L64: Can you provide a little more information about what these “morphological features” are?

L68: Incorrect period after “m” in 30 – 60 m a<sup>-1</sup>

L98: Surely given the magnitude of previous work done on this glacier, someone has quantified the melt season and you don’t have to just assume a start/end date? Or can you use meteorological data to identify when temperatures go above 0 °C on average?

L112: Is there any temperature offset between the two met stations? Do you correct for it?

Fig 3b: How is sea ice concentration defined?

L128: The sentence starting with “probably” should be combined with the previous sentence – it is not a complete sentence.

L134: How do you know the water came from snow on the mountains and isn’t locally sourced glacier melt?

L137: Can you see surface streams in the imagery? That could help you rule out surface connection between the lakes accounting for the synchronous timing. I suspect your latter hypothesis (separated systems responding to a shared forcing) is the most likely.

L139: Clustered how? Spatially or by their behavior? This is also discussion, not results.

L163-165: You should note that you can also use microwave remote sensing to see through clouds, coarser resolution traditional satellites (e.g., MODIS), or cubesats (e.g., Planet) to get around these cloud & temporal sampling issues.

L166: Subglacial discharge may not make it to the fjord surface if: 1) the flow is hyperpycnal due to high suspended sediment load, or 2) the upwelling discharge plume reaches neutral buoyancy below the surface (e.g., Donald Slater papers). These limitations should be acknowledged in using plumes as your sole proxy for subglacial discharge. (Recurring at L193).

L189: Citation or more justification needed that the discharge conditions would inhibit vertical water movement.

L198: Strange to say maximum temp is approximately 10 °C and then say 17 °C in the following sentence. Please clarify different metrics or simply statement.

L206: This finding could also suggest that subglacial hydrology acts as a flow integrator over these timescales.

L212: “Massive” is subjective, and you don’t actually quantify subglacial discharge > reword.

L231: This is stylistic, but I would suggest the conclusion have a “wrap up” sentence instead of ending with this specific example of air temp-plume area relationship.

Review by William Armstrong