Below, Reviewer 4's comments are in bold and our response is in normal font. Changes to the manuscript text are in italics.

Best regards,
Ian Delaney, on behalf of all authors

- **Line 10: change "Experiments" to "Numerical experiment".**

  Done.

- **Line 12: add "also" between "we" and "apply.**

  Done.

- **Equation 1: It seems wc was not explained. Also, in the previous version of the paper, Equation 1 does not have a wc term, but you have one in this version, could you explain the difference?**

  This was a mistake and the term as been removed.

- **Equation 3: Equation 1 has the variable wc, while Equation 3 does not. Please check this inconsistency.**

  Please see the comment above.

- **Line 124: Change "the first term" to "the first term on the right-hand side".**

  Done.

- **Line 128: what is the difference between "a width of the glacier bed w" at line 128 and "channel width wc" defined at Equation 9? Are they the same or not? If they are the same, please explicitly describe this. If not, then please explain the difference and clarify how to calculate glacier bed width w.**

  The text now reads:

  Note that w is not necessarily the channel width, but rather a representative width across the glacier bed over which sediment can be accessed by water flowing through the subglacial channel (Figure 2). The channel width w_c is used to calculate the width over which to apply the sediment discharge capacity and is discussed below in Equation 9, that converts the hydraulic diameter D_h to channel width.

- **Equation 8: In the previous version, the right-hand term is multiplied by wc, but in this new version, the wc is omitted. Is there a reason to do this?**

  This has been added.

- **Line 135: In Equation 7, is the term, (2 - Delta sigma H)/5, a dimensionless value? I suspect the format Delta sigma*H should be Delta sigma/H? From the texts at Line 135, Delta sigma has the same unit of H. The unit will be the squared unit of H if you multiply Delta sigma with H. Please add clarification for this. If I am correct that (2 - Delta sigma H)/5 should be (2 - Delta sigma/H)/5, then H = Delta sigma, means sigma(H) = (1+exp(1/5))$^{-1}$ = 0.45, which is not 0 as you mentioned at line 135. Please check on this.**

  We thank the reviewer for this comment, and note that the other reviewer brought similar concerns to light. The proper equation, and the one used in the code, is

$$\sigma(H) = \left(1 + \exp\left(10 - 5\frac{H}{\Delta\sigma}\right)\right)^{-1}. \tag{1}$$

The units of $\Delta\sigma$ are now m (Table 3), so the $\sigma(H)$ term is dimensionless. The text has been rewritten as *As H approaches $\Delta\sigma$...*.

- **Line 254: add parenthesis to separate T and C?**

  Done.

- **Line 339: Here you mentioned that the grain size is the most influential factor controlling the model's predictive capability. In my understanding, the grain size also has impacts on the Darcy- Weisbach friction factor. In this paper, the friction factor is assumed as a constant. Could you add a few comments on how the combined impacts of grain size on friction factor (Equations 1 and 11) and transport capacity (Equation 8) can likely affect the mode performance?**

  We appreciate this comment and believe that this is topic of important research. However, we are hesitant to comment on this given the assumptions of our hydraulics model and poorly constrained hydraulic factors, such as channel shape, sinuosity, and the variations between bedrock and sediment that could cause the factor to in response to till height.

  However, we have brought the matter to the reader's attention by including this comment in the "Model limitations" section:

  Lastly, we have chosen single friction factor f_r for the entirety of the run. This factor can vary in time (Pohle et al., 2022) and can be impacted by other factors such as sediment grain size or bedrock along the channel bed.

- **Line 359: add a space between "13" and "are".**

  Done.

References

Pohle, A., Werder, M. A., Gräff, D., and Farinotti, D. (2022). Characterising englacial R-channels using artificial moulins. *Journal of Glaciology*, page 1–12.

Below, Dr. Hergarten's comments are in bold and our response is in normal font. Changes to the manuscript text are in italics.

Best regards,
Ian Delaney, on behalf of all authors

- **Eq. 1 has an additional factor w_c compared to your 2019 paper, which makes it dimensionally incorrect.**

  This factor has been removed, and its addition was an unintentional.

- **The sigmoidal function (Eq. 7) is the same as in your 2019 paper, but the interpretation in the text is wrong. The property $\Delta\sigma$ must be inverse length, so that something like $\Delta\sigma = H$ makes no sense.**

  We appreciate this comment and am glad that Dr. Hergarten brought it to our attention. We have changed the text to read *As H approaches $\Delta\sigma$*. Additionally, while working on another project it was pointed out by a co-author that the equation for σ should be written as:

$$\sigma(H) = \left(1 + \exp\left(10 - 5\,\frac{H}{\Delta\sigma}\right)\right)^{-1}, \tag{1}$$

  The equation in the manuscript in has been updated. Note that the sediment connectivity factor (or mobilization height) is treated differently in **?**, such that here H is divided by $\Delta\sigma$, where as they are multiplied in **?**. However, the units here have been changed such that $\Delta\sigma$ is in m.

- **Q_{sc} in Eq. 8 is per unit width. So the channel width is missing (compare to your 2019 paper).**

  The term w_c has been added to the equation.