The Cryosphere Discussions

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Comment on tc-2021-151

Anonymous Referee #2

Referee comment on "Drainage of an ice-dammed lake through a supraglacial stream: hydraulics and thermodynamics" by Christophe Ogier et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-151-RC2, 2021

Review report, Ogier, Werder, Huss et al, Drainage of an ice-dammed lake, TCD

This manuscript is interesting for two reasons; first, it reports about interventions at an ice-dammed lake to mitigate flood risk and potential damage of a downstream village. Second, these interventions, i.e. lowering the lake level through a supraglacial channel, have been accompanied by a comprehensive measurement program to collect data on hydraulics and thermodynamics of supraglacial drainage. The first point is carefully documented for the reader having an interest in geohazards, but the focus is clearly on exploiting the second aspect. This choice is well motivated; drainage of water through ice-walled channels below glaciers has a strong influence on glacier dynamics, the incomplete understanding of which remains a major source of uncertainty in projections of future glacier response to climate change. Even though playing a very different role in glacier hydrology, by providing direct access supraglacial channels avoid the difficulty of accessing the subglacial environment and offer a great opportunity for studying thermodynamics and hydraulics of ice-walled drainage. So far, only few studies have exploited this aspect, and the submitted manuscript is therefore a welcome contribution. I do not have major objections, but the number of minor comments amounts to a moderate level of revisions, needed to make the manuscript publishable.

Detailed comments:

L21: add the Mayer&Schuler reference (Breaching of an ice dam, Annals of Glaciology, 2005) to complete the list of studies documenting type iii) drainage

L114: can you provide an uncertainty measure for the lake volume?

L127: hydraulic slope (dimensionless, expressed as water head drop per horizontal channel length)

L128: …the velocity averaged over the cross-section…

L154: …were marked with stakes…(plural)

L156: GPS accuracy: in the horizontal or in the vertical?

L157ff: CTD description: what are the specifications for the conductivity probe?

L161: the stated uncertainty of the water level measurements is in the same range as the readings presented in Fig 5. Isn't this a major problem? how significant are the recorded variations?

L169: uncertainty (instead of error)?

L170: please describe how you picture the formation of these melt-imprints and how this relates to diurnal discharge variations.

L179/180: either 'salt dilution' or 'tracer dilution', 'salt tracer dilution' is redundant

L180: referring to this method is ambiguous, there exits more than one dilution method, (continuous vs instantaneous injection)

L188: …which was the case for all presented measurements. How do you know this?

L191: clarify: correcting a shift is not the same as filling a gap

L198: The model has been calibrated using the seasonal mass balance data collected by…

L200ff: please add information to complete model description: what is the period over which the model has been applied? State source and location of data used for model forcing. How did you deal with precipitation? Simply using the meteorological records or some adjustments?

L210ff: the description of salt dilution measurements should be moved from 'data processing' to 'field measurements' (sect 4.1)

L212: were the concentration standards prepared using in situ water or de-ionized water? In the second case, how did you deal with naturally occurring background concentrations?

L214: …were integrated over the time of the tracer passage, for each injection…

L215ff: how many data samples have been used to establish the rating curve?

L225: wording: a gap in water level records cannot be filled with discharge.

L228: hydraulic slope or hydraulic gradient, use either or and be consistent throughout the paper, avoid synonymous expressions.

L235: …is the wetted cross-sectional area…

L250ff: since you describe Nu and Pr, do it for Re as well, what does it characterize?

L270ff: make this clear: there exist two parametrizations for Nu, in addition, you use two further methods to determine it. In the present text, this is confusing.

It would be very helpful to have a table listing all salt dilution measurements and their results (date, time, Q, v, S, used for rating curve y/n), but this may be material for the appendix.

L300: …of the latter compared to previous years.

L300: the increasing trends of both…are visible (plural)

L302: In warmer years, the date….

L303: …depletion of the winter snow cover…

L307/8: We distinguish four different phases.

L316: The channel bottom elevation and its evolution with time … The incision shows…

L320: In contrast, the higher slope…led to more turbulent water flow and subsequent formation of step-pools

L321: Note that meandering did not occur…

Fig2: please use a consistent formatting of timestamps on the x-axis. Here the format is DDMMM but in Figs 5,6 and 8 it is MM/DD

Fig3: vertical axis should be simply labeled 'Elevation'

Fig3: the color code for the lake level seems not to correspond to that of the channel bottom measurements. As is, the lake level is always lower than the channel bottom (for all dates), and since this is a subaerial lake, it is impossible that it would drain through the channel.

Fig6: use larger symbols to denote the measurement points, at the present size, the different symbols are difficult to discern.

Fig6a: vertical axis should be simply labeled 'Elevation'

L373: It is noteworthy that our results…

L378: We collected an extensive…

L406: is indication for slush-ice ….but also for the influence of form friction (as opposed to skin friction) in a complex 3d channel geometry

L422: …than our values and those of …

L423: …of these two studies…

L436: …the basis for estimating Nu in our …

L448: …was considered by Jarosch and Gudmundsson (2012) who suggest…

L451: …but extending the study of… could shed light on this issue.

L455: state the volumes!

L458: Still, construction costs were lower than the damage…

Sec 6.4: what are the perspectives for the future? Will the existing channel close are may it be re-used in subsequent years (then at a fraction of the costs!) what happened to the lake in 2020?

L478: However, the large spread found in our study suggests considering the friction factor…

L489: …afflicted with…

L491: …will have to allow for large uncertainties.

L496: A is the cross-sectional area (you used the symbol S in eq 6)?

L500: …the only relevant heat source is negative and stems from the consumption of energy related to ice melt…

L501: This can be justified, as these two sources are on the order…

L508: …which uses the assumption dQ/dx =0