

Brief communication: A ~50 Mm³ ice-rock avalanche on 22 March 2021 in the Sedongpu valley, southeastern Tibetan Plateau

Zhao et al.

General comments:

The authors present a good overview of a recent ice-rock avalanche that occurred in the Sedongpu Basin, which is turning into a global hotspot for large and highly mobile mass movements. The contribution is generally well written, easy to understand, and adequately illustrated with the most important figures. I mostly have some specific comments and questions, which I have outlined in detail below, as well as a number of small suggested technical corrections. To the extent that it is adequate for a brief communication, a bit more information about previous events and some more detailed meteorological analyses would, in my opinion, elevate the publication to a more meaningful contribution.

Specifically, it would be nice to have some additional context about what kind of terrain the 2021 avalanche encountered. The geomorphology of the basin has changed drastically since the low-angle glacier detachment documented by Kääb et al., 2021: How much ice is left? Is there a lot of loose debris that can be entrained, or is the valley largely scoured of such material? Additionally, I think it would be very informative if a map/table of all previous events could be provided: Did these all originate from the same ridgeline? When exactly did they occur, how large where they etc. Some of this can be gathered from various places in the text and the supplementary information, but it would be nice to have it all in one place. I'm not suggesting an in-depth analysis of all these events, but just showing the key parameters would provide really useful context.

With regards to the meteorological data, can you show more specifically for all the events what the meteorological conditions were in the days/weeks preceding the event (rather than focusing only on mean values). Possibly use positive degree days, positive degree content etc. Are the temperatures you show (Fig. 3) lapse-rate corrected for the elevation of the failure?

Specific comments:

L26: ...*considering the lens*... what do you mean by this? Can you be more specific. Also, consider separating this sentence clause from the previous, rather different ones.

L29: ...*region which ... Plateau interior* → unclear whether these glaciers are more sensitive to climate change because they are temperate or because there is some regional difference to those of the Plateau interior (or is the difference thermal)?

L37: ...*with development of its attendant economic corridor*... → unclear what this means, please clarify

L61: ...*led to the installation of* ... by the authors, by local authorities, ...? Please clarify who installed the instrumentation.

Fig. 1: Some suggestions: Indicate river flow direction in panel b); is *Brahmaputra* the correct label for the river in panel b)?; can you indicate the locations of e)f)g) in panel b). There are lots of panels in this figure – I wonder whether separating them into two figures, and also including something about the geologic context – which is currently completely missing – would be an option. It would be nice to see panels c-d) a bit bigger.

L98: Where the stage data also used for local alerting of authorities or only of scientific interest? This could be an interesting piece of context to provide here?

L101: Two events provide very little information about the true return period of such a catastrophic event. Maybe rather than being somewhat vague in saying that the data *provides insight in the minimum return period...* ” I think it would be better to be specific and just state something along the lines of: ... *indicate that no event of similar magnitude has occurred here in the past 200 years.*

L103: I presume you didn't actually just assume an overtopping height of 200m, but rather measured it somehow. Please specify how and where this was measured.

Figure 2: can you indicate avalanche travel direction in panel b)?

L115: What makes you assume that the avalanche could have exited the basin within 100 seconds? The velocities this gives you are extraordinarily high (faster than the speed of sound!!) and seem rather unrealistic, so you should provide more background on how you came up with this number.

L128: What exactly do you mean by *maximum depth*? Is this the maximum surface lowering in the source area? Or of the deposits? Or everything? Please clarify.

L136: *incorporating rock as it descends* → this formulation implies that the avalanche started as an ice avalanche, and entrained (incorporated) rock as it descended. However, in the video we cannot see the avalanche runout, so we cannot know whether rock was incorporated along the way. What we CAN see (in my opinion), is that the avalanche is initially made predominantly of ice (white dust clouds), but transitions to something that involves much more rock in the second part of the video (dust clouds get darker, we can see falling rocks). If this is what you were intending to describe, consider reformulating.

L141: can you put the 15.1 Mm³ of deposited material into context with the total volume?

Your next sentence implies that you expected more deposition, but you don't state this explicitly. Also, what area is *the valley* that you mention here? In other words, which area did you consider for this statement? All material has to go somewhere, so if the mobility of the flow was high, the material might just be further away. If the summation of all deposited material amounts to only 15 Mm³, then there are several options for why this could be the case: 1) 35 Mm³ were ice that melted and can no longer be detected in DEM differences 2) the material was deposited over such a large area that the resulting deposits are thinner than what can be detected in DEM differences 3) a lot of material was washed down the river. Of course any combination of factors can be the case. It would be interesting to get your perspective on the most likely scenario(s).

Finally, you say there that *most of the avalanched materials were widely distributed on the valley bottom, neighbouring glacier and the outlet of the valley basin.* Similar to the comment above: where did the rest (that is not most of the avalanched material) go? I get the sense that you have an assumption about this (e.g., transported away by the river), but you don't explicitly say so.

Figure 3: I think it would be very informative if you added an outline of the runout path to panel b). I also suggest making panels d-f their own figure: This is very different information, and I think the meteorological data deserve a bit more prominence on their own.

L154: During which time has the Gyala Peri region experienced more seismicity? Are you simply saying that its seismically more active than other regions (why do you compare to Namjagbarwa?) or are you making this statement for a certain time period associated with the occurrence of the mass movements?

L161: ... *eventual 2021 failure at the ridge crest is more commonly associated with earthquake triggering in historical inventories...* It is not clear to me what you are intending to say here. Please clarify.

L164: ...*significant increase in mean air temperature and decrease in precipitation ...* Consider showing this information in a figure?

L185: v) *increased meltwater lubrication at the bed of perched ice masses* → It's not clear whether the temperatures you show are for the elevation of the failure or not. Are there enough positive degree days to create significant melting?

L193: *event occurred outside the 'regular' summer ablation season* → make this point earlier, not only in the conclusions

L195: Are there specific plans for hydropower development close to this basin (you say *in the region* – but it is not clear how large of a region you are referring to) or are you making this as a general statement for places anywhere?

L196: turbidity → maybe mention this earlier? No details needed, but it's strange to bring up completely new facts in the conclusion.

Technical corrections:

L15: *highly mobile flow* → highly mobile *mass* flow

L23: *...international border, making it ...*

L24: *...complex events ... geomorphic legacy.* Rather awkward sentence construction that is a bit hard to read.

L38: Use of *Indeed* is not logical, since the following sentence does not really refer to anything that was mentioned in the previous sentence.

L42: *...in the southeastern Tibetan Plateau* → suggest removing this superfluous information

L44: *...at its confluence with ...* → *the* instead of *its*

L49: *...the basin has recently...* → delete *has*

L49: *...experienced large ice-rock avalanches...* → can you specify whether there were **two, three, several, a suite of ... ice rock avalanches that totaled 50 Mm³** (is it coincidence that this number is the same as that of the 2021 event?)

L52: *...damaged or seriously threatened roads, power lines...* → which one is it? Damaged or threatened? Or did both things happen, in which case **and** would be the more appropriate conjunction

L57: remove *of difference*

L69: delete *away*

L74: use *determine* instead of *establish*?!

L75: use *calculate* or *estimate* instead of *establish*

L76: what exactly do you mean by the *immediate flow path*?

L97: sudden lack *thereof* instead of lack *of*

L114: *If the avalanche material runout...* incorrect use of runout as a verb

L133ff: *Analyses...* This and the next sentence are very long, combining clauses that don't fit together very well, making them somewhat confusing. What is close to what? When were the things? Consider improving.

L137: Something is either *in the vicinity of [something else]* or *in the same region as, not same vicinity*

L141: Replace *preservation of deposits associated with the event* with simply *deposition* (→ *Such limited deposition implies that ...*)

L153: either *put forward as* or (more simple) *suggested* or *proposed*

L156: suggest removing *massive*