

## ***Interactive comment on “Geospatial Analysis and Simulation of Glacial Lake Outburst Flood Hazard in Hunza and Shyok Basins of Upper Indus Basin” by Syed Naseem Abbas Gilany et al.***

### **Anonymous Referee #1**

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Gilany et al. present an outburst flood modelling study for three glacial lakes in Pakistan. The study is interesting but lacking key details required for its justification. For example, it is not clear why these lakes are ‘potentially dangerous’ as referred to throughout the study. It should be detailed why these lakes constitute a hazard. The manuscript requires significant English language and grammar editing. The introduction requires significant restructuring, editing, and addition of relevant literature. It is repetitive in several places and does not proceed logically or provide a clear context for the study. Rather it jumps between discussions of glaciers in Pakistan, global glacier retreat, surging glaciers, glacial lakes, and Himalayan glaciers. There are numerous statements throughout the manuscript containing details that are not supported with ci-

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tations. The study requires significant attention in order to properly ground it in existing literature. The flow modelling procedure is lacking basic details on how it was carried out and how parameters were selected, which means it is difficult to review the results. Similarly, several flood modelling figures are lacking readable legends. It is also not clear from the figures that the model domain was large enough to avoid flood modelling errors, or that the DEM used is suitable, or what the associated uncertainties are in the modelling approach and simulated flood extents. I suspect that the manuscript may be suitable for publication in The Cryosphere after significant revisions, but it may fit better in another journal.

Specific comments: L10 ‘anthropogenic factors’.

L18 Why is the water ‘turbulent’? Do you mean the ASTER GDEM? If so cite the appropriate version and change in the later text.

L43 ‘Indian subcontinent’.

L44 This is not an appropriate reference relating to downstream water supply. See Immerzeel et al. (2010), Quincey et al. (2018), Immerzeel et al. (2020).

L48 Add a citation for ‘many disastrous glacial lakes’. ‘The damming’ of what?.

L51-52 This is incorrect.

L53-55 This needs a citation unless it is related to Che et al, in which case make it clear.

L71-73 This is repeating what has already appeared in the introduction.

L79-80 Also repetition.

L80-81 This sentence on Baltoro is out of place.

L84-85 Surges are not necessarily coupled with glacial lakes.

L95-97 A lake does not form in all cases.

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L98 Vital for the stability of what, the lake?

L99 What is a 'heavy accumulation zone'?

L109 'quite similar in length'?

L111-112 Provide a citation. Is this on average? I'm not sure it is really relevant.

L133 Superscript '2'

L152 Provide a citation.

L166 I think the grey shading between the panels is unnecessary. What are the brown coloured lines within the green polygons? Please show the location of all lakes modelled in this figure.

L176-178 I'm not sure that 'panoramic views' are relevant to the study, nor the following sentence.

L183 Specify the source of the glacier outlines. It would be useful to add an elevation model or river network to show the basin topography and flow direction.

L189 What are the other glaciers in addition to 'valley glaciers'?

L197 Use degree symbols.

L199 This figure could be added as a panel alongside Figure 2.

L205 Is this a version of the ASTER GDEM or a DEM you have generated using ASTER data? How were the data interpolated and why?

L214-215 Provide an NDWI citation.

L219 Specify the HECRAS version you used and whether it was a 1D or 2D model. Refer to other studies that have used HEC-RAS to model GLOFs, including limitations such as consideration of sediment loading and bank erosion.

L233-234 The meaning of this is unclear.

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L256 What is 6b?

L270 What are the specific thresholds used for these decision rules?

L279 What is 'erosion and blocked lakes'?

L280 Use km<sup>2</sup> for consistency.

L285 '5 km'.

L297 Earlier it was stated that you used a 15 m DEM. How was the energy slope derived?

L305 Detail why this empirical relationship is suitable for application to the lakes in your study.

L316 Quote fewer significant digits. Does depth refer to a max/mean depth?

L319 What is the 'data input interval'? Is this the complete duration of the simulation, or time to peak discharge?

L334 Why is this a potentially dangerous lake? The text is not visible on panels d-f. Why does it look like the model formed a large lake on (d)?

L343 Why is the damage extent in metres. Shouldn't this be an area?

L347 What was the source of information for the village areas?

L355 The village/buildings should be marked for clarity. Add a scale and north arrow.

L374 The 3D model on the left needs further information adding (legend, lake location, markers etc).

L393 These lake depth values are very small. What is the source of the data?

L402 The panels need legends.

L411 Specify what you mean by 'damage extent' and other 'output parameters'. Are

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these max values, or an average?

References Immerzeel, W.W., Lutz, A.F., Andrade, M., Bahl, A., Biemans, H., Bolch, T., Hyde, S., Brumby, S., Davies, B.J., Elmore, A.C., Emmer, A., Feng, M., Fernández, A., Haritashya, U., Kargel, J.S., Koppes, M., Kraaijenbrink, P.D.A., Kulkarni, A.V., Mayewski, P.A., Nepal, S., Pacheco, P., Painter, T.H., Pellicciotti, F., Rajaram, H., Rupper, S., Sinisalo, A., Shrestha, A.B., Viviroli, D., Wada, Y., Xiao, C., Yao, T., and Baillie, J.E.M. (2020). Importance and vulnerability of the world's water towers. *Nature* 577, 364-369. Immerzeel, W.W., Van Beek, L.P.H., and Bierkens, M.F.P. (2010). Climate change will affect the asian water towers. *Science* 328, 1382-1385. Quincey, D., Klaar, M., Haines, D., Lovett, J., Pariyar, B., Gurung, G., Brown, L., Watson, C., England, M., and Evans, B. (2018). The changing water cycle: the need for an integrated assessment of the resilience to changes in water supply in High-Mountain Asia. *Wiley Interdisciplinary Reviews: Water* 5, e1258-n/a.

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