

# ***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.***

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The following is a list of the specific comments and the changes incorporated in the manuscript:

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

Water in glacial lakes is ‘turbulent’ because of glacial mass movement. The ASTER GDEM has been utilized.

L43 ‘Indian subcontinent’.

Corrected.

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).

Corrected.

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

Inserted. The damming of glacial mass.

L51-52 This is incorrect.

Cited.

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

Citation is related to Che et al.

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

Deleted.

L79-80 Also repetition.

Deleted.

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

Corrected.

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

There is a probability.

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

Not necessarily, but it can happen.

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L98 Vital for the stability of what, the lake?

TCD

Vital for the stability of the glacier.

L99 What is a 'heavy accumulation zone'?

Heavy accumulation zone, because of heavy snow fall.

L109 quite similar in length'?

The glaciers were quite significant in length in comparison with today.

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

Cited.

L133 Superscript '2'

Corrected.

L152 Provide a citation.

Cited.

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

Figure has been changed.

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

Corrected.

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.

Figure has been changed.

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

TCD

Other glaciers in addition to valley glaciers are mountain glacier.

L197 Use degree symbols.

Corrected.

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

Ok.

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?

ASTER GDEM data has been interpolated to 15m for the purpose of achieving high resolution.

L214-215 Provide an NDWI citation.

NDWI is Normalized Difference Water Index.

L219 Specify the HEC-RAS 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.

HEC-RAS version 5.0 is used and it was a 2D model.

L233-234 The meaning of this is unclear.

Deleted.

L256 What is 6b?

It's one of the Landsat-7 band.

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

If the surface texture is smooth and the slope is not pronounced then such areas are

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recognized as glacial lakes.

TCD

L279 What is 'erosion and blocked lakes'?

Erosion and blocked lakes are the types of lakes.

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

Corrected.

L285 '5 km'.

Corrected.

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

Corrected. Energy slope was derived based on distributing glacial mass flow along boundary condition.

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

The Costa empirical relationship is suitable for application to the lakes in this study because this empirical formula deals with peak discharge.

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

Significant digits have been used for depth.

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

Data input interval is the discharge time interval in mins.

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)?

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The lake is potentially dangerous because of its potential outburst and being hazardous to the downstream settlements.

TCD

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

It is the damage extent in meters.

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

The percentage of village habitat was in terms of parcel counts of the village.

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

Incorporated.

#### References

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).

Inserted.

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Interactive comment on *The Cryosphere* Discuss., <https://doi.org/10.5194/tc-2019-292>, 2020.

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