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Discussions

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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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Thanks for your comment as, "this paper has potential in this regard", and for your constructive suggestions concerning key details required. We are grateful for your constructive input on the manuscript. The feedback has helped us to improve the clarity and structure of the manuscript. We presented an outburst flood modelling study for two River basins in Pakistan. Surely the GLOF hazard in the Himalaya is extremely important and relevant in the current scenario of climate change. The lakes being discussed in the study present a great threat to the downstream settlements.

General comments and answers:

1. The abstract is too long and general. It lacks in representing the importance of the given study.

The abstract has been shortened and the importance of the given study has been represented in the revised version of the manuscript.

2. The methods are not clearly outlined in the manuscript. It is poorly organized and contents of different sections overlap.

The revised version of the manuscript has been better organized and methods are clearly outlined.

3. The results produced in the study are not sufficient to support the interpretations and conclusions. The discussion section lacks a comparative analysis, the results do not show any quantitative comparison with other studies in the region.

The discussion section has been augmented with comparative analysis and the results produced support the conclusions.

4. The English needs improvement in the entire manuscript.

The requisite English language and grammar editing of manuscript has been done in the final revised version.

Section-wise Comments and answers

Introduction:

The introduction lacks the latest literature on GLOF modeling studies in the Himalaya. (see the references below). I would suggest summarizing the structure of the paper in a few lines towards the end of the section.

The requisite restructuring and editing of introduction including addition of more literature has been incorporated in the final revised version of the manuscript.

Materials and methods:

1. The sections (2.1, 2.2, and 2.3) can be combined together into a common section as "Study regions and climate".

It has been re-organized.

2. Sections (2.4 and 2.5) can be combined as "Data and Methods"

For clarity sack these sections have been kept separate.

3. The details of the remote sensing data sets used in the study are missing. I do not understand why ASTER DEM is interpolated to 15m as it has an actual resolution of 30m.

The ASTER GDEM has been interpolated to 15m resolution to match the domain area mesh of 15m x 15m. The details of the remote sensing data sets utilized in the study are given in section 2.4.

4. Area-based scaling has been used to calculate the volume of the lakes. However, it is not clear which empirical relation has been adopted for the calculations. (Refer to Huggel et al., 2004; Cook and Quincey,2015; Fujita et al., 2013). As this is the most crucial factor in GLOF hazard evaluation, it should be discussed.

The volume calculations of the lakes are based on area and depth (Refer table 2 of the study). Volume=Area*Depth

5. The flow chart and the methodology doesn't explain about the breach hydro-graph. How is it obtained? What are the breach parameters? Mechanism of failure?. The methodology sections need to be revised and rewritten giving more emphasis on the GLOF parameters and flood hydro-graphs. There is a lot of overlap between the methods and results in the presented manuscript.

The methodology section has been revised with more emphasis on the parameters of flood hydro-graphs. The overlap has been removed.

Results and Discussion:

This section is too short and vaguely written. It does not provide all the required details of the results obtained. This section should be thoroughly rewritten.

1. In section 3.1 – It is more of a methodology than results. The number of lakes and hazard evaluation criteria for selecting the specific lakes for this study remains unclear.

The identification of glacial lakes and hazard potential criteria for selecting the specific lakes for this study has been incorporated.

2. In Section 3.2 the text mostly explains about the classification of the lakes and does not fit well in the section as the section reads as "GLOF analysis of Hunza basin"

The section has been revised.

3. The hazard criteria adopted in the study does not explain the thresholds used for dam geometry, free board, and potential lake impacts.

The glacial lakes hazard criteria is based on outburst potential including dam geometry/ free board and risk to the downstream settlements.

Section 3.3

a. The results and methods are not well separated here. The input parameters of the hydrodynamic model fits well in the method section than the results.

The input parameters of the hydrodynamic model including the values assigned is placed in the results section.

b. Section 3.3.1 is not clear how flood volumes were considered for the different GLOF scenarios.

The volume calculations of the lakes are based on area and depth (Refer table 2 of the study). Volume=Area*Depth

c. The potential flood hydro-graphs produced in scenario modeling is not shown. The initial breach hydro-graph is most crucial in any GLOF analysis as it determines the

flood hydraulics downstream as the GLOF propagates along the flow channel. This section needs to be rewritten showing results of the breach parameters and flood hydro-graphs.

The section has been revised.

4. In section 3.3.2 and 3.3.3, the routing parameters are not clear, there has been no mention of the surface roughness along the flow channel.

The routing parameters of the hydrodynamic model including the values assigned are given in table 1 of the study.

5. The boundary condition (upstream and downstream) for routing the potential GLOF event remains unclear.

Refer table 1 of the study.

6. Are the flow depths/ velocities representing the mean value along the cross section or just at a specific point?

The flow depths/ velocities represent the mean value along the cross section at the settlements.

7. There has been no mention of the flood wave arrival timings at specific sites along the flow channel.

Refer table 1 of the study.

Figures:

All figures lack in proper resolution. I recommend exporting the figures with a minimum resolution of 300 dpi for more clarity. Figures 2 and 3 can be combined. The drainage of the basin and the location of the potentially inundated settlements are not shown in the figures. Figure 5 can be removed. Figure 6-The ïňĄgure lacks location information. The legends remain unclear. The figure can be better represented using other GIS

platforms instead of RAS MAPPER. Figure 5-The figure lacks location information and legends. Figure 9-see comments for figure 6.

Figures 2 and 3 have been combined. The drainage of the basin and the location of the potentially dangerous glacial lakes have been shown in the figure. Overall the figures have been improved as suggested.

References:

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Few of them have been inserted.

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