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Interactive comment on "Integrated evaluation of water-related disasters using the analytical hierarchy process under land use change and climate change issues in Laos" *by* Sengphrachanh Phrakonkham et al.

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We wish to thank you all for your constructive comments in this round of review. Your comments provide valuable insights to refine its contents and analysis. In this document, we try to address the issues raised as best as possible

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Discussion paper

Q:Line 19: a comma is essential after country

A:The comma has been added on line 19

Q:line 22: instead of 'can lead to' you may change to 'can increase'

A: We revised it as your comment.

Q: It seems that the current version lacks of international significance of this work. Hence think they may consider the following works to improve its readership. Furthermore, authors reviewed existing works but missed many in the area https://royalsocietypublishing.org/doi/pdf/10.1098/rsos.191957
https://www.sciencedirect.com/science/article/pii/S2212420920312632
https://www.sciencedirect.com/science/article/pii/S0264837720305470
https://www.nature.com/articles/s41598-020-69233-2

A:We agree with the referee comment. The additional references are important for our work. Therefore, the literature recommended have been added in the introduction section on âĂć line 34-36 In addition, based on Adnan (2020) study on land use/land cover change and flood hazard on poverty in Bangladesh. At the end of their study, they argue that disorganized planning for land use is can increasing flood and poverty âĂć line 40-45 Shah (2020) simulate for surface water under different climate change scenarios using set of regional circulation model (RCM) and soil and water assessment tool (SWAT) model for mid-century (2040-2070) and late century (2071-2100). The result of SWAT under future scenarios shows increase in steam flow for mid to late 21th century. However, the increase of steam flow for mid-century was a bit higher compare to late century due to the increase of temperature impact to snowfall and accumulation. âĂć line 82-87 Yousefi (2020) produced multi hazard risk map in mountainous area using machine learning such as support vector machine, boosted regression tree, and generalized linear model to find the best model for each hazard and then create an integrated multi hazard in ArcGIS by adding each hazard together. Not only the technical capabilities of multi hazard map have to be consider but also the design of information provided on multi hazard map have play as important role for end user's preferences(Dallo et al., 2020).

Q:This requires serious attention Section 3.2: What do you mean by expressions in lines 108-109? Unclear

A: This sentence was not clear. We revised it as follows. The overland flow has two runoff processes, which are surface flow and subsurface flow, and these flows are connected by infiltration process. More detailed information is available from Phrakonkham(2019) as shown in the main text.

Q: What was the resolution of DEM and what was the vertical accuracy of the model?

A: The DEM on the model is 1km x 1km made from the original data with a spatial resolution 90 m x 90 m for the distributed model. Shuttle Radar Topographic Mission (SRTM) Digital Elevation Map (DEM) was used in this study and based on the 'The Shuttle Radar Topography Mission Data Validation and Applications Workshop, 2005' mentioned 6.2m as the absolute vertical accuracy.

Q: Clarify Section 3.6.1 This section requires describing the method clearly, how have you done this?

A: We agree with the referee comments about section 3.6.1 and have revised this section more clearly as below: We propose a hazard index, which is adapted from the relationship between velocity and flood depth (Sally et al., 2008). The index is used for the identification of dangerous area where most of adults are unable to stand in floodwater depth more than 1.5m and are unable to stand in flood water depth 0.5 m and velocity 2 m/s (Russo et al., 2014; U.S. Department of the Interior, 1988). The index is scaled from zero to one, with zero representing the lowest hazard and one representing the highest hazard, and is divided into four categories from small to very high hazard. A top table of Figure 1 shows these categories for velocity and flooded depth. Here the categories for flood depth were shown as a case of velocity 0 m/s as one example in a middle table of Figure 1 and we obtained a relationship between flood depth and the hazard index on a bottom graph of Figure 1. This process providing to the hazard index was applied to the study area using velocity and flood depth by the numerical simulation.

Q: Existing texts do not support this Line 174: should be “we wanted to..”

A: The text in line 174 has been changed to “we wanted to. . .”

Q: Line 185: How they have been chosen? At random? Was there any ethical permission sought? What were the main elements of questionnaire?

A: We made the interview for all of experts of government offices in the field of hazards and risks. For the questionnaire we obtained ethical permission. The main elements of questionnaire in this study are to understand weighted values on important aspects used in making decision by experts for five criteria according to AHP process.

Q: Discussion section is not properly reflecting what are you trying to achieve relative to your objective(s). Specifically, analyze and interpret your findings with the aid of theory, show similarities, dissimilarities. How your finding(s) differs from theory? Existing works showed above may be of help.

A: These sentences have been added to the discussion part to improve the section in the text: Dankers and Feyen (2008) assessed the influence of climate change to future flood hazard in Europe. They concluded that discharge from many rivers will increase on both magnitude and frequency by the end of this century. However, a few rivers will decrease discharge especially in the northeast Europe region. Mirza et al (2011) indicated that climate change will highly influence the monsoon precipitation and will increase the frequency, magnitude and hazard of flood in south Asia such as India, Bangladesh and Pakistan. Bouwer (2010) considered future precipitation and socioeconomic change such as land use and asset value, and obtained the damage cost as future flood risk. He concluded that the climate change will increase the damage cost of flood around 35 to 170% by 2040 in Netherland. Ciabatta (2016) investigated the impact on landslide in Italy using PRESSA model in central Italy. The model based on the relationship between rainfall and soil moisture condition (Ponziani et al., 2012). Although all these studies are similar to our estimation for each hazard, the evaluation unified these hazards have been not carried out for future projection. AHP is useful to integrate the different hazard and successfully proposes the hazard map, which is easy for people to understand the local hazard, using values provided by decision makers.

Q: Conclusion section is also need improvements. What are the limitations? What are the take-home message(s) of this work? Nothing is clear. As it currently stands, conclusion section is sketchy and does not lead to useful conclusion(s)

A: Some sentences have been added to the conclusion part to explain the limitation and take home messages of this work: There are some limitations of the AHP approach. The AHP approach supposes linear independence of alternatives and criteria. It is recommended for the future study to make a comparison between AHP and other multi criteria decision making approaches. AHP results are obtained from current conditions and are not guaranteed in the future. Longer analysis from now in Lao PDR is necessary to predict more reliable future situation. In addition, a hazard map with this study resolution cannot explain it in smaller scale areas. DEM with higher resolution will be required for understanding of local hazard.

Q: Reduce number of maps in the work, show only crucial ones and the rest can go into Sup Info

A: Figure 5 to 7 have been moved to supplements.

Please also note the supplement to this comment:
https://nhess.copernicus.org/preprints/nhess-2020-195/nhess-2020-195-AC1-supplement.pdf

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