

**Review to Flood hazard mapping and disaster prevention recommendations based on detailed topographical analysis in Khovd City, Western Mongolia, Author(s): Narangerel Serdyanjiv et al., MS No.: nheSS-2024-91**

**RC2: Comment on nheSS-2024-91, Anonymous referee #2, 30 Jul 2024**

First of all, many thanks for all your valuable comments and suggestions. Please see below for changes based on your comments.

**General comments:**

The authors describe a trend of increasing flood intensity and occurrence in Western Mongolia and the lack of natural hazard maps making developing and implementing mitigation strategies difficult. In response, they derived, using UAVs and ALOS PALSAR DEMs flood hazard maps based on geomorphological elements and identified 4 flood risk areas.

**2.1.** However, flood hazard mapping which may be lacking in Western Mongolia, is not novel, nor is UAV utilization to develop hazard maps.

**2.2.** It is clear that the application of results from the presented paper is important to the local population and practitioners and in further developing Mongolian hazard planning but does not contribute significantly to the field of natural hazard assessment and related processes.

In the semi-arid region like Khovd, where the risk of flooding increases due to global warming, it is necessary to quickly identify areas where water is likely to collect due to topographical factors and notify residents of the risk. The purpose of this paper is to propose a simple preliminary flood hazard map creation method in such an urgent situation. Geomorphological hazard mapping of this area can alert residents to potential unknown risks. Specifically, it solves the following problems:

- 1) Because the area is semi-arid and there is no running water, residents do not recognize the risk of flooding.
- 2) Because the terrain is generally flat, residents do not know where the water will flow during floods.
- 3) After an artificial embankment was built in the 1990s, the flood flow path changed, but residents cannot predict what will happen if the embankment breaks.
- 4) The Buyant River flows at a low level on the west side of the city, but the residents of Khovd have never experienced floods there historically, so they are completely unaware of the risk of flooding.

**2.3.** A potential suggestion that would, in my opinion, make the results more impactful is to use the derived maps (DEMs), inventories of critical infrastructure, and relevant hydrological data to expand upon the current understanding of flood processes in the region with 1d or 2d (as suggested in line 130) numerical modeling to better delineate hazard zones as they relate to discharge scenarios, and the potential hazard reductions in response to deployed mitigative measures.

We mainly focused on the development of flood hazard mapping (surface water runoff and flash flooding) based on UAV. In the semi-arid region like Khovd, where the risk of flooding increases due to global warming, it is necessary to quickly identify areas where water is likely to collect due to topographical factors and notify residents of the risk. The purpose of this paper is to propose a simple preliminary flood hazard map creation method in such an urgent situation.

**2.4.** Therefore, I opine that additional analysis and synthesis are required which would ideally include models that show inundation zones (and relevant hydraulic variables) and deal with anticipated changes in the rainfall regime which would greatly improve the quality of the manuscript while making the results more impactful to a broader readership.

This mean is covered in our previous article, which is currently under review. Thanks for your valuable advice.

### Specific comments:

**2.5.** The introduction requires refinement and more focus, such as elaborating on the strategies Narangerel and Suzuki et al (2023) developed to improve flood protection and if the current growth and expansion follow these guidelines.

*In this regard, additional changes were made to the abstract and introduction of the manuscript.*

**2.6.** It would be interesting to know how the presented work aims to improve or modify what is currently available or practiced in terms of hazard response.

*Thanks for your valuable advice. Changes have been made to some section of the manuscript.*

**2.7.** In general, details are too vague, specific values instead of terms like relatively slow (line 180) or  $Q_{max}$  would help improve the clarity of the paper.

*Yes sure, this specific values is irrelevant and has been deleted.*

**2.8.** Seasonal rainfall totals, anticipated rainfall totals, and a catalog of past floods in the city would all be helpful to give the reader more context.

*This mean is covered in our previous article, which is currently under review. Thanks for your valuable advice.*

**2.9.** There are several unpublished references, but surely there are published ones that can be used. Also, why are they unpublished (in review, etc.)

*This manuscript is second of the previous article. The previous article is under review. I mean that.*

**2.10.** Section 5.1: How were hazardous and vulnerable areas delineated? Are the maximum inundation depths known in the depressions? Without the paper's results being applied to a numerical model, it is hard to fully understand the scope of the hazard and the area of the city exposed to the hazard.

*This is covered in section 4.2 of the manuscript, please see there. Maybe I'm wrong, please tell me again*

**2.11.** Section 5.2: How did you come to these recommendations? Are they based on a similar case? Given the unique nature of the flood hazard in a city where 72% of the people reside in nomadic dwellings and are therefore extremely vulnerable, it would be helpful to understand why you think these points would be successful.

*Mongolian traditional nomadic dwellings is a ger. The ger is very resistant to flooding. In this regard, it is based on a questionnaire survey of the local residents of Khovd City. Elderly residents of the flood-affected areas also spoke about this.*

**2.12.** In the conclusion section, I don't think it is appropriate to say that a detailed flood hazard assessment was conducted. There is very little hydraulic data provided and the assessment that has been done is based exclusively on topographical surveys.

*Yes sure, we chaged assessment to mapping...*

**2.13.** In my opinion, a detailed flood hazard assessment would include modeling results where actual scenarios are tested that could delineate flooded zones and flood severity based on past and anticipated discharge values.

*This mean is covered in our previous article, which is currently under review. Thanks for your valuable advice.*

### Technical Corrections:

**2.14.** Line 13: during *the* Summer

*Corrected*

**2.15.** Line 20: Change govern to governments or practitioners (or something similar)

*The sentences were deleted*

**2.16.** Line 21: Change on to in

*The sentences were deleted*

**2.17.** Line 22: Maybe change along basins to within basins?

Corrected

2.18. Lines 27-28: Suggest changing heavy and downpouring to extreme (or intense) rainfall events

Changed

2.19. Line 34: In the parentheses, is this a current emerging disaster caused by recent flooding or the 2016 and 2020 events?

*This is a separate flood that occurred in the region bordering Khovd province.*

2.20. Lines 35-36: I am not sure I would describe a situation with 10 floods occurring over 30 years as highly susceptible, especially compared to the flood frequencies of other mountain regions worldwide.

*The Khovd city is located in a semi-arid region and on gully of lower part of high mountains, so it is very vulnerable to flash floods.*

2.21. Line 48: change to expansions

Corrected

2.22. Line 51: delete a (...through a detailed topographical survey...)

Corrected

2.23. Line 82: km<sup>2</sup>

Corrected

2.24. Line 83: I don't think gully is the appropriate term here also is flash flooding in this context only overland flow i.e. not channelized?

2.25. Or describe how these processes (flash vs river flooding) are different as they relate to the region i.e. flood flood-generating mechanism, orographic influences, hazard potential, etc.

2.26. Line 84: What is a yellow water flood?

*Explained (snow meltwater)*

2.27. Line 86: the river *is* covered

Corrected

2.28. Line 88: What is the  $Q_{max}$  and how much has it increased? Add values, please.

Deleted

2.29. Line 110: How were the interviews used in the study?

*We collected questionnaires from 54 local residents during the field mapping study and double-checked flood risk areas. Added a small sentence about it on 3.1.section. It Included:*

*In addition, during the field mapping step, the flood hazard areas were checked under questionnaires from local residents.*

2.30. Line 115: What was the associated error of the validation process (relative and absolute accuracy)?

2.31. Line 124 (Figure 3) hiishade to hillshade.

Corrected

2.32. Line 128: What is (2022) referencing?

Deleted

2.33. Line 138: How were the 2 DEMs integrated to develop a flood hazard map?

*You're right, the Alos Palsar DEM was not used in this study to a particularly high importance, so the all means was removed from the manuscript altogether. It was my mistake sorry.*

2.34. Line 141: hiishade to hillshade

Corrected

2.35. Line 144: References in chronological order

2.36. Line 145: Is the newly developed DEM a combination of the 2 DEMs of unequal resolutions? More detail on this, please.

*It developed by UAV only*

2.37. Lines 148-155: Background information should be in the introduction.

*Moved to the Study area*

2.38. Line 160: Add space we developed

Corrected

**2.39.** Line 174: ...it is located...

Corrected

**2.40.** Lines 179-180: not clear

Improved the sentence.

**2.41.** Line 182 Fig. 4: The red line is not in the legend (same in fig 1).

Added a explain sentence in fig 1 and there have red line on the legend of fig 4 which are two longitudinal profiles.

**2.42.** Line 190: why and how were cells grouped?

In detailing the DEM we created from the drone mapping and aerial images , we calculated the percentage of each cell showing its own flow direction into the attribute database on GIS. This is important in determining where surface runoff may accumulate and pose a hazard.

**2.43.** Line 203: References in chronological order.

It is automatically by Zotero

**2.44.** Line 217: What sediment analyses were executed? Please provide details as to the sampling and analysis methodology.

Sorry it was mistake, we couldn't take sediment sample, and it is just sediment character and feature so I we changed the word for mean

**2.45.** Line 221: Sustained

Corrected

**2.46.** Lines 223-224: Are these based on the interviews shown in Fig. 2. If so add a reference.

Corrected

**2.47.** Line 231: Severe?

Corrected

**2.48.** Lines 234-243: All background information for the introduction. Most of section 4.3 is background information.

In this manuscript, I wanted to provide an understanding of the risk of flash floods in the dry valley and gullies of Khovd city and the flood risk of the Buyant River. These 2 flood conditions are separate understands and conditions. In other words, this city is located in the middle of the flash flood condition and the river flood condition.

**2.46.** Figures 5-7: Missing red dashed line in legend.

Added explain sentence in the figure desription

*The red dashed line shows the profile slope.*