

Review

“Assessment of climate change and land use development effects on dam reliability”
by P. Taherei Ghazvinei, H. Hassanpour Darvishi, R. B. Hashim, S. H. Musavi Jahromi, and N. Aghamohammadi

The manuscript under review presents a very applied study and claims to investigate how climate change and land use change in a catchment in Malaysia affects the dam reliability (which I would call safety) in some decades. Three variations of floods were simulated and it is concluded that those do only have a marginal effect on the water levels inside the reservoir/impoundment under investigation.

The topic generally addresses issues of importance to the readership of the journal. However, the manuscript is generally not well written, it lacks critical discussion and in most parts it is very difficult to read due to language issues. Based on the number of comments, questions, and concerns extended below, the manuscript in the present form is not yet mature enough to be considered suitable for the permanent literature.

Assessment: It is thus reasoned to not recommend it in its current form for publication.

Major and minor detailed comments are provided below to help the authors to further develop their manuscript.

General comments:

1. The manuscript does not read well in technical and linguistic terms. Before publication, it is consequently necessary to have it proof-read by a native speaker. The reviewer started suggesting language and expression improvements for the abstract but stopped as it was too tedious to continue throughout the manuscript. This needs a professional service before being ready for publication.
2. The introduction only partially touches the relevant literature. I cannot see any reference to the manifold bulletins which are published by the International Commission on Large Dams (ICOLD) which is a standard resource of information in regard to dams in general. It would suit the purpose of this manuscript to show that the findings (which are much on the applied side anyway) are well in agreement with those stipulations on dam constructions.
3. The introduction of the PMF is somewhat weak and deserves a more thorough description in order to allow readers understand what is spoken about later on. E.g., it is not enough to reduce the PMF to be influenced to change of land use and climate. It definitely is also a function of the drainage area, its topography and slope characteristics, hence the whole interplay of factors needs at least to be mentioned. In this context it would be interesting to also compare the author's results of conversion of PMP to PMF against empirical envelope methods such as the Creager or the Francou-Rodier equation which relate the peak flow with the drainage area. Please direct a comparison towards these empirical relations and discuss how this fits into the climate change influence discussed herein.
4. The introduction misses out on a key element in scientific papers: the level of novelty is not addressed at all. This observation aligns with the lack of clarity in terms of objectives and goals which are not found to be mentioned in the introduction. It is required to more clearly state what objectives the authors pursued and where those objectives are tied into the lack of knowledge which ideally was found from a proper

literature review/discussion. All those elements I cannot find easily in the introduction and thus it needs significant improvements.

5. Besides all the issues regarding the methodology section provided below, there is one main issue the reviewer holds against the authors. It relates to the modelling of the flow in the vicinity of the dam site which usually is composed of overflow conveyed over the spillway and the flow released through the sluice gate at the bottom of the dam. It does not become clear why there was no more modelling involved other than the parametric model HEC-HMS aiming at simulating the system on the catchment scale. In particular the flow through the spillway requires more sophisticated means of simulation, either 1D with e.g. HEC-RAS, or given the steep slopes of many spillways worldwide, better 2D or 3D models linked together in a model cascade.
6. It is also important to look into backwater effects which might occur downstream of the dam site effectively reducing the flow capacity of the spillway and river cross-section involved. The current work does not convince that there has been enough focus on those local effects which however become crucial when looking into dam reliability. And again, there is no information regarding the actual dam structure which makes it extremely difficult to judge what is going on there. The authors need to provide a fair bit of information to let the audience value the work by themselves.
7. The result and discussion section is particularly disappointing to read. From what is promised in the manuscript title one would expect to learn how the climate change and land use variation over the years would contribute to increase PMF used for the design of a dam as an application. But there is no more distinguishing between the two factors the authors set out to focus on. From the title, readers would expect to know how a single change, say of climate only, would affect the design for a dam. What is more, the manuscript suffers greatly from the unclear language in which it is written. There is a great need to be more specific and it is advised to use as many references as possible to underpin the author's case.
8. Section "Conclusion" should either be renamed to "Summary" or there needs to be actual meaningful conclusions to be drawn which will eventually help others to learn how to address climate and land use change with respect to dam reliability.
9. Moreover, it does not seem convincing that the maximum water level inside the impoundment just marginally increases and that the dam is still safe given the drastic increase in rainfall detailed in the methodology section. It might be more important to vary the climate change factor quite a bit more in order to see how these variations will affect the water levels inside the impoundment. Also, there is a need to look into the processes where the spillway is involved.

More detailed comments (keyed to page (P) and line (L) numbers):

1. P3/L9: Wrong/imprecise wording "Flood rises". Consider words like flow depth, surface elevation, flood level
2. P3/L9: Please write "Considering the climate change factor ..."
3. P3/L11: Please revise to "..., the year of 2020..."
4. P3/L14: Remove "of" before 2030
5. P3/L16: Define PMP, PMF, HEC-HMS also in Abstract.
6. P3/L16: Please modify to: "The software HEC-RMS..."
7. P3/L17: "flood rises", please see above comment
8. P3/L17: Revise the double use of "and" in the sentence.

9. P3/L18: Mention what “modified technique was used” or remove from abstract.
10. P3/L20: Use “investigated” instead of performed.
11. P3/L23: What is “marginally adequate”, reads awkward.
12. P3/L25: Please use: “..., the dam safety in terms of hydrology was assured.”
13. P4/L8: “As the importance of safety increases...” Please focus this sentence more clearly, it reads very unspecific. Without changes in external forcing such as climate change, there would definitely be no reason to re-assess dam safety as dams are usually build according to well-drafted design codes which include measures for safe constructions even under extraordinary loads.
14. P4/L19ff: Please add the exact reason why a re-assessment is necessary. This does not become clear without consulting the reference.
15. P4/L22: “Spillways are a common way to...”
16. P4/L23: Consider reformulating: “If a spillway is not designed properly...”
17. P4/L26: Please enclose abbreviations in brackets.
18. P4/L 27: “The body of a dam...” The actual design criteria needs to be explained in more detail. In particular, it is not about the body of the dam, but about the amount of water that can be stored in the dam impoundment and conveyed through the overflow spillway such that no crucial part of the dam construction is affected. This needs to be detailed in a more technically correct way.
19. P5/L1: What is normal in the context of historical climate data? This statement needs revision. Also, the sentence requires more explanation on what the “targeted performance” is. It appears as if this is a portion of some other work the first author led, but it is difficult to understand without further explanation. E.g., it would be advantageous to learn, for which types of infrastructure these statements were made and whether the methodology is applicable to dams in general and earth filled dams in particular.
20. P5/L17: Please detail the term “mismanagement” in this context. The term includes a pre-judgement and needs additional justification.
21. P5/L20: Refrain from stating the obvious yet highly contested without properly referencing.
22. P5/L20f: Sentence difficult to understand, please revise.
23. P5, L21f: Incorrect grammar (tenses mixed).
24. P6/L4: Grammar issue “It ...”
25. P6/L25: What height is referred to? Crest height? Please be specific. Is there a local datum to which this is referred to? Please state the important facts.
26. P6-Fig1: Figure is neither mentioned nor explained. Please tie in the Figure and introduce the study area to the readers.
27. P7/L1: What is “RL”, please always write in full the abbreviation used.
28. P7/L1f: What is “Integrated Agricultural”? Unclear.
29. P7/L3f: “... double cropping planting ...” Unclear what this sentence should say? Needs revisions.
30. P7/L8: Please always use SI units and its derivatives. I assume this is m^3/s
31. P7/L9: “the GIS tool ...” What GIS tools were used and what methods were applied to yield the information stated? Please be precise in your description of the work.
32. P6/7: Section 2 requires more visual details, e.g. provide a plan view of the dam and impoundment. Detailed overview over the spillway and related measures taken at the dam site would also greatly help the reader understand how the spillway is constructed as its cross-sectional area, slope, energy dissipation mechanisms will most certainly affect how well storm water discharge is conveyed downstream. This is

essential to this study which in my understanding exactly addresses this questions under climate change aspects.

33. P7/L19: “fundamental PMP convention”. Please detail, unclear. Needs citation/reference.
34. P7/L22: Please properly cite the software the authors used.
USACE, “Hydrologic modeling system,” HEC-HMS Technical Reference Manual CPD-74B, Hydrologic Engineering Center, Davis, Calif, USA, 2000.
Another reference for detailing the use of HEC-HMS might be the following:
D. Halwatura and M. M. M. Najim, “Application of the HECHMS model for runoff simulation in a tropical catchment,” Environmental Modelling and Software, vol. 46, pp. 155–162, 2013.
35. P8/L1-6: Please detail the rainfall logger units. What brand and manufacturer, is there information about accuracy? Who did collect the data or are these public domain? If so, a proper citation is needed? Who did the analysis
36. P8/L9: Please change to “coefficient of determination”.
37. P8/12: Please give proper reference to the Thiessen Polygon method.
38. P8/L14: What data correction was conducted? This needs more detail or proper referencing.
39. P8/L15-20: Figure 2 in general needs better explanation. Figure 2b needs to be explained particularly, as the data plotted are maximum rainfall data (at least it says so in the figure caption). When was this rainfall event? Do maybe exist discharge measurements in some of the rivers in the catchment area? This might help detailing the hydrological situation in the catchment.
40. P8/L21: Caption – please stick to one chosen way of calling the IDF’s. Earlier in the manuscript the term was hyphenated, now it is not. Also, there is no need to repeat what was introduced as an abbreviation before. Please revise.
41. P8/L23: Where are the positions of the auto-logger stations? How many?
42. P8/L25: What does that mean? Did the authors perform a peak-over-threshold method based on annual rainfall maxima? This needs more description in order to be comprehensible.
43. P9/L1: Please let the readers know more about the existing data? E.g. what time record was used to compile the existing rainfall intensity data?
44. P9/L4: What is the “Chart” station? Is this meant to be a name or something else?
45. P9/L5f: What was compared? Be more precise and specific.
46. P9/L5ff: Figure 3a shows distinct differences and the authors fail to explain those.
E.g., it would be advantageous to the manuscript to detail how the differences were brought about and yet, sufficient discussion is lacking. Please revise accordingly.
47. P9/L14: What is a “usual” storm burst? Please drop mentioning or explain in detail.
48. P10/L1-3: As the manuscript claims to deal with climate change and land use changes on dam reliability, it is odd that climate change impact on the rainfall intensity is treated just by referencing to work which was done by other (external) parties (NAHRIM). The reader is presented linear factors and there is no indication where these factors came from. The authors need to detail, how the CCF were produced. Was it regional downscaling and how did this happen? Then, it need discussion how this will affect the catchment area which could be accomplished by computing the differences in discharge. The reviewer figures that this might be somewhere else in the manuscript, but here is the place to mention this and discuss it properly.

49. P10/L11: Please name the agencies and stakeholders adequately. Currently there is no way to identify who is responsible for what.
50. P10/19ff: It is inadequate to present results of imperviousness and its projected change in future in such short way. As this is presented under the methodology section, one would at least hope to learn, how the main results – an increase in imperviousness of 4.5% - had been assembled. The authors cannot assume the reader to second-guess how these values were developed.
51. P10/L20: Mismatch between Figure 3c and text. What is the year the authors try to project land use data onto? 2020 or 2030? This should be devised more carefully.
52. P11/L1-4: Reference needed.
53. P11/L8ff: Please re-arrange the manuscript structure and refrain from micro-fracturing the text with all those 3rd level captions. This reads very odd.
54. P21/L3: Insufficiently detailed reference. Please revise or dig out the proper scientific basis of the work cited.
55. P11/L10ff: Awkward grammar, need revision.
56. P11/L19: Define “storm efficiency” as well as “storm maximization”.
57. P12/L4-9: The mention of the chosen reference storm event needs better citation. Also, how did the transposition of the storm event into the area of interest happened. Little is provided for the reader who might be well interested to know whether this was just by guessing or by some hidden scientific means.
58. P12/L12: Engineers don't “operate”, they design, plan, optimize or manage, consider word change.
59. P12/L16-19: Grammar revision needed. Please also increase clarity of writing.
60. P12/L28-P13/L10: Although the described method might be the method of choice in Malaysia, this part of the method section needs to be tied into the international context. One would need to answer, how the conversion from PMP to PMF is conducted in other parts of the world; in particular, it needs a portion in the introduction referring to standard procedures provided in literature.
61. P13/L11f: Do the authors mean “retention potential” or why does an estimate of the retention damage is of need? My understanding is that it is necessary to know how much water is held back during a major rainfall event and with what delay does it arrive at a certain site. This to my knowledge is called retention potential.
62. P13/L24: Figure 4 is introduced but the essence of what the figure shows is not mentioned. There needs to be more and specific information and description in the manuscript text.
63. P14/L1-6: Where do the readers find all the mentioned values? There needs to be a table or explicit mentioning in the text, what parameters were chosen.
64. P14/L13-16: It would be advantageous to present input parameters used for the modelling. Please amend the manuscript and properly describe/interpret them.
65. P15/L11-24: It is paramount to discuss properly why the different methods used yield so different results. In particular, the physical method (depicted in gray) yields very large precipitation values and it is not well explained why this happens. Is there an actual physical reason why the two Hershfield methods fail to produce such large precipitation values?
66. P21/L8: Editor name needs revision.
67. P25: Left panel of Fig. 1 needs a closer view. Additionally, legend fonts are illegible, there are no city and tributary names provided. Information content is thus poor and needs improvements. The reviewer understands that some of the methods provided

in here rely on GIS, so why did the authors not use such a GIS system to provide a much clearer and precise overview figure?

68. P26: Please add inset with greater location to Fig. 2b. Plot the rain fall stations used in this study accordingly. How should the reader know where these are? This will add to the impact of the manuscript. Positioning of the green rainfall amounts in the map need adjustment as they should not sit on top of the isohyets.
69. P27: All panels of figure 3 need larger label font size and improved readability. Correct mismatch between text and figure 3c as well. It also says current (2012) whereas in the text P10/L22, the authors refer to 2015. The reviewer does not hope that this material has been published elsewhere a couple of years ago.
70. P29: Figure 5. Please use SI units to label y axis. It is assumed that this is mm precipitation, but this needs to be indicated for readability. Also, legend does mention a “hydro meteorological model (gray)” and the two Hershfield methods, but it is fairly difficult to comprehend from the manuscript what all this should be. There needs to be more explanation.
71. P30: Figure 6: Use SI units only in the manuscript, drop cumecs units and abbreviate properly. Adjust figure caption as there is no mentioning of the larger rainfall durations (5 and 7 days).