**Response to the comments**

We are thankful to Reviewer (RC2) for their time and valuable feedback on our manuscript. We have carefully addressed and justified all the observations made in the review. Text in red color highlights the changes made in the revised manuscript.

1. Please ensure the **abstract** is short but reflects the approach, results, and conclusions correctly and concisely. Please check the keywords and highlights to ensure they are appropriate and complete. Highlights should be very brief and to the point and attractive to the readers of this journal. Kindly rearrange the keywords according to alphabetical order.

**Response:** Following the suggestion, the abstract has been modified, and keywords have been arranged according to alphabetical order. "Cliff collapses in small lakes and reservoirs induce powerful waves, threatening the offshore infrastructure. Unlike previous studies on waves induced by granular slide, this study experimentally and numerically investigates the waves induced by rotational cliff collapse, whereby the cliff fragments upon impact with the water surface, and determines the wave amplitude, runup, and energy transfer mechanics. Results indicate that as the water depth decreased, the impact Froude number and relative wave amplitude increased, wave velocity decreased, and splash showed greater elongation. The numerical modelling results also confirmed the experimental trends. Moreover, compared to an equivalent amount of granular mass sliding down a 30° slope, rotational cliff collapse produced 28-42% higher wave amplitudes due to the acute impact that transfers energy more efficiently. Machine learning based prediction models were subsequently developed to predict the wave amplitude and runup. The prediction models performed well both in the training and testing stages, with high $R^2$ values, and were validated via established statistical indices, sensitivity, and parametric analysis. The prediction models highlighted a cumulative 90% contribution of impact velocity, cliff height, and the number of fragments on the wave amplitude. In comparison, runup is greatly influenced by bank slope angle, impact velocity, cliff mass, and height. The experimental results and developed prediction models can provide the basis for understanding the rotational cliff collapse-induced waves and can help with disaster mitigation and risk assessment by effectively predicting the wave amplitude and runup.

Keywords: Cliff fragmentation; landslide tsunami; prediction models; rotational cliff collapse;

wave amplitude, and runup."

2. The paper lacks a comprehensive background and literature review section in a **tabulated form**. To enhance the significance of the study, the authors should include an in-depth review of related literature. To enhance the clarity and comprehensiveness of the introduction section, the authors are kindly requested recommended to include a pertinent table.

**Response:** We thank the reviewer for the suggestion. A comprehensive literature summary on the existing prediction models for the water wave amplitude and runup is already included in the original manuscript as Table 1. This table does not duplicate the literature that has been discussed in the text; rather, it provides a detailed summary of the key studies related to prediction modelling of water waves, thus highlighting the most relevant and fundamental work in the field of wave mechanics.

| Authors | Predictive model |
|---|---|
| (Kamphuis and Bowering, 1970) | $A_m = \left(\frac{v_s}{\sqrt{gh}}\right)^{0.7}\left(0.31 + 0.2\,log\left(\frac{l_s}{h^2}\right)\right) + 0.35e^{-0.08(x/h)}$ |
| (Noda, 1970) | $A_m = 1.32\frac{v_s}{\sqrt{gh}}$ |
| (Huber and Hager, 1997) | $\frac{H_m}{h} = 2 \times 0.88\,sin\,\theta\,cos^2\left(\frac{2\alpha}{3}\right)\left(\frac{\rho_5}{\rho_w}\right)^{0.25}\left(\frac{V}{wh^2}\right)^{0.5}\left(\frac{r}{h}\right)^{-\frac{2}{3}}$ |
| (Fritz et al., 2004) | $A_m = 0.25\left(\frac{v_s}{\sqrt{g_h}}\right)^{1\cdot4}\left(\frac{s}{h}\right)^{0.8}$ |
| (Panizzo et al., 2005) | $\frac{H_m}{h} = 0.07\left(\frac{T_s h^2}{ws}\right)^{-0.45}(sin\,\alpha)^{-0.88}e^{0.6cos^\theta}\left(\frac{r}{n}\right)^{-0.44}$ |
| (Heller, 2007) | $A_m = \frac{4}{9}\left[F\left(\frac{s}{h}\right)^{1/2}\rho^{1/4}\left(cos\frac{6\alpha}{7}\right)^2\right]^{4/5}$ |
| (Mohammed and Fritz, 2012b) | $A_m = max(A_{C_1}, A_{C2})$<br>$A_{c1} = 0.3F^{2.1}\left(\frac{s}{h}\right)^{0.6}\left(\frac{r}{h}\right)^{\left(-1.2F^{0.25}\left(\frac{s}{h}\right)^{-0.02}w-0.33/h\right)}\cos\alpha$<br>$A_{c2} = 1.0FS^{0.8}\left(\frac{w}{h}\right)^{-0.4}\left(\frac{l}{h}\right)^{-0.5}\left(\frac{\gamma}{h}\right)^{-1.5F^{0.5}\left(\frac{w}{h}\right)^{-0.07}\left(\frac{w}{h}\right)^{-0.3}}cos^2\,\alpha$ |
| (Wang et al., 2016b) | $A_m = 1.17F\left(\frac{sl}{bh}\right)^{0.25}\left(\frac{w}{b}\right)^{0.45}(\mathrm{Sin}^2\alpha + 0.6\cos^2\alpha)$ |
| (Li et al., 2023b) | $A_m = 0.59\sqrt{\frac{2H(1-f\,cot\alpha)}{h}\left(\frac{swl}{h^3}\right)^{N^{-0.11}}}\left(\frac{x}{h}\right)^{-0.43}\cos^2\left(\frac{2}{3}\alpha\right)$ |

*Note*: $l$ is the landslide length; $s$ is the landslide thickness; $w$ is the landslide width; m is the landslide mass weight; $V$ is the landslide volume; $H$ is the landslide height; $T_s$ time for motion of slide, $b$ is the river width; $h$ is the still water depth; $x(r)$ is the offshore distance from the bank slope; $\alpha$ is the slope angle; $\theta$ is the angular direction; $v_s$ is the impact velocity.

3. I am curious about the 'weak bond' as it is a critical parameter. It is recommended to provide a quantitative measure of bond strength. For example, what strength did you achieve by using 0.8 w/c and curing it for two hours? And how do you compare it with the inertial stresses upon impact with the water surface? This would allow others to reproduce the phenomenon and get results."

**Response:** We acknowledge the reviewer's observation, we have provided a detail on the bond strength in the revised manuscript. "To ensure the weak bond strength, several trials for bond strength were carried out after a curing period of 2 hours, and it was found to be in the range of 0.42-0.5 MPa. In contrast, the inertial stresses at the time of impact were several times higher, such that they caused the fragmentation of the cliff. This condition was purposely designed to imitate naturally fractured cliff materials, confirming that the structure fragmented primarily along the joints upon impact with the water surface, consistent with field observations of rotational cliff collapses".

4. "The negative quadratic coefficient in Fig. 6(a) indicates a nonlinear response, such that at the start the wave amplitude increases as the impact energy increases, but after a certain value it decreases, due to reduced energy transfer at higher impact values." Please elaborate on why energy transfer decreases.

**Response:** Thanks for your valuable comment. We have added details on why the energy transfer decreases in the revised manuscript. "At higher impact values, the released energy was not fully used in the wave formation and propagation; instead, a part of the energy was dissipated in the formation of splash, and in the formation of air pockets and their subsequent collapse".

5. The conclusions presented in the manuscript as a list of discrete findings, although these individual findings are valuable and provide a deep insight into your results. But it is recommended to provide a clear, most critical implication of your work. For instance, granular slides underestimate the hazard caused by rotational cliff collapse and the effect of water depth on the induced water waves.

**Response:** Following the suggestion, we have provided the clear implications of our study in the conclusions: "Research findings highlight that accurate hazard assessment of the cliff collapse requires models that account for the rotational failure mode and the fragmentation upon impact with the water surface. Traditional granular slide models may result in an underestimation of the initial wave amplitude and energy transferred".

6. To enhance the **quality and clarity** of the **figures** in the manuscript, it is strongly recommended to revise all the figures (preferably using Origin and/or MATLAB) and add more relevant explanation to the respective captions (they must include relevant details such as the data source, experimental conditions, and any important observations or trends depicted in the figure).

**Response:** Following the instructions, all the figures have been redrawn using Origin, and more relavent explaination has been added to the captions of following figures in the revised manuscript.

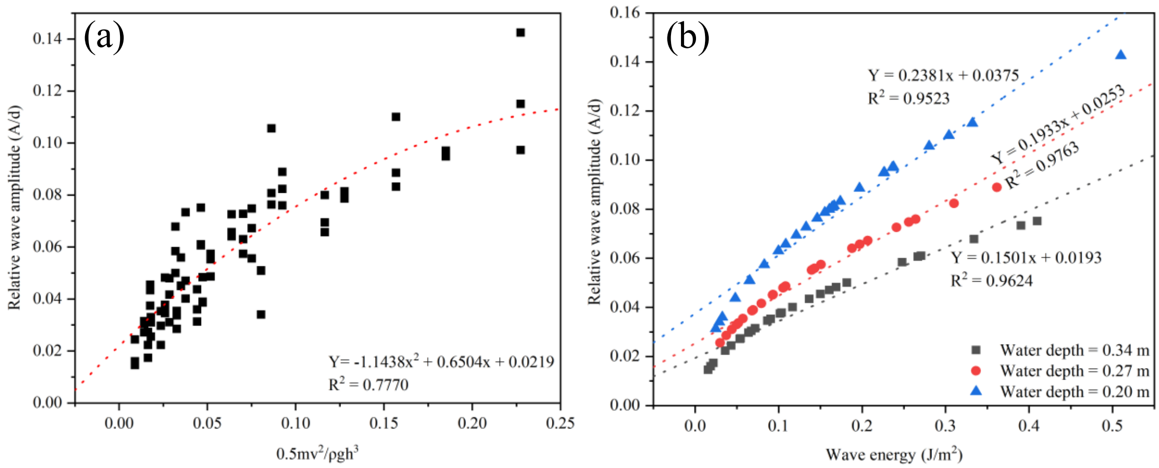


Fig. 6: (a) Dimensionless impact energy ($K.E/\rho gh^3$) vs relative wave amplitude, indicating a nonlinear trend, (b) Wave energy vs relative wave amplitude, indicating higher wave amplifications in shallow waters.

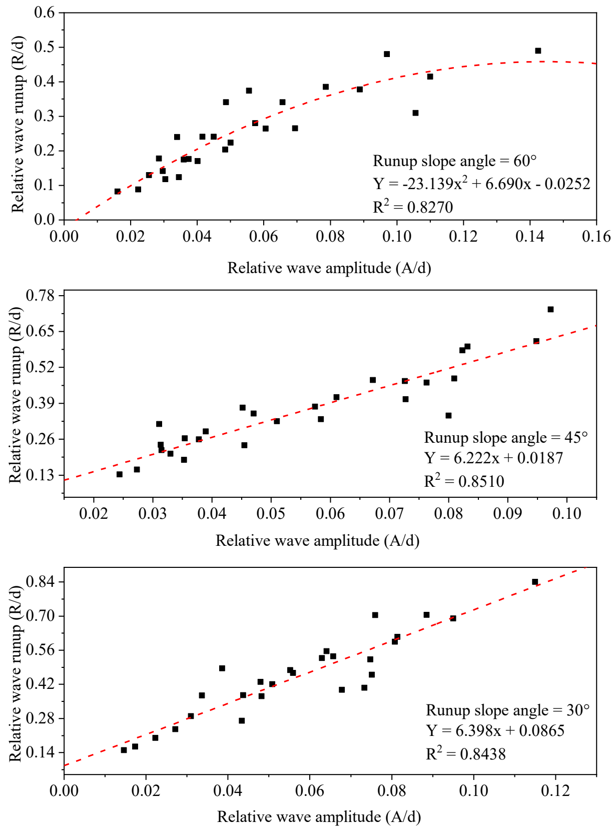


Fig. 7: Relative wave amplitude vs relative wave runup at various slope angles and water depth.

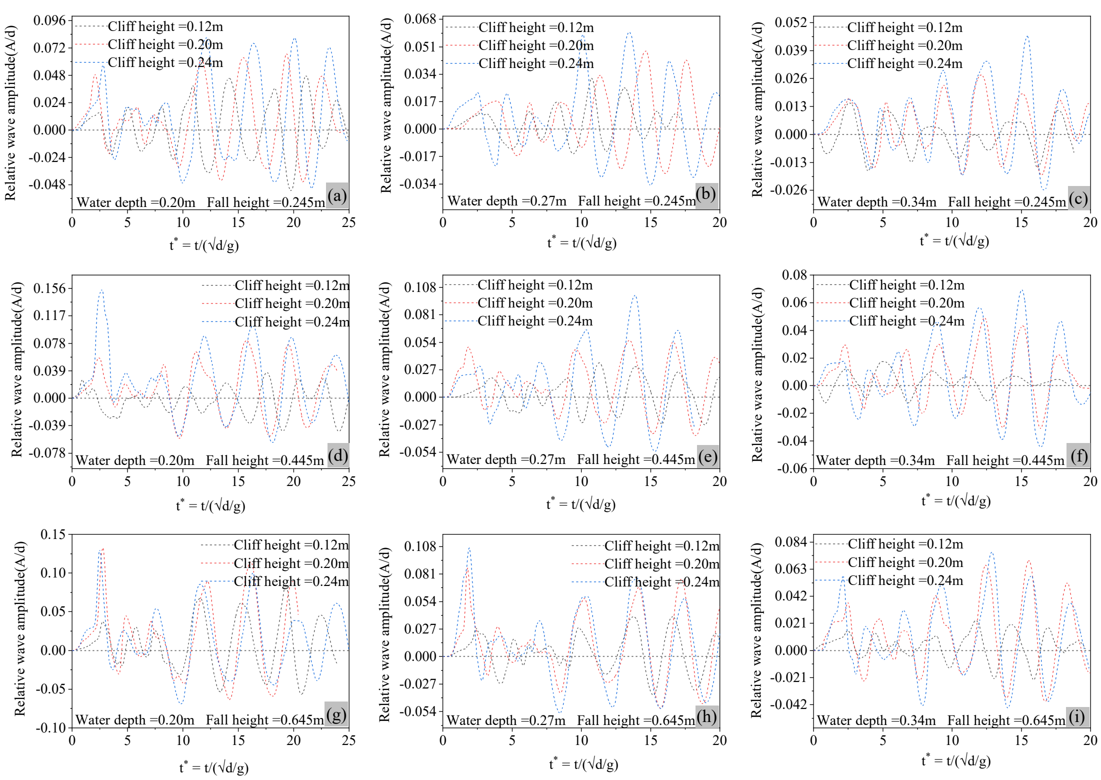

Fig. 10: Relative wave amplitude for various water depths, cliff height, and fall height at 30°runup slope angle, (a, b&c) relative wave amplitude induced by 0.245 m fall height, (d, e&f) relative wave amplitude induced by 0.445 m fall height, (g, h&i) relative wave amplitude induced by 0.645 m fall height.

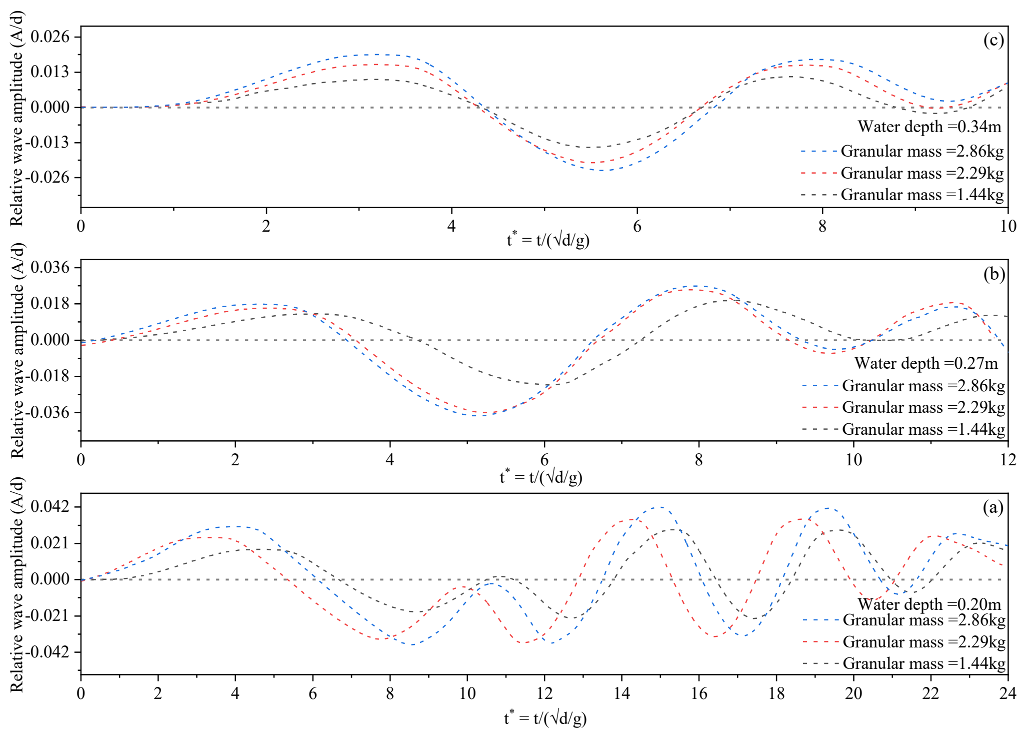


Fig. 11: Water waves induced by equivalent granular mass at 30° slope angle。

7. Kindly **rewrite the abstract and conclusion** of the research article by providing a detailed description of the main results and the methodical steps used to achieve them. Highlight the novelty in the Abstract. Please include specific quantitative values

**Response:** According to your suggestion, the abstract has been modified and rewritten. Explanation can be seen in the first comment. Moreover, the conclusions have also been revised according to the instructions.

1. It was concluded that water depth strongly controls the shape of the induced splash and wave amplification. Shallow water induced elongated, tall splashes, and higher wave amplitudes; in contrast, deep water produced mushroom-shaped splashes with higher energy dissipation and lower wave amplitudes.
2. The higher values of Froude number (> 1.2) for all the experiments indicate that the viscous effects were negligible, so the Froude number was selected as the most suitable dynamic

scaling factor for describing the behaviour of the waves.

3. The wave amplitude was greatly influenced by cliff height (51 %), number of fragments (22 %), Impact velocity (18 %), cliff mass (4.69 %), and water depth (4.36 %). Whereas the wave runup was governed by the runup slope angle, impact velocity, and cliff mass.
4. The amplitude of the wave induced by equivalent granular mass sliding on a 30° slope was 28-42% lower than the waves induced by rotational cliff collapse, thus concluding that the mode of energy transfer to the water body plays a critical role in wave dynamics.
5. A novel MEP-based prediction model was developed for wave amplitude and runup. The model showed great performance during the training and testing stage, and showed high sensitivity to the used parameters, thus confirming its reliability.
6. Research findings highlight that accurate hazard assessment of the cliff collapse requires models that account for the rotational failure mode and the fragmentation upon impact with the water surface. Traditional granular slide models may result in an underestimation of the initial wave amplitude and energy transferred.

8. In the **conclusion** section, kindly provide a comprehensive summary of the main findings of the study, including the novelty of the approach used and its potential applications in engineering?

**Response:** We are thankful to the reviewer for their valuable comment. The conclusions have been revised and can be found in the previous comment. Moreover, a paragraph explaining the novelty has already been added to the manuscript. Furthermore, the last conclusion in the revised manuscript highlights its potential application in engineering. "Research findings highlight that accurate hazard assessment of the cliff collapse requires models that account for the rotational failure mode and the fragmentation upon impact with the water surface. Traditional granular slide models may result in an underestimation of the initial wave amplitude and energy transferred."

9. Please enhance the **readability of the paper**. A concisely presented paper with high readability can improve the impact of the article. Addressing these aspects would significantly enhance the scientific rigor and practical applicability of the study.

**Response:** Following the instructions, the readability of the manuscript has been improved, and the abstract and the introduction have been revised. Sentence structure has been improved.

10. Please ensure the **referencing** is relevant, up to date, and accessible to our international readers. Please cite only references that are relevant and absolutely necessary. Papers with TOO MANY references are generally not acceptable. It is strongly recommended to declare your total self-citations if you haven't done so (max 5 or 20% of total references, whichever is smaller).

**Response:** Thanks for your valuable insights. We have tried to add the most relevant references to the manuscript, since the manuscript covers three aspects, i.e., experimental, numerical, and prediction modeling, which is why there are a bit more references. Nevertheless, we have removed marginally relevant and redundant citations from the text. The total number of self-citations remains less than 20% of the total citations and fewer than 5.