Responses to comments of Reviewer #2:

We thank the anonymous reviewer for their helpful and insightful review and the effort taken over the comments. We address the points raised (in blue) in order that they are raised. Our responses are in black with any suggested text revisions in red.

First, what is the motivation of using MLSW for this case?

Authors used multi-layer SWE for numerical simulations, and showed that the computational efficiency of the MLSW solver is poor. Recent studies on HTHH (Pakoksun et al. 2022) showed that numerical simulations with NLSW or Boussinesq-type equations are in good agreement with the near-field observation. It would be desirable for the authors to perform numerical simulations with NLSW and Boussinesq eqs, and compare the maximum inundation heights and computational efficiency.

Authors may argue that the waves generated by the volcanic eruption are very dispersive. However, I am not sure that Lake Taupo is large enough for the waves to develop dispersive characteristics since the waves reach the shore in 12 minutes or less.

- We thank the reviewer for raising this question. The motivation for use of a multilayer non-hydrostatic type model is established in Hayward (2022a), where the scheme was compared against NLSW and Boussinesq-type equations implemented within the same numerical framework for waves generated by initial displacements and explosions.

- It is well evidenced from previous field tests and experiments that explosively generated waves can exhibit significant dispersive characteristics (Le Méhauté & Wang, 1996). Prior investigation of this phenomena with the multitude of simulation equations can demonstrate strong differences, especially in the form of the resulting wavefield (Hayward 2022b). In these previous comparisons, it is not seen that the size of the lake prevents dispersive wave characteristics developing when utilising a scheme capable of resolving them.

Second, it is unclear how the authors handled the bottom friction. One of the important factors for predicting current speed and Inundation height is the bottom friction coefficient. In the study of inundation by storm surges, Madli and Dawson (2014) claimed that variable friction can be important to take into account in storm surge simulations, and numerical models apply complex bottom friction fields. I would like to know how authors considered the bottom friction, and wet/dry interface for simulations.

- Thank you for this important point. For the simulations run in this study, bottom friction is implemented in the similar way as is done in Hayward (2022a) by adding a quadratic bottom friction term which is applied across all cells at each timestep, and described further by Popinet (2011, 2015) and Beetham (2015). A short description and reference will be added to address this within the manuscript at the end of Section 2.1.

- The wet/dry interface problem is addressed by Popinet (2020) and is unaltered in its implementation in this model.

L59-63 unclear

- Will simplify and rephrase to:

"The aims of this work are to present a detailed case study of volcanic wave hazard from idealised explosive subaqueous sources. By utilising an appropriate numerical scheme for the types of generated waves and with high resolution digital terrain models (DTM), this work will provide a basis on which future probabilistic hazard and risk assessments can be developed to take into account this potential volcanic hazard source."

L77 "have been attempted using" -> used

- We accept this succinct change.

Section 2.1 & 2.2 are similar to Hayward et al. 2022b. Authors may shorten these parts.

- We note that it is essential to maintain the independence of individual works, and we feel that these sections are necessary to keep paper standalone and are already kept towards a minimum.

Inconsistent in the simulated time. Which is correct? L204 "All runs were executed for 24 minutes of simulated time" L219 "All scenarios were computed until a simulated time of 1400 s"

- Thank you for noticing this oversight; the simulations were originally planned for 24 minutes but were actually computed for a slightly shortened completion time of 1400 seconds. We will correct this at L204.

L211 "The number of these placed along a section is set to match the maximum horizontal grid resolution." unclear

- Will rephrase to:

"The resolution of numerical gauges across each section is set to match the maximum horizontal grid resolution of the simulation."

L240 "leading to a longer duration from the first arrival to the maximum amplitude wave at greater distances from the source" unclear

- Will rephrase to:

"...across most of the lake. This leads to a longer duration between the arrival of the first wave and the arrival of the wave with the largest crest amplitude as the distance from the source increased."

L309 "For these sources, this does not happen and therefore the reflection, and the incidence of troughs between wave peaks at the inlet, produces negative (or reverse) discharges from the inlet towards the lake." unclear

- Will rephrase to:

"For these sources, the gate is not overtopped. The flux down this channel is therefore reflected back down producing a trough that is equivalent to a negative (or reverse) discharge from the inlet back towards the lake."

L312 72% of something?

- Will rephrase this part of the sentence as:

"...this reduces the peak discharge by 72% when the wave travels..."

Figure 4 & 5 The information on the wave height is hard to discern from the figures. It would be better to plot the maximum wave height along the perimeter of the lake (in 2-D)

- We understand the issue of accurately reading the data in these figures. However, this proposal would not resolve the issue as it would result in 40 small graphs which would struggle to be any more discernible than these two figures to convey the same information. In addition, this would mask details of the spatial comparison.

- Reviewer 1 suggested alterations to the two current figures which will be implemented, please see the response to this reviewer. Additionally, the data used for these figures, including the Python code used to generate them, are accessible from permanent links within the work.

References:

Beetham, E., Kench, P.S., O'Callaghan, J. and Popinet, S., 2016. Wave transformation and shoreline water level on Funafuti A toll, Tuvalu. Journal of Geophysical Research: Oceans, 121(1), pp.311-326.

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Hayward, M.W., Whittaker, C., Lane, E., Power, W. and Nukurangi, N.T., 2022b, April. Submarine explosive volcanism–numerical modelling of tsunami propagation and run-up. In Australasian Coasts & Ports 2021 Conference.

Le Méhauté, B. and Wang, S., 1996. Water waves generated by underwater explosion (Vol. 10). World Scientific.

Popinet, S., 2020. A vertically-Lagrangian, non-hydrostatic, multilayer model for multiscale free-surface flows. Journal of Computational Physics, 418, p.109609.

Popinet, S., 2015. A quadtree-adaptive multigrid solver for the Serre–Green–Naghdi equations. Journal of Computational Physics, 302, pp.336-358.

Popinet, S., 2011. Quadtree-adaptive tsunami modelling. Ocean Dynamics, 61(9), pp.1261-1285.