Review

On the manuscript **"Nonlinear processes in tsunami simulations for the Peruvian coast with focus on Lima/Callao"** by Alexey Androsov, Sven Harig, Natalia Zamora, Kim Knauer, and Natalja Rakowsky.

Overview: Conditional Acceptance Upon Minor Revision

The paper presents numerical simulations of tsunami flooding in Lima and Callao caused by a historical 9.0 magnitude earthquake on the Peruvian coast including strong nonlinear terms. Two numerical codes are implemented for solving the shallow water equations, although with different spatial approximations. The study is mainly concerned with the properties of momentum advection, bottom friction, and volume conservation. The text is mostly well-written and provides an important contribution to the study of ancient natural hazards. However, below you will find minor specific comments (including the references therein) that should be addressed/added towards the publication of this work:

1. The introduction could be better formulated and widened for a broad spectrum of readers. The authors do not discuss how inhomogeneous coastal and geomorphological processes can affect tsunami run-up heights and arrival times estimation from simulations in the introduction. Note that although this is related to the first type of tsunami modeling (using the authors' own jargon), indeed, the Sumatra 2004 earthquake had a similar magnitude and demonstrated that complexities in large tsunamis are not well understood (Arcas and Titov, 2006; Broutman et al., 2014; Rabinovich et al., 2017), highlighting the need to understand better and estimate local bathymetry. Although nonlinear terms in the tsunami code is one of the signatures of this work, the authors also do not discuss the disturbance on tsunami signals by local bathymetry and coastal topography, resonance, refraction, and nonlinearity (Mofjeld, 2009) concisely (only the reflection is discussed later at the end of the introduction). It would be good to have a short discussion on the commonality of inhomogeneous effects affecting water wave hazards (Shuto, 1967; Tuck and Hwang, 1972; Pelinovsky and Mazova, 1992; Golinko et al., 2006; Tsai et al., 2013; Chugunov et al., 2020; Mendes et al., 2022; Mendes and Kasparian, 2022). Finally, both introduction an conclusions should mention that wave run-up, and by consequence flooding, is stochastic and assumes a statistical distribution over spatial domains regardless of the chosen deterministic numerical model, see for instance (Choi et al., 2002, 2006; Geist and Parsons, 2008).

2. Although the authors do plot bathymetry charts, they do not give a sense of slope magnitudes. I recommend they to briefly describe in the text the mean slope magnitude and maximum as well. Not only water depth is relevant, but how fast this change take place as well, i.e. the slope (see references in the comment above).

3. In section 5 the authors discuss nonlinearity. I believe it to be important to show how the three types of nonlinear forcings vary spatially so that a proper evaluation of their effect is compared with tsunami run-up and flooding characteristics. The authors are already similar to that for a sample time series and spatial distribution of the cumulative effect of the three nonlinear forcings or by omitting one of them, but a separate analysis of each is also called for. The present plots on the effects of omitting one of the nonlinear forcings analyze only the outcome, but not the nonlinear term itself varying spatially.

4. The quality of figures is pretty low and they are generally small. Provided there is no page limit, I would support larger figures with higher resolution whenever possible.

5. I see no reason for the context of appendix A to be detached from the text itself, I recommend bringing it back.

Conclusion

The reviewer thanks for the opportunity to read this important work. Overall, I support the publication of this preprint once all these minor issues have been clarified/amended.

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