EGU24-11223, updated on 25 Jan 2025
https://doi.org/10.5194/egusphere-egu24-11223
EGU General Assembly 2024

Sensitivity analysis of a shallow-water model for landslide-generated tsunamis in Mayotte

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Since May 2018, Mayotte Island has been experiencing seismo-volcanic activities which may trigger submarine landslides and tsunamis. Numerical models are a powerful tool to build tsunami hazard maps and to establish evacuation plans, improving early-warning systems. However, a lot of uncertainties still remain in model parameters making it difficult to reproduce the landslide dynamics and the generated waves.

In this work, we perform a sensitivity analysis using the multilayer HySEA shallow water model [1, references therein]. HySEA simulates both a landslide and a generated tsunami. We focus on a scenario posing the greatest threat to the local community, involving a submarine landslide on the eastern side of Mayotte's lagoon at a shallow water depth [2]. Hydrostatic and non-hydrostatic results are compared and several numeric and physical parameters are investigated: grid resolution, number of water layers in the vertical direction, rheological laws, friction coefficients and grain sizes.

Our results show that using non-hydrostatic conditions, increasing the grid resolution and the number of water layers greatly impacts the computed waves. Increasing these parameters is worth the larger computational cost. Physical parameters related to the landslide also affect the dynamic and the final deposit of the granular mass. While the choice of the grain size, the used rheological law or the friction angles may lead to different results, almost no change was observed over an hour of simulation when the Manning coefficient is modified. In all our test cases, the differences appear mainly at the early stages of the simulations. Numerical gauges placed at locations of interest on Mayotte's coast allow a closer look at the numerical waves for a finer sensitivity analysis.

References

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