NUMERICAL MODELLING OF TSUNAMI INUNUNDATION CONSIDERING THE PRESENCE OF OFFSHORE ISLANDS AND BARRIER REEFS

Héctor Colón-De La Cruz, University of Puerto Rico: Mayagüez campus, hector.colon3@upr.edu
Peter Rivera-Casillas, University of Puerto Rico: Mayagüez campus, peter.rivera6@upr.edu
Adam Keen, University of Southern California, adamkeen@usc.edu
Patrick Lynett, University of Southern California, plynett@usc.edu

INTRODUCTION

Advances in computer programming have permitted researchers to predict and visualize how tsunami waves affect coastline areas. Although it's possible to use numerical model simulations to predict the inundation of tsunamis, the process has some limitations. In order to solve the Boussinesq-type equations for tsunami propagation in the near-shore, it typically requires hundreds of hours of computation time and/or multiple CPUs. (Tavakkol and Lynett, 2017).

Recently the University of Southern California developed a numerical model called Celeris, which can solve the Boussinesq-type equations faster than real time. The numerical model can run with minimum preparations on an average-user laptop and is able to provide results of wave inundation in a matter of seconds (Tavakkol and Lynett, 2017).

The purpose of this research is to validate the results of wave inundation provided by Celeris and to study how reefs affect the inundation in the shoreline. If Celeris is validated, it could be used to study how to reduce the impact of tsunamis in the coast, explore the possibilities of using reefs to dissipate the energy of waves, improve evacuation routes, etc.

PHYSICAL MODEL

The experiment took place at the Directional Wave Basin (DWB) at the O.H. Hinsdale Wave Research Laboratory. Two types of waves where chosen for this experiment, Solitary (H = 0.2 m) and S-type (T = 5 sec) waves. The water depth was 0.3 m. To test how Celeris calculated the run up in a plausible real-life scenario, 2 conical islands and 1 reef were added to the DWB (see Figure 1).

RESULTS AND CONCLUSION

To compare with Celeris, optical based runup estimates were provided by Rivera-Casillas (2017). Figure 2 shows the comparison between the inundation provided by Celeris and the inundation of the physical for the solitary wave. The results provided by Celeris show that the reef does reduces the area of inundation, but in this scale, it's so minimal that has almost no significance.

The inundation shape is similar in both physical and numerical model, but there is a difference in the inundation in the cross-shore direction. The almost 0.4 m difference in the wave inundation could be significant if it is scaled to a geospatial dimension.

The possible reasons why there is a difference between the Celeris and the physical model may be that the simplified approach of Celeris many not include all of the significant dynamics. Other reasons may include the roughness variable of the set up or numerical dissipation in the model. However, further research is needed to conclusively analyze the results.

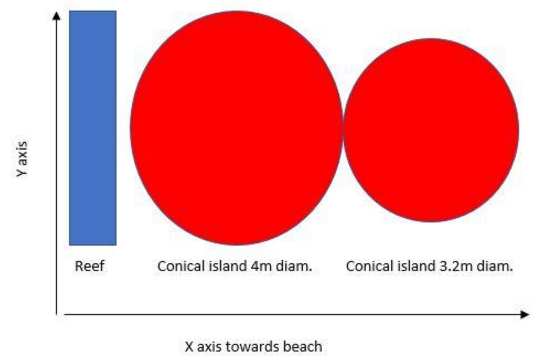

Figure 1. Physical modeling setup in the Directional Wave Basin.

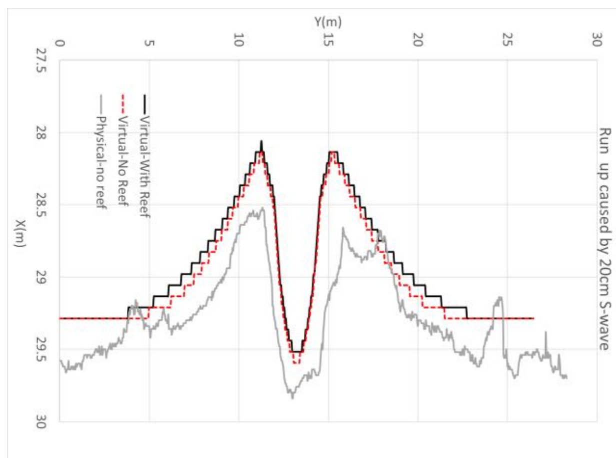

Figure 2. Comparison between the wave inundation in the physical model and the numerical model.

REFERENCES

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