FINITE VOLUME METHOD IN TSUNAMI MODELS AND COASTAL FOREST INTERACTION

JORGE MOYA

Abstract. This research is focused on modeling tsunamis and exploring the potential of coastal vegetation as a means of mitigation. To simulate tsunami propagation and coastal inundation, we employed finite volume methods combined with projection methods for the non-hydrostatic pressure, as described in [1]. The study was validated using field data and experimental observations.

In order to achieve that, we use a multilayer system based on the LDNH_0 model, which approximates the Euler equations under the assumptions of constant velocities and linear pressures [2]. In addition of that we add drag forces, inertia forces, and porosity to model the interaction with the forest, based on [3], and extended them to make them compatible with multilayer systems. This manner, we can more precisely model the vertical properties of the forest, making multilayer systems a valuable tool for future research in this field.

Our partial findings suggest that depending of the vegetation characteristics such as density, height, wood type, and arrangement, coastal vegetation can provide significant mitigation effects for tsunamis and be an effective natural defense against coastal hazards. This research has important implications for coastal planning, management and provides valuable insights into the potential role of ecosystem-based approaches for disaster risk reduction. This is a joint work with Dr. Fernandez-Nieto and Raimund Bürger. Partially supported by ANID/Doctorado Nacional/21211457.

Keywords: Tsunami Coastal vegetation Numerical simulation

Mathematics Subject Classifications (2010):

References

[1] Manuel Castro, Enrique Fernandez-Nieto, *A Class of Computationally Fast First Order Finite Volume Solvers: PVM Methods*, SIAM Journal on Scientific Computing, Volume 34, Issue 4, 2012

[2] Sánchez, C.E., Fernández-Nieto, E.D., de Luna, T.M. et al *Numerical Simulations of a Dispersive Model Approximating Free-Surface Euler Equations* J Sci Comput 89, 55 (2021). https://doi.org/10.1007/s10915-021-01552-6

[3] Kosuke Iimura, Norio Tanaka *Numerical simulation estimating effects of tree density distribution in coastal forest on tsunami mitigation* Ocean Engineering, Volume 54, 1 November 2012, Pages 223-232.

Universidad de Concepción
Email address: jorgemoya@udec.cl