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Influence of initial conditions on the Indian Ocean Tsunami and coastal flooding

J. Pietrzak, G. Stelling, R. J. Labeur, D. Ham, S. Kramer, W. Simons, E. Schrama and J. Battjes

(1) Faculty of Civil Engineering and Geosciences, Delft University of Technology, The Netherlands

(2) Faculty of Aerospace Engineering, Delft University of Technology, The Netherlands

(J.Pietrzak@citg.tudelft.nl)

The devastating Indian Ocean Tsunami has highlighted the need for both a tsunami forecasting system for this region as well as a coastal engineering analysis system for future reconstruction efforts. Such a coastal analysis system would allow an improved understanding of the vulnerability of densely populated areas to such catastrophic events. Traditionally, the numerical modelling of tsunamis has been carried out using hydrostatic models on structured grids. However, in order to properly simulate the evolution, shoaling, refraction, diffraction and reflection of these waves requires the accurate representation of the bathymetry and any islands, for example the island chains of the Andaman and Nicobar Islands. Here models using unstructured grids have an advantage. Additionally, it is clear that non-hydrostatic effects are substantial, both in the generation of the tsunami and as coastal regions flood. One problem that is quite often overlooked is the impact of the initial conditions on the resulting tsunami forecasts. Additionally, inundation of land implies sudden flow transitions due to obstacles such as roads, embankments, and buildings. Locally the hydrostatic assumption is no longer valid and alternative numerical techniques must be employed to handle hydraulic jumps and bores.

Currently our forecasting system consists of three components; a finite element non-hydrostatic model, a finite volume hydrostatic model and a coastal flooding model that uses a cut-cell technique. Flooding as the waves enter shallow coastal areas and inundate towns requires the use of advanced numerical techniques which ensure cor-

rect flooding. These techniques are different to those employed in traditional tsunami models.

Here we briefly present the models and show how they can be used to gain a better understanding of the generation and propagation of the Indian Ocean Tsunami and how coastal areas flooded. We explore the sensitivity to different initial conditions using a non-hydrostatic model for scenario testing, using as input data from solid Earth models, which are tuned with the help of observed GPS deformations in the region. This also raises the question of how sensitive tsunami forecasting systems are to the computations of seafloor displacements. We then use the output from these models to further explore wave propagation and coastal flooding. We plan to validate and tune the Indian Ocean Tsunami model with the help of satellite altimeter data and tide gauge records.