

Recent Improvements in State-of-the-art Models for Tsunami Hazard Assessment: Applications to Both Large Historical and Future Case Studies

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Abstract

The large megathrust events of 2004 in the Indian Ocean and 2011 in the Japan Trench have demonstrated that tsunamis pose one of the major coastal hazards to human society. These events have also identified shortcomings in state-of-the-art numerical models, tsunami sources considered, as well as standard validation methods for the models.

This has led to the development and efficient parallel implementation on large scale computer clusters of a new generation of fully nonlinear and dispersive long wave models, as well as non-hydrostatic three-dimensional models, and their application to both historical tsunami case studies and large future events, in order to perform comprehensive coastal hazard assessment (in terms of inundation, runup, and more recently velocities). To account for the vastly different spatial and temporal scales present, models have been implemented either on varying or coupled nested meshes of increasingly fine resolution, and their representation of dissipative processes (such as from bottom friction and breaking waves) have been improved. Standard coseismic sources have been modeled dynamically through bottom boundary conditions, rather than as a static initial surface elevation and similarly, full three-dimensional models have been used to model underwater or subaerial landslide sources (either as solids or as fluids). Finally, the solitary wave paradigm used for a long time for tsunami model validation, has been gradually replaced, in both analytical and experimental work, by gradually more complex wave trains that more realistically approximate actual tsunami wave trains.

For over 20 years, the speaker and co-workers have been involved in most of the developments summarized above and their application to both case studies and numerous works of tsunami hazard assessment for coastlines and critical coastal infrastructures. This seminar will give an overview of the speaker's work, experience, lessons learned, and recommendations with regard to future lines of work.

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