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Tsunami modelling with unstructured grids

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In support of a Tsunami Early Warning System for the Indian Ocean a Finite Element Model (TsunAWI) for simulations of the wave propagation has been developed. It is part of the German Indonesian Tsunami Early Warning System (GITEWS). Model results will be the main source for the prediction of arrival times and expected wave heights. The spacial discretisation employs unstructured meshes which allow for variable resolution. In the deep ocean a resolution of about 10 km is sufficient for a good representation of the wave propagation but runup processes need a resolution of 80 m or better. The variable triangular mesh of TsunAWI is capable of resolving both processes without the need of nesting different meshes. Since the transition from coarse resolution in the ocean interior to a fine mesh near the coast is rather smooth, the wave propagation is not affected by the changes in the density of computational nodes.

Numerical experiments simulating the Tsunami in the Indian Ocean generated by the earthquake of Dec. 26 in 2004 have been conducted with focus on two aspects:

1. How is the wave propagation affected by the model bathymetry?
2. How does the runup obtained by the model compare to observations in Banda Aceh region on Sumatra derived from satellite data?

The best available resolution of bathymetry is about 1' (GEBCO). These data have been improved by ship cruises investigating the deep-sea trench along Sumatra and especially the rupture zone of the aforementioned earthquake. On land X- and C-band topography data from the Shuttle Radar Topography Mission (SRTM) have been

incorporated into the model. We investigated the role of the model bathymetry and topography for wave propagation and runup and observed locally large differences. We conclude that a good representation of topography and bathymetry is essential for Tsunami simulations, especially in the context of an early warning system.