TsunAWI Model Description

The triangular discretization of the model domains allows for an excellent representation of complex coastlines and bathymetry.

- Model for the nonlinear shallow water equations with radiation boundary conditions.
- Finite Elements with linear basis functions for the surface elevation and normalizing function for velocity (U, V) as described in Hanert et al. (2005).
- Surface coordinates with resolution depending on water depth and steepness of bathymetry.

\[ \Delta x \geq \min \left( \frac{\eta_{\text{max}}}{h_{\text{min}}}, \frac{1}{V} \right) \]

\( h \) is water depth.

\[ \text{Ramp scheme based on extrapolation of model quantities to dry nodes in flooded areas.} \]

The tsunami scenario repository

GITEWS

- Covers events of Sumatra, Java, and Banda Sea.
- 347 scenarios for 3226 earthquakes from 92°E to 117°E.
- Magnitude: 7.4-7.8, A, A-1000 years.
- BupGan 2.0, GEBCO.

PROTECTS

- Scenario database for Indonesia.
- Large scenarios might pass from the strait between the Sunda Shelf and Java. Therefore the model domain covers the whole Sunda Shelf.
- 1100 additional scenarios for 187°E up to 129°E.
- 12 scenarios from initial database recombined on the extended grid.

The resulting scenario file is too large to be processed persistently stored.

- Postprocessing: The most difficult part is the process of postprocessing, Ocean Modelling (2005)
- The seismic selection.
- Scenarios within an ellipse around the measured epicenter.

Visualization of warning products for one scenario:
- SIM and ETA on the whole grid.
- SIM and ETA on 125 tsunami forecast points (Pinburgh). For each coastal forecast point, node closest to tsunami path is aggregated to one value, time series at the grid nodes.

Post processing and warning products

- In the post-processing phase, the quality of the solution is controlled.
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SIM - Warning System Design

Within the Tsunami Warning system, the simulation system (SIM) assesses the simulated importance and chooses the set of scenarios to issue a warning of.

- In an off-line inauguration phase, data is extracted from the full scenarios.
- In case of a crisis, the data is used to select the appropriate scenario.
- With GPS displacement measurements, scenarios can be excluded from the solution.

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Earthquake on 1 April 2014

- Offshore earthquake on the Chilean coast.
- Magnitude: 8.0.
- Depth: 10km.
- USGS finite fault source.
- Tidal gauge data from DSS and ETA level control monitoring facility.
- DSS and ETA level control monitoring facility.

Summary and conclusions

The tsunami approach with triangular elements resembles the simulations in many respects. However, the wave heights do not fit the real scenario. This could be improved by further development of the code.

Comparisons to observations from the minor tsunami on 1 April 2014 show good performance of the simulations with the DSS ETA source as well as of the postprocessed scenarios nearby.

Akknowledgements

- Parameters provided by SIM.
- PROTECTS funded by BMMP to the University of Hamburg.
- Thanks to our project partners.

Table 6.1: Overview of model domains, mesh densities and grid

Epicenters for major and minor scenarios.

Natalja Rakowsky, Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany; Natalja.Rakowsky@awi.de

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The operational use of the system at BMKG, Jakarta is supported by training courses for the operators. The costs of storage.

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