Tsunami warning
and decision support

Tsunami early warning software

TOAST

TOAST (Tsunami Observation And Simulation Terminal) is a commercial software for tsunami simulation and verification providing a quick hazard assessment. The results can be verified by oceanographic sensors such as tide gages or buoys. TOAST is optimized for its application in Tsunami Early Warning. While conventional Tsunami Early Warning systems are based on huge databases of pre-calculated scenarios TOAST uses by default an "on-the-fly" simulation approach. This allows to react on any atypical events, including earthquakes in unconsidered areas or with untypical rupture mechanisms. In addition to this "on-the-fly" simulation TOAST offers a flexible simulation interface to integrate pre-calculated simulation databases such as TsunAWI.

FEATURES

- Direct connectivity to SeisComP3
- Automatic reception of earthquake parameters
- Calculation of SSH, SSHMax, isochrones, arrival times, coastal wave heights
- Calculation of warning levels for forecast zones
- Automatic and interactive rupture generation
- GPU based "on the fly" simulation
- Pre-calculated simulation databases
- Worst-case scenario aggregation
- Integration of oceanographic sensor data
- Template-based bulletin generation
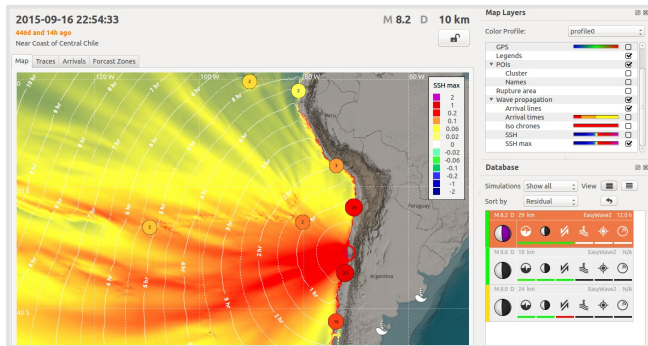
Decision support

Maps provide warning levels in forecast zones, wave heights, arrival times and many more. The simulation widget shows the match between simulation and observation (wave arrivals, earthquake hypocentre, magnitude and mechanism, rupture mechanism). Each parameter allows sorting of the simulations by the match which is color coded: from red = low match to green = good match.
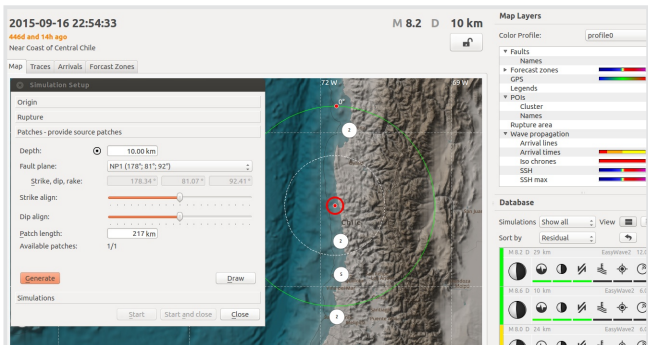
Rupture generation

TOAST uses pre-configured information to define the earthquake rupture area and mechanism for the tsunami simulation based on verified magnitude-area relations as well as pre-defined fault lines. With the simulation dialog also manual or semi-automatic patch generation is possible, providing very high flexibiliy and great efficiency for the simulations.

Simulation verificiation

The integration of sensor data as tide gauge or bouy data into TOAST allows to compare simulated (red) with observed (grey) mariograms. The interactive picker is used to pick onsets, periods and wave heights. Individual filters per trace can be applied. Observed mariograms and synthetics from various simulations can stacked and compared.

TECHNOLOGY

TOAST connects to a SeisComP3 system receiving earthquake parameters in real-time. When a hypocenter with a magnitude arrives, TOAST applies magnitude-area scaling (Wells & Coppersmith, 1984) to define the rupture, that can be placed at several pre-configured positions relative to the hypocenter. TOAST permits the tsunami simulation from several locations in parallel. The required fault parameters are derived from pre-defined faults or from moment tensors.

Once the rupture area is selected the simulation plug-ins are triggered. By default the "on-the-fly" simulation EasyWave is used but pre-calculated databases such as TsunAWI can also be chosen.

To verify the simulation results, TOAST provides a manual tsunami onset picker, allowing to pick onsets, amplitudes and periods based on real-time tide gage observations. The observed information is then used to calculate a scenario quality which represents how well the simulated and observed values match. The simulation widget shows these quality parameters not only for the tide gauge data, but also for epicenter, depth, magnitude, comparision with pre-configured rupture mechanisms and existing moment tensors.

The automatic bulletin generation allows to export onset times, wave heights for forecast zones as well as other points of interests as tide gauges.