# TSUNAMI INUNDATION MAPPING FOR OREGON AND WASHINGTON

# October Status Report


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### 1. SUMMARY OF MAPPING STATUS

***OREGON***

- YAQUINA BAY (Newport). Map in press. Should be ready within the next few weeks.

- SEASIDE. Most model runs completed. Interpretation of results and drawing of map are in progress.

- GOLD BEACH. Regional grid complete. Contractor constructing refined, local, merged bathymetry/topography grid.

- WARRENTON-ASTORIA. Generalized grid completed. PMEL digitizing linear shoreline barriers for refined grid.

***WASHINGTON***

Regional bathymetric grid is complete.

One month of field surveys are planned in November to map primary dunes; these data will supplement 10 m horizontal resolution DEM's in southwest Washington.

### 2. ADDITIONAL INFORMATION ON MAPPING EFFORTS

The Center for TIME, DOGAMI, OGI, and WA DNR are working together to produce inundation maps for high-priority areas on the Oregon and Washington coasts. All tsunami inundation

simulations are being performed with Baptista and Myers' finite element model (FEM), which extends the original tidal algorithm of Rick Luettich and Joannes Westerink to include tsunami simulations.

## ***OREGON***

- YAQUINA BAY (NEWPORT). The majority of this work was performed by OGI and DOGAMI as part of a NEHRP contract. Three Cascadia earthquake/tsunami scenarios are being mapped. The map has been completed, and is being digitized for final printing within about 2 weeks. A supporting report that documents the work is being finalized for delivery to NEHRP with the map; this will complete the NEHRP contract.

This work has helped to develop criteria for tsunami sources that will be useful in future inundation mapping efforts. But some issues require additional investigation, and these are outlined below.

- SEASIDE. Most model runs are complete, and the map drawing is in progress. Five scenarios were computed -- four Cascadia earthquakes (one of which assumes an additional, local asperity) and the 1964 Alaska teletsunami. Highlands near the open coast appear to be dry for all scenarios except for the case of a Cascadia earthquake with an additional asperity.

The evacuation at Seaside is so difficult that any high ground near the open coast is critical, so we want to make sure that the DEM is correct there. Local officials are therefore field checking the highlands in question.

There will be no separate report for Seaside. The method will be explained in the Newport report.

- GOLD BEACH. The regional grid is complete, and the local refined grid will be constructed as soon as a DEM is available. Photogrammetry for the DEM has been flown and processed for dry land values, a 1:12,000-scale planimetric base map, and topographic contours. Bathymetry from the USACE has also been sent to the contractor for merging with the dry land values to complete the DEM.

Local officials have been briefed on the project by George Priest. The photogrammetry contractor has also met with local interest groups to see if any additional map products could be developed for local needs.

- WARRENTON-ASTORIA. A generalized grid has been completed. Topographic maps with 2' contours have also been sent to PMEL for digitizing of linear shoreline barriers to refine the

xisting grid.

Thirty-six topographic maps were received on 8 October at PMEL. Initial setup of the PMEL digitizer has been completed, and an employee has been assigned to work 3 hours per day on the task.

A local advisory committee has met with George Priest and been briefed on the project.

***WASHINGTON***

The regional bathymetric grid for this work is complete.

On October 1, Washington State DNR received the contract to assist Antonio Baptista and the TIME center with the inundation mapping. Unfortunately, a proposed project by outside sources to obtain higher resolution topography did not get funded. Therefore, field surveys of the primary dunes will be completed to supplement the 10 m horizontal resolution DEM's in southwest Washington. DNR will probably begin gathering topographic data in November, using a combination of real-time GPS and laser leveling. Data collection should take less than a month.

DNR has also begun the process of scheduling workshops with local emergency managers and public works officials in Pacific and Grays Harbor counties. The first of these is scheduled for November 17 in Pacific County.

**3. SCHEDULE ESTIMATES**

Once the modeling issues discussed below are resolved, the modeling for the specific sites should proceed smoothly (approximately 1 community every 6 weeks). This assumes that there are no major problems incorporating bathymetry and topography data into a grid. Digitizing and field survey efforts may cause some delays. However, unreasonable delays (judged on a case-by-case basis) will not unduly hold up the production of initial map versions, and the maps will be made with the best available data.

Some community modeling will be completed at the TIME Center, while those under contract will be completed by OGI. It is estimated that the OGI contractual computer simulations for the OR and WA target communities may be completed as early as July of 1998.

Once a framework is set up by the states to produce inundation maps from the digital model results, it is estimated that mapping will lag behind modeling by only a month or so.

**4. MAPPING METHODOLOGY AND SOURCE SPECIFICATION**

While specific to the Oregon/Washington work, the general approach described below will clearly be relevant to other areas.

The largest uncertainty in any inundation mapping is specification of sources. For the OR/WA work, several sources were modeled, corresponding to tsunamis generated locally in the Cascadia Subduction Zone, and by a distant Alaska source.

The results of the inundation model computations were then provided to DOGAMI for interpretation and specification of the final set of inundation lines to be drawn on a map. The result corresponds to tsunami arrival at the mean high higher water (MHHW) tidal stage, and also takes into account local coastal subsidence. Three inundation lines are specified on the final map, corresponding to "moderately low," "moderately high," and "high" inundation levels.

***A. Regional Cascadia Sources:***

Four regional Cascadia subduction zone sources (and grids) have been constructed using the Okada point source algorithm and software developed by the Canadian Geological Survey.

The first source models a single segment rupture, while the second and third sources model ruptures of different widths along the entire subduction zone; each produces three significantly different run-up elevations.

The fourth source is a "worst case" model developed by Robert Kamphaus in collaboration with George Priest and OGI. This source begins with the scenario of the first three sources which produces the highest runup. To this source is added the effect of a local asperity; the asperity is defined as a doubling of the maximum probable slip on the subduction zone over a 100 km X 150 km area immediately offshore of the specific study area. This approach, i.e., adding an asperity to a full subduction zone rupture, produces results that are analogous in size and uplift to deformations induced by the Nankai and Chilean earthquakes.

***B. Alaska 1964 Source:***

Ed Myers and Antonio Baptista have constructed and run the first test of a 1964 Alaska earthquake source. The source produced good results in near source areas of Alaska but somewhat low run-up in distant areas. Ed and Antonio are taking a number of steps to solve the problem.

The inundation produced by this scenario will be included in the Seaside map, where there was severe enough flooding in 1964 to produce an extensive field database to check the scenario inundation. However, the scenario will have no influence on the final map for Newport (Yaquina Bay), because high relief and protection from jetties there make it an insignificant problem (the inundation line is not much more than a map of the Bay shoreline).

## 5. CONTINUING MODELING ISSUES.

Model improvement and testing is an ongoing concern. OGI proposes to use November and December to continue investigating the following issues.

***A. Model Testing by Tide Modeling.*** Myers and Baptista are continuing efforts to test the finite element grids by running tide simulations. This research has shown that grid refinement at the coastal scale and the local scale is extremely important. High resolution, accurate data and sufficient grid refinement to represent these features is necessary for accurate predictions in local areas.

***B. Tide/Tsunami Interactions.*** The effects of tides on tsunami inundation are presently being evaluated by OGI. If the tides are found to have simple linear effects, they will be disregarded in model runs. However, if non-linear effects are seen, future model runs will incorporate tidal forcing during the tsunami simulations.

***C. The 1964 Alaska Source Test Case.*** OGI continues to work on improving model results for this scenario (see short discussion, above).

***D. Leading Depression Wave Source.*** Robert Kamphaus and OGI continue to develop and investigate this alternate asperity waveform.

## 6. TIME ACTIVITIES

### *A. Model Transfers/Training*

Baptista and Myer's finite element model (FEM) has been transferred to the TIME Center, and Kamphaus completed the FEM training course at OGI in August. Periodic training continues, and a more formal training session will likely begin in the winter term at OGI. Several tsunami simulations have been successfully completed.

Titov's Method of Separation for Tsunamis (MOST) finite-difference model (FDM) was also transferred to TIME the week of 15 September. Titov provided training on the use of the model, and several test model runs were successfully completed.

Other visualization programs and analysis codes have also been transferred to the TIME computer facilities, and all hardware and software is performing well.

### *B. Bathymetry/Topography Databases*

In addition to the previously reported databases (ETOPO5, NOS hydrography, etc.), the Sandwell database (satellite, gravity-derived global bathymetry with 2-minute resolution) has been obtained and is now easily accessible. The NOAA VENTS program has several high resolution bathymetry data sets which will allow comparisons of the Sandwell data with measured bathymetry. These comparisons should be done by the end of November.

Additional merged bathymetry and topography data sets are being compiled at NGDC and should be available within the next few months. We continue to look for high resolution coastal data. The models have shown that current, accurate bathymetry and topography data is essential for good inundation maps.

***C. Alaska Coordination***

TIME has been working with Alaska and made some preliminary contacts for the future mapping that will begin at the completion of the WA-OR mapping.