Tsunami Evacuation Guidance for the Oregon Maritime Community

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FY13 NTHMP Task for Oregon: Statewide Maritime Guidance

1. Maritime advisory committee (MAC) representing
   – US Coast Guard
   – Port managers
   – Shipping fleet
   – Fishing fleet
   – Emergency responders
   – Planners
   – NTHMP partners (MMS)

2. Determine hazard parameters
   (velocity, min. flow depth, vorticity, wave steepness, shear flow )

3. Determine offshore safety zone (or zones) –
   maximum-considered distant and local tsunamis

4. Produce a statewide brochure/guide
Use Detailed Simulations from 11 Grids (2009-2012 work)
Open Ocean Hazard Issues

• California study of port damage may not be suitable for offshore hazard (i.e., 3-6 knots = minor to mod., 6-9 knots = mod. to significant, >9 knots = significant to total)

• Rapid velocity changes (over time and space), whirlpools, steep waves, and grounding may be more important than velocity.

• Debris hazard, especially from local events, may be important but how to evaluate?
Shear flow/vorticity
Tohoku, Japan Tsunami, March 11, 2011

DRAFT

Real-Time Mitigation Guidance

Distant Tsunamis

• **Warning**: NOAA
• **Tsunami arrival**: ≥ 4 hrs
• **Tied to dock**: Check w. port for guidance.
• **Offshore**: go to >30 fathoms(?)*
• **Land**: Go to evacuation site until local officials say it is safe to return.

Local Tsunamis

• **Warning**:
  – Ground shaking
  – Ocean roar
  – Water receding or surging
• **Tsunami arrival**: 15-20 min.
• **Tied to dock**: Go to evacuation site until local officials say it is safe to return.
• **Offshore**: go to >100 fathoms (?)*
• **Land**: Go to evacuation site until local officials say it is safe to return.

*Depth to be determined in FY13 work.*
XXL1 (~5,000-10,000-yr Cascadia event)

Velocity Simulation Relative to Key Isobaths

Paleoseismic Data - Turbidites

19 CSZ Earthquakes & Tsunami Over past 10,000 Years

Occurrence and Relative Size of Cascadia Subduction Zone Megathrust Earthquakes

1-2 “XXL” events in 10,000 yrs

Detailed 2012 simulation

Frequency of turbidites

Follow Time (proxy for slip deficit time)

Rel. Turbidite Mass

XL 1200 yrs
L  800
M  525
SM 300

Histogram modified from Witter et al. (2011), DOGAMI Special Paper 43
EXPLANATION OF VORTICITY UNITS:
Vorticity = $|\frac{dv}{dx} - \frac{du}{dy}|$, where
$dv =$ change of north velocity,
$du =$ change of east velocity
$dx =$ change of distance east
$dy =$ change of distance north

Example: 0.01 units of 1/sec = velocity changing 1m/s ec over 100-m distance

INTERPRETATIONS:
• 30-fathom isobath is seaward of the minimum contoured vorticity of 0.01
• >0.1 = very strong shear
L1 (~2,500-yr exceedance event – Crescent City PTHA)

**Velocity Simulation Relative to Key Isobaths**

**L1 (red line) vs 2475-yr Inundation**

Colored Areas are 2475-yr Inundation (as flow depth)

Colored Lines are Inundation boundaries from Oregon Scenarios

**PTHA MAPS** are modified from Crescent City Demonstration Projects of the California Probabilistic Tsunami Hazard Analysis Work Group by adding labels and inundations from Oregon CSZ splay fault sources M1, L1, XL1, and XXL1 simulated by the UW team.
AlaskaMax
Hypothetical Max. Distant Tsunami with ~750-yr return

Tsunami Focusing by AlaskaMax Source

Facility for the Analysis and Comparison of Tsunami Simulations (FACTS)
Maximum Wave Height (cm)

T (SECONDS): -30 to 86430

Figure from Tsunami Pilot Study Working Group (2006)

Vertical Deformation (m)

Figure from DOGAMI Special Paper 41

8/21/2013 NTHMP-MMS workshop, Seattle

George Priest, DOGAMI
Example of “Two-Zone” Maritime Tsunami Evacuation Map

**Yellow** = Local Cascadia Event; **Orange** = Distant Event

Maximum velocities and isobaths from preliminary 2011 regional simulations on coarse grids.