

State of Oregon
Department of Geology and Mineral Industries
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IMS-21
Tsunami Hazard Map of the
Coos Bay Area, Coos County, Oregon
By G.R. Priest and others
Text

TSUNAMI HAZARD MAP OF THE COOS BAY AREA, COOS COUNTY, OREGON

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Map Hazard Categories

Red **Extreme-hazard zone for tsunami flooding (300- to 600-year events)**

Elevations within and below this zone would be flooded by a Cascadia subduction zone tsunami from a magnitude 8.6 earthquake. See “Model 2Cs” in Priest and others (1997), for a complete explanation of this model earthquake and tsunami. See also Appendix 1.

Orange **High-hazard zone for tsunami flooding (300- to 600-year events)**

Elevations within and below this zone would be flooded by a Cascadia subduction zone tsunami from a magnitude 9.1 earthquake. See “Model 1A” in Priest and others (1997) for a complete explanation of this model earthquake and tsunami. See also Appendix 1.

Yellow **Moderate-hazard zone for tsunami flooding (300- to 600-year events)**

Elevations within and below this zone would be flooded by a Cascadia subduction zone tsunami from a magnitude 9.1 earthquake with doubling of the fault slip immediately offshore. See “Model 1A Asperity” in Priest and others (1997) for a complete explanation of this model earthquake and tsunami. See also Appendix 1.

White **Low- to negligible-hazard zone for tsunami flooding (300- to 600-year events)**

How to Use the Map

Mapped boundaries may be viewed as guides for evacuation planning in the event of an earthquake and tsunami. If strong earthquake shaking lasts 20 seconds or more, go immediately to the lowest hazard site available. A tsunami could arrive within a few minutes of the earthquake. Such nearby earthquakes and associated tsunamis only occur in intervals of 300–600 years. Distant tsunamis (teletsunamis) occur more often, are generally smaller than tsunamis from nearby earthquakes, and arrive hours after a distant earthquake. The West Coast and Alaska Tsunami Warning Center issues warnings for all tsunamis affecting the West Coast of the United States; their warnings will be most useful for teletsunamis. Earthquake ground shaking is the best warning for a locally generated tsunami.

The following figures illustrate the sequence of water elevation and velocity changes from tsunamis arriving after subduction zone earthquakes of three different sizes. These scenario tsunamis simulate low, moderate, and high tsunami run-up (see Priest and others, 1997, Models 2Cs, 1A, and 1A-Asperity for a complete explanation of scenario earthquakes and tsunamis). The inundation lines for these three scenarios correspond, respectively, to the mapped boundaries separating the extreme-, high-, moderate-, and low-hazard zones. Appendix 1 summarizes regional ground deformation predicted for the scenario earthquakes. The moderate- and high-run-up scenarios predict up to 6 ft (2 m) of subsidence at Coos Bay.

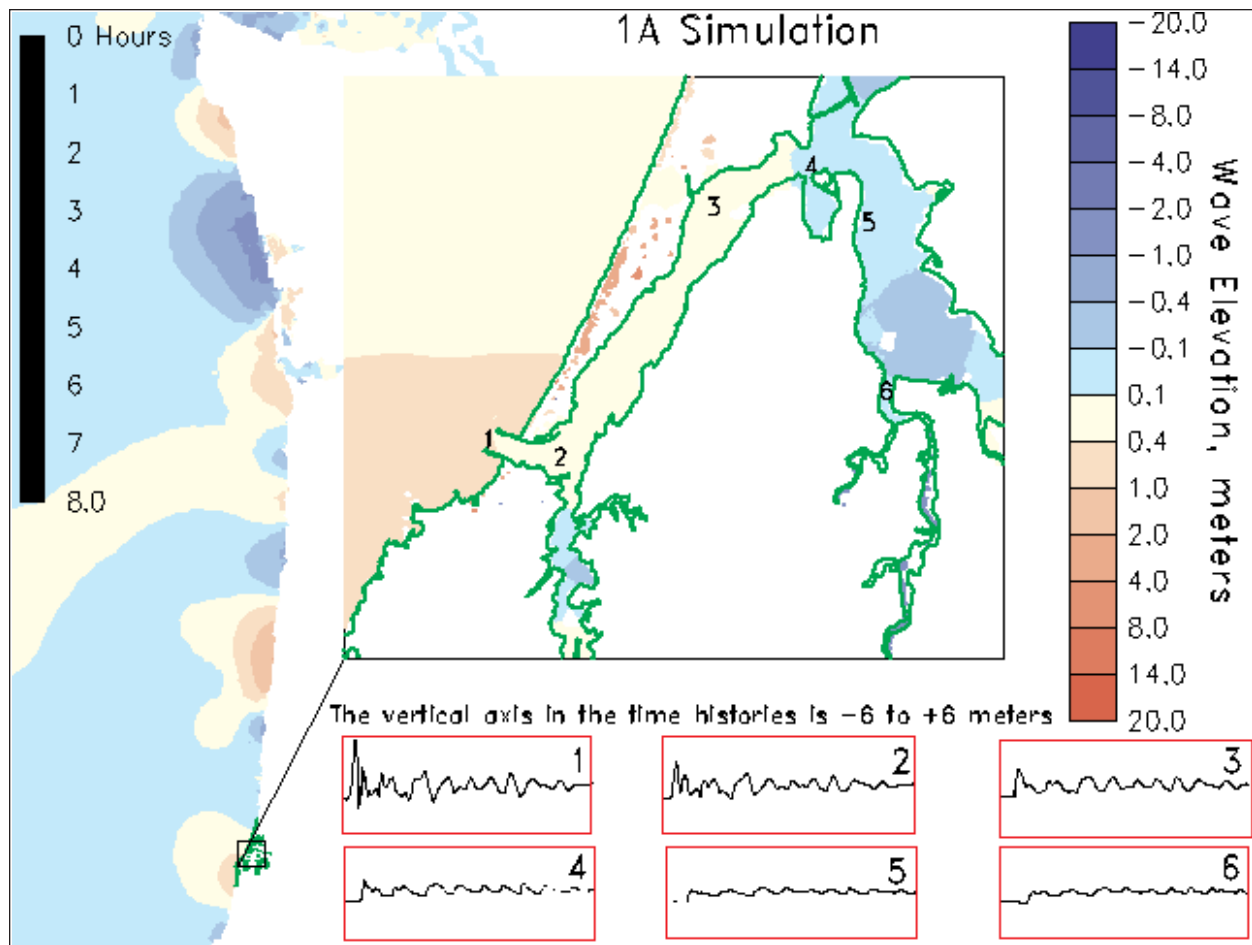


Figure 1. Background, visible only on left: Map of Washington and Oregon coast showing final frame of an animation that illustrates tsunami flooding during the eight hours following a magnitude 9.1 earthquake on the Cascadia subduction zone. Box on coastline indicates area of Coos Bay simulation that is shown expanded in insert map. Colors show water elevation contours at the end of eight hours; green indicates shorelines in the Coos Bay study area. Insert map shows locations of six observation stations for time histories of tsunami arrivals at Coos Bay. Keyed to those observation stations, a generalized view of one example time history (moderate-run-up scenario) is shown on the six graphs at the bottom of the figure. Detailed time histories of water elevation and velocity for all three scenarios are shown in Figures 2–13.

Station 1 Elevations

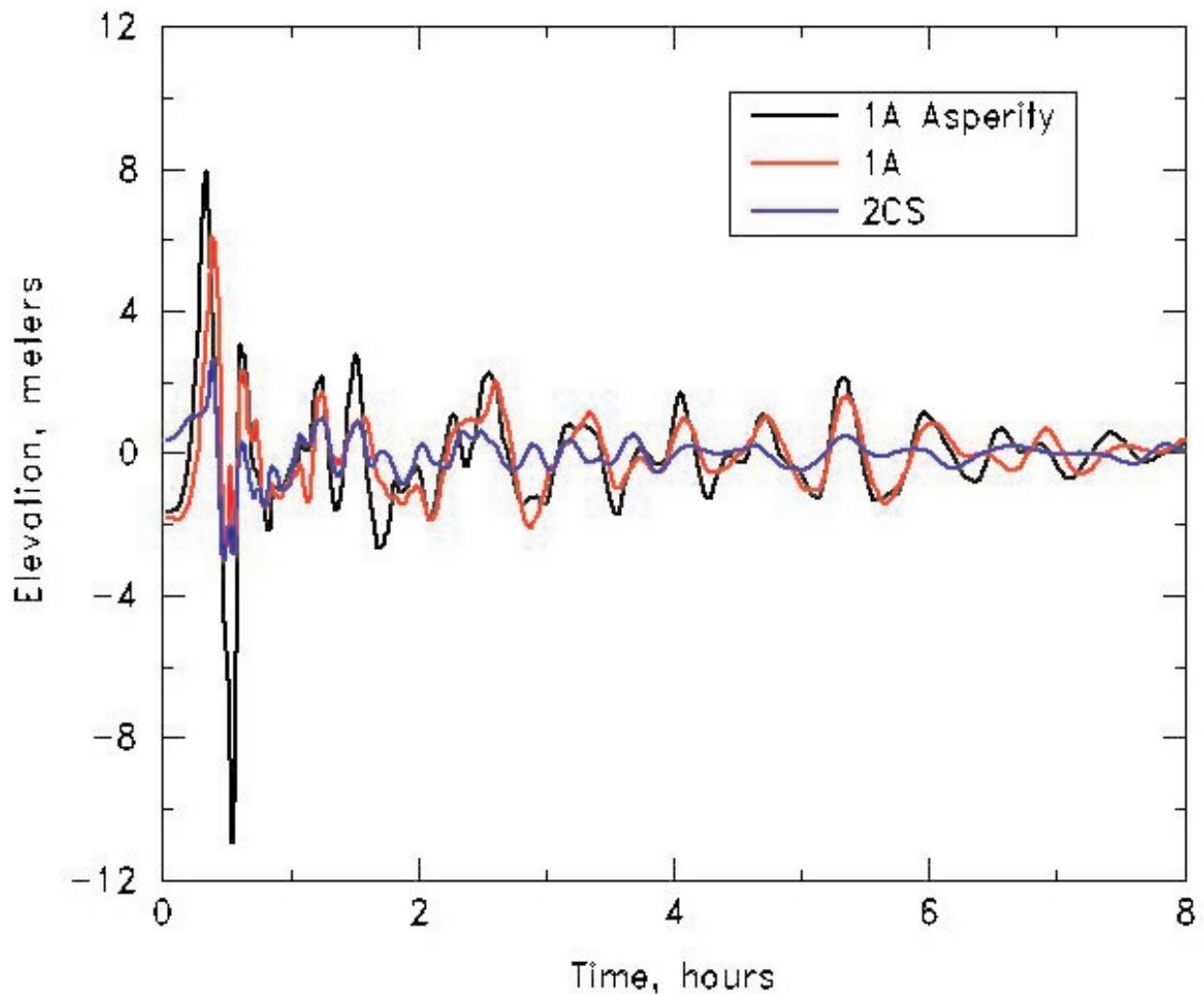


Figure 2. Station 1 time history of wave arrivals for three scenario earthquakes on the Cascadia subduction zone fault system (see location map of Figure 1). Observation point is at the mouth of Coos Bay and shows three scenario tsunami simulations: low (2Cs), moderate (1A), and high (1A-Asperity) run-up. Note that the first major surge of flooding does not strike this area until about 15 minutes after the earthquake; however, minor flooding may occur immediately after the earthquake due to subsidence by a few feet of the land surface. Actual tsunami wave elevation at shoreline sites will be higher than shown on the figure. The figure should be used to understand approximate timing and relative wave elevation, not absolute wave elevation at the shoreline.

Station 1 Velocities

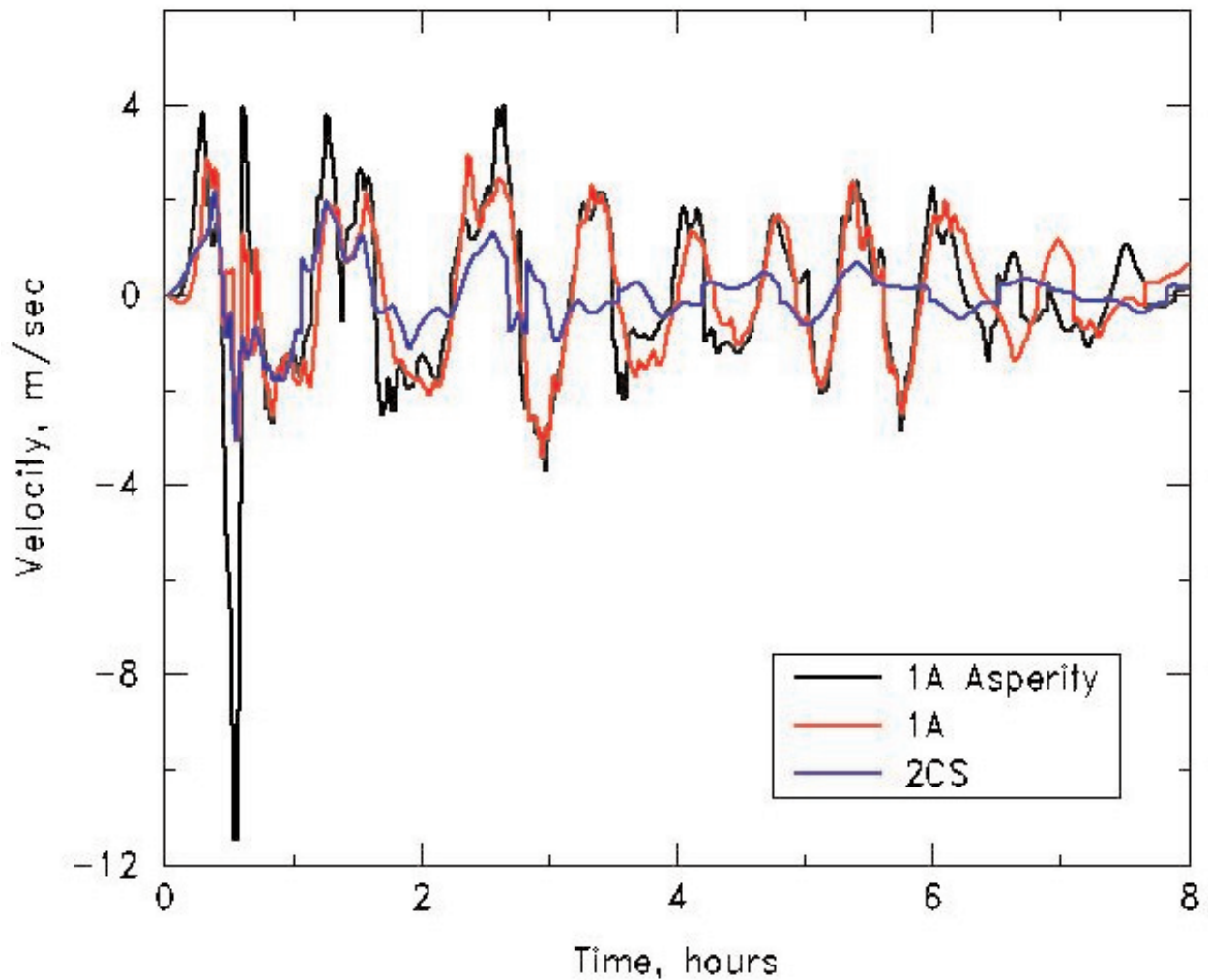


Figure 3. Current velocity changes for station 1. Negative velocities are for seaward currents; positive velocities are for landward (upstream) currents. Current direction in the estuary channels could be either seaward or landward during the first 5-10 minutes after the earthquake, depending on how the fault rupture process occurs. Note how quickly the current reverses direction as water surges in and out of the estuary. Such reversals can be a severe problem for large vessels at anchor. Meters per second converts to knots by multiplying by a factor of about two, so most maximum velocities are on the order of about eight knots during the first three hours after the earthquake.

Station 2 Elevations

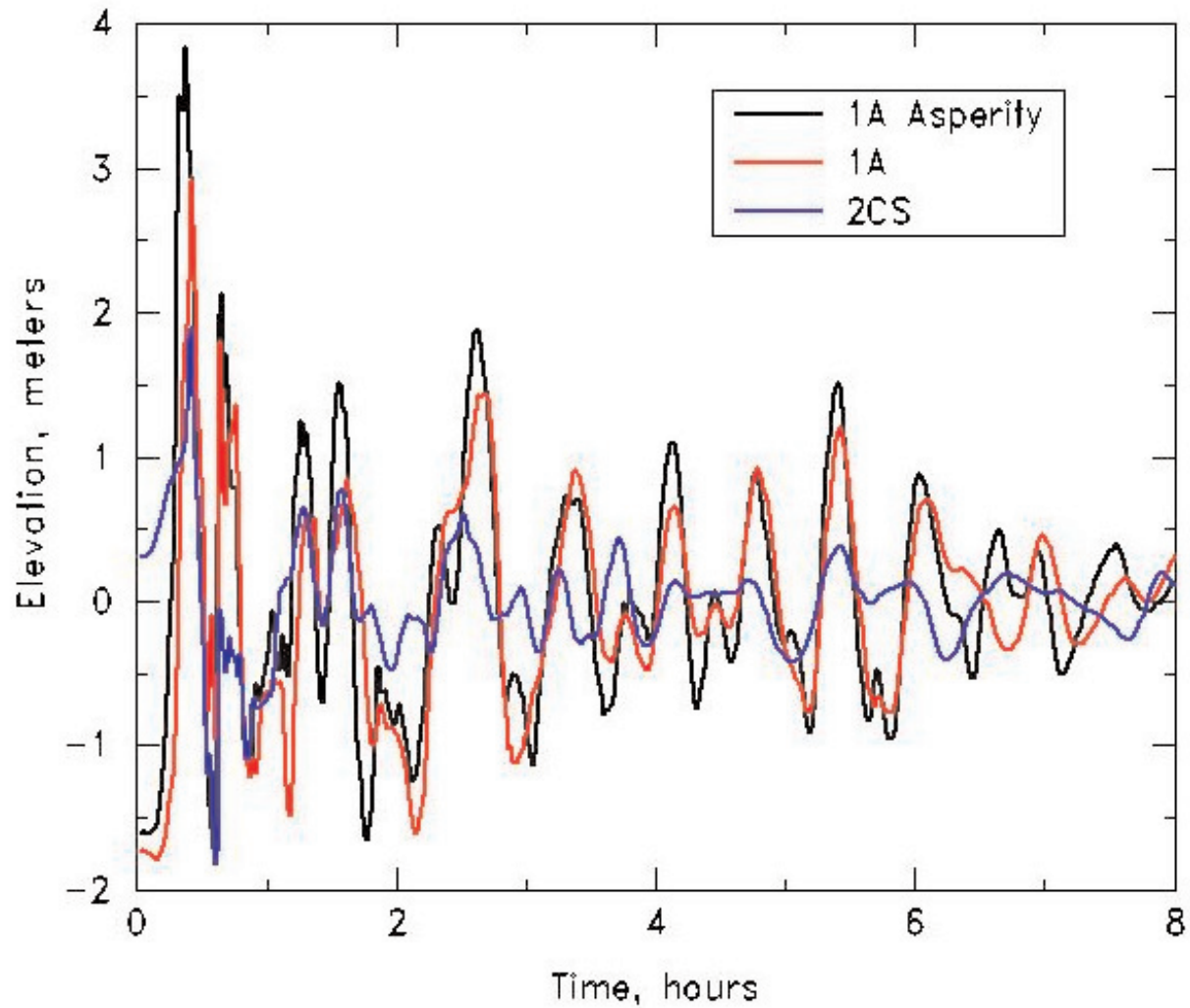


Figure 4. Station 2 time history of wave arrivals (Charleston area). See Figure 1 for location and Figure 2 for general explanation. Note that the first wave arrives about 20 minutes after the earthquake.

Station 2 Velocities

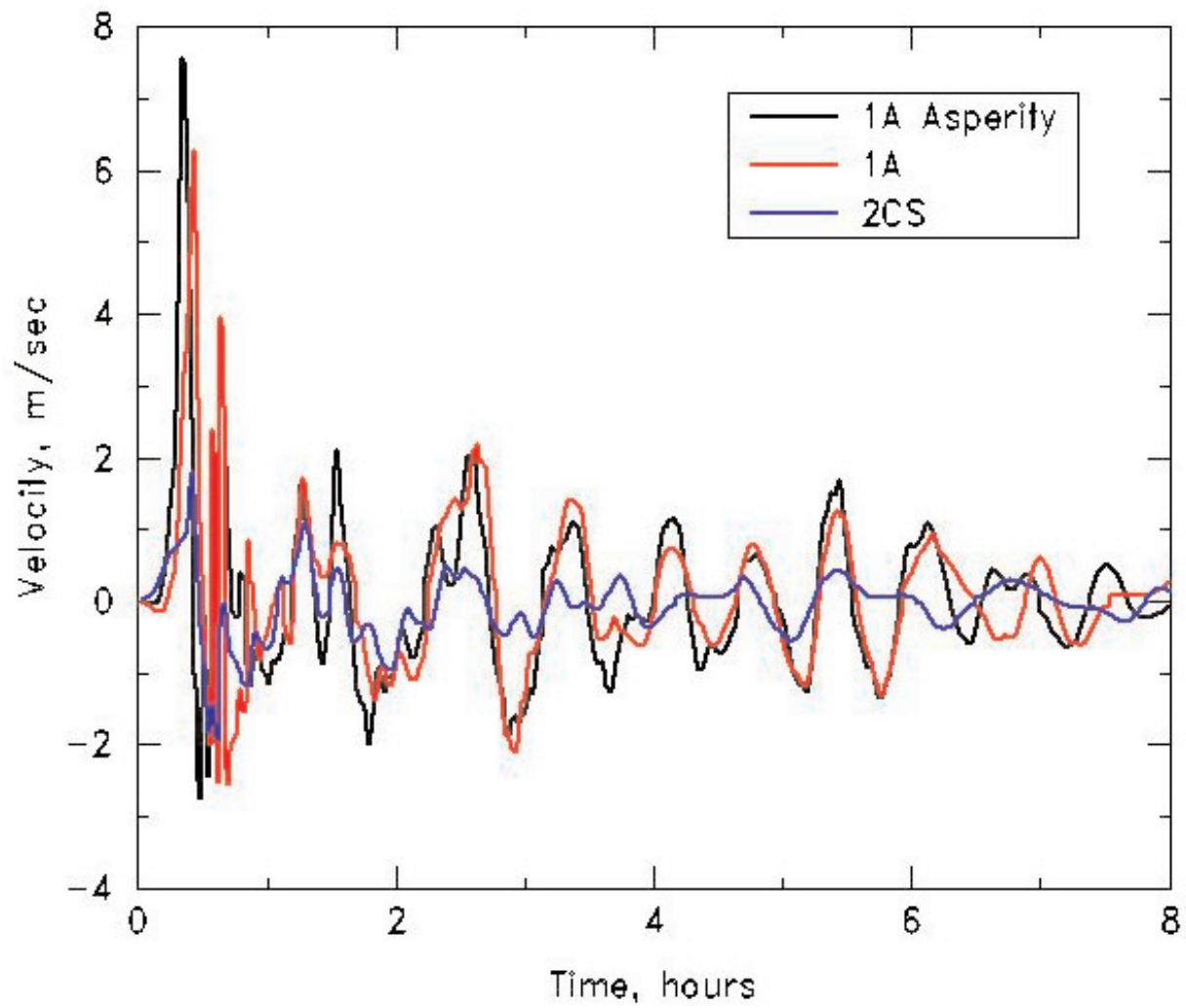


Figure 5. Current velocity changes for Station 2 (Charleston area). See Figure 1 for location and Figure 3 for general explanation.

Station 3 Elevations

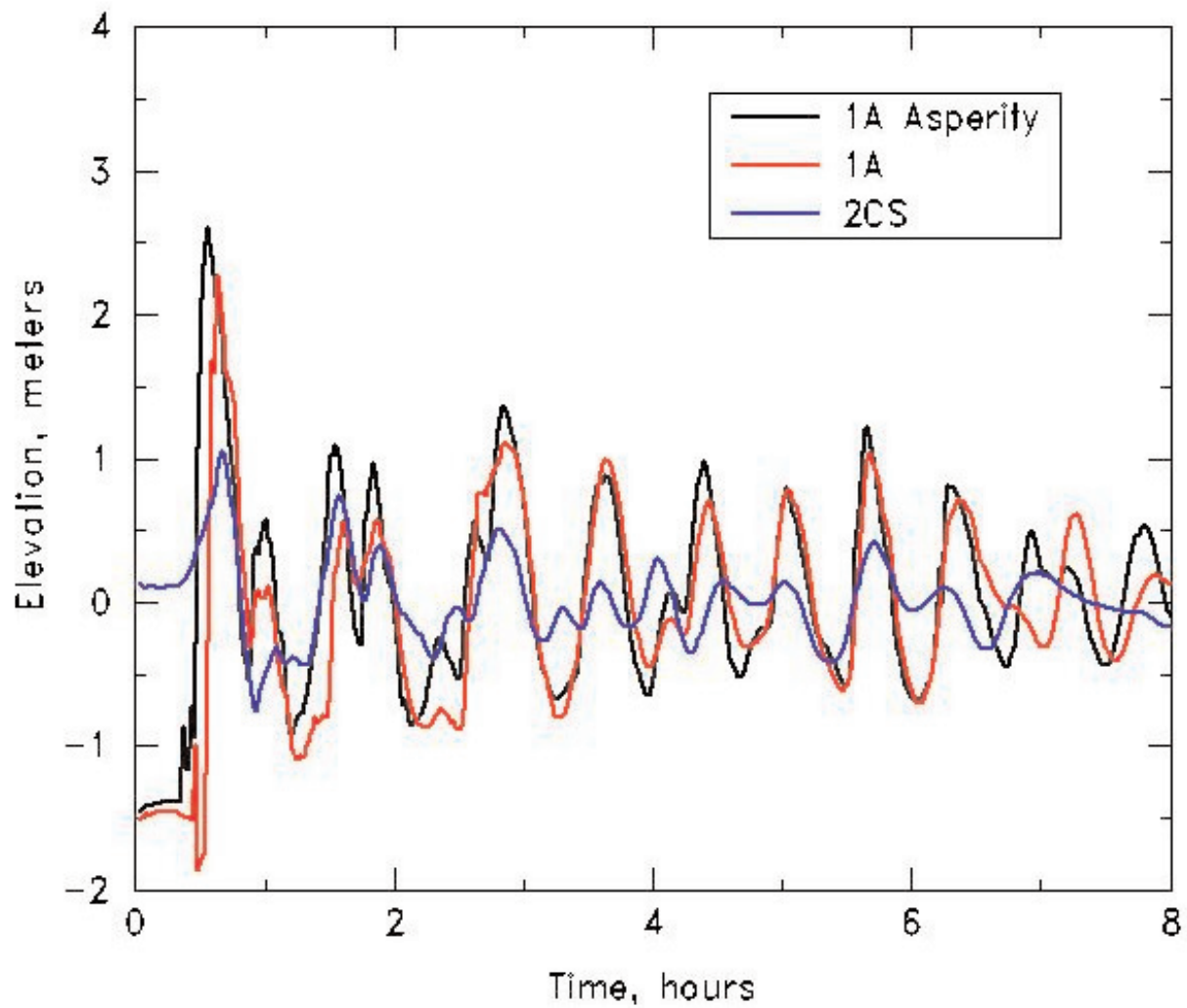


Figure 6. Station 3 time history of wave arrivals (Empire area). See Figure 1 for location and Figure 2 for general explanation. Note that the first wave arrives about 30 minutes after the earthquake.

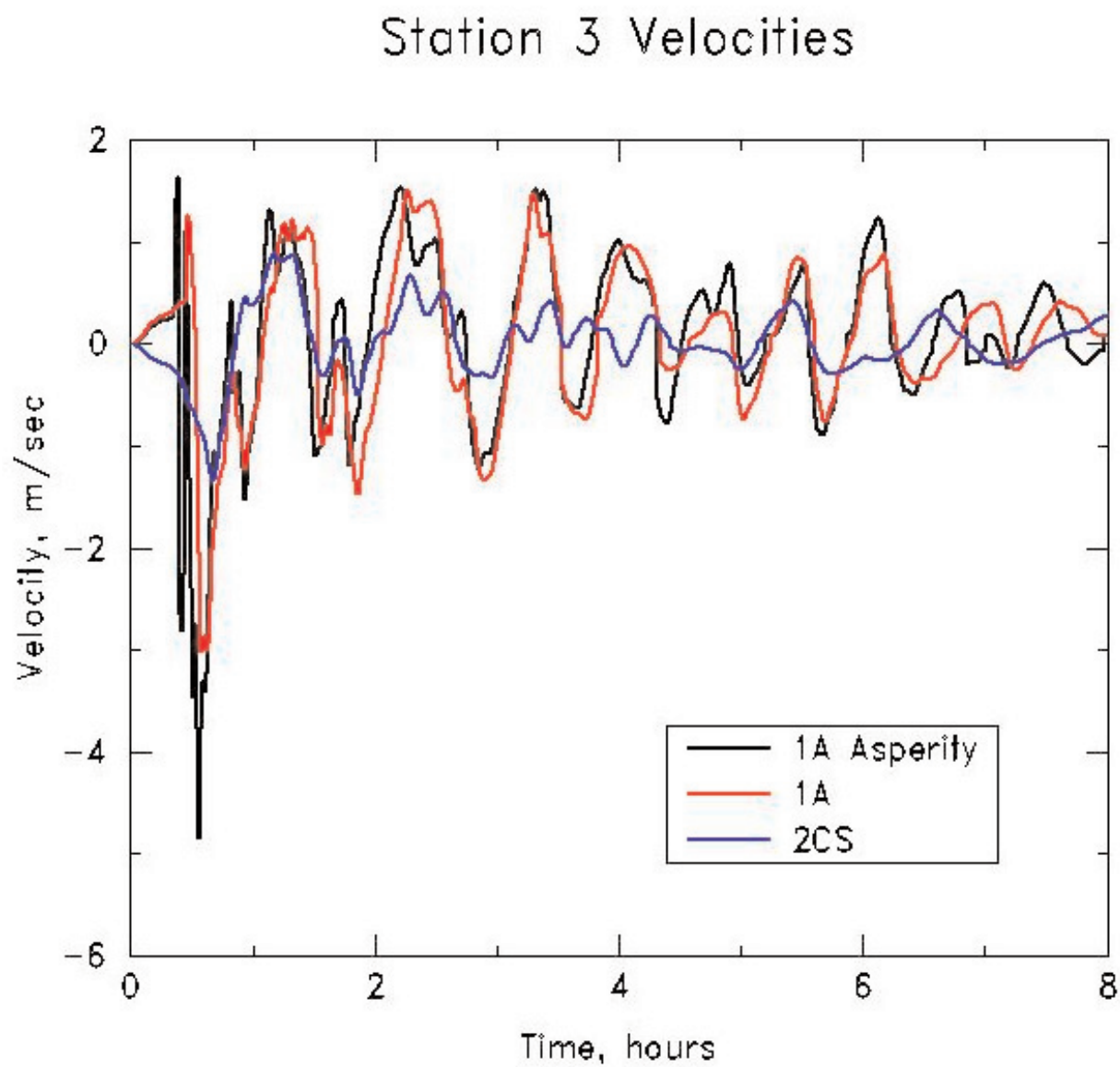


Figure 7. Current velocity changes for station 3 (Empire area). See Figure 1 for location and Figure 3 for general explanation.

Station 4 Elevations

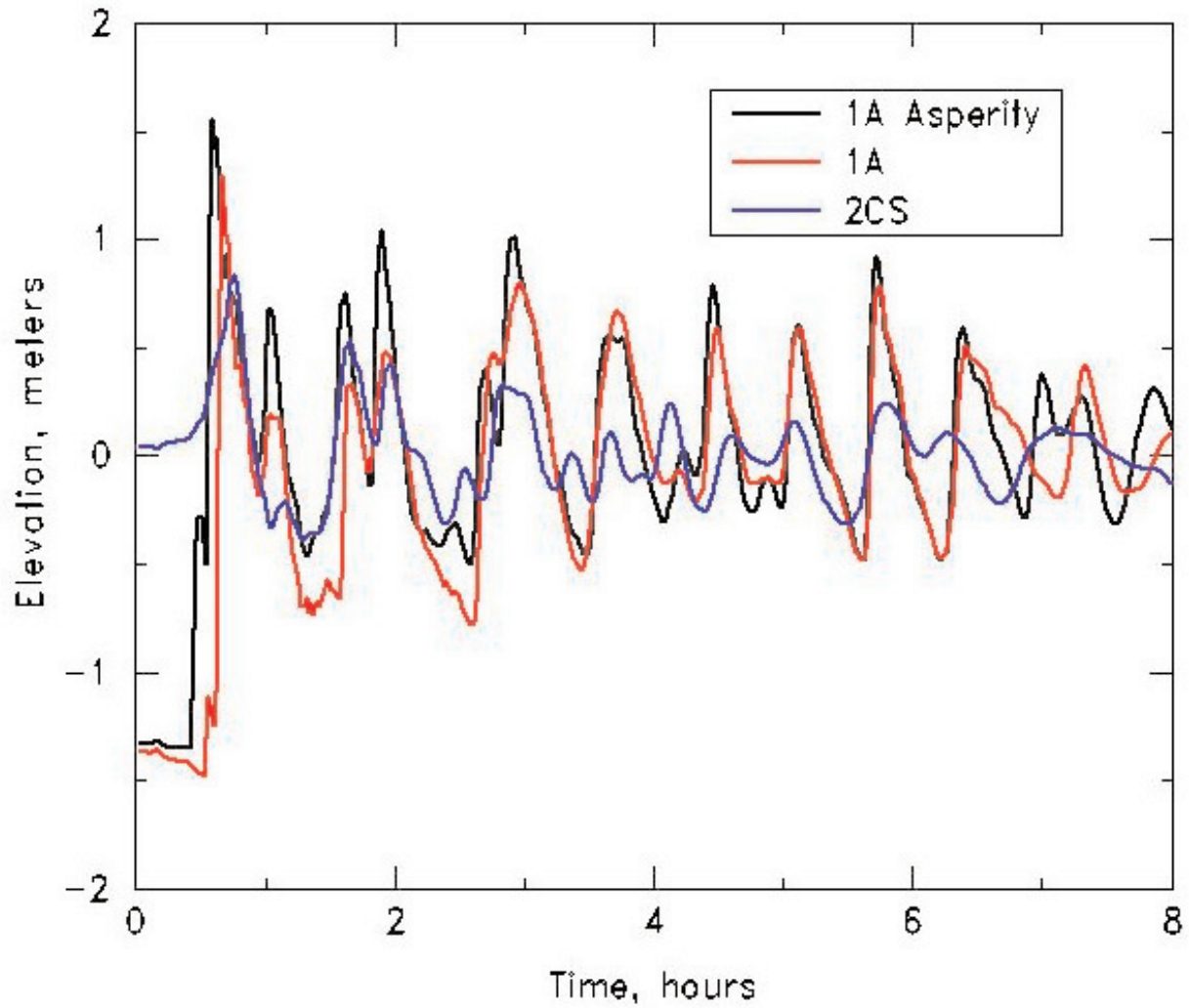


Figure 8. Station 4 time history of wave arrivals (Pony Slough area). See Figure 1 for location and Figure 2 for general explanation. Note that the first wave arrives around 45 minutes after the earthquake.

Station 4 Velocities

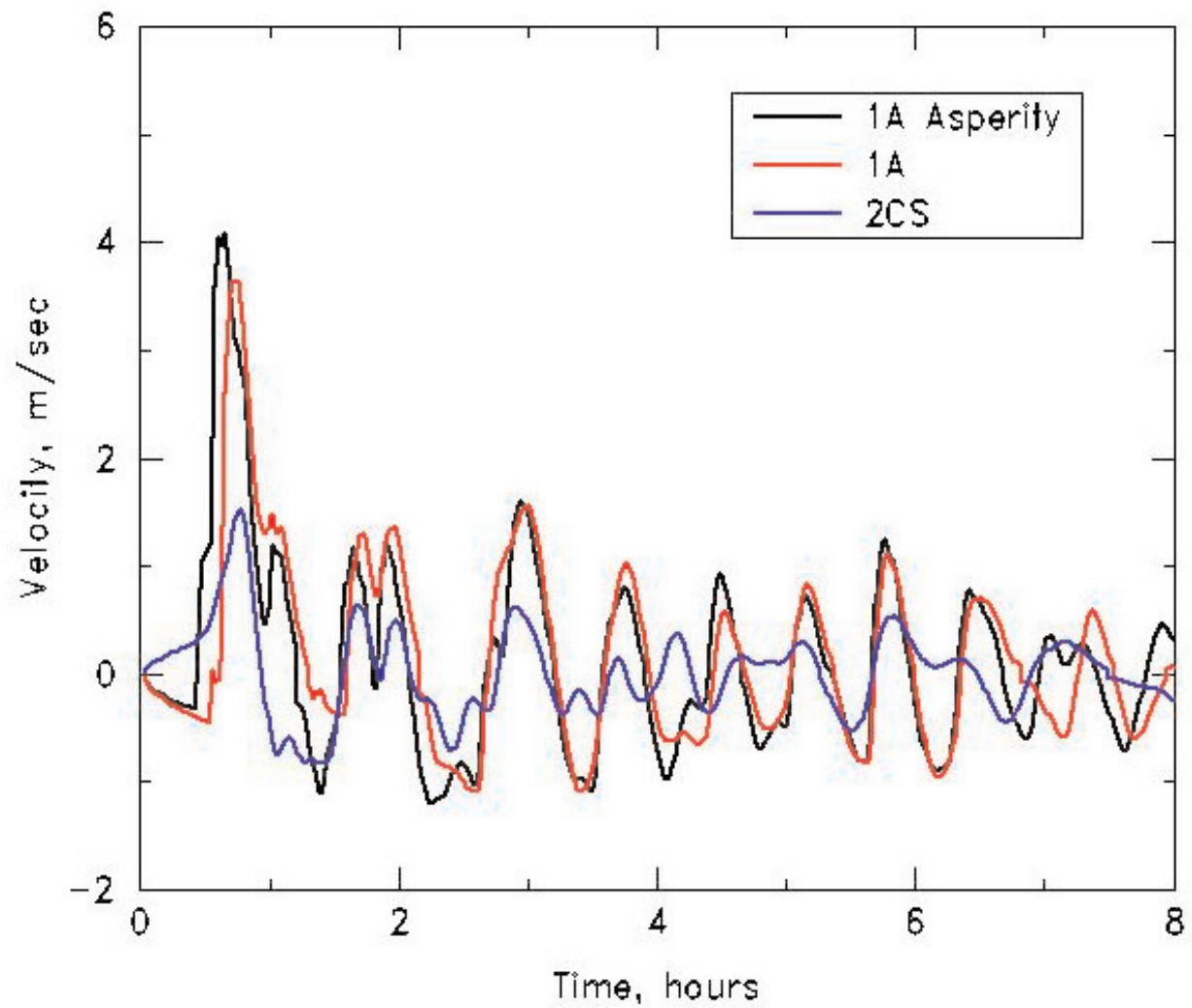


Figure 9. Current velocity changes for station 4 (Pony Slough area). See Figure 1 for location and Figure 3 for general explanation.

Station 5 Elevations

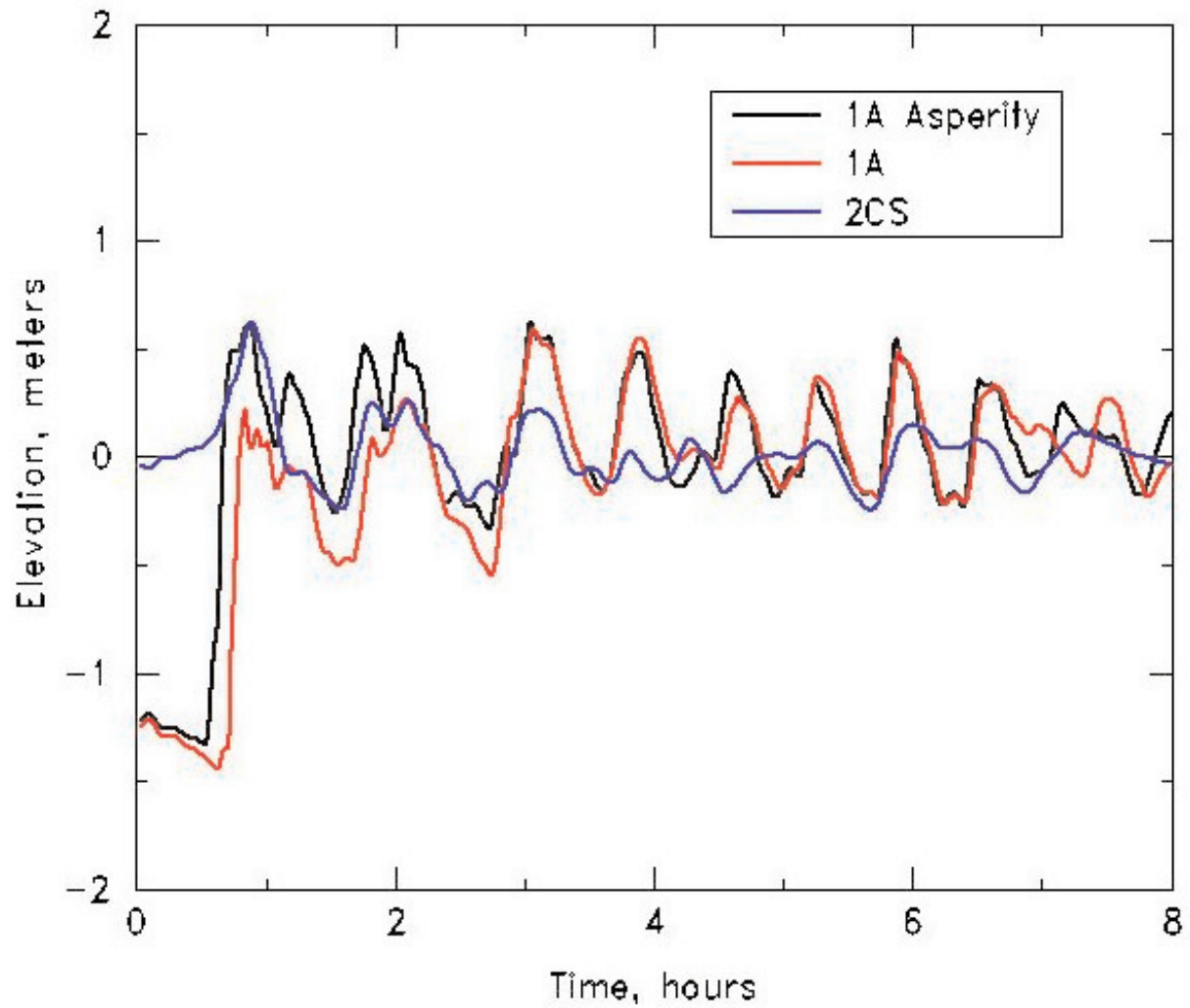


Figure 10. Station 5 time history of wave arrivals (North Bend area). See Figure 1 for location and Figure 2 for general explanation. Note that the first wave arrives nearly an hour after the earthquake.

Station 5 Velocities

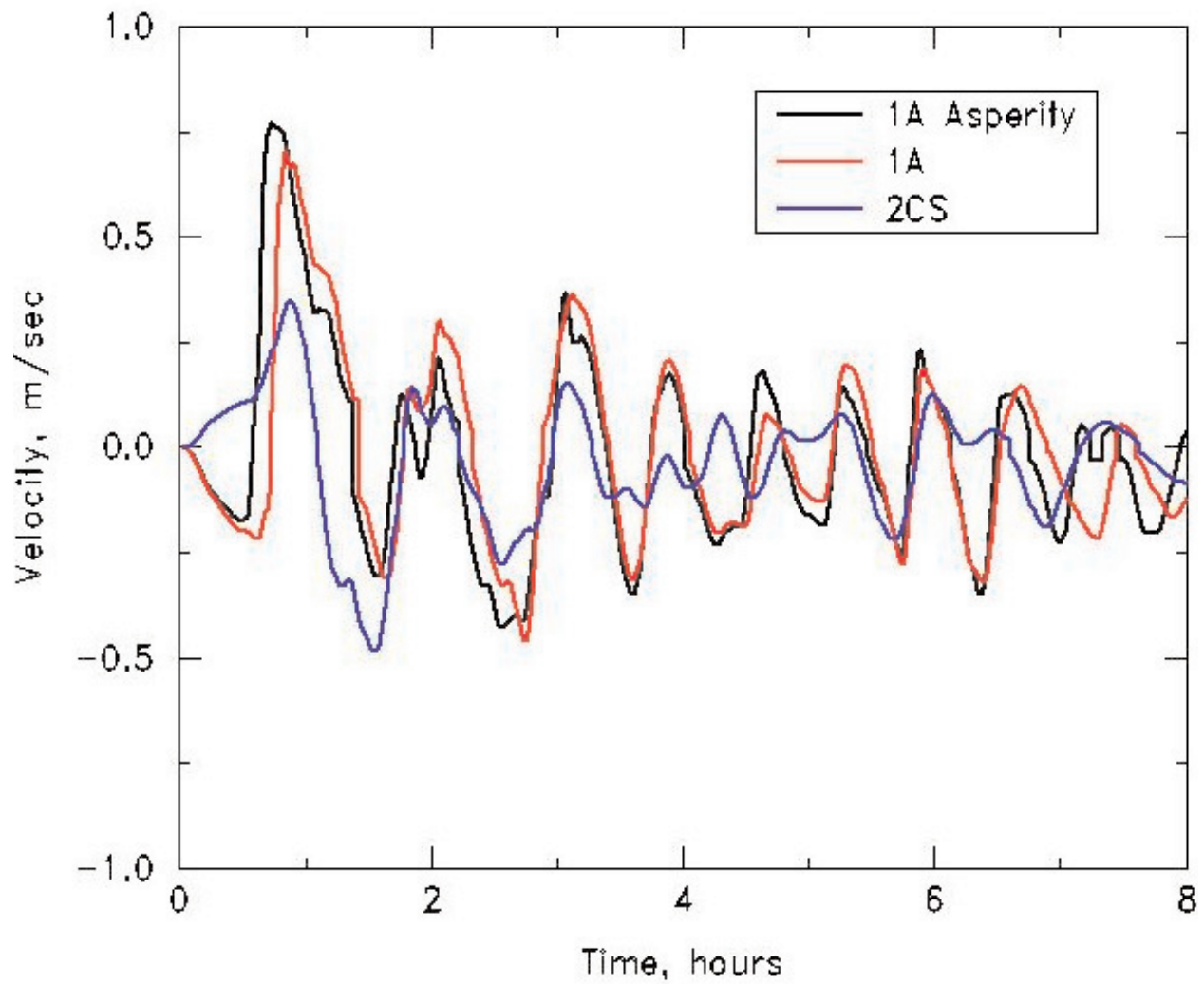


Figure 11. Current velocity changes for station 5 (North Bend area). See Figure 1 for location and Figure 3 for general explanation.

Station 6 Elevations

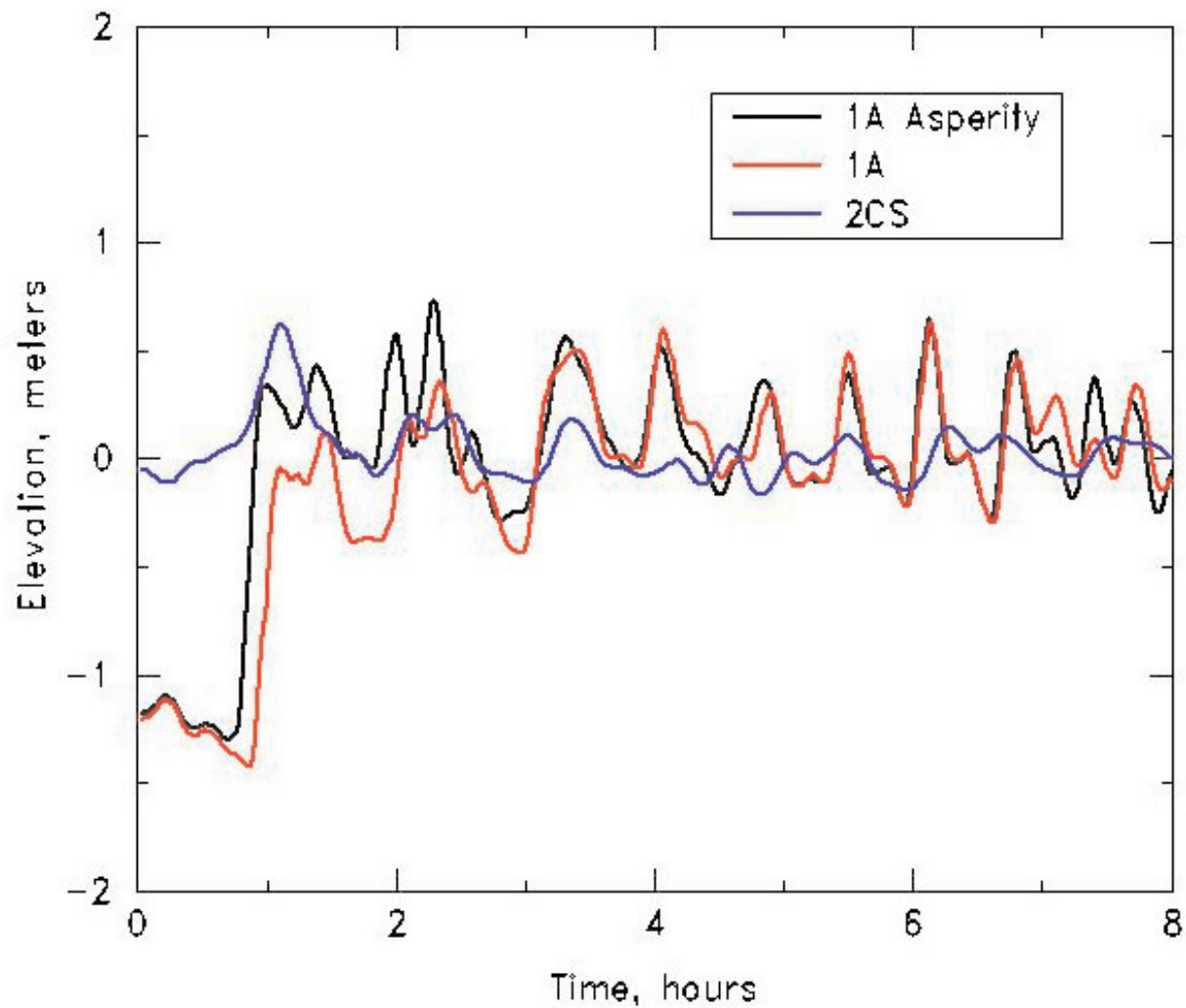


Figure 12. Station 6 time history of wave arrivals (Coos Bay area). See Figure 1 for location and Figure 2 for general explanation. Note that the first wave does not arrive until about an hour after the earthquake.

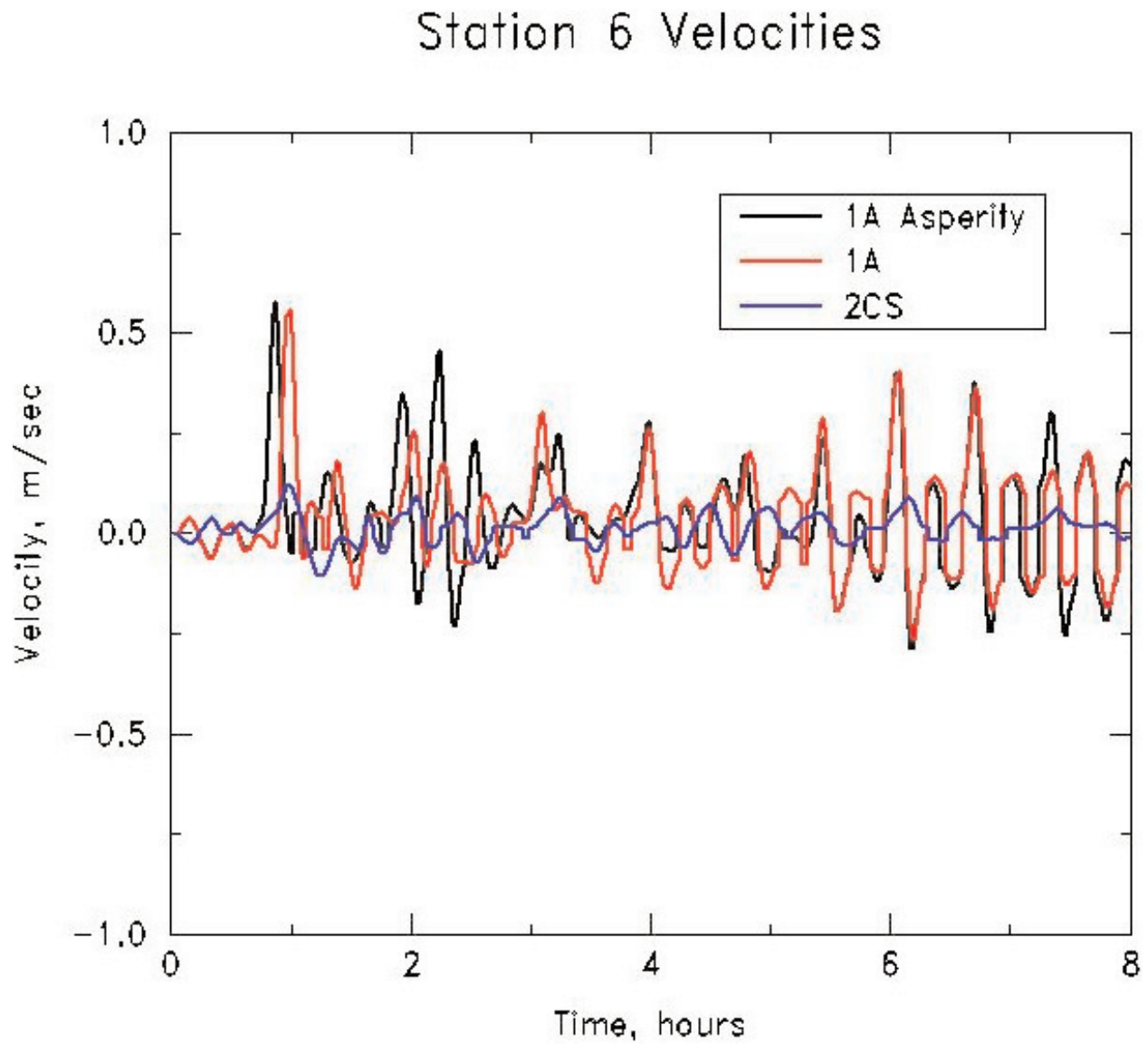


Figure 13. Current velocity changes for station 6 (Coos Bay area). See Figure 1 for location and Figure 3 for general explanation.

Tsunami flooding depicted on the map takes into account current topography with one exception: The high-run-up flooding scenario assumes that an erosion event precedes the tsunami, lowering foredunes to 4.5 m elevation over a width of approximately 200–300 ft (60–90 m) and a length depicted in Figure 14. The erosion scenario uses the method of Komar and others (1999) to predict retreat of foredunes assuming a high run-up event.¹ Ocean water levels and other oceanographic factors utilized in the wave erosion model are summarized in Table 1 below.

¹ This erosion scenario assumes that the rise in wave heights identified offshore from the Pacific Northwest coast buoy data by Allan and Komar (2000) continues over the next century. In effect, the 52.5-ft significant wave height used in this scenario is similar to a predicted 100-year storm wave. The 1.31-ft rise in mean sea level is expected to occur over the next 100 years and is based on trends determined for the South Beach, Yaquina Bay tide gauge (Flick and others, 1999). This combination of events has an extremely low probability of occurrence. However, the results are still useful in that they provide a landward limit of potential erosion (assuming no long-term trends in the coast) due to a particularly severe storm.

Table 1. Oceanographic factors utilized to predict fore-dune retreat for the high-run-up tsunami flooding scenario.

Significant wave height	52.5 ft (16.0 m)
Wave period	20 second peak
Mean higher high tide	7.55 ft (2.3 m)
Monthly mean water level	1.31 ft (0.4 m)
Storm surge	5.58 ft (1.7 m)
Sea level rise	1.31 ft (0.4 m)

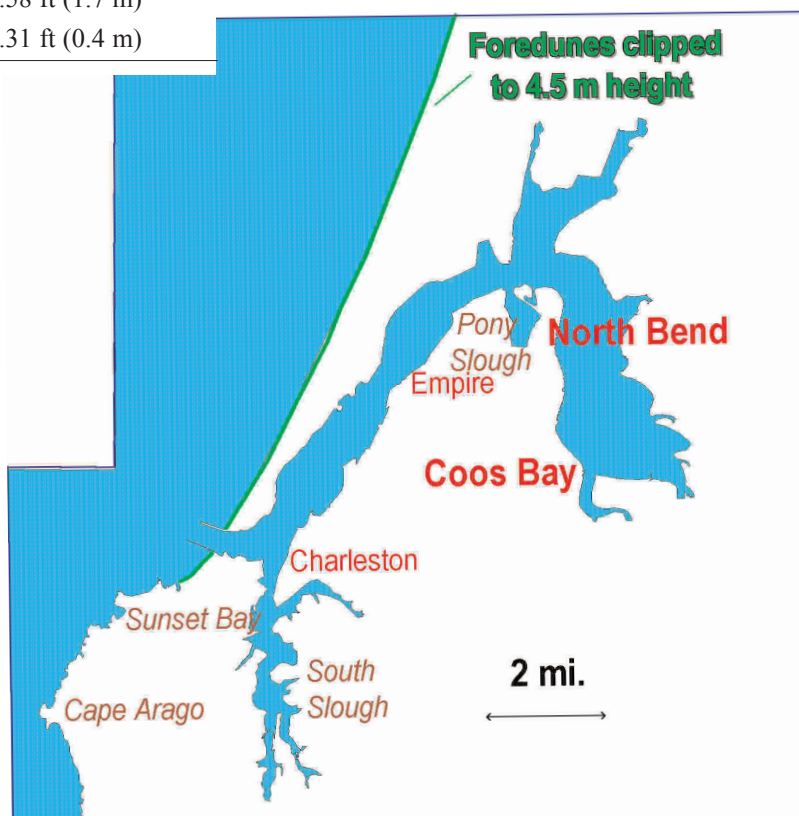


Figure 14. Approximate area of assumed foredune erosion for high-run-up tsunami flooding scenario.

Evacuation Planning

When planning evacuation routes and destinations, check with local officials for guidance. In general, go to the least hazardous site (uncolored area or coolest color) on the map by the shortest route and make sure that the route is not compromised by other earthquake hazards such as liquefaction or earthquake-induced landslides. Bridges may fail in the event of an earthquake. Consult with transportation authorities about the seismic stability of bridges used for evacuation.

Additional Detailed Information

See Oregon Department of Geology and Mineral Industries Open-File Report O-97-34 (Priest and others, 1997) for a detailed explanation of the mapping techniques (to obtain this publication go to world wide web site <http://www.naturenw.org>). The simulation techniques are also discussed by Myers and others (1999) and Priest and others (2000). World wide web links to these last two references are at <http://www.ccalmr.ogi.edu/STH/online/volume17/number1/mbp/> and <http://epubs.lanl.gov/tsunami/ts182.pdf>, respectively.

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NOTE

The Oregon Department of Geology and Mineral Industries is publishing this map because the subject matter furthers the mission of the Department. The map is not intended to be used for site-specific planning. It may be used as a general guide for emergency-response planning.

APPENDIX

Regional tectonic deformation for the scenario earthquakes

The initial condition for the tsunami simulations is the crustal uplift and subsidence associated with the scenario earthquake. The pattern of regional crustal deformation is essentially the initial tsunami wave, since the pattern is duplicated in the sea surface above. Predicted patterns of uplift and subsidence are illustrated in Figures A-1 through A-3.

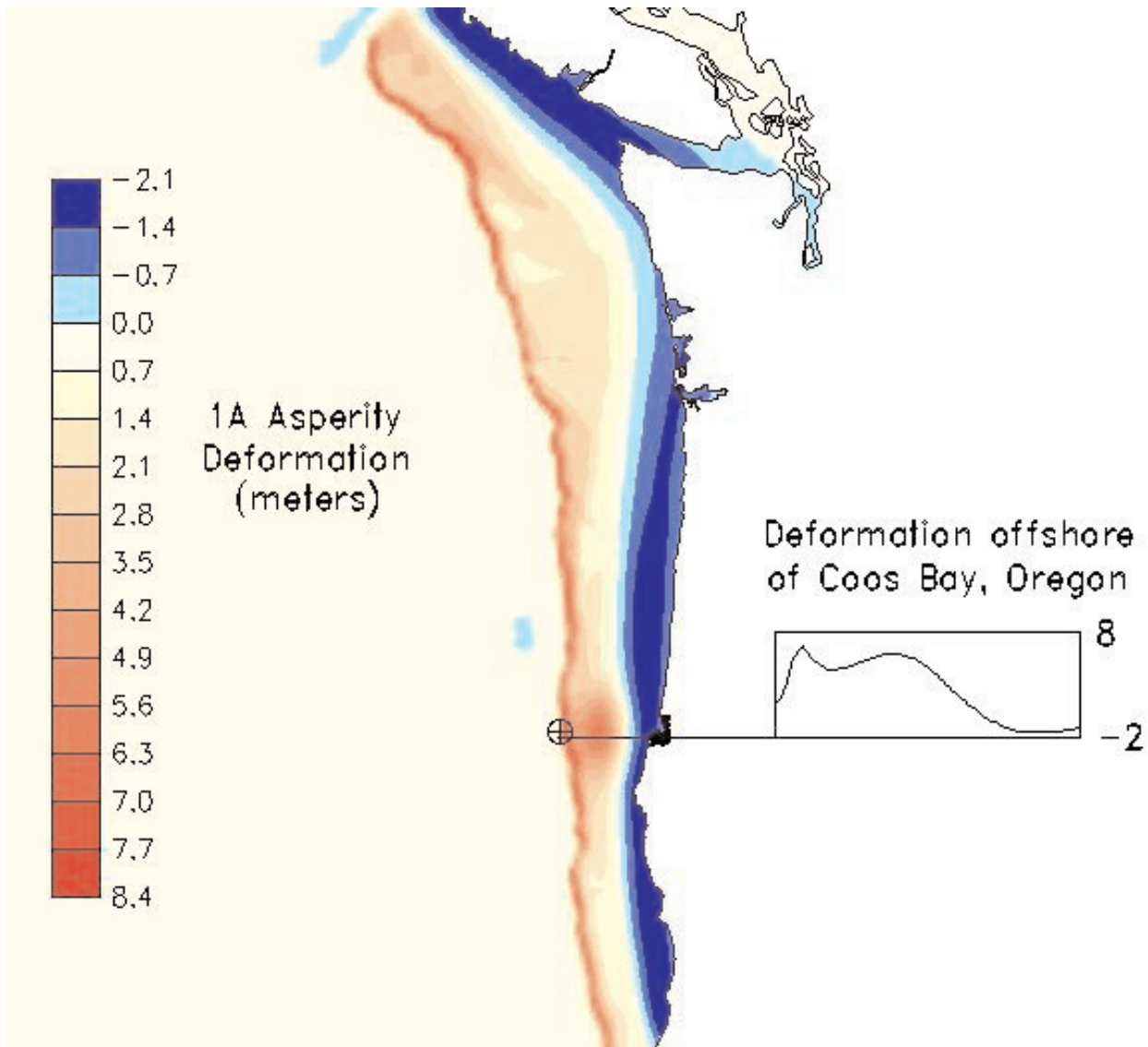


Figure A-1. Ground deformation for the high-run-up scenario earthquake showing a local mound of uplift roughly twice as high as the regional pattern immediately offshore from Coos Bay. This mound of uplift is termed an asperity and corresponds to actual uplift areas observed in the magnitude 9.2 earthquake that struck Alaska in 1964. Note that up to 6 ft (2 m) of subsidence may affect parts of Coos Bay, according to this scenario. This subsidence will likely persist for decades after the earthquake.

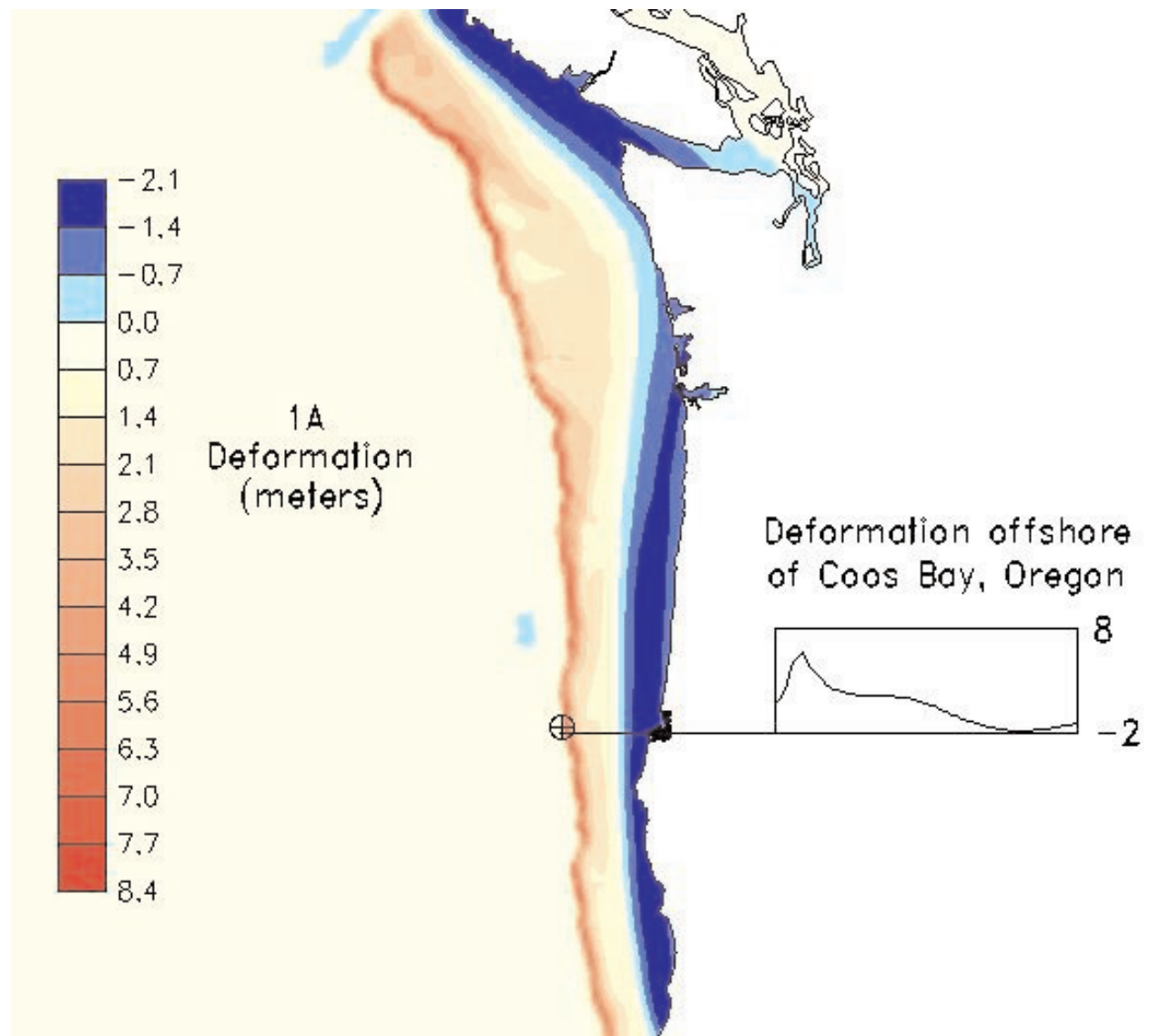


Figure A-2. Crustal deformation for the moderate-run-up scenario is essentially the same as in the high-run-up scenario but without the asperity offshore.

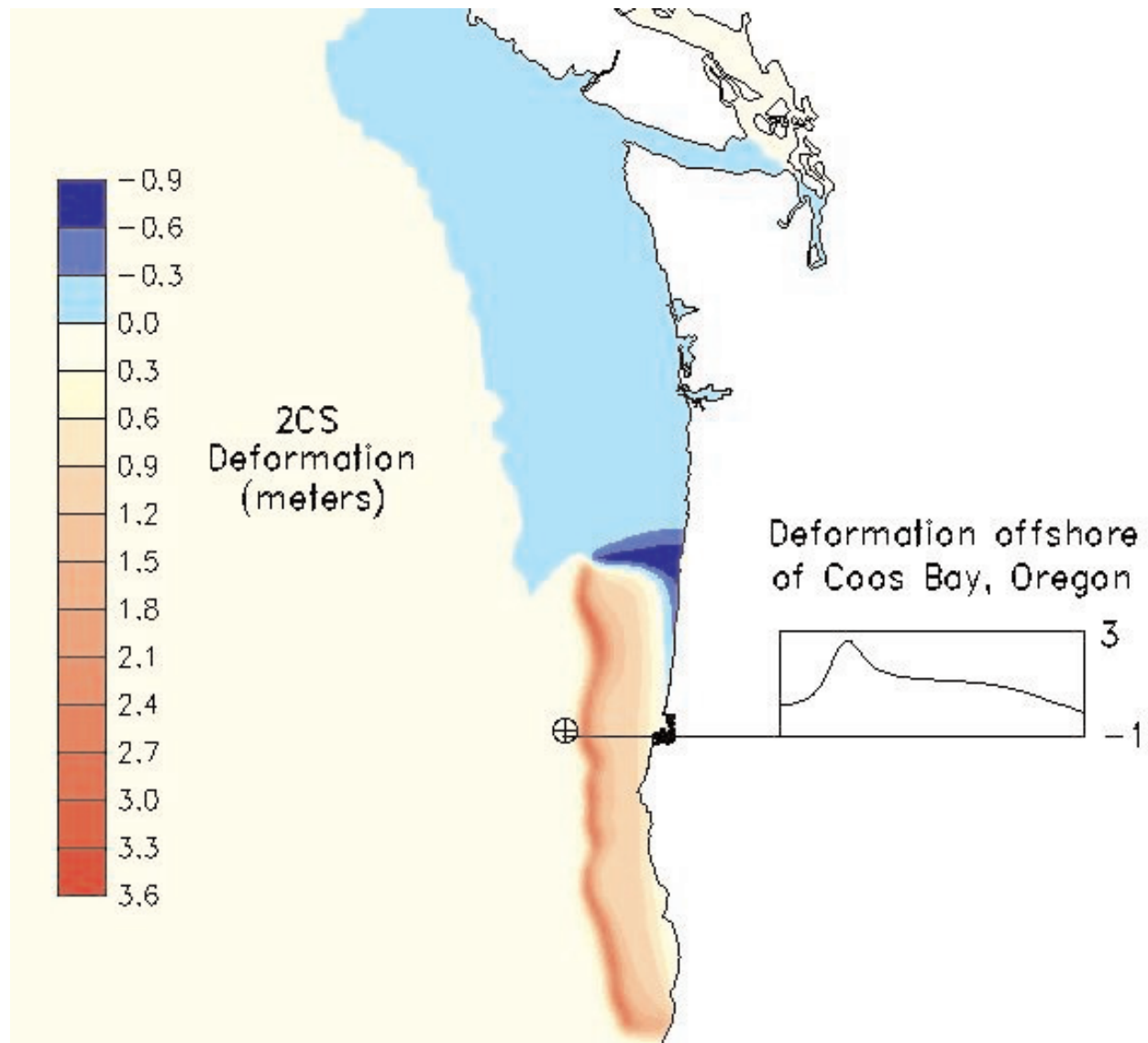


Figure A–3. Low-run-up scenario earthquake deformation. This scenario assumes that only the southern portion of the subduction zone ruptures and that total fault displacement will be about half that of the moderate-run-up scenario. This scenario also assumes a somewhat wider rupture, which is supported by some geological studies (see Priest and others, 1997 for discussion). Wider ruptures, all other things being equal, create smaller tsunamis than narrow ruptures in this geological setting. Note that no significant subsidence or uplift occurs at Coos Bay.