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Tsunami Hazard Assessment of the Northern Oregon Coast: A Multi-Deterministic Approach Tested at Cannon Beach, Oregon

Details

Meeting	2008 Fall Meeting
Section	Ocean Sciences
Session	Advances in Tsunami Research With Application to Forecasts and Warnings II
Identifier	OS42B-08
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Index Terms	Tsunamis and storm surges [4564]

Abstract

To update the tsunami hazard assessment method for Oregon, we (1) evaluate geologically reasonable variability of the earthquake rupture process on the Cascadia megathrust, (2) compare those scenarios to geological and geophysical evidence for plate locking, (3) specify 25 deterministic earthquake sources, and (4) use the resulting vertical coseismic deformations as initial conditions for simulation of Cascadia tsunami inundation at Cannon Beach, Oregon. Because of the Cannon Beach focus, the north-south extent of source scenarios is limited to Neah Bay, Washington to Florence, Oregon. We use the marine paleoseismic record to establish recurrence bins from the 10,000 year event record and select representative coseismic slips from these data. Assumed slips on the megathrust are 8.4 m (290 yrs of convergence), 15.2 m (525 years of convergence), 21.6 m (748 years of convergence), and 37.5 m (1298 years of convergence) which, if the sources were extended to the entire Cascadia margin, give Mw varying from approximately 8.3 to 9.3. Additional parameters explored by these scenarios characterize ruptures with a buried megathrust versus splay faulting, local versus regional slip patches, and seaward skewed versus symmetrical slip distribution. By assigning variable weights to the 25 source scenarios using a logic tree approach, we derived percentile inundation lines that express the confidence level (percentage) that a Cascadia tsunami will NOT exceed the line. Lines of 50, 70, 90, and 99 percent confidence correspond to maximum runup of 8.9, 10.5, 13.2, and 28.4 m (NAVD88). The tsunami source with highest logic tree weight (preferred scenario) involved rupture of a splay fault with 15.2 m slip that produced tsunami inundation near the 70 percent confidence line. Minimum inundation consistent with the inland extent of three Cascadia tsunami sand layers deposited east of Cannon Beach within the last 1000 years suggests a minimum of 15.2 m slip on buried megathrust ruptures. The largest tsunami run-up at the 99 percent isoline was from 37.5 m slip partitioned to a splay fault. This type of extreme event is considered to be very rare, perhaps once in 10,000 years based on offshore paleoseismic evidence, but it can produce waves rivaling the 2004 Indian Ocean tsunami. Cascadia coseismic deformation most similar to the Indian Ocean earthquake produced generally smaller tsunamis than at the Indian Ocean due mostly to the 1 km shallower water depth on the Cascadia margin. Inundation from distant tsunami sources was assessed by simulation of only two Mw 9.2 earthquakes in the Gulf of Alaska, a hypothetical worst-case developed by the Tsunami Pilot Study Working Group (2006) and a historical worst case, the 1964 Prince William Sound Earthquake; maximum runups were, respectively, 12.4 m and 7.5 m.

Cite as: Author(s) (2008), Title, *Eos Trans. AGU, 89*(53), Fall Meet. Suppl., Abstract OS42B-08