Simulating Tsunami Inundation in Southern Oregon, USA Using Hypothetical Cascadia and Alaska Earthquake Scenarios

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Abstract

We develop 15 full-margin rupture models for Cascadia subduction zone earthquakes that define vertical seafloor deformation used to simulate tsunami inundation at Bandon, Oregon. We consider rupture models that include slip partitioned to a splay fault in the accretionary wedge and models that vary the updip limit of slip on the megathrust. The design of coseismic slip models is based on the interpretation of paleoseismic and paleotsunami data, especially turbidite records offshore and a tsunami deposit sequence at Bradley Lake in southern Oregon. Alternative scenarios are evaluated using a logic tree that ranks model consistency with geophysical and geological data. The hydrodynamic computer model, SELFE, is used to simulate tsunami generation, propagation and inundation for the 15 Cascadia earthquake sources and two Alaska earthquake sources: the 1964 M_w 9.2 Prince William Sound earthquake and a maximum hypothetical earthquake beneath the Gulf of Alaska. Results describe levels of confidence (in percent) that a Cascadia tsunami will not exceed simulated wave runup. Maximum Cascadia tsunami wave elevations at the shoreline vary between ~4 and ~25 m above the model tide (mean higher high water) for earthquakes with 9 to 44 m slip and moment

magnitude (M_w) 8.7 to 9.2. The simulated inundation for all Cascadia scenarios is consistent with minimum constraints from the spatial extent of deposits left by the AD 1700 Cascadia tsunami and older predecessors. Simulations of the 1964 Alaska tsunami agree with limited historical observations of wave heights and runup in Bandon. We recommend using the maximum Cascadia tsunami scenario and the maximum Alaska tsunami scenario for delineating evacuation zones for the Oregon coast. The tsunami scenario most consistent with paleoseismic data or the larger splay fault scenario, which encompass ~80 to 95 percent of the hazard, should be considered for land use planning and future revisions to building codes along the coast.

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