SSA 2010 Annual Meeting Abstract

Session: Characterizing the Next Cascadia Earthquake and Tsunami
Schedule: Wed 21 Apr – 10:30 AM
Location: Salon F
Presentation Type: Oral
Presenter: Witter, Robert C

VALIDATING NUMERICAL TSUNAMI SIMULATIONS IN SOUTHERN OREGON USING LATE HOLOCENE RECORDS OF GREAT CASCADIA EARTHQUAKES AND TSUNAMIS

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Marine and coastal paleoseismic evidence for Cascadia subduction earthquakes imply a range of rupture scenarios that provide model inputs for tsunami simulations. 41 turbidites from submarine channels along the length of the margin define a mean Holocene recurrence of ~530 yr for ruptures ≥800-km-long and ~240 yr for southern Cascadia earthquakes that ruptured 3 shorter segments. Coastal paleoseismic records spanning the past ~7000 yr include 13 tsunami deposits archived in Bradley Lake in southern Oregon. We test the smallest Cascadia tsunami scenarios capable of reaching the lake for consistency with paleoseismic data. Earthquake scenarios employ either: 1) regional rupture with slip distribution symmetrically tapering to zero up and down dip; or 2) regional rupture diverting slip onto an offshore splay fault. Maximum slip in each scenario varies as the product of selected recurrence intervals and the convergence rate. Using the hydrodynamic model SELFE, we ran >50 tsunami simulations on numerical grids that reflect inferred changes in coastal paleotopography. Simulating the 1700 tsunami requires earthquake slip equivalent to ≥400 yr of convergence using the regional symmetric slip model. Augmenting uplift with a splay fault reduces the recurrence time to 360 yr – still longer than the 174 to 341 yr range of paleoseismic intervals that correlate with tsunami deposits in the lake. Earlier tsunamis, likely smaller than the 1700 wave, probably followed the largest earthquakes when the shoreline migrated to its most landward position due to subsidence and coastal erosion. Tsunami simulations with these conditions require a minimum recurrence of 280 yr. Other factors like seafloor acceleration or extreme tides may account for the smallest Cascadia tsunamis that reached the lake. Alternatively, these small events may release stored strain from previous earthquake cycles.

This abstract appears in *Seismological Research Letters* Volume 81, No. 2 on page 290.

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Posted: *18 February 2010*