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## Economics of Tsunami Mitigation in the Pacific Northwest

### Details

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<b>Section</b>	<a href="#">Natural Hazards</a>
<b>Session</b>	<a href="#">Tsunami Inundation, Risk, and Vulnerability Assessment: Toward Loss Reduction and Resilience II</a>
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<b>Index Terms</b>	<a href="#">Disaster risk analysis and assessment [4333]</a> <a href="#">Economic impacts of disasters [4336]</a> <a href="#">Disaster policy [4338]</a> <a href="#">Disaster mitigation [4339]</a>

### Abstract

The death total in a major Cascadia Subduction Zone (CSZ) tsunami may be comparable to the Tohoku tsunami - tens of thousands. To date, tsunami risk reduction activities have been almost exclusively hazard mapping and evacuation planning. Reducing deaths in locations where evacuation to high ground is impossible in the short time between ground shaking and arrival of tsunamis requires measures such as vertical evacuation facilities or engineered pathways to safe ground. Yet, very few, if any, such tsunami mitigation projects have been done. In contrast, many tornado safe room and earthquake mitigation projects driven entirely or in largely by life safety have been done with costs in the billions of dollars. The absence of tsunami mitigation measures results from the belief that tsunamis are too infrequent and the costs too high to justify life safety mitigation measures. A simple analysis based on return periods, death rates, and the geographic distribution of high risk areas for these hazards demonstrates that this belief is incorrect: well-engineered tsunami mitigation projects are more cost-effective with higher benefit-cost ratios than almost all tornado or earthquake mitigation projects. Goldfinger's paleoseismic studies of CSZ turbidites indicate return periods for major CSZ tsunamis of about 250-500 years (USGS Prof. Paper 1661-F in press). Tsunami return periods are comparable to those for major earthquakes at a given location in high seismic areas and are much shorter than those for tornados at any location which range from >4,000 to >16,000 years

for >EF2 and >EF4 tornadoes, respectively. The average earthquake death rate in the US over the past 100-years is about 1/year, or about 30/year including the 1906 San Francisco earthquake. The average death rate for tornadoes is about 90/year. For CSZ tsunamis, the estimated average death rate ranges from about 20/year (10,000 every 500 years) to 80/year (20,000 every 250 years). Thus, the long term deaths rates from tsunamis, earthquakes and tornadoes are comparable. High hazard areas for tornadoes and earthquakes cover ~40% and ~15% of the contiguous US, ~1,250,000 and ~500,000 square miles, respectively. In marked contrast, tsunami life safety risk is concentrated in communities with significant populations in areas where evacuation to high ground is impossible: probably <4,000 square miles or <0.1% of the US. The geographic distribution of life safety risk profoundly affects the economics of tsunami life safety mitigation projects. Consider a tsunami life safety project which saves an average of one life per year (500 lives per 500 years). Using FEMA's value of human life (\$5.8 million), 7% discount rate and a 50-year project useful lifetime, the net present value of avoided deaths is \$80 million. Thus, the benefit-cost ratio would be about 16 or about 80 for tsunami mitigation projects which cost \$5 million or \$1 million, respectively. These rough calculations indicate that tsunami mitigation projects in high risk locations are economically justified. More importantly, these results indicate that national and local priorities for natural hazard mitigation should be reconsidered, with tsunami mitigation given a very high priority.

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