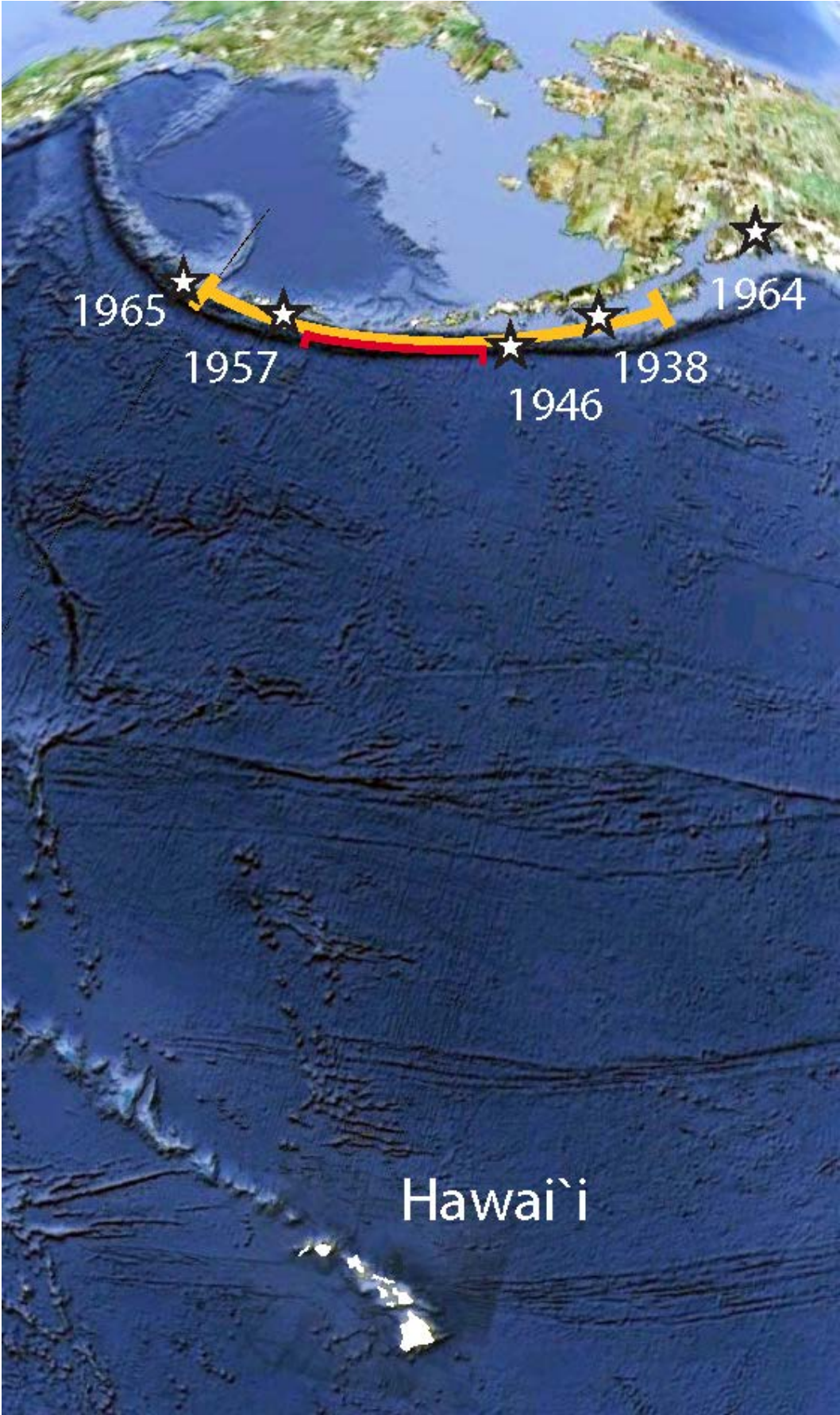


New research estimates probability of mega-earthquake in the Aleutians

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A map showing the Aleutians with respect to Hawai'i. The red and yellow arcs indicate the sections of the Aleutian subduction zones considered in the probability analysis. Stars and dates indicate epicenters of prior 20th century great earthquakes ($M_w > 8$). Credit: Butler et al., 2016

A team of researchers from the University of Hawai'i at Mānoa (UHM) published a study this week that estimated the probability of a Magnitude 9+ earthquake in the Aleutian Islands—an event with sufficient power to create a mega-tsunami especially threatening to Hawai'i. In the next 50 years, they report, there is a 9% chance of such an event. An earlier State of Hawai'i report (Table 6.12) has estimated the damage from such an event would be nearly \$40 billion, with more than 300,000 people affected.

Earth's crust is composed of numerous rocky plates. An [earthquake](#) occurs when two sections of crust suddenly slip past one another. The surface where they slip is called the fault, and the system of faults comprises a subduction zone. Hawai'i is especially vulnerable to a tsunami created by an earthquake in the subduction zone of the Aleutian Islands.

"Necessity is the mother of invention," said Rhett Butler, lead author and geophysicist at the UHM School of Ocean and Earth Science and Technology (SOEST). "Having no recorded history of mega tsunamis in Hawai'i, and given the tsunami threat to Hawai'i, we devised a model for Magnitude 9 earthquake rates following upon the insightful work of David Burbidge and others."

Butler and co-authors Neil Frazer (UHM SOEST) and William

Templeton (now at Portland State University) created a numerical model based only upon the basics of plate tectonics: fault length and plate convergence rate, handling uncertainties in the data with Bayesian techniques.

To validate this model, the researchers utilized recorded histories and seismic/tsunami evidence related to the 5 largest earthquakes (greater than Magnitude 9) since 1900 (Tohoku, 2011; Sumatra-Andaman, 2004; Alaska, 1964; Chile, 1960; and Kamchatka, 1952).



The only well-documented paleotsunami deposit in Hawai'i from the 16th

century is on Kauaʻi. The Makauwahi sinkhole, on the side of a hardened sand dune, is viewed toward the southeast from an apparent altitude of 342 m. Inset photos show two of the wall edges, indicating the edges of the sinkhole. The east wall (left) is 7.2 m above mean sea level, and about 100 m from the ocean. Note for scale the people in the right image. Credit: R. Butler (left), Gerard Fryer (right), GoogleMaps (background). Figure from Butler et al., 2014.

"These five events represent half of the seismic energy that has been released globally since 1900," said Butler. "The events differed in details, but all of them generated great tsunamis that caused enormous destruction."

To further refine the [probability](#) estimates, they took into account past (prior to recorded history) tsunamis—evidence of which is preserved in geological layers in coastal sediments, volcanic tephtras, and archeological sites.

"We were surprised and pleased to see how well the model actually fit the paleotsunami data," said Butler.

Using the probability of occurrence, the researchers were able to annualize the risk. They report the chance of a Magnitude 9 earthquake in the greater Aleutians is $9\% \pm 3\%$ in the next 50 years. Hence the risk is 9% of \$40 billion, or \$3.6 billion. Annualized, this risk is about \$72 million per year. Considering a worst-case location for Hawai'i limited to the Eastern Aleutian Islands, the chances are about 3.5% in the next 50 years, or about \$30 million annualized risk. In making decisions regarding mitigation against this \$30-\$72 million risk, the state can now prioritize this hazard with other threats and needs.

The team is now considering ways to extend the analysis to smaller

earthquakes, Magnitude 7-8, around the Pacific.

More information: Rhett Butler et al, Bayesian Probabilities for Mw 9.0+ Earthquakes in the Aleutian Islands from a Regionally Scaled Global Rate, *Journal of Geophysical Research: Solid Earth* (2016). [DOI: 10.1002/2016JB012861](https://doi.org/10.1002/2016JB012861)

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