Abstract Details

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Title: Tsunami Seismology of Subduction-zone Earthquakes • from Ocean Bottom to Coastal Deposits •

Abstract:

Tsunami data can be used to study earthquake sources in a way similar to that seismic data are used. Slip distribution on faults can be estimated by inversion of tsunami waveforms or measured runup heights. For old tsunamis, tsunami heights or inundation area can be estimated from damage description in historical documents or distribution of tsunami deposits. Seafloor dive surveys provide direct visual information on tsunami source area. Tsunami waveforms recorded on costal tide or bottom pressure gauges have been inverted to estimate heterogeneous fault motions of many large and great earthquakes in the Alaska-Aleutians, northern Japan, and Nankai trough. These studies show that the slip on the faults is not uniform, but there are patches, or asperities, where the coseismic slip is concentrated. Tide gauge records exist for more than a century at some stations, longer than seismographic observation, hence tsunamis are often the only instrumental data from old earthquakes. The history of instrumental observation is still short compared to a typical recurrence interval of earthquakes or tsunamis. Some countries, such as Japan, have long histories of written records that have provided accurate dates for past earthquakes and tsunamis. An interesting example of such studies is the 1700 earthquake in the Cascadia subduction zone, off the Pacific coast of North America. Date (9 pm of January 26) and size (moment magnitude Mw~ 9) of the earthquake have been estimated from Japanese tsunami damage by combining elastic dislocation modeling of crustal deformation and numerical simulation of the trans-Pacific tsunami. Tsunami deposits provide information of earthquake recurrence. Characteristic earthquakes along the Kuril trench, off Hokkaido, have been considered an Mw ~ 8 event rupturing single segments, on the basis of historical documents for the last two centuries. Deposits of larger, prehistoric tsunamis underlie lowlands and lagoons along 200 km of eastern Hokkaido•s Pacific coast. Extensive tsunami deposits from the past 7000 years imply an average recurrence interval of about 500 years. By using numerical simulations, the geologically inferred tsunamis are best explained by rupture of multi-segments with an Mw ~ 8.5. Visual observations of seafloor around Japan and Papua New Guinea, by using Remotely Operated Vehicles or submersibles, show some common features in tsunamigenic ocean floors. Fissures are typically observed in an earthquake/tsunamis source. Erosion and sediment deposition around the fissures qualitatively indicate their relative age. Debris deposits, fresh or buried in mud, are observed below steep slopes that collapsed due to strong ground motion. Unique cold-seep biological community is also common.

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