Geophysical Research Abstracts
Vol. 19, EGU2017-3469, 2017
EGU General Assembly 2017

Probabilistic tsunami inundation map based on stochastic earthquake source model: A demonstration case in Macau, the South China Sea

Linlin Li (1,2), Adam D. Switzer (1,2), Yu Wang (1), Chung-Han Chan (1), Qiang Qiu (3), and Robert Weiss (4)

(1) Earth Observatory of Singapore, Nanyang Technological University, Singapore, (2) Asian School of the Environment, Nanyang Technological University, Singapore , (3) School of Earth and Environment, University of Leeds, UK , (4) Department of Geosciences, Virginia Tech, Blacksburg, USA

Current tsunami inundation maps are commonly generated using deterministic scenarios, either for real-time forecasting or based on hypothetical "worst-case" events. Such maps are mainly used for emergency response and evacuation planning and do not include the information of return period. However, in practice, probabilistic tsunami inundation maps are required in a wide variety of applications, such as land-use planning, engineer design and for insurance purposes. In this study, we present a method to develop the probabilistic tsunami inundation map using a stochastic earthquake source model. To demonstrate the methodology, we take Macau a coastal city in the South China Sea as an example. Two major advances of this method are: it incorporates the most updated information of seismic tsunamigenic sources along the Manila megathrust; it integrates a stochastic source model into a Monte Carlo-type simulation in which a broad range of slip distribution patterns are generated for large numbers of synthetic earthquake events. When aggregated the large amount of inundation simulation results, we analyze the uncertainties associated with variability of earthquake rupture location and slip distribution. We also explore how tsunami hazard evolves in Macau in the context of sea level rise. Our results suggest Macau faces moderate tsunami risk due to its low-lying elevation, extensive land reclamation, high coastal population and major infrastructure density. Macau consists of four districts: Macau Peninsula, Taipa Island, Coloane island and Cotai strip. Of these Macau Peninsula is the most vulnerable to tsunami due to its low-elevation and exposure to direct waves and refracted waves from the offshore region and reflected waves from mainland. Earthquakes with magnitude larger than Mw8.0 in the northern Manila trench would likely cause hazardous inundation in Macau. Using a stochastic source model, we are able to derive a spread of potential tsunami impacts for earthquakes with the same magnitude. The diversity is caused by both random rupture locations and heterogeneous slip distribution. Adding the sea level rise component, the inundated depth caused by 1 m sea level rise is equivalent to the one caused by 90 percentile of an ensemble of Mw8.4 earthquakes.