Geophysical Research Abstracts
Vol. 20, EGU2018-1631, 2018
EGU General Assembly 2018

Evaluation of heterogeneous and uniform slip earthquake-tsunami scenarios for regional tsunami hazard assessments: Comparison with DART buoy observations.

Gareth Davies

Geoscience Australia, Community Safety Branch, Australia (gareth.davies@ga.gov.au)

Tsunami hazard assessments are often derived using computational approaches that model the occurrence rates of a suite of hypothetical earthquake-tsunami scenarios. While uniform slip earthquake models are often used, recent studies have emphasized that spatially non-uniform earthquake slip substantially affects tsunamis, with wave heights and run-up varying by a factor of three or more due to slip heterogeneities alone (i.e. assuming fixed 'bulk rupture parameters' such as the earthquake magnitude, rupture plane geometry, location, and shear modulus). As a result, stochastic slip models are increasingly being used for directly simulating slip variability in hazard assessments. Irrespective of how the tsunami scenarios are generated, the statistical properties of the modelled tsunami need to well approximate the statistical properties of real tsunami with the same bulk rupture parameters. For example, ideally a future real tsunami will have a 50% chance of having a peak wave height below the median corresponding synthetic peak wave height; a 90% chance of being below the 90th percentile; and so on.

Testing is required to determine whether any model has performance comparable to this ideal case. The literature suggests large differences in the statistical properties of stochastic slip models, implying not all will give a good representation of real tsunami variability. However, by comparing model scenarios against a suite of historic tsunami observations, we can statistically test whether key properties of real tsunami have the same distribution as their corresponding synthetic scenarios. We would recommend that such tests become standard in the validation of tsunami hazard scenario generation methods, to reduce the chance of using an inappropriate model which could significantly bias a hazard assessment.

The current study evaluates the statistical performance of earthquake-tsunami scenarios which form part of the updated Australian Probabilistic Tsunami Hazard Assessment, currently being developed by Geoscience Australia. The model scenarios are compared with deep-ocean DART buoy wave time-series for 15 recent tsunamis, each recorded at between 1 and 28 sites. No event specific calibration is applied to the models. We evaluate three different earthquake-tsunami scenario generation methods (fixed-size uniform slip; variable-size uniform-slip; variable-size stochastic-slip) in terms of how well they model the statistical properties of wave heights, and discuss the capacity of each method to generate wave time-series which match historical events. We find that some events cannot be well modelled using our fixed-size uniform-slip scenarios, while it is usually possible to match observations reasonably well with a variable-size uniform-slip event, or a variable-size stochastic-slip event. Both of the latter produce families of solutions which usually envelope the observed DART buoy tsunami wave heights, although quantiles of the variable-size uniform-slip events appear to have some downward bias, while quantiles of the variable-size stochastic-slip events seem more consistent with observations.