Geophysical Research Abstracts
Vol. 12, EGU2010-12827, 2010
EGU General Assembly 2010

Statistical Analysis of Tsunami Variability

Francesca Zolezzi, Tania Del Giudice, Chiara Traverso, Giulio Valfrè, Pamela Poggi, and Eric J. Parker
D'Appolonia S.p.A., Via San Nazaro 19, 16145 Genova, Italy (www.dappolonia.it)

The purpose of this paper was to investigate statistical variability of seismically generated tsunami impact. The specific goal of the work was to evaluate the variability in tsunami wave run-up due to uncertainty in fault rupture parameters (source effects) and to the effects of local bathymetry at an individual location (site effects). This knowledge is critical to development of methodologies for probabilistic tsunami hazard assessment.

Two types of variability were considered:
• Inter-event;
• Intra-event.

Generally, inter-event variability refers to the differences of tsunami run-up at a given location for a number of different earthquake events. The focus of the current study was to evaluate the variability of tsunami run-up at a given point for a given magnitude earthquake. In this case, the variability is expected to arise from lack of knowledge regarding the specific details of the fault rupture "source" parameters. As sufficient field observations are not available to resolve this question, numerical modelling was used to generate run-up data. A scenario magnitude 8 earthquake in the Hellenic Arc was modelled. This is similar to the event thought to have caused the infamous 1303 tsunami. The tsunami wave run-up was computed at 4020 locations along the Egyptian coast between longitudes 28.7° E and 33.8° E. Specific source parameters (e.g. fault rupture length and displacement) were varied, and the effects on wave height were determined. A Monte Carlo approach considering the statistical distribution of the underlying parameters was used to evaluate the variability in wave height at locations along the coast. The results were evaluated in terms of the coefficient of variation of the simulated wave run-up (standard deviation divided by mean value) for each location. The coefficient of variation along the coast was between 0.14 and 3.11, with an average value of 0.67. The variation was higher in areas of irregular coast. This level of variability is similar to that seen in ground motion attenuation correlations used for seismic hazard assessment.

The second issue was intra-event variability. This refers to the differences in tsunami wave run-up along a section of coast during a single event. Intra-event variability investigated directly considering field observations. The tsunami events used in the statistical evaluation were selected on the basis of the completeness and reliability of the available data. Tsunami considered for the analysis included the recent and well surveyed tsunami of Boxing Day 2004 (Great Indian Ocean Tsunami), Java 2006, Okushiri 1993, Kocaeli 1999, Messina 1908 and a case study of several historic events in Hawaii.

Basic statistical analysis was performed on the field observations from these tsunamis. For events with very wide survey regions, the run-up heights have been grouped in order to maintain a homogeneous distance from the source. Where more than one survey was available for a given event, the original datasets were maintained separately to avoid combination of non-homogeneous data. The observed run-up measurements were used to evaluate the minimum, maximum, average, standard deviation and coefficient of variation for each data set. The minimum coefficient of variation was 0.12 measured for the 2004 Boxing Day tsunami at Nias Island (7 data) while the maximum is 0.98 for the Okushiri 1993 event (93 data). The average coefficient of variation is of the order of 0.45.