Geophysical Research Abstracts
Vol. 12, EGU2010-12818, 2010
EGU General Assembly 2010

Run-up Variability due to Source Effects

Tania Del Giudice, Francesca Zolezzi, 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)

This paper investigates the variability of tsunami run-up at a specific location due to uncertainty in earthquake source parameters. It is important to quantify this "inter-event" variability for probabilistic assessments of tsunami hazard. In principal, this aspect of variability could be studied by comparing field observations at a single location from a number of tsunamigenic events caused by the same source. As such an extensive dataset does not exist, we decided to study the inter-event variability through numerical modelling. We attempt to answer the question "What is the potential variability of tsunami wave run-up at a specific site, for a given magnitude earthquake occurring at a known location". The uncertainty is expected to arise from the lack of knowledge regarding the specific details of the fault rupture "source" parameters.

The following steps were followed:

- the statistical distributions of the main earthquake source parameters affecting the tsunami height were established by studying fault plane solutions of known earthquakes;
- a case study based on a possible tsunami impact on Egypt coast has been set up and simulated, varying the geometrical parameters of the source;
- simulation results have been analyzed deriving relationships between run-up height and source parameters;
- using the derived relationships a Monte Carlo simulation has been performed in order to create the necessary dataset to investigate the inter-event variability of the run-up height along the coast;
- the inter-event variability of the run-up height along the coast has been investigated.

Given the distribution of source parameters and their variability, we studied how this variability propagates to the run-up height, using the Cornell "Multi-grid coupled Tsunami Model" (COMCOT). The case study was based on the large thrust faulting offshore the south-western Greek coast, thought to have been responsible for the infamous 1303 tsunami. Numerical modelling of the event was used to assess the impact on the North African coast. The effects of uncertainty in fault parameters were assessed by perturbing the base model, and observing variation on wave height along the coast.

The tsunami wave run-up was computed at 4020 locations along the Egyptian coast between longitudes 28.7 E and 33.8 E. To assess the effects of fault parameters uncertainty, input model parameters have been varied and effects on run-up have been analyzed. The simulations show that for a given point there are linear relationships between run-up and both fault dislocation and rupture length. A superposition analysis shows that a linear combination of the effects of the different source parameters (evaluated results) leads to a good approximation of the simulated results. This relationship is then used as the basis for a Monte Carlo simulation.

The Monte Carlo simulation was performed for 1600 scenarios at each of the 4020 points along the coast. The coefficient of variation (the ratio between standard deviation of the results and the average of the run-up heights along the coast) is comprised between 0.14 and 3.11 with an average value along the coast equal to 0.67. The coefficient of variation of normalized run-up has been compared with the standard deviation of spectral acceleration attenuation laws used for probabilistic seismic hazard assessment studies. These values have a similar meaning, and the uncertainty in the two cases is similar. The "rule of thumb" relationship between mean and sigma can be expressed as follows:

$$\mu + \sigma \approx 2\mu.$$

The implication is that the uncertainty in run-up estimation should give a range of values within approximately two times the average. This uncertainty should be considered in tsunami hazard analysis, such as inundation and risk maps, evacuation plans and the other related steps.