Geophysical Research Abstracts
Vol. 12, EGU2010-9851-1, 2010
EGU General Assembly 2010

Stochastic variation of tsunami run-ups due to heterogeneous slip on reverse faults

Finn Løvholt (1,2), Sara Bazin (2,3), Rolv E. Bredesen (4), Carl B. Harbitz (1,2), Daniela Kühn (5), and Hilmar Bungum (5)

(1) Norwegian Geotechnical Institute, Oslo, Norway (flo@ngi.no), (2) International Centre for Geohazards, Oslo, Norway, (3) Institut de Physique du Globe de Paris, France, (4) University of Oslo, Norway, (5) NORSAR, Oslo, Norway

Most tsunami models apply standard earthquake dislocation models that assume uniform slip over the entire fault plane. The purpose of this study is to cover a wide range of possible fault ruptures for one seismic magnitude and study how it influences the run-up distribution. Several authors have raised this issue, but a broader study on the stochastic effect over a range of possible slip distributions with variable rupture geometries is lacking. Moreover, the available studies in literature are so far limited to study the near shore wave-height using reflective boundaries, thus not including the inundation process and the explicit calculation of the run-up.

We investigate tsunami generation and run-up due to subduction earthquakes in idealized geometries using a series of numerical simulations varying fault geometries (different depths and dip angles) and co-seismic slip (slip varies randomly in dip direction). This study is motivated by a quantification of expected variability in run-up for an earthquake of a given magnitude. The slip distribution follows an autocorrelation function accounting for spatial complexity on the fault plane. A stochastic analysis is performed over 500 co-seismic slip distributions, all of them with the same mean slip. Seabed displacements are computed using a generalisation of the Okada (1985) analytical expression derived for ground deformations due to inclined faults in a half-space and finite rectangular sources. The stochastic realizations of seabed displacement are then applied on the sea surface for tsunami simulation. An idealized slope is used on the coast for run-up modelling. The run-up is simulated assuming plane incident waves using the NLSW GEOCLAW model . Through systematic grid refinement test, we observe a close to linear convergence of the maximum run-up heights with respect to spatial grid resolutions.

Variability in the fault geometry and slip distribution results in changes in the tsunami shape and run-up heights. Independently of fault depth, the maximum seabed displacement increases with increasing dip angles between 10° and 45°, then decreases with dip angles above 45°. The total water volume displaced at the seabed increases with increasing dip angles. This increase changes more rapidly as a function of dip angle for shallow than for deep faults. The maximum run-up heights, however, do not simply follow these simple patterns and we will document the statistical distribution of the run-up for different fault geometries and seabed slopes.