Coastal community risk from tsunami waves: Analysis of topographic influence on wave run-up using the 12 July 1993 Okushiri, Japan and the 12 December 1992 Flores Island, Indonesia tsunamis and computational and physical models

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Abstract. Maximum tsunami run-up signatures along a coastal region can have significant spatial gradients. These gradients may in part be attributed to the topographic profile the tsunami wave encounters along the coastline. For this study, over 1200 survey data points from the 12 July 1993 Okushiri, Japan and the 12 December 1992 Flores Island, Indonesia tsunamis were used to assess the influence of coastal topography on tsunami run-up height. The minimum distance between the coastline and each survey point was compared with run-up height. In addition, a one-dimensional computational model and a physical model of an idealized coastline and tsunami wave were employed to analyze tsunami run-up for coastlines with planar topography at various inclinations. There was common agreement of approximately 10–15 degrees for the optimal, topographic slope for maximum tsunami run-up height using the computational and physical model and the survey data. A theoretical model with three gradational zones is hypothesized to interpret the physical behavior of tsunami wave impact along coastal areas: 1) <10 degrees—a zone of fictional wave resistance, 2) 10–15 degrees—an optimal zone of maximum run-up, and 3) >15 degrees—a zone of wave reflection. These results suggest that coastlines with complex topography can have tsunami signatures with high spatial gradients and that risk along coastal communities may have a topographic component. Also, engineers should consider the dynamics of the wave/topography interaction before deciding upon a mitigation plan along any coastal area.

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