# GENERATION AND PROPAGATION OF TSUNAMIS TRIGGERED BY EARTHQUAKES AND LANDSLIDES: A THEORETICAL AND A SIMULATION VIEWPOINT

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We apply both theoretical and simulation techniques to identify critical properties of tsunamis generated by both earthquake dislocations and landslides, in order to define robust discriminant of their respective sources. In the far field, we derive asymptotic expressions for the energy, spectral amplitude and directivity of tsunami waves generated by double-couples obeying universal scaling laws, and by landslides modeled as single forces. We discuss the influence of Dahlen's [1993] quadrupolar corrections for the latter, which we find crucially important in the case of tsunami waves. We show that the spectrum of landslide tsunami waves is significantly offset to high frequencies (10 mHz), where dispersion becomes important thus diminishing far-field amplitudes. We reproduce the results of Kajiura [1981] on the growth of the energy of earthquake tsunamis as the power 4/3 of the seismic moment. We show that the total energy generated into a tsunami wave by a landslide of acceptable size remains dwarfed by that generated by a mega-thrust dislocation. We discuss the far-field directivity pattern due to source finiteness for both dislocation and landslide models, and conclude that strong directivity, i.e., a narrow azimuthal lobe of maximal amplitudes, requires generation by a dislocation source in the case of tsunami waves, and can thus be used a source discriminant. In the near field, we use numerical simulations to explore the influence of earthquake source parameters on observable properties of tsunami run-up amplitudes. These include earthquake geometry (source depth, strike, dip, slip angles), size (seismic moment), location (distance from shore and centroid depth), as well as beach geometry (water depth and beach slope). We focus both on maximum run-up and on the distribution of computed run-up along the beach, which leads to two dimensionless parameters, namely (i) the ratio of maximum run-up to the amount of slip on the fault; and (ii) the aspect ratio of a bell curve fitted to the lateral distribution of run-up. We find that the first parameter remains of order 1, while the second one remains smaller that the maximum strain released during the earthquake, itself an invariant. By contrast, in the case of landslide sources, the aspect ratio of the lateral distribution of run-up along the beach can be 1 to 2 orders of magnitude greater, suggesting its use as a potential discriminant in the near field. We apply these discriminants to the case of the 1946 Aleutian tsunami, and suggest that its source must have involved both a large slow earthquake (to explain the far field tsunami) and a coeval landslide (responsible for the near field tsunami).