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Propagation of tsunamis in the near-field from megathrust earthquakes

John McCloskey (1), Andrea Antonioli (1), Alessio Piatanesi (2), Kerry Sieh (3) Sandy Steacy (1), Suleyman Nalbant (1), Jiandong Huang (1), Paul Dunlop (1), Massimo Cocco (2), and Carlo Giunchi (2).

(1) Geophysics Research Group, School of Environmental Sciences, University of Ulster, Coleraine (j.mccloskey@ulster.ac.uk) (2) Seismology and Tectonophysics Department, Istituto Nazionale di Geofisica e Vulcanologia, Rome(3) Tectonics Observatory, California Institute of Technology, Pasadena

We investigate controls on tsunami generation and propagation in the near-field of great megathrust earthquakes using numerical simulations of subduction and tsunami-genesis on the Sumatran forearc. The Sunda megathrust here is advanced in its seismic cycle and may be ready for another great earthquake. We calculate the seafloor displacements and tsunami wave heights for about 100 complex earthquake ruptures whose synthesis was informed by reference to geodetic and stress accumulation studies and whose stochastic distributions of slip are chosen to conform to absolute limits on post-seismic strain which preclude the isolation of areas of high slip on the megathrust. Remarkably, results show for the first time that, for any near-field location: 1) the timing of tsunami inundation is independent of slip-distribution on the earthquake or even of its magnitude and 2) the maximum wave height is directly proportional to the vertical coseismic displacement experienced at that location. Both observations are explained by the dominance of long wavelength crustal flexure in near-field tsunami-genesis and we, therefore, argue that they may be general for all coastal sites in the near-field of great megathrust earthquakes.