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Shallow Rupture in Very Large and tsunami earthquakes evidenced by their High Frequency Energy Release Rate and its use for rapid assessment of enhanced tsunami potential

Jaime Andres Convers*[1] and Andrew Newman[2]

[1] *Universidade de São Paulo*
[2] *Georgia Institute of Technology*

Abstract

From the perspective of the radiated seismic energy from large earthquakes, we produce a robust high-frequency energy growth-rate discriminant for earthquakes that feature enhanced tsunami potential, using information gathered during only the initial P-wave arrival at teleseismic stations. We apply this to global earthquakes with moment magnitudes larger than 7 between 2000 and 2018, to identify that the scaling of high-frequency energy release rate directly relates to the total radiated broadband seismic energy for most events.

Earthquakes outside this scaling fall in two classes, deep earthquakes, which radiate energy up to 10× more rapidly, and most tsunamigenic earthquakes which radiate energy up to 10× more slowly. This second group includes MW 7.6-7.8 near-trench-rupturing tsunami earthquakes, and the two "total megathrust rupture" recent events; the MW 9+ Sumatra 2004 and Tohoku-Oki 2011 earthquakes. All of these tsunamigenic events rupture either partially, or entirely in the near-trench region, which slows rupture, reducing the overall energy-rate.

*Presenting Author.

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