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Tsunami early warning at EuroMed and global scales using earthquake rupture duration and predominant period

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After an earthquake, rapid assessment of hazards such as tsunami potential is important for early warning and emergency response. Tsunami potential depends on sea floor displacement, which is related to the length, L, width, W, mean slip, D, and depth, z, of earthquake rupture. Currently, the primary discriminant for tsunami potential is the centroid-moment tensor magnitude, MwCMT, representing the product LWD, estimated through an indirect, inversion procedure. The obtained MwCMT and implied LWD value vary with rupture depth, earth model and other factors, and is only available 30 min or more after an earthquake. The use of more direct procedures for hazard assessment could avoid these problems and aid in effective early warning, an important responsibility for seismic monitoring centers.

We present a direct procedure for rapid assessment of earthquake tsunami potential using two, simple measures on P-wave seismograms – the predominant period on velocity records, TauC, and the likelihood that the high-frequency, apparent rupture-duration, T0, exceeds 50-55 sec. TauC and T0 are related to the critical parameters L, W, D and z. For a set of large earthquakes, the period-duration product TauC x T0 gives more information on tsunami impact and size than MwCMT and other current discriminants. The results suggest that knowledge of rupture length, L, and depth, z, alone can constrain well the tsunami potential of an earthquake. With available real-time seismogram data, rapid calculation of the direct, period-duration discriminant can be completed within 6-10 min after an earthquake occurs and thus can aid in effective and reliable tsunami early warning. We show the implementation of the technique in the INGV seismic center for fast discrimination of potentially tsunamigenic earthquakes at both EuroMed and global scales.