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Tsunami early warning within 5 minutes

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Tsunamis are most destructive at near to regional distances, arriving within 20-30 min after a causative earthquake; effective early warning at these distances requires notification within 15 min or less. The size and impact of a tsunami also depend on sea floor displacement, which is related to the length, L, width, W, mean slip, D, and depth, z, of the earthquake rupture. Currently, the primary seismic discriminant for tsunami potential is the centroid-moment tensor magnitude, M_w^{CMT}, representing the product *LWD* and estimated through an indirect, inversion procedure. However, the obtained M_w^{CMT} and implied *LWD* value vary with rupture depth, earth model and other factors, and is only available 20-30 min or more after an earthquake. The use of more direct discriminants for tsunami potential could avoid these problems and aid in effective early warning, especially for near to regional distances.

Previously (http://alomax.net/posters/period-duration), we presented a direct procedure for rapid assessment of earthquake tsunami potential using two, simple measures on P-wave seismograms – the predominant period on velocity records, T_d, and the likelihood, T_{50}^{Ex}, that the high-frequency, apparent rupture-duration, T_0, exceeds 50-55 sec. We have shown that T_d and T_0 are related to the critical rupture parameters L, W, D and z, and that either of the period-duration products T_dT_0 or $T_dT_{50}^{Ex}$ give more information on tsunami impact and size than M_w^{CMT}, M_{wp} and other currently used discriminants. These results imply that tsunami potential is not directly related to the product *LWD* from the "seismic" faulting model, as is assumed with the use of the M_w^{CMT} discriminant. Instead, knowledge of rupture length, L, and depth, z, alone can constrain well the tsunami potential of an earthquake.

We introduce here special treatment of the signal around the S arrival at close stations, a modified, real-time, M_{wpd}(RT) magnitude, and other procedures to allow early estimation of event parameters and tsunami discriminants. We show that with real-time data currently available in most regions of tsunami hazard, event locations, m_b and M_{wp} magnitudes and the direct, period-duration discriminant, $T_dT_{50}^{Ex}$ can be determined within 5 min after an earthquake occurs, and T_0, T_dT_0, and M_{wpd}(RT) within about 10 min. This processing is implemented and running continuously in real-time within the Early-est earthquake monitor at INGV-Rome (http://early-est.rm.ingv.it). The rapid availability of these measures can aid in faster and more reliable tsunami early warning for near to regional distances.