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Early warning systems underestimate magnitude of large earthquakes

El Cerrito, CA -- Scientists seek to create reliable early warning systems that accurately estimate the magnitude of an earthquake within the first seconds of rupture. In this paper published by the *Bulletin of the Seismological Society of America*, authors S. Murphy of University College Dublin, Ireland and S. Nielsen of the Instituto Nazionale di Geofisica e Vulcanologia, Roma, Italy look at the idea that an earthquake's final size can be determined during its initiation, rather than something that only becomes apparent at the end of the rupture. They found that, while this may be true over a small range of earthquake sizes, it is unlikely to hold for the larger magnitudes, limiting its applicability for early warning systems.

Alternatively, the authors found that rapid magnitude estimation could be better explained in terms of what seismic stations capture of an earthquake in a few seconds. This section is generally quite large and is dependent on the relative position of the station to the fault. Therefore using a number of seismic stations around an earthquake fault, as is the case in early warning systems, the size of the earthquake can be quickly estimated.

This explanation shows a scaling between ground motion and final earthquake size similar to that observed from seismograms. The authors found that this relationship breaks down for very large earthquakes, i.e. earthquakes with a magnitude greater than 6.5. In these cases, the seismic stations no longer capture the edges of the fault in a few seconds due to the large area of the fault. When this happens, the authors suggest that early warning systems which use the peak ground displacement technique for estimating earthquake size, shall underestimate the size of the earthquake.

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BSSA: Volume 99:1, "Estimating Earthquake Magnitudes with Early Arrivals: A Test Using Dynamic and Kinematic Models," by S. Murphy and S. Nielsen.