Geophysical Research Abstracts
Vol. 14, EGU2012-2182, 2012
EGU General Assembly 2012

Results from the Quake-Catcher Network Rapid Aftershock Mobilization Project (QCN-RAMP) in Christchurch, New Zealand and Advances in QCN Rapid Earthquake Detections

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Following the 4 September 2010 M7.1 Darfield earthquake in New Zealand, we initiated a QCN Rapid Aftershock Mobilization Project (RAMP). We rapidly installed 180 low-cost 14-bit USB Micro-Electro-Mechanical Systems (MEMS) accelerometers in less than a week in order to record aftershocks as many aftershocks as possible. Using data recorded by these stations, we began performing real-time tests of a rapid earthquake detection and characterization program that had been developed through retrospective testing of data collected during the M8.8 Maule, Chile RAMP deployment in early 2010 (Chung et al., 2011).

QCN sensors recorded the M6.3 Christchurch event on 22 February 2011, and we used trigger information (station location, trigger time, and peak accelerations) to estimate the magnitude and location. In addition, we automatically produced a map of measured and predicted shaking intensities within 7 seconds of the earthquake origin time. Successive iterations improved the event characterization and, within 24 seconds of the earthquake, magnitude and location estimates were comparable to those provided by GNS.

Using the wealth of data from this event as well as the following aftershocks, we continue to improve the detection and identification algorithms. Recent improvements include inverting data from all recorded events along with the GNS data from the same events to find an empirical relationship between peak ground motion at the time of the detection, station to event distance, and final magnitude. Whilst still in development, our preliminary results using the data collected from these and other QCN stations around the world suggest that MEMS sensors installed in homes, schools, and offices provide a way to dramatically increase the density of strong motion observations for use in seismic hazard analysis and earthquake early warning.