Estimating ground motion from a single station record for an early warning of near-source earthquakes

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In October 2007, Japan launches its publicly available earthquake early warning system adding to the growing list of nations using early warning technology to mitigate seismic hazard. The earthquake early warning is issued by the Japan Meteorological Agency (JMA) and it takes about 10 seconds after the origin time according to the past reports (e.g. 2007 Noto Hanto earthquake, 2007 Niigata-ken Chuetsu-oki earthquake). Although this computation time strongly depends on station density of the strong motion network, the performance of the algorithm is important to estimate ground motion at a site as quick as possible.

In this presentation, we try to estimate ground motion at a site from a single station record for an early warning to near-source earthquakes. Some other onsite early warning algorithms such as Tau_c method (Wu and Kanamori, 2005) and UrEDAS (Nakamura, 1988) use the predominant frequency of the initial P-wave and estimate the final size of the earthquake. For near-source earthquakes, the P-S time is significantly short and the network approach (obtaining the source information from multiple P-wave records) is not suitable. We construct training dataset from the KiK-net strong motion records of events with JMA magnitude 4 to 7.3, and train a regression function to estimate the peak ground velocity (PGV) from the initial P-wave at the same site. Among various ground motion measures (acceleration, velocity, displacement, and predominant frequency) the Bayesian model class selection found the displacement and predominant frequency of the P-wave had a strong correlation with PGV.