Magnitude Determination Using Strong Ground-Motion in Earthquake Early Warning: (I) Attenuation, (II) Covered areas

Ting-Li Lin[1*] and Yih-Min Wu[1]
[1.] *Department of Geosciences, National Taiwan University, No. 1, Sec. 4, Roosevelt Road, Taipei 106, Taiwan*
**Corresponding author: T-L Lin, E-mail: mulas62@gmail.com, Tel: 886-2-33664956 ext. 309*

(I) We use 1661 strong-motion accelerograms with peak ground acceleration (PGA) larger than 80 Gal (1 Gal = 1.0 cm/s^2) from 77 earthquakes recorded by the Taiwan Strong Motion Instrumentation Program (TSMIP) stations to derive a strong-motion attenuation relationship. This relationship can be used to dynamically define a "M_{pga} magnitude" for earthquakes using earthquake locations determined by earthquake early warning process. The M_{pga} magnitude using this strong-motion attenuation relationship corresponds well with M_w given a sufficient number of PGA readings. MEMS (Micro Electro Mechanical Systems) acceleration sensor could be widely used for ground motion monitoring purposes. Thus, we propose that once a large earthquake has begun, that we might be able to use strong, near-field (tens of kilometers) PGA values to quickly estimate the earthquake's magnitude, which would improve earthquake early warning.
(II) We have collected the strong-motion accelerograms with PGA larger than 100 Gal recorded by the TSMIP stations to define the empirical relationship between the areas encircled by a variety of high level of PGA contours and their corresponding earthquake magnitudes using the large crustal earthquakes in Taiwan. We found that the logarithms of the covered areas inside the PGA contours have a definite linear relation to the corresponding earthquake magnitudes. We propose that such relationship might be able to rapidly define the earthquake magnitude while providing sufficient seismic station coverage and that might have practical application in earthquake early warning and rapid reporting systems. The proposed magnitude estimation method is directly related to the level of strong surface shaking and is inherently suitable for the purpose of the EEW and rapid reporting systems.