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RAPID ESTIMATION OF MAGNITUDE AND Δ FROM B-Δ METHOD FOR MOHAMMAD ABAD EARTHQUAKE

Shila ROSTAMI
M.Sc. Graduate, University of Advanced Technology, Kerman, Iran
sh.rostami@student.kgut.ac.ir
Mohammad Reza SEPAHVAND
Assistant Professor, Graduate University of Advanced Technology, Kerman, Iran
mrsepahvand@yahoo.com
Majid MAHOOD
Assistant Professor, IIEES, Tehran, Iran
m.mahood@iiees.ac.ir
Afsaneh NASRABADI
Assistant Professor, Graduate University of Advanced Technology, Kerman, Iran
a.nasrabadi@kgut.ac.ir

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Rapid estimation of the epicentral distance and magnitude of the earthquake is of particular importance for earthquake detection and warning systems. Because an earthquake early warning system should be able to estimate the magnitude, epicenter and hypocenter distance of the earthquake in a few seconds after the P-wave arrival, and based on this information, to warn areas at risk of seismic damage (Odaka at al., 2003; Heidari, 2016).

A new and applicable method in earthquake early warning systems is the B-Δ method, which estimate the epicentral distance and magnitude of an earthquake using a single station based on the initial seconds of the p-wave (usually 3 seconds). In the single-station method envelope of vertical component of the acceleration is used to estimate the epicentral distance of the earthquake (Odaka et al., 2003). By Fitting a simple function with the form of y(t)=Bt exp (-At) to the initial part of the waveform envelope, coefficients A and B are determined through the least-squares method and by overlapping this function on the Logarithmic envelope of vertical component of acceleration in the first 3 seconds of p-wave (Noda at al., 2012; Hadi, 2017).

B is the slope of the function fitting to the initial part of P wave, A is the change of amplitude over time, Y (t) is the Observed acceleration envelope and t is considered since the arrival of p wave (Mahood, 2016). Then, the magnitude can be estimated from the maximum amplitude observed in a short time interval after the P-wave arrival using an empirical magnitude-amplitude relation.

With examined 35 vertical component acceleration of two Mohammadabad Reagan earthquakes located in Kerman province occurred in 2010 and 2011 with magnitudes of 6.5 and 6.1, respectively, the 14 acceleration waves were processable, which in resulting the analysis of 10 acceleration waves with magnitude of M=6.1-6.5 and epicenter less than 96 km the Equation 1 for the earthquake epicentral distance and Equation 2 for the earthquake magnitude of this region were obtained, based on the maximum amplitude observed in the first seconds of the P wave.

$$\log\Delta = -0.8\log B + 2.11 \pm 0.72 \qquad (1)$$

$$M_{est} = -0.62\log P + 1.07\log B + 6.15 \qquad (2)$$

Figure 1 shows the vertical component acceleration of one of the Mohammadabad Reagan earthquake with magnitude of 6.1 and epicentral distance of 21 km in upper panel, and lower panel shows the logarithm of absolute amplitude of the selected 3-s time window is shown along with the curve fitted to the relation Bt*exp(-At). Figure 2 (left) shows the linear

relationship between logΔ (epicentral distance) and logB (coefficient B, slope of the initial part of the P-wave envelope). According to the figure, we can see the inverse relationship of the coefficient B with the epicentral distance, which decreases with increasing coefficient B. The relationship is independent of the earthquake magnitude and can be estimated using the coefficient B of the earthquake epicentral distance. We compared the relationships obtained in this paper, Northwestern Iran (Mahood, 2016), Tehran (Heidari, 2016) and Japan (Odaka et al., 2003) (Figure 2, right). The difference in the slope of the regions of Iran - Japan lines is due to the particular tectonic and seismic features of each region.

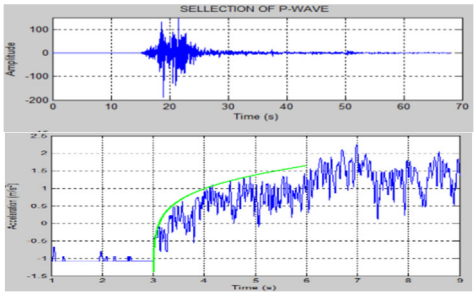

Figure 1. (Upper panel)Vertical component of acceleration recorded with magnitude 6.1. (lower panel) logarithm of absolute values for the selected waveform.

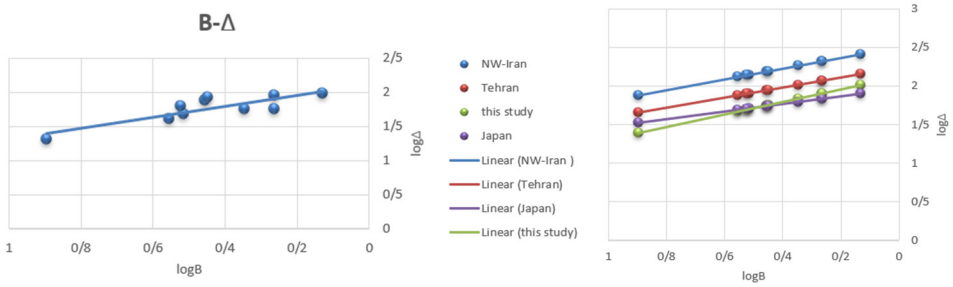

Figure 2. (left), the linear relationship between the coefficient B (the slope of the first part of the waveform P) and the epicentral distance. (right), Comparison of the relationship obtained in this study with the Northwest of Iran (Mahood, 2016), Tehran (Heidari, 2016) and Japan (Odaka et al, 2003).

Therefore, Due to the arrival time of the p-wave and fitting of the simple function Bt*exp(At) to the beginning of the seismic waveform, it is possible to estimate the magnitude and the epicentral distance of the earthquake by a single station method.

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