Evaluation of the accuracy of back-azimuths estimated in real-time by using single station record

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1. Introduction

Recently, the technology of earthquake early warning system has achieved an amazing development. However, the earthquake early warning system has some difficult problems. One of the important problems is how to estimate the location of hypocenters in real-time. In case an earthquake is detected only at a single station, the epicentral distance and the back-azimuth are estimated by B-delta method (Odaka et al., 2003) and Principal Component Analysis (PCA), respectively. PCA estimates the back-azimuths by using the principal axis of the first motion of P wave. However, the true back-azimuth values and the back-azimuth values estimated by PCA may be different. In this study, we evaluated the accuracy of the back-azimuths estimated by PCA.

2. Data and Analysis

We used 2,415 records observed at K-net stations in the period from May 1996 to December 2008. The epicentral distance was less than 300km, and the JMA instrumental seismic intensity was more than 3.5. The arrival times of P wave were automatically picked up. We analyzed the band-pass displacement wave records which were calculated from recurrence formula filter. Data in the 1.1 seconds from P wave arrival time were used. We excluded the data which were judged as noise record.

3. Result and Discussion

59% of all data of the differences between the true back-azimuth values and the back-azimuth values estimated by PCA were ranged between -30 and +30 degree. From this result, we can say that PCA is a good estimation method. The data of difference ranging between 60 and 90 degree or -60 and -90 degree, between 90 and 120 degree or -90 and -120 degree, between 120 and 150 degree or -120 and -150 degree, and between 150 and 180 degree or -150 and -180 degree accounted for 6%, 5%, 5%, and 10% of all data, respectively.

There is a lot of data representing difference ranging between 150 and 180 degree or -150 and -180 degree, because of mistakes of the polarity of the first motion of P wave estimated by PCA. The

identification of the polarity of the first motion of P wave estimated by PCA can change sensitively, influenced by the recurrence formula filter and the automatic picking of P wave arrival times.