Azimuth Estimation of KiK-net seismographs

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The dense strong motion network KiK-net deployed by NIED consists of pairs of borehole seismographs and surface ones. It has been reported that seismograms of some borehole seismographs are quite different from surface ones even if they are low-pass filtered (Kato *et al.*,2001; 2002). Kato *et al.* (2001, 2002) and Maeda *et al.* (2005) estimated differences in azimuths of seismograph pairs in some regions by evaluating cross-correlation between low-pass filtered waveforms of each pair. In this study, we estimated differences in azimuths for seismograph pairs in throughout Japan using tens of earthquakes that occurred in about twenty years.

We used waveforms of earthquakes larger than M6 to prevent waveforms with low S/N ratios. The minimum epicentral distance was set to be 50 km to reduce effects of geometrical difference in positions of seismograph pair. Further, we set the maximum epicentral distance depending on the magnitude (for earthquakes smaller than M6.5, it was 150 km; for those with M6.5-7.0, it was 300 km; for those larger than M7.0, it was 500 km), except for deep-focus earthquakes.

The S waves of horizontal components were analyzed after low-pass filtered (0.25 Hz). We evaluated residual sum of squares of differences in azimuths of particle acceleration for each waveform pair with weight of their amplitudes, as well as phase only correlation of each waveform pair.

We evaluated reliability of estimated azimuth differences of seismograph pairs when three seismogram pairs with high enough S/N ratios were available. For seismograph pairs in which borehole seismographs are installed deeper than 1300 m, azimuth differences were not able to be estimated since they were quite different even after low-pass filtered.

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