アイソクロン・バックプロジェクション法による２００７年３月２５日能登半島地震の震源過程

Rupture process of the Notohanto Earthquake (2007/3/25), by using an Isochrones Back-projection Method and Strong motion data

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We estimated the source process of the 2007/3/25 Notohanto earthquake (Hinet solution: latitude 37.236, longitude 136.652 and depth 11km) by using an Isochron Backprojection Method (IBM) and K-NET waveforms. The IBM method differs from conventional earthquake source inversion approaches, in that the calculation of Green ’s functions is not required. The idea of the procedure is to directly back-project amplitudes of seismograms envelopes around the source into a space image of the earthquake rupture. The method requires the calculation of theoretical travel times between a set of grids points distributed across the fault plane, and every station. For this purpose and for simplicity we assume a multi-layered 1D model. All travel times are adjusted by a station correction factor, calculated by taking the difference between observed and theoretical travel times at each station. Next we calculate the rupture time of every grid within the fault plane by assuming some arbitrary constant rupture velocity value, and obtain the isochrones distribution across the fault plane by adding subfaults rupture times and the corresponding travel times for every station. We select waveforms that have clear P and S wavelets, which means stations located approximately between 40 km and 150km from the epicenter. We extract P-wave windows between the origin time of the earthquake and the theoretical arrival of the S-wave, and taper 1s of the waveforms at the end. We band-pass filter the data between 1Hz and 30Hz, and calculate the waveforms envelopes using the root-mean-square of the original waveforms and their Hilbert transform. We calculate a grid “ brigthness ” by adding all the envelope amplitudes corresponding to every grid isochron time for all stations. In this way we scan for all possible isochrons contributions to the grid total brigthness from the shortest to the longest possible isochrons time values. The final result is a distribution of the brightness across the fault plane, which gives us an idea of the location of asperities within the fault plane. The present method is an extension of the source imaging method by Festa et. al. (2006) by incorporating high frequency seismograms (Pulido et. al., 2007a,b).

To estimate the fault brigthness we choose 35 K-NET stations of NIED, with distances ranging from 40km to 150km from the epicentre. We use a fault model corresponding the F-net solution (strike 58 degrees and dip 66 degrees), and assume the starting point of the rupture corresponding to the Hi-net hypocenter solution. The fault length is set to 36 km and the fault width to 24 km. For the calculation of travel times we used a velocity model developed for the Kanto region (Ukawa et. al., 1984).

We obtained an image of the total brigthness distribution across the fault plane of the Notohanto earthquake. Our results show that the grids with the largest brightness within the fault plane, corresponds to a region 10 km above the hypocenter. Another patch of large brightness is observed at the bottom of the northern end of the fault plane. These large brightness regions correspond approximately to the large slip areas obtained in the source model by Aoi and Sekiguchi (2007). We obtained that a rupture velocity of 2.1 km/s maximizes the total fault plane brigthness for the Notohanto earthquake.

References

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