Estimation of fault parameters of the 2001 Geiyo earthquake using strong motion duration

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Izutani and Hirasawa [1987] suggest a method to estimate fault parameters from the azimuthal dependence of strong motion duration. In this study, we applied this method to accelerograms of the 2001 Geiyo earthquake.

The accelerograms used here are obtained from K-NET, which is a network of accelerograms deployed all over Japan and is administered by the National Research Institute for Earth Science and Disaster Prevention. We used only the records of stations located up to 100 km from the epicenter of the 2001 Geiyo earthquake. This is because the distribution of the number of the stations has much deviation in the azimuth from the epicenter, concerning the stations that are located more than 100 km from the epicenter.

The strong motion durations are estimated as follows. First, the accelerograms are bandpass filtered between 5 and 10 Hz. Then Husid plots (e.g., Izutani and Hirasawa [1987]), which correspond to time-integral squared amplitude of the accelerogram, are calculated. We considered the time when the value of the Husid plot is 0.85 as the end of strong motion. The start of the strong motion is derived from the travel-time table, JMA2001 (Ueno et al. [2002]). The durations are defined as the time intervals between the starts and ends. The analyses were done using the records of EW- or NS-components of the accelerographs. Additionally we present the analysis for the case when we used the mean of two durations derived from the records of EW- and NS- components. The results of these three cases change only slightly; therefore, we show only the results for the mean of two durations.

The theoretical equations that represent the relation between the strong motion duration D and azimuth from the epicenter q are different whether the rupture process is unilateral or bilateral. As the feature of the data used here seems to fit better the equation for unilateral, we assumed the rupture process of the 2001 Geiyo earthquake is unilateral. Additionally, we assumed the average of rupture velocities of the previous earthquakes, as will be mentioned below, is the same as that of the 2001 Geiyo earthquake. Under the two assumptions, the relation between D and q is given by

$$D=AL(1-V/b\cos(a-q))+B,$$

where L is the fault length, V is the rupture velocity, a is the direction of rupture propagation, q is the azimuth of the station, and b is the S-wave velocity. The constants A and B were determined empirically through regression analysis between the fault length and the strong motion duration. For the regression analysis, we used the records of accelerograms from previous earthquakes that occurred in the same district as the 2001 Geiyo earthquake, with magnitudes 5.0 or greater, between 1997 and 2001. Using the values of A and B obtained from the regression analysis, the parameters of L, V/b, and a, concerning the 2001 Geiyo earthquake, were estimated by the least square method.

The following results were obtained: L=31.8+-0.8 [km], V/b=0.45+-0.04, and a=S22W+-4. Using waveform inversion, Yagi and Kikuchi [2001] show that the length of the main rupture is about 30 - 35 km and that the rupture propagated from north to south. Our results shown here is consistent with the results of Yagi and Kikuchi [2001], they are valid.

References

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