Estimation of a fault plane using the strong motion centroid

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The location of the strong motion centroid (SMC) is estimated using the peak acceleration-distance relation and observed peak acceleration data (e.g., Kanamori et al.[1993]). In this study, using the estimated location of the SMC, we suggest a method to determine which of two nodal planes given by a focal mechanism is a fault plane.

First, we assume geometries of two candidates of a fault plane based on a focal mechanism and magnitude of the studied earthquake. Next, the two planes are divided into some small regions. We assume that the SMC is located at one of the small regions, and fit an equation of the peak acceleration-distance relation developed by Shi and Midorikawa [1999] with observed peak acceleration data. The goodness-of-fit is evaluated by the likelihood function where the distribution of differences between the theoretical peak accelerations derived from the equation and the observed ones obey normal distribution. This evaluation is made for each of the small regions, and the values of likelihood function for each small region are normalized by the summation of the values of likelihood function. In consequence, the normalized likelihood function corresponds to a probability density function for the location of the SMC. Finally, we calculate two summations of the normalized likelihood function over each of the two fault planes, and compare these two summations. It is plausible that the SMC is located on the nodal plane of which summation is larger than the other.

We applied this method to four earthquakes of which magnitude is larger than 6.5 in the period after 2000. The observed peak acceleration data are provided by K-NET and KiK-net administrated by NIED. The length l and width w of the fault plane are estimated by the magnitude of the earthquake, the relation between the magnitude and the source area suggested by Utsu and Seki [1955], and the assumption of l=2w. Then, the length and width are doubled. The location of the fault plane is set up in order that the hypocenter determined by JMA is the center. This is because we considered the possibility that the hypocenter determined by JMA locates the edge of the fault plane. The orientations of assumed two fault planes are based on a focal mechanism estimated by F-net of NIED.

For the all of the four earthquakes, the summation of the values of likelihood function for a fault plane suggested by earlier studies is more than 0.7. This result suggests that our method would be useful for the determination of a fault plane.