Source model of aftershocks of 2003 Tokachi-Oki earthquake estimated using empirical Green's function method

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Strong motion records can provide precise view of source characteristics. Therefore, it is important to study source process using strong motion records not only for understanding source characteristics in detail but also for constructing the source model of strong motion prediction. However, when we investigate subduction zone earthquakes using strong motion records, we face one problem that the azimuthal coverage of only inland observation stations is poor. In September of 2003, Mw=7.9 Tokachi-Oki Earthquake occurred between the Pacific plate and the North American plate in the South East Off of Hokkaido. Ocean bottom seismometers (OBS) installed by Japan Marine Science and Technology Center (JAMSTEC) recorded the mainshock and a sequence of its aftershocks. Using these OBS records together with the inland records, we could reveal more reliable source process because of better azimuthal coverage. In this study, we estimate source model of these events using strong motion simulation based on empirical Green's function method.

Previous studies showed that broadband strong motion records can be successfully simulated using aftershock records as empirical Green's function assuming a rectangular source model (e.g. Kamae and Irikura, 1998; Miyake et al., 1999, 2003; Asano et al., 2003). This area, which we call strong motion generation area (SMGA), is found as a part of total rupture area. For inland crustal earthquakes, Miyake et al. (2003) showed the SMGA corresponded to the asperity deduced by kinematic waveform inversion, and that its size could be expected from an empirical relation between the size of the asperity and the seismic moment proposed by Somerville et al. (1999). Asano et al. (2003) analyzed shallow intraslab earthquakes in the similar manner and observed that the size of SMGA was smaller than that expected for crustal earthquakes with the same seismic moment. They also observed that the ratio of the derived size and the expected one was decreasing with focal depth, i.e., the stress drop on SMGA was increasing with focal depth. We already analyzed 2002 Miyagi-Oki earthquake (Mw 6.4; focal depth was 46km), which was thought to be an interplate event. We observed that the size of SMGA was almost half of the expected one by Somerville et al.'s empirical relation (Suzuki and Iwata, 2003).

We firstly model source of aftershocks which are larger than Mw 6.0. We estimate the size, the rise time and the location of SMGA, comparing the observed and synthetic S-wave portion of horizontal components at 4 stations. Empirical Green's function method proposed by Irikura (1986) is employed to calculate synthetic waveforms. Best model is selected using residual value of RMS of displacement waveforms and acceleration waveform envelopes between the observation and the synthetics with genetic algorithm approach. A tentative result shows that the SMGA of an Mw 6.4 event (Sep. 29, 2003; focal depth was 42km) is estimated to be about 90 km^2 and that of an Mw 6.2 event (Dec. 29, 2003; focal depth was 39km) is about 60 km^2. These sizes are larger than those expected from empirical relation estimated from inland crustal earthquakes. We can discuss the difference of source characteristics between mainshock and aftershocks as well as whether the stress drop on the asperity depends on the focal depth by examining the SMGA of a sequence of aftershocks deprived through similar method.

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