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Source inversion using curved fault model: Application to the two intraslab earthquakes in northeast Japan

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We have developed a new source inversion method using a curved fault model. The curved surface is constructed from the interpolation using Non-Uniform Rational B-Spline (NURBS). The multi-time-window linear waveform inversion method is implemented to the curved fault model. Applicability and effectiveness of the developed method are examined by applying the method to the two intraslab earthquakes that occurred in northeast Japan, the 2003 Miyagi-oki and 2008 northern Iwate earthquakes. They are considered to have the complex fault geometry from the source inversion analysis using strong-motion records (Wu and Takeo, 2004; Aoi et al., 2005; Suzuki et al., 2009). The waveform records of these earthquakes do not much suffer from the secondary generated seismic waves and clearly reflect the change of source mechanisms during the earthquake.

The slip distribution derived using the curved fault model shows that a large slip extends to an area that is a gap for a two rectangle fault plane model for the 2008 northern Iwate earthquake. This indicates that the curved fault, which would approximate the fault geometry more appropriately, could illuminate the slip that cannot be modeled by the planar fault model. The curved fault model gives the seismic moment closer to that derived from the moment tensor inversion than the two rectangular fault model. The moment tensor calculated from the slip distribution still differs from that derived from the moment tensor inversion. We will further investigate more appropriate fault model, which could give the moment tensor closer to the moment tensor solution. In the analysis of the 2003 Miyagi-oki earthquake, we can use the information of the aftershock distribution as well as the source mechanism and waveform fittings to construct the curved fault model. After we obtain the most appropriate fault model referring to the moment tensor calculated from the slip distribution and to the comparison of the waveforms, we will examine the effectiveness of the developed method compared with the inversion result using the rectangular fault model, particularly focusing on the extent of the asperities and the distribution of the stress change.

Keywords: source inversion, curved fault, strong motion, intraslab earthquake