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Rupture processes of the 2011 Tohoku-Oki earthquake sequence on the curved fault derived from strong-motion records

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Rupture processes of the interplate earthquake sequence of the 2011 Tohoku-Oki mega-thrust event have been derived using the strong-motion records. To construct fault models which approximate the geometry of the large fault zones as precisely as possible, we express the upper boundary of the subducting Pacific plate (Nakajima and Hasegawa, 2006; Nakajima et al., 2009; Kita et al., 2010) using NURBS (Non-Uniform Rational B-Spline). This mathematical expression of the plate geometry enables us to reproduce the fault models of the interplate earthquakes flexibly. Source inversion method using the curved fault expressed by NURBS is based on the method proposed by Suzuki et al. (2010). The derived rupture process of the mainshock indicates three main features related to the waveform radiation: 1) The shallow large slip area located far off Miyagi prefecture ruptured 60 seconds after the initial break for at least 40 seconds, generating the seismic waves rich in the very-low-frequency content. 2) The area between the hypocenter and the coastline of Miyagi prefecture experienced two rupture events, which seem to be responsible for the two large acceleration phases observed in and around Miyagi prefecture. 3) The rupture after 100 seconds proceeded to the south, off Fukushima prefecture, generating the large velocity phase that has similar onset time to the large acceleration phase observed in the Kanto district. The rupture process of the M7.6 largest aftershock, which occurred approximately 30 minutes after the mainshock near the southern edge of the mainshock fault, indicates that the large slip area extends to the east, shallower part of the fault plane. The velocity waveforms of the aftershock show the pulse, duration of which is longer than 10 seconds. This phase is well reproduced by the slip located in the shallower part. These features for the Tohoku-Oki earthquake sequence are essentially the same as those derived by the source inversion using the rectangular fault. It is considered better, however, for examining the characteristics of the strong-motion generation to approximate the geometry of the ruptured fault as precisely as possible.