Estimate of the rupture process of the 2021 off-Fukushima earthquake based on the finite-fault source inversion Inferred from strong motion records

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A Mw 7.1 intra-slab earthquake occurred off the coast of the Fukushima prefecture, northeastern Japan, at 23:07 on 13th February 2021 (JST). This earthquake generated strong shaking (the seismic intensity 6+ and 6- in JMA scale) along the coast of the Fukushima and Miyagi prefecture. In this study, we have estimated the rupture process of this event by the waveform finite-fault inversion method developed by Ji *et al.* (2002).We use three-components strong-motion records at 16 K-NET and KiK-net surface stations in the Fukushima and Miyagi prefecture. To improve the quality of the inversion results, we have introduced an individual 1D velocity structure model for each station in calculating Green’s functions. First, we have constructed the 1D velocity model for each station. We interpolate the Japan Integrated Velocity Structure Model [JIVSM] (Koketsu *et al.*,2012) for its subsurface, the seismic tomography model of Matsubara *et al.*(2019) for crust, and the PREM (e.g., Shearer, 2018) for mantle. Then, we calibrate these models by forward simulation for the record of a Mw 5 aftershock occurring in March 17, 2021. Consequently, we got good agreements in both arrival time and amplitude for the frequency range between 0.05~0.5Hz. For the inversion of the mainshock, we assumed one fault plane dipping 33 degrees to the east based on the aftershock distribution and F-net focal mechanism (Fukuyama *et al.*, 1998). The fault plane was divided into 2km by 2km sub-faults. We optimized five fault parameters (e.g. slip amplitude, rupture time, rake angle, starting and ending time of an assumed analytical slip-rate functions) for each individual sub-fault by minimizing an objective function defined in wavelet domain using simulated annealing (SA) inversion procedure. Our inverted results shown in the figure suggest that the fault rupture mainly propagated towards to the south-west. The area with large slip was detected on this side. The centroid time of the rupture of this asperity was about 10 sec from rupture initiation. Also, the area with large slip velocity is coincide with the area with large slip.

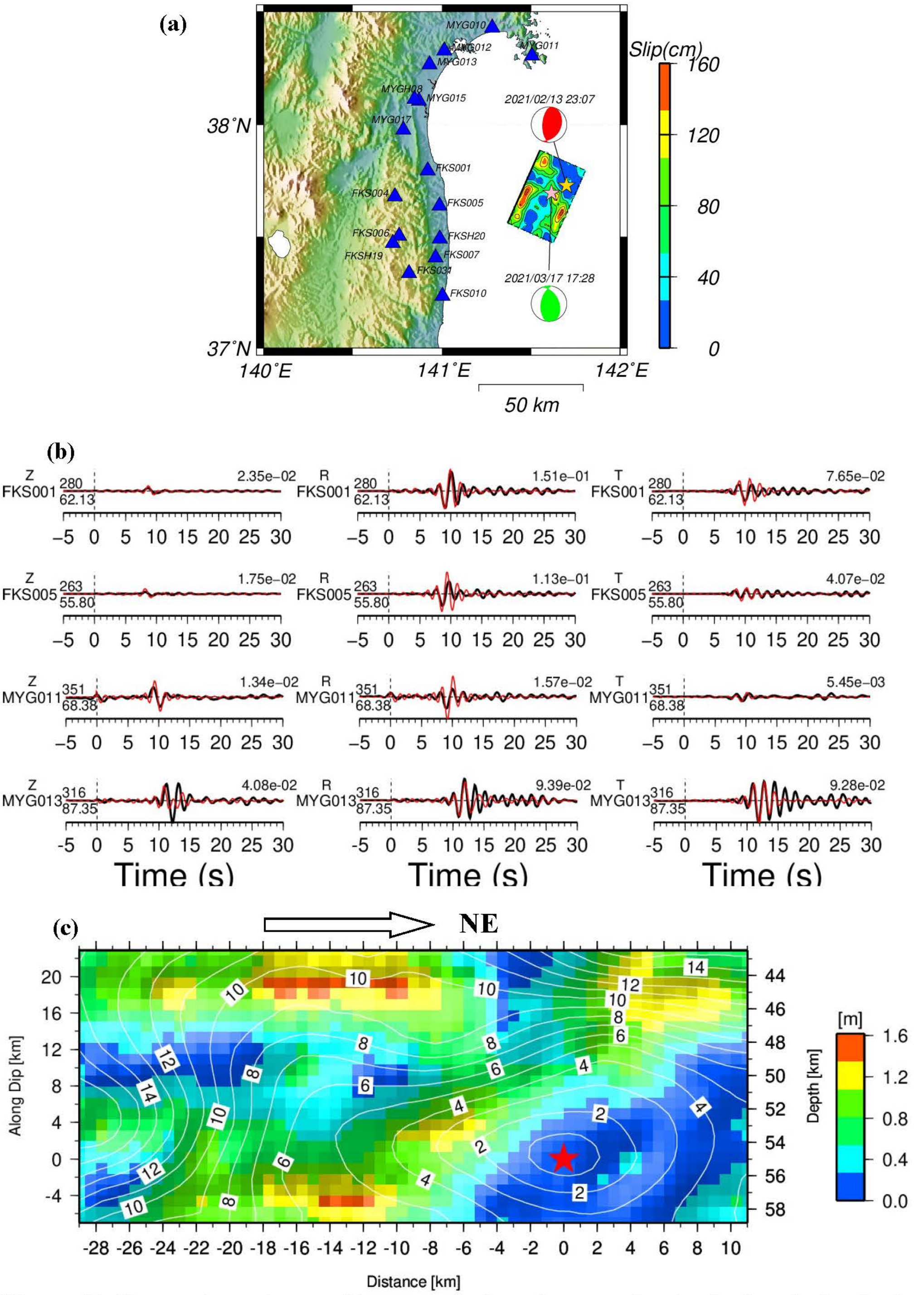

Figure: (a) Observation points used in our analysis, epicenters of main-shock and aftershock, and slip distribution of our inversion result. (b) Comparison of the observations (black line) and theoretical seismograms (red line) of the aftershock. (c) Slip distribution of Our inversion result. The contour lines in (c) denote the rupture time