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Source modeling of the 2011 off the Pacific Coast of Tohoku earthquake using the empirical Green's function method

Kimiyuki Asano[1*], Tomotaka Iwata[1]

[1]DPRI, Kyoto Univ.

A great subduction-zone earthquake of Mw 9.0 occurred along the Japan Trench off the east coast of east Japan on March 11, 2011. Strong ground motions from this event were densely observed by the strong motion networks all over Japan. It is quite important to analyze this rich data set for studying the detail structure of the source rupture process in terms of strong motion generation from such a great subduction earthquake. Aligning ground motion acceleration or short-period (<10s) velocity time-histories, which are strongly related to earthquake ground motion disaster, observed by the K-NET and KiK-net of NIED, Japan along the coast, several remarkable wave packets were captured. In Miyagi and Iwate prefectures, which were close to the northern part of the source fault, two remarkable wave packets (S1 and S2) propagating from the north part of the source region were observed, and these two wave packets are separated about 45-50s. In Fukushima and Ibaraki prefectures, which are close to the southern part of the source fault, another distinctive wave packets (S3) propagating from south part of the source region was observed. Using the observed travel time of these three wave packets that is related to damage by strong motions, the location of the rupture starting point of each strong motion generation area (SMGA) is estimated. The S1 and S2 are located west of the hypocenter off Miyagi prefecture, and those are located close to each other. The third one is located near the coast between Fukushima and Ibaraki prefectures. We modeled strong ground motions from this event using the empirical Green's function methods, and determined the source parameters (size, stress drop, rise time) of three SMGAs corresponding to three pulses S1-S3. Observed strong ground motions are reproduced well. Those SMGAs seem not to overlap the large slip area estimated by teleseismic, geodetic and Tsunami inversions. The sum of seismic moment of three SMGAs is only 2-3% of total seismic moment, which is comparable to Mw8.0 event.

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