Fault model of M7.0 Miyagi-oki earthquake on May 26, 2003, as estimated by GPS data

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1.Introduction

An intra-slab earthquake with M7.0 occurred on May 26, 2003 at a depth of about 65km under Kesen'numa city, Miyagi Prefecture, northeastern Japan. GPS measurements conducted by the Geographical Survey Institute (GSI) and Tohoku University revealed clear coseismic crustal deformations due to this event. The feature of the deformation field is that radial displacements of small amplitudes near the epicenter, are maximized at epicentral distances of about 20-30km, and then decrease with epicentral distance. This spatial pattern is different from that caused by low-angle reverse faults as a typical interplate earthquake. GSI proposed a rectangle-fault model to reveal good agreement between the observed and calculated displacements. The model fault, however, does not exactly coincide with the precise hypocenter distribution of aftershocks derived by Sakoda (2003, master thesis, Tohoku Univ.). We investigate slip distribution on a new planar rectangle fault model based on the precise aftershock distribution (Sakoda, 2003) and a moment tensor solution obtained by seismic waveform inversion (Okada et al., 2003).

2.Analysis

We utilized a geodetic inversion technique devised by Yabuki and Matsu'ura, (1992). Parameters of the fault geometry such as strike, dip, depth and location were assumed from the moment tensor solution (Okada, 2003) and the aftershock distribution (Sakoda, 2003). A fault plane with a length of 30km and width of 36km was divided into 3km*3km square grids, where bicubic B-splines function was defined to evaluate fault slip. Refer to Yabuki and Matsu'ura (1992) more in detail for the inversion procedure. We analyzed the coseismic GPS data of GEONET and the GPS network established by Tohoku University. Coseismic displacements were defined as the difference in the 5-days average of coordinates before and after the earthquake at continuous GPS sites operated by GSI and Tohoku Univ..

3.Result

Slip distribution estimated by the geodetic inversion shows that there exist two maximum slip areas with slip amount of about 3m: one is located at near the hypocenter and the other at northern and deeper part of the fault plane. The total seismic moment is 2.4*10^19Nm, Mw6.9. The present result is generally consistent with the slip distribution obtained by seismic waveform inversions (e.g. Yagi, 2003 and Okada, 2003). Aftershock activity tends to concentrate around the area of low slip amount. This suggests that many of aftershocks are caused by stress concentration due to the adjoining larger slip area.