Effects of dynamic stress changes caused by the 2004 Mid Niigata prefecture earthquake on aftershocks

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1. Introduction

The Mid Niigata prefecture earthquake (MJMA 6.8) occurred at 17:56 on 23 October 2004 (JST). One of the notable features of this event is that three M6 class aftershocks occurred within an hour after the mainshock occurred. And on 27 October, a large aftershock (MJMA 6.1) also occurred. Fault planes of the aftershocks inferred from the hypocentral distribution are clearly different from the fault plane of the mainshock. For example, the largest aftershock (MJMA 6.5) at 18:34 on 23 October occurred on a fault plane parallel to and deeper than the fault plane of the mainshock.

In this study, we calculate the dynamic stress changes in the source area by using the dynamic rupture model of the mainshock constructed by Kimura, et al. (2005). Then we compare the dynamic stress changes with the rupture process of aftershocks and examine the effects of the dynamic stress changes generated by the mainshock on the rupture process of the aftershocks.

2. Effects of dynamic stress changes caused by the mainshock on the aftershocks

We use the 3-D finite difference method and the dynamic rupture model of the 2004 Mid Niigata prefecture earthquake constructed by Kimura et al. (2005) in order to calculate the dynamic stress changes generated by the mainshock. This dynamic rupture model was constructed based on the kinematic rupture model estimated by the waveform inversion (Hikima and Koketsu, 2005).

First we evaluate the effects of various factors of the rupture model of the 2001 Mid Niigata prefecture earthquake on the dynamic stress changes. We examine various factors, for example, the position and size of the area with large slip and the directivity of the rupture process.

Then we evaluate the dynamic stress changes generated by the mainshock at the hypocenter of the largest aftershock determined by JMA. Both the dynamic shear stress change and the dynamic normal stress change are estimated to suppress the rupture there. We will evaluate the effects of dynamic stress changes by using hypocenter data determined more accurately. And we evaluate the effects not only on the hypocenters of aftershocks but also on the whole rupture process of large aftershocks estimated by Hikima and Koketsu (2005).