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Preliminary results of rapid determination of coseismic fault model using RTK-GPS

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[Introduction]
Detection of coseismic crustal deformation by Real-time Kinematic GPS (RTK-GPS) has been studied in the recent years [e.g., Nishimura et al., 2009, Blewitt et al., 2009]. Rapid estimation of seismic fault model by GPS data is important for understanding of earthquake size. The advantage of the GPS data that are detected directly displacement relative to the assumed reference sites or reference frame. It is useful for detection of ”tsunami” earthquake, which may cause slow displacement. In this study, we developed an algorithm for estimation procedure for coseismic displacement using RTK-GPS coordinate time series, and we tried to determine coseismic fault model based on these information.

[Method]
For the automatic detection algorithm for coseismic displacement, we use to the methods using short-term average (STA: 60 s) and long-term average (LTA: 600 s) [e.g., Matsumura et al., 1988], which is used for automatic detection of P-, S-, and later phases of seismic waves. We define D value as |LTA-STA|-SD(LTA), where LTA and STA are the mean coordinates for 600 and 60 seconds time window, respectively, and SD(LTA) is the standard deviation of LTA. We assume that permanent displacement is detected if D exceeds a threshold K=D’+4s, where D’ is a mean coordinate for the period without any earthquake and s is its standard deveation.

Once D $>$ K at the time Td, the next procedure is started to estimate coseismic displacements, which is defined by the difference between the postseisimc coordinate averaged over the time period of 20 seconds just before D becomes the maximum (Dmax), and the preseismic one averaged between 7 and 5 minutes before Td. We use only horizontal components for the procedure. This algorithm judges earthquake occurrence when D exceeds K at more than 4 sites within 100 square kilometers, and 30 seconds. This reduces misdetection. Also changing the definition of K value into D’+2s after judgement of earthquake occurrence helps to detect relatively small displacements.

[Result]
We tested this algorithm to 1 Hz RTK-GPS time-series of the 2008 Iwate Miyagi Nairiku (Inland) earthquake. Our algorithm success to estimated coseismic displacement at 20 sites out of 27 sites within about 80 seconds. This estimation result corresponds to crustal deformation from post processing analysis [Ohta et al., 2008] within 2 cm. This meansIt is suggested our algorithm is adequately useful for crustal deformation detection. Displacement detection and estimation limits are 5 cm, 3 cm respectively. We then estimated parameters of a rectangular fault in an elastic half space [Okada, 1992] using a nonlinear inversion program method with a priori constraints [Matsu’ura and Hasegawa, 1987] to reveal the consistent result with that obtained by Ohta et al. [2008] using GPS data from post processing. We took initial coordinate value of coseimic fault was first detected site coordinate valueIn this time, we still not success the full automatic coseismic fault determination because of we need to assume initial fault parameters in an evenhanded fashion. We will show full-automatic coseismic fault model estimation procedure in this meeting.

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