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Detection and analysis of early afterslip following the 2008 Iwate-Miyagi Nairiku, Japan, earthquake

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[Introduction] Afterslip is one of the slow earthquakes which have the long time period. Because of difficulty to observe and analyze the early afterslip phase, it's not clear how the early afterslip phase progresses. We first calculated time series of correlation coefficient between the 1-Hz GPS (Global Positioning System) waveform data and trends preliminary projected by afterslip near the mainshock and checked the afterslip signals. Because this data involved not only the afterslip signals but also the coseismic signals, we next enhanced the 1-Hz GPS waveform inversion to investigate simultaneously coseismic slip and early afterslip. Finally we investigated early (10-minutes) afterslip following the 2008 Iwate-Miyagi Nairiku, Japan, earthquake using this method.

[Detection] Static and dynamic ground displacements for this earthquake were observed at one-second intervals by a dense GPS network, called GEONET, operated by the Geographical Survey Institute of Japan (GSI) by processing GPS phase data using the method described by *Larson et al.* [2003]. This data was applied to infer the source process of this earthquake [*Yokota et al.*, 2009]. In this study, we first calculated time series of correlation coefficients between the 1-Hz GPS waveform data and trends preliminary projected by afterslip near the mainshock. The time series during about 2-hours before and after the mainshock showed the characteristic trends only during about 10 minutes after the mainshock.

[Inversion] In order to investigate simultaneously coseismic slip and early afterslip using this data, we next enhanced the 1-Hz GPS waveform inversion of *Yoshida et al.* [1996]. We adopted the 72 km x 24 km afterslip fault model with (strike, dip) = (203^o, 37^o), which was constructed by early aftershock distribution [*Enescu et al.*, 2010] and coseismic fault model used by *Yokota et al.* [2009]. We used the 1-Hz GPS data of 12 stations, which were selected from stations within approximately 50 km of the hypocenter so as to cover all directions. The GPS waveform data were windowed for 10 minutes. We calculated the dynamic Green's function for coseismic slip using FK method [*Zhu and Rivera*, 2002]. The slip rate function for afterslip was represented by B-spline function with knot interval of 60 seconds using the static Green's function calculated using FK method.

[Result] Figure shows the resultant slip distribution. This result suggests the total seismic moment of 3.0 x 10^{17} Nm ($Mw \sim$ 5.5) and maximum slip of about 5 cm. Early afterslip distribution is compared with the coseismic slip distribution for the $Mw \sim$ 6.9 mainshock and the 29-days afterslip distributions [*Iinuma et al.*, 2009]. The resultant early afterslip phases are inferred at the southwestern adjacent region of the main asperity, which are possibly triggered by the southern large asperity. The 29-day northern and eastern afterslips subsequently occurred. The resultant afterslip distribution and early (10-min) aftershock distributions determined by *Enescu et al.* [2010] are also partitioning in a complementary fashion. This result also shows that the afterslip does not evolve along the slow slip scaling [*Ide et al.*, 2007].

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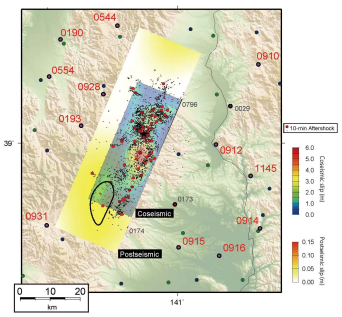

Keywords: early afterslip, high-rate GPS, the 2008 Iwate-Miyagi Nairiku, Japan, earthquake