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# Source Process of the 2009 Suruga Bay, Japan, Earthquake Inferred from 1-Hz GPS Inversion

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In this study, we inferred the source process of the Suruga Bay, Japan, earthquake ($M_{JMA}$6.5) from 1-Hz GPS data only. Over the past several years, high-rate GPS has been used for such purposes as monitoring volcano deformation and tsunami. The capability of high-rate GPS to record seismic wave fields for large (M8 class) earthquakes has been demonstrated [Larson et al., 2003]. Source process was inferred for a large earthquake [Miyazaki et al., 2004], and for a medium-sized (M6.9) earthquake solely from 1-Hz GPS data [Yokota et al., 2009]. However, none of the previous studies have succeeded in inferring the source process of the M6 class earthquake solely from 1-Hz GPS data. We performed a waveform inversion for the rupture process of the Suruga Bay, Japan, earthquake using 1-Hz GPS data only. We here discussed the rupture processes inferred from the 1-Hz GPS data and the strong motion data. We finally verified the frequency bands which 1-Hz GPS can observe.

Static displacements and dynamic ground motions can be observed at one-second intervals by a dense GPS network, called GEONET using the relativity measurement method of Larson et al. [2003]. We used the horizontal components of 1-Hz GPS data of 9 stations, which were selected from stations within approximately 30 km of the hypocenter. All GPS waveform data were sampled at a rate of 1 Hz, being windowed for 45 s in order to adequately include P- and S-waves.

We adopted the 10 km * 16 km (south) and 12 km * 16 km (north) fault models with (strike, dip, slip) = (63, 50, 12), (307, 35, 119) and the hypocenter (latitude: 34.805N, longitude: 138.502E, depth: 17.5 km) in the southern fault model, which were determined by the initial motion solution (Hi-net) and the aftershock distributions [Kato et al., 2009]. The fault model was divided into 88 subfaults of 2 km * 2 km. We assumed the rupture velocity to be 3.2 km/s. The Green's functions were computed using a wavenumber integration method called the FK method developed by Zhu and Rivera [2002]. We derived the 1-D velocity structure models for the GPS stations from the 3-D velocity structure model by Miyake et al. [2008]. The data were inverted to infer the rupture process of the earthquake using the inversion codes by Yoshida et al. [1996] with the revisions by Hikima and Koketsu [2005].

In the result of the 1-Hz GPS inversion, the total seismic moment is 2.8 * $10^{18}$Nm ($M_W$6.3) and the maximum slip is 1.0 m. These results are approximately equal to 2.7 * $10^{18}$Nm and 0.9 m from the inversion of strong motion data. The both inversions inferred that there are two asperities, each of which is located in the southern or northwestern fault plate. In both series of snapshots, the rupture propagated from the hypocenter to the northwestern part.

The comparison between spectra of 1-Hz GPS noise and earthquake signals suggested that 1-Hz GPS can observe strong ground motions of M6.0 - 6.3 earthquakes and static crustal deformations simultaneously. We believe that the ability of high-rate GPS will be significantly improved with detailed quantification of noise.

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Keywords: 1-Hz GPS, source process, the 2009 Suruga Bay, Japan, earthquake, strong motion