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Assessment of high-rate GPS time series at long periods

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High-rate GPS has been proven to be sensitive to ground motions that are induced by surface waves from large earthquakes even hundreds kilometers from the epicenter (Larson et al. (2003a)). Since the broadband seismometers are less sensitive to the long period surface waves (T > 300 seconds), the seismic velocity tomography models start to diverge for depths larger than 400 km (Becker and Boschi (2002); Ritsema et al. (2011)). Because of their good accuracy at long-periods (detecting ground displacements above 2 mm), GPS measurements could be used to support broadband seismometer networks (Houliè et al. (2011); Bilich et al. (2008)) and strong motion networks in near field (Houliè et al. (2014)) by providing high-quality waveforms in displacement for periods T > 3s.
We present the comparison of 1Hz high-rate GPS data, very broadband seismograms and super-conductivity gravimeter data for various period bands (T > 30 s) using the observations collected during three mega-thrust events: 2003 Hokkaido, 2004 Sumatra and 2011 Tohoku-Oki. We assess the performance of each dataset at the light of comparison with synthetic waveforms that were computed using the AXISEM and SPECFEM algorithms. With this study we aim at filling the gap between the surface wave (T < 60 seconds) and normal mode (T 1200 seconds) period ranges. We find that GPS is well capable on recovering millimeter ground motion oscillations in a wide range of periods, providing valuable information on the lithosphere and mantle heterogeneities on a scale of 300 to 3000 km.