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Consistency of GPS and strong-motion records: case study of the Mw9.0 Tohoku-Oki 2011 earthquake

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High-rate GPS data are today commonly used to supplement seismic data for the Earth surface motions focusing on earthquake characterisation and rupture modelling. Processing of GPS records using Precise Point Positioning (PPP) can provide real-time information of seismic wave propagation, tsunami early-warning and seismic rupture. Most studies have shown differences between the GPS and seismic systems at very long periods (e.g. >100sec) and static displacements. The aim of this study is the assessment of the consistency of GPS and strong-motion records by comparing their respective displacement waveforms for several frequency bands. For this purpose, the records of the GPS (GEONET) and the strong-motion (KiK-net and K-NET) networks corresponding to the Mw9.0 Tohoku 2011 earthquake were analysed.

The comparison of the displacement waveforms of collocated (distance<100m) GPS and strong-motion sites show that the consistency between the two datasets depends on the frequency of the excitation. Differences are mainly due to the GPS noise at relatively short-periods (<3-4 s) and the saturation of the strong-motion sensors for relatively long-periods (40-80 s). Furthermore the agreement between the GPS and strong-motion records also depends on the direction of the excitation signal and the distance from the epicentre. In conclusion, velocities and displacements recovered from GPS and strong-motion records are consistent for long-periods (3-100 s), proving that GPS networks can contribute to the real-time estimation of the long-period ground motion map of an earthquake.