

Detection of Earthquake-induced Prompt Gravity Signals in Multi-channel Data

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Seismic waves radiating from an earthquake rupture induce density perturbations of the medium, which in turn generate widespread transient gravity perturbations before the arrival of P-waves. Recently, signal detections of such prompt gravity perturbations from the 2011 Tohoku-Oki earthquake were reported. However, the data used for the detections were only a small subset of the available data, and the statistical significance of the signals were not sufficient nor discussed. In this study, we optimized multi-channel data recorded by several instruments and searched for the signals from the 2011 event. Though the single-trace records did not show any signal, the stacked trace of the broadband seismometer array data in Japan showed a signal clearly standing above the noise level, and this detection was confirmed with a sufficient statistical significance. This result provides the first constraint on the amplitude of prompt gravity signals by observation and will work as a reference for future detections.

Keywords: earthquake-induced gravity perturbation, transient deformation, time variable gravity, 2011 Tohoku-Oki earthquake