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Detecting anomalous gravity signals prior to earthquakes larger than Mw7.0 based on a superconducting gravimeter records in recent four years

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Using continuous 1-Hz data series recorded by a superconducting gravimeter (SG) at Hsinchu station, Taiwan, we investigate the anomalous gravity signals prior to 71 large earthquakes with seismic moment magnitude larger than 7.0 (Mw7.0) occurred in the period from 1 Jan. 2008 to 31 Dec 2011. For the first time we evaluated the noise level of the SG records at Hsinchu (HS) station in microseismic bands from 0.05Hz to 0.1Hz by computing the power spectral density (PSD) of seismically quiet days selected based on the RMS of records. The results suggest that the noise level in micro-seismic band of the SG data in HS station corresponds to that of the new low-noise model (NLNM). Based on the analysis of the noise level and the spectral features of the SG records, we detected anomalous gravity signals (AGSs) prior to large earthquakes. We apply Hilbert-Huang transformation (HHT) technique to the SG records to establish the time-frequency-energy paradigms (TFEP) and marginal spectra (MS) to examine whether there are such kinds of AGSs prior to all large earthquakes. Our statistical results show that 56.3% of all the examined large earthquakes were preceded by AGSs; and if we constrain the epicenter distance being smaller than 3500km and focal depth less than 300km, 75% of the examined large earthquakes have AGSs. We also investigated the TFEP and MS of the typhoon events, and results show that both of them have different natures from the corresponding ones of the AGSs non-contaminated by typhoon event prior to large earthquakes. In addition, our investigations suggest that the AGSs prior to large earthquakes may be related to focal depth, the epicentre distance and the location of the source. This study is supported by Natural Science Foundation China (grant No.40974015; No.41174011; No.41021061; No.41128003).