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Earth Oscillation after Major Strong Earthquakes in the Last ten Years (2004 – 2013)

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Precise relative gravimetric data contribute additional knowledge about the Earth's interior through careful analyses of superconducting gravimeter (SG) records particularly after strong earthquakes. Apart from life loss and damages which earthquakes cause, their signature in the collected data either seismic and/or gravity enables researchers to define the physical parameters of the Earth's interior, such as density profile and anelasticity with other geometric parameters as well. When an earthquake hits, the Earth is set to vibrations similar to a drum when it is hit. The vibrations of the Earth after an earthquake event are called the Earth's free oscillations (EFO) or normal modes. In the last ten years (2004 – 2013), the Earth was hit by three major strong earthquakes with a magnitude higher than or equal 8.8 Mw. The SG data from more than 40 stations recorded after earthquakes hit the Earth in 2004, 2010 and 2011 are used to investigate the properties of the long-period seismic modes: their frequencies, amplitudes, and quality factors.

In this study, the SG data from the Global Geodynamics Project (GGP) stations are used where all the unwanted signals are removed first from the gravity data such as the solid earth tides, ocean loading and polar motion. Then, the Least Squares Response Method (LSRM) is used to estimate the frequency-dependent admittance of the atmospheric pressure loading from the quiet SG data before the occurrence of the earthquake. After the pressure correction, gravity residual of each station is used to estimate the single spectrum. Finally, the Multi-station Product Spectrum Method which is developed based on the Least Squares Spectrum Analysis Method is applied to define and determine the spheroidal and toroidal modes of the Earth free oscillations. Many spheroidal and toroidal modes associated with their singlets are detected precisely in the frequency band from 300 uHz to 1500 uHz.