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Gravity changes before and after the 2015 Mw7.8 Nepal earthquake

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Based on the absolute gravity measurements of 4 gravimetric stations (Shigatse, Zhongba, Lhasa and Naqu) in southern Tibet surveyed from 2010 to 2013, we modeled the source region as a disk of 580 km in diameter by Hypocentroid model, shown that the gravity increase at these stations may be related to mass changes in the source region of the 2015 Mw7.8 Nepal earthquake. We analyzed the characteristics of gravity variations from the repeated regional gravity network, which including the 4 absolute gravimetric stations and 13 relative gravimetric stations from 2010 to 2019, to study the characteristics of gravity changes before and after the earthquake.

We firstly estimated the reliability of the absolute gravity measurements by the errors of each station, and considered the effect of vertical displacement, denudation of surface mass, GIA correction and the secular and background gravity changes. Secondly we employed the Bayesian adjustment method for the relative gravimetric network data analysis, which was more robust and adaptive for solving problems caused by irregular nonlinear drift of different gravimeters, and then carried out error analysis for the repeated relative gravity measurements. Furthermore, we took the Shigatse station as example, which covered absolute and relative measurements and was most close to the Hypocenter of the inversion Hypocentroid model, the hydrologic effects of the Shigatse station was modeled exactly, and the results shown that the secular and background gravity changes were much smaller than the observed gravity changes. Lastly we studied the characteristics of gravity changes before and after the earthquake through the Hypocentroid model, we found the coincident gravity increase both in absolute and repeated regional gravity results before the earthquake, and gravity decreased after the earthquake, which suggested that the pre-earthquake gravity increase may be caused by strain and mass (fluid) transfer in broad seismogenic source regions of the earthquake. Moreover, the study indicated that high-precision ground gravity measurements (absolute and relative) may provide a useful method for monitoring mass changes in the source regions of potential large earthquakes.

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