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GRACE卫星观测到的与汶川 M_s 8.0地震有关的重力变化

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Gravity changes associated with the M_s 8.0 Wenchuan earthquake detected by GRACE

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摘要

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摘要 利用GRACE卫星重力资料, 计算了中国大陆及周边的卫星重力时变场和地表密度变化分布, 获取了具有代表性的点位区重力变化时间序列. 同时获得了WUSH、LHAS、KUNM、LUZH站相对于区域参考框架的GPS位移时间序列. 卫星重力观测结果拉雅弧形带的重力在2004年苏门答腊 M_w 9.3地震后快速下降, 2006~2008年尤为明显, 西域地块西北边界带上震后重力下降; 而沿青藏高原北至东边界2007年出现明显的重力上升沿构造边界的弧形分布, 且2008年南北地震带中南段重力上升变化. 苏门答腊地震后的重力变化趋势到汶川地震发生后才开始改变. GPS位移结果显示四个台站均记录到苏门答腊大地震的同震: WUSH、LHAS、KUNM站水平位移向量出现明显的运动趋势改变, 且一直持续到2008年汶川 M_s 8.0地震的发生. GRACE卫星青藏高原及周边地表质量的变化为解释汶川地震的动力机制提供了新的观测途径和资料. 本文结合区域构造运动的特点和GPS-GRACE观测的时变重力场特征及汶川地震的动力机制进行了初步解释和讨论.

关键词: 汶川地震 苏门答腊地震 GRACE卫星 重力变化 GPS 位移

Abstract: Time variable changes in gravity field on and around Chinese Mainland before and after the M_s 8.0 earthquake are obtained from the GRACE satellite gravity data. Time series of gravity changes at locations are also obtained. At the same time, time series of displacements at GPS fiducial stations of WUSH, LHAS, KUNM and LUZH are obtained in the regional reference frame. Results from GRACE indicate that after the Sumatra earthquake along the Himalaya arc the satellite gravity showed rapid decrease, particularly during the period of 2006 to 2008 the decrease in gravity was significant; while along the northwestern boundary of the Tibetan plateau there was also significant post seismic decrease in gravity. And along the northern and eastern boundary of the Tibetan plateau there appeared an arc along the tectonic boundary with significant gravity increase in 2007. But in 2008 there was also significant increase in gravity in the southern and middle segments of the South seismic belt. This trend in gravity variations after the Sumatra earthquake changed only after the Wenchuan earthquake. Displacements at 4 GPS stations recorded coseismic signals of the great Sumatra earthquake, and then the horizontal displacement vectors at WUSH, LHAS and KUNM showed significant changes in their general trend until the occurrence of the Wenchuan M_s 8.0 earthquake. The changes in the density of ground mass in the Tibetan plateau and the surrounding areas as revealed by the GRACE satellites have provided a new observation approach and data for the explanation of the dynamic mechanism of the Wenchuan earthquake. A preliminary explanation and discussion on the characteristics of the time variable changes in the gravity field observed by GRACE and the dynamic mechanism of the Wenchuan earthquake are presented in this paper combining the features of regional tectonic movements and displacements of GPS observations.

Keywords: Wenchuan earthquake Sumatra earthquake GRACE satellites Change in gravity GPS Displacement