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联合Envisat和ALOS卫星影像确定 L'Aquila地震震源机制

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Source parameters of the 2009 L'Aquila earthquake, Italy from Envisat and ALOS satellite SAR images

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摘要 2009年4月6日意大利L'Aquila地区发生了M_w6.3级地震,该地震造成了300余人的人员死亡. 本文联合不同波长、不同入射倾角的升降轨Envisat和ALOS卫星的差分干涉数据对该地震进行震源机制解的反演研究. 研究首先对卫星雷达影像进行二通差分干涉处理,获取了覆盖L'Aquila地震震区的完整InSAR同震形变场,然后结合四叉树和均匀采样方法对原始观测数据进行降采样. 在此基础上,联合GPS形变观测数据,利用弹性半空间矩形和三角位错模型,以及断层自动剖分技术对断层面进行最优离散剖分,反演获取了发震断层的精确几何参数和最优断层滑动分布,结果显示分布式三角位错滑动模型能够很好地解释观测到的地表形变场. 反演结果表明发震断层是一个以正倾滑为主兼有少量右旋走滑的盲断层;基于观测数据最优确定的断层单元的最短边长为0.4 km,最长边长为6.3 km;此次地震的滑动分布主要发生在5～14 km深度的范围内,最大滑移量为1.07 m,释放的能量为3.43×10^{18} N·m(M_w6.32),与地震学的研究结果非常一致.

关键词 L'Aquila地震, 差分干涉测量, 同震形变, 滑动分布反演, 断层面自动剖分

Abstract: On the 6th April 2009, an M_w6.3 earthquake occurred in the region of L'Aqula of Italy, which caused more than 300 people to lose their lives. In this paper, the Envisat and ALOS satellite interferograms with different incidences and wavelengths are used to invert for the source parameters of the fault activated during the earthquake. Firstly, two-pass interferometry technique is used to obtain the coseismic deformation covering the whole epicenter region, then a combination method of quad-tree and uniform sample is employed to down-sample the original observed datasets. Secondly, the rectangle and triangle dislocation models in elastic half-space and an automated fault discretization method are used to derive the geometric and kinematic characteristic of fault combining with GPS surface displacement measurements. The best-fit solution shows that the distributed slip model can explain the data very well. The inversion result indicates that the fault is dominated by normal movement with small right-lateral strike-slip component. The shortest and longest length of the optimal fault patches based on the observing data are 0.4 km and 6.3 km, respectively. The fault slip concentrates mainly in the shallow depth between 5 km and 14 km, and the maximum slip is about 1.07 m. The inverted geodetic moment is 3.43×10^{18} N·m (M_w6.32), which is excellently consistent with the result of seismology.

Keywords L'Aquila earthquake, DInSAR, Coseimic deformation, Slip distribution inversion, Automated fault discretization

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