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GPS与PS-InSAR联网监测的台湾屏东地区三维地表形变场

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Mapping ground 3-D displacement with GPS and PS-InSAR networking in the Pingtung area, southwestern Taiwan, China

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摘要

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摘要 联合高精度的GPS水平位移观测和高密度的PS-InSAR雷达视线位移测量,实现地表三维形变的精确反演.本文在准确计算卫星轨道方位角基础上,使用GPS观测位移与星载雷达LOS方向形变的投影转换模型,将雷达LOS方向形变转换为垂直方向位移,并基于地面GPS与SAR影像PS目标联合构建形变监测网,采用参数平差算法估计区域地表形变场.以地质构造活动极其活跃的台湾岛及其西南屏东高雄地区为例,联合屏东地区48个GPS监测台站与雷达PS目标,监测该地区从1995-1999年间由于板块构造挤压运动和地下水抽取导致的三维地表形变.结果表明,该地区年均水平位移量为向西30~50 mm/a,高雄沿海地区发生明显的逆时针西偏南的逐渐增大的水平位移;垂直位移为屏东平原南部呈现-10 mm/a~-15 mm/a的地面沉降,而平原北部和高雄地区呈现约+5 mm/a~+10 mm/a的地面抬升.

关键词 地表形变, GPS, PS-InSAR, 网络, 监测

Abstract: It's promising to map ground 3-D displacement along the north, east and vertical directions combining accurate GPS observations and dense PS-InSAR measurement. This paper computes accurately the orbital azimuth of SAR satellites and analyzes the geometric transformation relationship between InSAR derived deformation in LOS direction and GPS observables. The model is employed to convert InSAR displacement into vertical deformation based on the accurate horizontal displacement from GPS. The selected PS targets and GPS stations are combined to establish a ground deformation monitoring network. The parameter adjustment method is used to estimate vertical displacement of PS. The algorithms are tested and validated using ERS-1/2 SAR images over the Pingtung area and GPS observations from 48 stations in southwestern Taiwan. The horizontal displacement in the Pingtung area is clearly derived from GPS observables; the annual velocity is 30~50 mm/a moving towards the west and the azimuth presents a counter-clockwise deviation towards the southwest. The vertical displacement field is derived from the GPS and PS-InSAR networking with the southern Pingtung plain subsiding at a rate of -10~-15 mm/a, the northern plain and Kaohsiung area uplifting at +5~+10 mm/a.

Keywords Ground deformation, GPS, PS-InSAR, Networking, Monitoring

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