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Uplift and reverse fault rupture of the 2013 Bohol earthquake (Mw 7.2), Philippines, revealed by SAR pixel offset analys

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Applying a pixel offset analysis using RADARSAT-2 SAR data to an inland crustal earthquake that occurred in Bohol Island, Philippines on 15 October, 2013, we succeeded in mapping a ground displacement associated with the earthquake. The most concentrated crustal deformation is located in the northwest of the island with ground displacement exceeding 1 m. The crustal deformation is zonally distributed with the length of approximately 50 km in the ENE-WSW direction. The ground in the mountainous area moves toward the satellite, while in the northern coastal zone the ground moves away from the satellite. A clear displacement discontinuity with the length of about 5 km, probably corresponding to earthquake surface faults, can be identified in the northeastern part. Our fault model that consists of two rectangular planes shows nearly pure reverse fault motions on south-southeast-dipping planes with moderate dip angles. A local rupture located in the northeast occurs at shallow depths, causing appearance of surface ruptures. Applying an additive color process using SAR amplitude images, significant changes in the backscatter intensity are detected along the coast from Maribojoc to Loon, suggesting that the seafloor uplifted and the shoreline shifted seaward resultantly. The area showing the shoreline change is in good spatial agreement with the locally-distributed large ground uplift predicted from our fault model. We can identify a good correlation between the ground upheaval produced by the reverse fault motion and the elevation in the mountainous area, consistent with the idea that the historically-repeated reverse faultings have developed the present-day topography.

Keywords: Bohol earthquake, Crustal Deformation, Pixel offset analysis, uplift, SAR, RADARSAT-2