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The 2010 Haiti Earthquake: Crustal deformation and a fault model inferred from InSAR analysis using ALOS/PALSAR data

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Preface:
A catastrophic inland earthquake with M=7.0 (USGS) struck Haiti on 12 January 2010 (13 January 2010 (JST)), whose hypocenter is about 20 km distant from the capital of Haiti "Port-at-Prince" that suffered from severe damages. This earthquake could be associated with the reactivation of a part of the Enriquillo fault zone which runs over a length of 200 km in the south of Hispaniola island. To map the surface displacement associated with this earthquake, we conduct interferometric SAR (InSAR) analysis using ALOS/PALSAR data. We will report the crustal deformation obtained from the InSAR analysis and a preliminary fault model constructed on the basis of the InSAR data.

SAR data:
We analyze SAR data acquired from the Path138 (Ascending orbit) and Path 447 (Descending orbit) which are strip-map imagery with off-nadir angle of 34.3 degrees. We process the SAR data from a level-1.0 product using a software package GSISAR. For the ascending orbit data (Path 13 8), master and slave images were acquired on 11 Nov. 2007 and 16 Jan. 2010, respectively, while for the descending orbit data (Path 447), master and slave images were acquired on 9 Mar. 2009 and 25 Jan. 2010, respectively. We use hole-filled SRTM3 DEM (Jarvis et al., 2008) to remove the topographic phase.

Result:
SAR interferograms obtained show clear coseismic deformation due to the 2010 Haiti earthquake. The major displacement distributes along the Enriquillo fault zone, which is distant (20-50km) from Port-at-Prince, suggesting that the major fault rupture did not occur in the proximity of Port -au-Prince. The result obtained from the descending orbit data (Path447) shows about 70 cm shortening of slant range at maximum, located ~15 km west from the epicenter. The result from ascending orbit data (Path138) measuring the displacement in the western source region shows a slant range shortening exceeding 40 cm, localized in the northern coastal zone with a steep displacement gradient. On the other hand, in the southern side about 40 cm lengthening of slant range is identified with a broader gradient than the northern side.
A preliminary fault model which consists of two rectangular faults with a uniform slip in an elastic half-space shows 1) that the total fault length is ~35 km, 2) a composite motion including both left-lateral and reverse slip components, 3) a north-dipping fault (dip angle ~55 deg.), 4) a slip amount of ~5 m, and 5) that the western segment is located at shallower depth with a larger slip than the eastern one.

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Keywords: 2010 Haiti Earthquake, InSAR, Enriquillo fault zone, ALOS/PALSAR