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Crustal and surface deformation associated with the Nepal earthquake detected by ALOS-2/PALSAR-2

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An earthquake of Mw 7.8 on April 25, 2015 in Nepal, Gorkha earthquake, brought about serious damages to the society of Nepal due to building collapse, structural damages, landslides, and liquefaction. In order to grasp the entire view of the disaster as quickly as possible, the Japan Aerospace Exploration Agency conducted emergency observation of ALOS-2/PALSAR-2. I am involved in the Earthquake SAR Working Group on the Coordinating Committee for Earthquake Prediction and processed observed images to detect crustal deformation associated with this earthquake. Here I report the preliminary results of analyses.

So far 5 observations that cover the affected area were made since April 28. Among them, a ScanSAR mode image acquired from the descending orbit on May 3 (Path 48 frame 3050) covers the entire source region and is the most suitable for the discussion of crustal deformation. The same observation was made on May 17 and gives us information of the largest aftershock (Mw 7.5) on May 12. Another useful observation is that from the ascending orbit on May 2 (Path 157, frame 500-560). I mainly present the results of these observations in this report.

I detected coseismic deformation in interferograms of pairs February 22 or April 5 and May 3 images. Unfortunately, forecast ephemerides are used so that there are lots of residual fringes in interferograms. I reduced them by fitting bi-linear/parabolic functions and detected large deformation in a area that is about 170 km in E-W and 100 km in N-S wide. Decrease of line of sight is dominant with maximum of $>$100 cm in its southern half. Katmandu is located in this area. In the northern half increase of LOS up to 100 cm is prevailing. Preliminary results of inversion suggest a low-angled thrust faulting beneath this zone of deformation with slip of several m. Solutions are, however, unstable probably due to inaccurate approximation of phase slope. It is essential to reprocess using precise ephemerides.

The analysis of the pair of May 3 and May 16 of P48 F3050 gave us coseismic deformation of the May 12 aftershock. Although reduction of residual fringes are necessary, a decrease of 60 cm and increase of 50 cm of LOS are found in the vicinity of the northeastern corner of the deformed area of the mainshock. This implies the rupture of a patch on the source fault that did not rupture during the mainshock.

I tried to detect affected areas of landslides, natural dams etc. by comparing intensity images, and found the region of intensity increase after the mainshock in a valley north of Kathmandu. I did not find any other significant signals. It is probably due to relatively large spatial resolution (˜50 m with multi-look processing). I did not find notable discontinuities that usually appear during a surface rupture faulting. On the other hand, local disturbances in Kathmandu probably due to liquefaction are clearly identified.

The ownership and copyright of ALOS-2/PALSAR-2 images belong to the Japan Aerospace Exploration Agency. All data used in this study were provided through the activity of Earthquake SAR WG, ALOS-2 CVST Science Team and Pixel.

Keywords: Nepal earthquake, ALOS-2/PALSAR-2, InSAR, coseismic deformation, surface deformation