Study and monitoring of Virunga volcanoes through Tandem-X interferometry.

F. Albino, F. Kervyn, B. Smets, N. d'Oreye

Virunga Volcanic Province, located in Central Africa (D.R. Congo, Rwanda and Uganda), is composed of few central volcanoes and many eruptive fissures and small cones.

Two central volcanoes are active in historical time:
(i) Nyiragongo with a persistent lava lake inside its main crater and flank eruptions in 1977 and 2002;
(ii) Nyamulagira with frequent eruptions, every 2-4 years for the last decades.

The last eruption of Nyamulagira started on November 6, 2011 and stopped five months later, in April 2012. The eruptive site, which is located 12 km east of the summit crater, developed along fissures oriented ~N70°E. It produced a large lava flow, which reached 20 km long, and two scoria cones up to 70m high. Interferometry techniques on Tandem-X SAR data were used to study this large effusive eruption. First, bi-static pairs were used to compute high-resolution Digital Elevation Models. The produced Tandem-X DEMs have a ground resolution of 5 meters, which is at least six times smaller than those from the DEMs previously available for the area.

Moreover, Tandem-X DEMs calculated from scenes acquired in the period 2011-2012 provide an updated vision of the topography (e.g. The SRTM DEM represents the topography of the year 2000). In new DEMs, new lava flows and scoria cones associated to the 2004, 2006 and 2010 eruptions are clearly identified. Secondly, the calculation of a time series of the topography during the 2011-2012 period enables to better characterize the 2011 eruption. From DEM difference between a pre-eruption stacked DEM and a post-eruption stacked DEM, the thickness and the volume of the lava flow have been derived. A total eruptive volume of 0.30 km^3 (with an error estimated around 6%) is found for the 2011 Nyamulagira eruption. This value is large in comparison with the previous historical eruptions, which mostly produced estimated lava flow volumes between 0.04-0.15 km^3. The long duration of the eruption and the intensity of fountain activity can partly explain the large volume. The better accuracy in the determination of the flow thickness from DEM difference can also explain volume bias between this eruption and past eruptions, where thickness could have been partially under-estimated. The coherence decorrelation over the 2011-12 lava flow is under study, in order to better constrain the estimated lava volume. In addition to topographic investigations, the Tandem-X imagery is used to study the ground deformation related to the 2011-12 eruption of Nyamulagira.