The crucial role of digital elevation modeling to study Nyiragongo and Nyamulagira volcanoes (North Kivu, Democratic Republic of Congo)

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The Virunga Volcanic Province (VVP), in the western branch of the East African Rift System, is one of the most active volcanic zones in Africa. Two of the height main volcanic edifices are currently very active, namely Nyiragongo and Nyamulagira. In regions where field investigations are problematic, remote sensing proved to be efficient for studying and monitoring volcanic activity. This is the case in the VVP, which is affected by recurrent periods of political unrest.

The presentation focuses on the study of Nyiragongo and Nyamulagira volcanoes (Eastern DR Congo) using digital elevation modeling. Stereo-photogrammetry, SAR interferometry and close-range photogrammetry are used to produce metric to sub-metric digital elevation models (DEM):
New generation of very high resolution (1 to 6 m) DEM are produced based on Pleiades (optical) and TanDEM-X (radar) satellite imagery. These DEM offer new perspectives compared to previous available DEM of the VVP (e.g. SRTM and ASTER). These new very high resolution DEM are exploited for 1) quantitative geomorphological investigations and 2) as input for lava flow modeling. For the first time, metric structures, such as small cones, thin lava flows and lava channels, can be studied in the VVP. The influence of these small reliefs on lava flows is assessed using flow modeling.
These DEM analyses efficiently complement the space-borne techniques, the ground-based techniques and fieldwork for the study of volcanic activity in the VVP.

A stereographic time-lapse camera (STLC) system was developed and installed inside the main crater of Nyiragongo. The STLC system takes pairs of images at a given time rate. Each pair of mist-free pictures enables the production of a 3D model of the lower part of the main crater. This technique aims at accurately estimating volume and surface changes linked to lava lake activity and its level fluctuations. First results of this innovative technique, which is still under development, indicate a great potential to study permanent lava lakes.

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