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Landslide characterization from space in the tropical environments of the Rift flanks west of Lake Kivu (DRC)

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The western branch of the East African Rift is an area where natural triggering and environmental factors such as heavy rainfall, tectonic activity and steep topography favour the occurrence of landslides [1]. In addition, sensitivity to slope instability is expected to increase in the future in response to increasing demographic pressure, deforestation and land use changes, and projected climate change [2]. The Rift flanks west of Lake Kivu (DRC) are one of the Congolese regions most affected by landslides [3, 4]. However, information on the regional distribution of the landslides and their dynamics is still limited. To achieve a comprehensive characterization of these processes in a data-poor context we used remote sensing data at two different scales.

First, a regional multi-temporal inventory was conducted in an area of 5,700 km² between the cities of Bukavu and Goma. The approach for the inventory relies on visual analysis of a 5 m resolution DEM produced from TanDEM-X interferometry [5], high-spatial resolution and multi-temporal Google Earth imagery and aerial photography. Field validation was performed in target places accounting for 5% of the study area. More than 2,000 landslides were mapped and distinction was made between deep and shallow, and slide and flow processes. The average landslide area is 6 ha (max. = 430 ha). Geomorphological analysis of landslide distribution suggests potential topographic, lithologic, climatic and seismic controls. Imagery provided by Google Earth was the only way to locate recent shallow failures triggered by known extreme rainfall events.

The second step of investigation was to focus on the city of Bukavu where more than 40% of the urban territory is affected by slope instability. Here we used a multi-temporal InSAR technique to monitor the ground deformations. Using 50 Cosmo-SkyMed SAR images, acquired between March - October 2015 with a revisiting time of 8 days (ascending and descending orbits), we produce displacement-rate maps and ground deformation time series using the PS technique. Movements with a velocity >5cm/yr with reference to the Line of Sight are detected, which is consistent with field observations. DGPS measurements, taken at 21 benchmarks in the area during the same period, allow validation of the results. Similar ground deformation rates are found for the period 2002-2008 using Envisat ASAR images. Furthermore, comparison with rainfall monitoring data acquired on-site should help us to understand the influence of water and the seasonality in the slide mechanisms.

Characterization of landslides at these two scales is a first step towards the understanding of the processes in these tropical environments. Further studies are needed to complete and validate the information, to better infer about the triggers, and to compute susceptibility and hazard predictions.

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