



The impacts of an extreme event: inventory, susceptibility, and exposure to landslides and debris-rich floods following Cyclone Idai in two mountainous districts of Zimbabwe

Antoine Dille¹, Olivier Dewitte¹, Jente Broeckx², Koen Verbist³, Andile Sindiso Dube², Jean Poesen^{2,4}, and Matthias Vanmaercke²

¹Royal Museum for Central Africa, Department of Earth Sciences, Tervuren, Belgium (antoine.dille@africamuseum.be)

²KU Leuven, Department of Earth and Environmental Sciences, Leuven, Belgium

³UNESCO, Regional Office for Southern Africa, Harare, Zimbabwe

⁴Institute of Earth and Environmental Sciences, UMCS, Lublin, Poland

Extreme rainfalls associated with tropical cyclones can have devastating impacts along the cyclone path. In mountainous regions, these rainfalls may trigger up to thousands of landslides, themselves feeding destructive debris-rich floods impacting downstream valleys sometimes over tens or hundreds of kilometres. Such compound events were observed in the mountains of eastern Zimbabwe alongside Cyclone Idai in March 2019. Hitting an area of high population vulnerability and exposure, this event had very-high human and geomorphologic impacts in the region. In the framework of the UNESCO project BE-RESILIENT Zimbabwe (funded by World Bank and managed by UNOPS), we analysed the consequences of the landslides associated with this event in the Chimanimani and Chipinge districts of eastern Zimbabwe (~8000 km²). Aiming at a rapid evaluation in a data-scarce region, we built on existing tools and open access satellite remote sensing and GIS data to obtain an exhaustive inventory of the spatial extent of the impacted area, and ultimately an assessment of the population exposure in the region. We mapped over 14 000 (mostly shallow) landslides associated with this single event. Alongside a high population vulnerability, the extreme impacts of the landslides were associated with the very large mobility – up to kilometre-long runout/deposition areas are found – of the landslides. To account for this, we distinguish three types of processes (zones) in our inventory, susceptibility, and exposure analyses: landslide source/depletion, landslide runout and debris-rich floods. This discrimination is key for apprehending the hazard imposed by landslides in the study area, and finally for properly evaluating the population exposure to this hazard. While this work aims primarily at guiding land use planning, mitigation, restoration, and prevention in the Chimanimani and Chipinge districts of eastern Zimbabwe, it also offers a case for the use of simple yet powerful approaches to assess the impacts of an extreme event and the exploitation of the astonishing amount of quality open access data now available for every corner of the globe.