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Innovative technologies to understand hydrogeomorphic impacts of climate change scenarios on gully development in drylands: case study from Ethiopia

Amaury Frankl (1), Cornelis Stal (1), Amanuel Abraha (2), Alain De Wulf (1), and Jean Poesen (3)

(1) Department of Geography, Ghent University, Belgium, (2) Institute of Climate and Society, Mekelle University, Ethiopia, (3) Division of Geography, Department of Earth and Environmental Sciences, KU Leuven, Belgium.

Taking climate change scenarios into account, rainfall patterns are likely to change over the coming decades in eastern Africa. In brief, large parts of eastern Africa are expected to experience a wetting, including seasonality changes. Gullies are threshold phenomena that accomplish most of their geomorphic change during short periods of strong rainfall. Understanding the links between geomorphic change and rainfall characteristics in detail, is thus crucial to ensure the sustainability of future land management. In this study, we present image-based 3D modelling as a low-cost, flexible and rapid method to quantify gully morphology from terrestrial photographs. The methodology was tested on two gully heads in Northern Ethiopia. Ground photographs (n = 88-235) were taken during days with cloud cover. The photographs were processed in PhotoScan software using a semi-automated Structure from Motion-Multi View Stereo (SfM-MVS) workflow. As a result, full 3D models were created, accurate at cm level. These models allow to quantify gully morphology in detail, including information on undercut walls and soil pipe inlets. Such information is crucial for understanding the hydrogeomorphic processes involved. Producing accurate 3D models after each rainfall event, allows to model interrelations between rainfall, land management, runoff and erosion. Expected outcomes are the production of detailed vulnerability maps that allow to design soil and water conservation measures in a cost-effective way.

Keywords: 3D model, Ethiopia, Image-based 3D modelling, Gully, PhotoScan, Rainfall.