EGU22-6501
EGU General Assembly 2022

Landslides, soil moisture, and land use changes in the mountainous Northern-western provinces of Rwanda: field-based research in a tropical environment

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The mountainous environments of the Northern-western provinces of Rwanda are often affected by severe cases of rainfall-triggered landslides. Recent studies carried out in the region reveal that the peak in the occurrence of these new landslides is not associated with the highest monthly rainfall, but occurs at the end of the wet season when the antecedent soil moisture conditions seem to be the most favourable. The Northern-western provinces of Rwanda are also densely populated. This high demographic pressure is associated with significant land use/cover changes (e.g. deforestation) and land management practices (e.g. agricultural terraces). Recent studies in the region have demonstrated that deforestation initiates a landslide peak that lasts several years. Our field observations also show that agricultural terraces seem to play a role in the occurrence of landslides. Nonetheless, not only for Rwanda, but also in general, our insights on the impacts of land use/cover changes and land management practices on the soil moisture conditions that lead to rainfall-triggered landslides remain very poorly quantified. This is especially true in the tropics. The goal of our research is to make a contribution to the quantification of these interactions. More specifically, we work at the level of six experimental hillslopes that present similar topographic characteristics but contrasting soil types, namely clayey soils and sandy soils. For each soil type, three hillslopes with different land uses and land management practices are investigated: cultivated hillslope, terraced hillslope, and forest hillslope. In total, we installed sixty access tubes, eighteen sensors, five rain gauges and six piezometers to monitor/measure the spatial-temporal variation of soil moisture content, rainfall and groundwater fluctuations. Both automatic and manual measurements are carried out, bringing accurate daily to sub-daily data for all the sites. The acquisition of the data was initiated during the wet season that started at the end of 2021.

Preliminary results show the occurrence of patterns of rainfall-soil moisture conditions. These data from the field measurements will be used to better link the landslide susceptibly of the region with the human-induced changes and the rainfall characteristics. Ultimately, this will serve to improve the prediction of spatial-temporal patterns of rainfall triggered landslides at local scale in this tropical and intensively cultivated environment.