Natural Hazards and Earth System Sciences Discussions

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/nhess-2021-222-RC1, 2021

Comment on nhess-2021-222

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Referee comment on "Integration of observed and model-derived groundwater levels in landslide threshold models in Rwanda" by Judith Uwihirwe et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-222-RC1, 2021

GENERAL COMMENTS

The paper investigates whether incorporating regional hydrological characteristics in empirical statistical landslide threshold models has potential to improve the quality of landslide predictions towards reliable early warning systems or not. In particular, based on field data and landslide intentory in the North-Western part of Rwanda, the Authors use a data driven time series approach to model the regional groundwater levels and investigate the predictive power of single variable and bilinear threshold landslide prediction models derived from both groundwater levels and precipitation.

The overall assessment of the paper is positive, especially taking into account the innovative aspects of the adopted approach. The potential of the suggested methods to rely on early warning systems in an area intensely affected by landslides and where, however, data are relatively scarce, is also noted.

SPECIFIC COMMENTS

Two aspects that appear to be critical and could be further explored and explained are highlighted below.

1) On page 7, rows 184-186, the Authors state that "the extrapolation was undertaken by keeping the parameters constant in each of the three catchments and by implicitly relying on the main assumption here that the subsurface characteristics do not exhibit spatial variability within the individual catchment." This basic hypothesis appears rather strong

and oversimplified, as it seems not to take into account the morphology of the area under study and the high variability of altitude and slope. It is believed that the extreme orographic variability of the area can have a significant influence on the estimation of the groundwater level. The model adopted has the merit of being simplified, but in this territorial context there is a risk of making completely misleading estimates.
Moreover, taking the same data from a single groundwater station and extending this data not only to the sites of the 3 rain stations (for each sector) but to the whole sector seems rather risky.

2) The second concern deals with the types of landslides considered. On page 7, row 200, the Authors declare that they use a catalogue that includes "42 accurately dated landslides located within the studied region". However, the main characteristics of these 42 landslides are not reported and not explained. The study area is intensely affected by several types of landslides: rainfall-induced landslides, deep seated landslides and also rock falls. In addition, in this area landslides occur very often on steep road cut-slopes, where the influence of the water table as a predisposing or triggering cause remains to be proven.

Authors are invited to incorporate some comments related to these shortcomings.

TECHNICAL CORRECTIONS

Page 10, row 281: "Ruhengeri" instead of "Ruhengeli".

Section 4.2 and Figure 4: the correlation between landslide triggering and increase of groudwater level is not so evident.

Figure 5: the caption refers to square shaped markers for TSS and cycle shaped marker for Rad, but cycle shaped markers are only reported in Figure 5.c: is it correct or some markers are missing?

Page 20, row 473: "...but the result was not as significant as..." instead of "...but the results was not as significant as...".