KU LEUVEN
Royal Academy for Overseas Sciences
Faculty of Sciences
Department of Earth and Environmental Sciences

Added value of regional versus global landslide susceptibility: western branch of the East African Rift

Arthur Depicker[1], Liesbet Jacobs[1], Jean-Claude Maki Mateso[2,3], Damien Delvaux[4], Hans-Balder Havenith[5], Gerard Govers[1], and Olivier Dewitte[4]

[1]KU Leuven, Department of Earth and Environmental Sciences, Belgium (arthur.depicker@kuleuven.be), [2]Centre de Recherche en Sciences Naturelles, Department of Geophysics, Lwiro, DR Congo, [3]Université catholique de Louvain, Earth and Life Institute – Environmental Sciences, Louvain-La-Neuve, Belgium, [4]Royal Museum for Central Africa, Department of Earth Sciences, Tervuren, Belgium, [5]Université de Liège, Department of Geology, Belgium

1. Problem statement

- The Global South is disproportionally affected by landslides in terms of casualties and infrastructural damage[1,2].
- We anticipate an increasing risk due to a growing population and climate change[3].

Figure 1: *Landslides triggered by heavy rainfall south of Kibuye on May 6th, 2018. Twenty people were killed.*

- Many South countries, such as there are in the western branch of the East African Rift (WEAR, ***Figure 2***), show problems in terms of **(i)** field accessibility, **(ii)** landslide detection due to excessive vegetation growth and rapid land reclamation, and **(iii)** available spatial data[4].
- The landslide susceptibility (LSS) in such regions has only been assessed through global models based on simplified covariates and landslide inventories which may not represent the region of interest well.

2. Research questions

- Which efforts are required to develop a regional LSS model? How is the quality impacted by
  a. The inventory size, and
  b. The use of more accurate spatial covariates?
- Does the regional LSS model scores significantly better than the global one?

3. Methods

- Build three regional LSS models:
  1. Logistic regression (LR),
  2. Random forests (RF), and
  3. Support vector machines (SVM).
- Quantify the effect of **(i)** inventory size and **(ii)** more accurate covariates on model accuracy and AUC.
- Compare the prediction rate of the best regional model to the one of global and continental models[7,8].

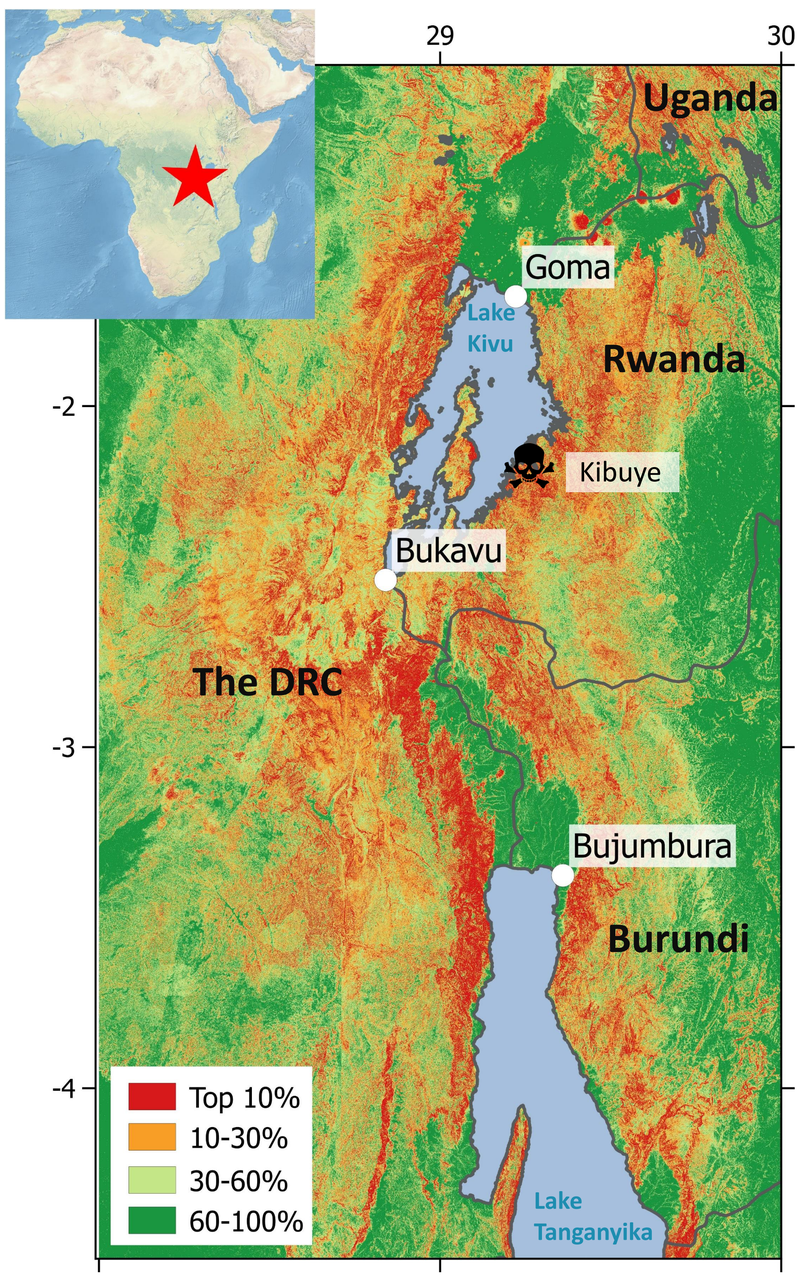

Figure 2: *LSS in the WEAR, calculated with RF.*

Table 1: *Difference in quality between models with regionally constructed versus global PGA and geo-lithology maps[6]. The prediction accuracy and AUC were calculated with both regular (CV) and spatial (SCV) cross-validation.*

Model	CV				SCV			
	Acc.		AUC.		Acc		AUC	
LR	77.2	-1.2	85.1	-1.0	75.5	-0.9	82.4	-0.2
RF	81.2	-1.0	89.0	-1.4	74.2	-1.6	81.4	+0.1
SVM	87.7	-2.4	86.2	-1.2	75.6	-1.5	81.6	-0.9

4. Results

- No significant improvement was made for inventory sizes > 500 (***Figure 3***).
- Added value of more accurate covariates was limited (***Table 1***).
- The prediction rates showed the regional LSS models have a higher discriminatory power (***Figure 4***).

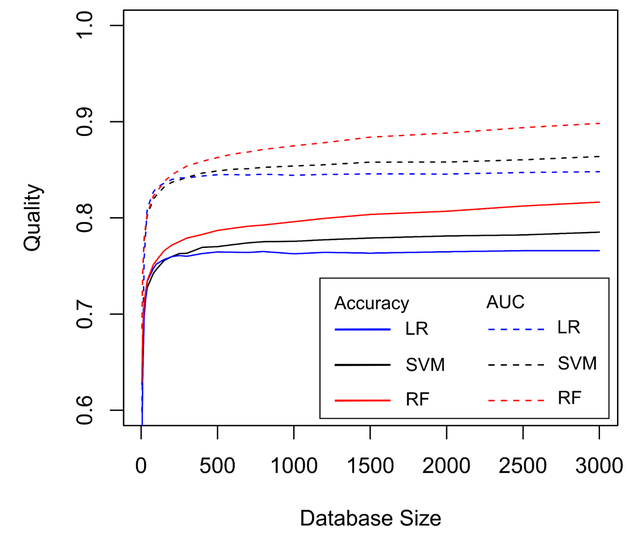

Figure 3: *Impact of the inventory size on the model prediction accuracy and AUC.*

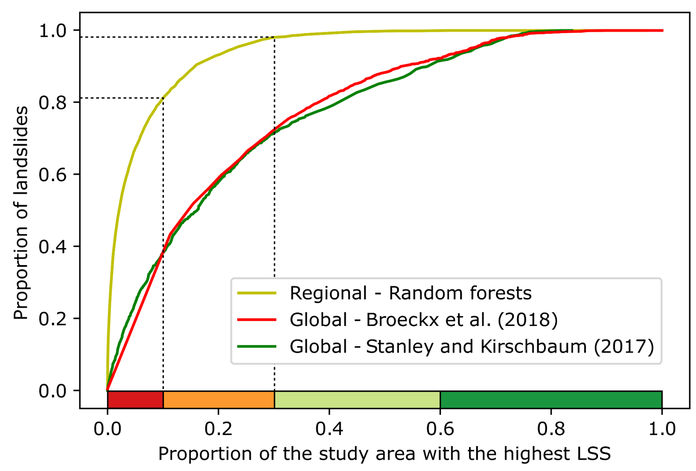

Figure 4: *Prediction rates for the regional RF model and two global models.*

5. Conclusions

- Global LSS helps to identify landslide-prone areas in the world.
- However, regional models have a higher performance.
- The difference in quality is caused by the use of a regional landslide inventory, not by the integration of more detailed variables.

Africa TERVUREN belspo PAStECA www.pasteca.africamuseum.be

6. References [1] Froude, MJ & Petley, DN (2018), *Natural Hazard and Earth System Sciences* [2] Walker, LR & Shiels, AB (2013), Landslide Ecology. Cambridge: *Cambridge University Press* [3] Souverijns, N *et al.* (2016), *Environmental Research Letters* [4] Monsieurs, E *et al.* (2018), *Geophysical Research Abstracts* [5] Monsieurs, E *et al.* (2017), *Landslides* [6] Delvaux, D *et al.* **(2017)**. *Journal of African Earth Sciences* [7] Broeckx, J *et al.* **(2018)**. *Earth-Science Reviews* [8] Stanley, T & Kirschbaum, DB **(2017)**. *Natural Hazards*