KU LEUVEN

Added value of regional landslide susceptibility analysis

the western branch of the East African Rift

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2. Efforts for regional LSS analysis
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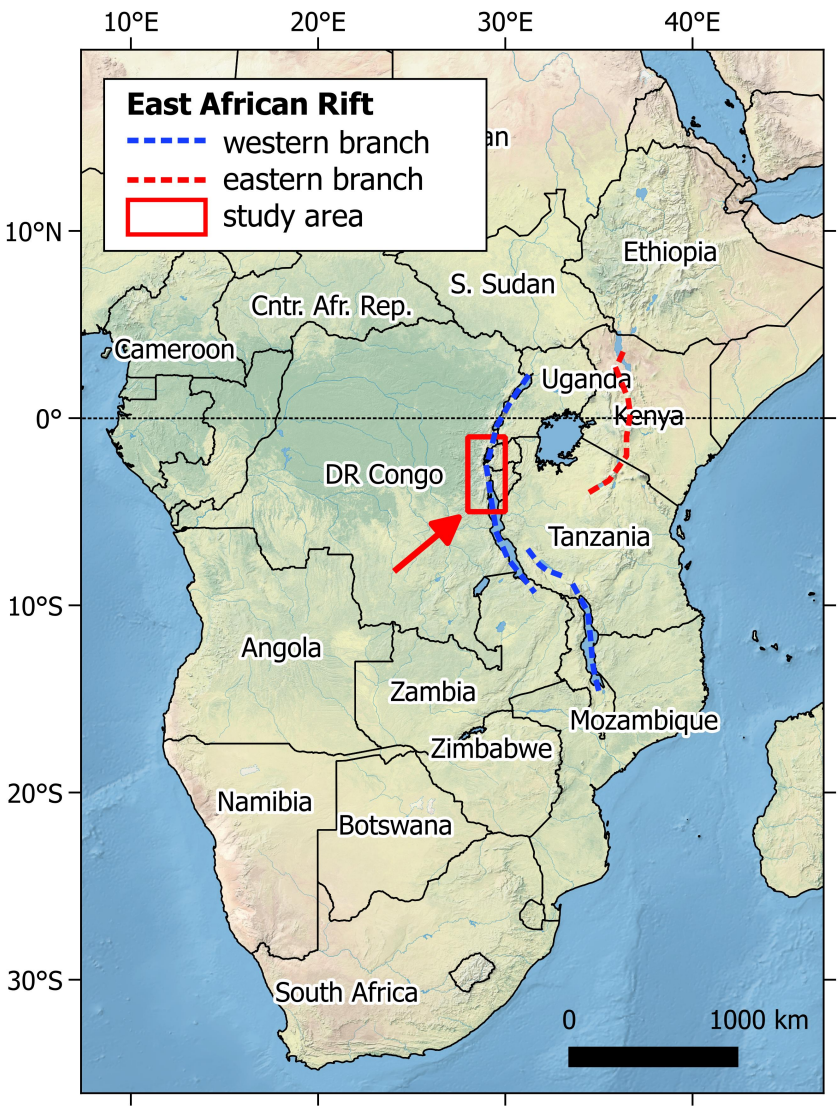
PAStECA

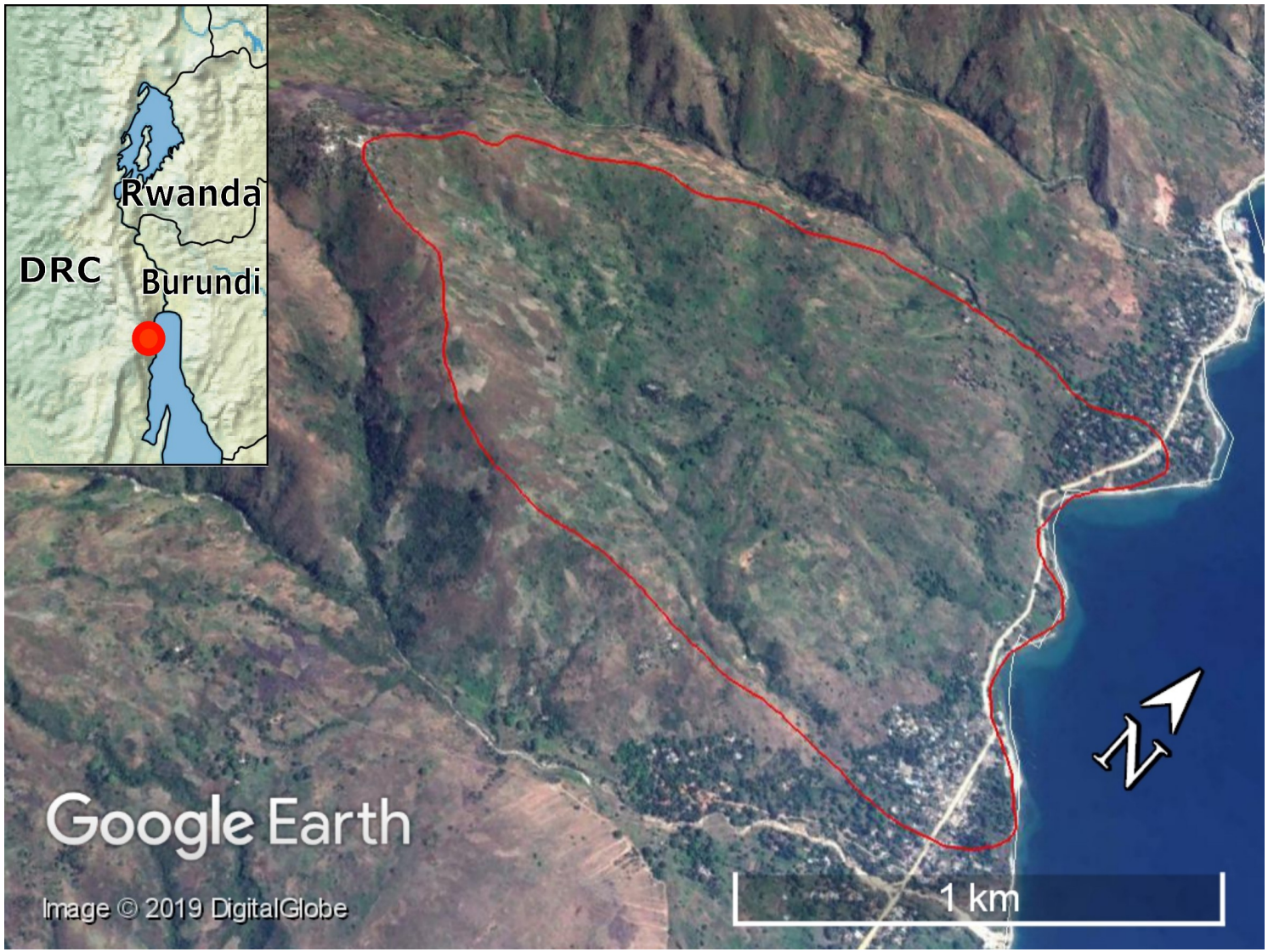
AFRICA museum

http://pasteca.africamuseum.be/

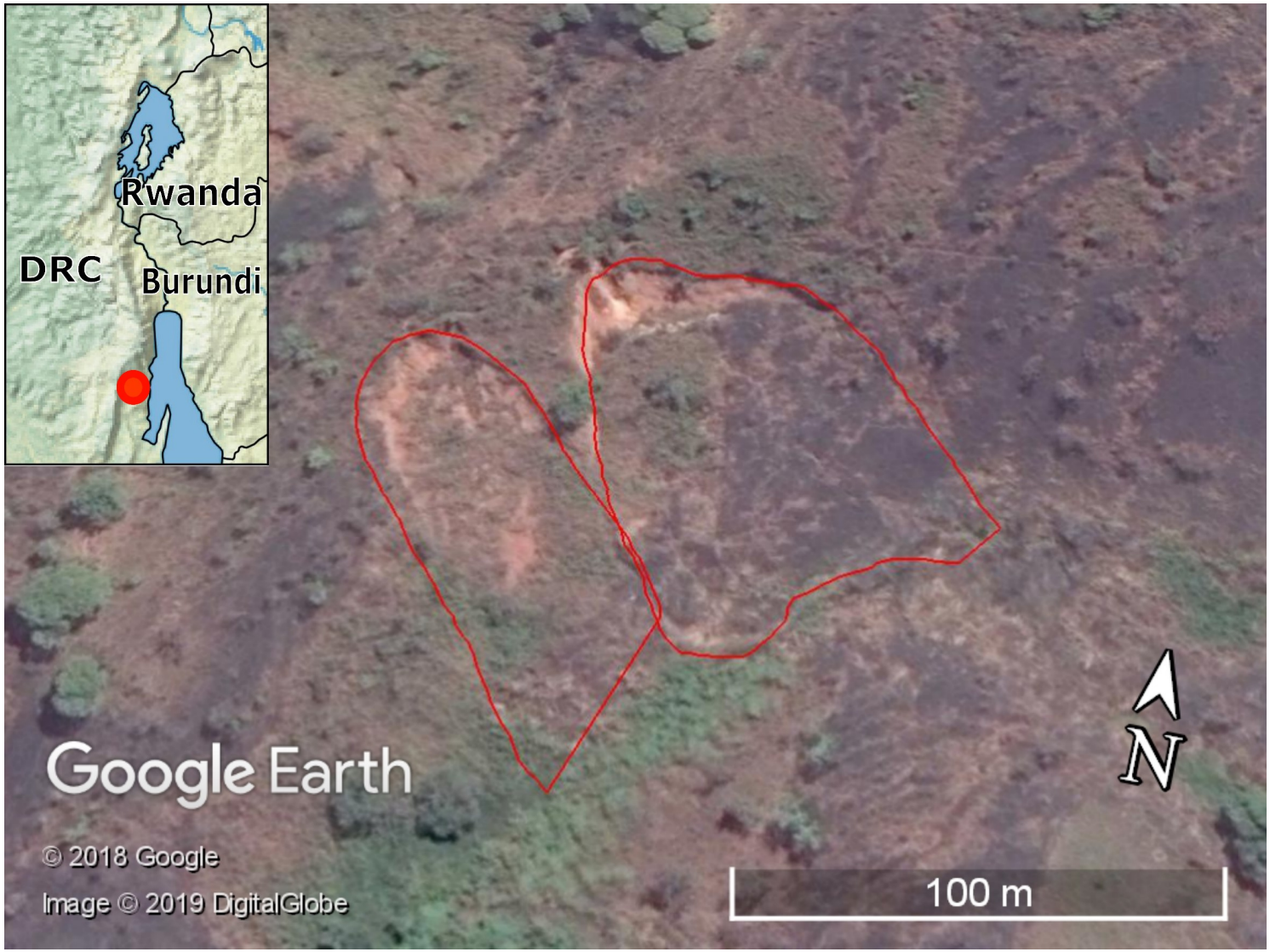
The western branch of the East African Rift



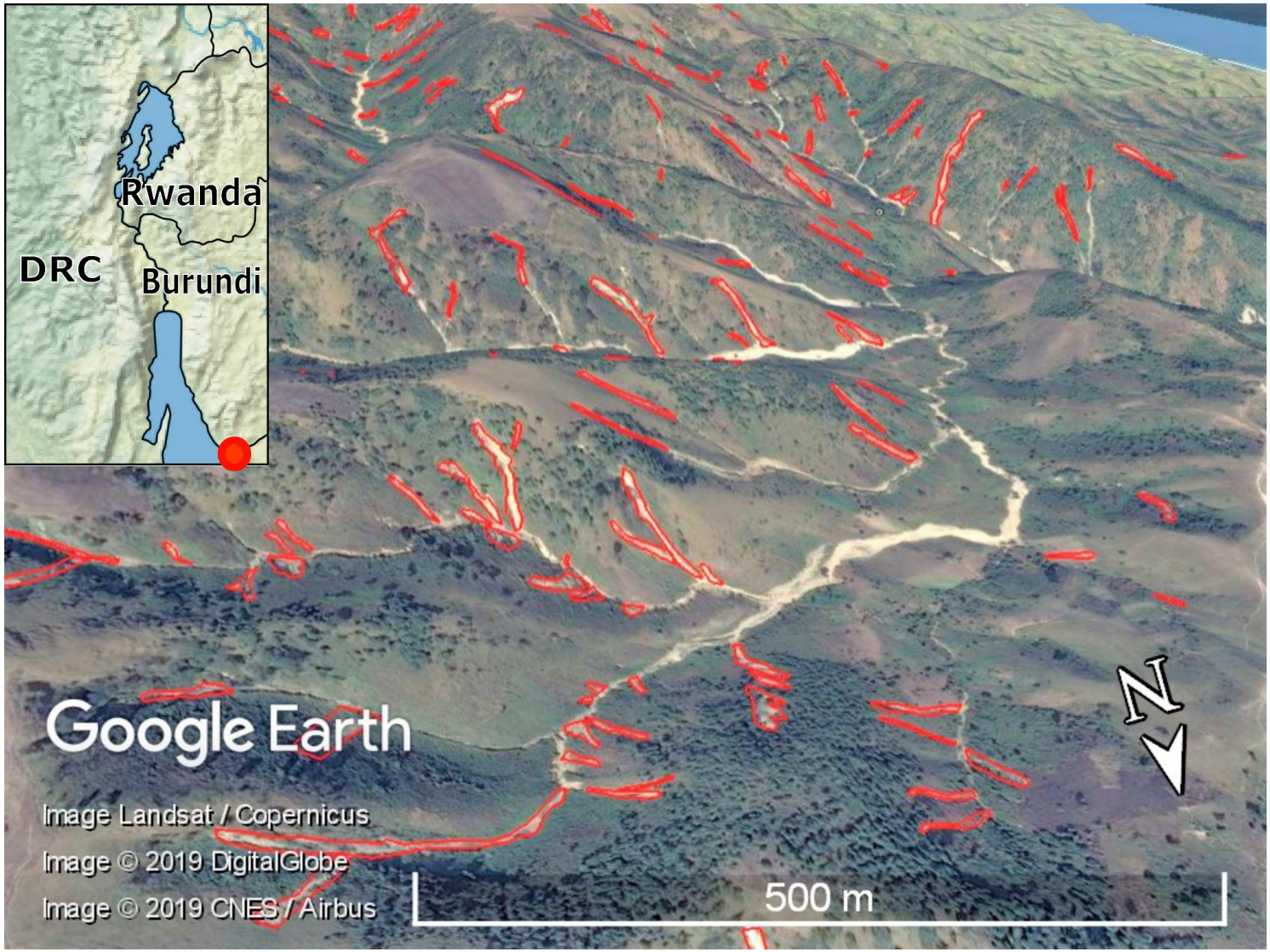
- Hazardous
  - earthquakes
  - active volcanism
  - floods
  - storms
  - . . . and landslides
- Explosive population growth
- Rapid land cover changes



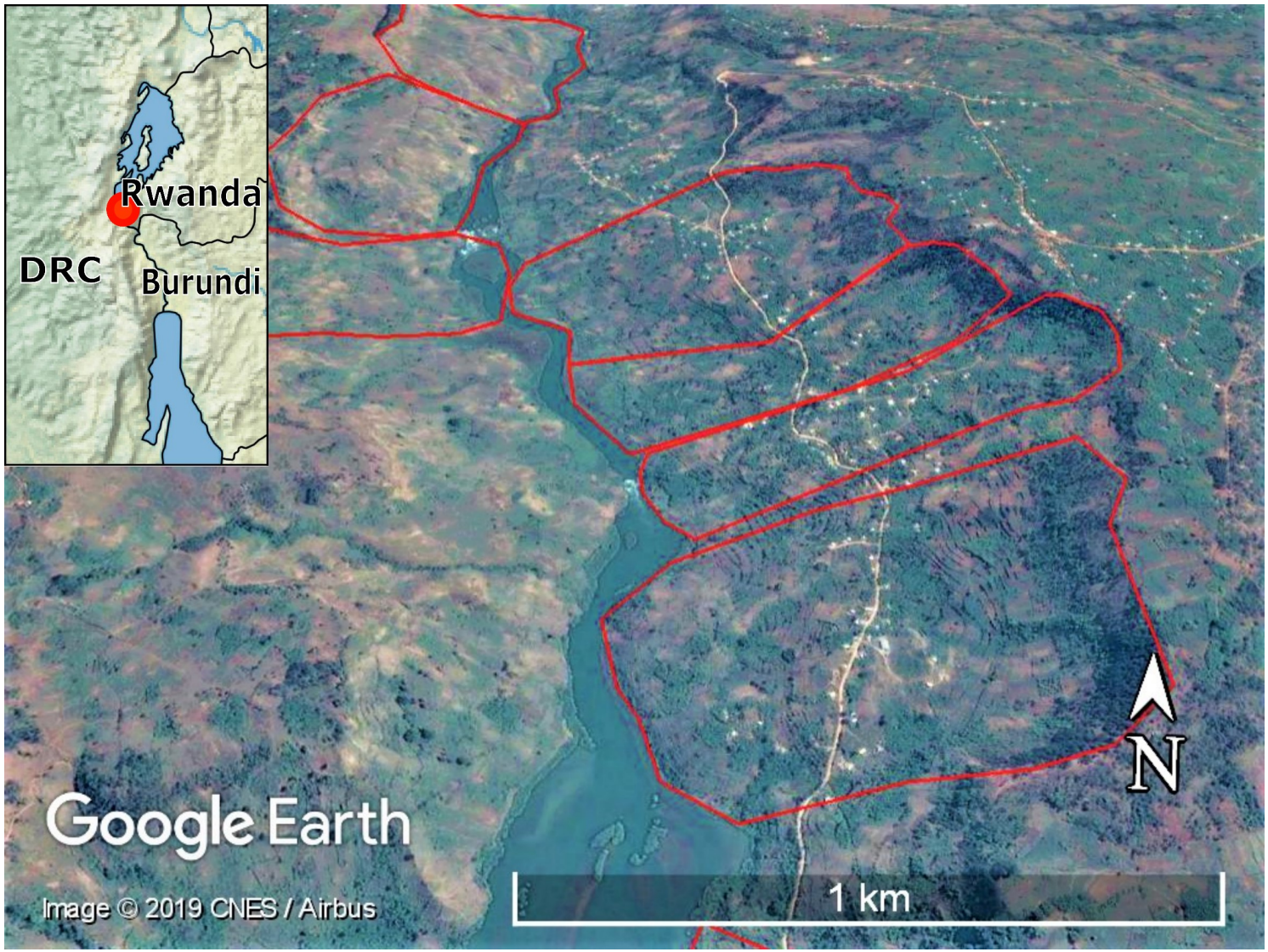
Old deep-seated landslide near Uvira, the DRC.



Rotational landslides near Katembo, the DRC.



Debris flows near Kalinzi, Tanzania.



Deep-seated rotational landslides near Bukavu, the DRC.

Debris slides in Bucyurabuhoro, Karongi District, Rwanda.

Need for a susceptibility analysis

- Rwanda 2018 (Jan – May)
  - 200 deaths
  - 9,974 houses
  - 4,500 ha crops

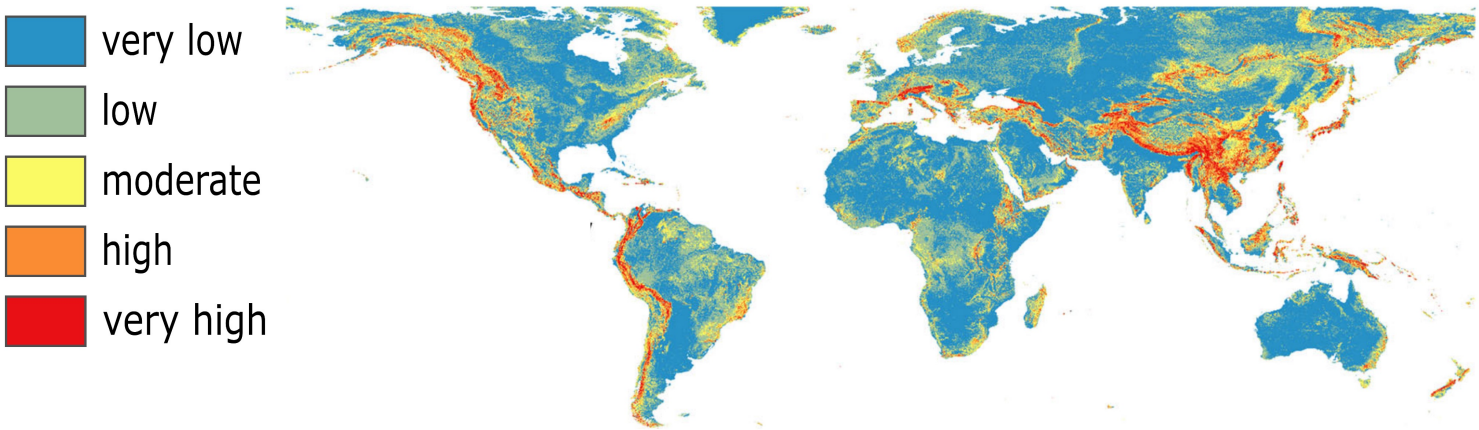
- *"We shall also relocate those living in high-risk zones"*

  – PM Ngirente

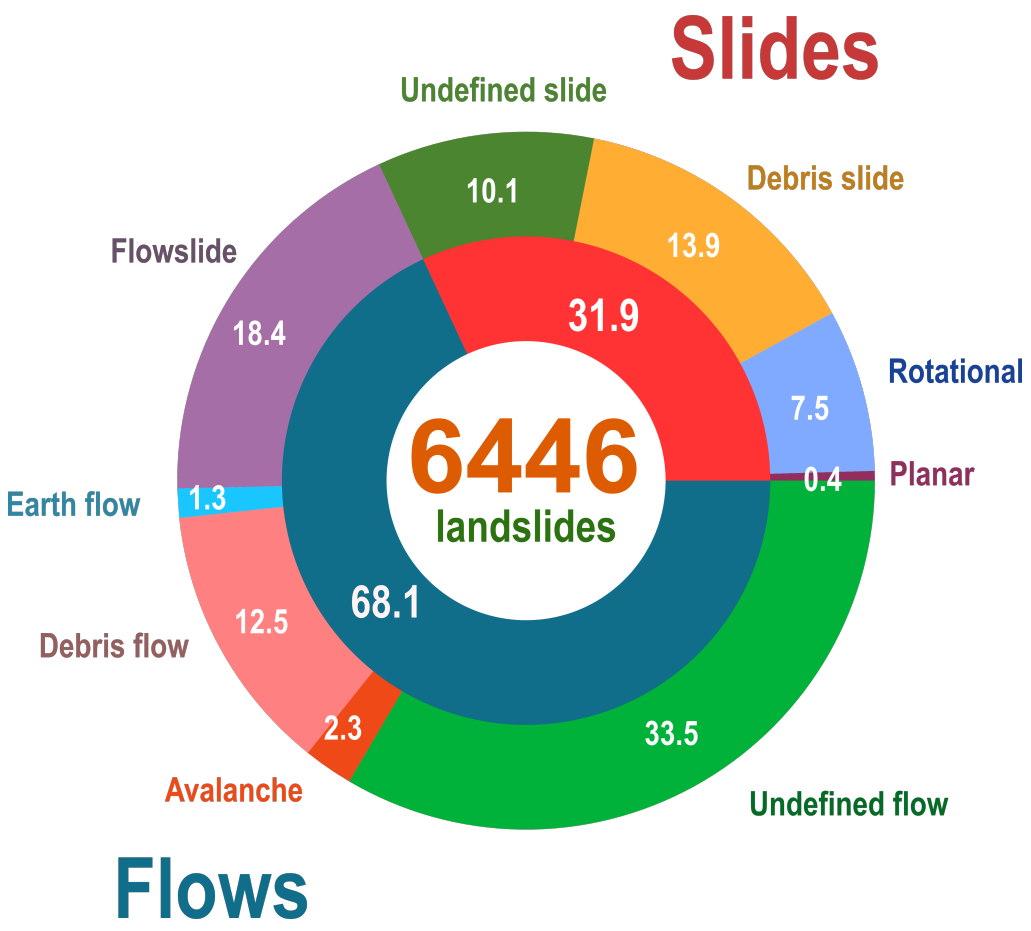
NEWS - NATIONAL

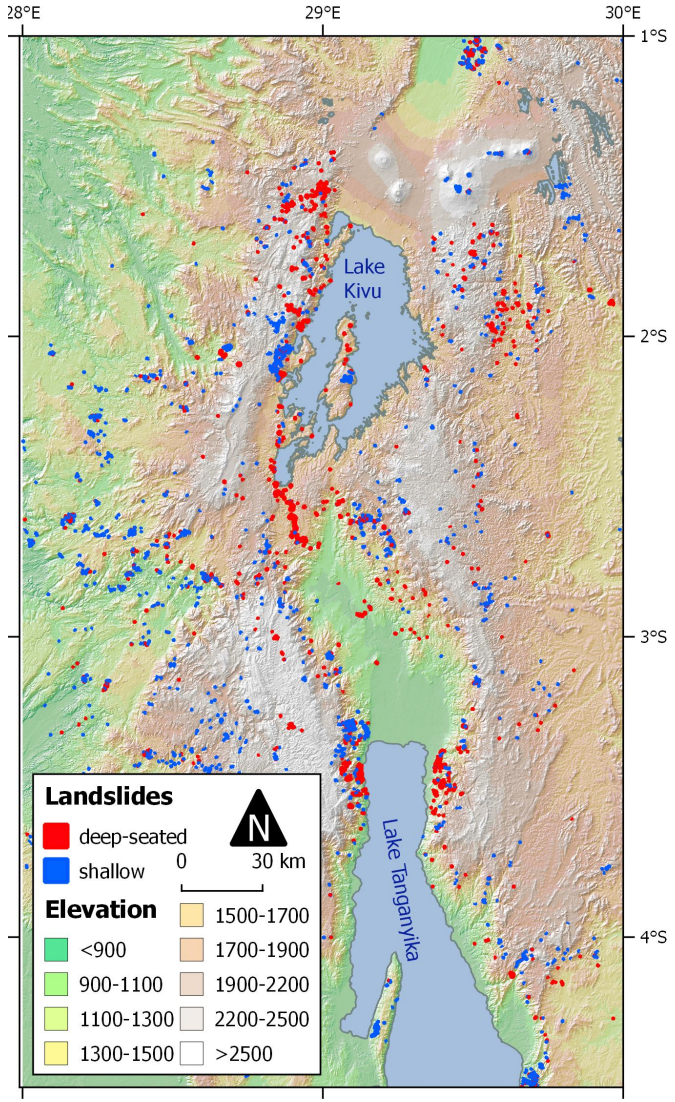
Grief And Horror As Landslide Victims Are Buried In Western Rwanda

Regional	Global/continental
+ high spatial resolution	– low spatial resolution
+ representative inventory	– global inventory
– labor-intensive	+ readily available
• inventory	
• regional covariates	



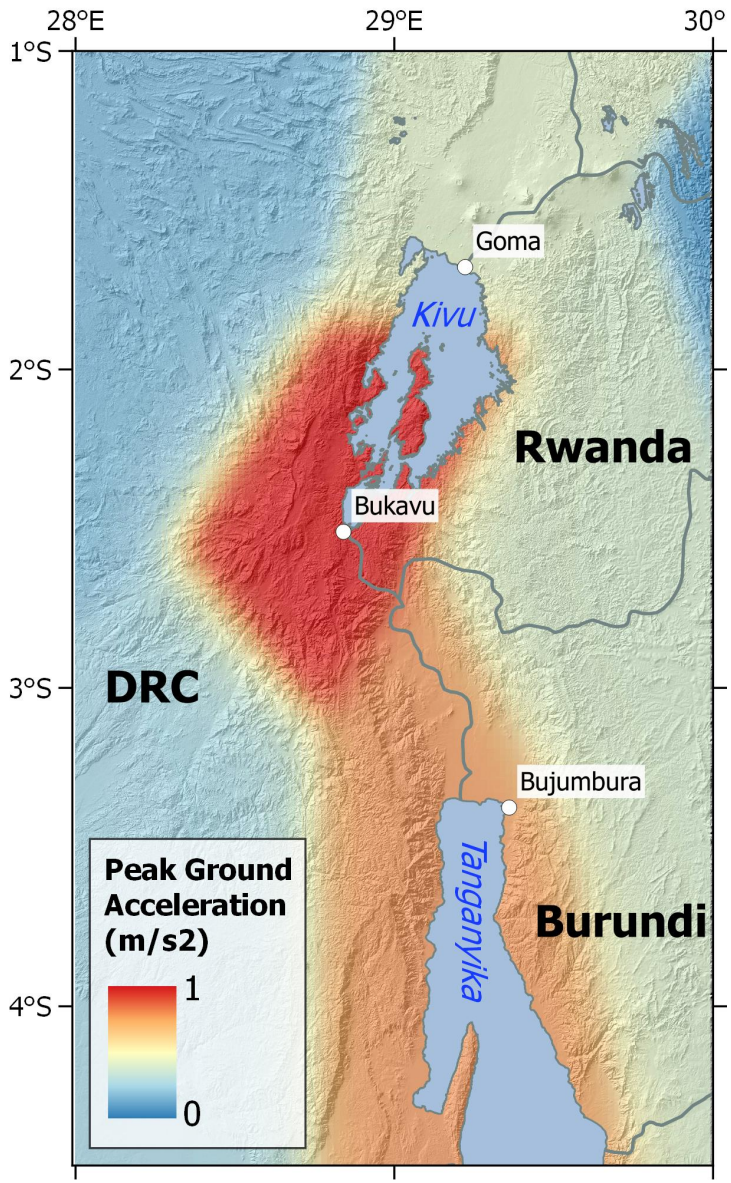
Stanley and Kirschbaum **(2017)** A heuristic approach to global landslide susceptibility mapping. *Natural Hazards*.


Slides
Undefined slide
10.1
Debris slide
13.9
Flowslide
18.4
31.9
Rotational
7.5
6446
landslides
Earth flow
1.3
0.4
Planar
68.1
12.5
Debris flow
2.3
33.5
Avalanche
Undefined flow
Flows

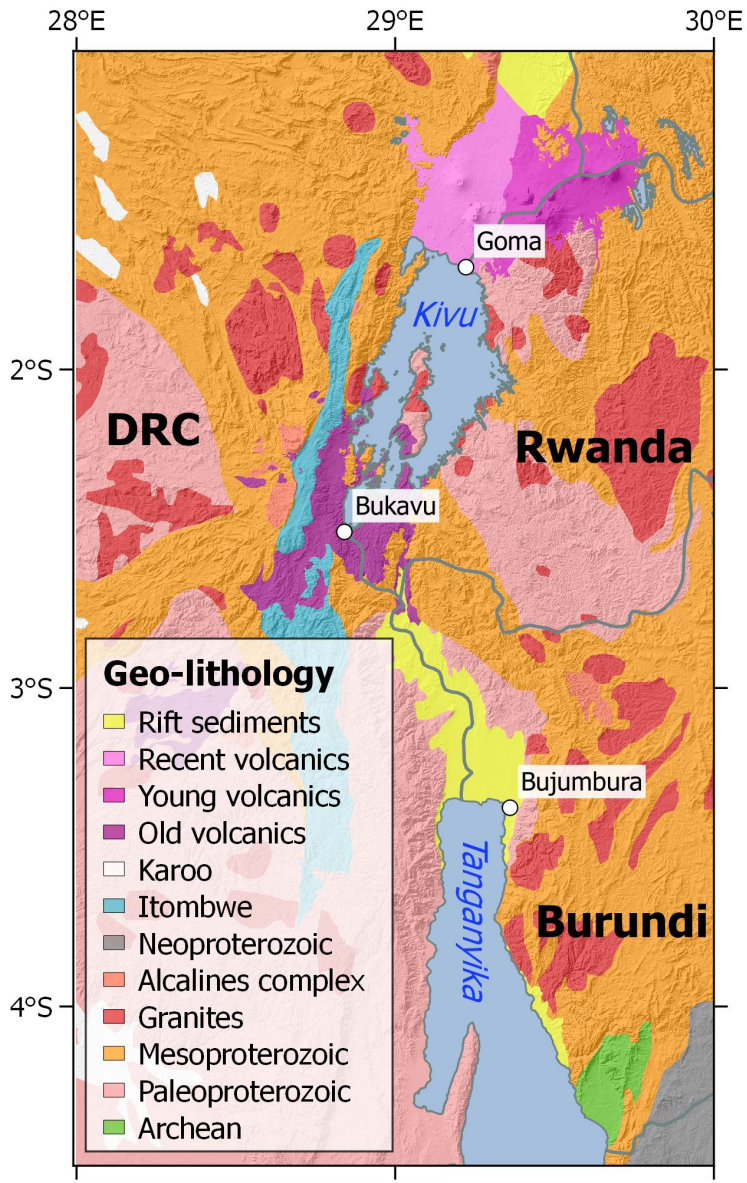

28°E
29°E
30°E
1°S
2°S
3°S
4°S
Lake Kivu
Lake Tanganyika
Landslides
deep-seated
shallow
N
0
30 km
Elevation
<900
900-1100
1100-1300
1300-1500
1500-1700
1700-1900
1900-2200
2200-2500
>2500

Theme	Predictor	Units	Res.	Source
Morphology	Slope	°	1”	SRTM
	North exposure	-	1”	
	East exposure	-	1”	
	Profile curvature	m^{-1}	1”	
	Planar curvature	m^{-1}	1”	
Hydrology	Distance to drainage	m	1”	
Land cover	Land cover	-	20 m	ESA CCI
Geology	Geo-lithology	-	1”	–
	Distance to active faults	m	1”	Smets et al. 2016; Delvaux et al. 2017
	PGA	$m\ s^{-2}$	2.2 km	Delvaux et al. 2017

- Regional peak ground accelaration model
- Regional geo-lithology map



a) Peak Ground Acceleration



b) Geo-lithology

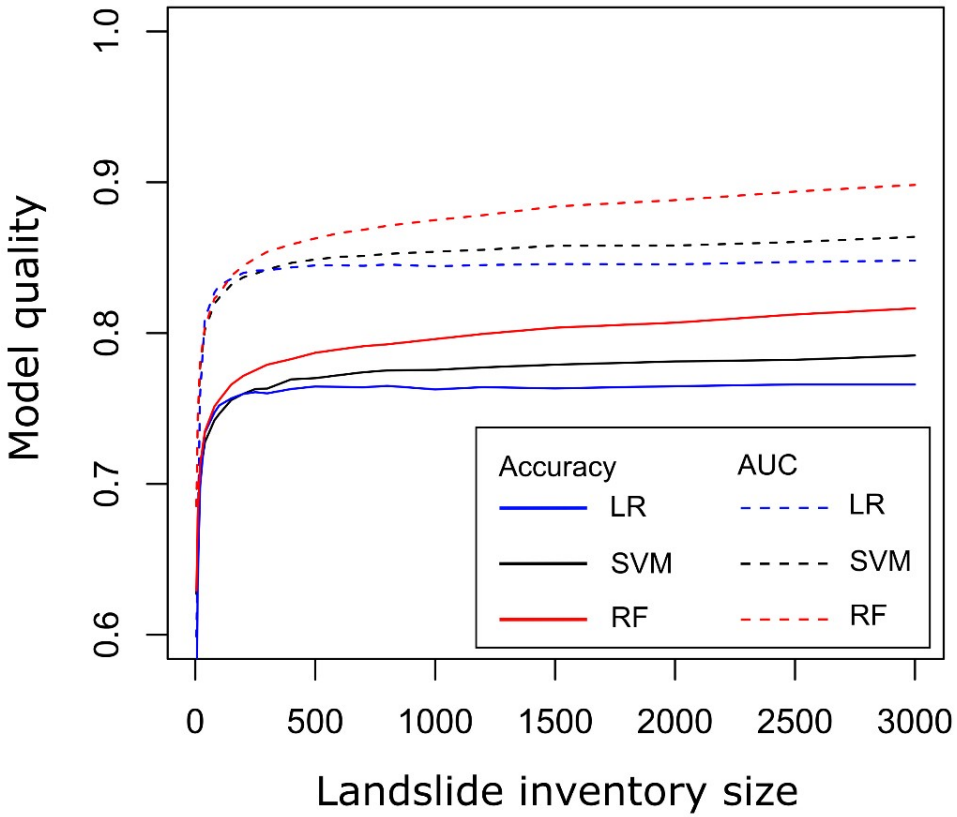
Central Question

Should we invest the effort **in** making a **regional susceptibility assessment** for data-scarce regions when global or continental models are available?

Contents

1. Relevance
2. **Efforts for regional LSS analysis**
   - **minimal inventory size**
   - **regional covariates**
3. Added value of regional LSS models

Inventory size



- Logistic regression (LR)
- Random forest (RF)
- Support vector machine (SVM)

Regional covariates

- How is the model quality affected by using global PGA and geo-lithology covariates?

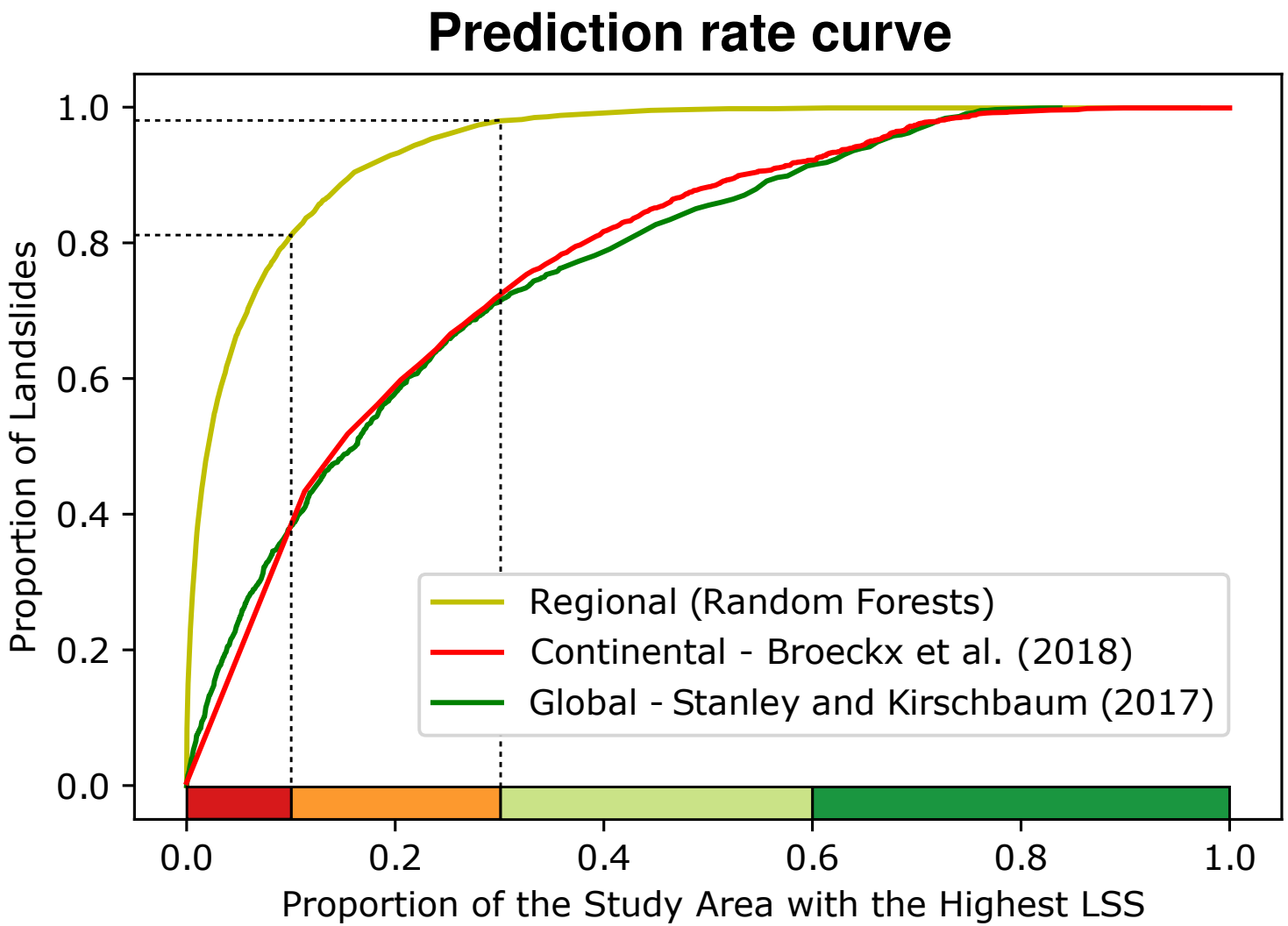
Model	Acc.	AUC
Logistic regression	77.2 $\downarrow -1.2$	85.1 $\downarrow -1.0$
Random forest	81.2 $\downarrow -1.0$	89.0 $\downarrow -1.4$
Support vector machine	78.7 $\downarrow -2.4$	86.2 $\downarrow -1.2$

Contents

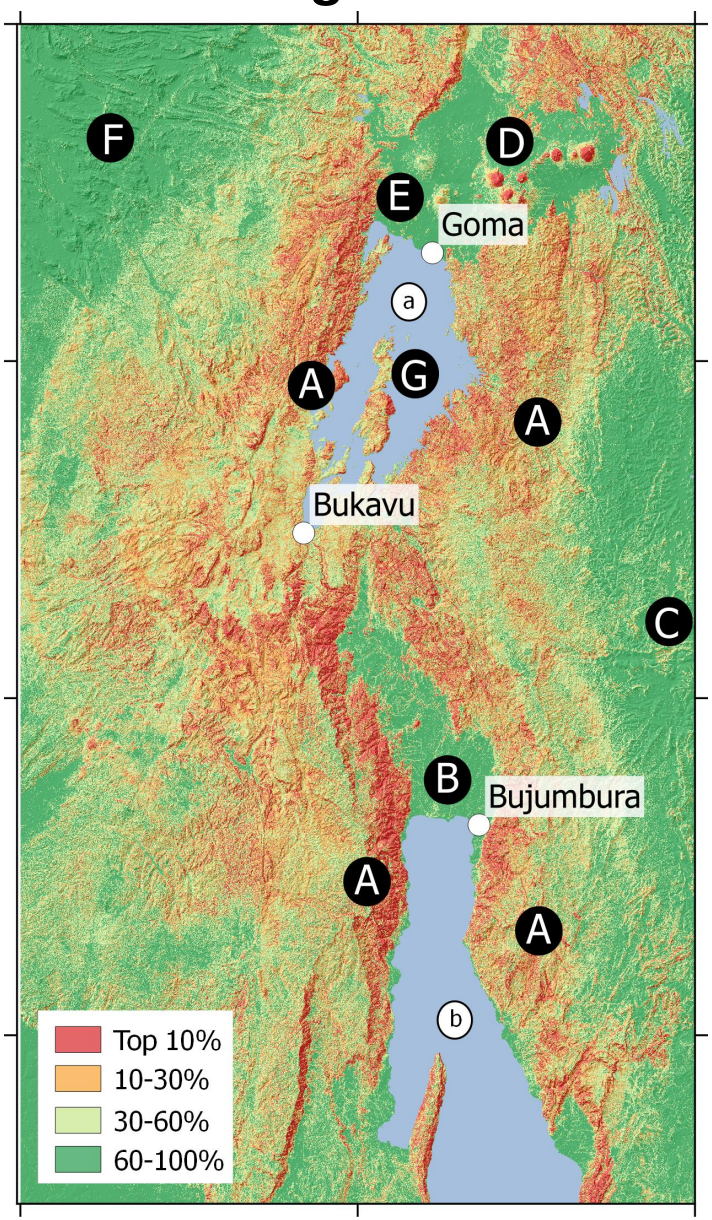
1. Relevance
2. Efforts for regional LSS analysis
3. **Added value of regional LSS models**
   - **model quality**
   - **plausibility**

Scale	Model	AUC
regional	Random forest	90.4
global	Stanley & Kirschbaum (2017)	74.1
continental	Broeckx et al. (2018)	74.8

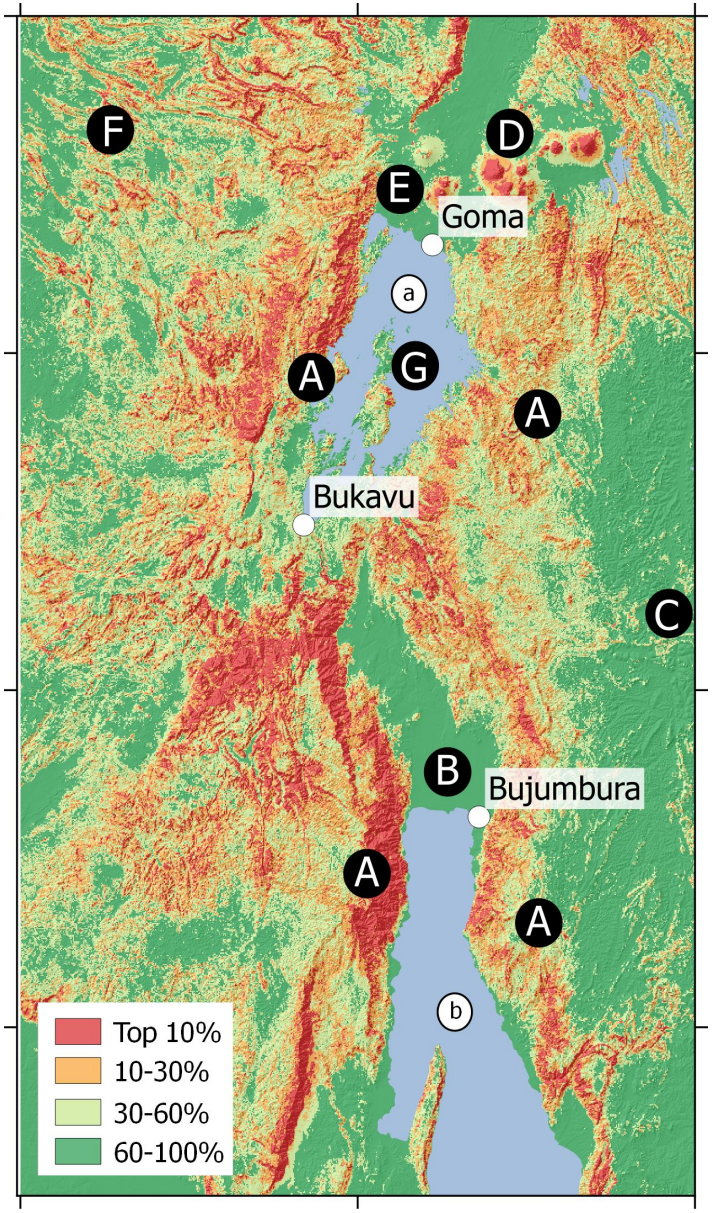
- Stanley & Kirschbaum **(2017)**. A heuristic approach to global land-slide susceptibility mapping. *Natura Hazards*.
- Broeckx et al. **(2018)**. A data-based landslide susceptibility map of Africa. *Earth-Science Reviews*.


Prediction rate curve
Proportion of Landslides
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Proportion of the Study Area with the Highest LSS
Regional (Random Forests)
Continental - Broeckx et al. (2018)
Global - Stanley and Kirschbaum (2017)

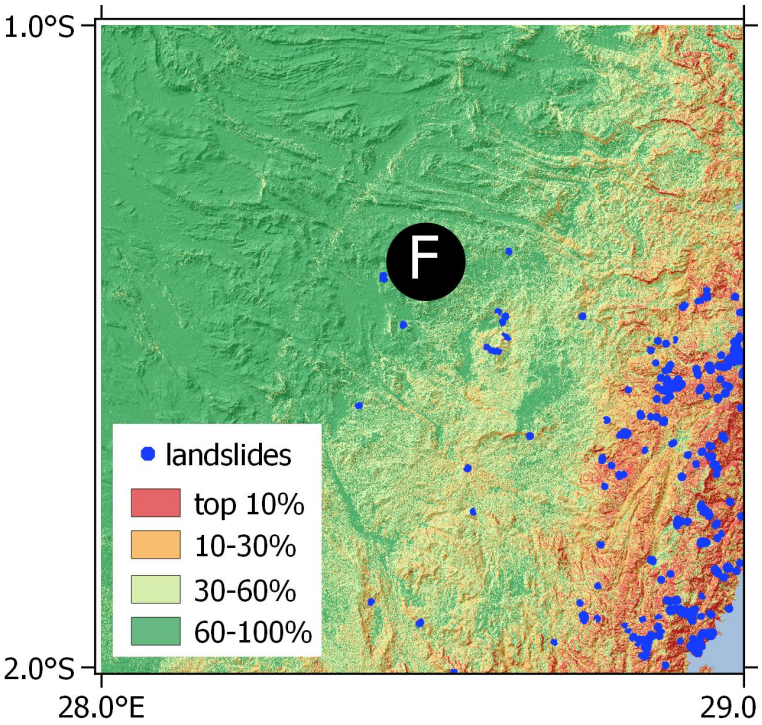
Regional



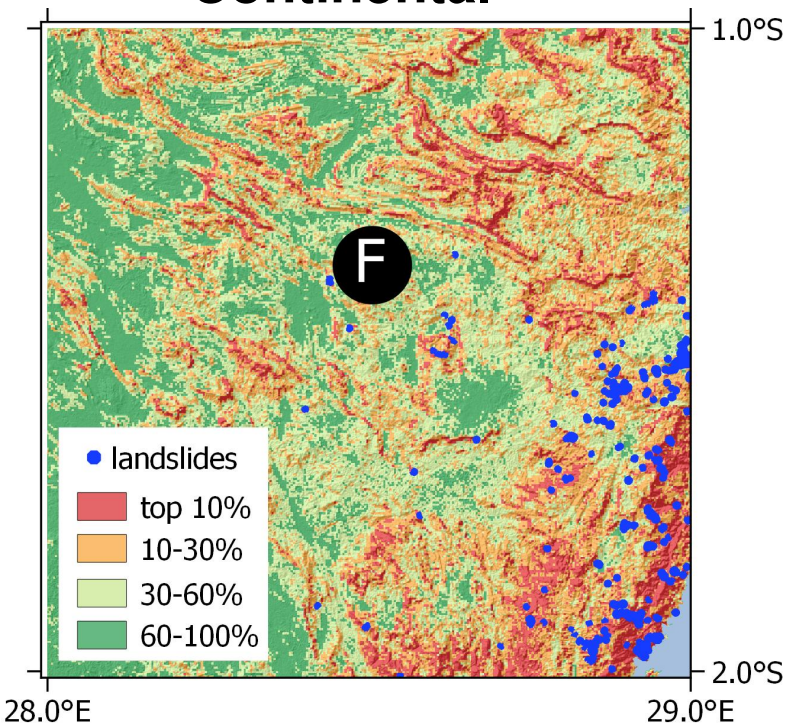
Continental

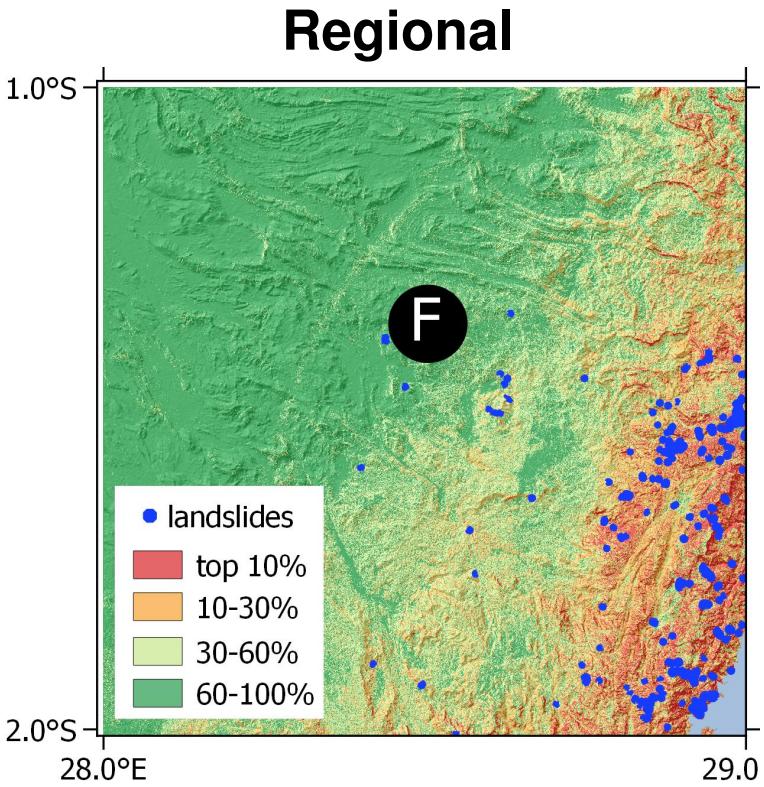


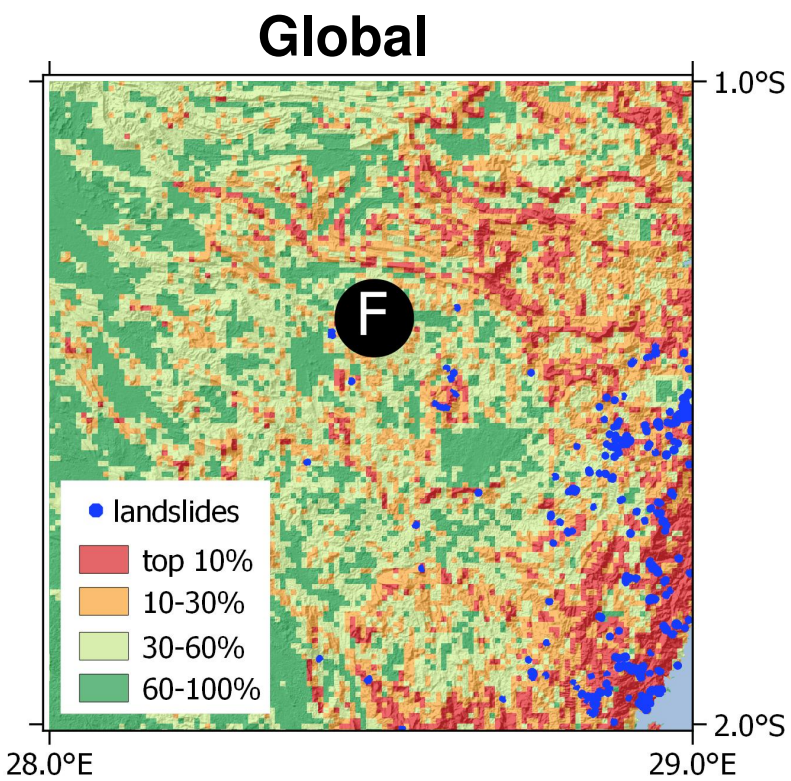
Regional



Continental




Regional
1.0°S
2.0°S
28.0°E
29.0
F
landslides
top 10%
10-30%
30-60%
60-100%


Global
1.0°S
2.0°S
28.0°E
29.0°E
F
landslides
top 10%
10-30%
30-60%
60-100%

Conclusion

- Efforts needed:
  - $\pm$500 landslides in inventory
  - openly available covariates can be used
- Added value of regional assessment:
  - much higher model quality
  - higher geomorphological plausibility

INVEST IN YOUR INVENTORY!!

(But not too much)

Questions?