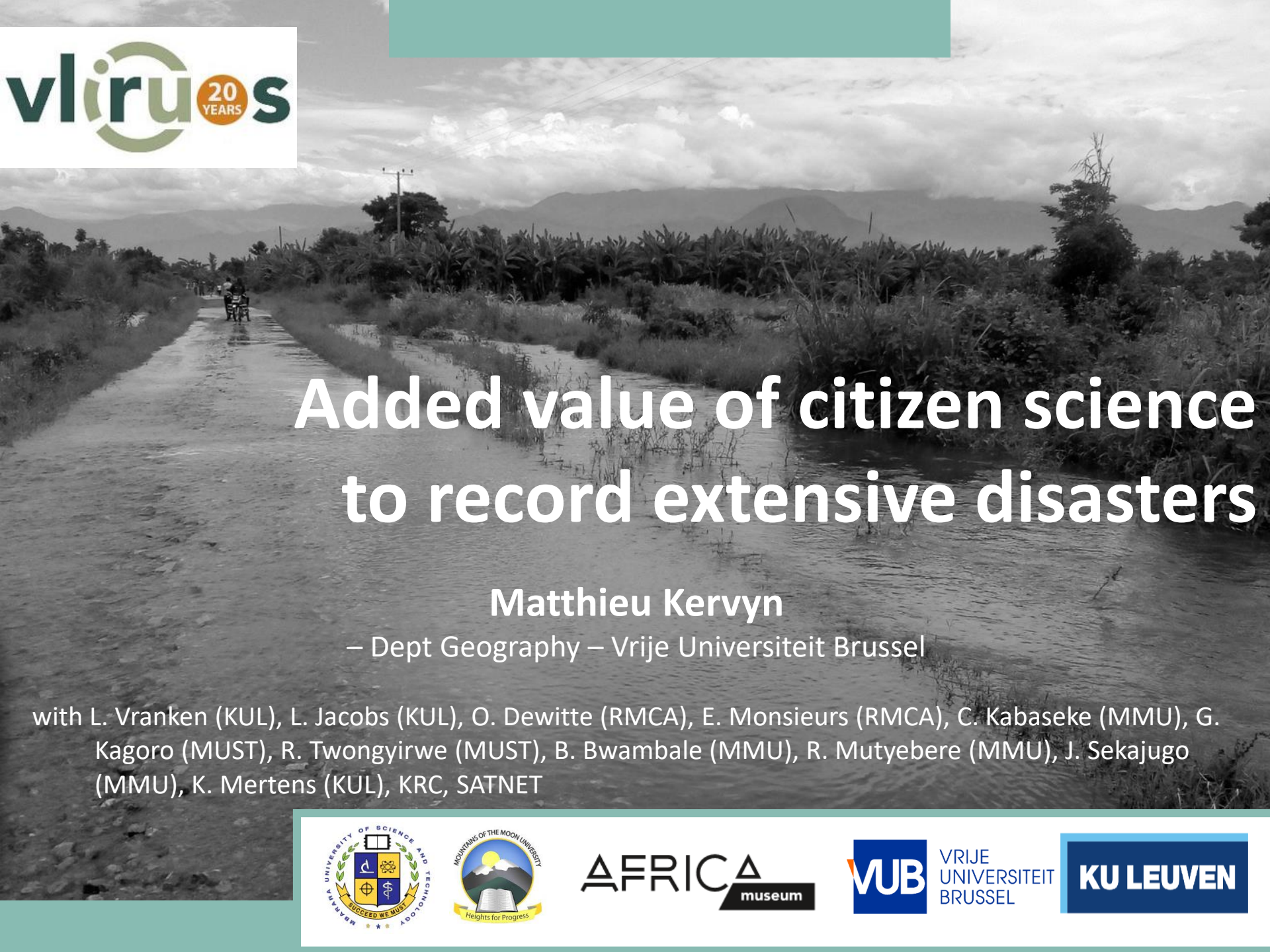


Added value of citizen science to record extensive disasters

Matthieu Kervyn
– Dept Geography – Vrije Universiteit Brussel

with L. Vranken (KUL), L. Jacobs (KUL), O. Dewitte (RMCA), E. Monsieurs (RMCA), C. Kabaseke (MMU), G. Kagoro (MUST), R. Twongyirwe (MUST), B. Bwambale (MMU), R. Mutyebere (MMU), J. Sekajugo (MMU), K. Mertens (KUL), KRC, SATNET

EXTENSIVE DISASTERS ?

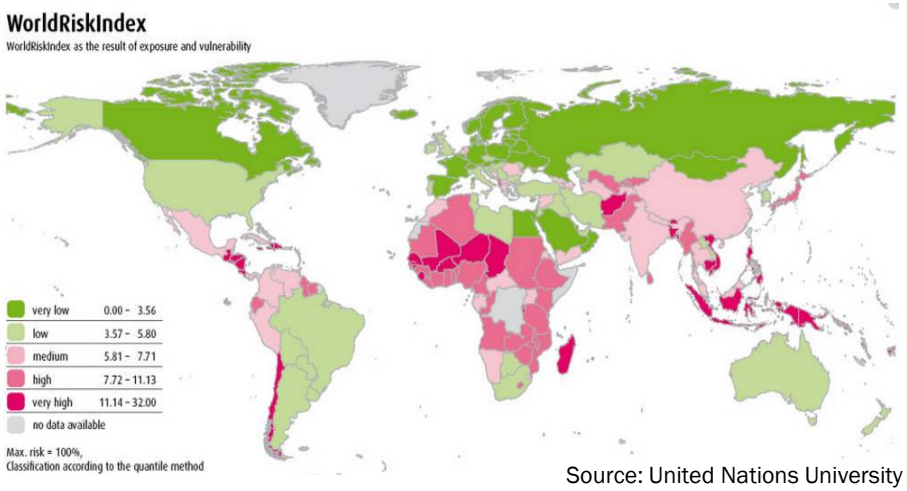
low-severity, high-frequency hazardous events

highly localized hazards

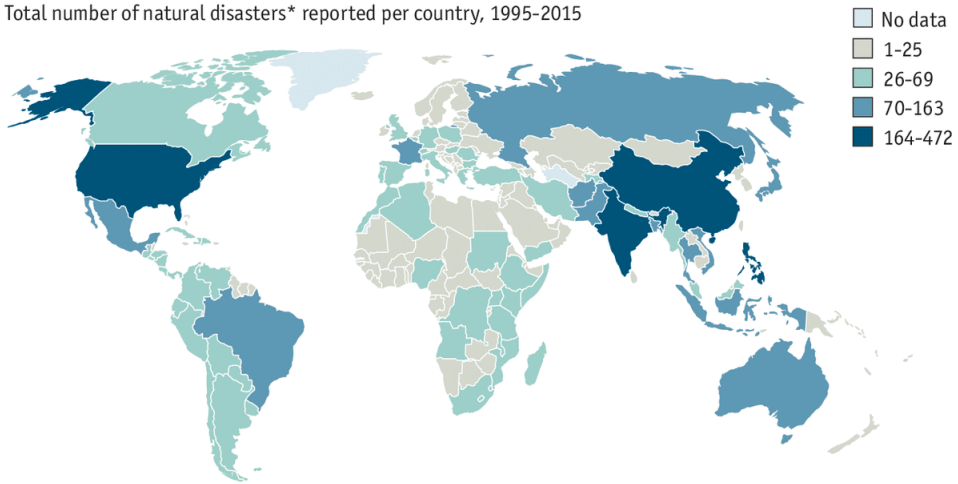
typically flash floods and landslides in mountainous terrains

absent of databases with high entry criteria; but significant cumulated impacts

NATURAL HAZARDS/RISK IN THE GLOBAL SOUTH



Source: United Nations University



Source: UNISDR

*Hydrological, climatological and meteorological

5x more fatalities in low income countries

25x larger impact of weather-related disasters in low-income countries

40% economic loss is due to extensive risk

? underreporting of disasters, blind-spot in disaster research

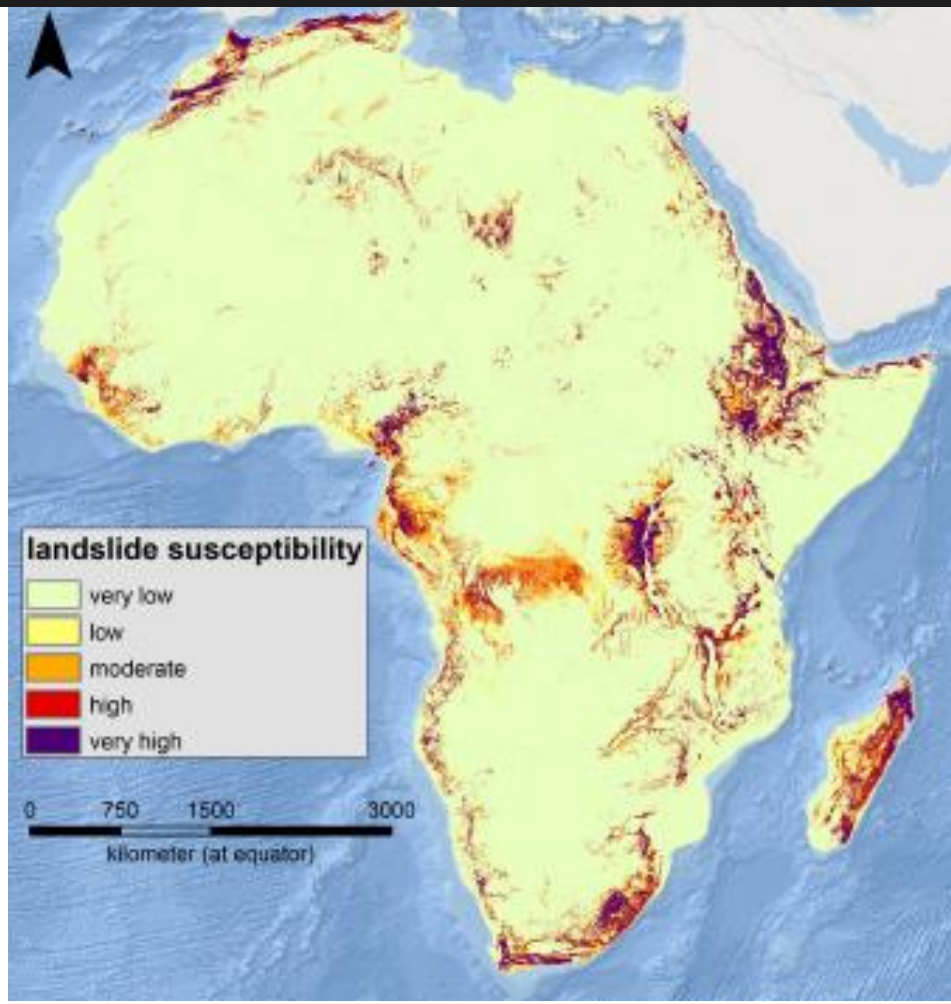
EXTENSIVE DISASTERS in CENTRAL AFRICA

Rapidly increasing & vulnerable populations

High susceptibility to landslides along East African Rift

High mortality per disaster in low income countries

Global blindspot for landslide hazard and risk studies



(Broeckx et al. 2018)

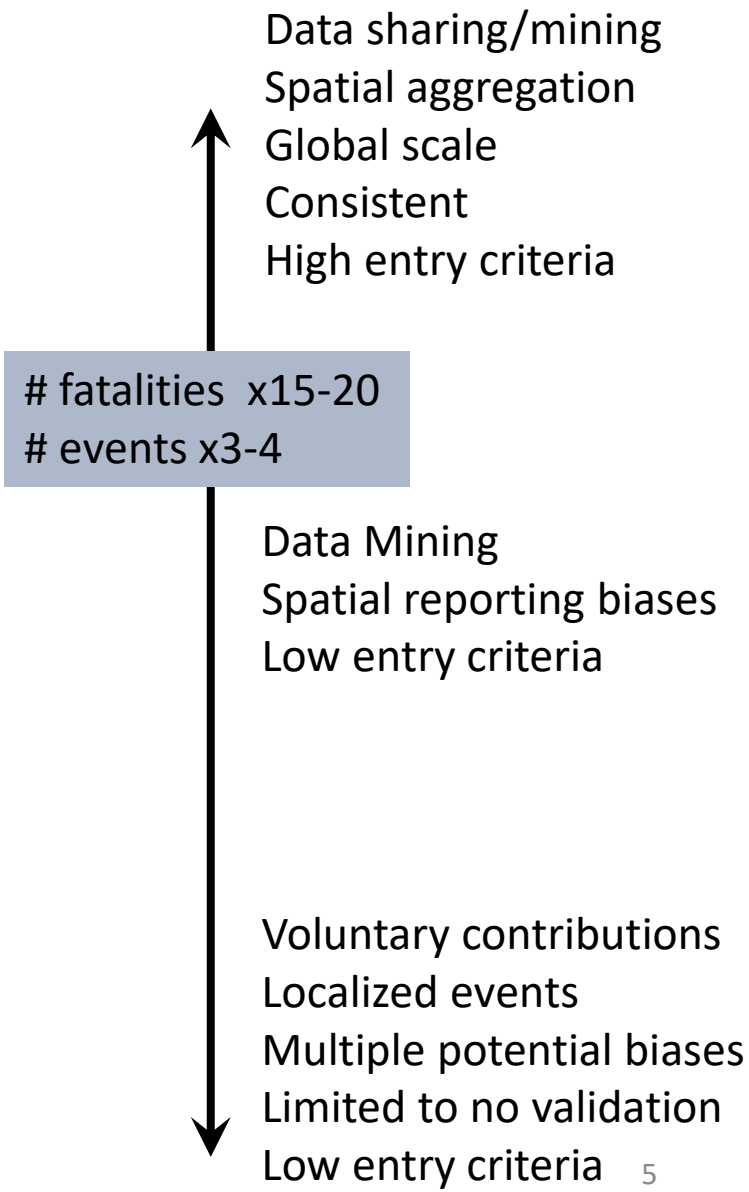
What hazards? Where? When?
What impacts? Why?

DISASTER DATA SOURCES for LANDSLIDES

- EM-DAT
- DFLD – Durham Fatal Landslide Database
  (Froude & Petley 2018)
- Global Landslide Catalogue (NASA)

⇒Cooperative Open Online Landslide Repository
(Juang et al. 2019)

- DesInventar - National databases
- Regional to sub-national crowd-sourcing databases
- Social media

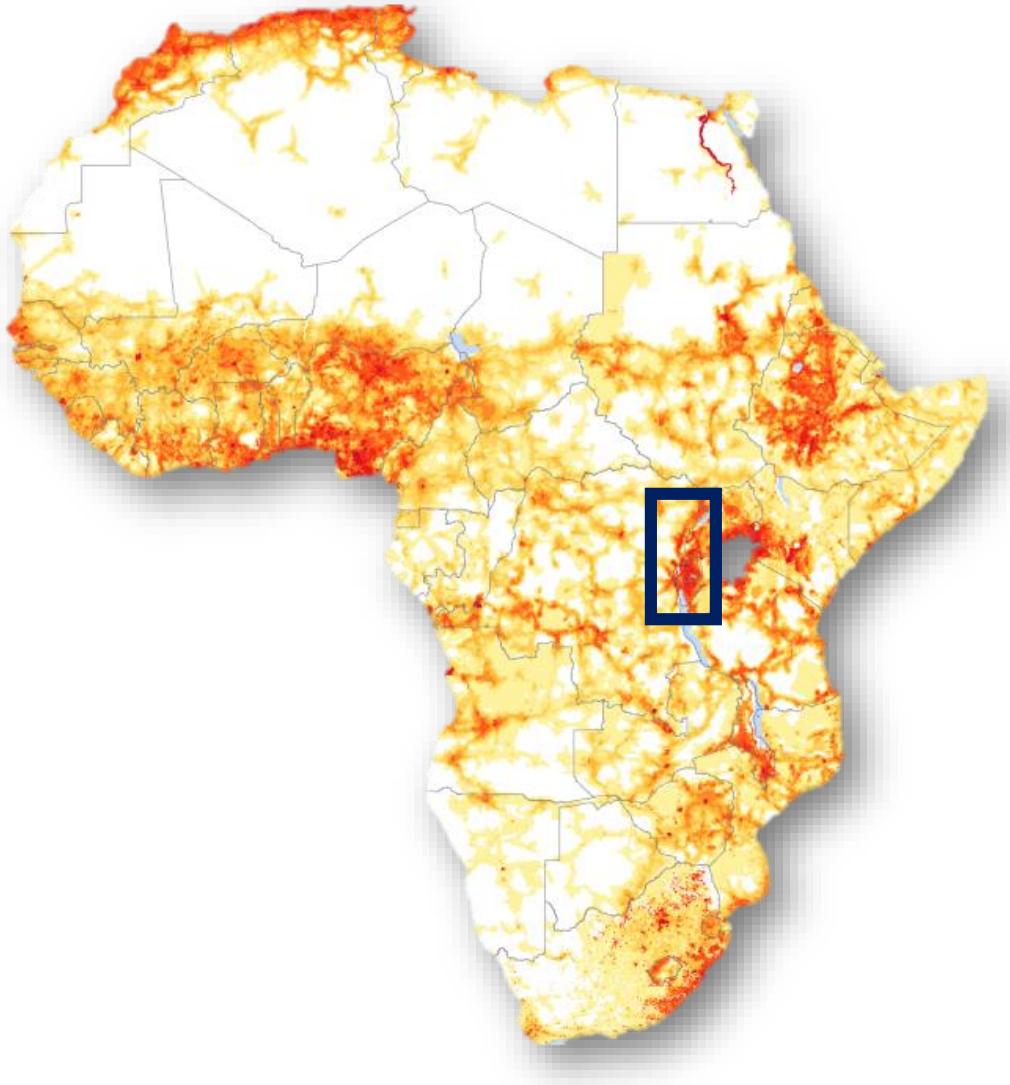


Very prone to (multi)- hazards

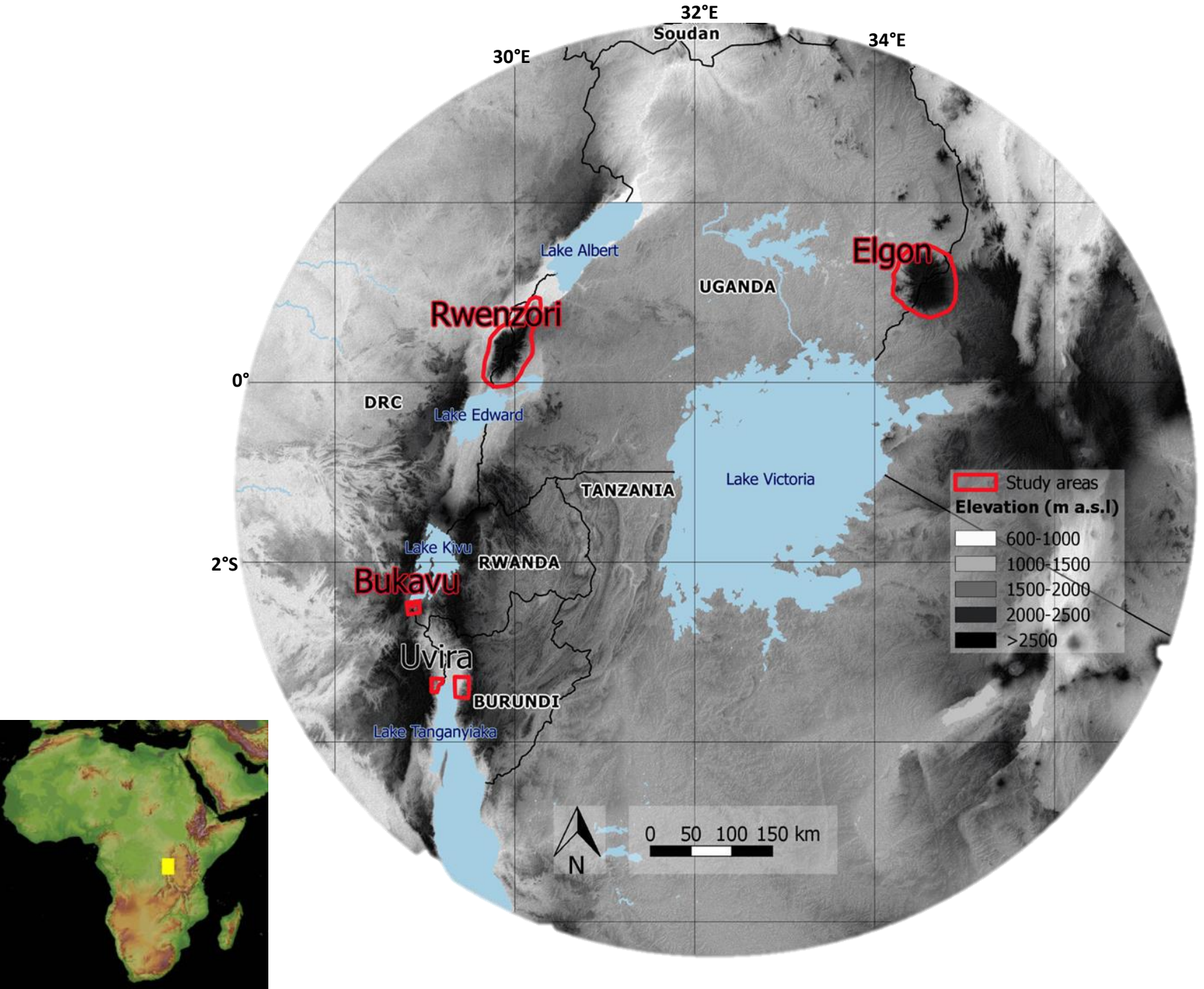
high population density and vulnerability

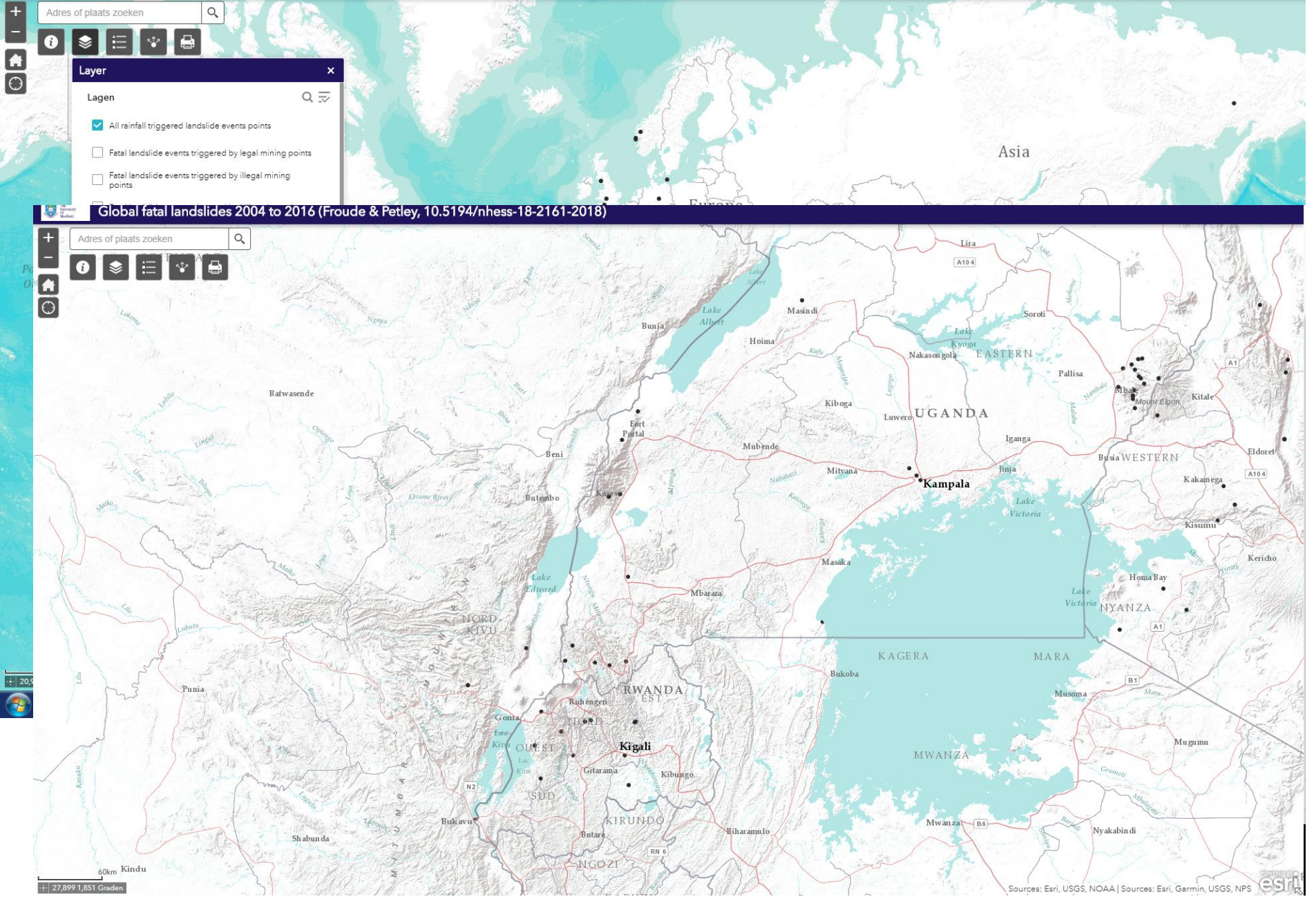
No centralized database/information

Our study area: Kivu & Rwenzori Mountains:



STUDY AREA

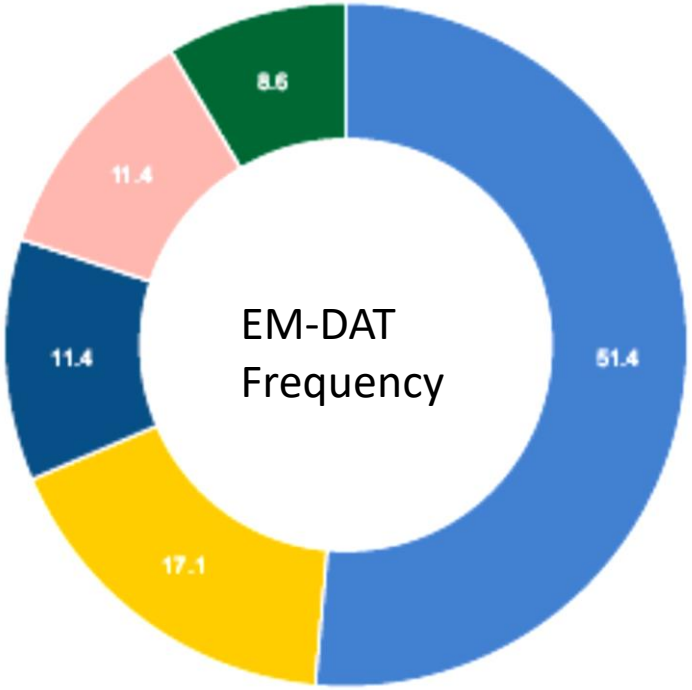

32°E
Soudan
34°E
30°E
Lake Albert
Elgon
UGANDA
Rwenzori
0°
DRC
Lake Edward
Lake Victoria
TANZANIA
Study areas
Elevation (m a.s.l)
600-1000
1000-1500
1500-2000
2000-2500
>2500
Lake Kivu
RWANDA
2°S
Bukavu
Uvira
BURUNDI
Lake Tanganyiaka
N
0 50 100 150 km

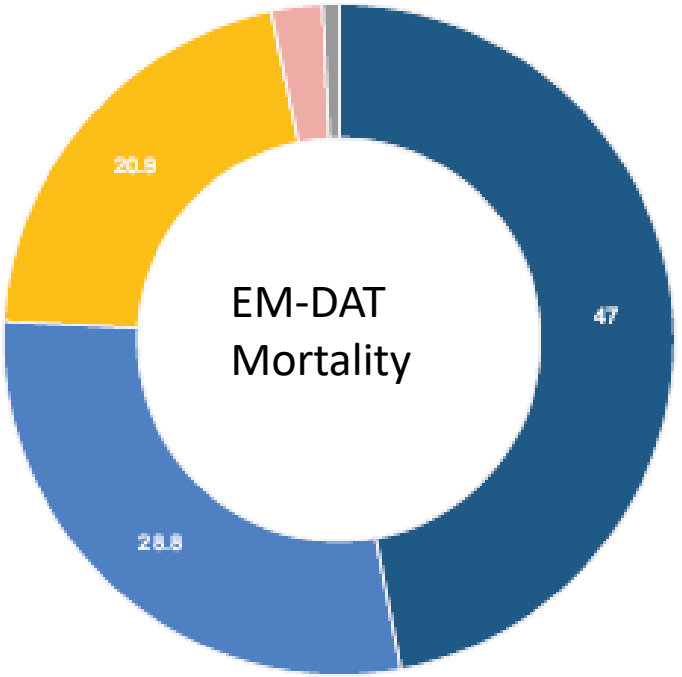


DFLD – Durham Fatal Landslide Database

(Froude & Petley 2018)

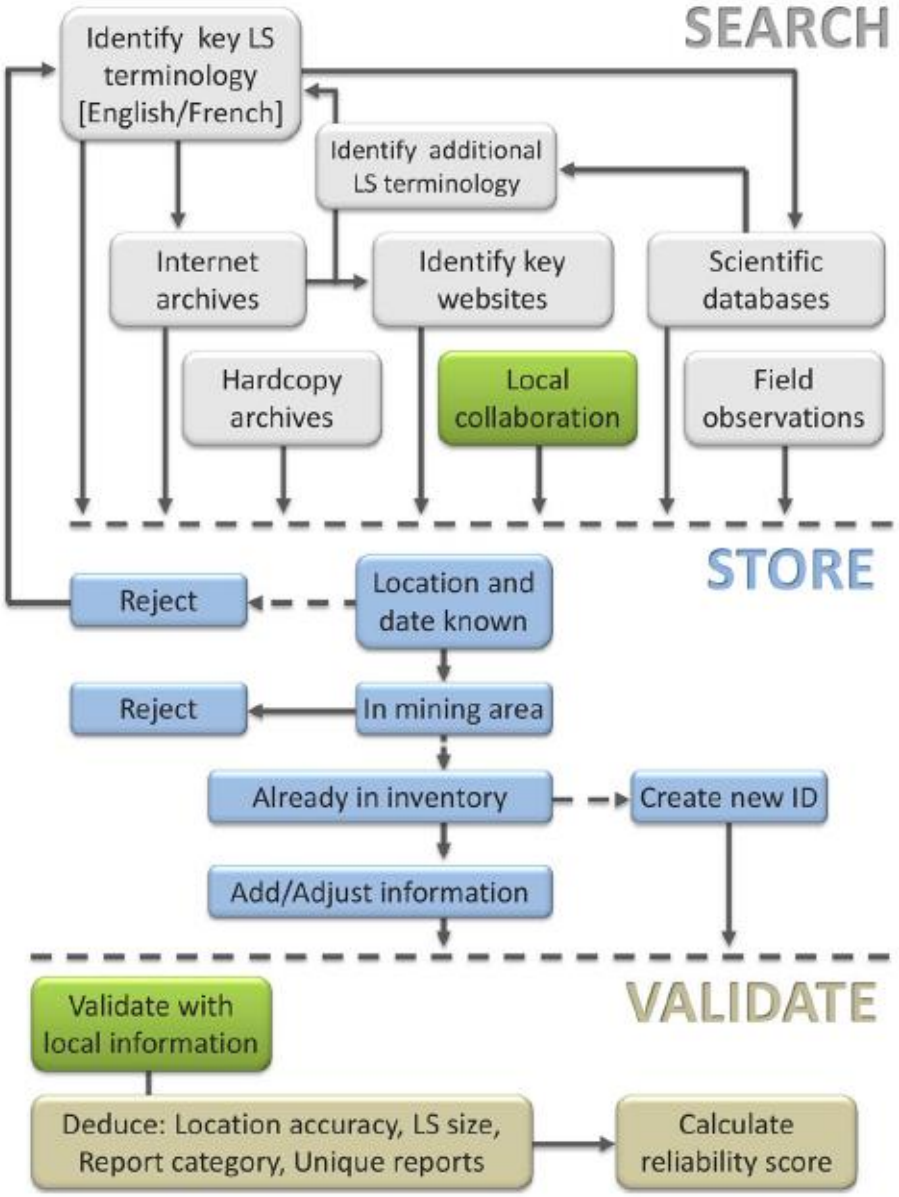
Disaster Statistics in Uganda:

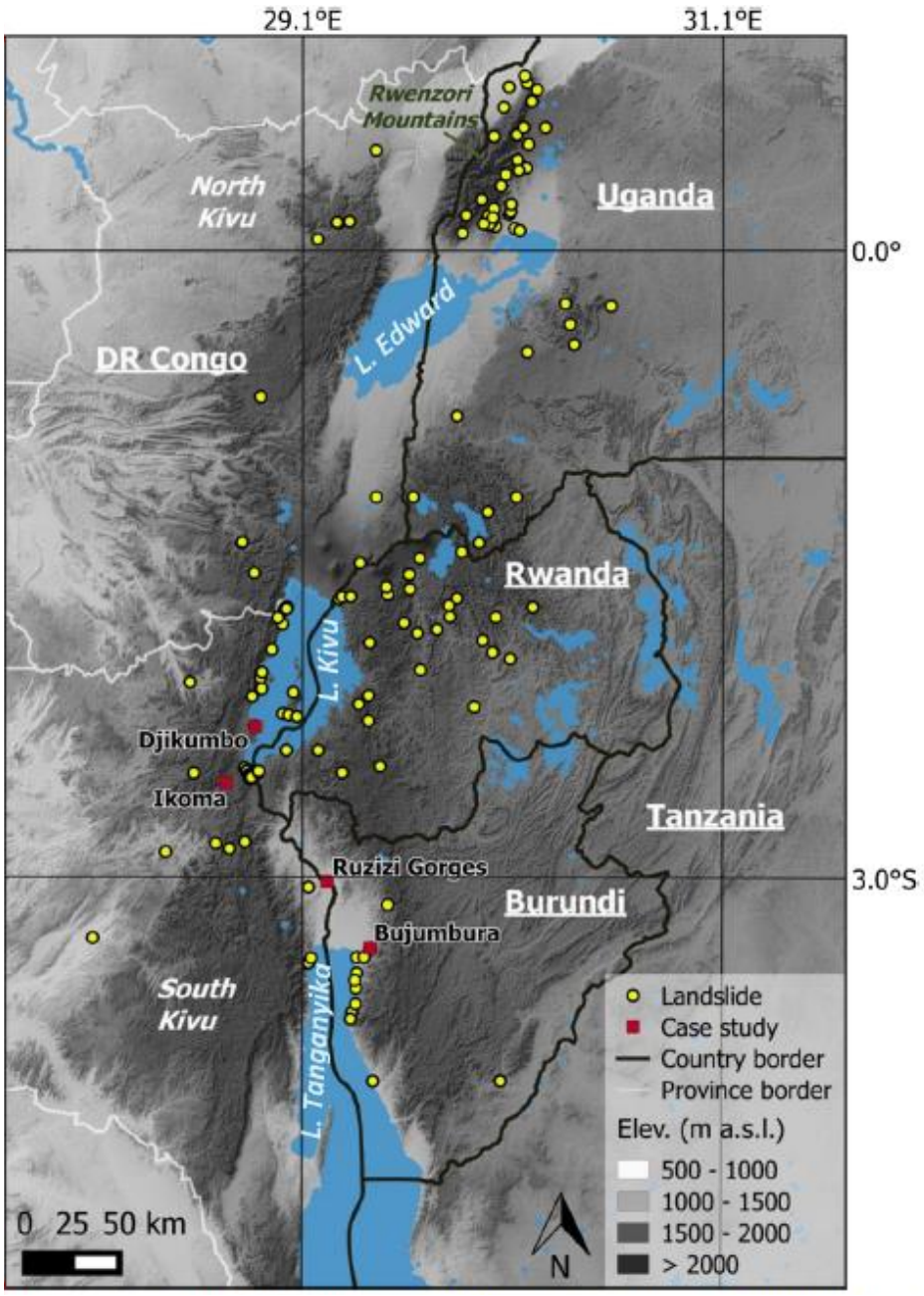




Bududa District, Eastern Uganda, 2012
Daily monitor

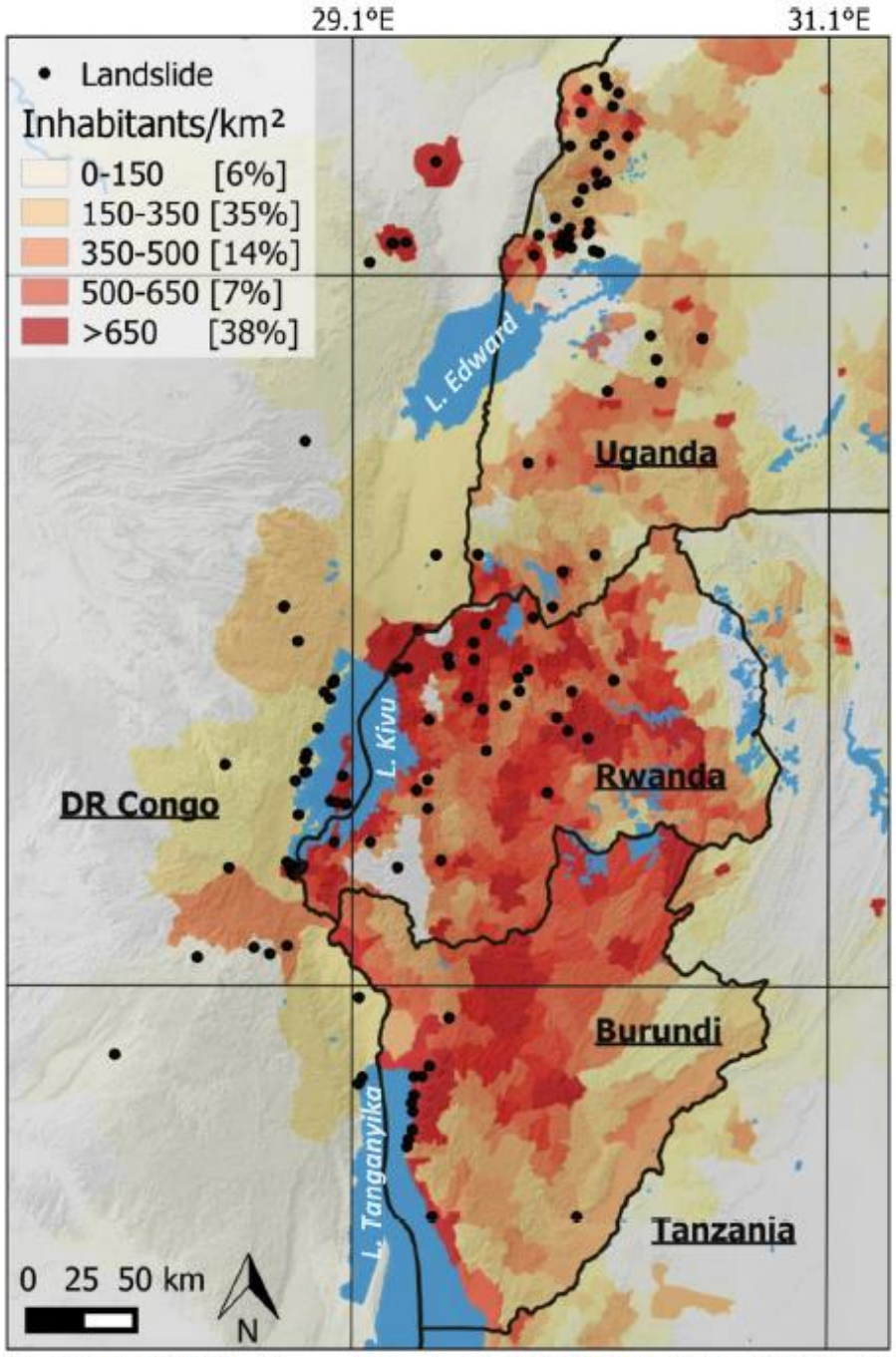
DATA MINING

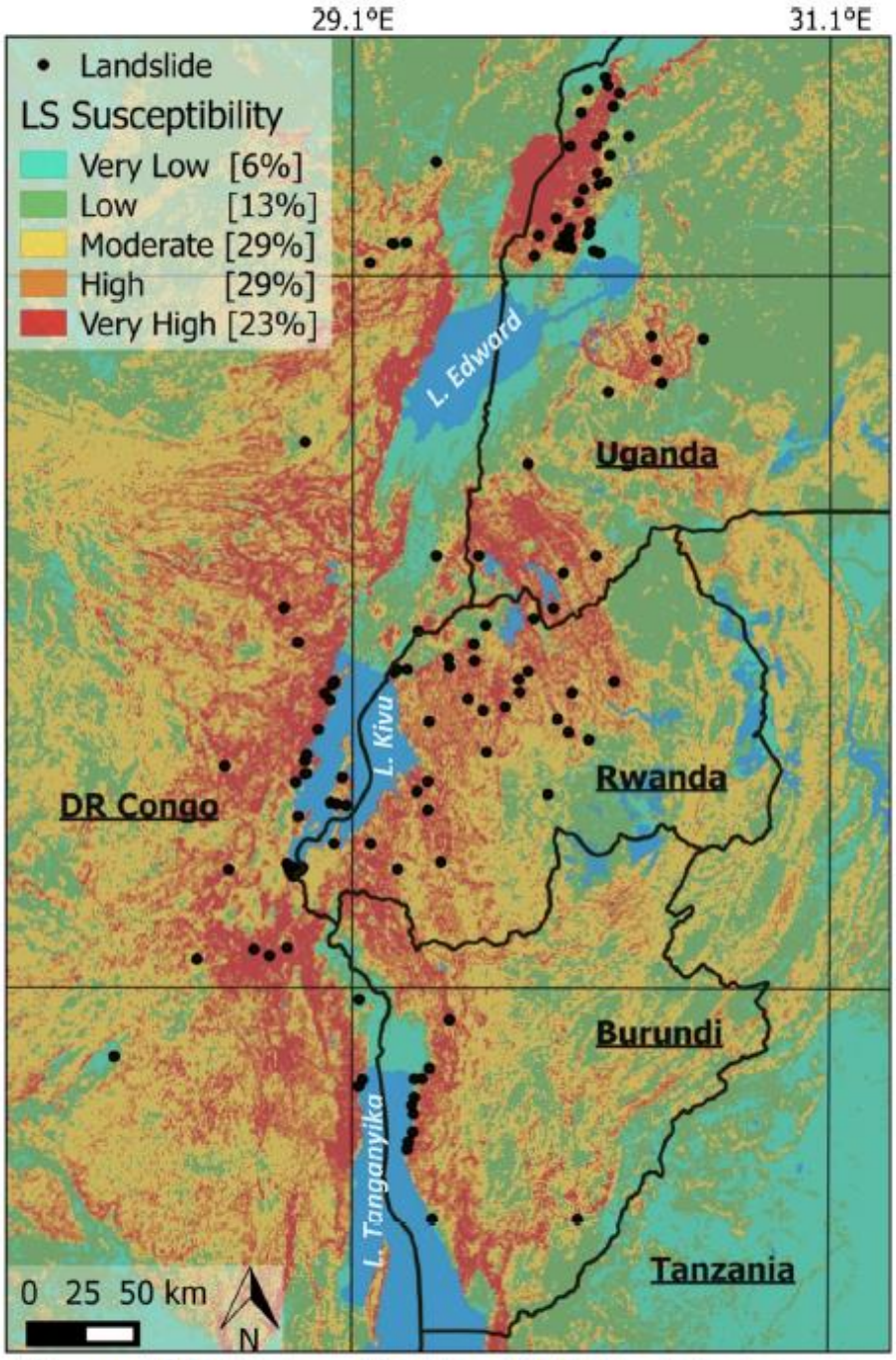




156 identified LS events in the study area (13 in EM-DAT)

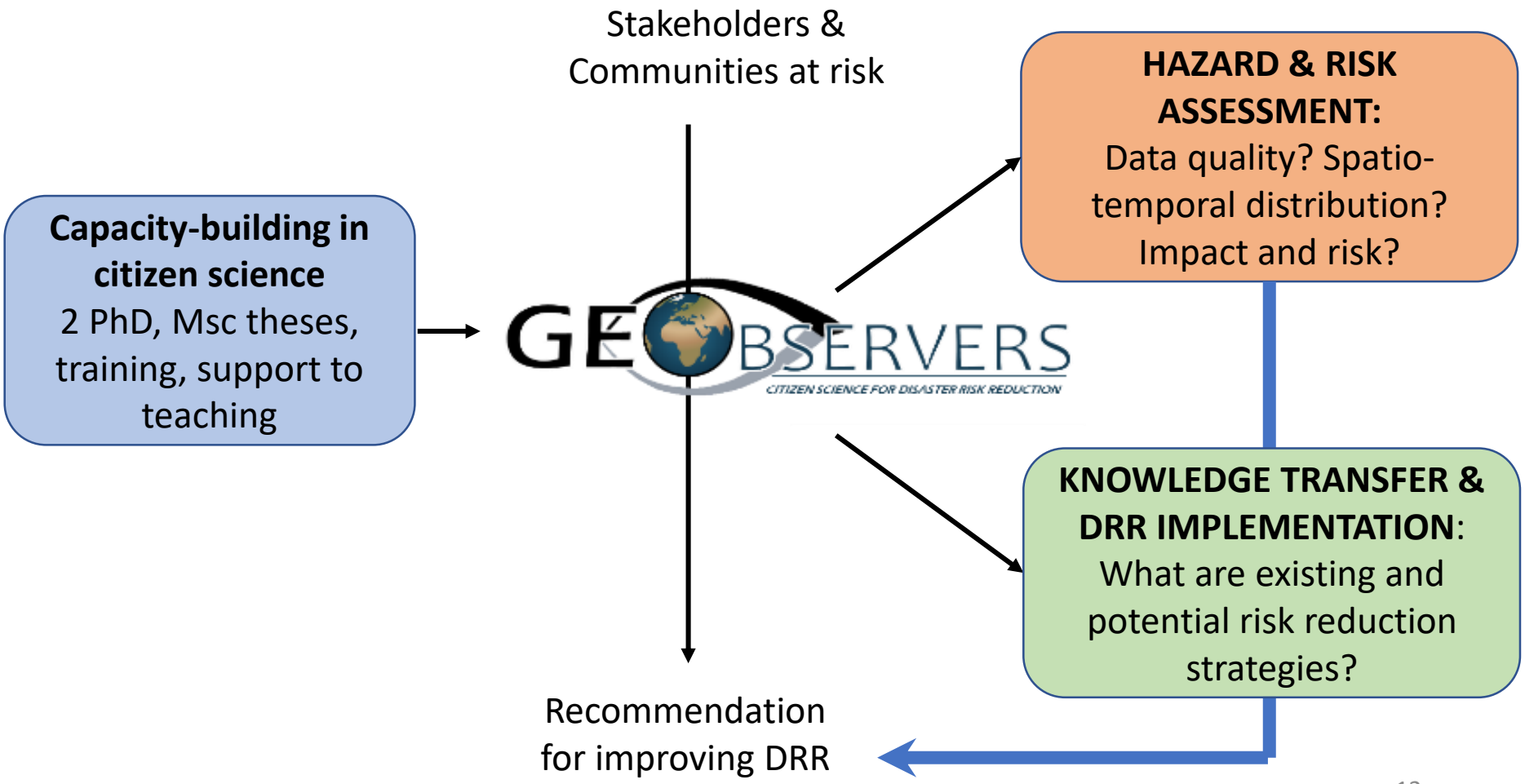
Monsieurs et al. 2018





Monsieurs et al. 2018

Can Participatory Sensing by Citizen Scientists alleviate the data bottleneck in evidence-based policy development?



Geo observer network

Knowledge on the timing and location of hazards and the impact they cause is the first step towards disaster risk reduction

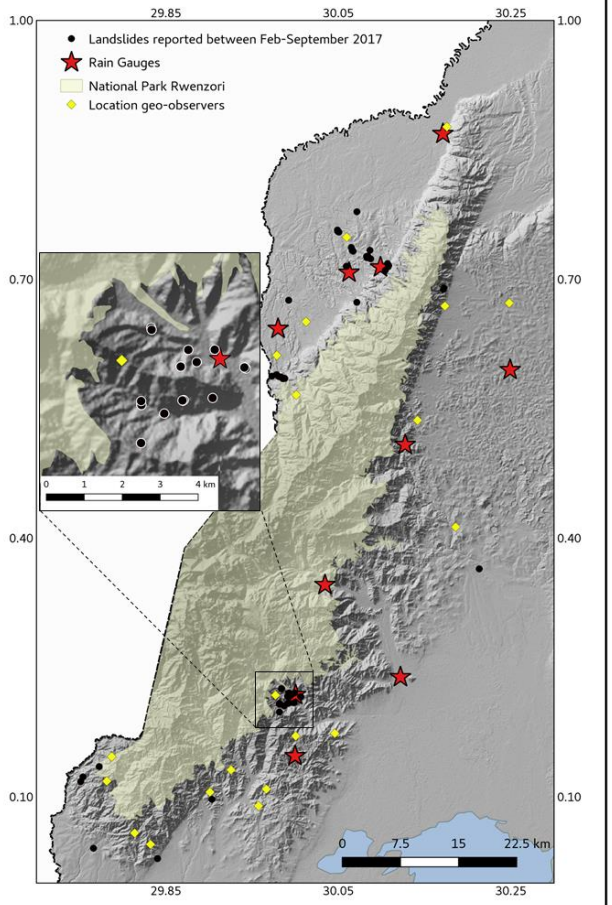
Local stakeholders are often consulted but rarely involved during the data collection phase

Local people are a valuable asset in collecting data on their environment:

- thorough knowledge on their environment
- in direct contact with the inhabitants of the region
- direct access to the field

GEOBSERVERS
CITIZEN SCIENCE FOR DISASTER RISK REDUCTION

THE SET UP OF A GEO-OBSERVER NETWORK



Geo-observers:

- 30 local citizen scientists
- trained to use a smartphone
- trained in the field to recognize and report using the KoboCollect application
- Collect data on 8 different disasters

Disasters:

- landslides
- floods
- pests/disease
- windstorm
- hailstorm
- lightning
- earthquake
- drought

1. Geo-observer receives information

2. Geo-observer reports using the app

3. Geo-observer sends report via mobile network

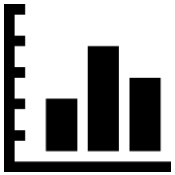
4. Quality check by Mountains of the Moon University

METHODOLOGY: the network

METHODOLOGY: data collection and analysis

DATA ANALYSIS: analyzing incoming reports

Quality control on reports:
- accurate GPS coordinates
- clear pictures
- realistic report content



Analysis of validated reports:
- which areas?
- when reported?
- which events?

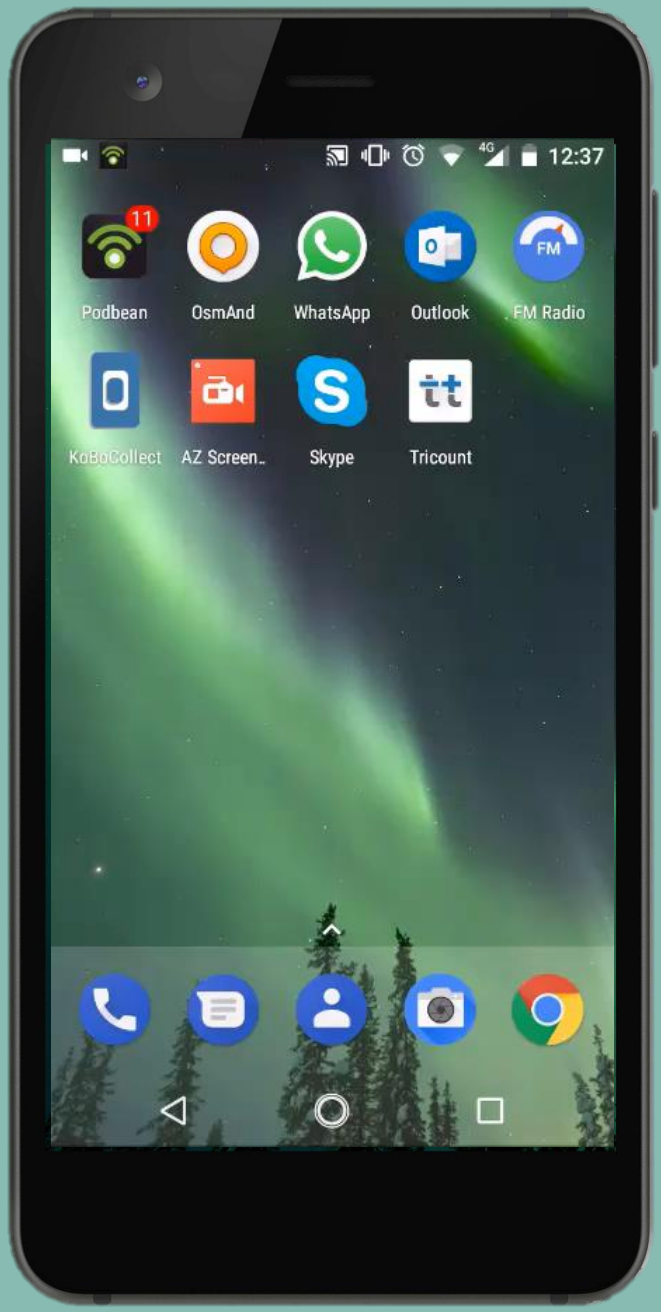
Damage assessment
- which events cause which damage
- added value compared to national database?

META ANALYSIS: analyzing geo-observer's activities

Check of bias:
- contribution bias
- spatial bias in reporting
- age bias

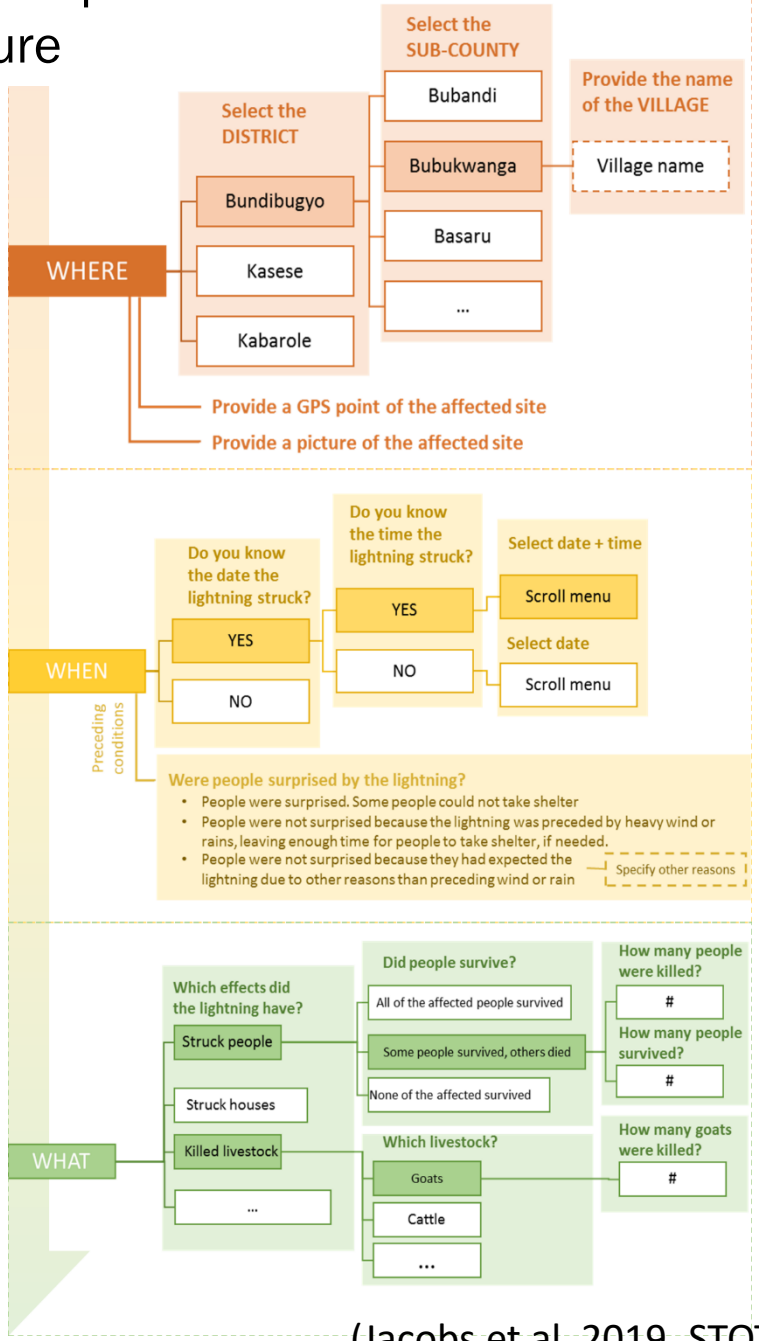
Survey among geo-observers
- major bottlenecks
- attitudes towards project
- motivations

(Jacobs et al. 2019, STOTEN)



METHODOLOGY: reporting App

Example question structure



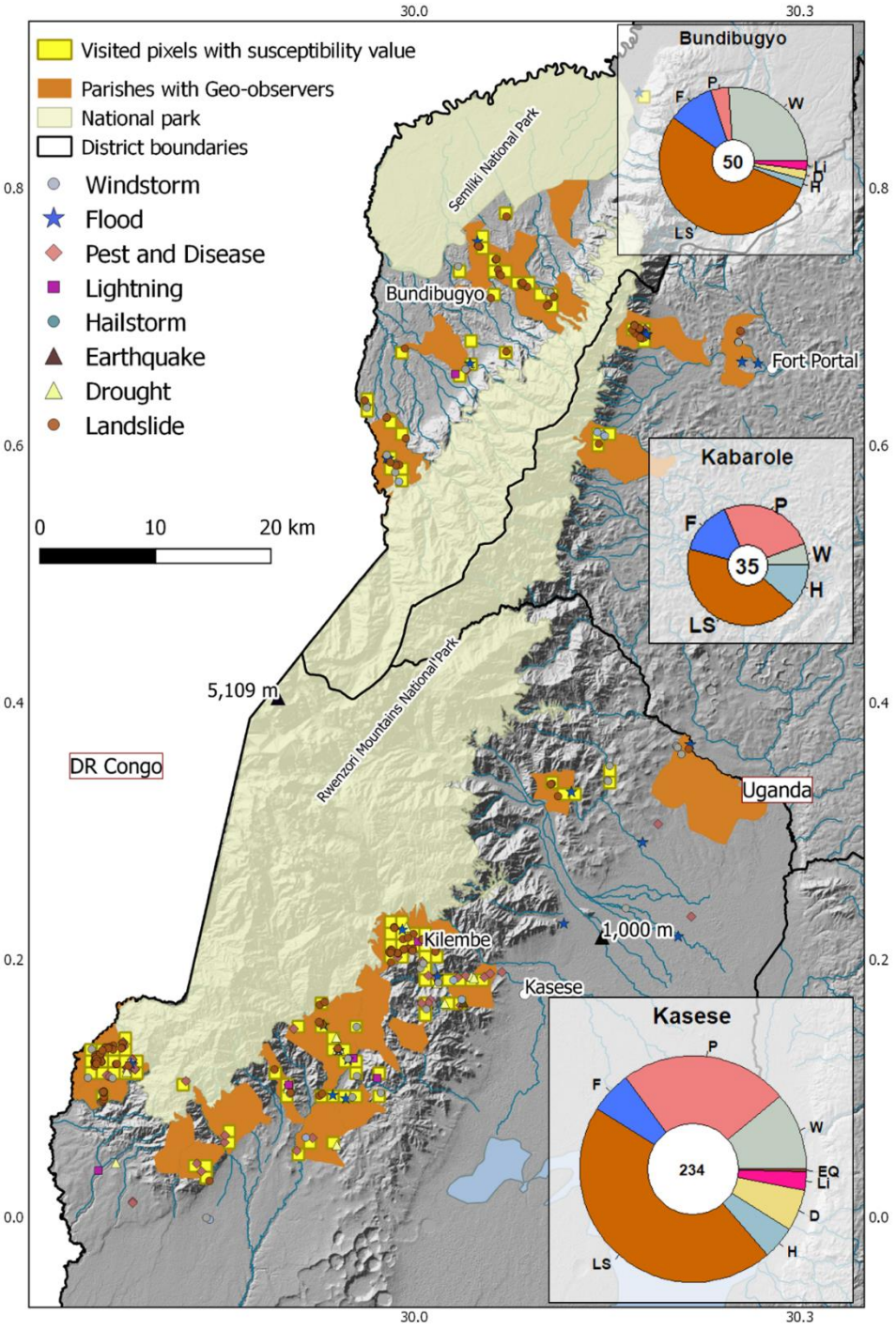
(Jacobs et al. 2019, STOTEN)

DATA ANALYSIS
FEB 2017-APRIL 2018

- 319 validated events
- predominantly landslides, pests-and diseases and floods

- Interactive content:

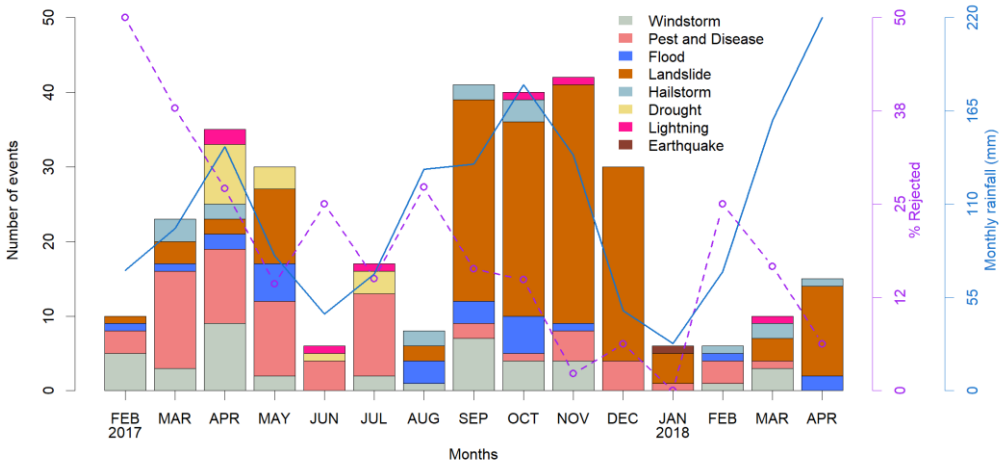
HERE or, here:



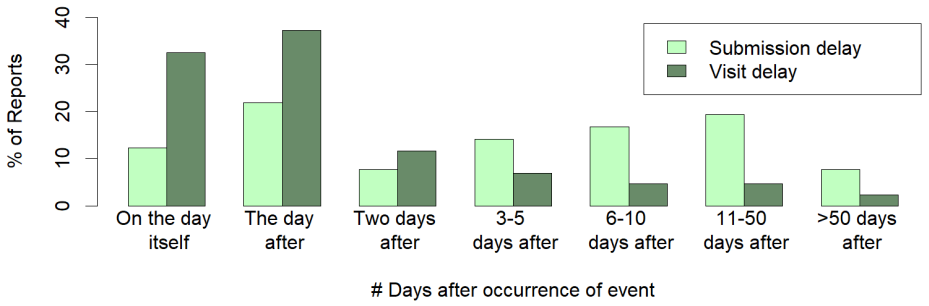
DATA ANALYSIS
FEB 2017-APRIL 2018

- 319 validated events:
  - over time, quality increased
  - predominantly in rainy seasons
  - reporters reach the site 1-2 days after the event
  - reports send reports in days-weeks after event

Validated reports over time:

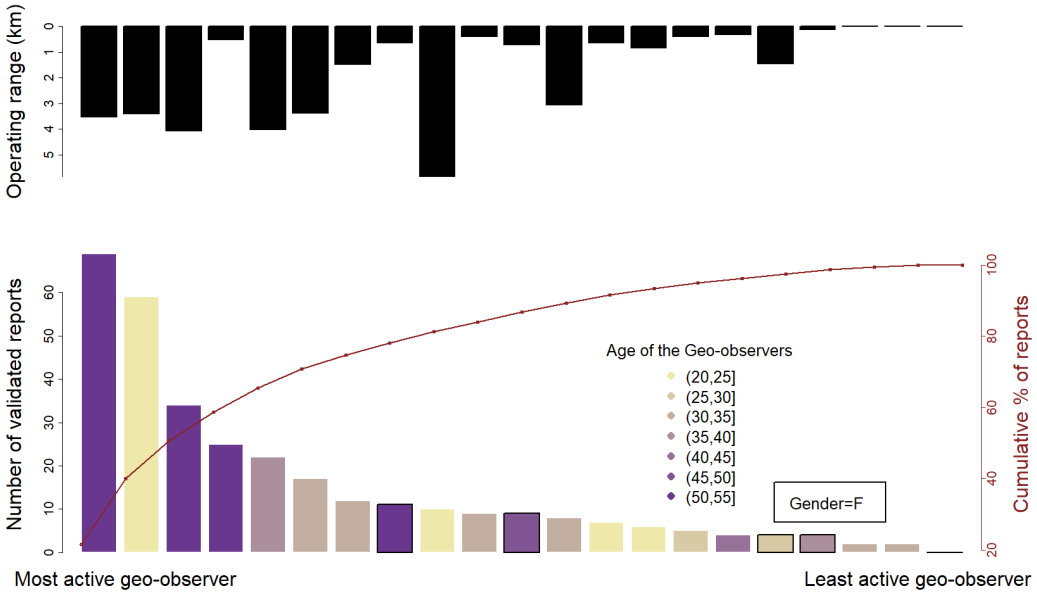


Visitation time and reporting delays:

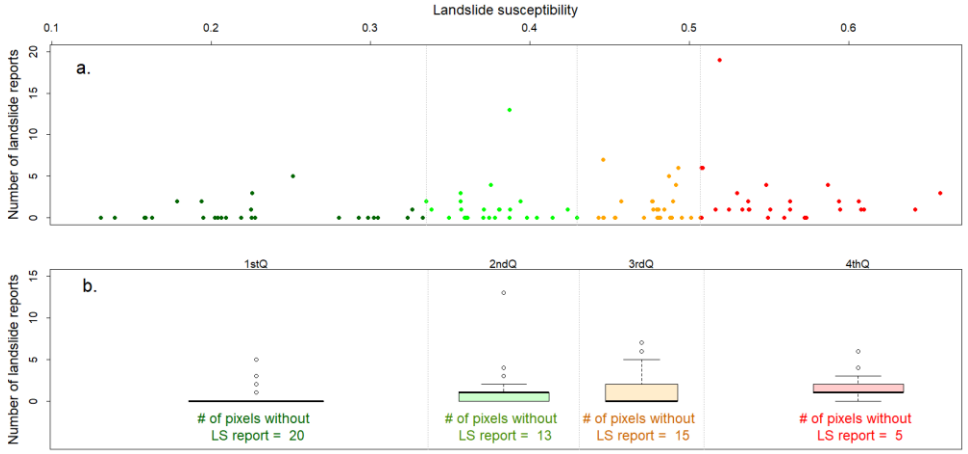


(Jacobs et al. 2019, STOTEN)

Reporting contributions:



Spatial bias?



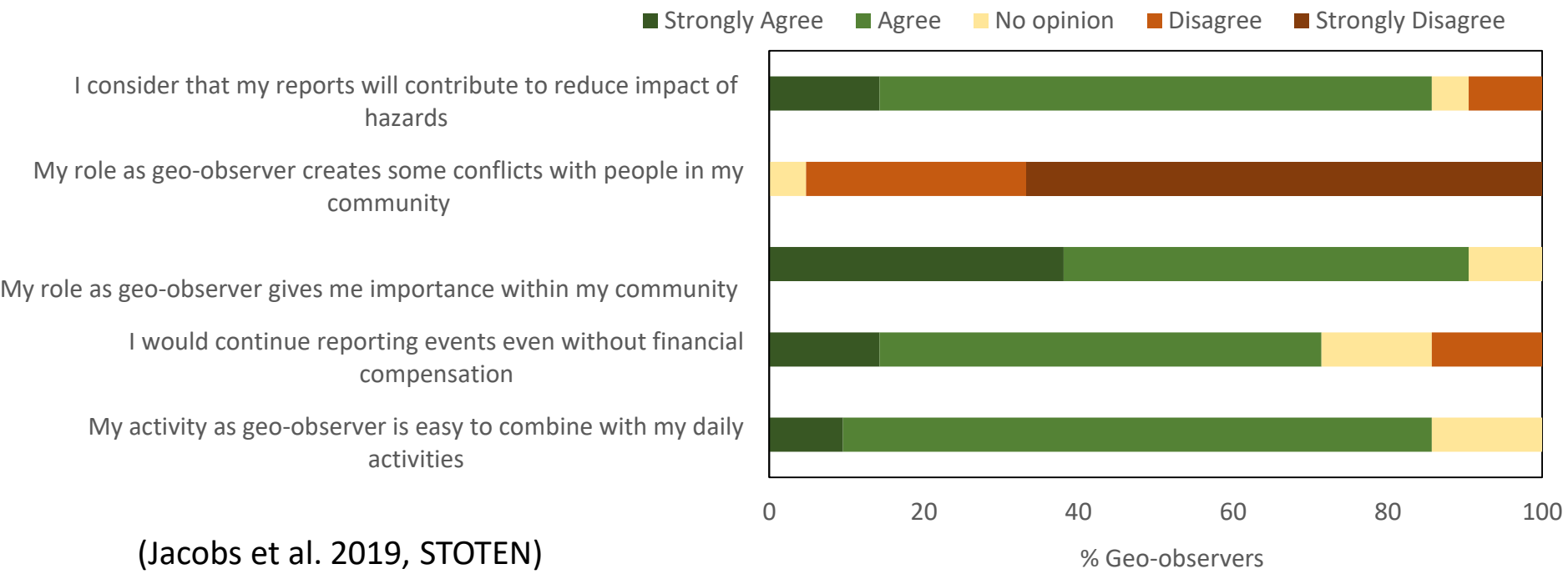
META-ANALYSIS
REPORTER ACTIVITIES

- one third of reporters contribute 75% of data
- older reporters report more
- more active reporters also travel further to report
- Higher landslide susceptibility = more landslide reports

(Jacobs et al. 2019, STOTEN)

META-ANALYSIS
Survey of geo-observers

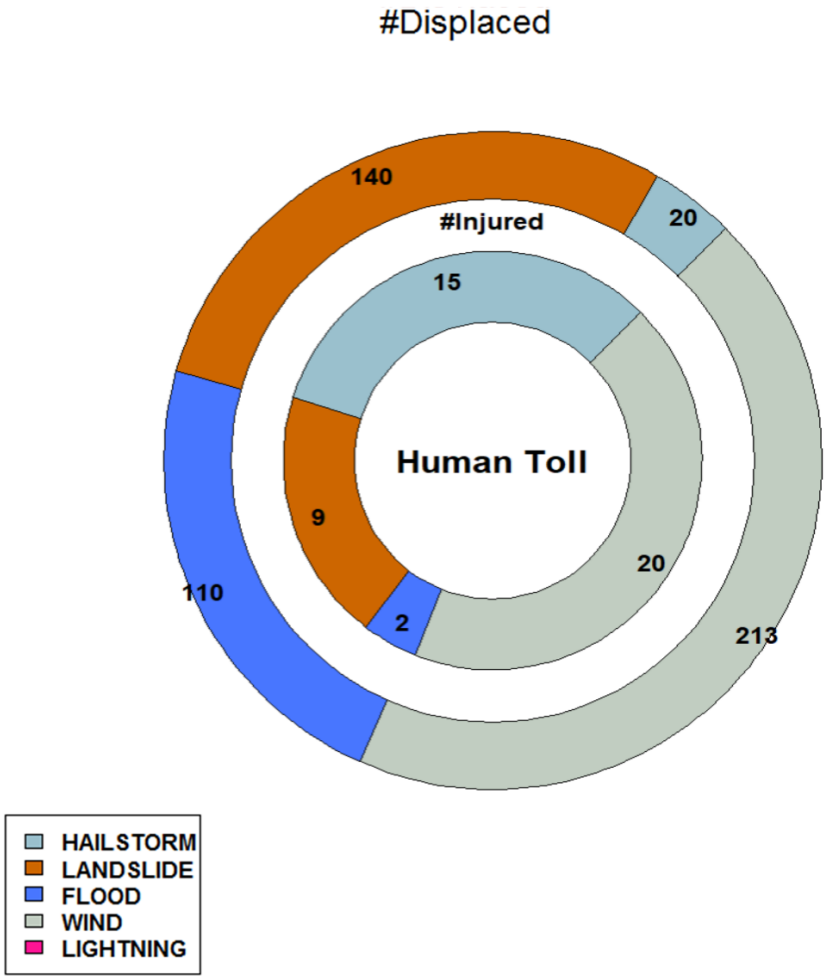
- geo-observers mostly driven by non-pecuniary incentives:
  ➔ role in community, learning from reporting, contributing to research
- lack of events is major reason for non-reporting



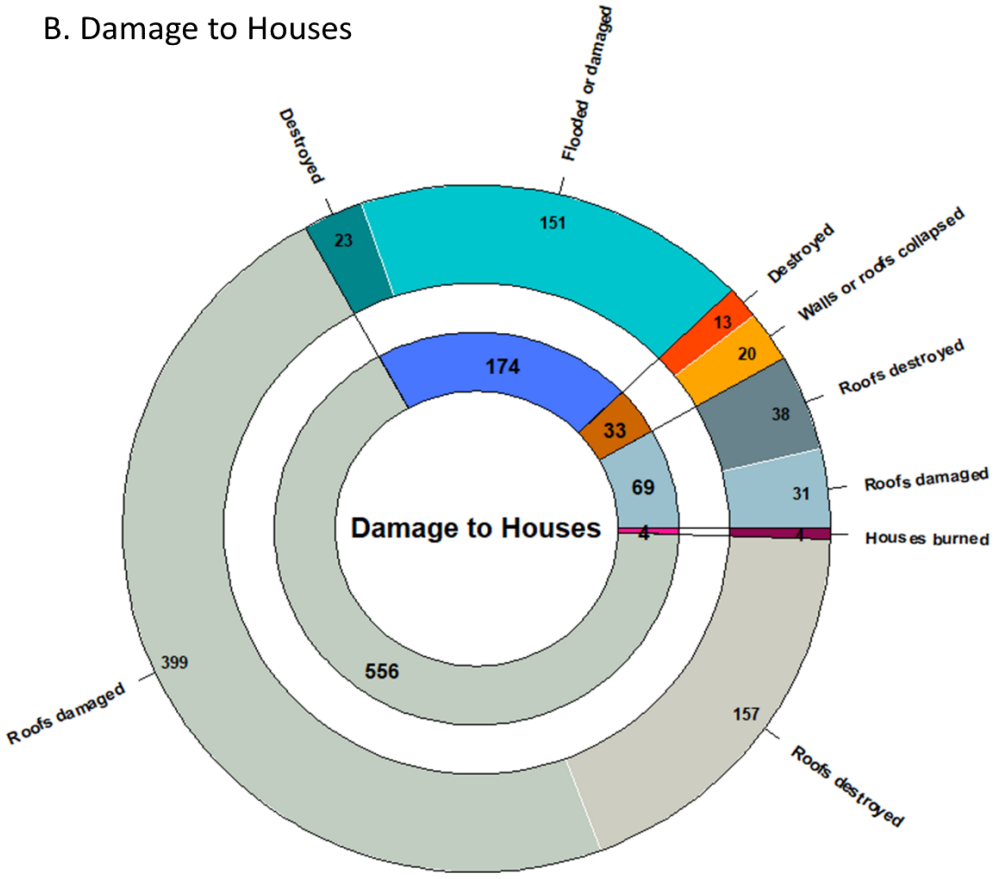
(Jacobs et al. 2019, STOTEN)

DAMAGE ASSESSMENT

A. Human Toll

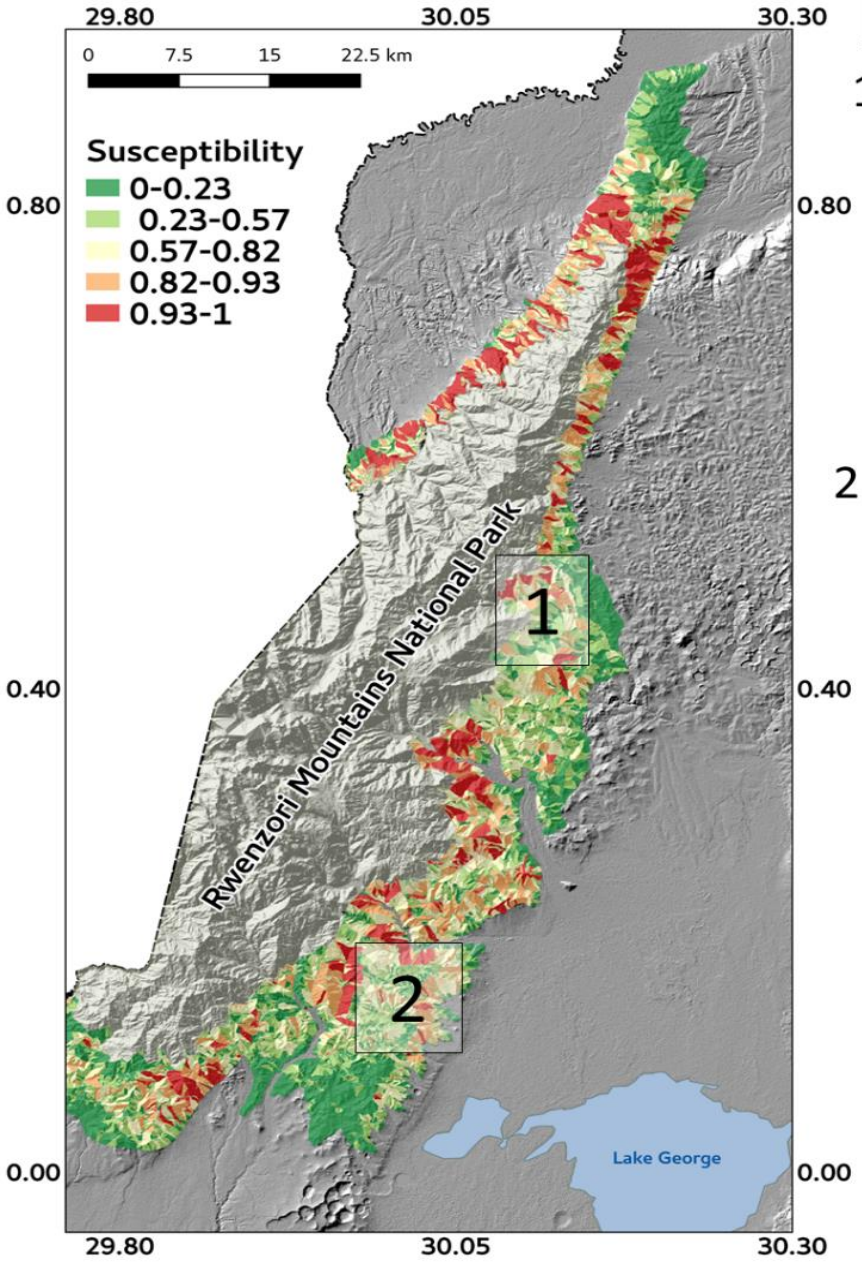


B. Damage to Houses



(Jacobs et al. 2019, STOTEN)

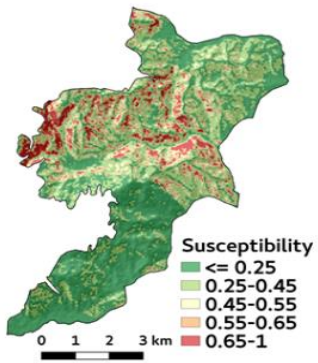
Landslide Susceptibility Modelling

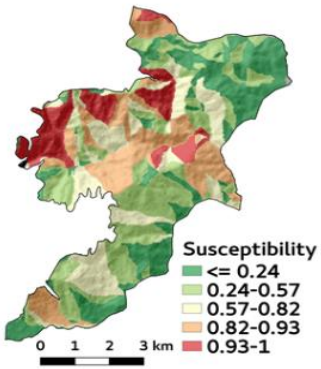


Pixel-based:

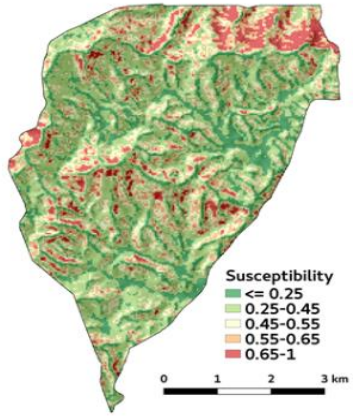
Slope unit-based:

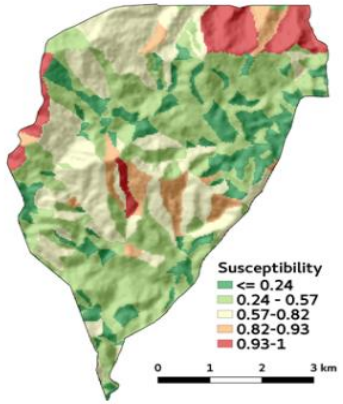
1

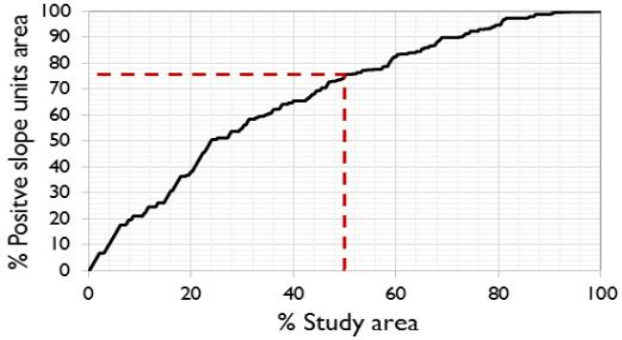




2

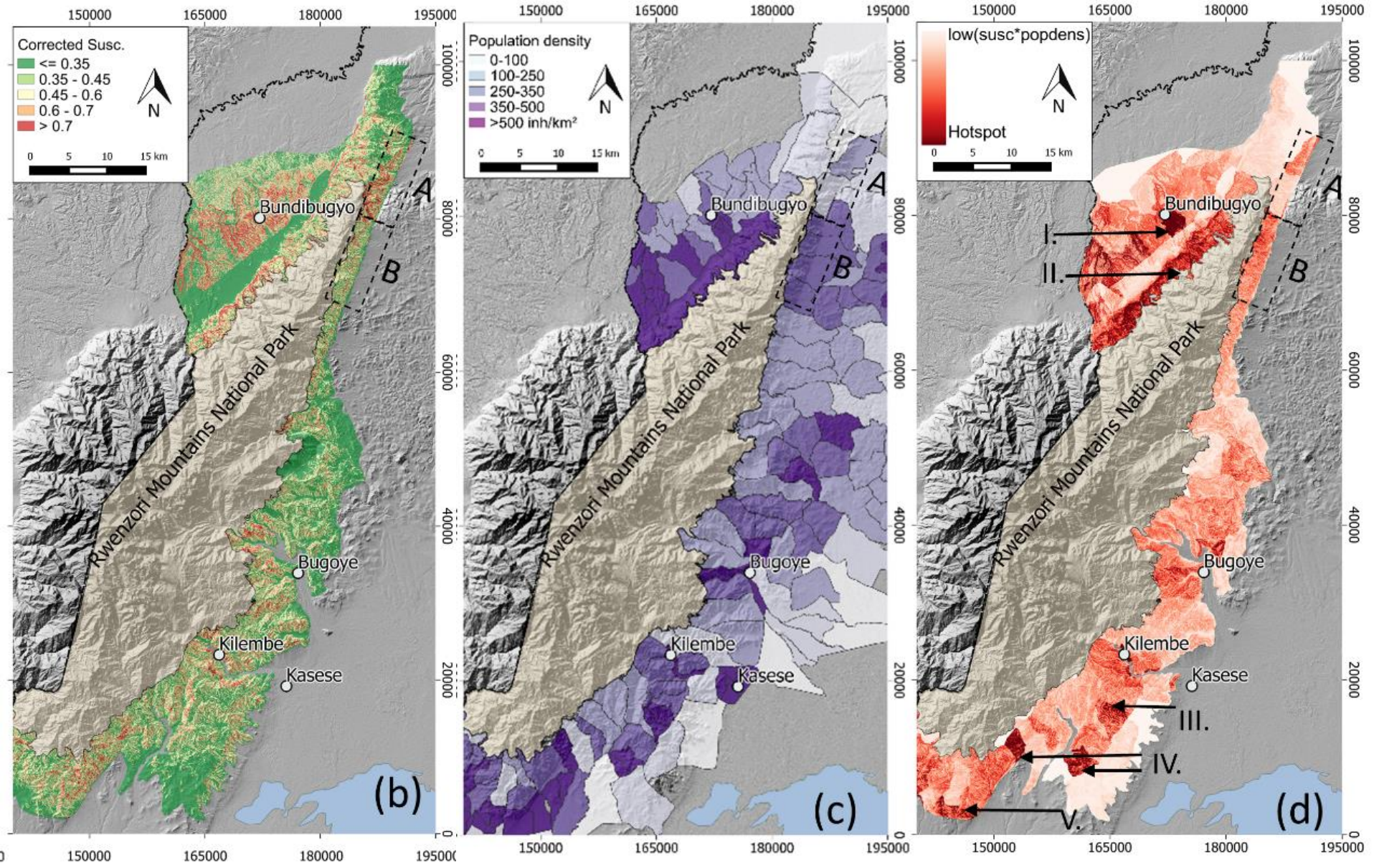


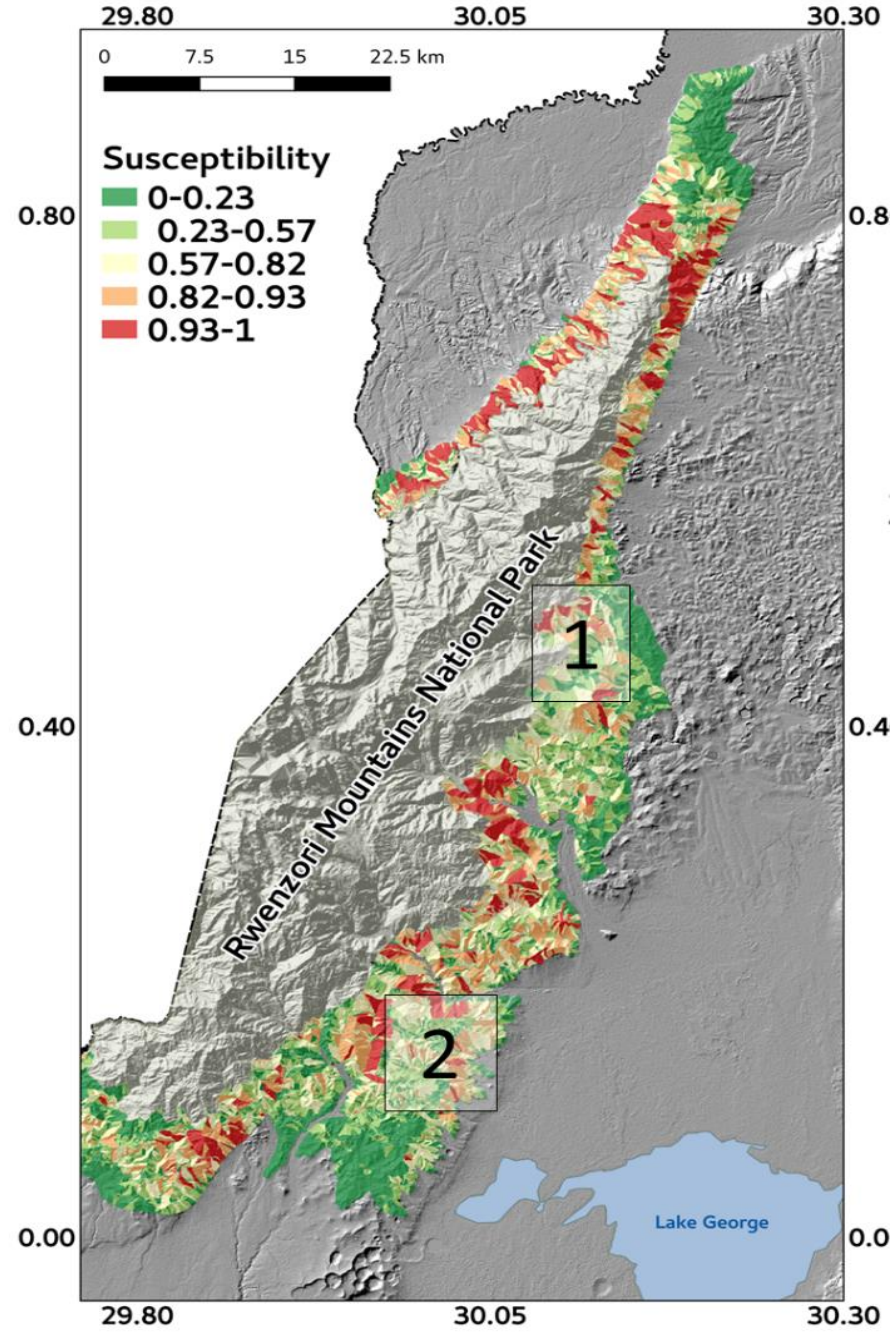




(Jacobs et al. 2018, NHESS)

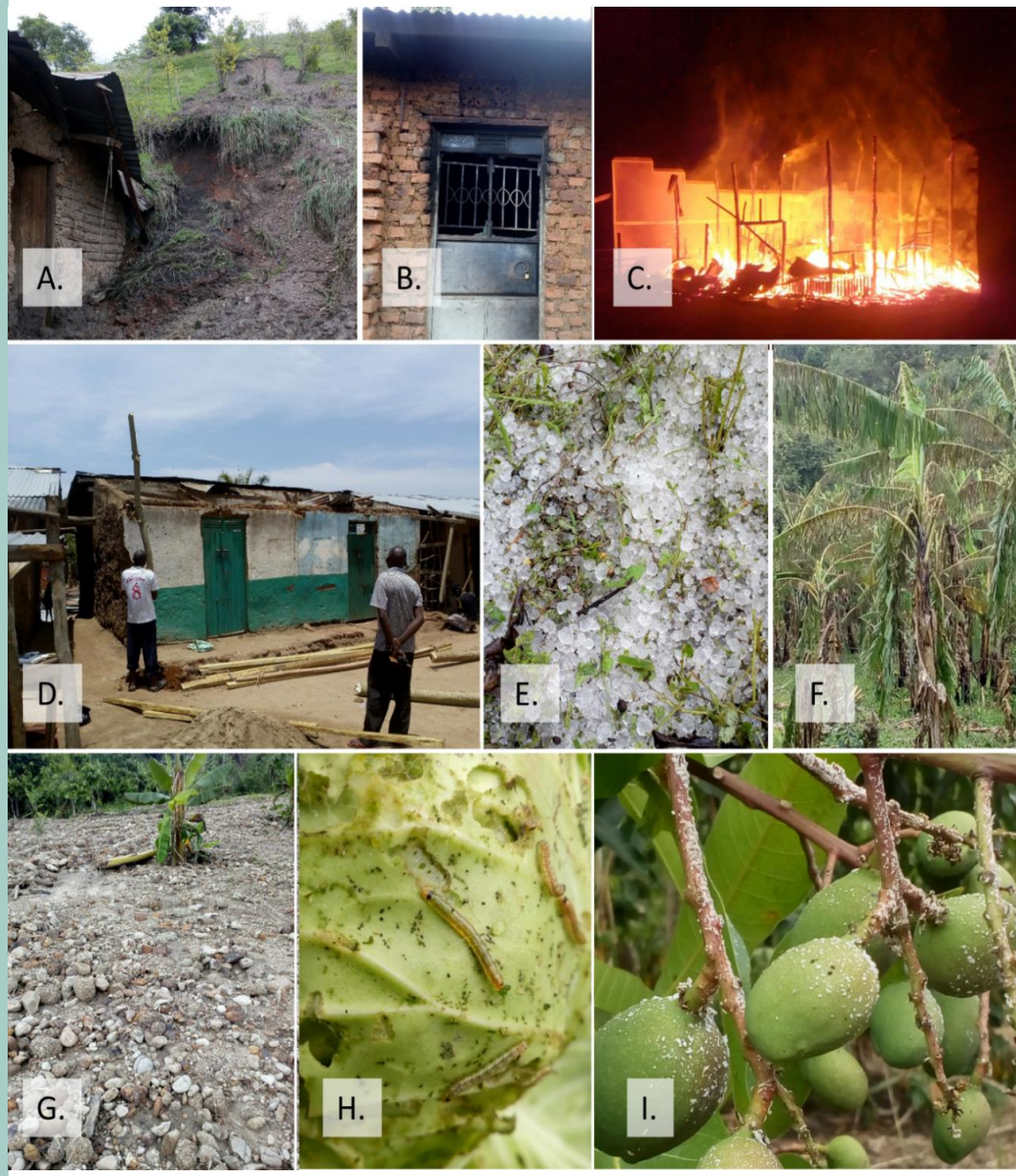
Landslide Exposure and Risk Modelling




29.80
30.05
30.30
0
7.5
15
22.5 km
Susceptibility
0-0.23
0.23-0.57
0.57-0.82
0.82-0.93
0.93-1
0.80
0.40
0.00
0.8
0.4
0.0
Rwenzori Mountains National Park
1
2
Lake George

CONCLUSIONS

- Citizen science provide on-site information on disasters with short response time
- Intrinsic motivation of geo-observers
- Citizen science as a way to raise DRR awareness
- Differences in motivation and/or mobility can lead to reporting bias
- High data density for a data poor region
- Issues of up-scaling, sustainability and data validation



VRIJE UNIVERSITEIT BRUSSEL

makervyn@vub.be

vliruos 20 YEARS

MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SUCCEED WE MUST

MOUNTAINS OF THE MOON UNIVERSITY
Heights for Progress

KU LEUVEN

ROYAL MUSEUM FOR CENTRAL AFRICA
Africa TERVUREN

ULB UNIVERSITÉ LIBRE DE BRUXELLES