



# Slow-moving **L**Andslides in **C**hanging **Tr**Opical landscapes: dynamics and hillslope connectivity from **S**pac**E**

Olivier Dewitte<sup>1</sup>, Matthias Vanmaercke<sup>2</sup>, Benoît Smets<sup>1,3</sup>

<sup>1</sup> Royal Museum for Central Africa, Belgium

<sup>2</sup> KU Leuven, Belgium

<sup>3</sup> Vrije Universiteit Brussel, Belgium



STEREO IV

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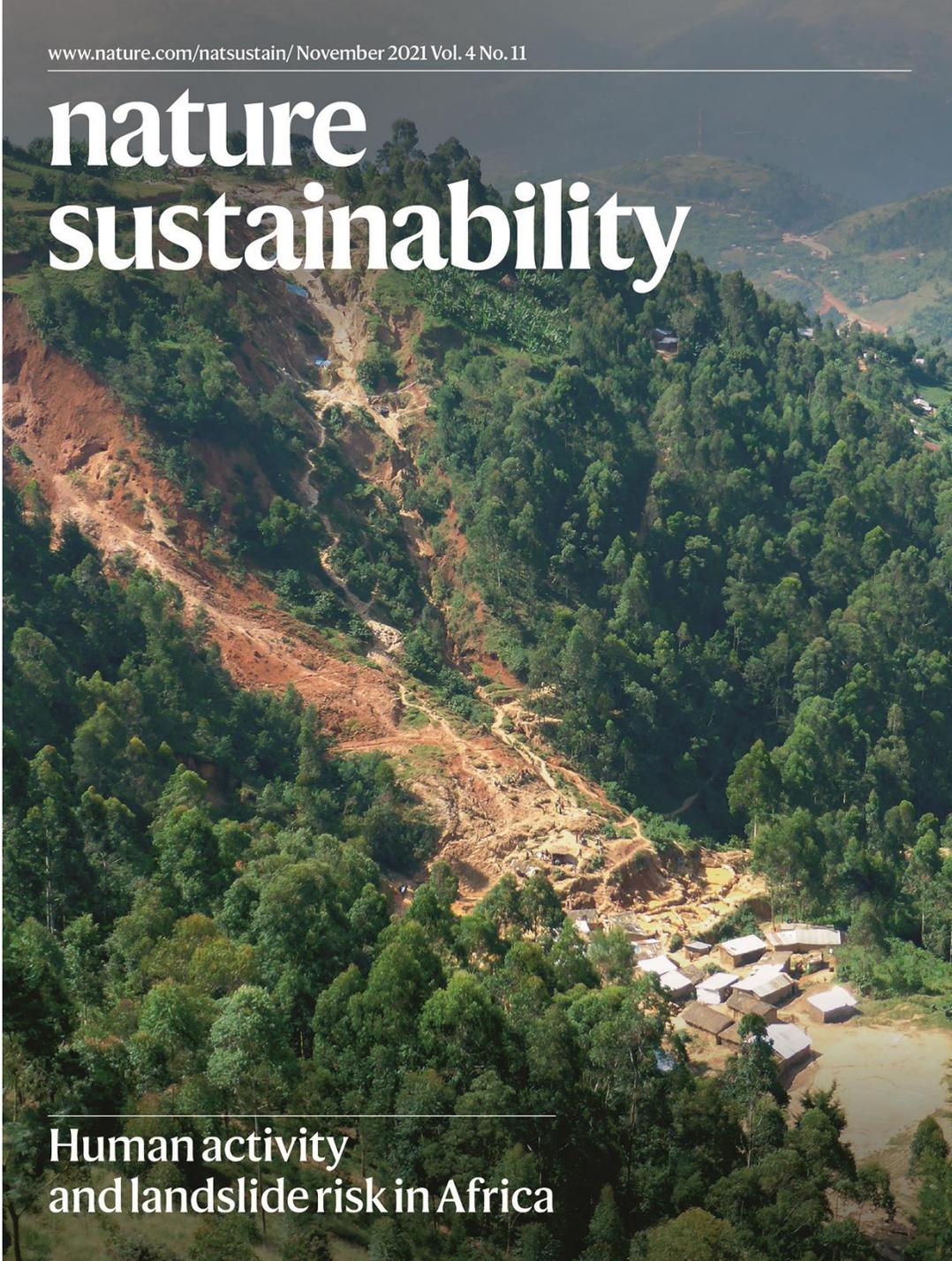
# WHAT IS A LANDSLIDE?

- The term '**landslide**' describes a variety of processes that result in the downward and outward movement of slope-forming materials, including rock, soil, artificial fill or a combination of these
- Landslide causes and triggers can be natural or/and human-related



# nature sustainability

## Human activity and landslide risk in Africa



## Comment



A mudslide in August 2017 killed hundreds of people in Freetown, Sierra Leone.

## How climate change and unplanned urban sprawl bring more landslides

Ugur Ozturk, Elisa Bozzolan, Elizabeth A. Holcombe, Roopam Shukla, Francesca Pianosi & Thorsten Wagener

More settlements will suffer as heavy rains and unregulated construction destabilize slopes in the tropics, models show.

**T**he first half of 2022 was one of the deadliest on record for landslides. In January and February, cities across South America were hit by devastating soil, rock and mud flows – burying at least 14 people in their homes at Dosquebradas in Colombia, and killing 24 people in Quito, Ecuador, and at least 220 in Petrópolis, Brazil. In

April, May and June, hundreds more were killed in Pilar in the Philippines, Durban in South Africa, Recife in Brazil and across Bangladesh.

That's fast approaching the roughly 4,500 people who are killed on average worldwide each year by landslides<sup>1</sup>. Economic damages from these events amount to US\$20 billion annually<sup>2</sup>, which is roughly one-quarter of those resulting from floods.

Over the past 50 years, disasters caused by landslides have become ten times more frequent<sup>3</sup>. And landslide risk is set to escalate, owing to two increasing trends – climate change and urbanization. Now, researchers need to assess where and to what extent such risks will rise.

More than 80% of fatal landslides occur in the tropics<sup>4</sup>. They are triggered mainly by heavy rain, often during cyclones and

monsoons. Climate projections show that, on average, the intensities of tropical deluges could double by the end of the century<sup>5</sup>. But it's hard to say what will happen in any given place.

The rapid pace of urbanization, especially in low- and lower-middle-income nations in tropical regions, will put more people in the path of landslides. For example, the population of Freetown in Sierra Leone has nearly doubled, to more than 1.2 million, since 2000. Many people arriving in the city end up living in poor or informal settlements on hills and floodplains at the city margins. Informal housing practices such as unregulated deforestation, slope cutting and household water drainage, can increase the chance of landslides. And such communities are hit disproportionately hard. For example, in Latin America and the Caribbean, 81% of the people

# LANDSLIDES AND THEIR IMPACTS ON GEOMORPHOLOGY



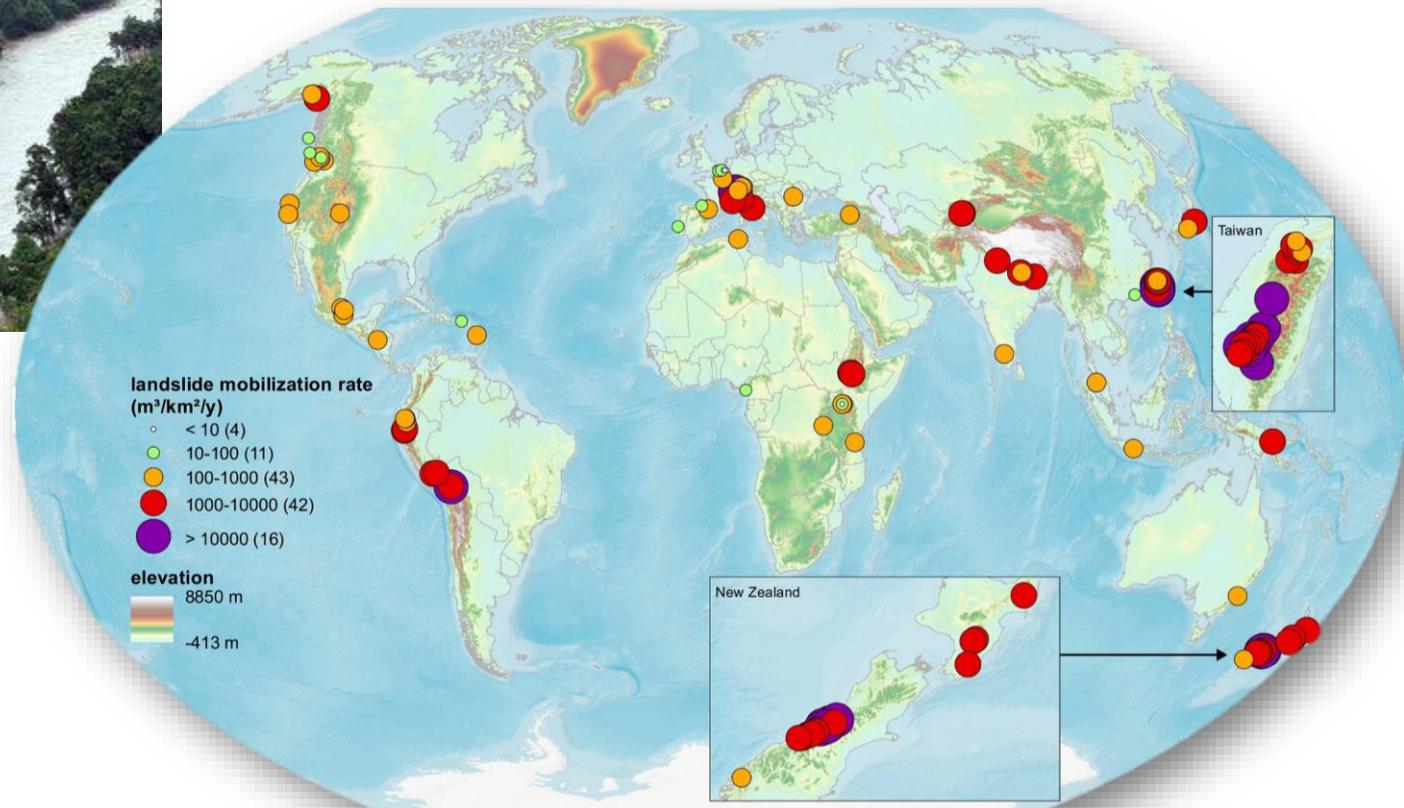
Landslides mobilize  
sediments – river  
connectivity

# LANDSLIDES AND THEIR IMPACTS ON GEOMORPHOLOGY



Landslides mobilize sediments – river connectivity

## Landslide mobilization rates



Broeckx et al. 2020,  
*Earth-Science Reviews*



DR Congo © D. Delvaux

shallow  
landslides



Japan © A. Shimbun



DR Congo © D. Delvaux

shallow  
landslides



New Zealand © K. Pedley



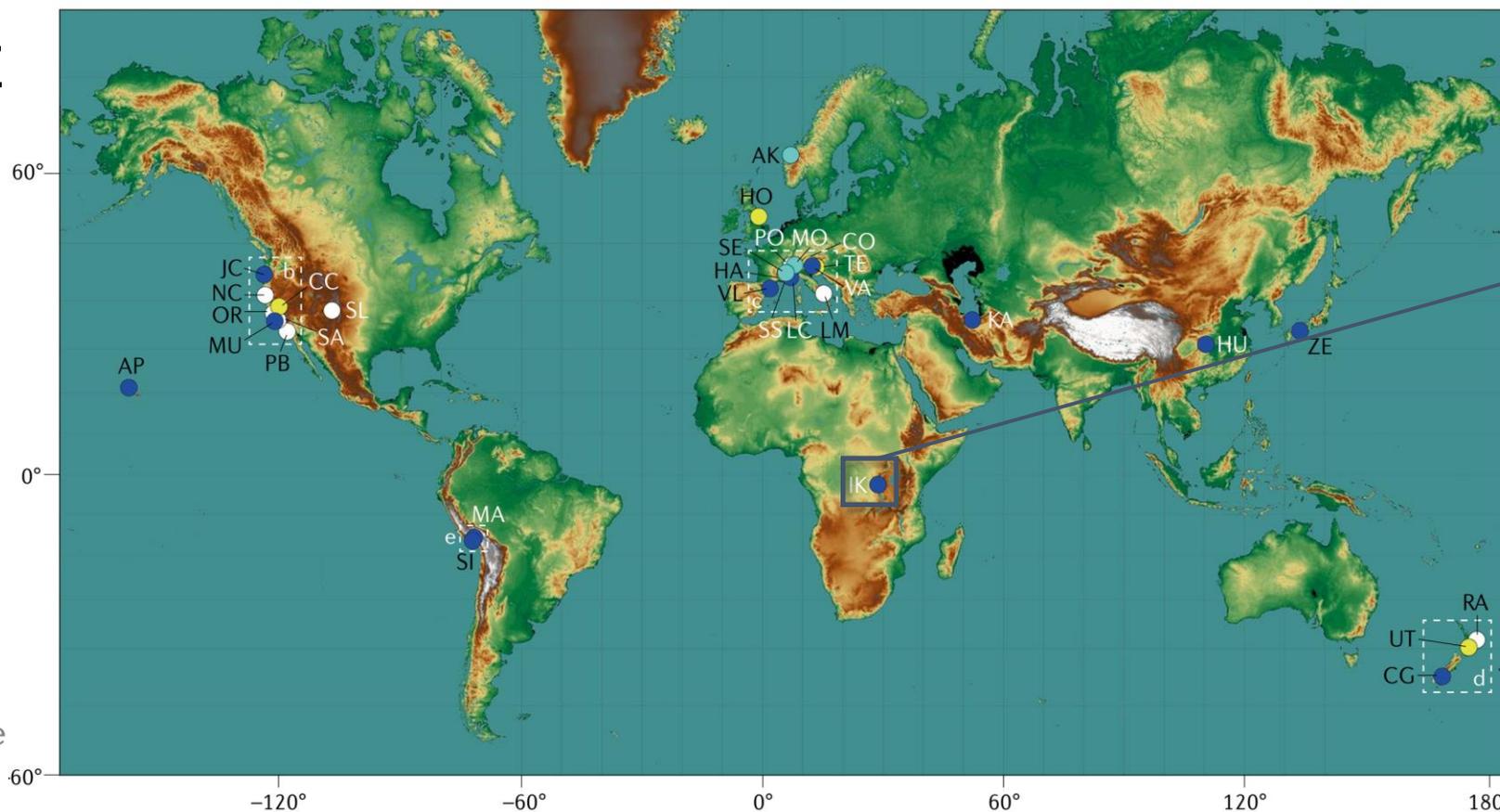
Japan © A. Shimbun

deep-seated  
landslides



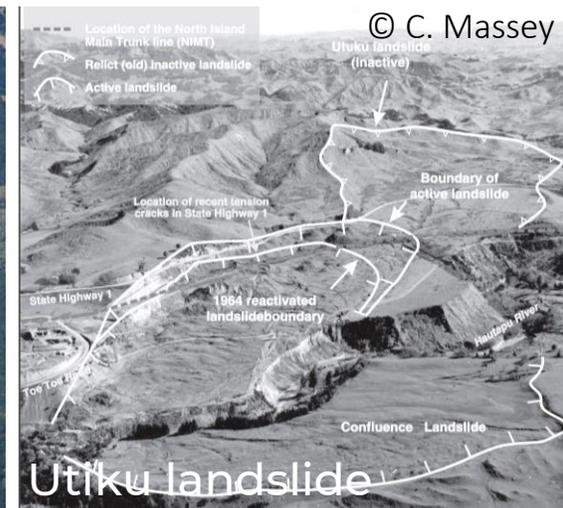
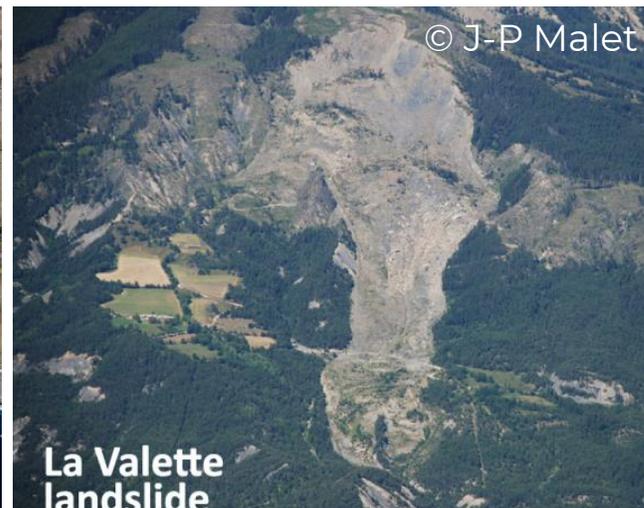
Canada © R. Couture

# WHY IN THE TROPICS ?



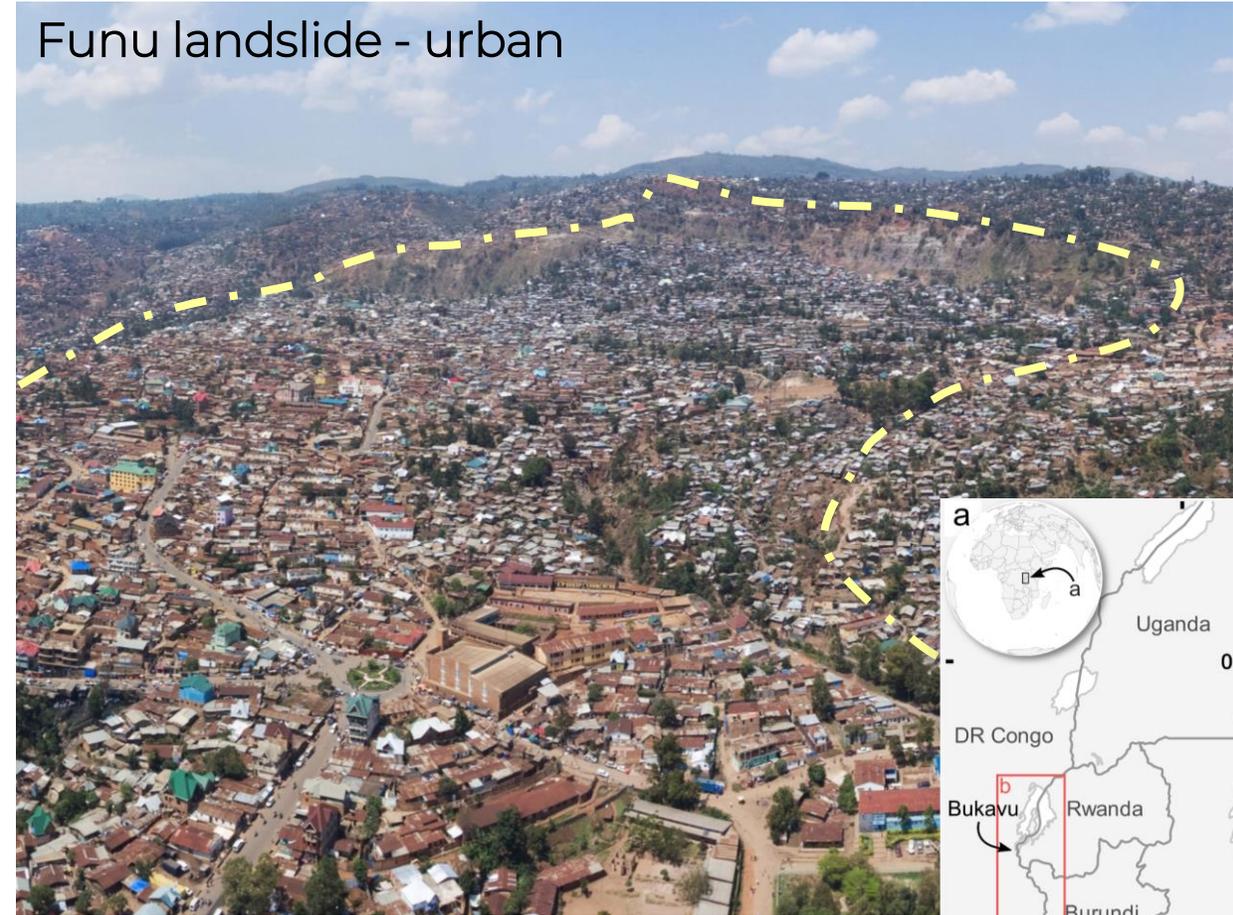
**Ikoma landslide**

Lacroix et al. (2020),  
*Nature reviews*



# EQUATORIAL AFRICA, KIVU RIFT – The MODUS project

Bukavu, DR CONGO



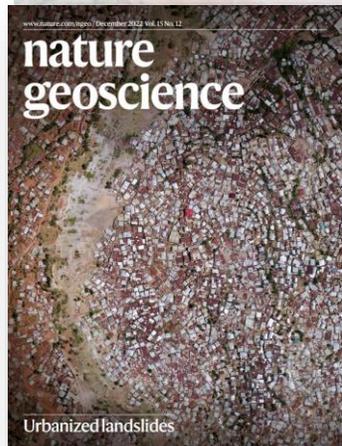
# EQUATORIAL AFRICA, KIVU RIFT – The MODUS project

Bukavu, DR CONGO



Ikoma landslide - natural

- First detailed investigation of **slow-moving landslides in the tropics**
- First to **demonstrate the role of anthropisation**
- First **combined use** of 100's of **optical + SAR** satellite images



Dille et al. 2019, *Geomorphology*  
Dille et al. 2021, *Remote Sensing of Environment*

Funu landslide - urban

Samsonov et al. 2020, *Engineering Geology*  
Dille et al. 2022, *Nature Geoscience*

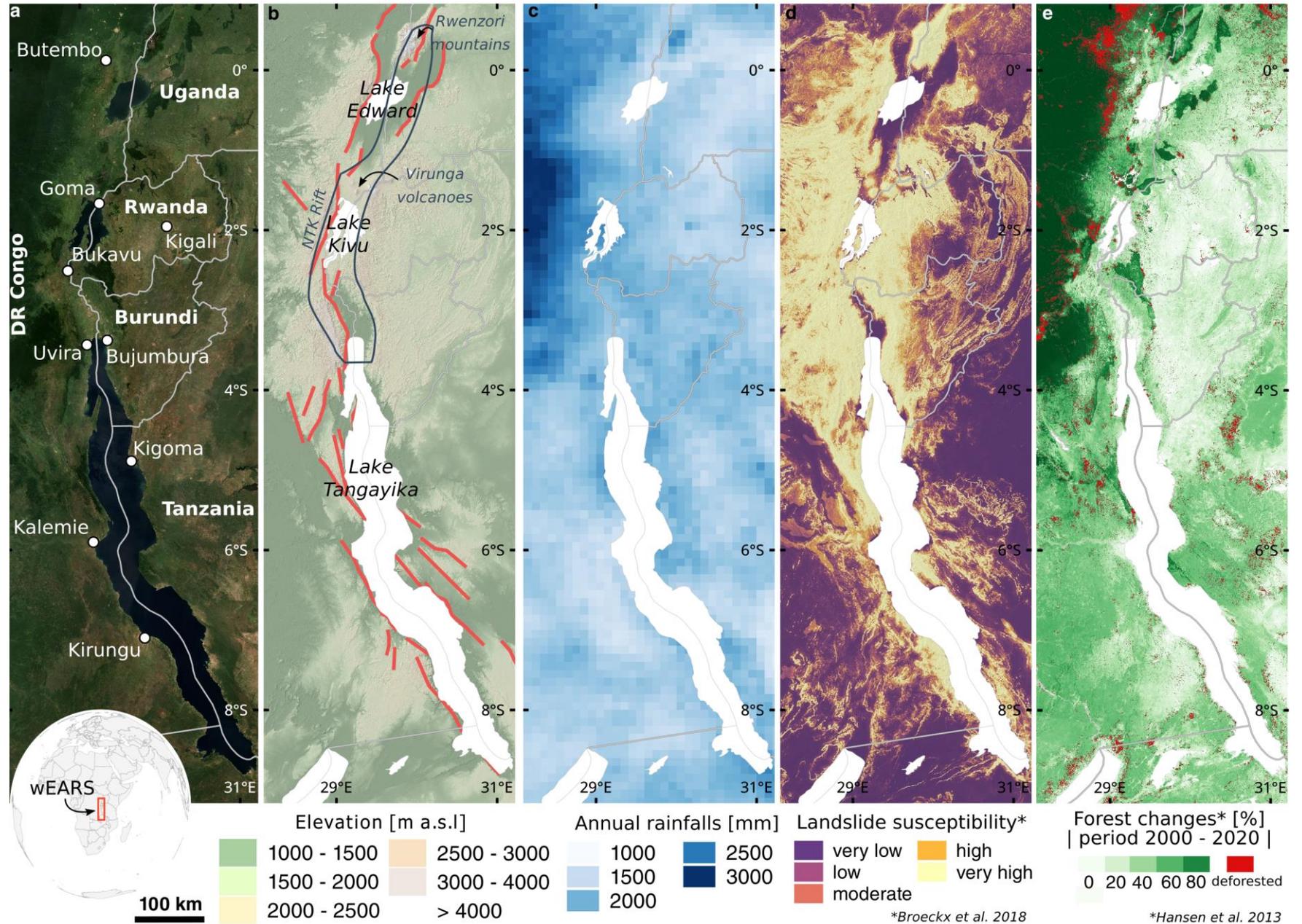


## The LACTOSE project – SCIENTIFIC OBJECTIVES

Quantify at the regional scale how natural and human-induced environmental conditions control the dynamics of **slow-moving landslides** (SML) and their sediment contribution to river systems in changing tropical landscapes

# WESTERN BRANCH OF THE EAST AFRICA RIFT

An ideal candidate at an unprecedented scale





# Thank you!

Olivier Dewitte, Matthias Vanmaercke, Benoît Smets