Government of Nepal
Ministry of Home Affairs
National Disaster Risk Reduction & Management Authority

ICIMOD

CONSULTATIVE MEETING ON

Development of multi-hazard risk and loss and damage assessment framework for HKH

8–9 December 2022

#HKHmultihazardL&D

Integrated disaster risk management for sustainable development in HKK

Markus Stoffel & Simon K. Allen

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES

Introduction

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES

- HKH, a global hotspot for disasters, hosts some of the world's most vulnerable mountain communities.

- Widespread destruction and cascading risks with prolonged and far-reaching consequences.

- Truly integrated and forward-looking catchment-scale approaches critically needed for integrated multi-hazard disaster risk management…

- …extending beyond traditional siloes and recognizing the full interlinkages and interdependencies between hazards, and societal drivers of risk.

Introduction

- Aim: Showcase experiences in Integrated Disaster Risk Management (IDRM) pioneered in Switzerland under the Federal Office for the Environment

Legend:

- elevated risk
- high risk
- medium risk
- low risk

Source:
Sörenberg
(Flühli Municipality),
Canton Lucerne

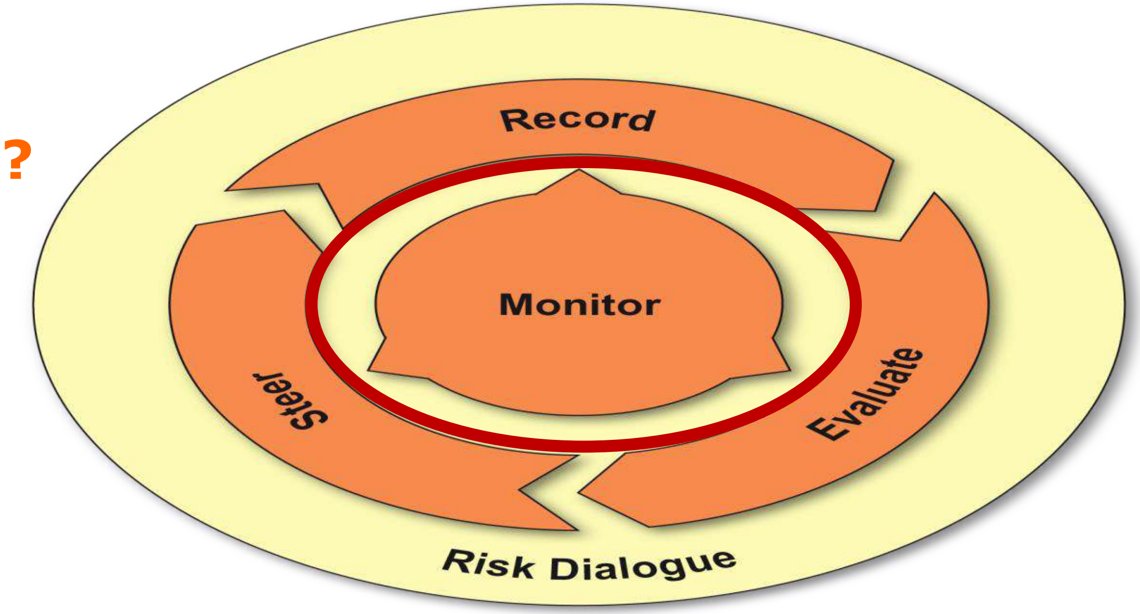
Original scale:
1:5'000

Introduction

- Aim: Showcase experiences in Integrated Disaster Risk Management (IDRM) pioneered in Switzerland under the Federal Office for the Environment

What can happen?
Analysis of hazard exposure, vulnerability and risk

What should be done?
Use all chances to influence the risk:
- **Avoid risk**
  Land-use planning
- **Reduce risk**
  Structural and non-structural measures
- **Transfer risk**
  Insurance



What is allowed to happen?
Identification of protection deficits based on protection objectives

⇒ **Integrated risk management**: continuous assessment/monitoring of risk situation, planning/realization of protection measures and deal with residual risks. It's an universal approach for all hazards.

Introduction

- Idea: Showcase experiences in Integrated Disaster Risk Management (IDRM) pioneered in Switzerland under the Federal Office for the Environment

- Could these approaches be transferred to HKH?

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES

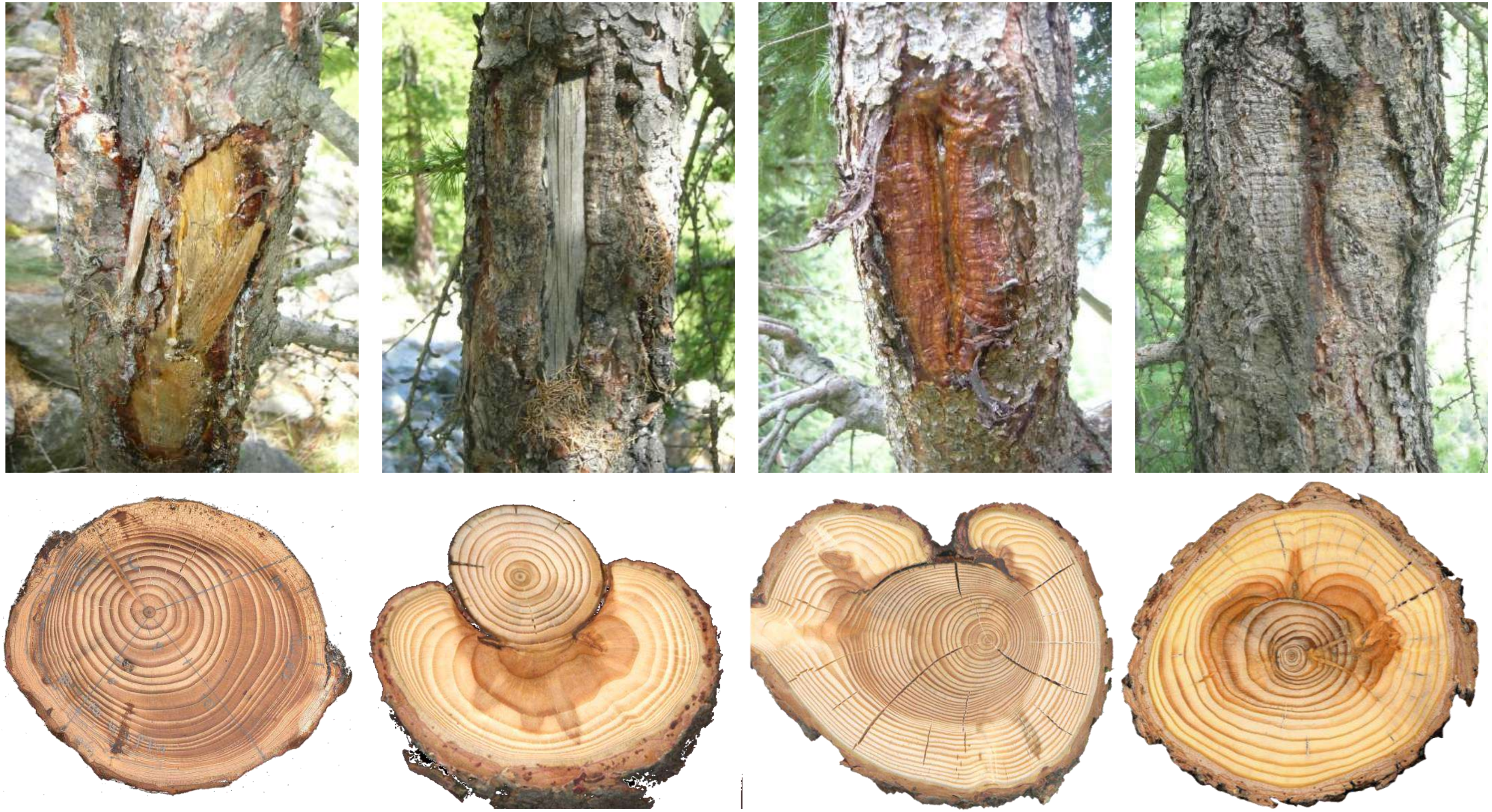
Integration of historical and tree-ring records to improve the flood risk assessments in poorly gauged regions

Floods in Kullu District, Himachal Pradesh

Indian Himalayas Climate Adaptation Programme, Swiss Agency for Development and Cooperation (SDC)

Creating baselines

Natural disasters recorded in trees

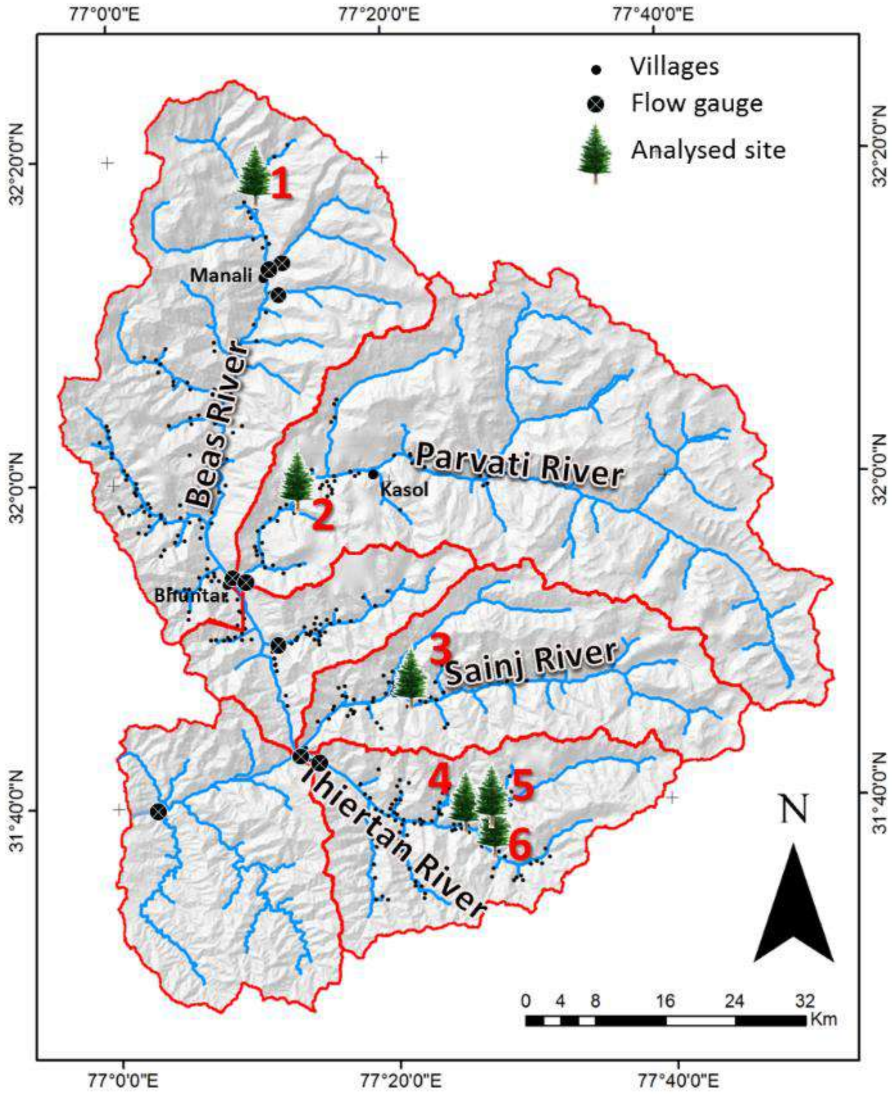


Trappmann & Stoffel (2014) *Geomorphology*

Floods in Kullu District, Himachal Pradesh

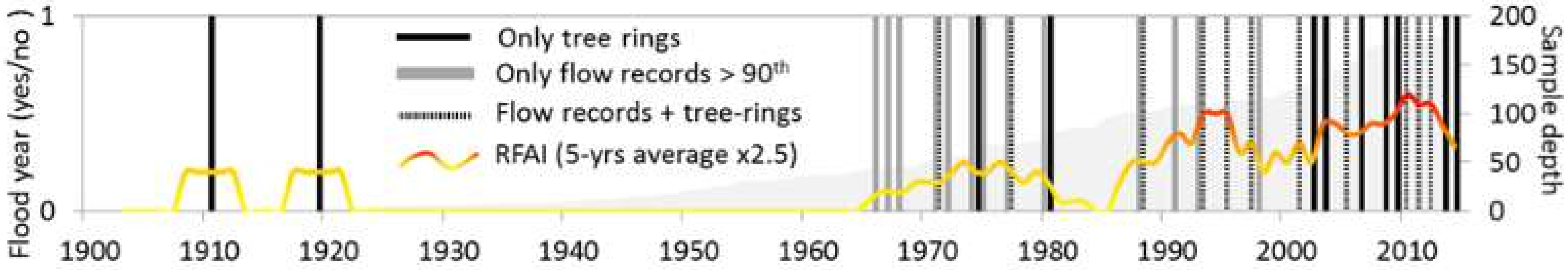
- Area: 5,500 km^2
- > 400,000 people
- >5,000 fatalities since 1950

- 6 river reaches
- 177 affected trees
- 253 samples



Floods in Kullu District, Himachal Pradesh

Flood frequency reconstruction

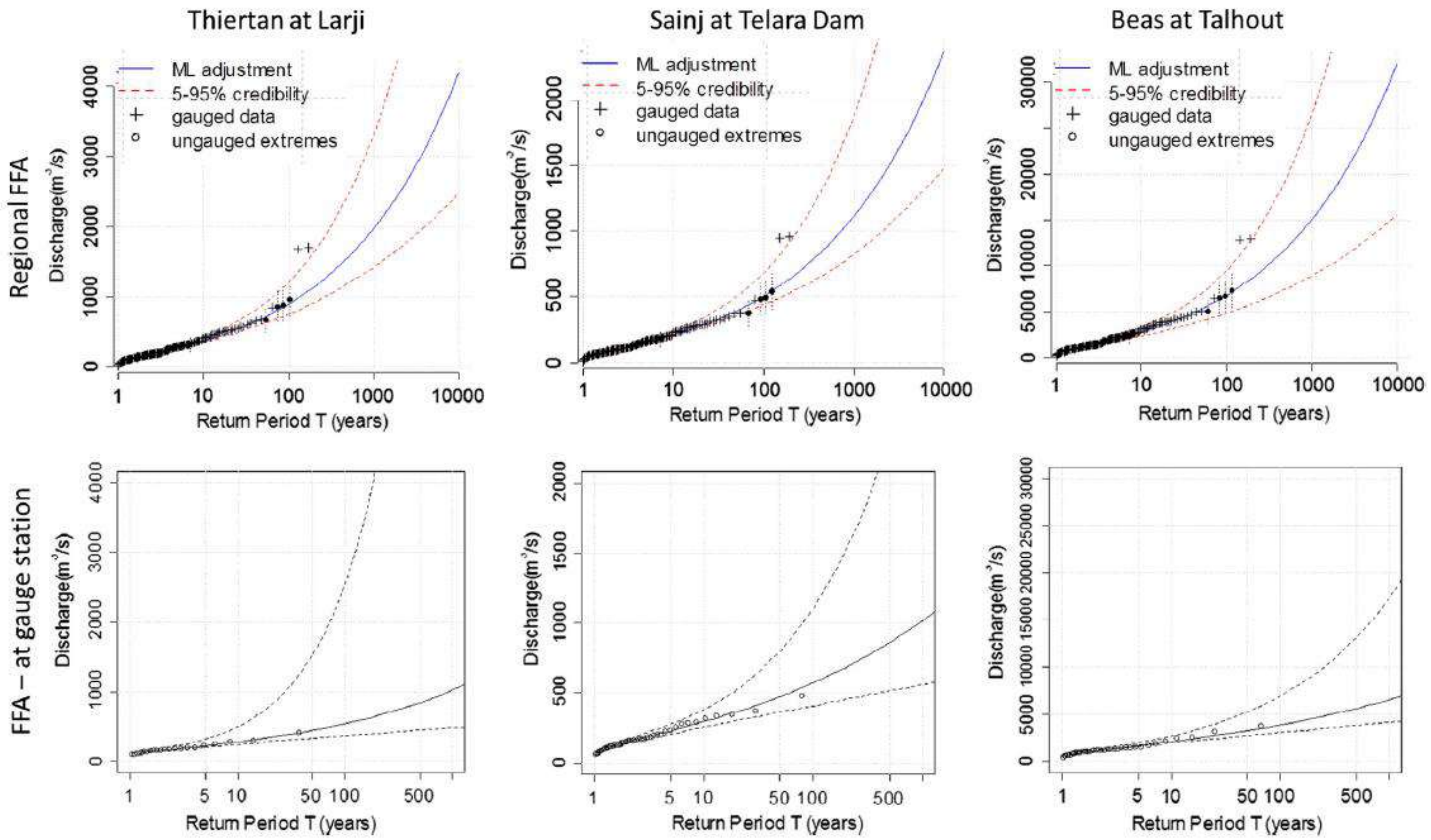


Ballesteros et al. (2017)

- Frequency : 0.29 event/yr > since 1970: 0.6 event/yr.
- Different phases of activity, e.g. 1977-1981 vs. 1981-1987.
- Provides a more reliable regional flood frequency with reduced uncertainties.

Floods in Kullu District, Himachal Pradesh

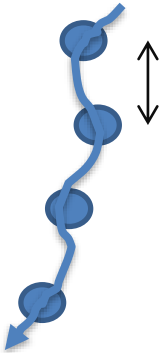
UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES



Floods in Kullu District, Himachal Pradesh

Flood risk assessment

1) Flood hazard index

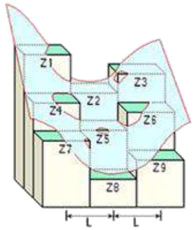


500 m

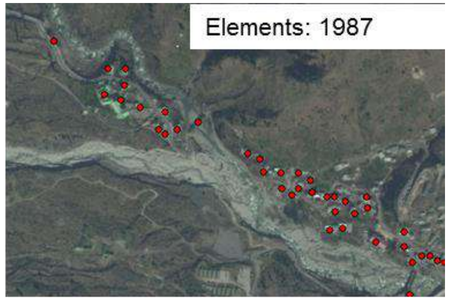
Combine:

- Regional flood frequency (tree rings)
- Channel slope (SRTM DEM)
- Hazard = Q_{100}/Q_{bank} x slope

2) Exposure index

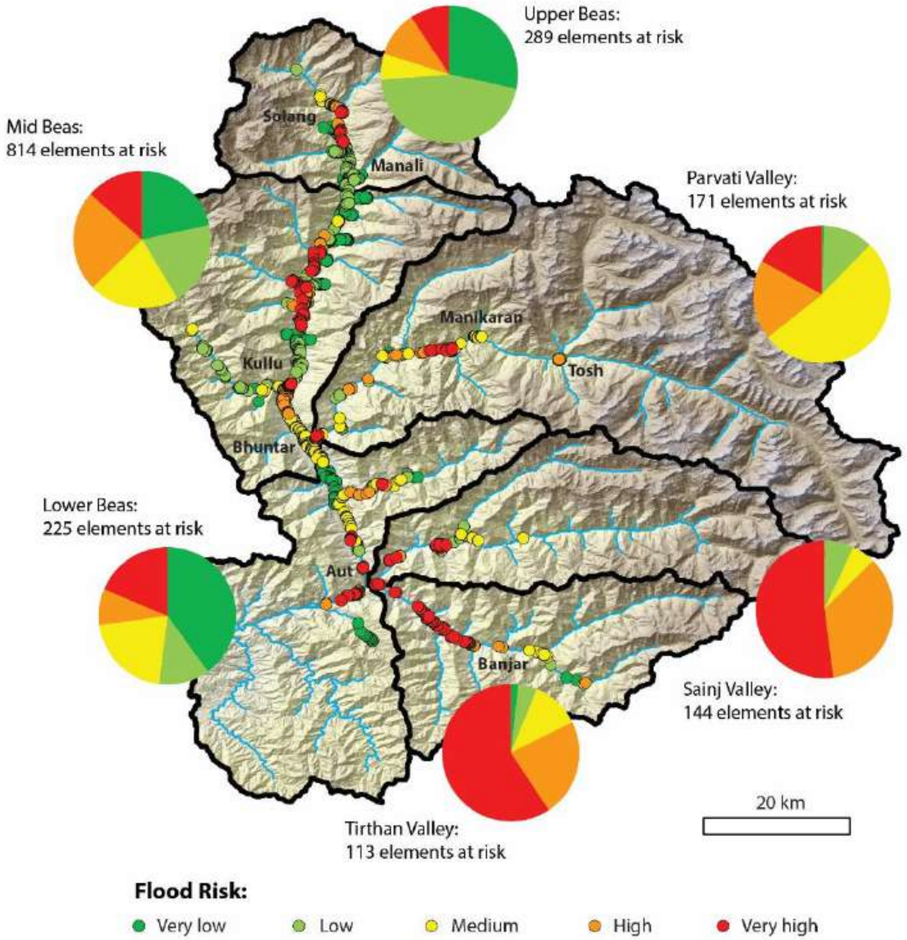


Floodplain morphology



Diff in altitude (m) between
Houses and channels

Combine

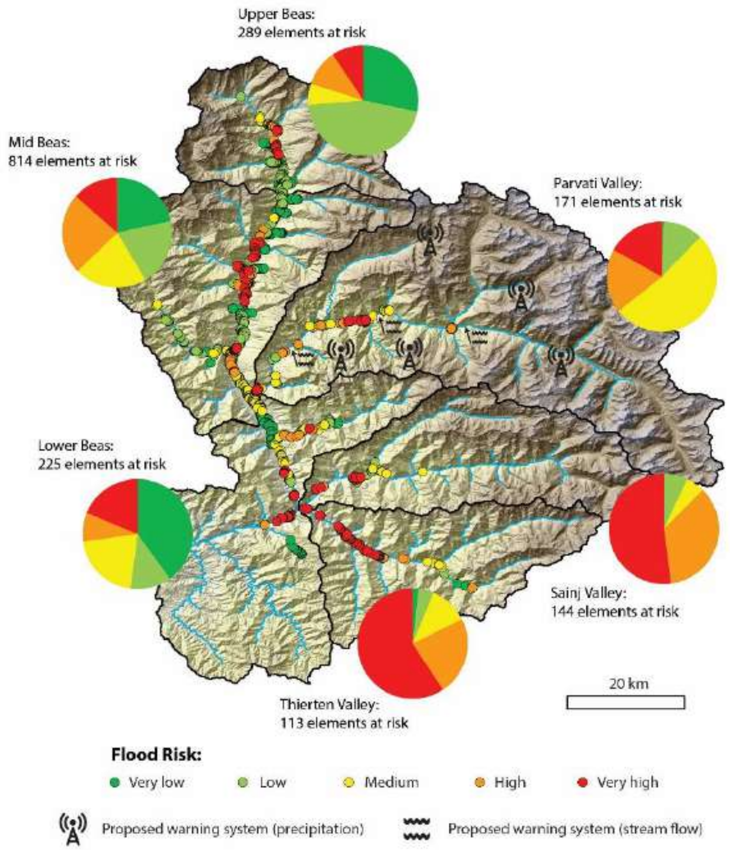


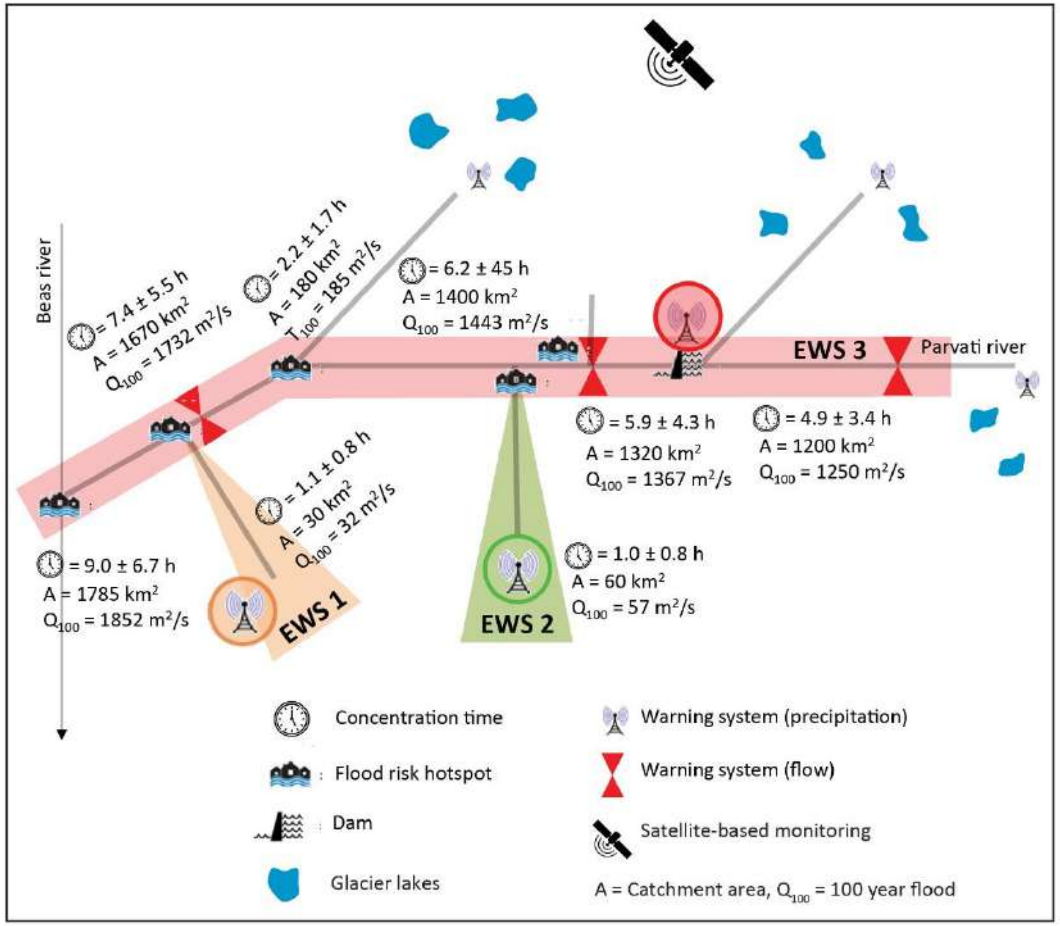
3) Vulnerability index

Socio-economic data from Indian Census 2011

Floods in Kullu District, Himachal Pradesh

Early warning systems





UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES

Landslide trend analyses and hazard modelling in data-scarce regions

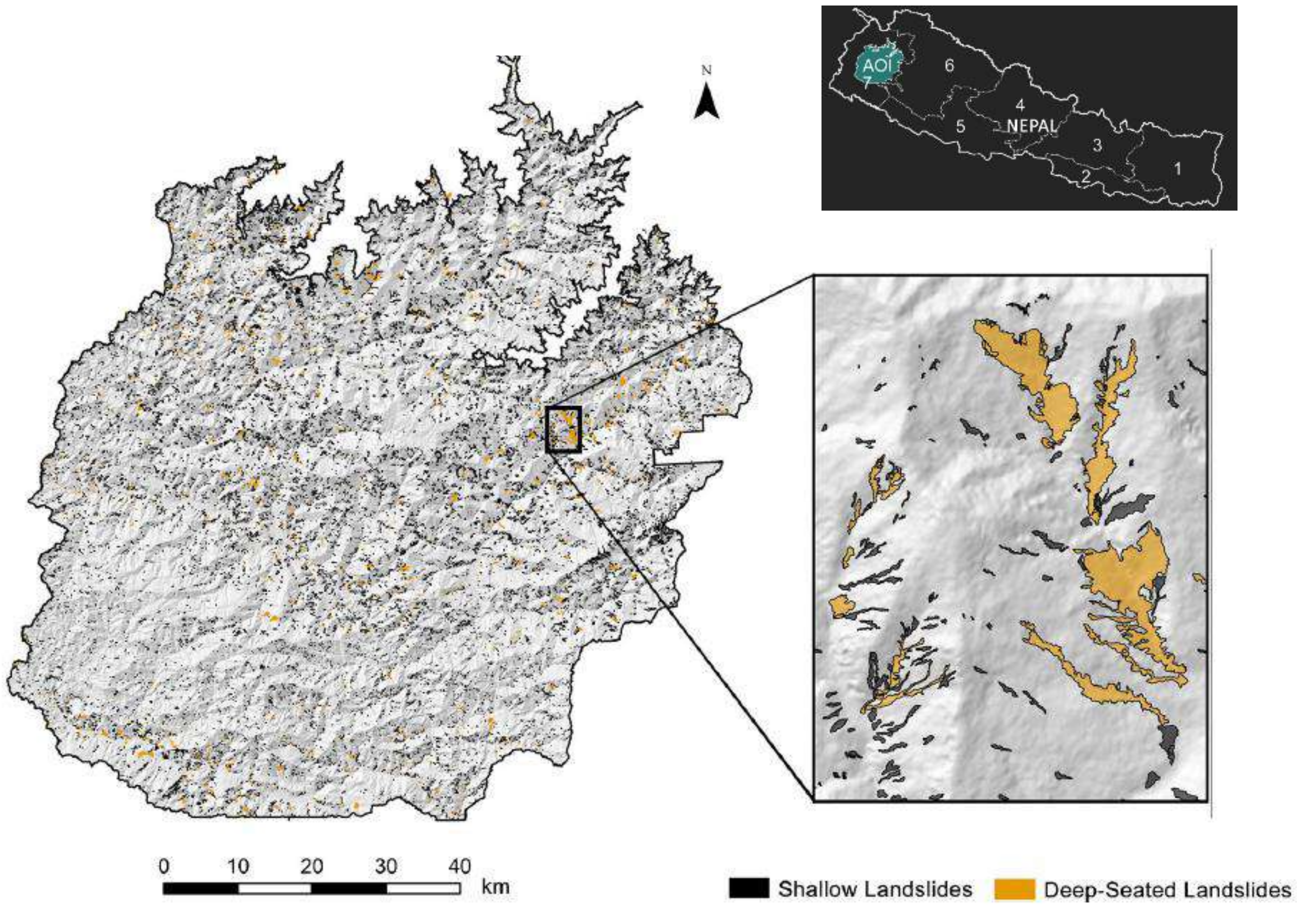
Karnali basin, Western Nepal

NERC (Natural Environment Research Council) and DFID (Department for International Development) under the UK SHEAR (Science for Humanitarian Emergencies and Resilience) programme

Landslides in Karnali basin, Western Nepal

Landslide database

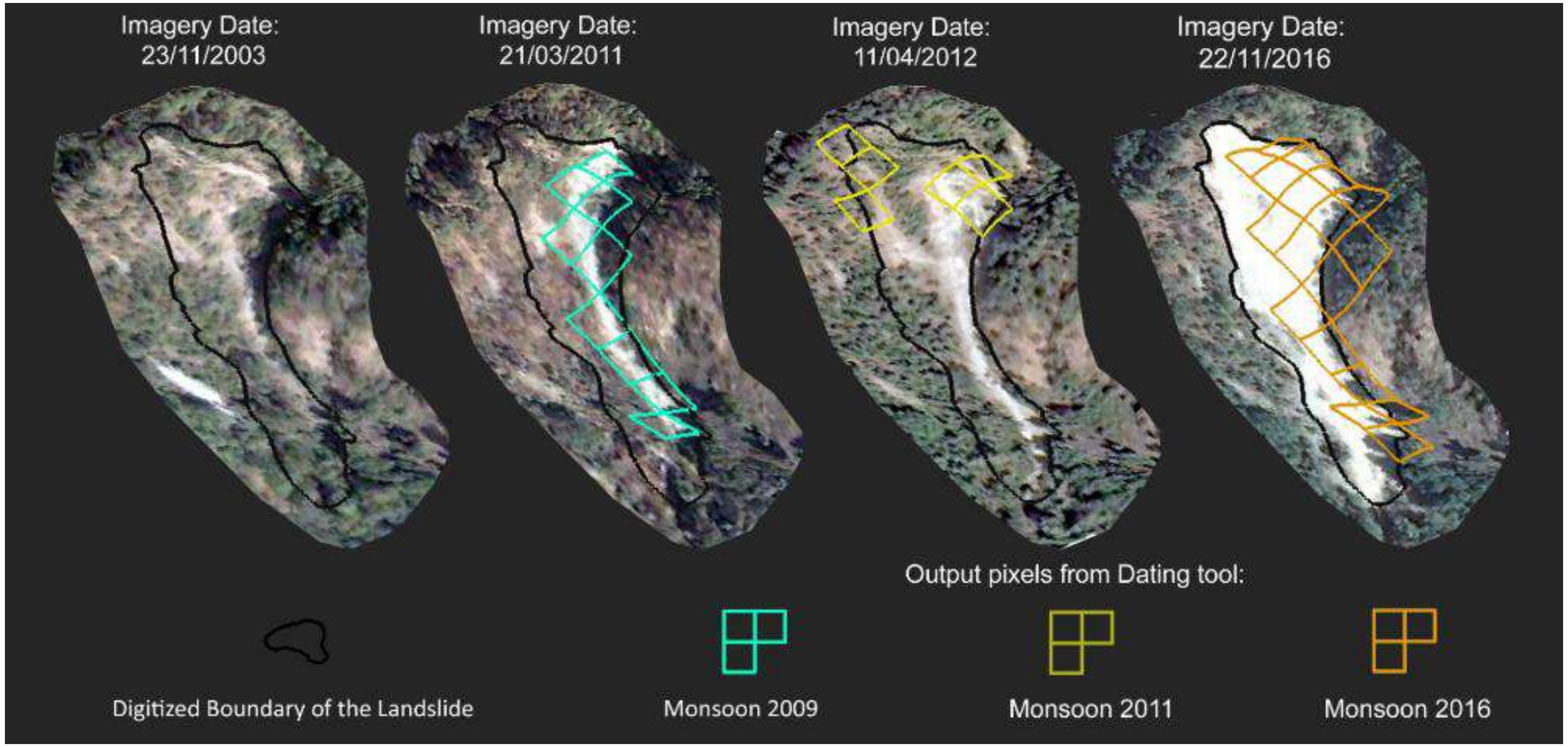
- 26,350 mapped landslides from Google Earth imagery.
- 8,778 single events annually dated 1992-2018 using automated techniques.

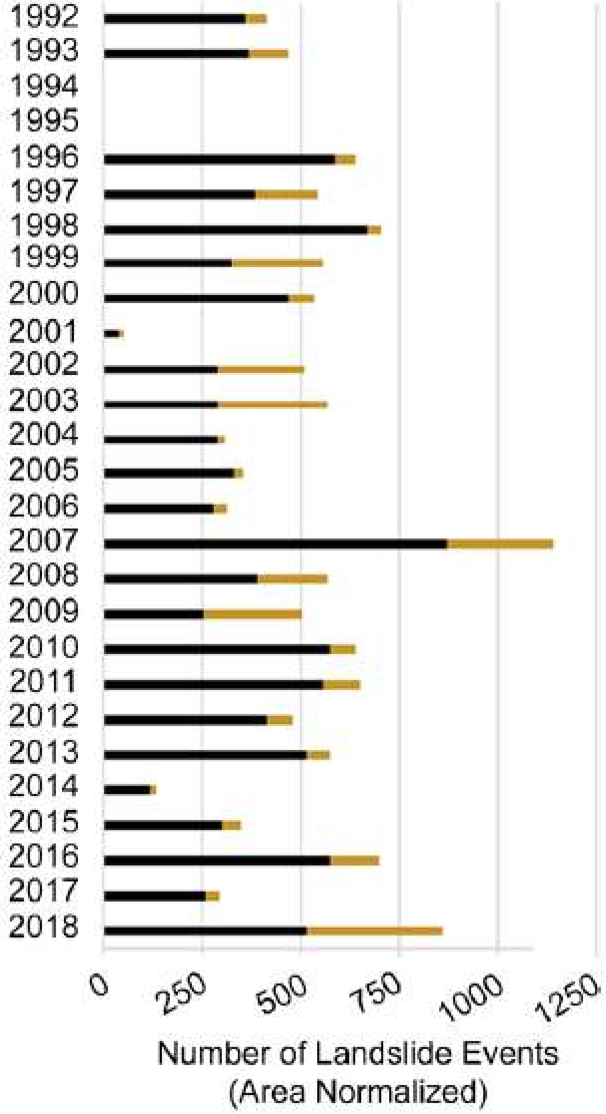


Muñoz-Torrero Manchado et al. (2021)

Landslides in Karnali basin, Western Nepal

Landslide classification and frequency



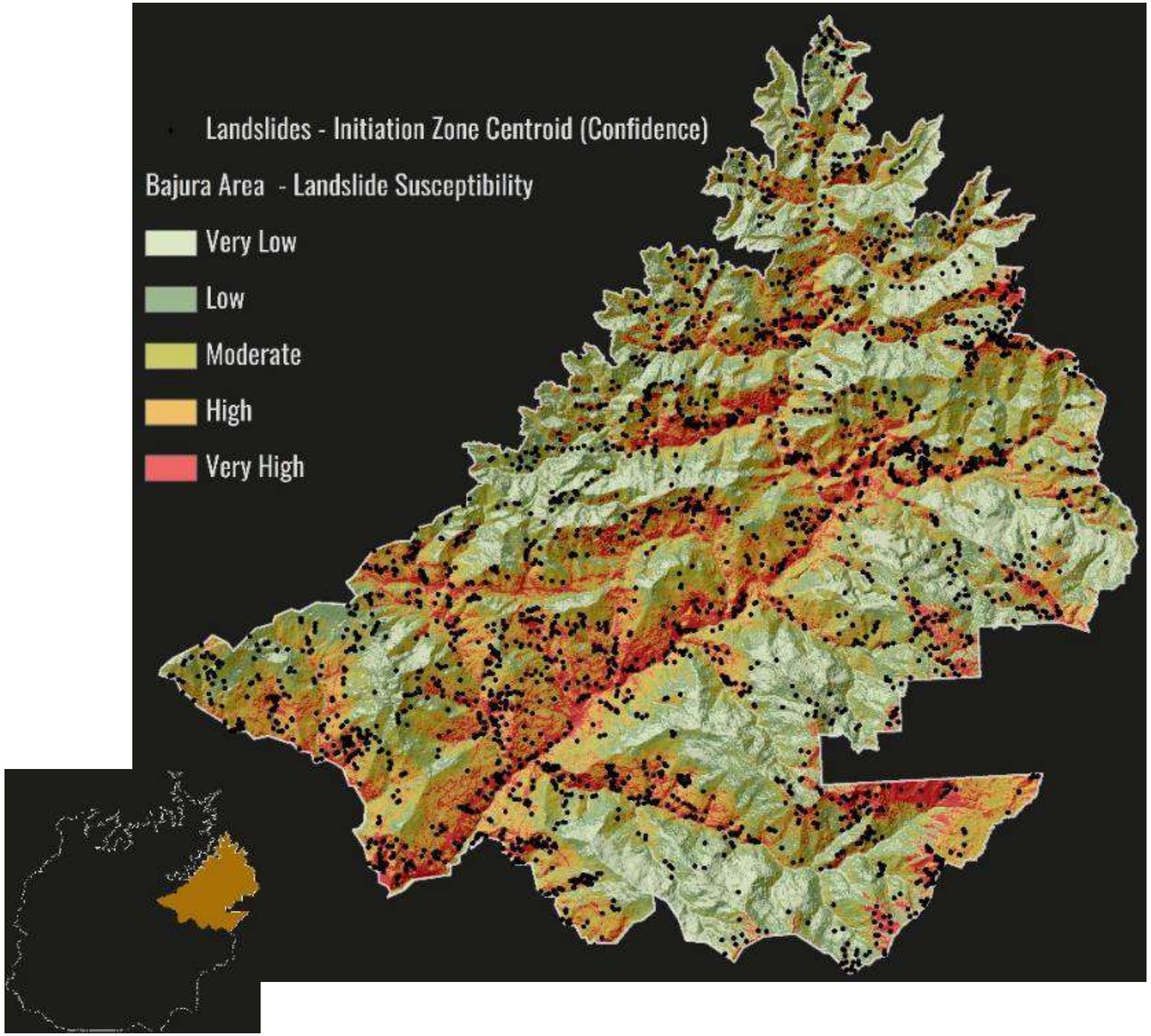


- ArcGIS toolbox developed for annual dating of landslides using Landsat imagery.

Landslides in Karnali basin, Western Nepal

Hazard and risk modelling

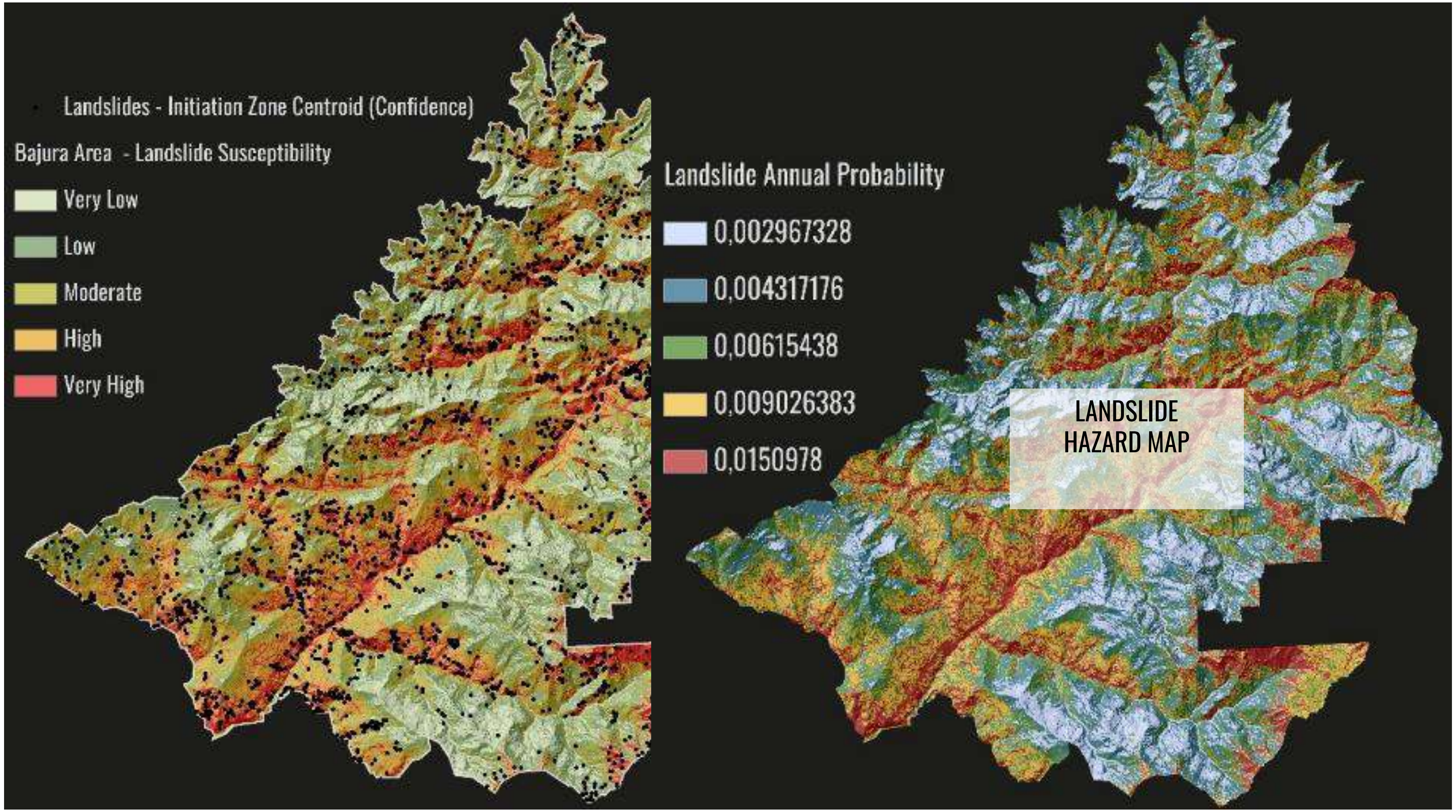
- 12 different input layers (factors)
- Selection of the best model by creation of Success Rate Curves and calculating Area Under Curve (AUC).
- 75% accuracy in final classification.

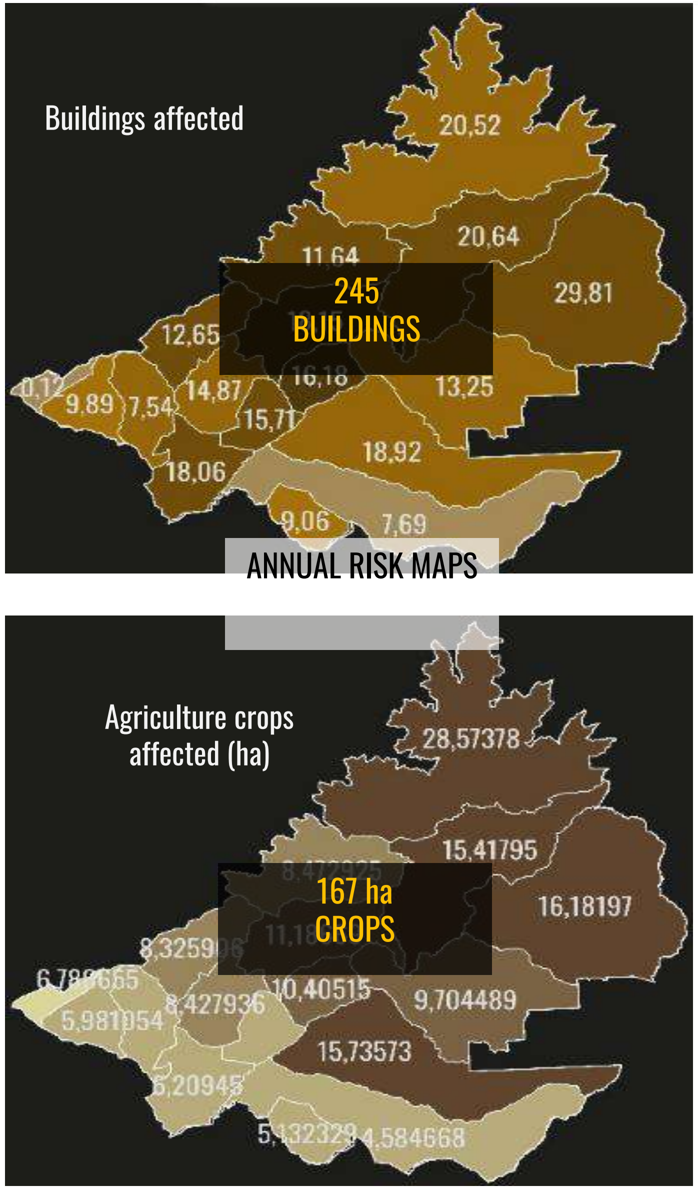


Landslides in Karnali basin, Western Nepal

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES

Hazard and risk modelling





Final considerations

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES

- A successful implementation of a MHRAF will critically depend on baseline data and…
- …truly integrated and forward-looking catchment-scale approaches.
- Innovation will be critical as readily existing approaches may not be easily transferable to HKH
- Switzerland needed 70 years to be where it is today, but now has a functional and widely accepted IRM framework

Government of Nepal
Ministry of Home Affairs
National Disaster Risk Reduction & Management Authority

ICIMOD

CONSULTATIVE MEETING ON

Development of multi-hazard risk and loss and damage assessment framework for HKH

8–9 December 2022

#HKHmultihazardL&D

Thank you!

Markus Stoffel & Simon K. Allen

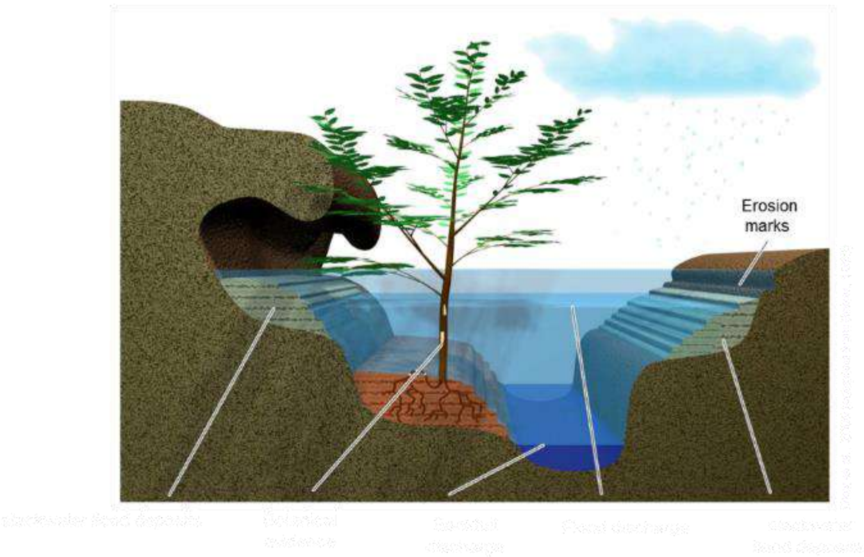
markus.stoffel@unige.ch

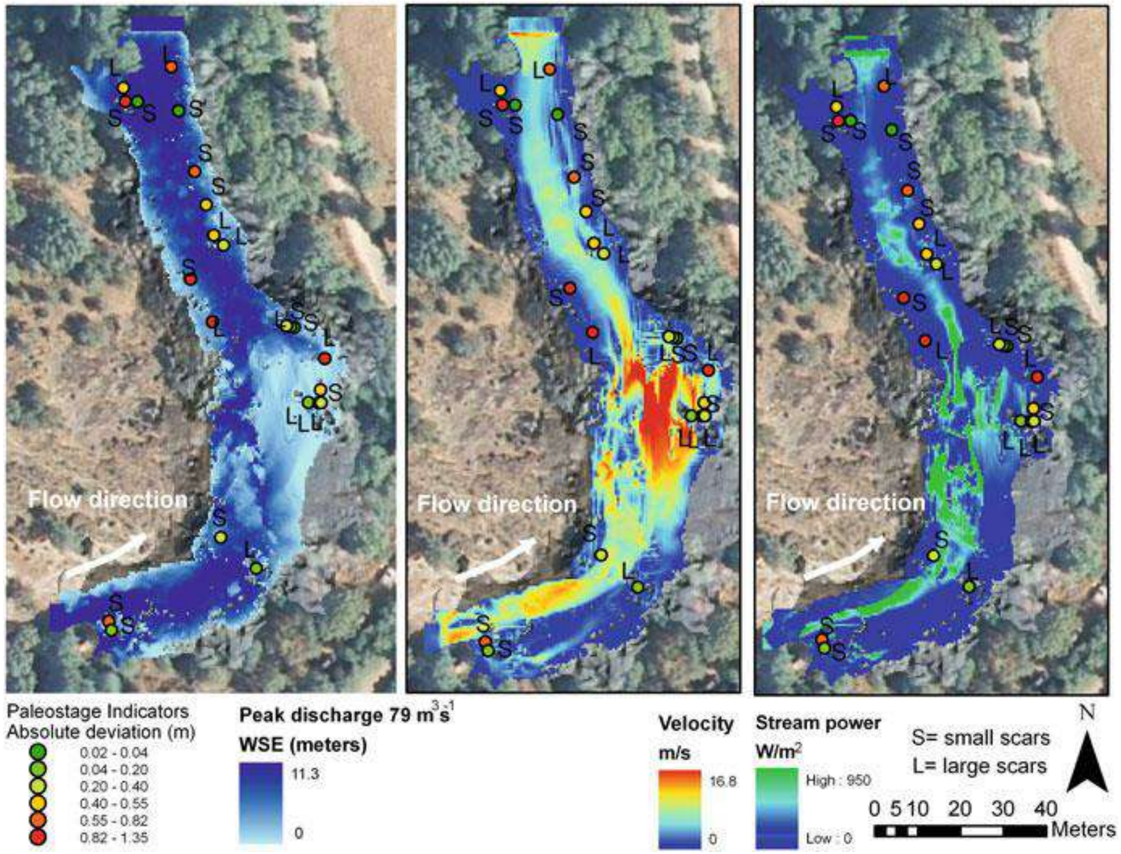
www.c-cia.ch ¦ www.dendrolab.ch

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES

Floods in Kullu District, Himachal Pradesh

Flood magnitude reconstruction





Ballesteros et al. (2011)