SWISS NGO DRR PLATFORM

*Integrated floods management:*
*Acting locally, linking beyond!*

# Integrated management of floods and flows

## Challenges, limits and potential of science and technology

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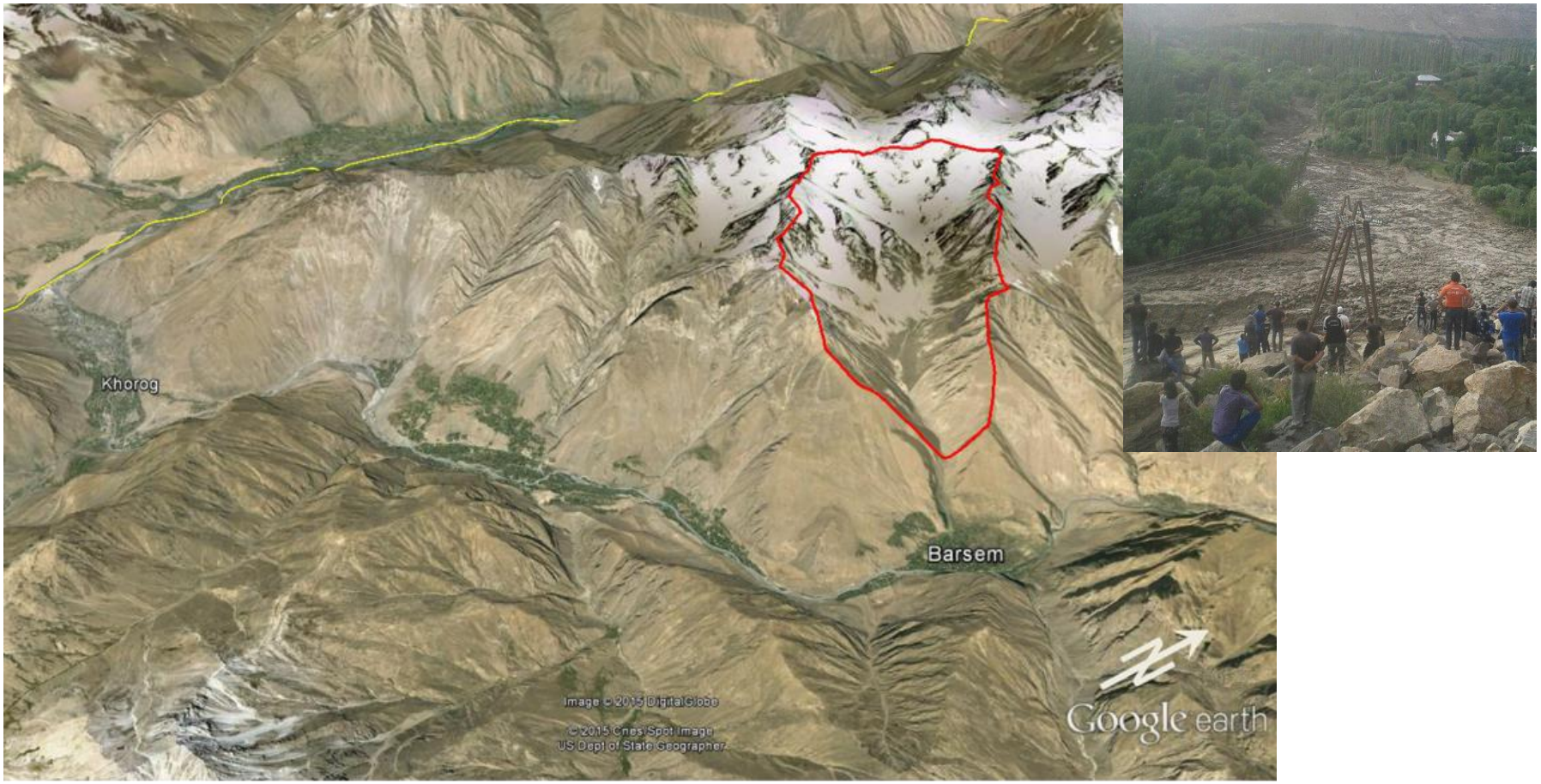
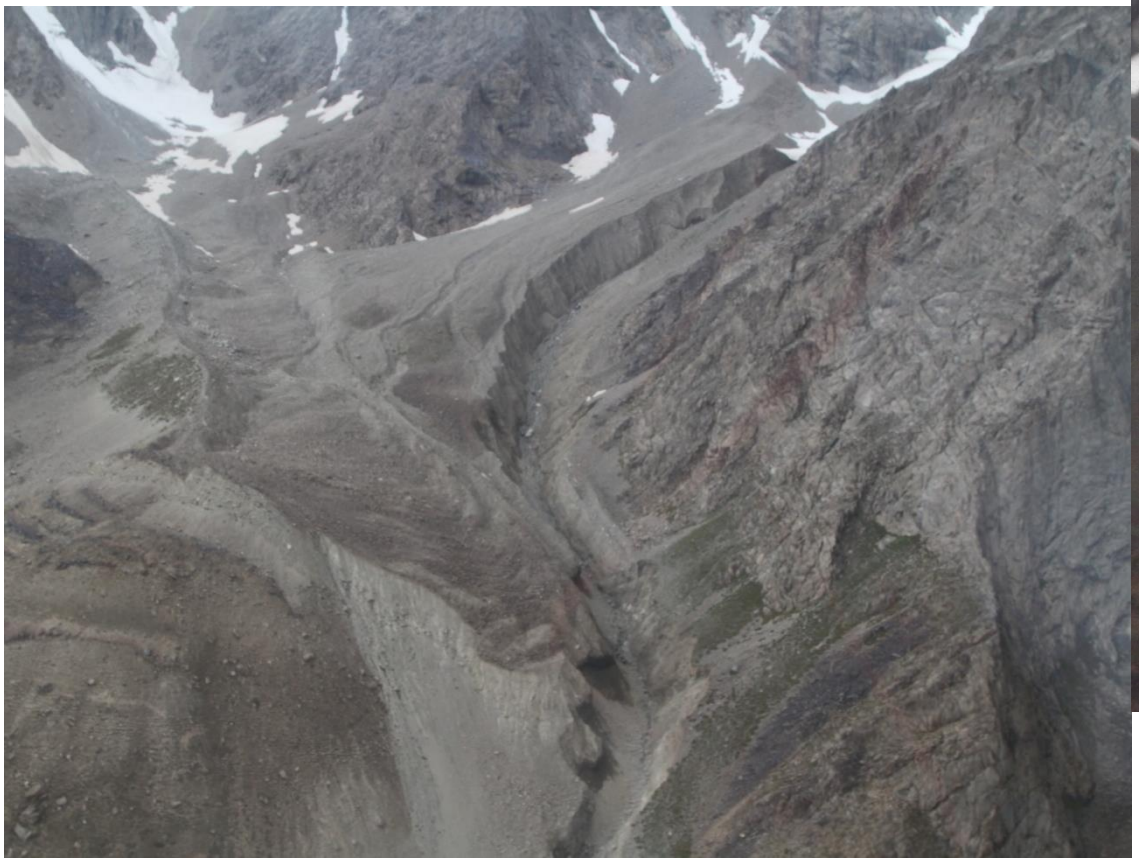
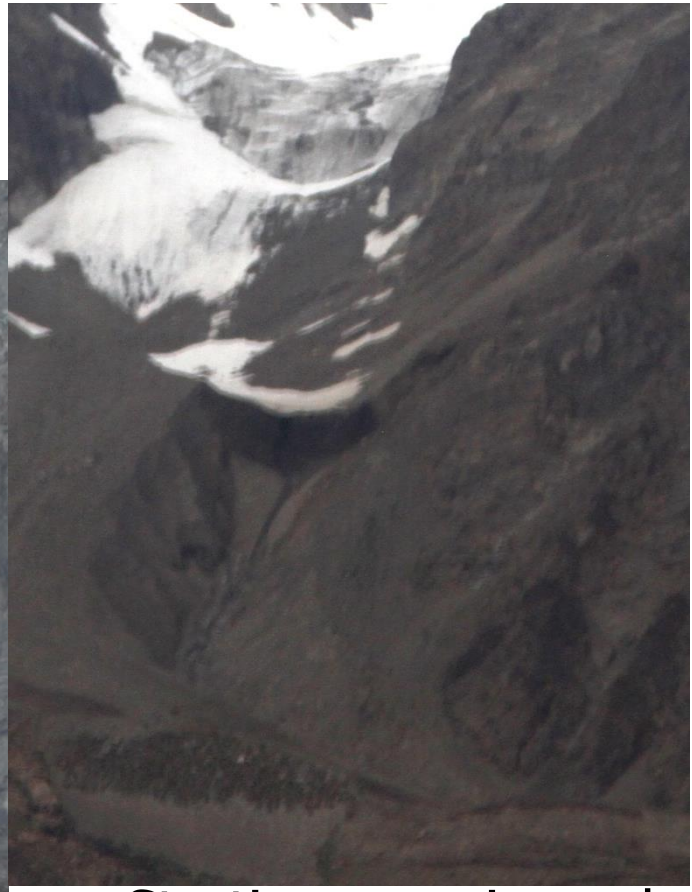
10 November 2015




Barsem, Pamir, Tajikistan; 16 July 2015
1500 inhabitants; first debris flows occurred





Starting zone in push moraine; recently glacier covered; with indications for permafrost melting

Barsem Valley; July 2015
unusually hot, unusually wet

Barsem, 19 July 2015: 1.5 million $m^3$ of debris dammed Gunt River, made 100 families homeless, livelihoods of 200+ households heavily affected, interrupted Pamir Highway, destroyed energy lines and other infrastructure.

→ Intention to relocate people in similar conditions

## What can we learn from this event?

- Sediments can be more important than water
  → nothing new, but keep in mind
- Long-term changes as pre-conditions for large events
  → events without historical parallels might occur
- People's view and behaviour during and after such event
  → sometimes more complex than nature
- Communities at risk can be identified, eventually be protected (or relocated) and definitely be prepared
  → integrated approach required

# Overview

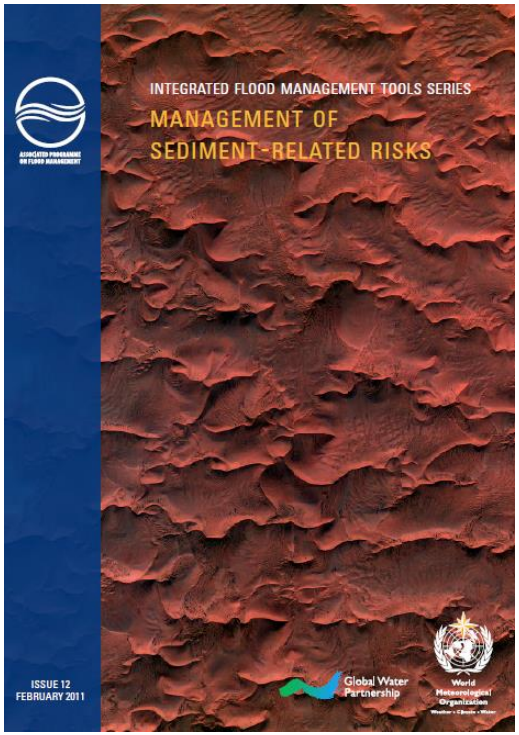
Integrated management of floods and flows:
Challenges, limits and potential of science and technology

1. Sediment-related disasters: some characteristics
2. Assessment of hazards and risks; extreme events where sediments are relevant
3. Evaluation (weighting) of risks: people's perception, interpretation and willingness to invest in risk reduction

# 1 Sediment-related risks and disasters

Sediment-related disasters are defined as phenomena that cause direct or indirect damage to life and property of individuals, inconvenience their lives, and/or deteriorate the environment through large-scale movement of soil and rock.

*Source: Integrated Flood Management Tools Series No.12: Management of Sediment-related Risks*
*www.apfm.info/?page_id=696*



# Characteristics of sediment-related risks and disasters

- Relatively small in geographical extent, as compared to floods
- Changing landforms: accumulation of landslides or debris flows can alter the landscape dramatically
- Often very fast movements: high intensity, short warning time
- Highly destructive due to

  …

  …

# Lost ground

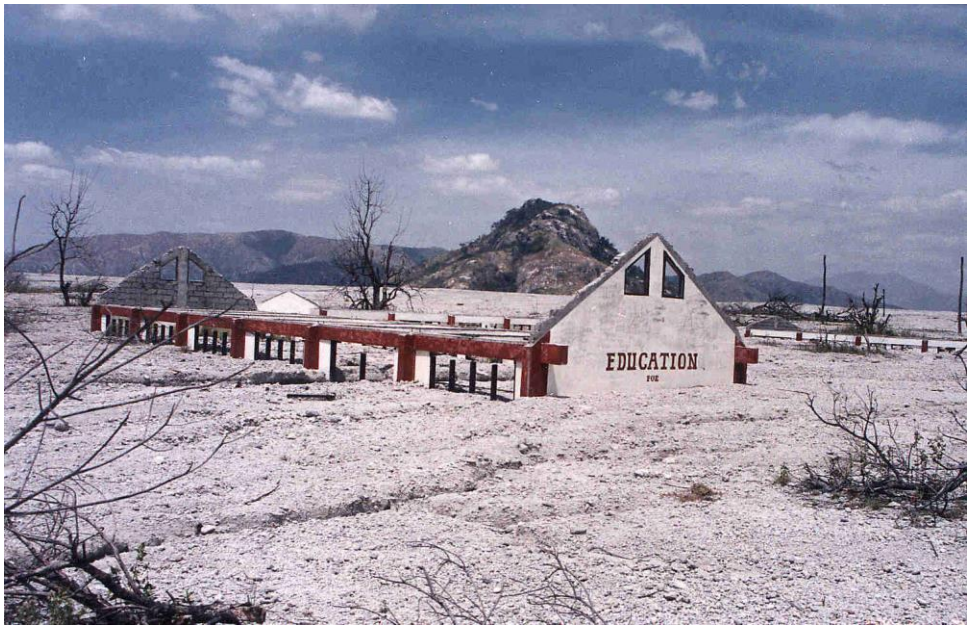
Deep-seated landslide, Falli Hölli, Fribourg, June 1994

http://www.planat.ch/de/bilder-detailansicht/datum/2010/04/12/erdrutsch-falli-hoelli-1994/

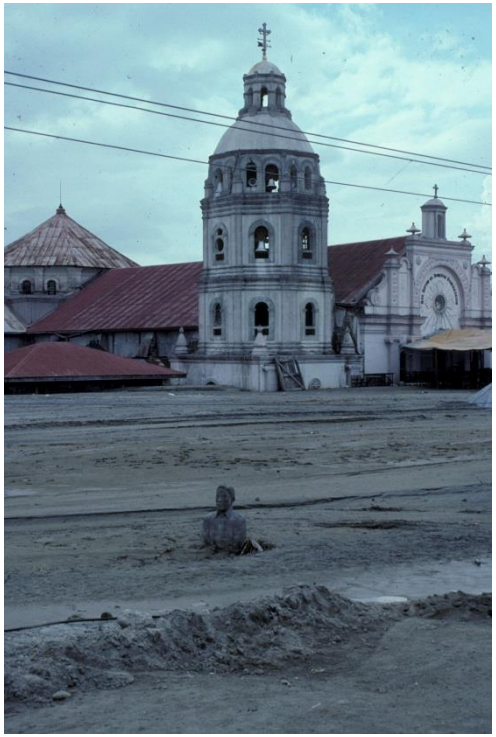
# Destructive force of mass movement

Debris flow in Gitch, Gilgit-Baltistan
Pakistan, July 2006

# Buried land




School in Santo Tomas



Church in Bacolor

Eruption of Mt Pinatubo, Philippines in June 1991;
lahars for several consecutive years; buried approx. 300 $km^2$
of arable land, settlements and infrastructure

# Aggradation of river bed

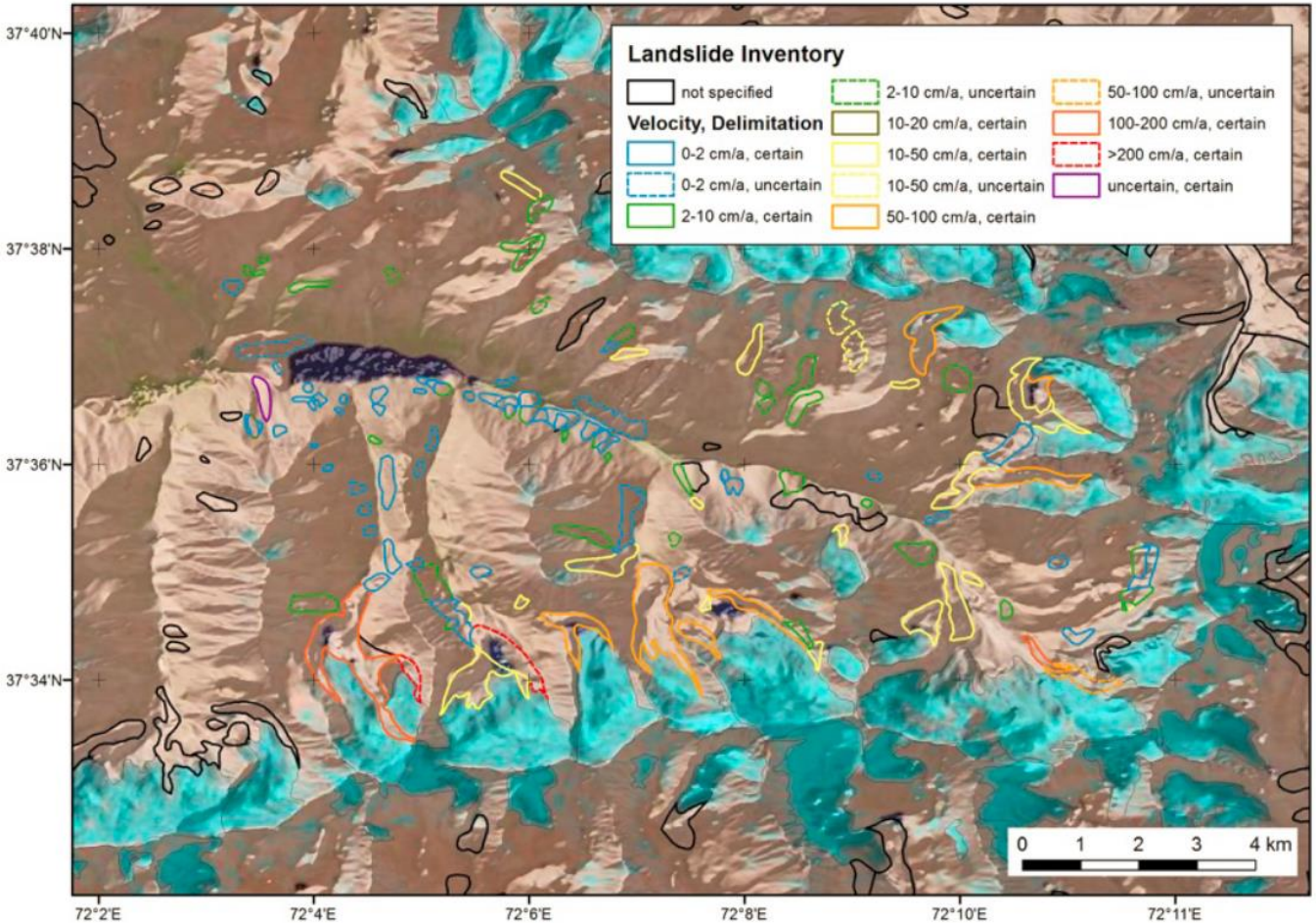
Langar River, Tajikistan: gradual river bed rising
September 2012

# 2 Assessment of hazard and risks

Identification and analysis of hazards (and sediment sources) can make use of powerful scientific methods, for example

- Radar interferometry
- Interpretation of satellite and airborne imagery for environmental changes
- Empirical formulas and modelling for the analysis of peak discharge, velocity, travel distance, transported sediment volume, etc.

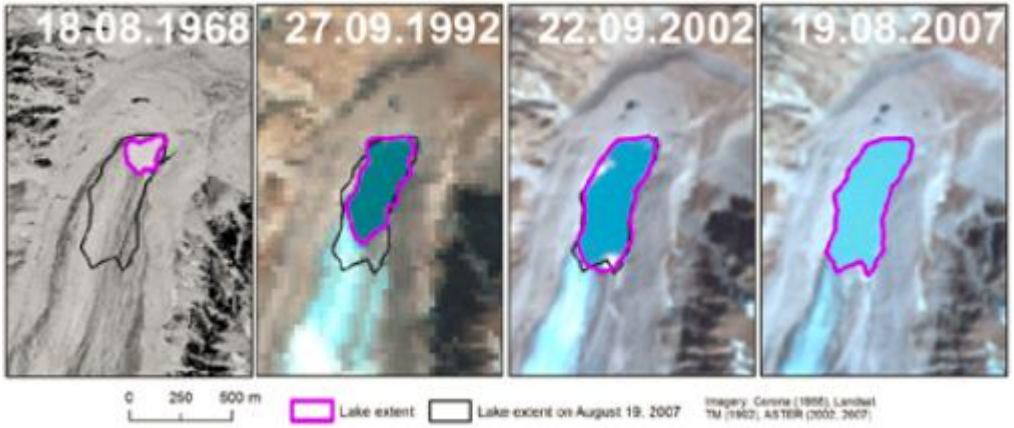
# Assessment of landslide hazard using InSAR



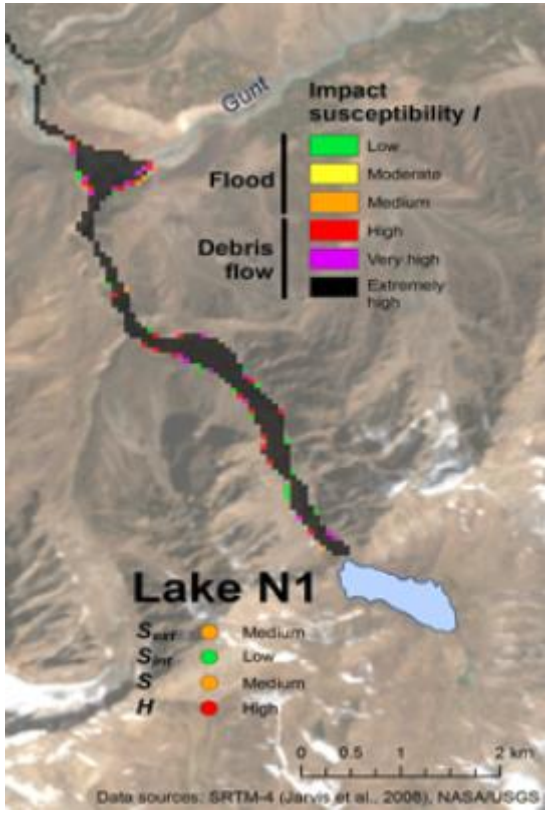

SGLAMO
gamma-rs.ch

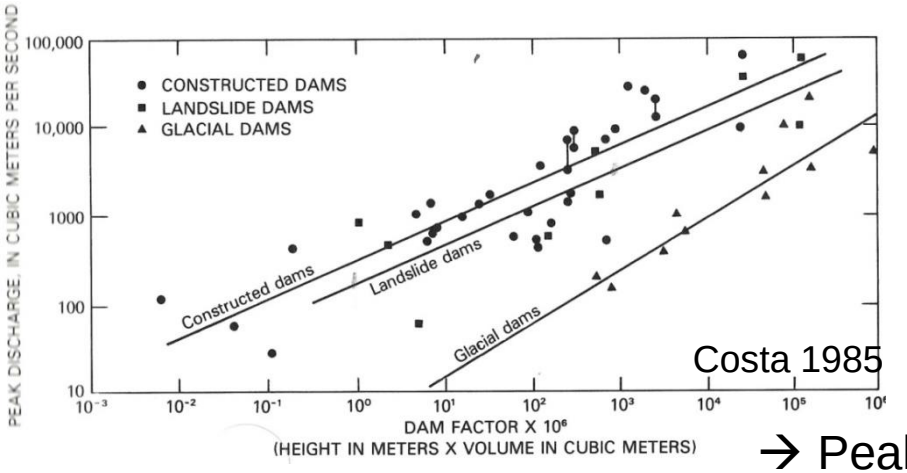
Landslide inventory for Rivakkul (Tajikistan) and its surrounding, based on SAR interferometry: → landslide assessment for large areas

# Assessment of glacial lakes' development




Mergili and Schneider 2011:
Nat. Hazards Earth Syst. Sci., 11, 1447–1462

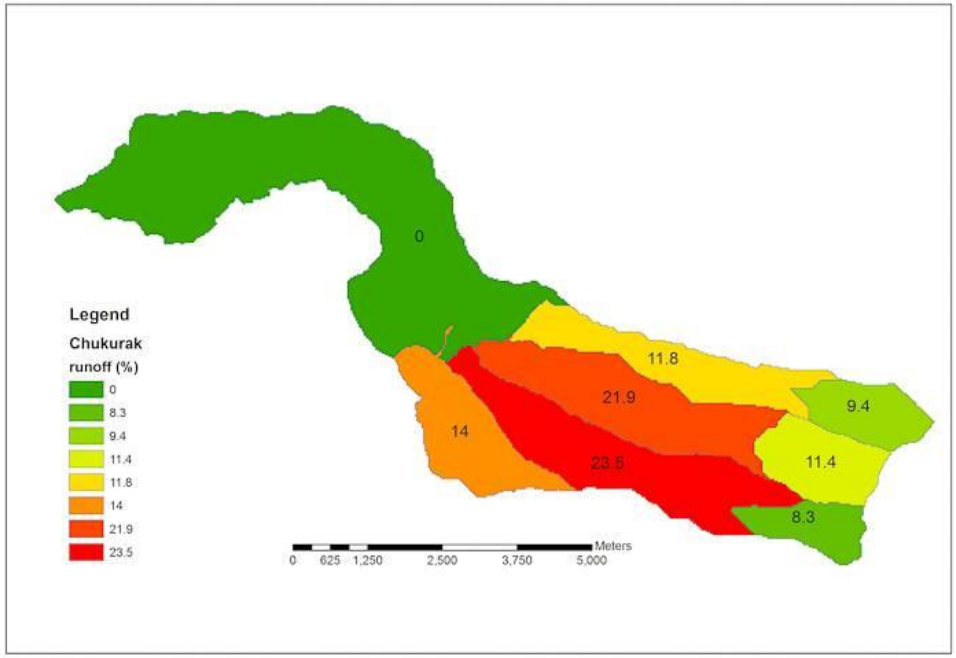



Costa 1985

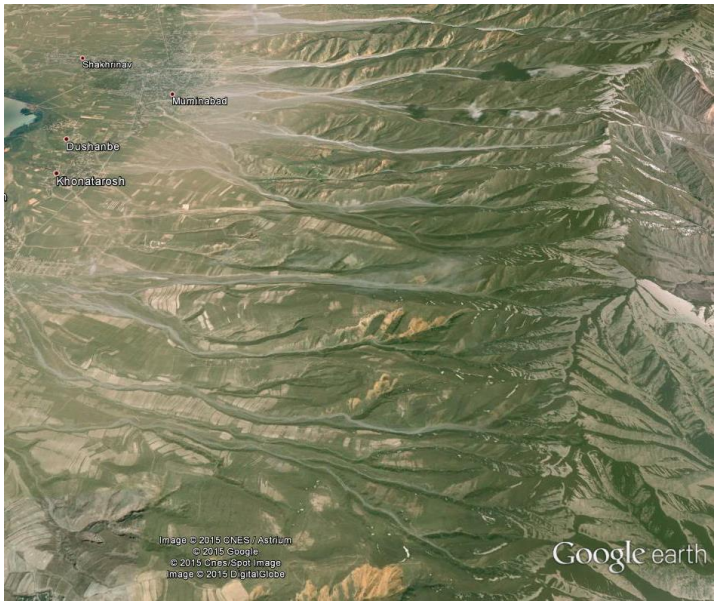
→ Peak flow discharge

# Hydrological modelling in watersheds




Chukurak watershed, Muminabad, Tajikistan.
Modelled rainfall run-off
Chukurak Watershed Activity Plan,
2012, by CARITAS

This information can be directly used to focus watershed management options




Google Earth is a powerful tool to support any type of assessment, modelling and developing of measures

## Challenges and limits

Science-based assessment results

- may point to conditions for events without historic parallels (often not detected in a community risk profile)
- often show worst-case scenarios; difficult to implement
- often indicate *WHERE* and *HOW BIG,* but are silent regarding the question of *WHEN / HOW OFTEN* (probability of occurrence / recurrence interval) because measurements / observations are missing

➔ knowledge and know-how is required, also at the local level to translate scientific results into local-level development decisions

# 3 People's perception and view on risks

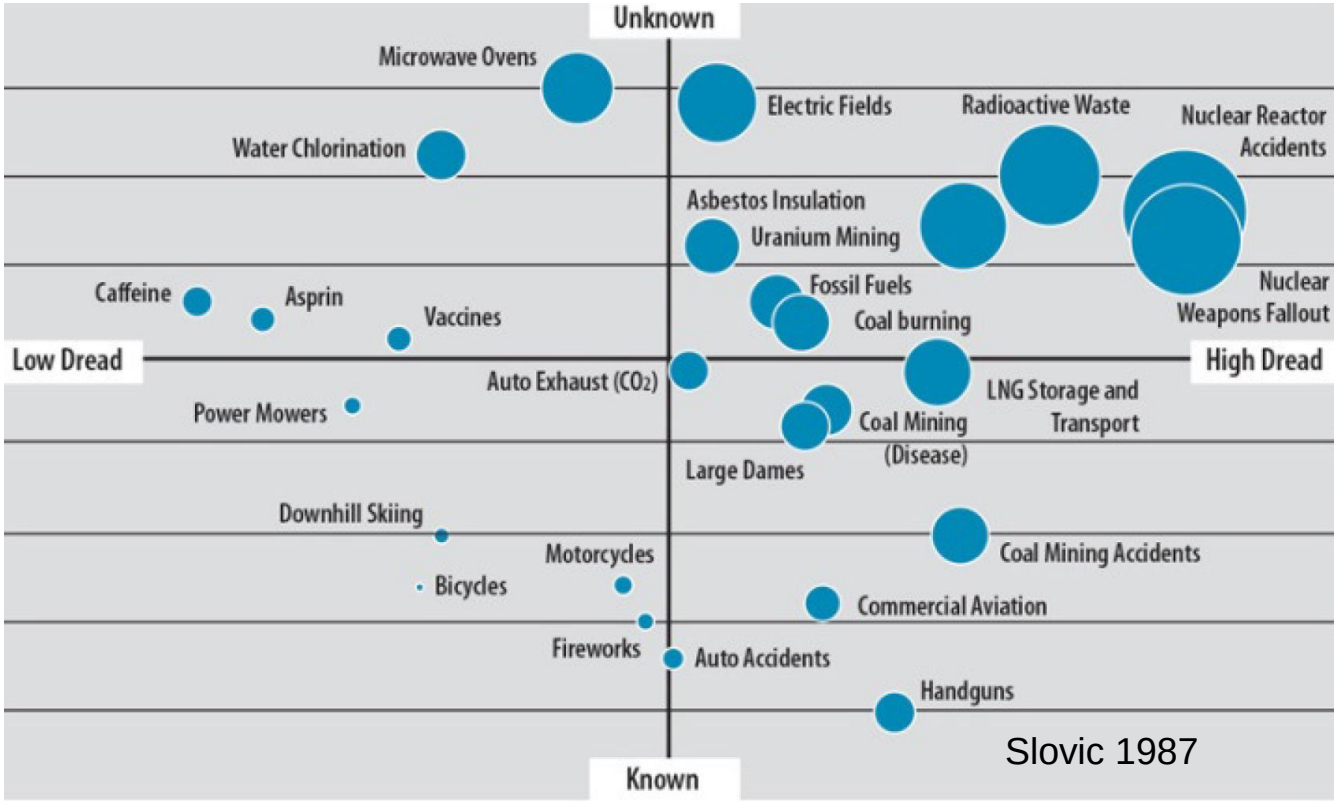
People's perception of risks, their interpretation of disasters and their view on risk management is often very complex and not directly accessible

Social sciences provide theories and tools:

→ to understand overall risk context
→ to learn about people's cultural orientation
→ to evaluate people's preferences

# Social science's theories (1)

Psychometric paradigm
- low-high dread
- known-unknown




Slovic 1987

# Social science's theories (2)

## Cultural Theory of Risk with Grid-Group-Model

| | | |
|---|---|---|
| *High Grid* | **Fatalism**<br>Low cooperation within group<br>Lack of risk assessment | **Hierarchism**<br>High cooperation within group<br>Philosophy of risk limitation |
| *Low Grid* | **Individualism**<br>Each persons for themselves<br>Maxime of optimization risk | **Egalitarianism**<br>High group participation in decision making<br>Dogma of zero risk |
| *Grid-Group-Coordinates* | *Low Group* | *High Group* |

Douglas and Wildavsky (1982)

# Social Science's Tools

- Rapid Rural Appraisal
- Ethnographic Research
- Case Study Research
- Focus Group Discussion
- ...

e.g. http://www.csc.noaa.gov/mpass/tooltable.html.)

## Risk evaluation and weighting: challenges and limits

- Risk from various threats might be more important than those from natural hazards
- What we interpret as fatalism may have clear cultural/religious explanations
- The need for risk reduction might not be at the forefront of people's mind as increased security is not tangible

➔ Social issues have to be integrated into (flood) risk management concepts and approaches. This is often neglected in applied projects.

# Summary

Science can contribute to:

- identify hazards and risks in a changing environment
- analyse hazards and risks quantitatively
- understand people's view and perception or risks
- develop appropriate countermeasures

The local level requires capacity to:

- understand and interpret results from science
- consider people's view for risk reduction
- provide measure that have tangible effects in addition to reduced risks

# *Thank you for listening*

# 4 Management options

- avoid: e.g. land-use planning, including relocation
- mitigate: watershed management, structural protection
- prepare: emergency management, including EWS
- transfer: insurance and other transfer mechanisms

# Land-use planning

Relocation is very popular in a number of countries: following the Barsem case, the government together with and an NGO opted to relocate all communities at risk

→ Relocation is an option when the threat is imminent.

→ Relocation to places that are really safe

➔ Science can contribute with up-to-date information about magnitude and probability of particular events in order to avoid decisions based on worst-case scenarios.

# Watershed management

Addressing the root causes of floods and sediment disasters:

→ stabilising slopes

→ improving vegetation cover

→ reducing peak water discharge

→ reducing erosion

➔ Science collected and developed a full set of approaches and technologies for sustainable land management (SLM), presented in the WOCAT tool box.

WOCAT

World Overview of Conservation Approaches and Technologies

# Watershed management

Measures to reduce water discharge and to prevent erosion might include:

**Pasture management** in higher altitudes

**Conservation agriculture** in lower altitudes

**Energy efficiency** to reduce pressure on vegetation in watershed

**Reforestation** with fruit trees or by combining agro-forestry measures

**Small-scale structural mitigation** in lower reaches to prevent erosion