

Standardizing tools for Glacier Lake Outburst Flood mapping for capacity building



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Project 672 - Himalayan glaciers: assessing risks to local communities from debris cover and lake changes using new satellite data

IGCP project meeting in 2018

- 1. Workshop on use of remote sensing and GIS for geoscience applications, held at Royal Thimphu College (Bhutan): 3-4 June 2018

This two-day workshop, co-sponsored by the IGCP 672 project and the USAID-funded CHARIS project at University of Colorado provided training on fundamentals of GIS and remote sensing for a variety of geoscience applications. The topics included introduction to ArcGIS software, fundamentals of remote sensing, searching and ordering data from various platforms, image pre-processing and glacier mapping using Landsat f satellite images of Bhutan and importing MODIS data. The workshop participants were from RTC as well as other Bhutanese institutions, with a total of 23 participants (11 female and 12 male) representing eight different agencies, namely Private Consultancy firm, National Land Commission, Samtse College of Education, National Center for Hydrology and Meteorology, Jigme Namgyel Engineering College, Royal Thimphu College, Sherubtse College, including two external participants (IGCP project collaborators) from Delhi Technological University and Indian Institute of Technology (IIT), Indore, India.

RELATED INFORMATION

Project Leader

- Dr Adina E. Racoviteanu

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- Duration: 2018-2022

- IGCP Theme: Geohazards

IGCP theme: Geohazards

Glacial and lake Hazards



The
Geological
Society

Debris-covered glaciers: from remote sensing and field-based tools to local communities

Date: 02 - 04 September 2019



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Event type: Workshop

Organised by: Geological Society Events, 2019 Year of Carbon

Venue: Burlington House, London

[Map](#)

Goal of the workshop:

- Collaborate on **standardizing remote sensing methodology** for GLOF assessment (regional → local scales)
 - **Short-term: Transfer scientific knowledge** to local partner institutions in high Asia through trainings and workshops
 - **Long-term: Inform the decision process** on hazard mitigation

Glacier Lake Outburst Floods: A systems approach

TRIGGERS:

Ice calving

Ice fall from
hanging glaciers

Rock/ice/snow
avalanches

Dam failure

Ice-cored moraine
degradation

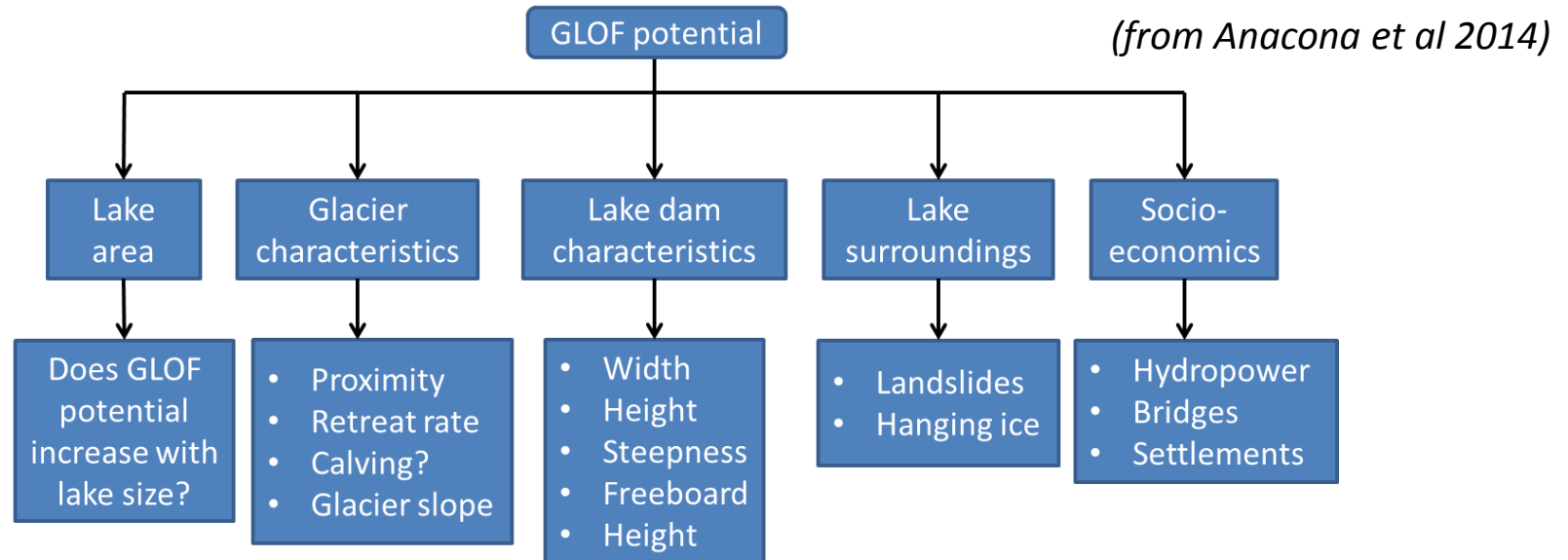
Q: Is this lake
hazardous?

RISK = Hazard

x

Vulnerability

GLOF criteria : Gaps / needs



- Need a **standard, objective, unified** ranking scheme
- Use **new RS and digital terrain data**
- Recommend a **method** (decision-based, multi-criteria, etc.)
- **Transfer the method** across regions

Previous lake ranking schemes

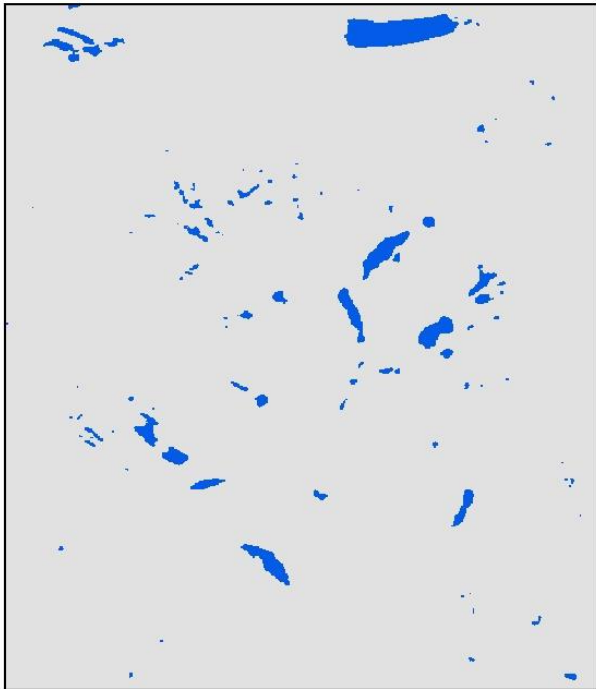
Method	References	Limitations
Multi-criteria (a-priori knowledge)	<i>Reynolds, 2014 and other papers GAPHAZ 2007</i>	<ul style="list-style-type: none">• Need expert knowledge
Remote sensing (decision-based)	<i>Quincey et al., 2007; Bolch et al., 2008a, 2011; Wang et al., 2011; Worni et al., 2013; Iribarren Anacona et al., 2014; Rounce et al., 2016; Kougkoulos et al., 2018; Allen et al, 2019</i>	<ul style="list-style-type: none">• No consensus on a standardized scheme• No consensus on data to be used
New automated (GIS/RS approach)	<i>Allen et al, 2019</i>	<ul style="list-style-type: none">• Code not yet shared (ArcGIS)

Working group outcome

Assessing GLOF susceptibility: 2 stages

1. REGIONAL SCALE: 'First –order' screening of lakes

GAPHAZ Criteria (2007 & updated coming soon)



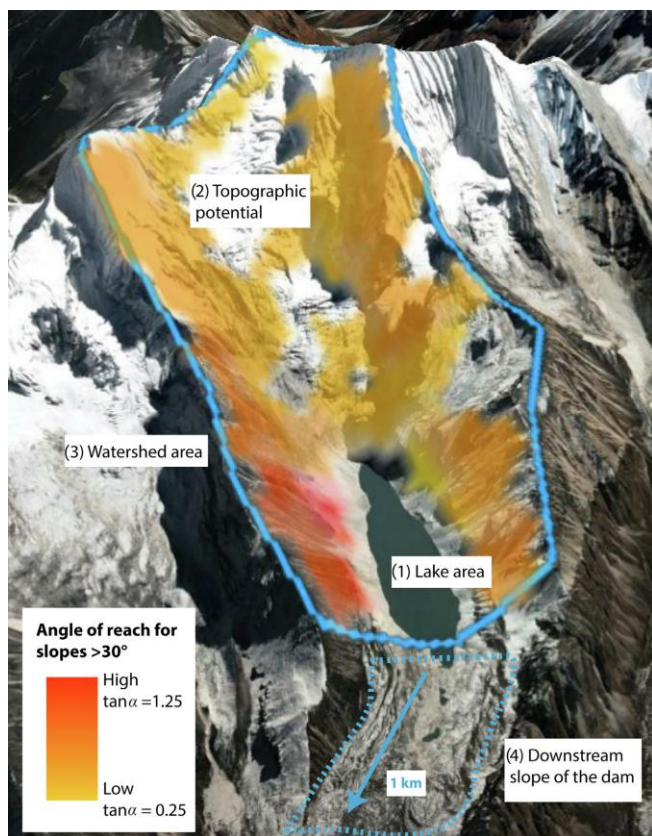
Need to filter automatically lake inventories (thousands lakes) to identify “hot spots” for detailed analysis

Working group outcome

Assessing GLOF susceptibility: 2 stages

1. REGIONAL SCALE: ‘First – order’ screening of lakes

GIS/ Remote sensing-derived Criteria (*Allen et al 2019*):



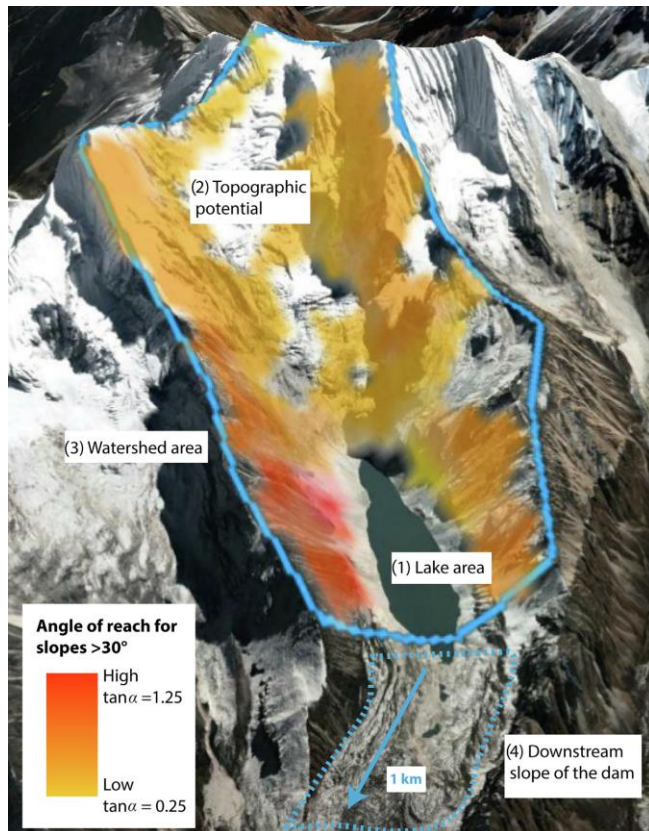
- Lake area (threshold)
 - “Topographic potential” (potential for avalanche to hit lake)
 - Area of watershed upstream
 - Downstream slope of the dam
- +
- Distance from glaciers
 - Overhanging ice (yes/no)
- (*Anaconda et al 2014, Kougkoulos et al 2018*)

Working group outcome

Assessing GLOF susceptibility: 2 stages

1. REGIONAL SCALE: 'First – order' screening of lakes

GIS/ Remote sensing-derived Criteria (*Allen et al 2019*):



Data sources (freely available)

- *Landsat, ASTER, Sentinel*
- *SRTM (30, 90 m)*
- *ALOS DEM (30 m)*

Methods:

- Lake mapping: NDWI, sub-pixel
- Glacier mapping: Band ratios
- Topographic: DEM analysis

Working group outcome

Assessing GLOF susceptibility: 2 stages

2. LOCAL SCALE: DETAILED ANALYSIS



Data sources (not free)

- *UAV data*
- *Google Earth*
- *High resolution DEM (stereo)*

Methods:

- DEM analysis (GIS)
- InSAR (movement)
- visual assessment

This Step more difficult to automate!!

Summary and outlook

- **Consensus:**

- Existing GLOF assessments from RS **yet needs to be standardized**
- 2-stage lake system assessment protocol in progress
- Unified scheme (incl. GLOF routing) still needs time

- **Old/New data :**

- Landsat, Sentinel-2 : update lake and glacier inventories
- 30m SRTM, ASTER, ALOS DEMs – sufficient for regional scale

- **Platform:** aim towards **open source code** (eg. Python); open source platform (e.g. OGGM)

Thank you!