



Wasim Gahfoor  
s-waghaf@uni-greifswald.de

# Glacial retreat-driven hazards and the adaptive capacity of high-altitude communities



## Introduction:



Globally, between 150,000 and 200,000 glaciers are rapidly receding as a result of warming temperatures as shown in fig 1. In many areas, this retreat—which averages 10 meters annually—is speeding up. One obvious and well-known effect of climate change is the loss of glaciers, which highlights its effects on landscapes, natural hazards and water resources. Global awareness has been raised by high-profile cases, such as the melting glaciers in Glacier National Park and Mount Kilimanjaro. Addressing glacier retreat has proven challenging despite the efforts of agencies such as the UNFCCC, and failure to do so may indicate more significant difficulties in addressing the wider effects of climate change. [3]

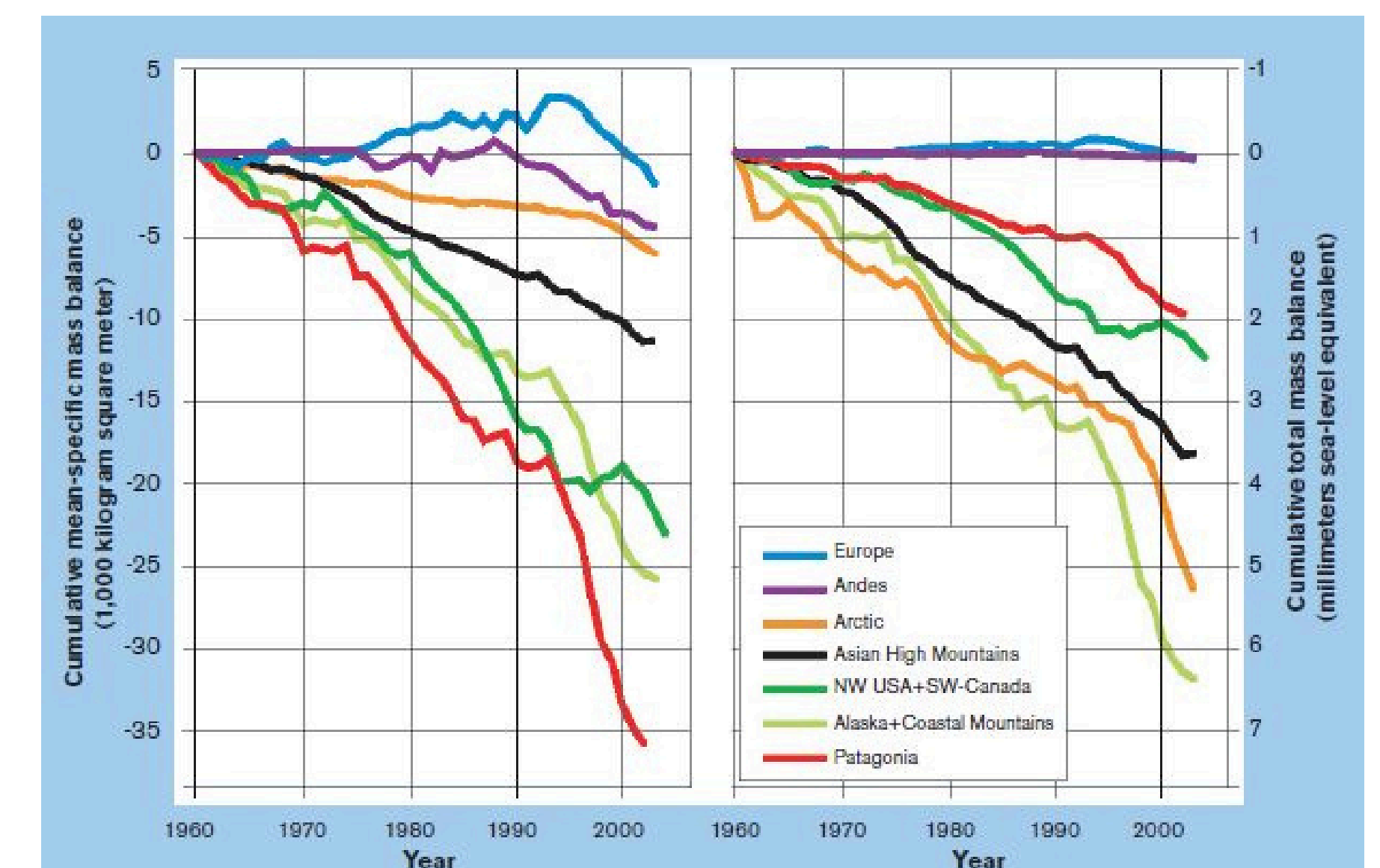


Fig:1, Trends of glacier Melting in different Continents [3]

## Challenges faced by mountain Communities :

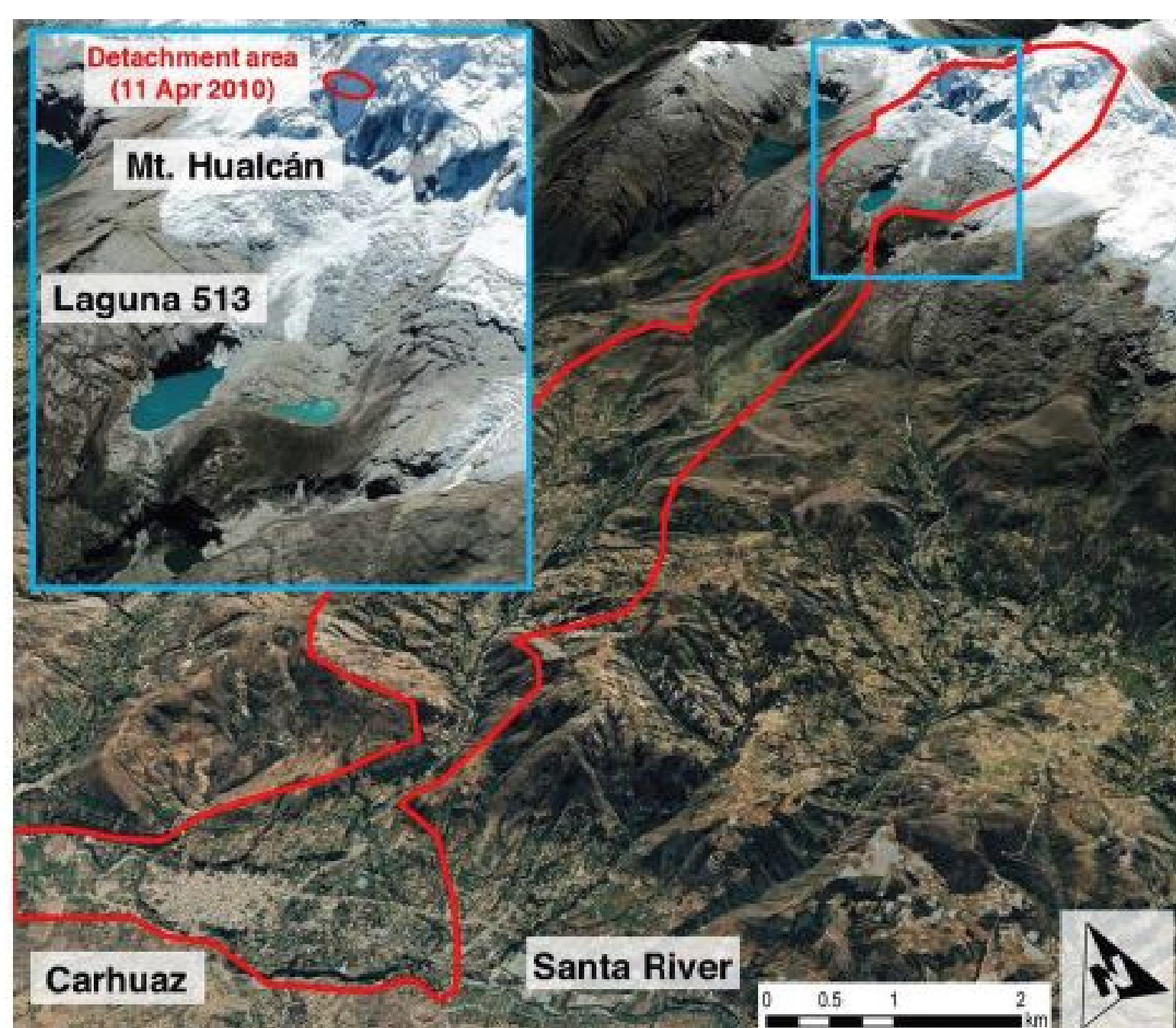
### Glacial outburst lake flow:

As glaciers melt and pour massive amounts of water into nearby lakes ,15 million people across globe live under threat of a sudden and deadly outburst flood ,a new study finds. More than half of those living in the shadow of the disaster called glacial lake outburst floods are in just four countries: India, Pakistan, Peru and China, according to a study in Tuesday's Nature Communications. [1]



Fig: 2, Chunks of ice calved from Perito Moreno Glacier into Lake Argentina on March 10, 2016. As glaciers melt globally, millions face the risk of sudden glacial lake outburst floods. [1]

### Avalanches and landslides:



The avalanches caused a tsunami-like push-wave on the lake, resulting in a dam spillover despite the over 20m freeboard. The resulting GLOF damaged several bridge, water service infrastructure along its trajectory and eventually reached the debris fan of the city of Carhuaz. [2]

Fig 3: Overview map of lake 513 and carhuaz, indicating the 2010 ice avalanches sources zone producing the GLOF that reached down to Carhuaz.

### Heavy rains and flash floods:

Heavy rains and a glacial lake outburst flood combined in 2013 in India to kill thousands of people. A 2021 deadly flood in India that was initially attributed to a glacial lake outburst wasn't caused by one, studies later found.

## Limits to Adaptation:



Fig 7: A number of ski resorts around the world feature runs on the surface of glaciers. This resort, Chacaltaya in Bolivia, has been abandoned because of glacier retreat [3]

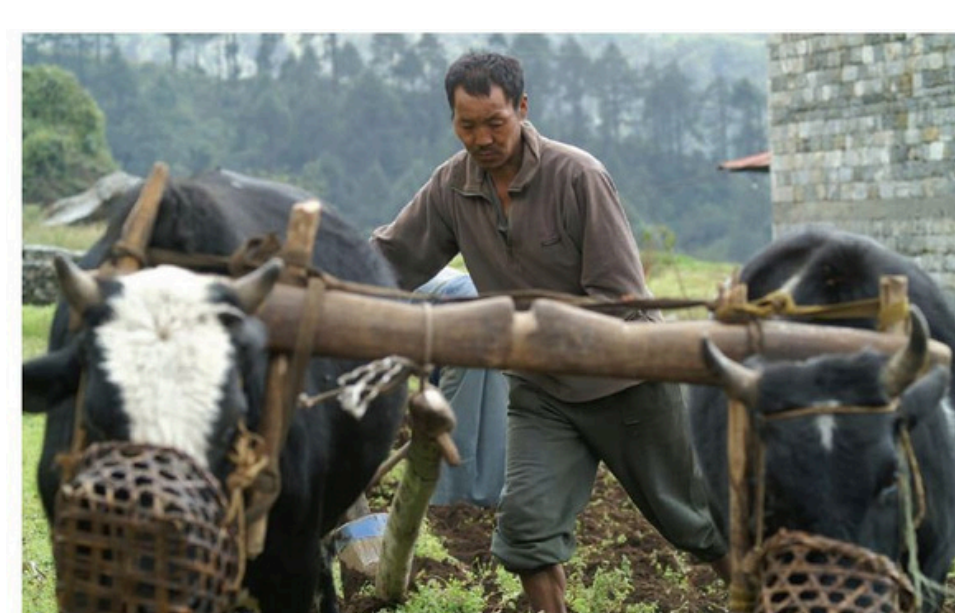


Fig 8: Small-scale farmers in the Himalayas and elsewhere have faced dwindling water supplies to irrigate their fields in recent decades because of glacier retreat. [3]



Fig 9: The dangerously large Lake Tsho Rolpa in Nepal was manually lowered in 2002 at the cost of US\$3 million, reducing the risk of floods. [3]

## Adaptation:

1. risk knowledge
2. monitoring and warning
3. dissemination and communication
4. response capability

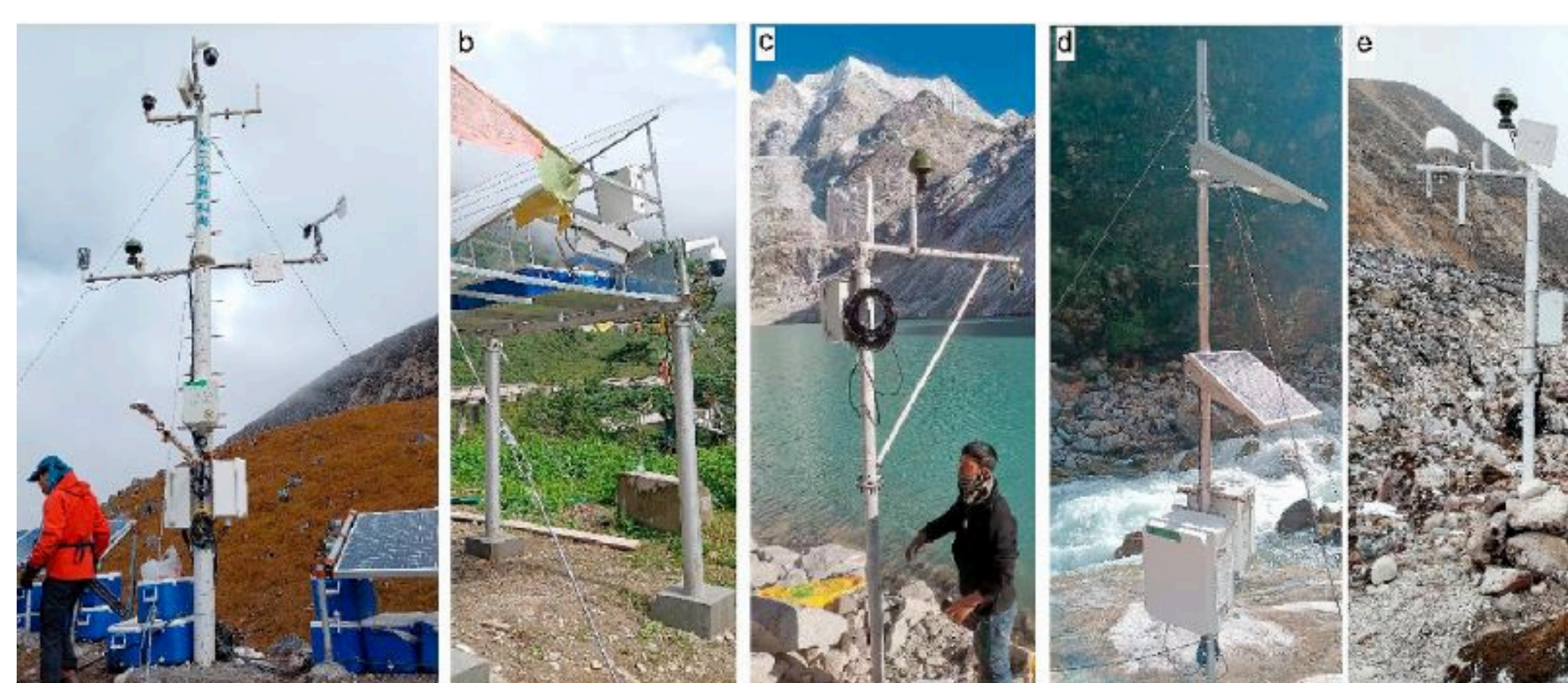


Fig 4: The Early Warning System at Cirenmaco comprises nine services, including monitoring of the glacier-fed lake, its parent glacier, downstream river environment, glacial lake and river water levels, and moraine dam dynamics. [4]

Fig 5: The Cirenmaco EWS schematic shows glacier-lake, river, and dam monitoring, meteorological observation, surveying (bathymetric and topographic), data transmission, and early warning signal delivery. [4]

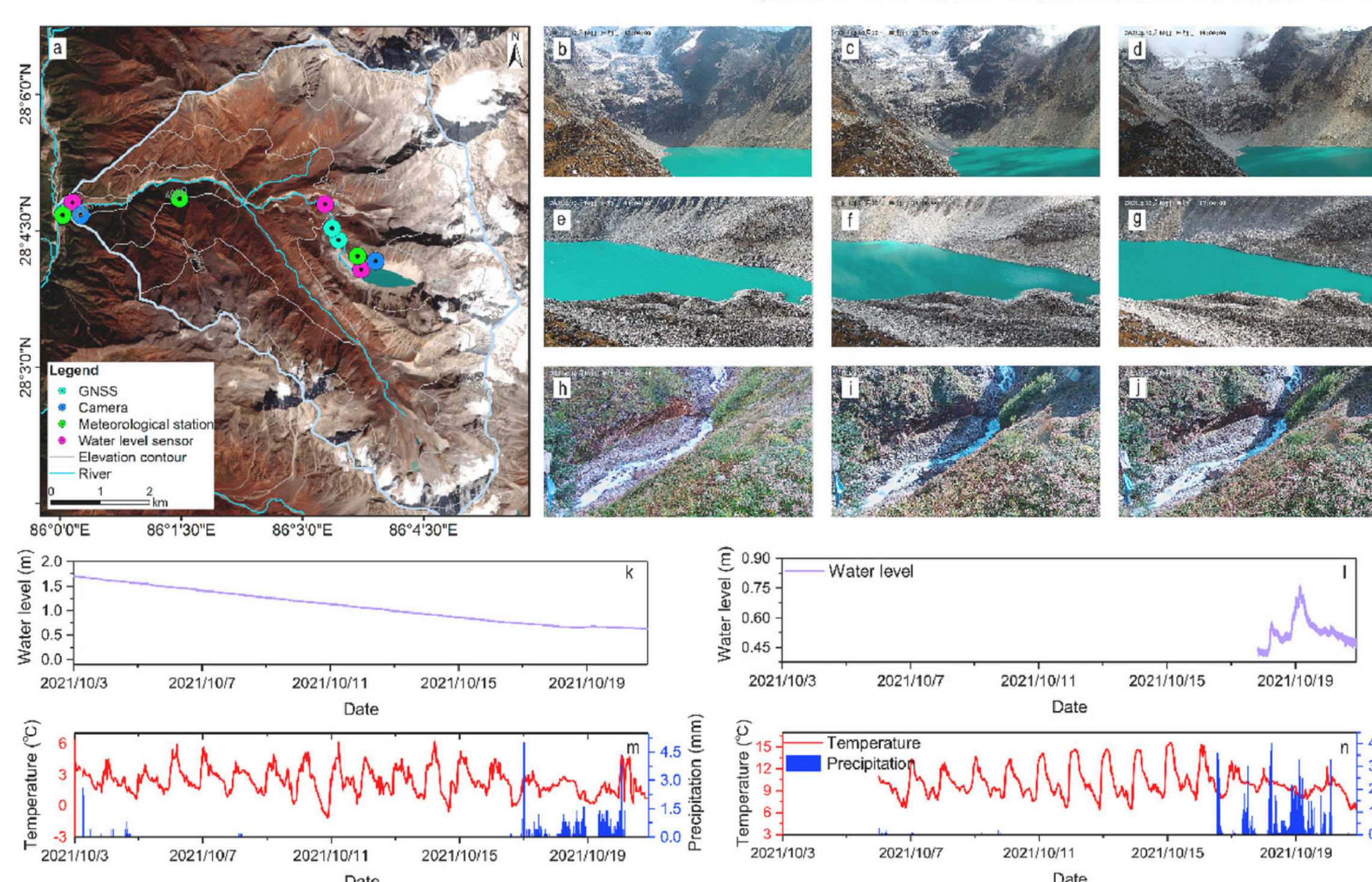
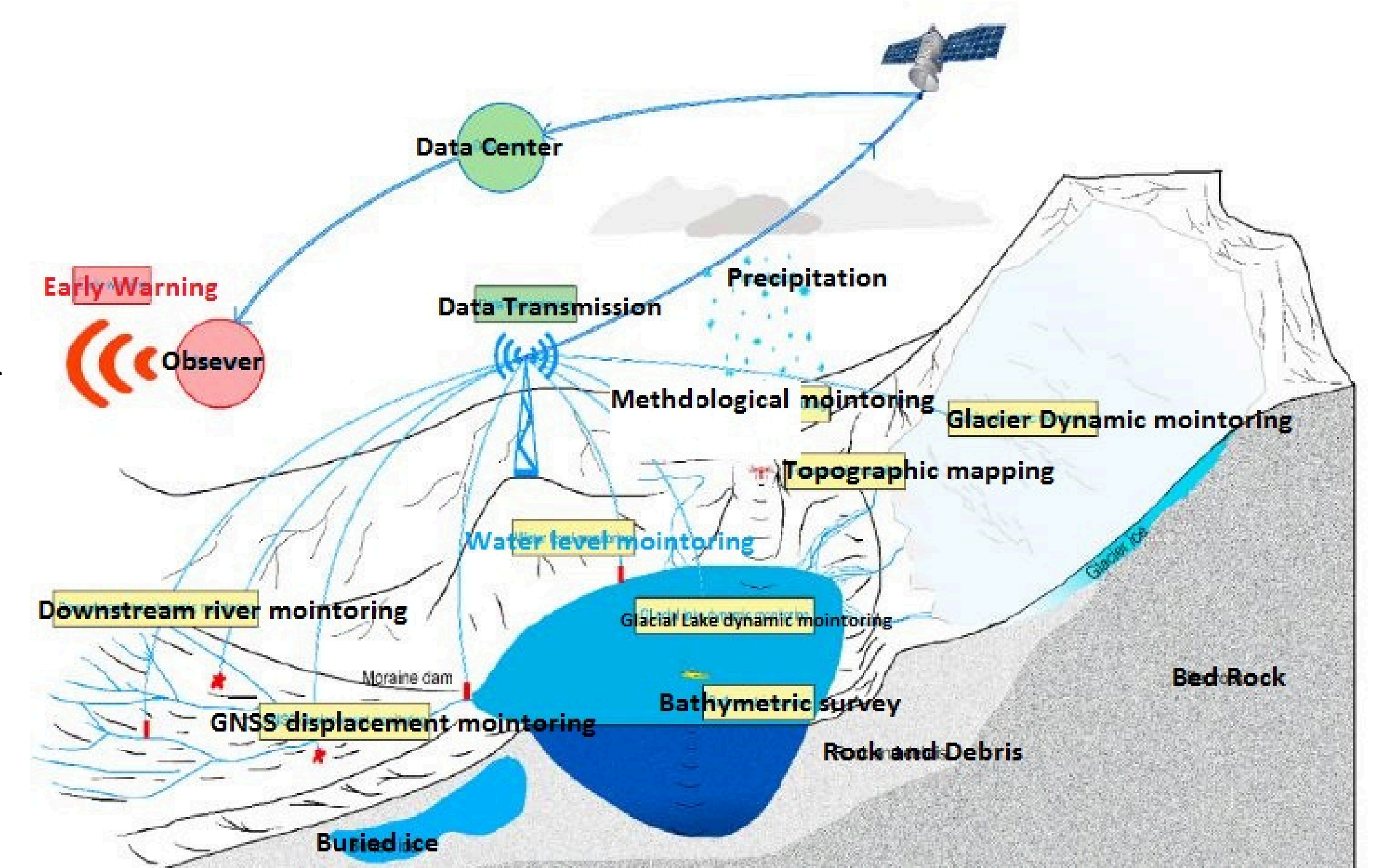


Fig 6: The Cirenmaco Early Warning System includes nine services, notably monitoring the glacier, glacial lake, downstream river, water levels, and moraine dam dynamics. [4]

## conclusion:

Rising temperatures are expected to worsen droughts in areas that rely on snowpack for freshwater, while increasing both the severity and frequency of hazards like avalanches, landslides, flash floods and glacial lake outburst flood. About 1.1 billion people live in mountain communities, which suffer the most immediate impacts of glacier loss, due to the increasing risks with natural hazards and unreliable water sources. The remote locations and difficult terrains also make cheap fixes difficult to come .We need to advance our scientific knowledge, we need to advance through better observing systems, through better forecasts and better early warning systems for the planet and the people.

## Reference:

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4. Weicai Wang a,, Taigang Zhang a,b,\* , Tandong Yao a, Baosheng An a Monitoring and early warning system of Cirenmaco glacial lake in the central Himalayas

