

The state of the Himalayan glaciers

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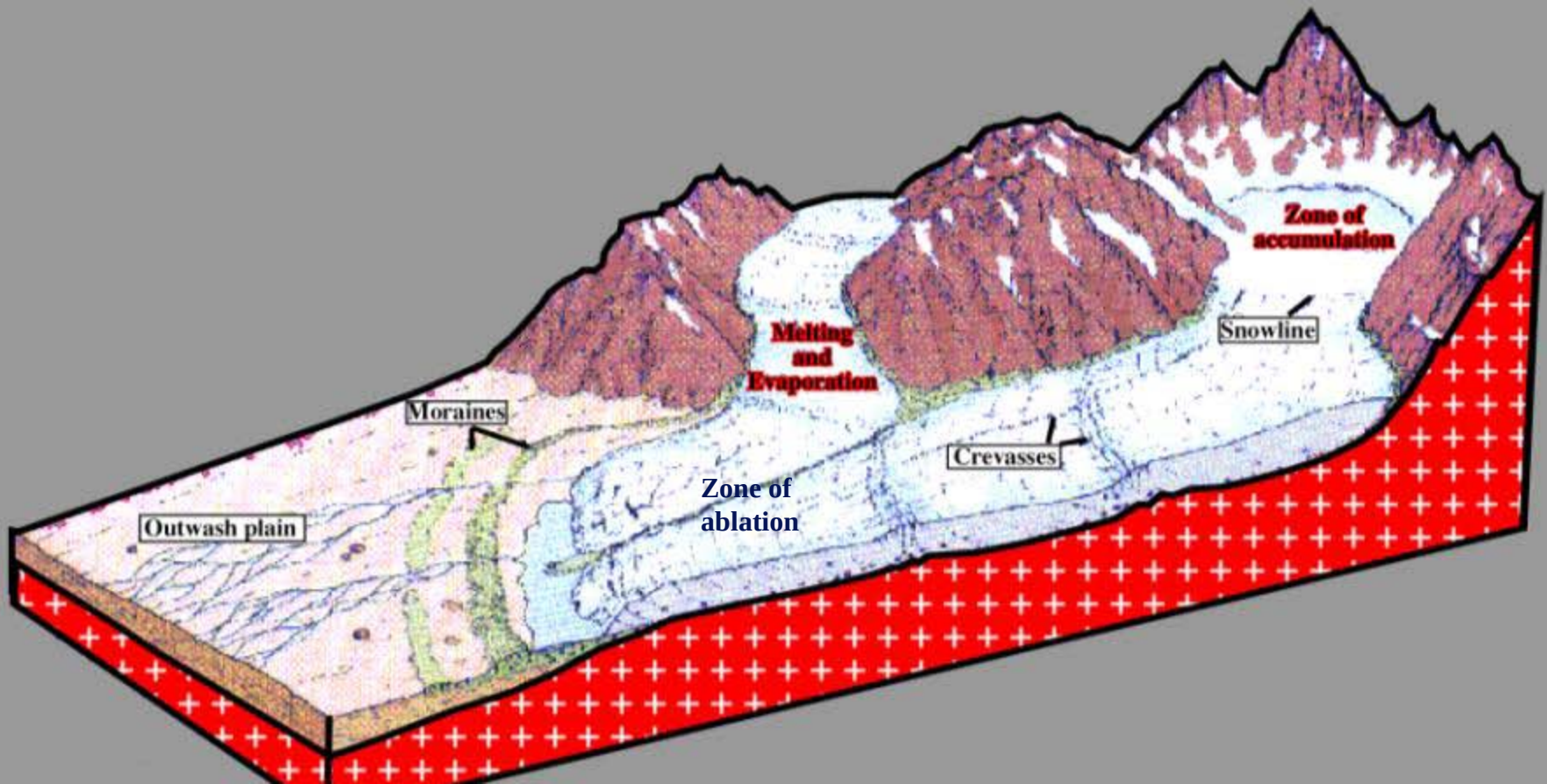
South Asia Media Workshop on Adaptation to Climate Change
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- What is glacier retreat or advance?
- Are HKH glacier retreating?
- Does retreat or advance tells the complete Story?
- What are the methods to assess glacial dynamics?
- Are HKH glaciers going to vanish? When?
- Himalayan Glaciers are Melting Faster than Anywhere else!
- Consequences

What is a glacier?

- A glacier is a large body of ice, in which ice from a higher elevation is transported to a lower elevation. The body of ice must be at least 30 metres thick for this to take place. The movement of the ice is always from the upper part of the glacier towards the lower end (the snout), regardless of whether the glacier is **advancing or retreating**.





Types of glaciers

<http://nsidc.colorado.edu/glaciers>

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Piedmont



Icefields



Hanging glacier



Ice Cap



Outlet

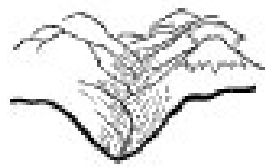


Mountain



Valley

River valley/glacial valley



V-shaped valley



U-shaped valley



What is glacier retreat or advance?

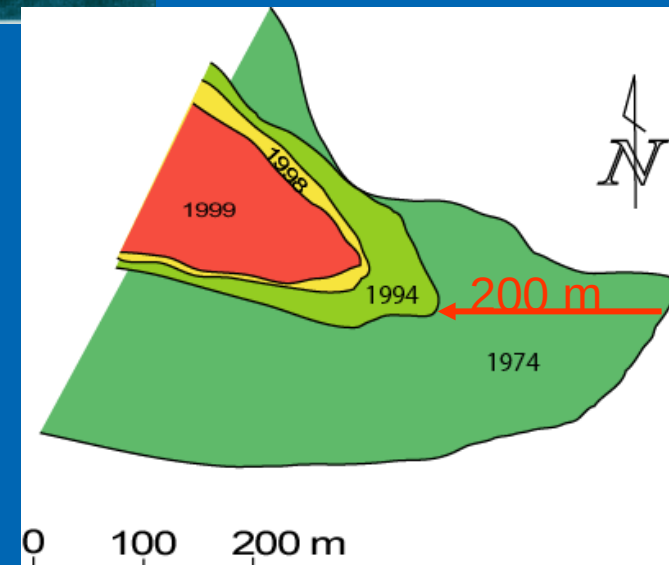
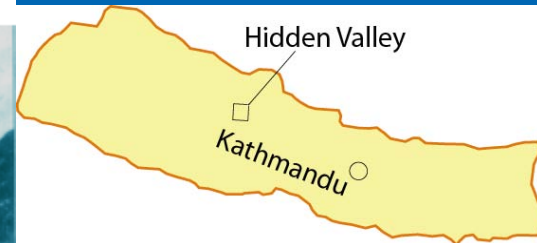
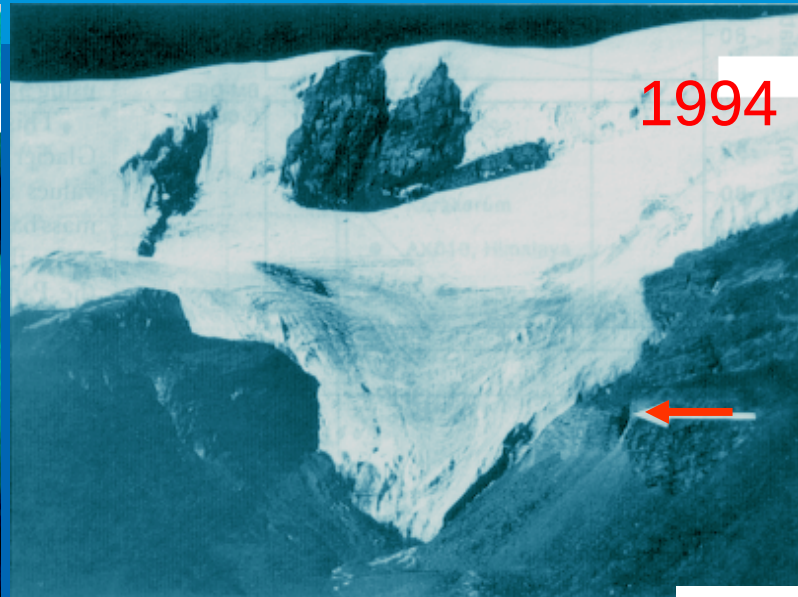
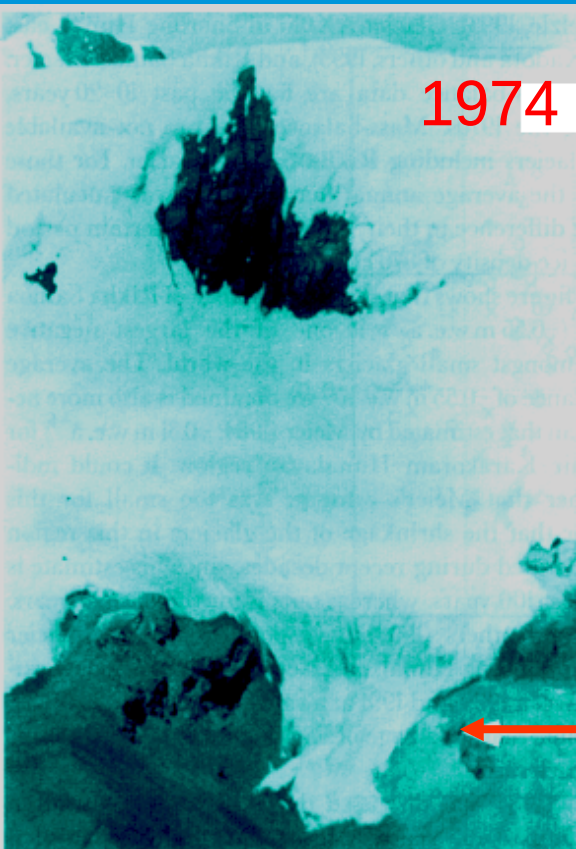
- A glacier is said to retreat or advance when the position of the end (terminus or snout) of the glacier changes, retreating higher up the slope or advancing down the slope.

Are HKH glacier retreating?

Rika Samba Glacier

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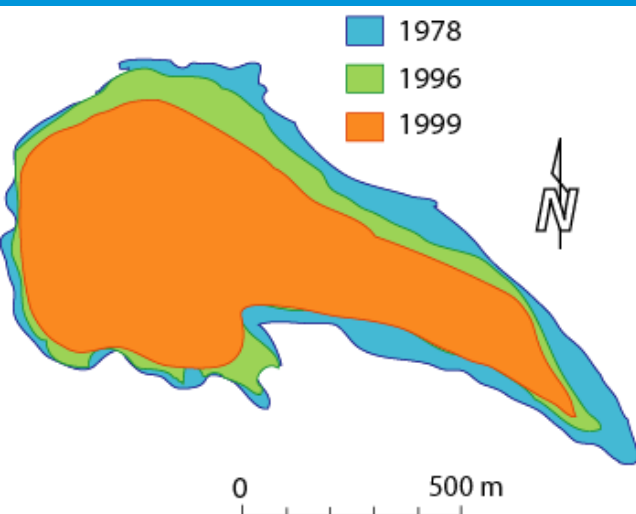
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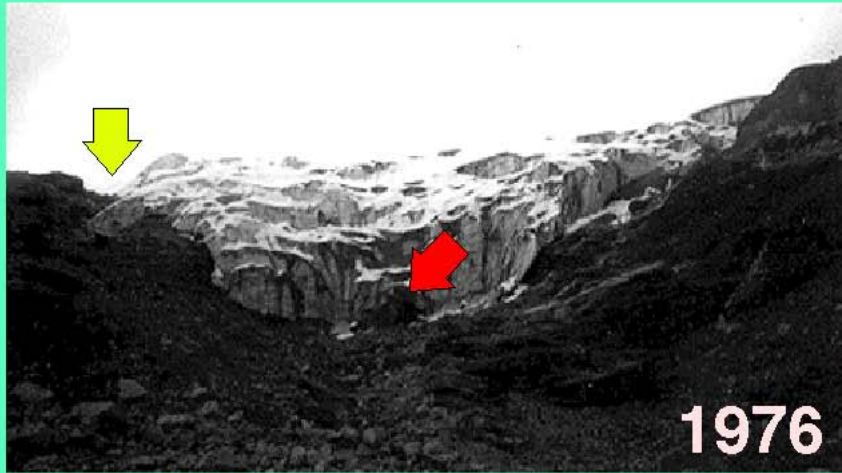
SOURCE: GEN/DHM RESEARCH

Glacier AX010, Nepal

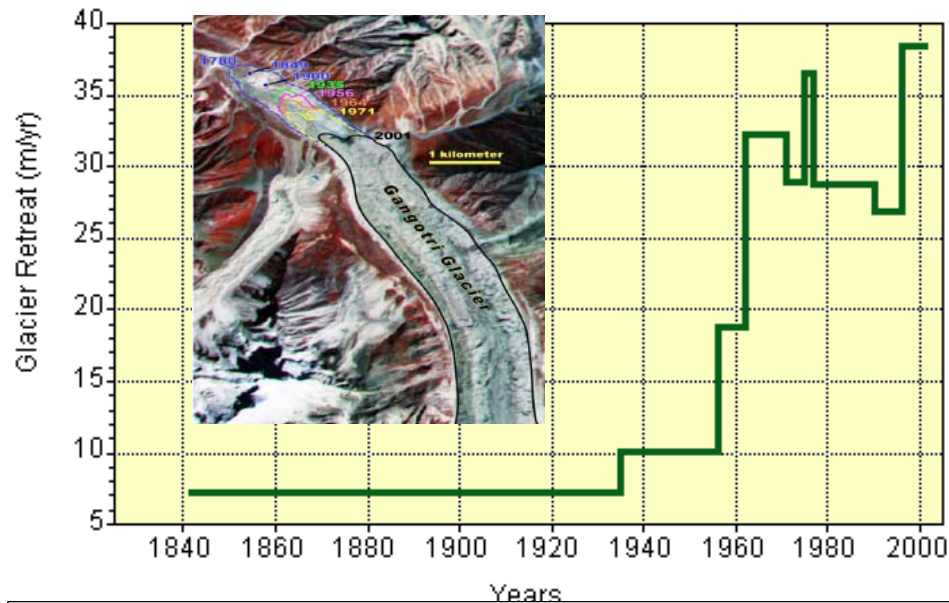
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Fluctuation of EB050 glacier



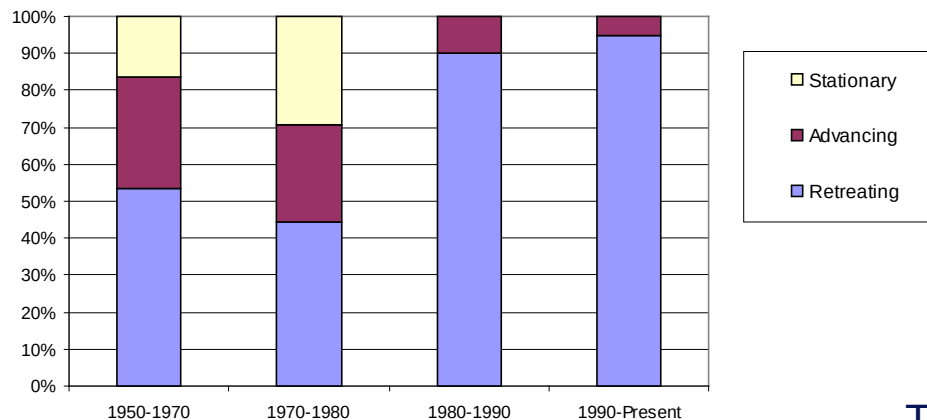
Gangotri, India Tibet, China



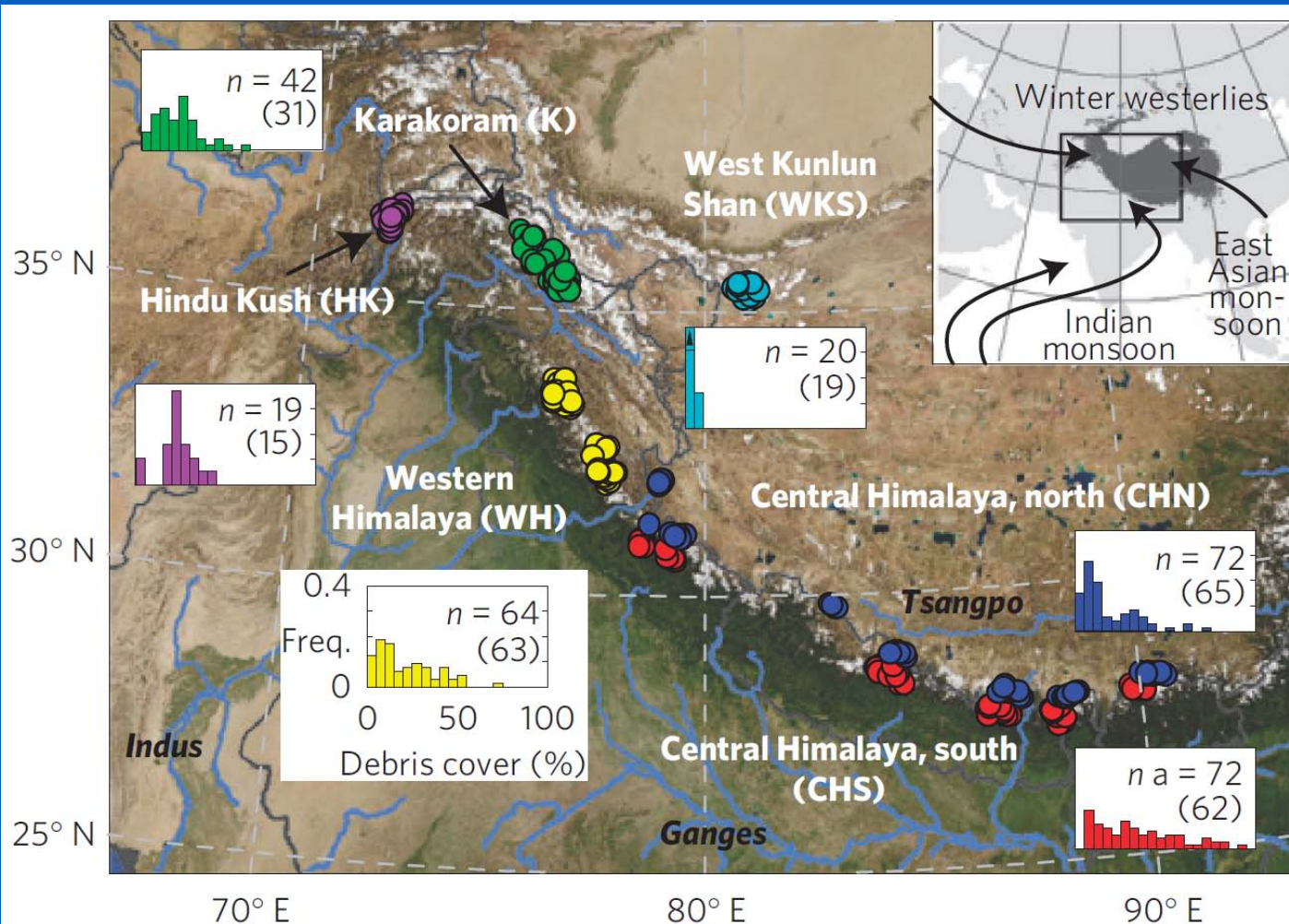
- Deglaciation is widespread in HKH
- Some advances in Hindu Kush and Karakorum

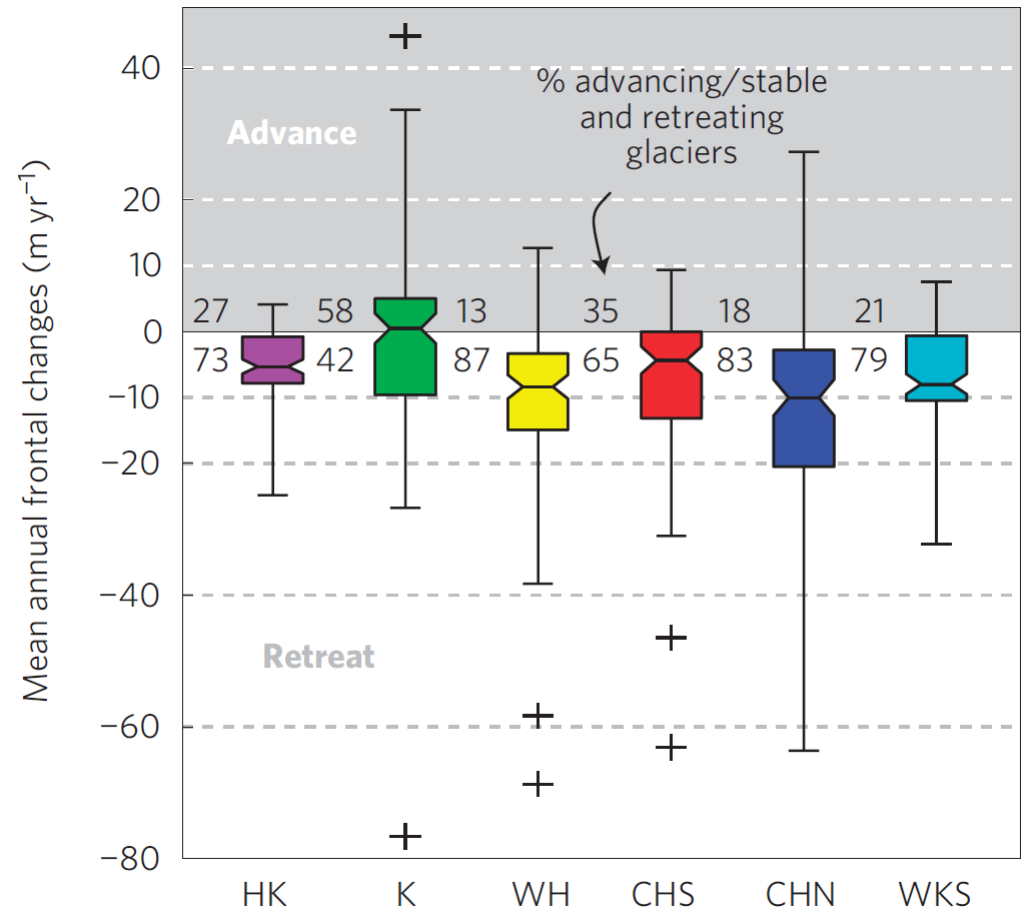
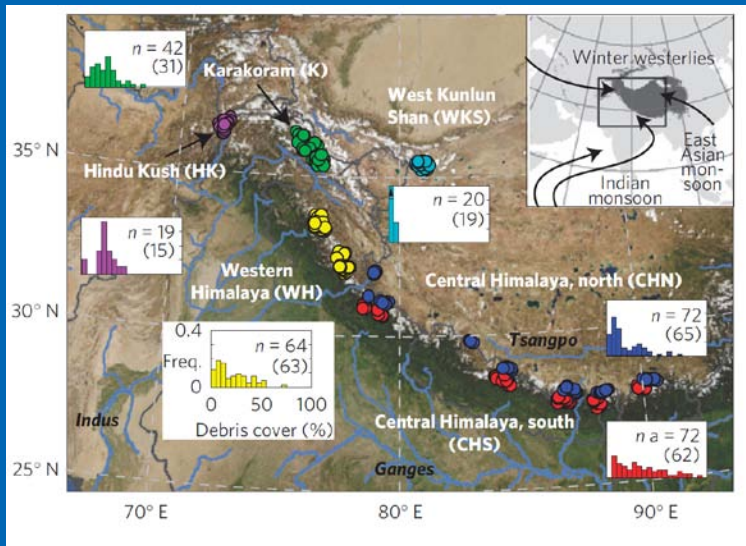
J. Kargel, USGS

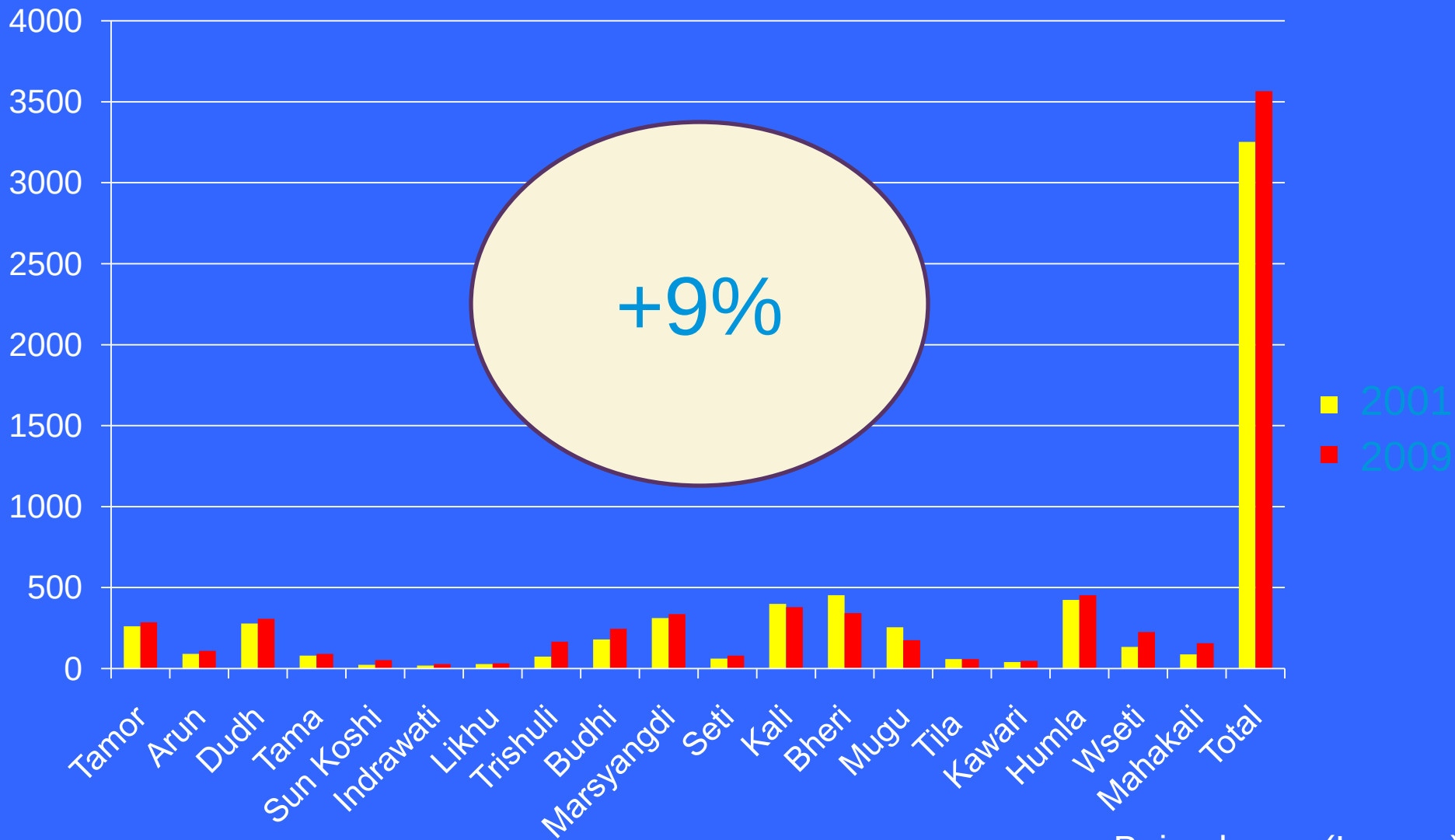
Status of Glaciers in Tibetan Plateau

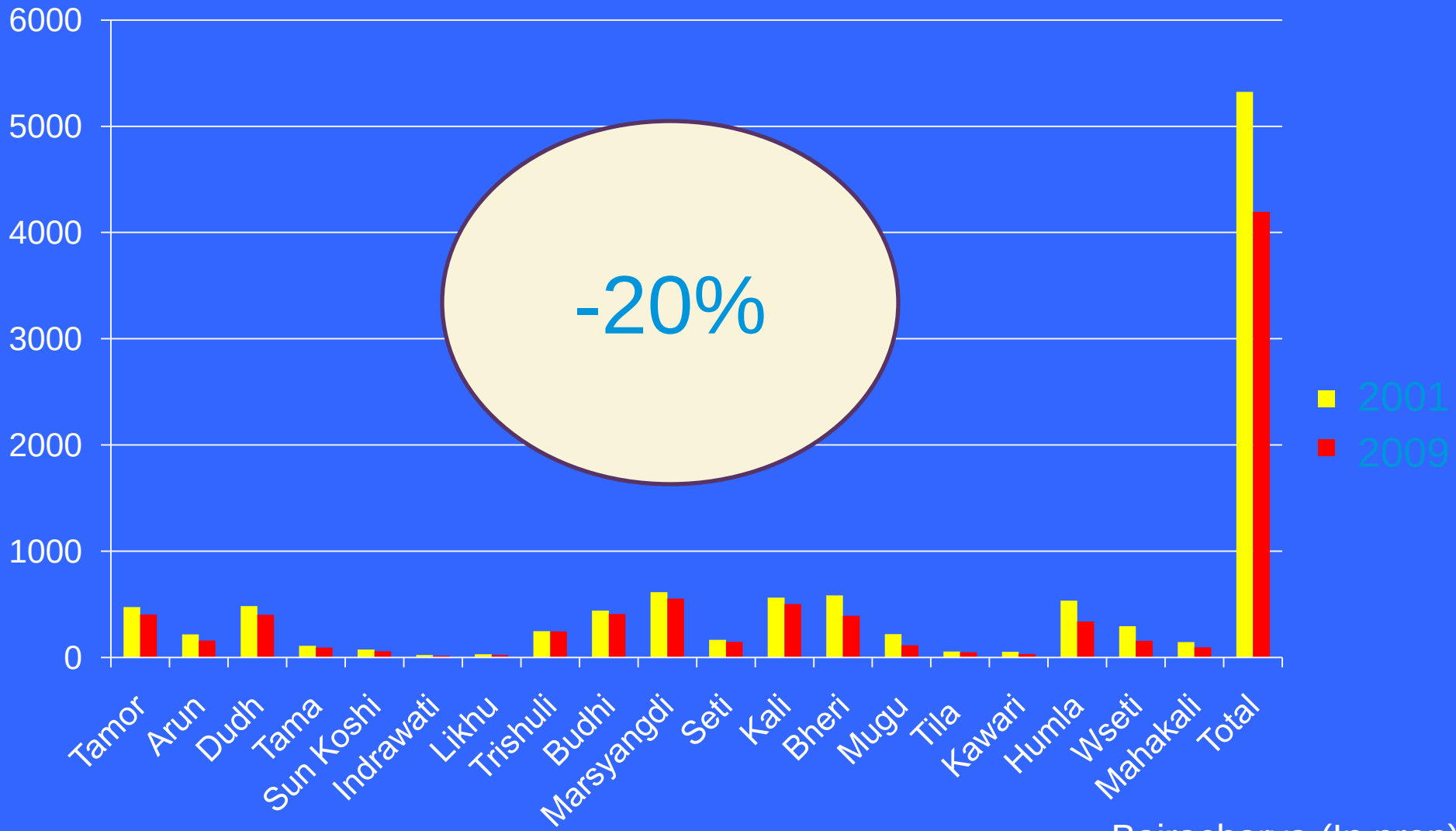


Tandong et al., 2004









Does retreat or advance tells the complete Story?

- In general, a change in the position of a glacier snout is a good indication of change taking place in the total amount of ice in the glacier
- But the relationship is not direct; the position of the snout is only an indicator, it does not give exact information about changes (or otherwise) in the amount of ice in the glacier.

What are the methods to assess glacial dynamics?

		Relative confidence rating of method – with increasing confidence signalling greater accuracy and scientific rigour				
		Very low  Very high				
	Mass-balance	Vertical balance profile / Climate records	Flux divergence method	Hydrological method	Geodetic method / Remote sensing	Glaciological method
	Volume Change	Thickness profiling & Field Mapping	Remote sensing with baseline field mapping	Remote sensing and digital elevation model		
	Area change	Description	Terrestrial photography	Field mapping / Mapping from aerial photographs	Remote sensing with baseline geo-referenced field mapping	Remote sensing
	Terminus shift	Description	Terrestrial photography	Field mapping / Mapping from aerial photographs	Remote sensing with baseline geo-referenced field mapping	Remote sensing

Miller et al., DFID System. Rev.

What is the evidence about glacier melt across the Himalaya (in Prep.)

<http://www.nature.com/ngeo/journal/vaop/ncurrent/full/ngeo1068.html>.

Are HKH glaciers going to
vanish?
When?

Climate change debate

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There won't be any glaciers left in the central and eastern Himalaya by 2035 if they continue to recede at the present rate

(Down to Earth 1996)

Glaciers in the Himalaya are receding faster than in any other part of the world (see Table 10.9) and, if the present rate continues, the likelihood of them disappearing by the year 2035 and perhaps sooner is very high if the Earth keeps warming at the current rate. Its total area will likely shrink from the present 500,000 to 100,000 km² by the year 2035 (WVWF, 2005).

IPCC 2007

The degradation of the level already by

Himalayan glaciers, although shrinking in volume and constantly showing a retreating front, have not in any way exhibited, especially in recent years, an abnormal annual retreat, of the order that some glaciers in Alaska and Greenland are reported

It is premature to make a statement that glaciers in the Himalayas are retreating abnormally because of the global warming.

MoE 2009

Kotlyakov, 1996

THE TIMES OF INDIA

ISRO: 75% of Himalayan glaciers retreating

Jayashree Nandi, TNN | May 16, 2011, 03.04am IST

BANGALORE: A comprehensive study of [Isro satellite images](#) reveals 75% of [Himalayan glaciers](#) are on the retreat, with the average shrinkage being 3.75km during the 15 years under study. The grim findings come after raging controversy over claims in the [2007 IPCC report](#) of Himalayan glaciers disappearing by 2035, which were later retracted.

The project, which studied 2,190 glaciers, was commissioned by the ministry of environment and forests and department of space to break myths about the disappearance of Himalayan glaciers. However, the findings are sure to raise concern over the health of Asia's 'water towers'.

"I can't say we are in a comfortable position because you can see that 75% of the glaciers have retreated. Only 8% have advanced and 17% are stable. We are going to publish the data soon, probably in the Current Science journal," said Dr Ajai, group director, Marine, Geo and Planetary Science Group (MPSG), Space Applications Centre, Ahmedabad, on Saturday in [Bangalore](#). Detailed charts showing the retreat and images were also displayed at the Isro campus.

The study used satellite images taken by Resourcesat-1 over a period of 15 years (1989-2004). Around 50 experts and 14 organizations were involved in the project which included field trips.

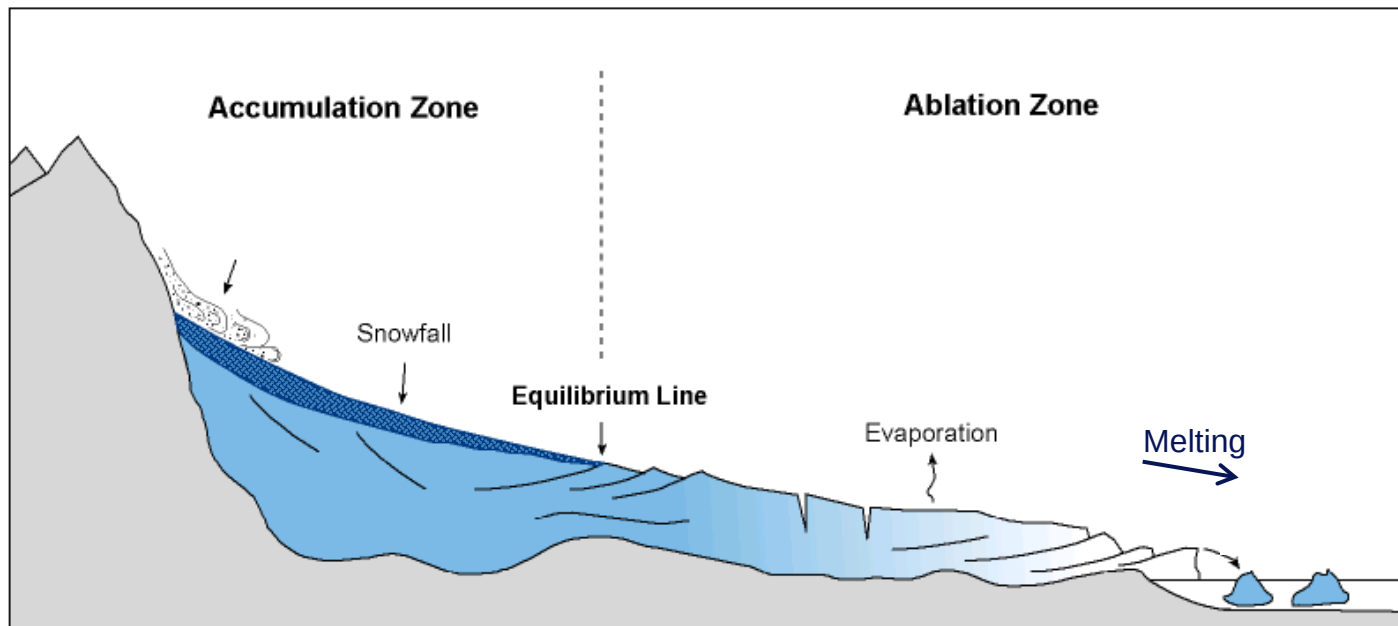
Organisations that were part of a comprehensive study on Himalayan glaciers included G B Pant Institute of Himalayan Environment and Development, Kashmir University and Jawaharlal Nehru University. The experts also physically visited the glaciers to compare the study results.

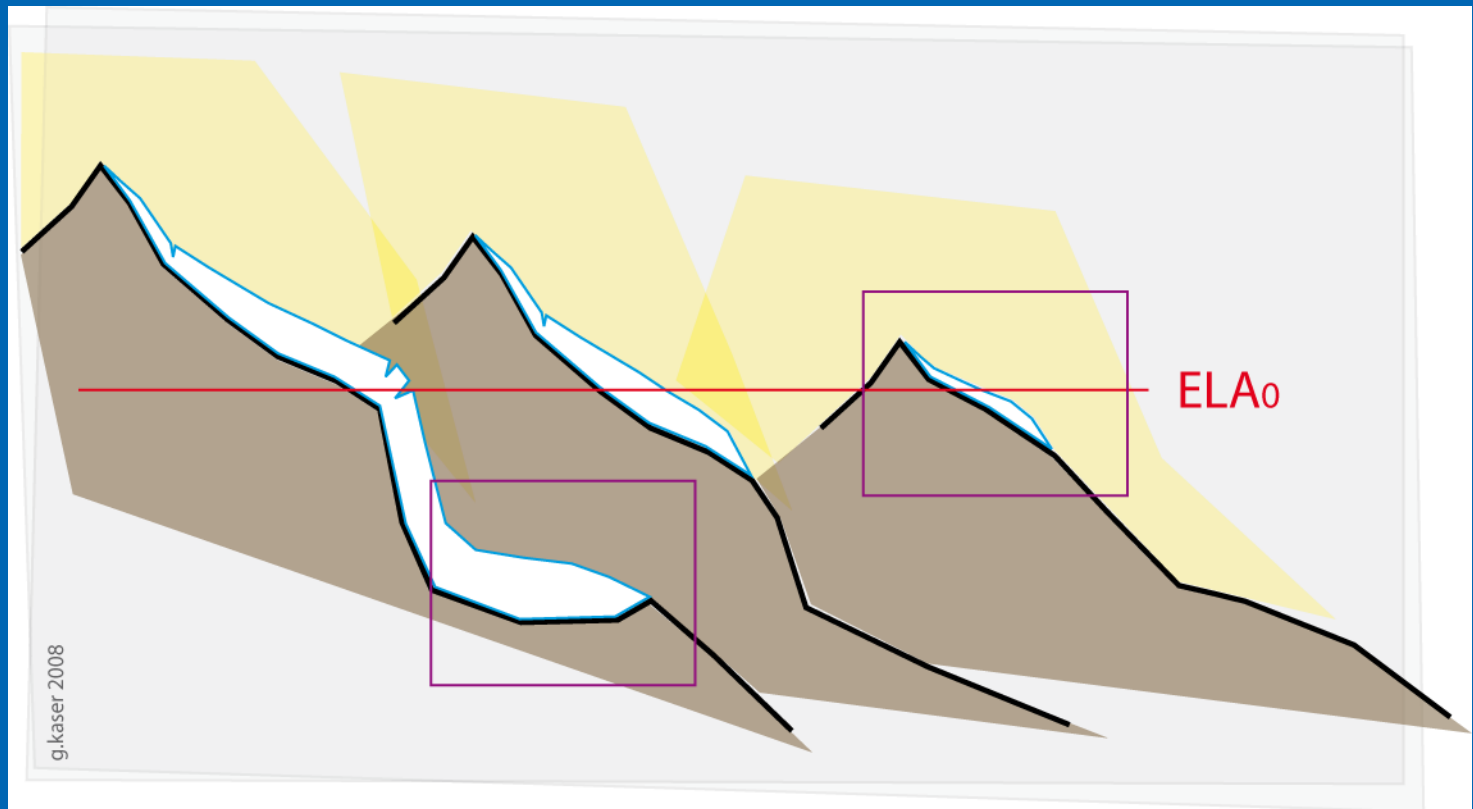
"Many Himalayan glaciers are still in a healthy condition. They will not disappear. And the cause for retreat of these glaciers is not only high temperatures," Dr Ajai, group director, Marine, Geo and Planetary Science Group (MPSG), Space Applications Centre, Ahmedabad, said in Bangalore. The IPCC report had claimed that Himalayan glaciers were likely to disappear by 2035. It was later discovered that the claims were based on popular articles and not peer-reviewed scientific reports.

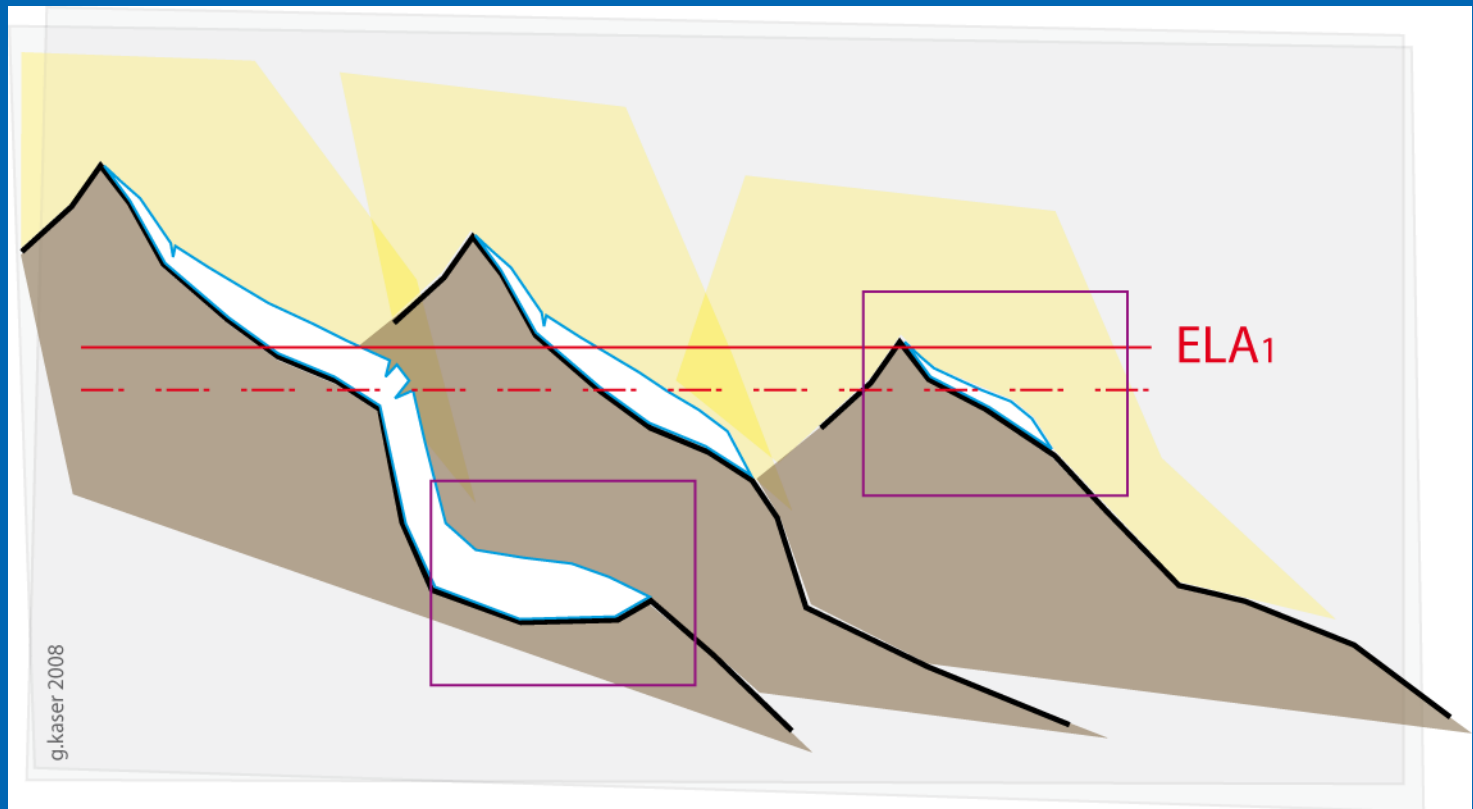
The present study included the basins of the Indus, Ganga and Brahmaputra, as well as parts of [China](#), [Nepal](#), [Bhutan](#) and [Pakistan](#). "For the first time, such a study has been done on Himalayan glaciers and the international community is awaiting it. Only in the Alps have a few glaciers been monitored, and their retreat rates are higher," Ajai added.

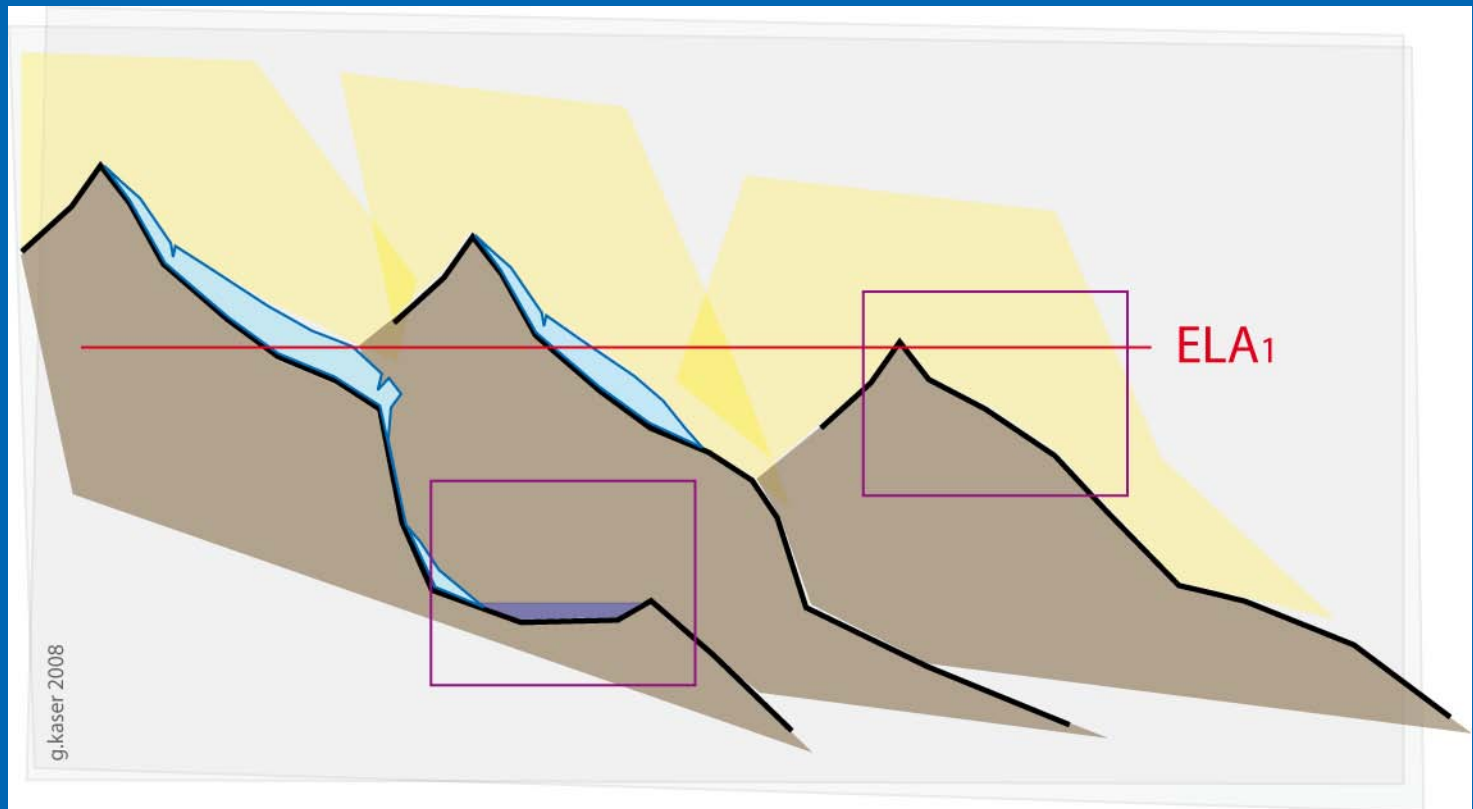
This is the second report on glaciers released by Isro recently. In March 2010, the space organization released a study involving 1,317 Himalayan glaciers which said these glaciers had retreated by 16% since 1962. Isro's satellite images also show a slight increase in the area under mangroves.

How does a glacier operate?





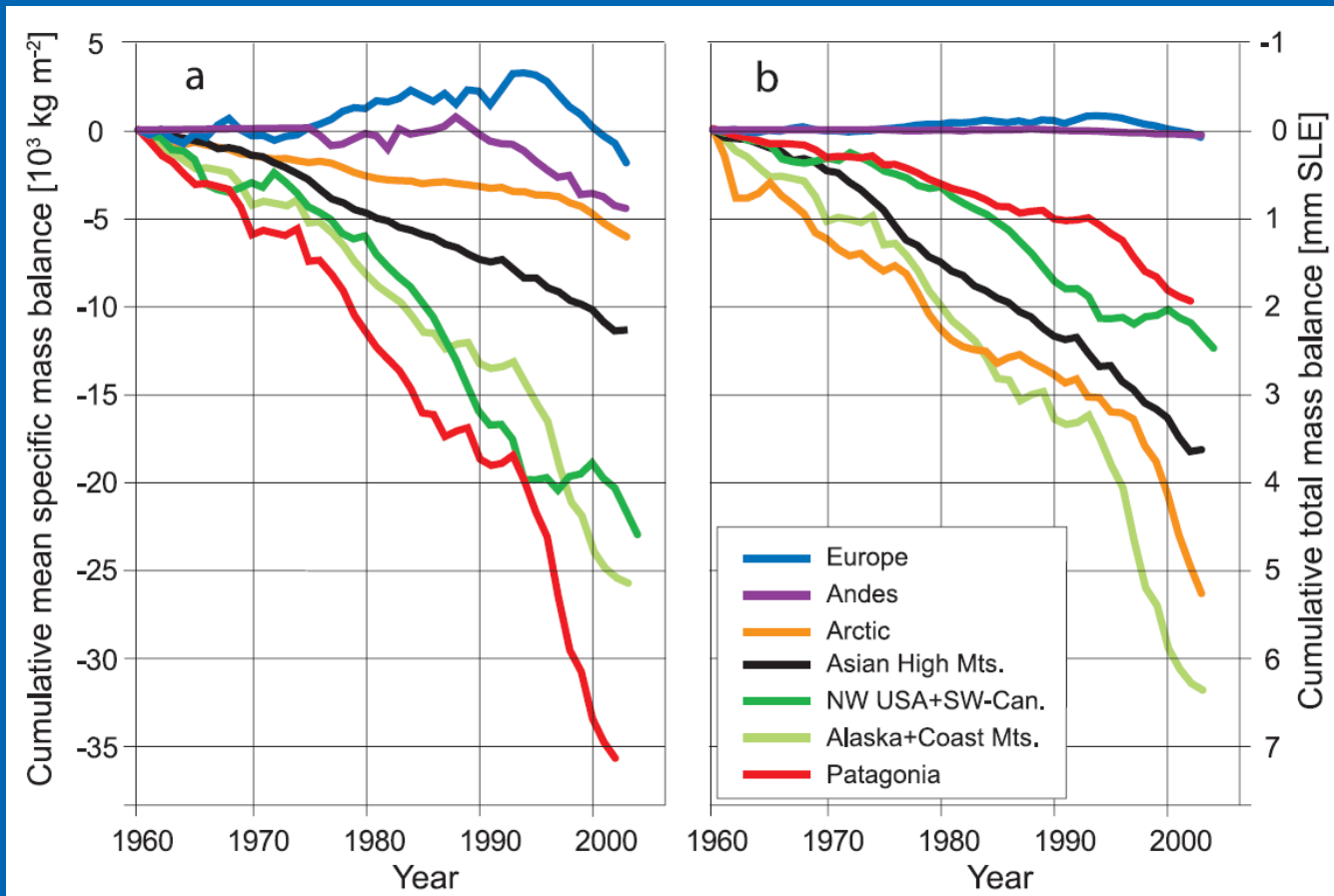




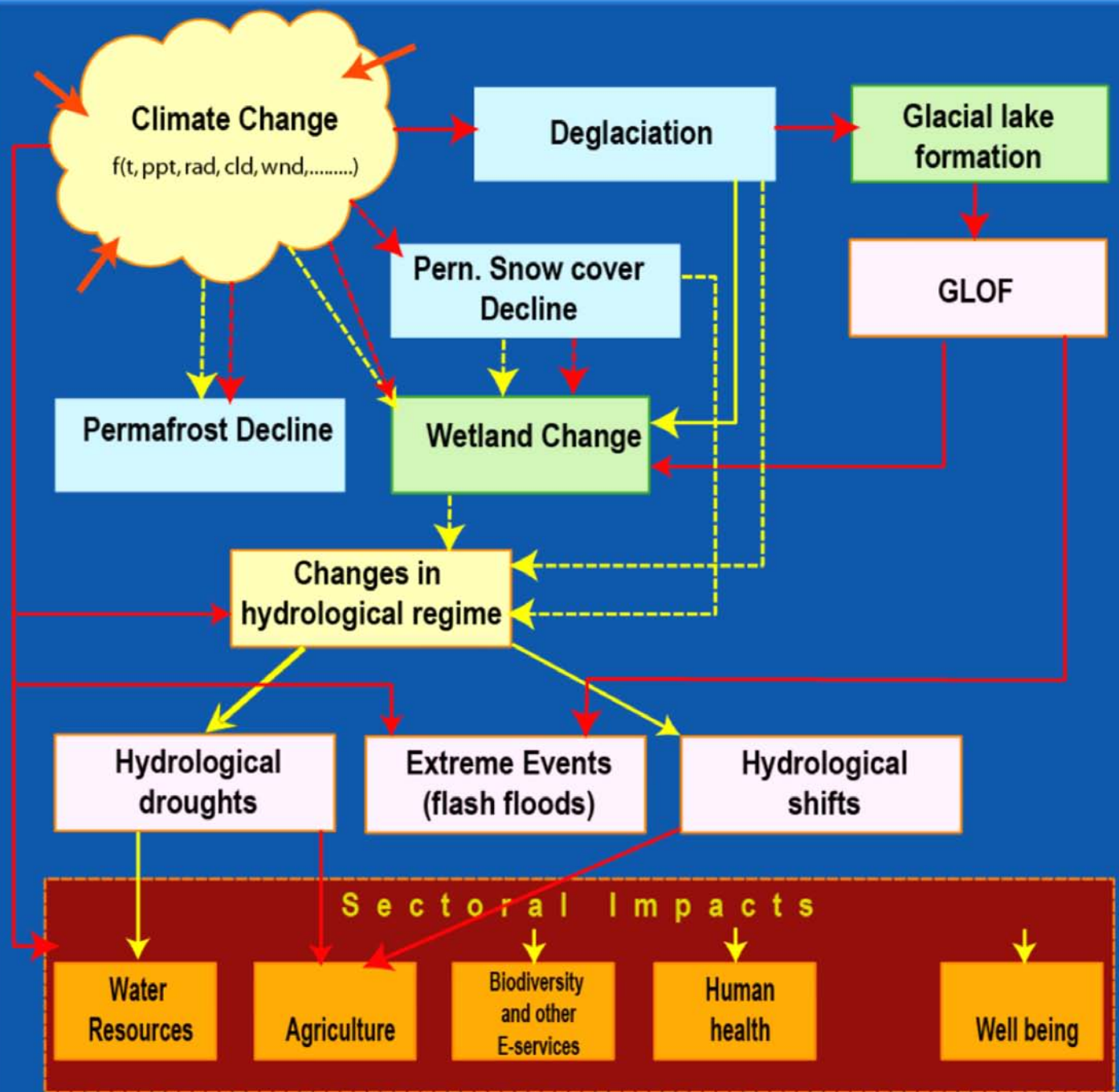
An example

- The average position of the zero degree isotherm (ZDI) in the Himalayan ranges is thought to be around 5400 metres above sea level (masl).
- Above this altitude, the free air temperature never rises above zero. The ZDI is an approximate indicator of the level above which glaciers accumulate ice.
- The accumulation zones of most Himalayan glaciers extend much higher than this elevation.
- As overall temperatures rise, the position of the ZDI will also move to higher altitude.
- For example, a 4°C rise in temperature would cause the ZDI to rise by about 650m to 6050 masl. Even at this level, many of the Himalayan glaciers will still lie above the ZDI and will continue to exist. Equally, large glaciers

Himalayan Glaciers are Melting
Faster than Anywhere else!

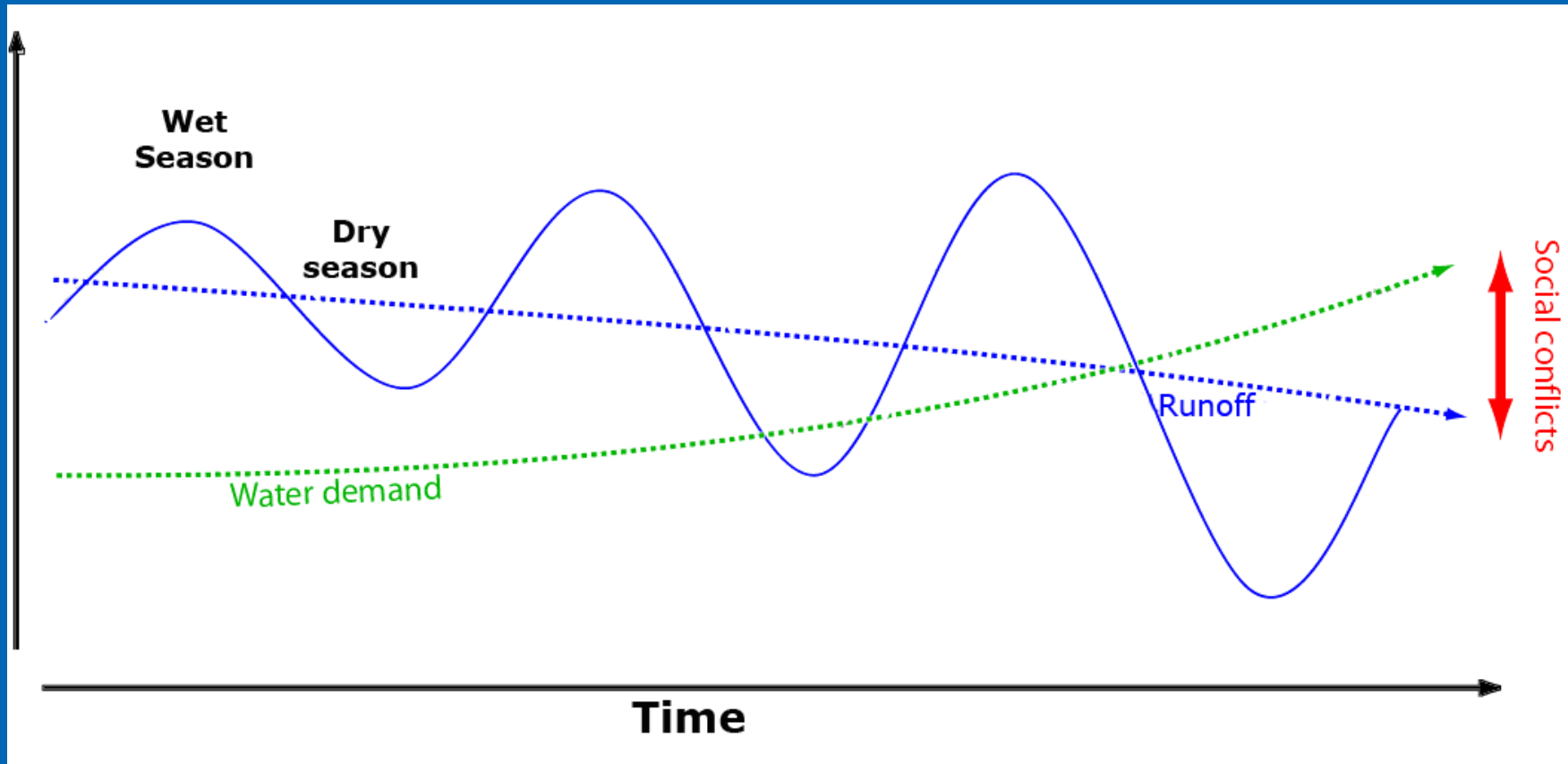


Consequences



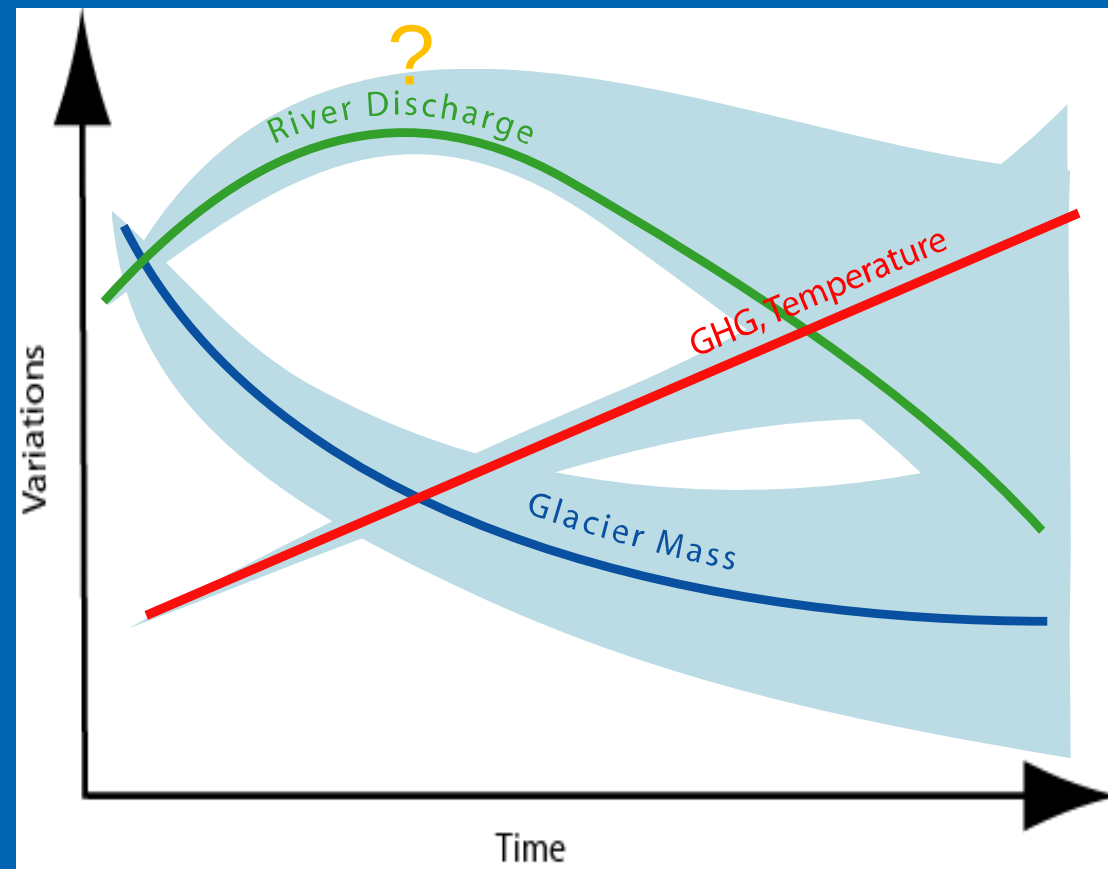


Changes in Runoff over Time: Seasonal and long term



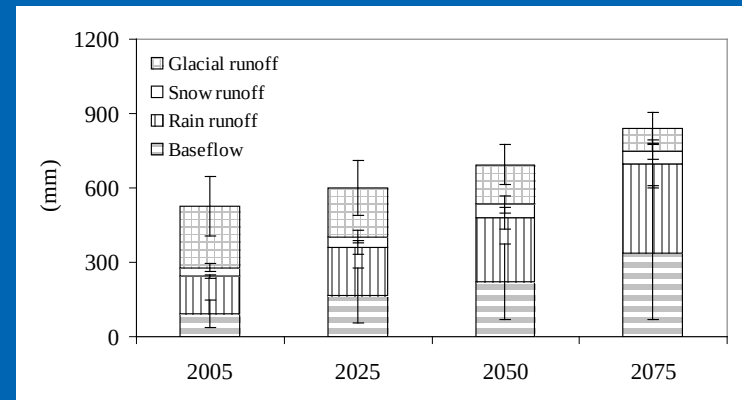
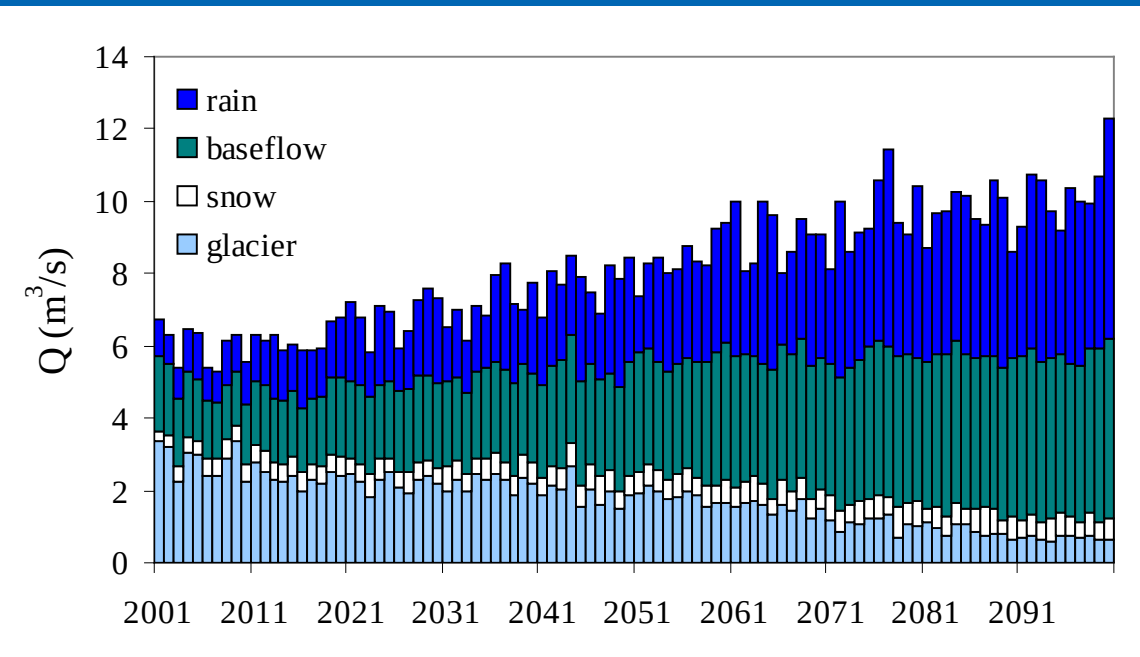


Scientific uncertainties



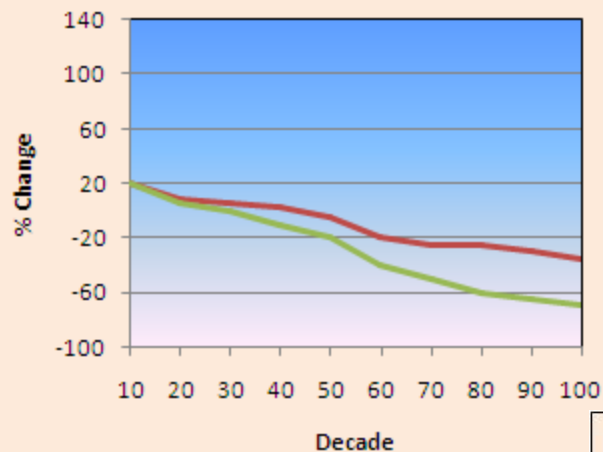
- How?
- How much?
- Where?
- When?
- Challenging environment
- Limited baseline information
- Low capacity
- Low awareness

Langtang, Nepal

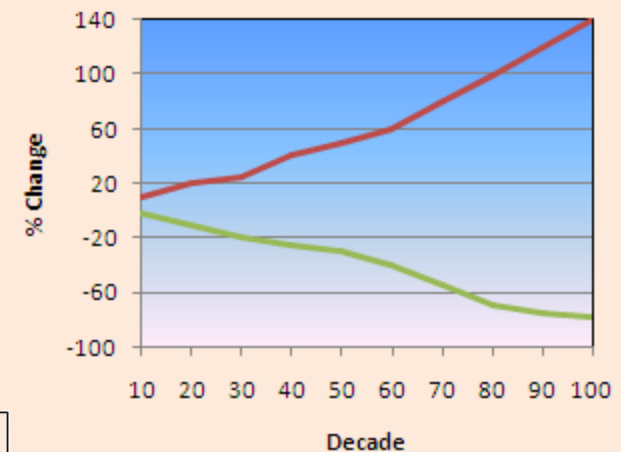


Rees et al. (2004)

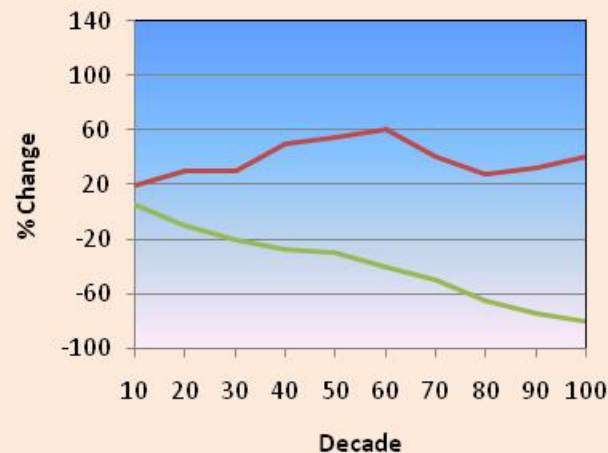
Upper Indus



Ganges



Brahmaputra



$T=0.06^{\circ}\text{C/yr}$
 $P=15\%/yr$



Thank you
Thanks to global warming

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