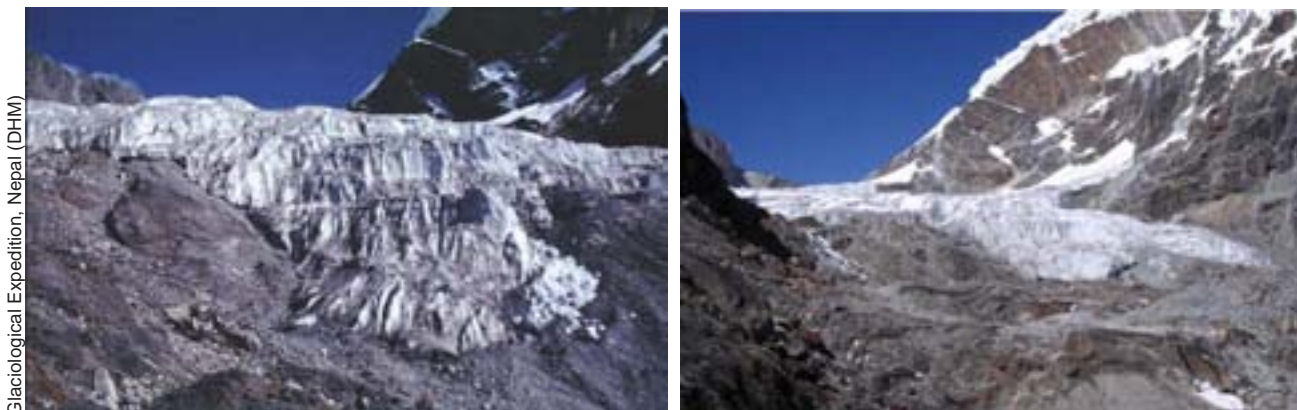


# Climate Change, the Himalayan Mountains, and ICIMOD

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Glaciological Expedition, Nepal (DHM)

Terminus positions of Glacier EB060, Khumbu Himal, Nepal in 1997 (left) and 2004 (right)

**The Fourth Assessment Report of the Intergovernmental Panel on Climate Change shows that the warming of the global climate system is unequivocal and is very likely due to increased greenhouse gas concentrations in the atmosphere resulting from human activities. Even if greenhouse gas concentrations were to stabilise, climate change and rising temperatures as well as sea level rise would continue for centuries due to time-scales associated with climate processes and feedback (IPCC 2007).**

Many natural systems and regions including the Hindu Kush-Himalayan region are affected by regional climate changes. Mountains in many parts of the world are susceptible to the impacts of a rapidly changing climate. The change in hydrological cycle may affect river runoff, accelerate water-related hazards, and affect agriculture, vegetation, forests, biodiversity, and health (Beniston 2003). On the other hand, mountain ecosystems have a significant role in biospheric carbon storage and carbon sequestration, particularly in semi-arid and arid areas. Mountain ecosystem services such as water purification and climate regulation extend beyond geographic boundaries and affect all continents.

## Climate change in the Himalayan mountains

Climate change is a major concern in the Himalayas because of potential impacts on the economy, ecology, and environment of the Himalayas and areas downstream. Himalayan glaciers cover about three million ha, or 17% of the global mountain area. They are the largest bodies of ice outside the polar caps. The total area of the Himalayan glaciers is 35,110 sq km. The total ice reserve of these glaciers is 3,735 km<sup>3</sup>,

which is equivalent to 3,250 km<sup>3</sup> of fresh water. The Himalayas, the water tower of the world, is the source of nine giant river systems of Asia: the Indus, Ganges, Brahmaputra, Irrawaddy, Salween, Mekong, Yangtze, Yellow, and Tarim, and are the water lifeline for 500 million inhabitants of the region, or about 10% of the total regional human population (IPCC 2007).

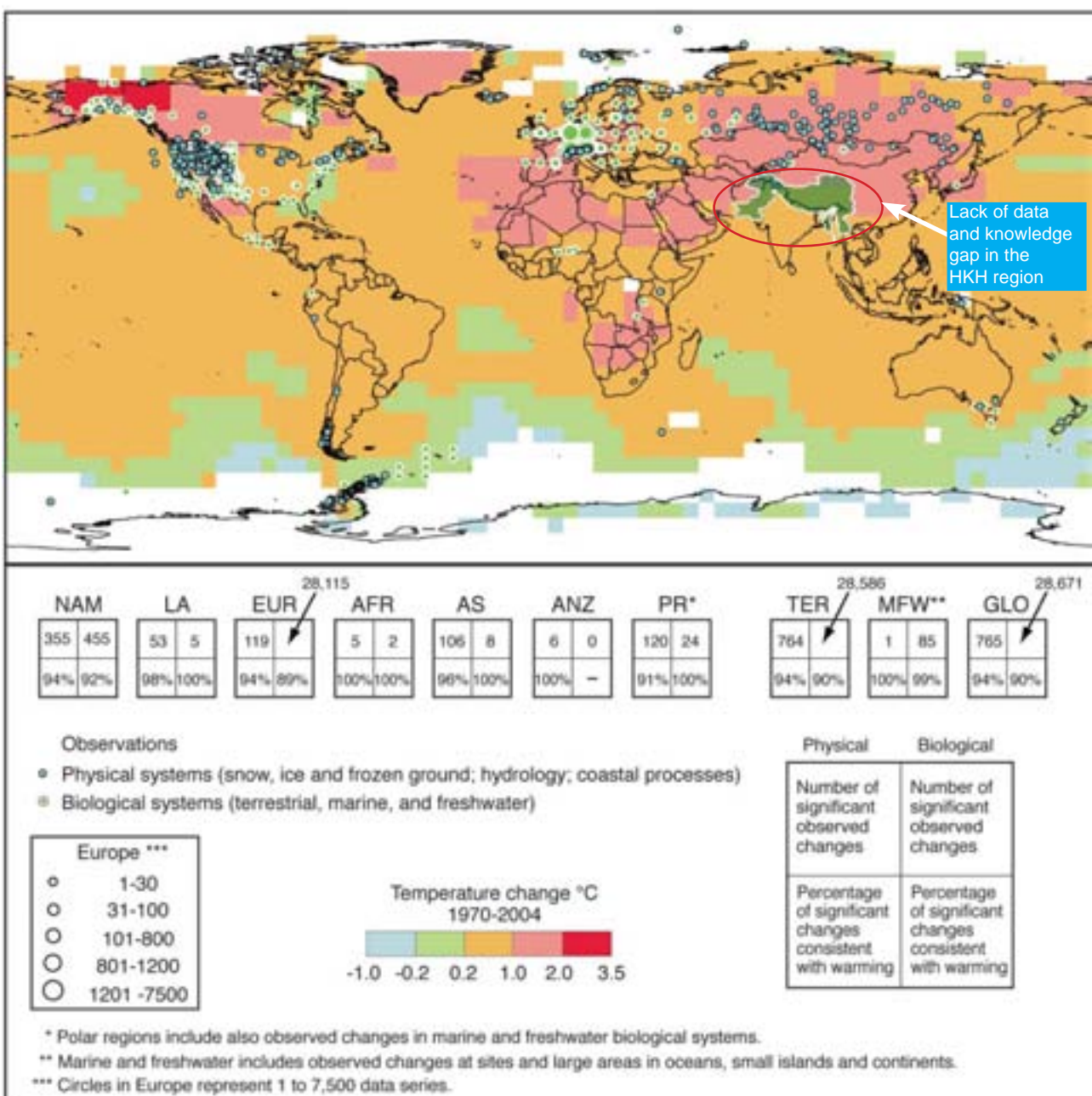
Although regional differences exist, growing evidence shows that the glaciers of the Himalayas are receding faster than in any other part of the world. For example, the rate of retreat of the Gangotri glacier over the last three decades has been more than three times the rates of retreat during the preceding 200 years. Rapid deglaciation is taking place in most of the glaciers studied in Nepal: the reported rates of glacial retreat range from several metres to 20 m/year. On the Tibetan Plateau, the glacial area decreased by 4.5% over the past 20 years and by 7% over the past 40 years (CNCCC 2007). If present retreat trends continue, the total glacier area in the Himalayas will likely shrink from the present 500,000 to 100,000 sq. km by the year 2035. In northwest China, 27% of glacier areas equivalent to an ice volume of 16,184 km<sup>3</sup> will disappear; so will 10-15% of frozen soil area by 2050 (Qin et al. 2002).

The receding and thinning of Himalayan glaciers can be attributed primarily to global warming. Isolated studies on Himalayan climate change have revealed warming synchronous with yet greater than global average warming rates. For example, the last 30 years witnessed an average temperature increase of 0.6°C decade in the Nepal Himalayas, while in the Tibetan Plateau the average temperature increased by 0.3°C decade.

As the glaciers are a water source for nine major populated river basins, rapid shrinkage of these glaciers is likely to seriously threaten water availability in the region, particularly during lean flow seasons when meltwater contribution is crucial to sustain the river flow which supports human activities and ecosystem services in these areas and downstream. As glacier

melt accelerates, river runoff will initially increase as the ice reserve reduces below a critical threshold. This will have an impact on the livelihoods of half a billion people in the Himalayas, and also for 1.3 billion people living in the nine river basins.

Accelerated glacier melting has led to increased glacial hazards in the Himalayas known as glacial lake outburst floods (GLOFs). Approximately 200 potentially dangerous glacial lakes in the region could cause catastrophic floods (referred to by others as the 'mountain tsunami'), which can sweep away all means of livelihood in a single stroke (Bajracharya et al. 2007). There is clear evidence of permafrost degradation in the region, with potential to cause ground surface subsidence and failure of infrastructure.



Observed climate change in different regions of the world (1970-2004), highlighting the lack of data in the Hindu Kush-Himalayan region



A stretch of the Himalayas as seen on the way to Bumthang, Bhutan.

## Knowledge gap on regional vulnerability and a policy setting for adaptation

While the Arctic, Sub-Saharan Africa, Small Island States, and Asian mega deltas have been found to be the most vulnerable regions in the world in the context of global climate change (IPCC 2007), the vulnerability of the Himalayas is unclear because of the lack of data and knowledge at the regional level (see Figure p.11). Knowledge gaps in the following areas have been identified.

- Inventories of glaciers and other physical and ecological systems
- Changes in the Himalayan glaciers in the past and projections for the future under different temperature scenarios
- Glacier melt induced hydrological changes: floods and droughts
- Regional adaptive capacity

## The role of ICIMOD

The relevant findings of national perspectives from countries of the region such as China and India in the IPCC Assessment Report 4 are far from adequate to reflect the regional magnitude and urgency of climate

change impacts. The knowledge gaps identified require a comprehensive regional database, a regional observation network of key physical and ecological systems, as well as integrated, in-depth analysis and synthesis. Enhanced regional coordination on these aspects is increasingly important. ICIMOD, as a regional inter-governmental knowledge and learning centre for the Himalayas is therefore well placed to play such a coordinative role.

Ground-based observations are rather poor in many parts of the region. Meteorological stations are clustered around low altitude belts and settlements, whereas hydrometric stations are located far away from the glaciated regions being observed. Glacier monitoring work is largely limited to a terminus survey. Observation and systematic monitoring of glacier ice volumes through mass balance studies are scanty, isolated, and not standardised. Ecosystem monitoring stations are at best patchy and limited. ICIMOD can facilitate the coordination of these regional observation networks, including but not limited to providing guidance and standards to existing networks and, where gaps are identified, to helping establish field stations. It is suggested that ICIMOD continue to update glacier inventories to document their changes, model these

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changes under different climate change scenarios, and establish a regional database that member countries contribute to and share. This will provide the basis for a regional picture that reflects past and possible future changes in the regional climate system and their likely impacts on the livelihoods of local and downstream populations. To this end, the development of climate modelling expertise at ICIMOD is necessary for assessing climate change impacts annually in various parts of the region.

ICIMOD is also well positioned to facilitate communication and exchange among research institutions in the region for concerted research activities on such areas as glacier changes under different temperature scenarios, glacier melt induced hydrological changes and their consequences including floods and droughts, and adaptive capacity assessment. Information on these areas of study will provide governments of the region with vital information to set up policy on adaptation to climate change across the region and in the individual member countries.

These efforts can be implemented building on the strength of the member countries and need not start from scratch. Support from outside the region is essential and will strengthen ICIMOD's role as the only regional inter-governmental centre providing relevant knowledge on adaptation to climate change.

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