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Snowfall may be key to why some Himalayan glaciers aren't melting

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Global warming is shrinking glaciers across the world, whether in the Alps or the Himalayas. Except in one spot: the Karokaram mountain range in the northwest Himalayas. Most of the glaciers in this region, which cuts across Pakistan, India, and China, are stable. Some are even growing.

Ever since this "anomaly" came to light in the early 2000s, scientists have been trying to figure out why. Recent research has been honing in on one factor: snowfall. Now, a new study confirms its importance. Modelling fluctuations in glaciers and snowfall over several decades, researchers from the Indian Institute of Education and Research (IISER) in Pune found that variability in snowfall accounts for 60% of changes in glacier mass since 1989.

The findings show that snowfall is the controlling factor in glacier loss in the Himalayas, said Argha Banerjee, study co-author and professor at IISER Pune.

"We knew that fluctuations in snowfall can affect glacier mass but now we know just how much by a factor of five," said Banerjee. He added, "Now that we know snowfall controls glacier mass so strongly, we can also understand the Karakoram anomaly better."

The model showed that although snowfall is reducing in most of the Himalayas due to global warming, it is relatively insensitive to local temperature changes in the Karakoram. (Snowfall affects glaciers both directly and indirectly: Accumulation of snow grows the glacier; more snow cover also means a larger white surface to reflect away sunlight, known as the albedo effect.)

Why would snowfall be more stable in the Karakoram? Several theories abound. For one, the Karakoram seems to receive most of its snowfall during winter driven by a meteorological phenomenon called the Westerly Disturbance and not during the summer monsoon as in the rest of the region. Warm summer temperatures affect snowfall in the rest of the Himalayas more, a 2014 study notes, "as temperatures rise above freezing precisely when the majority of precipitation falls".

Another study found that a "vortex" of cold air gets trapped in the Karakoram mountains during the summer, countering warming. And another important 2018 study found that irrigation in China, Pakistan, and north India could be increasing snowfall. As irrigated land increases, more water evaporates from the ground, leading to more moisture in the atmosphere. This, in turn, means more cloud cover and snow in the hills.

Understanding glacier response to climate change in the Himalayas—often called the third pole—is considered key to South Asia's water security. The Himalayas are the source of the region's main river systems, and the Karakoram region alone holds 13,700 glaciers.

The latest findings highlight the importance of getting more data on snowfall, said Bannerjee. Glacier loss happens slowly over decades, making it hard to integrate into climate models. Snowfall trends may be easier to detect and incorporate into projections—if we can get good data, that is. "Snow is the biggest unknown factor in the Himalayas," said Banerjee. "On glaciers, we have some information, though little compared to Europe, but on snow we have virtually nothing."

More data for glaciers is critical, agreed RAAJ Ramsankaran, an IIT Bombay scientist also working on glaciers. "For the first time, this study reveals that snowfall variation has a stronger role in mass balance variation in the Hindukush Himalayas," said Ramsankaran.

Many questions remain to be explored, added study co-author Raghu Murtugudde, who is an earth scientist at the University of

Maryland in the US. For one, understanding seasonality is important. “Summer snow is becoming more rain in some places, whereas warmer winters may be bringing more snow in some other places,” he said.

Also, the transition from eastern to western Himalayas with the impact of the Pacific/El Niño and the monsoon giving over to westerly disturbances and the influence of the Atlantic, is not fully understood, he said.