Ngozumpa Glacier
Solokhumbu, Nepal

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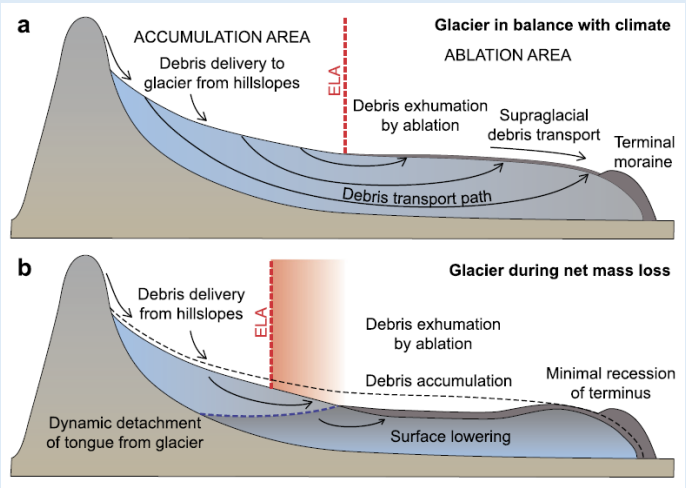
The Ngozumpa Glacier in 2016:

- Longest glacier in Nepal
- Descends from Cho Oyu (8188 m a.s.l.) and Gyachung Kang (7922 m a.s.l.)
- The Gaunara is a former tributary glacier that used to flow into the Nguzumpa from the east.
- **Length:** 18 km, **Area:** 61 km^2
- The lower 15 km of the glacier is covered in rock debris, increasing in thickness towards the terminus.
- The glacier extends ~500 m lower than clean glaciers in the area.
- **Ice loss**: Aggregated over the ablation area, the glacier is currently lowering by around 1 m per year.
- The glacier surface lies ~150m below the crest of the bounding moraines

Shrinking debris-covered glaciers:

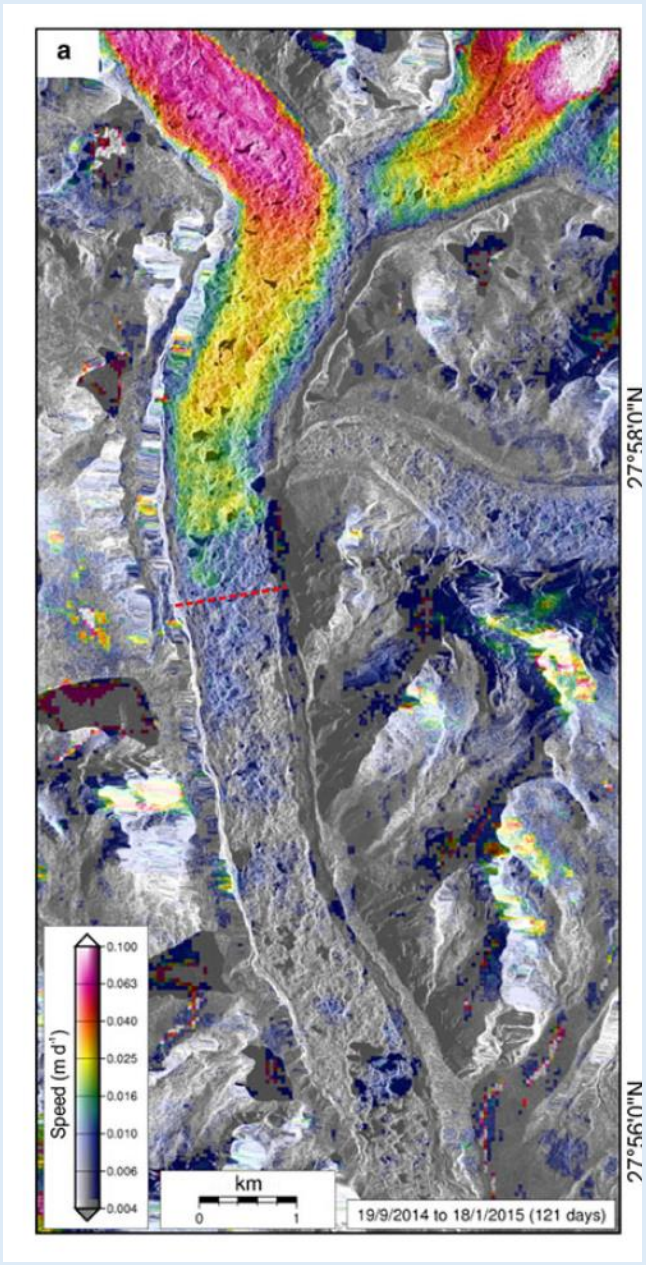
Thick debris cover at the end of the glacier protects the underlying ice from melting, and instead of retreating upvalley as they shrink, like clean ice glaciers do, these glaciers get thinner without changing the position of the glacier terminus much (Rowan and others, 2015).



This pattern of surface lowering leaves a long, relatively flat debris covered terminus lying well below the ridgetops of the moraines around it, which were built before the glacier started shrinking.

The low surface angle of the glacier surface means its flow speed slows down and also that surface water cannot easily drain off the glacier, and out beyond the moraine barrier.

Glacier velocity:



- **Maximum velocity:** about 36 m per year
- **Velocity within the debris-covered tongue**: the lower 6.5 km, below the confluence of the Gaunara glacier is not flowing
- The main glacier is fed only from the western (Cho Oyu) tributary.
- This data is derived from a radar satellite called **Terra SAR**-X (Thompson and others, 2016)
- Unlike optical images, radar images of the earth surface can be collected from satellites even when it is cloudy.

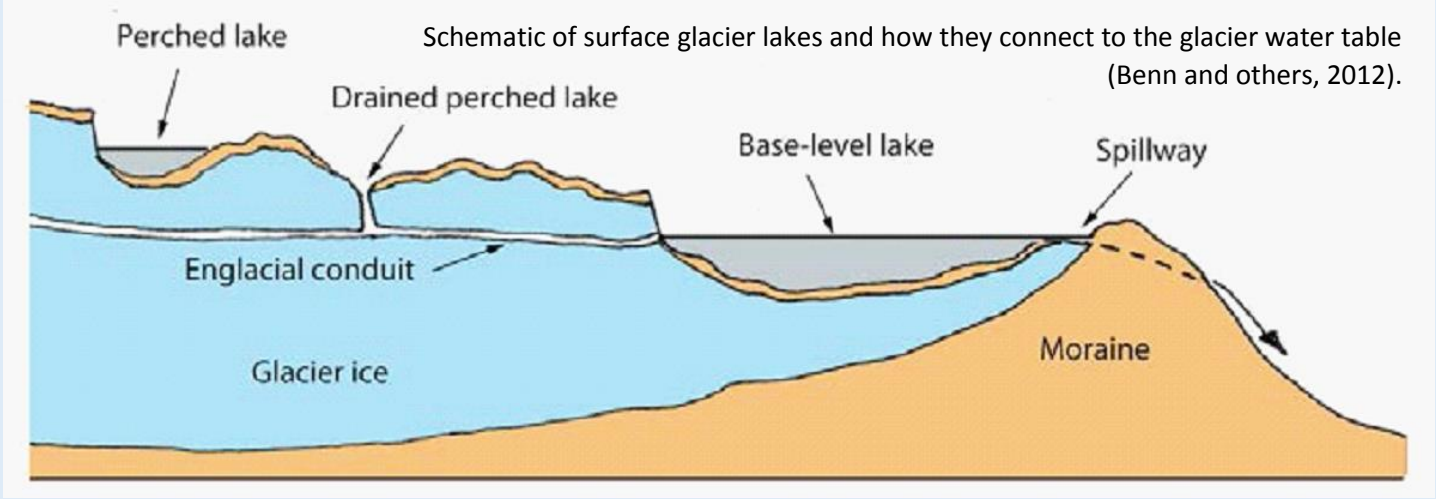
Water flow and storage at a debris-covered glacier:


Inside Ngozumpa glacier (Gulley and others, 2007)

Meltwater flows on top of and within the glacier.

If a glacier is flowing the ice deformation usually closes the internal water pipes quite fast, but in the stagnant parts of the debris-covered glaciers they stay open and have been explored by scientists to understand how these drainage tunnels form.

The hummocky surface means that meltwater, and rain during the monsoon, collects in surface ponds. These ponds, perched above the glacier water table, can drain suddenly if they connect with one of the drainage conduits inside the glacier.



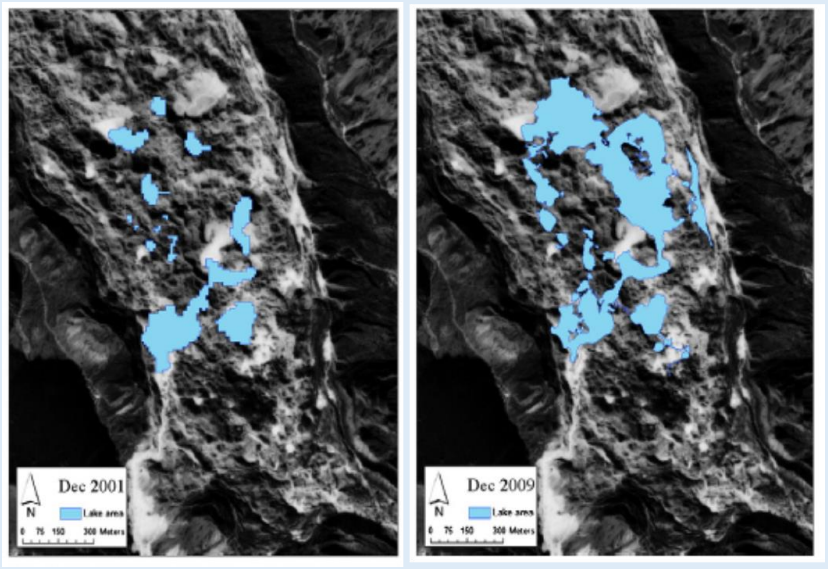
Schematic of surface glacier lakes and how they connect to the glacier water table (Benn and others, 2012).

Spillway lake:

Near the end of Ngozumpa glacier is a different kind of lake which is at the base level of the glacier water table. The lake level here is controlled by a spillway over the moraine. This lake was expanding by 10% of its area each year between 2001 and 2009, but as of 2016 has stopped expanding (Thompson and others 2016).

The changes in the surface lakes in this part of the glacier is why the route of the path across the glacier has had to change over time.

Continued study of this lake will help us understand how large, potentially dangerous glacier lakes form.



This leaflet was prepared by Dr Lindsey Nicholson of the University of Innsbruck, Austria (www.lindseynicholson.org)

Benn, D. I., Bolch, T., Hands, K. A., Gulley, J. D., Luckman, A., Nicholson, L. I., Quincey, D, Thompson, S., Toumi, R. and Wiseman, S. (2012). Response of debris-covered glaciers in the Mount Everest region to recent warming, and implications for outburst flood hazards. Earth-Science Reviews, 114(1–2), 156–174.

Rowan et al., (2015). Modelling the feedbacks between mass balance, ice flow and debris transport to predict the response to climate change of debris-covered glaciers in the Himalaya. Earth and Planetary Science Letters. 430, 427-438.

Thompson, S., Benn, D. I., Mertes, J., & Luckman, A. (2016). Stagnation and mass loss on a Himalayan debris-covered glacier: processes, patterns and rates. Journal of Glaciology. 62(233), 467-485.