FORCING THE RETREAT

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Remote sensing and glaciers:

The aim of this poster is to show the role remote sensing can play in the detection, monitoring and reporting of glacial reduction.

How and why?:

- Satellites using SWIR bands (e.g., Sentinel-2 or Landsat) detect snow and ice loss by tracking changes in infrared reflectance.
- New Zealand's glaciers have lost about 30–50% of their volume since the 1970s, including a 42% drop (2005–2023) [2].
- Globally, glaciers have lost roughly 5% of total ice volume since 2000 [3].

A Vital Role:

Satellites enable real-time, cost-effective glacier monitoring in remote areas. They help model glacier depth, volume, and long-term change, with ongoing research in the Southern Alps tracking retreat.

Supports **SDG 13** – Climate Action and **SDG 12** – Responsible Consumption & Production by highlighting climate-driven glacier loss.

Top glacier Reducers:

Debris cover and albedo changes – darker surfaces absorb more heat, speeding up ice melt.

Climate cycles – El Niño/La Niña events shift snow and temperature patterns.

Human influence – greenhouse gas emissions drive long-term warming, while tourism and land use changes add local pressures.

Method:

- Landsat 5–9 Level 2 surface reflectance images (2000, 2011, 2025) were processed with scale correction [1].
- CIR composites (NIR–Red–Green) highlighted ice and vegetation, while NDSI identified snow.
- A 30 m SRTM DEM provided terrain context.
- Unsupervised k-means classification attempted to map glacier surfaces.
- 2000–2025 timelapse visualised glacier retreat and lake expansion in CIR.

2000 | 2011 | 2025

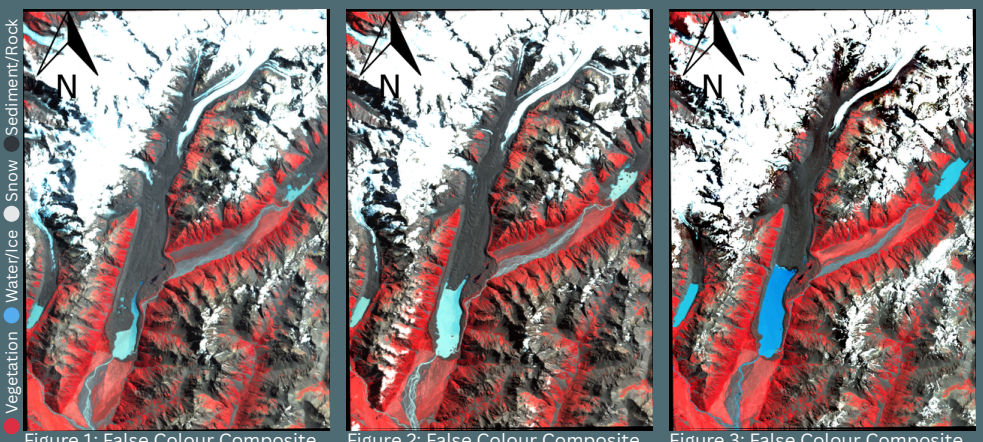


Figure 1: False Colour Composite (CIR) of Tasman Glacier, 9 Feb 2000 (Landsat 7, Bands 4-3-2, range 0–30).

Figure 2: False Colour Composite (CIR) of Tasman Glacier, 15 Feb 2011 (Landsat 5, Bands 4-3-2, range 0–30).

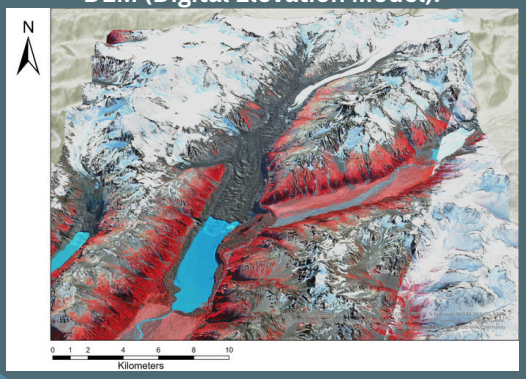
Figure 3: False Colour Composite (CIR) of Tasman Glacier, 4 Jan 2025 (Landsat 8, Bands 5-4-3, range 0–30).

2000:
Tasman Glacier still extended far down the valley, with a small proglacial lake forming. Red areas show vegetation, while grey-blue tones mark ice and debris. Moraines show its former reach into Lake Pukaki.

2011:
The glacier has now thinned and retreated, with Tasman Lake expanded noticeably. More calving and exposed rock indicate faster melt, while new vegetation spread along the valley slopes.

2025:
The glacier's terminus has receded several kilometres, leaving a large lake filled with sediment-rich meltwater. Vegetation now dominates deglaciated areas, showing rapid long-term retreat.

DEM (Digital Elevation Model):



The DEM emphasises steep alpine relief, while the CIR overlay highlights surface types—ice and snow in blue, vegetation in red, and rock in grey. The enlarged Tasman Lake reflects major glacier retreat since 2000.

Figure 4: 3D DEM of Tasman Glacier overlaid with a 2025 Sentinel-2 False Colour Composite (Bands 8-4-3). The image shows the expanded proglacial lake and debris-covered glacier tongue within the Southern Alps, NZ.

Quantitative Results:

Between 2000 and 2011, New Zealand's glacier ice volume decreased at an average rate of 0.53 km³ per year. From 2011 to 2023, this rate increased to a 1.27 km³ loss of volume per year, more than doubling the pace of ice melt. Across the full 2000–2023 period, the average loss was 0.91 km³ per year, highlighting a clear acceleration in glacier retreat consistent with Tasman Glacier observations.

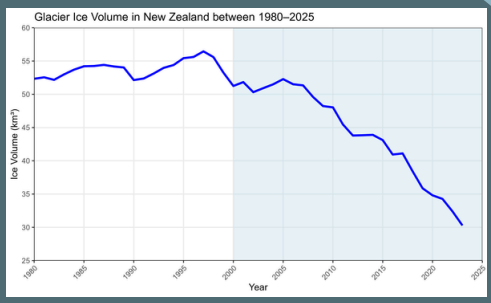


Figure 5: Tasman Glacier retreat and lake expansion, 2000–2023 [2].

Tasman Glacier Timelapse (2000–2025):

The timelapse shows the retreat of the Tasman Glacier and growth of its proglacial lake between 2000 and 2025.
https://drive.google.com/file/d/1k3mwhAL_JnzbNYx6tRIOa8jvwYurTpX8/view?usp=sharing

References:

1. Google Earth Engine. (n.d.). Landsat surface reflectance datasets. Google Developers. Retrieved October 12, 2025, from https://developers.google.com/earth-engine/datasets/catalog/landsat
2. Stats NZ. (2024). Annual glacier ice volumes: Data to 2023. Retrieved October 12, 2025, from https://www.stats.govt.nz/indicators/annual-glacier-ice-volumes-data-to-2023/
3. BBC News. (2024, September 19). New Zealand's glaciers are melting at an accelerating rate, scientists warn. Retrieved October 12, 2025, from https://www.bbc.com/news/articles/cy4ly8vde85o