Part 1
Glaciers on Spitsbergen

What is a glacier?

- A glacier consists of ice and snow.
- It has survived at least 2 melting seasons.
- It deforms under its own weight, the ice flows!

How do glaciers form?

Glaciers form where:

- Summer temperatures are not high enough to melt all the snow accumulated during the previous winter.
- In winter fresh snow accumulates, year after year, on top of the snow that survived summer.
- When the ice gets 10s of meters thick it begins to flow out- and downwards to areas with higher temperature. Here the ice melts or calves into the sea.

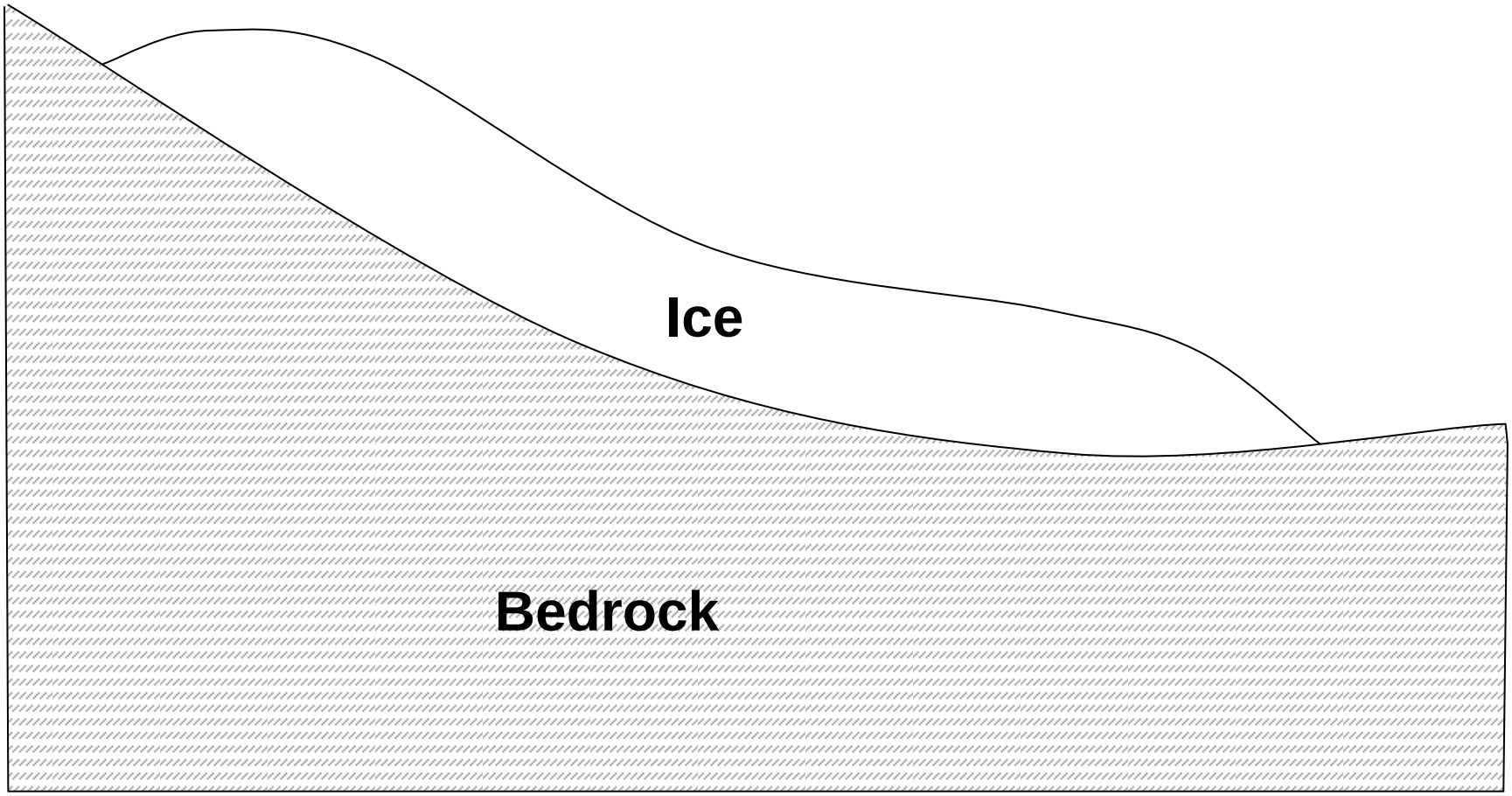


Illustration: K. Bælum

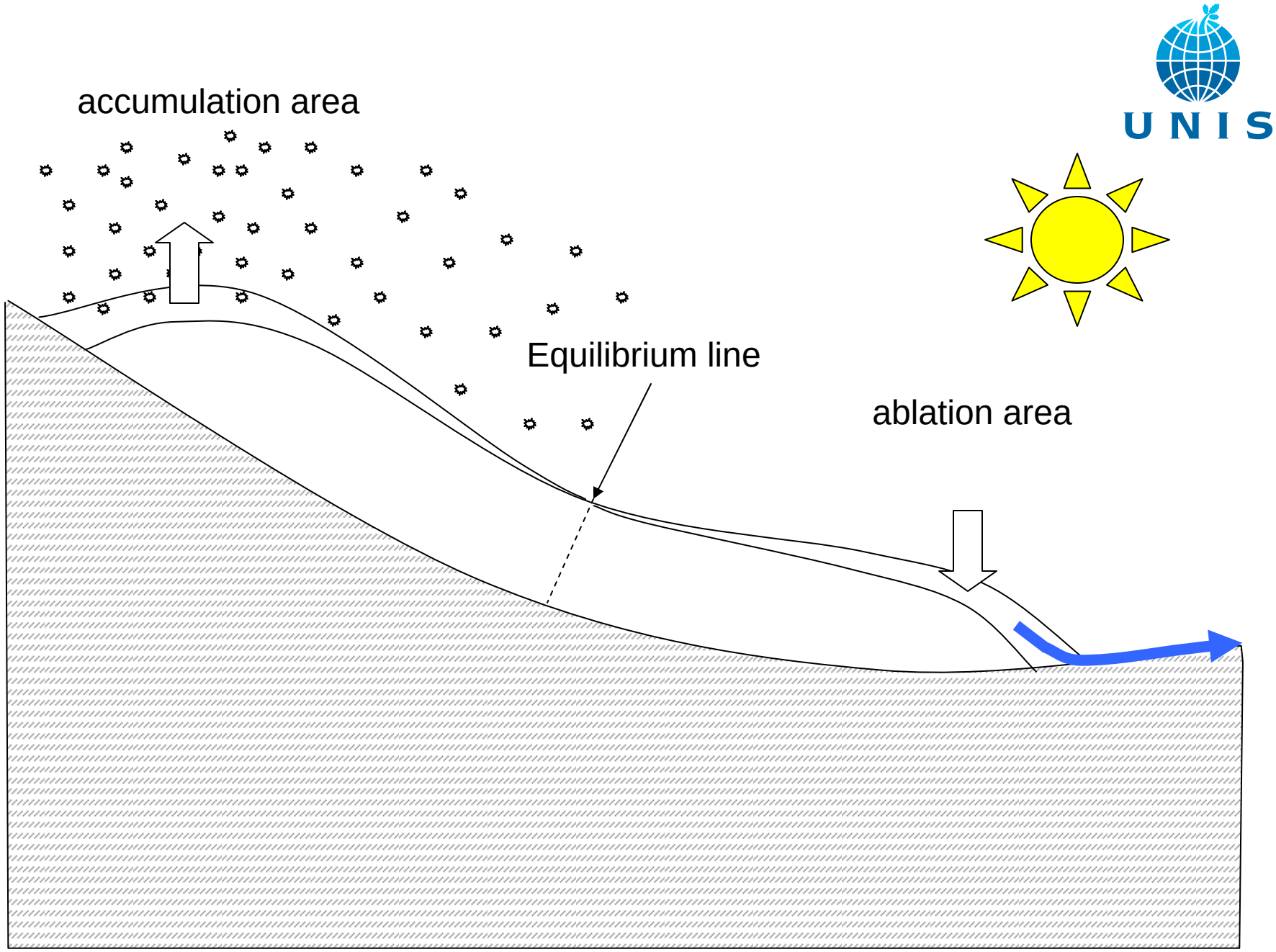


Illustration: K. Bælum

accumulation area

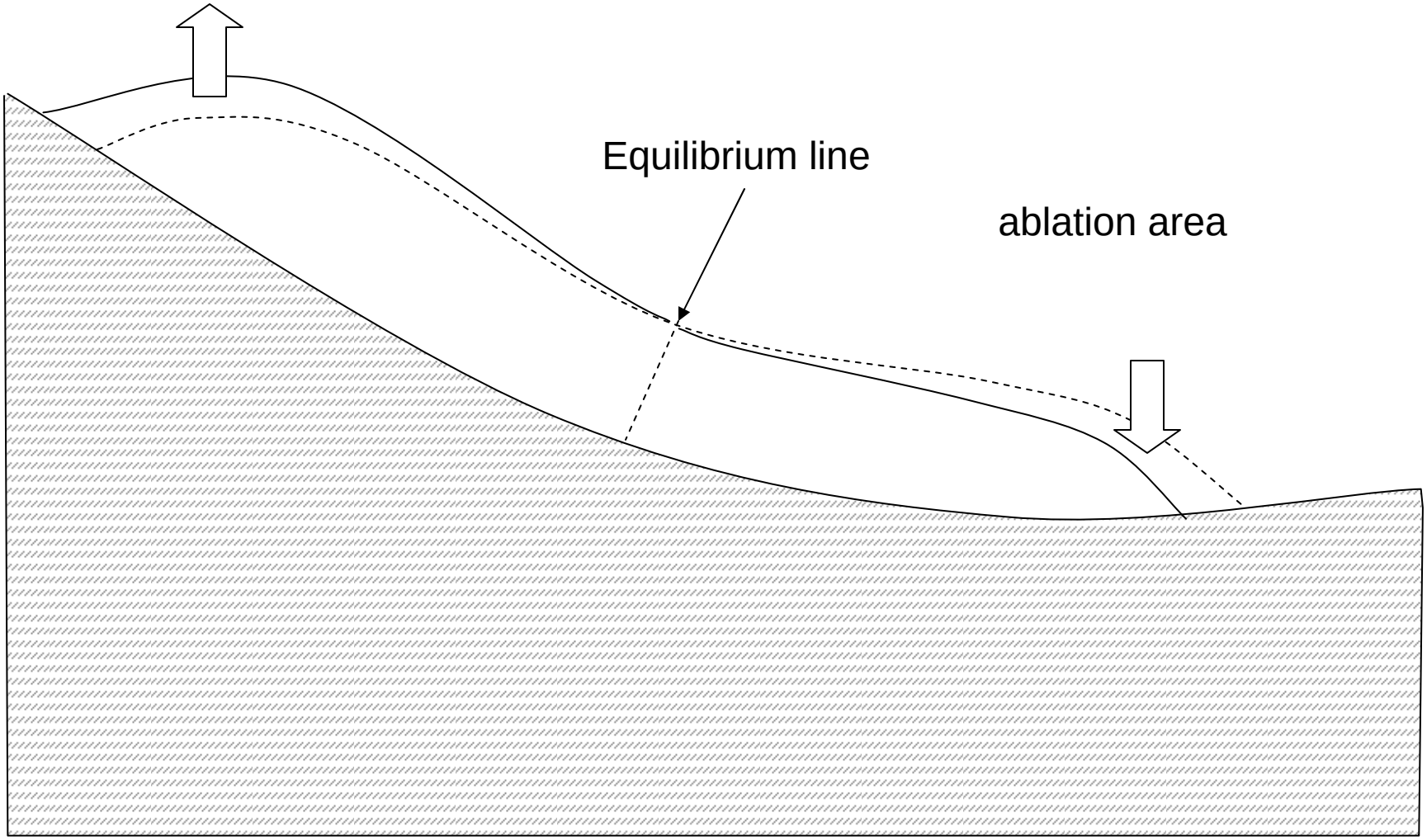


Illustration: K. Bælum

The ice flows down hill to lower lying areas

accumulation area

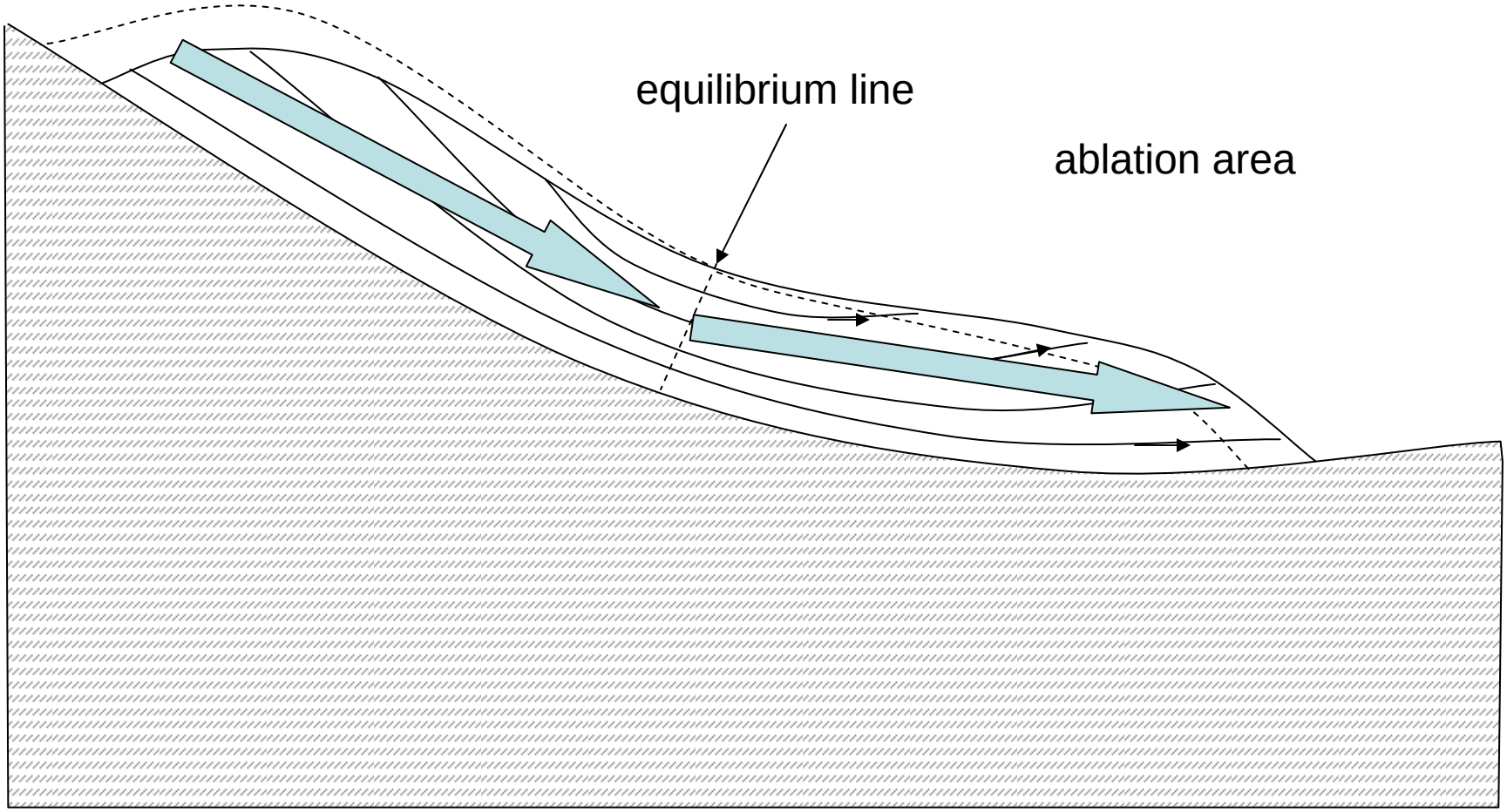


Illustration: K. Bælum

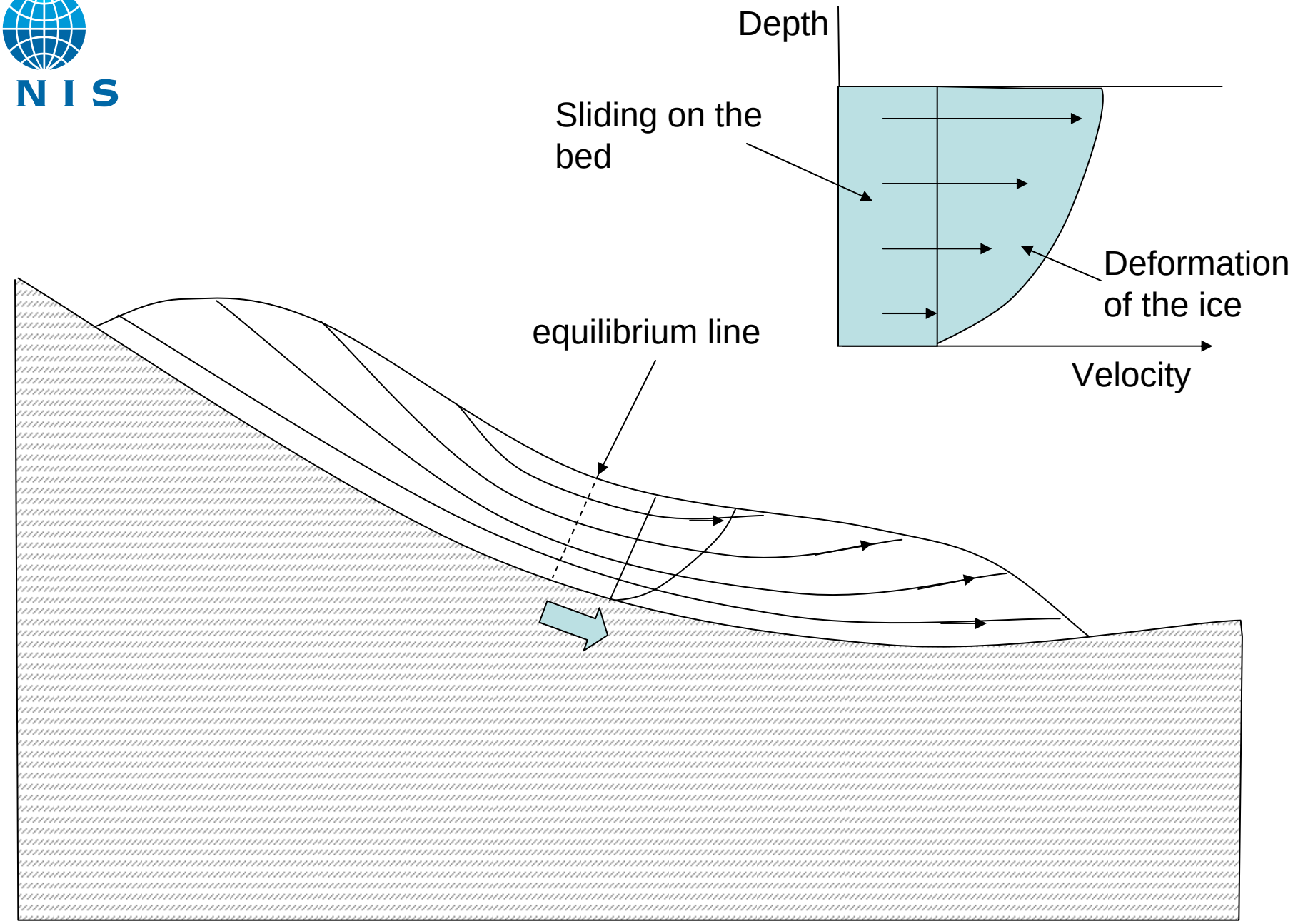


Illustration: K. Bælum

The ice flows faster near the surface of the glacier than along the bottom

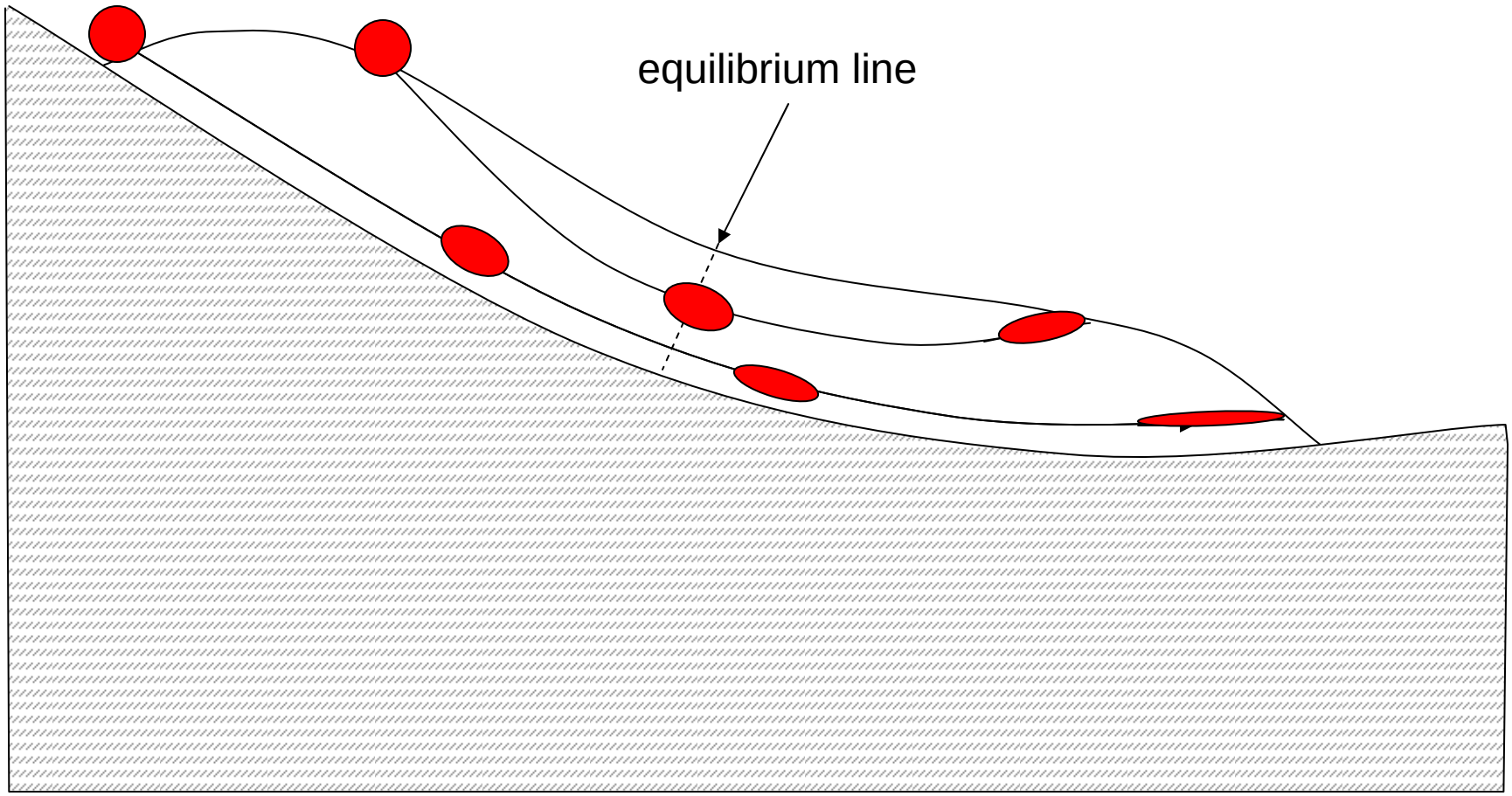


Illustration: K. Bælum

The ice flows faster in the middle of the glacier than along the sides

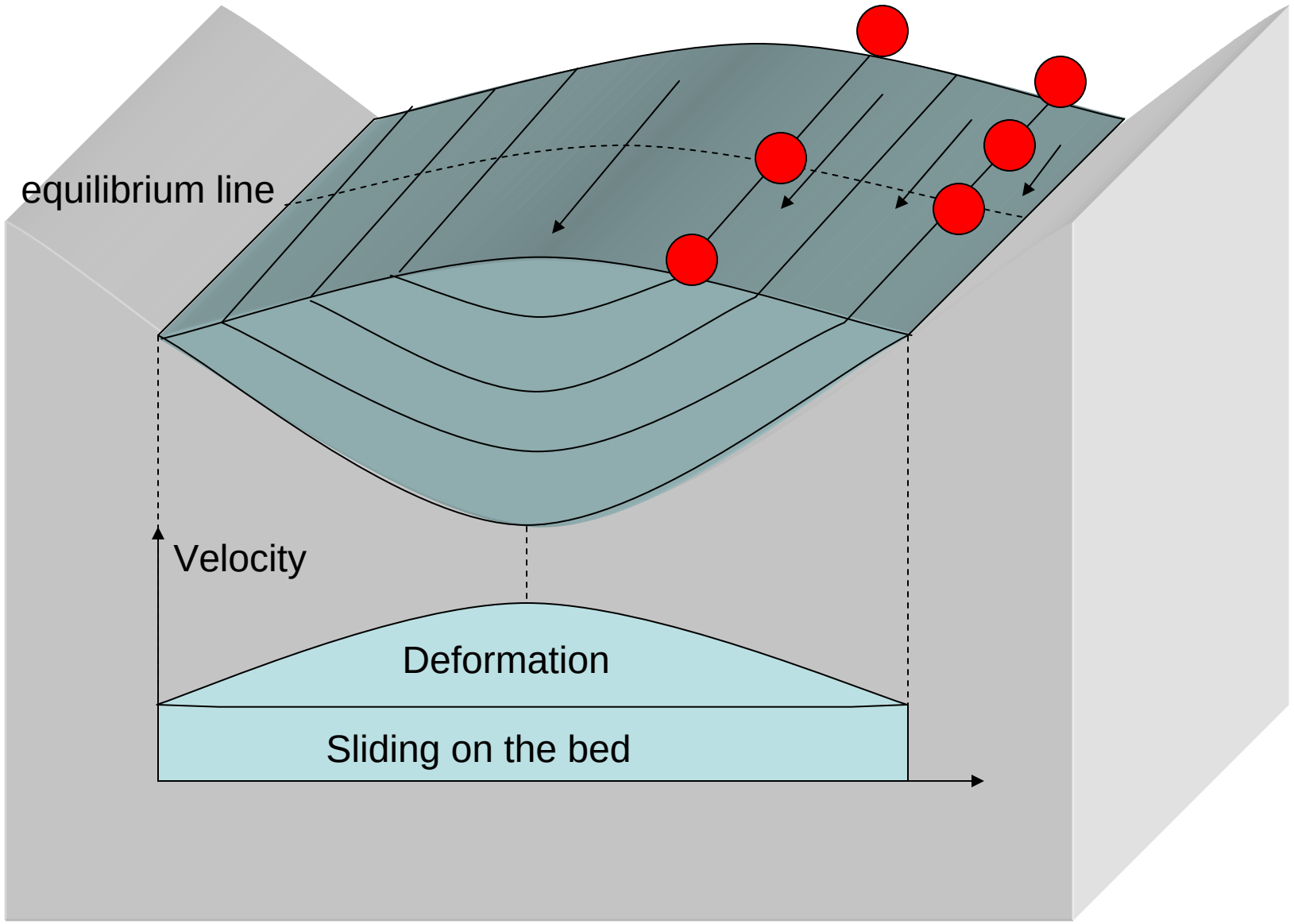


Illustration: K. Bælum

Snow + ice in = melting and calving

=> Glacier in **balance**

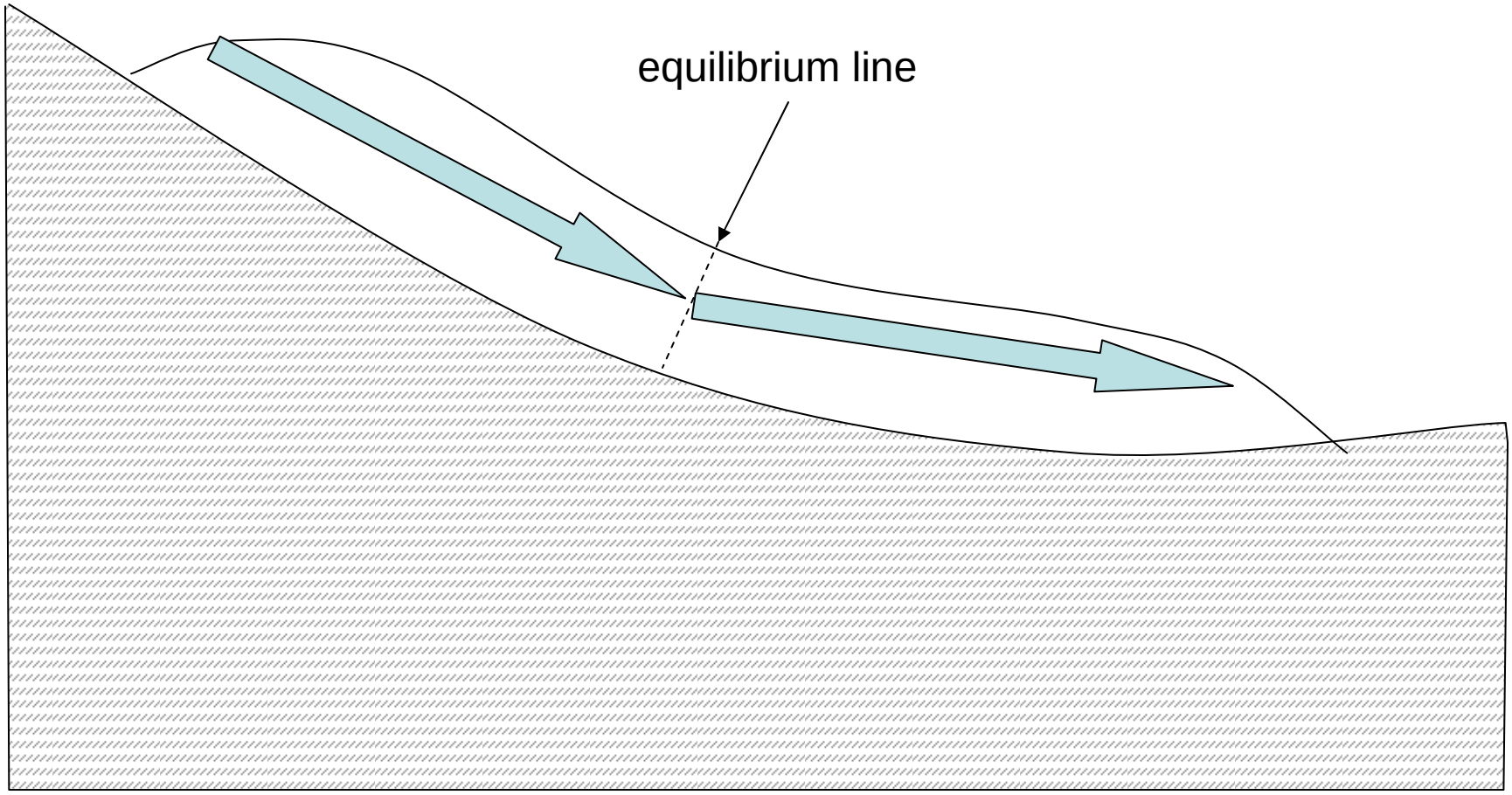


Illustration: K. Bælum

Snow + ice in < melting and calving

=> Glacier is **shrinking**

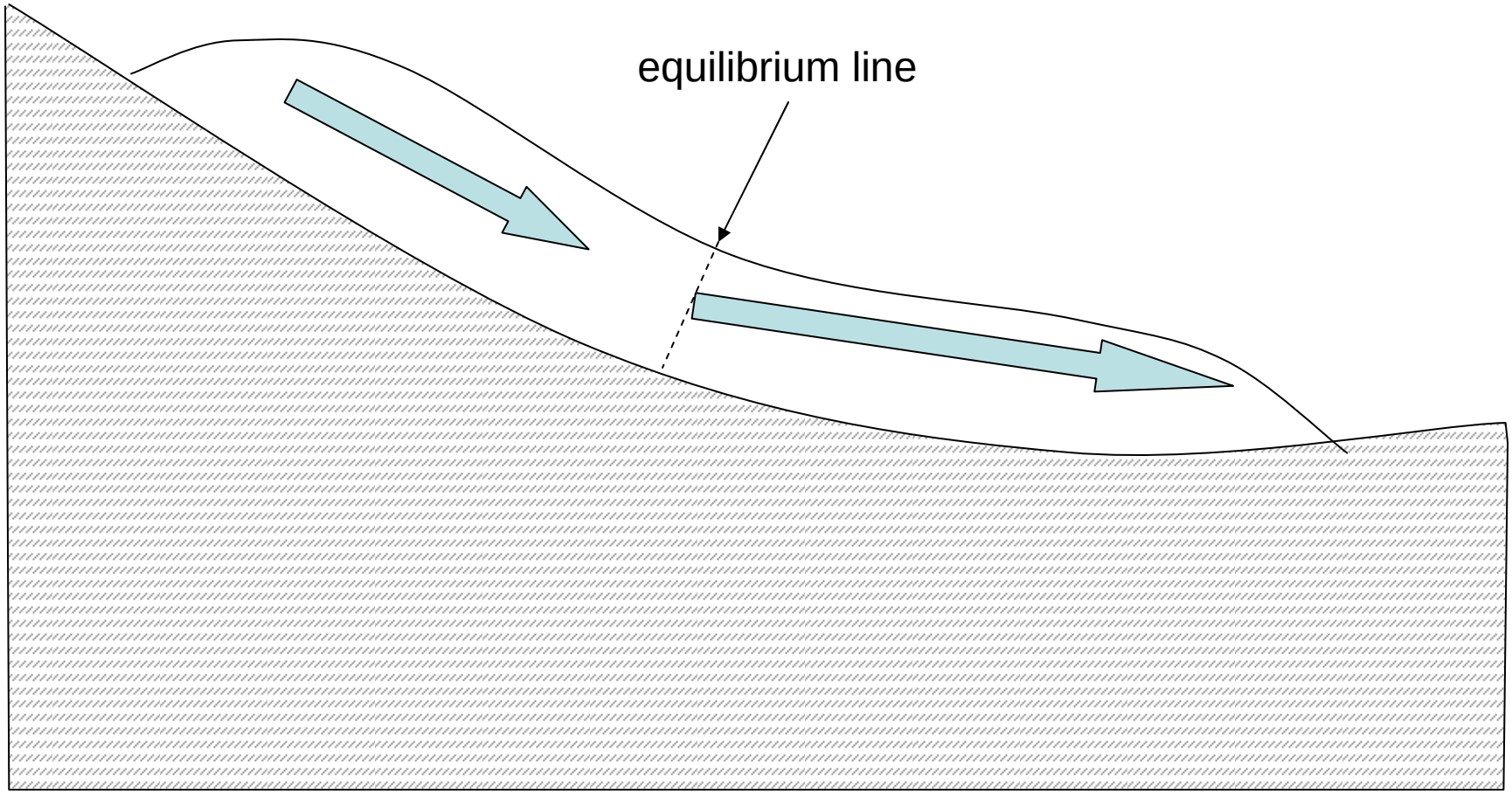


Illustration: K. Bælum

Snow + ice in > melting and calving

=> Glacier is **growing**

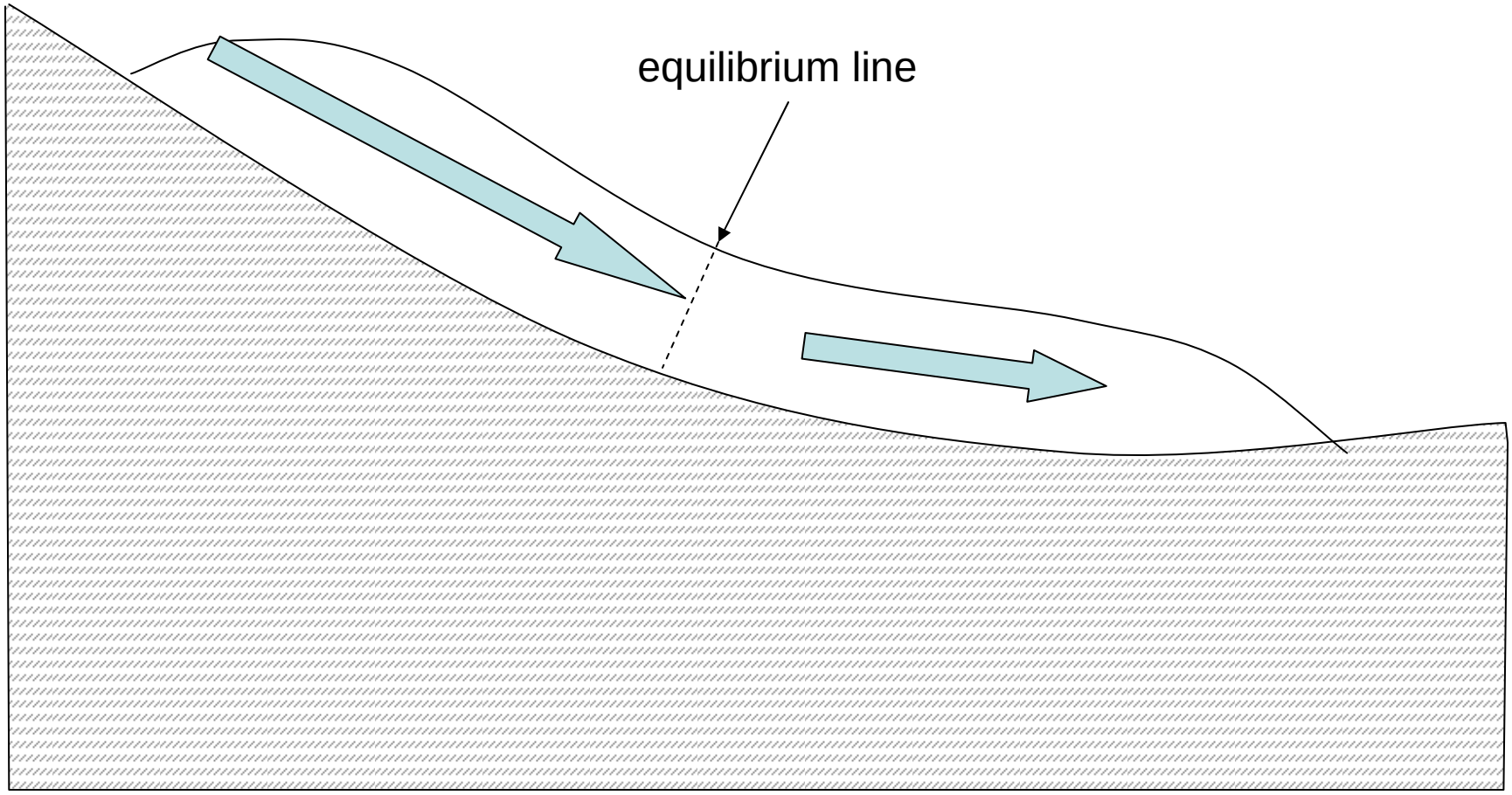


Illustration: K. Bælum

Speed of glacier < balance speed

=> Glacier is **growing** in the top**, retreating** in the front

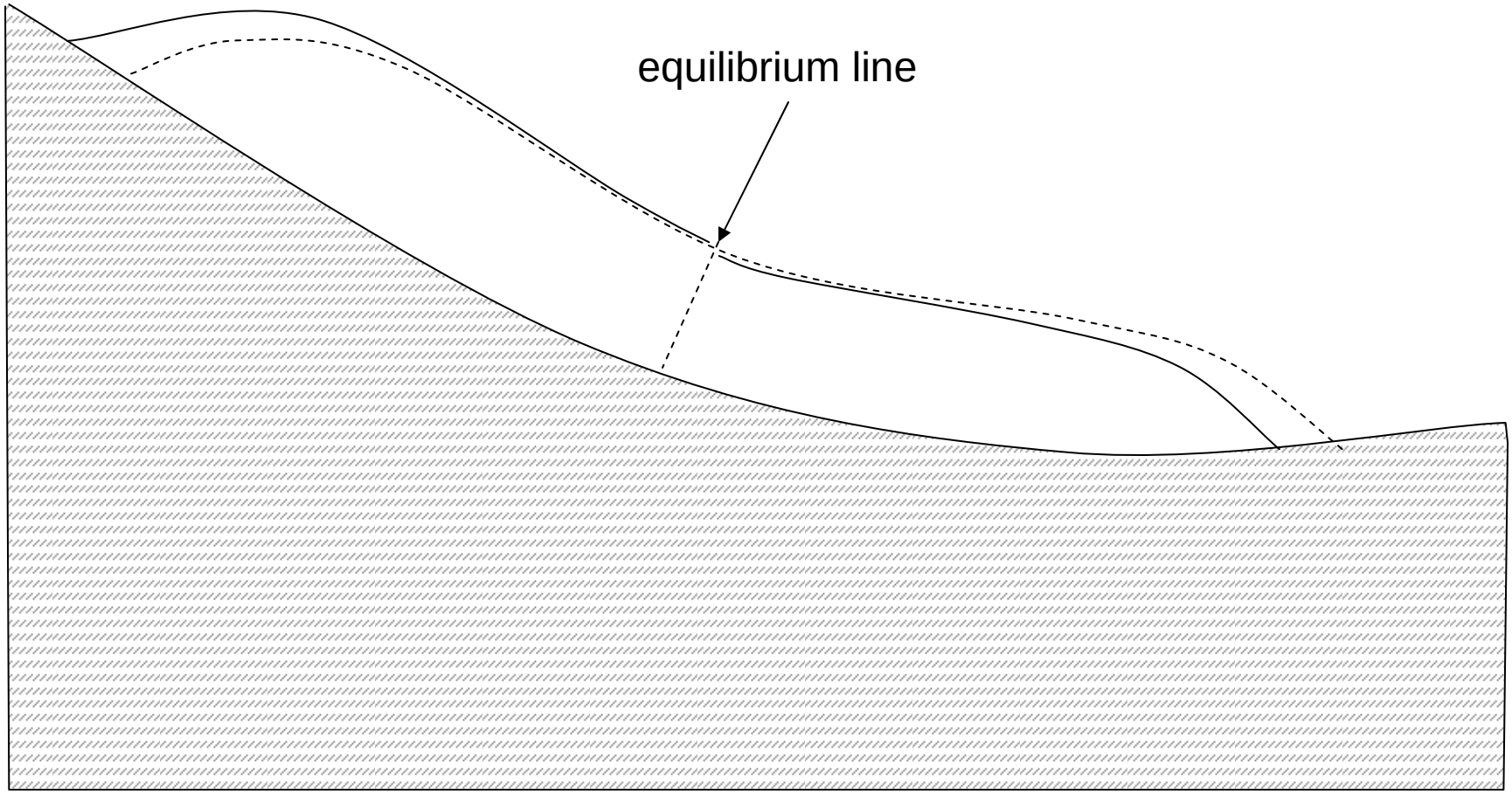
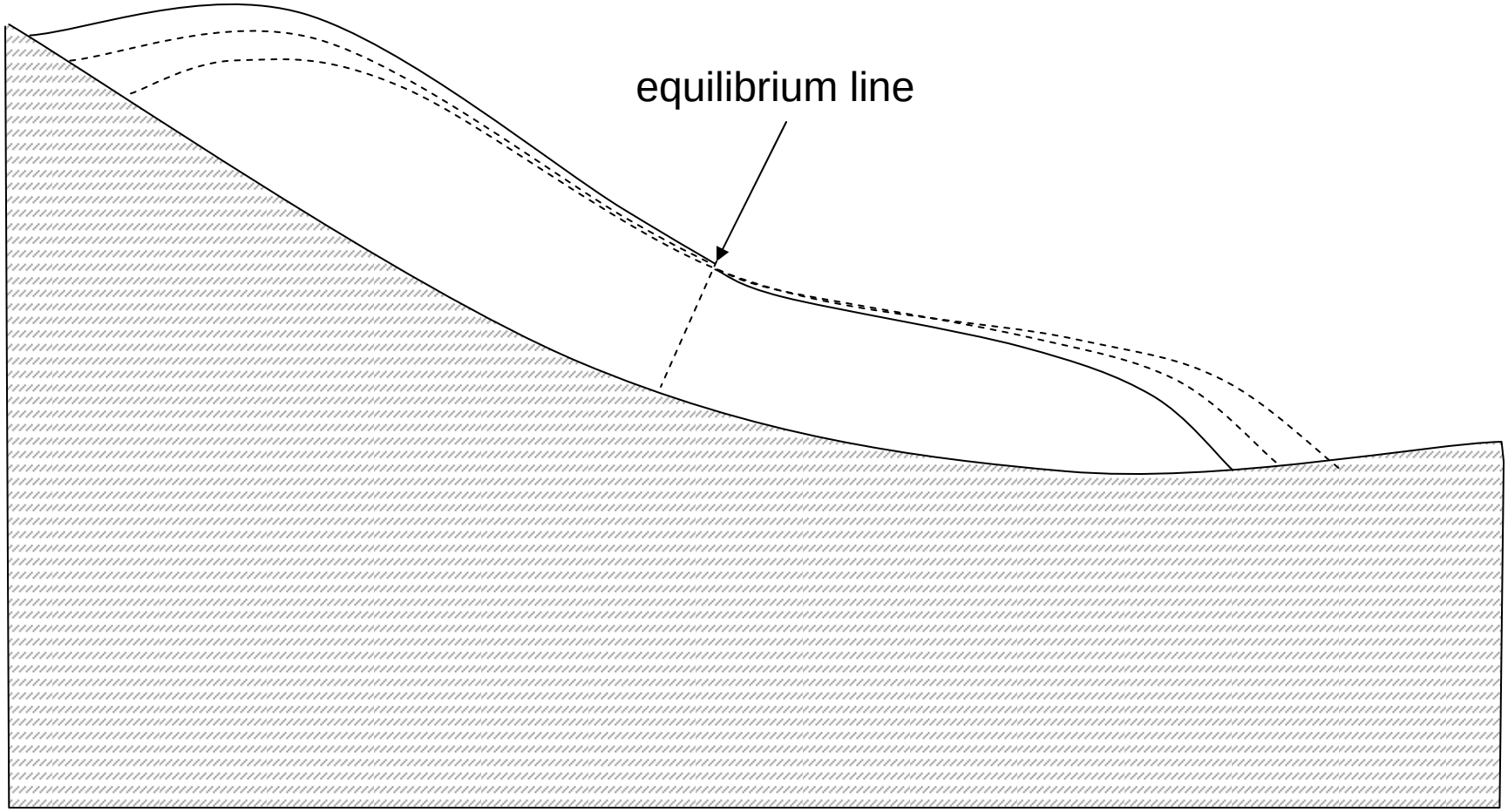


Illustration: K. Bælum



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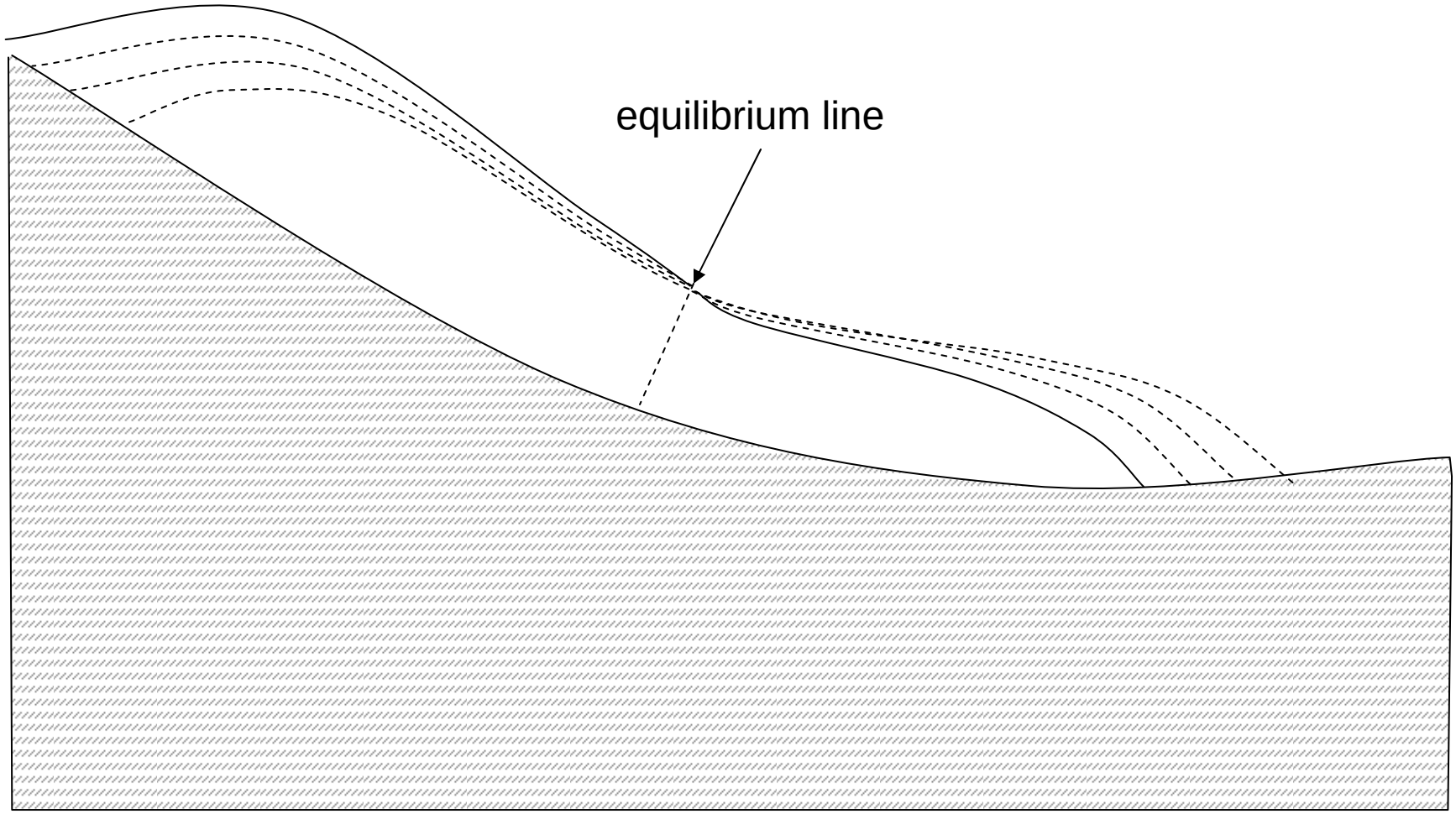


Illustration: K. Bælum

SURGE!!!!

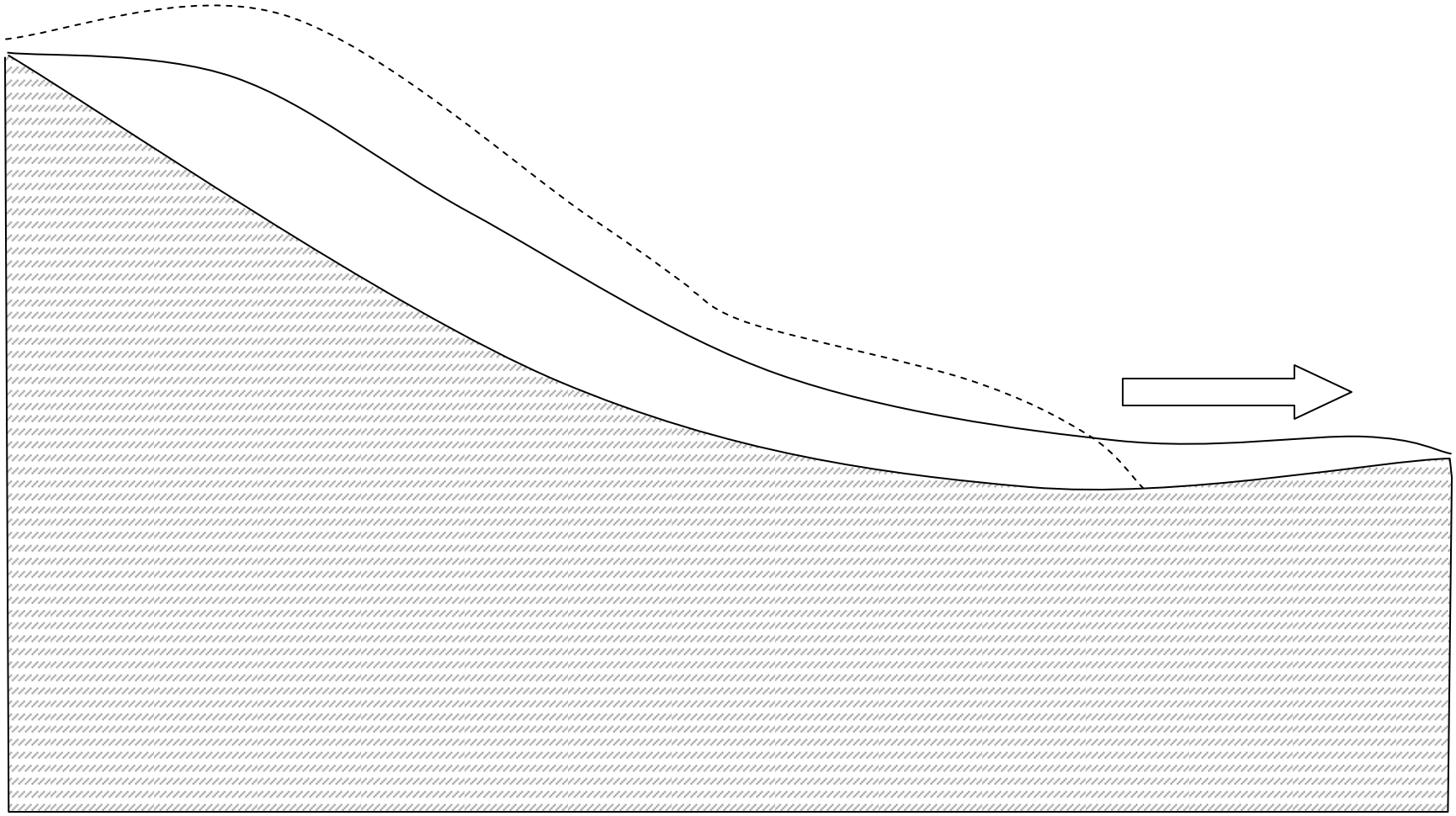


Illustration: K. Bælum

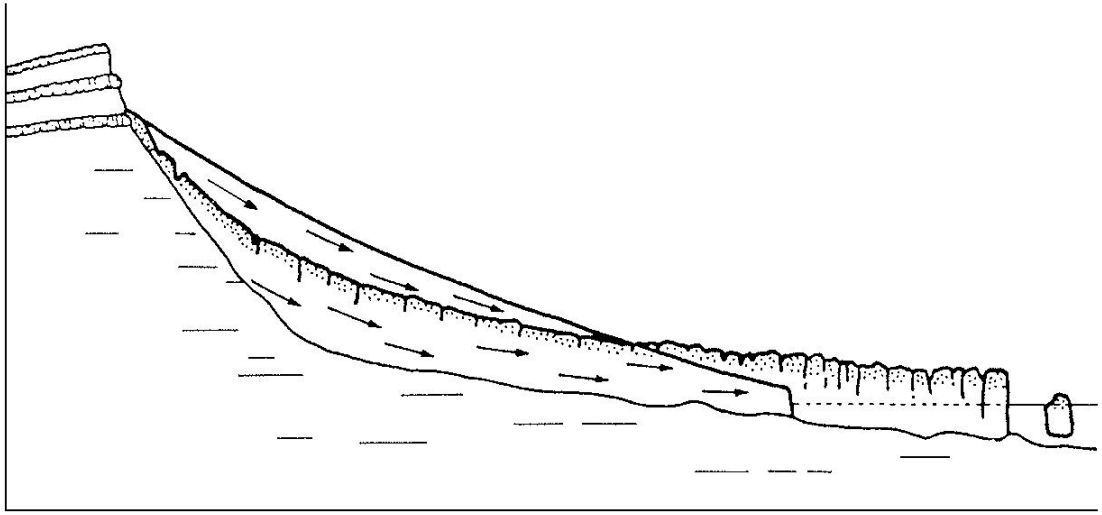
What is a surge?

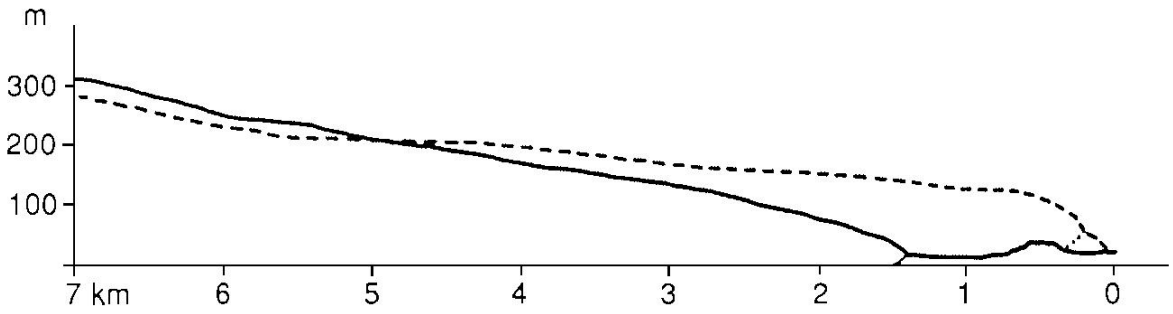
- A response to an imbalance in the glacier geometry caused by insufficient mass transport from accumulation to ablation area (In Svalbard probably linked to permafrost).
- A sudden increase in speed (often from 10s of meters/year to 1000s of meters/year)
- The buildup period between surges in Spitsbergen is typically 50-500 years
- The surge typically lasts from 2 to 10 years

What is a surge?

- Often, but not always, the terminus (tip) of the glacier advances several kilometers.
- The surface of the glacier becomes heavily crevassed (fractured) as a result of the increased speed.
- It takes from 10-20 years for the newly formed crevasses to close up.
- Estimates of Svalbard glaciers that surge lie between 30% and 90%

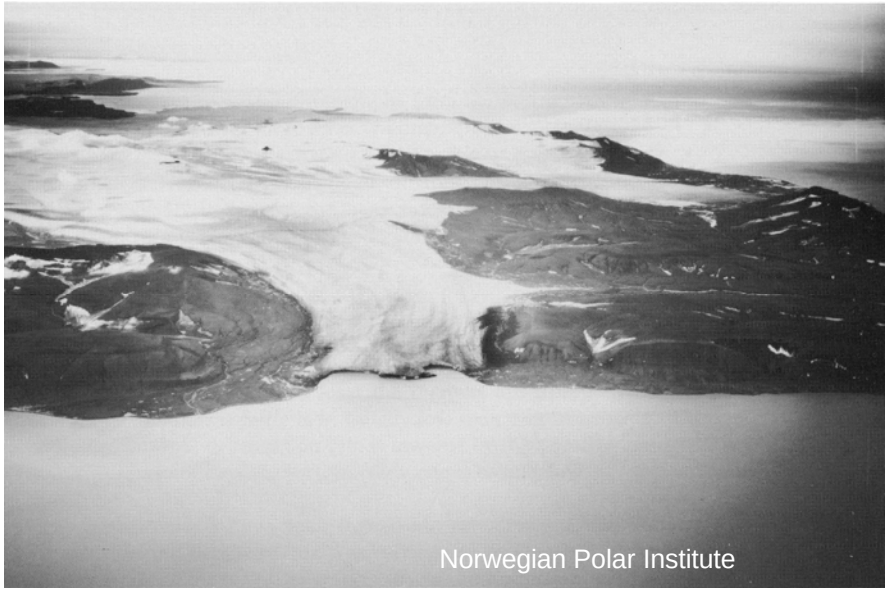
Surges occur both in water-terminating and terrestric glaciers





Example of surge - Freemannbreen

1936



1956

Example of surge - Skobreen

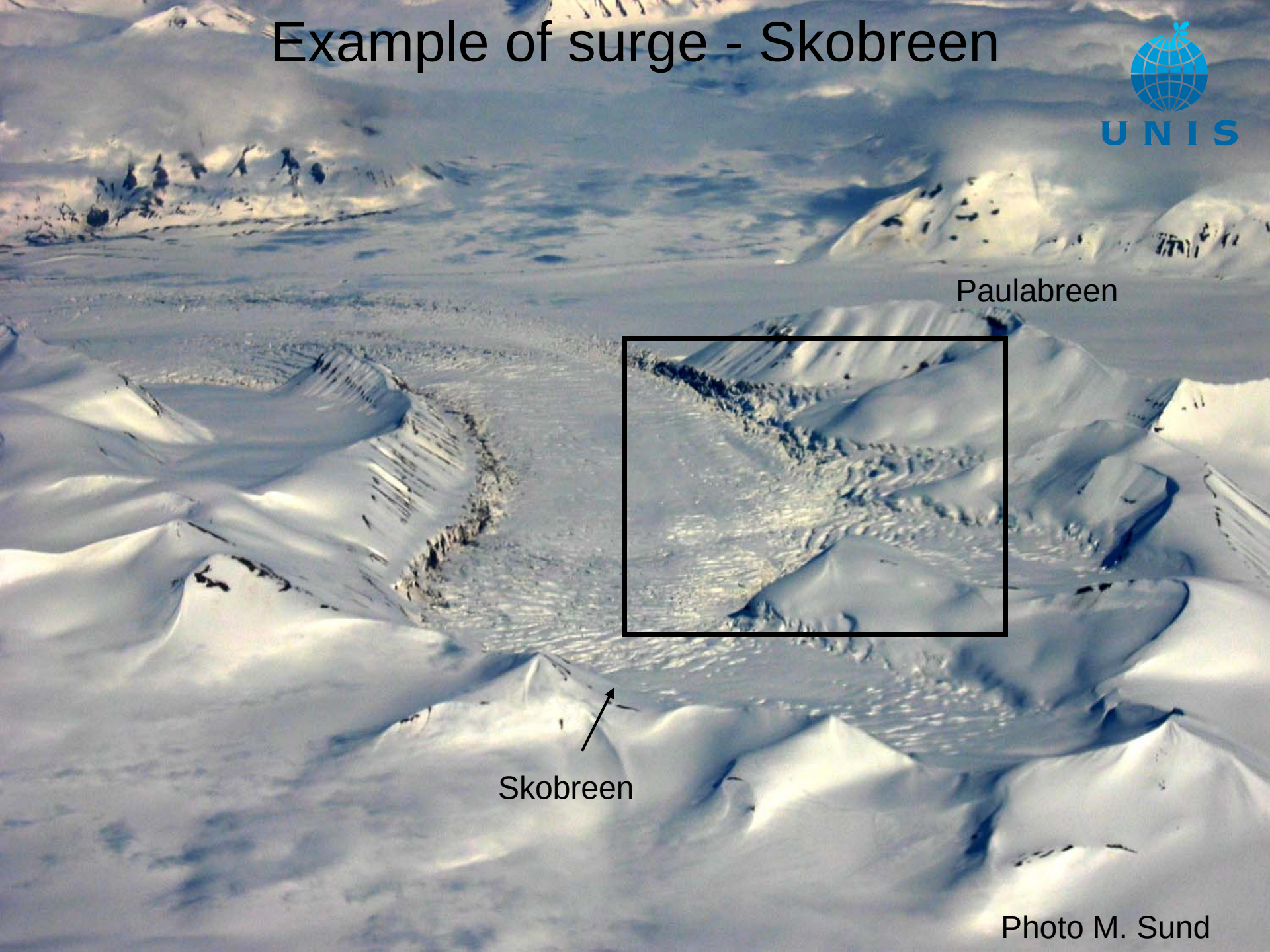
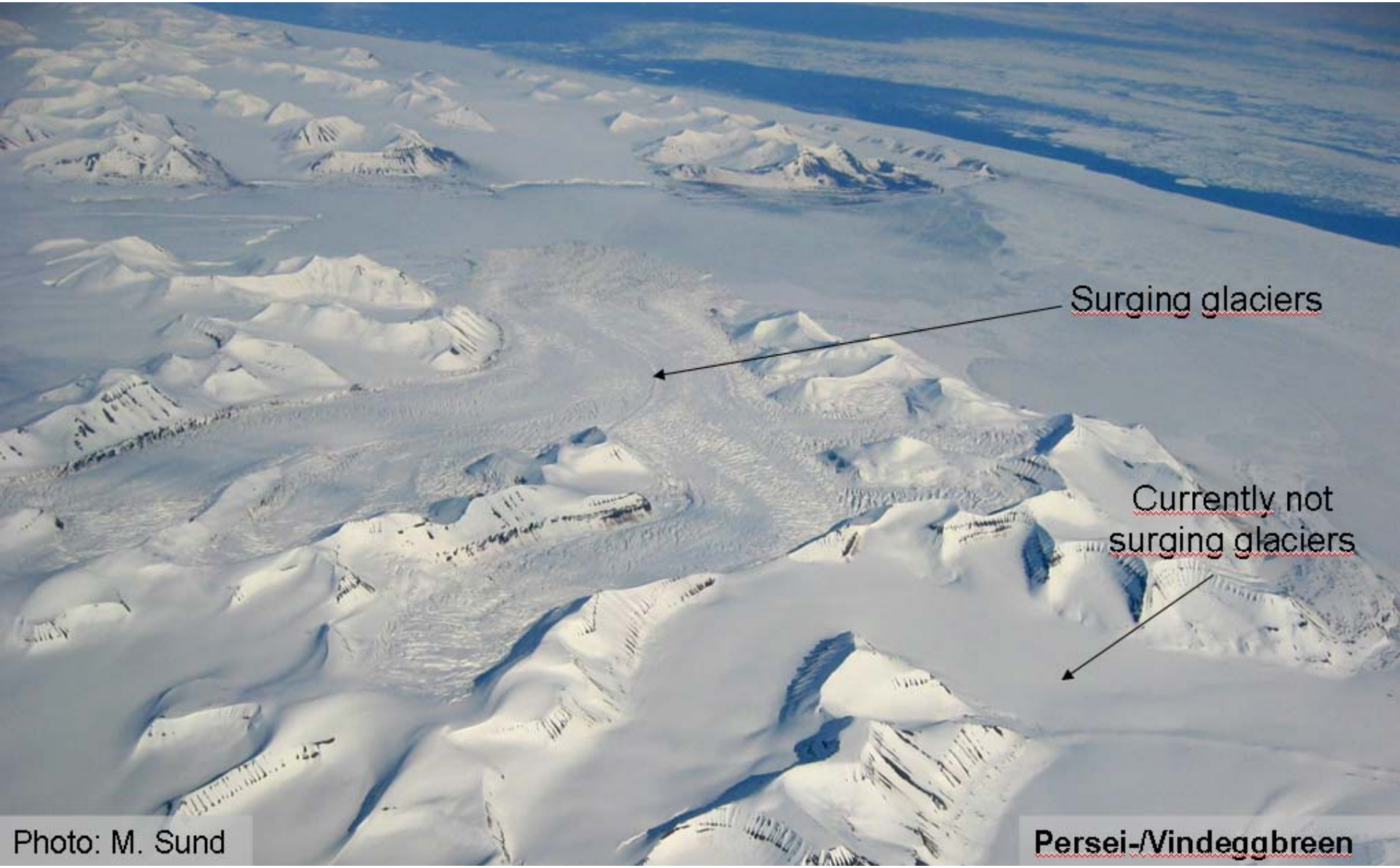


Photo M. Sund

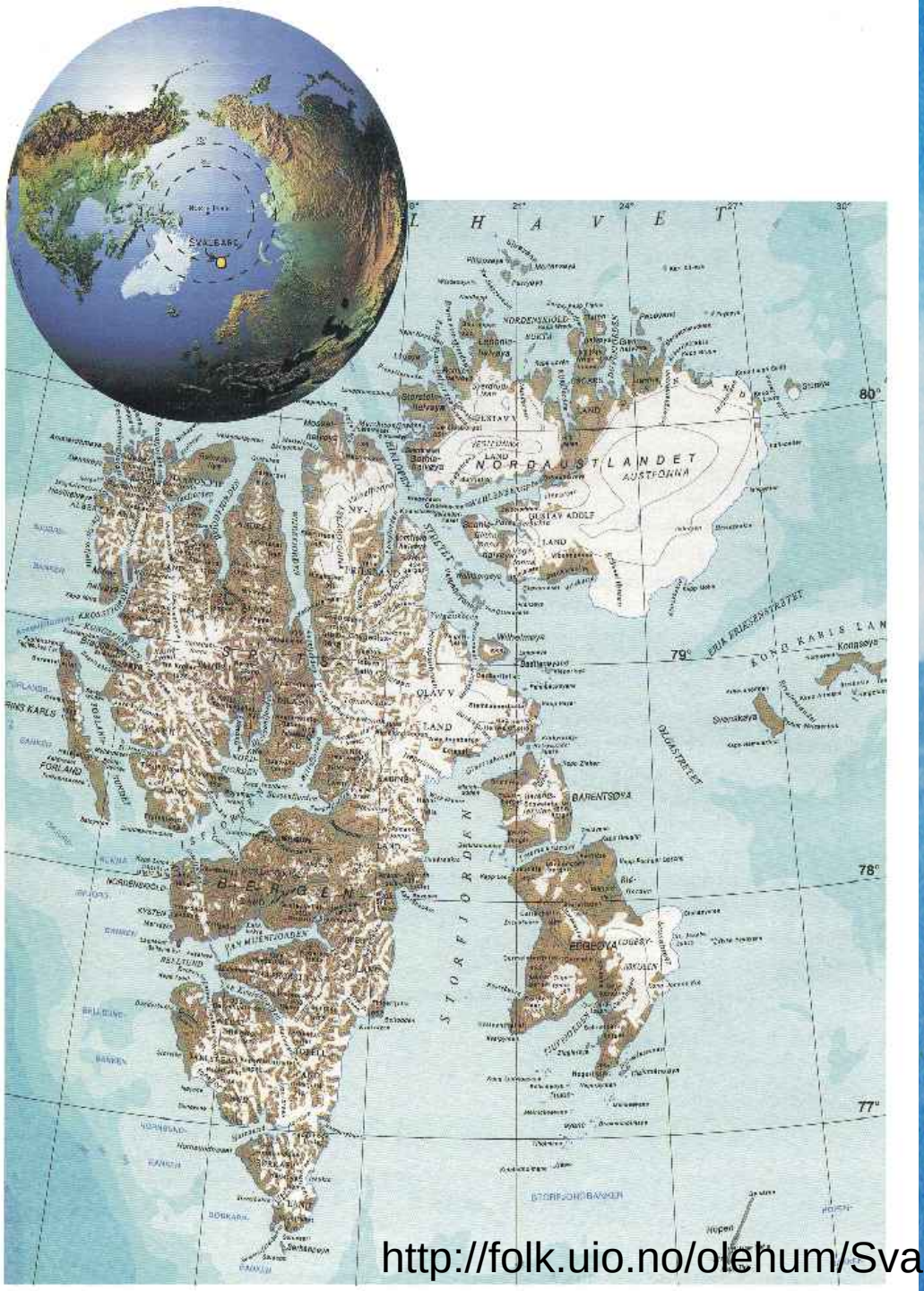

25.09.2005
Example of surge - Skobreen
UNIS
Photo: L. Kristensen

Surging glaciers



Glaciers in Svalbard - Today

- 60% of Spitsbergen is covered by glaciers



http://folk.uio.no/olehum/SvalbardOutline.html

Glaciers in Svalbard - Today

- 60% of Spitsbergen is covered by glaciers
- Austfonna; The worlds 3. biggest ice cube
- The largest glaciers are on the east coast and in the northern parts due to more precipitation

Glaciers in Svalbard - Today

- Longyearbyen: 300 mm/year, an arctic desert
- Mean annual temperature -5°C
- For glaciers the summer temperature is more important than the winter temperature

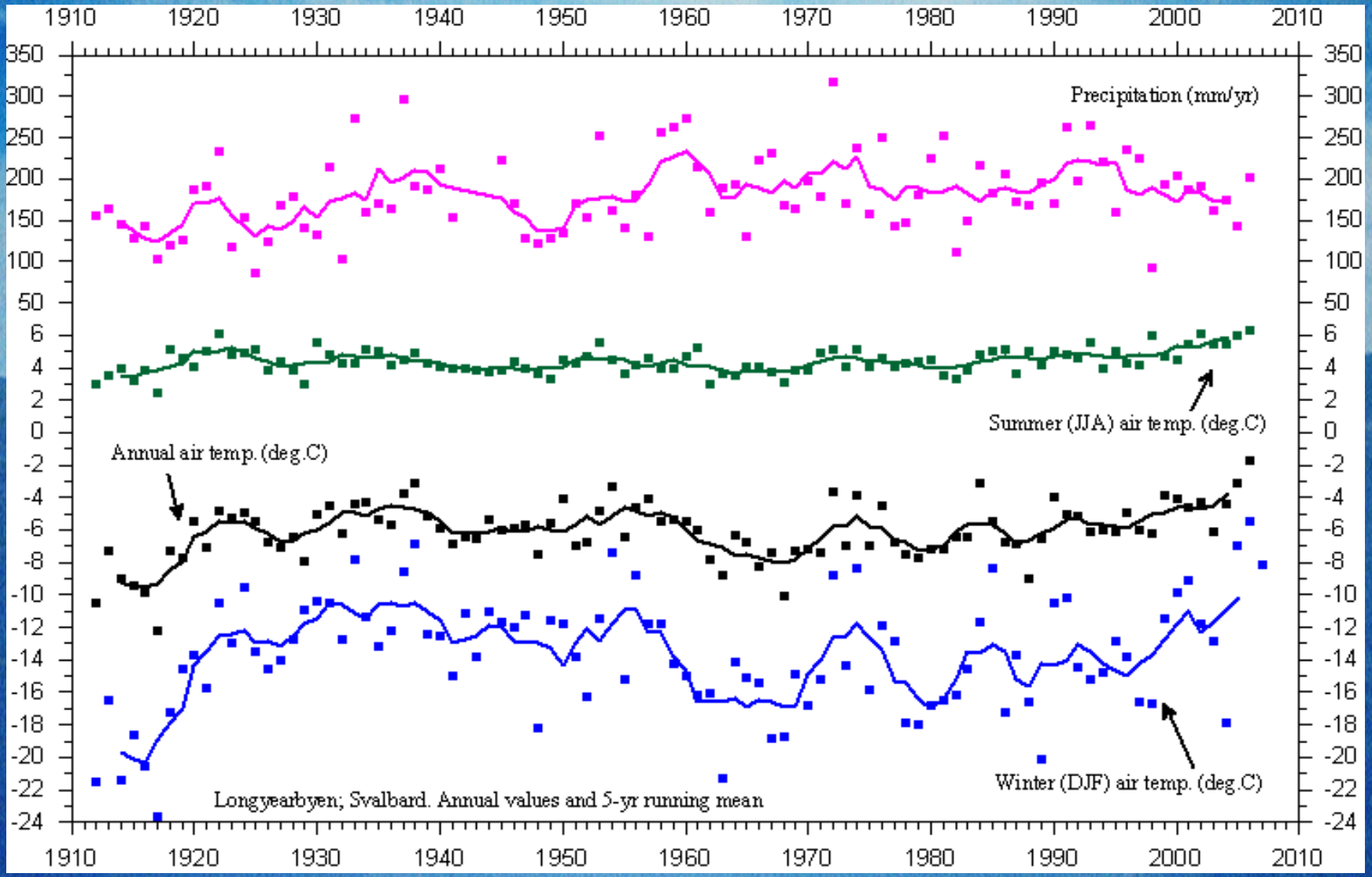
Glaciers in Svalbard - Past

- 18.000 BC: Ice age, most of Spitsbergen covered by ice.
- 10.000 BC: Holocene optimum. Relatively warm with few glaciers.
- 5500 BC: Colder again, climate similar to today.
- 1000 BC: Milder than today, Vikings were growing grain on Greenland

Glaciers in Svalbard - Past

- 500 BC: Little Ice Age begins. The mean annual temperature sinks considerably and the glaciers are growing.
- 1920 -1925 Little Ice Age ends on Spitsbergen Mean annual temperature rises several degrees.
- 1925-2000: Mean annual temperature -5C. The glaciers are to large for todays climate and are therefore shrinking.

Glaciers in Svalbard - Past



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Glaciers on Spitsbergen - Future

- Glaciers will return to their pre little ice age size.
- If temperatures rise, models indicate that the precipitation might increase as well.
- The surge frequency for glaciers might change.
- The velocity and calving rates might change as well.