

# Hvad er en gletsjer?

En ismasse, der

1. Består af is dannet af nedbør
2. Flyder under sin egen vægt



Photo: Henrik Egede-Lassen

# Hvad gælder der for de områder, <sup>2</sup> hvor vi kan finde gletsjere?

- Der skal være kolde somre (for at sneen ikke smelter helt væk hvert år)
- Der skal være tilstrækkelig nedbør

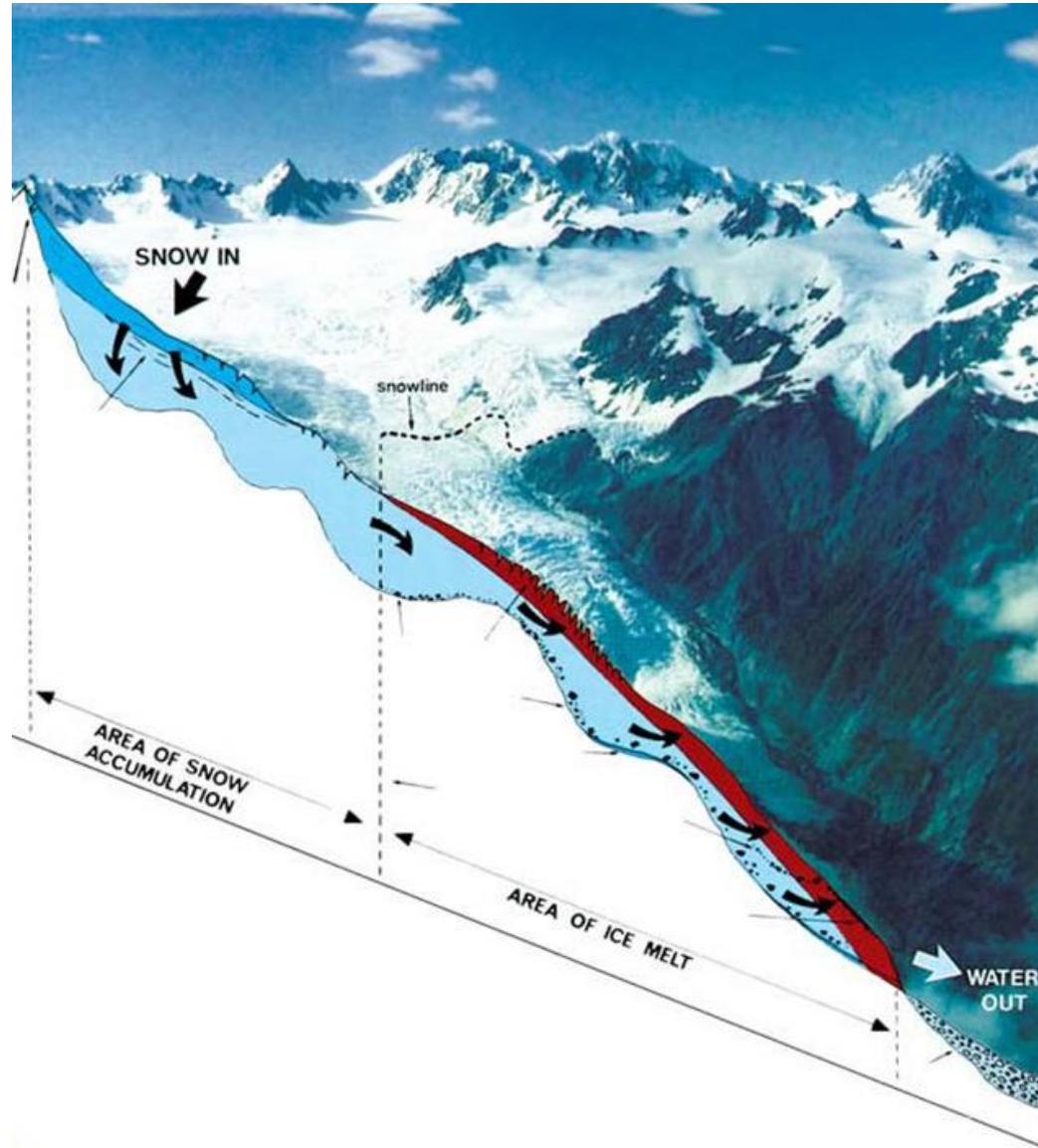


# Is og havniveauændringer



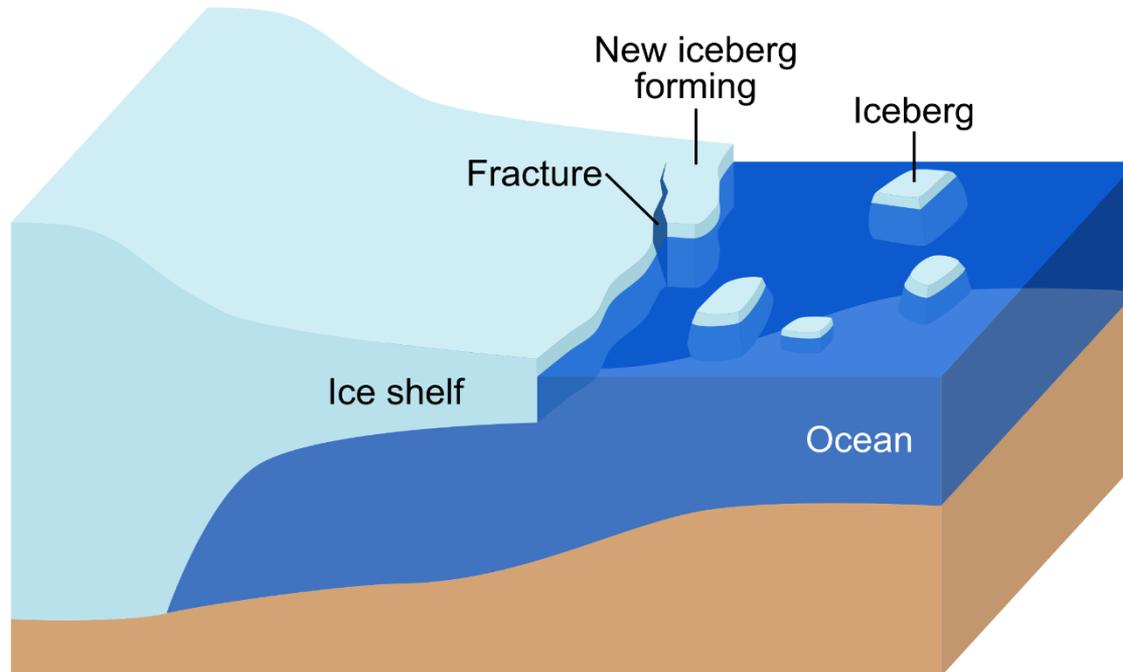
Ismasse	Areal ( $10^6 \text{ km}^2$ )	Volumen ( $10^6 \text{ km}^3$ )	Havniveaustigning (m)
Grønland	1,71	2,95	<b><math>\sim 7</math></b>
Antarktis	12,1	29	<b><math>\sim 60</math></b>
Andre gletsjere	0,68	0,18	<b><math>&lt; 0,5</math></b>
Havis	25	0,05	<b>0</b>

# Massebalance



# Akkumulation og ablation

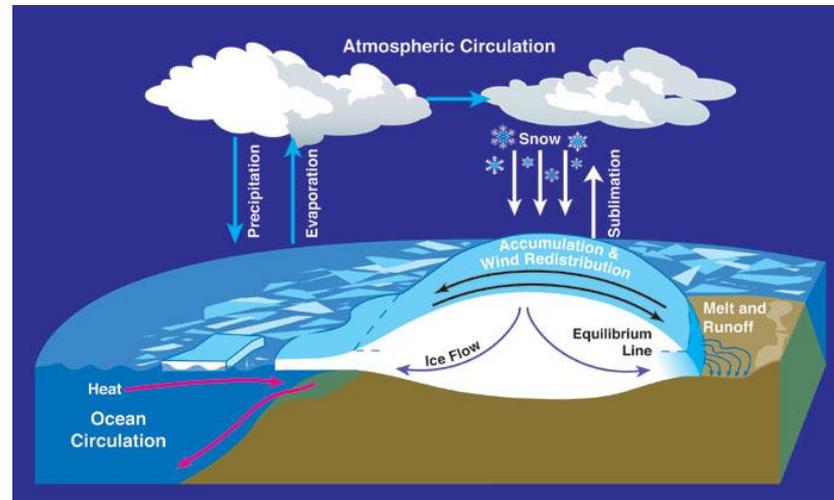
- Nedbør (sne, ...)
- Smeltning
- Kælvning



# Eksempler

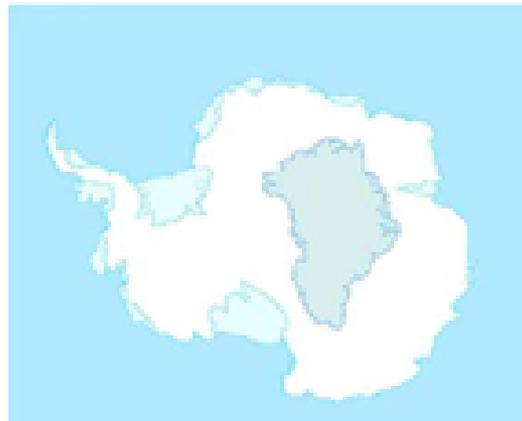
## Antarktis

- Kælvning
- Bundsmeltning



## Grønland

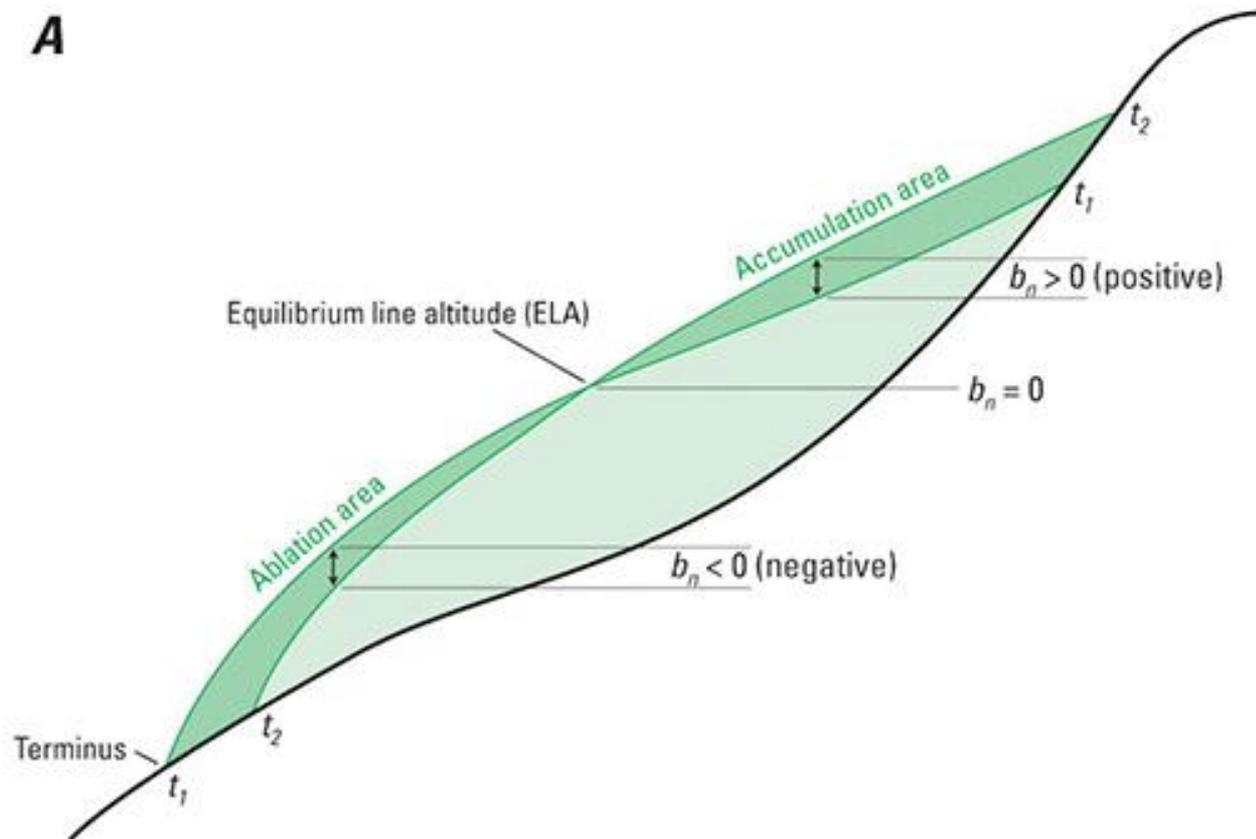
- Overfladesmeltning
- Kælvning



Fra Lenaerts et al. (2019)

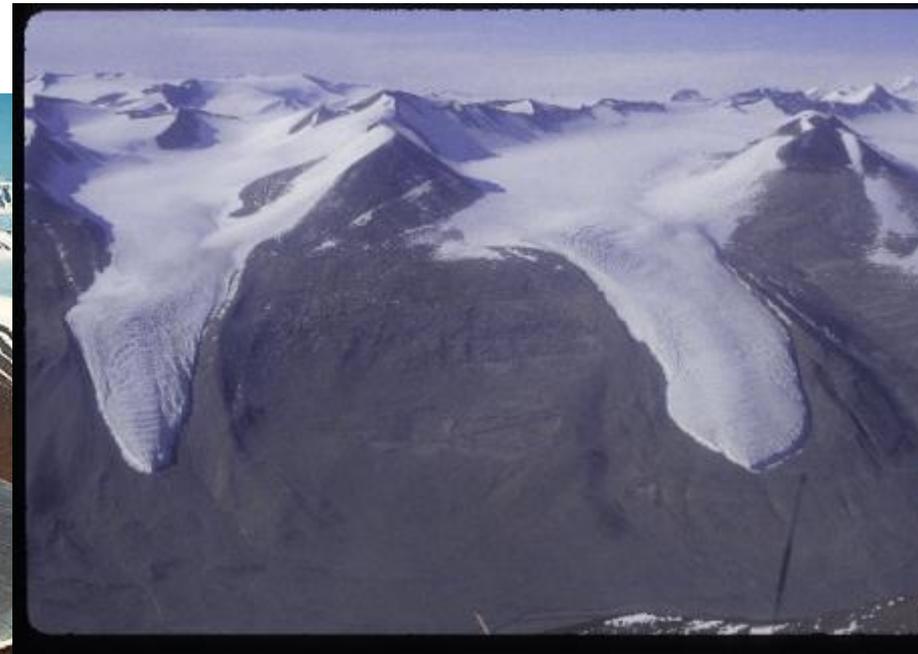
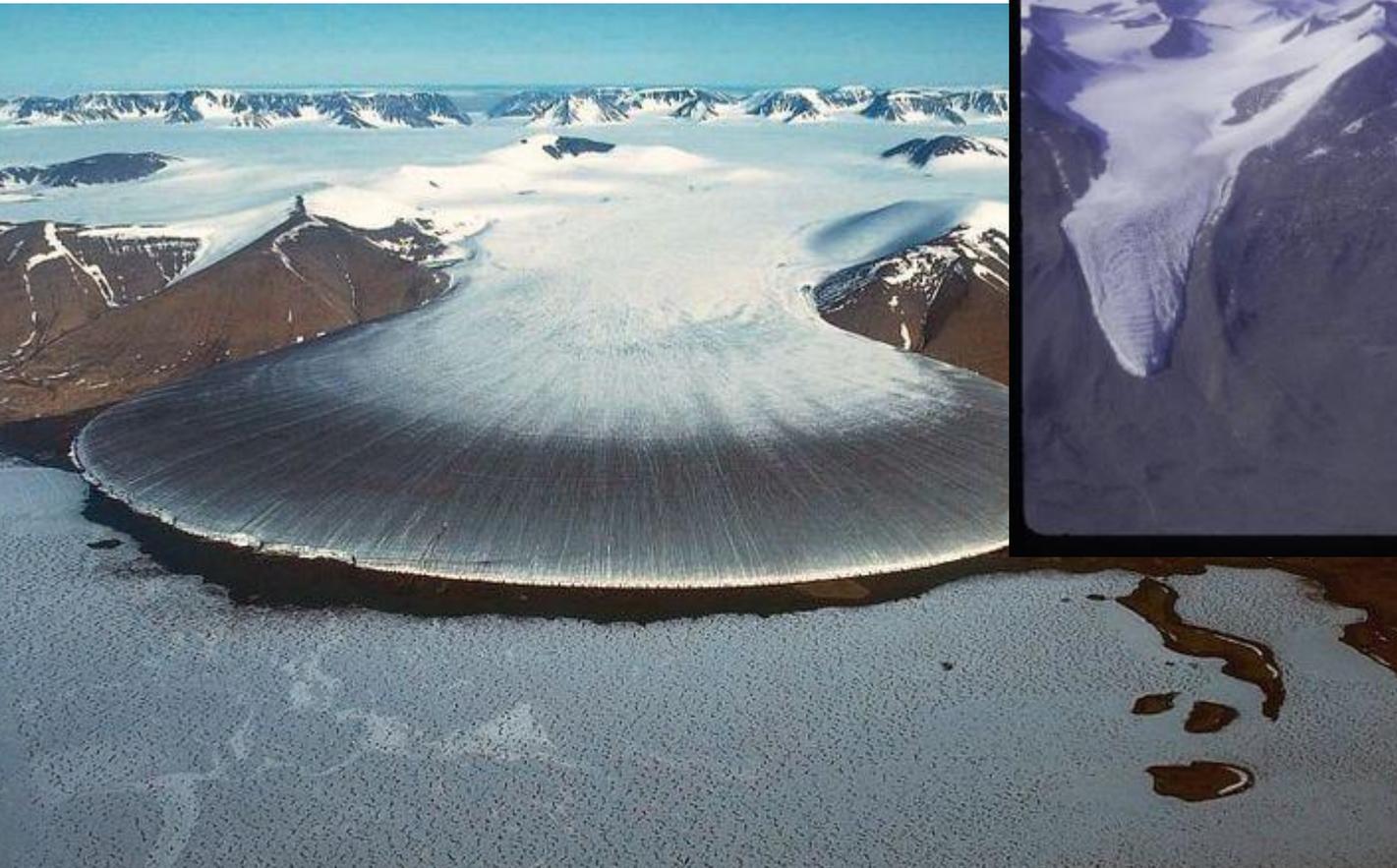
# Akkumulation og ablation

- Nedbør (sne, ...)
- Smeltning
- Kælvning



# Is flyder!

- Is deformeres under sin egen vægt – altså det flyder.



Oct 2016



Photo: Henrik Egede-Lassen

Oct 2019



Oct 2022



Photo: Susanne Goul Hovmand

Photo: Eileen Sylvan Johnson

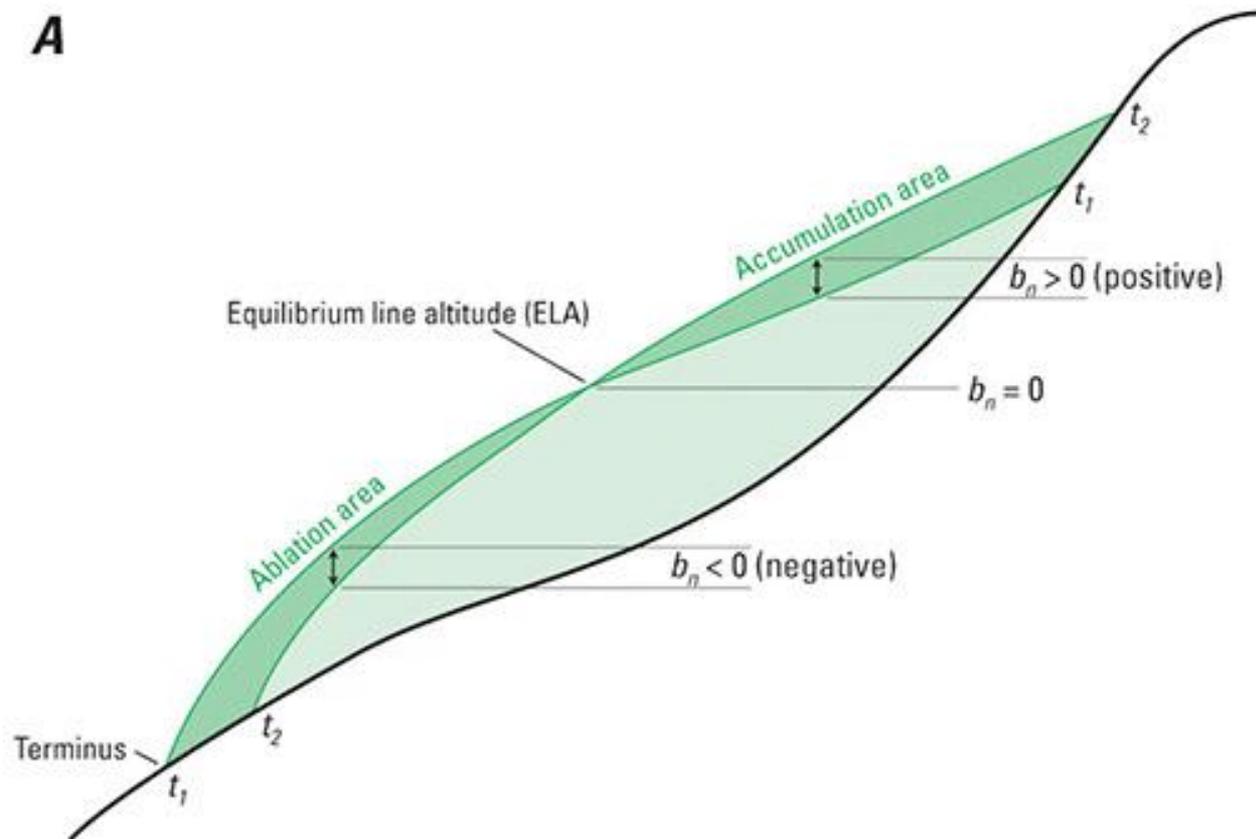
Nov 2021



Photo: Dennis Erdogan Bilginer

# Akkumulation og ablation

- Nedbør (sne, ...)
- Smeltning
- Kælvning



# Hvordan måles det?

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- Den glaciologiske metode
  - Snegrave/kerner (akkumulation)
  - Ablations-stænger (ablation)

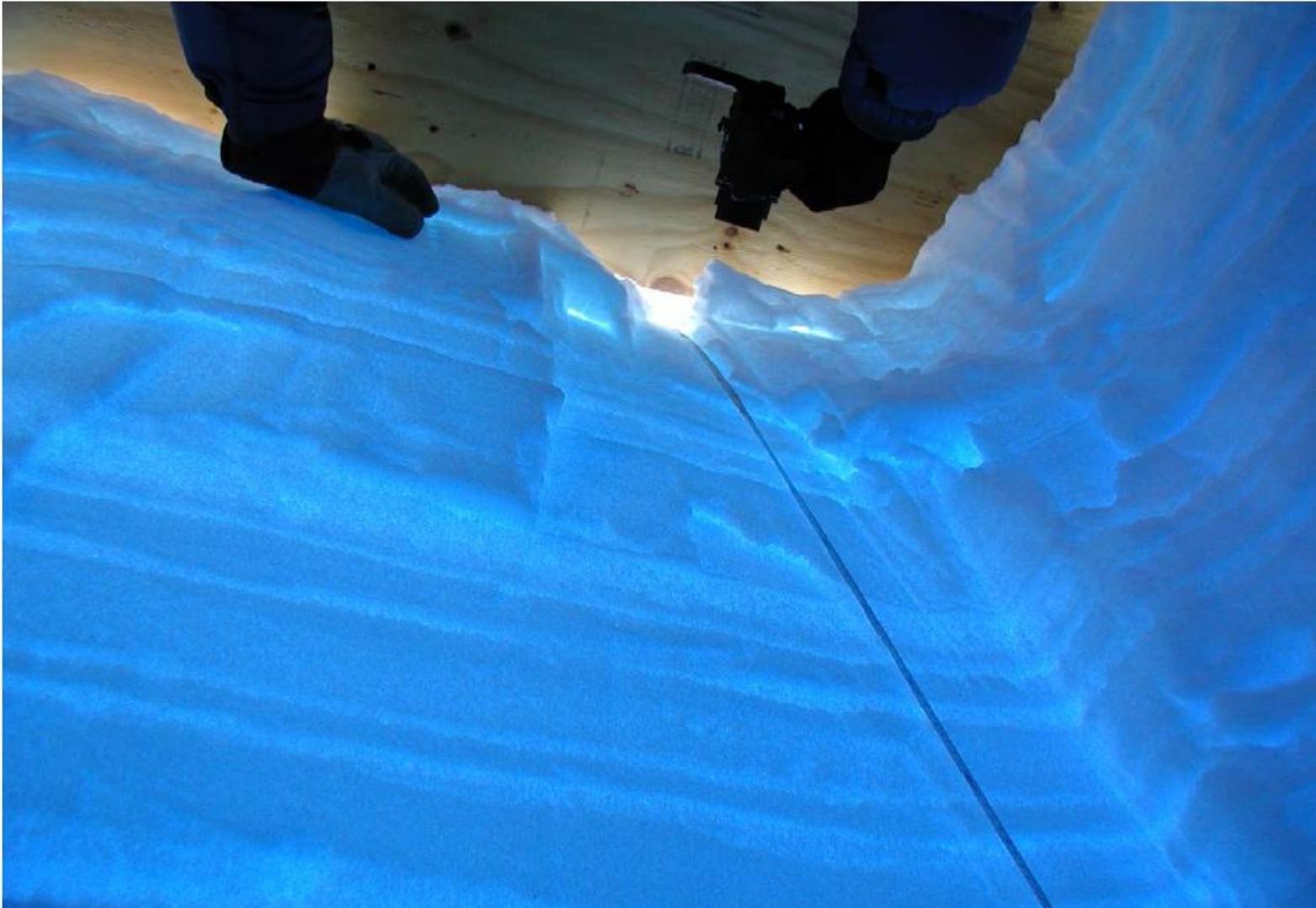
# Snegrave

Greenland Snow Pit 2003

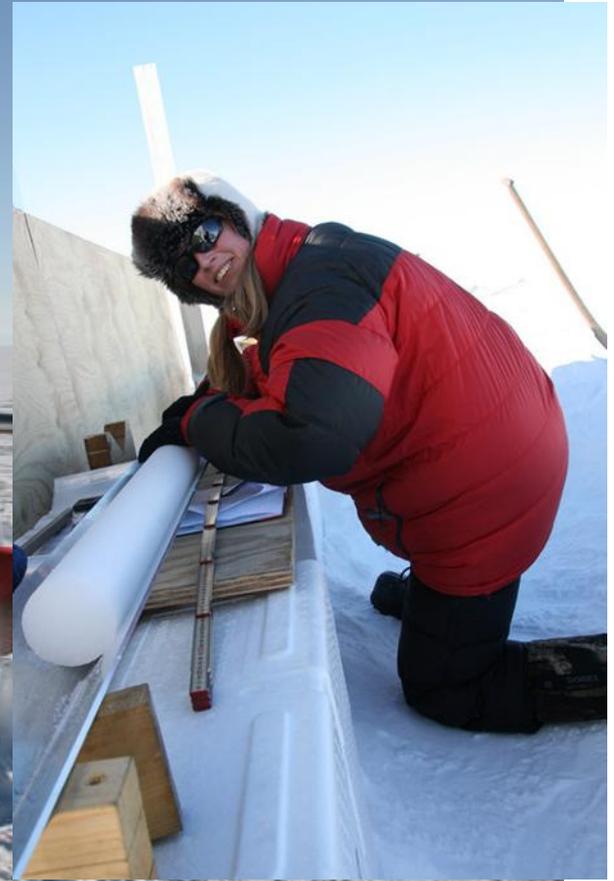
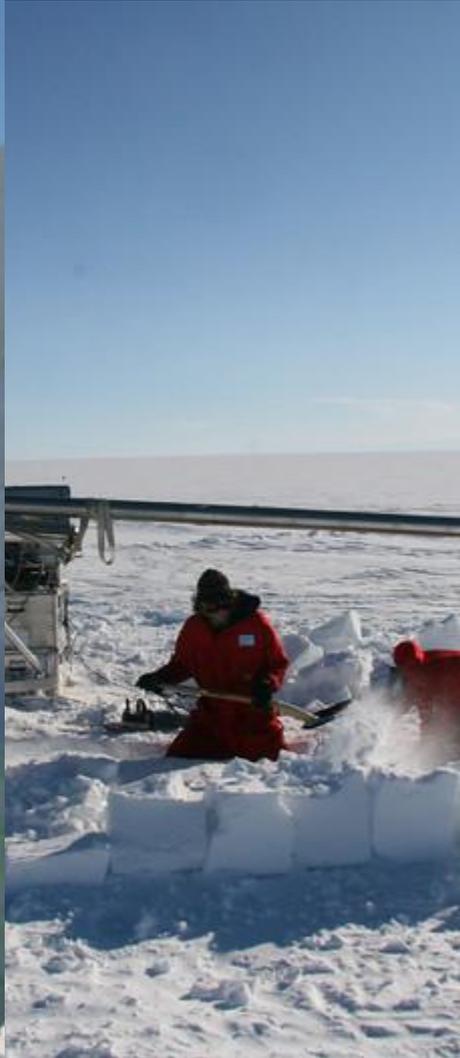


# Snegrave

Greenland Snow Pit 2003



# Snekerner



# Snekerner

## Accumulation measurements: snow core



Snow core in the accumulation zone  
with the dust layer of previous summer



Snow core in the ablation zone  
with the snow/ice transition

# Ablationsstænger



# Vatnajökull massebalance

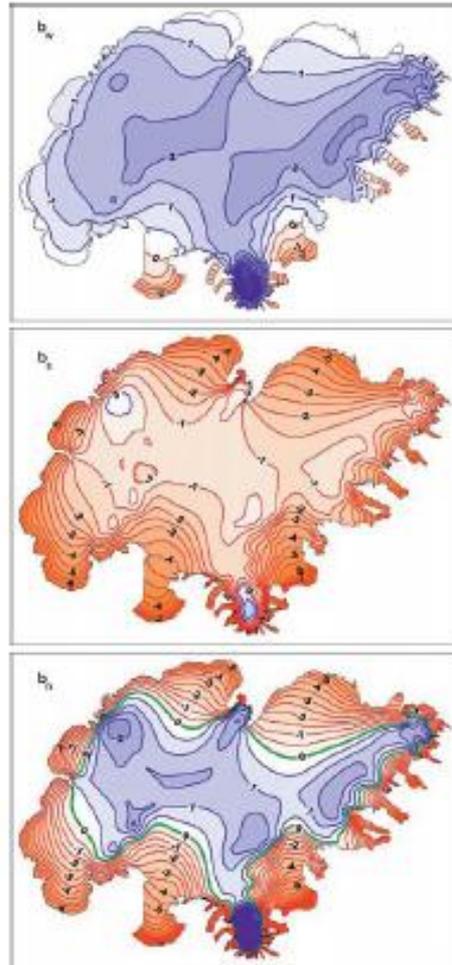
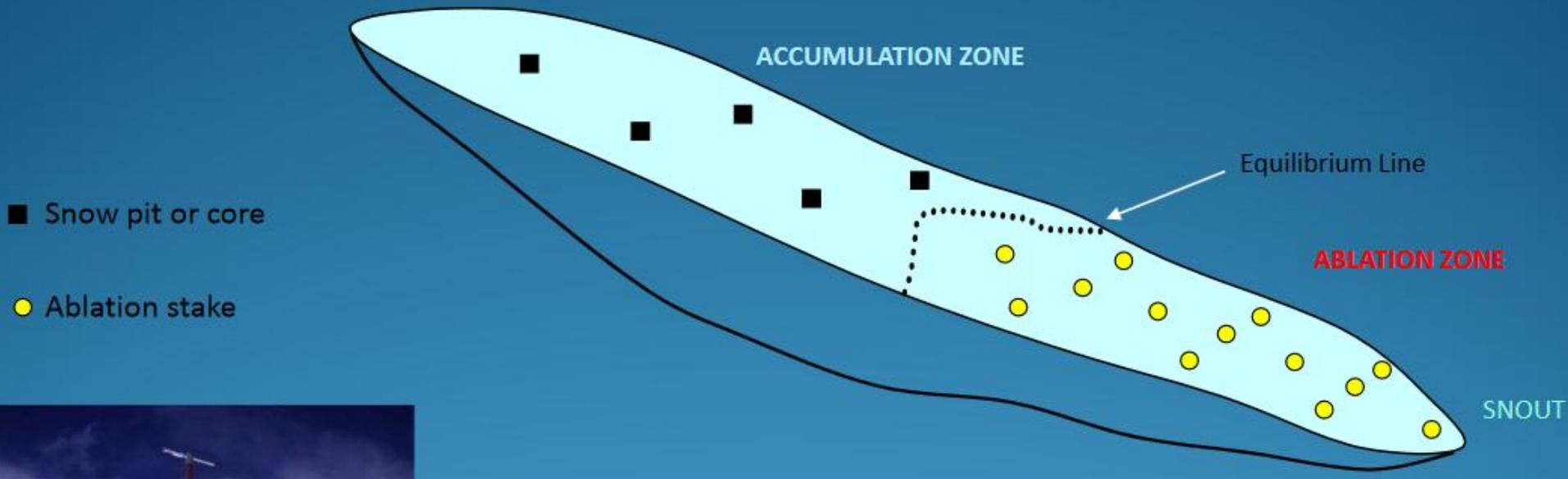


Figure 5. Maps of average mass balance (m water equivalent) for Vatnajökull, glacier years 1991/92 to 2005/06. Specific mass balance in m water equivalent,  $b_w$ : winter balance,  $b_s$ : summer balance,  $b_n$ : annual net balance (see Björnsson *et al.*, 1998). Mass balance was calculated by a stratigraphic method, based on measured changes in thickness and density relative to the summer surface at about 50 sites. – *Kort af meðalafkomu á Vatnajökli frá 1991/92 til 2005/06;  $b_w$ : vetraraðfoma,  $b_s$ : sumaraðfoma,  $b_n$ : ársaðfoma í metrum vatns.*

## The glaciological method



# Hvordan måles det?

---

- Den glaciologiske metode
  - Snegrave/kerner (akkumulation)
  - Ablations-stænger (ablation)
- Den geodætiske metode
  - Vha. billeder

# Sólheimajökull, Iceland



Photos: <https://glaciermelt.is/>

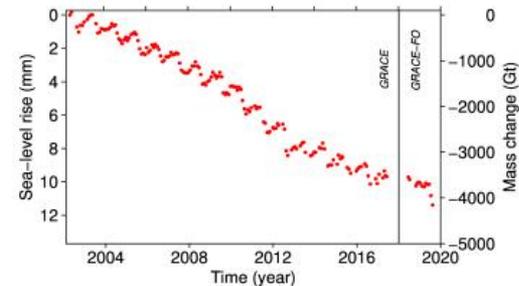
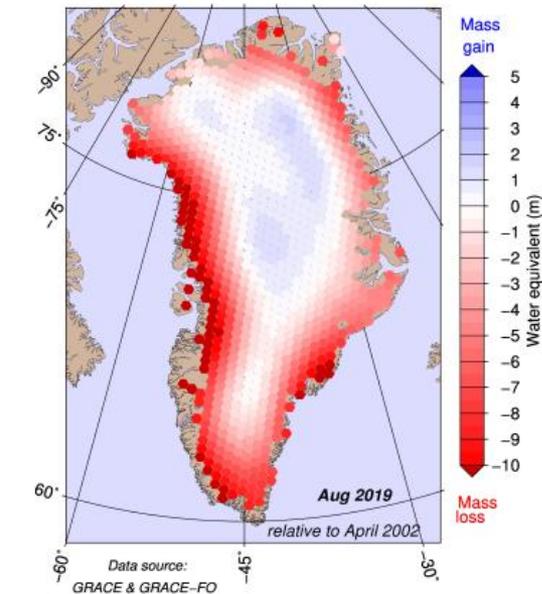
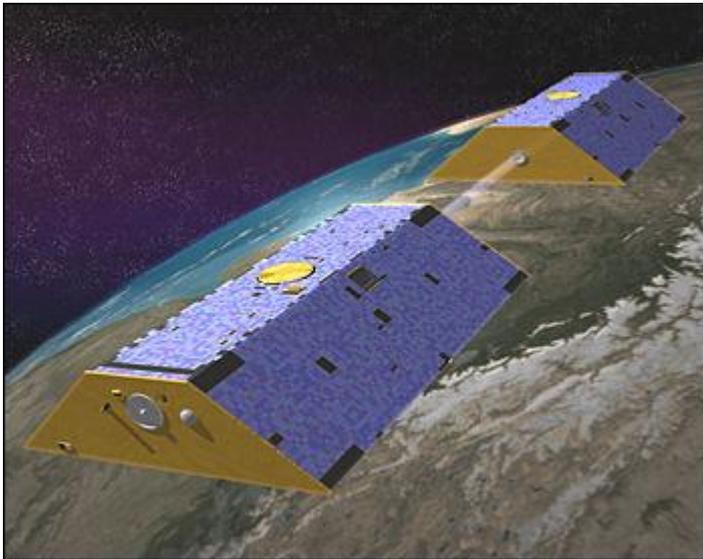
# Hvordan måles det?

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- Den glaciologiske metode
  - Snegrave/kerner (akkumulation)
  - Ablations-stænger (ablation)
- Den geodætiske metode
  - Vha. billeder
- Den gravimetriske metode
  - Vha. tyngdemålinger fra satelitter

# GRACE satellites

- <http://polarportal.dk/en/greenland/mass-and-height-change/>

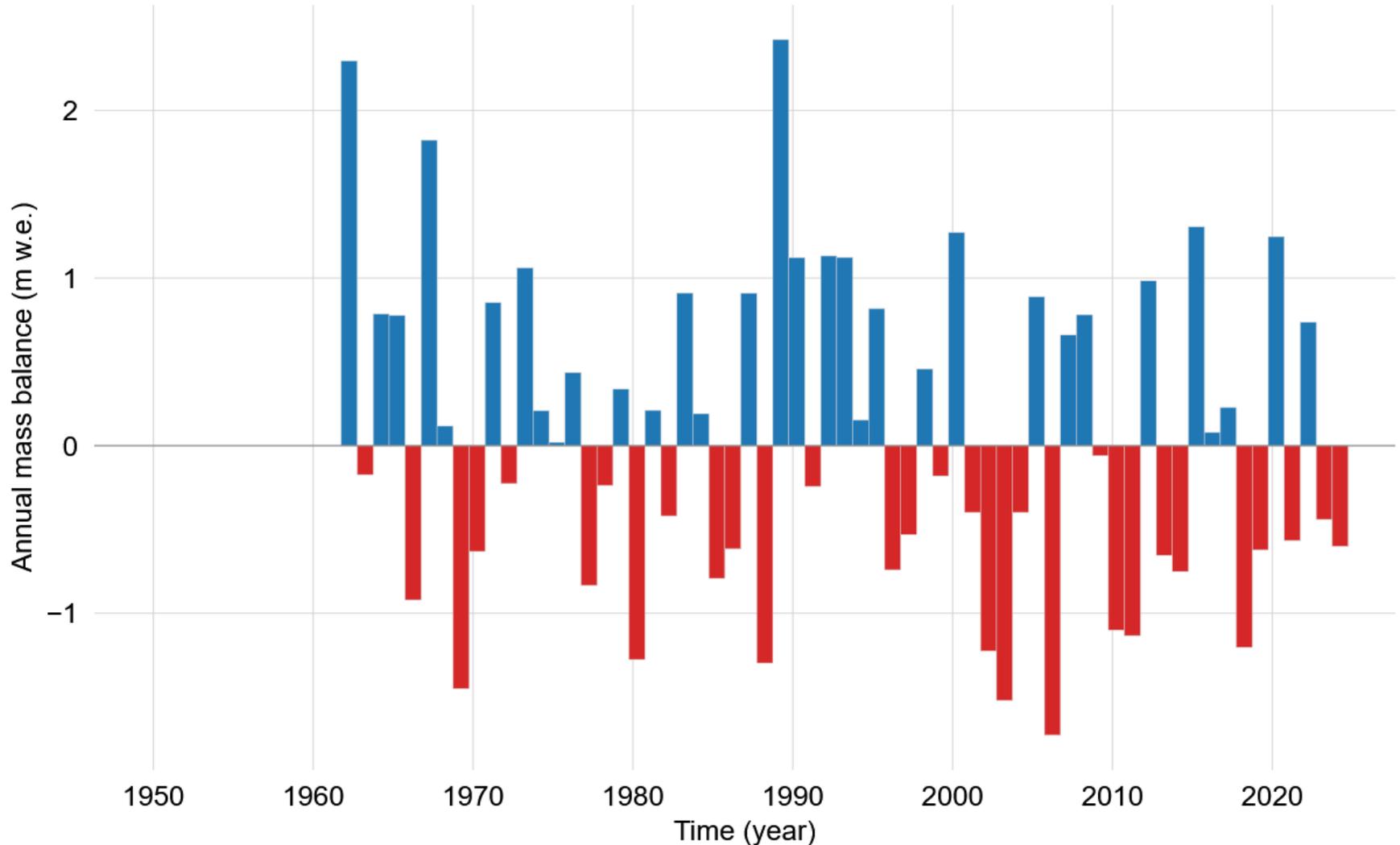




# Årlig massebalance

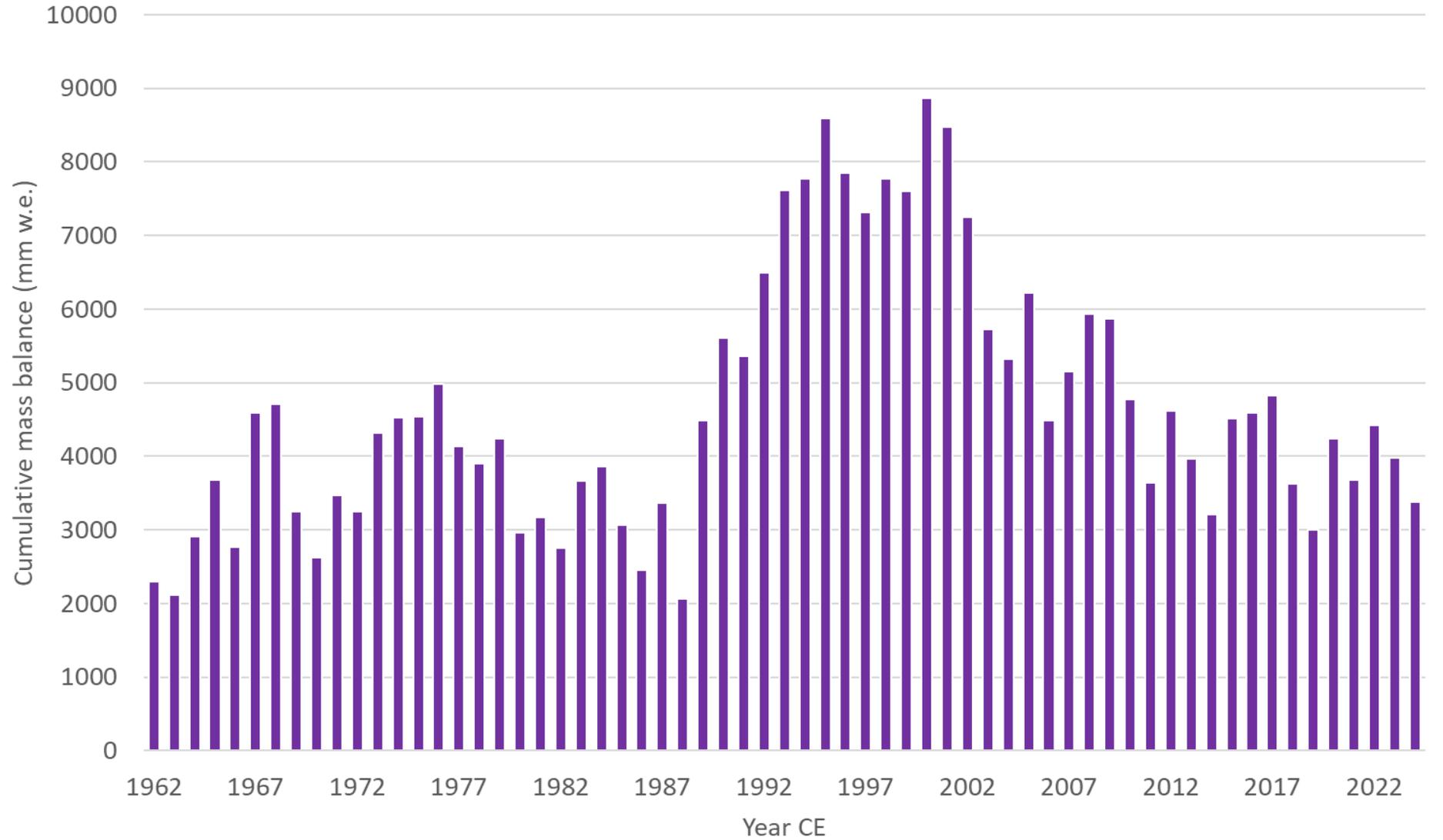
NIGARDSBREEN, NO (WGMS Glacier ID: 290)

WGMS Fluctuations of Glaciers database (doi:10.5904/wgms-fog-2025-02b)

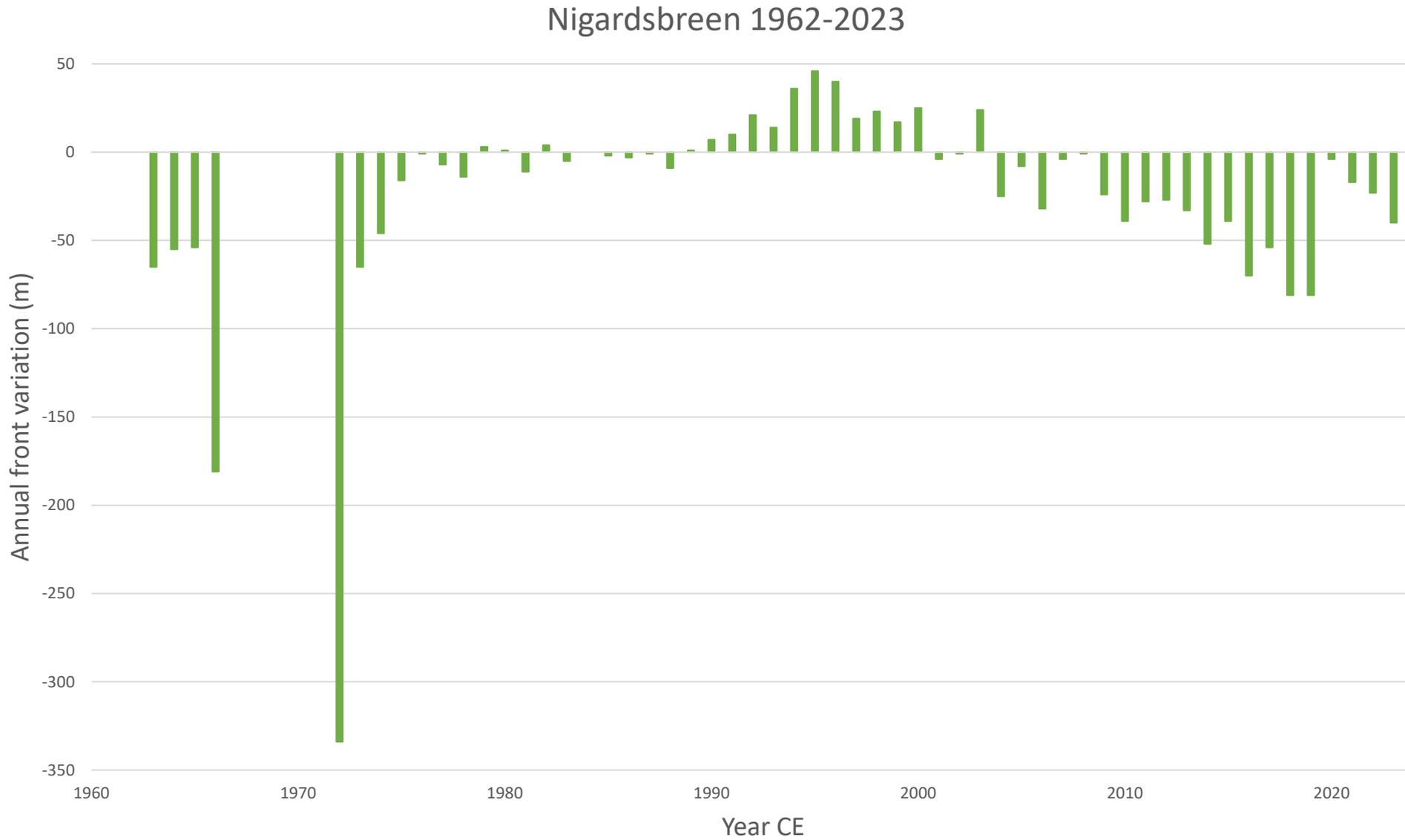


# Akkumuleret masseændring

## Nigardsbreen 1962-2024

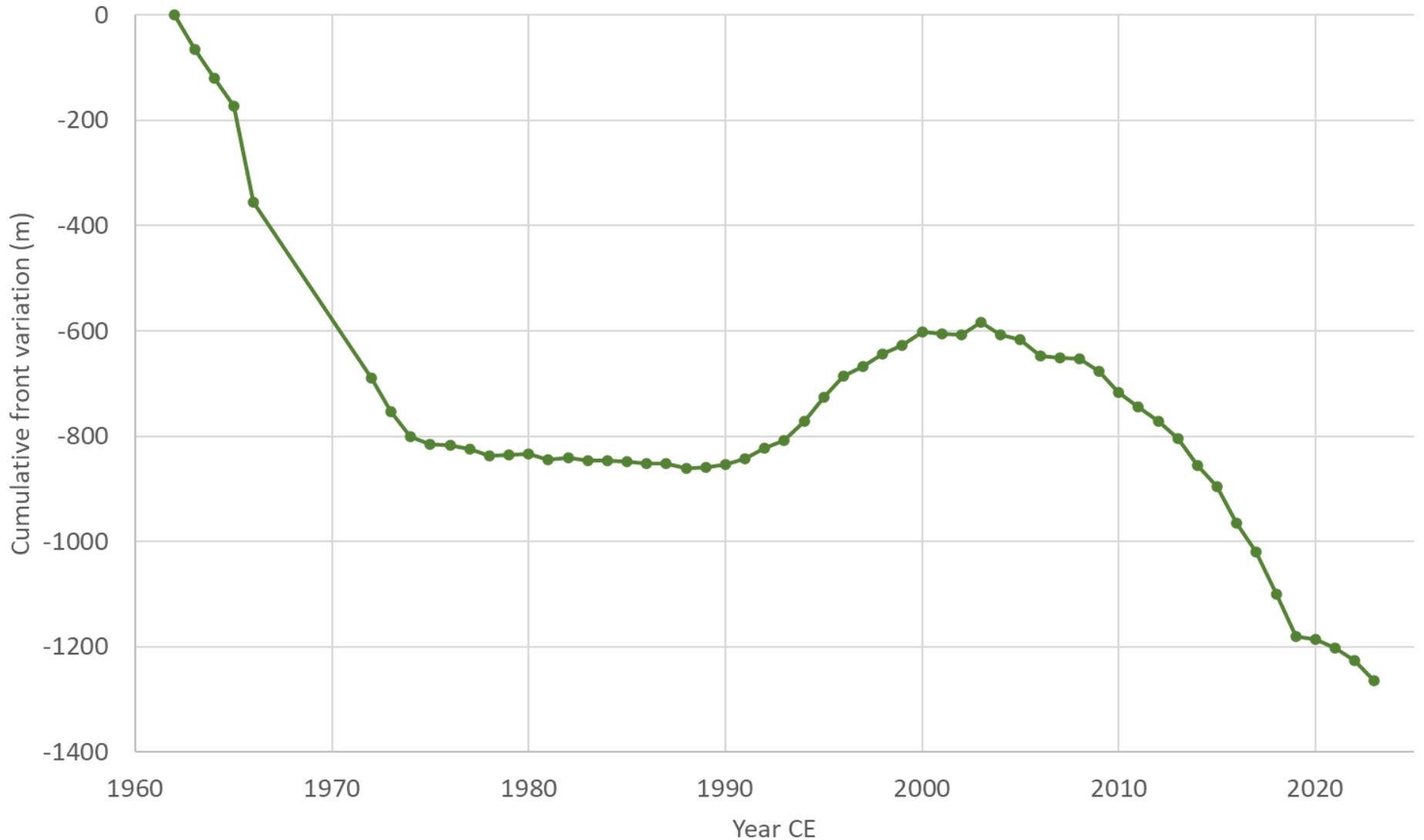


# Gletsjerrandens position



# Akkumulert ændring i randposition

## Nigardsbreen 1962-2023



# Spørgsmål – første runde

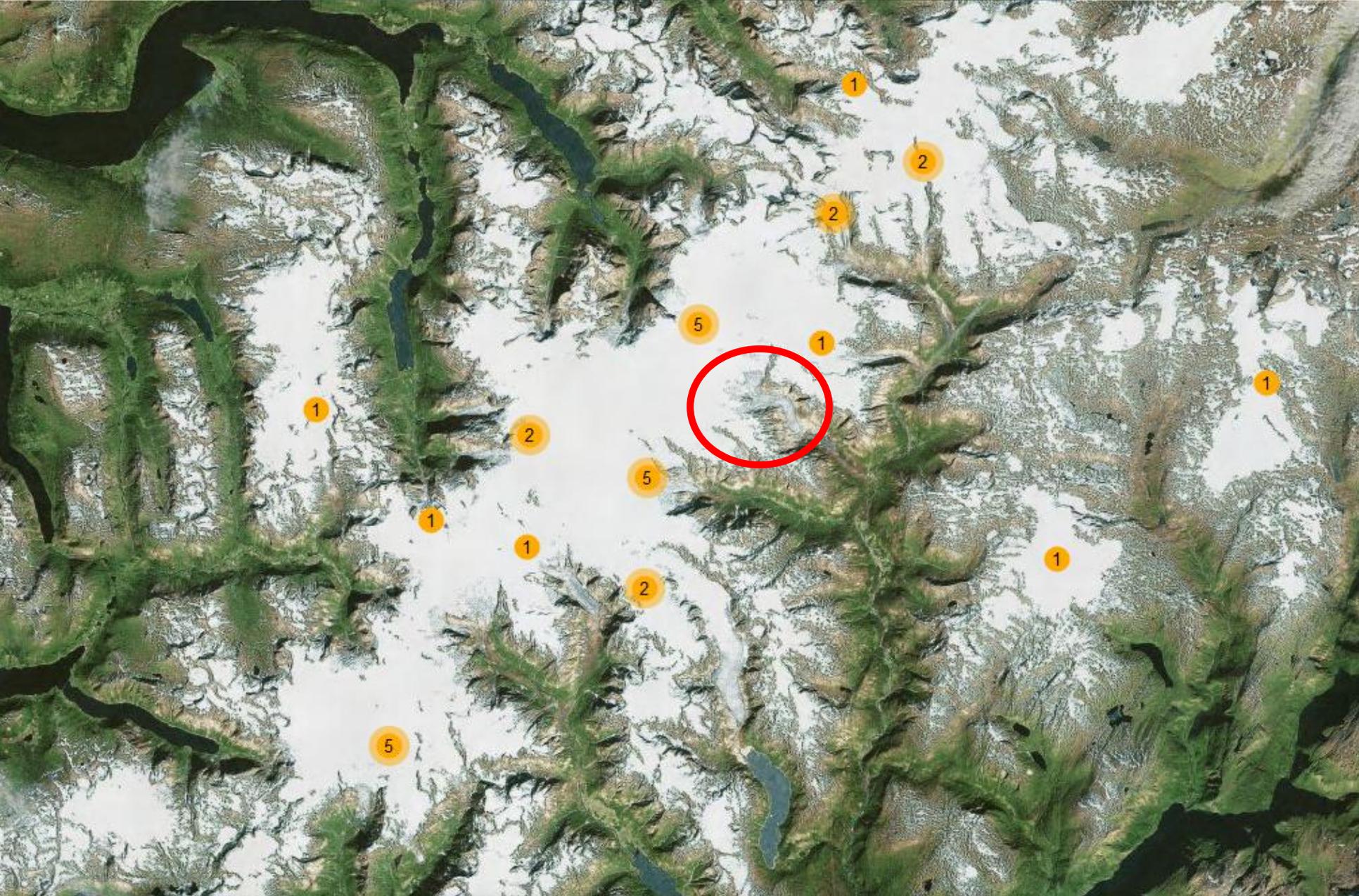
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- Find ud af, hvad figurerne viser, og forklar det til hinanden
- Baseret på den viden, I har fået fra figurerne, hvad vil I konkludere om massebalancen for Nigardsbreen?

# Spørgsmål – anden runde

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- Forklar jeres data for den anden gruppe
- Diskuter Nigardsbreens massebalance baseret på dataene for massebalance og randposition – ser I et konsistent billede?
- Hvilket scenario kan forklare begge datasæt?



# Nigardsbreen



# Nigardsbreen



# Nigardsbreen



# Spørgsmål?



# wgms Glacier app (gratis)

