



GLOFs in Greenland

Glacial Lake Outburst Floods (GLOFs) are sudden releases of freshwater stored in ice- or moraine-dammed lakes. In Greenland, GLOFs deliver large **pulses of freshwater** and sediment that impact fjord ecosystems and circulation. When routed beneath the glacier, the drainage can **accelerate ice flow** velocities and permanently modulate the subglacial drainage system. Resulting subglacial discharge plumes at marine termini can **enhance submarine melt and calving**. Yet research on GLOFs in Greenland remains confined to case studies of individual lakes (e.g. Kjeldsen et al., 2014, Carrivick et al., 2017, Grinsted et al., 2017, Dømggaard et al., 2023, Wehrle et al., 2025) and **no ice-sheet wide assessment of timing and volume** of drainage activity exists, motivating the systematic inventory presented here.

Aim Create an inventory of the timing and volume of GLOFs in Greenland between 2016 and 2025

Lake selection

Database of lake level changes of ice marginal lakes in Greenland by Dømggaard et al., 2024

Select lakes:

- Lake level changes > 4 m
- Lake > 2 km²

Methods

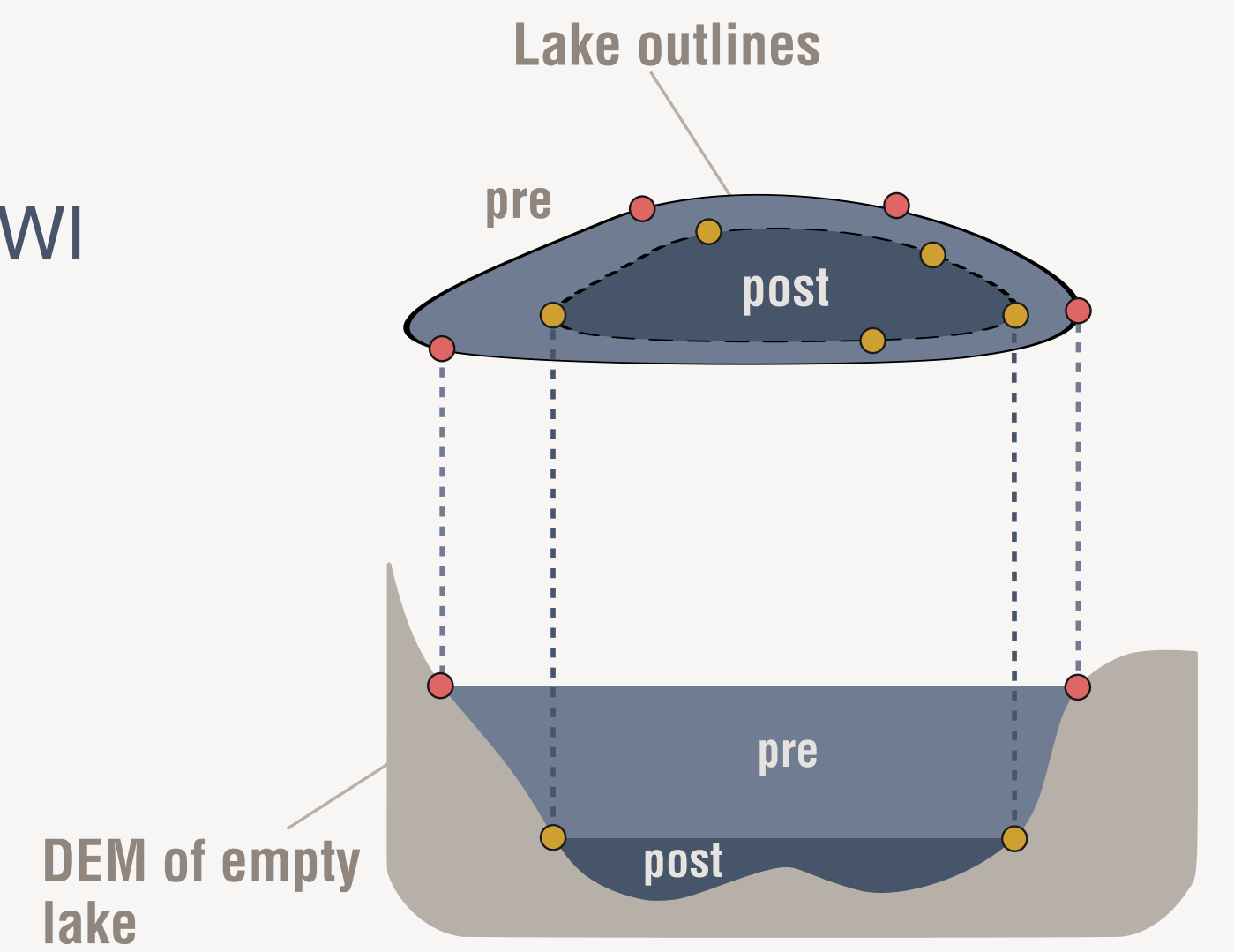
Drainage detection

- S1 radar backscatter
- NDWI
- Surface texture
- Multitemporal digital elevation models (ArcticDEM)

Time frame: 2016-2025

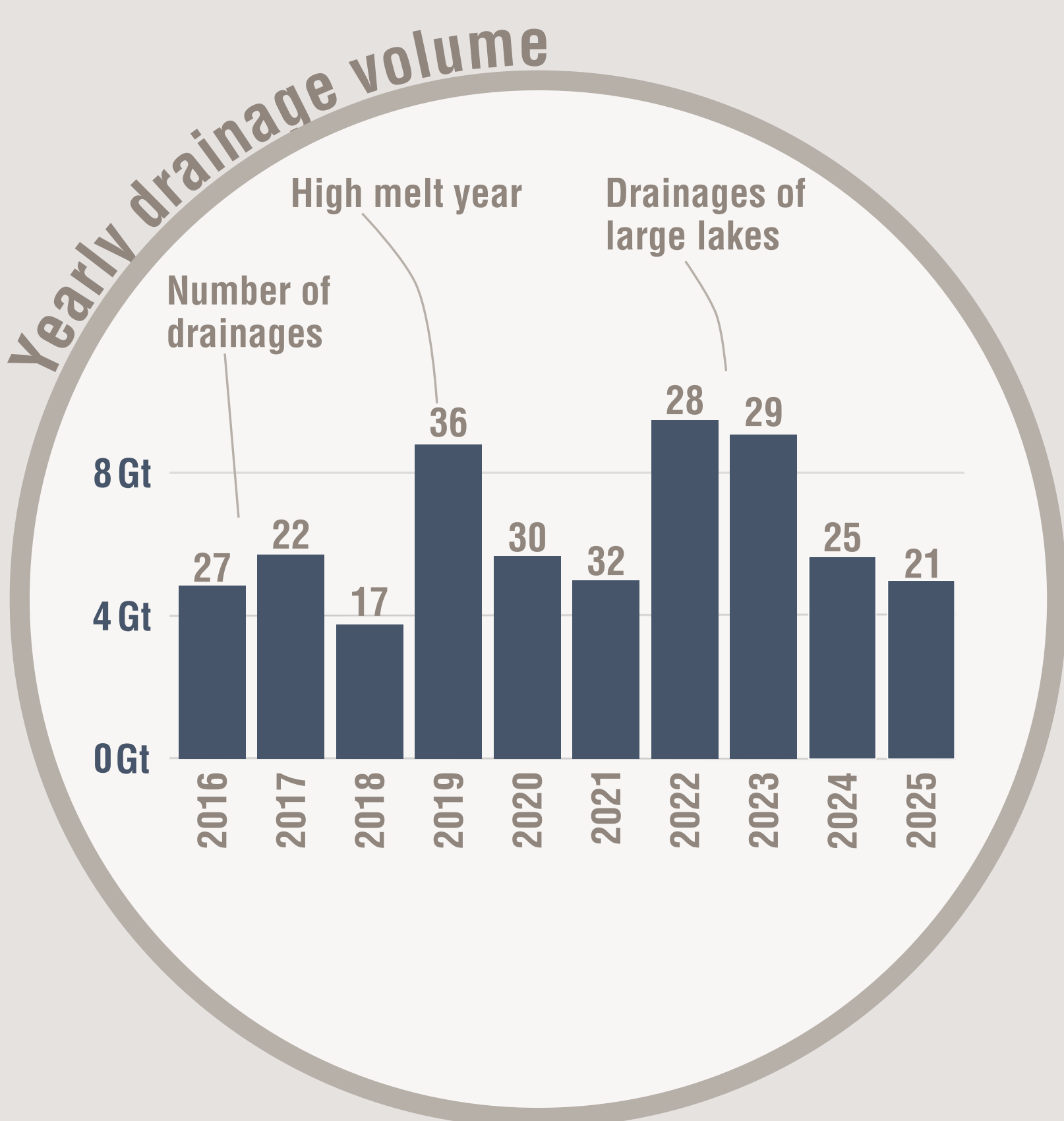
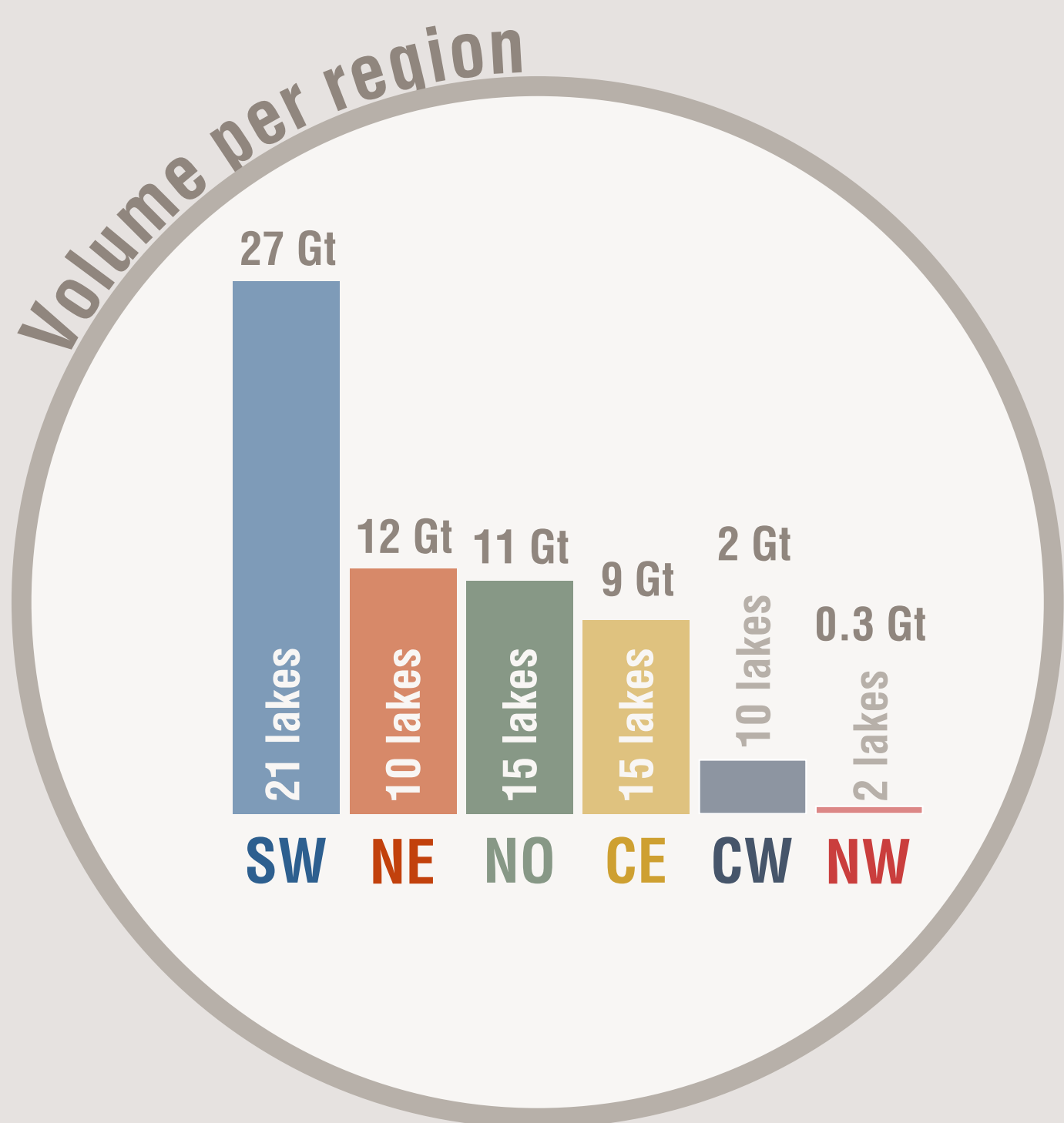
Volume estimation

- We create lake outlines manually or based on NDWI
- We intersect the outlines with a DEM of an empty lake and extract the elevation
- We fill the DEM to estimate volume



First inventory of GLOFs in Greenland

2016-2025



Largest drainage volume of each lake

- < 0.1 Gt
- 0.1 - 0.5 Gt
- 0.5 - 1 Gt
- > 1 Gt

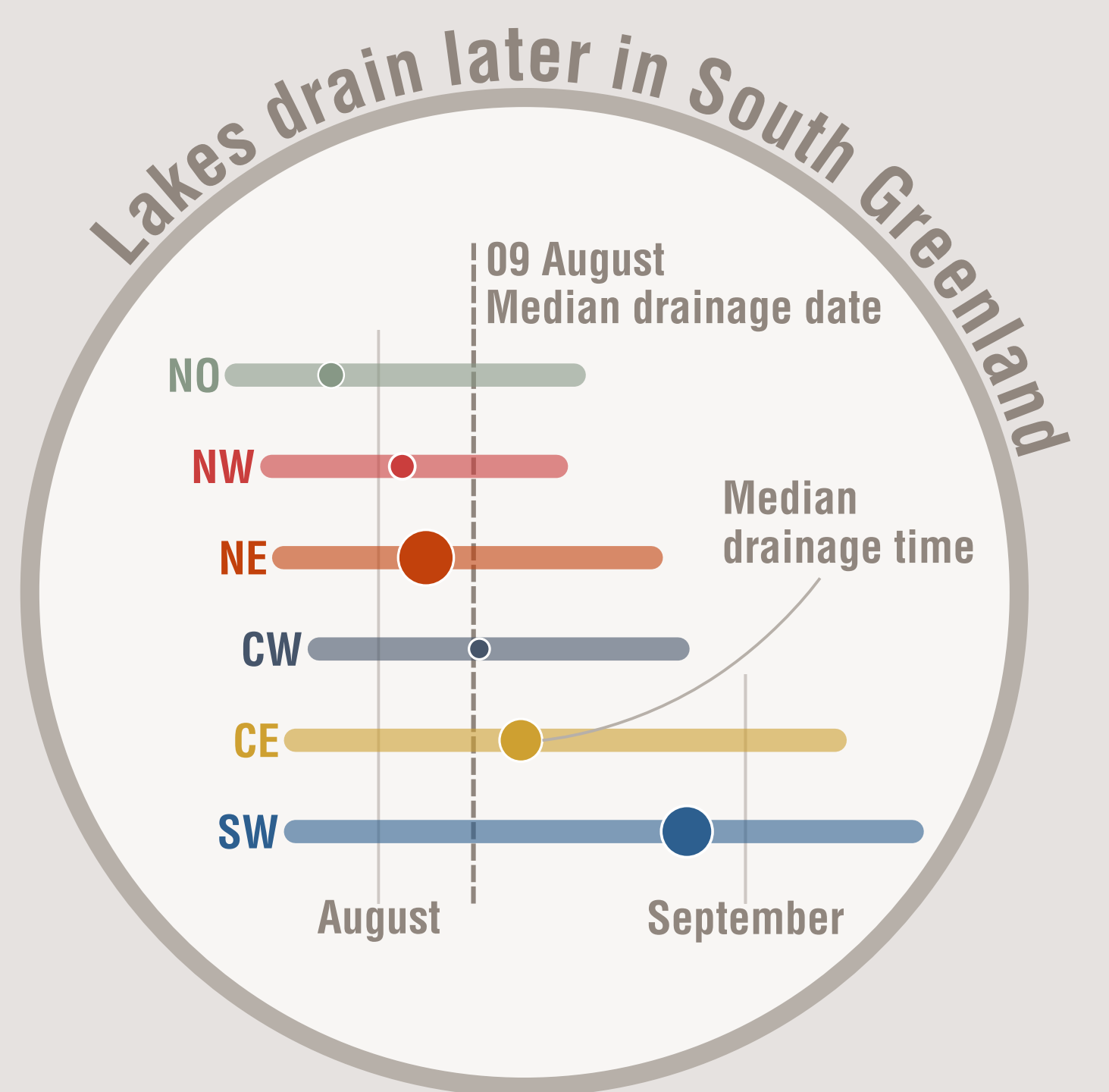
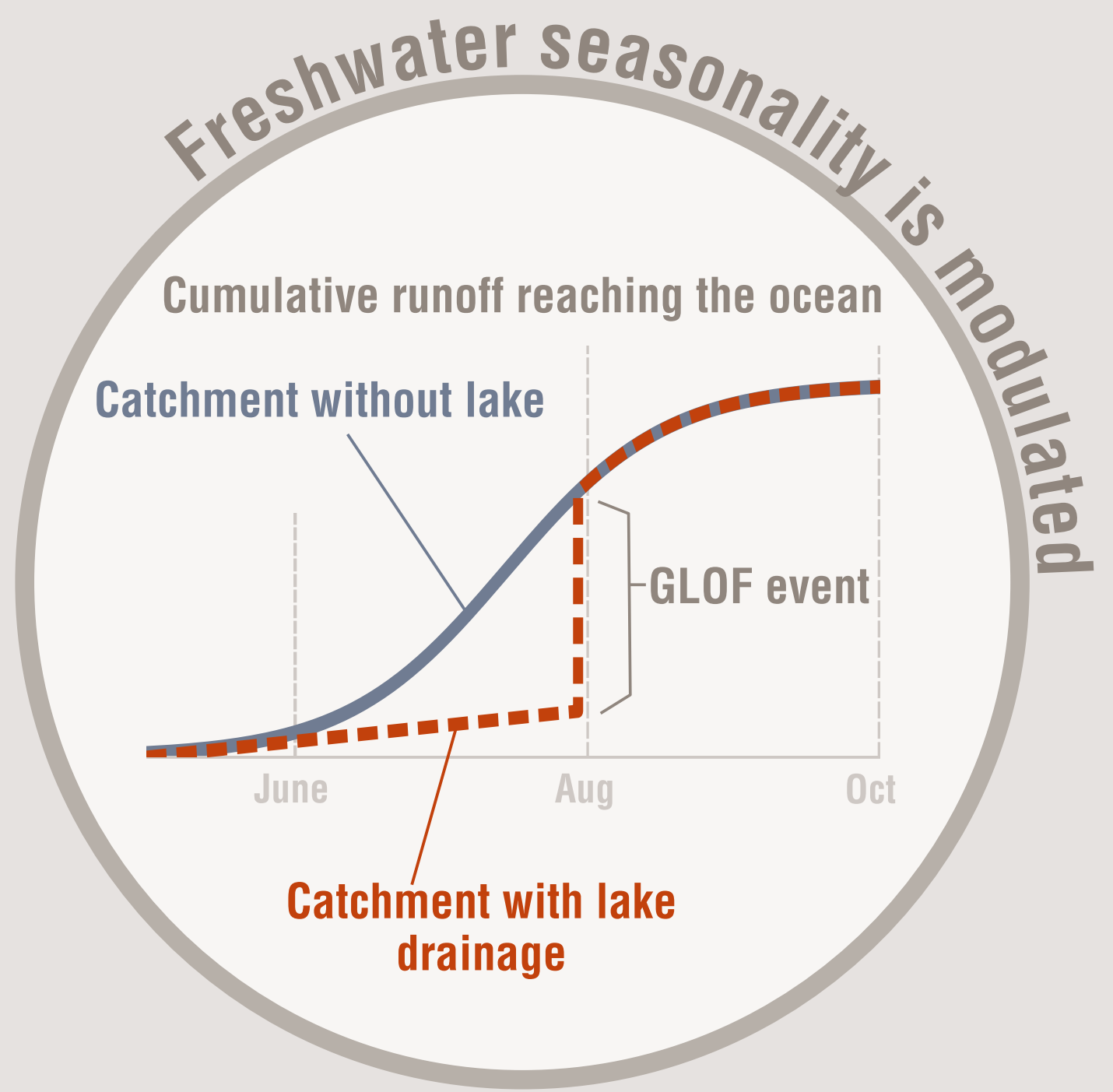
Iluliallup Tasia (3.6 Gt)
Second largest drainage event

Lake Iluliartoq (1.7 Gt)
Drains into Nuup Kangerlua close to Nuuk

Unnamed lake (4.9 Gt)
Largest drainage event

Catalina Lake (3 Gt)
Periodic outburst floods described by Grinsted et al. (2017)

81 Lakes > 2 km²
270 drainage events
2.6 years average cycle



Conclusions

- Southwest Greenland has the most lake drainages and highest overall volume
- Lakes drain earlier in the north than in the south
- Lake drainages are periodic and a typical lake drains every 2 to 3 years

Future work: extend the inventory and include smaller lakes, investigate the effects on the freshwater cycle and glacier dynamics.

Affiliations

- 1 Department of Physical Geography, Utrecht University, The Netherlands
- 2 Institute for Marine and Atmospheric research Utrecht, Utrecht University
- 3 Royal Netherlands Institute for Sea Research (NIOZ)
- 4 Royal Netherlands Meteorological Institute (KNMI)

