Evidence and ecological implications of subglacial discharge under sea-ice at a Svalbard tidewater glacier

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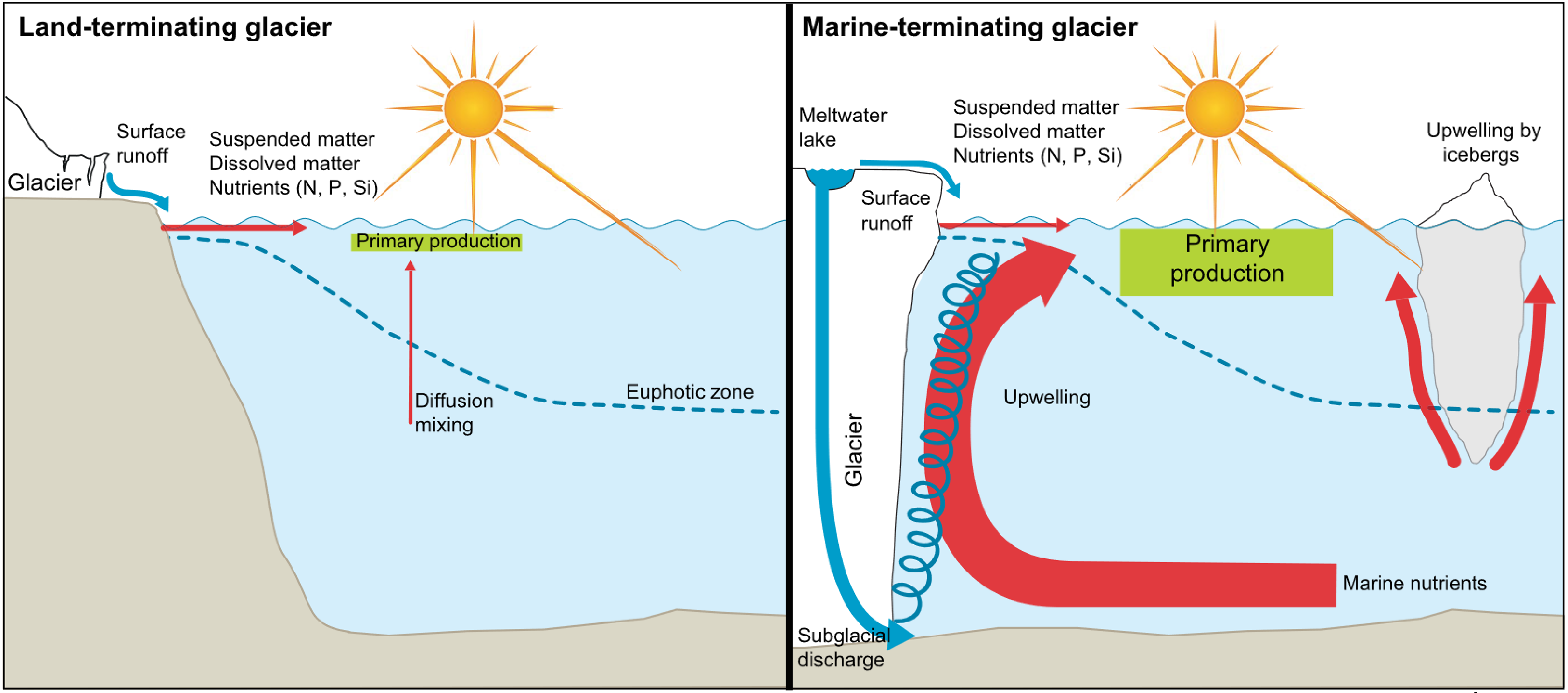
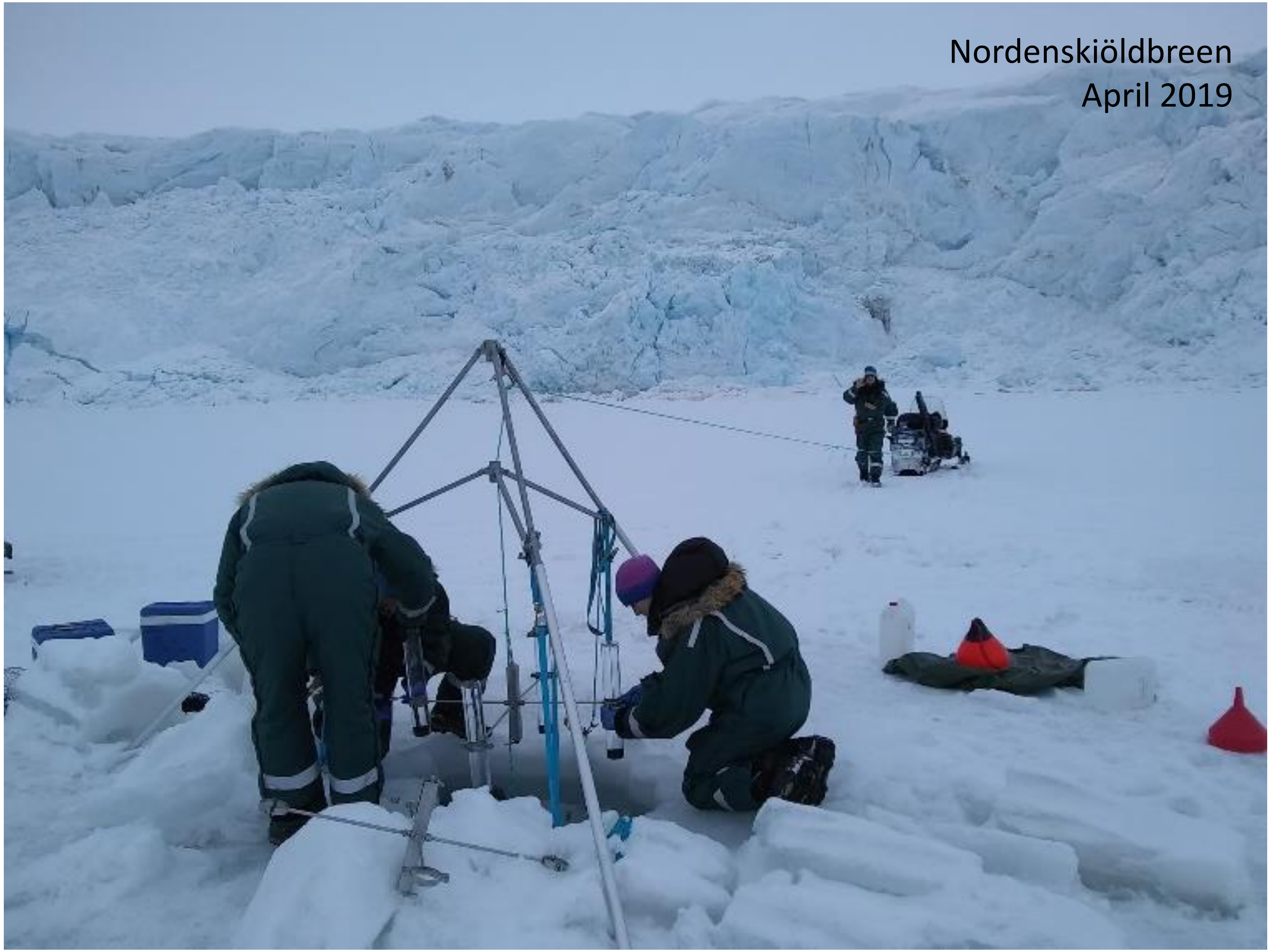
Glacier – Fjord inerface in summer

Subglacial upwelling of nutrients

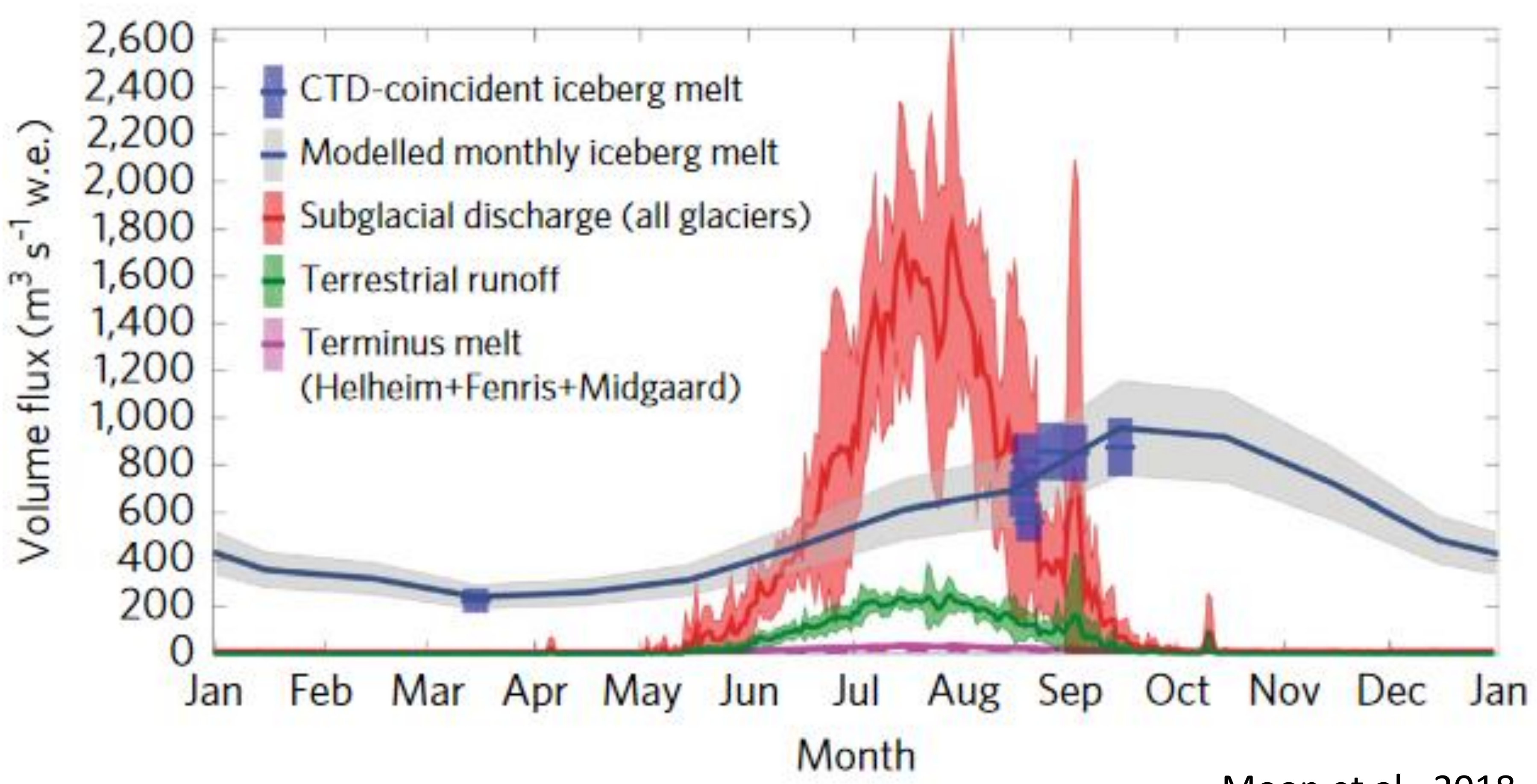


Meire et al., 2017

Glacier – Fjord interface in winter



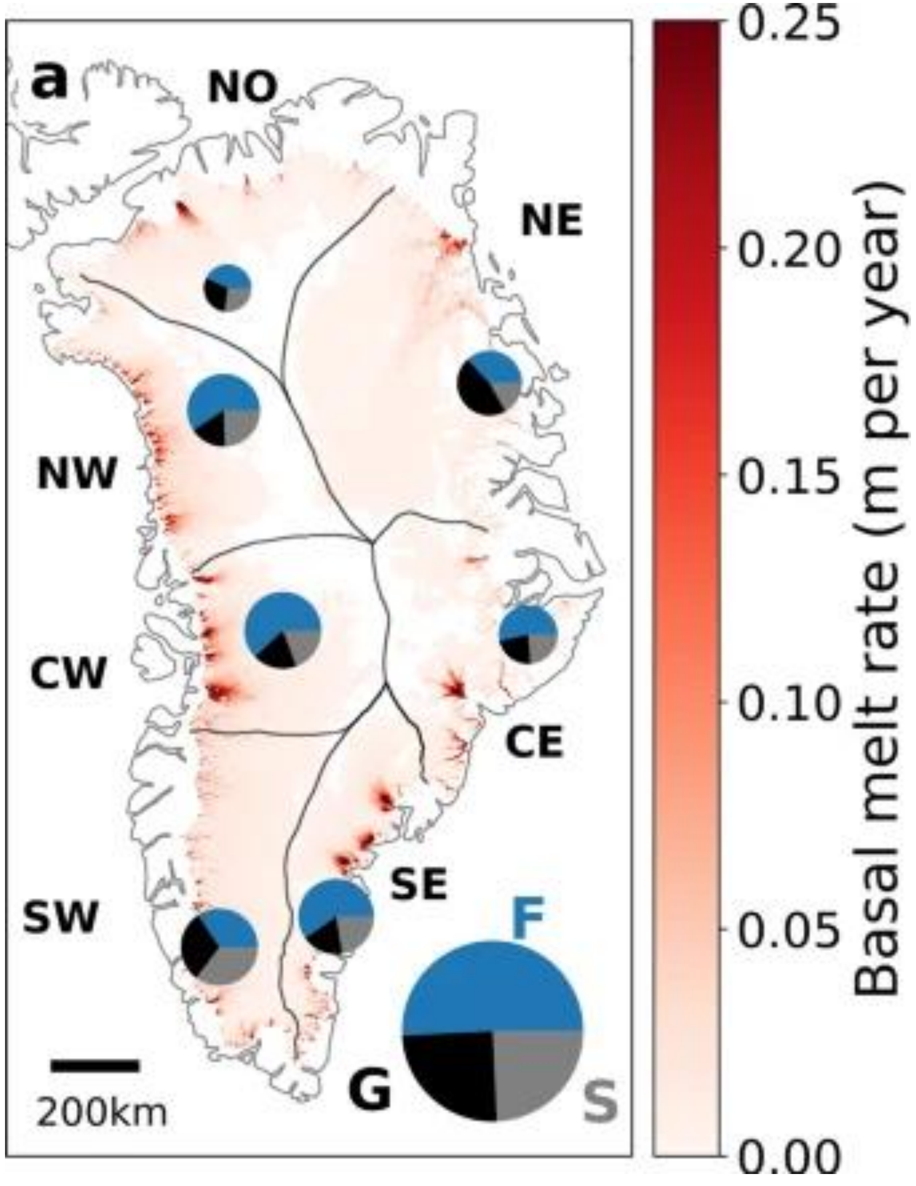
Subglacial discharge absent in winter?

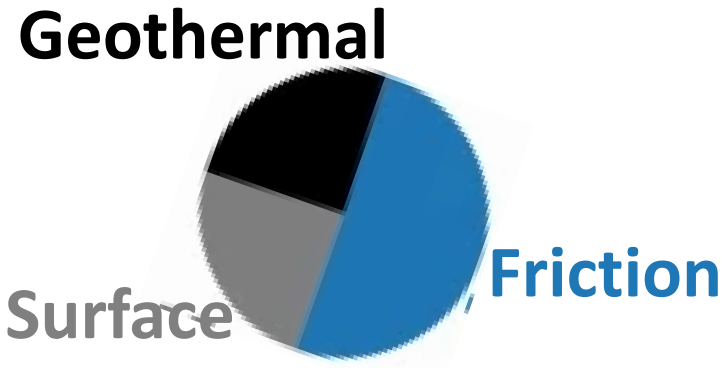


Moon et al., 2018

Model assumption:
Subglacial discharge is only fed by surface melt with no delay

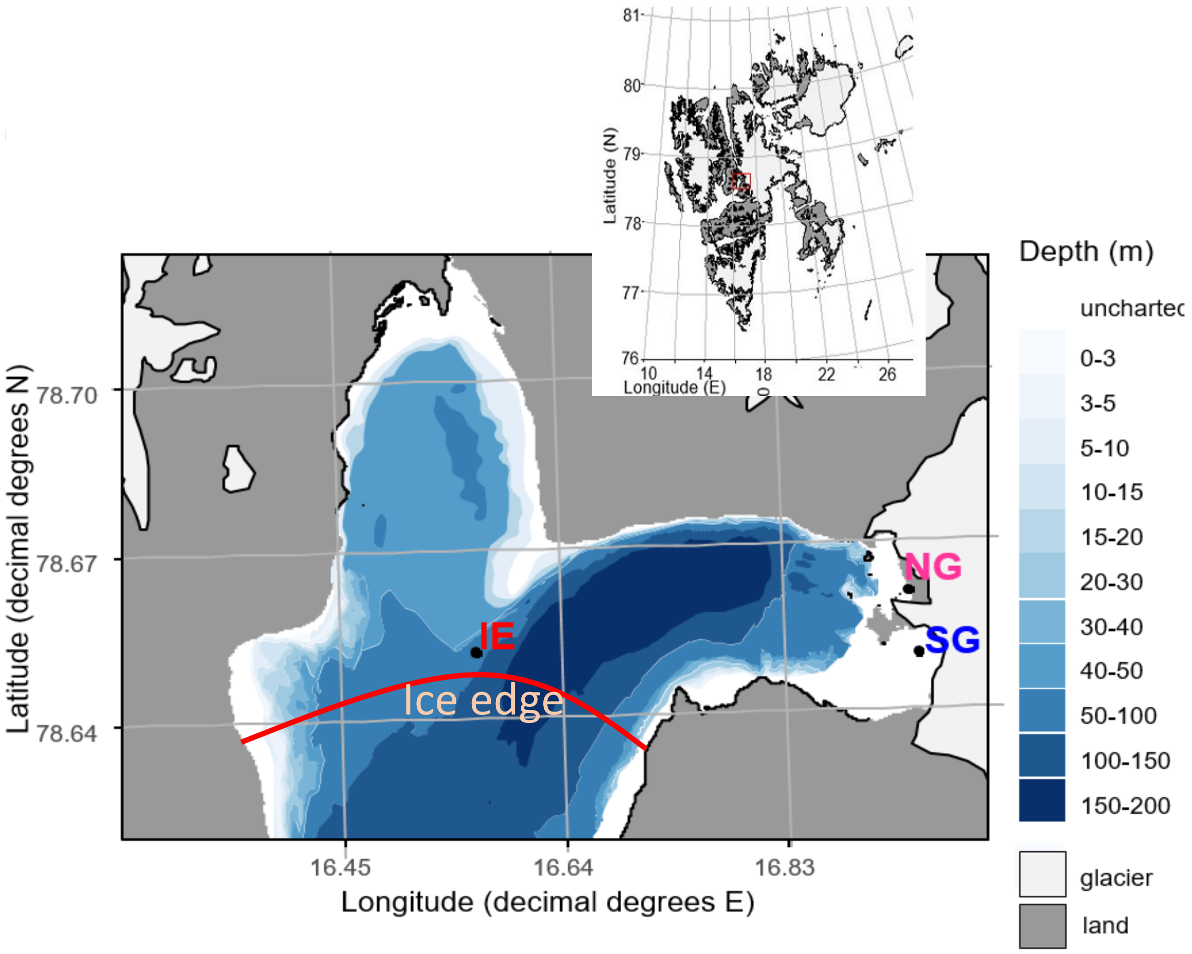
Subglacial discharge throughout winter



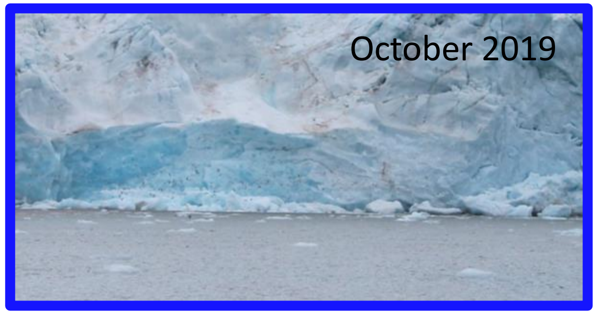


Karlsson et al., 2021

Winter subglacial discharge in Billefjorden



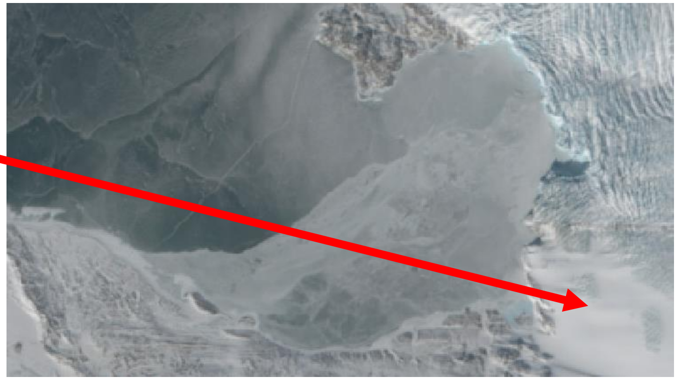
SG – Tidewater glacier



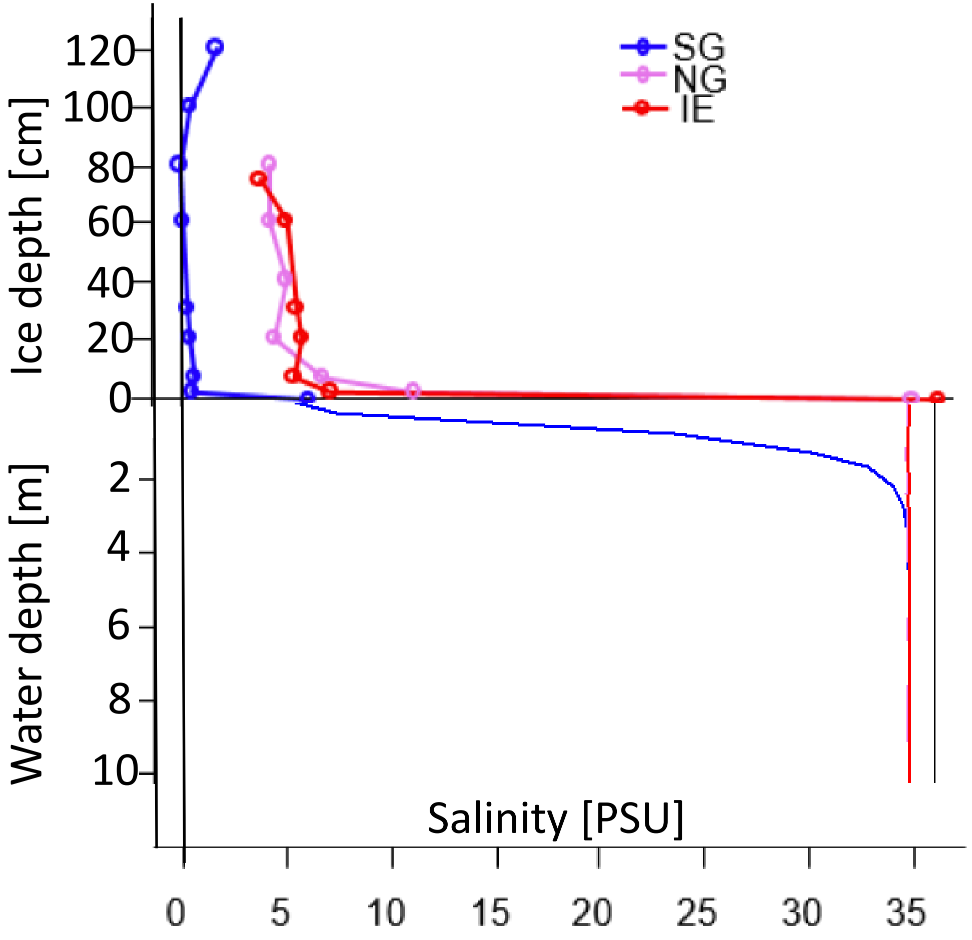
NG – Land-terminating Reference

IE – Marine Reference

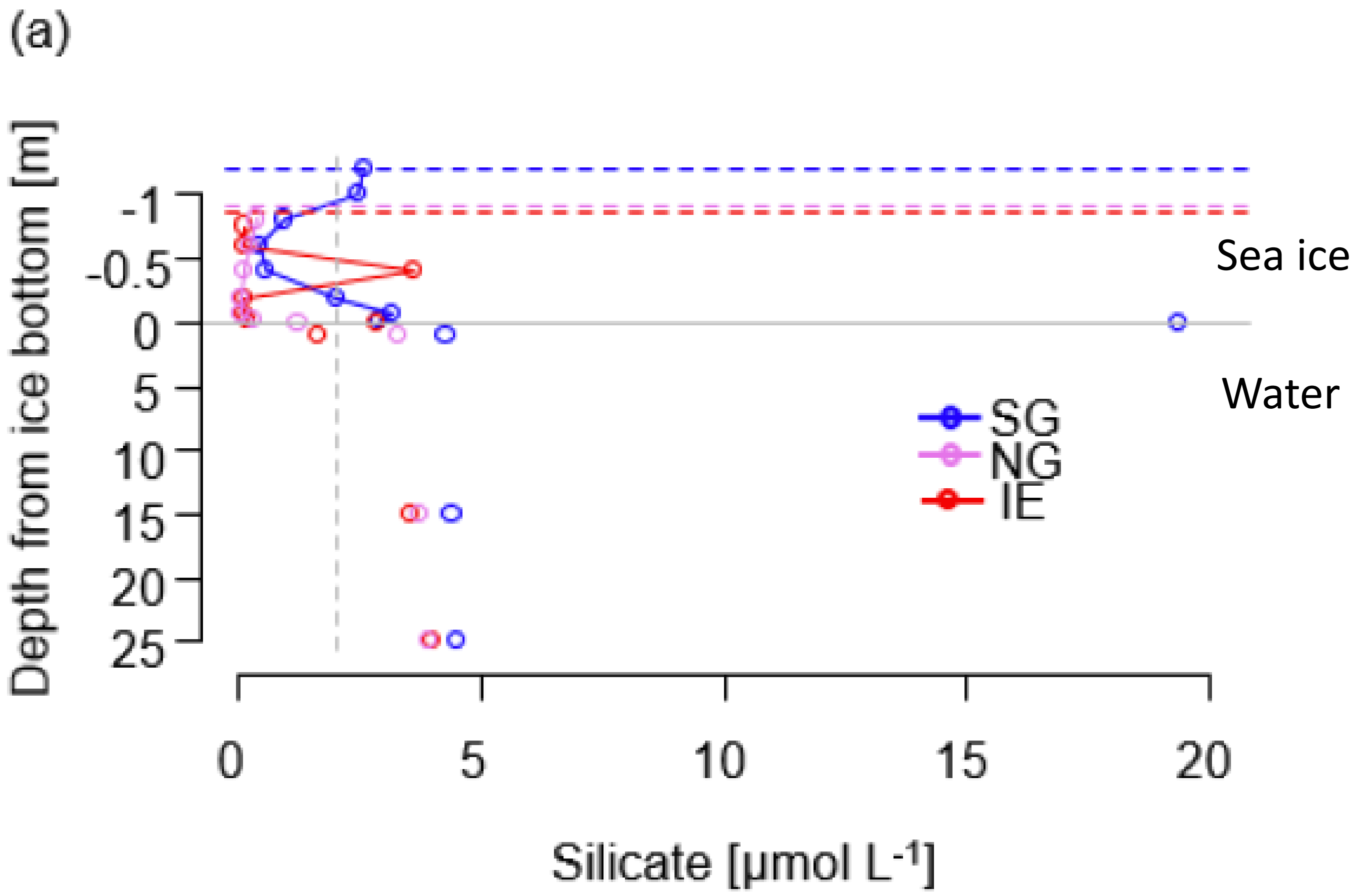
Aufeis at the glacier front



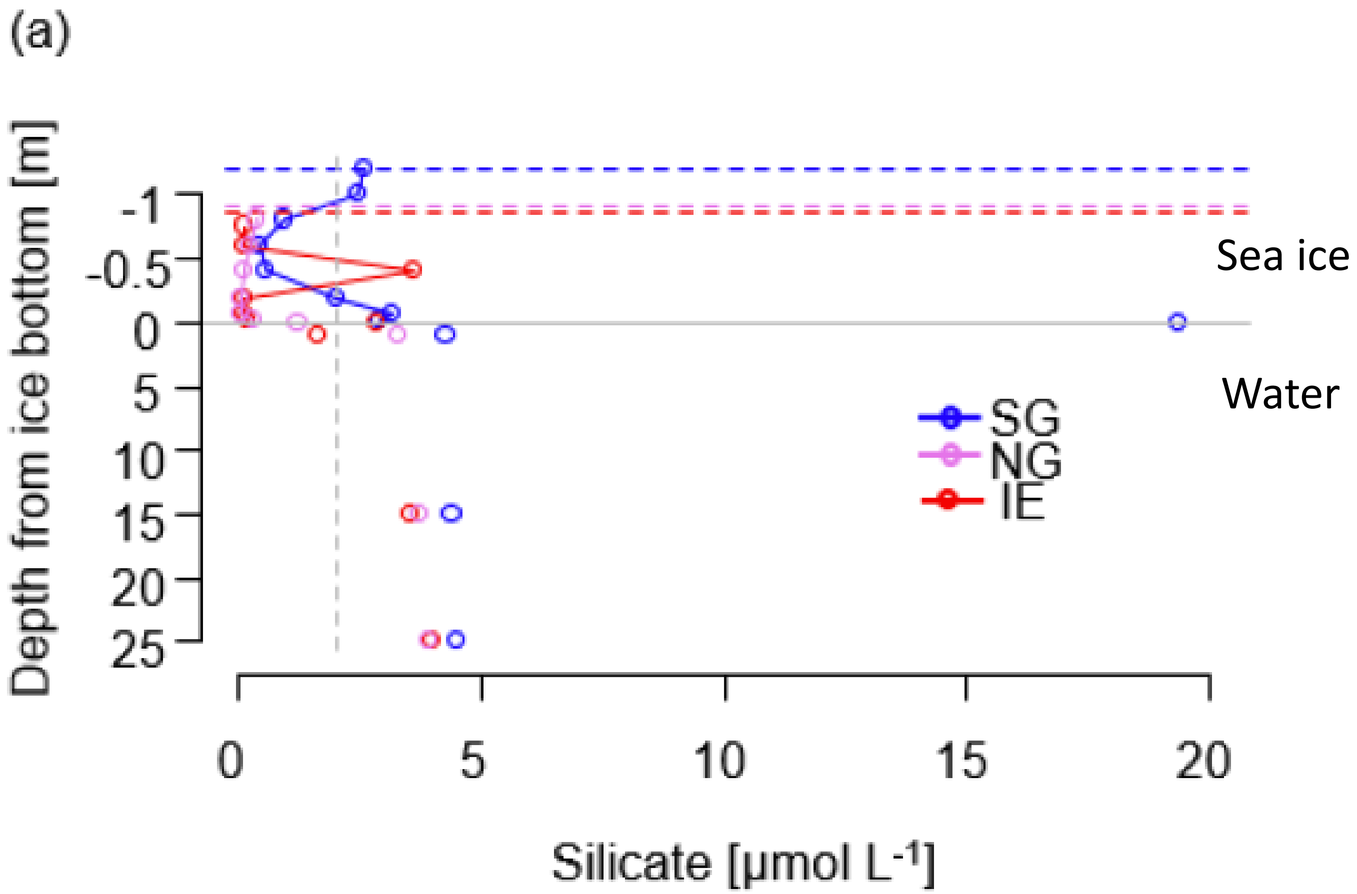
Winter subglacial discharge in Billefjorden



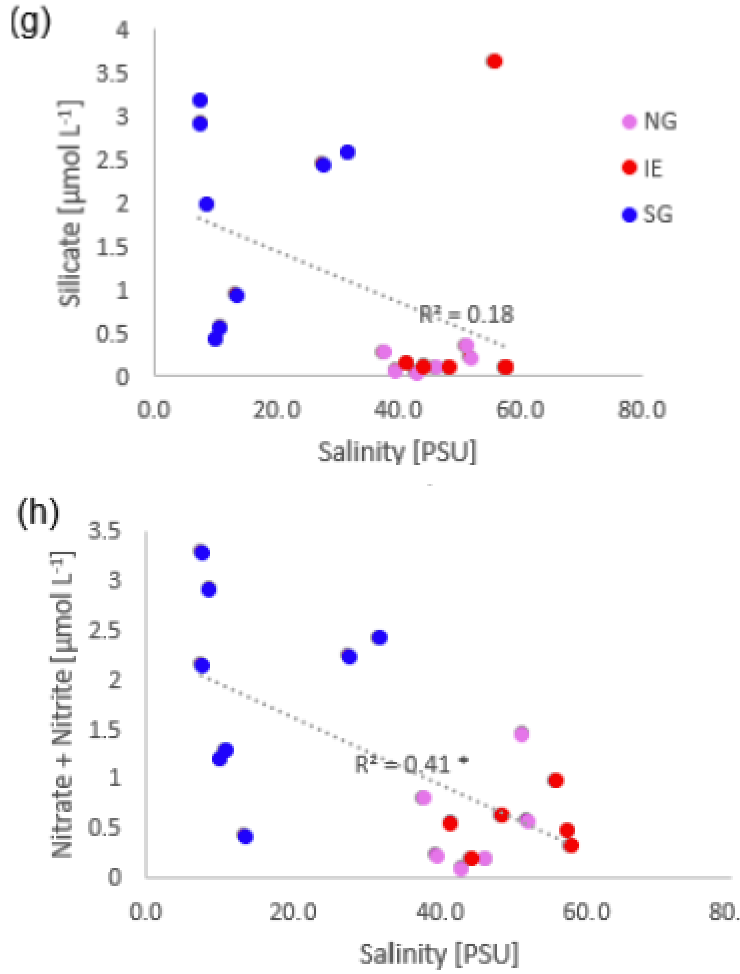
Nutrient inputs with/from subglacial discharge



Nutrient inputs with/from subglacial discharge



Sea ice: brine salinity - Nutrients



Reconstructing the microbial C cycle

Primary production PP

In situ LIGHT ^{14}C-DIC uptake

Bacterial production BP

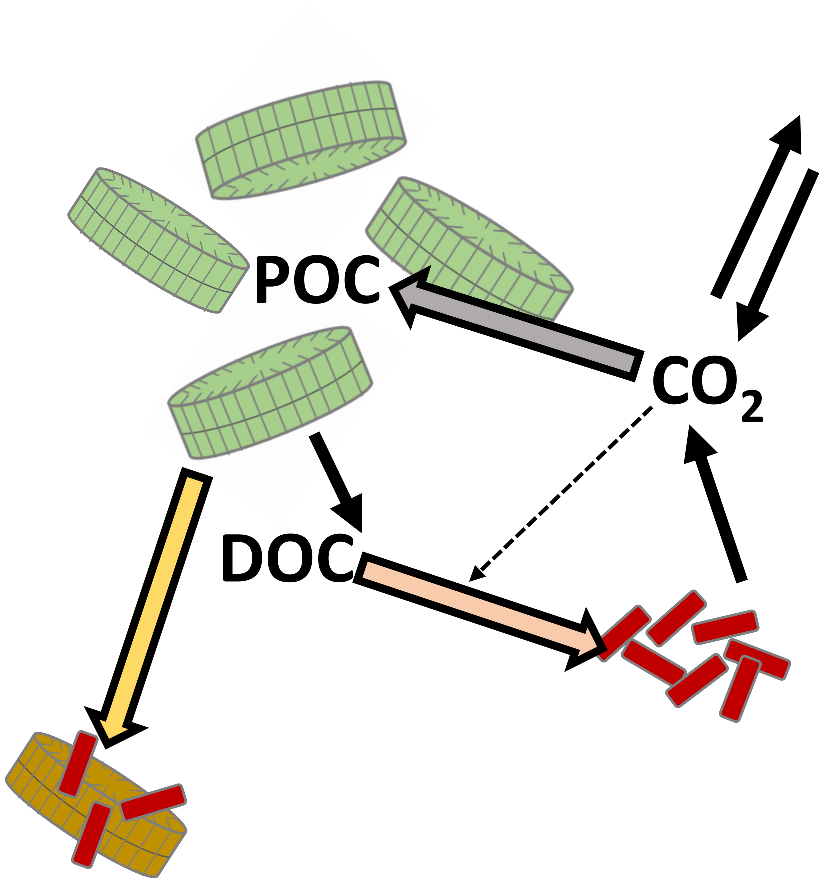
In situ DARK ^{14}C-DIC uptake

(129 gC gDIC^{-1}, Molari et al., 2013)

Vertical Export VE

Chl a in Sediment traps

(30 gC gChl^{-1}, Cloern et al., 1995)



AB **Algae biomass**

Chloropyll a

(30 gC gChl^{-1}, Cloern et al., 1995)

BB **Bacteria biomass**

DAPI cell counts

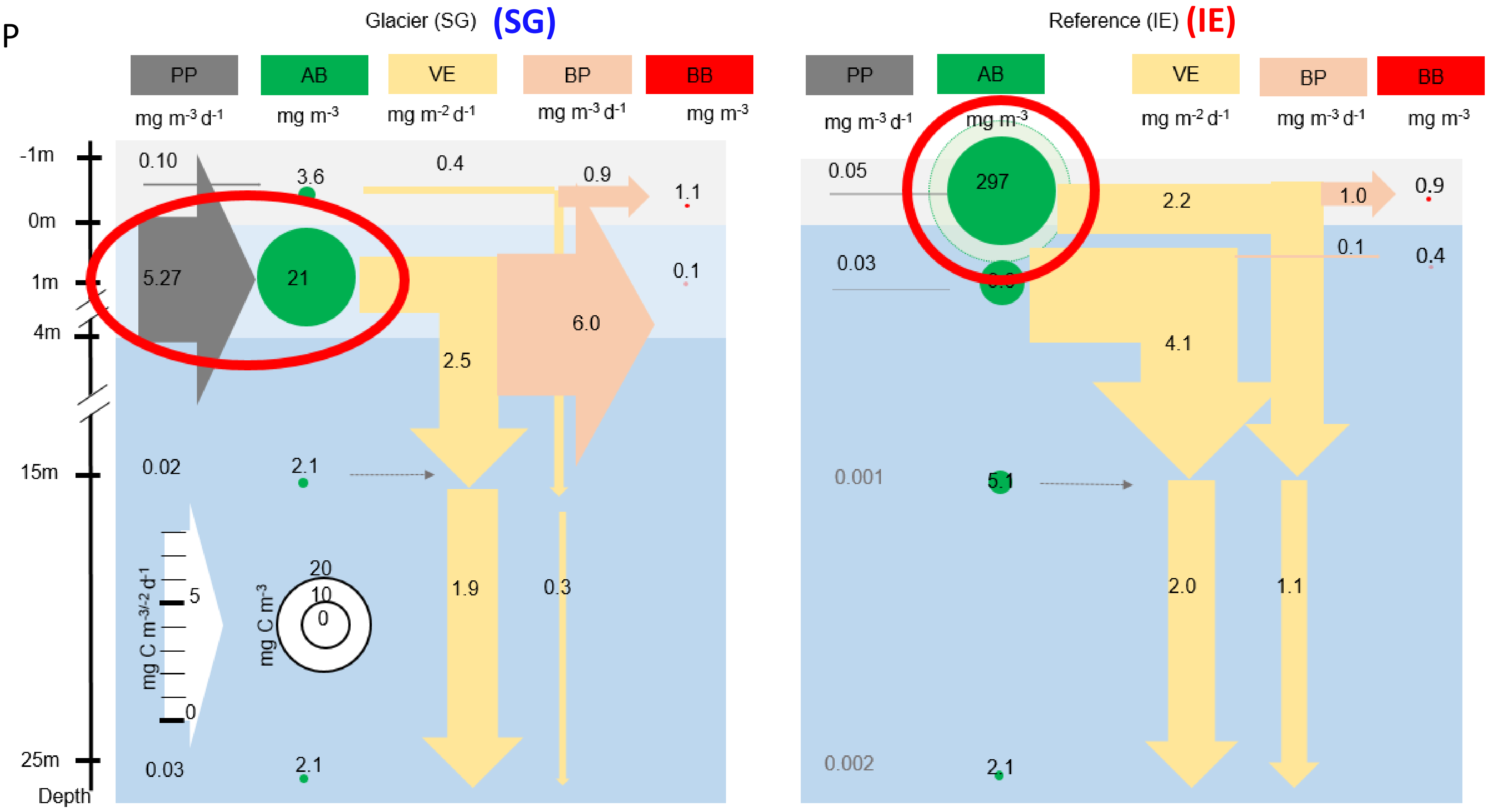
(20 fg C cell^{-1}, *Lee and Fuhrman, 1987)*

Increased under ice primary production

Integrated PP

42.6

mg C m^{-2} d^{-1}

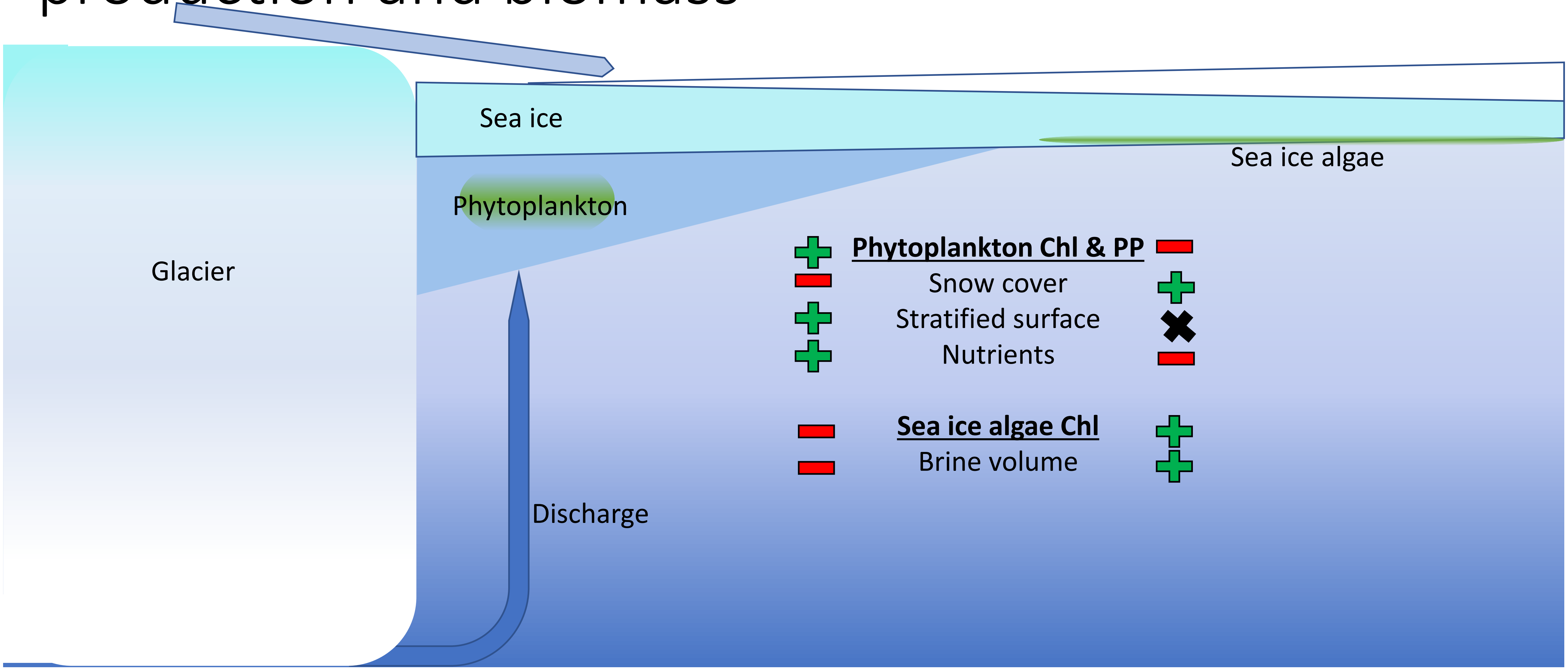


Integrated PP

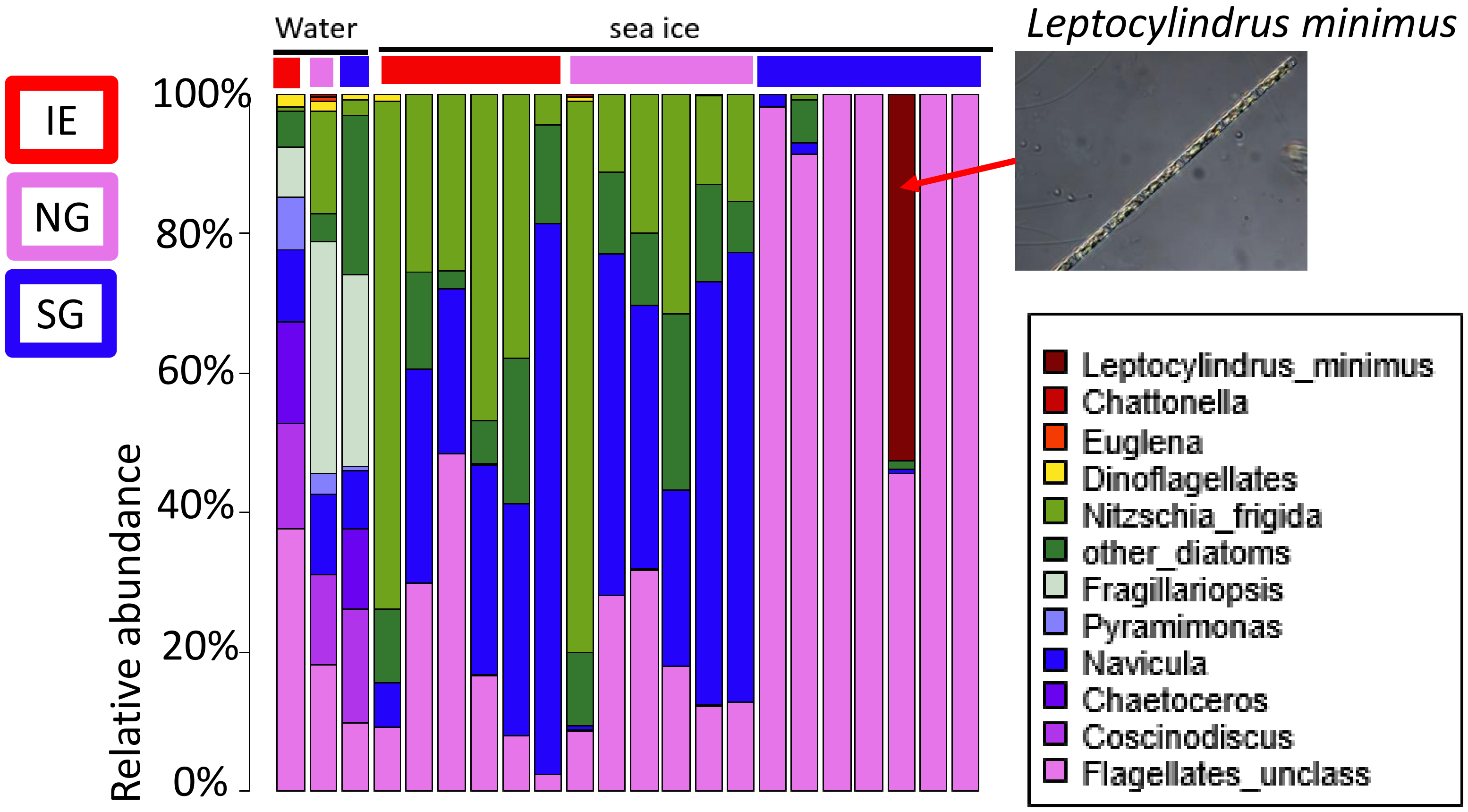
0.2

mg C m^{-2} d^{-1}

Impacts of tidewater glaciers on algae production and biomass



Impacts on algae communities



Take home messages

- Subglacial discharge also plays a role in winter/ spring
- At a shallow tidewater glacier, subglacial discharge can lead to a highly stratified surface layer and brackish sea ice
- Nutrient inputs, a stratified surface layer, and less snow facilitate a moderate under-ice phytoplankton bloom
- Critically low brine volume fractions in sea ice limit ice-algae biomass and leads to a unique community

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