Funn fra arbeid i Rijpfjorden

Kunnskapsseminaret, mars 2016

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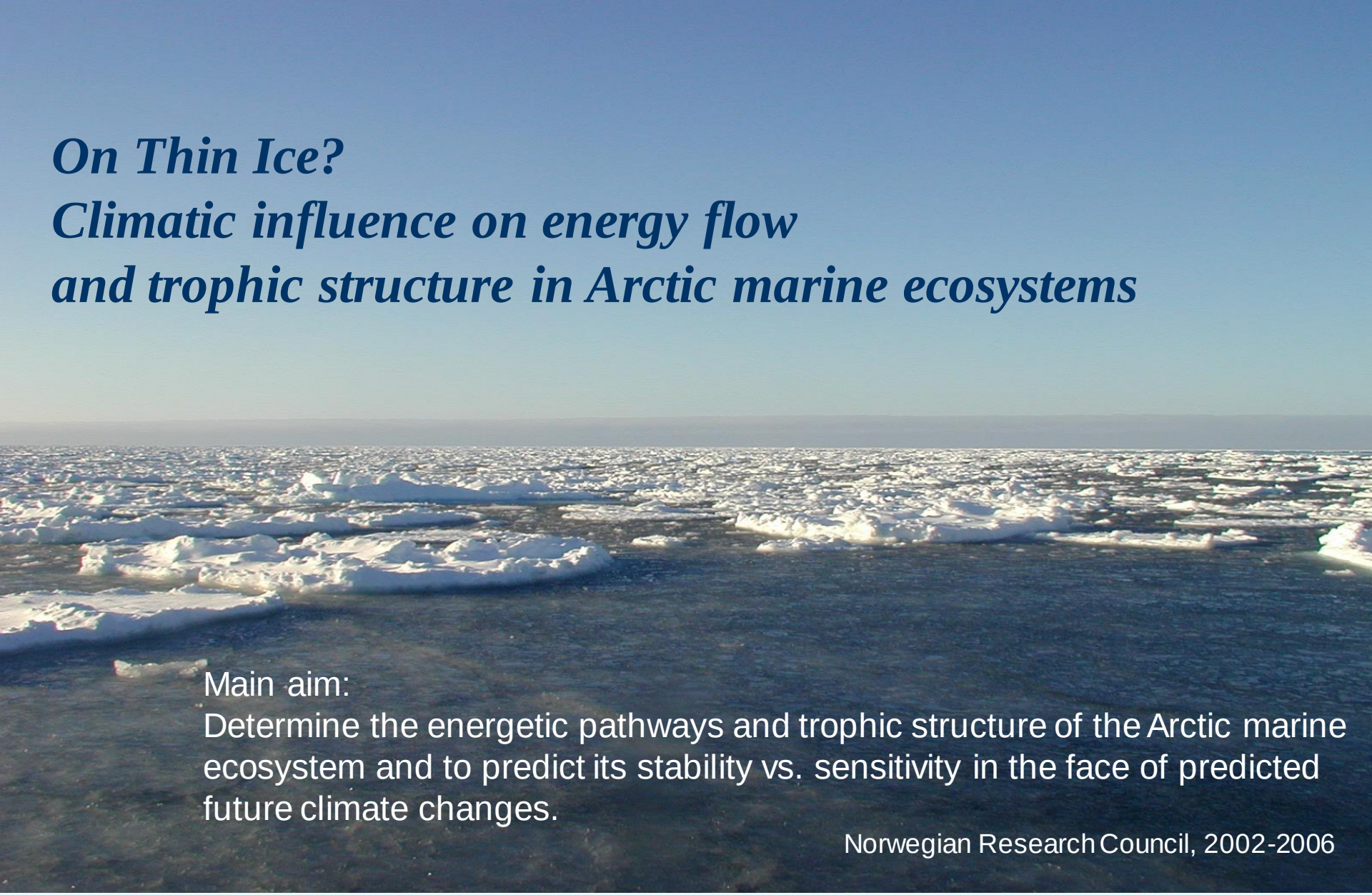
Arktisk Biologi, UNIS
Janne.Soreide@unis.no

Hva skal jeg snakke om i dag?

- Litt prosjekthistorie…….
- Hvorfor Rijpfjorden?
- Noen nøkkelresultater
- Andre viktige studier i Svalbards fjorder
- Framtidsplaner



On Thin Ice?
Climatic influence on energy flow and trophic structure in Arctic marine ecosystems

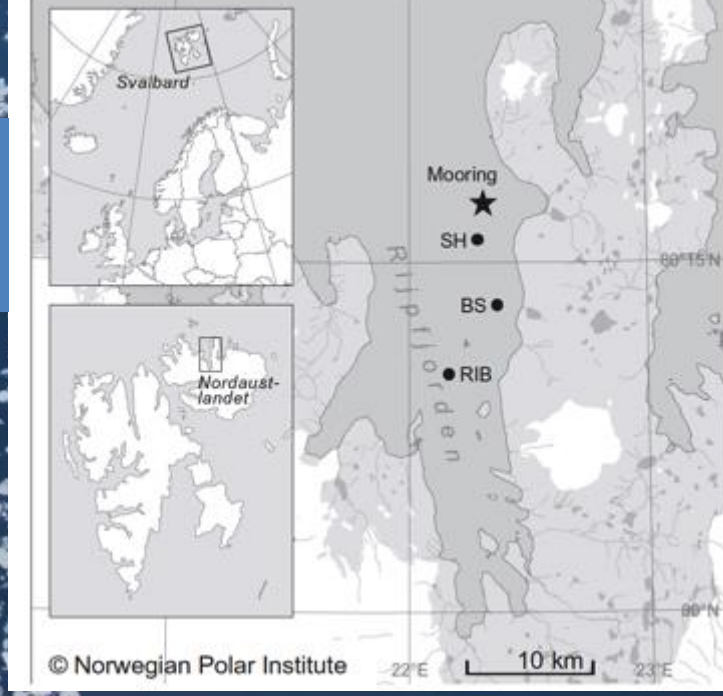
Main aim:
Determine the energetic pathways and trophic structure of the Arctic marine ecosystem and to predict its stability vs. sensitivity in the face of predicted future climate changes.

Norwegian Research Council, 2002-2006

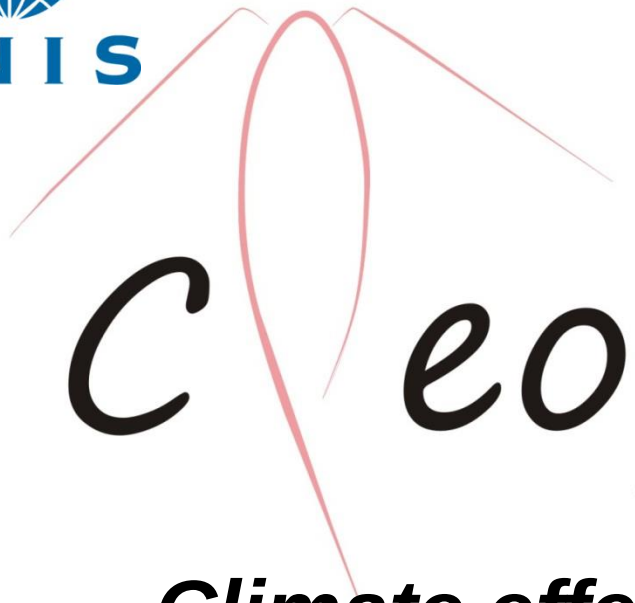
Founded by the Research Council of Norway through the ARKTØK program
(later part of the NORDKLIMA program)

CLEOPATRA I: Climate effects on planktonic food quality and trophic transfer in the Arctic marginal ice zone, NFR 2007-2010

2007 2008 POLARAET



The Ice Edge Programme and Arctos research in Rijpfjorden



Cleopatra II

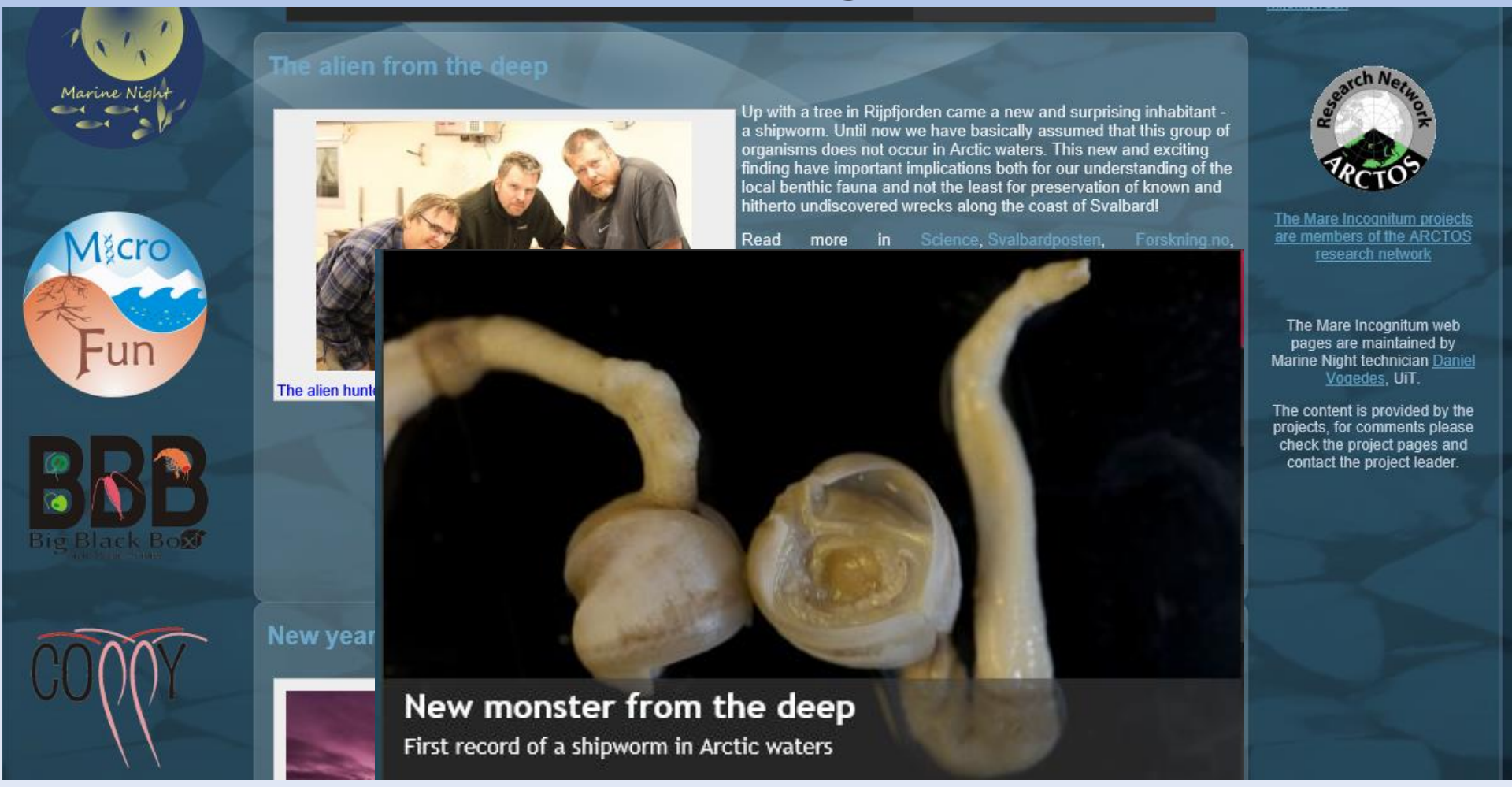
Climate effects on planktonic food quality and trophic transfer in the Arctic marginal ice zone

NFR (Norklima) 2012-2015

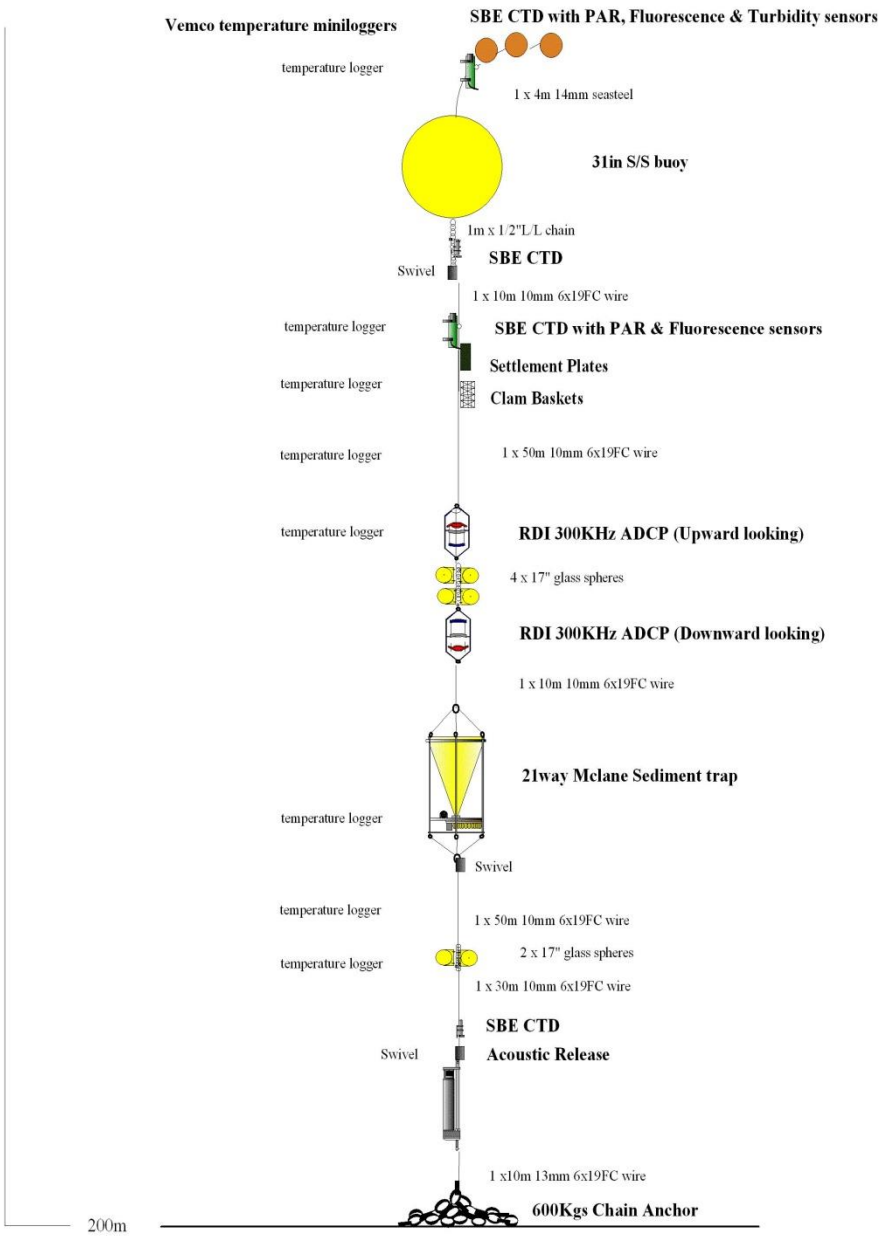
Mare incognitum

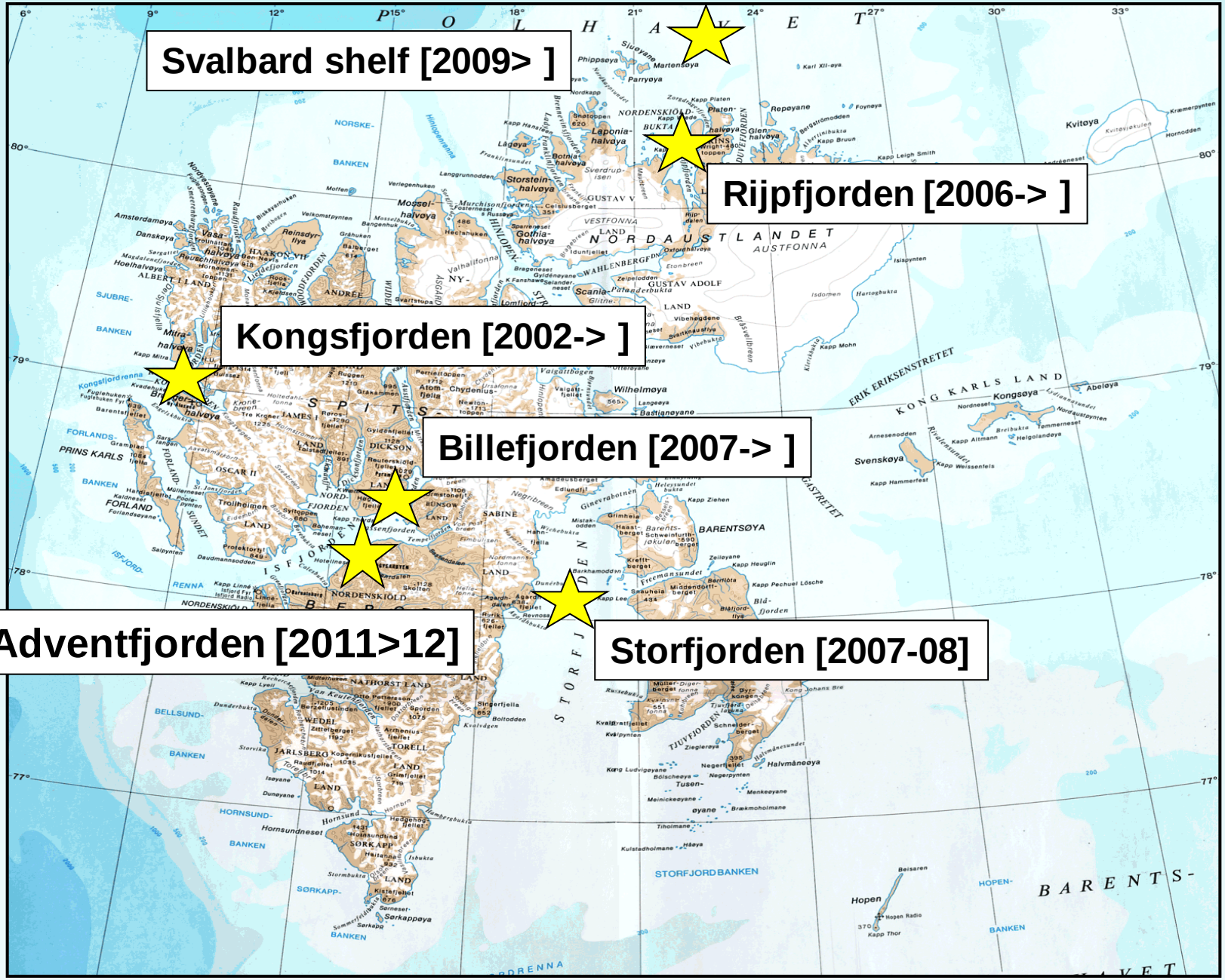
Unraveling the mysteries of Arctic marine systems

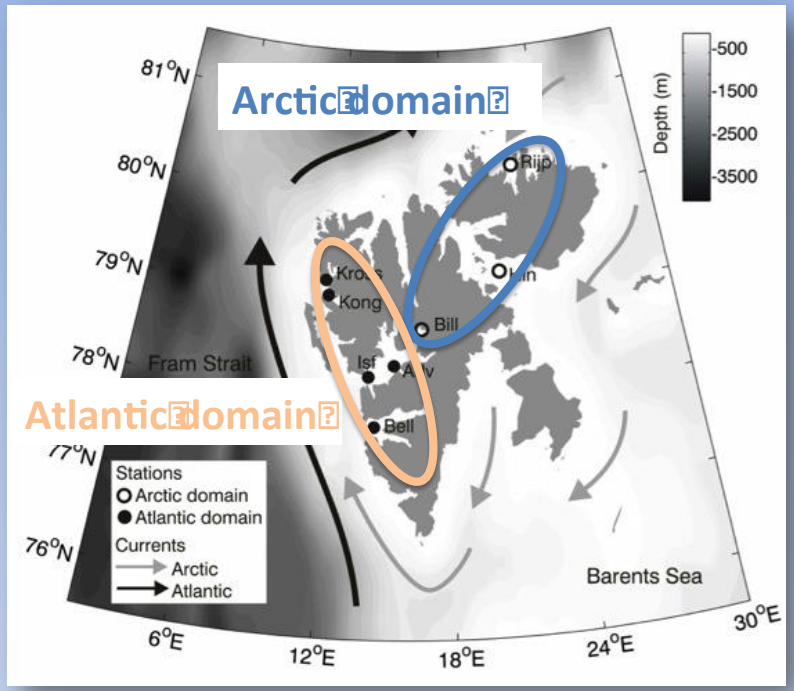
www.mare-incognitum.no



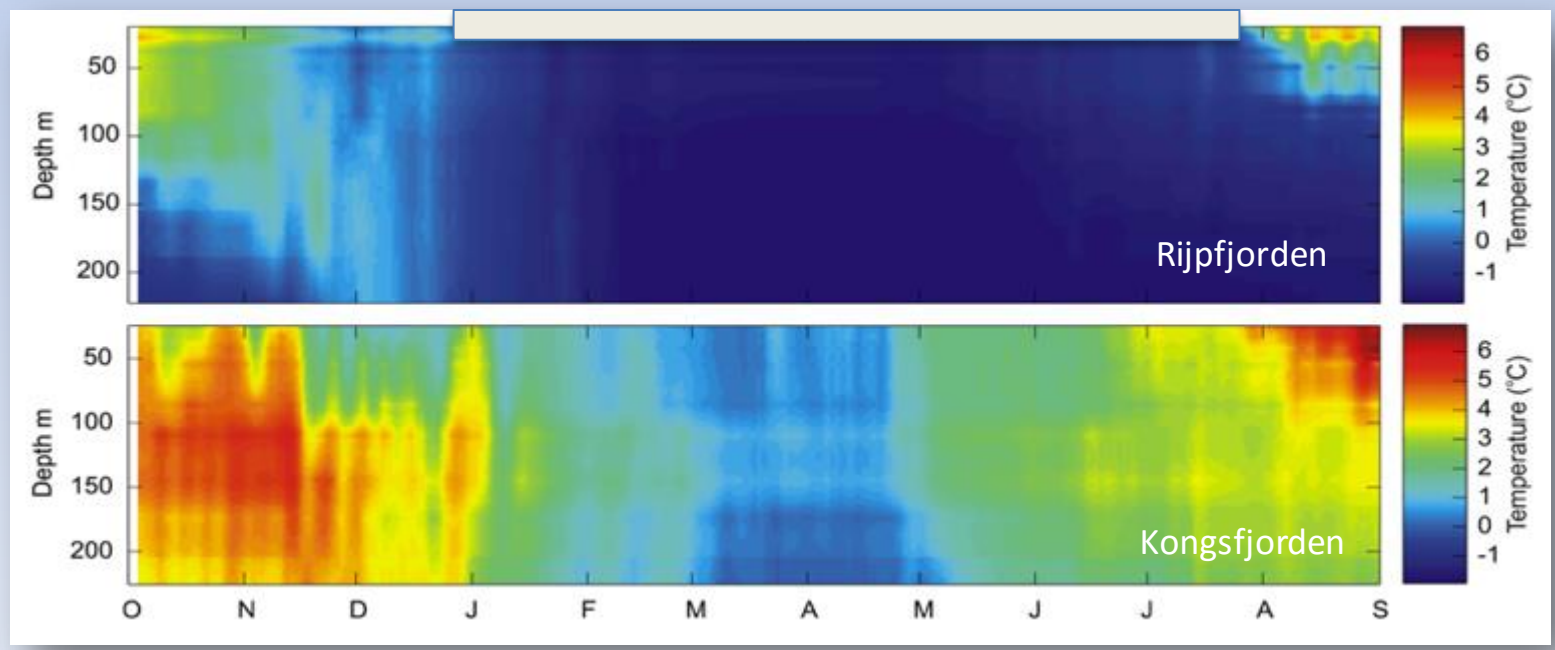
Værstasjoner i havet



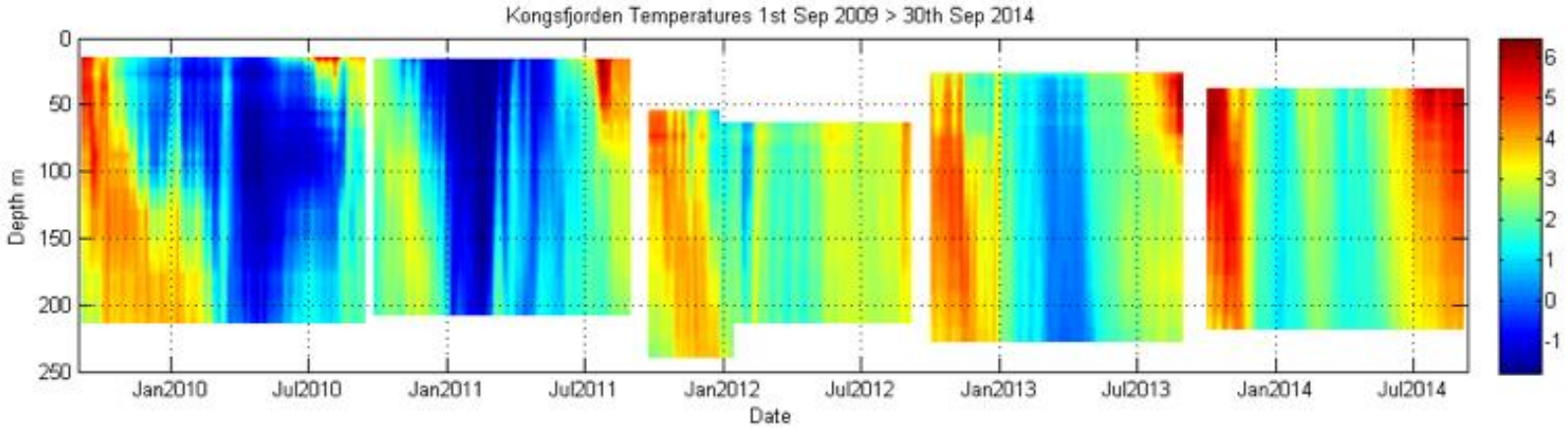

Svalbard shelf [2009>]
Rijpfjorden [2006->]
Kongsfjorden [2002->]
Billefjorden [2007->]
Adventfjorden [2011>12]
Storfjorden [2007-08]

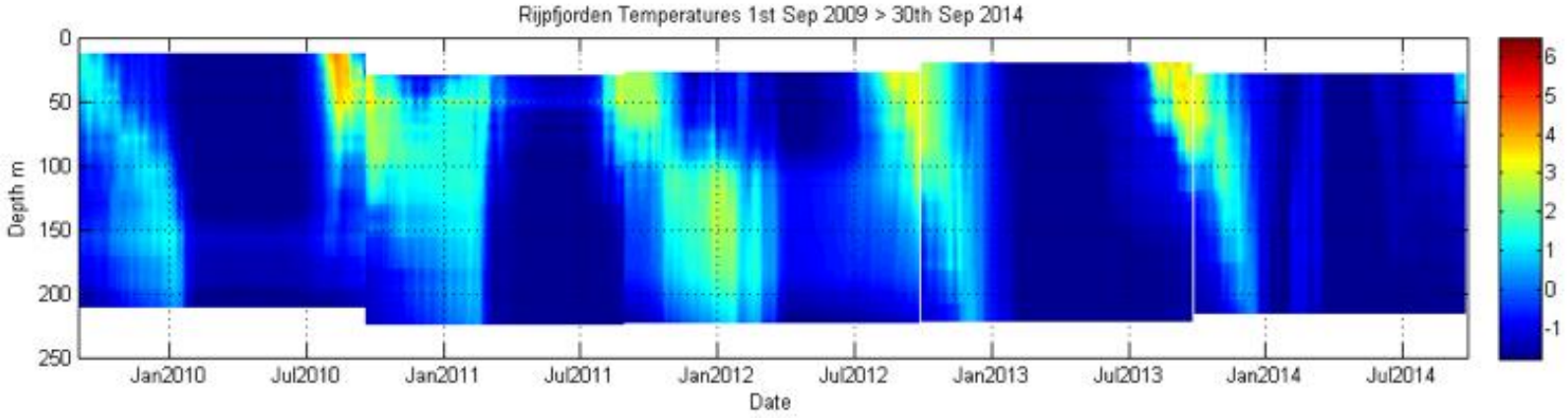


Seasonal temperature plots



Kongsfjorden



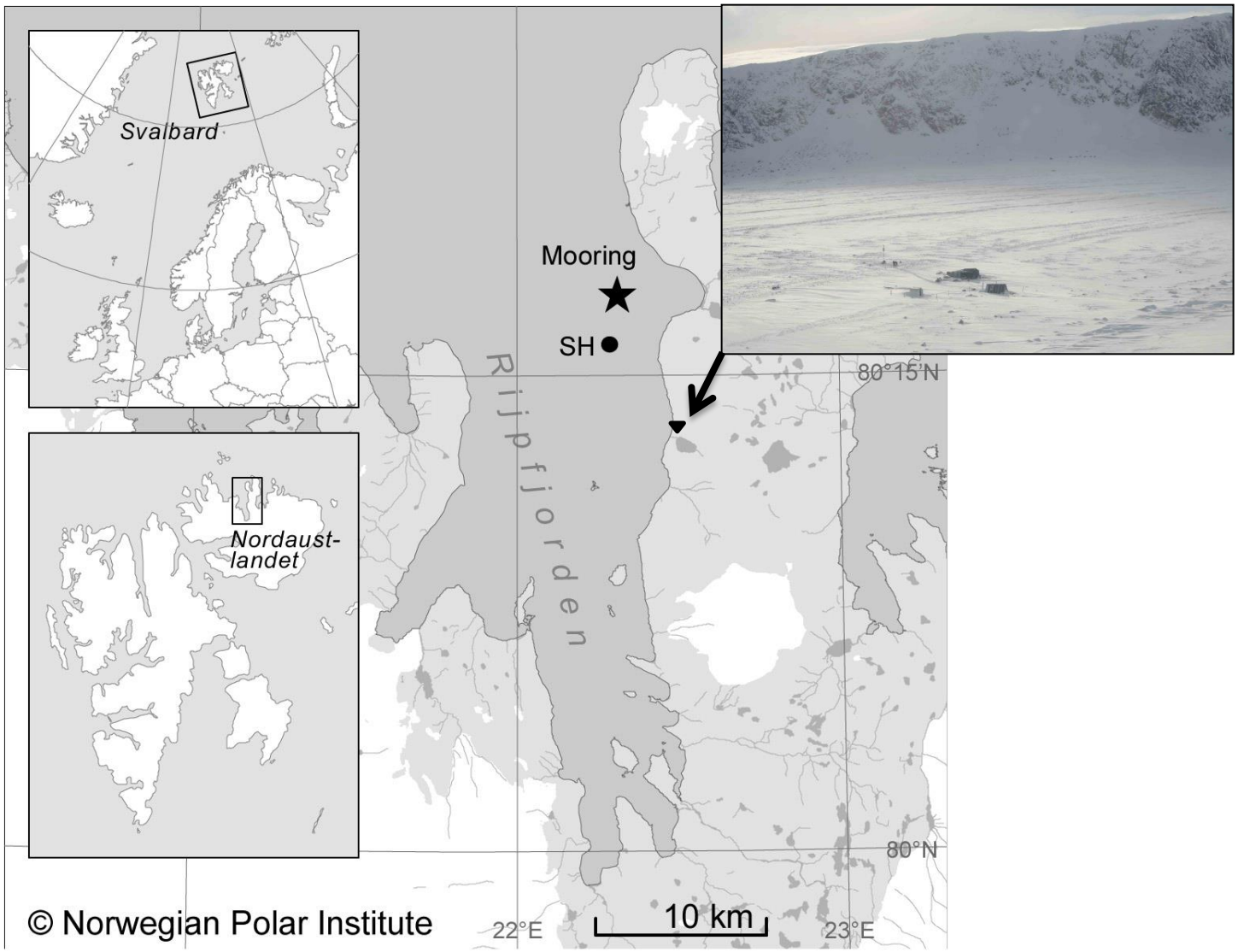


2010-2014

Rijpfjorden

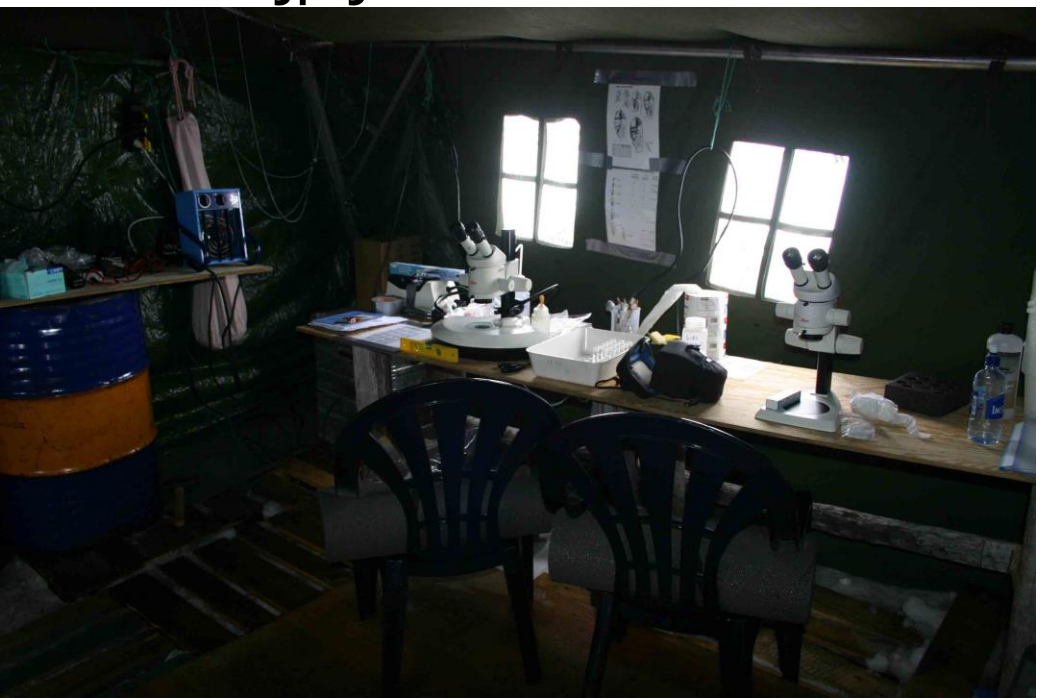
Rijpfjorden July 2007

Rijpfjorden:
an ice-dominated ecosystem

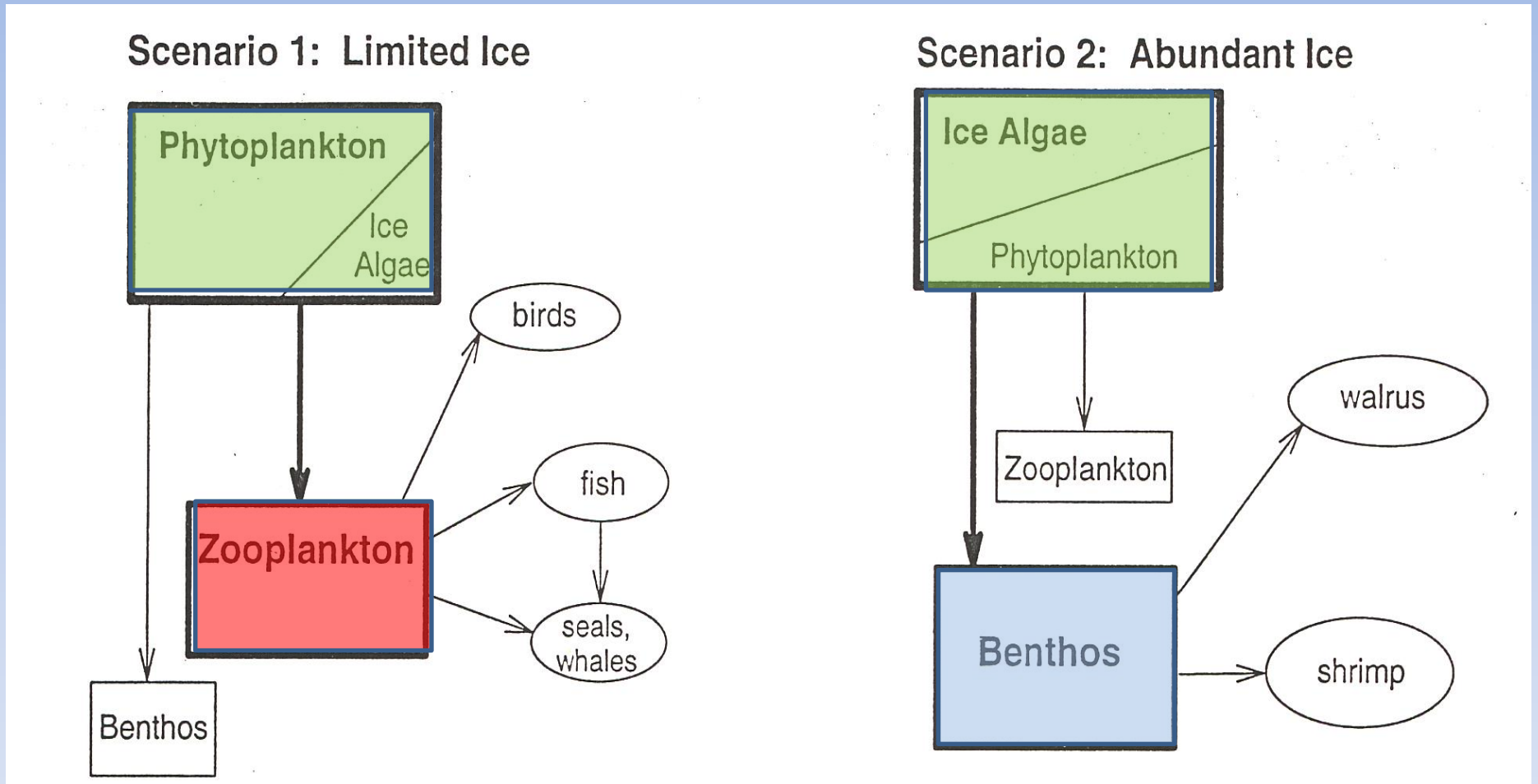


Rijpfjorden feltstasjon

Rijpfjorden laboratorium



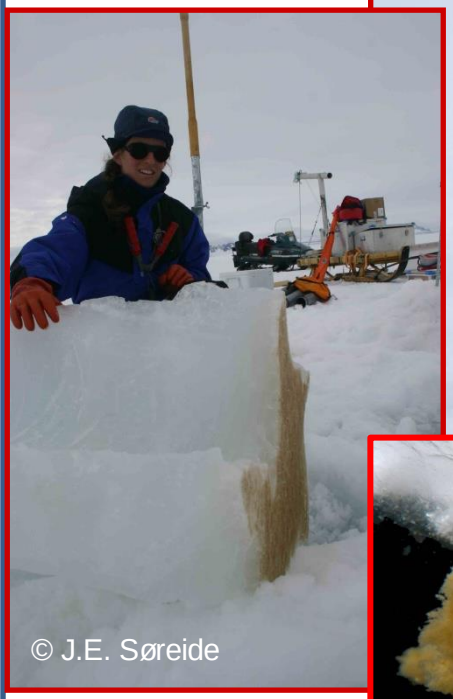
How important are ice algae?



Carroll & Carroll 2003

Offshore: two food sources in Arctic seas

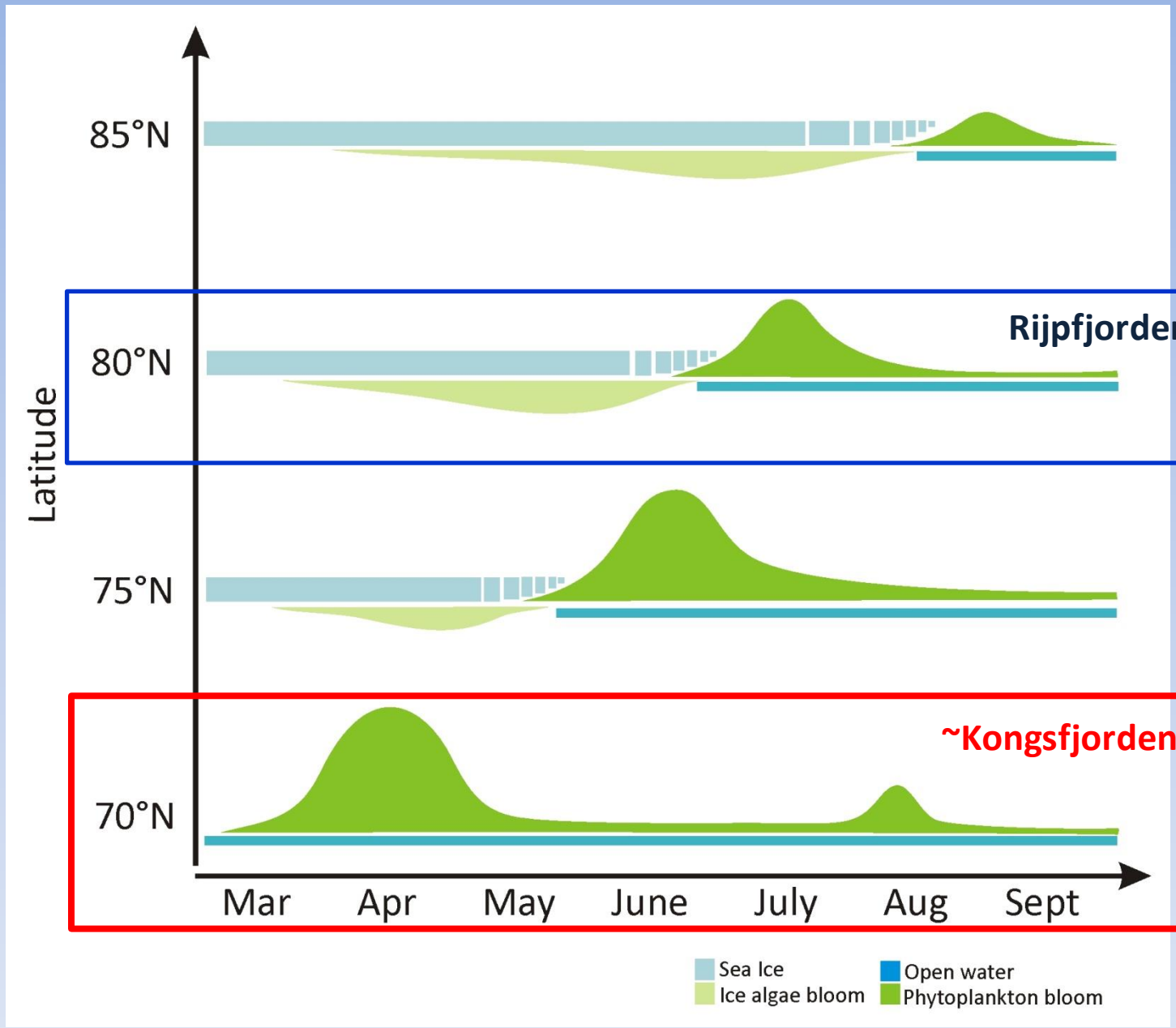
Ice algae



within and on the underside of sea ice

Phytoplankton

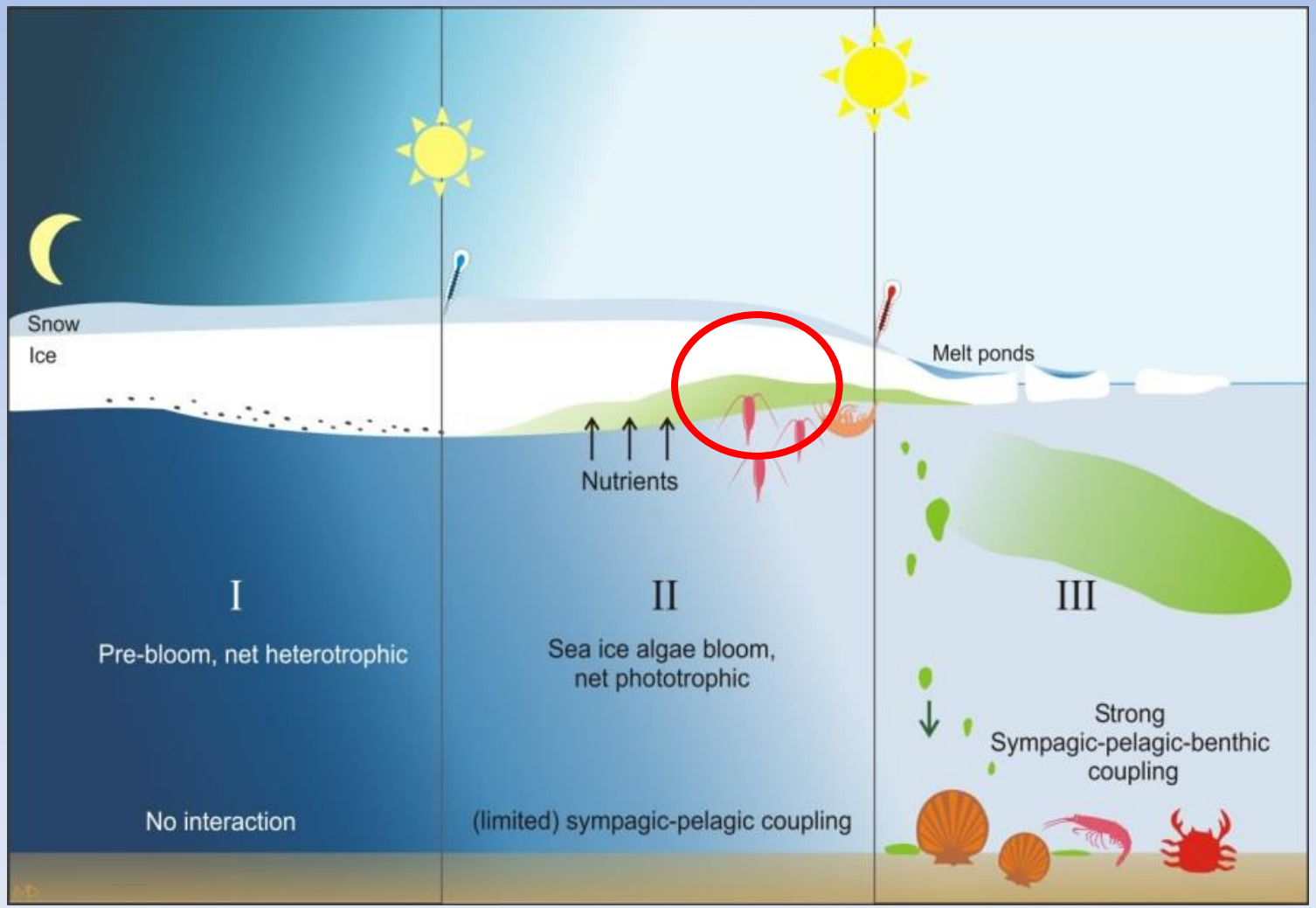
in water



Ice algae <1% to 57% of the total primary production in the Arctic

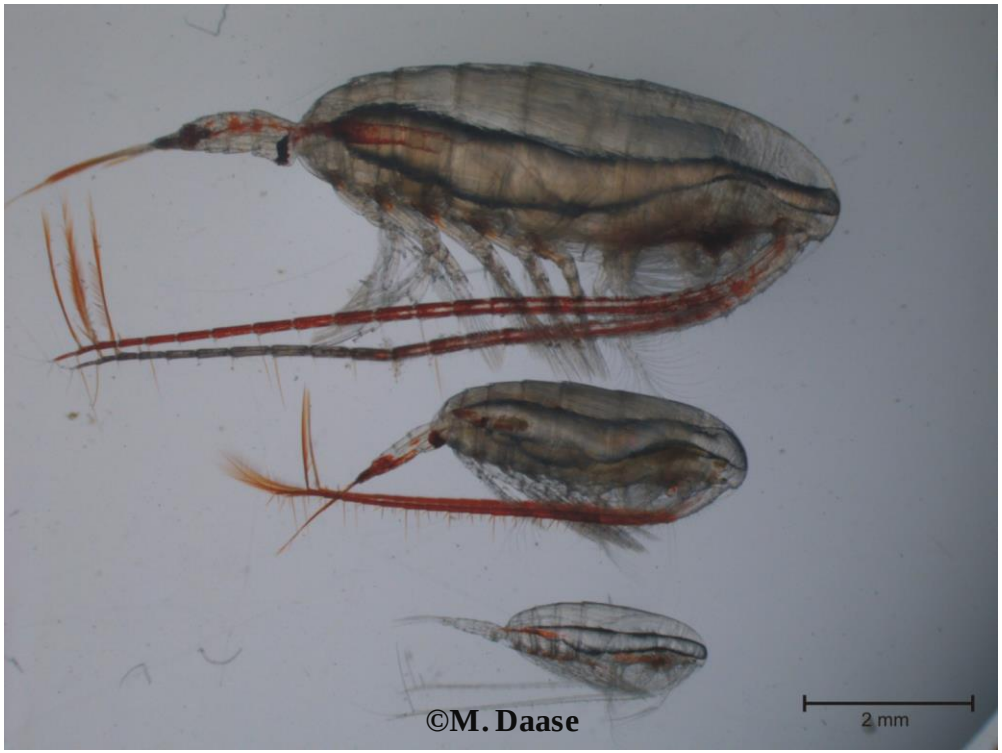
Leu, Søreide et al. 2011

Primary and secondary producers: Match or mismatch? Seasonal adaptation?

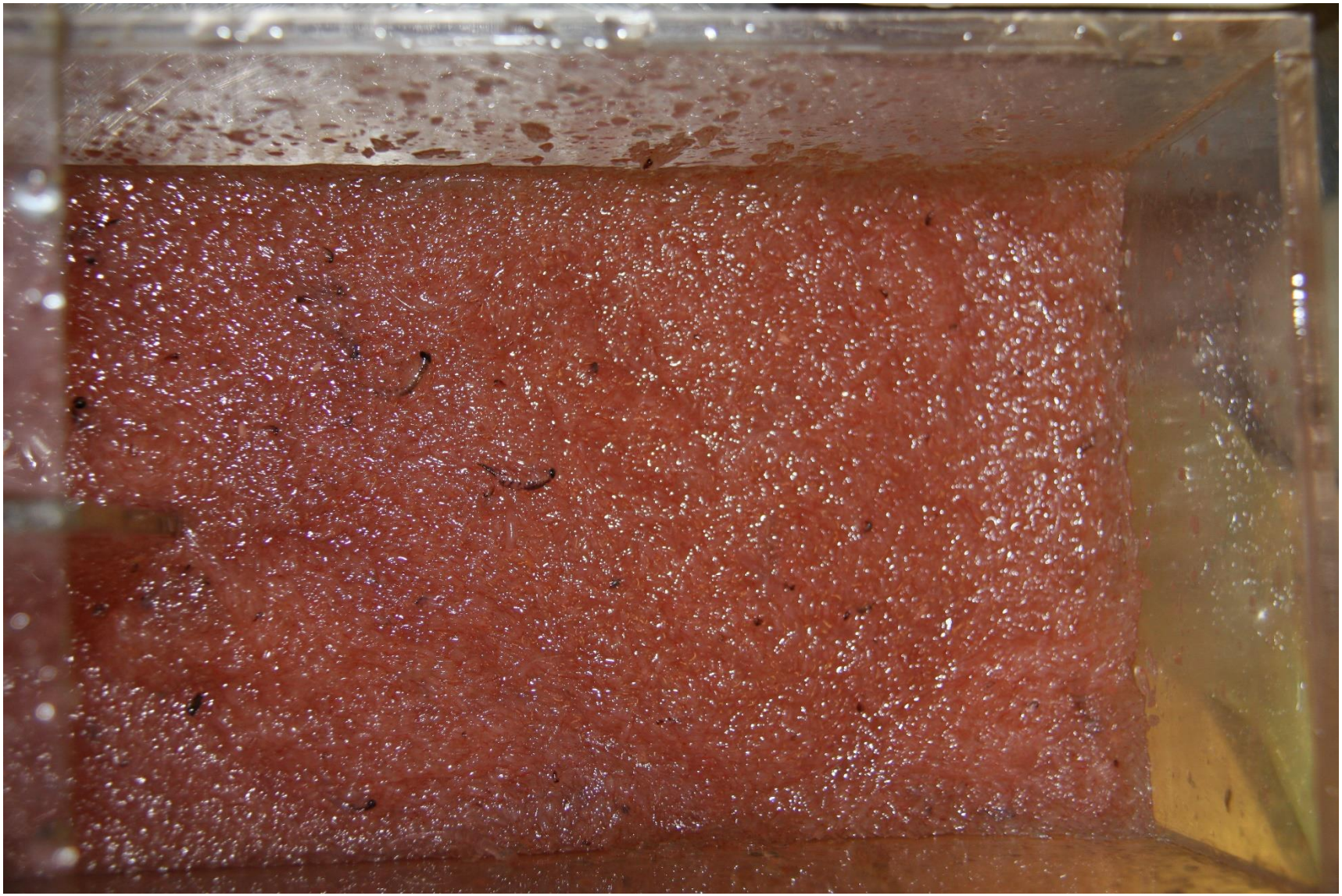


Eva Leu

Arctic and North Atlantic *Calanus* species



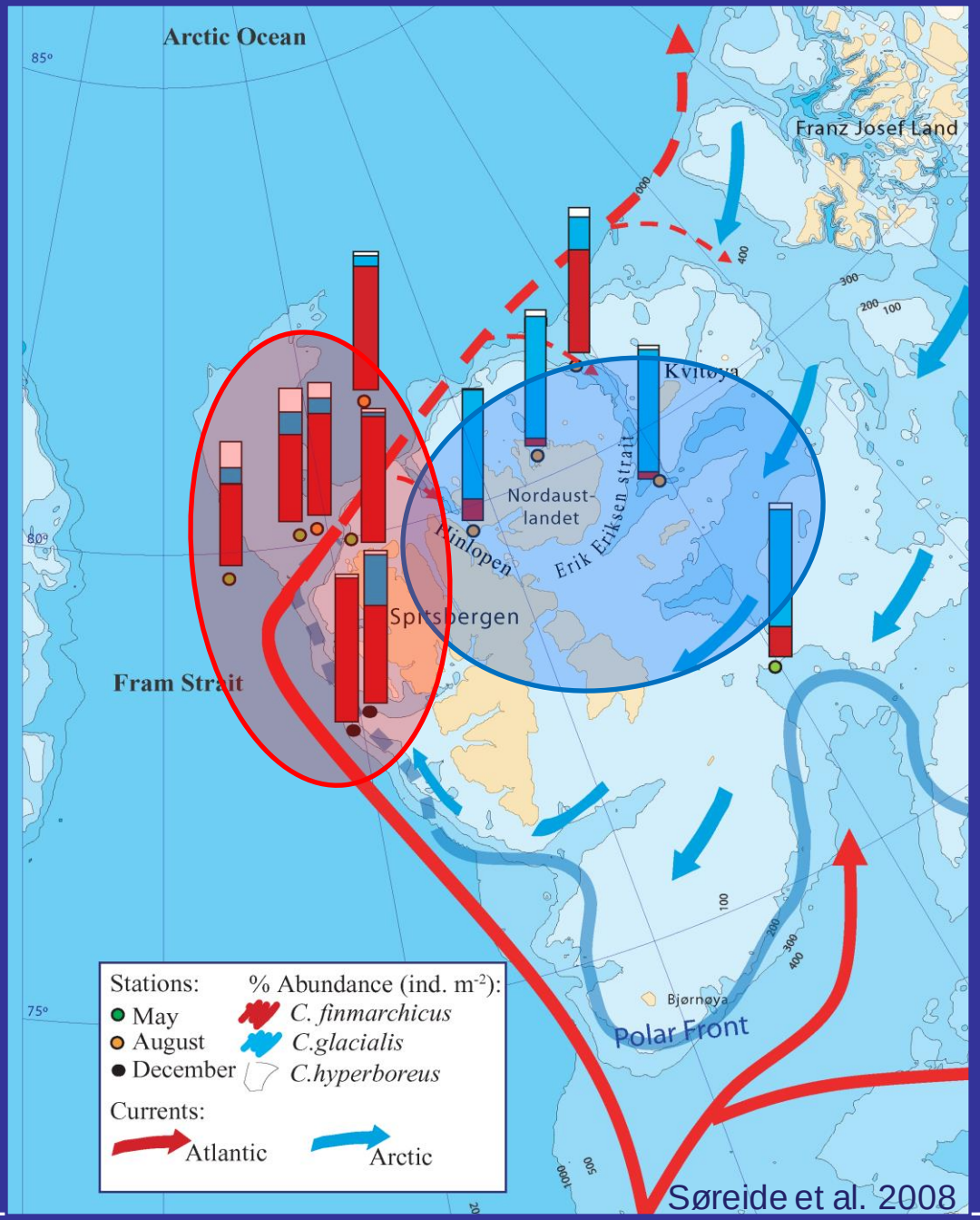
Calanus spp. account for 50-80% of the total mesozooplankton biomass (dry weight)
in the Arctic



©M. Daase

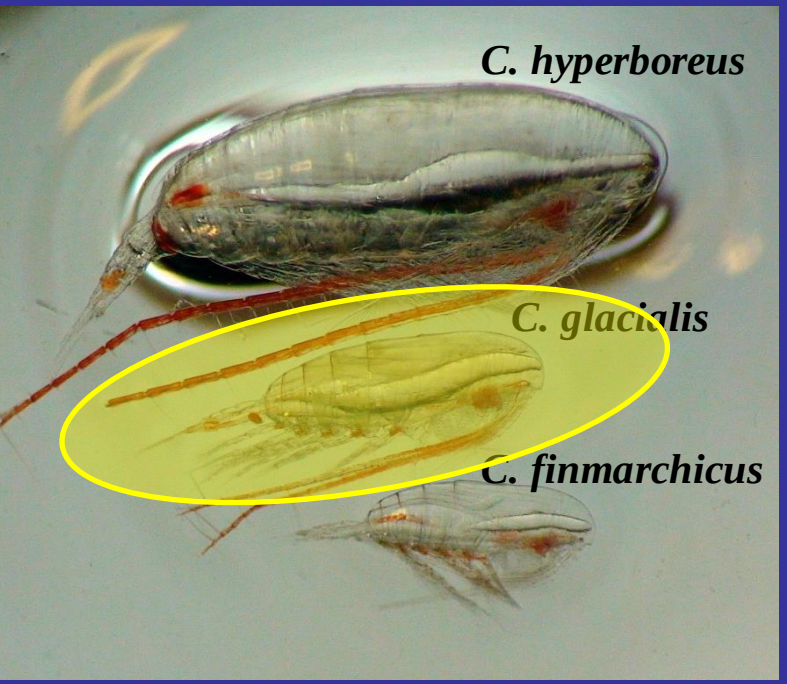
% ABUNDANCE

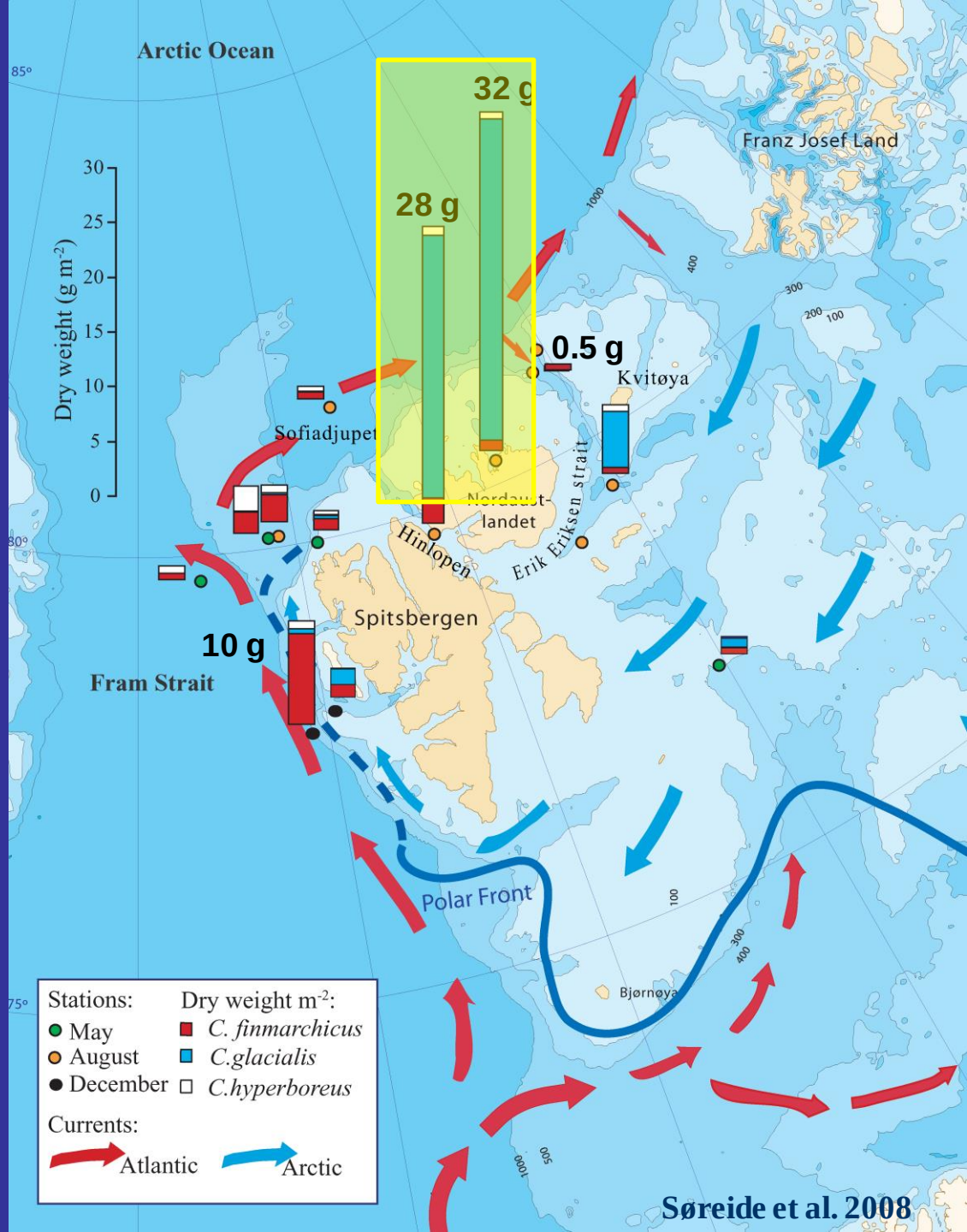

Arctic deep water
Calanus hyperboreus
Arctic shelf water
Calanus glacialis
North Atlantic
Calanus finmarchicus


Arctic Ocean
85°
80°
75°
Franz Josef Land
Kvitøya
Nordaust-landet
Erik Eriksen strait
Hinlopen
Spitsbergen
Fram Strait
Bjørnøya
Polar Front
Stations:
May
August
December
% Abundance (ind. m-2):
C. finmarchicus
C.glacialis
C.hyperboreus
Currents:
Atlantic
Arctic
Søreide et al. 2008

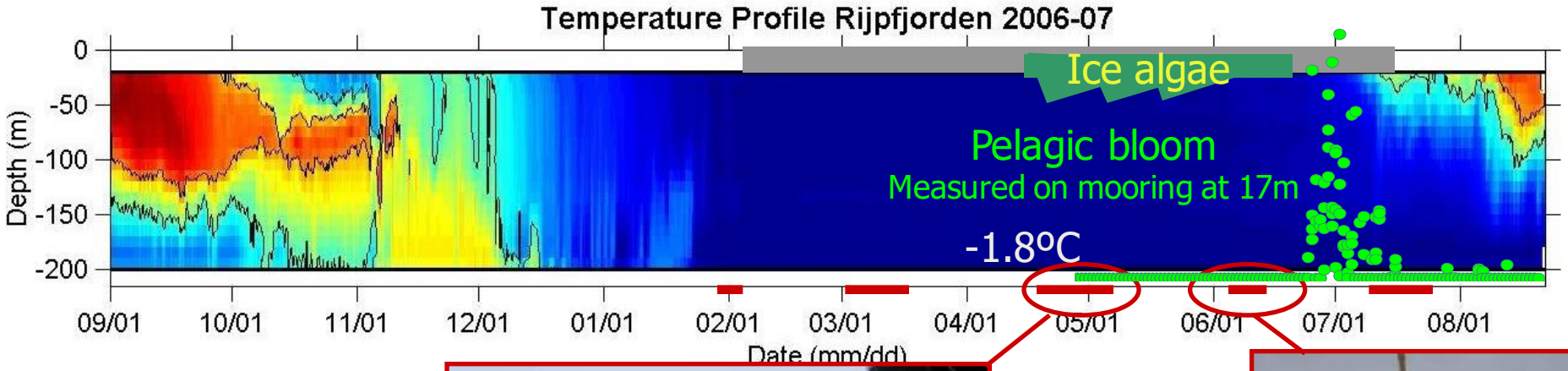
Zooplankton biomass

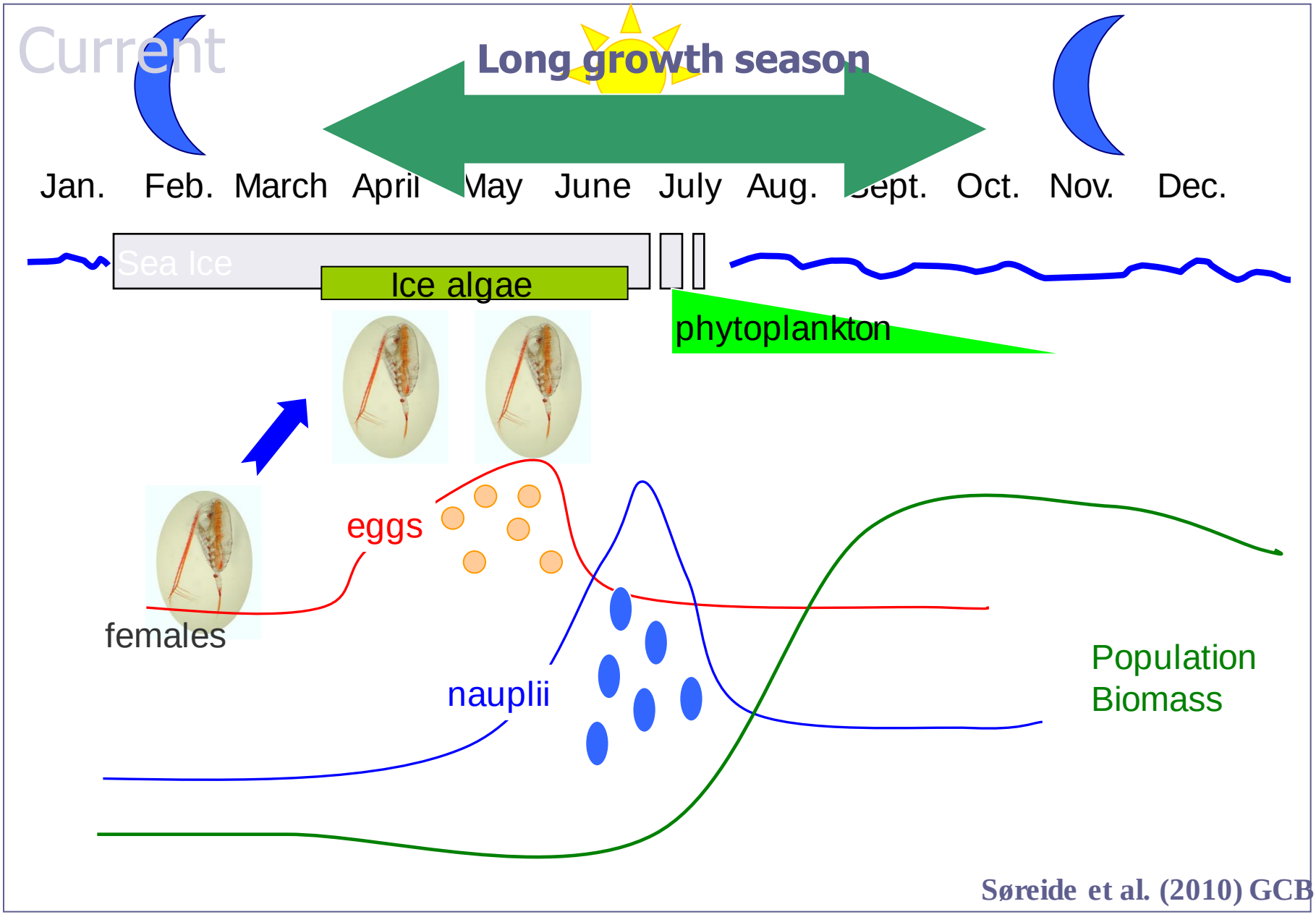
- *C. finmarchicus* (0.3 – 8.7 g DW m^{-2})
- *C. glacialis* (0.1 – 30.6 g DW m^{-2})
- *C. hyperboreus* (0.1 – 2.6 g DW m^{-2})





Timing of ice algal vs. pelagic bloom in Rijpfjorden 2006/07





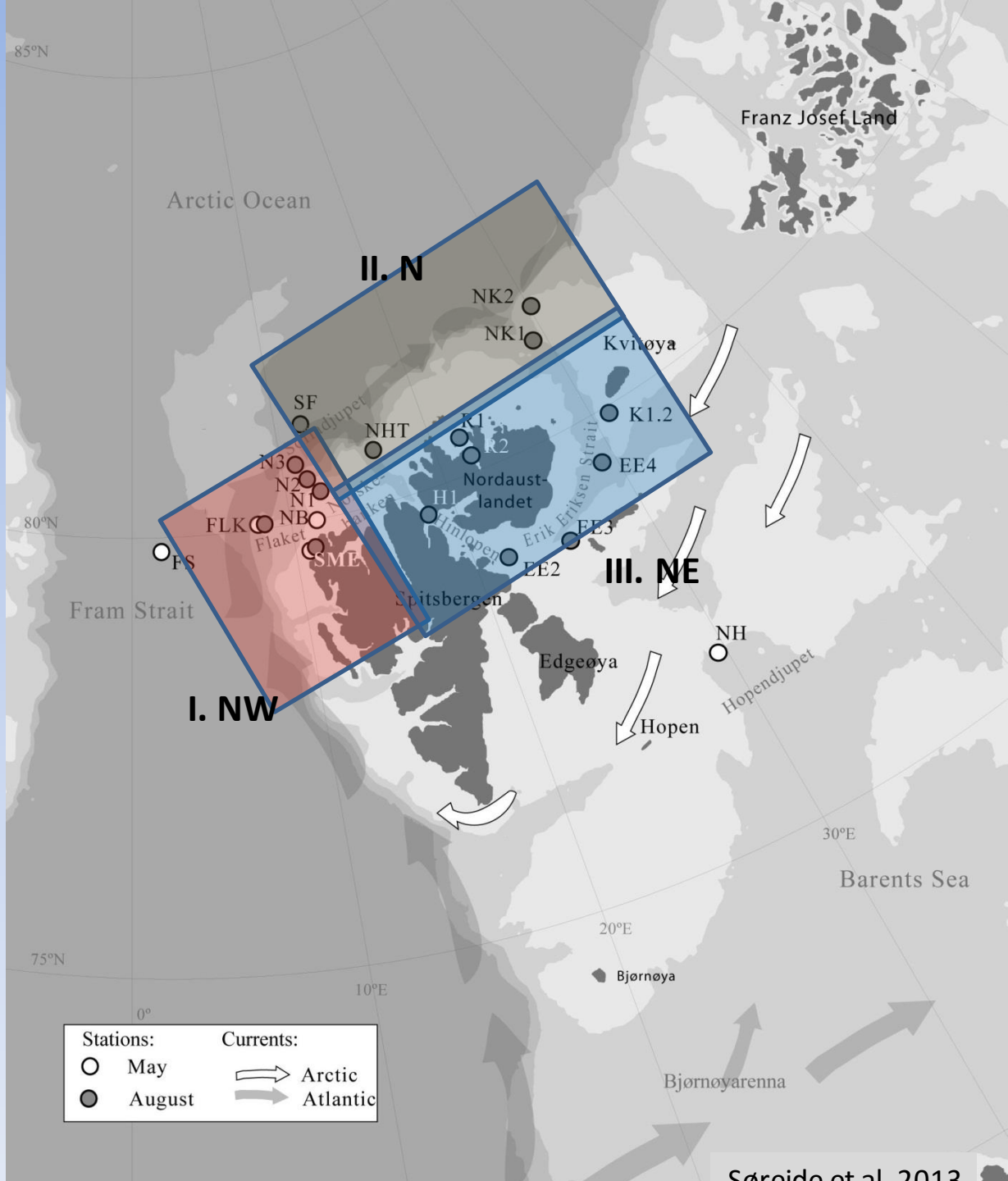
Søreide et al. (2010) GCB

Study area
(2003-04)

I. **NW Svalbard dominated by Atlantic water (AtW) and limited seasonal sea ice (3-5 months).**

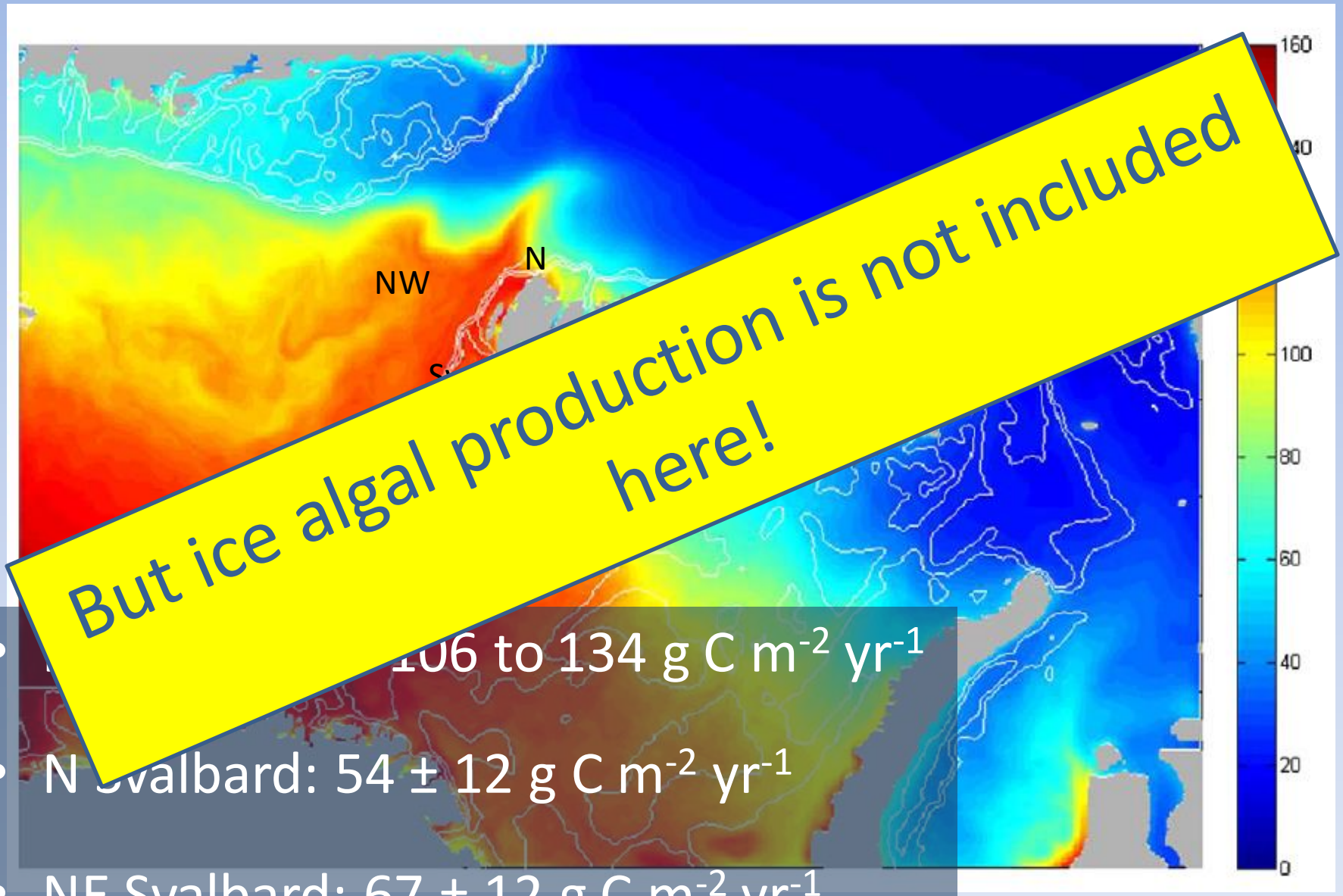
II. **N Svalbard dominated by AtW and perennial sea ice (10-12 months).**

III. **NE Svalbard dominated by Arctic water (ArW) and extensive seasonal sea ice (7-9 months).**



Søreide et al. 2013

Annual primary production (PP)



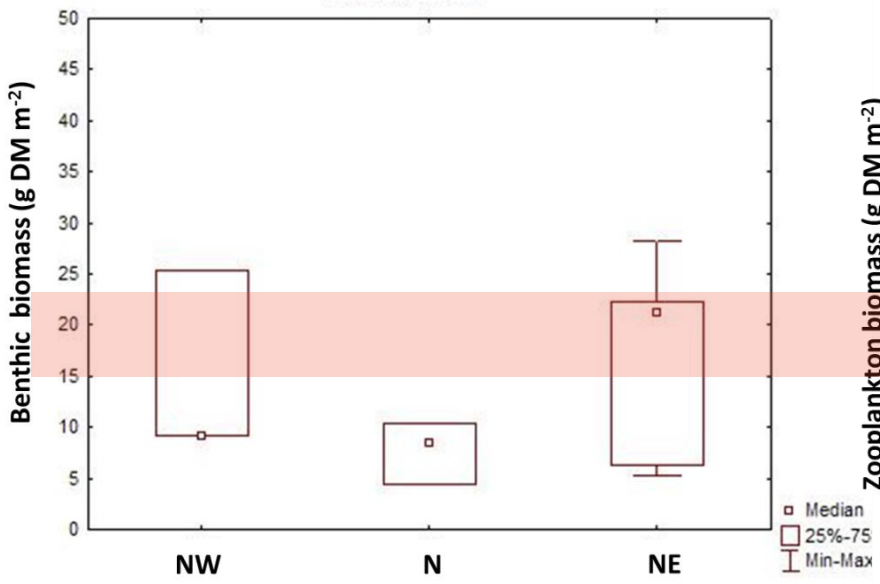
But ice algal production is not included here!

- 106 to 134 g C m^{-2} yr^{-1}
- N Svalbard: 54 ± 12 g C m^{-2} yr^{-1}
- NE Svalbard: 67 ± 12 g C m^{-2} yr^{-1}

Source: Reigstad et al. 2011

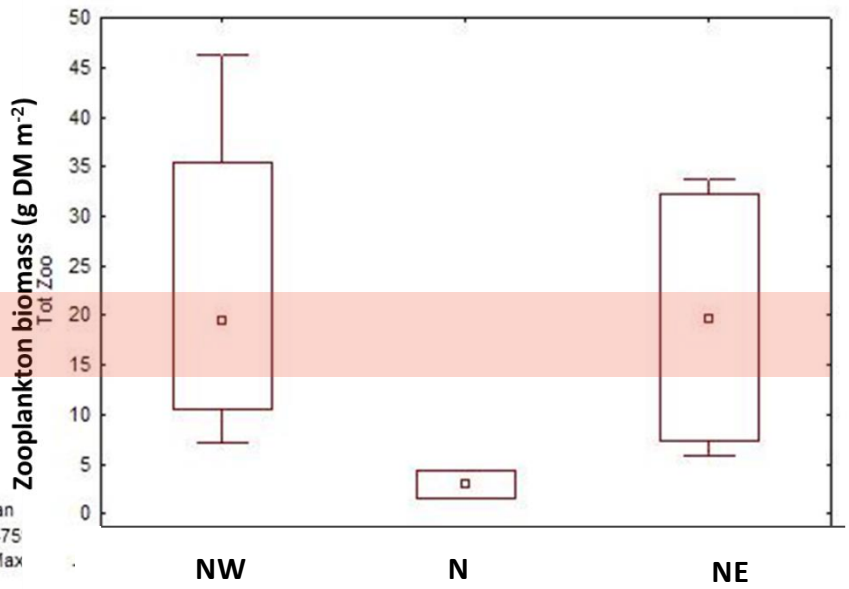
Biomass (g DM m^{-2})

Benthic infauna (> 0.5 mm)



Svalbard

Zooplankton (> 0.02 mm)

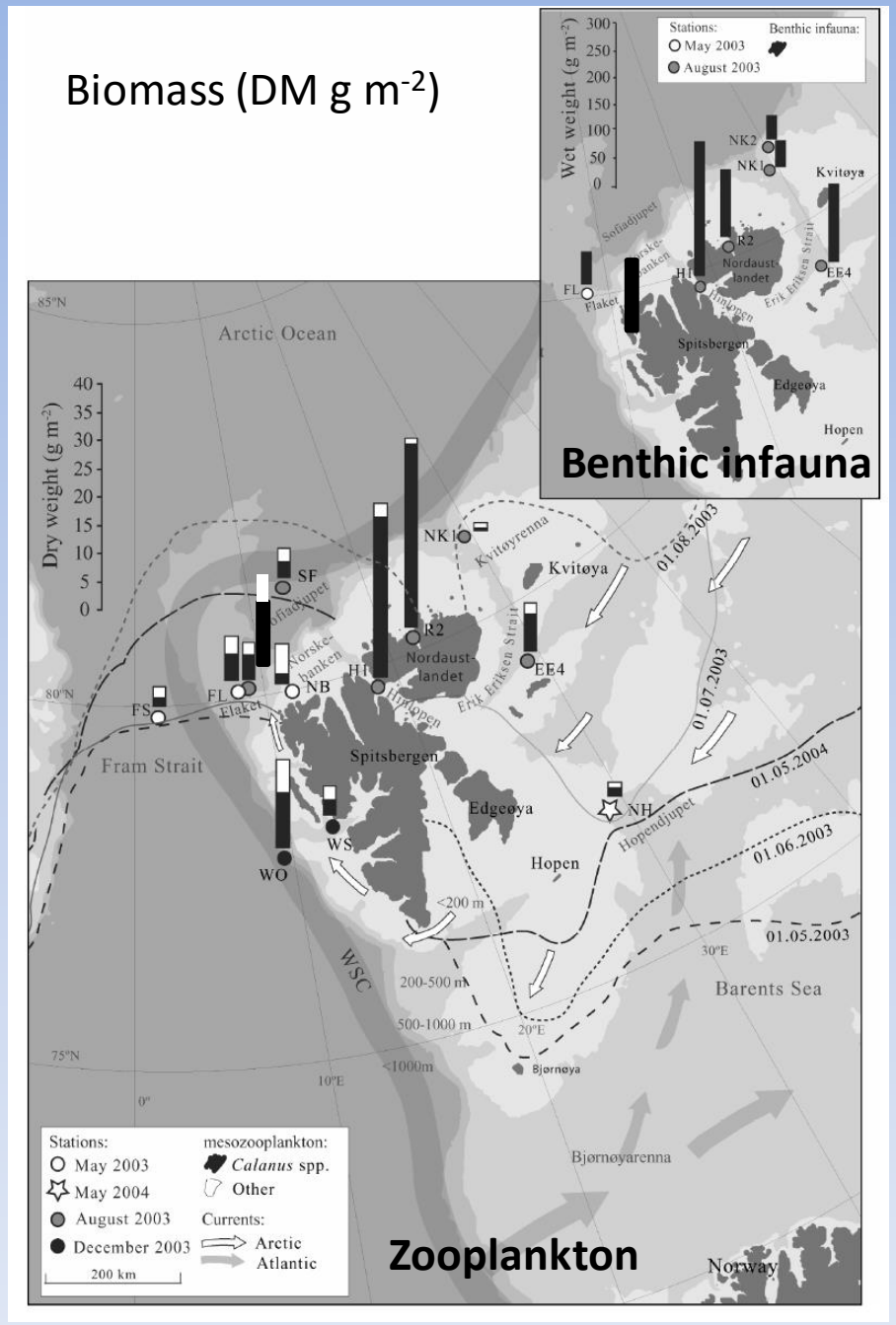


Svalbard

Pelagic and Benthic biomass pos. correlated
($y = 0.54x + 7.29$; $r^2=0.65$, $p<0.05$)

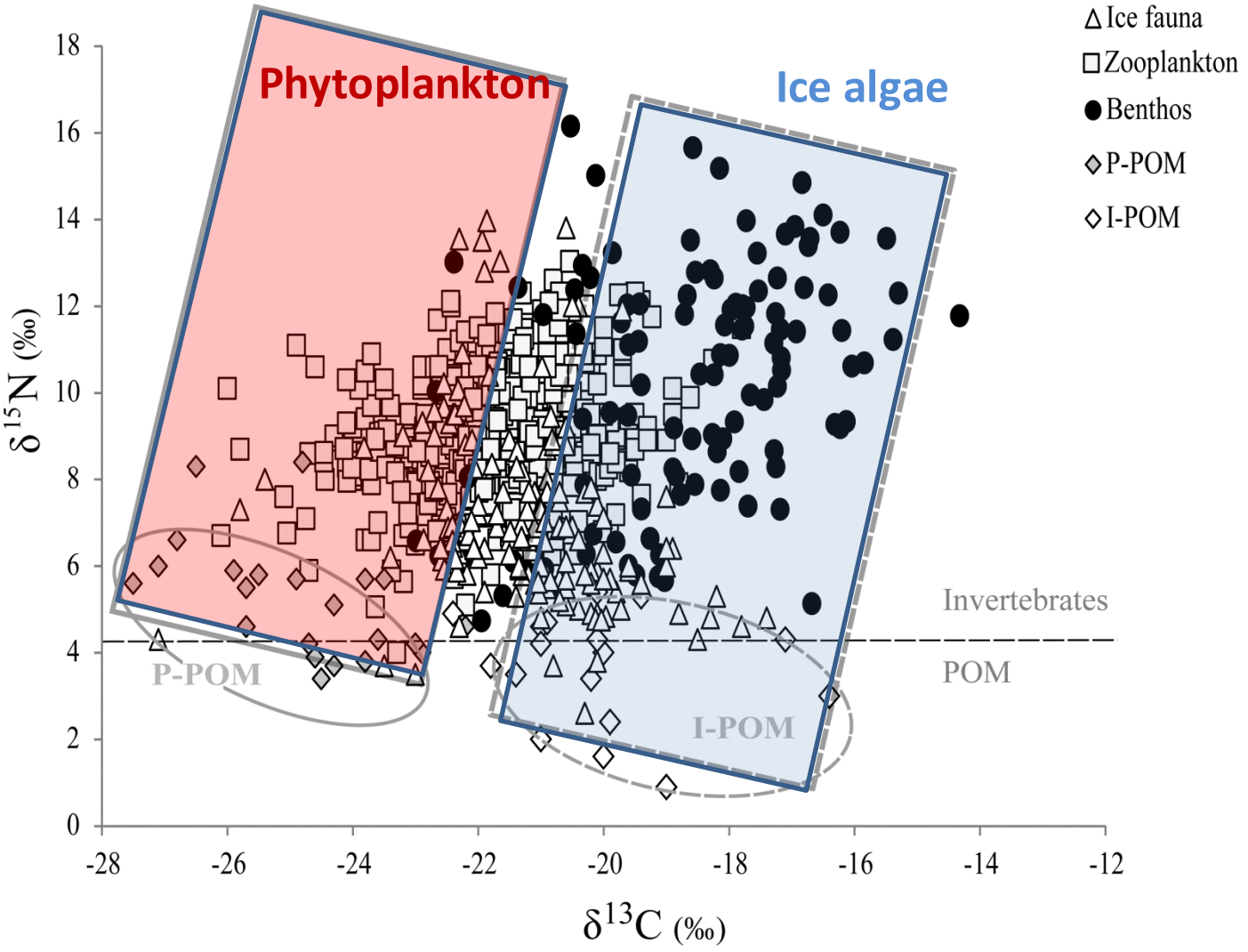
Søreide et al. 2013

- Coinciding **pelagic** and **benthic** biomass «hot spots» only found in Arctic waters, NE Svalbard.



Søreide et al. 2013

Available litteratur data from Svalbard and N Barents Sea



P-and I-POM: Pelagic and Ice particulate organic matter

Søreide et al. 2013

Summary - Biomass

- Pelagic and benthic biomass positively correlated (r^2=0.66, $p<0.05$) and similarly high in Atlantic vs. Arctic climate regimes
- N Svalbard had particularly low zooplankton and benthic biomass, reflecting the overall low primary production there
- Biological «hot spots» in NE Svalbard (Rijpfjorden and Hinlopen) most likely due to input of ice-derived organic matter and highly specialized Arctic zooplankton (*C. glacialis*).

Summary – Carbon sources

- Ice algae and phytoplankton are both important carbon sources for ice fauna
- Phytoplankton is the most important carbon source for zooplankton, but ice algae are important seasonally (spring).
- Ice algae (and/or refractory material) are the most important carbon source for benthic invertebrates

High winter mortality for temperate/boreal zooplankton Zooplankton community reset back to a more Arctic one over the winter

Journal of
Plankton Research

plankt.oxfordjournals.org

J. Plankton Res. (2013) 00(0): 1–12. doi:10.1093/plankt/fbt031

Ice-related seasonality in zooplankton community composition in a high Arctic fjord

AGATA WEYDMANN[1]*, JANNE E. SØREIDE[2], SŁAWEK KWAŚNIEWSKI[1], EVA LEU[3], STIG FALK-PETERSEN[3,4] AND JØRGEN BERGE[2,4]

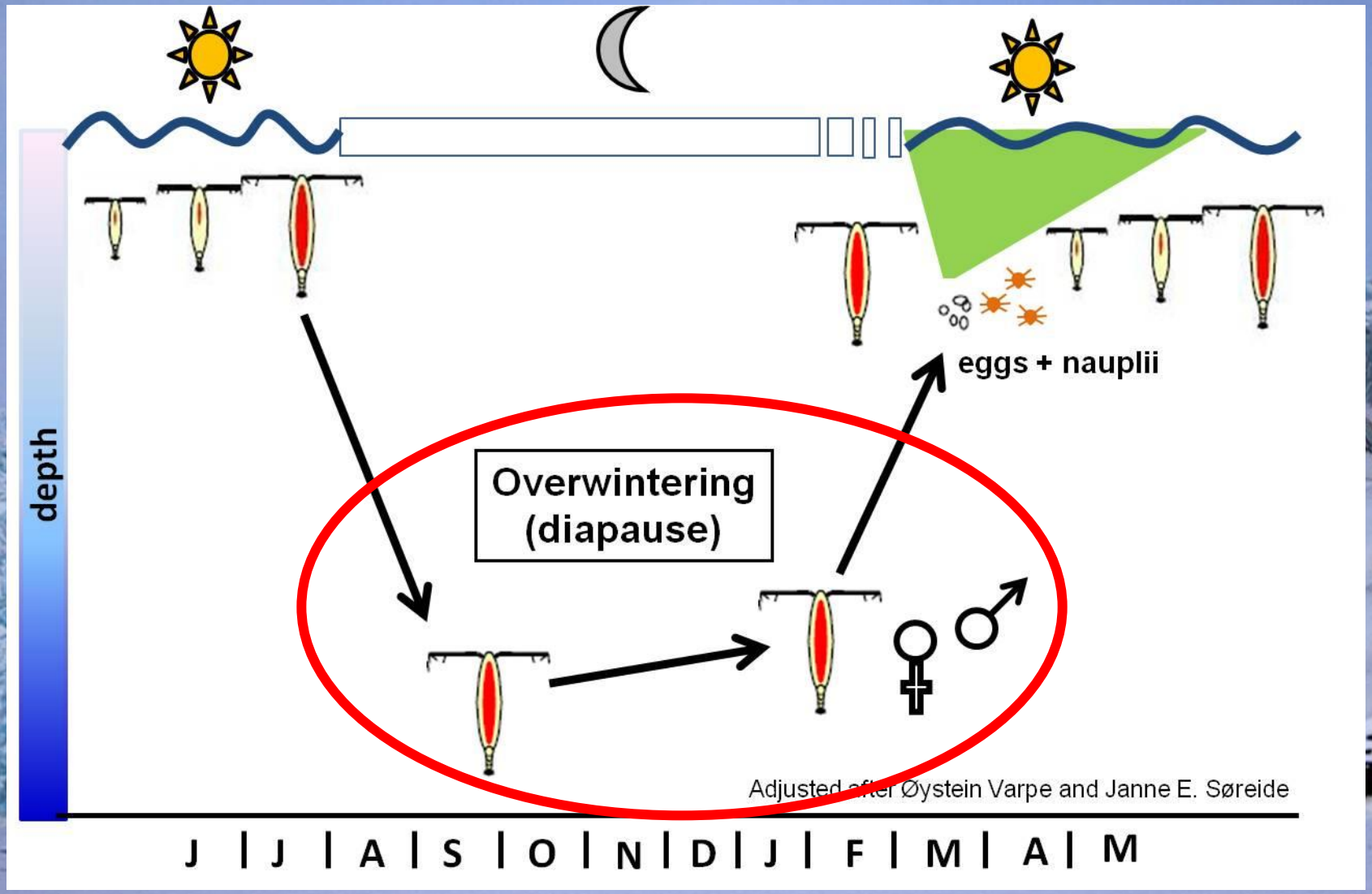
[1]INSTITUTE OF OCEANOLOGY, POLISH ACADEMY OF SCIENCES, POWSTAŃCÓW WARSZAWY ST. 55, 81-712 SOPOT, POLAND, [2]THE UNIVERSITY CENTRE IN

To predict impacts of climate change we need more data on how organisms «cope» with seasonality

establish a seasonal baseline

what is extreme and what is normal?

Life cycle of *Calanus glacialis*



Overwintering strategy

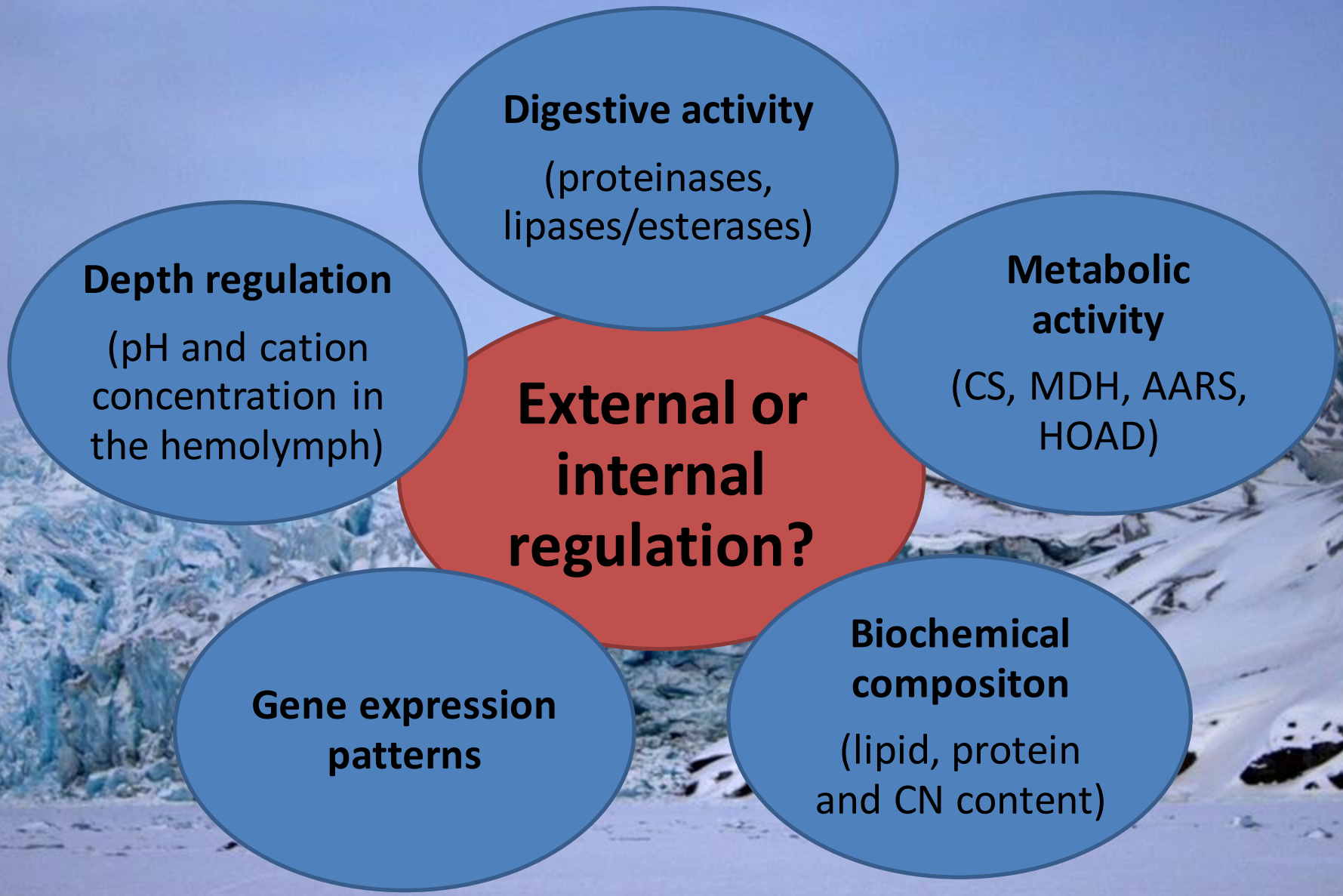
What we know…

- arrested development
- reduced metabolism
- reliance on internal energy reserves
- lipid reserve fuel reproduction the next spring

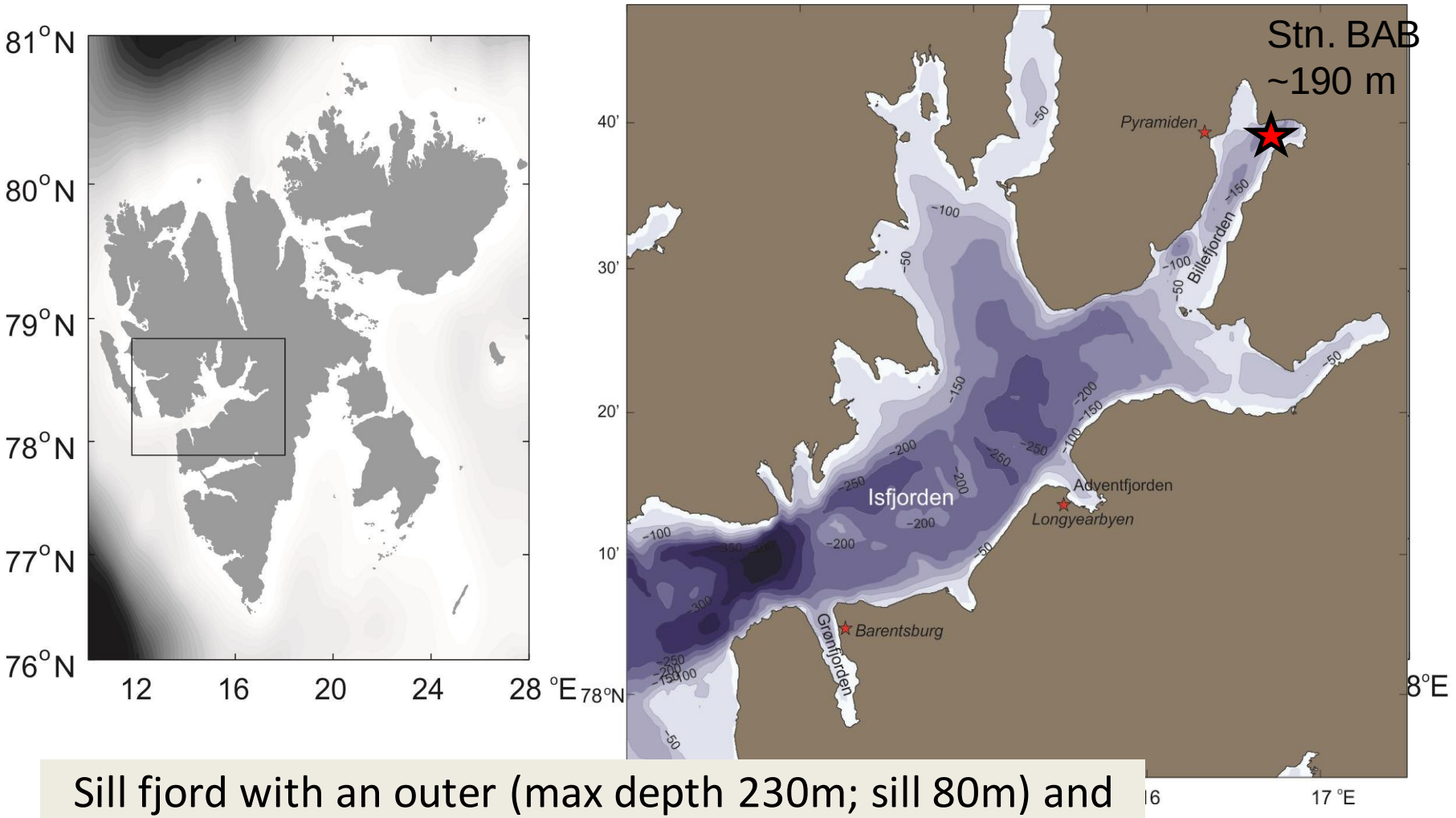
Open questions

- What happens physiological during overwintering?
- How do changes in external factors (e.g. temperature, food, light) impact the overwintering success?
- What triggers the onset and offset of the overwintering state?

Approach on different physiological levels



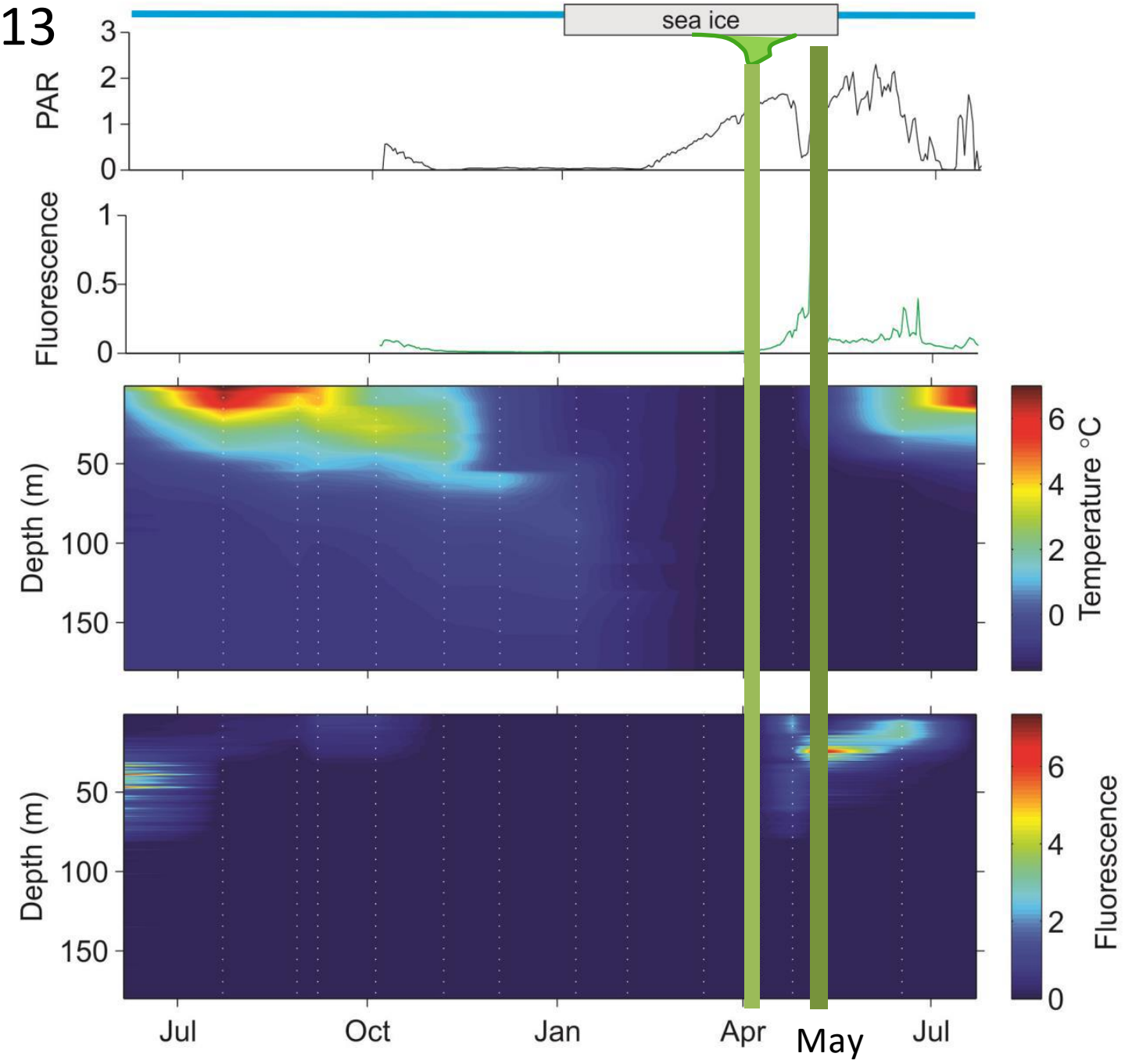
Case study – Billefjorden 78°N



Sill fjord with an outer (max depth 230m; sill 80m) and inner basin (max depth 190 m; sill 45m).

UNIS

2012-13

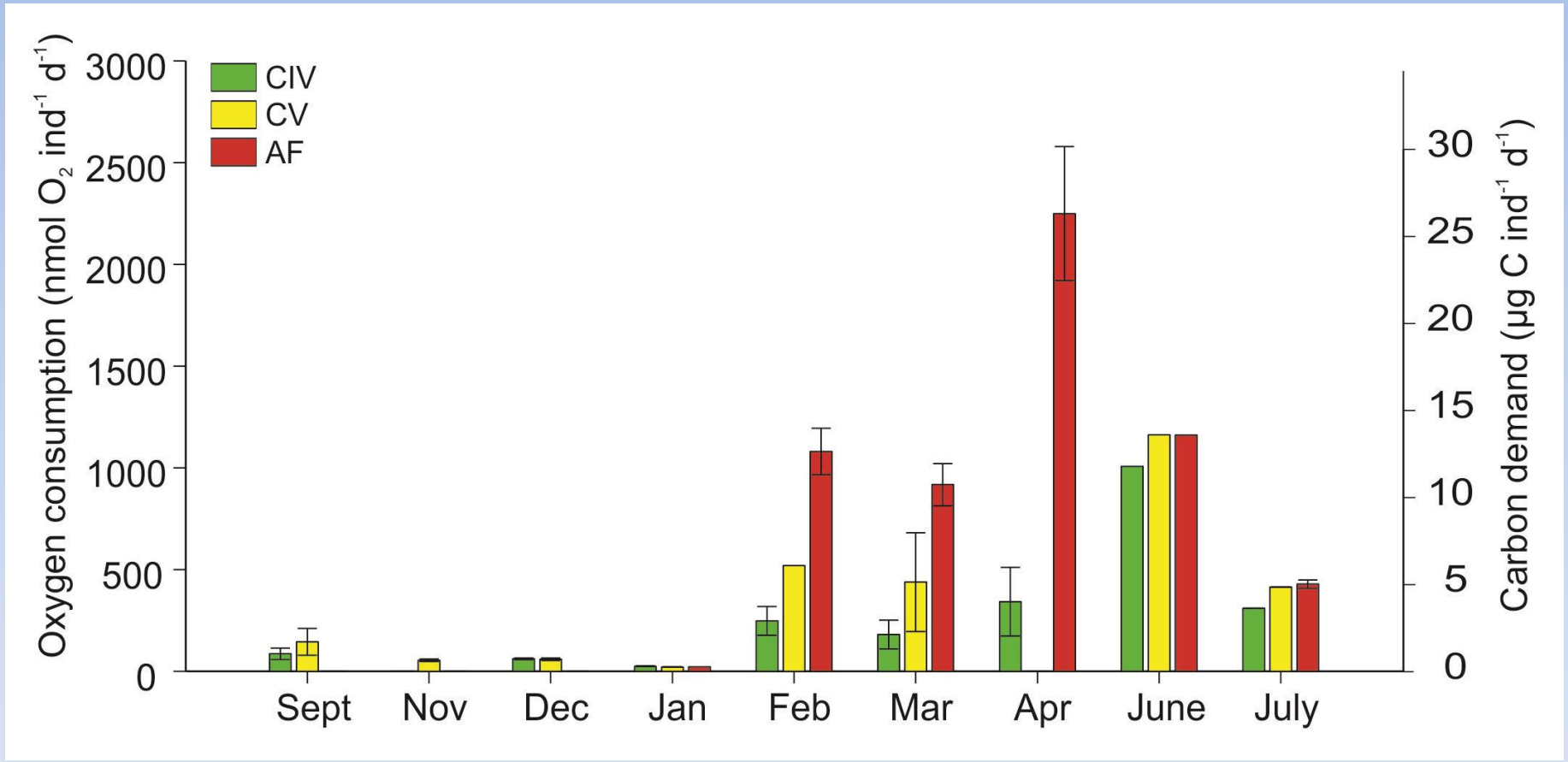

sea ice
PAR
3
2
1
0
Fluorescence
1
0.5
0
Depth (m)
50
100
150
Temperature °C
6
4
2
0
Depth (m)
50
100
150
Fluorescence
6
4
2
0
Jul
Oct
Jan
Apr
May
Jul

UNIS

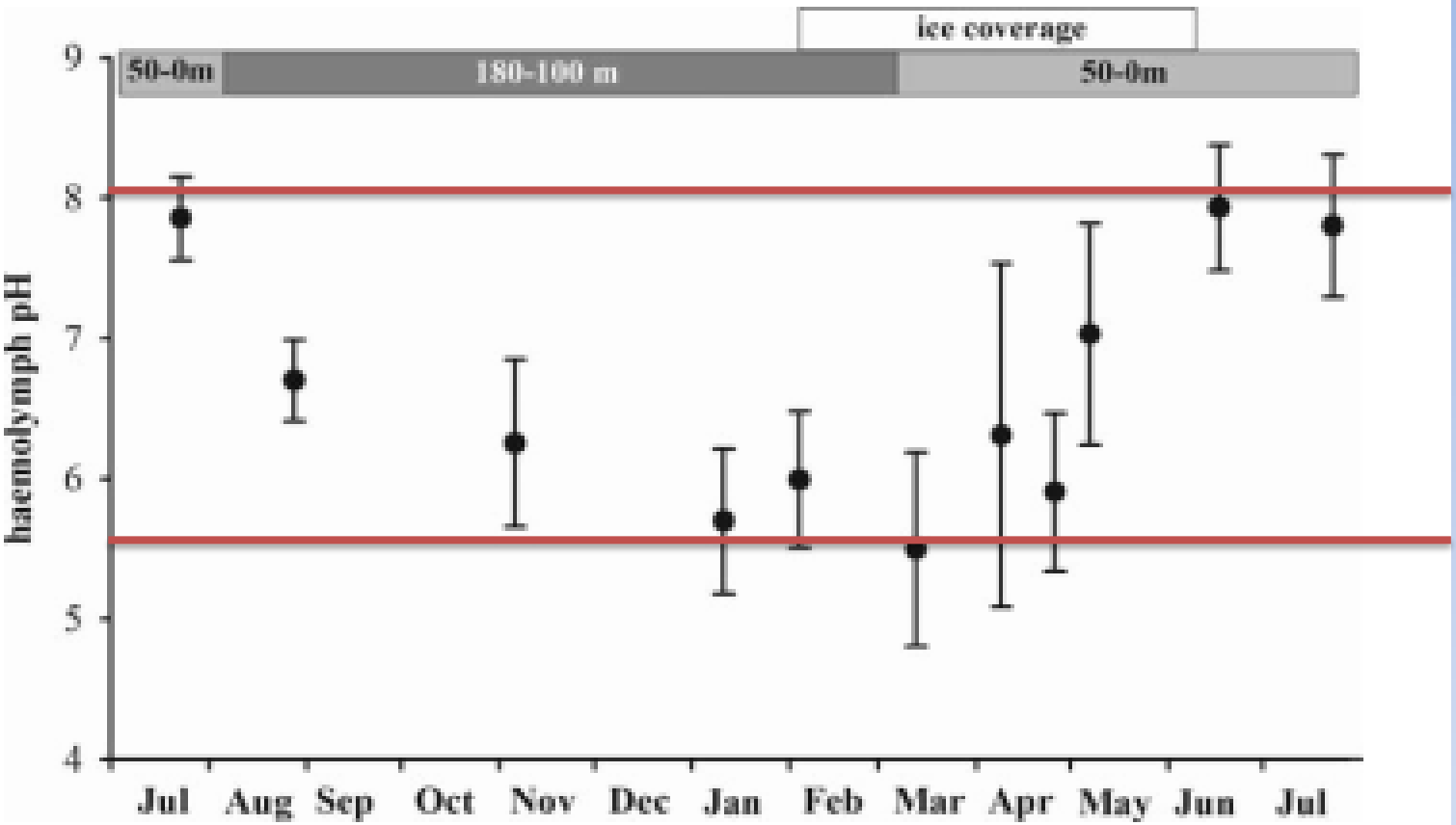
Monthly sampling in Billefjorden – an unique dataset from a seasonal ice covered location in 2008-2009 and 2012-2013


YAMAHA

Seasonal metabolism in C. glacialis



pH endringer i kroppsvæsken til *Calanus glacialis*



LIMNOLOGY and OCEANOGRAPHY

ASLO

Limnol. Oceanogr. 60, 2015, 2121–2129

doi: 10.1002/lno.10158

Seasonal patterns in extracellular ion concentrations and pH of the Arctic copepod *Calanus glacialis*

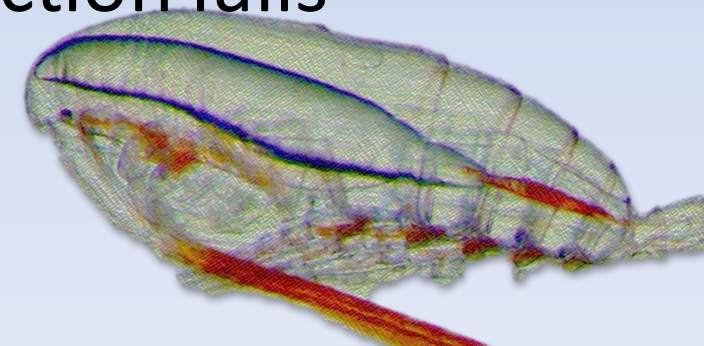
Daniela Freese,*[1,2] Barbara Niehoff,[1] Janne E. Søreide,[2] Franz Josef Sartoris[1]
[1]Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Am Handelshafen 12, 27570 Bremerhaven,

The fate of *C. glacialis*

- 1-
- M
- Lig
  dormancy
- It
  en
- Cl
  wl
  population garanty if reproduction fails

C. glacialis is robust and will survive. It is well adapted to dynamic sea ice and food conditions

***BUT** high winter temperatures is worrying for their overall energy budget*
More winter studies needed to identify potential «population bottlenecks»!



Nå og fremover……

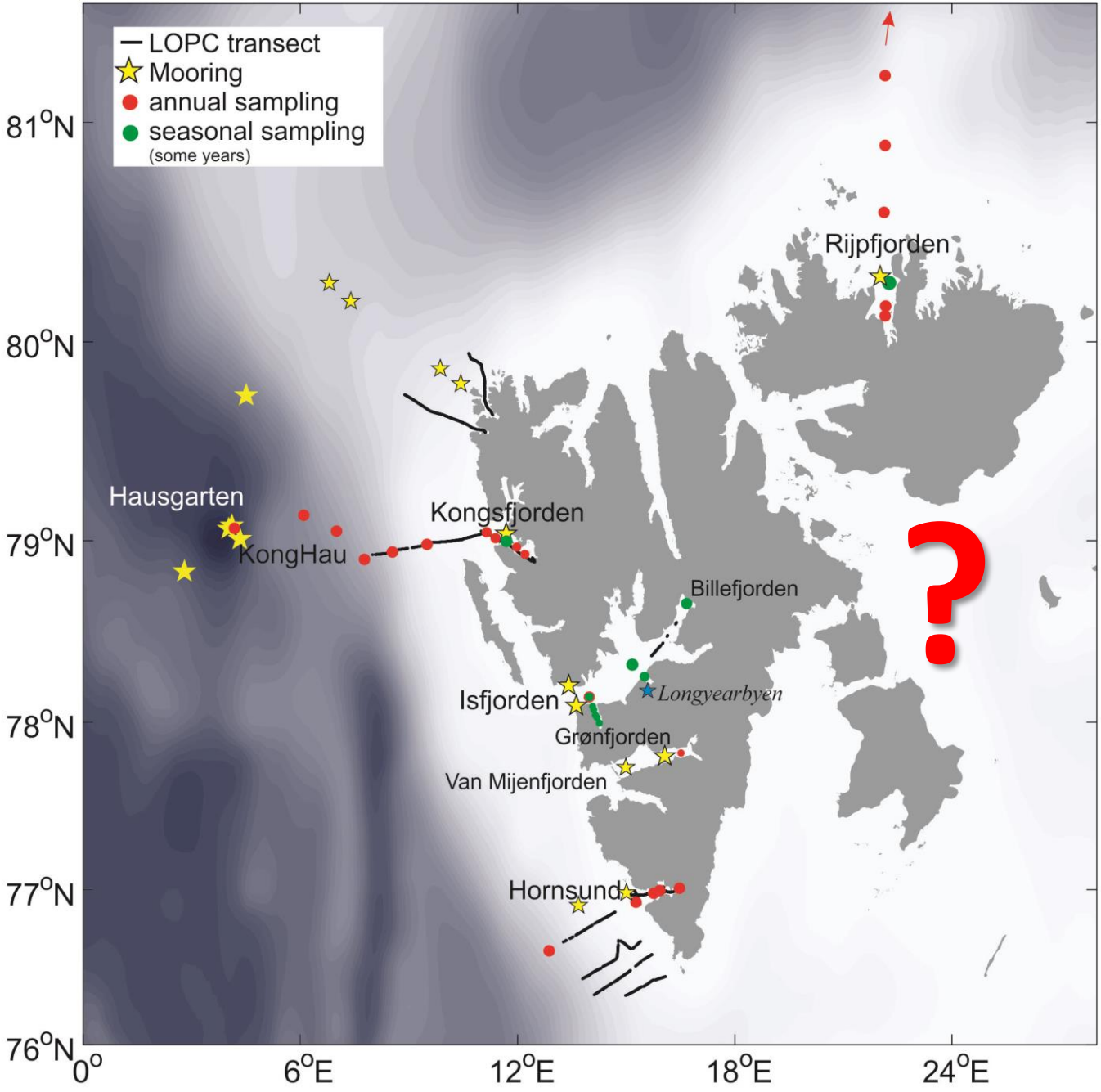
- Fortsette vår biologiske tidsserie i Rijpfjorden
- Fortsette den høyoppløselige biologiske «overvåkningen» på hydrografi og plankton i Isfjorden (inkludert Billefjorden)
- Fortsette våre sjøis-biota studier (biodiversitet

fokus på alt smått: isalger- og protister og meiofauna)

Plankton Research in Svalbard (PRIS)

All together 40 plankton scientists and data managers from Poland, Germany, Russia, Sweden and Norway met last week during 2 intensive workshop days at UNIS, Svalbard December 2015.

SVALBARD SCIENCE FORUM


LOPC transect
Mooring
annual sampling
seasonal sampling
(some years)
81°N
80°N
79°N
78°N
77°N
76°N
0°
6°E
12°E
18°E
24°E
Rijpfjorden
Hausgarten
KongHau
Kongsfjorden
Billefjorden
Isfjorden
Longyearbyen
Grønfjorden
Van Mijenfjorden
Hornsund
?

General recommendations

- Long-term funding for the time series of hydrography and zooplankton monitoring in Kongsfjorden and Rijpfjorden should be secured (reference sites for Atlantic and Arctic climate regimes).

- There is a need for better coordination of the zooplankton monitoring in Svalbard

- Monitoring the occurrence of new and boreal plankton species in the waters around Svalbard should be developed.

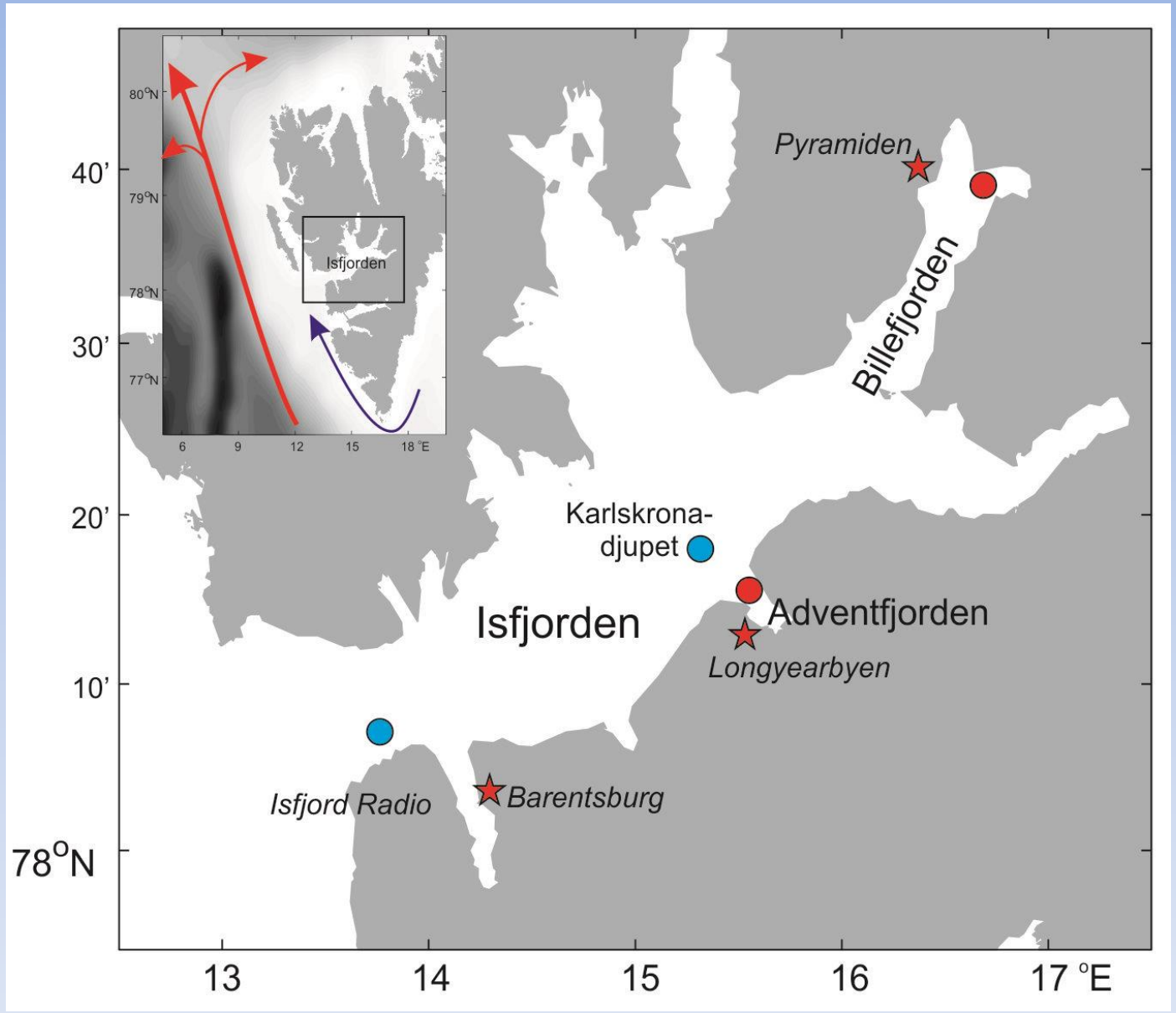
Isfjorden Marine Observatory Svalbard (IMOS)

UNIS and Murmansk Marine Biological Institute (MMBI)

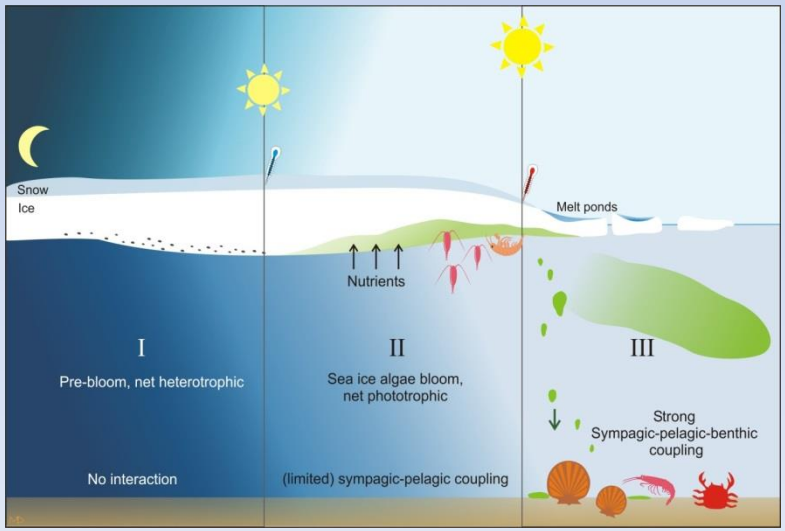
IMOS

2015-2018

Norwegian Research Council, Polarprog, NOR-RUSS, 2015-2018


80°N
79°N
78°N
77°N
6
9
12
15
18 °E
Isfjorden
40'
30'
20'
10'
78°N
13
14
15
16
17 °E
Pyramiden
Billefjorden
Karlskrona-
djupet
Isfjorden
Adventfjorden
Longyearbyen
Isfjord Radio
Barentsburg

FAABulous: **F**uture **A**rctic **A**lgae **B**looms – and their role in the context of climate change

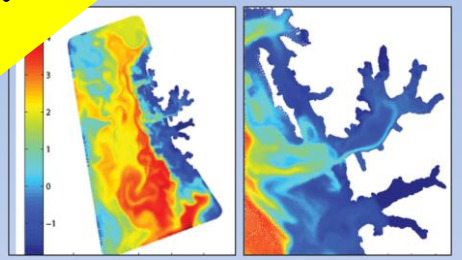


PI Eva Leu

Tove Gabrielsen, Janne E. Søreide, Jørgen Berge, Marit Reigstad, Ole Anders Nøst, Andre Staalstrøm, Vigdis Tverberg, Björn Rost, Clara Hoppe, Marcel Nicolaus, Martin Graeve, Jozef Wiktor, Dirk Notz, Finlo Cottier, Thomas Brown, Michael Greenacre

Forskningsrådet

- Funded by the Norwegian Research Council (NFR), 2015-2020
- Total budget: 16 (23) million NOK
- Norwegian partners: Akvaplan-niva, UNIS, UiT, NIV
- International partners:
  - Germany: AWI, MPI-Met
  - Poland: IOPAS
  - Great Britain: SAMS, UoPlym



Field work canceled in 2016!

Project aim: To study the joint … *light conditions*, *ocean acidification* and *increased* … *mperate species* on algal bloom development in sea ice … e Arctic.

WP 1: Process studi…

- Seasonal fiel… Mijenfjorden and Kongsfjorden (2016/17…
- Aut… tories in sea ice and water (2016-2018)

WP…

Apply … el FVCOM for Western Spitsbergen, with special focus on vMF and …

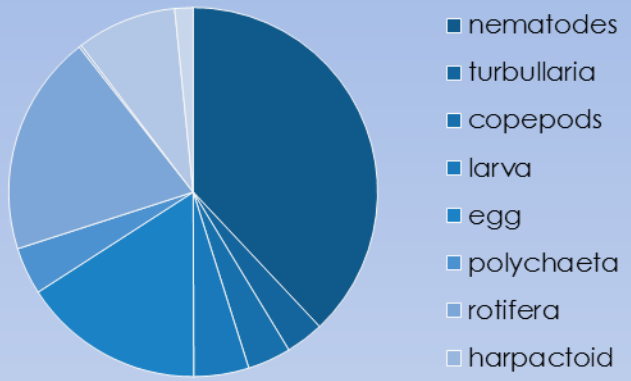
nsequences of

Van Mijenfjorden 9 mars 2016

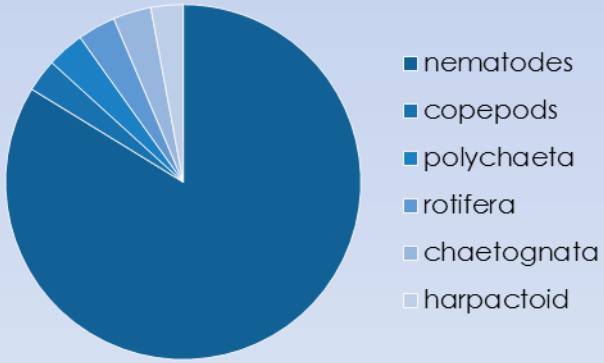
-covered waters

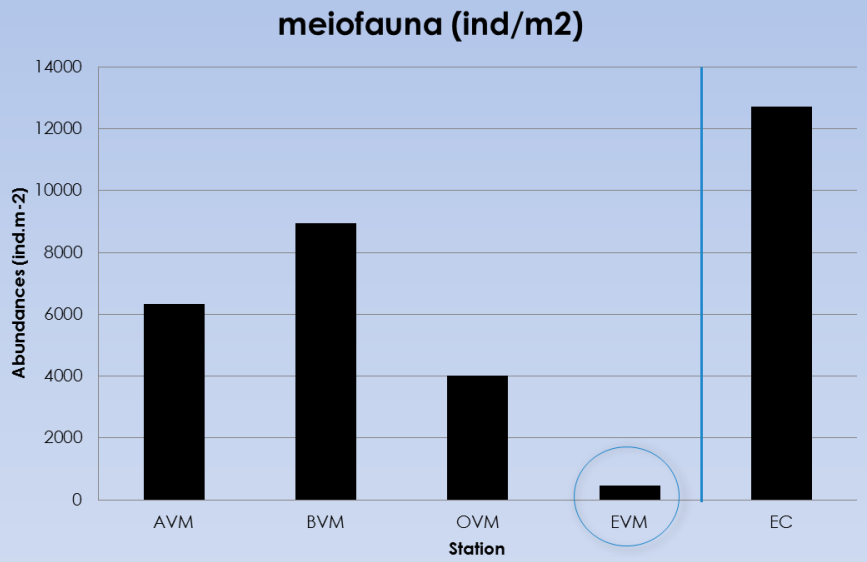
Sea ice meiofauna biodiversity

East Coast **EC**



Van Mijenfjorden **OVM**





Meiofauna

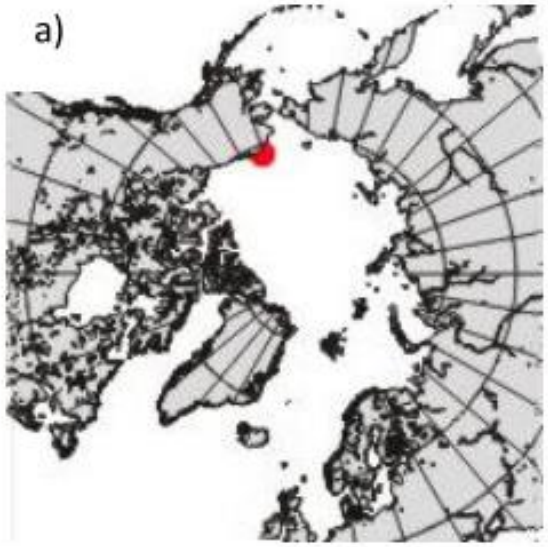


Figure 1. Current distribution map (a) of the cnidaria *Sympagohydra tuuli* (Piraino, Bluhm, Gradinger & Boero, 2008) (http://www.arcodiv.org/seaice/hydroids/Sympagohydra_tuuli.html) and (b) one of several specimens of a Cnidaria we found in Van Mijenfjorden in April 2015 (photo Miriam Marquardt/UNIS) .

A big «thank you» to the Scottish Association for Marine Science and Jørgen Berge, UiT for mooring data, and Captain and crews on KV Svalbard, RV Helmer Hanssen and RV Lance, and UNIS logistics for valuable help in field.

Cleopatra II

Climate effects on planktonic food quality and trophic transfer in the Arctic marginal ice zone

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