

Ice matters

*Arctic and Antarctic under-ice communities linking
sea ice with the pelagic food web*

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V. Siegel, S. Kruse, B. Hunt, E. A. Pakhomov, ...

Outline

1. Introduction

2. The sea ice – food web link

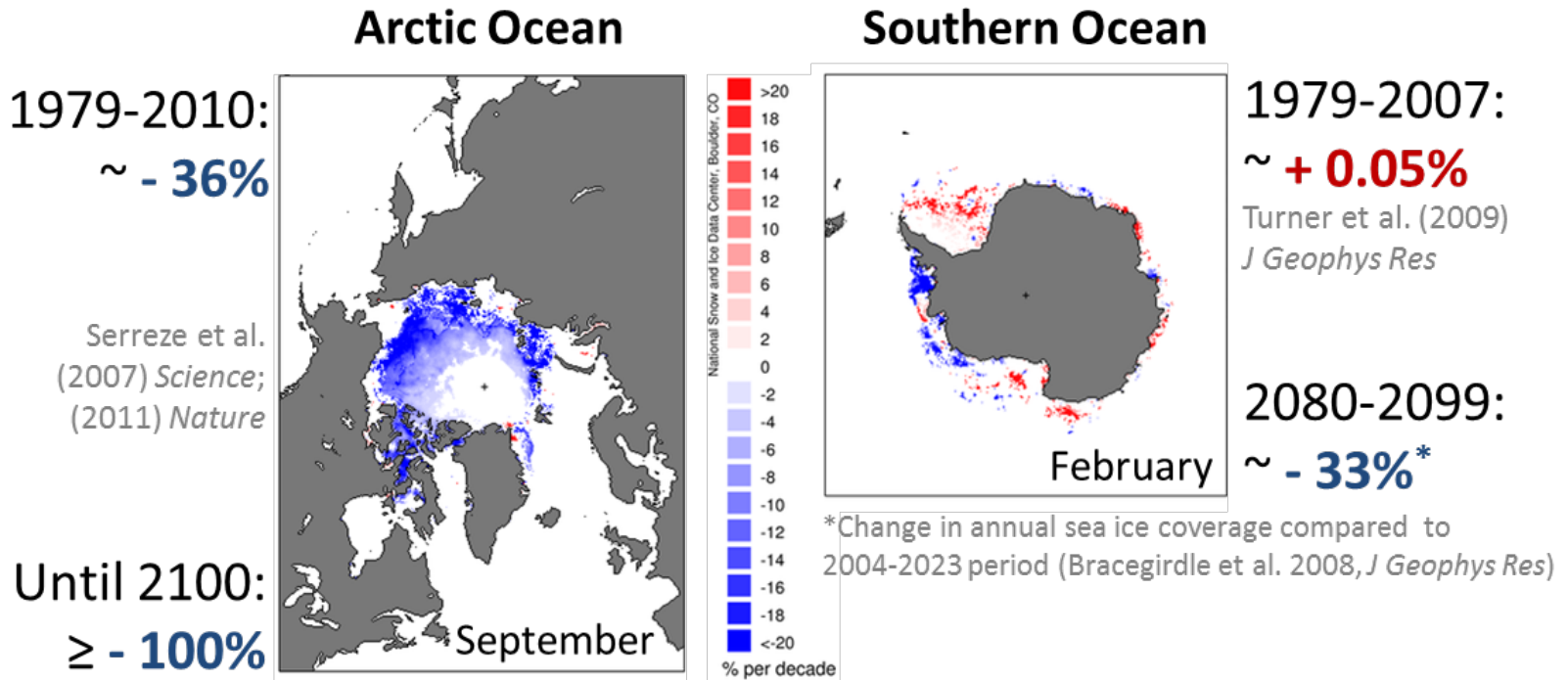
a) Lessons from the Antarctic ice underside

b) First insights from a field study in the Arctic

3. Conclusions



Climate change in Polar Regions



Summer sea ice concentration trends 1979-2011

National Snow and Ice data Center (2011) <http://nsidc.org>

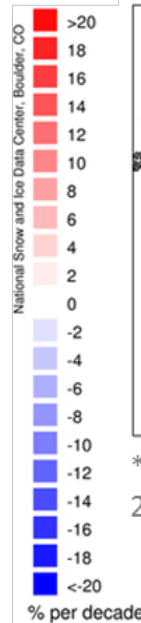
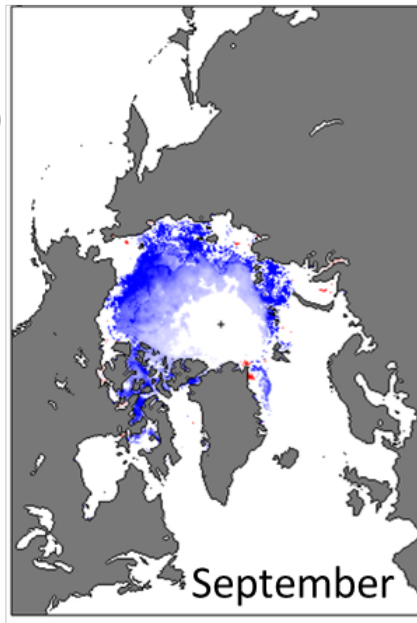
Climate change in Polar Regions

Arctic Ocean

1979-2010:
~ - 36%

Serreze et al.
(2007) *Science*;
(2011) *Nature*

Until 2100:
≥ - 100%



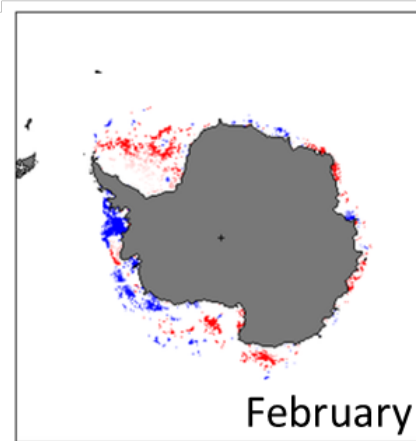
Southern Ocean

1979-2007:
~ + 0.05%

Turner et al. (2009)
J Geophys Res

2080-2099:
~ - 33%*

*Change in annual sea ice coverage compared to 2004-2023 period (Bracegirdle et al. 2008, *J Geophys Res*)



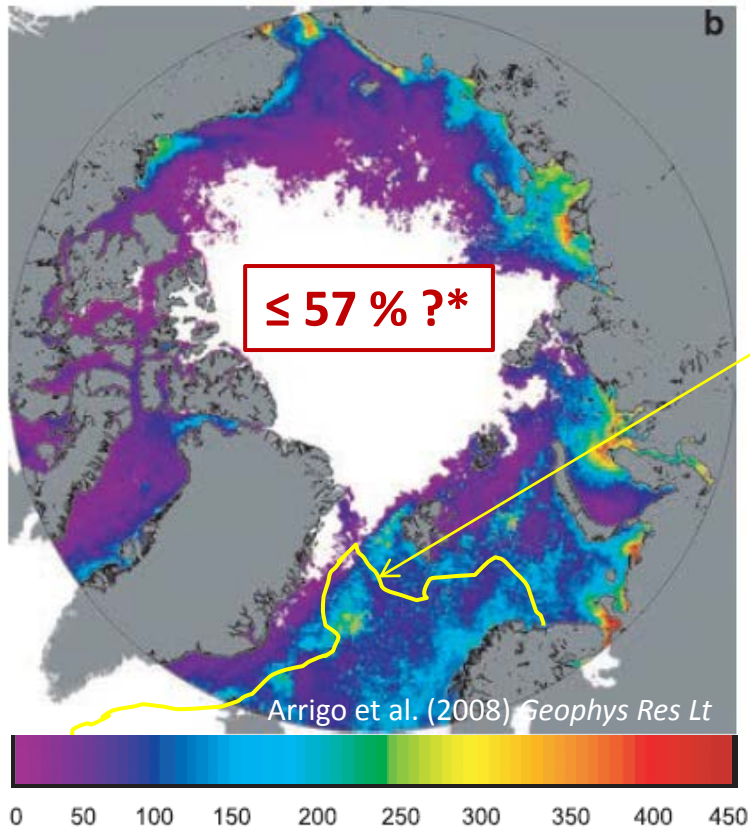
Summer sea ice concentration trends 1979-2011

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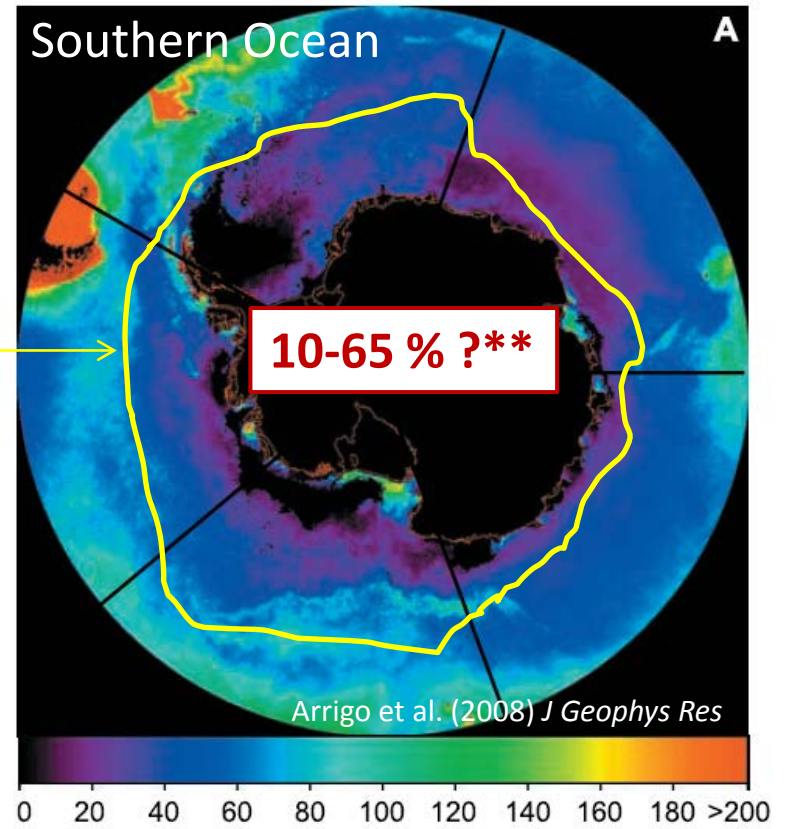


Ice algae

Annual water column primary production ($\text{g C m}^{-2} \text{y}^{-1}$)



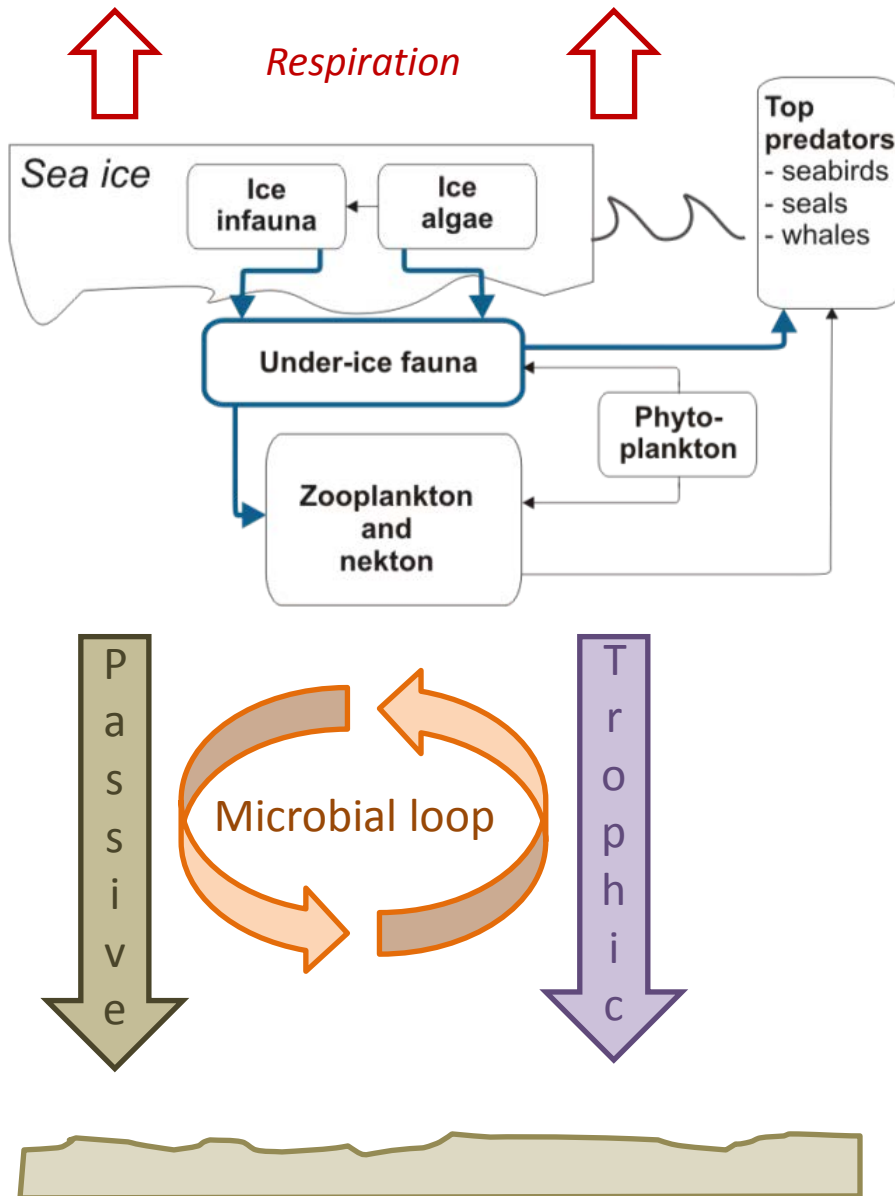
*Gosselin (1997)
Deep-Sea Res II



** Arrigo & Thomas
(2004) *Ant Sci*,
McMinn et al.
(2010) *Mar Biol*

Proportional contribution of ice algal primary production

Sea ice – food web transition



www.arcodiv.org

Calanus glacialis

J.A. van Franeker

Antarctic krill

Humpback whale

Euphausia superba



Sea ice-associated fauna

Antarctic

Boreogadus saida

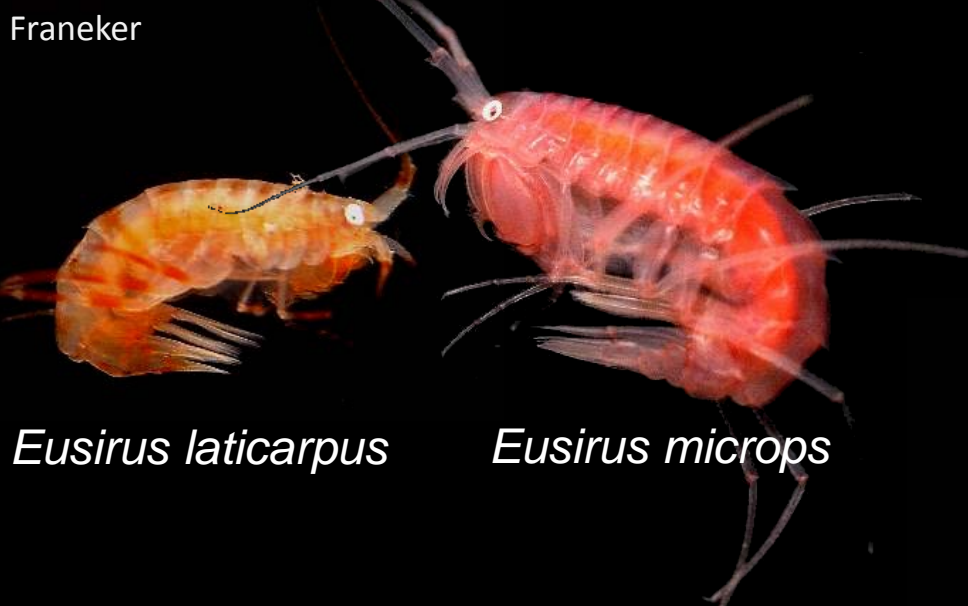


Gammarus wilkitzkii

Arctic



J.A. van Franeker



Eusirus laticarpus

Eusirus microps



Apherusa glacialis

Arcodiv.org

Bluhm&Gradinger UAF/CoML

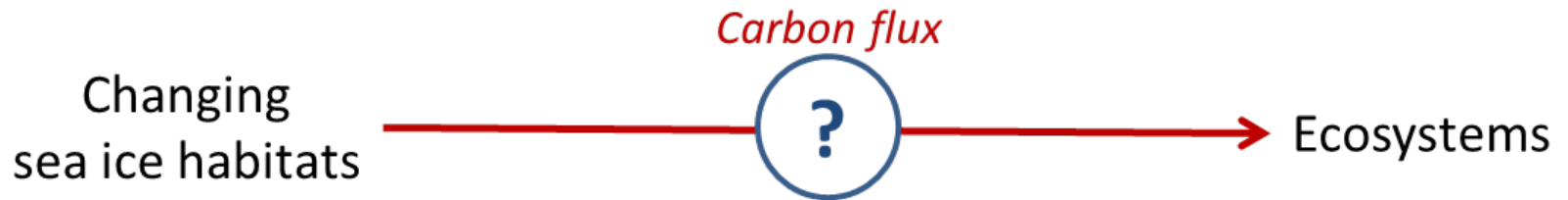


Onissimus glacialis

Arcodiv.org

Bluhm UAF/CoML

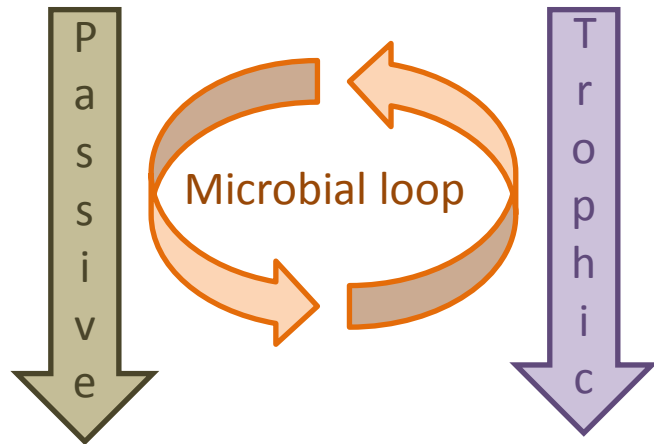
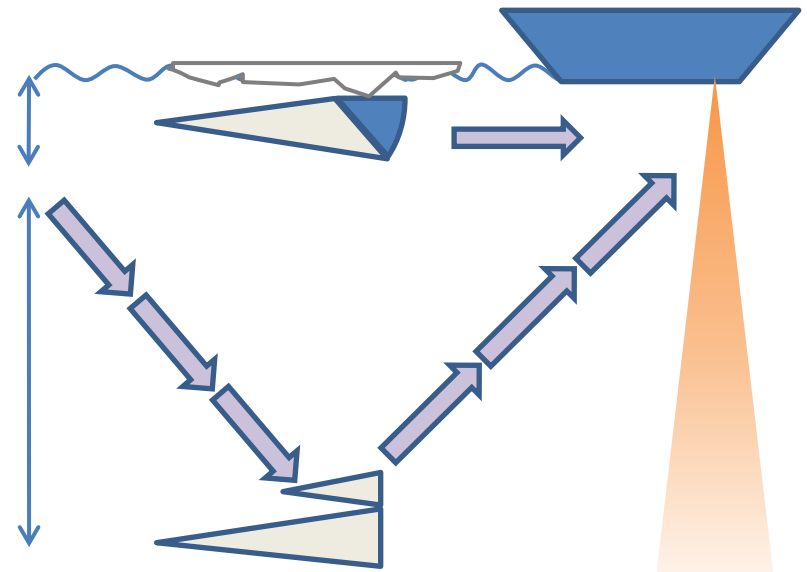
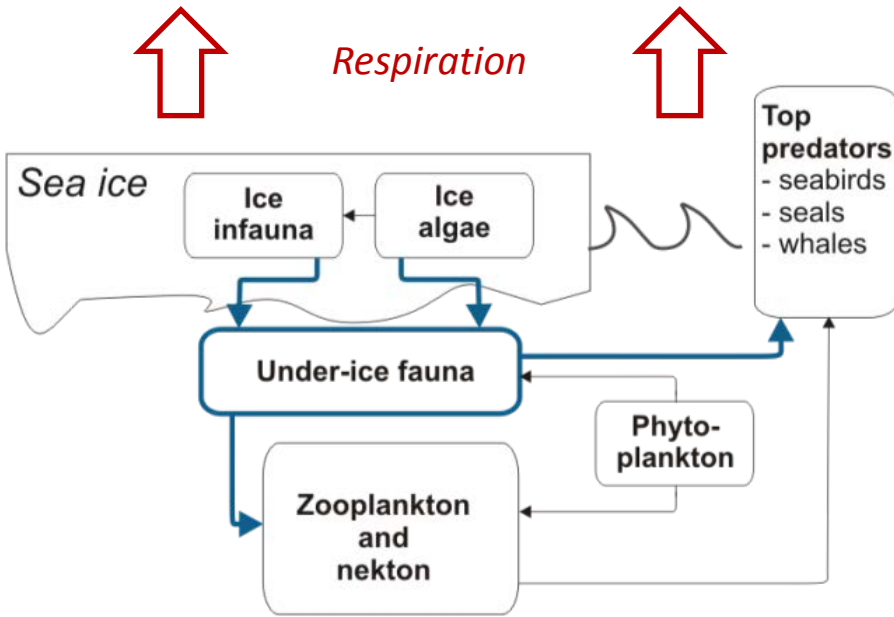
Iceflux approach



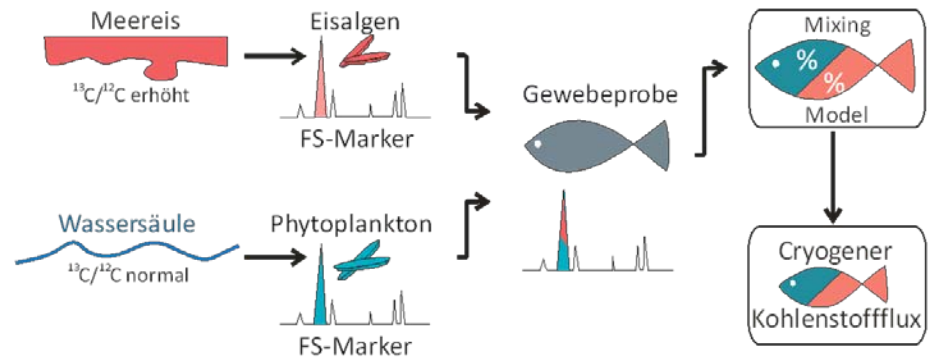
Objective:

Quantifying the flux of sea ice-derived carbon into the under-ice communities in Arctic and Antarctic ecosystems

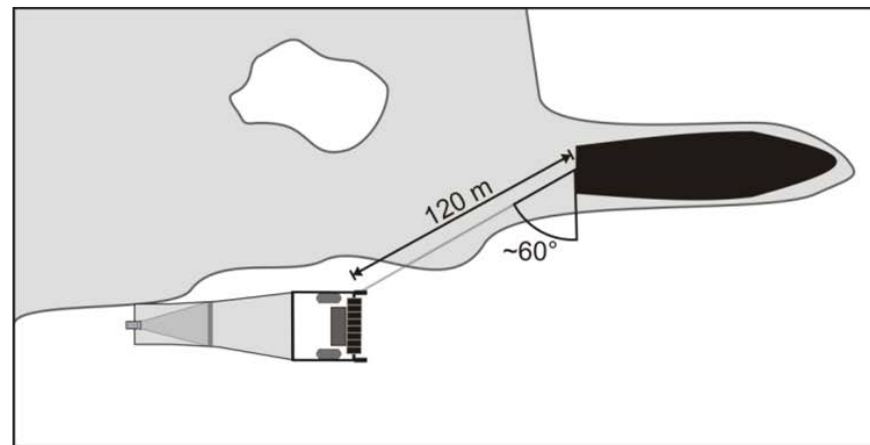
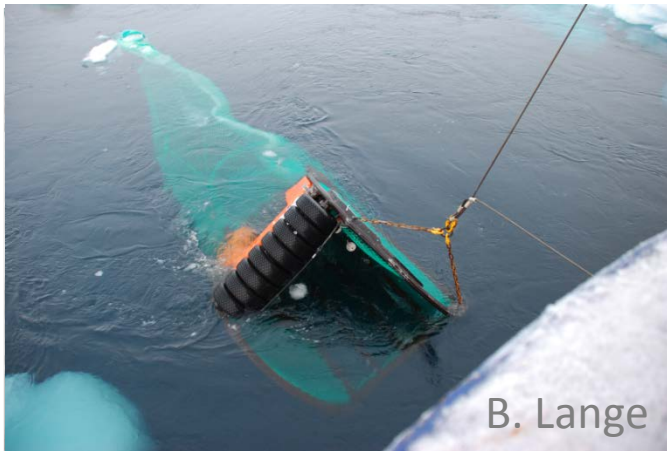
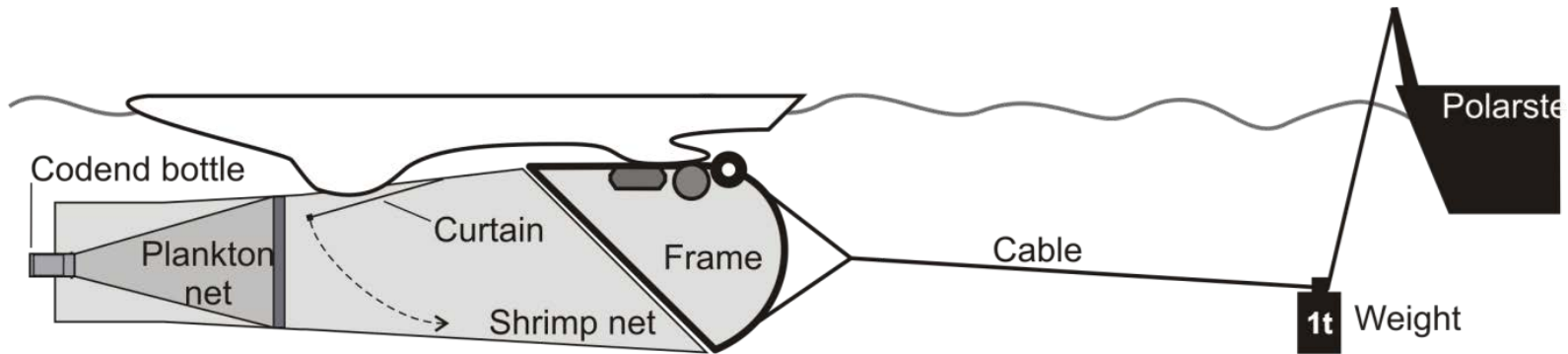
Iceflux approach



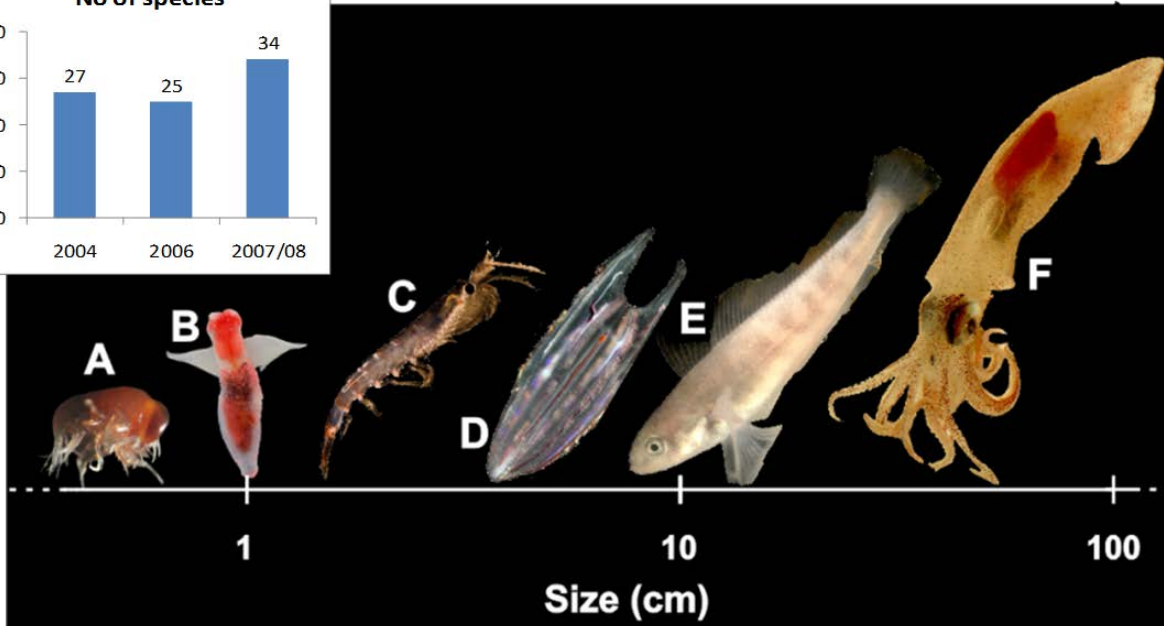
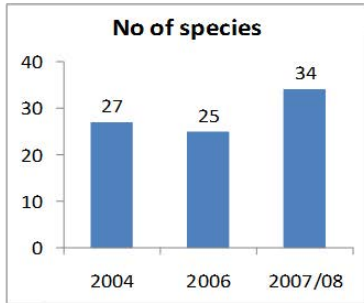
Biomarkers / tracers



The Surface and Under-Ice Trawl (SUIT)

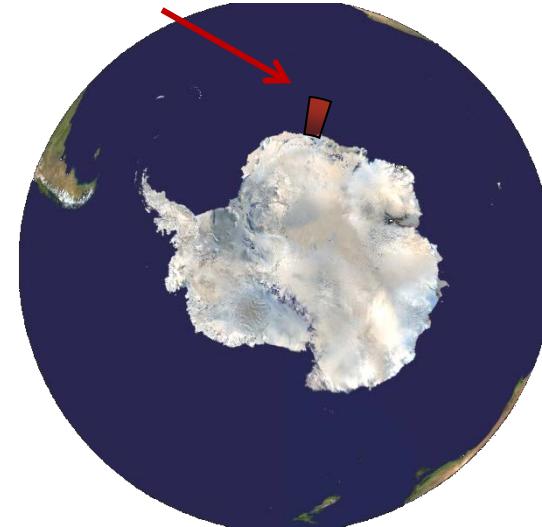


Macrozooplankton sampled under Antarctic sea ice



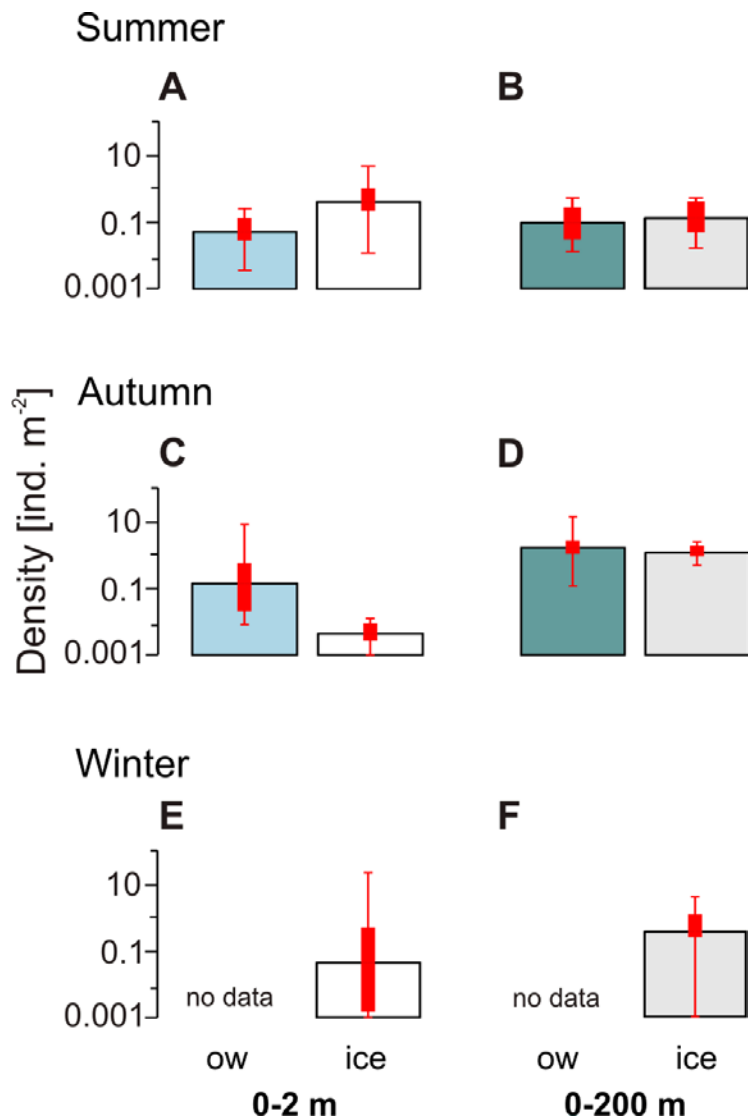
A: *Hyperiella dilatata*; B: *Clione antarctica*; C: Antarctic krill
D: *Callianira antarctica*; E: *Aethotaxis mitopteryx*;
F: *Slosarczykovia circumantarctica*

Lazarev Sea



RV Polarstern

Antarctic krill under sea ice



Summer:

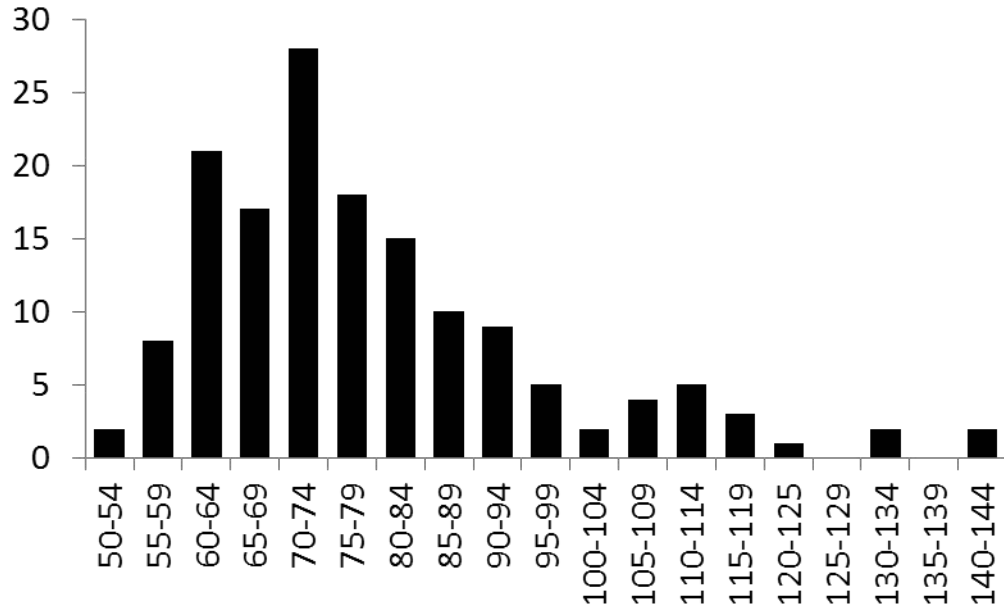
- Krill signific. **more abundant** under ice than in ow
- Under ice per-area abundances consistantly **higher** than 0-200 m abundances from pelagic nets

Winter

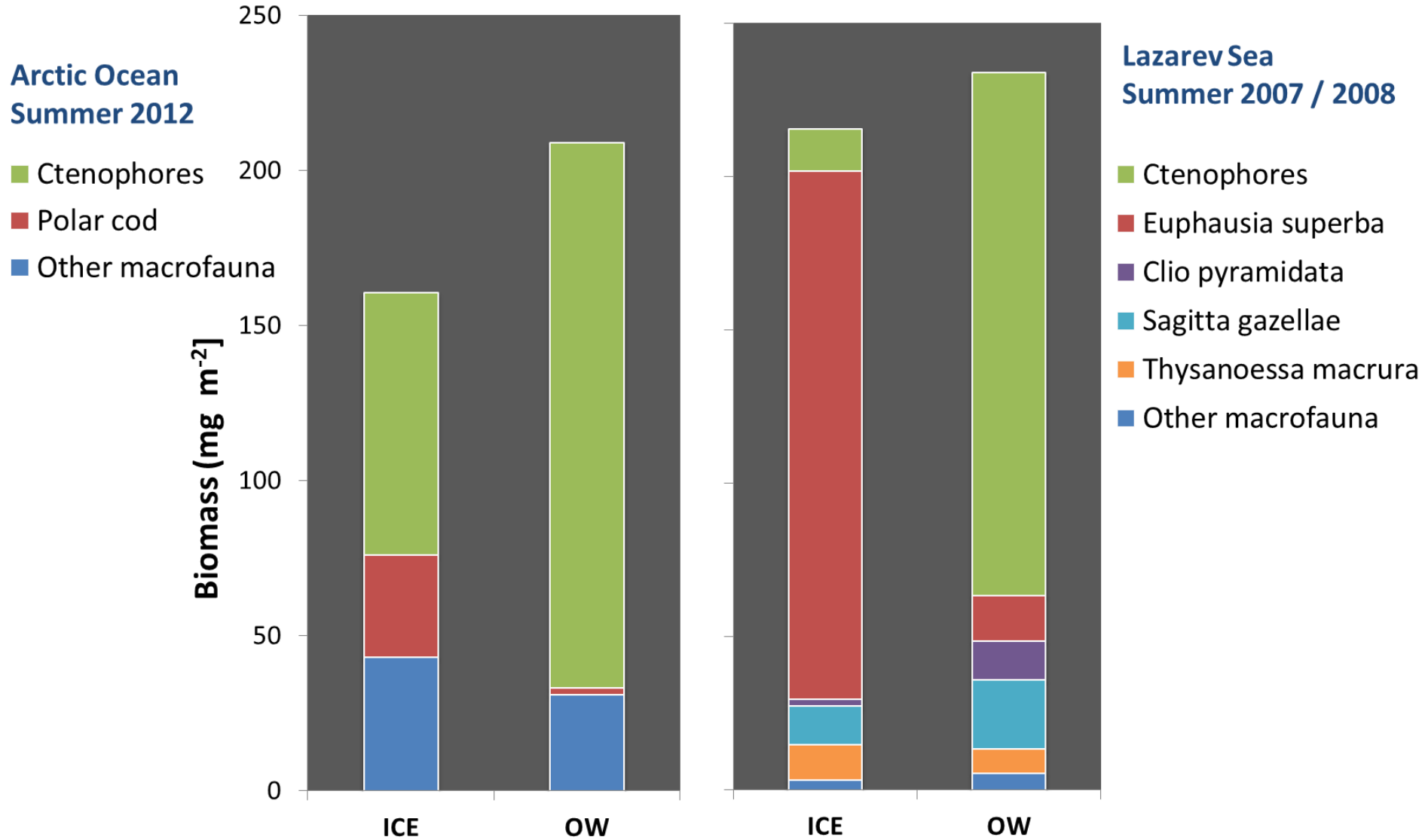
- **Maximum** seasonal abundances under **winter sea ice**
- Local per-area **abundances far exceeded** 0-200 m abundances



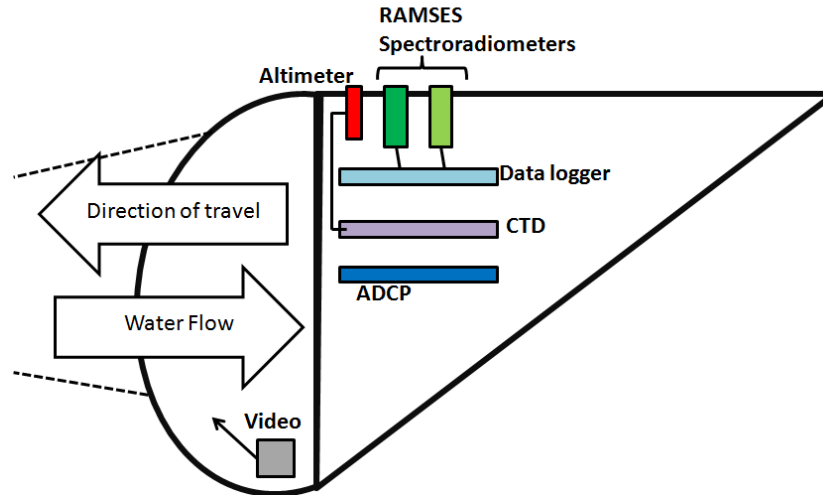
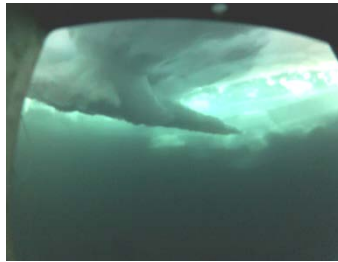
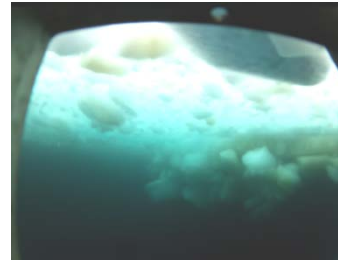
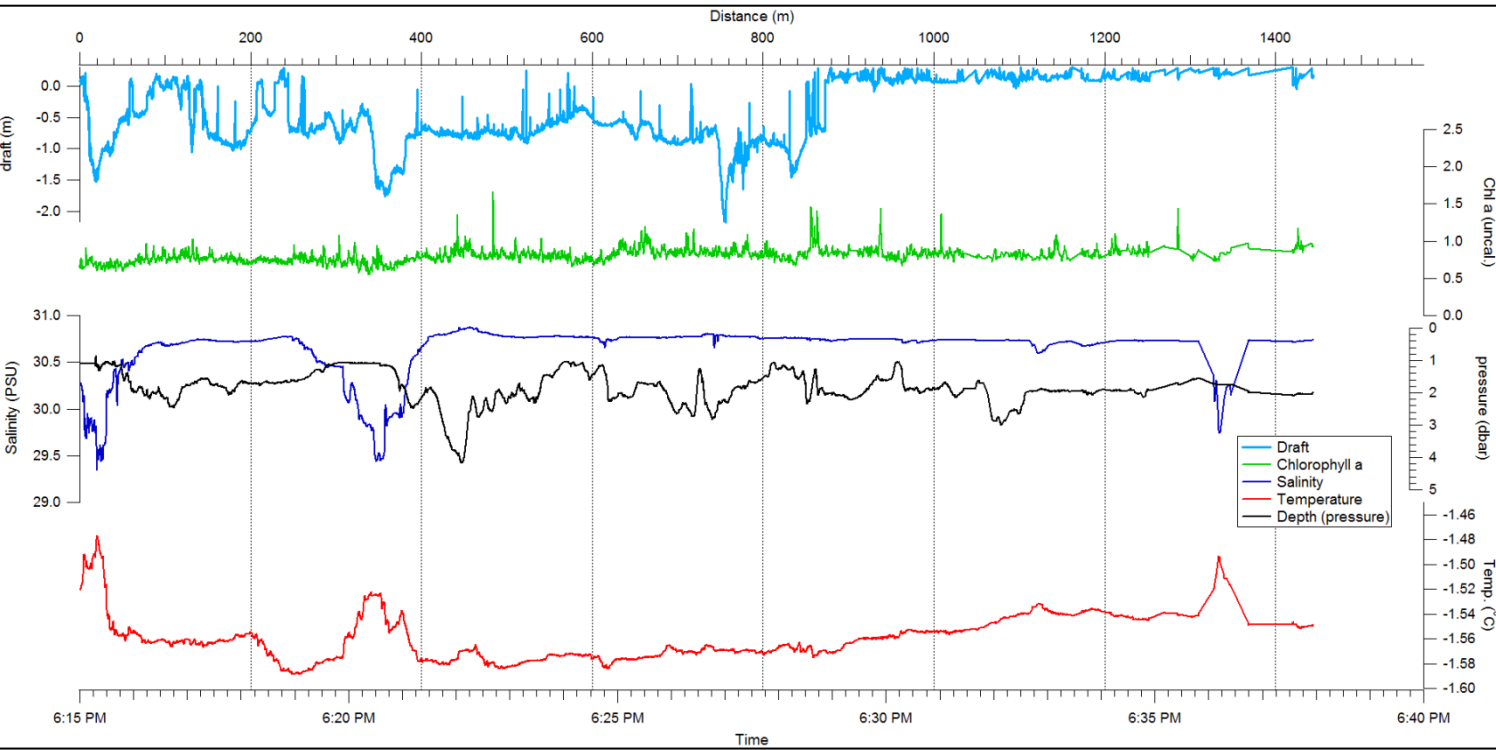
Polar cod



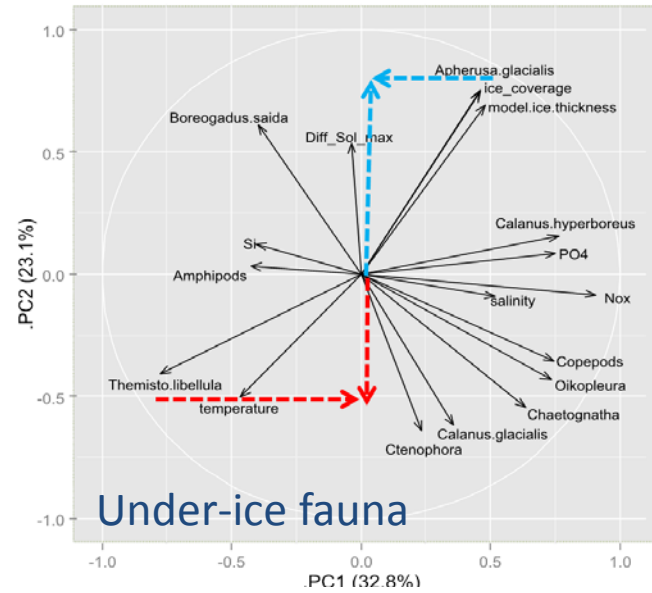
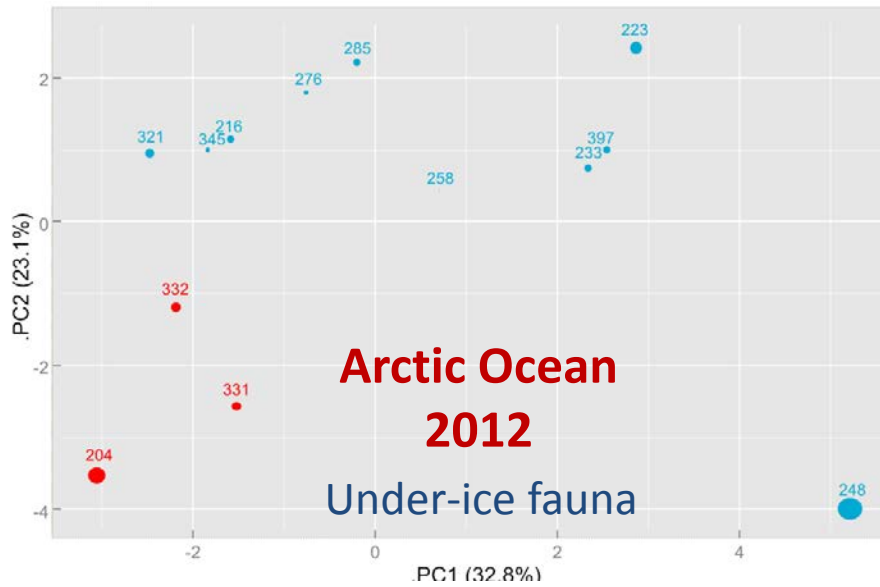
Biomass comparison



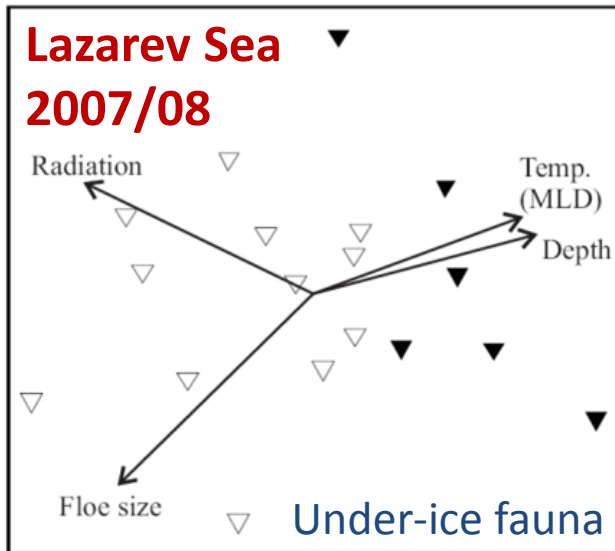
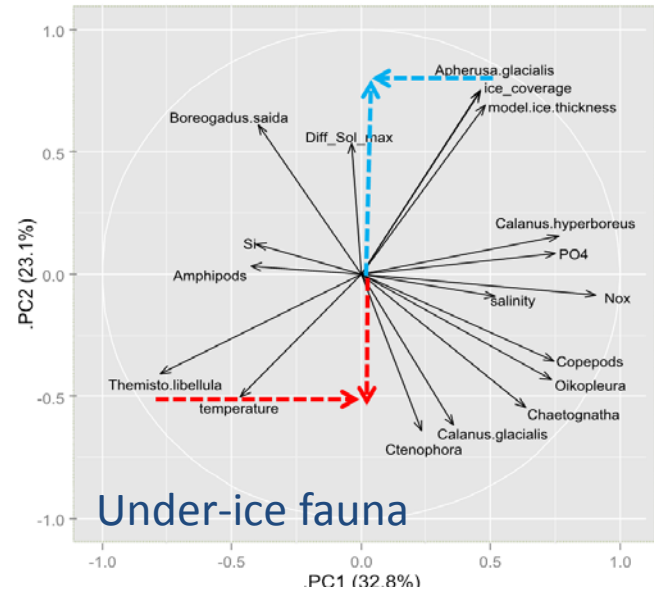
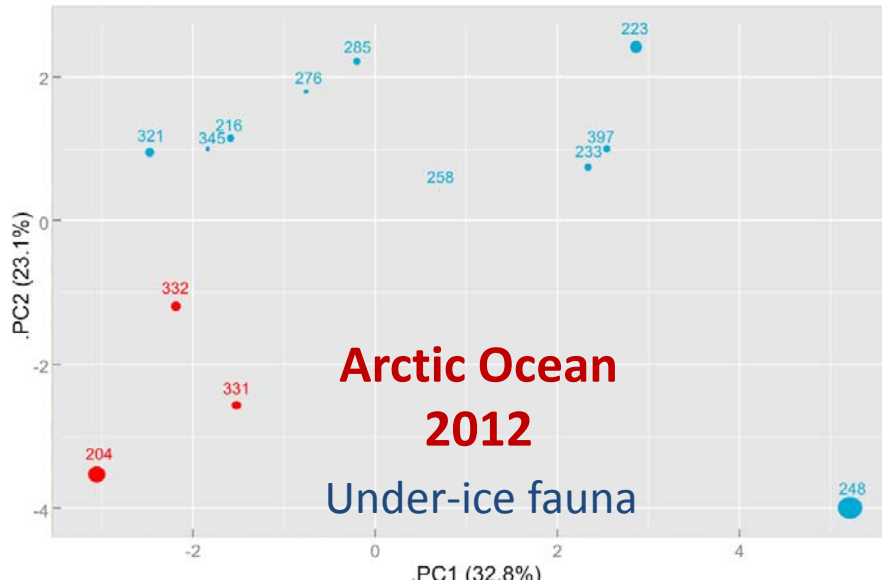
SUIT sensors



Linking data



Linking data



Conclusions

- **Rich under-ice community** both in the Arctic and the Antarctic Ocean
- Antarctic krill is **associated with sea ice** almost year-round
- **Ctenophores** often dominate biomass in sea ice ecosystems
- Like Antarctic krill, **Arctic cod dominates** non-gelatinous **biomass** under sea ice
- Traditional sampling gear can **under-estimate** under-ice species abundance significantly
- Arctic and Antarctic surface layer community composition is related to **sea ice habitat properties**
- Changing sea ice habitats can significantly **impact on Polar ecosystems**



Thank you.

SUIT on-deck crew, Polarstern ARK XXVII/3