

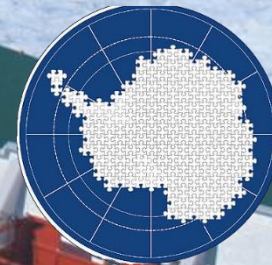
# Microbial Seasonality in the Arctic and Antarctic Oceans

## From Gene to Ecosystem

Matthias Wietz



DFG PRIORITY PROGRAM 1158

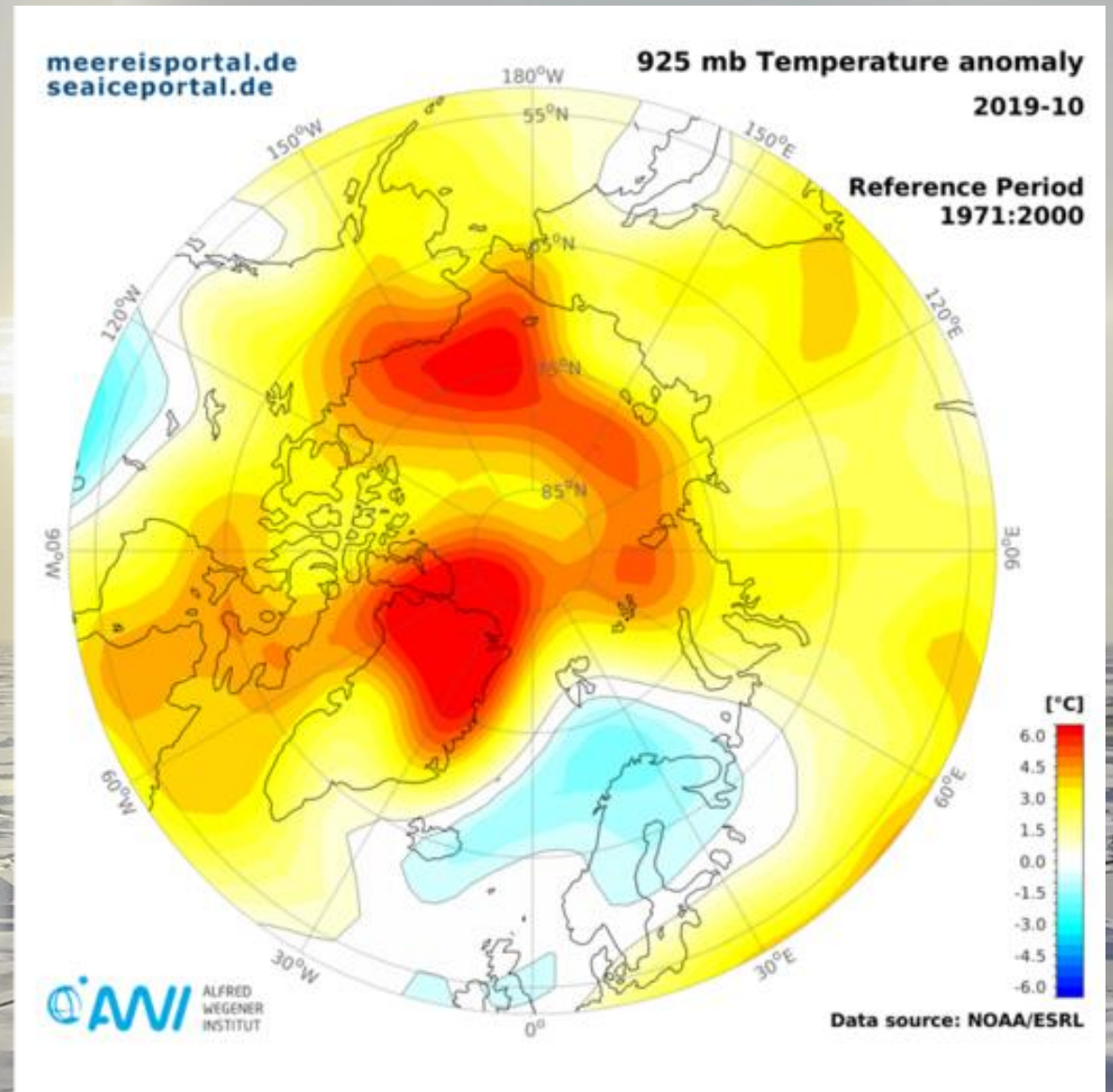


**ANTARCTIC  
RESEARCH**



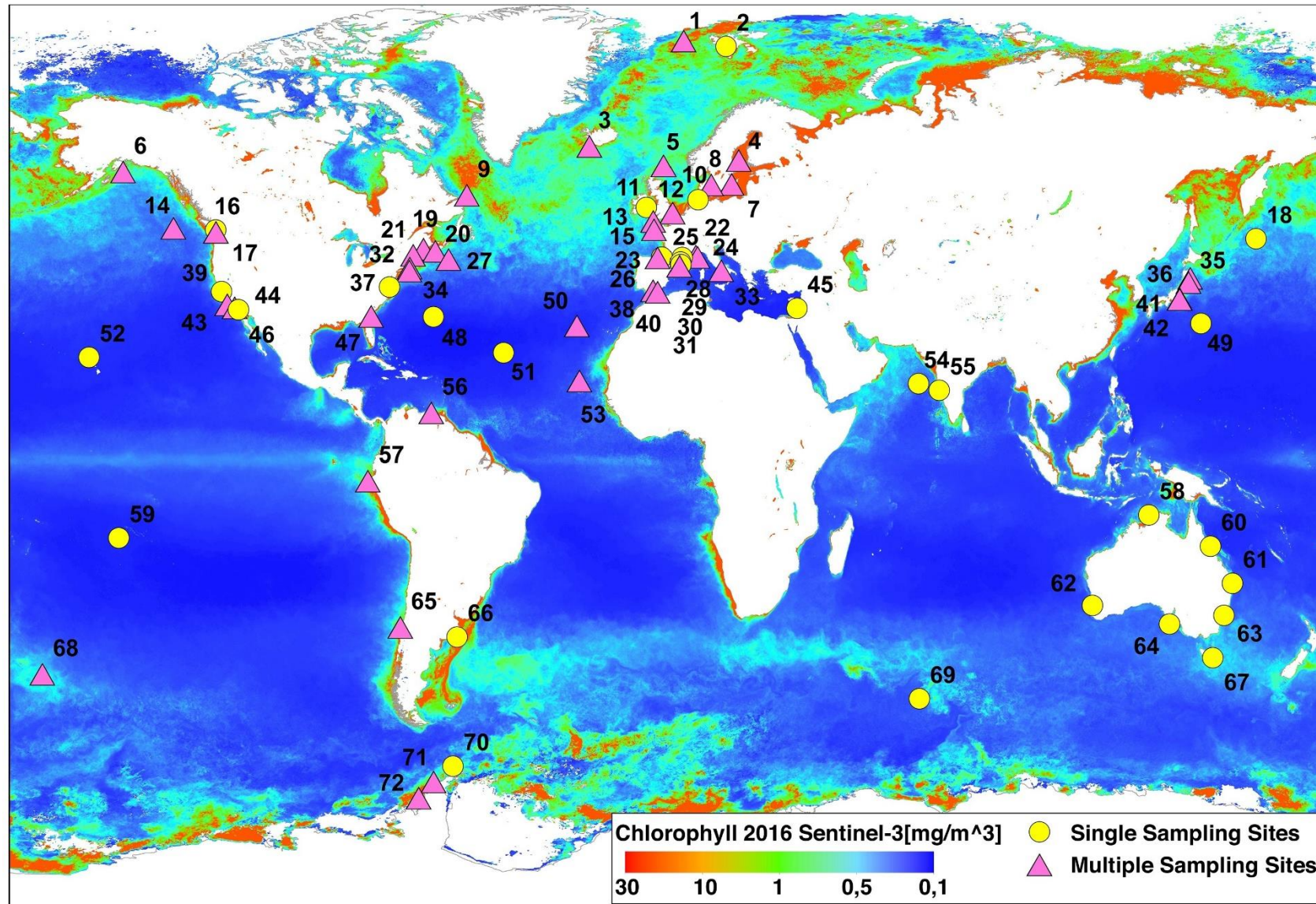
# The polar oceans are changing

>> Long-term, continuous observations are essential



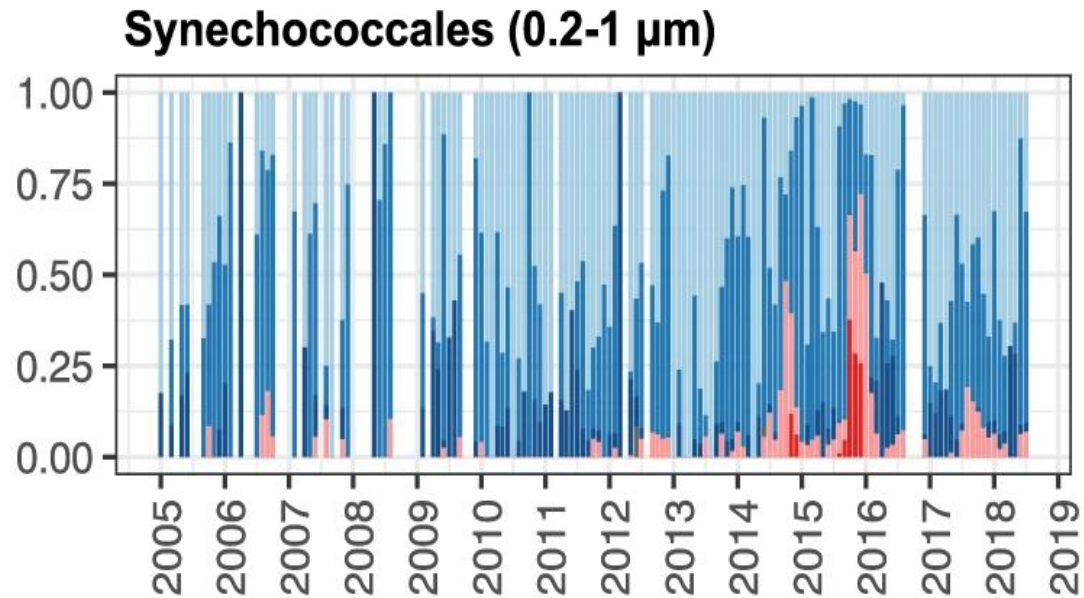


# Ocean time-series: mostly in warmer waters



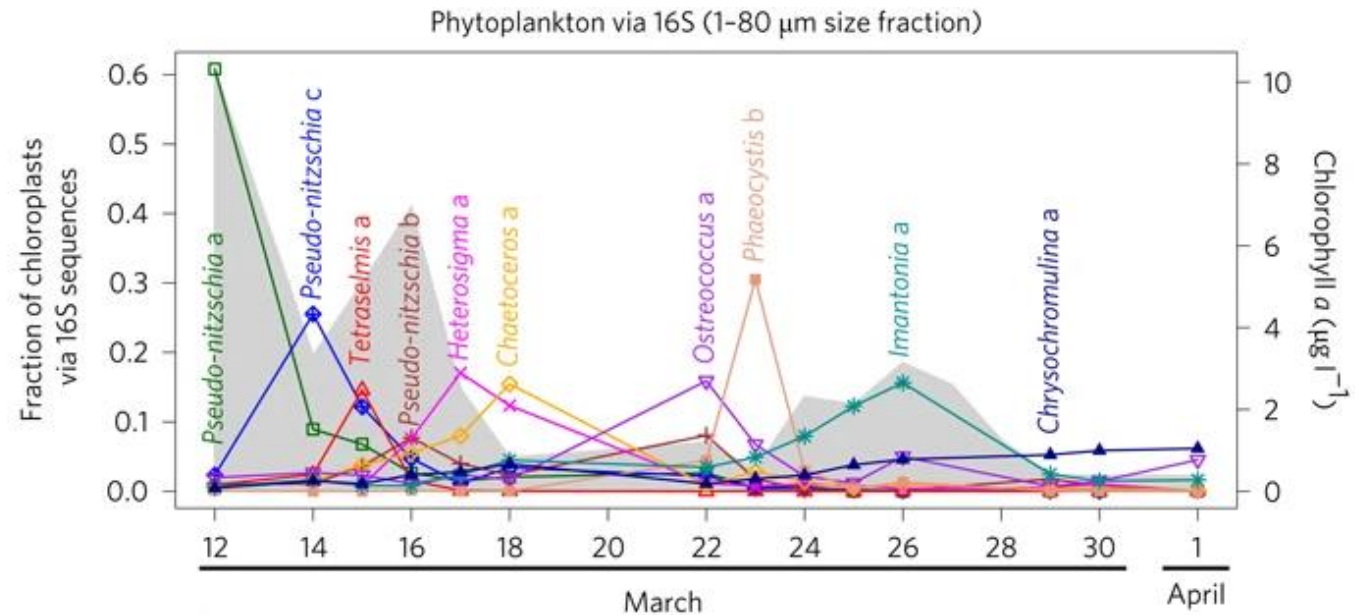
Buttigieg et al. 2018  
doi:10.1016/j.mib.2018.01.015

# Microbial dynamics from decadal ...



Yeh & Fuhrman 2022  
doi:10.1038/s41467-022-35551-4

# ... to daily timescales



Needham & Fuhrman 2016  
doi:10.1038/nmicrobiol.2016.5

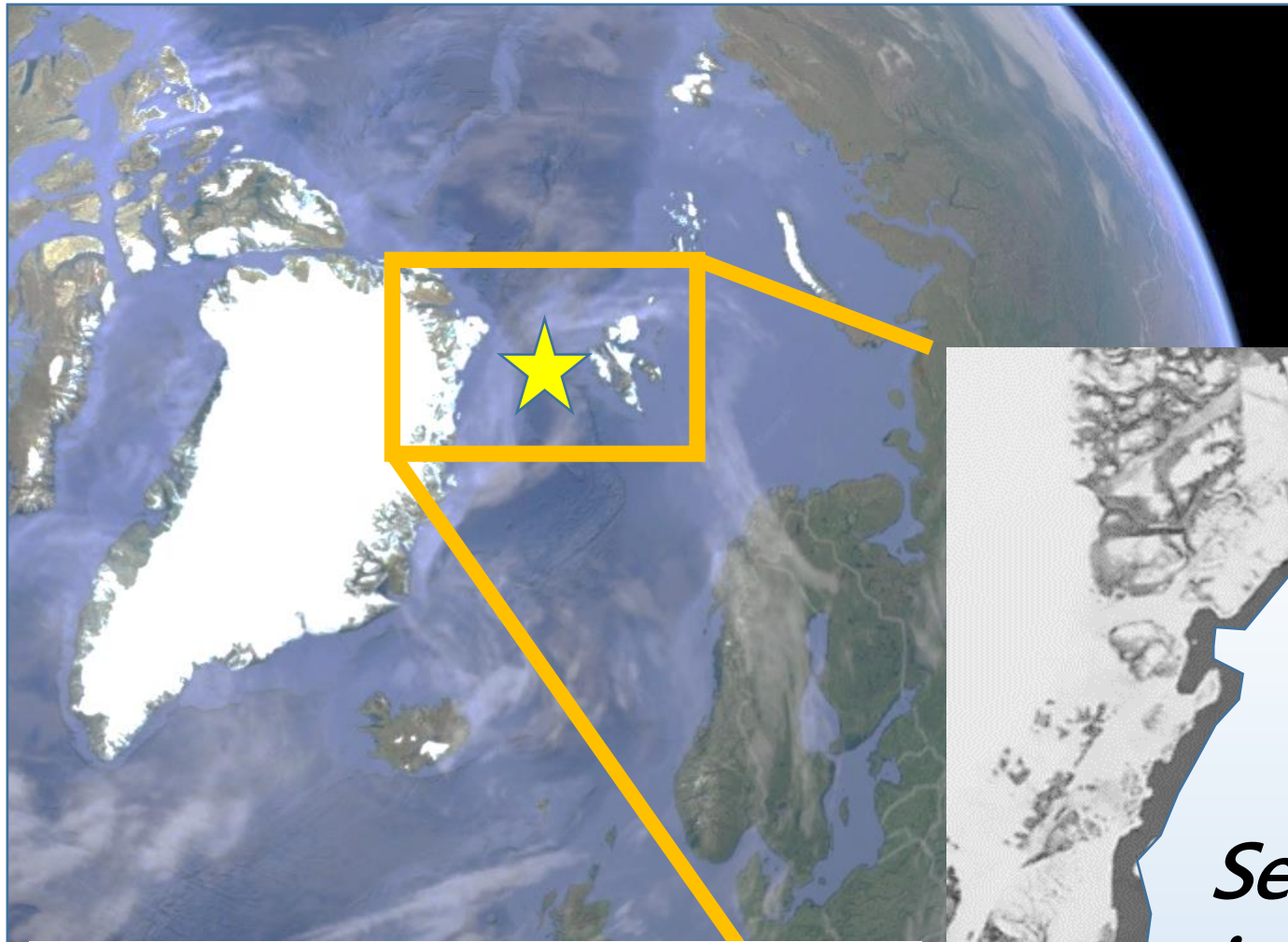


# Few time-series records from the polar oceans

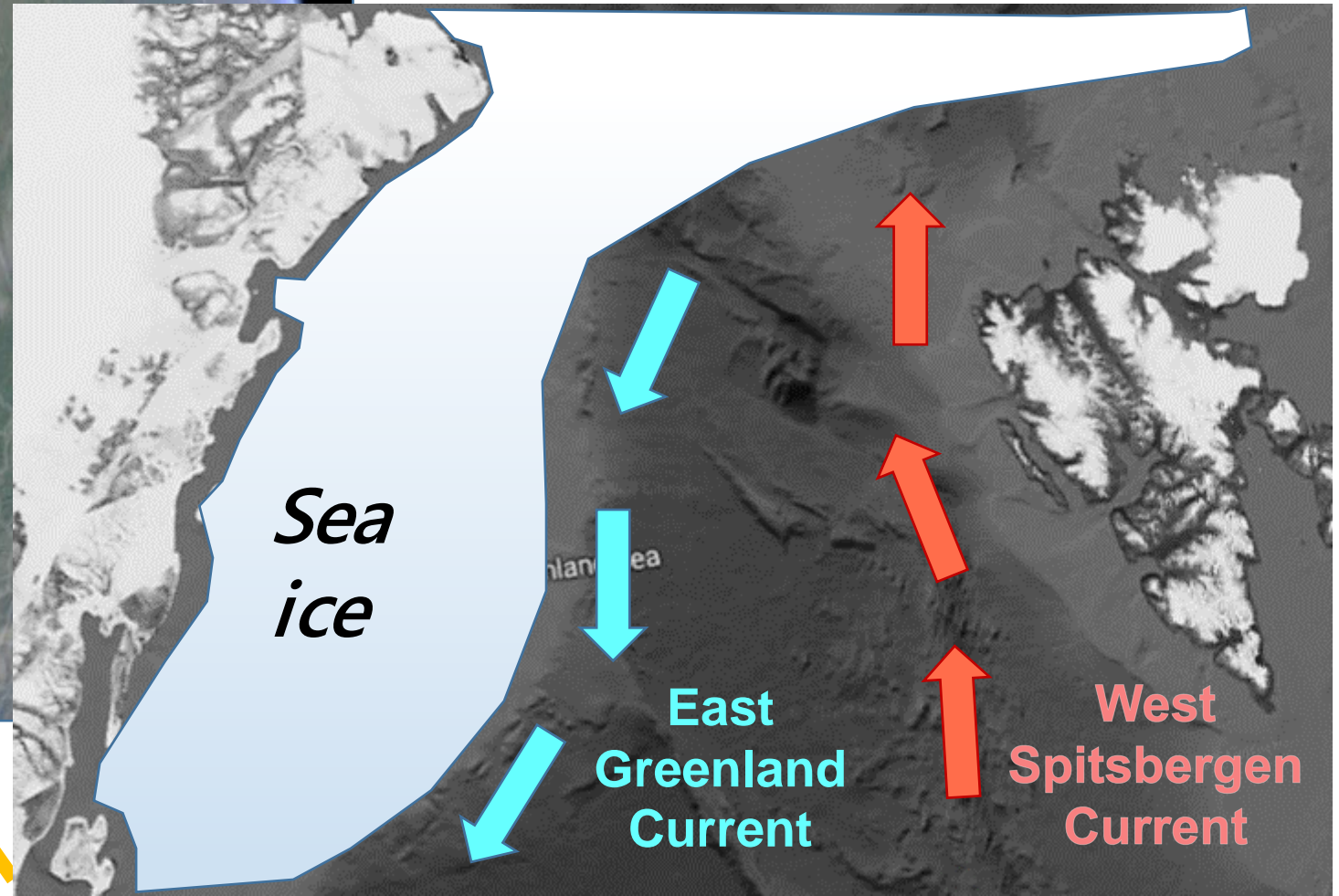


**FRAM**

Frontiers in  
Arctic Marine Monitoring



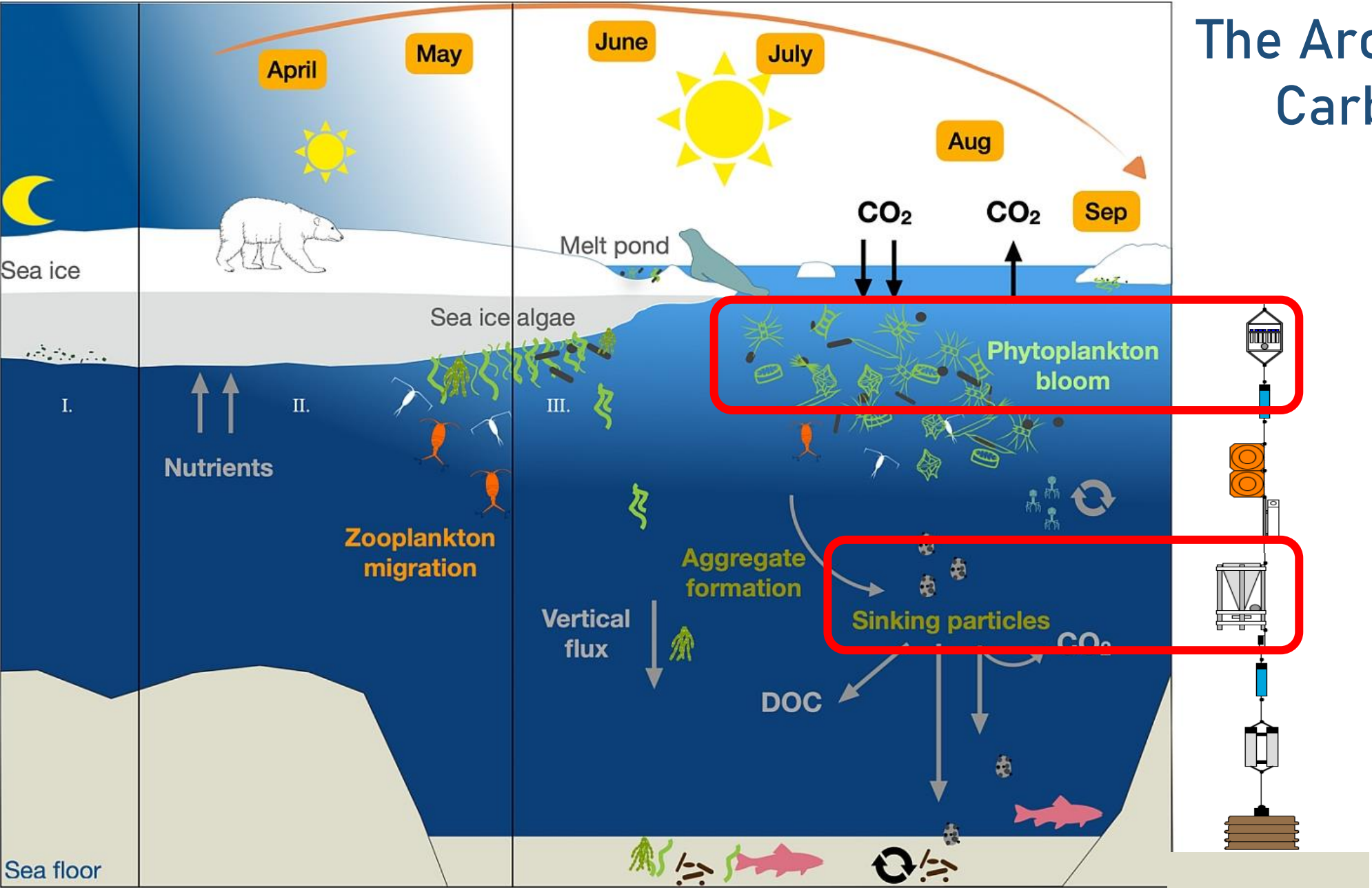
The „Hausgarten“ /  
FRAM LTER







# The Arctic Microbial Carbon Pump





# Moored autonomous samplers: Year-round microbial dynamics and drivers



Remote Access Sampler  
(surface water)



Sediment trap  
(sinking particles)

- High-resolution eDNA catalogue
- Amplicon and PacBio metagenome sequencing
- Context with sea-ice, oceanography, nutrients

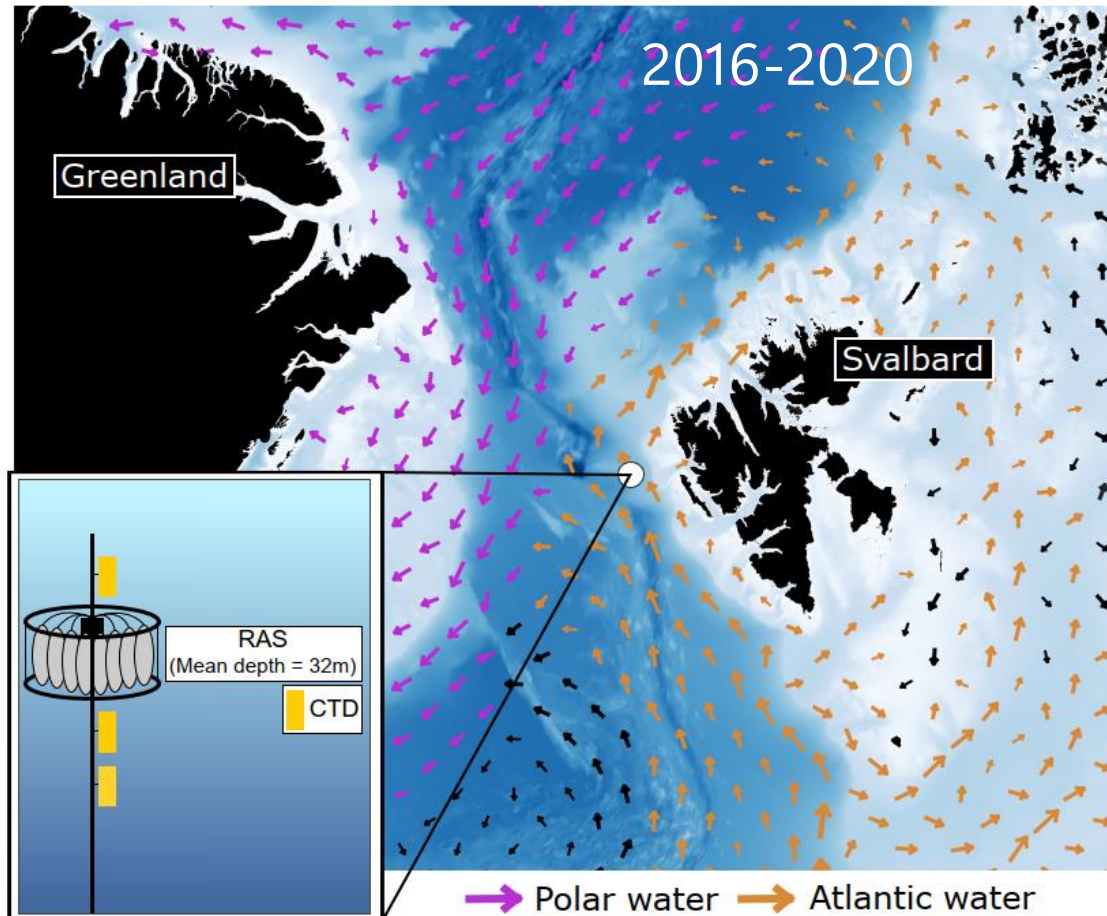
# Seasonal recurrence and modular assembly of an Arctic pelagic marine microbiome



Taylor Priest



Ellen Oldenburg



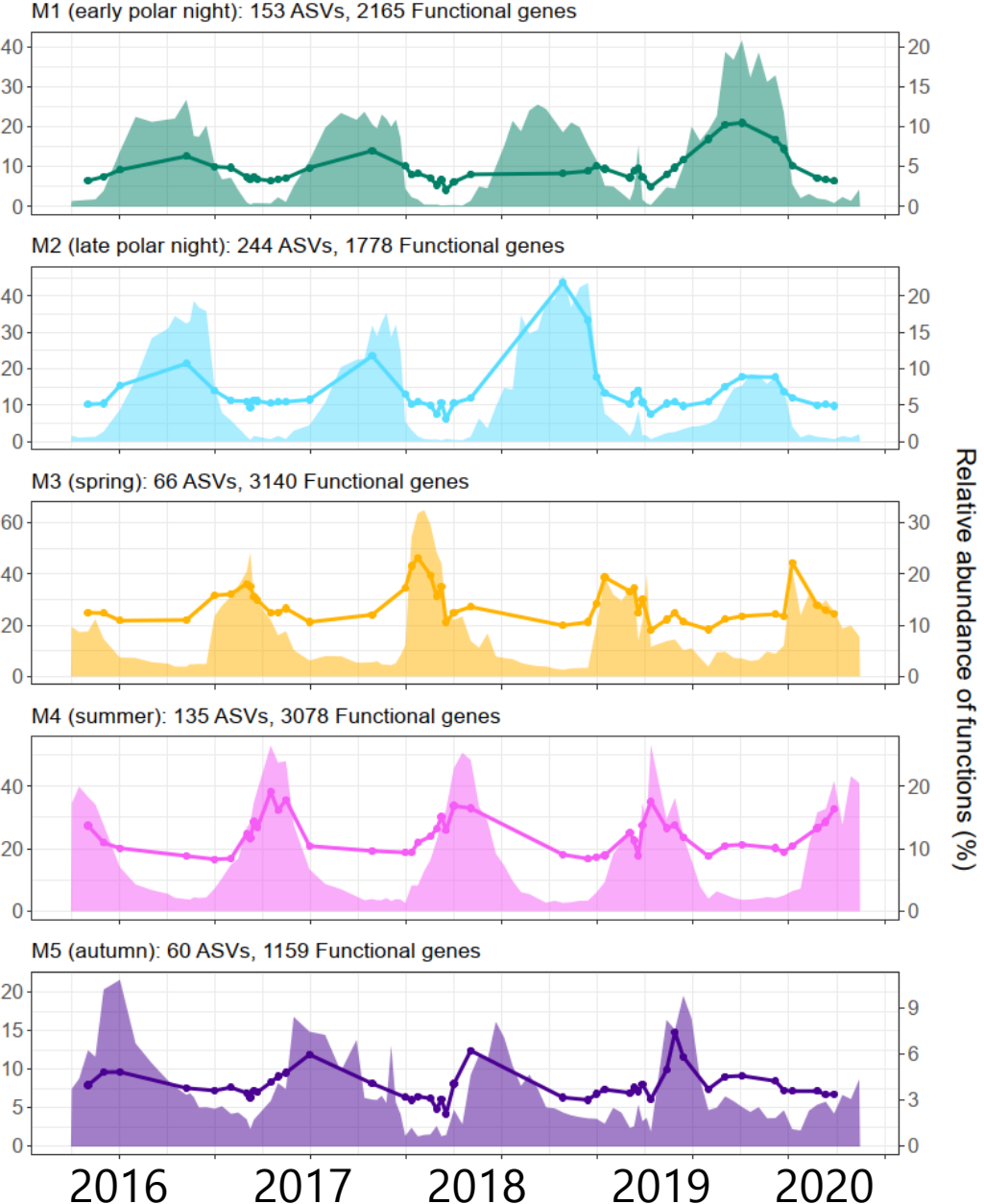
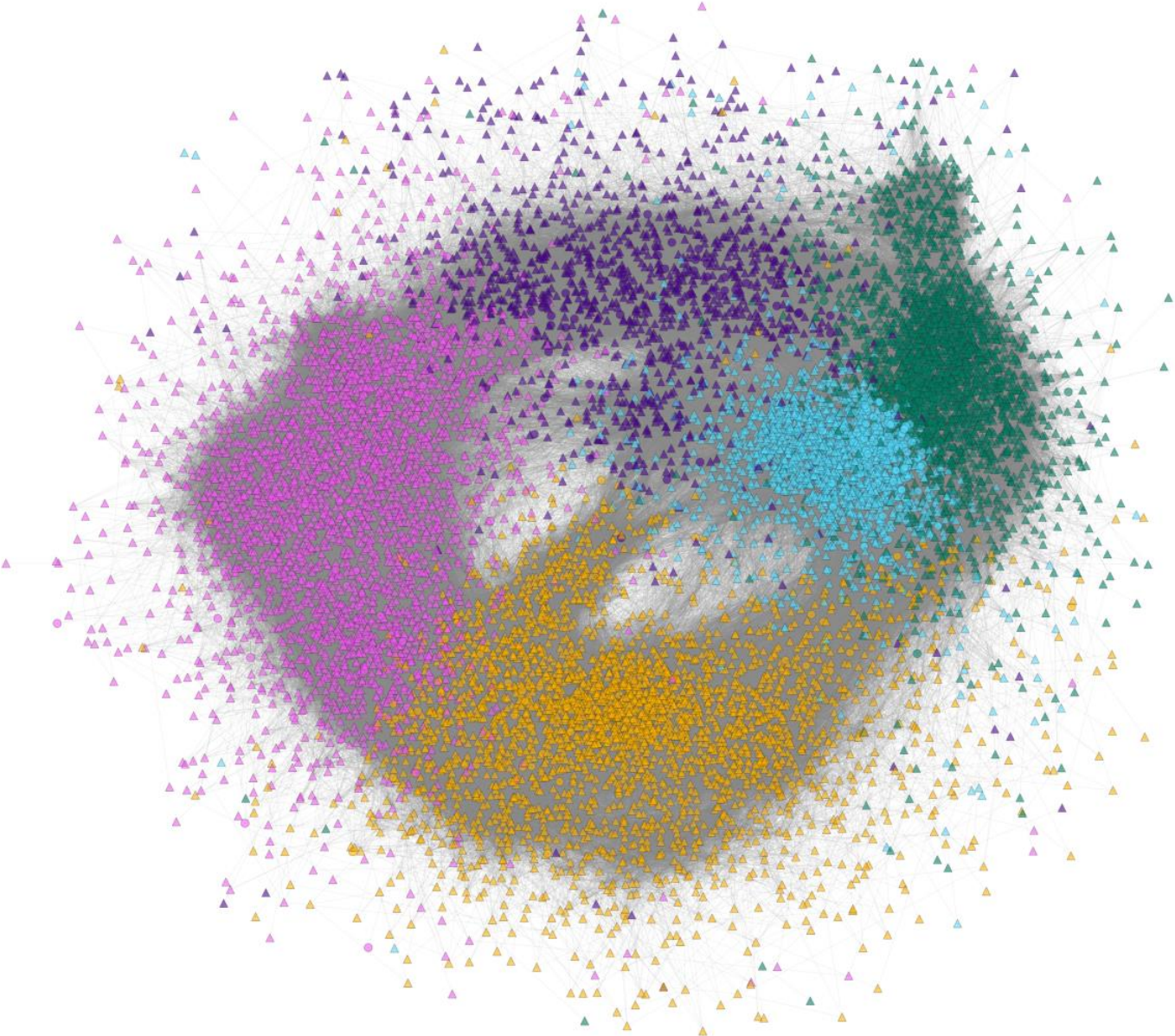
- 94 amplicon (16S / 18S rRNA) and 47 metagenome events
- Transformation of ASV / gene abundances into oscillation signals
- Co-occurrence network and Louvain clustering



*In review*



# Seasonally recurrent microbial modules



# Distinct taxonomic, genetic and environmental signatures

## Autumn

AEGEAN-169  
*Loktanella*

O<sub>2</sub>  
conc

## Early polar night

Nitrosopumilus  
Arctic97-B4

Nitrification

Water  
temp

## Summer / late bloom

*Amylibacter*  
*Synechococcus*

MeSH,  
taurine,  
QS, motility

Mixed  
layer  
depth

## Late polar night

*Thalassobius*  
*Arenicellaceae*

Nitrogen  
metabolism

Mixed  
layer  
depth

## Spring / early bloom

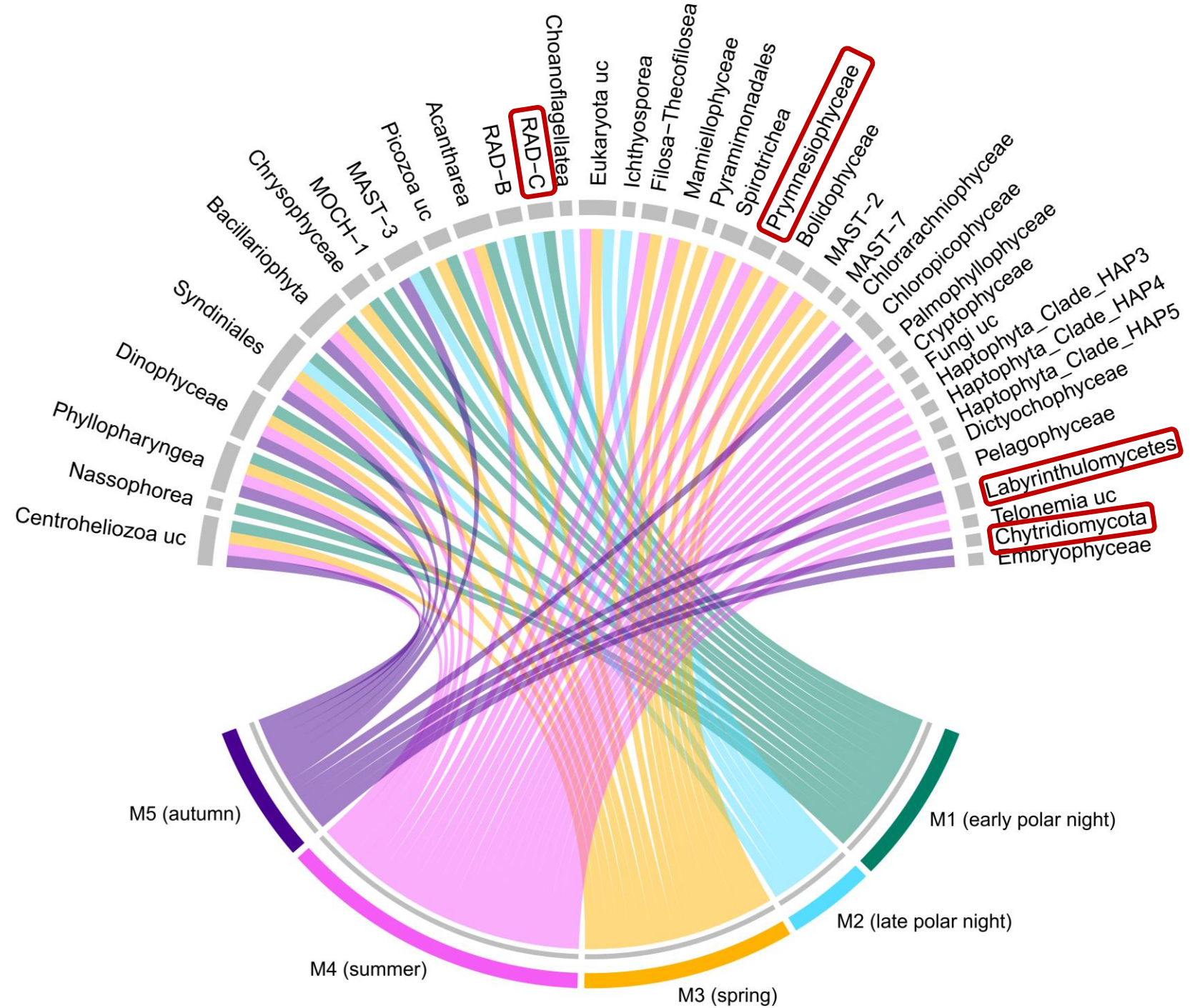
*Polaribacter*  
*Aurantivirga*

CAZymes  
DMS(P/O)

PAR



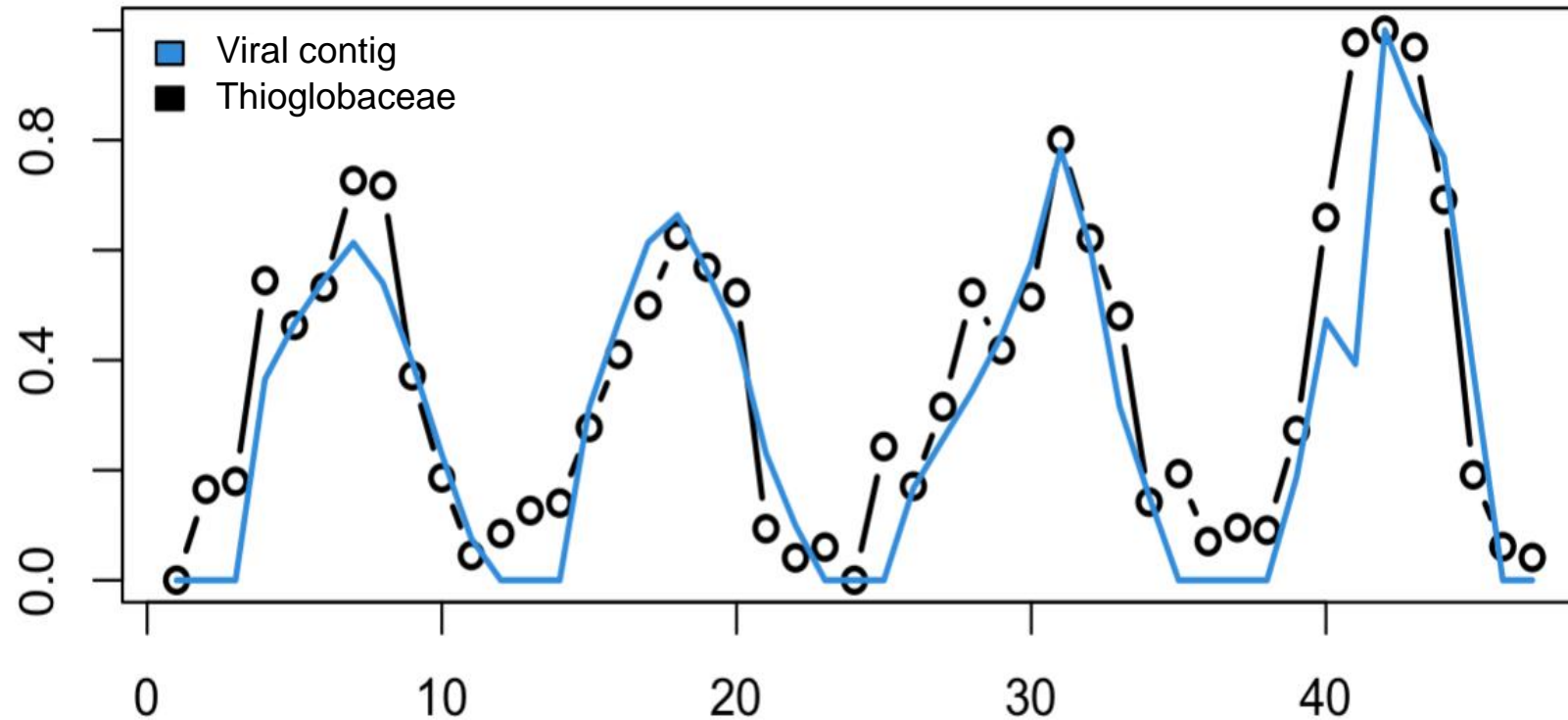
# Connection with microeukaryotes



# Seasonality of viral communities



David Needham /  
Alyzza Calayag  
(GEOMAR)





**Seasonal recurrence in  
ice-free (Atlantic) waters...**

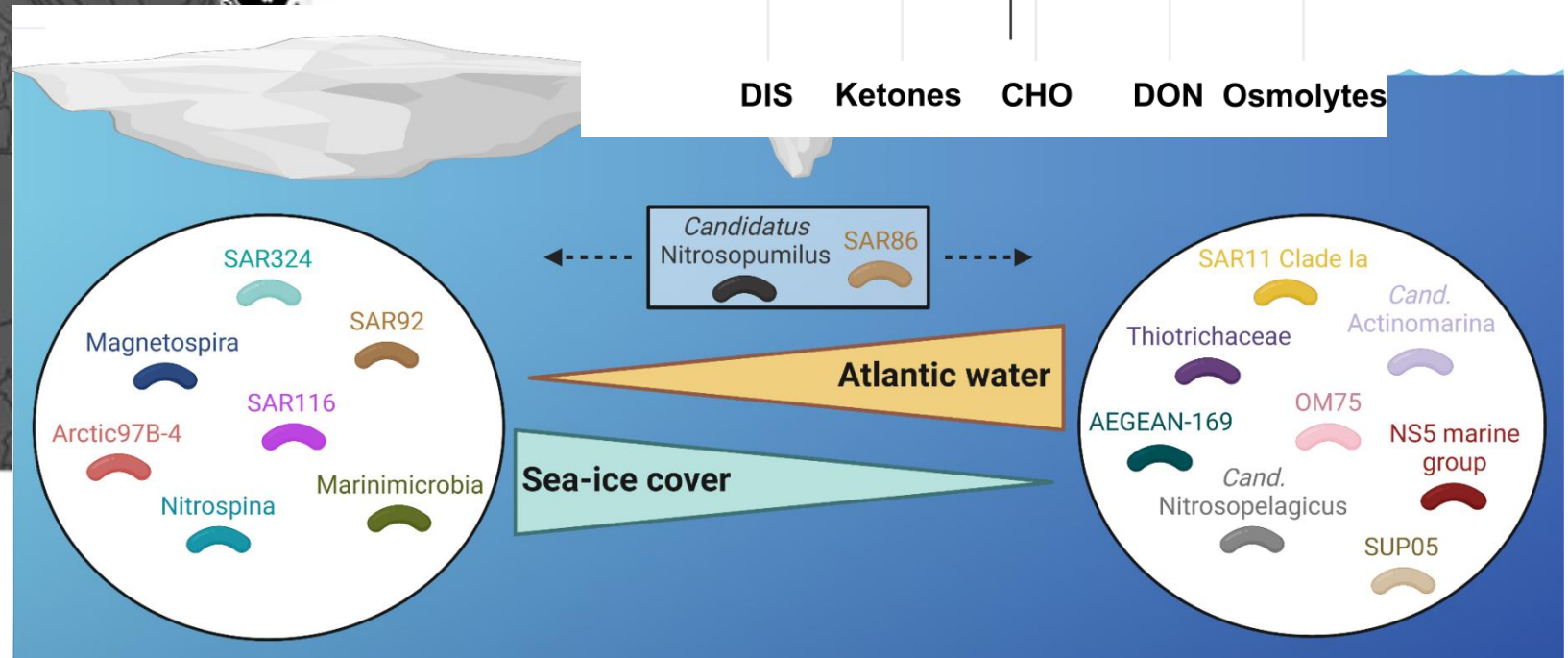
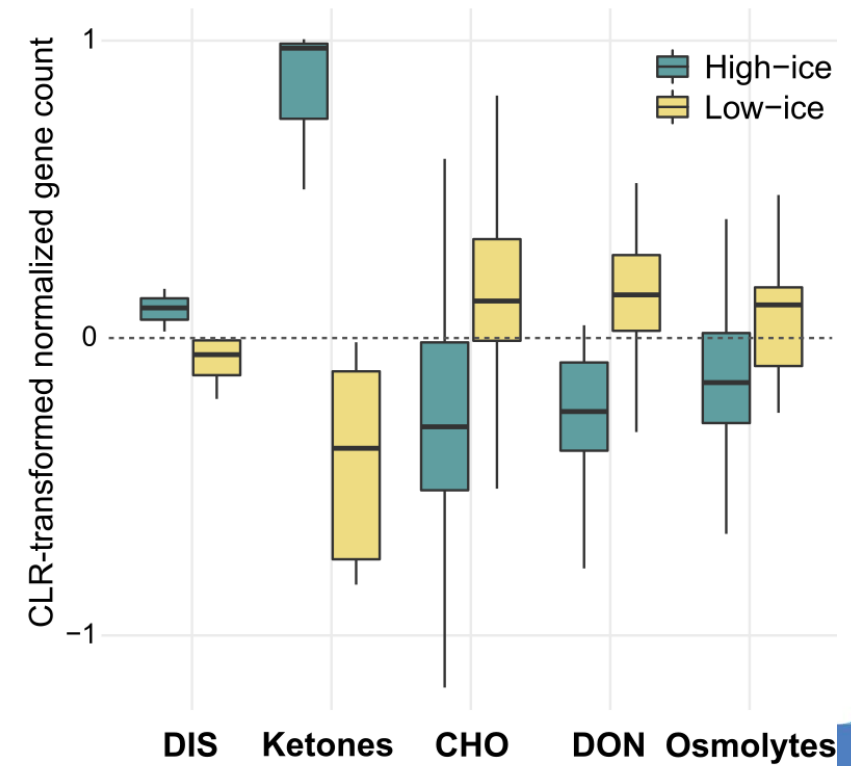
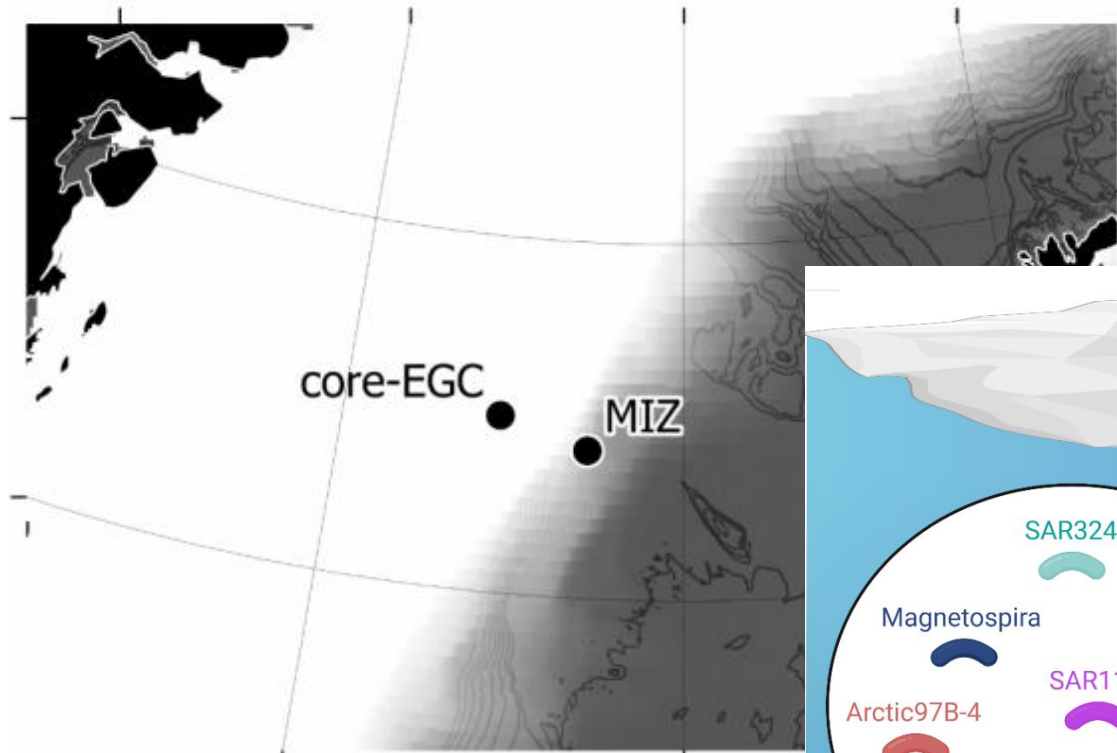


**... but how about  
icy polar waters?**





# East Greenland Current: Ice cover & Atlantic water shape microbial dynamics

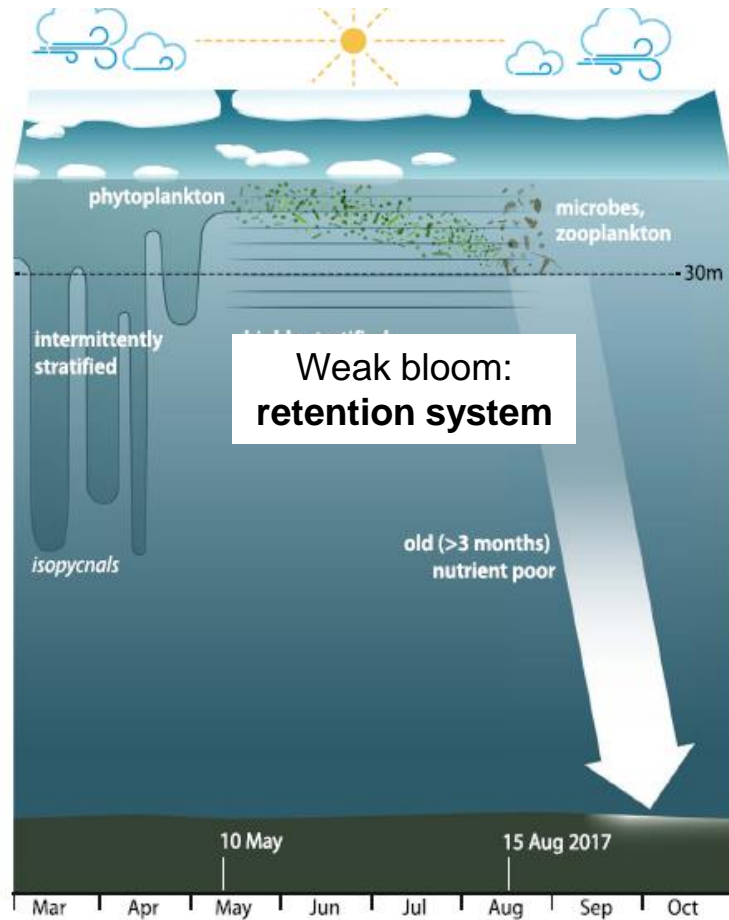


Priest et al. (2023) ISME J  
doi:10.1038/s41396-023-01461-6

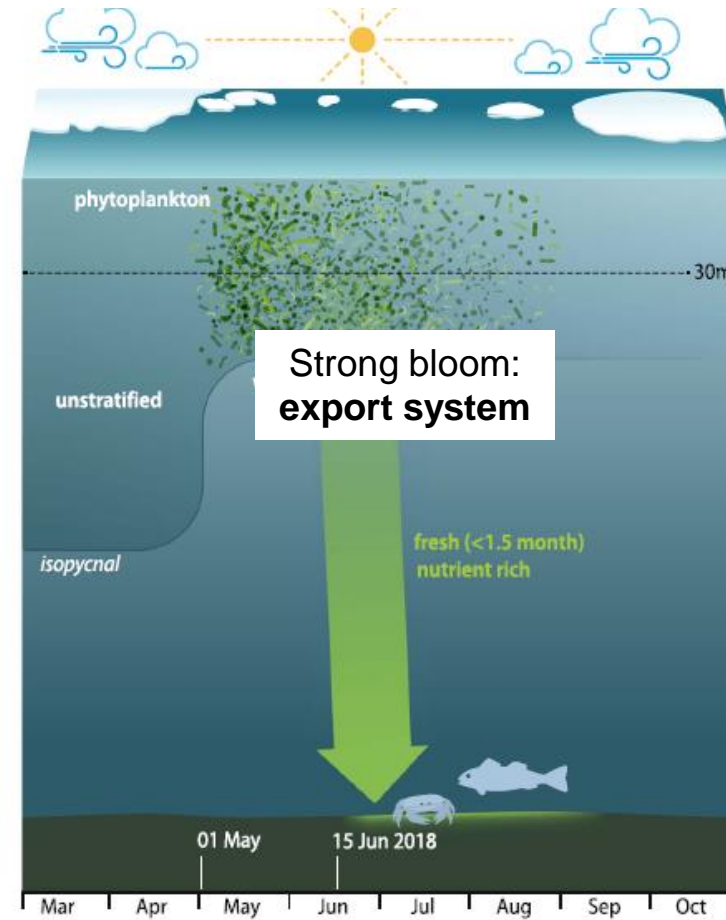


# The bigger picture: meltwater slows the biological carbon pump

**Meltwater regime: ice melt in location**



**Mixed layer regime: distant ice melt**



**Marked blooms & carbon export: The future Arctic Ocean?**

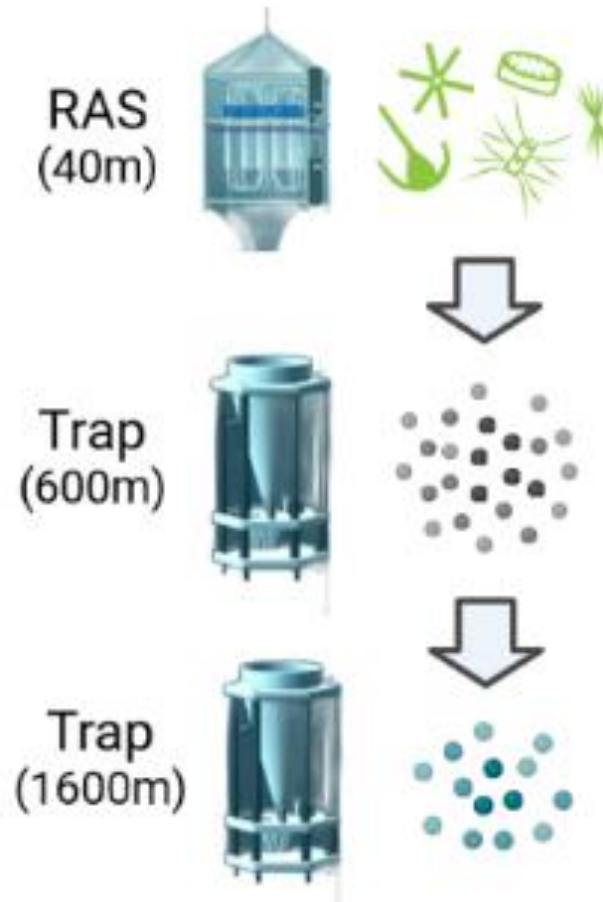
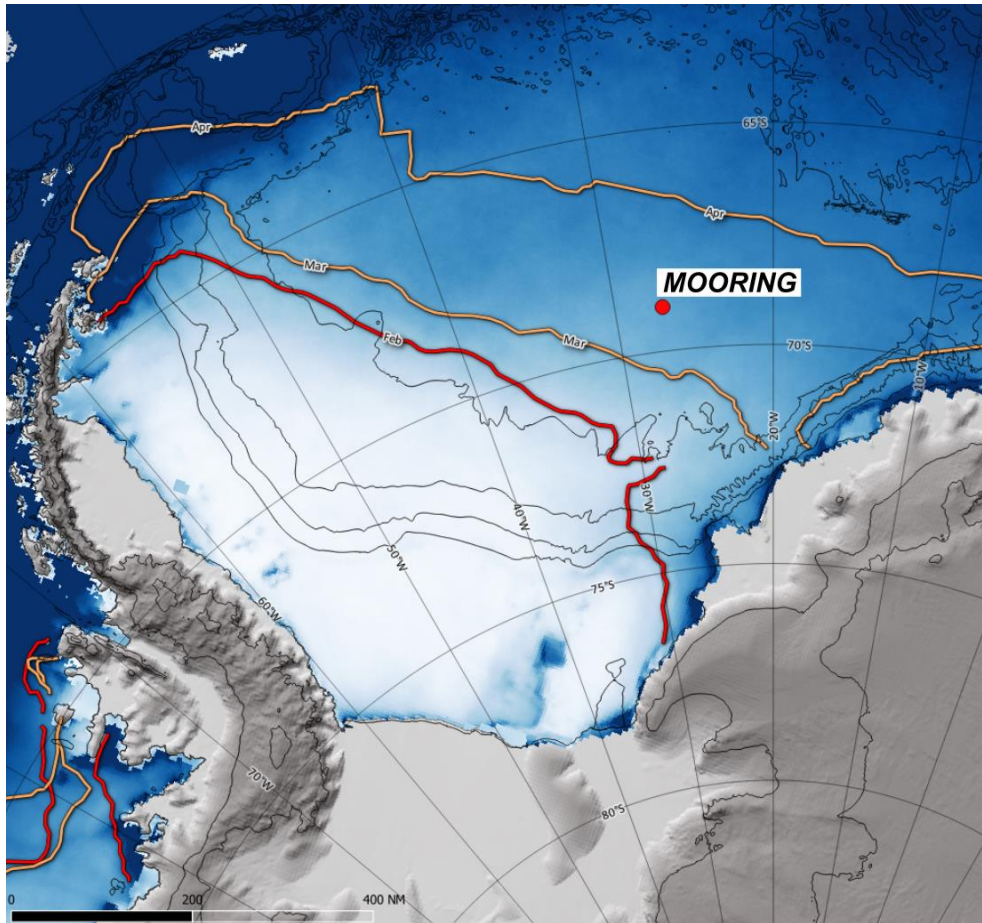


from North  
to South





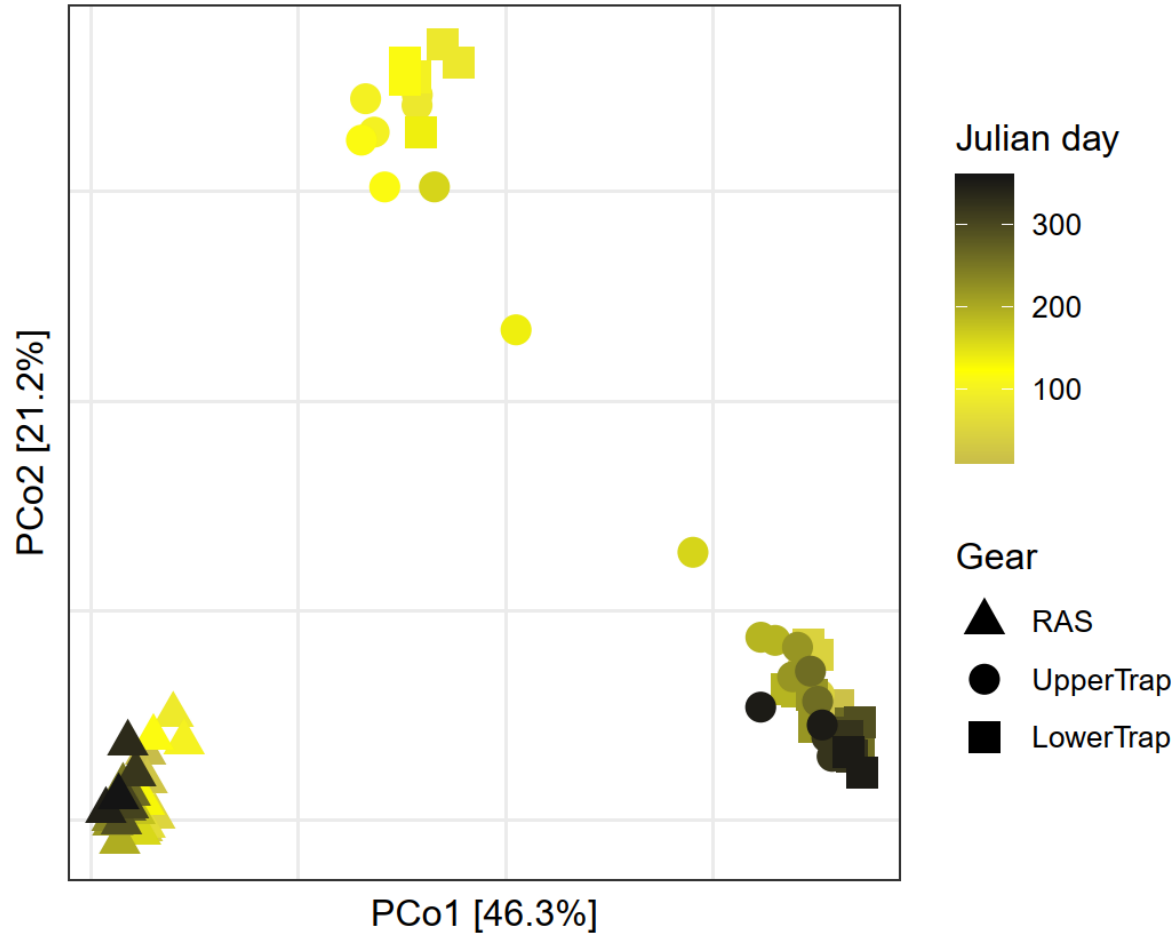
# The seasonal biological carbon pump in the Weddell Sea



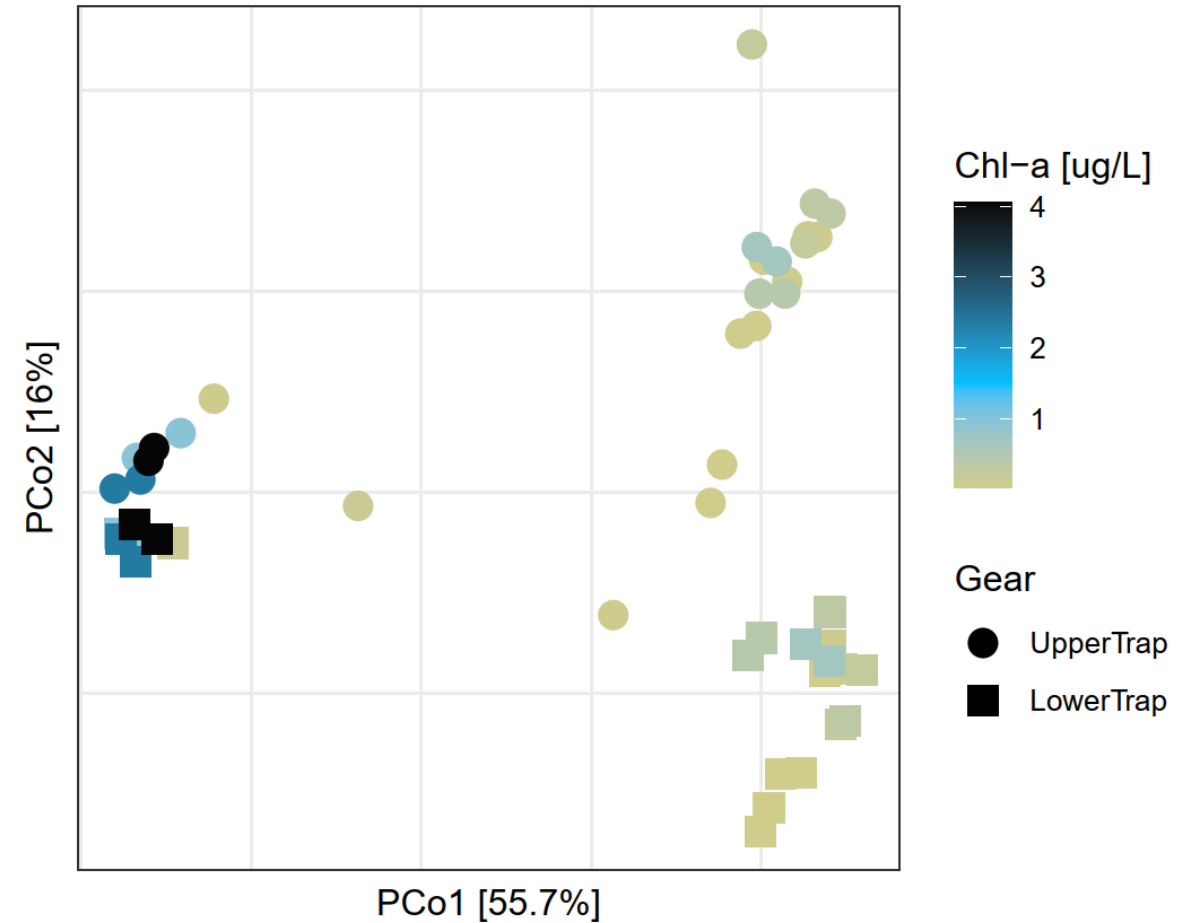
**Seasonality and vertical connectivity**

**Bipolar patterns?**

# Seasonal, habitat-specific bacterial communities

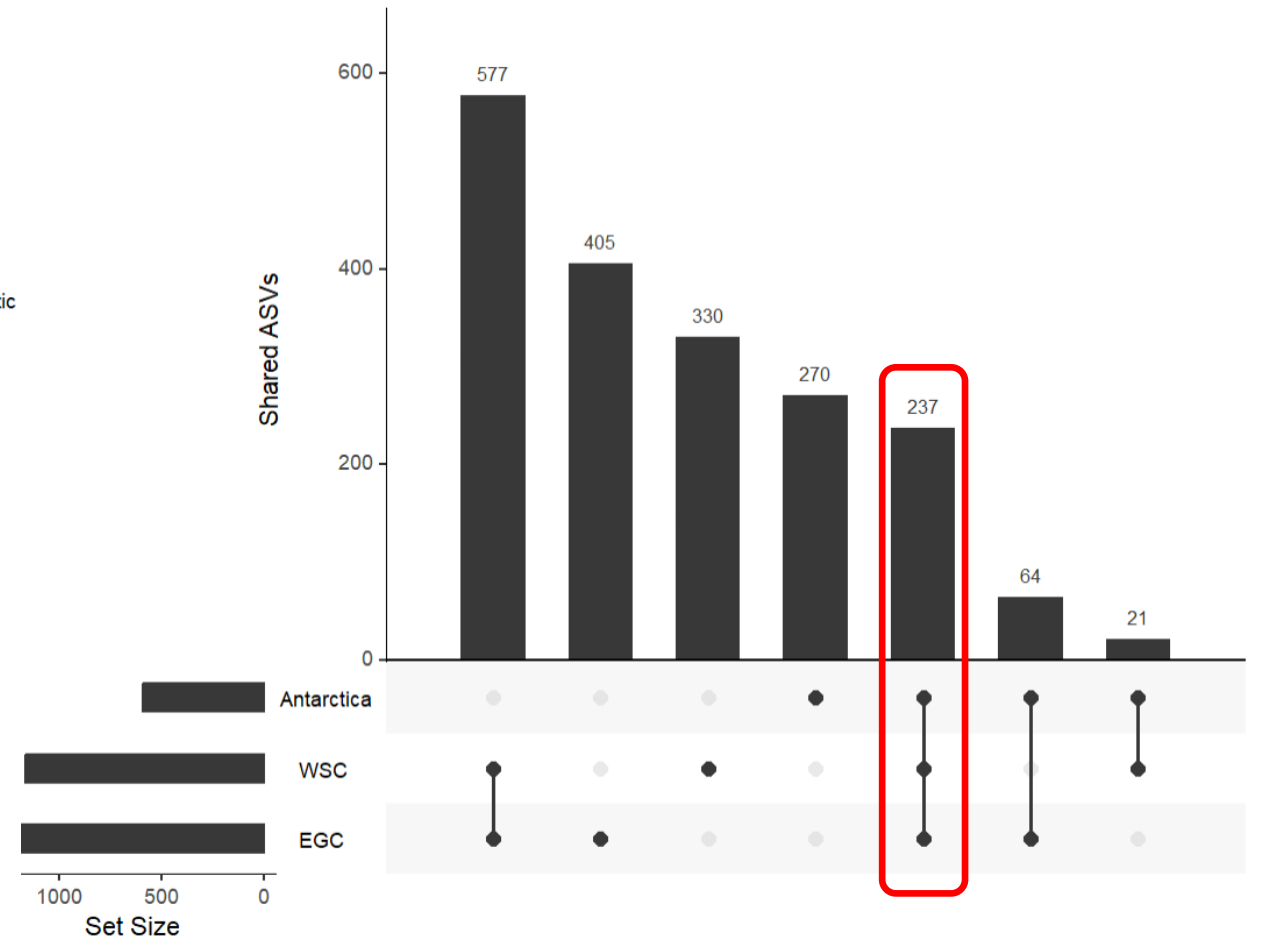
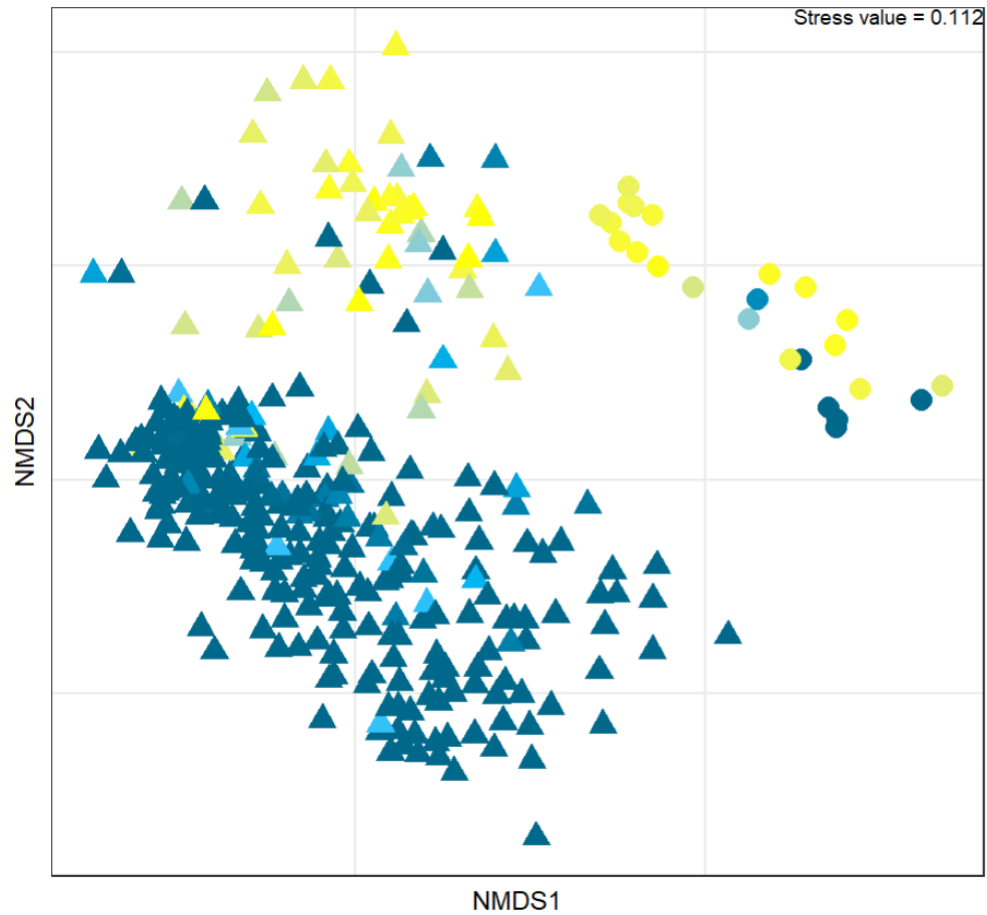


# Particle microbiomes: similar during bloom, distinct in winter





# Arctic vs. Antarctic surface waters: ice-driven similarities



# Conclusions

- **Autonomous observations: discerning the temporal-environmental structuring of polar microbiomes**
- **Microbiome assembly scales with season and sea-ice**
- **Mechanistic insights into the biological carbon pump**
- **Bi-polar similarities increase with sea-ice**
- **Baseline for predicting the future polar microbiome**







**FRAM**

Frontiers in  
Arctic Marine Monitoring

Deep-Sea / Habitat Group

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MPI for Marine Microbiology

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**Thank you!**

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**the.arcwatchers**