

Patterns of Macrobenthic Production and Function in the Deep Arctic Ocean

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Overview

- Arctic ecosystem
- Current questions

Spatial Patterns & Drivers

Part I: Production

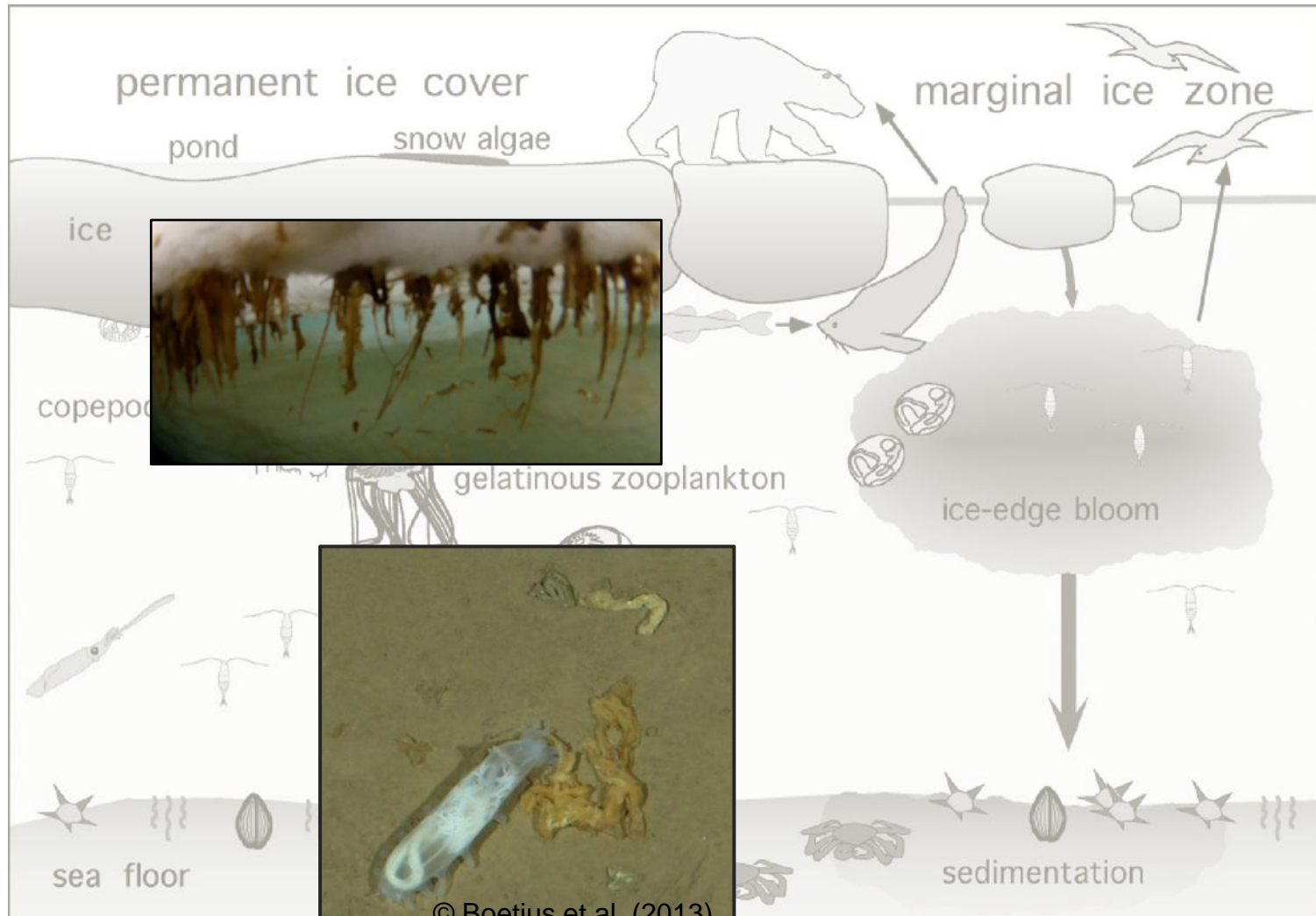
Part II: Functions



Sea ice



Arctic food web



© Boetius et al. (2013)

© Rolf Gradinger

Seasonal ice melt 2013



NASA

Sea ice decrease



Pink line: 1979-2000 September median
White: September 12, 2012

Consequences

Habitat loss

Spring bloom shift

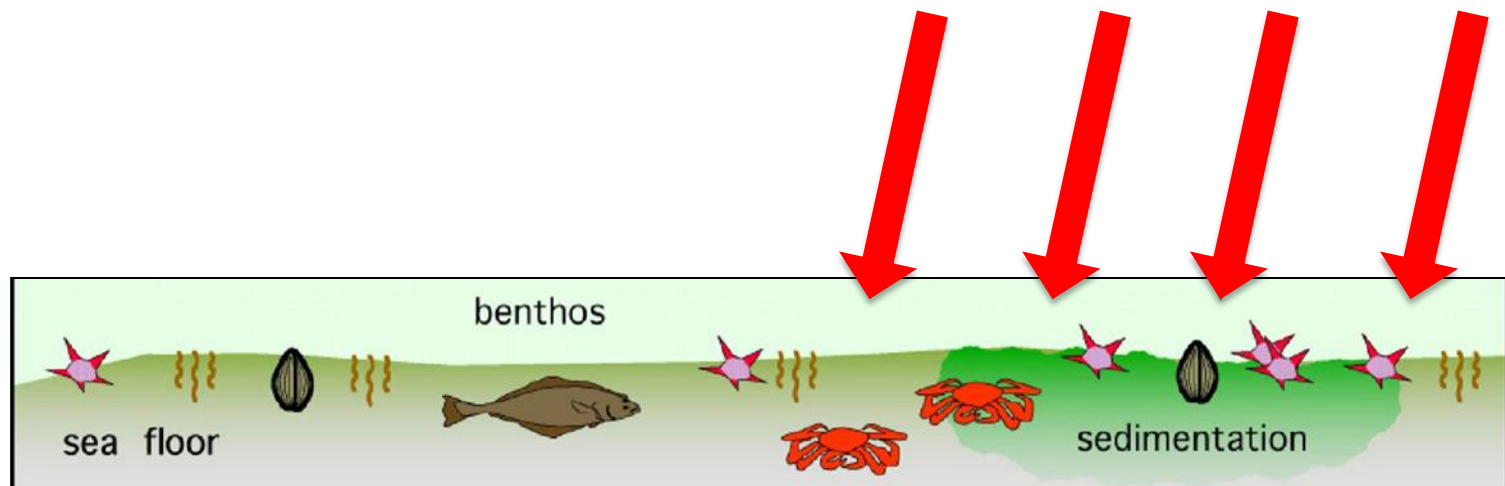
Increase in production

Decrease in production

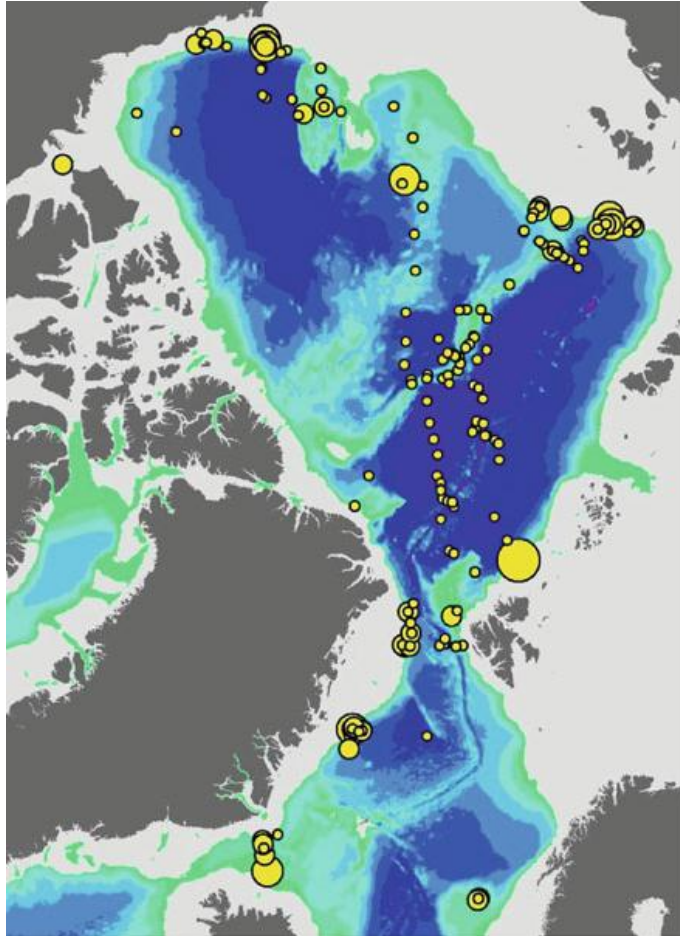


Benthos

- Good indicator of change
- Size classes – time scales
- Important functions
- But lack of baseline data!

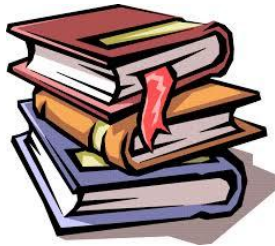


Benthos



Bluhm et al. (2011)

Data mining



Berichte
zur Polar-
und Meeresforschung

Reports
on Polar and Marine Research



PANGAEA



marbef



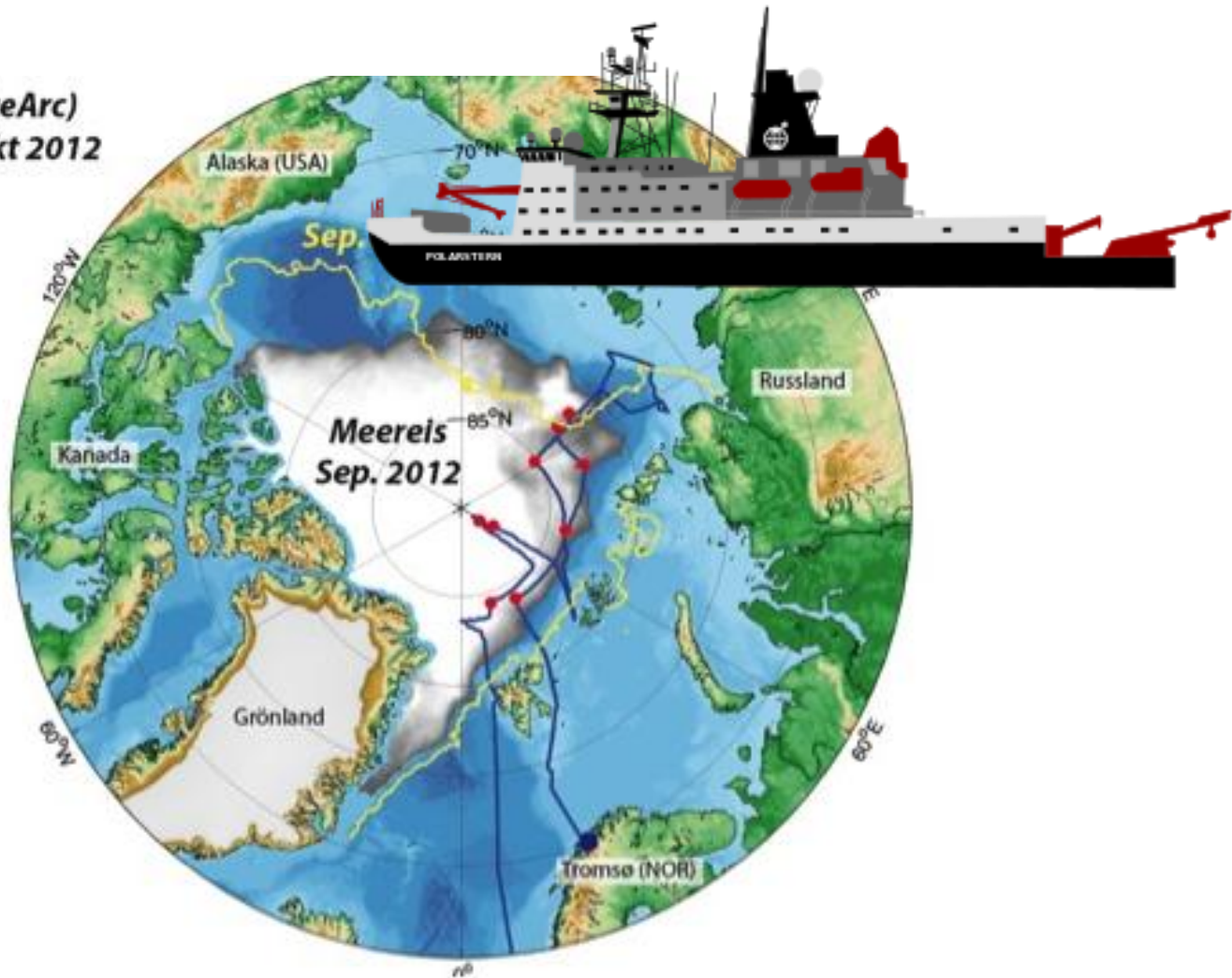
Data mining

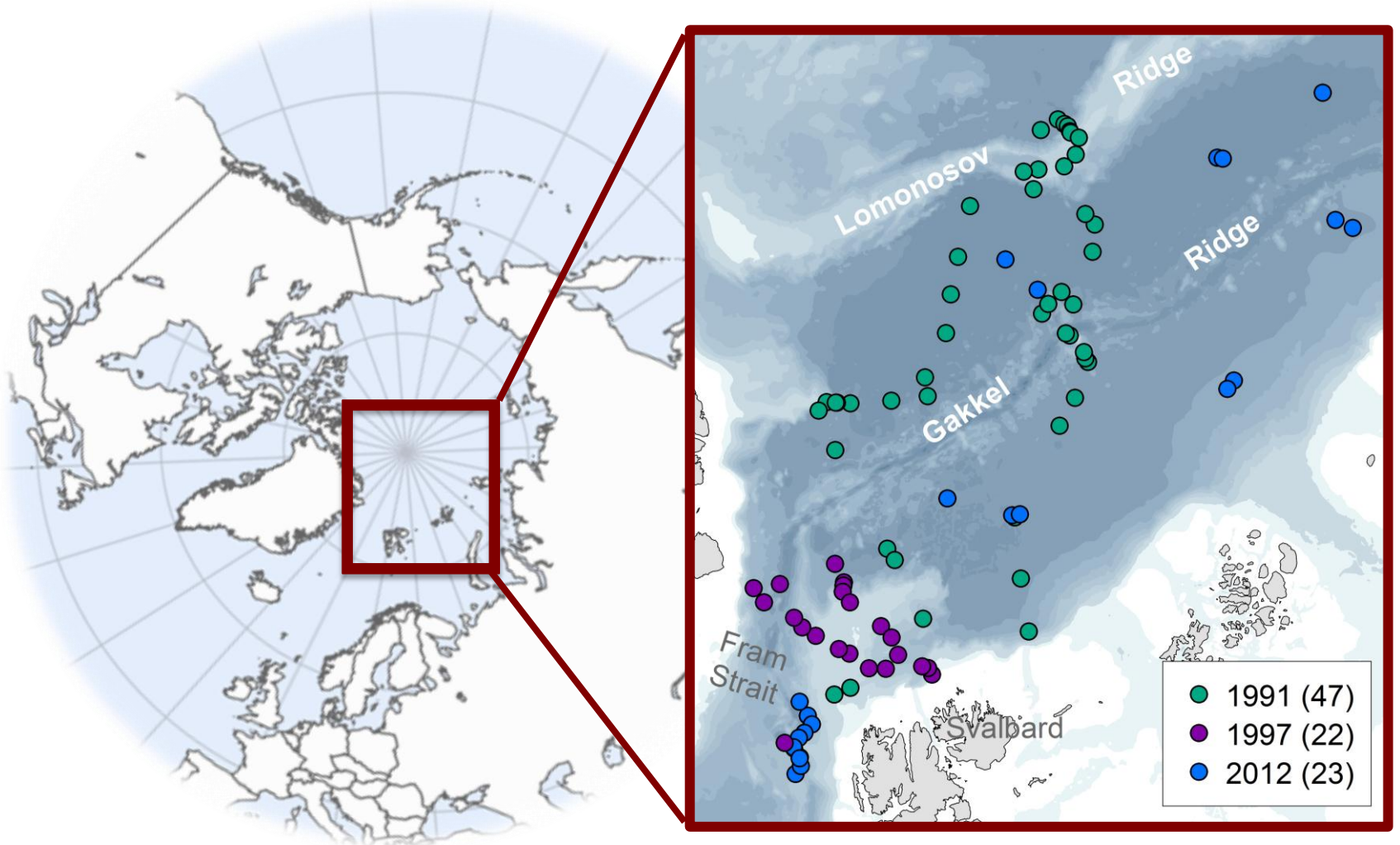


Ice Arc cruise 2012



ARK-XXVII/3 (IceArc)
02. Aug - 08. Okt 2012

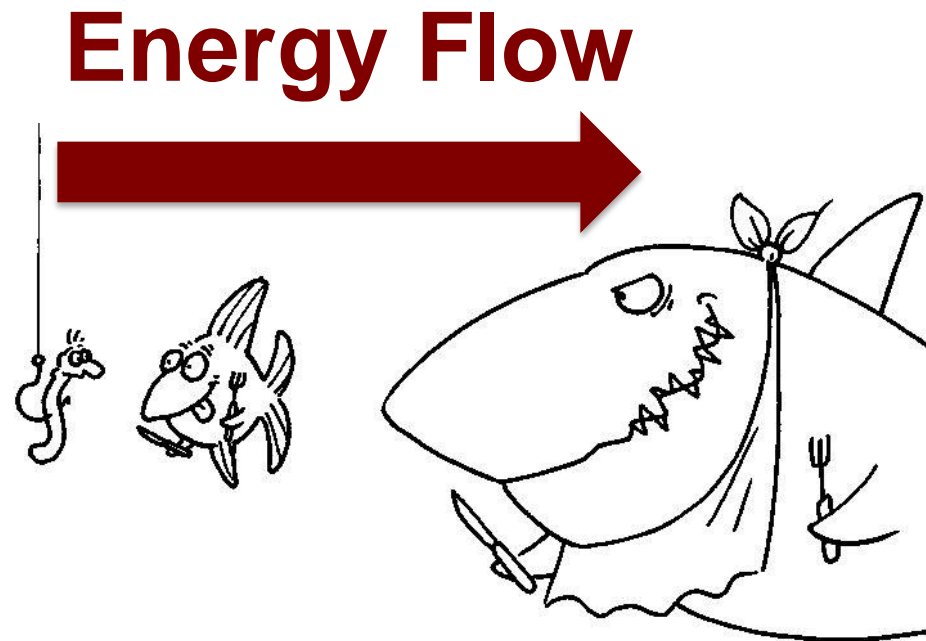




❖ PANGAEA (<http://doi.pangaea.de/10.1594/PANGAEA.828348>)

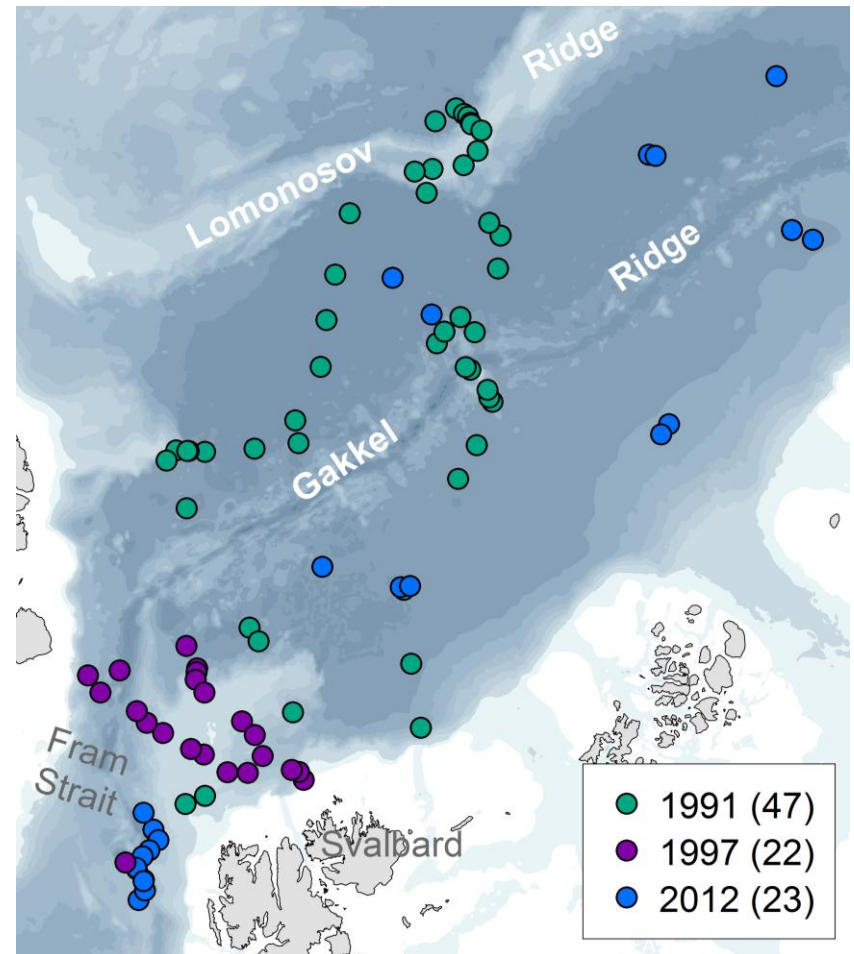
Benthic secondary production

- New biomass formed per unit area and time ($\text{g C m}^{-2} \text{y}^{-1}$).



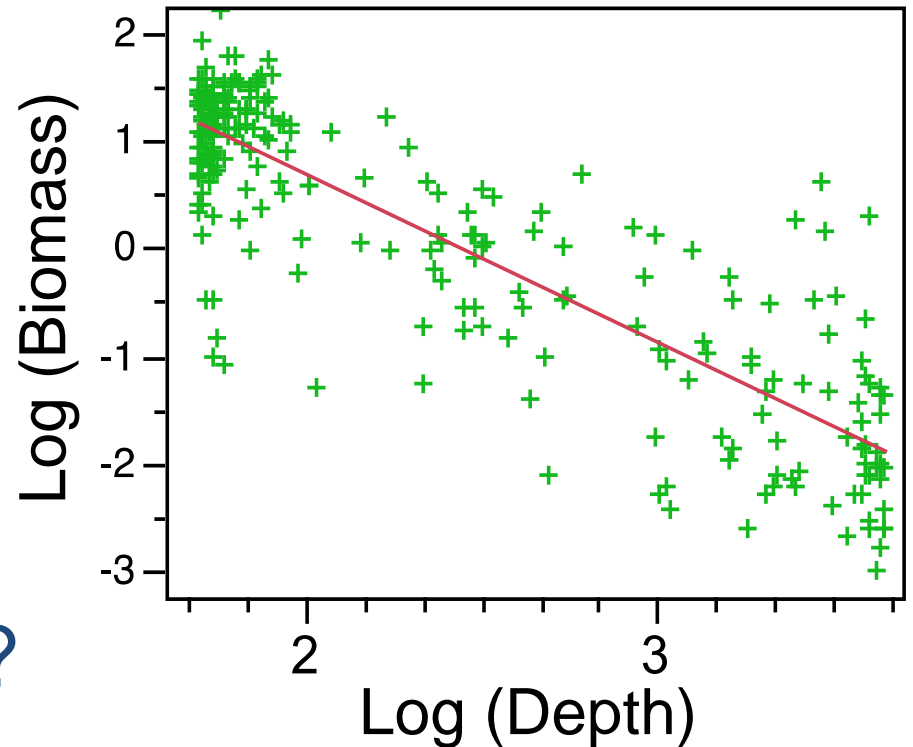
Part I: Production

- Patterns?
- Drivers?



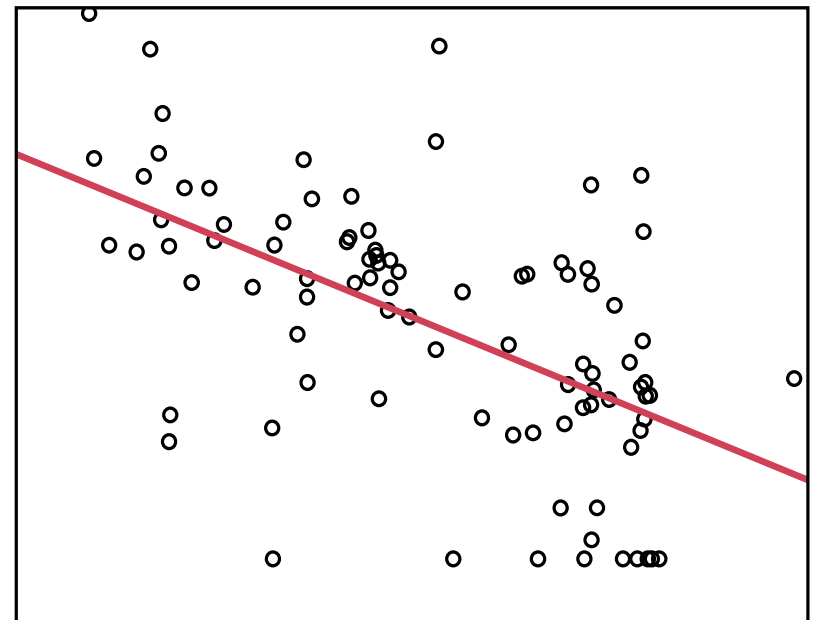
Current knowledge

- Water depth
- Latitude
- Latitude (- Depth)?
- Sea Ice?
- Regions?



Production ($\text{mg C m}^{-2} \text{y}^{-1}$)

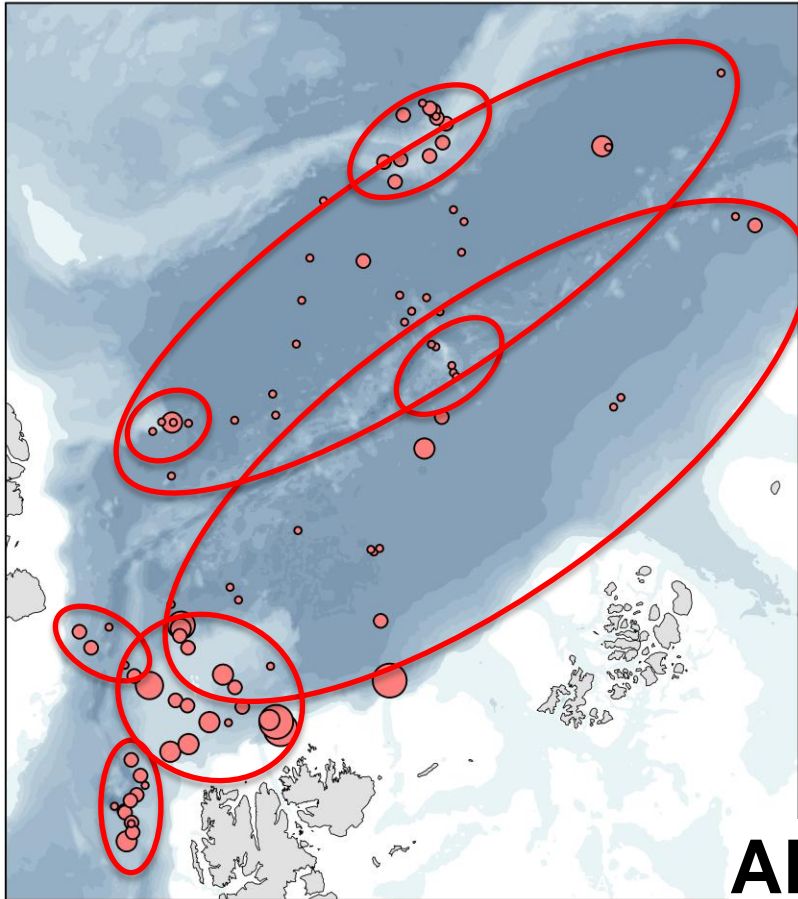
	R^2
Depth	0.32
Latitude	0.19
Sea Ice	0.11



Depth (m)

➤ **ANCOVA**

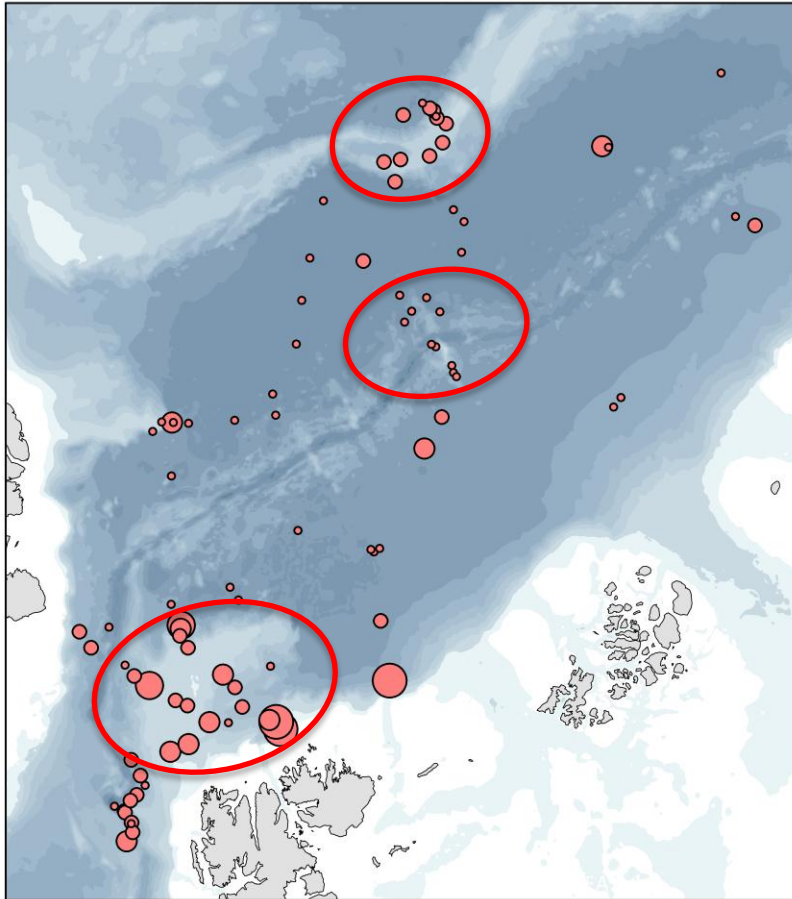
Regions differ significantly



- Lomonosov Ridge
- Amundsen Basin
- Morris Jesup Rise
- Gakkel Ridge
- Nansen Basin
- Fram Strait
- Yermak Plateau
- NW-Spitsbergen

ANCOVA	R²	p
Production	0.56	< 0.0001

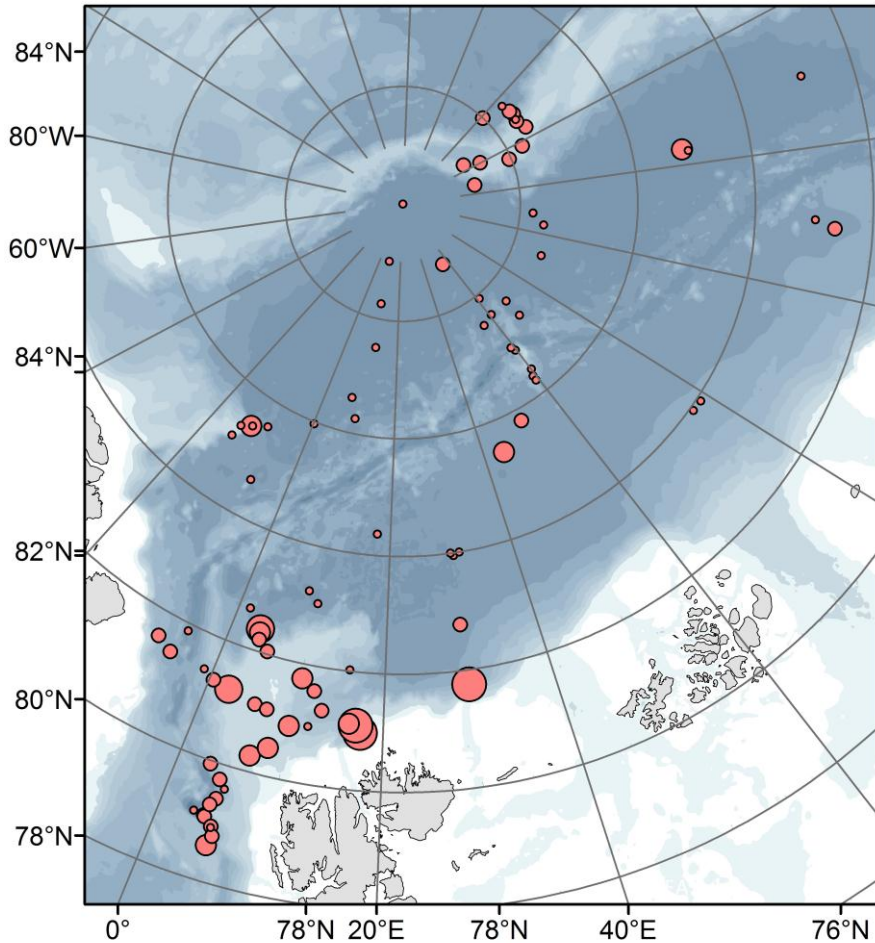
Regional differences **visible**



P (mg C
m⁻² y⁻¹)

Lomonosov Ridge	42 - 130
Amundsen Basin	0 - 109
Morris Jesup Rise	4 - 205
Gakkel Ridge	0 - 12
Nansen Basin	1 - 1580
Fram Strait	9 - 70
Yermak Plateau	9 - 2530
NW-Spitsbergen	12 - 182

Latitudinal bands differ significantly



Latitude (°N)

90-88

88-86

86-84

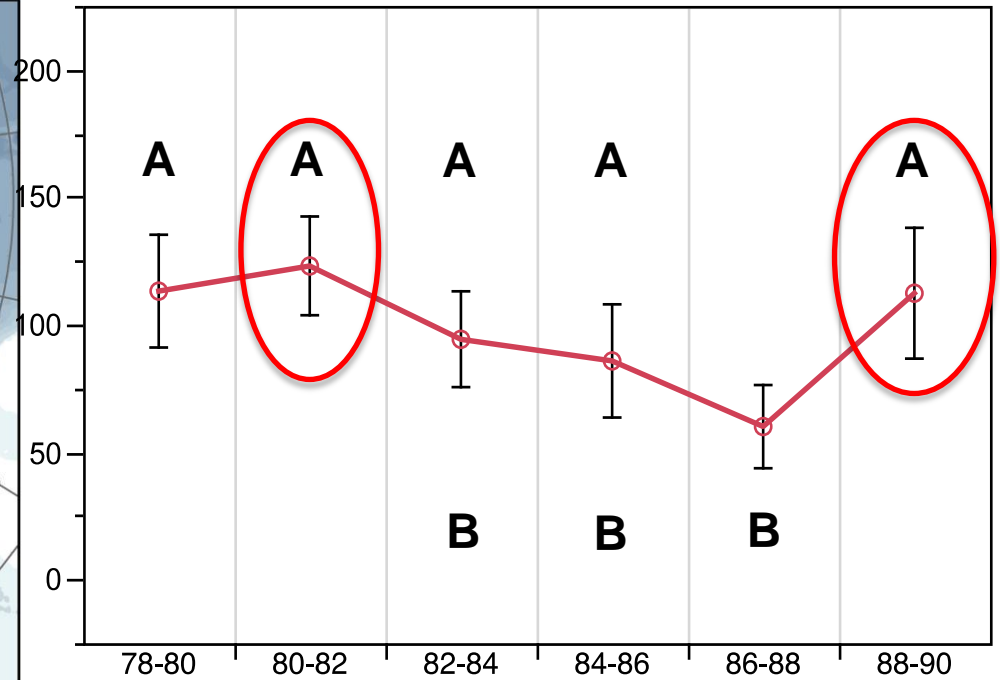
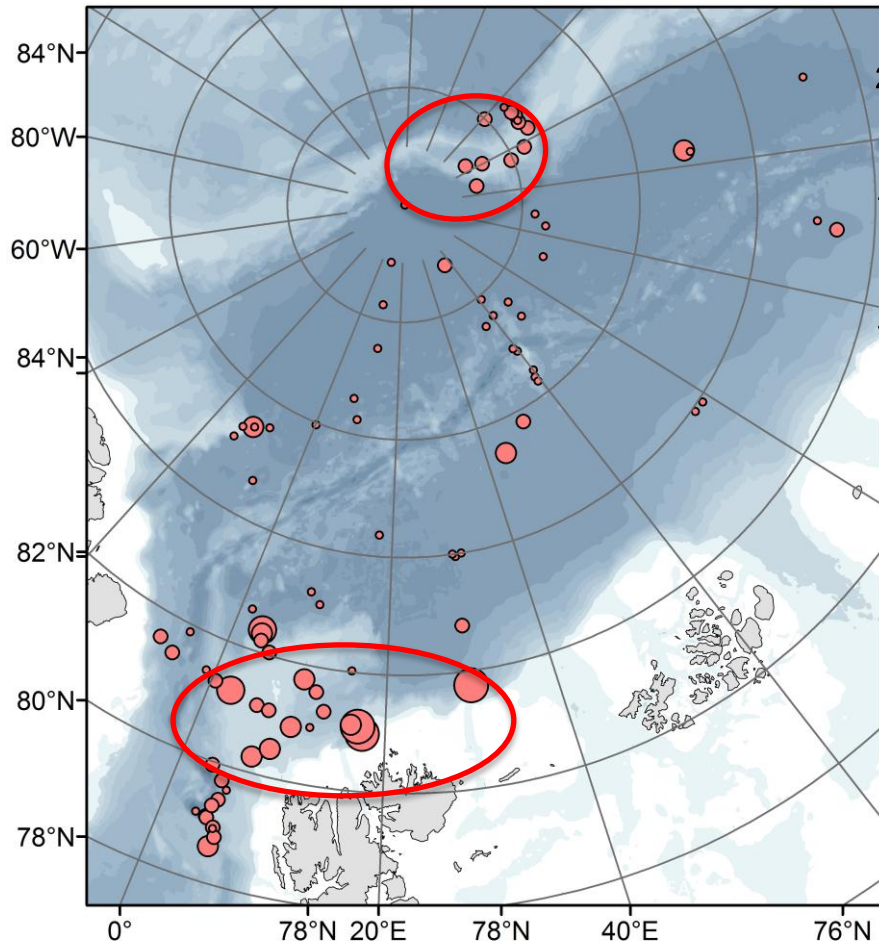
84-82

82-80

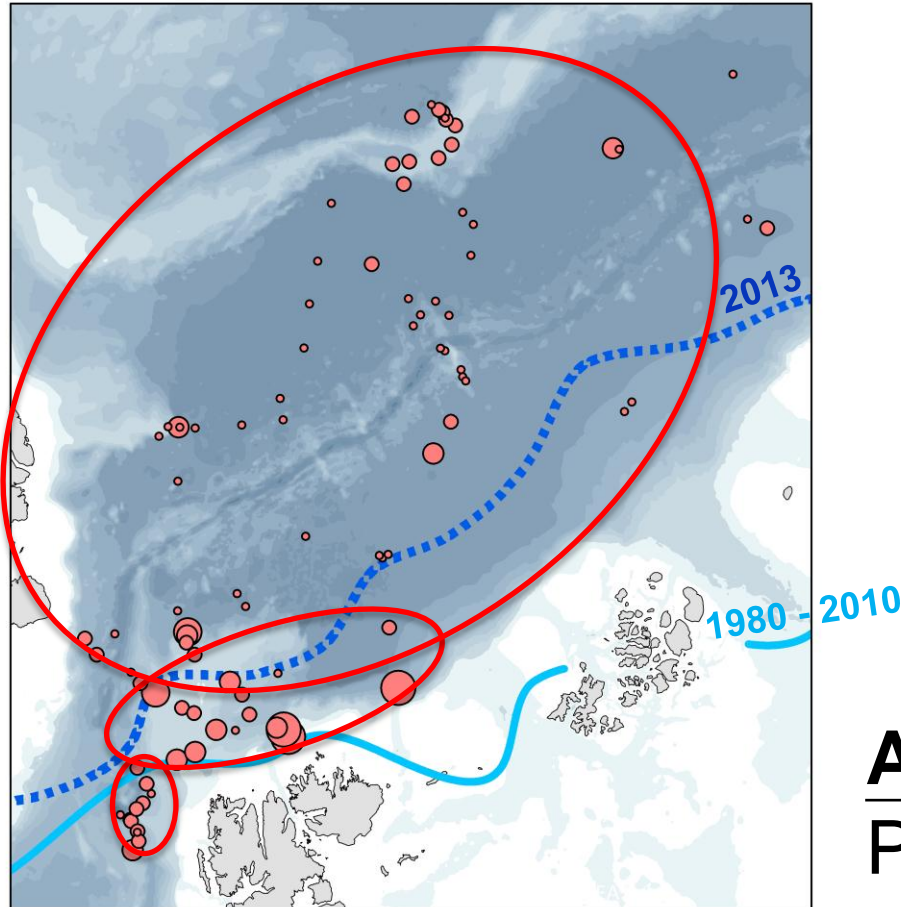
80-78

ANCOVA	R²	p
Production	0.5	< 0.0001

Latitudinal trend visible, but weak



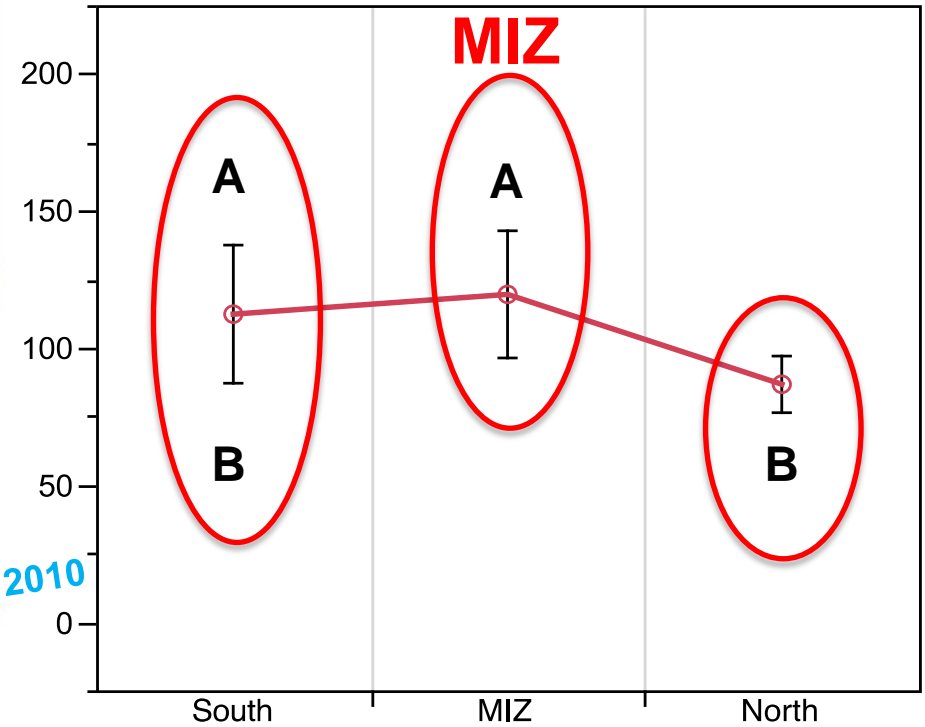
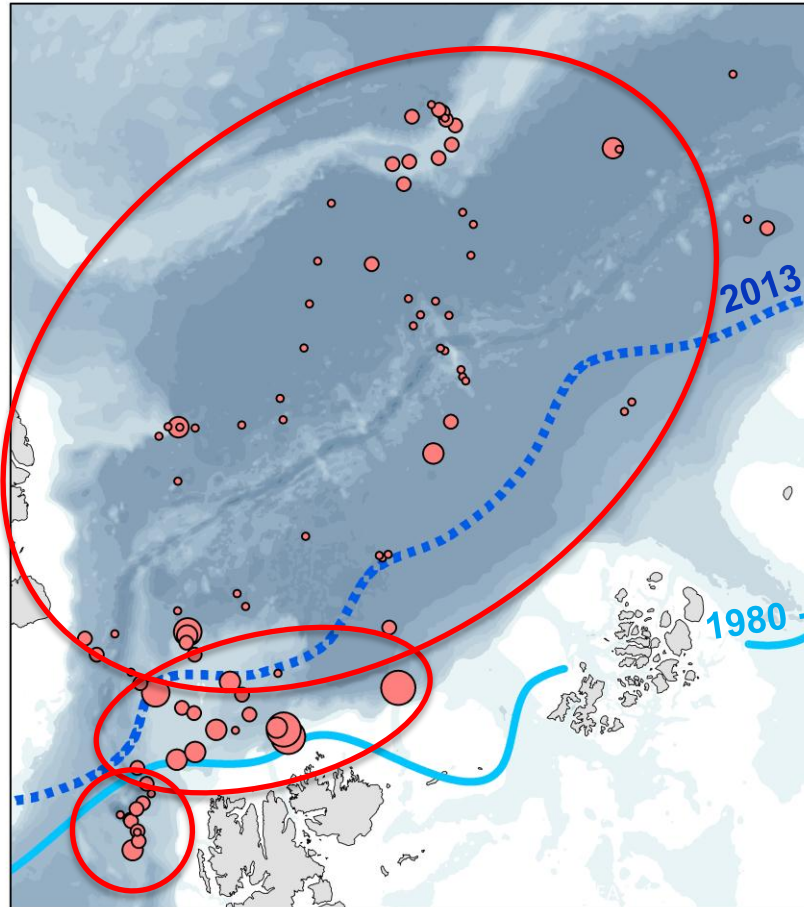
Sea ice zones differ significantly



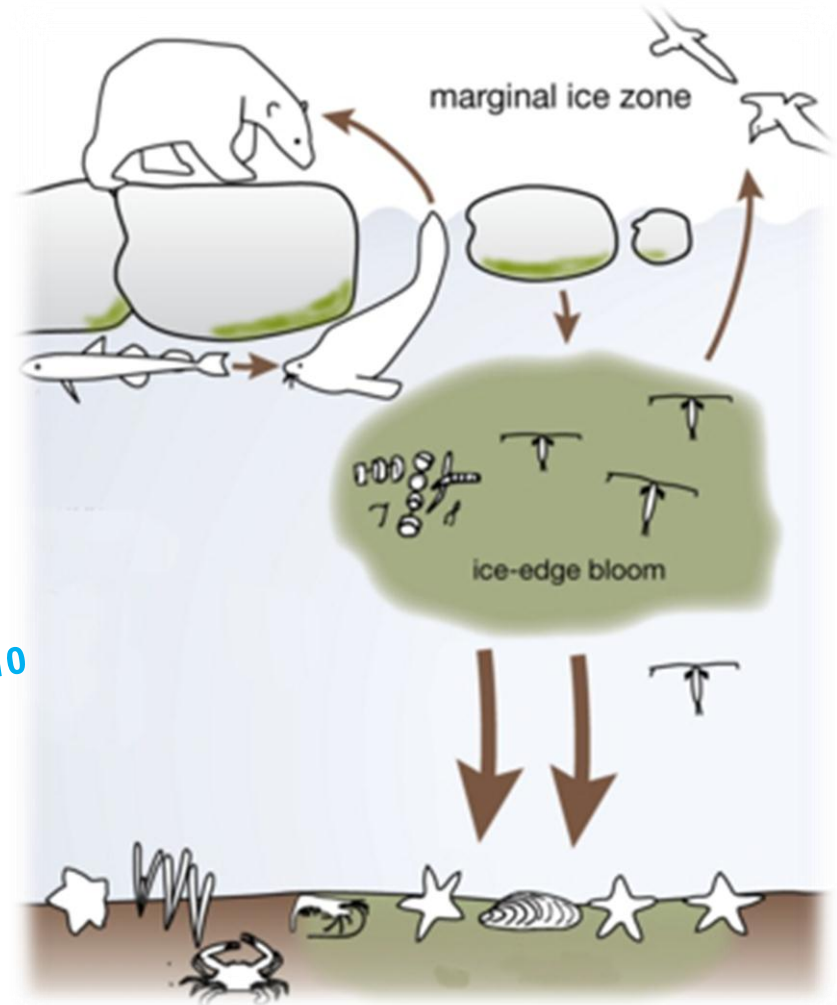
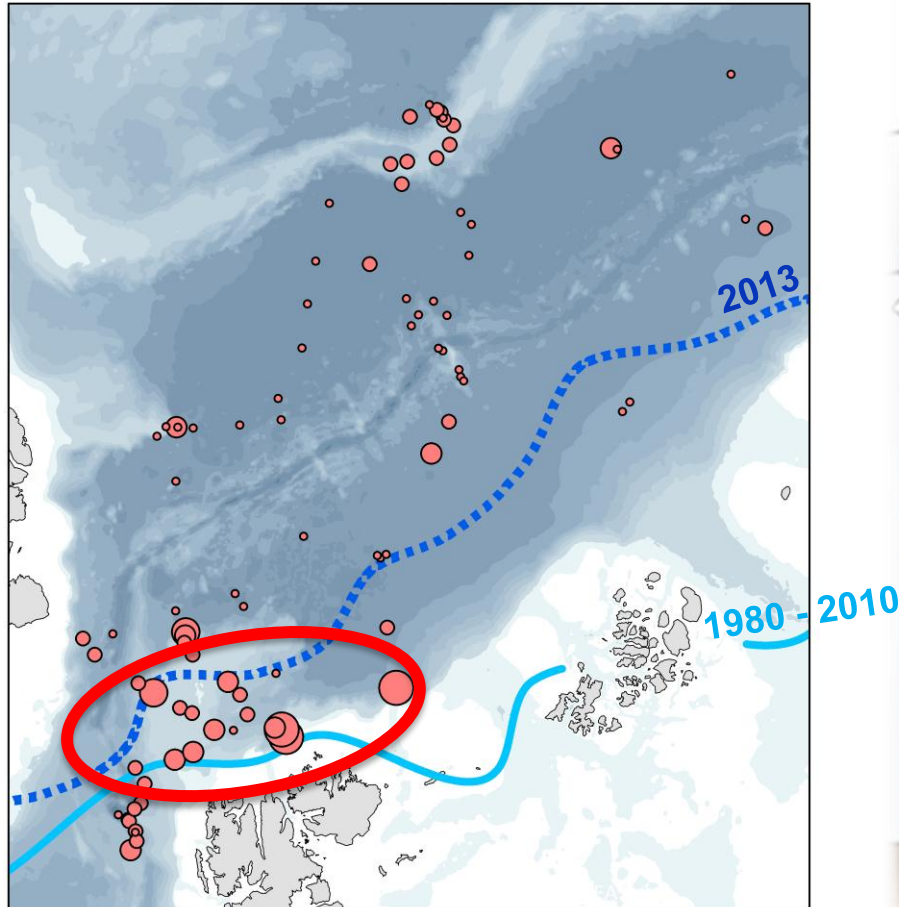
South
Marginal Ice Zone (MIZ)
North

ANCOVA	R²	p
Production	0.38	0.0173

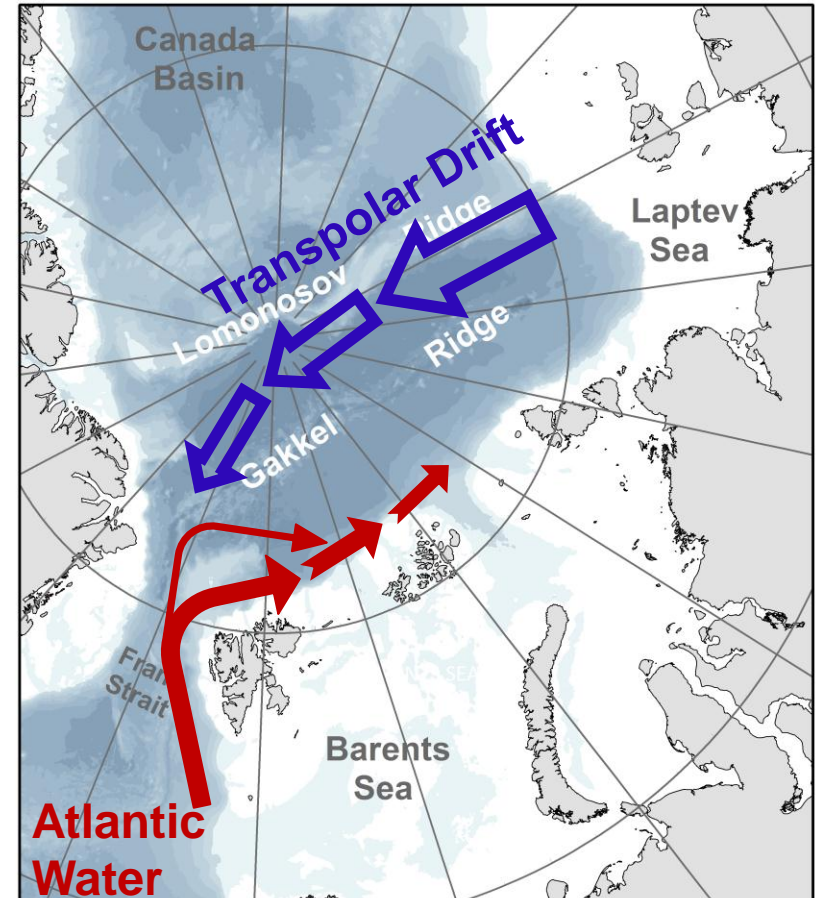
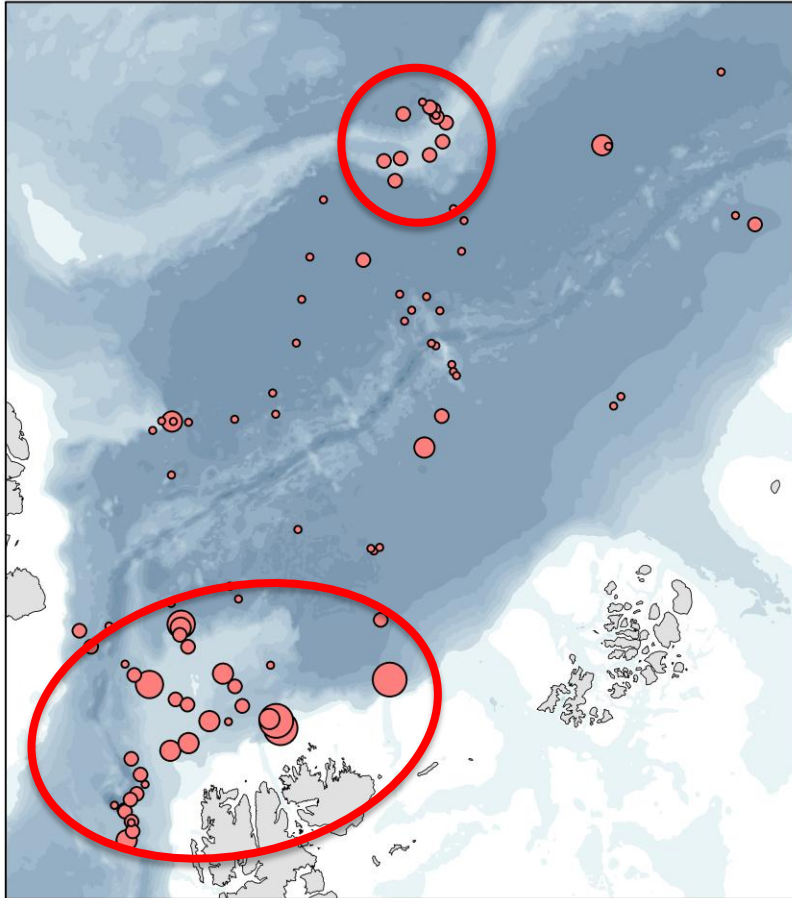
Sea ice effect is visible



High P in high vertical flux area



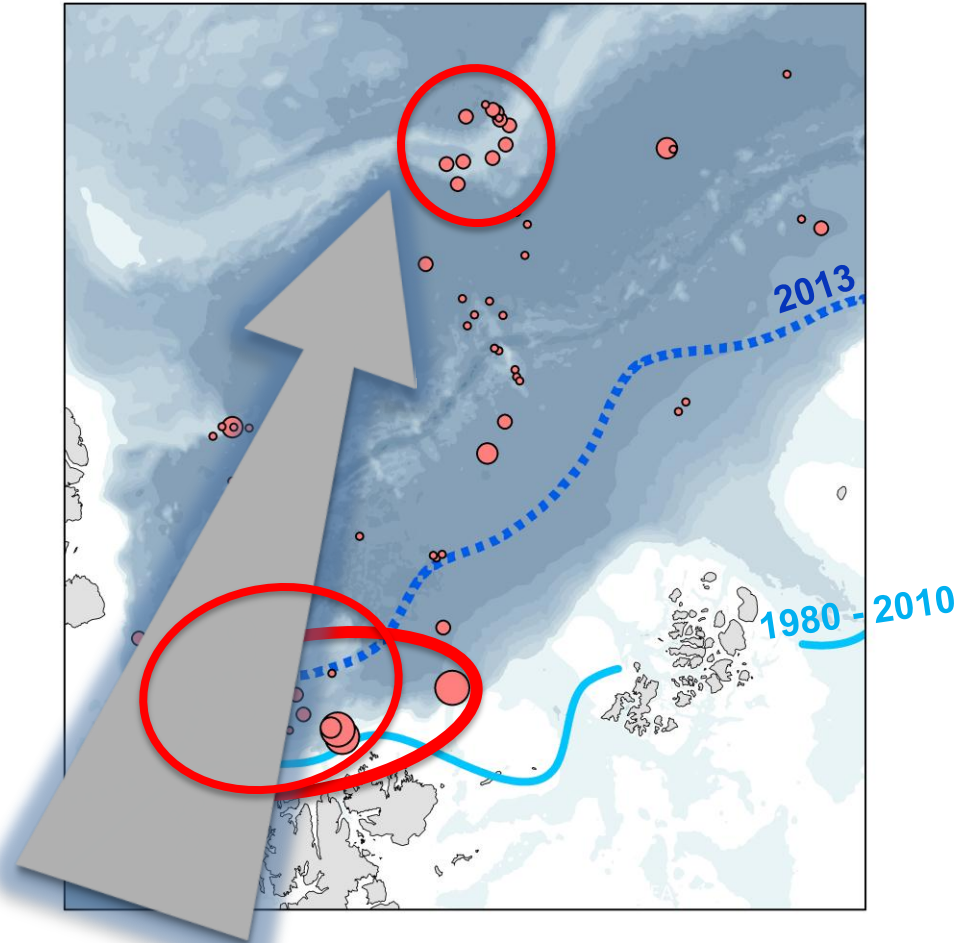
High P fueled by lateral transport



Conclusions part I

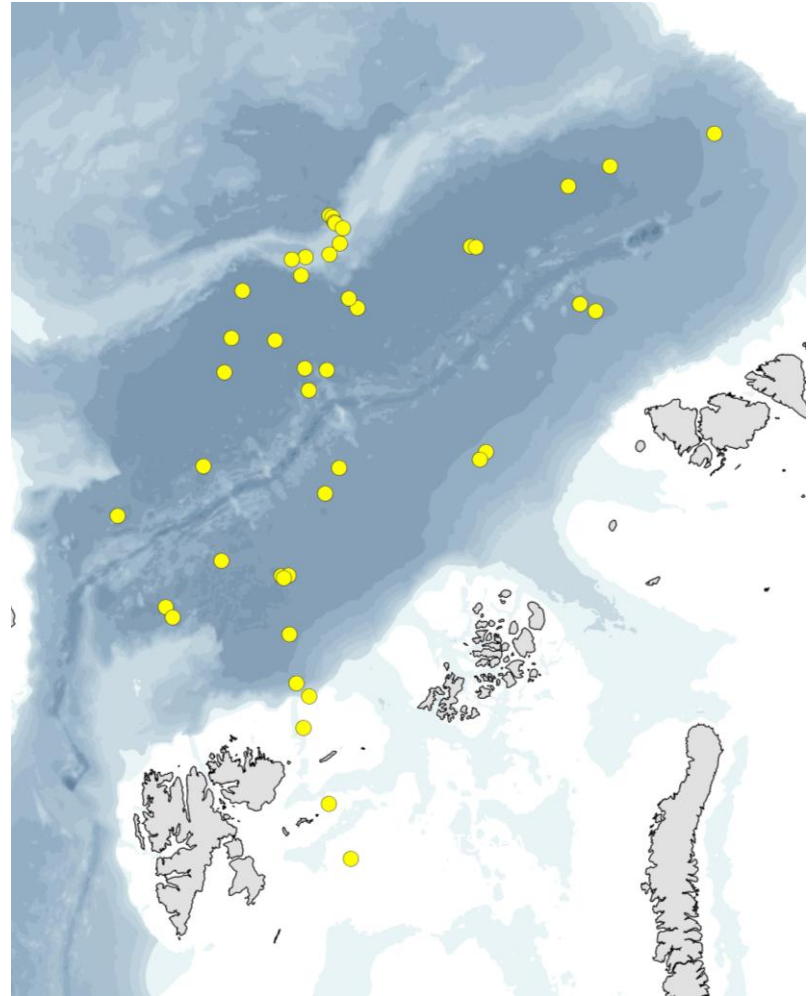
- Depth effect
- Sea ice effect
- Latitudinal effect
- Regional effect

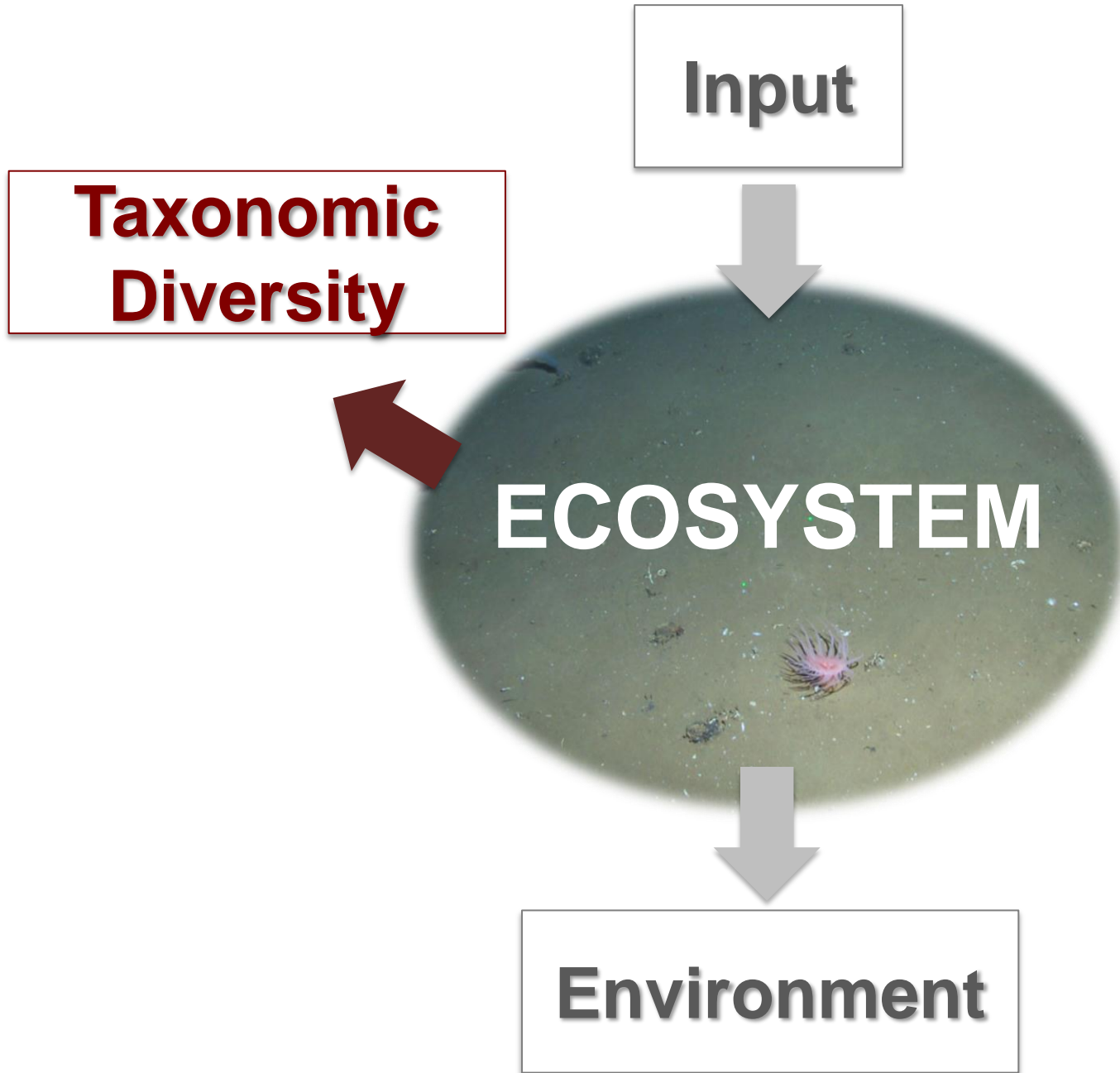
- Function?

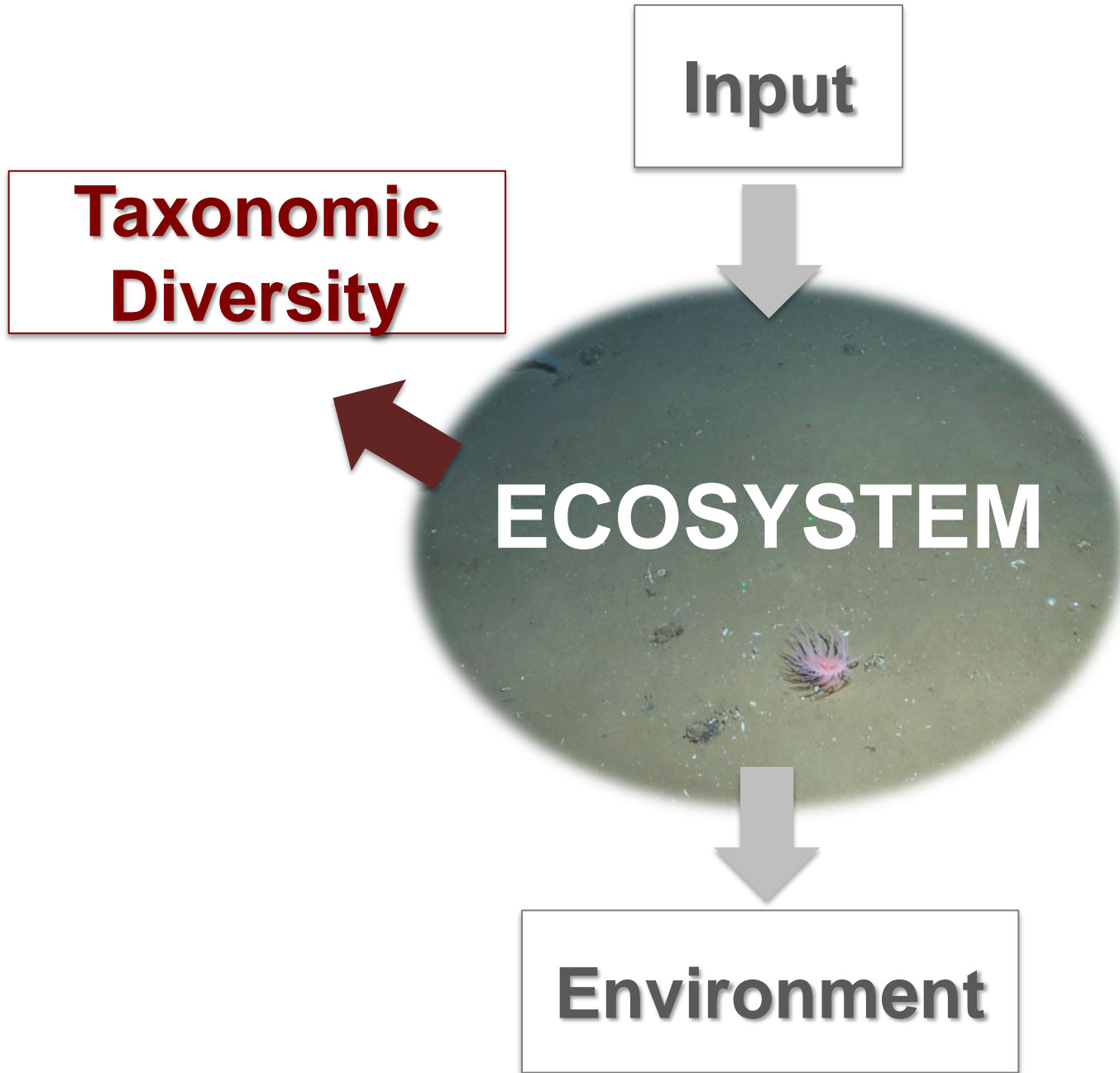


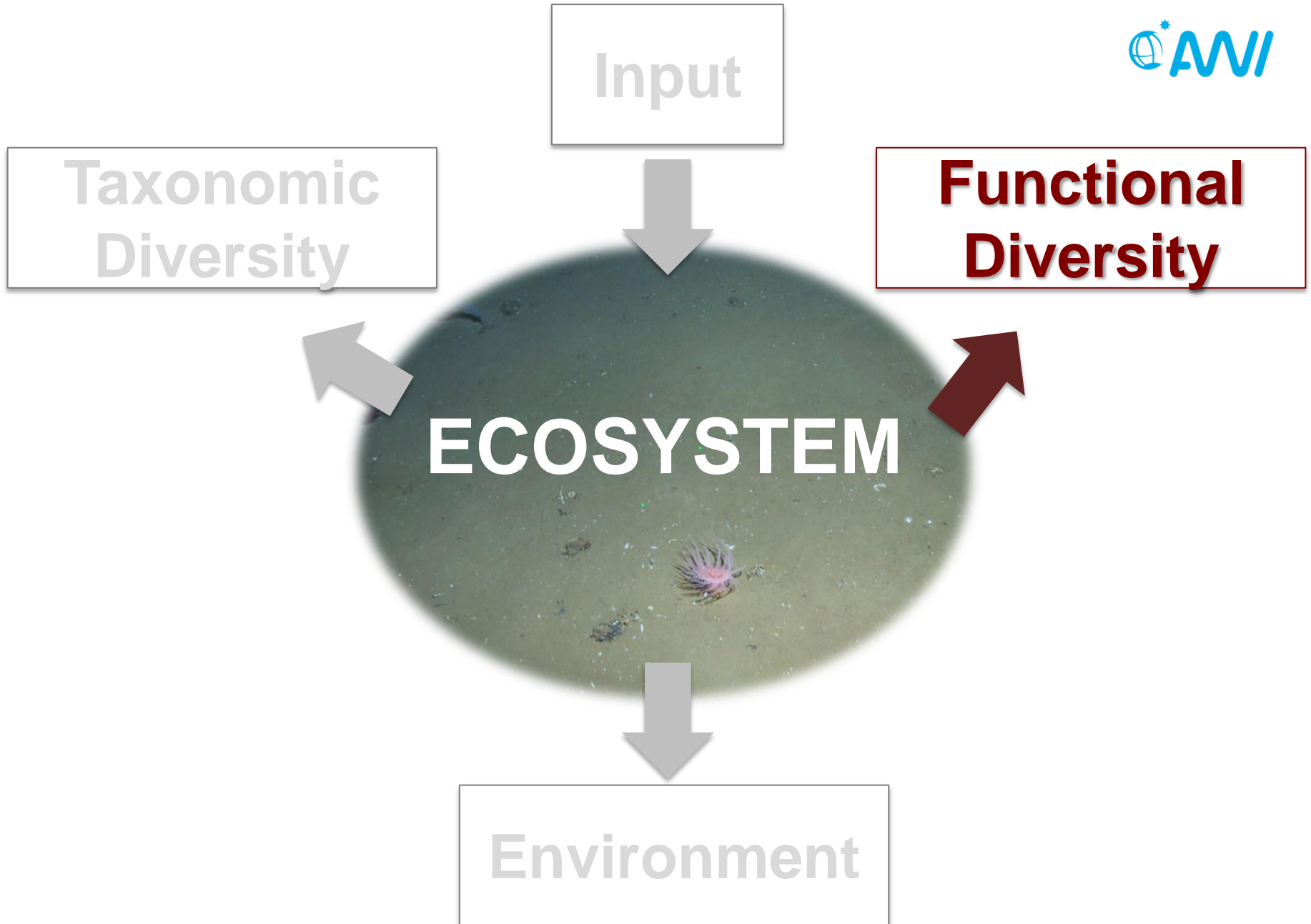
Part II: Functions

- Patterns?
- Drivers?







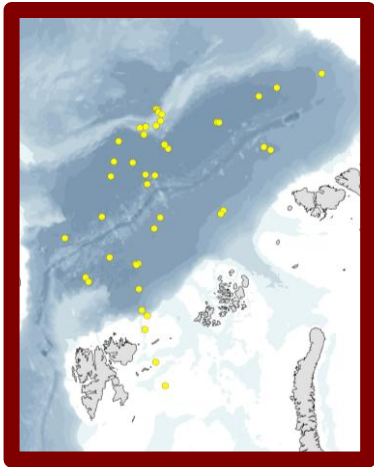


What are functional traits?

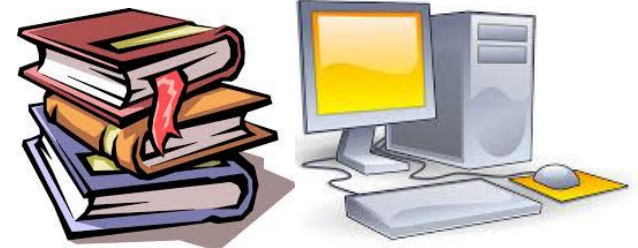


Assessment of functional diversity
Patterns
Climate change

Biological Trait Analysis (BTA)

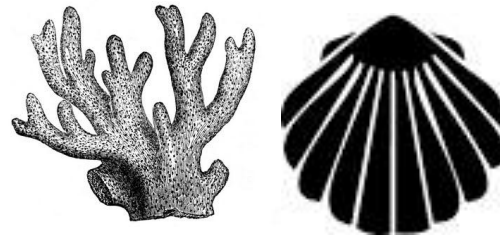


→ **Taxonomy
Production** →



**Traits &
fuzzy coding**

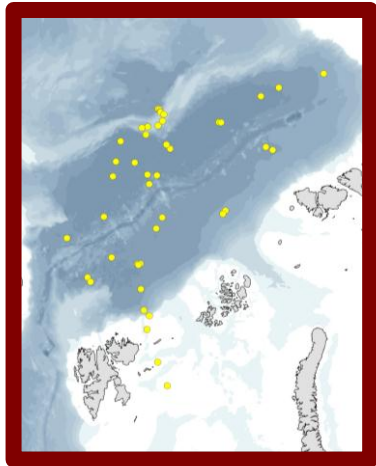
Mobility



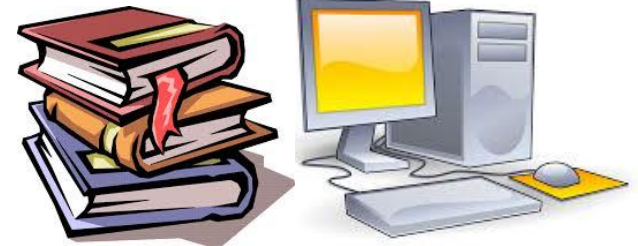
sessile	3	1
motile	0	1
semi-motile	0	2

„Fuzzy Coding“

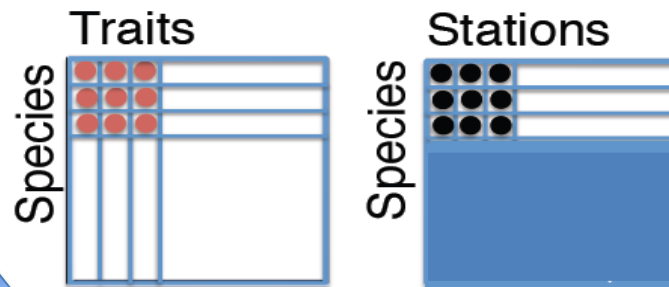
Biological Trait Analysis (BTA)



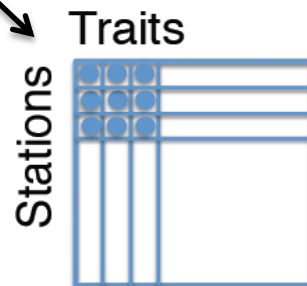
Taxonomy
Production



Traits &
fuzzy coding

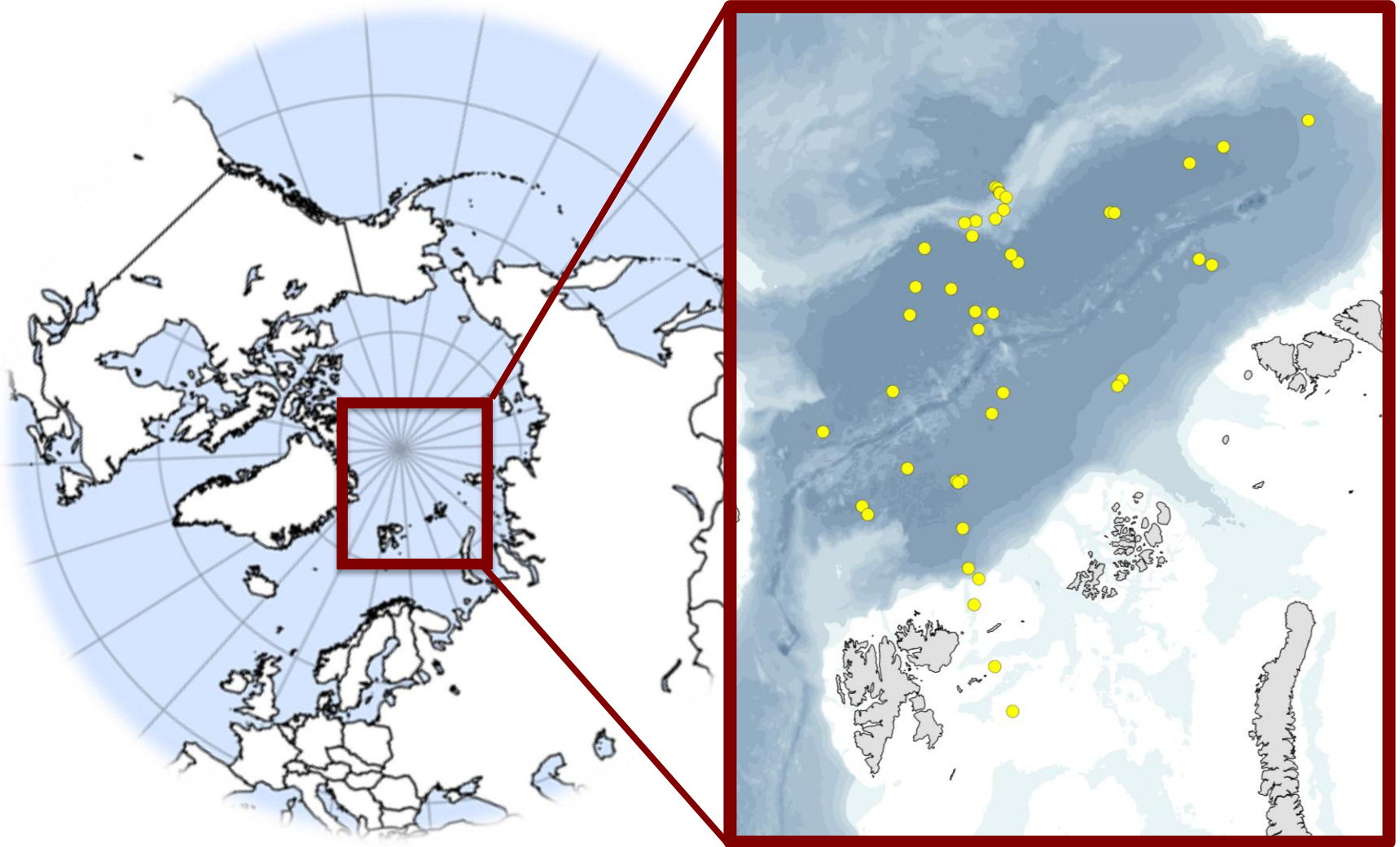


Co-Inertia

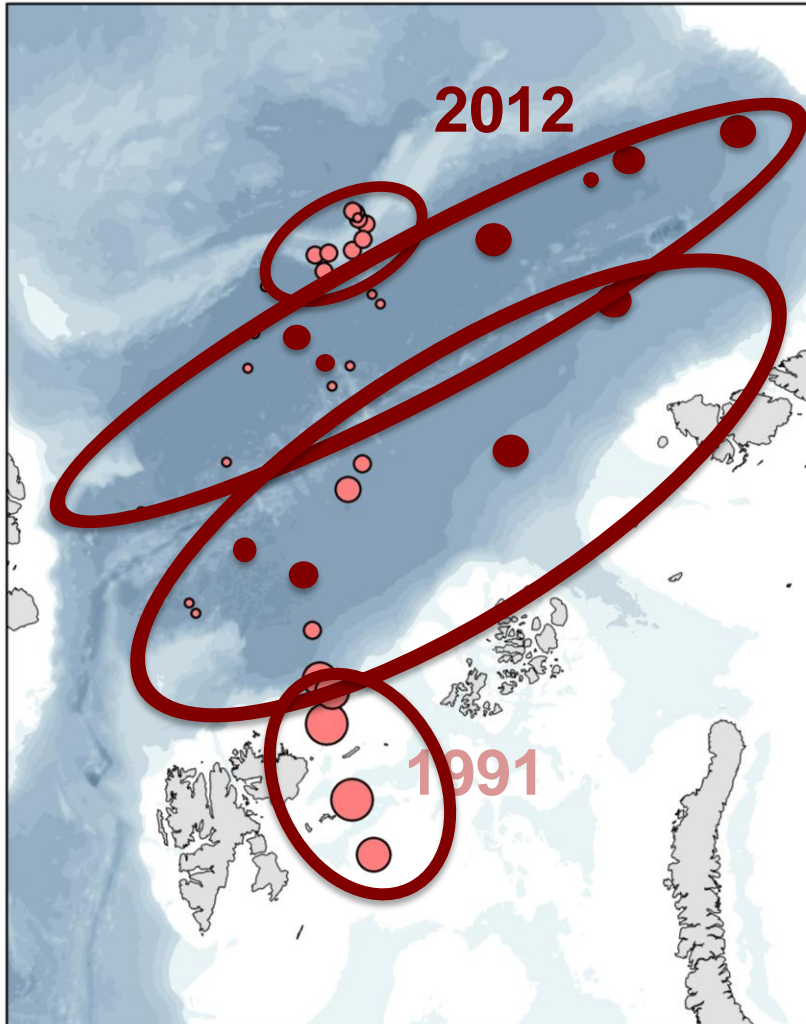


Traits/Region
MDS

Study Area



Secondary Production



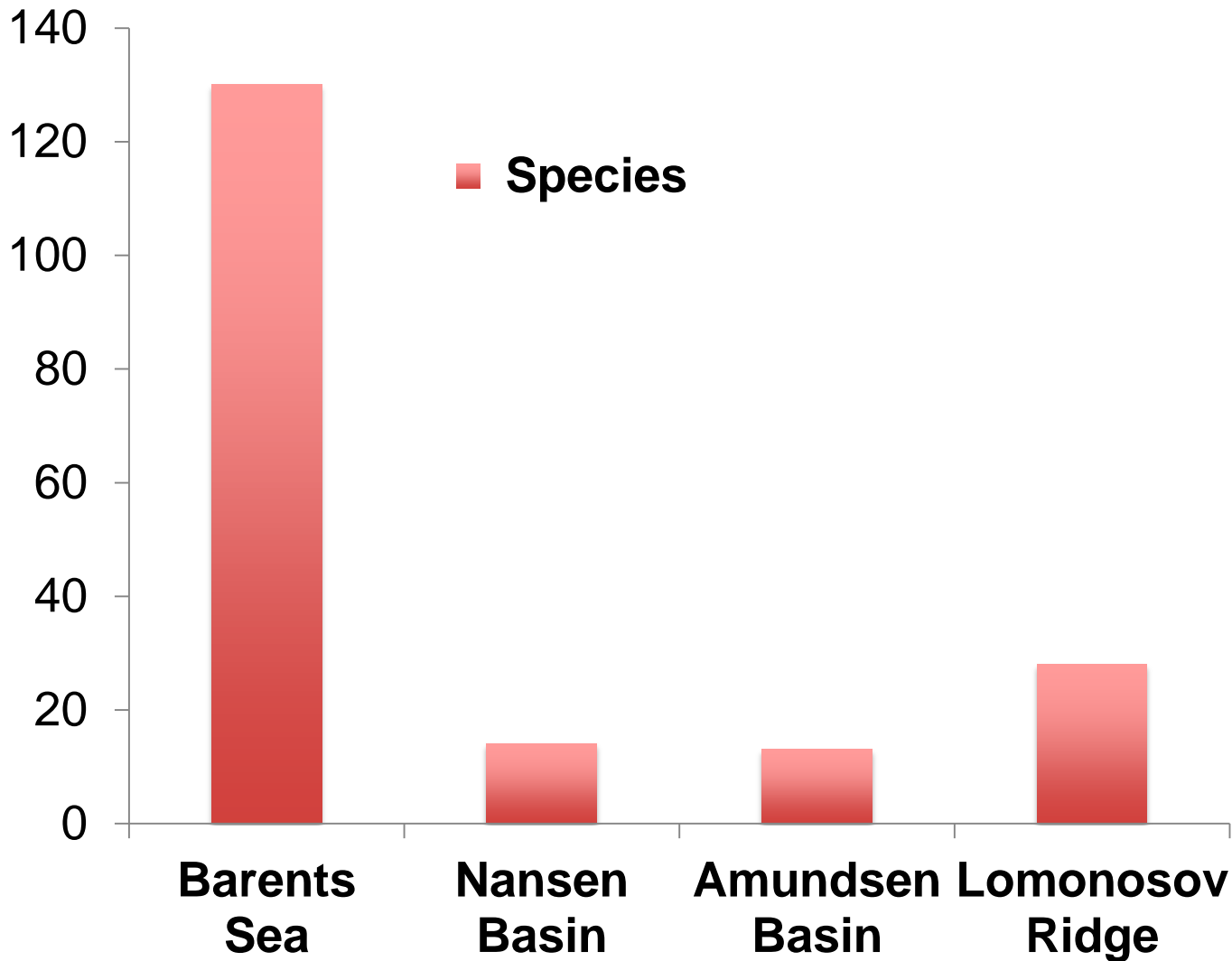
Lomonosov Ridge

Amundsen Basin

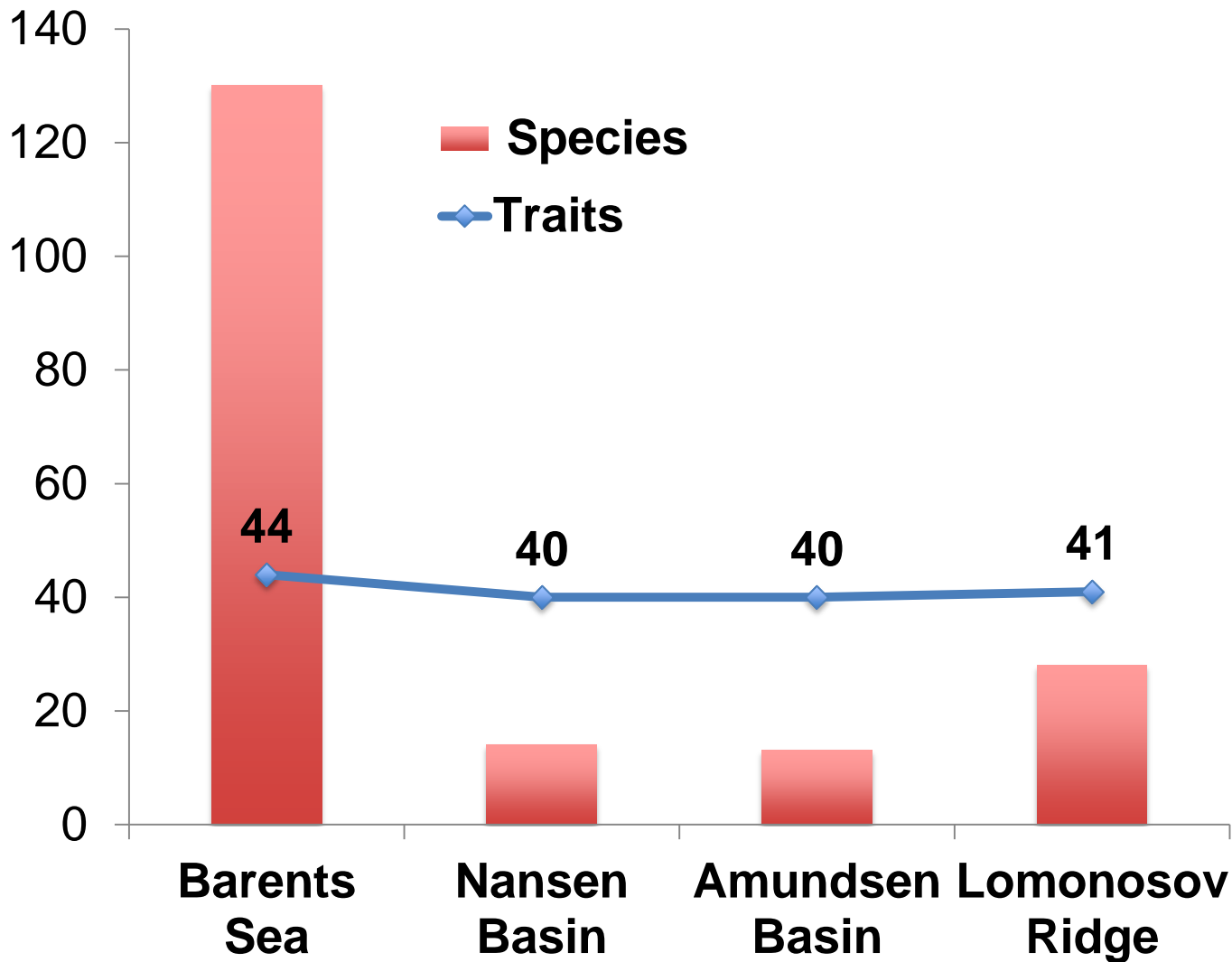
Nansen Basin

Barents Sea

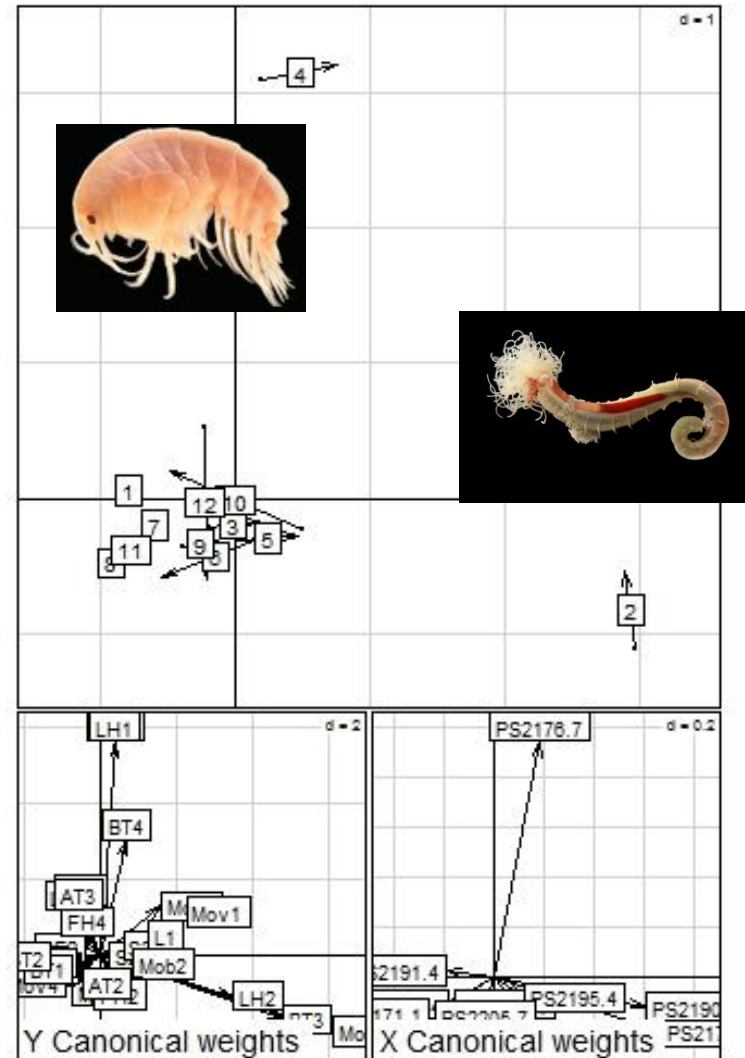
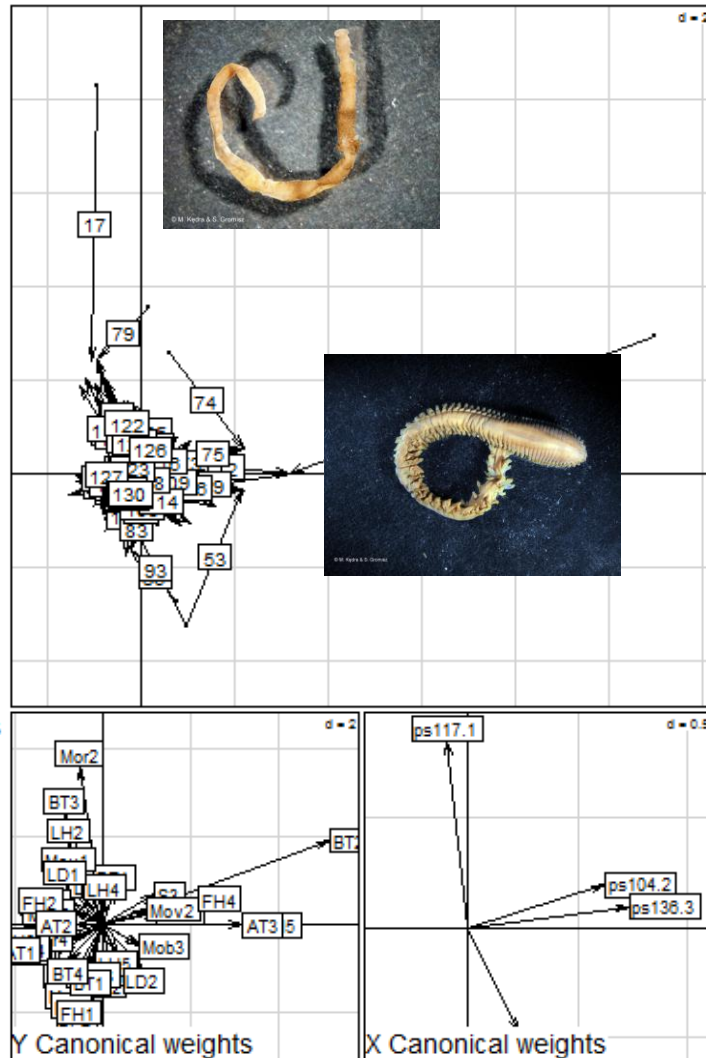
Number of species & traits / Region



Number of species & traits / Region



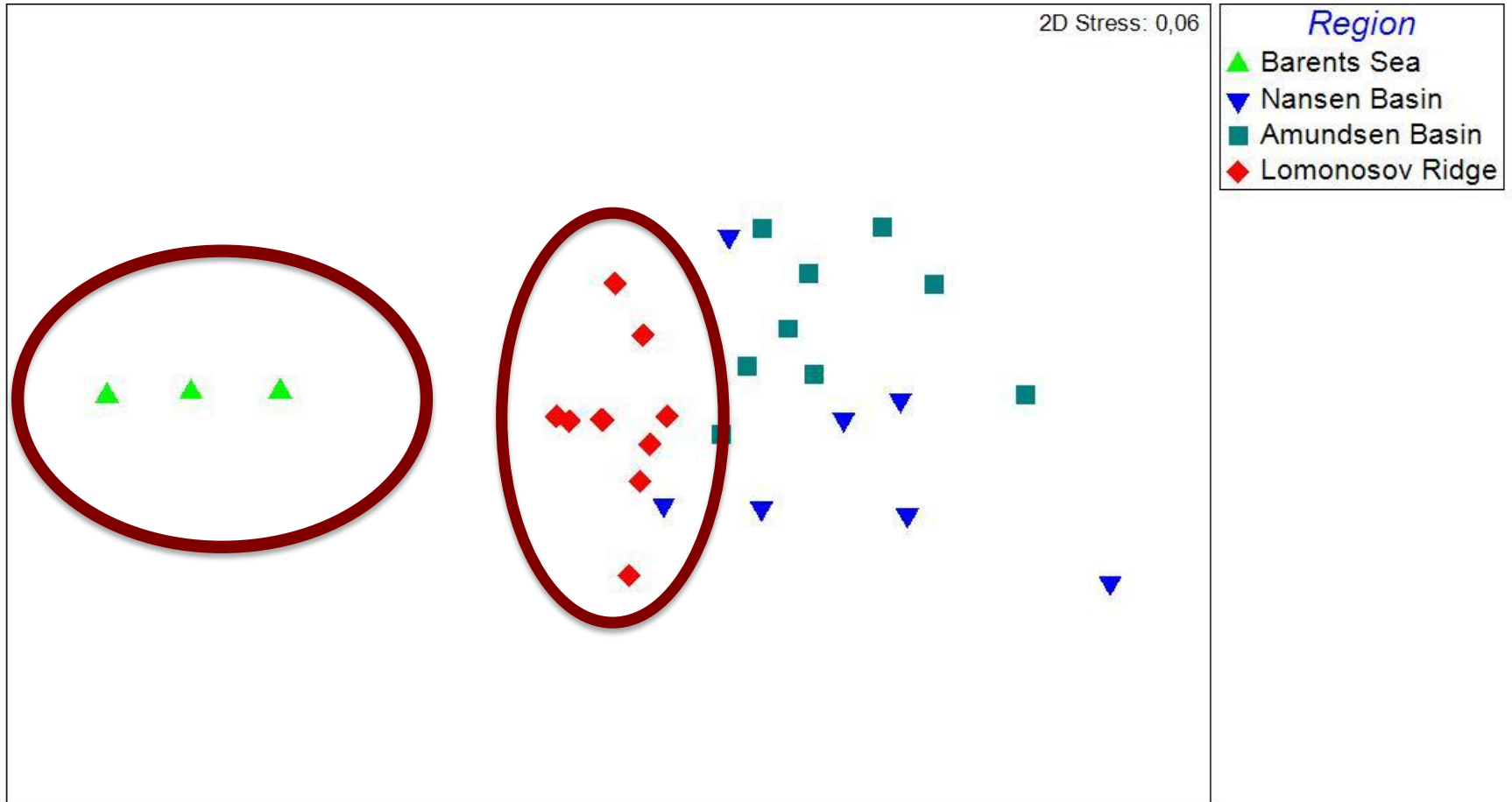
Co-inertia Analysis



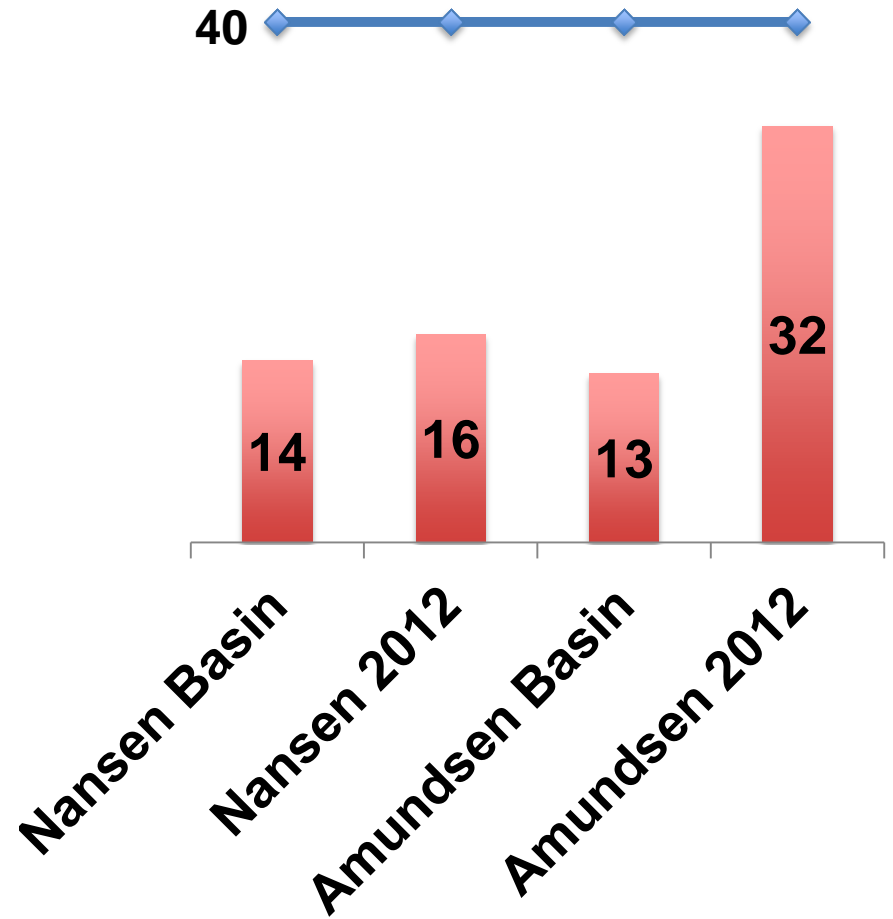
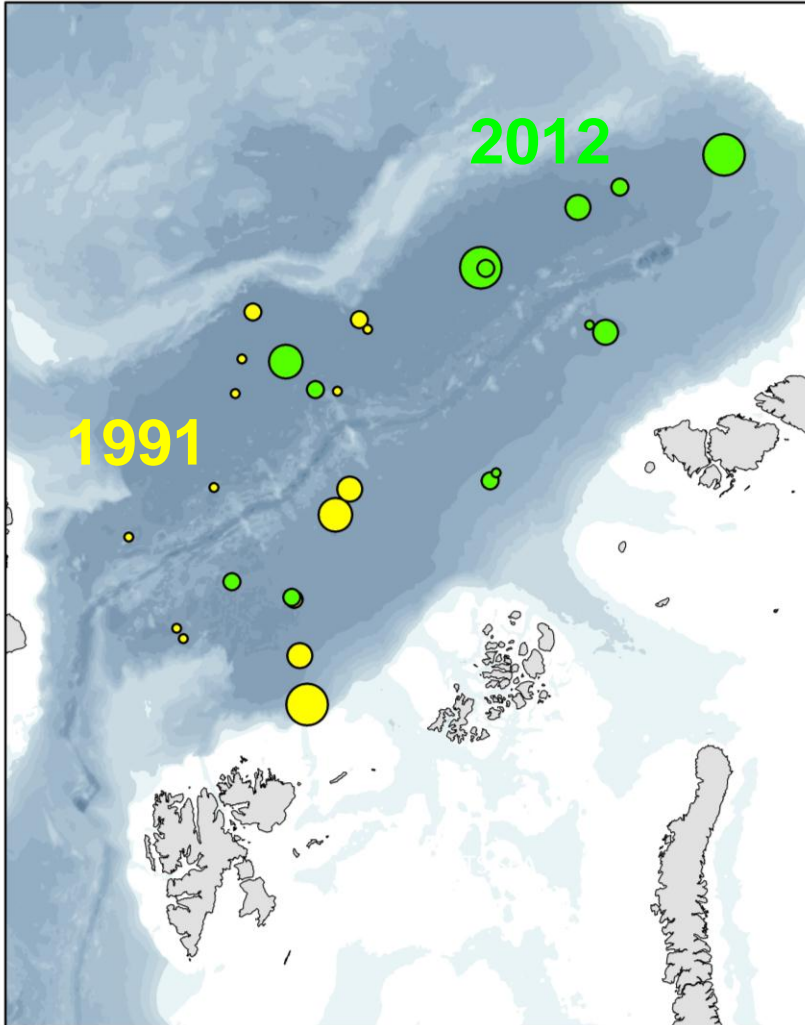
Barents Sea

Amundsen Basin

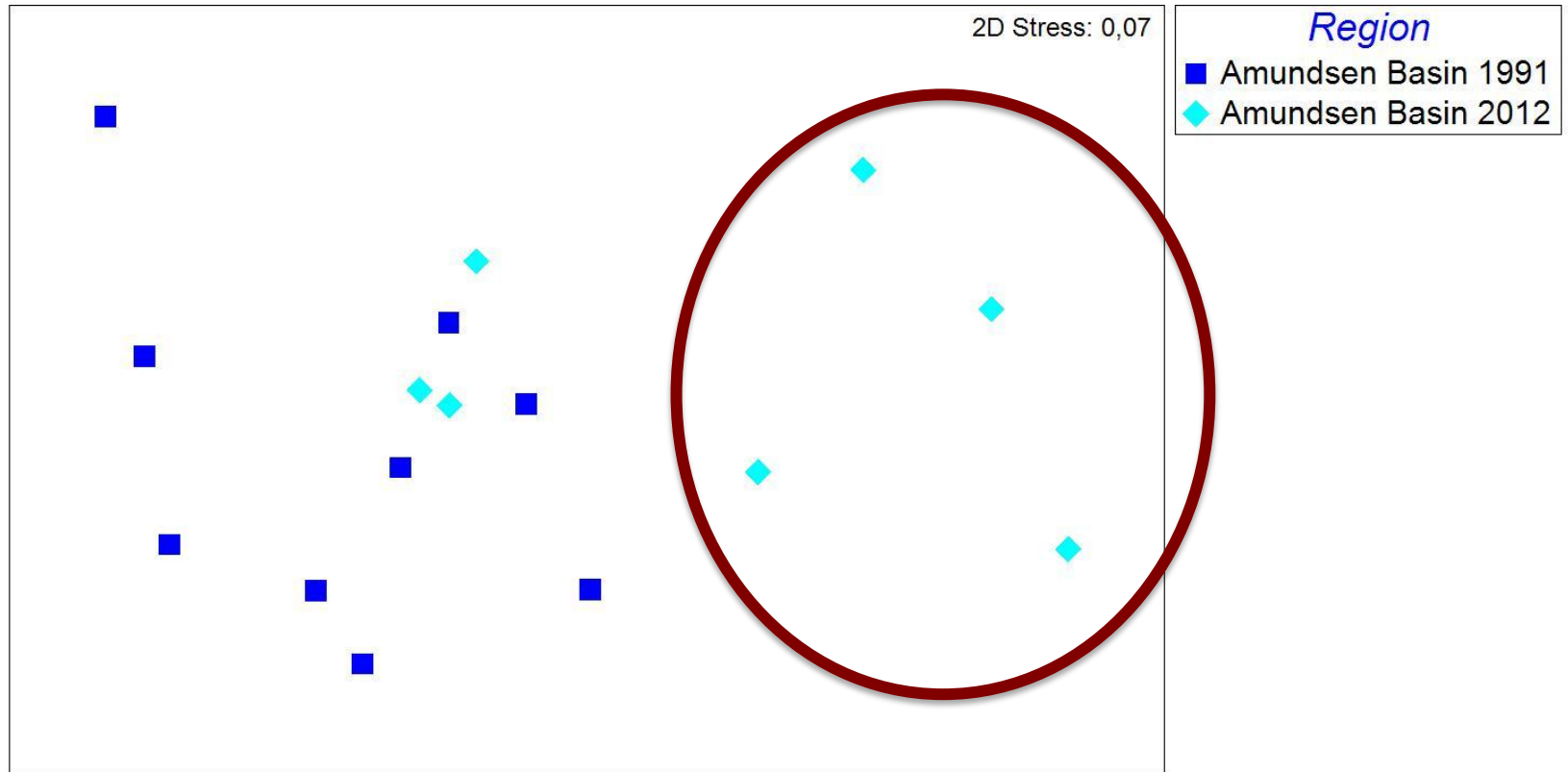
MDS



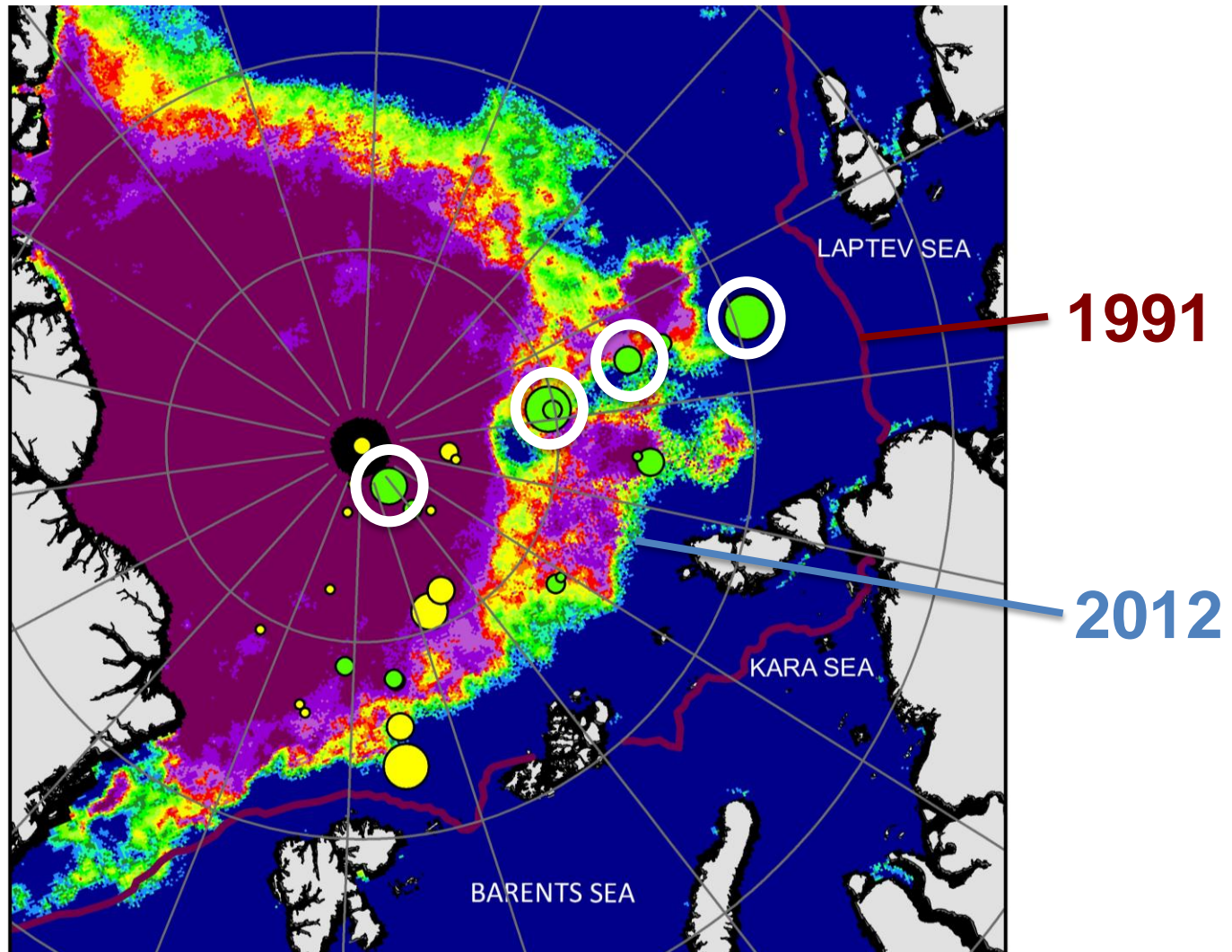
1991 vs 2012



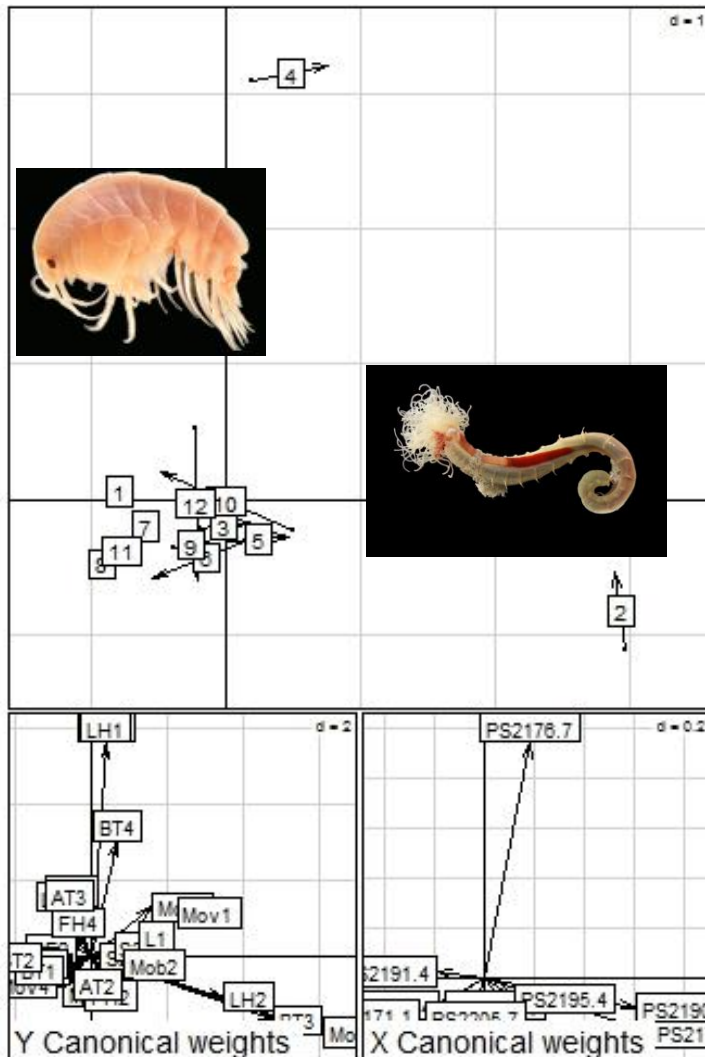
1991 vs 2012: MDS



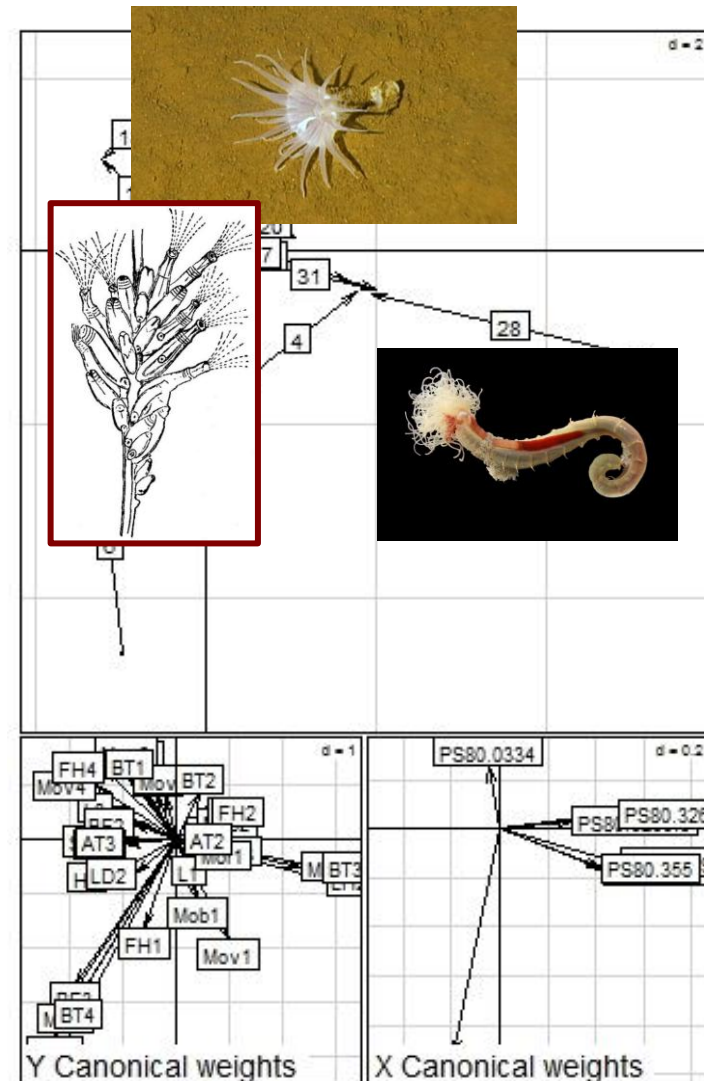
1991 vs 2012: Sea Ice



1991 vs 2012: Co-inertia



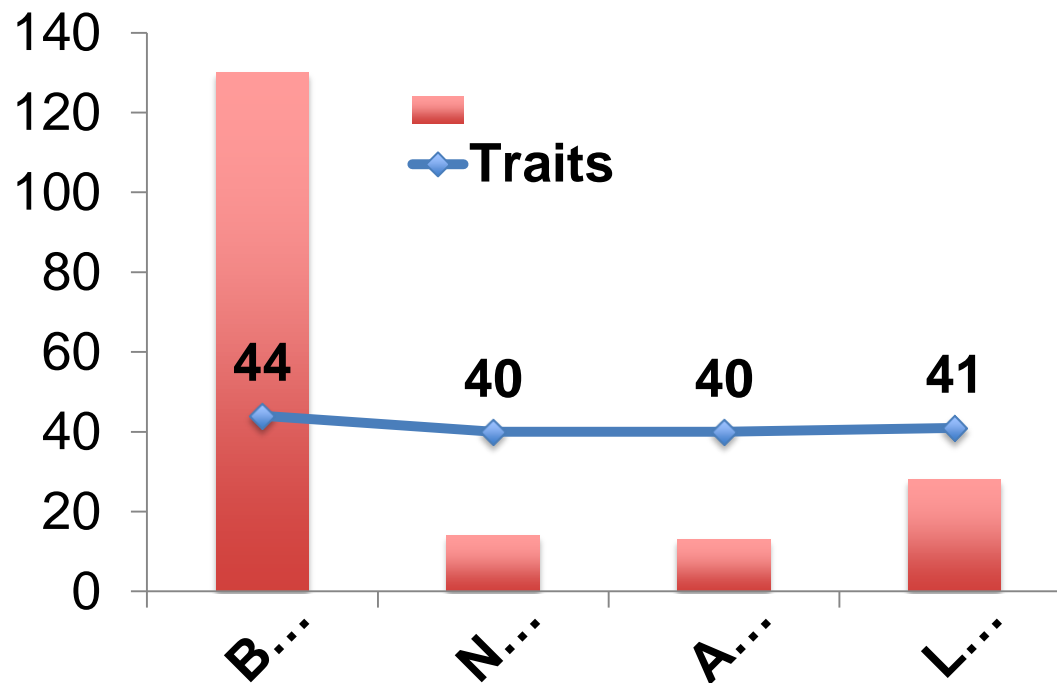
Amundsen 1991



Amundsen 2012

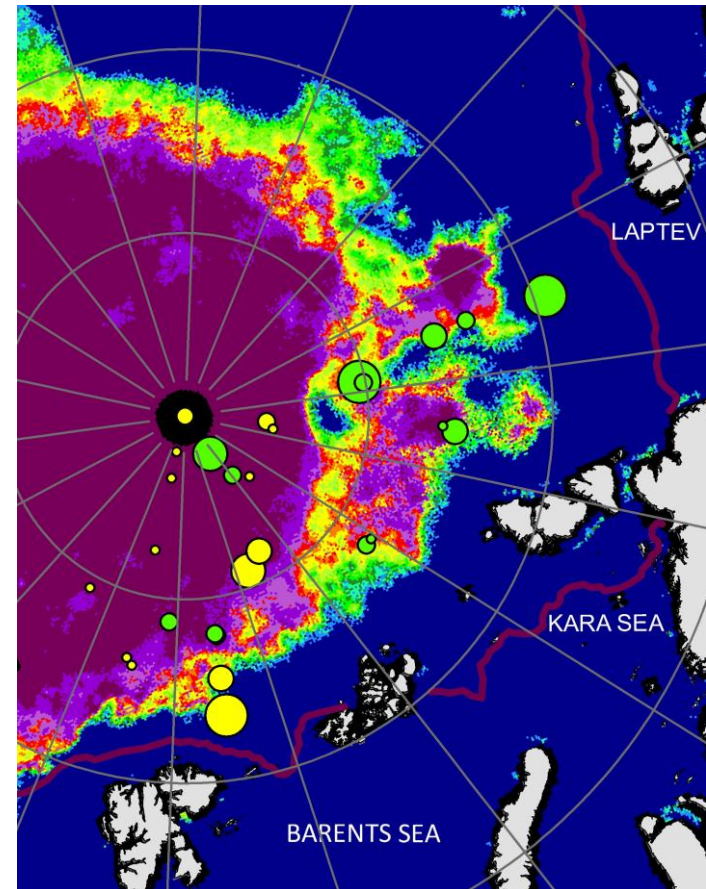
Conclusion part II

- Decrease of taxa \neq decrease of function
 - “Generalist” traits in deep-sea



Conclusion part II

- BTA & climate change
- Reference stations!



Outlook



Production

- Pan-Arctic scale
- Arctic ecosystem- & foodweb models

Functional Traits

- Pan-Arctic trait database

➤ CONTINUE DATA MINING!!!

Acknowledgements



- ❖ Collaborators
- ❖ Captain and crew of RV Polarstern
- ❖ Graduate school POLMAR
- ❖ Supervisors Tom Brey and Antje Boetius
- ❖ Colleagues & Friends

Thank you for your attention!

