ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

Patterns of macrozoobenthic production in the deep Arctic Ocean

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POLMAR
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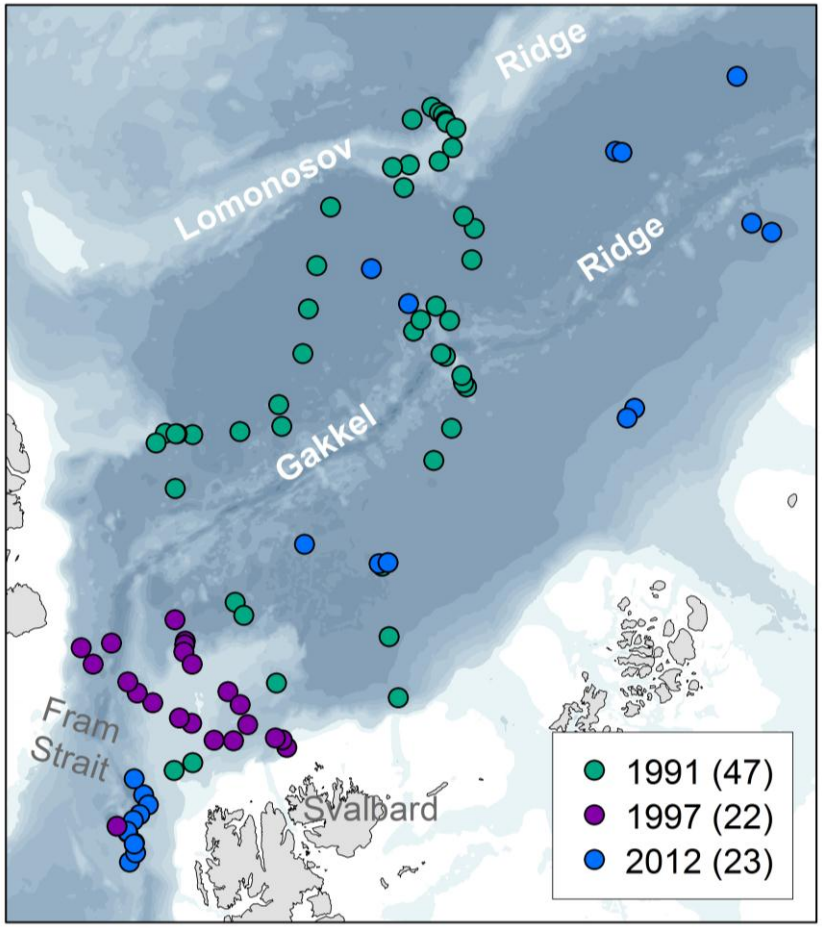
Overview

92 stations (1991 – 2012)
Static parameters: abundance & biomass
Dynamic: secondary production

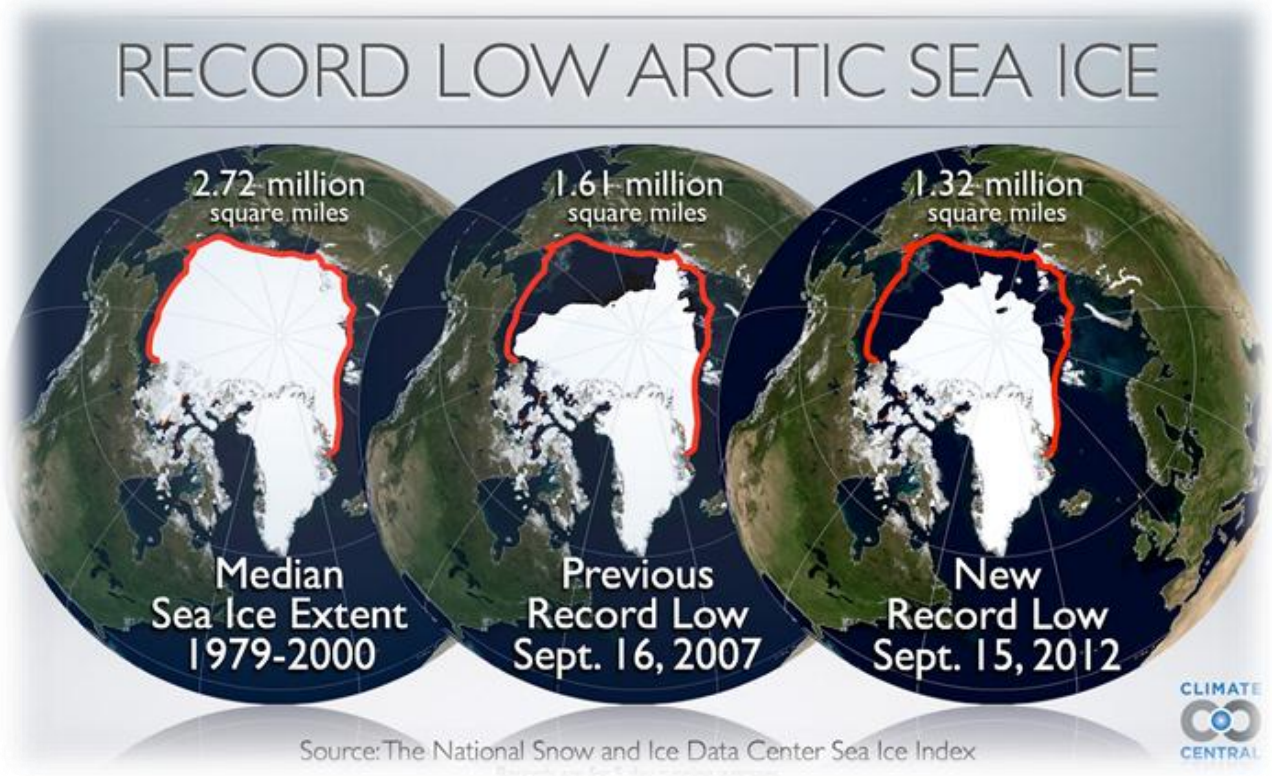
Patterns:
Water depth is main shaping factor; further:

- Regional effect
- Sea ice effect
- Latitudinal effect

Drivers:
Vertical and lateral transport processes



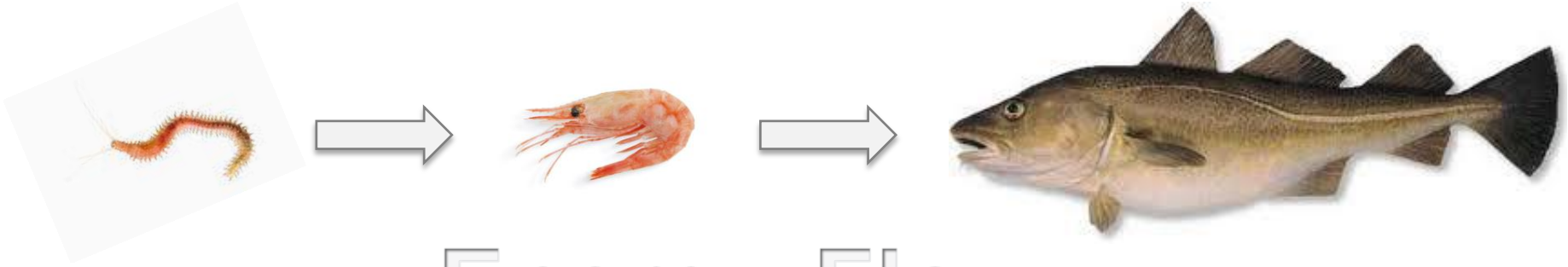
Climate change in the Arctic



- Deep-sea benthos is a good indicator of change.
- How will climate change affect benthic communities?

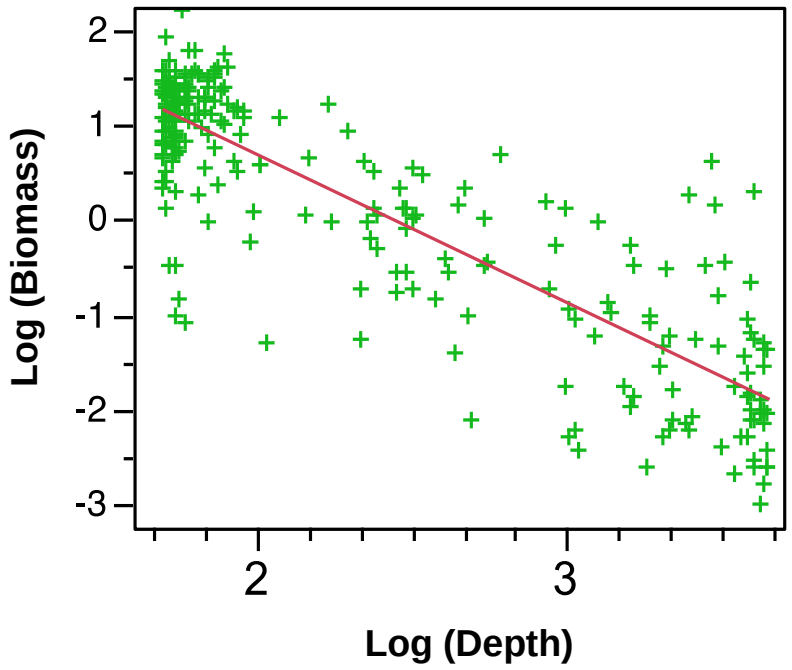
Benthic secondary production (P)

- Heterotrophic equivalent to primary production (ratio; J or g C m^{-2} y^{-1}).
- Dynamic parameter (vs biomass which is static).
- Direct information on energy available as food for next trophic level in the food web (food web models!)



Patterns of benthos distribution in the Arctic

- Significant decrease of standing stock with increasing **water depth**.
- Significant correlation of abundance & biomass with **latitude** (Bluhm et al. 2011).

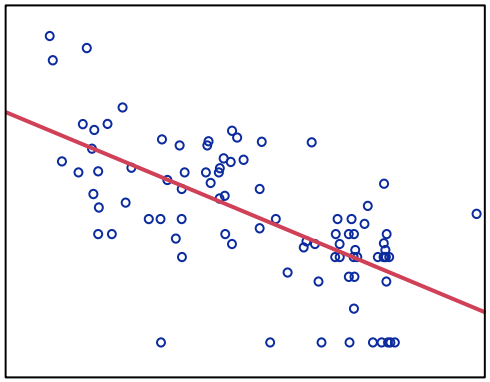


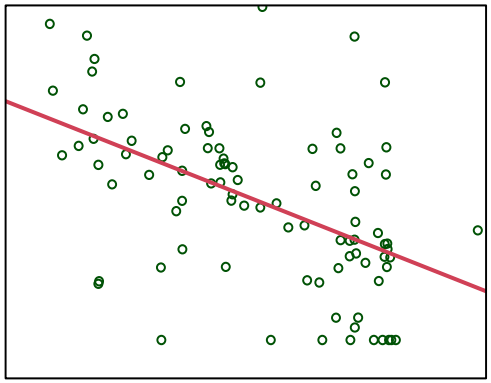
N = 253; R^2 = 0.74; p < 0.0001
(unpublished data collection of Brey)

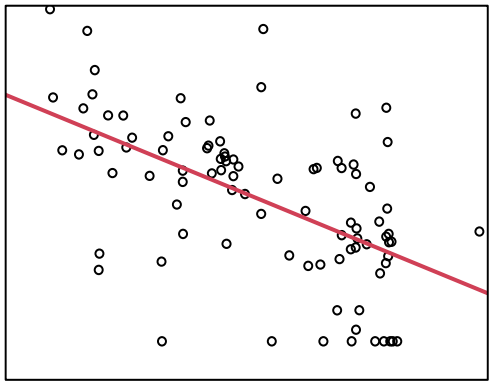
- Effect of latitude independent from depth?
- Sea Ice effect?
- Regional differences?

Water depth is the main factor

	Abundance R^2	Biomass R^2	Production R^2
Depth	**0.43**	**0.27**	**0.32**
Latitude	0.37	0.17	0.19
Sea Ice	0.22	0.08	0.11

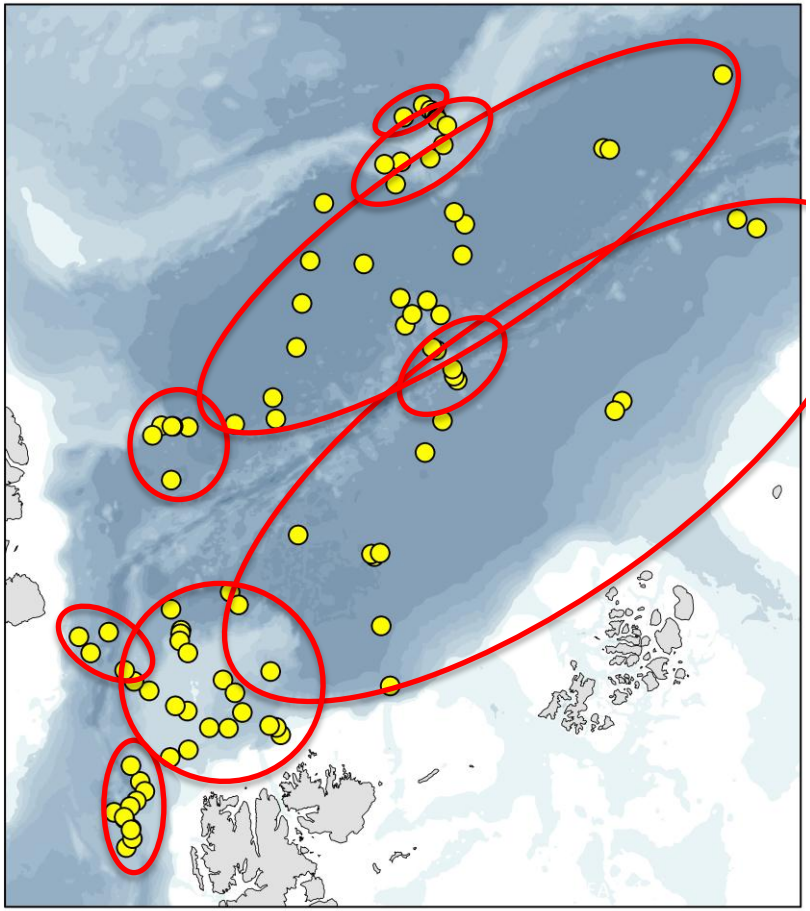






- **Depth used as co-variable in all following ANCOVA analysis!**

Geographical entities differ significantly

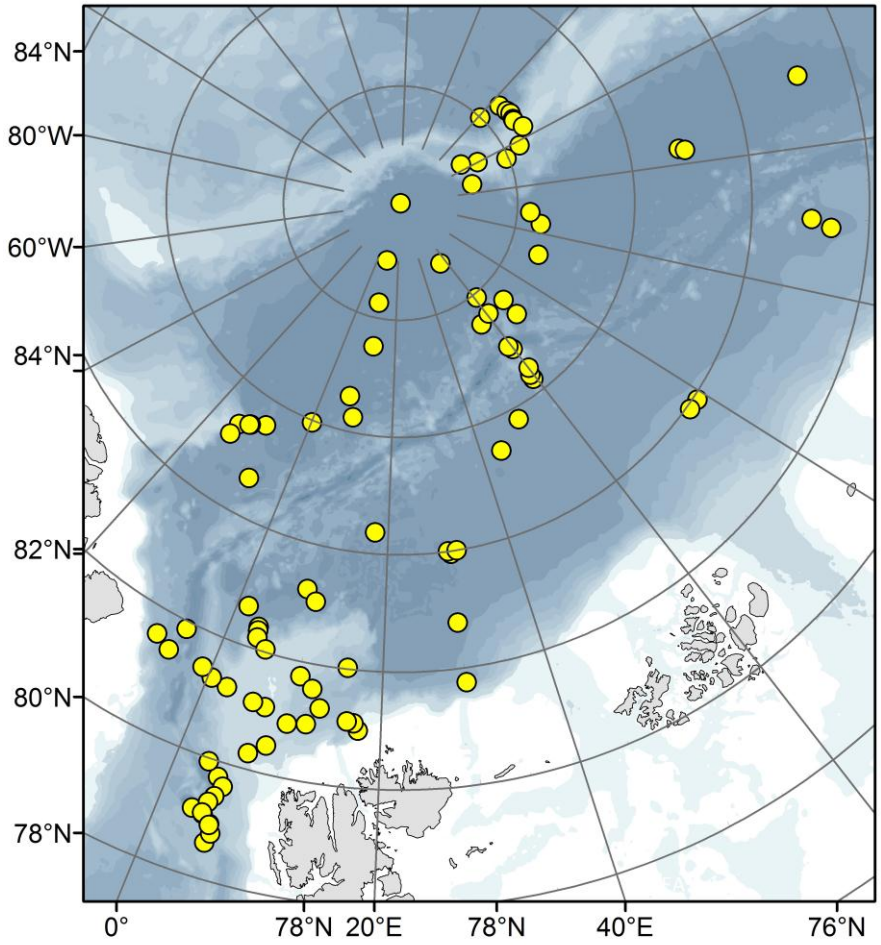


Region (Number of Stations)

- Makarov Basin (2)
- Lomonosov Ridge (10)
- Amundsen Basin (20)
- Morris Jesup Rise (5)
- Gakkel Ridge (5)
- Nansen Basin (15)
- Fram Strait (4)
- Yermak Plateau (19)
- NW-Spitsbergen (12)

ANCOVA	R^2	p
Abundance	0.69	< 0.0001
Biomass	0.49	0.0001
Production	0.56	< 0.0001

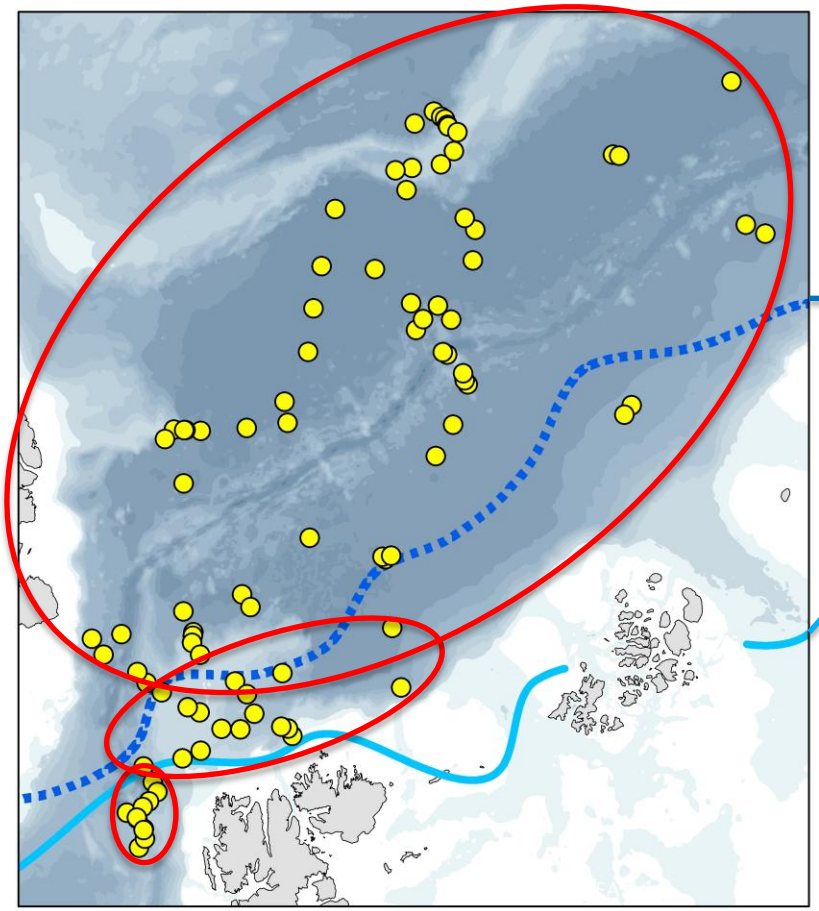
Latitudinal entities differ significantly



Latitude Zone (°N)
88-90 (9)
86-88 (23)
84-86 (12)
82-84 (17)
80-82 (19)
78-80 (12)

ANCOVA	R^2	p
Abundance	0.67	< 0.0001
Biomass	0.44	0.0002
Production	0.5	< 0.0001

Sea ice zones differ significantly



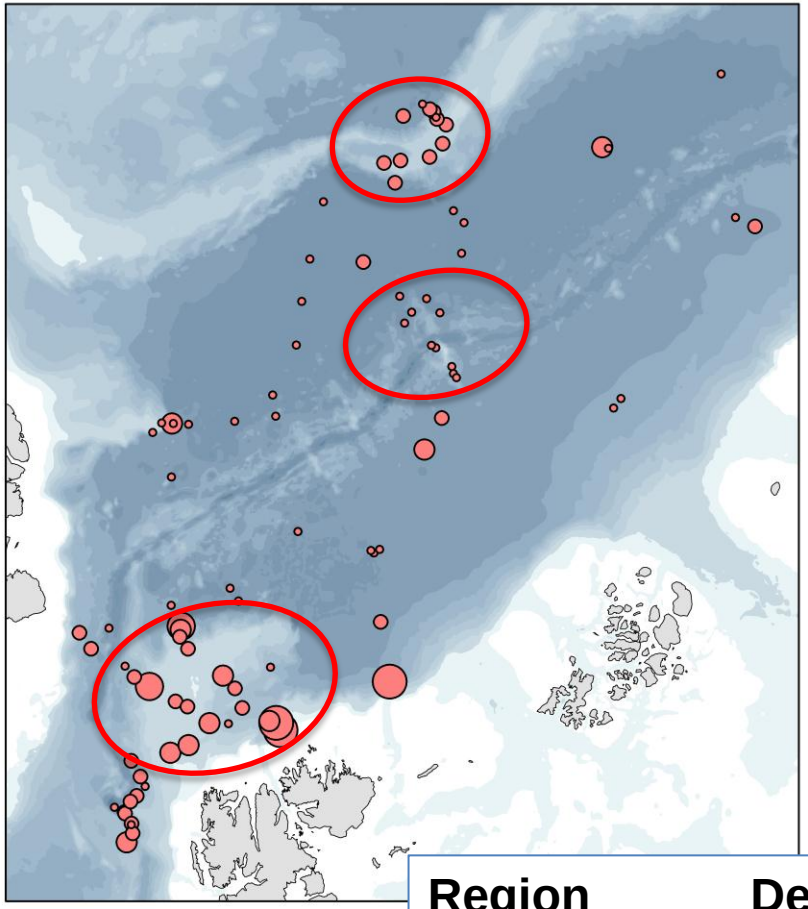
Sea ice zone
Southern (11)
Marginal Ice Zone MIZ (14)
Northern (67)

Sea ice extent September 2013 (median)

Sea ice extent September (30 years median)

ANCOVA	R^2	p
Abundance	0.54	< 0.0001
Biomass	0.31	0.0496
Production	0.38	0.0173

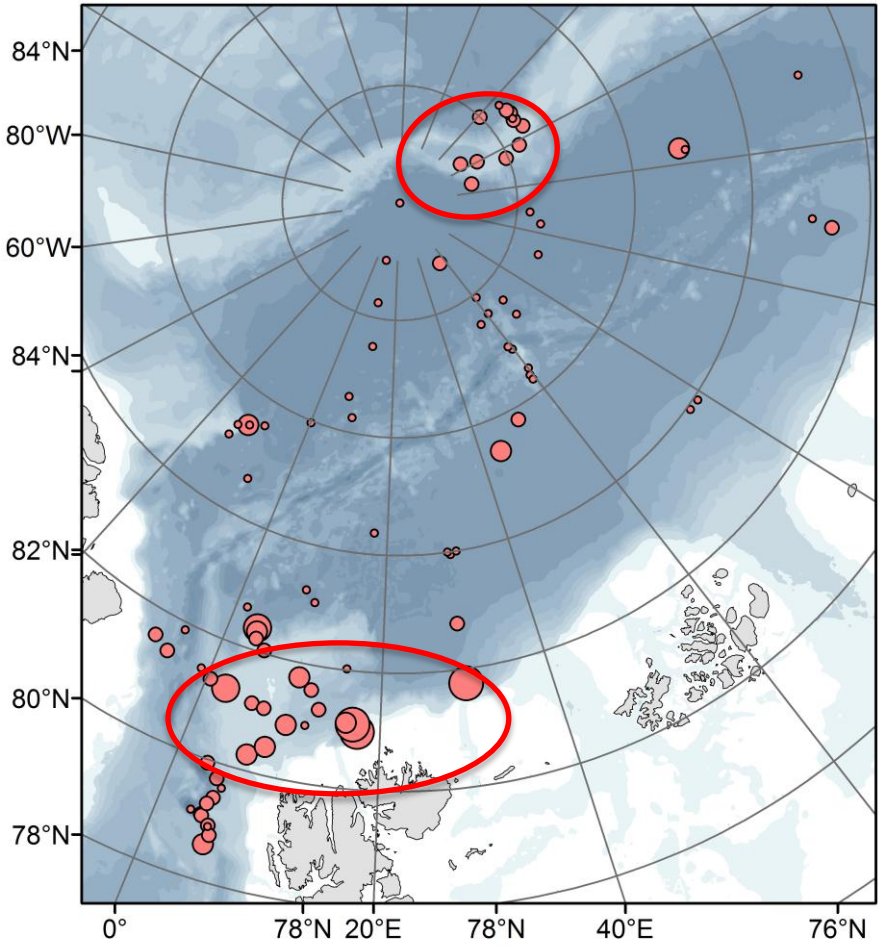
Production: regional differences **are visible**

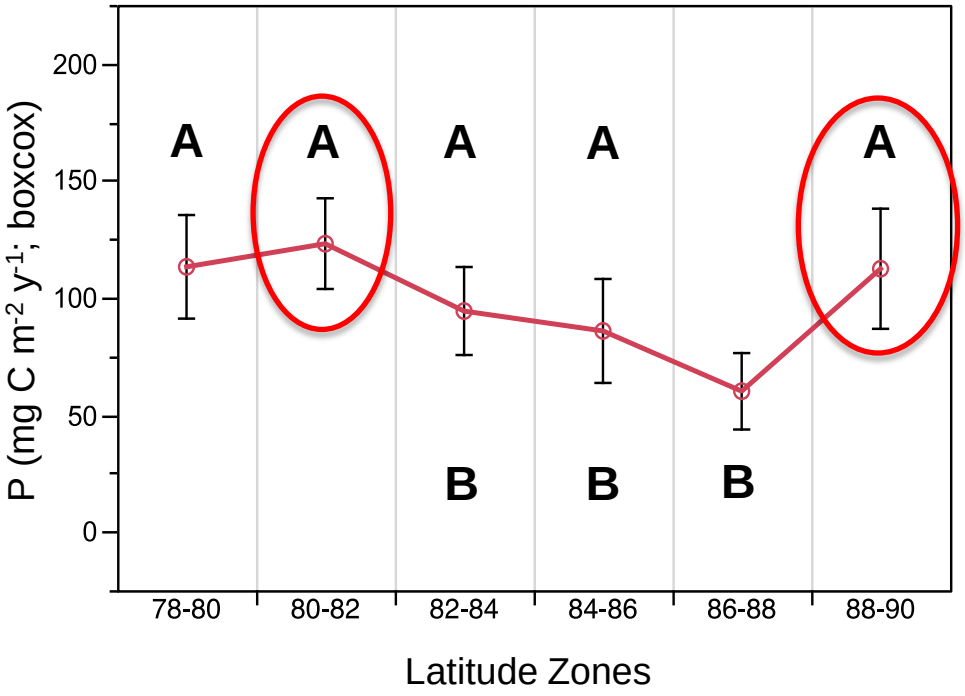


Region	P (mg C m^{-2} y^{-1})
Makarov Basin	8 - 50
Lomonosov Ridge	42 - 130
Amundsen Basin	0 - 109
Morris Jesup Rise	4 - 205
Gakkel Ridge	0 - 12
Nansen Basin	1 - 1580
Fram Strait	9 - 70
Yermak Plateau	9 - 2530
NW-Spitsbergen	12 – 182

Region	Depth (m)	P (mg C m^{-2} y^{-1})	
NE-Atlantik	2900	122	Gage (1991)
Barents Sea	50-150	200-5300	Kedra et al. (2013)

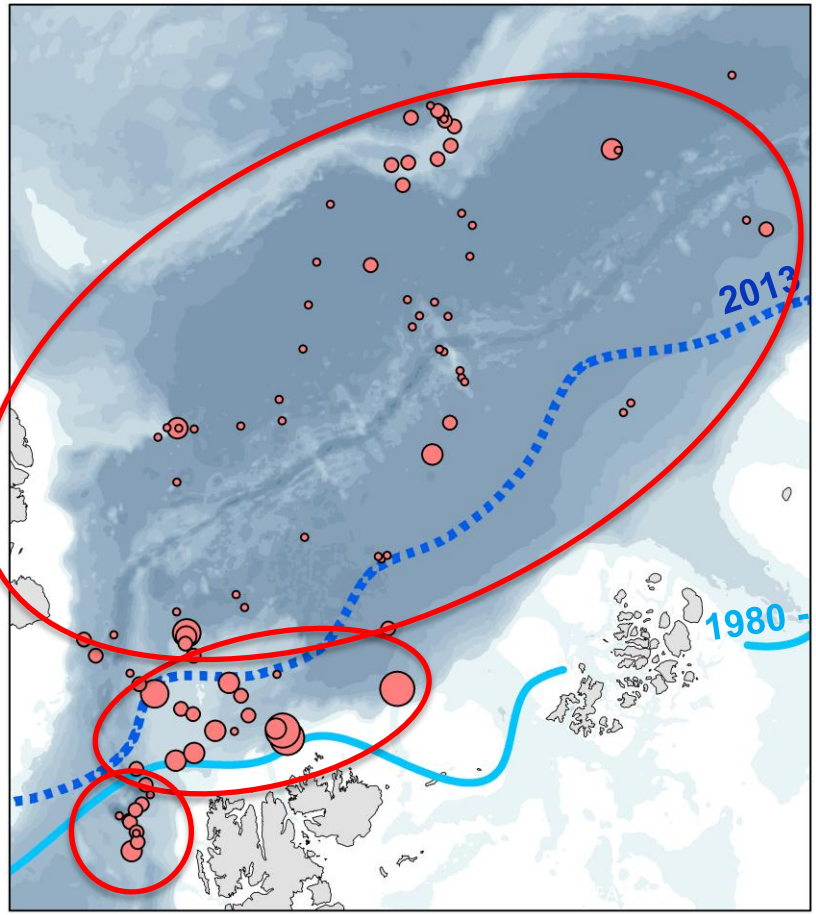
Production: latitudinal trend is visible, but weak

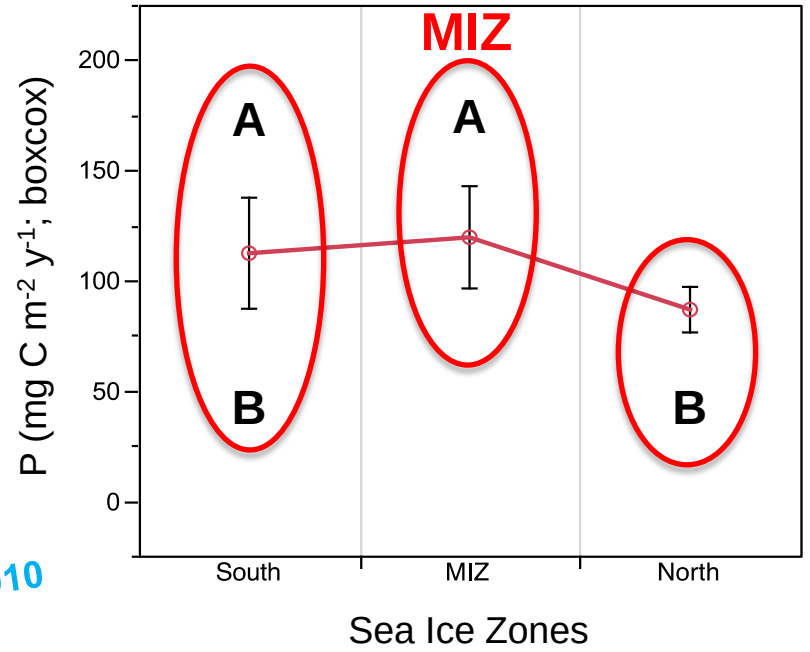




A, B: Tukey`s HSD posthoc test

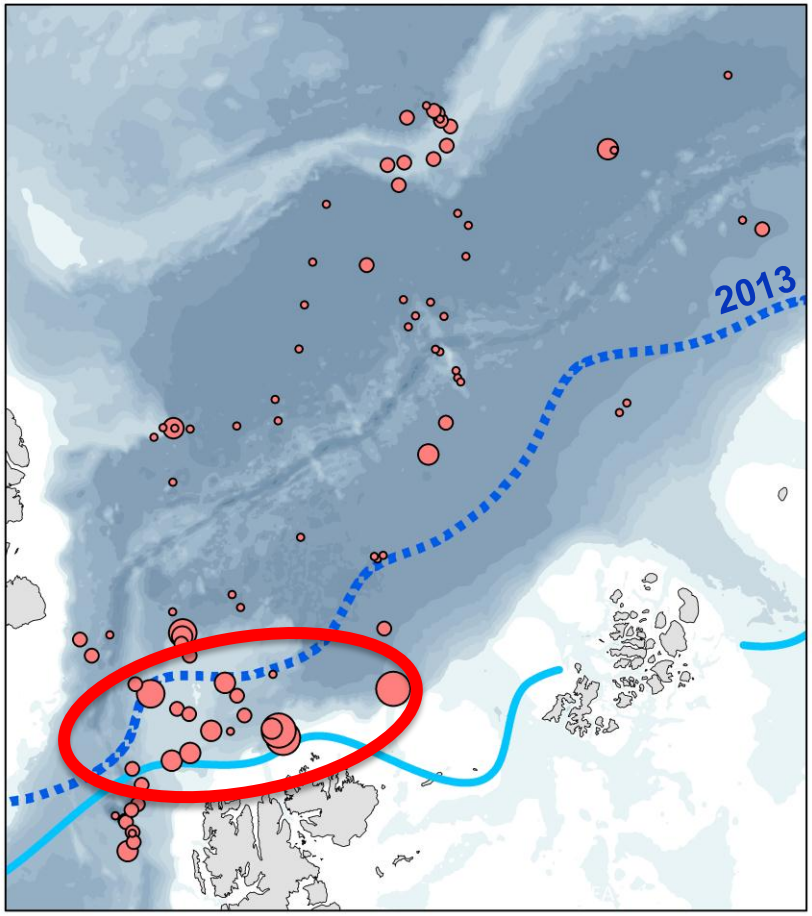
Production: sea ice effect is visible

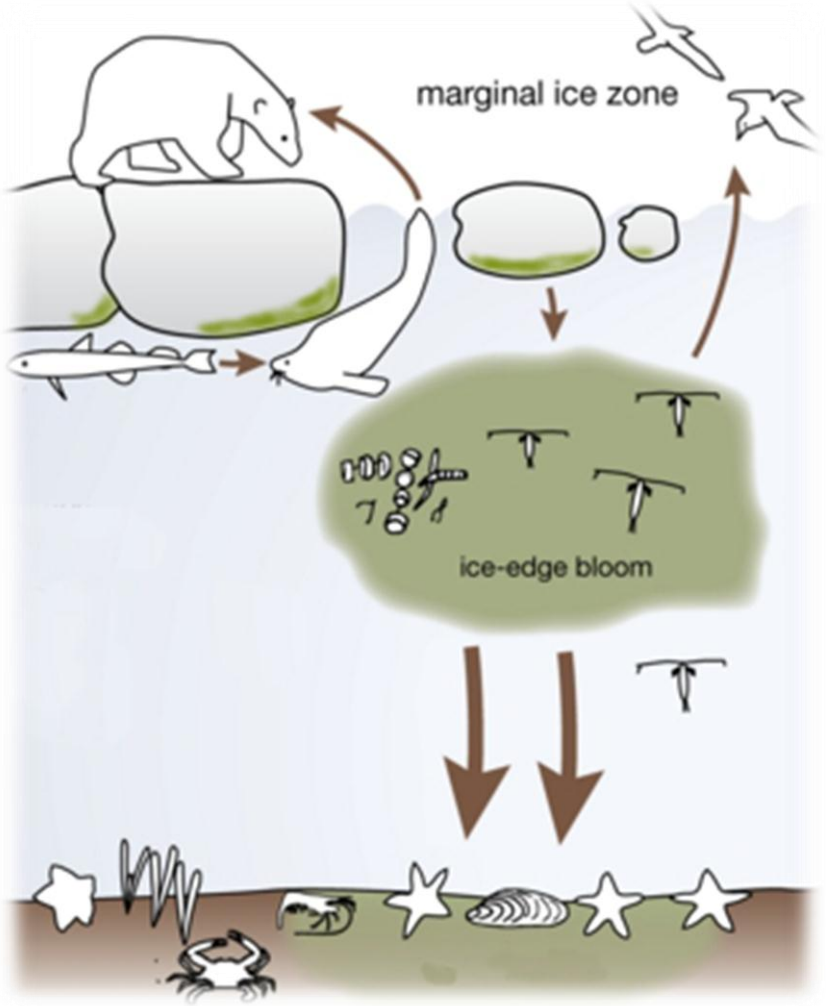




A, B: Tukey`s HSD posthoc test

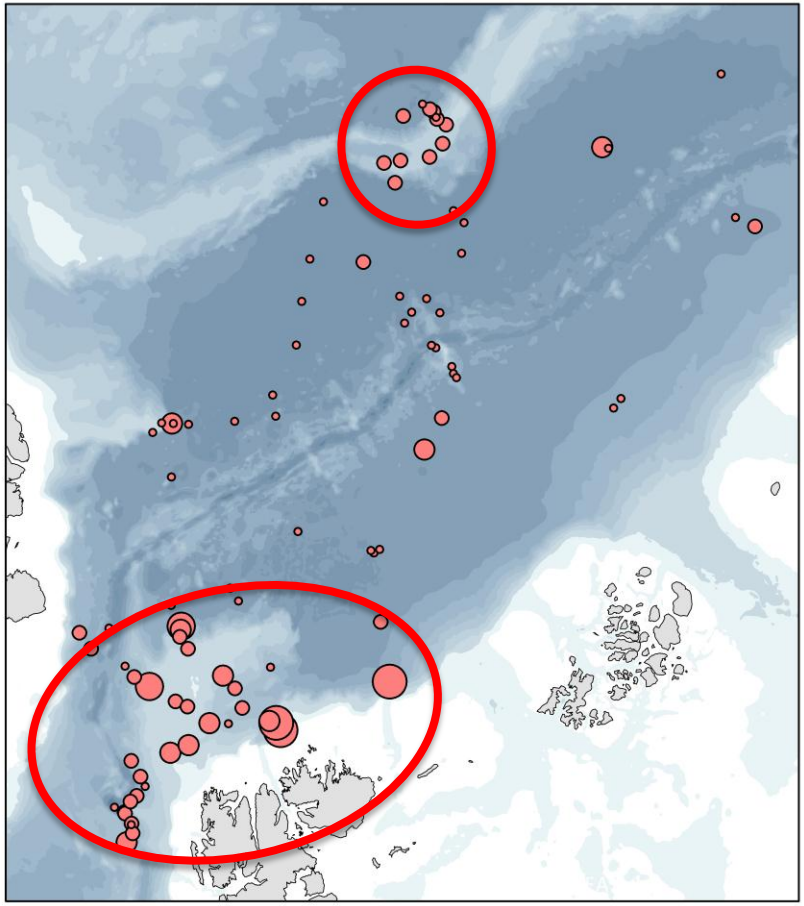
High production in the high flux area MIZ

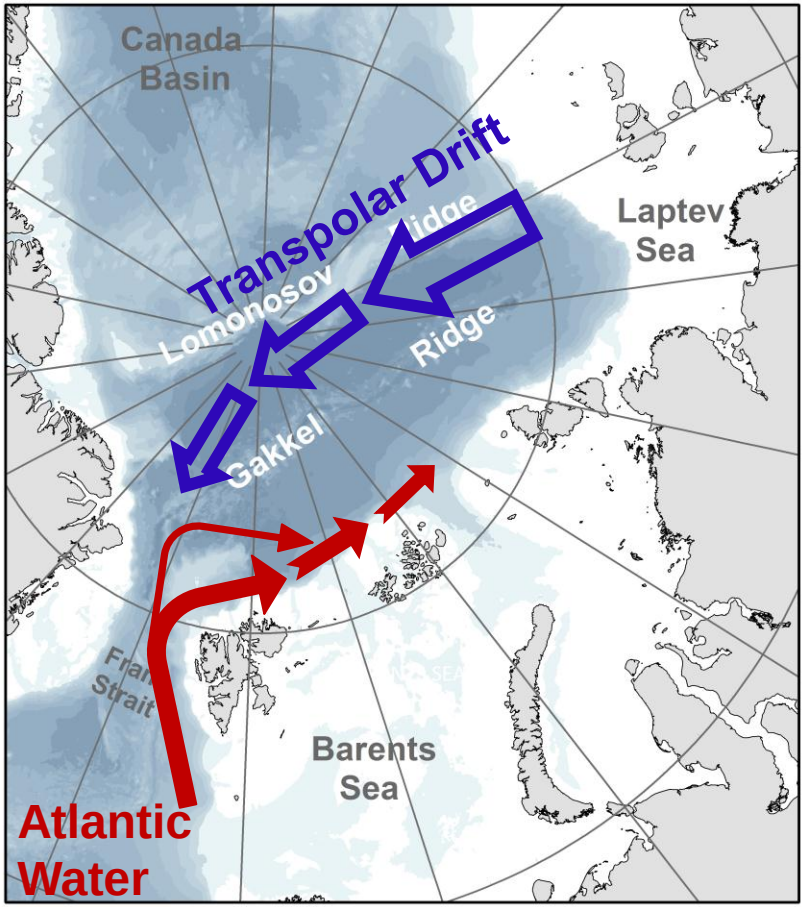




modified from CAFF report 2010

High production fueled by transport processes



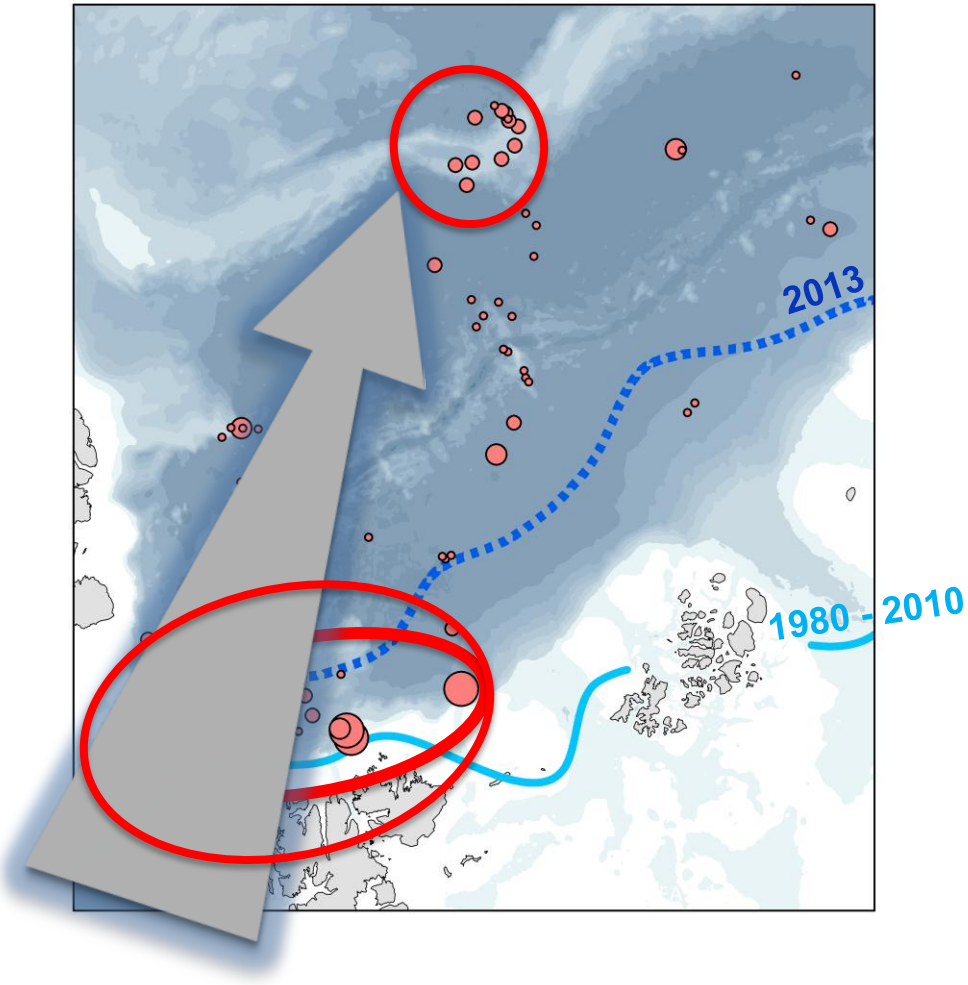


Conclusions

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

Outlook

- Use production data in ecosystem and foodweb models



Acknowledgements

- Captain and crew of RV Polarstern at Arctic expedition 2012
- Graduate school POLMAR

Dataset

- available via the online platform PANGAEA (http://doi.pangaea.de/10.1594/PANGAEA.828348)

Thank you for your attention!