



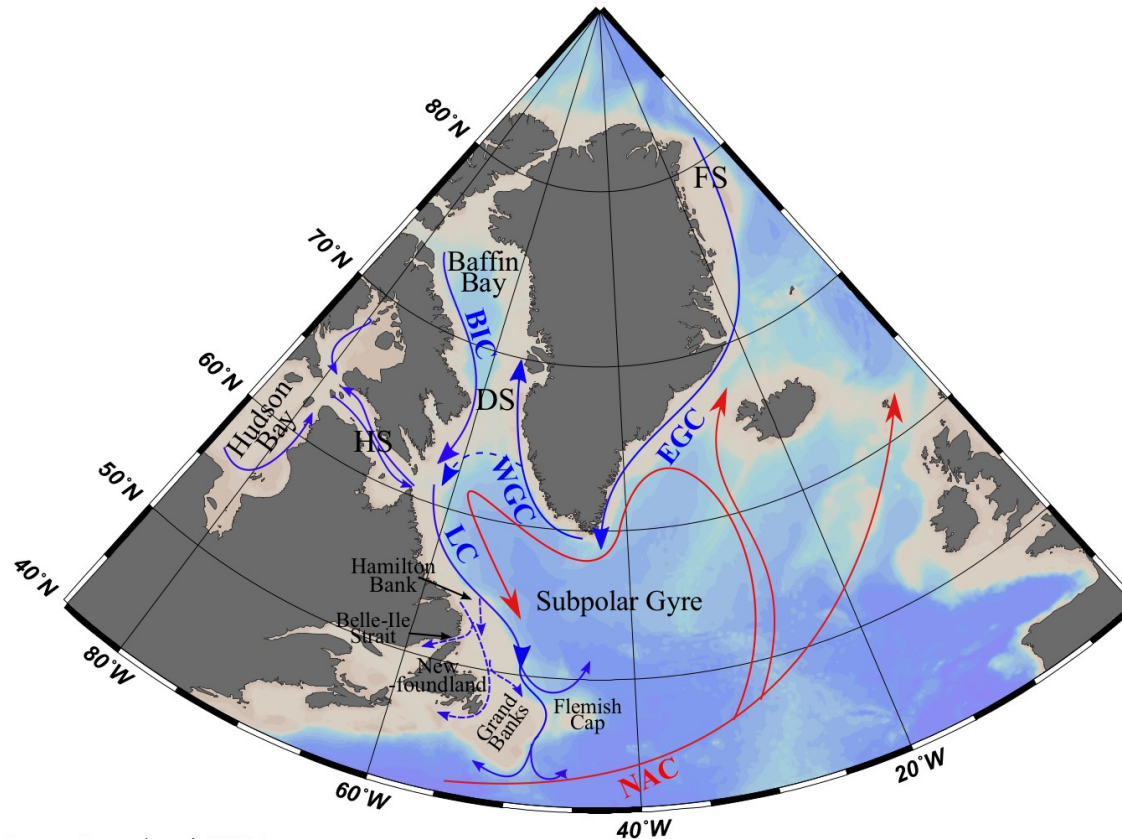
Decadal environmental changes in the Newfoundland and Labrador ecosystem

F. Cyr, D. Bélanger, E. Colbourne, G. Maillet & P. Pepin

**Fisheries and Oceans Canada,
Northwest Atlantic Fisheries Centre,
*St. John's, NL***



Context: NL shelves a crossroads of the North Atlantic Circulation

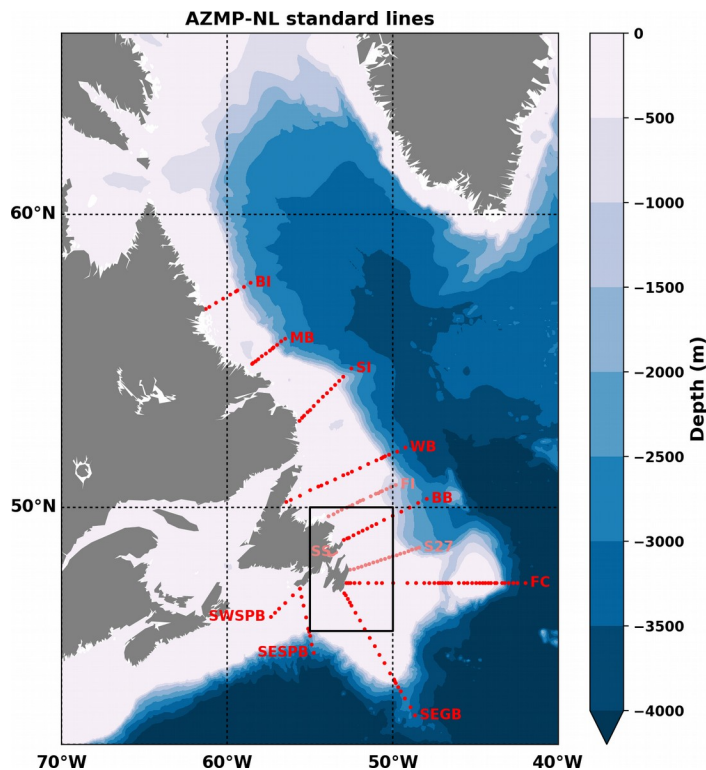


Source: Benetti et al. (2017)

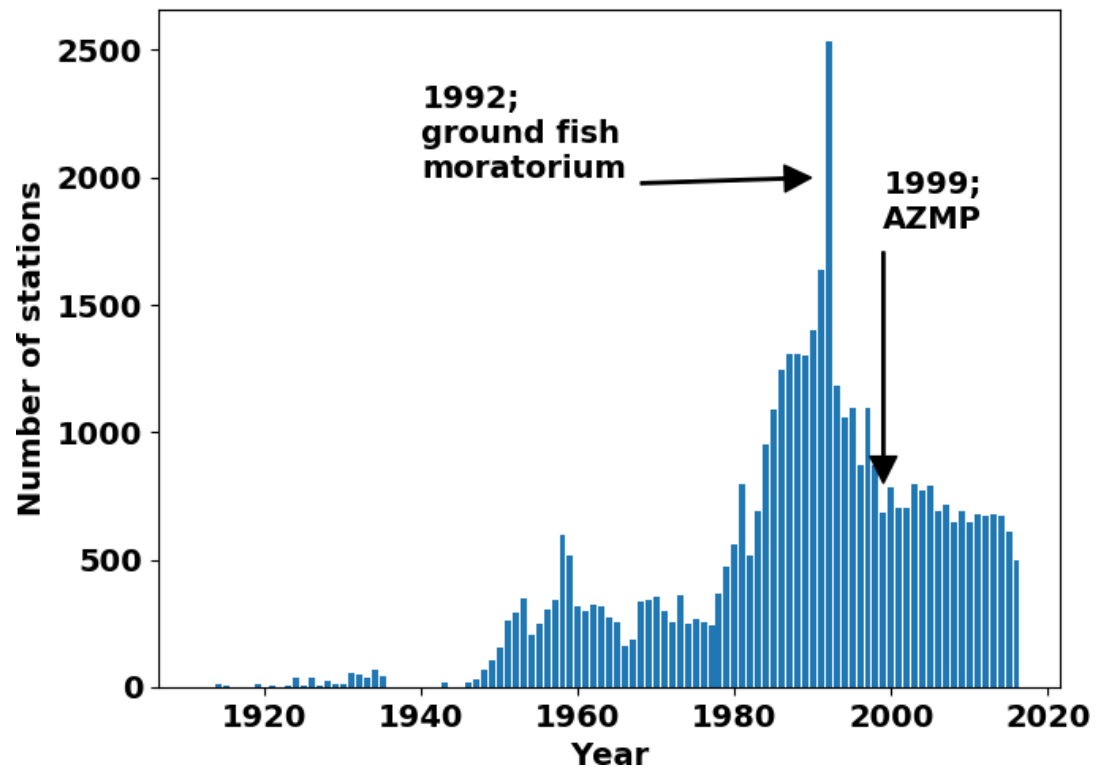


Context: Long history of measurements on NL shelves (physical and biogeochemical)

Atlantic Zone Monitoring Program (AZMP)



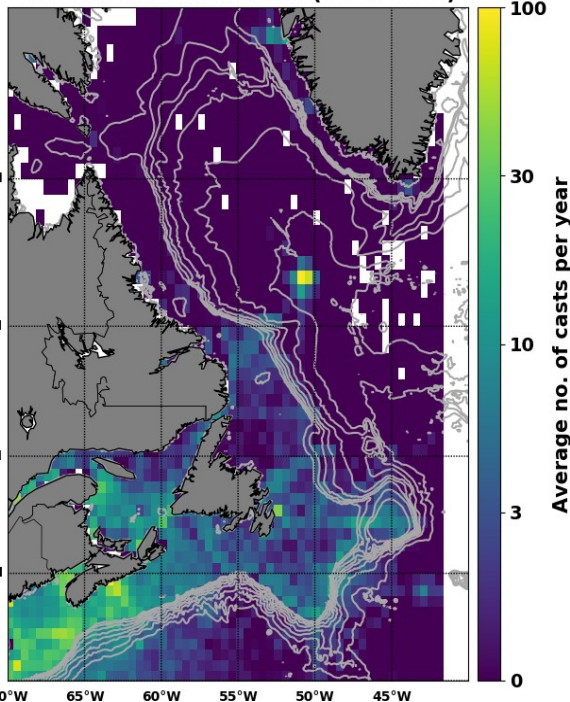
Temperature casts



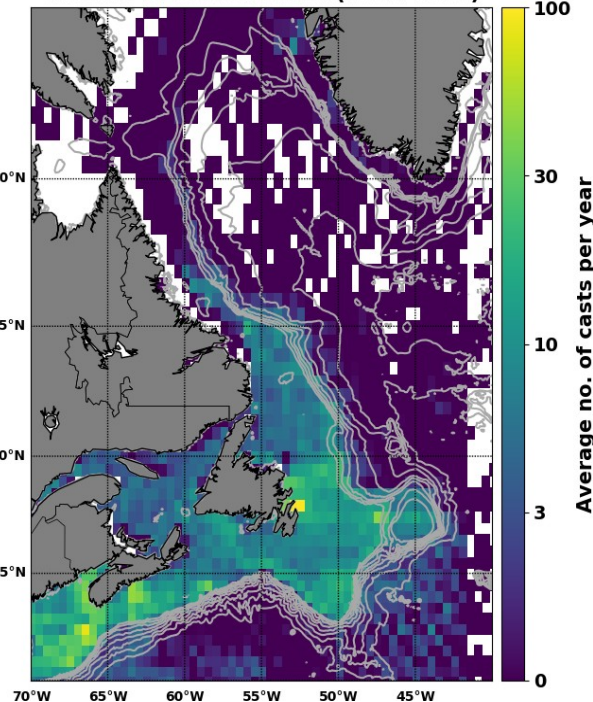


Context: Long history of measurements on NL shelves (physical and biogeochemical)

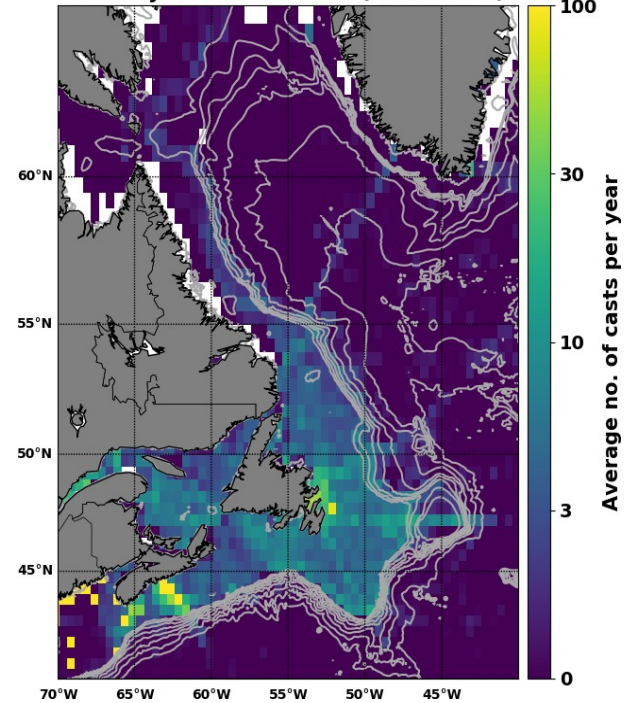
Number of observations (1950-1980)



Number of observations (1980-1998)



Density of observations (1998-2017)



→ +700K observations



The project:

What can we tell from these historical data?

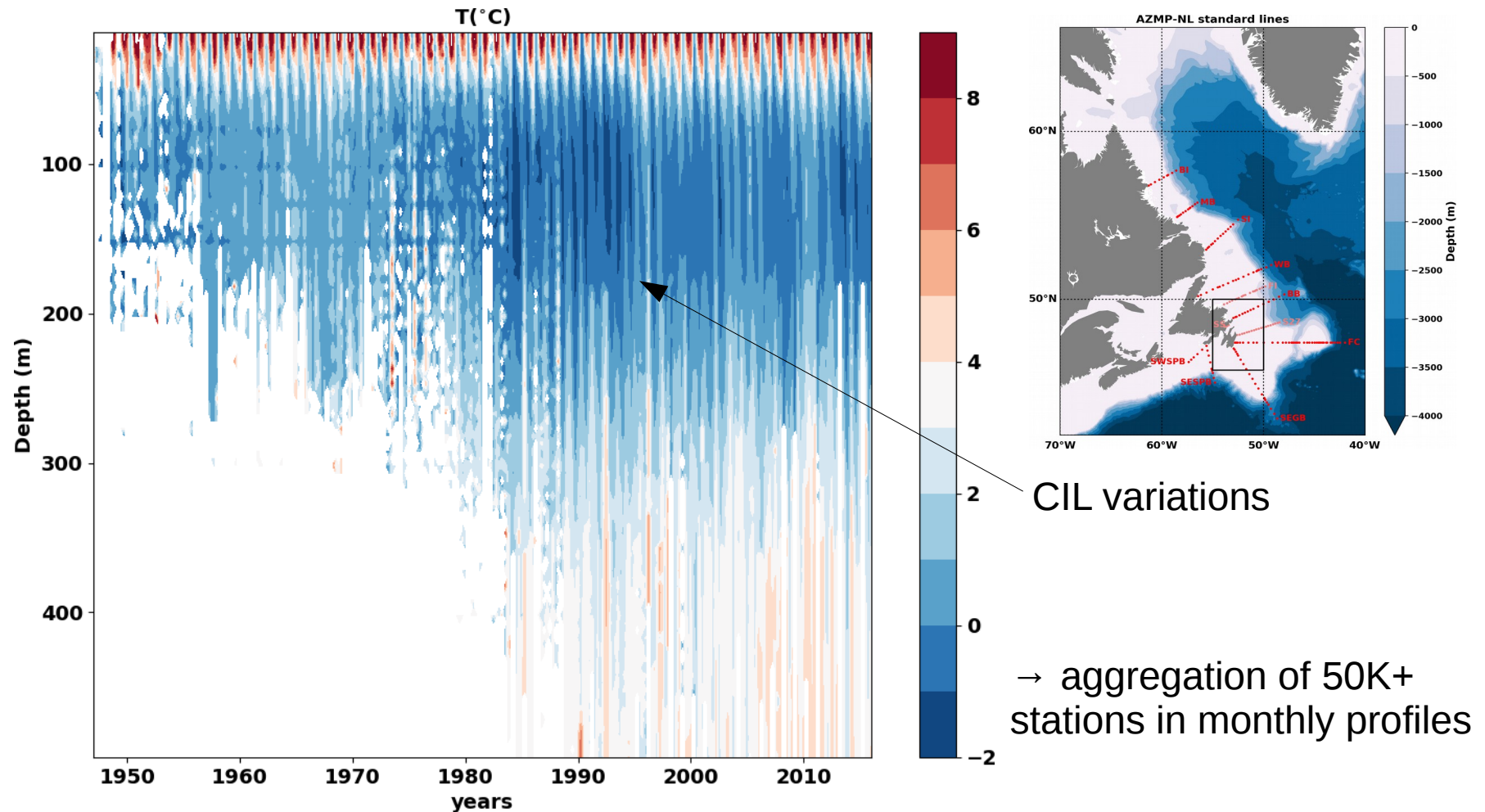
→ ACCASP project started Jan. 2018
(DFO initiative for climate change)



Physical oceanography (1948-2018)

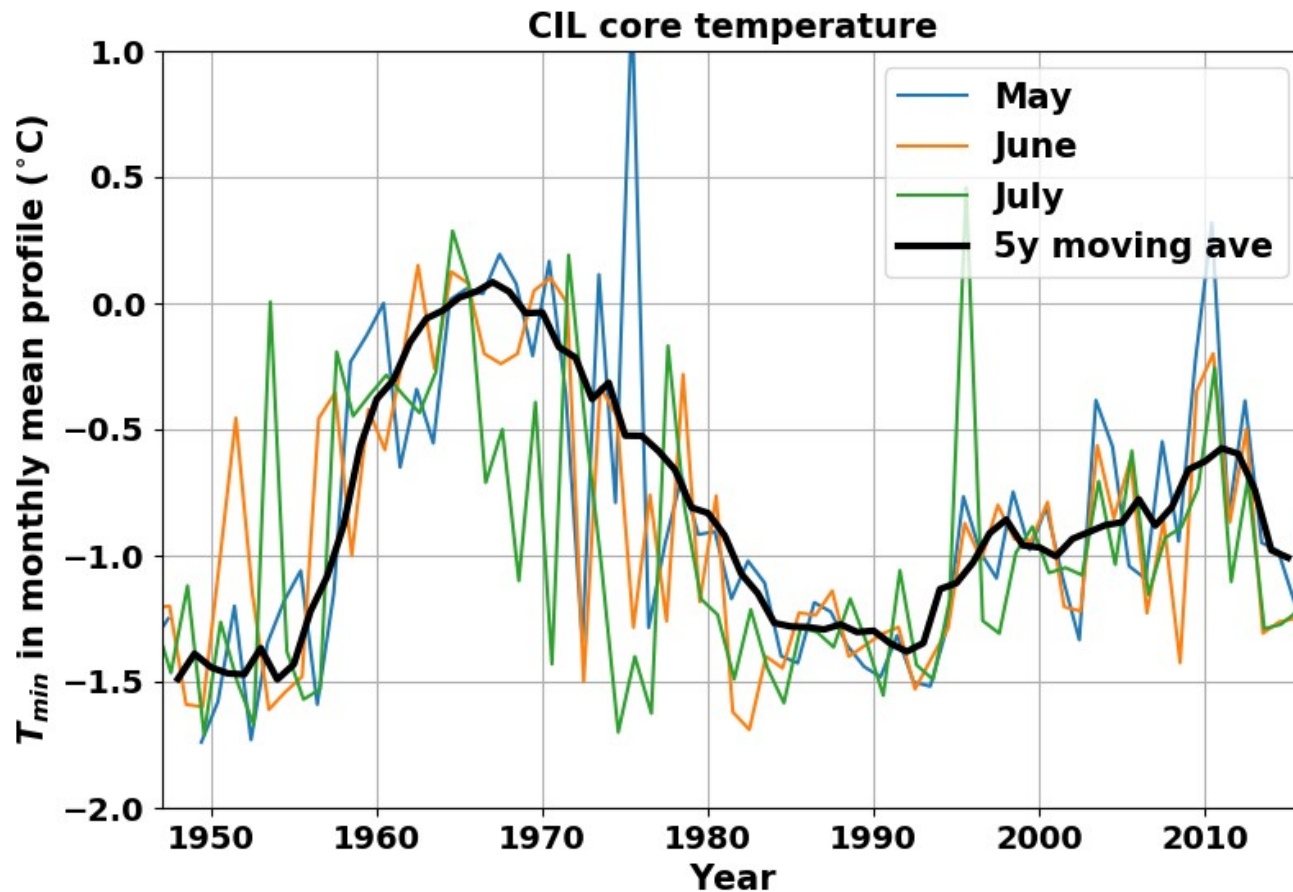


Interannual temperature field (since 1948)



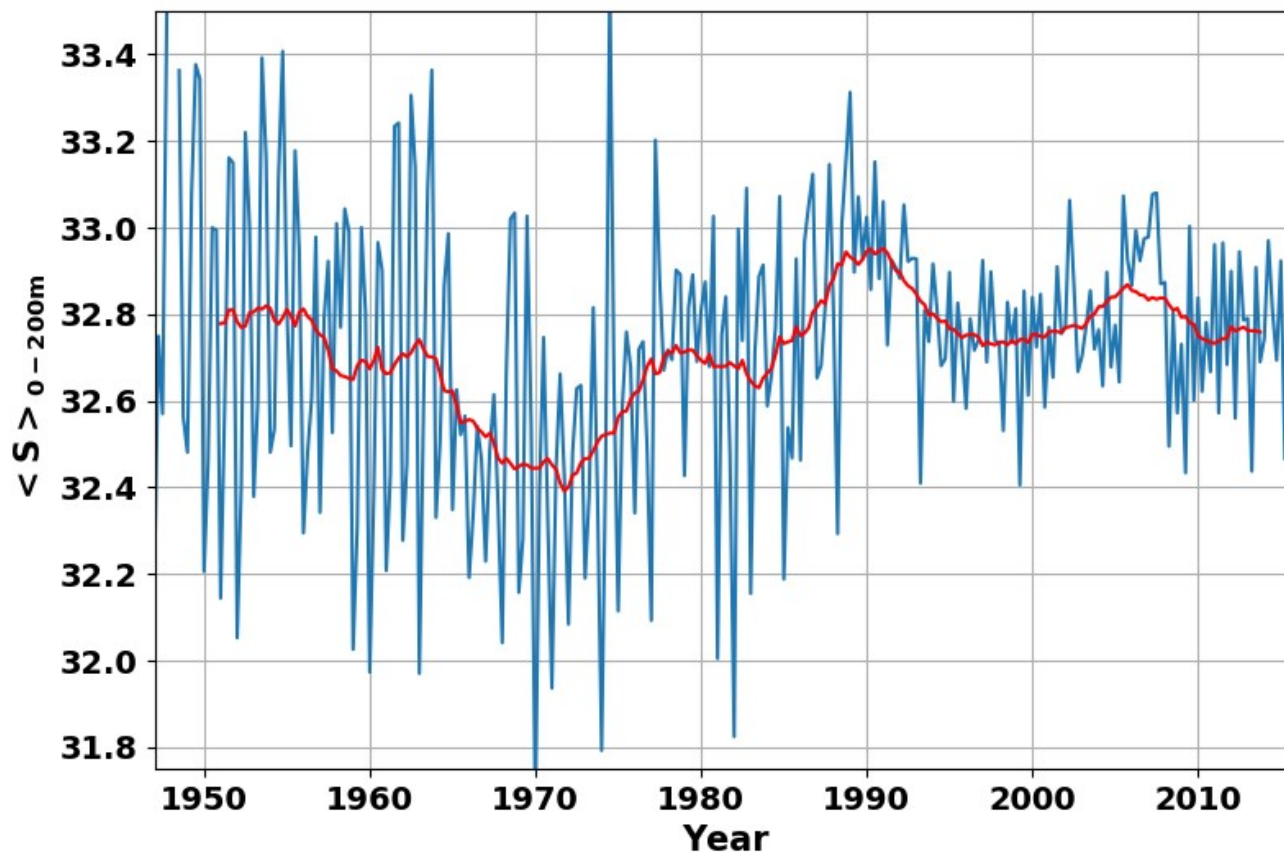


CIL summer core temperature



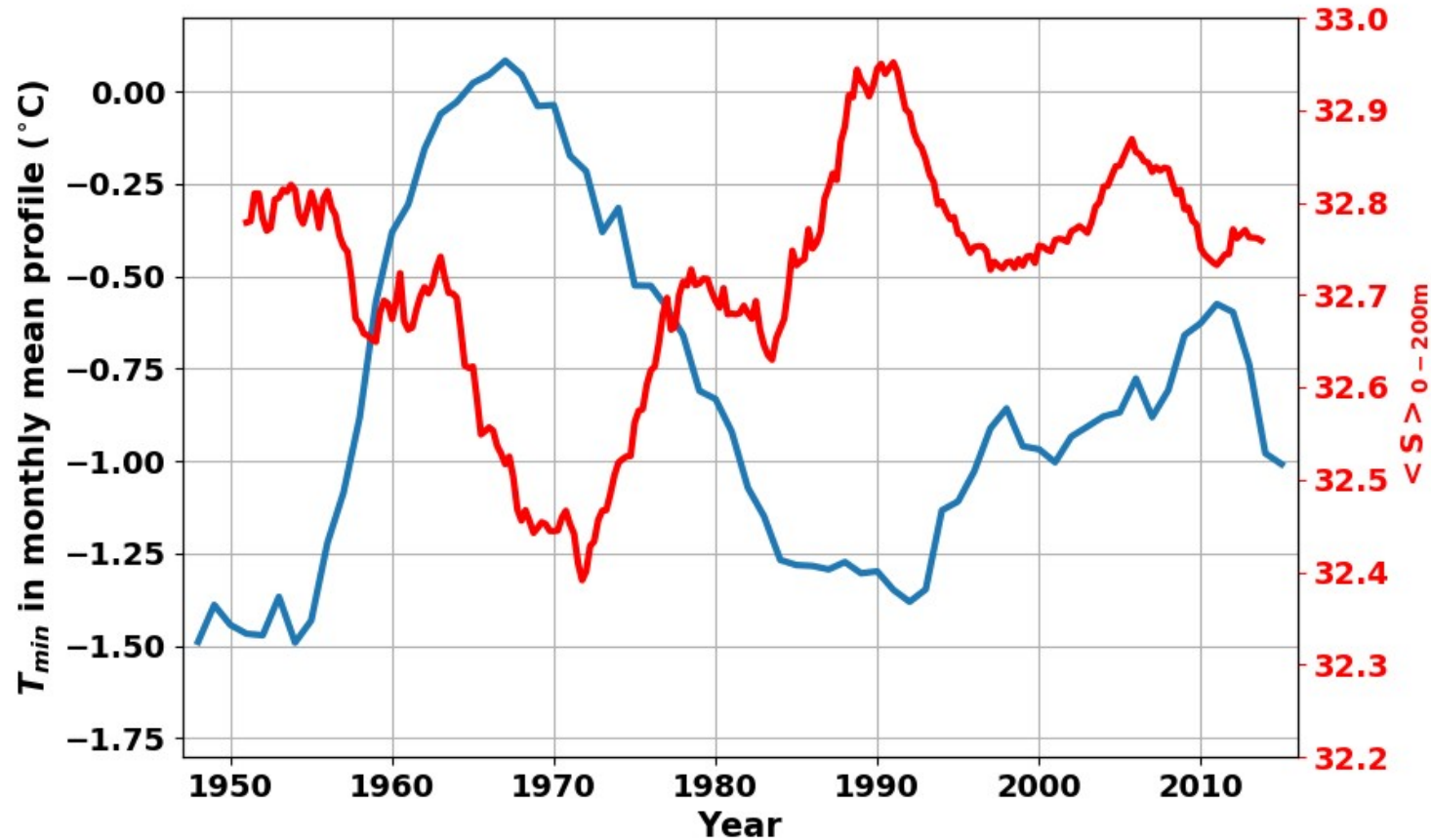


Salinity (0-200m average)



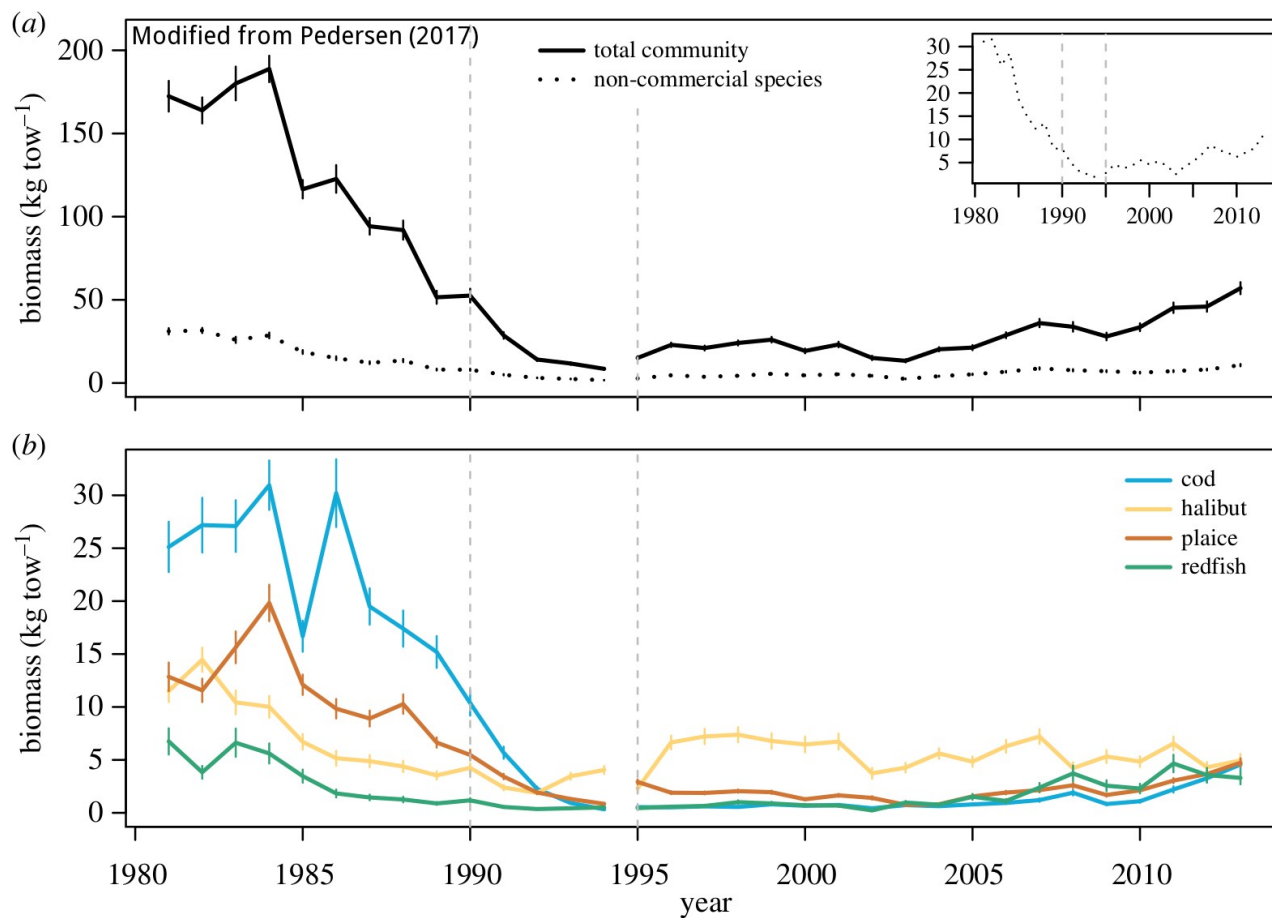


Significant environmental changes at decadal scales



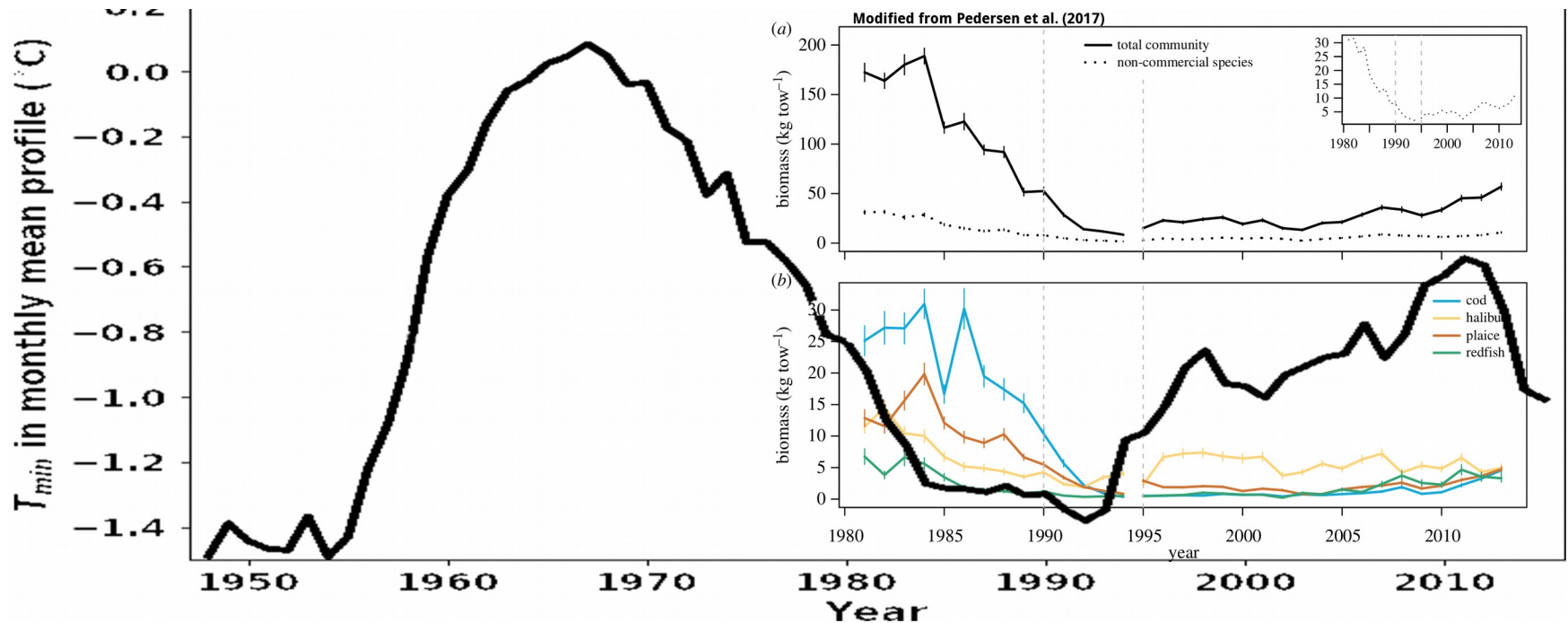


A changing ecosystem (e.g. ground fish stocks decline)





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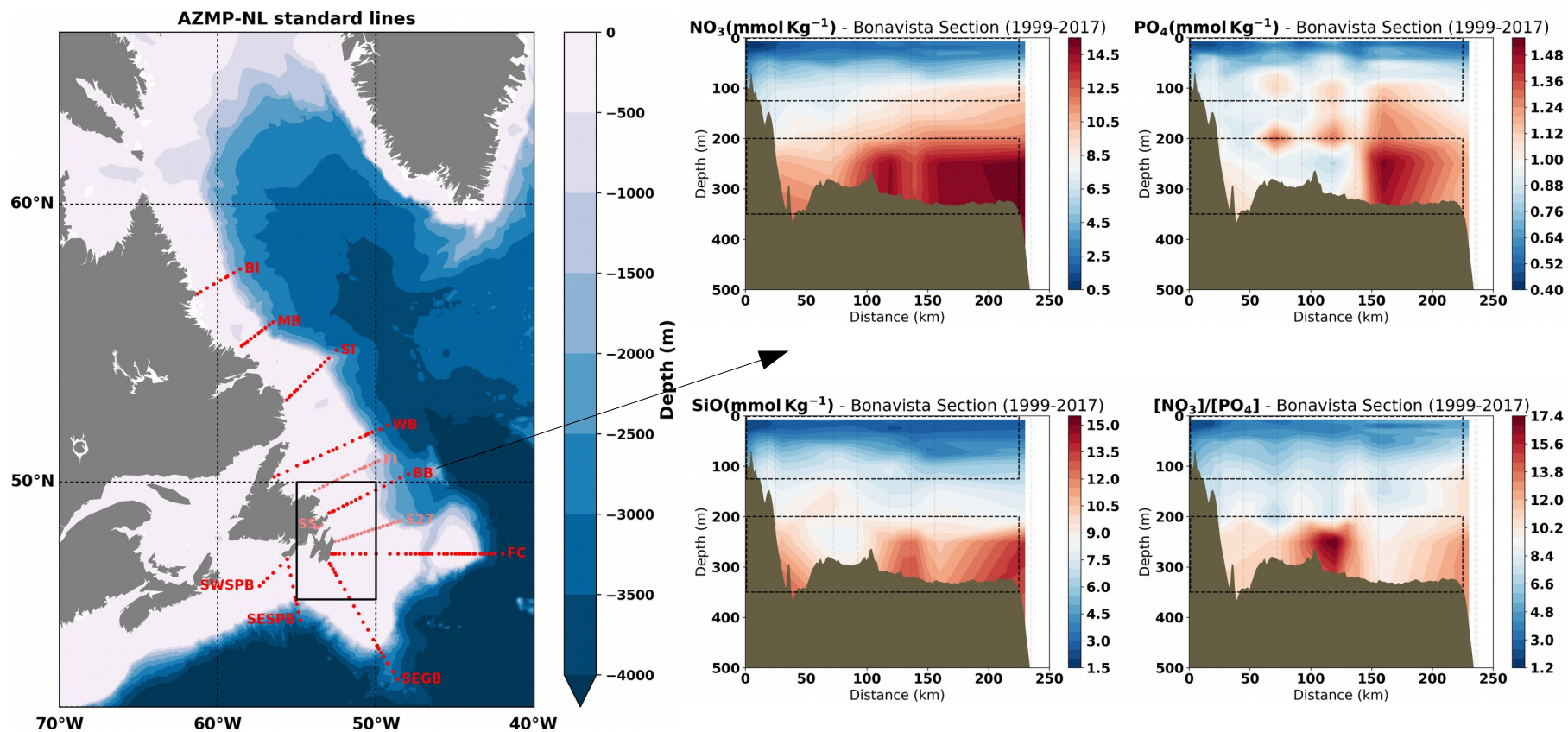




Biogeochemistry (AZMP; 1999-present)



Nutrients (Bonavista section)



Nitrate/Phosphate ratio

AGU PUBLICATIONS



Journal of Geophysical Research: Oceans

RESEARCH ARTICLE

10.1002/2016JC012244

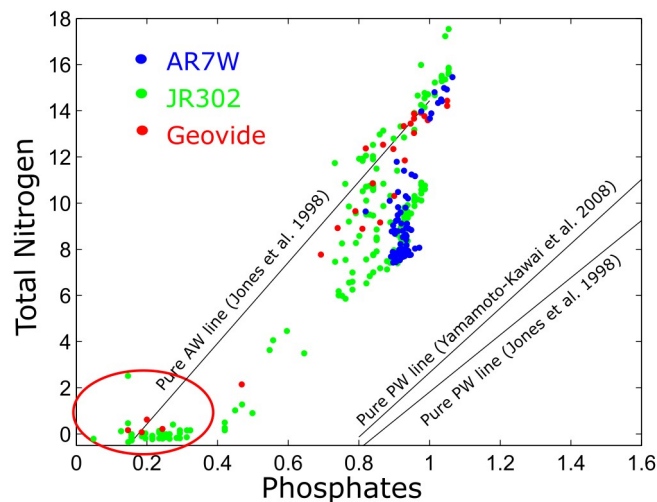
Composition of freshwater in the spring of 2014 on the southern Labrador shelf and slope

M. Benetti^{1,2}, G. Reverdin¹, C. Lique¹, I. Yashayaev⁴, N. P. Holliday⁵, E. Tynan⁵, S. Torres-Valdes⁵, P. Lherminier², P. Tréguer⁶, and G. Sarthou⁶

Key Points:

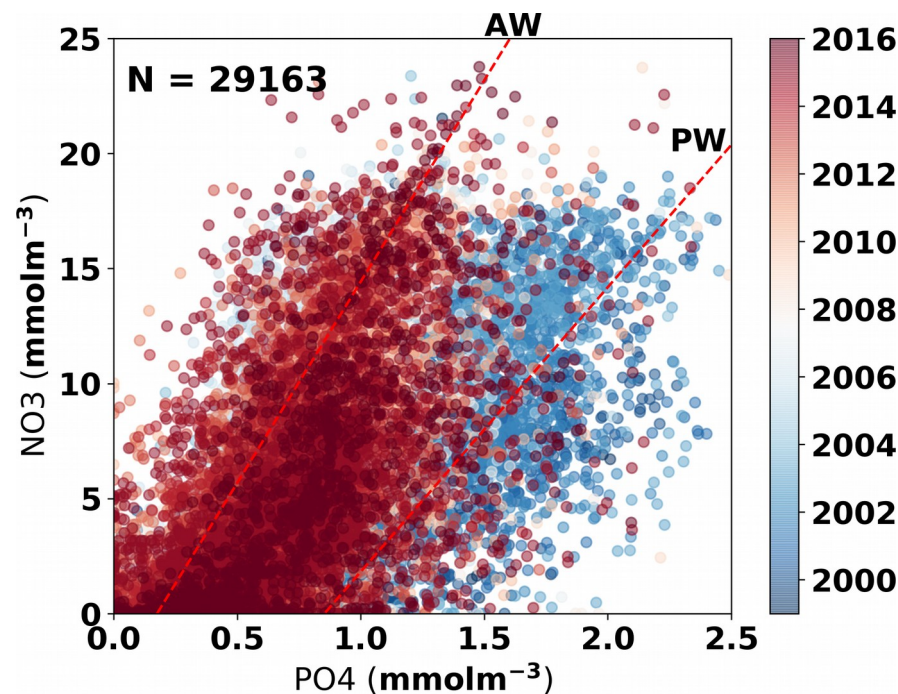
- The data set reveals a large contribution of water from the Canadian Arctic to the southern Labrador shelf
- There is evidence of advection of water from the slope region to the midshelf between 55°N and 52°N
- Observations from 1995 and 2008 suggest a higher fraction of brine and Pacific water on the shelf

¹Sorbonne Universités (UPMC, Univ Paris 06)-CNRS-IRD-MNHN, LOCEAN Laboratory, Paris, France, ²Institute of Earth Sciences, University of Iceland, Reykjavik, Iceland, ³Ifremer, Univ. Brest, CNRS, IRD, Laboratoire d'Océanographie Physique et Spatiale (LOPS), IUEM, F-29280, Plouzané, France, ⁴Department of Fisheries and Oceans, Ocean Sciences Division, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, ⁵National Oceanography Centre, Southampton, UK, ⁶Laboratoire des Sciences de l'Environnement Marin (UMR 6539 CNRS/UBO/IRD/Ifremer), Plouzané, France



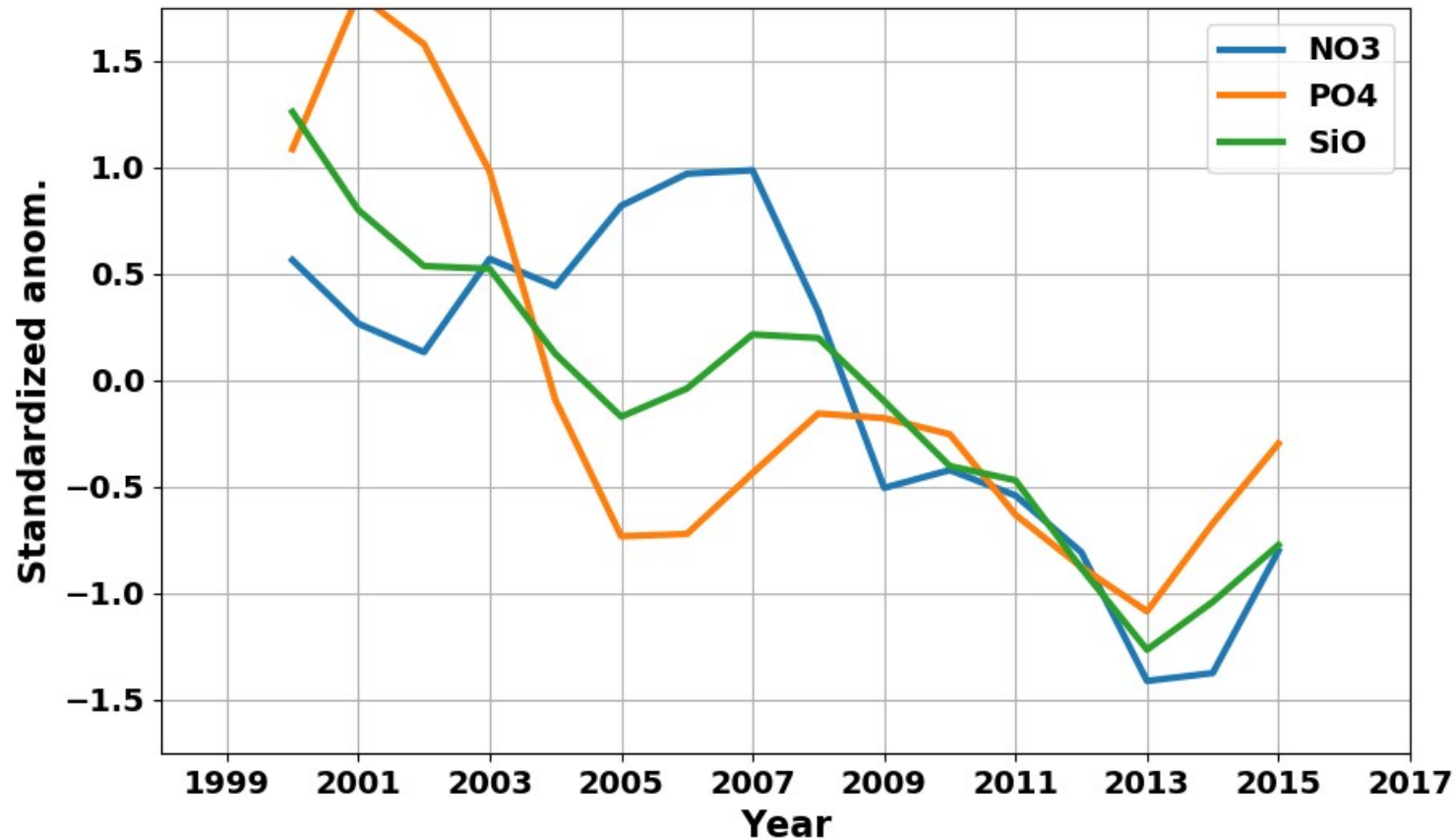
Benetti et al. (2017)

→ Recent changes towards less Pacific/Arctic waters





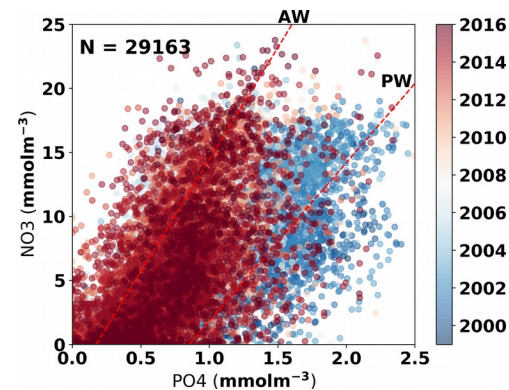
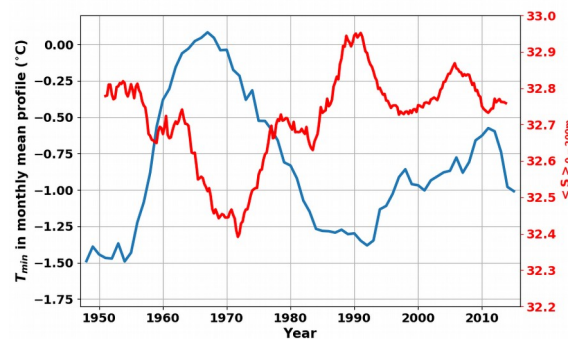
Overall decrease in nutrient concentration



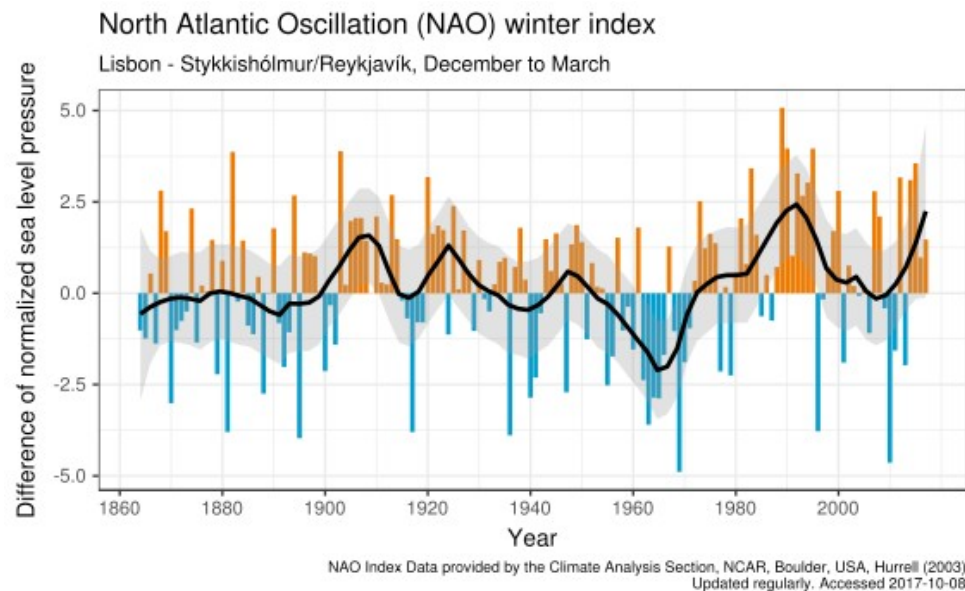
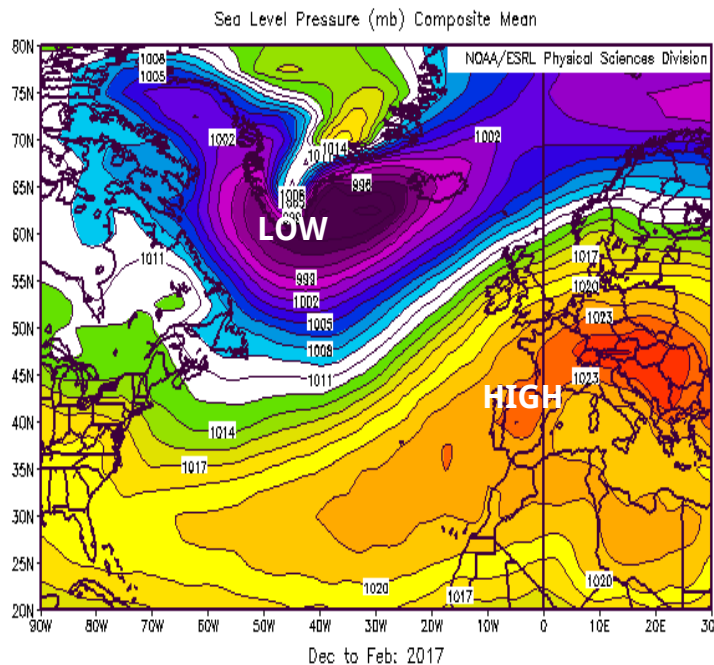


Origin and impact of these change : A review of 2 climate indices

→ Preliminary *qualitative* analysis



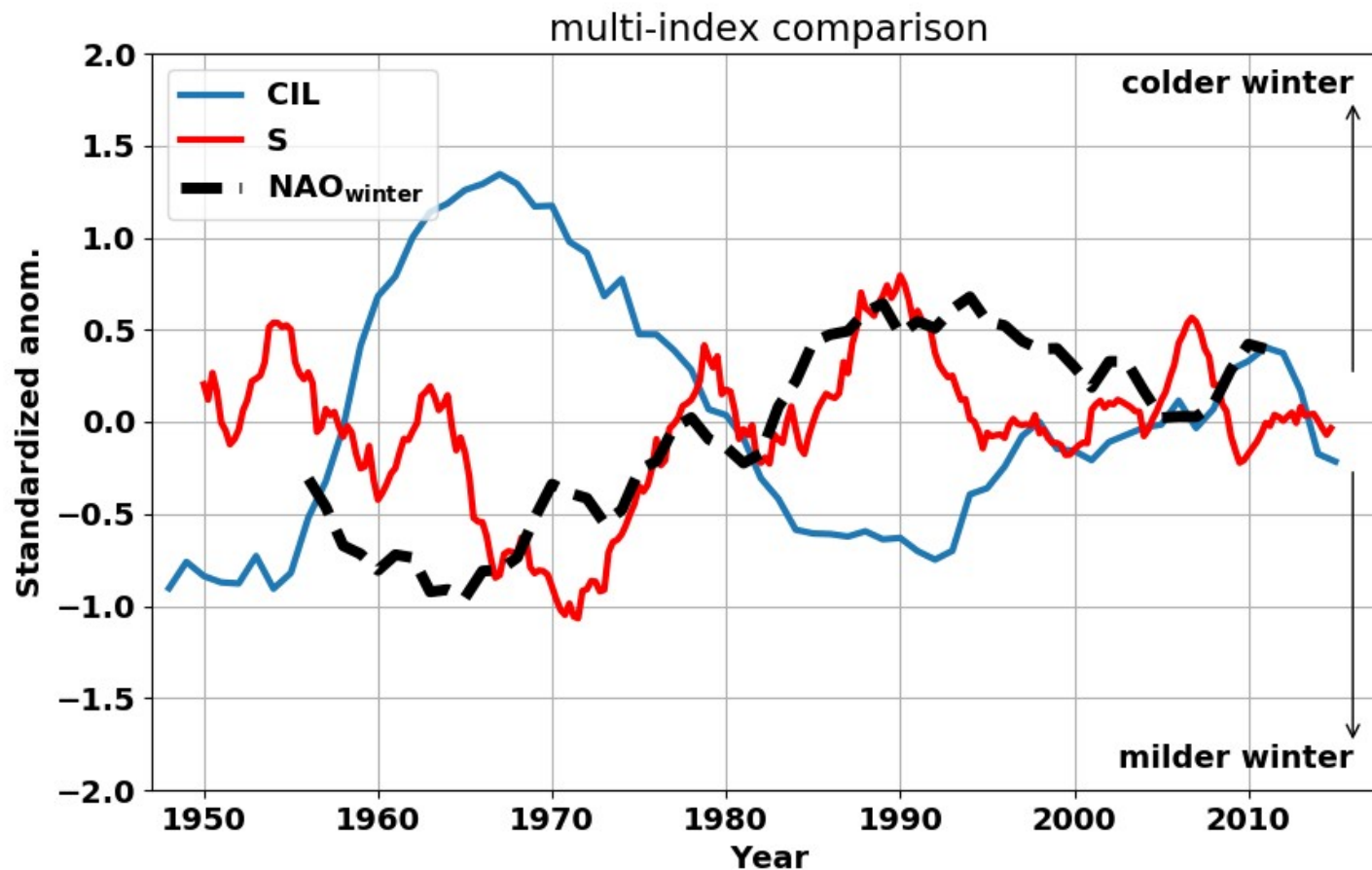
1. North Atlantic Oscillation (NAO)



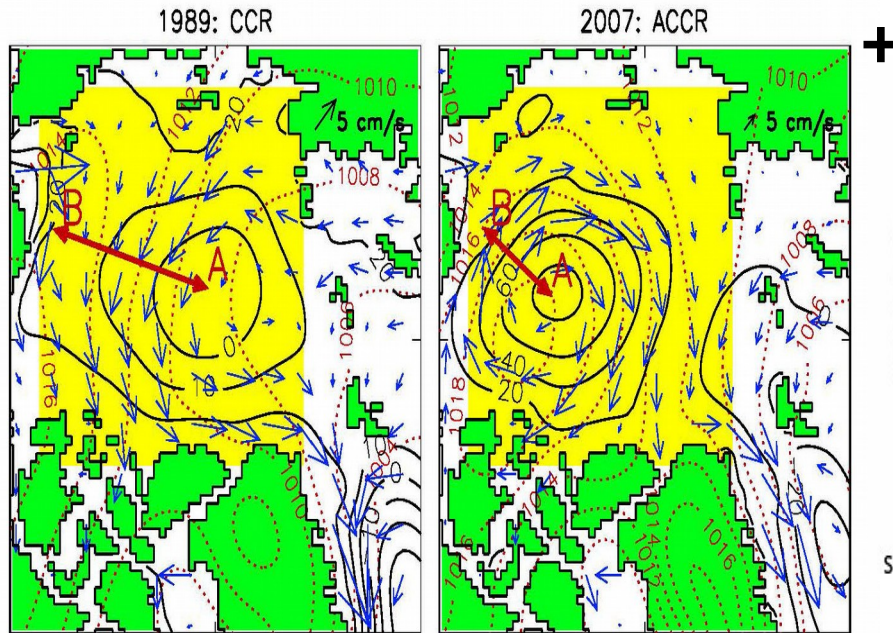
- *Atmospheric index*
- Explains a large portion of climate variability in NA (e.g. harsh winters)



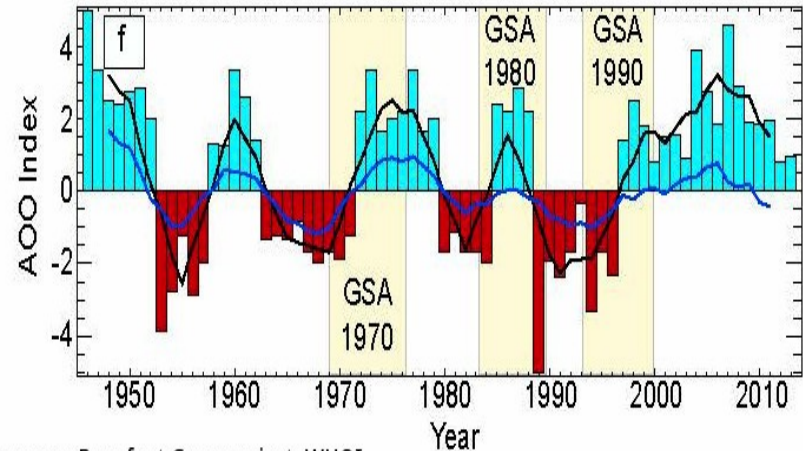
1. North Atlantic Oscillation (NAO)



2. Arctic Ocean Oscillation ($AOO \neq AO$)



+

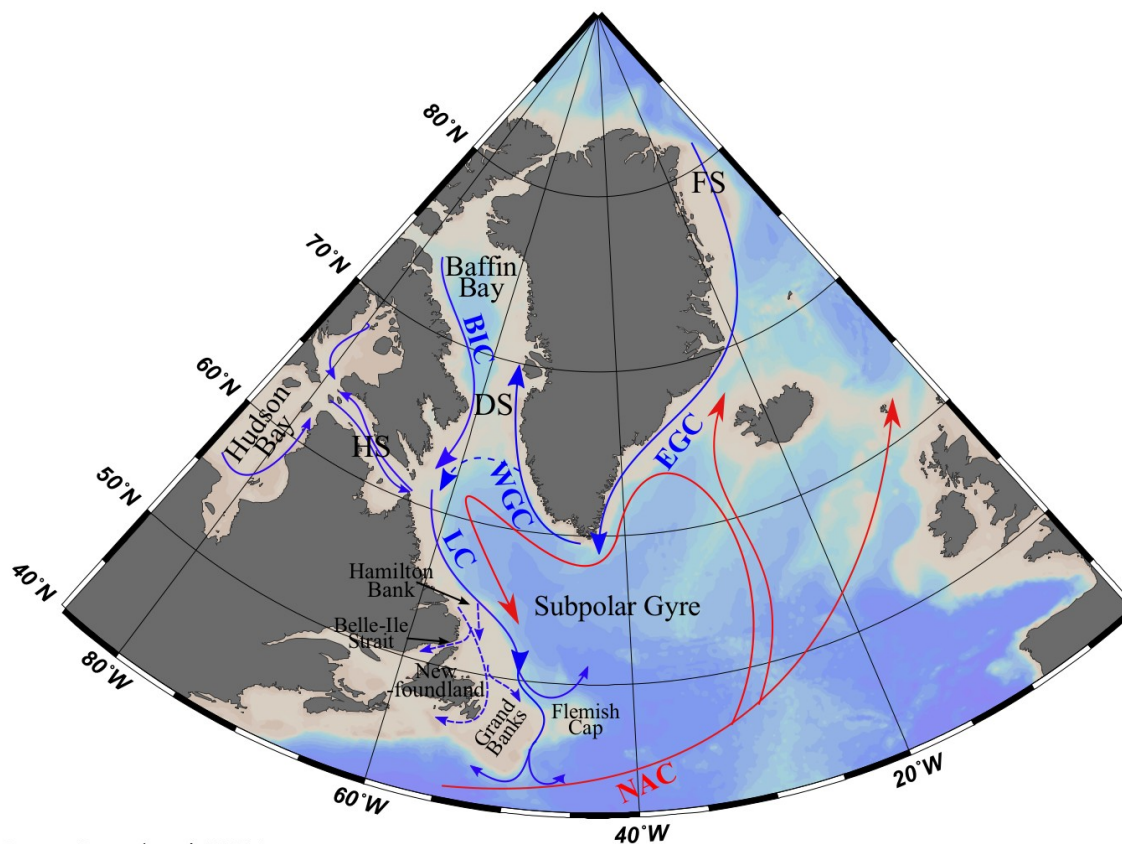


source: Beaufort Gyre project, WHOI

- Index based on wind-driven SSH patterns (cyclonic / Anticyclonic)
-> e.g., Proshutinsky et al., 2015 – Arctic circulation regimes
- Explains a large portion of freshwater export from Arctic (e.g. nutrient-rich waters)



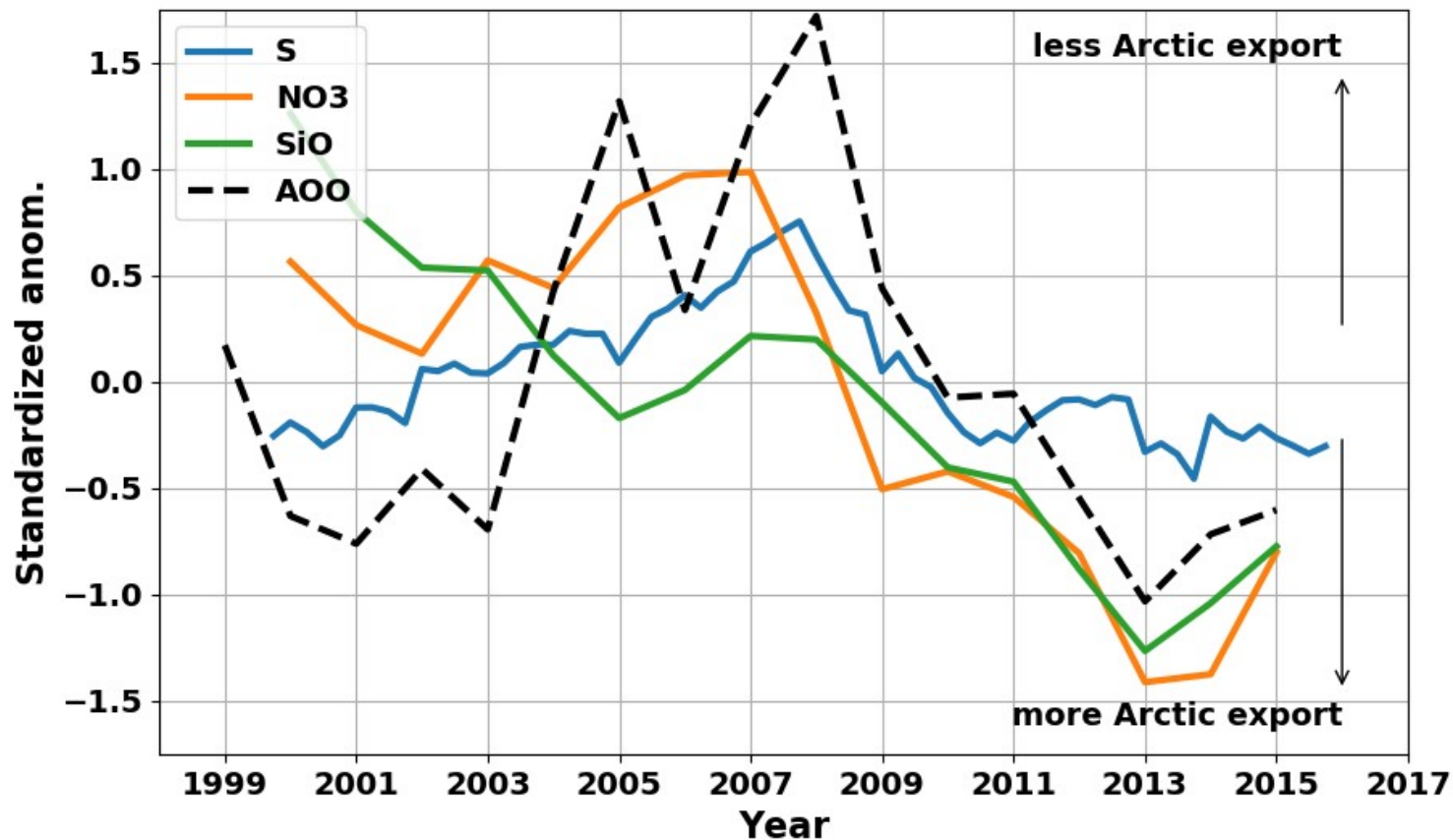
Circulation on the NL shelves



Source: Benetti et al. (2017)



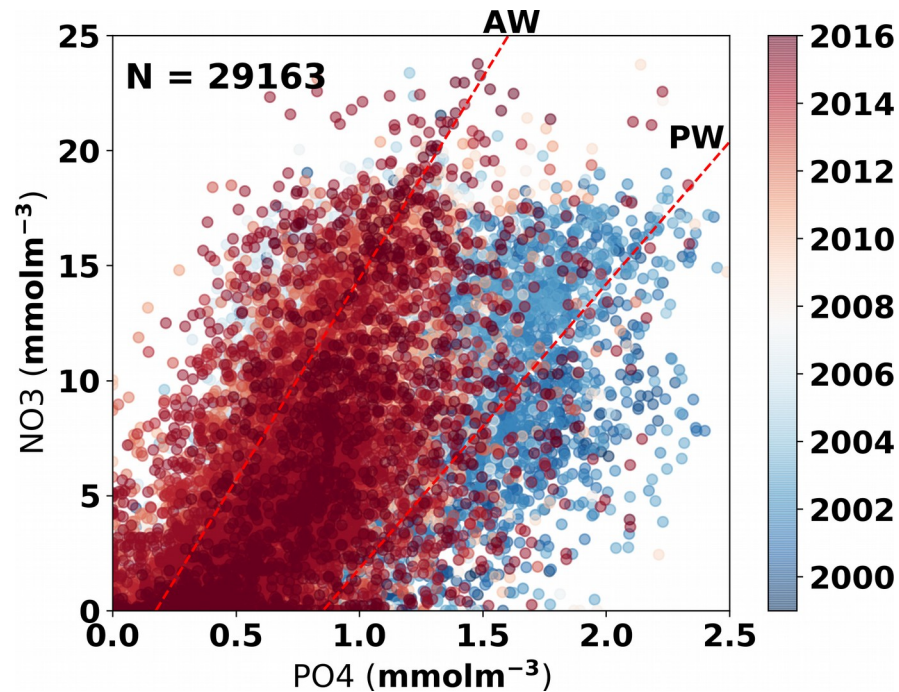
Recent AOO vs Nutrients (50-150m)



→ Less nutrients seems incompatible with more Arctic export...



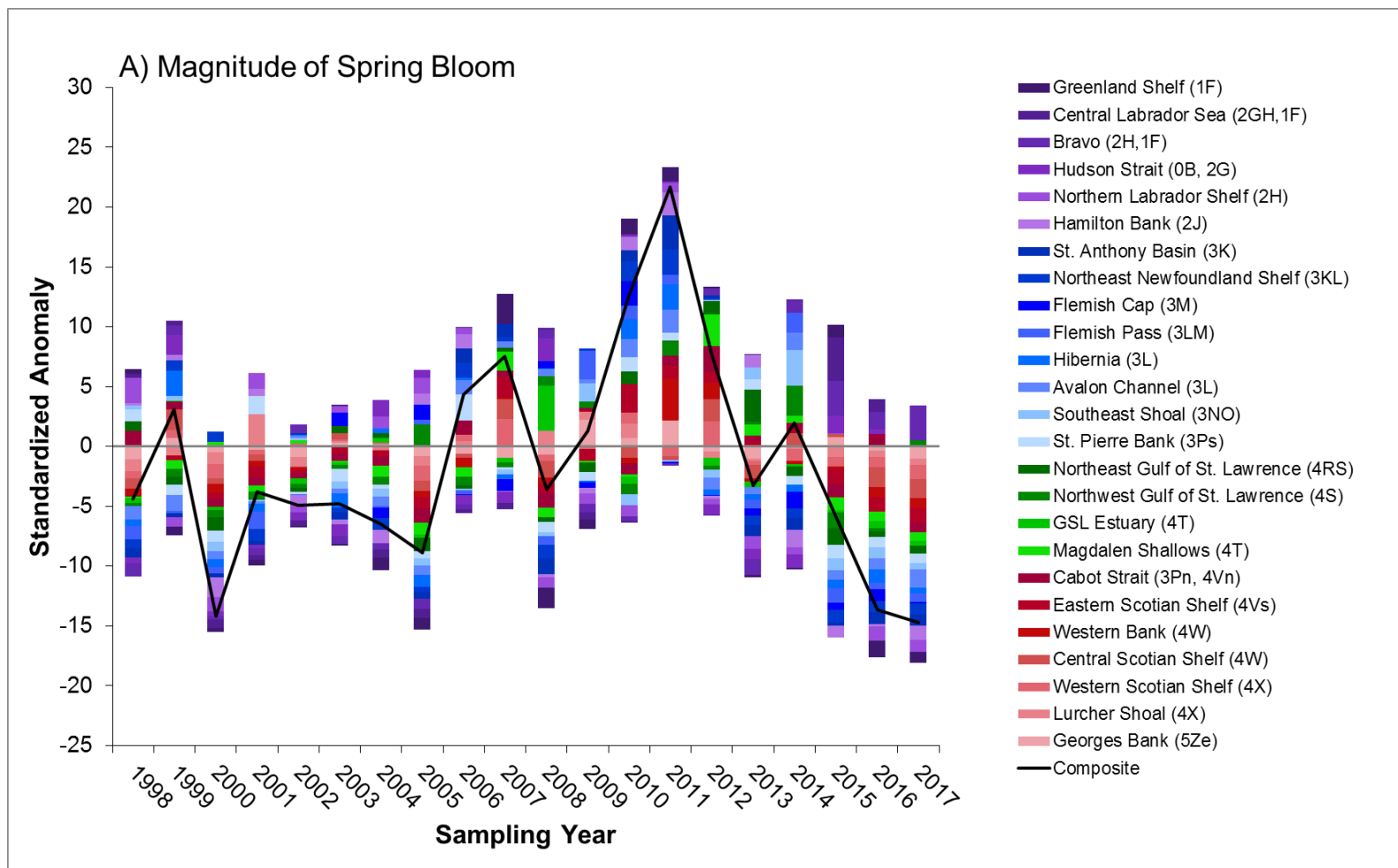
Recent AOO vs Nutrients (50-150m)



→ Recent changes towards less
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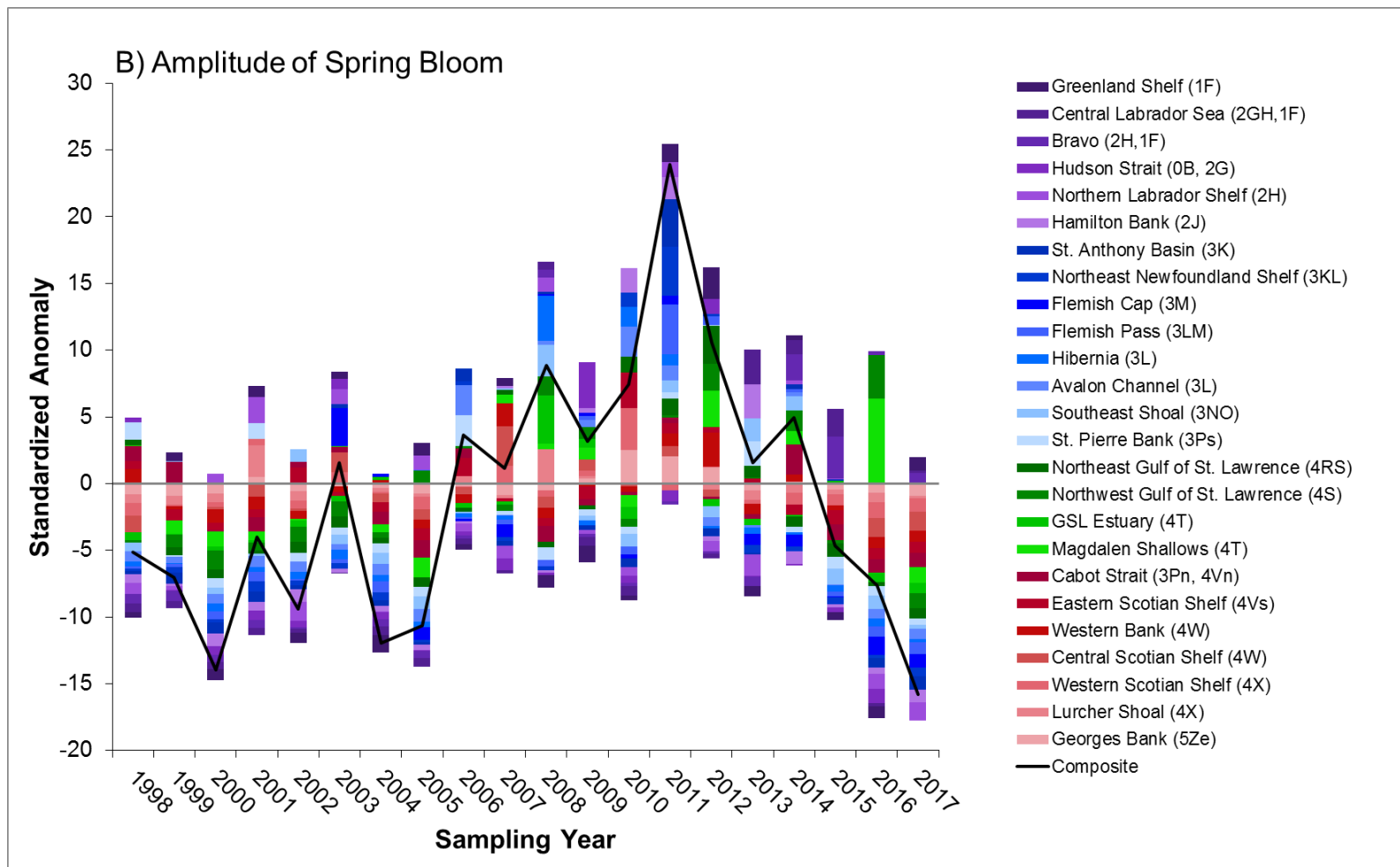


Primary production





Primary production





Conclusion

What can we tell from these historical data?

- Decadal changes in physical environment that fits NAO;
- Recent change in proportion of Atlantic/Pacific waters (less Pacific waters) that doesn't fit AOO;
- Recent decrease in nutrient concentrations consistent with less Arctic water in the system.



Thanks for listening!

Questions or comments?

Thanks to everyone making AZMP possible,
specially J. Holden and D. Senciall who helped with
the database.

To follow up :



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cyr0006.github.io



[@cyr0006](https://twitter.com/cyr0006)