



# Physical Oceanographic Environment on the NL Shelf in 2017

*Oceanography Section, NAFC, St. John's, NL*



# Outline

1. Introductory remarks
2. Large-scale context
3. Monitoring effort
4. New products
5. Summary



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# Introductory remarks

- Acknowledge E. Colbourne's help!
- New concept giving only the “big picture”  
(comments welcome!)
- **1981-2010** is the reference period (anomalies calculated as the departure from average)
- **“Normal” within  $\pm 0.5$  STD from average**



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1. Introductory remarks

**2. Large-scale context**

→ Indices (NAO, AMO)

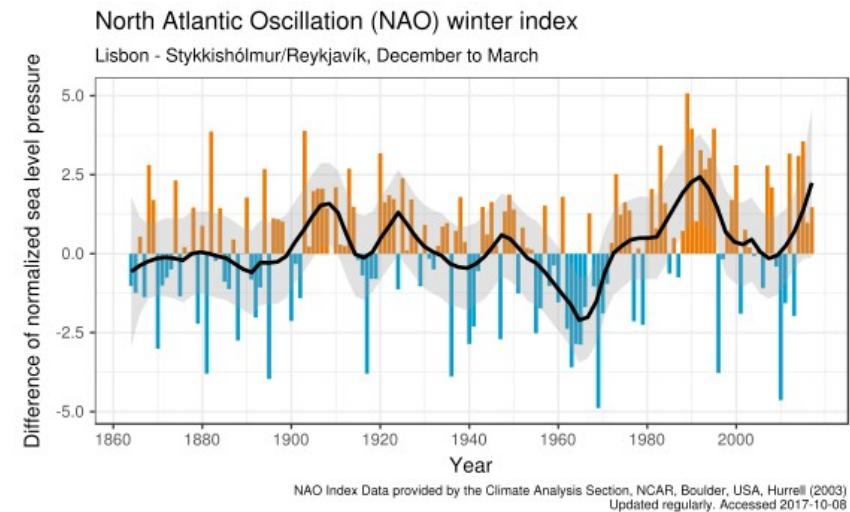
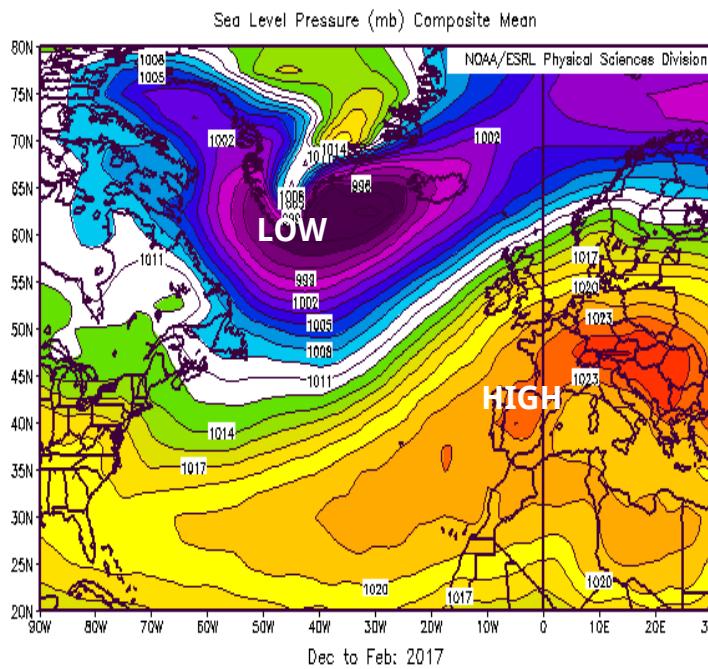
→ Large-scale observations (Air T°, SST, Sea ice)

3. Monitoring effort

4. New products

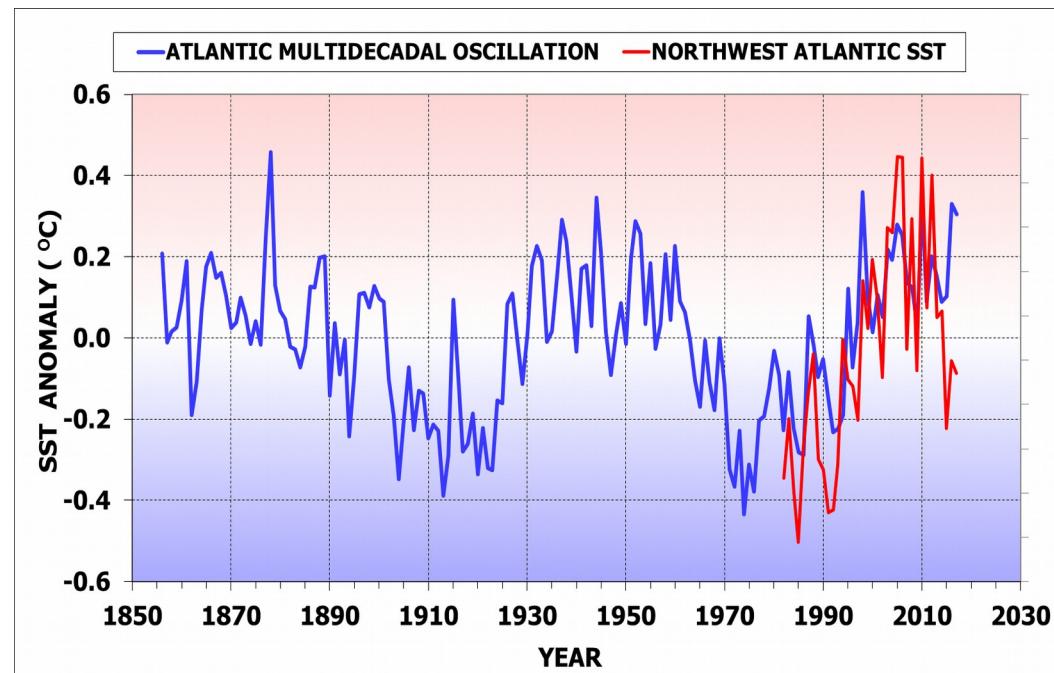
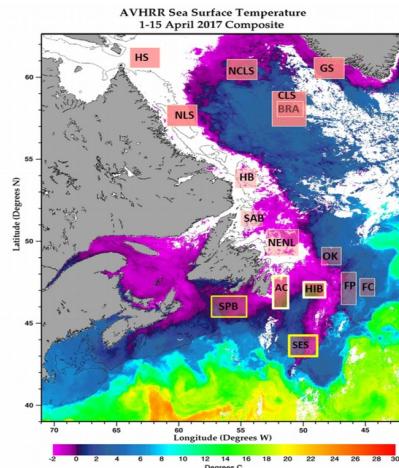
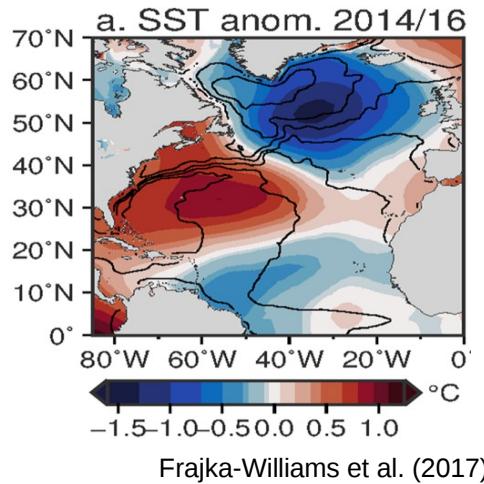
5. Summary

# North-Atlantic Oscillation (NAO) index



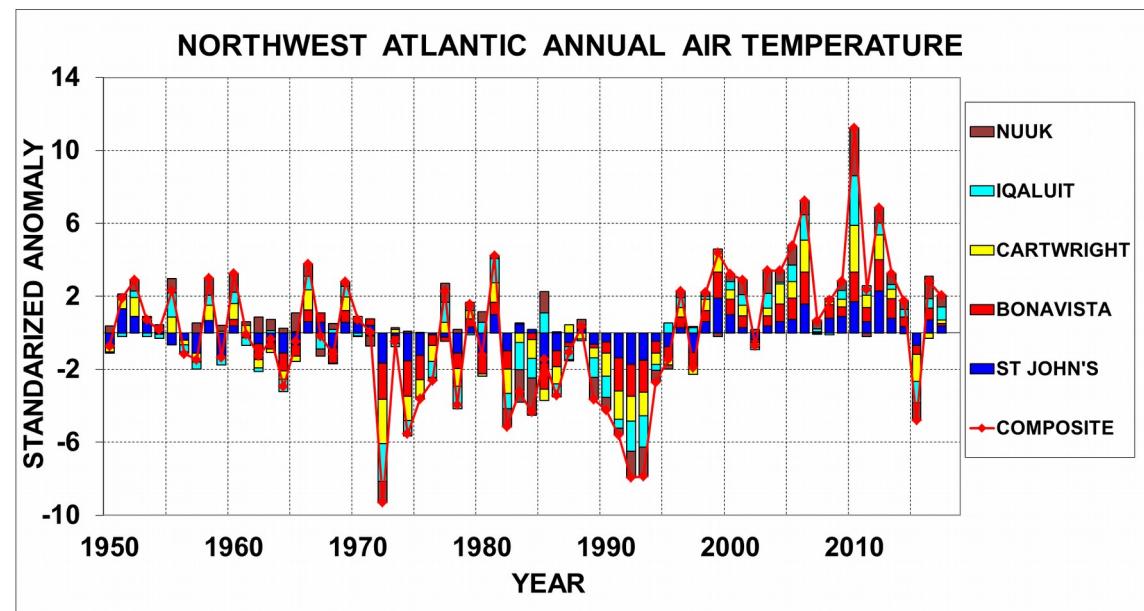
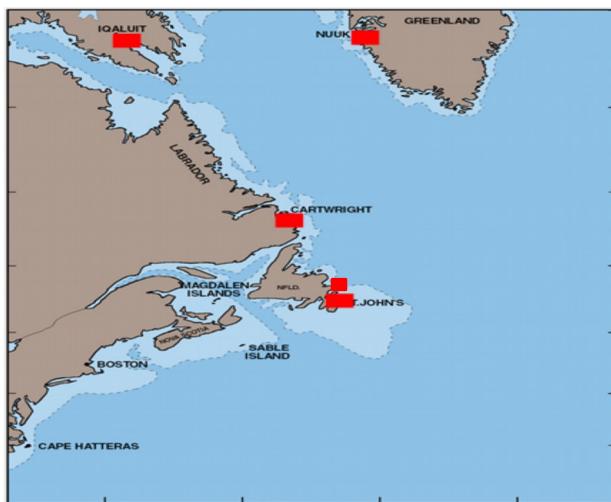
- **Atmospheric index** responsible for large part of weather variability on both sides of the Atlantic
- 2017: NAO+
- Recent trend towards lower NAO

# Atlantic Multidecadal Oscillation (AMO)



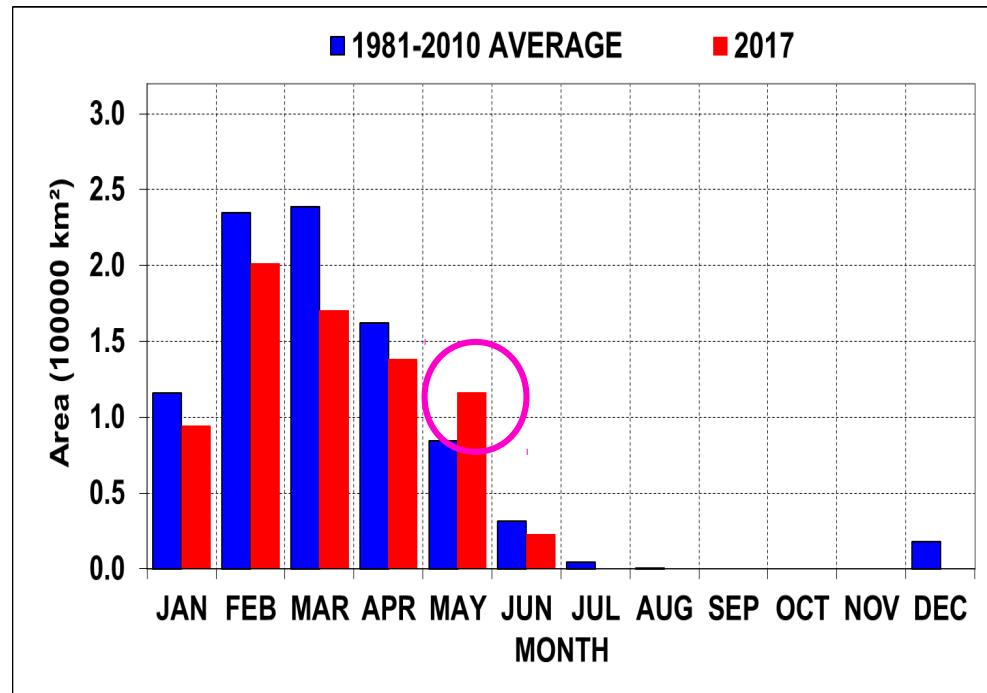
- Index based on North Atlantic SSTs
- Low frequency cycles (60-70 yr)
- Proxy for the AMOC (overturning circulation)
- Emerging negative trend (Frajka-Williams et al., 2017)

# Large-scale observations: Air T°



- 2017 Air temperature generally close to normal, consistent with decreasing NAO index
- Spring colder than normal

# Large-scale observations: Sea ice



→ 2017 Follows long-term trend of **below normal** sea ice extent (**except for May**)

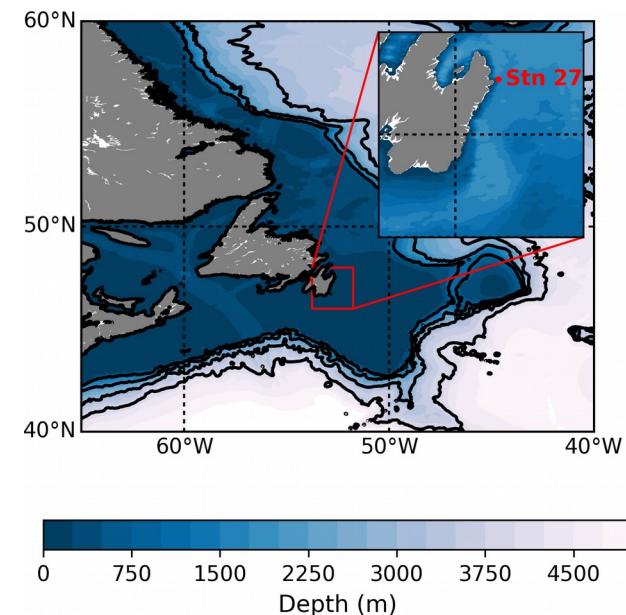
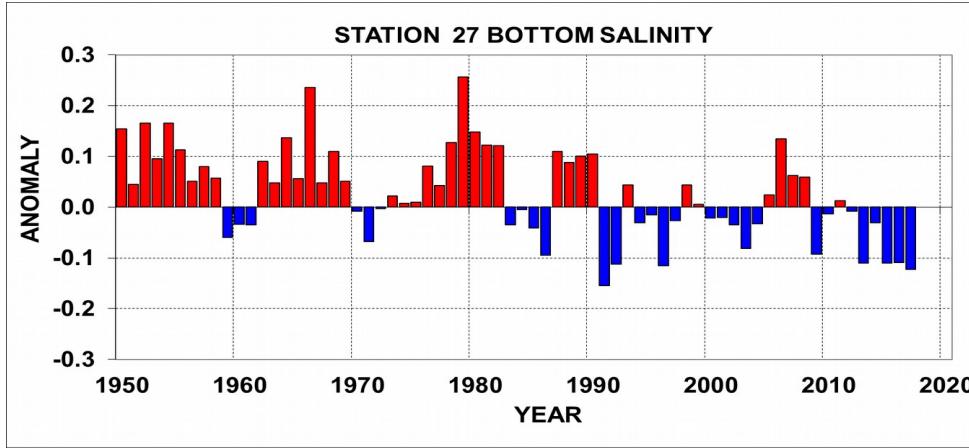
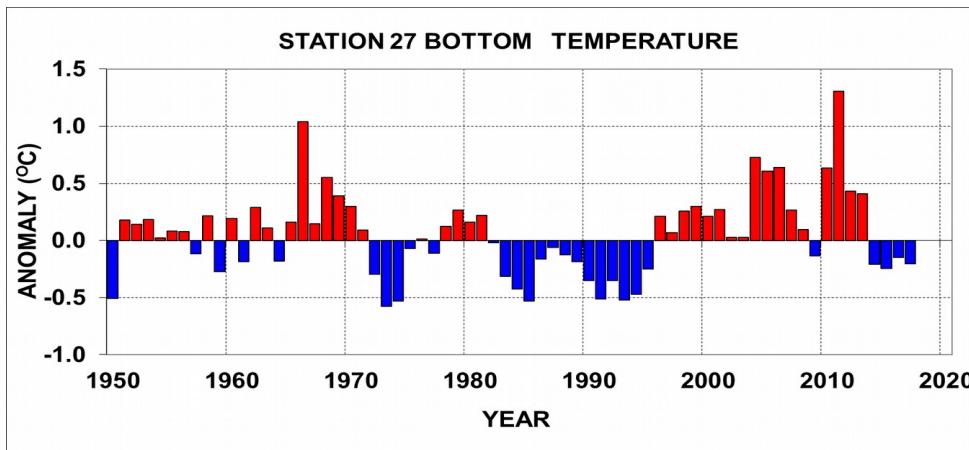


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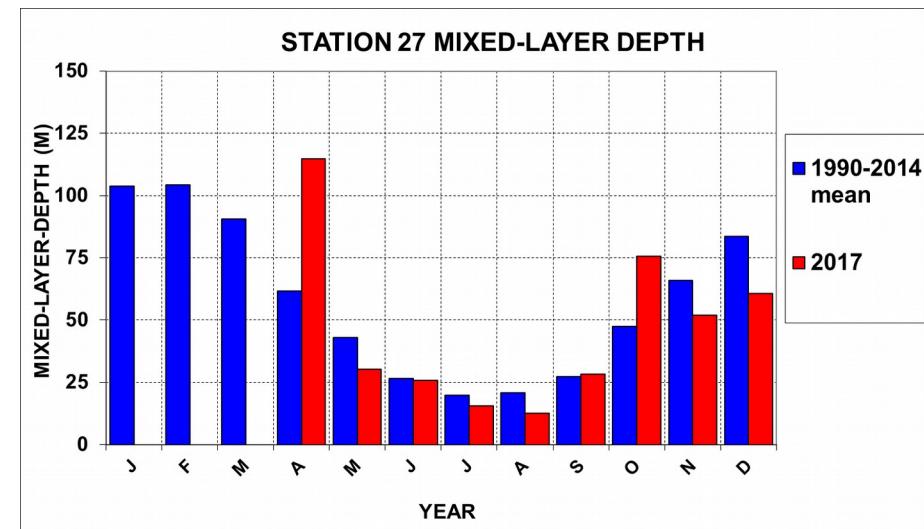
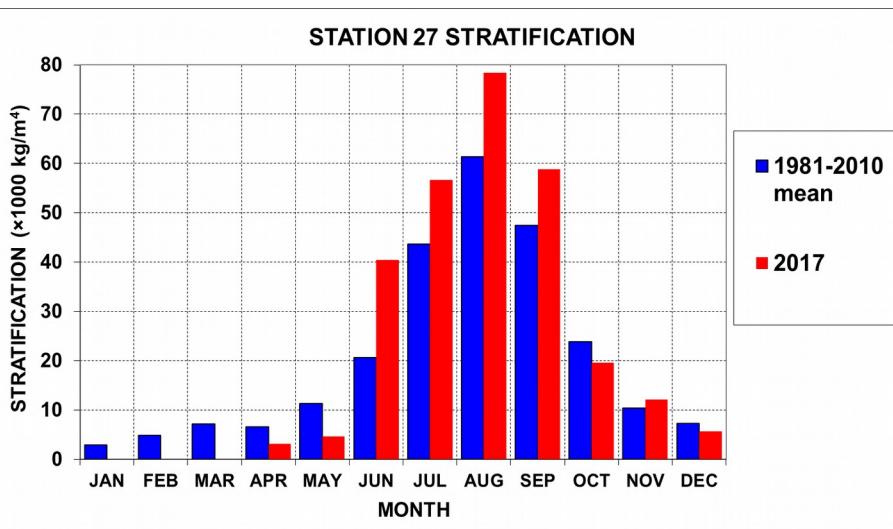


# Monitoring effort: Station 27



- $\text{T}^{\circ}$  record high in 2011
- $\text{T}^{\circ}$  near-normal 2014-2017
- Salinity below normal 2012-2017 (-1.5 SD in 2017)

# Monitoring effort: Station 27

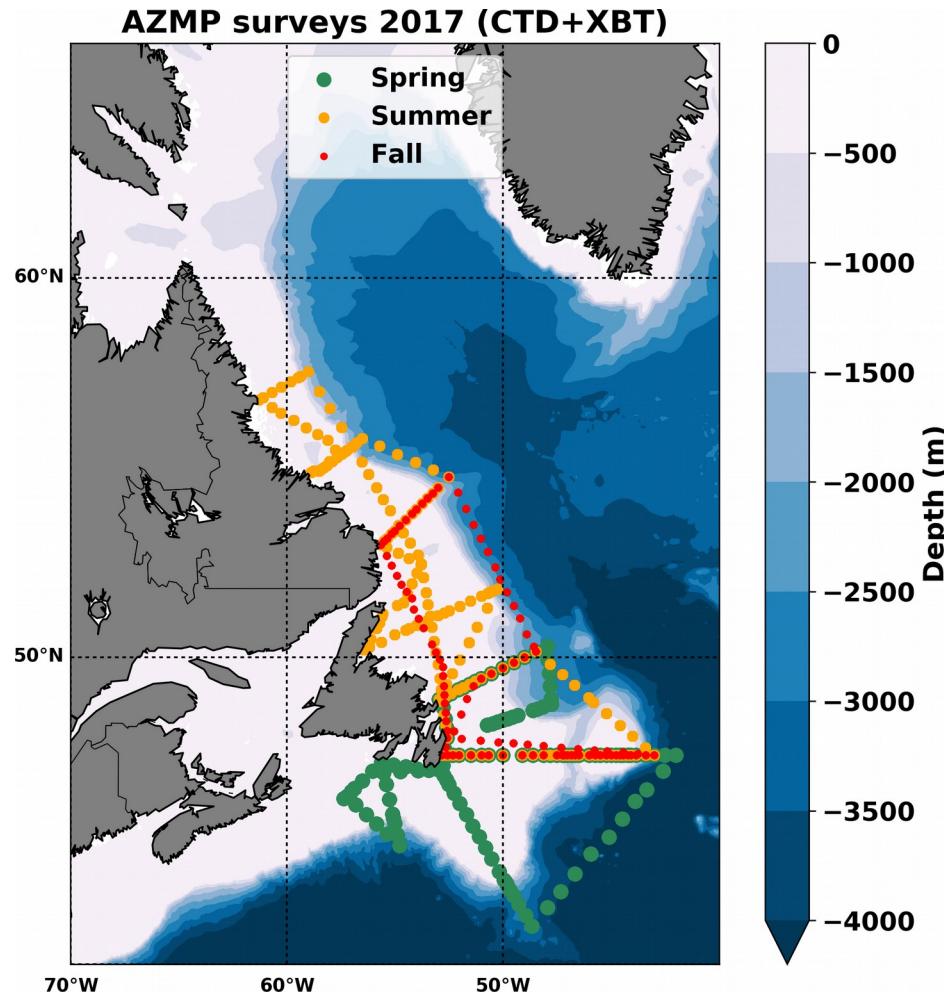


→ Summer stratification above normal

→ Mixed layer depth much deeper in April (cold spring)

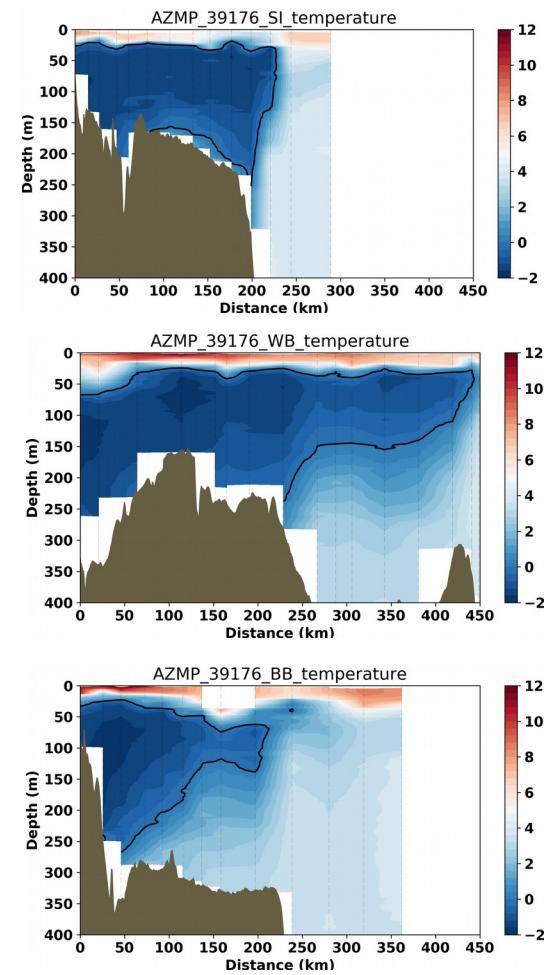
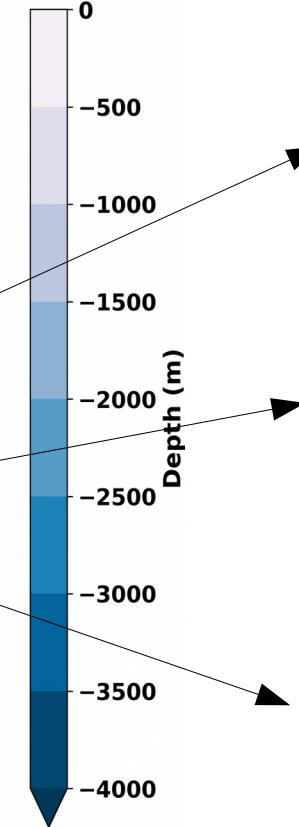
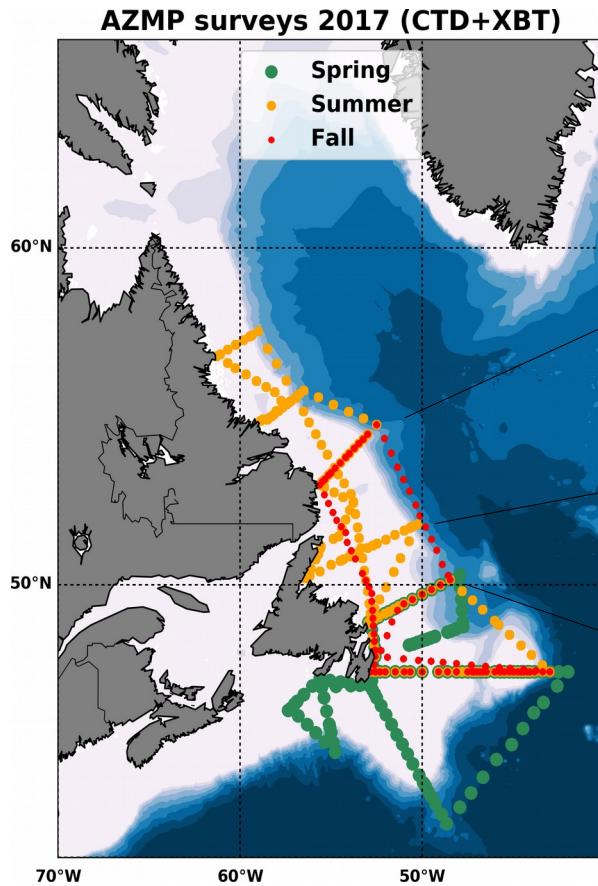


# Monitoring effort: AZMP-NL sections

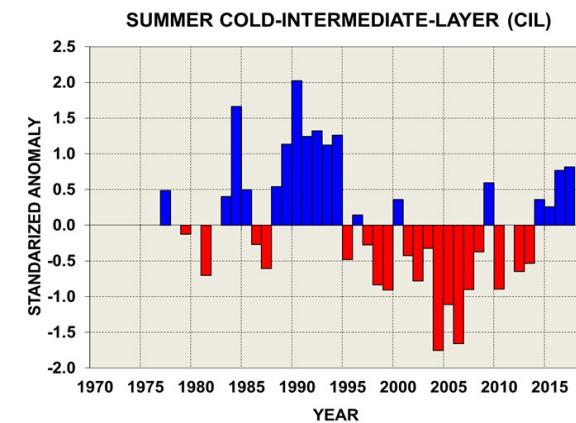
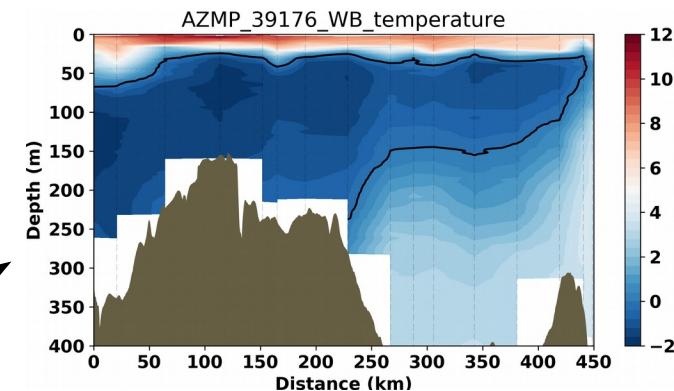
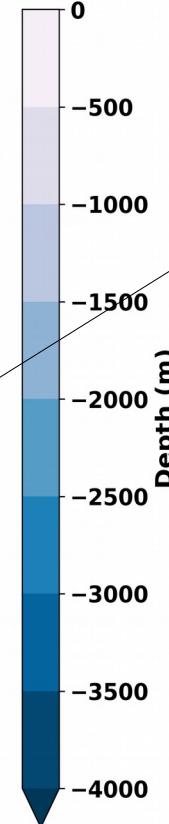
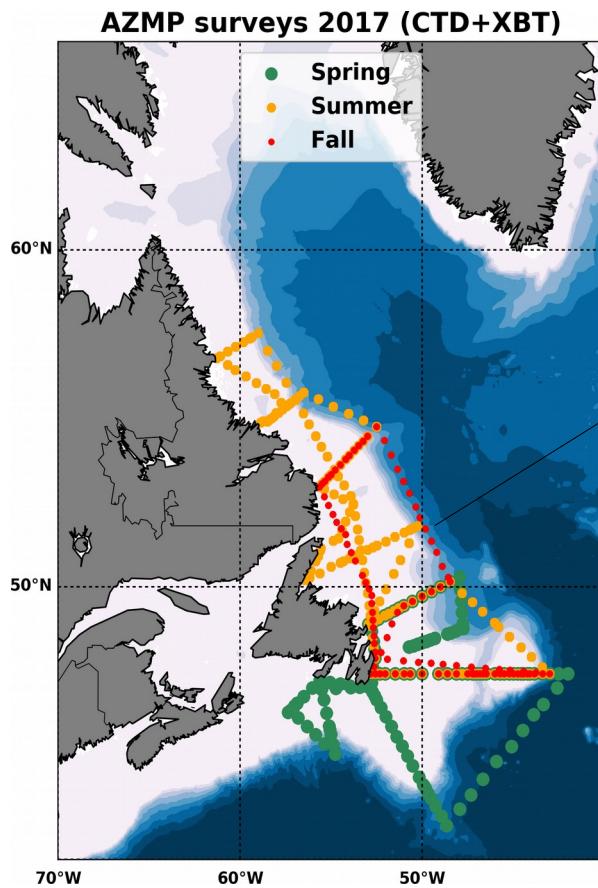




# Monitoring effort: AZMP-NL sections



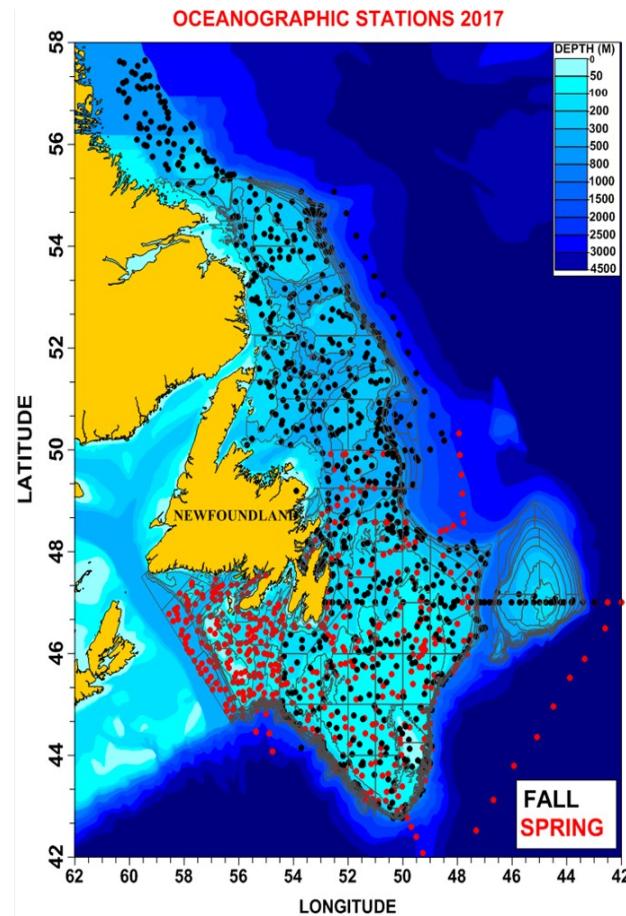
# Monitoring effort: AZMP-NL sections



- Increasing volume of NE shelf CIL ( $T < 0^\circ\text{C}$ ) over last 4 yr (+0.8 SD in 2017)
- Consistent with other sections



# Monitoring effort: Bottom conditions (multi-species & AZMP)





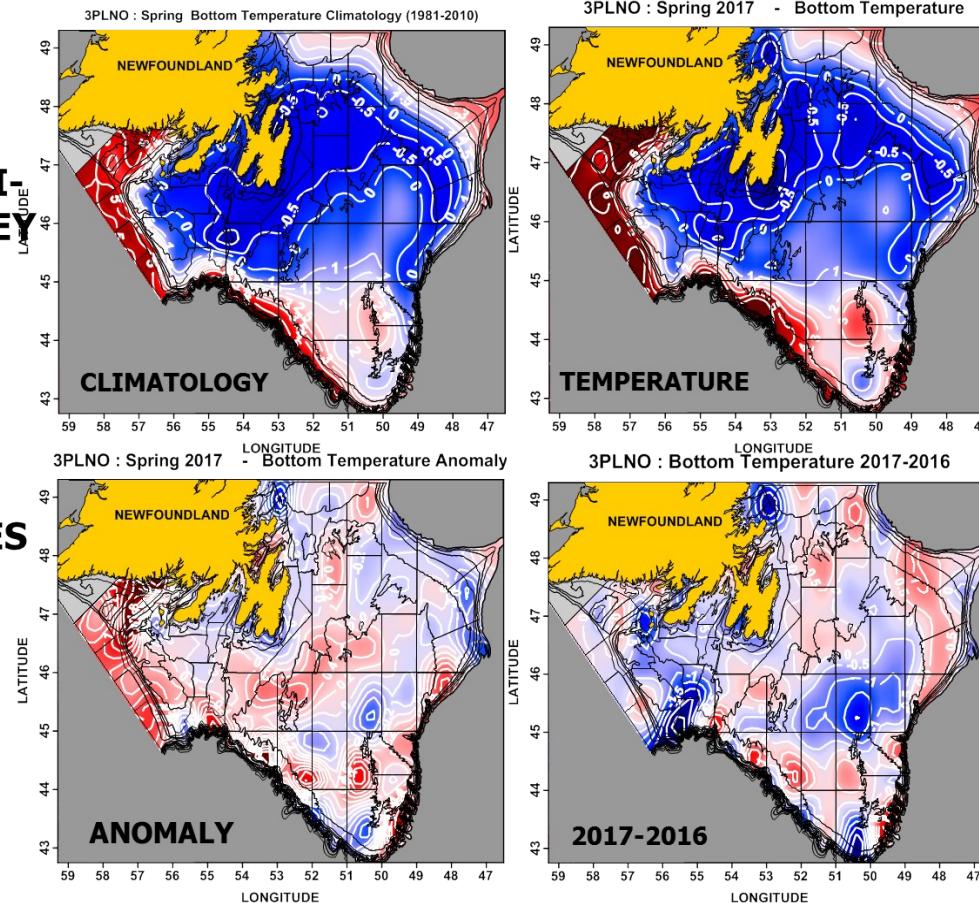
# Monitoring effort: Bottom T°

**SPRING MULTI-SPECIES SURVEY**

**SPRING**

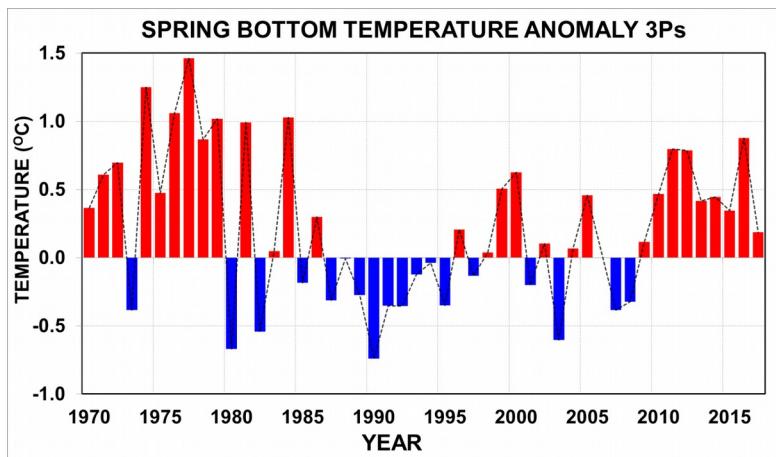
**2017**

**BOTTOM TEMPERATURES**

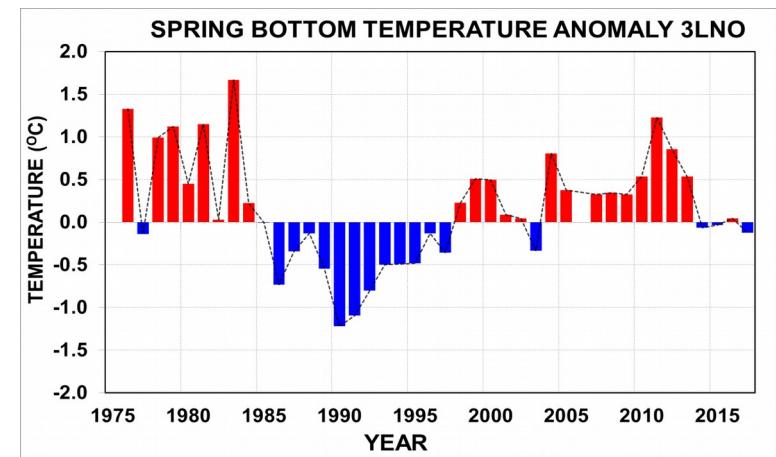


# Monitoring effort: Bottom T° (3Ps/3LNO)

## Spring



(South NL / North of Laurentian channel)

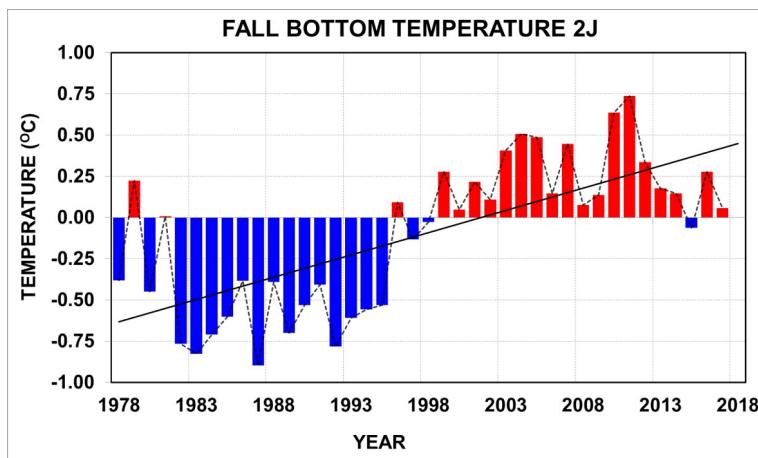


(Tip of Grand Bank)

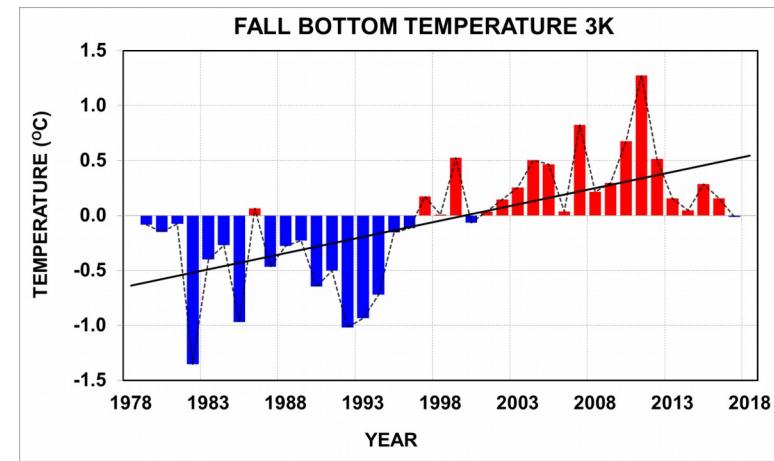
→ Low frequency cycles, but not always spatially consistent (e.g. record-high in 3Ps in 2016, but normal in 3LNO)

# Monitoring effort: Bottom T° (3Ps/3LNO)

## Fall



(Southern Labrador)



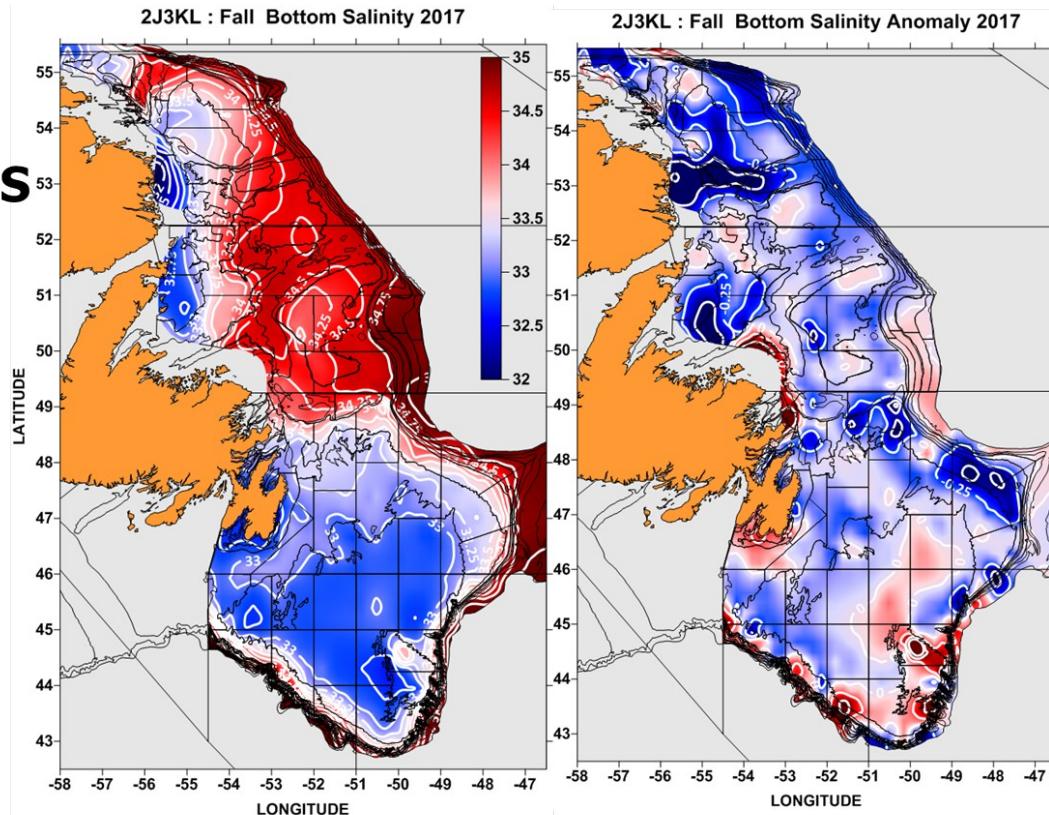
(Northern NL)

- Warming trend since 1978 that may be misleading (likely natural low frequency cycles)
- 2017 near normal across sub-regions



# Monitoring effort: Bottom S

**MULTI-SPECIES  
BOTTOM  
SALINITY  
SURVEY**  
**FALL 2017**



**Wide Spread Negative Salinity Anomalies  
during Fall of 2017.**

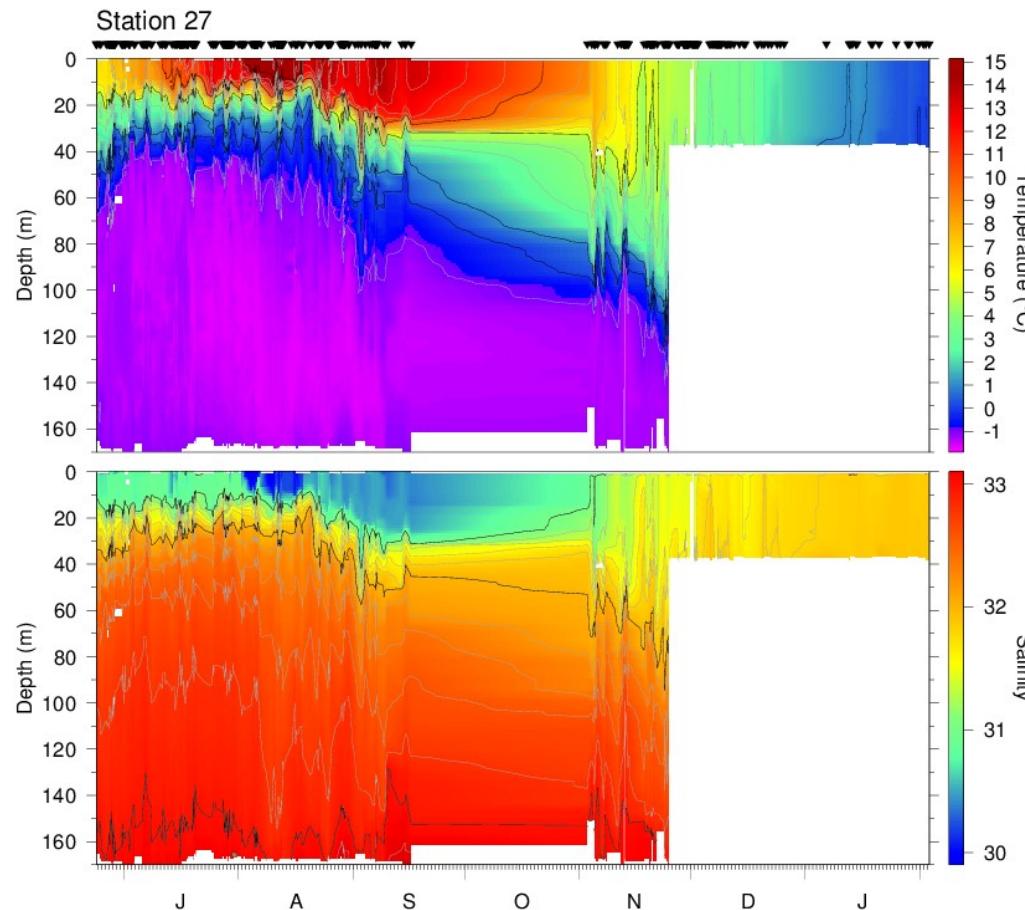


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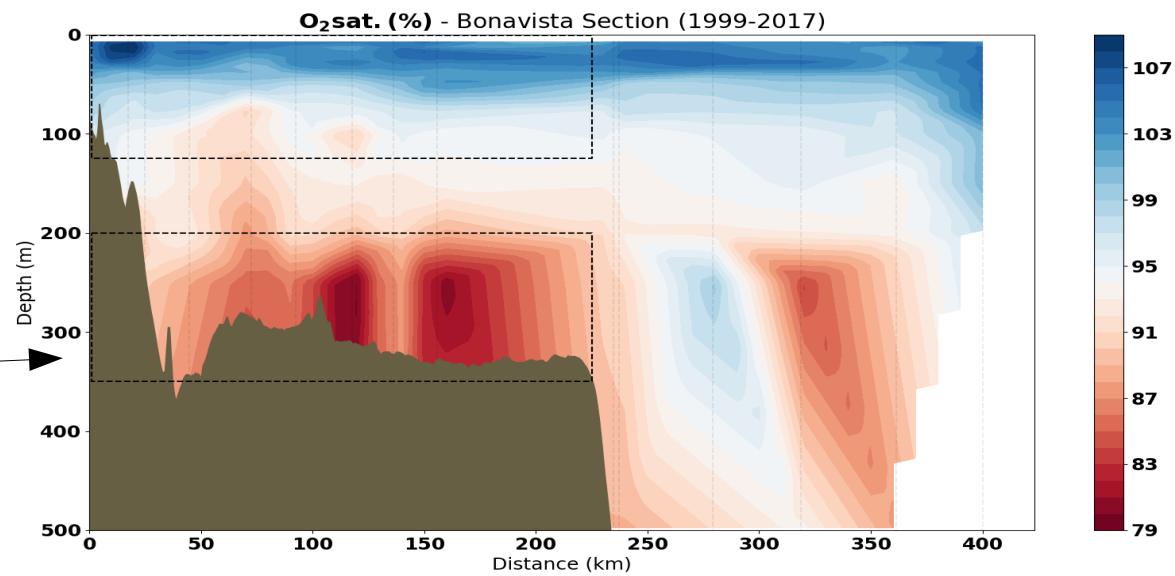
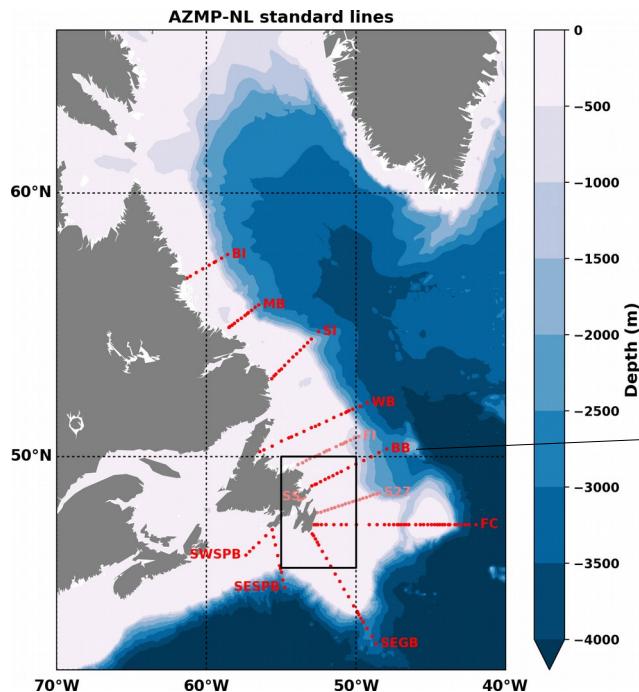
# New product: Viking buoy @Stn27



Automatically generated by P.S. Galbraith

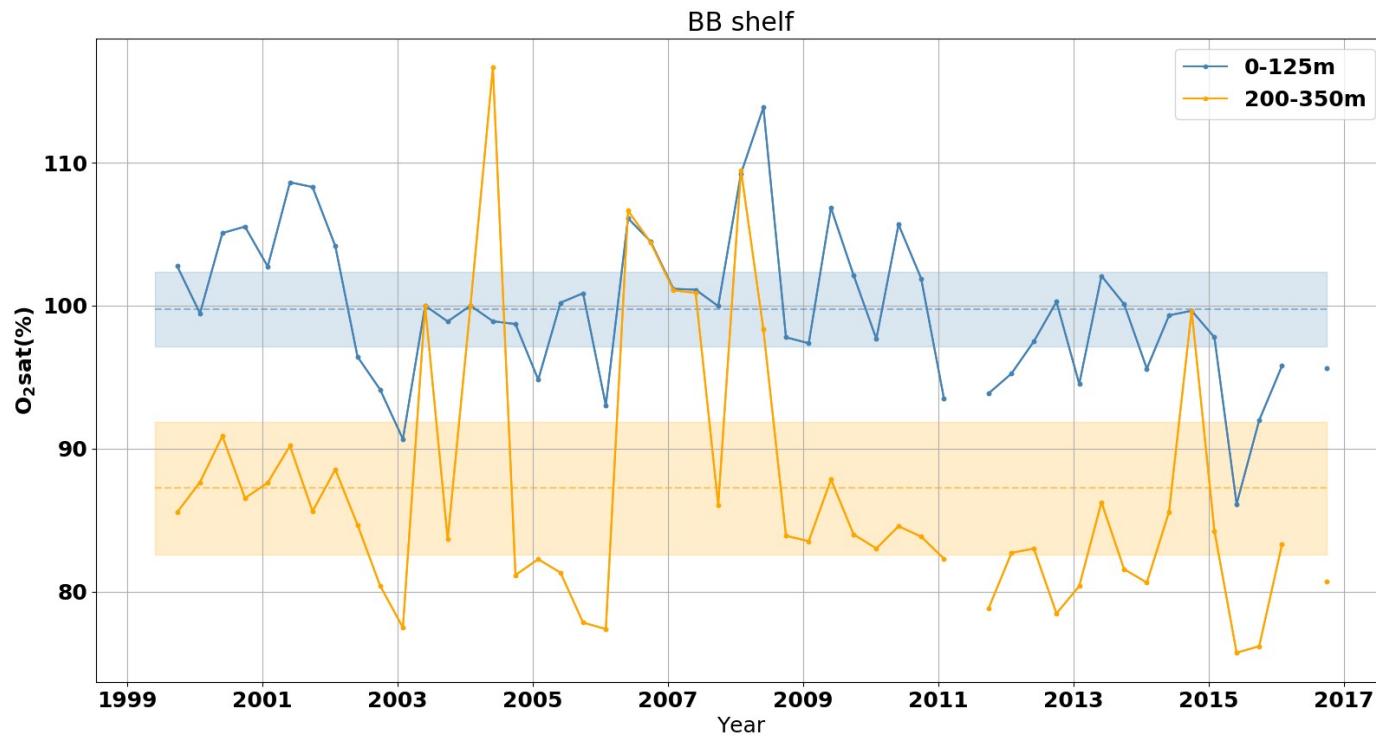


# New product: Dissolved Oxygen (%sat)



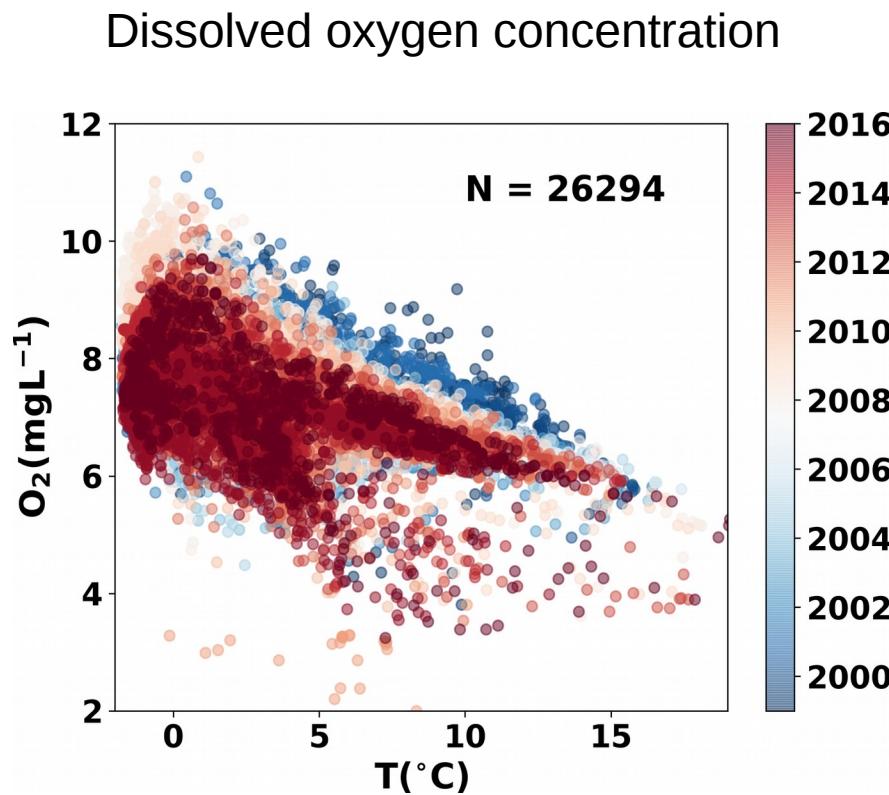


# New product: Dissolved Oxygen (%sat)





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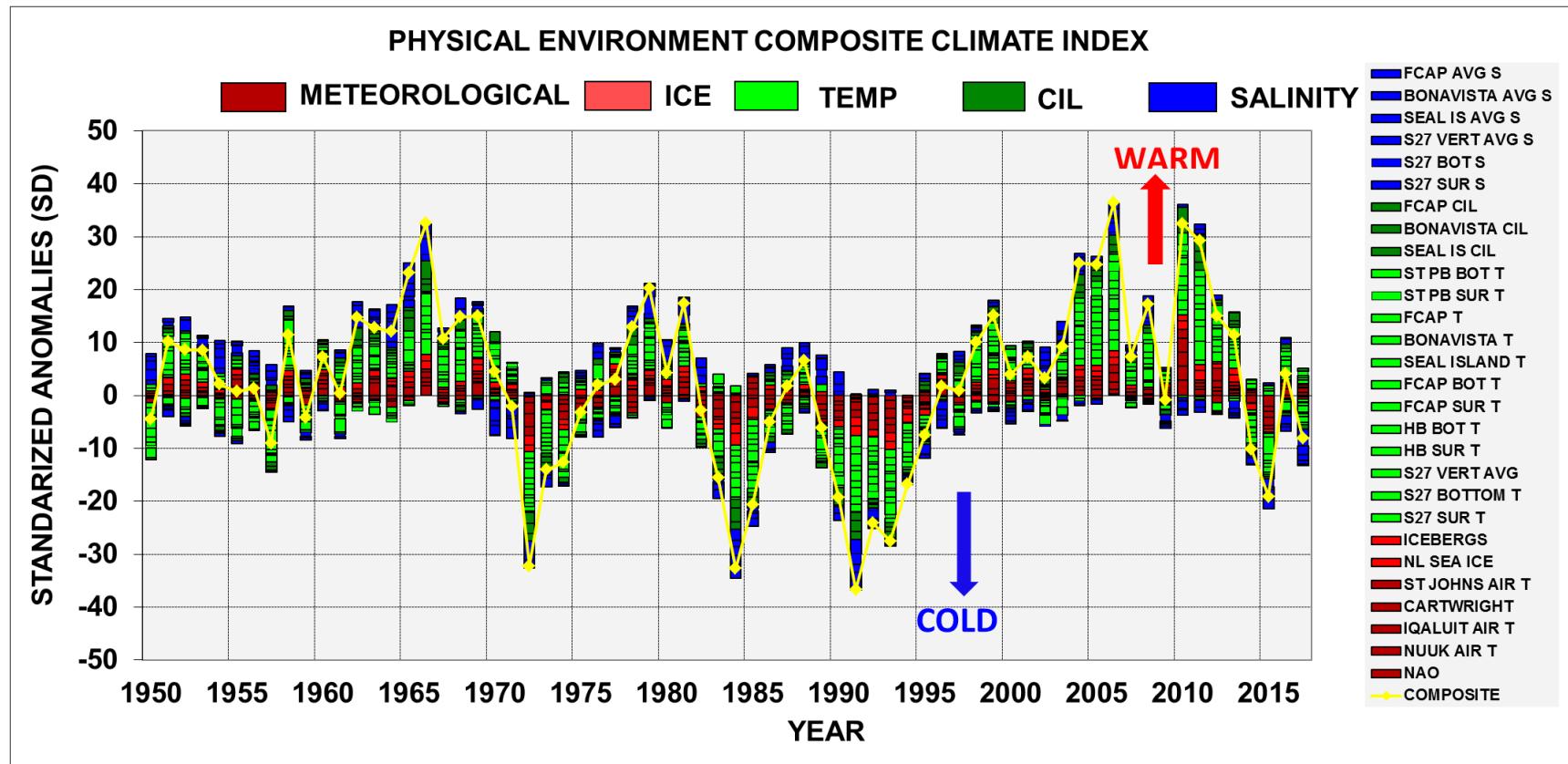




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# Summary



→ Composite index back to negative (like 2014/15) after being positive in 2016



# Summary

**Overall, 2017 relatively close to normal, but:**

- Spring was cold and full of ice
- Air T° slightly above normal (except cold spring)
- Stn27 was (slightly) cold and fresh (summer stratification above normal)
- CIL volume increasing over last 4 years
- Widespread fresh anomaly over the NL shelves in the fall

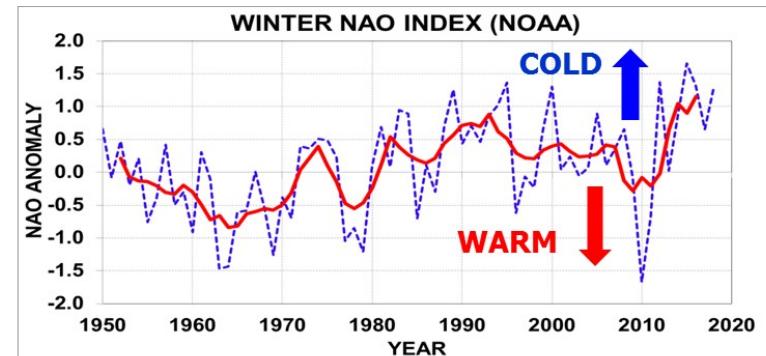
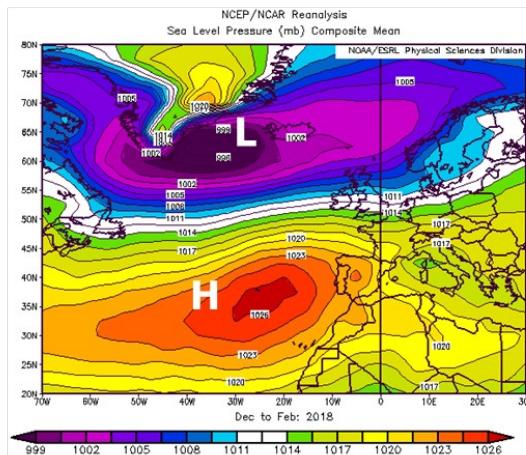
**Perspectives:**

→ **weird NAO in 2018**

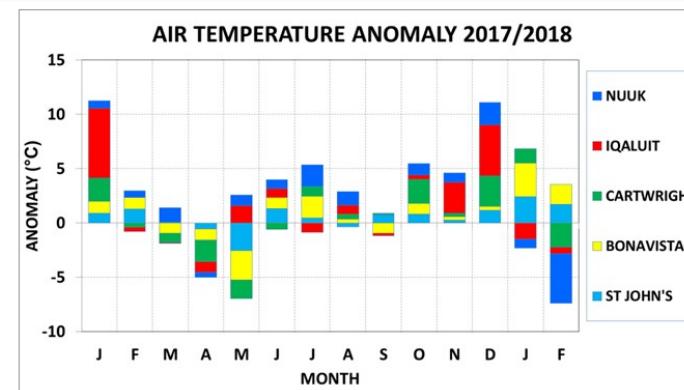
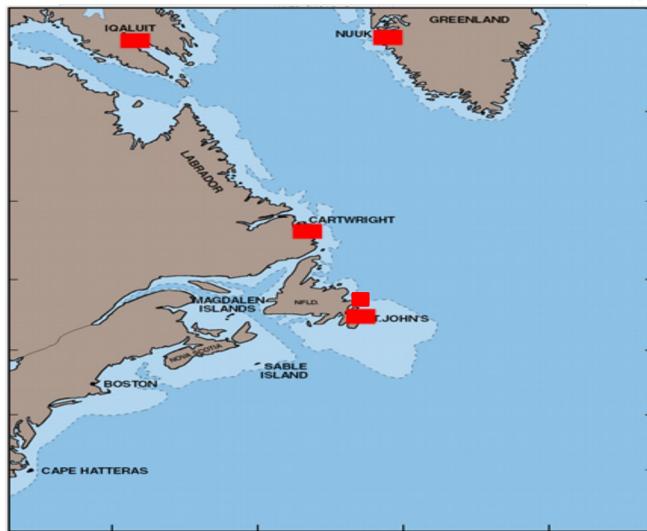


# NAO UPDATE FOR WINTER 2018

S  
L  
P



- **NAO Positive Phase in 2018 (5<sup>th</sup> highest).**
- **Greenland-Iceland Near-Normal SLP.**
- **Mid-Latitude-Azores SLP Higher than normal.**
- **Southwesterly flow dominating in most of Newfoundland with above normal air temperatures.**





# First day of spring in Marseille (South France)





# Summary

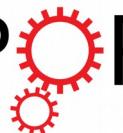
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## Perspectives:

- **weird NAO in 2018**
- **Progression towards a shift in AMO continues**

## SCIENTIFIC REPORTS



OPEN

Emerging negative Atlantic  
Multidecadal Oscillation index in  
spite of warm subtropics

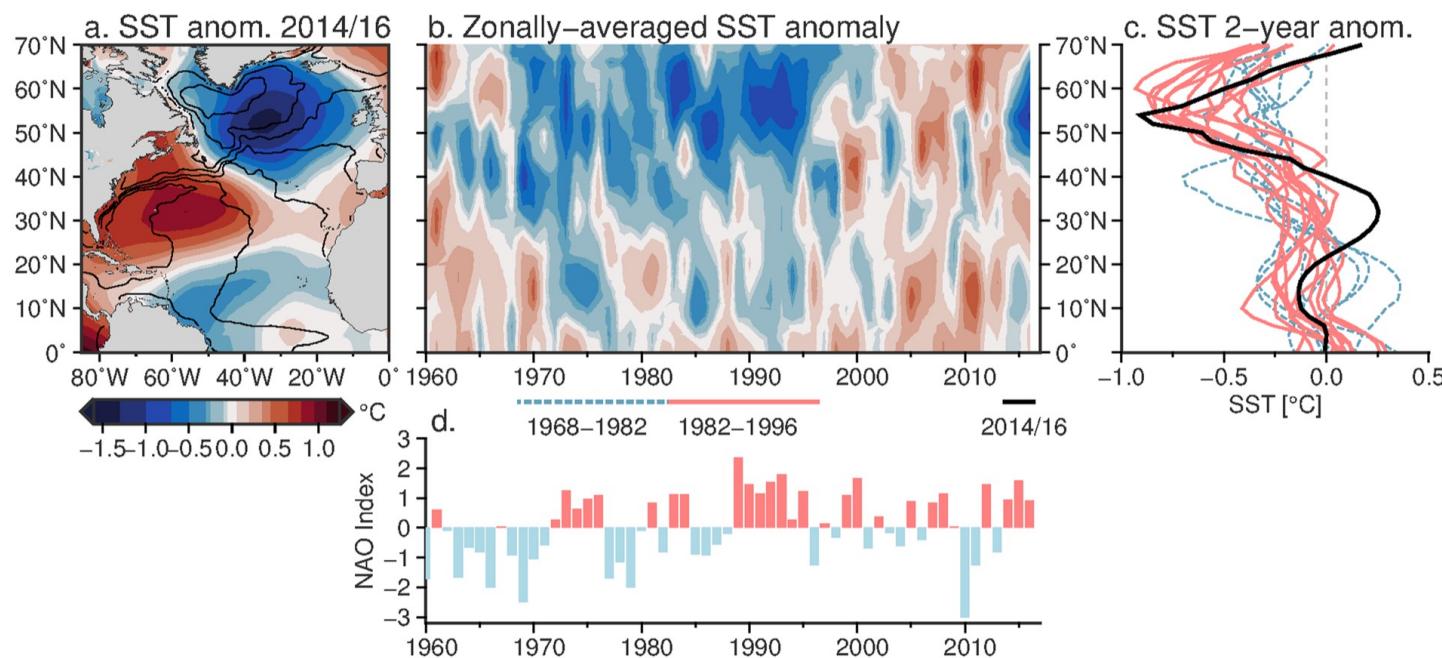
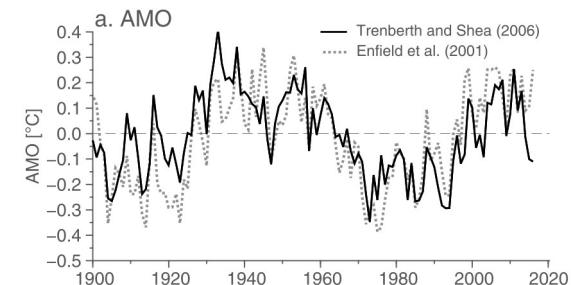
Received: 16 March 2017

Accepted: 8 August 2017

Published online: 11 September 2017

Eleanor Frajka-Williams<sup>1</sup>, Claudie Beaulieu<sup>1</sup> & Aurelie Duchez<sup>2</sup>

Sea surface temperatures in the northern North Atlantic have shown a marked decrease over the past several years. The sea surface in the subpolar gyre is now as cold as it was during the last cold phase of





# Thanks!

(specially those who made the AZMP-NL machine running in 2017)

- AZMP 2017 scientific crew:

W. Bailey, E. Colbourne, W. Coffey, F. Cyr, G. Doyle,  
S. Fraser, P. Hawkins, J. Higdon, R. King, S. Lewis, G.  
Maillet, K. Millar, B. Molloy, M. O'Toole, B. Pye, A.  
Robar, S. Snook, B. Squires & D. Sullivan.

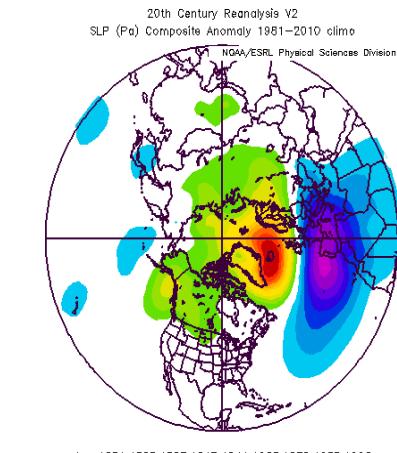
- Data management:

J. Holden, B. Pye & D. Senciall.

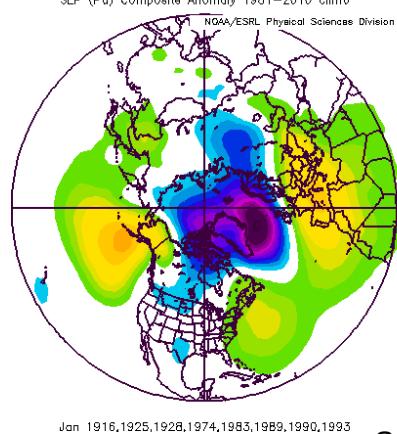


# North-Atlantic Oscillation (NAO) index

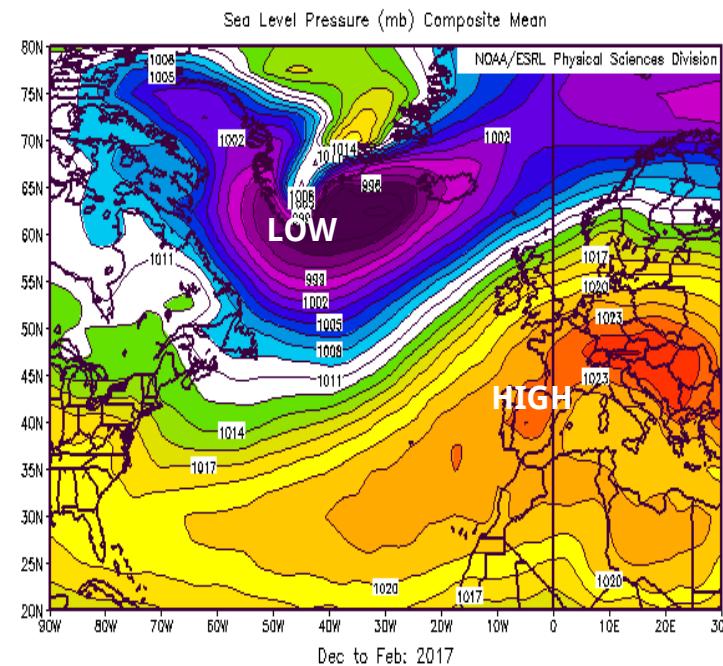
NAO -  
(warm)



NAO +  
(cold)



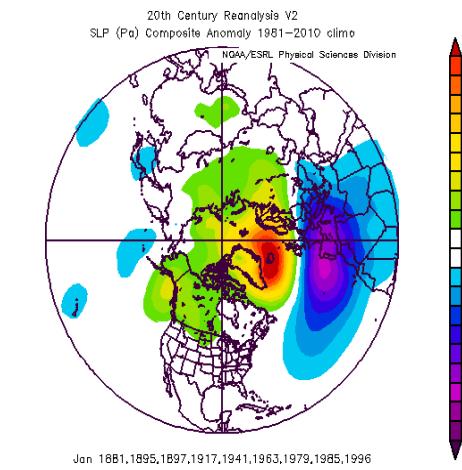
Source : ESRL/NOAA



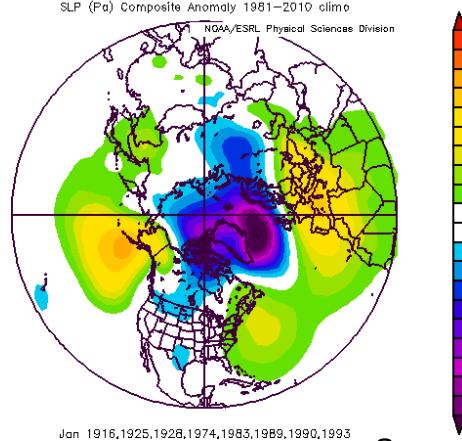


# North-Atlantic Oscillation (NAO) index

NAO -  
(warm)

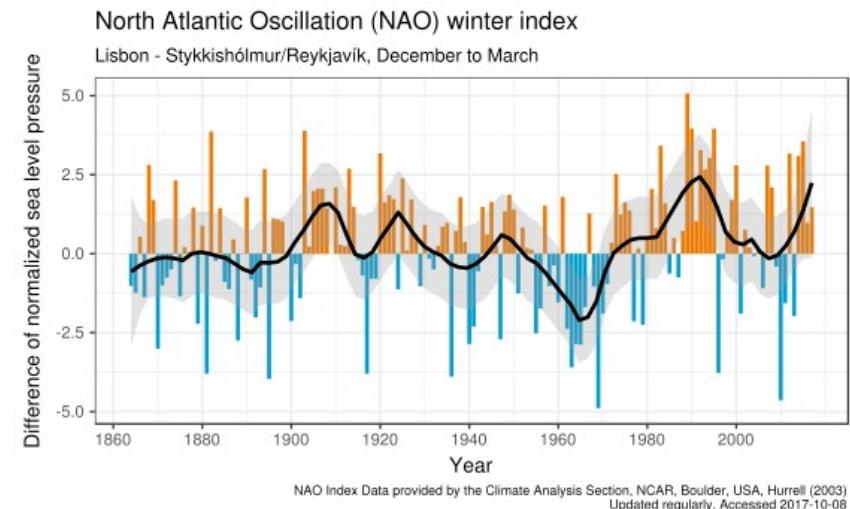


NAO +  
(cold)



Source : ESRL/NOAA

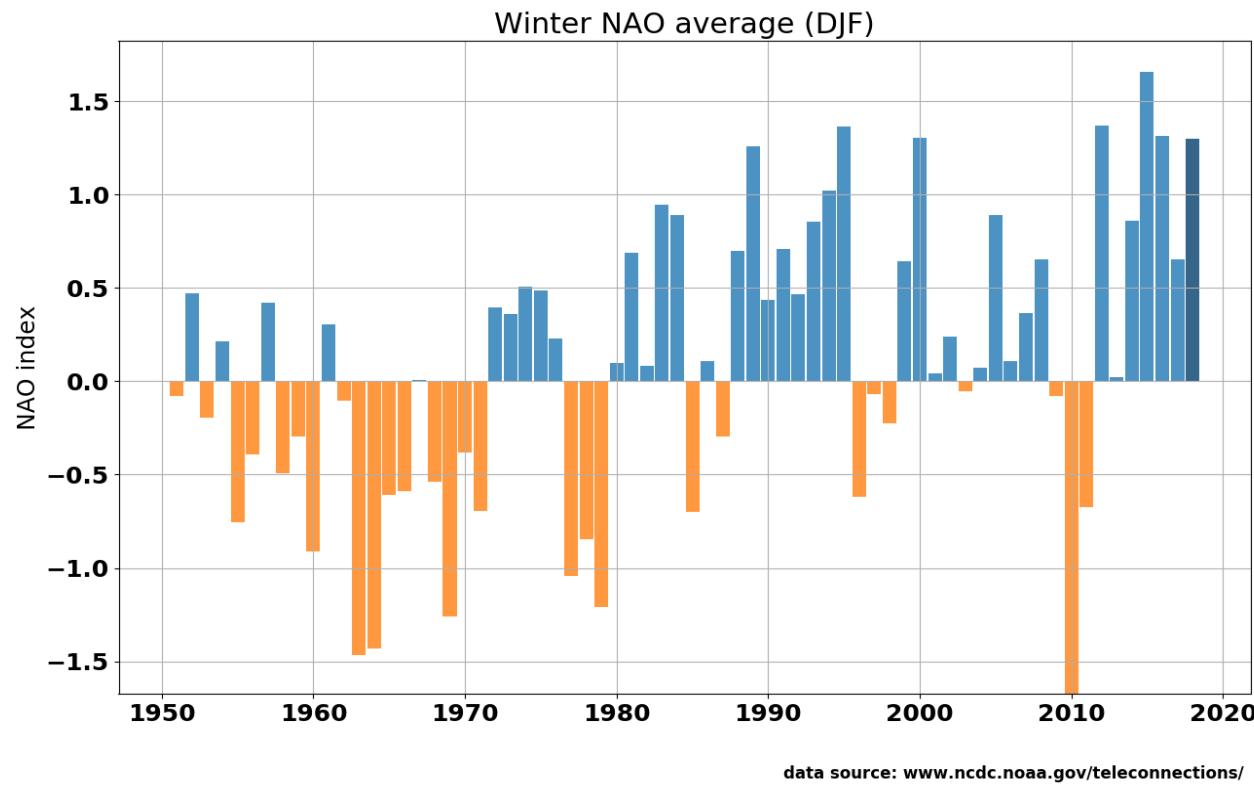
Large-scale context



- **Atmospheric index** responsible for large part of weather variability on both sides of the Atlantic
- 2017: NAO+
- Recent reversal towards lower NAO

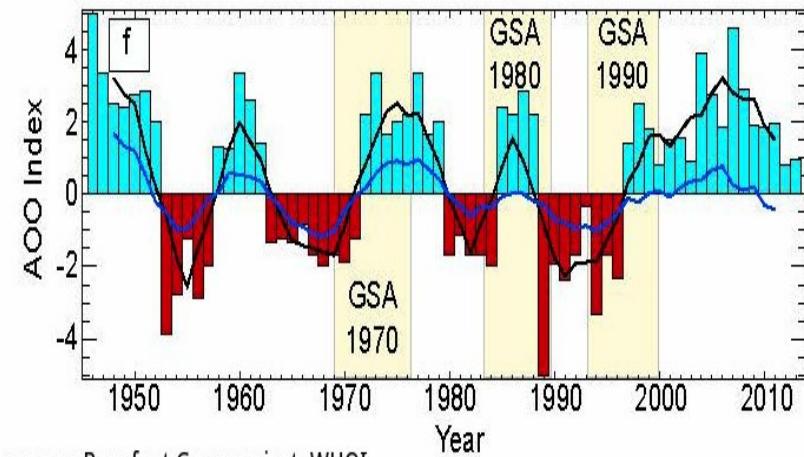
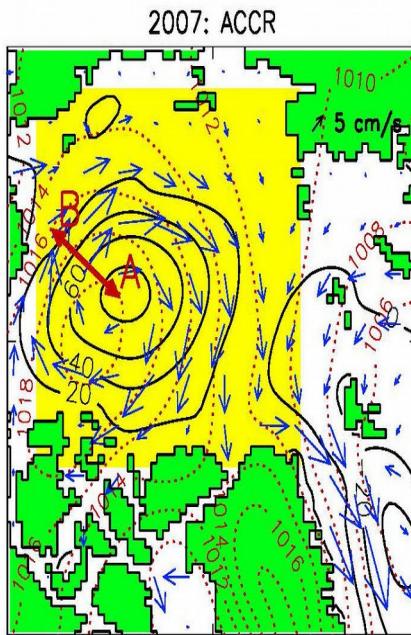
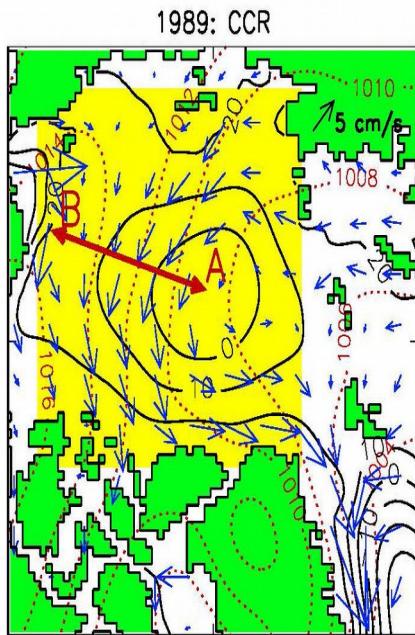


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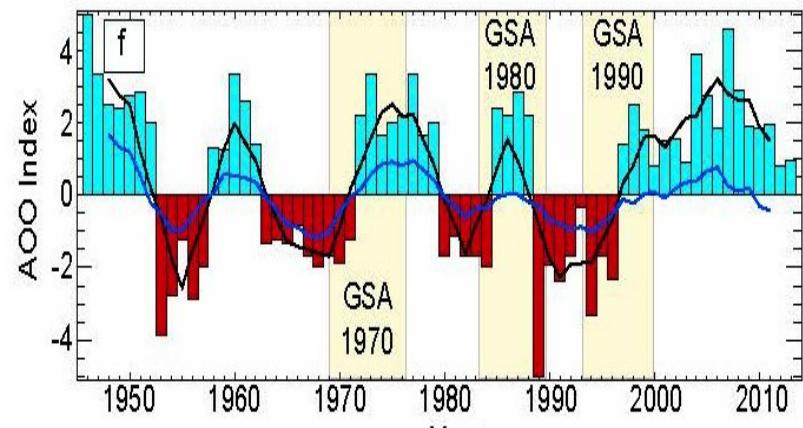
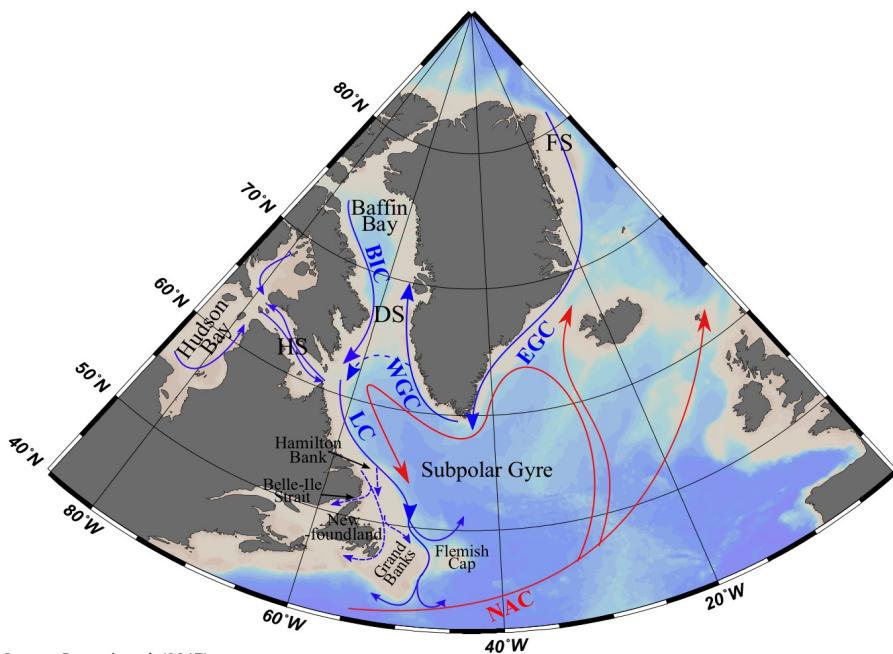


# Arctic Ocean Oscillation (AOO)



→ **Index based on wind-driven sea surface heights.** Responsible for large part of freshwater transport from the Arctic

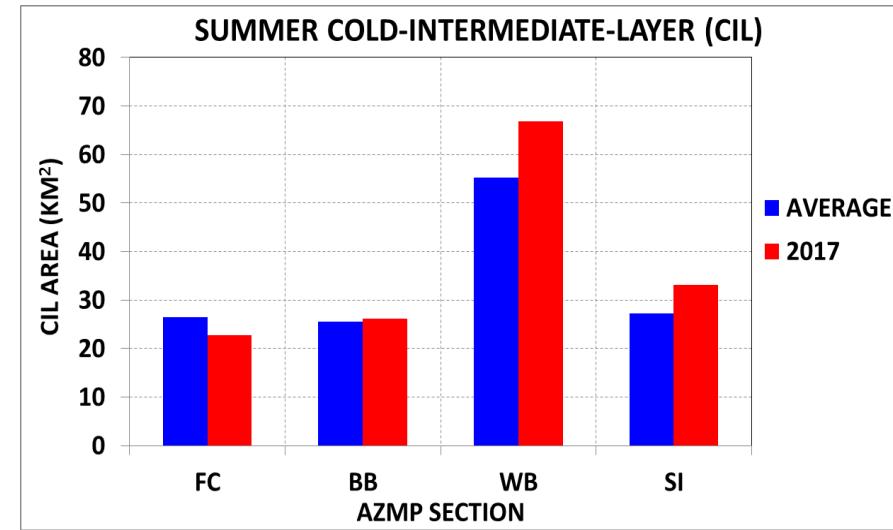
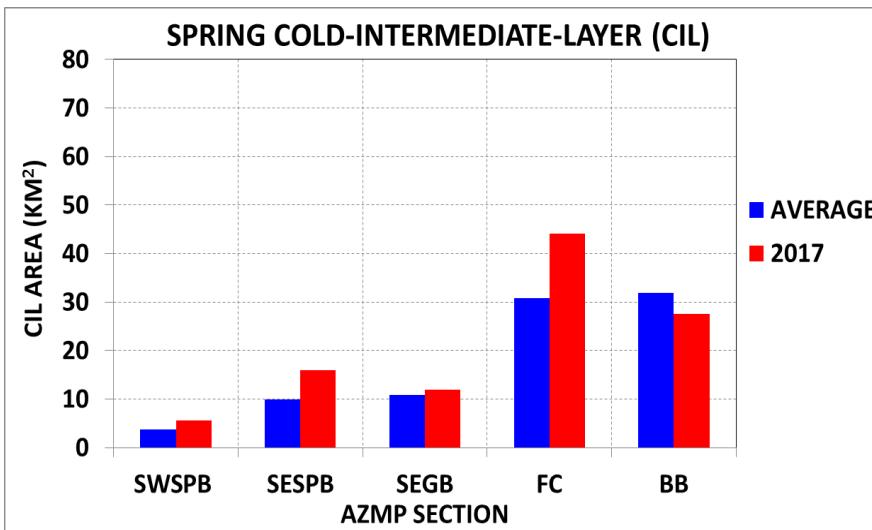
# Arctic Ocean Oscillation (AOO)



source: Beaufort Gyre project, WHOI

- Responsible for large part of freshwater transport from the Arctic (Proshutinsky et al., 2015)
- May control nutrient-rich waters flow on NL shelves

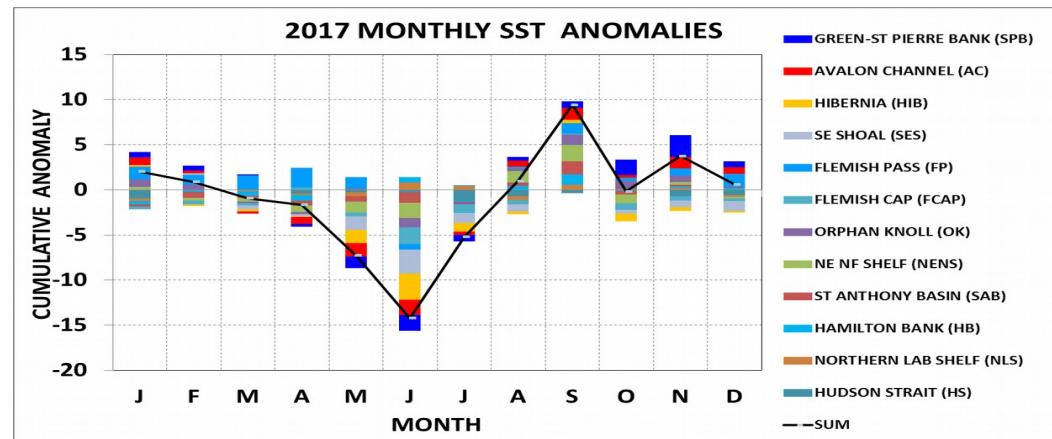
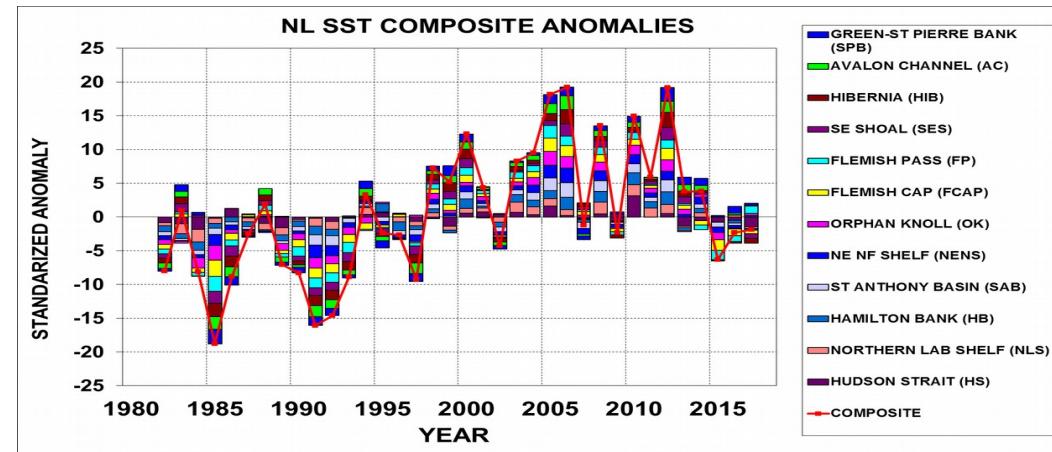
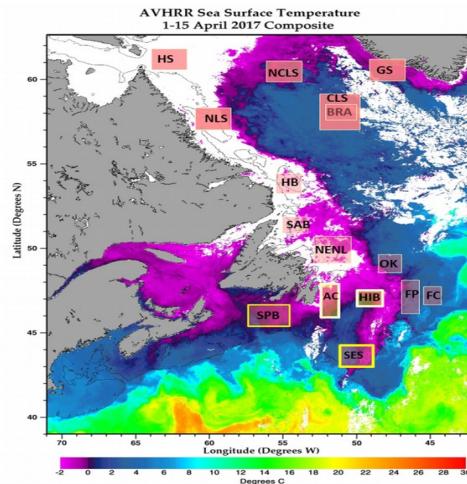
# Monitoring effort: AZMP-NL sections



→ CIL « volume » generally above normal, but variable between section  
(meso-scale activity?)



# Large-scale observations: SST



- 2017 SST slightly below normal
- Cold spring!
- Trend since 2015 consistent with emerging negative AMO)