



**NAFO** Northwest Atlantic  
Fisheries Organization



# **The Newfoundland and Labrador Climate Index and the decadal variability of NAFO Subareas 2 and 3**



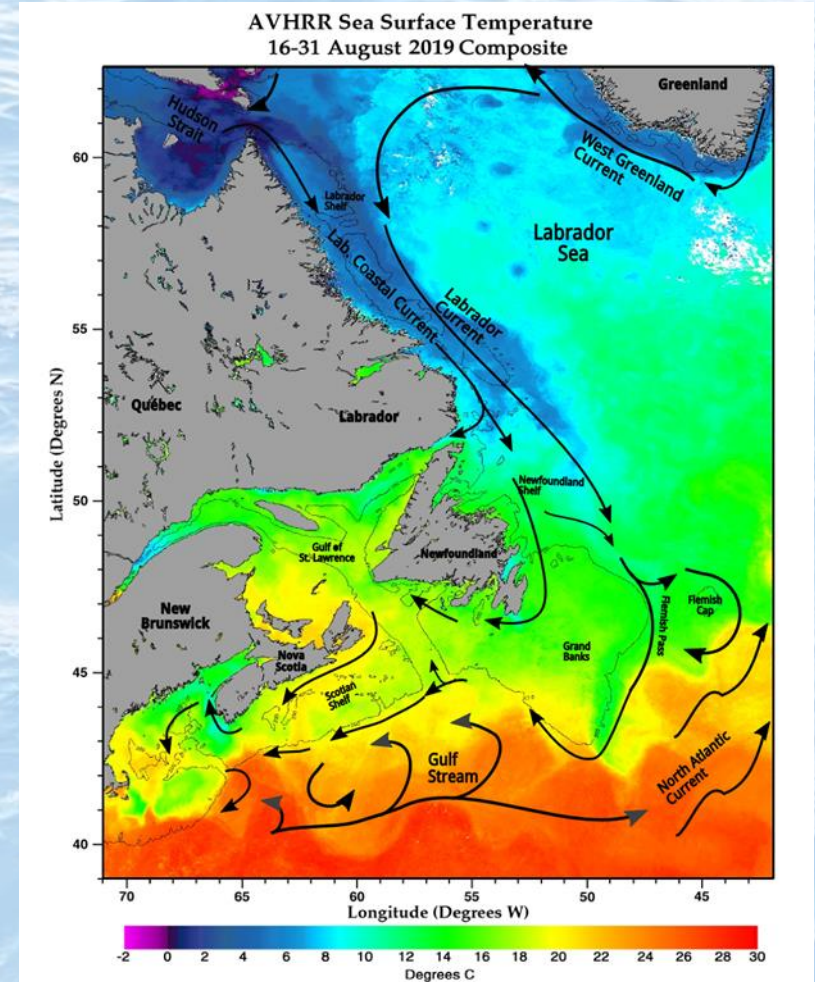
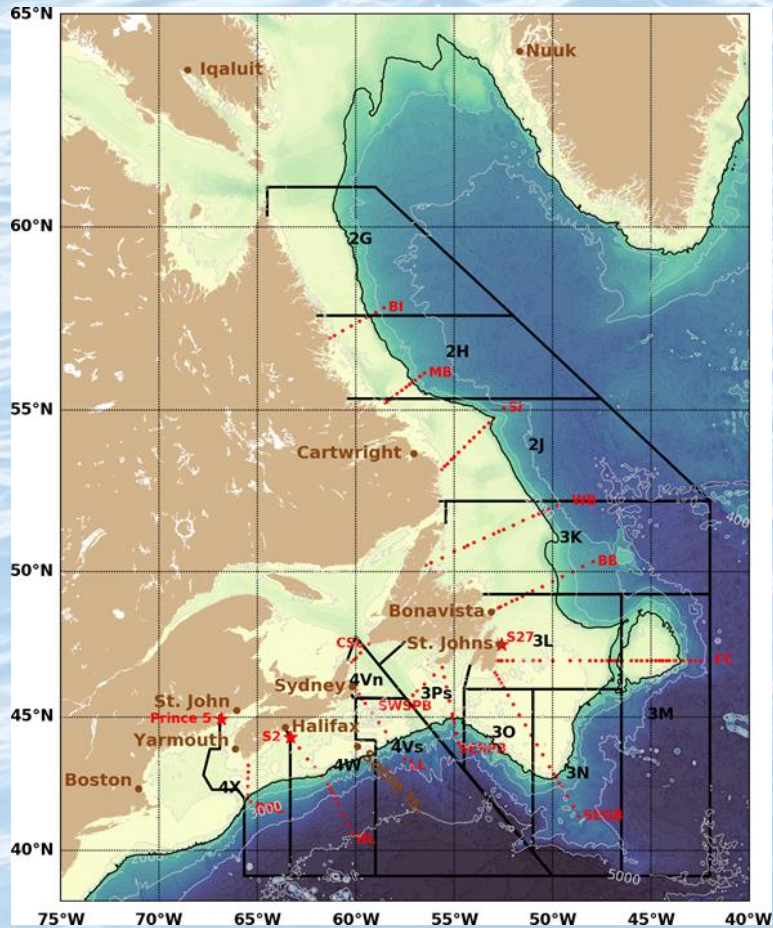
Fisheries and Oceans Pêches et Océans  
Canada Canada

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Atlantic Zone Monitoring Program (AZMP)  
NAFO Oceanography Section



# NAFO Subareas 2 and 3 – Main features and general circulation





# Climate Index: background

## Climatology:

- “Normal” is defined as the 1991-2020 average

**Normalized anomaly:**  $\tilde{X}_{\text{std}} = \frac{X - \bar{X}}{\text{sd}}$

anomaly

- $X$  is any measured variable or time series (e.g., air temperature)
- $\bar{X}$  is the climatological average (e.g., 1991-2020)
- sd: standard deviation of climatology (e.g., 1991-2020)

## Climate Index:

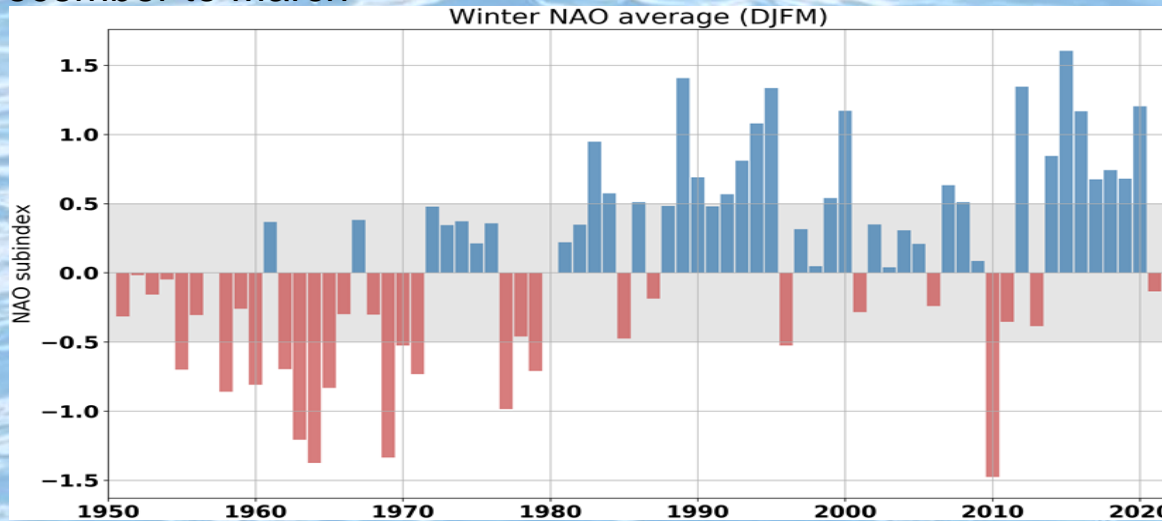
- average of 10 individual indices



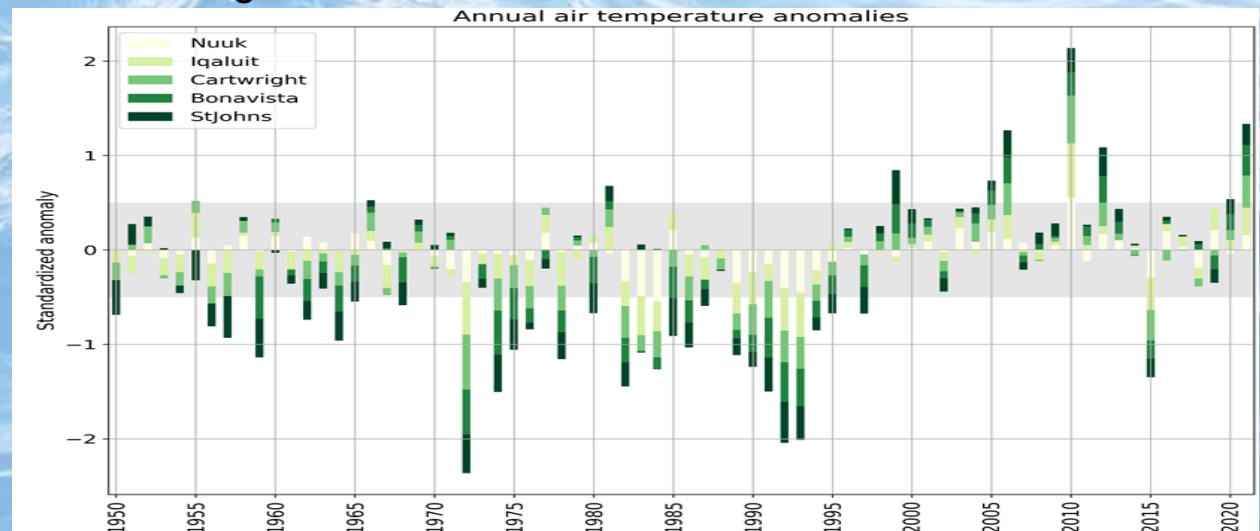


# Climate Index components: 10 environmental indices as normalized anomalies

## 1. Winter North Atlantic Oscillation (NAO) index averaged over December to March

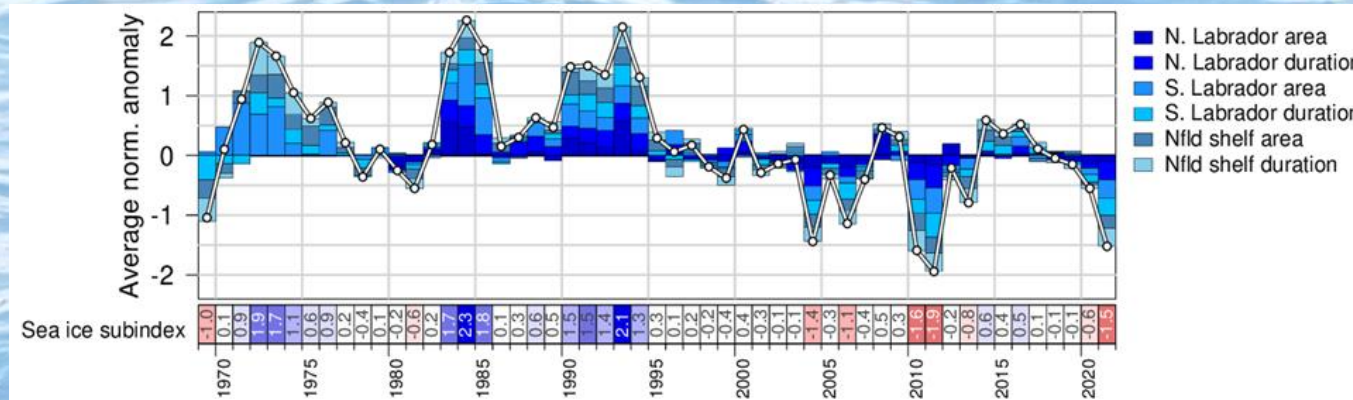


## 2. Air temperature index averages the annual normalized anomalies at five coastal locations

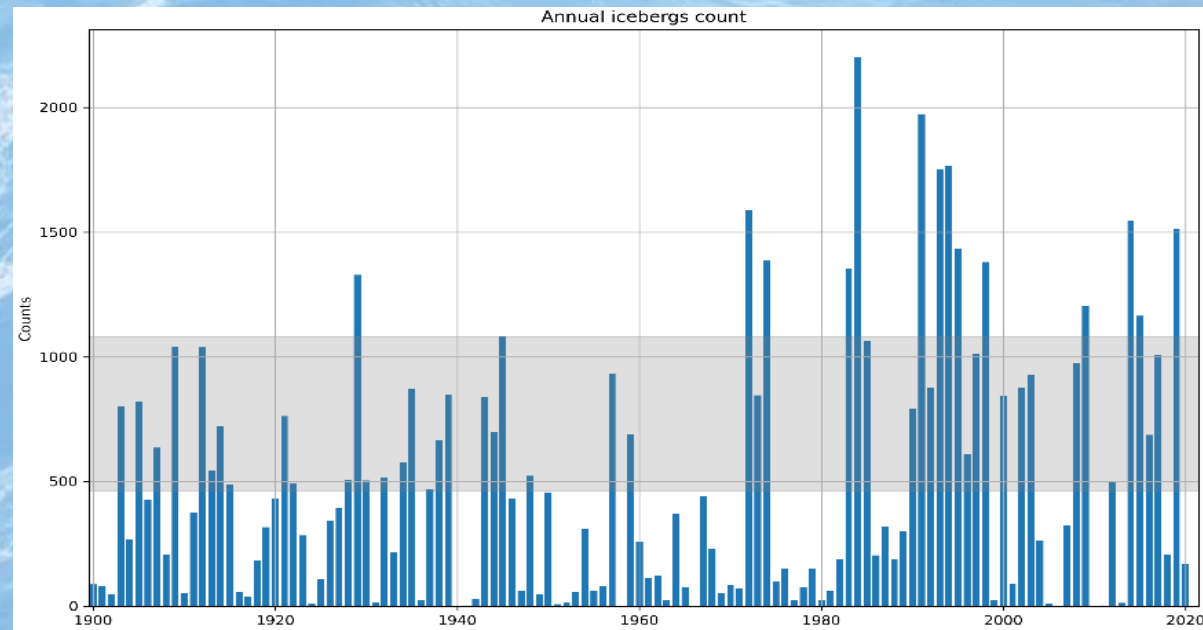


# Climate Index componentes: 10 environmental indices as normalized anomalies

## 3. Sea Ice index as the normalized anomalies of volume and duration of sea ice



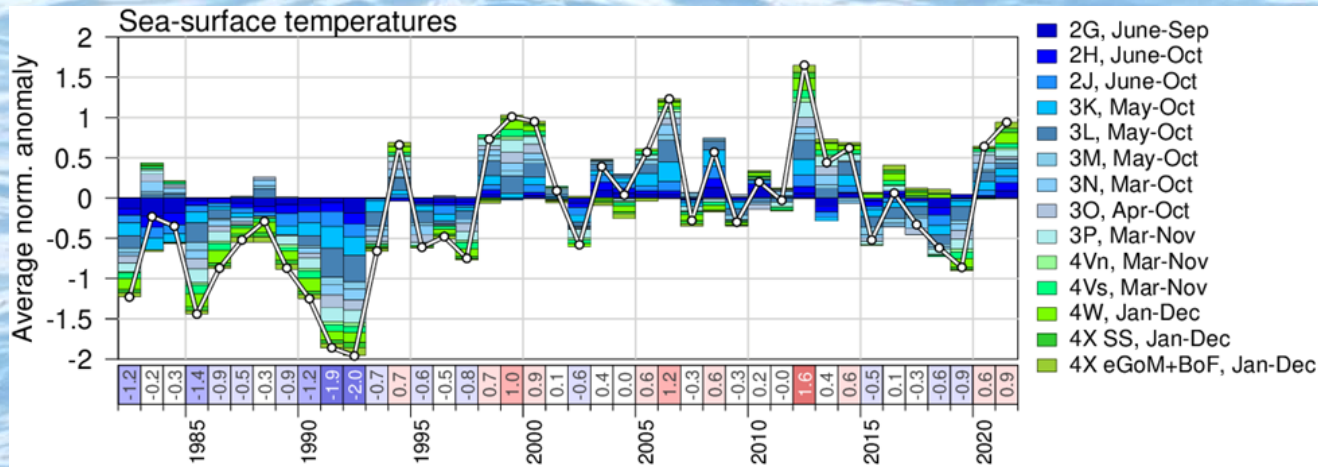
## 4. Iceberg index as the number of icebergs drifting south of 48° N in the Northwest Atlantic



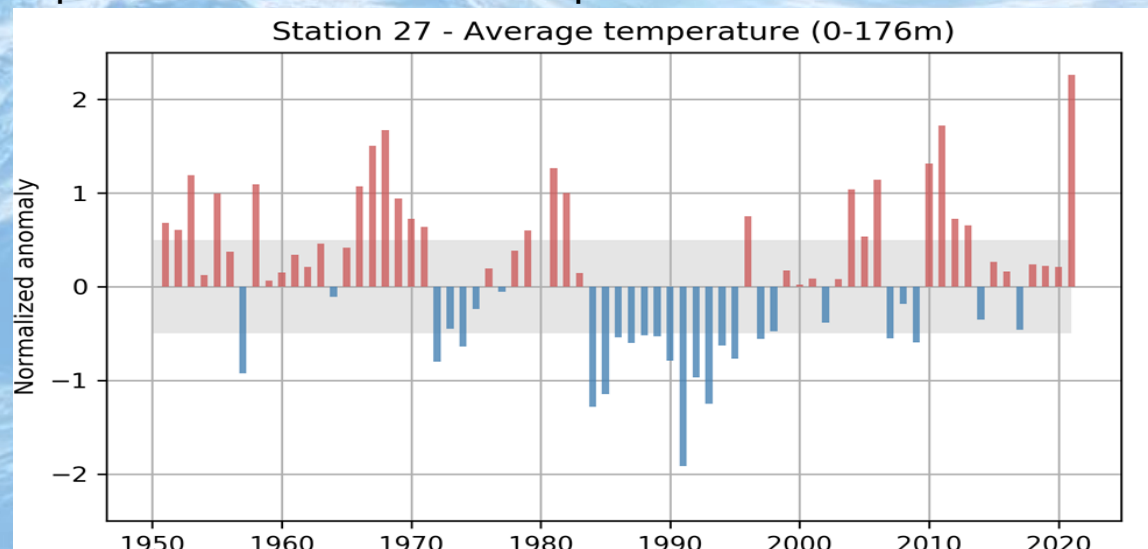


# Climate Index componentes: 10 environmental indices as normalized anomalies

## 5. Sea surface temperature index as normalized anomalies averaged over the ice-free season.

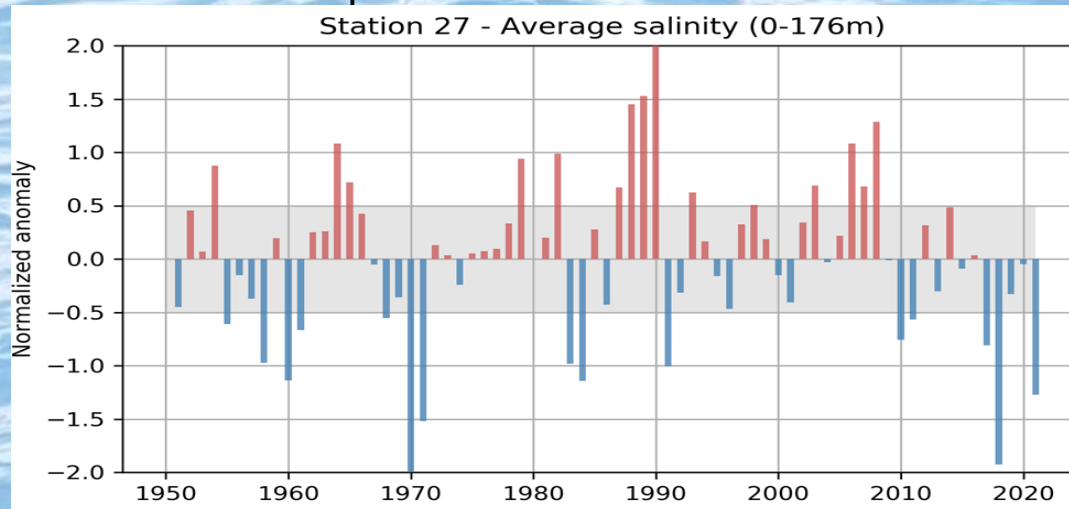


## 6. St.27 average temperature index as the vertical annual average of the normalized anomaly of ocean temperature from 0 to 176m depth

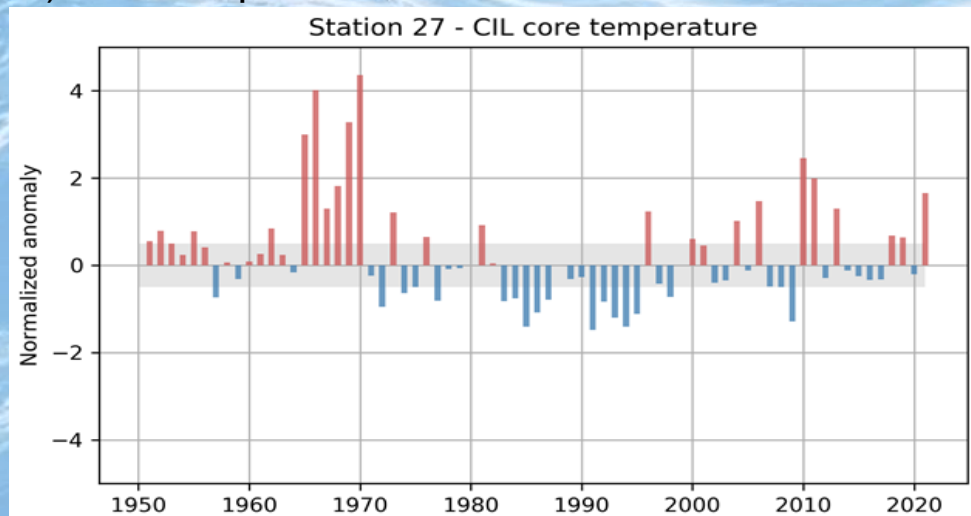


# Climate Index componentes: 10 environmental indices as normalized anomalies

## 7. St.27 average salinity index as the average of monthly normalized anomalies at 0-176m depth



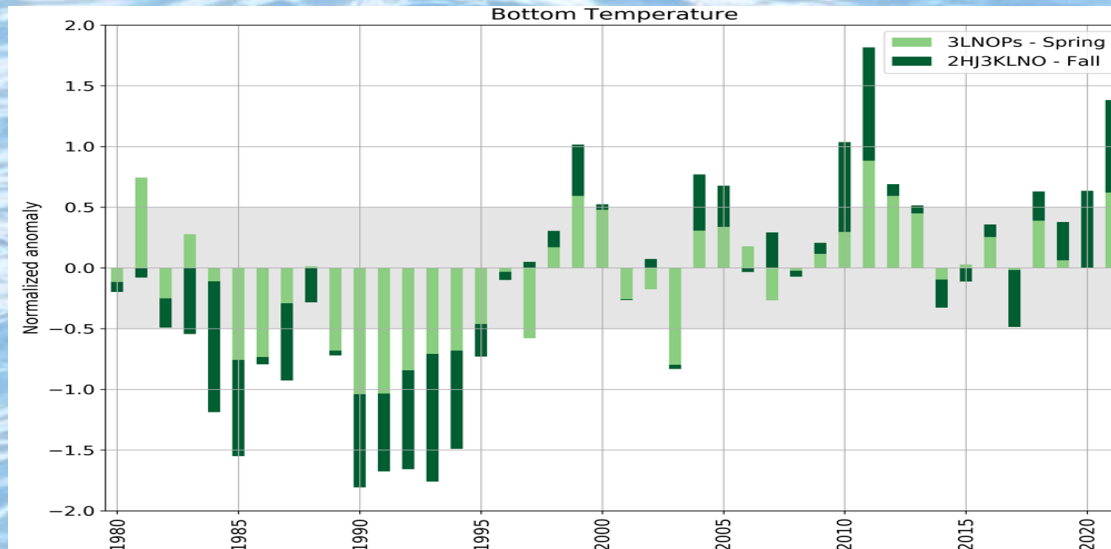
## 8. Cold Intermediate layer (CIL) index is the average normalized anomalies of the summer (June–August) core temperature



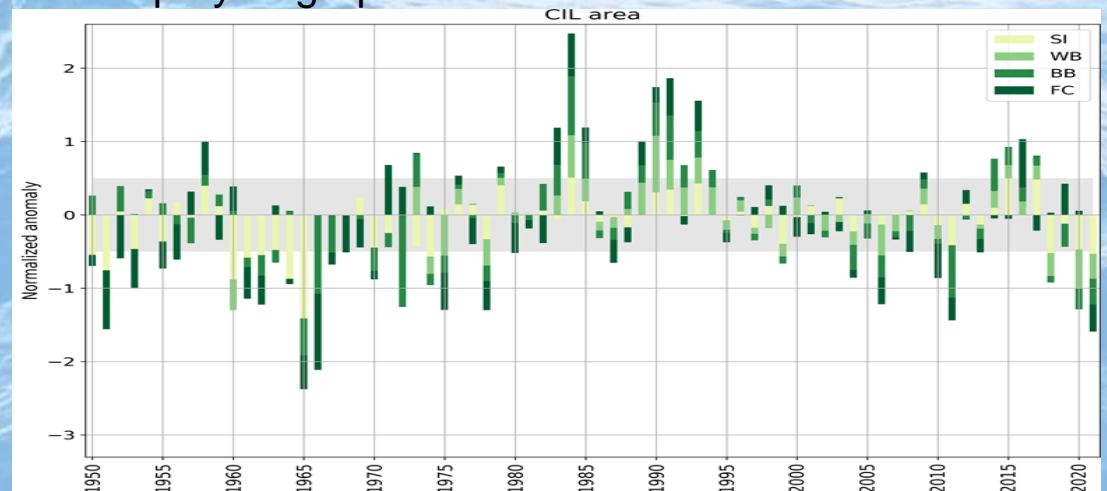


# Climate Index componentes: 10 environmental indexes as normalized anomalies

9. **Bottom temperature index** as the normalized anomalies of bottom temperature derived from *in loco* data at each NAFO area.

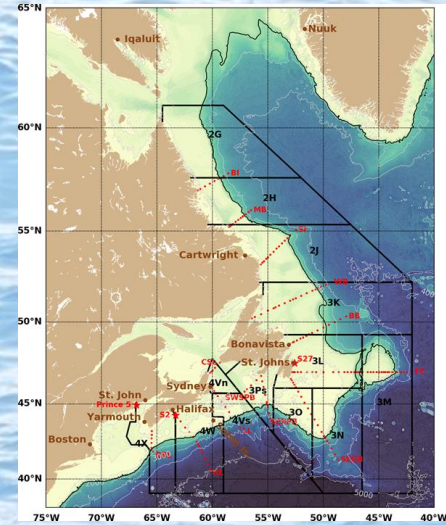
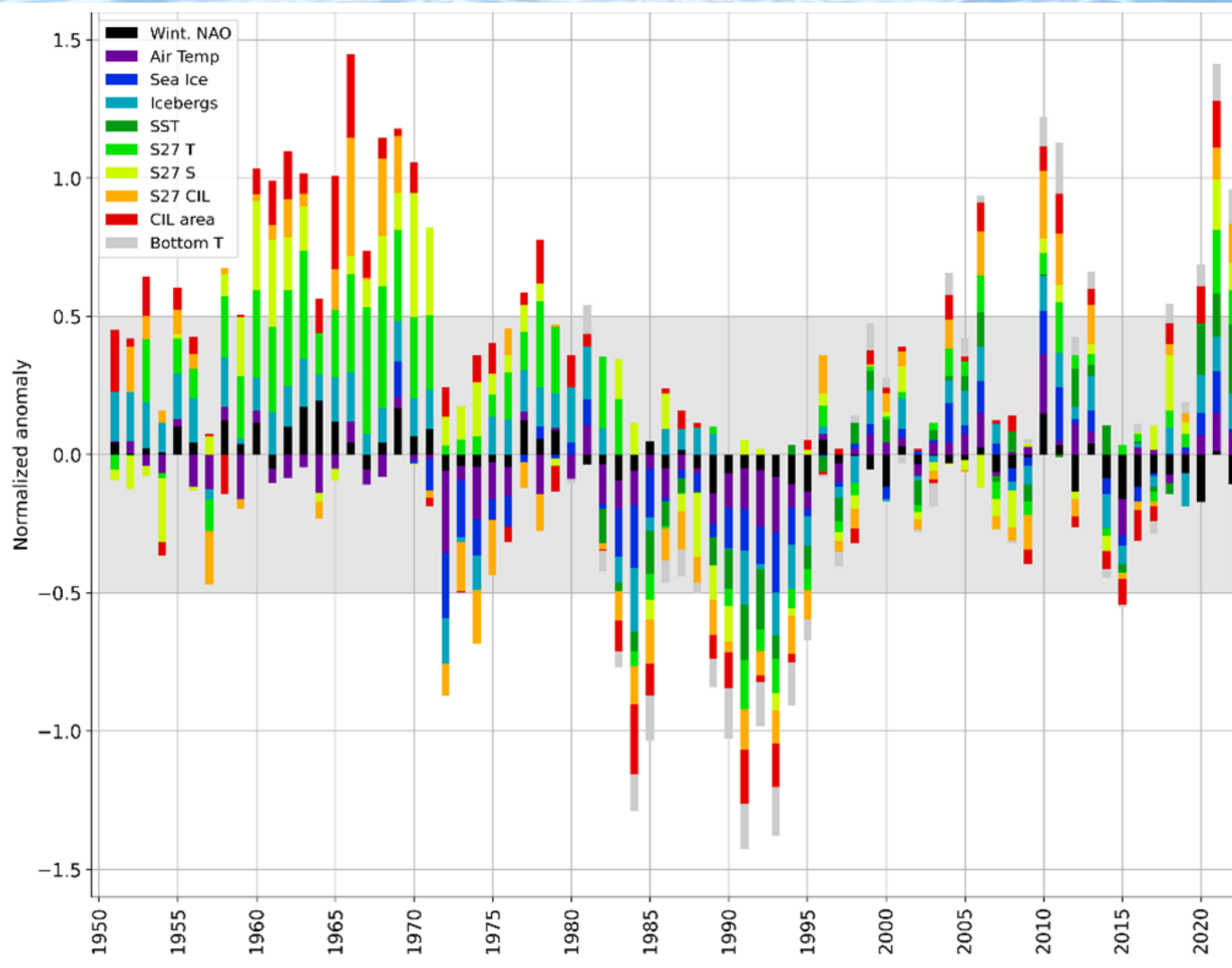


10. **CIL area index** as the volume for the area of water below  $0^{\circ}\text{C}$  along Seal Island, Bonavista Bay and Flemish Cap hydrographic sections.





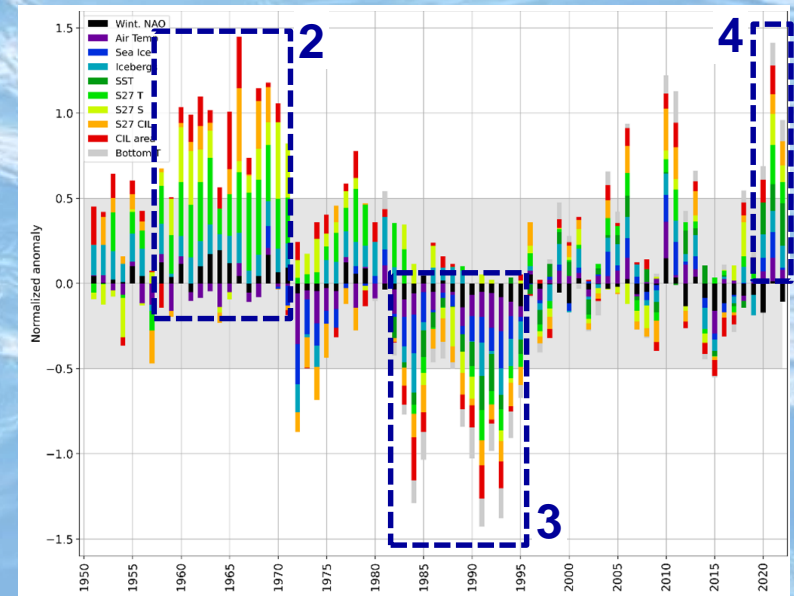
# Newfoundland and Labrador Climate Index (NLCI)





# Highlights

1. The **Climate Index** shows **large decadal variability** of the **NW Atlantic** climate.
2. The **1960s** was the **warmest decade**.
3. The **mid-1980's / early 1990's** was the **coldest** period (1991 the coldest year ever).
4. Since **2020** the NL **climate index** is in a **warm phase**.
5. **2021** was at a **record high** (tied with 1966).







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#### Sources:

- Cyr, F. Galbraith, P.**, (2021). A climate index for the Newfoundland and Labrador shelf. Earth System Science Data, 13:1807–1828 <https://doi.org/10.5194/essd1318072021>
- Cyr, F. Galbraith, P.**, (2020). Newfoundland and Labrador climate index. Federated Research Data Repository. <https://doi.org/10.20383/101.0301>
- Cyr, F., Galbraith, P., Bélanger, D.** (2022). Seven decades of climate variability on the Newfoundland and Labrador shelf. 4<sup>th</sup> ICES/NAFO Decadal Symposium on Decadal Variability of the North Atlantic and its Marine Ecosystems: 2010-2019.