

# A model study of the inter-annual and decadal variations of sea surface height, temperature, and gyre circulation in the North Atlantic

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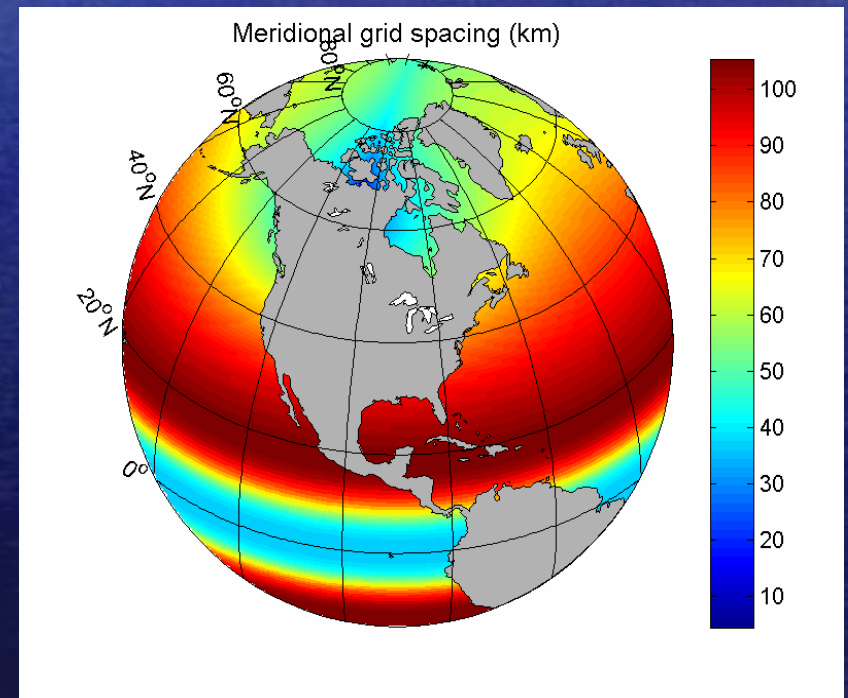
Fisheries and Oceans Canada

Acknowledgements

CONCEPTS, GOAPP, COMDA, PERD, ...

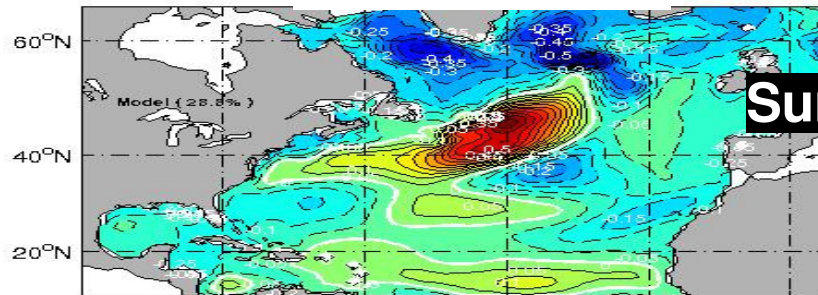
# Model Description

- Based on NEMO (Nucleus for European Modelling of the Ocean )
  - ocean module is OPA (z-level, C-grid)
  - ice module is LIM2 (2 layers ice, 1 layer snow)
- Nominally  $1^\circ$  in lat/lon; tri-polar configuration.
- Forcing: CORE 1958-2004; monthly river runoff; SSS restoration; bulk formulae
- Levitus and PHC climatological Temperature and Salinity for initializing the model

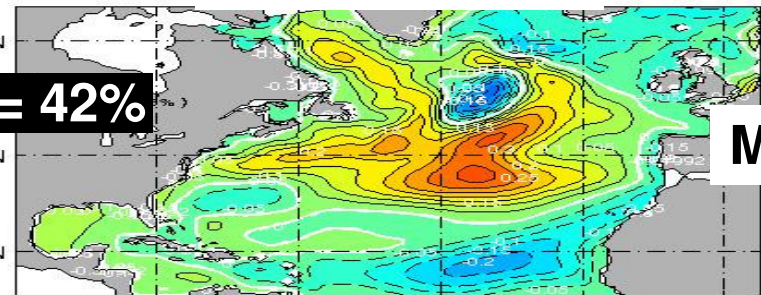


# Validation: NA Sea Levels (1993-2004)

## 1<sup>st</sup> annual EOF



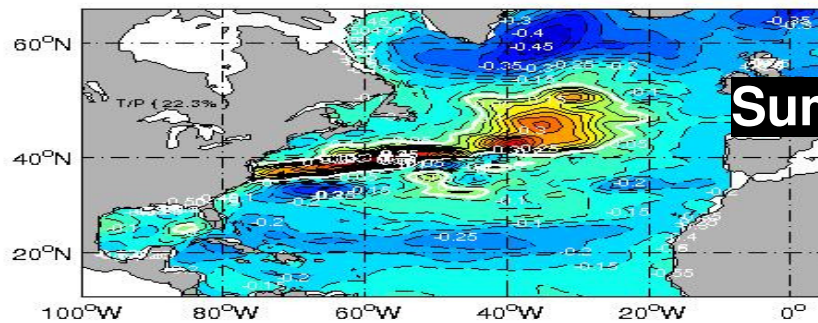
## 2<sup>nd</sup> annual EOF



**Sum = 42%**

**Model**

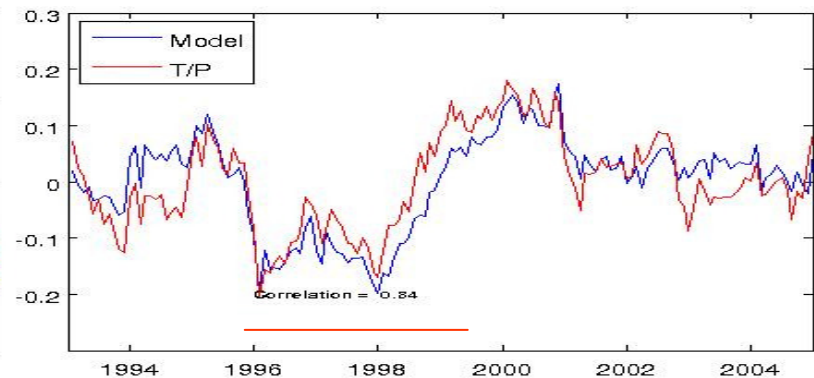
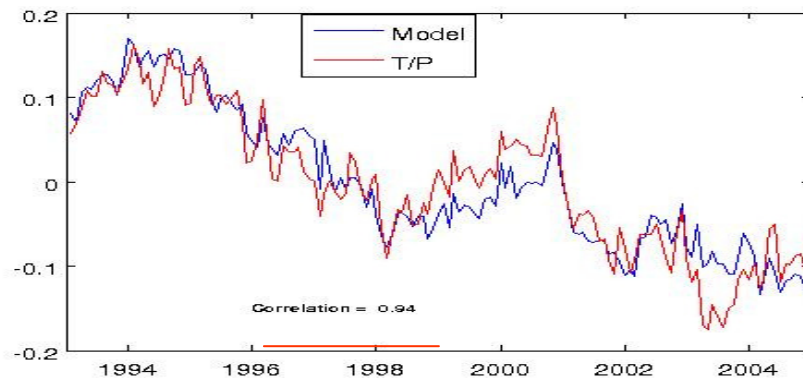
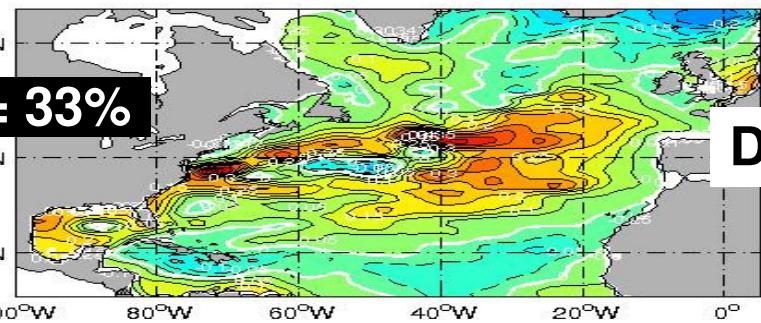
## 1<sup>st</sup> annual EOF



**Sum = 33%**

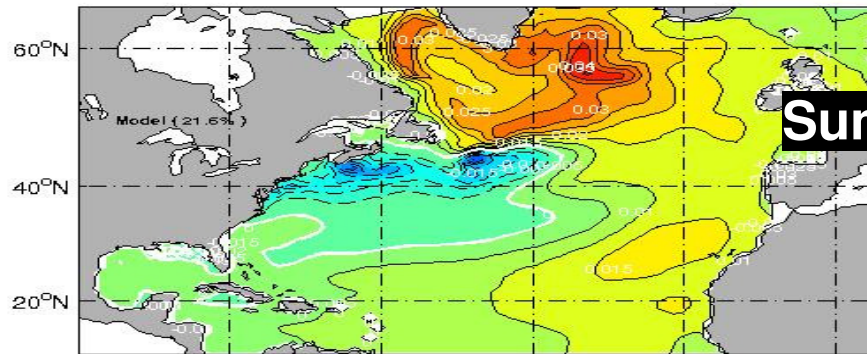
**Data**

## 2<sup>nd</sup> annual EOF

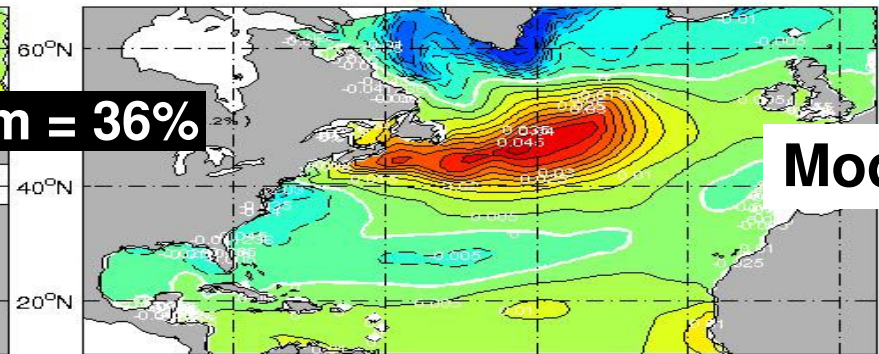


# Validation: NA SST(1982-2004)

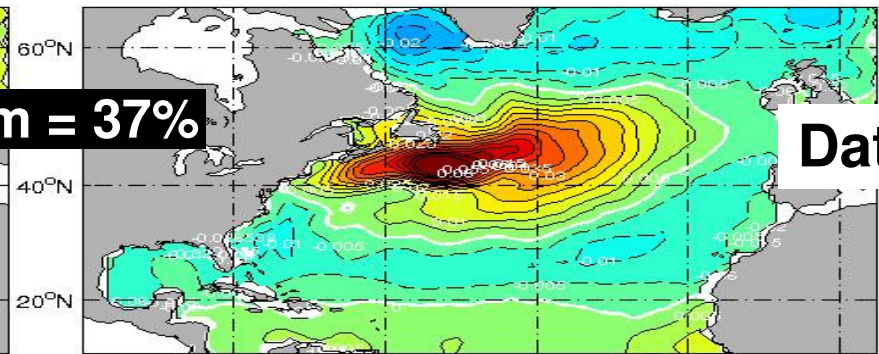
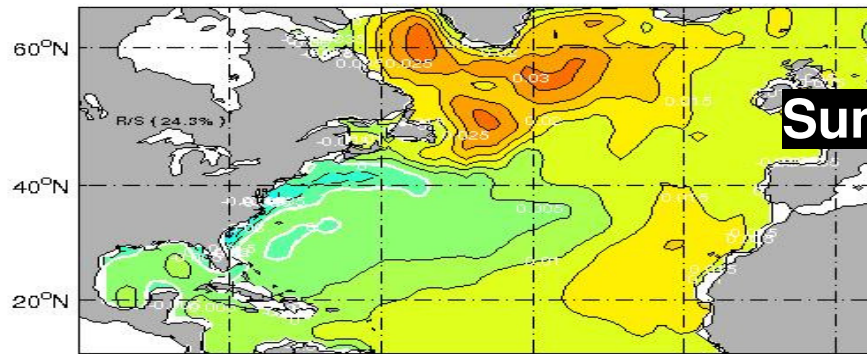
## 1st monthly EOF



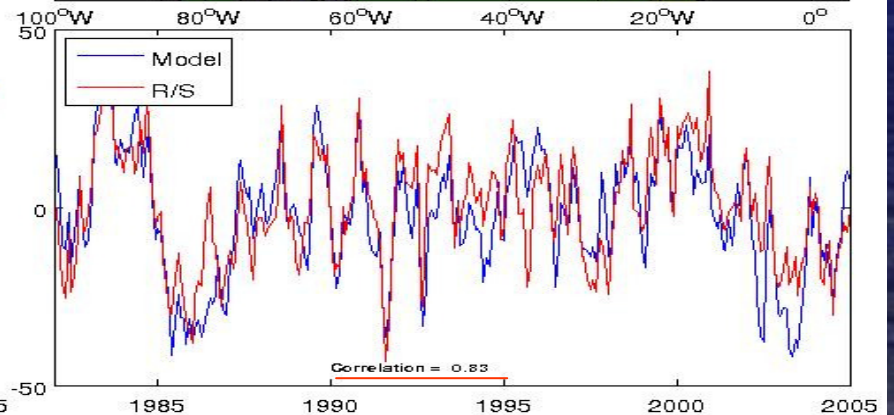
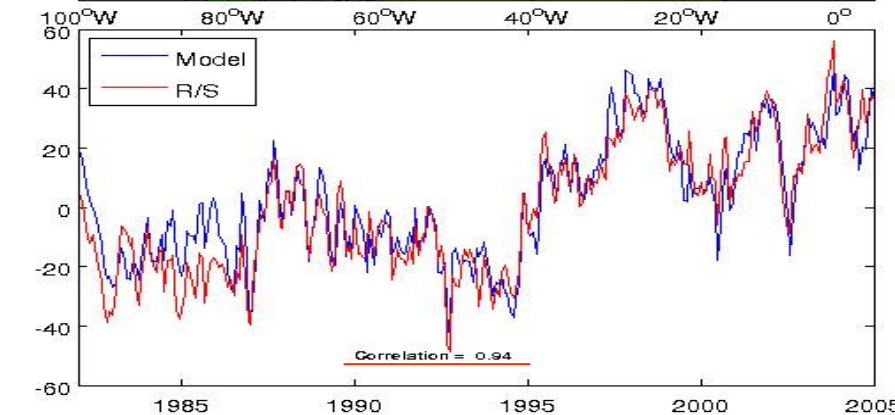
## 2nd monthly EOF



Model



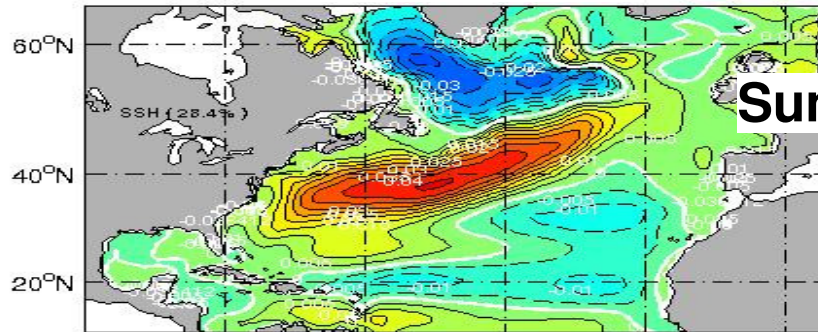
Data



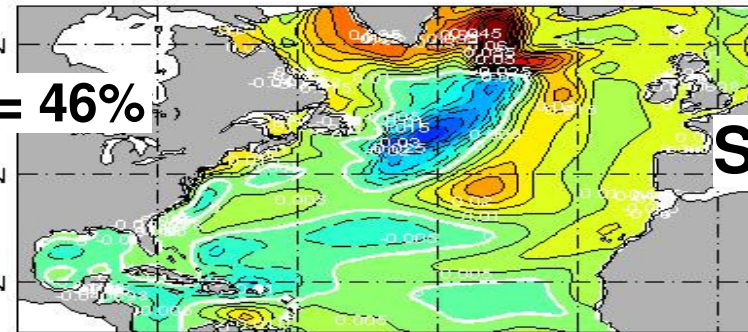
# Model Results: SSH & SST(1958-2004)

1st EOF

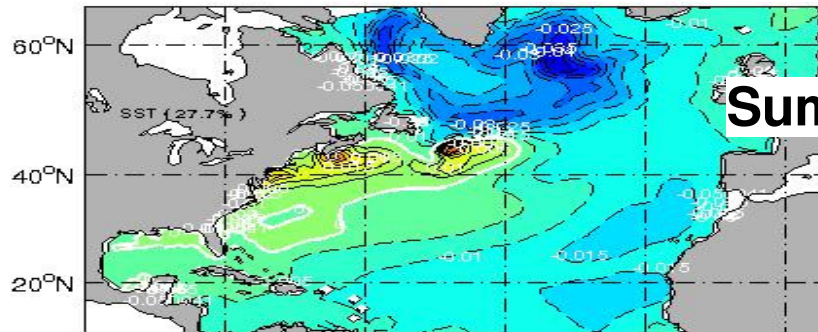
2nd EOF



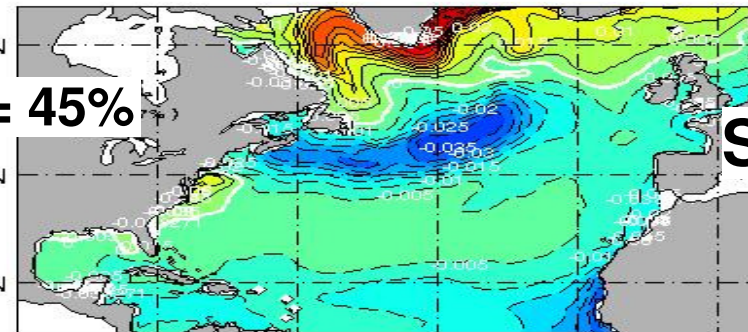
Sum = 46%



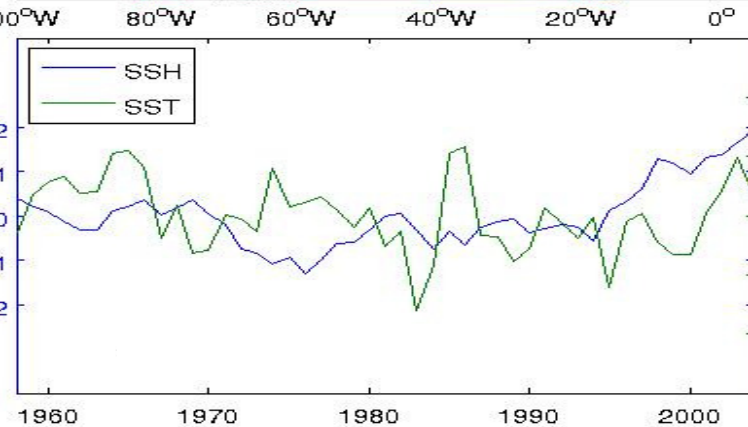
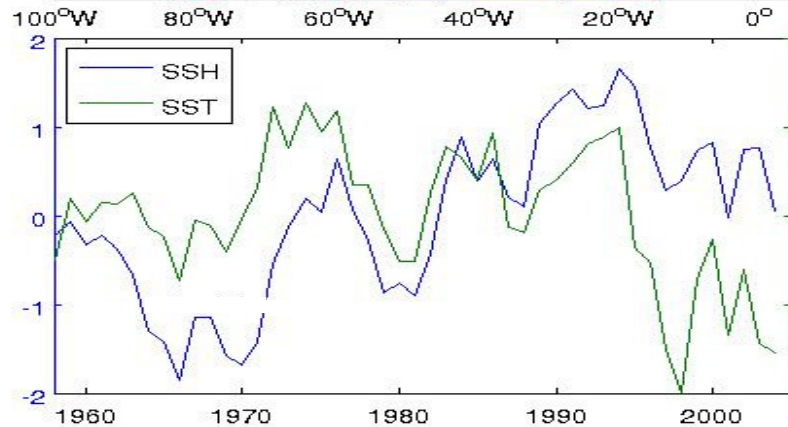
SSH



Sum = 45%

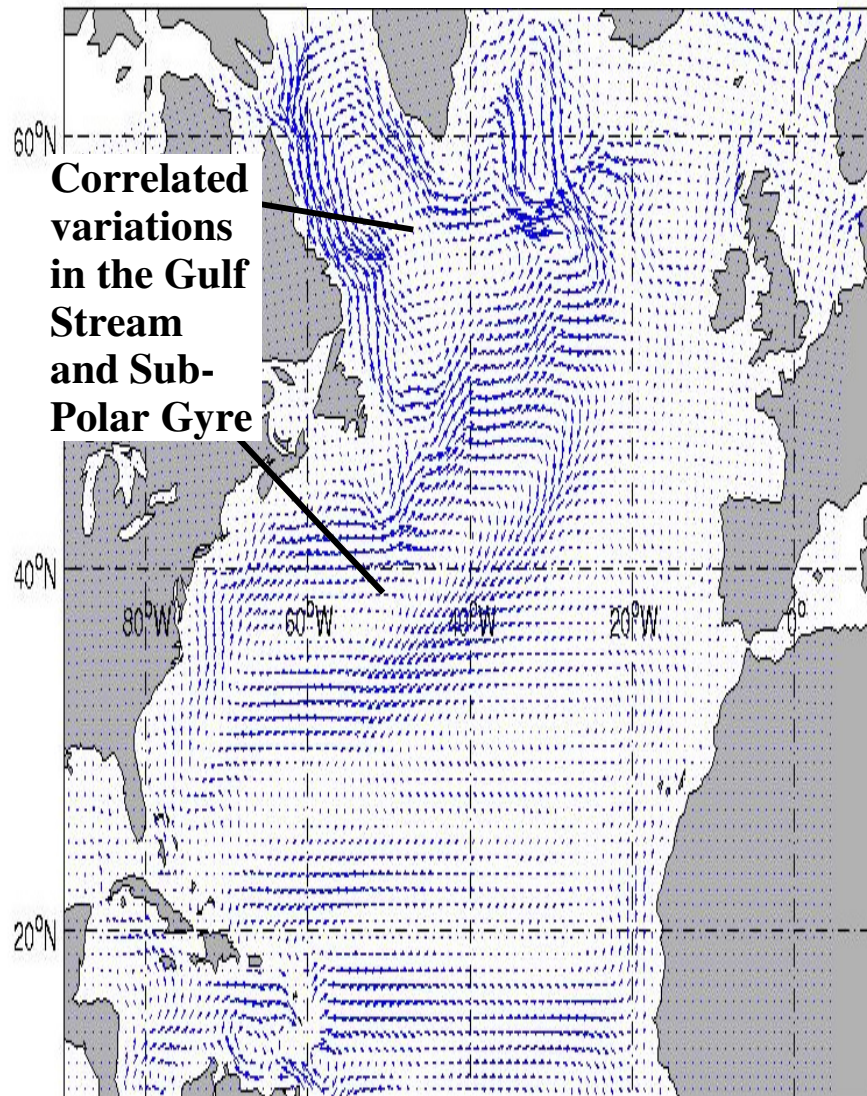


SST

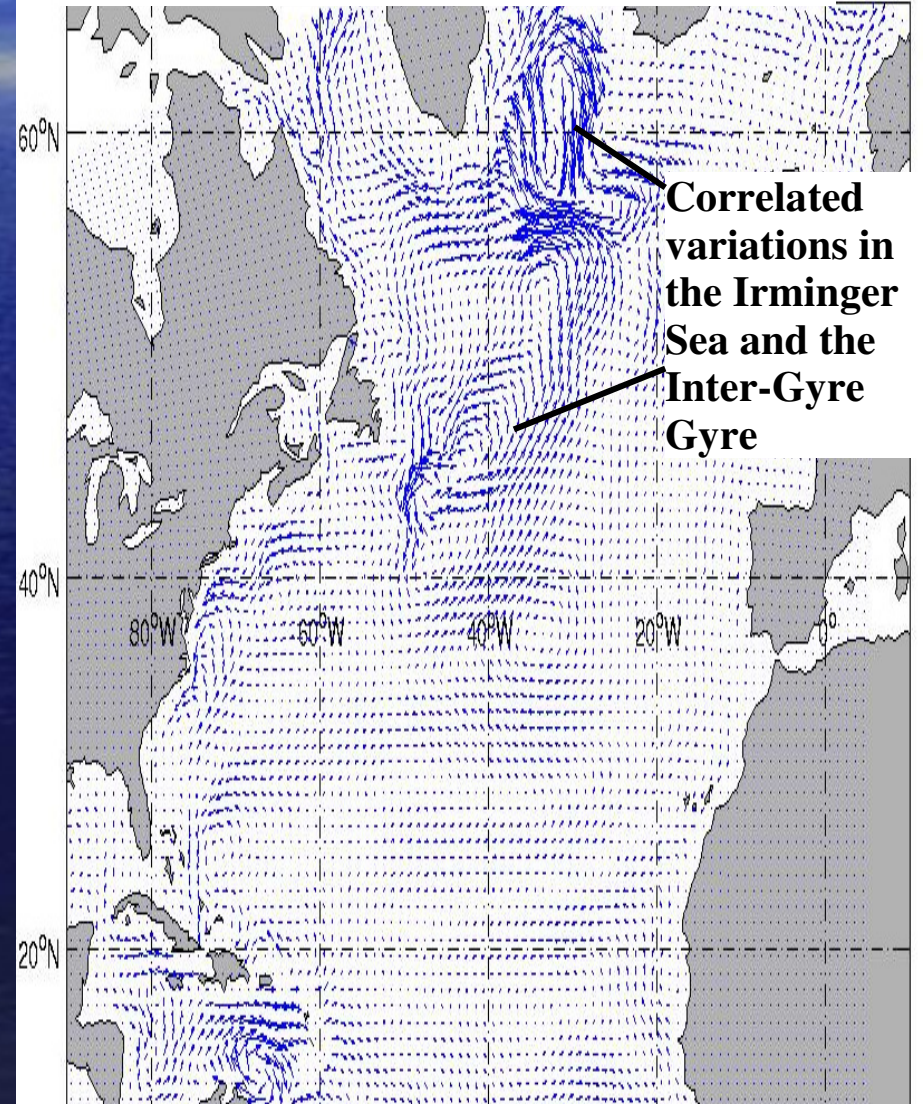


# Anomalous Surface Geostrophic Circulation: Computed from EOF1 and EOF2 of SSH

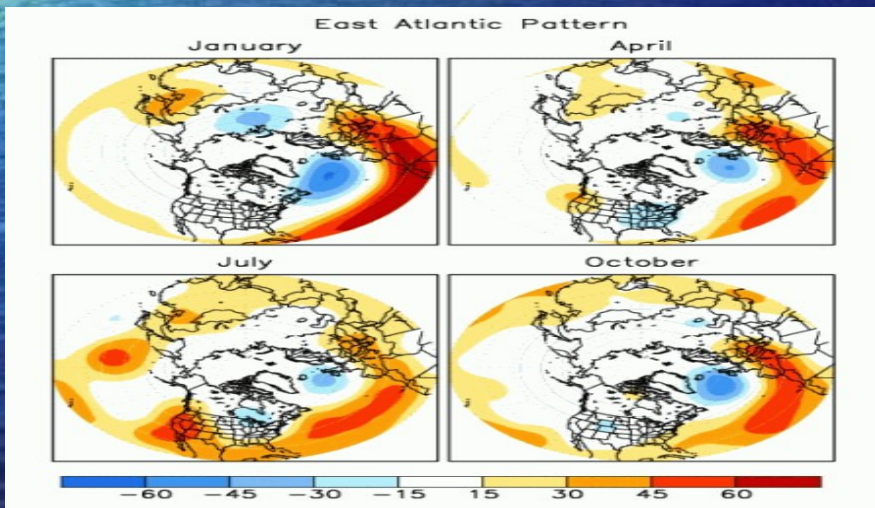
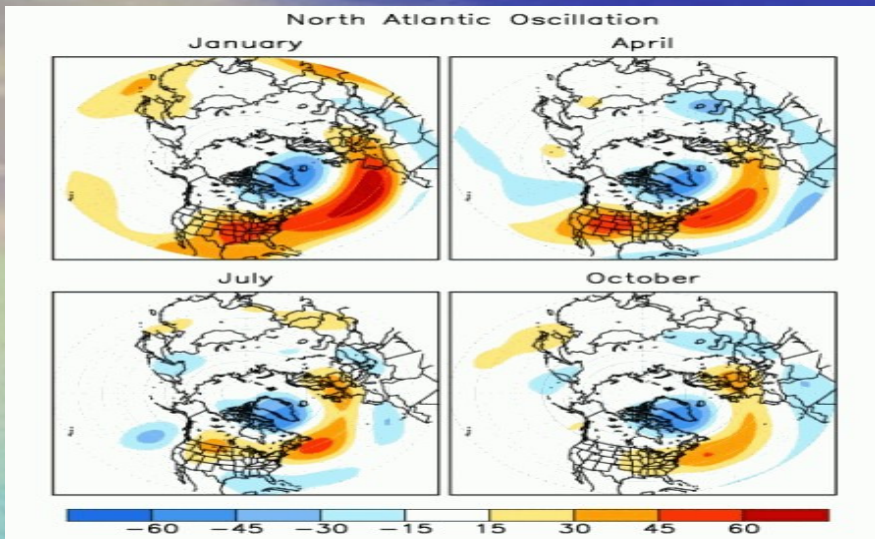
EOF1



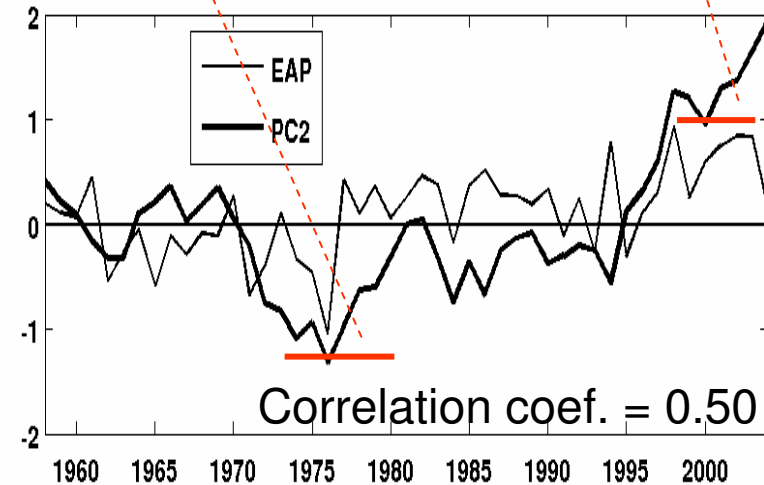
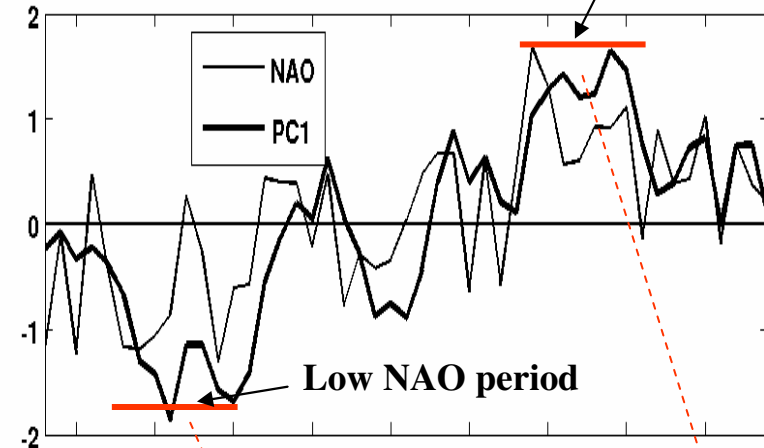
EOF2



# Link to Atmospheric Forcing



Correlation coef. = 0.80 High NAO period

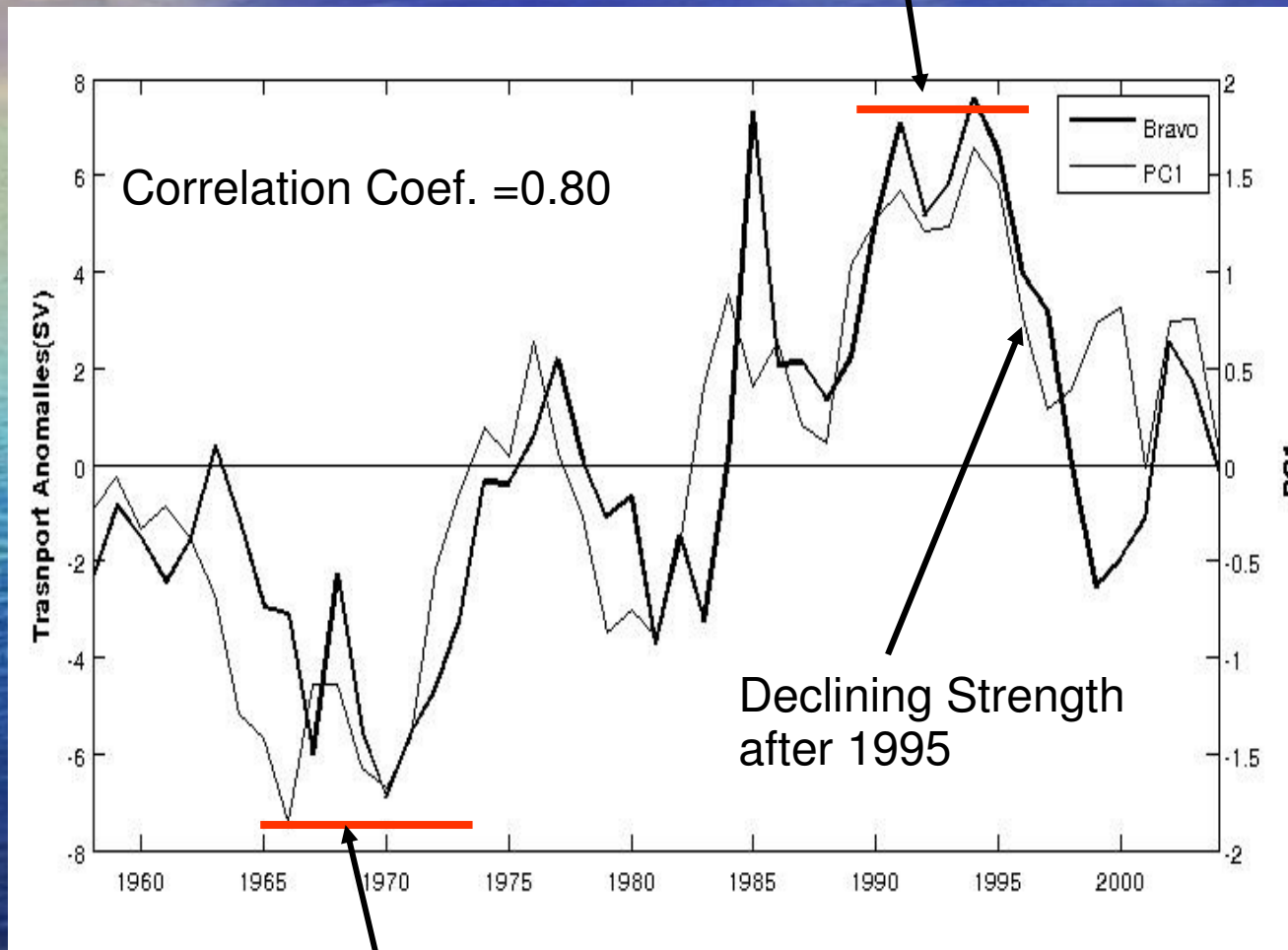


[www.cpc.noaa.gov](http://www.cpc.noaa.gov)

Some connection between NAO and EAP, also for PC1 and PC2 of SSH

# Correlation between PC1 of SSH and Strength of Sub-polar Gyre (Volume Transport Integrated from Labrador Coast to Bravo)

High NAO => Strong Circulation



Low NAO => Weak Circulation

After 1985, the sub-polar gyre is still stronger than during the period 1958 to 1984. It is getting weaker, but still stronger than before!



# Region-Averaged SST and SSH Anomalies

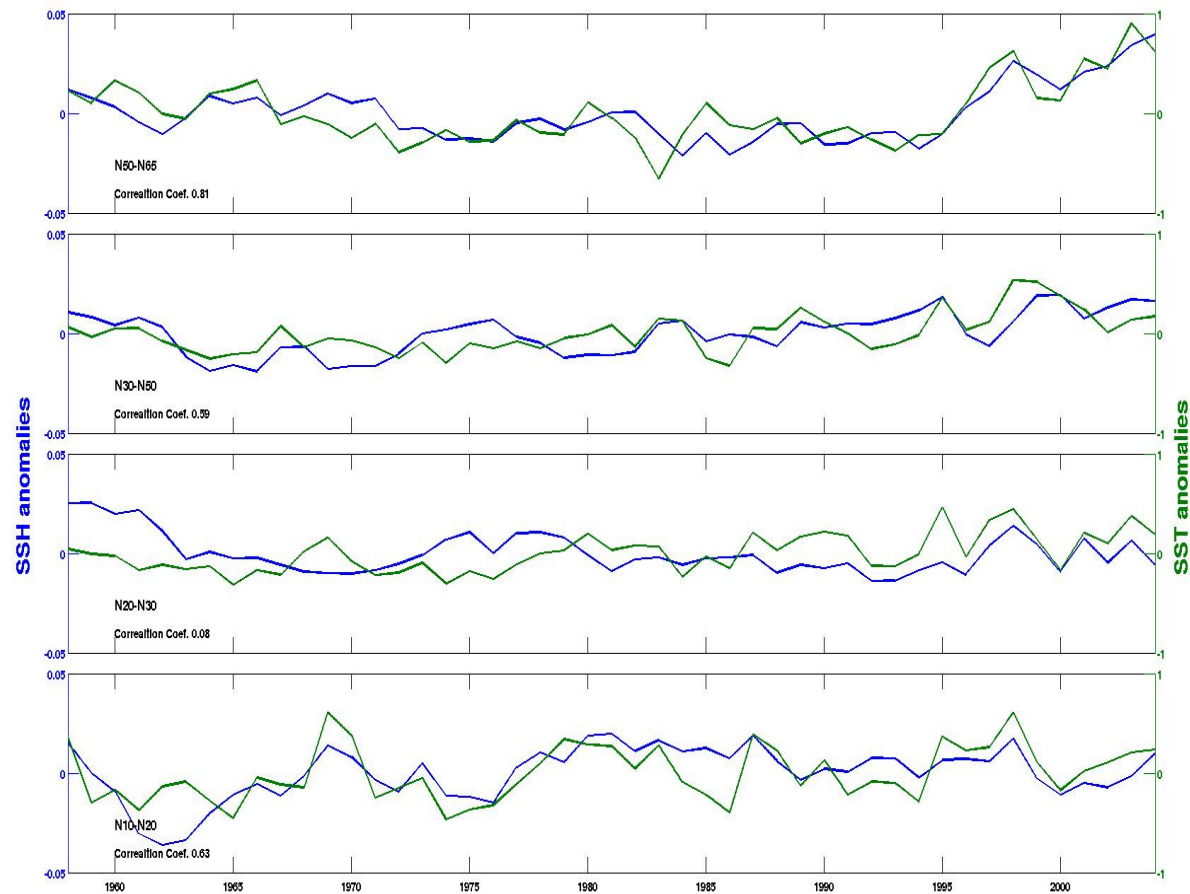
Sub-Polar region

Gulf Stream region

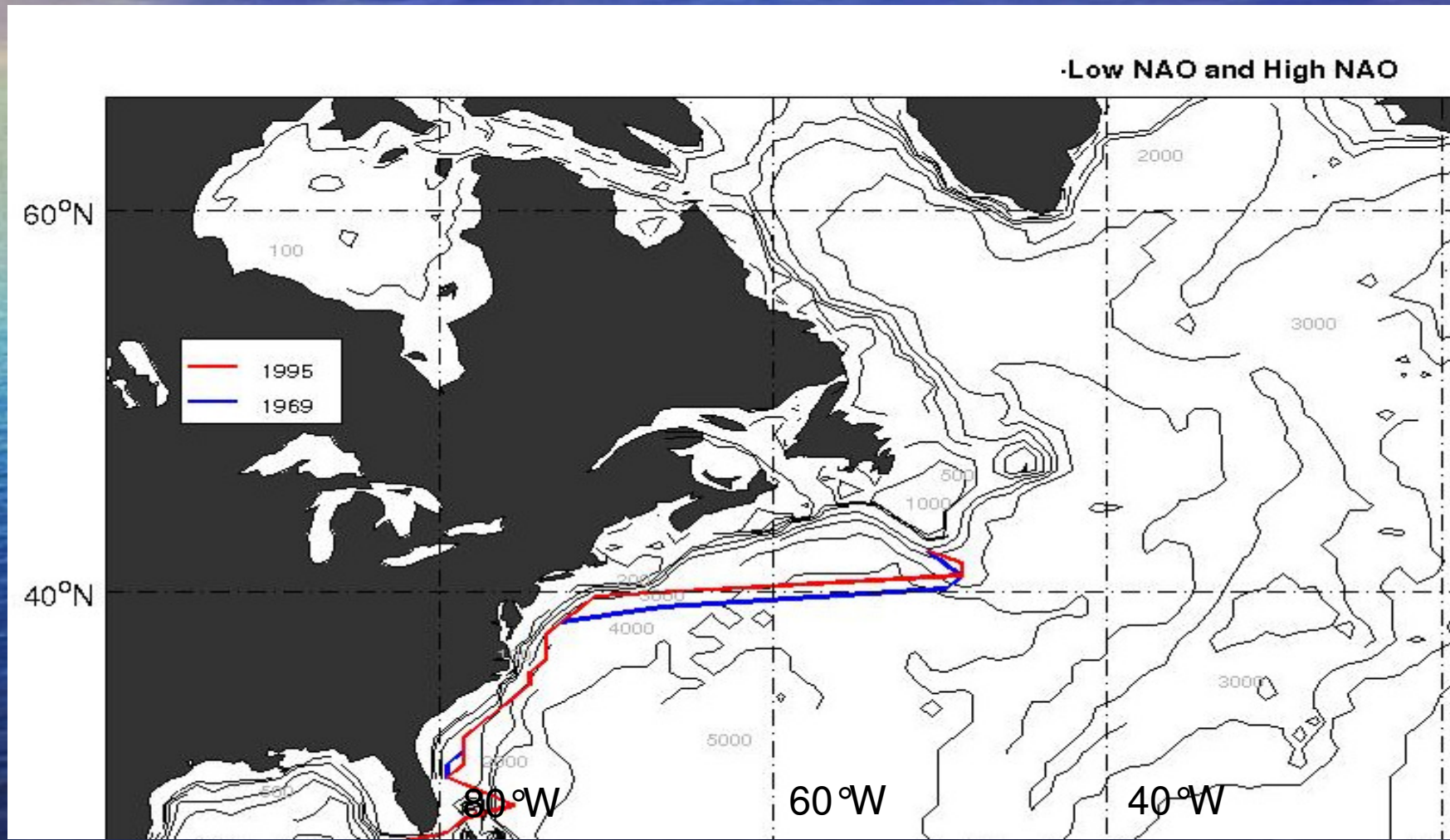
N20 – N30

N10 – N20

Blue for SSH; Green for SST



# Just for Fun: Shifting of Gulf Stream in 1° model!



# Summary

- Our 1° model shows ability to reproduce inter-annual and decadal variability of SSH and SST in North Atlantic.
- The PC's of SSH and SST are correlated, suggesting linkage between these two quantities. (Evidence that PC1 of SST leads PC1 of SSH.)
- Results show PC1 of SSH highly correlated with winter NAO; PC2 moderately correlated with the East Atlantic Pattern (EAP).
- Higher SSH-SST correlation in sub-polar compared with other regions of NA.
- Some indication of a Gulf Stream shift connected with the winter NAO.



**Thank you!**