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Sea Grant

LONG ISLAND SOUND STUDY
A PARTNERSHIP TO RESTORE AND PROTECT THE SOUND

Meteorological and Climate Forcing of Temperature and Salinity Variability in the Long Island Sound

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Introduction

- Weather is often associated with large-scale modes of climate variability.
- Examples include the Pacific Decadal Oscillation (PDO; Mantua et al., 1997), North Atlantic Oscillation (NAO; Hurrell, 1995), and the Eastern Northern American (ENA; Schulte et al., 2015) pattern.
- This talk will focus on the ENA and PDO patterns.

Data

Monthly European Center for Medium Range Forecast (ERA) Interim Reanalysis.

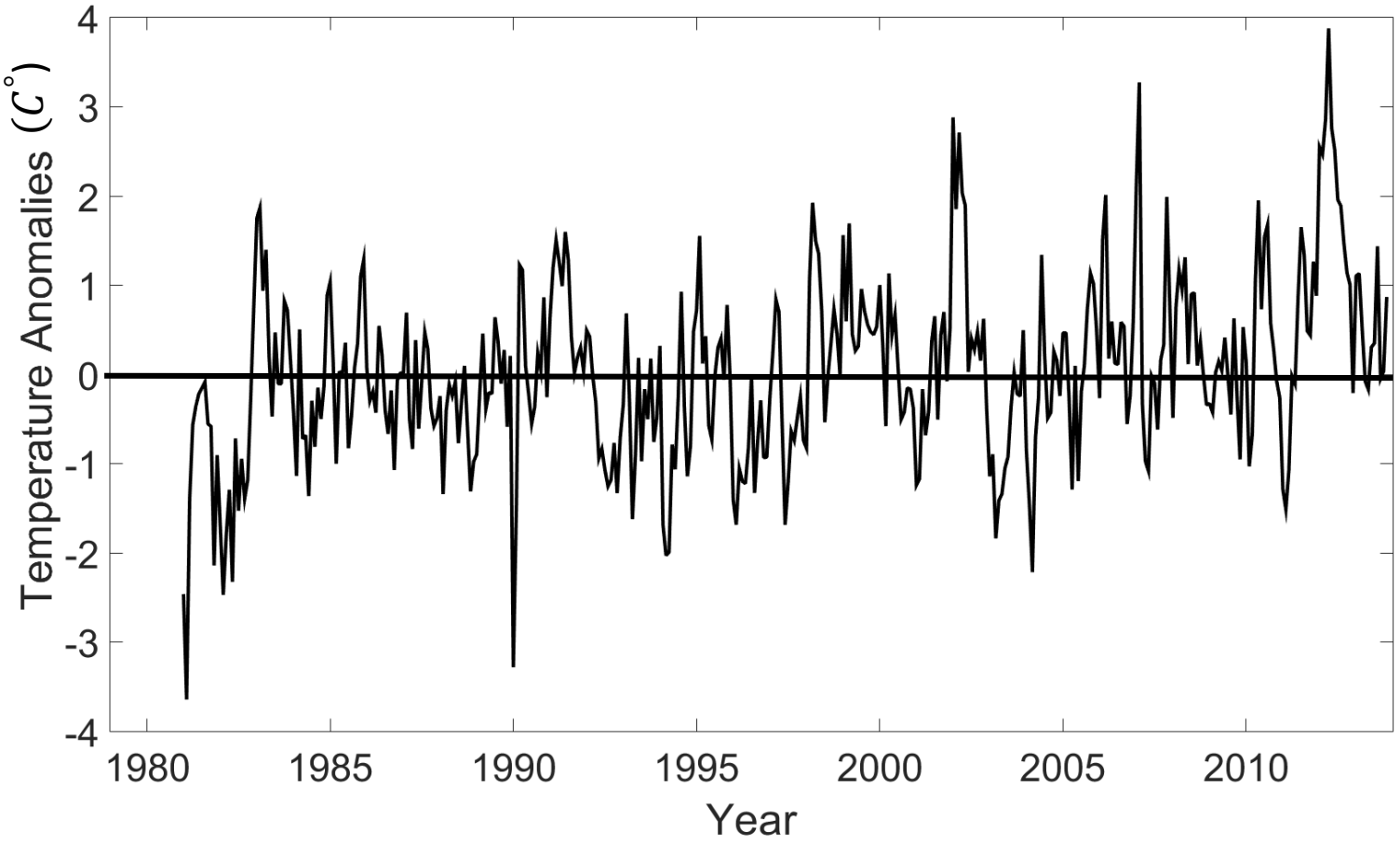
New York Harbor Observing and Prediction System (NYHOPS) monthly temperature and salinity data.

Annual cycles were removed from all time series.

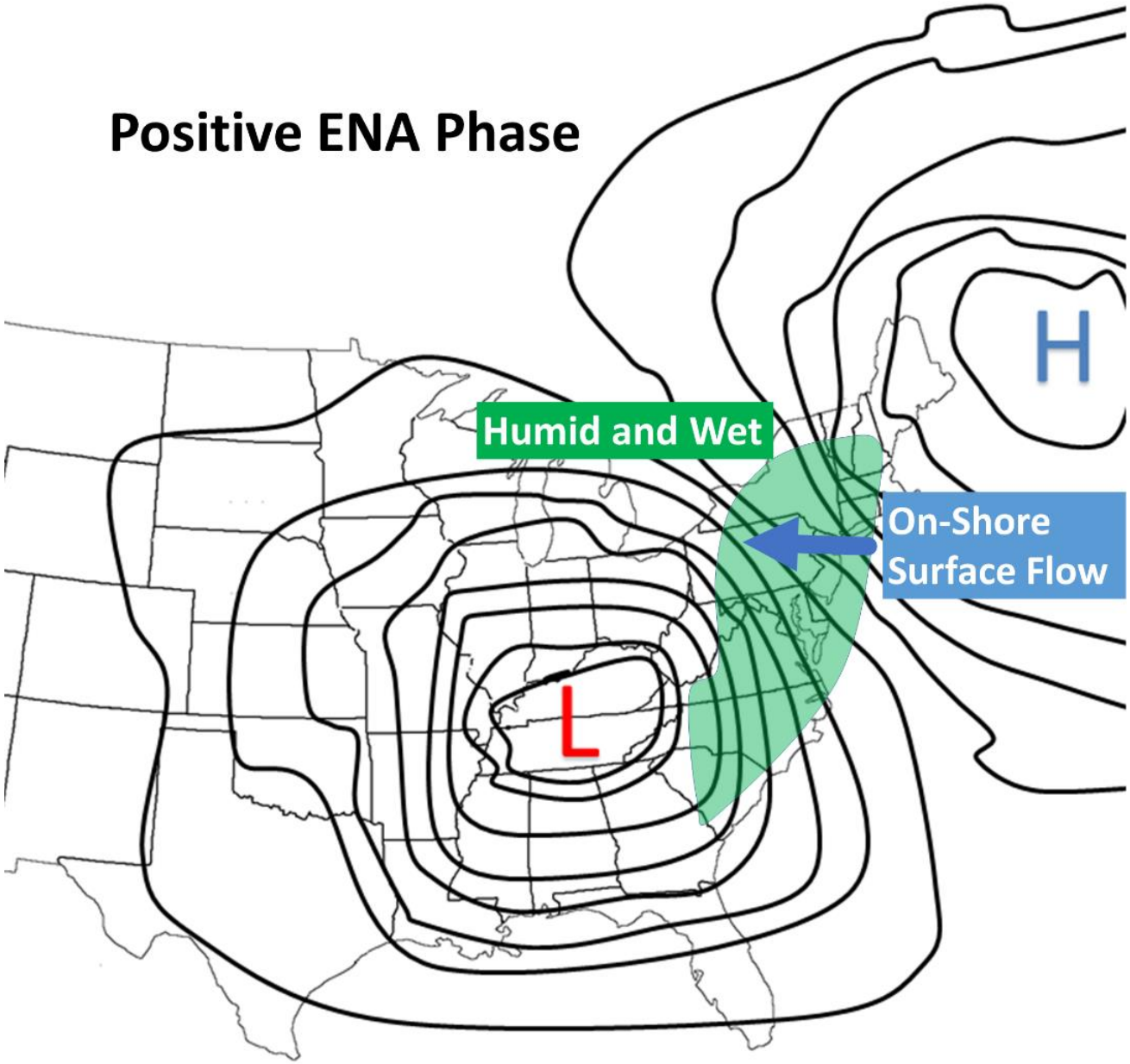
Period of study: 1979-2013.

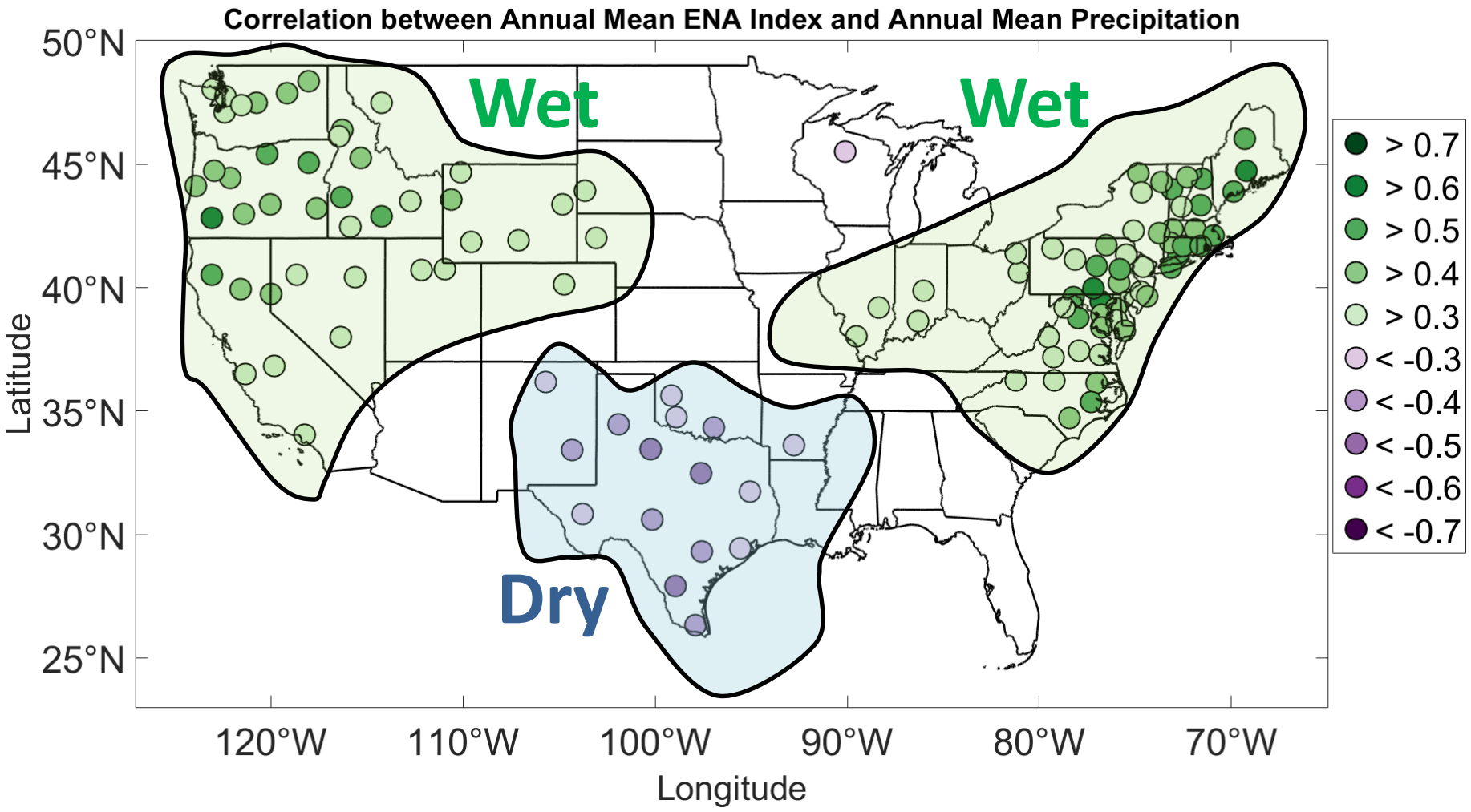
Motivation/Research Questions

What were the climate drivers of salinity and temperature variability in the Long Island Sound?

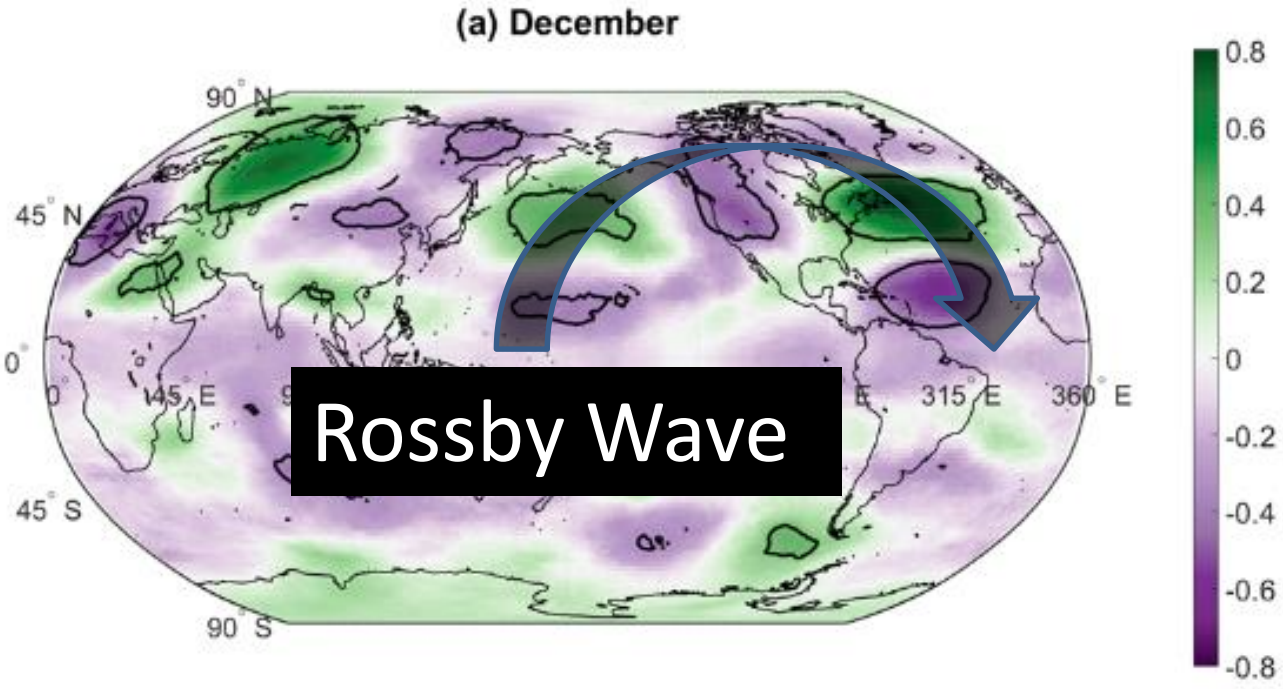


Salinity Variability

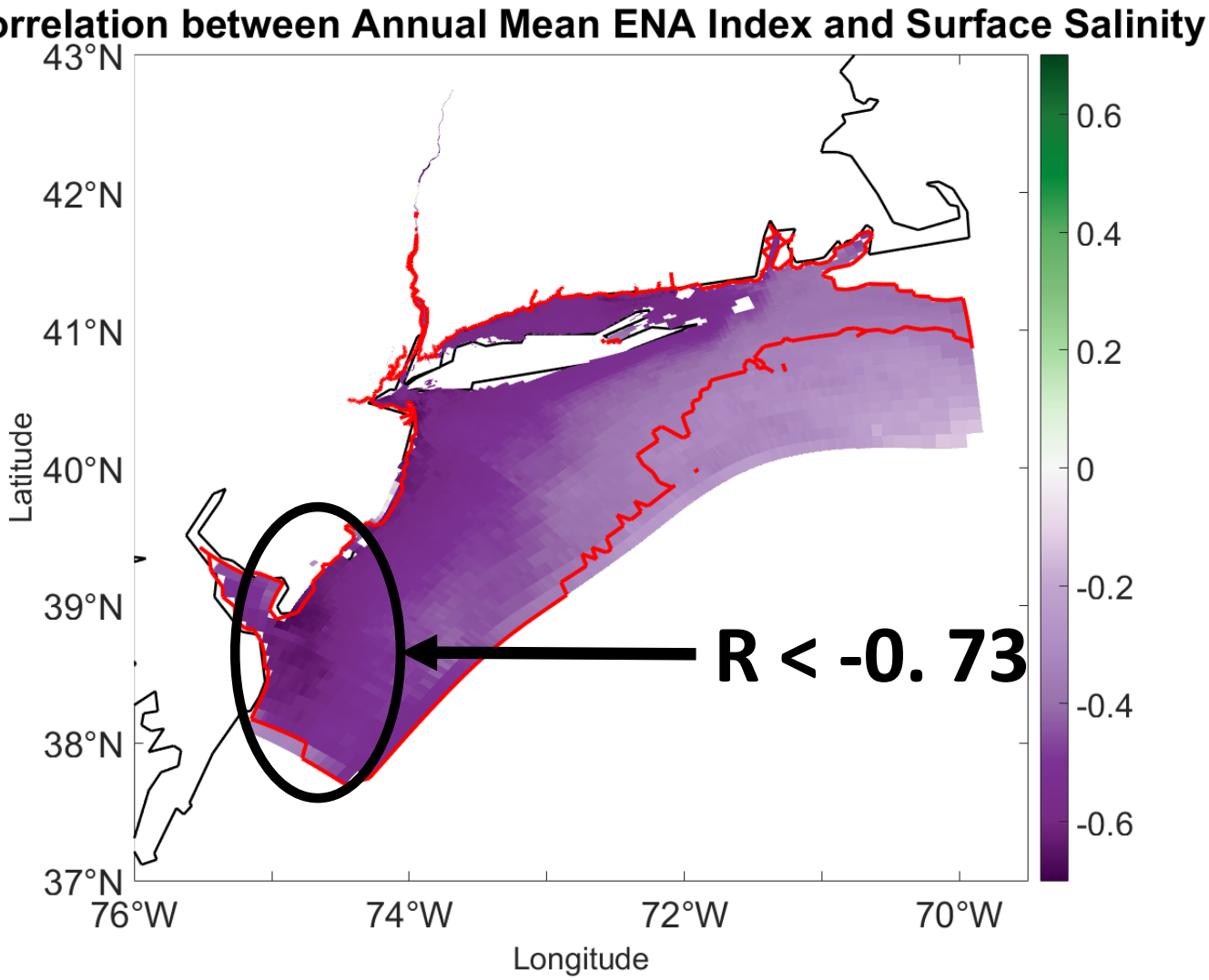

Positive ENA Phase
H
Humid and Wet
On-Shore
Surface Flow
L


Correlation between Annual Mean ENA Index and Annual Mean Precipitation
Wet
Wet
Dry
50°N
45°N
40°N
35°N
30°N
25°N
Latitude
120°W
110°W
100°W
90°W
80°W
70°W
Longitude
> 0.7
> 0.6
> 0.5
> 0.4
> 0.3
< -0.3
< -0.4
< -0.5
< -0.6
< -0.7

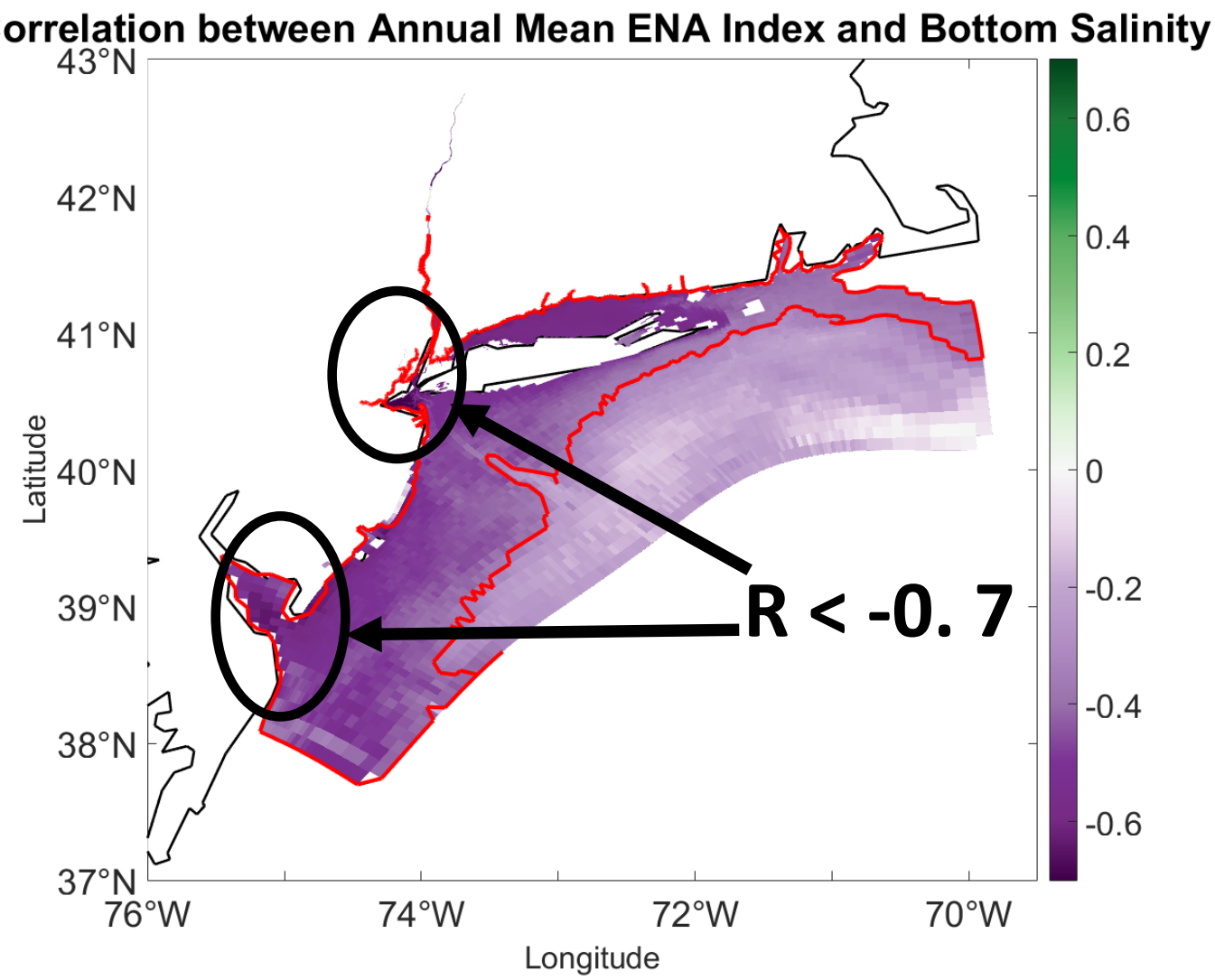
Correlation between ENA Index and 500-hPa Geopotential Height



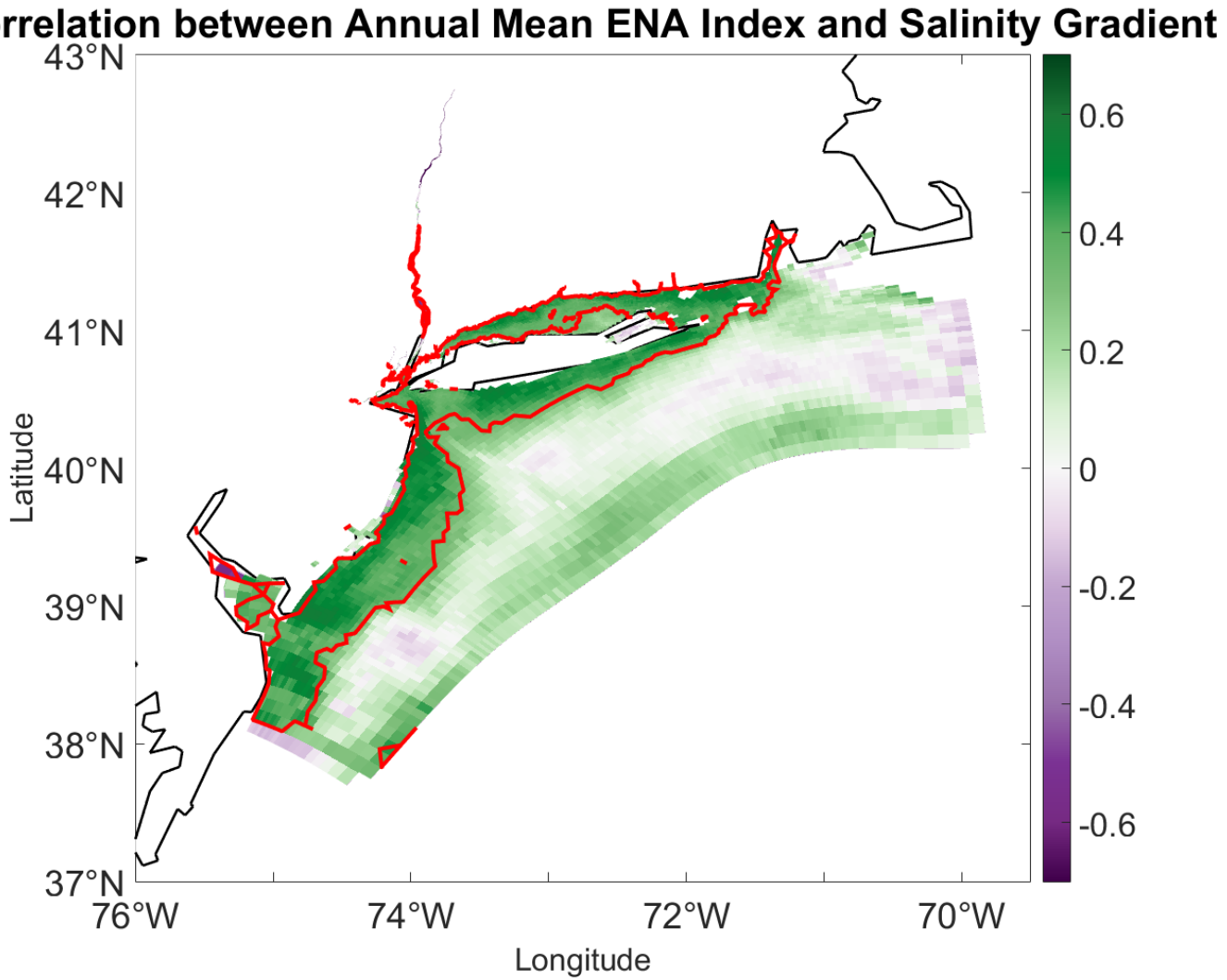
Red contours indicate 5% statistical significance

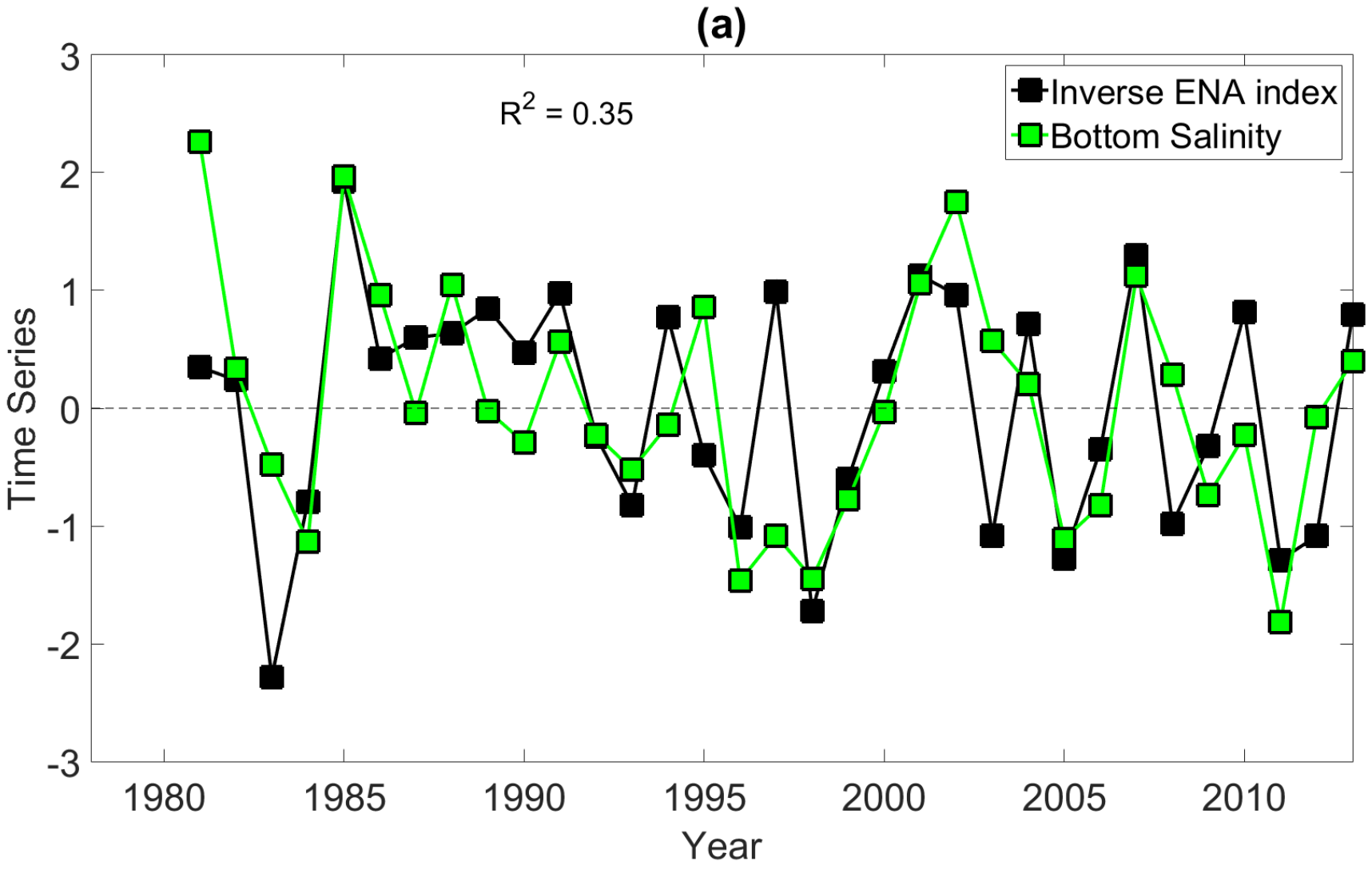


Red contours indicate 5% statistical significance



Red contours indicate 5% statistical significance




(a)
R^2 = 0.35
Inverse ENA index
Bottom Salinity
Time Series
Year
3
2
1
0
-1
-2
-3
1980
1985
1990
1995
2000
2005
2010

Temperature Variability

Pacific Decadal Oscillation

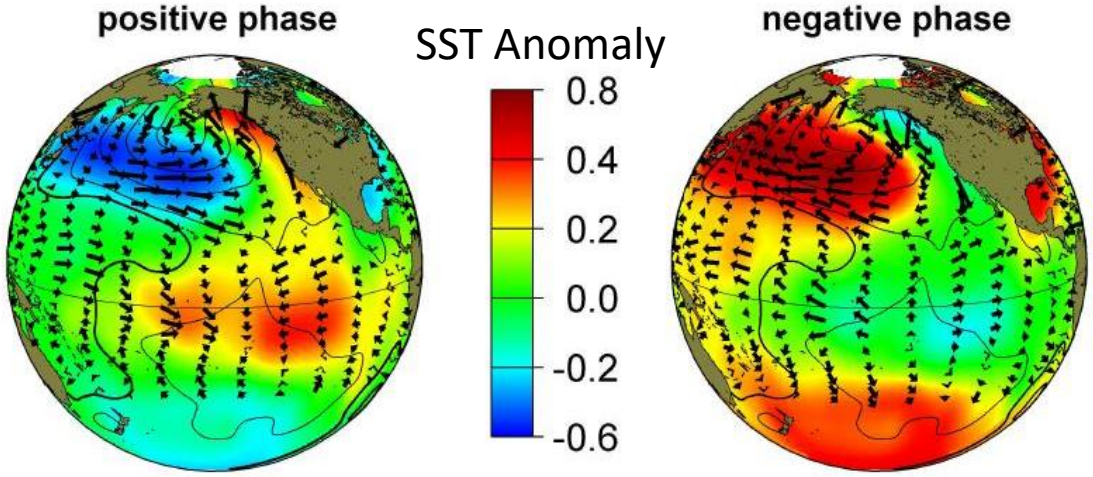
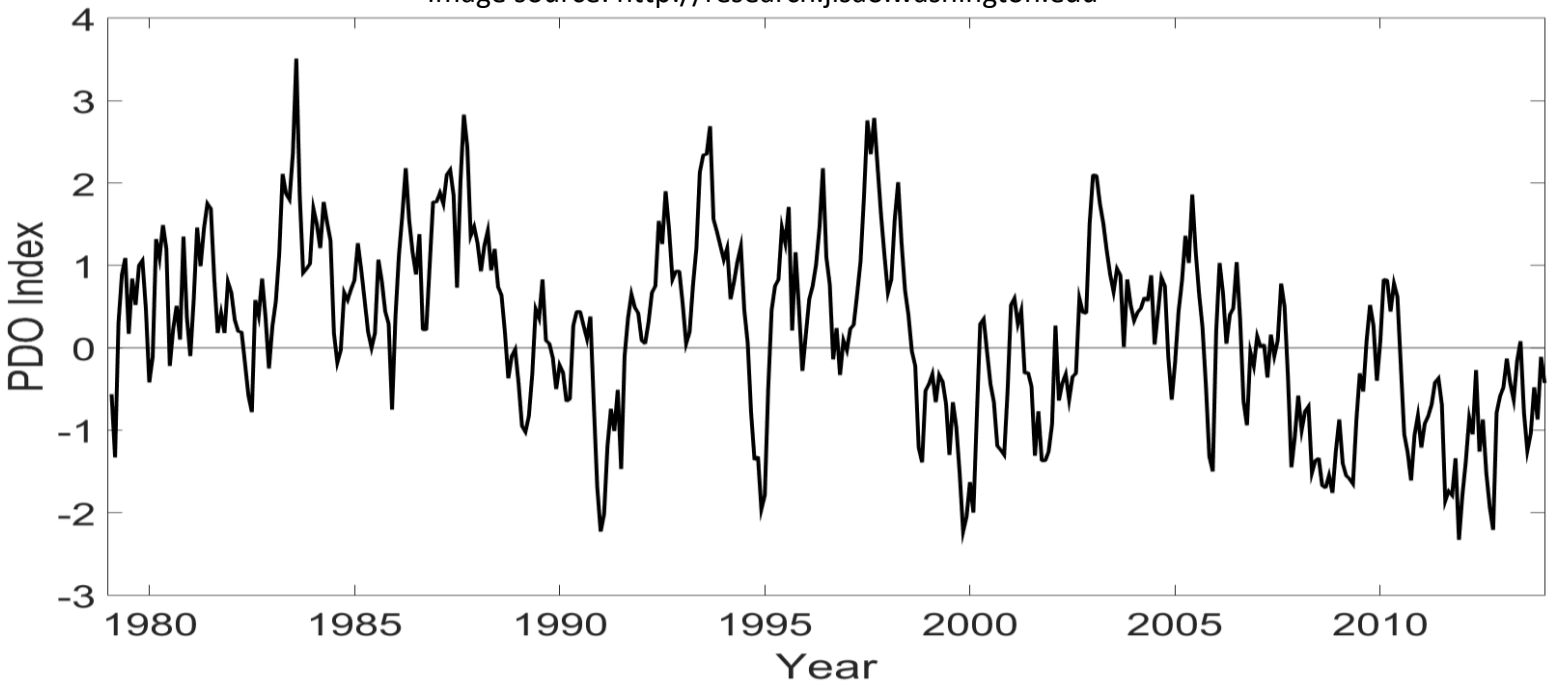
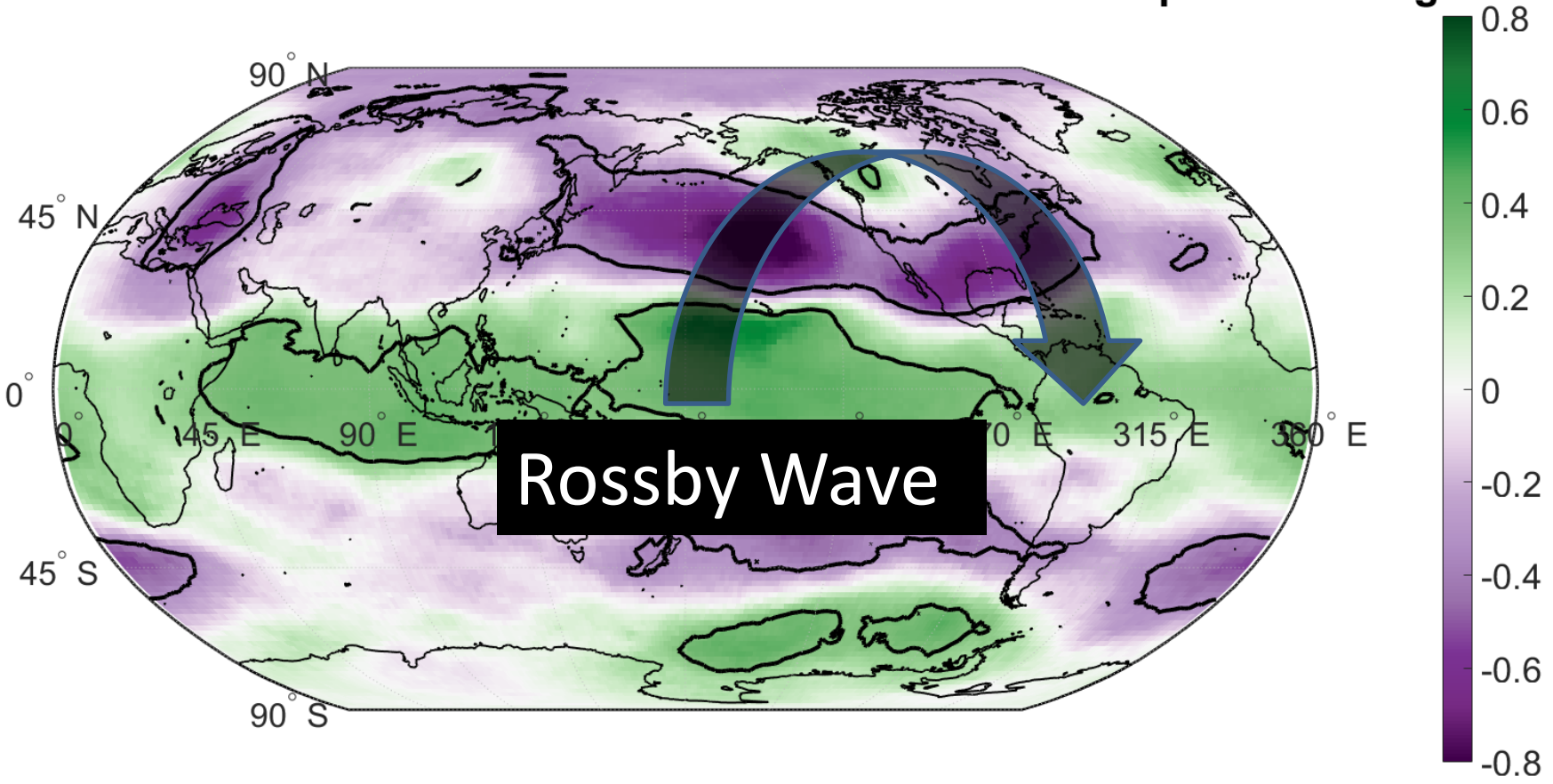


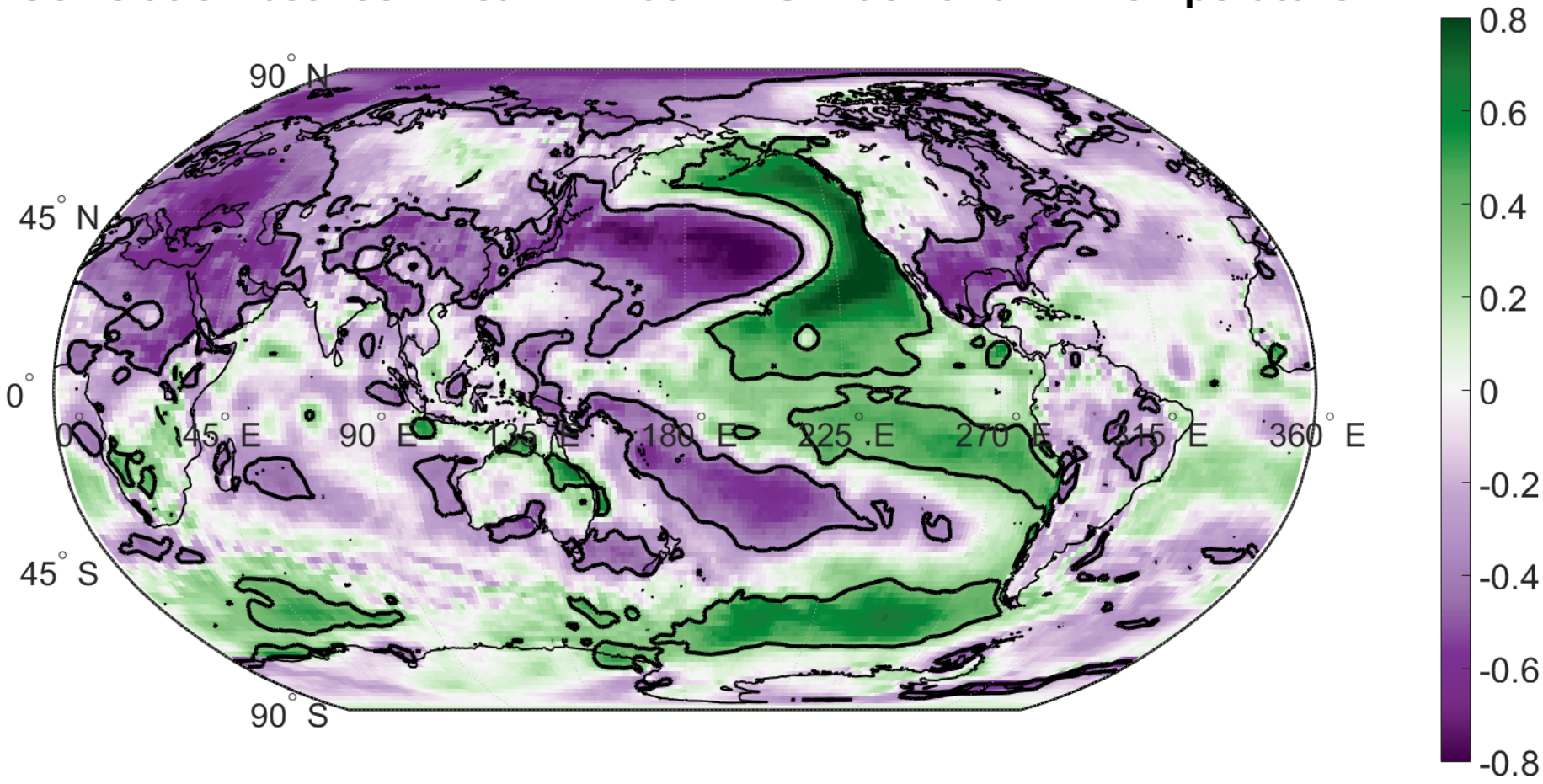
Image source: http://research.jisao.washington.edu



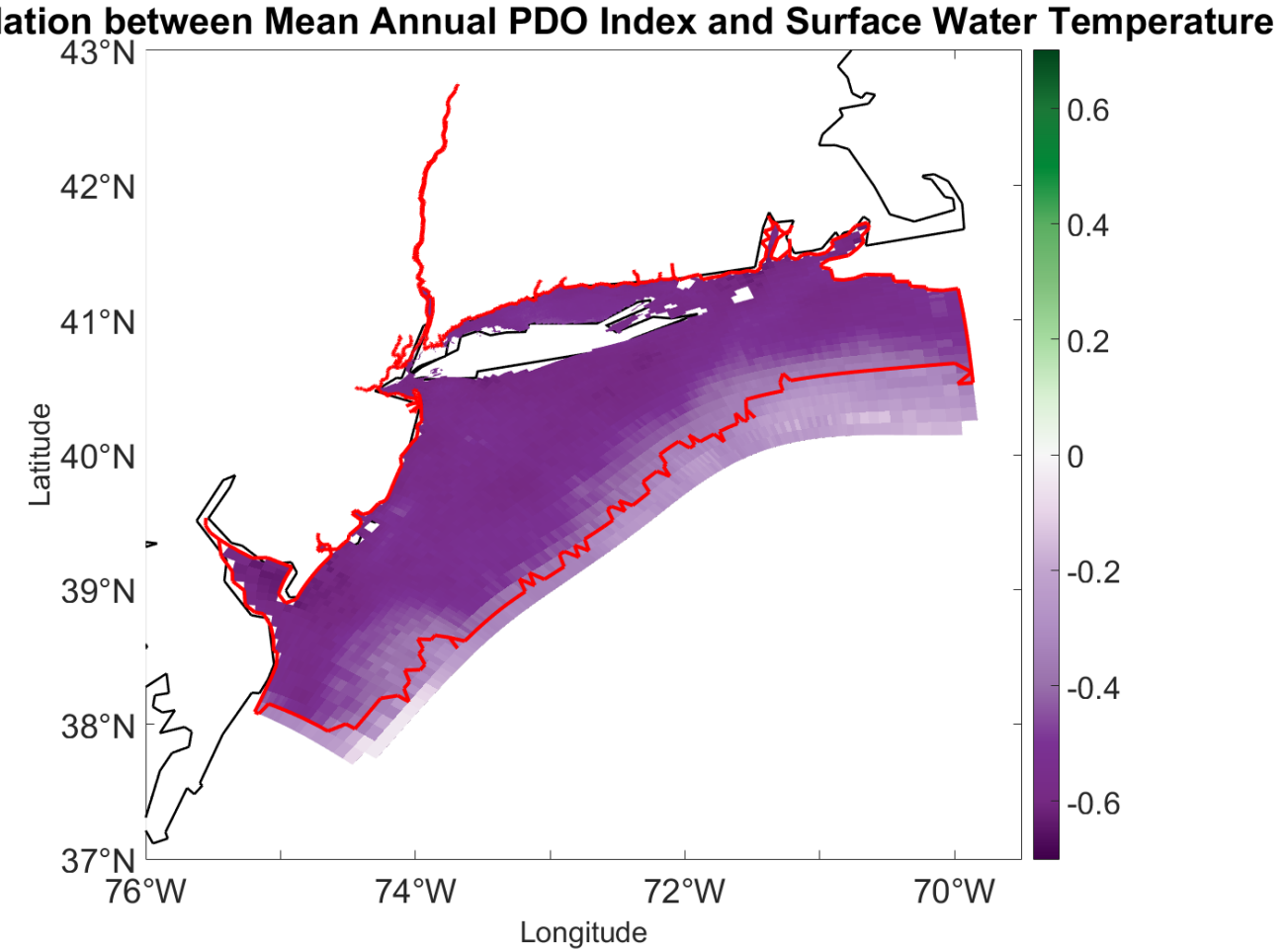
Correlation between Mean Annual PDO Index and 500-hPa Geopotential Height



Correlation between Mean Annual PDO Index and Air Temperature



Red contours indicate 5% statistical significance



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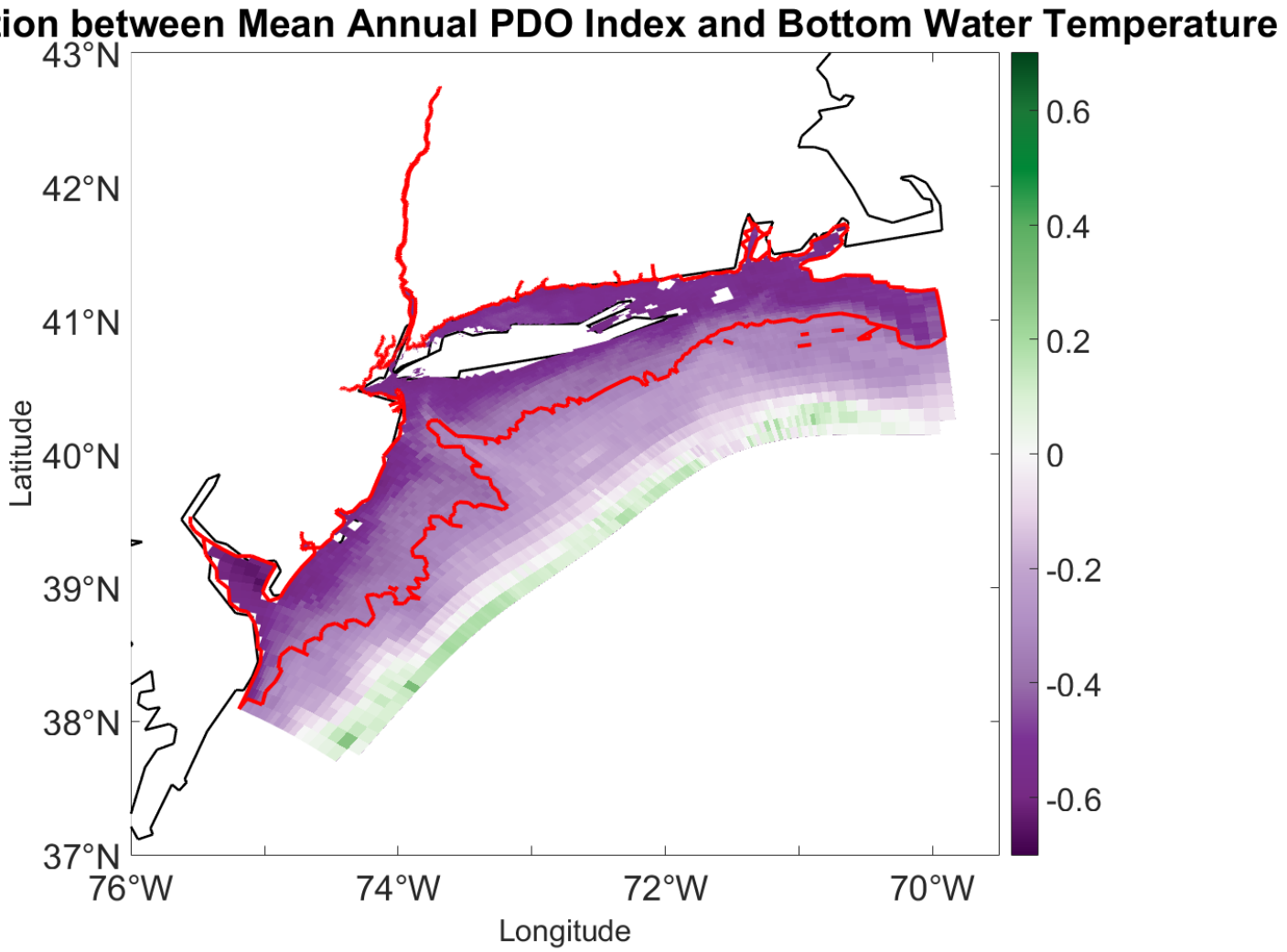

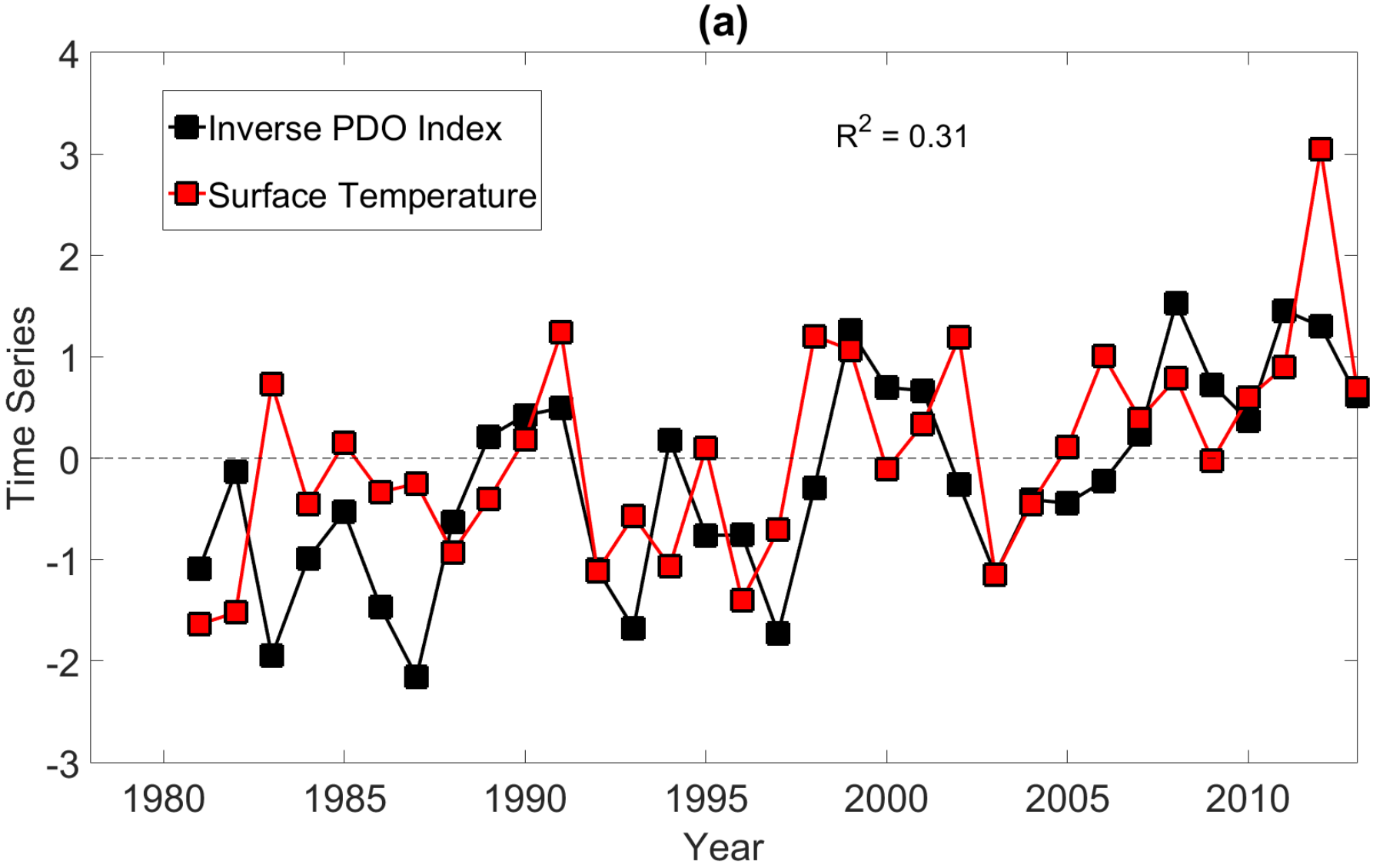
(a)
Inverse PDO Index
Surface Temperature
R^2 = 0.31
Time Series
Year
4
3
2
1
0
-1
-2
-3
1980
1985
1990
1995
2000
2005
2010

Conclusions

The ENA index can explain 35% of the mean annual salinity variability in the Long Island Sound and up to 56% in other regions of the NYHOPS domain.

The PDO index can explain 31% of the mean annual temperature variability in the Long Island Sound and up to 50% in other regions of the NYHOPS domain.

Both the ENA and PDO indices were associated with Rossby waves emanating from the North Pacific Ocean, linking North Pacific atmospheric variability to Northeast US. climate variability.

References

Hurrell, J.W., 1995: Decadal Trends in the North Atlantic Oscillation: Regional Temperatures and Precipitation. Science: Vol. 269, pp.676-679

Mantua, N.J. and S.R. Hare, Y. Zhang, J.M. Wallace, and R.C. Francis 1997: A Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the American Meteorological Society, 78, pp. 1069-1079.

Schulte, J. A., Najjar, R. G, and Lee, S. Salinity and Streamflow Variability in the Mid-Atlantic Region of the United States and its Relationship with Large-scale Atmospheric Circulation Patterns, submitted to Journal of Hydrology

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