Georgia Tech
College of Sciences

Sharing is encouraged

Variability of North Atlantic Water Mass Properties along the Deep Western Boundary Current

Anne-Sophie Fortin[1] and Susan Lozier[1]

[1]Georgia Institute of Technology

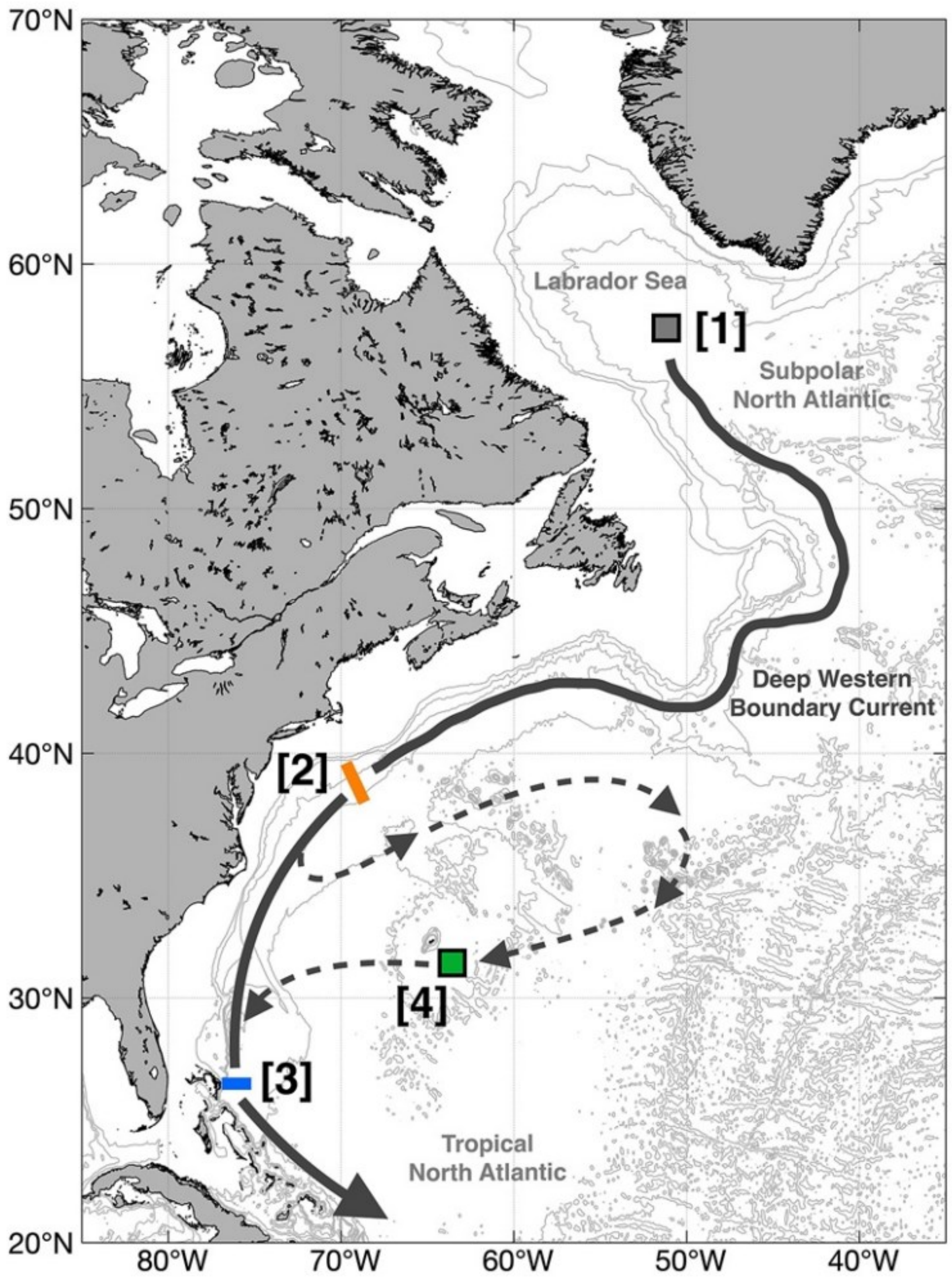
Background

Many studies* estimate the advective time scale for [1] Labrador Sea Water (LSW) anomalies to reach the low latitudes via the Deep Western Boundary Current (DWBC).

[2] Line W (39°N): 3-7 years

[3] Abaco (26.5°N): 9-14 years

* e.g.; Curry and McCartney 1996; van Sebille et al. 2011; Le Bras et al. 2017; and Chomiak et al. 2022

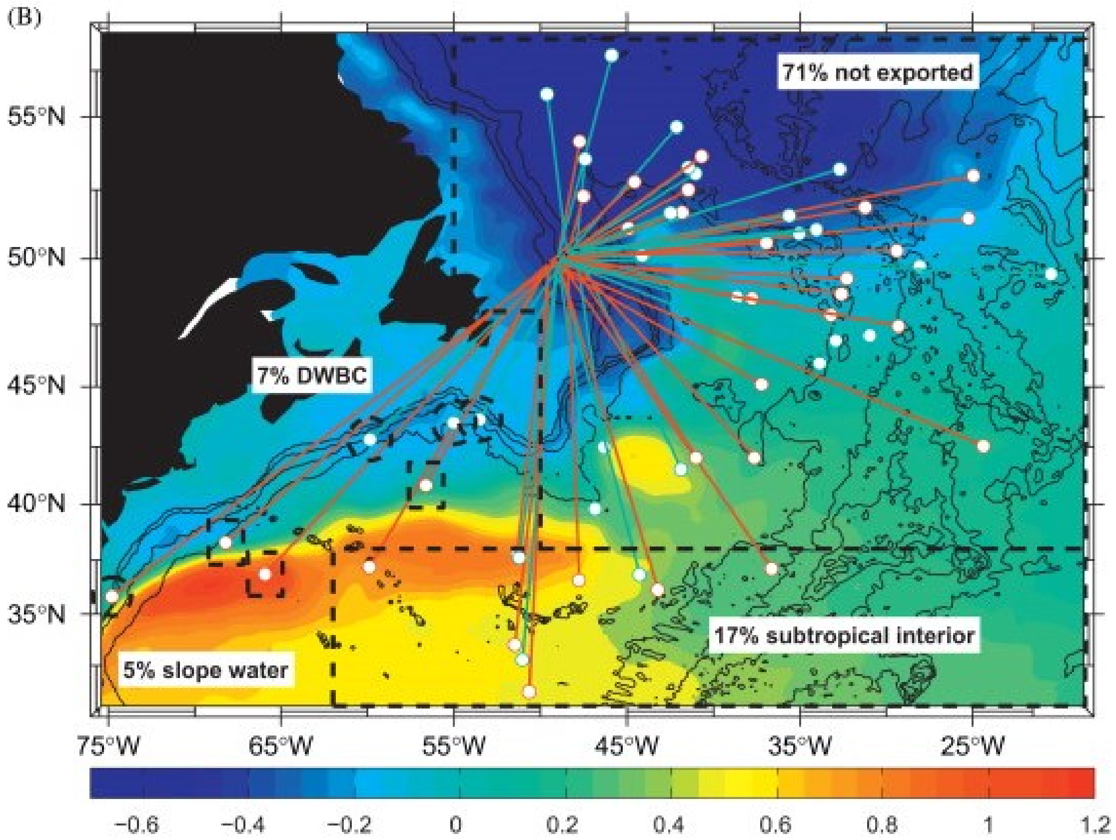


Reprinted from Chomiak et al. (2022)

Background

Many studies* estimate the advective time scale for [1] Labrador Sea Water (LSW) anomalies to reach the low latitudes via the Deep Western Boundary Current (DWBC).

However, only a small fraction of LSW is exported continuously along the DWBC (~7%; Bower et al., 2011).



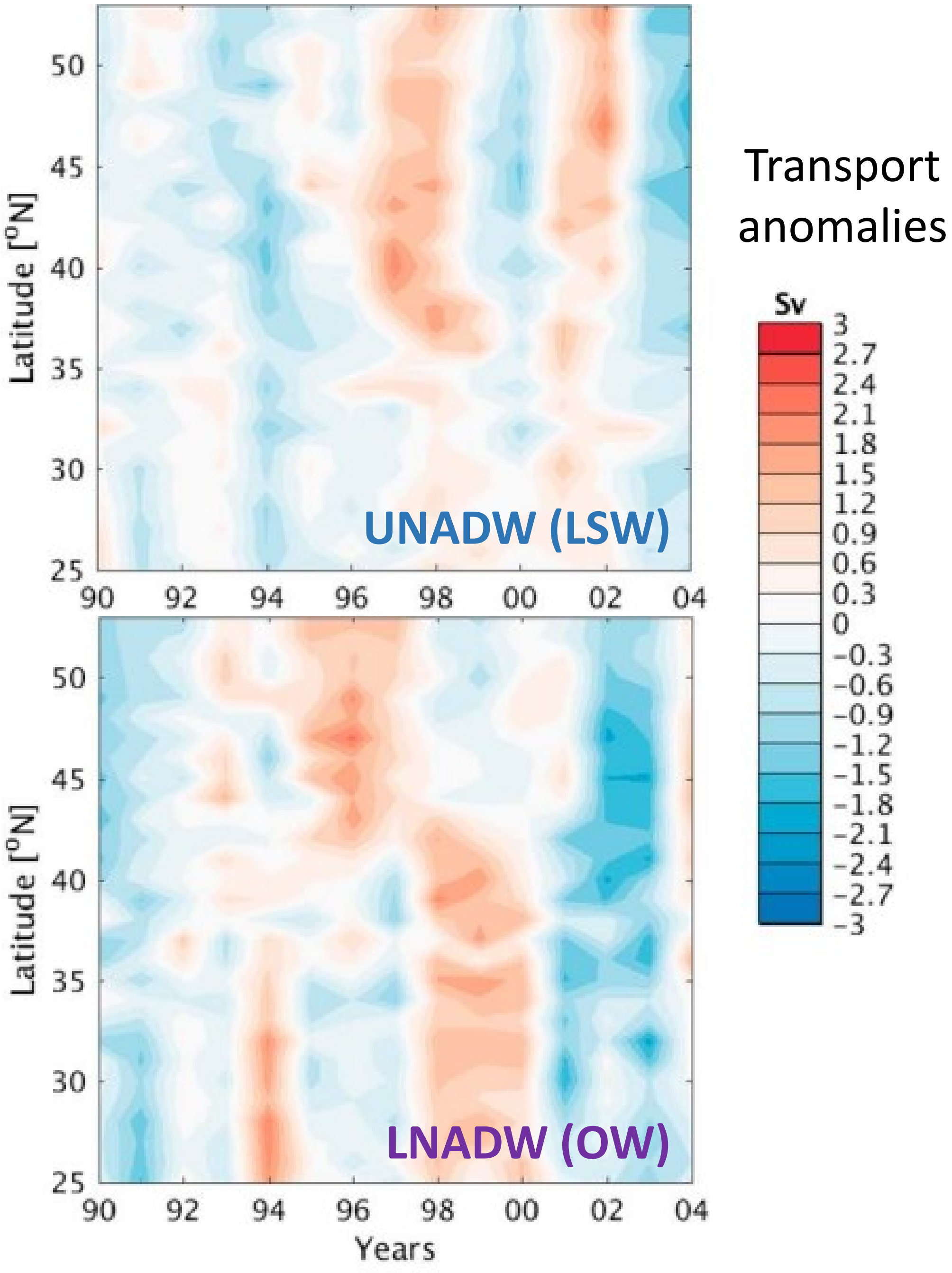
Displacement vectors for the trajectories of 55 RAFOS floats released at 50^{o}N at 700 m & 1500 m. Reprinted from Bower et al. (2011).

Background

Many studies* estimate the advective time scale for [1] Labrador Sea Water (LSW) anomalies to reach the low latitudes via the Deep Western Boundary Current (DWBC).

However, only a small fraction of LSW is exported continuously along the DWBC (~7%; Bower et al., 2011).

Anomalies are mostly propagated at great depths, as shown in a recent study using eddy-resolving model (Zou et al., 2019).



Adapted from Zou et al. (2019)

Goal of this study

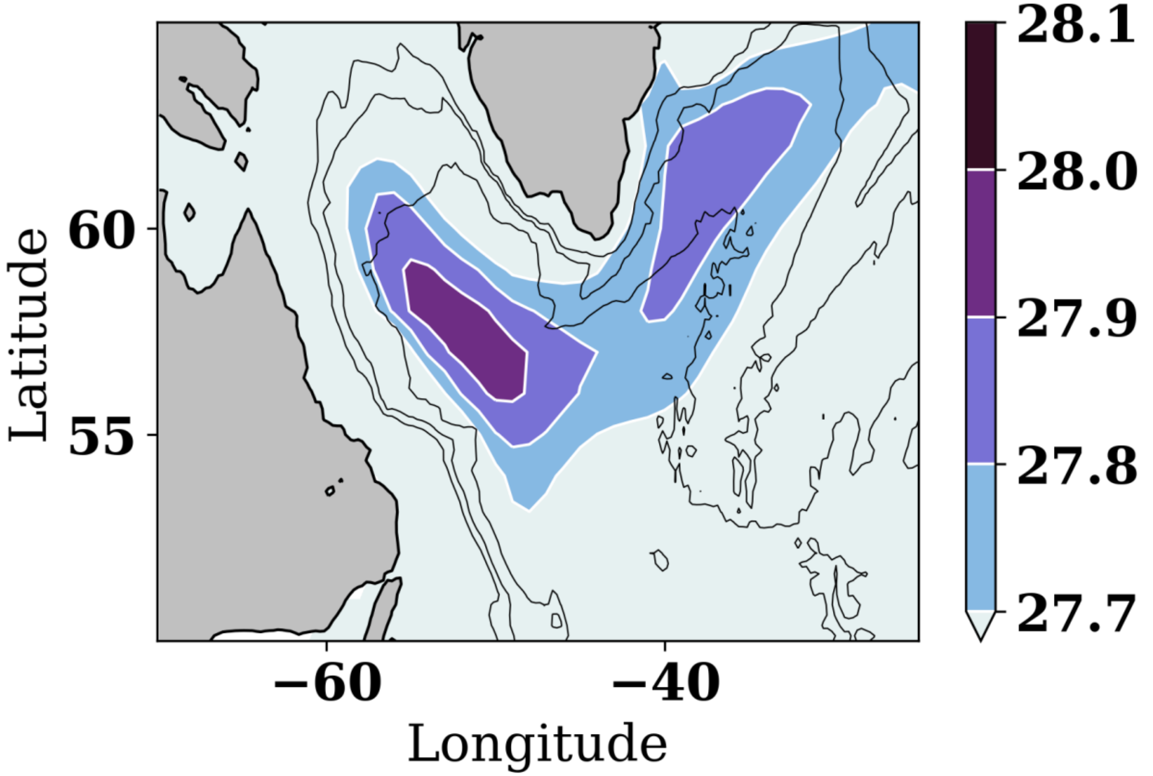
To investigate the propagation of NADW anomalies along the DWBC from the exit of the Labrador Sea to the Rapid Line at 26°N using observational data.

We compare the propagation of UNADW anomalies to those for LNADW.

We investigate

1) in-situ property variability
2) Correlation with the exit of the LS

Surface Neutral Density in March



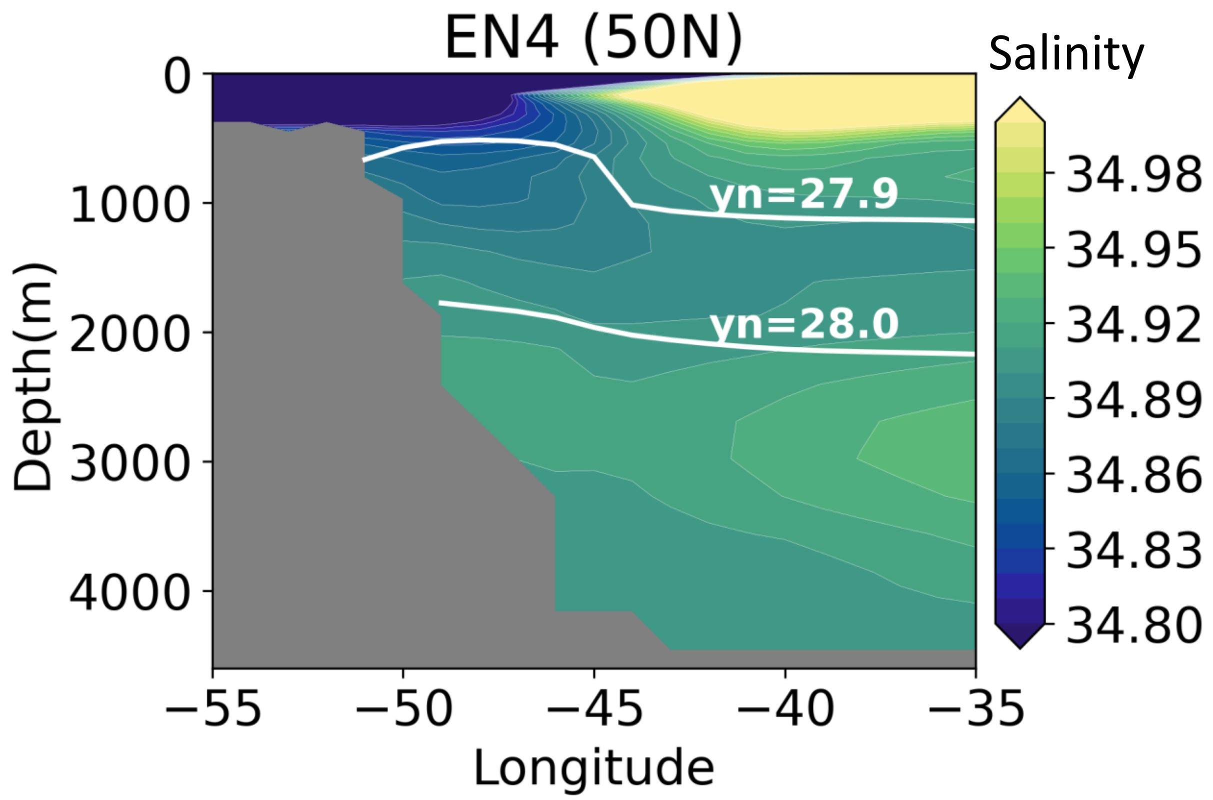
EN4: Reanalysis product from the Met Office

Gridded reanalysis product

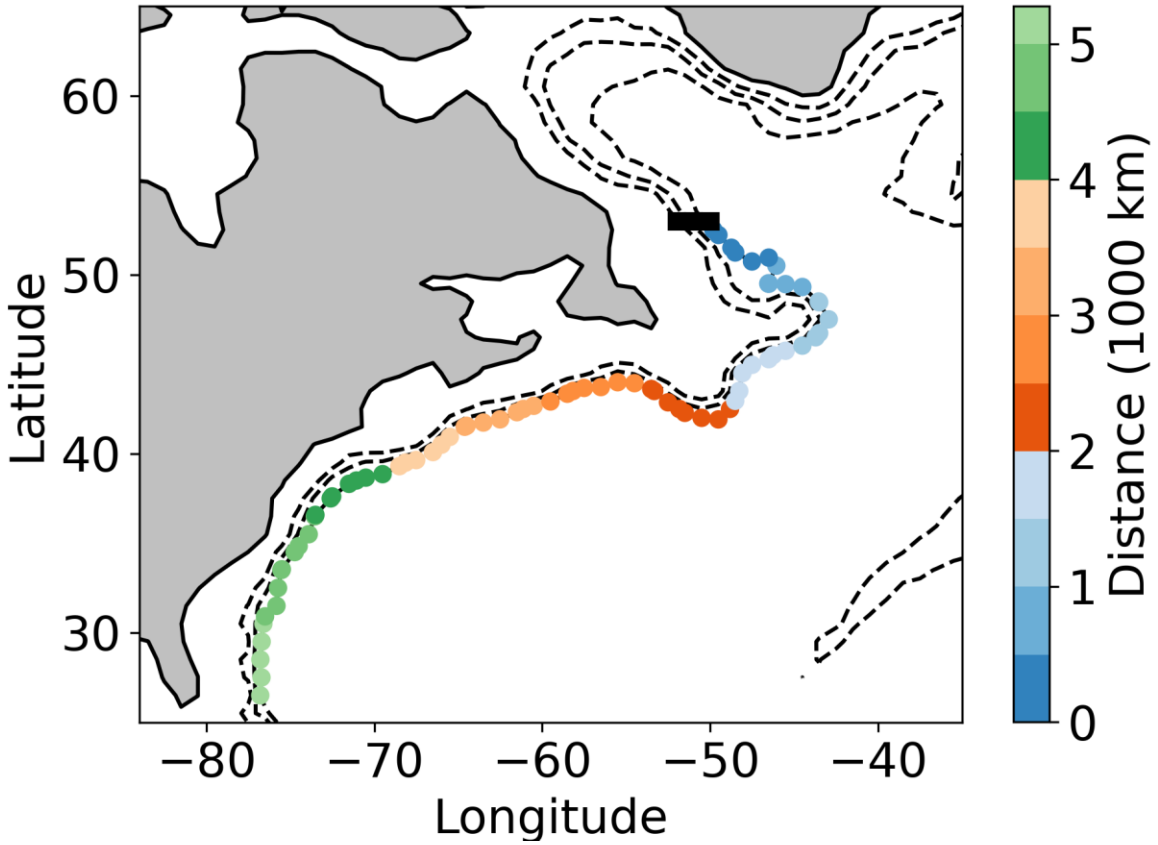
1^{o} x1^{o}, 42 depths; combines data from Argo, ASBO, GTSPP, and WOD18; relaxed to climatology (1971-2000) if no obs.

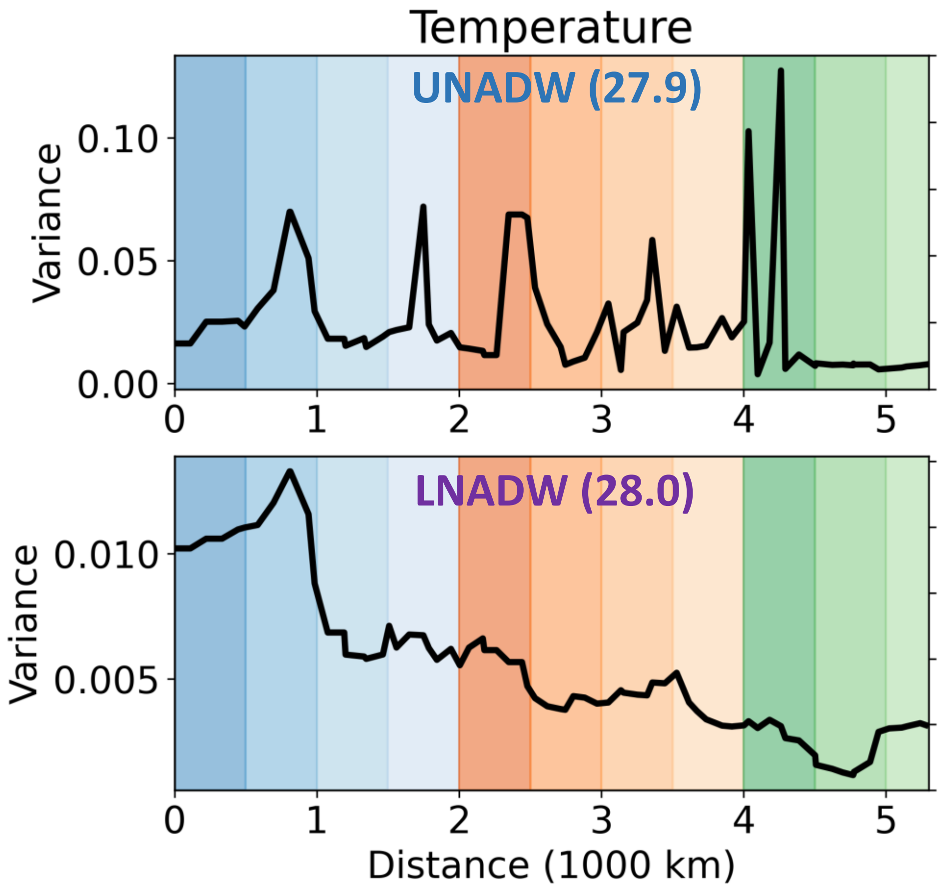
We use data from 1970-2020.

We use the neutral density surface 27.9 for Upper NADW and 28.0 for Lower NADW.



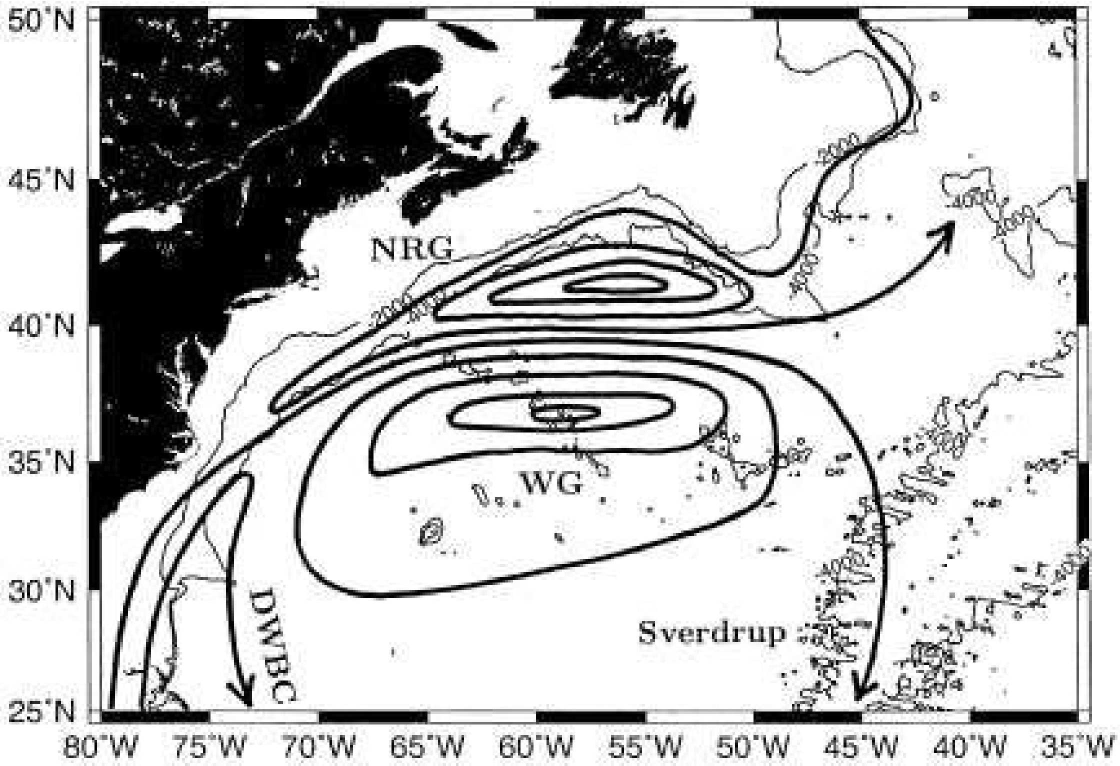
DWBC Pathway – Variance and best lagged correlation over the period 1970-2020 in EN4



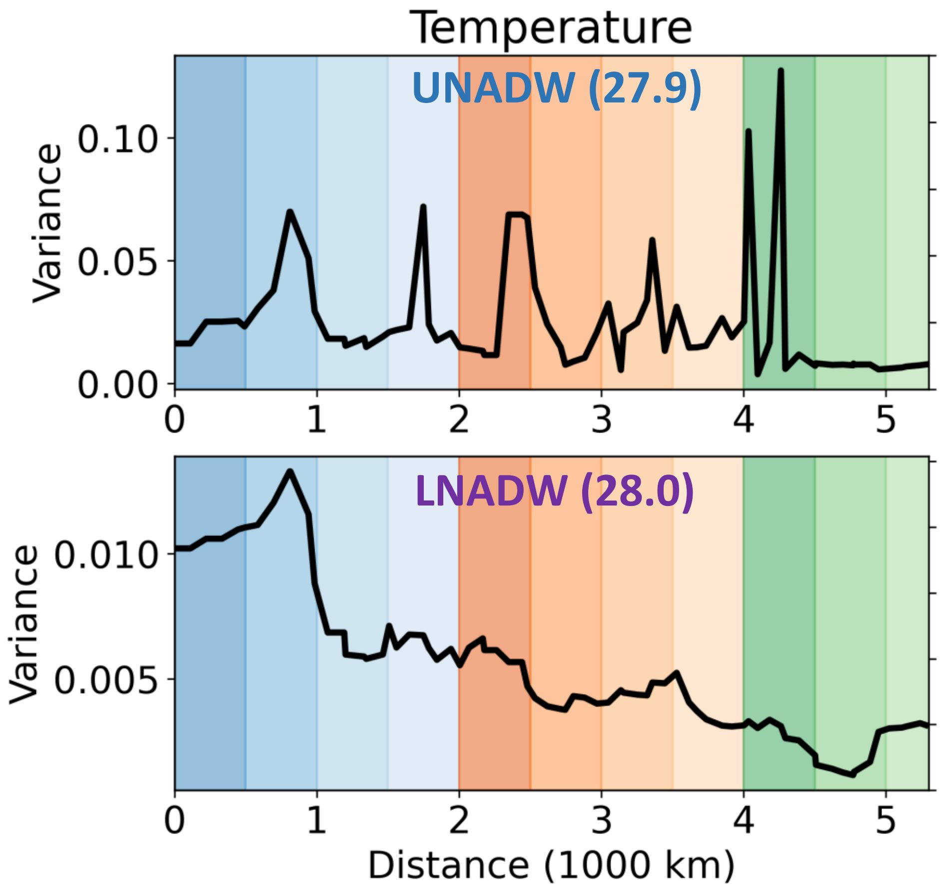


in-situ variance for yearly timeseries

DWBC Pathway – Variance and best lagged correlation over the period 1970-2020 in EN4

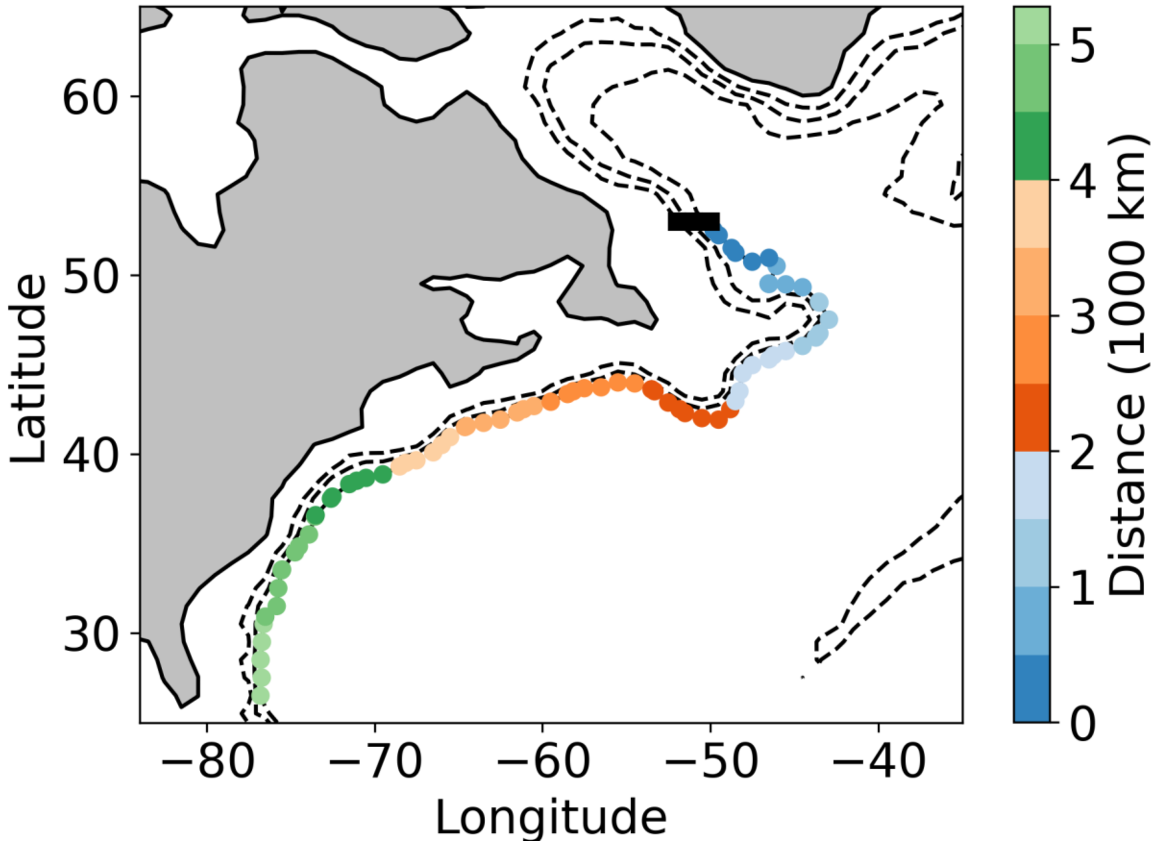


Reprinted from Sheremet (2002);
Adapted from Hogg (1992)

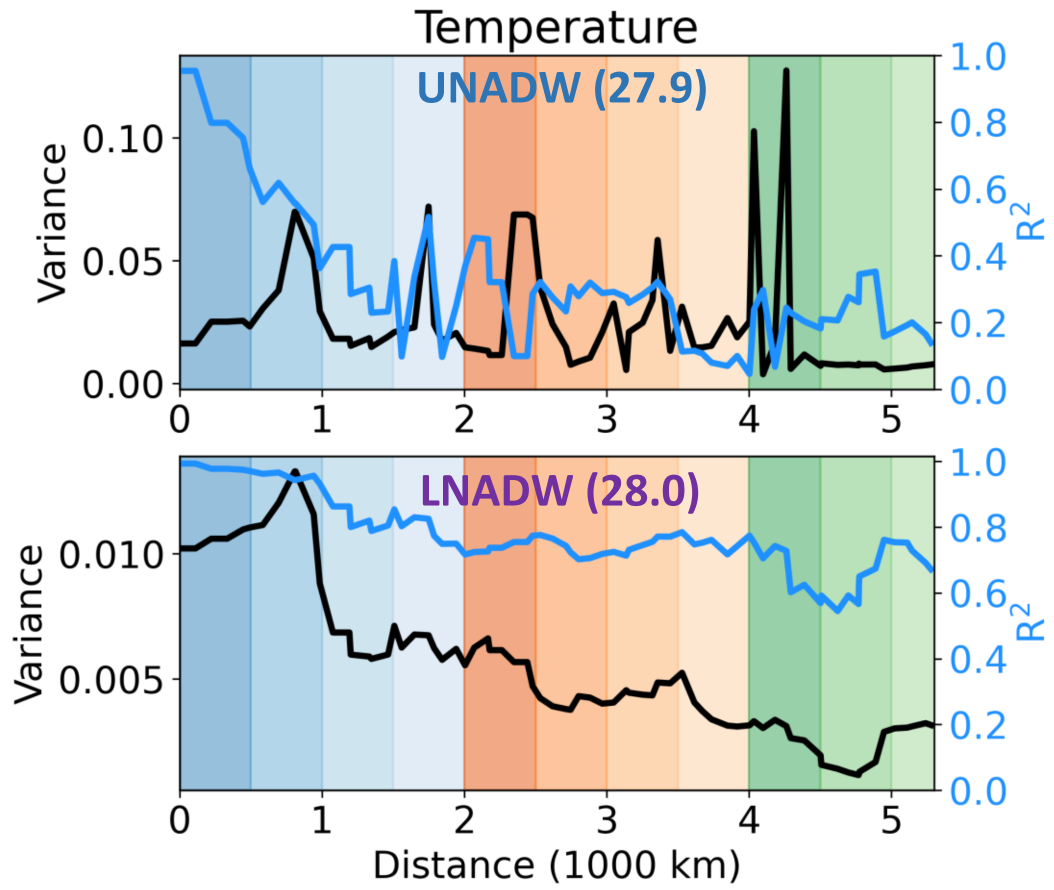


in-situ variance for yearly timeseries

DWBC Pathway – Variance and best lagged correlation over the period 1970-2020 in EN4



Best lag correlation at every point with Labrador Sea exit

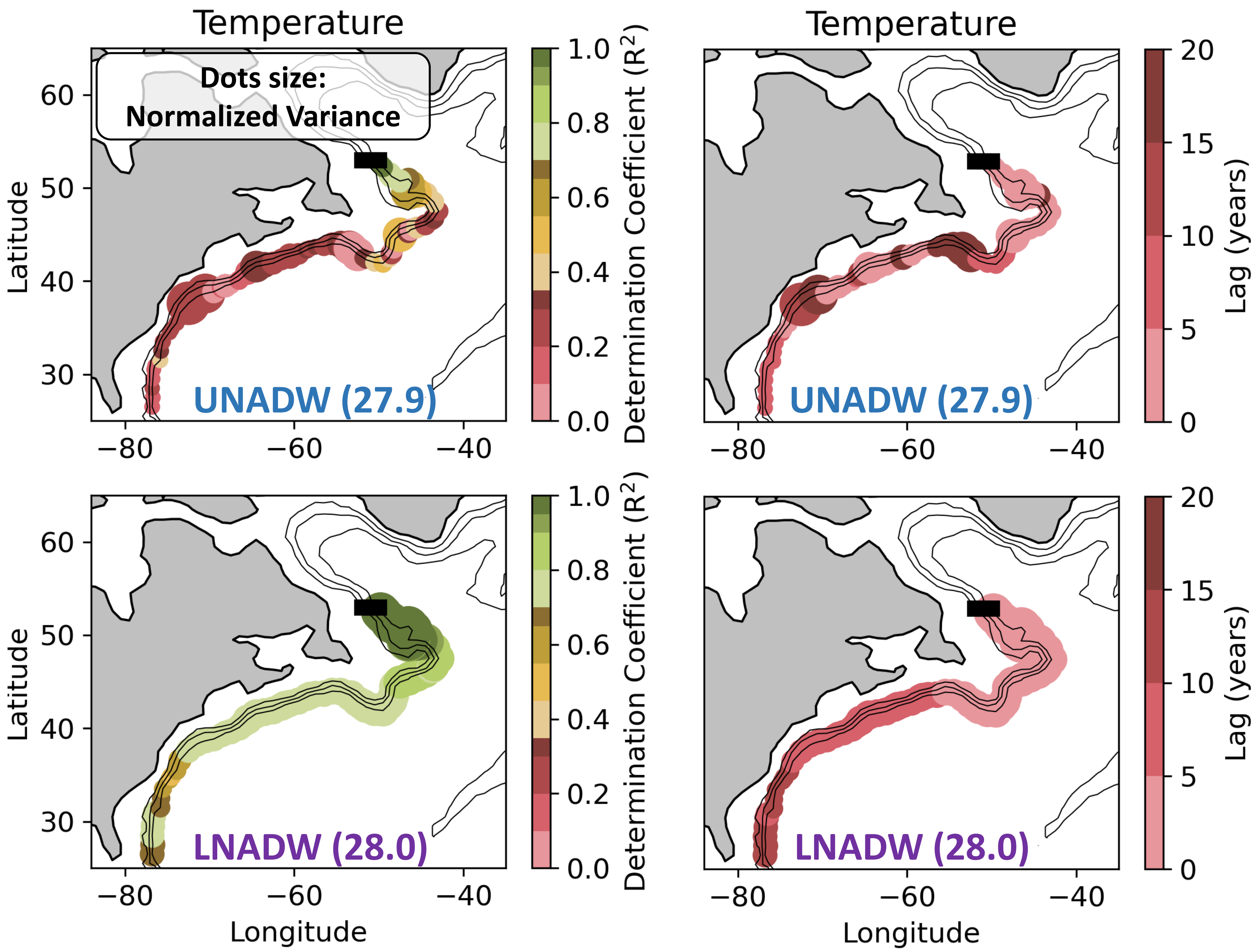


R^2 = (Best lagged correlation)^2
= "Determination Coeff."

DWBC Pathway – Variance & Best Lagged Correlation

UNADW anomalies show discontinuous and low correlations downstream, and the lags do not monotonically decrease along the DWBC.

LNADW correlations are strong along the path of the DWBC, and the lags monotonically decrease downstream.



Conclusion

There is a sharp difference in the downstream propagation of **Upper NADW** anomalies compared to that for **Lower NADW** anomalies. The former is **discontinuous and shows weak meridional coherence**, while the latter exhibits **strong coherence and realistic lags downstream**.

We attribute these differences to strong in situ variability along the DWBC at the depths of UNADW compared to that at LNADW depths. We attribute the stronger variability at UNADW depths to strong interactions with the North Atlantic Current and local recirculations.

Next Steps

Validation of our results with GloSea5 for 1993-2019.

Using similar methods, an investigation of the meridional coherence of anomalies in the interior of the North Atlantic.

Download this presentation