

Some Thoughts on Recent Changes south of New England

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What is going on in the past few years?

- Big Warming in 2012
- Very cold winters in 2013/14 and 2014/15
- Gulf Stream water over the continental shelf
- Extreme storminess in early 2015

Why is this happening and what are the causes?

Regional Circulation

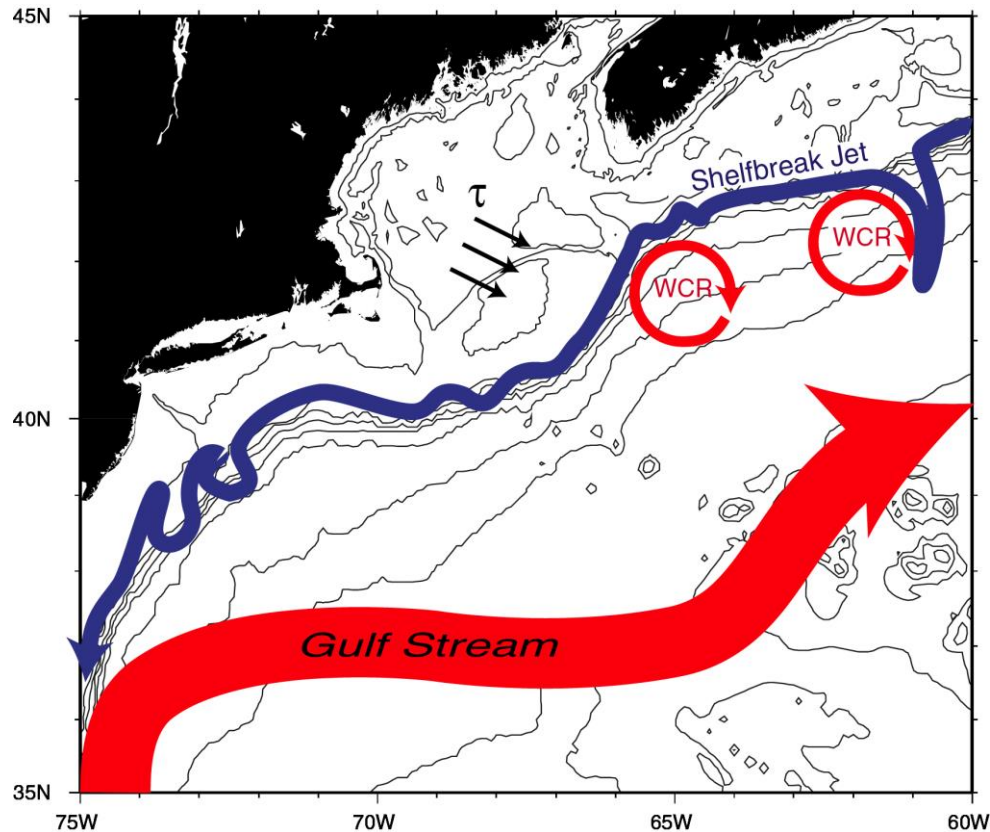


Figure courtesy
P. Fratantoni

Shelfbreak jet runs along offshore edge of continental shelf
Current extends from Labrador Sea to Cape Hatteras
Current is present year round
Gulf Stream interacts with shelfbreak via Warm Core Rings
Front is unstable and frequently forms meanders and eddies

Shelfbreak Frontal Structure

Alongshelf jet near shelfbreak
Typical jet speeds 20-30 cm/s
May be up to 80 cm/s

Temperature difference of 4° C
and salinity difference of 2 PSU
across front

Cross-shelf scale for jet is
roughly 20 km

Offshore mean flow in the
bottom boundary layer
(Ekman transport)

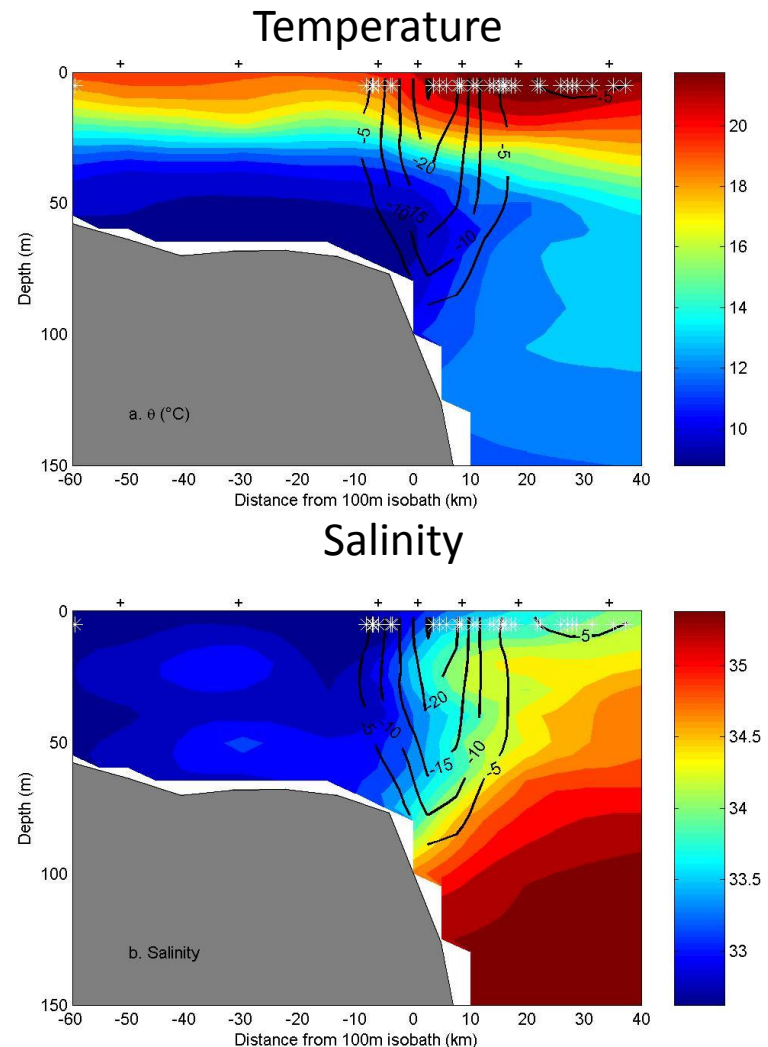


Figure
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Cartoon of Shelfbreak Processes

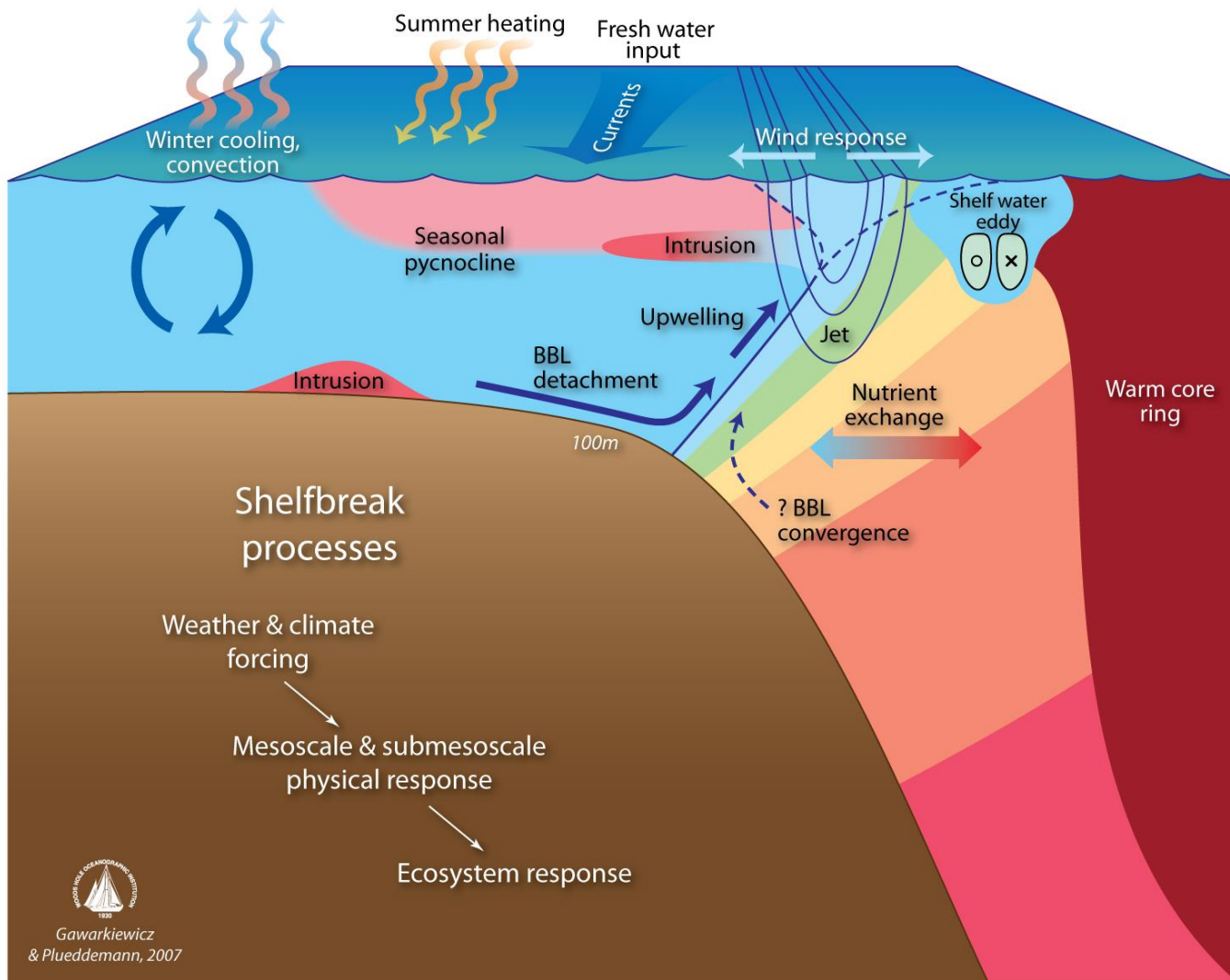


Figure
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A. Plueddemann
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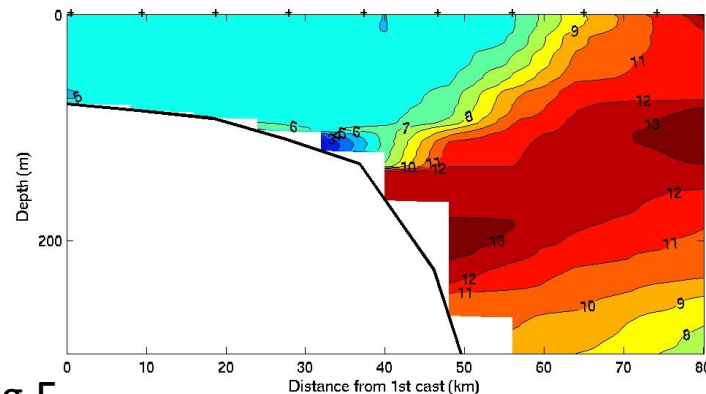
Typical Winter Conditions (Feb. 2005)

Profiles: 71 70 69 68 67 66 65 64 63

Shelf temperature is fairly
Uniform (6 Deg C=43 Deg F)

Slope temperature is about
12 Deg C=54 Deg F

Temperature Difference is ~11 Deg F



Salinity is fairly uniform over the
Shelf 32.5

Slope salinity is about 35

Salinity difference is 2.5

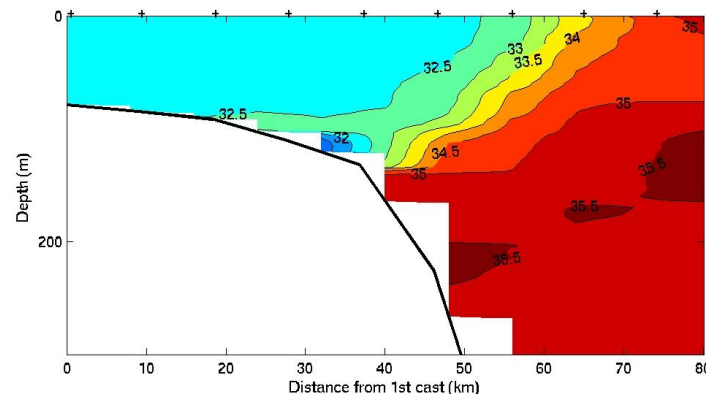


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MacArthur CTD Data Collection

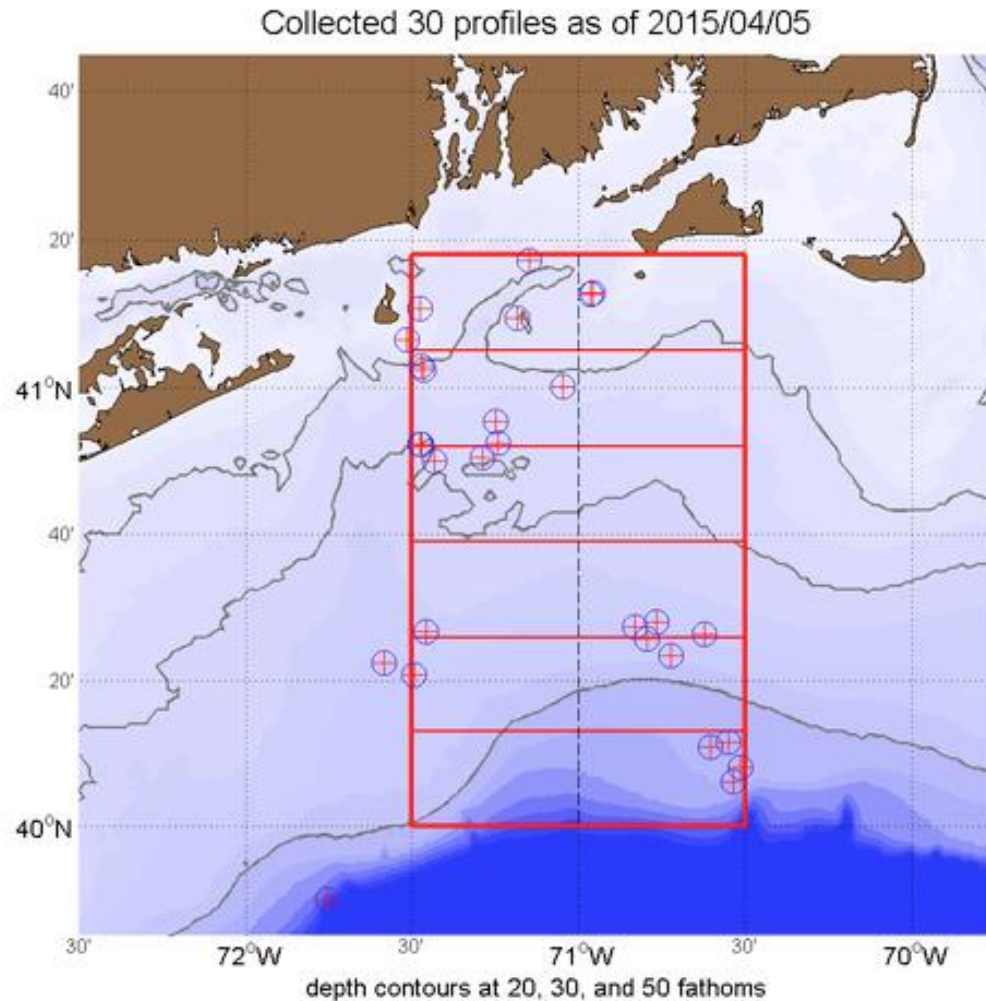
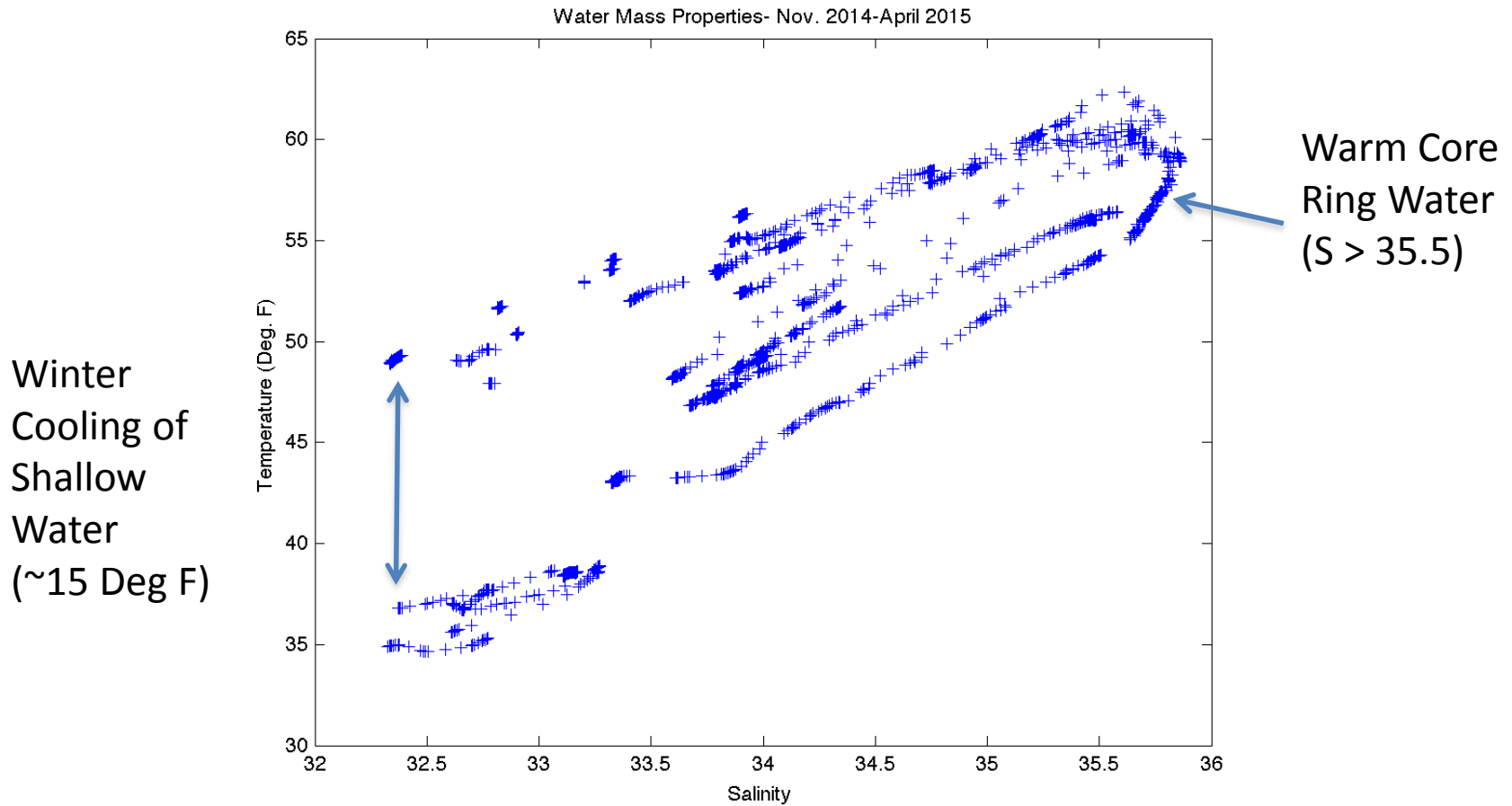
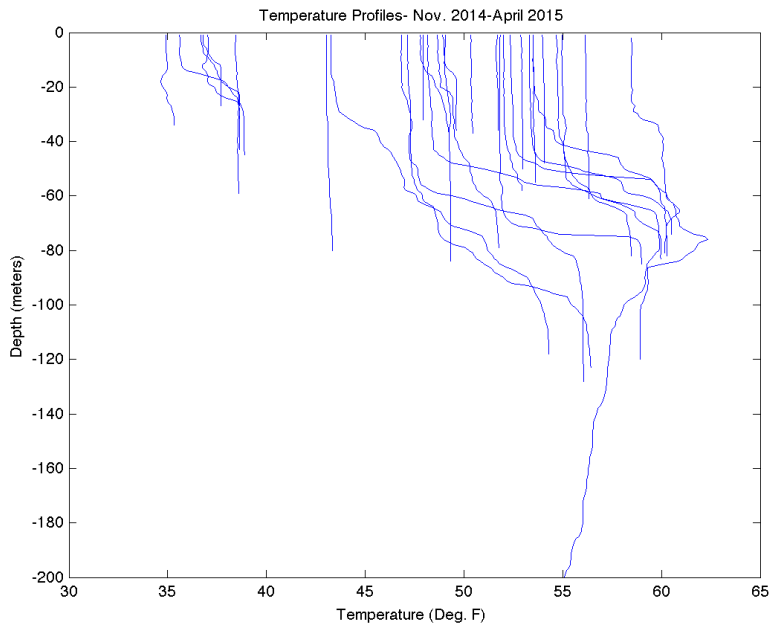


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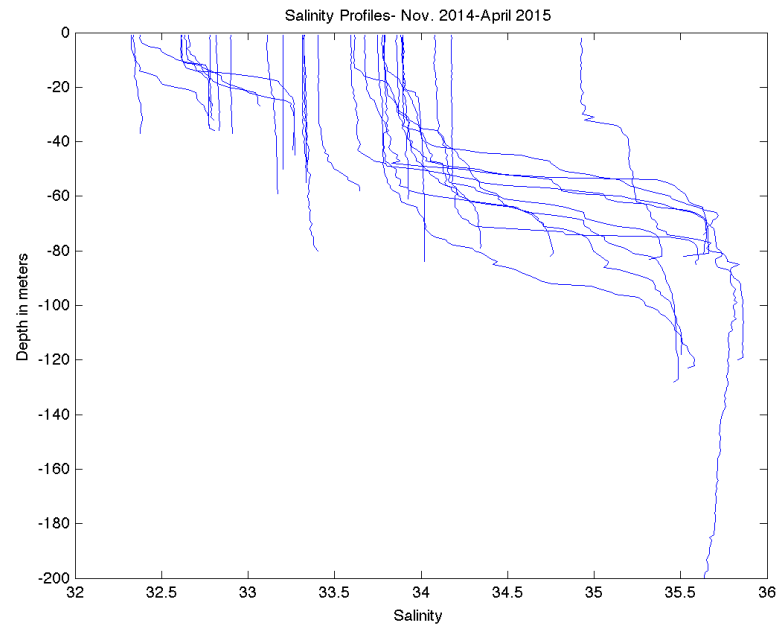
Water Mass Properties



Temperature/Salinity Profiles (All)

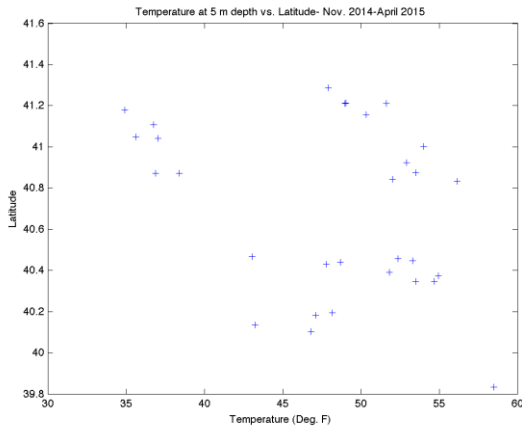


Temperature

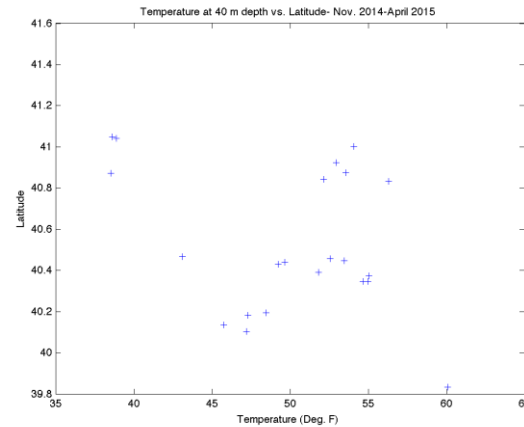


Salinity

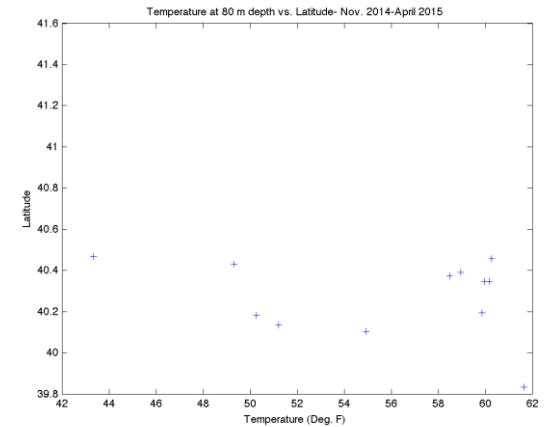
Temperature versus Latitude at z=5 m, 40 m, 80 m



Depth = 5 m (15 ft)

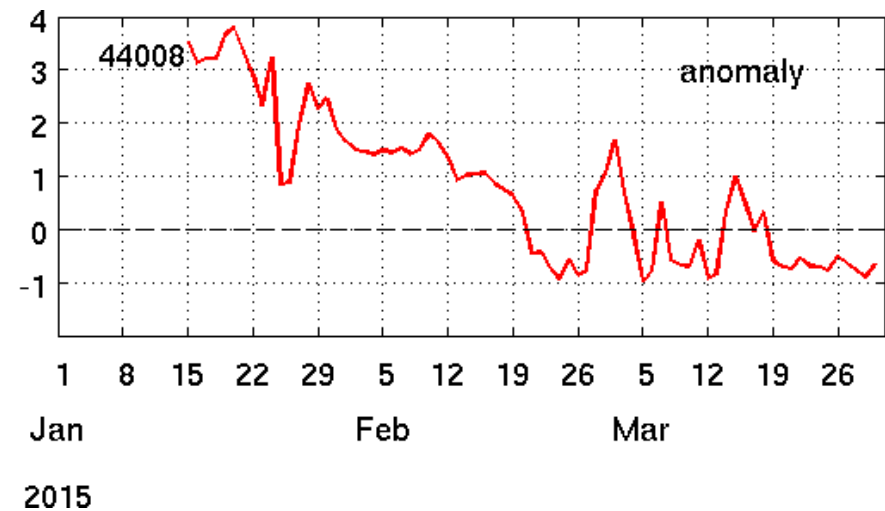
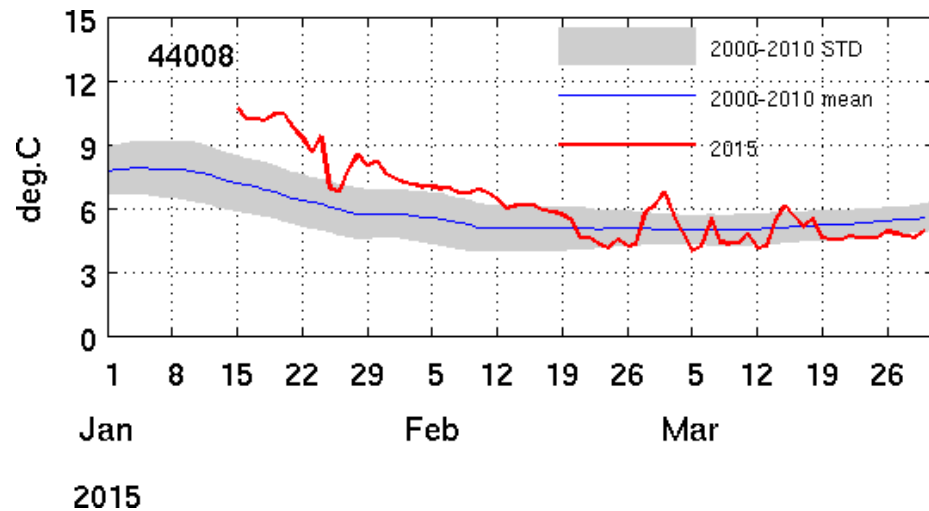


Depth = 40 m (120 ft)



Depth = 80 m (240 ft)

Big Cooling Occurred with Blizzards (Jan. 27 and Feb. 15)



Nantucket Shoals NDBC buoy

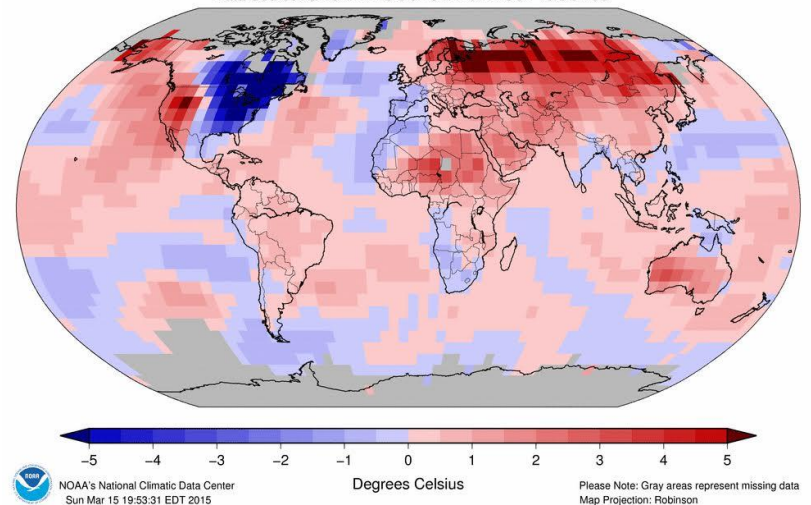
Figure
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What is going on with the atmosphere?

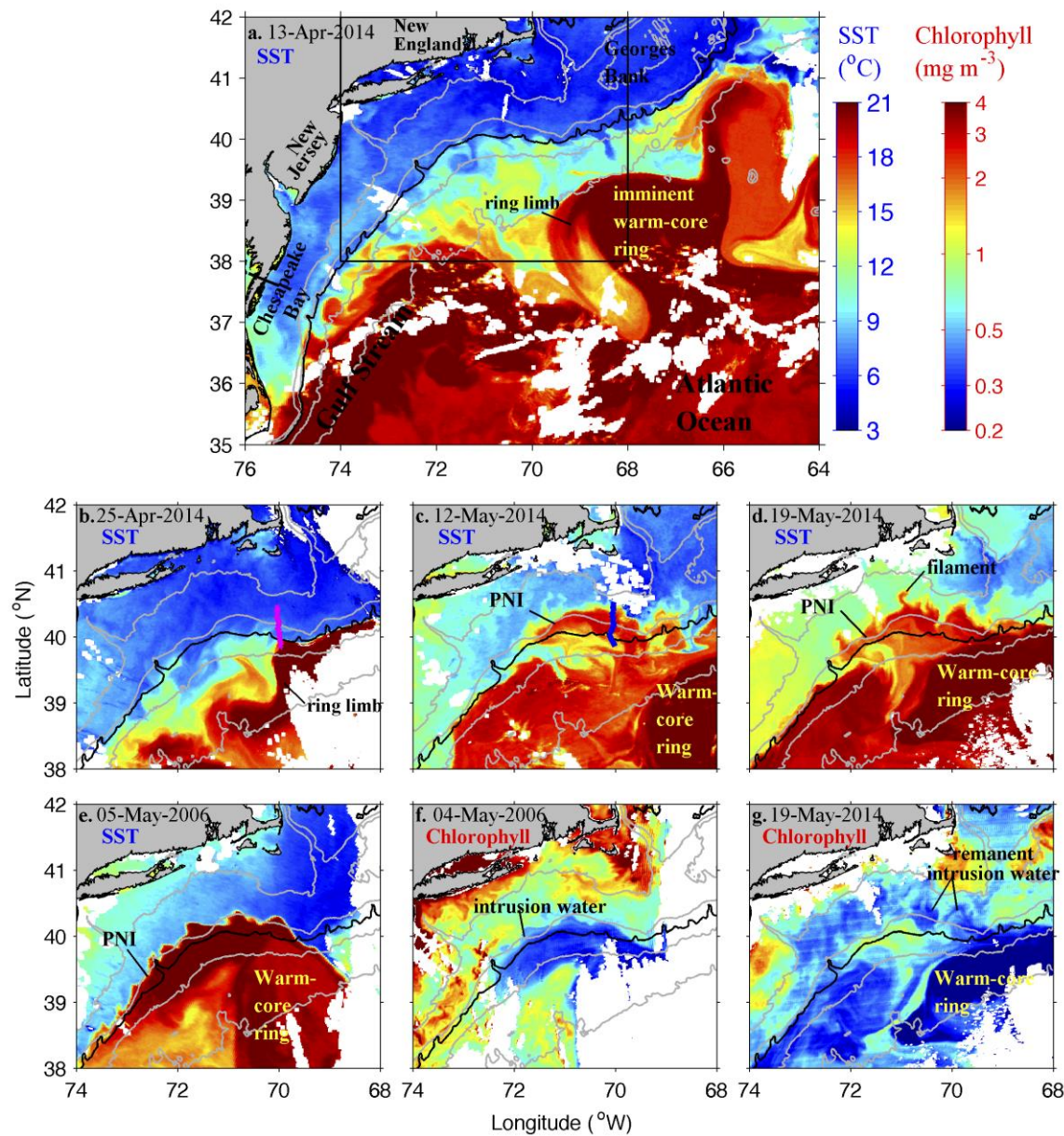


Land & Ocean Temperature Departure from Average Feb 2015
(with respect to a 1981–2010 base period)

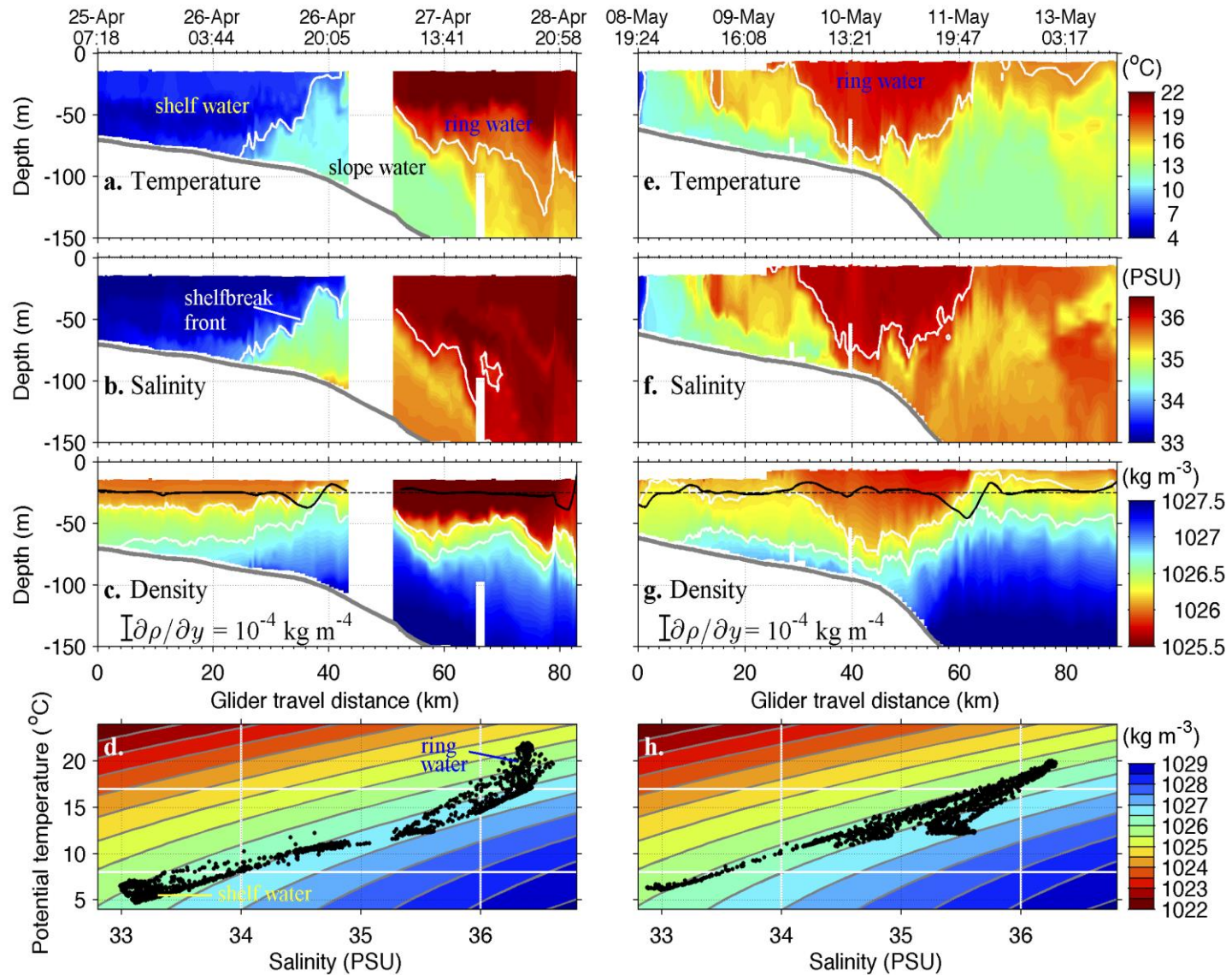
Data Source: GHCN-M version 3.2.2 & ERSST version 3b



Jet Stream trough over eastern half of US from mid-January to March
Opposite pattern from winter 2011-2012 (exceptionally warm winter on East Coast)



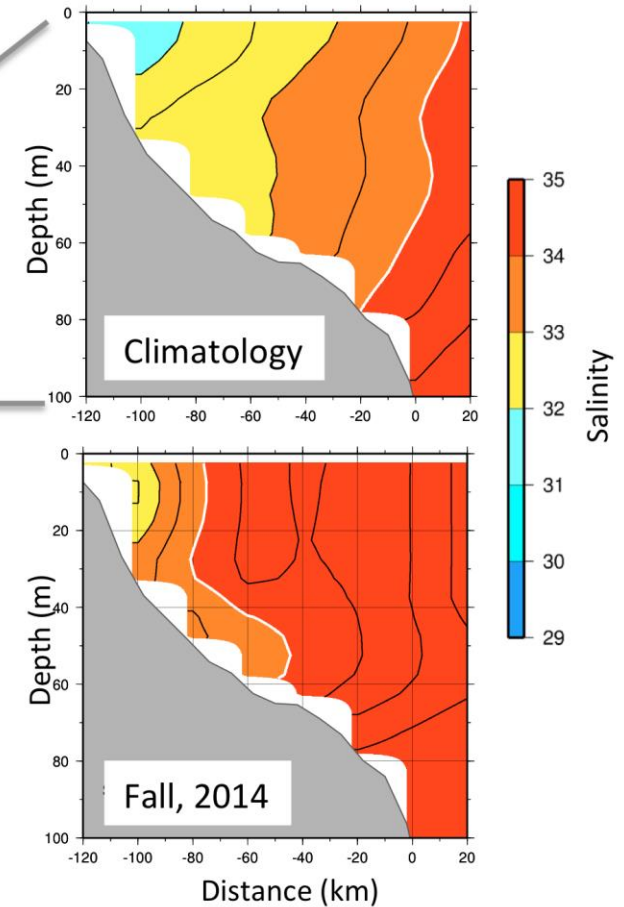
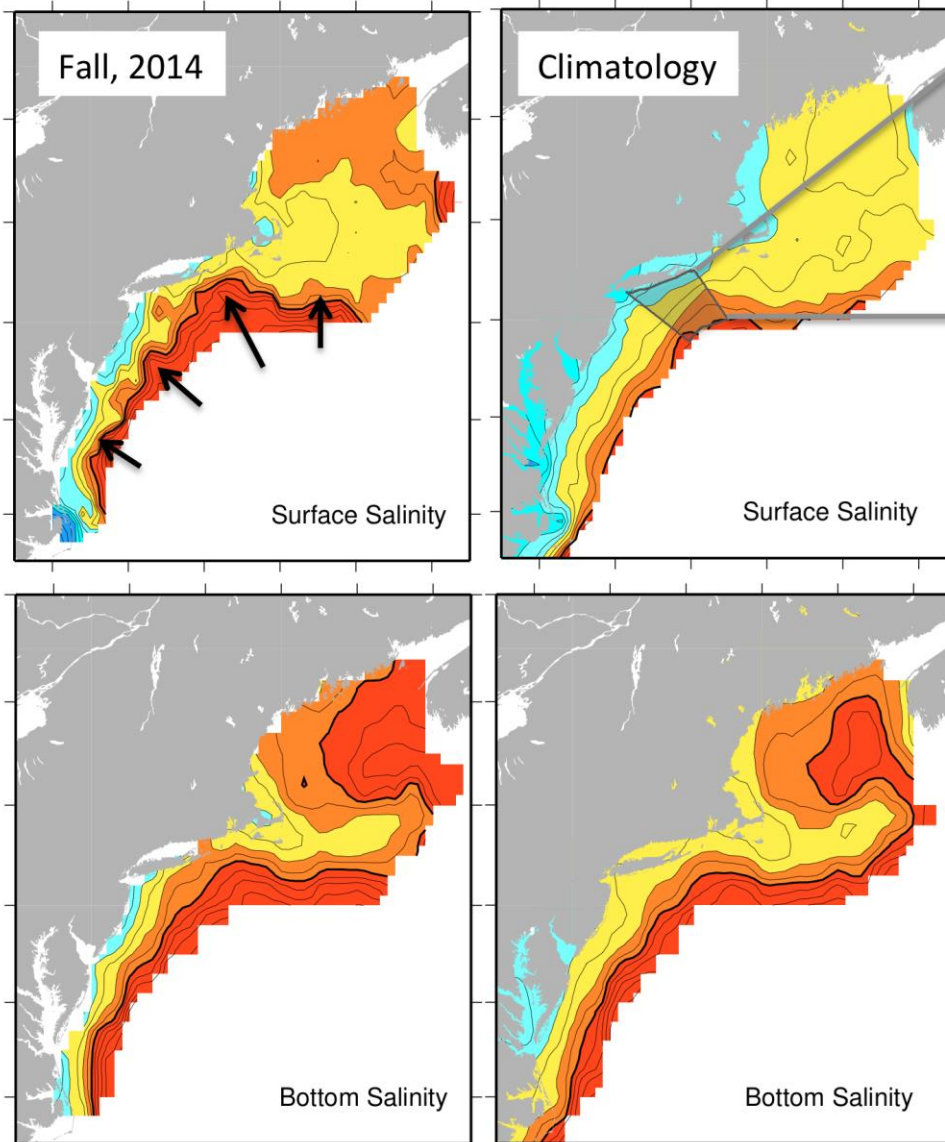
OOI Pioneer Data- April/May 2014 Shelfbreak Entrainment of Ring Water
 Zhang and Gawarkiewicz (2015)



OOI Glider showing the initial limb of ring water (left panels) and the feature trapped along the shelfbreak (right panels)

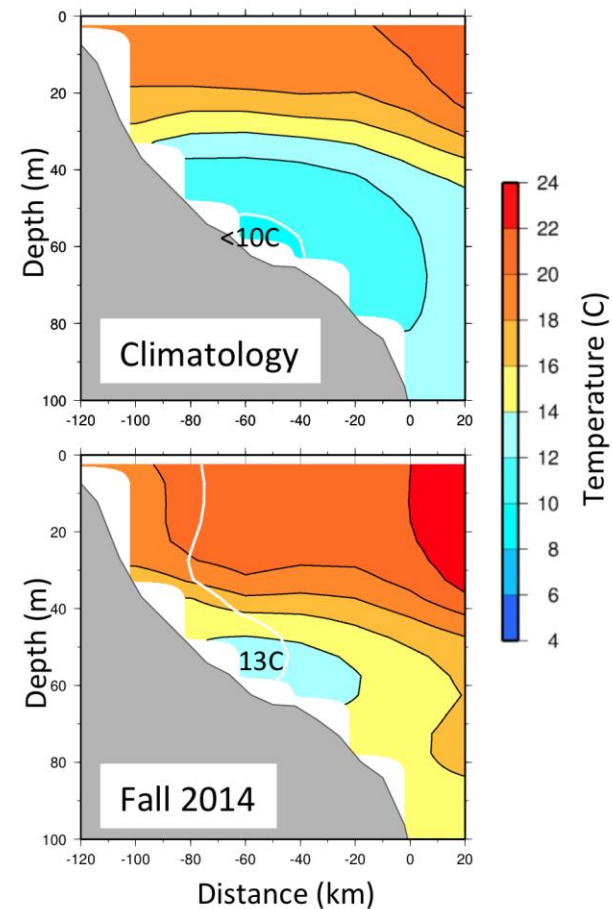
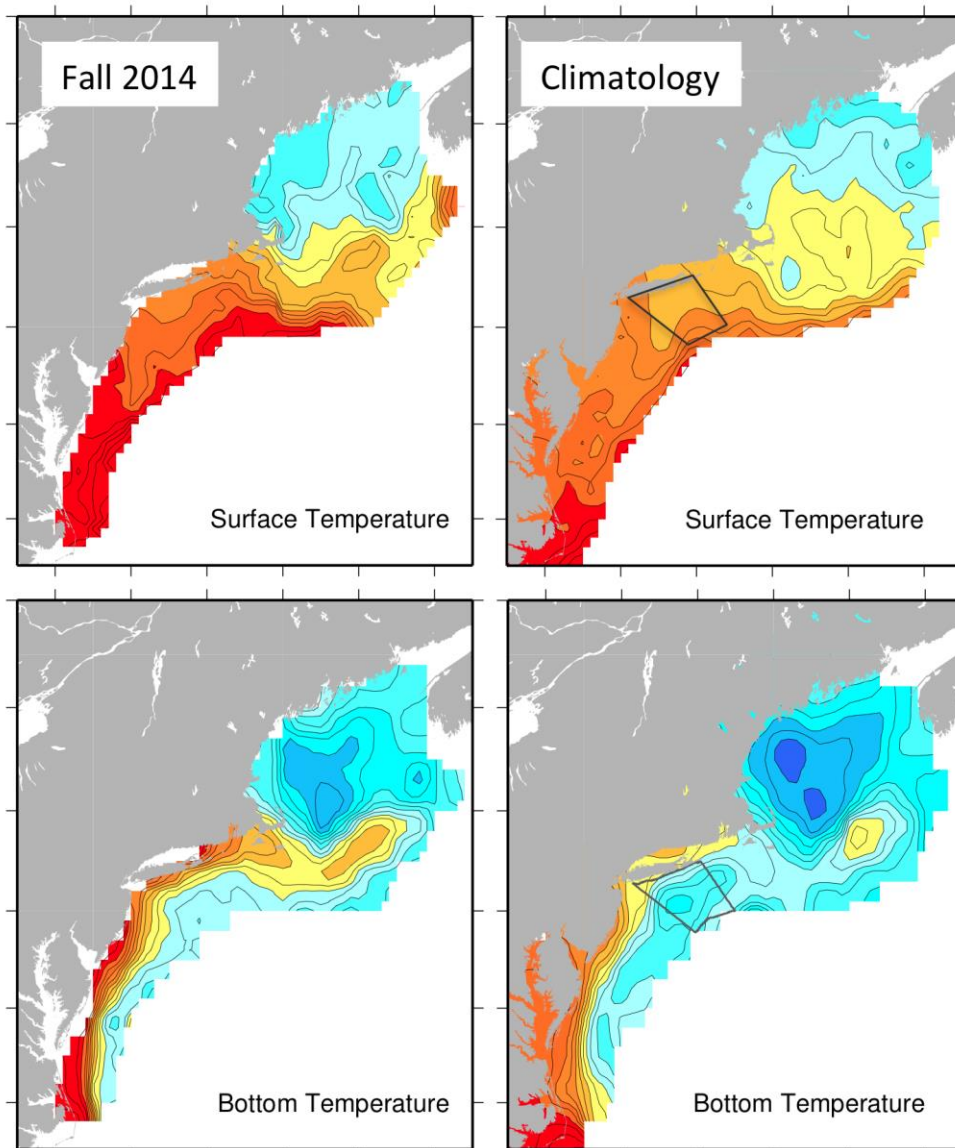
Zhang and Gawarkiewicz (2015)

4. 2014 Conditions – Regional Hydrography



- A significant slope water intrusion occurred in Fall 2014
- cross-shelf salinity gradients stronger in 2014

4. 2014 Conditions – Regional Hydrography



2014 characterized by warm thick upper layer and warmer/smaller cold pool