RUTGERS

Coastal Ocean Observation Lab

Cape Cod

New Jersey

Cape Hatteras

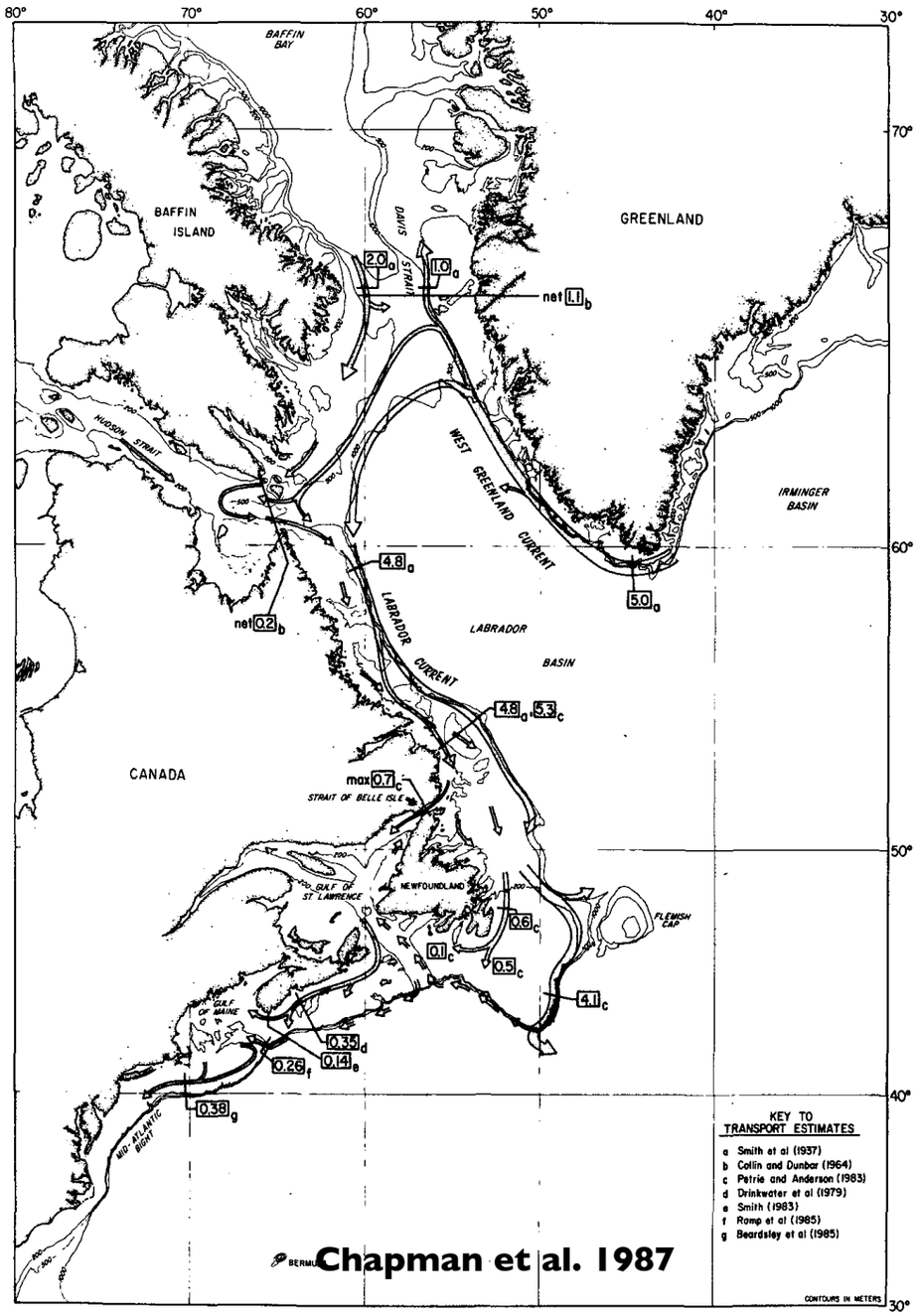
Seasonal Transport on the Mid-Atlantic Bight

Donglai Gong
Josh Kohut, John Wilkin & Scott Glenn

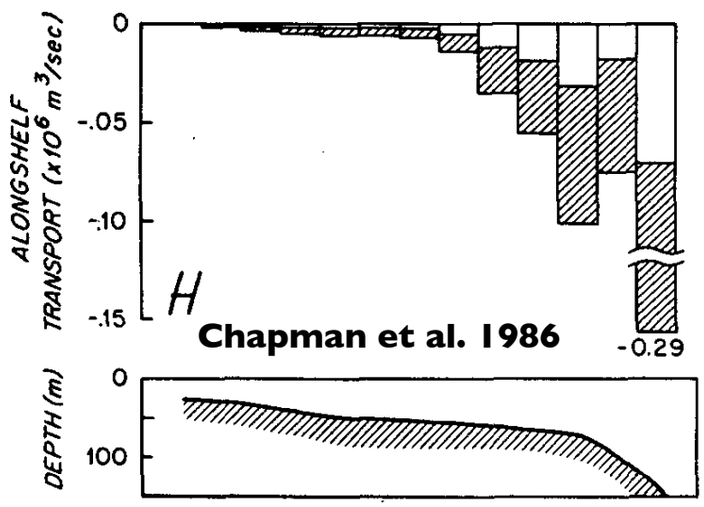
Ocean Sciences 2010
2010-01-27

Aim of this talk:

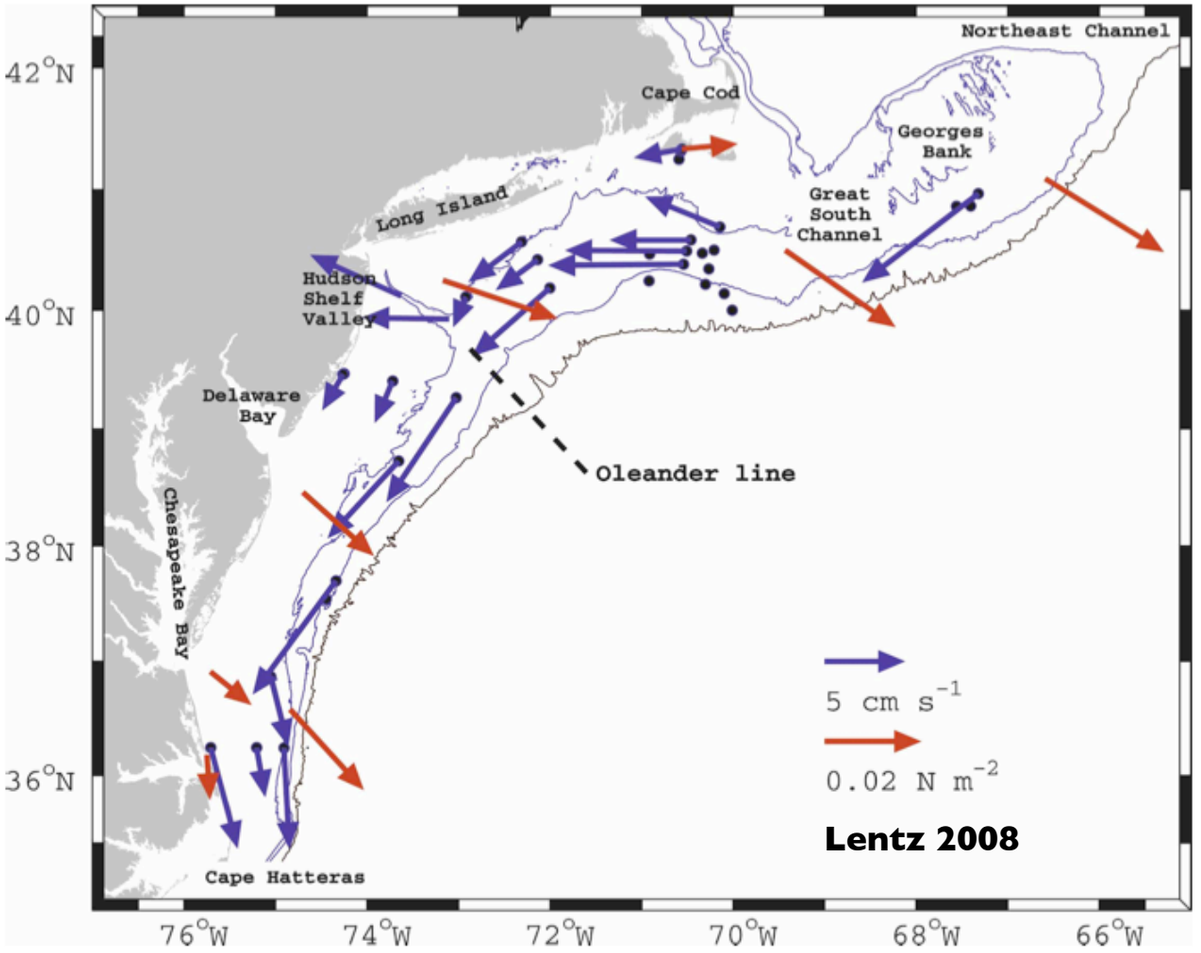
- Recent observational results: NJ shelf wind-driven seasonal surface circulation
- Formulating questions for modeling study based on observations
    - Effect of topography, stratification & winds on the whole water column transport?
- Seasonal behavior of along-shore and cross-shore transport on the shelf
- Discovery of a persistent transport pathway downstream of the Hudson Shelf Valley



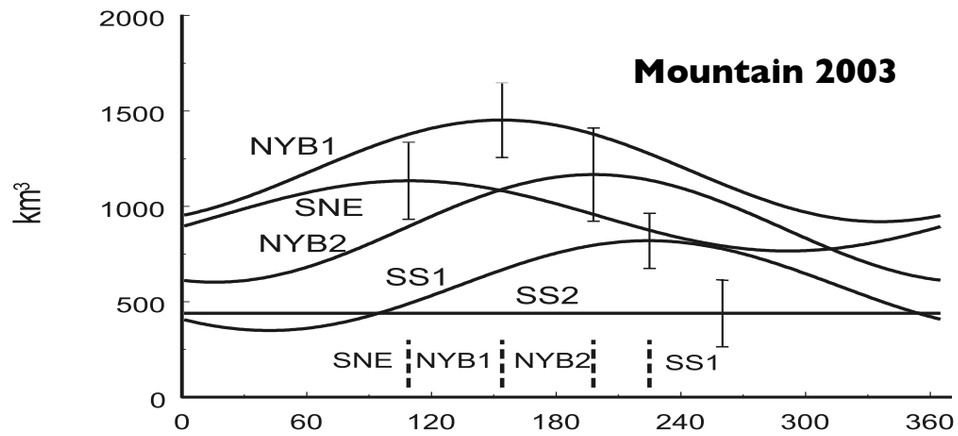
Chapman et al. 1987

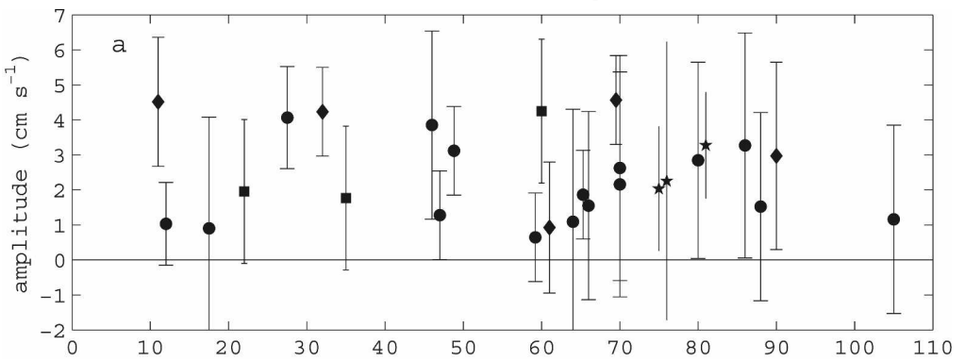


Chapman et al. 1986



Lentz 2008





Lentz 2008

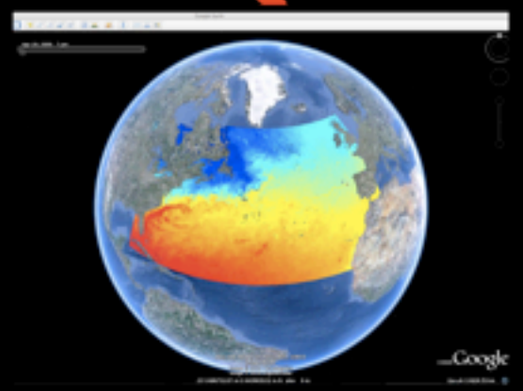
RUTGERS
School of Environmental and Biological Sciences

Institute of Marine and Coastal Sciences
Coastal Ocean Observation Lab

Rutgers University - Coastal Ocean Observation Lab
Operations, Data Fusion & Training Center

CODAR Network

L-Band & X-Band Satellite Receivers

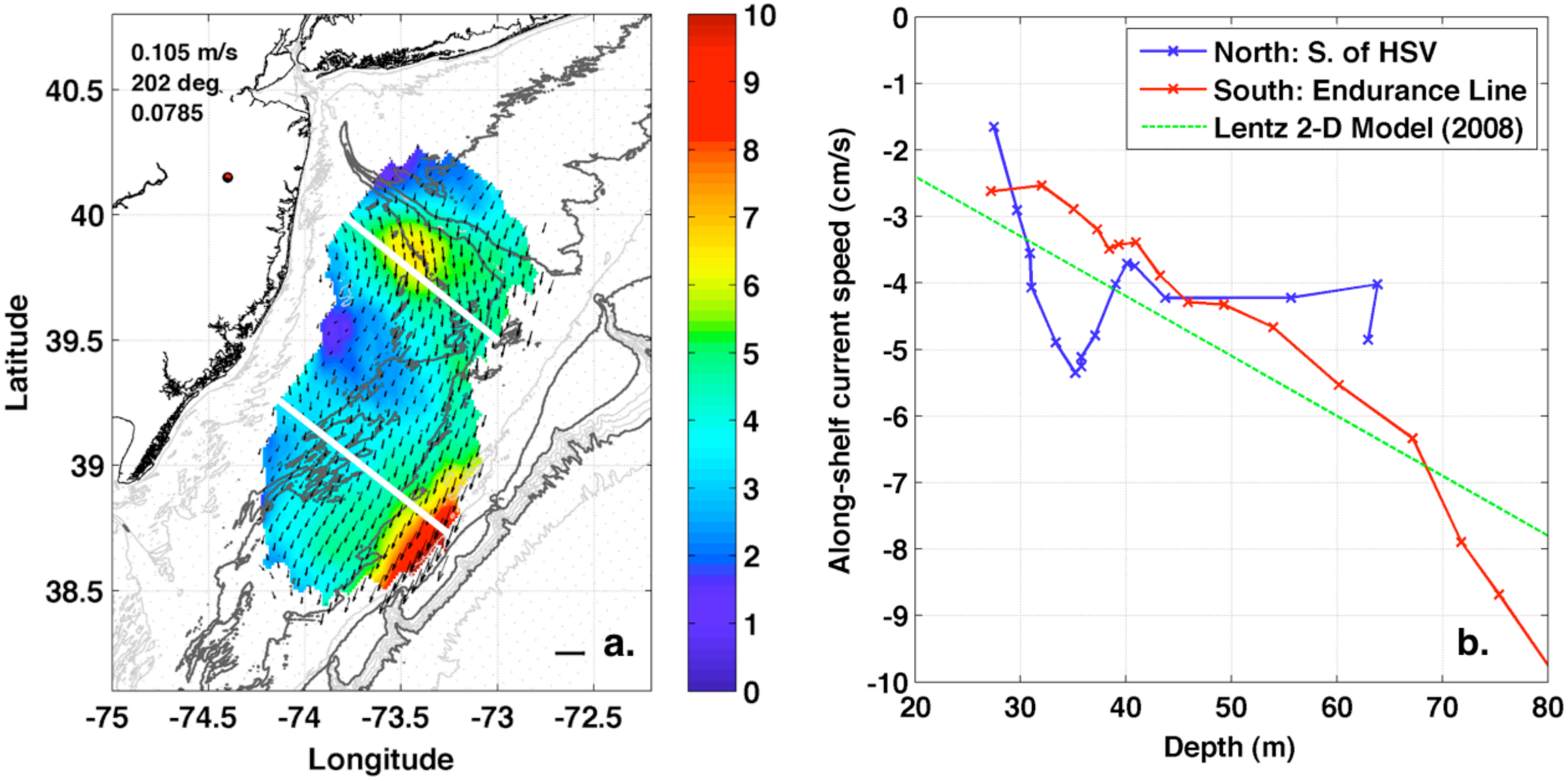


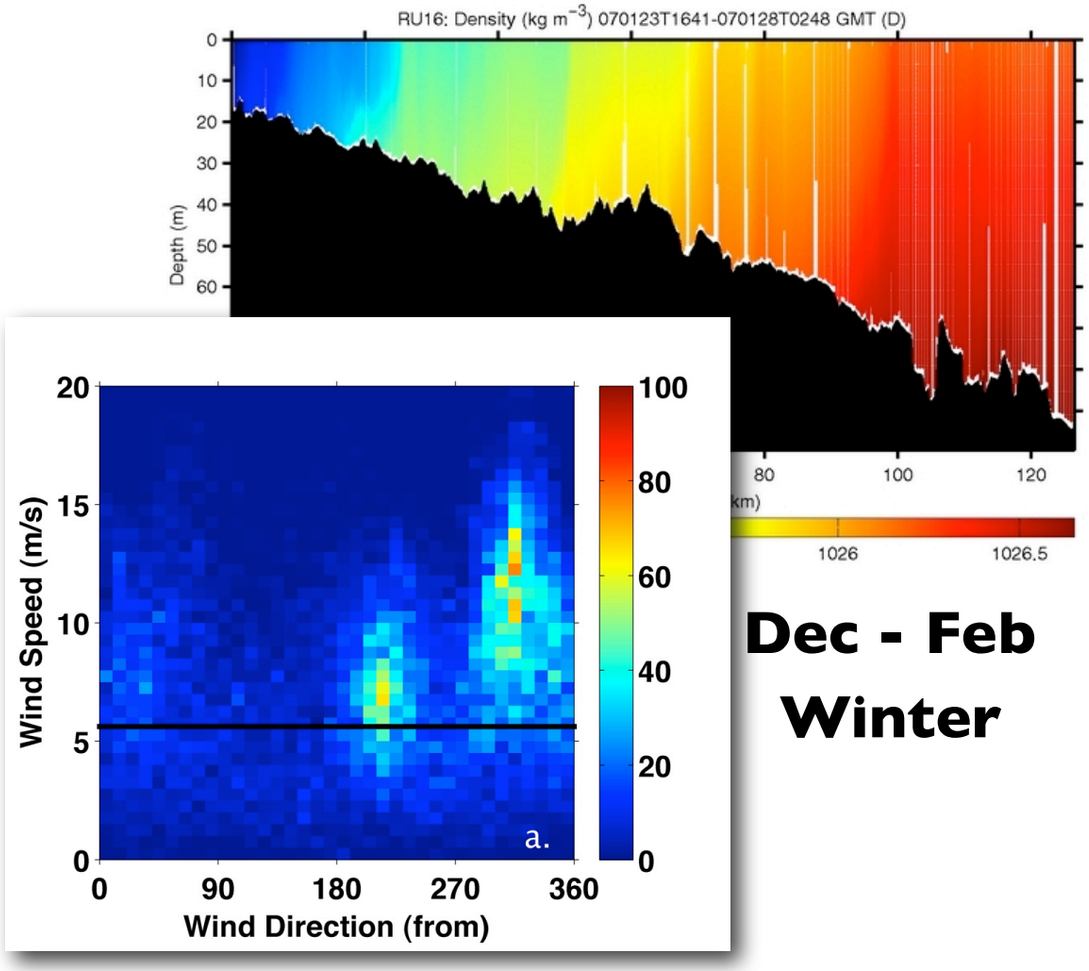
3-D Nowcasts & Forecasts

Glider Fleet

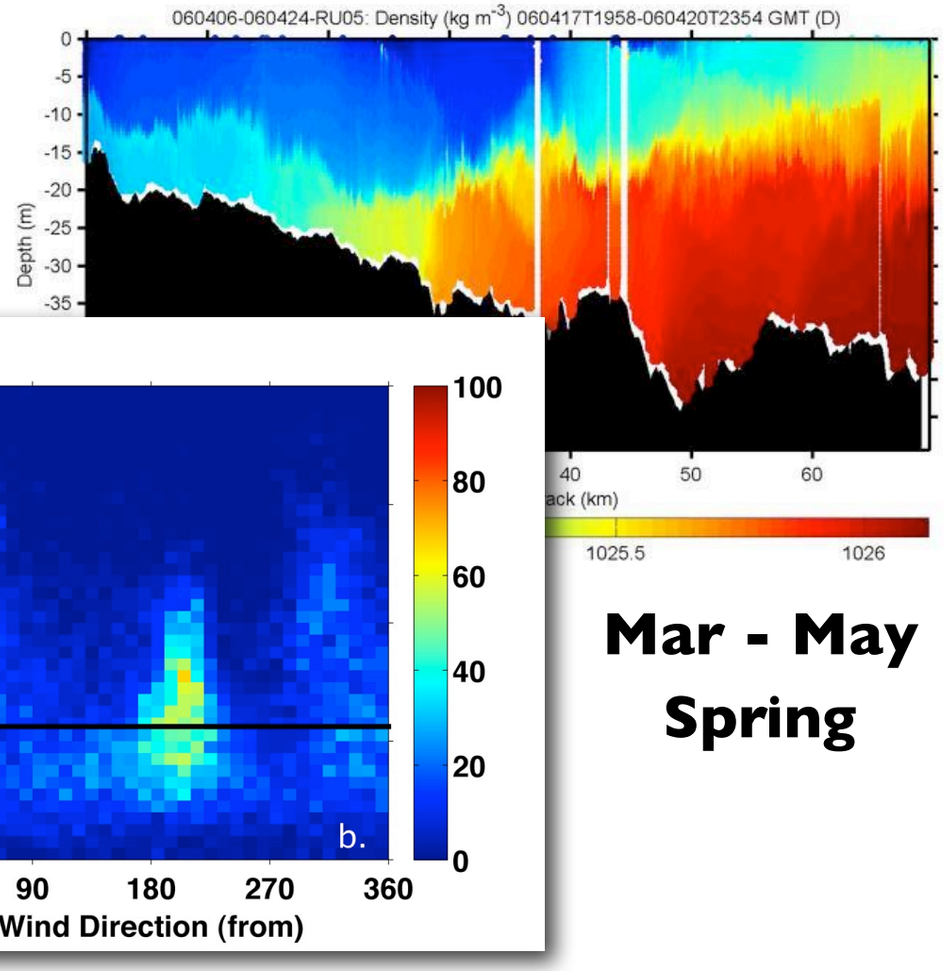
DEPARTMENT OF THE NAVY ONR Science & Technology · NSF · NOAA · U.S. DEPARTMENT OF HOMELAND SECURITY · DEPARTMENT OF DEFENSE · NASA · IOOS INTEGRATED OCEAN OBSERVING SYSTEM · NOPP · BPU · PSE&G · OPT OCEAN POWER TECHNOLOGIES · The G. Unger Vetlesen Foundation · GORDON AND BETTY MOORE FOUNDATION

Background no-wind flow

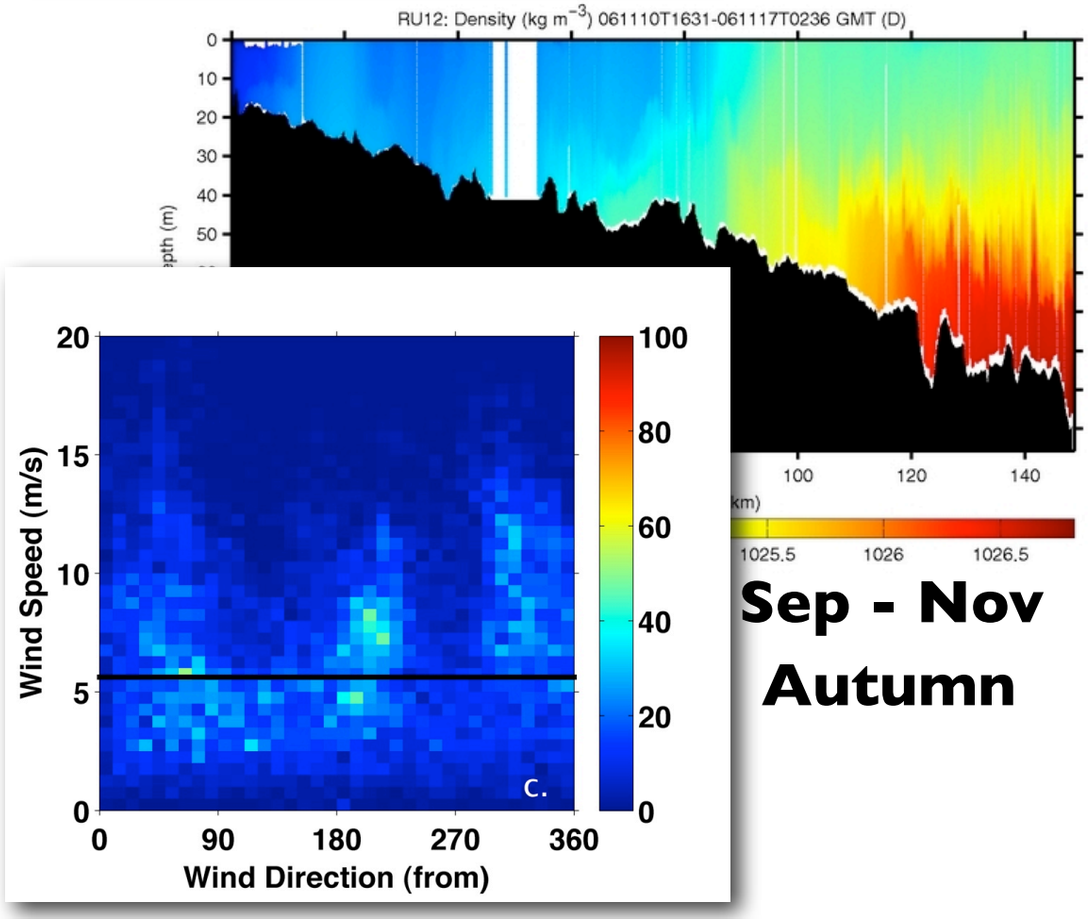




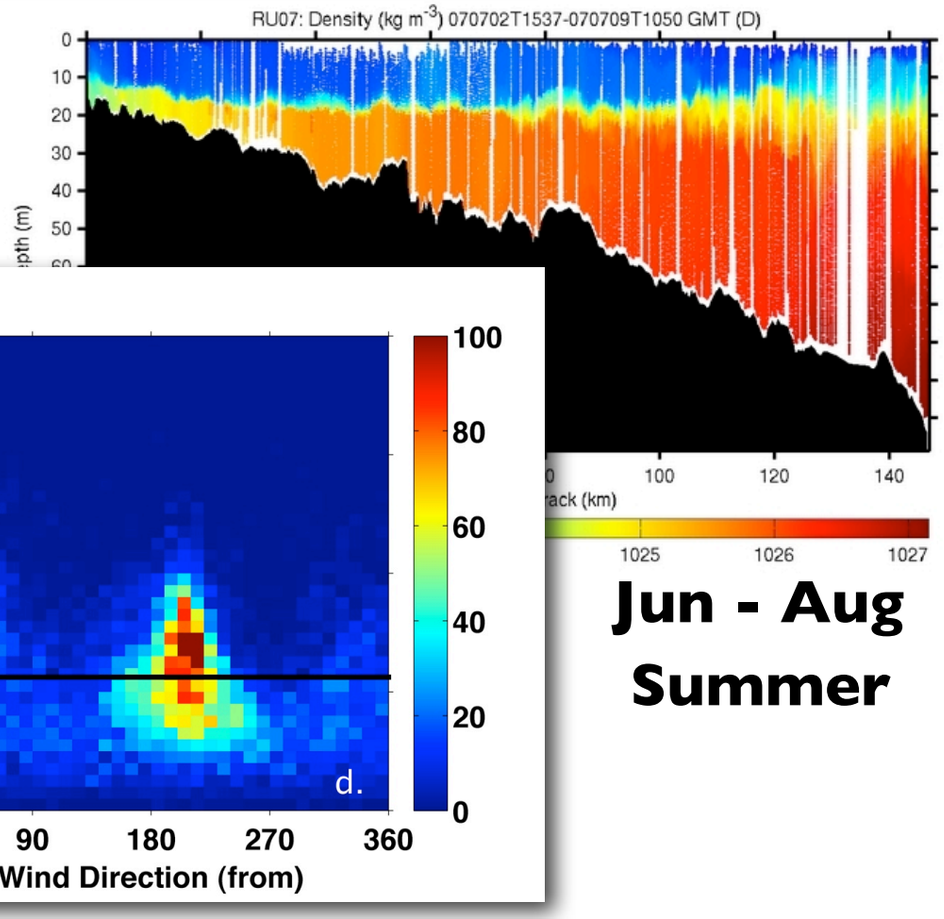
Dec - Feb
Winter



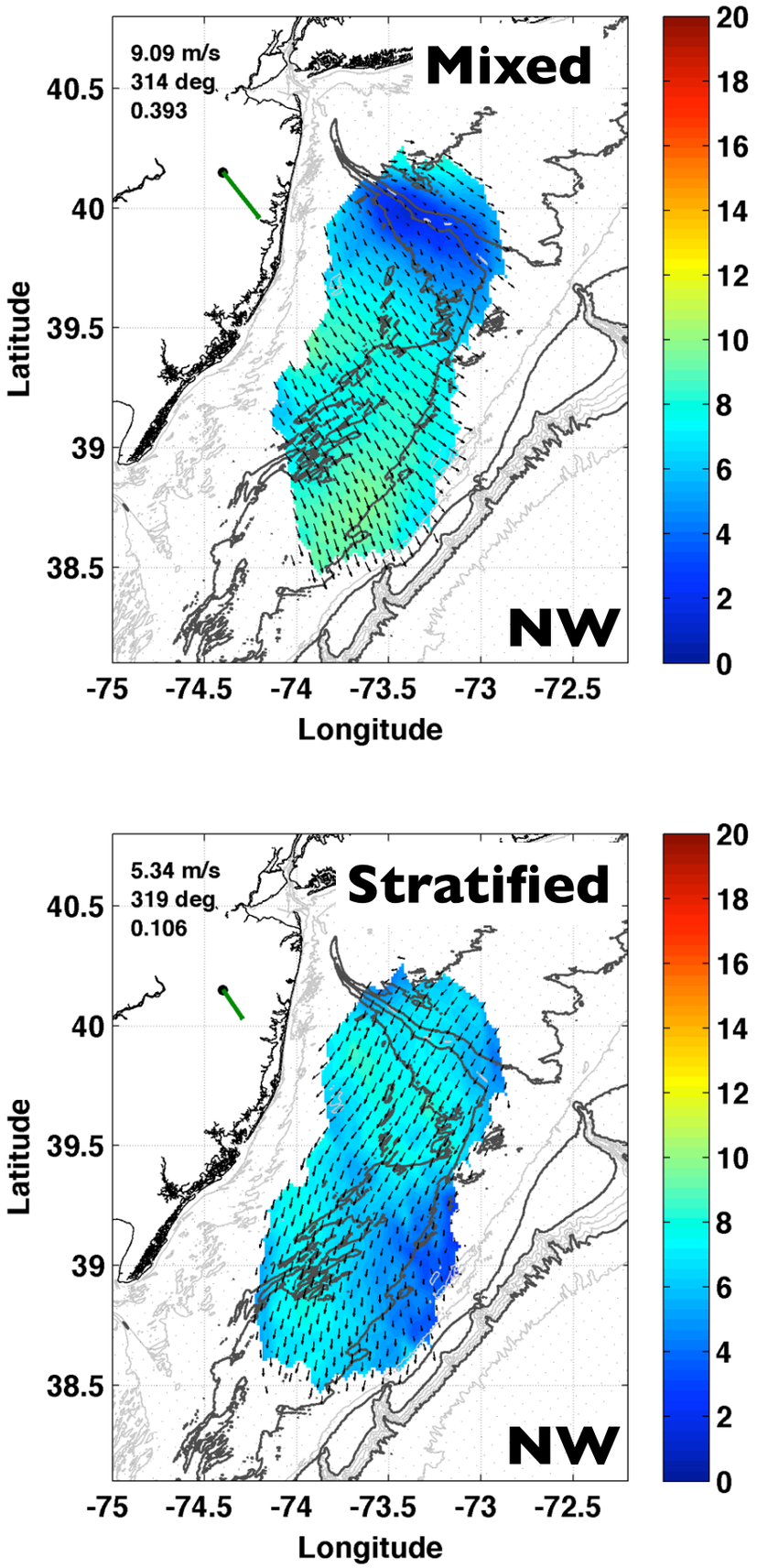
Mar - May
Spring

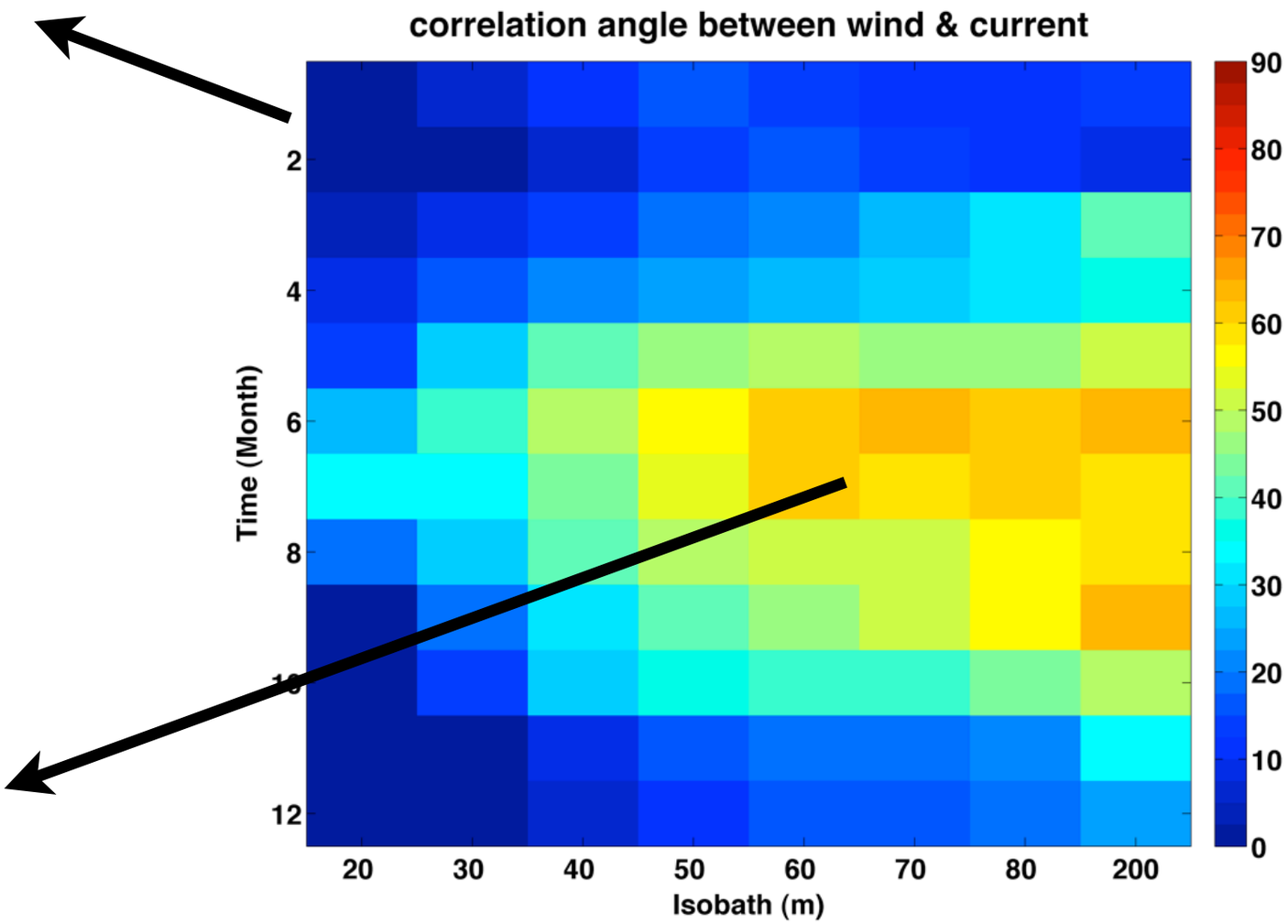


Sep - Nov
Autumn



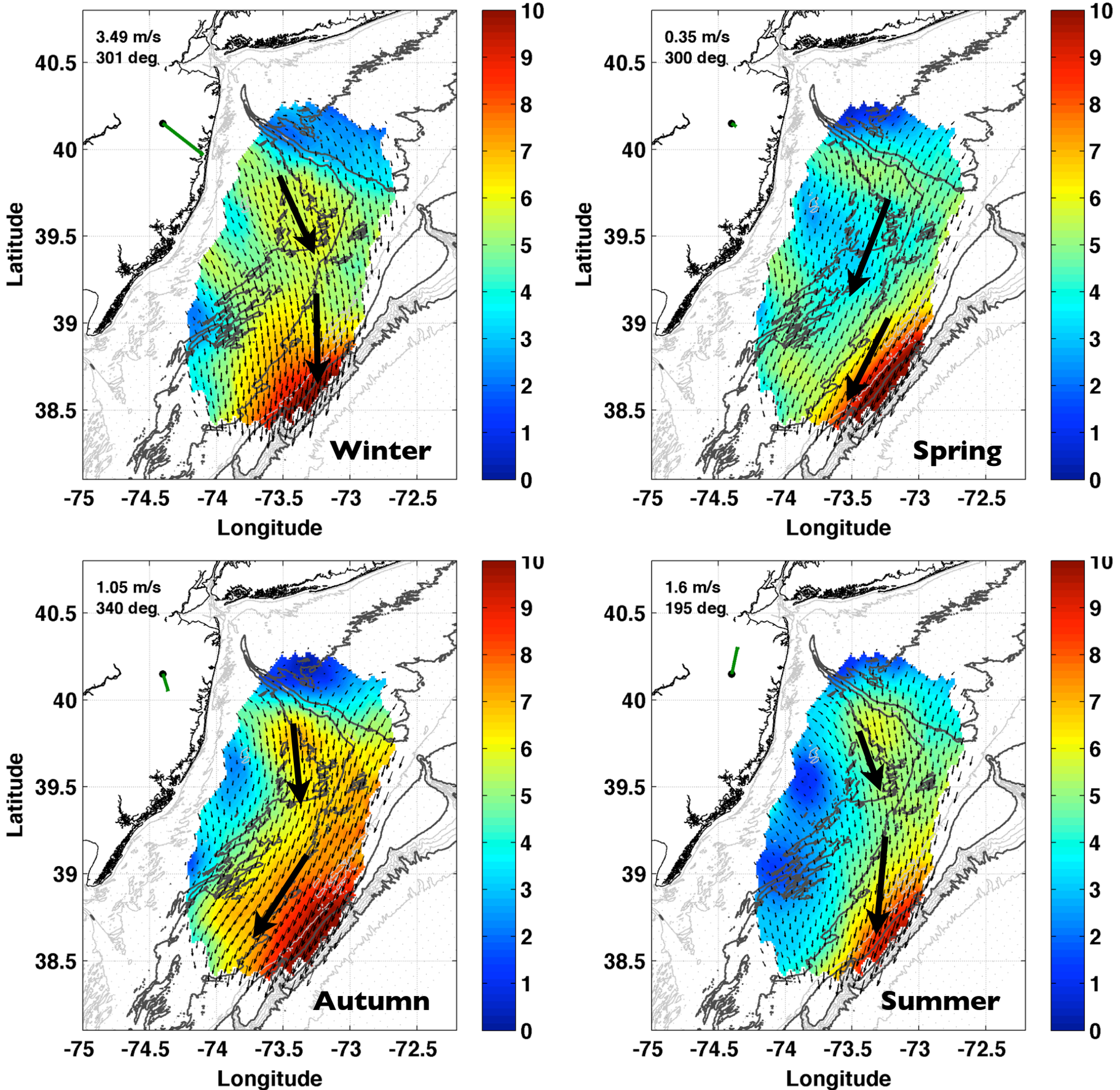
Jun - Aug
Summer

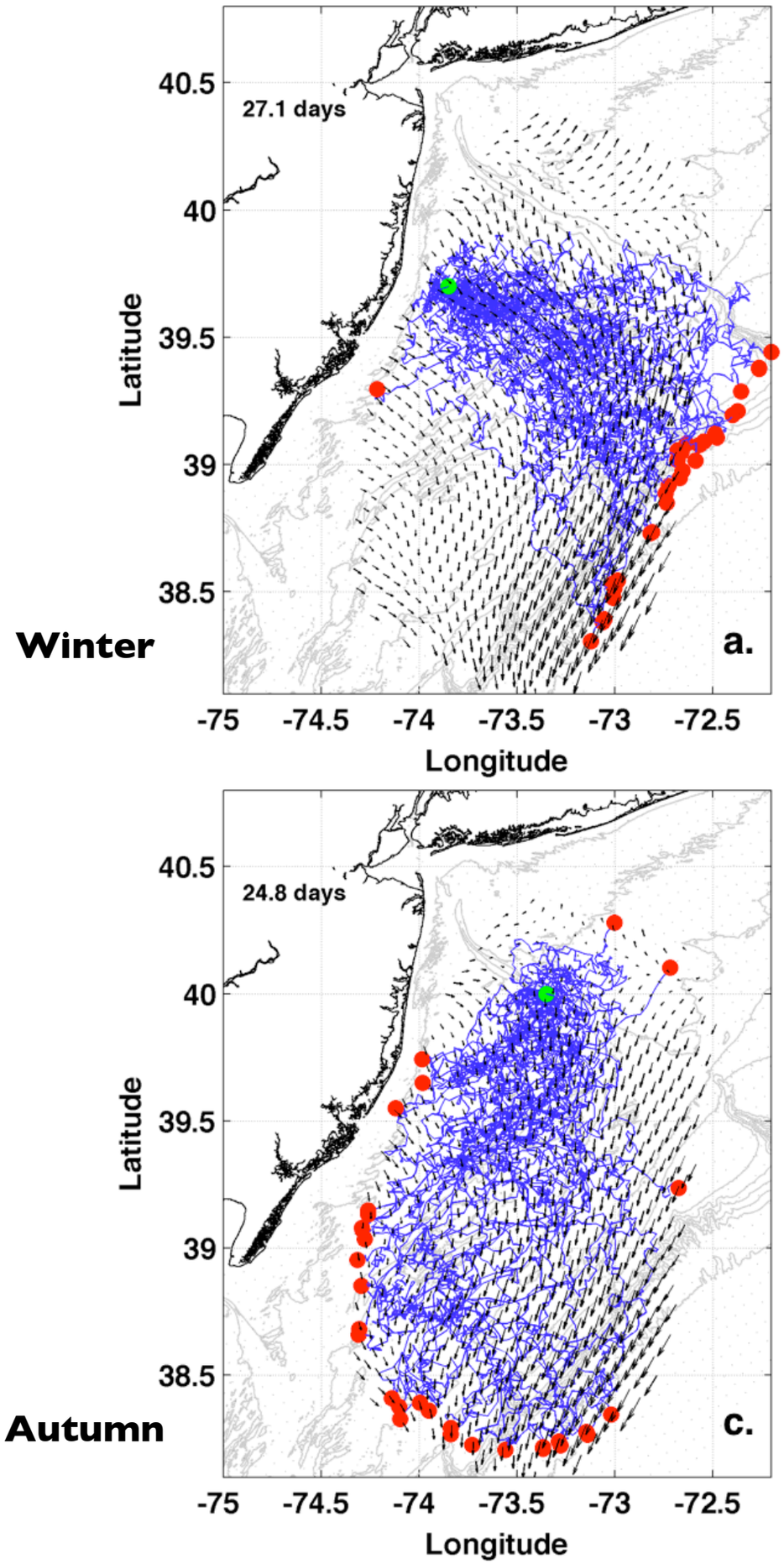

9.09 m/s
314 deg
0.393
Mixed
NW
5.34 m/s
319 deg
0.106
Stratified
NW
Latitude
Longitude
40.5
40
39.5
39
38.5
-75
-74.5
-74
-73.5
-73
-72.5
20
18
16
14
12
10
8
6
4
2
0


correlation angle between wind & current
Time (Month)
Isobath (m)
2
4
6
8
12
20
30
40
50
60
70
80
200
90
80
70
60
50
40
30
20
10
0

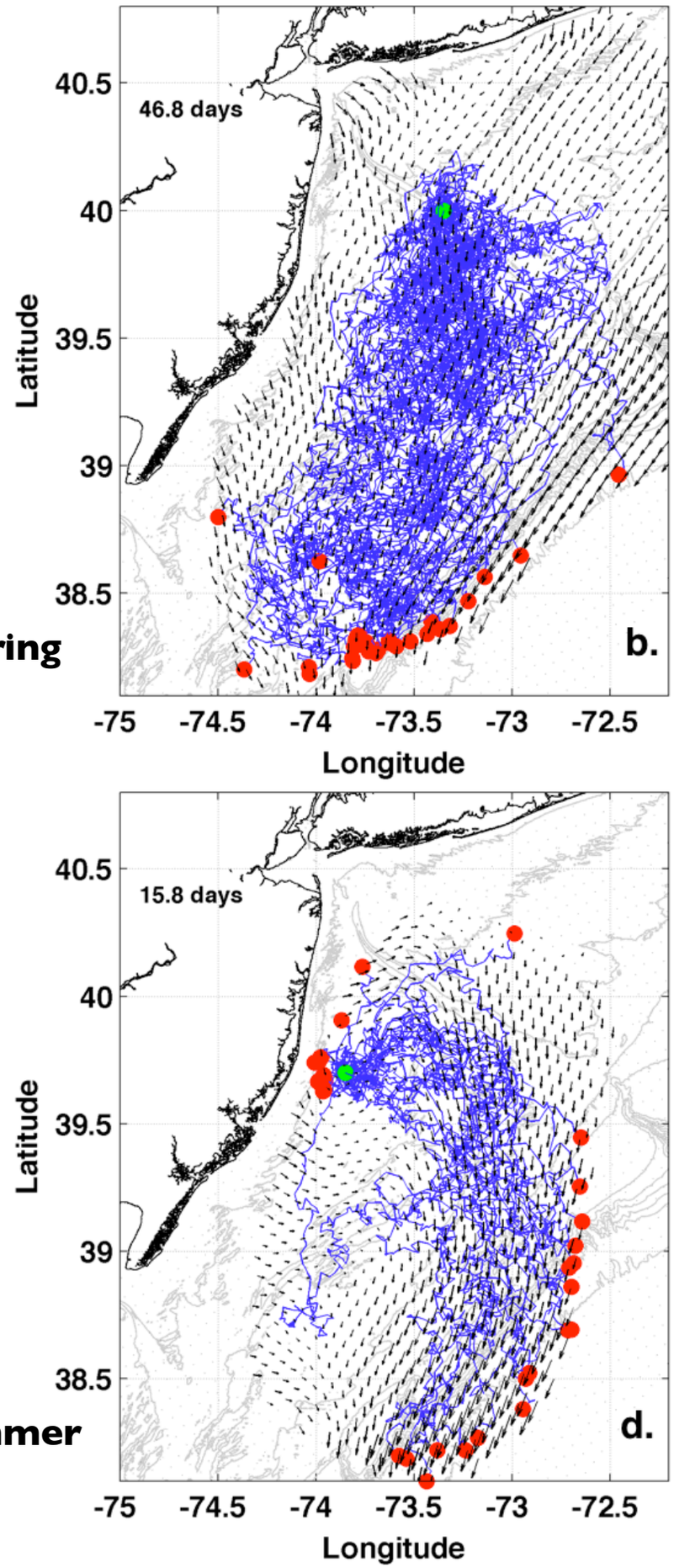
NJ Shelf Seasonal Currents (2002 - 2007)

CODAR





Winter



Spring

Autumn

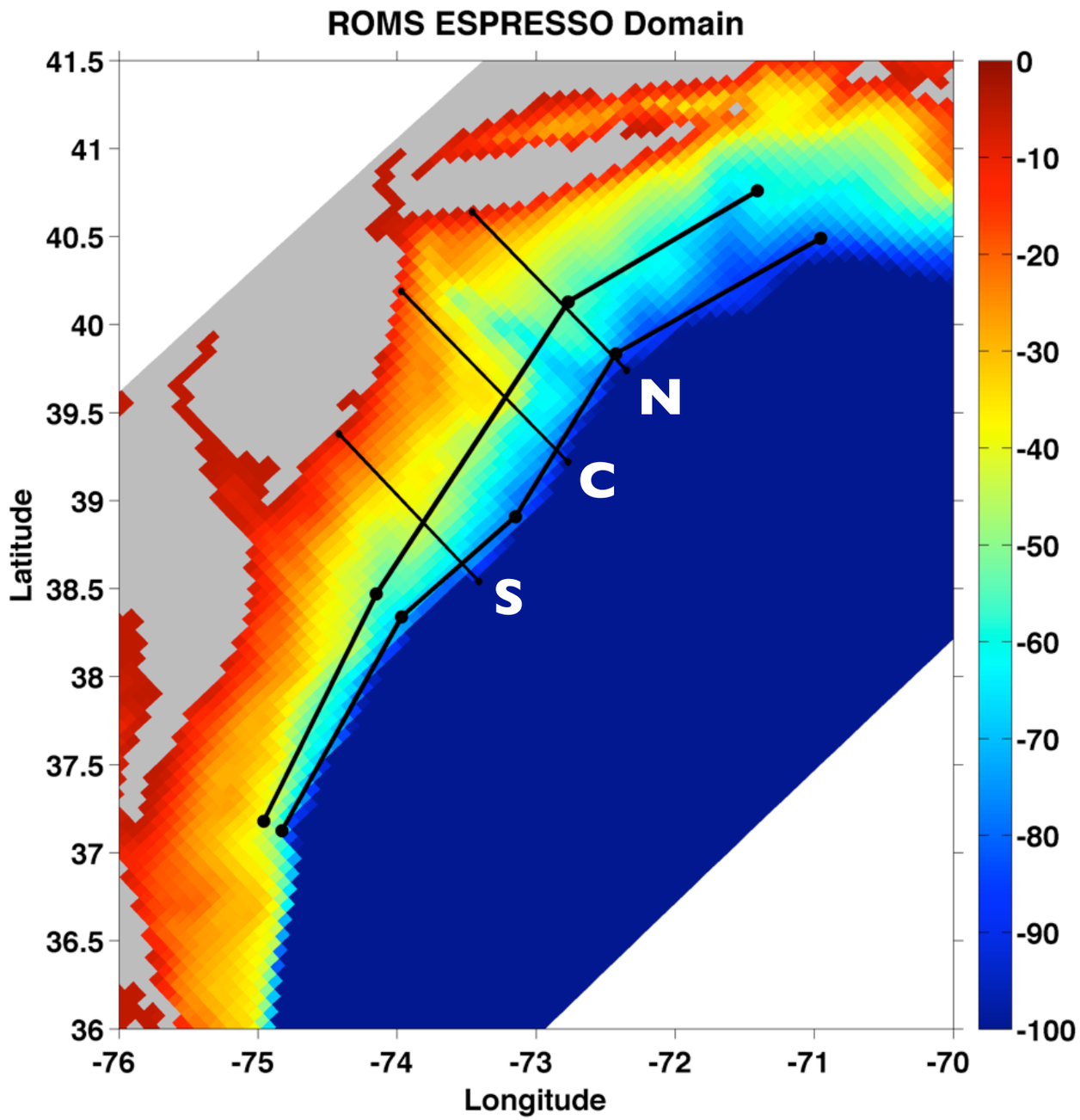
Summer

Observation: seasonal flow patterns

- Flow on the shelf is affected by the presence of a cross-shelf valley, region to the south amplified
- Shelf flow has a strong seasonal pattern driven by seasonal stratification and wind pattern.
- Flow mainly cross-shelf (offshore) during stratified and mixed seasons, and mainly along-shelf (downshelf) during transition seasons. the residence time is on the order of 1-5 weeks.

Modeling: Cross & along-shelf transport

- How does the model do compare to data?
  - Mean flow
  - Seasonal flow
  - Hydrography
- *Quantifying flow in the whole water column and transport of key tracers*
- *Along & cross-shelf variability of the transport, role of the HSV?*

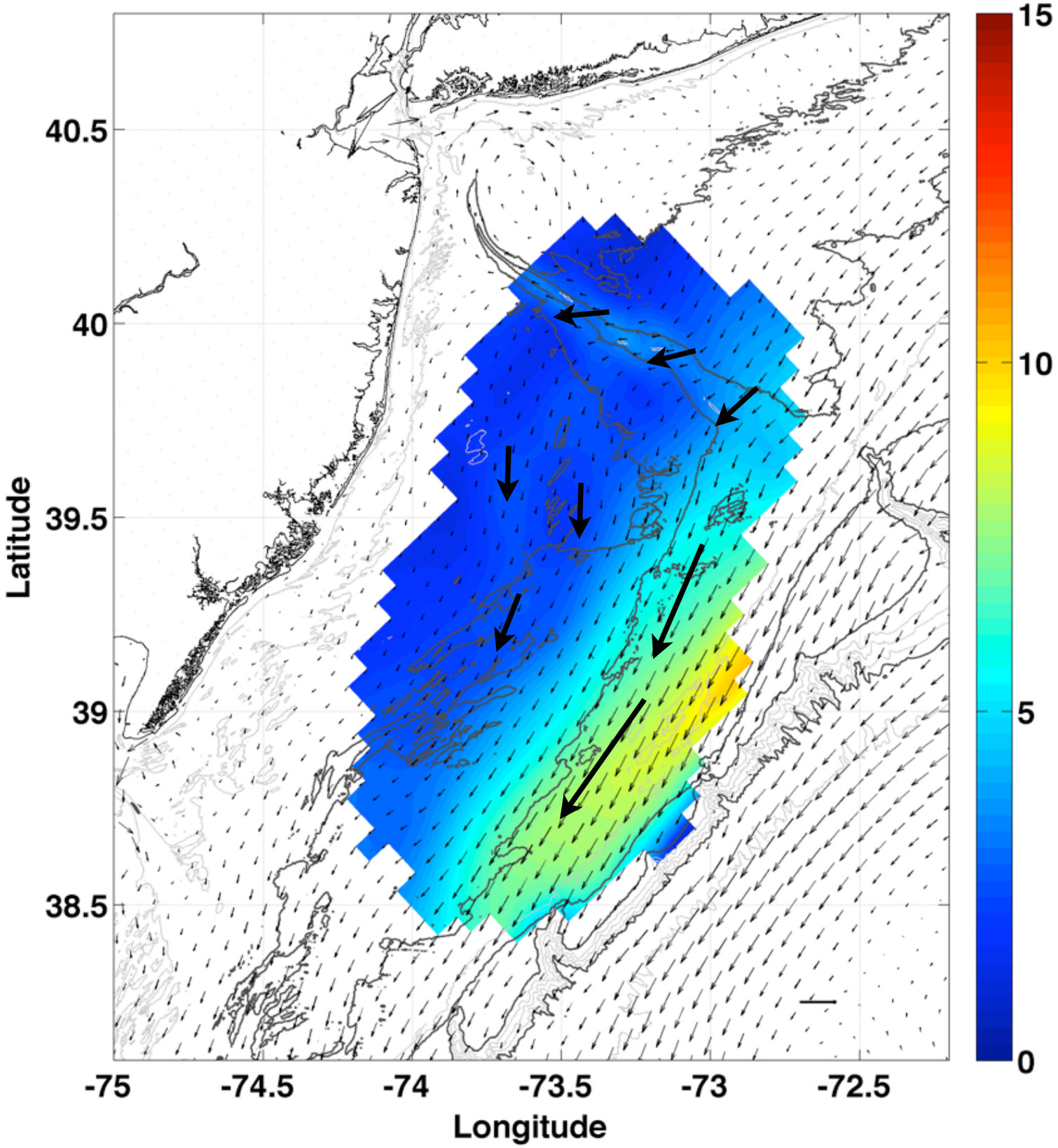


ROMS
5.5 km grid
36 levels

Forward
Model Only

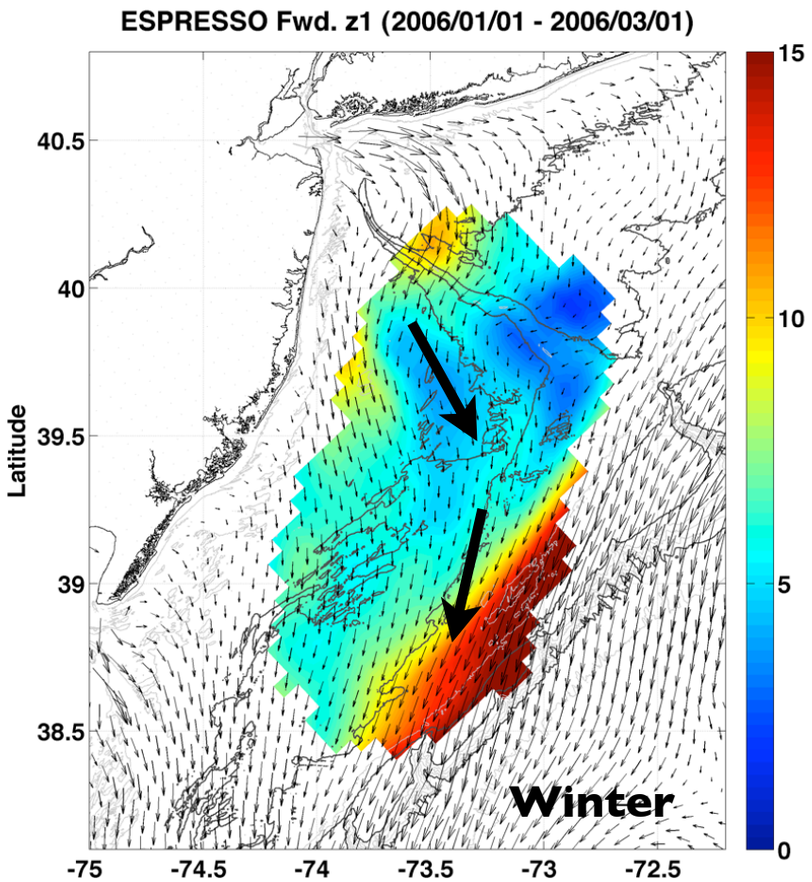
Realistic
Met. Forcing

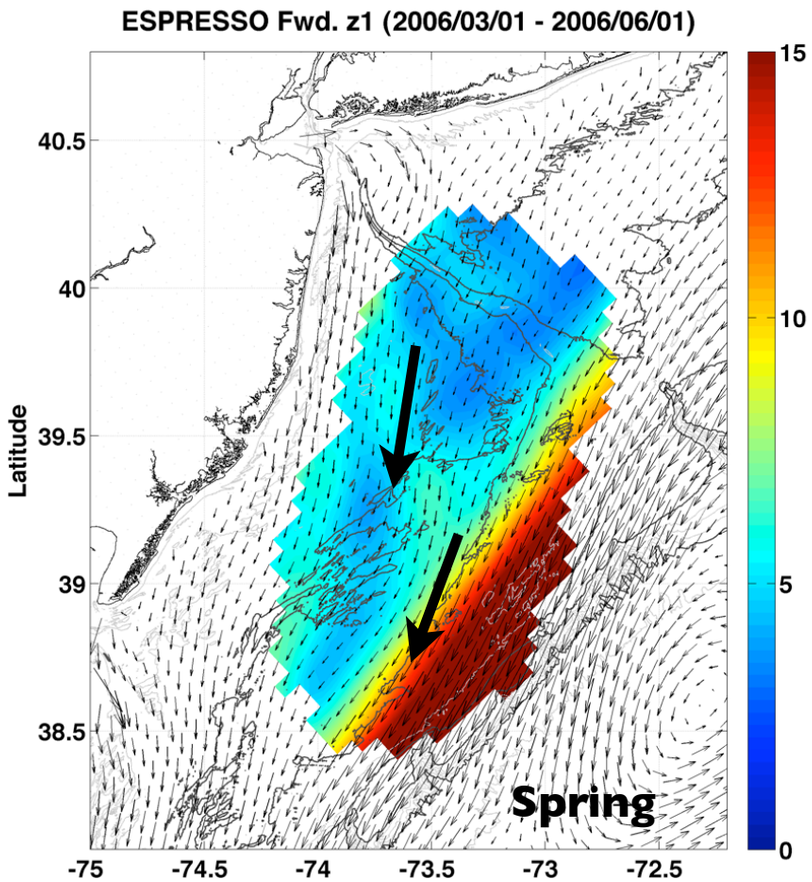
Boundary:
MABGoM

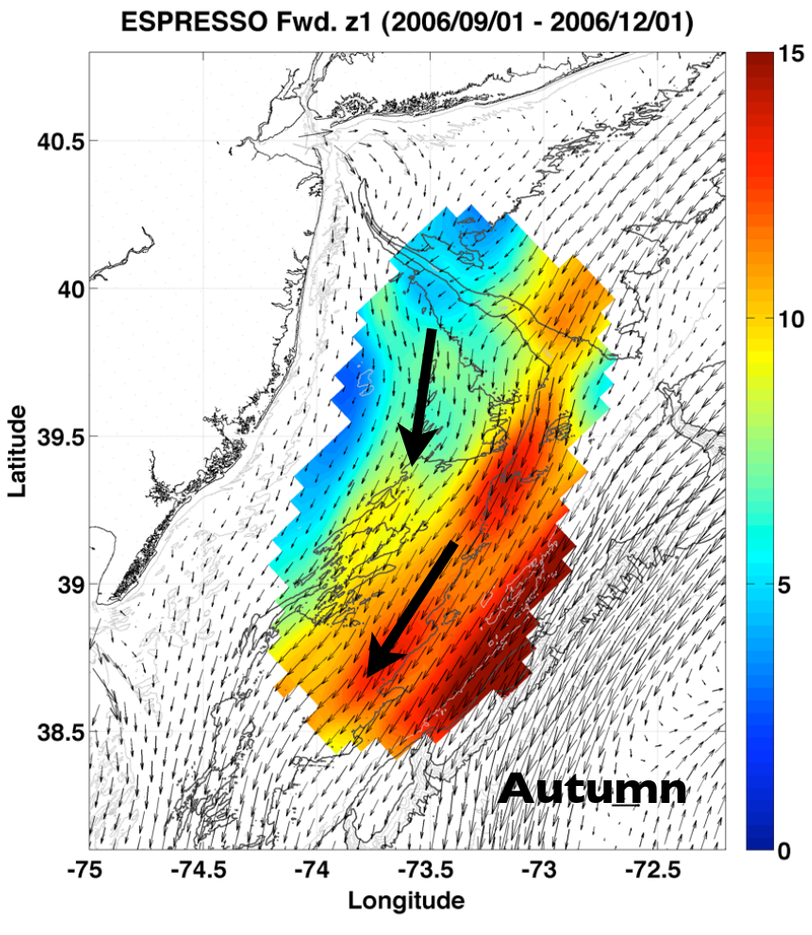


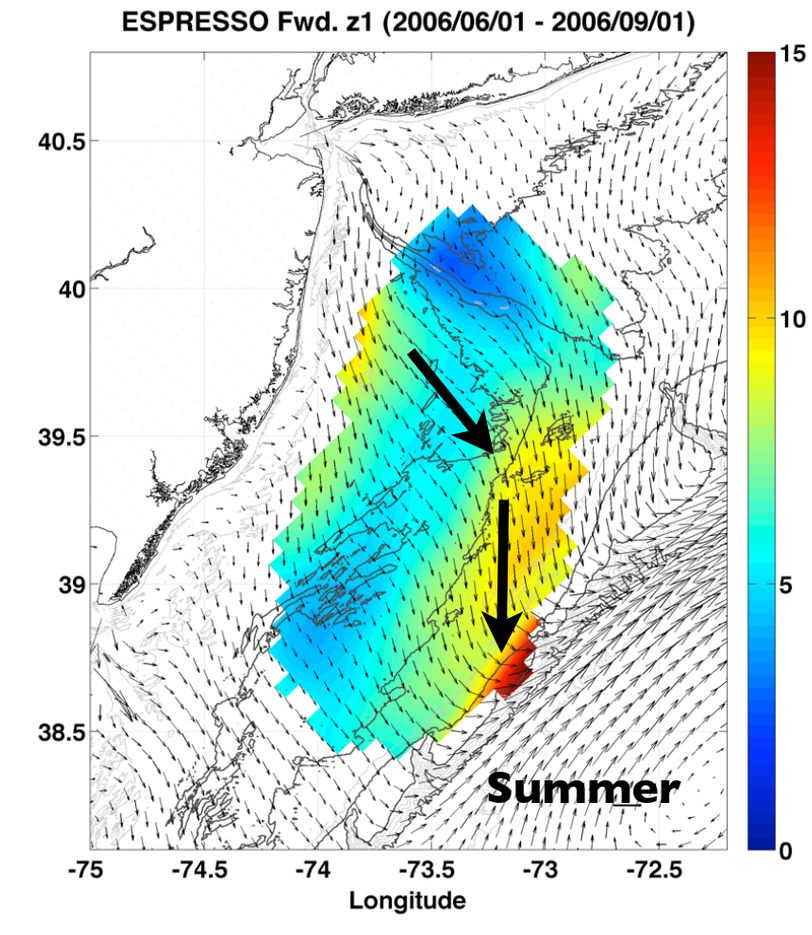
Model outputs provided by Gordon Zhang

ROMS

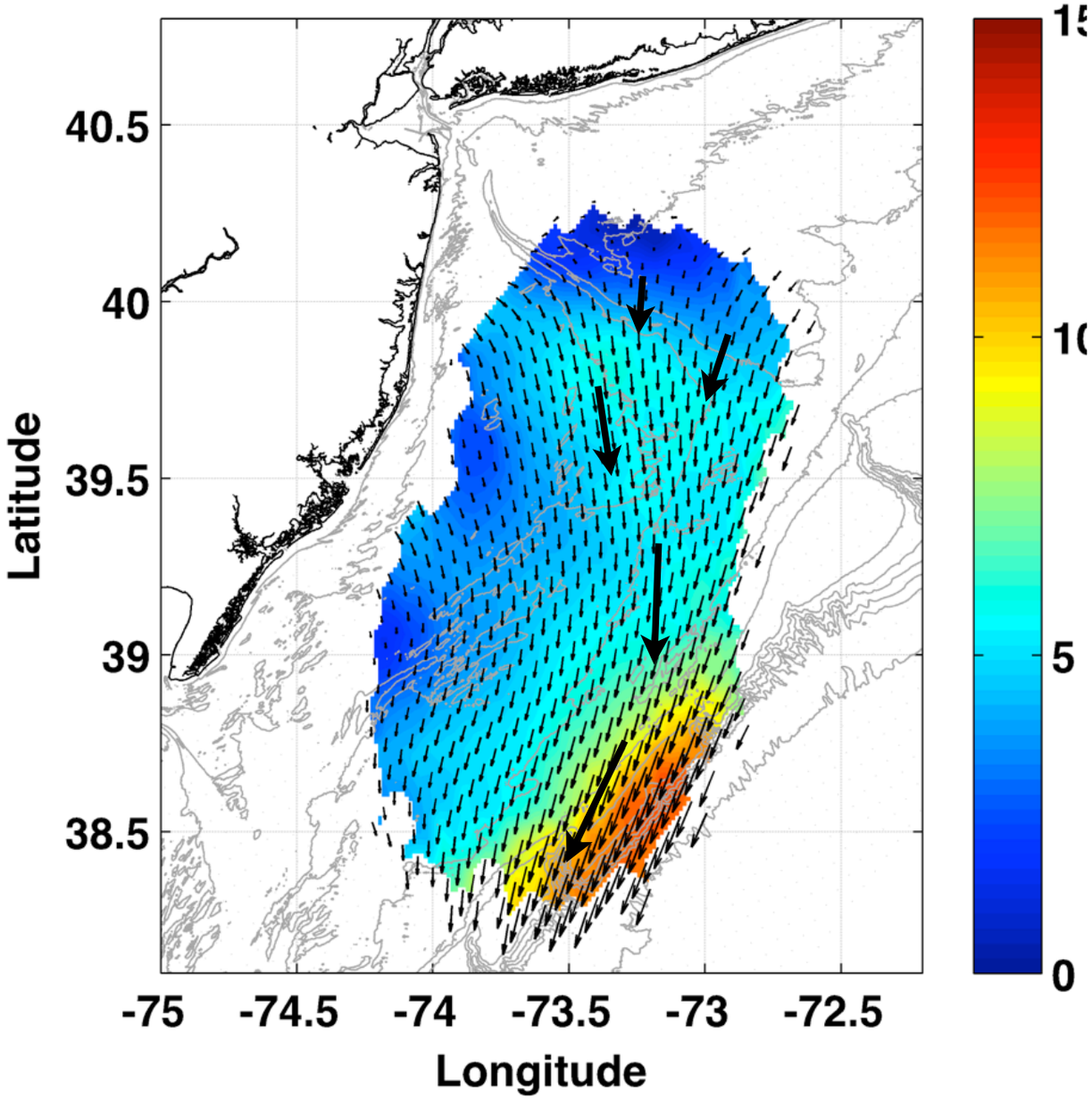

ESPRESSO Fwd. z1 (2006/01/01 - 2006/03/01)
Winter
Latitude
40.5
40
39.5
39
38.5
-75
-74.5
-74
-73.5
-73
-72.5
15
10
5
0


ESPRESSO Fwd. z1 (2006/03/01 - 2006/06/01)
Spring
Latitude
40.5
40
39.5
39
38.5
-75
-74.5
-74
-73.5
-73
-72.5
15
10
5
0

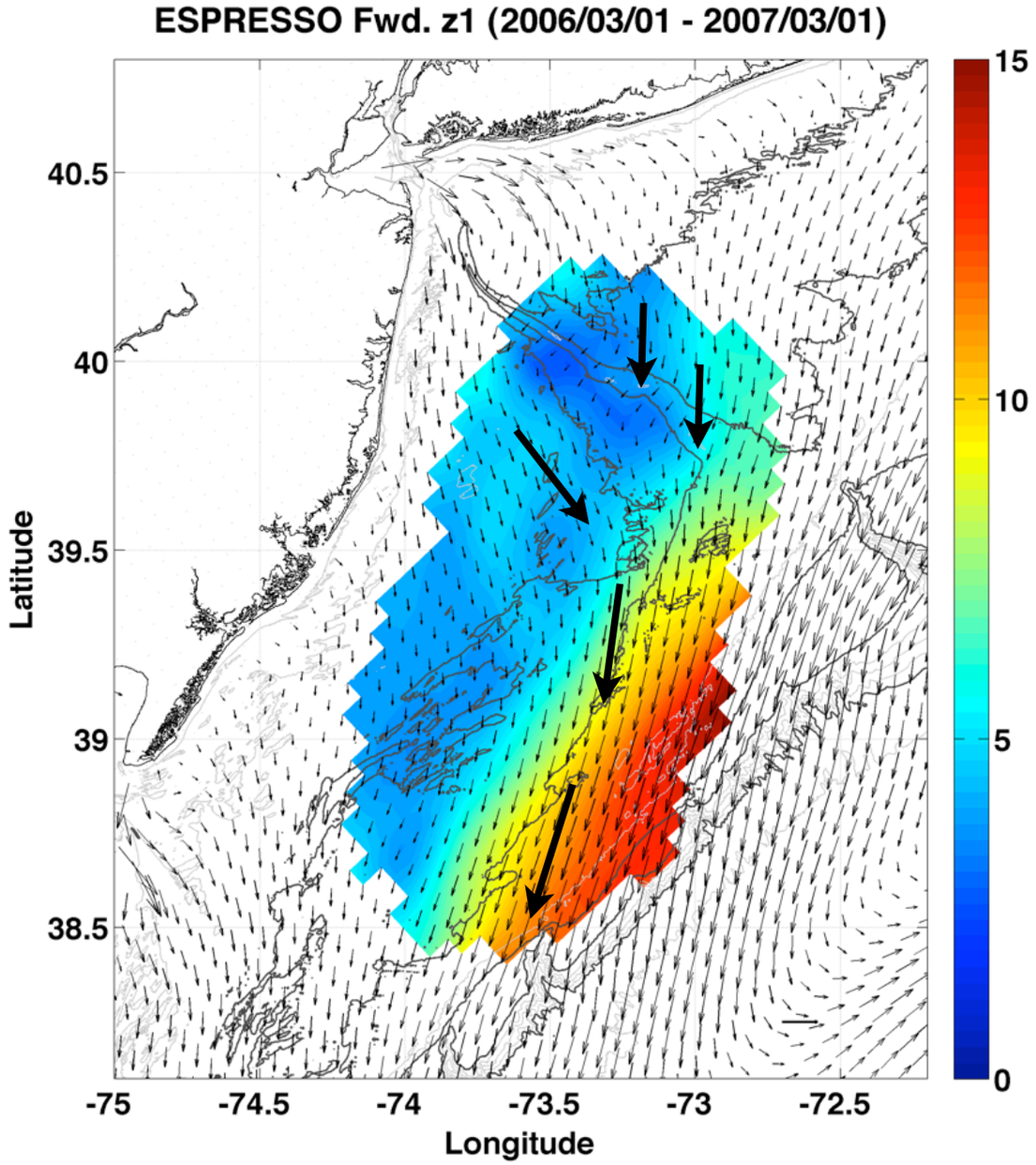

ESPRESSO Fwd. z1 (2006/09/01 - 2006/12/01)
Autumn
Latitude
40.5
40
39.5
39
38.5
-75
-74.5
-74
-73.5
-73
-72.5
Longitude
15
10
5
0


ESPRESSO Fwd. z1 (2006/06/01 - 2006/09/01)
Summer
40.5
40
39.5
39
38.5
-75
-74.5
-74
-73.5
-73
-72.5
Longitude
15
10
5
0

CODAR (2002 - 2007)

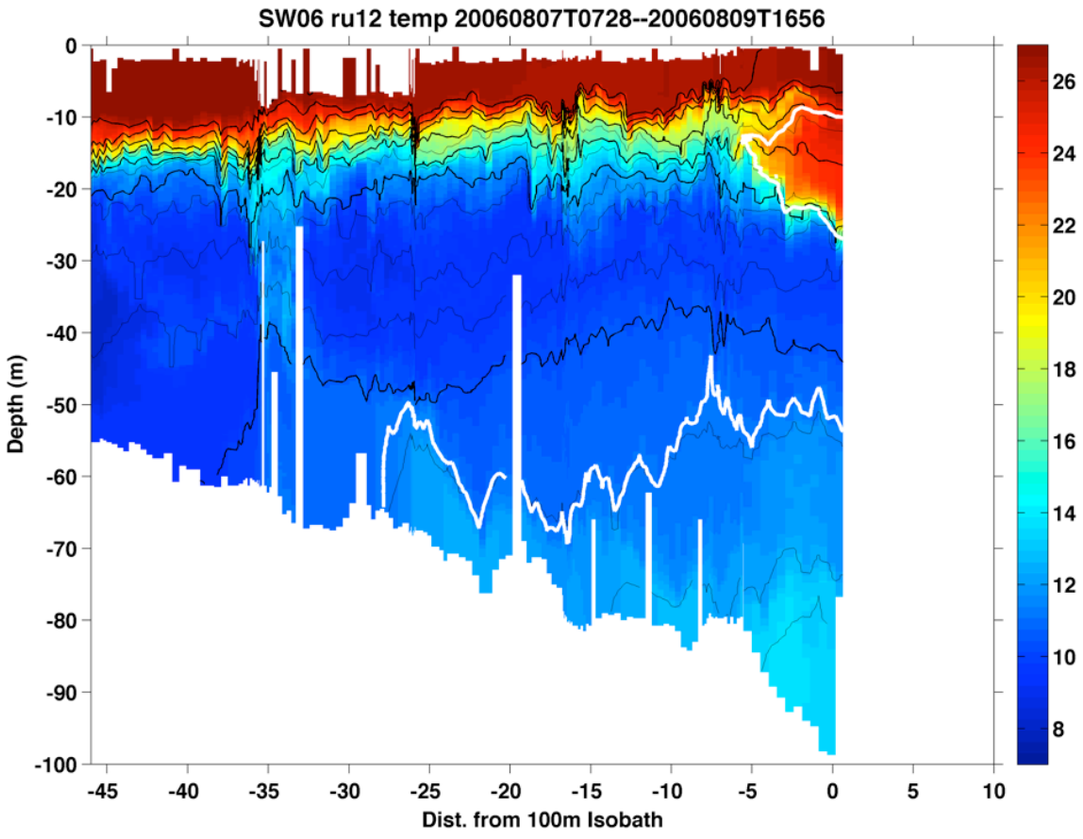


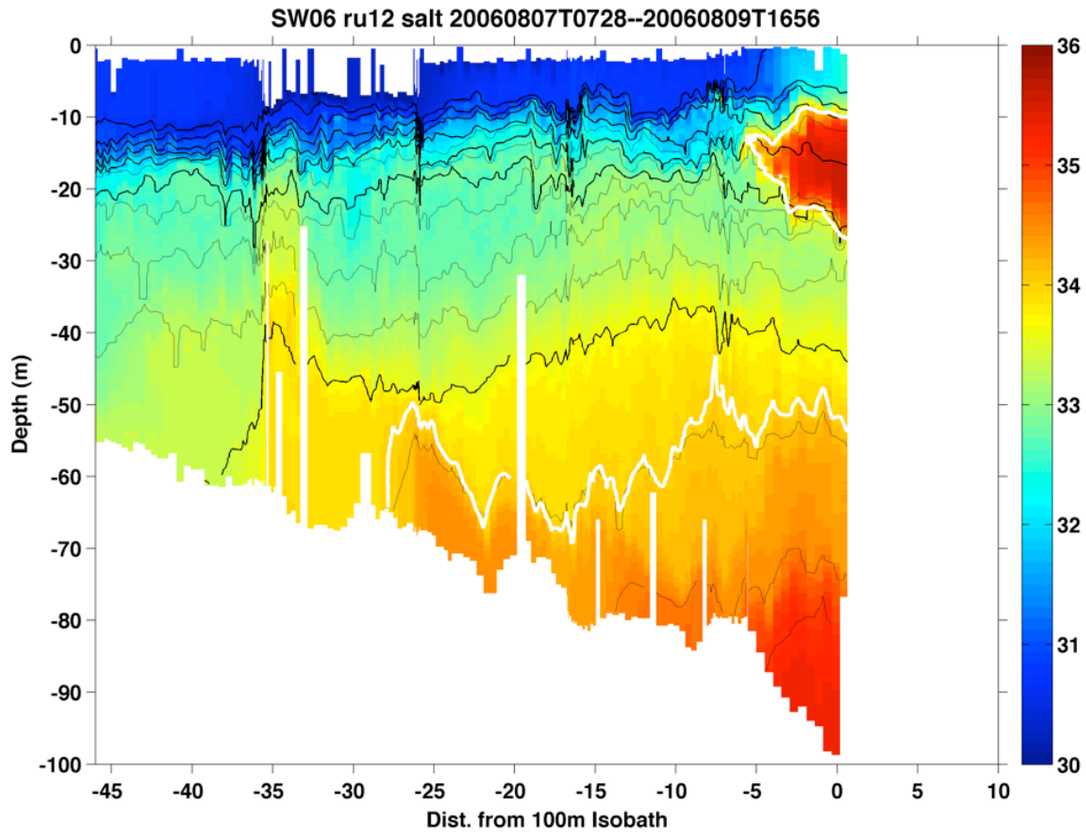
ROMS (2006-2007)



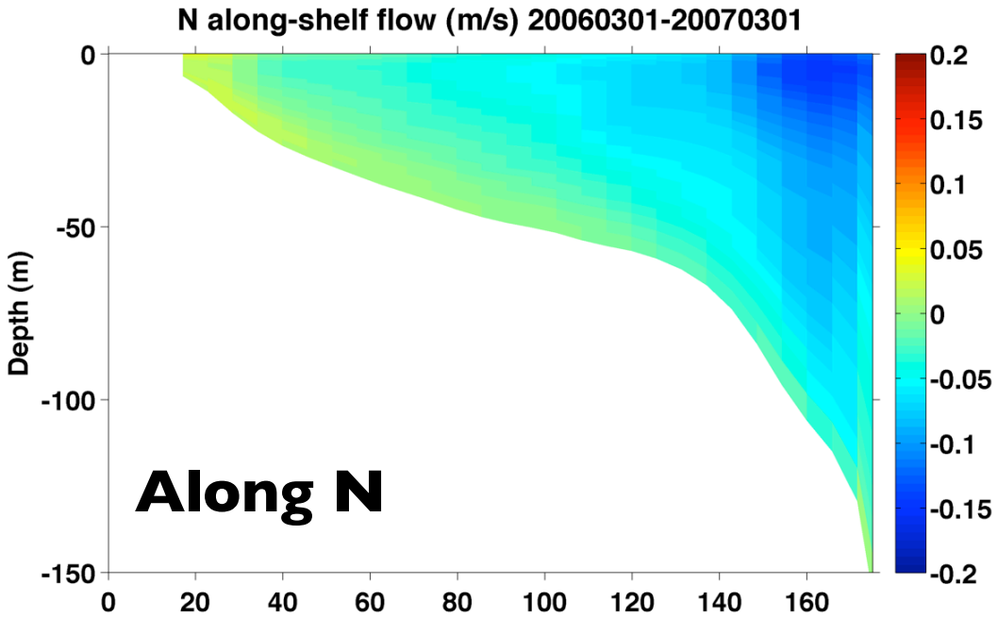
"Seasonal Climatology of Wind Driven Circulation on the NJ Shelf"
Gong, Kohut, Glen. in press.

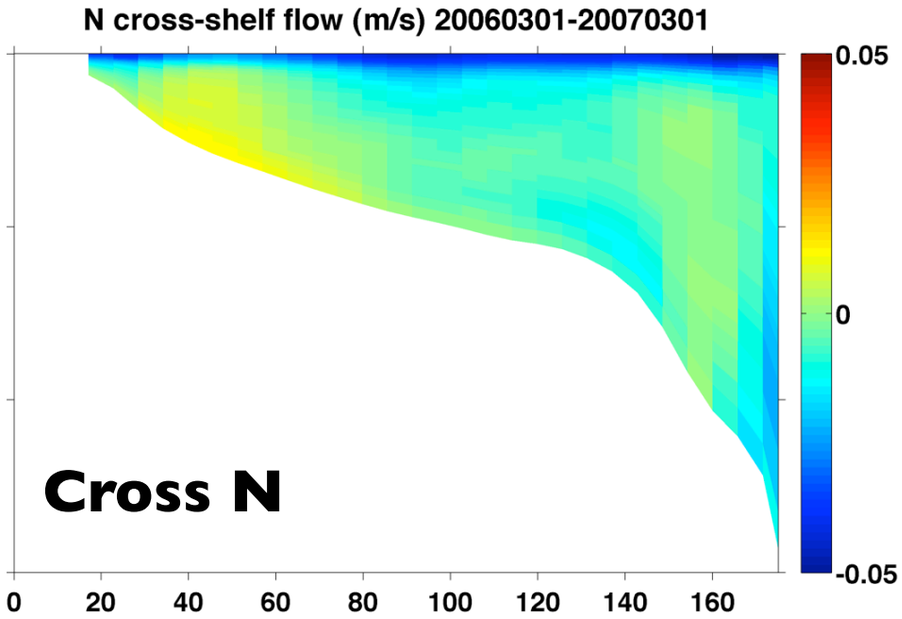
Data vs. Model: August 7-9, 2006

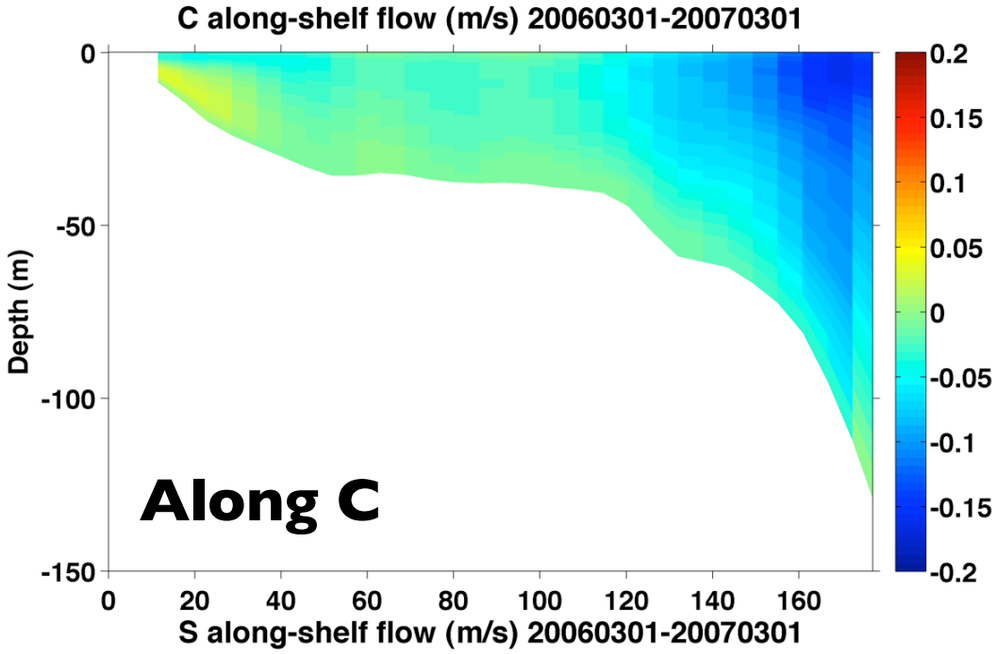


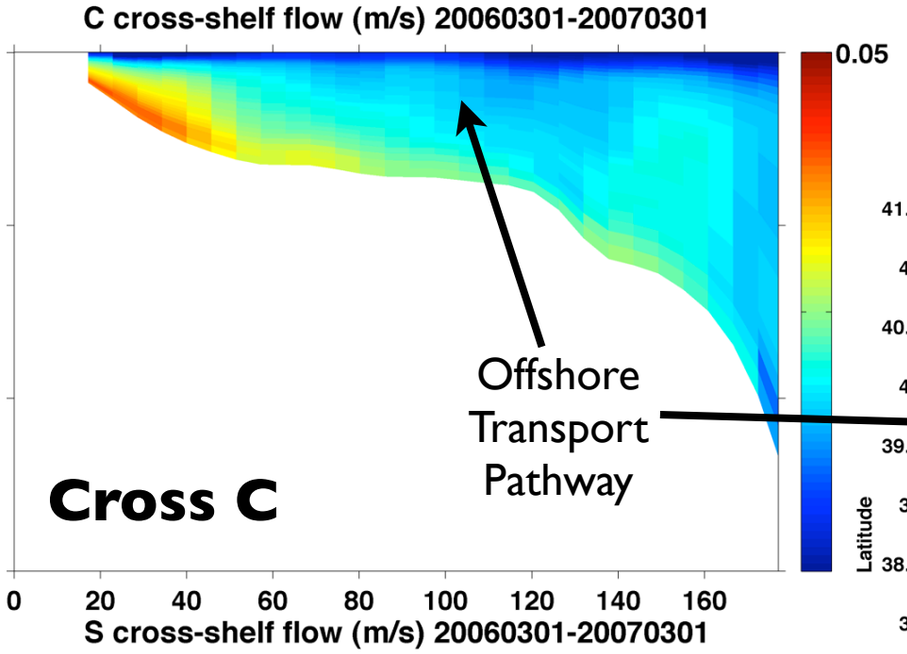


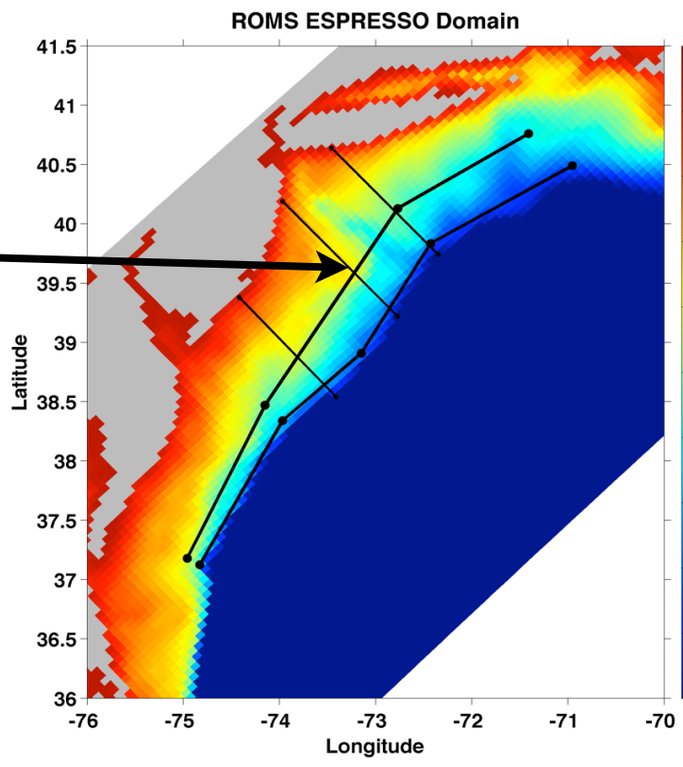
1 Year Current Velocities



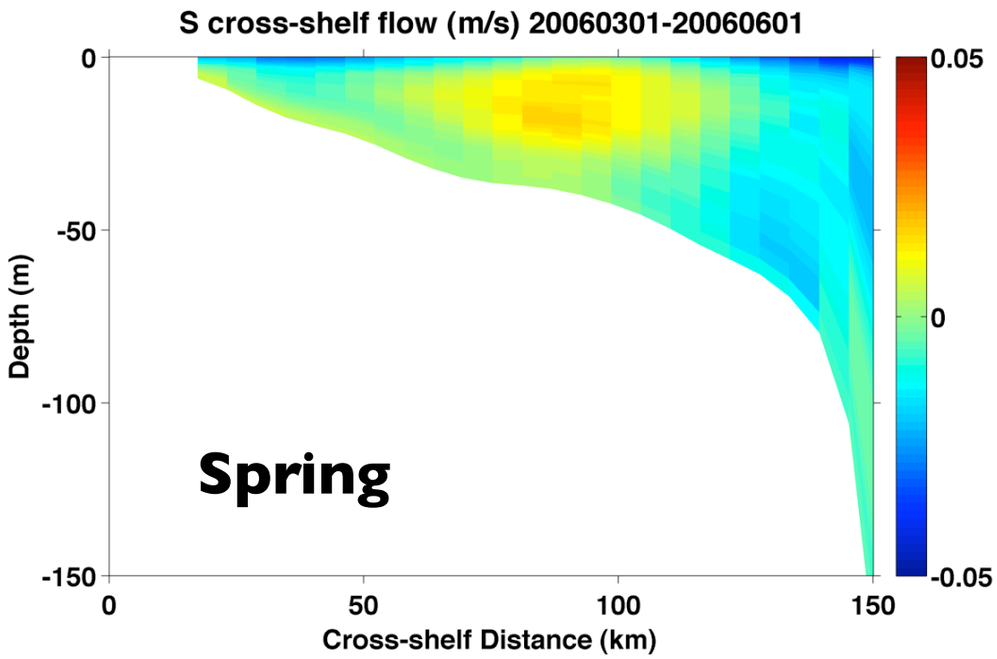


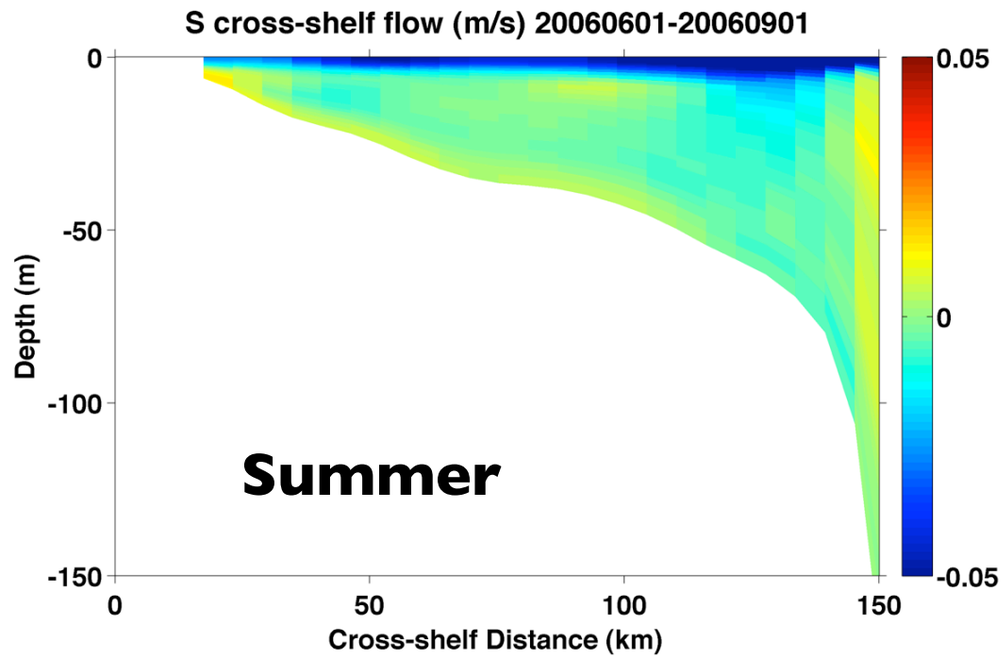


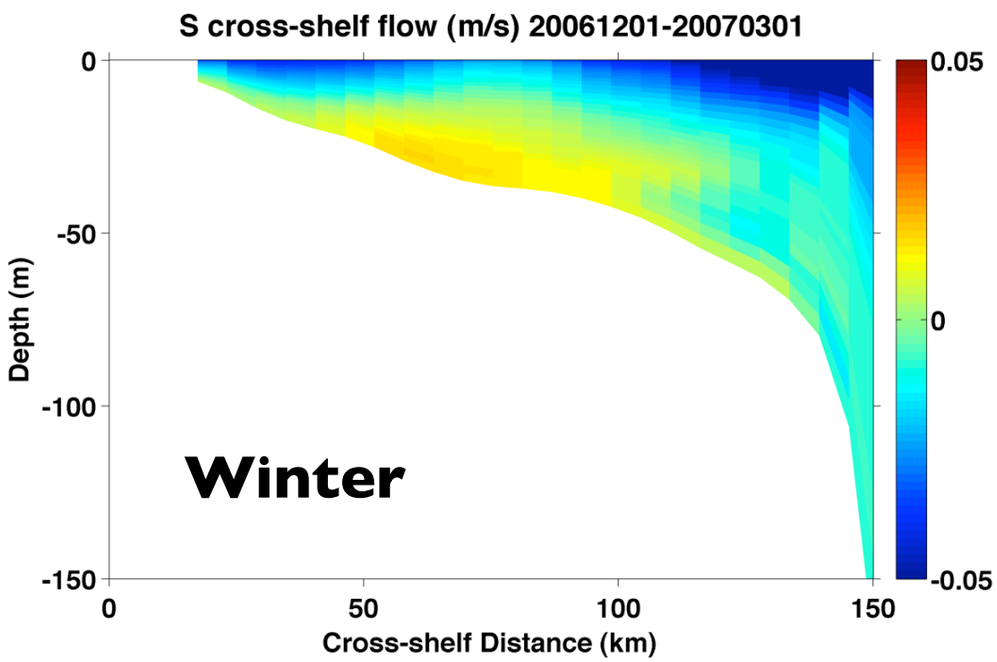


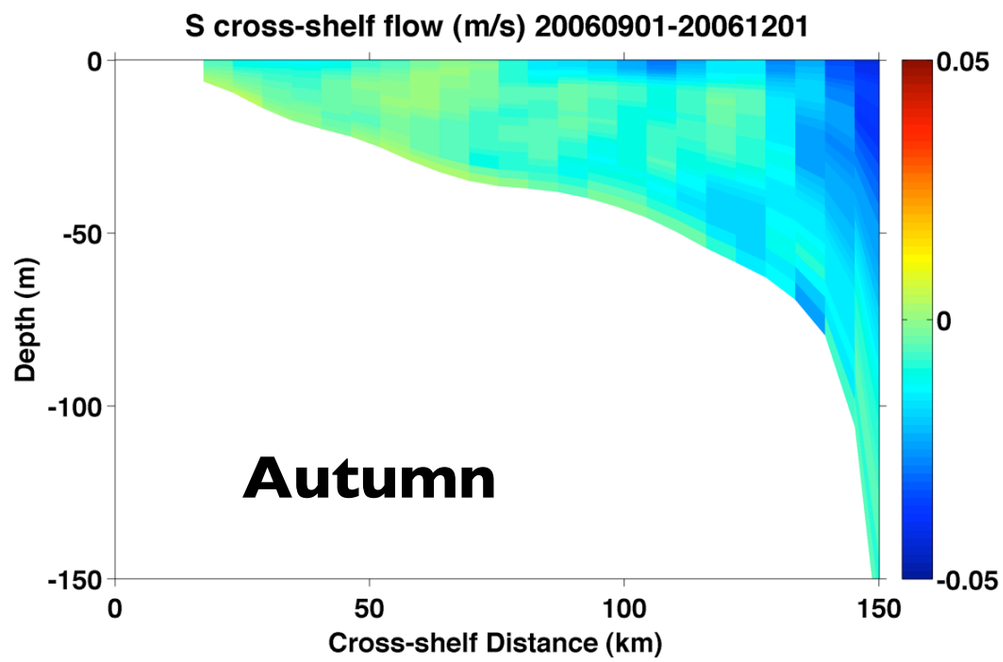


Cross-shelf flow (Southern Section)

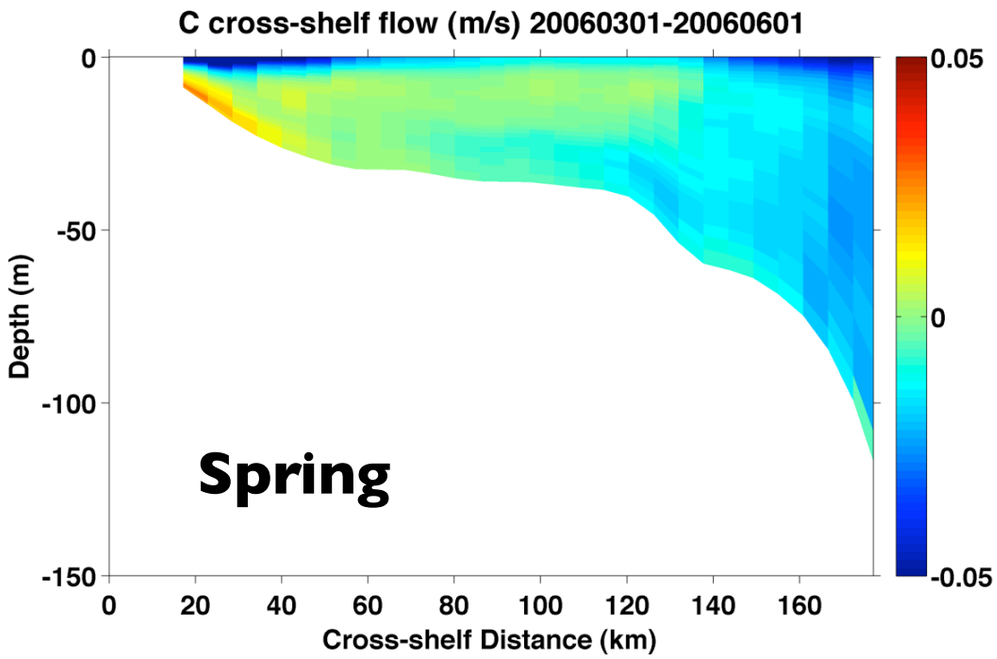


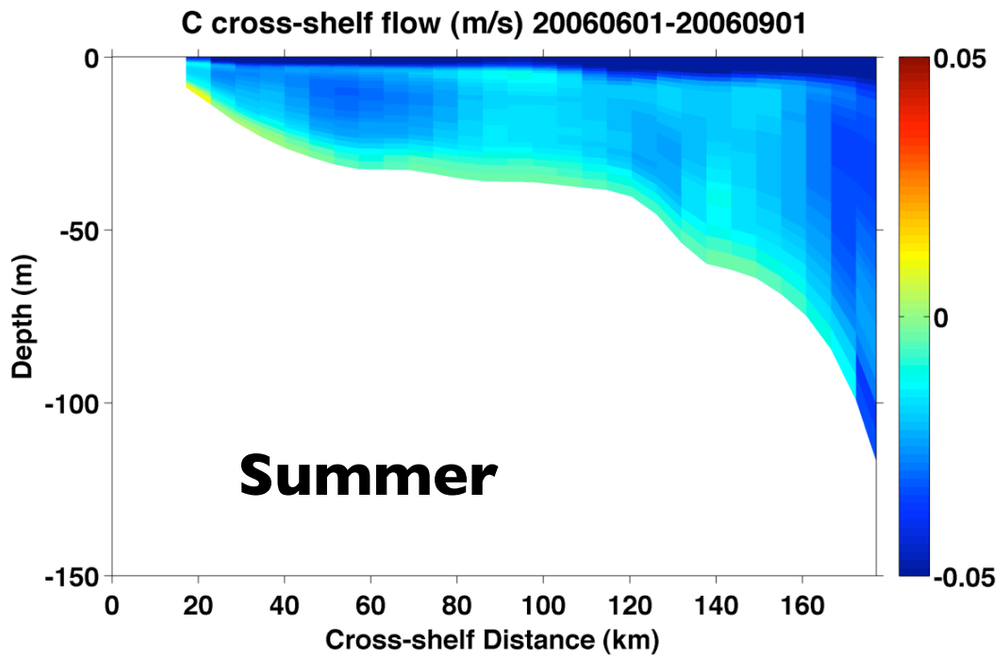


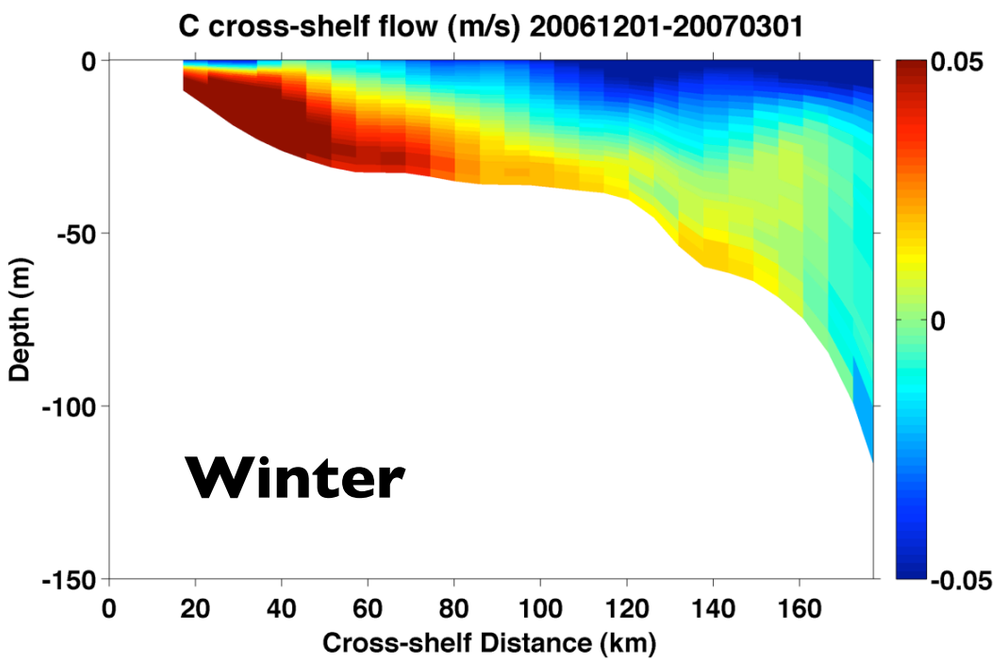


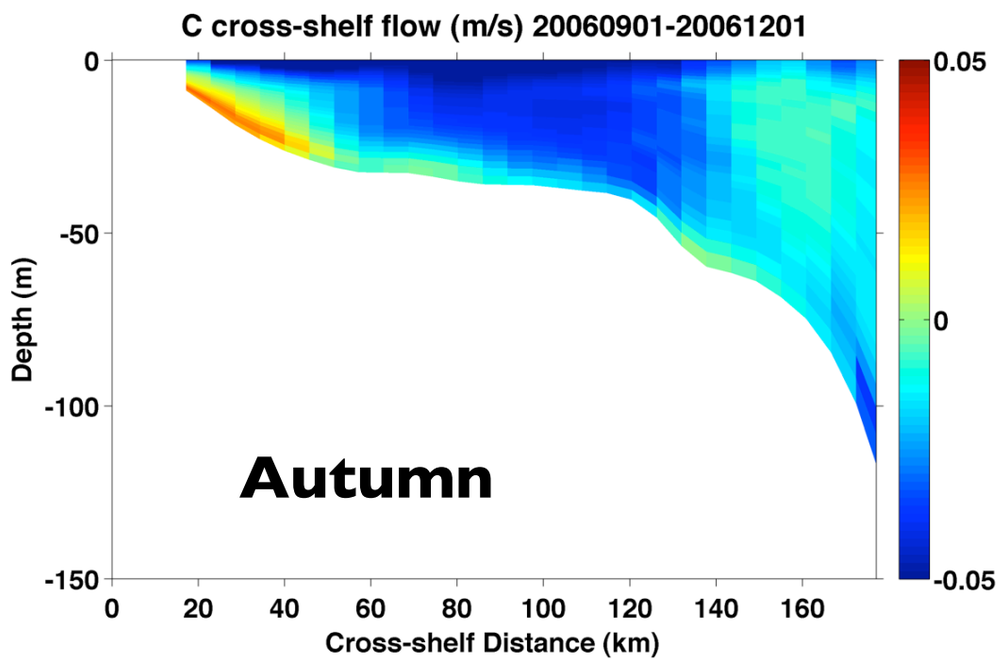


Cross-shelf flow (Central Section)

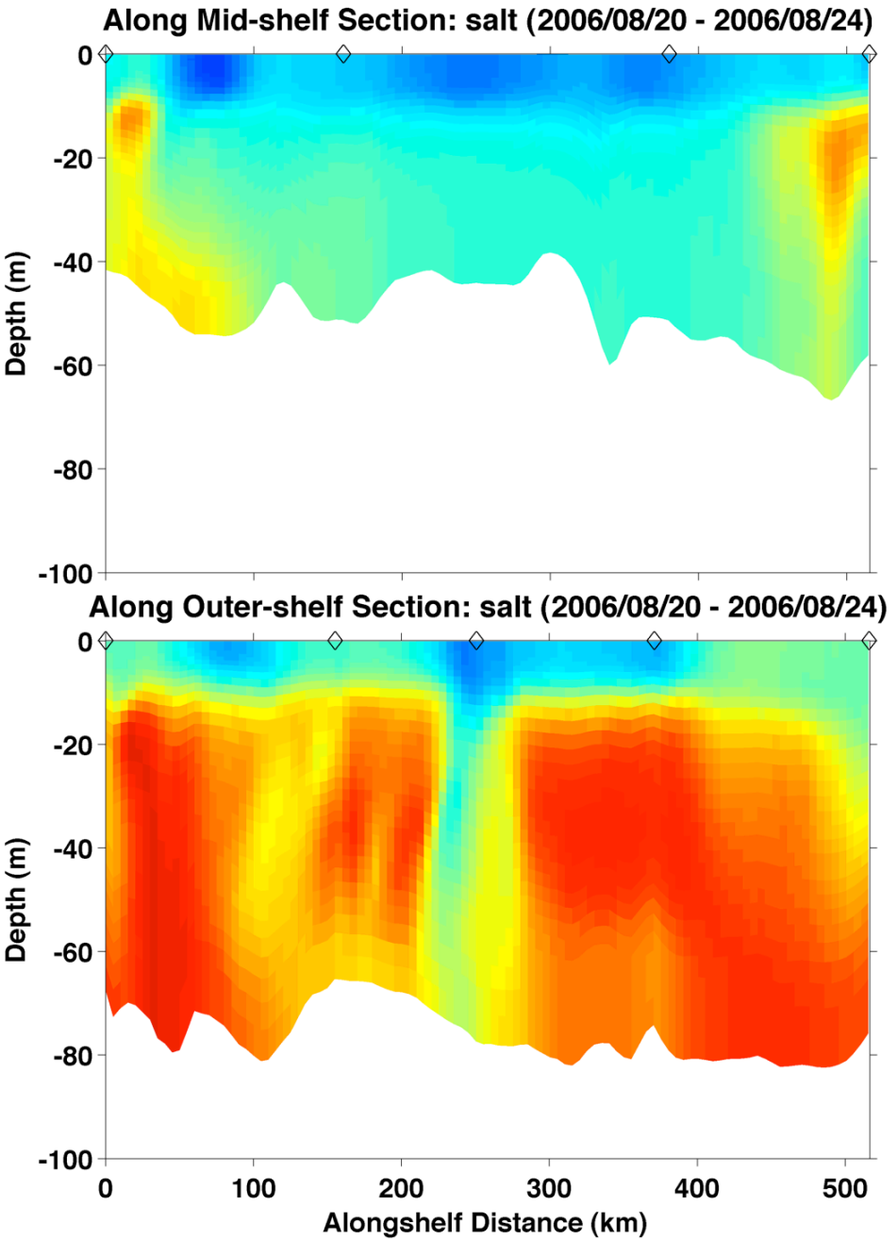


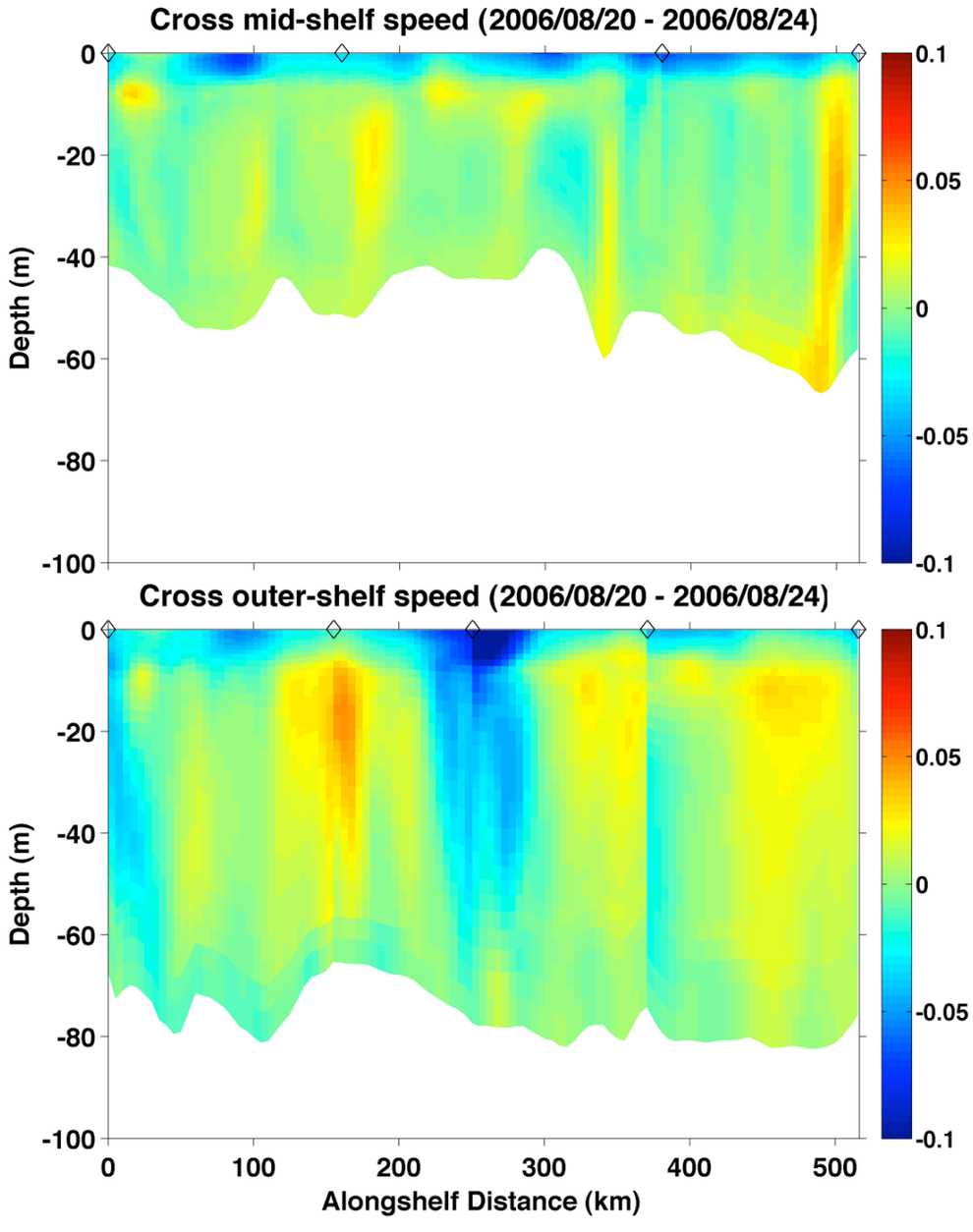


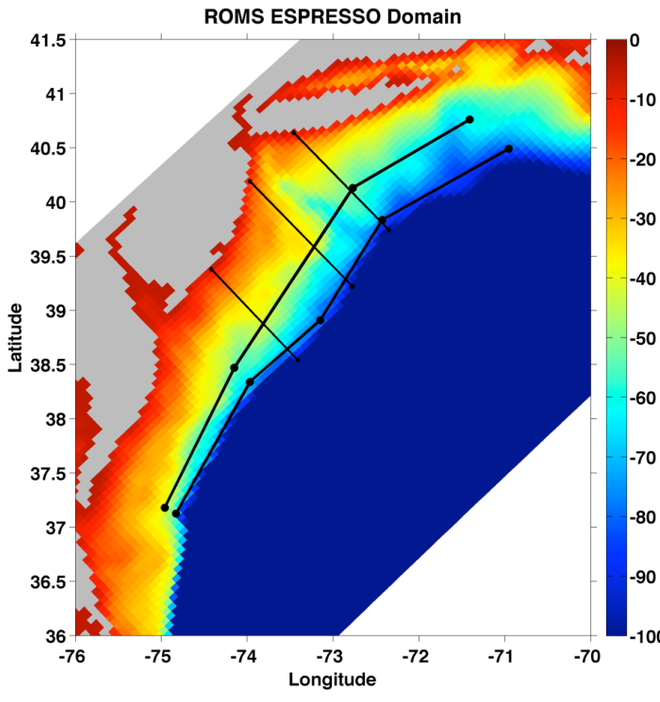




Along-shelf variability (Summer 2006 Example)







Study Summary

- Along-shelf transport is concentrated at the mid-outershelf, especially during summer and winter.
- Identified a persistent offshore transport pathway just south of the Hudson Shelf Valley
- There is significant along-shelf variability in cross-shelf transport, more prominent at the offshore end
- Combined observatory data & modeling approach is very powerful for identifying large scale spatial patterns and longterm temporal patterns

Next steps:

- Look at the temporal variability of shelf flux of salt & heat, correlate with forcing mechanisms
- Seasonal mixing dynamics & effect on cross-shelf exchange
- Compare with data assimilative model runs, can a forward only model effectively capture seasonal transport?
- Effect of high energy, episodic events on cross-shelf exchange & transport (i.e. storms, major discharge, large offshore eddies)

Cross-shelf density