

Using
OCEAN GLIDER OBSERVATIONS
To Assess
UPWELLING & HYPOXIA
on the
NORTHERN NEW JERSEY COAST

... CURRENT PROGRESS

Kate Tremblay

Major Advisor: Dr. Wendell Brown

Assistance: Rich Arena



Organization



- A Lil Bit of History
- Research Goals
- Data / Approach
- Current Progress

(My) Background

The *straight & narrow*
path from MA to NJ..

Gliders, Hypoxia, & Upwelling... Oh My!

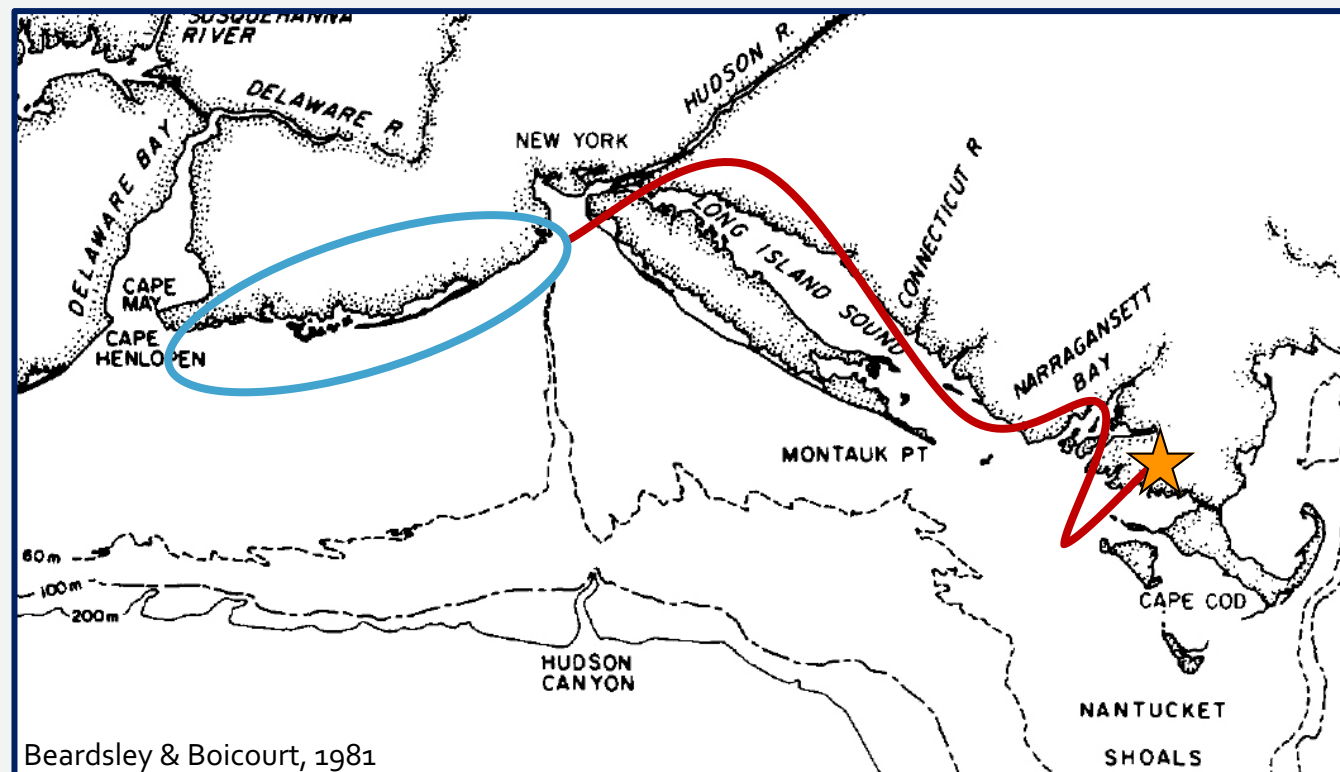
What's...

hypoxia?

its locations?

its frequency?

its precursors?



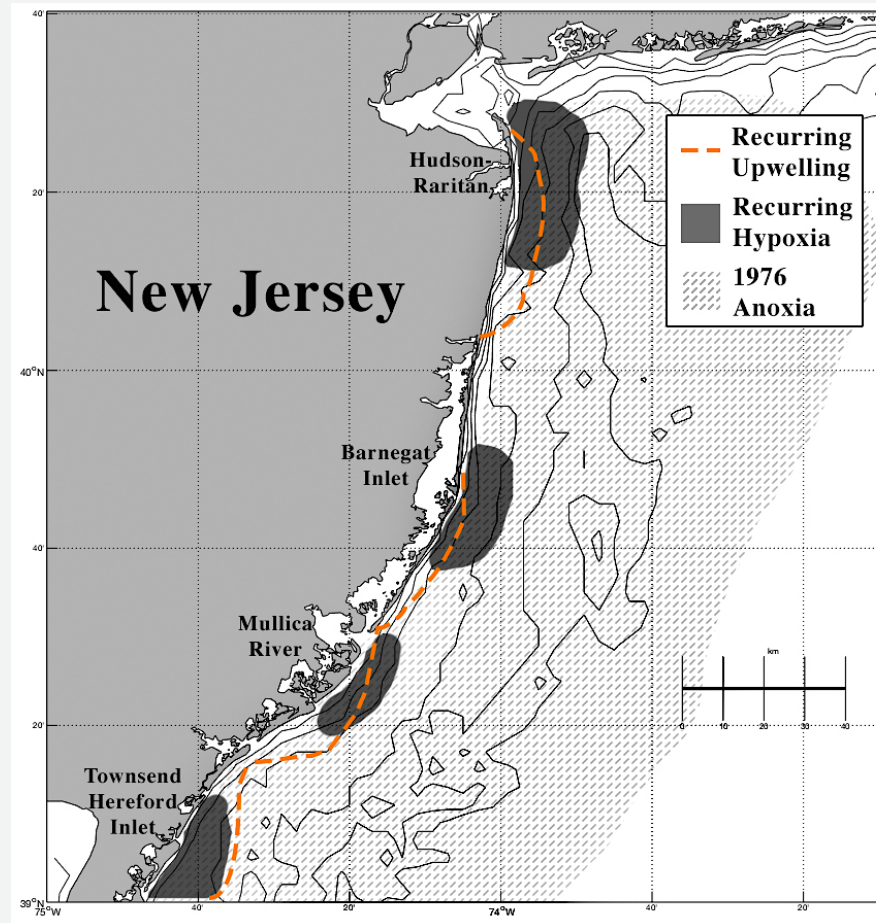
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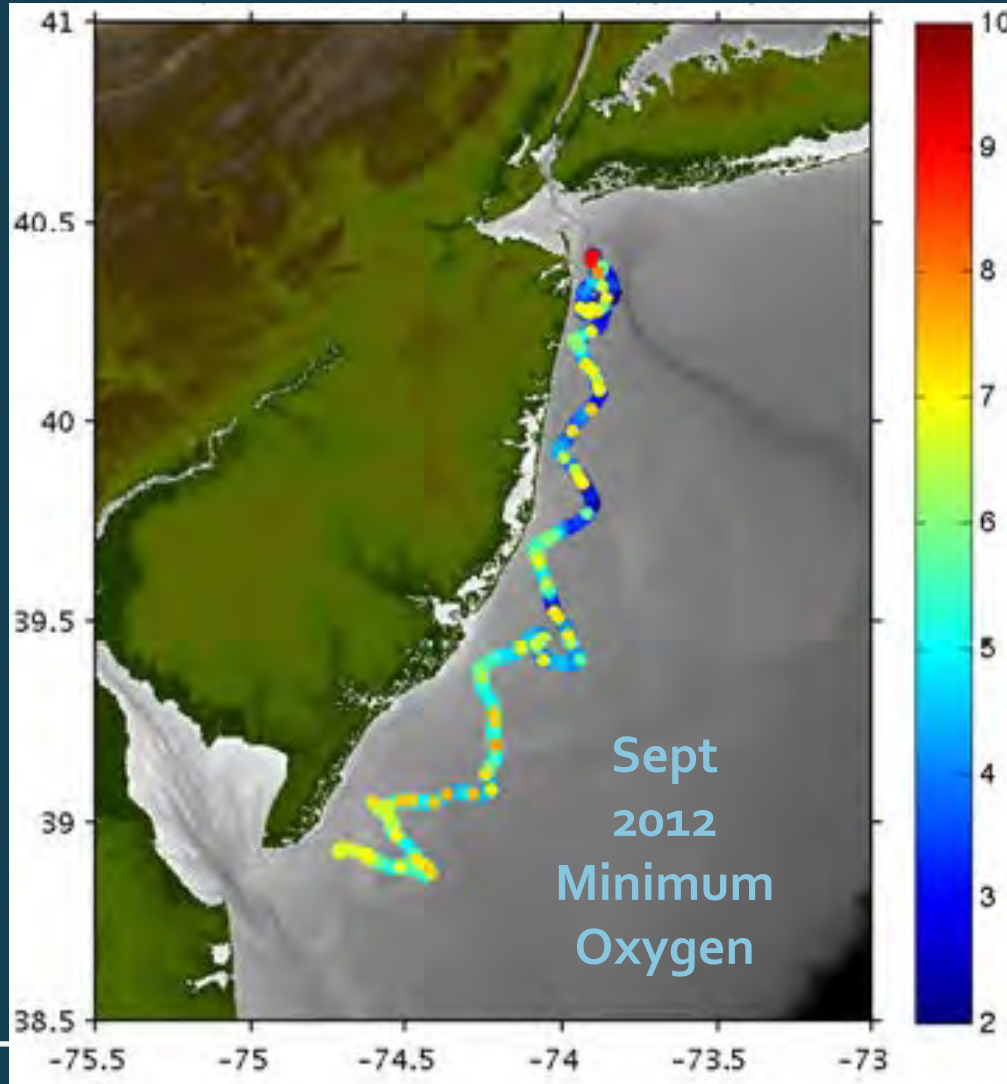
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Warsh et al. ('87)
Glenn et al. ('96, '04)

- $< 4.8 \text{ mg/L DO}$
- 4 main areas on the NJ Coast
- Multiple times per summer
- Upwelling & Phyto-blooms

Context



Kohut et al. ('14)

EPA Glider Runs
Northern hypoxia

Questions for RU28: September 2013

1. Do we see upwelling and/or hypoxia in Sept. 2013 ?
2. Do wind and SST data indicate upwelling conditions?
3. And about that .. Cold Pool !
 - What is the role of the Cold Pool in this process?



Data

Gliders, RU28!

Timeline – 1st 7 legs

Uplifted thermocline (CTD)
< 4.8 mg/L (Optode)

Cold Pool – 8-10 C

Buoy Wind!

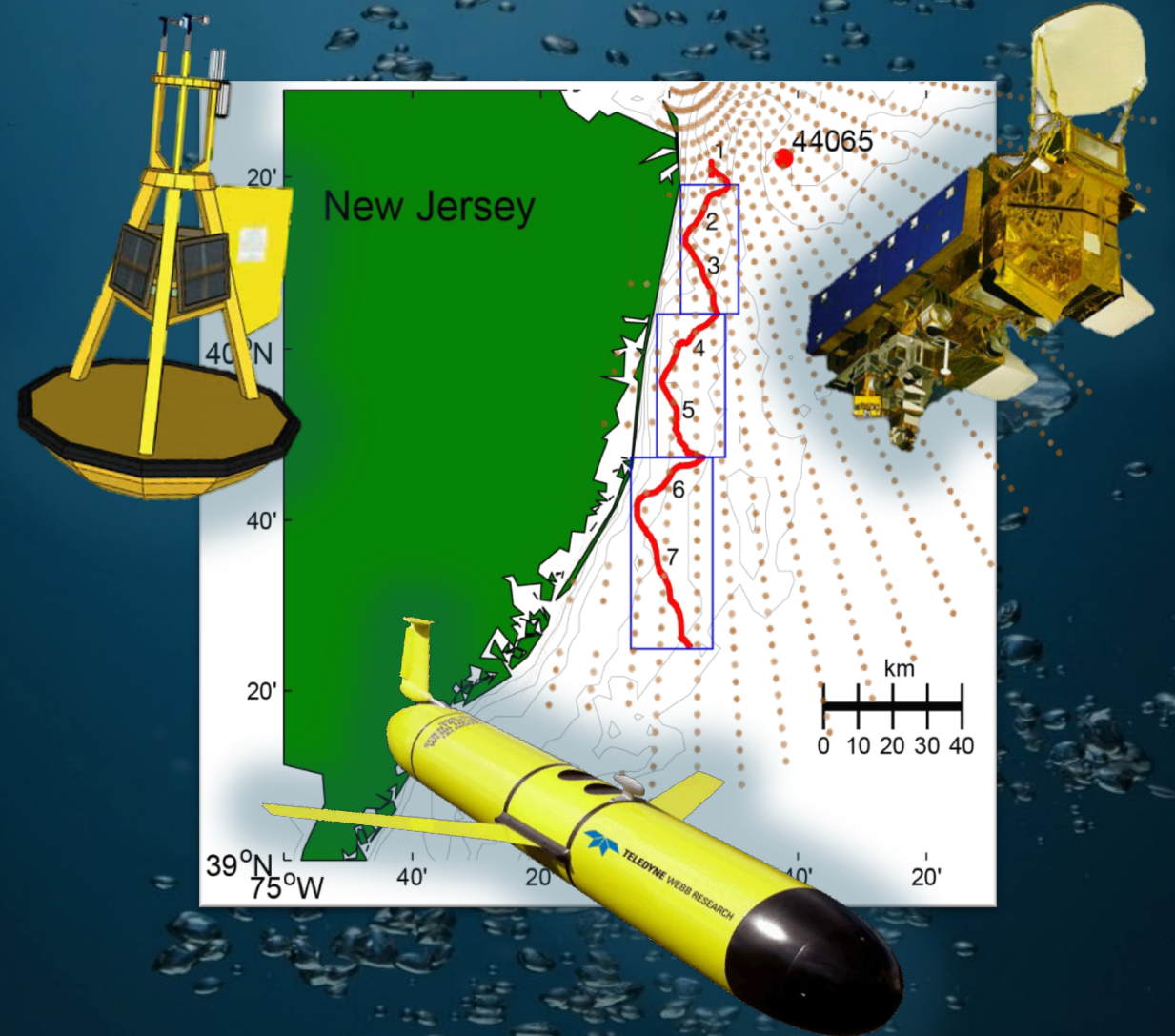
Upwelling winds (NE) ↗

Satellite SST!

Cold Front at Surface

CODAR!

Surface Currents



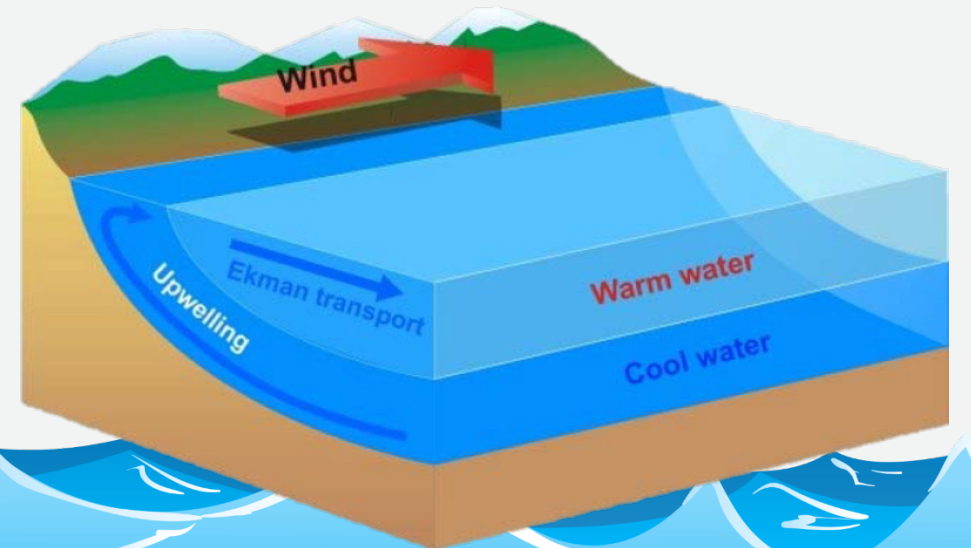
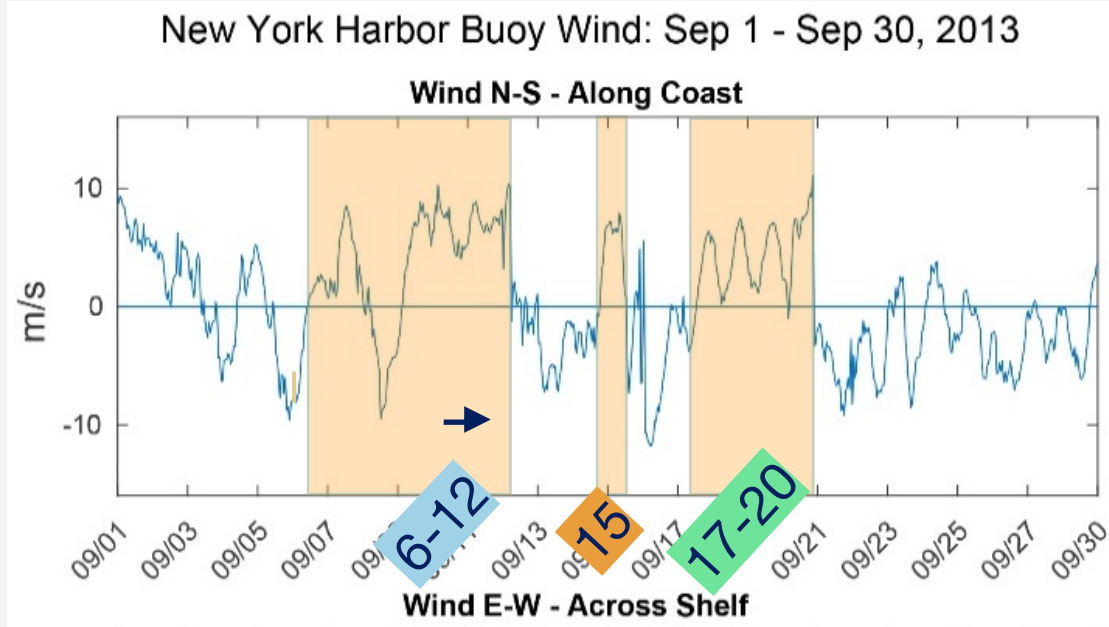
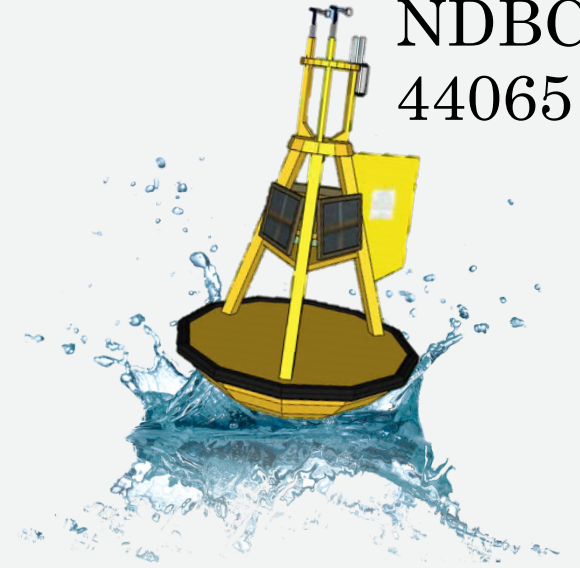
There's a lot of **YELLOW!**

Wind - NBDC

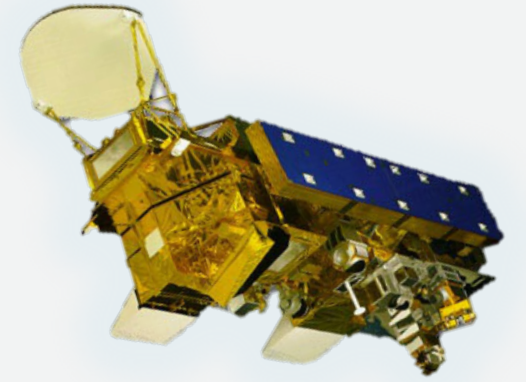
Confirmed northeastward winds!

One extended event, a brief pulse, oscillation .

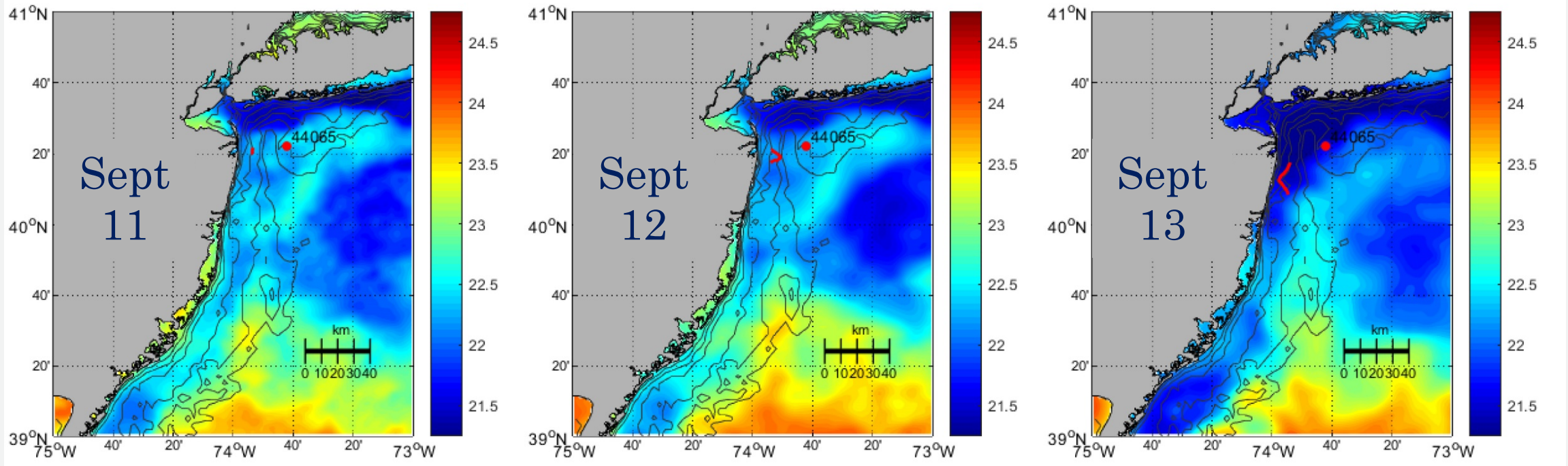
NDBC
44065



Sea Surface Temperature



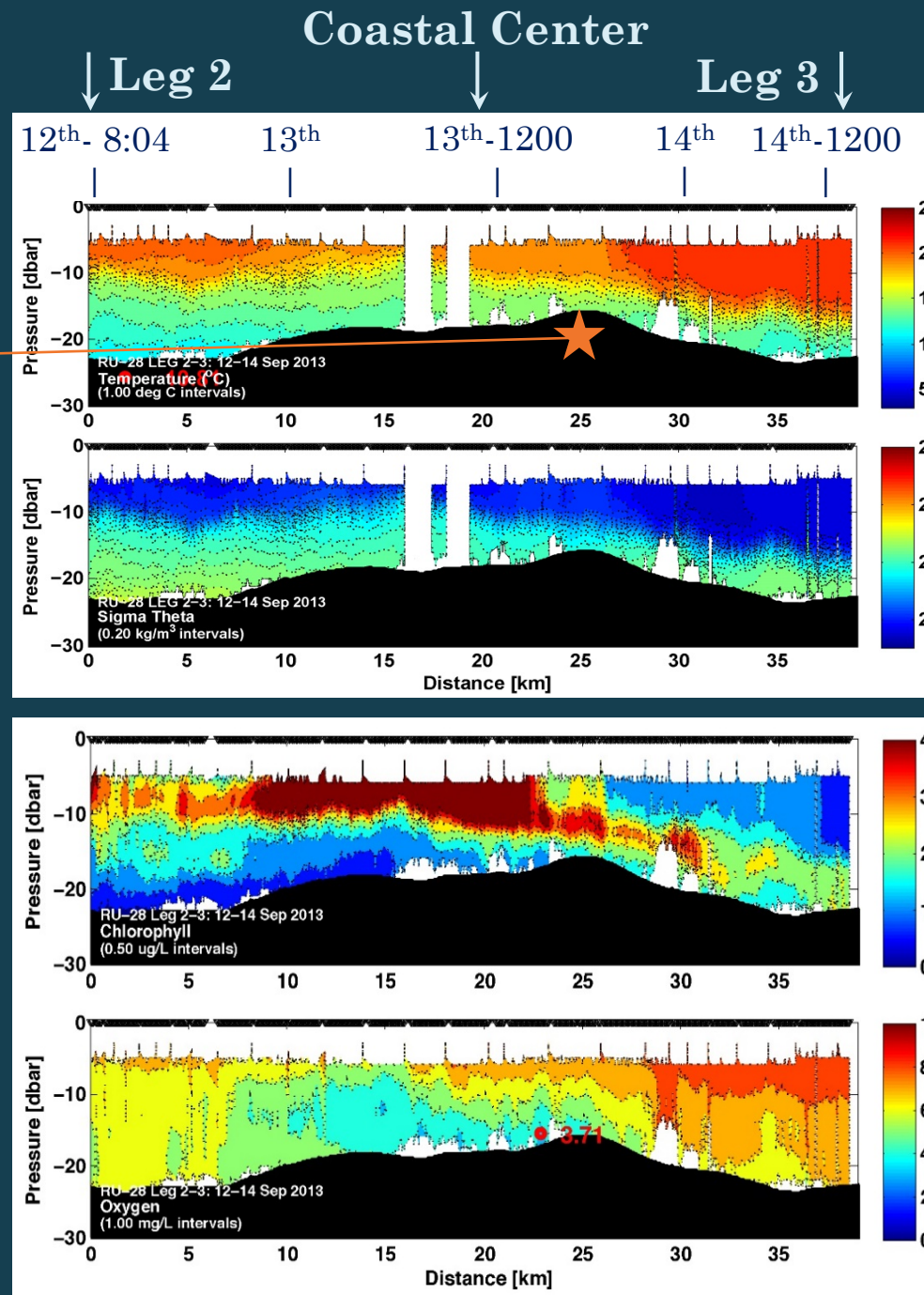
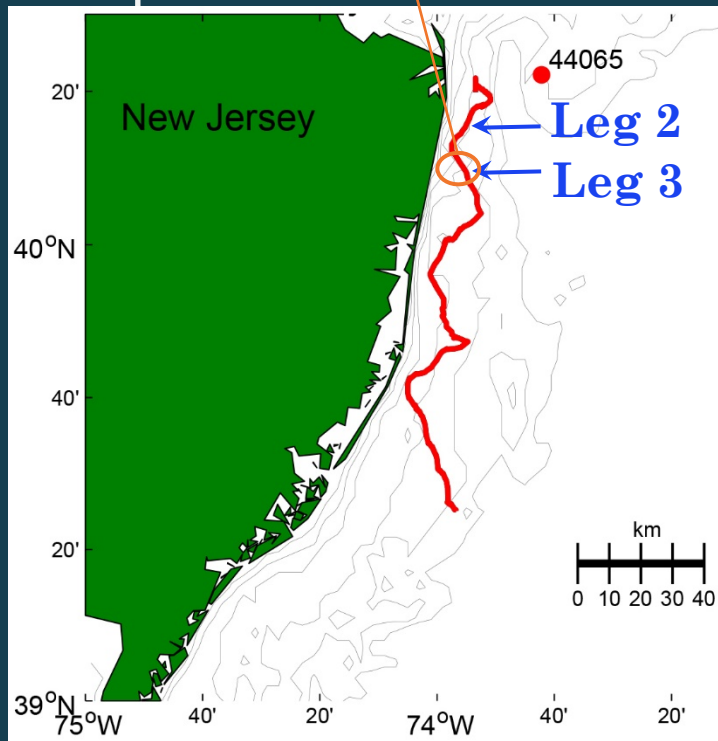
Cold Surface Patch Prior to Glider Launch



RU28: Leg 2-3

Sept 12-14

Raised Bathymetry



Observations

Temperature

Temp-min – 10.8°C
Uplifted thermocline

Density

Uplifted pycnocline

Chlorophyll-a

Near Surface Aggregation

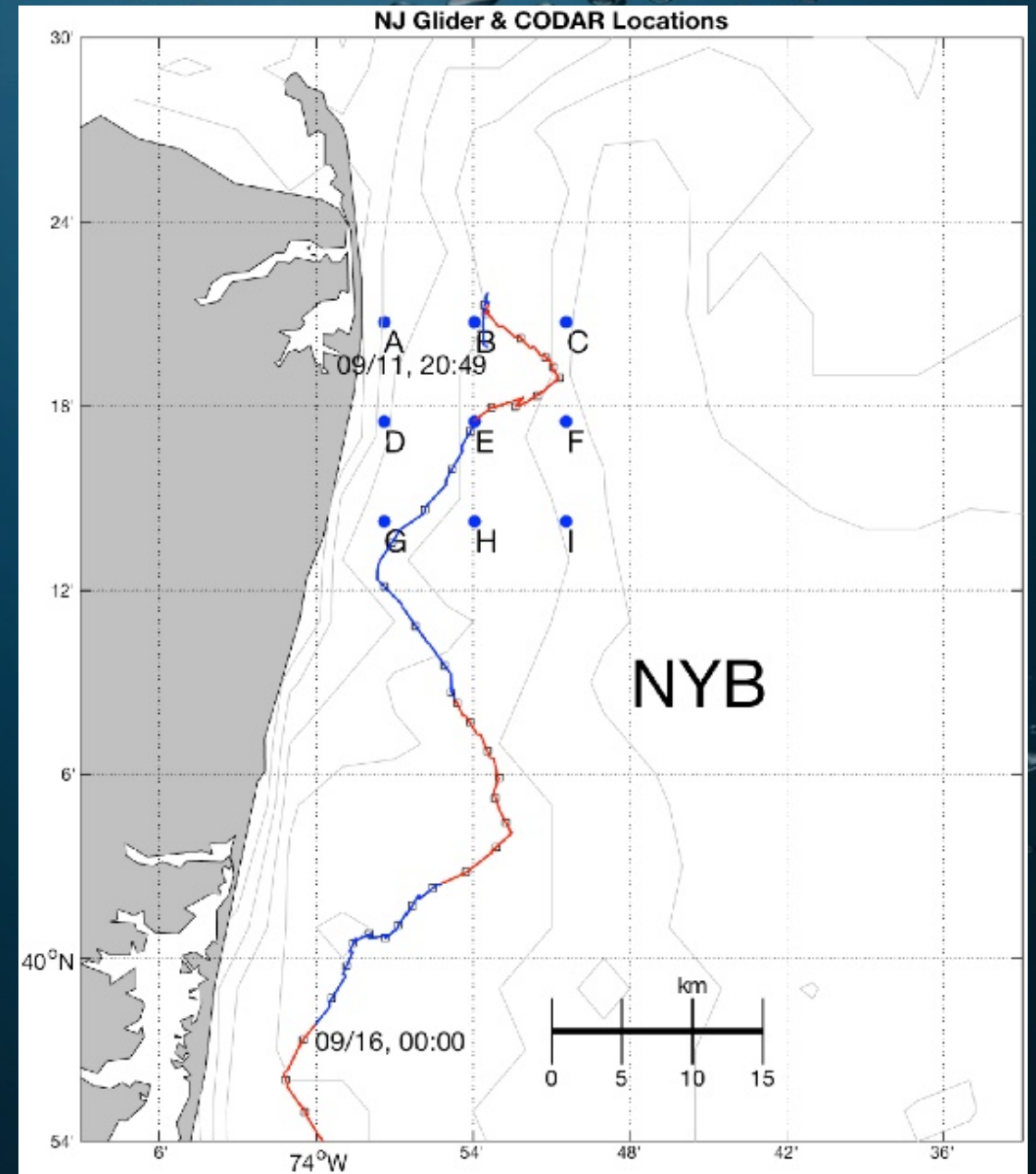
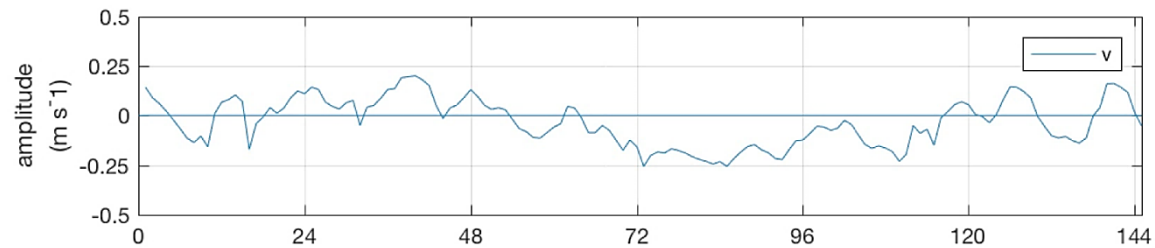
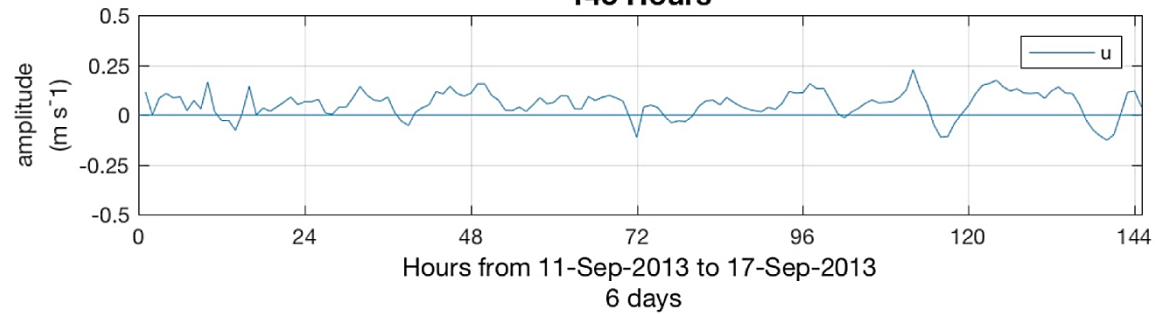
Dissolved Oxygen

Oxy min – 3.71 mg/L
Hypoxia!

CODAR

9 Grid Locations

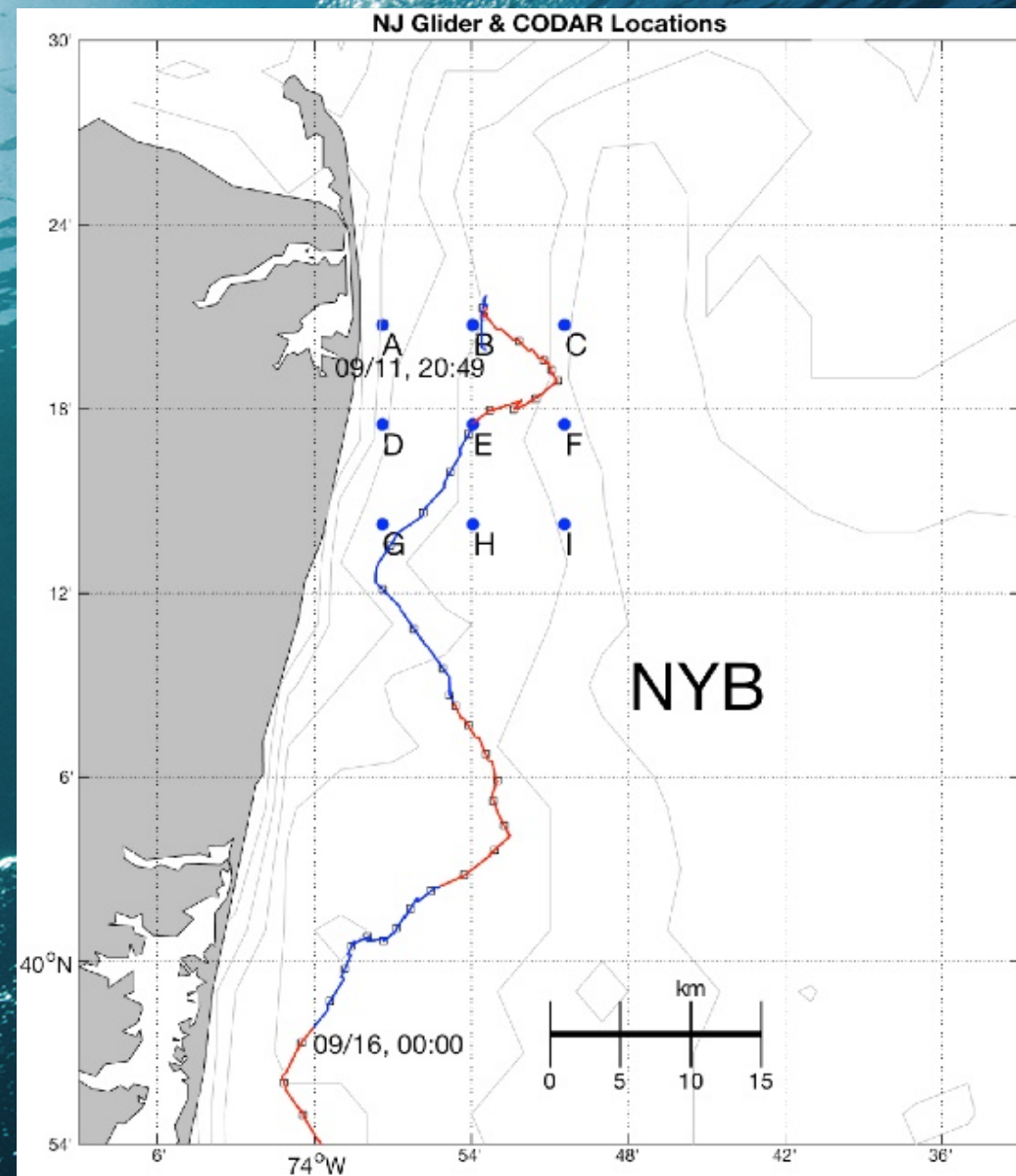
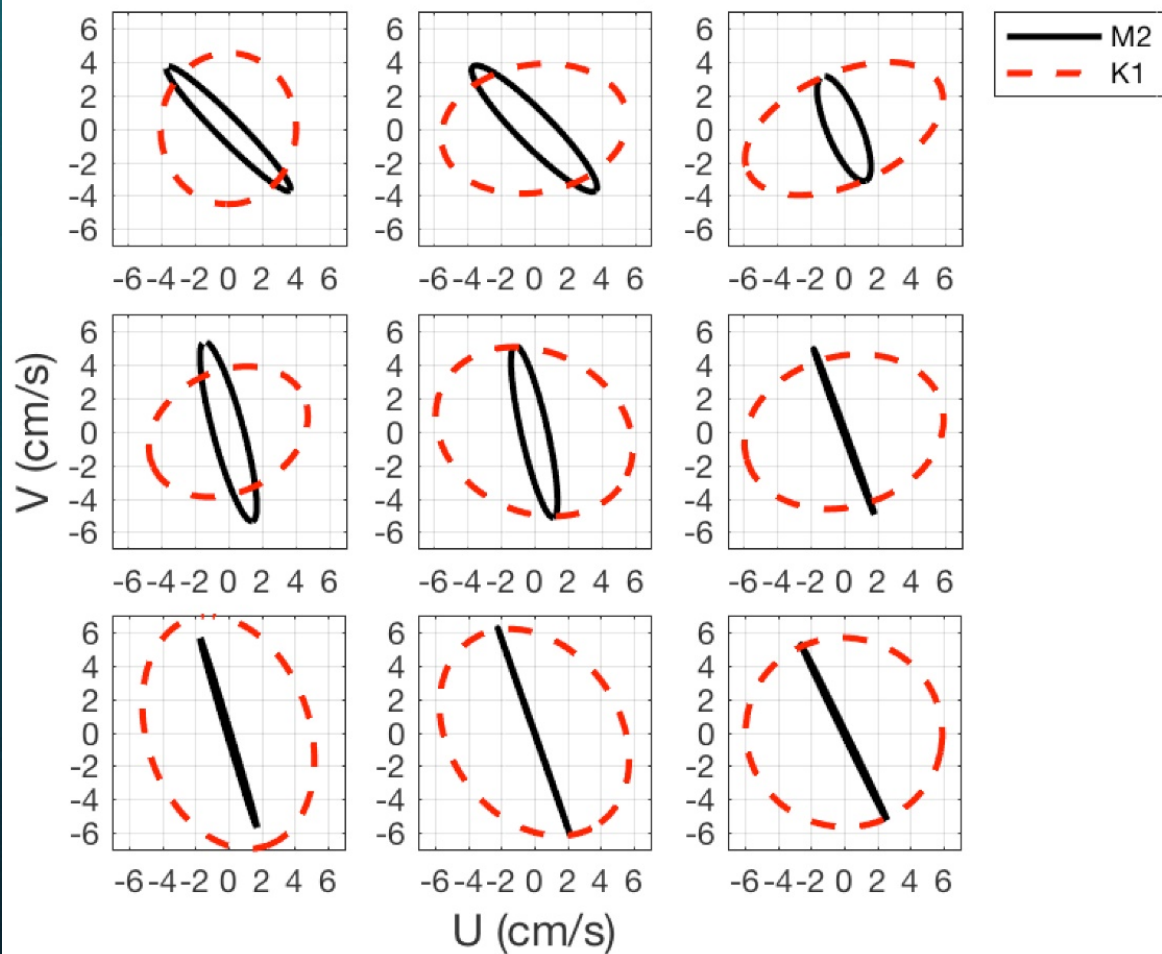
CODAR Mean Timeseries U & V in NYB - Glider
145 Hours



CODAR

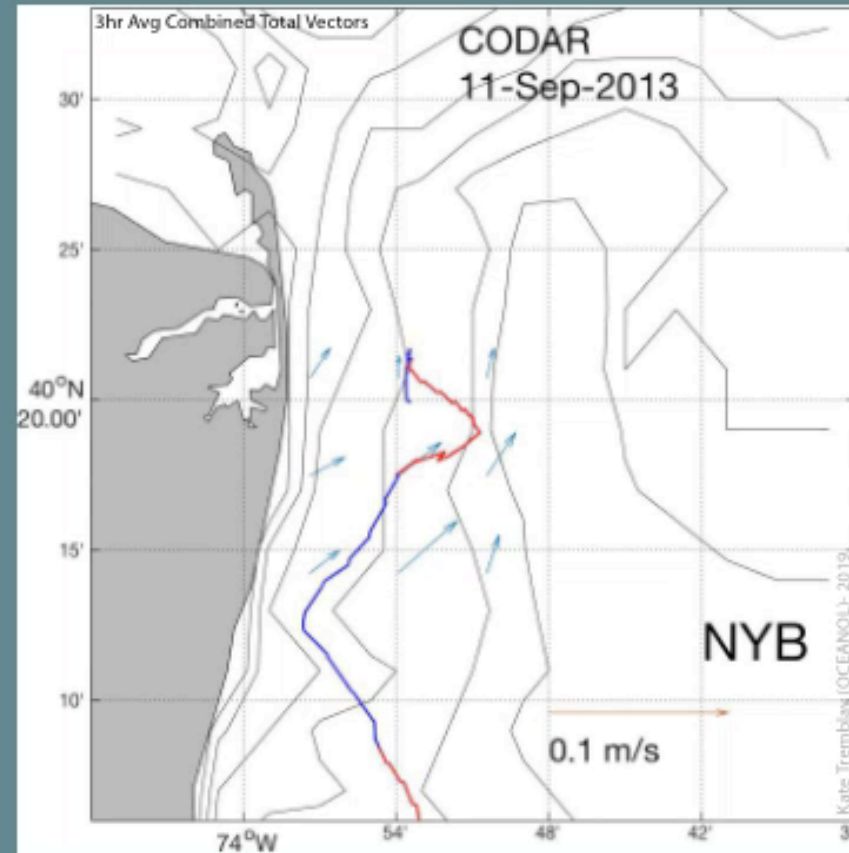
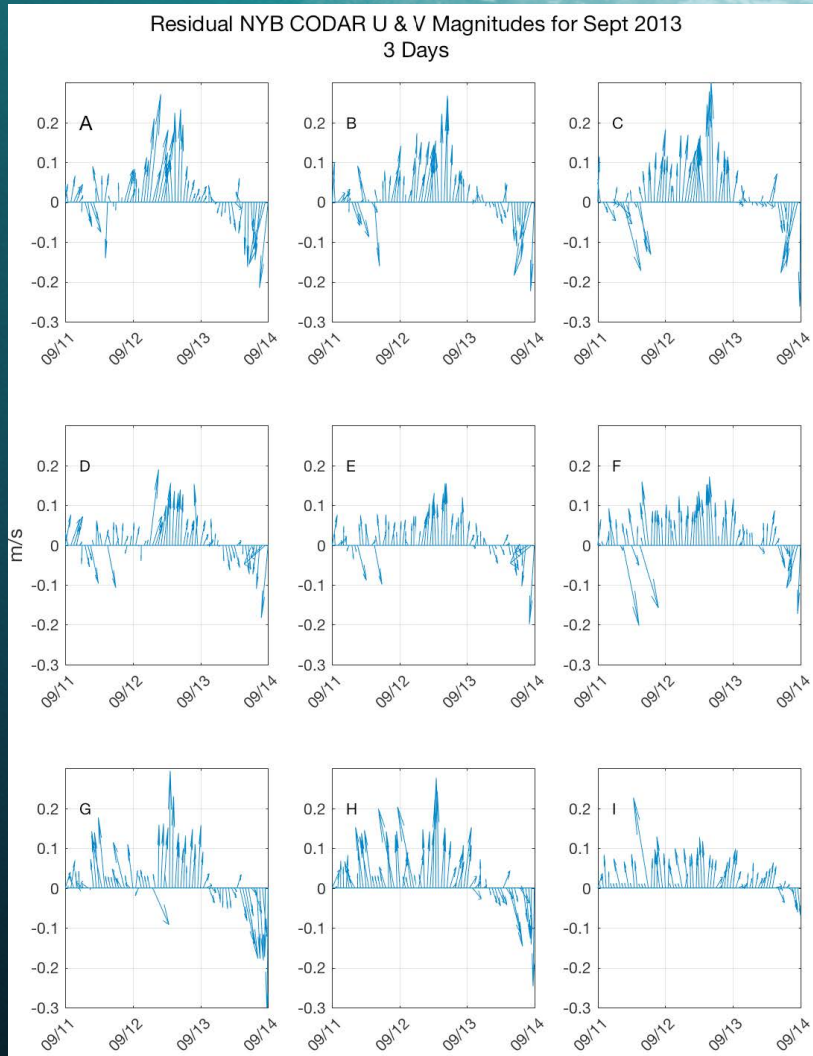
Tidally Driven – M2 & K1

M2 & K1 Tidal Current Ellipses from Fill 2



CODAR

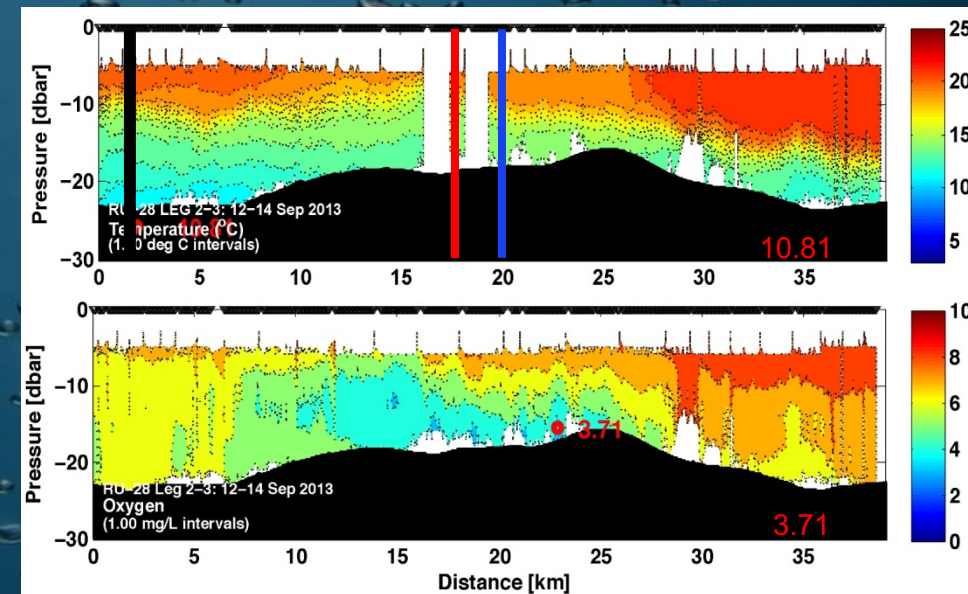
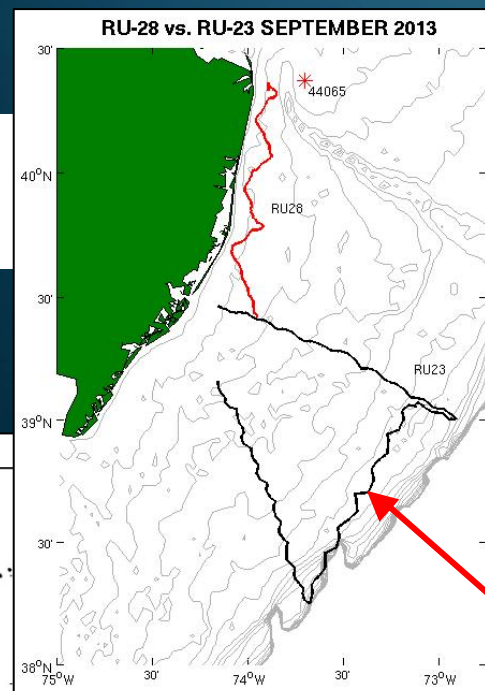
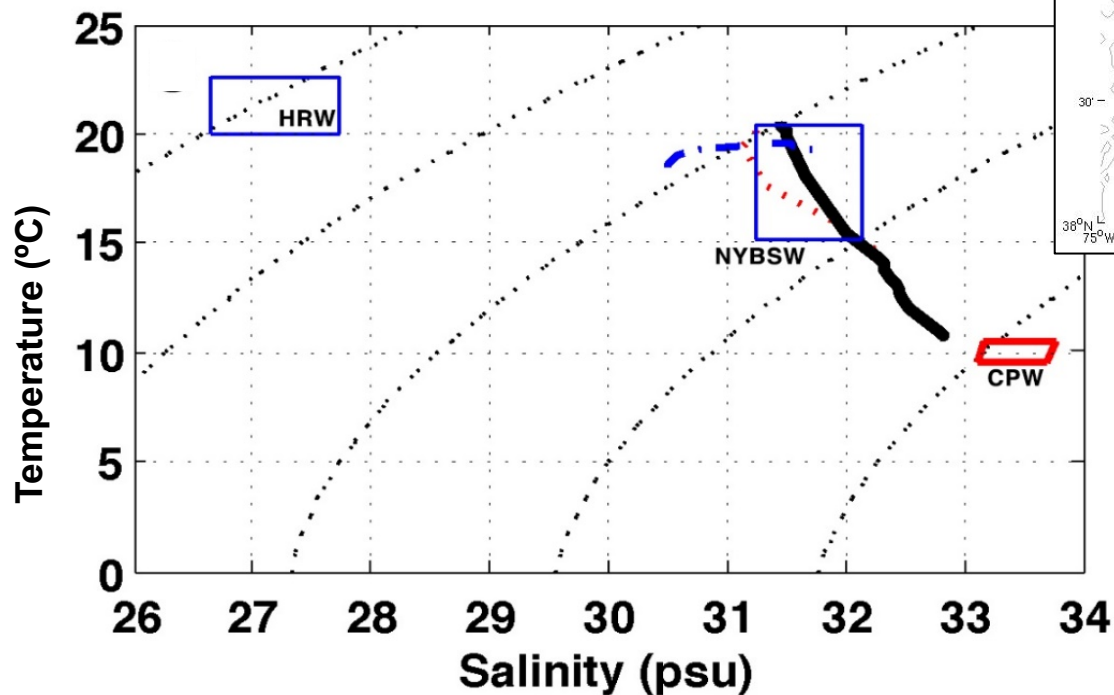
Residual Currents



Water Mass Analysis

T-S Diagram: RU28 Leg 2

Mid Transect T-Min -10.81 **Most Coastward**
STA 873 red STA 351 black **STA 893 blue**



September 2013 Definitions:

MAB Cold Pool Water - CPW

T: 9.489 °C - 10.511°C RU23: Leg 2 profile
 S: 33.18 PSU - 33.78 PSU

New York Bight Surface Water - NYBSW

T: 15.15 °C - 20.43°C RU28: Leg 1 profile
 S: 31.23 PSU - 32.13 PSU

Hudson- Raritan River Water - HRW

T: 19.98 °C - 22.57 °C NY-EPA:
 S: 26.64 PSU - 27.74 PSU Old Orchard Light

WM Contributions

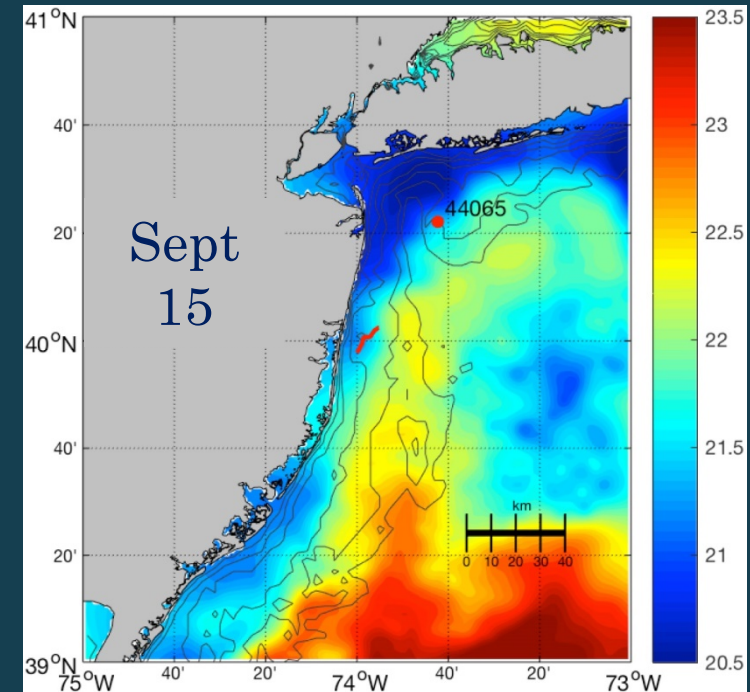
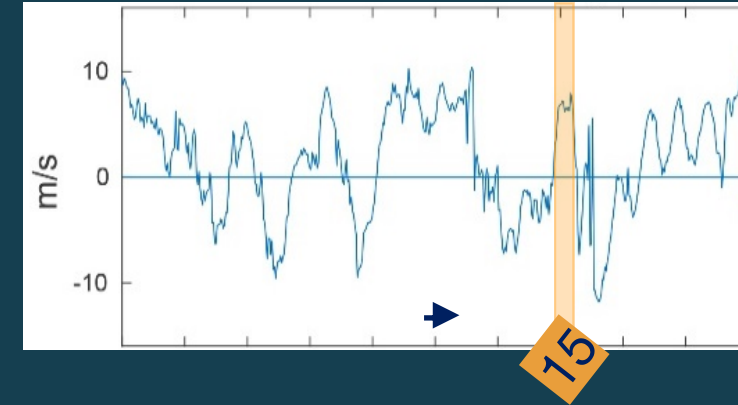
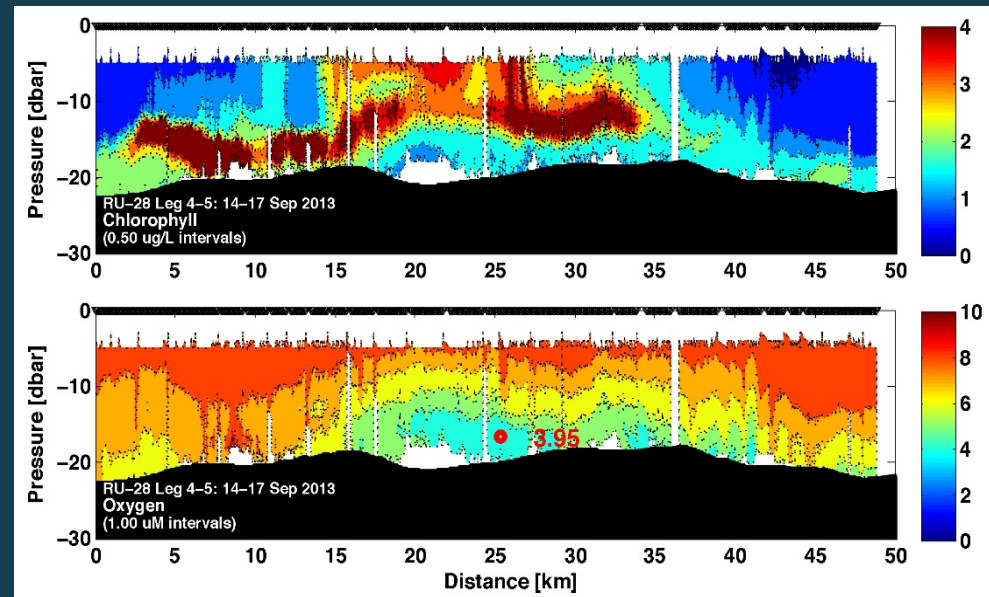
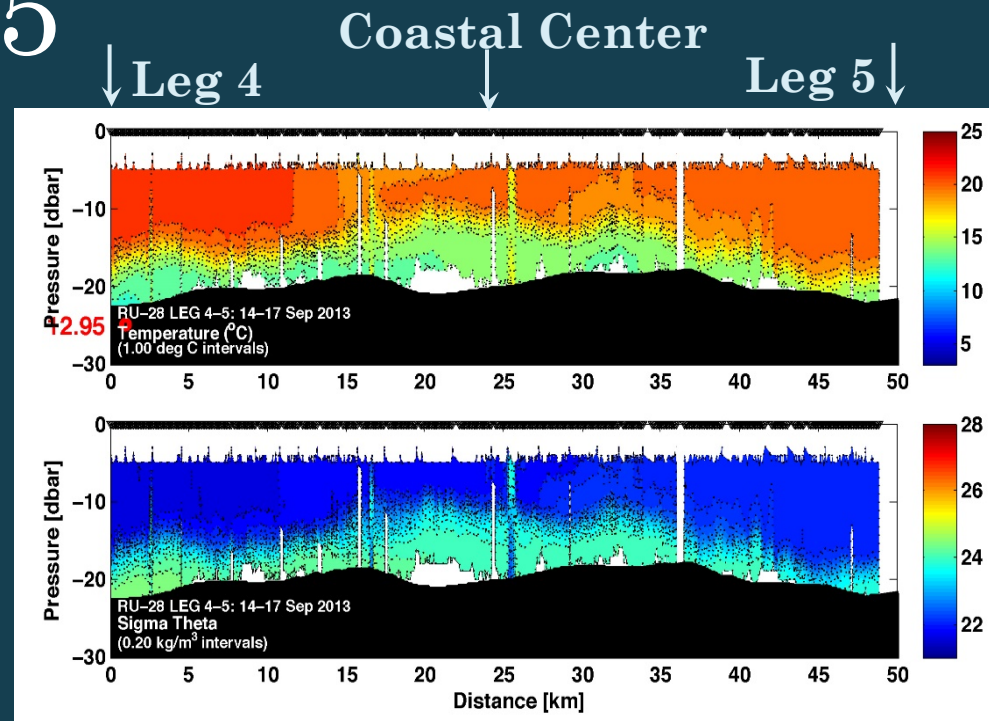
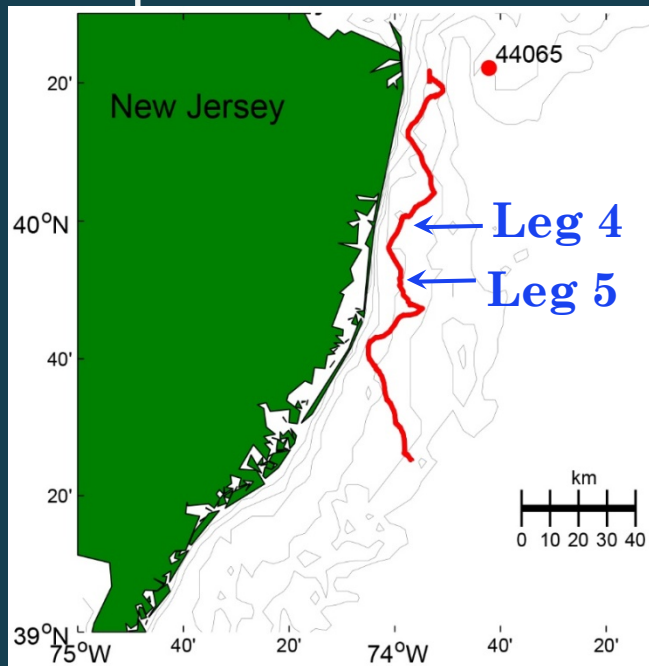
STA 873 red

Top: **16% CPW**
 75% NYBSW
 10% HR

Bottom: **67% CPW**
 22% NYBSW
 11% HR

RU28: Leg 4-5

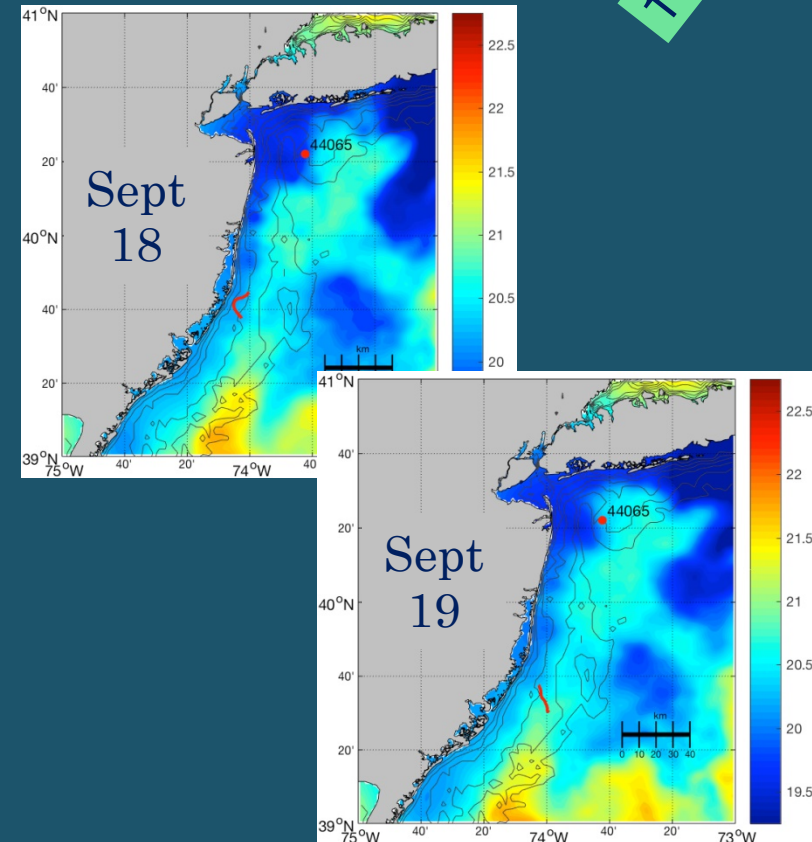
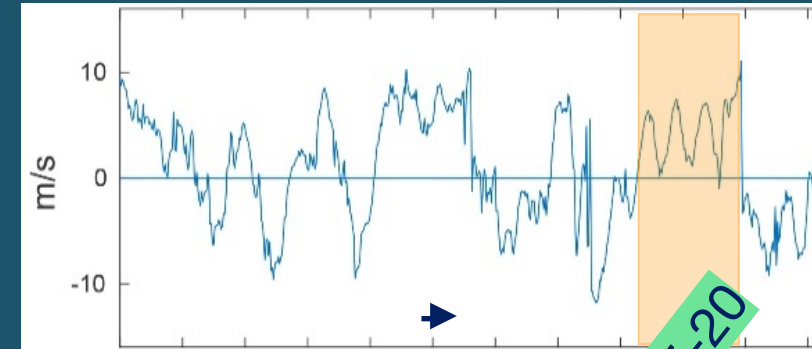
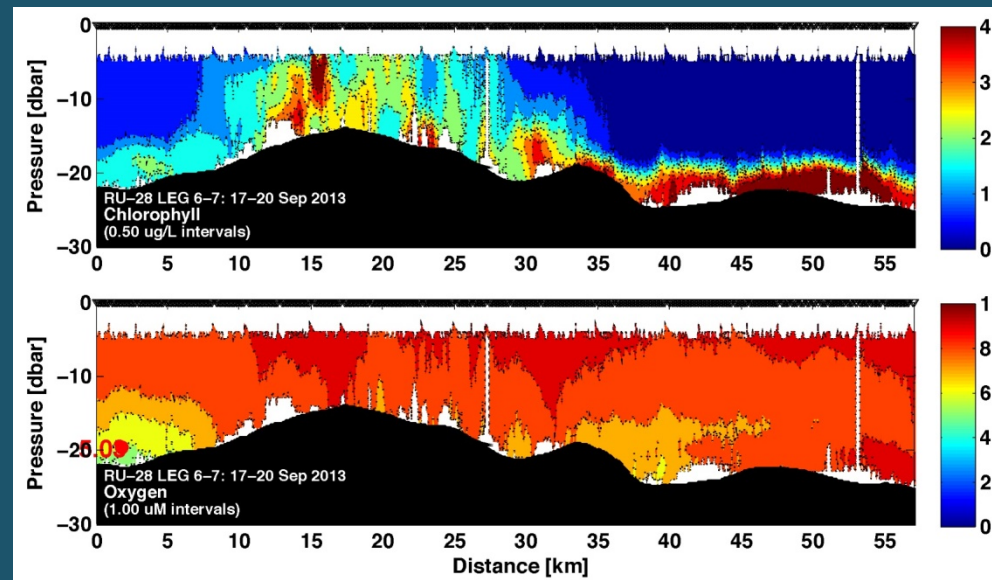
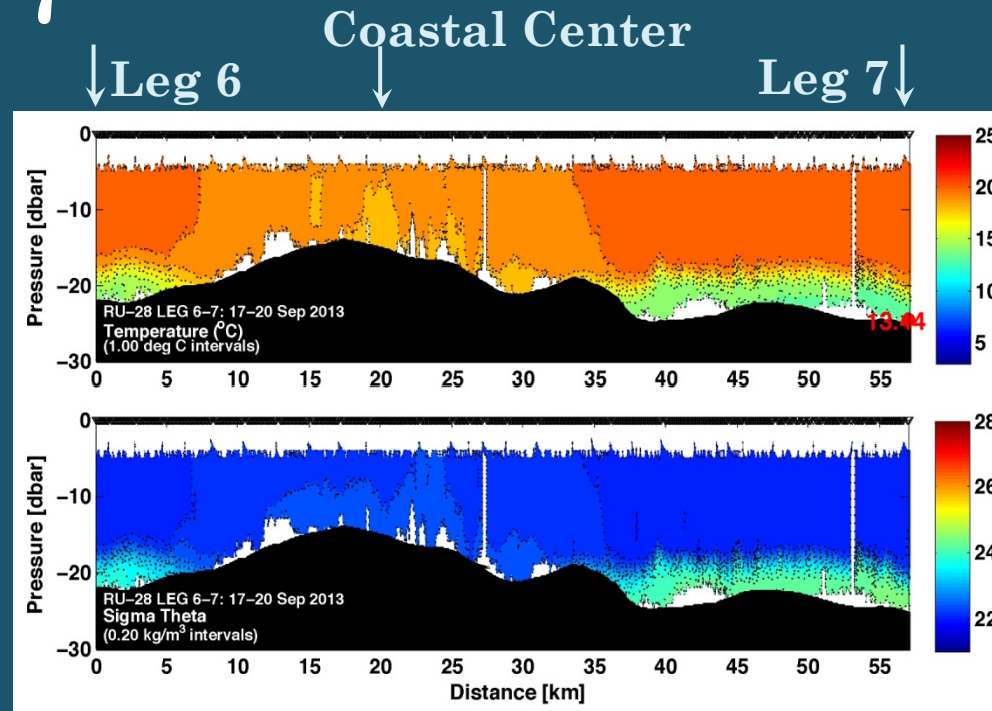
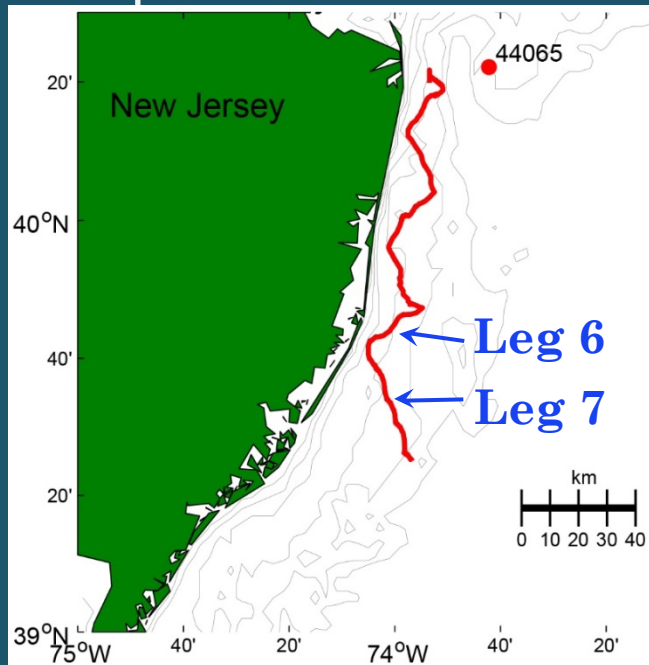
Sept 14-17



RU28: Leg 6-7

Sept 17-20

Raised Bathymetry



Summary

- Found uplifted thermocline / pycnocline in response to upwelling favorable
- Identified a SST cold patch consistent with upwelling.
- Identified CODAR derived currents consistent with upwelling favorable winds.
- Found hypoxia under aggregations of chlorophyll-a.
- Cold Pool water mixing in the T-min profile Leg 2 & 3.

Future Plans: Compare the glider depth averaged velocities to the data set.



Many Thanks!

This research has benefited significantly through advisement from Dr. Wendell Brown and Richard Arena.

Also, thanks to the whole Rutgers University crew for their NJDEP/EPA glider efforts.

Contact Information:

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Funding provided by NOAA's Integrated Ocean Observing System (IOOS) via subcontract to Rutgers University.

