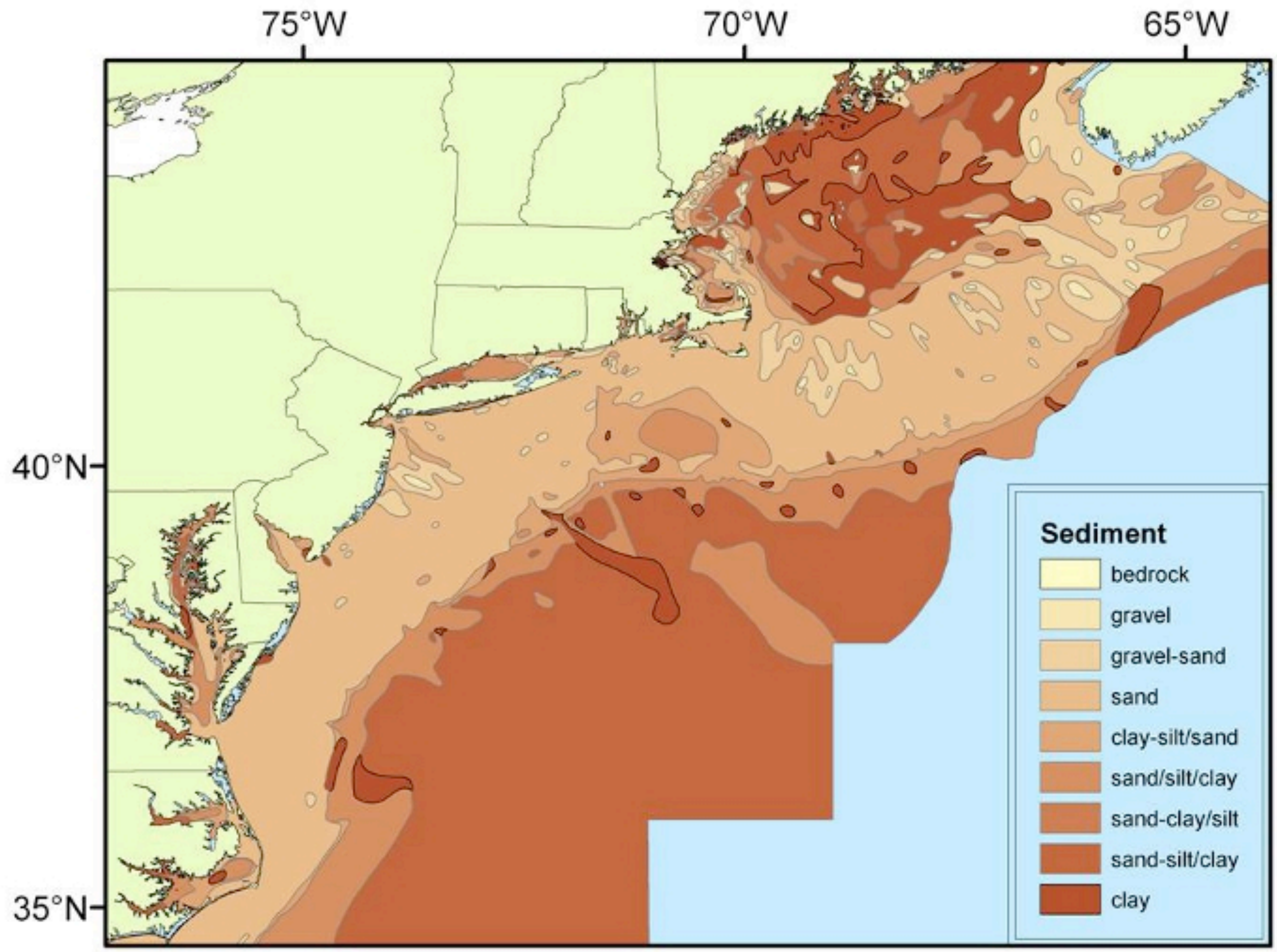
Slides for Dec 2014 Seabed Characterization Program Workshop

“Water Column Issues”

Tim Duda

WHOI

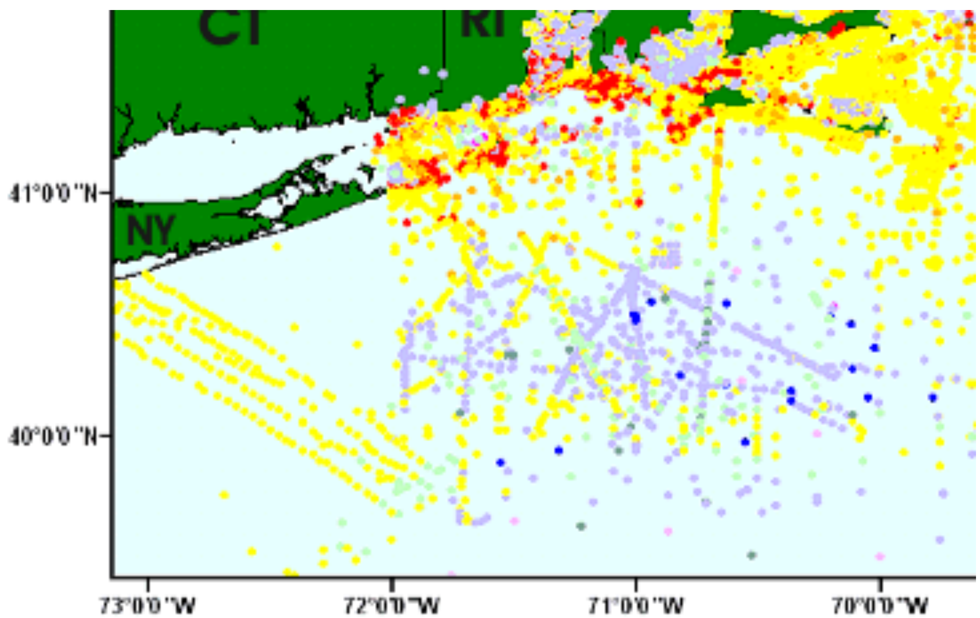
http://www.nefsc.noaa.gov/ecosys/ecology/PhysicalSetting/
"Mudpatch" 70 to 72 W, 40 to 40.7 N, oval.

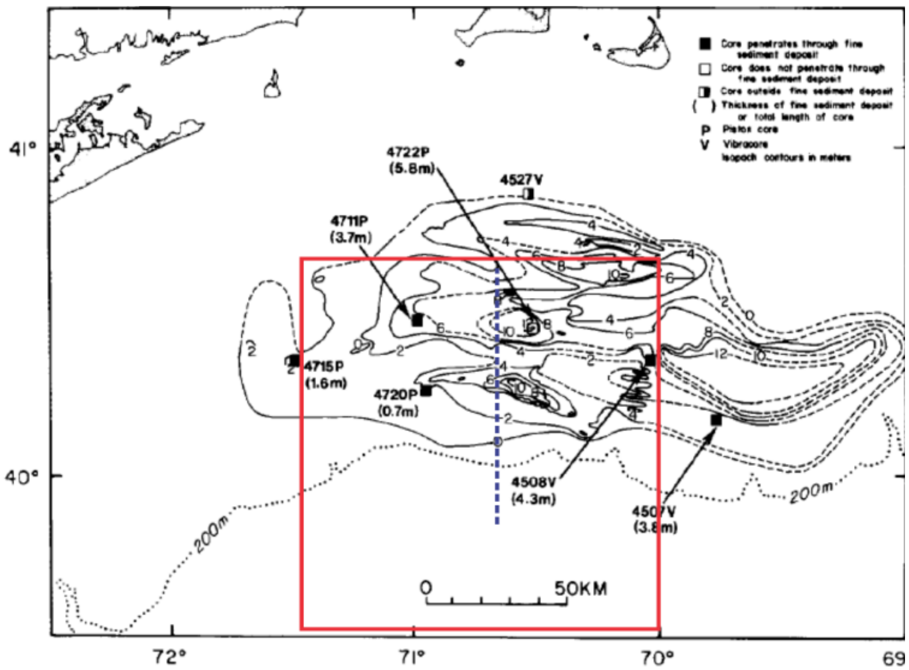


The mud patch lies west of an area of exaggerated tides at Fundy/Gulf of Maine, downstream in the prevailing shelf current

U.S. Geological Survey Open-File Report 03-001
Surficial Sediment Data from the Gulf of Maine, Georges Bank, and Vicinity:
A GIS Compilation

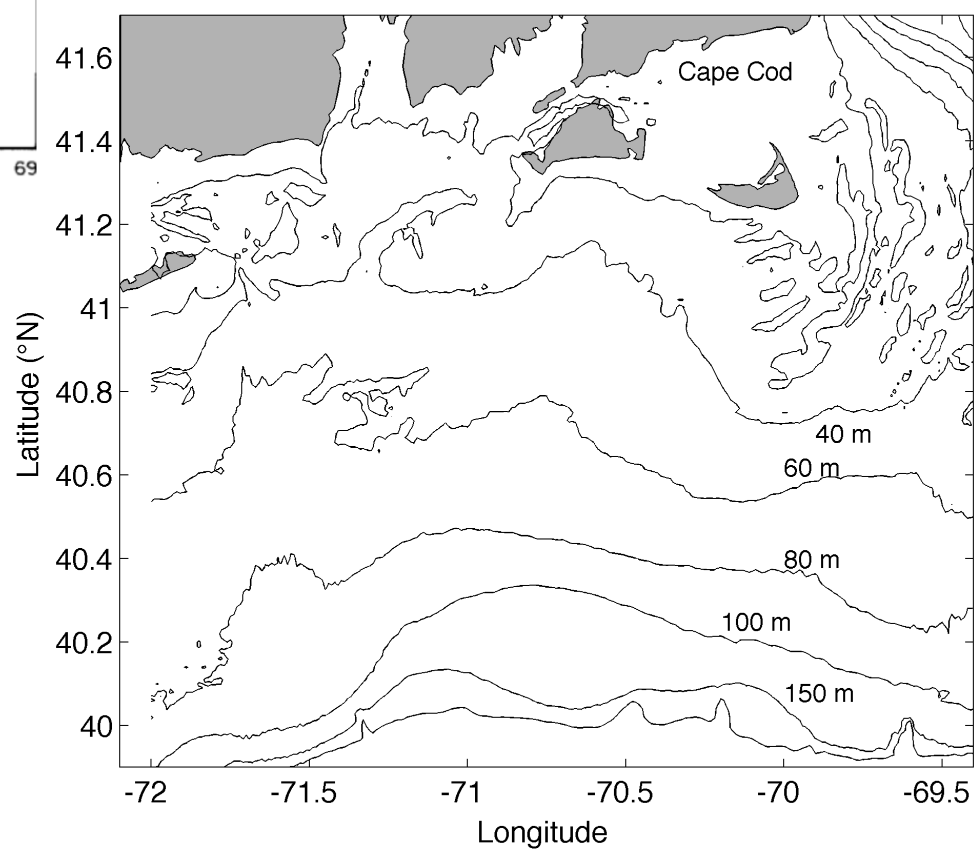
Lilac means mud.

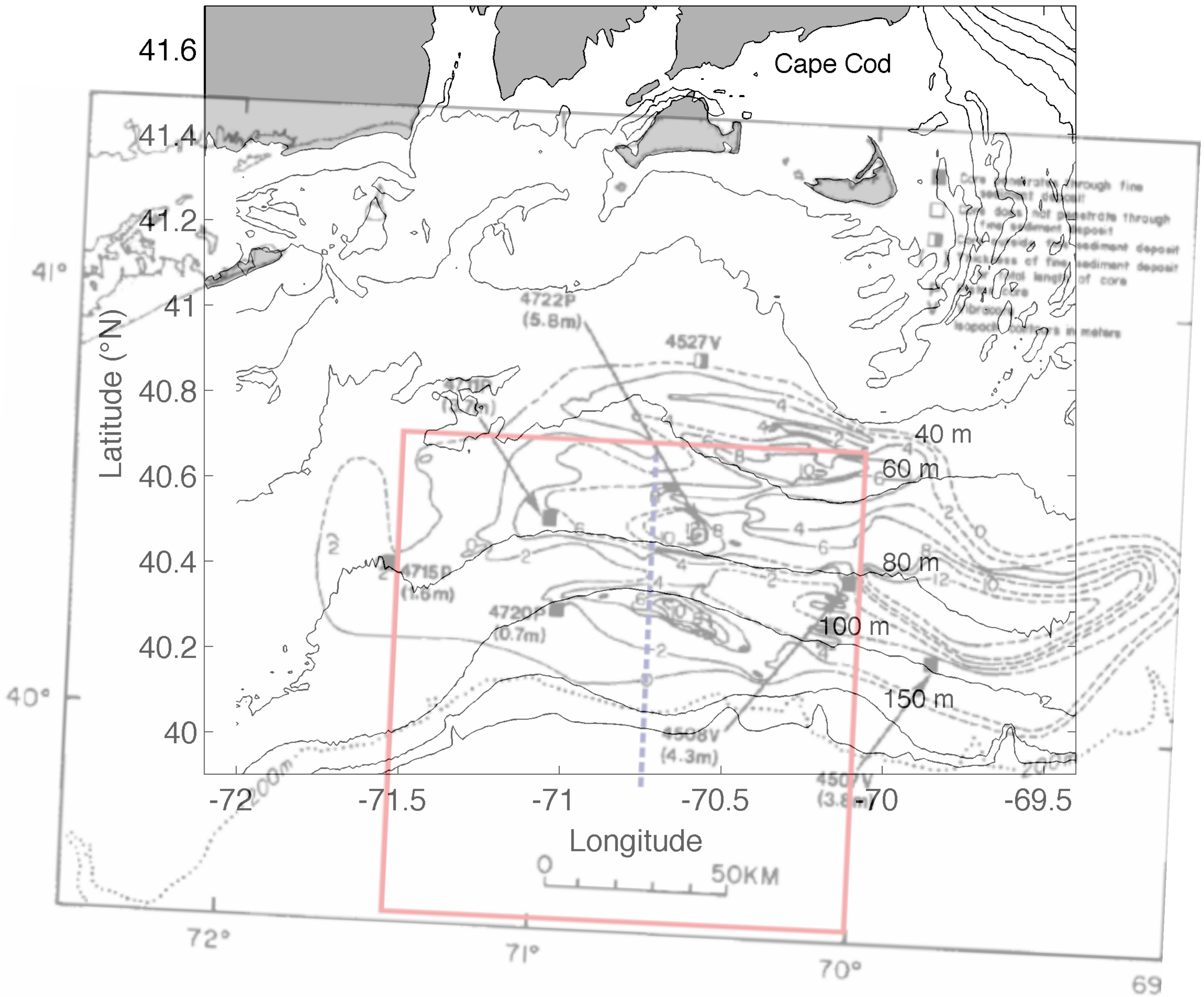




Above: Twichell's mud layer map.

This is overlaid onto the bathymetry on the next slide.



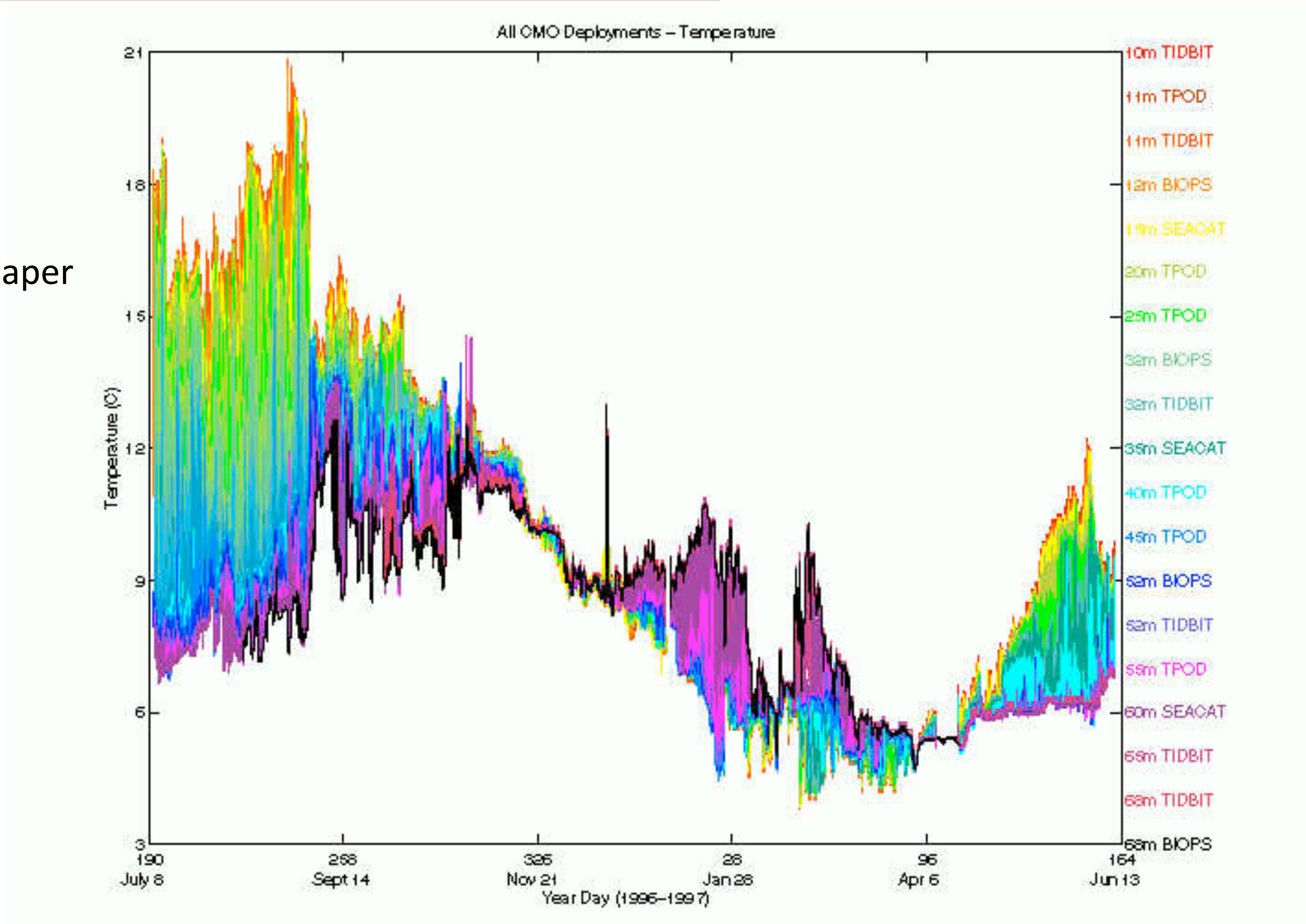


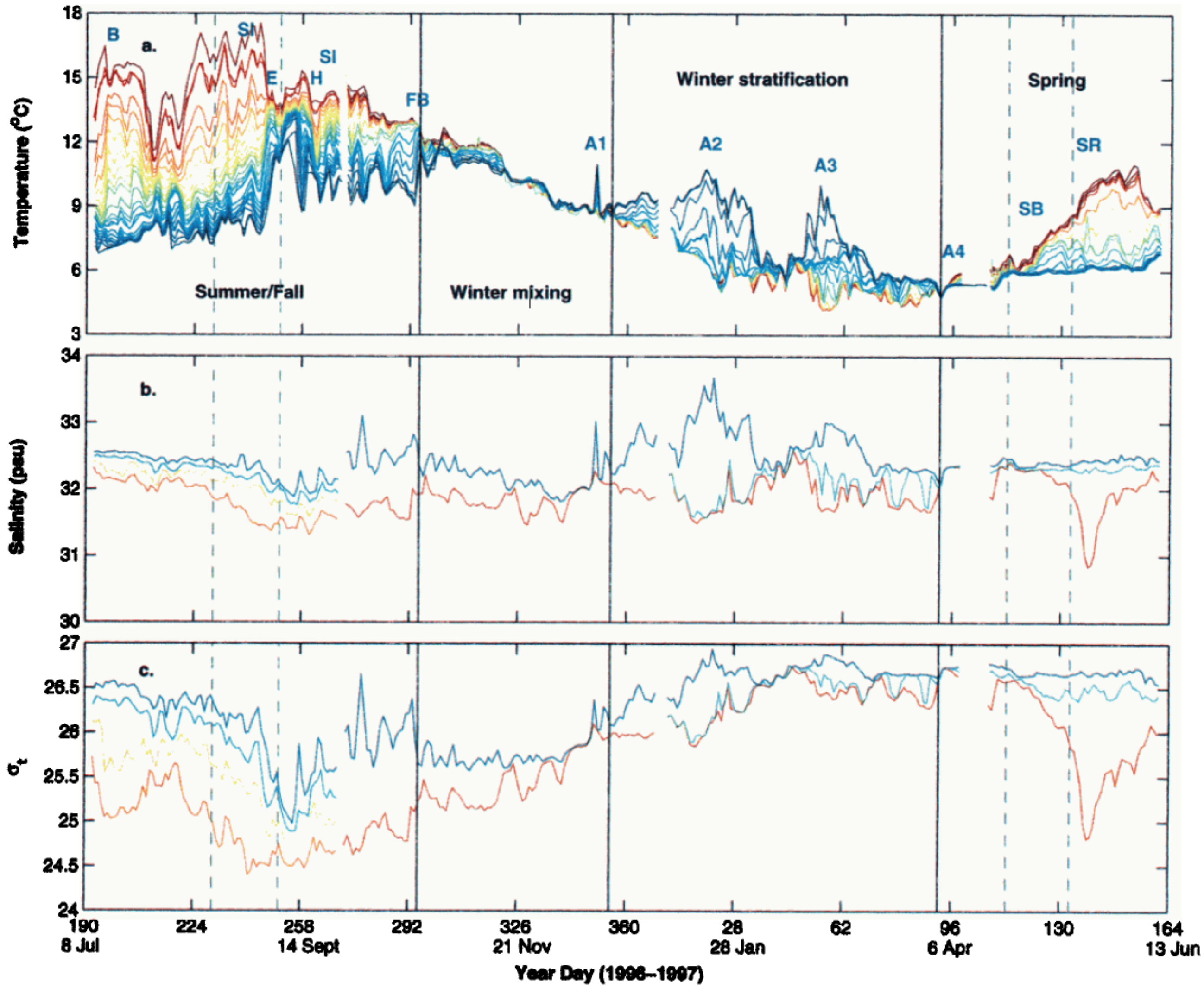
Cape Cod
41.6
41.4
41.2
41
40.8
40.6
40.4
40.2
40
Latitude (°N)
-72
-71.5
-71
-70.5
-70
-69.5
Longitude
40 m
60 m
80 m
100 m
150 m
4722P
(5.8m)
4527V
4715P
(1.6m)
4720P
(0.7m)
4508V
(4.3m)
0
50KM
41°
40°
72°
71°
70°
69

Deployment	Date Deployed	Date Recovered	Location
1	July 8, 1996	Sep 26, 1996	40.5°N, 70.5°W
2	Sep 27, 1996	Jan 4, 1997	40.5°N, 70.5°W
3	Jan 6, 1997	April 4, 1997	40.5°N, 70.5°W
4	April 17, 1997	June 10, 1997	40.5°N, 70.5°W

ONR sponsored
year-long moored temperature record.

Chang,
Dickey paper
JGR

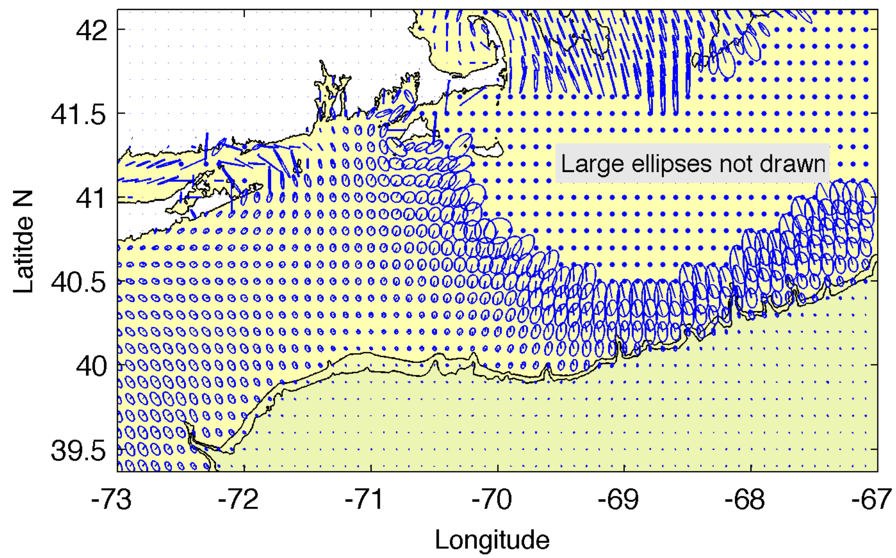




Chang
Dickey
JGR vol 106

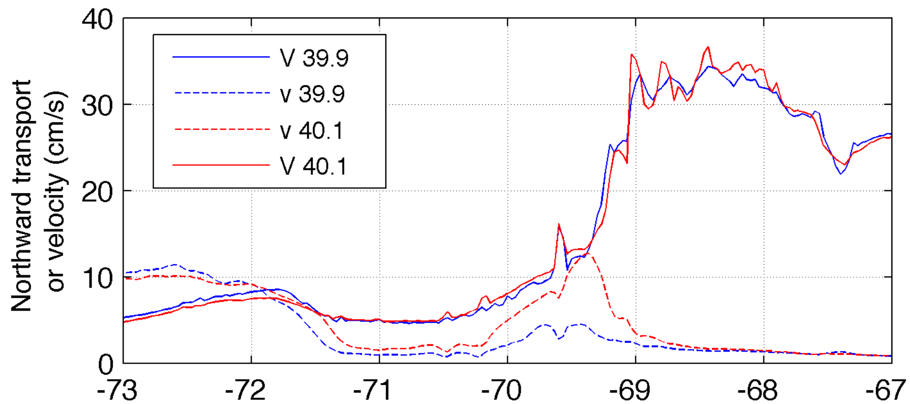
Plate 1

Plate 1. Time series stack plots of 36 hour averaged (a) temperature, (b) salinity, nd (c) sig- t during the 11 month experimental period. The depths o f temperature sensors w ere approximately every 3 m between 11 (red) and 68 m (blue; Tables 1, 2, and 3). Salinity sensors ere deployed a t 15 (red), 35 (green), and 60 m (blue) except during the summer/fall period, hen he depths were 11.5 (red), 26 (orange), 39 (cyan), and 54 m (blue; Tables 1, 2, and 3). The same color coding of depths used for Plate lb is used for Plate lc. Dates are also presented as decimal year day, with the convention that 0 hours UTC January 1 is day 1.0. Events are B, E, and H, Hurricanes Bertha, Edouard, and Hortense, respectively; S, I, high-salinity water mass intrusions; FB and SB, fall and spring bloom, respectively; A1, A2, and A3, slope water advection events; and SR, spring runoff. Seasons are separated by black vertical lines and labeled. The green vertical dashed lines indicate the time periods when complementary profile data were obtained.

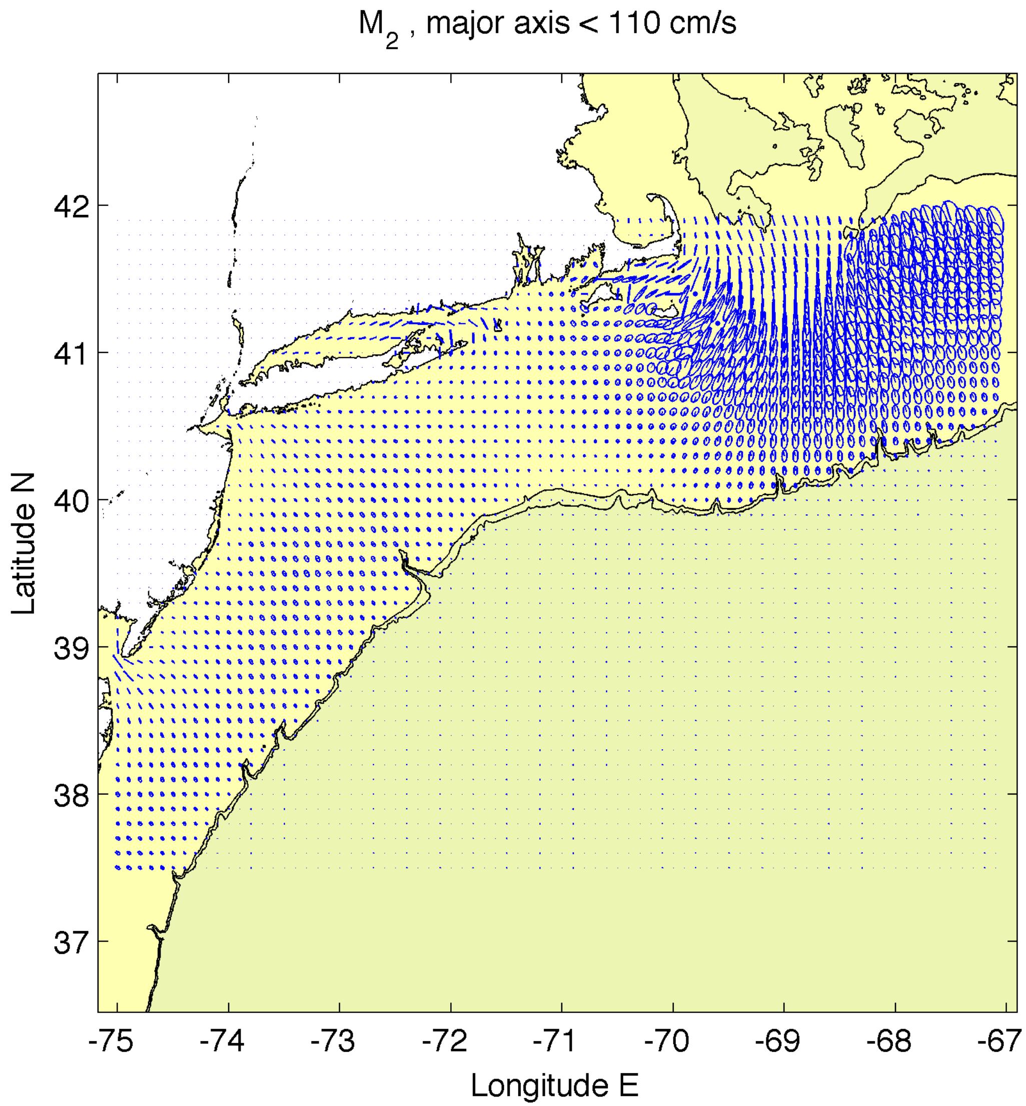


Tidal current ellipses.

M_2 (12.42 hour period)



Current along zonal lines 39.9, 40.1 lat.


M2 , major axis < 110 cm/s
Latitude N
42
41
40
39
38
37
-75
-74
-73
-72
-71
-70
-69
-68
-67
Longitude E

1996 2nd dye injection: Prevailing westbound current

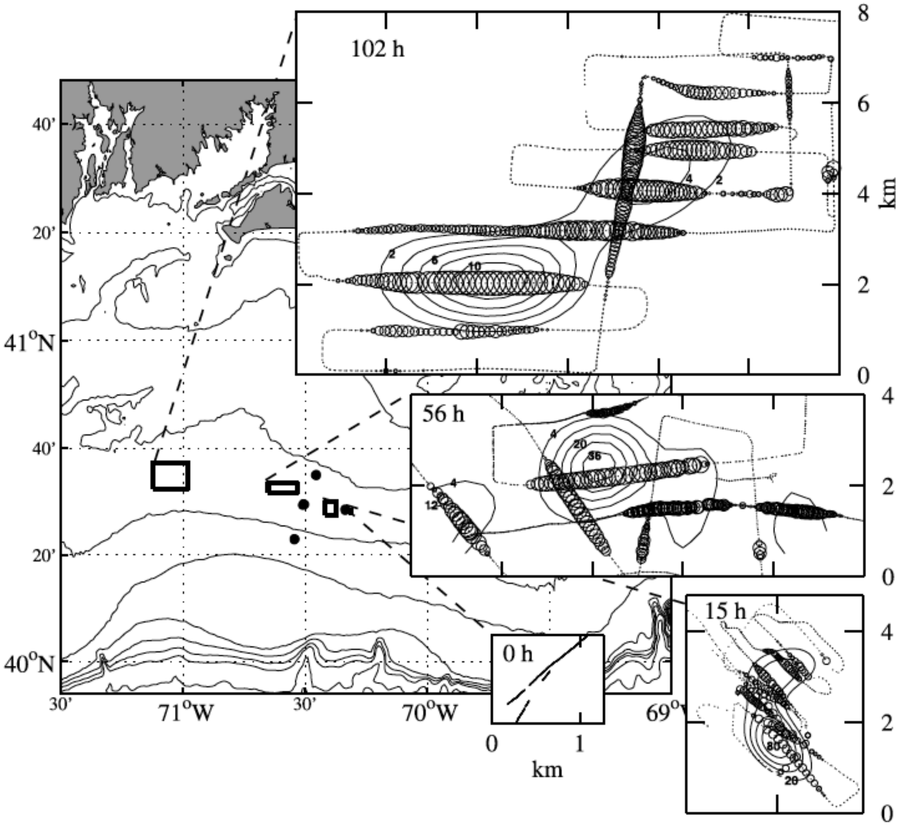


Figure 4. Plan view of Experiment 3. The injection streaks (0 hours) were broken up due to clogging of the lines. The survey maps are made by plotting a point for each profile, surrounded by a circle, with a diameter proportional to the logarithm of the column integral. A different concentration scale is used for each survey. Contours in the inset maps show the column integral of dye estimated from an objective mapping routine. The contour intervals are 20, 8, and 2 kg/m3 for the 15-hour, 56-hour, and 102-hour surveys, respectively. The positions within each survey have been transformed to a reference time using the integral of the shipboard ADCP velocity. The survey maps are all to the same scale, while the scale of the injection map at 0 hours is twice as great.

1997 1st dye injection: "No current"

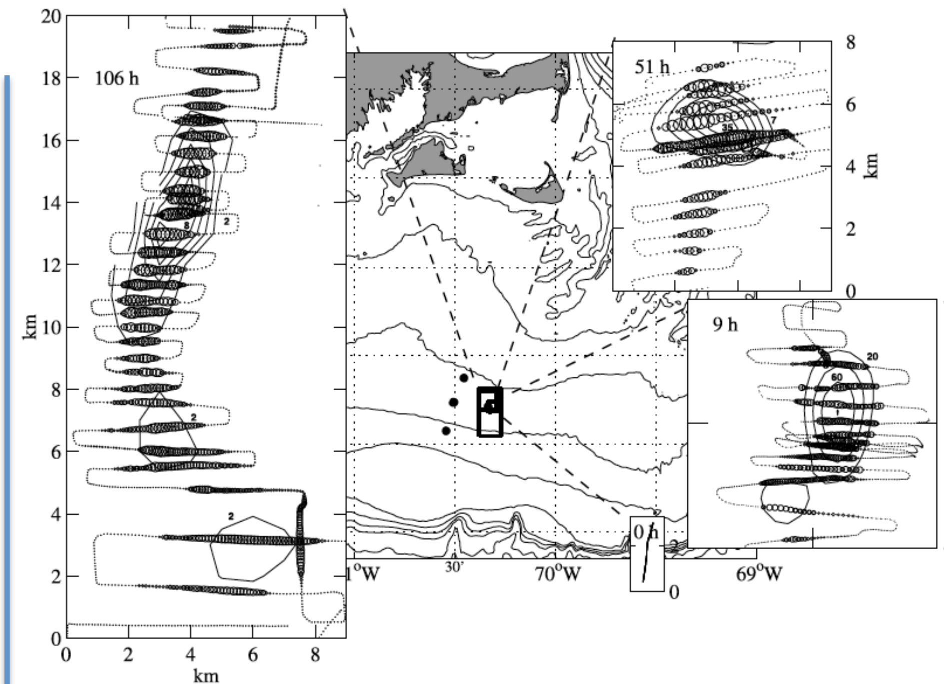


Figure 11. Plan view of Experiment 4. The survey maps are made as for Figure 4. The 9-hour inset has been expanded by a factor of 2 for clarity. The contour intervals are 20, 7, and 2 kg/m3 for the 9-hour, 51-hour, and 106-hour surveys, respectively. In this experiment the injection was continuous, and inconsistencies in the dye finds where tracks cross are less apparent.

Ledwell, Duda, Sundermeyer, Seim, JGR Vol 109, 2004.

1997 2nd dye injection: Eastward current

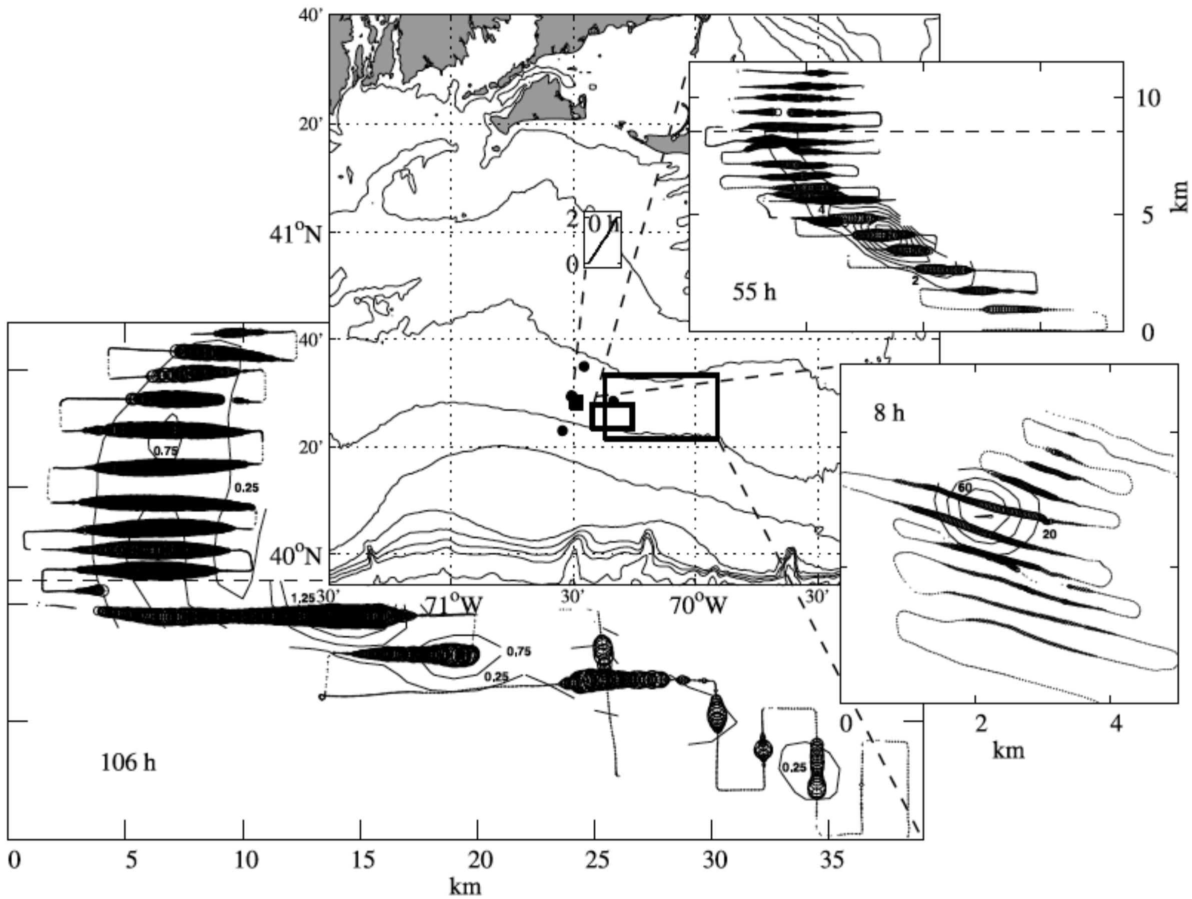
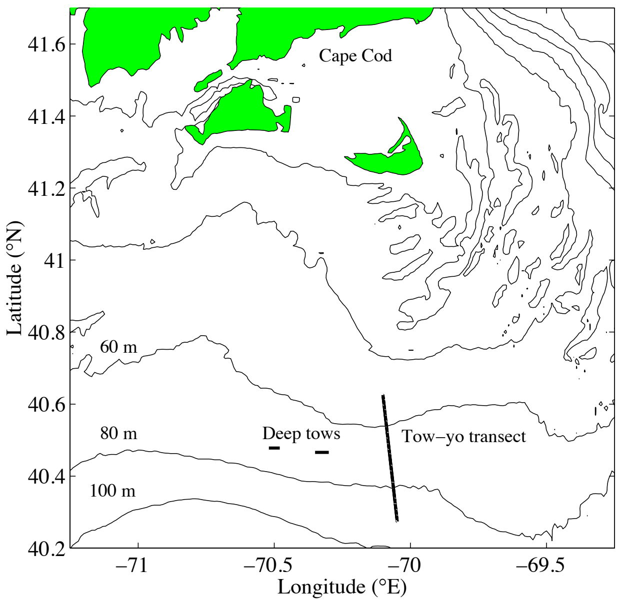
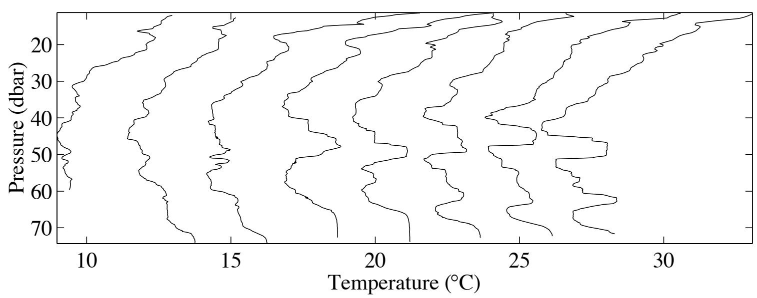
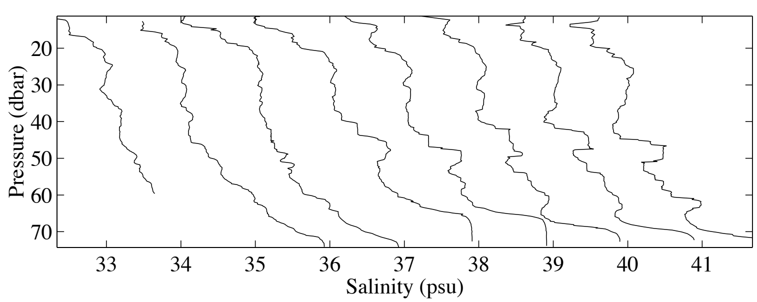
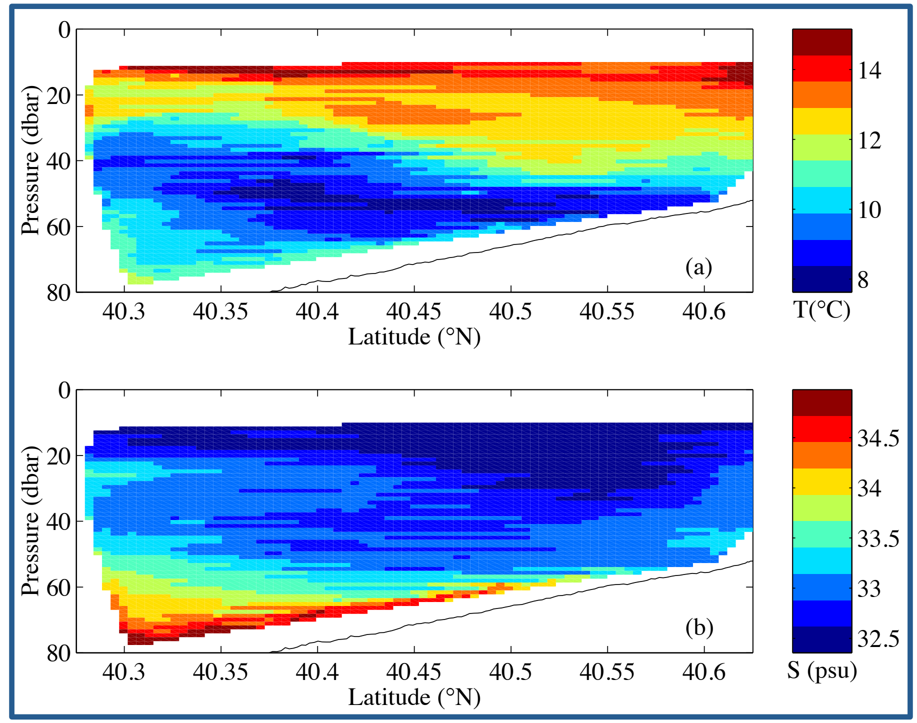


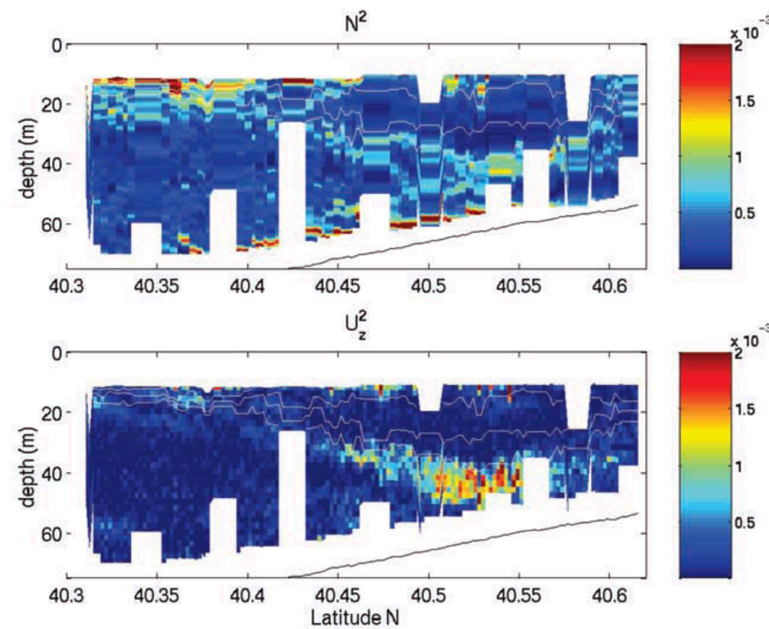
Figure 15. Plan view of Experiment 5. The survey maps are made as for Figure 4. The 8-hour inset has been expanded by a factor of 3 for clarity. The contour intervals are 20, 2, and 0.25 kg/m3 for the 8-hour, 55-hour, and 106-hour surveys, respectively. The dashed lines in the 55-hour and 106-hour panels separate the bottom-attached part of the patch, to the north, from the interior part of the patch, to the south.





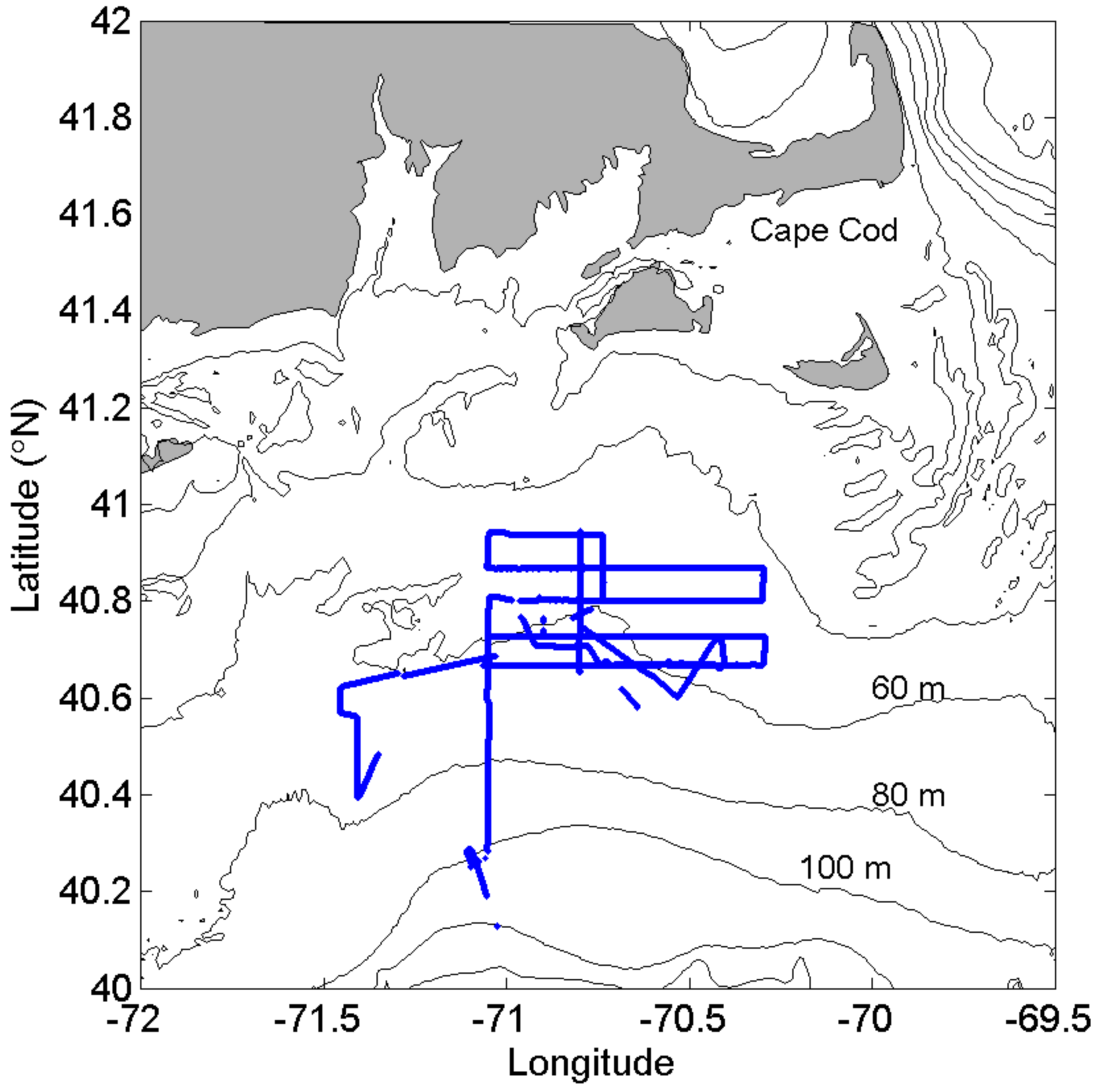






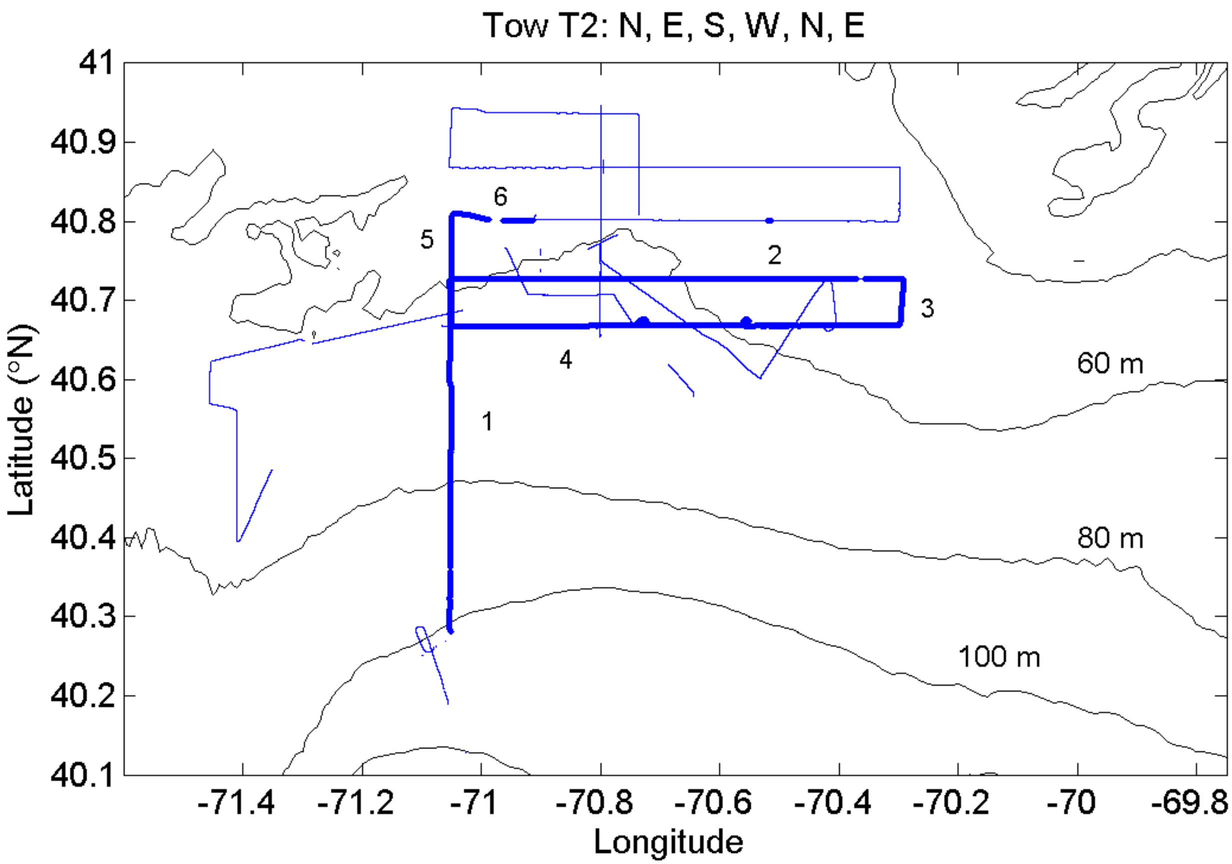
Tow-yo system showing intrusion at the offshore end of transect

Micro-conductivity towfish transects, August 2004



Micro-Conductivity towfish transects

First 6 (of 25) annotated.



Modal wavenumber and phase-speed anomalies of large intrusions

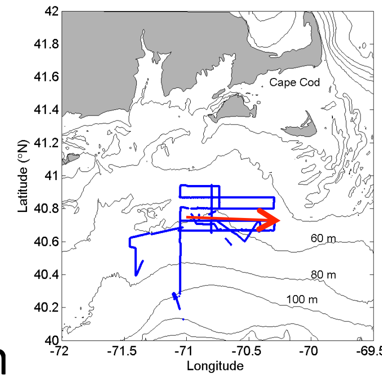
- The spatial scales differ from those of internal waves
- Fronts/intrusions and IW have comparable modal *k* and C_p variances
- Shapes and anisotropy poorly known; surmise that anisotropic fronts create anisotropic intrusions.
- Snell's law:

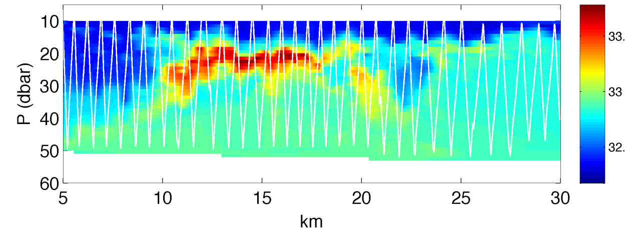
$$\theta \text{ crit.} = \cos^{-1}(k+\Delta k / k)$$

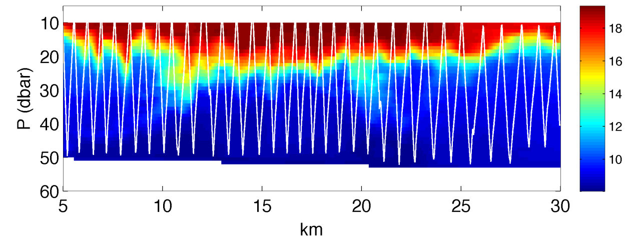
$$= \cos^{-1}(C_p / C_p+\Delta C_p)$$

$$4.7° = \cos^{-1} (1500/1505)$$

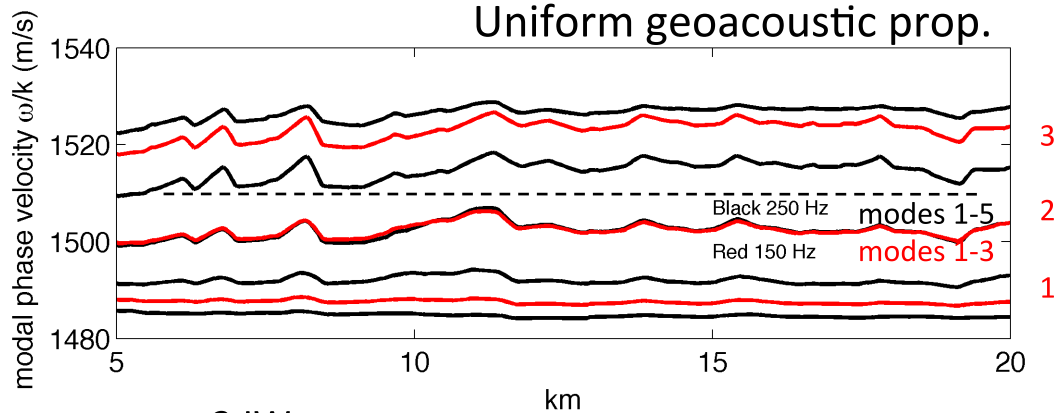
Tow 2 leg 2
(micro transect 2)



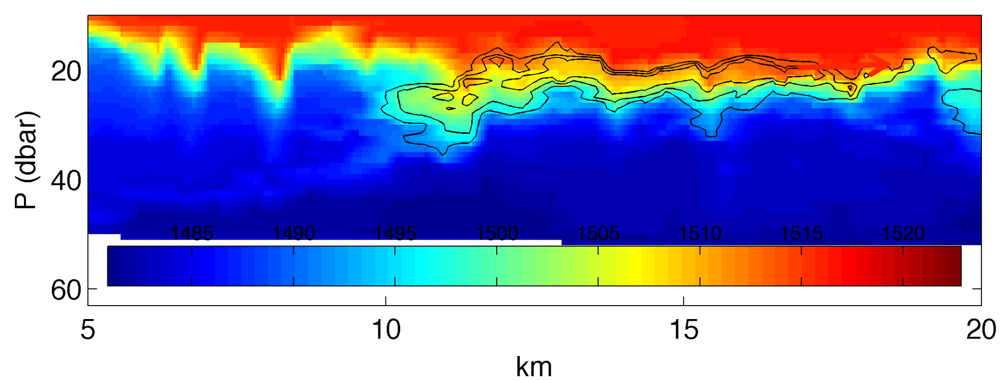




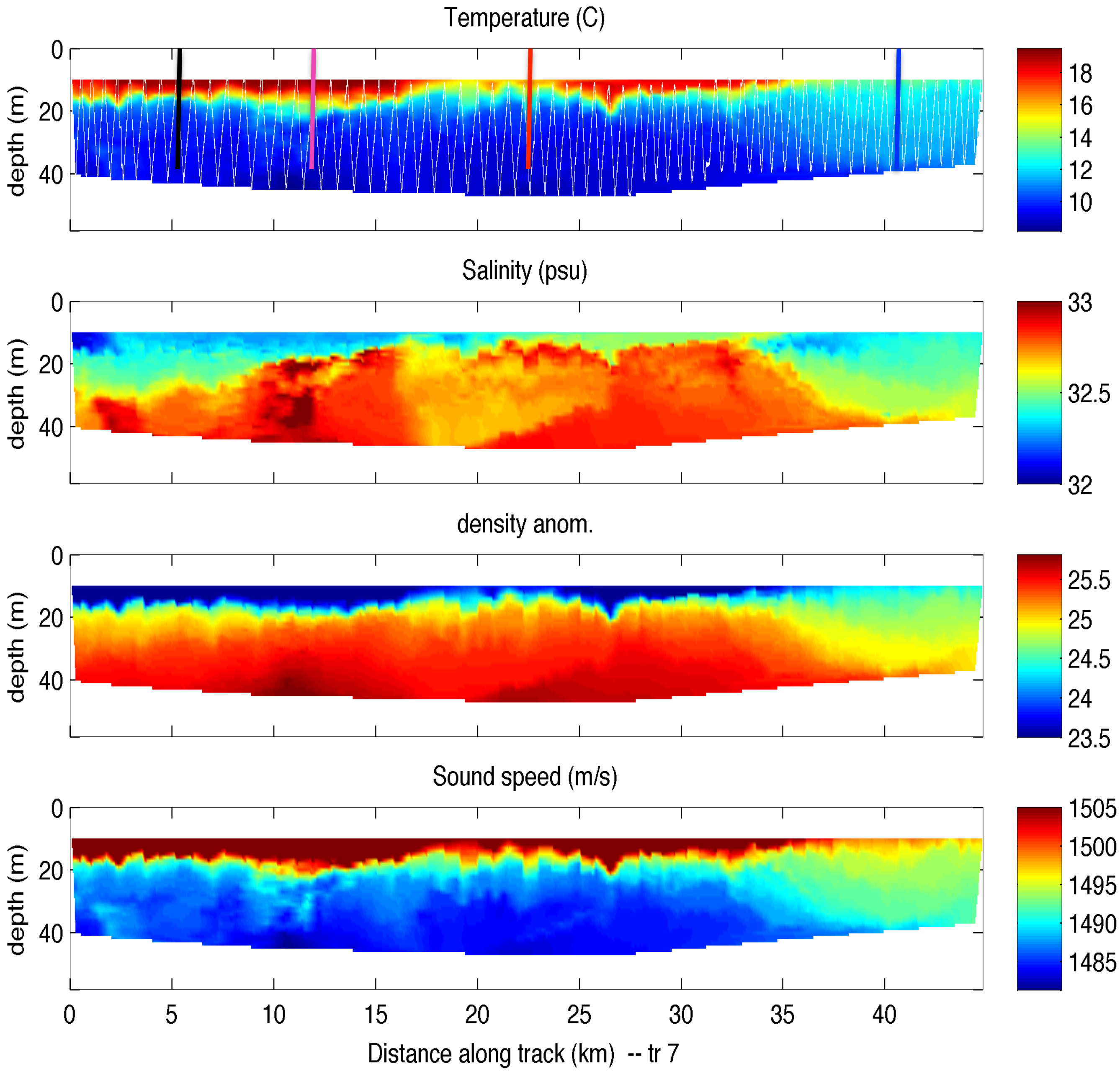
Uniform geoacoustic prop.

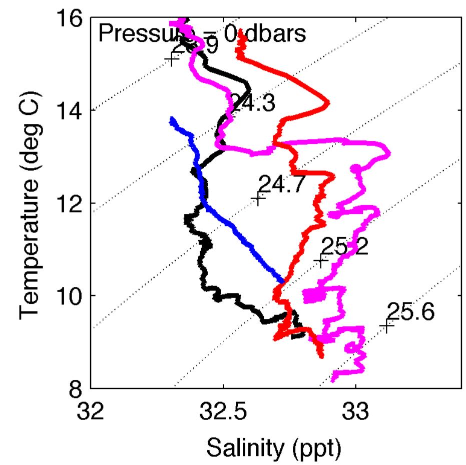


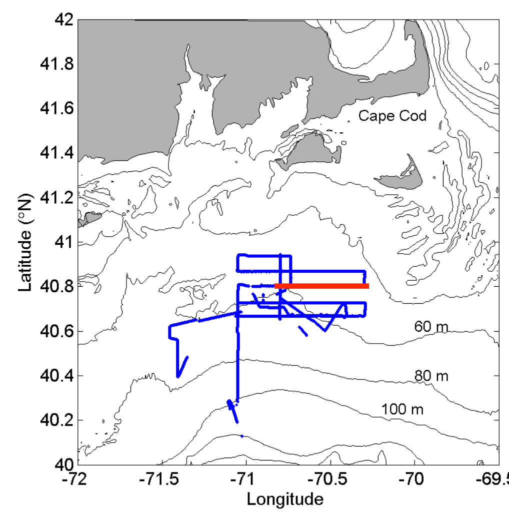
3 IW

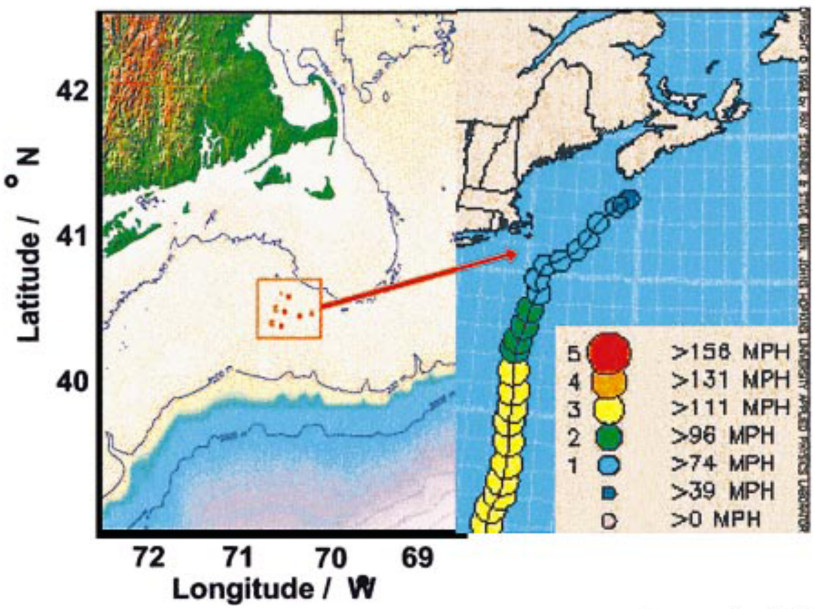


Tow 3 leg 1
(transect 7)









MacKinnon, J. A. and M. C. Gregg, "Mixing on the late-summer New England Shelf-solibores, shear, and stratification," J. Phys. Oceanog., vol. 33, pp. 1476-1492, 2003.

FIG. 1. Location of the CMO experiment (square in left panel). Profiling took place near the central site (labeled ''C'') in a box 1.5 km wide (not shown). The right panel represents the path and changing wind speed of Hurricane Edouard in early September. (Panels are at different scales.) The arrow between panels indicates the rough location of the CMO site. Right panel courtesy of S. Babin and R. Sterner, The Johns Hopkins University Applied Physics Laboratory.

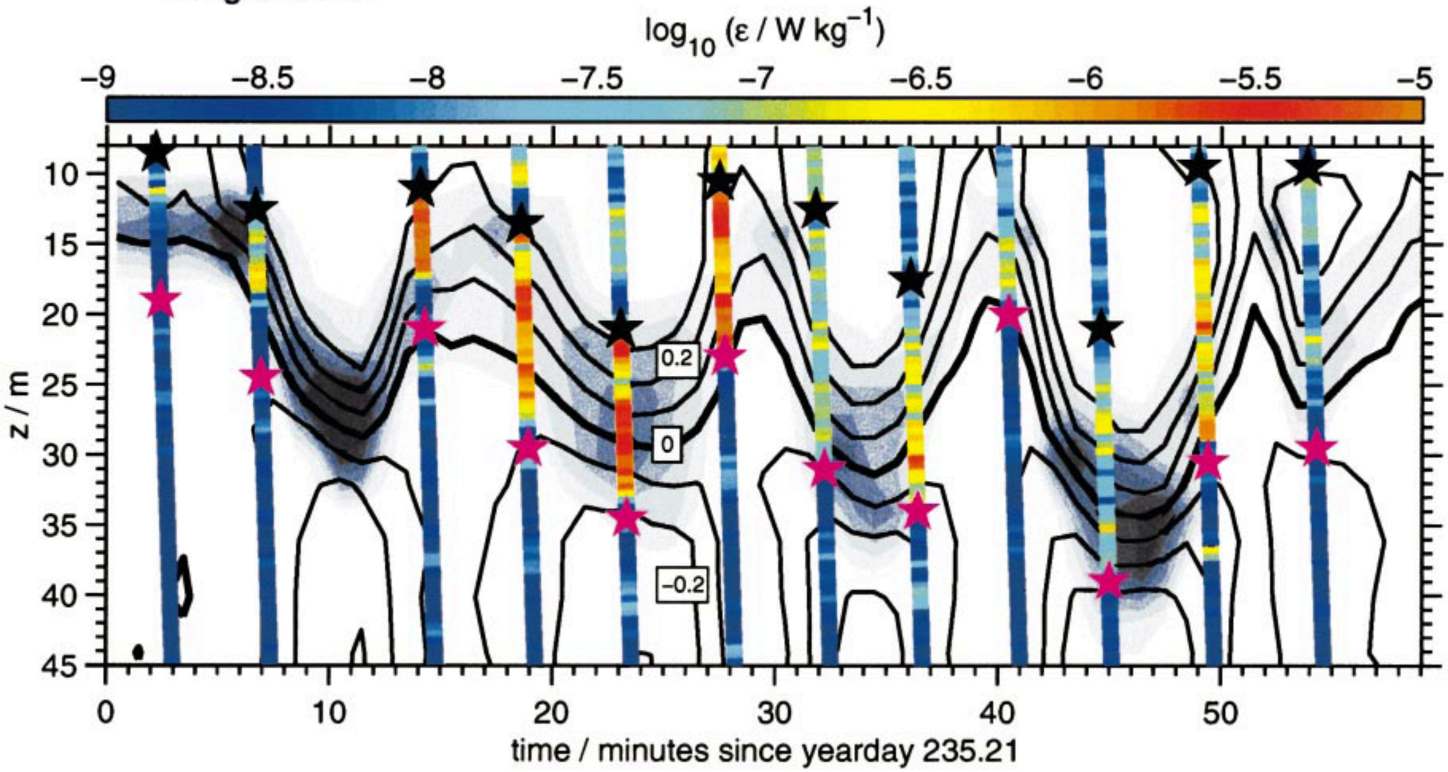
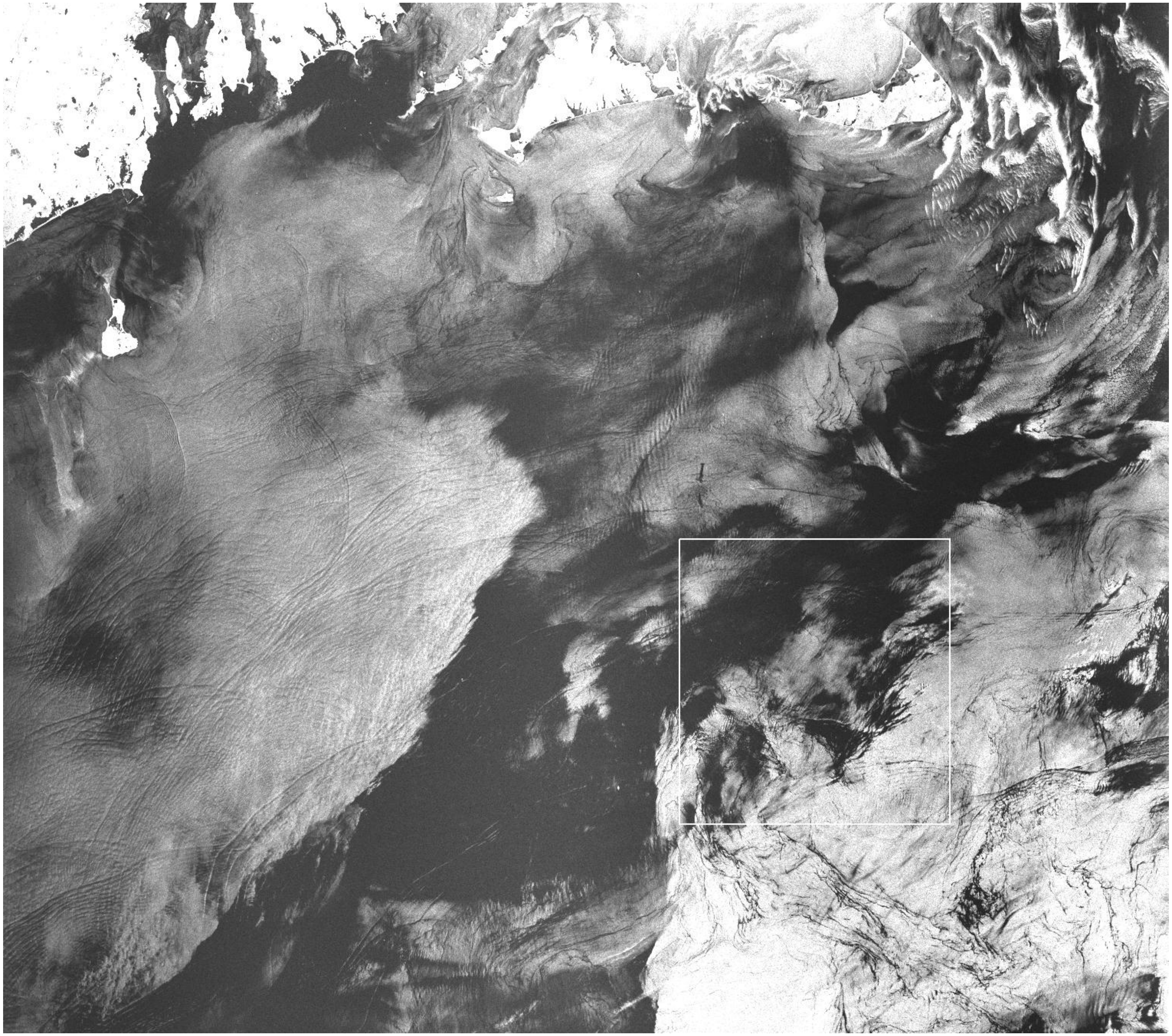


FIG. 10. The solid lines are contours of northward (onshelf) baroclinic velocity from 20.3 to 0.3 m/s in intervals of 0.1 m/ s.

The shaded areas are 4-m shear variance, … Dissipation rate overlain (color)



CMO
SAR
Images

Nonlinear
internal
waves