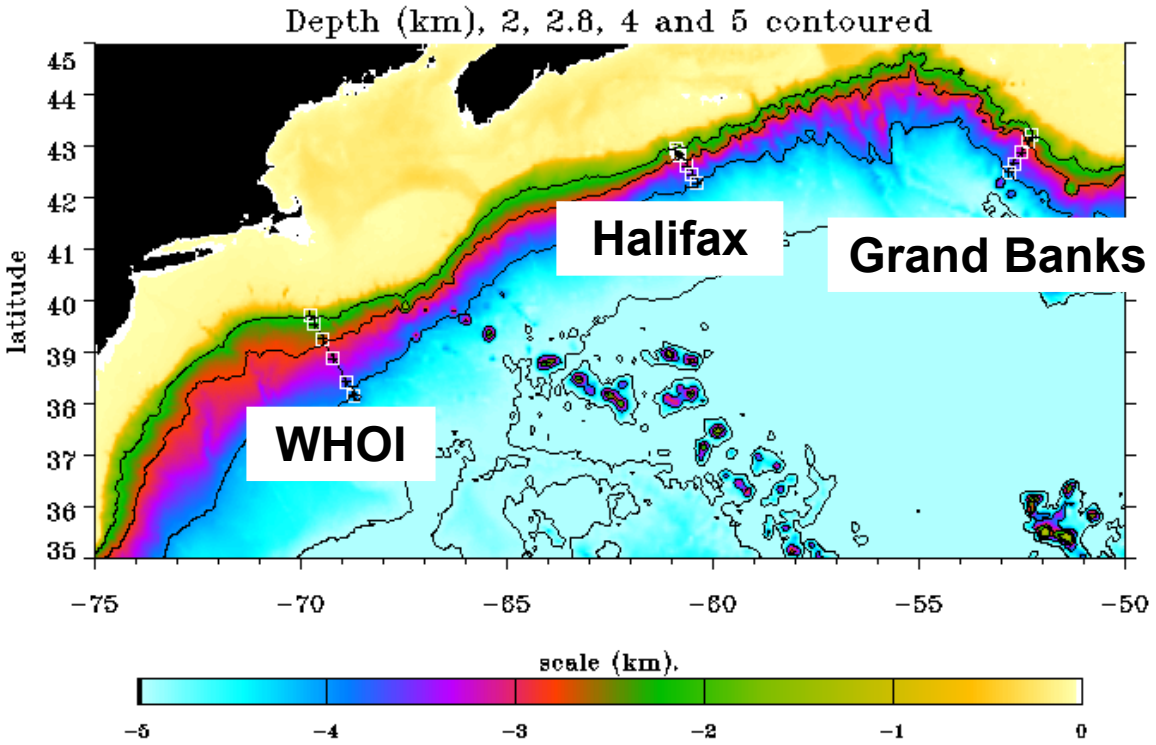
RAPID-WAVE moorings in the Northwest Atlantic

M. A. Morales Maqueda
Proudman Oceanographic Laboratory

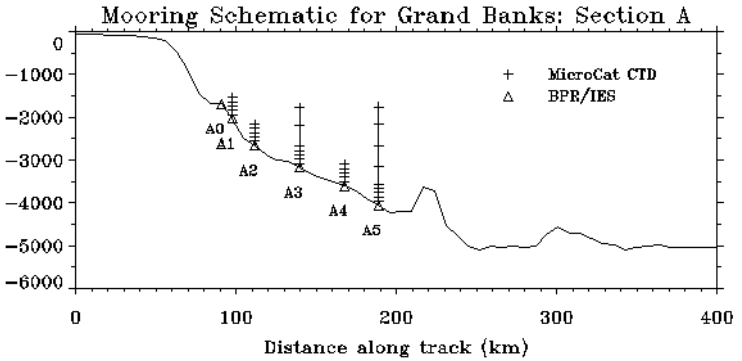
West Atlantic Variability Experiment (WAVE)

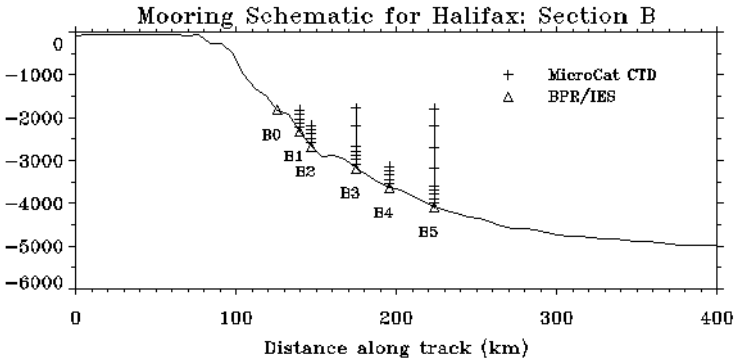
i. How do signals propagate along the Atlantic's deep western boundary current?
ii. Can the meridional overturning circulation be monitored from the Atlantic western boundary?

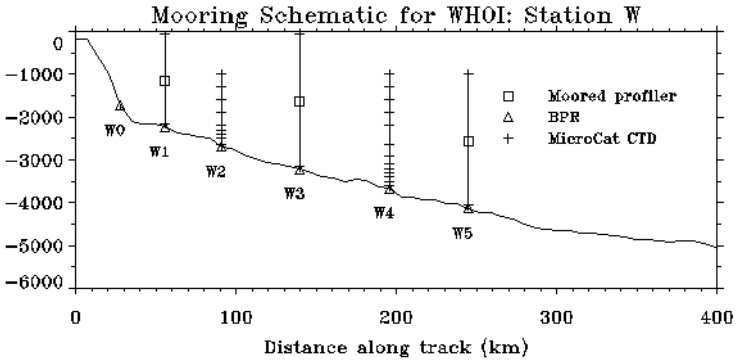
RAPID-WAVE arrays 2004-2006



1) Positions of Station W, Line A and Line B moorings



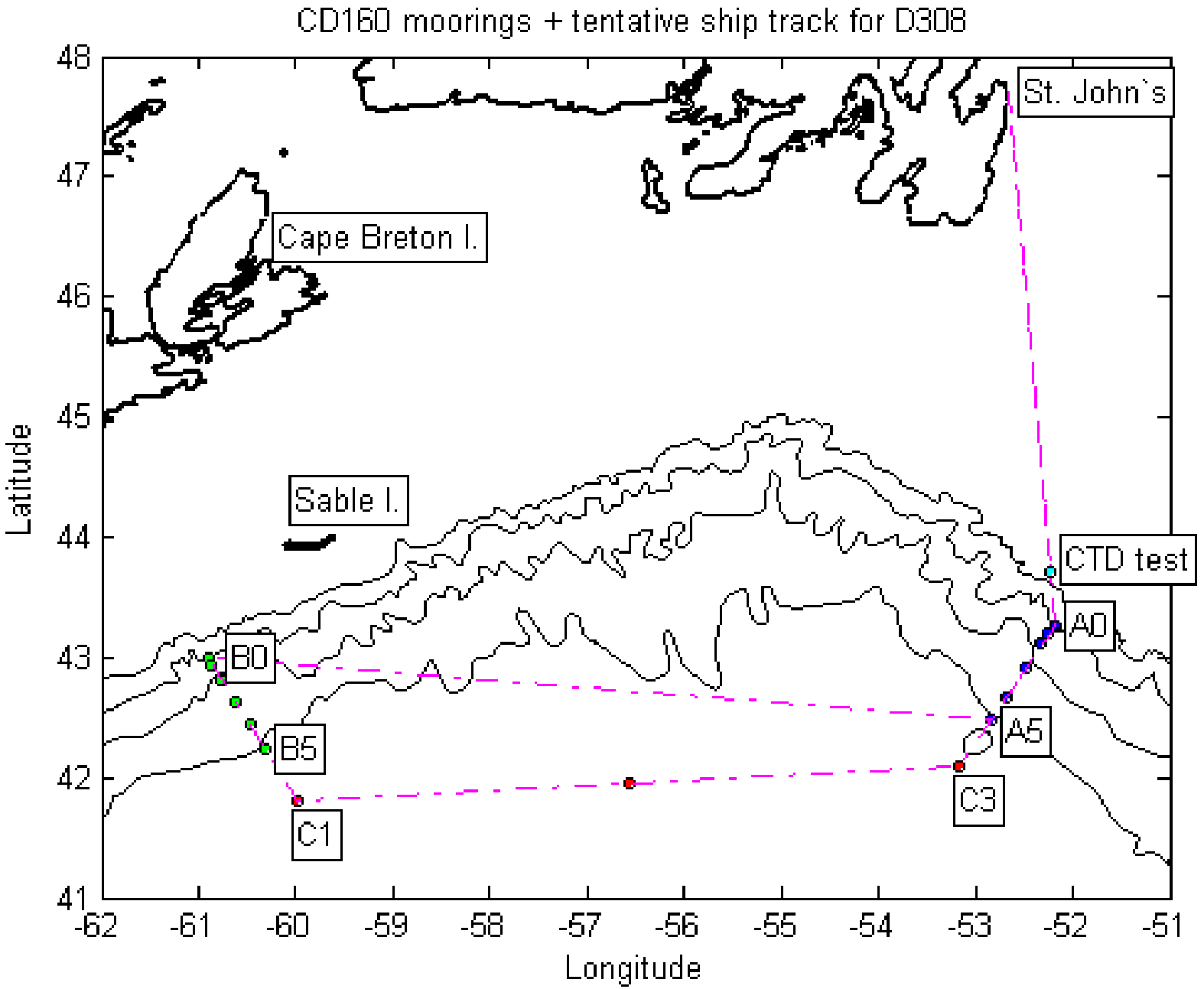




2) Mooring designs

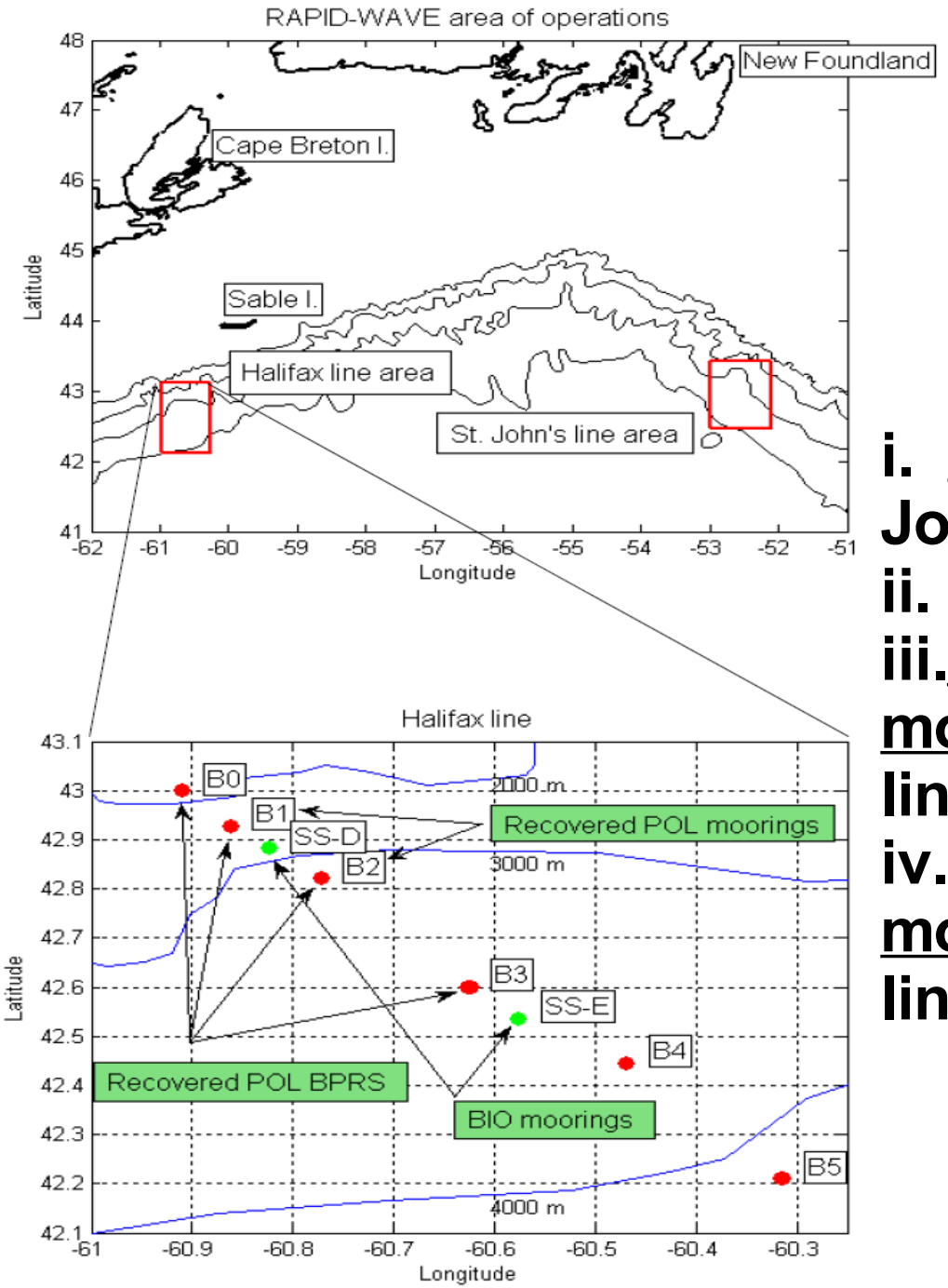
RAPID-WAVE field work 2004-2006

Cruise	Area	Date	BPR moorings	CTD/CM/BPR moorings	Sampling stations
Oceanus OC401 (WHOI)	SE of Cape Cod	April-May 2004	6 deployed		
Hudson AZMP-2004 (BIO)	SE Scotian Slope	June 2004		2 CM deployed	
Charles Darwin CD160 (NERC)	SW Grand Banks	August 2004	6 deployed	5 CTD deployed	6 (Iodine, Oxygen isotopes)
	SE Scotian Slope	August 2004	6 deployed	5 CTD deployed	6 (Iodine, Oxygen isotopes)
Hudson AZMP-2005 (BIO)	SE Scotian Slope	June 2005		2 CM recovered & redeployed	
Oceanus OC421 (WHOI)	SE Cape Code	April 2006	2 recovered 4 deployed	1 deployed	
Hudson AZMP-2006 (BIO)	SE Scotian Slope	June 2006		2 CM recovered & redeployed	
Discovery D308 (NERC)	SW Grand Banks	July 2006	2 recovered 0 deployed	0 recovered	6 (3H-3He, Oxygen concentration)
	SE Scotian Slope	August 2006	4 recovered 6 deployed	2 CTD recovered, 2 CTD/BPR deployed	6 (3H-3He, Oxygen concentration)



Locations of the BPRs and moorings deployed during CD160 (line A: blue circles; line B: green circles). CTD stations were carried out at each BPR/mooring site during CD160 (with the exclusion of A4, A5 and B0) and D308 (all sites). In D308, three additional CTD casts were performed along line C (red circles) plus at CTD test as indicated on the map. Also shown in the figure is the intended ship track for D308. Bathymetric contour: 1000 m.

Summary of D308 cruise (July-August 2006)



i. <u>Two BPRs</u> recovered on St. John's line.

ii. St. John's line abandoned.

iii.<u>Four BPRs</u> and <u>two CTD moorings</u> recovered in Halifax line.

iv. <u>Four BPRs</u> and <u>two CTD/BPR moorings</u> deployed in Halifax line.

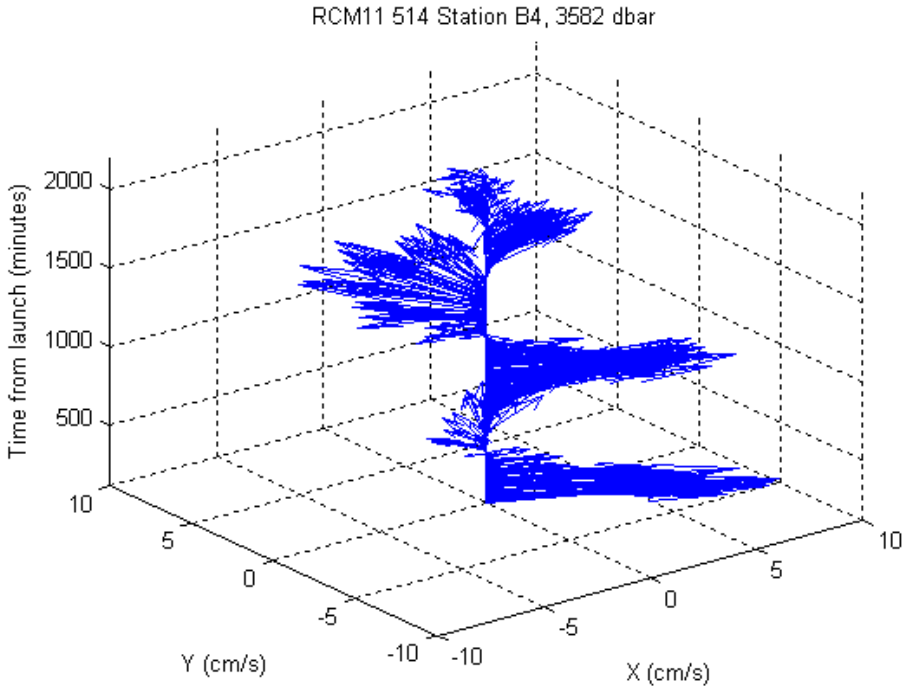
Analysis of failures

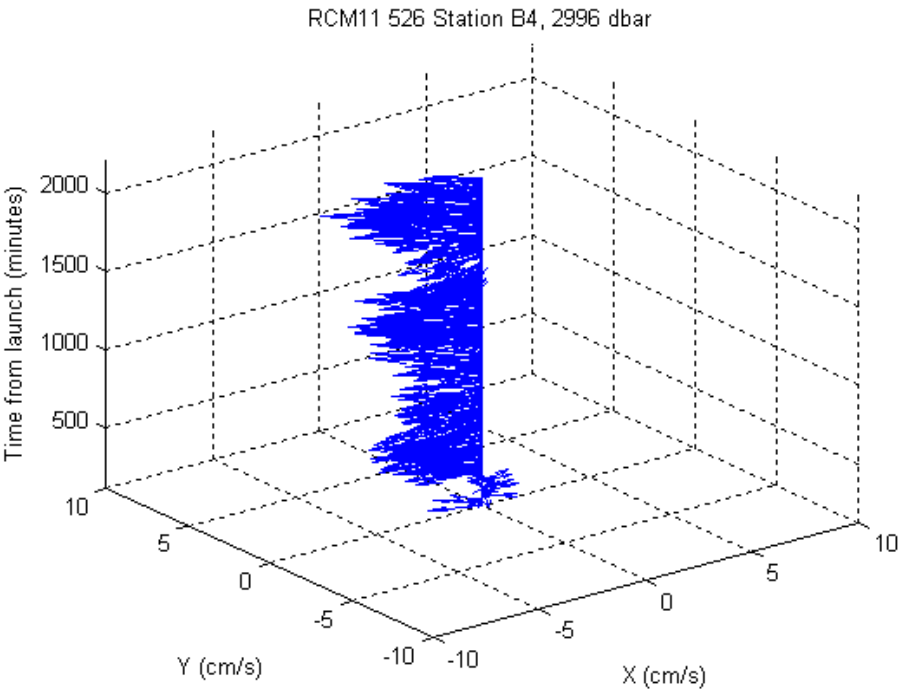
- **BPRs.**

  i. **Leakage through the pressure feed-throughs. Believed solved.**

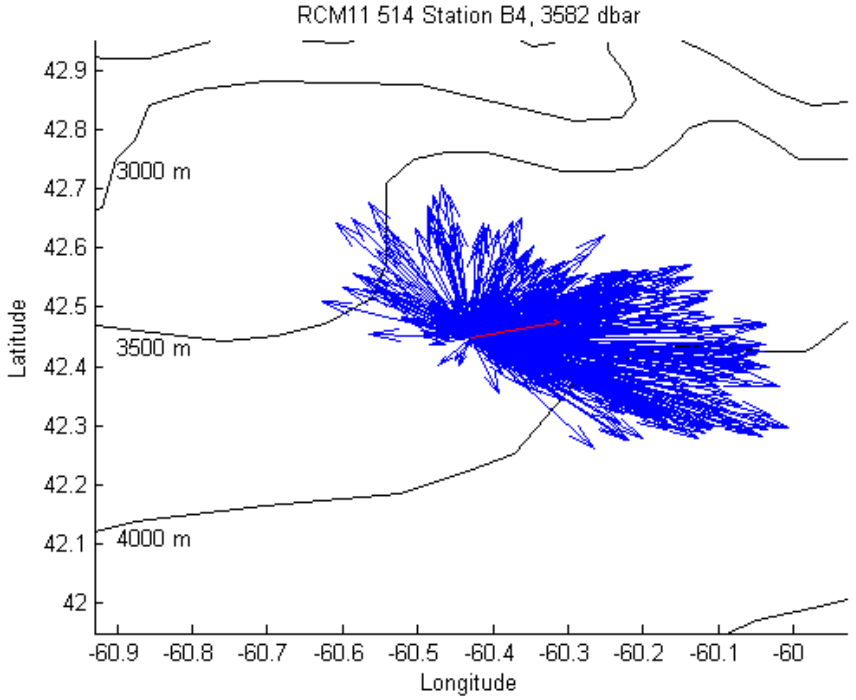
- **CTD Moorings.**

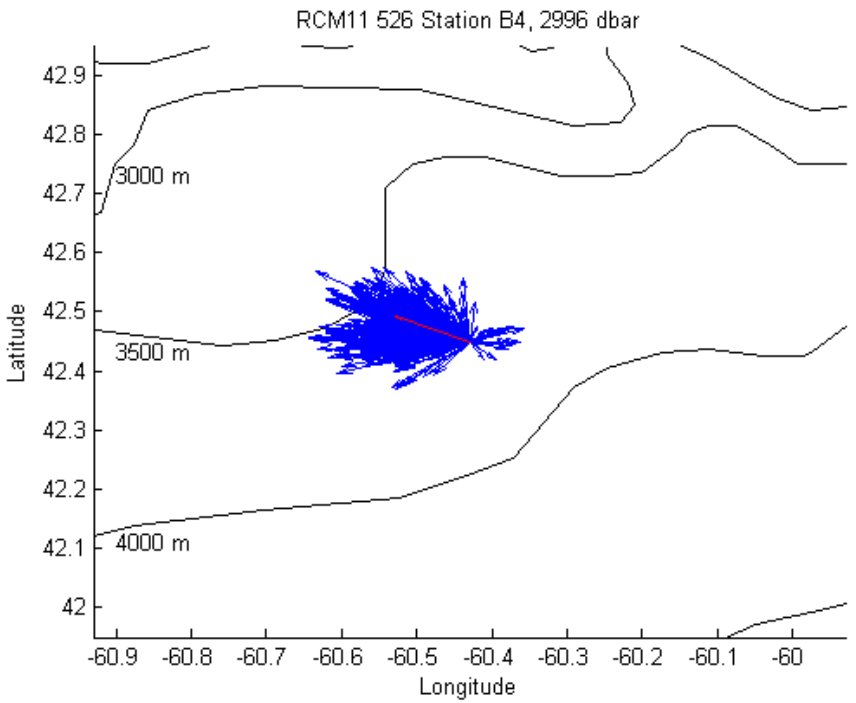
  i. **Trawlers? Unlikely. The Admiralty has been notified of the positions of the instruments.**
  ii. **Strong deep ocean currents? Two current surveys were carried out. No indication of anomalously fast currents.**
  iii. **Failure of on-board equipment? Unlikely. Two moorings were recovered without problem. Same equipment was used successfully in Cape Farewell cruise following D308.**
  iv. **Failure of releases? These are the same that have been used without major problems on 26.5N and Cape Farewell.**
  v. **Batteries? Alkaline batteries, rather than lithium ones, were used.**
  vi. **Corrosion? Corrosion was observed in the releases and anchor links in 26N cruises and in this cruise.**





24-h Current survey at B4

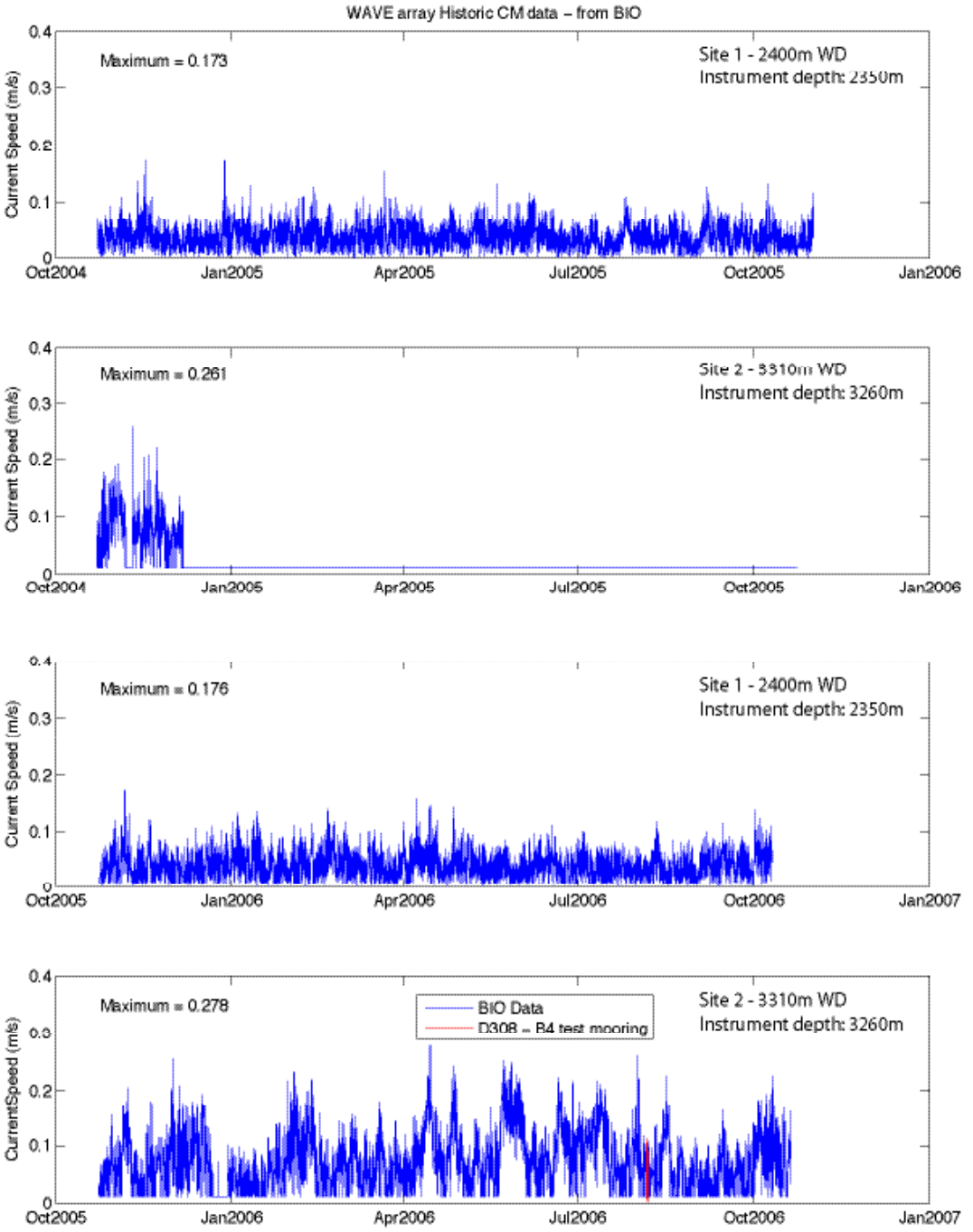




Analysis of currents
Darren Rayner, NOC

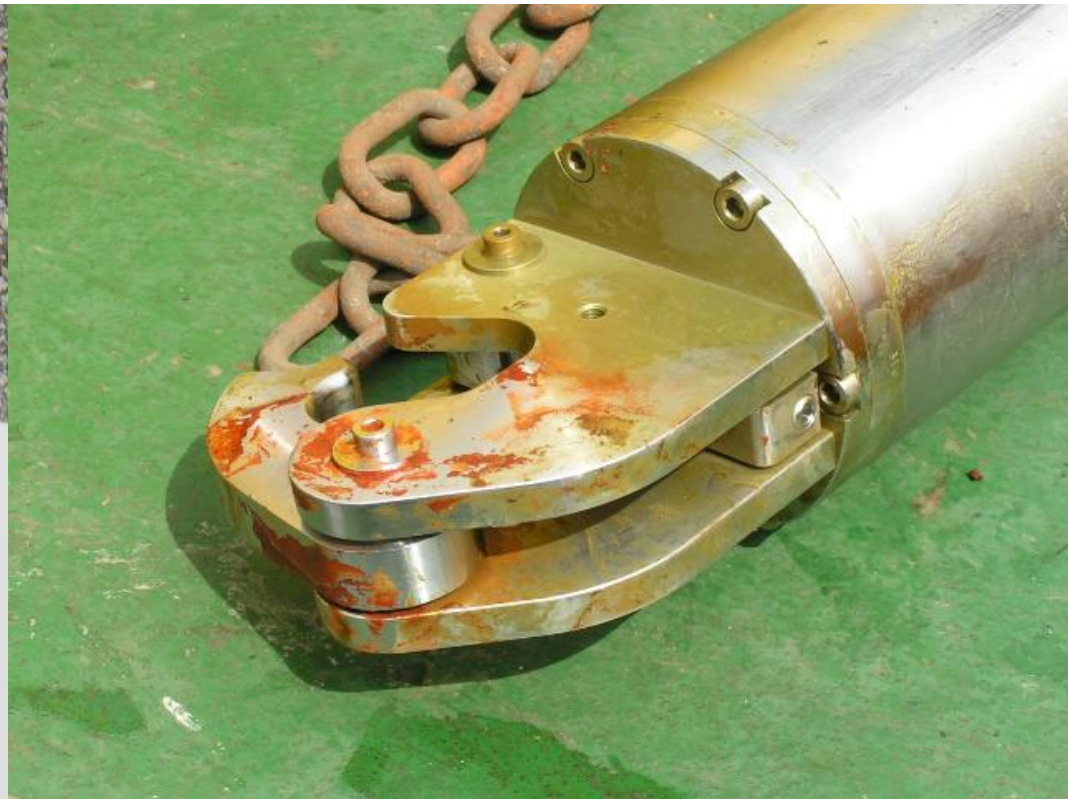
Based on two 2-year (Autumn 2004-Autumn 2006) near bottom current meter profiles provided by John Loder (BIO).

The currents at the mooring sites are higher than first thought, and this may have caused B5 to be moved offsite. However, mooring B4 should not have been moved by the currents.



Analysis of corrosion

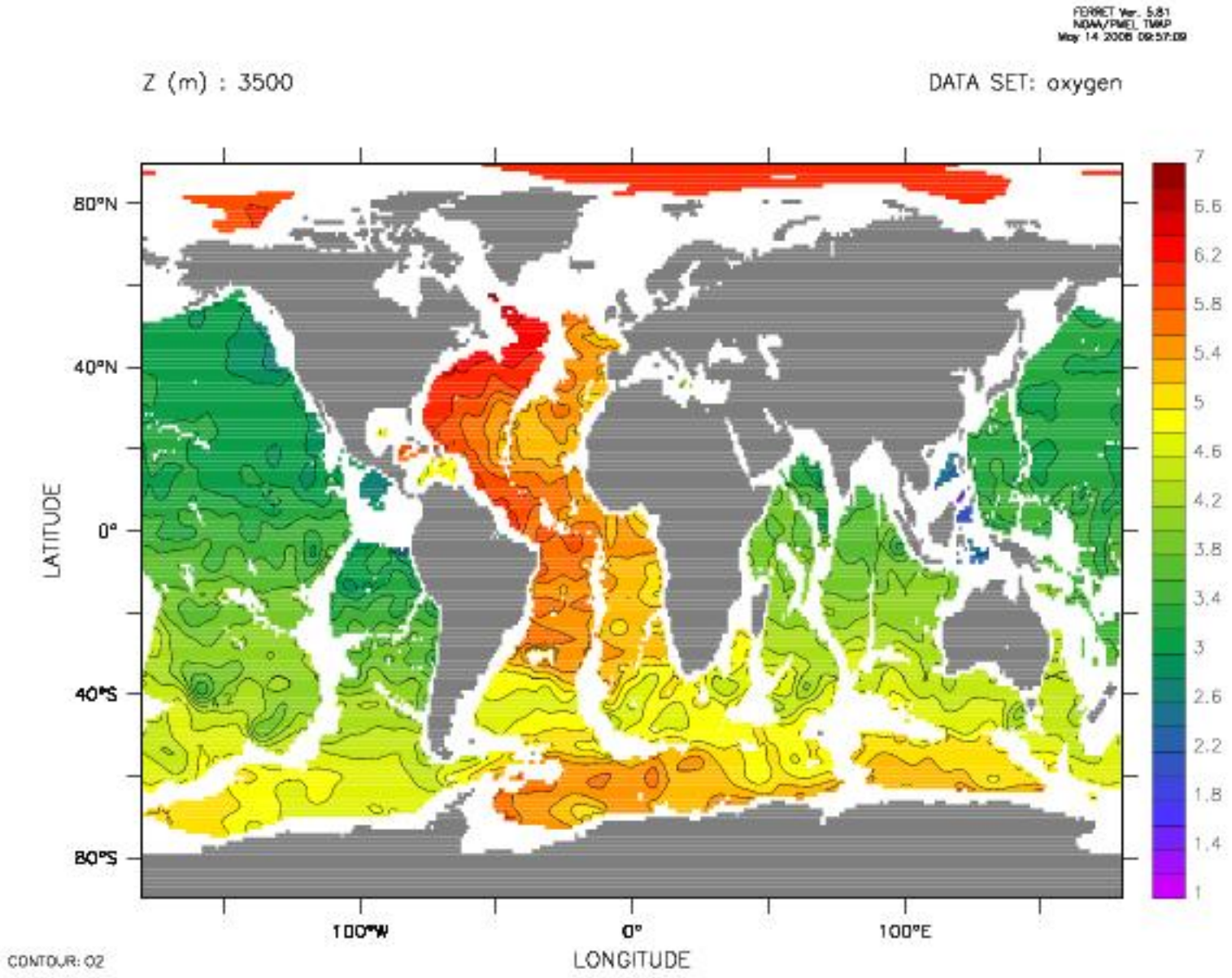
26N release, year 1
(courtesy of Darren Rayner)



RAPID-WAVE release, year 2.

Annual mean Oxygen concentration (ml/l) at 3500 m (Levitus Atlas)

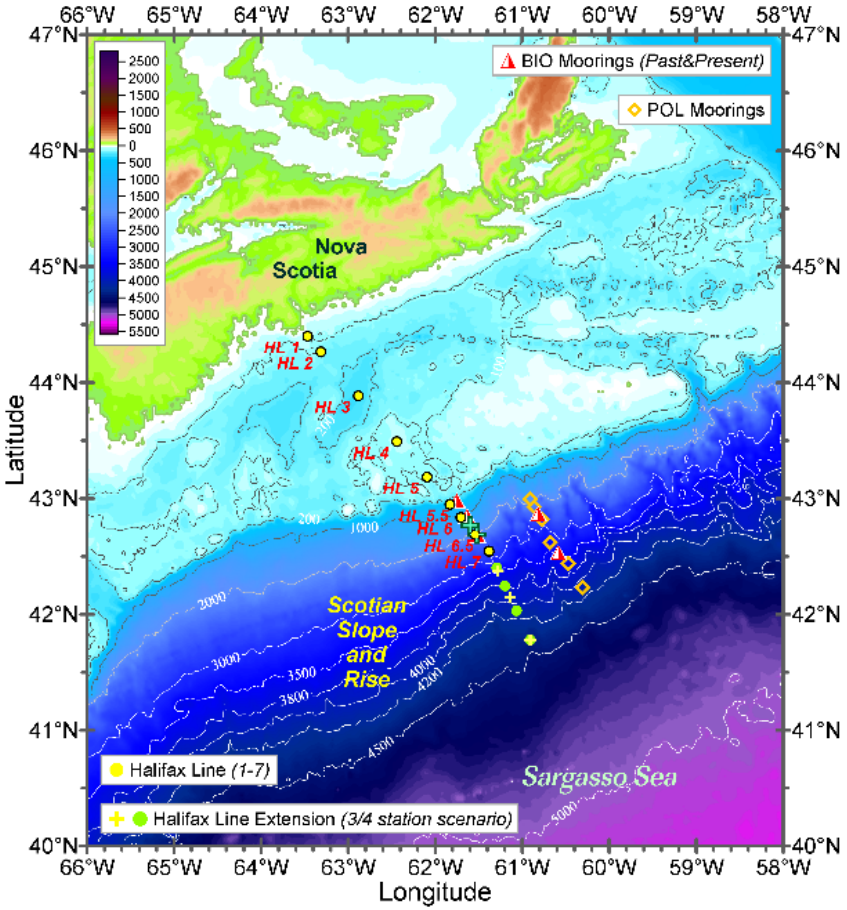
High Oxygen, high salinity waters!



Recommendations

i.Perform test on any new instruments in waters of the appropriate depth before future deployments.
ii.Install current meters in some of the long moorings.
iii.Replace mooring alkaline batteries by lithium ones.
iv.Install marine recovery beacons on moorings for tracking.
v.Improved (stainless steel dual links) and duplicate releases.
vi.Recover moorings yearly (BIO collaboration).

Joint Programme Agreement with Bedford Institute of Oceanography (BIO)



HL1-7 are stations on present Halifax line. Possible sites for addition of 3 or 4 offshore stations, and 2 or 3 stations between HL5 and HL7 are indicated. Past and present BIO and POL mooring sites are indicated.

Aim: to integrate RAPID-WAVE Halifax line with the Atlantic Zone Monitoring Programme (AZMP) and Atlantic Zone Off-Shelf Monitoring Programme (AZOMP).

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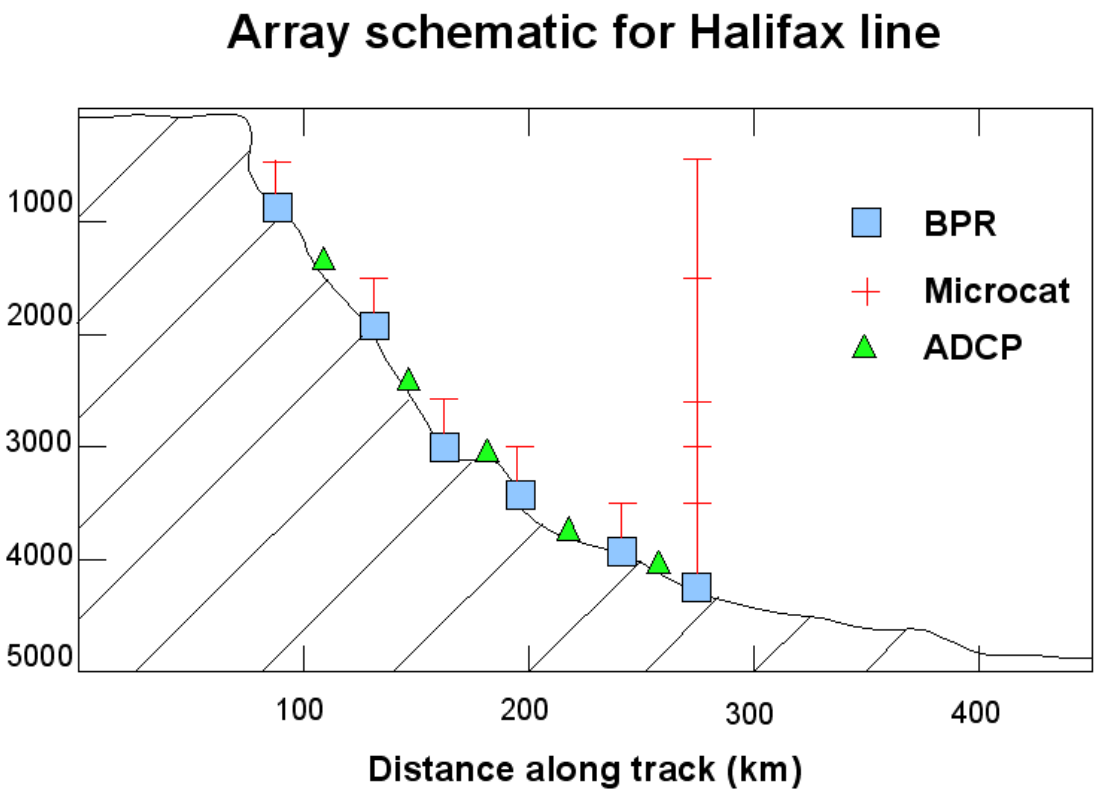
Hudson AZMP-2007	SE Scotian Slope	September-October 2007	2 recovered redeployed	2CTD/BPR recovered & redeployed	6 ()xygen concentration)
Oceanus (WHOI)	SE Cape Code	May 2008	Bad weather, but making good progress		
Hudson AZMP-2008	SE Scotian Slope	September-October 2008	In preparation		

BIO/RAPID-WAVE Joint Project Agreement

- **RAPID 2007-2008.**
  - **2007. Recovery/redeployment of 2 CTD moorings and 3 BPRs.**
    - **BIO in-kind: ship time (6 days), CTD/tracer station equipment and BIO salaries.**
    - **RAPID-WAVE to cover: overtime, enhanced tracer sampling (T,S,O) and redeployment of BIO CM moorings.**
  - **2008. Recovery of 2 CTD moorings and 6 BPRs.**

- **RAPID-WATCH 2008-.**
  - **Shift of RAPID-WAVE Halifax line to BIO extended Halifax line.**
    - **BIO in-kind: ship time (~6 days), spare ADCPs and MCs, CTD/tracer station equipment and BIO salaries.**
    - **RAPID-WAVE to cover: overtime, BPRs, ADCPs and MCs, enhanced tracer sampling (T,S,O, CFCs, I19), data processing and analysis costs.**

New Halifax Line Array



5 ADCPs, 6 BPRs, 10 Microcats

CCGS Hudson