

CLIVAR A10

Cape Town to Rio de Janeiro
August 28th-October 31st, 2011

Darren Pilcher

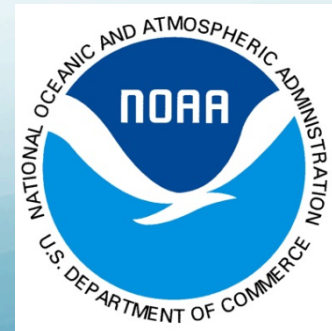


CLIVAR/Carbon A10

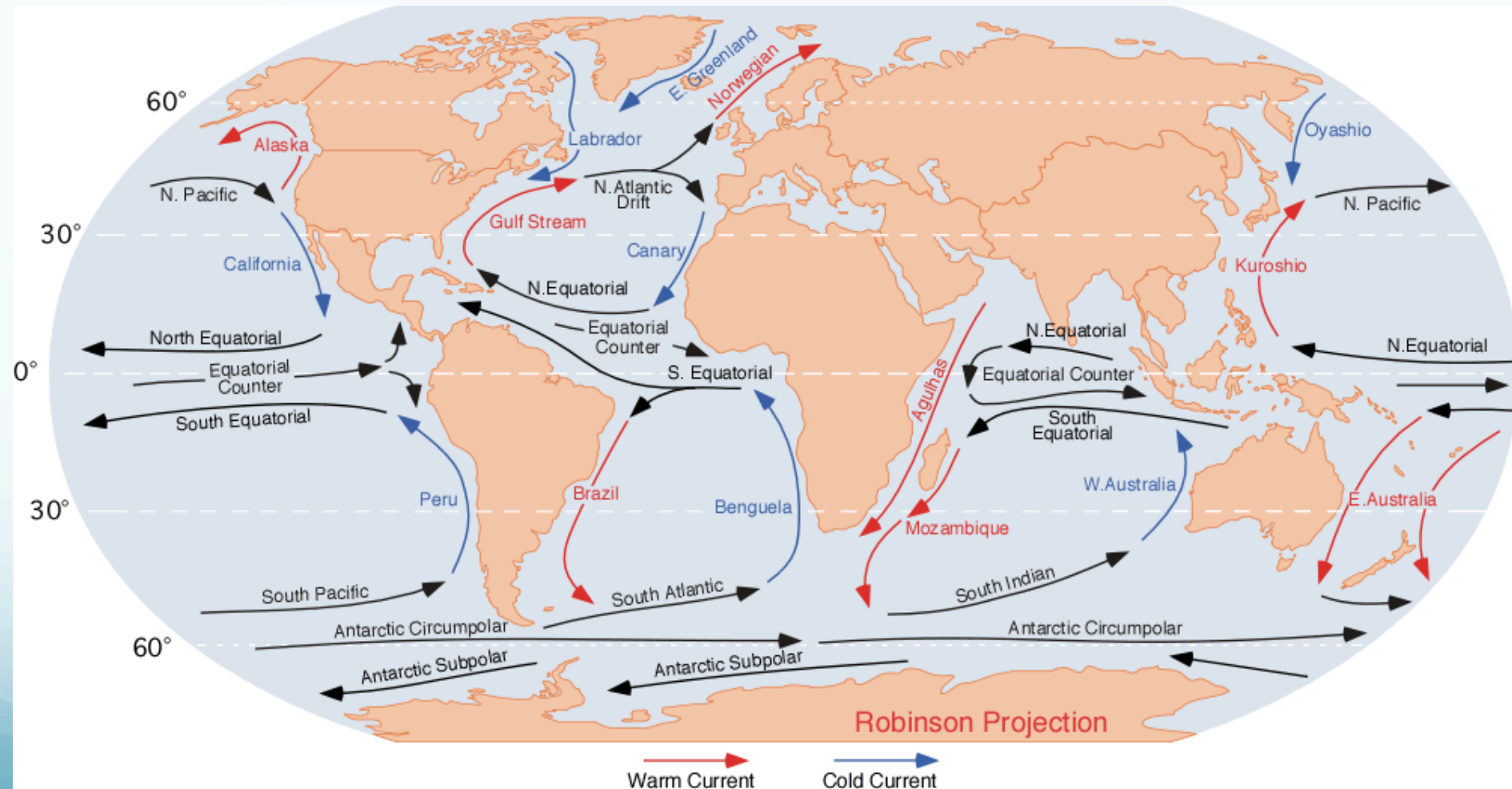
- Collect water samples at depth along a transect line
- Decadal series of repeat hydrography research cruises
- A10 occupies the 30° S transect
- Transect also completed in 1992 and 2003



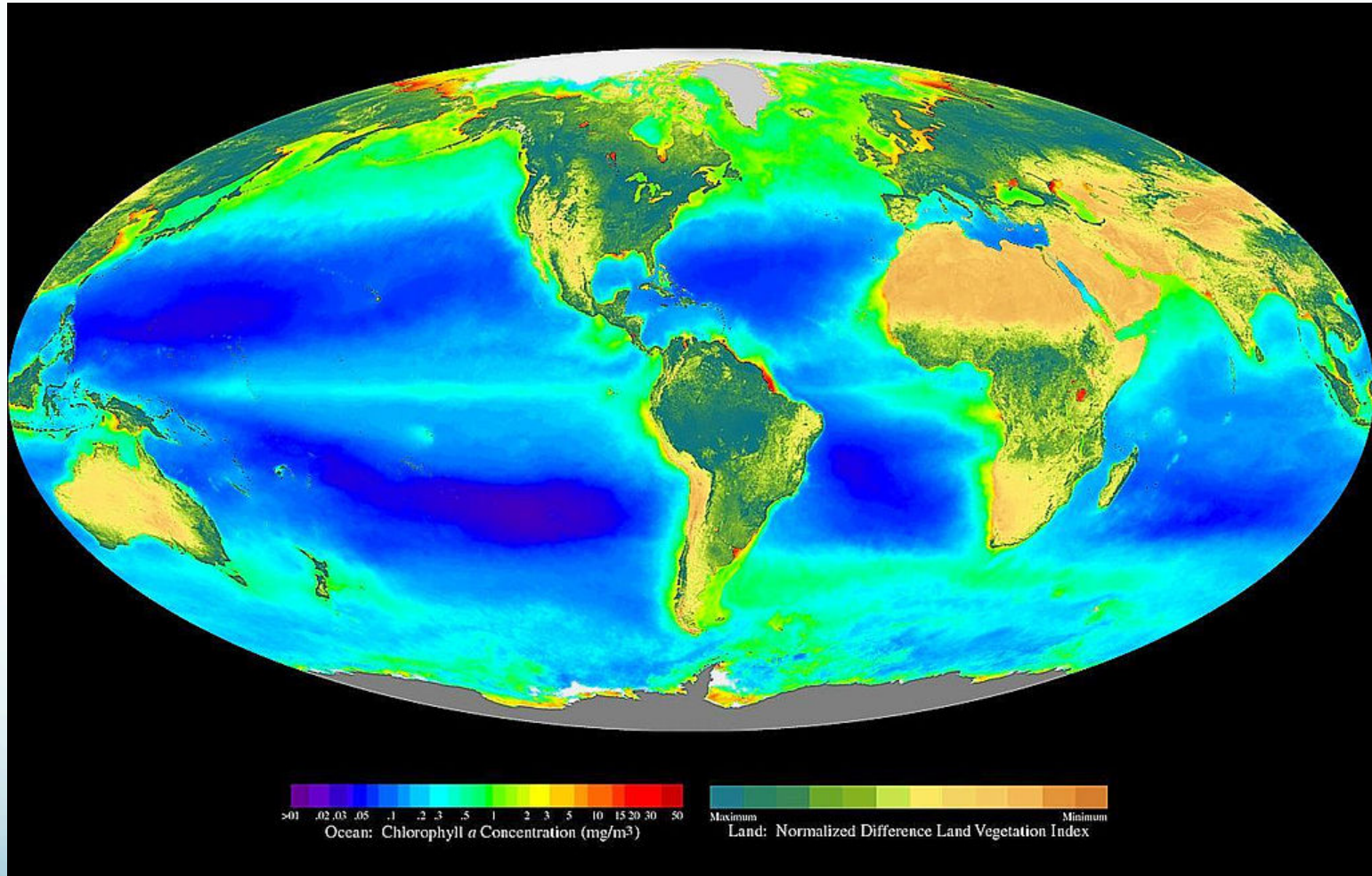
Climate Variability and Predictability



Subtropical Gyre

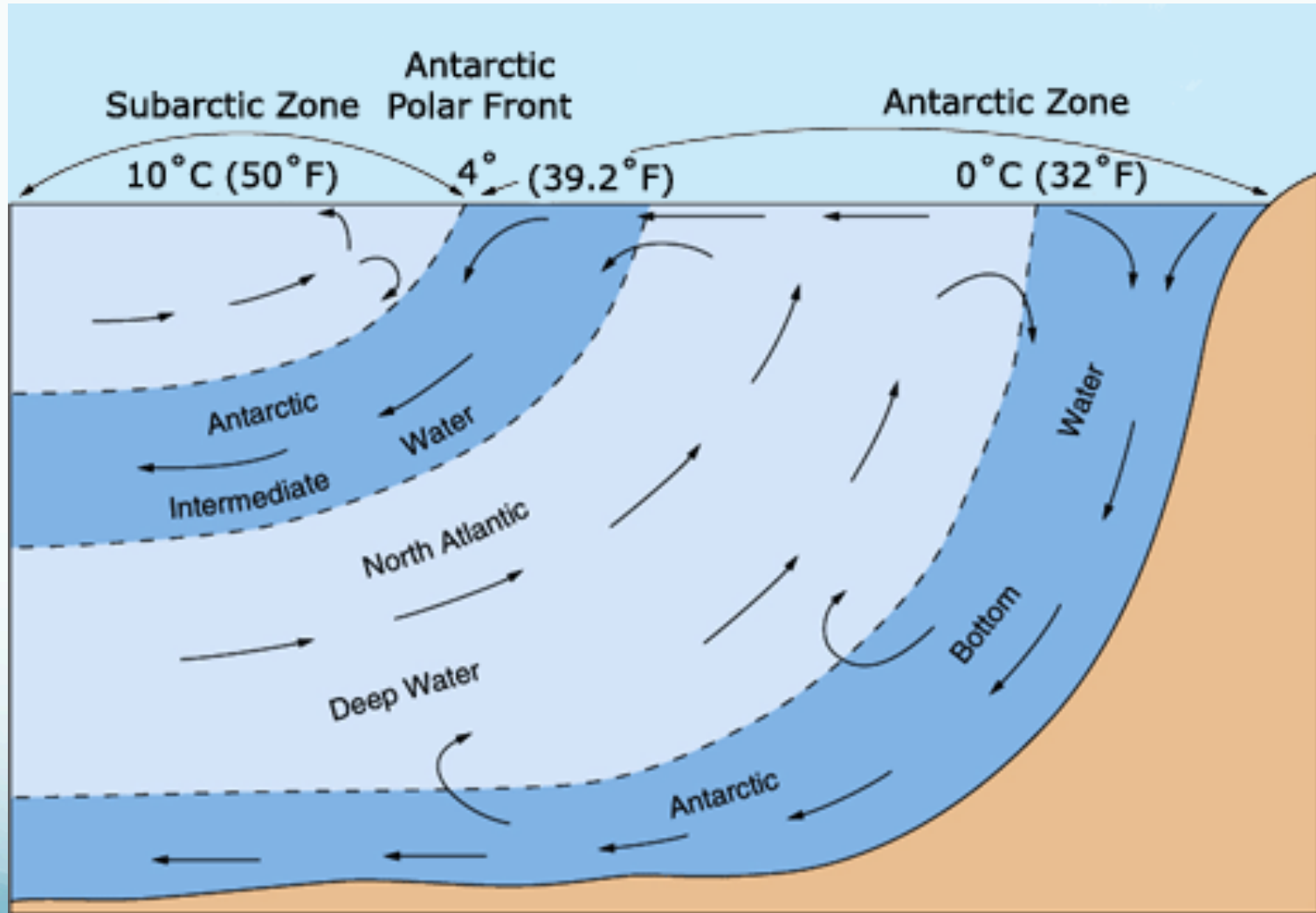


Subtropical Gyre



SeaWiFS

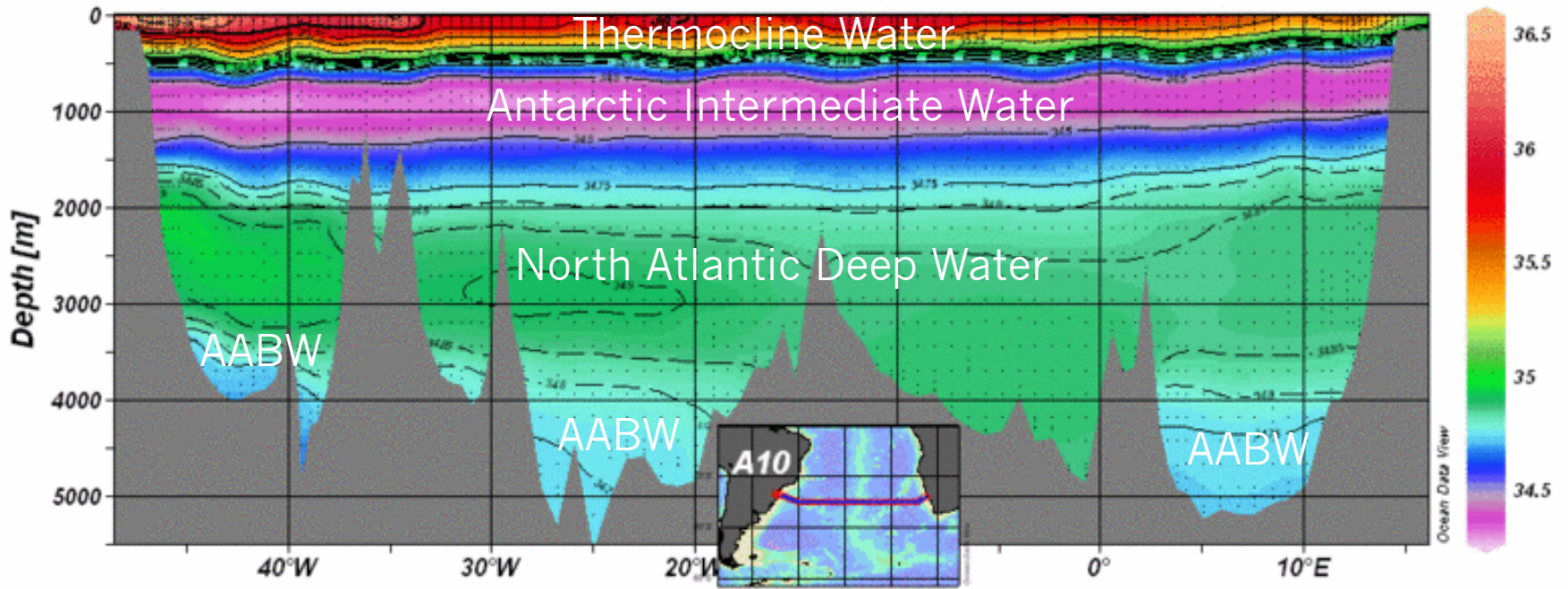
Water Mass Formation



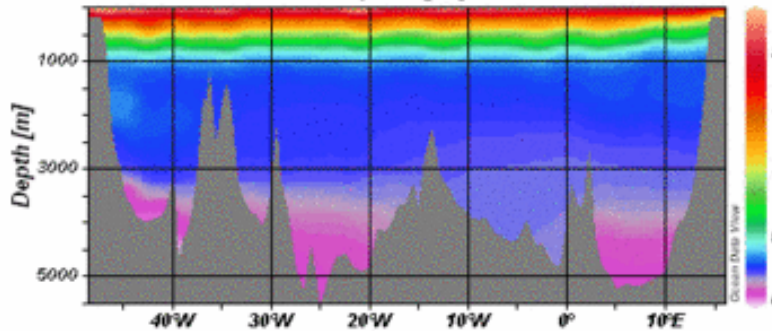
A10 WOCE

eWOCE

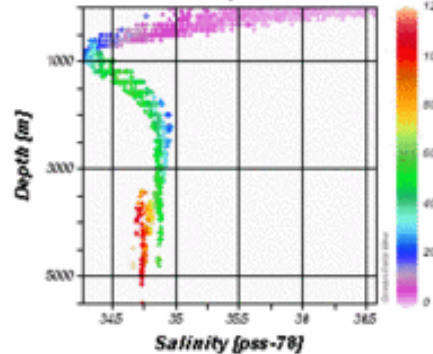
Salinity [pss-78]



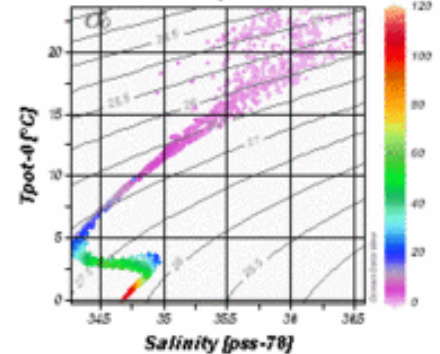
Tpot-0 [°C]



Silicate [$\mu\text{mol/kg}$]



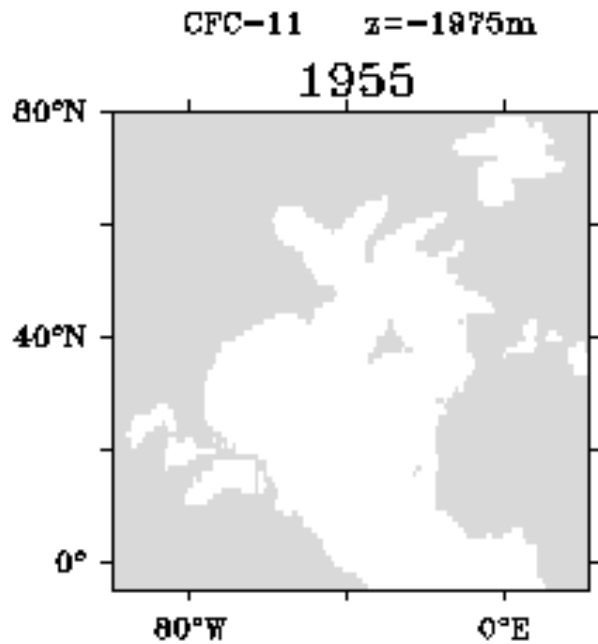
Silicate [$\mu\text{mol/kg}$]



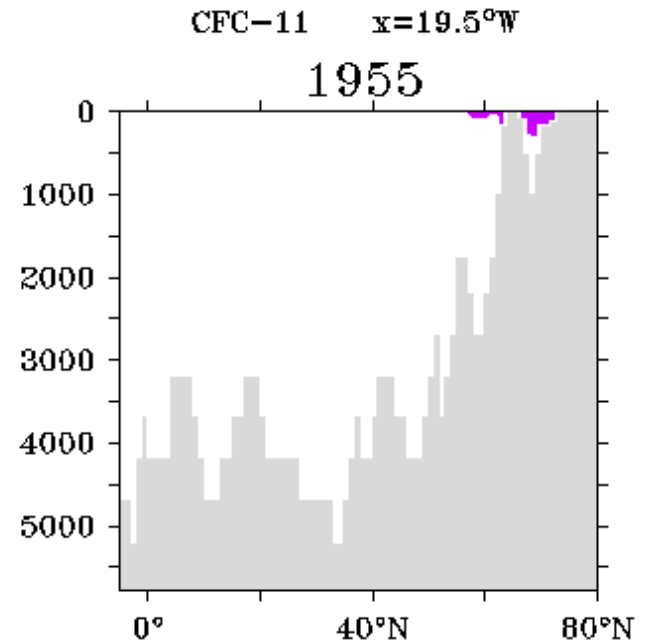
My Role

- Graduate student volunteer funded by a NSF grant from Dr. Jim Swift at Scripps Institute of Oceanography
- Part of 3-man group collecting and analyzing water samples for CFC gas concentration
- CFCs: bad for ozone layer but useful for oceanographers
- CFC research for Dr. John Bullister at Pacific Marine Environmental Laboratory
- Little personal cruise experience

CFC Invasion

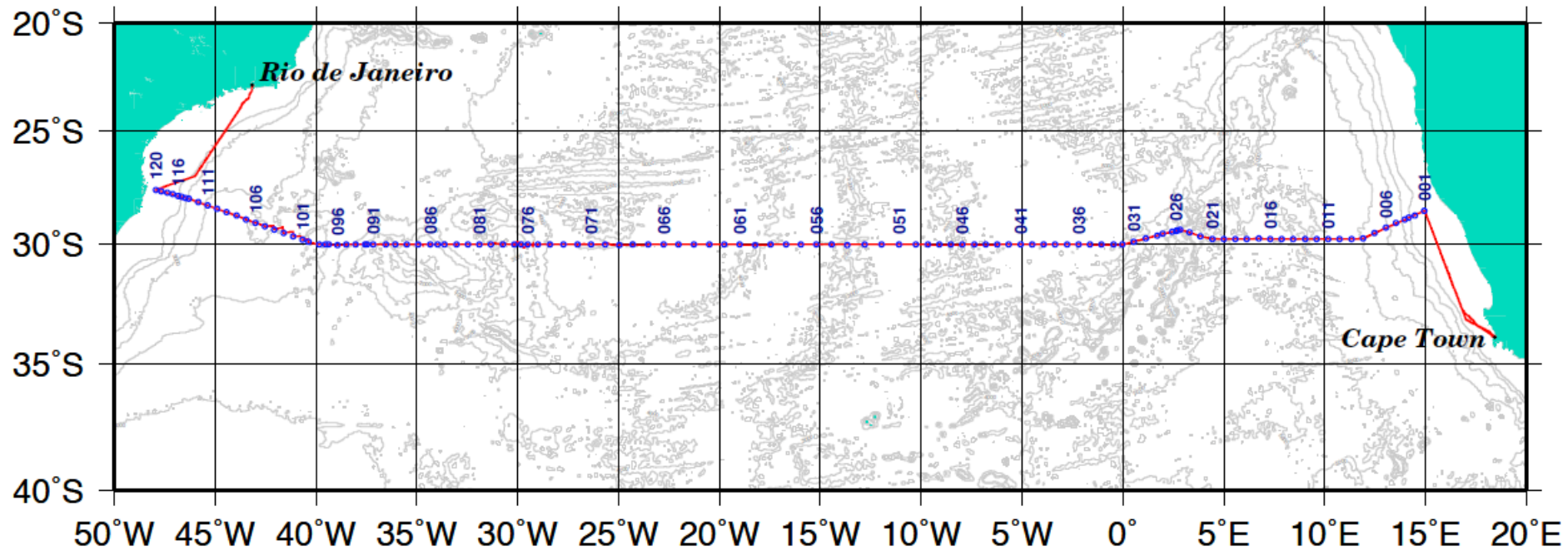


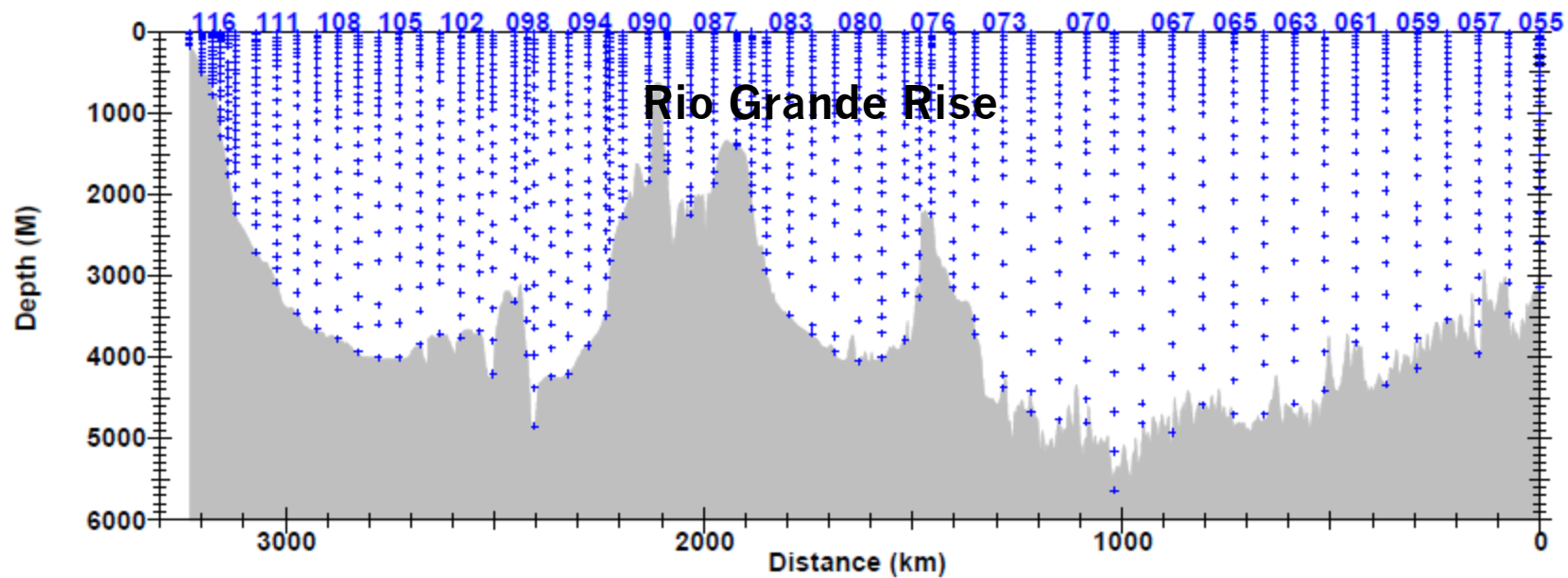
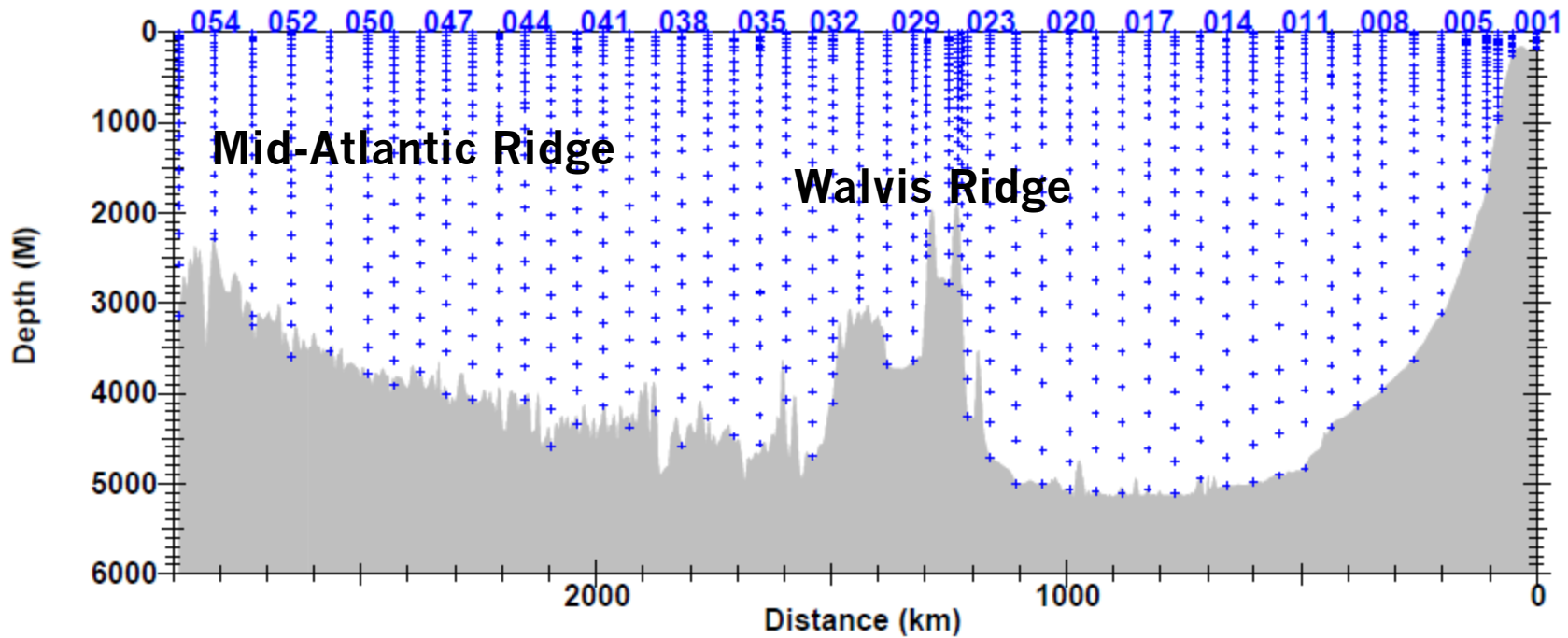
<http://puddle.mit.edu/~mick/cfcall.html>



<http://puddle.mit.edu/~mick/cfcsec.html>

Cruise Stations





Cruise Details

- 25 in science party and 26 crew and officers
- Chief scientist – Dr. Molly Baringer (Atlantic Oceanographic and Meteorological Laboratory)
- Co-chief scientist – Dr. Alison Macdonald (Woods Hole Institute of Oceanography)
- CFCs, He³, O₂, pH, DIC, total alkalinity, C¹⁴, black carbon, density, DOC, O¹⁸, tritium, nutrients, salinity, temperature, and phytoplankton



R/V Ronald H. Brown

Cape Town



Cape Town



Delayed

- Departed on August 28th
- Winch problems during first test cast station
- Hydraulic pump failure forces shutdown of engine
- Limp back into Cape Town at half-speed on one screw
- Many more delays would follow...
- 29 days before successful sea trials allow us to leave Cape Town once again

September 26th - Underway at Last!



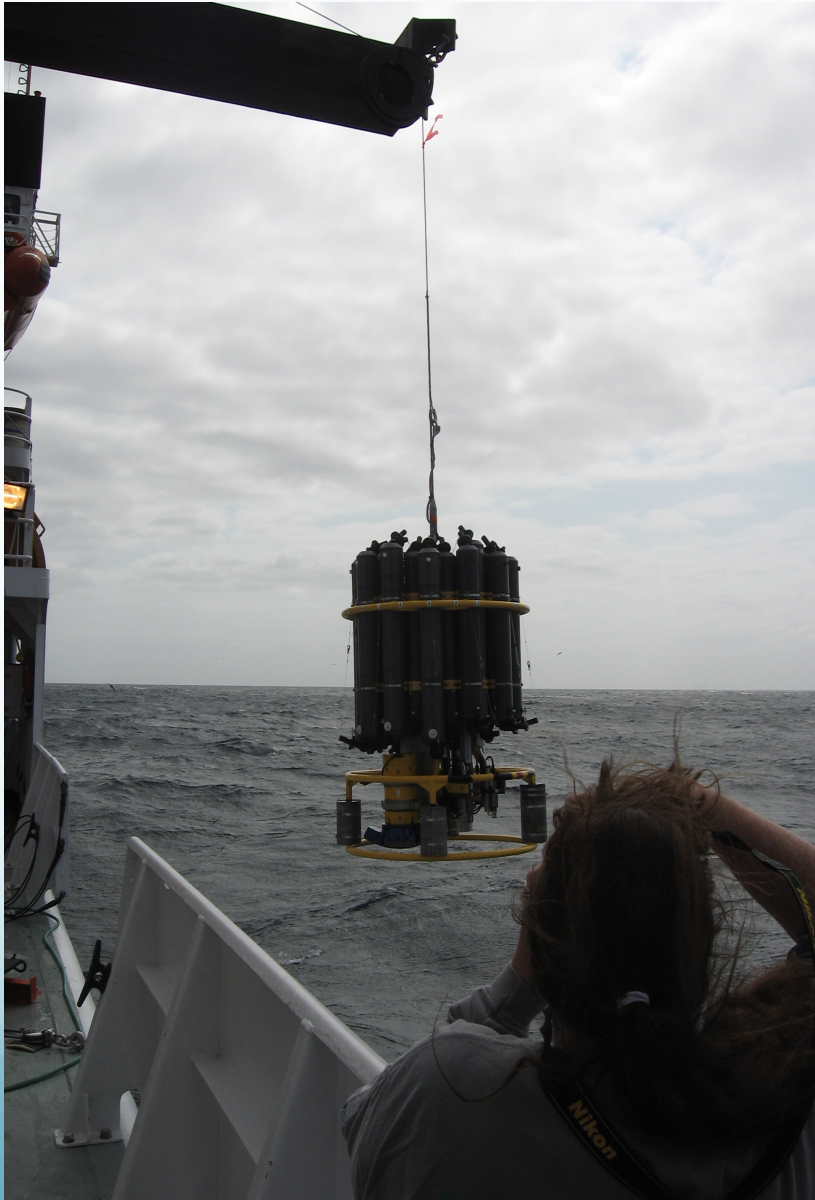
Schedule

- On call: 17:00-21:00
- On shift: 21:00-5:00
- On call: 5:00-9:00
- “On call” sampled entire cast, while “on shift” assisted while also running samples
- Wake up for sunset; go to bed after sunrise
- Ship operated 24 hours, but drills, meetings, and announcements in the afternoon...

Night shift = lots of sunsets



CTD Cast



Sampling

- Many different people sampling many different variables
- Sampling hierarchy and “sample cop” reduced confusion
- CFC sampled first due to ultra-low concentration and air contamination

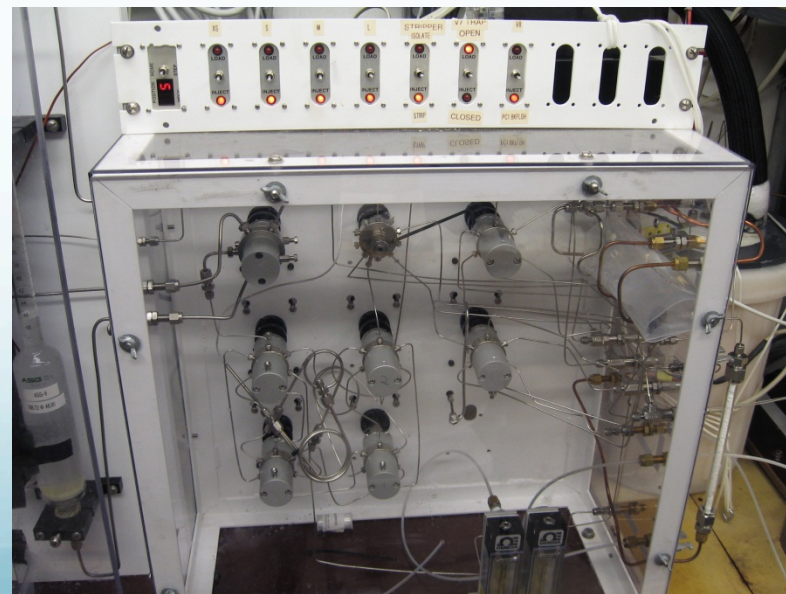
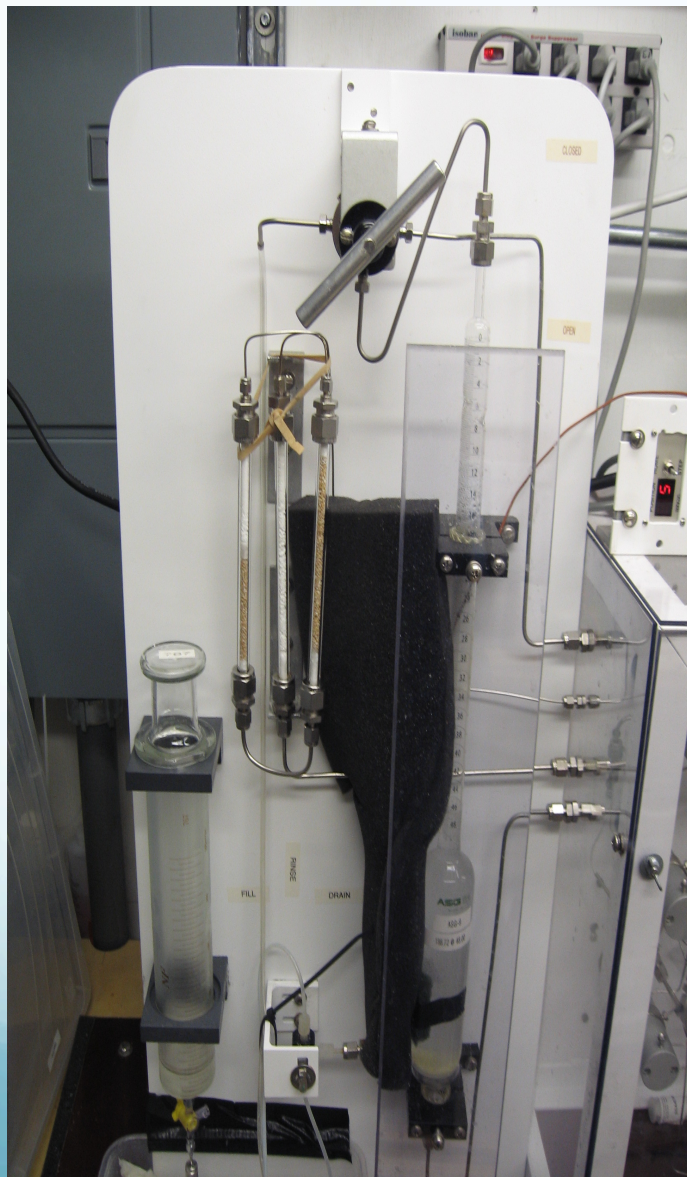
Sampling Video

Waiting to sample...



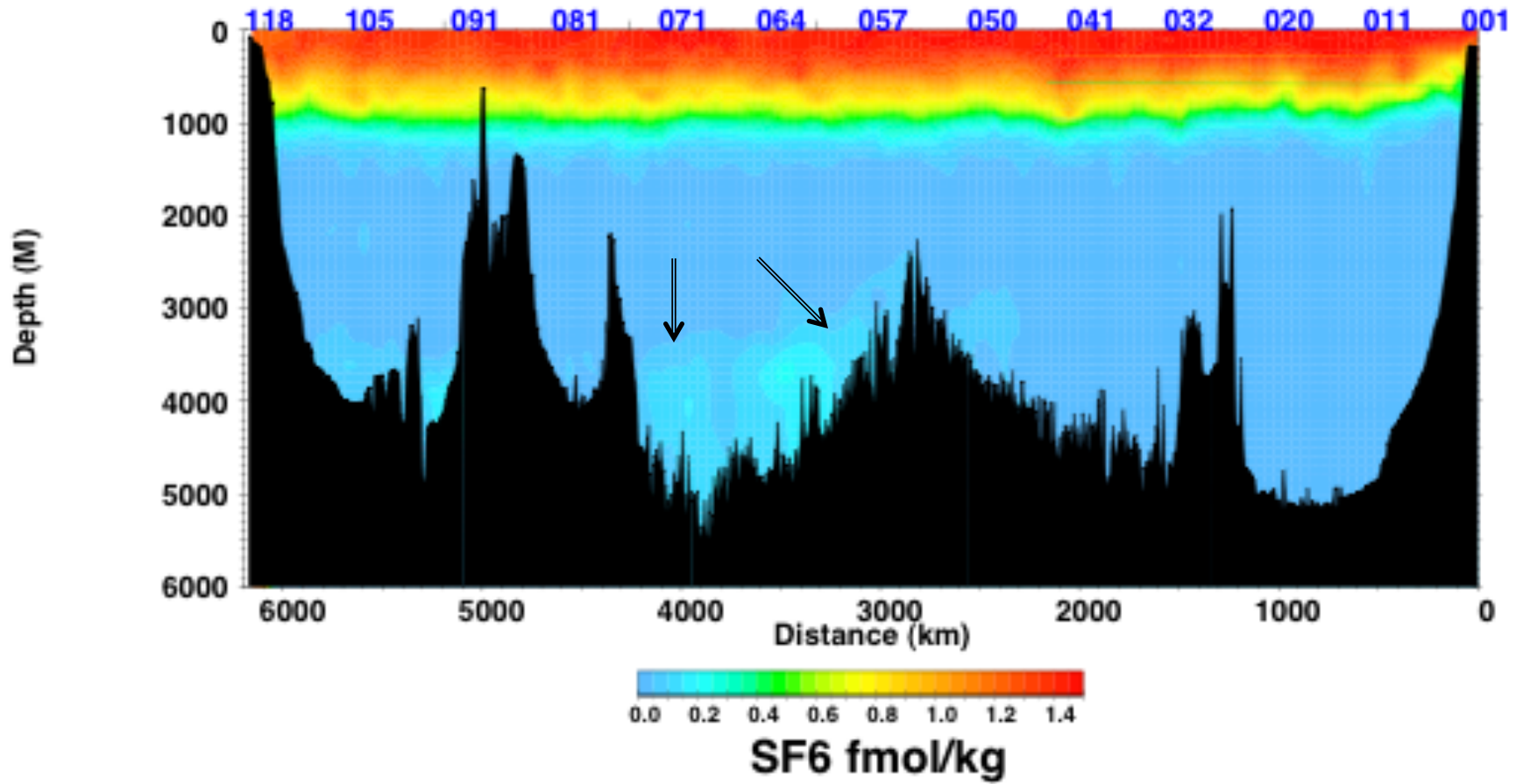


Instrumentation



CFC Analysis

- Gas chromatography with electron capture detector (ECD)
- Column #1 for SF₆, column #2 for CFC-11 and CFC-12, and column #3 for N₂O and CCl₄.
- SF₆ measured as fmol/kg
- CFC-11 and CFC-12 in pmol/kg
- ~ 12 minutes to complete one sample



SF₆ Deepwater Concentrations

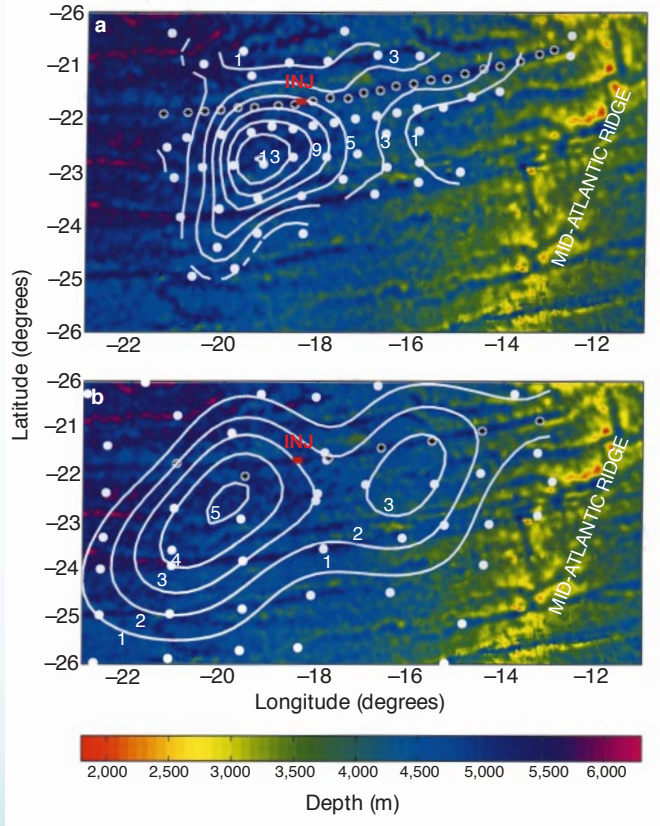


Figure 1 Tracer distribution. **a**, 14 months after release; **b**, 26 months after release. The red bars labelled 'INJ' mark the release site of the tracer. The contours denote the column integral of SF₆ (in nmol m⁻²) and colours denote bottom depth. The tracer mapping procedure did not take the bathymetry into account, and hence the meridional distribution in the east in **a** appears broader than the valleys where the stations are located and which actually hold most of the tracer. The bathymetry is from Smith and Sandwell¹⁶. The stations are shown as white dots; those with stars are used for the sections in Fig. 2. Southerly latitude and westerly longitude are shown negative.

Evidence for enhanced mixing over rough topography in the abyssal ocean

J. R. Ledwell, E. T. Montgomery, K. L. Polzin, L. C. St. Laurent, R. W. Schmitt & J. M. Toole

Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543

Released 110 kg of SF₆ on western edge of Mid-Atlantic Ridge in 1996!

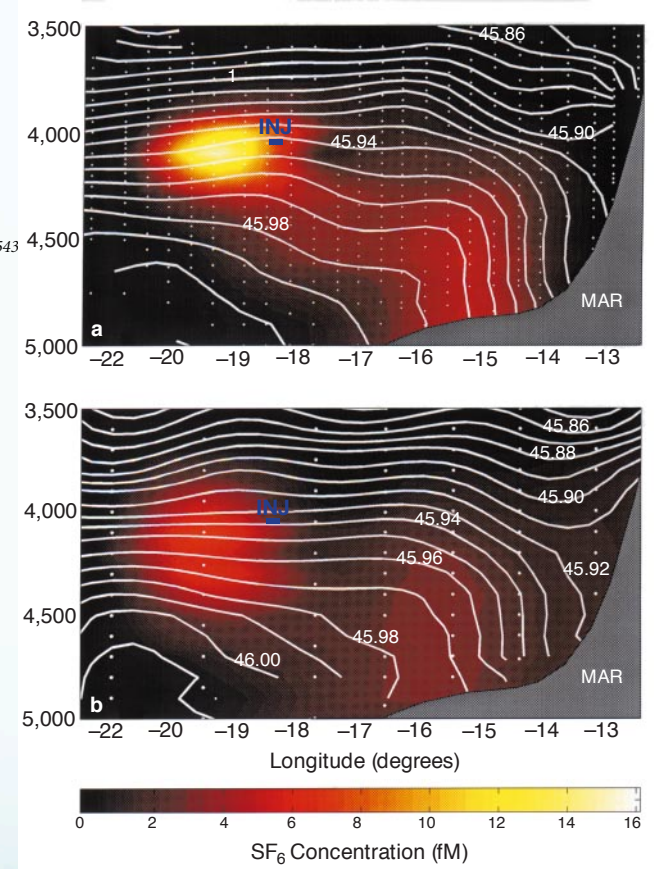
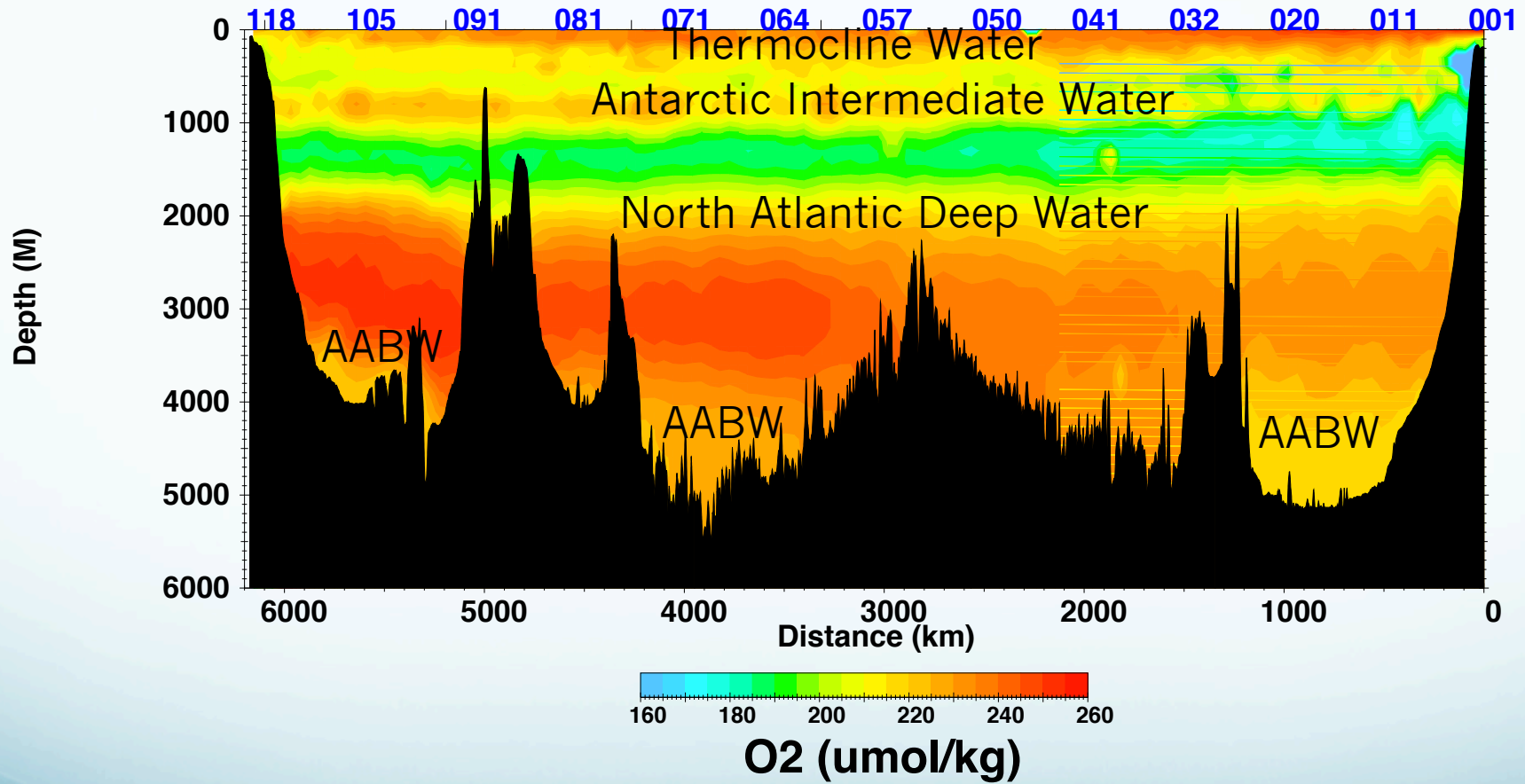


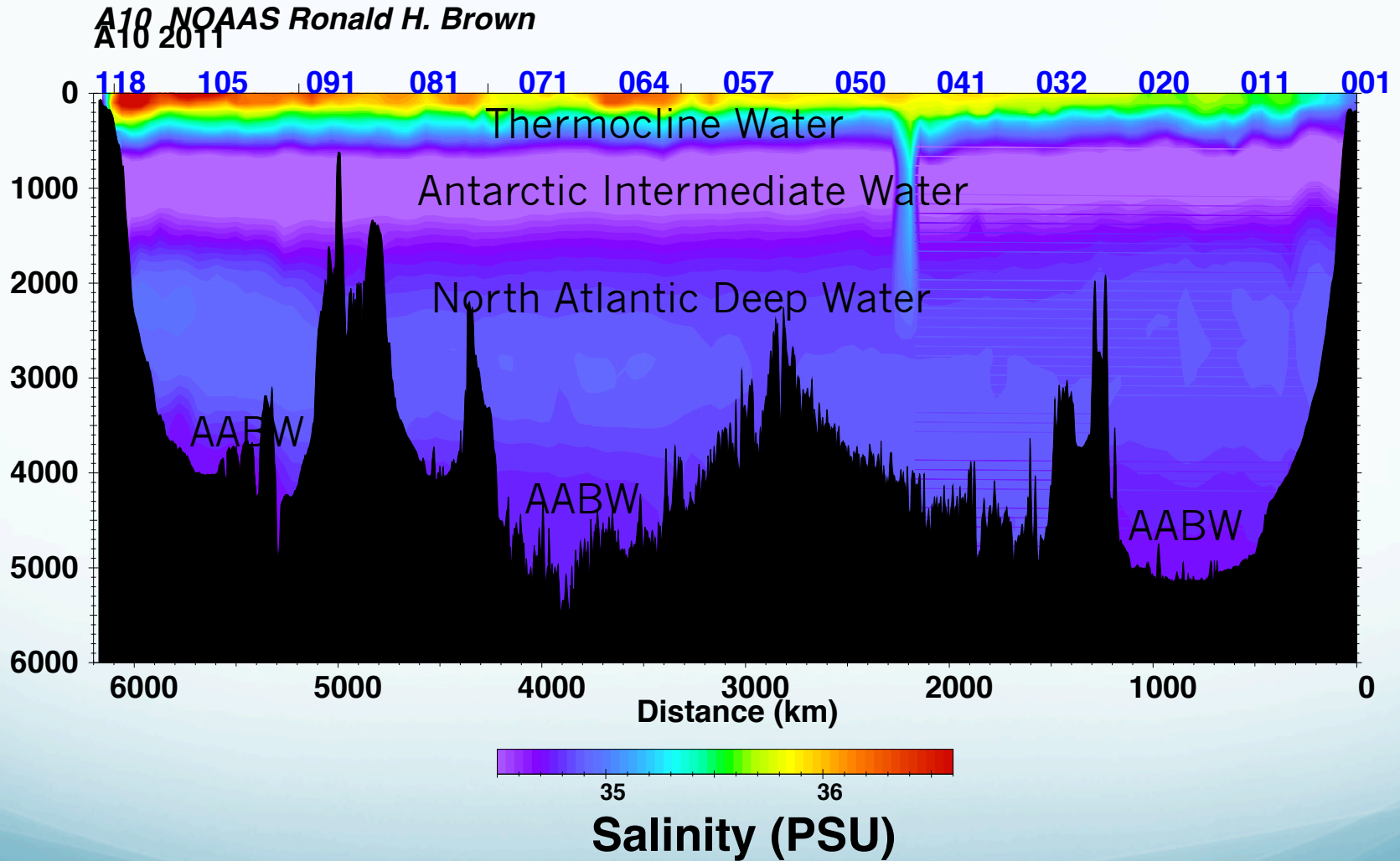
Figure 2 Sections of tracer concentration and potential density from the valley where the tracer was released. **a**, 14 months after release; **b**, 26 months after release. The dots show the tracer sample locations, and the blue bar labelled 'INJ' marks the release site of the tracer. The sea floor (labelled MAR for Mid-Atlantic Ridge) is a polynomial fit to the soundings from the 14-month survey. The valley is enclosed by ridges to the north and south whose depths are indicated roughly where the white density contours (in kg m⁻³) bend sharply down. The colours show the trace concentration: 1 fM = 10⁻¹⁵ M.

Oxygen

A10 NOAA Ronald H. Brown
A10 2011



Salinity



Morale

- Serious concern for longer cruises, especially those that are plagued with problems from the start...
- Connection to outside world via limited internet is immensely helpful.
- Close proximity to a large number of people
- Sometimes, it's the little things that matter:
 - Artisan jam
 - World series and football games
 - Endless supply of ice cream

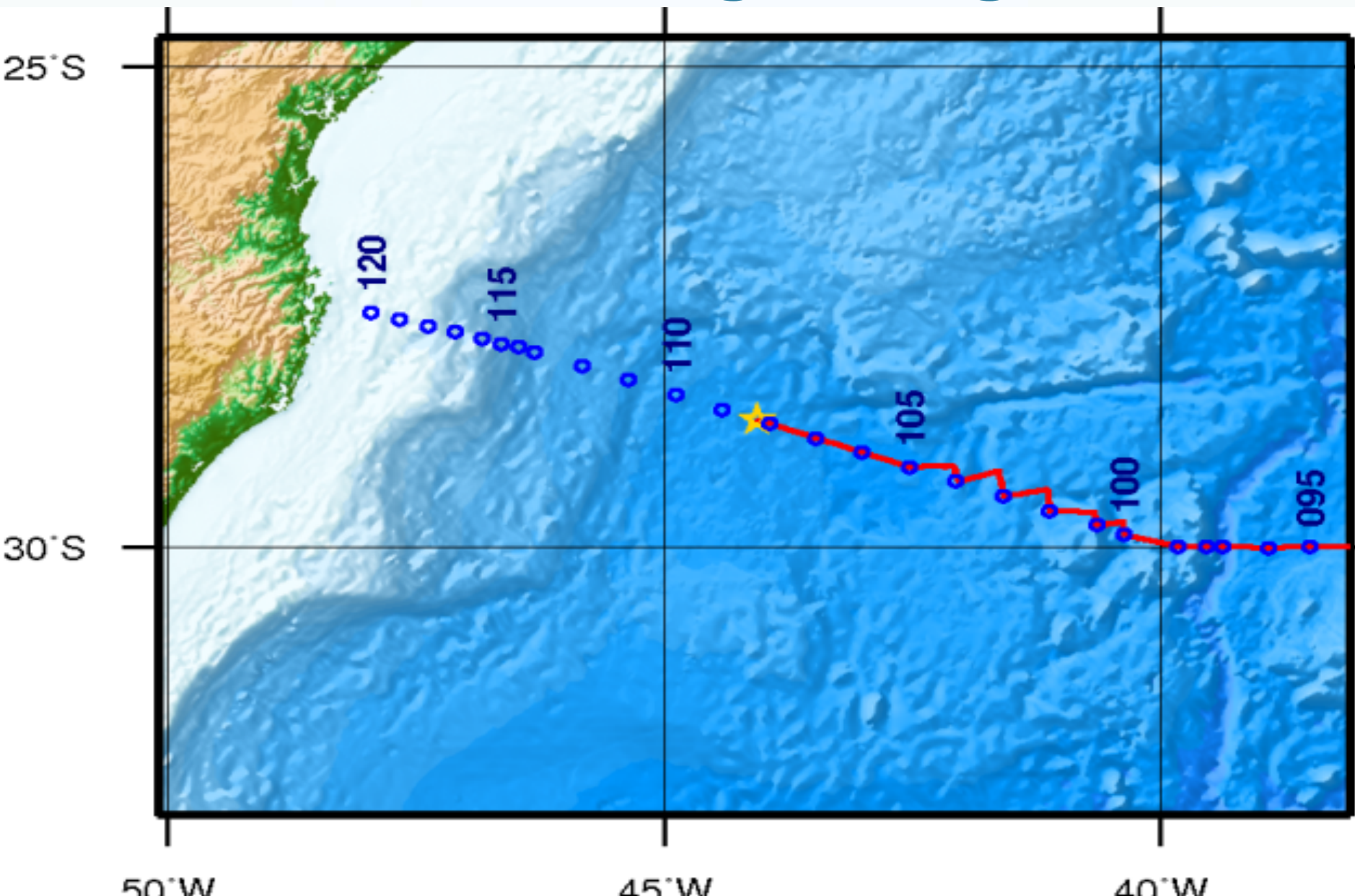
Weather



Wildlife



Following along



After 36 days: a dreary Rio!



Better weather



Summary

- September 26th to October 31st totaling 36 days of sea time
- 120 stations, 15 Argo floats, and 10 surface drifters.
- Up to 24 bottles on each cast, totaling 2,816 water samples
- ~2300 water samples analyzed for CFCs

Questions?

