U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Atlantic Oceanographic and Meteorological Laboratory
4301 Rickenbacker Causeway Miami FL 33149

Miami, Sep 19, 2012

Master,
M/V EXPLORER

Dear Captain:

On behalf of the United States Department of Commerce's Atlantic Oceanographic and Atmospheric Administration, I would like to thank you and Semester at Sea for your help and cooperation in providing us with the opportunity to use your ships to deploy oceanographic instrumentation. Mr. Jaime Soto, of NOAA-AOML, will be the scientific party in this operation.

The Atlantic Oceanographic and Meteorological Laboratory is located in Miami, Florida, and is one of twelve laboratories of the National Oceanographic and Atmospheric Administration (NOAA). You may be familiar with one of our sister organizations, the U.S. National Weather Service.

The Physical Oceanography Division of this laboratory has the mission to investigate the effect of the ocean on climate. To accomplish this we maintain an oceanographic and climate observing system to, for example, measure the upper ocean thermal structure and currents. Several data sets are obtained and developed by our laboratory's staff of scientific and technical support personnel to investigate the ocean processes and their link to climate variability and environmental changes.

Some of these observations are made by hydrographic measurements including the acquisition of temperature sections across long oceanic sections. The ship tracks used to deploy eXpendable BathyThermographs (XBTs) to obtain these temperature sections are usually referred as lines. The line between Durban and Santos is known as line AX18. The ships your company has made available run along this line. Moreover, other instruments such as drifters and floats are sometimes also deployed to help investigate ocean currents. Remote sensing procedures are also used, including satellite observations to monitor surface ocean currents, wind fields and sea surface temperatures.

Many of the results obtained from our research can be viewed in real or near-real time on our laboratory's web pages. As we obtain the data, we place updates on the progress of our research, which can be accessed through our web pages. This information can be accessed by navigating our laboratory (www.aoml.noaa.gov) or divisional (www.aoml.noaa.gov/phod) web pages. Of special interest to you could be the web pages where we show results obtained from high density (www.aoml.noaa.gov/phod/hdenxbt) or low density (www.aoml.noaa.gov/phod/uot/seasxbt.html) deployments, done from ships that join the Voluntary Observing System. Moreover, results from satellite-derived ocean surface currents (www.cwcaribbean.aoml.noaa.gov, click in 'Access CoastWatch Data', and then in 'Altimeter and GTS Data') and surface winds (www.cwcaribbean.aoml.noaa.gov, click in 'Access CoastWatch Data', and then click in 'Near Real-Time Wind Data') can also be accessed through our web pages.

Results obtained from observations and instrument deployments from volunteer ships are transmitted in real-time to our laboratory and then used by the National Weather Service to produce their marine and atmospheric forecast. Shipping companies such as yours then use their information as an aid for their operations.

Please feel free to contact us in case you have any question regarding our activities or results, or if you are further interested in using our ocean currents and wind products. We sincerely appreciate the opportunity you give us to do our research and enhance the current ocean observing system.

Thank you very much for your time, consideration and attention.

Dr. Gustavo Jorge Goni

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Cruise Plan
Implementation of High-Density XBT Line AX18.

National Oceanic and Atmospheric Administration
Atlantic Oceanographic and Meteorological Laboratory
Physical Oceanography Division
4301 Rickenbacker Causeway
Miami, Florida 33149

Principal Investigators:
Gustavo Goni and Molly Baringer

Dates: Loading: Jun 15, 2012, Port Everglades, USA.
Departing Cape Town, South Africa, approximately Oct 22, 2012; arriving in Buenos Aires, Argentina, approximately Nov 02, 2012.

Ship Name: M/V EXPLORER

Scientific Party: Mr. Jaime Soto, of NOAA-AOML, Miami, Florida USA.

Description of the Program:

The Atlantic Ocean plays an important role within the global ocean thermohaline circulation, through the interocean and interhemispheric exchanges of water, heat, salt and vorticity. The Meridional Overturning Circulation (MOC) in the subpolar North Atlantic is driven by the formation of the North Atlantic Deep Water (NADW), with a formation rate and properties that are highly influenced by climate changes on the decadal and interdecadal time scales. These climate changes affect the air-sea buoyancy flux in the subpolar basin, where warm-to-cold water transformation processes take place. Recent results indicate that the formation of the NADW is the cause of strong traces of the North Atlantic Oscillation (NAO), a leading signal in decadal time scale climate changes in the Atlantic. The MOC in the subtropical North Atlantic is mostly affected by changes in momentum, air-sea fluxes and salinity. However, the processes by which they cause changes in the ocean dynamics are not completely known, particularly at decadal and longer time scales.

The upper limb of the MOC carries warm waters from the South Atlantic into the North Atlantic subtropical gyre through pathways and mechanisms that are not completely understood and need to be investigated further. This connection between the upper limbs of the gyres in the southern and northern hemispheres in the tropical Atlantic is primarily composed by zonal currents, which are forced by the wind field, primarily by the position and intensity of the Inter-Tropical Convergence Zone (ITCZ). Therefore, the tropical Atlantic is of critical interest for the large-scale ocean circulation since it is where strong western boundary currents contribute to inter-hemispheric transport of properties. The MOC carries warm water from the South Atlantic to the North Atlantic off the coast of Brazil within a western boundary current, the North Brazil Current (NBC). Below

the NBC, colder, fresher Antarctic Intermediate water flows north in the North Brazil Undercurrent. In addition to the northward flow of the NBC a shallow Subtropical Cell (STC) carries subducted surface water from the southern subtropics to the equator, where it is upwelled to the surface.

While time scales of decades or more characterize the deep flows, the time scales of the boundary currents and STCs are of months to several years. Monitoring water mass properties as well as the velocity structure of the hypothesized pathways between the subtropics and the tropics provides the tools to characterize both the mean and the time-dependent properties of the tropical portion of the MOC and the Atlantic STC. The role of the South Atlantic in the Meridional Overturning Circulation (MOC) can be better understood by reducing the uncertainty in the meridional heat flux through the subtropical band.

This program is designed to measure the upper ocean thermal structure in key regions of the Atlantic Ocean. The seasonal to interannual variability in upper ocean heat content and transport is monitored to understand how the ocean responds to changes in atmospheric and oceanic conditions and how the ocean response may feedback to the important climate fluctuations such as the NAO. This increased understanding is crucial to improving climate prediction models. Within this context, four XBT lines have been chosen to monitor properties in the upper layers of the Atlantic Ocean.

The key objective of this program is to implement the high density XBT line AX18 to improve the existing climate observing system in the tropical Atlantic. These observations will allow improving our knowledge of the spatial and temporal variability of the surface currents in the South and tropical Atlantic and to estimate the meridional heat transport in the South Atlantic

This will be the 20th realization of a five-year program to survey this line four times a year (Figure 1). Additional information on this project may be obtained from **http://www.aoml.noaa.gov/phod/hdenxbt/**

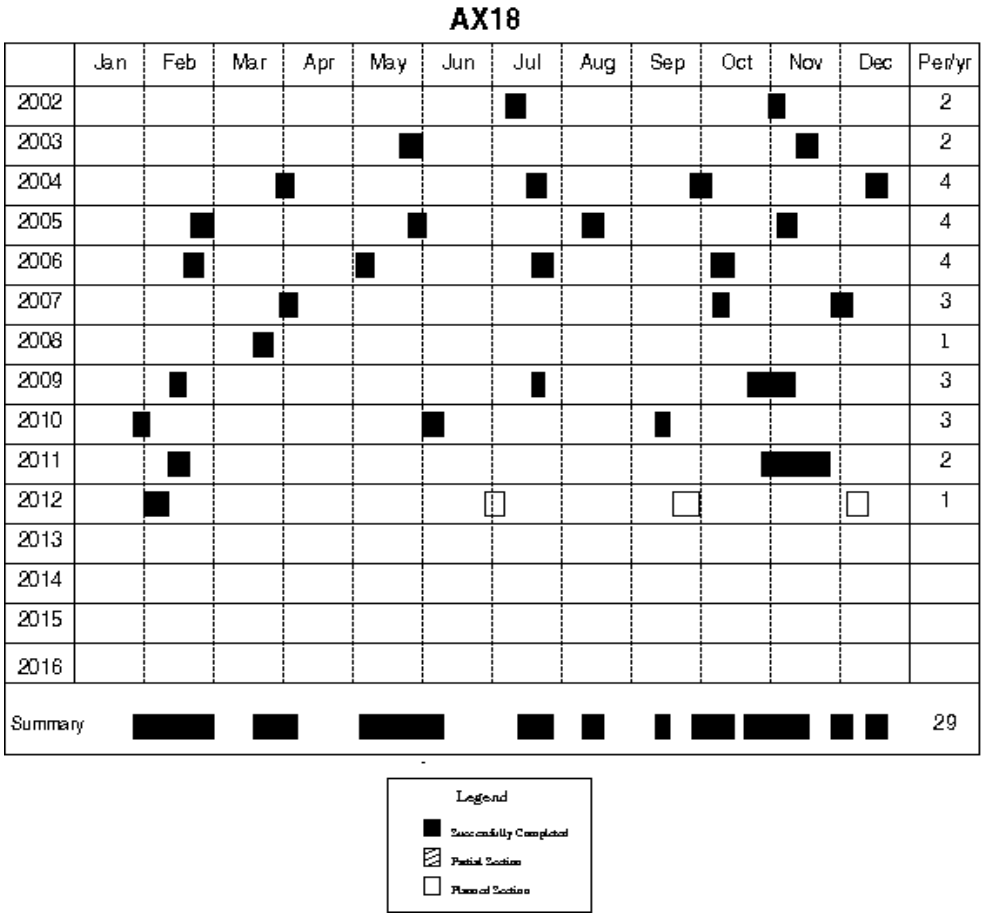

Figure 1. Deployment schedule for AX18.

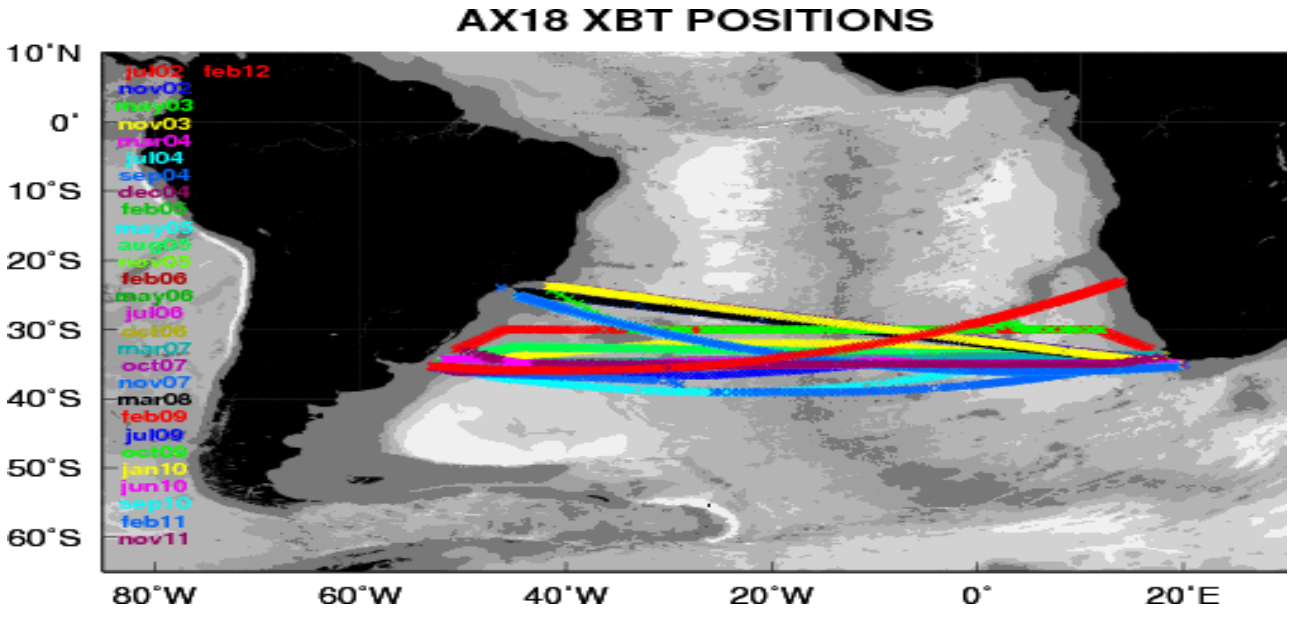

Figure 2. The location of XBT deployments for the previous AX18 XBT transects. The key objective of this project is to improve the existing climate observing system in the tropical Atlantic.

Based on recommendations from the Climate Observing System for the Tropical Atlantic (COSTA) Workshop (Miami, May 1999) this program will increase data collection on the AX18 low density XBT VOS line between Argentina and South Africa traversing key regions in the tropical Atlantic four times a year. These observations will allow to improve our knowledge of the spatial and temporal variability of the zonal surface currents in the tropical Atlantic Ocean.

Implementation:
Three types of instruments will be deployed:

(a) EXpendable BathyThermographs, XBTs.

The XBTs will be launched from an autolauncher in two modes, High Density (every 20 km) and Intermediate Density (every 50 km), performed between South Africa and Brazil.

1. **High Density:** Between the coast of South Africa once the ship enters water deeper than 200m (approx 18.5^{o}E) continuing to 1^{o}W. Approximately 50 XBTs.
2. **Intermediate Density**: Between 1^{o}W and 40^{o}W. Approximately 60 XBTs.
3. **High Density:** Between 40^{o}W and coast of South America once the ship enters waters deeper than 200m (approx. 53 ^{o}W). Approximately 65 XBTs.

Total: approx 175 XBT's.

(b) ARGO Profiling Floats

A total of 18 ARGO Profiling Floats will be deployed at positions to be determined.

The time spacing between drops will be determined by the ship speed (Table I).

XBT Drop rate						
Ship Speed (knots)	Desired Sampling Space					
	10 km	**15 km**	**20 km**	**30 km**	**40 km**	**50 km**
10	32 min	48 min	1 h 04 min	1 hr 37 min	2 hr 09 min	2 hr 42 min
11	29 min	43 min	58 min	1 hr 28 min	1 hr 57 min	2 hr 27 min
12	27 min	40 min	54 min	1 hr 21 min	1 hr 47 min	2 hr 15 min
13	25 min	37 min	50 min	1 hr 15 min	1 hr 39 min	2 hr 04 min
14	23 min	34 min	46 min	1 hr 10 min	1 hr 32 min	1 hr 55 min
15	22 min	33 min	44 min	1 hr 05 min	1 hr 26 min	1 hr 48 min
16	20 min	30 min	40 min	1 hr 00 min	1 hr 20 min	1 hr 41 min
17	19 min	29 min	38 min	57 min	1 hr 16 min	1 hr 35 min
18	18 min	27 min	36 min	54 min	1 hr 11 min	1 hr 30 min
19	17 min	25 min	34 min	51 min	1 hr 08 min	1 hr 25 min
20	16 min	24 min	32 min	48 min	1 hr 04 min	1 hr 20 min
21	15 min	22 min	30 min	46 min	1 hr 01 min	1 hr 17 min
22	14 min	21 min	28 min	44 min	58 min	1 hr 13 min
23	13 min	20 min	26 min	42 min	56 min	1 hr 10 min
24	13 min	19 min	25 min	40 min	53 min	1 hr 07 min
25	12 min	18 min	24 min	38 min	51 min	1 hr 04 min

Table I. Time interval between XBT launches based on ship speed and desired sampling spacing.

Temperature sections and surface conditions:

The two temperature sections obtained during the February 2006 and March 2007 transects reveal the main surface currents in the region that can be detected from the slope of the isotherms (Figure 3).

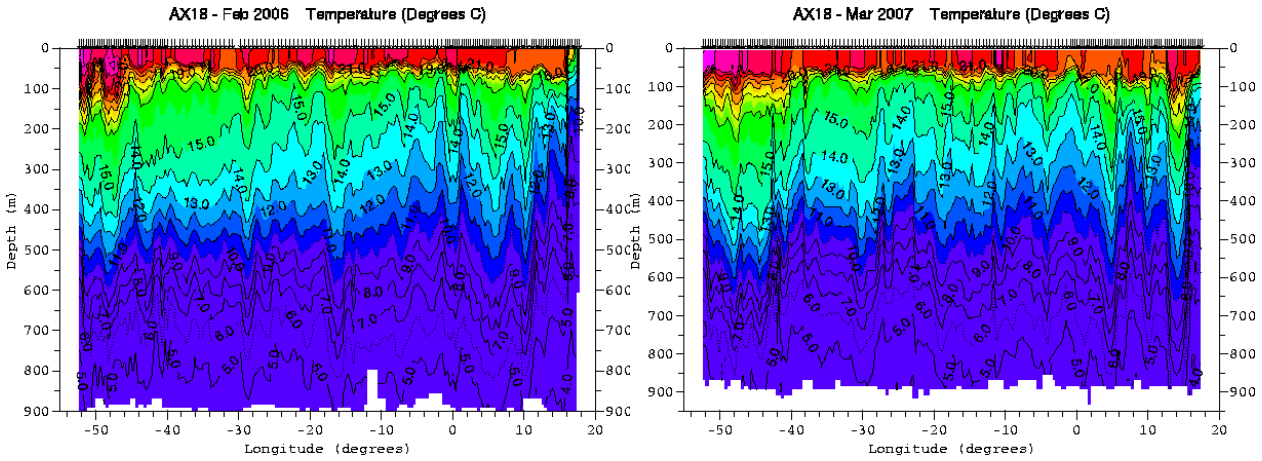

Figure 3. Temperature sections obtained from the February 2006 and March 2007 transects.

The satellite altimetry derived surface currents (Figure 4) in the region indicate that there is a warm ring centered approximately 8E 33S.

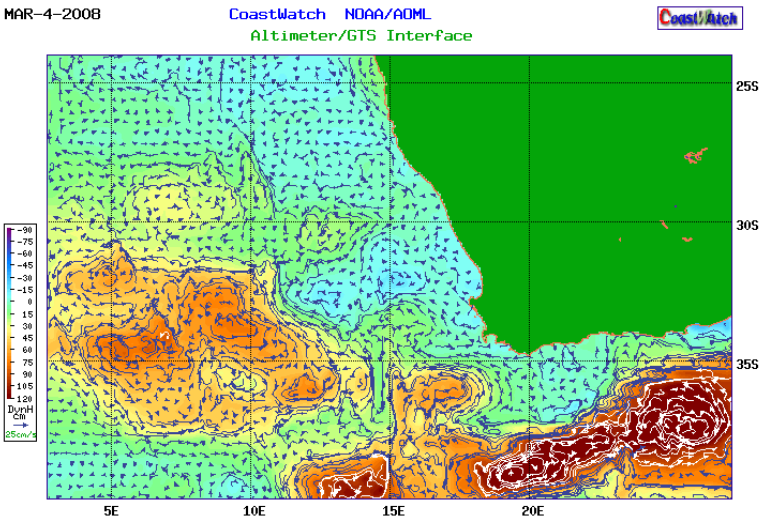

Figure 4. Altimetry-derived geostrophic currents for March 4, 2008

I. High Density Check-out list

DONE √	**At the end of the transect voyage please secure that the following has been done before leaving the vessel:**	**Date Completed**
	Notify by email that the cruise is over to: TO: Robert.Roddy@noaa.gov CC: Francis.Bringas@noaa.gov CC: Zach.Barton@noaa.gov - This is done so that a follow up thank you note can be forwarded to the captain and crew. - List any special thanks or comments that you would like included in the note.	
	Make a hard copy of: The AMVERSEAS file c:\ProgramFiles\AMVERSEAS Which includes: - XBT data in .BIN, .NDC. - Electronic XBT drop log sheet. - HistoryAllAttempts.txt	

J. Cruise follow up

Write a cruise report that includes the following descriptions:

- XBTs deployed
- Drifters deployed (ID, date, time, latitude, longitude)
- Profiling floats deployed (start time, deployment time, latitude, longitude)
- GTS transmission (Real-time, twice a day, problems)
- Additional equipment, tools, supplies needed
- Problems
- Recommendations
- Other narrative

Email the cruise report to:
Gustavo.Goni@noaa.gov, Molly.Baringer@noaa.gov, Yeun-Ho.Chong@noaa.gov, Silvia.Garzoli@noaa.gov, Francis.Bringas@noaa.gov, Robert.Roddy@noaa.gov, and Jaime.Soto@noaa.gov.
Email Cruise Data to: Robert.Roddy@noaa.gov, Yeun-Ho.Chong@noaa.gov, Jaime.Soto@noaa.gov.

If drifters were deployed also send a deployment log to Shaun.Dolk@noaa.gov.
If ARGO profiling floats were deployed send in a deployment log sheet to
deploymentinfo@whoi.edu