

Shipboard Surveys of Regional and Worldwide Field Operations

PhOD personnel spend on average a total of 420 days at sea every year. The following is a summary of the divisional led effort at sea.

CLIVAR CO₂/Repeat Hydrography: Goals – To monitor changes in water properties on a decadal time scale. The program is a collaboration between NOAA and NSF with many partners nationally and internationally. Within NOAA, the program is a collaboration between AOML/OCD, AOML/PHOD and Pacific Marine Environmental Laboratory (PMEL). PHOD's responsibilities includes support for CTD observations and discrete salinity and oxygen measurements. The operational components include: Typically two major cruises every three years are conducted on a subset of the global historical survey lines. PHOD is responsible for a sending 2 discrete oxygen analysts, 1 salinity analyst and CTD engineer. Cruises are generally 30 to 60 days long.



PIRATA Northeast Extension (PNE): Goals – To study both ocean and atmosphere in the tropical eastern Atlantic. The program routinely has partner/piggy-back programs from Earth System Research Laboratory (ESRL), University of Miami, and Howard University. Number of PHOD people going on each cruise: 3 – 5. Operations typically involve a CTD survey along 20°W and the annual servicing of three PIRATA moorings located along 20°N and 20°W. The operational components include:



1. Normally one cruise per year ranging from 31 days depending on the ports of call.
2. In 2010 the PNE cruise took place in April 22 - May 22, and in 2011 cruise is schedule for end of August till end of September.

Western Boundary Time Series (WBTS): Goals – To study the components of the Meridional Overturning Circulation (MOC) near the western boundary of the Atlantic basin at 26.5°N. Presently, the WBTS program includes the following two sea-going components:



Florida Current measurements along 27°N: These cruises have several goals that include determining the volume and heat transport in the Florida Straits to use for calibration of the submarine cable voltage measurements, and providing boundary current transports for the determination of the meridional heat and volume transport associated with the XBT transect AX07 and the MOCHA/Rapid/WBTS program (see below). These measurements include:

1. Small charter boat 1 day cruises: These cruises are done on a chartered fishing boat from the Sailfish Marina in West Palm Beach and involve sending one person with an AOML designed dropsonde that provides the vertically averaged horizontal velocity. Eight to ten cruises each year are timed to occur within a two week period quarterly, coinciding with the high density XBT transect AX07.



2. Coastal Survey Vessel: 2 to 3 day cruises, typically using the R/V Walton Smith. These cruises are planned for quarterly occupation (subject to ship time charter funding) and involve 3 PhOD personnel. Data resulting from these cruises include profiles of temperature, salinity, oxygen and velocity (from lowered and shipboard ADCP measurements). Starting in 2009, most of these cruises have included net tows in collaboration with the NOAA Southeast Fisheries Science Center.

Deep Western Boundary Current cruises along 26.5°N: These cruises seek to quantify water mass variability in the Deep Western Boundary Current east of the Bahamas and to provide an estimate of the volume flow. Since 2004 *in-situ* PIES and CPIES moorings provide time series estimates of the DWBC (and the smaller northward-flowing Antilles Current) and cruises include servicing (as appropriate) and downloading the subsurface data (via telemetry). In addition to travel time series data, these cruises provide full water column estimates of temperature, salinity, oxygen, and velocity east of the Bahamas, along 26°N, 27°N in the Florida Straits, and near 78°W across the Northwest Providence Channel (time permitting).

Meridional Overturning Circulation Heat-flux Array (MOCHA):

Goals - To determine the basin-wide Meridional Overturning Circulation (MOC) at 26.5°N. This is a collaborative program between NOAA, NSF and the United Kingdom Natural Environment Research Council (NERC) and builds on the longstanding NOAA Western Boundary Time Series Program (see above). The NSF funded part of the program is called MOCHA, while the UK funded part is called RAPID-MOC.



Expendable Bathythermograph (XBT) network: Goals - To measure the upper ocean mesoscale temperature and current variability in the Atlantic Ocean using expendable bathythermographs deployed with horizontal separation of 10-50 km. Ten High Density XBT transects are maintained by AOML with sampling typically quarterly for a total of 32 sections each year, with the notable exceptions that AX25 is repeated twice each year and AX97 is repeated six times per year. Each transect requires 1 ship rider to deploy XBTs, drifters, and Argo floats. International collaborators work with AOML personnel on the vast majority of these sections, covering two of the North Atlantic transects AX07 and AX10. The length of these cruises ranges from as many as 35 days (AX25 and AX08) to 3-4 days (AX10 and AX97).