

## **The Ship Of Opportunity Program**

Gustavo Jorge Goni, Molly Baringer, and Silvia Garzoli  
NOAA/Atlantic Oceanographic and Meteorological Laboratory, Miami, FL

### **Project Summary**

The Ship Of Opportunity Program (SOOP) is an international effort that supports the implementation of a network of cargo vessels, cruise ships, and research vessels to deploy scientific instruments that collect oceanographic observations. The most important of these instruments is the Expendable Bathythermograph (XBT). XBTs are deployed along fixed, pre-established transects, which are repeated at least 4 times per year, to measure the water temperature from the sea surface to a maximum depth of 850 m. The XBT network currently in place has been recommended by the international scientific community during the OceanObs99 and OceanObs09 meetings. The countries that provide the largest contributions to this program are the United States, Australia, France, South Africa, Brazil, Germany, Italy, and Japan. On average, approximately 20,000 XBTs are deployed per year, of which AOML is involved in some aspect of the logistics, operations, data processing, etc, of about 90% of them. AOML leads or co-leads with its international collaborators the implementation and operations of 12 Atlantic Ocean transects.

XBT temperature measurements are used to monitor changes of key surface and subsurface currents, to study meridional heat transport in all ocean basins, and to supplement other observational platforms to assess the variability of the upper ocean heat content. All XBT transects have been justified by their impact of our understanding of how the upper ocean dynamics and thermal structure may be linked to long-term climate signals, extreme weather events, ecosystem assessments, etc. Scientists using XBT data produce more than 25 publications annually in peer review scientific publications, in addition to presentations in scientific meetings, and a large number of other applications in which several products for ocean condition monitoring are created.

Some of the XBT transects have been maintained for many years, for example AX32, which runs from Newark to Bermuda. This transect is geared towards investigating the variability of the Gulf Stream, and has been carried out for 31 consecutive years since 1981. These measurements represent the longest time series available of the Gulf Stream. Other transects, such as AX07 (from Miami to Gibraltar) and AX18 (From Cape Town to Buenos Aires), are geared towards monitoring the Meridional Heat Transport in the South and North Atlantic Ocean, respectively. In fact, the AX18 transect that is currently maintained by AOML is the only observational platform that can provide estimates of this parameter. In addition to the 12 Atlantic XBT transects for which NOAA/AOML maintain a lead or co-lead role, the AOML SOOP project collaborates by providing probes, equipment,

and/or data transmission support for 11 transects in the Pacific Ocean and 6 transects in the Indian Ocean.

Most of the data obtained through this project are distributed onto the Global Telecommunication System (GTS) within 24 hours of its acquisition, thereby providing critical input to weather and climate forecasts models and scientific applications. Additional scientific quality control is carried out at AOML to provide data with quality for climate studies. These data are distributed to NOAA/NODC and to other data distribution centers.

This project is also involved in activities aimed at the continuous development of new technologies in support of the operations carried out as part of the XBT network. During recent years the engineering group at AOML has developed new equipment for the automatic deployment of several models of XBTs during cruises with high rate of deployments, for the transmission of data in real-time using different satellite networks, and for the substitution of several components saving money for the project. In addition, AOML scientists continue working on XBT fall rate studies and collaborating with Lockheed Martin Sippican to develop a new, upgraded, XBT probe that will be able to provide climate quality observations.

To facilitate the data collection effort, the SOOP project has developed and currently maintains the Shipboard Environmental Data Acquisition System (SEAS), which is software used to collect and transmit observations from XBTs, ThermoSalinoGraphs (TSGs), and meteorological observations, which contribute to the largest source of marine meteorological observations used by the NOAA National Weather Service for Marine forecast. In addition, this software provides regular reports to the US Coast Guard's Automated Mutual-Assistance Vessel Rescue System (Amver), which aids in finding ships in the vicinity of vessels in distress, in order to save lives and property.

SOOP is also responsible for the installation and operation of TSGs, which are instruments that continuously measure the values of sea surface temperature and salinity along the ship path. In addition this project supports other observational networks, such as the global drifter array, and Argo profiling floats. TSG observations are used in conjunction with pCO<sub>2</sub> observations and provide critical information to determine frontal regions and mixed layer depths for ocean acidification assessments.