New Instrument Developments at NOAA/AOML: Drifting Buoy with Mini-Met Station and XBT Data Recorder

Pedro Pena[1], Diego Ugaz[2], and Ulises Rivero[1]

1. NOAA/Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
2. University of Miami, Cooperative Institute for Marine and Atmospheric Studies (CIMAS), Miami, Florida, USA.

2019 NOAA Emerging Technologies Workshop. June 25-26, NOAA Center for Weather and Climate Prediction (NCWCP). College Park, MD.

Emerging Technologies

Abstract

The Instrumentation Group at the Physical Oceanography Division (PHOD) of NOAA/Atlantic Oceanographic and Meteorological Laboratory (AOML) is an engineering team focused on the improvement, development, and implementation of new technologies in support of a suite of observational efforts that are carried out by PHOD. During the last two years this group has been responsible for the development of new prototypes to improve and enhance the data collection operations carried out by different projects. This poster details two of these new prototypes 1) a new drifting buoy including a mini-meteorological station and 2) a new data recorder for eXpendable Bathythermograph (XBT) data.

Tests have been conducted during field operations and both prototypes have performed according to design and requirements. In addition to sea surface temperature and salinity, the new drifting buoy will allow the simultaneous collection of relative wind speed and direction, air temperature, humidity, and barometric pressure. The new AOML XBT data Recorder (AXR) will be able to substitute its counterpart, the MK-21 by Lockheed Martin, with a reduction in size, improved integration using existing equipment, and will save NOAA approximately $9000 per unit. The NOAA XBT Network is responsible for the deployment of 8000 XBTs per year globally.

1. Motivation

Drifting Buoy with Mini – Meteorological Station

Temperature has been measured and studied extensively over the years, whereas salinity measurements are historically sparse. Ocean salinity can be regarded as an indicator of the strength of the hydrological cycle. In order to characterize and predict changes in the global water cycle, it is critical to advance our knowledge of the processes controlling ocean salinity variability.

The PhOD Instrumentation Group built a prototype buoy equipped with a mini weather station on a mast as part of the NASA Ocean Salinity Science Team project with an in-kind contribution from NOAA-AOML. An identical mini weather station was mounted on the Rosenstiel School of Marine and Atmospheric Science (RSMAS) pier for calibration purposes. The objective of the experiment was to evaluate the quality of wind speed/direction, precipitation, air temperature/humidity measurements by comparing them to concurrent measurements to the mini weather station on the pier and by the permanent RSMAS weather station.

AOML XBT Data Recorder

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. One important component of this effort is the NOAA/AOML XBT network. XBTs are deployed along fixed pre-established transects, which are repeated at least 4 times per year, to measure water temperature profiles from the sea surface to a maximum depth of 850m.

These 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. An improved data recording system is key for successful XBT operations.

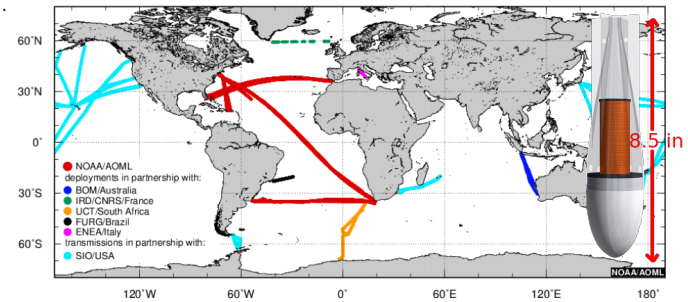

Figure 1. Location of the AOML XBT deployments and AOML-supported XBT deployments and transmissions during FY2018 carried out by AOML or in partnership with national and international collaborators. NOAA is responsible for the collection of approximately 8,000 XBT profiles globally every year during operations conducted by AOML and its partners.

2. Drifting Buoy with Mini-Meteorological Station

- This prototype drifting buoy may potentially lead to the design of surface drifters equipped with dual surface (20 cm) and subsurface (tethered) temperature and salinity sensors with a mini weather station on a mast.
- Such drifters may make it possible to directly observe how the near-surface temperature and salinity structure is affected by atmospheric forcing (temperature, wind, and precipitation) in a Lagrangian frame of reference.

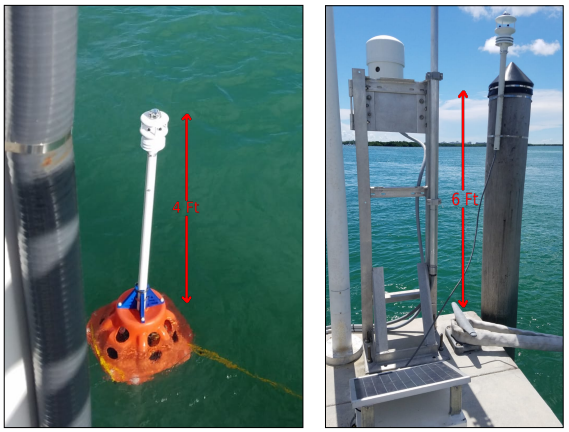

Figure 2. **(left)** Prototype of Mini-Meteorological Station on top of a buoy. This Mini-Met. Station can collect relative wind speed and direction, air temperature, humidity and barometric pressure. When installed on top of a drifting buoy, these parameters will be simultaneously collected with sea surface temperature and salinity. **(right)** A weather station currently installed on a pier at RSMAS was used as a reference to compare the measurements collected by AOML's Mini-Met. Station prototype.

3. AOML XBT Data Recorder

- By improving on the current methods of acquiring data, the costs attributed to servicing, deployment, and upgrading of the system can be greatly reduced.
- Engineers, technicians and scientists at AOML continue developing an XBT data acquisition device. This new device, called the AXR, performs the same measurement operations as its costlier counterpart the MK-21 by Lockheed Martin, has a smaller footprint and easily integrates with existing equipment.
- Production cost for the AXR prototype is less than $100 per unit. Possibly reducing hardware costs by 85 times.

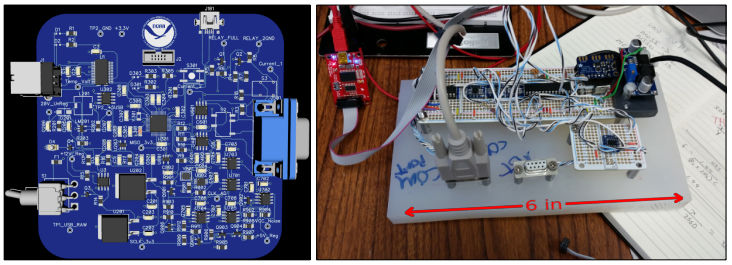

Figure 3. **(left)** Design of the data acquisition circuit for the AXR. **(right)** Proof of concept AXR tested on the bench. A total of 3 prototypes have been built and tested. Each new generation includes dramatic enhancements in terms of efficiency, ease f use and data quality. Tests have been conducted during field operations and the latest prototype have performed according to all design requirements.

Acknowledgments

This project is funded by NOAA/OAR and NOAA/AOML, and supported by UM/CIMAS.

For a pdf of this poster: