An Enhanced XBT probe

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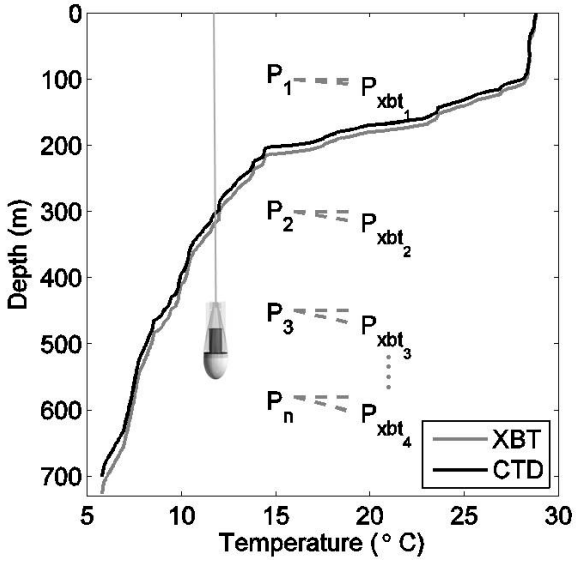
Expendable BathyThermograph (XBT) observations account for a large percentage of the existing global ocean temperature record. Historical temperature differences between XBT and conductive- temperature-depth (CTD) profiles are found in the historical record, which are mostly due to time variable XBT depth biases. These biases account for most of the apparent interannual variation of heat content in the ocean, and therefore, may influence the ability of climate models to better simulate the ocean heat uptake.

Traditional XBT probes do not contain pressure sensors. Depth is estimated according to a semi-empirical quadratic relationship between the time of descent and depth, known as the fall rate equation (FRE). According to the manufacturer, systematic errors associated with XBT temperature measurements are typically a linear bias of ± 2% of depth, a depth offset of ± 5m, and a temperature accuracy of ±0.15°C. The objective of this work is to produce a new XBT probe which will produce temperature profiles with a temperature precision of ~ 0.02°C and a maximum depth bias of ~ 2m, comparable to Argo measurements. Scientists and engineers from NOAA/AOML along with Lockheed Martin Sippican engineers are carrying out theoretical and sea experiments to design a new Climate Quality XBT (CQ-XBT) system. The CQ-XBT system will consist of three main improvements upon its predecessor:

1) The inclusion of pressure switches in the XBT probes (Figure) will reduce the depth biases associated with the FRE. Results from a theoretical study (Goes et al., 2013) show that given the typical XBT depth biases, using two pressure switches is a reliable strategy for reducing depth biases, and that the measurements should be taken in the lower thermocline and deeper in the profile.

2) Improved thermistor calibration to reduce pure temperature errors. Several sea trials have already been carried out in the tropical and North Atlantic oceans aiming at testing different thermistor calibration methods.

3) An updated firmware to accommodate all the changes, as well as be capable to work with previous systems.



Schematic of the depth correction using pressure switches. During the descent of the XBT probe (probe not to scale), a temperature profile is produced. Pressure switches installed in the probe are triggered at various depths, and the recorded measurements P1, P2,..., Pn correct the profile to the actual depths