

Current Experiments of XBT Fall Rate Equation at NOAA/AOML

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XBT profile biases and offsets

Attempts to understand and quantify biases and offsets identified in XBT profiles include:

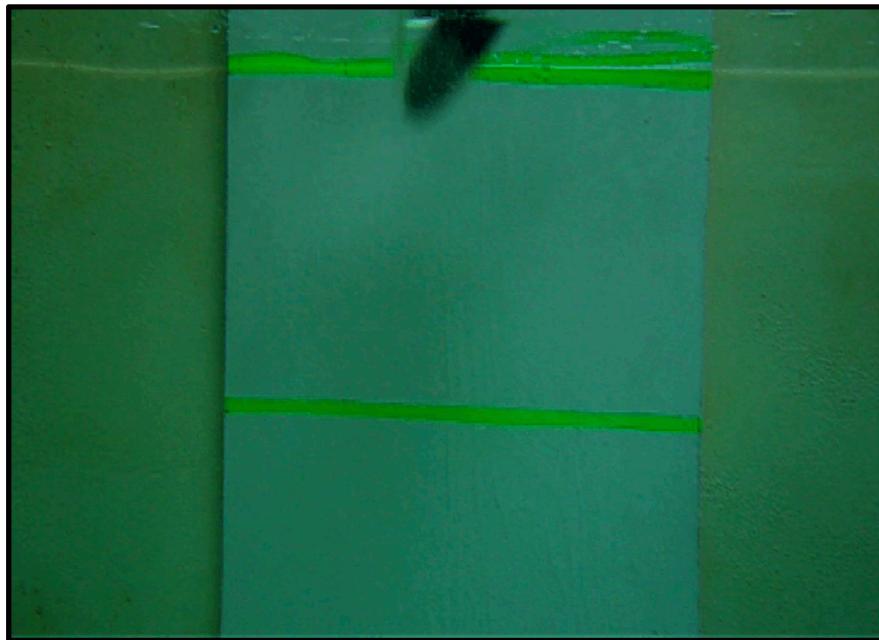
- Conducting experiments
- Testing XBT equipment (data recorders, launchers, ...)
- Comparing XBT profiles with observations from other platforms (CTD, Argo floats, altimetry, ...)

High quality XBT profiles are obtained after corrections are applied taking into account:

- a) Time-dependent fall rate equation (FRE) coefficients
- b) Pure temperature biases
- c) Depth offsets

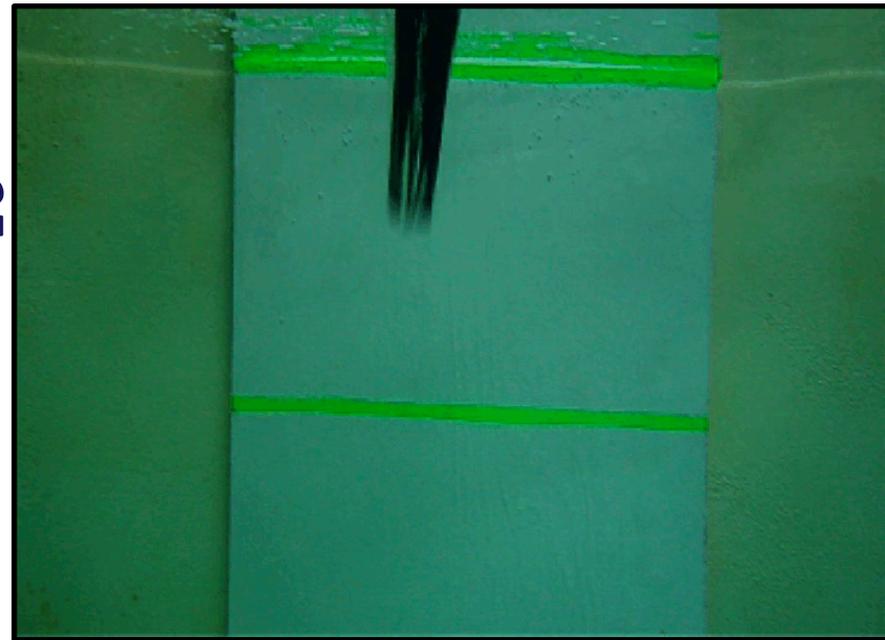
The first 20 meters

Swimming pool and water tank experiments



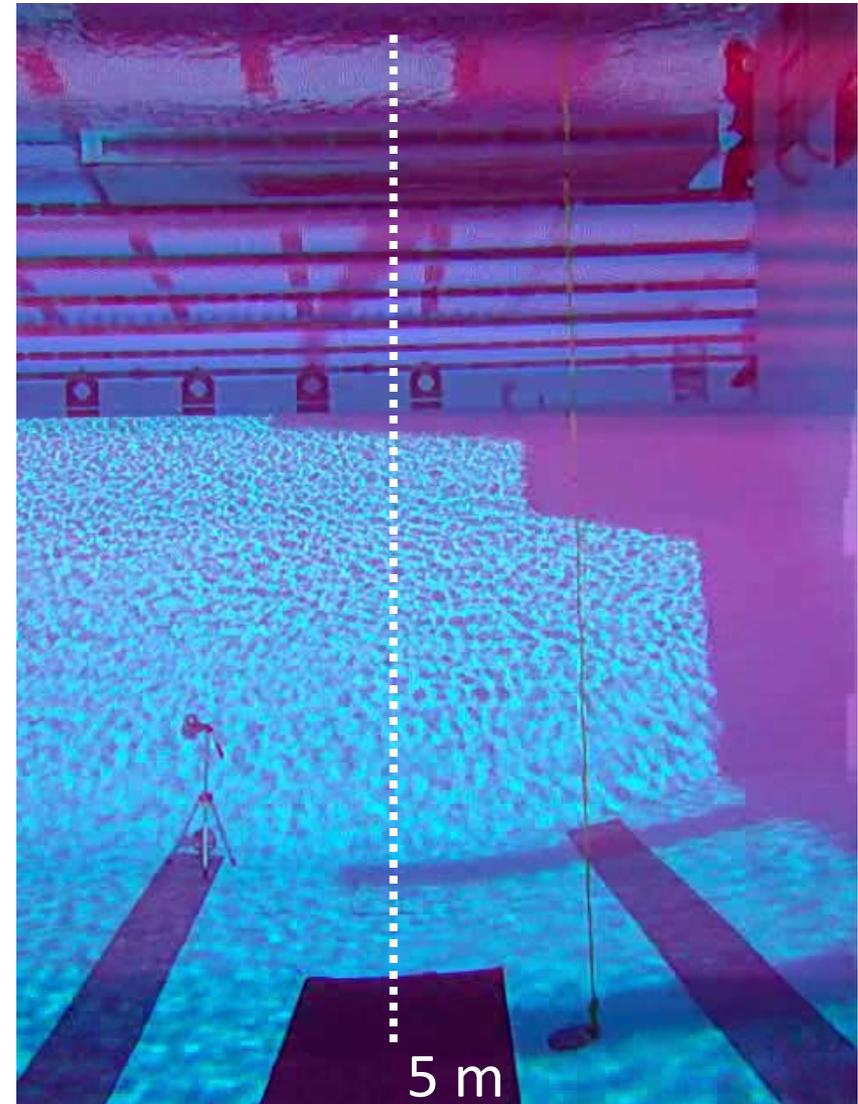
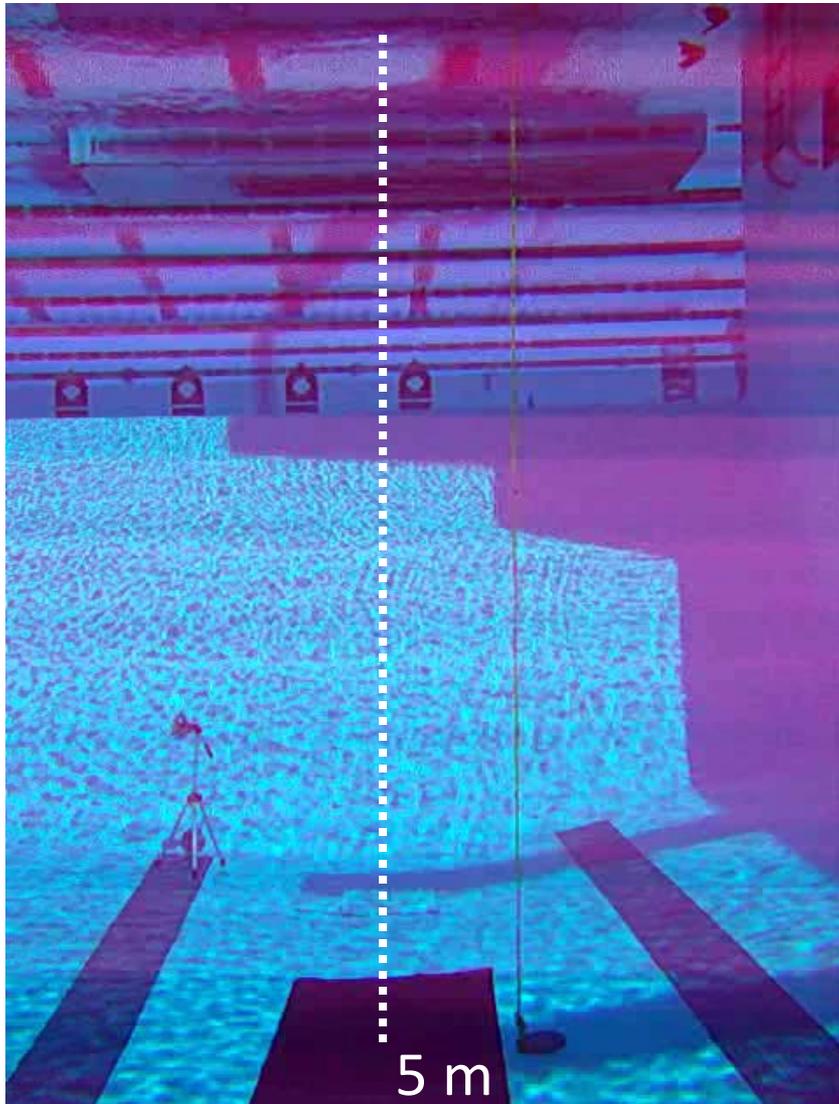
$$h_0 = 1 \text{ m}; \quad \varphi = 45^\circ$$

25 cm



$$h_0 = 1 \text{ m}; \quad \varphi = 180^\circ$$

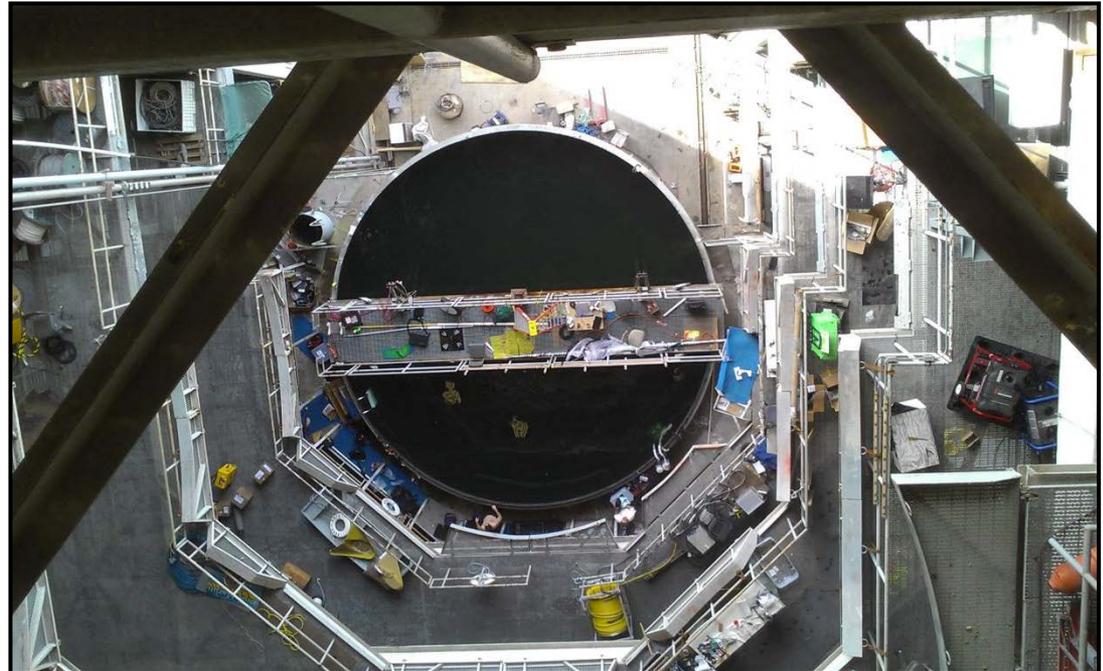
The first 20 meters



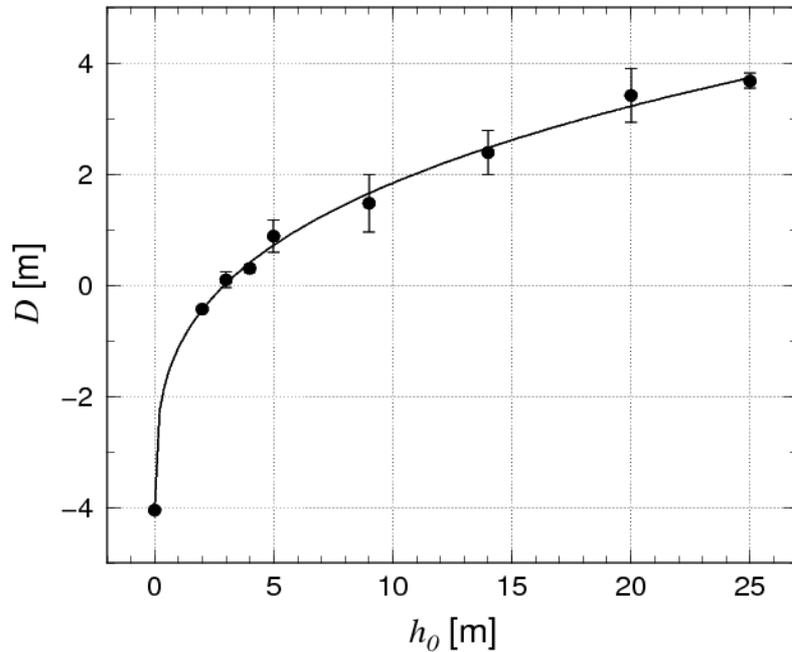
The first 20 meters



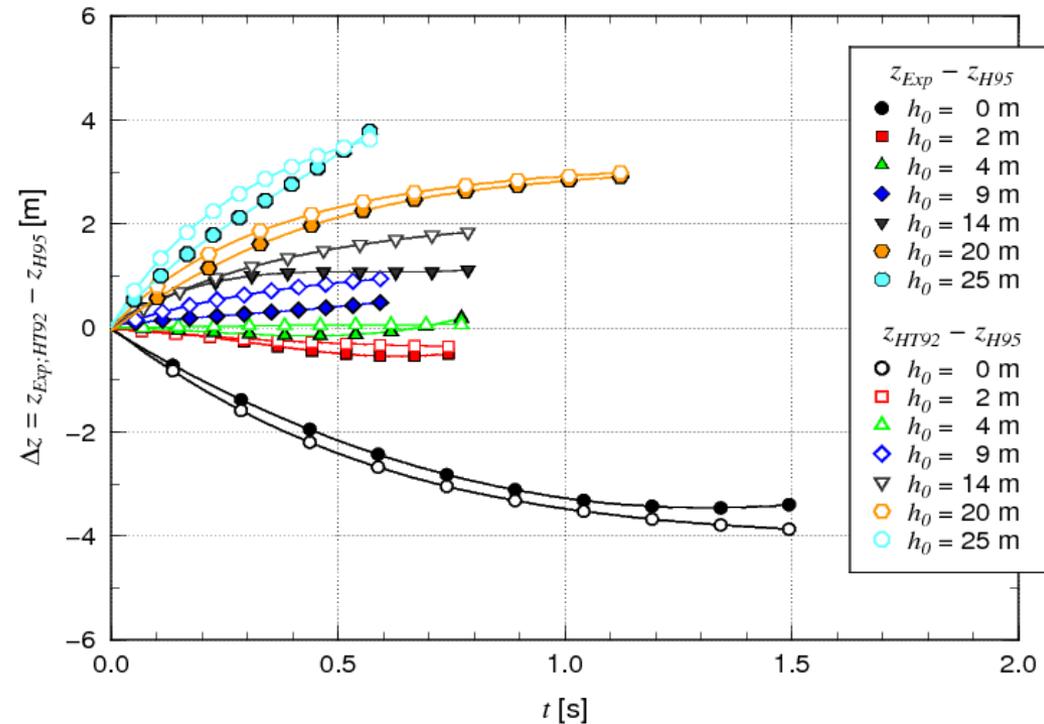
John C. Stennis Space Center
Mississippi
Building 3203: NOAA / National Data Buoy
Center (NDBC)



The first 20 meters



Maximum depth offset (D) in the FRE compared to H95 as a function of the deployment height (h_0)



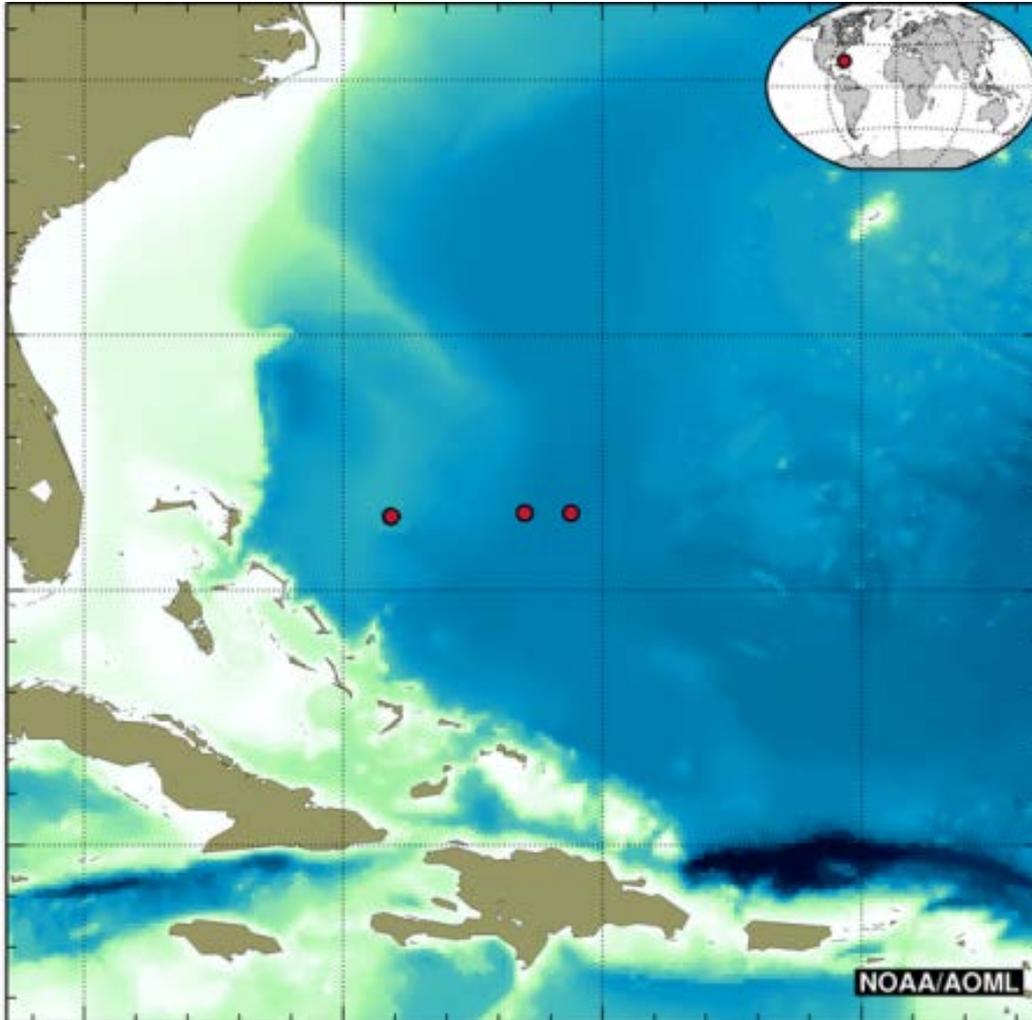
$D \approx 0$ for $h_0 \sim 3$ m

H95: Hanawa et al. *Deep-Sea Res.*, 42, 1423–1451 (1995)

HT92: Z.R. Hallock and W.J. Teague. *J. Atmos. Oceanic Technol.* 9, 470-483 (1992)

Bringas, F. and G. Goni. *J Atmos. Oceanic Technol.*, 32, 2253–2263 (2015)

Effect of the deployment height and ship speed

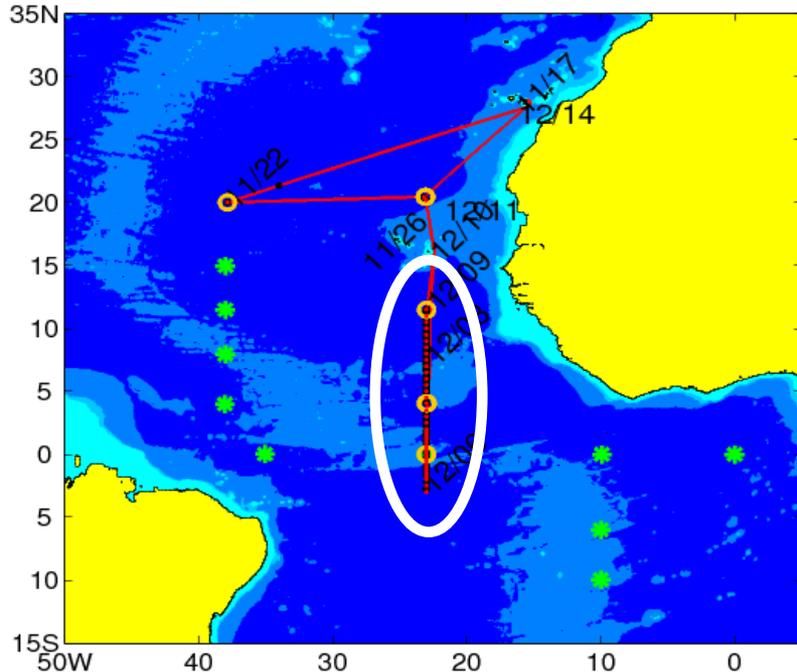


In-situ experiment during an AOML cruise in February, 2015

- Simultaneous XBT + CTD deployments (ship speed ~ 0)
- XBTs deployed from different heights
- XBTs also deployed from different heights during transit (ship speed ~ 9 kn)

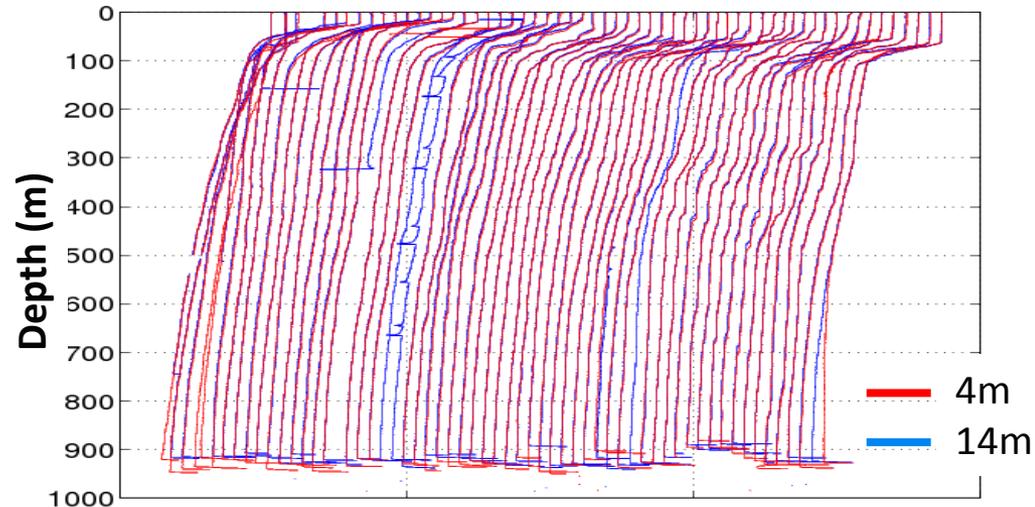
Western Boundary Time Series (WBTS) cruise – Feb. 2015

Effect of the deployment height and ship speed

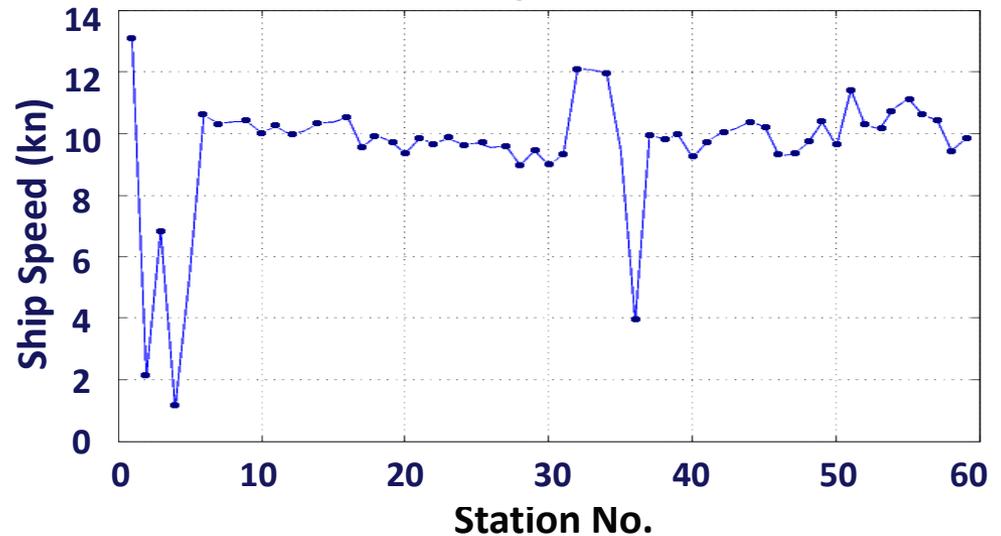


PIRATA Northeast Extension Cruise – Nov. 2015

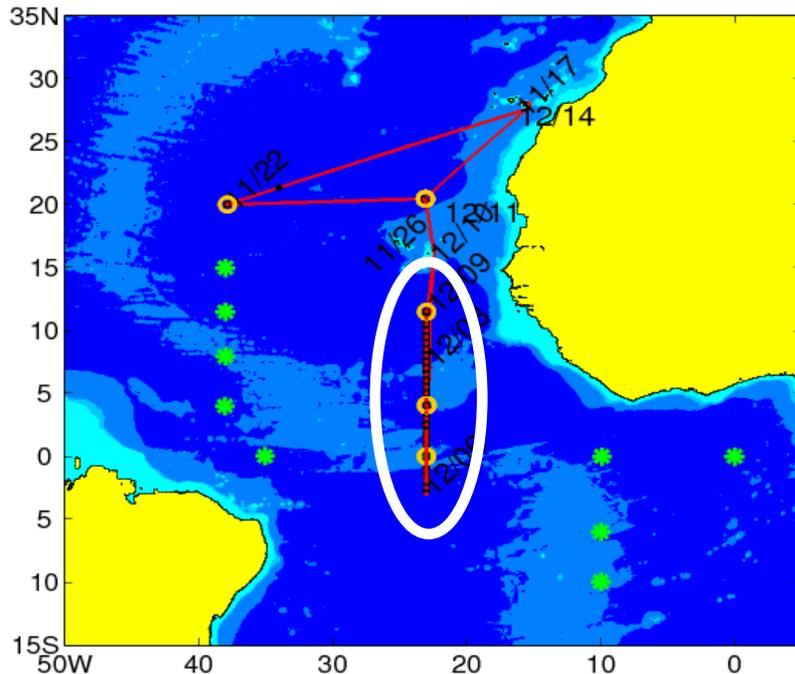
187 XBTs deployed from 4 m and 14 m at different ship speeds between 2-14 kn.



Temperature

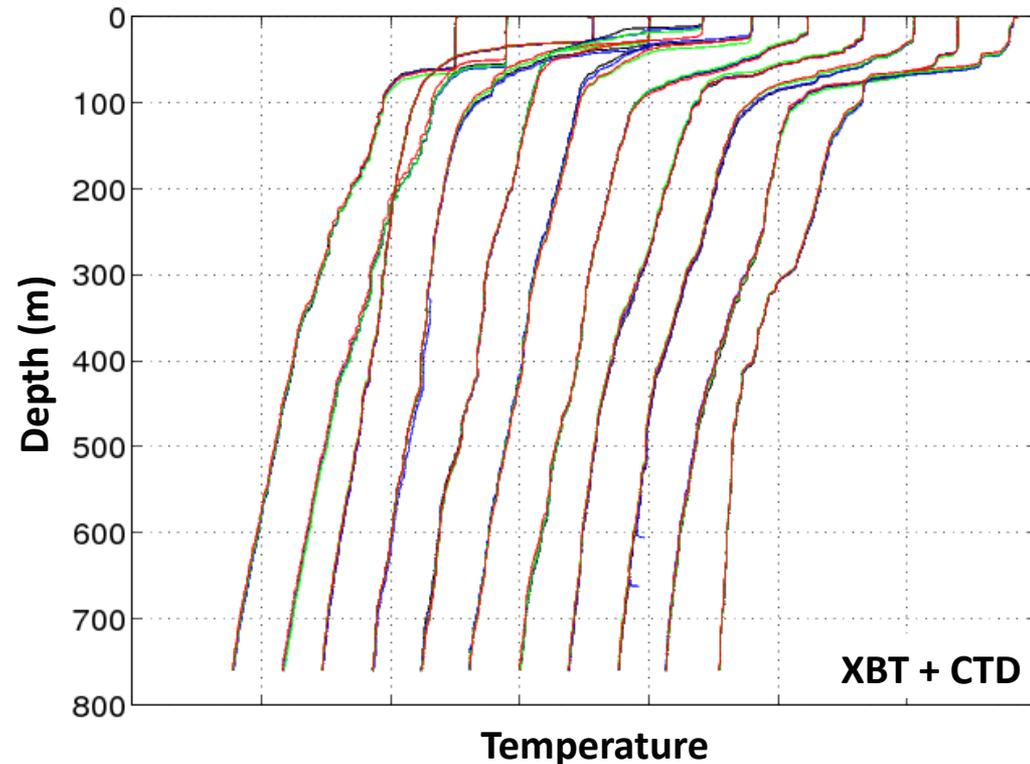


Enhanced (climate quality) XBT probe experiments



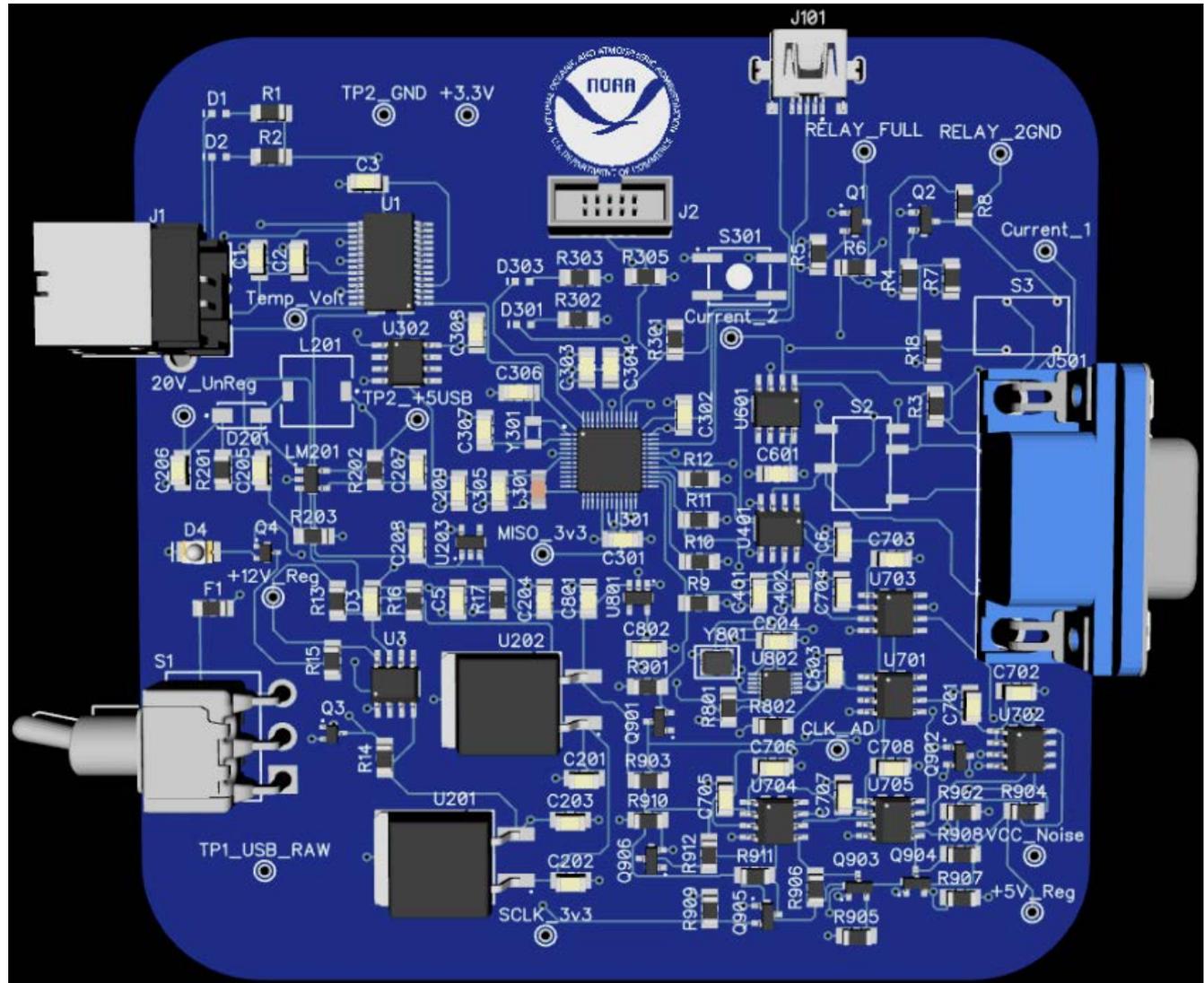
PIRATA Northeast Extension Cruise – Nov. 2015

- 3 experiments (2012, 2013, 2015), ~190 XBT profiles during CTD stations
- Enhancements in probes include wire imbalance, screened thermistors, thermistor calibration, tight weight tolerance, and thermal time constant

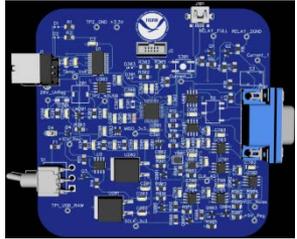


XBT recording system and time delay

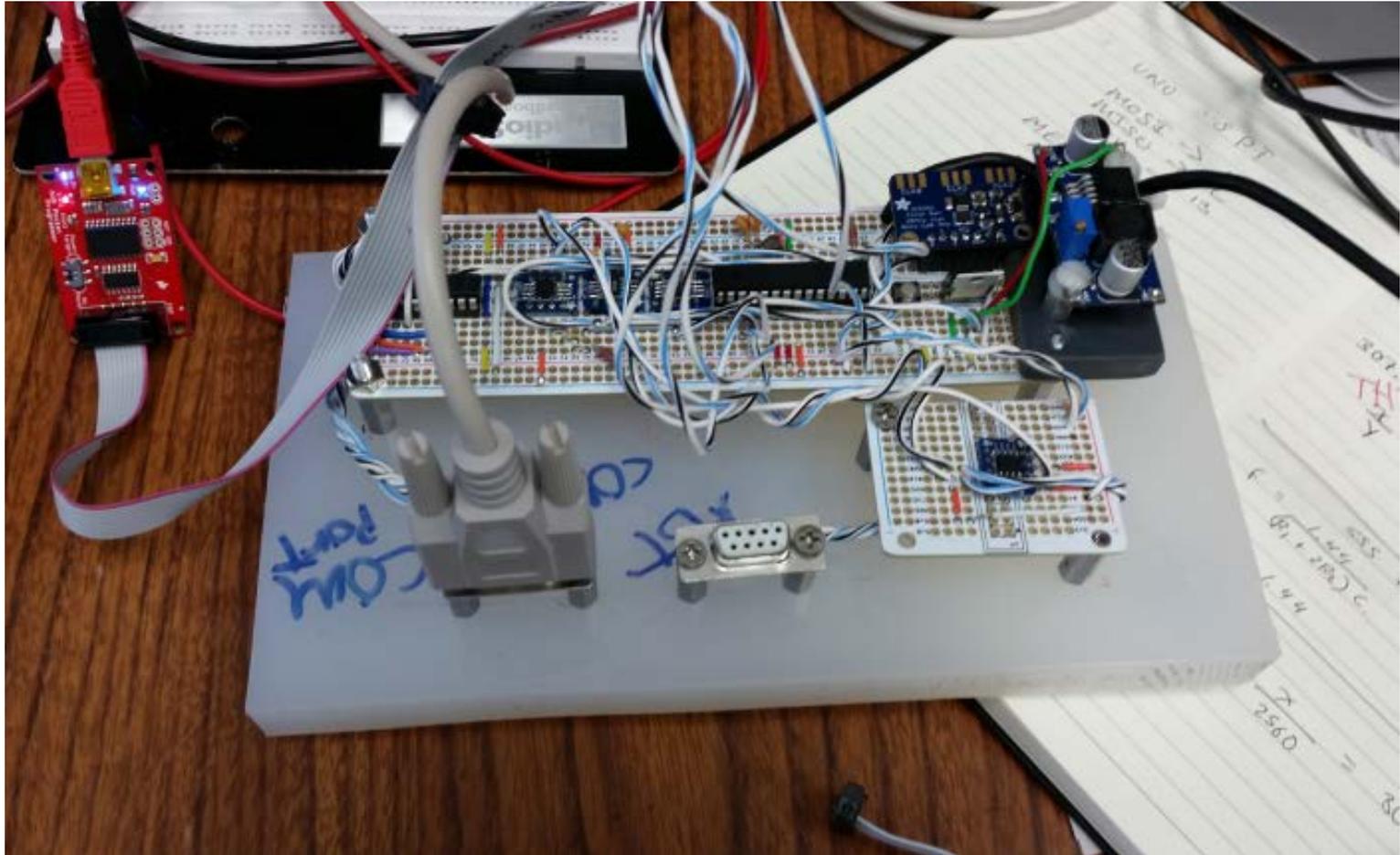
AOML XBT Recorder (AXR)



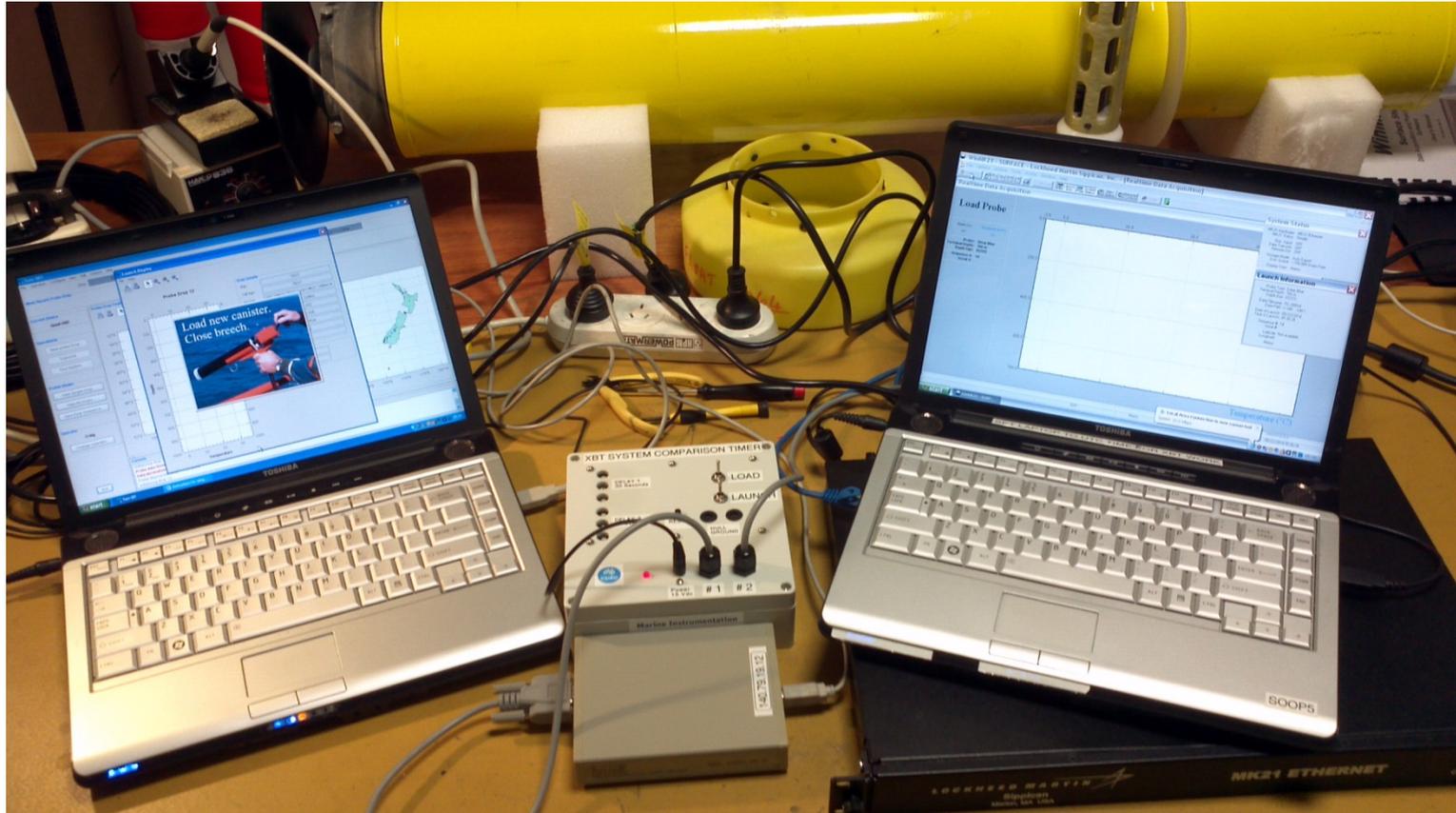
XBT recording system and time delay



AXR

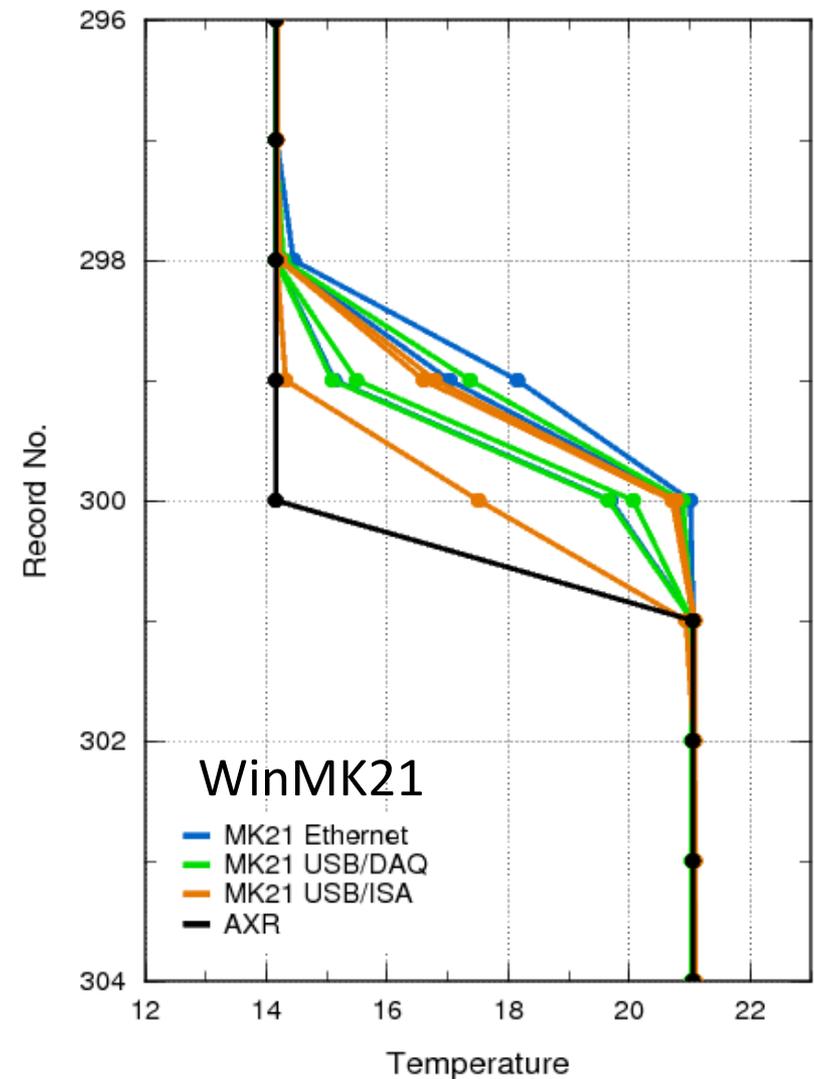
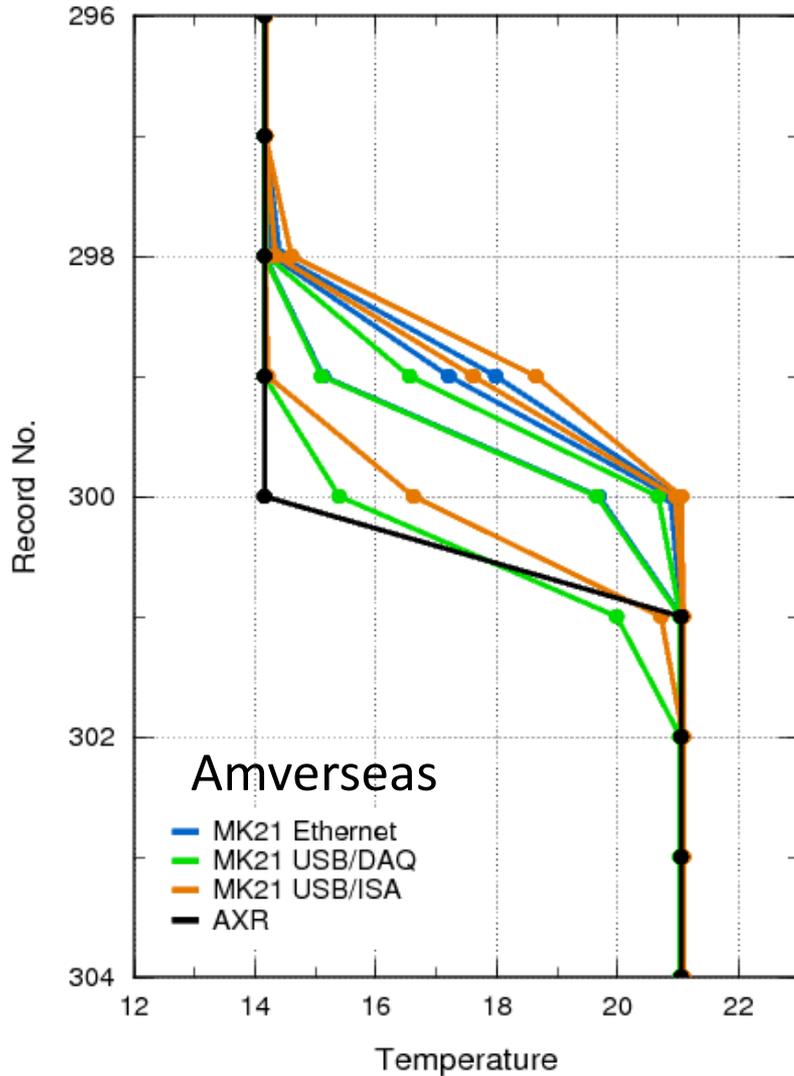


XBT recording system and time delay



CSIRO Timing Box

XBT recording system and time delay





Future plans

- Present results to scientific community for evaluation
- Discuss with scientific community the need of additional experiments for terminal velocity, ship speed, launch height, recording systems, other...
- Communicate results to Lockheed Martin engineers
- New experiments are planned with XBT + underway CTD deployments, as well as XBT + CTD, and deployments of XBT enhanced probes