Depth and Temperature Biases in XBT Data: a New Correction Method

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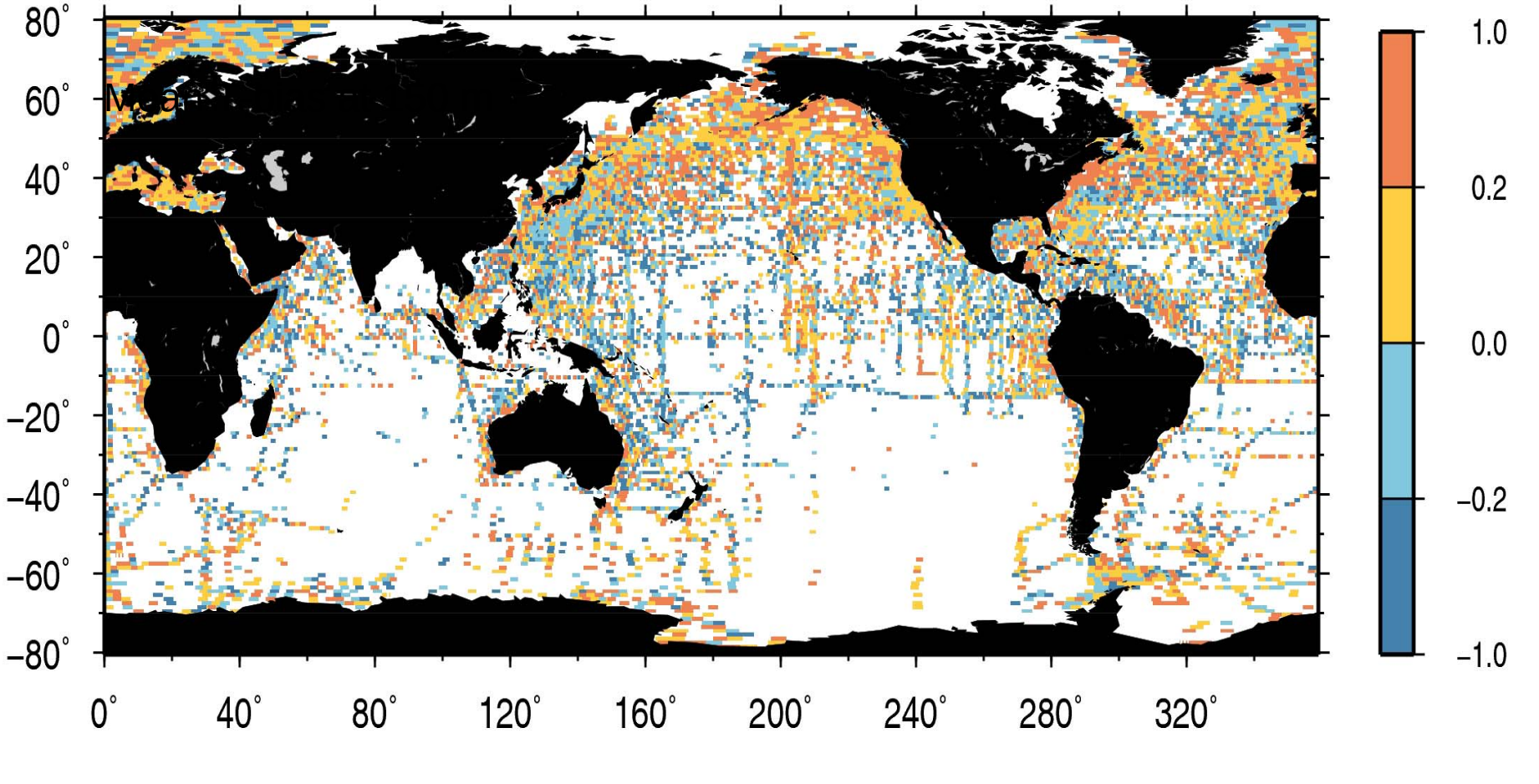
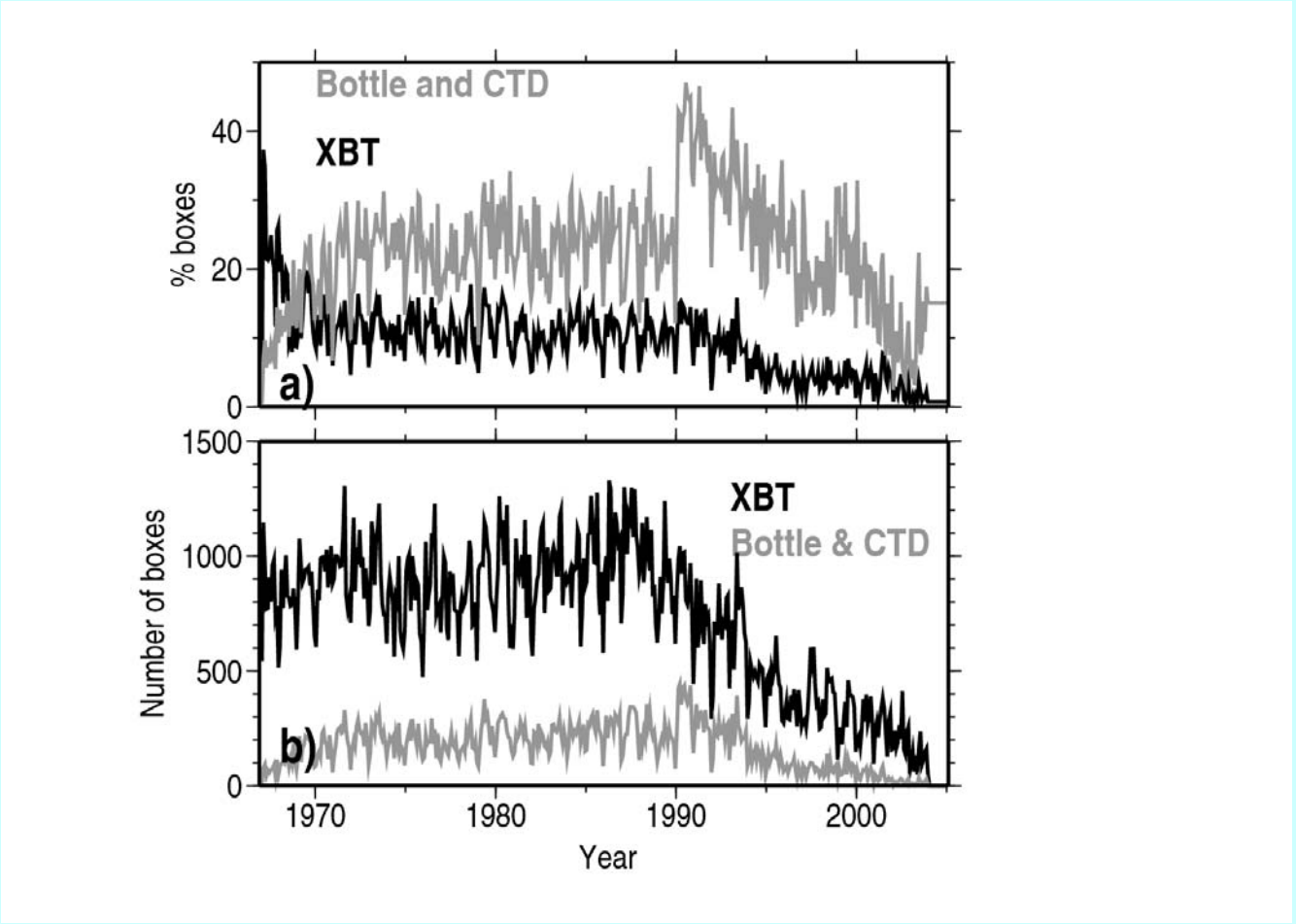
METHOD: Analysis of collocated XBT & CTD boxes

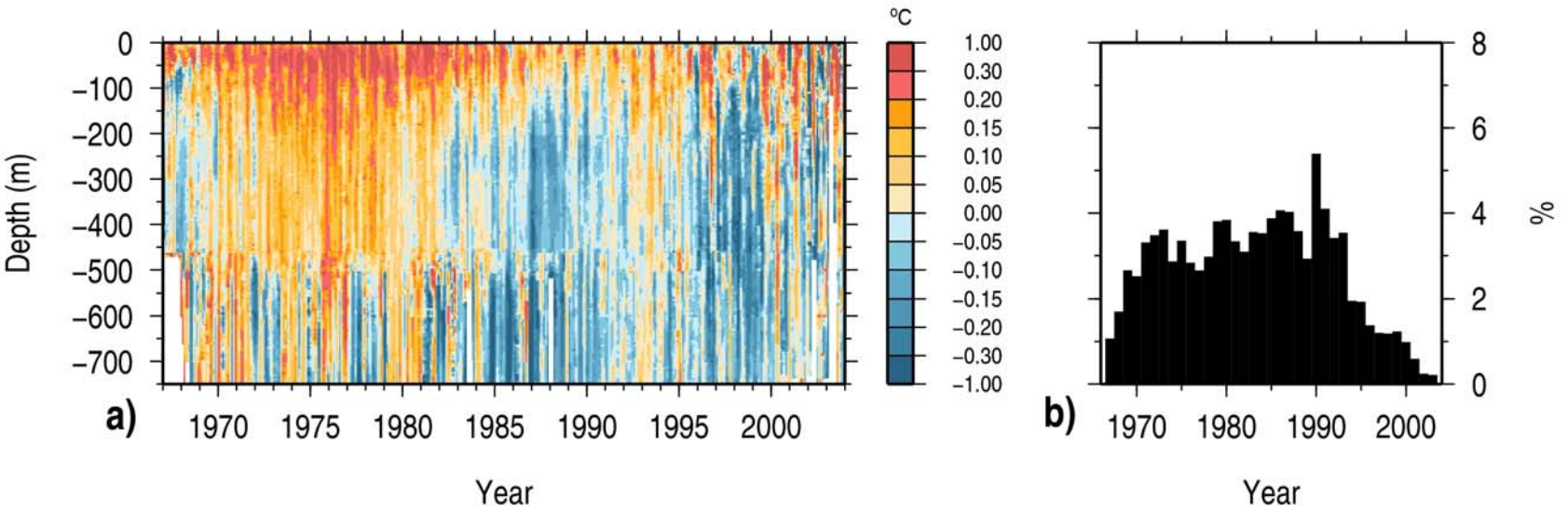


About 82,000 XBT/CTD-Bottle overlapping boxes

Not-perfect overlapping but large sample size

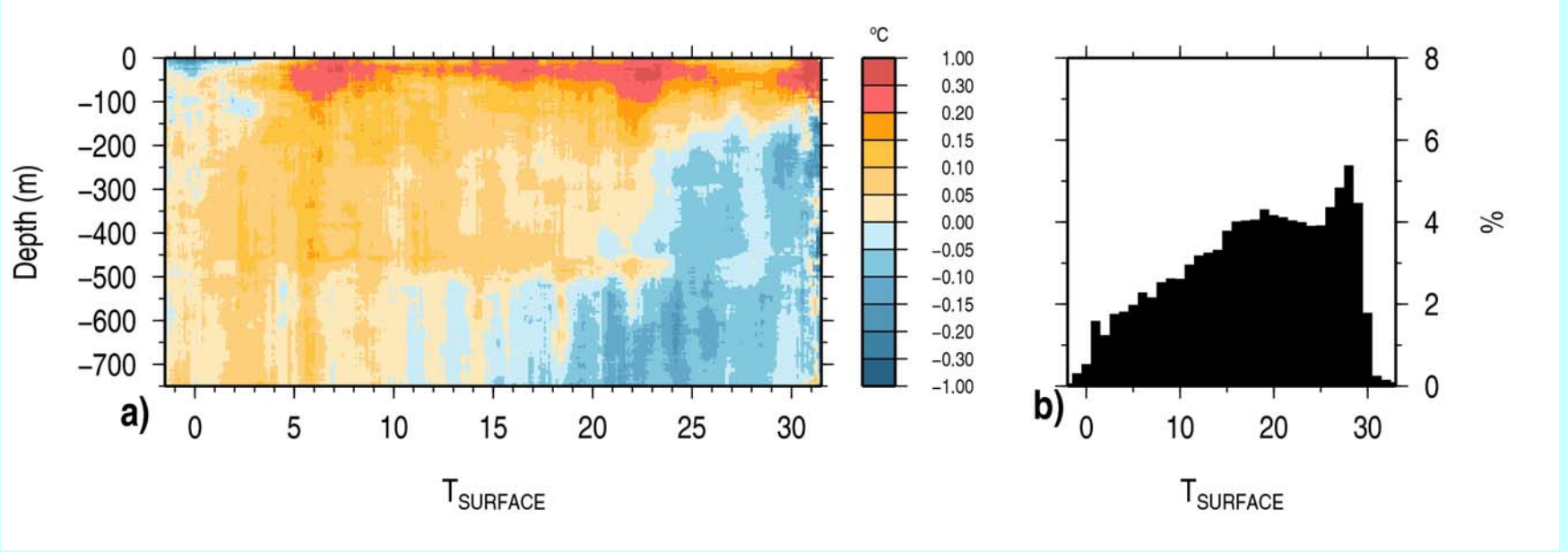


XBT BIAS: Time/Depth projection



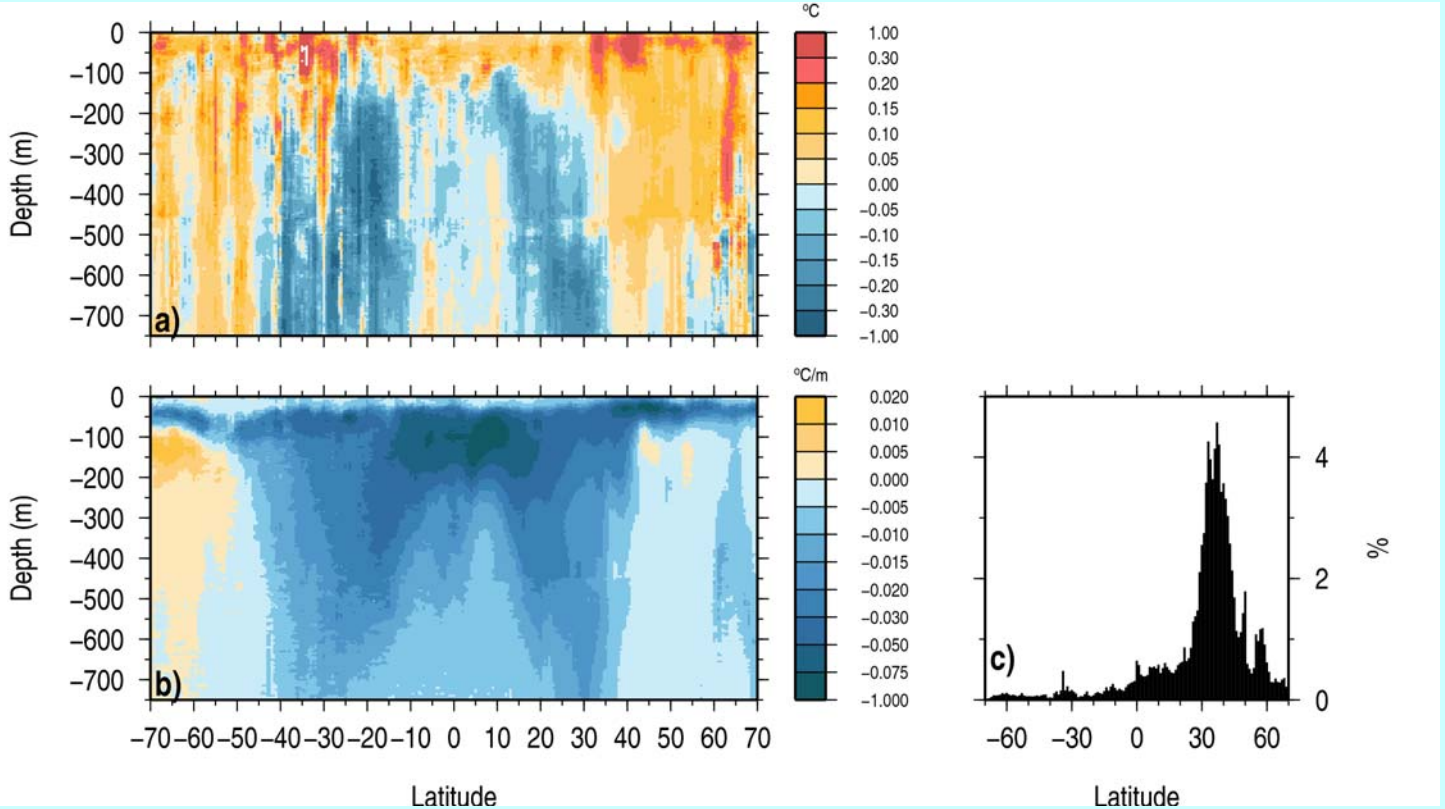
- Total bias time and depth dependent
- Seasonal component
- Near-surface maximum
- Much less overlapping boxes before 1970 and after 1995

XBT BIAS: $T_{surface}$ / Depth projection



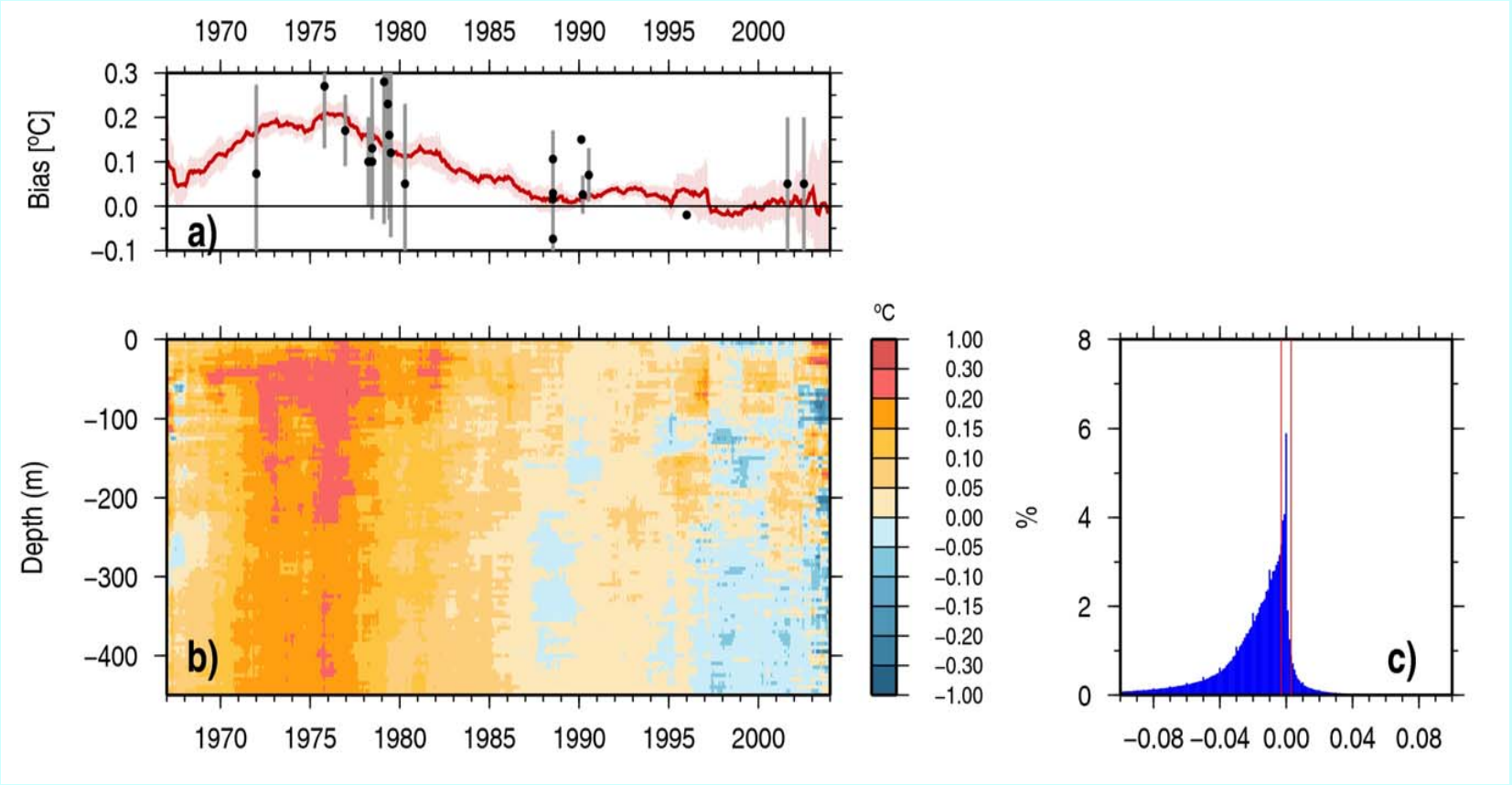
- Change to negative bias values at depth in areas of stronger stratification (implication of a faster fall velocity compared to the FRE)
- Strong T-Bias maximum in near-surface layers (implication of a slower fall velocity compared to the FRE)
- Poor sampling in waters of extremely high/low temperature

XBT BIAS: Latitude/Depth projection



- Clear geographical pattern in T-bias suggests dependence on dT/dz
- T-Bias ~vertically homogeneous in high latitudes (presence of the depth-error independent bias component)
- Very irregular sampling (possibility of geographical bias)

Depth independent warm T-bias

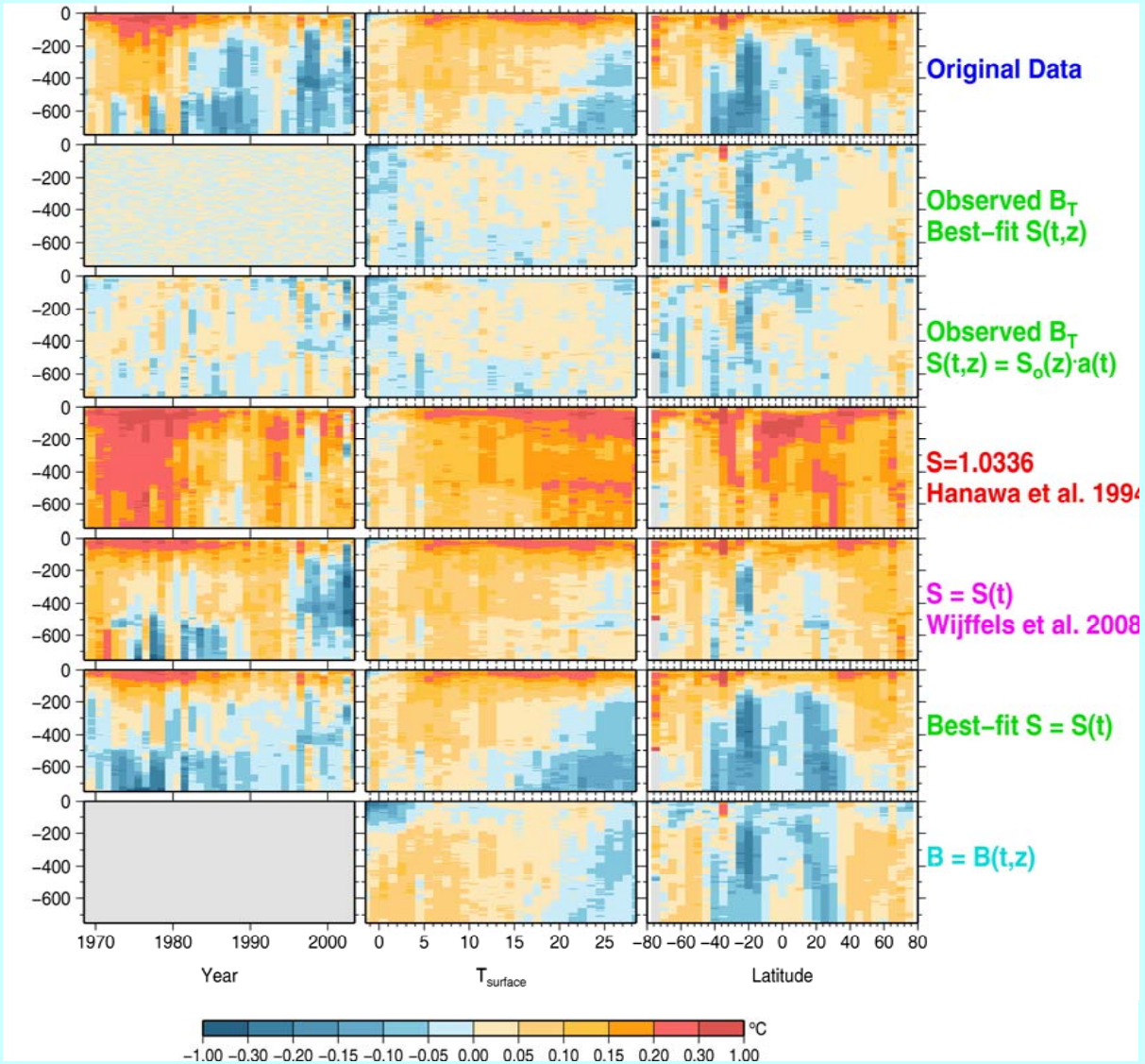


- Temperature bias is time variable
- General agreement with independent estimates
- 1970-80 bias maximum probably due to analoge acquisition systems

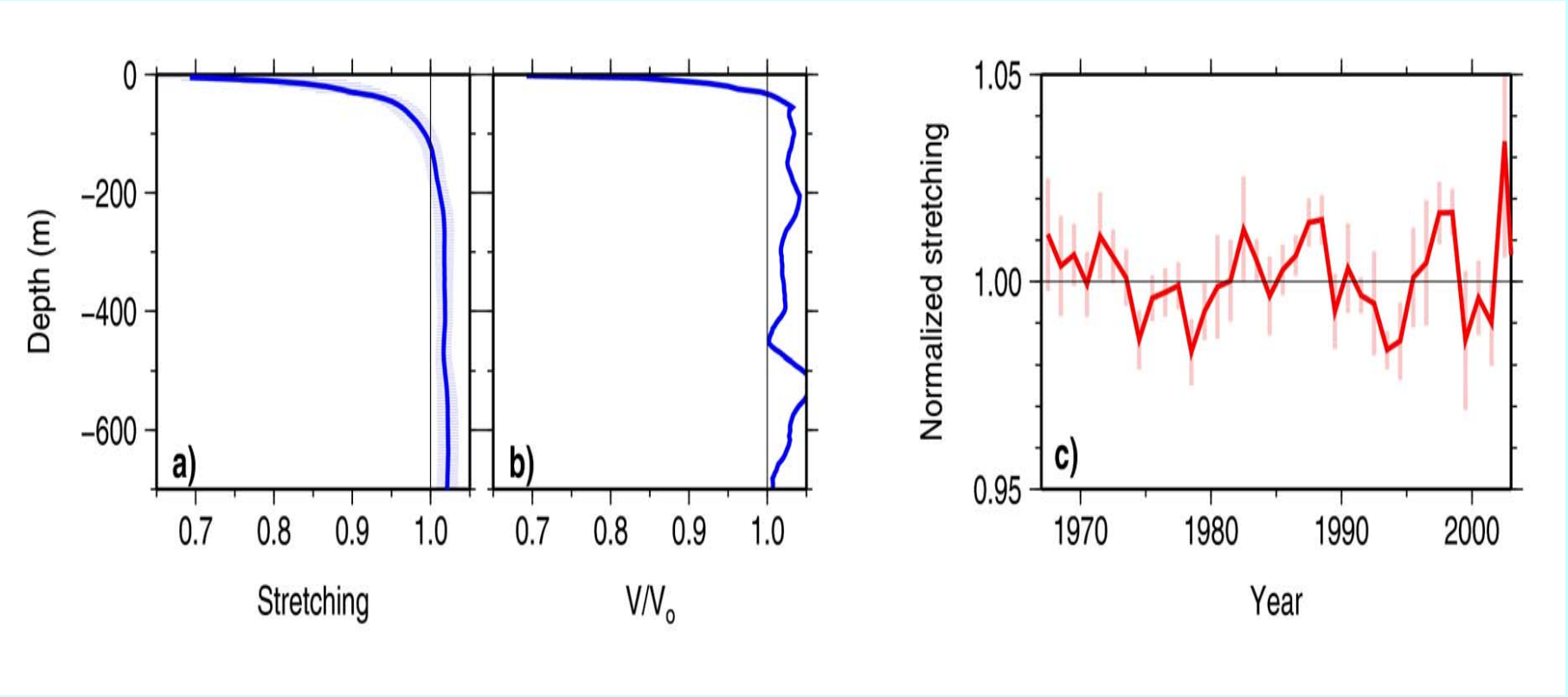
Estimation of T- and depth corrections

- Data basis: monthly temperatures in 111x111 km boxes
- Reference: CTD and Bottle data
- Vertical resolution: 5 meters
- Mean „pure“ T-bias is estimated in areas with low dT/dz
- Best fit: change XBT observed depth to produce the minimal bias relative to the CTD&Bottle data

Comparison of different correction schemes: residual total temperature bias

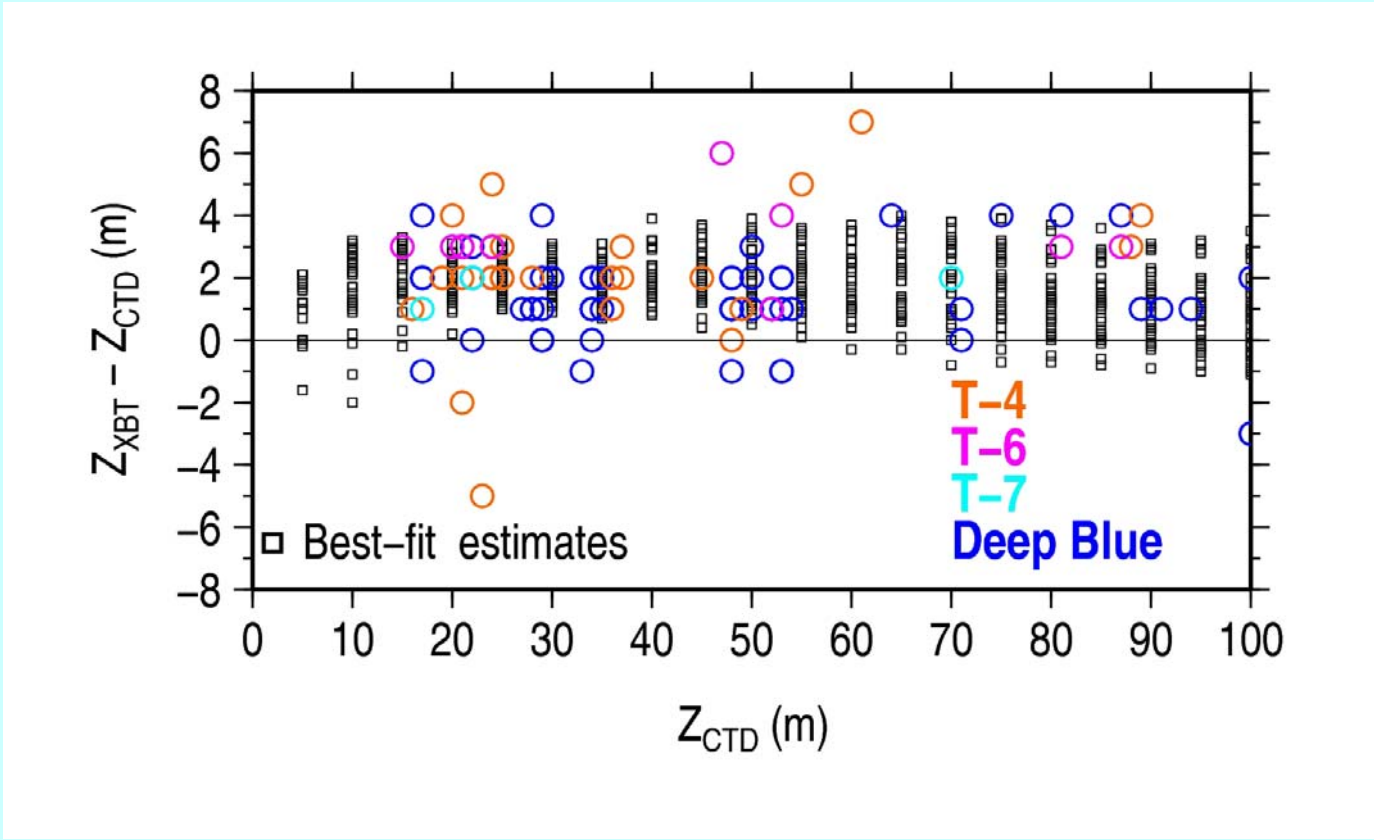


Best-fit depth stretching and fall velocity

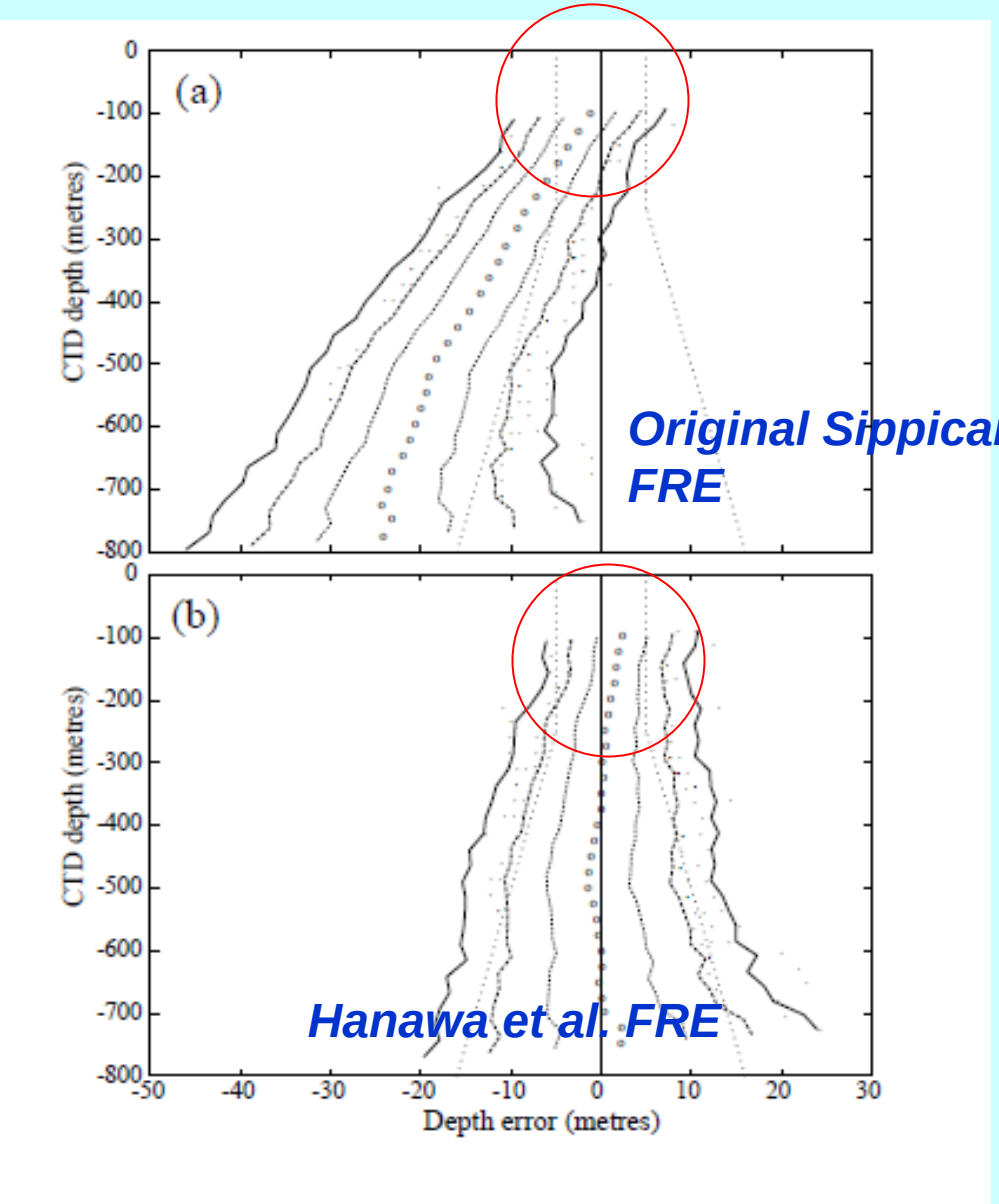


- Best-fit depth corrections suggest fall velocity varying with depth
- Transient effects are important (dominant) within the upper ~30 m

Observed and calculated XBT depth error in the upper layer



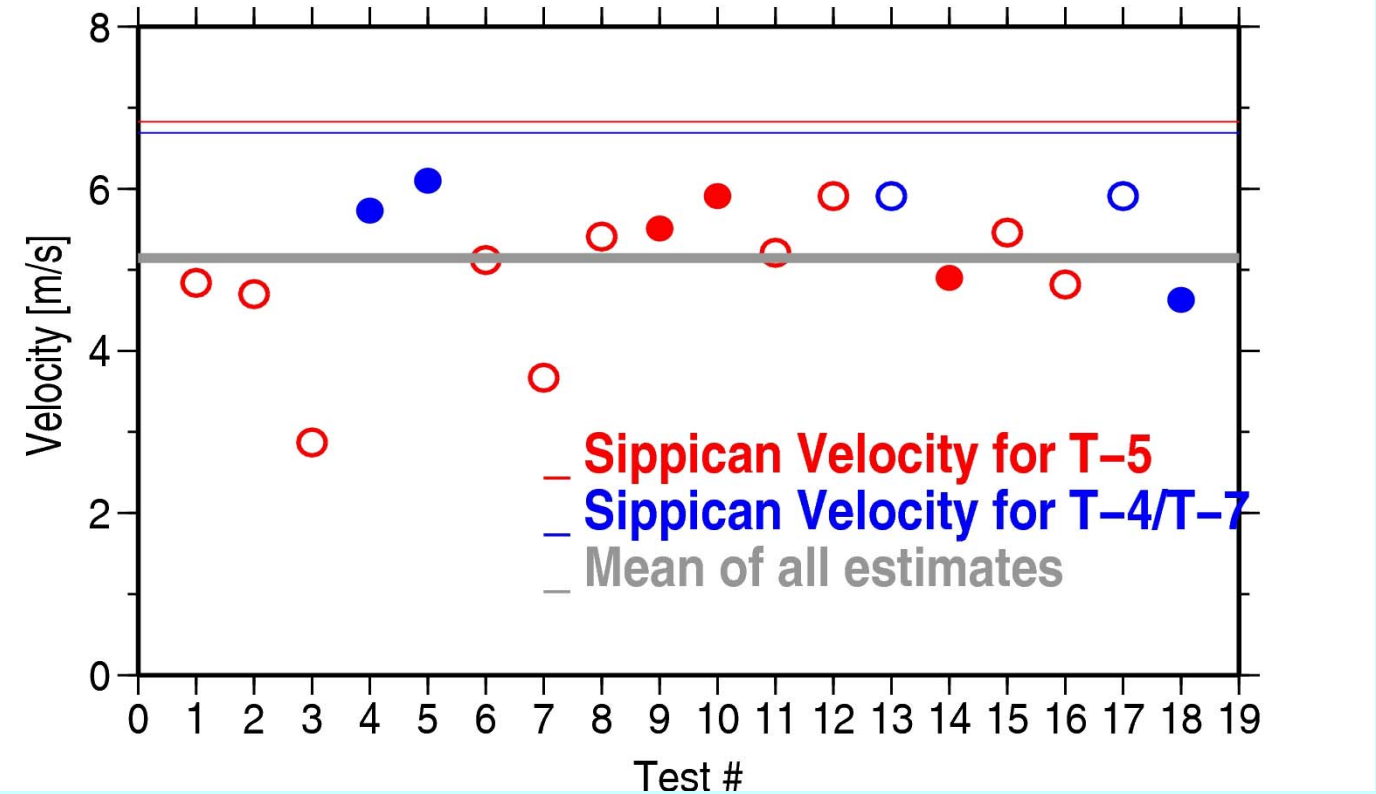
Sparton XBT-7 Depth Errors as a function of depth



•Some early studies also suggest change in depth error sign at a certain depth

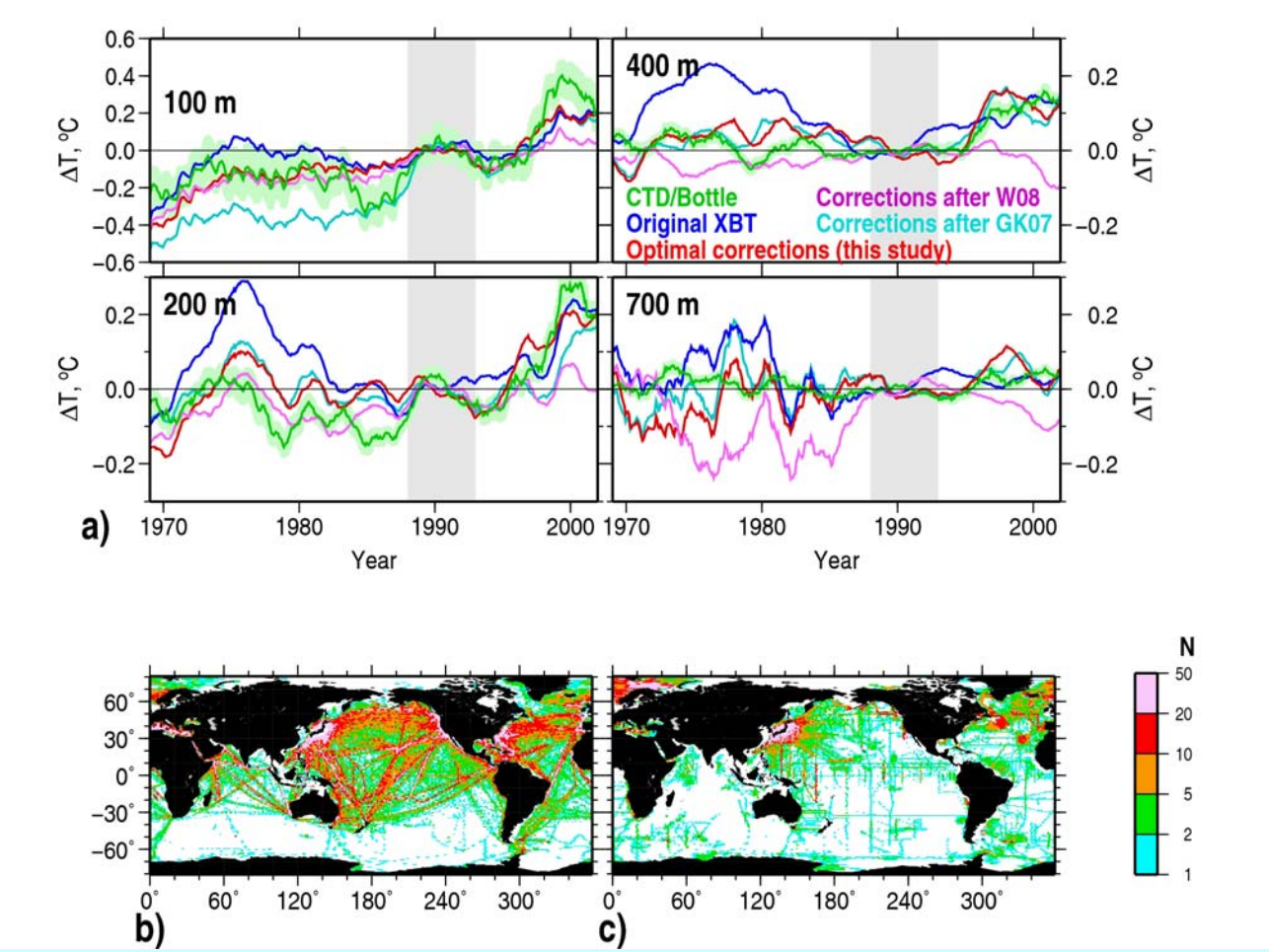
From Rual et al., 1996

Direct estimates of the XBT fall velocity in the upper 19-meter layer (data from R. Bartz, 1992)



- These are the only available laboratory measurements of the XBT fall velocity
- Manufacturer FRE seems to produce large errors in the near-surface layer
- Depth overestimation is responsible for the near-surface T-bias maximum
- Respectively designed tests in a special facility needed!

Temperature anomalies at selected levels for difefrent correction schemes



•Corrections for XBT data are needed to allow their use for climate relevant application