AN ASSESSMENT OF THE XBT FALL-RATE ERROS IN POLAR REGIONS: AN APPLICATION TO THE SOUTHERN OCEAN

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Background

Context

- SO warming at faster rate (Gille, 2008; Sprintall, 2008).
- Before ARGO, data was mostly provided by XBTs (Wijffels et al., 2008).

Issues

- Existing FRE aren't representing well the extreme conditions of the SO (Thadathil et al., 2002; Hutchinson et al., 2013).

Questions

- How this bias is affecting the OHC estimates in the SO?

Hypothesis

- XBT profiles are overestimating the HEAT in the SO.

What do we want?

- Identify and quantify XBT fall rate errors in the Southern Ocean;
- Evaluate the performance of a regional fall-rate equation;
- Estimate the impacts on OHC.

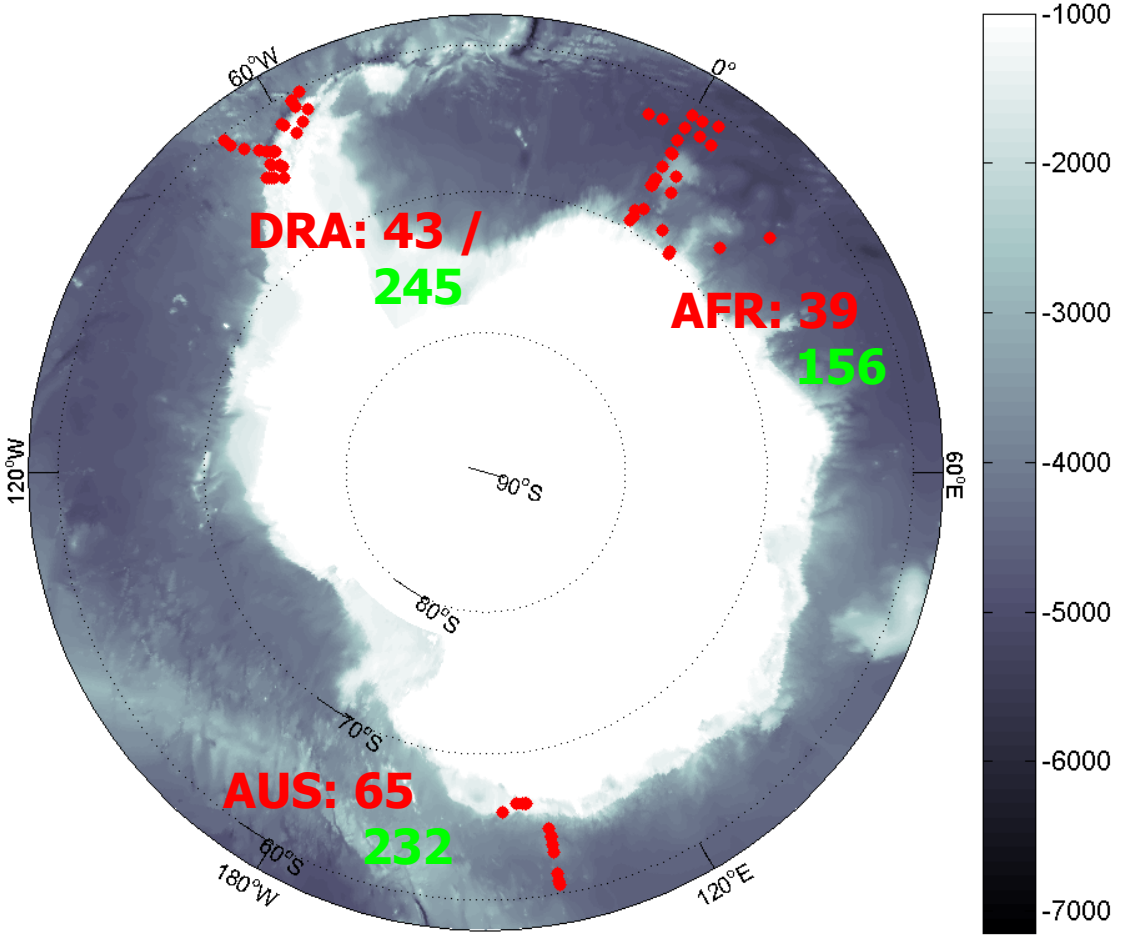
DB/T7
1980 to 2015
(WOD13)

0.2° LAT/LON
10h

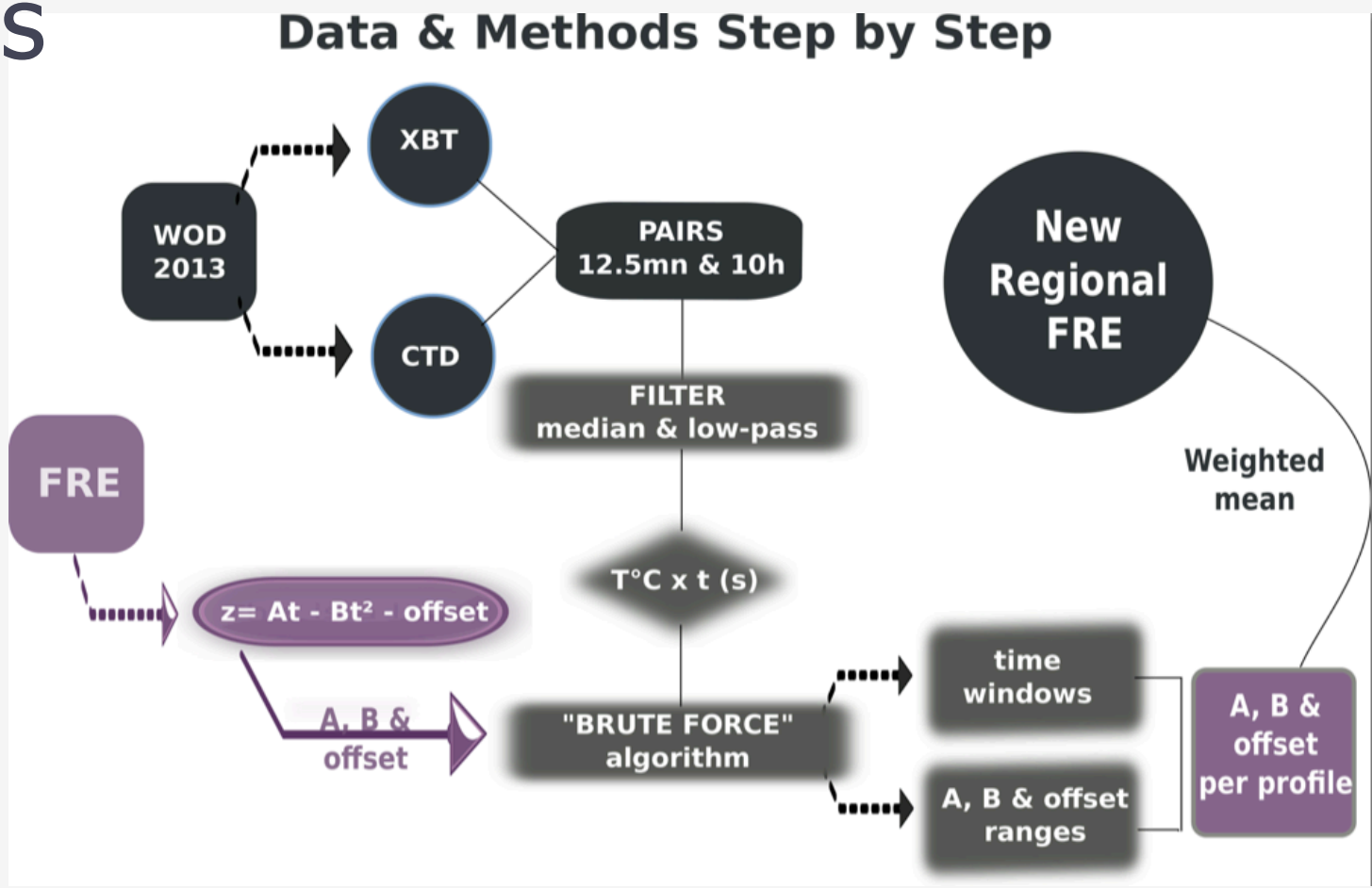
CHENG METHOD

↓

MANUAL QC

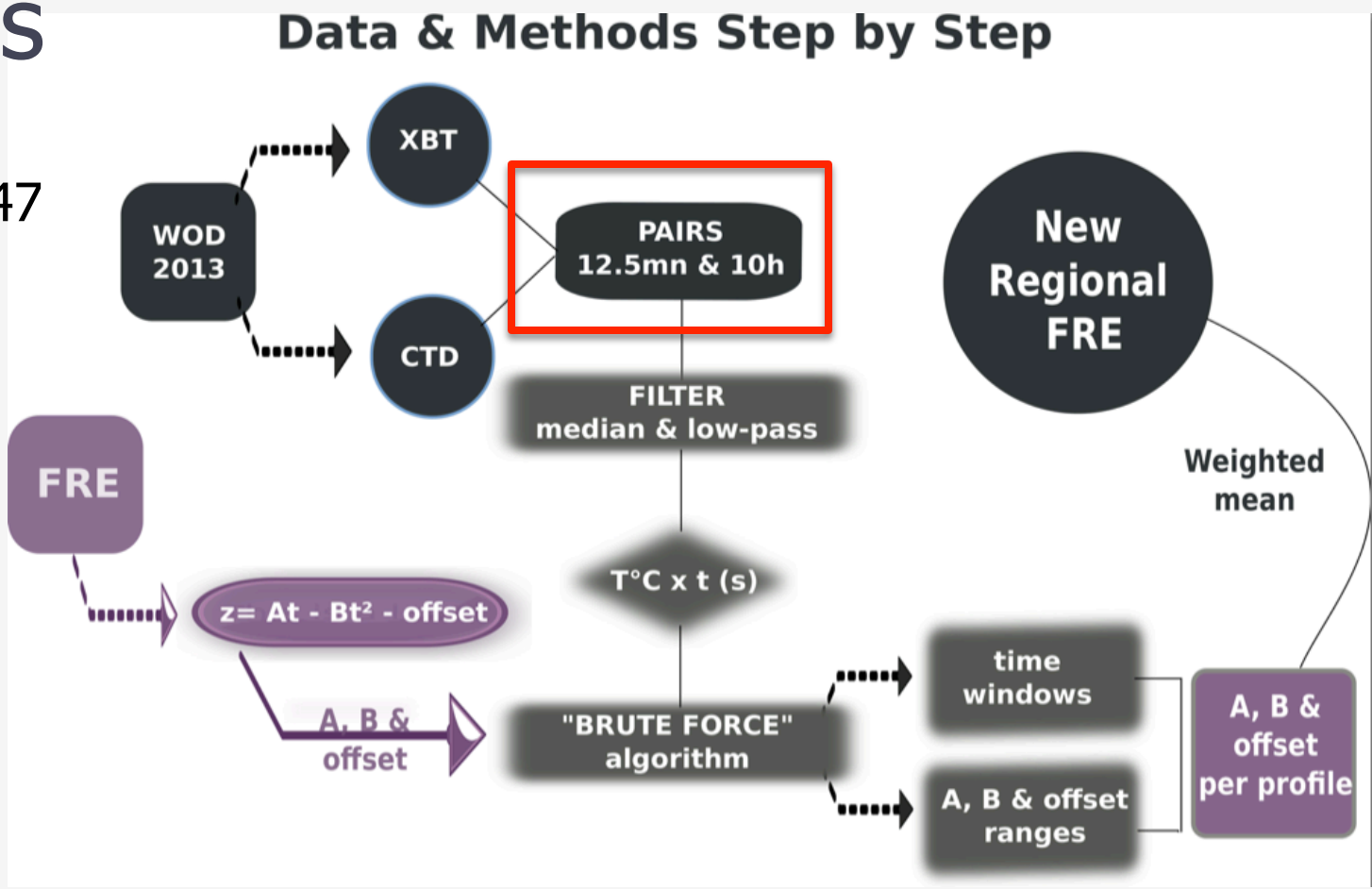


Methods


Data & Methods Step by Step
XBT
WOD 2013
CTD
PAIRS 12.5mn & 10h
FILTER median & low-pass
T°C x t (s)
"BRUTE FORCE" algorithm
time windows
A, B & offset ranges
New Regional FRE
Weighted mean
A, B & offset per profile
FRE
z= At - Bt² - offset
A, B & offset

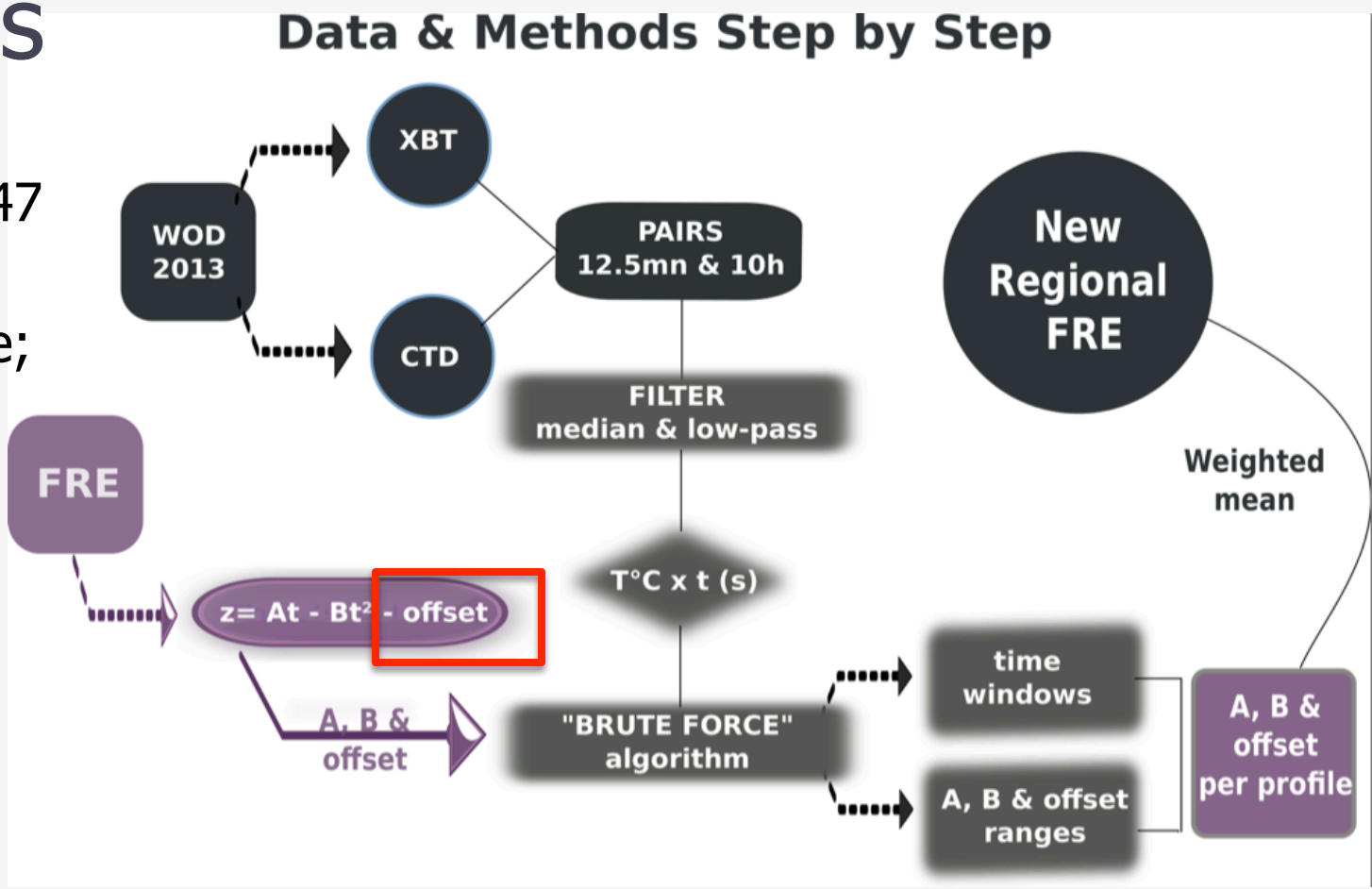
Methods

- Total of pairs: 147



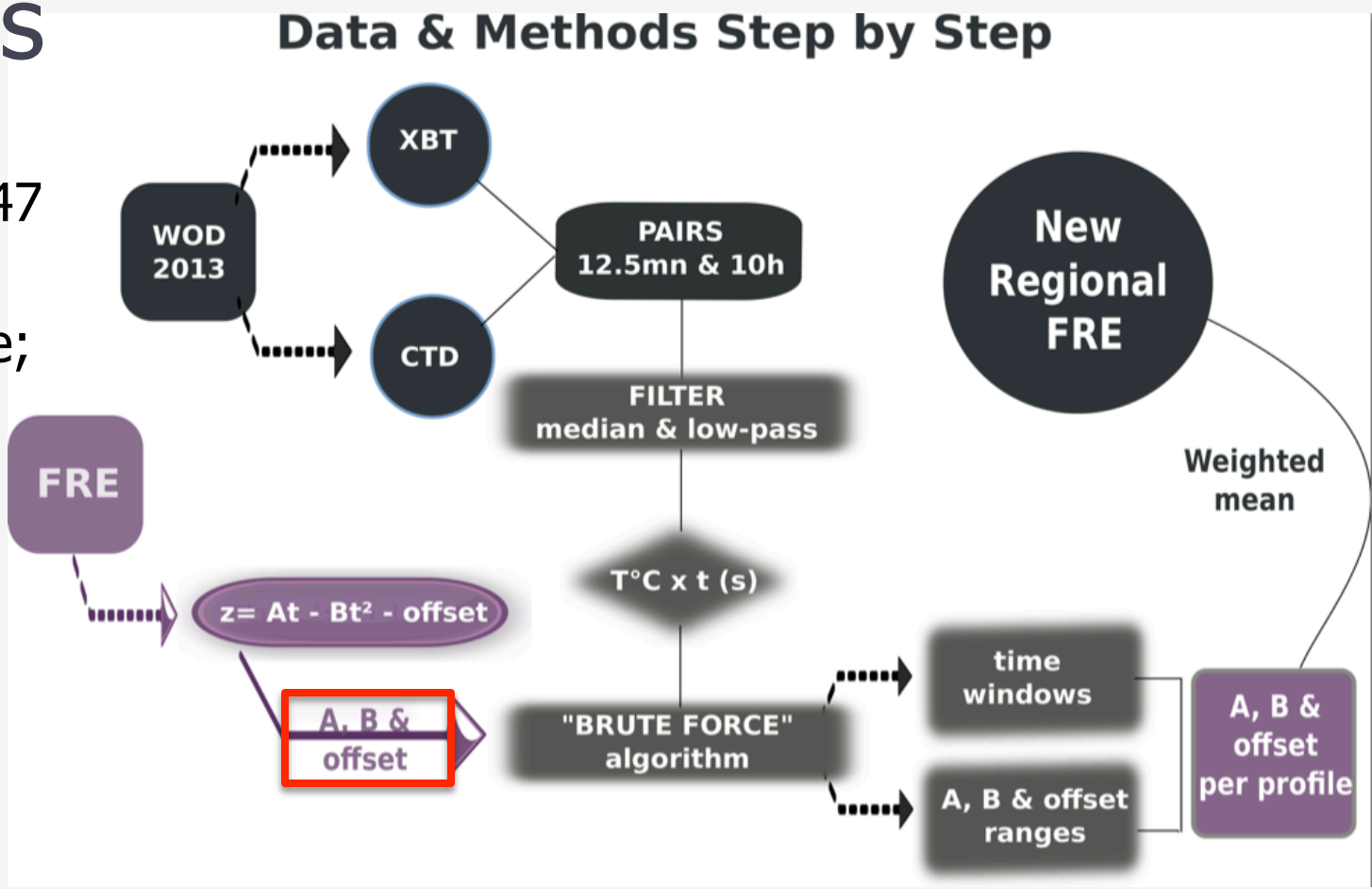
Methods

- Total of pairs: 147
- Offset per profile;



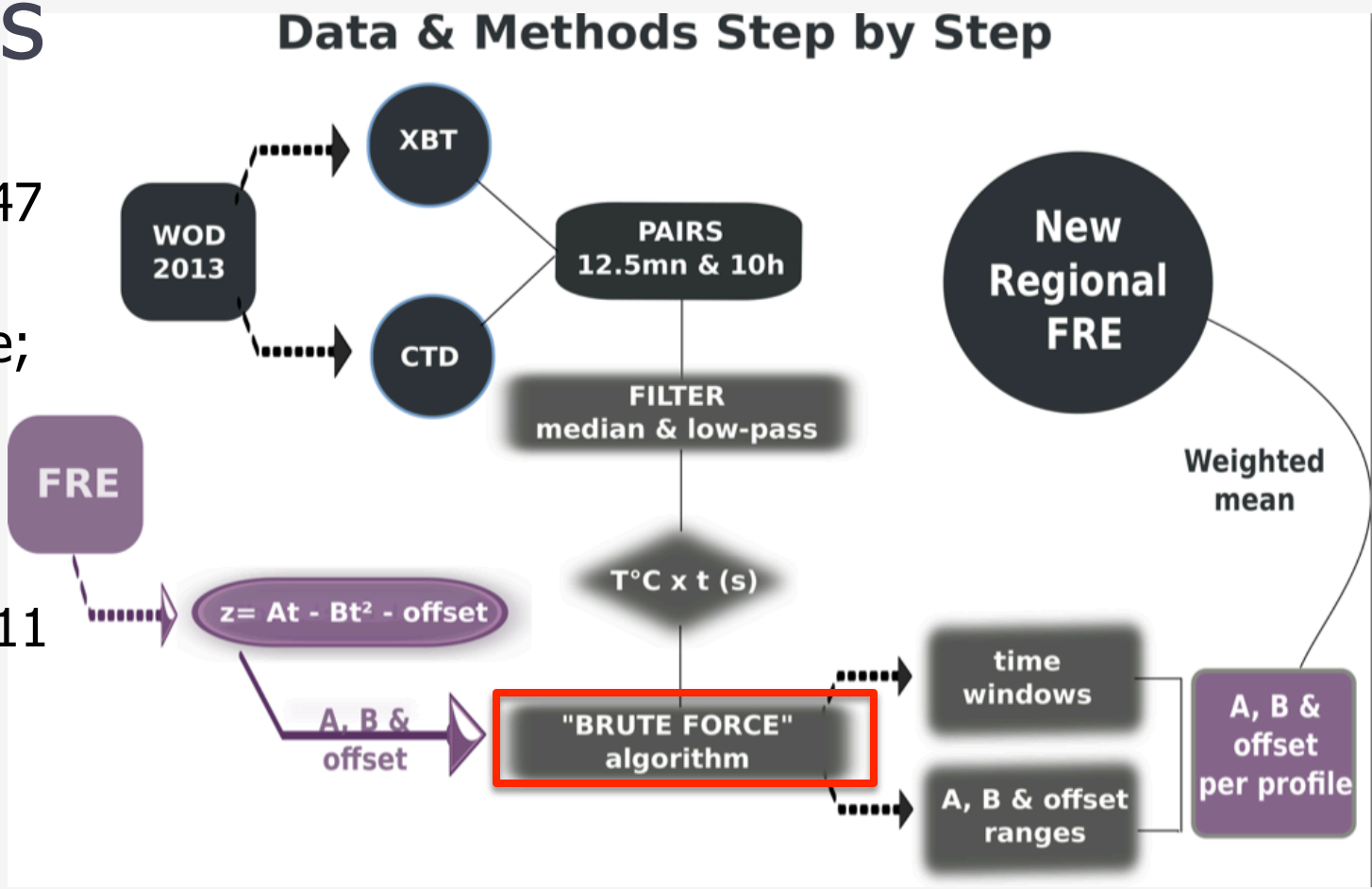
Methods

- Total of pairs: 147
- Offset per profile;
- A & B avg;

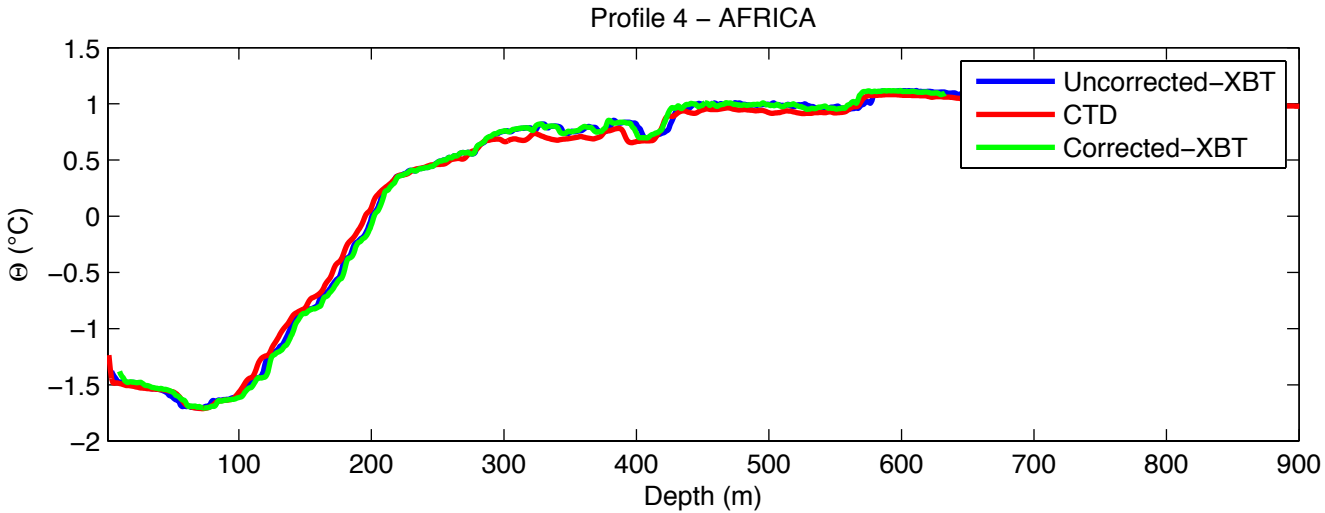


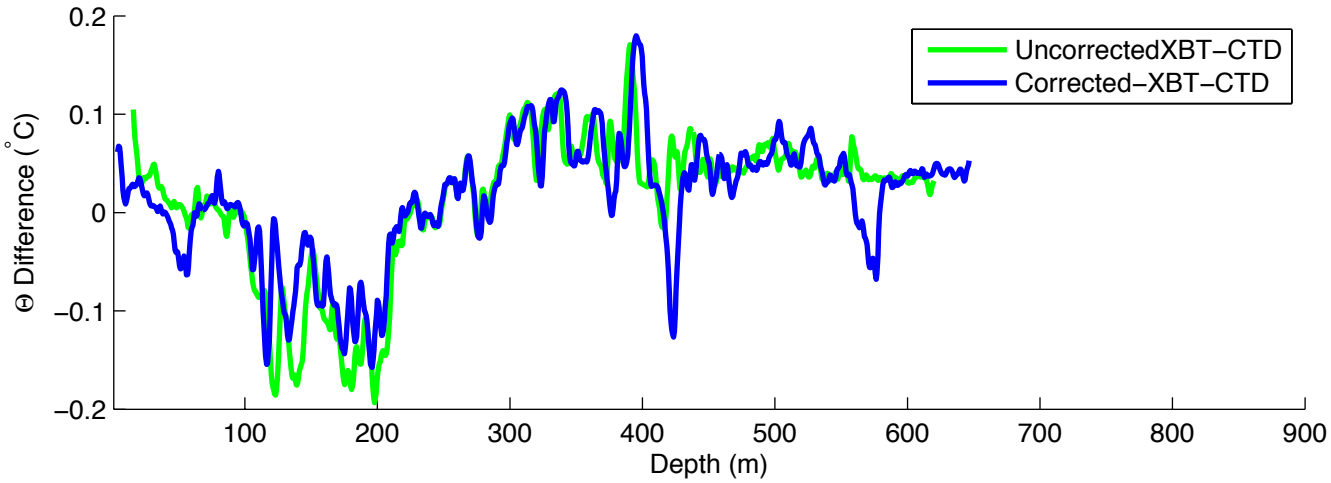
Methods

- Total of pairs: 147
- Offset per profile;
- A & B avg;
- Cheng et. al, 2011 2014.



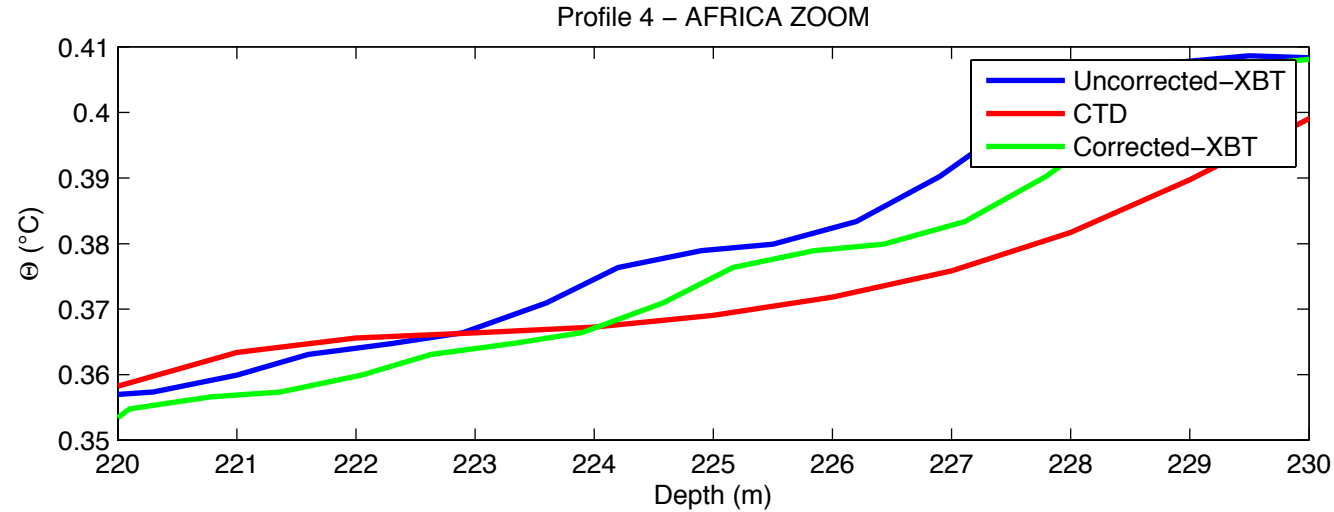
What were we expecting to find?

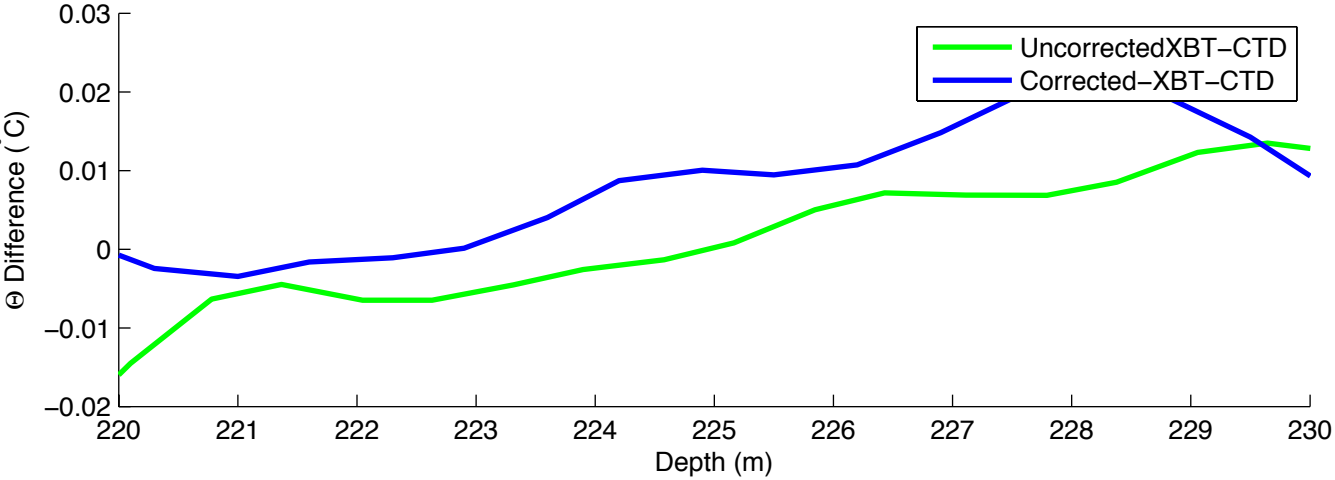




What were we expecting to find?

- XBT warmer than the CTD!





Results

SIPPICAN FALL-RATE
$z(t) = 6.472\,t - 0.00216\,t^2$

HANAWA ET AL., 1995
$z(t) = 6.701\,t - 0.0028\,t^2$

-0.4%

DRAKE
$z(t) = 6.449\,t - 0.0029\,t^2 + 1.4047$

+0.1%

AFRICA
$z(t) = 6.481\,t - 0.0033\,t^2 - 1.2513$

-4.0%

AUSTRALIA
$z(t) = 6.208\,t - 0.0024\,t^2 - 1.2985$

-1.9%

SOUTHERN OCEAN
$z(t) = 6.351\,t - 0.0024\,t^2 - 0.4952$

Results

SIPPICAN FALL-RATE
$z(t) = 6.472\,t - 0.00216\,t^2$

HANAWA ET AL., 1995
$z(t) = 6.701\,t - 0.0028\,t^2$

-0.36%

DRAKE
$z(t) = 6.449\,t - 0.0029\,t^2 + 1.4047$

+0.13%

AFRICA
$z(t) = 6.481\,t - 0.0033\,t^2 - 1.2513$

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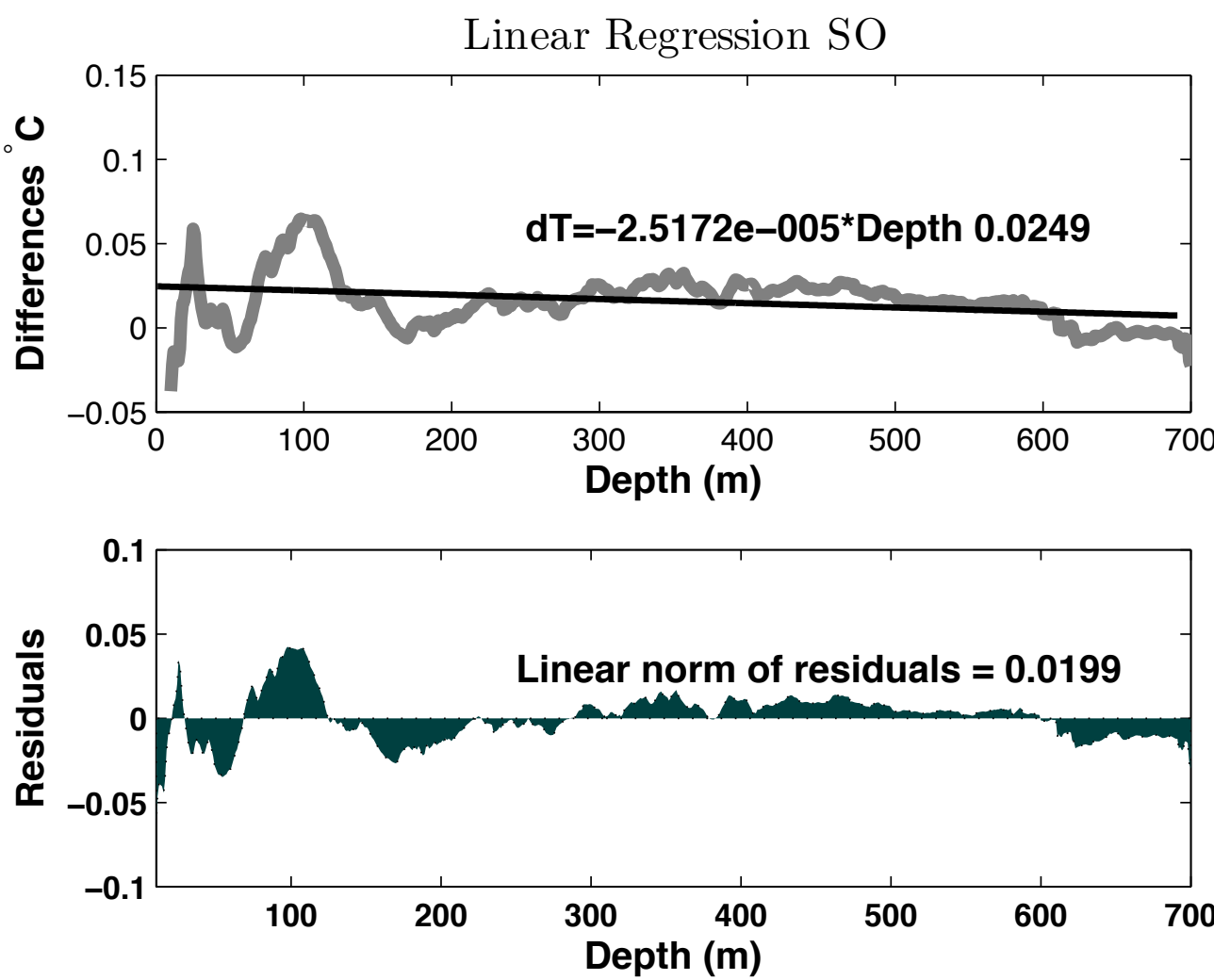
SOUTHERN OCEAN
$z(t) = 6.351\,t - 0.0024\,t^2 - 0.4952$

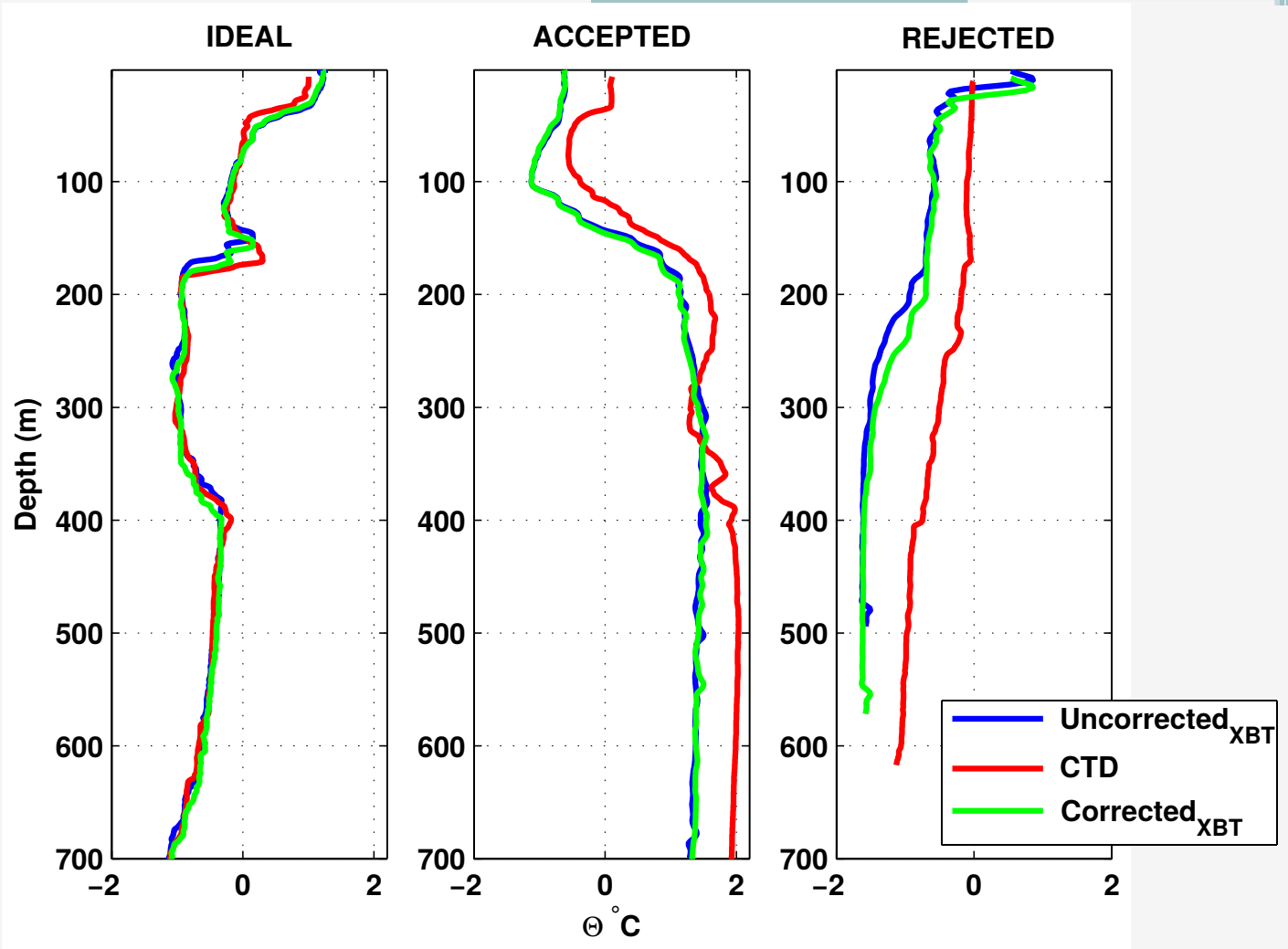
Cheng/Ideal Coef A 2% < Sippican.

Robust Fit

- Cheng et al. (2014) recommended correction values for dT.
- Date of launch not DOB.

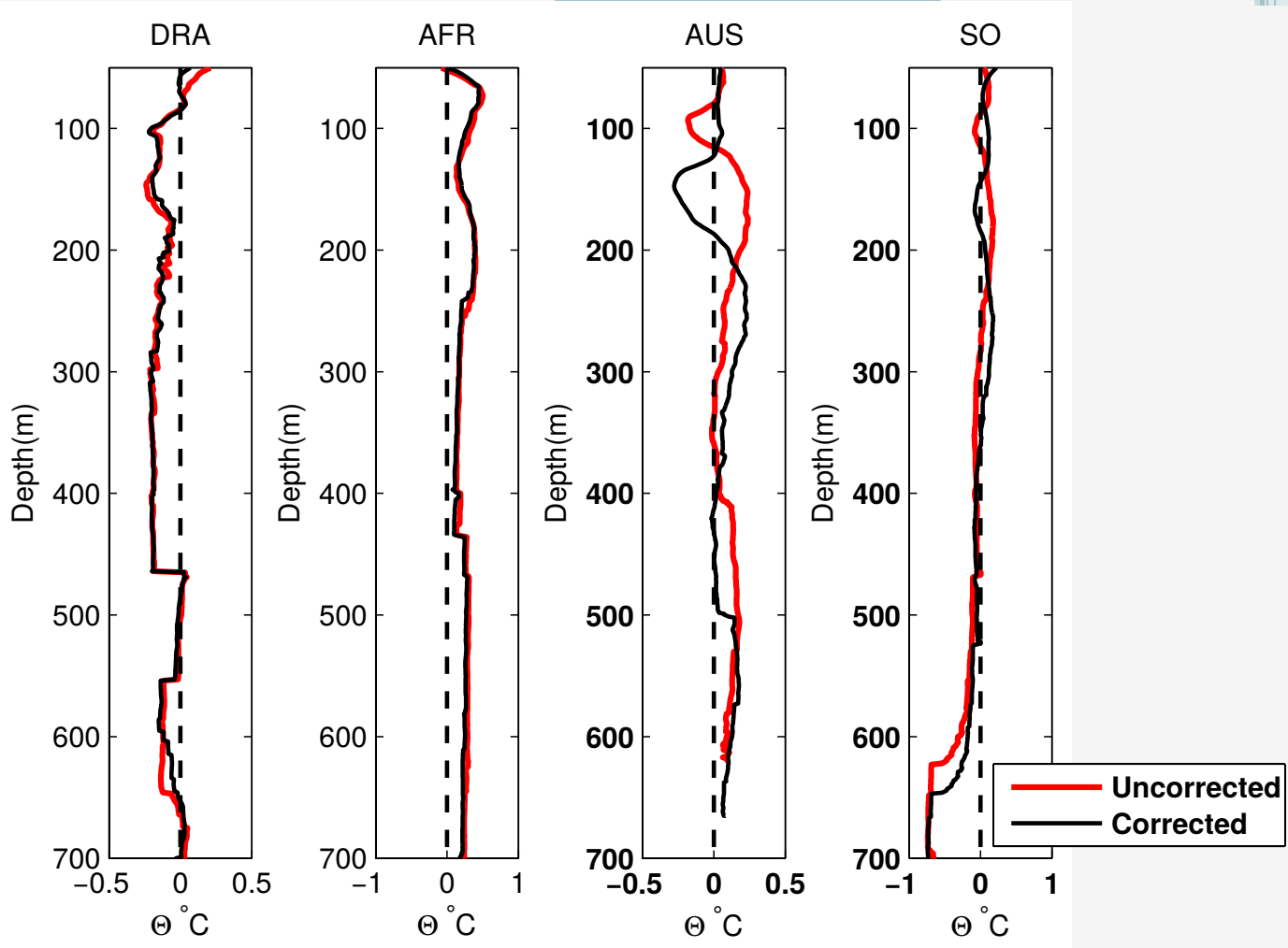


PAIRS vs QC


IDEAL
ACCEPTED
REJECTED
Depth (m)
100
200
300
400
500
600
700
−2
0
2
Θ °C
Uncorrected XBT
CTD
Corrected XBT

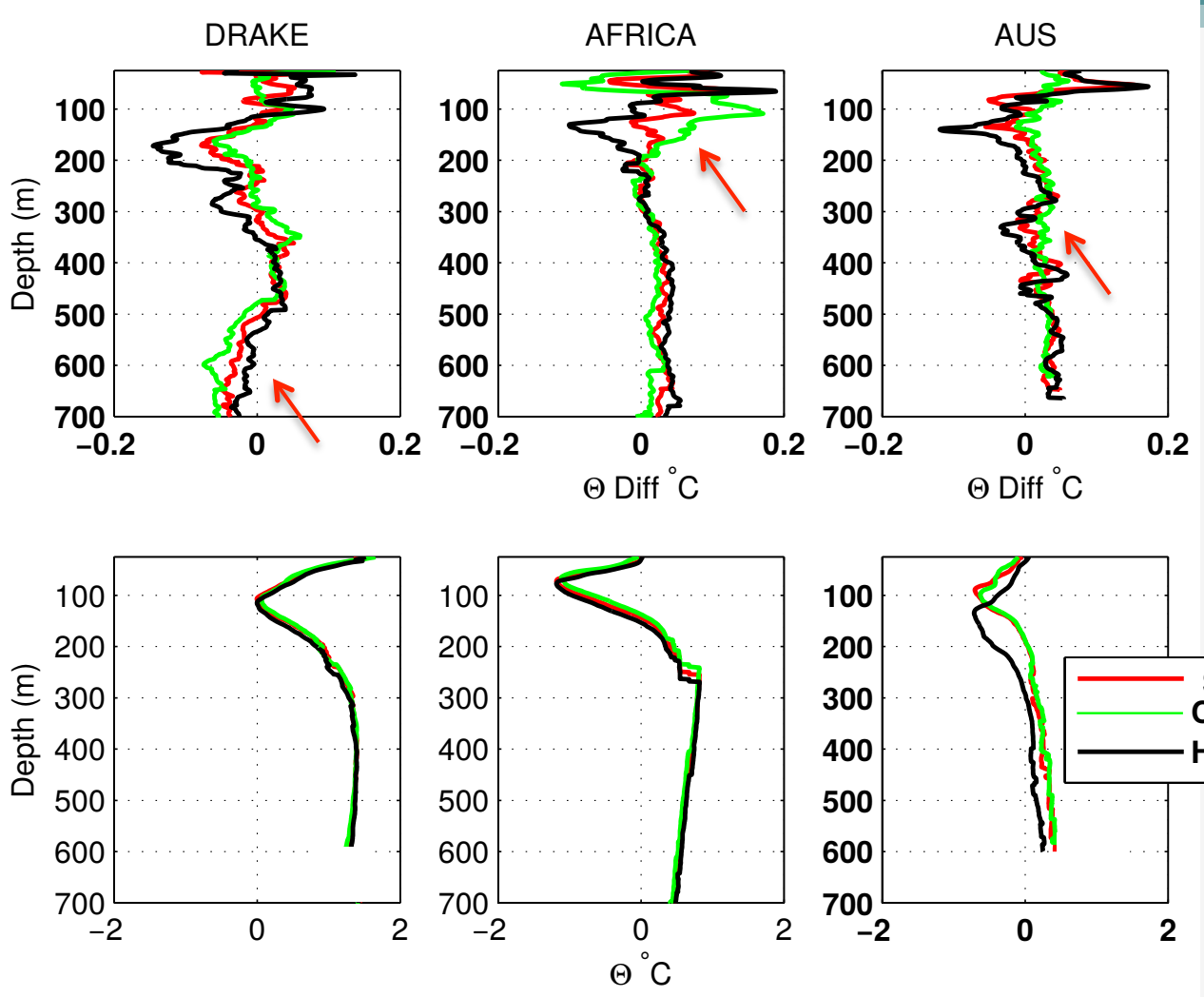
RMS

- CTD-XBT
- XBT warmer than CTD in AUS and AFR
- XBT colder than CTD in DRA



Avg T

- Cheng is the best fit for all chokings.
- Exception: DRA >600m



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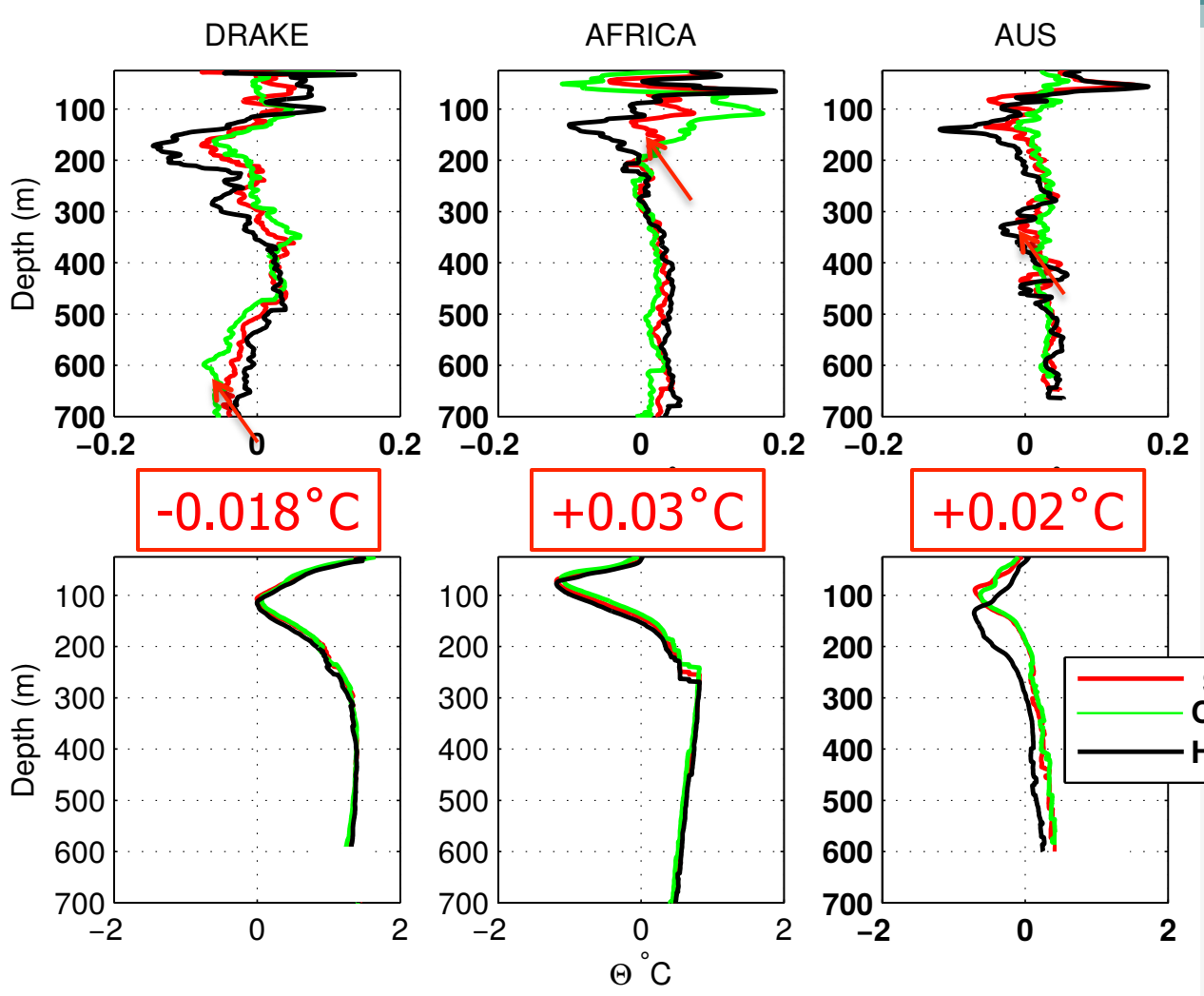
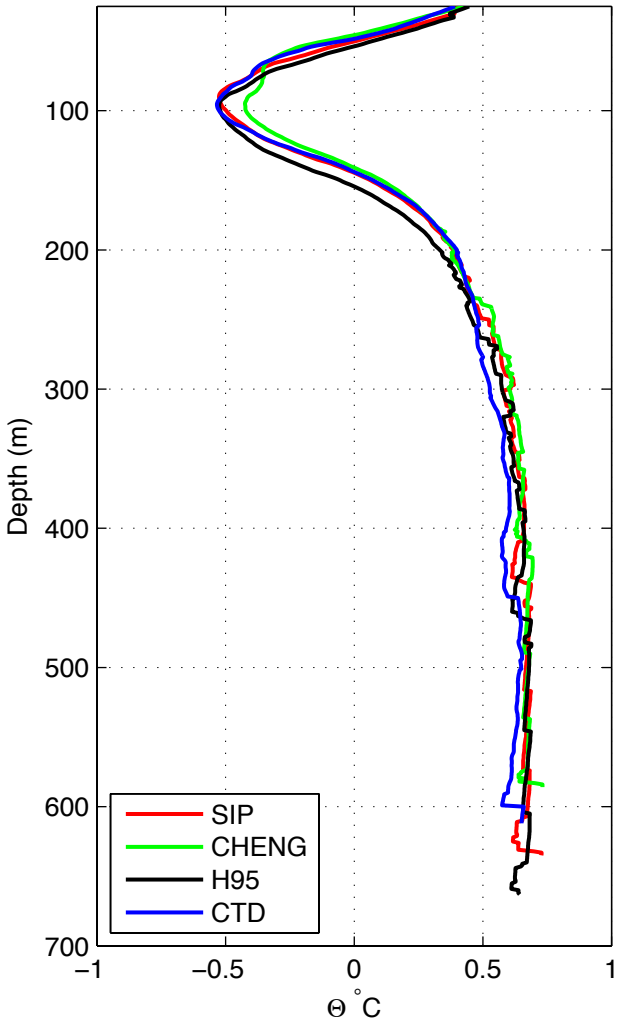
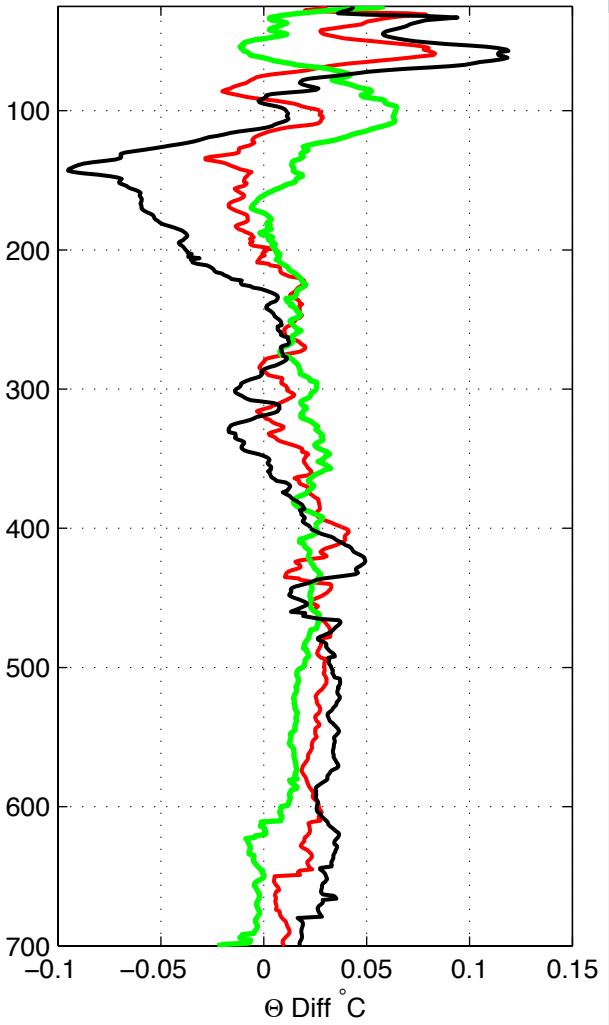


Results

- Mean standard deviation for Southern Ocean
- Cheng is the best fit.
- SO BIAS: + 0.0167°C





Vertical RMS

- H95 has the worst performance for all chokings.
- DRA: Only region where Sippican truly performs best than Cheng.

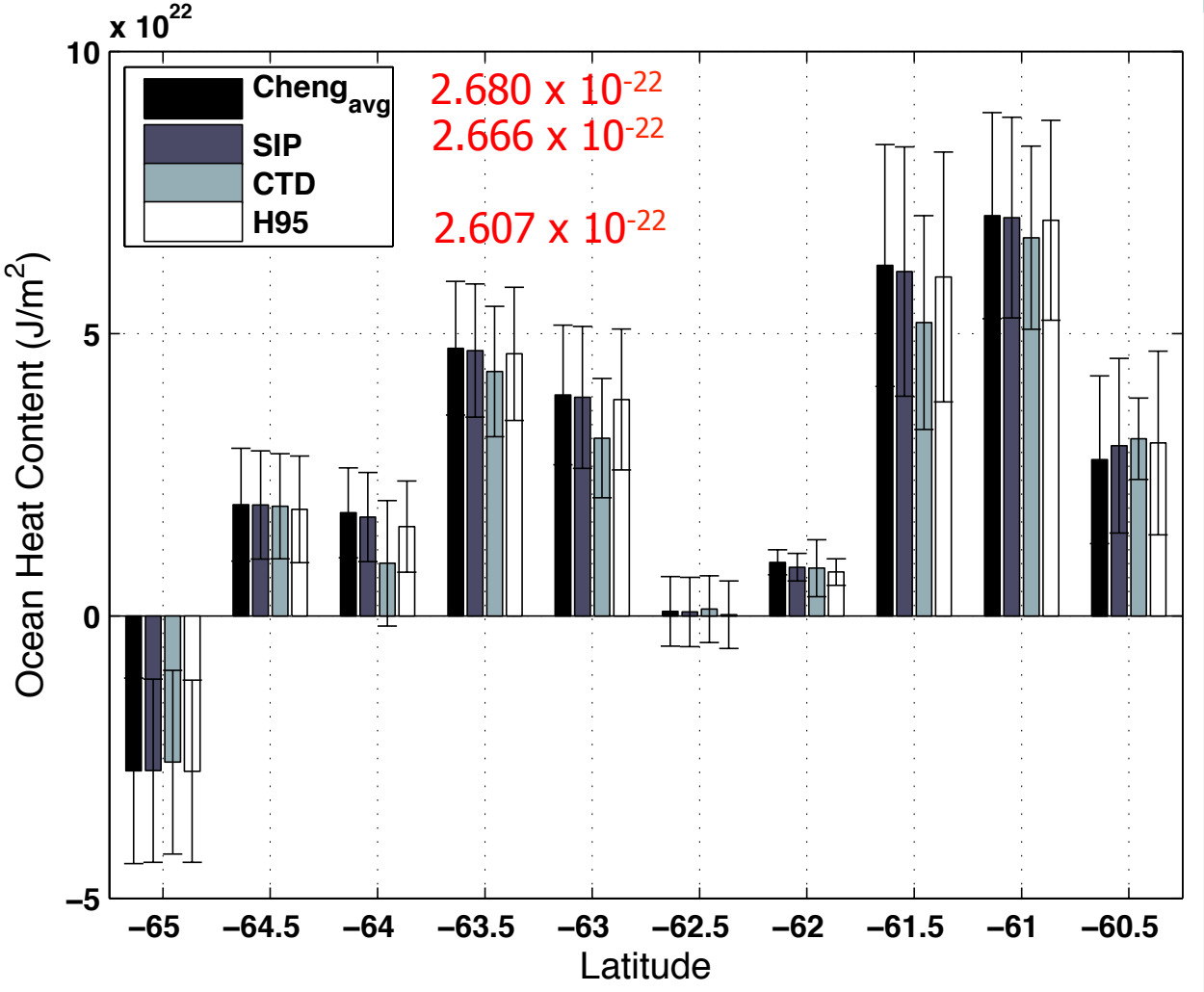
	DRA	AFR	AUS	SO
SIP	0.0634	0.0576	0.0371	0.0537
CHENG	0.0731	0.0518	0.0284	0.0330
H95	0.1542	0.0559	0.0445	0.0544

CHENG IMPROVES ESTIMATES BY 0.02˚C

OHC

- Recommended method and Sippican show an overestimation of OHC for the Southern Ocean of about **10%**.

CTD: 2.377 x 10^{-22} Jm^{-2}



Conclusions

- Sippican FRE performs better in the SO than in other regions of the ocean.
- AFR and AUS XBT>CTD || DRAKE XBT < CTD. Winter intrusions or high dynamics of the region (Hutchinson et al., 2013).
- Eddies might be affecting AFRICA estimates.
- Since the differences are still up to 0.02˚C for the SO (and less than 0.01˚C for other regions) and when analyzing the Global Dataset SO has less profiles comparing to other regions, it is important to account for it in an individual way.
- OHC differences indicate that previous studies might have overestimated Southern Ocean warming rate.

Thank you / Obrigada !