# Comparison of temperature data collected by XBT and CTD instruments in a mesoscale eddy dominated environment

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# Background

*Flow discontinuous

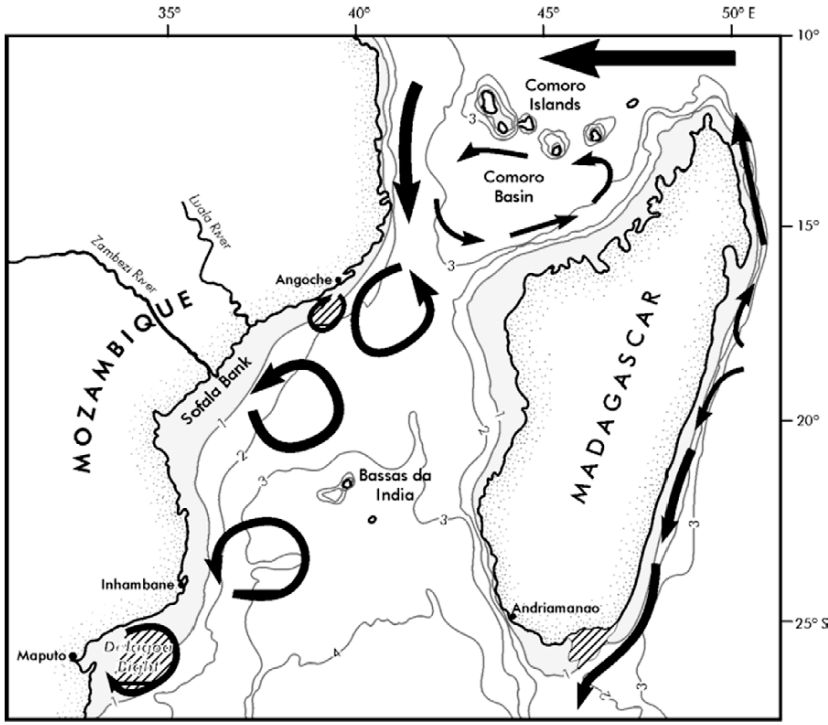
*Forcing – Rossby waves?

*Southward (poleward) propagation of
4-5 anti-cyclones per year
(8.6 Sv; std dev – 14.1 Sv)

*Less consistent and weaker cyclones

*Northward undercurrent
~1500-2500 m (1.5 Sv)

*Thermohaline circulation contribution



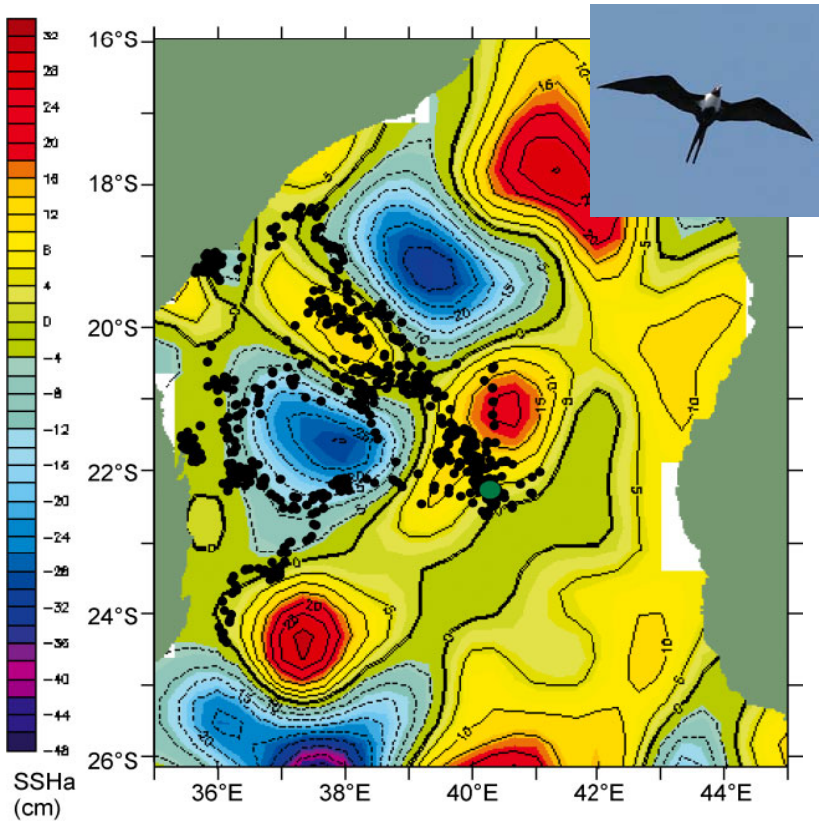

*(Tew-Kai and Marsac, 2010)*

*Harlander et al (2009), Lutjeharms (2006), Schouten et al (2003)*

# Background

First evidence of biological coupling to mesoscale eddies – frigate bird foraging

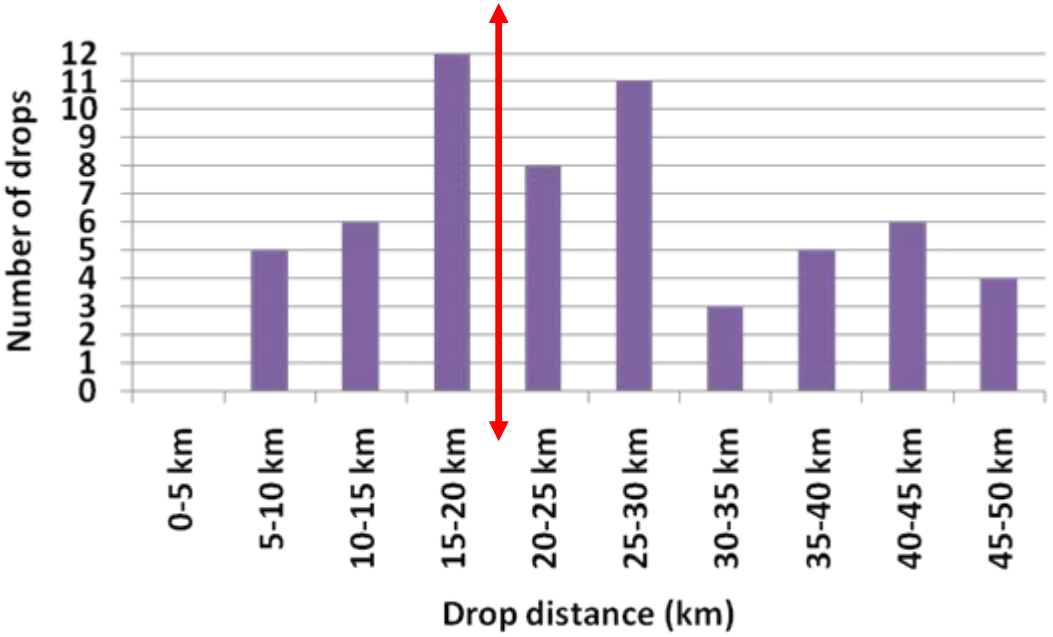
**MESOBIO** – Study the influence of **MESO**scale dynamics on **BIO**logical productivity at multiple trophic levels in the Mozambique Channel




*(Weimerskirch et al., 2004*
*Photo credit: Trevor Hardaker)*

*spatial and temporal scale research
*multi-disciplinary teams
*limited ships time – hence the use of XBT's to compliment CTD deployments

# Drop separation: CTD and XBT stations

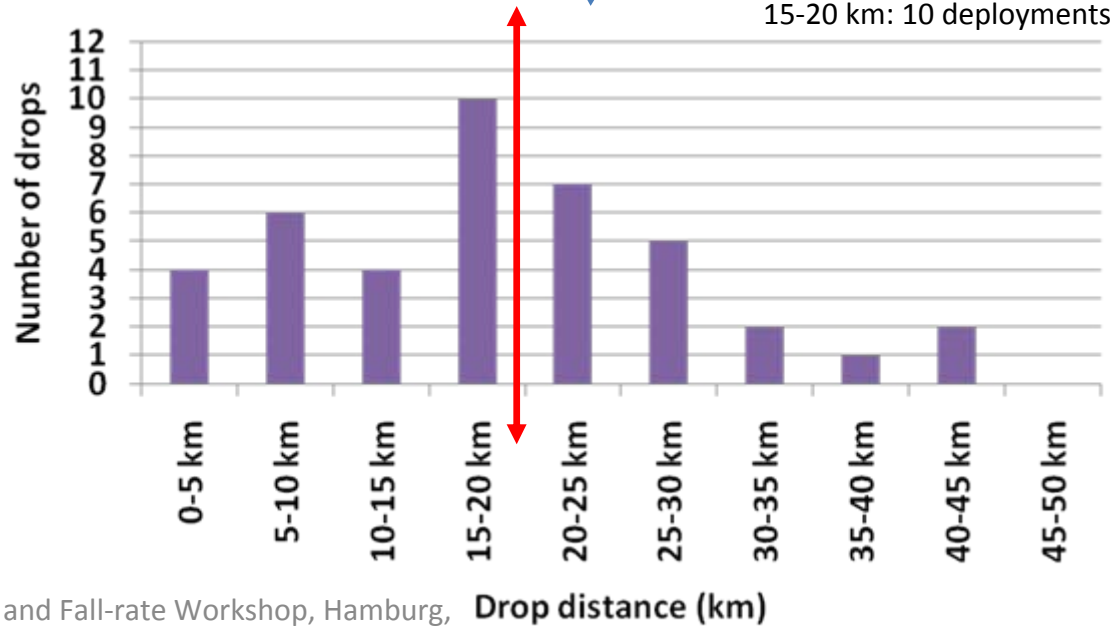



0-5 km: 0 deployments
5-10 km: 5 deployments
10-15 km: 6 deployments
15-20 km: 12 deployments

← Nansen 2008

Antea 2010

0-5 km: 4 deployments
5-10 km: 6 deployments
10-15 km: 4 deployments
15-20 km: 10 deployments

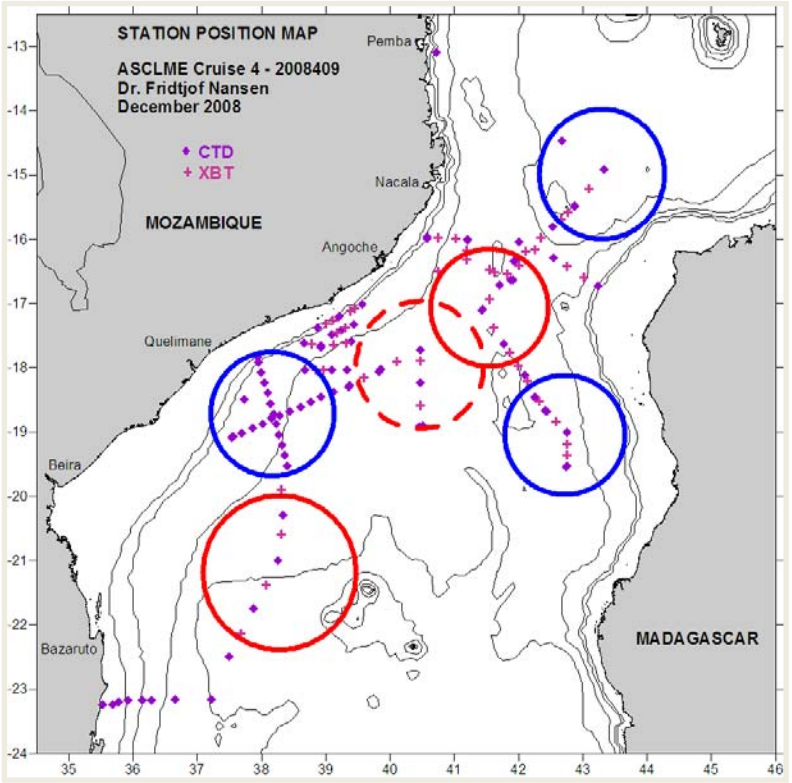



*Three XBT cruises

*20 km criteria (5 km increments)

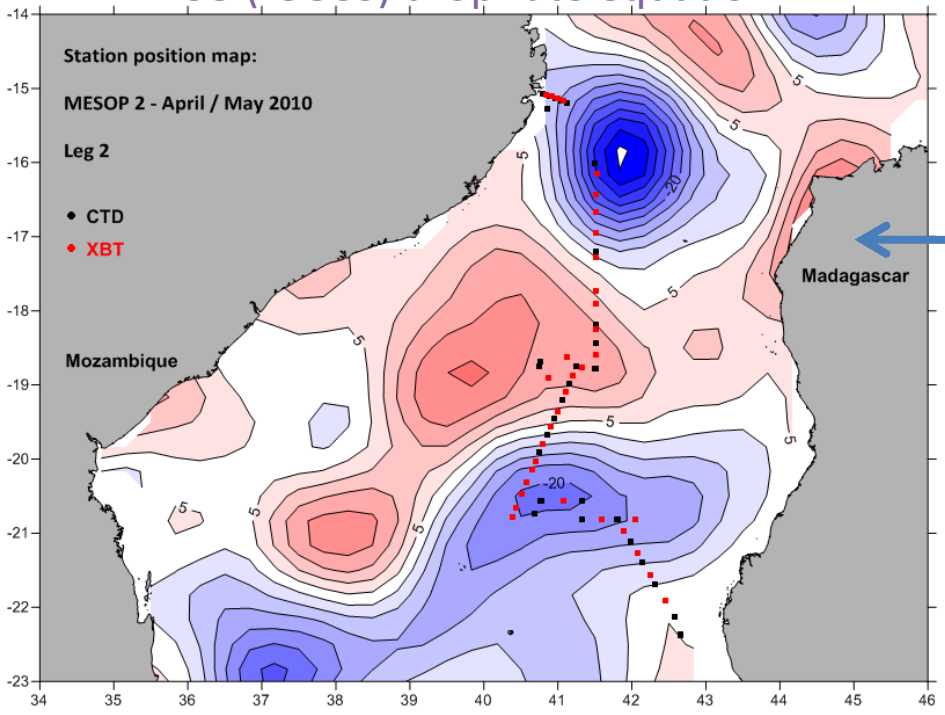
*Only two cruises with sufficient drop pairs

# Cruise data (SSH imagery)




## Nansen 2008 Cruise

- December (summer); North - central channel
- CTD specifications:
  - Standard SBE 3+ temperature sensor
  - Calibrated: 25 July 2007 (~16 months)
  - No calibrations sampled
- XBT specifications:
  - Sippican T-7 (760 m depth rating)
  - H95 (IGOSS) drop rate equation




## Antéa 2010 Cruise

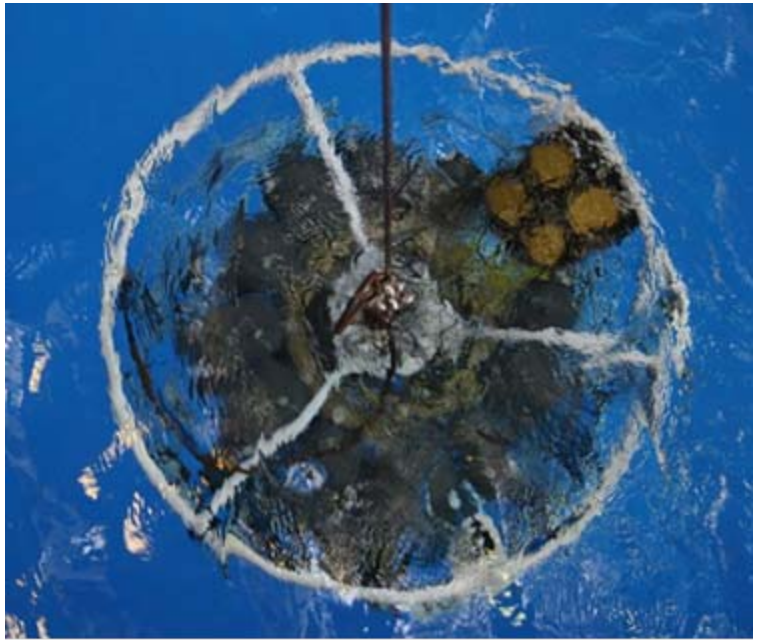
- April / May (Autumn); North - central channel
- CTD specifications:
  - Standard SBE 3+ temperature sensor
  - Calibrated: 27 Feb 2009 (~14 months)
  - No calibrations sampled
- XBT specifications:
  - Sippican Deep Blue (900 m depth rating)
  - H95 (IGOSS) drop rate equation (re-processed after cruise)

# Methods for temperature comparison

*Data handling – processing

*Data plotting and representation – MatLab

*Data interpolation – MatLab scripts (interp);
CTD pressure to depth



*Statistics (basic) calculations

*Comparisons:

1) 0-100 m
2) 100 m – max. depth
3) Entire water column

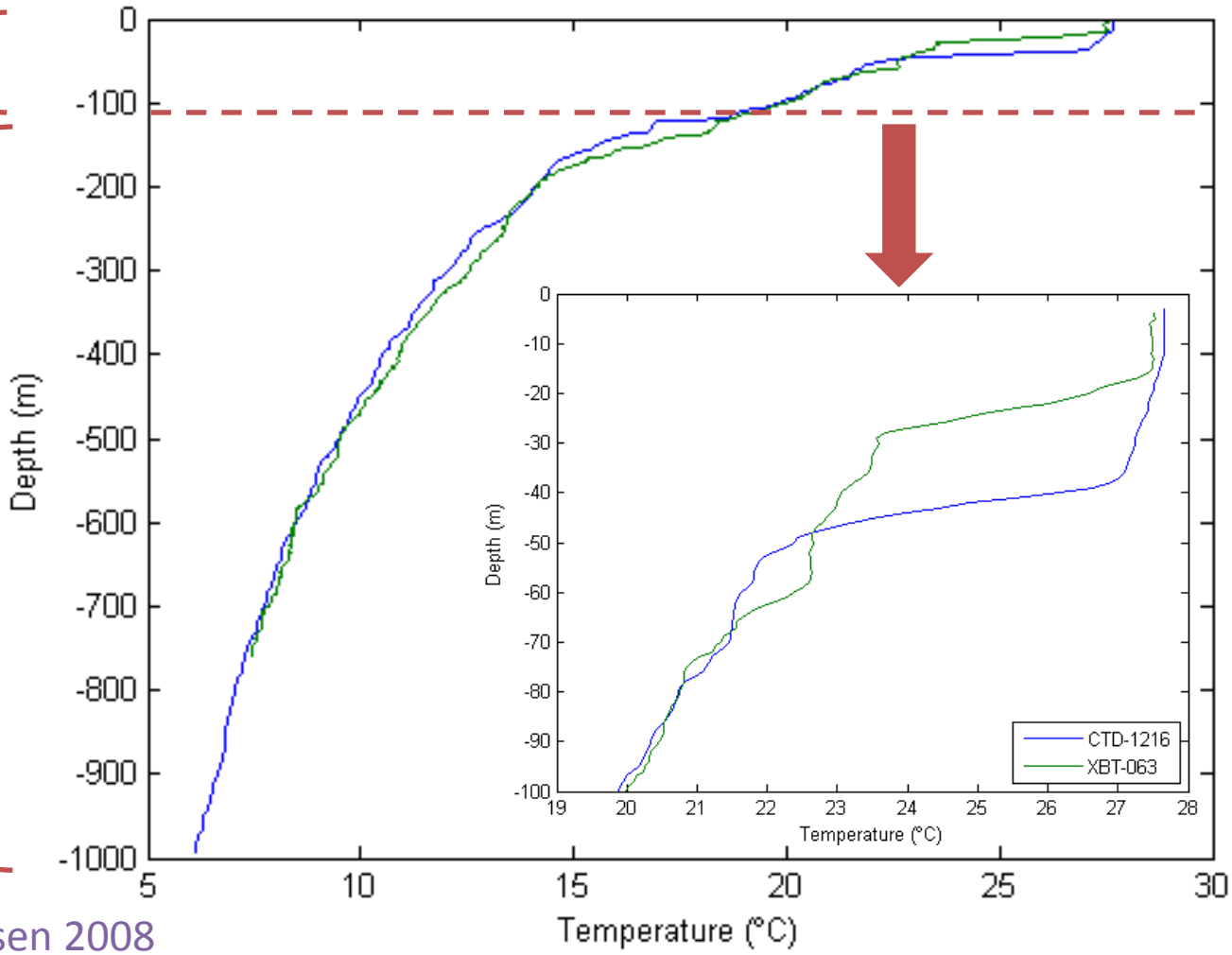
*Vertical sections – Ocean Data View

# Methods for temperature comparison cont...

Upper 100 m:
CTD warm bias
(0.68 ˚C)

Entire water column:
XBT warm bias
(0.15 ˚C)

100 - 760 m:
XBT warm bias
(0.27 ˚C)



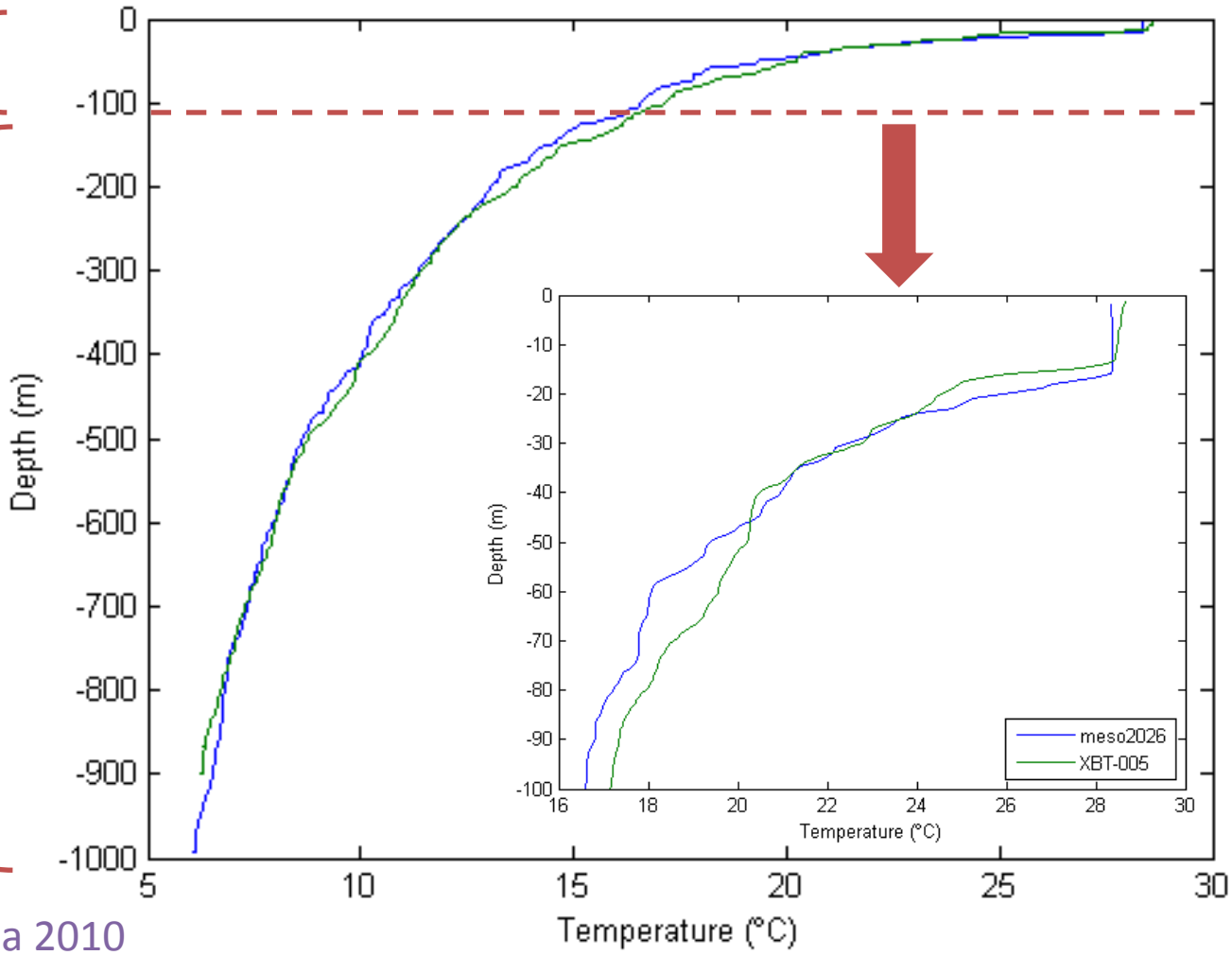

CTD 1216 vs. XBT 063 – Nansen 2008
Distance: 7.37 km
Coastal upwelling region

# Methods for temperature comparison cont...

Upper 100 m:
XBT warm bias
(0.29 ˚C)

Entire water column:
XBT warm bias
(0.14 ˚C)

100 - 900 m:
XBT warm bias
(0.13 ˚C)




CTD 2026 vs. XBT 005 – Antéa 2010
Distance: 15.62 km
Cyclonic core

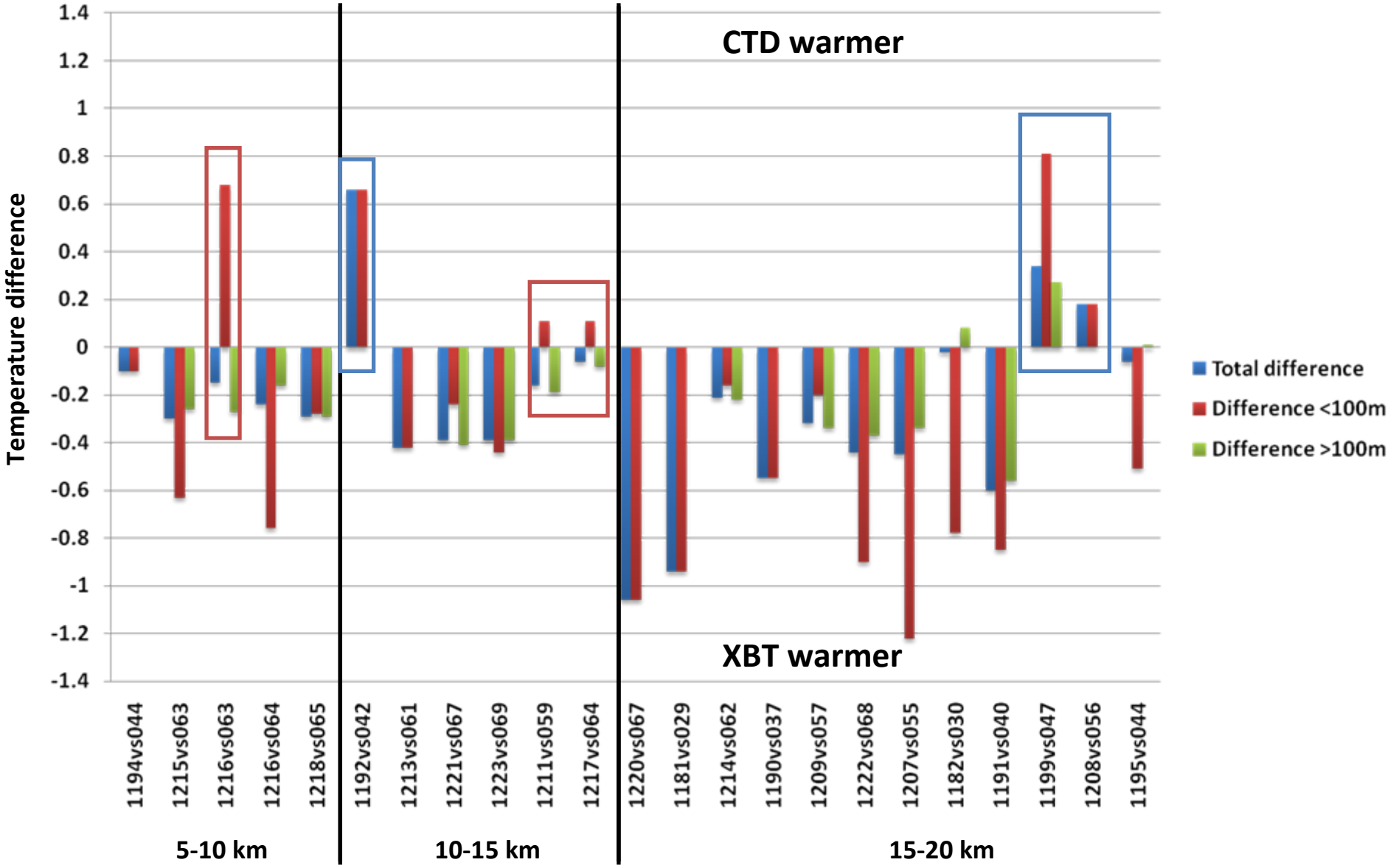
# Nansen 2008 temperature comparison

| °C | Average (total) | Std. Dev (total) | Average (<100 m) | Std. Dev (<100 m) | Average (>100 m) | Std. Dev (>100 m) |
|---|---|---|---|---|---|---|
| **All data** | **-0.26** | **± 0.37** | **-0.33** | **± 0.56** | **-0.22** | **± 0.21** |
| **0-5 km** | n/a | n/a | n/a | n/a | n/a | n/a |
| **5-10 km** | -0.22 | ± 0.09 | -0.22 | ± 0.57 | -0.25 | ± 0.06 |
| **10-15 km** | -0.13 | ± 0.41 | -0.04 | ± 0.42 | -0.27 | ± 0.16 |
| **15-20 km** | -0.34 | ± 0.42 | -0.52 | ± 0.59 | -0.18 | ± 0.28 |

*XBT warm bias for all categories

Highest std. deviation

# Nansen 2008 temperature comparison



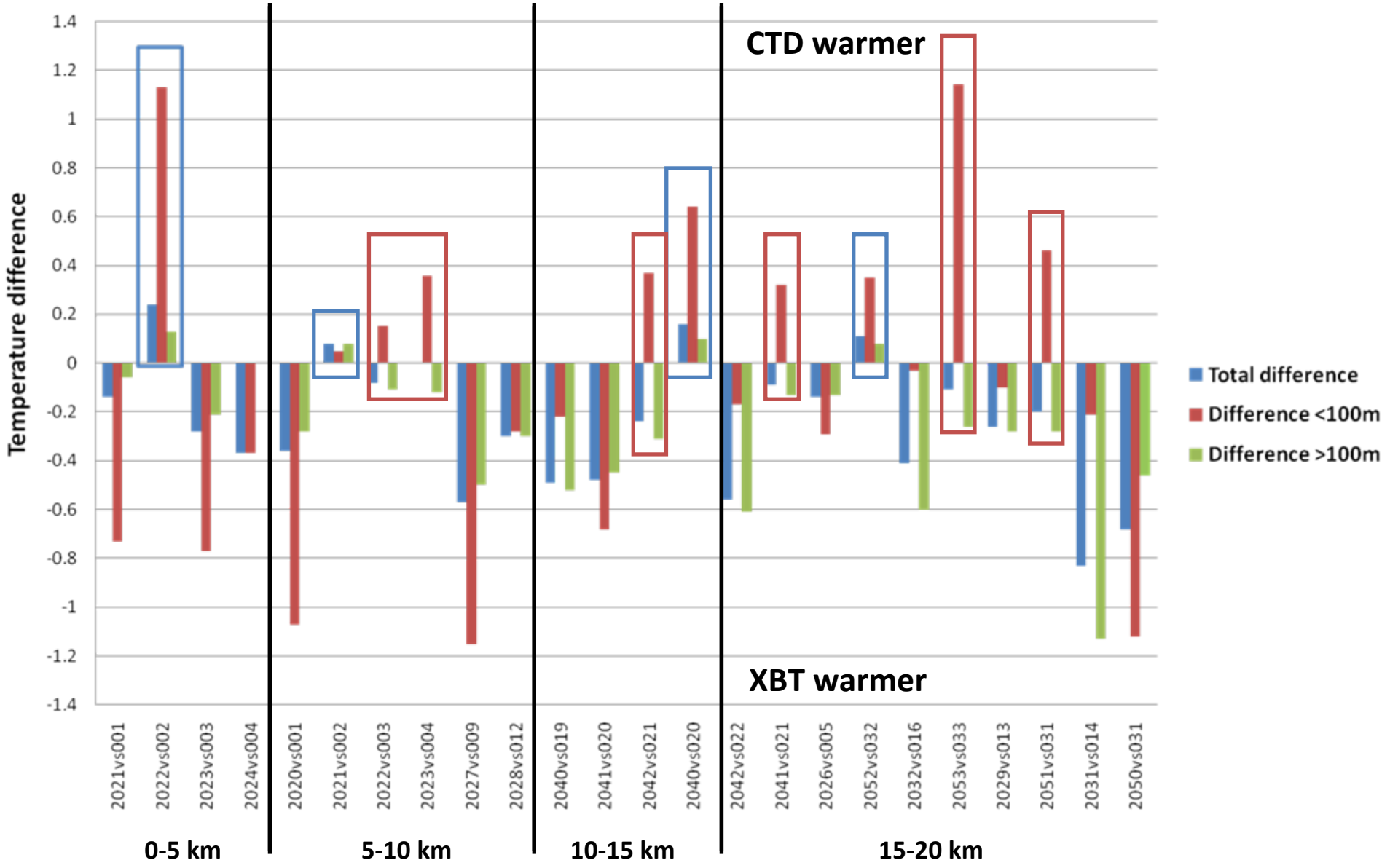
# Antéa 2010 temperature comparison

| °C | Average (total) | Std. Dev (total) | Average (<100 m) | Std. Dev (<100 m) | Average (>100 m) | Std. Dev (>100 m) |
|---|---|---|---|---|---|---|
| **All data** | **-0.25** | **± 0.27** | **-0.09** | **± 0.63** | **-0.27** | **± 0.29** |
| **0-5 km** | -0.14 | ± 0.27 | -0.19 | ± 0.89 | -0.05 | ± 0.17 |
| **5-10 km** | -0.21 | ± 0.25 | -0.32 | ± 0.64 | -0.21 | ± 0.20 |
| **10-15 km** | -0.26 | ± 0.30 | **0.03** | ± 0.59 | -0.30 | ± 0.28 |
| **15-20 km** | -0.32 | ± 0.30 | **0.04** | ± 0.59 | -0.38 | ± 0.34 |

*XBT warm bias for most categories, except
<100 m for 10-15 and 15-20 km categories (not significant)

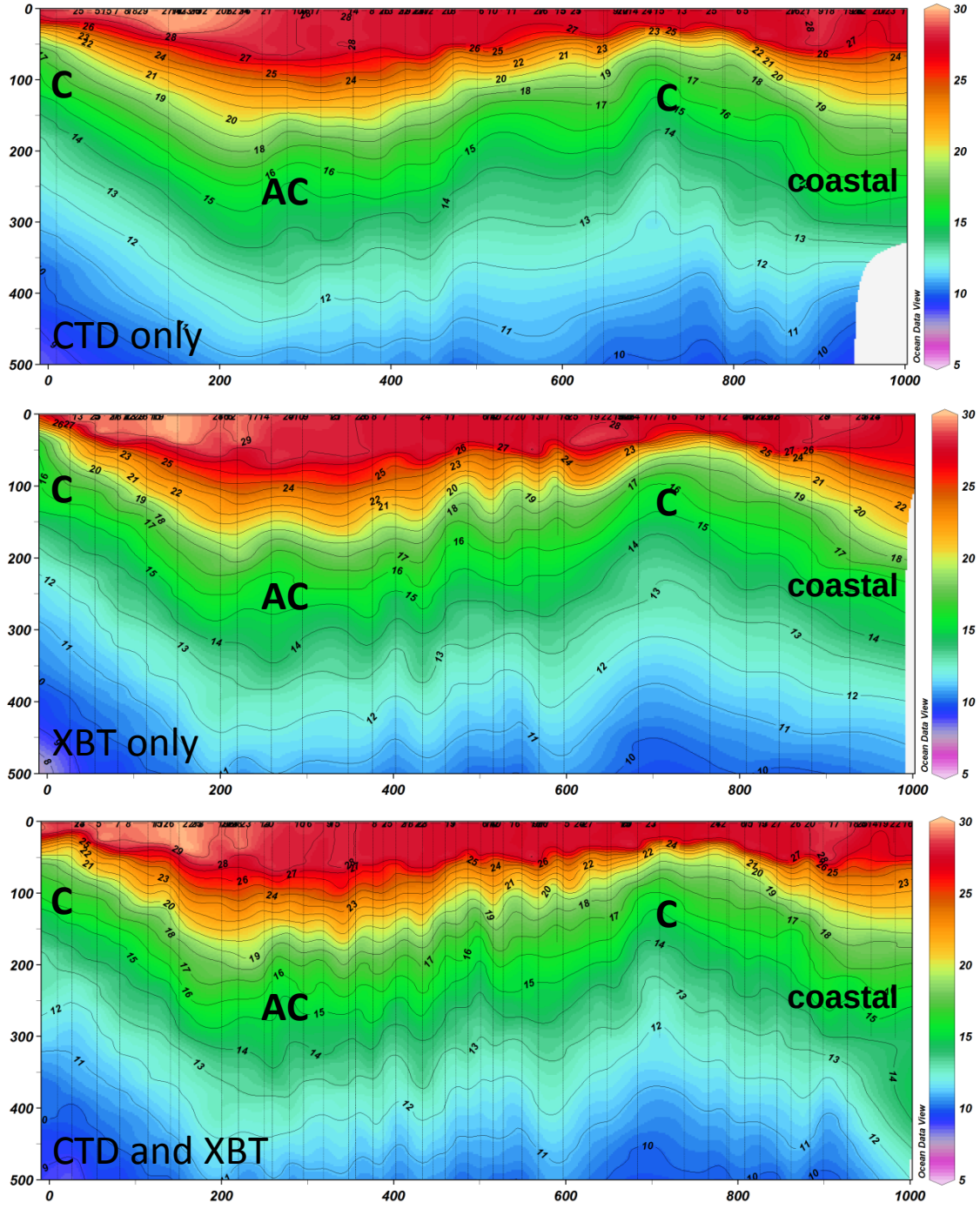
Highest std. deviation

# Antéa 2010 temperature comparison



# Data correction

Antéa 2010 Cruise
N-S transect
(interpolation same)



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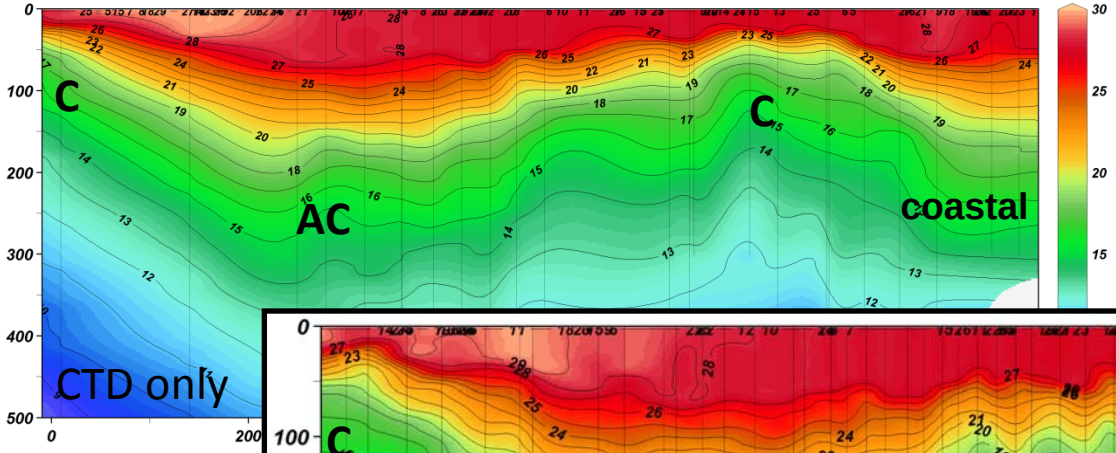
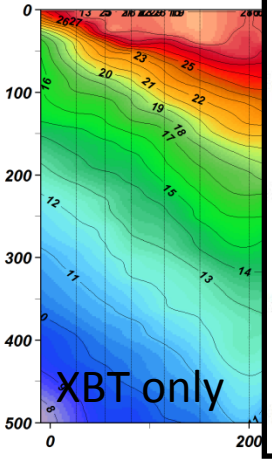
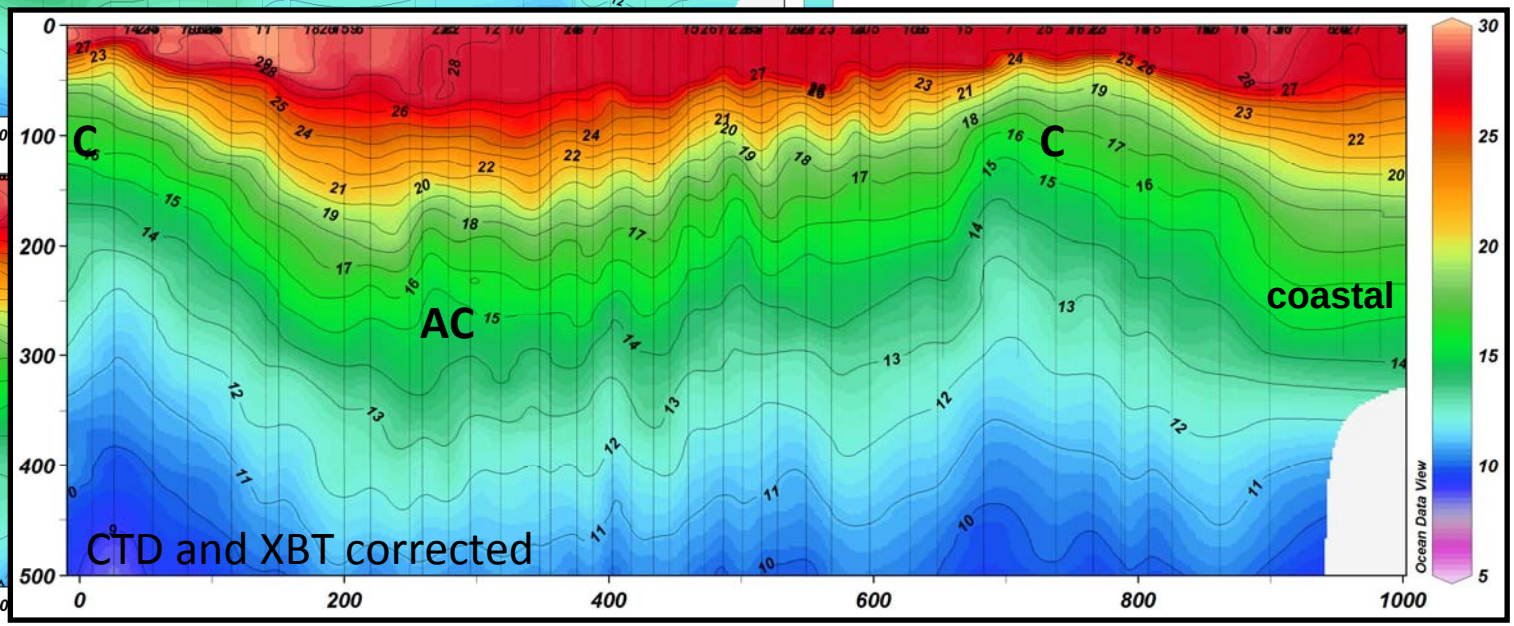
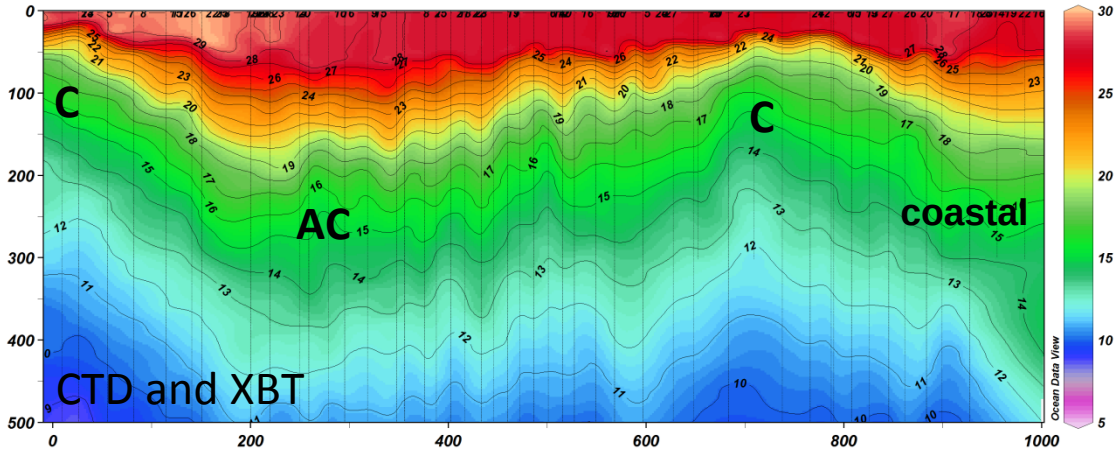


# Conclusions

*Current data sets ill-suited for this type of comparison (distances)

*Overall XBT bias (0.25 ˚C) for both cruises

*Greatest std. dev. in upper 100m

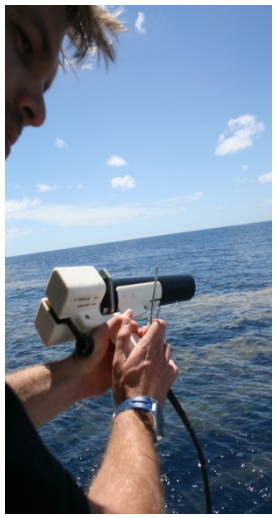
*CTD warm bias in upper 100 m – coastal upwelling

*Complete CTD bias – eddy frontal regions (high variability)

*Correction by average warming – no real change

*For meso-scale work, bias perhaps not as critical as for micro-scale research

# Acknowledgements

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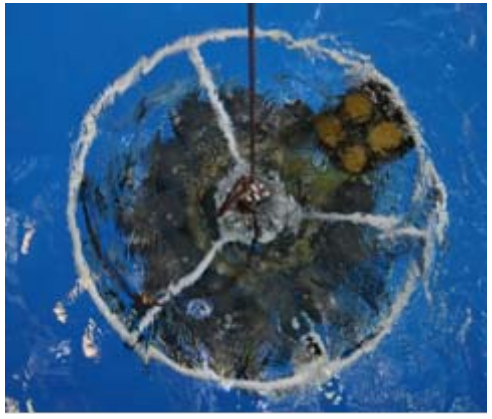

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