An OSSE system to assess the meridional transport uncertainties along 34°S

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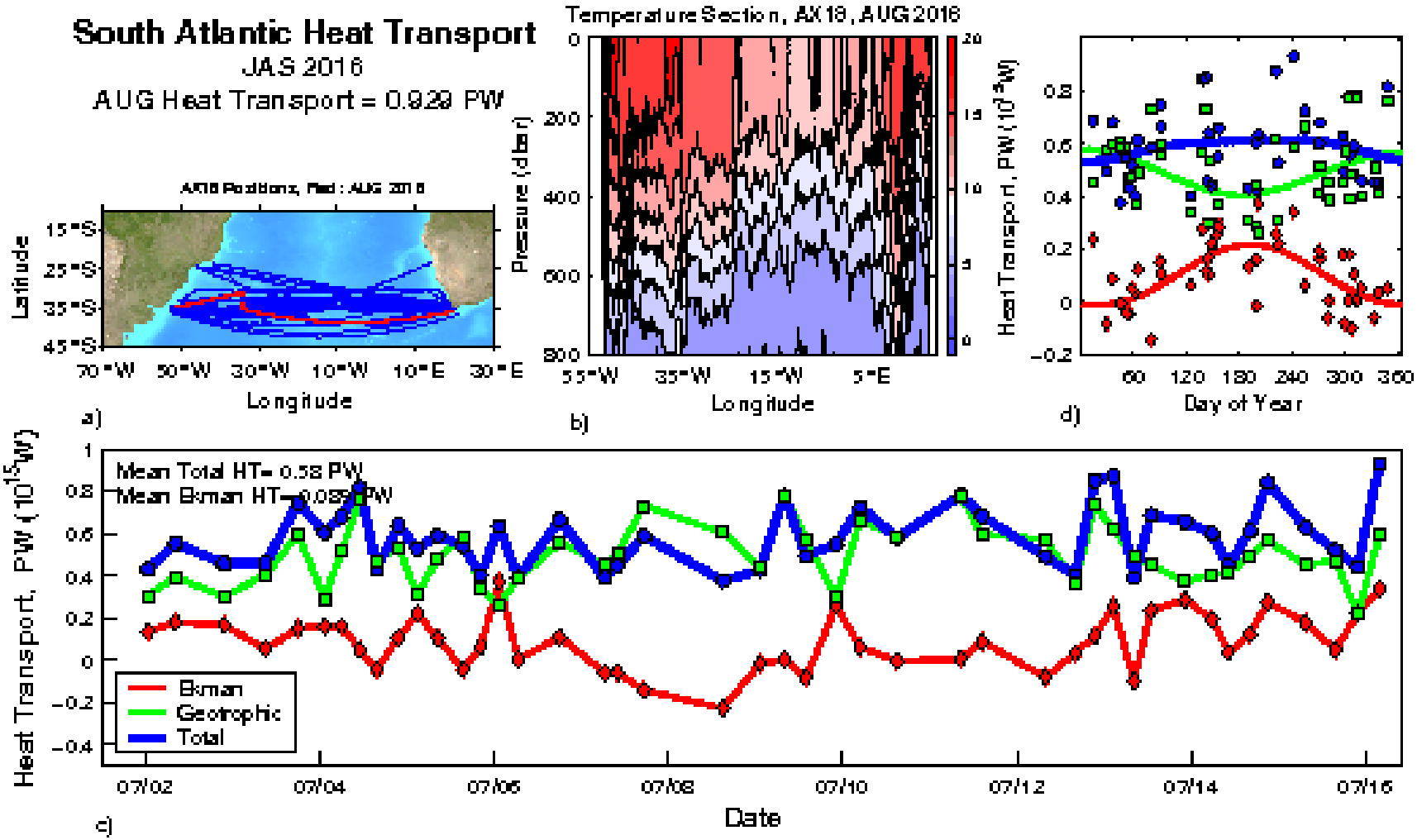


The Atlantic MOC is formed by the northward surface flow of warm waters and by the southward deep flow of cold waters, resulting in a net heat transport to the north called Meridional Heat Transport (MHT).

http://www.aoml.noaa.gov/phod/goos/xbtscience/mht_products.php

Simulating the AX18 transect

Salinity

- 0 - 800m: T-S lookup table
- 800m - bottom: Climatology padding

Temperature

- 800m-bottom: Climatology padding

Geostrophic Velocity

- Reference level: $\sigma_2 = 37.09$ Kg/m^3

Time Sampling: Quarterly

Spatial Sampling:

- 25 km in the boundaries, 50 km in the interior

Observing System simulation experiment

- Use a model to simulate the observing system.
- Assume the true variability (nature run) is the original model estimates.
- Assess the uncertainty associated with the observing system by including or denying features of that system in the model.
- Test new ideas to improve the current observing strategy.

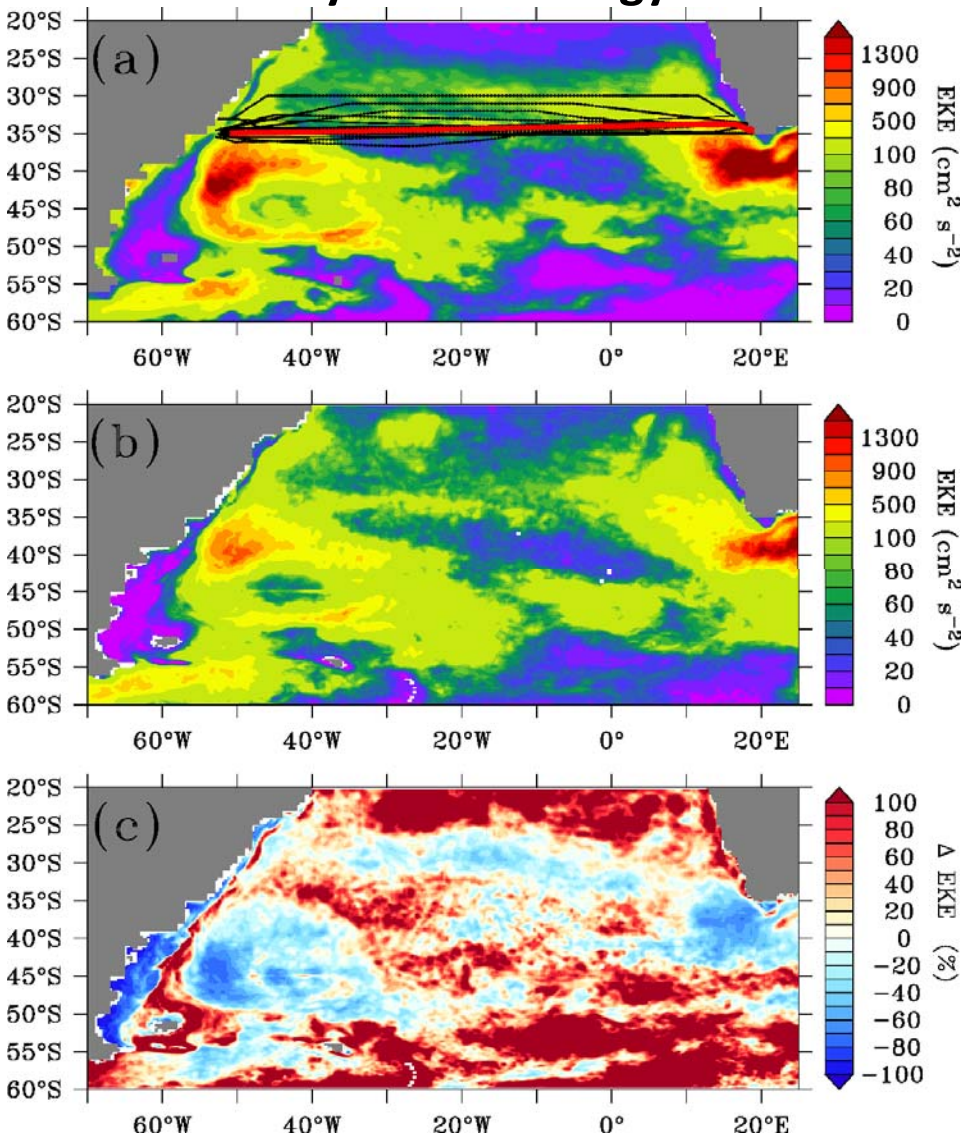
Model Energetics

Eddy Kinetic Energy

AVISO

HYCOM

HYCOM – AVISO



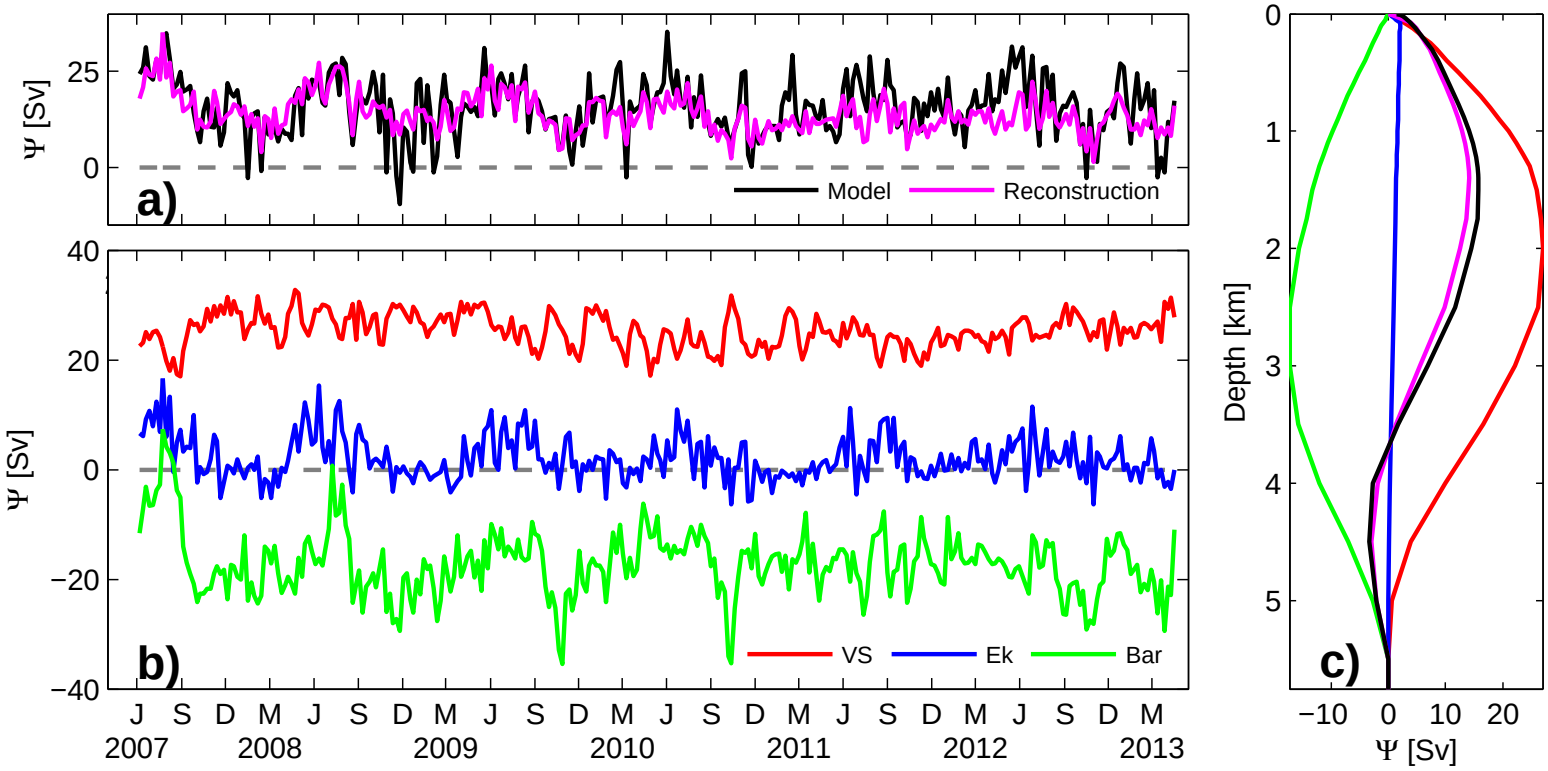
- Regional features compare well with observations.
- Model variability generally underestimated in hi-EKE regions, and overestimated in lo-EKE regions.

Meridional Transport

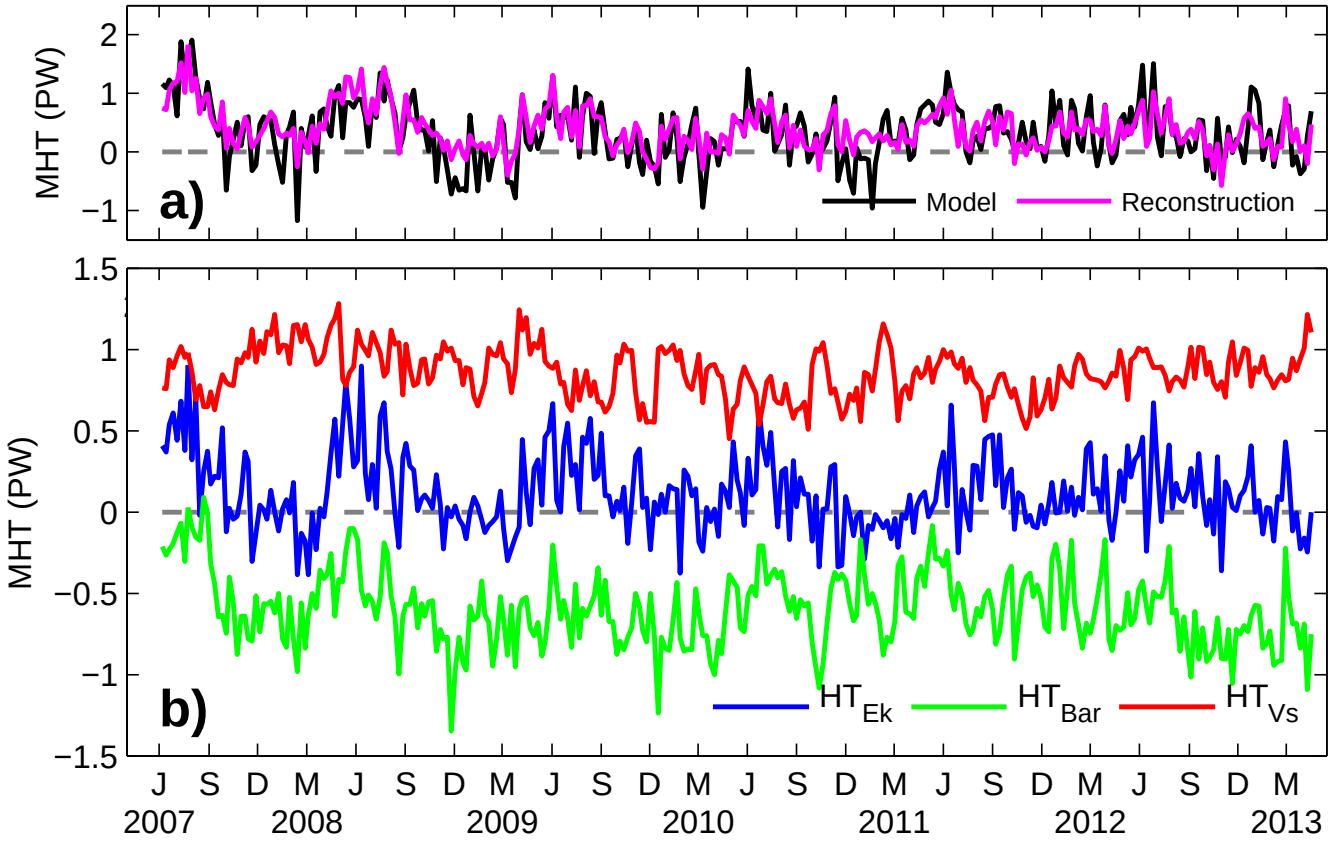
- Volume transport (AMOC) Streamfunction:

$$PSI = \int_{xE}^{xw} \int_{-H}^{z} v(x,z)\,dx\,dz$$

- *AMOC strength = max(abs(PSI))*



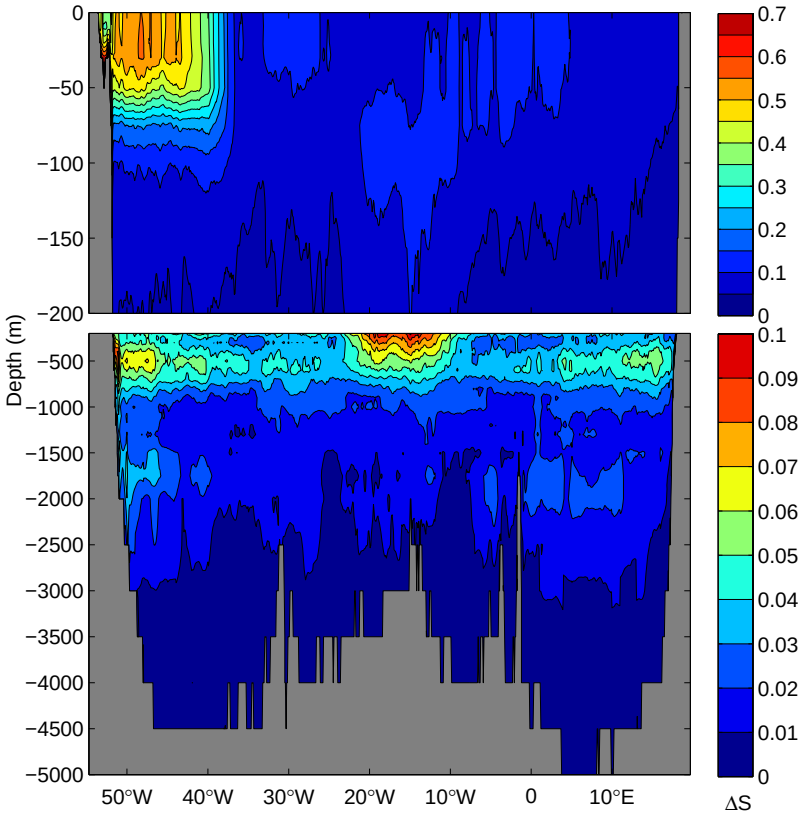
Reconstructed MHT



Component	HYCOM	Garzoli et al. (2013)
Total	0.33 ± 0.5 PW	0.55 ± 0.14 PW
Geostrophic	0.21 ± 0.2 PW	~ 0.45 ± 0.1 PW
Ekman	0.12 ± 0.24 PW	0.08 ± 0.2 PW

Effect of Salinity and Deep temperature estimates

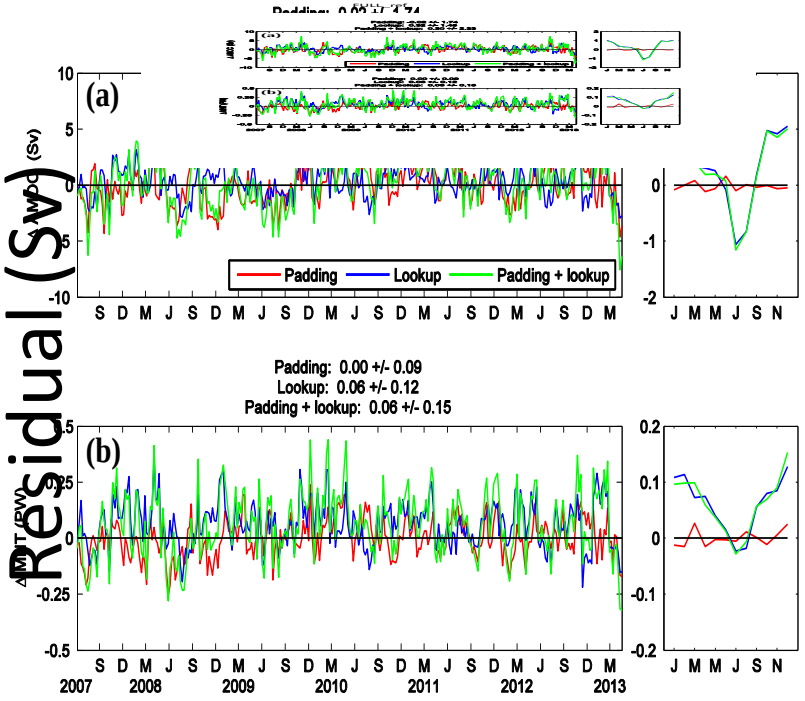
The model salinity is replaced by the annual climatological mean using a lookup table (0-800m) and padding (800m-bottom)



Lookup

Padding

RMS difference (model – estimated) of salinity



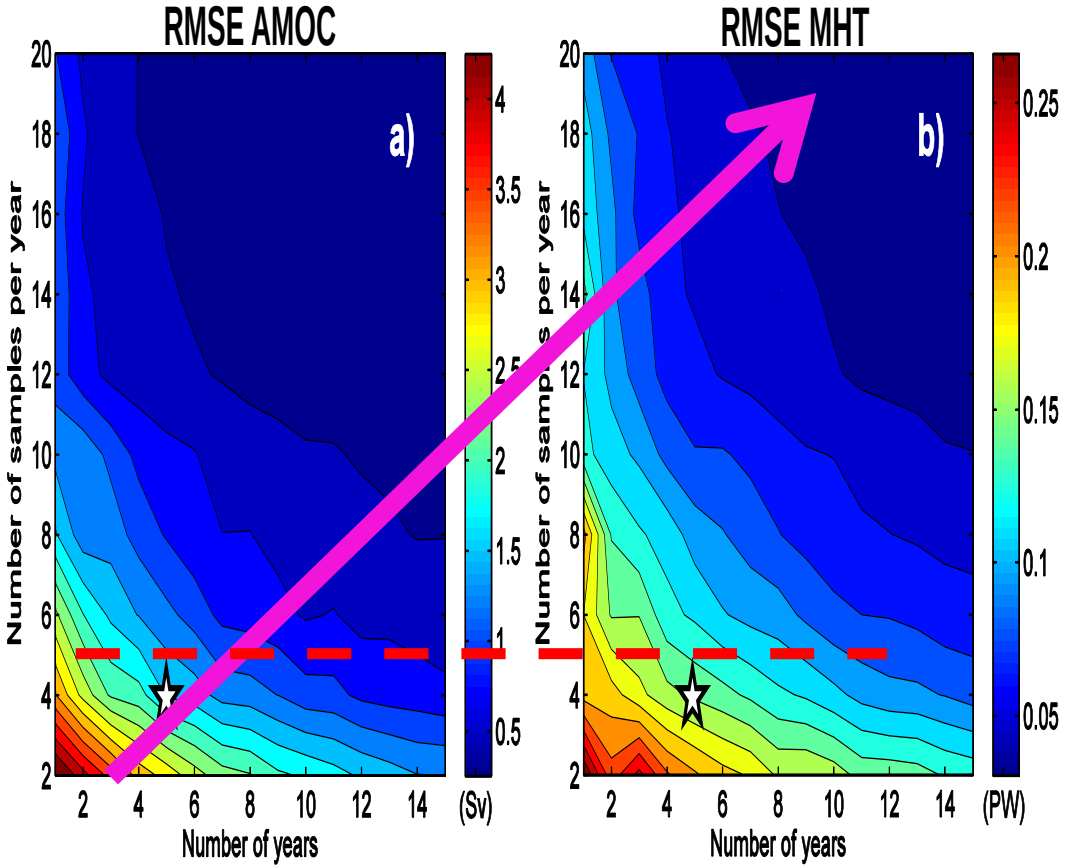
Padding

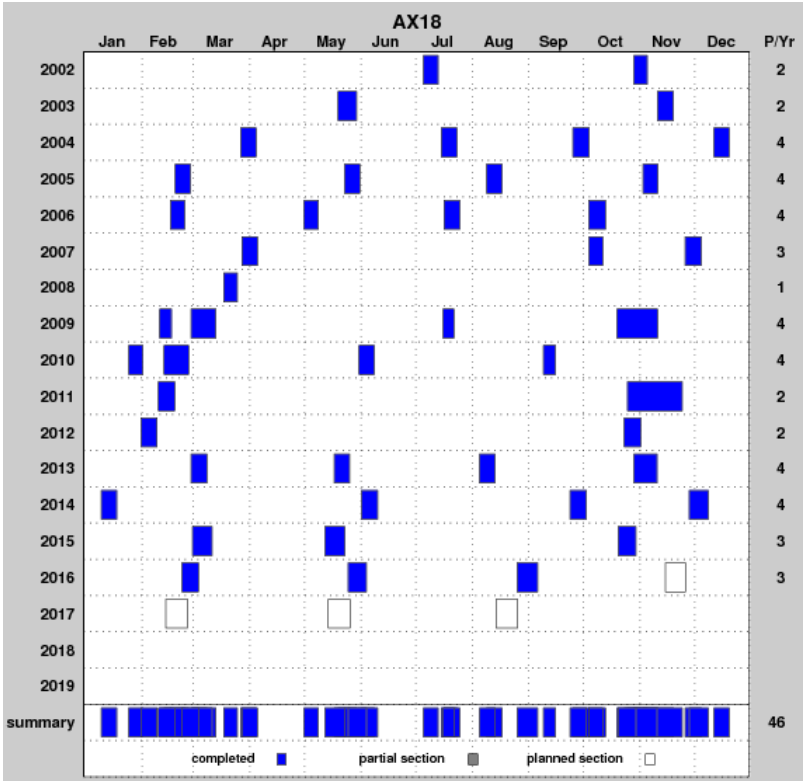
Lookup

Padding + lookup

solve seasonal

ty

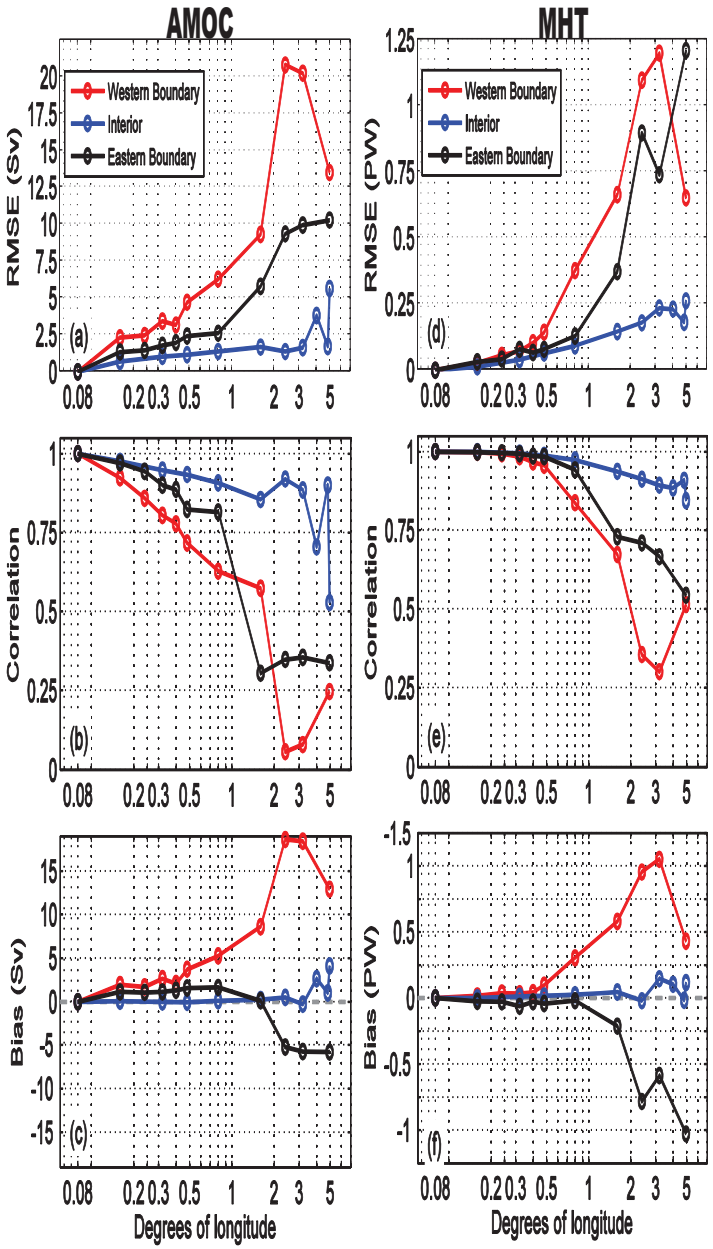


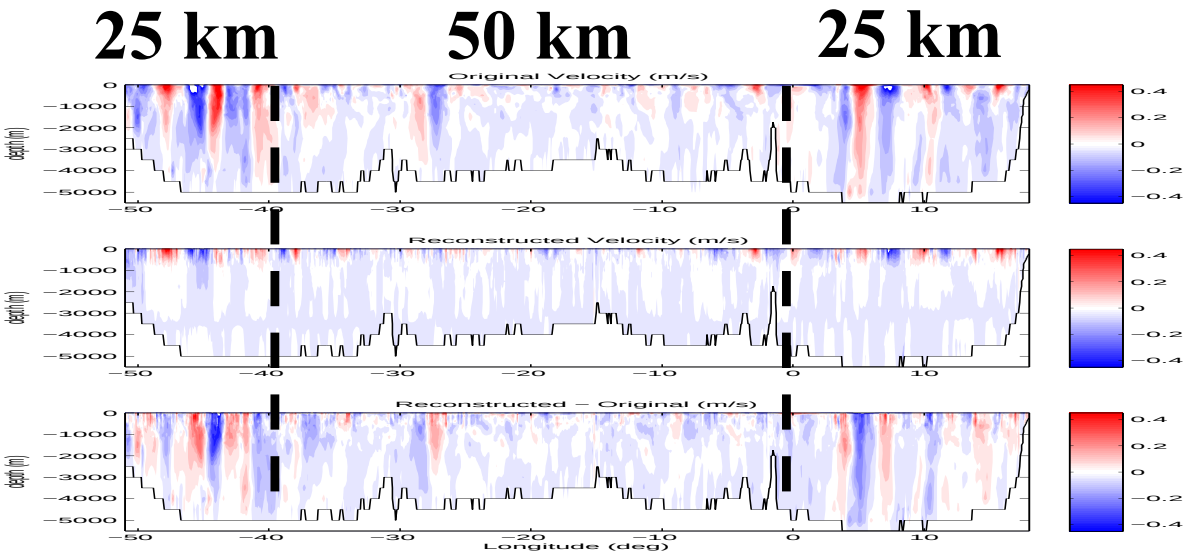


http://www.aoml.noaa.gov/phod/hdenxbt/ax_home.php?ax=18

Sampling	AMOC	MHT
5 years/ 4 x year	±1.7	±0.15
12 years/ 4 x year	±1.4	±0.13

Spatial Sampling

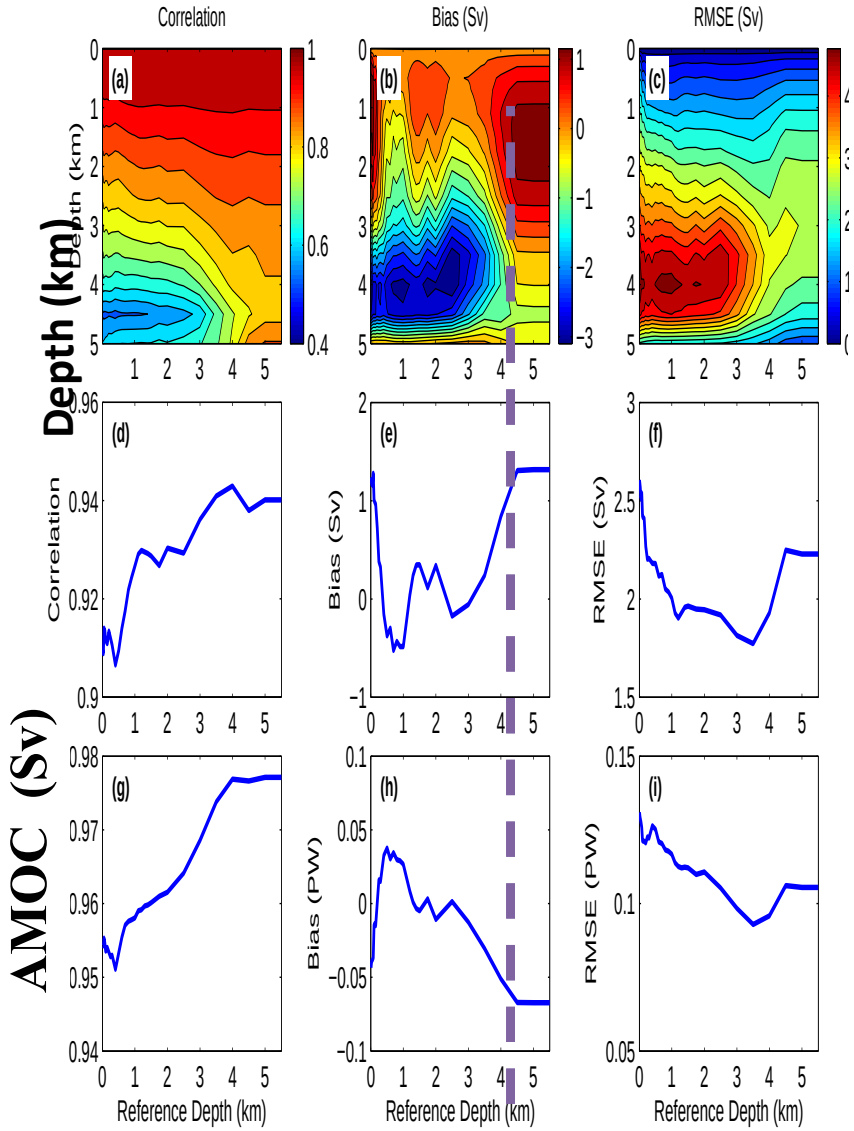


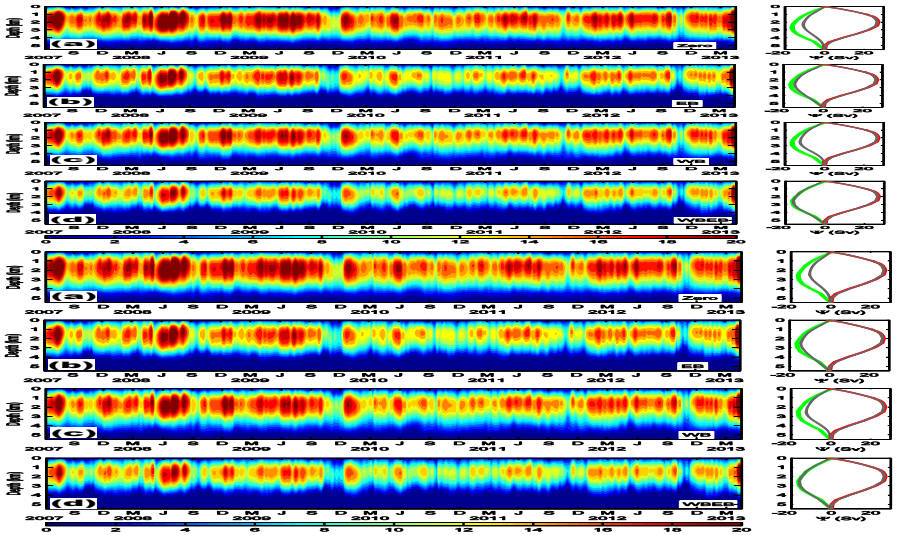


How the zonal resolution affects the reconstruction of the AMOC?

Region	AMOC	MHT
Interior (50km)	-0.1±1.1	0.01±0.06
East (25 km)	1.0±1.4	-0.03±0.04
West (25 km)	1.7±2.4	0.03±0.06

Reference level and velocity



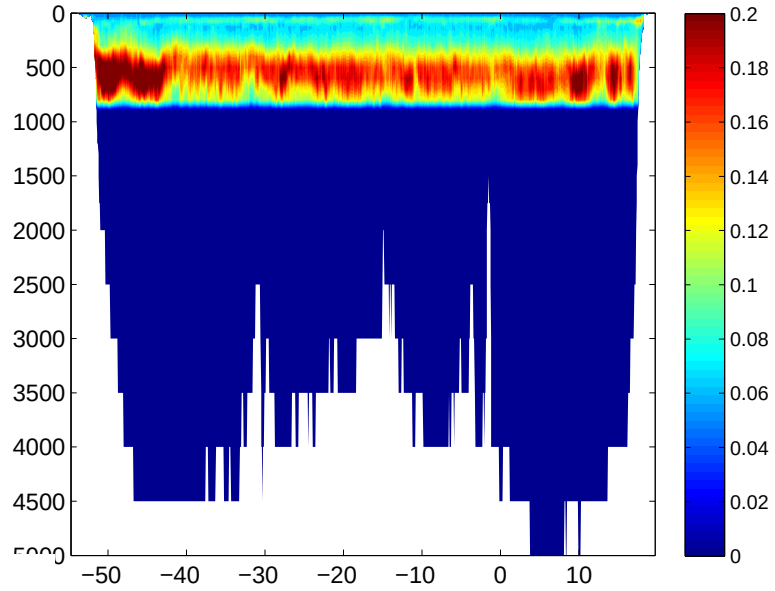


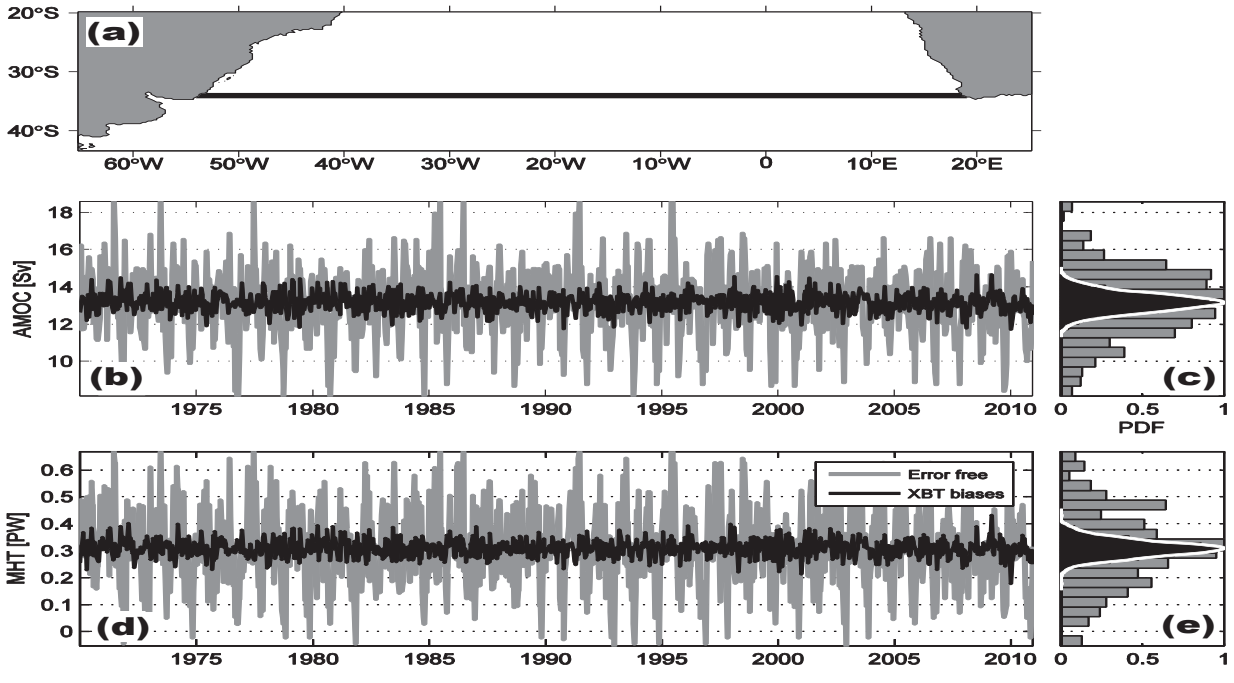
Barotropic
Vertical Shear
Reconstruction

Vref	Bias(Sv)	RMS (Sv)
East + West	0.3	4.4

How XBT measurement errors affect the AMOC and MHT estimates?

RMS error for the 34S temperature section





The errors associated with XBT manufacture tolerances account for **3% (0.38 Sv)** and **8% (0.025 PW)** of their mean values, for the AMOC and MHT, respectively

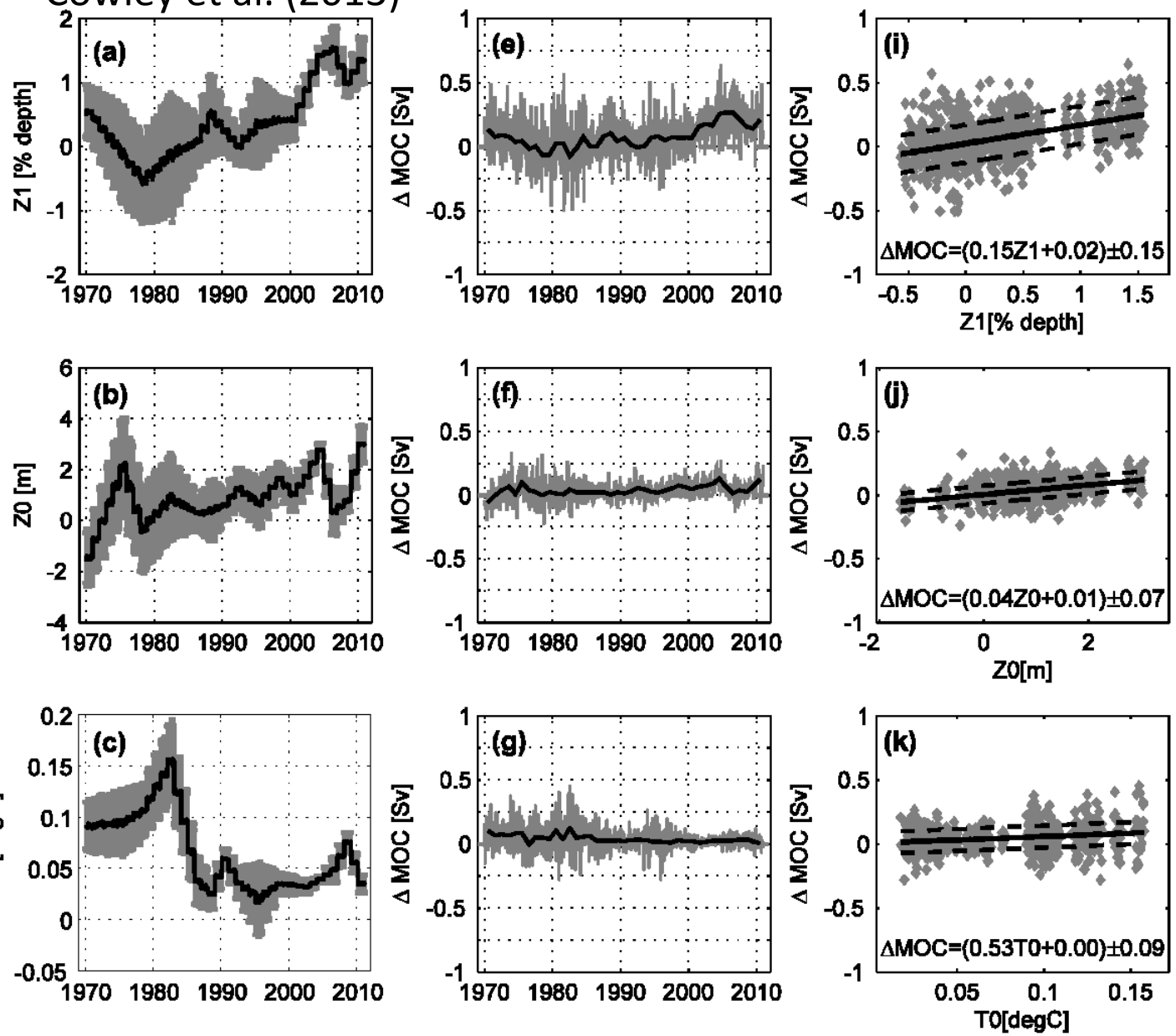
MOC sensitivity to historical XBT bias parameters

Cowley et al. (2013)

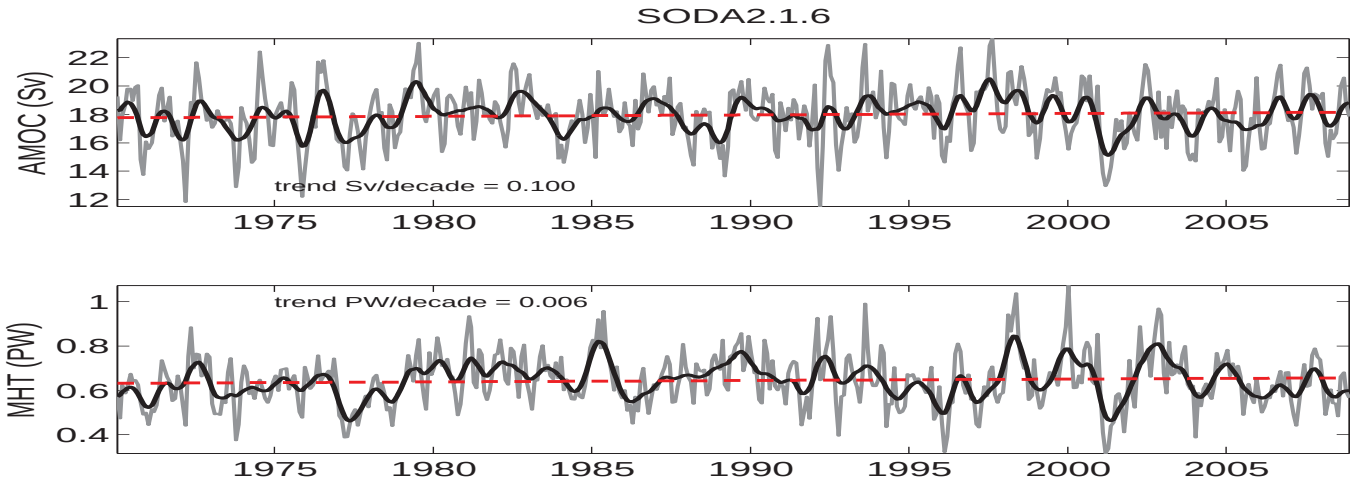
Depth linear bias

Depth offset

Temperature offset

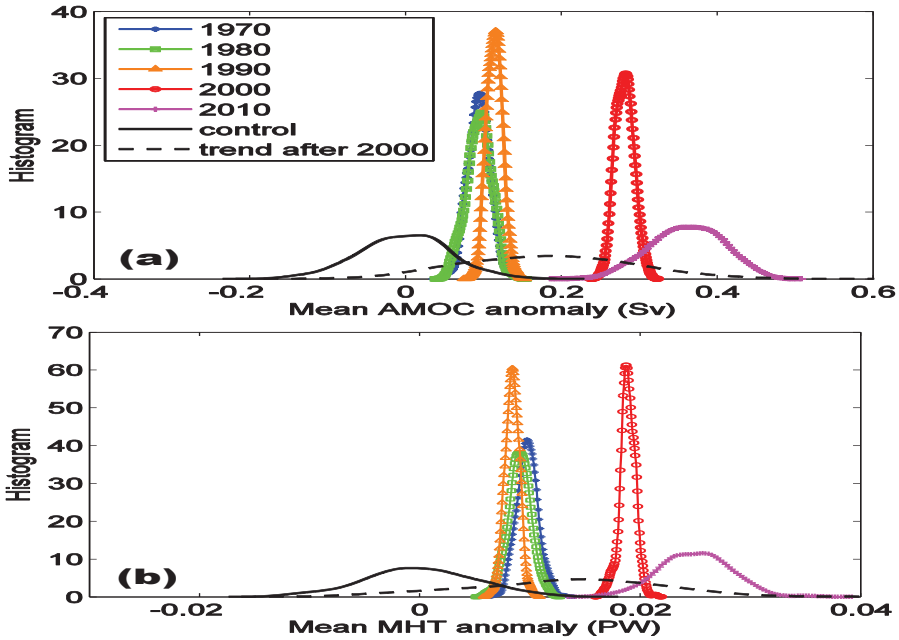


Historical AMOC and MHT trends from SODA

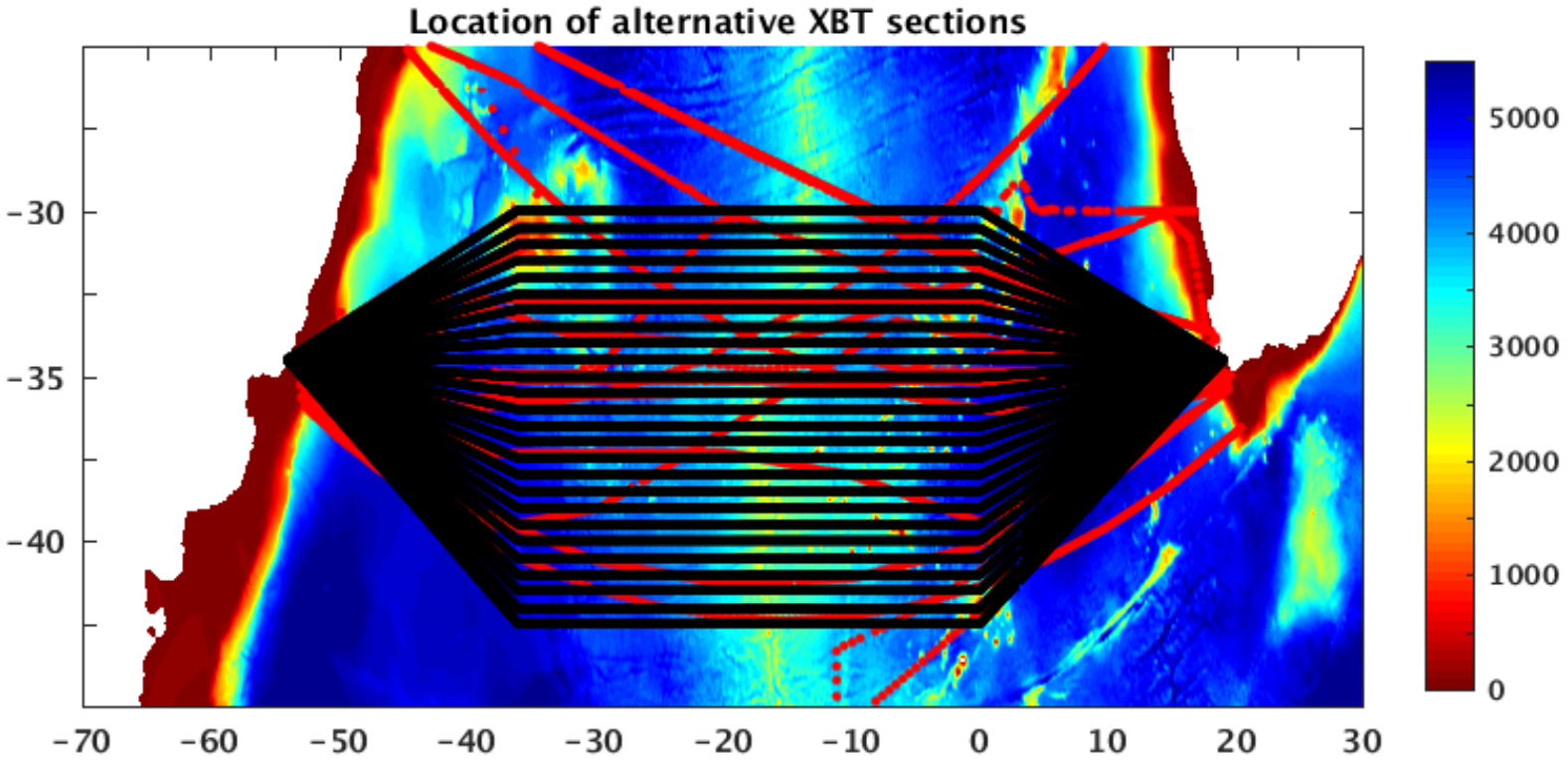


The distribution of the mean biases due to XBT after 2000 are statistically different than the CONTROL.

The XBT biases should be corrected for long term AMOC/MHT monitoring.

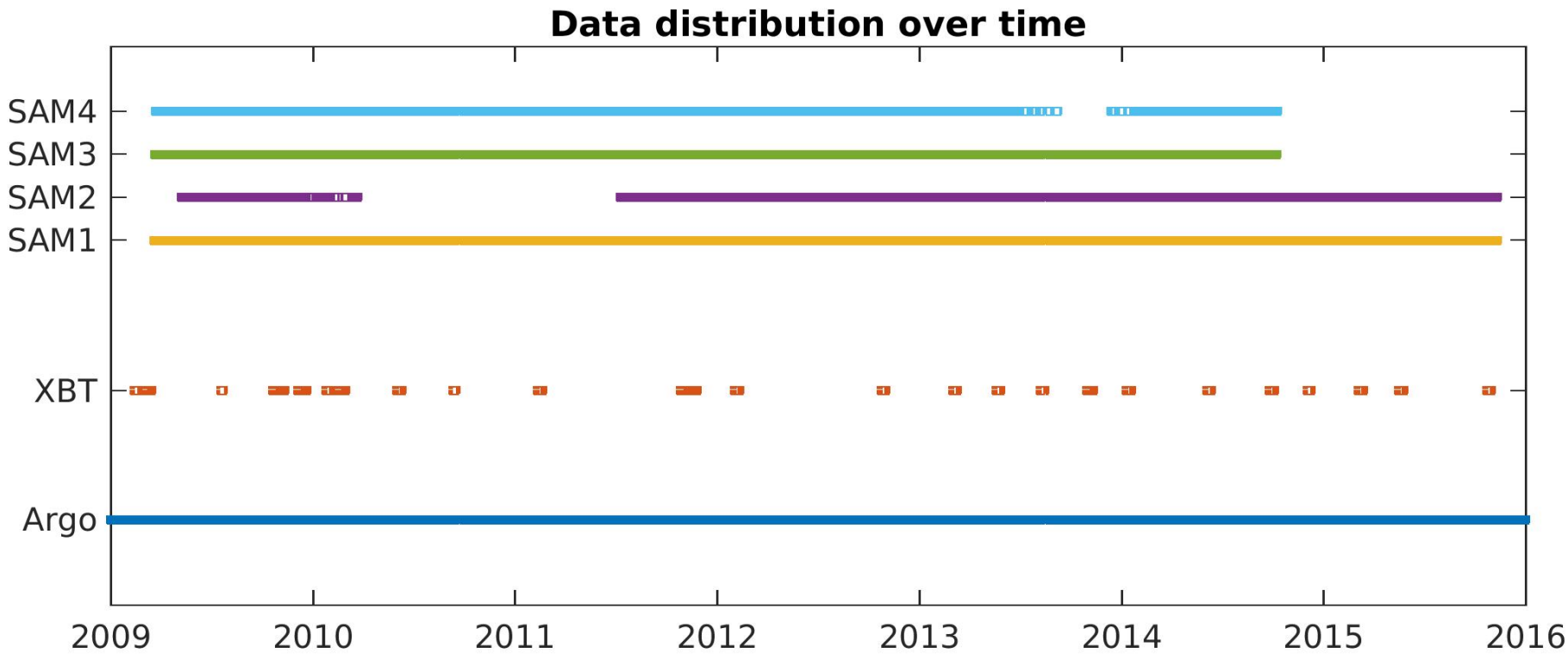


The location of AX18



Next steps: We will investigate the effect of transect location .

Other observing systems



Next steps: We will investigate the synergy with other observing systems in the region (SAM, Argo, etc.)

Thank you