Global Ocean Monitoring and Observing
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION

NOAA Global XBT Network

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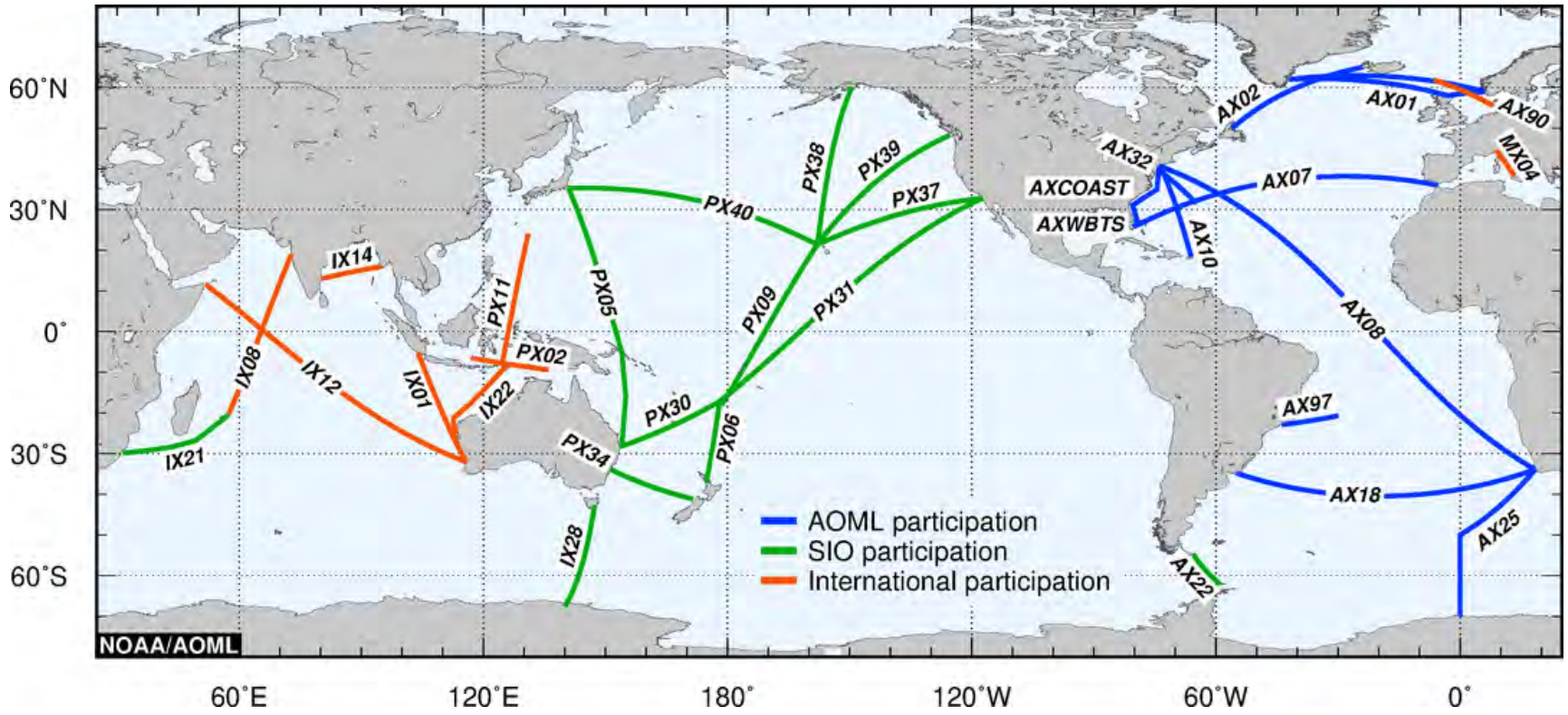
Goni, G.J., J. Sprintall, F. Bringas, L. Cheng, M. Cirano, S. Dong, R. Domingues, M. Goes, H. Lopez, R. Morrow… (2019). More than 50 years of successful continuous temperature section measurements by the Global Expendable Bathythermograph Network, its integrability, societal benefits, and future. Frontiers in Marine Science, 6:452, doi:10.3389/fmars.2019.00452.

Program Overview: The Global XBT network



GOMO Supported: AOML, SIO
All XBT data freely available on GTS and through NCEI

An EXpendable BathyThermograph (XBT) with it's probe inside a canister (top). On the right is an exploded view of the XBT.

Far left: XBT handlauncher
Middle and right: AOML and SIO automatic launchers

Program Overview: XBT Network Impacts

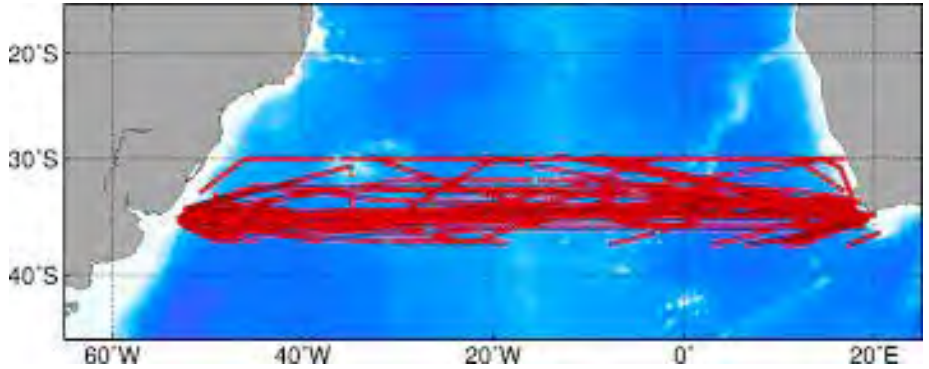
Goal: To enhance our knowledge of the ocean variability and its link to weather, climate, and ecosystems for societal benefits

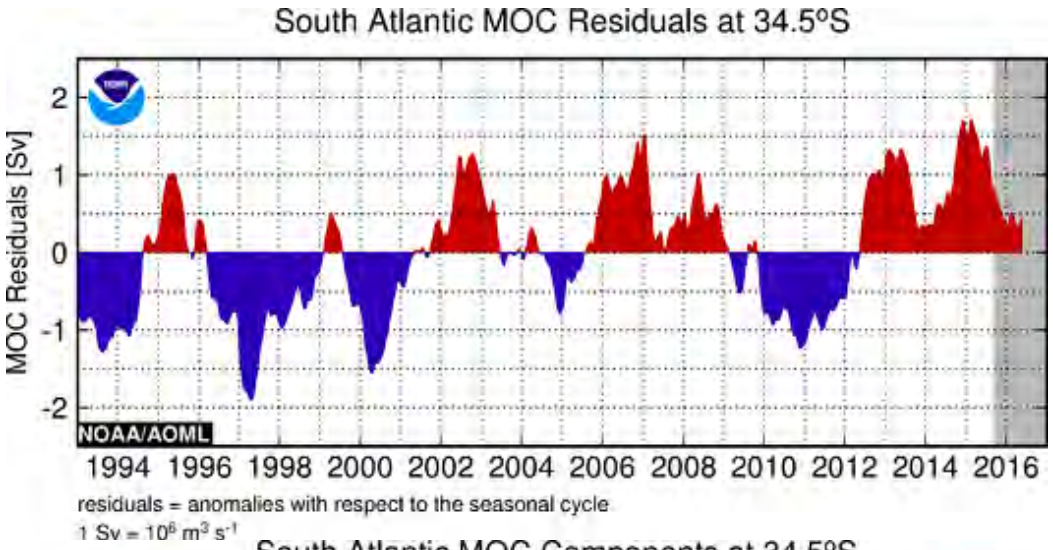
Objectives

Design, implement, and maintain XBT observations that provide a long record of temperature sections along fixed repeat transects to assess the state of the ocean and to:

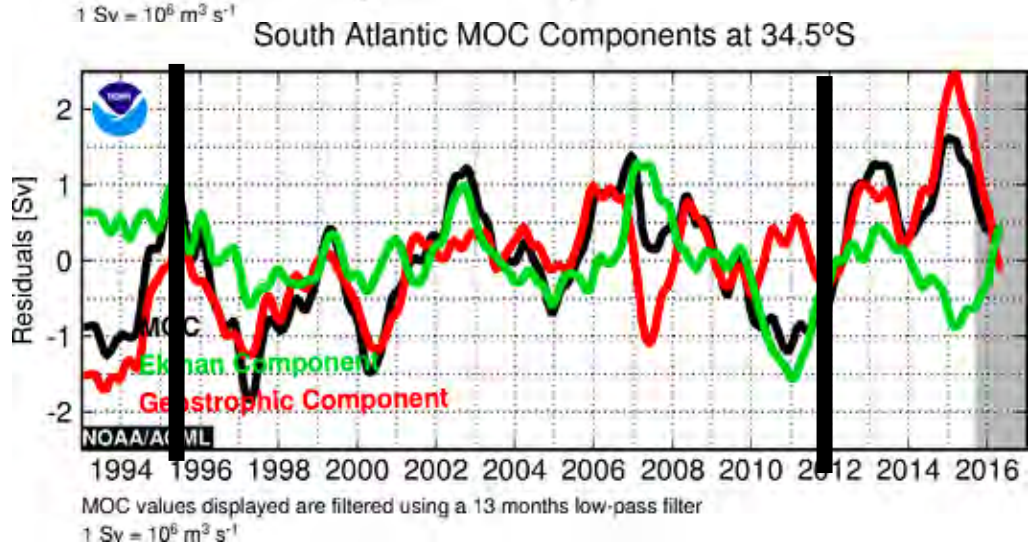
- Monitor **ocean heat transport**;
- Monitor **variability of key ocean boundary, surface, and subsurface currents**;
- Provide upper ocean temperature profiles for **ocean heat content** and for areas where otherwise there are no other profile temperatures (e.g. divergence zones, shelf observations for TCs,…) ;
- Provide observations to continue building a better **climatological record** and initialize **numerical forecast models**;
- Provide temperature section observations to other **complementary observing platforms**; and
- Provide expertise and **logistics for deployment of other observational platforms.**

Achievements: South Atlantic MHT at 35°S





At 35S
MOC mostly negative before 2001
MOC mostly positive after 2001



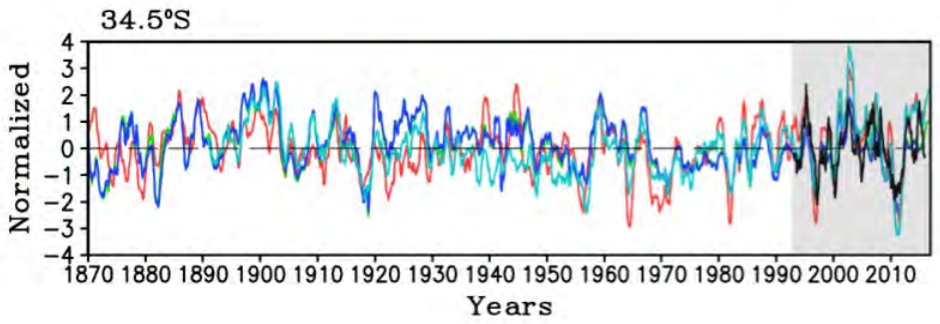
At 35S
MOC dominated by Geostrophy until 1995
MOC dominated by Ekman until 2011
MOC dominated by Geostrophy since 2011

Geostrophic **Ekman** **Geostrophic**

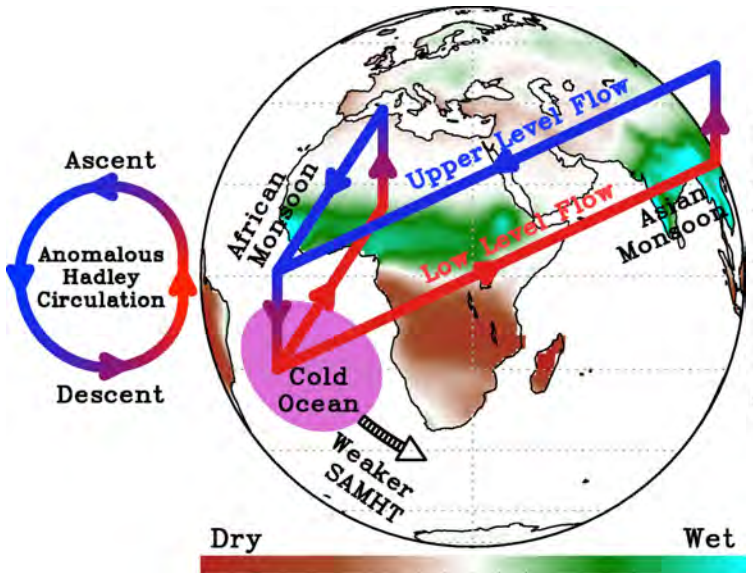
Dong et al., 2015

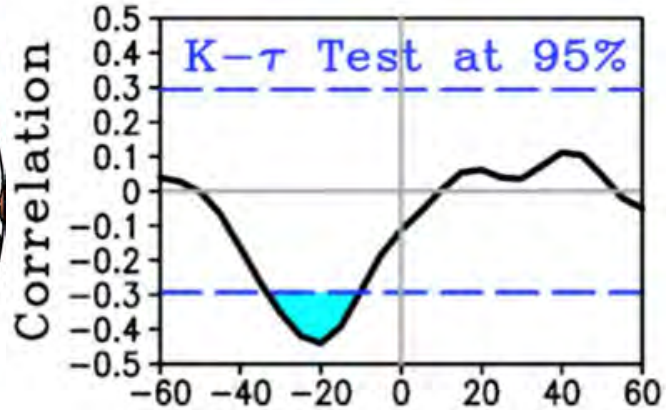
Dong et al. (2015)

Achievements: South Atlantic MOC Reconstruction and Global Monsoon Rainfall



Four century-long SST products used to reconstruct a century long MOC in the South Atlantic.





Weak SAMHT leads to negative heat content anomaly at 20 years lead time.

Forcing an anomalous Hadley circulation bringing moisture to the NH and heat towards the SH.

Leading to atmospheric heat flux convergence (divergence) in the NH (SH), reinforcing ascent (descent) motion.

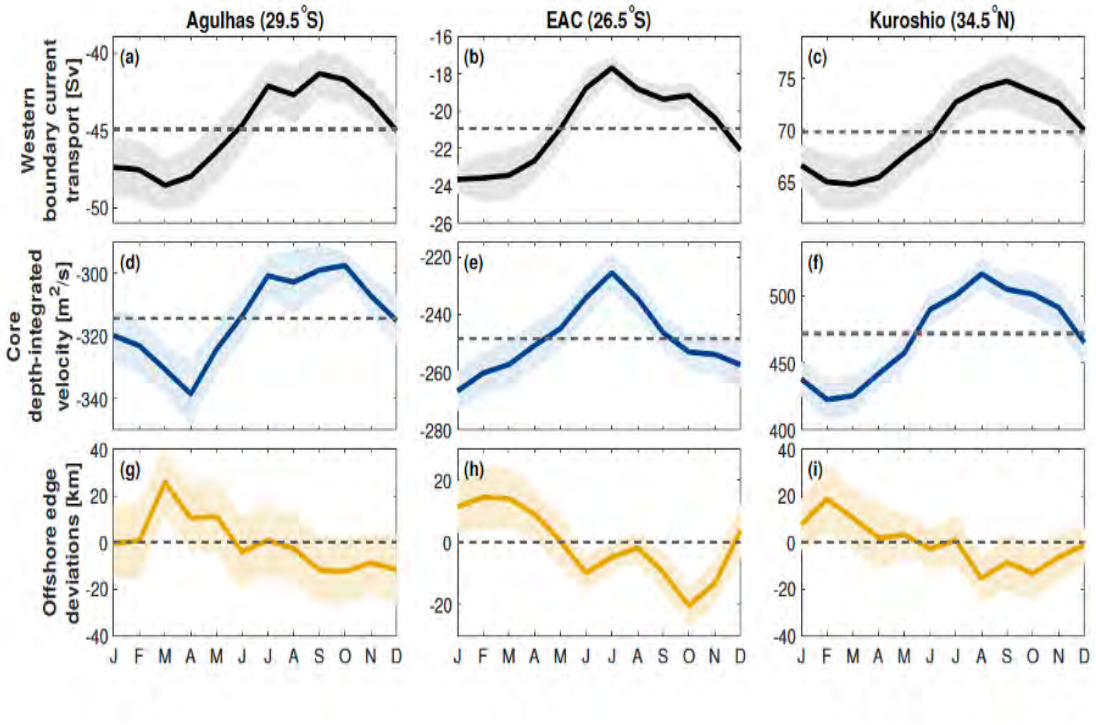
Which in turn produces **stronger** (weaker) NH (SH) monsoon rain.

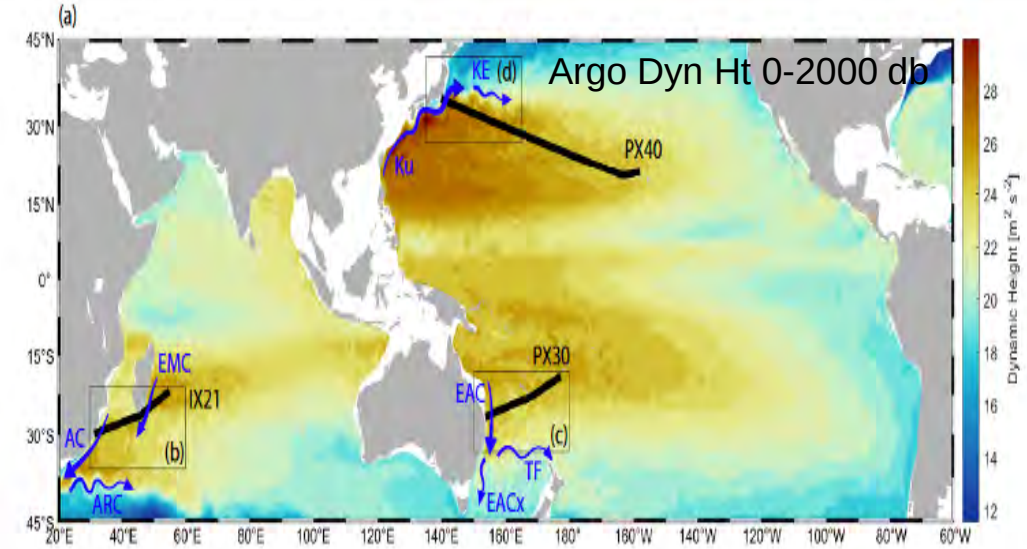
Key Results: A reconstructed century long SAMOC time series allowed to find physical links between heat transport in the South Atlantic and global monsoons. Correlation between MHT at 35S and rainfall due to monsoons, supported by physical analysis, indicate that strong MHT in SA leads (~15 years) to weaker global monsoon-linked rainfall

Lopez, H., et al (2017): A reconstructed South Atlantic Meridional Overturning Circulation time series since 1870. *Geophysical Research Letters.*

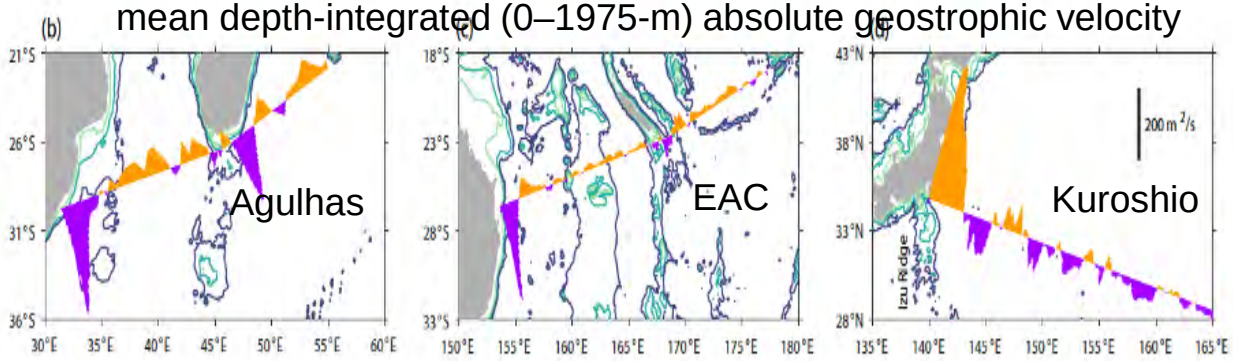
Achievements: Observing Western Boundary Current Variability

- Combining observations from HR-XBT, Argo and altimeter allows estimation of WBC variability from 0–1975-m over 2004–2019.
- Transport in all three WBCs is greatest in summer and related to coincident changes in core speed and not width of the current



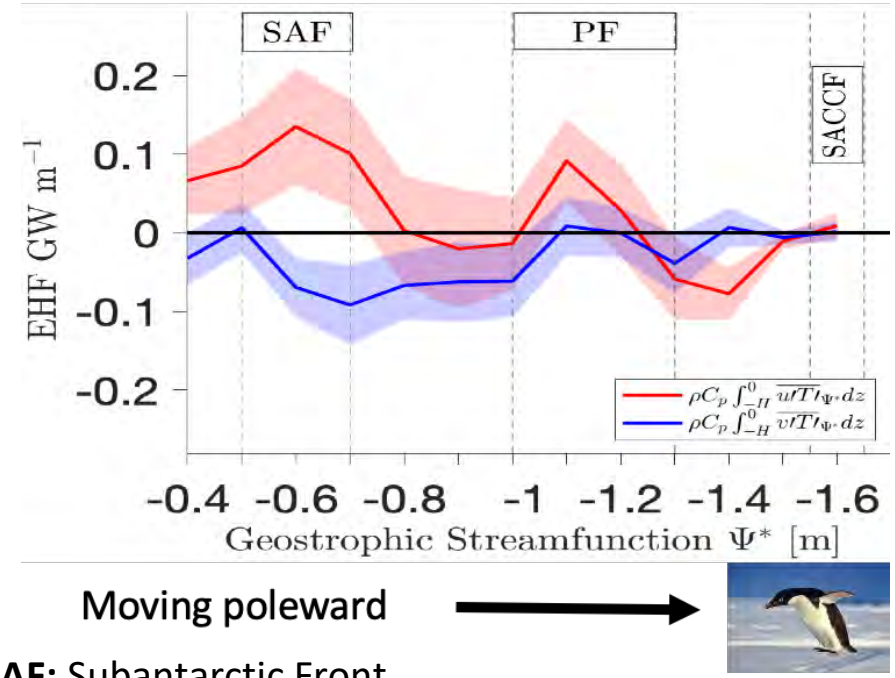


mean depth-integrated (0–1975-m) absolute geostrophic velocity



Chandler, M., N. V. Zilberman and J. Sprintall (2022). Geophysical Research Letters

Achievements: Eddy heat flux across the Antarctic Circumpolar Current



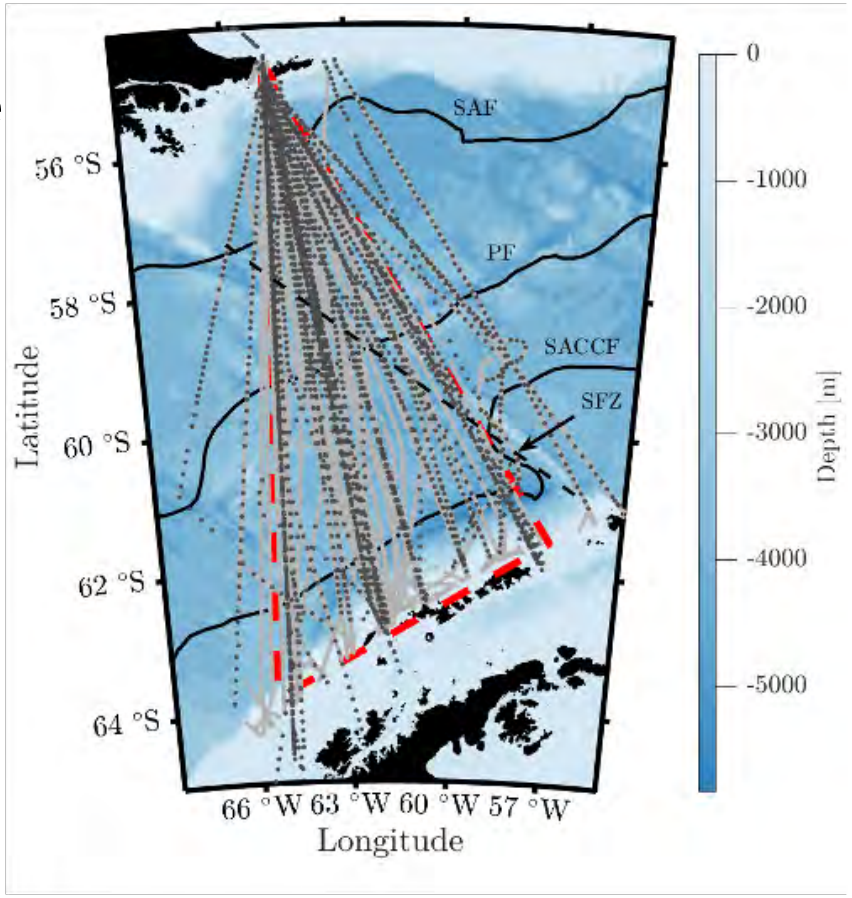
Moving poleward

SAF: Subantarctic Front

PF: Polar Front

SACCF: Southern ACC Front

Concurrent temperature (AX22 XBT Transects) and ADCP velocity transects since 1999 enable the first observational analysis of repeat estimates of eddy heat flux in the ACC



Across-stream depth-integrated (0-800 m) Eddy Heat Flux is largest poleward in SAF, but is continuously poleward from the SAF through the PFZ, tapering to insignificant in the PF.

Gutierrez-Villanueva, M. O., T. K. Chereskin and J. Sprintall (2020). *Journal of Physical Oceanography.*

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XBT Project Review
July 2022

Strengths of the XBT Network

1. Operations are driven by scientific questions.

2. Maintain repeated surface and subsurface temperature profile observations along fixed transects across strong currents, providing data not reproduced by other observational platform, and/or where other temperature observations are scarce or nonexistent.

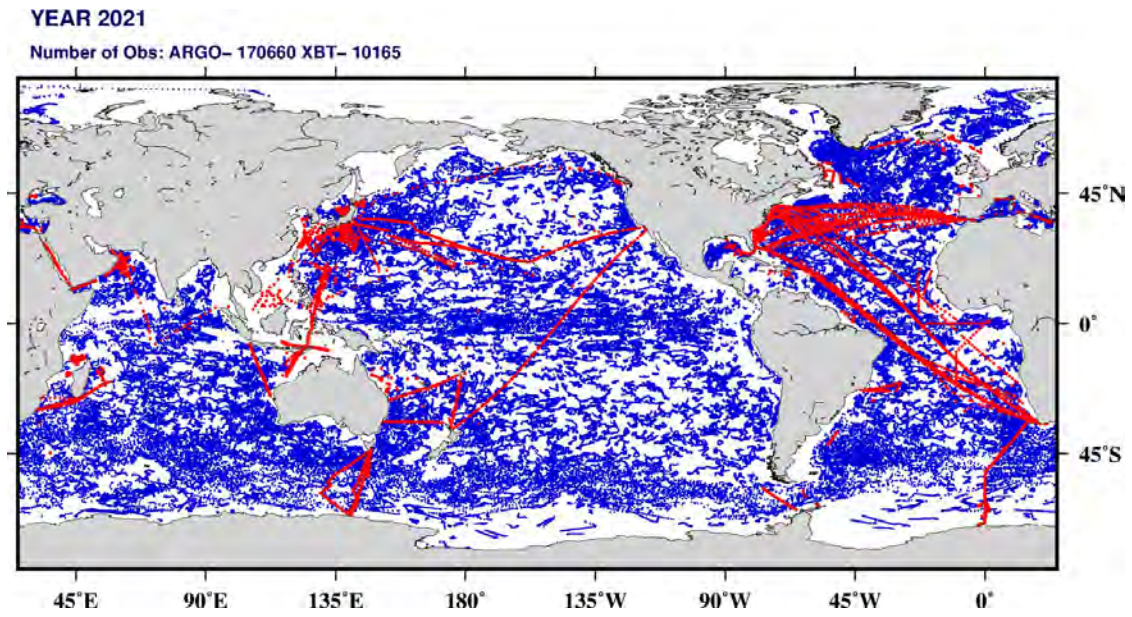
3. Key contributor to the historical temperature profile record, with many transects providing data for longer than 10, 20, or even 30 years.

4. Can be implemented and maintained in a cost-effective fashion together with partners and collaborators.

5. XBT ships easy to outfit with additional ocean and atmospheric sensors to create key interdisciplinary records.

6. XBT ships provide a platform for deployment of other observational instrumentations (e.g. drifters, floats).

Complementarity of XBT and Argo float Observations



Why XBTs in addition to Argo?

Argo provides global large scale T/S observations for:

- estimates of reference velocities for XBT transport computations;
- data to build historical T/S relationships.

XBT observations resolve mesoscale features along fixed transects which are not continuously observed by any other observing platform.

Estimates of XBTs Meridional Heat Transport improved by 20% when combined with Argo floats

Supplemental 1:
Observing the boundary current systems

Kuroshio (2 transects)

Gulf Stream (4)

Agulhas Current (2)

Atlantic Equatorial current system (1)

Brazil Current (2)

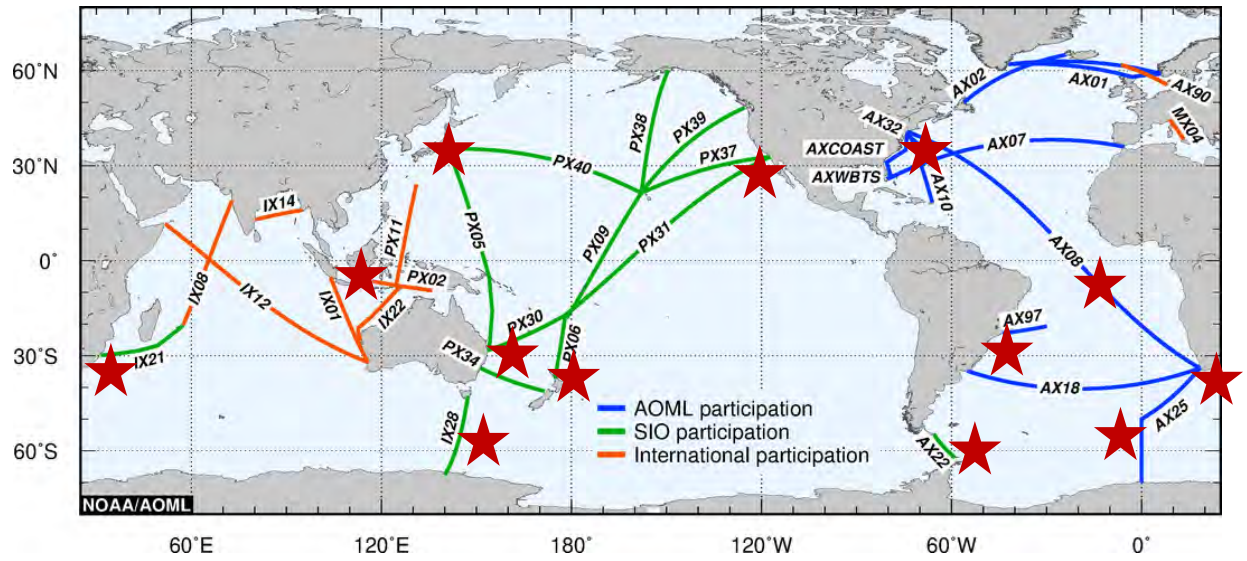
East Australian Current (2)

East Auckland Current and Tasman Outflow

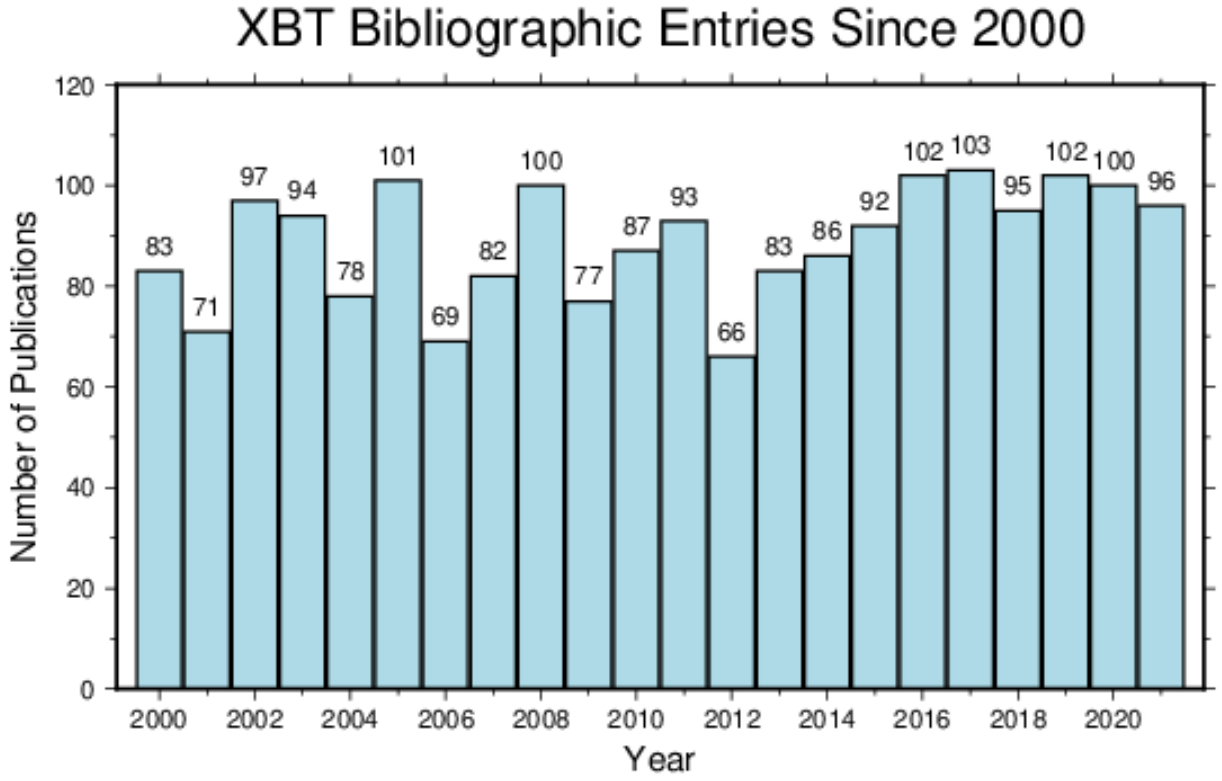
Eastern boundary currents (California Current, Alaska Current, Leeuwin Current, …)

Low latitude WBCs: Solomon Sea, Indonesian Throughflow (1)

Antarctic Circumpolar Current (3)



Supplement 3:
XBT Publications
Communicating the state of the ocean



1000+ Manuscripts using Global XBT data

400+ Different authors

120+ Different affiliations from 30+ countries

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