State of the Climate: Quarterly Reports on the Meridional Heat Transport in the Atlantic Ocean

PIs: M. Baringer[1], S. Garzoli[2,1], G. Goni[1], and Shenfu Dong[2,1]
[1]NOAA Atlantic Oceanographic and Meteorological Laboratory, Miami, FL
[2]University of Miami, Miami FL

This project supports the development of a methodology to estimate heat transport variability using data collected along two high density expendable bathythermograph (XBT) transects operated by NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML), satellite data (altimeter and scatterometer), wind products from the National Center for Environmental Prediction (NCEP) reanalysis, and products from general circulation models. Quarterly reports estimates of meridional oceanic heat transport in the center of the subtropical gyres in the North and South Atlantic are posted on the AOML website.

Recent results

Estimates of the heat transport across the North and South Atlantic continue to be posted on the AOML website, typically within two months of the completion of any given cruise.

This year the meridional heat transport (MHT) in the South Atlantic was highlighted in three publications:

- Dong et al. (2014) examined observations from AX18 that suggest that the geostrophic transport plays an equal role to the Ekman transport in the AMOC seasonal variations at 34°S. This is different from the predominant control of the Ekman transport on the AMOC seasonality in the coupled climate models in the South Atlantic. Our results indicate that model biases in both the geostrophic and Ekman transports contribute to this difference. Compared to the observations, the models show stronger seasonal cycles in the Ekman transport and weaker seasonal cycles in the geostrophic transport.
- Baringer et al. (2014) extended this time series through 2013 and compared it to the ECCO2 state estimation model.
- Macdonald and Baringer (2013) compared the 35°S XBT derived meridional heat transport estimates to the estimates at 26°N and 41°N.

Ongoing analysis includes estimating the differences between *in situ* heat transport estimates and model-based estimates. In additional we are extending observational estimates to include satellite derived synthetic XBT profiles and hence longer monthly time series estimates along 20°S, 25°S, 30°S, and 35°S back to 1992.

An expansion of this program could include the analysis of all *in situ* data (not just XBT data) to determine the physical processes involved in meridional heat and mass transport throughout the Atlantic Ocean.

Online data

Heat transport estimates: http://www.aoml.noaa.gov/phod/soto/mht/index.php
XBT data: http://www.aoml.noaa.gov/phod/hdenxbt/index.php

Bibliography

Baringer, M. O.,W. E. Johns, S. Garzoli, S. Dong, D. Volkov, W. R. Hobbs, and J. Willis, 2014: [Global Oceans] Meridional Oceanic Heat Transport in the Atlantic Ocean, [in "State of the Climate in 2013"]. *Bull. Am. Meteor. Soc.*, **95** (6), S69-S71, doi:10.1002/2014EO060001.

Dong, S., M. Baringer, G. Goni, C. Meinen, and S. Garzoli, 2014: Seasonal variations in the South Atlantic Meridional Overturning Circulation from observations and numerical models. *Geophys. Res. Lett.*, **41,** 4611-4618, doi:10.1002/2014GL060428.

Macdonald, A., and M. Baringer 2013: Ocean heat transport. *Ocean Circulation and Climate: A 21st Century Perspective*, G. Siedler, S. M. Griffies, J. Gould, and J. A. Church, Eds. International Geophysics Series, Volume 103, Academic Press, 759-785.

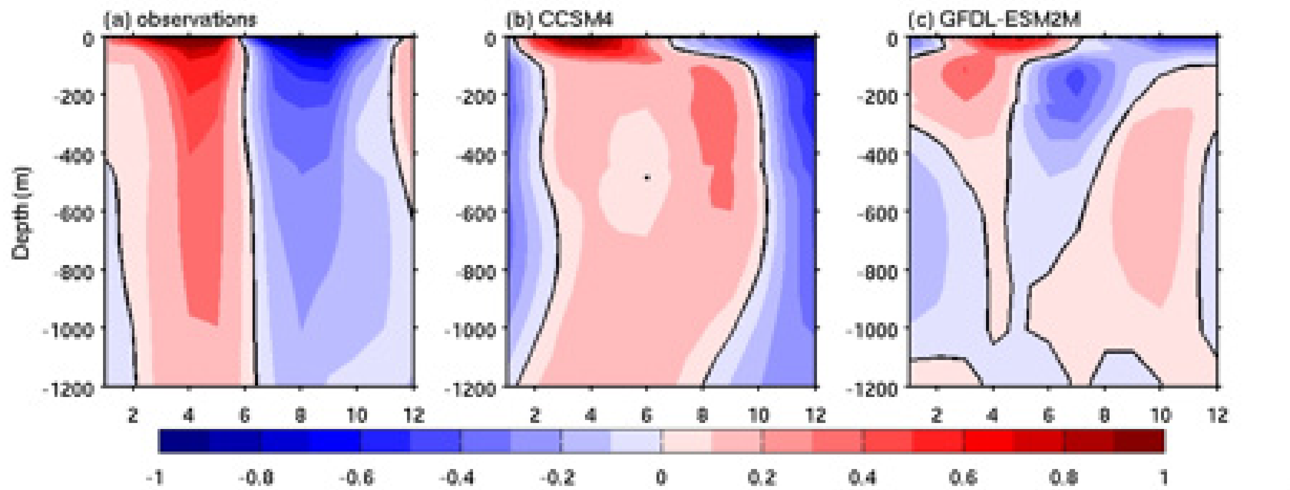

Figure 1: Month and depth distribution of zonally averaged meridional velocity along 34°S in the upper ocean computed from (a) observations and two CMIP5 models (b) CCSM4 and (c) GFDL-ESM2M. Time-mean values at each depth have been removed to better demonstrate the seasonal variations. Units are 10^{-3} m/s. One factor behind the strong seasonal cycle in the geostrophic transport from the observations is associated with the vertical coherence in the velocity signals below the mixed layer. The models lack this vertical coherence, showing strong baroclinicity below the surface mixed layer, yielding out-of-phase variations that sum to a very weak annual cycle in the geostrophic transports in the models.