Meridional Overturning Circulation and Heat Transport Array / Rapid Watch Climate Change Program

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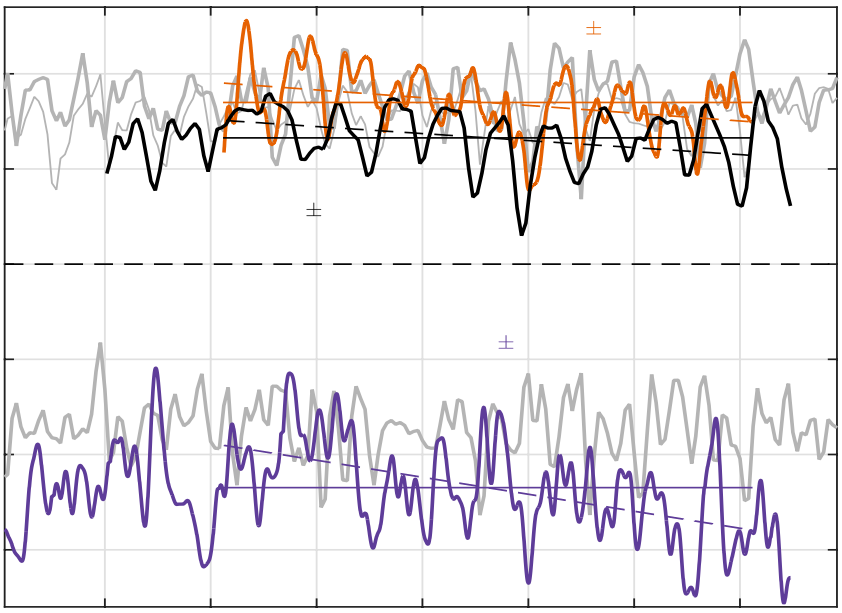
"An outstanding problem in the oceanic sciences is the rate of heat and freshwater transport from the equator to the poles, for it is this transport which powers the Earth's weather and climate system." Keffer and Holloway, Nature (1988).

The Meridional Overturning Circulation (MOC) and Heat-flux Array (MOCHA) is a collaborative project, partnered with the Rapid Watch Climate Change Program (UK RAPID), to measure the MOC and ocean heat transport in the North Atlantic Ocean (see figure). These transports are primarily associated with the thermohaline circulation. Simply put, warm waters move poleward at the surface of the ocean, where they cool and sink, to return equatorward in the deep ocean. Climate models suggest that the MOC in the Atlantic, and the accompanying oceanic heat flux, vary considerably on interannual time scales. In addition to abrupt climate change scenarios in which the MOC can virtually shut off (Manabe and Stouffer, 1993; Vellinga and Wood, 2002), the "natural" interdecadal variation may range from 20% to 30% of its long-term mean value, according to some models (e.g., Hakkinen, 1999). However, until recently no direct measurement system had been put in place that could provide regular estimates of the Meridional Overturning Circulation to determine its natural variability or to assess these model predictions. Such a system is now deployed along 26.5°N in the Atlantic as part of the joint U.K./U.S. RAPID-MOCHA program, which has been continuously observing the MOC since March 2004.



Estimates of Atlantic Ocean meridional overturning circulation from the Argo/Altimetry estimate at 41°N (black; Willis 10), the RAPID-WATCH/MOCHA/WBTS 26°N array (red; McCarthy et al. 2015), and the German/NOAA MOVE array at 16°N (blue; end et al. 2011) shown versus year. All time series have a three-month second-order Butterworth low-pass filter applied. Horizontal lines are mean transports during similar time periods as listed in the corresponding text. Dashed lines are trends for each series over the same time period. For the MOVE data, the net zonal and vertical integral of the deep circulation represents the lower limb of the MOC (with a negative sign for southward flow) and hence a stronger negative southward flow represents an increase in the MOC. The light grey lines show the ECCO2-derived transports: (top) thin grey is the 41°N transport, thick grey is the 26°N transport, (bottom) shows the negative meridional overturning circulation in the model for ease of comparison with the 16°N