Western Boundary Time Series

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Project Summary

This project continuously monitors two important components of the thermohaline circulation in the Subtropical North Atlantic with the ultimate goal of determining the state of the overturning circulation and providing a monitoring system for rapid climate change and hence addresses the program deliverable on "ocean heat content and transport". The components include the northward flowing Florida Current and the southward flowing Deep Western Boundary Current. The Florida Current is the warm surface intensified flow that represents the bulk of what we call the upper limb of the thermohaline circulation (or meridional overturing circulation, MOC) in the subtropical Atlantic. Over the past 30+ years the program has worked to measure both the warm upper and cold lower limbs of the MOC near the western boundary of the Atlantic Ocean at 27°N and is the longest time series of the flow that makes up the MOC available globally.

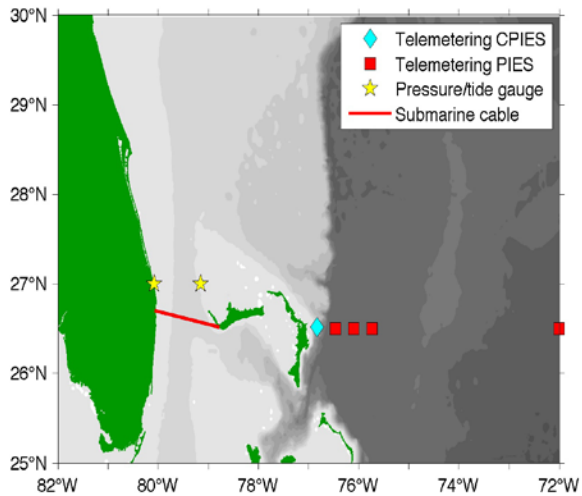

Figure 1: *Summary locations of continuous time series components of the Western Boundary Time Series program. Inverted echo sounder with pressure gauges (PIES), inverted echo sounders with pressure and current velocity (CPIES), pressure gauges and the submarine cable all provide daily estimates of the strength of the Western Boundary Currents components of the MOC.*

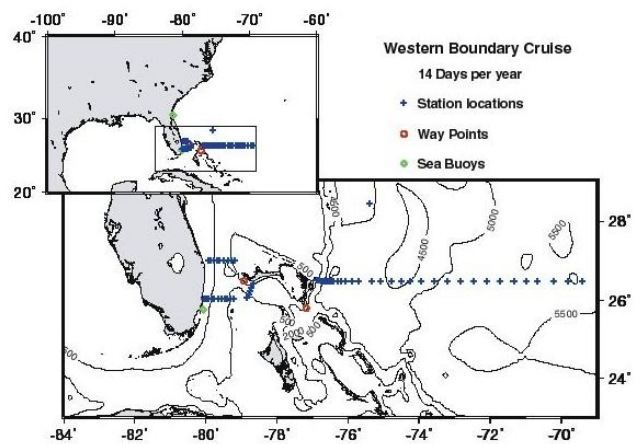

Figure 2: *Summary locations of discrete hydrographic and dropsonde locations from the Western Boundary Time Series program. All station locations are occupied with full water column samples at least annually. The stations along 27N in the Florida Straits are occupied during the quarterly Walton Smith and approximately bi-monthly small boat cruises.*

The project maintains NOAA's well-established and climatically significant Florida Current volume transport time series. Daily mean voltage-derived transports have been obtained for the Florida Current using out-of-service and in-use cables spanning the Straits of Florida since 1982. The cable voltages can be converted to physically meaningful transport estimates i.e., intensity of the flow, using electromagnetic induction theory. The correlation of Florida Current transport variability with the climate relevant phenomena has been documented in numerous published scientific studies. These

strong correlations link the Florida Current transport with significant weather changes, climate phenomena and large-scale ocean-atmosphere patterns in the Atlantic, including decadal and inter-decadal variations in fisheries, rainfall, and hurricane activity.

The repeated hydrographic and tracer sampling of the Deep Western Boundary Current (DWBC) collected by this project has established a high-resolution, high quality record of water mass properties east of Abaco Island Bahamas at 26.5ºN. Events such as the intense convection period in the Labrador Sea and the renewal of classical Labrador Sea Water in the 1980s are clearly reflected in the cooling and freshening of the Deep Western Boundary Current waters off Abaco with the arrival of a strong chlorofluorocarbon pulse approximately 10 years later. This data set is unique in that it is not a single time series site but in instead a time series of transport sections, including high quality water property measurements, of which very few are available in the ocean that approach even one decade in length. This element includes cruises across the DWBC to measure the water mass properties and transports. With the cooperation of University of Miami researchers (Drs. Johns and Beal) and funding from the National Science Foundation for the Meridional Overturning Circulation and Heat transport Array (MOCHA), as well as sharing of personnel and ship-time resources, these cruises have been conducted as much as twice each year since 2004.

Components of the observing system include continuous real-time cable measurements of Gulf Stream transport, cable calibration cruises including eight to ten small boat dropsonde cruises and quarterly Walton Smith hydrographic and velocity cruises in the Florida Straits, annual full depth hydrographic cruises across the Deep Western Boundary Current and beginning in 2004 continuous moored measurements of the deep transports using inverted echo sounders. Figures 1 and 2 show the location of the various components of the observing system.