

**A proposed program to sample variability of the water properties, stratification and circulation in the Northwest Atlantic and developing techniques for sustained ocean observations.**

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The circulation of the Northwest Atlantic Ocean at mid-latitude involves poleward transport of warm water by the Gulf Stream and equatorward flow of colder intermediate and deep waters. Comprehension of how these limbs of the global current system and their associated regional recirculations vary on decadal time scale is incomplete; that of the causes and consequences of such circulation changes is inadequate. Limiting advance in understanding is the lack of long, well resolved records to document interannual signals in water properties, stratification and transport of the Gulf Stream and Deep Western Boundary Current (DWBC) systems anywhere north of the Florida Strait/Abaco region. Importantly, anomalies created at subpolar latitudes may be profoundly altered or even blocked by the Gulf Stream. Conversely, subpolar anomalies may influence the position/strength/stability of the Stream, and in turn affect patterns of air-sea exchange throughout the North Atlantic. Indeed, a composite of historical observations between the continental shelf break south of New England and Bermuda hint at dramatic changes in the DWBC, the Gulf Stream and its southern recirculation that may be associated with variations in regional air-sea interactions and water mass modification. But from this cobbled record it is also clear that the community has already missed the opportunity to adequately sample the evolution of a recent, major climate anomaly: the period of enhanced Labrador Sea convection that occurred in the early 1990's.

We propose to rectify this observational gap by initiating a measurement program south of New England along a line from Woods Hole to Bermuda that coincides with a TOPEX/JASON altimeter satellite ground track. Moored observations will be made of temperature, salinity and velocity that resolve the DWBC on the continental slope and bracket the meander envelope of the Gulf Stream, and a hydrographic/velocity/tracer section from the New England shelf to Bermuda (site of the long-running Bermuda Atlantic Time Series Station and Hydrostation S: BATS/S) will be occupied annually.

The slope array (that encompasses Station W) will quantify changes in DWBC water properties, stratification (potential vorticity) and transport. The Stream-bracketing moorings, together with altimetric-based sea level estimates, will index total geostrophic transport changes in the Gulf Stream. In similar spirit, combination of our southern mooring, BATS/S and the altimeter will index the southern recirculation.

Spatially well resolved transport estimates will derive from the annual cruises, setting a context for the above indices. A subset of the moored observations will be made available in real time for assimilation studies and float calibration. The full data set will be made available as instrumentation is recovered for model validation and study of regional processes by any interested investigators. In addition to raw observations, value-added products such as time series of core properties and transport by water mass, and the geostrophically-leveled geoid along the track will be produced and distributed.

We will encourage other researchers to build on our infrastructure to augment the fields being sampled. Equally important, we will explore whether a subset of our proposed array is sufficient to index water property and transport variations in this area, setting the stage for a long-term ocean observing system.

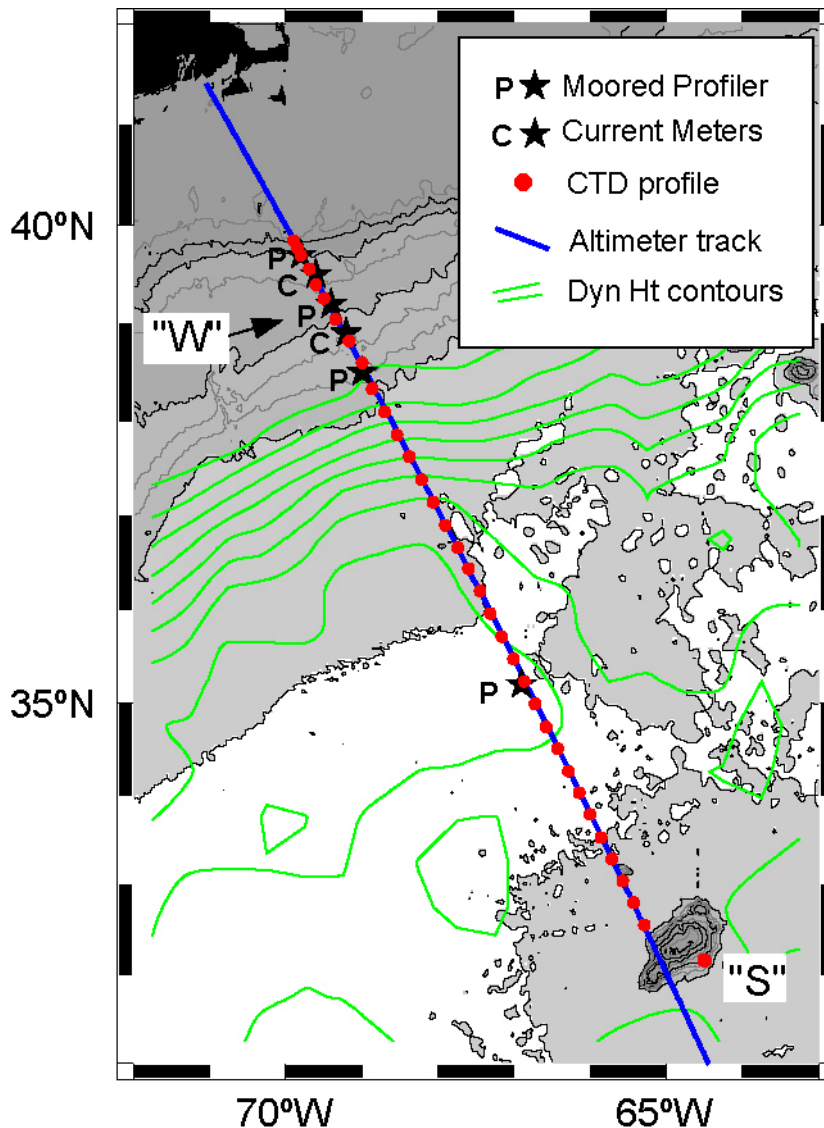


Figure 1. Basic components of a long-term observational system which we have recently proposed for the Gulf Stream and Deep Western Boundary Current (DWBC) south of New England. The proposed instrumentation includes a moored array across the DWBC (black stars: 2 current meter moorings and 3 profiling ctd moorings equipped with bottom pressure sensors and temperature/ADCP recorders) and a fourth moored profiler to be located south of the Gulf Stream near the peak of the subtropical sea surface height "dome". At least one of the moored profilers (but eventually two) will be equipped with telemetering capabilities to relay data back to shore in real time. All the moorings are located along an altimeter track denoted by the blue line in the figure. An annual hydrographic line will be occupied along the same line: red dots indicate positions of CTD/O<sub>2</sub> casts which will include 24-bottle rosette sampling for salinity/oxygen/cfc/he/tu, LADCP (lowered ADCP) and SADCPC (underway shipboard ADCP). Ongoing time series measurements near Bermuda (BATS and Station S) will anchor the seaward side of the proposed array with sampling that is quite sufficient to resolve low frequency baroclinic adjustments of the gyre interior.

This suite of sustained ocean measurements, when combined with altimeter-based SSH and SST measurements, will address several critical issues pertaining to ocean transports of mass, heat, and freshwater in the North Atlantic and their amplitude/phase relationships with atmospheric climate variability. Our immediate and long-term goals include the following:

- provide annual absolute mass and property transport estimates of the Gulf Stream and its recirculations between Woods Hole and Bermuda, derive the geoid on this track, and thus produce absolute cross-track surface geostrophic velocity and net geostrophic transports every 10 days.
- document the time-varying properties and stratification of the waters over the continental slope south of New England, estimate the net southward transport of the NADW components inshore of the Gulf Stream with monthly resolution (averaging over topographic Rossby wave frequencies).
- acquire and provide to the community real-time, full-depth T/S/velocity data that resolve tidal, topographic and eddy motions from sites in the Slope Water and the Sargasso Sea just south of the Gulf Stream.
- construct a time series of anthropogenic transient tracer concentrations in the DWBC and GS systems to explore the relationships among water mass renewal rates, boundary current transport and signal propagation speeds, as well as between potential vorticity and non-dynamical tracer anomalies.