Significant Findings of the BATS Program

- **Mesoscale eddies** are a significant physical feature in the quadrant of the Sargasso Sea where BATS samples.
  **Implications:** Eddies are contiguous physical features that propagate through the area of the BATS study site and, as such, impart an additional level of variability on many of the parameters that we measure on a monthly basis. There are several types of eddies and they are broken into two groups depending upon whether they raise seawater density layers closer to the surface, thereby bringing nutrients into the sunlit region of the ocean, or depress seawater density layers. Both of these eddy types have significant, but poorly understood, impacts on phytoplankton community structure and the sequestration of carbon in the ocean interior.

- **A multi-year increase in CO₂ concentrations** in the surface ocean has now been conclusively documented.
  **Implications:** At the beginning of BATS, it was hypothesized that inorganic carbon dioxide concentrations in the surface ocean would increase as the concentrations increased in the atmosphere, but detection of this increase would be "masked" by the large seasonal changes in carbon dioxide. Fourteen years of high-quality measurements have now shown that surface carbon dioxide concentrations are, in fact, increasing. How the biological system will respond to this increase, however, is much less clear. Different phytoplankton groups have different affinities for carbon dioxide and also have varying efficiencies with which they remove this carbon into the ocean interior.

- **Dissolved organic carbon (DOC)** is now quantified as the largest exchangeable carbon pool in the ocean and, at BATS sites, has been shown to be a seasonally important carbon sequestration term.
  **Implications:** Beyond DOC, dissolved organic nitrogen (DON) and phosphorus (DOP) pools are the largest pools of nitrogen and phosphorus in the surface ocean. Understanding how all of these organic elemental cycles vary with respect to each other has a significant impact on not only the long-term storage of DOC but also potentially the assimilation of carbon dioxide.

- After 14 years of data collection, we can now show there are links between major biogeochemical parameters in the Sargasso Sea and low-frequency climate patterns, such as the El Niño-Southern Oscillation (ENSO) and North Atlantic Oscillation (NAO).
  **Implications:** Physical processes at a variety of temporal and spatial scales concurrently impact biogeochemical cycling of key elements in the ocean. With regard to global change (i.e., long-term changes), the oceans can be thought of in terms of regional provinces (e.g. the North Atlantic subtropical gyre of which the Sargasso Sea is part) that are impacted by regional, low-frequency physical
forces, such as the North Atlantic Oscillation that governs long-term climate in the North Atlantic. So, although each year in the northern temperature latitudes is characterized by a seasonal cycle, the NAO (in part) determines the extent to which winters can be warmer or cooler than the average. An understanding of how these low-frequency physical forces impact biogeochemical cycling is key to predicting future changes within the ocean.