

(e.g., Biowatt, Marine Light in the Mixed Layer, Coastal Mixing and Optics, HyCODE; see references on www.opl.ucsb.edu). Here we highlight results from three distinct oceanographic domains: subtropical gyres of the North Atlantic and North Pacific Oceans, the Arabian Sea, and the equatorial Pacific Ocean. We have selected these as case studies because they portray several different and important physical and biogeochemical processes as well as sharing some in common. It should be emphasized that the results described below were enabled by major breakthroughs in platform and interdisciplinary sensor and system technologies including those described earlier.

3.1 BERMUDA TESTBED MOORING AND HALE-ALOHA MOORING PROGRAMS

The JGOFS Bermuda Atlantic Time-series Study (BATS) and the Hawaii Ocean Time-series (HOT) programs, established in 1988, have been used extensively to observe, quantify, and model temporal variability of the biogeochemistry and ecology of the oligotrophic oceans off Bermuda in the North Atlantic and off Hawaii in the North Pacific, respectively (e.g., Karl et al., 2001; Deep-Sea Research II, 43(2-3), 1996; 48(8-9), 2001). The ship-based studies along with complementary mooring observations document seasonal effects quite well. The BATS site is characterized by quite strong seasonal variability in physics (Figure 5) and biogeochemistry whereas the seasonal effect is subtler at the HOT site (located at a lower latitude than BATS), which is perhaps, influenced relatively more by interannual variability. Both sites will likely serve as bellwethers for decadal oscillations as their records continue; already hints of influences of interannual and decadal variability have been reported (Karl et al., 2001). Traditional shipboard sampling at two or, more commonly, four week intervals has been used as the primary data collection methodology for these two programs. Since this observational mode cannot capture important phenomena with characteristic time scales from minutes to a month, high frequency, long-term, autonomous mooring observations were established first using the Bermuda Testbed Mooring (BTM; Dickey et al., 1998a, 2001) near the BATS and Ocean Flux Study (OFF; e.g., Conte et al., 2002) sampling sites in 1994 and in 1996 using the HALE-ALOHA mooring near the HOT site (Letelier et al., 2000). These programs have clearly shown the importance of several processes, which cannot be resolved by bi-weekly or monthly shipboard sampling (see Figures 5 and 6).