tially varying shelf slope front just offshore from our observational site [e.g., *Barth et al*., 1998; *Linder and Gawarkiewicz*, 1998], (2) strong vertical variability in water column currents and physical and bio-optical properties, and (3) mesoscale variability forced by advection of warm core eddies, jets, filaments, meanders, etc., onto the shelf [e.g., *Pickart et al*., 1999]. Temporal variability derives from (1) distinct seasonal cycles in hydrography [*Flagg*, 1987] and primary productivity [*O'Reilly et al*., 1987], (2) a prominent semidiurnal tidal cycle [*Brown and Moody*, 1987], (3) internal gravity waves and small-scale mixing events associated with internal solitary waves [*Colosi et al*., this volume; *Wang et al*., this volume], high current shear, and atmospheric forcing, (4) episodic frontal movements [*Pickart et al*., 1999], and (5) strong wind forcing associated with storms [e.g., *Wright et al*., 1986; *Madsen et al*., 1993; *Wright et al*., 1994] and hurricanes [*Dickey et al*., 1998a; *Chang et al*., this issue; *Williams et al*., 2001].

The rate of primary productivity over the southern New England continental shelf is extremely high compared to the rest of the world's oceans. It has been reported to be 3 times the mean of the world's continental shelves and 10 times the rate of that of the open ocean [*Bourne and Yentsch*, 1987]. Shallow shelf waters and relatively high nutrient availability (from upwelling favorable conditions and recycling) all contribute to the high concentrations of chlorophyll, phytoplankton, nanoplankton, and those organisms higher in the food chain [*O'Reilly et al*., 1987]. Intense vertical and horizontal mixing and vertical and horizontal advection resulting from frontal activity also promote high primary productivity in the region.

The overall objective of our research is to determine the effects of physical forcing on particle and optical properties under various oceanic conditions on a continental shelf. Some of our specific objectives are to (1) quantify the variability of optical and physical properties on timescales from a few minutes to the annual cycle, (2) relate physical processes (as listed earlier) to optical variability, (3) make general distinctions among particle types and quantitatively partition their origins [*Chang and Dickey*, 1999], (4) relate optical and particle variability near the ocean bottom to physical processes affecting sediment resuspension [*Chang et al*., this issue], and (5) compare and contrast the present coastal results with analogous open ocean results.

We acquired an extensive set of unique observations of processes, such as internal solitary waves and their effects on bio-optics, bio-optical effects of the passage of two hurricanes, several water mass intrusions, and the evolution of the seasonal cycle in hydrography and phytoplankton biomass as inferred from chlorophyll *a* concentration [Chl *a*]. Our 11 month time series measurements of physical and bio-optical parameters also enables other CMO investigators to utilize high temporal resolution physical and bio-optical data relevant to their research, as most other studies focus on the details of specific events or disciplinary processes [see *Dickey and Williams*, this issue]. In addition, our data are used to quantify statistically physical and biological processes and their relationships and can be used for the development and testing of coupled physical-optical-biological, radiative transfer, and sediment resuspension and transport models and as inputs into data assimilation models to predict bio-optical responses to physical forcing. The present paper focuses on the description, quantification, and interpretation of temporal variability of physical processes and associated bio-optical responses on the Mid-Atlantic Bight (MAB) of the southern New England continental shelf over the period of July 1996 through June 1997. The experimental methods are presented in section 2. A description of the time series observations is provided in section 3. A summary of the physical and bio-optical relationships by statistical analyses is given in section 4. A comparison of our findings with those of analogous open ocean results is also presented in section 4.

2. Methods

The site of CMO was the "Mud Patch" of the MAB continental shelf, the southern portion of the New England shelf. The site is located ~110 km south of Martha's Vineyard, Cape Cod, Massachusetts, with a water depth of ~70 m (Figure 1). Newly developed oceanographic instruments were placed on a mooring and a bottom tripod at the CMO site (roughly 40.5°N, 70.5°W) to collect concurrently high-resolution time series of physical and bio-optical data at several depths (Tables 1, 2, and 3; Figure 2). Four mooring deployments were conducted from July 8, 1996, through June 11, 1997. The tripod was deployed ~400 m southeast of the mooring, also in 70 m water depth, from August 9, 1996, through June 11, 1997. Mooring and tripod turnarounds were done approximately every 3 months with 1–7 day breaks for mooring and tripod recovery and redeployment. Our observational study was coordinated with studies by other CMO investigators using shipboard, mooring, and satellite [*Thompson and Porter*, 1997] data sets to complement our measurements [see *Dickey and Williams*, this issue]. The data obtained during the mooring and tripod deployments were compared to profile and discrete bottle sample data taken from ships near the CMO mooring site (within ~200 m) during the first and fourth deployments as well as before and after each mooring turnaround.

2.1. Subsurface Mooring Physical Instrumentation

Several instruments were deployed on the subsurface mooring to measure physical properties and currents during the first deployment by the Oregon State University (OSU) group (Table 1). These instruments included temperature, salinity, and pressure sensors at several depths and an uplooking RD Instruments acoustic Doppler current profiler (ADCP; 300 kHz RDI Workhorse) at 65 m for currents binned every 4 m. A summary of OSU instrumentation details and sampling rates (intervals) is given in Table 1. For further instrumentation details, see *Boyd et al*. [1997].

Similar physical instruments were deployed on the subsurface mooring by the University of California, Santa Barbara (UCSB), group during the remaining three deployments of CMO. The UCSB instruments, depths of deployment, manufacturers, accuracy estimates, and sampling rates (intervals) are summarized in Table 2. All physical sensors utilized manufacturer's calibrations. Intercalibrations were performed by comparing mooring-derived temperature and salinity measurements to temperature and salinity profiles taken by W. S. Pegau (OSU, personal communication, 1997) and W. Gardner (Texas A&M, personal communication, 1997) between August 17 and September 7, 1996, and between April 23 and May 13, 1997 (green vertical dashed lines in Plate 1). Temperature and salinity time series were also compared to hydrographic properties measured by S. Lentz (Woods Hole Oceanographic Institution (WHOI), personal communication, 1997) from one of his nearby physical moorings. Meteorological data were also