biophysical parameters related to photosynthesis (e.g., quantum yield as affected by nutrient and light conditions). The pump and probe technique is being used in the development of an aircraft instrument as well (Yoder et al., 2001). Many of these optical instruments have been deployed from ships, moorings, and drifters. Thus, sampling with both high spatial and temporal resolution, comparable to those of physical parameters, is now possible. One of the common uses of *in situ* optical measurements has also been for groundtruthing and algorithm development of ocean color imagers (e.g., Dickey et al, 2002).

Other optical instruments, using the Fraunhofer light diffraction effect, have been used successfully to obtain particle size distributions. The Fraunhofer effect occurs when planar light passes through a small aperature or slit and changes direction (bent) or is spread out into finite lines (for slit aperture) or circles (for circular aperture). A different and extremely powerful optical technology, flow cytometry, has been successfully used onshore and onboard ships for counting and distinguishing particles and phytoplankton as well as for characterizing their optical properties. Work is advancing to miniaturize and ruggedize flow cytometers for deployment at-sea from buoys and AUVs. The time series obtained from many of the aforementioned *in situ* optical systems show remarkable variability associated with high frequency and episodic events as well as longer term processes. The interpretation of these time series is often difficult, because of the complex nature of the observed medium and organismal physiology. Thus, more effort in understanding these types of data will be essential. Nonetheless, some unexpected correlations have been noted (e.g., very high correlations between beam attenuation (660nm) and particulate organic carbon and between optical backscatter and particulate organic carbon; Bishop, 1999).

3. EXAMPLES OF BIOGEOCHEMICAL TIME SERIES STUDIES

Several times series experiments and programs have been devoted to studies of biochemical variability, particularly as it relates to physical forcing and processes, within approximately the past decade and a half (e.g., see reviews by Dickey, 2001a; Dickey and Falkowski, 2002). Several of these have utilized a multi-platform approach with interdisciplinary moorings serving as the primary means of obtaining high temporal resolution (sampling intervals on scales of minutes) data with durations of at least one year. Several of these have been done as part of the JGOFS program and earlier and subsequent Office of Naval Research programs