Within the past decade*, in situ* spectral absorption-attenuation meters have become commercially available (Moore et al., 1992; see Roesler and Boss, 2005). These instruments concurrently measure spectral absorption and attenuation coefficients at up to 90 wavelengths for spectral signatures of both particulate and dissolved material (WET Labs, Inc. ac-9 for nine wavelengths; Pegau and Zaneveld, 1993; Pegau et al., 1995, 1997; and WET Labs, Inc. ac-s for hyperspectral; Zaneveld et al., 2004). Seawater is pumped through two tubes. The inside of the beam c tube (c-tube) is flat black to minimize reflections whereas the absorption coefficient tube (a-tube) is reflective in order to maximize internal reflection to better estimate absorption. The spectral scattering coefficient is computed from ac-meter data by simply performing the difference $b(\lambda) = c(\lambda) - a(\lambda)$. Absorption-attenuation meter data and spectral decomposition models can be used to provide *in situ* estimates of phytoplankton, detrital, and gelbstoff absorption (Roesler et al., 1989; Bricaud and Stramski, 1990; Gallegos and Neale, 2002; Chang and Dickey, 1999; Schofield et al., 2004). Hyperspectral absorption-attenuation meters (ac-s) can in principle be used to isolate pigment peaks for HAB species identification (see Section X.5.2; Millie et al., 1997; Kirkpatrick et al., 2000; Chang et al., 2004).

Phytoplankton (HAB) biomass is often inferred from measurements of chlorophyll fluorescence (see Babin, 2005). *In situ* chlorophyll fluorometers generally employ stimulated fluorescence techniques, exciting phytoplankton with blue light and measuring its light emission in the red, e.g., excitation/emission (ex/em) wavelengths of, for example, 470/695 nm. Novel *in situ* fluorometers (e.g., WET Labs, Inc. ECOfl3) utilize different ex/em wavelengths to provide information about, for example: CDOM (ex/em = 370/460 nm), fluorescein for dye tracer studies (ex/em = 470/530 nm), or phycoerythrin for red cyanobacteria concentration (ex/em = 540/570 nm). These new spectral fluorometers are relatively small and lightweight and are commercially available.

Backscattering at several different wavelengths or angles can be measured using commercially available, operational instruments that are based on scattering theory and statistical relationships relating scattering at a given angle to the integral over the backward direction (Maffione and Dana, 1997; Boss and Pegau, 2001; see Roesler and Boss, 2005). Particle size distribution, mass concentration, shape, and composition (biological vs. detrital vs. sediment) can be estimated with backscattering and scattering properties, and the ratio of backscattering to scattering (Ulloa et al., 1994; Twardowski et al., 2001; Babin et al., 2003; Boss et al., 2004a,b; Roesler and Boss, 2005). *In situ* particle size distributions can also be measured using operational laser (Fraunhofer) diffraction instruments (Sequoia Scientific, Inc. LISST-100; Agrawal and Pottsmith, 1994). Modified versions of these instruments measure particle-settling velocities (Sequoia Scientific, Inc. LISST-ST), which are important for quantifying the vertical movement of phytoplankton. The backscattering and scattering properties of phytoplankton reveal information about cell size and index of refraction (Stramski et al., 2001), which can be used in conjunction with other IOP observations (absorption, scattering, and attenuation coefficients) to provide details about *in situ* phytoplankton populations, e.g., composition, size, morphology, and internal structure (Roesler and Boss, 2005). This additional information can help us understand more about the growth and distribution patterns of harmful algal species.

Some HAB species are dinoflagellates that are bioluminescent, meaning that they produce light by a chemical reaction that originates in the organism (e.g., Case et al.,