floats, using buoyancy changes to move vertically, have provided near real-time interdisciplinary data collected during their rise and descent through the water column (e.g., Mitchell et al., 2000; Bishop et al., 2003). The oceanographic data and Global Positioning System (GPS) data collected on drifters and floats are satellite telemetered after surfacing briefly at pre-specified times. Drifter data allow detailed examinations of interdisciplinary processes on short time and space scales and the evaluation of de-correlation scales of chlorophyll and physical variables (Abbott and Letelier, 1998), which is important for the development of observation systems and models. The disadvantages of these platforms are similar to those of moorings and bottom tripods – biofouling and limitations in size, weight, and power of instrumentation. An additional disadvantage of the use of drifters and floats in HAB studies is the presence of boundaries in the coastal ocean. Currents tend to transport these platforms offshore or onto beaches, away from HABs. However, drifters and floats may be useful for determining physical processes leading to the formation and cessation of HABs (see study by Tester and Steidinger, 1997), in addition to the chemical effects [e.g., particulate organic and inorganic carbon (POC and PIC) production] of HABs on regional oceanography (Bishop et al., 2003).

Autonomous underwater vehicles (AUVs), remotely operated vehicles (ROVs) and gliders

Recently, numerous programs have begun to exploit autonomous underwater vehicles (AUVs), remotely operated vehicles (ROVs), and gliders for coastal ocean scientific studies (Yu et al., 2002), with the potential for HAB research. A description of the history, and present and future capabilities of AUVs is provided by Griffiths et al. (2001); AUVs specifically for HAB research are discussed by Griffiths (2005). Modern capabilities of AUVs and ROVs have become possible because of the development of new oceanographic sensors and systems that are relatively small in size, consume moderate power, and can be interfaced to the AUVs, ROVs, and gliders. Dynamically diving AUVs are relatively small, lightweight, neutrally buoyant, and powered by batteries. Some of the advantages of these autonomous platforms include low cost per deployment, potential to sample in environments generally inaccessible to ships, good spatial coverage and sampling over repeated sections, capability of feature-based or adaptive sampling, and ability for deployment of several vehicles from moorings, ships, offshore platforms, and coastal stations. The primary disadvantage of AUVs and ROVs is related to its power consumption. AUVs and ROVs must be recharged regularly and hence, cannot be used for long-term deployments without a docking station. The glider concept uses variable buoyancy control, lift surfaces (wings), a hydrodynamic shape, and trajectory control using internal moving mass to control its motion and therefore does not draw as much power as an AUV or ROV. With typical forward speeds of 0.25 m s^{-1}, gliders may be used as long-term virtual moorings or for long transects (Davis et al., 2003). Schofield et al. (2003 and 2005) review sampling strategies and “smart” vehicles with respect to glider technology.

X.4 Sensor and system design of HAB monitoring and assessment programs

A long-term, interdisciplinary HAB program is necessary for monitoring and assessment of HAB development, persistence, and cessation. Data should be collected at timescales