2.5 AUVs AND GLIDERS

Autonomous underwater vehicles (AUVs) and gliders are rapidly emerging as valuable sampling platforms (e.g., Griffiths et al., 2001; Dickey, 2002a). AUVs are essentially robotic underwater submarines (varying in size and capabilities) that take advantage of breakthroughs in microelectronics, navigation, computer control systems, and in-water and in-air data telemetry. Gliders are essentially unpowered AUVs, with adaptive sampling control, that are designed to observe the ocean interior over long ranges. They use wings and hydrodynamic shape to induce horizontal travel from buoyancy control. The key elements enabling long-range glider missions are efficient buoyancy control, modest hydrodynamic performance, low-power electronics, on-board computing, satellite navigation, and two-way communication for near real-time data transmission and remote control. Gliders are limited by energy considerations to move through the ocean at speeds comparable to ocean currents and their transect sections are thus prone to aliasing. However, one creative way to use gliders is to control them so as to maintain their geographic position by stemming the ambient currents, and thus operating them as "virtual moorings."

Several recent activities have begun to exploit AUVs and gliders for scientific studies (e.g., Griffiths et al., 2000; Yu et al., 2002). This has become possible because of the development of new sensors and systems, which are relatively small in size, consume moderate power, and can be interfaced to the vehicles. Some of the key advantages of AUVs and gliders include cost per deployment, capability to sample in environments generally inaccessible to ships (e.g., in hurricane or typhoon conditions and under ice), good spatial coverage and sampling over repeated sections, ability to do feature-based or adaptive sampling, and potential deployment of several vehicles from moorings, mother ships, offshore platforms, and coastal stations. Creative uses of AUVs and gliders will involve networking and informational feedback loops to guide sampling programs (in some areas involving predictive models), and responses to extreme natural and anthropogenic driven events.

2.6 SENSORS AND SYSTEMS

Next we consider a few of the newer chemical and bio-optical sensors and systems that are relevant to biogeochemical studies.

2.6.1 Chemical Sensors and Systems Until quite recently, most ocean chemistry was done using water samples collected by ships with bottles at-sea. Laboratory methods using wet chemical techniques require