

of sampling large numbers of variables using relatively large vehicles or using highly rugged and capable deep-sea moorings. A second may use large numbers of smaller platforms or vehicles with fewer sensors, sacrificing the number of different sensors per platform and simultaneity of measurements. Each concept has advantages, and both could be used in complementary modes.

Telemetry: Shore-Based and Satellite-Based

PRESENT AND NEAR-FUTURE CAPABILITIES

Shore-based or satellite-based systems—and coaxial cable or fiberoptic cable links—can be used to telemeter data from open ocean moorings or other fixed location platforms (e.g., Dickey et al. 1993, 1998a; Detrick et al. 1999; Frye et al. 2000). Power can also be supplied via the coaxial cable method while both modes allow for high bandwidth transmissions. These cabling methods have great advantages, but can be quite expensive if cable networks are not already in place. Where direct link transfer is not feasible, data can be telemetered from moorings. Two steps are involved: (1) data can be sent from instruments at depth to a surface buoy and then (2) the data can be sent from the buoy to land stations using radio or satellite modes. Inductive modems have been used for subsurface transmission of data to the surface from moored instrumentation, with the mooring wire acting as the transmission element and by using subsurface acoustic modems. Telemetry of these data from surface buoys can be accomplished using line-of-sight radio frequency, cellular phone, or communication satellite transmissions (e.g., Dickey et al. 1993, 1998a). The radio frequency method works well for near-coastal applications, and relays can also be used to extend the range farther offshore. Open ocean telemetry requires dedicated communication satellites. Surface hardware for the communication of data is often commercially available. An excellent example of the power of data telemetry is the use of data transmitted from the TOGA-TAO array in the equatorial Pacific for ENSO predictions (e.g., McPhaden 1995; McPhaden et al. 2001).

TOWARD THE FUTURE

The amount of data that can presently be transmitted is quite limited because of bandwidth availability. Major programs are underway to expand bandwidth using large numbers of low earth orbit satellites. Cost per transmission is an important factor and will likely be prohibitive for some applications. For nearshore applications, data transmission may be accomplished