

## TOWARD THE FUTURE

The costs of drifters and floats are expected to decrease as more are produced and used. Emerging systems will be simplified and made more rugged to enable easy deployment from ships-of-opportunity and aircraft. Alternative deployment modes include preprogrammed and on-command releases of floats. New GPS and telemetry (including two-way duplex information exchange) capabilities will continue to improve position accuracy and increase the daily number of reported positions, resulting in greater computed current resolution and accuracy along with much greater volumes of data throughput. Within the past decade, a few oceanographers have begun to deploy optical and/or chemical sensors from drifters and floats (Abbott et al. 1990; Chavez et al. 1997; James Bishop, personal communication; Greg Mitchell, personal communication). An increasing number of interdisciplinary variables are expected to be sampled from these platforms in the future as sensor or system size, weight, power, etc., become less limiting. Biofouling of conductivity as well as chemical and bio-optical sensors will require special measures, as mentioned earlier.

## Manned Submersibles

## PRESENT AND NEAR-FUTURE CAPABILITIES

Manned submersibles have been in regular use for ocean exploration since the 1960s. Human observations have been important for scientific and industrial activities as well as for engaging the public in ocean exploration (see Hawkes 1997). These craft have been equipped with a variety of in situ sensors and allow on-site decision making by scientists and operators. Investigations of hydrothermal vents, mid-ocean ridges, deep-sea biology and bioluminescence, exploration of archaeological sites and shipwrecks, and pipeline inspection are only a few of the many diverse examples of the usefulness of manned submersibles. Manned submersibles have also been used recently for exploring and collecting baseline data in national undersea marine sanctuaries and parks in the United States (e.g., Earle and Henry 1999).

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New designs of manned submersibles will probably enable deeper dives. Some efforts are being directed toward lightweight “microsubs,” that could be operated economically as independent vehicles from research and commercial vessels (Hawkes 1997). The use of microsensors and microprocessors and new hull materials facilitates these approaches. The use of real-time