A national glider network for sustained observation of the coastal ocean

Sustained subsurface observations in the coastal ocean are essential to address climate change, ecosystem management, and water quality. The boundary currents that are important drivers of climate change pass through the coastal ocean, such as the Gulf Stream on the US east coast. Interannual climate variability caused by El Niño has profound effects on the ecosystem of the west coast of the US. The Loop Current, and its associated eddies, dominates circulation in the Gulf of Mexico, influencing dispersion of pollutants. Addressing these issues often reduces to questions of the source of water reaching the coastal ocean, and the destination of water leaving. With the goal of observing and predicting the sources and destinations of waters in the coastal ocean, here defined as the US Exclusive Economic Zone (within 200 miles of shore), we propose a plan using underwater gliders.

Autonomous underwater gliders developed, over the last several years and now operated routinely, offer sustained fine resolution observations of the coastal ocean. In typical use gliders profile from the surface to 500-1000 m, taking 3-6 h to complete a cycle from the surface to depth and back. During the cycle the gliders travel 3-6 km in the horizontal for a speed of about 1 km/h. Deployments of 3-6 months are routine, during which time the gliders' survey tracks typically extend well over 2000 km. Gliders can sense the bottom to enable operations in shallow water. During a few minutes on the surface, gliders obtain location by GPS and communicate through the Iridium satellite phone system. Sensors on gliders measure such physical variables as pressure, temperature, salinity, and current, biological variables relevant to the abundance of phytoplankton and zooplankton, and ecologically important chemical variables such as dissolved oxygen and nitrate. As pH sensors mature, gliders will provide excellent platforms for monitoring ocean acidification. Gliders may be deployed and recovered from a wide range of platforms, including small boats and chartered fishing vessels.

A national network of glider observations should include about 7-10 gliders deployed at all times on lines along the east, west, and gulf coasts. The capability to sustain such lines has been demonstrated for several years, for example off Southern California and the Pacific Northwest. This national network of 20-30 gliders is practical, not only operationally, but also financially. Experience suggests that a glider line can be maintained locally at a reasonable cost, with one glider in the water and one being refurbished in the lab at all times. Initial capital costs are estimated to be roughly twice that for annual operations and maintenance. There is no question that a national glider network is practical and affordable.

Glider data is transmitted to shore in real time, so a national distribution and archiving scheme is essential. At present, glider data is received by servers and distributed in a variety of formats and through several protocols. Establishing a standards-based approach to serve glider data at a national level will simplify the distribution process for glider operators and data users alike. The creation of a standard format for glider data will make exchange more efficient. Standardizing procedures for quality control must be a priority. Archiving this data in a national repository will ensure its continued availability to all users.

Among the primary users of glider data are ocean modelers. Glider data has proven essential to constrain assimilating models of coastal circulation. Just as the combination of Argo floats and satellite data are the primary input for models of global circulation, gliders and remote sensing will be the important data sources for predictions of the coastal ocean. A complete observing and predicting system for the coastal ocean is the ultimate outcome.