Development of Oceanographic Sampling Networks Using Autonomous Gliding Vehicles

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LONG-TERM GOALS

Our long-term goal is to develop an efficient, relocatable, infrastructure-free ocean observing system composed of high-endurance, low-cost gliding vehicles with near-global range and modular sensor payload. Particular emphasis is placed on the development of adaptive sampling strategies and the automated control of large glider fleets operating within the framework of an autonomous oceanographic sampling network.

OBJECTIVES

The primary objective of this program is to demonstrate moderate-term (weeks to months) operation of a multi-vehicle network of autonomous gliders in both coastal and blue-water environments. Secondary objectives include continued improvement of multi-vehicle communication and control systems and the development, implementation, and field-testing of adaptive sampling algorithms and sensor intercalibration schemes.

APPROACH

We will field-test three environmentally-powered gliders constructed by Webb Research Corporation. Initial sea trials will be performed in the Bahamas (Tongue of the Ocean) during winter 2002-2003. Pending completion of sea trials the vehicles will be deployed near the BATS time series site south of Bermuda. The vehicles will be programmed to continuously sample a 75 km radius circle surrounding the BATS station over a period of several months with intensive observations at the BATS site coincident with R/V Weatherbird II occupations. Sampling patterns will adapt in response to interesting mesoscale features (eddies, fronts) identified using satellite remote sensing products. In parallel, a small network of electrically-powered gliders will be used to characterize the three-dimensional, time-dependent structure of the shelfbreak front in the Mid-Atlantic Bight south of Nantucket Shoals.

WORK COMPLETED

A prototype environmentally-powered completed 17 successful missions in Lake Seneca during August 2000. Performance of the thermal engine in this deep, well-stratified lake was excellent. A major redesign of the vehicle has resulted in refinement of its hydrodynamic performance and near-

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14. ABSTRACT
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surface stability. A second round of controlled-environment field trials at Lake Seneca was performed fall 2000 prior to beginning construction of two new vehicles. The unique thermal engines have been redesigned to improve efficiency and incorporate an auxiliary booster pump enabling electrically-powered buoyancy changes when oceanic conditions are unsuitable for environmentally-powered operation.

Iridium is now the primary means of bidirectional vehicle-to-shore communications. Initial tests indicate that the system is robust and should enable truly global operation of autonomous glider networks.

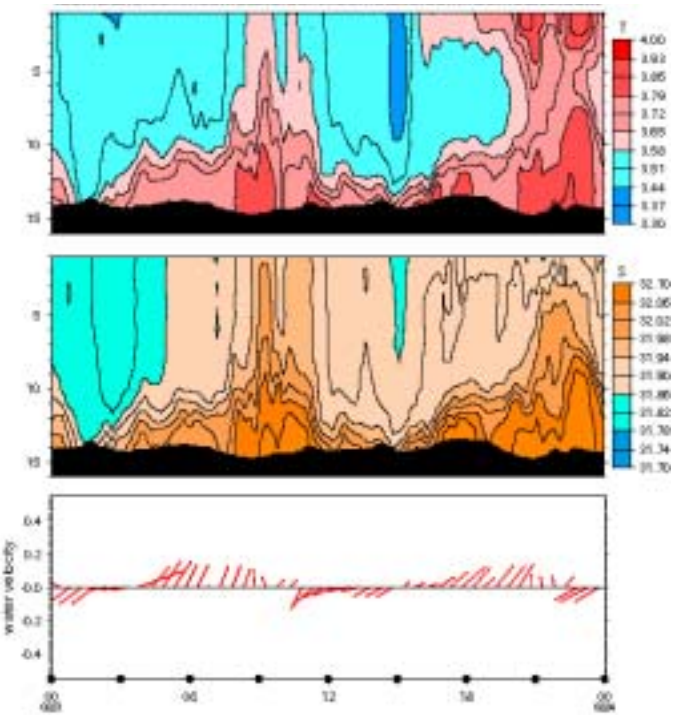
RESULTS

Operations in Buzzards Bay with three electric vehicles during winter 2001-2002 yielded approximately 450 total hours of automated network operation resulting in nearly 8000 vertical profiles of temperature and salinity. A prototype environmental optics package (chlorophyll fluorometer, PAR, turbidity) was developed and tested.

IMPACT/APPLICATIONS

Continued development of adaptive multi-vehicle network operations will enable adaptive measurement of time-dependant or transient ocean phenomena such as mesoscale eddies and fronts, as well as generic distributed environmental observations in remote or hostile locations. A network of gliding vehicles will supply, in an efficient and cost-effective manner, high-quality, near-real-time environmental information for operational ocean/atmosphere forecasting and model validation.

<u>Left</u>. Electrically-powered glider ashore and in the water with tail elevated for data transmission.



<u>Above:</u> Temperature and salinity data (time vs. depth) and inferred water velocity during a 24-hour period in Buzzard's Bay. Right panel depicts trajectory of vehicle during the same time period. Water depth was approximately 15 m. Total distance covered in 24 hours was approximately 36 km. Note the +/- 20 cm/s velocity tidal cycle measured by the glider and the corresponding temperature and salinity features.