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Adaptive Oceanographic Sampling in a Coastal Environment 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 autonomous vehicles with near-global range and modular sensor payload. Particular emphasis is placed on the development of adaptive sampling strategies and the intelligent control of large glider fleets operating within the framework of an autonomous oceanographic sampling network.

OBJECTIVES

The primary objective of this program is to develop and demonstrate moderate-term (weeks) operation of a multi-vehicle network of autonomous gliders in a coastal environment. Secondary objectives include continued development of a adaptive sampling strategies suitable for large fleets of slow-moving autonomous vehicles, and development and implementation of new oceanographic sensors and sampling methodologies.

APPROACH

We will continue to collaborative with Webb Research Corporation (East Falmouth, MA) on the redesign and field testing of the next generation coastal glider. We will perform sea trials of this vehicle in Buzzards Bay and other locations in order to evaluate and improve long-term vehicle performance in a shallow-water coastal environment.

WORK COMPLETED

The main task completed was a complete redesign of the vehicle incorporating significant improvements in modularity, capability, and robustness. Major improvements include addition of a modular science payload bay with a dedicated computer system, integration of acoustic transducers in the bow cone, and addition of a servo-controlled rudder for improved lateral control. A dedicated science computer was implemented to reduce the processing load on the main computer and facilitate the addition of modular sensor packages.

We have completed the development of an integrated glider data management system. This system is now in routine use in our laboratory and has been linked with a web-based front-end for near-real-time data distribution via the internet for integration with assimilating numerical models (see https://glider.whoi.edu). We have developed a desktop-based mission simulator which allows efficient prototyping of adaptive sampling algorithms and multiple-vehicle interaction with arbitrary, realistic environmental forcing (winds, tides, currents, etc.). Iridium satellite phone is now the primary means of bidirectional vehicle-to-shore communications. The system is robust and capable of providing truly global operation of autonomous networks.

RESULTS

Operations in Tongue of the Ocean (Bahamas) and Buzzards Bay (MA) with three vehicles during winter 2002-2003 yielded approximately 350 total hours of automated network operation and nearly 3000 vertical profiles of temperature and salinity. Improvements to glider hardware and software stemming from these field operations have resulted in a significantly more capable and robust vehicle and network control system which is now ready for operational scientific use.

IMPACT/APPLICATIONS

Continued development of multi-vehicle network operations will enable efficient measurement of transient ocean phenomena such as mesoscale eddies and fronts and streamline 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.

RELATED PROJECTS

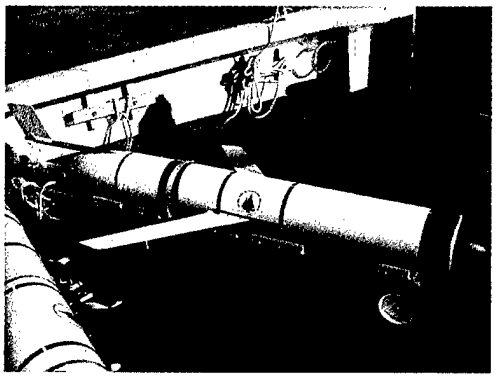
Development of Oceanographic Sampling Networks using Autonomous Gliding Vehicles (D. M. Fratantoni, N00014-00-1-0256)

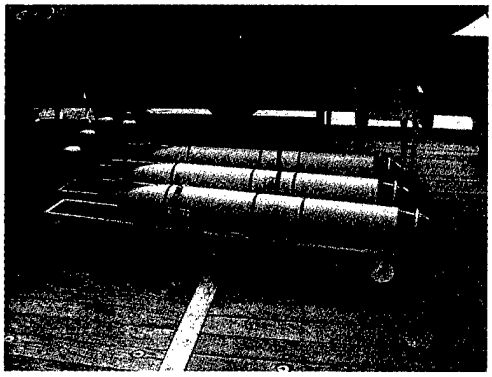
An Autonomous Glider Network for the Monterey Bay Predictive Skill Experiment / AOSN-II (D.M. Fratantoni, N00014-02-1-0846)

REFERENCES

Graver, J. G., R. Bachmayer, N. E. Leonard, and D. M. Fratantoni, 2003. Underwater glider model parameter identification. *13th International Symposium on Unmanned Untethered Submersible Technology (UUST)*, Durham, NH, August 2003.

Fratantoni, D.M., D.A. Glickson, D.C. Webb, C.P. Jones, T.K. Campbell, The Slocum Autonomous Glider. *EOS, Transactions AGU*, 81(48), 660, presented at the AGU Fall Meeting, San Francisco, 2000.





Above: (LEFT) Redesigned electric glider. Major improvements include addition of a modular science payload bay (center section) with a dedicated computer system, integration of acoustic transducers in the bow cone for underwater communications, and addition of a servo-controlled rudder for improved lateral control. (RIGHT) Three vehicles prior to deployment in Tongue of the Ocean, Bahamas (January 2003) for deep-water testing.