DEVELOPMENT, ASSESSMENT, AND COMMERCIALIZATION OF A BIOGEOCHEMICAL PROFILING FLOAT FOR CALIBRATION AND VALIDATION OF OCEAN COLOR AND OCEAN CARBON STUDIES

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Lead PI:

Emmanuel Boss
Office of Research and Sponsored Programs
University of Maine
5717 Corbett Hall
Orono, ME 04469-5717
Phone: 207-581-4378 Fax: 207-581-4388 Email: emmanuel.boss@maine.edu

Co-PI:

Marlon Lewis
Satlantic, Inc.
Pier 9, Richmond Terminals
Halifax, Nova Scotia, Canada
Phone: 902- 492-4780 Fax: 902- 492-4781 Email: marlon.lewis@dal.ca

Co-PI:

J. Ronald Zaneveld
WET Labs Inc.
PO Box 518
Philomath, OR 97370
Phone: 541-929-5650 Fax: 541-929-5277 Email: ron@wetlabs.com

Co-PI:

Daniel Webb
Teledyne Webb Research
82 Technology Park Drive
E. Falmouth, MA 02536-4441
Phone: 508.548.2077 Email: danwebb@webbresearch.com

Co-PI:

William Woodward
CLS America, Inc.
1441 McCormick Drive, Suite 1050
Largo, MD 20774
Phone: 301-925-4411 Fax: 301-925-8995 Email: bwoodward@clsamerica.com

Co-PI:

James Acker
NASA GES DISC Code 610.2
Greenbelt, MD 20771
Phone: 301-614-5435 Email: James.G.Acker@gsfc.nasa.gov

Co-PI:

Herve Claustre
Laboratoire d'Océanographie de Villefranche
Caserne Nicolas Quai de la Darse, BP 8 06238 Villefranche-sur-Mer, Cedex France Email:
claustre@obs-vlfr.fr

Co-PI:

David Antoine
Laboratoire d'Océanographie de Villefranche
Caserne Nicolas Quai de la Darse, BP 8 06238 Villefranche-sur-Mer, Cedex France Email:
antoine@obs-vlfr.fr

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http://misclab.umeoce.maine.edu/research/FloatUpdates/FloatHome.htm

LONG-TERM GOALS

The primary goals of this effort are to develop the technology and expertise to measure optical properties of the upper ocean autonomously over long time scales (months to years) and to make those observations easily accessible to researchers and the public. This will allow monitoring of events such as phytoplankton blooms and will aid in our understanding of physical and biogeochemical dynamics of the upper ocean. This work will also lead to development of alternative (and cheaper) methods to calibrate satellite ocean color observations using sensors that can be easily deployed across a wide geographic range.

OBJECTIVES

- Manufacture and test five floats that will measure physical and optical quantities in the upper 2000 m of the ocean.
- Develop an optical package that communicates with the float and is able to update sampling strategy using commands telemetered from shore.
- Develop hardware, software, and variable parameters for customized sampling strategies.
- Determine the best sampling strategies to maximize data quality within power, data, and cost constraints.
- Field-test to examine robustness of the measurements (compare to satellite observations)
- Develop software to transfer data efficiently to end users
- Develop software to link with NASA remote sensing products that will provide context for float measurements

APPROACH AND WORK PLAN

We have approached this work collaboratively. Several manufacturers are involved in designing, assembling, and integrating instruments and software (WET Labs, Satlantic, Teledyne Webb, CLS America). Some of the instruments are nearly unmodified versions of stock instruments, while others have required substantial modifications to meet the needs of this mission. The data display technology and data products are also being developed collaboratively (CLS America and NASA-Goddard). The technical work is being overseen and coordinated by the University of Maine. All the manufacturers and developers have worked together to meet the needs of the project within the constraints of the instruments being used.

University of Maine will be responsible for data analysis and scientific results. Data quality will be assessed using

- Stability of deep water values
- Comparison of surface measurements to satellite observations

- Redundancy of measurements–some particle properties can be computed from multiple instruments on the platform, and these quantities can be compared.
- Tests at the site of an established ocean optical observatory (*e.g.* BOUSSOLE)

This project has involved several individuals at each organization, principally:

- UMaine–Emmanuel Boss and Greg Gerbi: coordination and oversight. Development of data analysis methods
- CLS America–Bill Woodward, Phillipe Le Normand, and Seth Ornstein: communications and software development
- NASA-Goddard–James Acker: software development and coordination with NASA's GIOVANNI satellite data products
- Satlantic–Marlon Lewis, Keith Brown, and Diego Sorrentino: Hardware and software development to integrate optics instruments with each other and with float
- Teledyne/Webb–Dan Webb, Hugh Fargher, Bill Wallace, and Matt DeDonato: Hardware and software development to integrate optics instruments with float and to control mission
- WET Labs–Ron Zaneveld, John Koegler, and Andrew Barnard: instrument modification and assembly
- Laboratoire d'Océanographie de Villefranche–Herve Claustre and David Antoine: logistical coordination of field tests and assistance with data comparison to existing buoy observations

In the coming year we will complete assembly of the first two floats and perform field tests in the spring of 2011. Based on the outcomes of the field tests we will evaluate sampling strategies and construct floats three and four with appropriate modifications. We will deploy those floats on ships of opportunity in areas of interesting ocean dynamics and optical processes. Data processing will be a priority in the coming year. This includes data display development and coordination with NASA satellite products will also take place in the coming year. UMaine will work on algorithms to assess heat flux and primary production from the observations.

WORK COMPLETED

The bulk of the joint efforts began in February, 2010, with a full-day meeting between partners at the at the Portland Hilton prior to the Ocean Sciences meeting in Portland, Oregon. UMaine has since coordinated weekly or bi-weekly conference calls with partners to coordinate developments and planning and to keep progress on schedule. Beginning with determining specifications for this new float, float hardware and software have been developed, integrated and assembled. This has included considerable hardware integration and software development. The float has been assembled (figures 1) and in-water testing began in early November, 2010 (figures 2).

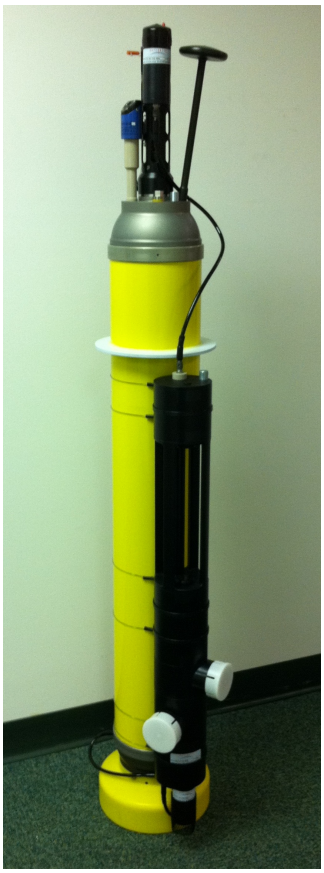

Figure 1: Biogeochemical float with optics suite attached to side and irradiance sensor, CTD, Optode, and antenna on top.

RESULTS

The year's progress has been technical, not scientific. The centerpiece of this progress is the nearly-completed float with a unique, large, and robust set of instruments that will be tested in the next month. Starting from scratch we have developed an autonomous system that integrates measurements from 14 instruments, performs onboard computations, and telemeters the data to shore via satellite. In this process we have learned how to integrate a variety of measurement platforms designed by several manufacturers.

IMPACT AND APPLICATIONS

Economic Development

The technology developed here will lead to new products in data display (CLS), and will lead to new observational products for Teledyne Webb and Satlantic who have done the systems integration for float design. These observational products include complete floats using optical instruments or other instruments that are attached into the modular framework developed for the optical instruments.

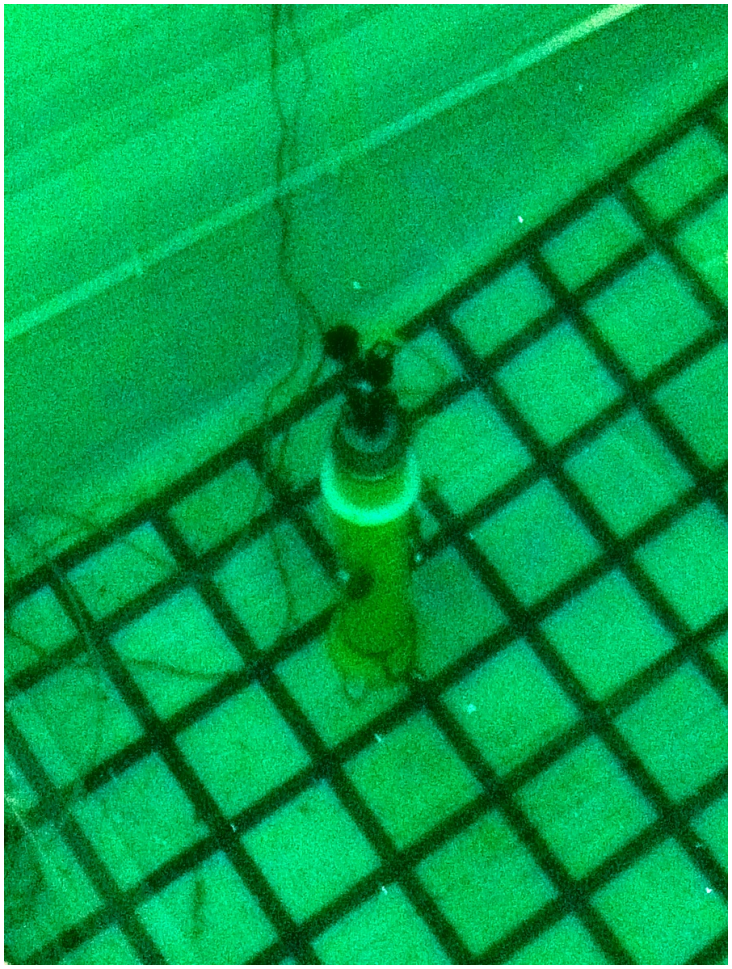

Figure 2: Biogeochemical float in test pool at Teledyne Webb Research.

Quality of Life

The science that will be enabled by the floats produced in this project will aid in understanding of the interaction of biological, physical, and chemical processes in the upper ocean. This will increase our ability to predict and understand many processes that involve the upper ocean, from hurricane paths to phytoplankton blooms both on the shelf and further offshore. Analysis that we performed of optical data collected with a profiling float (Boss and Behrenfeld, 2010) is challenging the current dogma regarding phytoplankton dynamics in the North Atlantic.

Science Education and Communication

The data products and integration with NASA's GIOVANNI will lead to data being freely and easily accessible to scientists, educators, and other interested parties. It will also be straightforward for users to put the work in the context of satellite observations. The availability of float data and contextual data will be beneficial for anyone with an interest in upper ocean dynamics.

TRANSITIONS

This work is developmental by its nature. Although we expect the results to be incorporated into other programs in the future, such incorporation has not yet begun.

RELATED PRODUCTS

An order for eight floats similar to the floats developed in this NOPP effort has been submitted to Teledyne-Webb (with components from Satlantic, WETLabs, and CLS-America).

REFERENCE

Boss, E. and M. Behrenfeld, 2010. ***In situ* evaluation of the initiation of the North Atlantic phytoplankton bloom.** *Geophysical Research Letters*, 37, L18603, doi:10.1029/2010GL044174.

PUBLICATION

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