# PROGRESS REPORT

**Project:** **The Alliance for Coastal Technologies (ACT):** National-Scale Efforts Toward Verification and Validation of Observing Technologies

**Grant No.** **NA11NOS0120037**

**Reporting Period: 6/1/11-11/30/11**

## 1) Project Summary

The Alliance for Coastal Technologies (www.act-us.info) was established by NOAA in 2001 to bring about fundamental changes to innovation and engineering practices in marine technology. It arose at a time when the United States began moving toward the development and implementation of a sustained national Integrated Ocean Observing System (IOOS). ACT's goal is to facilitate the creation and application of knowledge on current and emerging ocean-observing technologies to improve the capabilities of existing observations and deliver innovative solutions to specific emerging global environmental issues and operational ocean-observing challenges.

ACT priorities include transitioning emerging technologies to operational use rapidly and effectively; maintaining a dialogue among technology users, developers, and providers; identifying technology needs and novel technologies; documenting technology performance and potential; and providing IOOS with information required for the deployment of reliable, cost-effective networks.

ACT provides three fundamental public services: (1) a third-party testbed for quantitatively evaluating the performance of new and existing coastal technologies in the laboratory and under diverse environmental conditions, (2) a forum capacity building through technology specific workshops that review the current state of instrumentation, build consensus on future directions, and enhance communications between users and developers, and (3) an information clearinghouse through a searchable online database of environmental technologies and community discussion boards.

This new ACT award is for the first year of a five-year cooperative agreement between the University of Maryland Center for Environmental Science (UMCES) and NOAA. While the official award start date was 1 June 2011, NOAA funds were not received by UMCES until the first week of September 2011. Therefore, some activities are behind schedule.

## 2) Scope of Work (as described in the May 2011 revised ACT proposal selected for funding by NOAA)

***Technology Evaluations****:* ACT conducts two levels of IV&V Technology Evaluations: Verifications and Demonstrations. Technology Verifications focus on classes of commercially available instruments to provide confirmation that each technology meets the manufacturer's performance specifications or claims and/or provides verified data on those operational parameters that stakeholders require to make a use decision. Verifications are a 25-step process, which includes community consensus on test protocols, laboratory and field-testing, and QA/QC based on EPA and ISO guidelines (Appendix B). Field tests are carried out at no less than four but typically all six ACT partner sites. Technology Demonstrations involve fewer steps and focus on highlighting the capabilities and potential of pre-commercial or emerging early-stage technologies, building user awareness, and facilitating technology maturation and transition into operational observing. Working closely with developers, Demonstration field tests may be conducted at only two or three Partner sites, depending on stakeholder priority needs.

Technologies are selected for IV&V based on: (1) stakeholder consensus that there is a legitimate management and science need for the technology, (2) there are multiple commercial or near commercial-ready instruments for testing, and (3) testing is feasible within a reasonable time frame and ACT capabilities and funding. Based on ACT's experience in implementing Technology Evaluations, the time required to complete the evaluation of one sensor class is approximately 18 months and spans two project year cycles. The sequence of testing is staggered to avoid 'in-water' testing of two unrelated technologies at the same

time, which would exceed our current capacities. During Yr 1 of the cooperative agreement, ACT Technology Evaluations will include:

**(A)** Completion of the $pCO_2$ analyzer Demonstration with 6-month field deployment in Alaska (adjacent to the UAF GAK1 mooring at the mouth of Resurrection Bay) to document long-term reliability of these instruments under upper latitude conditions. However, sampling cruises, and thus the total number of reference samples collected to evaluate the performance of instruments being tested, will be reduced by one third from what was originally agreed to in the Test Protocols. Ocean acidification has become one of the most significant and urgent issues facing ocean resource harvesters and managers and monitoring the open oceans and coastal waters for $CO_2$ levels will become paramount in assessing impacts and developing regulatory criteria, both nationally and internationally (e.g., ACT 2005, www.act-us.info/workshops_ reports.php; Doney et al., 2009). In 2010, ACT completed a Demonstration of four individual in situ $pCO_2$ sensors at field sites in Kaneohe Bay, HI, and Hood Canal, WA. The Alaska field Demonstration will follow the test protocols for $pCO_2$ analyzers tests in 2010 (www.act.us.info/Download/pCO2/ACT_DP09-01_pCO2_Protocols.pdf). Instruments to be tested include the Contros Systems GmbH HydroC / CO2 Subsea Sensor; NOAA-PMEL MAPCO2 System; Pro-Oceanus Systems, Inc. CO2-Pro; Sunburst Sensors SAMI-CO2; and YSI 6600 EDS Sonde w/ prototype pCO2 sensor.

**(B)** Completion of the in situ hydrocarbon sensors Verification in collaboration with the NOAA AOML-led effort, *Deciphering Hydrocarbon Fluorescence,* which also involves Fisheries and Ocean Canada, US EPA, USF, Louisiana State University, and ACT. The Deepwater Horizon spill is just the latest example of the critical need for high spatial and temporal resolution measurements of hydrocarbons in coastal waters. A number of hydrocarbon sensors are commercially available for in situ measurements of oil in water (www.act-us.info/tech_db.php). However, there is no "hydrocarbon sensor that accommodates multiple, continuous, real-time data" for operational decisions during and after a spill (ACT, 2008; www.act-us.info/workshops_ reports.php). In addition to accuracy and reliability, in situ hydrocarbon sensors must minimize risk of erroneous measurements. For example, optical fluorescence hydrocarbon sensors can be susceptible to false positive readings simply because crude oil commonly fluoresces near 500 nm induced by UV excitation, which can be difficult to distinguish from naturally occurring colored dissolved organic matter (CDOM; P. Coble and A.M. Wood pers. comm.). Although linked to the NOAA effort, the ACT Verification will focus on capabilities/limitations of commercial optical instruments adapted for in situ measures of diverse hydrocarbons, and not specifically on oil from the Deepwater Horizon spill. The Technical Advisory Committee and participating vendors have agreed to a Test Protocol, which will now require modifications because of limited funding. First, the total number of reference samples collected and analyzed to evaluate the performance of instruments being tested will be reduced by approximately 30%. Second, the two sets of laboratory evaluations (MLML and Bedford Institute of Oceanography, Nova Scotia) will still be conducted, with minor reductions in effort to reduce costs. Finally, one planned field test, a freshwater site in the Great Lakes, will also be elimination resulting in only two sets of field evaluation: a one-month moored deployment in the Port of Baltimore (UMCES/CBL) and a three-day cruise in the Gulf of Mexico for vertical profile testing (USF and University of Southern Mississippi) on the LUMCON Research Vessel *Acadiana*. This Performance Verification will still be conducted on eight distinct instruments from eight different companies and reference standards will include: EPA SW846 Method 8015B,C; spectrofluorometric characterization (EEMS); and gas chromatography with a mass spectrometer (GCMS Method 8270D). However, the broader value and applicability of results will be less than originally planned. Complete Test Protocols are available upon request.

**(C)** A Verification of in situ pH sensors, which was identified by stakeholders as the next priority theme for a Technology Evaluation. Like $pCO_2$, high spatial and temporal measures of pH directly in the field are key to address a variety of critical environmental issues. For example, monitoring changes in ambient pH will provide insight to carbonate mineralization and its impact on the health of calcifying organisms and communities such as planktonic foraminifera, coral reefs, and oyster reefs (e.g., Fabry et al., 2008). As in all prior ACT Evaluations, this Verification will follow the established process resulting in the release of public reports on the performance of individual instruments. While the current funding level does not allow for the actual testing of in situ pH sensors during Yr 1 of this cooperative agreement, ACT will complete the initial steps (e.g., establish a Technical Advisory Committee, release a Request for Technologies, conduct a Needs

and Use Assessment, and develop an agreed to Test Protocol) so we are prepared to move forward with laboratory and field test during the summer of 2012 (if minimum required funding is available).

*Needs and Use Assessments* – As described above, ACT will conduct a Needs and Use Assessment for in situ pH sensors. ACT will employ a web-based survey methodology to systematically acquire an accurate picture of current sensor use, including parameters most important to management, research, and observing community instrument users, predominant applications, perceived advantages and limitations of the technology, and suggestions for improvement. The target sample size is approximately 50 respondents, representative of a cross-section of the user community. Questionnaires are designed to allow for a structured response to provide quantitative data for statistical analysis. The results are published in reports that are used to: (1) identify priority parameters and applications for ACT Technology Evaluations; (2) define the focus and critical questions for ACT Technology Workshops; and (3) supplement specific ACT Workshop conclusions and recommendations. All assessment reports are made available to the public through the ACT website as PDF files.

***Technology Information Clearinghouse****:* Basic website and database activities will continue but reductions in funding will only allow for periodic updates and maintenance. In Yr 1, ACT will continue to post all Technology Evaluation and Workshop final reports (as download PDF files), related news items and web links, and basic program information on the public ACT website. The ACT website was launched in 2001 to facilitate access to and improve the quality of information related to the development and application of coastal and ocean technologies. The site is continually evolving, providing up-to-date information about ACT's activities and products. It allows direct access to databases, ACT reports, and other publications, and promotes exchange of information on a variety of environmental technology issues. Enhancements to content and interface are driven by user feedback and anticipation of changing needs. ACT will also continue our collaboration with the NWQMC National Environmental Methods Index (NEMI, www.nemi.gov) on the integrated Methods of Environmental Measurement and Observation (MEMO). The MEMO web portal allows for searches of specific environmental parameters that result in listings and documentation on both standard methods and commercial instruments to quantify/measure the parameter of interest.

***Outreach and Community Involvement****:* Outreach is a core ACT function, key to the solicitation of stakeholder input, and includes those activities in which ACT seeks to increase its visibility and facilitate the exchange of ideas and information with interested individuals, organizations, agencies, and government entities. These activities help to forge partnerships, involve the community, and engender the mutual understanding and trust critical to program success. ACT outreach activities fall into two general categories: outreach to the public and practicing professionals via electronic, web, and print media and community involvement through dialogue and linkage with related programs. We plan to continue some fundamental outreach activities but the scale and scope of these efforts will be reduced dramatically due to the limited funding available in Yr 1. This will include participation in only one (as opposed to the several originally proposed) national conference, symposium or workshop and it will not be possible to publish the ACT biannual *the Sensor* newsletters.

ACT Headquarters staff will focus on priority national and international outreach and collaborations, while working with Partner Institutions to coordinate regional outreach and educations activities. Each Partner will be responsible for representing ACT in their regions and communicating directly with respective IOOS RAs. These activities help maintain communication between ACT and the broader community; facilitate communication between various members of the coastal and ocean science, management, technology, and education communities; and augment or support local efforts. Because of limited resources, these efforts will focus mostly in personal communications as opposed to formal events or joint activities.

*Partnerships with Related Programs* – ACT will work directly with our Board of Directors, Advisory Council and the IOOS office to utilize the results from our ongoing program evaluation to address community needs and IOOS regional priorities, and to incorporate RA input into related sensor validation activities. In particular, at the June 9, 2011, ACT Board of Directors meeting, we will conduct an exercise to clearly define: (a) primary and secondary clients, (b) client needs, and (C) strategies for engaging clients.

ACT will also work with NFRA and the RAs to establish a mechanism (e.g., surveys) for formal RA input on priorities for ACT Technology Evaluations and Workshops themes, to coordinate outreach activities with the RAs to efficiently/effectively engage overlapping stakeholders, and to promote ACT and RA collaboration on websites and other venues. However, lack of funding will prevent other proposed ACT/RA activities, including joint workshops and the establishment of a joint Technical Operations Committee.

In addition, ACT will continue communications with, or support of, NDBC, CO-OPS, USACE, NWQMC, Ocean Observatories Initiative (OOI), National Ecological Observing Network (NEON), and Quality Assurance of Real-Time Ocean Data (QARTOD) and will continue pursuing joint activities with other related agencies and efforts, including NIST, BOEMRE and EPA.

***Program Administration:*** Since its inception, ACT Principal Investigators have taken a proactive approach to fully understanding: (1) the social, political, physical, and economic environment in which the program operates; (2) the dynamics of change; and (3) the critical role these factors play in forming and sustaining an effective process for continuous adaptation of ACT's organization and services. In general, this context evaluation or situational analysis assesses which contextually have the greatest bearing on project successes or failure. This is followed by a process for priority setting and development of an action plan described in each annual proposal to NOAA, which leads ACT proactively toward the future rather than reactively away from the past.

ACT will maintain required routine governance responsibilities and management functions and schedules. ACT Headquarters will continue to coordinate core functions and guide program-wide activities, such as partnerships with other agencies and linkages with the coastal management community. Monthly Partner conference calls and one annual Partner meetings will continue during year 1. Although two face-to-face meetings per year were requested, limited funding will only allow for one ACT Board of Directors meeting in year 1. However, we will also facilitate four to six 1-hour conference calls, dependent on need. The ACT Advisory Council will continue participation in specific project guidance, advice, and prioritization, as well as peer-review of Technology Evaluation and Workshop reports. An annual face-to-face meeting (as originally proposed) will not be possible, but four to six Advisory Council conference calls will be held.

The following is a table of specific tasks for this period under the current award, and their original timelines by month (starting in June 2011 through May 2012).

| **Functional Area / Tasks** | **J** | **J** | **A** | **S** | **O** | **N** | **D** | **J** | **F** | **M** | **A** | **M** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *1. Technology Evaluations* | | | | | | | | | | | | |
| $pCO_2$ Analyzer Demonstration | X | X | X | X | X | | | | | | | |
| Hydrocarbon Sensor Verification | X | X | X | X | X | X | X | X | X | X | | |
| pH Sensor Verification | | | X | X | X | X | X | X | X | X | X | X |
| *2. Technology Information Clearinghouse* | | | | | | | | | | | | |
| Maintain & update | Minimum required activities | | | | | | | | | | | |
| *3. Outreach and Community Involvement* | | | | | | | | | | | | |
| Regional ACT Outreach Activities | Scaled down, reduced activities | | | | | | | | | | | |
| Links with other Related Programs | Scaled down, reduced activities | | | | | | | | | | | |
| Electronic, Web and Print Media Outreach | Scaled down, reduced activities | | | | | | | | | | | |
| *4. Program Administration* | | | | | | | | | | | | |
| Partner and Board meetings | X | | | | | | | | | | | |
| Routine management and evaluation | Minimum required activities | | | | | | | | | | | |

**3) Progress and Accomplishments**

The following table provides a comparison of actual versus proposed accomplishments with the goals and objectives for the period, and reasons why objectives/goals were not met (if needed).

| **Technology Evaluations** | | |
|---|---|---|
| **Activity** | **Purpose** | **Status** |
| Demonstration: $pCO_2$ sensors. | Evaluation of in situ carbon dioxide sensing technologies to support the understanding of ocean acidification and to facilitate technology innovations. | Testing Completed / On Schedule. Extension of the original ACT Technology Evaluation is progressing as planned with field test in Alaska initiated in March and completed in September 2011. Data is now being analyzed and final reports are being drafted. |
| Verification: hydrocarbon sensors | Evaluation of in situ hydrocarbon sensors oil spill monitoring and restoration. An extension and collaboration with the NOAA AOML-led effort, *Deciphering Hydrocarbon Fluorescence,* which involved Fisheries and Ocean Canada, EPA, USF, LSU, and ACT. Although linked to the NOAA effort, the ACT Verification is focused on capabilities/limitations of commercial optical instruments adapted for in situ measures of diverse hydrocarbons, and not specifically on oil from the Deepwater Horizon spill. | Testing Completed / On Schedule. Two sets of laboratory evaluations, at MLML and Bedford Institute of Oceanography (Canada), have been completed. Two sets of field tests, moored deployment (Baltimore Harbor) and vertical profiling (Gulf of Mexico), have also been completed. Data is now being analyzed and final reports are being drafted. |
| Verification: pH sensors | Like $pCO_2$, high spatial and temporal measures of pH directly in the field are key to address a variety of critical environmental issues. While the current funding level does not allow for the actual testing of in situ pH sensors during year 1 of this cooperative agreement, ACT will complete the initial Technology Evaluations steps of (a) establishing a Technical Advisory Committee, (b) conducting a Needs and Use Assessment, (c) releasing a Request for Technologies (RFT), and (d) develop an agreed to Test Protocol. | Ongoing / Off Schedule by two or three months. The pH Technical Advisory Committee (TAC) has been established and we have held three TAC conference calls. The Needs and Use Assessment has been completed, result are being used to draft RFT, and are being prepared for a stand-alone report. A draft RTF is now being reviewed by the TAC, with an RFT scheduled release date of December 1, 2011. A protocol workshop is scheduled for March 2012 with final Test Protocols completed by April 1, 2012. |

| **Technology Information Clearinghouse** | | |
|---|---|---|
| **Activity** | **Purpose** | **Status** |
| Manage, maintain, and update interactive on-line database. | Provide ocean technology community a single resource for identifying available technology options; facilitate coastal observing technology providers and users to match needs in a virtual "marketplace" environment. | On Schedule / Ongoing. ACT website includes 40 Technology Evaluation reports, 38 Technology Workshop reports, and over 4,000 instrument listing (from over 300 international companies) in the searchable Technology Database. ACT database has also been harmonized and linked with National Environmental Methods Index (NEMI, through USGS and NWQMC) and the new web portal called Methods of Environmental Measurement and Observation (MEMO), has now been released to the public. All ACT reports, including Test Protocols, Technology Evaluations, Workshops, and Needs and Use Assessments, will continue to be searchable and available as download pdf files through the website |

| **Outreach and Community Involvement** | | |
|---|---|---|
| **Activity** | **Purpose** | **Status** |
| Coastal Zone 2011 conference, Chicago, Illinois | Build awareness and identify community needs | Completed. July 18 – 20, 2011 |
| Meeting with NIST and IOOS office on joint activities, Solomons, Maryland | Build awareness and develop collaborations, in particular on Technology Evaluations | Completed. July 25, 2011 |
| Coastal and Estuarine Research Federation (CERF) conference, Daytona Beach, Florida | Build awareness and identify community needs | Completed. November 6 – 10, 2011 |
| Annual NFRA 2011 Board meeting and workshop, Portland, Maine | Build awareness, partnerships and collaborations with IOOS Regional Associations | Completed. November 15, 2011 |
| MarineGEO Workshop, Annapolis, Maryland | Assist the Smithsonian Institute in an initiative to build a biological coastal ocean observing system | Completed. November 17 – 18, 2011 |

| **Program Administration** | | |
|---|---|---|
| **Activity** | **Purpose** | **Status** |
| ACT Board of Directors and Partner meeting, Washington DC | Progress reports, prioritizing activities and strategic planning | Completed. June 9, 2011 |
| ACT Board of Directors and Partner meeting, NOAA IOOS Office, Silver Spring, Maryland | Progress reports, prioritizing activities and strategic planning | On Schedule. February 9, 2012 |
| ACT Partner conference calls | Coordination, progress reports, and planning. | Ongoing, first Thursday of each month |
| ACT Advisory Council conference calls | Community input and selection of themes and activities | Ongoing, first call was June 2011 |

**4) Personnel and Organizational Structure and Program Administration**

The ACT organizational structure has several important characteristics that are crucial to program success. ACT was created as a true community partnership to enable researchers, resource managers and technology companies to communicate and collaborate. ACT organizational structure (Figure 1) features a Board of Directors to guide strategic planning for continued growth, foster links with the broader community, and provide independent program assessments. Original Board members include: *Richard Spinrad*, Oregon State University; *Steve Weisberg* (Board Chair), Southern California Coastal Water Research Project; *Ralph Rayner*, Institute of Marine Engineering Science and Technology; *Chris Scholin*, Monterey Bay Aquarium Research Institute. Two new members were voted in during this period, *Scott McLean,* Ocean Networks Canada and University of Victoria, and *Jan Van Smirren*, Fugro Geos and Society for Underwater Technology, and *Thomas Miller*, new Director of CBL/UMCES has replaced Margaret Palmer as an *ex officio* member representing the ACT lead institution.

ACT Headquarters, located at the Chesapeake Biological Laboratory, Solomons, MD, coordinates and oversees all ACT activities. ACT's expertise comes from three sets of teams: (1) the Co-PIs from the six ACT *Partner Institutions*, possess significant scientific understanding of their regional environments and technology expertise, and perform the various ACT tasks (Figure 2); (2) the ACT *Advisory Council* consisting of individuals representing a cross-section of diverse constituents, who advise on what technologies and issues ACT should engage in based on stakeholder priorities and serve as external peer-reviewers of ACT Evaluation and Workshop reports; and (3) *Topic Expert Committees*, which are established to guide and critique the scientific quality of specific projects, such as a Technology Evaluation or Workshop. The current ACT Advisory Council includes: *Jan Newton*, NANOOS and University of Washington; *Richard Burt*, Chelsea Instruments; *Josie Quintrell*, National Federation of Regional Associations (NFRA); *Bruce Michael*, Maryland Department of Natural Resources; *Casey Moore*, WET Labs; *Rob Ellison*, YSI; *Scott Pegau*, Alaska Oil Spill Recovery Institute; *Dan Sullivan*, US Geological Survey; *Oscar Schofield*, Rutgers University, MACOORA and OOI; and *Pam Mayerfeld*, Turner Designs.

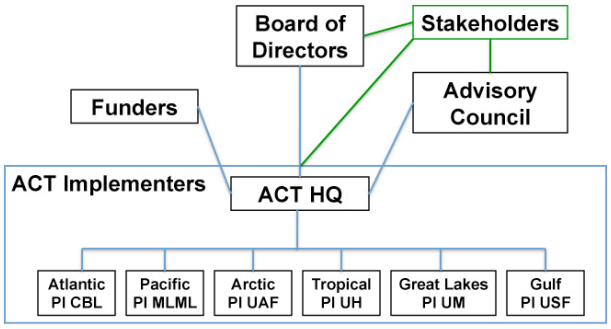


Figure 1. ACT Org Chart. Connections between formal ACT components are shown in blue. Broad stakeholder input takes place at multiple levels, shown in green.


Figure 3. Current ACT Partner Institutions. Note that ACT Partnerships have been established with the institutions and not the individual Primary Investigators designated by the institutions.

**5) Budget Analysis**

Actual expenditures have been incurred in accordance with the spending plan provided in the UMCES application. It is not anticipated that any budget modifications will be needed during the next reporting period. All financial reports for this award are up to date.