ALLIANCE FOR COASTAL TECHNOLOGIES

REQUEST FOR TECHNOLOGIES

TITLE **Performance verification of *in situ* fluorometers to detect harmful algae and cyanobacteria**

DATE **August 29, 2016**

PROGRAM **The Alliance for Coastal Technologies (ACT)**

DEADLINE **Application (form with signed cover letter) must be received by 5:00 pm Eastern Time on October 14, 2016.**

The Alliance for Coastal Technologies (ACT) is currently accepting preliminary applications from developers and manufacturers of commercially-available field-deployable and/or portable fluorescence-based instruments designed to characterize phytoplankton abundance and taxonomic composition to participate in independent performance testing. This evaluation is a follow up to an ACT Technology Evaluation conducted on chlorophyll fluorometry in 2005/2006 and aligns with our current theme on technologies for the detection of harmful algae and their toxins. Over the past 10 years, there have been significant advancements in this class of instrumentation and their ability to estimate biomass and classes of phytoplankton, including marine species and cyanobacteria. Testing will be conducted under controlled laboratory conditions, as well as under diverse natural field conditions and deployment applications. Like all ACT Technology Evaluations, participation in this effort will be free of charge for qualifying applicants, and results will be made available to the public in individual summary reports.

ACT is a component of U.S. Integrated Ocean Observing Systems (IOOS), funded by NOAA and EPA, and a partnership of research institutions, agencies, state and regional resource managers, and private sector companies interested in developing, improving, and applying sensor technologies for studying and monitoring aquatic environments. ACT was established on the understanding that instrument validation is necessary so that effective existing technologies are recognized and promising new technologies can be made available to support both successful coastal science and resource management, and the long-term success of IOOS. The specific functions of ACT are to serve as: (1) an unbiased, third-party testbed for evaluating existing, new, and developing coastal sensors and sensor platforms, (2) a comprehensive data and information clearinghouse on coastal technologies, and (3) a forum for capacity and consensus building.

Please visit our website at www.act-us.info for additional information on ACT, to download application forms, and for detailed information on the ACT Fluorometer II performance verification (including deadlines). More information can also be obtained by contacting Dr. Mario Tamburri (tamburri@umces.edu) and Dr. Tom Johengen (johengen@umich.edu).

SYNOPSIS OF PROGRAM

The Alliance for Coastal Technologies (ACT) provides an unbiased, third party testbed for evaluating existing, new and developing sensors, and related technologies, for studying and monitoring freshwater, coastal and ocean environments. ACT has initiated a follow-up to our 2005/2006 Performance Verification of commercially available *in situ* chlorophyll fluorometers, focused on fluorescence-based instruments designed to characterize abundance/biomass of phytoplankton and community composition. In general, three criteria are considered in the selection of a technology evaluation theme. First, there was a consensus of the stakeholders that there is a legitimate coastal management and research need for the technology. Second, there are a number of fluorescence-based instruments designed for the detection of algae and cyanobacteria biomass as well as classes of phytoplankton available for testing. Third, testing of these instruments is feasible within a reasonable timeframe with existing ACT capabilities and funding.

The occurrence of harmful algal blooms in fresh, estuarine and coastal water is increasing in both frequency and extent worldwide, with large negative impacts on the environment, economy and human health. A critical component to understanding and addressing this significant problem lies in the ability to quantify and identify harmful algae and cyanobacteria directly in the field with high spatial and temporal resolution.

It is important to note that ACT does not certify technologies or guarantee that a technology will always, or under circumstances other than those used in testing, operate at the levels verified. ACT does not seek to determine regulatory compliance; does not rank technologies or compare their performance; does not label or list technologies as acceptable or unacceptable; and does not seek to determine "best available technology" in any form. ACT will avoid all potential pathways to picking "winners and losers". Therefore, although performance verification will apply to all instruments evaluated under common testing protocols, no direct comparisons will be made between instruments from different manufacturers and instrument-specific Verification Statements will be released to the public for each instrument type as a final report.

FOCUS OF PERFORMANCE VERIFICATION

Predicting and identifying harmful algae and cyanobacteria requires high spatial and temporal resolution monitoring that characterizes both environmental conditions and phytoplankton species distributions. Traditional *in situ* chlorophyll fluorometry is a relatively simple and affordable approach to estimate algal abundance (and to identify blooms) but lacks the ability to determine community composition. Differences in pigmentation, however, allow for use of the spectral characteristics of phytoplankton fluorescence to be used to quantify specific groups of phytoplankton (e.g. cyanobacteria via phycocyanin) and/or differentiate among classes of phytoplankton. Several *in situ* instruments are now commercially available that take advantage of differences in fluorescence excitation and emission spectra to estimate abundances of specific harmful species. ***As these instruments are incorporated into harmful algal bloom monitoring efforts, it is important to understand their performance.***

This ACT Performance Verification will therefore focus on the suite of instruments with the specific application of detecting harmful algae and cyanobacteria biomass and/or community composition using field-deployable and/or portable fluorescence-based approaches. The performance evaluation will quantify instrument accuracy, precision, range/detection limits, and reliability against microscopic-based reference samples. Protocols and a detailed test plan will be developed with the aid of applicants and a Technical Advisory Committee to evaluate these specific parameters under both controlled laboratory and diverse field conditions. Initial laboratory tests will focus on quantifying accuracy, precision, and range under controlled environments. The field tests will follow that focus on instrument reliability and ability to consistently track natural changes in phytoplankton communities.

ELIGIBLE TECHNOLOGIES MUST BE:

- Commercially available technologies.
- New, near-commercial technologies that are ready for the market with available quality testing data to support performance claims.
- Designed to quantify biomass and/or identify classes of harmful algae and cyanobacteria using fluorescence-based approaches in the field (*in situ* or portable).

Multiple (likely two or three) instruments may be requested from each participant, depending on the specific evaluation protocols developed and timing of test deployments. ACT will take responsibility for the sensors during the verification testing and will return all units when the evaluation is complete. Qualifying applicants will also be asked to participate in the design of evaluation protocols. The results and summaries from all verifications will be provided to qualifying applicants and made public after evaluations are complete. Because of limited resources, ACT may select to evaluate only one sensor model or type per individual developer, manufacturer, or distributor depending on the numbers of qualifying applicants. We will, however, consult with applicants if this selection process is necessary.

BENEFITS OF TECHNOLOGY VERIFICATION

ACT will provide technology developers an independent, scientifically objective process for testing their instruments in a diverse range of coastal and freshwater environments and under actual situations for which their products were designed. Moreover, ACT results will provide potential investors and users of innovative approaches with information on how technologies perform in comparison to conventional methods. Through this process of verification, ACT will ultimately aid in the implementation of accurate and reliable technologies that will enable the effective monitoring and an increased understanding of coastal resources and processes.

Specific benefits for technology developers, manufacturers, and vendors:

- Access to expertise in demonstrating, verifying, and applying coastal monitoring technologies.
- An opportunity to test a technology on a nation-wide basis under different environmental conditions.
- An unbiased, reputable evaluation of technology performance.
- Increased credibility from having independent performance data.
- Increased potential of regulatory acceptance due to the recognition of ACT results.
- Increased recognition nationally and internationally through ACT outreach.
- A potential market advantage that customers and users may consider in their technology purchasing decisions.
- Increased confidence for investors.

Specific benefits for technology users:

- Timely information on the performance of sensors required to address an environmental emergency and recovery.
- Easily accessible information on coastal sensor technologies.
- Credible technology performance verifications and demonstrations independent of developer, manufacturer, or vendor claims.
- Performance-based verification and demonstration testing addressing realistic data quality objectives under varying environmental conditions.
- ACT and NOAA support of verification and demonstration results.

APPLICATION PROCESS AND ACCEPTANCE FOR RAPID RESPONSE EVALUATION

The application and acceptance process consists of four steps: a preliminary application, conditional acceptance, a full application, and agreement on a test plan. The tentative schedule and deadlines for each step are provided below.

Step 1: Preliminary Application. Applicants (developers, manufacturers, and distributors) are requested to provide summary information about the technology proposed for testing and about their organization by submitting a signed cover letter (no longer than two pages) and by completing the ACT Application for Evaluation form (available at www.act-us.info/rft.php). The purpose of the preliminary application is to assess if the technology meets the criteria/requirements set forth in this Request for Technology, if ACT facilities are capable of conducting an appropriate and safe evaluation, and to ensure that no conflict of interest exists between the applicant and ACT. Preliminary applications are screened and categorized by ACT Headquarters staff based on at least the following criteria:

- Does the technology fit the stated theme?
- Does the technology address the stated priorities?
- Is the technology applicable to *in situ* monitoring/studying of aquatic systems?
- Is the technology based on sound scientific and technical principles?
- Is the technology sufficiently commercial-ready for verification testing?
- Can the applicant demonstrate ownership of the technology?

Step 2: Conditional Acceptance. All applicants that meet the requirements for an ACT Technology Evaluation will be identified and accepted contingent upon the successful completion of Steps 3 and 4. Acceptance notification will be delivered to the applicant within one week of the receipt of the initial application.

Step 3: Full Applications. The Full Application for testing requests additional information about the technology to ensure a clear understanding of the proposed technology, including the scientific and engineering principles of operation, previous performance data (if applicable), and potential users/customers. The application should include appropriate peer review literature, technical articles, reports, process flow diagrams, equipment specification sheets, operating instructions, and other related materials to enable the reviewer to fully understand the technology and any data and information that is available to support the application.

Full applications must also include proposed protocols for conducting the evaluation. The draft protocols should be based on standard scientific testing practices and must include:

- Requirements for qualifications of test personnel.
- Requirements for health and safety of test personnel, the public, and the environment.
- Proposed methods and procedures for verification including: a) set-up, b) period of operation, c) operation parameters, d) experimental design with number of replicates and controls, and e) demobilization.
- A standard measure or existing, accepted technology for the new technology to be calibrated by or tested against.
- Proposed methods and procedures for storing, retrieving, analyzing, and reporting data.

Step 4: Agreement on Test Plan. ACT Headquarters staff, Technology Advisory Committee, Technical Coordinators for each Partner Institution, QA/QC Coordinator, and representatives for each qualifying applicant will gather for a workshop tentatively scheduled for January/February 2017, at Moss Landing Marine Laboratories, to discuss and draft a Verification Plan based on the recommendations for each qualifying applicant and an appropriate QA/QC strategy. The draft will be externally reviewed for appropriateness of experimental design and statistical analyses before a Final Verification Plan is submitted to the qualifying applicants. Although ACT does not conduct direct comparisons of instruments being evaluated, the standardization of methods in Verification Plans will allow the assessment of the various instruments simultaneously and permits end-users to draw their own conclusions regarding the *in situ* fluorometer that best meets their needs.

DEADLINES AND DATES

- Initial Application (form with signed cover letter) must be received by 5:00 p.m. Eastern Time – October 14, 2016
- Notification of Conditional Acceptance – November 4, 2016
- Full Application packages due – December 2, 2016
- Protocol Workshop, Moss Landing, CA – January/February 2017
- Final verification protocols and Test Plan – February, 2017
- Laboratory testing tentatively scheduled to begin in April 2017.

VERIFICATION AGREEMENT

A legal agreement between ACT and individual qualifying applicants will be drafted to state that all parties agree to conduct the evaluation in accordance with the final Verification Plan and that the results will be released to the public. The agreement will also state that there will be no modifications to final Verification Plan, regardless of unforeseen circumstance encountered during testing, without written consent from all parties. Furthermore, the agreement will clearly state that although the developers, manufacturers, or distributors will be allowed to view the Verification Statements before they are released to the public, they will not be allowed to make changes to the final report. Under special circumstances ACT will consider inclusion of comments (in the form of a one-page letter) from the developers, manufacturers, or distributors as an appendix to Verification Statements. Finally, it will be noted that all data collected during verifications by the instruments tested are the property of the proponent and cannot be used by any other party without consent. The agreement will be signed by the ACT Director and the appropriate representative from the qualifying applicant's organization.

ADDITIONAL INFORMATION AND FORMS

Please visit our website at www.act-us.info for additional information on the ACT program, details on the ACT Evaluation Process, and to download required application forms. More information can also be obtained by contacting Dr. Mario Tamburri (tamburri@umces.edu) and Dr. Tom Johengen (johengen@umich.edu).

INITIAL TECHNICAL ADVISORY COMMITTEE

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