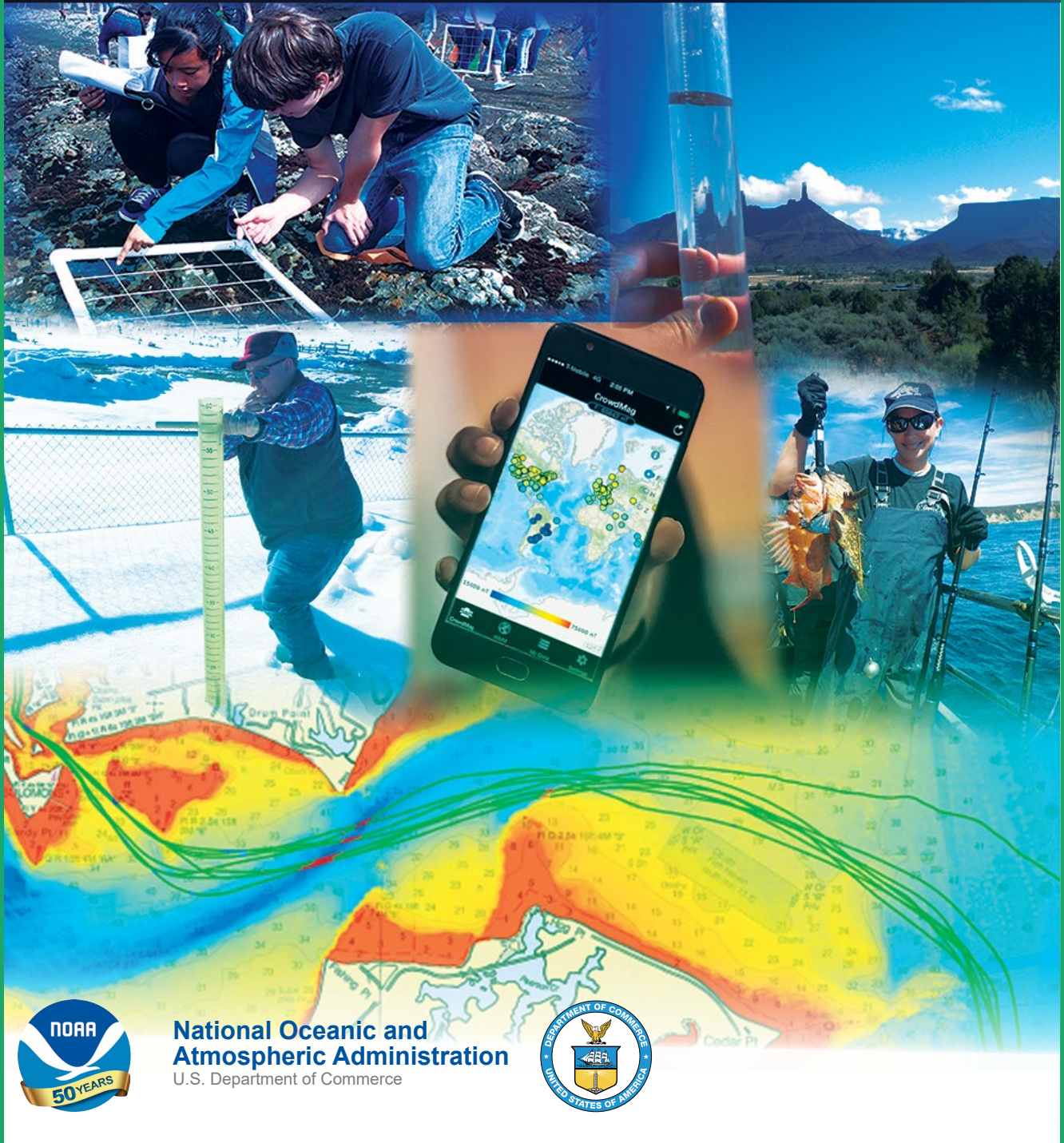


NOAA Citizen Science Strategy

Applying the Power of the Crowd



National Oceanic and Atmospheric Administration
U.S. Department of Commerce



NOAA Science & Technology Focus Areas:

Uncrewed Systems ■ Artificial Intelligence ■ 'Omics ■ Cloud ■ Citizen Science ■ Data

January 2021



NOAA Citizen Science Strategy

Applying the Power of the Crowd

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Introduction

The NOAA Citizen Science Strategy outlines a path for the agency to engage the public in support of key mission areas. Citizen science as well as crowdsourcing, and challenge competitions all provide opportunities for the agency to engage the American public, address societal needs and accelerate science, technology, and innovation. New and emerging technologies, a growing field of practice and a better connected public are rapidly enhancing citizen science as a powerful tool for research and monitoring. NOAA is well positioned to leverage and contribute to this growth and harness the power of the crowd.

This Strategy aligns with the [Crowdsourcing and Citizen Science Act](#), that highlights the unique benefits of citizen science, such as “including accelerating scientific research, increasing cost effectiveness to maximize the return on taxpayer dollars, addressing societal needs, providing hands-on learning in STEM, and connecting members of the public directly to Federal science agency missions and to each other”. It also aligns with recommendations in Section 8 of the [National Integrated Drought Information System Reauthorization Act of 2018](#) to improve one of the National Weather Service’s long standing citizen science programs, the Cooperative Observer Program.

In addition, the Strategy addresses recommendations from the NOAA Science Advisory Board’s [Potential for Citizen Science in Support of Data Needs for Ecosystem-Based Science](#) 2018 report. It also supports the Administration’s commitment to “unleash Federal resources, strengthen partnerships inside and outside of government, and encourage citizens to tackle great scientific challenges,” as articulated by Dr. Kelvin Droegemeier, Director of the Office of Science & Technology Policy, on release of the [Implementation of Federal Prize and Citizen Science Authority: Fiscal Years 2017-18](#) report. Lastly, the NOAA Citizen Science Strategy supports the goals to [Accelerate American Leadership](#) and [Support Economic Activity](#) of the DOC Strategic Plan for 2018-2022 by advancing innovation and providing additional data streams. The Earth Prediction Innovation Center (EPIC) will serve as a model for how community-developed contributions can benefit operational applications.

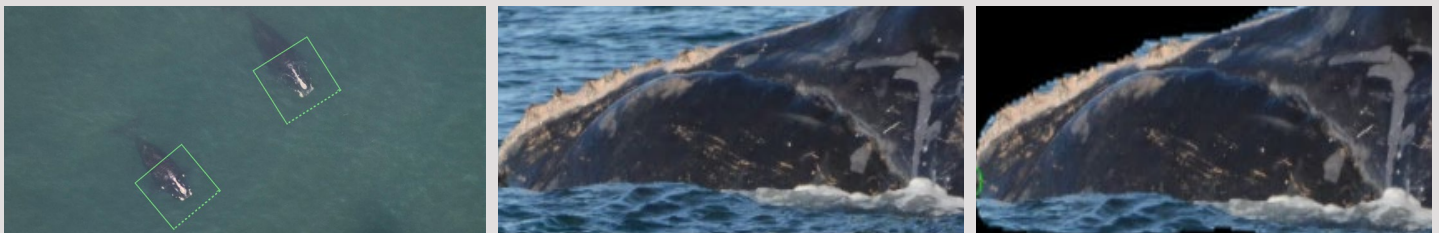


Image: Process of training the lateral viewpoint on a right whale head (taken from a boat instead of a plane). Image Credit: NOAA Fisheries

Whale Recognition

NOAA Fisheries is using citizen science and Artificial Intelligence (AI) to advance conservation of the endangered North Atlantic right whale through worldwide collaboration on two initiatives: 1) right whale photo-identification and 2) the launch of a new project to detect whales from satellite imagery. The use of AI for photo-identification automates the whale classification from aerial and vessel photographs, while a new project was launched to explore an operational whale detection system using satellite imagery.

Background

Citizen science has a rich history within NOAA. Volunteer observations have helped inform our Nation’s prediction and management of weather, oceans and coasts for over a century. This experience, paired with strengthened coordination, operational capabilities, workforce proficiency, and multisector partnerships will enable NOAA to lead citizen science efforts for years to come. NOAA will maximize and contribute to new pathways for evolving how the public engages with scientific research and monitoring. NOAA established a citizen science community of practice in 2013 and stood up an executive committee in 2020 to help inform this strategy. Our agency was also a founding member of the [Federal Crowdsourcing and Citizen Science Community of Practice](#) which now involves over 400 participants from 60 agencies. The majority of NOAA’s projects in this area are performed through partnerships. Collaboration is inherent in this type of work and the increased capacity within our agency will inform and benefit private and public institutions throughout the Nation.

What is Citizen Science?

Citizen Science is defined by the Crowdsourcing and Citizen Science Act (5 U.S. Code § 3724) as a form of open collaboration in which individuals or organizations participate voluntarily in the scientific process in various ways, including: (A) enabling the formulation of research questions; (B) creating and refining project design; (C) conducting scientific experiments; (D) collecting and analyzing data; (E) interpreting the results of data; (F) developing technologies and applications; (G) making discoveries; and (H) solving problems.

This work can go by other names (e.g., Community Science, Volunteer Monitoring, and Public Participation in Scientific Research).



Vision Statement

NOAA supports opportunities for the public to engage with the agency’s mission and address societal needs through science, technology, and innovation.

Purpose

The goals and supporting objectives in this strategy are intended to directly improve the understanding, coordination, awareness, and application of citizen science across NOAA. They are designed to ensure that NOAA-affiliated citizen science projects represent the high standards of our agency’s scientific products and services. By improving coordination of citizen science, routinely integrating citizen science into agency operations, building an infrastructure to ensure appropriate data quality, strengthening partnerships, and increasing proficiency for appropriately using citizen science, NOAA will be able to more fully harness innovation and public participation in research.

For the purposes of this strategy, citizen science also includes crowdsourcing: a “method to obtain needed services, ideas, or content

by soliciting voluntary contributions from a group of individuals or organizations, especially from an online community” as well as prizes and challenges. Challenges may also be referred to as “prize competitions,” and allow the public to solve problems presented by federal agencies and receive awards for the best solutions (source Challenge.gov).

NOAA’s Strategic Goals for Citizen Science

The strategy incorporates five goals that collectively drive change and position NOAA to fully leverage the power of public participation in support of agency mission areas.

Goal 1: Coordinate and Support Citizen Science Efforts across NOAA

NOAA values public participation and ingenuity to help meet its mission. It is critical that project managers apply best practices to build trusting relationships with project participants, assess project impacts, and produce high quality data. Toward this end, NOAA maintains a community of practice, with subject matter experts to provide the foundation for contemporary information exchange. NOAA will stay on the frontline of innovation by building and supporting an internal community empowered to effectively engage the public.

Objectives:

- a. Strengthen and expand an agency community of practice
- b. Increase awareness, and capacity to use, citizen science as a viable and increasingly capable tool to engage the public in helping NOAA meet its mission
- c. Develop flexible and diverse metrics and processes to track projects and impacts
- d. Ensure project managers take into consideration the particular needs, skills and motivation of project participants
- e. Establish a formal program and designate a Program Manager, pending available resources, to support existing and new projects and facilitate opportunities for collaboration
- f. Recognize citizen science in NOAA budget submissions



CrowdMag

NOAA’s CrowdMag project utilizes technology already found in smartphones! The project collects data from digital magnetometers in smartphones as volunteers go about their daily lives and creates a complete magnetic field map. CrowdMag has 65,000 users who have contributed more than 60 million magnetic data points that help improve NOAA’s models used in pointing, navigation and geolocation applications.

Image: Timeline for the DEVELOP competition. Image Credit: NREL

Goal 2: Expand integration of citizen science into agency mission activities as resources permit

NOAA will promote appropriate use of citizen science across the agency to address and advance mission areas and help fill data gaps. A necessary first step is increasing staff awareness of citizen science as a viable and valid tool to meet science and education needs and to highlight its unique ability to provide additional benefits like building relationships with stakeholders. Having this additional tool in the toolbox will aid the NOAA workforce in best addressing complex questions they face.

Objectives:

- Consider citizen science and community-based activities, where participants play a key role in project development, to address research and monitoring needs and help develop innovative solutions to complex scientific problems
- Ensure diversity, equity, and inclusion are considered in project design and implementation to maximize the benefits of citizen science
- Collaborate with NOAA's other Science and Technology Focus Areas to maximize collective impact
- Recommend new Cooperative Institute (CI) prospectuses include citizen science, and encourage current CIs to expand their inclusion of citizen science derived data and applications

Goal 3: Promote Citizen Science Data Quality and Accessibility at NOAA

Citizen science projects vary in their core objectives. Some may focus on educating students while others primarily seek to collect data

for science and management purposes. Regardless of core objective, any citizen science project which involves NOAA and its resulting data should strive to represent NOAA's high standards and uphold our agency's reputation as an objective, trusted source of information. Towards this end, projects should be designed with scientific quality and data credibility as core considerations. Data collected for legal, regulatory, and/or policy actions may have specific requirements in order to be used. Citizen science data must meet these requirements in order to be considered for such actions and will require more extensive quality assurance and documentation than data collected for increasing public understanding. Ultimately, the goal is to put agency processes and resources in place to ensure that NOAA and NOAA-affiliated citizen science projects apply appropriate data fitness for use.

Objectives:

- Ensure projects are designed with scientific quality and data credibility as core considerations
- Provide strategies and templates to aid NOAA projects in applying and documenting best practices in support of data quality
- Encourage NOAA projects to maximize accessibility of their data and metadata and provide transparency in the presentation of the methods by which data are collected
- Ensure projects have access to data repositories and visualization tools that meet their needs
- Ensure appropriate data fitness for use, particularly when citizen science data are considered for use for regulatory purposes
- Ensure NOAA sponsored or applied citizen science data adhere to the principles and support the goals of NOAA's Data Strategy

Community Collaborative Rain, Hail and Snow (CoCoRaHS) Project

Over 19,000 active trained observers collect precipitation data through the Collaborative Community Rain, Snow, and Hail (CoCoRaHS) Network. Their daily data provide small-scale coverage, which helps researchers and the National Weather Service better understand the spatial variability of precipitation. The real-time reports help the National Weather Service issue timely alerts on severe weather conditions. With support from a Microsoft Artificial Intelligence for Earth grant, CoCoRaHS is working to use AI technology to help process and share collected data.

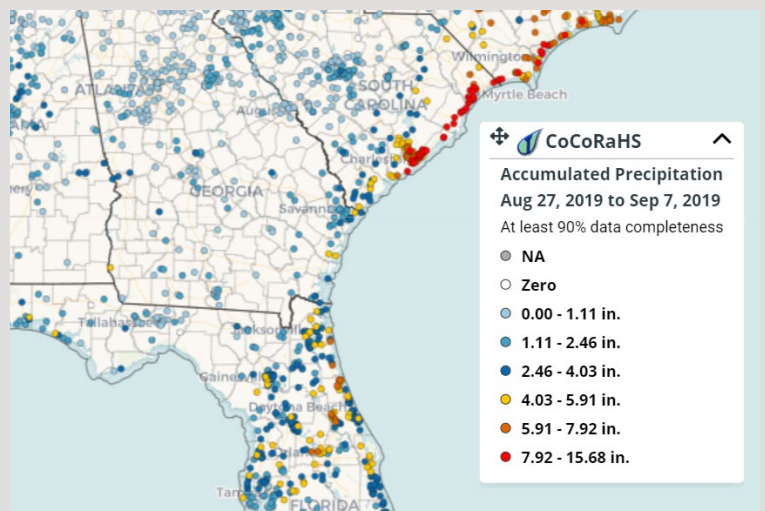


Image: Precipitation amounts reported by CoCoRaHS volunteers during Hurricane Dorian. (source: maps.cocorahs.org)

Goal 4: Strengthen and Expand Partnerships to Advance Citizen Science

Collaborative work forms the basis for every citizen science project and is likewise essential to effectively advance innovation work on an agency level. Partnerships with all sectors, public and private, will allow NOAA to stay current in this rapidly evolving field and maintain the ability to contribute to efforts of organizations working toward similar goals. NOAA encourages an approach to partnerships in which the unique set of skills, capacities and perspectives of all parties are viewed as strengths and valuable contributions. Such collaborative partnerships are essential to positioning NOAA as a leader in this field.

Objectives:

- a. Strengthen and expand intergovernmental partnerships through the Federal Community of Practice for Crowdsourcing and Citizen Science and the Federal Community of Prizes and Challenges
- b. Review existing NOAA non-governmental partnerships and modify the corresponding agreements for those which are most amenable to add citizen science components
- c. Develop new partnerships to expand use of citizen science and supporting technologies in mutually-beneficial projects with the following entities: private sector; philanthropic organizations; institutions of higher education; community-based organizations, formal and informal education institutions and organizations; state and local government agencies; and Indian tribal governments
- d. Work with partners to ensure NOAA citizen science project managers are well-informed on the latest technologies and services to support efforts
- e. Engage the various environmental community listservs, distributions, and professional societies to promote NOAA Citizen Science application and the formation of new partnerships

- f. Include discussion of citizen science in NOAA executive level engagement and communications with key stakeholders with emphasis on the NSTC Select Committee on STEM Education

Goal 5: Increase Workforce Proficiency for Appropriately Using Citizen Science

Success of this strategy relies on a diverse, collaborative, and well-trained NOAA staff knowing if, when, and how to use citizen science. This includes understanding how to approach liability and privacy issues related to public participation. We will provide targeted training to staff interested in citizen science to evaluate if this is an appropriate approach, and if so, how to design and apply projects according to best practices, including how to successfully recruit and engage volunteers. This will be achieved through focused, current, and accessible training opportunities that convey well-established principles and best practices from the field. NOAA's existing development programs are well suited to include such trainings. In addition, collaboration with partners such as the National Park Service, National Conservation Training Center, U.S. Forest Service, and Citizen Science Association may provide options to develop skills, understanding, and expertise.

Objectives:

- a. Provide training, information, and tools to guide appropriate application of citizen science to meet desired project goals
- b. Leverage and contribute to a growing body of research and best practices
- c. Provide formal training materials and modules through internal and external venues
- d. Conduct outreach and education on NOAA's Citizen Science Program to new supervisors, interns, scholars, fellows, NRAP details, and Mentoring and LCDP Program cohorts across NOAA

HABscope

In Florida and Texas, citizen scientists are helping to protect public health and the economy by participating in the Red Tide Respiratory Forecast. The citizen scientists use HABscope, a portable microscope system with video and AI, to quickly analyze water samples for *Karenia brevis*, the organism that causes red tides in the Gulf of Mexico.



Left Photo: The HABscope system in the field. Right Picture: shows the AI program identifying *Karenia brevis* with the green squares. Image Credit: Mote Marine Laboratory and Robert Currier.

DEVELOP COMPETITION

*Hurricane Monitoring:
Self-Charging AUVs*

DESIGN CONTEST

Draft plans and models

- 120 days
- Up to 10 winners
- \$400,000 in prizes

BUILD CONTEST

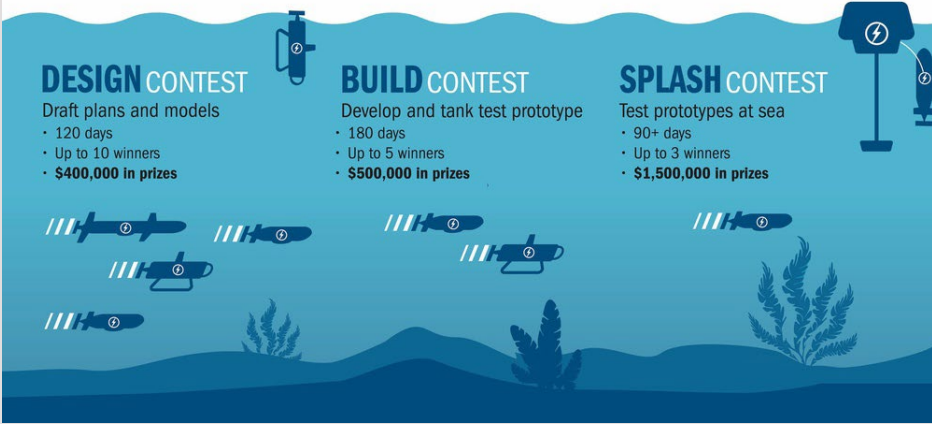
Develop and tank test prototype

- 180 days
- Up to 5 winners
- \$500,000 in prizes

SPLASH CONTEST

Test prototypes at sea

- 90+ days
- Up to 3 winners
- \$1,500,000 in prizes



DISCOVER and DEVELOP Competitions

The Ocean Observing Prize consists of two competitions designed to incentivize accelerated innovation in marine energy and ocean observations, which can help fill data gaps to realize the full potential of the Blue Economy. The DISCOVER Competition, solicited novel concepts that integrate ocean observing technologies with marine energy systems. The DEVELOP Competition will focus on a single theme: Buoys and Autonomous Systems.

Image: Timeline for the DEVELOP competition. Image Credit: NREL

Environmental Monitors on Lobster Traps and Large Trawlers (eMOLT)

Since 2001, more than 100 commercial fishing vessel captains have helped deploy oceanographic sensors in waters of New England as part of the Environmental Monitors on Lobster Traps and Large Trawlers (eMOLT) program. Over 50 vessels have transmitted 12,000 bottom temperatures in real time, which are now being fed to ocean forecast models. These vital monitoring efforts allow for the fisheries to be sustained in the rapidly changing environment.




Image: eMOLT in action. Image Credit: Huanxin Xu

Conclusion

This Strategy will guide the application of citizen science across NOAA using best practices while ensuring data quality and integrity. It will increase the use of innovation and public participation to help accomplish NOAA's mission. It will also set the course to involve the public, when appropriate, in developing innovative solutions to scientific problems. As a next step, NOAA is developing a Citizen Science Strategic Plan that will define detailed action items, deadlines, metrics, and responsibilities as resources permit. Together with our advances in NOAA's other science and technology focus areas— Artificial Intelligence, Cloud Computing, Data, 'Omics, and Unmanned Systems—NOAA's citizen science activities will help the U.S. continue to lead in developing innovative, cost-effective and collaborative solutions to global environmental and technology issues.



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Acknowledgements

The NOAA Citizen Science Strategy is led by Timothy Gallaudet, Ph.D., Rear Admiral, U.S. Navy (Ret.), Assistant Secretary of Commerce for Oceans and Atmosphere / Deputy NOAA Administrator. John McLaughlin from the NOAA Office of Education and Laura Oremland from NOAA Fisheries Office of Science and Technology are coordinating the overall process in collaboration with the NOAA Citizen Science Executive Committee, which is chaired by Rear Admiral Gallaudet with Louisa Koch from the NOAA Office of Education as Vice-Chair and whose members are listed below:

National Environmental Satellite, Data, and Information Service: Jennifer Jencks

National Marine Fisheries Service: Cisco Werner

National Ocean Service: John Armor

National Weather Service: Stephan Smith

Office of Oceanic and Atmospheric Research: Jonathan Pennock, Kevin Wood

Office of Marine and Aviation Operations: John McDonough

