

Charter of NOAA's Atlantic Oceanographic and Meteorological Laboratory

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Mission Statement and Vision:

The Atlantic Oceanographic and Meteorological Laboratory (AOML) conducts basic and applied research related to oceans and climate, coastal ecosystems, and tropical meteorology. The program seeks to understand the physical, chemical, and biological characteristics and processes of the ocean and the atmosphere, both separately and as a coupled system. The principal focus of these investigations is to provide knowledge that will ultimately lead to improved prediction and forecasting of severe storms, better utilization and management of marine resources, better understanding of the factors controlling climate and affecting environmental quality, and improved ocean and weather services for the nation.

Core Competencies:

- ✓ In situ hurricane observation, airborne instrumentation development and application, high resolution numerical model development and testing, data assimilation techniques, rapid intensification prediction
- ✓ Ocean observing system design, implementation, quality control, and processing.
- ✓ pCO₂ monitoring technology development, data processing and flux estimations
- ✓ Global and coastal ocean circulation observation, modeling
- ✓ Mico-level detection of oceanic nutrients and molecular analysis of coastal pathogens

Charge Under NOAA's Strategic Plan:

AOML research is mandated by 28 federal statutory authorities, as well as the following NOAA Goals:

- Weather and Water –
 - Increase lead-time and accuracy for weather and water warnings and forecasts
 - Increase development, application, and transition of advanced science and technology to operations and services
 - Reduce uncertainty associated with weather and water forecasts and assessments
 - Enhance environmental literacy and improve understanding, value, and use of weather and water information and services
- Ecosystems –
 - Provide tools, technologies, and information services that are effectively used by NOAA partners and customers to improve ecosystem based management
 - Advance understanding and characterization of coastal, marine, and Great Lakes ecosystem health and associated socioeconomic benefits, and develop forecasting capabilities to meet management needs
- Climate –
 - Describe and understand the state of the climate system through integrated observations, monitoring, and data management
 - Understand and predict climate variability and change from weeks to decades to a century
 - Improve the ability of society to plan for and respond to climate variability and change

Charge Under Statutory Authority:

1. *National Weather Service Organic Act of 1890 (as amended), 15 U.S.C. § 313 et seq.:* Ensures there are atmospheric, oceanic, and terrestrial measurements suitable for establishing and recording U.S. climate conditions.
2. *National Climate Program Act of 1978, 15 U.S.C. § 2901-2908, at 2904(d) (4), et seq.:* Requires that one program element will be the provision of "useful and readily available information on a continuing basis." It authorizes global data collection, monitoring, and analysis activities to provide reliable, useful and readily available information on a continuing basis. In addition, the act authorizes measures for increasing international cooperation in climate research, monitoring, analysis, and data dissemination.
3. *Coastal Zone Management Act (CZMA) of 1972 (as amended 1990), 16 U.S.C. § 1450 et seq.:* Requires understanding and predicting long-term climate change, which may have large impacts in the coastal zone such as global warming and associated sea level rise.
4. *Global Change Research Act of 1990, 15 U.S.C. § 2921 et seq.:* This act provides for the development and coordination of a comprehensive and integrated United States research program which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change. Ensures the establishment of global measurements and worldwide observations, and requires an early and continuing commitment to the establishment and maintenance of worldwide observations and related data and information systems.
5. *Clean Air Act 1990, 42 U.S.C. § 7401 et seq.:* Amendment to the Clean Air Act mandates that "the Administrators of the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration shall monitor, and not less often than every 3 years following November 15, 1990, submit a report to Congress on the current average tropospheric concentration of chlorine and bromine and on the level of stratospheric ozone depletion."
6. *Global Climate Protection Act of 1990, 7 U.S.C. § 6701 et seq.:* Requires research in climate change needed to protect the environment.
7. *Oceans Act of 2000, Pub. Law No. 106-256:* Led to the Congressionally-mandated report of the U.S. Commission on Ocean Policy and the Executive response, the U. S. Ocean Action Plan of 2005: Requires federal agencies to participate in building a Global Earth Observation Network that includes integrated oceans observations. The U.S. is implementing

this through the Integrated Ocean Observation System (IOOS), the Integrated Earth Observation System (IEOS), and participation in GEOSS.

8. *Consolidated Appropriations Act of 2005, Pub. Law No. 108-447*: “Establish[es] a Federal research program that examines ocean resources and their applications to human health.” The Act aims to “...ensure that any integrated ocean and Coastal observing system provides information necessary to monitor, predict and reduce marine public health problems including: (A) baseline observations of physical ocean properties to monitor climate variation; (B) measurement of oceanic and atmospheric variables to improve prediction of severe weather events; ...”
9. *Integrated Coastal and Ocean Observation System Act of 2009, Pub. Law No. 111-11* (as passed in the *Omnibus Public Land Management Act of 2009*): Establishes NOAA as the lead Federal agency for the implementation of a national integrated system of ocean, coastal, and Great Lakes observing systems “to support...weather, climate and marine forecasting...improve the Nation’s capability to measure, track, explain, and predict events related directly and indirectly to weather and climate change, natural climate variability, and interactions between the oceanic and atmospheric environments, including the Great Lakes; and authorize activities to promote basic and applied research to develop, test and deploy innovations and improvements in coastal and ocean observation technologies, modeling systems, and other scientific and technological capabilities to improve our conceptual understanding of weather and climate, ocean-atmosphere dynamics, [and] global climate change.”
10. *Federal Ocean Acidification Research and Monitoring Act of 2009, Pub. Law No. 111-11* (as passed in the *Omnibus Public Land Management Act of 2009*): Establishes an ocean acidification program within NOAA to conduct research, monitor ocean chemistry and biological impacts of ocean acidification, and coordinate with appropriate international ocean science bodies.
11. *Secure Water Act of 2009, Pub. Law No. 111-11* (as passed in the *Omnibus Public Land Management Act of 2009*): NOAA shall provide the Secretary of the Interior with “access to the best available scientific information with respect to presently observed and projected future impacts of global climate change on water resources.”
12. *Ocean and Coastal Mapping Integration Act, Pub. Law No. 111-11* (as passed in the *Omnibus Public Land Management Act of 2009*): Requires NOAA to: (1) “establish a program to develop a coordinated and comprehensive Federal ocean and coastal mapping plan for the Great Lakes and coastal state waters, the territorial sea, the exclusive economic zone, and the continental shelf of the United Seas...to facilitate, to the extent practicable, the collection of real-time tide data,” and (2) “advance the use of remote sensing technologies for ... ocean observations.”
13. *Omnibus Public Land Management Act of 2009*: NOAA and DOI are directed to establish and lead an inter-agency panel to review current scientific understanding of climate change on the quantity and quality of U.S. water resources and develop strategies to improve observational capabilities, expand data acquisition, increase the reliability and accuracy of modeling and prediction systems to benefit water managers, and increase the understanding of the impacts of climate change on aquatic ecosystems. NOAA will establish an ocean acidification program and in collaboration with NSF and NASA will develop and coordinate an interagency plan that will assess impacts from ocean acidification. NOAA is authorized to perform research on marine ecosystem adaptation to ocean acidification, including coordinated interdisciplinary and international research, long-term monitoring, and research to develop adaptation strategies for marine ecosystems.
14. *Federal Water Pollution Control Act* (Clean Water Act), 33 U.S.C. § 1251 et seq. - The principle statute governing water quality with the goal is to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters. The CWA regulates both the direct and indirect discharge of pollutants into the Nation’s waters and prohibits the discharge into navigable waters of any pollutant by any person from a point source unless it is in compliance with a National Pollution Discharge Elimination System (NPDES) permit.
15. *National Response Framework*, Department of Homeland Security (March 22, 2008), <http://www.dhs.gov/xlibrary/assets/NRPbaseplan.pdf> - Uses the foundation provided by the Homeland Security Act, HSPD-5 and the Stafford Act to provide an all hazard approach to incident management. It tasks the Department of Commerce and NOAA with acquiring and disseminating weather data, forecasts, and emergency information.
16. The *U.S. Ocean Action Plan*, December 17, 2004, calls for a national monitoring network to observe, analyze, and forecast natural and human-induced changes that affect watershed, estuarine, and coastal ecosystems.
17. *U.S. Weather Research Program (USWRP) Authorization Act*: The U.S. Weather Research Program (USWRP) is mandated to accelerate forecast improvements of high impact weather and facilitate full use of advanced weather information.
18. *U.S.C. § 883d*, Improvement of methods, instruments, and equipments; investigations and research. To improve the efficiency of the National Ocean Survey and to increase engineering and scientific knowledge, the Secretary of Commerce is authorized to conduct developmental work for the improvement of surveying and cartographic methods, instruments, and equipments; and to conduct investigations and research in geophysical sciences (including geodesy, oceanography, seismology, and geomagnetism).
19. *33 U.S.C. § 883(d)*, Improvement of methods, instruments, and equipments; investigations and research: To improve the efficiency of the National Ocean Survey and to increase engineering and scientific knowledge, the Secretary of Commerce is authorized to conduct developmental work for the improvement of surveying and cartographic methods, instruments, and equipments; and to conduct investigations and research in geophysical sciences (including geodesy, oceanography, seismology, and geomagnetism).
20. *The Coral Reef Conservation Act of 2009* – This Act is the primary driver for the CRCP activities by directing NOAA to develop and implement a national strategy and program for coral reef conservation and management that includes coastal uses and management; water and air quality; mapping and information management; research, monitoring, and assessment; international and regional issues; outreach and education; local strategies developed by the States and

- Federal agencies, including regional fishery management councils; and conservation, including how the use of marine protected areas to serve as replenishment zones will be developed consistent with local practices and traditions
21. *Coastal Zone Management Act* – Provides direction for NOAA and the CRCP to work with state/territory and local entities to collaboratively develop coral reef management actions.
 22. *National Marine Sanctuary Act* - mandates that NOAA shall support, promote, and coordinate scientific research on, and long-term monitoring of, the resources of marine sanctuaries, and evaluate the implementation of each sanctuary's management plan and goals. It also mandates NOAA to “prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man.”
 23. *Harmful Algal Bloom and Hypoxia Research Control Act*: NOAA shall develop research plans and assessments and examine alternatives to reduce, mitigate, and control hypoxia and HABS in coastal waters including the Great Lakes.
 24. *National Sea Grant College Program Act* (as amended by the Reauthorization Act of 2008): The Act directs the Secretary of Commerce to “. . . provide support for . . . national strategic investments in fields relating to ocean, coastal, and Great Lakes resources...”
 25. *Oceans and Human Health Act* - the Secretary of Commerce established an Oceans and Human Health Initiative to coordinate and implement research and activities of NOAA related to the role of the oceans in human health.
 26. *America Competes Act* [P.L. 110-69] Title IV of this Act directs NOAA to coordinate with NSF and NASA to establish a coordinated program of ocean, coastal, Great Lakes, and atmospheric research and development (in collaboration with academic institutions and other nongovernmental entities) that focuses on the development of advanced technologies and analytical methods that will promote United States leadership in ocean and atmospheric science and competitiveness.
 27. *Magnuson Stevens Fishery Conservation and Management Reauthorization Act* (1976, 1996, 2006): Provides for research to support fishery conservation and management, including but not limited to, biological research concerning the abundance and life history parameters of stocks of fish, the interdependence of fisheries or stocks of fish, the identification of essential fish habitat, the impact of pollution on fish populations, the impact of wetland and estuarine degradation, and other factors affecting the abundance and availability of fish.
 28. *National Coastal Monitoring Act* (Title V of the Marine Protection, Research, and Sanctuaries Act: Requires the Administrator of the Environmental Protection Agency and the NOAA Under Secretary, in conjunction with other Federal, state and local authorities, jointly to develop and implement a program for the long-term collection, assimilation, and analysis of scientific data designed to measure the environmental quality of the nation's coastal ecosystems.

Science Themes and Research Areas:

- Hurricanes
 - Improve the basic physical understanding and model forecasts of tropical cyclone track, intensity, and structure change and their impacts (rainfall, storm surge, flooding, damaging waves and winds), and develop model systems to test with actual observations.
- Coastal Ecosystems
 - Characterize, understand and predict the impact of remote oceanographic and meteorological forcing, climate change, ocean acidification, and land-based sources of pollution, and their synergistic interactions, on coastal and coral reef ecosystems of south Florida, the Gulf of Mexico and the Caribbean Sea.
 - Develop the next generation of methodologies, instruments, sensors, and integrated environmental monitoring systems required to monitor ecological and chemical processes in the coastal marine ecosystem.
 - Integrate data, models, and information to develop reliable ecological forecast and incorporate these forecasts into management decision support.
- Oceans and Climate
 - Observe variations in the ocean circulation and property transport from fine-scale mixing to long-term climate change and improve our understanding of the physical processes and mechanisms that control these variations. (Projects include the Western Boundary Time Series Program, the South Atlantic Meridional Overturning Circulation, Rapid/MOCHA, the High Density XBT program, the PIRATA Northeast Extension, AOML's satellite products, the Global Drifter Program, the Argo float program and the Ship of Opportunity Program)
 - Quantify the role of the oceans in sequestering carbon dioxide using buoys, research ships and vessels of opportunity, and the role of coastal oceans in the global carbon cycle and the impacts of ocean acidification on marine resources. (Projects include the CLIVAR/CO₂ Repeat Hydrography, Ocean SITES moored CO₂ measurements, and surface underway CO₂ measurements)

Products and Results:

- Develop a set of diagnostic packages to compare hurricane models and observations.
- Develop the experimental Hurricane Weather Research & Forecast model (HWRFx) and tested it in real-time for every Atlantic tropical system in 2009 with 9-km outer and 3-km inner resolution.

- Coordinate and conduct yearly Intensity Forecast Experiment in partnership with NWS, NESDIS, and AOC to collect high quality observations in support of operations and HFIP needed to improve hurricane track and intensity forecasts. Continue development and testing of new instrumentation, in particular the G-IV tail Doppler radar.
- Develop and test ensemble Kalman filter data assimilation system for possible implementation in NOAA's operational hurricane regional model system (HWRF). Test impact of assimilation of airborne and ground-based Doppler radar data.
- Develop and test advanced nesting capability for possible implementation into HWRF to enable simulations at resolutions down to 1 km.
- Improved understanding of the role of ocean currents on economically important larval reef fish and a better ability to designate optimal Marine Protected Areas (MPAs).
- Developed ecological forecasting in the Integrated Coral Observing Network (ICON) Program which acquires and integrates near real-time data from in situ, satellite, radar and other data sources at important U.S. and international coral reef ecosystems to compose ecological forecasts for Marine Protected Area (MPA) managers and researchers to understand and predict coral reef ecosystem response to climate change, such as coral bleaching, ocean acidification, harmful algal blooms, ocean current shifts, spawning, migration, and other marine phenomena.
- Conduct observational research and modeling to assess the impacts of land-based sources of pollution and water use practices, including treated wastewater and inlet discharges, on marine ecosystems and human and animal health to guide the management process.
- Develop a method to estimate air-sea CO₂ fluxes on seasonal time scales utilizing ship of opportunity and satellite remote sensing data.
- Observe key components of the Atlantic Meridional Overturning Circulation in the South Atlantic.
- Contributed with the deployment and data management of the global array of Argo floats and surface drifters.

Customers:

AOML partners with many components of NOAA (National Ocean Service's Florida Keys National Marine Sanctuary and Office of Response and Restoration, the National Marine Fisheries Service Southeast Fisheries Science Center, and the Office of Oceanic and Atmospheric Research's Earth Systems Research Laboratory and Geophysical Fluid Dynamics Laboratory. NOAA's National Weather Service is primary customer of AOML, with scientific understanding, observing technologies, and intensity predictive capabilities directly improving the National Hurricane Center's ability to produce the best possible forecasts. AOML also partners with many universities, especially the University of Miami through the Cooperative Institute of Marine and Atmospheric Studies (CIMAS); numerous other Federal agencies including the Environmental Protection Agency, Army Corps of Engineers, NASA, and the Office of Naval Research; regional agencies such as the South Florida Water Management District; and several foreign research organizations.

Future Expectations:

AOML expects to NOAA's long term mission objectives, goals and strategic plans by building and sustaining a center of excellence in scientific research, instrument development and observational expertise in the areas of hurricane forecasting, coastal ecosystems and climate. AOML will continue to lead the implementation and maintenance of the ocean observing system for climate studies and a continued emphasis in analysis of these observations. Enhanced ocean acidification chemistry and ocean optics observations will be added to the existing observational programs in Florida Keys, Puerto Rico, and the U.S. Virgin Islands. AOML will continue to develop the observation simulation experiments and modeling programs including the analysis and evaluation of data assimilation schemes for the Hurricane Weather Research and Forecast experimental model system (HWRFx) focusing on the use of dropsondes and Doppler radars. Hurricane Research will be advanced through the planning and execution of the Intensity Forecast Experiment, coordinating with National Science Foundation-sponsored PREDICT and National Aeronautics and Space Administration-sponsored Genesis and Rapid Intensification Processes field projects.