NOAA's Atlantic Oceanographic and Meteorological Laboratory
U.S. Department of Commerce

Accomplishments for Fiscal Year 2021
NOAA's Atlantic Oceanographic and Meteorological Laboratory

Cutting-edge Earth system research and observations for the Atlantic region to predict changes in weather, climate, ocean, and marine ecosystems

NOAA's Atlantic Oceanographic and Meteorological Laboratory
4301 Rickenbacker Causeway, Miami, Florida 33149
www.aoml.noaa.gov

Letter from the Director

As I continue in my second year of serving as the AOML Director, I am pleased to report that In Fiscal Year 2021, our team at AOML worked to carry out NOAA's mission amidst the ongoing challenges of a pandemic. Our people have proven resilient and resourceful in a telework environment by capitalizing on partnerships, collaborating with other labs, and piloting new staffing projects with OAR. I want to express my sincere gratitude for everyone in the AOML community and to our cooperative institutes, cooperative science centers, partner programs, and collaborators across NOAA for your support and partnership throughout this challenging period.

Despite the ongoing pandemic, the AOML team continued to be very productive, thanks in part to the services provided by members of our administrative, computer support, and engineering teams. Our scientists successfully executed several field campaigns, and with newly expanded remote and uncrewed observing capabilities, have streamlined data collection to continue the mission of studying the influence of the Atlantic Ocean and its impacts on the region. These campaigns provided important observations that AOML used to improve our understanding of important Earth system components and to further develop models used by NOAA operational units and decision makers. We developed and advanced numerous transition plans to ensure our research is transitioned into usable information and shared our research results with the scientific community and the public by publishing 136 scientific papers in peer-reviewed publications in FY 2021 (the highest number for a single year in AOML's history). Much of our research also contributed key data and analyses to global reports and initiatives.

In FY 2021, we also launched our new strategic plan for FY 2022-2026. The strategy will inform priority decisions in funding, scientific endeavors, and partnerships, and identify new opportunities to expand and prioritize the diverse portfolio of research at AOML. We also incorporated diversity and inclusion through mentorship and internship programs, ensuring equity in awards and performance evaluations, and serving in various diversity and inclusion positions across OAR.

This accomplishments document highlights our major accomplishments for FY 2021, as it reflects our strategic objectives to support OAR and NOAA. With a focus on the future, we aim to empower our team, observe, assess, and model components of the Earth system, and to transition our research to the people who benefit from it. In the coming year, we look forward to working with and expanding our community to provide the best science possible to represent NOAA and deliver authoritative, actionable results for our nation.

Sincerely,

Dr. John Cortinas
Director of NOAA's Atlantic Oceanographic and Meteorological Laboratory, Miami, Florida

Goal 1: Empower Our Team

Create an inclusive and cutting-edge environment that fosters discovery, exploration, and success.

Facility Upgrades to Create Healthier, More Efficient Workspaces with Upgraded Capabilities

As part of an ongoing effort to provide staff with a world-class research facility, AOML has made significant progress in modernizing its historic building by renovating laboratory spaces, updating computing capabilities, improving energy efficiency, and providing resources for employee wellness, health, and safety.

These improvements include new guardrails, environmentally friendly water fountains with no-touch fill stations, hand sanitizer dispensers, new fume hoods for laboratory spaces, a completely renovated gym, much needed roof repair, a new small boats shed, and major cosmetic repairs to the second and third floor bridge wings. Additionally, AOML's Data Center was relocated and updated with state-of-the-art equipment to meet the lab's evolving computing needs.

AOML Paves the Way by Providing Accessible Diversity and Inclusion Resources Online

AOML unveiled a new top-level Diversity and Inclusion hub on its website in both English and Spanish. The web page includes a wealth of resources and a comprehensive calendar of events regarding health and wellness, employee assistance, workplace violence and prevention, employee resource groups, equal employment opportunity, and diversity programs, as well as events occurring with AOML's Cooperative Institutes and scientific and professional associations. The page has been used as a model for other OAR labs and programs to use for displaying comprehensive diversity and inclusion resources online.

AOML Scientists Strengthen Management Capabilities by Completing Rigorous Leadership Development Training

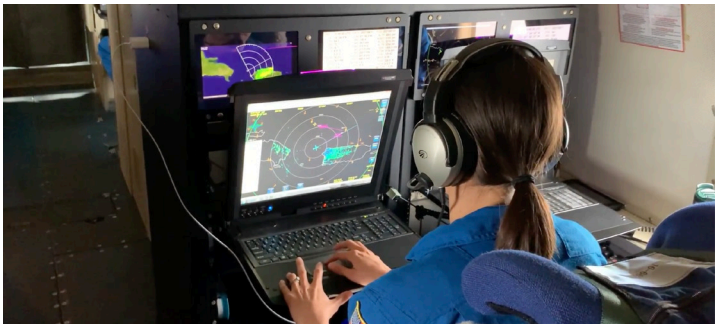
In FY 2021, two AOML scientists completed NOAA's Leadership Competencies and Development Program. This program is a competitive, 18-month program that provides participants with leadership development experiences and assignments to broaden their understanding of NOAA's strategic vision, mission, and goals, as well as business practices. Congratulations to Dr. Sundararaman Gopalakrishnan and Dr. Robert Rogers. AOML looks forward to supporting their new capabilities.

AOML Receives Funds Obligation Award at OAR

In this year's competition, OAR's Office of the Chief Financial Officer announced that AOML had attained an obligation rate of 99.58% for its FY 2021 budget, the highest rate of obligation achieved by OAR's research labs and programs.

A Strong Focus on Diversity and Inclusion through Mentoring and Internships Brings in Top Talent

AOML collaborates with the local community, NOAA Cooperative Science Centers, and other minority-serving institutions to advance research and attract new talent through internships and mentorship. AOML serves as the co-technical monitor for NOAA's Center for Coastal and Marine Ecosystems and hosted a postdoctoral student during the 2021 GOMECC-4 cruise. AOML also hosted 18 interns throughout FY 2021, including four William Lapenta Interns, a Hollings Scholar, two NOAA Experiential Research and Training Opportunities students, and several others from seven academic institutions.



Early career scientist working with the 2021 Hurricane Field Program.

Researchers at AOML Receive Major Awards for Excellence in Research, Career Achievement and Community Impact

In FY 2021, 26 AOML scientists were recipients of 10 prestigious awards, including Department of Commerce Bronze Medals, the NOAA Administrator's Award, NOAA's Distinguished Career Award, and the NOAA Employee of the Month Award. External awards that recognized AOML scientists for their outstanding work included The Oceanographic Society's Ocean Observing Award, the American Meteorological Society's Joanne Simpson Tropical Meteorology Award, the Global Employee Resource Group Network's Diversity Impact Award, the Royal Meteorological Society's Reviewer's Certificate, and the Association of Marketing and Communication Professionals' Hermes Creative Platinum Award for Outstanding TV Placements and Outstanding Overall Publicity Campaign.

Goal 2: Observe the Earth System

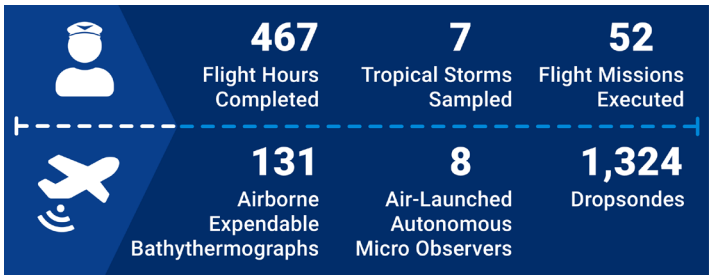
Collect and evaluate ocean, atmosphere, and marine ecosystem observations that contribute to the body of scientific knowledge of the Atlantic Ocean region to improve the ability to better assess and predict the Earth system.

Integrating Ocean Observations to Improve NOAA's Hurricane Intensity Forecasts Workshop Yields New Collaborations and A Case Study in Hurricane Isaias

In partnership with NOAA's Global Ocean Monitoring and Observing Program and the U.S. Integrated Ocean Observing System, AOML held a virtual workshop in FY 2021 that brought together leaders in the observational and modeling communities to discuss ways to improve integration, coordination, and communication across NOAA ocean observing and modeling activities as they relate to hurricane intensity forecasting.

A great example of cross-line office collaboration, workshop hosts represented OAR and the National Ocean Service. Keynote presentations were given by representatives from NOAA's National Weather Service and Office of Marine and Aviation Operations. A number of individuals from labs and line offices within NOAA and many external organizations (e.g., U.S. Navy, Naval Research Laboratory, Rutgers University, University of Washington) also participated.

Hurricane Isaias provided a test case to evaluate the ocean component of the full end-to-end hurricane forecast data flow across three key regions. The team coordinated observations in front of and along the track of Hurricane Isaias with air-deployed drifters and pre-positioned Argo floats and gliders. Scientists are in the process of conducting an analysis of the data and their potential ocean impacts.



AOML Hurricane Field Program, By the Numbers for FY 2021.

Hurricane Field Program Targets Rapid Intensification with the Office of Naval Research

In collaboration with the Office of Naval Research, AOML sampled three rapidly-intensifying storms, Grace, Ida, and Sam. They deployed over 1300 GPS dropsondes and 70 expendable bathythermographs before, during, and after rapid intensification, collecting 3-D profiles of the ocean to depths of hundreds of meters to better understand how thermal energy in the ocean helps storms rapidly intensify. Doppler radar on board the NOAA Hurricane Hunter aircraft provided over 146 3-D snapshots of wind and rain activity to gain insight into the inner core development of hurricanes and how rainfall contributes to rapid intensification.

In addition to developing research platforms, Doppler radar observations obtained during airborne missions were are quality controlled and transmitted to the National Weather Service for initialization of NOAA's operational hurricane models. This collaboration is a key component of NOAA's Intensity Forecast Experiment.

Hurricane Gliders Create a Picket Fence to Collect Critical Ocean Data During Storms

In FY 2021, researchers at AOML found that assimilating ocean data collected from NOAA hurricane gliders into coupled forecast models reduced the error in intensity forecasts by 56%. *(continued on page 4)*

AOML Teams Up with Saildrone and PMEL to Tackle Rapid Intensification Research

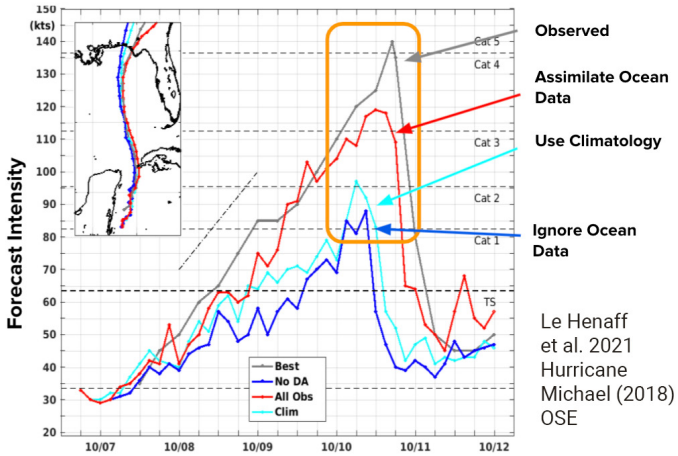
In FY 2021, we teamed up with NOAA's Pacific Marine Environmental Laboratory and Saildrone, Inc. to deploy five new extreme weather saildrones into hurricanes to collect data at the ocean/atmosphere interface in the Caribbean and western tropical Atlantic. The drones spent a combined 480 continuous days at sea. In a world first, one saildrone withstood winds of 125 mph to bring back video footage and real-time data from the eyewall of Hurricane Sam. These were the first measurements from a surface uncrewed autonomous vehicle in the eyewall of a major Atlantic hurricane.

These observations complemented tools already in use by AOML. The array of simultaneous observations taken from the atmosphere, ocean surface, and ocean depths will help NOAA better represent the conditions that drive hurricanes and improve models for better forecasting. By understanding ocean conditions, inner storm processes, and storm structure, researchers better understand rapid intensification and provide more accurate warnings when rapidly intensifying storms threaten landfall.

Goal 2: Observe the Earth System

(continued from page 3) This year, observations obtained in the Caribbean Sea, tropical North Atlantic Ocean, off the U.S. eastern coast, the Gulf of Mexico, and the Bahamas as the result of a partnership between AOML, IOOS, the U.S. Navy, academic institutions, and private industry created a picket-fence of hurricane gliders.

The gliders spent a total of 750 days at sea and transmitted 8,500 individual data profiles in near real-time to models. NOAA's hurricane gliders, together with data assimilation research, have demonstrated a promising return on their investment to significantly improve intensity forecasts and protect lives and property.



Research published by scientists at AOML in FY 2021 showed that correctly representing the ocean in models can reduce intensity errors by up to 56%.

Gulf of Mexico Ecosystems and Carbon Cruise Builds Time-Series of Data on Ocean Acidification

AOML contributed to a 2019 study published in *Science* that described the ocean's uptake of atmospheric CO_2, showing the global ocean absorbed four times as much carbon from 1994-2007 than it had since the start of the Industrial Revolution. AOML partners with NOAA's Ocean Acidification Program to perform large-scale surveys of ocean acidification trends and dynamics in the Gulf of Mexico.

The R/V Ronald H. Brown returning to port after the GOMECC-4 cruise.

During the 39-day Gulf of Mexico Ecosystems and Carbon Cycle (GOMECC-4) cruise this year, scientists measured ocean carbonate chemistry and other biogeochemical properties along select coastal transects. They also evaluated surface water characteristics along the cruise track to assess the extent of ocean acidification, its trends, and potential impacts. The coastal ocean provides valuable ecosystem services but is particularly vulnerable to ocean acidification. Researchers used innovative new tools to study the impact of ocean acidification on recreation and fisheries in the region, as well as a possible link to harmful algal blooms. By sampling sediments on the ocean floor for the first time, they will also be able to build a time-series extending hundreds of years into the past to understand the course of ocean acidification in the Gulf.

AOML and the National Coral Reef Monitoring Program Conduct Cruise in the Dry Tortugas

In partnership with the National Coral Reef Monitoring Program, AOML completed a 7-day research cruise in the Dry Tortugas National Park, completing 63 dives across four locations. Fixed monitoring sites allowed them to track changes in seawater temperature and chemistry over time to observe how these factors may be affecting the status of coral reefs.

3yr	10	879	24
Temperature Record Retrieved	Bioerosion Monitoring Units Redeployed	pH Observations Retrieved	Carbonate Chemistry Samples Collected

Notable sampling metrics from the Dry Tortugas cruise.

New Argo Floats Deployed During GOMECC-4 Monitor Ecosystem Health in the Gulf of Mexico

During the GOMECC-4 cruise, scientists at AOML deployed new biogeochemical Argo floats with sensors to capture near-real-time data about the health of Gulf of Mexico waters, an important fishery region. Despite the ecological and economic significance of the Gulf, there is not yet a year-round consistent dataset to monitor and assess its health. These new observations will fill vital gaps in understanding Gulf waters and deliver data to improve weather and climate predictions and forecasts. The floats join a long-standing global array of nearly 4,000 Argo floats measuring upper ocean conditions.

Goal 2: Observe the Earth System

AOML and PMEL's Joint PIRATA Northeast Extension Cruise Successfully Executed

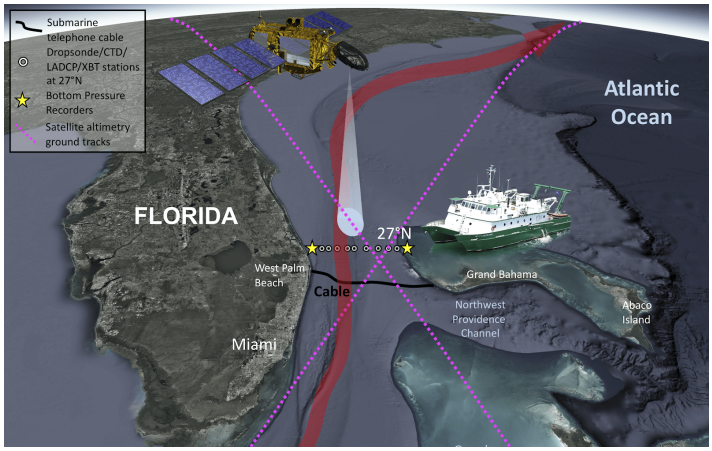
The PIRATA Northeast Extension is a joint project to maintain the array of tropical moored buoys into the northern and northeastern sectors of the tropical Atlantic Ocean for improved prediction of weather and climate variability. PIRATA is funded by GOMO, the NWS, AOML, and PMEL.

In FY 2021, the cruise was successfully conducted aboard the NOAA Ship *Ronald H. Brown*. During the cruise, all four Northeast Extension buoys were recovered and redeployed, and a new mooring was deployed to replace a recovered Brazilian mooring that had gone adrift. Additionally, a French PIRATA mooring was serviced with new sensors, 61 Conductivity, Temperature, and Depth (CTD) casts were conducted, 12 Argo floats were deployed, atmospheric measurements were taken, and the Fearless Fund collected Sargassum, as well as more than 300 water samples for post-cruise nutrient analysis.

Scientists collect water samples from a CTD cast aboard the R/V Ronald H. Brown during the 2021 PIRATA cruise.

Six Red Tide Cruises Completed for Continuous Water Quality Monitoring off the Florida Coast

In partnership with the State of Florida, AOML completed six cruises in south Florida coastal waters to examine red tide blooms and the ecological impact of Everglades Restoration efforts. As a result of these observations, AOML researchers were able to inform the commercial fishing community of a hypoxic area on the southwest Florida Shelf in fall of 2021.



A submerged telephone cable along 27°N that extends from the coast of Florida to Grand Bahama Island provides daily estimates of the Florida Current strength.

Deep Western Boundary Current Global Class Cruise Produces Quality Data Contribution for the Scientific Community

Western boundary currents are some of the strongest ocean currents in the world, carrying with them large amounts of heat, fresh water, nutrients, and other chemicals that alter global and regional weather, climate, sea level, and marine ecosystems. AOML's Western Boundary Time Series (WBTS) project addresses NOAA's mission to observe, understand, and predict changes in climate, weather, oceans, and the coasts by conducting sustained time series measurements of the western boundary currents in the subtropical North Atlantic Ocean.

In FY 2021, six scientific papers and three NOAA data reports were published specifically using WBTS cruise data. The most recent cruise was conducted in February 2021 aboard the UNOLS R/V *Endeavor*. Scientists and technicians gathered Conductivity, Temperature, and Depth (CTD) and Lowered Acoustic Doppler Current Profile (LADCP) hydrography measurements east of Abaco Island in the Bahamas, the Northwest Providence Channel, and in the Straits of Florida.

A total of 49 CTD/LADCP casts were completed, project time-series moorings were serviced, four deep-sea tall moorings were replaced, and six Pressure Inverted Echo Sounders were recovered and redeployed. This long-term project examines the temporal and spatial variability of the Atlantic Meridional Overturning Circulation at 26.5°N, including its strength, structure, and water mass properties.

Goal 3: Assess and Model the Earth System

Understand the Earth system by creating accurate, predictive, high-fidelity models that characterize and assess change and predict future Atlantic Ocean regional and global outcomes.

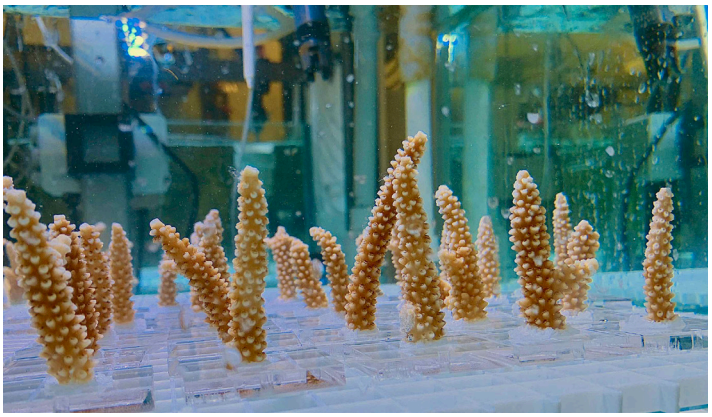
AOML and GFDL Scientists Initiate a Grassroots Effort to Strengthen Collaboration

In autumn of 2019, researchers at AOML, NOAA's Geophysical Fluid Dynamics Laboratory (GFDL), and Princeton University held a virtual workshop with the goal of better leveraging the observational and modeling expertise present at both labs. Session topics included Ecosystems and Biogeochemistry, Weather and Extremes, Subseasonal-to-Seasonal Prediction, and Interannual-to-Decadal Phenomena.

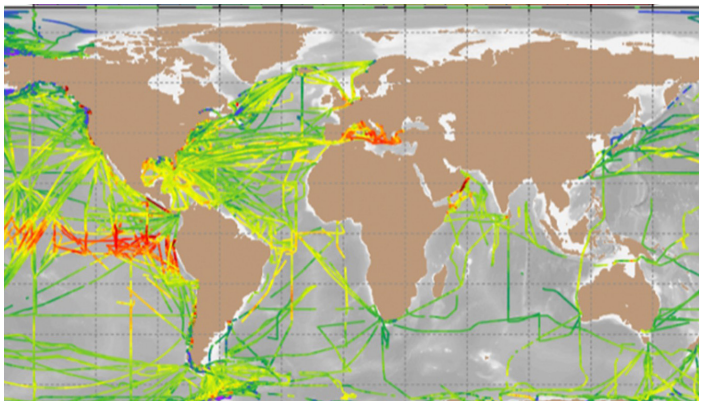
Four new research projects were initiated as a result of the workshop, and three others were revitalized. The collaborative projects include improving the understanding of deep ocean temperatures, biogeochemistry, convective processes, microphysics, and El Niño.

Simulating End-of-Century Climate Change Scenarios and Evaluating Coral Resilience

Using the Experimental Reef Lab infrastructure at the University of Miami's Cooperative Institute for Marine and Atmospheric Studies, AOML scientists have conducted 16 experiments since FY 2020, encompassing coral disease transmission and treatment, coral genotype evaluation, stress-testing and stress-hardening, and sponge bioerosion. These experiments also support multiple early career researchers, including three postdoctoral scientists and four graduate students.



Staghorn coral fragments in a glass aquarium tank. The experiment was conducted by Ph.D. student Allyson DeMerlis to understand how prolonged temperature exposure affects coral response to future heat stress.



Tracks of ships outfitted with autonomous pCO_2 systems sponsored by the NOAA/GOMO program, color coded for pCO_2 values.

AOML Leads the Ships of Opportunity Program, Providing Key Data for the Global Carbon Budget

AOML leads the Ships of Opportunity Program, an effort that collectively contributes roughly 30% of the global surface data available in the Surface Ocean CO_2 Atlas, a global collaboration to quantify CO_2 ocean uptake and a cornerstone of the Global Carbon Budget.

The data are collected from a network of cargo vessels, cruise ships, and research vessels and managed by investigators at AOML, PMEL, and cooperative institutes. "Our program has greatly enhanced the quantity and quality of surface CO_2 measurements worldwide, leading to a more accurate determination of the ocean carbon sink," said Dr. Denis Pierrot, lead investigator for the program at AOML.

Scientific Contributions to the State of the Climate Report Shows a Shift in Global Ocean Processes

A number of researchers at AOML communicated the impacts of the Earth's warming and changing environments on the global oceans in Chapters 3 and 4 of the *2020 State of the Climate* report, with sections including thermal expansion at the ocean surface and in the deep sea, surface and thermohaline circulation changes, ocean precipitation and salinity patterns, the ocean's uptake of carbon dioxide, and the Atlantic hurricane season.

Several AOML Projects Selected for Endorsement by the UN Ocean Decade

Scientists at AOML are collaborating with national and international partners and stakeholders to conduct research that supports the vision of the UN Ocean Decade through initiatives such as the Observing Air-Sea Interactions Strategy, the Ocean Biomolecular Observing Network for Omics research, *(continued on page 7)*

Goal 3: Assess and Model the Earth System

(continued from page 6) the Global Ocean, Biogeochemistry Array, and the Ocean Acidification Research for Sustainability program.

New Ecosystem Indicator Selection Method Debuted in Florida Keys Ecosystem Status Report

Scientists at AOML developed an objective ecosystem indicator selection methodology and applied it to the Florida Keys National Marine Sanctuary to produce an ecosystem status report and communicate the status of the sanctuary to inform the next management plan that is under development. The indicator selection methodology developed at AOML was leveraged by other sanctuaries and used to develop indicators for the Caribbean Fisheries Management Council with Southeast Fisheries Science Center.

Ecosystem Indicators for the Florida Keys National Marine Sanctuary include human use and activity, ecosystem services, habitat, living resources, and waters.

A Focus on Omics for Ecosystem Research

In FY 2021, AOML integrated more Omics technologies to better understand coastal, pelagic, and coral reef ecosystems. This expanded AOML's capacity for Omics research via new autonomous technologies, computational tools, and laboratory upgrades, all in support of the NOAA Omics Strategic Plan.

AOML Research Shows Coral Bleaching Nine Years Earlier than Expected in UN Environment Programme Report on Coral Bleaching Projections

AOML used raw data from previous climate models to create projections of coral bleaching under different global climate scenarios. "Using the latest climate models the projected year of annual severe bleaching is 2034; this is nine years earlier than was projected using the previous generation of climate models," said Dr. Ruben van Hooidonk, Principal Investigator on the project.

New Model Upgrade Allows High-Resolution Hurricane Development Tracking

AOML has created the world's first high-resolution, hurricane-following nest within the Finite Volume Cubed Sphere (FV3) dynamical core. This moving nest will support forecast improvements in the Hurricane Analysis and Forecast System (HAFS), a hurricane application of NOAA's Unified Forecast System and successor to the world-renowned Hurricane Weather Research and Forecasting model. Reliable guidance on how tropical cyclones move and evolve is the primary goal of HAFS. As a result of the upgrade, researchers can track storm activity with increased resolution (1-2 km) inside the core of hurricanes where winds are the strongest and most destructive. This improvement will greatly benefit emergency planning efforts to save lives and reduce property damage.

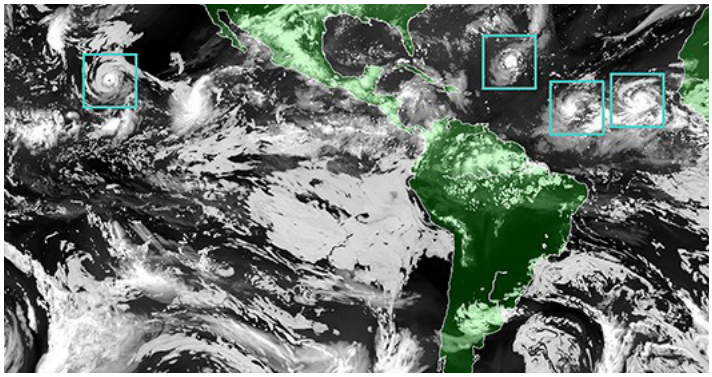


Image showing the multiple storm-following nest technology in the new FV3 dynamical core within the Hurricane Analysis and Forecast System.

Identifying Transmission of Stony Coral Tissue Loss Disease via Sediments using Omics

Florida's coral reefs are currently experiencing an outbreak of stony coral tissue loss disease, which has caused a rapid death in roughly half of all Caribbean reef-building coral species. Given the spread of this disease, it is imperative to find solutions and minimize damage to coral reefs. AOML has conducted research that not only has shown reef sediments can spread the disease among corals in as little as 24 hours, but has also identified potential pathogens responsible for the disease using omics techniques. These findings suggest that the transport of reef sediments (e.g., through port dredging and ship's ballast water transfer) may negatively impact coral reefs in Florida and beyond.

Goal 4: Transition Our Research

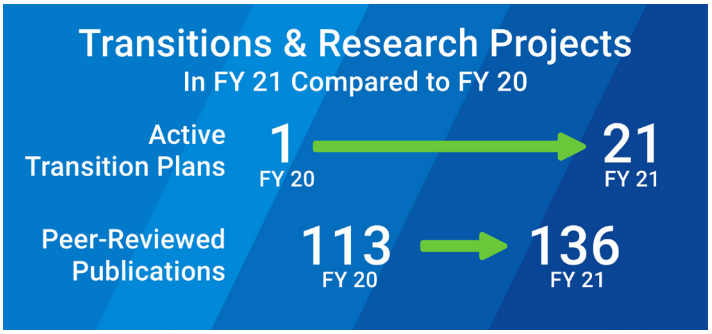
Empower end users with research and knowledge that enables decision-making, drives outcomes for operational partners, and advances scientific knowledge.

New Transitions Process Makes Exceptional Progress in its First Year

As a first for a NOAA laboratory, in FY 2021 AOML hired a full-time Transitions Manager dedicated to progress efforts toward transitioning AOML's Research to Operations, Applications, and Commercialization. Over the year, more than 40 AOML projects were identified for transition, with more than half in the development, review, or approval phase.

Serving as a representative on multiple NOAA-level transition related groups (e.g., Office of Research, Transition, and Application Tiger Team and the Readiness Level Training Task Force), AOML advocated for and helped shape improvements to NOAA's Transition Planning process. AOML additionally developed templates and guidance that were made available to AOML's researchers. The lab also led the development of a Transition Planning Seminar Series aimed at accelerating AOML's transitions.

Understanding the comprehensive nature of the transition process and the lack of dedicated resources at other NOAA laboratories, AOML, together with the Geophysical Fluid Dynamics Laboratory, initiated the OAR Transition Management Community of Practice to foster collaboration among OAR laboratories and share best practices regarding the management of their transitions.



AOML transitions and publications metrics for FY 2021.

Environmental DNA Sampling Upgraded with New Open-Source Technology for Omics Research

This fiscal year, scientists at AOML developed a low-cost, subsurface automated environmental DNA (eDNA) sampler, for in-situ sampling. Sampling of eDNA in seawater allows scientists to non-invasively assess marine biodiversity, detect cryptic or invasive species, and monitor groups of organisms in ways that are more expansive than visual surveys.

AOML provided the design through an open-source license, allowing a more financially accessible option for automated collection of eDNA samples that is adaptable for a range of future eDNA research applications. A significant milestone for AOML, the sampler is one of the first projects to move through the rigorous transition process, from the desks of scientists in the laboratory, to organizational approval channels, to the wider scientific community with full accessibility to the public.

The novel technology officially transitioned from NOAA Research to commercialization (open-source) via NOAA's Technology Partnership Office, making the capability readily available to the eDNA community at large.

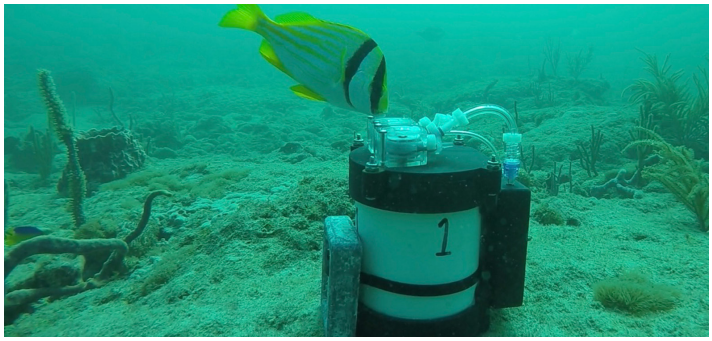


Image showing (SASe) deployed on a reef for sample collection.

Record-Breaking Publication Year Provides Significant, Actionable Insights for the Atlantic Ocean and Earth System

With 136 peer-reviewed publications for FY 2021, AOML contributed significantly to the scientific research community. Researchers conducted analyses to show the deep sea is slowly warming, constructed daily time-series for deep ocean circulation in the South Atlantic, discovered a new ocean current structure, demonstrated the important role of ocean observations for improving hurricane intensity forecasts, and linked cloud ice and microphysics to hurricane intensification.

Other promising research included a possible prediction method for seasonal to sub-seasonal tornado activity, construction of anthropogenic carbon transport in the Atlantic, identification of the transmission of coral disease via sediments, and research that some corals are thriving in unlikely places, such as the Port of Miami.

Looking Forward to FY 2022

In FY 2022, scientists at AOML will work with partners at NOAA's Aircraft Operations Center to test three small uncrewed aircraft systems in anticipation of their deployment during the 2022 hurricane season. These systems will relay near real-time data to NOAA's Environmental Modeling Center and National Hurricane Center to improve hurricane forecasts and NOAA's coupled hurricane forecast system model. Hurricane scientists at AOML have also planned three field campaigns focused on predicting rapid intensification, extreme rainfall in the Pacific, and hurricane formation in the western Atlantic. AOML will collaborate with the Office of Naval Research, National Science Foundation, and NASA to accomplish these research objectives during the 2022 Hurricane Field Program.

AOML's work to improve hurricane forecasts by observing the oceans will continue in FY 2022, with targeted observations from multiple ocean observing platforms to better understand air-sea interactions and how they fuel hurricanes. This research has already contributed significantly to reducing forecast error, especially with regard to hurricane intensity.

Understanding how Atlantic Ocean circulation patterns affect heat waves, hurricanes, tornadoes, and other extreme weather across the globe will remain a priority for AOML in FY 2022. Scientists will participate in major research cruises, conduct ocean modeling experiments, analyze changes and patterns in ocean circulation that modulate global climate, and collaborate with multiple partners to accurately represent key ocean and ecosystem variables in the Gulf of Mexico and along the U.S. eastern seaboard.

In FY 2022, AOML will continue its efforts to observe, assess, and model the Earth system. Our ecosystem sampling and assessment work will help create new tools for informed management of marine and coastal ecosystems. Researchers will sample the oceans to track harmful algal blooms, assess water quality, and identify land-based sources of pollution. Surface pCO2 sampling will augment time series and advance understanding of the global carbon cycle and its impacts for ocean acidification.

In collaboration with University of Miami-Cooperative Institute partners, we will conduct experiments to identify the molecular mechanisms of coral resilience and disease transmission vectors at coral reefs. Omics technology will additionally improve our ability to more quickly identify, monitor, and understand biological communities, facilitating more accurate ecosystem assessments. This portfolio of research focused on our understanding of the Atlantic Ocean ecosystem and Earth system will allow AOML to continue to provide world-class, actionable research to key decision-makers and the public in support of NOAA's strategic objectives to serve the nation.