

2020

BUSINESS BRIEF



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

March 2020



NOAA's ship recapitalization plan met important milestones in 2019, with the NOAA AGOR Variant (NAV) entering the design phase of a multi-year construction contract for two new NAV vessels. *Pictured: NOAA Ship Pisces, a 208-foot fisheries survey vessel (FSV), is homeported in Pascagoula, Mississippi.*

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MESSAGE FROM Dr. Neil Jacobs

During NOAA's 50th anniversary year, I am especially proud to highlight the recent accomplishments of our world-class workforce in the 2020 Business Brief. Blazing a trail of innovation and discovery over five decades, NOAA's cutting-edge science and technology keep Americans safer, and contribute to greater U.S. economic growth than ever before.

Through new and creative partnerships with the flourishing space and weather enterprises—and by upgrading our global weather forecast model and supercomputer capacity—NOAA is poised to deliver the world's best weather forecasts.

We are also powering growth in the American Blue Economy, taking decisive steps to more fully explore our ocean, help expand domestic marine aquaculture production, and maximize sustainable commercial fishing by streamlining regulations.

By strategically embracing leading-edge science and technology, including in our focus areas—unmanned systems, artificial intelligence, 'omics, and cloud computing—NOAA's dedicated employees daily deliver on our mission in bold and innovative ways.

Dr. Neil Jacobs

Assistant Secretary of Commerce for Environmental Observation and Prediction, performing the duties of Under Secretary of Commerce for Oceans and Atmosphere



Our Science and Technology Focus Areas

As in the last 50 years, bold new strategies are needed to solve today's toughest challenges. NOAA is dramatically expanding the application of four emerging science and technology focus areas to more effectively fulfill our mission priorities.

Unmanned Systems (UxS)

There's a lot of critical information in places that are too remote or too dangerous to send humans. Enter UxS: Aerial, terrestrial, or marine vehicles that can execute data collection missions without a human presence aboard to monitor endangered species or improve hurricane tracking.

1

Artificial Intelligence (AI)

We're training computers to detect and identify patterns from huge amounts of data. AI refers to those techniques in machine learning and deep learning that can help us automate analysis of large datasets for use in stock assessments and recognize extreme weather formation while freeing humans to do higher value work.

2

'Omics

We're unlocking secrets held in the genes of living things in marine environments. This is 'omics, a suite of revolutionary methods used to analyze materials, such as DNA, RNA, or proteins, to keep our water supply and seafood safe, and to make corals more stress-resilient.

3

Cloud Computing

We collect and use a formidable amount of data daily to monitor and model complex Earth systems. The cloud provides more of the safe and reliable storage and computing we need and is also scalable and on-demand with minimal management effort.

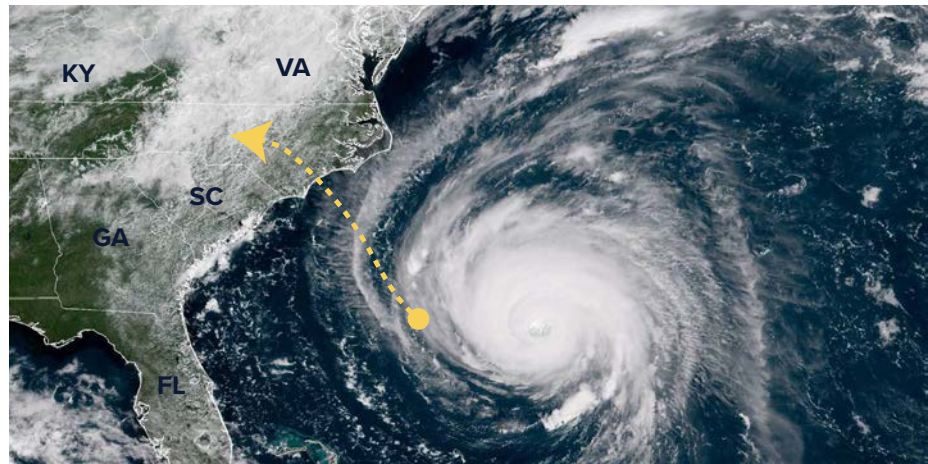
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NOAA operates on the front lines of weather and water disaster prediction, response, and recovery with an estimated **\$700 billion** of annual U.S. economic activity sensitive to weather.

Fourteen weather, water, and climate disaster events, causing losses exceeding \$1 billion each, struck communities across the country in 2019. To meet these challenges, NOAA accelerated its research to operations during the year—including improved hurricane, tornado, seasonal and subseasonal precipitation, drought, and smoke movement forecasts deployed. These improvements were also responsive to meeting the Weather-Ready Nation goals of the Weather Research and Forecasting Innovation Act of 2017 and the National Integrated Drought Information System Reauthorization Act of 2018.

In the face of increasing vulnerability to extreme weather, water, and climate events, our weather forecast experts worked shoulder to shoulder with emergency managers to keep Americans out of harm's way and to help communities recover in the aftermath. NOAA's diverse capabilities came together to help combat the devastating Northern California Kincadee fires. Sophisticated instruments from NOAA's next-generation satellites provided fine-grained data on fire intensity that—when coupled with our upgraded High-Resolution Rapid Refresh-Smoke model and on-the-ground decision support services—helped support firefighters and FEMA to more quickly respond and contain the blazes in October and November 2019.

In assessing the global climate in recent years, NOAA found that 2019 was the second hottest year on record, with nine of the 10 warmest years occurring since 2005. Moreover, our 2019 Arctic Report Card documents the near-record-high air and ocean temperatures and loss of sea ice that are affecting the range of certain commercially valuable fish species.



The improved Global Forecast System weather model tested to be up to **14% more accurate** than the old model at forecasting the track of certain Atlantic storms.

Global Forecast System Upgraded

NOAA's flagship weather model, the Global Forecast System, was upgraded in 2019, reflecting years of advancing leading-edge research into operations, including improvements in severe weather, winter storm, and hurricane forecasts. With the launch of the Earth Prediction Innovation Center (EPIC), and a tripling of high-performance computing capacity, NOAA is ready to further improve critical forecasts to keep Americans out of harm's way.

Earth Prediction Innovation Center

EPIC is looking ahead to partner with university and industry scientists and engineers to advance U.S. numerical weather prediction, laying its foundation with a significant supercomputer upgrade in early 2020. In August 2019, Dr. Neil Jacobs led an EPIC community workshop, attended by over 300 stakeholders, and in November NOAA released a Draft Cloud Strategy. Cloud is an essential foundation for EPIC because high-performance cloud computing architecture enables external research partners to develop, test, and provide constructive feedback on the American modeling system. We also released a request for information on EPIC's optimal governance structure and conducted extensive market research to gauge what is possible in moving EPIC forward.

Responding to Deadly Flooding

NOAA met two key performance goals in 2019 to respond to the dangers of flooding, which killed 92 people during the year and was responsible for billions of dollars in property damage and loss:

- Successfully demonstrated flood inundation maps covering **25 million people**, supported by our National Water Model upgrade. The demonstration maps will help emergency operations with pre-positioning assets and informing evacuation plans.
- Underscored the threat for potentially deadly excessive rainfall **one day sooner** by releasing a new 3-day excessive rainfall product. Before record-breaking rainfall in the Houston metro area resulting from Tropical Storm Imelda, NOAA provided emergency managers earlier excessive rainfall warnings.

In 2019, NOAA met or exceeded almost all of its key performance goals to improve forecasts and warnings to keep Americans safe and benefit the economy, such as:

- ✓ Seasonal temperature outlook forecasts;
- ✓ Severe flash-flood warnings;
- ✓ Winter storm warnings;
- ✓ Marine wind forecasts;
- ✓ Aviation visibility forecasts; and
- ✓ Geomagnetic storm forecasts.

So NOAA can meet its goals for tornado warnings, we seek a targeted investment in 2021 to establish the Tornado Warning Improvement and Extension Program to improve tornado warning lead time and accuracy in accordance with the Weather Research and Forecasting Innovation Act of 2017.

Targeted Investments

To advance U.S. leadership in weather forecasting mandated by the Weather Research and Forecasting Innovation Act of 2017 and the National Integrated Drought Information System Reauthorization Act of 2018, NOAA requests targeted investments in FY 2021 to:

- **Increase** support for the Earth Prediction Innovation Center to expand the suite of Unified Forecast System applications supported in a cloud development environment;
- **Improve** tornado warnings by establishing the Tornado Warning Improvement and Extension Program; and
- **Improve** the frequency and reliability of observational data used to generate weather and water forecasts, watches, and warnings by increasing data sharing through the World Meteorological Organization.



NOAA's Decision Support Improves Disaster Response

More and more, emergency managers tell NOAA that our improved impact-based forecasts, communicated through trusted relationships, change the way they do their life-saving work and build a Weather-Ready Nation. Our decision-support services, including how we communicate forecasts and warnings, help emergency managers and communities to make better decisions when responding to the impacts of extreme weather and water events. In addition to our pinpoint forecasting, NOAA's disaster response includes providing the most recent nautical charts as well as training emergency managers.

During the record spring 2019 floods affecting the Nation's heartland and northern plains, NOAA's accurate predictions, enabled by our satellite data, as well as our decision support helped local officials make life- and property-saving decisions. In North Dakota, the Grand Forks emergency manager decided to close levees early, and Fargo metro area leaders kick-started essential flood-fighting efforts an astonishing two weeks before flooding began.

In the last two weeks of May 2019, the National Weather Service received 434 reports of tornadoes; yet relatively few casualties occurred, which is testament not just to NOAA's enhanced predictive capacities but our strong relationships with local officials. During two particularly ferocious storms in late May 2019—striking Dayton, Ohio, and Kansas City, Kansas—the National Weather Service issued timely dire tornado emergency warnings that spurred prompt and decisive on-the-ground action, resulting in no casualties.

“For Dorian, however, the remarkably strong forecasting models gave meteorologists, government officials and residents so much confidence South Florida communities were able to rest with the knowledge the mammoth storm was going to take a turn north. And it did.”

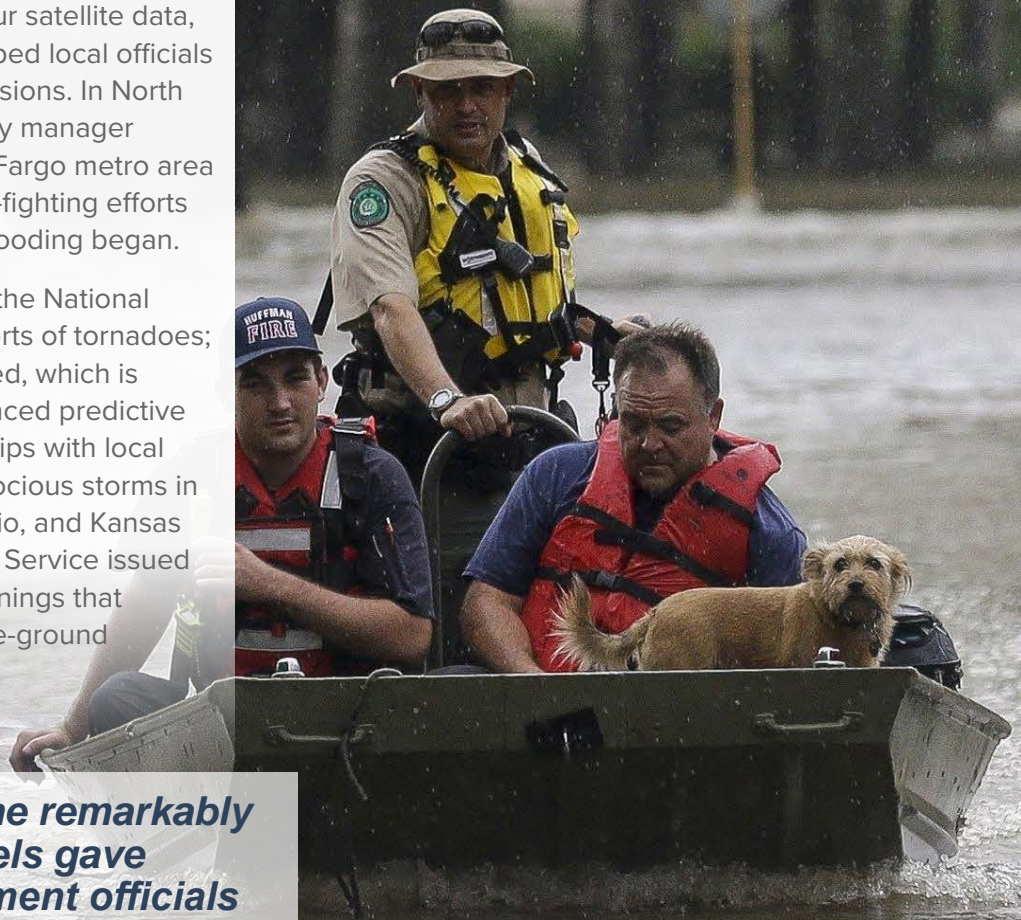
—The Florida Times-Union

NOAA-led 2019 Disaster Preparedness and Planning Training

2,814
people



41% ↑
over our goal



NOAA Helps Communities Recover from Extreme Weather

During 2019's most powerful storms, NOAA collected aerial damage assessments and emergency hydrographic data to aid safe navigation and to assess damage to ports, waterways, and coastal communities. In July, NOAA assessed damages from Hurricane Barry, a major storm that pummeled a large swath of the southeastern U.S. and brought record-breaking rain to parts of Arkansas. For Hurricane Dorian, one of the strongest hurricanes ever recorded in the Atlantic Ocean, NOAA's National Geodetic Survey partnered with FEMA and other state and federal partners over four days in September to collect 12,516 images covering 3,682 miles from Florida to Virginia to help determine the extent of the damage in coastal areas. NOAA's Office of Coast Survey collected 192 square nautical miles of hydrographic data to reopen ports and waterways to safe marine navigation.



NOAA's aircraft recapitalization is critical to meet essential services to the nation. NOAA's Office of Marine and Aviation Operations met major milestones during 2019 to bring a new Gulfstream 550 and King Air aircraft online. Pictured: NOAA Corps officer Lt. Cmdr. Rebecca Waddington with NOAA's Beechcraft King Air 350CER emergency response and coast mapping aircraft.

For communities hard hit by catastrophic hurricanes in 2017 and 2018, including Irma, Harvey, Florence, and Michael, NOAA's National Ocean Service used funds designated by Congress for disaster relief to swiftly identify and remove marine debris across six states and territories—including over eight million pounds in coastal Georgia. NOAA also collected about 4,430 miles of aerial imagery and 1,270 square nautical miles of hydrographic data in Texas, Florida, Puerto Rico, and U.S. Virgin Islands shoreline so safe maritime navigation and commerce could resume swiftly. The Office for Coastal Management provides assistance in long-term recovery planning in areas impacted by a hurricane. NOAA staff assists in the development of coastal project plans, coordinates with other federal and state organizations involved in recovery planning, and assists with the design and implementation of activities to involve local communities in planning for their own long-term recovery.

NOAA's new science and technology focus areas, outlined on page four, will greatly improve weather and water forecasts as well as disaster response, building on our current strong track record. For example, in early 2019 during a historic flood event in and around Greenville, Mississippi, NOAA's Northern Gulf Institute used an unmanned aerial vehicle to capture critical aerial imagery so forecasters were able to adjust their flood predictions and warnings quickly to inform local response efforts. NOAA and its partners have also positioned gliders (*shown right*) in the Caribbean Sea to collect salinity and temperature data that have improved hurricane intensity forecasts.

Through creative partnerships with the flourishing weather and space enterprises, NOAA made strides in 2019 to deliver the world's best weather forecasts, promote and advance the U.S. commercial space industry, and improve space safety to strengthen economic and national security.

During the year, we:

- ✔ Released a new draft rule for commercial remote sensing. The rule streamlines the licensing process and allows commercial firms to bring new products and services to market faster;
- ✔ Began implementation of Space Policy Directive-3, through the Office of Space Commerce (OSC), by issuing and receiving commercial input on a space situational awareness (SSA) request for information. Additionally, OSC participated in commercial SSA experiments, conducted broad outreach, and began planning the future commercial SSA warning system;
- ✔ Launched COSMIC-2, a network of six remote-sensing microsattellites that will constantly orbit Earth collecting atmospheric data used for weather forecasting, climate monitoring, and space weather;
- ✔ Met milestones in leveraging commercial capabilities in the \$400 billion global space industry by conducting Round 2 of the Commercial Weather Data Pilot;
- ✔ Engaged the commercial sector in developing new concepts for NOAA's future space-based observation architecture; and
- ✔ Requested offers for the Space Weather Follow On spacecraft procurement. Enhanced space-weather prediction is essential given an electronic power interruption from a moderate space-weather event could cost consumers between \$400 million and \$10 billion depending on the location.

More Progress in Space Innovation

NOAA is acting on the findings of its Satellite Observing System Architecture study by engaging the commercial sector to develop new concepts for meeting our requirements. NOAA has also identified a strong need for integrating data from multiple observations, platforms, agencies, and nations as well as focusing on solutions to bring in these diverse data sources with zero latency by piloting a secure way to ingest data.



Cloud Innovation

Harnessing the capabilities of the commercial cloud represents a unique opportunity, and NOAA's strategic, unified, and collaborative approach is paying dividends. During 2019 NOAA's cutting-edge innovation and strategic multisector partnerships for developing cloud applications established the foundation for improved performance and skill in satellite data products and services, numerical weather prediction, ocean models, and big data analysis, storage, and dissemination.

Big Data Project

Creative partnerships with commercial cloud providers sets NOAA apart from others in making more of its data publicly accessible. Limits on NOAA's ability to store and process the more than 20 terabytes of daily observational data it collects means that innovative partnerships with cloud service providers are well suited to provide free public access to 70+ NOAA datasets and counting.

One dataset popular with companies, and made easier to use via NOAA's cloud partnerships, is the Global Summary of the Day, containing numerous weather variables from around the world, which helps businesses better understand, predict, and address how weather impacts logistics, inventory, and deliveries.

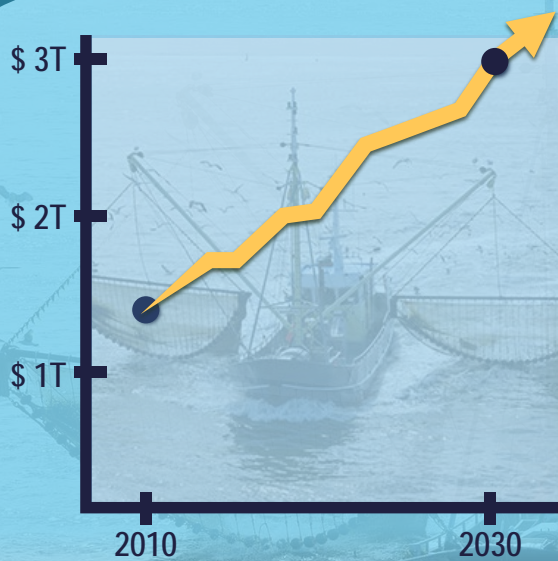
Targeted Investments

NOAA seeks targeted investments in its FY 2021 budget to expand space commerce and partner engagement in accordance with the Weather Research and Forecasting Innovation Act of 2017 and the National Integrated Drought Information System Reauthorization Act of 2018, including:

- **Support** the Space Weather Follow On mission;
- **Execute** the Commercial Data Purchase for radio occultation data and the next stage of the Commercial Weather Data Pilot; and
- **Launch** Data-source Agnostic Common Services to securely ingest essential data and observations from diverse partners to meet mission requirements cost-effectively.



American Blue Economy



Source: OECD (2016) *The Ocean Economy in 2030*

With the global ocean economy projected to grow to \$3 trillion by 2030—offering new sources of growth, jobs, and innovation—NOAA’s leadership in five key areas is critical to help ensure Americans benefit from these opportunities. NOAA has released new strategies to accelerate the application of transformative ocean science and technology across these mission areas to sustainably expand the American Blue Economy.

Seafood Production

U.S. fish stocks continue positive trends with 45 fish stocks rebuilt since 2000 and overfishing near the all-time low. NOAA completed 17 deregulatory actions in 2019, removing outdated regulations and opening previously closed fishing areas for Atlantic scallop and West coast groundfish fisheries—sweeping changes that increased jobs and income across the country. NOAA is also leading inter-agency efforts to streamline aquaculture permitting, opening up new opportunities for industry.

Marine Transportation

NOAA made strides in 2019 to collect and integrate important data for mariners’ operational decision making—navigation services that can help reduce operating costs at major seaports and contribute to safeguarding 26% of overall U.S. gross domestic product.

Tourism & Recreation

The Mallows Bay-Potomac River National Marine Sanctuary became the first new marine sanctuary designated since 2000. NOAA and its local, state, federal, and tribal partners commemorated the new sanctuary on November 9, 2019.

Ocean Exploration

In November, NOAA teamed with the White House and multisector partners to announce a national marine “moonshot”—a bold new era building on our strong track record of efficiently mapping, exploring, and characterizing priority areas within the U.S. Exclusive Economic Zone (EEZ).

Coastal Resilience

Coastal managers and companies use NOAA’s OceanReports tool, released in April 2019, with more than 100 datasets, to assist with coastal management and to streamline permitting. These tools can help ocean industries, including offshore aquaculture and renewable energy, reduce their costs.

Photo Credit: Aric Crabb/
MediaNews Group/
The Mercury News via
Getty Images



“ It is the first time we really sat down and talked to each other ... It’s one of these Cinderella stories that never happens—but this one did.”

— Nick Edwards, a Coos Bay, Oregon, fisherman (Mr. Edwards joined the talks that led to the breakthrough decision on West Coast groundfish)

Photo Credit: Aric Crabb/MediaNews Group/The Mercury News via Getty Images

More Fish in the Sea, and on Our Tables

NOAA’s sound science combined with innovative fisheries management practices help make the most of the sustainable economic and social contributions of our ocean and coastal resources. Examples include reopening lucrative West Coast groundfish fishing areas and allowing states to manage private angling for red snapper in the Gulf of Mexico. NOAA rebuilt economically valuable fish stocks while also streamlining regulations, completing 17 deregulatory actions representing almost \$4 million in annualized cost savings. We also helped to coordinate national interagency efforts to streamline permitting and to align aquaculture research to address key bottlenecks impeding domestic aquaculture production.

Since 2000, NOAA’s leading-edge science, coupled with its innovative and trusted fisheries management practices, have paid dividends, with 45 fish stocks rebuilt and only 26 stocks subject to overfishing, near the all-time low. In November, NOAA announced the reopening of areas of historically productive West Coast groundfish fisheries, working collaboratively with diverse stakeholders to simplify the quota-management procedures and enhance flexibility in commercial, recreational, and tribal groundfish fisheries by removing outdated regulations while limiting bycatch. NOAA’s science and management practices have supported 8.5 million anglers enjoying 194 million fishing trips, and saw commercial fishermen land 9.4 billion pounds of seafood valued at \$5.6 billion in 2018.



Photo Credit: Alaska Journal of Commerce

NOAA’s innovative fisheries management practices help U.S. fisheries support 1.7 million jobs.

Aquaculture Moving Forward

NOAA is committed to enabling a significant increase in domestic aquaculture production. NOAA leadership is vital to expanding overall seafood production in the U.S., creating new businesses and jobs throughout the seafood supply chain. The vast U.S. Exclusive Economic Zone presents untapped potential for sustainable industry expansion that is compatible with existing ocean users. NOAA's invaluable siting tools and datasets, strong partnerships with leading researchers, entrepreneurs, and technology developers, NGOs, and tribal groups—as well as our critical coordination role within the federal government—help drive the growth in this economic sector.

Key accomplishments in 2019 include:

16

Projects, products, and workshops completed to improve the efficiency and predictability of the federal permitting process;

42

New NOAA aquaculture project investments, totaling \$16 million, including a Great Lakes region collaboration to address shared barriers to aquaculture production in the Great Lakes;

57

Aquaculture research projects completed that advance marine aquaculture in the U.S.; and

345

Businesses created or sustained because of NOAA aquaculture investments.

Advances in Ocean Science & Technology

To increase seafood production sustainably and efficiently, NOAA is accelerating strategic use of new technologies. For example, cutting-edge fisheries genomics are being used to understand the environmental stresses on fish populations and to better manage fisheries, such as efforts to differentiate eastern and western stocks of Atlantic bluefin tuna to reduce uncertainty in assessing and managing these economically valuable fisheries. Artificial intelligence and machine learning are also being used to process imagery from fishery surveys and electronic monitoring systems on commercial fishing vessels to improve fishery management.



At-sea eDNA analysis conducted by NOAA Fisheries Dr. Jeanette Davis during a U.S. west coast survey by NOAA Ship *Bell M. Shimada* to explore the use of eDNA to improve information on fish distribution and biomass.

[Background] Oyster farmer tends to his lines in Alabama.

Virtually nonexistent in 2010, oyster farming here has grown into a thriving industry due to the Mississippi-Alabama Sea Grant Consortium support for research and best practices on production methods and management approaches. Photo credit: Mississippi-Alabama Sea Grant Consortium.

Growth in Marine Commerce Requires Better Navigation Services

NOAA's world-class navigation services, developed through close consultation with America's leading ports, are crucial investments to help ensure safe and efficient transportation. NOAA's navigation services help support \$5.4 trillion in economic activity and 31 million jobs that rely on U.S. seaports.

Precision Navigation represents the next-generation of marine navigation tools and has huge potential to increase safety and reduce operating costs at major seaports. NOAA has initiated projects in two seaports where these tools may have a significant effect: the ports of the Lower Mississippi River and New York/New Jersey. Precision Navigation focuses on the ability of deep draft vessels to more safely and efficiently navigate and operate from the sea buoy to the berth using integrated, interoperable observational, forecast, and geospatial information.

In July NOAA went operational with two improved oceanographic models in Lake Huron, Lake Michigan, and Alaska's Cook Inlet to help mariners navigate local waters safely and more efficiently, providing more robust nowcast and forecast guidance.

Great Lakes shipping alone generates **\$25.6 billion** in economic activity and supports over **147,000 jobs**.



On August 1, 2019, Commerce Secretary Wilbur Ross designated Rear Admiral Tim Gallaudet (U.S. Navy ret.) (pictured, left) as the Chairman of the Committee on the Marine Transportation System. Rear Admiral Gallaudet's goal for this one-year chairmanship is to "Advance U.S. Maritime Competitiveness."

 An infographic featuring a dark blue silhouette of a ship's superstructure on the left. To its right is a grid of 10 colored squares arranged in two rows of five. The top row has four yellow squares followed by one dark blue square. The bottom row has two yellow squares followed by three dark blue squares. The number '43%' is written in large yellow font over the top-left portion of the grid.

43%

of major seaports have embraced our flagship Physical Oceanographic Real-Time System (PORTS®) data to increase marine safety and reduce shipping costs.

Thriving U.S. Tourism and Recreation

The newest member of NOAA's network of underwater parks came into being in 2019 with the Mallows Bay-Potomac River National Marine Sanctuary, about 40 miles south of Washington, D.C. On November 9, 2019, NOAA and its federal, state, local, and tribal partners commemorated the first National Marine Sanctuary designation since 2000 (*pictured below*). NOAA's 14 national marine sanctuaries protect America's most iconic natural and cultural marine resources, and also support tourism and responsible and sustainable recreational use. More than 68,895 youth participated in hands-on learning in NOAA sanctuaries during 2019, and volunteers contributed over 117,000 hours to support science and education programs.

In February 2019, NOAA partnered with the recreation industry to help communities realize even greater social and economic benefits from sustainable recreational fishing and boating in federal waters, including in National Marine Sanctuaries, with a special emphasis on recreation opportunities for children, youth, and families. America's 8.5 million anglers support about half a million jobs across the country.

NOAA understands the importance of tourism and recreation to the economy, and that coastal communities must be prepared to combat the incidents that threaten economic growth. In Florida, businesses reported nearly \$150 million in losses in 2018 due to the killing of fish, other marine creatures,



NOAA is using Environmental Sample Processors designed by the Monterey Bay Aquarium Research Institute and mounted on a UUV to study potentially toxic algal blooms in Lake Erie, in collaboration with NOAA's Great Lakes Environmental Research Laboratory.

and littered beaches. By eliminating marine debris along the shoreline of Ohio's Lake Erie, local economies could generate an increase of \$216 million in tourism-related spending and over 3,700 jobs.

NOAA also aided coastal economies in 2019 by providing routine harmful algal bloom forecasts (red tides), removing 4,357 metric tons of marine debris, and utilizing autonomous underwater vehicles to enhance data collection. Mapping blooms and measuring toxin levels provided water-quality data to local drinking-water managers in Lake Erie. In Florida, 'omics techniques were used successfully to combat red tides and to understand the underpinnings of coral resilience to improve resistance on the reef.

A National Marine “Moonshot”

The United States is leading a bold new era in ocean exploration, buoyed in November by a presidential memorandum that directs the co-chairs of the Ocean Policy Committee to coordinate the creation of a national strategy to map, explore, and characterize the U.S. Exclusive Economic Zone (EEZ). The memorandum calls for a focus on mapping the U.S. EEZ, identifying priority areas for exploration and characterization, and enhancing opportunities for innovative multisector collaborations. It also tasks NOAA with developing a proposed strategy to map the shoreline and nearshore of Alaska. Accomplishing these ambitious goals will yield enormous economic and ecological benefits, including the likely discovery of new sources of critical minerals, marine-derived pharmaceuticals, and energy—as well as areas of important conservation value.

NOAA’s leadership over decades in ocean exploration and hydrographic services establish a strong track record to help achieve our new goals. In 2019, NOAA conducted important expeditions on NOAA Ship *Okeanos Explorer* that mapped, explored, and characterized—that is, identified and evaluated sites’ natural and cultural resource properties—largely unexplored areas of the deep ocean and tested new and emerging technologies. During remotely operated vehicle operations on the *Okeanos Explorer* and other NOAA-supported platforms, we characterized 135 sites in the U.S. EEZ, exceeding our target goal by 35%.



In addition, mapping operations on the ship contributed to NOAA’s public holdings of bathymetric data. These holdings show that through the work of NOAA and our partners, 43% of U.S. waters are mapped to modern standards, and more than 50% of that coverage is in deep water (>200 m). Also in 2019, NOAA released 13 new large-scale electronic navigational charts of Etolin Strait, Alaska, a nearly 20-fold increase in scale over the previous charts.

Embracing new and emerging technologies is essential for the U.S. to lead in exploring and understanding the ocean at unprecedented levels of detail and geographic scale. For example, NOAA is accelerating the use of unmanned systems (UxS) through centralized support of UxS at an enterprise level to build on our demonstrated leadership and better position the U.S. to achieve the Administration’s ambitious national marine “moonshot.”

The Blue Economy Depends on Resilient Coasts

American prosperity depends on the long-term health of our coastal and Great Lakes communities, which are home to almost half of all U.S. economic activity. For example, U.S. coral reefs protect over \$825 million in coastal infrastructure from flooding annually, helped by NOAA's leading-edge coral reef conservation efforts. NOAA provides a variety of tools to mitigate coastal hazards—including our new Coastal Inundation Dashboard to help coastal communities prepare for flooding events—alongside training and technical assistance. In 2019, we met our goal of providing 77% of U.S. coastal communities with tools to improve their ability to prepare for, respond to, and recover from weather and climate hazards.

To protect our communities using the power of natural landscapes, NOAA and the National Fish and Wildlife Foundation, along with their partners, announced \$30 million in coastal resilience investments (\$89 million total with matching support) in November 2019. Protecting Texas marshes from erosion and an Alaska Native village from the Bering Sea are two of 44 awards to help communities prepare for and recover from extreme events, such as hurricanes and flooding.

Since its release in April 2019, NOAA's OceanReports tool has brought a wealth of ocean data, contained in more than 100 authoritative datasets, to coastal managers, mariners, and blue economy entrepreneurs and investors. These datasets include information on species and habitats, underwater hazards, and ocean industries to help companies kick-start their ability to take advantage of a global ocean economy that is projected to grow to \$3 trillion by 2030.



The Ventura Shellfish Enterprise is using NOAA's OceanReports tool to expedite a permitting process that has been hindered by the lack of data. Each year that project approval is delayed costs between \$20 million and \$30 million in projected lost revenues.

Photo Credit: Al Grillo via AP Images

Targeted Investments

To make the most of the sustainable economic and social contributions of our ocean and coastal resources, NOAA seeks targeted investments in FY 2021 to:

- **Map, explore, and characterize** priority areas of the U.S. Exclusive Economic Zone and develop a proposed strategy to map the shoreline and nearshore of Alaska consistent with the November 19, 2019, “Presidential Memorandum on Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and Nearshore of Alaska”;
- **Coordinate** and support unmanned systems (UxS) acquisition and operations at an enterprise level to rapidly expand their application and benefit across NOAA’s mission areas;
- **Improve** access to credible marine data and information for decision makers through regional ocean data portals; and
- **Increase** support for the National Oceanographic Partnership Program.

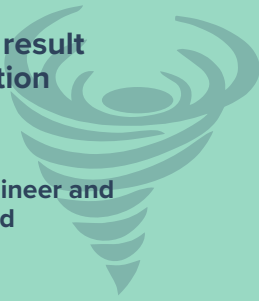
Trusted NOAA science and innovative management practices have led to a resurgence in West Coast groundfish (pictured: rosy rockfish among California hydrocoral). In 2019, Southern California cowcod was among 45 fish stocks rebuilt since the year 2000.

NOAA knows we need bold multisector collaboration to achieve our strategic priorities. As the statements below highlight, delivering the world's best forecasts, exploring our ocean more fully, and rethinking NOAA's future space-based observation architecture all require innovative, mutually beneficial partnerships.

Community partnerships lie at the heart of our strategy for the Earth Prediction Innovation Center (EPIC). The vision is to create a structure that links world-class scientists and software engineers in academia, the private sector, and partner agencies with the research, development, and operational activities inside NOAA.

“There is substantial evidence that a broad collaborative approach to numerical weather prediction development can result in superior numerical weather prediction operational capabilities.”

— Dr. Peter P. Neilley, IBM Distinguished Engineer and Director of Weather Forecasting Sciences and Technologies, the Weather Company



“We have extraordinary opportunities before us to steward, explore, and utilize the vast resources of America’s oceans by embracing public-private partnerships in ocean science and technology.”

— Kelvin Droegemeier, Director, White House Office of Science and Technology Policy



In November, the White House hosted more than 100 public and private leaders and experts to identify partnership opportunities to leverage science and technology to more fully explore and understand our oceans. Key messages included enhancing existing partnership mechanisms, such as the National Oceanographic Partnership Program as well as aligning priorities across stakeholders

In October, NOAA solicited feedback from stakeholders to engage the commercial sector, including the \$400 billion commercial space industry, to develop new concepts for instruments, spacecrafts, business models, and mission elements. By embracing rapid advancements in space-based technologies through public-private partnership, NOAA will deliver the most effective and diverse set of future Earth observations.

“As NOAA moves towards the future architecture, we believe that increased and regular engagement with the private sector will have many benefits.”

— Ball Aerospace & Technologies Corp.



NOAA partners with the Global Foundation for Ocean Exploration (GFOE) to operate the ROV system on NOAA Ship *Okeanos Explorer* for ocean mapping, exploration, and characterization. Seen with members of the ship's crew, the GFOE Team is a perfect example of the type of partnership NOAA will expand in the follow up to the November 2019 White House Summit on Ocean Science and Technology Partnerships.

World-Class Workforce



NOAA Employee Job Satisfaction on the Rise

73 percent of NOAA employees were satisfied with their jobs in 2019, two percentage points higher than 2018, marking a seven-year run in which employees have felt increasingly satisfied with their work. The actions highlighted below demonstrate NOAA's commitment to drive those numbers even higher.

Investing in NOAA's Leaders

31 high-potential NOAA employees participated in our flagship **Leadership Competencies Development Program** Class of 2019, an 18-month training and multidisciplinary learning experience that includes residential training at the Federal Executive Institute in Charlottesville, Virginia.

The **NOAA Leadership Seminar** brought 82 employees (*pictured above*) together from across the agency for a 4 ½ day residential training program in August. The seminar focused on building executive competencies for leadership development. Through 2019, almost 1,700 NOAA employees have attended the seminar.

The **NOAA Mentoring Program** is a 9-month structured program providing resources for 100 employees at all career levels to connect with seasoned mentors to help achieve their professional goals.

The **NOAA Honors Program** recruited and groomed the best and brightest recent college graduates for a rigorous one-year developmental assignment program with the option to non-competitively convert to a permanent NOAA position upon successful program completion.

In May 2019, NOAA welcomed 125 **Ernest F. Hollings Undergraduate Scholars** and 11 **José E. Serrano Educational Partnership Program** with Minority Serving Institutions Undergraduate Scholars. We also established the William M. Lapenta NWS Student Internship Program; will welcome the first Margaret A. Davidson Graduate Fellowship class in 2020; and offer both the Dr. Nancy Foster Scholarship Program and the John A. Knauss Marine Policy Fellowship Program to qualified graduate students.

NOAA's Workplace Violence Prevention and Response Program brings awareness and resources to leaders and employees and implements best practices, such as bystander intervention training, proven to be a strong contributor to prevent workplace violence.

NOAA conducted its highly successful **Annual Diversity & Inclusion Summit** with over 700 participants, a 40% increase over 2018.

NOAA advanced its 2030 **Footprint Initiative** to better align facilities with mission while consolidating its footprint into more modern, 21st-century workplaces for its employees to reduce overhead costs and invest savings back into meeting our core science mission.

Special Recognition

Jamie Rhome (*pictured right, center*) was awarded the prestigious **Service to America Medal** in October for his scientific expertise and visionary leadership in forecasting and warning the public about deadly and destructive hurricane storm surge.

In July, eight NOAA scientists, including Elizabeth Siddon (*pictured bottom, left*) won the highest honor given by the U.S. government to early-career scientists, called the **Presidential Early Career Award for Scientists and Engineers**, for pioneering research on the Earth's atmosphere, weather, our ocean, coasts, fisheries, and marine ecosystems.

Catalina Martinez (*pictured directly below, far left*) completed a remarkable and inspiring journey from high-school dropout at 16 to becoming an accomplished physical scientist, receiving the coveted **Diversity Leadership in Government Award** at the 2019 Women of Color in STEM conference for her work in diversity, equity, and inclusion, acknowledged alongside five other NOAA STEM stars.



NOAA recently received the **Breastfeeding Friendly Workplace Gold Award** from the Maryland and D.C. Breastfeeding Coalitions recognizing our supportive work environment for nursing mothers.

NOAA received a 2019 **Government Innovation Award** from GCN for its pioneering partnerships with commercial cloud providers, called the Big Data Project, successfully testing a new business model that incentivized cloud providers to make more of NOAA's dataset available for free.

Coinciding with National Public Service Week, the White House in May unveiled its **Gears of Government President's Award** where Timothy Davis, Stephanie Moore, and Gregory Doucette received special recognition for their work in radically advancing detection of harmful algal bloom to ensure safe drinking water delivery in Lake Erie and access to safe seafood in Washington State.

Leadership Team



Dr. Neil Jacobs

Assistant Secretary of Commerce for Environmental Observation and Prediction, performing the duties of Under Secretary of Commerce for Oceans and Atmosphere



RDML Tim Gallaudet

Ph.D., USN Ret.
Assistant Secretary of Commerce for Oceans and Atmosphere and Deputy NOAA Administrator



Benjamin Friedman

Deputy Under Secretary for Operations



Kenneth M. Bailey

Director, Office of Inclusion and Civil Rights



Kimberlyn "Kim" Bauhs

Director, Office of Human Capital Services



Zachary Goldstein

NOAA Chief Information Officer



Deirdre Jones

NOAA Chief Administrative Officer



Drew Lawler

Deputy Assistant Secretary for International Fisheries



Nicole LeBoeuf

Acting Assistant Administrator for NOAA National Ocean Service



Wendy Lewis

Director of Legislative Affairs



John Luce

Chief of Staff and General Counsel



Craig McLean

Assistant Administrator for NOAA Oceanic and Atmospheric Research



Chris Oliver

Assistant Administrator for NOAA Fisheries



Mark Seiler

NOAA Chief Financial Officer



RADM Michael Silah

Director, NOAA Office of Marine and Aviation Operations and NOAA Corps



Jeffery S. Thomas

Director, NOAA Acquisition and Grants Office



Dr. Louis Uccellini

Assistant Administrator for NOAA National Weather Service



Dr. Stephen Volz

Assistant Administrator for NOAA National Environmental Satellite, Data, and Information Service



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4. NOAA (2019). NOAA Research Council Science and Technology Focus Areas. <https://nrc.noaa.gov/NOAA-Science-Technology-Focus-Areas>.
5. Lazo, et. al. (2011): U.S. economic sensitivity to weather variability. Bull. Amer. Meteor. Soc. 92. <https://journals.ametsoc.org/doi/pdf/10.1175/2011BAMS2928.1>. 3.4% of GDP sensitive to weather calculated using 2018 GDP to arrive at \$700 billion.

NOAA (2019). Billion-Dollar Weather and Climate Disasters. <https://www.ncdc.noaa.gov/billions/>.

NOAA (2019). Arctic Report Card: Update for 2019. <https://arctic.noaa.gov/Report-Card>.

NOAA (2019). Assessing the Global Climate in 2019. <https://www.ncei.noaa.gov/news/global-climate-201912>.
6. NOAA (2019). FY19/21 Annual Performance Plan and Report (the APPR is part of the FY21 Congressional Justification document). <https://www.noaa.gov/organization/budget-finance-performance/budget-and-reports>.

Department of Commerce (2019). Agency Priority Goal: Mitigate Flood Impacts by Demonstrating Improved Decision Support Services to Emergency Managers. https://www.performance.gov/commerce/APG_commerce_2.html.

NOAA (2020). U.S. to triple operational weather and climate supercomputing capacity. <https://www.noaa.gov/media-release/us-to-triple-operational-weather-and-climate-supercomputing-capacity>.
9. IDA Science and Technology Policy Institute (2019). NOAA's Advisory Committee on Commercial Remote Sensing (ACCRES) Meeting, How Big is the Space Economy? https://www.nesdis.noaa.gov/CRSRA/pdf/ACCRES_LaL_June_2019_Final.pdf.

Abt Associates for NOAA (2017). Social and Economic Impacts of Space Weather in the United States. <https://www.weather.gov/media/news/SpaceWeatherEconomicImpactsReportOct-2017.pdf>.
10. NOAA (2019). NOAA Big Data Project. <https://www.noaa.gov/media-release/cloud-platforms-unleash-full-potential-of-noaa-s-environmental-data>.
11. NOAA (2019). Fishery Stock Status Updates. <https://www.fisheries.noaa.gov/national/population-assessments/fishery-stock-status-updates>.
12. OECD (2016). The Ocean Economy in 2030. <https://www.oecd.org/environment/the-ocean-economy-in-2030-9789264251724-en.htm>.
13. NOAA (2020). Fisheries of the United States, 2018. <https://www.fisheries.noaa.gov/feature-story/fisheries-united-states-2018>.
14. NOAA (2019). NOAA Sea Grant in Aquaculture. <https://seagrant.noaa.gov/Our-Work/Aquaculture>.

Martin and Associates (2018). Economic Impacts of Maritime Shipping in the Great Lakes - St. Lawrence Region. <http://greatlakesseaway.org/downloads/2018-glsls-study-en-hr.pdf>.

Martin Associates (2018). 2018 National Economic Impact of the U.S. Coastal Port System. <https://www.aapa-ports.org/advocating/PRDetail.aspx?ItemNumber=22306>.

U.S. Committee on the Marine Transportation System (2019). MG Scott Spellmon Turns over CMTS Coordinating Board Chairmanship to Department of Commerce, RDML Tim Gallaudet. <https://www.cmts.gov/posts/4e11ffd0-55e1-4775-85b0-407664fe3600>.
15. NOAA (2019). NOAA Marine Debris Program 2019 Accomplishments Report. <https://marinedebris.noaa.gov/report/accomplishments-report>.

Abt Associates for NOAA (2019). The Effects of Marine Debris on Beach Recreation and Regional Economies in Four Coastal Communities: A Regional Pilot Study Final Report. https://marinedebris.noaa.gov/sites/default/files/2019.07.Econ_Impacts.Marine.Debris.complete.wFN_30Aug2019_508.pdf.
16. Presidential Memorandum (2019, November 19). "Memorandum on Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and Nearshore of Alaska." <https://www.whitehouse.gov/presidential-actions/memorandum-ocean-mapping-united-states-exclusive-economic-zone-shoreline-nearshore-alaska/>.
17. NOAA (2019). National Fish and Wildlife Foundation announce \$30 million in grants to support coastal resilience efforts across the nation. <https://www.noaa.gov/media-release/noaa-nfwf-announce-30-million-in-grants-to-support-coastal-resilience-efforts-across>.
19. NOAA (2019). NOAA Coral Reef Conservation Program. The Value Coral Reefs Provide against Hazards. <https://coralreef.noaa.gov/aboutcrp/news/featuredstories/may19/welcome.html>.

Hearing, Subcommittee on Environment (2019). A Task of EPIC Proportions: Reclaiming U.S. Leadership in Weather Modeling and Prediction. <https://science.house.gov/hearings/a-task-of-epic-proportions-reclaiming-us-leadership-in-weather-modeling-and-prediction>.

The White House Office of Science and Technology Policy Council on Environmental Quality (2019). Summary of the 2019 White House Summit on Partnerships in Ocean Science and Technology. <https://www.whitehouse.gov/wp-content/uploads/2019/11/Ocean-ST-Summit-Readout-Final.pdf>.

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Check out career and other special program opportunities for students, faculty, and volunteers at <https://www.noaa.gov/work-with-us>.

National Oceanic and Atmospheric Administration

U.S. Department of Commerce

Office of the Chief Financial Officer
Performance, Risk and Social Science Office
1315 East West Highway
Silver Spring, Maryland 20910
www.noaa.gov