

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

# Business Brief

**NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION**

*Science. Service. Stewardship.*

**APRIL 2019**



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## MESSAGE FROM DR. NEIL JACOBS

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

No one document can properly include all of NOAA's accomplishments, but in this new Business Brief, we hope to hit some of the highlights. Showcasing our performance successes underscores how we deliver on our ambitious promises and exceed expectations in achieving results in three main areas:

- **Responding to extreme weather and water events:** NOAA saved lives by making strong forecasts, working closely with emergency managers and other decision makers responsible for moving people out of harm's way. Our response to extreme events demands the world's best global weather model and the most robust observational systems.
- **Powering the blue economy:** We took decisive steps to address the seafood trade deficit, enabled real-time navigational decisions at busy ports, and further mapped our Exclusive Economic Zone to support offshore energy production.
- **Employing our observational and cyber infrastructure:** We launched powerful new satellites, made a down payment on building a new fleet of research vessels, and upgraded our high-performance computing capabilities while also pursuing cloud-based options.

The Brief also shows results in putting our people first, leveraging strategic partnerships, and making progress to bolster our science and technology capabilities.

- **People:** I'm proud to lead an organization where employee satisfaction scores have risen six years in a row. We took decisive steps to train our next-generation leadership, mentor our employees, diversify our workforce, and achieve a safe workplace.
- **Partnerships:** Because NOAA tackles large-scale challenges, we intensified our efforts to forge robust partnerships, such as shifting into a higher gear towards community weather modeling to produce stronger weather forecasts.
- **Progress in innovation:** We accelerated our use of unmanned systems, cloud computing, genomics, and artificial intelligence to position NOAA and its partners on the forefront of science.

I hope you agree with me that NOAA is a good investment of taxpayer dollars that produces important, tangible results that improve each of our lives every day. I am truly proud of the NOAA team who made all of our accomplishments possible and thank them for a job well done.



**Millions** of Americans were in danger from extreme weather and water events in 2018 as the nation endured destructive and deadly hurricanes and tornadoes, devastating floods, droughts, wildfires, and powerful winter storms, including 14 billion-dollar weather events.

Hurricane Florence's landfall near Wrightsville Beach, North Carolina, was only about two miles off of where NOAA's five-day forecast on September 8, 2018, said it would hit. Improved hurricane track forecasts are among our many vital hurricane prediction, response, and recovery products and services.

Days in advance of Hurricane Michael striking the Florida panhandle on October 10, 2018, governors, mayors, and emergency managers were able to pre-position assets, coordinate resources, and warn the public and businesses, largely because of NOAA's tracking, lead-time, storm-surge and flooding projections.

In 2017—with monster storms Harvey, Irma, and Maria accounting for three of the costliest hurricanes on record—NOAA made its most accurate prediction for a hurricane season, and we continued our strong track record into 2018. Accelerated improvement in

our hurricane intensity models suggests that recent investments in new models and techniques are paying dividends.

Storm-by-storm forecasts from NOAA's National Hurricane Center were aided by high-resolution imagery from our new GOES East satellite and the American Global Forecast System model. Providing invaluable data in support of forecasting, research, and emergency response, NOAA's hurricane hunter aircraft flew more than 580 hours during a 2018 hurricane season that produced 15 named storms, including eight hurricanes. Following a storm's devastation, NOAA ships surveyed waterways and NOAA planes captured high-definition aerial photos so that response agencies could assess damage and get local commerce back in business.

As Florence made landfall in North Carolina, NOAA's response teams were ready to conduct surveys in the affected ports and waterways, updating charts in less than 24 hours. Partnering with the U.S. Coast Guard and the Army Corps of Engineers, we helped get commerce moving again. After Hurricane Michael, NOAA collected 9,580 aerial damage assessment images, coordinating with the Federal Emergency Management Agency and the U.S. Coast



**NOAA will extend its severe rainfall outlook by one day to allow the public and emergency managers to better prepare for flooding**





Guard, to provide a cost-effective way to better understand the damage sustained to property, coastlines, and critical infrastructure.

Hurricanes capture attention because of their size and destructive power, but tornadoes and other severe weather are just as dangerous. NOAA issues about 2,900 tornado warnings per year. Radar scan advancements allow forecasters to more accurately spot imminent tornadic activities. In December 2018 in Taylorville, Illinois, NOAA's diligent tornado forecasting and robust partnerships with local emergency managers led the community to cancel a parade less than an hour before a strong (EF-3) tornado plowed through town, destroying more than 500 buildings, but with no lives lost.

NOAA's National Water Model provided accurate flood forecast information for the catastrophic flood levels experienced in North Carolina during Hurricane Florence and helped emergency managers and responders plan for and respond to the flooding. Effective drought monitoring and prediction helped emergency managers, water resources decision makers, and businesses mitigate the effects of weather disasters in 2018. To improve future drought warnings, NOAA and its partners are beginning to transition to

operations the Evaporative Demand Drought Index, an early warning and monitoring tool helpful to agricultural producers as well as water, fire, forest, and range managers.

***“To be clear, my decisions were heavily based on the conversations I had ... leading up to the storm impact. This was especially important as hundreds of parade participants were in place one block away from what ended up being the tornado path. In my view, the entire decision support program you have long promoted, worked flawlessly.”***

Mike Crews, Christian County, Illinois  
Emergency Management Agency Director/City of Taylorville Fire Chief

Earlier warnings about precipitation and temperature are invaluable. The 2017 Weather Act requires NOAA to improve its seasonal and subseasonal forecast accuracy. NOAA has exceeded its U.S. temperature forecast accuracy, or skill, over the past three years. New findings by NOAA-funded scientists show how atmospheric conditions in the tropics can influence U.S. weather in predictable



**NOAA's improved performance in understanding and predicting extreme weather and water events is critical given each year the U.S. averages some 10,000 thunderstorms, 5,000 floods, 1,300 tornadoes and two Atlantic hurricanes, as well as widespread droughts and wildfires causing about 650 deaths**



ways within 20–25 days. Better forecasts in such time frames will transform how potential spikes in energy demand are assessed, how businesses make supply-chain decisions, how farmers choose when to plant and irrigate, and how the aviation industry plans, routes, and places crews and aircraft.

NOAA operates on the front lines of weather, water, and climate disaster prediction, response, and recovery. In 2018 we provided disaster preparedness and planning training to 2,743 people, including emergency managers, a 29 percent increase over 2017. We also provided local communities and emergency responders Impact-based Decision Support Services, or IDSS, the real-time intelligence first responders need to understand risk, assess damage, and accelerate recovery. It's all part of making the U.S. a Weather-Ready Nation—prepared for and responsive to extreme weather, water, and climate events—and committed to building community resilience in the face of our increasing vulnerability to these events.

During the deadly Camp Fire and Woolsey Fire in California, emergency responders combined NOAA's powerful new satellite sensors and weather models to give emergency responders accurate smoke movement forecasts. NOAA staff went to the California State Emergency Operations Center for about 45 days to provide around-the-clock support. These support services immediately provided detailed weather

information that led to critical fire-fighting decisions to move people out of danger and save lives.

In 2018, NOAA exceeded its target of transitioning research and development products to operations. Our forecasts are better because of advances in leading-edge research to operations, data assimilation, and modeling. The High-Resolution Rapid Refresh Version 3 product increases weather forecast accuracy and doubles lead time for some hazards. NOAA will establish bold new performance targets: extending useful forecast lead time beyond the current skill of 9.5 days to 10 days in 2020, producing the best global weather models by 2022, and transitioning 15 new forecast improvements to operations in support of the Weather Act and the U.S. weather enterprise.

To mitigate the impact of extreme weather and water, NOAA requests targeted investments in FY 2020 to:

- Start measuring subseasonal temperature forecast accuracy and to carry out other provisions in the Weather Act to close the gap between weather and climate prediction;
- Advance the Joint Technology Transfer Initiative; and
- Create the Earth Prediction Innovation Center to shepherd promising weather research to operations and to advance community-developed enhancements to the Next Generation Global Prediction System.





## Extreme Weather Performance Highlights



24 research and development

products are **advancing** to operations

NOAA introduced storm surge warnings in 2017 and, although storm surge is historically the leading cause of U.S. hurricane deaths, there were **no known fatalities** that year despite 3 major hurricanes. Even with 2 major hurricanes, there were few fatalities in 2018

2018 ✓ Seasonal Temperature Forecast Skill level targets have been **exceeded** the **past three years**

2017 ✓

2016 ✓





**Americans** love seafood. The need to increase our nation's seafood supply is a continuing and growing challenge. Rebuilding and maintaining stocks at their sustainable levels will help achieve this goal.

Ending overfishing and rebuilding stocks strengthens the value of U.S. fisheries' contribution to the economy, which in 2016 exceeded \$212 billion, and supports the communities and marine ecosystems that depend on healthy fisheries. In the U.S., approximately 10 million saltwater anglers support more than 470,000 jobs and generate \$68 billion in sales effects.

In partnership with the eight regional fishery management councils and commercial and recreational fishing industries, the U.S. continues to ensure the long-term sustainability of its fisheries. Overfishing for seven stocks ended in 2018 resulting in the number of stocks subject to overfishing being near all-time lows. By the end of 2018, the number of stocks not subject to overfishing increased to 91 percent with only 28 stocks subject to overfishing. One additional fish stock was rebuilt in 2018, bringing the total number of rebuilt stocks to 45 since 2000. As new scientific information becomes available, NOAA and the fishery management councils continue to take the needed steps to end overfishing and rebuild overfished stock.



**NOAA's effectiveness in ending overfishing and rebuilding stocks strengthens the value of the \$212 billion U.S. fisheries industry**

Rebuilding stocks provides more opportunities for fishermen. Canary rockfish, one of more than 60 species of rockfish included in the West Coast groundfish fishery, was declared overfished in 2000. To rebuild the stock would take about 30 years.

Working with fishermen, managers, and scientists, the Pacific Fishery Management Council incorporated a variety of management tools and an innovative catch share program to speed up the stock rebuilding. Thanks to the stewardship of our fishermen who honored the recovery provisions, the canary rockfish stock was declared rebuilt in 2015, 15 years ahead of schedule.

***“Even though canary (rockfish) is not a target fish for us, since the stock status was declared rebuilt, when I catch canary, I do not have to stop fishing for what I’m targeting.”***

Kevin Dunn, commercial fisherman, Oregon

Other successes include rebuilding the Pacific ocean perch populations 34 years ahead of schedule. Bycatch of Pacific ocean perch limited the West Coast trawl fishery catches. Rebuilding Pacific ocean perch and other stocks let fishermen expand opportunities to harvest healthy groundfish stocks.

Illegal, unreported, and unregulated fishing and seafood fraud—including misrepresented seafood products—jeopardize the health of fish stocks, distort legal markets, erode consumer confidence, and unfairly compete with the products of law-abiding fishermen, aquaculture producers, and seafood producers.

NOAA launched the Seafood Import Monitoring Program in 2018 establishing permitting, reporting, and record keeping requirements to prevent illegal, unreported, and unregulated-caught and/or misrepresented seafood from entering the U.S. marketplace. By the end of the year, after shrimp and abalone were included, the list of priority species represented nearly doubled the coverage of edible seafood imports by value. The Seafood Import Monitoring Program marks a significant step in combating illegal, unreported, and unregulated fishing and seafood fraud, and helps maintain fairness for U.S. seafood producers.

While NOAA works to expand fishing opportunities and access to foreign markets for our wild-caught fishing industry, we must also do more to develop a viable domestic aquaculture industry. The U.S. has one



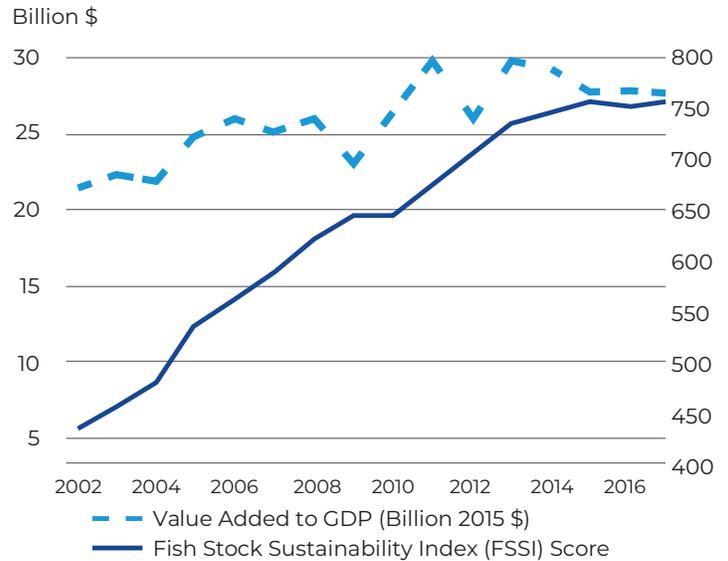
of the largest Exclusive Economic Zones in the world, but ranks 16th in worldwide aquaculture production. One-half of the global seafood supply is farmed, but less than 10 percent of U.S. seafood production by volume is from aquaculture. NOAA and the Department of Commerce seek to expand this while protecting our wild-caught stocks and expanding export markets for wild-caught fish.

NOAA is developing the science to grow the farmed fish industry wisely and sustainably. NOAA is committed to streamlining the use of existing authorities to expand aquaculture in federal waters. We are working with Congress to clarify the statutory authorities and provide the regulatory certainty required to develop a robust domestic aquaculture industry.

To enhance seafood competitiveness, NOAA requests targeted investments in FY 2020 to:

- Allow regional fishery management councils to support deregulatory changes which reduce the burden on fishermen and improve economic performance;
- Fund enforcement for the monitoring program to ensure foreign exporters play by the same set of rules as our fisheries industries; and
- Support NOAA's aquaculture science and to streamline permitting to accelerate sustainable aquaculture industry growth.

## Fish Stock Sustainability Index & U.S. Commercial Fishing Industry Value Added to GDP 2002-17



### Environmental AND Economic sustainability can be achieved:

- **Value added** to GDP by commercial fishing industry modestly **outpaced** US GDP growth while **rebuilding 43 stocks!**
  - **FSSI score** increased **74%**
  - **US GDP increased** at average annual rate of **2.0%\***
  - Commercial fishing industry **value added to GDP** grew at average annual rate of **2.2%\***
- \*adjusted for inflation**





**Wondrous** bodies of water—the ocean and the Great Lakes are the source of a blue economy that includes the transport of trillions of dollars of goods to and from our shores, numerous commercial and recreational opportunities, and the intriguing potential of energy sources held within.

A vibrant U.S. economy depends on healthy ocean, coastal, and Great Lakes resources. To advance America’s economic, security, and environmental interests, it is critical that we explore, map, and inventory our nation’s waters and understand their role in and the effects of a changing climate.

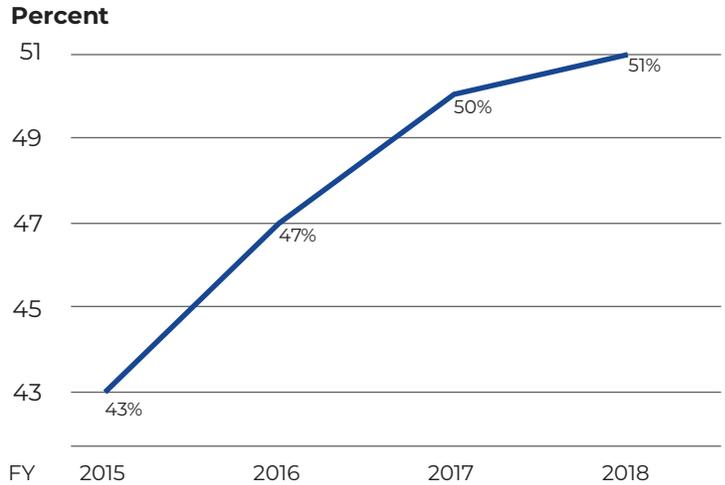
Billions of tons of product valued in the trillions of dollars move through our ports every year, so even small improvements in port efficiencies have tremendous economic effect. In 76 top seaports around the country, NOAA’s Physical Oceanographic Real-Time Systems (PORTS®) program provides data on water levels, tides, currents, waves, and much more to help vessels navigate. When large vessels enter a port—when space is tight and time is critical—mariners anticipate ocean and weather conditions by using NOAA observations, forecasts, nautical charts, and underlying foundational data.

Strong currents in the transit into Corpus Christi Bay make it difficult for vessels to navigate. Most of the vessels coming into the Port of Corpus Christi carry hazardous materials, such as liquid natural gas and other chemicals. The port authority requested a PORTS® with real-time current meters to provide pilots with information to help them arrive and depart the seaport safely. Corpus Christi joined the increasing number of PORTS® facilities in 2018.



Through the use of NOAA’s PORTS®, super-sized ships coming through the recently expanded Panama Canal can now more safely and efficiently enter the Miami seaport.

### Mapped U.S. Exclusive Economic Zone deeper than 200m to Seabed 2030 resolution standards (100m<sup>2</sup>)



***“Toledo is probably the most dynamic port on the Great Lakes when it comes to rapidly changing currents, water levels and weather. We are very happy to finally have the PORTS® system in place where we have one source for all the real-time data that we need,”***

Captain George Haynes, a local pilot in Toledo, Ohio, which joined PORTS® in 2018

NOAA is the nation’s coastal cartographer. Commercial and recreation mariners rely on these nautical charts and other products to ensure safe navigation along our almost 95,000 miles of ocean and Great Lakes coasts. To ensure the marine transportation system is safe, efficient, and environmentally sound, it requires information about water depth, the shape of the seafloor and coastline, the location of possible obstructions, and other physical features of water bodies. NOAA exceeded its targets for number of nautical miles in U.S. waters where we determined bathymetry, including locating wrecks and obstructions to safe transport. As we continue to work with partners to map the U.S. Exclusive Economic Zone, NOAA’s mapping products are critical to chart our course.

We import almost all of our nation’s critical minerals, which help build modern infrastructure from jet engines, power plants, and cell phones. Relying on foreign sources of critical minerals is a national security vulnerability that NOAA can help address





through exploration of our ocean and coastal resources. It is critical that NOAA work with partners to preserve and share the data already collected and identify high-priority data gaps. Within the U.S. Exclusive Economic Zone, the U.S. has sovereign rights to explore, exploit, conserve, and manage the natural resources of the seabed, subsoil, and overlying waters and produce energy from the water, currents, and winds.

The U. S. has mapped the moon and Mars to a better resolution than our own seafloor. NOAA is able to survey roughly 3,000 square nautical miles annually. NOAA and partners made steady progress mapping the U.S. Exclusive Economic Zone deep-water ocean—deeper than 200 meters—covering 51 percent by the end of FY 2018. The advancement of autonomous vehicles and remote sensing technologies within our own waters will aid navigation and mapping to identify sources of valuable energy and minerals, including those that contribute to pharmaceutical production.

We enjoy a robust economy from ocean and Great Lakes tourism and recreation. Ocean-based tourism and recreation employs almost 2.3 million people, more than the construction and telecommunications sectors combined. One in three Americans participate in some form of ocean or Great Lakes recreation; the average beachgoer spends 14 days at the shore each year.

Every U.S. coastal and Great Lakes state experience harmful algal blooms. These blooms are a national concern because they affect not only the health of people and marine ecosystems, but also the health of our economy—especially coastal communities dependent on the income of jobs generated through fishing and tourism. Harmful algal bloom forecasts are critical to support state and local decisions related to drinking water, shellfisheries, and beach recreation in coastal communities now representing about 50 percent of gross domestic product.

President Trump highlighted the effect marine debris can have on coastal recreation and economies when he signed the Save Our Seas Act of 2018. A study showed that residents in Orange County, California, would save \$32 million in travel costs over three months in the summer if there was a 25 percent reduction in beach litter; eliminating beach litter completely would save \$148 million over the same time.

Each year, tens of millions of people visit NOAA's national marine sanctuaries and estuarine research

reserves contributing billions of dollars to coastal economies, including \$3.8 billion to the local economy of Florida alone. In 2018, volunteers spent almost 128,000 hours to support science, education, and public engagement programs to raise awareness and meet the National Marine Sanctuaries' science needs.

In FY 2018, NOAA reduced processing time for informal consultations of the Endangered Species Act from 53 days to 45. Completion time for formal consultations under the Act was reduced by 22 percent.

To enhance our leadership of the blue economy, NOAA requests targeted investments in FY 2020 to:

- Address international sources of marine debris through NOAA's Marine Debris Program;
- Reduce the backlog of consultations and permits under the Endangered Species Act and the Marine Mammal Protection Act;
- Create a national dissemination site for NOAA marine and geospatial data and hydrographic models;
- Provide technical assistance to stakeholders to understand how to deploy the systems necessary for Precision Navigation; and
- Create a dedicated funding source for the National Oceanographic Partnership Program to leverage coordination with other federal and private-sector funding.



**NOAA's harmful algal bloom forecast gave the State of Washington confidence to open a closed razor clam fishery which contributed about \$7 million in revenue for the region**



## Blue Economy Performance Highlights

Due in part to successful hurricane response, NOAA **exceeded** its measure for **hydrographic surveying** by **50%**

With NOAA's PORTS® **expansion** in 2018, the program now covers the nation's **top 20 seaports** by tonnage

Harmful algal bloom forecasts are **vital** for decision makers in coastal communities now representing about **50% of GDP**

Fish stocks rebuilt since 2000 reach **45**, the **highest level** of sustainability in recent years





**NOAA** used its complement of ships, planes, satellites, and computing power to full advantage during the active 2018 hurricane season. Those assets were also deployed to help the response to wildfires and other natural disasters as well as conducting research and collecting data for daily weather reports and climate models.

Our largest research vessel *Ronald H. Brown* completed an around-the-world voyage with international scientific partners—servicing buoys that monitor the tropical ocean that influence U.S. heat waves and flooding. NOAA also harnessed high-tech emerging observational technologies, such as our newest satellites. We experimented with unmanned underwater vehicles in Lake Erie to detect and track harmful algal blooms, potentially improving forecasts to inform local health and recreation decision making.

Historic launches of two NOAA next-generation satellites, including NOAA-20 in November 2017 and GOES-17 (now GOES West) in March 2018, vastly improve the prospects of saving lives and spurring economic growth.

NOAA-20, together with its European polar-orbiting partners, the MetOp series, provides 85 percent



**Polar-orbiting satellites provide 85% of data that feed weather forecast models, forecasts that in turn provide over \$35 billion in economic benefit to U.S. households**

of the data that feed weather forecast models, demonstrating the enormous economic return on investment provided by these satellites given the tens of billions of dollars on average in annual damages caused by extreme weather and water events.

The two geostationary satellites (GOES East and West) scan five times faster, have four times the image resolution, and triple the number of channels of their precursors, translating into critical enhanced capabilities such as better tracking of hurricanes and smoke detection. Each of the GOES satellites also hosts four, cutting-edge space-weather instruments. These provide advanced warning of solar storms that can disrupt communications, navigation, and power grids; cause damage to spacecraft; and even put astronauts and airline passengers at risk of exposure to space radiation.

NOAA exceeded its goal of providing critical real-time satellite data without gaps, data vital to improving timely forecasts, detecting wildfire smoke, and providing national security. We also expanded our pilot program to evaluate commercially available weather data and to understand how NOAA might incorporate such data into our forecast models. The next round of the pilot explores a much broader range of potential data, from sea surface height, to solar imagery, to soil moisture.

***“Fire crews in Creek County, OK were dispatched to a fire based upon a hotspot notification, and before any 911 calls were received. Upon arrival in the area, they found a grass fire threatening a residence that was occupied by a woman with limited mobility. The EM noted that if the crew had not arrived when they did, they likely would not have been able to save her life.”***

Covey Murray, Creek County (Oklahoma) Emergency Management Coordinator

Using NOAA’s assets to collect and analyze critical observations are bedrock capabilities needed to translate data into vital intelligence for emergency managers, businesses, and the public. NOAA leverages international assets, such as Europe’s MetOp satellites, to augment our data capacity and global satellite coverage.

NOAA continues to meet its milestones toward the long-term recapitalization of our aging fleet of ships. Timely funding procurement activities in 2018 moved toward the acquisition of a new NOAA research vessel. With one-



## EMPLOYING OBSERVATIONAL AND CYBER INFRASTRUCTURE

half of our 16 research and survey ships operating past their designed service lives, NOAA's successful Fleet Plan implementation creates a path to construct sophisticated new ships. These ships will have unique capabilities to collect data that directly feed products and services vital to the U.S. economy and health.

Because of our robust effort to keep our aging fleet on the water to conduct research and survey missions, we met about 85 percent of our target, fairly consistent in recent years, even though the vessels needed unscheduled repairs.

NOAA underwent a massive supercomputer upgrade in 2018, increasing high-performance computing capability by 50 percent, paving the way to launch the next-generation Global Forecast System. NOAA also added 60 percent more storage capacity, enabling billions of observations from airplanes, satellites, buoys, and ground observing stations around the world to be ingested and analyzed daily. Disaster recovery funding in 2018 allows NOAA to better combat future extreme weather and water emergencies. These upgrades will help us to better meet the information and decision support needs of emergency managers, the weather industry, and the public.

Partnering with the U.S. Navy, we launched in one hurricane season the most unmanned ocean gliders used in support of Atlantic hurricane forecasts to improve future predictions. These innovative systems used in 2018 include:

- Unmanned ocean gliders or aerial hurricane trackers, such as Coyotes, that take environmental

readings where our ships, aircraft, and satellites often cannot safely or feasibly operate;

- Sail drones to monitor fish stocks to help maximize fishing limits; and
- Drones to experimentally map coastlines and nearshore waters or count protected marine species.

To harness our observational and cyber assets more effectively, NOAA requests targeted investments in FY 2020 to:

- Centralize operations of our unmanned systems to safely and efficiently take full advantage of these promising technologies;
- Fund Space Weather Follow On, future satellite architecture decisions, and commercially available weather data purchases;
- Boost ship maintenance, including performing progressive lifecycle maintenance on ships, to ensure they operate at their maximum capacity;
- Invest in secure cloud computing environments, providing significant cybersecurity, performance, and cost-effective advantages over hard-iron computing, including for the Earth Prediction Innovation Center to allow NOAA to regain its international leadership in weather modelling; and
- Establish an effective insider-threat capability to protect national security.



**NOAA's land, sea, and space observational assets were productively deployed in 2018 to save lives, conduct research, and protect our coasts**



## Observational and Cyber Infrastructure Performance Highlights



Launched **2 Next-Generation Weather Satellites** and Began  
**Fleet Recapitalization**



Increased **high-performance computing** capability by **50%**  
to meet NOAA's mission

Critical satellite data provided without gaps **contributes**  
to **\$35 billion** benefits in  
weather forecasting



NOAA met **85%** of its **Days-at-Sea** target  
by proactive management of its aging fleet





## Harnessing Unmanned Systems to Meet the Mission

Seventeen hurricane “picket line” gliders were deployed and operating in the Caribbean and Atlantic to collect real-time observations of Hurricanes Florence and Isaac in 2018. The NOAA U.S. Integrated Ocean Observing System (IOOS) and Atlantic Oceanographic and Meteorological Laboratory worked with the Navy and IOOS Regional Association partners to place the gliders in front of the storms to help forecasters and researchers better understand the ocean conditions ahead of a hurricane.

## Innovating Use of Artificial Intelligence and Machine Learning

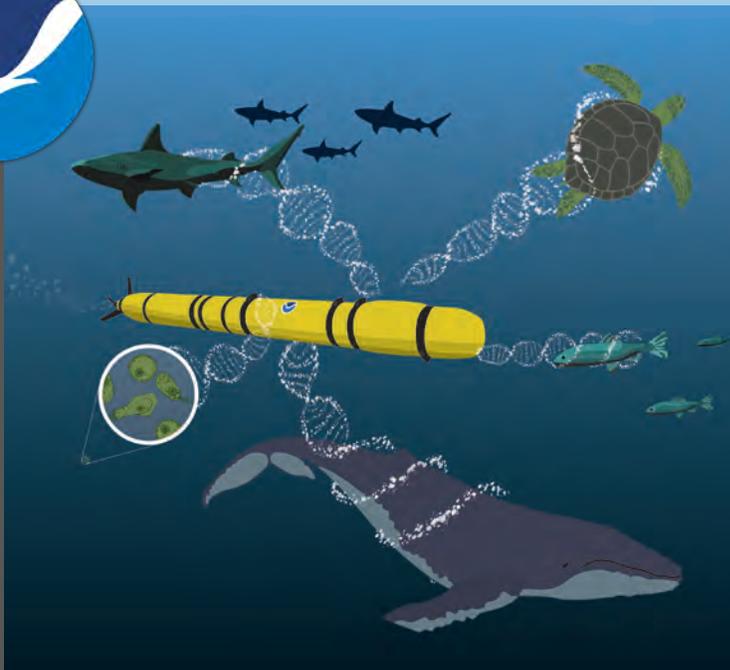
NOAA employs the innovative uses of artificial intelligence and data science technologies, such as machine learning. NOAA’s efforts in artificial intelligence support the Administration’s American Artificial Intelligence Initiative. Researchers at NOAA’s Center for Satellite Applications and Research developed a prototype artificial intelligence extension to a software package for remote sensing, data assimilation, preprocessing, and quality control. Leveraging these new techniques will improve efficiency in computing performance, data pre-processing, and significant reductions in the time to generate products.

# PROGRESS IN INNOVATION HIGHLIGHTS



## Transitioning Operations and Big Data to the Cloud

The NOAA Big Data Project explores the potential benefits of storing key observations and model outputs with commercial cloud providers. NOAA works with five commercial cloud providers to see how their services can facilitate full and open data access to the taxpayer and to foster innovation by leveraging new automation tools to make our data more readily accessible. To date, more than 40 NOAA datasets have moved to commercial cloud-provider systems.



## Exploring New Scientific Techniques: Genomics

NOAA’s Atlantic Oceanographic and Meteorological Laboratory is engaged in several projects to hone bioinformatic expertise. Using innovative tools, scientists conduct research to understand biological changes of coral reefs and fisheries at individual, population, and ecosystem scales. Scientists also are testing if autonomous sampling coupled with eDNA (environmental DNA) analysis can help offset increasing ship-time costs.





## Advancing Community Weather Modeling

NOAA and the National Center for Atmospheric Research will design a user-friendly common modeling infrastructure so the entire weather enterprise can collaborate and accelerate the transition of new approaches from research into operations to improve weather and climate forecasting models.



## Joining Academia to Promote Mission Research and Education

NOAA partners with more than 40 colleges and universities through Sea Grant and the Cooperative Institute Program to educate and train future scientists, conduct scientific research and extension projects for the conservation and practical use of the coasts, Great Lakes, and other marine areas, and execute additional NOAA mission research projects.

## Spurring Private-Sector Innovation

NOAA continues to invest in the Commercial Weather Data Pilot. Contracts were awarded to GeoOptics, Inc., Spire Global, Inc., and Space Sciences and Engineering LLC to provide space-based global navigation satellite system radio occultation data to demonstrate data quality and potential value to NOAA's weather forecasts and warnings.

## Partnering with States to Protect Coastal Habitat

NOAA partners with states to acquire and designate coastal, marine, and Great Lakes habitat for long-term protection through the Coastal and Estuarine Land Conservation Program under the National Coastal Zone Management Program. Through this program in 2018, NOAA provided grants to states to acquire 5,857 acres of habitat for protection.



# PARTNERSHIP HIGHLIGHTS

## Enhancing a Long-Term Conservation Partnership

NOAA and the National Fish and Wildlife Foundation have promoted marine conservation since 1994. In 2018 the partnership expanded when three new National Coastal Resilience Fund programs were created, under the direction of Congress, to support the protection and resilience of coastal communities. In its first year, the program funded 35 new grants totaling \$28.93 million and leveraging \$38.29 million in matching funds from grantees.

## Streamlining Ocean Use Permitting with Interagency Partners

NOAA, the Department of Energy, and the Bureau of Ocean Energy Management used the Marine Cadastre database to develop the Ocean Reports tool that generates automated analyses that can help identify the best sites for aquaculture and other industry uses. This can streamline the permitting process and accelerate responsible industry expansion.



### Continuing a 6-year Run of NOAA Employee Job Satisfaction

Seventy-one percent of NOAA employees were satisfied with their job in 2018, higher than the government-wide average, and improving six years in a row. The actions highlighted on this page show our commitment to driving employee satisfaction even higher.

### Promoting a Diverse Workforce

One hundred people attended NOAA's Diverse Hiring event. We are committed to recruiting qualified individuals with diverse backgrounds to advance NOAA's mission. Diversity initiatives across NOAA include enhancing selection and assessment practices to support the hiring of diverse, highly qualified candidates.

### Funding, Hiring Students from Underrepresented Communities

Our Educational Partnership Program funded 289 students attending minority-serving institutions. Forty-four students graduated with mission-related science, technology, engineering, and math post-secondary degrees. Seventeen of the graduates are pursuing further education and 27 students found employment with NOAA or other natural resource or science organization. In 2018, we also helped 12 students through our Nancy Foster Scholarship Program, supporting research by female and minority students.



# PEOPLE HIGHLIGHTS



### Safeguarding NOAA's People

NOAA's Workplace Violence Prevention office has begun a "best-in-class" approach to extend more robust victim advocacy response services and prevention initiatives.

### Developing New NOAA Leaders

Thirty-one NOAA employees completed the prestigious 18-month NOAA Leadership Competencies Development Program in 2018. NOAA's flagship leadership program offers a series of training and multidisciplinary learning experiences designed to broaden participants' understanding of NOAA's strategic goals and business processes.

### Mentoring NOAA Employees

The new NOAA-wide mentoring program provides resources for employees at all career levels to connect with seasoned mentors to achieve their professional goals, build strategic relationships, enhance their knowledge and skills, and gain a broader perspective of NOAA's mission.





## WHO IS NOAA?

We are 11,400 government employees in research, scientific, program, and administrative fields.

We are supported by a number of partners, contractors, fellows, and university researchers.

We are meteorologists, computer specialists, physical scientists, fish biologists, program managers, and many other professional and support occupations.

We live and work from Pole to Pole, around the world, and likely some place near you.

**4** NOAA Personnel awarded the Nobel Prize (cumulative)

**6** NOAA Employees honored at the 2019 Black Engineer of the Year Awards

**34** Teachers from 26 states went to sea on NOAA ships to advance STEM education

**321** Number of authorized Commissioned NOAA Corps Officers

**828** NOAA Personnel with Doctorate Degrees

**1794** Peer-Reviewed Publications



**2664** NOAA Personnel with Masters Degrees

**4400+** Postsecondary students trained in NOAA-related sciences through NOAA-funded programs

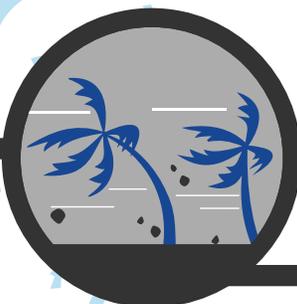
**6773** NOAA scientists and engineers studying and monitoring our environment



# CHARTING OUR COURSE

In this Brief, we presented the strong results of taxpayer investment in NOAA programs and services. NOAA exceeded expectations in 2018, providing quality service and a healthy return on investment with steady hands on the helms of leadership and accountability. In our FY 2020 budget request we seek support to stay on course to improve how we protect Americans, promote economic growth, and advance our strategic priorities. The new performance measures outlined below allow you to hold us accountable should these crucial investments be provided.

**Improve subseasonal temperature skill score**



**Increase number of forecast and mission improvements based on The Weather Research and Forecasting Innovation Act of 2017**

**Increase forecast length considered for accurate Global Ensemble Forecast System**

**Increase number of aquaculture research products transitioned toward use**

**Streamline review of aquaculture permits**



**Increase annual number of sites characterized in the US Exclusive Economic Zone**

**Streamline environmental reviews**

**Increase number of volunteer hours and participation in education programs for National Marine Sanctuaries**

**Strengthen compliance with the Seafood Import Monitoring Program**

**Accelerate use of unmanned systems**



## NOAA LEADERSHIP

**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 / Deputy NOAA Administrator

**BENJAMIN FRIEDMAN**

Deputy Under Secretary for Operations

**DREW LAWLER**

Deputy Assistant Secretary for International Fisheries

**DR. STUART LEVENBACH**

Chief of Staff

**JULIE KAY ROBERTS**

NOAA Deputy Chief of Staff

**KEVIN WHEELER**

NOAA Policy Director

**WENDY LEWIS**

Director of Legislative Affairs



**NICOLE R. LEBOEUF**

Acting Assistant Administrator for NOAA National Ocean Service



**CRAIG MCLEAN**

Assistant Administrator for NOAA Oceanic and Atmospheric Research and Acting Chief Scientist



**CHRIS OLIVER**

Assistant Administrator for NOAA Fisheries



**RADM MICHAEL J. SILAH**

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



**DR. LOUIS W. 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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U.S. Department of Commerce



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**APRIL 2019**