



NOAA Unmanned Systems (UxS) Strategy *Update to NOAA Science Advisory Board*

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NOAA Office of The Undersecretary (on detail)
December 16, 2019



Outline

- **Reprise background context from July**
- **Process to, highlights of current draft**
- **Next Steps**
- **A few recent and related events**
- **Questions**



Moving towards a NOAA UxS Program

Establish Unmanned Systems Operations Program



(FY 2020 Request +\$4,000,000)

The FY 2020 President's Budget builds on bipartisan Congressional actions, such as the *Commercial Engagement Through Ocean Technology Act of 2018*, to enhance the Blue Economy. The budget establishes an Unmanned Systems (UxS) Operations Program to provide centralized UxS support and guidance across NOAA within the Office of Marine and Aviation Operations (OMAO). This implements the Executive Order on *Maintaining American Leadership in Artificial Intelligence* and helps the cloud capabilities to process, archive, and assimilate priority data identified by the AI research community.

NOAA currently has more than 100 UxS, including aerial and marine systems that serve as force multipliers to increase NOAA's ability to collect data in many sectors, and are particularly valuable in remote and extreme environments. Unmanned systems complement observations from satellite, ships, aircraft, balloons, and surface-based sensors. Rapidly evolving UxS technology is invaluable in supporting NOAA mission requirements such as hydrographic and habitat mapping, marine mammal population and fishery stock assessments, and oceanographic and atmospheric observations that improve forecasting of extreme weather events.

A centralized UxS program will be used for NOAA's management and standardization of safety, training, inspections, and operational reviews. It will also manage the agency's acquisitions, operations, and maintenance to ensure that platforms are standardized, efficiently meet NOAA requirements, and are in compliance with Federal requirements. NOAA will coordinate with labs and programs within all line offices that have extensive experience in unmanned marine systems and remotely operated vehicle research and development, to create a more organized and cost-effective corporate operation in OMAO. This will enable NOAA to take full advantage of available UxS technologies and will facilitate and standardize the training and certification of UxS engineers, technicians and operators within NOAA and across other federal agencies, academic institutions, and industries.

This investment underpins a NOAA goal to increase the economic contributions of the Blue Economy and furthers the Department of Commerce strategic goals of accelerating American leadership, enhancing job creation, and strengthening U.S. economic and national security.



Left top image: A NOAA Carbon Wave Glider collecting data in Prince William Sound in Alaska to help scientists better understand how melting glaciers may be intensifying ocean acidification in a region with conditions already conducive to acidification.

Right top image: NOAA's remotely operated vehicle Deep Discoverer surveys large amounts of stony coral at the top of the crest of Richardson Ridge on June 21, 2018.

Left bottom image: Saldrome Inc. works with NOAA scientists to integrate 18 sensors into the drone capable of collecting measurements such as air and water temperature, wave height, salinity, carbon dioxide concentration, fish abundance and the presence of marine mammals.

Right bottom image: First test of the radiosonde, weather balloon, released from an auto-launcher on April 11, 2018 in Fairbanks, AK.

- **\$4M in FY20 PresBud for NOAA UxS Program**
 - centralized, cost-effective support within OMAO
 - standardized safety, training, inspections, operational reviews
 - support acquisition, ops, and maintenance to ensure Fed compliance and meet NOAA requirements
- **Builds on bipartisan Cong. actions, e.g. *Commercial Engagement Through Ocean Technology Act of 2018 (CENOTE)***
- **Underpins a NOAA goal to increase economic contributions of the Blue Economy**

Getting to a “final” draft

- **Two products originally targeted for completion by Sept 30:**
 - NOAA UxS Strategy Paper
 - NOAA UxS Implementation Plan
- **Coordination with other NOAA technology initiatives (‘Omics, AI, Cloud Computing)**
- **White House Science & Technology Summit as a “driver” for completion**



Draft NOAA Unmanned Systems Strategy

Maximizing Value for Science-based Mission Support



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



NOAA welcomes your input on this draft strategy. Please send your comments via email to oar.rc.execsec@noaa.gov. Complete information, including the submission deadline, is available at <https://nrc.noaa.gov/NOAA-Science-Technology-Focus-Areas>.

NOAA Science & Technology Focus Areas:

Unmanned Systems ■ Artificial Intelligence ■ Omics ■ Cloud

*Draft published
November 14*

Introduction
(with definition)

Background

Vision

Goals & Objectives

Conclusions

References

Acknowledgements

Goals

GOAL 1. **Coordinate and Support UxS Operations at an Enterprise Level.**

GOAL 2. **Expand UxS Applications Across NOAA's Mission Portfolio.**

GOAL 3. **Accelerate Transition of UxS Research to Operations.**

GOAL 4. **Strengthen and Expand UxS Partnerships.**

GOAL 5. **Promote Workforce Proficiency in UxS Use and Operations.**



Goals & Objectives

GOAL 1. Coordinate and Support UxS Operations at an Enterprise Level.

- **Objective 1.1.** Establish an Effective and Adaptive Organizational Structure.
- **Objective 1.2.** Identify and Deliver Priority Core Services Including Cybersecurity, Training, and Acquisition
- **Objective 1.3.** Implement an Innovative, Robust, and Encompassing UxS Data Enterprise.

GOAL 2. Expand UxS Applications Across NOAA's Mission Portfolio.

- **Objective 2.1.** Establish A Requirements-Based Process to Prioritize UxS Operational Applications and Use.
- **Objective 2.2.** Establish a Thriving UxS Community-of-Practice at NOAA.
- **Objective 2.3.** Institutionalize Operational Applications Through Formal Concepts of Operations.

GOAL 3. Accelerate Transition of UxS Research to Operations.

- **Objective 3.1.** Identify and Prioritize Candidate UxS Platforms for NOAA Use.
- **Objective 3.2.** Develop Transition Plans With Operational Partners.
- **Objective 3.3.** Conduct Systematic Testing and Evaluation to Ensure High Performance.

Goals & Objectives

GOAL 4. Strengthen and Expand UxS Partnerships.

- **Objective 4.1.** Increasingly Leverage Interagency Integration.
- **Objective 4.2.** Reinforce Cooperation With Academia.
- **Objective 4.3.** Dramatically Grow Research Partnerships With the Private Sector.

GOAL 5. Promote Workforce Proficiency in UxS Use and Operations.

- **Objective 5.1.** Expand Recruiting Efforts To Showcase NOAA UxS Activities.
- **Objective 5.2.** Establish Formal Training and Certification.
- **Objective 5.3.** Include NOAA UxS Assignments as a Retention Tool.



Definition

Unmanned systems are vehicles - aerial, terrestrial, or marine – and associated elements such as communications software that can execute data collection missions without a human presence aboard.

They are typically controllable or programmable, self-powered, untethered, and operate on a continuum from attended to fully autonomous.

This Strategy also includes Remotely Operated Vehicles which are typically deployed from ships and receive power and operator instructions from a tether.



Vignettes

NOAA Unmanned System Strategy v.3.3, November 12, 2019



NOAA's Office of Coast Survey prepares to launch a Hydrolab HSE1000 ASV on a bathymetry mapping mission. This vehicle can operate for 24 hours at a time up to 400 meters while maintaining accurate communications with the host ship.

Vision
Accelerate and expand the transformative use of unmanned systems to the benefit of NOAA and the nation.

Goals and Objectives
These goals and supporting objectives are intended to directly improve the understanding, coordination, awareness, and application of Unmanned Systems (US) at NOAA. NOAA includes a strong supporting environment for investigations on experimental and innovative uses and designs that advance NOAA's research, operational applied science missions. The report outlines the transformational advances in every mission area.

GOAL 1. Coordinate and Support US Operations at an Enterprise Level.

Improving overall coordination of US's while, in parallel, prioritizing these systems in formulation, strategic communications, and IT investments such as cloud computing applications, will rapidly increase US's use and value across NOAA.

Objective 1.1. Establish an Effective and Adaptive Organizational Structure.

New capacity is needed to support the rapidly expanding use of US's across NOAA to raise safety standards, increase efficiency, and promote the economical operation of the agency. To effect this, NOAA will establish a new unmanned systems operation within the Office of Marine and Aviation Operations to provide centralized support, and to improve coordination of US's activities across the agency in alignment with the existing NOAA US's Executive Oversight Board. Recent NOAA advances in the governance and resourcing of unmanned aircraft systems (UAS) activities and the current NOAA small boat program provide useful examples. The purpose of the program will be to provide higher quality, cost-effective services at faster cycle times that result in higher operational performance and safety than any individual NOAA office or program can provide for itself.

Objective 1.2. Identify and Deliver Priority Core Services Including Cybersecurity, Training, and Acquisition

NOAA Unmanned Systems Strategy

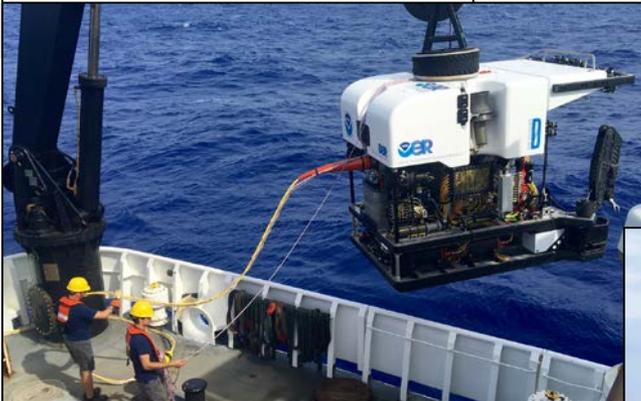
Goal 1: Coordinate and Support Operations at an Enterprise Level

Goal 2: Expand US Application Across NOAA's Mission Portfolio

Goal 3: Accelerate transition of US Research to Operations

Goal 4: Strengthen and Expand US Partnerships

Goal 5: Promote Workforce Proficiency in US Use and Operations



White House Summit Release

Dec 4 NOAA all hands msg from RDML (Ret.) Gallaudet:

White House Summit Outcomes & Presidential Memorandum on Ocean Mapping:

As Dr. Jacobs mentioned in his November update, he, I, and other members of NOAA leadership participated in the White House Science and Technology Summit on November 14. Approximately 100 leaders from the ocean science and technology community came together to focus on strengthening partnerships to address societal needs such as exploring the oceans, conserving marine biodiversity, and leveraging big data. **Our release of four draft strategies on NOAA: unmanned systems; artificial intelligence; 'Omics; and cloud computing and storage resonated well at the Summit and underpinned the themes of most of the meeting breakout sessions.** NOAA showed clear leadership throughout the Summit, and is already embarking on new, transformative partnerships to advance our application of Ocean science and Technology to the American Blue Economy, and more are planned for 2020.



2 page Fact Sheets for each Strategy



NOAA Unmanned Systems Strategy

The NOAA Unmanned Systems (UxS) Strategy will dramatically expand the application of unmanned aircraft and marine systems (together, "unmanned systems" or "UxS") in every NOAA mission area by improving the efficiency, effectiveness, and coordination of UxS development and operations across the agency. As future data exploitation opportunities continue to increase exponentially with improved UxS platforms and architectures, the integration of artificial intelligence, and new commercial data sources, this Strategy will guide transformative advancements in the quality and timeliness of NOAA science, products, and services.



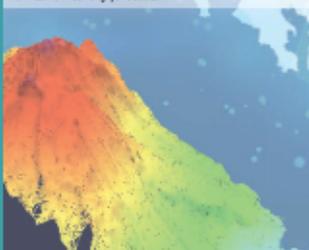
Demonstrated Leadership in Unmanned Systems

Many NOAA programs have pioneered the innovative use of UxS as a valuable force multiplier—augmenting data collection often at lower costs, increased safety, and reduced risk, especially in remote or extreme environments. The systems we have used to conduct research and operations include unmanned underwater vehicles (UUVs), such as gliders, remotely operated vehicles (ROVs), unmanned surface vehicles (USVs), and unmanned aerial vehicles (UAVs). UxS data are improving fishery stock assessments, hurricane intensity forecasts, and ocean and habitat mapping. Accelerating and expanding the use of unmanned systems across every NOAA mission area will provide NOAA customers with higher-quality, cost-effective services at faster cycle times that result in higher operational performance and safety. Example applications include:

- Hydrographic and disaster response surveys;
- Ocean exploration;
- Seafloor and shoreline mapping;
- Weather and flood damage assessment;
- Remote sensing for hazardous weather warnings;
- Marine mammal surveys;
- Fishing surveys for stock assessment; and
- Satellite sensor calibration.



NOAA's Integrated Ocean Observing System partnered with the U.S. Navy and Shell Oil Co. to share data from over 20 gliders deployed in the Gulf of Mexico in 2018. Salinity and temperature data from gliders can improve hurricane intensity forecasts.



NOAA Science & Technology Focus Areas: Unmanned Systems • Artificial Intelligence • Omics • Cloud **November 2019**

The draft UxS Strategy is being made available for public comment at <https://www.noaa.gov/NOAA-Science-Technology-Focus-Areas>.

Unmanned Systems Strategy Goals

1. Coordinate and support UxS operations at an enterprise level.
2. Expand UxS applications across NOAA's mission portfolio.
3. Accelerate transition of UxS research to operations.
4. Strengthen and expand UxS partnerships.
5. Promote workforce proficiency in UxS use and operations.



NOAA research biologist, Katie Sweeney and Dr. Brian Foley, deploy a hexacopter to monitor depleted northern fur seal populations with minimal disturbance. UxS can be ideal for marine mammal monitoring in difficult-to-traverse environments, such as the remote Aleutian Islands, at reduced cost and risk to scientists.

The FY 2020 President's budget includes \$4M to support establishing a NOAA Unmanned Systems Operations Program and aligns with:

- Bipartisan Congressional action, such as the Commercial Engagement Through Ocean Technology Act of 2018 (CENOTE).
- The Executive Order on Maintaining American Leadership in Artificial Intelligence.
- The National Science and Technology Council's Science and Technology for America's Oceans: A Decadal Vision as well as the Executive Office of the President's August 30, 2019, Memorandum "Fiscal Year 2021 Administration Research and Development Budget Priorities."



For the third year in a row, 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.



NOAA's Office of Coast Survey prepares to launch a Hybrid REMUS 600 autonomous underwater vehicle on a bathymetric mapping mission. This vehicle can operate for 20+ hours at depths up to 450 meters while maintaining acoustic communications with the host ship.

NOAA Science & Technology Focus Areas: Unmanned Systems • Artificial Intelligence • Omics • Cloud **November 2019**

Draft NOAA Artificial Intelligence Strategy

Analytics for Next-Generation Earth Science

Draft NOAA 'Omics Strategy

Strategic Application of Transformational Tools

Draft NOAA Cloud Strategy

Maximizing the Value of NOAA's Cloud Services

draft Strategies posted for 32 day comment period

(closes Dec 16)

Draft NOAA Unmanned Systems Strategy

Maximizing Value for Science-based Mission Support



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NOAA Science & Technology Focus Areas
Unmanned Systems • Artificial Intelligence



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NOAA Science & Technology Focus Areas
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NOAA Science & Technology Focus Areas:
Unmanned Systems • Artificial Intelligence • 'Omics • Cloud

Next Steps

- **Finalize Strategy** (public comments, NOAA review)
- **NOAA Tiger Team for 36 mo. Implementation Plan** (3-4 mo. effort?)
 - *planning assumptions*
 - *spend plan*
- **External engagement after public review?**
 - *listening sessions?*
 - *national “workshop” of key stakeholders?*



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Related Recent Activities

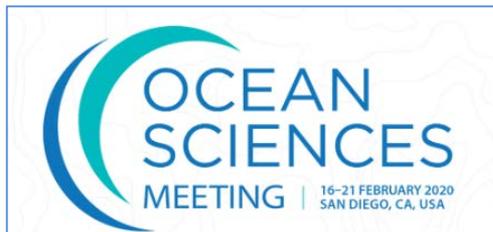
1 *Oceans in Action 2019*

November 4-6
Courtyard Marriott Beachfront
Gulfport, Mississippi



- 2 (a) **SHORT TITLE.**—This Act may be cited as the “Commercial Engagement Through Ocean Technology Act of 2018” or the “CENOTE Act of 2018”.
- New Annex for USN/NOAA MOU
 - USN/NOAA collaboration on ANTX 2020

3



Related Recent Activities

USM's Center for Ocean Enterprise breaks ground at Port of Gulfport



Nov 8th

4



NOAA

SCIENCE. SERVICE. STEWARDSHIP.



Thank You!

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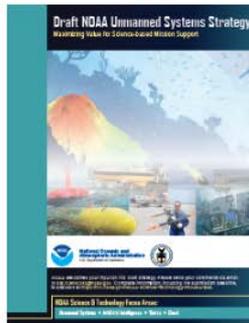


NOAA SCIENCE & TECHNOLOGY FOCUS AREAS

The NOAA Unmanned Systems, Artificial Intelligence, 'Omics, and Cloud Strategies are intended to dramatically expand our application of these four emerging science and technology focus areas by improving the efficiency, effectiveness and coordination of their development and usage across the agency. As unmanned systems, artificial intelligence, 'omics, and cloud technologies are revolutionizing our ability to observe, predict, and understand the environment, these strategies will guide transformative advancements in the quality and timeliness of NOAA science, products, and services.

NOAA welcomes your input on these draft strategies. Please submit your comments by the deadline to oar.rc.execsec@noaa.gov. For specific instructions, visit <https://www.federalregister.gov/documents/2019/11/14/2019-24753/four-draft-noaa-science-and-technology-strategies-noaa-unmanned-systems-artificial-intelligence>.

Draft NOAA Unmanned Systems Strategy



PDF

Draft NOAA Artificial Intelligence Strategy



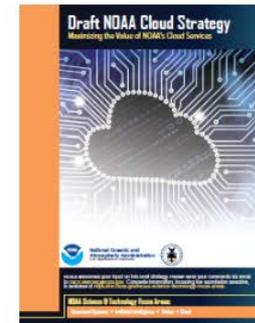
PDF

Draft NOAA 'Omics Strategy



PDF

Draft NOAA Cloud Strategy



PDF

In recent years, NOAA and its multisector partners have worked tirelessly to advance successful unmanned systems, artificial intelligence, 'omics, and cloud solutions that improve our mission accomplishment. The draft strategies will ensure robust agency-wide coordination and strong institutional support from NOAA senior leadership for these emerging science and technology focus areas to guide transformational advances in the quality and efficiency of NOAA's science, products, and services.

<https://nrc.noaa.gov/NOAA-Science-Technology-Focus-Areas>