NOAA Science Update to the Science Advisory Board

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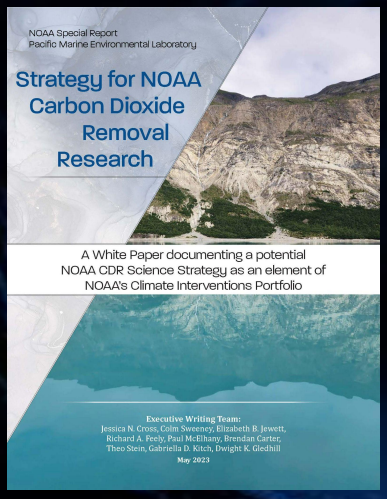
July 26, 2023

CDR Strategy Released



The Strategy for NOAA Carbon Dioxide Removal (CDR) Research was published in June 2023

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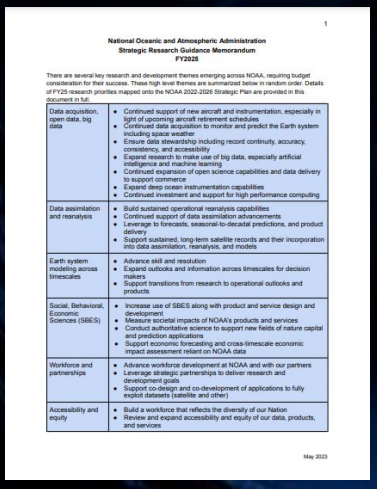
- Let's kick off this discussion with one recent white paper that was released last month.
- NOAA's new Carbon Dioxide Removal Research Strategy is another way that NOAA is working with Congress and our partners to build a Climate Ready Nation.
- In this context, the CDR industry is growing rapidly, and could be as much as a $1 Trillion market by 2050, according to McKinsey.
- However, many CDR methods are currently in their infancy. This is especially true of CDR methods that impact the oceans
    - Overall, current CDR capacity falls about 80 percent short of the requirement suggested by IPCC.
    - Future deployment of technologies that are found to be efficient, effective, and acceptable will still take considerable time to scale up.
    - In the broader landscape of CDR research, NOAA has the right expertise to assess the efficiency, effectiveness, and environmental impact of marine and terrestrial CDR techniques proposed by non-NOAA entities.
    - This is likely to require a portfolio of NOAA science, including carbon observations, environmental monitoring, modeling, technology development, and decision support.

- In particular, we want to ensure that any carbon dioxide removal techniques that are implemented as part of the growing Blue Economy have a well known risk-benefit profile.
    - NOAA's science and stewardship missions can help evaluate CDR strategies and implementations to ensure that they are safe, sustainable, and fair.
- We believe the time is now to start this research.
    - The next decade is a critical time to address the climate crisis.
    - We have a small window to shift to a carbon-neutral economy and hold climate impacts in check.
    - We must enact transformational change at the national level, but we must also harness the power of ambition and the call for action at every level to solve this challenge together.
    - NOAA's portfolio of climate intervention research can help us do that.
- https://sciencecouncil.noaa.gov/cdr-strategy/

Strategic Research Guidance Memorandum Released



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National Oceanic and Atmospheric Administration
Strategic Research Guidance Memorandum
FY2025

There are several key research and development themes emerging across NOAA, requiring budget consideration for their success. These high level themes are summarized below in random order. Details of FY25 research priorities mapped onto the NOAA 2022-2026 Strategic Plan are provided in this document in full.

Data acquisition, open data, big data	• Continued support of new aircraft and instrumentation, especially in light of upcoming aircraft retirement schedules • Continued data acquisition to monitor and predict the Earth system including space weather • Ensure data stewardship including record continuity, accuracy, consistency, and accessibility • Expand research to make use of big data, especially artificial intelligence and machine learning • Continued expansion of open science capabilities and data delivery to support commerce • Expand deep ocean instrumentation capabilities • Continued investment and support for high performance computing
Data assimilation and reanalysis	• Build sustained operational reanalysis capabilities • Continued support of data assimilation advancements • Leverage to forecasts, seasonal-to-decadal predictions, and product delivery • Support sustained, long-term satellite records and their incorporation into data assimilation, reanalysis, and models
Earth system modeling across timescales	• Advance skill and resolution • Expand outlooks and information across timescales for decision makers • Support transitions from research to operational outlooks and products
Social, Behavioral, Economic Sciences (SBES)	• Increase use of SBES along with product and service design and development • Measure societal impacts of NOAA's products and services • Conduct authoritative science to support new fields of nature capital and prediction applications • Support economic forecasting and cross-timescale economic impact assessment reliant on NOAA data
Workforce and partnerships	• Advance workforce development at NOAA and with our partners • Leverage strategic partnerships to deliver research and development goals • Support co-design and co-development of applications to fully exploit datasets (satellite and other)
Accessibility and equity	• Build a workforce that reflects the diversity of our Nation • Review and expand accessibility and equity of our data, products, and services

May 2023

The FY25 Strategic Research Guidance Memorandum (SRGM) was published in May 2023.

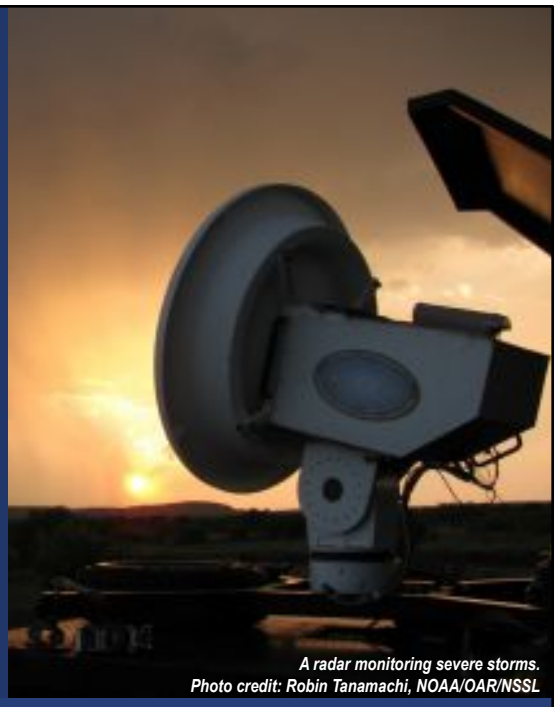
The FY26 SRGM is in development.

- The FY25 Strategic Research Guidance Memorandum, which provides the portfolio logic of NOAA's R&D enterprise, was finalized in May 2023
- The overarching topics for this FY25 SRGM are:
  - Data acquisition, open data, big data
  - Data assimilation and reanalysis
  - Earth system modeling across timescales
  - Social, Behavioral, Economic Sciences
  - Workforce and partnerships
  - Accessibility and equity
- The FY26 is under development and we will have a more in depth discussion about this.
- https://sciencecouncil.noaa.gov/council-products/strategic-research-guidance-memorandum/

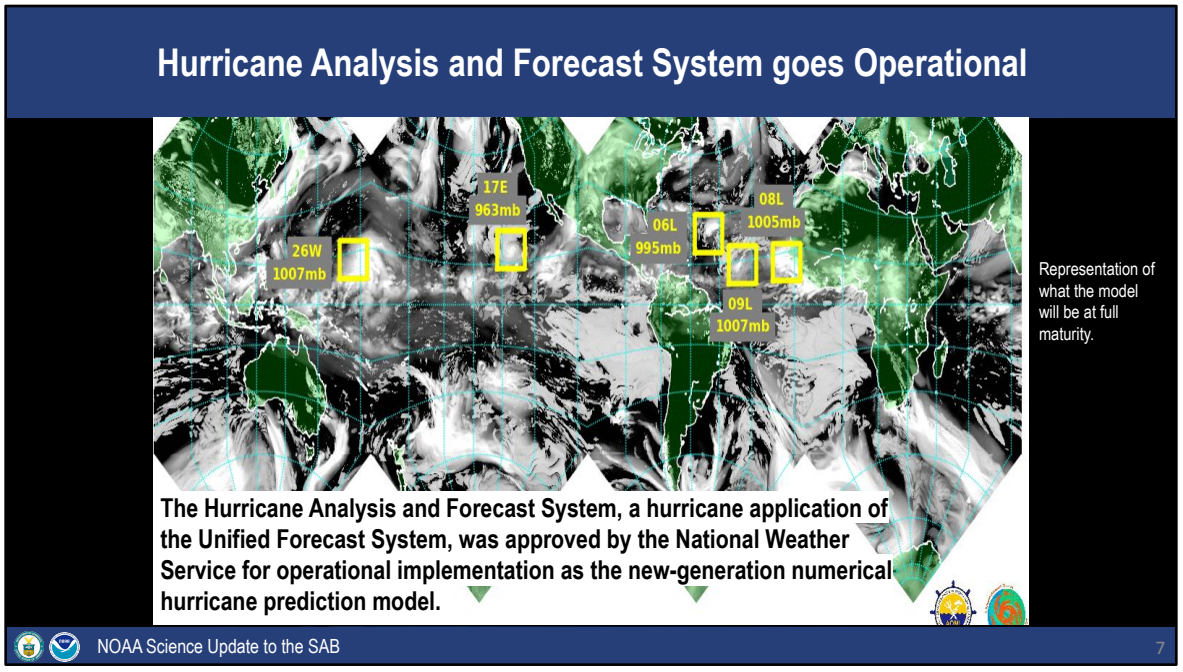
The NOAA R&D Vision Areas provides direction on NOAA's R&D and enables proactive actions to align NOAA's resources, budget, and functional activities to achieve stated goals.

- This briefing has been organized under these three vision areas

Vision Area 1: Reducing societal impacts from hazardous weather and other environmental phenomena



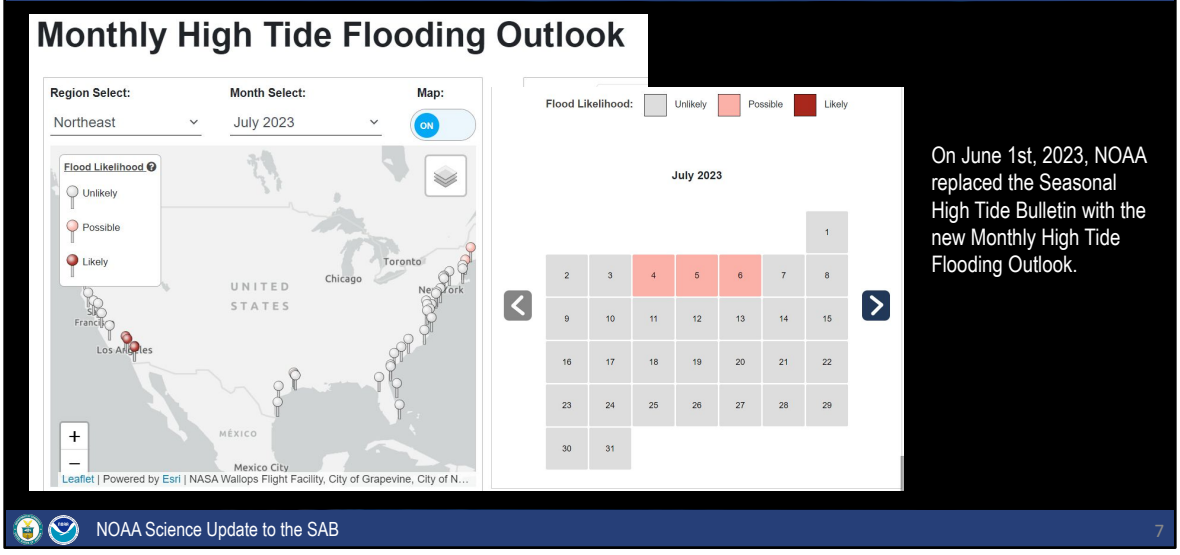
A radar monitoring severe storms.
Photo credit: Robin Tanamachi, NOAA/OAR/NSSL



- NWS
- The Hurricane Analysis and Forecast System (HAFS) model was jointly developed by AOML, NCEP's Environmental Modeling Center of NWS, and their partners becomes operational.
    - Key to this success was the development of a Research to Operations Transition Plan that provided a roadmap for the process and facilitated communication between AOML (R&D) and NWS (operations).
- This was a true collaborative effort with vital contributions from senior modelers to a student scientist who supported AOML through the NOAA Experiential Research and Training Opportunities (NERTO) program.
- The overarching goal is to improve forecasts and provide more accurate numerical guidance to forecasters and stakeholders so as to reduce loss of life and property damage.
- Operationalized in 2023, the HAFS, part of the Unified Forecast System, provides improved forecasting of storm track, intensity (hurricane winds), and structure by allowing scientists to "zoom in" and follow a close-up view of the storm.
- With this upgraded storm view, scientists can look for clues that may indicate conditions ripe for rapid intensification–tropical cyclone winds increasing by at least 35 mph in a 24 hour period–and other unique features of the storm.

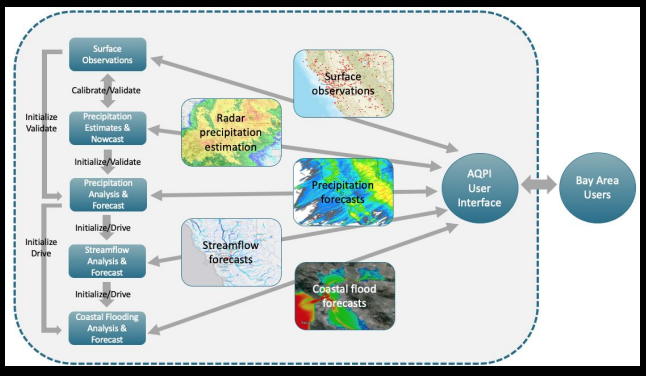
- Was this a community effort within UFS or was this only AOML/EMC?
  - all of the players but mostly AOML/EMC/CIMAS/GFDL
- What is causing the improvements in this model?
  - HAFS comprises five major components: (a) High-resolution moving nest (b) High-resolution physics (c) Multi-scale data assimilation (DA) (d) 3D ocean coupling, and (e) Observations to support the DA.
  - enabled multiple sets of moving telescopic nests to follow more than one tropical cyclone at a time.
  - having storm-following nests around all active tropical cyclones at the same time produced more accurate forecasts
  - Intensity forecasts improved as more tropical cyclones and, consequently, more moving nests were added to the model, with gains of up to 30%
- Recent interview:
  - https://research.noaa.gov/2023/05/24/noaas-new-hurricane-forecast-model-a-conversation-with-the-lead-modeler/
  -

New Monthly High Tide Flooding Prediction Model



- NOS
- On June 1st, 2023, NOAA replaced the Seasonal High Tide Bulletin with the new Monthly High Tide Flooding Outlook.
- CO-OPS, with partners from University of Hawaii and NESDIS NCEI, published new research which demonstrates skillfull monthly prediction of daily High Tide Flooding likelihood up to a year in advance.
- CO-OPS then worked to implement this R&D into CO-OPS operations, as a new monthly High Tide Flooding Outlook, within about 7 months time.
- The outlook is updated monthly and provides coastal communities with likely coastal flood days for the next year at NOAA tide gauges.
- It is important to note that this product is a “user-driven product development process". The team has been working to gather user feedback since their soft launch on June 1st and feedback will be incorporated into future versions.
- A full media rollout of the outlook is likely to occur on August 22

Advanced Quantitative Precipitation Information (AQPI)



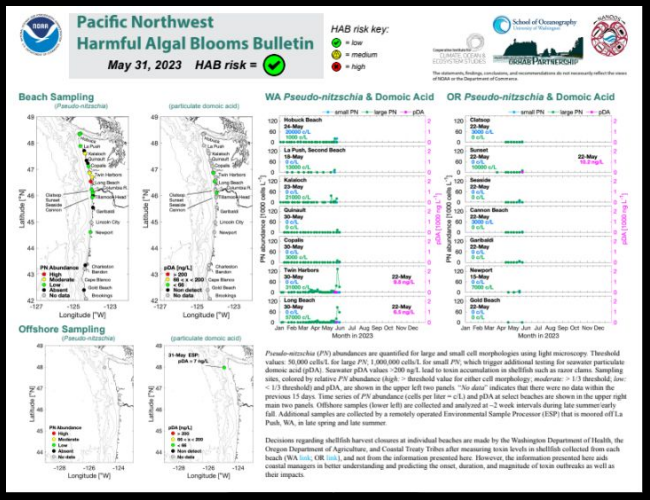
- On the West Coast, NOAA is developing a network of advanced weather radars and new surface meteorology stations that will feed into numerous meteorological and hydrologic models throughout NOAA and USGS.
- This project, called Advanced Quantitative Precipitation Information (AQPI) will help to improve precipitation and temperature forecasts, and during this last winter season, led to better rainfall estimates and overall situational awareness for the atmospheric river events that affected the San Francisco area.

- OAR
- In the western US, NOAA continues to research and develop ways to prepare for and respond to extreme drought and precipitation events.
- On the West Coast, NOAA is developing a network of advanced weather radars and new surface meteorology stations that will feed into numerous meteorological and hydrologic models throughout NOAA and USGS.
- This project, called Advanced Quantitative Precipitation Information (AQPI) will help to improve precipitation and temperature forecasts, and so far this year, has led to better predictions of two big atmospheric river events that affected the San Francisco Area.
- NOAA is also in the process of developing multiseasonal atmospheric river frequency forecasts, which will allow for longer-term preparation for water resources.

Vision Area 2: Sustainable use and stewardship of ocean and coastal resources

South entrance of Detroit River to the right and northeast corner of Lake Erie to the left. Photo credit: NOAA/OAR/GLERL

Value of the Pacific Northwest Harmful Algal Bloom (HAB) Forecast



- The Pacific Northwest HAB Bulletin is a forecasting tool that provides early warning of HABs to coastal shellfish managers.
- A NOAA-funded study on the economic impact of recreational harvest closures found these generate over $50 million annually for local communities, with the community of Long Beach, WA alone facing at least $840,000 in lost revenue for area businesses if a bloom causes the razor clam season to close.

- NOS
- The Pacific Northwest (PNW) Harmful Algal Bloom (HAB) Bulletin is a forecasting tool that provides information to managers to facilitate their decisions
- The Bulletin has already helped protect the health of tens of thousands of harvesters and consumers in northwest region.
    - In Washington, the Bulletin helps managers decide when and where to open the fishery.
    - In Oregon, where only limited tissue toxin data is available, the Bulletin allows managers to systematically prioritize additional sample collections ahead of potential area closures.
- In the Pacific Northwest, toxins associated with blooms of Pseudo-nitzschia can contaminant razor clams resulting in closures of recreational harvests and significant local economic impacts.
- A NOAA-funded study on the economic impact of these closures led by Woods Hole Oceanographic Institute found the recreational harvests generate over $50 million annually for local communities, with the community of Long Beach, WA alone facing at least $840,000 in lost revenue for area businesses if a bloom causes the razor clam season to close.
- This study demonstrated the value in the Pacific Northwest HAB Bulletin, an

- ecological forecast that provides early warning of toxin blooms and minimizes the need for widespread harvest closures.

PFAS in Marine Ecosystems

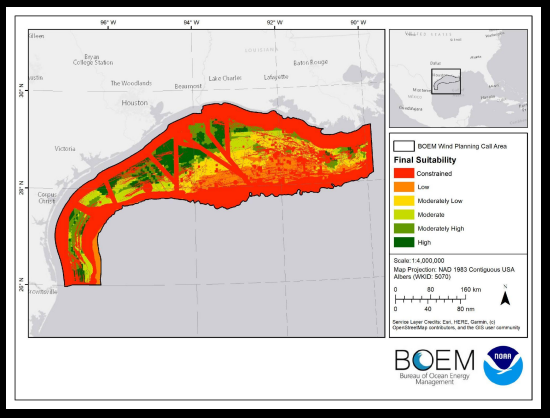
PFAS are mobile and persistent

- 80% of pollution to the marine environment comes from the land.
- NOAA is involved in Per- and Polyfluoroalkyl Substances (PFAS) because things tend to end up in the ocean.
  - PFAS are broad group of fluorinated chemicals
  - Can provide oil, water, temperature, chemical, and fire resistance.
- NOAA's role is to detect PFAS, understand its biological and ecological effects, assess risk, assess alternatives

- NOS
- 80% of pollution to the marine environment comes from the land.
- NOAA is involved in Per- and Polyfluoroalkyl Substances (PFAS) because things tend to end up in the ocean.
  - These are a broad group of fluorinated chemicals
  - Can provide oil, water, temperature, chemical, and fire resistance.
  - Can cause liver damage, kidney cancer, thyroid disease/cancer, increased cholesterol, autoimmune diseases, among other health related issues.
- NOAA's role is to assess the risk of PFAS to coastal, marine, Great Lakes environments and living marine resources.
- NOAA is conducting laboratory studies to determine PFAS toxicity thresholds for marine and estuarine species as part of the standard suite of contaminants via the Mussel Watch program.
  - By environmental sampling, laboratory toxicity testing, field and mesocosm studies, and ecological forecasts.
- NOAA works closely with federal and state agencies to translate our data into technological solutions and management actions that mitigate pollution impacts and protect sustainable use of coastal resources.

- The White House PFAS ((Per- and Polyfluoroalkyl Substances) Report was released in March 2023

Offshore Wind Team Provides Spatial Planning Models



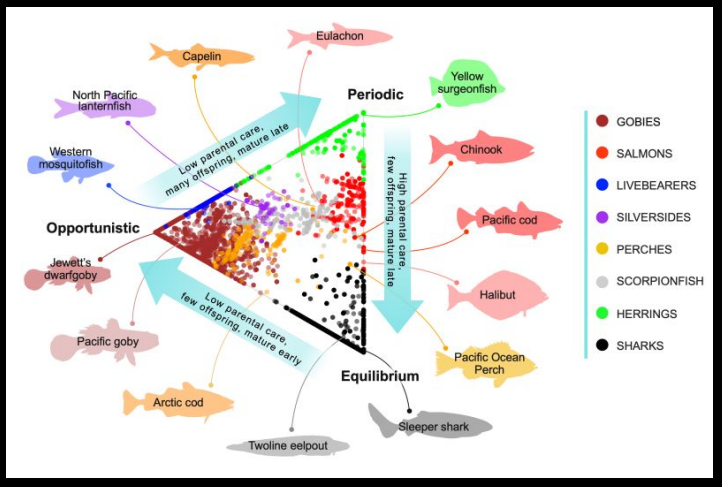
- The offshore wind team is developing comprehensive spatial models to help characterize ocean environments and industries to more holistically and efficiently inform BOEM's decision-making on offshore wind siting.
- The team has completed models for the Gulf of Mexico and Central Atlantic with models for Oregon and the Gulf of Maine in development.

- NOS
- In support of NOAA's renewable energy efforts, NOAA partnered with BOEM (Bureau of Ocean Energy Management) to help identify the most suitable locations for offshore wind energy siting.
- The offshore wind team is developing comprehensive spatial models to help characterize ocean environments and industries to more holistically and efficiently inform BOEM's decision-making on offshore wind siting.
- The team has completed models for the Gulf of Mexico and Central Atlantic with models for Oregon and the Gulf of Maine in development.
- In addition, the team is developing cable routing models to help inform energy transmission.

Vision Area 3:
A robust and effective research, development, and transition enterprise

The GOES-17 satellite above the thermal vacuum chamber. Photo credit: Lockheed Martin.

Scientists Can Predict Traits for All Fish Worldwide for the First Time



- Scientists have developed a new model that can now predict growth, survival, and reproductive strategies for all known fish in the world.
- The results will inform ecosystem-based fisheries management, help forecast consequences of climate change, and advance our understanding of evolutionary relationships.

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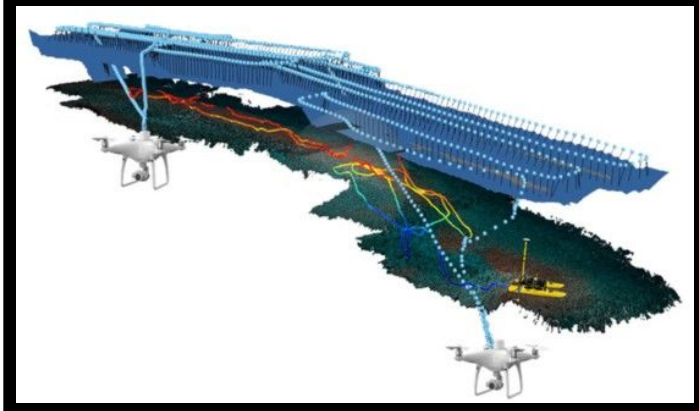
- NMFS - Fisheries
- Scientists have developed a new model that can now predict growth, survival, and reproductive strategies for all known fish in the world.
- The new model uses 33 traits—describing size, growth, reproduction, parental care, lifespan and more— to classify more than 34,000 fish species among three dominant strategy types.
- The model uses the Robin-Hood approach (borrow from data-rich species to predict strategies for data-poor species) and also uses evolutionary information to inform which species are closely related.
- We can only assess a fraction of the fish species that are caught around the world. This model can predict traits and strategies for all the rest.
- The results will inform ecosystem-based fisheries management, help forecast consequences of climate change, and advance our understanding of evolutionary relationships.

Integration of Aerial and Underwater UxS Data into the Cloud



Graphic showing the integration of different data streams from airborne and water surface drones to map shallow water (<10 m) depths. Credit: NOAA.

- We made significant progress towards integrating these goals by developing and procuring uncrewed aerial and underwater vehicles with novel payloads;
  - by storing and processing data from these vehicles in Microsoft's Azure cloud environment;
  - by applying commercially available AI to translate data from these systems into information.

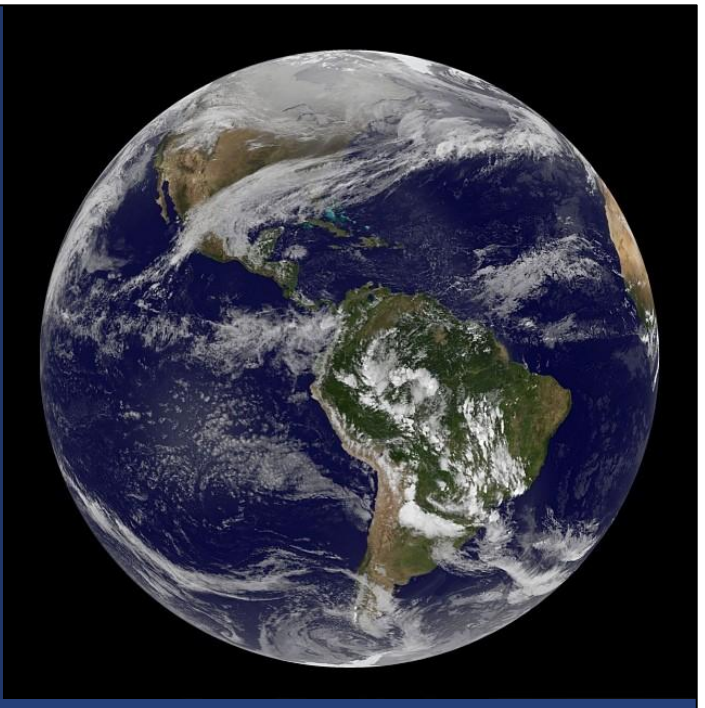
- NOS
- NOAA has committed to using cloud services, uncrewed systems and artificial intelligence (AI) to provide accurate and timely scientific information to advance the new blue economy and build a climate ready nation.
- In 2023, the National Centers for Coastal Ocean Science (NCCOS) made significant progress towards integrating these goals by developing and procuring uncrewed aerial and underwater vehicles with novel payloads; by storing and processing data from these vehicles in Microsoft's Azure cloud environment; and by applying commercially available AI to translate data from these systems into information.
- While there is still work to be done, these advances have increased NOAA's technical capacity to respond to the growing list of challenges facing U.S. oceans and coastal communities.

High-altitude Research Tool Passes Key Milestone

The HORUS glider and balloon prepared for a test flight on May 17, 2023 in Colorado's Pawnee National Grasslands. (Credit: NOAA)

The Global Monitoring Laboratory deployed high-value, balloon-borne greenhouse gas and meteorological instruments onboard a glider to 90,000 feet and returned them to the launch point, an achievement that greatly expands NOAA's ability to observe the upper atmosphere in both remote and climate-critical regions.

Balloon-borne instruments are traditionally considered expendable or need to be recovered manually.

- OAR
- NOAA's Global Monitoring Laboratory (GML), with collaborators from NOAA's Office of Research Transition and Application (ORTA) and Office of Marine and Aviation Operations (OMAO), developed a reliable, cost-effective way to retrieve balloon-borne instruments from the stratosphere.
- On May 17, 2023 over the eastern Colorado plains, GML used a balloon to lift the glider with a scientific sensor package—the GML-designed AirCore sampling system—to an altitude of 90,000 feet (where the atmosphere is only 2% as dense as at the surface) in controlled airspace and return it to the original launch location.
- The balloon lifts a remote-controlled glider with an instrument package installed in its belly to altitudes up to 90,000 feet.
- The glider is programmed to release from the balloon at a specific altitude and then navigate back to a loiter point above the landing spot, where it circles until the launch crew takes over controls and lands it.
- This milestone is a major achievement for weather and climate research, which has long depended on balloon-borne measurements but has been limited by the fact that balloons drift with the wind, carrying instrumentation as far as 100 miles from the launch point.

Thank you!