NOAA | Pacific Marine Environmental Laboratory

Strategic Plan

2021-2030

PMEL
Pacific Marine Environmental Laboratory
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

PMEL

Pacific Marine Environmental Laboratory

For over 40 years, PMEL has been making critical observations and conducting groundbreaking research to advance our knowledge of the global ocean and its interactions with the earth, atmosphere, ecosystems, and climate.

PMEL is a laboratory of 200 scientists, engineers, administrative, and IT professionals. Based in Seattle, Washington with a satellite campus in Newport, Oregon, we conduct research around the globe.

PMEL is a federal research laboratory, part of the Office of Oceanic and Atmospheric Research within the National Oceanic and Atmospheric Administration. NOAA is a part of the United States Department of Commerce.

(Cover) Sunrise in the Chukchi Sea from the U.S. Coast Guard Cutter *Healy*. Credit Lindsey Leigh Graham/NOAA, August 2019

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PMEL researchers measure underwater sound environment off King George Island, Antarctica. Credit Robert Dziak/NOAA

Vision

What We Hope to Achieve

Predictable, safe, and healthy oceans based on scientific knowledge and sustained for future generations as our planet changes.

Mission

What We Do

Deliver trusted scientific information through innovative oceanographic and atmospheric research, observations, and technology development in support of society's response to urgent global and regional environmental challenges.

Sunset at sea during the Madden-Julian Oscillation (DYNAMO) field campaign in the tropical Indian Ocean. Credit Owen Shieh (DOD Joint Typhoon Warning Center)/NOAA 2011

Values

Attitudes, Behaviors, and Beliefs That Underpin What We Do

EXCELLENCE that delivers the highest quality science relevant to society, through the dedicated effort and integrity of every team member.

INNOVATION that advances our mission and energizes the organization through the creative ideas and unique talents of every contributor.

TEAMWORK AND PARTNERSHIPS that value the contributions of all, blending the full range of skills, experiences, and perspectives.

OPENNESS in distribution of our data and approach to research.

COMMUNICATION of our science that engages and informs those we serve in the region, the nation, and the world.

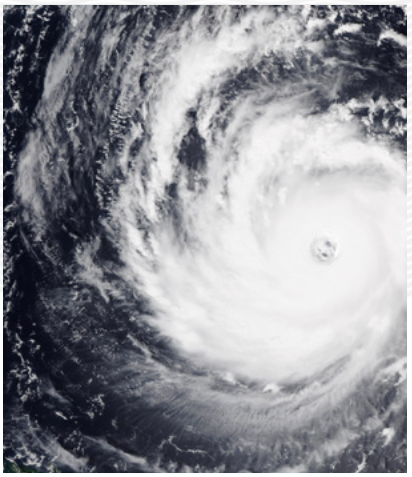
INTEGRITY in how we conduct and communicate our science.

COMMITMENT to achieving equity, inclusion, and diversity in the earth sciences.

Rainbow seen in the Bay of Bengal, Indian Ocean.
Credit Michael McPhaden/NOAA, February 2017

Introduction

NOAA Kuroshio Extension Observatory (KEO) moored buoy off the coast of Japan measures the exchanges of heat and moisture between the atmosphere and ocean associated with typhoons. Pictured here with a juvenile brown booby. Credit Nathan Anderson (University of Washington)/NOAA 2019



Our ocean and atmosphere are facing changes that are unprecedented in human history.

PMEL is driven not only to understand these changes, but also to provide the foundational information that will allow effective societal responses to them. Our work is fundamental to solving these core challenges in ocean and atmospheric science. We are a leader in observing system design, development, and improvement. We conduct integrative studies that enhance our understanding of how the Earth System functions, and provide key information for improving forecasts and models at all scales.

(Clockwise top left) Coastal storm surge threatens cities. Credit Michael Meigs/Unsplash; Satellite imagery of Super Typhoon Trami in the Western Pacific. Credit NOAA; The Trinity River in Dallas flooded up to the levees in June, 2015. Seen from the Commerce Street bridge. Credit Wikimedia; Snow storm strands commuters in Chicago. Credit Kiichiro Sato/AP 2011

PMEL supports NOAA's mission of Science, Service, and Stewardship, and provides information that is useful for NOAA and the world.

(Top) The crew of the catcher-processor *Starbound* posing with a pop-up float prior to deployment. These were among the first industry collaborators to deploy these floats in the Bering Sea in August 2020. Credit *Starbound* Crew; (Bottom) Research Scientist Tamara Baumberger (Oregon State University/NOAA PMEL) extracting methane samples from a gas tight sampler onboard R/V *Falkor* to better understand how and why methane seeps on the seafloor off the U.S. Pacific Coast have formed. Credit Shelton Du Preez/Schmidt Ocean Institute

Our work directly supports NOAA's Oceanic and Atmospheric Research's strategic goals of ***Exploring the Marine Environment, Detecting Changes in the Ocean and Atmosphere, Improving Forecasts, and Driving Innovative Science***.

Key to PMEL's success are cultural elements that we seek to nurture and build. The strong integration of our engineering enterprise with our science underlies many of our accomplishments. The desire to observe new features of our planet in new places with new partners drives novel technologies; these, in turn, drive new observations and scientific discoveries.

Our success depends on the research capabilities of university Cooperative Institutes that are an integral part of PMEL, as well as contractors that provide critical core services support. Similarly, we depend on domestic and international collaborations, and our global reach is built upon this foundation. Finally, our world-class workforce is the bedrock of our organization and its achievements, and as we further diversify our workforce, these achievements will accelerate.

This strategic plan describes PMEL's three key goals for the next ten years.

Goal 1 describes our science and research, which is centered on both a fundamental understanding of our ocean and atmosphere, and the growing societal need for scientific knowledge to make informed decisions in adapting to and mitigating the changes we are observing. This is our core mission.

Goal 2 focuses on the catalysts and enablers of our science. These include technological and data science advances that expedite further scientific discovery and understanding. They are also the innovations that improve our ability to observe and understand our world.

Goal 3 addresses PMEL's foundational underpinnings – its workforce, infrastructure, partners, and stakeholders. Strength in these areas is necessary for comprehensive success in all our endeavors.

In the following pages, we outline a series of strategic objectives under these three goals. These objectives reflect both current activities and future steps to be taken as we move forward in the coming decade.

In addition, we have two cross-cutting objectives that are important to sustain PMEL as a vibrant and innovative enterprise that provides societally useful research.

Regularly scope emerging issues to determine and pursue PMEL's unique contributions to these areas.

Draw on social science to ensure that our data and science are providing maximum value to users and helping society respond to a broad range of urgent global and regional environmental challenges.

Strategic Goals

U.S. Coast Guard officers retrieve the NOAA hydrophone in November 2015 from Challenger Deep, Western Pacific Ocean. The device captured 23 days of sound from whales, ship traffic, earthquakes, and a typhoon passing over the ocean surface. Credit Petty Officer 2nd Class Tara Molle/NOAA Office of Ocean Exploration and Research 2015

GOAL 1

Prepare society to respond to a rapidly changing planet by leading integrated and interdisciplinary ocean, atmosphere, climate, and ecosystem research.

The NOAA Ship *Fairweather* sampling near an National Data Buoy Center (NDBC) buoy that houses one of PMEL's sea-air CO_2 sensors. Credit Richard Feely/NOAA

Goal 1

Society is facing many challenges resulting from increasing environmental change and disruption.

These challenges must be met with interdisciplinary approaches guided by reliable scientific information and knowledge that are based on robust data and their rigorous analysis. PMEL Strategic Goal 1 aims at the societal need for accurate information and advanced knowledge to inform policy making at global and regional scales. Critical steps are identified to accomplish this goal.

This goal targets all aspects of the Earth System that are critical for society's ability to respond to the changing planet and that can be addressed by PMEL. These aspects range from weather to climate timescales, from the Arctic to the tropics, and across the global ocean. Our work spans physics, chemistry, biology, and geology. We begin with high quality measurements of the ocean, its ecosystems, and the atmosphere. We then analyze and transform these data into advanced scientific information and knowledge. Finally, we deliver our high quality measurements, information, and knowledge to various users, such as prediction centers, the scientific community, policy makers, and the general public.

Understanding the Earth System and improving predictions and projections

1.1 Revolutionize the ways ocean observations are harnessed to improve weather and climate forecasts from subseasonal to decadal timescales and improve projections of a changing climate.

1.2 Engage with the modeling and observing communities to ensure observations are used to the fullest extent possible for improved models, model analyses, and forecasts.

1.3 Improve forecasting of extreme weather and climate events through improved observations and understanding of ocean heat anomalies, including marine heat waves.

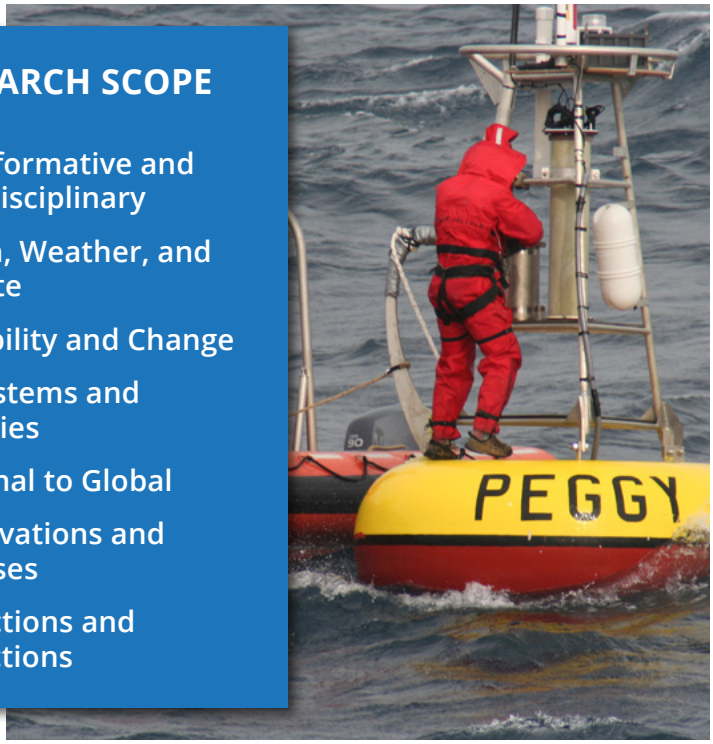
1.4 Improve forecasting of sea level rise by substantially reducing the uncertainty in global ocean heat budget estimates.

1.5 Increase societal confidence in climate projections by meaningfully reducing the uncertainty of the ocean component of the global carbon budget.

1.6 Prepare for ice-free Arctic summers by supporting Arctic predictions with foundational knowledge linking sea ice, physical and chemical oceanographic conditions, marine ecosystems, and the global atmosphere.

RESEARCH SCOPE

- Transformative and Interdisciplinary
- Ocean, Weather, and Climate
- Variability and Change
- Ecosystems and Fisheries
- Regional to Global
- Observations and Analyses
- Predictions and Projections



PMEL's EcoFOCI crew servicing a moored buoy in the Bering Sea. The buoy is named for Peggy Dyson, who for years radioed weather information to fishermen in the Bering Sea and North Pacific Ocean. Credit NOAA/Office of Marine and Aviation Operations (OMAO), July 2006

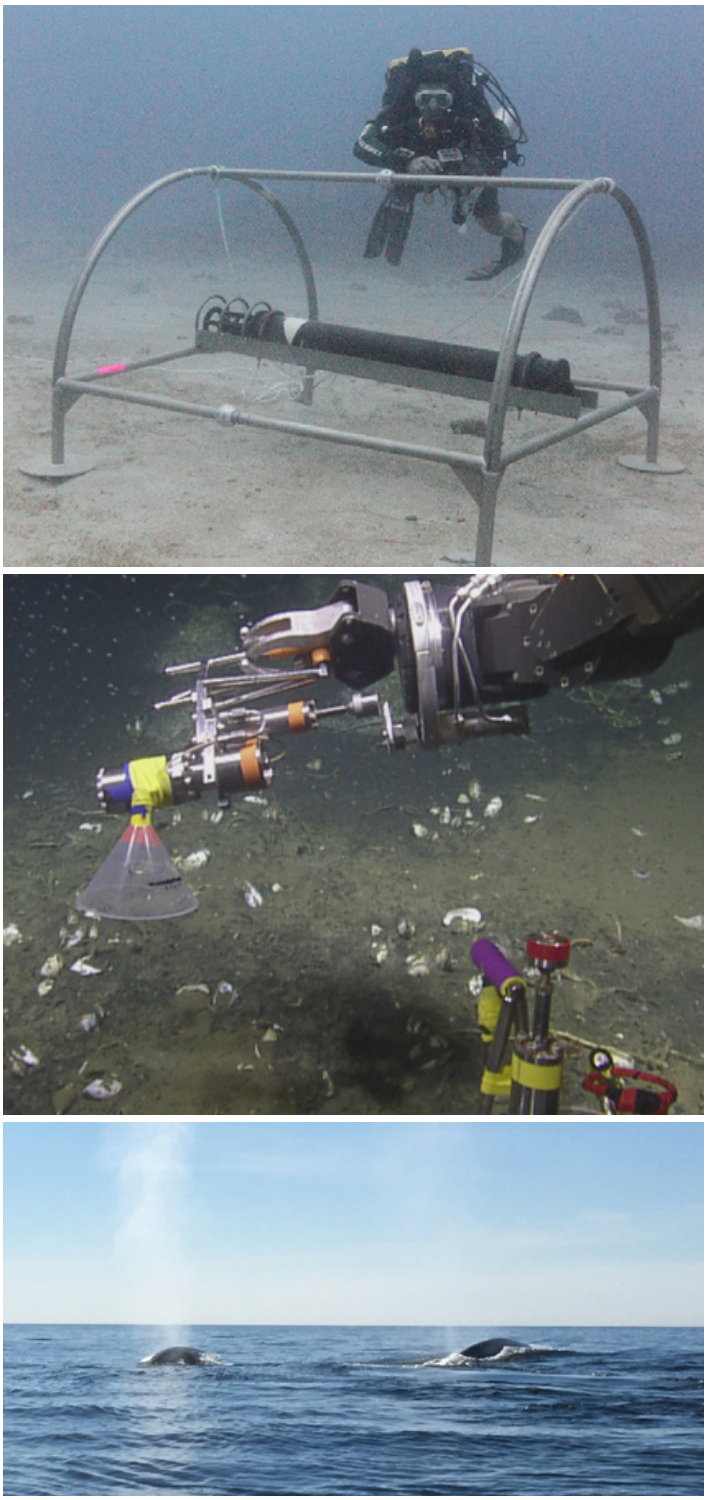
Supporting effective management of marine resources and ecosystems

1.7 Transform our understanding of how climate change affects carbon, oxygen, nutrient, and marine components of the hydrologic cycle to support effective management of living marine resources.

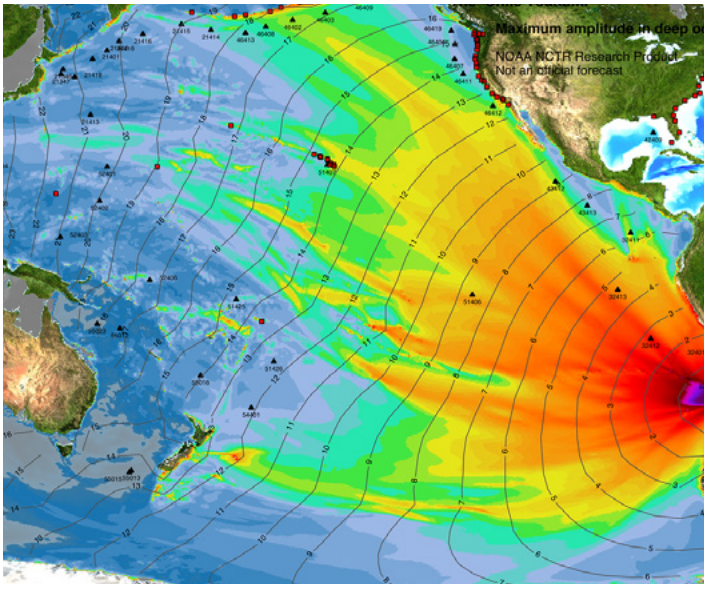
1.8 Inform fishery, protected species, and habitat management by evaluating impacts of changes in physical, acoustic, and chemical conditions on Pacific and Arctic marine communities.

1.9 Explore and characterize the seafloor to reveal connections between biogeochemical processes, benthic ecosystems, and marine chemistry.

1.10 Support long-term stewardship of the ocean environment by providing information to assess the impacts of commercial activities and marine research on marine ecosystems.



(Top) Deployment of a Noise Reference Station in the National Park of American Samoa on June 11, 2015. Credit Megan McKenna/ National Park Service; (Middle) PMEL-developed gas tight sampler capturing methane bubbles escaping from the seep on the seafloor. Credit Ocean Exploration Trust; (Bottom) Two northeast Pacific blue whales seen spouting off Newport, Oregon on October 17, 2018. NMFS permit 20465, Credit Robert Dziak/NOAA



Protecting coastal communities through improved understanding of coastal processes

1.11 Pioneer new understanding of the interconnections between open ocean and coastal processes to inform adaptation and mitigation strategies in Pacific and Arctic coastal communities.

1.12 Safeguard coastal lives and property from extreme flooding caused by tsunami, storm surge, coastal inundation, and other marine-related events by continuously improving early warning, detection, and prediction capabilities.

1.13 Support responsible ocean-based economic activities by evaluating the impact of interactions between human activities with coastal and seafloor processes, habitats, and ecosystems.

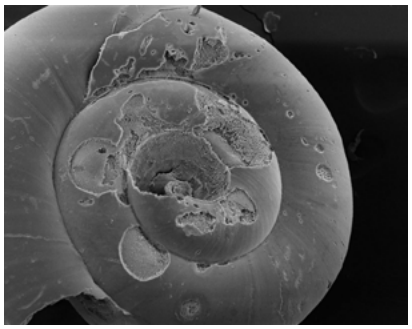
(Top) The maximum tsunami amplitude forecast during 24 hours of wave propagation after the Mw 8.3 earthquake west of Illapel, Chile on September 16, 2015. Credit NOAA; (Middle) November storm in the western North Atlantic during the first North Atlantic Aerosols and Marine Ecosystem Cruise. Credit Christien Laber; (Bottom) Oceanographer/Forecast System Developer Chris Moore (left) working with emergency managers to use PMEL-developed tsunami modeling applications to generate results and create easy to read public evacuation maps for the NOAA TsunamiReady program. Credit NOAA/NWS Caribbean Tsunami Warning Program

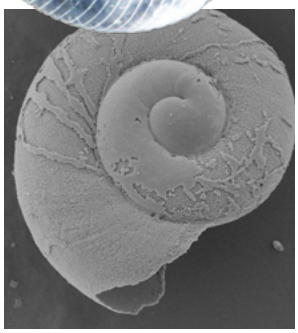
Supporting climate adaptation, mitigation, and resilience

1.14 Inform and assess societal adaptation strategies in the face of ocean acidification, coastal inundation, extreme weather, climate and ocean events, ocean warming, hypoxia, changes in species distribution, invasive species, and marine disease.

1.15 Empower society to mitigate the effects of climate change by evaluating the efficacy and impacts of potential geoengineering approaches, including ocean-based Carbon Dioxide Removal methods.

1.16 Explore approaches to enable marine and coastal systems to be resilient in the face of external stresses imposed upon them by climate change.





(Top) Janet Duffy-Anderson, NOAA EcoFOCI Program Co-Lead, and Knauss Fellow Chrissy Hayes rinse bongo nets for processing. Credit Lindsey Leigh Graham/NOAA, August 2019; (Middle and Bottom) Pteropods are free-swimming marine snails that are some of the first marine organisms to show signs of shell dissolution due to ocean acidification. Credit Steve Ringman/NOAA for *National Geographic Magazine*, (Bottom 2) Nina Bednarsek (Washington Ocean Acidification Center-University of Washington)

GOAL 2

Drive scientific discovery and research through groundbreaking technology development, engineering, and systems design.

Goal 2

Groundbreaking scientific research at PMEL is highly dependent on innovation in observing systems technologies, data handling optimization, and the development of new analytic techniques and models.

PMEL is uniquely positioned with well-integrated engineering and data science teams that support all PMEL science projects. Innovation at every stage in support of PMEL's scientific efforts is ever more important as new frontiers such as bioinformatics, artificial intelligence, and robotics are explored. More interdisciplinary data delivered from new platforms at ever-increasing volumes and rates demand effective data management to ensure the availability of high-quality data for PMEL's scientific research endeavors. PMEL recognizes its obligation to not only preserve but to maximize the value of these data through novel analysis methods that deliver additional information and insight.

Saildrone uncrewed surface vehicle sailing in the Pacific Ocean collecting high quality oceanic and atmospheric observations to improve the Tropical Pacific Observing System (TPOS). Credit Saildrone, Inc.

Transforming the design of the global ocean and climate observing systems

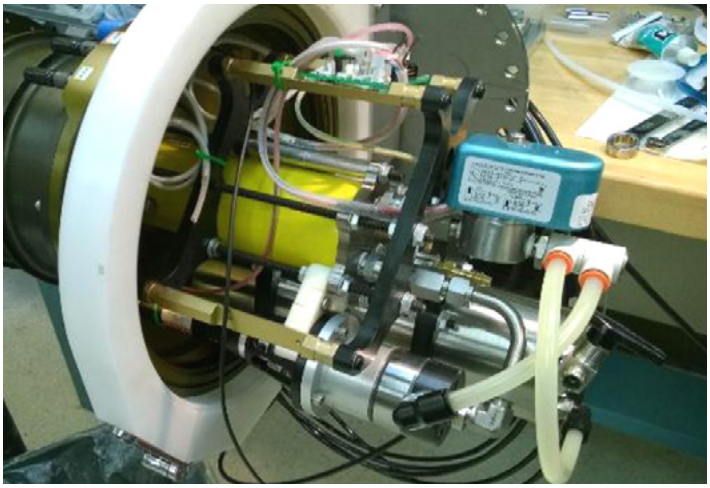
2.1 Sustain essential long-term climate-quality data to ensure the continuity of irreplaceable oceanic and atmospheric records.

2.2 Expand observations to fill critical gaps in coverage, for example in the Arctic, the Southern Hemisphere, boundary currents, and the deep ocean.

2.3 Integrate multidisciplinary (physical, biogeochemical, and biological) observing systems to address complex scientific challenges and enhance ocean observing platform efficiency.

2.4 Harness self-adapting observing systems that respond in real-time to their surroundings to enable rapid response to environmental events.

(Top) L3 Latitude and NOAA/PMEL have been developing an uncrewed aerial vehicle with the ability of vertical take-off and landing (VTOL) from a ship to sample sea spray particles in the ocean and to observe how they are impacting cloud properties. Credit Aaron Farber/NOAA December 2017; (Middle) Physical Science Technician Nick Delich testing the Oculus Coastal Glider in Puget Sound, Washington. Credit NOAA. (Bottom) Scientists prepare to deploy a CTD (Conductivity-Temperature-Depth) rosette to collect water samples from different water depths in Niskin bottles sealed by remote control. Credit NOAA



Developing innovative sensors and platforms

2.5 Revolutionize the design of sensors and platforms that enable new scientific discovery.

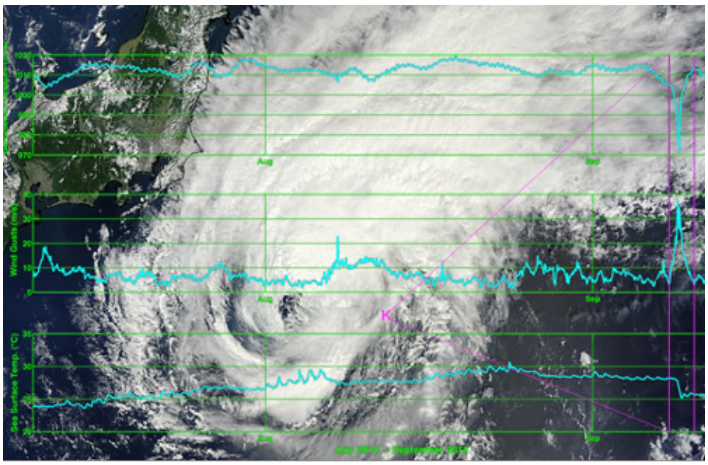
2.6 Design fully integrated sensor and data systems resulting in real-time, holistic, environmental information to advance our understanding of the ocean and atmosphere.

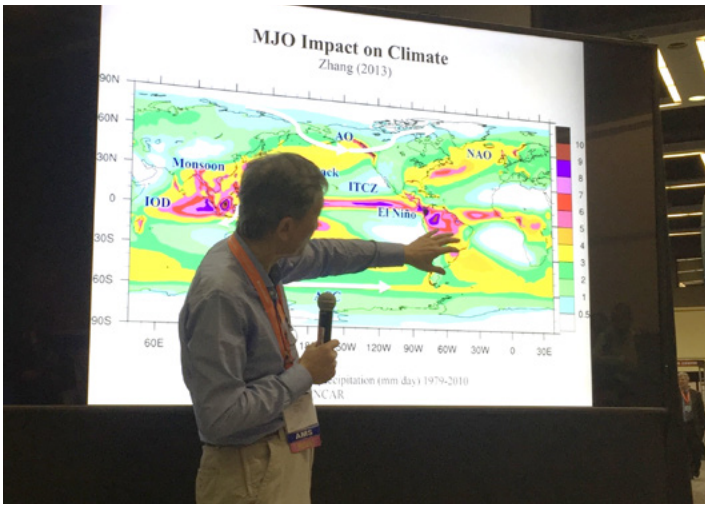
2.7 Advance the application and development of new technologies to address all aspects of ecosystem research.

SENSOR DEVELOPMENTS

- Acoustic
- Biodegradable
- Chemical tracer
- Cost effective
- Decreased energy use
- Extreme environments
- Increased energy storage
- Integrated
- Miniature
- Remote locations

(Top) Internal working of the Oculus Coastal Glider. The glider uses an oil fuel bladder and a battery pack to easily move up and down the water column. Credit NOAA; (Middle-left) As part of a PMEL-Saildrone-CSIRO collaborative effort, Ocean Engineer Noah Lawrence-Slavas trains CSIRO scientists on the operation of a carbon sensor incorporated onto Saildrone vehicles to collect data on the ocean's absorption of carbon dioxide from the atmosphere. Credit Andreas Marouchos/CSIRO; (Middle-right) Research Assistant Alex Turpin assembling the second generation of the Autonomous Surface Vehicle Carbon Dioxide (ASVCO2) sensor to be mounted on various autonomous vehicles. Credit NOAA; (Bottom) Scientists collecting seawater samples from a CTD (Conductivity-Temperature-Depth) rosette to understand carbon dioxide changes along the U.S. Pacific Coast. Credit Richard Feely/NOAA





Revolutionizing data acquisition and dissemination

2.8 Pioneer robust infrastructure resulting in seamless and automated data acquisition, processing, and quality control to reduce throughput from months to minutes and empower scientific output.

2.9 Maximize the value of data through automated techniques (e.g., machine learning) to extract environmental information and answer key environmental questions.

2.10 Ensure the widest possible distribution and preservation of data and metadata for advancing scientific research, forecasting, decision-making, and public outreach.

2.11 Deliver data visualizations and science products to provide essential and understandable information to a wide range of partners and stakeholders.

(Top) GOES-16, the first of NOAA's highly advanced geostationary weather satellites. Credit NOAA; (Middle) Tropical cyclones and typhoons regularly pass NOAA KEO mooring during the autumn storm season. The mooring collects data in near real-time, on barometric pressure (uppermost graph), wind gust (center), and sea surface temperature (lowest graph). Credit NASA photo and graphic by J. Keene; (Bottom) Ocean Climate Research Division Leader Chidong Zhang presents his findings at the annual American Meteorological Society (AMS) conference. Credit NOAA

GOAL 3

Position PMEL to succeed in a changing world by nurturing the passion and dedication of our people, building vibrant and diverse partnerships, and investing in a diverse, inclusive, and high-performing organization.

Goal 3

PMEL's organizational health underlies all its successes. Therefore, our third critical goal for the next ten years focuses on enhancing the conditions and culture in which we work.

We support an inclusive culture and robust workforce, nurturing mentorship and opportunities for career development. We will develop and enhance organizational structures that complement our goals and facilitate our science and communication. Finally, we will strengthen two-way engagement with our partners and stakeholders to maximize the use and value of our work. Because our sustained success is dependent on our ability to garner sustained support, these efforts will also ensure that we are using existing resources efficiently, and allow us to demonstrate our value to key partners and stakeholders.

Aboard the U.S. Coast Guard Cutter *Healy*, Program Analyst Kelley Uhlig (NOAA Global Ocean Monitoring and Observing (GOMO) Program) looks at a sample of microplastics in Chukchi Sea mud to make a connection between microplastics in Arctic benthic organisms and microplastics found in their environment. Credit Lindsey Leigh Graham/NOAA August 2019

Goal 3

M2 "Peggy" mooring celebrates 25 years of providing the pulse of the Bering Sea. Preparing a mooring for deployment requires the assistance of engineers, administrative staff, researchers, and technicians. Credit Paul Hillman/NOAA

Optimizing organization and business practices

3.1 Reduce the PMEL carbon footprint significantly in everything we do.

3.2 Transform the PMEL organization, business, and IT processes to improve coordination, integration, transparency, strategic communications, efficiency, and decision-making.

3.3 Ensure the competitiveness of our science and our ability to engage in novel scientific activity by enhancing the financial sustainability of the organization.

Cultivating the workforce of the future

3.4 Ensure growth and continuity of expertise at the cutting edge of science and research to maintain PMEL's leadership role in oceanic and atmospheric science and technology.

3.5 Hire, retain, and advance a highly skilled, multi-disciplinary, and diverse workforce, adaptive to changing conditions and positioned to address the urgent science challenges of today and tomorrow.

3.6 Promote and ensure diversity, equity, and inclusion (DEI) within PMEL and the atmospheric and ocean sciences by identifying, challenging, and eliminating organizational structures, policies, practices, and attitudes that inhibit DEI.

(Top) Research Oceanographer Jessica Cross shows Danyelle DeMars the course of an unmanned wind-propelled and solar-powered surface vehicle from a computer on the bridge of the U.S. Coast Guard Cutter *Healy* as the crew transited the southern Chukchi Sea. Credit Petty Officer 3rd Class Amanda Norcross/U.S. Coast Guard August 2017; (Bottom) Electronics Technician Dirk Tagawa testing instruments in the lab. Credit NOAA

Promoting a culture of collaboration and innovation

3.7 Nurture the unique integration of science and technology that is at the core of PMEL's culture to catalyze solutions to the world's most difficult and pressing environmental problems.

3.8 Foster a culture of innovation and risk-taking to promote scientific and technological discovery and breakthrough thinking.

3.9 Engage and support the workforce in continuous improvement activities to maximize inclusivity, diversity, teamwork, transparency, and workflow.

(Top) Readying hydrophones to collect ocean sound data from icebergs, marine mammals, and more in Antarctica. Credit Robert Dziak/NOAA; (Middle) Buoys with the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA) are designed to study the Indian Ocean's role in the monsoons. Credit NOAA; (Bottom) NOAA Corps Officer Sarah Donohoe testing pop-up floats prior to deployment in the Bering Sea. Credit Heather Tabisola (University of Washington)/NOAA Spring 2018

Strengthening partnerships through strategic capacity building and engagement

3.10 Strengthen our partnerships throughout the lifecycle of PMEL activities to understand partner needs, complement and enhance partner capabilities, and deliver useful products.

3.11 Accelerate the transition of PMEL research and technology products to implementation-ready partners, and work with international partners to further build research and observing capacity around the globe.

3.12 Engage strategic partners to create a regional hub of oceanic and atmospheric research and development, and inspire mutual support and investment.

(Top) A Saildrone is recovered in Dutch Harbor, Alaska after the 2016 NOAA Arctic mission. Credit Saildrone, Inc.; (Bottom) Engineering Technician John Shanley recovering a Prawler buoy in the Gulf of Mexico. Credit NOAA

Enhancing communications, outreach, and education

3.13 Develop and execute multi-faceted strategic communications to:

- Broadly communicate the societal value and relevance of PMEL research
- Engage the local community in PMEL science
- Ensure that stakeholders are involved in developing and using research outcomes

3.14 Value and invest in targeted education, outreach, and mentorship efforts to support the next generation of scientists, including those from our local underserved communities.

Reimagining facilities

3.15 Envision and create a physical workplace that promotes creativity and productivity.

(Top) Middle school students learn more about oxygen levels in Lake Washington during NOAA Science Camp in Seattle. Credit Adi Hanein (University of Washington)/NOAA; (Bottom) PMEL is primarily housed at NOAA's Western Regional Center in Seattle, Washington on Lake Washington. Credit NOAA

Moving Forward

Two black-browed albatross fly with a flock of cape petrels. Credit Malte Damerau/NOAA NMFS SWFSC Antarctic Marine Living Resources (AMLR) Program, February 2009

Moving Forward

PMEL will review and update this strategic plan annually to ensure that it remains in alignment with agency and national needs. In addition, we will have implementation plans that track our progress towards achieving each strategic objective. Together, these efforts will ensure that our financial and organizational resources are both sustained and consistent with our stated goals.

PMEL, a world leader in oceanographic, atmospheric, climate, ocean carbon, and tsunami research, works in collaboration with many partners and stakeholders. We will build on this scientific excellence to enhance our capacity to respond to emerging needs, ensuring that we continue to serve the nation and the world into the next decade.

Celebrating a successful RAMA cruise carried out in partnership between NOAA/PMEL, the Indonesian Agency for Meteorology, Climatology, and Geophysics (BMKG), and the Indonesian Institute of Sciences (LIPI) on the R/V *Buruna Jaya VIII* in the eastern Indian Ocean. Credit Michael McPhaden/NOAA 2017

Artist statement: **"I enjoy painting in oil bar and writing haiku because both favor distillation while affording expression. My art primarily focuses on the natural world, often informed by my scientific work on the ocean's roles in climate. Hence contributing a painting and poem for PMEL's strategic plan was a pleasure."**

Painting and haiku by PMEL oceanographer Gregory C. Johnson/NOAA. *Image retouched by Sarah Battle*

pmel.noaa.gov

NOAA/PMEL
Western Regional Center
7600 Sand Point Way NE
Seattle, WA 98115

NOAA/PMEL
Hatfield Marine Science Center
2115 SE OSU Drive
Newport, OR 97365

Phone: (206) 526-6811
oar.pmel.webmaster@noaa.gov

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PMEL Strategic Plan 2021-2030
Feb. 2021 | v.9 | Contribution ID - 5201