

# ANNUAL REPORT 2015



## CLIMATE PROGRAM OFFICE

Advancing scientific understanding, monitoring, and prediction of climate and its impacts to enable effective decisions

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# CPO ANNUAL REPORT 2015

Suggested Citation

NOAA Climate Program Office. February 2016. *2015 CPO Annual Report*.  
<http://cpo.noaa.gov/2015CPOAnnualReport>

◀ **ON THE COVER:** Looking northwest from Point Conception. Point Conception, California. Credit: Robert Schwemmer, Channel Islands Marine Sanctuary.

# CONTENTS



## 2 LETTER FROM THE DIRECTOR

## 3 ABOUT CPO

## 4 CLIMATE OBSERVATION DIVISION

6 Ocean Climate Observations (OCO)

8 Arctic Research Program (ARP)

10 Climate Monitoring Program



## 12 RESEARCH PROGRAMS DIVISION

14 Climate Variability and Predictability (CVP)

16 Atmospheric Chemistry, Carbon Cycle, and Climate (AC4)

18 Modeling, Analysis, Predictions, and Projections (MAPP)



## 20 CLIMATE AND SOCIETAL INTERACTIONS

22 Regional Integrated Sciences and Assessments (RISA)

24 International Research and Applications Project (IRAP)

26 Coastal and Ocean Climate Applications (COCA)

28 Sectoral Applications Research Program (SARP)



## 30 INTEGRATED INFORMATION SYSTEMS

32 National Integrated Drought Information System (NIDIS)

34 National Integrated Heat Health Information System (NIHHIS)



## 36 COMMUNICATIONS AND EDUCATION

## 38 INTERNATIONAL

## 40 A SPECIAL COMPETITION

## 42 RESOURCES AND ACHIEVEMENTS STATISTICS



# LETTER FROM THE DIRECTOR

Every day, communities and businesses in the United States and around the world grapple with environmental challenges stemming from changing climate conditions and extreme events. Here at NOAA's Climate Program Office, we've made it our mission to help people, businesses, and the environment thrive in the face of a changing climate and its impacts.

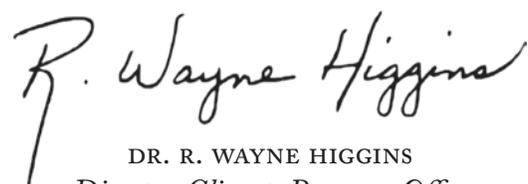
In 2015, the Climate Program Office (CPO) continued vital work—developing partnerships, improving climate models, supporting research, sustaining climate observations, and providing foundational information to enable effective decision making and thereby enhance preparedness and build resilience at national, regional and local scales. The Regional Integrated Sciences & Assessments (RISA) program provided information and expertise during and following major extreme events, including Hurricane Sandy, the Colorado floods, and the extreme droughts in Texas, Oklahoma, California, and Nevada to help the nation prepare for and build resilience to future extreme events. The Sectoral Applications Research Program (SARP) worked with the National Integrated Drought Information System (NIDIS) to establish a new Drought Risk Management Research Center. Through this new center, NIDIS is working with federal, state, tribal, and local partners to enhance preparedness efforts and reduce potential impacts of severe drought.

The societal demand for timely, accurate, and actionable scientific information on the impacts of climate variability and change continues to increase. CPO's foundational programs continue to strengthen the underlying observing, modeling, and prediction systems that are required to deliver this information. In 2015, CPO's Climate Observation Division (COD) successfully tested Deep Argo technology—a fleet of robotic floats that measure temperature and salinity from the surface to 6,000 feet below. The Modeling, Analysis, Predictions, and Projections

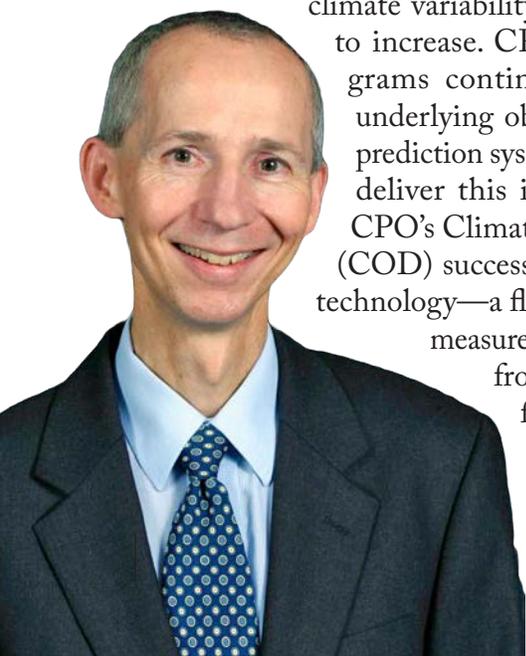
(MAPP) program played a central role in developing the North American Multi-Model Ensemble (NMME) seasonal prediction system, which is being used in the National Weather Service operations, and hosted the first annual US Climate Modeling Summit.

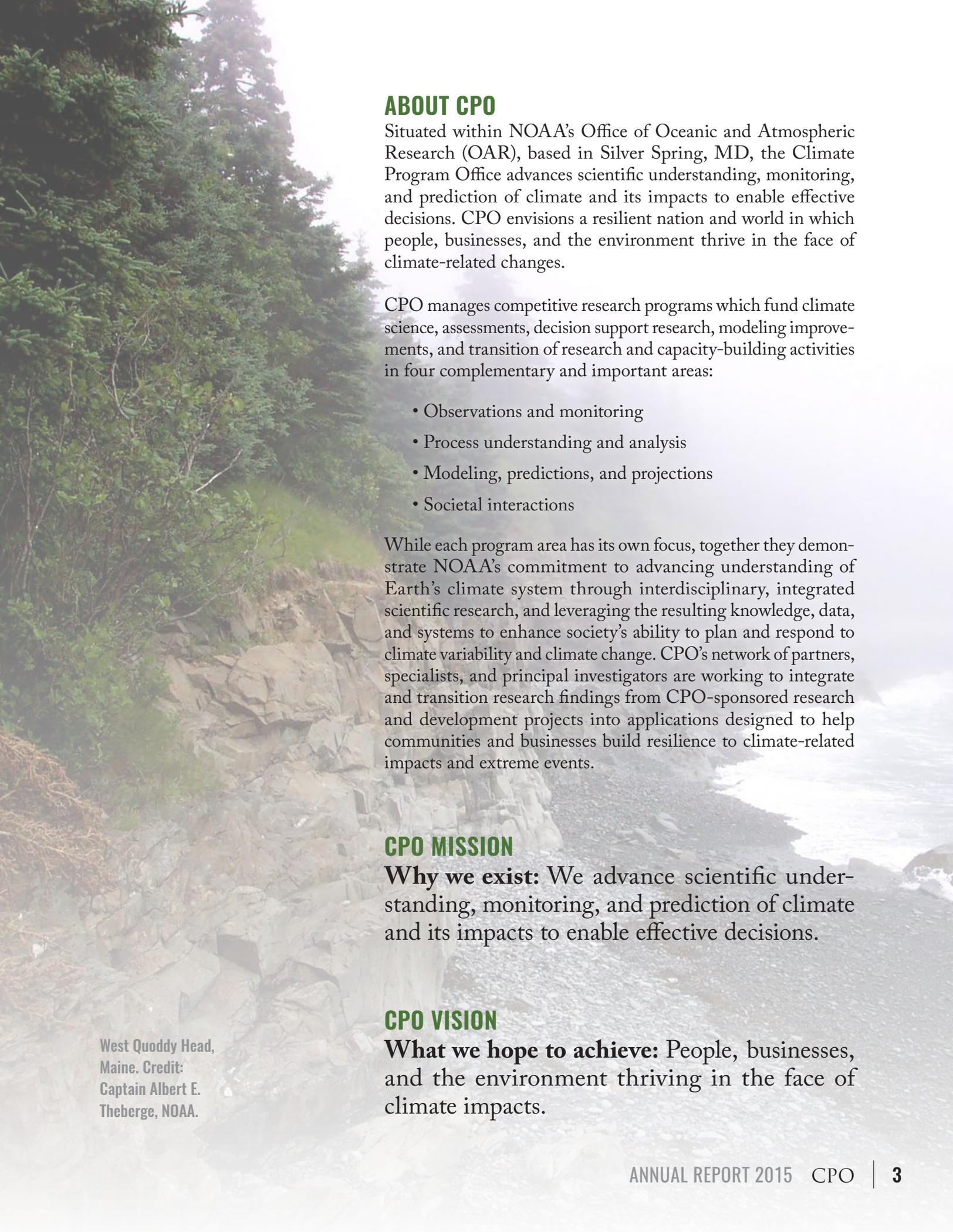
CPO's competitive grants programs play an integral role in advancing understanding of Earth's climate system and in transitioning data, tools, information, and operations to applications that the public can use to improve decision making. As part of this competitive grant process, CPO held 11 grants competitions and awarded 53 new projects valued at more than 48 million dollars in 2015. In addition to the 11 competitions mentioned above, CPO's Coastal and Ocean Climate Applications (COCA) also program partnered with the National Marine Fisheries Service to advance the sustainable management and resilience of the nation's fisheries in a changing climate. CPO also provided strong support for the President's *Climate Action Plan*, and played the lead role in a key deliverable, the US Climate Resilience Toolkit, to help communities and businesses all across the nation build resilience to climate-related impacts and extremes.

These are just a few examples of the work we do at CPO. In this report you will find many more examples. We look forward to continuing to help people, businesses, and the nation as a whole build climate resilience in 2016 and beyond.



DR. R. WAYNE HIGGINS  
Director, Climate Program Office





## ABOUT CPO

Situated within NOAA's Office of Oceanic and Atmospheric Research (OAR), based in Silver Spring, MD, the Climate Program Office advances scientific understanding, monitoring, and prediction of climate and its impacts to enable effective decisions. CPO envisions a resilient nation and world in which people, businesses, and the environment thrive in the face of climate-related changes.

CPO manages competitive research programs which fund climate science, assessments, decision support research, modeling improvements, and transition of research and capacity-building activities in four complementary and important areas:

- Observations and monitoring
- Process understanding and analysis
- Modeling, predictions, and projections
- Societal interactions

While each program area has its own focus, together they demonstrate NOAA's commitment to advancing understanding of Earth's climate system through interdisciplinary, integrated scientific research, and leveraging the resulting knowledge, data, and systems to enhance society's ability to plan and respond to climate variability and climate change. CPO's network of partners, specialists, and principal investigators are working to integrate and transition research findings from CPO-sponsored research and development projects into applications designed to help communities and businesses build resilience to climate-related impacts and extreme events.

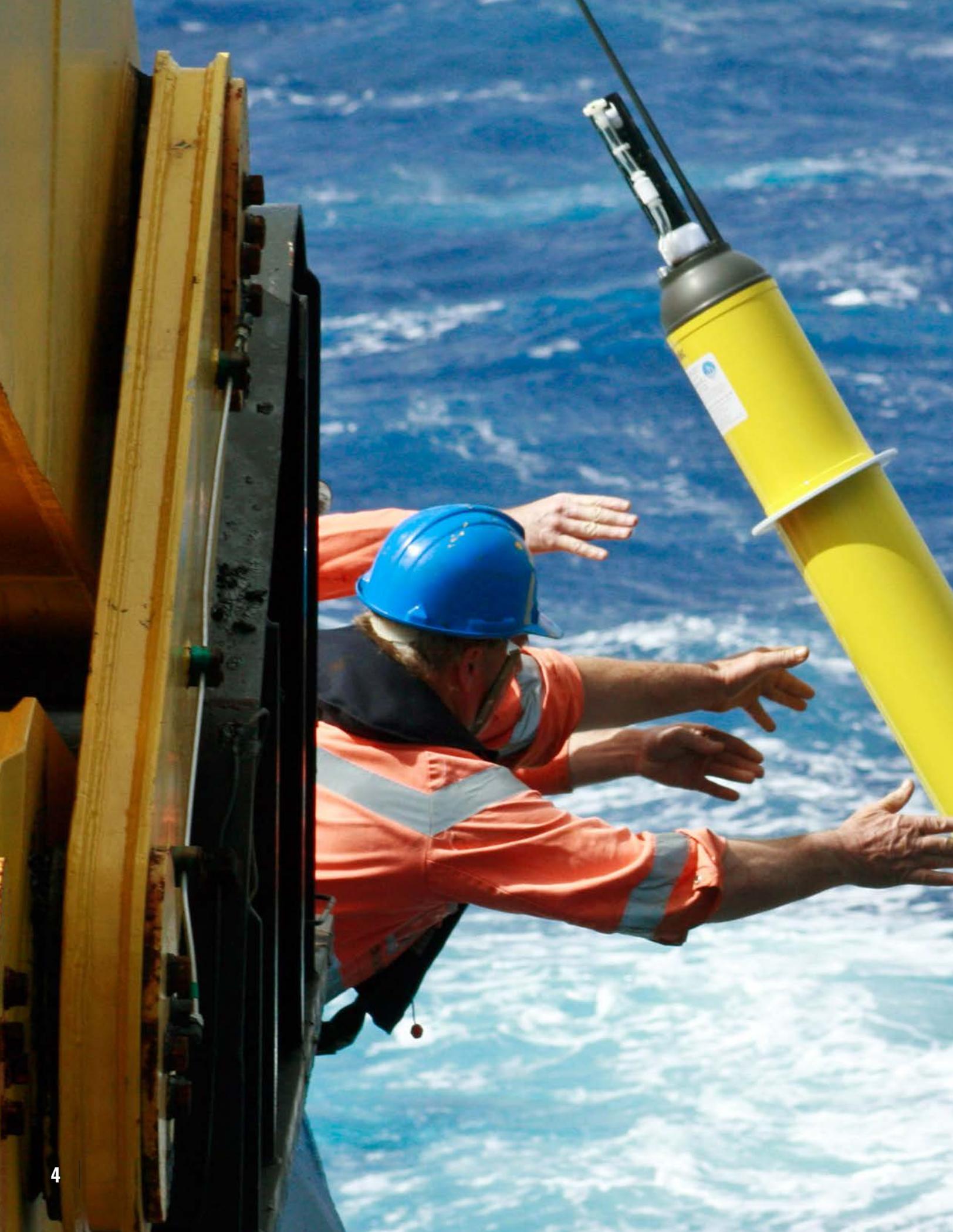
## CPO MISSION

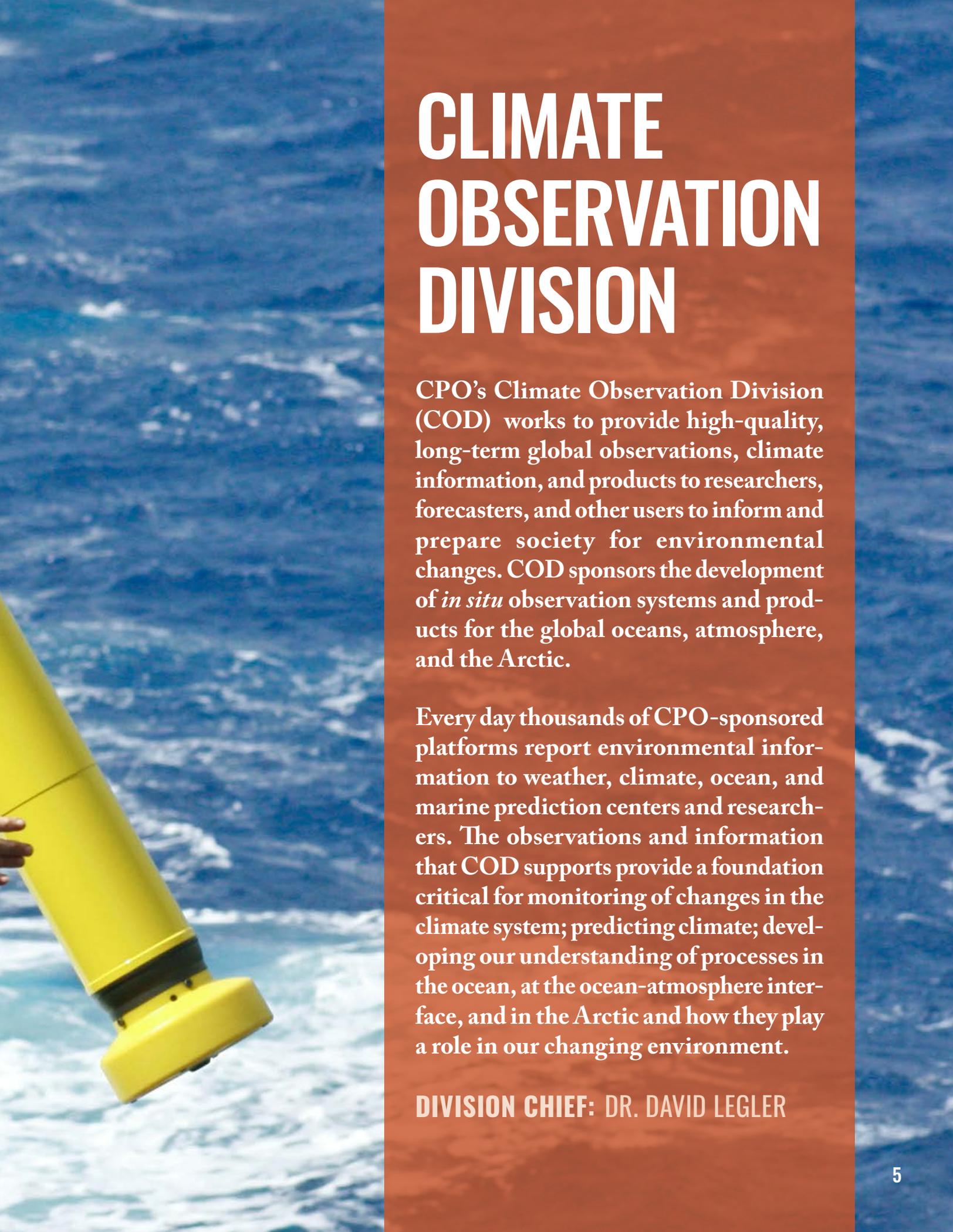
**Why we exist:** We advance scientific understanding, monitoring, and prediction of climate and its impacts to enable effective decisions.

## CPO VISION

**What we hope to achieve:** People, businesses, and the environment thriving in the face of climate impacts.

West Quoddy Head,  
Maine. Credit:  
Captain Albert E.  
Theberge, NOAA.



A yellow buoy is being held over the ocean. The buoy is cylindrical with a black band near the bottom. The background is a vast blue ocean with white-capped waves. The text is overlaid on a dark orange vertical band on the right side of the image.

# CLIMATE OBSERVATION DIVISION

CPO's Climate Observation Division (COD) works to provide high-quality, long-term global observations, climate information, and products to researchers, forecasters, and other users to inform and prepare society for environmental changes. COD sponsors the development of *in situ* observation systems and products for the global oceans, atmosphere, and the Arctic.

Every day thousands of CPO-sponsored platforms report environmental information to weather, climate, ocean, and marine prediction centers and researchers. The observations and information that COD supports provide a foundation critical for monitoring of changes in the climate system; predicting climate; developing our understanding of processes in the ocean, at the ocean-atmosphere interface, and in the Arctic and how they play a role in our changing environment.

**DIVISION CHIEF: DR. DAVID LEGLER**

# OCEAN CLIMATE OBSERVATION

CPO's Ocean Climate Observation program (OCO) supports the advancement of climate science by providing high quality observational data for the climate research, modeling, and forecasting communities.

[CPO.NOAA.GOV/OCO](http://CPO.NOAA.GOV/OCO)



▲ The deployment of an Argo float into the ocean. Credit: CSIRO.

Working with international partners, OCO builds and maintains the in-water network of open-ocean observations around the globe. This work contributes to the Global Climate Observing System and the US Integrated Ocean Observing System.

## Global Observing Systems

In FY15, the Ocean Climate Observations program sustained NOAA's contributions towards several global ocean observing systems with more than 8,000 platforms—including Argo, the Global Drifter Program, GLOSS, OceanSites, GO-SHIP, RAMA, PIRATA, and SOOP—in support of NOAA's research and operational requirements.

## Deep Argo

Design, development, and testing of new Deep Argo technology (by Scripps Institution of Oceanography and Teledyne-Webb Research) to withstand the

crushing forces of the deep ocean (6,000 meters), improving on previous generation of Argo robots, which can observe only the upper half of the global oceans.

## Sea Level Change Measurements

New technology added to 13 tide gauge/GPS stations to aid in characterizing local sea-level changes.

## Ocean Climate Markers Show Impact

Ocean observations from COD provided foundational information for the *2015 State of the Climate Report* indicating record-setting ocean heating. COD also helped NOAA monitor progress of El Niño conditions in the Pacific.

## International Partnership

Established and continued key international partnerships (e.g., with Indonesia) leading to contributions of ship time and increased global ocean observing capabilities towards NOAA's missions. □

## WHAT'S NEXT?

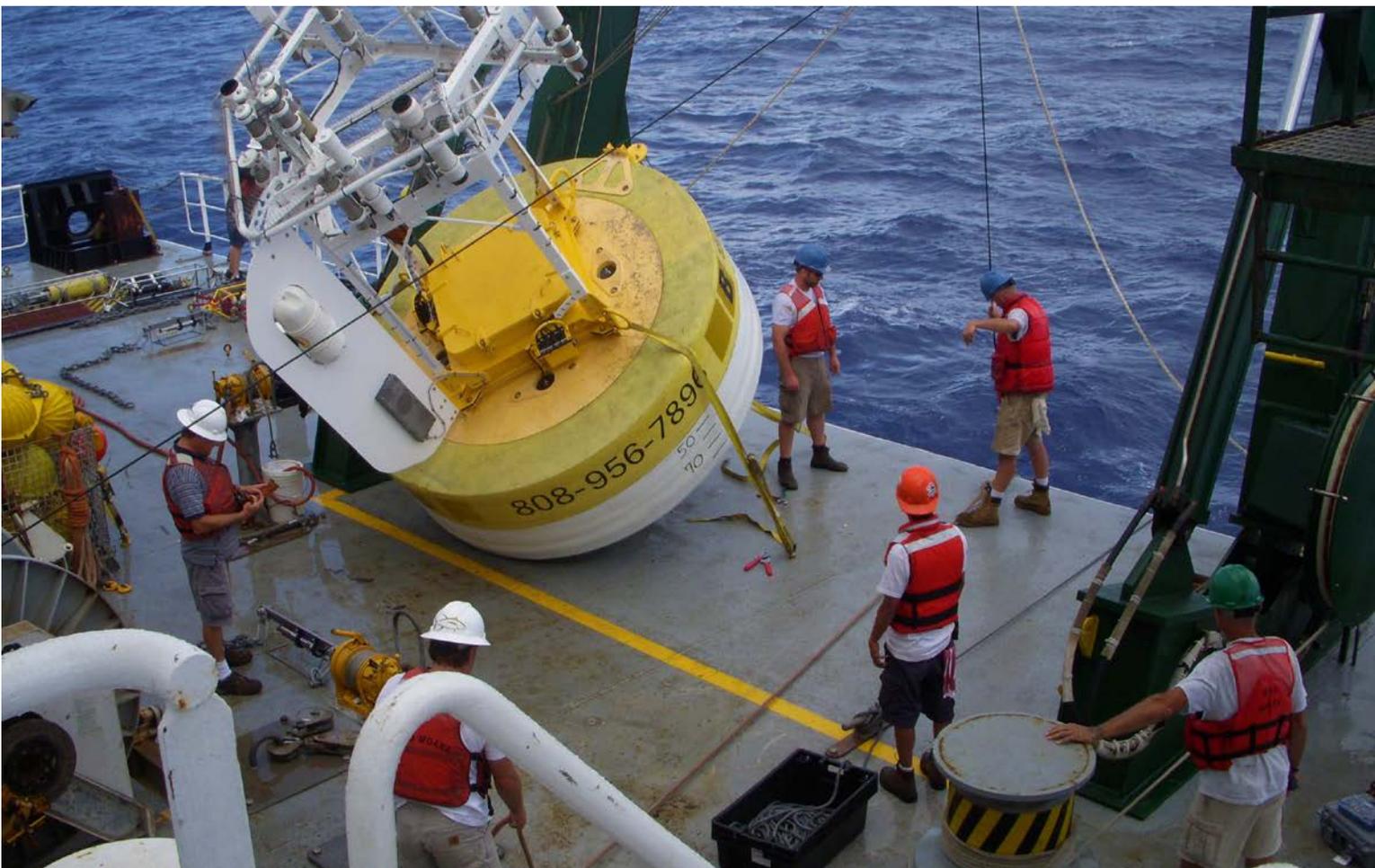
❶ **TPOS-2020:** OCO will initiate several new Tropical Pacific Observing System (TPOS) grants focusing on testing of new observing technologies, and release the first TPOS-2020 plan for research and development to improve the observing system in the Tropical Pacific.

❷ **Global Observing Systems:** OCO will support development and release of the *WMO Global Climate Observing System Implementation Plan* that provides guidance for NOAA's climate observing systems with other nations' climate observing systems worldwide.



◀ Deployment of an Argo float. Credit: Lieutenant Elizabeth Crapo, NOAA Corps.

▼ Scientists prepare to deploy the COD-funded WHOI Hawaii Ocean Timeseries Station (WHOTS) mooring north of Oahu. Credit: WHOI.





NOAA scientists explore the Arctic during a 2005 mission. Credit: J. Potter, NOAA.



# ARCTIC RESEARCH PROGRAM

The Arctic Research Program (ARP) provides support for maintaining and extending networks of climate observing systems around the Arctic, in collaboration with international partners.

[CPO.NOAA.GOV/ARCTIC](http://CPO.NOAA.GOV/ARCTIC)

The observing systems measure temperatures of water, ice, and air as well as thickness of sea ice and biogeochemistry, species abundance, and biodiversity. Scientists use data from these systems to document the physical state of the Arctic Ocean, its bordering seas, and adjacent coastal areas. The data also document observed ecological responses to physical changes.

## Arctic Report Card

The *Arctic Report Card* has been issued annually since 2006. It is a timely and peer-reviewed source of clear, reliable and concise environmental information on the current state of different components of the Arctic environmental system relative to historical records. The *Report Card* is intended for a wide audience, including scientists, teachers, students, decision-makers and the general public interested in the Arctic environment and science.

## Conducting RUSALCA Cruises

The project goal is to carry out long-term research to understand the causes and consequences of the reduction of ice cover in the northern part of the Bering Sea and the Chukchi Sea in the Arctic Ocean. This work is done bilaterally with Russia and also participants from other countries.

## Building and Maintaining Atmospheric Observatories

The goal of this program is to improve polar climate prediction and sea ice/ weather forecasting using observations and models to measure and understand cloud properties, boundary-layer processes, and their interactions with the underlying surface (snow, permafrost, ice sheets, open ocean, and sea-ice) via exchanges of heat, momentum, and mass. The program maintains monitoring stations throughout the Arctic. □

## WHAT'S NEXT?

### ① Build an observation network:

In the next few years, the program will work to elevate its influence in order to support a pan-Arctic, multi-agency, sustained Arctic Observing Network.

② **Inform the public:** As in the past, ARP will continue to produce high-quality synthesis products including the annual *Arctic Report Card*.

# CLIMATE MONITORING PROGRAM

**Climate Monitoring supports research that creates authoritative, tailored climate products and information, which contribute directly to the environmental intelligence of the nation.**

[CPO.NOAA.GOV/CLIMATEMONITORING](http://CPO.NOAA.GOV/CLIMATEMONITORING)



▲ **A typical observing station from the US National Weather Service's Cooperative Observer network. Credit: NOAA.**

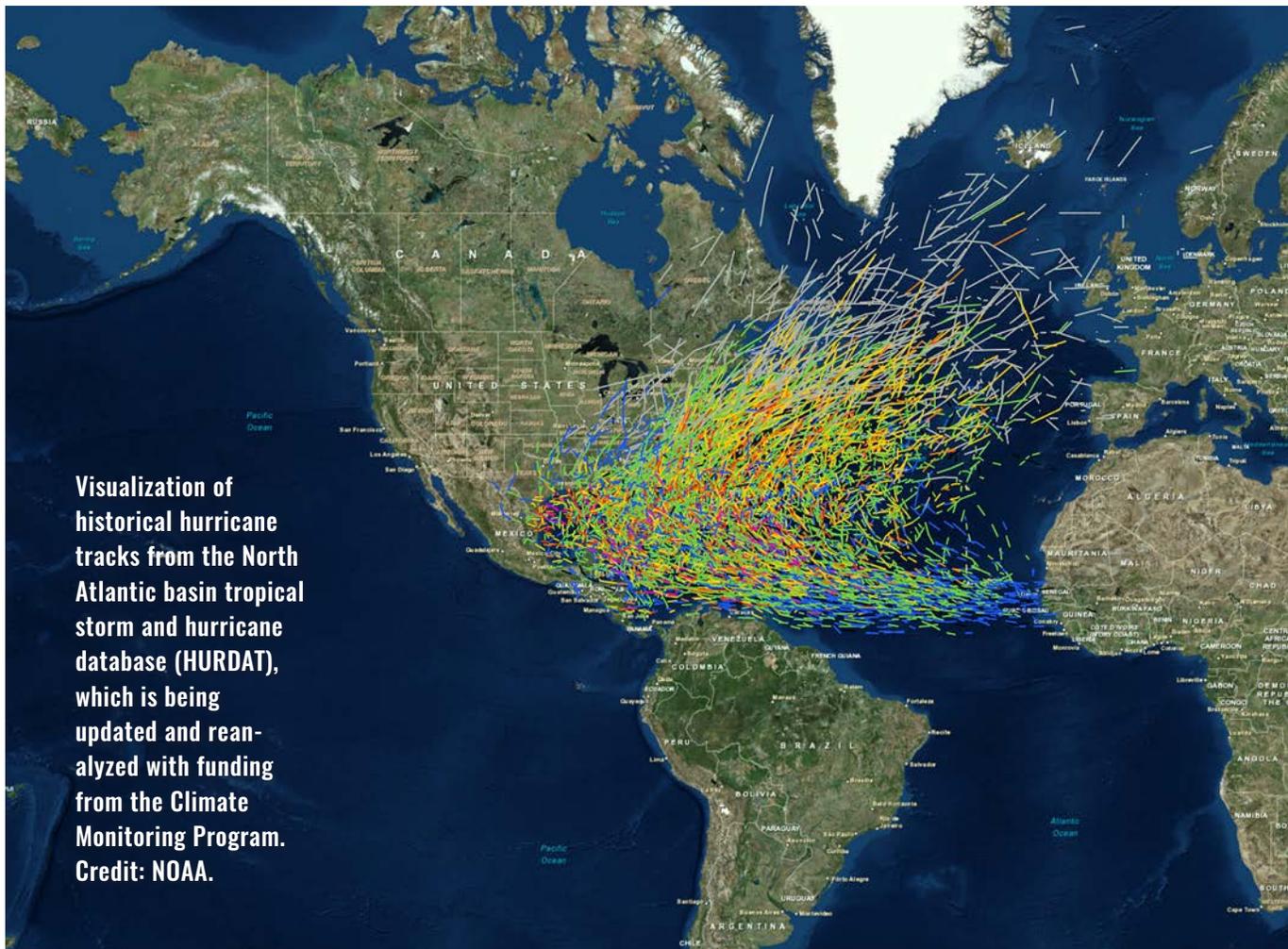
By engaging with NOAA and external research communities, the program supports projects that advance our ability to detect, measure and analyze the signals of climate variability and change through the production and improvement of authoritative long-term climate datasets, and through the testing and development of new climate products and indicators.

## **Robust Project Portfolio**

The Climate Monitoring Program held its first competition in three years in FY14. In FY15, the program's continued support helped to: document the historical and projected variability and changes in weather phenomena including floods, droughts, and other extreme events; develop and test observation-based global and regional indices that facilitate monitoring of the ocean's physical properties from weeks to decades; and develop new and improve existing datasets and information products from key observing systems.

## **Last Millennium Climate Reanalysis Project**

This multi-institution synthesis project supported by the Climate Monitoring Program involves cutting-edge model reanalysis techniques, paleoclimate data assembly, paleoclimate model development, and community meetings. In FY15, the project held an in-depth community workshop in May 2015 in which more than two dozen highly accomplished, leading paleoclima-



**Visualization of historical hurricane tracks from the North Atlantic basin tropical storm and hurricane database (HURDAT), which is being updated and reanalyzed with funding from the Climate Monitoring Program. Credit: NOAA.**

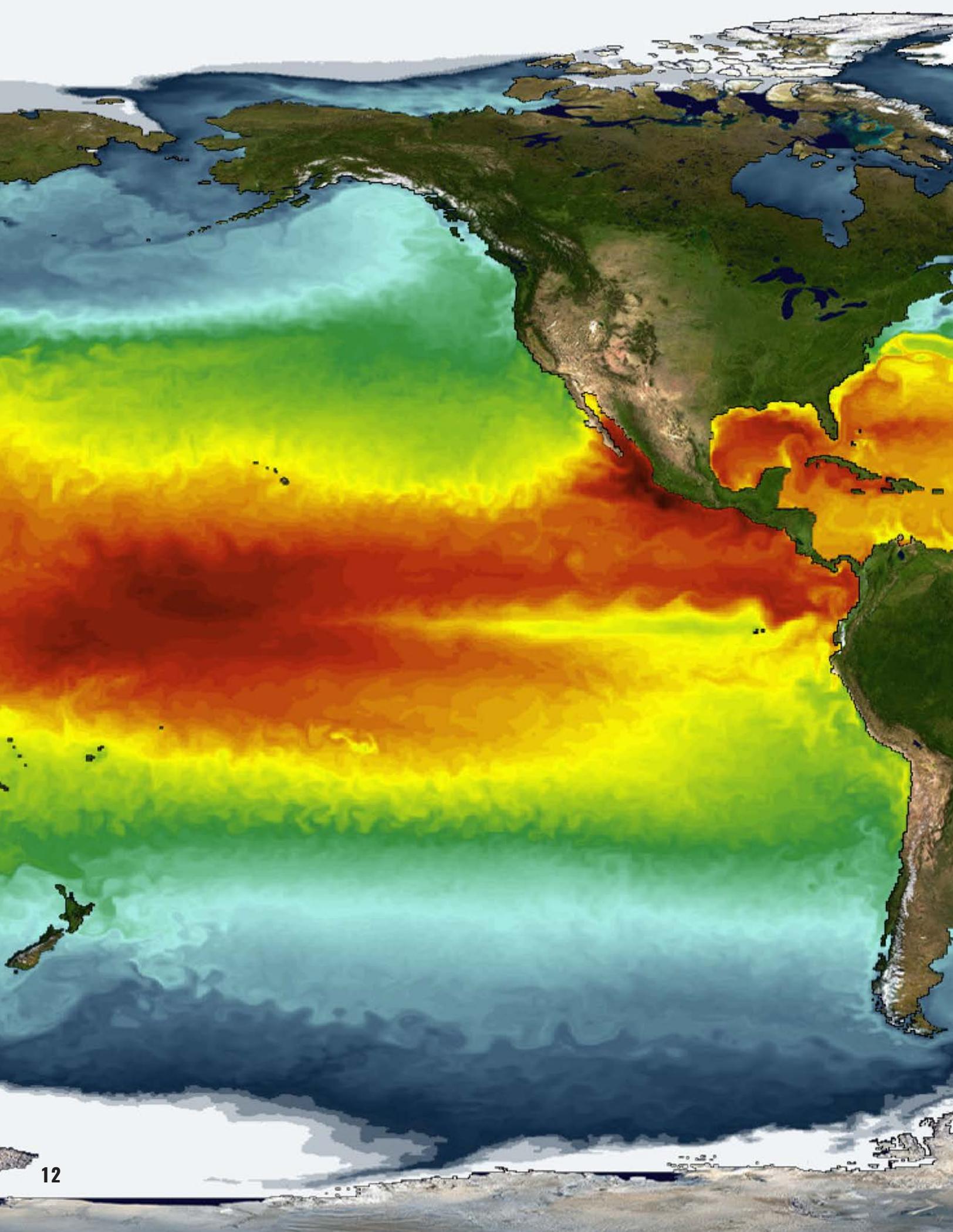
tologists convened to synthesize and chart a path forward for the cutting-edge science of Proxy System Models. The project presented their initial reanalysis work to the MAPP program’s climate reanalysis task force in June 2015.

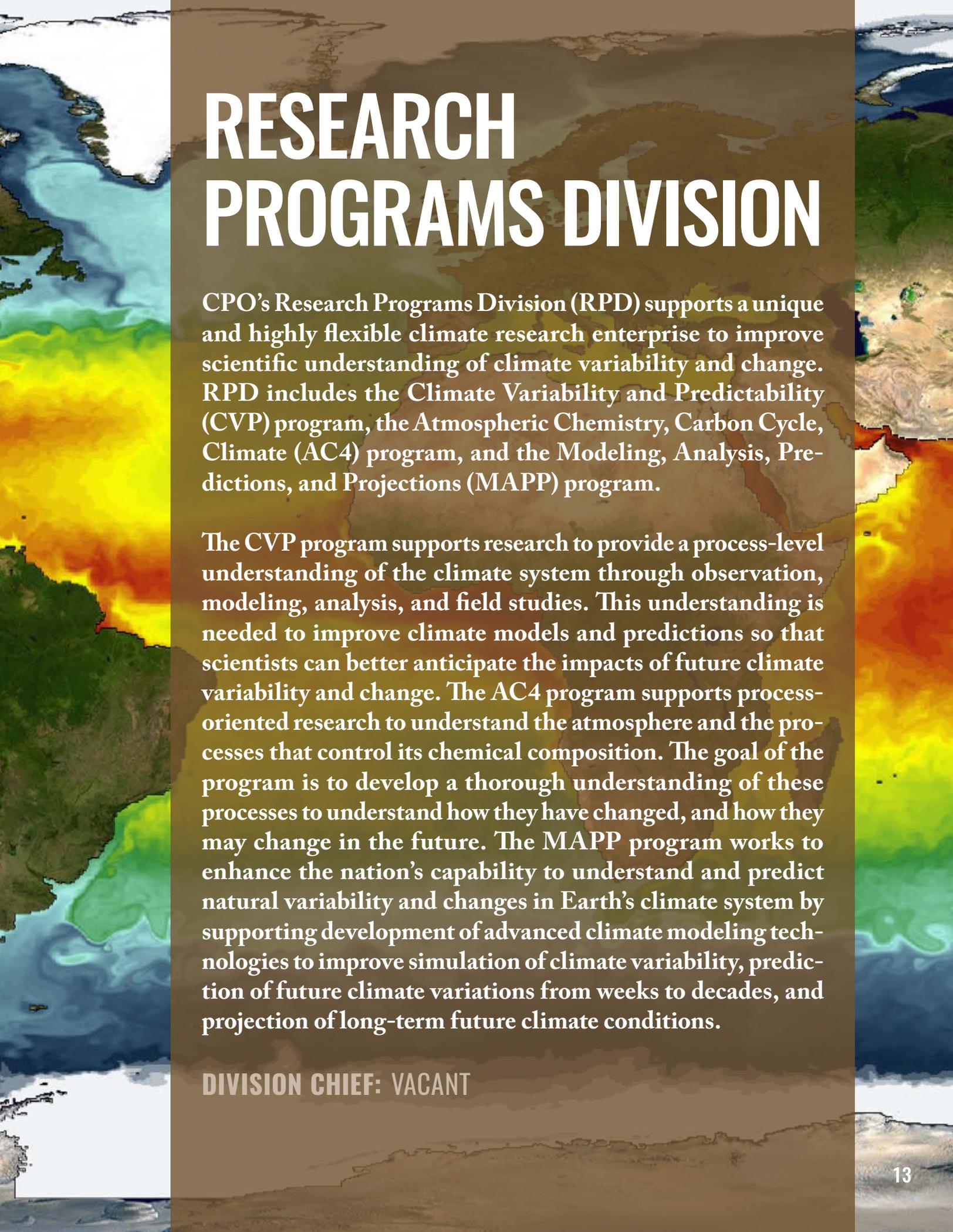
### **New Publications**

Projects supported by the Climate Monitoring Program produced 37 peer-reviewed publications in FY15. Some highlights include: *Atmospheric Circulation Processes Contributing to a Multidecadal Variation in Reconstructed and Modeled Indian Monsoon Precipitation*, by Qu and Hu; *Climatic and Biotic Thresholds of Coral Reef Shutdown*, by Toth et al.; and *A Reanalysis of Hurricane Camille*, by Kieper et al. □

## **WHAT'S NEXT?**

- 1 Community Release of the Last Millennium Climate Reanalysis:** A community release of the *Last Millennium Climate Reanalysis*. This reanalysis includes many new data records and a new 1,000-year record of climate that has been community vetted and contributed.
- 2 New Competition:** A new competition with funds starting in fiscal year 2017. This competition will aim to create a cohort to work together and share results with a defined connection to a group of stakeholders.
- 3 Ocean Climate Indicators:** Get results from a set of projects on piloting ocean climate indicators. These results will include community assessment of the prospect of developing a full-ocean climate indicators system for climate monitoring and prediction.





# RESEARCH PROGRAMS DIVISION

CPO's Research Programs Division (RPD) supports a unique and highly flexible climate research enterprise to improve scientific understanding of climate variability and change. RPD includes the Climate Variability and Predictability (CVP) program, the Atmospheric Chemistry, Carbon Cycle, Climate (AC4) program, and the Modeling, Analysis, Predictions, and Projections (MAPP) program.

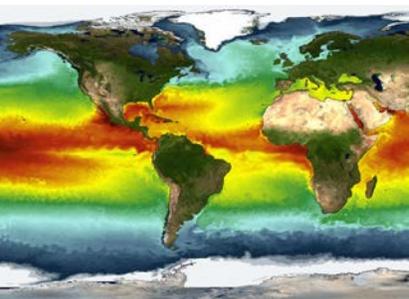
The CVP program supports research to provide a process-level understanding of the climate system through observation, modeling, analysis, and field studies. This understanding is needed to improve climate models and predictions so that scientists can better anticipate the impacts of future climate variability and change. The AC4 program supports process-oriented research to understand the atmosphere and the processes that control its chemical composition. The goal of the program is to develop a thorough understanding of these processes to understand how they have changed, and how they may change in the future. The MAPP program works to enhance the nation's capability to understand and predict natural variability and changes in Earth's climate system by supporting development of advanced climate modeling technologies to improve simulation of climate variability, prediction of future climate variations from weeks to decades, and projection of long-term future climate conditions.

**DIVISION CHIEF: VACANT**

# CLIMATE VARIABILITY AND PREDICTABILITY

The Climate Variability and Predictability (CVP) Program supports research that enhances our process-level understanding of the climate system through observation, modeling, analysis, and field studies.

[CPO.NOAA.GOV/CVP](http://CPO.NOAA.GOV/CVP)



▲ Daily field of sea surface temperature as simulated by the GFDL CM2.5 high-resolution coupled model (Delworth et al., 2012). Colors show daily SST values, with red and blue colors indicating warmer and colder waters, respectively. Credit: NOAA, GFDL.

This vital knowledge is needed to improve climate models and predictions so that scientists and society can better anticipate the impacts of future climate variability and change.

## Improved Understanding of Ocean Circulation

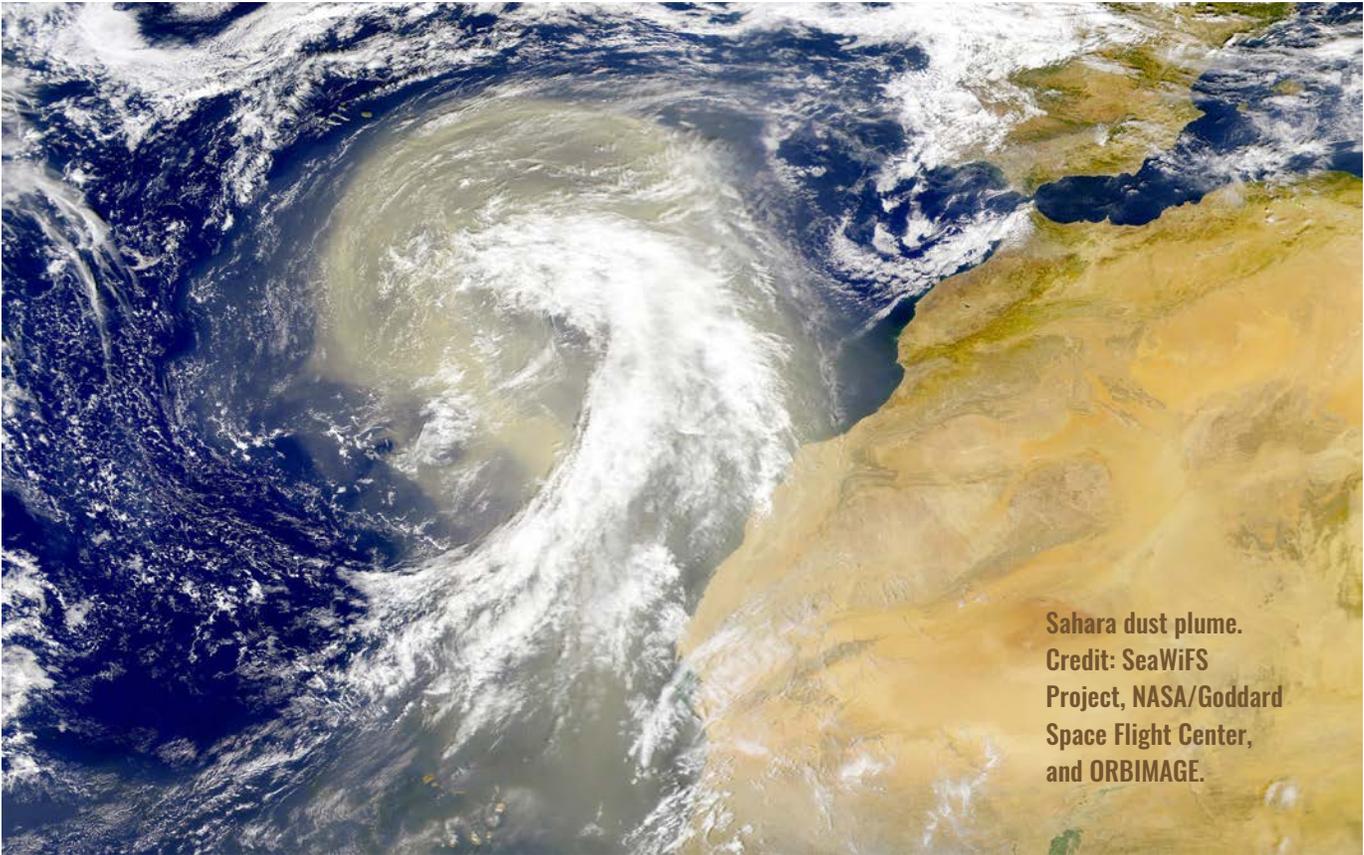
A CVP-funded study determined that a string of unusual floods and high tides along the East Coast in 2009 and 2010 were caused by an unprecedented surge in sea level related to changes in the Atlantic Meridional Overturning Circulation (AMOC). The paper by Goddard et al. found that warmer-than-average water temperatures in the North Atlantic caused a 30 percent slowdown in the AMOC—resulting in piling up water along the eastern Atlantic coast. This finding was covered by major media outlets, including *The Washington Post*.

## Achieving Increased Skill in Decadal Prediction

A paper by Yeager et al., (2012) from the CVP-funded project, *Understanding AMOC Variability Mechanisms and Their Impacts on Decadal Prediction*, was awarded NCAR's 2014 Outstanding Publication. The authors evaluate an ensemble of initialized decadal prediction experiments and found they showed considerable skill at forecasting changes in North Atlantic upper-ocean heat content and surface temperature up to a decade in advance.

## Interpreting Observations from the DYNAMO Field Campaign

A CVP-funded paper by Chen et al. (2015) examined the science outcomes of the many observations made by aircraft during the Dynamics of the Madden-Julian Oscillation (DYNAMO) field campaign. The paper provides an overview of the observations of the interactions between

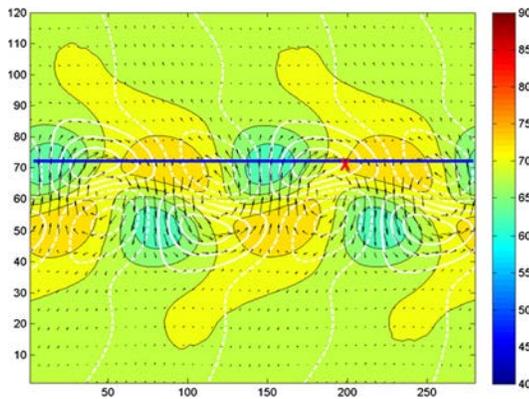


Sahara dust plume.  
Credit: SeaWiFS  
Project, NASA/Goddard  
Space Flight Center,  
and ORBIMAGE.

convective cloud systems, environmental moisture and winds, air-sea fluxes, and convective cold pools.

### New Webinar Series on Decadal Variability and Predictability

The CVP program hosted a webinar series from August to October, 2015, focused on decadal variability and predictability. This series is based on recently funded projects that explore the role and inherent predictability of coupled ocean-atmosphere interactions in the global climate system. These projects aim to improve NOAA's ability to predict climate at the decadal time scale, which is important for agriculture, logistics, emergency planning, and countless other industries and sectors. □



▲ An idealized mixed Rossby-Gravity wave simulation, produced with the COAMPS model, is used to highlight the potential role of such wave circulations on moisture during certain phases of the Madden-Julian Oscillation. Credit: Chen et al. 2015.

## WHAT'S NEXT?

- ① **Improve understanding of AMOC:** Select and fund projects that will refine current scientific understanding of AMOC state, variability, and change.
- ② **Inform the public:** Launch a new webinar series on AMOC research, share results from the program, and promote collaboration.
- ③ **Tropical Pacific Biases Task Force:** Assist with development of a Tropical Pacific Biases Task Force and plan a meeting for funded principal investigators. These new activities will provide opportunities for researchers to exchange information and make advancements across different model platforms.

# ATMOSPHERIC CHEMISTRY, CARBON CYCLE, AND CLIMATE

The Atmospheric Chemistry, Carbon Cycle, and Climate (AC4) Program supports world-class research to advance scientific understanding of the chemistry of the atmosphere.

[CPO.NOAA.GOV/AC4](http://CPO.NOAA.GOV/AC4)



▲ A solitary oil pump at the Teapot Dome Oilfield in Wyoming. Credit: Department of Energy.

AC4 supports projects designed to observe and model gases and aerosols, and their evolution in the atmosphere, to quantify their impacts on air quality and climate. The resulting knowledge and data answer key questions about the air we breathe.

## Extending Remote-Sensing Data for Atmospheric Chemistry Research

Most current space-based instruments for observing and measuring the chemistry of the atmosphere are well past their design lifetimes, and the loss of these instruments and their datasets would substantially impede scientific research on air quality, climate change, and Earth system processes. In 2015, the AC4 Program sponsored a workshop to discuss and document the potential for using the Cross-track Infrared Sounder (CrIS) instrument, aboard NOAA's Joint Polar Satellite System (JPSS)-Suomi NPP satellite, to continue many of the atmospheric chemistry datasets begun by NASA's Earth Observing System satellites. This work-

shop was NOAA's first in a series of critical steps to extend the atmospheric chemistry data record to include space-based observations, which is essential to scientists' ability to understand and model the factors controlling the chemical composition of the atmosphere.

## Observing and Measuring Emissions of Methane and Other Gases from Oil and Natural Gas Industries

As the nation contemplates policies and technologies to reduce atmospheric concentrations of heat-trapping gases (particularly following the President's *Climate Action Plan* to reduce methane emissions), it is vital that we have an ability to observe and quantify their sources. To this end, AC4 supported a major field campaign examining methane emissions from shale gas production in the western United States. The campaign utilized aircraft and mobile platforms. A subsequent data workshop in October 2015 included a discussion of preliminary estimates. □



## WHAT'S NEXT?

- 1 Update Earth System Models:** Advance understanding of Earth's nitrogen cycle by incorporating an active nitrogen cycle into the NOAA Geophysical Fluid Dynamics Laboratory's Earth System Model.
- 2 FIREX:** Determine the chemical composition of wildfire smoke plumes and their impact on human health in the first phase of FIREX.
- 3 Air Quality Forecasts:** Improve air quality forecasts and help people avoid harmful impacts due to smoke inhalation from wildfires with the results of the FIREX campaign.
- 4 Urban Emissions:** Quantify emissions of carbon dioxide and other key greenhouse gases from urban areas through AC4-funded projects.

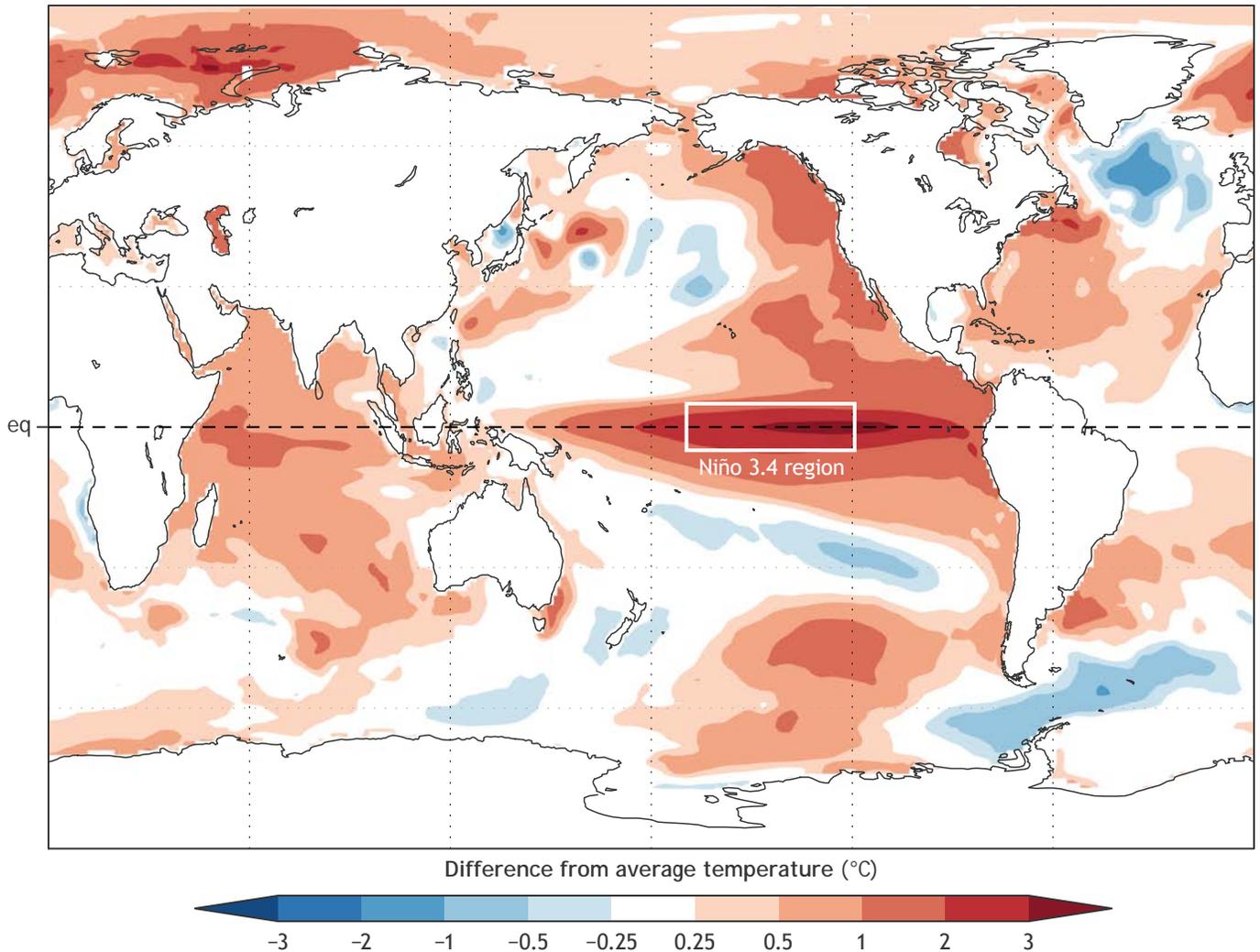


▲ A wildfire just outside of San Diego, California. Credit: Shutterstock.

◀ Brushfire in the Gila River Valley southwest of Phoenix, Arizona, in 2008. Credit: TI9380.

# MODELING, ANALYSIS, PREDICTIONS, AND PROJECTIONS PROGRAM

September NMME forecast of sea surface temperature anomalies for Dec 2015–Feb 2016



# The Modeling, Analysis, Predictions, and Projections (MAPP) Program supports development of advanced climate modeling technologies to improve simulation of climate variability, prediction of future climate variations from weeks to decades, and projection of long-term future climate conditions.

[CPO.NOAA.GOV/MAPP](http://CPO.NOAA.GOV/MAPP)

To this end, MAPP supports research focused on the coupling, integration, and application of Earth system models and analyses across NOAA, partner agencies, and the research community.

## North American Multi-Model Ensemble (NMME)

MAPP played a core role in the development and implementation of the NMME seasonal prediction system for use as part of NWS operations. The NMME combines forecasts from the leading North American climate models toward a multi-model prediction system typically more skillful than any individual model. This multi-agency and multi-institutional research-to-operations (R2O) effort was jointly led by the MAPP program and the NOAA Climate Test Bed (CTB).

## Understanding and Predicting California Drought

MAPP released its second report on the origin of major US droughts in support of NIDIS. This assessment report, titled

◀ **North American Multi-Model Ensemble (NMME) forecasts of sea surface temperature anomalies for December 2015–February 2016 showing the developing El Niño.**  
Credit: NOAA.

*Causes and Predictability of the 2011–14 California Drought*, was produced by the NOAA Drought Task Force and focused on precipitation variability and its causes in influencing California drought.

## NOAA Technical Report on Climate Processes and 21st Century Projections

MAPP published a report, titled *Regional Climate Processes and Projections for North America: CMIP3/CMIP5 Differences, Attribution and Outstanding Issues*, that compares results from two generations of climate model simulations. The report will be used to inform the next National Climate Assessment.

## February 2015 Climate Modeling Summit

MAPP hosted the first annual US Climate Modeling Summit after playing a key role in proposing and scoping this new event. Convened by the USGCRP, this summit brought together leads from the nation's major climate modeling development groups to enhance strategic planning, communication, and organization toward a common national climate modeling strategy. □

## WHAT'S NEXT?

① **Establish an NMME Special Collection:** Organize a special collection of NMME research papers demonstrating the use of the NMME system for research and new applications.

② **Improve NWS Operations via the Climate Test Bed:** Transition to NWS operations of select new prediction methodologies and model components as an outcome of MAPP-Climate Test Bed projects.

③ **Develop a New Seasonal Prediction System Prototype:** Contribute to the development of a prototype for the next-generation NWS Climate Forecast System (CFSv3) via coordination and research as part of the MAPP Climate Model development Task Force.

④ **Improve Predictive Information at Weeks 3 and 4:** Promote better understanding of the capabilities and products that improve predictive information at subseasonal time scales in support of the NWS.

⑤ **Develop Model Evaluation Metrics:** Develop metrics and a framework to evaluate climate models in national modeling center packages; and specifically in support of NOAA's modeling activities.





# CLIMATE AND SOCIETAL INTERACTIONS

The Climate and Societal Interactions (CSI) Division's mission is to provide leadership and support for research, assessments, and climate services designed to bring sound, interdisciplinary science to bear on climate-sensitive resource management and adaptation challenges in key sectors and regions.

The CSI Division builds upon the work of CPO's COM, AC4, CVP, and MAPP programs to understand and anticipate changes in the climate system, and transfers this knowledge to members of society in meaningful and useful ways.

To achieve its mission, CSI supports research in the United States and abroad that augments current understanding and practices used to meet the climate-related needs of decision makers. CSI comprises the COCA, IRAP, RISA, and SARP programs.

**DIVISION CHIEF: NANCY BELLER-SIMMS**

# REGIONAL INTEGRATED SCIENCES AND ASSESSMENTS

NOAA's Regional Integrated Sciences and Assessments (RISA) program supports regional teams that help expand and build the capacity of those seeking to prepare for and adapt to climate variability and change.

[CPO.NOAA.GOV/RISA](http://CPO.NOAA.GOV/RISA)



▲ A CSI-funded researcher interviews a rancher in Hawaii to better understand the impacts of drought on her ranch operations. Credit: V. Keener.

The network of ten RISA research teams around the country work hand-in-hand with stakeholders and decision makers to ensure that climate research and information is tailored to their needs.

## Supporting NIDIS

RISA is a critical backbone of research and stakeholder engagement for the National Integrated Drought Information System (NIDIS). In most of the NIDIS regions, RISA teams lead the NIDIS Regional Drought Early Warning Systems (RDEWS) pilots, link NIDIS efforts to the RISA's broader stakeholder network, and leverage their core RISA research and engagement efforts to help NIDIS achieve its mission.

## Expanding Partnerships

In FY15, RISAs continued to develop strong partnerships with the National Weather Service, US Department of Agriculture Regional Climate Hubs, Depart-

ment of the Interior Climate Science Centers, Landscape Conservation Cooperatives, and other state, local, and federal entities to advance the capacity of communities to adapt to climate impacts and become more resilient.

## Building Resilience to Extreme Events

RISA research teams have played integral roles in providing needed information and expertise to improve response activities and build resilience following major extreme events, such as Hurricane Sandy in the northeast, floods in Boulder, Colorado, extreme droughts in Texas and Oklahoma, and the current drought in California and Nevada. □

► A member of the audience poses a question for panelists at the December 10, 2012 Pacific Islands Climate Services Forum. Credit: PIRCA, Pacific RISA

► Participants at the July 15, 2011 Pacific RISA workshop at the East-West Center. Credit: Pacific RISA



◀ Dr. Finucane on set for production of the *Climate Matters for Waikiki Beach* documentary. September 2011. Credit: Pacific RISA



## WHAT'S NEXT?

❶ **Tailor information:** Tailor new findings, information, and expert advice on extreme events and El Niño impacts in various regions of the United States.

❷ **Develop tools and partnerships:** Develop new tools—such as the climate, agriculture, and water toolbox in the Pacific Northwest—and new partnerships with cities and communities to improve planning and coordinated responses to extreme events.

❸ **RDEWS:** Help to develop and implement the National Integrated Drought Information System (NIDIS) Regional Drought Early Warning System (RDEWS).

❹ **Enhancing Adaptation:** Provide new research and assessment inputs and engage with regional stakeholder networks to enhance national climate adaptation and assessment efforts.

❺ **Heat Health:** Support the implementation of regional climate-health initiatives as part of the developing National Integrated Heat Health Information System (NIHHIS) and support the developing Integrated Information Systems within CPO.

# INTERNATIONAL RESEARCH AND APPLICATIONS PROJECT

The International Research and Applications Project (IRAP) is CPO's primary investment in interdisciplinary, applied research with an international scope.

[CPO.NOAA.GOV/IRAP](http://CPO.NOAA.GOV/IRAP)



Participants discuss climate resilience efforts on the island model of Caribba at the 2014 Dry Season CariCOF. Credit: Elizabeth Gawthorp.

At IRAP's core is a project titled *Integrating Climate Information and Decision Processes for Regional Climate Resilience*, which seeks to advance the resilience of communities and sectors in developing nations that are vulnerable to climate variability and change by supporting decision-making and risk management through improved design, production, and provision of use-inspired climate information, particularly as an integral part of international development goals.

The IRAP team, supported by NOAA and USAID, is co-led by the International Research Institute for Climate and Society (IRI) and the University of Arizona.

### **Understanding the Economic Value of Climate Information**

IRAP (in partnership with the University of West Indies) estimated the differences in economic losses of farmers who received, in different forms, climate information services during the severe 2014 drought. We interviewed 453 farmers, some of whom participated in trainings on climate and weather information hosted by Jamaican organizations. Results show that farmers who received the most exposure to the climate and weather information perceived their losses in production to be 10 percent less, on average, than farmers who did not participate.

### **Drought Monitoring/Forecast Tools**

IRAP works with the Caribbean Institute for Meteorology and Hydrology (CIMH) to evolve the quality and presentation of *Drought Outlooks*, which are now a regular product of the Caribbean Climate Outlook Forum (CariCOF) and are accompanied by recommendations for actions (when appropriate). Additionally, IRAP provided training and support to the Comité Regional de Recursos Hidráulicos to create similar information.

### **Linking Vulnerability and Climate Service Products**

IRAP completed the first stage of a comprehensive climate vulnerability assessment of Blue Mountain coffee farmers. Researchers conducted 12 focus group discussions in 12 communities, reaching 143 farmers. The research identified a set of climate information that can reduce climate-related vulnerability, including developing more robust historical climate information that can help characterize Blue Mountain climate variability, improved weather forecasts for the onset of the wet season, and improved seasonal forecasts. Significant progress has already been made on these climate information priorities. □

## **WHAT'S NEXT?**

- 1 Resilient Development:** Provide technical input to US government efforts to advance climate resilient development.
- 2 World Bank Ties:** Develop an innovative partnership with the World Bank in India to integrate climate research and services in resilient development.
- 3 Bihar Assessment:** Complete a baseline assessment of climate impacts and user needs for the northern Indian State of Bihar.
- 4 India-tailored Information:** Tailor subseasonal-to-seasonal climate information for India, with a focus on the state of Bihar, and translate that climate information to sectoral impacts, such as water, food, and disasters.
- 5 CIMH:** Training of social science approaches in climate services with the regional organization Caribbean Institute for Meteorology and Hydrology (CIMH).
- 6 Subseasonal Climate Information:** Develop at least one new subseasonal climate information product to be developed for the CariCOF, in collaboration with regional partners such as CIMH.
- 7 Enhancing Jamaica's Resilience:** Design a tailored climate service developed to enhance climate resilience in Jamaica, focused on agriculture, in partnership with the Jamaican Coffee Industry Board, farmers, coffee buyers, the Jamaican Meteorological Service, Jamaican extension services, and others.

# COASTAL AND OCEAN CLIMATE APPLICATIONS

**The Coastal and Ocean Climate Applications (COCA) program addresses the needs of decision makers dealing with pressing climate-related issues in coastal and marine environments.**

[CPO.NOAA.GOV/COCA](http://CPO.NOAA.GOV/COCA)

COCA is designed to support interdisciplinary teams of researchers in the development and transition of climate-related research and information to advance the resilience of coastal communities and coastal and marine ecosystems.

## **Support Adaptation in the National Estuarine Research Reserve System**

One of the goals of the COCA program is to integrate National Ocean Service (NOS) climate and coastal-related priorities and programs into COCA competitions and activities. In FY12, COCA-funded research projects to conduct vulnerability assessments and support adaptation planning in two NOS National Estuarine Research Reserve System (NERRS) sites. This research integrated the NERRS climate change and resilience initiatives with the priorities of COCA by supporting efforts to better understand the Reserves' vulnerabilities to changing climate conditions. Results of the two

projects will be shared across the reserve system and used to inform future climate-related work completed at individual sites.

## **Climate Impacts on Fish Stocks**

In FY15, COCA entered into a new collaboration with the National Marine Fisheries Service (NMFS) Office of Science and Technology to inform sustainable management and resilience of the nation's fisheries in a changing climate. COCA held the partnership's first competition for research funding to advance understanding and projection of climate-related impacts on fish stocks, and to address key information needs for sustainable management of fisheries in the Northeast Shelf Large Marine Ecosystem. □



▲ **Catch of Atlantic herring. Credit: NOAA FishWatch.**



River management strategies affect flood risk for coastal communities. Credit: Tim Carruthers, IAN Image Library.

## WHAT'S NEXT?

### ① Support community resilience:

Complete ongoing COCA research on ecosystem services and natural infrastructure to support coastal community resilience.

### ② Stakeholder engagement:

Continue and scale up stakeholder and scientist engagement on achieving sustainability goals for urban coasts. The COCA and RISA programs will continue engagement with scientists, sustainability practitioners and engineers to discuss research gaps and decision-makers' needs for supporting urban coastal sustainability goals.



▲ A fishing trawler at sea. Credit: NOAA.

# SECTORAL APPLICATIONS RESEARCH PROGRAM

The Sectoral Applications Research Program (SARP) supports interdisciplinary research to advance understanding of how climate variability and change affect key socioeconomic sectors, and promotes the application of this new knowledge into tools and methodologies that improve climate-related decision making.

[CPO.NOAA.GOV/SARP](http://CPO.NOAA.GOV/SARP)

## Founding of DRMRC

SARP helped create the Drought Risk Management Research Center (DRMRC), led by staff at the University of Nebraska-Lincoln, to work with leaders of the National Integrated Drought Information System (NIDIS) and its federal, state, tribal, and local partners to improve drought monitoring, impacts assessment, and risk management. DRMRC is expected to enhance drought preparedness efforts and reduce potential impacts.

## Climate Resilience Toolkit “Water Resources” Section

SARP led development of the “Water Resources” section of the US Climate Resilience Toolkit. This site currently holds over 90 case studies highlighting people in communities and businesses taking action to build resilience, and over 200 decision-support tools and training opportunities.

## Support of Relevant Research

SARP-supported research completed in FY15 has provided us with an improved

understanding of how water use varies by crop type in response to drought conditions. Knowledge gleaned from these projects will be used by decision and policy makers to support adaptive management in agricultural and urban sectors.

## Prototype Extreme Events Dashboard for Water Resource Managers and Urban Planners

SARP developed a dashboard prototype that will be used for decision making as well as education and outreach activities, based on inputs from a variety of national water and planning organizations, the American Planning Association, and NOAA line offices.

## Webinar Series on Climate Information for Managing Risks in Water Resources

SARP led an inter-agency and inter-NGO activity with eight partners to provide webinars about every month or two. Nearly 900 participants attended six webinars in the last year. □

▼ Water manager assessing infrastructure’s capacity to accommodate sudden heavy flows of storm water runoff.  
Credit: NOAA.





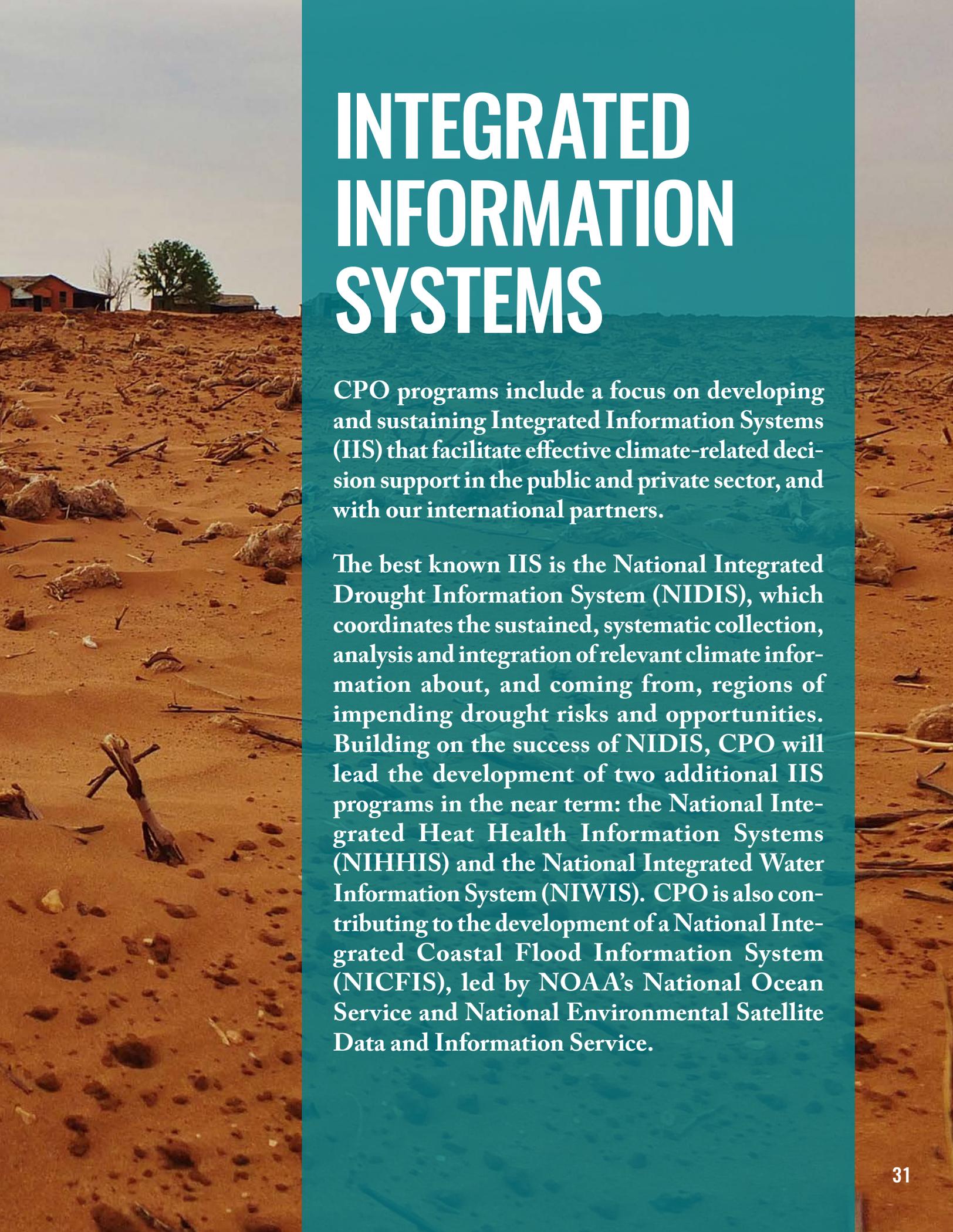
## WHAT'S NEXT?

**1 New Dashboard:** Publication of the Water Resources Dashboard for use by water resource managers and urban planners.

**2 Expand the Climate Resilience Toolkit:** Develop and deploy new engagement and training series in the Climate Resilience Toolkit to help water utilities and water resource managers find and use science-based tools and data to build resilience to climate-related changes and extreme events.

▲ Infrastructure improvements have made it possible to irrigate crops like alfalfa and cotton in Phoenix, Arizona, one of the hottest metropolitan areas in the US. Credit: Jennifer A. Johnson.





# INTEGRATED INFORMATION SYSTEMS

CPO programs include a focus on developing and sustaining Integrated Information Systems (IIS) that facilitate effective climate-related decision support in the public and private sector, and with our international partners.

The best known IIS is the National Integrated Drought Information System (NIDIS), which coordinates the sustained, systematic collection, analysis and integration of relevant climate information about, and coming from, regions of impending drought risks and opportunities. Building on the success of NIDIS, CPO will lead the development of two additional IIS programs in the near term: the National Integrated Heat Health Information Systems (NIHHIS) and the National Integrated Water Information System (NIWIS). CPO is also contributing to the development of a National Integrated Coastal Flood Information System (NICFIS), led by NOAA's National Ocean Service and National Environmental Satellite Data and Information Service.

# NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

Since 2006, the National Integrated Drought Information System (NIDIS) has worked to improve the nation’s capacity to manage drought-related risks by providing the best available information and tools to assess the potential impacts of drought, and to prepare for and mitigate the effects of drought.

[CPO.NOAA.GOV/NIDIS](http://CPO.NOAA.GOV/NIDIS)

DIRECTOR: GENOVEVA DEHEZA



▲ These cotton plants were left in the field after drought conditions made them unsuitable for harvest. Photo taken about 5 miles south of Ropesville, Texas, in 2014. Credit: Tim Benson, NOAA Research Photo Contest.

## Addressing the California Drought

In FY15, NIDIS initiatives addressed the exceptional drought in California by analyzing the potential for El Niño to alleviate the drought, producing a report on how NIDIS has supported the *California Water Action Plan*, and by providing support for the Drought Task Force’s *Causes and Predictability of the 2011–2014 California Drought* assessment, conducted through CPO’s MAPP program.

## US Drought Monitor

NIDIS continued its ongoing support for the US Drought Monitor ([Drought.gov](http://Drought.gov)), including creation of a *USDM 101* brochure in collaboration with the National Drought Mitigation Center.

## Western State Drought Coordinators Meeting

In 2015, Western drought coordinators and emergency managers gathered in

Seattle for the first time to explore strategies for coping with drought. Participants noted the value of networking opportunities with an ability to compare drought strategies from state to state.

## WGA Drought Forum

From 2014–2015, NIDIS partnered with the Western Governors Association (WGA) for its Drought Forum series, where Western planners, experts, and practitioners—organized by sector—discussed drought impacts and policy solutions.

## Tribal Engagement

During FY15, NIDIS engaged with tribes in the Missouri River Basin with the goal of developing drought preparedness and resilience. An example is collaboration on the Wind River Reservation in Wyoming, which helped develop a drought summary document for planning going forward. □



Lake Oroville, a reservoir in Northern California, in July 2014. Credit: California Department of Water Resources.

## WHAT'S NEXT?

- 1 **Drought.gov:** Redesign the website [Drought.gov](http://Drought.gov), and conduct user testing and evaluation.
- 2 **Midwest DEWS:** Establish a new Drought Early Warning System in the Upper Mississippi and Ohio Basins of the Midwest, with associated stakeholder engagement activities.
- 3 **Pacific NW DEWS:** Establish a Pacific Northwest Drought Early Warning System, with associated stakeholder engagement activities.



View from Marine One en route to Firebaugh, California on February 14, 2014. Official White House photo by Pete Souza.

# NATIONAL INTEGRATED HEAT HEALTH INFORMATION SYSTEM

Extreme weather and climate events such as heat waves, hurricanes, or floods can profoundly affect society and the environment, resulting in loss of life, productivity, property, and natural habitat.

CPO.NOAA.GOV/NIHHIS

DIRECTOR: JULI TRTANJ



Heat Health Director Juli Trtanj giving a presentation about climate and public health in 2014. Credit: US Mission Geneva.

From 1979–2003, excessive heat exposure caused 8,015 deaths in the United States. During that period, more people died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

NOAA’s scientific research and services help the nation understand, anticipate, and respond to increased heat waves and heat-related events. Toward this goal, CPO is leading development of a new National Integrated Heat Health Information System (NIHHIS), in partnership with the US Centers for Disease Control. Sustained collaboration between the public health sector and weather and climate communities over the past several years has defined the demand for and capacity to use heat forecasts and related vulnerability and adaptation information.

### Establishment of NIHHIS

NOAA and the Centers for Disease Control and Prevention partnered together to improve societal resilience to extreme heat by developing a suite of decision support services as an integrated information system. This collaboration was formally announced by the White House as the National Integrated Heat Health Information System.

### National Integrated Heat Health Information System Workshop

From July 28–30, 2015, this workshop convened participants from several US agencies and other countries with experience in heat early warning in order to assess current capabilities and needs, as well as to develop a network of collaborators for the NIHHIS.

### Development of International Partnerships

CPO’s Climate and Heat Health Director Juli Trtanj went on the road at the end of

FY15 to develop connections to climate and health initiatives in Africa and India, and to share NOAA’s work on health early warning systems for cholera, malaria, meningitis, and extreme heat. □



◀ Airman 1st Class Jeffery Albright drinks at Nellis Air Force Base in Nevada. Working in near record temperatures as high as 117°F, airmen must hydrate frequently to avoid heat-related injuries. Credit: Master Sgt. Jason W. Edwards, US Air Force.

## WHAT'S NEXT?

- 1 **Develop partnerships:** NIHHIS will continue to develop international and domestic partnerships between meteorological services, public health and medicine, and other agencies at the local, state, and national scale.
- 2 **Communication and discussion:** After the successful 2015 workshop in Chicago, NIHHIS plans to hold a second workshop in 2016. This will build on the discussions and outcomes from the Chicago workshop, with a stronger focus on communication and stakeholder needs.
- 3 **Building a web presence:** NIHHIS has plans to establish a web presence to serve as an information source and testing area for the program’s continued development.

# COMMUNICATION AND EDUCATION

Decision makers, resource managers, business and policy leaders, educators, students, and citizens are increasingly asking for information from NOAA to help them understand and address climate-related challenges and opportunities.

CPO.NOAA.GOV/COMMED

DIRECTOR: DAVID HERRING



▲ Students look at NOAA's Science on a Sphere at South Florida Science Museum.

► CommEd's News & Features team created this schematic to show average conditions during El Niño winters. Credit: Fiona Martin, NOAA Climate.gov.

In response to public demand, the Climate Program Office's Communication and Education (CommEd) program provides climate data and information to help build a climate-smart and resilient nation. Our goal is to foster a climate-literate public that understands its vulnerabilities to a changing climate and makes informed decisions.

## Building US Resilience to Climate-Related Impacts

In response to President Obama's *Climate Action Plan*, CommEd led development of the US Climate Resilience Toolkit ([toolkit.climate.gov](http://toolkit.climate.gov)) to provide scientific tools, information, and expertise to help people manage their climate-related risks and opportunities, and improve their resilience to extreme events.

## Informing the Public

In FY15, [Climate.gov](http://Climate.gov)'s "News & Features" section expanded its popular blog depart-

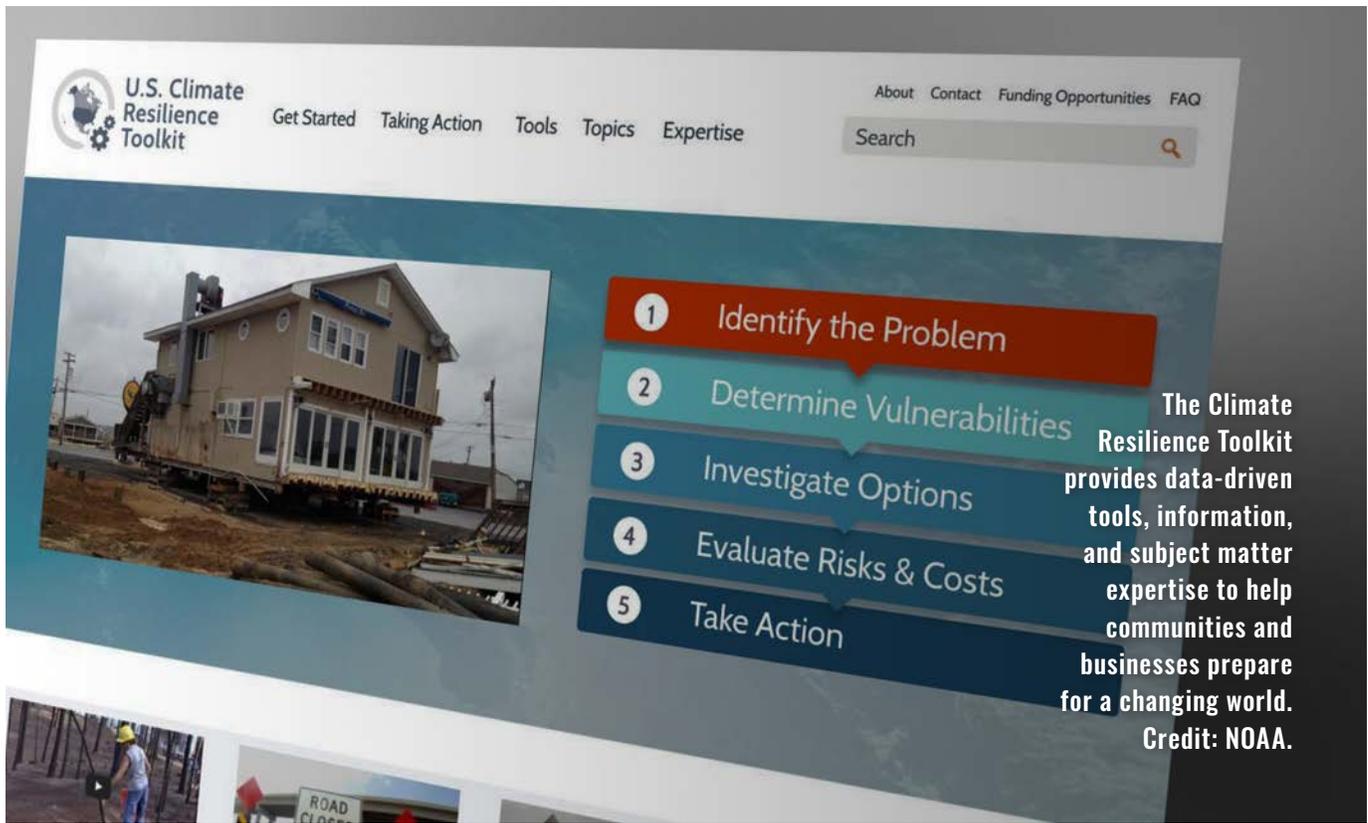
ment by adding the "Beyond the Data" blog, which features stories written by the nation's official climate record keepers—the National Centers for Environmental Information (NCEI). In addition, [Climate.gov](http://Climate.gov) continued the "ENSO Blog", which covers monitoring and forecasting of El Niño, La Niña, and its impacts.

## Providing Easy Access to Climate Maps and Data

In FY15, CommEd deployed a newly rebuilt "Maps & Data" section. The new "Data Snapshots" viewer allows users to display, animate, and download maps showing observed and forecasted climate conditions on national and global scales. The new "Data-set Gallery" and "Climate Data Primer" make it easier for visitors to find and use climate data for their own applications.

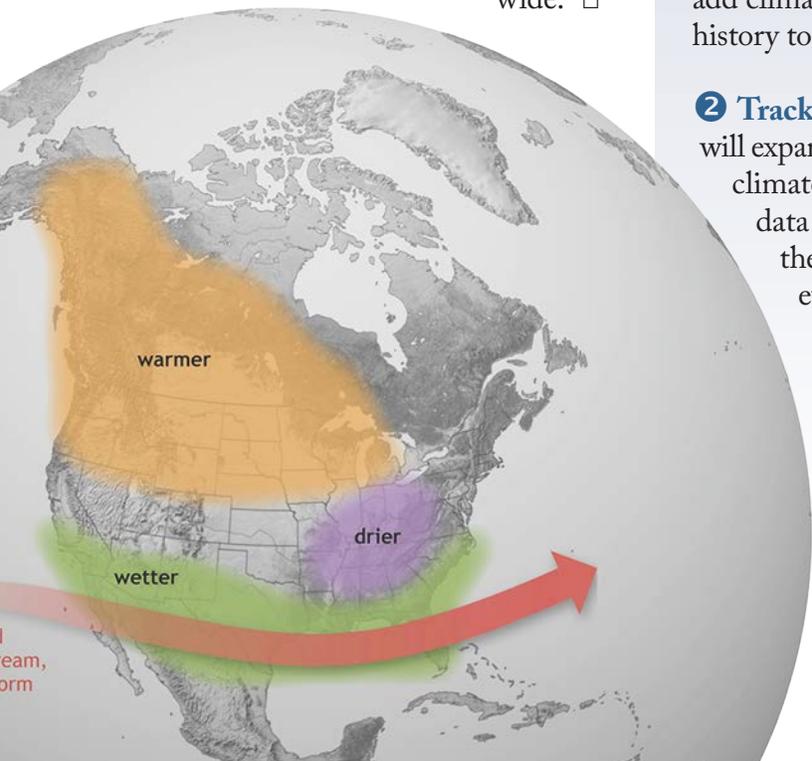
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### Enhancing Standards-Based Climate Science Education

In FY15, CommEd helped to grow and syndicate the rigorously reviewed collection of 668 very high quality climate and energy education resources available through [Climate.gov](#)'s "Teaching Climate" section to educators nationwide. □



### WHAT'S NEXT?

**1 Expand the Toolkit:** CommEd will add a new "Climate by Location" widget to the Climate Resilience Toolkit, allowing users to easily access and interact with local and regional scale climate data and maps of decision-relevant measurements they need to help them build resilience. We will also add climate projection data so users can compare trends in history to trends projected to the year 2100.

**2 Track Climate Events:** The "News & Features" team will expand their "Event Tracker" effort in FY16 to monitor climate-related events worldwide and provide images, data visualizations, and written explanations to help the public understand where, how, and why extreme events and climate-related impacts occur.

**3 Train Educators:** The "Teaching Climate" team will develop an educator training series to increase awareness and use of the CLEAN collection in formal and informal science education institutions.

# INTERNATIONAL

Recognizing that climate variability and change are global concerns, CPO is engaged in international activities to advance climate science and services worldwide.

[CPO.NOAA.GOV/INTERNATIONAL](http://CPO.NOAA.GOV/INTERNATIONAL)

**DIRECTOR:** MEREDITH MUTH



▲ **Hurricane Sandy on October 27, 2012. Credit: NASA, MODIS/LANCE.**

CPO's international partnerships are designed to advance climate observations and research, connect US climate science experts, tools, and services with international needs and expertise, participate in design and planning of NOAA and US government climate policy and activities, and represent the US in bilateral, regional, and global partnerships. These activities connect our climate science and services priorities to international policy, and develop strategic partnerships to strengthen NOAA's climate science and services.

## Providing Leadership on Implementing the GFCS

The Global Framework for Climate Services (GFCS) is an intergovernmental partnership focused on enhancing the quality, quantity, and application of climate information to empower decision-makers to manage the risks and opportunities of a changing climate. CPO provides US government representation to the intergovernmental GFCS. In 2015, CPO effectively represented US positions during governance meetings, and substantially contributed to the Framework's progress through leadership in increasing access to

climate information products and in co-chairing the development of a GFCS strategic work plan.



► **CPO's Drs. Wayne Higgins and Meredith Muth, and Farhan Akhtar from the Dept. of State, represent the US at the October 2015 Intergovernmental Board on Climate Services (IBCS) meeting in Geneva, Switzerland. Credit: NOAA.**

### Strengthening Interagency Cooperation on International Research and Resilient Development Engagement

The Climate Program Office helped re-establish an interagency working group on International Activities under the US Global Change Research Program (USGCRP). The goal of this working group is to increase awareness and cooperation on issues related to global research efforts and international partnerships. NOAA CPO co-chairs this interagency working group with the National Science Foundation. CPO also represents NOAA in an interagency working group on international resilient development that is focusing on the integration of climate-resilient considerations into United States international development activities, and co-chairs the Working Group's Climate Screening Subgroup.

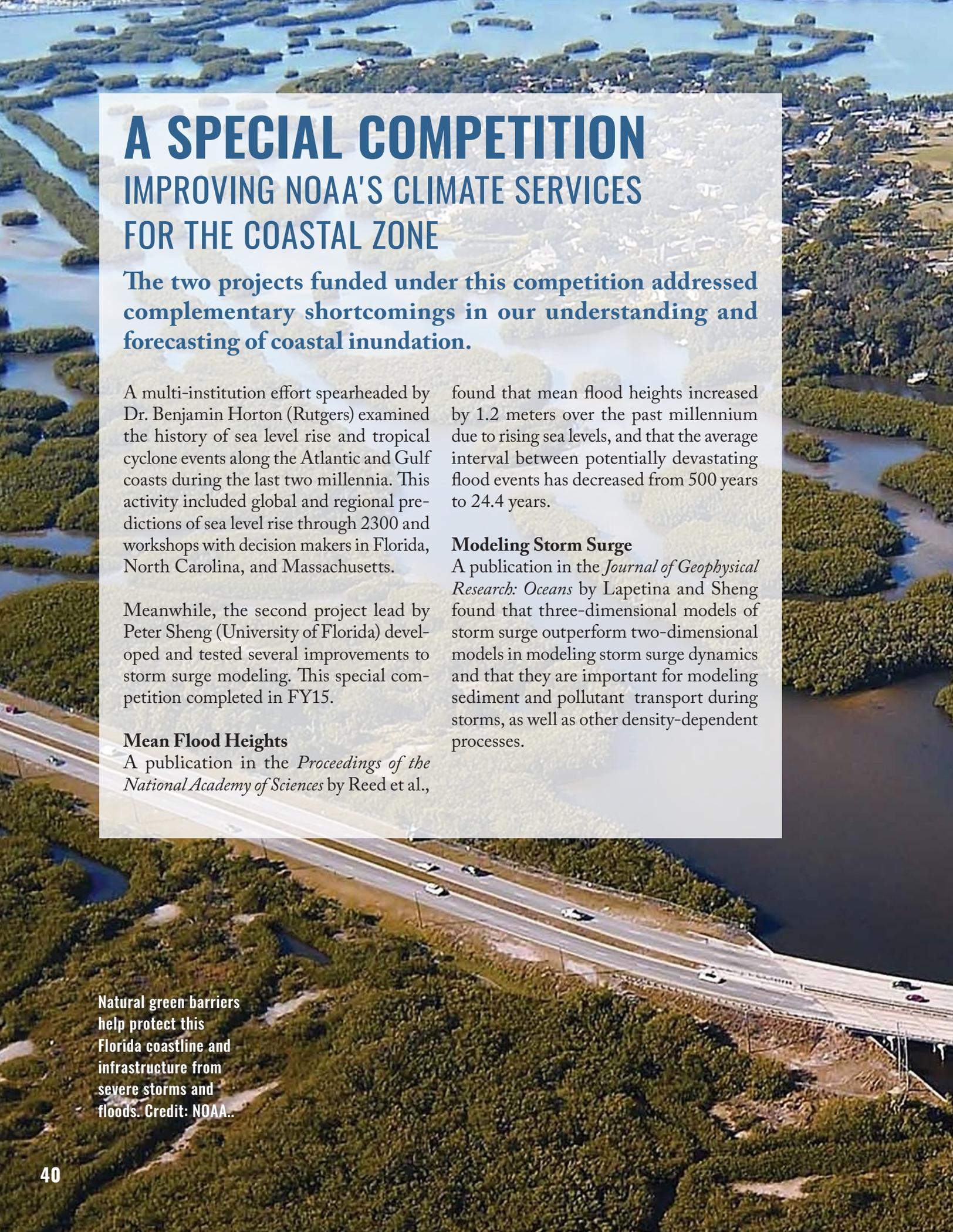


### Supporting US Positions for International Climate Policy

CPO worked closely with the US State Department in developing and negotiating US positions at the United Nations Framework Convention for Climate Change (UNFCCC) related to scientific research, observations, and adaptation issues. □

## WHAT'S NEXT?

- 1 Advance Collaborations on Transboundary Climate Services:** Share lessons learned in transboundary climate services based on experiences of the North American Climate Services Partnership (NACSP), which CPO coordinates on behalf of the United States.
- 2 Increase Accessibility of Climate Information for Global Partnerships:** Lead efforts under the World Meteorological Organization to develop a Climate Services Information System that will be relevant for global, regional, and national partners.
- 3 Demonstrate Transboundary Proof-of-Concept for Integrated Information Systems:** Establish a Mexico-US regional pilot for an integrated heat-health information system.
- 4 Support International Climate Policy:** Lead and support US efforts to clarify and implement the outcomes of UNFCCC COP21, particularly under the Subsidiary Body of Scientific and Technological Advice (SBSTA).
- 5 Enhance International Resilient Development:** Lead NOAA's engagement in several initiatives and partnerships related to utilizing climate information and services in resilient development around the world.
- 6 Strengthen Scientific Collaborations:** Engage in international efforts that support CPO and NOAA's priorities for climate observations and research, including the Global Climate Observing System, the World Meteorological Organization, the Group on Earth Observations, and the World Climate Research Program.

An aerial photograph of a coastal region. In the foreground, a multi-lane highway runs horizontally across the frame, with several cars visible. To the left of the highway is a dense area of green mangroves. To the right, a body of water is visible, with more mangroves extending into it. The background shows a vast expanse of water with numerous small, green islands or peninsulas scattered throughout. The sky is clear and blue.

# A SPECIAL COMPETITION

## IMPROVING NOAA'S CLIMATE SERVICES FOR THE COASTAL ZONE

**The two projects funded under this competition addressed complementary shortcomings in our understanding and forecasting of coastal inundation.**

A multi-institution effort spearheaded by Dr. Benjamin Horton (Rutgers) examined the history of sea level rise and tropical cyclone events along the Atlantic and Gulf coasts during the last two millennia. This activity included global and regional predictions of sea level rise through 2300 and workshops with decision makers in Florida, North Carolina, and Massachusetts.

Meanwhile, the second project lead by Peter Sheng (University of Florida) developed and tested several improvements to storm surge modeling. This special competition completed in FY15.

### **Mean Flood Heights**

A publication in the *Proceedings of the National Academy of Sciences* by Reed et al.,

found that mean flood heights increased by 1.2 meters over the past millennium due to rising sea levels, and that the average interval between potentially devastating flood events has decreased from 500 years to 24.4 years.

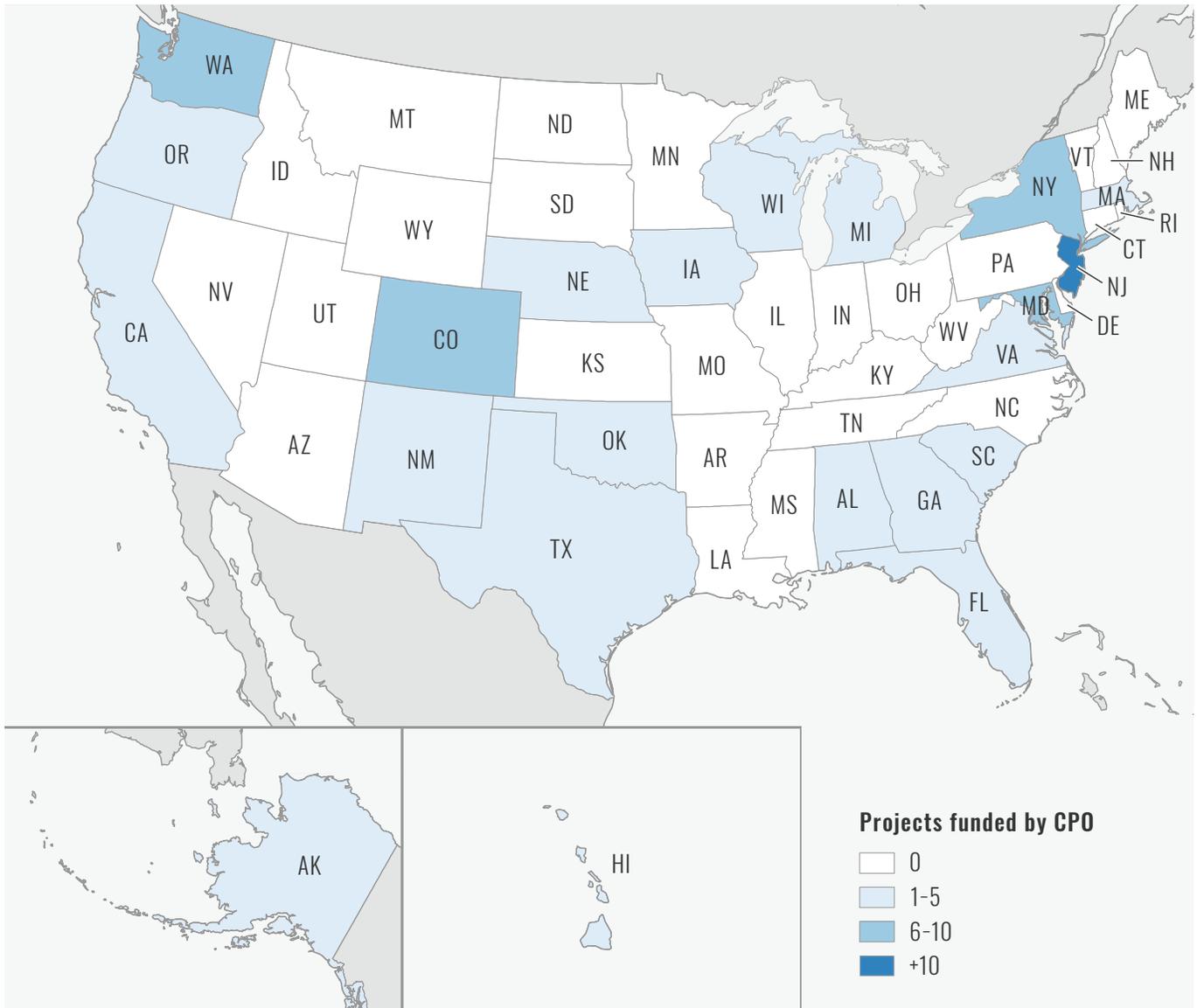
### **Modeling Storm Surge**

A publication in the *Journal of Geophysical Research: Oceans* by Lapetina and Sheng found that three-dimensional models of storm surge outperform two-dimensional models in modeling storm surge dynamics and that they are important for modeling sediment and pollutant transport during storms, as well as other density-dependent processes.

Natural green barriers help protect this Florida coastline and infrastructure from severe storms and floods. Credit: NOAA..



# RESOURCES AND ACHIEVEMENTS



▲ Map of all states receiving funding from CPO for FY15 new competitive awards, by number of projects.

## FY15 ACHIEVEMENTS (quick stats)

**Competitions held: 11**

**New projects: 53**

**Ongoing projects from past competitions: 264**

**New publications supported: 747**

## REPORTS/PUBLICATIONS

Alvarado et al. August 2015. *Advancing Atmospheric Chemistry Through the Use of Satellite Observations from the Cross-track Infrared Sounder (CrIS)*.

Circumpolar Biodiversity Monitoring Program Marine Steering Group. 2015. Arctic Marine Biodiversity Monitoring Plan Annual Plan 2014. *CAFF Monitoring Report*. US contributions.

COD. September 2014. *Climate Observation Division 2015–2020 Strategic Plan*.

Crane, K. November 2015. *RUSALCA 2015 North and South Cruise Report*.

DeWitt et al. March 2015. *NOAA Holistic Climate and Earth System Model Strategy Phase I: Current State*.

Guido et al. 2014. *Integrating Climate Information and Decision Processes for Regional Climate Resilience in the Caribbean*. University of Arizona Institute of the Environment and Columbia University International Research Institute for Climate and Society.

Jeffries MO, Richter-Menge J, Overland JE. 2015. *Arctic Report Card 2015*.

NACSP. April 2015. *North American Climate Services Partnership Annual Accomplishment Report*.

NOAA National Centers for Environmental Information. September 2015. *State of the Climate: National Overview for August 2015*.

Seager et al. December 2014. *Causes and Predictability of the 2011–14 California Drought*.

Seager et al. August 2015. *What can drought-stricken California expect from the El Niño Winter Forecast?*

Sheffield et al. December 2014. *Regional Climate Processes and Projections for North America: CMIP3/CMIP5 Differences, Attribution and Outstanding Issues*.

Wood KR, Wang J, Salo SA, Stabeno PJ. 2015. The climate of the Pacific Arctic during the first RUSALCA decade 2004–2013. *Oceanography* 28(3): 24–35.

## NEWSLETTERS

*Alaska Climate Dispatch Newsletter*. Published quarterly by ACCAP RISA.

*Carolinas Climate Connection*. Published quarterly by CISA RISA.

*COD Community Newsletter*. Published monthly on The Observer by COD.

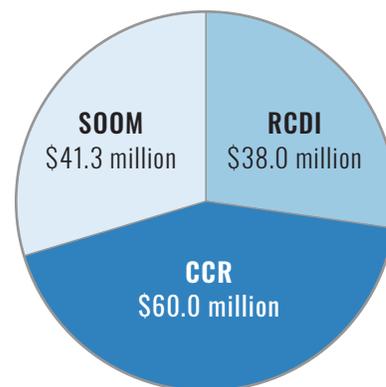
*International CLIVAR Exchanges*. Published quarterly by CVP, COD, and MAPP.

*MAPP Newsletter*. Published quarterly by MAPP.

*NOAA Climate Connection*. Published monthly by CommEd.

*Northwest Climate Magazine*. Published annually by CIRC RISA.

*Southern Climate Monitor*. Published monthly by SCIPP RISA.



▲ CPO's programs and activities are funded primarily through three NOAA budget line items, which can be found in NOAA's budget documents. In FY15, the budget line items were: Regional Climate Data and Information (RCDI); Climate Competitive Research (CCR); and Sustained Ocean Observations and Monitoring (SOOM).

*The Climate CIRCulator*. Published monthly by CIRC RISA.

*The Southwest Climate Outlook*. Published monthly by CLIMAS RISA.

*This Week on Climate.gov*. Published weekly by CommEd.

*US CLIVAR Newsgram*. Published monthly by CVP, COD, and MAPP.

## WORKSHOPS

### (sponsored and/or led by CPO)

September 30–October 2, 2014. Climate Prediction Task Force Virtual Workshop on Bias Corrections in Subseasonal to Interannual Predictions. WebEx Virtual Workshop.

December 2, 2014. Advancing Climate Resilience: New Conversations About Climate Risks. Caribbean Climate Outlook Forum. Antigua and Barbuda.

December 12–14, 2014. Ocean's Carbon and Heat Uptake: Uncertainties and Metrics. San Francisco, CA.

December 15, 2014. FIREX Town Hall. 2014 Annual AGU Meeting.

January 13–15, 2015. RISA 2015 Annual Meeting. Charleston, SC.

February 11, 2015. US Climate Modeling Summit. College Park, Maryland.

March 30–31, 2015. NMME Sub-seasonal Forecast System Exploratory Workshop. College Park, MD.

April 2015. Development of a Climate Ecosystem Observatory in the Pacific Arctic. Pacific Arctic Group meeting. Tokyo and Toyama, Japan.

May 4–5, 2015. NOAA Climate Reanalysis Task Force Technical Workshop. College Park, MD.

May 5–6, 2015. 2014–2015 Pacific Anomalies Science and Technology Workshop. La Jolla, CA.

May 5–7, 2015. Deep Argo Workshop. Tasmania, Australia.

June 15–17, 2015. COD Community Workshop. College Park, MD.

July 21–24, 2015. Towards a Holistic Picture of the Atlantic Meridional Overturning Circulation. RAPID/US AMOC International Science Meeting. Bristol, UK.

July 28–30, 2015. National Integrated Heat Health Information Workshop. Chicago, IL.

August 27, 2015. FIREX Virtual Town Hall.

September 29–October 2, 2015. CLIVAR Workshop on Energy Flow through the Climate System. Exeter, UK.

September 30–October 2, 2015. Workshop on High-Resolution Coupling and Initialization to Improve Predictability and Predictions in Climate Models. College Park, MD.

October 6, 2015. Sustainable Coasts in the Urban Northeast. Hoboken, NJ.



