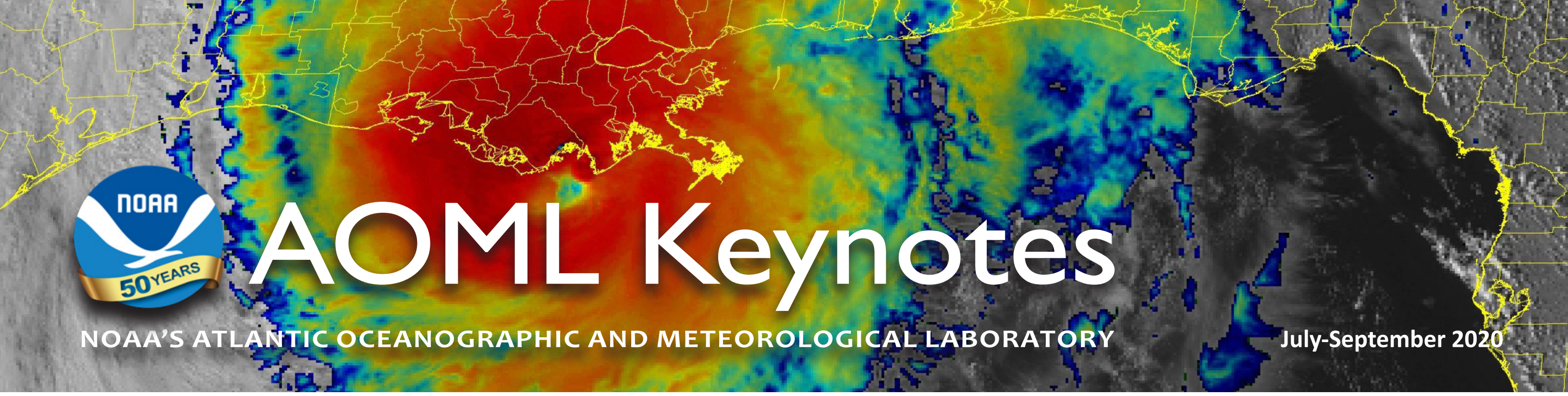


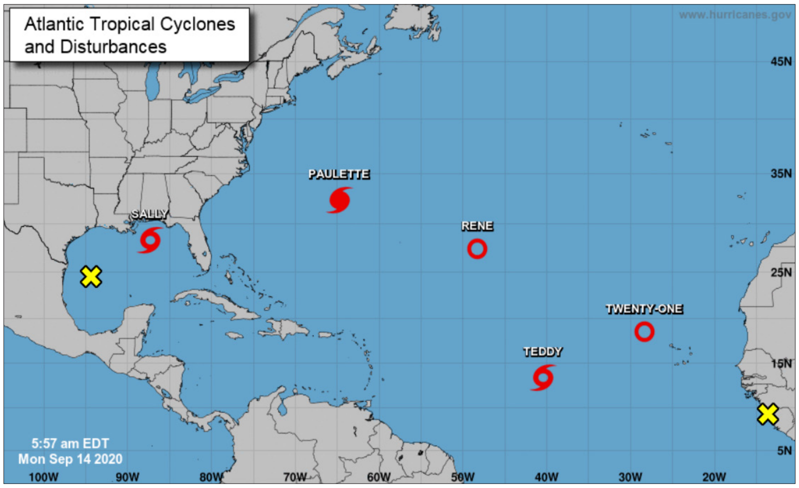
AOML is an environmental laboratory of NOAA's Office of Oceanic and Atmospheric Research located on Virginia Key in Miami, Florida

AOML Collects/Quality Controls Airborne Data Vital to Forecasts

Hurricane scientists at AOML gathered data in multiple storms this summer as a record number of tropical systems formed in the Atlantic in quick succession. Warm sea surface temperatures throughout the tropical Atlantic Ocean and Caribbean Sea, as well as other climate factors, spurred the development of more than 20 named storms as the Atlantic approached its most active period for hurricane formation. Of these named storms, AOML sampled eleven—Cristobal, Hanna, Isais, Laura, Nana, Paulette, Sally, Teddy, Gamma, Delta, and Zeta—during airborne missions of NOAA's P-3 and G-IV Hurricane Hunter aircraft.

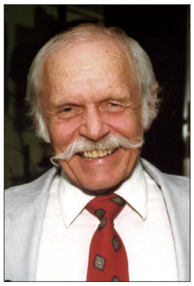
The data were assimilated into the Hurricane Weather Research and Forecasting model to improve structural, track, and intensity forecasts, helping NOAA prepare the public for severe weather. AOML scientists worked aboard the P-3 and remotely at ground locations to collect and quality control data from tail Doppler radar, a stepped frequency microwave radiometer, ocean sensors, airborne expendable bathythermographs, dropsondes deployed along the flight track, and other onboard instruments. These observations provided vital information to the National Hurricane Center about storm structure, storm intensity, precipitation, and the atmospheric steering currents that influence track and landfall location.

The majority of the missions were operationally-tasked in support of NOAA's efforts to provide timely, accurate forecasts; however, data were also collected for hurricane studies to better understand the complex processes of how and why tropical cyclones form, strengthen (or fail to strengthen), and dissipate.



National Weather Service map of the Atlantic basin featuring numerous tropical systems in various stages of development and decline on September 14, 2020: Hurricane Paulette; Tropical Storm Sally; Tropical Storm Teddy; Tropical Depression Rene; Tropical Depression Twenty-One (future Tropical Storm Vicky); and two areas of low pressure with the potential for further development marked by a yellow x—one in the Gulf of Mexico (future Tropical Storm Beta) and the other emerging off the west coast of Africa (future Tropical Storm Wilfred).

In Memoriam



Dr. Hugo Bezdek, a former director of AOML, died on October 6, 2020. He was 84 years old. Dr. Bezdek began at AOML in 1980 as the lab's first permanent director following the retirement of AOML founder Dr. Harris Stewart in 1978. Dr. Bezdek led AOML for 17 years, becoming the lab's longest serving director.

His long tenure as director were times of immense change as emerging new technologies transformed AOML's work environment. Advances in hardware and software led to leaps in computing power, as well as to the use of personal computers, email messaging, and the invention of the World Wide Web. Additionally, an array of labor-intensive administrative functions—time and attendance, document production, budget reconciliations, and more—were fast tracked by their transition to digital applications.

Under Dr. Bezdek's leadership, AOML's science portfolio shifted away from marine geology, geophysics, and seafloor sedimentation. This research was supplanted by studies still ongoing today on the large-scale physics and chemistry of the oceans related to climate variation and global change. In 1983, staff from the National Hurricane Research Laboratory were transferred to AOML and became the Hurricane Research Division. Studies on the nature and mechanisms of hurricanes continue as a major research theme at the lab.

Reflecting on Dr. Bezdek's legacy, OAR Assistant Administrator Craig McLean remarked that "Hugo brought much success and many talented people to AOML, as did his wit and energy, both technically and personally." Recalling her early days as a new scientist at the lab, AOML oceanographer and Deputy Director Molly Baringer fondly remembered that "He came by my office often to ask about my latest theory or where my science investigations were taking me. Hugo was always friendly, with his sharp wit and tough questions promoting lively debate."

Dr. Bezdek earned a PhD in physics from the University of Colorado in 1970. He held several leadership positions with the Office of Naval Research and Scripps Institution of Oceanography before joining AOML in 1980. His research interests included underwater acoustics, surface physics, physical oceanography, and data analysis methodology. He retired as the AOML director in 1997.

NOAA Increases Likelihood for "Extremely Active" Atlantic Hurricane Season

NOAA released an updated seasonal outlook for the Atlantic basin on August 6, supplanting its initial outlook issued in May. According to forecasters at NOAA's Climate Prediction Center, a division of the National Weather Service, atmospheric and oceanic conditions are primed to fuel storm development in the Atlantic, leading to what could be an "extremely active" season.

The updated outlook calls for 19-25 named storms (39 mph winds or greater), of which 7-11 will become hurricanes (74 mph winds or greater), including 3-6 major hurricanes (111 mph winds or greater). An average season produces 12 named storms, including 6 hurricanes and 3 major hurricanes (Category 3, 4, or 5).

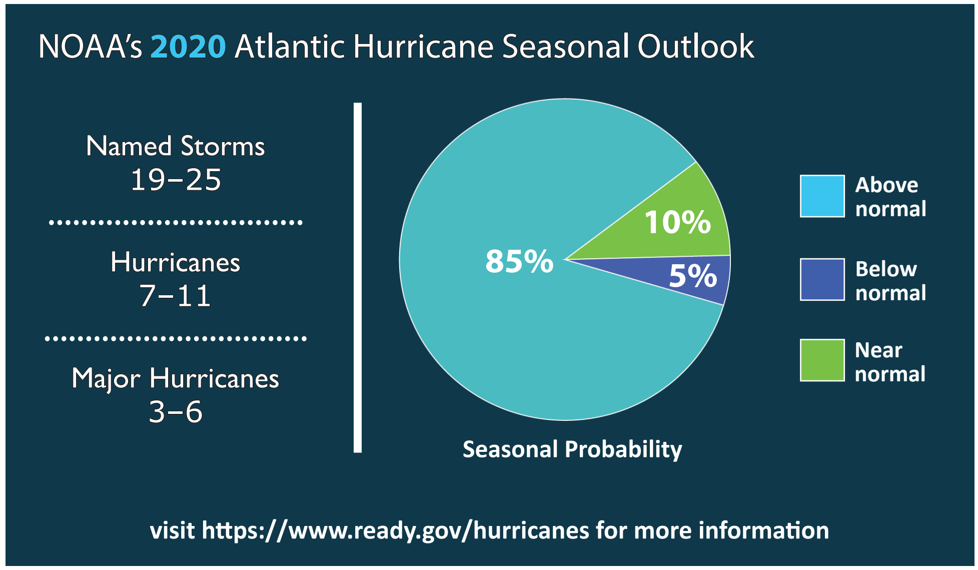
The update covers the entire 6-month hurricane season, which ends November 30, and includes the 9 named storms already formed by August 6 when the update was released. Historically, only two named storms form on average by early August, and the ninth named storm typically does not form until October 4.

A comprehensive measure of the overall hurricane season activity is the Accumulated Cyclone Energy (ACE) index, which measures the combined intensity and duration of all named storms during the season. Based on the ACE projection, combined with the above-average numbers of named storms and hurricanes, the likelihood of an above-normal Atlantic hurricane season has increased to 85%, with only a 10% chance of a near-normal season and a 5% chance of a below-normal season.

"This year, we expect more, stronger, and longer-lived storms than average, and our predicted ACE range extends well above NOAA's threshold for an extremely active season," said Gerry Bell, PhD, lead seasonal hurricane forecaster at NOAA's Climate Prediction Center.

2020 Atlantic Storm Names

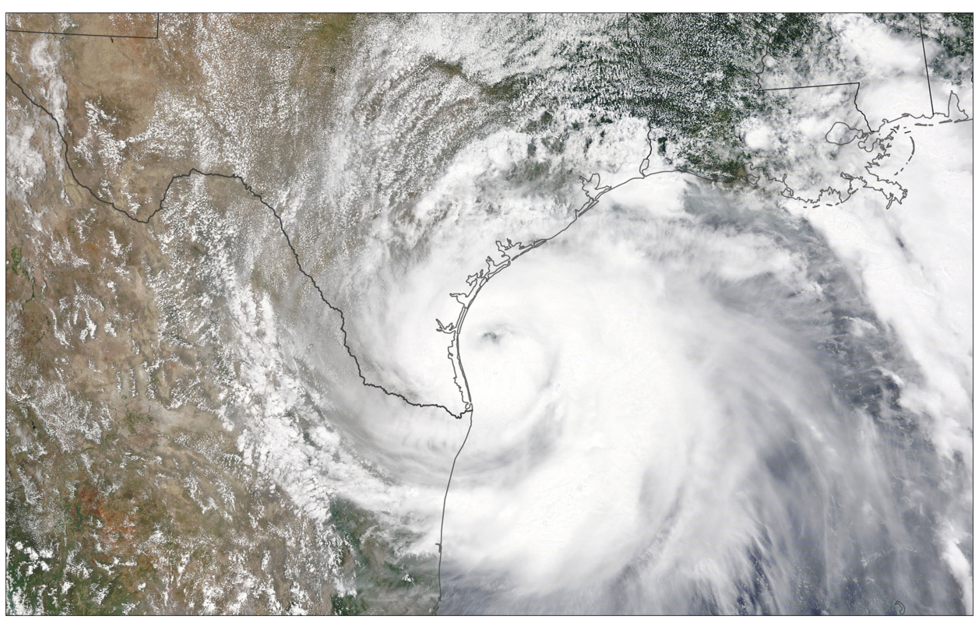
Arthur	Hanna	Omar
Bertha	Isaias	Paulette
Cristobal	Josephine	Rene
Dolly	Kyle	Sally
Edouard	Laura	Teddy
Fay	Marco	Vicky
Gonzalo	Nana	Wilfred



Current oceanic and atmospheric conditions that make an "extremely active" hurricane season possible are warmer-than-average sea surface temperatures in the tropical Atlantic Ocean and Caribbean Sea, reduced vertical wind shear, weaker tropical Atlantic trade winds, and an enhanced west African monsoon. These conditions are expected to continue for the next several months. A main climate factor behind these conditions is the ongoing warm phase of the Atlantic Multi-Decadal Oscillation, which reappeared in 1995 and has been favoring more active hurricane seasons since that time.

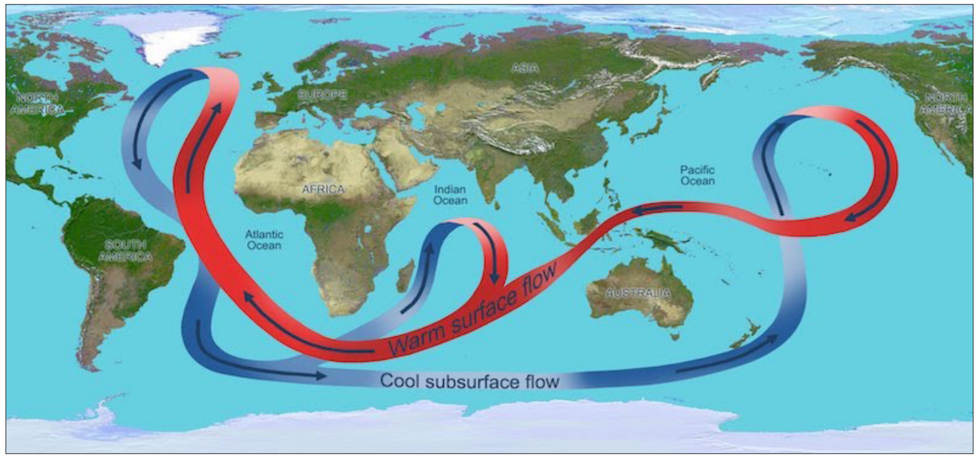
Another contributing climate factor this year is the possibility of La Niña developing in the months ahead. Indicative of cooler-than-average sea surface temperatures in the equatorial regions of the eastern Pacific Ocean, La Niña can further weaken the wind shear over the Atlantic basin, allowing storms to develop and intensify.

NOAA's National Hurricane Center provides tropical weather outlooks out to five days in advance, provides track and intensity forecasts for individual storms, and issues watches and warnings for tropical storms, hurricanes, and their associated storm surge. The Atlantic basin outlooks are an official product of NOAA's Climate Prediction Center, produced in collaboration with the National Hurricane Center and AOML.



NASA satellite image of Hanna, the first hurricane of the 2020 Atlantic season, before landfall along the south Texas coast. Hanna became a named storm in the central Gulf of Mexico on July 24 and intensified into a hurricane on July 25 before coming ashore with top sustained winds of 90 mph.

First Ever Daily Time Series Reveals the Strength of the South Atlantic's Deep Ocean Circulation



Simplified, early schematic of the Meridional Overturning Circulation's global transport of water.

In a recent study published in the journal *Science Advances*,* oceanographers at AOML and the Cooperative Institute for Marine and Atmospheric Studies for the first time describe the daily variability of the circulation of key surface and deep currents in the South Atlantic Ocean that are linked to climate and weather. The study found that the circulation patterns in the upper and deeper layers of the South Atlantic often vary independently from one other, an important new result about the broader Meridional Overturning Circulation (MOC) in the Atlantic.

The MOC, one of the main components of ocean circulation, consists of an upper cell of warmer, lighter water that sits atop colder, denser waters, known as the abyssal cell. These water masses travel around the global ocean, moving heat, salt, carbon, and nutrients along the way. Variations of the MOC have important impacts on many global scale climate phenomena such as sea level changes, extreme weather, and precipitation patterns.

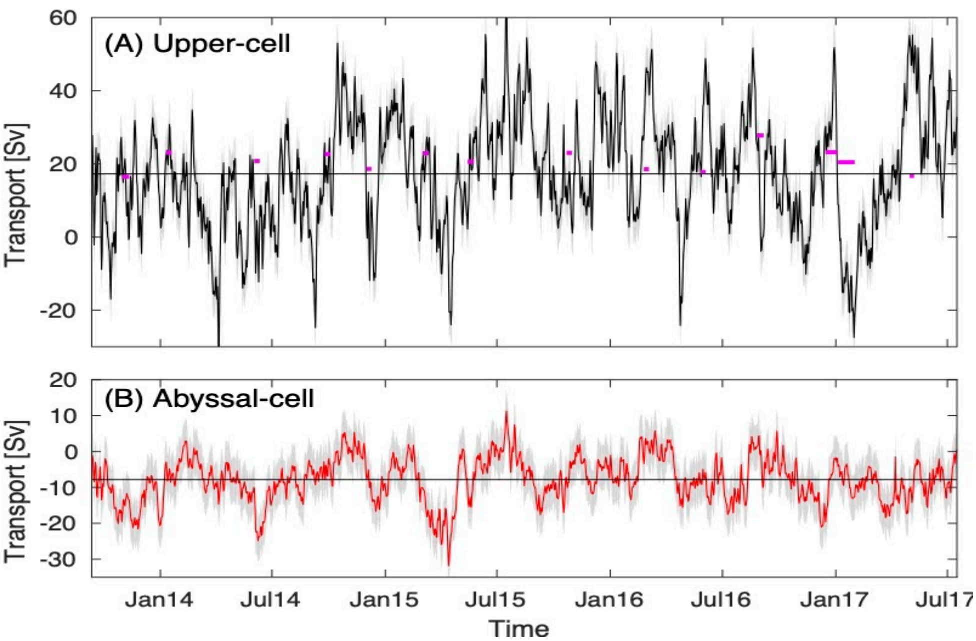
Traditionally, most MOC observations have been focused in the North Atlantic, where the largest volumes of new deep ocean waters are formed. Observations in the South Atlantic were historically limited in comparison. In 2009, scientists and engineers at AOML began working with international partners to build the South Atlantic MOC Basinwide Array (SAMBA), a line of oceanographic sensors anchored on the seafloor at locations across the South Atlantic to provide a more complete understanding of the behavior of the MOC in that region.

"A key finding from this study is that our data show ocean currents in the deepest parts of the South Atlantic Ocean behave differently than we thought before we had this new long-term dataset, which may have large implications for the climate and weather forecasts made by ocean models in the future," said Marion Kersalé, PhD, a University of Miami-Cooperative Institute oceanographer and lead author on the study.

The study found that the upper layer circulation is more energetic than that in the very deep, or abyssal, layer at all time scales ranging from a few days to a year (see plots lower left). The flows in the upper and deep layers of the ocean behave independently of one another, which can impact how the entire MOC system influences sea level rise and hurricane intensification in the Atlantic.

For many years oceanographers had an overly simplistic idea of the MOC (see image above), believing it brought warm water to the northern North Atlantic where the water cooled, sank, and returned to the south. This simple schematic can be thought of as a conveyor belt that rotates with surface and deep waters moving in opposite directions. The results of this study show that the MOC is much more complex than previously understood.

Research such as this led by Kersalé will help oceanographers to refine and improve their understanding of the complexities of the MOC system, in particular, the variability of the South Atlantic's deeper abyssal cell. The time series will also allow scientists to validate earth system models, ultimately helping NOAA to improve its understanding of the climate/weather system.



Temporal variability of the volume transports from the SAMBA array within the upper (A–black) and abyssal (B–red) cells of the South Atlantic. Gray shading indicates the estimated daily accuracy. The magenta dots/bars highlight the independent volume transports estimated using data from the trans-basin expendable bathythermograph (XBT) line at 35°S (AX18). (XBT data courtesy of Shenfu Dong, NOAA/AOML).

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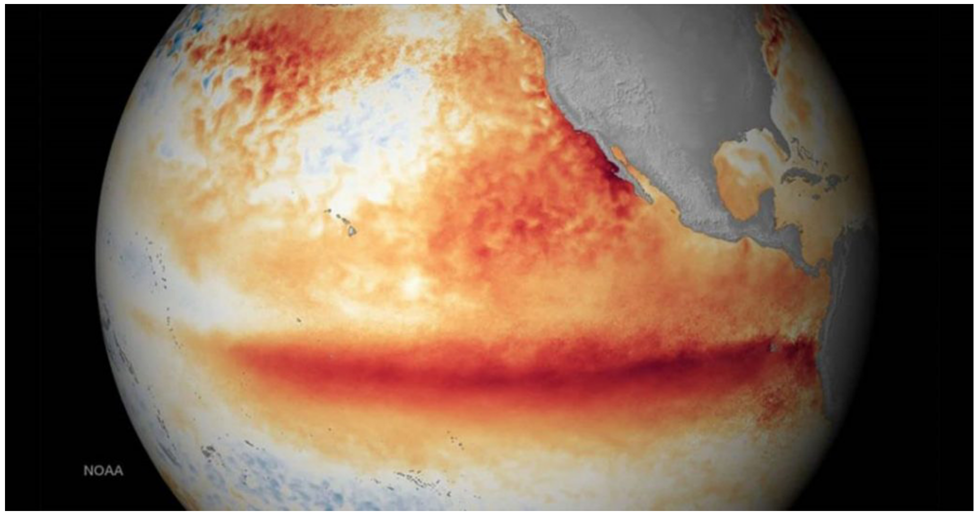
*Kersalé, M., C.S. Meinen R.C. Perez M. Le Hénaff, D. Valla, T. Lamont, O.T. Sato, S. Dong, T. Terre, M. van Caspel, M.P. Chidichimo, M. van den Berg, S. Speich, A.R. Piola, E.J.D. Campos, I. Ansorge, D.L. Volkov, R. Lumpkin, and S.L. Garzoli, 2020: Highly variable upper and abyssal overturning cells in the South Atlantic. *Science Advances,* 6(32):7573 (https://doi.org/10.1126/sciadv.aba7573).

Testing the Trade Wind Charging Mechanism and its Influence on the El Nino-Southern Oscillation

A new study documents the role of ocean dynamics in linking Pacific atmospheric variability to El Niño-Southern Oscillation (ENSO) event generation, holding the promise of improved prediction of ENSO and its impact on precipitation, droughts, hurricanes, and tornadoes.



The postive or warming phase of the El Niño-Southern Oscillation, known as El Niño, raises sea surface temperatures across the equatorial Pacific Ocean from 1-3ºC above average, denoted above by orange to deep red colors.

In a new article published in the *Journal of Climate,** scientists at AOML and the Cooperative Institute for Marine and Atmospheric Studies, with collaborators at Boston University, Texas A&M, and North Carolina State University, document the role of ocean dynamics in linking North Pacific atmospheric variability to El Niño-Southern Oscillation (ENSO) event generation. The results of the study could be used to develop a potential predictor of ENSO events up to a year in advance.

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern that lasts between 2 and 7 years that involves changes in the temperature of the waters in the central and eastern Pacific Ocean. The positive and negative phases of this oscillation cause surface waters to warm or cool from 1˚–3˚ Celsius compared to average surface temperatures. The oscillating warming pattern, or El Niño, and cooling pattern, or La Niña, directly affect rainfall patterns in the tropics, as well as strongly influence weather across the globe.

In this new study led by Soumi Chakravorty, PhD, a University of Miami-Cooperative Institute oceanographer at AOML, a series of numerical model experiments were used to examine how a reduction in the strength of the North Pacific east-to-west prevailing winds, known as the trade winds, in the winter can generate an El Niño event a year later.

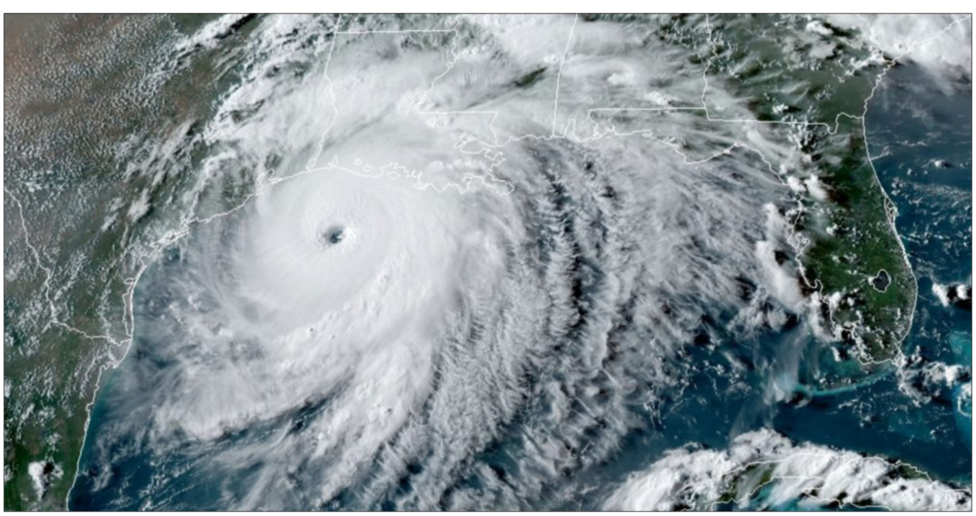
The variation of strength in the North Pacific trade winds accumulates warm water below the surface in the off-equatorial central Pacific which in turn warms the equatorial Pacific. This mechanism is known as "trade wind charging."

In this study, model experiments showed that trade wind charging consistently built upper ocean heat content in the equatorial central Pacific in the spring through equatorward transport of warm water. This warm water was later transported eastward and upward along the sloped equatorial thermocline (a water layer in which water temperature decreases rapidly with increasing depth) and emerged in the summer as a warm surface temperature signal in the eastern equatorial Pacific.

This surface warming was amplified by air-sea feedbacks, resulting in an El Niño event in the winter. Overall, trade wind charging "primes" the equatorial Pacific for El Niño event development.

The study found trade wind charging was three times more likely to lead to strong El Niños than in an identical experiment without trade wind charging. These results shed light on how ocean dynamics, driven by trade wind charging, can serve as a potential predictor of ENSO up to one year in advance.

Given the far-reaching impacts of the ENSO on global weather and climate, improving the accuracy of ENSO predictions has been a long-standing goal in climate research. Better representation of the precursors of these events in coupled models can lead to an improved prediction of ENSO, and ultimately, its impact on temperature, precipitation, droughts, hurricanes, and tornadoes.



The negative or cooling phase of the El Niño-Southern Oscillation, known as La Niña, produces cooler than average sea surface temperatures over the equatorial region of the eastern Pacific Ocean. La Niña events weaken wind shear across the Caribbean Sea and tropical Atlantic, boosting the likelihood that a greater number of tropical cyclones will develop and intensify in the Atlantic basin.

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*Chakravorty, S., R.C. Perez, B.T. Anderson, B.S. Giese, S.M. Larson, and V. Pivotti, 2020: Testing the trade wind charging mechanism and its influence on ENSO variability. *Journal of Climate,* 33(17):7391-7411 (https://doi.org/10.1175/JCLI-D-19-0727.1).

NOAA's HWRF Model Evaluated for Rainfall Forecast Performance

A recent study published in the journal *Atmosphere** for the first time evaluated the rainfall forecast performance of NOAA's Hurricane Weather Research and Forecasting (HWRF) model. The study focused how well HWRF was able to predict the location and amount of rainfall from Hurricane Harvey. Harvey came ashore along the Texas and Louisiana coasts in August 2017 as a Category-4 hurricane that dropped more than 3 feet of accumulated rain on the region over a five-day period.

"The most promising results showed that after running the model 20 times with different initial conditions, we discovered it could forecast the locations of the heaviest rainfall five days before the event," said Mu-Chieh Ko, a University of Miami-Cooperative Institute hurricane researcher and lead author on the study (Figure 1).

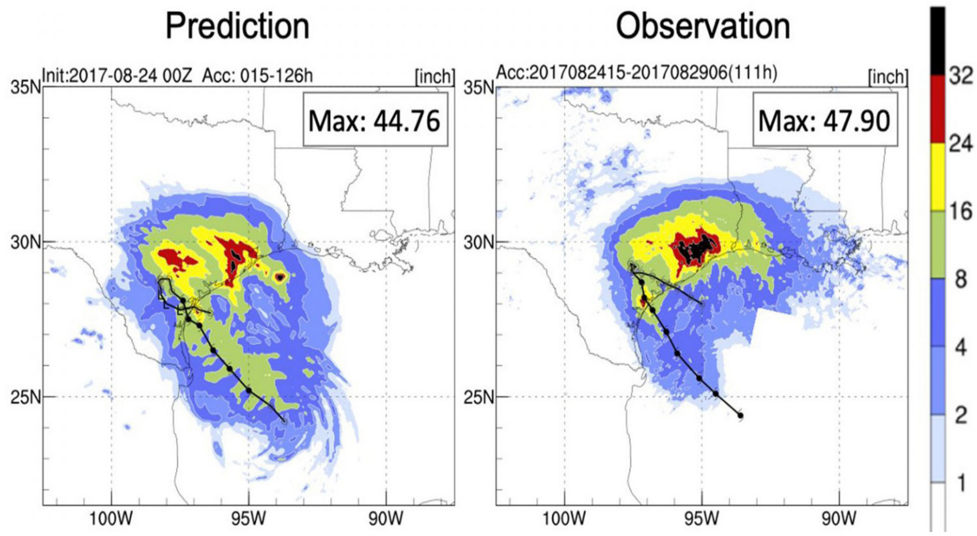

Fig. 2. Five-day accumulated rainfall totals from the HWRF model (left) and from observations (right). The extreme rainfall values in inches are shown in the top-right corners of each panel. The figure demonstrates the HWRF model predicted the amount and location of Harvey's extreme rainfall.

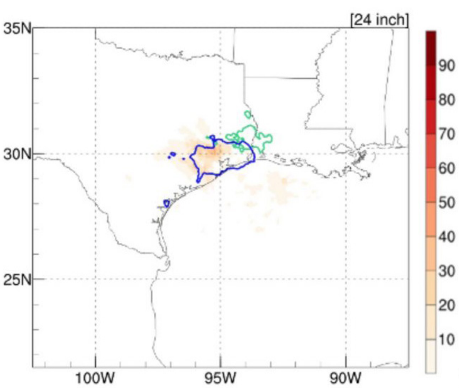

Fig. 1. The chance (percent in red shading) of rainfall exceeding 24 inches within five days from the 20-run HWRF ensemble. Blue and green lines indicate the regions receiving at least 24 inches of rain based on observations and HWRF, respectively. The large overlap of the red shaded and blue contour areas indicates the 20-member ensemble produced more accurate locations for rainfall exceeding 24 inches than a single run of the HWRF model.

Hurricane Harvey's cumulative rainfall totals over the span of five days caused catastrophic flooding in both Texas and Louisiana. However, its rainfall was located far from the center, or eye, of the storm. This was unusual, as the strongest rainfall typically occurs near the eye of a tropical system. Unusual events such as this make it difficult for forecast models to correctly predict rainfall when hurricanes or tropical storms make landfall.

The study aimed to understand how forecast models perform during such rare occurrences as Hurricane Harvey. The research team tested two versions of the HWRF model, developed by researchers at AOML and NOAA's Environmental Modeling Center. The study demonstrated the potential for using HWRF as an effective forecasting tool for rainfall (see Figure 2 above).

The ability to predict rainfall in tropical systems remains a forecasting challenge. However, the methods used to evaluate the HWRF model in this study will be helpful when applied to other models and storms. The majority of fatalities in tropical systems are due to rising water from excessive rainfall and/or storm surge. Better rainfall forecasts will aid NOAA's efforts to prepare vulnerable communities to the dangers posed by flooding.

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*Ko, M.-C., F.D. Marks, G.J. Alaka, and S.G. Gopalakrishnan, 2020: Evaluation of Hurricane Harvey (2017) rainfall in deterministic and probabilistic HWRF forecasts. *Atmosphere,* 11(6):666 (https://doi.org/10.3390/atmos11060666).

AOML Debuts New Diesel Generator

A powerful diesel generator was installed on the grounds of the AOML facility in July. The generator holds 10,000 gallons of fuel, and its casing is strong enough to withstand 175 mph winds. To protect against damage, the tank is double walled, and the 6-inch gap between the inner and outer tanks is filled with concrete. A 70-ton crane was needed to lift the empty 87,000 pound tank and generator combo onto rollers to position it into place. Should AOML be impacted by a landfalling tropical system or other causes for power outages, the generator will keep the entire facility operating for at least two weeks.

The installation of AOML's diesel generator required careful precision, a tedious process that took 12 hours to complete.

AOML and GFDL Researchers Host Virtual Workshop to Strengthen Collaborations

Scientists at AOML and NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) participated in a virtual workshop in August to explore ways to better study earth-system problems of mutual interest. Close to 140 scientists attended the two-day event focused on strengthening collaborations for research in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea.

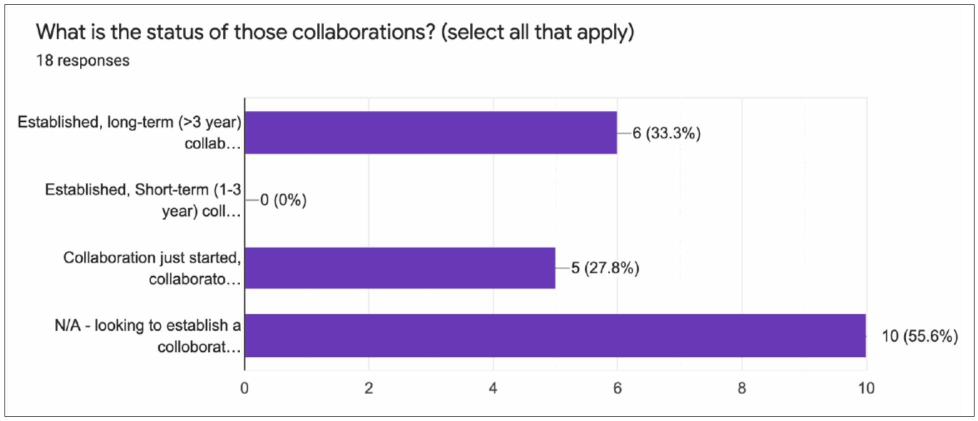
The roots of the workshop stretch back more than a year when Renellys Perez, an AOML oceanographer, contacted Sonya Legg, a GFDL/Princeton oceanographer, to brainstorm on how the two labs could increase their collaboration. Perez and Legg identified various barriers, including a lack of access to model output.

Legg explained that one of the biggest barriers was time: "Often the researchers most visible to people outside their own lab are the most senior people who are very busy with multiple commitments, and therefore, unable to take on new collaborations. However, earlier career scientists, who might not be as widely known, might be more able to provide ways for making connections, leading to collaborations that could benefit their careers."

"We identified that we could do a virtual workshop between the two labs, but realized we needed to reach out to other people to reflect that spectrum of interaction," said Perez. "It grew into this huge endeavor organically, and we started pulling in other people to help us organize an event."

Perez and Legg put together a diverse organizing committee with representatives from both AOML and GFDL. The virtual workshop became a grassroots effort by scientists wanting to build stronger connections between the two labs.

Before the workshop, the Organizing Committee conducted a survey to collect a census of the current status of cross-lab collaborations. It also provided information on research topics, models, and observations of interest between the two labs. It was discovered that 33% of the respondents already had established long-term collaborations (see histogram above), but the majority of researchers were eager to start new collaborations and were interested in suggestions for how to do so.



Histogram showing the status of cross-lab collaborations based on pre-meeting survey responses.

Almost a full year after the initial discussions between Perez and Legg, the first AOML-GFDL Science Connections virtual workshop was held on August 12-13, 2020. The two-day event featured four 2-hour workshop sessions jointly chaired by scientists from both labs that focused on ecosystems and biogeochemistry, weather and extremes, subseasonal-to-seasonal prediction, and interannual-to-decadal phenomena.

The sessions were designed to be cross-cutting and span as many disciplines as possible. "The different themes were chosen to entrain a wide cross-section of researchers from across the two labs," according to Legg. "Session organizers were encouraged to include scientists at different career stages and to pay attention to gender balance and other aspects of diversity."

The sessions allotted approximately an hour for scheduled talks ranging from 5 to 20 minutes in length, followed by opportunities to share slides about ongoing or new collaborative research ideas. Participants were asked to identify research topics of common interest and ways in which leadership could support cross-lab collaborations. Scientists also discussed the breadth of available observational data sets and models to share and provided recommendations for how to do so.

"This was a great starting point; it gave people a list of more than 10 topics with researchers at both labs working on similar problems," said Perez. "We now know who to contact and that they are interested in collaborating because they gave a talk at the workshop."

Scientists shared topics such as alkalinity in biogeochemistry models and observations and global climate model downscaling. African dust and the Atlantic meridional overturning circulation were also mentioned. The Organizing Committee knew of some of these topics in advance, but many were surprises.

Recommendations from the workshop were compiled and synthesized by committee members, and a final report will be distributed to both labs. Scientists also discussed the possibility of setting up a postdoctoral exchange program."Some people noted that we are often competing for the same early career scientists," said Perez. "So rather than it be a competition, early-career scientists could go to one lab and then spend some of their time at the other lab to get a more well rounded post-doc experience, and bring their expertise to the other lab in the process."

The Organizing Committee is currently conducting a post-meeting survey to plan future virtual meetings. During AOML's 2019 lab review, NOAA's Office of Oceanic and Atmospheric Research recommended more collaboration between AOML and GFDL. This virtual workshop obtained a list of clear actionable recommendations on how to foster such interactions.

"There were about a dozen research topics that seem to be of interest to people across both labs; they are low hanging fruit in terms of where we could get started," said Perez. "It would be great to continue with the AOML-GFDL workshops and make them an annual occurrence."

AOML-GFDL Organizing Committee

Renelly Perez	AOML
Sonya Legg	Princeton
Leticia Barbero	CIMAS/AOML
Jan-Huey Chen	GFDL/UCAR
John Dunne	GFDL
Sundara. Gopalakrishnan	AOML
Lucas Harris	GFDL
Matthew Harrison	GFDL
Sang-Ki Lee	AOML
Robert Rogers	AOML

Children Visiting Beaches with Open Wounds are More Susceptible to Bacterial Infection

A new paper in the *International Journal of Environmental Research and Public Health** examines how the presence of children's open wounds and abrasions may put them at greater risk of skin infections from marine bacteria and other pathogens they encounter during play at the beach. The study finds that children with existing or newly-acquired wounds are more susceptible to infection. It also discusses possible adverse health effects from *Vibrio vulnificus,* a waterborne pathogen, due to its prevalence in recreational waters and its potential to cause severe infection.

"Last summer, there were a number of stories about flesh-eating bacteria in the news, with several of these infections being acquired at Florida beaches," said Maribeth Gidley, a microbiologist with the University of Miami's Cooperative Institute for Marine and Atmospheric Studies. "While there are a number of bacteria responsible for necrotizing fasciitis (flesh-eating disease) when acquired in marine waters, *Vibrio vulnificus* is usually the cause. This bacteria typically needs a portal of entry such as a skin abrasion to cause infection. Children may be less aware than adults of prior or new skin injuries acquired when playing at the beach and what risk they could pose."

Researchers set up shop at the beach to study the behavior of children while playing in the sand and surf to better determine their risk of infection.

This study expands on the BEACHES (Beach Exposure And Child Health Study) project that pairs child behavioral science with environmental contamination risk to evaluate how children interact with the beach environment; specifically, how their behavior affects their exposure to beach contaminants such as harmful bacteria and chemicals.

Researchers used genetic markers developed at AOML to identify sources of bacteria and to assess their individual threat. BEACHES scientists then recruited volunteer families with young children to visit two recreational beaches in Miami-Dade County, Florida, and two beaches in Galveston County, Texas. Their goal was to observe how children interacted with the beach environment during typical play sessions.

"The study is unique in that it documented the number and types of wounds (e.g., cuts versus insect bites) and also documented play behavior through videotaping technology," said Helena Solo-Gabriele, an environmental engineer and Associate Dean for Research at the University of Miami's College of Engineering. "The information collected can be used to better estimate children's risks to infection during beach play."

Scientists discovered that more than half of the children had at least one pre-existing abrasion before visiting the beach. Children who acquired new abrasions most often played in seawater, with most wounds occurring on exposed skin, such as the knees.

Since 2008, the Florida Department of Health has reported an increasing number of *Vibrio vulnificus* cases, stating that it is a rare, but underreported disease. Most *Vibrio* illnesses are contracted by eating contaminated seafood or by wound exposure. It is a naturally occurring marine bacteria species that proliferates in low salinity waters and warmer temperatures, with the highest rates of infection occurring in the summer.

The Food and Drug Administration reports a 51.6% mortality rate for individuals who acquire this infection. Those most vulnerable to bacterial infections from marine recreational water at beaches include young children that tend to contract wounds during play activities, adults above the age of 64, and those with chronic diseases or weakened immune systems.

However, the risk of infection can be decreased if parents or guardians identify open abrasions and cover them with waterproof bandages prior to allowing children to play in a marine environment.

"Both children and adults are at risk for skin infections when playing or recreating at a beach setting. This certainly shouldn't stop people from going to the beach, but instead use basic precautions, such as using waterproof bandages on open skin abrasions and immediately washing any newly acquired scrapes or scratches with soap and water," Gidley said.

The BEACHES project is a collaborative effort between AOML, the University of Miami's Cooperative Institute and its College of Engineering, along with the Universities of Texas, Arkansas, and North Carolina A&T. It aims to aid beach managers in making more informed decisions about beach closures and activities and to empower individuals and families in making wise beachgoing decisions.

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*Tomenchok, L.E., M.L. Gidley, K.D. Mena, A.C. Ferguson, and H.M. Solo-Gabriele, 2020: Children's abrasions in recreational beach areas and a review of possible wound infections. *International Journal of Environmental Research and Public Health,* 17(11):4060 (https://doi.org/10.3390/ijerph17114060).

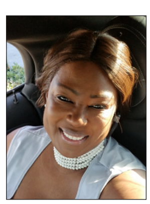
Welcome Aboard

Sandra Bringas joined the staff of AOML's Physical Oceanography Division in August as a University of Miami-Cooperative Institute Research Associate. Sandra will work with Drs. Gregory Foltz and Jun Zhang on the development of a database of satellite-derived and in-situ observations focused on hurricane research applications. She holds a Computer Engineering degree from the University of Matanzas.

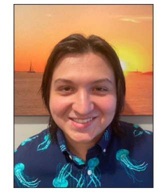
George Dillon joined the Office of the Director in August as AOML's new Safety Officer. George will work as a contractor with AOML's Associate Director, NOAA Corps Officer LCDR Andrew Colegrove, to develop safety programs and procedures for improving and implementing safe work practices across all AOML areas of operation. He comes to AOML with a 30-year background in the field of safety, mostly working with the chemistry industry. He additionally spent 6½ years with the Virginia Occupational Safety and Health Program as a Compliance Safety and Health Officer.

Alexandra Fine joined the staff of AOML's Ocean Chemistry and Ecosystems Division in June as a University of Miami-Cooperative Institute Research Associate. Alexandra will support land-based sources of pollution projects, with an initial focus of determining the potential relationship between water quality in the Florida Keys and coral bleaching. She will also investigate how changes in shipping traffic at the Port of Miami due to COVID-19 affect fish populations in the urban coral nursery site at that location. Alexandra comes to AOML from the Mote Marine Lab in the Florida Keys where she ran the Ocean Acidification laboratory. She holds a MA degree in Marine Conservation and Policy from Stony Brook University.

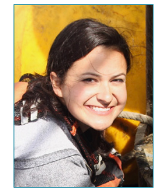
Dr. Fabian Gomez joined the staff of AOML's Physical Oceanography Division in July as a contractor through the University of Miami-Cooperative Institute. Fabian will work closely with researchers in both the Physical Oceanography Division and Ocean Chemistry and Ecosystems Division on projects related to ocean acidification, biophysics, and climate-fishery interactions using high resolution ocean-biogeochemical models. Fabian previously worked at AOML from 2016-2018 as a Northern Gulf Institute post-doctoral scientist with research focused on ocean acidification and the impacts of the El Niño-Southern Oscillation on plankton dynamics along the US Gulf coast.



Izella Murry joined the staff of AOML's Office of the Director in August as a new administrative support contract employee. Izella will tend to an assortment of duties in support of the Admin Group, with tasks that include security clearances, budgeting, and receptionist activities. She joins AOML with an extensive background in banking and entrepreneurism. Izella's varied work experiences will aid in her ability to fully function in the multiple roles she will serve at AOML.



Brandon Navarro joined the staff of AOML's Physical Oceanography Division in September as a University of Miami-Cooperative Institute Research Associate. Brandon will work with Dr. Claudia Schmid to support the autonomous, real-time quality control of Argo data in AOML's Argo Data Assembly Center. He holds a BS degree in Chemistry and Interdisciplinary Studies in Marine Sscience from the University of Florida.



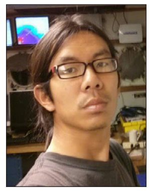
Dr. Emily Osborne joined the staff of AOML's Ocean Chemistry and Ecosystems Division in August as a Physical Scientist. Emily began her career with NOAA in 2017 as a Sea Grant Knauss Fellow. Since then, she has worked with the Arctic Research Program, Global Ocean Monitoring and Observing Program, the Climate Office, and Ocean Acidification Program. At AOML, Emily will lead the coordination of biogeochemical data from Argo floats and conduct biogeochemical research. She holds a PhD in Marine Science from the University of South Carolina.

Dr. Nastassia Patin joined the staff of the Ocean Chemistry and Ecosystems Division in August as a University of Miami-Cooperative Institute Post-Doctoral Scientist. Nastassia will work with Dr. Kelly Goodwin at the Southwest Fisheries Science Center in La Jolla, California on a variety of sequence datasets with a focus on a new project funded by the National Oceanographic Partnership Program. She holds a PhD in Marine Biology from the Scripps Institution of Oceanography/University of California at San Diego. Nastassia comes to AOML from Georgia Tech, where she performed postdoc research on environmental microbiomes and bioinformatics with Frank Stewart and Kostas Konstantinidis.

Dr. Joshua Wadler joined the staff of AOML's Hurricane Research Division in September as a University of Miami-Cooperative Institute Post-Doctoral Scientist. Joshua will work with Dr. Joe Cione and other Hurricane Research Division colleagues on projects that highlight the importance of air-sea processes in tropical cyclones. In 2015 he spent a summer at AOML as a NOAA Hollings Scholar, working with Dr. Rob Rogers to develop a convective burst identification algorithm for tropical cyclones using airborne Doppler observations. Joshua holds a PhD in Meteorology and Physical Oceanography from the University of Miami's Rosenstiel School.

Dr. Robert "Bobby" West joined the staff of AOML's Physical Oceanography Division in August as a Northern Gulf Institute Post-Doctoral Scientist. Bobby will work with Drs. Hosmay Lopez and Sang-Ki Lee, along with Dr. Andrew Mercer of Mississippi State University, to develop an outlook for landfalling hurricanes. The research will include an analysis of ocean and atmospheric observations, as well as numerical modeling experiments, to assess coupled ocean-atmospheric modes of variability. These observations will be used to predict the steering flow, and hence, landfall of tropical cyclones on the subseasonal to seasonal time scale. Bobby holds a PhD in Meteorology from Florida State University.

Welcome Aboard (continued)



Dr. Bo Yang joined the staff of AOML's Physical Oceanography Division in September as a University of Miami-Cooperative Institute Senior Research Associate. Bo will work with Dr. Claudia Schmid to expand the capacity of AOML's Argo Data Assembly Center to process biogeochemical data from Argo floats in real-time. Once this is accomplished, Bo will then determine and apply near-real-time corrections to these data. Prior to joining AOML's Argo team, Bo analyzed and interpreted chemical tracer and bio-optical data from biogeochemical floats at the University of Washington and University of Virginia. He completed his PhD in Marine Science at the University of South Florida with a dissertation focused on the marine carbon dioxide system and ocean acidification.

Farewell

Lillian Estefan, a University of Miami-Cooperative Institute Administrative Assistant with AOML's Office of the Director, departed in September. During Lillian's 6 years at AOML, she provided management support to the Admin Group and tended to a variety of financial, clerical, procurement, and personnel-related duties. In her various roles, Lillian interacted with a large number of AOML and Cooperative Institute staff to pay bills, reconcile credit cards, and process clearances. She also provided updates to the AOML Admin and NOAA financial management systems.

Charline Quenée, a University of Miami-Cooperative Institute Research Associate with AOML's Ocean Chemistry and Ecosystems Division, resigned in August to relocate in Virginia. During her almost five years at AOML, Charline supported south Florida ecosystem research by writing juvenile sportfish reports, assisting with field activities to analyze the relationship between ecosystem status and ecosystem services, and examining public perceptions of the Florida Keys National Marine Sanctuary.

Erica Rule, the Director of Communications at AOML, resigned in August to accept a position at NOAA's Southeast Fisheries Science Center as the Chief of Staff for Science Planning and Operations. Erica began at AOML in 1999 as an outreach coordinator with the Office of the Director. Over the years, she managed all aspects of AOML's communications on a diverse range of topics that included, among others, hurricanes, coral ecosystems, ocean acidification, global ocean observing systems, the carbon cycle, and coastal oceanography. To this end, she worked closely with laboratory leadership to ensure the coordination and clear communication of the lab's programs throughout NOAA's Office of Oceanic and Atmospheric Research and the agency. In 2018, she completed NOAA's Leadership Competencies Development Program. Erica also spearheaded social media communications at AOML, as well as mentored numerous interns who have since established themselves as science communicators in south Florida and other locales.

Congratulations

Ruth Almonte, a Management and Program Analyst with AOML's Admin Group, received NOAA's Silver Sherman award in July. Ruth was recognized for her exceptional customer service, professionalism, and dedication to supporting AOML's administrative functions associated with budget, human resources, equal employment opportunity, and cooperative institutes. Because of Ruth's outstanding support, AOML is able to continue conducting world-class research for the American public.

Dr. Jim Hendee, the Director of AOML's Ocean Chemistry and Ecosystems Division, retired in September after 30 years of federal service, all spent at AOML. Jim began his federal career at AOML in 1990 as a data manager for several ocean chemistry programs. He launched the Coral Health and Monitoring Program (CHAMP) in 1993 and a few years later created a CHAMP web page, AOML's first web site and the first coral reef-related web page in the world. In 1998, Jim led a growing team of CHAMP researchers in devising a new design for an in situ coral reef monitoring station and began installing the stations at coral reef sites in the Caribbean. Since then, CHAMP has received more than $8M in funding for coral reef research and the development at AOML of an expert system that is at the heart of the Coral Reef Early Warning System (CREWS) currently used for ecological forecasting. He became the Ocean Chemistry and Ecosystems director in 2015, leading a diverse team of researchers focused on enhancing the basic understanding of the coupled ocean/atmosphere system and assessing the current and future effects of anthropogenic activities on atmospheric and coastal/deep ocean environments, as well as coral reef ecosystem dynamics.

Dr. George Halliwell, an Oceanographer with AOML's Physical Oceanography Division, retired from federal service in August. George earned his PhD in Oceanography in 1987 from Oregon State University, followed by post-doctoral work at the University of Rhode Island. He moved to Miami in 1990 to become a research assistant and then associate professor at the University of Miami's Rosenstiel School. In 2009, George came aboard at AOML as a federal scientist. While at AOML, he authored 26 peer-reviewed papers on ocean modeling (nine as the lead author), including the role of ocean observations in improving hurricane forecasts, and led the development of AOML's ocean modeling group. He retires as a recognized leader in ocean data assimilation and the use of the Global Hybrid Coordinate Ocean Model (HYCOM).

Dr. Denis Pierrot, a University of Miami-Cooperative Institute Associate Scientist with AOML's Ocean Chemistry and Ecosystems Division since 2006, began his federal career at AOML in August as a Physical Scientist. Denis received his PhD in Physical Chemistry at the University of Miami's Rosenstiel School under Dr. Frank Millero. He currently serves as a member of the Global Carbon Cycle group and leads the effort at AOML to measure the surface partial pressure of carbon dioxide (pCO_2) on Volunteer Observing Ships.

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Keynotes is published quarterly to highlight AOML's recent research activities and staff accomplishments.

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Recent Publications *(AOML authors are denoted by bolded capital letters)*

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