July-August 2016
Vol. 20/No. 4

AOML Keynotes

ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LABORATORY

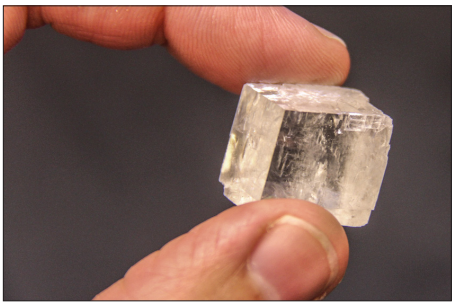
AOML is an environmental laboratory of NOAA's Office of Oceanic and Atmospheric Research located on Virginia Key in Miami, Florida

Ocean Acidification Increases Bioerosion of Coral Reefs

Coral reefs live and thrive by maintaining a careful balance between their rates of growth and erosion. Scientists have come to understand that the projected global increase of carbon dioxide into the oceans, a process known as ocean acidification, will slow the rate at which corals are able to build the calcium carbonate skeletons that form the foundation and integrity of their habitat.

A new study in *PLoS ONE* demonstrates that in highly acidified waters coral skeletal structures also face increased erosion from microboring organisms, called bioerosion. Bioerosion in waters with low pH results in an accelerated breakdown and dissolution of coral reef colonies and, potentially, the loss of essential habitat.

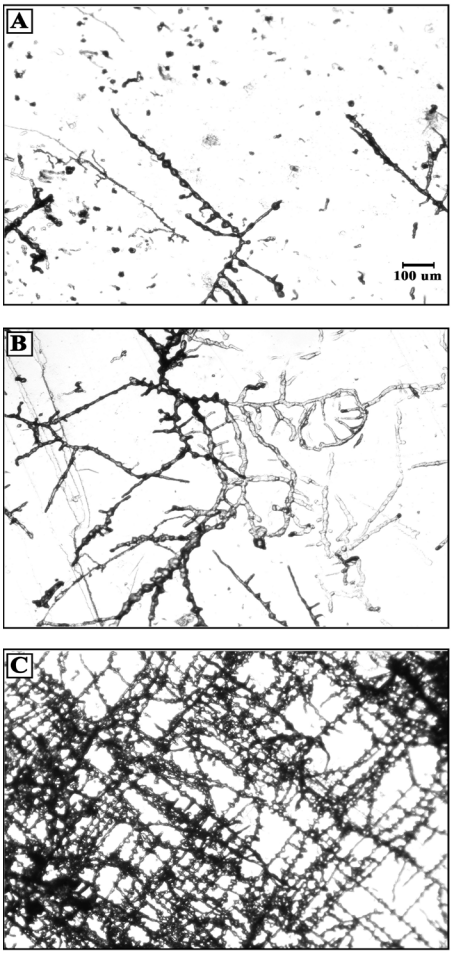
A team led by coral ecologist Ian Enochs of AOML's Ocean Chemistry and Ecosystems Division and the Cooperative Institute for Marine and Atmospheric Studies at the University of Miami confirmed these results during a study at the remote Pacific island of Maug in the Northern Marianas Islands. The region contains natural carbon dioxide seeps that bubble up from the ocean floor, lowering the pH of the surrounding waters and providing a natural laboratory to study ocean acidification conditions predicted to occur by the end of the century.



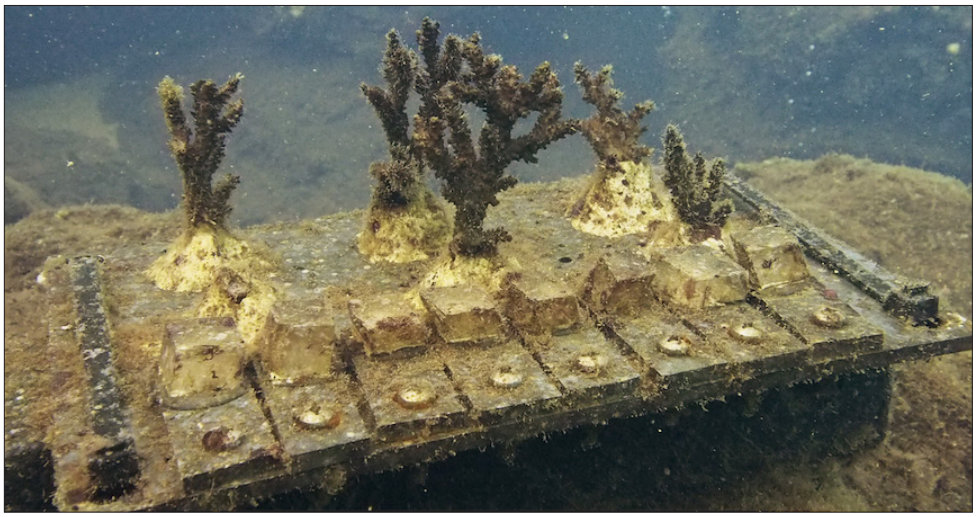
Calcite blocks were used to study the relationship between ocean pH and bioerosion.

By placing small blocks of calcite in acidified areas of lower pH, and in unaffected control sites for a period of 3 months, the research team was able to compare the amount of bioerosion that occurred with increasing levels of ocean acidification. Microscopic organisms that naturally exist and erode all calcium carbonate structures in the reef environment increased their erosion of coral in the most acidified waters. The microborers left behind a network of microscopic cavities, smaller than the average diameter of a human hair (see images at right).

The results at Maug are significant in that they are the first to demonstrate the relationship between increased ocean acidification and increased bioerosion by microscopic organisms outside the laboratory, in a complex, real-world ecosystem. The Maug study was supported by funding from NOAA's Coral Reef Conservation and Ocean Acidification programs.



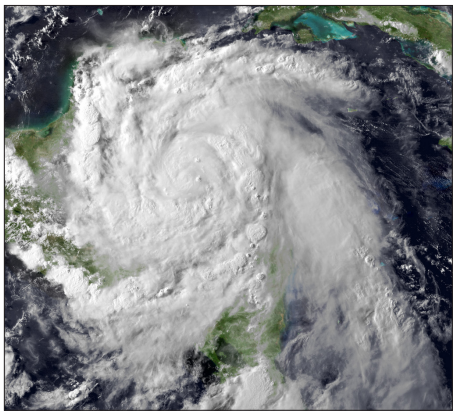
Trails left by microboring organisms within calcite blocks at the (a) control, (b) mid-level carbon dioxide, and (c) high-level carbon dioxide test sites in Maug.



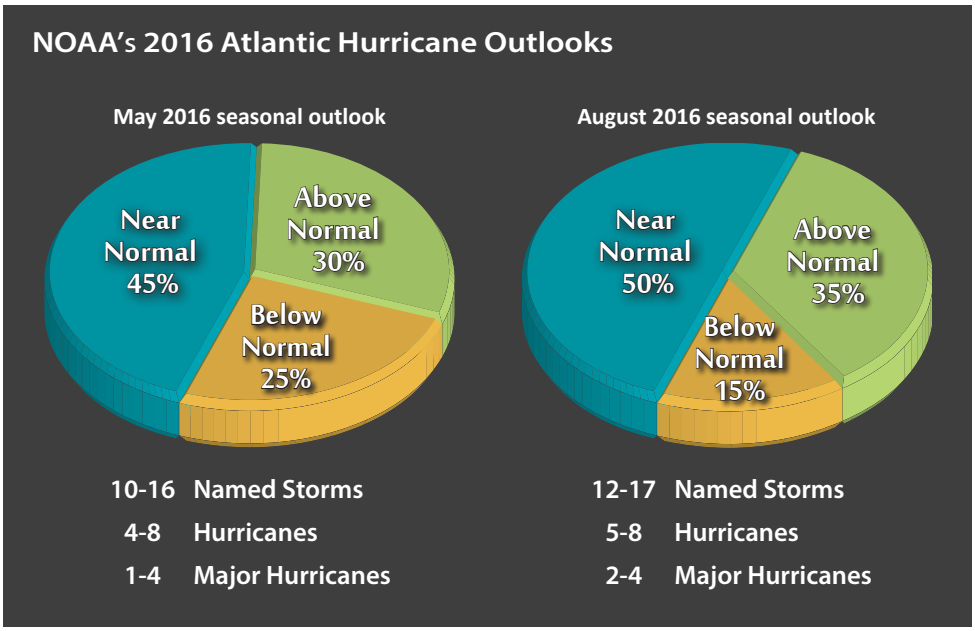
Calcite blocks at a test site in Maug, Northern Mariana Islands.

*Enochs, I.C., *et al.,* 2016: Elevated colonization of microborers at a volcanically acidified coral reef. *PLoS ONE,* 11(7):e0159818.

NOAA Ups the Chances for Near-Normal/Above-Normal Atlantic Hurricane Season



Satellite image of the 2016 Atlantic season's first landfalling hurricane, Earl, on its approach towards Belize on August 3rd.



NOAA's team of seasonal hurricane forecasters issued their updated outlook for the 2016 Atlantic hurricane season on August 11th, slightly increasing the likelihood for a near-normal or above-normal season and decreasing the likelihood for a below-normal season. The 2016 season is still expected to be the most active since 2012.

Forecasters now anticipate a 70 percent chance for 12–17 named storms to develop before the season ends on November 30th, with 5–8 named storms expected to become hurricanes (winds above 73 mph). It is also expected that 2–4 named storms will intensify into major hurricanes (winds above 110 mph, categories 3, 4, and 5 on the Saffir-Simpson wind scale). The initial outlook issued in May called for 10–16 named storms, 4–8 hurricanes, and 1–4 major hurricanes. The seasonal averages for the Atlantic are 12 named storms, 6 hurricanes, and 3 major hurricanes (see graphic above right).

"We've raised the numbers because some conditions now in place are indicative of a more active hurricane season, such as El Niño ending, weaker vertical wind shear and weaker trade winds over the central tropical Atlantic, and a stronger west African monsoon," said Dr. Gerry Bell, lead seasonal hurricane forecaster at NOAA's Climate Prediction Center. "However, less conducive ocean temperature patterns in both the Atlantic and eastern subtropical North Pacific, combined with stronger wind shear and sinking motion in the atmosphere over the Caribbean Sea, are expected to prevent the season from becoming extremely active. Given these competing conditions, La Niña, if it develops, will most likely be weak and have little impact on the hurricane season."

NOAA's seasonal outlooks provide a general guide to the expected overall activity during hurricane season; they do not predict how many storms will make landfall or imply levels of activity for any particular region. Coastal residents and communities at risk from landfalling storms and flooding are urged to remain vigilant in monitoring the tropics and to have preparedness measures and action plans in place should the need arise to implement them.

The 2016 Atlantic seasonal hurricane outlooks are official products of NOAA's Climate Prediction Center, produced in collaboration with the National Hurricane Center and AOML's Hurricane Research Division (HRD). HRD meteorologist Stanley Goldenberg has been a part of the seasonal outlook team since its inception in 1998. More information about NOAA's hurricane outlooks can be found at www.cpc.ncep.noaa.gov/products/outlooks/hurricane.shtml.

2016 Atlantic Storm Names		
Alex	Hermine	Otto
Bonnie	Ian	Paula
Colin	Julia	Richard
Danielle	Karl	Shary
Earl	Lisa	Tobias
Fiona	Matthew	Virginie
Gaston	Nicole	Walter

The eye of Hurricane Earl as viewed by AOML's hurricane researchers aboard NOAA's P-3 Hurricane Hunter aircraft on August 3rd.

Hurricane Researchers Capture the Genesis and Development of Hermine

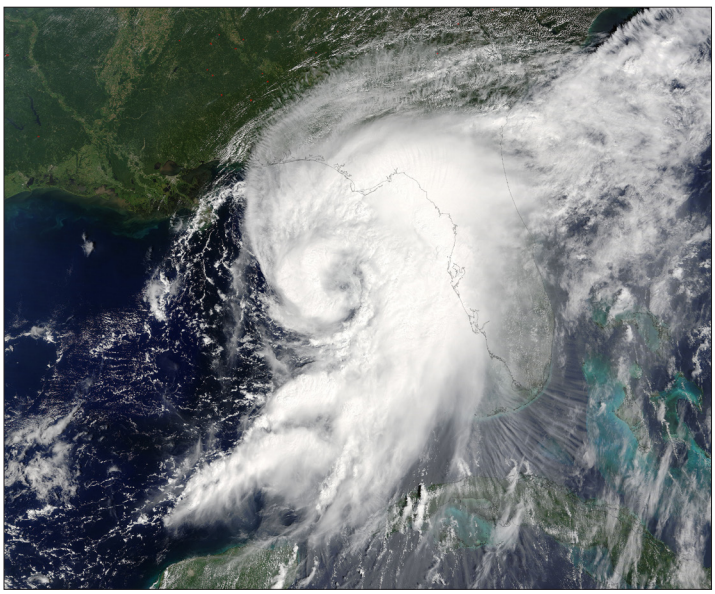
In late August, scientists with AOML's Hurricane Research Division began flying back-to-back missions into Hermine to capture its evolution from a cluster of thunderstorms known as Invest-99L into a tropical storm and later a hurricane. These missions were undertaken in support of NOAA's Intensity Forecasting Experiment (IFEX) hurricane field program, a key aspect of which is the collection of observations during all portions of a hurricane's life cycle, particularly its early stages.

Observations gathered during a storm's genesis is one approach NOAA is taking to improve the understanding and forecasting of storm development. Collecting data during the development of a storm is needed to improve the accuracy of hurricane models, which currently don't predict these transitions well, and to better understand how tropical disturbances interact with and are impacted by the surrounding environment.

NOAA scientists recently developed a new model to predict tropical cyclogenesis in the North Atlantic Ocean, the Tropical Cyclone Genesis Index, which provides forecasters with an objective tool for forecasting hurricane formation in the 2-day and 5-day time frames. Based on early model predictions, NOAA researchers began studying Hermine.

Hermine emerged off the coast of Africa as a tropical wave designated as Invest-99L on August 18th. This tenacious low-pressure system traveled thousands of miles across the Atlantic, failing to either intensify or dissipate. Concern for Invest-99L's future track and intensity mounted as the disturbance traveled north of the Leeward Islands and followed a general west-northwest path towards the Bahamas and southeastern US. Several computer models forecast the system to strengthen into a major hurricane before projecting landfall in Florida.

AOML's hurricane researchers began sampling Invest-99L from aboard NOAA's P3 Hurricane Hunter aircraft on August 25th. Observations of the tropical disturbance's inner core and surrounding environment were gathered using an array of instruments that included Doppler radar to measure the strength of Invest-99L's winds and GPS dropwindsondes for vertical profiles of atmospheric pressure, temperature, and humidity.



Hurricane Hermine in the Gulf of Mexico on September 1st, as captured by the MODIS instrument aboard NASA's Terra satellite. On September 2nd, Hermine came ashore along the Florida Panhandle near St. Marks as a Category-1 hurricane with sustained winds of 80 mph.

NOAA's P3 Hurricane Hunter aircraft flies through Invest-99L on August 28th. Data gathered by AOML's hurricane researchers aboard this flight enabled forecasters at the National Hurricane Center to upgrade Invest-99L to a tropical depression.

Forecasters at the National Hurricane Center (NHC) used the data from these instruments, as well as other flight-level instruments, to assess the dynamic and thermodynamic structure of Invest-99L. Real-time observations from the NOAA P3 flights were assimilated into weather forecast models to improve the prediction of Invest-99L's track and intensity. The much needed data enabled NHC forecasters to upgrade Invest-99L to a tropical depression (TD9) on August 28th.

NASA's unmanned Global Hawk aircraft began sampling TD9 on August 29th in support of NOAA's Sensing Hazards with Operational Unmanned Technology (SHOUT) program. The Global Hawk, equipped with GPS dropsondes, a dual frequency Doppler radar (HIWRAP), and a multi-spectral microwave sounder (HAMSR), collected data in the convective center and surrounding environment of the storm at altitudes up to 60,000 feet during two 24-hour research missions. Global Hawk data were also being assimilated into forecast models in real-time and, on August 30th, NHC used observations from the unmanned aircraft to determine the storm's intensity. Data from a subsequent P3 research flight on August 31st resulted in TD9 being named Tropical Storm Hermine.

On September 1st, Hermine intensified into a Category-1 hurricane in the Gulf of Mexico with sustained winds of 80 mph. During this time, Global Hawk observations were used by NHC to determine the storm's motion toward the Florida coastline. The following day Hermine came ashore along the Florida Panhandle, ending the state's 11-year hiatus from landfalling hurricanes (the last hurricane to strike Florida was Wilma on October 24, 2005).

In total, AOML's hurricane researchers flew 11 missions into Hermine. The data from these flights documented Hermine's transition from a disorganized cluster of thunderstorms into a hurricane, aiding NOAA's ongoing efforts to build a more weather-ready nation.

What's Happening in the Tropics?

AOML's Hurricane Research Division hosts daily tropical weather discussions at 12 noon in the AOML first-floor conference room in support of NOAA's 2016 Hurricane Field Program. Everyone is welcome to attend, either in person or remotely.

For audio access:

1-866-700-1361, pass code 491147

For GoToMeeting access:

https://www2.gotomeeting.com/join/151354330

New Tool Monitors Real-time Gulf of Mexico Conditions for Bluefin Tuna

In a new study published recently in *Fisheries Oceanography*,* scientists with AOML's Physical Oceanography Division (PhOD) worked in close collaboration with scientists from NOAA's Southeast Fisheries Science Center in Miami, the University of Miami, and the City University of New York on the development of the BFT_Index, an ocean indicator parameter to monitor and track areas in the Gulf of Mexico with favorable conditions during the spring for the occurrence of bluefin tuna larvae (*Thunnus thynnus*).

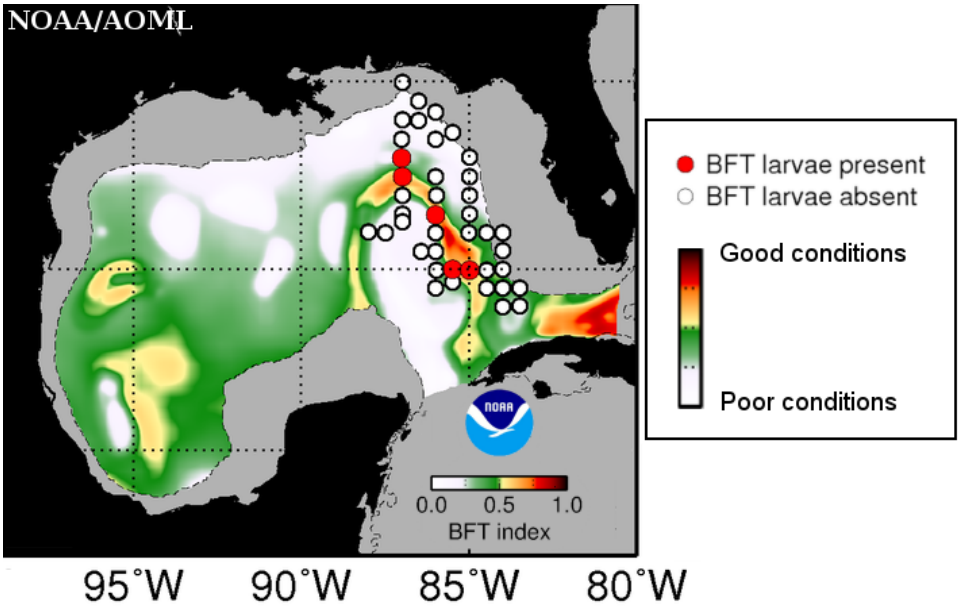
The BFT_Index was developed using a combination of historical captures of bluefin larvae in the Gulf of Mexico, with simultaneous measurements of hydrographic parameters such as temperature and salinity profiles, along with satellite observations. Values of the BFT_Index range between 0 and 1 and indicate the available conditions for the occurrence of bluefin tuna larvae, which varies from poor to optimal within the Gulf of Mexico.

The science team computed weekly maps of the BFT_Index for 1993-2011 using satellite observations. An analysis of the data revealed that overall favorable conditions for bluefin tuna larvae in the Gulf of Mexico exhibited strong year-to-year variability during this 18-year period. For example, results showed that the spring of 2001 featured extremely favorable environmental conditions for the occurrence of bluefin tuna larvae in the Gulf, whereas extremely unfavorable conditions were generally observed in 2010.

(A) Bluefin tuna larvae (credit: Fisheries Oceanography for Recruitment and Climate Ecosystem Studies Unit at NOAA's Southeast Fisheries Science Center). (B) Bluefin tuna adult about to strike (credit: Gilbert Van Ryckevorsel/TAG A Giant, available at NOAA fisheries website).

The results also indicate the existence of key areas in the Gulf of Mexico where favorable conditions are generally linked to high-recruitment rates to the adult bluefin tuna population. This analysis suggests that changes in environmental conditions during spawning season may drive a relevant component (58%) of the stock variability, despite the fact that bluefin tuna have long undergone strong overfishing pressures. In other words, specific ocean conditions such as sea surface temperature and ocean currents at the time bluefin tuna are spawned have a large impact on their chances of surviving to recruit to the adult population.

PhOD researchers recently completed a real-time implementation of the BFT_Index for the spring months of March through June, the spawning season for Atlantic bluefin tuna in the Gulf of Mexico. The BFT_Index is currently computed on a daily basis for the Gulf of Mexico during the spring months, and maps depicting the BFT_Index are distributed through a PhOD web page (see an example of a map at left). These daily maps support the bluefin tuna stock assessment operations and management activities carried out by NOAA's Southeast Fisheries Science Center.



Example of a map of the BFT_Index for the Gulf of Mexico averaged for the period between April 28-May 12, 2010. Red circles indicate the location where bluefin tuna larvae were captured during this period, whereas white circles indicate the locations where bluefin tuna larvae were not found. Real-time and delayed-time access to maps of the BFT_Index dating back to 1993 can be found at http://www.aoml.noaa.gov/phod/research/ecosystems/fisheries/bft_maps.php.

*Domingues, R., G. Goni, F. Bringas, B. Muhling, D. Lindo-Atichati, and J. Walter, 2016: Variability of preferred environmental conditions for Atlantic bluefin tuna (*Thunnus thynnus*) larvae in the Gulf of Mexico during 1993-2011. *Fisheries Oceanography,* 25(3): 320-336.

2016 Summer Interns Get their Feet Wet (Literally)

It has become somewhat of a tradition at AOML that our summer interns are allowed to participate in the fieldwork we conduct. This year was no exception. On July 13th and 14th, Alycia Ciresi, Dylan Gates, and Hanna Payne joined scientists from AOML's Physical Oceanography Division (PhOD) on a 2-day research cruise to measure the transport of the Florida Current at 27°N in the Florida Straits.

The bimonthly survey, conducted aboard the R/V *F.G. Walton Smith*, is a component of AOML's Western Boundary Time Series (WBTS) program and a perfect opportunity for students, interns, and volunteers to gain field research experience and learn how oceanographic measurements are made. The 2-day trip begins and ends on Virginia Key at the University of Miami's Rosenstiel School pier.

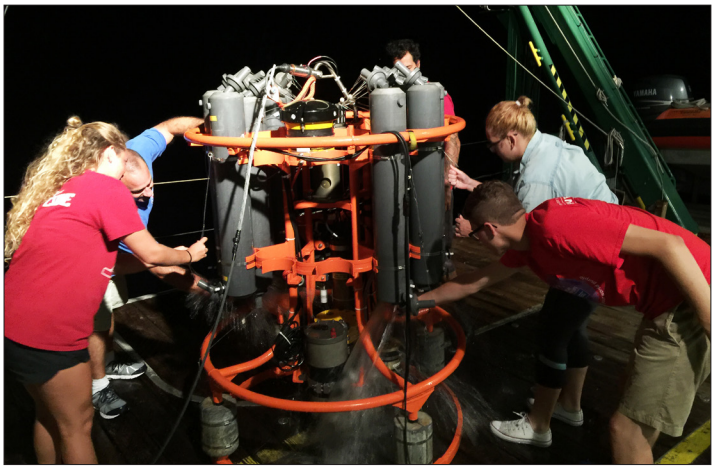
During the cruise, the ship travels north to 27°N where nine historical hydrographic stations are occupied. CTD (conductivity, temperature, depth)/LADCP (lowered acoustic Doppler current profiler) casts are performed to quantify the total amount of water flowing through the Florida Straits at 27°N and to measure specific water properties of the current such as temperature, salinity, and dissolved oxygen. Interns participate in the deployment and recovery of the CTD/LADCP instrument package and in the collection of water samples for laboratory analysis. Samples are drawn from Niskin bottles attached to the CTD package, which are closed at predetermined depths in the water column.

Hanna Payne grew up in Miami and is now attending Stanford University in California. She is majoring in environmental science with an emphasis on oceanic systems. Conservation journalism and visual storytelling are also fields of interest for Hanna. Following her participation on our July 27°N Florida Current survey, she thought a merger of these disciplines might be a path worth pursuing: "Being at sea encouraged me to keep research and fieldwork open as options in the future, and to work towards combining fieldwork with anything in communications that I do. I'm excited to be more involved in marine research over the next few years and to learn how to best share those experiences with others." Hanna worked with Erica Rule, the Communications Director at AOML, during her internship this summer.

Dylan Gates is originally from Binghamton, New York and is now a senior at the State University of New York-Oswego in upstate New York. Dylan is majoring in applied mathematics and hopes to pursue a career involving data analysis. As a NOAA Hollings Scholar, Dylan worked with Greg Foltz and Renellys Perez (in PhOD) this summer researching tropical Atlantic climate variability and the factors that influence the Atlantic Equatorial Mode. Following his internship at AOML, Dylan said that he prefers working with environmental/oceanographic datasets on dry land, versus seagoing oceanographic data collection.

AOML summer interns Alycia Ciresi, Hanna Payne, and Dylan Gates aboard the R/V *F.G. Walton Smith*.

Alycia Ciresi is an instructor at MAST Academy on Virginia Key where she teaches chemistry and physics. She is originally from Clearwater, Florida and received a BS in chemistry from Florida State University in 2015. Alycia plans to return to school for an advanced degree and pursued an internship with AOML this summer to gain more exposure to the physical sciences. While at AOML, she worked with Renellys Perez and Shenfu Dong (in PhOD) to examine water mass variability in the South Atlantic Subtropical Gyre by analyzing historical ARGO float profiles collected in the region. Alycia hopes to become a research professor some day working in environmental science.



AOML summer interns Hanna Payne, Dylan Gates, and Alycia Ciresi gather water samples from the CTD/LADCP instrument package after a night-time deployment.

July 2016 science team (from left to right): Maria Arroyo (UM-RSMAS), Sarah Bercovici (UM/RSMAS), Alycia Ciresi (PhOD intern), Dylan Gates (PhOD intern), Marc Weekley (AOML-NOAA Corps), Jay Hooper (PHOD), Hanna Payne (OD intern), Grant Rawson (PhOD), and Ryan Smith (PhOD).

Members of NOAA's Space Platform Requirements Working Group.

NOAA Group Meets to Assess Future Satellite Needs

AOML Director Dr. Bob Atlas attended NOAA's Space Platform Requirements Working Group meeting in Boulder, Colorado on July 12-13th. The group is part of a National Environmental Satellite, Data and Information Service effort to plan for the future operational environmental satellite system that will follow the GOES (Geostationary Operational Environmental Satellite) and JPSS (Joint Polar Satellite System) programs, beginning about 2030. During the meeting, they assessed new and existing requirements against the baseline architecture, and provided relative priorities for observational requirements in the context of the future architecture.

AOML Researchers Attend NOAA's Emerging Technologies Workshop

Several AOML researchers attended NOAA's Emerging Technologies Workshop in Silver Spring, Maryland on July 27th. The one-day event was the first of its kind hosted by NOAA to showcase technologies that could potentially be used to replace or improve NOAA's current observing capabilities and fill observational gaps, as well as lower costs, within the next 3-5 years. AOML's contributions to the workshop included presentations on four observing platforms that are either being used operationally or undergoing testing.

Ulises Rivero, Gustavo Goni, NOAA Corps RADM David Score, Kelly Goodwin, and Joseph Cione.

AOML hurricane researcher Joe Cione presented information on the Coyote unmanned aircraft system that gathers observations in the lowest levels of the hurricane environment, a data-sparse region. AOML environmental microbiologist Kelly Goodwin discussed an autonomous underwater vehicle being tested for marine microbiome data collection and analysis. AOML oceanographer Gustavo Goni shared information on AOML's use of underwater gliders in the Caribbean Sea and tropical North Atlantic Ocean to assess the impact of hurricane-force winds on the upper ocean's density structure and the impact of ocean profile data from the gliders on hurricane intensity forecasts.

Finally, AOML engineer Ulises Rivero presented information on the Adaptable Bottom Instrument Information Shuttle System (ABIISS) developed at AOML. ABIISS uses expendable pods to transfer data at pre-programmed intervals from deep ocean moored instruments to the ocean surface. All of these technologies hold the promise of helping NOAA reduce operating costs, improve data collection efforts, and advance scientific understanding.

Members of the US delegation attending the Argentina-US Ocean Science Meeting.

Argentina-US Ocean Science Meeting Opens Doors for Collaboration

Drs. Gustavo Goni and Silvia Garzoli of AOML, together with 18 other scientists from the US, participated in the Argentina-US Ocean Science Meeting in Mar del Plata, Argentina during the week of August 22nd. Dr. Goni was the co-organizer of the meeting on the US side, while Dr. Garzoli led a science panel on ocean observations.

Local hosts included the US Embassy in Buenos Aires, the Argentine Ministry of Science, and the Argentine Fisheries Institute. Together with these hosts, NOAA was the other organizer. The US Ambassador in Argentina, the Argentine Minister of Science, and the directors of the Argentine National Science Foundation, Space Agency, and Fisheries Institute attended the first day, while Judith Garber of the US State Department's Bureau of Oceans and International Environmental and Scientific Affairs participated remotely. The meeting focused on enhancing partnerships for the two nations in the ocean sciences following a recent understanding signed by US Secretary of State John Kerry and Argentine President Mauricio Macri. Participants discussed how to jointly study and monitor key environmental parameters in the South Atlantic Ocean.

Potential projects include the use of additional ship time in support of current NOAA observational efforts in the South Atlantic, partnering with the Argentine Space Agency in the validation of the upcoming satellite ocean color mission, enhancement of observations from ships of opportunity, use of new technology such as autonomous underwater vehicles, monitoring ocean conditions for fisheries stock assessments and for determining potential marine protected areas, and capacity building. An action plan containing the main recommendations from the meeting is being drafted.

Underwater Gliders Deployed for Atlantic Hurricane Season

AOML's fifth underwater glider mission began on July 21st with the successful deployment of two gliders in the Caribbean Sea south of Puerto Rico. A second pair of gliders was subsequently deployed in the Atlantic Ocean north of Puerto Rico on August 4th. During their 4-5 month mission, the gliders will gather upper-ocean profiles of temperature, salinity, oxygen, current velocity, turbidity, and chlorophyll to help improve tropical cyclone intensification and seasonal forecasts. They are each expected to navigate an estimated 4,000 km and transmit about 1,600 profiles of each parameter. Data gathered will be transmitted in real-time to the Global Telecommunications System and assimilated into numerical hurricane forecast models, as well as used for Atlantic hurricane studies. This latest mission supports the AOML-CariCOOS (Caribbean Coastal Ocean Observing System) Underwater Glider Operations project, funded by NOAA's Office of Oceanic and Atmospheric Research, AOML, and CariCOOS. Data from the gliders can be viewed by visiting www.aoml.noaa.gov/phod/goos/gliders/observations.php.

Sea gliders aboard the R/V *La Sultana* prior to their deployment. The gliders enable researchers to study the thermal structure of the upper ocean in regions linked to the rapid intensification of tropical cyclones.

R/V *Hildebrand* Sails Away Under New Ownership

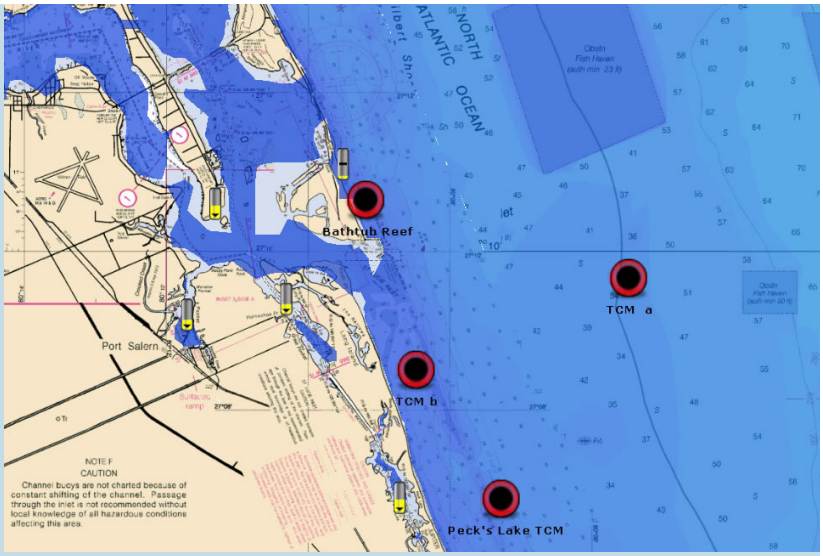
The R/V *Hildebrand*, a 41-ft vessel acquired by AOML in 2009 for coastal research, was sold in August to save on dockage and maintenance costs. The *Hildebrand* faithfully served AOML for 7 years as a platform for diving and water sampling operations, as well as the deployment and retrieval of moored instruments, on a host of projects led by researchers with AOML's Ocean Chemistry and Ecosystems Division. The *Hildebrand* was also used to measure the Gulf Stream current and was instrumental in the first ever tagging cruise of endangered leatherback sea turtles in the Gulf of Mexico. On August 19th, the *Hildebrand* sailed away from Miami under new ownership. She will be missed but not forgotten.

The R/V *Hildebrand* in Biscayne Bay.

Current Meters Deployed near Site of Massive South Florida Algal Blooms

In June and July, the coastal zone near the mouth of the St. Lucie River became severely impacted by nutrient- and algae-rich water exiting the inlet. The toxic, soupy, foul-smelling algal blooms were so severe Florida Governor Rick Scott declared a state of emergency for St. Lucie and Martin counties.

Researchers with AOML's Ocean Chemistry and Ecosystems Division joined colleagues with the Florida Fish and Wildlife Conservation Commission in August to deploy four current meter instruments in the area near the St. Lucie Inlet. The instruments measure the velocity of the water current flow and will aid in describing the circulation around the St. Lucie Inlet, as well as the dispersion of materials exiting the inlet.



Red circles mark the locations along the St. Lucie Inlet where current meter instruments were deployed by AOML researchers in collaboration with colleagues from the Florida Fish and Wildlife Conservation Commission.

Data collected by the current meters will also be used to calibrate circulation models under development at the Harbor Branch Oceanographic Institution of Florida Atlantic University and provide information to fisheries biologists studying larval recruitment in this area located at the northernmost extent of the Florida reef tract. Additional partners in the effort included the Martin County Department of Environmental Protection, Harbor Branch Oceanographic Institution, and the Southeast Florida Coral Reef Initiative in conjunction with NOAA's National Ocean Service.

Student Interns Hone Skills and Career Goals at AOML

I would definitely consider pursuing a career with a federal agency, most likely NOAA, because I have enjoyed my experience here as an intern and have felt that the things I learned are skills I can use for a lifetime.

Daniel Gutierrez
Florida State University

AOML was pleased to welcome 14 student interns to the lab this summer, each leveraging their break from the academic year to learn new skills while working alongside career scientists in a research setting. The majority of interns were undergraduate and graduate students from a variety of colleges and universities (see table below right), but AOML also hosted several high school students from the neighboring Maritime and Science Technology (MAST) Academy on Virginia Key.

Student interns worked with mentors in the three science divisions at AOML, as well as with the Office of the Director's Communications team. Mentors assimilated interns into their respective research group and developed activities for them to provide hands-on training and practical experience in the marine and atmospheric sciences.

AOML's motivated student interns tackled an array of assignments focused on tropical meteorology, engineering, physical oceanography, coastal ecosystems, and science communications. Their experiences ranged from learning new software, to performing data analysis, to perfecting technical laboratory skills, to collecting observations in the field.

Student intern Ian Smith, an oceanography major at the University of Washington, gained valuable field experience during a Florida Bay water quality monitoring cruise.

Some of AOML's 2016 students interns included (from left to right): Eduardo Garcia-Montes, Daniel Valla, Madison Jackson, Cody Yeary (National Hurricane Center), Erin Dougherty, Isadora Smith, Joshua Wadler (National Hurricane Center), Nicholas Komisarjevsky, and Hanna Payne.

Besides learning from a cadre of seasoned professionals, AOML's student interns were also able to become better acquainted with NOAA, its mission, and the array of federal career opportunities offered by the agency. It is hoped the skills and relationships they developed while at AOML had a positive impact and will better prepare them for future career and educational opportunities.

AOML wishes its young generation of budding scientists all the best and applauds the dedication of the many mentors who guided their efforts.

2016 Student Interns	AOML Mentors
Alycia Ciresi MAST Academy (science teacher)	Renellys Perez/Shenfu Dong Physical Oceanography Division
Erin Dougherty State University of New York-Albany	Robert Rogers/Jun Zhang Hurricane Research Division
Ailen Garcia Florida International University	Bradley Klotz Hurricane Research Division
Gabriella Garcia MAST Academy	Charles Fischer Ocean Chemistry and Ecosystems Division
Eduardo Garcia-Montes Massachusetts Institute of Technology	Ulises Rivero Physical Oceanography Division
Dylan Gates, NOAA Hollings Scholar State University of New York-Oswego	Gregory Foltz/Renellys Perez Physical Oceanography Division
Daniel Gutierrez Florida State University	Pedro Pena/Ulises Rivero Physical Oceanography Division
Madison Jackson University of Miami-Rosenstiel School	Derek Manzello/Lauren Valentino Ocean Chemistry and Ecosystems Division
Nicholas Komisarjevsky University of Miami-Rosenstiel School	Erica Rule Office of the Director
Hanna Payne Stanford University	Erica Rule Office of the Director
Taylor Shropshire Florida State University	Sang-Ki Lee Physical Oceanography Division
Ian Smith University of Washington	Christopher Kelble/Lindsey Visser Ocean Chemistry and Ecosystems Division
Isadora Smith MAST Academy	Ulises Rivero Physical Oceanography Division
Daniel Valla University of Buenos Aires	Christopher Meinen Physical Oceanography Division

In Their Own Words...

AOML's 2016 student interns met a variety of challenges during their time at the lab. A survey conducted to evaluate the relevance of their experiences revealed a common gratefulness for the opportunity to work alongside NOAA employees and an appreciation for the science NOAA performs. However, the clearest measure of these sentiments is best expressed in their own words:

"As a teacher at MAST Academy I have, and will continue, to recommend NOAA to my students as a means of internship. MAST stands for Maritime and Science Technology, and the AOML facility is the best local source of maritime-focused research."

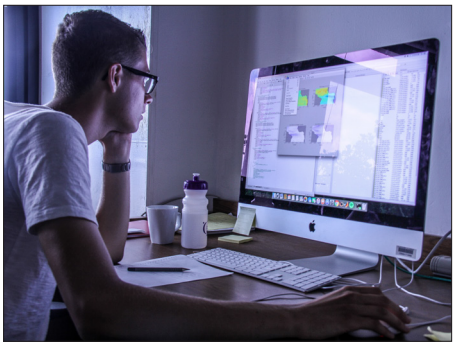
Alycia Ciresi
MAST Academy

"I think NOAA provides great opportunities for students of all educational levels, and that they are accommodating to different interests and levels of experience."

Hanna Payne
Stanford University

"Even though I am only halfway through this internship, it has taught me a lot about myself. It has really shown me that I can accomplish amazing things. Learning MATLAB was a significant challenge, but getting through it has been gratifying and has given me confidence in my own abilities."

Dylan Gates
State University of New York-Oswego



NOAA Hollings Scholar Dylan Gates, an undergraduate student majoring in Applied Mathematics, learned MatLab, a computational mathematics software program, during his internship with AOML's Physical Oceanography Division. In just two short months, Dylan learned how to do composite analysis, run significance tests, and perform multiple linear regressions using Matlab, and to apply these techniques to a large-scale oceanographic problem.

Eduardo Garcia-Montes, a mechanical engineering major at MIT, worked on a cruise simulator coding project during his internship with AOML's Physical Oceanography Division, as well as several three-dimensional computer-aided drafting (CAD) modeling projects.

"The internship at AOML has been fantastic in helping me pinpoint exactly which facets of engineering I particularly enjoy."

Eduardo Garcia-Montes
Massachusetts Institute of Technology

"I believe the main lesson I will take away from this internship is understanding that experiments don't always run smoothly, no matter how meticulous you are, and that's just a part of science."

Madison Jackson
University of Miami

"I would most definitely recommend opportunities at NOAA, as they are a great way to receive experience in a laboratory, work with world-renowned researchers, and be able to perform important research."

Gabriella Garcia
MAST Academy

"Working here at NOAA/AOML is an incredible experience. I get to meet and talk with top-class oceanographers and enthusiastic students as well."

Daniel Valla
University of Buenos Aires

"My internship has shown me the real world application of what I have learned in school. I will take away very relevant professional experiences and techniques from this amazing opportunity, as well as an appreciation for the individuals who have devoted years to this agency, as I have formed valuable professional relationships that will further enhance my career for years to come."

Ian Smith
University of Washington

Student intern Erin Dougherty (center), along with hurricane researchers Kathryn Sellwood and Lisa Bucci, before deploying for a mission into Hurricane Earl aboard NOAA's P-3 Hurricane Hunter aircraft. During her internship with AOML's Hurricane Research Division, Erin worked with Drs. Rob Rogers and Jun Zhang to analyze aircraft observations of the structure and evolution of Hurricane Bonnie (1998) in vertical wind shear.

"Being at AOML's Hurricane Research Division and working alongside hurricane experts is an incredible opportunity that has provided me with some new insights into my research."

Erin Dougherty
State University of New York-Albany

"Being able to increase my communications skills, as well as learning about the science that is going on here, makes my internship very exciting."

Nicholas Komisarjevsky
University of Miami

"I am interning with AOML's Physical Oceanography Division and help engineer underwater instruments. Creating something that is effective and pushes the boundaries is the most exciting thing about my internship."

Isadora Smith
MAST Academy

MAST Academy high school student Isadora Smith spent the summer learning how underwater instruments are constructed by interning with the Instrument Development Group of AOML's Physical Oceanography Division.

Congratulations

A team of researchers with AOML's Physical Oceanography Division are the recipients of a 2016 NOAA Administrator's Award, announced August 11th by NOAA Administrator Dr. Kathryn D. Sullivan. Francis Bringas, Gustavo Goni, Caridad Gonzalez, Pedro Pena, and Ulises Rivero were recognized "for their efforts to develop and implement an Iridium-based, real-time transmission system for oceanographic and meteorological observations from ships." The team began work on the new Iridium system in 2011 to improve the cost-effectiveness and reliability of expendable bathythermograph (XBT) data transmissions of the upper ocean's thermal structure.

The Iridium team at AOML includes Pedro Pena, Francis Bringas, Ulises Rivero, Caridad Gonzalez, and Gustavo Goni.

Initial tests conducted in 2013 helped to optimize the system, greatly reducing the number of connection drops and data loss. By 2015, it was transitioned into use by all cargo ships with XBT transects operated by AOML and the Scripps Institution of Oceanography, providing a stable platform for the transmission of XBT profile data at a fraction of the cost of the original system.

XBT profiles were historically transmitted via the Inmarsat-C satellite network, with a cost of $18 per profile, resulting in annual costs of about $215,000. The average transmission cost for the Iridium system is $0.80, a 95% cost reduction.

Although originally developed for XBT observations, the Iridium system has been expanded to transmit other types of oceanographic and atmospheric observations. It can also be configured to transmit data over telephone land lines and computer networks, furthering the potential to reduce data transmission costs for NOAA.

The team will be honored and receive the award at a ceremony to be held at NOAA headquarters in Silver Spring, Maryland this November.

Farewell

Dr. Jili Dong, a University of Miami-Cooperative Institute postdoctoral researcher with AOML's Physical Oceanography Division, departed in July to accept a position with NOAA's Environmental Modeling Center (EMC) in College Park, Maryland. For his postdoctoral research at AOML, Dr. Dong initially worked at EMC to learn about the Hybrid Coordinate Model-Hurricane Weather Research and Forecasting (HYCOM-HWRF) coupled hurricane prediction system used operationally by NOAA. He then transferred to AOML to perform research using this coupled prediction system.

Dr. Dong developed a methodology to enable the impact of ocean observations on coupled hurricane forecasts to be identified and studied. His primary focus was to study the impact of underwater glider data on hurricane prediction, and his work with Hurricane Gonzalo (2014) demonstrated the importance of observing the ocean with gliders, both to improve ocean model initialization and to evaluate the ocean model response to storm forcing. The methods he developed are now being applied to evaluate other ocean observing systems and new ocean observing strategies with respect to improving hurricane intensity prediction using ocean Observing System Simulation Experiments. At EMC, he will continue to improve coupled hurricane prediction systems, particularly HYCOM-HWRF, and will continue to interact with AOML researchers.

Welcome Aboard

Dr. Sean Casey joined the staff of AOML's Hurricane Research Division in July as a University of Miami-Cooperative Institute research scientist. Sean will work with the Observation System Simulation Experiments (OSSE) group within HRD, focusing on the assimilation of hyperspectral infrared satellite data into the Global Forecast System of NOAA's National Centers for Environmental Prediction. Sean will collaborate with HRD researchers remotely, being based offsite at NOAA's Joint Center for Satellite Data Assimilation in College Park, Maryland.

Morgan Manning joined AOML's Office of the Director in August as a Federal part-time student trainee with the Pathways Program, which enables students to explore public service careers while still in school through their employment with Federal agencies. Morgan is currently working towards completing a Masters degree in Journalism at the University of Miami. During her time at AOML, she will create videos and infographics to highlight AOML employees and research. She holds a BA degree in Film and Media Arts from American University.

Miami Regional Librarian Hosts OceanDocs Steering Group

NOAA Miami Regional Librarian Linda Pikula hosted a meeting of the International Oceanographic Data and Information Exchange's (IODE) Steering Group for the OceanDocs project on August 22-24th. Participants represented eight member countries of the IODE's Intergovernmental Oceanographic Commission (IOC).

Members of the IODE's Steering Group for the OceanDocs Project met in Miami, Florida on August 22-24th.

OceanDocs is a an IODE project to collect, preserve, and facilitate online discovery and access to all research output from members of the ocean research and observation community, specifically their Ocean Data and Information Networks (ODINS).

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

ATLAS, R., V. Tallapragada, and **S.G. GOPALAKRISHNAN,** 2015: Advances in tropical cyclone intensity forecasts. *Marine Technology Society Journal,* 49(6):149-160.

ATLAS, R., L. BUCCI, B. ANNANE, R. HOFFMAN, and **S. MURILLO,** 2015: Observing System Simulation Experiments to assess the potential impact of new observing systems on hurricane forecasting. *Marine Technology Society Journal,* 49(6):140-148.

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Flower, H., M. Rains, D. Lewis, **J.-Z. ZHANG,** and R. Price, 2015: Control of phosphorus concentration adsorption and desorption in shallow groundwater of subtropical carbonate estuary. *Estuarine, Coastal and Shelf Science,* 169:238-247.

Le Quéré, C., R. Moriarty, R.M. Andrew, J.G. Canadell, S. Sitch, J.I. Korsbakken, P. Friedlingstein, G.P. Peters, R.J. Andres, T.A. Boden, R.A. Houghton, J.I. House, R.F. Keeling, P. Tans, A. Arneth, D.C.E. Bakker, **L. BARBERO,** L. Bopp, J. Chang, F. Chevallier, L.P. Chini, P. Ciais, M. Fader, R.A. Feely, T. Gkritzalis, I. Harris, J. Hauck, T. Ilyina, A.K. Jain, E. Kato, V. Kitidis, K. Klein Goldewijk, C. Koven, P. Landschützer, S.K. Lauvset, N. Lefèvre, A. Lenton, I.D. Lima, N. Metzl, F. Millero, D.R. Munro, A. Murata, J.E.M.S. Nabel, S. Nakaoka, Y. Nojiri, K. O'Brien, A. Olsen, T. Ono, F.F. Pérez, B. Pfeil, **D. PIERROT,** B. Poulter, G. Rehder, C. Rödenbeck, S. Saito, U. Schuster, J. Schwinger, R. Séférian, T. Steinhoff, B.D. Stocker, A.J. Sutton, T. Takahashi, B. Tilbrook, I.T. van der Laan-Luijkx, G.R. van der Werf, S. van Heuven, D. Vandemark, N. Viovy, A. Wiltshire, S. Zaehle, and N. Zeng, 2015: Global carbon budget 2015. *Earth System Science Data,* 7(2):349-396.

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Nagamani, P.V., M.M. Ali, **G.J. GONI,** T.V.S. Udaya Bhaskar, J.P. McCreary, R.A. Weller, M. Rajeevan, V.V. Gopala Krishna, and J.C. Pezzullo, 2016: Heat content of the Arabian Sea mini warm pool is increasing. *Atmospheric Science Letters,* 17(1):39-42.

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