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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

New Technologies Successfully Deployed in Recent Hurricane Flights

During NOAA's aircraft reconnaissance and surveillance missions into Hurricane Edouard, an expendable unmanned aircraft system (UAS) was successfully deployed for the first time. On September 16th, the Coyote UAS, manufactured by Sensintel, Inc., was released into Hurricane Edouard's eye using NOAA's P-3 Hurricane Hunter aircraft operating out of Bermuda as the delivery vehicle.

Once deployed from the underside of the P-3 aircraft, the 13-pound Coyote opened its wings, spanning five feet, and spiraled downward into the high-wind hurricane eyewall of Edouard. At an altitude of approximately 2900 feet, the Coyote penetrated Edouard's western eyewall and then proceeded to orbit into the southwestern portion of the eyewall during its 28-minute historic mission.

The following day, still operating out of Bermuda, the team was able to successfully conduct a second Coyote mission into Hurricane Edouard. This time, the experiment was designed to send the Coyote along a low-level inflow channel similar to what air might experience as it spirals towards the eye.

This second flight set an endurance record for the Coyote, which remained airborne for 68 minutes at a controlled altitude of 1200-2500 feet. The Coyote may have also directly measured the sea-surface temperature as it expired into the ocean.

One of four Coyote unmanned aircraft systems prior to its deployment into Hurricane Edouard from aboard NOAA's P-3 Hurricane Hunter aircraft.

Drew Osbrink and Eric Redweik of Sensintel, Inc. and AOML's Dr. Joe Cione monitor a Coyote unmanned aerial system after its launch into Hurricane Edouard.

Edouard, the first major hurricane of the 2014 Atlantic season, proved the perfect storm for testing the Coyote UAS. The system remained far from land as it intensified and developed a well-defined eye, while its top winds of 115 mph enabled researchers to monitor how well the Coyote endured the harsh conditions found inside the hurricane environment.

Hurricanes are fueled by warm water, and vital information needed to better understand and predict intensity change may rest close to the sea surface where manned aircraft cannot fly.

In addition to the Coyote UAS, a new technology built upon the proven success of the GPS dropwindsonde was also tested for the first time this hurricane season, thanks to support from the Disaster Relief Appropriations Act of 2013 (the Sandy Supplemental) and the stellar engineering by staff at NOAA's Aircraft Operations Center and the National Center for Atmospheric Research.

Several modified dropwindsondes that incorporate an infrared sensor allowed for the first-ever estimates of colocated air-sea thermodynamic measurements within a hurricane. These instruments, called IR sondes, included an experimental, large parachute design which allowed for higher-resolution vertical sampling than was previously available.

"Data from these new and promising technologies have yet to be analyzed," said Joe Cione, an AOML hurricane researcher and principal investigator for the Coyote project, "but are expected to provide unique and potentially ground-breaking insights into a critical region of the storm environment that is typically difficult to observe in sufficient detail."

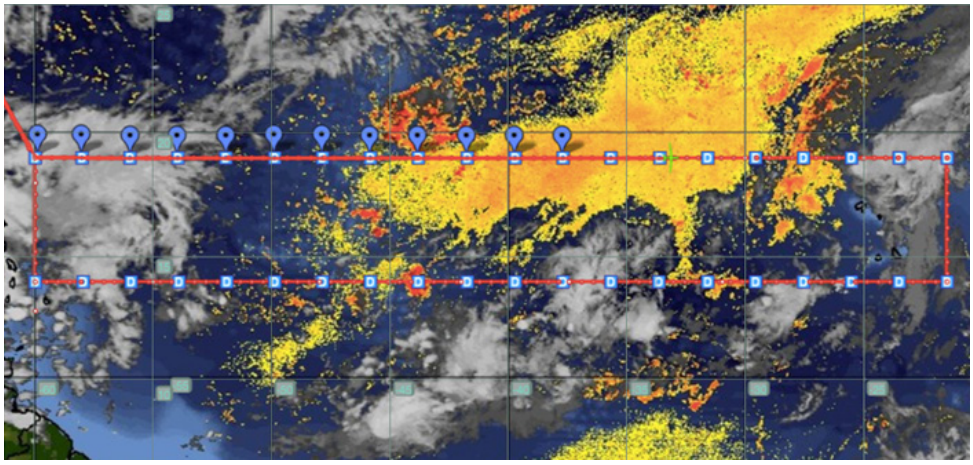
These first-of-their-kind data hold the potential to reveal new details of how tropical systems develop and intensify, ultimately leading to improved forecasts that save both lives and property.

Global Hawk Missions Augment Tropical Cyclone Sampling Efforts

NOAA's hurricane researchers have once again collaborated with NASA in an effort to improve forecasts of severe storms. In September, NASA flew two missions of its Global Hawk unmanned aerial vehicle (UAV) that captured much of the life cycle of Hurricane Edouard, the Atlantic basin's first major hurricane of 2014 (see below). The Global Hawk UAV also completed two missions designed by NOAA to methodically sample the Atlantic basin's main development region for tropical cyclones, the first sampling of the region since 1974.

These missions were conducted in support of NASA's Hurricane and Severe Storm Sentinel (HS3) program, a five-year effort begun during the summer of 2012 to better understand the processes that contribute to intensity change in Atlantic basin tropical cyclones. The Global Hawk's ability to gather high resolution data for longer periods and farther distances than manned aircraft, as well as its ability to fly at altitudes greater than 60,000 feet, has proven it to be a valuable surveillance resource.

Global Hawk UAS missions are launched from NASA's Wallops Flight Facility in Wallops, Virginia. The Global Hawk can gather data for longer periods of time, as well as greater distances, than U.S.-based manned aircraft.



In September, NASA's Global Hawk UAS completed the first systematic sampling of the Atlantic basin's main development region for tropical cyclones since 1974, deploying 105 dropsondes during two 24+ hour missions.

During the 2014 Atlantic hurricane season, a new collaborative effort began between NOAA and NASA—the Sensing Hazards with Operational Unmanned Technology (SHOUT)—to evaluate the cost and feasibility of routinely using the Global Hawk UAVs to gather observations from severe storms forming in the Atlantic, Pacific, and Artic oceans.

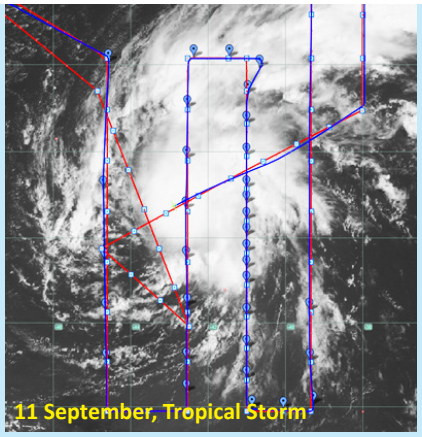
The three-year experiment is driven by the need to increase lead times for severe weather events, enabling impacted communities to be better prepared, as well as mitigate the risk of diminished weather forecasts and warnings that might occur from gaps in satellite observations.

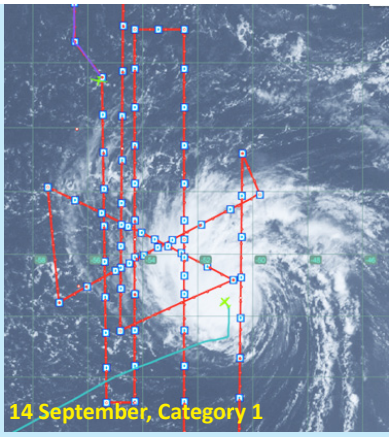
Although SHOUT doesn't officially begin until 2015, researchers are using data gathered during 2014 for computer simulations to evaluate how well numerical models represent the tropical atmosphere in regions where only satellite observations are available, as well as test and evaluate the operational effectiveness of the Global Hawk's remote sensing instruments.

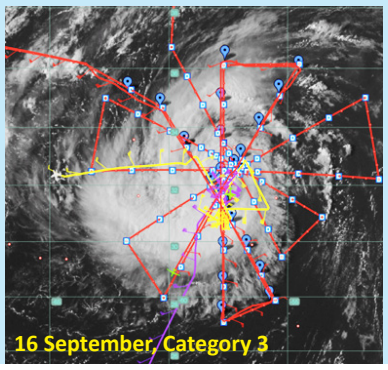
Global Hawk Missions Sample Life Cycle of Edouard

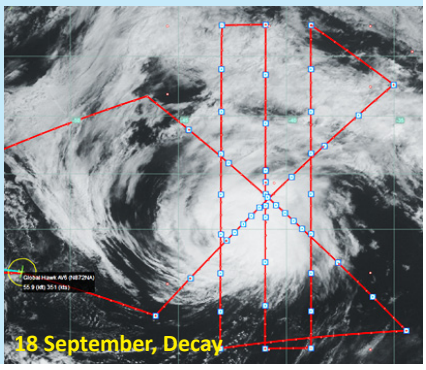
Global Hawk missions in September sampled almost the entire life cycle of Atlantic tropical cyclone Edouard, from tropical storm, to category 1 hurricane, to category 3 hurricane, and to decay into an extra-tropical storm.

- 282 dropsondes were deployed in Edouard during more than 58 hours of sampling over and near the storm.
- The September 16th flight plan was designed and coordinated by NOAA scientists.
- Multiple dropsondes were released into the eye and eyewall of Edouard at an altitude of more than 60,000 feet. Data from selected dropsondes suggested that Edouard underwent rapid intensification on September 15th.
- Novel observations documented Edouard's weakening and decay over colder waters.
- Dropsonde data were processed in real time, transmitted to the National Weather Service gateway, and assimilated into the operational Hurricane Weather Research and Forecasting model.
- Global Hawk observations from Edouard will facilitate several forecast impact studies using multiple numerical models.







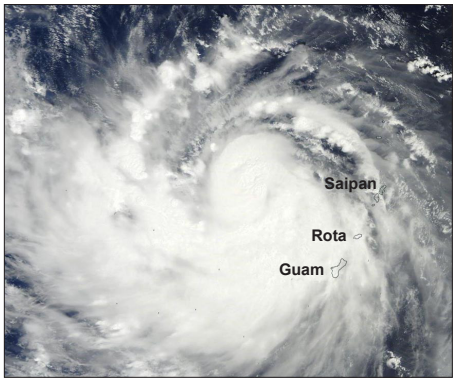


Typhoon Vongfong Destroys Saipan Coral Reef Monitoring Station

The Saipan coral reef monitoring platform in Lao Lao Bay was the first established in the Pacific by AOML members of NOAA's Coral Health and Monitoring Program.

The Coral Reef Early Warning System (CREWS) station established in Lao Lao Bay, Saipan in August 2011 was destroyed by the recent passage of Typhoon Vonfong. Vongfong barreled through the U.S. Mariana Islands in the Pacific as a category-2 storm on October 5th, packing 105 mph winds and passing within 50 nautical miles of the Lao Lao Bay station.

Representatives with Saipan's Bureau of Environmental and Coastal Quality reported on October 9th that the station's fiberglass pylon had been snapped off just above the ocean surface and was missing, along with the station's modem and the suite of atmospheric-sensing instruments it held (see photos at right). It is presumed the hollow pylon, filled with polyurethane foam to make it buoyant, was carried away by the turbulent seas churned up by Vongfong's passing.



NASA-MODIS satellite image of Typhoon Vongfong on October 5, 2014 at approximately 9 pm Eastern Daylight Time. The eye of Vongfong passed just north of the island of Rota in the Mariana Islands as a category-2 storm with 105 mph winds.

The lower portion of the station is still anchored to the ocean floor but in a much degraded state (see photos at right). The Lao Lao Bay station has thus been declared a total loss, and what remains of it will be dismantled and removed in the near future.

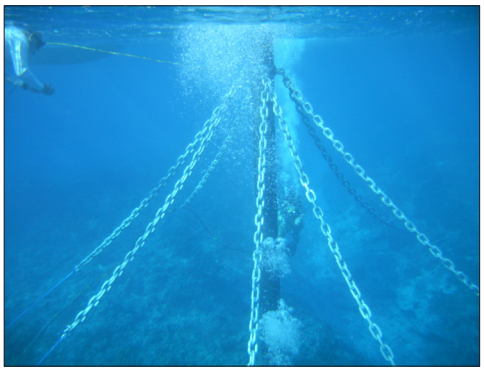
Coral researchers at AOML established the Lao Lao Bay, Saipan CREWS site in August 2011 through an initiative between the Coastal Resource Management Office of the Commonwealth of the Northern Mariana Islands and NOAA's Coral Health and Monitoring Program (CHAMP). The station was located next to the Forbidden Island Marine Sanctuary and became part of the network of NOAA's environmental monitoring platforms and satellite monitoring "virtual stations" that collectively form the Integrated Coral Observing Network (ICON). ICON stations report marine and atmospheric data in near real-time to monitor and assess the health of coral reef ecosystems.

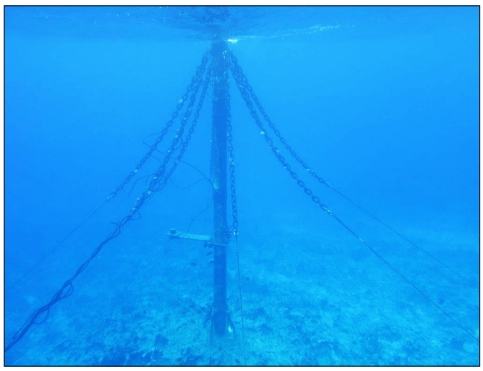
***Left:* The fully instrumented Lao Lao Bay CREWS station when it first premiered in August 2011. *Right:* What remained of the station pylon above the ocean surface following Typhoon Vongfong's passage through the Mariana Islands on October 5th. The top portion of the station was completely severed and is believed to have been carried away by turbulent seas.**

Since its inception, however, the Lao Lao Bay site had experienced intermittent communication outages, power and instrument failures, and challenges in securing maintenance support. The station underwent refurbishment in both 2012 and 2013 and had been offline but locally storing data since this past July 31st, when its cellular account was terminated. As a result of the passage of Vongfong, all Lao Lao Bay data produced since July are believed to be unrecoverable.

The islands of Guam, Rota, Tinian, and Saipan suffered extensive power outages following Vongfong's passage through the Mariana Islands but sustained only minor structural damage. As Vongfong moved away, it underwent rapid intensification, strengthening from a category-2 storm with 105 mph winds on October 6th into a category-5 storm with 180 mph winds by October 7th. Vongfong will thus be remembered as one of the most intense tropical cyclones of 2014. Moving northward into cooler waters, Vongfong weakened substantially before impacting the islands of Okinawa and Japan.

More information about the Lao Lao Bay CREWS station is available at http://llbp7-log.blogspot.com/.





Before and after photographs of the mooring cables at the Lao Lao Bay CREWS station in Saipan. *Left:* Moorings in August 2011 as the station was being established and anchored in Lao Lao Bay. *Right:* Moorings following the passage of Typhoon Vongfong.

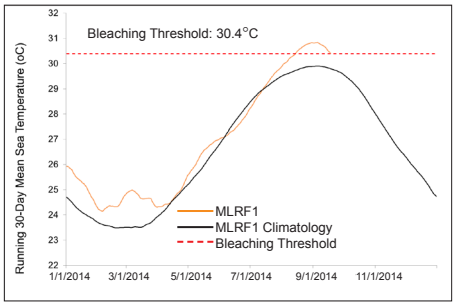
Warm Ocean Temperatures Trigger Massive Coral Bleaching in the Florida Keys

Coral researchers with NOAA's Coral Health and Monitoring Program at AOML manage the Integrated Coral Observing Network (ICON) of environmental platforms that report marine and atmospheric data from reef sites worldwide.

This past summer, the Fowey Rocks and Molasses Reef ICON sites in the Florida Keys began recording elevated ocean temperatures. In fact, temperatures at Molasses Reef were the warmest on record since the station's inception in 1988, prompting ecoforecast models used by the ICON system to issue alerts for the likelihood of coral bleaching.

Coral bleaching occurs when the colorful algae that live in coral limestone, zooxanthellae, are ejected due to stress factors such as warm ocean temperatures. With the algae expelled, corals appear colorless or "bleached."

In August, AOML's coral researchers observed extensive bleaching throughout Biscayne National Park while installing temperature sensors at reef sites in support of the newly initiated National Coral Reef Monitoring Program (NCRMP). Biscayne National Park comprises the northern extent of the Florida Reef Tract, the third largest reef system globally. It parallels the Florida Keys and stretches all the way to the Dry Tortugas, which lies 70 miles to the west of Key West.



Ocean temperatures at the Molasses Reef ICON site during 2014. Above average ocean temperatures occurred during the winter months and began reoccurring in July. By August, ocean temperatures had exceeded the threshold for coral bleaching.

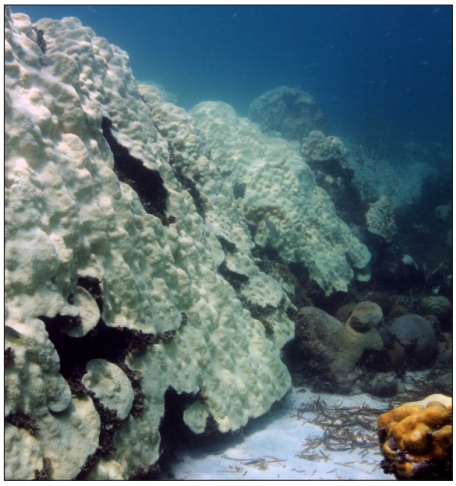
Extensive coral bleaching was observed by AOML's coral researchers at Emerald Reef, offshore of Key Biscayne, Florida, on August 29, 2014.

In September, they visited Cheeca Rocks, a NCRMP-designated climate and ocean acidification monitoring sentinel site, where coral bleaching was observed to be severe. Together with Dr. Brooke Gintert of the University of Miami's Rosenstiel School they documented the bleaching using high-resolution landscape mosaic imagery, creating a first-of-its-kind dataset.

Cheeca Rocks is one of the few reef sites in the Florida Keys that has been resilient to recent environmental stresses, maintaining a high level of coral cover. AOML's coral researchers will thus be concentrating their efforts to monitor and document how coral ecosystems at Cheeca Rocks respond to this thermal stress event.

AOML coral researchers returned to Cheeca Rocks in October to collect zooxanthellae samples from colonies of the endangered coral *Orbicella faveolata* at various sites and to identify if certain zooxanthellae clades were associated with the recovery of this critically-endangered species. Work to document the extent of the bleaching, as well as the incidence of disease and mortality, will be ongoing.

The last major bleaching event to impact the Florida Keys occurred in 2005; however, the current event appears to be more severe.



Bleached colony of *Orbicella faveolata* observed by AOML's coral researchers on September 17th in the Florida Keys.

AOML coral researcher Xaymara Serrano visited Key Largo during the months of August and September to assist with coral spawning efforts (of species *Acropora palmata* and *Orbicella faveolata*) and conduct experiments with coral larvae and newly-settled recruits. This work was performed in conjunction with Drs. Margaret Miller of NOAA's Southeast Fisheries Science Center and Jim Hendee of AOML's Ocean Chemistry and Ecosystem Division; its main goal was to assess the effects of increased nutrients and thermal stress on corals during their early life stages. Since both of these focal species were recently listed as threatened under the U.S. Endangered Species Act (ESA), results are critical for managers in the U.S. and wider Caribbean, as they are expected to provide empirical evidence that might support the implementation of environmental policies which improve water quality and increase reef resilience. Extensive coral bleaching was observed.

Researchers Continue Efforts to Monitor the Meridional Overturning Circulation

Mr. Rigoberto Garcia, a University of Miami-Cooperative Institute for Marine and Atmospheric Studies scientist with AOML's Physical Oceanography Division, joined with partners from Argentina and Brazil in October to study the Meridional Overturning Circulation (MOC) at 34.5°S in the South Atlantic. The cruise aboard the Argentine research vessel ARA *Puerto Deseado* was the ninth joint cruise undertaken in support of the NOAA-funded Southwest Atlantic MOC (SAM) project since March 2009. Participants included researchers from the Universidade de Buenos Aires (UBA), the Servicio de Hidrografía Naval (SHN), the Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP), the Universidade Federal do Rio Grande (FURG), and the Universidade de Sao Paulo (USP), as well as NOAA-AOML.

The MOC is the major driver in the north-south redistribution of heat in the ocean-climate system. It is a vertical circulation cell that exchanges surface and deep waters via poleward surface transports, sinking at high latitudes and upwelling elsewhere. MOC variability has been linked in numerical models to significant changes in precipitation patterns, surface air temperatures, and hurricane intensity over large portions of the Earth. NOAA-AOML has taken a leading role with its partners to collect observations of the South Atlantic portion of the global MOC system to gain a more complete understanding of its complex nature. A complete trans-basin array to measure the MOC at 34.5°S is in the process of being deployed, and the NOAA instruments near the western boundary are the cornerstone of the full array.

Science party aboard the Argentine research vessel ARA *Puerto Deseado* during a cruise to study the meridional overturning circulation in the South Atlantic on October 4-16, 2014.

On this cruise, data were acoustically downloaded from four pressure-equipped inverted echo sounder (PIES) moorings in the SAM array, as well as two similar Brazilian instruments. These instruments send sound pulses to the sea surface and listen for the return of the reflected sound waves. The round-trip acoustic travel time measurements are then combined with historical hydrographic data to obtain daily estimates of the temperature, salinity, and density for the full water column above the mooring. The pressure gauges meanwhile provide information on the variability of deep water flows. The combination of data sets from the PIES moorings provides long-term observations of the shallow and deep western boundary currents at 34.5°S, key components in the MOC system.

The existing array is scheduled to continue through at least 2016, with annual or semi-annual cruises planned to collect new hydrographic information and to acoustically download PIES data. NOAA's contribution to this effort is funded by the Climate Program Office/Climate Observations Division and by AOML.

WPLG, Channel 10, the local ABC-affiliated television station in Miami, hosted the September meeting of the Greater Miami Chapter of the American Meteorological Society (AMS). AMS members, including AOML staff, were given a tour of the station by Channel 10 chief meteorologist Max Mayfield, as well as a behind-the-scenes view of a live news broadcast. They also had the chance to watch a live weather segment by Channel 10 meteorologist Betty Davis.

New X/L-Band Satellite Receiving System Premieres at AOML

Protective radome covering is prepared.

After months of preparation, a new X/L-band satellite receiving system was installed on the AOML roof in September. It includes a radome-protected, 2.4-meter antenna and associated data processing and storage equipment.

The new system augments AOML's existing L-band antenna, in place since the year 2000, and expands AOML's ability to receive telemetry for remote monitoring of environmental conditions. It also enables AOML to create products in support of climate research and operational weather forecasts from the next generation of NOAA's polar-orbiting satellites, including the Suomi National Polar-orbiting Partnership (S-NPP) and Joint Polar Satellite System constellation (JPSS). Sensors being received include the Cross-track Infrared Sounder, Advanced Technology Microwave Sounder, Visible Infrared Imager Radiometer Suite, and Ozone Mapping and Profiler Suite.

Satellite dish is secured to the station base.

Radome is lifted to the AOML roof.

The dual nature of the new system provides backup reception for the POES and MetOp satellites, whose telemetry is received by the L-band system. The use of both antennas allows AOML to expand the range of satellites and sensors being received, solve pass-scheduling problems, and guarantee the operational distribution of the Argos Data Collection and location System (DCS) in-situ data to the Argos program. Infrared and microwave sounder data from the system will be delivered to NOAA's National Centers for Environmental Prediction for assimilation into numerical weather prediction models.

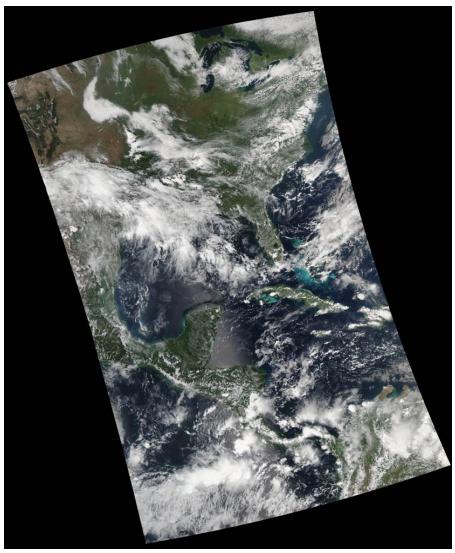
This project is designed to demonstrate the value of improved latency (i.e., faster turnaround times from satellite observations to availability of processed data) for National Weather Service and National Environmental Satellite, Data and Information Service applications prior to future JPSS actions for improving Level 1 latency requirements.

The AOML site was chosen because of its unique location, as well as other advantages: immediate technical support; excellent line-of-sight that ensures optimal coverage of the Caribbean, Gulf of Mexico, and U.S. east coast regions; low radio-frequency interference; close interaction with federal and university researchers; synergy with a community of local entities; and good bandwidth for rapid product dissemination. AOML also hosts the Caribbean-Gulf of Mexico regional node of NOAA's CoastWatch program and will host NOAA's Atlantic OceanWatch node, which expands upon the CoastWatch program by gathering satellite observations over large ocean and/or global areas.

Radome is placed over the satellite dish.

Radome is secured to the station base.

Funding for the project was provided by the Disaster Relief Appropriations Act of 2013 (the Sandy Supplemental). Thanks are due to CDR Stephen Meador, AOML's Associate Director, for overseeing this project from start to finish.



First true color image received at AOML from the Visible Infrared Imager Radiometer Suite sensor on September 18th.

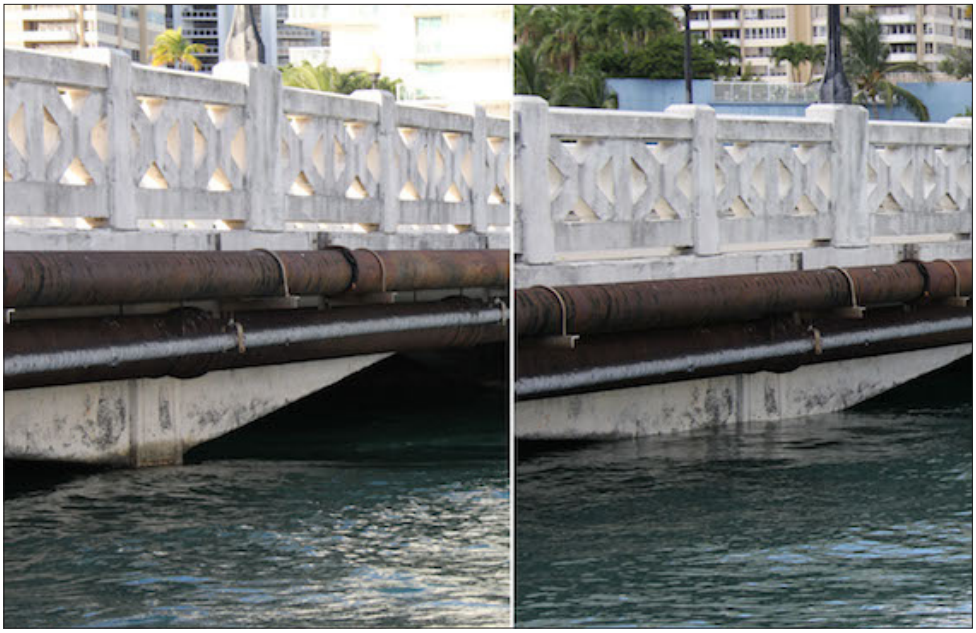
Research Fit for a "King Tide"

The highest astronomical tide of the year has returned once again, flooding the urbanized landscape of Miami Beach. This annual event, called the "King Tide," reached its peak in the Miami Beach area on October 9th around 10:30 am, bringing approximately an extra 12 inches of water onshore.

AOML's Microbiology Team was on the scene near Miami Beach to investigate these floodwaters. The microbiologists are part of a multi-institutional research consortium for sea-level rise and climate change, led by Florida International University's Southeast Environmental Research Center. Scientists sampled the water along Miami Beach and the bay's receiving waters while the City of Miami Beach actively pumped these super-tidal floodwaters from the "King Tide" back into Biscayne Bay.

Miami Beach now regularly floods during super-tidal events or severe storms. It is important to understand how such coastal inundation events may transport land-based sources of pollution into the marine environment and how this may impact both ecosystems and human health.

"We don't really know what comes from brackish water tidal floods in a built environment like Miami Beach, where the water cover roads, yards, parking lots, and commercial sites" said AOML's Dr. Chris Sinigalliano. "We have not really measured how such tidal floodwater is similar or different to regular storm water in the kinds of contaminants it accumulates and potential associated risks."



Left: **Water height under a bridge at Miami Beach on October 9th at 8:30 am.** ***Right:*** **Water height at Miami Beach 2 hours later, when the incoming tide was at its peak.**

Dr. Chris Sinigalliano of AOML takes water quality measurements with a YSI sensor.

Researchers participating in this sampling effort collected water samples in the flooded streets and near storm drains, as well as offshore samples collected by boat, to sample water pumped back into Biscyane Bay. AOML's team continuously monitored and collected water samples over a 5-hour period at locations in Maurice Gibb Memorial Park. During this sampling, they also continuously monitored physical water properties such as temperature, salinity, pH, turbidity, and dissolved oxygen content.

Back at their respective laboratories, FIU scientists will test the water samples for a wide array of nutrients and biogeochemical markers, while AOML's microbiologists will test for an array of bacterial contamination markers to characterize the microbial water quality of the samples.

AOML helped develop and validate the molecular genetic techniques for analyzing the sources of various bacterial contaminants, a process known as Molecular Microbial Source Tracking. This analysis will help scientists, managers, and stakeholders understand what types of microbial pollutants come from tidal floods and the possible environmental impacts of pumping this floodwater back into the bay. AOML's contributions to the King Tide Day sampling effort included field sampling, analytical detection, and measurement of specific fecal-indicating bacteria and other microbial contaminants, as well as identifying their potential sources using Molecular Microbial Source Tracking.

AOML scientists will measure live enterococci (the fecal bacteria used for regulatory water quality monitoring of marine bathing waters) and will also quantify the abundance of specific source tracking bacteria. These source-tracking methods can determine the host animals that fecal pollution is coming from, including human, dog, birds, cows, and pigs.

Knowing the potential source of contamination provides actionable environmental intelligence that can inform managers as they address contamination problems. Sewage and septic contamination is linked with the human marker, terrestrial runoff is linked with the dog marker, and agricultural waste contamination with the pig marker. This insight as to the potential source of contamination helps managers better tailor their response.

The collective water quality information gathered from these Miami Beach King Tide floodwaters will be integrated across all the multi-institutional research teams. Results could further the understanding of the environmental impacts from tidal flooding of urban coastal landscapes and improve understanding of current and possible future impacts of sea-level rise.

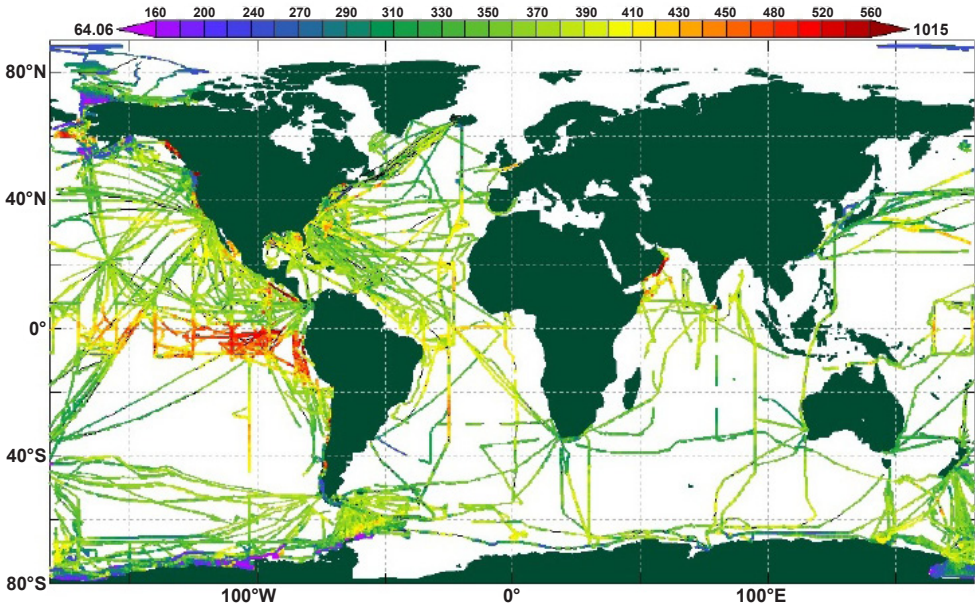
AOML Contributes Key Data to Global Carbon Assessment Report

A report released in September by the Global Carbon Project on changing carbon dioxide levels in the Earth's atmosphere, oceans, and land environment draws heavily from data gathered by NOAA, including AOML's Ocean Carbon Cycle Group, and NOAA's research partners.

For the first time, the Global Carbon Project's annual carbon assessment includes data from autonomous instruments installed on research vessels, ships of opportunity, and moorings by NOAA scientists to determine the variability of carbon dioxide at the ocean surface. AOML's Ocean Carbon Cycle Group has been a primary contributor to this ocean-carbon dataset.

With funding support from NOAA's Climate Program Office, researchers with AOML's Ocean Carbon Cycle Group, other NOAA research laboratories, Cooperative Institutes, and academic collaborators are developing a global, surface-ocean carbon dioxide observing network to measure ocean carbon dioxide sources and sinks.

The measurement of carbon dioxide sources and sinks in the ocean is needed for improved understanding of how carbon dioxide is distributed in the atmosphere, oceans, and land; an accurate assessment of anthropogenic carbon dioxide emissions and their redistribution helps support projections of future climate change. NOAA's investment in improved observations and technology has reduced the uncertainty in the ocean carbon sink from 45 to 20 percent.



Global map showing the transects where NOAA's Ship of Opportunity CO_2 consortium have gathered carbon dioxide measurements. These NOAA-funded observations account for approximately 40% of all global oceanic carbon data collected between 1990-2013.

The oceans absorb an estimated 25 percent of the extra carbon dioxide released into the atmosphere through human activity. While this absorption is mitigating the rapid rise of carbon dioxide in the atmosphere, it is also contributing to changes in the ocean's chemistry. These changes, referred to as ocean acidification, make it more difficult for some marine organisms to grow, build shells, reproduce, and respond to other environmental stresses.

The 2014 Global Carbon Budget report estimates that the ocean sequestered 29 percent of the carbon dioxide emissions from fossil fuel burning in 2013, the most recent year studied. This is a three-fold increase in ocean uptake compared to 50 years ago.

More information about the 2014 Global Carbon Budget report is available online at http://www.globalcarbonproject.org/carbonbudget/index.htm.

Information on this page is adapted from news articles appearing on the website of NOAA's Office of Oceanic and Atmospheric Research (www.research.noaa.gov).

Researchers with the Ocean Carbon Cycle Group at AOML are part of the global effort to monitor and measure carbon dioxide in the ocean. Collecting data at sea, however, can be expensive and time consuming. To counteract the costs, AOML is part of an initiative called the Ship of Opportunity Program, which is a component of the Global Ocean Observing System.

The Ship of Opportunity Program provides an economically efficient means to increase carbon dioxide monitoring in different parts of the ocean, particularly data-sparse regions. AOML recruits private industry and academic partners to voluntarily host an autonomous instrument aboard their ships that records carbon dioxide data at the ocean surface.

The Ocean Carbon Cycle Group has installed, maintained, and collected carbon data from ships of opportunity since 1997 using an automated system that measures the difference between the partial pressure of carbon dioxide (pCO_2) in the air and seawater. This difference reveals the amount of carbon being absorbed in a particular area. The group leads the largest ship of opportunity carbon dioxide consortium in the world.

Kevin Sullivan, a University of Miami Cooperative Institute scientist with AOML's Ocean Carbon Cycle Group, records data and monitors the pCO_2 system aboard the *Explorer of the Seas*, a Royal Caribbean passenger ship. The pCO_2 system aboard the *Explorer of the Seas* has been gathering carbon dioxide data since 2000.

There are currently 17 ships outfitted with automated pCO_2 systems gathering surface water measurements. The data from these ships, along with an improvement in the determination of gas transfer and in global wind products, have led to a 20% decrease in the uncertainty of global sea-air CO_2 flux estimates.

Underwater Gliders Complete Their 1000th Dive

AOML's underwater gliders recently completed dive number one thousand, which corresponds to two thousand temperature and salinity profiles. Since their deployment this past July, both gliders (SG609 and SG610) have been providing temperature and salinity profiles to depths as great as 1000 m in the Caribbean Sea and tropical North Atlantic Ocean. The underwater glider project is funded through the Disaster Relief Appropriations Act of 2013, also known as the Sandy Supplemental, to help assess the impact of ocean observations on tropical cyclone seasonal and intensity forecasts.

In early August, the glider located in the tropical North Atlantic, north of Puerto Rico (SG609), gathered observations as Hurricane Bertha passed overhead. Two months later, this same glider was located close to the path of Hurricane Gonzalo.

During Gonzalo's passage, SG609 was held steady in its location to obtain information on how temperature and salinity conditions are impacted by tropical cyclone forces. The observations showed that changes did occur in the salinity and temperature in the ocean's upper 100 m. Two days after Gonzalo's passage, the glider was moved northward for researchers to obtain data along a section that had already been surveyed shortly before Gonzalo passed through the area.

Dr. Gustavo Goni, director of AOML's Physical Oceanography Division and lead principal investigator for the *Sustained and Targeted Ocean Observations with Underwater Gliders* project, with Craig McLean, the acting assistant administrator of NOAA's Office of Oceanic and Atmospheric Research, who holds an underwater glider while visiting the lab in early October.

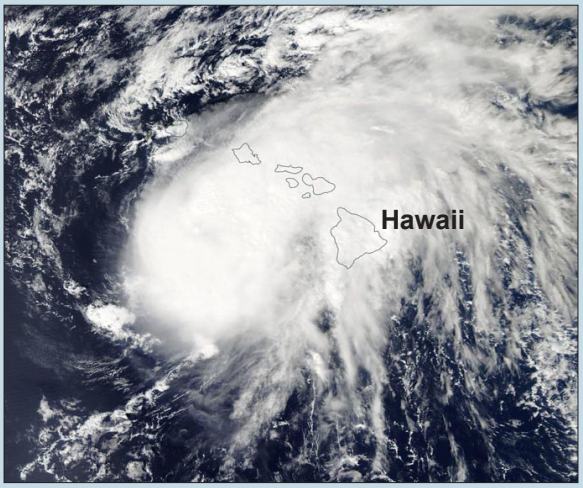
Underwater gliders before their deployment.

The Gonzalo observations were used in real-time numerical model intensity forecasts. They will also be jointly analyzed with observations obtained in Hurricane Bertha to assess their impact on tropical cyclone intensification forecasts.

Recovery of the two gliders is planned for the week of November 16th. Until then, they will continue traversing their respective regions, gathering temperature and salinity profiles. By the end of this first mission, they will have travelled more than 4000 km and collected approximately 3500 temperature and salinity profiles. For more underwater glider information, visit www.aoml.noaa.gov/phod/gliders.

Drifters Deployed Under the Track of Tropical Cyclone Ana

On October 17th, as Tropical Storm Ana strengthened in the Pacific, Air Force Hurricane Hunters deployed 10 drifting buoys in her path. Ana was forecast to become a hurricane as she passed over the drifter array on her approach towards the Hawaiian Islands. Data from nine of the drifters were successfully retrieved, providing information about Ana's wind speeds, wind direction, and barometric pressure, as well as ocean temperatures to 150 m depth and ocean currents in the mixed layer. These drifters helped reveal Ana's strength and the structure of her oceanic wake, and will help improve hurricane intensity forecasting models with an active ocean component. The deployments were coordinated by researchers with NOAA's Global Drifter Program at AOML after negotiations between researchers with AOML's Hurricane Field Program and the National Hurricane Center opened the possibility for this opportunity.



NASA MODIS satellite image of Hurricane Ana sideswiping the Hawaiian Islands on October 18th while passing over an array of NOAA drifting buoys.

AOML Reaches Goal of 8000 XBT Temperature Profiles

AOML reached an important milestone in October: the deployment of 8000 expendable bathythermograph (XBT) probes each year for the past two consecutive fiscal years. XBTs are launched globally from ships of opportunity and measure ocean temperature as they descend through the water. AOML's XBT network includes the maintenance of 15 XBT transects in partnership with institutions from Argentina, Australia, Brazil, France, Italy, Japan, South Africa, and the U.S. In addition to the collection and distribution of temperature profiles, AOML's XBT network also provides support to the National Weather Service for the collection of marine meteorological observations, as well as to the Global Drifter and Argo programs. During the last two fiscal years, 93 drifters and 67 Argo floats were deployed by XBT riders on cargo ships in data sparse remote regions without much ship traffic.

Kyle Seaton of AOML on the stern of the cargo ship *Horizon Navigator,* next to a mounted XBT auto-launcher developed at AOML.

5th Annual NOAA-Miami Health Fair

(hosted by AOML)

Friday, November 14th ☙ 10 am—2 pm

AOML lobby and first-floor conference room

- Federal Employee Health Benefits (FEHB) providers will be onsite to answer questions and provide information about their health care plans
- CVS Pharmacy will be onsite to administer free flu shots with insurance company pre-approval (contact Evan Forde or stop by CVS for the forms)

For more information:
Howie Friedman—954-648-0274; Evan Forde—305-361-4327

- Complimentary health screenings for
  - ✧Blood pressure
  - ✧Blood glucose
  - ✧Spinal assessment
  - ✧Postural analysis
- Complimentary chair massage offered courtesy of Miami-Dade College massage therapy students

Representatives from more than 25 nations gathered in Miami on August 25-29th for a meeting of the Caribbean Marine Atlas Phase 2 (CMA2) project sponsored by the International Coastal Atlas Network (ICAN) of the Intergovernmental Oceanographic Data and Information Exchange (IODE). Linda Pikula, NOAA regional librarian at AOML and IODE Chair for the Group of Experts in Marine Information Management, assisted and participated in organizing the event. Information about the CMA2 project can be found at www.iode.org/index.php?option=com_oe&task=viewEventRecord&eventID=1488.

AOML Researchers Participate in U.S.-Argentina Joint Commission Meeting on Ocean Sciences

Drs. Gustavo Goni and Silvia Garzoli of AOML participated in the U.S.-Argentina Joint Commission Meeting (JCM) on Science and Technology, organized by and held at the U.S. State Department, on October 22-23. The U.S. delegation was led by Catherine Novelli, the U.S. Undersecretary for Economic Growth, Energy, and Environment, and attended by representatives of the Office of Naval Research, National Science Foundation, the State Department, Smithsonian Institution, and several U.S. universities.

The Argentine counterparts were led by their Minister of Science, Technology, and Innovation and attended by the Ministry Director of International Relationships, members of the Argentine Hydrographic Office, Argentine Coast Guard, several Argentine universities, and the Ambassador of Argentina.

Gustavo Goni led the ocean sciences discussions, and Silvia Garzoli presented the status and plans of work related to the South Atlantic Meridional Overturning Circulation (SAMOC) project. Following the discussions, an Action Plan was drafted. This Action Plan included the continuing support of current partnership efforts to maintain the global ocean observing system in the southwest Atlantic Ocean (including surface drifters, Argo floats, and XBT operations), maintain and enhance observational and research efforts related to the SAMOC moorings at 35°S, and increase capacity building in the areas of technological innovation, data stewardship, scientific exchange, and research on regional impacts in ecosystems and the environment related to climate variability. JCMs such as this one present an excellent opportunity to discuss current NOAA and U.S. research work and plans with scientists and high-level government officials.

Dr. Gustavo Goni (AOML), Dr. Cecilia Nahon (Argentine Ambassador to the U.S.), Dr. Lino Baranao (Argentine Minister for Science and Technology), Dr. Agueda Menvielle (National Director for International Relations of Argentina), Dr. Alejandro Mentaberry (Coordinator, Pampa Azul Ocean Sciences Initiative), Dr. Silvia Garzoli (University of Miami and AOML), and Dr. Santiago Ceria (Director, Sadosky Foundation in Argentina).

Welcome Aboard

Dr. Jian Ma joined the Physical Oceanography Division in September as a research associate with the University of Miami's Cooperative Institute for Marine and Atmospheric Studies. Jian will work with Dr. Greg Foltz to conduct research on tropical climate variability, with an emphasis on extreme events in the tropical Atlantic. He received his Ph.D. from the University of Hawaii at Manoa and most recently was a post-doctoral scholar at the University of California-Irvine.

During the afternoon of September 19th, Virginia Key was drenched by a passing rain shower. As the storm subsided, one of AOML's itinerant crocodiles was spotted in the pond that surrounds the northwest corner of the AOML facility resting its snout against a support pier and, apparently, enjoying the rain as it cascaded down upon its head.

Combined Federal Campaign

November 5-26, 2014

AOML CFC Coordinators:

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305-361-4319

Evan Forde
305-361-4327

Alejandra Lorenzo
305-361-4404

Chris Sinigalliano
305-361-4384

Ryan Smith
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Farewell

AOML Director Dr. Bob Altas presents Alan Leonardi with a certificate of appreciation honoring Alan's four years of service as AOML's deputy director.

AOML's Office of the Director and senior leaders hosted a farewell party in September to thank Dr. Alan Leonardi for his four years of service as AOML's deputy director. Alan departed AOML in early October for Silver Spring, Maryland to begin his duties as the new director of NOAA's Office of Ocean Exploration and Research.

Alan's career highlights include more than 16 years of combined research, teaching, science leadership, and management experience in various government, academic, and private industry arenas. During this time, he was awarded research fellowships from the Naval Research Laboratory and National Aeronautics and Space Administration; he also served as a guest speaker/lecturer at national and international scientific meetings and symposia. In 2010, he received a Department of Commerce Silver Medal for his leadership in fostering a partnership with Google, Inc., to make oceanographic data accessible to the scientific community and general public on the Google Earth platform.

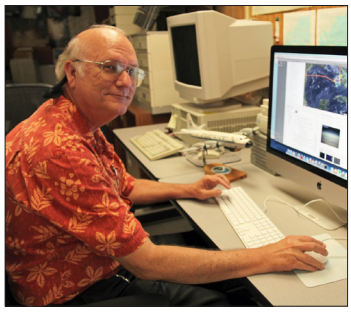
NOAA's Office of Ocean Exploration and Research is dedicated to exploring the deep ocean through the use of state-of-the-art research platforms and vehicles. A key element of this research is the *Okeanos Explorer* program, which uses the NOAA Ship *Okeanos Explorer* to explore the most unknown areas of the world's ocean, while engaging scientists, educators, students, and the public in undersea exploration and discovery through active participation in real time, including high-definition video of the seafloor.

Best wishes to Alan for his continued success.

Congratulations

Ruth Almonte, a budget analyst with the Office of the Director's Admin Group, is one of 15 federal employees in the south Florida area selected to participate in the High Performance Leadership Program (HPLP) facilitated by the South Florida Federal Executive Board. The HPLP is designed to help participants develop a broad range of administrative and managerial competencies through training, lectures, and mentoring. Ruth's professionalism and steadfastness, as well as her commitment to customers and stakeholders, made her an excellent candidate.

Dr. Molly Baringer, Deputy Director of AOML's Physical Oceanography Division, was selected in September to serve as AOML's Acting Deputy Director. Molly fills the vacany left by the departure of Alan Leonardi, AOML's former deputy director. The Office of the Director welcomes Molly and looks forward to her contributions as a member of AOML's management team. Molly previously served as the acting AOML deputy director in 2010 and provided the lab with excellent leadership, particularly during the Deep Water Horizon incident and AOML's associated response.



Neal Dorst of AOML's Hurricane Research Division (HRD) was named NOAA's October 2014 Employee of the Month. Neal serves as the historian and webmaster of HRD, as well as data manager, tape librarian, and archivist. Due to his efforts, all analog, digital, and film data from the early beginnings of the U.S. Weather Bureau's hurricane flights in 1956 to the present day have been preserved. Neal is also seeking to convert all archived analog data into a digital state, ensuring their use by future hurricane research scientists in perpetuity.

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