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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 on Virginia Key in Miami, Florida

Deep Western Boundary Current Data Collected in South Atlantic during International Cruise

Researchers with AOML's Physical Oceanography Division (PhOD) joined with partners from the Argentine and Brazilian Naval Hydrographic Services to collect observations of the Deep Western Boundary Current along 34.5°S as part of the NOAA-funded South Atlantic Meridional Overturning Circulation (SAM) project. The scientists acoustically downloaded data from a line of moored instruments in late December 2010 as part of a research cruise aboard the Argentine research vessel *Puerto Deseado*. This cruise was the fourth conducted as part of an international collaborative program between the United States, Argentina, and Brazil to monitor the western boundary components of the global Meridional Overturning Circulation (MOC) in the South Atlantic.

The MOC is a slow vertical circulation that exchanges surface and deep waters via poleward surface transports, sinking at high latitudes, and upwelling elsewhere. The variability of the Atlantic MOC has been shown in numerical models to impact global climate signals such as air temperature and precipitation over large portions of the Northern Hemisphere and beyond. Observations of the southern portion of the Atlantic MOC are critical to gaining a more complete picture of this complex ocean circulation system.

The SAM instrument array, made up of three inverted echo sounders (IES) equipped with pressure gauges (PIES) and one PIES equipped with an added current meter (CPIES), was deployed in March 2009. The PIES/CPIES array is anchored on the ocean floor at depths ranging from 1300 m to 4500 m. The instruments send sound pulses to the sea surface and listen for the return of the reflected sound waves. The round-trip travel time of these acoustic pulses are then combined with historical hydrographic data to obtain daily estimates of the temperature and salinity for the full water column.

Researchers prepare for CTD (conductivity-temperature-depth) operations after completing an acoustic telemetry download of data from one of the NOAA PIES instruments deployed as part of the South Atlantic Meridional Overturning Circulation array.

The current meter on the CPIES measures the near-bottom current, while the pressure gauges provide information on the variability of deep water flows along the very bottom of the ocean.

While IES technology has been in use for many decades, PhOD researchers were the first to apply IES/PIES/CPIES technology to monitoring Deep Western Boundary Currents in the North Atlantic in 2004. The SAM array is now the first application in the South Atlantic. The array is planned to be in place for at least four years with acoustic data download cruises conducted annually or bi-annually. The present cruise represents the third retrieval of data from the array since its deployment in March 2009.

PhOD researchers are working with collaborators at the Scripps Institution of Oceanography, the University of Miami, and the Massachusetts Institute of Technology, as well as with scientists from France, Argentina, South Africa, and Brazil, to plan a complete trans-basin array of moored instruments in the South Atlantic. The SAM array will be a cornerstone for this new array, which will allow for the measurement of all components of the MOC at 34.5°S and will lead to an improved understanding of the global MOC system.

NOAA's contribution to this effort is funded by the Climate Program Office/Office of Climate Observations, with additional ship time resources provided by the naval hydrographic service agencies of Argentina and Brazil.

Cruise participants, including Rigoberto Garcia of AOML (center), gathered on December 24, 2010 aboard the Argentine research vessel ARA *Puerto Deseado* for a holiday celebration.

Study Proposes New Standards for Hurricane Season Atmospheric Variability

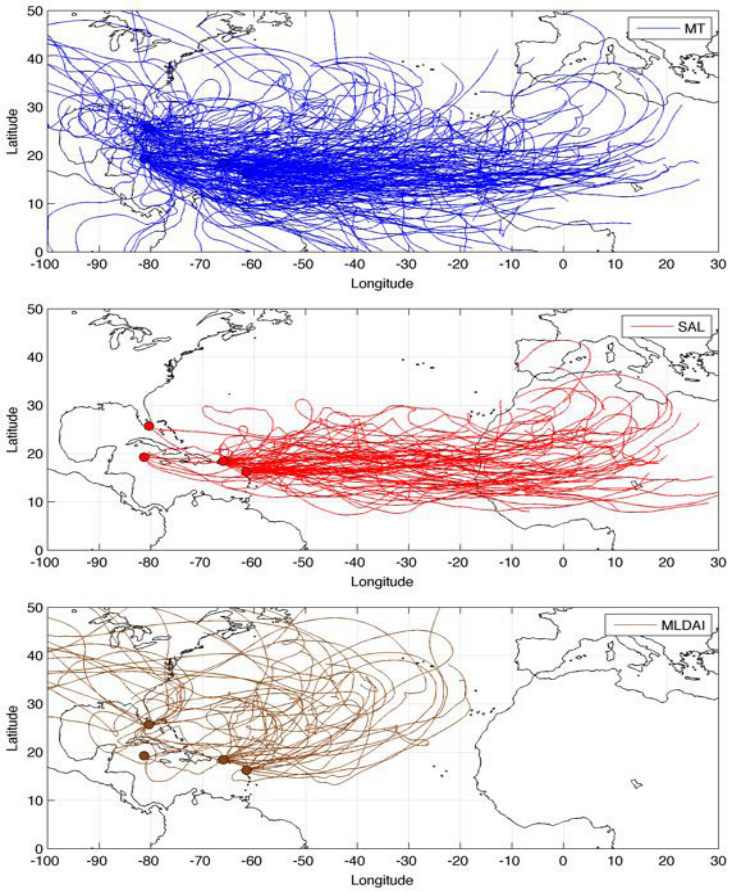
Over the tropical North Atlantic Ocean and Caribbean Sea, the birthplace of hurricanes, meteorologists regularly monitor and measure properties of the atmosphere using devices such as weather balloons to collect data for both forecasts and research. A recent *Journal of Climate* study by Jason Dunion* of AOML's Hurricane Research Division provides new insights about atmospheric variability and proposes three mean tropical soundings rather than one be used as benchmarks to represent the region's climatology during the Atlantic hurricane season (June 1st-November 30th).

Weather balloons that measure air pressure, relative humidity, temperature, and other properties have been routinely launched from Caribbean stations for the past several decades. More than 50 years ago, C.L. Jordan used data collected from these Caribbean weather balloons to assemble a comprehensive climatology, or average profile, of the tropical Atlantic atmosphere.

These three-dimensional atmospheric profiles, known as soundings, provided the first detailed look at the mean temperature and moisture characteristics that exist in the tropical Atlantic during hurricane season. Jordan's pioneering work also provided valuable insight into the conditions necessary for tropical cyclone formation and became a longstanding benchmark for understanding and representing the atmosphere over the tropical Atlantic.

Since Jordan's original 1958 work, advances in balloon sounding technology, the development of meteorological satellites, and improved understanding of the tropical Atlantic have led to a revisit of his atmospheric climatology. Dunion examined 6,000 soundings from four rawinsonde stations in the Caribbean for the core months (July-October) of the 1995-2002 hurricane seasons. Unlike Jordan's study, Dunion focused on identifying the origin of the air masses that were sampled by the ballooned instruments.

Weather balloons measure and transmit atmospheric data to rawinsonde stations on the ground every 1-2 seconds via radiosonde sensors.



Twelve-day back-trajectory analyses showing the origins of the middle level (3,000 m) air masses that regularly affect the four rawinsonde stations used in the Dunion study. *Top panel:* Moist tropical environments (blue curves) account for about two-thirds of the Caribbean balloon soundings, have a relatively wide variety of origins, and support tropical cyclone genesis and intensification. *Middle and bottom panels:* Saharan air layer (red curves) and mid-latitude dry air intrusion (brown curves) air masses overspread the Caribbean about one-third of the time during the Atlantic hurricane season, have more distinct flow patterns across the North Atlantic, and are significantly more hostile environments for tropical cyclones.

Dunion found that three dominant, yet distinct, air masses impact the tropical Atlantic throughout hurricane season—moist tropical air, the Saharan air layer, and mid-latitude dry air intrusions—and that a single mean climatological sounding like Jordan's did not adequately describe the atmosphere's variability. In fact, given the technology and understanding of his day, Jordan may have been unaware that his single mean tropical sounding likely contained a mixture of these three distinct air masses.

The first air mass identified by Dunion, moist tropical air, dominates approximately two-thirds of the tropical Atlantic atmosphere. This sounding has deep vertical moisture, low vertical wind shear, and is quite unstable, making it ripe for tropical cyclone formation. It represents the background tropical atmosphere, yet is routinely interrupted by two other air masses that are more hostile to tropical cyclone formation.

One of the two hostile air masses is the Saharan air layer or SAL, which derives from Saharan dust storms that travel in a thin vertical layer ~1-3 miles above the tropical Atlantic. SAL outbreaks are most active during the early part of the hurricane season and move out over the Atlantic from Africa every three to five days. The SAL sounding contains very dry air, strong winds in the middle levels, and is quite stable, making it less conducive to tropical cyclone development.

The other hostile air mass, the mid-latitude dry air intrusion, originates at high latitudes and routinely impinges on the tropics. The sounding for this air mass brings dry air, strong high level winds, and very stable conditions to the region.

Dunion's study presents three new mean soundings for the tropical North Altantic Ocean-Caribbean Sea and includes information about their variability, temperature, moisture, winds, and stability. These soundings represent a new standard for atmospheric variability and have important implications for better understanding the climatology of this region. "I've updated my hurricane model codes to use these new soundings for my simulations," said Dr. David Nolan, professor of hurricane research at the University of Miami's Rosenstiel School. "Dunion's soundings are more realistic so they provide a more realistic simulation of the tropical cyclone and its development."

Dunion's study could also help enhance understanding of intra- and inter-annual climate variability in the tropical North Atlantic Ocean-Caribbean Sea and has relevancy to tropical cyclone forecasting and modeling.

*Dunion, J.P., 2011: Rewriting the climatology of the tropical North Atlantic and Caribbean Sea atmosphere. *Journal of Climate,* 24(3):893-908 (doi:10.1175/2010JCLI3496.1).

Southern Ocean Sampled to Determine Changes in Ocean Chemistry and Physics

Kevin Sullivan of AOML's Ocean Carbon Group departed McMurdo Station in Antarctica on February 20th to participate in a two-month cruise aboard the U.S. Antarctic Program's icebreaking research ship *Nathaniel B. Palmer*. Sullivan joined a complement of 34 scientists aboard the *Palmer* for sampling efforts in the turbulent Southern Ocean. The cruise is part of an ongoing effort to determine changes in global ocean carbon content and transport in support of the U.S. contribution to the World Climate Research Program's CLIVAR (Climate Variability) Repeat Hydrography Program and the International Ocean Carbon Coordination Project.

Decadal time-scale resampling of hydrographic sections enables researchers to better assess the shifting biogeochemical and physical characteristics occurring in the ocean by quantifying changes in the storage and transport of climatically significant parameters such as carbon dioxide (CO_2), nutrients, fresh water, and heat. The current resampling effort along 67°S follows the track of a 1992 Russia-U.S. cruise called S4P of the *Akademik Ioffe.*

The *Nathaniel B. Palmer* at port near McMurdo Station in Antarctica.

Amidst 18-foot waves and wind gusts greater than 50 knots, a ship-mounted camera photographs the sea washing over the rear deck of the *Nathaniel B. Palmer* during the first week of sampling operations in the Southern Ocean. The CO_2 analyses van in the foreground was off-limits during this time.

Sullivan is assisting Nancy Williams, a research scientist with NOAA's Pacific Marine Environmental Laboratory in Seattle, Washington, in obtaining total inorganic carbon measurements throughout the water column to assess the Southern Ocean's role in sequestering anthropogenic CO_2. A former NOAA Hollings Scholar at AOML, Williams completed a 10-week internship with the Ocean Carbon Group in 2007 under the tutelage of Dr. Rik Wanninkhof.

Sampling operations from aboard the *Palmer* began near Cape Adare in eastern Antarctica, a region known for its high winds and rough seas. Inclement weather brought sampling efforts to a halt for several days as researchers waited for the stormy weather to pass (see photograph above). Nevertheless, preliminary observations suggest that significant changes in seawater temperature and salinity have occurred along the transect of stations northeast of Cape Adare since the last hydrographic survey of the region in 1992. The cold, salty Ross Sea Bottom Water dense outflow so prominent in 1992 is now gone, and the Circumpolar Deep Water offshore is warmer and saltier than it was 19 years ago.

The *Palmer's* 65-day voyage from McMudro Station in Antarctica to Punta Arenas, Chile will end in the latter part of April.

Researchers with the South Florida Program (SFP), an interdisciplinary collaboration between AOML's Ocean Chemistry and Physical Oceanography Divisions, completed a cruise aboard the RV *FG Walton Smith* in February as part of their continuing efforts to monitor the sensitive marine habitats and coastal waters of south Florida. Chris Kelble, an oceanographer with AOML's Ocean Chemistry Division, served as the chief scientist.

For the first time since the SFP's bimonthly cruises began in the early 1990s, observations were obtained in February to quantify the distribution of Sargassum along the western boundary of the Florida Current and over the southwest Florida shelf. The SFP is gathering these observations in response to the Deepwater Horizon Gulf of Mexico oil spill to evaluate the condition of the pelagic seaweeds transported out of the Gulf which serve as a critical food source for sea turtles and other marine animals.

In addition to the Sargassum observations and other data routinely gathered to document the region's circulation, salinity, water quality, and biology, a large, intense *Trichodesmium* bloom was also observed during the cruise that extended for approximately 15 nm to the east of the Dry Tortugas. *Trichodesmium* is a colonial cyanobacterium (blue-green algae) that fixes nitrogen. Blooms are common off the southwest Florida shelf but are less common off the Florida Keys.

A Neuston net deployed to sample south Florida's surface waters is brought aboard the RV *Walton Smith*.

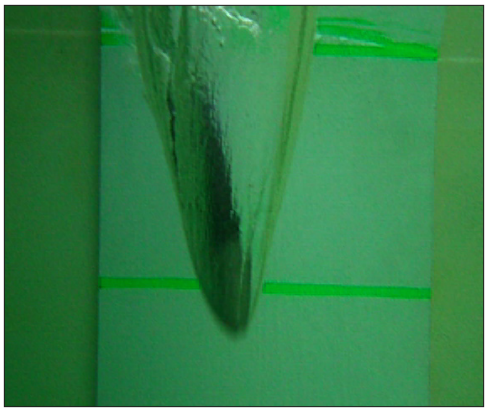
XBT Testing Seeks to Improve Data Accuracy

Researchers with the Ship of Opportunity Program at AOML have been conducting tests to assess the acceleration and terminal velocity of expendable bathythermographs (XBTs). XBTs are instruments deployed from ships around the globe to measure the ocean's temperature to a depth of 800 m. The fall rate of an XBT probe is calculated using a formula provided by the manufacturer that is based on the time an instrument has been in the water.

Through these tests, it is expected that the accuracy of the fall rate equation can be improved, thereby providing better data for future and past XBT drops. To collect the data for these tests, several experiments were carried out in which XBTs, an underwater camera, and a frame of reference were used to calculate acceleration and speed.

To simulate actual deployment conditions, the first step in the testing process was to determine how a probe's angle of entry upon impact with the water surface affected its acceleration. This was achieved by dropping XBTs into a test tank at four different angles: a straight drop (0° angle), a drop with a 45° angle, a drop with a 90° angle, and an inverted drop (180° angle). The drops were performed from heights of 1 m and 3 m, with 3 m being the ideal drop height suggested by the manufacturer.

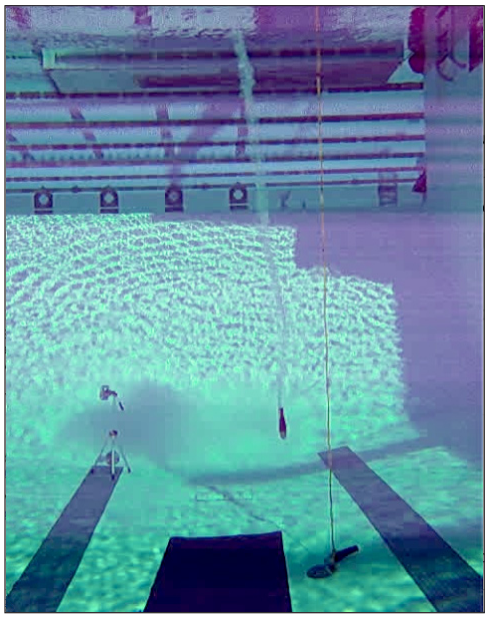
Initial tests closely examined the first 0.5 m of water to determine how quickly an XBT probe would correct itself when dropped from a non-ideal angle. The results were very impressive. All the test probes corrected themselves and headed straight downward within half a second, regardless of their drop angle.



Tests of expendable bathythermographs—XBTs—were initially conducted to observe how a probe's angle of entry at the water surface affected its acceleration.

The tests were then expanded to observe the drop in its entirety to a depth of 2 m, continuing the practice of dropping four XBTs from two different heights. It was found that if a probe was dropped from a height of 3 m, the drop angle was irrelevant to the time it took to reach 2 m. If dropped from 1 m, there was a greater disparity in the amount of time it took to reach its target, although there was only a difference of 1/6 of a second between the fastest and slowest probes.

After the deepest water available for testing was exhausted at AOML, the experiment was moved to the 5-m pool on the main campus of the University of Miami. For these tests, the probes were dropped at 0° angle from heights of 3 m and 5 m. Test results are currently being processed, but the initial conclusion is that the drops from 3 m were about 1/6 of a second slower in reaching the 5 m depth than those dropped from 5 m.



An XBT dropped from a height of 5 m into a pool on the main campus of the University of Miami quickly plunges to the bottom. An underwater camera photographs its descent as a means of calculating the XBT's acceleration and speed.

The next step in this experiment will be to expand the tests to a deeper pool or to the open ocean. There are a few possibilities for additional pools, but pools deeper than 5-10 m are difficult to access for this type of study. If the tests are conducted in the open ocean, they will most likely occur at Looe Key Reef in the Florida Keys.

Mike Jankulak, a CIMAS research associate with AOML's Ocean Chemistry Division and the Coral Health and Monitoring Program, spent the week of January 24th-28th at the Little Cayman Research Centre (LCRC) in the Cayman Islands. While there, he met with Rob Hedges, the new station manager, and gave him a detailed introduction to the care and maintenance of the Little Cayman Coral Reef Early Warning System (CREWS) station. By the end of the week, Hedges was fully trained in climbing the pylon and connecting the station's control unit (or "brain"), which will dramatically increase LCRC's ability to service and upgrade their CREWS station without direct NOAA supervision. Rob becomes only the fourth person in CREWS history to have performed this type of work on a CREWS station.

Mike also facilitated a new collaboration between LCRC and University of Miami Rosenstiel School professor Dr. Peter Minnett when he installed four self-logging temperature sensors on the CREWS station for a graduate-level project being conducted to study sea temperatures near the ocean's surface. This diving work paired Mike Jankulak with diver Mike Rosen who works for LCRC and the Shoals Marine Laboratory. Similar sensors were installed on the La Parguera, Puerto Rico CREWS station in November 2010.

Finally, Mike worked with Rob Hedges, Mike Rosen, and LCRC diver Lowell Forbes to perform the annual instrument replacement on the station. The station's failing satellite transmitter could not be repaired since the LCRC's backup transmitter failed upon deployment. However, the LCRC's radio connection from the station to a land-based computer was repaired so that a "near real time" data link could be fully resumed; the station is once again online and gathering data.

Left: **Perched atop the Little Cayman CREWS station's 38-foot tall pylon, Rob Hedges of the Little Cayman Research Centre installs the station's reprogrammed control unit, or "brain."**

Right: **Subsurface sensors installed along the pylon of the Little Cayman CREWS station record sea temperature and pressure data every six minutes in support of a graduate-level study being conducted by the University of Miami.**

AOML's Physical Oceanography Division Holds Two-Day Science Retreat

AOML's Physical Oceanography Division (PhOD) held a two-day Science Retreat on Virginia Key on February 15-16, 2011. Each PhOD scientist gave a 15-minute presentation about one topic of her or his current research. The goal of this retreat was to share information about the Division's current projects, to participate in useful group discussions, to foster future collaborations both within PhOD and AOML, and with the broader Virginia Key scientific community, and to discuss directions in research within the Division and within AOML.

A total of 44 participants attended the Retreat, from PhOD, the Ocean Chemistry Division, the Hurricane Research Division, the Office of the Director, the University of Miami, the Cooperative Institute for Marine and Atmospheric Studies, the University of Sao Paulo, and the Federal University of Rio Grande, Brazil.

Twenty-six oral presentations were given over the two-day period, divided into five sessions: (1) Atlantic Meridional Overturning Circulation, (2) Tropical Atlantic Variability, (3) Oceans and Ecosystems, (4) Oceans and Weather, and (5) General Physical Oceanography. At the close of the morning and afternoon sessions, there was a 50-minute discussion period. The presentations covered a wide range of ongoing projects, and inspired many lively discussions not only on the five physical oceanography session topics but also on such interdisciplinary topics as hurricanes and the ocean, coastal water quality, and physical oceanography/fisheries joint programs.

Participants of the Physical Oceanography Division's two-day retreat pose for a group photo in between discussion and presentation sessions.

Science discussions recognized the important role of inter-disciplinary work in PhOD research that makes full use of data from multiple platforms. Some examples of such projects included (1) the use of satellite and in situ observations for estimates of meridional heat transport in the North and South Atlantic oceans, (2) satellite and model analysis of fish stock assessment and its link to both episodic and long-term signals, and (3) investigation of the linkage between the tropical oceans and weather and climate using a combination of hydrographic, satellite, and model data. In addition, scientists discussed the importance of encouraging collaborations between early- and mid-career scientists within PhOD and other NOAA laboratories as a means to grow a culture of inter-laboratory collaboration within NOAA.

Overall, the consensus was that the PhOD Science Retreat was an excellent use of the participants' time, allowing everyone to gain a better understanding of the research that PhOD is conducting, and to make connections and collaborations that will lead to future successful and rewarding research for the Division, the Laboratory, and NOAA.

AOML oceanographers will collaborate with members of the Dominican Republic's National Authority of Maritime Affairs (ANAMAR) in April and May of this year during a research cruise aboard the NOAA ship *Nancy Foster*. ANAMAR is a science agency that was recently established to better manage and conserve the Dominican Republic's ocean resources.

Plans for the joint effort were discussed in February during a visit to AOML by a delegation from the Dominican Republic led by Mr. Pelegrin Castillo, President of the Maritime Commission in the Dominican House of Representatives. Castillo and colleagues met with AOML leadership to voice their interest in better defining and exploring the Dominican Republic's national waters; specifically, the need for geological and oceanic current surveys, improved fisheries management to counteract destructive fishing practices, and greater understanding of climate change impacts in the Caribbean through ocean observations that support climate research.

As part of the upcoming *Nancy Foster* larval fish dispersion study in the northeastern Caribbean, AOML researchers will train their Dominican colleagues from ANAMAR in the methods of interdisciplinary oceanography. This will include physical and biological sampling techniques associated with hydrographic surveys and larval fish net tows. Additionally, participants will deploy drifting buoys and learn to utilize the data collected during the cruise to study surface ocean currents and local ocean dynamics. As many as five drifters will be given to researchers in the Dominican Republic for deployment following the *Nancy Foster's* port stop in Santo Domingo.

***Top right*: Representatives from the Dominican Republic pose with AOML staff. Pictured from left to right are Alan Leonardi (AOML Deputy Director), Hugo Orizondo (with La Rinconada), Silvia Garzoli (AOML Chief Scientist), Pelegrin Castillo (President, Maritime Commission in the Dominican House of Representatives), Radhames Batista (Dominican Ambassador to Haiti), and Mayra Pazos (Manager of AOML's Drifter Data Assembly Center).**

***Bottom right:* Mayra Pazos of AOML holds one of several drifting buoys NOAA will give to the Dominican Republic to gather ocean observations in support of improved climate prediction.**

Blue Bell Ice Cream Social

Representatives from the Blue Bell Ice Cream company visited AOML on February 8th to host an ice cream social. Blue Bell sponsored the event in honor of National Weatherperson's Day, officially celebrated on February 5th, in recognition of AOML's role in improving weather forecasts and warnings. The ice cream social was Blue Bell's way of thanking those who help keep them safe while on the roads: the company depends upon daily weather forecasts as a means of ensuring the safety of its delivery drivers and, consequently, the safe delivery of its ice cream to store locations. AOML staffers fully capitalized upon Blue Bell's generous offer to enjoy a variety of its ice cream flavors and left many wishing National Weatherperson's Day was celebrated on a monthly rather than annual basis.

Congratulations

Altug Aksoy and Frank Marks of AOML's Hurricane Research Division were both award recipients at the American Meteorological Society's 91st Annual Meeting in January.

Altug Aksoy, a CIMAS assistant scientist with AOML's Hurricane Research Division, and Frank Marks, director of the Hurricane Research Division, were both award recipients at the American Meteorological Society's 91st Annual Meeting in January. Aksoy received a 2011 Editor's Award for having provided a large number of high quality reviews to several of the editors of the journal *Monthly Weather Review.* Marks received the 2011 Vernon E. Suomi Award, presented for his creative use of airborne Doppler radar aboard NOAA's hurricane hunter aircraft and other technologies that have helped advance understanding of the structure and dynamics of tropical cyclones.

Judith Gray, AOML's former Deputy Director, is the recipient of a 2010 U.S. Department of Commerce Distinguished Career Award. Gray was recognized for her leadership skills, service, and exceptional management of NOAA employees throughout 30 years of Federal service.

2011 Federal Holidays

Martin Luther King, Jr. Birthday
Monday, January 17th

Washington's Birthday
Monday, February 21st

Memorial Day
Monday, May 30th

Independence Day
Monday, July 4th

Labor Day
Monday, September 5th

Columbus Day
Monday, October 10th

Veterans Day
Friday, November 11th

Thanksgiving Day
Thursday, November 24th

Christmas Day
Monday, December 26th

Welcome Aboard

Ian Enochs joined the staff of AOML's Ocean Chemistry Division (OCD) in January as a CIMAS post-doctoral associate. Ian recently earned his Ph.D. from the Department of Marine Biology and Fisheries at the University of Miami's Rosenstiel School and is an expert in coral reef biodiversity and its response to ecosystem degradation. While at AOML, Ian will work with Dr. Derek Manzello of OCD on a project entitled *Coral Growth and Reef Framework Persistence of the Florida Reef Tract with Accelerating Ocean Acidification.* Specifically, Derek and Ian will be investigating the pathways by which ocean acidification affects reef ecosystem structure and function.

Shawana Roach joined the staff of the Administrative Office of AOML's Office of the Director in December 2010. Shawana is working on a part-time basis to provide administrative and management support services to the Admin staff, as well as tending to financial and procurement duties. She is responsible for bankcard reconciliations, the payment of invoices, and management of supplies. Shawana also provides daily updates to the Admin and NOAA financial management systems.

AOML Mourns the Loss of Paul Dammann

Paul Dammann, a former oceanographer with AOML's Ocean Chemistry Division, died in Miami, Florida on January 16, 2011 after a three-year battle with cancer. He was 57 years old.

Paul was introduced to AOML in 1973 shortly after the Laboratory relocated to its newly constructed site on Virginia Key. He was hired on a temporary student appointment and became part of the first group of staffers to occupy the unique, state-of-the-art facility under the leadership of Dr. Harris B. Stewart, AOML's founder. After fulfilling the terms of his appointment, Paul left AOML to pursue his education with the hope of one day returning.

In 1977, Paul rejoined the staff of AOML as an electronics technician. He was made a full-time Federal oceanographer in 1979 after earning a B.S. degree in ocean engineering from Florida Atlantic University. The position was a perfect fit for Paul, a native Floridian who had been fascinated by the ocean since childhood. In 1991, he obtained a M.S. degree from the Applied Marine Physics Division of the University of Miami's Rosenstiel School.

While at AOML, Paul worked in support of a variety of research programs. He was particularly involved, however, with developing and testing acoustic backscatter techniques to detect, measure, and monitor dredged material and wastewater effluent in the coastal ocean environment. In the mid-1980s, he married Jacqueline Chapman, an administrative assistant with AOML's Ocean Acoustics Division. He retired in January 2010 with 32 years of Federal service.

Paul was a part of AOML from its earliest days; his dedication, hard work, and contributions over the years helped to establish the Laboratory as a center for scientific excellence. He is survived by his wife Jackie and daughters Laura and Holly.

In January, AOML oceanographer Evan Forde was a guest lecturer of an educational program created by the Smithsonian Institution to spark greater interest in science and mathematics. Forde made nine presentations to high-school students in Lafayette, Louisiana, an area dramatically impacted by the Deepwater Horizon oil spill, in which he detailed the marine geology that makes the Gulf of Mexico an oil-rich region. He also outlined the harsh conditions on the seafloor that made it difficult to cap the leaking well and the physical and chemical oceanographic processes that moved and transformed the oil once it spilled into the environment. Close to 300 students attended Forde's lectures and participated in hands-on laboratory activities.

Travel

Rik Wanninkhof attended the Impacts of Ocean Acidification on Marine Biology and Ecosystems Workshop in Okinawa, Japan on January 17-19, 2011.

Kelly Goodwin attended the 11th National Conference on Science, Policy, and the Environment: Our Changing Oceans in Washington, DC on January 19-21, 2011.

Altug Aksoy, Gregory Foltz, George Halliwell, Frank Marks, Erica Rule, and Eric Uhlhorn attended the American Meteorological Society's 91st Annual Meeting in Seattle, Washington on January 24-27, 2011.

Bob Atlas chaired the Integrated Observing and Assimilation Systems for the Atmosphere, Ocean and Land Surface Conference at the American Meteorological Society's Annual Meeting in Seattle, Washington on January 24-27th. He also attended Dr. Eddie Bernard's retirement party at NOAA's Pacific Marine Environmental Laboratory on January 24th, as well as the High Impact Weather Workshop in Norman, Oklahoma on February 24th.

Leticia Barbero and Denis Pierrot attended the Third Annual North American Carbon Program All-Investigators Meeting in New Orleans, Lousiana on January 31-February 4, 2011.

Renellys Perez made a presentation and discussed ways to enhance collaborative efforts with researchers at NOAA's Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey on February 2-3, 2011.

Molly Baringer attended a meeting of the Integrated Process Team, a working group of the NOAA Fleet Council, in Washington, DC on February 9-10, 2011.

Dwight Gledhill, Christopher Kelble, and Michelle Wood attended the ASLO Aquatic Sciences Meeting in San Juan, Puerto Rico on February 14-18, 2011.

Alan Leonardi attended a NOAA Senior Research Council meeting in Boulder, Colorado on February 7-11, 2011. He also attended an Ocean Research Visioning Workshop sponsored by the X Prize Foundation in Washington, DC on February 24, 2011.

Rick Lumpkin and Renellys Perez attended a planning meeting for a National Science Foundation study of high frequency drifter motion in Seattle, Washington on February 22-24, 2011.

Gregory Foltz and Gustavo Goni attended a NASA Aquarius/SPURS (salinity processes in the upper ocean regional study) planning meeting in Boston, Massachusetts on February 22-25, 2011.

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

Brandt, P., V. HORMANN, A. Kortzinger, M. Visbeck, G. Krahmann, L. Stramma, R. LUMPKIN, and C. SCHMID, 2010: Changes in the ventilation of the oxygen minimum zone of the tropical North Atlantic. *Journal of Physical Oceanography*, 40(8):1784-1801 (doi:10.1175/ 2010JPO4301.1).

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Jiang, L.-Q., W.-J. Cai, R.A. Feely, Y. Wang, X. Guo, D.K. GLEDHILL, X. Hu, F. Arzayus, F. Chen, J. Hartmann, and L. Zhang, 2010: Carbonate mineral saturation states along the U.S. east coast. *Limnology and Oceanography,* 55(6):2424-2432 (doi:10.4319/lo.2010.55.6.2424).

KELBLE, C.R., P.B. Ortner, G.L. Hitchcock, M.J. Dagg, and J.N. Boyer, 2010: Temporal and spatial variability of mesozooplankton in a shallow subtropical bay: Influence of top-down control. *Estuaries and Coasts,* 33(3):727-737 (doi:10.1007/ s12237-010-9270-9).

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Kimball, S.K., M.S. Mulekar, S. CUMMINGS, and J. STAMATES, 2010: The University of South Alabama Mesonet and coastal observing system: A technical and statistical overview. *Journal of Atmospheric and Oceanic Technology,* 27(9): 1417-1439 (doi:10.1175/2010JTECHA1376.1).

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Atlantic Oceanographic and Meteorological Laboratory

4301 Rickenbacker Causeway
Miami, FL 33149
www.aoml.noaa.gov

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