



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

AOML Researchers Continue Efforts to Monitor the Tropical Atlantic

Researchers with AOML's Physical Oceanography Division participated in a trans-Atlantic cruise beginning in January to gather an array of oceanographic and meteorological data and to service a network of deep ocean moored buoys. The effort in support of the PIRATA (Prediction and Research Moored Array in the Tropical Atlantic) project brought together three research teams aboard the NOAA Ship *Ronald H. Brown*.

The PIRATA Northeast Extension (PNE) cruise began with the *Brown's* departure from Charleston, South Carolina on January 8th and ended a month later on February 13th in San Juan, Puerto Rico (see cruise track on page 2).

The AOML team – Claudia Schmid (chief scientist for the cruise), Greg Foltz, Grant Rawson, Zachary Barton, and Dillon Amaya – led the overall project aboard the *Brown* and collected hydrographic observations, while the team from NOAA's Pacific Marine Environmental Laboratory (PMEL) led the effort to service the moored buoys. The AEROSE



Three research teams—hydrographic (AOML), moorings (PMEL), and atmospheric (AEROSE)—pose for a group photograph aboard the NOAA Ship *Ronald H. Brown* during the annual PIRATA Northeast Extension cruise across the Atlantic. PIRATA observations are gathered to better understand climate variability in the tropical Atlantic Ocean.

(Aerosols and Ocean Science Expeditions) team representing NOAA's Center for Atmospheric Sciences at Howard University collected atmospheric observations.

PIRATA is a multinational collaboration between Brazil, France, and the United States to better understand the ocean-atmosphere dynamics occurring in the tropical Atlantic Ocean and the resulting climate impacts on the countries bordering the Atlantic basin. Through the deployment and maintenance of an array of deep ocean moored buoys that measure oceanographic and meteorological variables, the PIRATA project monitors the upper ocean and near-surface atmosphere of the tropical Atlantic.

The original array, deployed between 1997 and 2001, consisted of ten moored buoys running east-west along the equator that extended southward to 10°S at 10°W and northward to 15°N at 38°W. Since 2001, the array has expanded to include the northeast, southeast, and southwest portions of the Atlantic.

The northeast extension of the PIRATA array (three moorings at 23°W north of the equator and a mooring near 20°N, 38°W) is an important region for data collection due to the strong climate variations that occur there on intraseasonal to decadal scales. Previous studies have shown that these climate variations play a critical role in rainfall rates on adjacent land masses (e.g., the United States) (continued on page 2)



Zachary Barton of AOML and Jonathan Shannahoff, the chief survey technician aboard the NOAA RV *Ronald H. Brown*, gather water samples from a CTD (conductivity-temperature-depth) rosette for analysis of oxygen titration and salinity.

(continued from page 1)

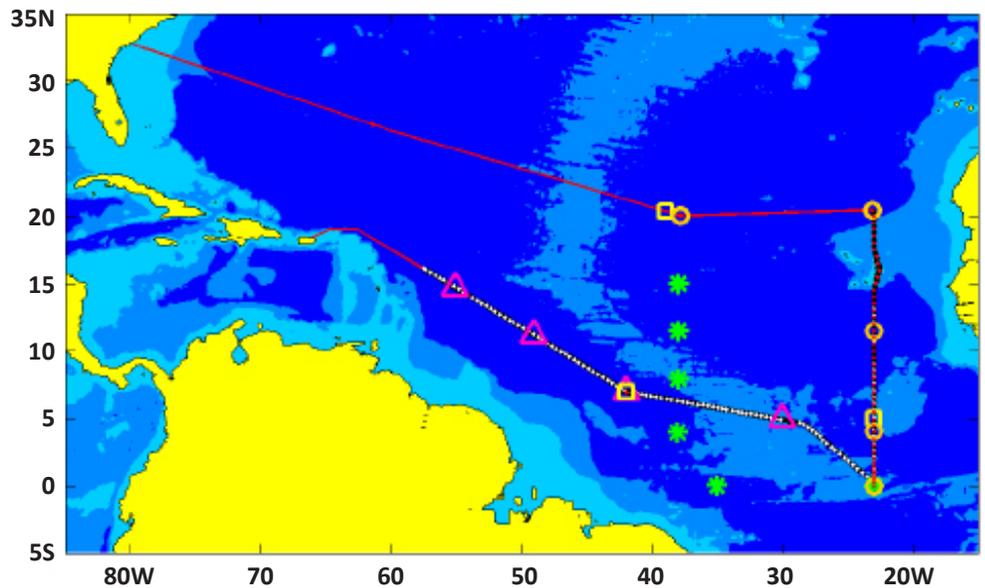


The NOAA R/V *Ronald H. Brown* during small boat operations in the Atlantic at the equatorial PIRATA mooring at 23°W.

States and Brazil) and for the formation of tropical cyclones in the North Atlantic.

The suite of oceanographic observations collected by AOML's hydrographic team included 50 casts of the CTD/O₂/LADCP (conductivity-temperature-depth/oxygen/lowered) acoustic Doppler current profiler) system, taken mostly along 23°W, to measure ocean temperature, salinity content, density, dissolved oxygen, and current velocity. The team also completed 265 XBT (expendable bathythermograph) profiles to measure the heat content in the upper ocean and 120 underway CTD profiles taken along 23°W and along the return transit to Puerto Rico.

During the cruise, nine mooring sites were visited. The PMEL team recovered and redeployed four ATLAS moorings that belong to the northeast extension of the PIRATA array and a TFlex mooring (the next generation ATLAS mooring) near 20°N, 38°W. They also performed a



Track (red line) of the NOAA RV *Ronald H. Brown* during 2013 PIRATA Northeast Extension cruise. Buoy recovery and deployment sites are denoted by circles, CTD stations by red dots, XBT profiles by black dots, underway CTD profiles by white dots, hydrophone mooring sites by squares, and Argo deployment locations by triangles.

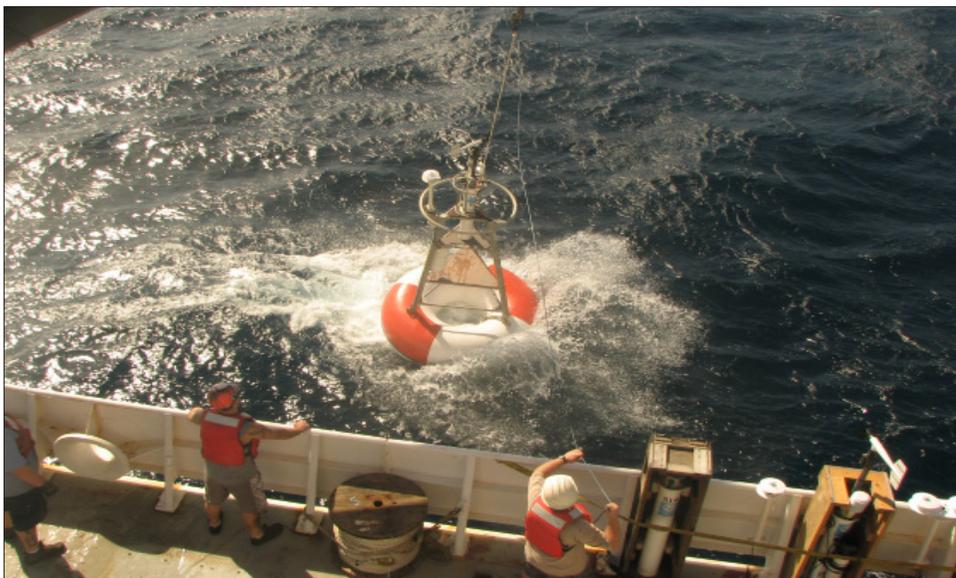
sensor swap and tube reprogramming on the PIRATA mooring at 0°N, 23°W.

As in previous years, the AEROSE team collected meteorological observations of aerosols, ozone, and atmospheric conditions. These data are being used to investigate the effect of the Saharan air layer on the marine boundary layer, clouds, precipitation, and the surface radiation balance.

The 2013 PNE cruise also supported several additional projects to gather more measurements and to test existing observational technologies. The AOML team collected data that will result in an improvement to XBT technology by

conducting six sets of XBT/XCTD comparison drops using 108 probes. These tests were performed near selected CTD stations using instruments provided by Sippican. The AOML team also tested an underway CTD system throughout the cruise and deployed five Argo profiling floats in regions of low float density. The PMEL team recovered and redeployed two hydrophone moorings and deployed one new hydrophone mooring.

PIRATA observations have become an important component of the global ocean observing system that contribute to climate studies, as well as to operational weather, ocean, and climate forecasting.



Deployment of an ATLAS (Autonomous Temperature Line Acquisition System) buoy to measure atmospheric variables including wind direction and speed, air temperature and humidity, rainfall, and solar radiance, as well as oceanic properties from the sea surface to depths as great as 500 m.



Recovery of a hydrophone mooring used to detect and record seismic activity and sounds from whales.

Coral Monitoring Station Surveyed and Upgraded

During the week of January 28th to February 1st, Pamela Fletcher and Mike Jankulak of AOML's Ocean Chemistry Division travelled to La Parguera, Puerto Rico to replace instruments on the Coral Reef Early Warning System (CREWS) station at Media Luna Reef and survey the surrounding area.

CREWS stations monitor and assess the health of coral reefs. The near real-time data they gather are transmitted to AOML for processing by an expert system that uses artificial intelligence technology and then posted to the CHAMP web site. Early warning alerts are issued when parameters conducive to coral bleaching and other impact events for corals and coral reef ecosystems are met.

The La Parguera station was last visited in August 2012 (also by Pamela and Mike) for an extensive equipment swapout. By mid-October 2012, however, the station's hourly satellite transmissions had mostly gone silent, and its GOES transmitter and antenna appeared to be in need of replacement. By all other indications the station seemed to be operating normally (and writing data to a local memory card), except for the integrated Weather Transmitter (WXT), whose acoustic wind



Pamela Fletcher assembles a 1-meter PVC frame to conduct photographic surveys of the ocean floor environment surrounding the La Parguera CREWS station.

sensors had failed. Thus, the WXT was also targeted for replacement.

On site, Mike conducted several climbs up the station's pylon to replace the GOES antenna, the antenna cable, and WXT transmitter. Locally-stored data (from August 2012 through January 2013) were recovered and downloaded to a laptop computer, and an updated data logger program was installed.

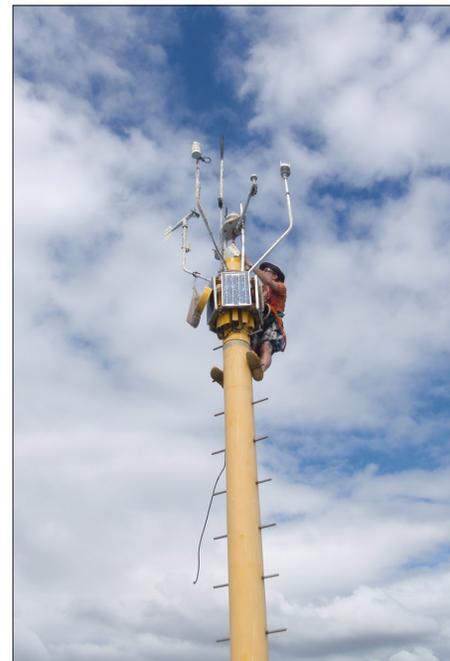
While at the station, two very large birds were seen resting on the station's extended structures and instruments, including the analog anemometer, surface light sensor, and satellite antenna. These birds did not fly away, even while Mike worked at the top of the station.

Meanwhile, Pamela brought along a PVC frame which she designed and built in collaboration with AOML's Michael Shoemaker. The base of the frame features a 1-meter box with 10-centimeter length stripes, and the top holds an opening for the CHAMP underwater camera.

Using this frame, Pamela led two dives to lay out 25-meter transects in all four cardinal directions from the base of the station and then photographed the biology and substrate types surrounding the station



Photographic survey example of the ocean floor environment at the La Parguera CREWS site using an underwater camera in conjunction with a newly developed 1-meter PVC frame.



Working approximately 18-20 feet above sea level, Mike Jankulak removes a failed satellite antenna from the La Parguera CREWS station.

in 1-meter increments. Each photograph shows the 1-meter box for size reference (see photo below). These photographic surveys provide a useful baseline for future biological studies of the area, as well as provide a useful model for surveys at other CREWS stations.

Following the work at the La Parguera CREWS site, data transmissions initially resumed with a >90% success rate, although there continued to be short, intermittent outages that were not traceable to equipment malfunction. The persistent presence of the large birds observed perching on the antenna is suspected of affecting the strength of the transmission signal. A subsequent failure of data communications on March 17th is likely due to a loose connection from the station's solar panels and will be addressed at the earliest opportunity.

Nevertheless, work is proceeding on near real-time feeds of data to the CHAMP web reports, the National Data Buoy Center, the G2 Ecoforecasting System, and the CHAMP database. Additionally, an upcoming collaboration between AOML's CHAMP researchers and Sonia Otero of AOML's Hurricane Research Division is expected to result in a web-based query prototype for data from the CHAMP database.

The AOML team is grateful to the University of Puerto Rico and its facility on Magueyes for the warm welcome and logistical support.

2013 Federal Holidays

New Year's Day
Tuesday, January 1st

Martin Luther King, Jr. Birthday
Monday, January 21st

Washington's Birthday
Monday, February 18th

Memorial Day
Monday, May 27th

Independence Day
Thursday, July 4th

Labor Day
Monday, September 2nd

Columbus Day
Monday, October 14th

Veterans Day
Monday, November 11th

Thanksgiving Day
Thursday, November 28th

Christmas Day
Wednesday, December 25th

Exhibit Highlights NOAA's Hurricane Hunter Aircraft and Field Program

The Miami Science Museum is the home of a captivating new exhibit that highlights the role of NOAA and its hurricane field program. Unveiled in November 2012, the exhibit commands attention when you turn the corner and come face to face with the nose cone of a P-3 aircraft, painted to replicate a NOAA hurricane hunter plane complete with Miss Piggy and Kermit the Frog insignias on either side.

AOML partnered with Florida International University's International Hurricane Center (IHC) to create the new hurricane display. The life-size cockpit has been used in different venues over the years, and was procured through the IHC for this exhibit. AOML and NOAA's Aircraft Operations Center contributed to the new display, including the donation of four P-3 seats, the instrument panel design, drop-



Replica of the nose cone of NOAA's P-3 aircraft on display at the Miami Museum of Science.



Youngsters at the Miami Science Museum explore the cockpit of NOAA's P-3 hurricane hunter aircraft.

sondes, videos, animations, and interviews to help tell the story of NOAA's hurricane hunter program.

The hurricane exhibit also features displays that discuss the science of hurricane formation and observation, including a beautiful mural depicting a cross section of a hurricane, complete with a P-3 aircraft flying in the eye.

Adjacent to the P-3 replica is a display on the history of Hurricane Andrew (1992) and its devastating impacts on South Florida, a working small-scale version of Florida International University's 12-fan

Wall of Wind, and an interactive Magic Planet that uses NOAA data and visuals projected into a 5-foot diameter globe. Together, these displays and activities create a wonderful space to learn about earth science in a fun environment.

AOML will continue to partner with IHC and the Miami Science Museum to identify additional topics for future exhibits, with a goal that the exhibits be displayed at the museum's new site in downtown Miami's Bayfront Park, the Patricia and Phillip Frost Museum of Science, scheduled to open in 2015.

Researchers Meet to Discuss Tropical Cyclone Forecasting in the Western Pacific

Drs. Sundararaman Gopalakrishnan and Xuejin Zhang of AOML's Hurricane Research Division were invited participants at the High-Resolution Regional Modeling for Tropical Cyclones Workshop in Shanghai, China on December 20-21, 2012. The event was hosted by the Shanghai Typhoon Institute (STI) of the China Meteorological Administration (CMA) and held at the Shanghai Meteorological Bureau.

Workshop participants met to discuss the progress made towards producing more accurate tropical cyclone predictions, generating better data assimilation and physics techniques, and applying NOAA's Hurricane Weather Research and Forecasting (HWRF) high-resolution model to the western Pacific region.

Discussions also focused on future directions for model development, how to



Workshop participants, including Drs. Xuejin Zhang and Sundararaman Gopalakrishnan of AOML (third and fourth from the left in front row), in Shanghai, China.

improve the operational forecast systems at SMB, and the possibility for collaboration between CMA/STI and NOAA. The need to enhance STI's typhoon prediction capabilities, including the use of a high-

resolution numerical modeling system, was recognized. Several recommendations to establish a collaborative research effort between NOAA and CMA/STI researchers were presented.

AOML Hosts International Workshop on South Atlantic Basinwide Array

Drs. Christopher Meinen, Renellys Perez, and Shenfu Dong of AOML's Physical Oceanography Division hosted an international workshop at AOML on January 29-31st to discuss logistics and planning for a trans-basin array to measure the Meridional Overturning Circulation (MOC) along 34.5°S in the Atlantic.

The need for a trans-basin MOC array in the South Atlantic has been well documented, with a specific call for it in the recent U.S. Atlantic MOC implementation plan. Further support comes from a broad initiative to improve understanding of the MOC in the South Atlantic (SAMOC) that was recently endorsed by the international CLIVAR organization.

Since 2009, NOAA-AOML has been maintaining a "cornerstone" array of four pressure-equipped inverted echo sounders to monitor the western boundary components of the MOC at 34.5°S as part of the Southwest Atlantic MOC (SAM) project.

During the workshop, partners from AOML, the University of Miami, and the Scripps Institution of Oceanography joined with international participants from France, South Africa, and Brazil to discuss the recent (December 2012) deployment of new Brazilian moorings that augment the existing SAM western boundary array. The group also made plans for new French and South African



Participants of an international workshop at AOML to discuss implementation of an Atlantic basinwide array along 34.5°S. Missing from the photo are Drs. Edmo Campos and Gustavo Goni.

deployments that will occur near the eastern boundary later in 2013.

Agreements were made regarding deployment locations, sampling strategies, and processing methods to be used in this multi-national collaborative project. Data sharing policies and plans for student collaborations and scientific publications

were also agreed upon. Finally, plans were discussed for a collaborative U.S.-Brazil proposal to further augment the western boundary array.

The results from this workshop will hopefully lead to the actual implementation of a prototype MOC basin-wide array along 34.5°S by the end of 2013.



Pond on the northwest corner of AOML



AOML main gate

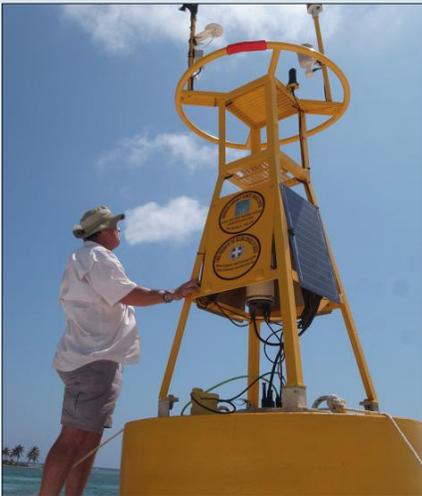
Whether taking a leisurely swim, patrolling the main gate, or soaking up the rays, AOML's itinerant band of 3-5 American crocodiles, collectively known as "Darwin," is never far away. Although normally timid, crocodiles are territorial and can become aggressive during mating season or if they feel threatened. Darwin siring email alerts help keep AOML staff aware of their presence and of the need for vigilance. South Florida is the only region in the U.S. where this endangered species is found. More information about crocodiles can be found at <http://www8.nos.noaa.gov/onms/park/parks/SpeciesCard.aspx?PID=8&refID=6&CreatureID=730>.



Mangrove and pond on the northwest corner of AOML

The 12th meeting of the Group of Experts on Marine Information Management (GEMIM) of the International Oceanographic Data and Information Exchange (IODE) was held at the NOAA Regional Library at AOML on January 22-25th. Participants include representatives from Cameroon, Senegal, the Cayman Islands, Ukraine, Canada, Italy, Belgium, and the United States.

Linda Pikula, regional NOAA librarian and GEMIM chairperson, hosted the meeting and welcomed participants to Miami. Products that are produced and guided by GEMIM on behalf of IODE include OceanExpert, OceanDocs, Aquatic Commons, and the OceanTeacher workshops conducted in developing countries.



A Coral Reef Early Warning System (CREWS) buoy was installed at the University of Belize (UB) field station on Calabash Caye, Belize in February as part of an effort between NOAA's Coral Health and Monitoring Program (CHAMP) and the Caribbean Community Climate Change Center (5C's). The buoy will monitor environmental conditions in the Turneffe Atoll Marine Reserve, one of the largest and most biologically diverse coral reef ecosystems in the western hemisphere. AOML-CHAMP researcher Jim Hendee worked with Jon Fajans of 5C's (pictured above) and John Halas of Environmental Moorings International, Inc. to install the buoy, which is now part of a growing global network of stations dedicated to assessing environmental impacts on coral reef ecosystems. NOAA posts the real-time data gathered by the network online for use by the international science community. Ecological forecasts for coral bleaching and other marine environmental events will be formulated in the future for use by the CHAMP group and partnering research laboratories. The station will be maintained by UB staff and scientists.

For information, contact Erica Rule at 305-361-4541 or Essie Coleman-Duffie at 305-361-4237

May 24th—Student Day
May 25th—General Public

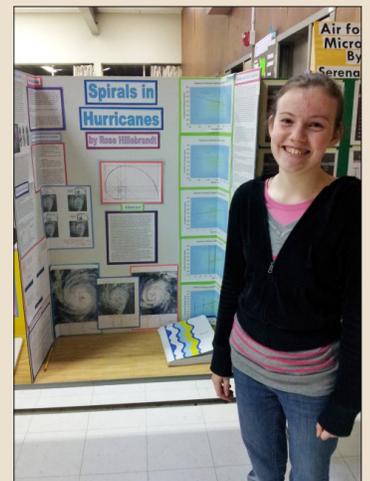
May 24 and 25
10 AM - 3 PM

NOAA Open House!

75 Virginia Beach Drive, across from the Miami Seaquarium on Virginia Key

NOAA's Southeast Fisheries Science Center and Atlantic Oceanographic and Meteorological Laboratory are hosting an open house for the general public. Learn about fisheries, coasts, corals, hurricanes, and meet NOAA scientists!

Rose Hillebrandt, an 8th grade student at Goleta Valley Junior High School in Goleta, California, contacted the NOAA Miami Regional-National Hurricane Center Branch Library in February for information related to her science project about hurricanes. Data sources supplied by the librarian supported the 13-year old student's research on the possible correlations between the shape of a hurricane's spiral bands and various physical characteristics such as wind speed, precipitation, and the size of the hurricane eye. Rose's project has since been selected to advance to the Santa Barbara county-wide level of competition. Congratulations to Rose! Miami's regional librarians look forward to your continued use of NOAA's resources for your future education and profession.



Welcome Aboard

Dr. Zhenya Song joined the staff of AOML's Physical Oceanography Division in January as a postdoctoral research associate with the University of Miami's Cooperative Institute for Marine and Atmospheric Studies. During his time at AOML, Zhenya will work with Drs. Sang-Ki Lee and Chunzai Wang to examine the coupled ocean-atmosphere model biases in the tropical Atlantic by performing model experiments. Zhenya obtained his Ph.D. in physical oceanography from the Ocean University of China in 2011 and previously worked as a researcher in charge of the FIO-ESM CMIP5 experiments at the First Institute of Oceanography of the State Oceanic Administration in Qingdao, China.



Dr. Kelly Kearney joined the staff of AOML's Ocean Chemistry Division in January as a post-doctoral scientist with the Marine Biology and Fisheries Division of the University of Miami's Rosenstiel School of Marine and Atmospheric Science. While at AOML, Kelly will work with Dr. Chris Kelble to couple physical, biogeochemical, and ecological models to investigate the combined ecological effects of climate change and south Florida ecosystem restoration. Prior to her arrival at AOML, Kelly was a collaborator at NOAA's Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey while she pursued her doctoral degree. Kelly earned her Ph.D. in 2012 from the Department of Geosciences at Princeton University.



AOML recycles:

- Paper
- Cardboard
- Aluminum cans
- Clear/green/brown colored glass
- Plastic bottles and containers (nos. 1, 2, and 3)
- Batteries (lithium & dry/wet cell)



Congratulations

AOML's Hurricane Research Division-Hurricane Weather Research and Forecast Model Development Team is the recipient of a 2012 NOAA Research Employee of the Year Award. The award recognizes employees who have made outstanding contributions to the promotion of excellence in the operations or programs of NOAA's Office of Oceanic and Atmospheric Research. The team members—Dr. Sundararaman Gopalakrishnan [team lead], Dr. Thiago Quirino, Stanley Goldenberg, Robert Black, and Dr. Frank Marks, along with Dr. Xuejin Zhang and Lisa Bucci of the University of Miami's Cooperative Institute for Marine and Atmospheric Studies—were recognized through a group award for “innovative work on the NCEP/EMC (National Centers for Environmental Prediction/Environmental Modeling Center) hurricane forecast model that has led to greatly improved hurricane track and intensity forecasts.”



The HWRf Model Development Team (clockwise from left to right): Lisa Bucci, Sundararaman Gopalakrishnan (team leader), Robert Black, Thiago Quirino, Stanley Goldenberg, Frank Marks, and Xuejin Zhang.

Dr. Chunzai Wang, an oceanographer with AOML's Physical Oceanography Division, is the recipient of a 2012 NOAA Research Employee of the Year Award. Chunzai was recognized for his personal and professional excellence and exceptional productivity. During fiscal year 2012, Chunzai had eight papers published in scientific journals, 10 papers accepted for publication, and four papers submitted for review. Three of his publications were highlighted in the journals *Science*, *Nature*, and *Nature Geosciences*. While maintaining this high level of productivity, Chunzai also served as an editor for the *Journal of Geophysical Research* (Oceans), an associate editor for the *Journal of Climate*, and as a member of the editorial board for two international journals, the *Indian Journal of Geo-Marine Sciences* and the *Journal of Ocean University of China*. Chunzai's research has provided significant advances in understanding the ocean's role in extreme weather events and on longer-term climate scales, thus advancing climate science that has benefitted both NOAA and the nation.



Drs. Chunzai Wang and Robert Detrick.

Farewell

Dr. Sylvie Lorsolo, a Cooperative Institute for Marine and Atmospheric Studies scientist with AOML's Hurricane Research Division, resigned in December to accept a position with AIR Worldwide in Boston, Massachusetts. During Sylvie's five years at AOML, she analyzed tail Doppler radar data gathered from aboard NOAA's hurricane hunter aircraft to document the fine-scale structure of the hurricane boundary layer. She produced new insights into the structure of turbulent kinetic energy in the hurricane boundary layer and eyewall. Sylvie was also instrumental in developing techniques for testing the impact of new observing strategies using the Doppler radar in observing system simulation experiments.



Dr. Michelle Wood, director of AOML's Ocean Chemistry Division, resigned from federal service in January to return to the Institute for Ecology and Evolution at the University of Oregon. As a professor of biology, Michelle will focus on building a new non-majors science literacy course to educate students about coastal issues in Oregon and ocean issues globally, as well as performing research on phytoplankton and the physical processes that influence them. During her three years at AOML, Michelle led the overall research activities of AOML's Ocean Chemistry Division, including serving as Chief Scientist on several Deepwater Horizon related research cruises and leading a multi-institutional effort to calibrate fluorescence-based oil sensors in Nova Scotia.





Department of Commerce

1401 Constitution Avenue, NW
Washington, DC 20230
www.doc.gov

Dr. Rebecca A. Blank
Acting Secretary



National Oceanic and Atmospheric Administration

1401 Constitution Avenue, NW
Room 5128
Washington, DC 20230
www.noaa.gov

Dr. Kathryn D. Sullivan
Acting Undersecretary of
Commerce for Oceans and
Atmosphere and
NOAA Administrator



Office of Oceanic and Atmospheric Research

1315 East-West Highway
Silver Spring Metro Center
Building 3, Room 11458
Silver Spring, MD 20910
www.oar.noaa.gov

Dr. Robert S. Detrick
Assistant Administrator

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

BARINGER, M.O., S.A. Cunningham, **C.S. MEINEN**, **S. GARZOLI**, J. Willis, M. Lankhorst, A. Macdonald, U. Send, W.R. Hobbs, E. Frajka-Williams, T.O. Kanzow, D. Rayner, W.E. Johns, and J. Marotzke, 2012: Global oceans: Meridional overturning circulation observations in the subtropical North Atlantic. In *State of the Climate in 2011*, J. Blunden and D.S. Arndt (eds.). *Bulletin of the American Meteorological Society*, 93(7):S78-S81.

Bell, G.D., E.S. Blake, C.W. Landsea, T.B. Kimberlain, **S.B. GOLDENBERG**, J. Schemm, and R.J. Pasch, 2012: The tropics: Atlantic basin. In *State of the Climate in 2011*, J. Blunden and D.S. Arndt (eds.). *Bulletin of the American Meteorological Society*, 93(7):S99-S105.

Boyer, T., S. Levitus, J. Antonov, J. Reagan, **C. SCHMID**, and R. Locarnini, 2012: Global oceans: Subsurface salinity. In *State of the Climate in 2011*, J. Blunden and D.S. Arndt (eds.). *Bulletin of the American Meteorological Society*, 93(7):S72-S75.

Everroad, R.C., and **A.M. WOOD**, 2012: Phycoerythrin evolution and diversification of spectral phenotype in marine Synechococcus and related picocyanobacteria. *Molecular Phylogenetics and Evolution*, 64(3):381-392.

Feely, R.A., C.L. Sabine, R.H. Byrne, F.J. Millero, A.G. Dickson, **R. WANNINKHOF**, A. Murata, L.A. Miller, and D. Greeley, 2012: Decadal changes in the aragonite and calcite saturation state of the Pacific Ocean. *Global Biogeochemical Cycles*, 26:GB3001 (doi:10.1029/2011GB004157), 15 pp.

GONI, G.J., J.A. Knaff, and I.-I. Lin, 2012: The tropics: Tropical cyclone heat potential. In *State of the Climate in 2011*, J. Blunden and D.S. Arndt (eds.). *Bulletin of the American Meteorological Society*, 93(7):S114-S116.

GRAMER, L.J., A.J. Mariano, and **J.C. HENDEE**, 2012: Heat budget for Florida reefs: Reef-scale thermal stress via satellite. *Proceedings, 12th International Coral Reef Symposium*, D. Yellowlees

and T.P. Hughes (eds.), Cairns, Australia, July 9-13, 2012. James Cook University, 5 pp.

HENDEE, J., L.J. GRAMER, S.F. Heron, M. JANKULAK, N. AMORNTHAMMARONG, M. SHOEMAKER, T. Burgess, J. Fajans, S. Bainbridge, and W. Skirving, 2012: Wireless architectures for coral reef environmental monitoring. *Proceedings, 12th International Coral Reef Symposium*, D. Yellowlees and T.P. Hughes (eds.), Cairns, Australia, July 9-13, 2012. James Cook University, 5 pp.

Kruczynski, W.L., and **P.J. FLETCHER** (eds.), 2012: *Tropical Connections: South Florida's Marine Environment*. IAN Press, University of Maryland Center for Environmental Science, Cambridge MD, 492 pp.

Moyer, R.P., T.S. Viehman, G.A. Piniak, and **D.K. GLEDHILL**, 2012: Linking seasonal changes in benthic community structure to seawater chemistry. *Proceedings, 12th International Coral Reef Symposium*, D. Yellowlees and T.P. Hughes (eds.), Cairns, Australia, July 9-13, 2012. James Cook University, 5 pp.

LUMPKIN, R., G. GONI, and K. Dohan, 2012: Global oceans: Surface currents. In *State of the Climate in 2011*, J. Blunden and D.S. Arndt (eds.). *Bulletin of the American Meteorological Society*, 93(7):S75-S78.

Sabine, C.L., R.A. Feely, **R. WANNINKHOF**, T. Takahashi, S. Khatiwala, and G.-H. PARK, 2012: Global oceans: Global ocean carbon cycle. In *State of the Climate in 2011*, J. Blunden and D.S. Arndt (eds.). *Bulletin of the American Meteorological Society*, 93(7):S84-S89.

WANG, C., 2012: The tropics: Atlantic multi-decadal oscillation. In *State of the Climate in 2011*, J. Blunden and D.S. Arndt (eds.). *Bulletin of the American Meteorological Society*, 93(7):S119-S122.

ZHANG, L., and L. Wu, 2012: Can oceanic freshwater flux amplify global warming? *Journal of Climate*, 25(9):3417-3430.

Atlantic Oceanographic and Meteorological Laboratory (AOML)

4301 Rickenbacker Causeway
Miami, FL 33149

- Dr. Robert Atlas.....AOML Director
- Dr. Alan LeonardiAOML Deputy Director
- CDR Stephen MeadorAOML Associate Director
- Dr. Frank MarksHurricane Research Division Director
- Dr. Alan Leonardi (Acting).....Ocean Chemistry Division Director
- Dr. Gustavo Goni.....Physical Oceanography Division Director

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

Keynotes publishing editor: Gail Derr



www.aoml.noaa.gov

AOML conducts research to understand the physical, chemical, and biological characteristics and processes of the ocean and the atmosphere, both separately and as a coupled system. The principal focus of these investigations is to provide knowledge that leads to more accurate forecasting of severe storms, better utilization and management of marine resources, better understanding of the factors affecting both climate and environmental quality, and improved ocean and weather services for the nation.