

The contributions of the following individuals were instrumental to the success of AOML's quadrennial science review:

#### Climate Research Presentations:

- Molly Baringer – *Meridional Overturning Circulation*
- David Enfield – *Large Scale Climate Dynamics*
- Chunzai Wang – *Climate and Atlantic Hurricane Activity*
- Gustavo Goni – *Global Ocean Variability and Trends*
- Rick Lumpkin – *Upper Ocean Dynamics*

#### Ecosystem Research Presentations:

- Rik Wanninkhof – *The AOML Ocean Carbon Program*
- James Hendee – *Integrating Near Real-Time Data for Coral Reef Ecosystem Forecasting*
- Christopher Kelble – *The NOAA/AOML South Florida Ecosystem Restoration Program*
- Jia-Zhong Zhang – *Nutrient Dynamics in the Ocean*
- Elizabeth Johns – *Connectivity of the South Florida Coral Reef Ecosystem to Upstream Waters of the Western Caribbean and Gulf of Mexico*
- Christopher Sinigalliano – *The AOML Environmental Microbiology Program*

#### Hurricane Research Presentations:

- Jason Dunion – *Physical Processes of Hurricane Intensity Change*
- Mark Powell – *Hurricane Impacts*
- Sim Aberson – *Hurricane Track Improvements*
- Robert Rogers – *Evaluation of Numerical Models to Improve Prediction of Hurricane Intensity Change*
- Sundararaman Gopalakrishnan – *Hurricane Intensity Model Improvements*

## AOML Science Program Assessed during Quadrennial Review

February and March were busy months at AOML as the Laboratory prepared for a critical assessment of its science program. On March 18-20th, five reviewers and several invited guests including Drs. Richard Spinrad and Alexander MacDonald of NOAA's Office of Oceanic and Atmospheric Research (OAR) visited AOML to participate in the Laboratory's quadrennial science review.

AOML Director Dr. Robert Atlas began the proceedings by presenting an organizational overview of the Laboratory, followed by an overview of AOML's three science divisions presented by Drs. Silvia Garzoli, Frank Marks, and John Proni.

Reviewers were tasked with evaluating AOML's science program based upon three research themes derived from the mission goals of NOAA's Strategic Plan: oceans and climate, coastal ecosystems, and hurricanes. Science presentations for each theme (see shaded box to the left) were tailored to address a series of key questions aimed at demonstrating the quality of the research performed, its relevance

to NOAA and the nation, and its overall effectiveness in terms of advancing scientific understanding, leadership, planning, and transition into operational application. A poster session, as well as a question and answer period with the reviewers, followed the formal presentations for each research theme.

Scientific reviews are performed by NOAA to evaluate the quality, relevance, and effectiveness of research conducted at OAR laboratories to both internal and external interests, and to help strategically position the laboratories in planning their future science. The reviews are also intended to ensure that OAR laboratory research is linked to NOAA's strategic plan, relevant to the NOAA Research mission and priorities, and consistent with NOAA planning, programming, and budgeting.

Preparations for the review were organized and coordinated by Judith Gray and Erica Rule of AOML's Office of the Director. Additionally, AOML's administrative, scientific, technical, and maintenance staff all contributed to the successful endeavor. The time, attention, and efforts of the review team—Drs. Douglas Luther (University of Hawaii), Steven Murawski (NOAA-National Marine Fisheries Service), James Miller (Rutgers University), Robert Houze (University of Washington), and Ramesh Kakar (National Aeronautics and Space Administration)—are gratefully acknowledged and appreciated.



Photo courtesy of Robert Houze

AOML Director Dr. Robert Atlas (left), invited guests, reviewers, and staff converge in the first-floor conference room during the three-day evaluation of AOML's science program.

## Recent AOML Publications

**ELIPOT, S.**, and **R. LUMPKIN**, 2008:

Spectral description of oceanic near-surface variability. *Geophysical Research Letters*, 35(2):L05606, doi:10.1029/2007GL032874.

Johns, W.E., L.M. Beal, **M.O. BARINGER**, J.R.

Molina, S.A. Cunningham, T. Kanzow, and D. Rayner, 2008: Variability of shallow and deep western boundary currents off the Bahamas during 2004-2005: Results from the 26°N RAPID-MOC array. *Journal of Physical Oceanography*, 38(3):605-623.

Levine, N.M., S.C. Doney, **R. WANNINKHOF**,

K. Lindsay, and I.Y. Fung, 2008: Impact of ocean carbon system variability on the detection of temporal increases in anthropogenic CO<sub>2</sub>. *Journal of Geophysical Research*, 113(C3):C03019, doi: 10.1029/2007JC004153.

Mainelli, M., M. DeMaria, L.K. Shay, and **G.**

**GONI**, 2008: Application of oceanic heat content estimation to operational forecasting of recent Atlantic category 5 hurricanes. *Weather and Forecasting*, 23(1):3-16.

**MANZELLO, D.P.**, 2008: Short and long-

term ramifications of climate change upon coral reef ecosystems: Case studies across two oceans. Ph.D. thesis, University of Miami, Rosenstiel School of Marine and Atmospheric Science, 82 pp.

**MURILLO, S.T.**, 2008: Determination of the

circulation center and inner core evolution of Hurricane Danny (1997) using the GBVTD-simplex algorithm. M.S. thesis, University of Hawaii at Manoa, 57 pp.

Pu, Z., X. Li, C.S. Velden, **S.D. ABERSON**,

and W.T. Liu, 2008: The impact of aircraft dropsonde and satellite wind data on numerical simulations of two landfalling tropical storms during the Tropical Cloud Systems and Processes Experiment. *Weather and Forecasting*, 23(1):62-79.

Serafy, J.E., **C.R. KELBLE**, T.R. Capo, S.A.

Luthy, and **P.B. ORTNER**, 2008: Vertical movement rates of captive larval billfishes (*Istiophoridae*) collected from the Straits of Florida. *Florida Scientist*, 71(1):23-30.

**UHLHORN, E.W.**, 2008: Gulf of Mexico

Loop Current mechanical energy and vorticity response to a tropical cyclone. Ph.D. thesis, University of Miami, Rosenstiel School of Marine and Atmospheric Science.

\*Names of AOML authors are in blue capital letters.

## Southern Ocean Cruise Probes Climate-Relevant Gases

More than 30 scientists, including a small group from AOML's Ocean Chemistry Division, embarked on a research cruise aboard the NOAA Ship *Ronald H. Brown* in February to study how gases important to climate change move between the atmosphere and the ocean under high winds and seas. The Southern Ocean Gas Exchange Experiment was co-sponsored by the National Aeronautics and Space Administration, NOAA, and the National Science Foundation.

The *Brown* departed Punta Arenas, Chile near the southern tip of South America on February 29th to cruise the turbulent waters of the Southern Ocean, which surrounds Antarctica. Amidst roaring winds, rolling waves, and frigid temperatures, scientists measured turbulence, waves, bubbles, ocean temperature, and ocean color to determine how these factors relate to the exchange of carbon dioxide and other climate-relevant gases.

"The Southern Ocean is the largest ocean region where the surface waters directly connect to the ocean's interior currents, providing a pathway into the deep sea for carbon dioxide released from human activities," said Christopher Sabine, an oceanographer at NOAA's Pacific Marine Environmental Laboratory in Seattle, Washington and co-chief scientist on the cruise. "Understanding how atmospheric carbon dioxide is absorbed into these cold surface waters under high wind speeds is important for determining how the ocean uptake of carbon dioxide will respond to future climate change."

The world's oceans are estimated to absorb about two billion metric tons of carbon dioxide from the atmosphere every year. NOAA's leading research on ocean acidification resulting from carbon dioxide uptake indicates that many organisms that support marine biodiversity may be threatened by climate change in the future. Scientists know that higher wind speeds promote a faster exchange of gases, but there have been very few studies aimed at directly measuring these exchanges under real world conditions where other factors, like breaking waves, can influence the process.

In spite of the challenging conditions, an unprecedented number of measurements were gathered during the cruise which should help determine the processes that control air-sea gas exchange. "Our ongoing efforts to understand the global carbon cycle will benefit from the data this cruise produced about the mechanisms that govern gas transfer in this remote part of the world's ocean," said Paula Bontempi, manager of NASA's ocean biology and biogeochemistry research program.

"We directly assessed the rate and mechanism by which the ocean takes up carbon and releases it," said co-chief scientist David Ho of the Lamont-Doherty Earth Observatory of Columbia University in Palisades, New York. "This is the first U.S.-led effort to use all of the state-of-the-art tools that we have to quantify gas exchange in the Southern Ocean." Data gathered during the six weeks at sea are expected to eventually improve the accuracy of climate models and predictions. The cruise ended in Montevideo, Uruguay on April 12th.

*Adapted from an online article appearing on the NOAA web site.*



Scientists from 22 universities and research institutions cruised the turbulent waters of the Southern Ocean aboard the NOAA Ship *Ronald H. Brown* to study how greenhouse gases like carbon dioxide are transferred between the atmosphere and the ocean.



NOAA's FY-2008 Information Technology Security Awareness Course must be completed by all federal, joint institute, and contract employees by April 25th. Visitors on site for more than 30 days are also required to complete the course, which can be accessed at <http://noaa.learnsecuritywith.us>.

## Nation's Hurricane Hunter Fleet Equipped with Surface Wind Instruments

America's entire fleet of hurricane hunter aircraft are now equipped with a state-of-the-art remote sensing instrument that reliably measures the surface winds in tropical cyclones. Data gathered by the instrument, a stepped frequency microwave radiometer (SFMR), will provide forecasters with a more accurate view of the strength and extent of the damaging winds that impact coastal communities during landfalling storms.

The current generation of the SFMR was first tested aboard NOAA's two WP-3D Orion hurricane hunter aircraft in 2003. A validation study performed by AOML scientists that subsequently demonstrated its accuracy resulted in the SFMR being used operationally beginning with the 2005 Atlantic hurricane season. Efforts to install the SFMR aboard the Air Force Reserve's WC-130J aircraft have been ongoing since 2006. In February 2008, all ten of the 53rd Weather Reconnaissance Squadron's planes had been outfitted. The instrument attaches to the under portion of the aircraft's wing.

In the past, flight crews estimated surface wind speeds by extrapolating the aircraft's altitude or by deploying Global Positioning System dropsondes. By contrast, the SFMR provides continuous, real-time measurements of surface winds directly beneath the aircraft. The instrument detects radiation that is naturally emitted from foam created on the sea by winds at the surface. Computers onboard the aircraft then determine surface wind speeds based on the level of microwave radiation detected.



To assist with quality control of Miami-Dade County's public transit system, please report your comments, concerns, suggestions, and problems to the Miami-Dade Transit Authority at [www.miamidade.gov/transit/feedback\\_zone.asp](http://www.miamidade.gov/transit/feedback_zone.asp) or by calling 305-770-3131.

Major or persistent transit problems should also be reported to Stanley Goldenberg, AOML's transit liaison at:

305-361-4362

[Stanley.Goldenberg@noaa.gov](mailto:Stanley.Goldenberg@noaa.gov)

## Ocean Drifter Training Seeks to Remedy Data Void

In conjunction with the United States Navy, Shaun Dolk of AOML's Drifter Operations Center visited Ghana in March to train regional researchers in the deployment and data acquisition procedures for Argo floats, global drifting buoys, and expendable bathythermographs (XBTs). The training was conducted onboard the U.S. Navy vessel HSV-2 *Swift* off the west coast of Africa in the Gulf of Guinea, a region historically undersampled.

While similar training sessions have been held in the past, this particular training was unique in that it was conducted at sea. The ability of the Navy to host the training aboard one of its vessels allowed for a novel "hands-on" experience which enabled participants to become familiar with the instruments. The endeavor was conducted as part of a U.S. Navy Africa Partnership Station initiative that supports NOAA's climate research and ocean-observing efforts.

During the three-day session, one Argo float, three drifting buoys, and 12 XBTs were deployed from the HSV-2 *Swift* to gather temperature, salinity, and current measurements. Data from the instruments are transmitted via satellite to the Global Telecommunication System for use by the international oceanographic and meteorological communities in ocean and climate studies, weather modeling, and marine operations.

Representatives from all west African countries were invited to attend the training. Participants included oceanographers, academic professors, military personnel, graduate and post-graduate students, fisheries representatives, and geologists from Ghana, Cameroon, and Nigeria.

As the network of west African regional partners develops, it is anticipated that a greater number of ocean-observing instruments will be deployed in the area, leading to improved short and long-term climate forecasts.



Twenty-four participants from Ghana, Cameroon, and Nigeria attended the buoy deployment and data acquisition training offered aboard the U.S. Navy High Speed Vessel HSV-2 *Swift* on March 11-13th.



HSV-2 *Swift* crew member Matthew Rishovd and Shaun Dolk of AOML oversee the deployment of a drifting buoy in the Gulf of Guinea.

Mary Glackin, NOAA's recently appointed Deputy Under Secretary for Oceans and Atmosphere, visited Miami on February 14th to meet with line office managers and to roll out the President's 2009 budget to NOAA constituents. Pictured from left to right: Dr. William Read, Director of the National Hurricane Center; Dr. Bonnie Ponwith, Acting Director of the Southeast Fisheries Science Center; Mary Glackin; and Judith Gray, Deputy Director of AOML.



## Foundation Established for Cayman Islands Coral Monitoring Station

The foundation for a new Integrated Coral Observing Network (ICON) station was established off the northern coast of Little Cayman Island in the Cayman Islands during the week of April 6th. The site is located in 22 feet of water offshore of the Little Cayman Research Center, a facility of the Central Caribbean Marine Institute.



Photo courtesy of Carrie Manfrino

AOML oceanographer Jules Craynock and Tim Austin, Assistant Director for Research and Assessment of the Cayman Islands Department of Environment, aboard the R/V *Sea Keeper*.

Jules Craynock and LCDR Nancy Ash of AOML performed the initial underwater layout of the two-foot square, stainless steel center base plate and eight peripheral pins. Drilling operations at the site were performed by the crew of the R/V *Sea Keeper*, a coastal service vessel operated by the Cayman Islands Department of Environment.

The bottom plate will support a coral monitoring platform equipped with an array of meteorological and oceanographic instruments positioned above and below the ocean surface along an upright pylon. The station will aid researchers in observing environmental conditions at the site when it is completed later in the year.

The Little Cayman ICON station will become part of a growing network of coral reef monitoring platforms installed in accordance with goals established by the U.S. Coral Reef Task Force and NOAA for monitoring and assessing the health of coral reefs. ICON stations are already operating in St. Croix, Puerto Rico, and Jamaica.

## AOML Plays Host to Workshops and Meetings

AOML hosted the following workshops and meetings during the March-April time frame:

• ***XBT Fall-Rate Workshop, March 10-12th:*** Drs. Gustavo Goni and Molly Baringer of AOML's Physical Oceanography Division organized the event. An international group of scientists met to discuss the recently observed contradiction between global sea level rise estimates and heat content changes. Recent work has shown a steady increase or a leveling off of sea-level trends globally, but heat content changes since 2000 have declined. A closer examination of the underlying data used for heat content estimates led to the discovery that several issues could impact the global heat content trend estimates based on the data sources themselves. Participants focused on the small but systematic discrepancies in ocean temperature profile observations between expendable bathythermographs (XBTs) and other observing platforms such as CTDs (conductivity-temperature-depth) and Argo floats. Recommendations included a routine systematic intercomparison of platform types and highlighted the particularly valuable nature of dual data sources to diagnose potential problems for constructing a climate quality time series. The workshop was supported by NOAA's Climate Program Office and endorsed by the World Meteorological Organization's Ship Observations Team.

• ***11th Annual Meeting of the Variability of the American Monsoon Systems (VAMOS) Panel, March 25-28:*** Dr. David Enfield of AOML's Physical Oceanography Division organized the event. Participants met to discuss the coordination of several ongoing climate experiments being conducted in southwestern North America, the southeast Pacific, and the La Plata Basin which intersects Argentina, Uruguay, Brazil, and Paraguay. The centerpiece for the meeting was the presentation of a Science and Implementation Plan for a new climate program, the Intra-Americas Study of Climate Processes (IASCLIP), which is projected to begin in 2009 and extend to the middle of the next decade. IASCLIP is centered in the Caribbean and Gulf of Mexico, forming a geographical and phenomenological nexus between the North and South American monsoon systems. The program will investigate the physical processes that drive rainfall and tropical cyclone variability in the Intra-Americas Sea and surrounding regions and improve their prediction. Researchers from across the U.S., Caribbean, and Central-South America will be involved, including many from the Virginia Key science community (AOML and University of Miami). VAMOS is an international program of CLIVAR and the of World Climate Research Program.

• ***Observing System Experiments (OSEs) and Observing System Simulation Experiments (OSSEs) Workshop, April 14-17:*** AOML Director Dr. Robert Atlas convened the event; Drs. Silvia Garzoli of AOML and Christopher Mooers of the University of Miami's Rosenstiel School served as co-convenors. Researchers from diverse communities met to focus efforts on creating a national capability for conducting observing system experiments (OSEs) and observing system simulation experiments for the ocean (OSSEs). OSSEs consist of controlled, quantitative assessments of the value of a system of observations based on sophisticated numerical models of the circulation. It was proposed to develop an ocean OSSE capability to meet NOAA's needs for OSE and OSSE results in designing ocean observing systems and, specifically, to quantify the value of existing and proposed ocean observing systems in the context of the Integrated Ocean Observing System and the Global Ocean Observing System. The proposed capability will be built in partnership with national laboratories and universities. Participants defined the topic area, strengthened partnerships, and outlined an action plan for implementing a true ocean model assessment system.

NOAA Miami Regional librarian Linda Pikula represented the Group of Experts in Marine Information Management (GEMIM) at a recent International Oceanographic Data and Information Exchange (IODE) Officers meeting in Oostende, Belgium. Pikula presented an update on GEMIM activities and provided a work plan and budget for 2008-2009 activities. The approved budget supports the continued information management programs for capacity building projects in Latin America, Africa, and eastern Europe. The continuation and expansion of the OceanDocs online repository was approved, as well as the OceanTeacher project. The complete IODE Officers report can be viewed at [www.iode.org/index.php?option=com\\_oe&task=viewEventRecord&eventID=162](http://www.iode.org/index.php?option=com_oe&task=viewEventRecord&eventID=162).

## Welcome Aboard

Dr. Alexandre Fierro joined the staff of the Hurricane Research Division in February as a National Research Council post-doctoral research associate. Fierro recently received a Ph.D. from the University of Oklahoma where he studied microphysics and electrification in tropical squall lines using numerical models and observations. Fierro will work with Dr. Robert Rogers to evaluate microphysics fields in tropical cyclone simulations, compare them with observations, and test the sensitivity of simulated microphysics to various model configurations.

Christine Wiley joined the staff of the NOAA Miami Regional Library in March as a librarian. Wiley is originally from Augusta, Georgia. She is a recent graduate of Florida State University with a Master's of Library Science degree in information architecture and a B.A. in business information systems.

Dr. Kao-San (Kevin) Yeh joined the modeling team of AOML's Hurricane Research Division in February as a CIMAS scientist from NASA's Goddard Earth and Science Technology Center. Yeh obtained a Ph.D. in meteorology from Purdue University in 1997 and has focused his research on weather and climate modeling, numerical weather prediction, and data assimilation. He is one of the developers of the Canadian GEM (Global Environmental Multiscale) model and NASA's finite-volume general circulation model, both well known global atmospheric modeling systems.

Dr. Xuejin (Ken) Zhang joined the modeling team of AOML's Hurricane Research Division in February as a CIMAS assistant scientist. Zhang earned a Ph.D. in atmospheric sciences from North Carolina State University in 2007. His research interests include numerical modeling and model development, land-air-sea interactions, and numerical method and parallel computing.



## Congratulations

Molly Baringer and Gustavo Goni, both oceanographers with AOML's Physical Oceanography Division, have been selected to participate in NOAA's Leadership Competencies Development Program (LCDP). The LCDP is a competitive, 18-month program that provides a series of training and learning experiences to prepare individuals to assume greater leadership responsibilities within NOAA.

Derek Manzello, a CIMAS research associate with AOML's Ocean Chemistry Division, has been awarded a Ph.D. in marine biology from the Division of Marine Biology and Fisheries of the University of Miami's Rosenstiel School of Marine and Atmospheric Science. In April, Manzello successfully defended his thesis entitled *Short and Long-Term Ramifications of Climate Change upon Coral Reef Ecosystems: Case Studies Across Two Oceans*.

Shirley Murillo, a meteorologist with AOML's Hurricane Research Division, has been awarded a Master's of Science degree in meteorology from the Department of Meteorology of the University of Hawaii at Manoa. In March, Murillo successfully defended her thesis entitled *Determination of the Circulation Center and Inner Core Evolution of Hurricane Danny (1997) using the GBVTD-Simplex Algorithm*.

Eric Uhlhorn, a meteorologist with AOML's Hurricane Research Division, has been awarded a Ph.D. in meteorology from the Division of Meteorology and Physical Oceanography of the University of Miami's Rosenstiel School of Marine and Atmospheric Science. In April, Uhlhorn successfully defended his thesis entitled *Gulf of Mexico Loop Current Mechanical Energy and Vorticity Response to a Tropical Cyclone*.

AOML has been recognized as a Federal partner in a National Oceanographic Partnership Program (NOPP) Excellence in Partnering Award. The award acknowledges a broad consortium of academic, Federal, and commercial institutions who have collaborated on the NOPP-based U.S. GODAE: Global Ocean Prediction with the HYbrid Coordinate Ocean Model (HYCOM) project. AOML was one of several Federal partners participating in the consortium for assimilating observational data into the HYCOM model.



Photo by Armando Cuervo

AOML celebrated Bring Your Sons and Daughters to Work Day on April 24th with a program of activities planned and hosted by outreach coordinator Erica Rule. About 15 children visited the Laboratory to participate in the fun and to learn about all the interesting things their parents do in support of NOAA's mission. Activities included a tour of the engineering labs where global drifter buoys are constructed, a tour of the R/V *Virginia Key*, and a workshop to build their very own models of planet Earth. An outdoor lunchtime pizza party topped off the event.

## Travel

Robert Castle, Charles Fischer, and Kevin Sullivan participated in the Southern Ocean Gas Exchange Experiment cruise aboard the NOAA Ship *Ronald H. Brown* from Punta Arenas, Chile to Montevideo, Uruguay on February 29-April 12, 2008.

Stanley Goldenberg made a presentation at the 2008 International Conference on Climate Change in New York City, New York on March 2-4, 2008.

A large component of scientists from AOML attended and made presentations at the American Geophysical Union's Ocean Sciences Meeting in Orlando, Florida on March 2-7, 2008.

John Gamache, Sundararaman Gopalakrishnan, Frank Marks, Shirley Murillo, Mark Powell, Robert Rogers, and Eric Uhlhorn attended the 62nd Interdepartmental Hurricane Conference in Charleston, South Carolina on March 3-7, 2008.

Robert Atlas attended an OAR Senior Research Council meeting and visited Florida congressional representatives in Washington, D.C. on March 10-13, 2008. He also attended NOAA's Hurricane Forecast Improvement Project Summit in Arlington, Virginia on April 4, 2008.

Pamela Fletcher attended the Global Coral Reef Environmental Observatory Network (CREON) Integration Meeting in Kenting, Taiwan on March 13-14, 2008.

Jules Craynock and Nancy Ash installed the bottom plate/foundation for an Integrated Coral Observing Network (ICON) station offshore of Little Cayman Island, Cayman Islands on April 7-11, 2008.

Gustavo Goni was an invited instructor for a CLIVAR-sponsored course at the Institut Universitaire Européen de la Mer in Brest, France on April 21-24, 2008.

A large component of scientists from AOML attended and made presentations at the American Meteorological Society's 28th Conference on Hurricanes and Tropical Meteorology in Orlando, Florida on April 28-May 2, 2008.

Judith Gray attended the annual planning meeting of the Coastal Storms Program in Washington, D.C. on April 29-30, 2008.



Photos by Armando Cuervo

AOML was honored by the visit of Florida Congresswoman Ileana Ros-Lehtinen on March 24th. Ros-Lehtinen met with AOML Director Bob Atlas and was given a tour of the facility. Along the way, she spoke with Hurricane Research Division scientists about their efforts to improve intensity forecasts and the potential for Aerosonde unmanned aircraft to gather observations from tropical cyclones. She toured the Physical Oceanography Division's engineering labs to learn how ocean observing networks are shedding new light on climate change processes. A tour of the Ocean Chemistry Division's Environmental Microbiology Laboratory led to a discussion of how AOML is developing techniques for quickly and reliably detecting microbial contaminants in Florida's coastal waters.

*Keynotes* is published bi-monthly by the Atlantic Oceanographic and Meteorological Laboratory to promote the research activities and accomplishments of staff members. Contributions are welcome and may be submitted via email (Gail.Derr@noaa.gov), fax (305-361-4449), or mailing address (NOAA/AOML, *Keynotes*, 4301 Rickenbacker Causeway, Miami, FL 33149).

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