AOML Keynotes

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William Brennan Becomes Acting NOAA Administrator

Dr. William J. Brennan became the Acting Under Secretary of Commerce for Oceans and Atmosphere and the acting administrator for NOAA on November 1st.

Brennan, the former Assistant Secretary and Deputy Administrator, succeeded retired Navy Vice Admiral Conrad C. Lautenbacher, Jr., who resigned in October to return to private life after guiding NOAA for the past seven years.

Brennan was confirmed as the Assistant Secretary by the U.S. Senate in June. He is responsible for managing NOAA's science and operational programs.

Previously, Brennan served as NOAA's Deputy Assistant Secretary of Commerce for international affairs. In this role, he led NOAA's international efforts to support policies and interests in ecosystem-based management, climate change, earth observation, and weather forecasting.

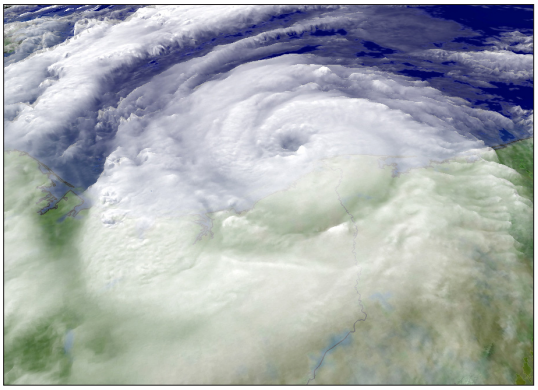
Brennan also serves as Director of the U.S. Climate Change Science Program (CCSP), the interagency program that coordinates and integrates scientific research on changes in climate and related systems. CCSP is composed of 13 federal scientific agencies and integrates the planning and budgeting of federal climate and global change activities.

Brennan holds a B.S. degree in marine biology, a M.A. degree in marine policy, and a Ph.D. in ecology and environmental sciences.

Hurricane Season Meets NOAA's Expectations for Active Year

The six-month long 2008 Atlantic hurricane season ended quietly on November 30th, but not before a series of powerful storms had left a trail of death and destruction behind them. In August, NOAA forecasters predicted with 85% certainty that the 2008 season would be marked by above-normal levels of storm activity. At that time, they predicted 14-18 named storms, with seven to 10 becoming hurricanes, and three to six intensifying into major hurricanes with winds above 110 mph (category 3 and stronger on the Saffir-Simpson scale). Living up to expectations, the season produced 16 named storms, eight hurricanes, and five major hurricanes (Bertha, Gustav, Ike, Omar, and Paloma).

The United States suffered impacts from six consecutive landfalling systems: three from tropical storms (Edouard, Fay, and Hanna) and three from hurricanes (Dolly, Gustav, and Ike). Tropical Storm Edouard caused only minimal damage and flooding along the upper Texas coast, while Tropical storm Fay criss-crossed Florida in August, making four separate landfalls and flooding portions of the state with more than 30 inches of rain. Tropical Storm Hanna came ashore briefly at the border between South and North Carolina, knocking out power to homes and businesses, before skirting up the eastern seaboard with torrential rains. Hurricanes Dolly, Gustav, and Ike all impacted the Gulf coast, with Texas bearing the brunt of devastation from both Dolly and Ike. Two million people evacuated coastal portions of Louisiana in anticipation of Gustav, which came ashore south of New Orleans on September 1st with 110 mph winds.



GOES-12 satellite image of Hurricane Dolly shortly before making landfall on South Padre Island, Texas on July 23rd.

Hardest hit, however, was the island of Cuba, which experienced its worst hurricane season on record. Three major hurricanes–Gustav, Ike, and Paloma–plus Tropical Storm Fay all made landfall in different regions of the country, producing damages estimated as high as $10 billion dollars.

Haiti also experienced a significant loss of life and massive damage to infrastucture as four consecutive storms–Fay, Gustav, Hanna, and Ike–flooded large portions of the impoverished nation in the brief span of a few weeks. More than 800 people are estimated to have lost their lives in storm-related deaths.

The 2008 hurricane season was the tenth year of the past 14 years to produce above-normal activity. This activity was attributed to lingering La Niña effects, warm tropical Atlantic Ocean temperatures, and the ongoing active phase of the Atlantic multidecadal oscillation, which is believed to have contributed to a greater number of storms since it began in 1995.

Rapid Intensity Experiment Conducted in Hurricane Paloma

Hurricane Paloma, the 2008 Atlantic hurricane season's fifth and final major hurricane, provided AOML's Hurricane Research Division with its first ever opportunity to conduct a coordinated experiment to study the phenomenon of rapid intensification. Paloma strengthened quickly from a tropical storm to a major hurricane in the 48-hour period of November 6-8 as the storm trekked towards the Cayman Islands and Cuba.

HRD researchers conducted three NOAA WP-3D missions into the core of Paloma and two Gulfstream-IV missions into Paloma's near-storm environment. During the 24-hour time frame of the experiment, Paloma's maximum winds increased by 50 knots and mean sea level pressure dropped by 38 millibars.

A total of 115 GPS (global positioning system) dropwindsondes were released, and data from most of these instruments were transmitted to hurricane forecasters in real time from the aircraft. Additionally, 54 AXBTs (airborne expendable bathythermographs) were deployed to sample the upper ocean's heat content beneath Paloma, and 14 Doppler analyses were performed and transmitted during the WP-3D flights. Multiple sets of super obs (observations reduced by 90% for efficient model assimilation) were generated for model initialization. Five real-time runs of the high resolution research model HRS were also completed at AOML.

Improved understanding of how and why tropical cyclones undergo rapid intensification is crucial to the ability to more skillfully predict the threat posed by these powerful storms and is a major goal of NOAA's Hurricane Forecast Improvement Project.

Happy Holidays

New Study Details Ocean Acidification in the Caribbean

A new study, which confirms significant ocean acidification across much of the Caribbean and Gulf of Mexico, reports strong natural variations in ocean chemistry in some parts of the Caribbean that could affect the way reefs respond to future ocean acidification caused by human-related increases in atmospheric carbon dioxide. Such short-term variability has often been underappreciated and may prove an important consideration when predicting the long-term impacts of ocean acidification to coral reefs.

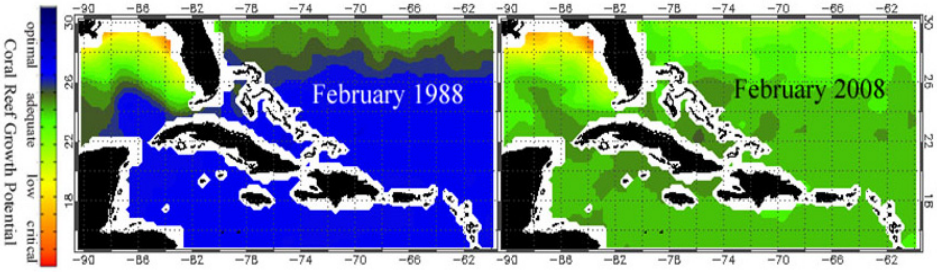
Gledhill, D.K., R. Wanninkhof, F.J. Millero, and M. Eakin, 2008: Ocean acidification of the greater Caribbean region, 1996-2006. *Journal of Geophysical Research,* 113(C10): C10031, doi: 10.1029/2007JC004629.

The study, conducted by scientists with NOAA, including AOML's Ocean Chemistry Division, and the University of Miami's Rosenstiel School of Marine and Atmospheric Science was published in the October 31st issue of the *Journal of Geophysical Research*.

Previous NOAA studies have shown that about a quarter of the carbon dioxide that humans place in the atmosphere each year ends up being dissolved into the ocean. The result is that the ocean is becoming more acidic, making it harder for corals, clams, oysters, and other marine life to build their skeletons or shells. A number of recent studies demonstrate that ocean acidification is likely to harm coral reefs by slowing coral growth and making reefs more vulnerable to erosion and storms.

In the new study, scientists used four years of ocean chemistry measurements taken aboard the Royal Caribbean Cruise Line ship *Explorer of the Seas,* together with daily satellite observations, to estimate changes in ocean chemistry over the past two decades in the Caribbean region. The resulting new ocean acidification tracking products are available online, along with animations of the changes since 1988 (http://coralreefwatch.noaa.gov/satellite/oa/).

"Ocean acidification has become an important issue to coral reef managers and researchers," said Tim Keeney, Deputy Assistant Secretary for Oceans and Atmosphere and co-chair of the United States Coral Reef Task Force. "These new tools provide these communities with better information to guide future research. This is the first time that anyone has been able to track ocean acidification on a monthly basis."



The potential for coral growth in the Caribbean region is dramatically changing due to ocean acidification.

The study supports other findings that ocean acidification is likely to reduce coral reef growth to critical levels before the end of this century unless humans significantly reduce carbon dioxide emissions. While ocean chemistry across the region is currently deemed adequate to support coral reefs, it is rapidly changing as atmospheric carbon dioxide levels rise.

"The study demonstrates a strong natural seasonal variability in ocean chemistry in waters around the Florida Keys that could have important consequences for how these reefs respond to future ocean acidification," says NOAA's Dwight Gledhill, lead author of the study.

Mark Eakin, a co-author and coordinator of NOAA's Coral Reef Watch Program, said "Organisms from highly variable environments are often better adapted to changes like we have seen in the last 20 years. The real question is how far corals can adapt and if this natural variability will be enough to protect them." Additional co-authors of the paper include Drs. Rik Wanninkhof of AOML's Ocean Chemistry Division and Frank Millero of the University of Miami's Rosenstiel School of Marine and Atmospheric Science.

Modified from a November 21st article that appeared on the NOAA web site.

Recent AOML Publications

DUNION, J.P., and C.S. Marron, 2008: A reexamination of the Jordan mean tropical sounding based on awareness of the Saharan air layer: Results from 2002. *Journal of Climate,* 20(21):5242-5253.

Gledhill, D.K., **R. WANNINKHOF,** F.J. Millero, and M. Eakin, 2008: Ocean acidification of the greater Caribbean region, 1996-2006. *Journal of Geophysical Research,* 113(C10):C10031, doi:10.1029/2007JC004629.

HUANG, X.-L., and **J.-Z. ZHANG,** 2008: Rate of phosphoantimonylmolybdenum blue complex formation in acidic persulfate digested sample matrix for total dissolved phosphorus determination: Importance of post-digestion pH adjustment. *Talanta,* 77(1):340-345.

HUANG, X.-L., Y. Chen, and M. Shenker, 2008: Chemical fractionation of phosphorus in stabilized biosolids. *Journal of Environmental Quality,* 37(5):1949-1958.

Li, Q.P., D.A. Hansell, and **J.-Z. ZHANG,** 2008: Underway monitoring of nanomolar nitrate plus nitrite and phosphate in oligotrophic seawater. *Limnology and Oceanography: Methods,* 6:319-326.

LOWAG, A., M.L. BLACK, and M.D. Eastin, 2008: Structural and intensity changes of Hurricane Bret (1999), Part I: Environmental influences. *Monthly Weather Review,* 136(11):4320-4333.

MOLINARI, R.L., Z. Garraffo, and **D. SNOWDEN,** 2008: Differences between observed and a coupled simulation of North Atlantic sea surface currents and temperature. *Journal of Geophysical Research,* 113(C9):C09011, doi:10.1029/2008JC004848.

POWELL, M.D., and T.A. Reinhold, 2008: Reply to Hsu and Blanchard's comments on "Tropical cyclone destructive potential by integrated kinetic energy." *Bulletin of the American Meteorological Society,* 89(10):1577.

Shay, L.K., and **E.W. UHLHORN,** 2008: Loop Current response to Hurricanes Isidore and Lili. *Monthly Weather Review,* 136(9): 3248-3274.

Smith, R.K., and **M.T. MONTGOMERY,** 2008: Balanced boundary layers used in hurricane models. *Quarterly Journal of the Royal Meteorological Society,* 134(635): 1385-1395.

*Names of AOML authors are in blue capital letters.

SEAS 2K Software Vital to Rescue and Data Acquisition Efforts

SEAS 2K is a Windows-based, real-time shipboard environmental data acquisition and transmission system developed at AOML in 2001 with the assistance of NOAA's Office of Marine and Aviation Operations. The software enables various types of atmospheric and oceanographic data to be obtained from ships and transmitted in real time to AOML for quality control. The data are subsequently transmitted to the Global Telecommunication System and several operational databases for use by scientists as input to weather and climate forecast models. SEAS 2K software also supports the Coast Guard's Automated Mutual-Assistance Vessel Rescue (AMVER) program.

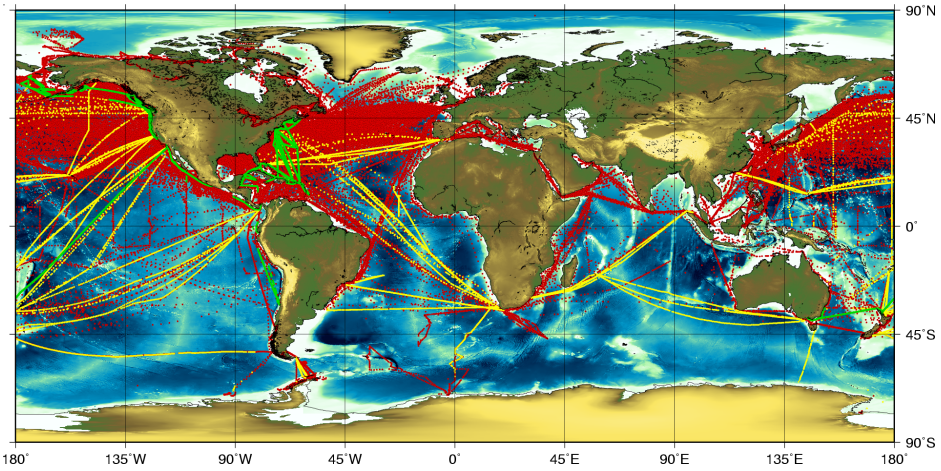
A major component of SEAS 2K is the acquisition of ocean data using expendable bathythermographs (XBTs). XBTs are probes that are deployed in all ocean basins to measure the temperature profile at the location of deployment to a depth of 760 m. These probes are used to investigate the thermal structure of the upper ocean. XBTs are mainly deployed from approximately 30 ships participating in AOML's Ship of Opportunity Program. AOML and the Scripps Institution of Oceanography are the principal users of the XBT software, with AOML being responsible for close to 90% of all 25,000 XBTs deployed annually. NOAA's National Marine Fisheries Service also uses the software to investigate the frontal variability of the Gulf Stream using XBTs and thermosalinograph observations from the M/V *Oleander*.

The SEAS 2K software supports physical, biological, and meteorological marine studies, as well as vessel rescue efforts of the U.S. Coast Guard.

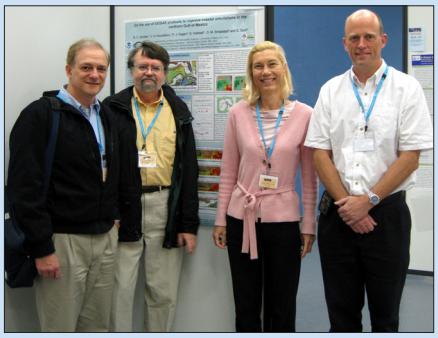
The National Weather Service uses SEAS 2K software to generate and transmit marine meteorological (MET) observations. Over 400 vessels operated by NOAA, the University-National Oceanographic Laboratory System (UNOLS), and the Coast Guard, as well vessels participating in NOAA's Volunteer Observing Ship Program, participate in reporting MET observations, which contain atmospheric, oceanographic, and position data acquired both manually and automatically by shipboard sensors. More than 200,000 SEAS 2K MET observation bulletins are transmitted annually.

Additionally, the Coast Guard uses AMVER reports, along with SEAS 2K MET observations, to support their AMVER vessel search and rescue program. The SEAS 2K software creates a series of reports that include a ship's medical personnel, point of departure, route, positions underway, and arrival to help locate able vessels near vessels in distress. Over 14,000 AMVER reports are transmitted annually to the Coast Guard. These reports have helped rescue more than 2,100 lives during the last seven years; SEAS 2K accounts for nearly 20% of the Coast Guard's AMVER reports.

SEAS 2K is used for data transmissions by different NOAA line offices with applications to physical, biological, and meteorological marine studies. The software is supported, maintained, and updated by a group of employees and contractors working with AOML's Physical Oceanography Division.



World map denoting the locations of oceanographic (yellow=expendable bathythermographs; green=thermosalinographs) and meteorological (red) observations transmitted by SEAS K2 software in 2007.



Dr. Gustavo Goni, an oceanographer with AOML's Physical Oceanography Division, attended the final GODAE (Global Ocean Data Assimilation Experiment) Symposium in Nice, France in November. The poster he co-authored with colleagues from the University of Miami's Rosenstiel School and the Naval Research Laboratory, *On the use of GODAE and satellite products to improve coastal simulations in the northern Gulf of Mexico* (R. Schiller, V. Kourafalou, P. Hogan, O. Smedstad, G. Halliwell, and G. Goni), won the award for best science poster. The poster presents work conducted under a collaborative research project for the Northern Gulf Institute, a NOAA Cooperative Institute, with Goni serving as the lead principle investigator. Pictured above in front of the poster, from left to right, are Gustavo Goni, George Halliwell, Vassiliki Kourafalou, and Ole Smedstad.

A new web-based calculator is now available to determine a hurricane's Integrated Kinetic Energy (IKE), a figure that aims to give a more accurate assessment of the potential damage resulting from hurricane winds. Since the 2007 hurricane season, AOML hurricane researcher Mark Powell has been calculating an IKE value for every tropical cyclone in the Atlantic basin. This value incorporates both the size and intensity of a storm's wind field and is meant to convey a more meaningful description of the damage potential of a given storm. Powell and his colleagues have been providing an IKE classification (ranging from .1 to 5.9) along with the H*Wind hurricane wind analyses they produce every 3-6 hours when there is an active storm. The IKE classification is one that Powell and his colleagues hope will spur discussion and eventual creation of a hurricane classification system that helps citizens better prepare for the damage anticipated from any landfalling storm.

OCEANS Project Enhances Science Knowledge and Skills

Miami-Dade County students participated in a unique educational experience this past November through the Oceanographic Curriculum Empowering Achievement in Natural Sciences (OCEANS) project. AOML oceanographer Evan Forde created and developed the OCEANS curriculum, which was designed to immerse students in a supportive learning environment to study the biology, physics, chemistry, and geology of the world's oceans. Forde taught the three-week long course at the North Miami Public Library to a group of enthusiastic middle-school students.

Evan Forde (kneeling, front row) poses with the first group of Miami-Dade County students to participate in the OCEANS project.

The OCEANS project addresses the need for enhanced science education and ocean literacy in the Miami-Dade community. Specific goals of the project include the following:

- Improve academic performance, especially in the areas of science and mathematics.
- Improve Florida Comprehensive Assessment Test (FCAT) science and math performance.
- Develop library-related research skills.
- Promote the scientific method as a strategy to address and solve challenges that occur not only in science, but in everyday life.

Evan Forde teaches students how to measure the density of seawater using a hydrometer.

- Inspire, motivate, and facilitate mastery of scientific principles and critical thinking skills, based on teaching strategies that encompass inquire-based learning.
- Enhance participants' integrity and social skills by establishing personal and community accountability as part of the class structure.

As part of the strategic alliance between the Institute for Shipboard Education's Semester at Sea program and AOML, Dr. Shane Elipot, a CIMAS post-doctoral researcher with AOML's Physical Oceanography Division, was aboard the MV *Explorer* for seven days in the South Atlantic this past September from Salvador, Brazil to Walvis Bay, Namibia. The *Explorer* is a floating campus that transports more than 700 undergraduate students around the world while completing a semester of education. The program's academic sponsor is the University of Virginia. While on board, Elipot worked closely with the ship's crew, staff, faculty and, more importantly, students, to deploy 10 Argo floats in this undersampled region of the world ocean. Elipot also gave lectures and participated in classes to educate students about the Argo and Global Drifter Programs, and bring awareness about how both of these programs are relevant to understanding and monitoring the state of the climate of the planet. Pictured above is Shane Elipot (on the right) preparing an Argo float for deployment as Semester at Sea staff and students look on.

Congratulations

Dr. Frank Marks, Director of AOML's Hurricane Research Division, is the recipient of a 2008 NOAA Research Employee of the Year Award. Marks was recognized for his leadership role on NOAA's new Hurricane Forecast Improvement Project (HFIP), a long-term effort to accelerate improvements to hurricane intensity forecasting in the one- to five-day range. As the Project Lead for the HFIP, Marks has been instrumental in organizing NOAA's existing research and development efforts, coordinating the participation of NOAA line offices and external organizations, and executing oversight authority for the project's elements and plans.

Welcome Aboard

Dr. Geun-Ha Park joined the staff of AOML's Ocean Chemistry Division (OCD) in November as a CIMAS post-doctoral scientist. Park will work with Dr. Rik Wanninkhof and the CO_2 Group to investigate the ocean's role in controlling atmospheric carbon dioxide levels. She recently obtained her doctorate from Pohang University in South Korea under the guidance of Professor Kitack Lee, a former OCD researcher.

Dr. Renellys Perez joined the staff of AOML's Physical Oceanography Division in November as a CIMAS assistant scientist. Perez is a physical oceanographer that specializes in merging data from numerical models with in-situ or satellite measurements. She recently completed a National Research Council post-doctoral fellowship at NOAA's Pacific Marine Environmental Laboratory. Perez will combine data sets collected and maintained at AOML with numerical models to study three-dimensional ocean processes.

Dr. Haoping Yang joined the staff of AOML's Physical Oceanography Division in November as a CIMAS post-doctoral scientist. He will be working on a National Oceanographic Partnership Program project to monitor the Atlantic meridional overturning circulation, an important factor for the earth's climate. Yang will participate in observing system simulation experiments that use computer models to determine which simulated observations have the greatest potential for revealing information about the overturning circulation.

Farewell

Jason Dunion, a meteorologist with AOML's Hurricane Research Division (HRD), relocated to Marlborough, Connecticut with his wife and two children. He will, however, continue his affiliation with AOML and support of HRD's ongoing tropical cyclone research as a University of Miami CIMAS researcher. Dunion is credited with having developed a remote sensing technique to track the movement of the Saharan Air layer (SAL), a dry, mineral-laden layer of dusty air that often blankets large portions of the Atlantic Ocean during hurricane season. The SAL is linked to tropical cyclone suppression. During his eight years with HRD, Dunion served as President of the Greater Miami Chapter of the American Meteorological Society (AMS), Director of the Division's field program, and was the chief scientist aboard numerous hurricane hunter research missions. He is also a member of the AMS Committee on Tropical Meteorology and Tropical Cyclones, a host researcher/lecturer for the National Geographic Society's JASON Project, and other outreach efforts in support of science education.

Dr. Shane Elipot of AOML's Physical Oceanography Division (PhOD) departed the Laboratory in December. During his two years with PhOD, first as a National Research Council post-doctoral fellow and then as a CIMAS post-doctoral researcher, Elipot performed research with Dr. Rick Lumpkin on the dynamics of the upper ocean using data from satellite-tracked surface drifters. He has accepted a permanent position as a physical oceanographer at the Proudman Oceanographic Laboratory in Liverpool, United Kingdom. Best wishes to Shane for his continued success.

Travel

Joseph Cione and Robert Rogers attended NOAA's Unmanned Aerial System Team Workshop in Boulder, Colorado on November 5-6, 2008.

Gustavo Goni attended the Ocean Surface Topography Science Team Meeting and the Final Global Ocean Data Assimilation Experiment (GODAE) Symposium in Nice, France on November 10-15, 2008.

James Hendee attended the Pacific Coral Reef Mapping and Monitoring Workshop in Honolulu, Hawaii on November 18-20, 2008.

Eric Uhlhorn attended a HIRAD (Hurricane Imaging Radiometer) meeting in Huntsville, Alabama on November 18-21, 2008.

Frank Marks and Robert Rogers attended the Working Group for Tropical Cyclone Research Meeting in Silver Spring, Maryland on November 19-21, 2008.

Bob Atlas attended the NASA Ocean Vector Winds Science Team meeting in Seattle, Washington on November 19-21; visited the National Academy of Sciences in Washington, D.C. on December 4th; and co-chaired a symposium on hurricanes and presented several papers at the American Geophysical Union Fall Meeting in San Francisco, California on December 15-19, 2008.

Molly Baringer and Silvia Garzoli attended the 4th Aquarius/SAC-D Science Workshop in Puerto Madryn, Argentina on December 3-5, 2008.

Elizabeth Johns, Christopher Kelble, Nelson Melo, and Jia-Zhong Zhang attended the 2008 Florida Bay and Adjacent Marine Systems Science Conference in Naples, Florida on December 8-11, 2008.

Tsung-Hung Peng, Robert Rogers, and Rik Wanninkhof attended the American Geophysical Union's annual Fall Meeting in San Francisco, California on December 15-19, 2008.

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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