

2008 Federal Holidays

New Year's Day...
◊ Tuesday, January 1

Martin Luther King's Birthday...
◊ Monday, January 21

Washington's Birthday...
◊ Monday, February 18

Memorial Day...
◊ Monday, May 26

Independence Day...
◊ Friday, July 4

Labor Day...
◊ Monday, September 1

Columbus Day...
◊ Monday, October 13

Veterans Day...
◊ Tuesday, November 11

Thanksgiving Day...
◊ Thursday, November 27

Christmas Day...
◊ Thursday, December 25

New Year's Day (2009)...
◊ Thursday, January 1

Global Warming Could Reduce the Number of U.S. Landfalling Hurricanes

Atlantic hurricane activity has been shown to have largely increased in frequency and intensity since 1995. The recent increase in Atlantic hurricane activity has fueled a debate on the role of global warming in the increase. An article published in the January issue of *Geophysical Research Letters* by Drs. Chunzai Wang and Sang-Ki Lee of AOML's Physical Oceanography Division concludes that the recent increase in Atlantic hurricane activity attributed to global warming is premature. Global warming may, instead, decrease the likelihood of hurricanes making landfall in the United States.

Observations over the past 153 years show that global warming occurs almost everywhere over the global ocean (Fig. 1), with exceptions in the region south of Greenland, in the North and South Pacific, and in the region around Antarctica where cooling appears. In particular, large warmings occur in the tropical Pacific, Atlantic, and Indian Oceans. The temporal variation shows that the global ocean is mainly cooled before the 1940s and warmed after the 1940s.

It is known that hurricanes were undercounted before the era of aircraft reconnaissance (the mid-1940s) and satellite technology (the mid-1960s) since hurricanes over the open ocean during that time could rarely be detected. Given hurricane data problems, by far the most reliable Atlantic hurricane measurement over the long term is the number of U.S. landfalling hurricanes since it excludes hurricanes over the open ocean (which never make landfall and were hardly detected before the aircraft reconnaissance and satellite eras).

Associated with the secular warming of the global ocean, U.S. landfalling hurricanes show a downward trend (Fig. 2). The downward trend is robust because it is independent of the beginning of the linear fit as long as the fitted hurricane data cover at least a full cycle of the Atlantic multidecadal oscillation. In addition to the (continued on page 2)

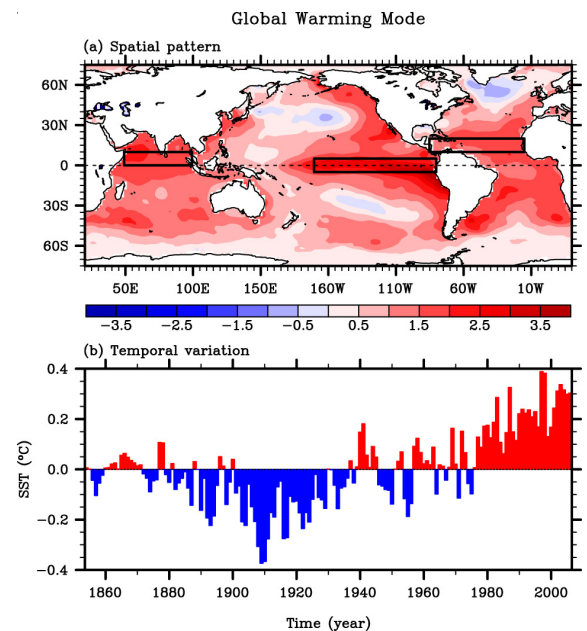


Figure 1. The spatial pattern and temporal variation of global ocean warming.

Recent AOML Publications

AMORNTHAMMARONG, N., and **J.-Z. ZHANG**, 2008: Shipboard fluorometric flow analyzer for high-resolution underway measurements of ammonium in seawater. *Analytical Chemistry*, 80(4): 1019-1026.

DONG, S., S.L. Hautala, and K.A. Kelly, 2007: Interannual variations in upper-ocean heat content and heat transport convergence in the western North Atlantic. *Journal of Physical Oceanography*, 37(11): 2682-2697.

Griffa, A., **R. LUMPKIN**, and M. Veneziani, 2008: Cyclonic and anticyclonic motion in the upper ocean. *Geophysical Research Letters*, 35(1):L01608, doi:10.1029/2007GL032100.

Hitchcock, G.L., W.S. Arnold, M. Frischer, **C. KELBLE**, and R.K. Cowen, 2008: Short-term dispersal of an intentionally-released patch of larval *Mercenaria* Spp. in the Indian River Lagoon, Florida, USA. *Bulletin of Marine Science*, 82(1):41-57.

Lavelle, J.W., and **W.C. THACKER**, 2007: A pretty good sponge: Dealing with open boundaries in limited area ocean models. *Ocean Modelling*, 20(3):270-292.

LEE, S.-K., and **C. WANG**, 2008: Tropical Atlantic decadal oscillation and its potential impact on the equatorial atmosphere-ocean dynamics: A simple model study. *Journal of Physical Oceanography*, 38(1):193-212.

Lee, T.N., **N. MELO**, **E. JOHNS**, **C. KELBLE**, **R.H. SMITH**, and **P.B. ORTNER**, 2008: On water renewal and salinity variability in the northeast subregion of Florida Bay. *Bulletin of Marine Science*, 82(1):83-105.

MANZELLO, D.P., R. Berkelmans, and **J.C. HENDEE**, 2007: Coral bleaching indices and thresholds for the Florida Reef Track, Bahamas, and St. Croix, U.S. Virgin Islands. *Marine Pollution Bulletin*, 54(12):1923-1931.

THACKER, W.C., 2008: Estimating salinity between 25° and 45°S in the Atlantic Ocean using local regression. *Journal of Atmospheric and Oceanic Technology*, 25(1):114-130.

WANG, C., and **S.-K. LEE**, 2008: Global warming and United States landfalling hurricanes. *Geophysical Research Letters*, 35(2):L02708, doi:10.1029/2007GL032396.

*Names of AOML authors are in blue capital letters.

(continued from page 1)

downward trend, U.S. landfalling hurricanes also show a multidecadal variability, with enhanced numbers during 1875-1895, 1905-1915, 1930-1955, and after 1995. Reduced numbers occur in between, indicating that hurricanes are related to the Atlantic multidecadal oscillation.

The physical reason for the inverse relationship between global warming and U.S. landfalling hurricanes is that global ocean warming produces an increase of tropospheric vertical wind shear in the main Atlantic hurricane development region, an important factor affecting hurricane activity. The calculation of the regression of vertical wind shear onto the time series of global warming shows a positive regression in the main hurricane development region, and the positive wind shear regression extending northwestward to the United States via the Gulf of Mexico.

This indicates that the global warming-induced increase of wind shear extends beyond the main development region toward to the United States via the Gulf of Mexico, creating a condition that disfavors hurricane intensification and landfall in the United States. Thus, global warming may reduce the formation and development of hurricanes, resulting in fewer U.S. landfalling hurricanes. The observed relationship between global warming and wind shear is consistent with previous studies of the paleoclimatic proxy data and future model projections under global warming scenarios for the 21st century, suggesting that the increase of vertical wind shear associated with global warming is a robust feature.

Why does global ocean warming produce an increase of the vertical wind shear in the main Atlantic hurricane development region? Warmings over the global tropical oceans compete with one another for affecting atmospheric circulation over the tropical North Atlantic. Tropical Pacific and Indian warmings increase the vertical wind shear in the main Atlantic hurricane development region, whereas tropical North Atlantic warming decreases the wind shear. Warmings in the tropical Pacific and Indian Oceans win the competition and produce increased wind shear which results in fewer U.S. landfalling hurricanes.

This study suggests that the spatial distribution of global ocean warming is important for determining the vertical wind shear in the main development region for Atlantic hurricanes. Whether future global warming increases Atlantic hurricane activity will probably depend on the relative role induced by secular warmings over the three tropical oceans. For example, if the effects of warmings in the tropical Pacific and Indian Oceans cannot continue to overcome that of Atlantic warming, future global warming may favor landfall incidence for the United States. Therefore, model projections of ocean warming patterns under future global warming scenarios may be crucial in predicting future Atlantic hurricane activity.

U.S. Landfalling Hurricanes

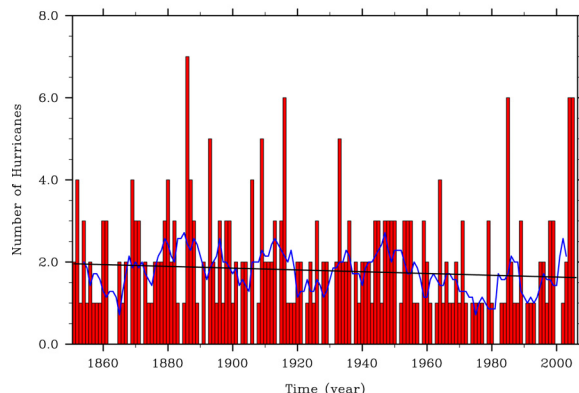


Figure 2. The number of U.S. landfalling hurricanes from 1851 to 2006. The black straight line is the linear trend that is fitted to the U.S. landfalling hurricane time series. The blue line is the seven-year running mean of U.S. landfalling hurricanes.

Thank You

AOML's 2007 holiday-giving campaign benefited several families in south Florida during December. AOML employee contributions were used to purchase gift certificates from local grocery stores, which were given to seven families with young children just in time for the holidays. Since the program's inception in 1998, AOML's holiday-giving campaign has helped 112 families. Thanks to all whose generosity helped make the holidays more joyful for families in our community.

AOML Represented at Florida Senate Environmental Meeting

Dr. John Proni, Director of AOML's Ocean Chemistry Division, spoke before the Florida Senate Committee on Environmental Preservation and Conservation on January 9th. Proni presented information about the potential impacts of treated sewage effluent discharged from outfall pipes upon south Florida's coral reefs.

The Committee is considering legislation to halt operations at six outfall sites in Miami-Dade, Broward, and Palm Beach counties. The sites pump millions of gallons of treated sewage effluent daily into the coastal waters of southeast Florida. Divers have noted the presence of the algae *Lyngbia* on coral reefs off of Palm Beach County and have asserted that the algae are the result of nutrients discharged by a nearby outfall.

Proni presented information on the dilution, transport, and dispersion of the effluent discharge plume, as well as on the nutrient and microbiological content of the plume. He also provided information on other known sources of nutrients to the coastal ocean in the vicinity of the outfalls. Among these sources are the outflow from adjacent inlets and the process of upwelling that has long been noted in the area. Nutrient measurements in ocean water likely to be upwelled have shown elevated concentrations of nutrients.



Four recent recipients of NOAA's Ernest F. Hollings Scholarship Award visited AOML this past December. AOML will welcome them back in the coming summer months to intern with Drs. John Proni, Thomas Carsey, and David Enfield. Pictured from left to right are Brittany Perrin (University of Missouri), Ynhi Thai (University of Alabama), Rene Boiteau (Northwestern University), and Ryan Walter (Cornell University).

Pioneering Science Effort Succumbs to Funding Shortfall

A seven-year collaboration between Royal Caribbean Cruise Lines, the University of Miami's Rosenstiel School, AOML, and other partners has been suspended. In December 2007, Dr. Otis Brown, Dean of the Rosenstiel School, announced the decision to close the oceanographic and meteorological laboratory program aboard the Royal Caribbean ship *Explorer of the Seas* due to funding constraints. Presently, efforts are underway to explore alternatives for transforming the project into a less costly, autonomous format.

Since 2000, the *Explorer* had enabled researchers to collect environmental data along the ship's cruise track through the Caribbean on a continual basis. The *Explorer* supported a suite of atmospheric and oceanographic sampling instruments. Data from these instruments fueled studies to improve understanding of the ocean-atmospheric carbon flux, hurricane intensification processes, biological variability within the Gulf Stream, and the interhemispheric transport of warm water.

The *Explorer* also provided a unique venue for science education and public outreach. During its years in operation, approximately 85,000 passengers toured the laboratories, while more than 300 visiting scientists participated as lecturers and researchers for the program. Additionally, data from the *Explorer* served as the basis for over 100 presentations and research papers.

AOML and Rosenstiel School scientists worked closely with Royal Caribbean architects during the construction of the *Explorer* to design and outfit the ocean and atmospheric science labs. The *Explorer* subsequently became the first commercial passenger ship equipped with research facilities to promote environmental awareness. The endeavor created a novel partnership between the commercial, academic, and federal maritime communities.



The *Explorer of the Seas* at port in Labadee, Haiti.

Southeast Florida Coastal Ocean Sampled

A group of eleven scientists from AOML and the University of Miami's Rosenstiel School returned to Miami on February 16th after an eight-day research cruise aboard the NOAA R/V *Nancy Foster*. The cruise was conducted in support of the Florida Area Coastal Environment (FACE) program under the guidance of Dr. John Proni of AOML's Ocean Chemistry Division.

AOML scientists included LTJG Madeleine Adler, Joe Bishop, Cheryl Brown, Thomas Carsey, Shailer Cummings, Chuck Featherstone, Chris Sinigalliano, and Jack Stamates, while Rosenstiel School participants included Courtney Drayer, Samantha Evans, and Amel Saied. The cruise involved obtaining water and sediment samples for stable isotope (nitrogen-15 and carbon-13) analysis, as well as water samples for nutrient, total sediment loading, and microbiological analysis.

On several occasions during the cruise, two "tow fish" instruments were towed in the water from the ship; one detected water characteristics (salinity and temperature), while the second gathered acoustic backscatter and acoustic Doppler current profiler data. All data obtained during the cruise will be analyzed to improve understanding of the extent of anthropogenic influences on Florida's coastal ocean environment, especially in the areas surrounding six treated-wastewater outfall sites and two inlets (Port Everglades Inlet and Boynton Inlet).



FACE science team gathered on the deck of the NOAA R/V *Nancy Foster*.

AOML is partnering with a unique U.S. Naval vessel to deploy oceanographic sensors off the west coast of Africa in the Gulf of Guinea, a region infrequently sampled. This past December, Matthiew Rishovd, a crew member from the *HSV-2 Swift*, visited AOML for training in the deployment and data acquisition of surface drifters, Argo floats, and expendable bathythermographs (XBTs).



The U.S. Naval Ship *HSV-2 Swift*.

The *Swift* is a high-speed, wave-piercing catamaran that can reach cruising speeds of up to 40 knots. In addition to being the fastest ship in the U.S. Naval fleet, it is also the first to rely entirely upon electronic navigation.

In early January 2008, the *Swift* deployed five surface drifting buoys on its transit from Rota, Spain to Dakar to participate in an African Partnership Station (APS) initiative. During the six-month APS, the *Swift* will participate in several initiatives that support NOAA's ocean observing efforts.

Working in conjunction with researchers at AOML, the *Swift* will deploy a total of 70 drifting buoys and 10 Argo floats off the coast of west central Africa. Data from the instruments will improve short-term local weather forecasts, as well as improve longer-term climate forecasts.

Shaun Dolk of AOML's Global Drifter Program will travel to Ghana in March to provide buoy deployment training for regional researchers. By developing a network of partners in African countries, it is hoped that drifter deployments will continue in this data-sparse area after the APS initiative concludes.

Barcelona Express Honored for Ship of Opportunity Efforts

Pedro Di Nezio and Sommyr Pochan of AOML's Physical Oceanography Division recently visited the *Barcelona Express* of Hapag-Lloyd, a vanguard member of the Ship of Opportunity program (SOOP). The large commercial vessel has been a participant in SOOP since August 2004 and periodically performs expendable bathythermograph (XBT) deployments in high-density and frequently-repeated modes along a transect that runs between Gibraltar and Miami, Florida.

Di Nezio and Pochan presented Captain Ankur Arya and his crew with a plaque in recognition of their outstanding efforts and leadership in the program. Additionally, they loaded XBTs onto the ship, trained crew members, and reviewed current XBT sampling strategies.

SOOP utilizes a network of about 50 merchant and research vessels to gather global ocean observations. NOAA/AOML is the main contributor to SOOP and accounts for about 90% of the acquisition, deployment, and data transmission of the approximate 25,000 XBTs deployed globally every year. The program is supported by both the World Meteorological Organization and the Intergovernmental Oceanographic Commission.

XBTs enable the thermal structure of the ocean to be monitored to a depth of 800 m. Data obtained from the instruments are processed, formatted, and transmitted in real-time via satellite to the Global Telecommunications System (GTS). A wide array of national and international organizations, academic institutions, and government laboratories use the data for weather and climate forecasting and for climate research. Information about SOOP and the Division's XBT operations can be found at www.aoml.noaa.gov/phod/goos.



Captain Ankur Arya of the *Barcelona Express* with Pedro Di Nezio of AOML's Physical Oceanography Division.



Sommyr Pochan of AOML's Physical Oceanography Division with Cadet Ayush Hirvani and Second Officer Baljeet Singh of the *Barcelona Express*.



The following research articles by AOML authors (names appear in capital letters) were listed on the American Meteorological Society's web site as some of the most popular articles viewed online for their respective journal during January 2008:

- ABERSON, S.D., 2003: Targeted observations to improve operational tropical cyclone track forecast guidance. *Monthly Weather Review*, 131(8):1613-1628.
- ABERSON, S.D., 1997: The prediction of the performance of a nested barotropic hurricane track forecast model. *Weather and Forecasting*, 12(1):24-30.
- ATLAS, R., R.N. Hoffman, S.C. Bloom, J.C. Jusem, and J. Ardizzone, 1996: A multiyear global surface wind velocity dataset using SSM/I wind observations. *Bulletin of the American Meteorological Society*, 77(5):869-882.
- DUNION, J.P., and C.S. Velden, 2004: The impact of the Saharan Air Layer on Atlantic cyclone activity. *Bulletin of the American Meteorological Society*, 85(3):353-365.
- SCHMID, C., G. Siedler, and W. Zenk, 2000: Dynamics of intermediate water circulation in the subtropical South Atlantic. *Journal of Physical Oceanography*, 30(12):3191-3211.

Welcome Aboard

Juan Delgado joined the staff of the Physical Oceanography Division in January as a CIMAS research associate in support of the Division's global oceanographic data collection efforts through the Ship of Opportunity Program. Delgado holds a M.S. degree obtained in 1997 from the Centro de Investigación Científica y Educación Superior de Ensenada (CICESE) in Mexico.

Dr. Heike Lueger rejoined the Ocean Carbon Group of AOML's Ocean Chemistry Division in February. Lueger has returned from a year's stay at the University of Plymouth in the United Kingdom where she earned a degree in environmental management. Her efforts on behalf of the Ocean Carbon Group will focus upon data assembly of underway and coastal CO₂ data.

Dr. Ernesto Muñoz joined the staff of the Physical Oceanography Division in January as a CIMAS post-doctoral associate. Muñoz will conduct research on the interaction between the ocean and atmosphere in the region of the Atlantic warm pool. A native of Puerto Rico, Muñoz received both a M.S. (2004) and Ph.D. (2007) from the University of Maryland.

Sommyr Pochan joined the staff of the Physical Oceanography Division in January as a CIMAS research associate in support of the Division's global oceanographic data collection efforts through the Ship of Opportunity Program. Pochan holds an M.S. degree in electrical engineering from Cornell University and a M.S. degree in sustainable international development from Brandeis University.

Dr. Jun Zhang joined the staff of the Hurricane Research Division in December as a National Research Council post-doctoral Research Associate Fellow. Zhang will conduct research on fluxes of heat, moisture, and momentum in the hurricane boundary layer and analyze data collected during the Coupled Boundary Layer Air-Sea Transfer (CBLAST) experiment. He recently obtained a Ph.D. from the Division of Applied Marine Physics of the University of Miami's Rosenstiel School.

Congratulations

Robert Rogers, a meteorologist with AOML's Hurricane Research Division, received the American Meteorological Society's (AMS) 2008 Editor's Award for the journal *Weather and Forecasting*. Rogers was acknowledged for providing "timely and constructive reviews that were beneficial to both the authors and the journal." The award was presented by Dr. Richard Anthes, AMS president, during the organization's 88th annual meeting in New Orleans, Louisiana in January.



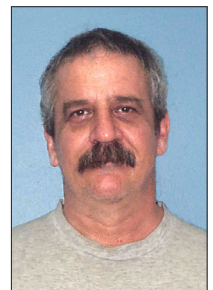
AMS President Dr. Richard Anthes with Dr. Robert Rogers of AOML, recipient of the 2008 AMS *Weather and Forecasting* Editor's Award.

The Western Boundary Time Series-Meridional Overturning Circulation Team is the recipient of a 2007 U.S. Department of Commerce Bronze Medal. The team, comprising a large cadre of scientists and technicians with AOML's Physical Oceanography Division (PhOD), among others, was recognized for its "long-term research, design, and support of an observing system for the Florida Current and the Meridional Overturning Circulation." NOAA has monitored the Meridional Overturning Circulation in the Straits of Florida since 1982.

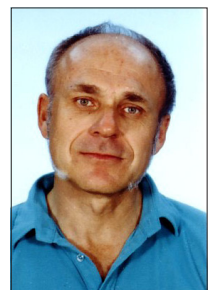
Peter Black, Peter Dodge, John Gamache, Shirley Murillo, Mark Powell, and Eric Uhlhorn, all meteorologists with AOML's Hurricane Research Division, along with Richard Knabb (National Weather Service) and Paul Chang (National Environmental Satellite, Data, and Information Service), are recipients of a 2007 U.S. Department of Commerce Bronze Medal. The group was recognized for "employing a unique technology to diagnose Hurricane Katrina's winds, a technology needed for surge, wave, intensity, and ecosystem modeling efforts."

In Memoriam

AOML was recently saddened by the untimely death of Douglas Anderson, a former electronics technician with the Physical Oceanography Division. Anderson died at home on December 6, 2007 from an apparent heart attack. He was 55 years old. During the 28 years he worked at AOML, Anderson sailed aboard an assortment of NOAA and commercial ships in support of the Division's data-gathering field efforts in the Caribbean Sea, Gulf of Mexico, and Atlantic, Pacific, and Indian Oceans. Anderson's technical expertise and uncanny ability to withstand rough seas without the slightest trace of seasickness ensured the success of many a research effort. He retired from Federal service in 2005 and relocated to New Tazwell, Tennessee with his wife. A memorial service was held at AOML on December 17th to reminisce and fondly remember Doug, an old friend and co-worker to many.



Victor Wiggert, a former senior meteorologist with AOML's Hurricane Research Division, passed away peacefully on January 14, 2008 after suffering a heart attack while driving on January 2nd. He was 70 years old. Wiggert was a life-long weather aficionado who spent much of his career with NOAA studying tropical meteorology. He was a long-term member of a group of researchers that worked with the Sea, Lake, and Overland Surge from Hurricanes (SLOSH) computer model. SLOSH charts are widely used by both the National Hurricane Center and emergency managers in coastal states to estimate the potential storm surge height associated with impending tropical cyclones. Wiggert retired in 2002 with 35 years of Federal service to his credit. He is survived by his wife of 46 years and two children, a son and a daughter.



Travel

Sim Aberson, Robert Atlas, Joseph Cione, Jason Dunion, Frank Marks, Shirley Murillo, Mark Powell, Robert Rogers, and Erica Rule attended the 88th Annual Meeting of the American Meteorological Society in New Orleans, Louisiana on January 20-24, 2008.

James Hendee and Elizabeth Johns attended the Gulf of Mexico Initiative-Islands in the Stream Science Forum in Sarasota, Florida on January 23, 2008.

Judith Gray attended a meeting of NOAA's Regional Team representatives in Kansas City, Missouri on January 29-31, 2008.

Jason Dunion was an invited guest speaker at the National Geographic Society's JASON Project-Monster Storms program presented at schools in Mercedes, Texas on February 3-8, 2008 and in Berryville, Virginia on February 12-13, 2008.

Robert Rogers attended the Third Tropical Rainfall Measuring Mission (TRMM) International Science Conference in Las Vegas, Nevada on February 4-8, 2008.

Rik Wanninkhof was an invited participant at the K-Conundrum Workshop to discuss advances in the study of air-sea gas transfer in Norwich, United Kingdom on February 5-7, 2008.

Robert Atlas attended a meeting of the Working Group for Space-Based Lidar Winds in Monterey, California on February 5-7, 2008. He also represented NOAA at the 2008 Congressional Caucus Leadership Summit on Modeling and Simulation in Virginia Beach, Virginia on February 11, 2008.

Madeleine Adler, Joseph Bishop, Cheryl Brown, Thomas Carsey, Shailer Cummings, Charles Featherstone, and Jack Stamates participated in a Florida Area Coastal Environment (FACE) research cruise aboard the R/V *Nancy Foster* on February 8-16, 2008.

Rick Lumpkin attended the 13th annual PIRATA (pilot research moored array in the tropical Atlantic) meeting on February 18-23, 2008 in Natal, Brazil as a U.S. representative to the Science Steering Group.

Happy Holidays 2007



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).

Editors – Robert Atlas/Judith Gray
Publishing Editor/Writer – Gail Derr

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