

"Please extend my appreciation to all members of the "NOAA Hurricane Team" for their outstanding work covering Hurricanes Dennis and Floyd. I am especially proud of their professionalism displayed in accurately forecasting these storms and communicating life-saving information to the public. I know that events such as these major hurricanes place extra burdens on employees both in the office and at home, and I extend my gratitude to the families of the team members as well. Thanks to the work of the "team," Americans feel safer knowing that they are protected by the best weather forecasting system in the world."

*William M. Daley
Secretary of Commerce
September 23, 1999*

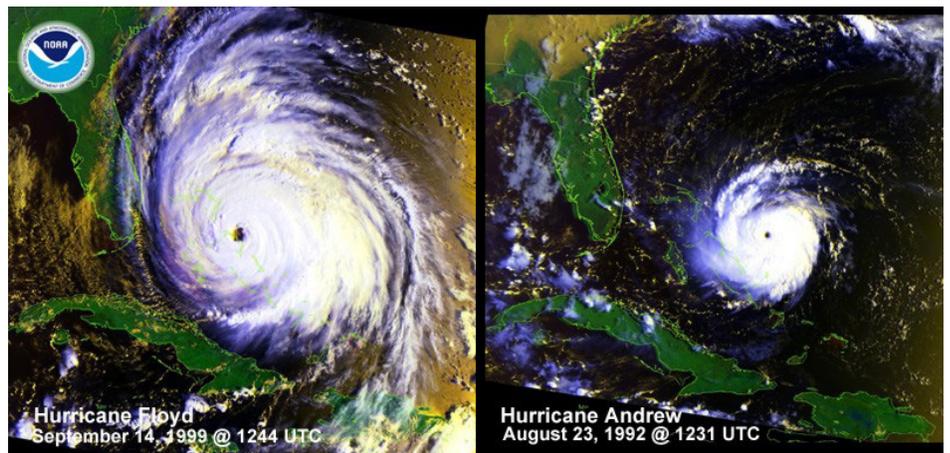
Residents Flee as Floyd Hangs 10 Along U.S. East Coast

Southeastern coastal residents watched and waited anxiously this past September as powerful Hurricane Floyd drifted towards the United States. Deemed one of the strongest storms of the 20th century, Floyd's massive size (see graphic below) and 155-mile per hour winds commanded everyone's attention.

Urgency upstaged complacency as emergency management officials from Florida to the Carolinas contemplated the possibility of experiencing Floyd's pounding winds and rain. Despite a forecasted turn to the north by computer models, Floyd's close proximity along the coast proved too menacing for comfort. Collectively, emergency managers staged what may be the largest evacuation of citizens in U.S. history. More than two million coastal residents packed their belongings, boarded up homes and businesses, and fled inland away from the path of Floyd's fury.

Meteorologists at the National Hurricane Center were aided in their forecasts of Floyd by a new method of collecting wind data via a Stepped Frequency-Microwave Radiometer (SFMR) pioneered by scientists from AOML's Hurricane Research Division (HRD). The sensor provides continuous measurement of wind speeds over large areas. Detailed profiles of Floyd's winds from the SFMR enabled forecasters to better understand their extent and strength which, in turn, assisted emergency managers in their preparations. HRD scientists conducted eight data-gathering reconnaissance missions into Floyd.

Floyd's curve to the north on September 15th spared both Florida and Georgia from the full force of a 140-mph, category 4 storm. Although Floyd was downgraded to a category 2 storm with 115-mph winds as it drifted northward, its landfall near Cape Fear, North Carolina on September 16th produced massive flooding and devastation.



Side-by-side satellite images of Hurricanes Floyd and Andrew, both strong category 4 storms on the Saffir-Simpson scale. The two storms appear in approximately the same geographic location, moving westward towards the eastern coast of Florida. Note the large difference in size. Hurricane Andrew's south Florida landfall in 1992 caused billions of dollars worth of damage and destruction.

"Kick Off"

1999 Combined
Federal Campaign
Program

"Good things happen
when you give"



October 22, 1999

AOML Lobby

10:00 a.m.

Contact Sharon Kenefick
for more information

(305-361-4451 or
kenefick@aoml.noaa.gov)

Guest Seminar*

**Particles in a Variable
Atmosphere: Concepts
of Measurement of
Cloud and Precipitation**

Dr. John Hallett
(University of Nevada/
Desert Research Institute)

October 27, 1999

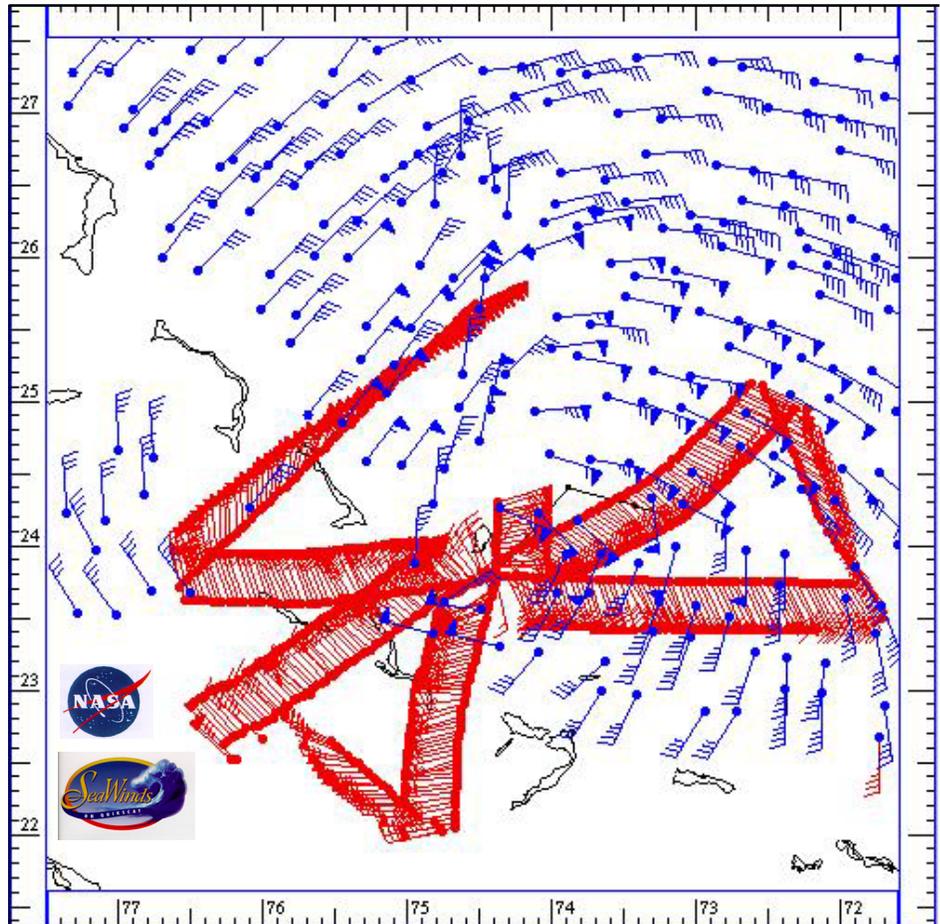
*Seminars begin at 3:00 p.m. in the first
floor conference room. Refreshments
are served at 2:45 p.m.



Columbus Day
October 11, 1999

AOML's Demonstration Project of Satellite Hurricane Wind Analysis

The image below illustrates two new techniques for diagnosing and researching hurricanes that are aimed at improving estimates of the surface wind structure in hurricanes. The remotely sensed surface wind data were collected in the same time period as when the photograph that appears on the last page of this issue of *Keynotes* was taken.



Surface wind map of Hurricane Floyd on September 13, 1999 (center time: 23:11 UTC, range from 19:00 to 23:11). Image produced by E. Uhlhorn (NOAA/AOML).

Surface wind vectors (blue) derived from the SeaWinds scatterometer on NASA's QuikSCAT satellite are read with a resolution cell every 25 km. QuikSCAT was a collaborative effort of two NASA laboratories, the Jet Propulsion Laboratory and Goddard Space Flight Center. It was launched on June 19, 1999 and is currently in the calibration/validation phase. The data displayed here are thus preliminary and do not give the exact wind speed but were used at AOML in a demonstration project to evaluate how they can contribute to the real time surface wind analysis scheme of the Hurricane Research Division (see September issue of *Keynotes* and article by Powell, Houston, Amat, and Morisseau-Leroy ("The HRD real-time hurricane wind analysis system," *Journal of Wind Engineering and Industrial Aerodynamics*, 77&78, 53-64, 1998).

The red butterfly pattern of wind barbs was obtained along the flight track of the NOAA P-3 aircraft and is derived from a Stepped Frequency Microwave Radiometer aboard the aircraft. This instrument measures the surface wind mostly as a function of foam coverage. It has been developed by AOML and the University of Massachusetts and was built by Quadrant Engineering. In collaboration with NOAA's Aircraft Operations Center engineering staff, Peter Black and Eric Uhlhorn of AOML have recently accomplished the task of transmitting these data to the National Hurricane Center in real time. Note the general agreement in direction between the two sets of wind vectors. Speed comparisons are part of the calibration effort for both systems.

Blood Drive

make a difference...
give the gift of life!

October 15, 1999

9:00 a.m.-1:00 p.m.

American Red Cross
Bloodmobile

AOML Parking Lot

Contact Sharon Kenefick
to schedule a blood
donation appointment

(305-361-4451 or
kenefick@aoml.noaa.gov)

HALLOWEEN

HAPPY



NOAA's Office of Oceanic and Atmospheric Research (OAR) is currently undergoing a reorganization. AOML Director Kristina Katsaros will present a seminar in November to discuss the OAR reorganization and explain how AOML will fit within the new structure (stay tuned for future email messages for seminar details). Information regarding the OAR reorganization, including functional statements for the reorganized offices of OAR, can be found at:

<http://www.oarhq.noaa.gov/>

La Niña Atlantic Hurricanes More Damaging, Costly, Scientists Discover

Atlantic hurricanes making landfall create much more damage in La Niña years, costing millions of dollars to U.S. coastal communities, according to scientists at the National Oceanic and Atmospheric Administration (NOAA) and National Center for Atmospheric Research (NCAR).

In their article "La Niña, El Niño, and Atlantic Hurricane Damages in the United States," published in the October *Bulletin of the American Meteorological Society*, Roger Pielke, Jr., of NCAR, and Chris Landsea, of NOAA, compare damage caused by landfall hurricanes during the 1900s (normalized to 1997 dollars) to the number of storms each year and the presence of an El Niño or La Niña.

"We found that in terms of median U.S. cost of damage from hurricanes, 20 times more damage costs occur in La Niña years versus El Niño years," says Landsea, a research meteorologist at NOAA's Atlantic Oceanographic and Meteorological Laboratory in Miami, Florida. "The current La Niña, which began in mid-1998 and is ongoing, typifies the damages that can happen in La Niña events, with Hurricanes Bonnie, Earl, and Georges last year and Hurricanes Bret, Dennis, and Floyd (so far) this year. The 1998 and 1999 total will likely be more than \$7 billion in damages from those hurricanes. These busy years contrast with the last El Niño event in 1997, which produced only \$100 million in U.S. damages from Hurricane Danny."

One major conclusion is that not only are there more storms in La Niña years, these storms are stronger, resulting in more damage from wind, storm surge, and rain-related flooding. In terms of U.S. dollars, there is a 77% chance that more than \$1 billion of hurricane damage will occur in a La Niña year, and a 36% chance that more than \$5 billion in damage will occur. These probabilities are much greater than the 32% and 14% chances, respectively, in El Niño years.

"The state of the El Niño-Southern Oscillation has historically proven to be a statistically significant indicator of U.S. hurricane damage, with annual damages in La Niña years totaling many times those during an El Niño event," says Pielke. "In addition, damages from individual storms in La Niña years are, on average, twice the cost of damages in El Niño years. For decision makers who can manage their risk, in disciplines like insurance and finance, this information is of large potential value. For the typical coastal resident, however, improved preparation makes sense in any year, as a powerful storm can strike in any season."

La Niña refers to cooler-than-average sea-surface temperatures across the eastern tropical Pacific Ocean. El Niño is an abnormal warming of the ocean temperatures across the eastern tropical Pacific Ocean. Both phenomena bring important consequences for weather around the globe.

These seasonal forecasts help resource and emergency managers prepare for the likelihood of more frequent and stronger hurricanes in La Niña years. However, El Niño and neutral years do not mean no hurricanes will make landfall, and one hurricane can have large impact. Hurricane Andrew is the most recent example of this phenomenon, a neutral-year storm that became one of the costliest natural disasters in U.S. history, with estimates of \$30 billion in damage.

"What this means for decision makers is that the absence of La Niña should not lead to complacency about hurricane impacts," Landsea says.

Scientists stress that El Niño and La Niña are not the only climate factors related to relative levels of hurricane damage. Considerable variation in hurricane damage is evident in neutral years as well. Landsea and Pielke noted that this study revealed only one of the recurring cycles associated with hurricanes. To understand and predict other elements, there is an ongoing body of research within NOAA and other organizations to calculate the interannual variability of hurricane seasons, track, and intensity forecasts of individual storms and economic impacts.

Official NOAA press release of September 28, 1999. Contact: Jana Goldman (301-713-2483 or goldman@noaa.gov).

Welcome Aboard

Qi Yao joins the staff of the Physical Oceanography Division as a CIMAS Research Assistant. Dr. Yao obtained her doctorate in applied mathematics from the University of Shanghai and her Master's of Science in mathematics from the University of Illinois at Urbana-Champaign. She comes to AOML from the Bedford Institute of Oceanography in Dartmouth, Nova Scotia.

Good Luck, Mark!

Mark Powell, meteorologist with the Hurricane Research Division, will compete in the Windsurfing Olympic Trials competition in Eau Gallie, Florida on October 16-24, 1999. Windsurfing is one of ten medal events in the sport of Sailing. The top finisher in the competition will represent the United States at the Sydney 2000 Summer Olympic Games. Addition information about the Sailing olympic trials for the 2000 summer games can be found at <http://www.web-showcase.com/windsurfing/index.html>.

Visitors

Karen Tolsen, secretary from NOAA's Office of Oceanic and Atmospheric Research in Silver Spring, Maryland, visited AOML on September 21-23, 1999. Karen met with Gail Derr, Erica Van Coverden, and Evan Forde for technical training to assist her in the formulation and creation of an OAR quarterly newsletter.

DAILY TROPICAL WEATHER DISCUSSION



**12:30 P.M. (WEEKDAYS)
4TH FLOOR MAP ROOM
APPROX. 20 MINUTES**

In support of the Hurricane Research Division's annual Hurricane Field Program, join us for daily map discussions about tropical cyclones around the world, with a focus on Atlantic hurricanes. Each week a new volunteer will lead the discussions. For more information, contact Chris Landsea (landsea@aoml.noaa.gov or 305-361-4357).

AOML Bids a Fond Farewell to Warren Krug

Warren Krug, 25-year veteran of AOML's Physical Oceanography Division, left AOML on October 8, 1999 to accept a position with the National Ocean Service (NOS) in Chesapeake, Virginia. Warren will work with the NOS' Physical Oceanographic Real-Time System (PORTS) program. PORTS promotes safe and cost-efficient navigation by providing the maritime user community with accurate real-time information (such as currents, water levels, and other oceanographic and meteorological data from bays and harbors) required to avoid groundings and collisions.



AOML Director Kristina Katsaros, Warren Krug, and Judy Gray, Deputy Director with farewell cake for Warren..

Warren began working for the Physical Oceanography Division in 1975 as an Electronics Technician. Over the years, he participated in numerous research cruises in support of oceanographic programs such as TOGA-COARE (Tropical Ocean Global Atmosphere-Coupled Ocean Atmosphere Response Experiment), STACS (Subtropical Atlantic Climate Studies), and EPOCS (Equatorial Pacific Ocean Climate Studies). As part of his duties, he traveled extensively in South America installing and maintaining tide/meteorology stations along the western coasts of Colombia, Ecuador, Peru, and Chile. He also traveled throughout the Caribbean, western Pacific Islands, southern Africa, and Australia in support of the Physical Oceanography Division's research programs. In 1998, Warren became the manager of AOML's Global Drifter Center. In 1999, he was promoted to the position of Physical Scientist.

Friends and co-workers gathered in AOML's lobby on Friday, October 1, 1999 to say their good-byes and to wish Warren and his family the best of luck in their move to Virginia. Deputy Director Judy Gray presented Warren with a commemorative plaque and thanked him for his many years of dedicated service. Much success to Warren, one of AOML's finest.

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Octoberween Party

*Kraut
Apple Cider*

October 28, 1999

*Wurst
Potato Salad*

\$6.00 Per Person (before 12 noon
on October 27th)

\$10.00 at the Door

Goblins under 10 eat Free

Costume Contest

Bring a dessert to share!

Starts at 4:00 p.m.

Picnic Shack (southeast side of AOML)



Travel

James Hendee met with Dr. Al Strong of NOAA/NESDIS and personnel from NOAA's Coastal Services Center, Charleston, South Carolina on September 21, 1999 to discuss a future collaborative effort entitled Coral Reef Watch. The focus of Coral Reef Watch will be to remotely monitor conditions conducive to coral bleaching and to present the conditions and finding in near real-time using various Web-based technology. James will also attend the Third Coral Reef Task Force Meeting in St. Croix, Virgin Islands, to discuss monitoring protocols on October 31-November 3, 1999.

Joseph Bishop, Jeffrey Bufkin, Ulises Rivero, Jack Stamates, and Bret Elkind participated in a research cruise aboard the NOAA ship *Ferrel* on September 25-30, 1999 to conduct an acoustic rainfall analysis within the AUTECH range off the Bahamas.

Rik Wanninkhof attended the Joint Global Ocean Flux Study (JGOFS) Scientific Steering Committee Meeting in Honolulu, Hawaii on October 4-7, 1999.

Kristina Katsaros will attend the first OAR Senior Research Council Meeting (which replaces the ERL Directors Retreat) in Silver Spring, Maryland on October 13-14, 1999.

Silvia Garzoli, Robert Molinari, David Enfield, Derrick Snowden, and Mark Swenson will attend the Ocean Observing System for Climate (OCEANOBS 99) Conference in San Raphael, France on October 17-22, 1999.

Steven Cook and Mark Swenson will attend the Data Buoy Cooperative Panel and Joint Tarafe Agreement Meetings in Wellington, New Zealand on October 20-November 4, 1999.

Gustavo Goñi will attend the Topex/Poseidon and JASON-1 Science Working Team Meeting in San Raphael, France on October 22-November 1, 1999.



Daylight Savings
Time ends on
October 31, 1999

Hurricane Floyd...Seen from Within



View of low-level clouds swirling in the center of Hurricane Floyd as seen from the window of one of NOAA's P-3 (N43RF) reconnaissance aircraft. The P-3's wingtip appears in the upper left corner. The eyewall rises up in the far right corner another 10 km or so above the aircraft flight level which is at 4 km elevation.

I was treated to the experience of a lifetime, when included on the "best" hurricane reconnaissance flight of the 1999 season, flying four penetrations through Hurricane Floyd from mid-day until 10 p.m. (local time) on September 13 when Floyd was still an innocent category 4 storm over the ocean. I wasn't quite certain whether this was the "acid test" of the Lab Director of AOML by the intrepid folks of the Hurricane Research Division, but I rather view the flight as a generous gift. They shared with me the thrill and beauty of their work, which makes up for the long, grueling hours of effort spent collecting data.

I had expected to be air sick (and embarrassed) but was spared. Surprisingly, the flight was not much bumpier than the clear air turbulence I've experienced aboard commercial jets, only more continuous. Other guests on board included a television crew (ABC news), Liz Richie, a young Australian researcher now working at the Naval Postgraduate School, Ed Walsh, a NASA collaborator, and Edwin Campos, a Costa Rican forecaster.

We returned home to a Miami that had been placed under a hurricane warning. In the end, we only experienced tropical-storm force winds and heavy rain, but this awe-inspiring phenomenon of nature wreaked havoc from northern Florida to the Maritime Provinces of Canada as it progressed northward, causing devastating floods, many deaths, and billions of dollars worth of damage.

Many thanks to the great team of the Aircraft Operations Center and our very own HRD researchers for helping me appreciate the risks and dedication of airborne hurricane research. *Kristina Katsaros*

Keynotes can be viewed online in PDF format at the following
Internet web site address:
<http://www.aoml.noaa.gov/keynotes>

Keynotes is published monthly by the Atlantic Oceanographic and Meteorological Laboratory. Contributions are welcome and should be submitted prior to the last week of each month to ensure inclusion in the following month's edition. Please address all correspondence to: Office of the Director, 4301 Rickenbacker Causeway, Miami, FL 33149. Contributions may also be submitted by fax at (305) 361-4421 or by email (derr@aoml.noaa.gov).

Editor - Kristina Katsaros
Publishing Editor - Gail Derr

The deadline for submitting material for the November issue of *Keynotes* is Friday, October 22, 1999.