September-October 2013
Vol. 17/No. 5

AOML Keynotes

ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LABORATORY

AOML is an environmental laboratory of NOAA's Office of Oceanic and Atmospheric Research on Virginia Key in Miami, Florida

Shutdown!

Due to a lapse in fiscal year 2014 appropriations, AOML staff reported to work on October 1st to find the following message from President Barack Obama:

The Federal Government is America's largest employer, with more than 2 million civilian workers and 1.4 million active duty military who serve in all 50 states and around the world. But Congress has failed to meet its responsibility to pass a budget before the fiscal year that begins today. And that means much of our Government must shut down effective today.

Staff were given four hours to prepare their offices, work areas, and the laboratory for an orderly suspension of operations. AOML closed its doors later in the day, and employees were dismissed from active duty until further notice. The majority of federal employees were furloughed as non-essential workers, while contract employees were sent home due to the closing of the AOML facility. Cooperative institute employees were able to continue working but at off-site locations from AOML.

On October 17th, Congress reached a bipartisan agreement to fund the federal government through January 15, 2014, and all staff returned to AOML and to active duty status.

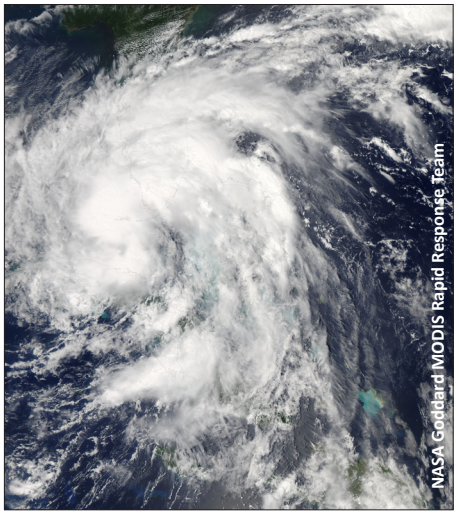
Tropical Cyclones Worsen Ocean Acidification at Reefs

While tropical cyclones can dramatically impact coral reefs, a new study reveals their passage also exacerbates ocean acidification, rendering reef structures even more vulnerable to damage. Calcareous marine organisms such as corals that thrive in alkaline-rich waters are increasingly imperiled as seawater becomes more acidic due to the ocean's uptake of carbon dioxide. The detrimental effects upon these organisms have been documented, but less is known about how reefs might react to ocean acidification when coupled with an additional stress factor such as a tropical cyclone.

To assess how reefs might respond to such a scenario, AOML coral researchers collected data from reefs in the Florida Keys before, during, and after the passage of Tropical Storm Isaac in August-September 2012. Their findings appear online in the *Journal of Geophysical Research*.*

Derek Manzello, Ian Enochs, and Renee Carlton, all University of Miami Cooperative Institute scientists at AOML, along with Sylvia Musielewicz of the University of Washington and Dwight Gledhill of NOAA's Ocean Acidification Program, analyzed seawater carbonate chemistry and environmental data from Cheeca Rocks and Little Conch Reef, both coral monitoring sites, as well as data from a coastal marine automated network station at Molasses Reef.

They found that Tropical Storm Isaac caused both an immediate and prolonged decline in seawater pH and carbonate saturation state at the two coral reef sites studied. The post-storm pH levels were the lowest recorded values to date from over two years of high-resolution data measured at the Cheeca Rocks ocean acidification monitoring site, and this depression in pH lingered for more than a full week.



NASA image of Tropical Storm Isaac passing over the Florida Keys and Florida reef tract on August 26, 2012.

Prior concerns regarding ocean acidification and coral reefs assumed carbonate undersaturation would not occur at reefs in the foreseeable future due to their location within the highly supersaturated tropical oceans. However, the study demonstrates that carbonate undersaturation at reefs will occur from even the passage of a modest tropical storm when coupled with ocean acidification.

With climate models projecting a steady increase in the rate of ocean acidification, along with stronger, more frequent tropical cyclones, the future for coral reefs thus appears bleak. In the coming decades, tropical cyclones could depress carbonate seawater saturation levels to such an extent that reefs will undergo periods of post-storm dissolution, weakening coral reef frameworks and worsening the widespread ecological and economic consequences of the coral reef crisis.

*Manzello, D., I. Enochs, S. Musielewicz, R. Carlton, and D. Gledhill, 2013: Tropical cyclones cause $CaCO_3$ undersaturation of coral reef seawater in a high-CO_2 world. *Journal of Geophysical Research,* 118, doi:10.1002/jgrc.20378.

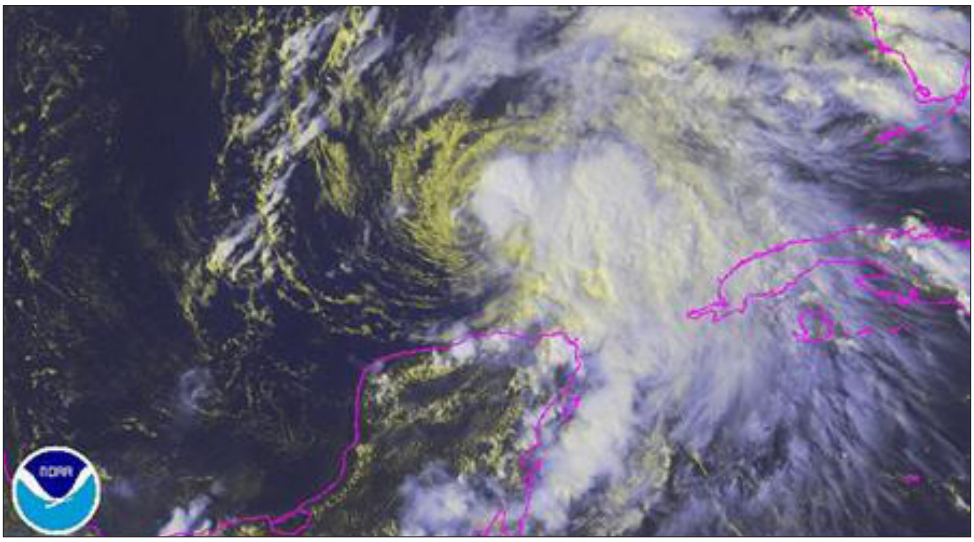
AOML Provides Essential Services during Appropriations Lapse

In early October, following the closure of the federal government, Tropical Storm Karen churned in the Gulf of Mexico, headed towards the Louisiana coast and Florida Panhandle. At the time, it was unknown whether the storm would weaken or strengthen into a hurricane. As Karen moved closer to shore, it became apparent that more information was needed to assess storm conditions.

To address this need, AOML Director Dr. Bob Atlas recalled six of AOML's hurricane researchers to conduct a P-3 tail Doppler radar mission into the storm. Data gathered aboard NOAA's hurricane hunter aircraft from the tail Doppler radar instrument were used to assess Tropical Storm Karen's structure and potential threat. These data were transmitted in real time to the operational Hurricane Weather Research and Forecasting (HWRF) model, resulting in a 12-hour forecast that correctly showed the storm was weakening.

The results of this model run led to the National Weather Service's decision to scale back on its watches and warnings, saving coastal communities both time and resources by preventing unnecessary preparations and evacuations. This P-3 mission marked the first occasion that tail Doppler radar data were transmitted to the operational HWRF model in real time.

During the P-3 flights, scientists with AOML's Hurricane Research Division (HRD) also deployed global positioning system dropsondes to collect information about Karen's atmospheric conditions. As dropsondes fall towards the ocean surface, they measure humidity, pressure, temperature, wind speed, and wind direction.



NOAA GOES satellite image of Tropical Storm Karen churning in the Gulf of Mexico on October 3, 2013. Karen initially posed a threat to Gulf coast and Florida panhandle communities but weakened into a depression and dissipated on October 5th prior to coming ashore.

HRD researchers pioneered the use of dropsondes in tropical cyclones and are experts in processing and transferring their real-time data to the National Weather Service and to modeling centers worldwide. These data were also used to verify that Tropical Storm Karen was weakening and helped to confirm NOAA's decision to cancel a hurricane watch that had been placed in effect for portions of Louisiana and the Florida Panhandle.

AOML also manages the data from a global network of free drifting Argo floats that measure the temperature and salinity of the upper 2000 meters of the ocean. Data from this global ocean observing system support U.S. Naval operations and U.S. Coast Guard search and rescue operations that render aid to people in distress while at sea. The data are also helpful in minimizing property losses and damage to the maritime environment.

The Navy runs an ocean data assimilation system on a daily basis that uses key ocean data to produce initial conditions for operational global ocean models. The real-time output from the Navy system, along with models from NOAA's National Centers for Environmental Prediction, are used to support search and rescue operations, as well as a wide range of other applications.

Given the potential risks to human life from the loss of such data, Dr. Atlas recalled an AOML employee to maintain the real-time Argo network data, with support from staff at the University of Miami's Cooperative Institute for Marine and Atmospheric Studies (CIMAS). Although partial Argo data monitoring was re-established, other monitoring of critical data (surface drifters, moorings, expendable bathythermographs, etc.) was unable to be resumed before the end of the lapse in appropriations.

Dr. Atlas also recalled two additional CIMAS employees needed to manage critical computer systems: the AOML-developed AMVERSEAS software in support of U.S. Coast Guard search and rescue operations and the NOAA-U.S. Coast Guard's mandatory ship reporting system for reducing the number of ship collisions with North Atlantic right whales.

Combined Federal Campaign

December 15, 2013-
January 15, 2014

AOML's 2013 CFC coordinators:

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To better reflect the diversity of its research, staff within AOML's Ocean Chemistry Division collectively decided in September to change the division's name to the Ocean Chemistry and Ecosystems Division (abbreviated as OCED). While OCED continues to conduct research in the disciplines of air-sea carbon dynamics, ocean acidification, and marine nutrient chemistry, the new name also reflects that the division now engages in research of coral reef ecosystems, ecosystem modeling, integrated ecosystem assessments, environmental and ecosystem microbiology, and the ecosystem impacts of ocean acidification.

Holiday Happenings at AOML

- Tree Trimming
- Lobby Decorating
- Dessert Contest
- Awards Ceremony

December 6, 2013
Lobby—10:30 am-12 noon

Holiday Party

December 19, 2013
Lobby—12 noon-2 pm

Bring a covered dish or dessert to share

$10.00 per person

Contact Ivan Castro for tickets
(305) 361-4420

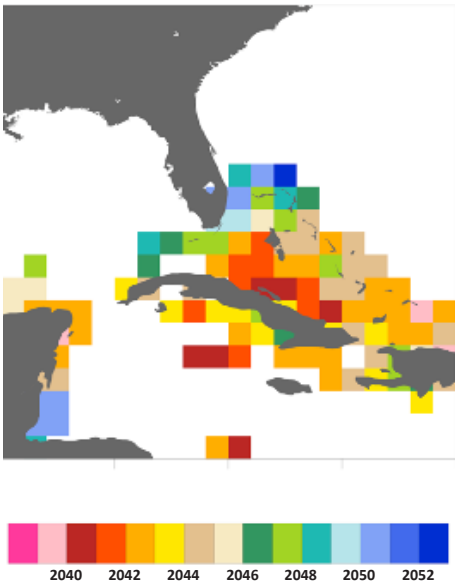
No Safe Haven for Coral Reefs

Coral reefs worldwide face serious challenges due to climate change impacts such as ocean acidification and coral bleaching. In a recent paper published online by *Global Change Biology*,* coral researchers at AOML and the Laboratoire d'Excellence in French Polynesia used an ensemble of climate models derived from the Fifth Assessment Report of the Intergovernmental Panel on Climate Change to examine future scenarios posed by this dual threat.

Ruben van Hooidonk and Derek Manzello, University of Miami Cooperative Institute scientists with AOML's Oceans Chemistry and Ecosystems Division, along with coauthors Jeffrey Maynard and Serge Planes, present new climate model projections that assess the effects of changing seawater chemistry and warming ocean temperatures on the health of tropical coral reefs.

The study concludes that coral reefs will suffer severe impacts from both ocean acidification and bleaching events in the coming years. The opposing latitudinal gradients found for the two threats indicate that locations experiencing bleaching stress at later dates will be exposed for longer periods to the effects of ocean acidification. "As greenhouse gas emissions are currently tracking above worst-case scenario projections, our results indicate that there are no long-term refugia for coral reefs from both threats," said Ruben van Hooidonk, lead author.

By 2055, 90% of all reef locations are projected to experience severe bleaching events on an annual basis. While greatly reducing greenhouse gas emissions might buy coral reefs decades of time to adapt, the ongoing effects of climate change present serious challenges to the survival of coral reefs as they currently exist.



Projections for when coral reefs in the Caribbean, based on multimodel ensembles, will begin to experience coral bleaching on annual basis.

A Google Earth™ application will be launched in early November that allows viewers to see projections of the combined impacts for all coral reef regions at different future dates.

*van Hooidonk, R., J.A. Maynard, D.P. Manzello, and S. Planes, 2013: Opposing latitudinal gradients in projected ocean acidification and bleaching impacts on coral reefs. *Global Change Biology,* doi:10.1111/gcb.12394.

Drs. Ian Enochs and Derek Manzello of AOML's Ocean Chemistry and Ecosystems Division visited St. Croix in September to deploy subsurface temperature recorders on the north, east, west, and south sides of the island. Working with Dr. Tyler Smith of the University of the Virgin Islands, they deployed recorders across four depth transects (1, 5, 10, and 25 m) and gathered carbonate chemistry samples adjacent to NOAA's Salt River Bay Integrated Coral Observing Network/Coral Reef Early Warning System monitoring station. Data from the temperature recorders, as well as the carbonate chemistry samples, will be used by researchers with the National Coral Reef Monitoring Program to assess the impacts of climate change and ocean acidification on coral reefs.

Left panel: A friendly hawksbill sea turtle looks on as Drs. Ian Enochs and Tyler Smith install a subsurface temperature recorder on the west end of St. Croix at Sprat Hole. Right panel: The subsurface temperature recorder after its installation on the ocean floor.

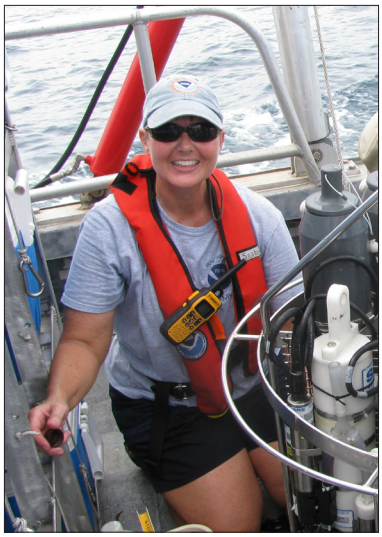
Welcome Aboard

Monica Allen recently joined the staff of NOAA's Office of Oceanic and Atmospheric Research (OAR) as the new Director of Communications. Monica has worked for NOAA since 2007 as part of a team that handled a broad array of national and international fisheries science and policy issues. She will serve as OAR's public affairs officer and should be consulted for guidance and assistance with all public affairs-related issues, particularly in regard to electronic or print media contacts and/or requests for interviews.

Graham Kolodziej joined the Ocean Chemistry and Ecosystems Division in September as a research associate of the University of Miami's Cooperative Institute for Marine and Atmospheric Studies. Graham will work with Drs. Derek Manzello and Ian Enochs in support of the Coral Health and Monitoring Program's efforts to study the impacts of ocean acidification on coral reefs. He holds a B.S. degree in marine and atmospheric science from the University of Miami's Rosenstiel School.

AOML Associate Director Steve Meador and his family worked to remove trash and debris from Pelican Harbor Park on September 21st as part of the International Coastal Cleanup Day sponsored by the Ocean Conservancy. The annual event draws thousands of volunteers worldwide every third Saturday in September to clean beach and coastal regions.

Farewell



Cheryl Brown, a research associate with the University of Miami's Cooperative Institute for Marine and Atmospheric Studies (CIMAS), resigned in October after six years of working with AOML's Ocean Chemistry and Ecosystems Division. Cheryl was first employed at AOML under Dr. Alex Pszenny in the late 1990s, participating in a number of cruises and operating the ion chromatography analytical instrumentation. She subsequently worked at NOAA's Southeast Fisheries Science Center before serving in the Peace Corps on the island of Vanuatu in the South Pacific. Cheryl returned to AOML through a CIMAS appointment in October 2007 to work with the Florida Area Coastal Environment group as a ship's captain on the RV *Cable*, a deck hand, and an analyst. Cheryl is currently working for Alta Systems in Miami, which provides aerial photographs from balloons.

4th Annual NOAA-Miami Health Fair

November 12, 2013

10 a.m. – 2 p.m.

AOML lobby and First-Floor Conference Room

Health care vendors will be onsite to provide information and answer questions

Free chair massage offered courtesy of Miami-Dade College massage therapist students

In conjunction with the health fair, the Society for Financial Awareness will present three free seminars at AOML (Second Floor Conference Room):

- **Getting Fiscally Fit (10 a.m.)**
- **Identity Theft (12 noon)**
- **Strategies for a Sustainable Income in Retirement (2 p.m.)**

Contact Howie Friedman for more information: Howie.Friedman@noaa.gov/305-361-4319

U.S. Department of Commerce
Ms. Penny Pritzker
Secretary of Commerce
www.doc.gov

National Oceanic and Atmospheric Administration
Dr. Kathryn D. Sullivan
Undersecretary of Commerce for Oceans and Atmosphere
and NOAA Administrator (Acting)
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Atlantic Oceanographic and Meteorological Laboratory

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Dr. Alan P. Leonardi
Deputy Director

CDR Stephen S. Meador
Associate Director

Dr. Frank D. Marks
Hurricane Research Division Director

Dr. James C. Hendee (Acting)
Ocean Chemistry and Ecosystems Division Director

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

Keynotes publishing editor: Gail Derr

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

Carson, H.S., P.C. Lopez-Duarte, **G.S. COOK,** F.J. Fodrie, B.J. Becker, C. DiBacco, and L.A. Levin, 2013: Temporal, spatial, and interspecific variation in geochemical signatures within fish otoliths, bivalve larval shells, and crustacean larvae. *Marine Ecology Progress Series,* 473: 133-148.

Frajka-Williams, E., W.E. Johns, **C.S. MEINEN,** L.M. Beal, and S.A. Cunningham, 2013: Eddy impacts on the Florida Current. *Geophysical Research Letters,* 40(2):349-353.

Gall, R., J. Franklin, **F.D. MARKS,** E.N. Rappaport, and F. Toepfer, 2013: The Hurricane Forecast Improvement Project. *Bulletin of the American Meteorological Society,* 94(3): 329-343.

Giammanco, I.M., J.L. Schroeder, and **M.D. POWELL,** 2013: GPS dropwindsonde and WSR-88D observations of tropical cyclone vertical wind profiles and their characteristics. *Weather and Forecasting,* 28(1):77-99.

GOPALAKRISHNAN, S.G., F. MARKS, J.A. ZHANG, X. ZHANG, J.-W. Bao, and V. Tallapragada, 2013: A study of the impacts of vertical diffusion on the structure and intensity of tropical cyclones using the high resolution HWRF system. *Journal of the Atmospheric Sciences,* 70(2):524-541.

KELBLE, C.R., 2013: Low salinity predation refugia could cause HAB initiation. *Journal of Phycology,* 49(91):18-19.

Letscher, R.T., D.A. Hansell, C.A. Carlson, **R. LUMPKIN,** and A.N. Knapp, 2013: Dissolved organic nitrogen in the global surface ocean: Distribution and fate. *Global Biogeochemical Cycles,* 27(1):141-153.

Li, X., **J.A. ZHANG,** X. Yang, W.G. Pichel, M. DeMaria, D. Long, and Z. Li, 2013: Tropical cyclone morphology from spaceborne synthetic aperture radar. *Bulletin of the American Meteorological Society,* 94(2):215-230.

LINDO-ATICHATI, D., F. BRINGAS, and **G. GONI,** 2013: Loop Current excursions and ring detachments during 1993-2009. *International Journal of Remote Sensing,* 34(14):5042-5053.

LUMPKIN, R., and P. Flament, 2013: Extent and energetics of the Hawaiian Lee Countercurrent. *Oceanography,* 26(1):58-65.

LUMPKIN, R., S.A. Grodsky, L. Centurioni, M.-H. Rio, J.A. Carton, and D. Lee, 2013: Removing spurious low-frequency variability in drifter velocities. *Journal of Atmospheric and Oceanic Technology,* 30(2):353-360.

MEINEN, C.S., W.E. Johns, **S.L. GARZOLI,** E. Van Sebille, D. Rayner, T. Kanzow, and **M.O. BARINGER,** 2013: Variability of the Deep Western Boundary Current at 26.5°N during 2004-2009. *Deep-Sea Research, Part II,* 85:154-168.

Privé, N.C., Y. Xie, J.S. Woollen, S.E. Koch, **R. ATLAS,** and R.E. Hood, 2013: Evaluation of the Earth Systems Research Laboratory's global Observing System Simulation Experiment (OSSE) system. *Tellus A,* 65:19011, 22 pp.

Terwey, W., S.F. Abarca, and **M.T. MONTGOMERY,** 2013: Comments on "Convectively generated potential vorticity in rainbands and formation of the secondary eyewall in Hurricane Rita of 2005." *Journal of the Atmospheric Sciences,* 70(3):984-988.

VAN HOOIDONK, R., J.A. Maynard, and S. Planes, 2013: Temporary refugia for coral reefs in a warming world. *Nature Climate Change,* 3(5):508-511.

WANG, C., L. ZHANG, and **S.-K. LEE,** 2013: Response of freshwater flux and sea surface salinity to variability of the Atlantic warm pool. *Journal of Climate,* 26(4):1249-1267.

WANNINKHOF, R., G.-H. PARK, T. Takahashi, C. Sweeney, R.A. Feely, Y. Nojiri, N. Gruber, S.C. Doney, G.A. McKinley, A. Lenton, C. Le Quere, C. Heinze, J. Schwinger, H. Graven, and S. Khatiwala, 2013: Global ocean carbon uptake: Magnitude, variability and trends. *Biogeosciences,* 10(3):1983-2000.

Zheng, J., Q. Liu, **C. WANG,** and X.-T. Zheng, 2013: Impact of heating anomalies associated with rainfall variations over the Indo-Western Pacific on Asian atmospheric circulation in winter. *Climate Dynamics,* 40(7-8):2023-2033.

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