Introducing EMILY and other innovations to improve hurricane forecasts

2012 Hurricane Research News Briefs

May 17, 2012

As long-time coastal residents know, hurricane forecasts are significantly more accurate than they were decades ago, particularly when it comes to predicting the track a storm will follow. Such gains are the result of research at NOAA, other federal agencies, and academic institutions. NOAA researchers will be using several innovative tools, techniques, and research results during the 2012 hurricane season to continue to improve hurricane forecasting. Several of these are summarized below in our 2012 hurricane research news briefs.

Zooming into a hurricane's eye at sea level

Meet EMILY, a sleek red and yellow, water-going, high-tech marvel. A 65-inch water-tight unmanned surface vehicle (USV), EMILY joins hurricane hunter planes Miss Piggy and Kermit as the newest member of NOAA's hurricane research cast of characters. Research meteorologists will do initial testing of EMILY with the aim of gathering surface data from the center of tropical storms and hurricanes. EMILY's sensors will collect barometric pressure, air and sea surface temperatures, salinity, and wind speed and direction. An onboard high-definition camera will also relay images back to NOAA scientists. Such surface data and imagery were previously impossible to obtain and represent a critical data gap for hurricane forecast improvement.

EMILY, a 65-inch water-tight craft, is one of the newest of NOAA's hurricane research platforms. Outfitted with a satellite link, camera, battery and gasoline motor, and a variety of snesors, EMILY will collect sea-level data from within a hurricane beginning with the 2012 hurricane season. Credit: Hydronalix, Inc.

Hydronalix Inc. developed EMILY (an acronym for Emergency Integrated Life Saving Lanyard) for a variety of uses, including assisting beach lifeguards in choppy water rescues. The company is developing the EMILY hurricane tracker under a federal Small Business Innovation Research grant with funding support from the NOAA Unmanned Aircraft Systems Program Office. The concept of steering a small, remotely operated boat into the eye of a hurricane to gather data originated with NOAA Research. The EMILY autonomous surface platform can also be utilized for a variety of NOAA's innovative research applications including monitoring of national marine sanctuaries, and detection of seafloor habitats, marine debris, and cultural resources.

After testing in the Channel Islands National Marine Sanctuary off the California coast, the EMILY USVs will be ready for initial trials into tropical storms and hurricanes by summer 2012. With a battery and a gasoline motor, EMILY can run for up to 10 days. Scientists will remotely guide EMILY into a storm system's eye. A "short burst data" satellite link on EMILY will facilitate a stream of data to scientists from the storm, and will allow scientists to steer the craft.

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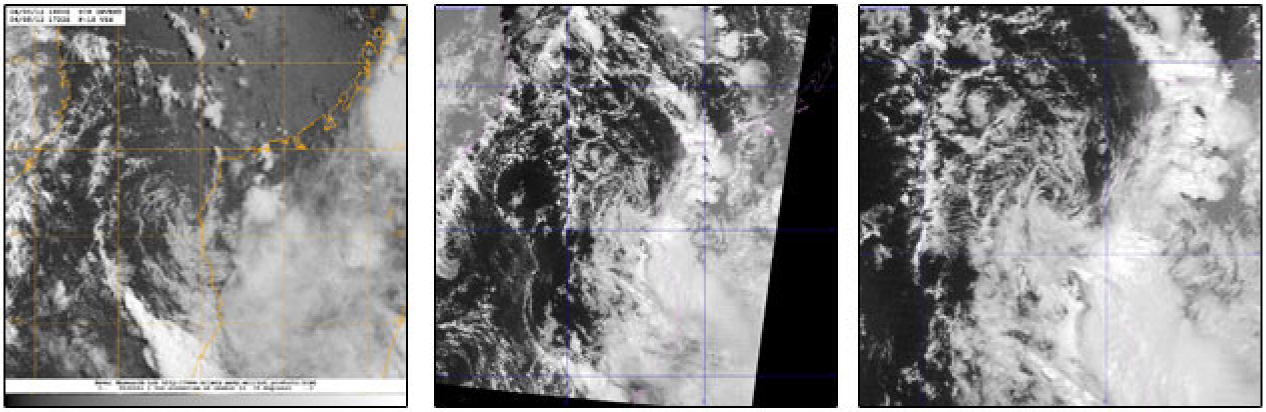
Sophisticated new satellite sensor locates center of forming tropical storms at night

One of the most challenging aspects of tropical storm forecasting is locating the center of a newly-formed or forming tropical storm. As soon as a storm center is located, meteorologists can initiate model runs and forecasts using information about the storm center. During daylight, visible satellite observations help make this task easier, as the center of the storm can be identified by looking for tell-tale spirals of low-level clouds surrounding the low pressure system. At night, however, visible observations cannot be used, and infrared sensors cannot tell the difference between low-lying clouds and the sea surface. This leaves forecasters with a long gap at night during which storms centers are difficult, if not impossible, to locate.



Satellite images from April 5, 2012, on the southeastern coast of Africa - Visible light image from the Naval Research Lab, on left, shows a low level circulation in clouds. Center: New day-night band sensor on NASA National Polar-orbiting Operational Environmental Satellite (NPP) image taken six hours later over the same area has less noise and higher spatial resolution. A small storm center is visible in the center of the image. Right: Storm center is clearly visible in this zoomed-in version of the center day-night band sensor image. Credit: Naval Research Lab/NASA/CIRA

Researchers at the NOAA Cooperative Institute for Research in the Atmosphere (CIRA) at Colorado State University have been working on how to find forming storm centers at night. They are investigating use of the new day-night band (DNB) sensor aboard NASA's news National Polar-orbiting Operational Environmental Satellite. The sensor is so sensitive that it can "see in the dark" using only reflected moonlight.
CIRA researchers have been leveraging this capability to identify storm centers in the dark. Having the ability to locate storm centers at night means that forecasters can get a head start on making, analyzing, and refining their forecasts.

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Profiling ocean temperature for improved hurricane intensity forecasts

Since warm waters can fuel and sustain a hurricane as it churns across the ocean, forecasters rely on accurate water temperature data to predict the storm's intensity. Researchers at the NOAA Cooperative Institute for Marine Ecosystems and Climate (CIMEC) in San Diego are developing a smaller, more compact version of an ocean drifting buoy that will improve collection of water temperature and other data. The new version of the drifter will be easier to deploy from a variety of aircraft than an older model of the drifter, which could only be deployed from the large Hurricane Hunter C-130J aircraft. This would enable deployment of the drifters ahead of any hurricane threatening landfall along the U.S. coast.

Over the past nine years, Hurricane Hunter planes have successfully deployed 200 drifters, developed at Scripps Institution of Oceanography, in six hurricanes in the Atlantic and four typhoons in the western Pacific. Typically, the planes drop one or two lines of drifters in the path of a hurricane about a day before the storm will reach them. The drifters transmit data - barometric pressure, wind speed, sea surface temperature, and temperature from the surface to a depth of 150 meters - in real time via a satellite link.

CIMEC is a partnership between NOAA and the Scripps Institution of Oceanography at the University of California San Diego.

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Mapping hurricane surface winds

Understanding the structure of tropical storms is key to making more accurate forecasts. For example, changes in the winds that form a hurricane's eyewall can signal that its intensity will change. Researchers at the NOAA Cooperative Institute for Research in the Atmosphere (CIRA) at Colorado State University have developed a new technique to combine satellite and aircraft observations to generate highly accurate maps of surface winds at 10-meter resolution. This information is critically important, especially in the case of storms making landfall. Having the ability to leverage all possible observations into one unified wind map product is of great utility for researchers.

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Sophisticated computer models focus on seasonal hurricane forecasts

It is notoriously difficult to predict how many hurricanes will occur in a given hurricane season, but research at the NOAA Geophysical Fluid Dynamics Laboratory in Princeton, N.J., could change that. The lab, which develops sophisticated computer models for studying Earth's climate, has recently developed an experimental system for forecasting seasonal hurricane frequency in the North Atlantic. If further research validates the accuracy of the forecasts, the system could be used to forecast the frequency of tropical storms up to seven months before hurricane season. Learn more about the experimental system at http://gfdl.noaa.gov/hyhufs.

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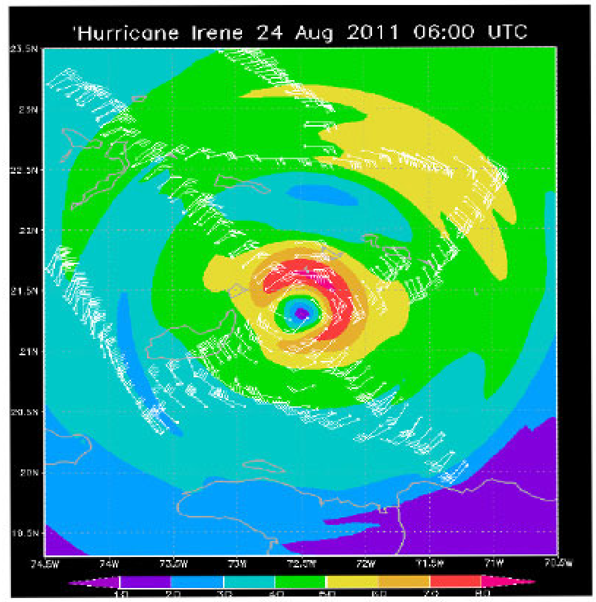

Superimposed observations of winds taken from satellite and aircraft observations from Hurricane Irene in August 2011.
Credit: John Knaff/CIRA

Unmanned planes to gather hurricane data from high above storm systems

NOAA scientists are part of a multi-agency team sending two massive unmanned aircraft over Atlantic hurricanes this fall to better understand - and therefore predict - the destructive storms. Two 115-foot-wingspan Global Hawks will take off and land from Wallops Island, Va., during the five-week mission, soaring up to nearly 65,000 feet to get perspective on storms developing over the ocean. "They're almost like satellites at that point," said Gary Wick, Ph.D., a physicist with NOAA's Earth System Research Laboratory in Boulder, Colo. Instruments on board the aircraft include sophisticated radar, lidar, and other systems to measure wind speed and direction, droplets of precipitation, and even the foamy sea spray on the surface of the ocean below the storm. Key to the hurricane mission are 500 "dropsondes" that can be released above hurricanes to fall through the storms, taking measurements along the way. NASA is leading the Hurricane and Severe Storm Sentinel mission, HS3, with participation by NOAA, the National Center for Atmospheric Research, and several academic institutions.

NASA's Global Hawk awaits a science flight at NASA's Dryden Flight Research Center in California's Mojave Desert. Credit: NASA

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Understanding why some hurricanes intensify

NOAA scientists will be flying through hurricanes as part of a multi-year study to better understand why some storms gather speed and energy - intensify - while others do not. NOAA's Hurricane Research Division, part of the Atlantic Oceanographic and Meteorological Laboratory in Miami, will lead the 2012 Intensity Forecasting Experiment (IFEX). This study collects observations that will help improve current hurricane computer models and develop the next-generation hurricane model.

NOAA began IFEX in 2005 and focuses on three approaches to improve prediction of hurricane intensity:

Collecting observational data over the duration of a tropical storm, from its initial formation to its last gust in order to evaluate how well models perform;

Developing and refining measurement strategies and technologies that provide improved real-time monitoring of storm intensity, structure, and environment; and

Improving understanding of the physical processes important in intensity change for a hurricane at all stages of its life cycle.

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