NASA Satellites Record A Month For The Hurricane History Books

8 September 2005

July 2005 was a record-setting month in the world of Atlantic Ocean hurricanes. That's because there were more named storms recorded in the month of July than ever in the hurricane history books.

Satellites from NASA and the National Oceanic and Atmospheric Administration (NOAA) had a busy month in July following the five named storms in July: Cindy, Dennis, Emily, Franklin and Gert.

During July, 2005 NASA and NOAA investigators flew sophisticated research aircraft within and above several of these storms, as part of NASA's Tropical Cloud Systems and Processes (TCSP). TCSP was undertaken to better understand the processes that lead to the birth and intensification of hurricanes.

"Hurricane Emily was the most powerful hurricane that NASA has ever flown over," stated Dr. Jeffrey Halverson, Severe Weather Meteorologist, at NASA's Goddard Space Flight Center, Greenbelt, Md. "Emily and Dennis were both strong hurricanes, meaning Category 3 or higher; it is highly unusual for two strong storms to develop in close succession as early as July in the Atlantic hurricane season."

NASA provides researchers and forecasters with space-based observations, data assimilation, and computer climate modeling. NASA also provides measurements and modeling of global sea surface temperature, precipitation, winds and sea surface height, all ingredients that contribute to the formation of tropical cyclones (which is the general name for typhoons, tropical storms and hurricanes).

What was the reason for this record setting number of named storms? According to NASA satellite data, the winds and sea surface temperatures were perfect during the month of July to help these five tropical cyclones form.

Winds can help storms form, or tear them apart (wind shear). Several times during July, NASA satellites detected rotating winds over the ocean's surface, precursors to tropical cyclone development. From those winds the five storms were born.

Wind shear is simply a change with the wind in height. When wind shear is present, the warm moist air that needs to rise high in the atmosphere is blown in varying directions depending how high in the atmosphere you are. Hurricane development requires that the rising air remain stacked vertically to produce very deep thunderstorm activity.

During July, the amount of wind shear in the Atlantic was minimal. The NASA-provided SeaWinds instruments aboard Japan's Midori 2 and NASA's QuikSCAT satellites can detect these winds before other instruments, providing early notice of developing storms to forecasters and scientists.

Warmer-than-normal sea-surface temperatures were also a key player in the record number of storms. Tropical cyclones need ocean surface water temperatures of 82 degrees Fahrenheit (F) or greater to fuel the evaporation and rising air that helps create the thunderstorms in a tropical cyclone.

Sea surface temperatures (SST) in the tropical Atlantic and Gulf of Mexico easily surpassed the "hurricane threshold" beginning in July 2005 and continued to climb into the mid- to high 80's through August. These sea surface temperatures are 1 to 3 degrees F above normal. "Hurricane-wise, we are in an incendiary situation," said Bill Patzert, oceanographer at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "These toasty SSTs are high octane fuel for September's hurricanes." September is usually the busiest month for Atlantic hurricanes.

Unlike traditional infrared satellite instruments, the Aqua satellite's Advanced Microwave Scanning Radiometer (AMSR-E) and the Tropical Rainfall Measuring Mission's (TRMM) Microwave Imager can detect sea surface temperatures through clouds. This valuable information can help determine if a tropical cyclone is likely to strengthen or weaken. The Jason-1 satellite altimeter provides data on sea surface height, a key measurement of ocean energy available to encourage and sustain hurricanes.

Air temperature and humidity are also important factors. The Atmospheric Infrared Sounder (AIRS) experiment suite aboard the Aqua satellite obtains measurements of global temperature and humidity throughout the atmosphere. This may lead to improve weather forecasts, improved determination of cyclone intensity, location and tracks, and the severe weather associated with storms, such as damaging winds.

The TRMM satellite's Precipitation Radar (PR) instrument provided by Japan for the TRMM satellite provides CAT scan-like views of rainfall in the massive thunderstorms of hurricanes.

TRMM instruments look at rainfall intensity for the likelihood of storm development. TRMM also sees "hot towers" or vertical columns of rapidly rising air that indicate very strong thunderstorms. These towers are like powerful pistons that convert energy from water vapor into a powerful wind and rain-producing engine. Once a storm develops, TRMM provides an inside view of how organized and tightly spiraled rain bands are, key indicators of storm intensity.

The TRMM PR got a good workout with Tropical Storms Cindy and Dennis as they both formed in early July, and both packed heavy rains.

After Cindy formed on July 3 in the extreme western Caribbean Sea just east of the Yucatan-Belize border. After crossing the Yucatan peninsula and re-entering the Gulf, she became a tropical storm on July 5. She moved northward, making landfall near Grand Isle, La. Just under hurricane strength. She brought heavy rains and inland flooding as she moved northeastward across the eastern U.S.

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Tropical Depression Dennis formed on July 4 near the southern Windward Islands and moved west-northwestward across the Caribbean Sea. When he became a tropical storm on July 5, it was the earliest date on record for a fourth named storm. On July 8, just south of central Cuba, Dennis became the earliest category 4 hurricane on record with 150 mph winds.

Dennis made landfall along the south-central coast of Cuba with 145 mph winds, causing considerable damage, widespread utility and communications outages.

Dennis weakened to a category 2 storm before making landfall along the western Florida panhandle near Navarre Beach late July 10. Considerable storm surge related damage occurred near St. Marks Florida, well east of the landfall location. Heavy rainfall and flooding occurred across much of Florida and extended well inland over portions of the southeastern U.S. at least thirty-two deaths were reported with most occurring in the Caribbean region.

Emily formed July 11, 1300 miles east-southeast of the Lesser Antilles. She moved west, and became a tropical storm on the 12. In two days she was a major hurricane (just below a category 5) with winds of 155 mph, south of Hispanola. On July 18, Emily struck Cozumel and crossed Mexico's Yucatan Peninsula with 135 mph winds. After a brief regeneration in the Gulf of Mexico, she made final landfall with winds near 125 mph in northeastern Mexico.

On July 21, Franklin grew from a depression to a tropical storm near the central Bahamas. His peak winds of 70 mph occurred on July 23, as he turned north and northeast in the Atlantic. Franklin merged with a frontal zone while passing south of Newfoundland, Canada on July 31.

Tropical Storm Gert set the month's record, forming in the Bay of Campeche on July 23. Late on July 24, Gert made landfall with 45 mph winds near Cabo Rojo on Mexico's east coast. She brought locally heavy rainfall to those areas that had been affected by Hurricane Emily less than a week earlier. Gert dissipated well inland over central Mexico on July 26.

Scientists rely on information gathered by NOAA and the U.S. Air Force Reserve personnel who fly directly into storms in hurricane hunter aircraft; NOAA, NASA and the U.S. Department of Defense satellites; NOAA data buoys, weather radars and partners among the international meteorological services.