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Research Team Seeking Clues to a Hurricane's Birth

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Twenty-one days before Hurricane Katrina made landfall at New Orleans last summer, a relatively small "wave" of turbulent air emerged from western Africa and headed out to sea.

Over the ocean, that trough of low atmospheric pressure began to shrink, and it was further diminished by a mass of dry and dusty air from a large Saharan dust storm that blew offshore at about the same time. Over the eastern and central Atlantic, the dusty cloud mingled with the tropical wave and helped keep it weak and diffuse.

But somewhere out over the Atlantic, that same atmospheric wave joined up with one or more other tropical depressions coming off Africa. Within days, the relatively small turbulence grew into the tropical cyclone that, as it crossed the ocean, became the hurricane that would devastate the Gulf Coast two weeks later.

Although many hurricanes that reach the United States are born as tropical depressions in the waters off Africa, little is known about why some peter out and others become monster hurricanes on the other side of the ocean. This is increasingly important information to have, and so a team of researchers from NASA and the National Oceanic and Atmospheric Administration will spend the next two months off the African coast trying to find the answer.

"These waves are pretty innocuous -- lines of heavy rain with some thunderstorms," said Jeffrey Halverson, a NASA mission scientist and professor at the University of Maryland in Baltimore County. "But about 10 percent change character as they move to sea and get rotations and start building up power. That's the big mystery: Where does the spin come from?"

From bases in the Cape Verde Islands and in Dakar, Senegal, the researchers will track, measure and analyze some of the 60 waves that every year come off West Africa in the late summer and head toward the Caribbean and North America, carried by trade winds.

Most of the time, these weather patterns -- called African easterly waves because they form over the Darfur region of Sudan or Ethiopia in East Africa -- stretch 1,200 to 1,500 miles and last three to four days before they dissipate, unless they grow into something bigger. They get their initial power and instability from the difference in temperature between the very hot Sahara Desert air and the substantially cooler air along the coast of the Gulf of Guinea.

NASA has outfitted a DC-8 jet with advanced atmospheric-research instruments and will fly it through tropical waves to take a wide range of measurements. Officials said that a NASA team had studied the phenomenon in the mid-1970s but that this year's research could be groundbreaking because of newer instruments. Sensors on the aircraft will measure the sizes and shapes of clouds and airborne particles, wind speed and direction, rainfall rates, and atmospheric temperature, pressure and relative humidity. They will also study air patterns before and after the waves move through.

Imaging from NASA's fleet of Earth-observing satellites -- which can capture, for instance, the vertical shape of a brewing storm -- will be used extensively.

The research will focus on the aspect of hurricane forecasting that scientists say remains most challenging -- how and why a tropical storm develops the intensity to become a hurricane. Forecasters often get the movement and direction of a storm right, but its intensity remains much harder to predict.

"We're 15 to 20 years behind when it comes to understanding hurricane intensity compared with hurricane movement," said NOAA's Jason Dunion, a hurricane modeler who will lead his agency's effort. "That's why the main goal here is to study intensity, to learn more about the factors that have to come together to make a big storm."

There is some general understanding of what is needed to create a hurricane -- a particular combination of moisture in the atmosphere, warm ocean temperature and winds. But by going back to the birthplace of about 80 percent of the hurricanes that hit North America, researchers hope to learn much more.

There is considerable interest as well in learning more about how small swirling tropical cyclones merge to become bigger systems -- and sometimes hurricanes.

"There seems to be a real element of chance involved," Halverson said. "To get large areas of rotating air, you need smaller vortices to act as building blocks. We think that they'll merge if they're close together, but it seems this is where chance comes in. If these thunderstorm clouds are far apart, then they won't merge."

Scientists will also focus on the role of the Saharan air layer that forms over the desert during the late spring, summer and early fall, and generally moves out over the tropical Atlantic Ocean. Its very hot and dry air, strong winds and airborne dust are thought to inhibit cyclone development. There is some evidence that the dust makes it more difficult for rain to form, but that factor is currently not considered in hurricane computer models.

One issue the research will not address is whether global warming is leading to the formation of more or fiercer hurricanes. Last year's very intense hurricane season was preceded by above-average temperatures in the usually cool waters off West Africa, but it remains unclear what effect that unusual warmth might have had.

The NASA African Monsoon Multidisciplinary Analyses is an offshoot of a larger international effort to better understand the West African monsoon, which brings heavy rains to the often-parched region. The initiative, funded primarily by the European Union, is designed largely to help West Africans with forecasting and crop planting. But the same July and August easterly waves that bring the monsoon can spawn storms such as Hurricane Katrina, and so NASA is spending $4 million to $5 million for hurricane research as its part of the effort.

NASA and NOAA have collaborated on three other hurricane studies since the mid-1990s. In keeping with their missions and expertise, NASA will focus on the upper reaches of the weather systems and NOAA will focus on the lower altitudes. Dunion said he expects some information from the Africa project, NAMMA, to be available almost immediately and useful in improving hurricane modeling and forecasting, although other data will take months or years to analyze.

"We believe our new knowledge from NAMMA could help protect Americans from hurricanes," he said.