NOAA'S HURRICANE HUNTERS

Specially equipped NOAA aircraft play an integral role in hurricane forecasting. Data collected during hurricanes by these high-flying meteorological stations and from a variety of other sources are fed into numerical computer models to help forecasters predict how intense a hurricane will be, and when and where it will make landfall. These computer models fulfill two important purposes: to help forecasters make accurate predictions during a hurricane; and to help hurricane researchers achieve a better understanding of storm processes, improving their forecast models.

P-3 Aircraft: Into the Storm

Slicing through the eyewall of a hurricane, buffeted by howling winds, blinding rain and violent updrafts and downdrafts before entering the relative calm of the storm's eye, NOAA's two P-3 turboprop aircraft probe every wind and pressure change, repeating the grueling experience again and again during the course of a ten-hour mission.

Scientists aboard the aircraft deploy Global Positioning System dropwindsondes as the P-3 flies through the hurricane. These instruments continuously transmit measurements of pressure, humidity, temperature, and wind direction and speed as they fall toward the sea, providing a detailed look at the structure of the storm and its intensity.

Storm surge forecasts recently received a boost with the addition of newly developed Stepped Frequency Microwave Radiometers to NOAA's P-3s. SFMRs measure over-ocean wind speed and rain rate in hurricanes and tropical storms, key indicators of potentially deadly storm surges. Surges are a major cause of hurricane-related deaths.

NOAA pilots have flown P-3s into hurricanes at low altitudes (1,500-10,000 ft.) to collect research-mission data critical for computer models that predict hurricane intensity and landfall. In addition, NOAA P-3s and WC-130s of the U.S. Air Force Reserves 53rd Weather Reconnaissance Squadron participate in hurricane reconnaissance missions, primarily to locate the center of the storm and measure central pressure and surface winds around the eye. Information from both research and reconnaissance flights directly contribute to the safety of people living along and visiting the vulnerable Atlantic and Gulf coasts.

In addition to flying hurricane research and reconnaissance missions, NOAA P-3s participate in a wide variety of national and international meteorological and oceanographic research programs. Recently, these aircraft have been used in major studies on storms approaching the continents of Europe and North America to improve forecasts and study the effects of El Niño, atmospheric gases and aerosols over the North Atlantic, large-scale convective storm complexes in the Midwest, and winter storms battering U.S. Pacific coastal states.

G-IV Jet: Seeking the Storm's Path

NOAA's Gulfstream IV SP jet, which can fly high, fast and far with a range of 4,000 nautical miles and a cruising altitude of 45,000 ft., paints a detailed picture of weather systems in the upper atmosphere surrounding developing hurricanes. The G-IV's data also supplement the critical low altitude research data that are collected by NOAA's P-3s.

Since the beginning of the 1997 hurricane season, the G-IV has flown missions around every Atlantic-based hurricane that has posed a potential threat to the United States. The jet's mission covers thousands of square miles surrounding the hurricane, gathering with GPS dropwindsondes vital high-altitude data needed for improved numerical forecast models. The G-IV has added a vital new dimension as it maps the steering currents that influence the movement of hurricanes.

Data from GPS dropwindsondes that measure pressure, temperature, humidity and wind information are relayed to the aircraft for transmission by satellite to the National Hurricane Center in Miami and the National Centers for Environmental Prediction in Camp Springs, Md. There, the data are available for many numerical forecast models, providing important information about regions – mostly over oceans – in which there are no other sources of weather data.

Since obtaining the aircraft in 1997, G-IV flight data have enabled numerical guidance computer models to improve hurricane landfall and track forecasts by approximately 20 percent. Currently under development is a tail Doppler radar system that will enable the G-IV to acquire three-dimensional hurricane core wind field data. The data will be fed into the new Hurricane Weather Research and Forecasting model being developed by the NOAA National Weather Service to improve hurricane intensity forecasts.

After hurricane season, NOAA's interest in severe weather becomes focused on the winter storms affecting the western, central and northeastern United States. NOAA has used the G-IV to help monitor and study these storms to advance the understanding of them and improve winter storm forecasts. The G-IV has also been used to study clear air turbulence – a condition that threatens the safety of air traffic

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– over the Pacific Ocean, helping scientists increase their ability to understand and predict this potentially deadly phenomenon.

Unmanned Aircraft Systems—Flights of the Future

Unmanned Aircraft Systems (UAS) have been widely used by the military and intelligence agencies overseas. In recent years, NOAA and other federal agencies have begun to test the use of UAS for environmental observations, firefighting, and other civilian applications. UAS are powered aerial systems that do not carry a pilot, but are independently or remotely piloted. They can be land-, air-, or ship-launched and can carry an internal or external payload of scientific equipment.

UAS have the potential to take measurements in areas that are currently unmonitored because of airplane and pilot limitations. The systems could provide research and operational activities in these hard-to-reach environments more accurately and with less risk than traditional aircraft. NOAA hurricane researchers are leading the collaborative effort to test the ability of using a UAS to fly into the eyewall of a hurricane at altitudes as low as 300 feet. Scientists hope using unmanned aircraft will help fill a gap in near-surface observations. These data have been hard to gather because of the safety risks of low-level manned flight.

In 2007, NOAA flew an Aerosonde UAS into Hurricane Noel with great success. The flight provided unique insights and continuous observations in a region of the storm where the ocean's energy is directly transferred to the atmosphere just above. In future missions, a second UAS may be launched as the first aircraft returns. This would result in longer continuous storm coverage. Once in the storm, up-to-the-minute data will be relayed to NOAA's National Hurricane Center. Coordinating UAS flights to coincide with a manned NOAA P-3 will provide a volume of data on a hurricane from top to bottom. This level of information saturation is valuable to researchers, providing a more complete picture of storm structure and intensity changes that becomes a valuable tool for forecasters.

NOAA's Aircraft Operations Center

The P-3s and G-IV are based at NOAA's Aircraft Operations Center at MacDill Air Force Base in Tampa, Fla. AOC is part of NOAA's Office of Marine and Aviation Operations, which includes civilians as well as officers of the NOAA Corps, one of the nation's seven uniformed services. NOAA Corps pilots and civilian flight engineers, meteorologists and electronic engineers are highly trained to operate in the kind of adverse weather conditions that keep other aircraft on the ground. Much of the scientific instrumentation flown aboard NOAA aircraft is designed, built, assembled, and calibrated by AOC's Science and Engineering Division. During non-hurricane season months, the P-3s and G-IV are tailored by AOC engineers for use in other severe weather and atmospheric research programs, and flown by NOAA Corps pilots worldwide in a variety of weather conditions.