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Orion advances

NASA marked a major milestone Dec. 5 on its journey to Mars as the Orion spacecraft completed its first voyage to space, traveling farther than any spacecraft designed for astronauts has in more than 40 years.

“Today’s flight test of Orion is a huge step for NASA and a really critical part of our work to pioneer deep space on our journey to Mars,” said NASA Administrator Charles Bolden. “The teams did a tremendous job putting Orion through its paces in the real environment it will endure as we push the boundary of human exploration in the coming years.”

Orion blazed into the morning sky, lifting off from Cape Canaveral Air Force Station in Florida on a United Launch Alliance Delta IV Heavy rocket. The Orion crew module splashed down approximately 4.5 hours later in the Pacific Ocean, 600 miles southwest of San Diego.

During the uncrewed test, Orion traveled twice through the Van Allen belt where it experienced high periods of radiation, and reached an altitude of 3,600 miles above Earth. Orion also hit speeds of 20,000 mph and weathered temperatures approaching 4,000



14-235

NASA/Bill Ingalls

The United Launch Alliance Delta IV Heavy rocket with NASA’s Orion spacecraft mounted atop lifts off.

Armstrong assists with Orion

By Jay Levine
X-Press editor

NASA’s Orion spacecraft provided a glance at the future of the U.S. space program and NASA Armstrong helped capture the event as it was happening for the world to see.

Armstrong’s remotely piloted Ikhana aircraft generated a live video feed of the Orion Crew Module as it descended through the atmosphere into the Pacific Ocean. While Ikhana loitered at 27,000 feet altitude, the onboard infrared camera detected the capsule then an optical camera observed Orion’s descent through parachute deployment and splashdown and sent real-time video via satellite to NASA TV for live broadcast.

While Orion will continue to take steps toward eventually carrying crews to beyond low Earth orbit and onto

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IceBridge campaign wraps up

By George Hale

NASA Goddard Space Flight Center

NASA's Operation IceBridge recently completed its 2014 Antarctic campaign, marking the mission's sixth set of flights over the continent. During the six-week-long deployment from Punta Arenas, Chile, researchers aboard NASA's DC-8 airborne laboratory measured land and sea ice from above to continue building a record of change in the Antarctic.

The campaign began on Oct. 16, with a flight aimed at measuring sea ice in the Weddell Sea. This first flight – like many that followed – covered areas that IceBridge studied during previous campaigns. The flights this year were of particular importance because it will compare data from two years ago when the DC-8 previously flew in Punta Arenas.

Repeating lines flown in past years is crucial for understanding how ice conditions are changing over time. In addition, some survey lines follow the paths measured by NASA's Ice, Cloud and Land Elevation Satellite, or ICESat, from 2003 to 2009. This helps cover the gap between ICESat and its successor, ICESat-2, scheduled to launch in a few years.

In addition to these repeated surveys, IceBridge carried out missions intended to expand



NASA/George Hale

This view from an IceBridge survey flight on Nov. 3, 2014, shows cloud cover on crevassed Antarctic ice.

coverage into new areas. One example would be the Nov. 14 flight that measured farther inland from previous surveys of the Foundation Ice Stream and Support Force Glacier. The ice surface, bedrock and sub-ice water depth data collected on this flight will be helpful for scientists projecting future changes to the Antarctic Ice Sheet.

Two other newly designed missions also had the aim of setting a baseline for validating ICESat-2

measurements. On Oct. 23 and 26, the DC-8 flew a survey around the South Pole at 88 degrees south. Every planned ICESat-2 orbit intersects at 88 degrees, giving scientists a reference point for verifying the satellite's accuracy.

One of these pole flights was part of a set of eight surveys considered the highest priority by IceBridge mission planners. These flights, known as baseline missions, target areas that are rapidly changing and thus

needing repeat measurement, or are otherwise scientifically important, like flights building comparison points for ICESat-2. Of the 22 flights IceBridge carried out during this campaign, seven were in this baseline category. In addition to the South Pole flight, three targeted glaciers in West Antarctica and the Antarctic Peninsula, and three collected data on Antarctic sea ice.

On top of the mission's scientific work, IceBridge also hosted high-profile visitors. On the Oct. 28 flight, NASA's Chief Scientist Ellen Stofan and Michael Hammer, the U.S. Ambassador to Chile, met the IceBridge staff.

As in previous campaigns, IceBridge researchers reached out to students both back in the United States and in Chile. On several survey flights students used an online text chat portal that allowed them to ask researchers questions over the DC-8's satellite communication system. During these chats, IceBridge communicated with 867 students in 37 classrooms.

With the conclusion of several weeks in the field, IceBridge's various instrument teams now look ahead to processing the data they collected and to preparing for IceBridge's upcoming Arctic campaign, scheduled to begin in March 2015.

HS3 science missions successful

By Robert Gutro

NASA Goddard Space Flight Center

NASA's Hurricane and Severe Storms Sentinel, or HS3, mission investigated four tropical cyclones in the 2014 Atlantic Ocean hurricane season: Cristobal, Dolly, Edouard and Gonzalo. The storms affected land areas in the Atlantic Ocean Basin and during the investigations intensified.

The HS3 mission pilots flew an unmanned Global Hawk aircraft over Cristobal, Dolly, and Edouard

and flew a manned WB-57 aircraft over Gonzalo. During the flights, Cristobal transitioned from a hurricane into an extra-tropical storm. Edouard strengthened from a tropical storm into a strong Category 2 hurricane during the Global Hawk fly-overs. Gonzalo was a major Categories 3 and 4 hurricane when NASA's WB-57 investigated.

"Despite forecasts for a below-normal hurricane season, 2014 became our best deployment year

of the mission by providing us with four storms, two of which became major hurricanes," said Dr. Scott Braun, HS3 mission principal investigator from NASA's Goddard Space Flight Center in Greenbelt, Maryland.

The HS3 mission was based out of NASA's Wallops Flight Facility in Wallops Island, Virginia, for the third year to investigate the processes that underlie hurricane formation and intensity change in the Atlantic Ocean basin.

Hurricane Cristobal Became an Extra-Tropical Storm

NASA's Global Hawk No. 872 aircraft, which is based at NASA Armstrong and situated at Wallops for the HS3 missions, flew over Hurricane Cristobal on Aug. 26 and 27 when it was a Category 1 hurricane northeast of the Bahamas. The Global Hawk flew again on Aug. 28 and 29 when the storm was transitioning into an extra-tropical

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Astronaut class visits

The NASA astronaut class of 2013 visited NASA Armstrong on Nov 19. The 2013 astronaut selectees were chosen following an extensive year-and-a-half search. Just eight people were selected from the second largest group of astronaut applicants ever – more than 6,100. The astronauts have been visiting each of the NASA centers and they toured Armstrong and saw a number of projects, including the Ikhana remotely piloted aircraft.



ED14-0346-56

NASA/Ken Ulbrich

News at NASA

NASA is best place to work

For the third year in a row, NASA is the number one choice in the Best Places to Work survey for a large government agency.

NASA's employees have a job satisfaction and commitment score of 74.6 out of 100. The score increased from 74 in the 2013 tabulations.

Individual NASA centers also received some of the best scores.

NASA Armstrong received high marks with an overall ranking of 27th of 315 similar government agency offices. The center received a 71.9 rating, which is better than its 2013 score of 71.6. Armstrong was tied with Glenn Research Center at number 27 with an identical score.

Stennis Space Center was ranked fourth overall, Goddard Space Flight Center was ranked sixth, Marshall Space Flight Center was seventh, Langley Research Center was 13th, Johnson Space Center was 17th, Ames Research Center was 22nd and NASA Headquarters and the Kennedy Space Center tied at 35th.

NASA is followed in the large agency category by the Department of Commerce, with a score of 68.7, and the Department of State, which received a score of 68.2.

The Best Places to Work in the Federal Government rankings are produced by the Partnership for Public Service, a nonprofit, nonpartisan organization committed to improving the effectiveness of government.

Miller wins NESC award

Chris Miller, center, receives a NASA Engineering and Safety Center Engineering Excellence Award from NESC Chief Engineer at Armstrong Lance Richards, left, and Armstrong Center Director David McBride. Miller received the award for his work as lead engineer on the F/A-18 Full Scale Advanced Systems Testbed Space Launch System Launch Vehicle Adaptive Control project. The project tested and validated SLS controls.



ED14-0369-01

NASA/Ken Ulbrich

Vroom!

It's hard to tell who's controlling this car, but Madison, from left, and Katelyn Haupt appear to be having a great time driving toward Christmas. Katelyn and Madison were just a few NASA Armstrong children to enjoy the holiday party Dec. 11 at the Mulligan Family Fun Center.



ED14-0319-082

NASA/Ken Ulbrich

NASA Social has aeronautics focus

By Jay Levine
X-Press editor

NASA is transforming aviation by reducing aircraft environmental impacts, enhancing safety and leading the way in revolutionary new technologies.

Those are some of the key ideas from a two-day NASA Aeronautics Research Mission Directorate Social event Nov. 18-19 at NASA Armstrong. The event highlighted past, current and future NASA flight technologies that influenced and revolutionized aviation.

"I knew NASA touched so many things in our everyday lives, but I didn't realize how much work they do in monitoring the environment and reducing emissions," said Pasquale Murena, an attendee.

One such technology is the NASA-developed Automatic Ground-Collision Avoidance System. Extensive flight testing at NASA Armstrong demonstrated the advanced computing technology could significantly reduce the number of accidents attributed to controlled flight into terrain, a leading cause of fatalities in civilian and military aviation that results in about 100 fatalities a year in the United States.

Cockpit warning systems have virtually eliminated these kinds of accidents for large commuter aircraft, but the system could meet the challenges still existing for fighter aircraft, helicopters and general aviation. Lives have already been saved since system integration recently started with U.S. Air Force F-16 aircraft.

"I learned so much about NASA innovations for commercial airlines that have enhanced safety and added to safer travel and how NASA technology has affected different industries," said participant Chirag Sagar.

In addition to the Automatic Ground-Collision Avoidance



ED14-0345-047

NASA/Tom Tschida

NASA Social attendees, news media, project managers and escorts gathered in front of NASA's Gulfstream III aircraft during an event at NASA Armstrong.



ED14-0345-048

NASA/Tom Tschida

Tom Rigney, far left, Active Compliant Trailing Edge project manager, gives Valerie Skuovaty, Melissa Aho and Trina Marie Phillips a hands-on look at the ACTE flap on NASA's Gulfstream III aircraft.



ED14-0345-047

NASA/Tom Tschida

Mark Skoog explained to NASA Social attendees the NASA-developed technology called the Automatic Ground-Collision Avoidance System.



ED14-0345-118

NASA/Tom Tschida

Mark Hodge and Tom Miller detail Global Hawk hurricane study missions at the NASA Social at Armstrong.

System, Sagar said he learned about digital fly by wire. First flown on a NASA Armstrong F-8, digital fly by wire is a method for controlling an aircraft and enhancing maintenance and safety that is transitioning into the automotive industry. Several car manufacturers already use braking systems based on digital fly-by-wire technology and some are beginning to offer vehicles that use drive-by-wire technology for parking and various elements of driving.

Another presentation focused on the Adaptive Compliant Trailing Edge flexible wing flap. Researchers believe a pair of experimental morphing flaps for the ACTE project flown on a NASA Gulfstream III aircraft can make future airliners quieter and more fuel efficient.

This past summer researchers replaced an airplane's conventional aluminum flaps with advanced, shape-changing assemblies that form seamless bendable and twistable surfaces. Flight testing will determine whether flexible trailing-edge wing flaps are a viable approach to improve aerodynamic efficiency



ED14-0345-036

NASA/Tom Tschida

NASA pilots Hernan Posada, from left, Tom Miller, Manny Antimisiaris and Scott Howe talk about their careers and flying NASA missions. At far left, Armstrong social media manager Kate Squires leads the panel discussion.

and reduce noise generated during takeoffs and landings.

Included in the two-day event was a look at the NASA Global Hawk aircraft. NASA uses the autonomously flown vehicles for science research missions, like the recently completed Hurricane and Severe Storm Sentinel mission over the Atlantic Ocean. The study to

learn more about how tropical storms form and intensify into hurricanes was based at NASA's Wallops Flight Facility in Virginia.

In addition to interactive briefings, participants toured the center to see its aircraft and walk through its support facilities. Another aspect of the two-day event was a panel discussion with four

NASA Armstrong pilots including Manny Antimisiaris, Scott Howe, Tom Miller and Hernan Posada shared their careers and missions for NASA.

Participants said they had experiences they will remember while learning about NASA technologies, missions and how NASA is "with you when you fly."

Practice for the moon

By Peter W. Merlin

NASA Armstrong Public Affairs

Before the Apollo astronauts landed on the moon, they first had to practice on Earth.

A colloquium at NASA Armstrong on Oct. 29 marked the 50th anniversary of the first flight of a most unusual vehicle that was used to train the first humans to visit another world – the Lunar Landing Research Vehicle, or LLRV. Guest speakers included former project manager Gene Matranga, engineer Wayne Ottinger, pilot Donald Mallick, and Rocket Shop supervisor Dave Stoddard. Other original LLRV team members present included Glenn Angle and Adam Mello.

In the early 1960s, NASA studied several techniques for simulating descent to the lunar surface. Electronic simulators and a tethered mockup provided valuable training but only a free-flying vehicle could provide a truly high-fidelity simulation. Hubert Drake at NASA's Flight Research Center (known today as the Armstrong Flight Research Center) conceived a concept that became the LLRV.

Built of aluminum alloy trusses and shaped like a giant four-legged bedstead, the vehicle simulated a lunar landing profile with the help of a 4,200-pound-thrust turbofan engine mounted vertically in a gimbal. Upon reaching the maximum test altitude, the pilot then throttled back until the jet supported just five-sixths of the vehicle's weight, simulating the moon's reduced gravity. Two variable-thrust hydrogen peroxide rockets controlled the LLRV's rate of descent and horizontal movement. Sixteen smaller hydrogen peroxide thrusters gave the pilot control in pitch, yaw and roll.

For the initial flights on Oct. 30, 1964, research pilot Joe Walker flew the LLRV three times for a total of just under 60 seconds, reaching a modest peak altitude of 10 feet. Later flights were shared between



ED14-0329-21

NASA/Ken Ulbrich

NASA Armstrong hosted a colloquium to celebrate the 50th anniversary of the first LLRV flight. Guests included original team members, from left, Wayne Ottinger, Dave Stoddard, Glenn Angle, Gene Matranga, Donald Mallick and Adam Mello.

Walker; Donald Mallick; the Army's Jack Kleuver; and Joseph Algranti and H.E. "Bud" Ream of NASA's Manned Spacecraft Center (now the Johnson Space Center) in Texas.

The first LLRV was shipped to Houston in December 1966, followed a month later by its nearly identical twin. Three slightly larger craft joined the training fleet, and all were re-designated Lunar Landing Training Vehicles. Three of the five were later destroyed in non-fatal accidents. Fittingly, the two surviving vehicles are currently displayed at Armstrong and Johnson.

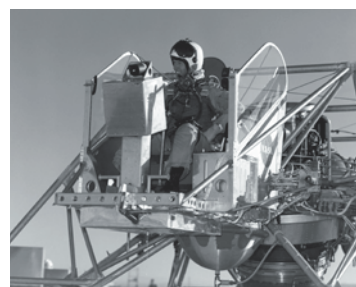
All prime and backup commanders assigned to Apollo lunar landing missions practiced in the craft and later acknowledged the benefits. Apollo 11 astronaut Neil Armstrong, first human to step onto the moon's surface, said the mission would not have been successful without the quality of simulation that resulted from the LLRVs. Other astronauts echoed these feelings.



ECN-506

NASA

Above, the LLRV is seen in flight. Below, pilot Joe Walker is at the LLRV controls.



ECN-453

NASA

Graphics chief passes at 69

Justine Mack, a long-time NASA Armstrong Graphics Department chief, died Oct. 31, 2014. She was 69.

She was hired in 1982 as the sole graphic artist. With a drafting table, T-square, ink set and a small room, she used pen and ink for all the drawings prior to the advent of computer graphics programs.

Mack drew schematics, aircraft parts, directional maps and research report graphs. A contract changeover resulted in a larger budget and she was able to hire other graphic artists and staffing for the reproduction office and the technical publications office.

She remained in charge as the staff grew to six graphics personnel, four people in tech pubs and two in repro. She started a time and job-tracking (graphics orders) system long before metrics were established.

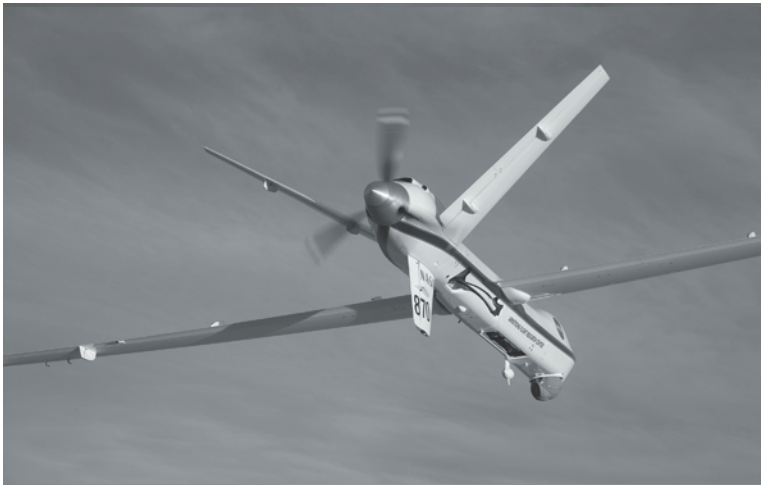
As contracts changed, she led the graphics department, but the other areas were merged into different organizations. Budget cuts as well as implementation of computers resulted in a reduction in the number of graphics personnel to the current number of three.

Mack was known to many long-time NASA Armstrong employees as "Mother Graphics" and remembered throughout the center as a dedicated, conscientious worker who would tackle any job no matter how large or small.

New pub listed

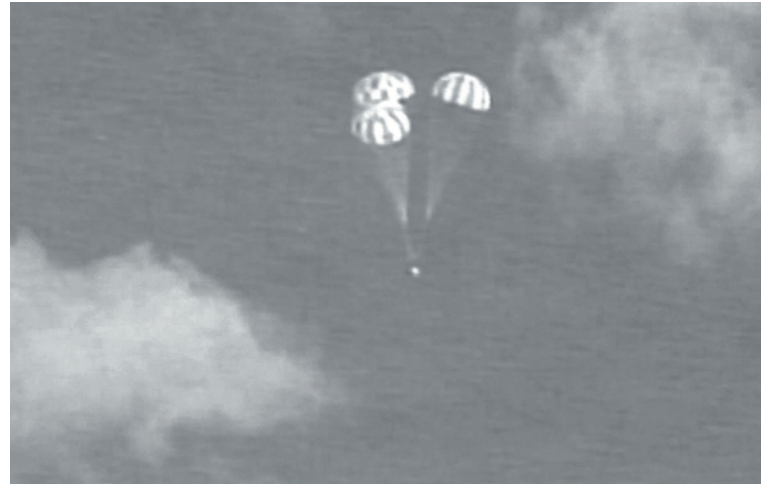
NASA Armstrong partnerships resulted in a technical publication.

In November, Daniel W. Jones, James T. Heineck, Paul S. Bean, Brittany J. Martin, David Nils Larson, Edward T. Schairer and Louise A. Walker collaborated on, "Flight Validation of an Air-to-Air Background Oriented Schlieren Technique," ITAR NASA/TM-2014-218323.



ED14-0341-50

NASA/Carla Thomas



NASA

Ikhana recorded the Orion splashdown in the Pacific Ocean.

Orion as seen from the remotely piloted Ikhana aircraft.

Assist... from page 1

Mars, Armstrong will continue to have roles, said Chuck Rogers, Armstrong's Orion project manager and recent acting Exploration and Space Technology mission director.

The Armstrong Exploration and Space Technology Mission Directorate supported flight test planning and helped develop the test objectives for the Dec. 5 Orion flight test. Armstrong's Bob Clark is chief engineer for the Orion Flight Test Management Office.

Armstrong also has supported systems engineering and technical

integration, range and network requirements and verifications and development of flight instrumentation, Rogers said.

Armstrong continues to work on preparations for the future Ascent Abort-2, or AA-2, a transonic/maximum dynamic pressure test of the Orion Launch Abort System.

NASA aircraft based at Armstrong also recently documented the Orion parachute tests in Yuma, Arizona, with a photographer and videographer aboard. Critical documentation of the capsule

parachute assembly system drops in Yuma is ongoing. See an upcoming article in the X-Press for more details.

Armstrong's connection to Orion also includes the May 6, 2010, test of the Orion Pad Abort-1 Launch Abort System test using a full-size boilerplate capsule for the NASA Johnson Space Center in Houston. The flight from the U.S. Army White Sands Missile Range in New Mexico was to ensure the reliability of the system intended to give the crew of an Orion capsule

the option to initiate an abort in the case of an emergency on the pad or shortly after liftoff.

In addition, a NASA F/A-18 research aircraft in November 2013 safely and economically tested and re-tested auto-pilot systems for the Space Launch System that will propel Orion on its missions beyond low Earth orbit.

While the Orion missions will be out of this world, some of the groundwork for successful flights will happen here on Earth and at Armstrong.

Orion... from page 1

degrees Fahrenheit as it entered Earth's atmosphere.

Orion will open the space between Earth and Mars for exploration by astronauts. This proving ground will be invaluable for testing capabilities future human Mars missions will need. The spacecraft was tested in space to allow engineers to collect critical data to evaluate its performance and improve its design. The flight tested Orion's heat shield, avionics, parachutes, computers and key spacecraft separation events, using many of the systems critical to the safety of astronauts who will travel in the capsule.

On future missions, Orion will launch on NASA's Space Launch System (SLS) heavy-lift rocket currently being developed at the agency's Marshall Space Flight

Center in Huntsville, Alabama. A 70 metric-ton (77 ton) SLS will send Orion to a distant retrograde orbit around the moon on Exploration Mission-1 in the first test of the fully integrated Orion and SLS system.

"We really pushed Orion as much as we could to give us real data that we can use to improve Orion's design going forward," said Mark Geyer, Orion Program manager. "In the coming weeks and months we'll be taking a look at that invaluable information and applying lessons learned to the next Orion spacecraft already in production for the first mission atop the Space Launch System rocket."

A team of NASA, U.S. Navy and Lockheed Martin personnel aboard the USS Anchorage recovered Orion and returned it to U.S. Naval Base



NASA/Bill Ingalls

NASA Administrator Charles Bolden and William Gerstenmaier, associate administrator for NASA's Human Exploration and Operations Directorate, and others monitored the Orion spacecraft as it returned to Earth.

San Diego. Orion then was delivered to NASA's Kennedy Space Center in Florida, where it will be processed.

The crew module will be refurbished for use in Ascent Abort-2, a test of Orion's launch abort system.

HS3... from page 2

system. Storms become extra-tropical when the warm air at the storm center is replaced by colder air and the storm begins to resemble a mid-latitude low pressure system.

Tropical Storm Cristobal became a hurricane late on Aug. 25 as it moved through the Bahamas. A rainfall analysis using data from NASA-JAXA's Tropical Rainfall Measuring Mission, or TRMM, satellite showed heavy rainfall over the Dominican Republic and Puerto Rico that exceeded 275 mm (10.9 inches). The satellite analysis found the greatest rainfall totals during that period along Cristobal's track near the Turks and Caicos Islands where rainfall was over 350 mm (13.8 inches). After drenching the eastern Caribbean, Cristobal moved north and intensified into a hurricane, eventually passing to the west of Bermuda.

During the Global Hawk's 24-hour mission on Aug. 28 - 29, the aircraft flew a "lawnmower," or back-and-forth, pattern over Hurricane Cristobal while gathering data using dropsondes and two other instruments. A dropsonde is a device that measures winds, temperature, pressure and humidity as it falls from the aircraft to the surface. The aircraft released 69 dropsondes over Hurricane Cristobal.

The dropsonde data showed maximum low-level winds of 85 - 90 knots (97.8 to 103.6 mph/157.4 to 166.7 kph) just east and northwest of the center of circulation (near 49 degrees west longitude and 43.5

north latitude). These strong winds were located 124 to 186 miles (200 to 300 km) from the storm center, suggesting a shift of the strongest winds outward from the center compared to earlier stages in Cristobal's lifecycle.

Dropsonde data also revealed that very dry air was rapidly moving eastward across the western and southern sides of the storm as it made its transition.

On Aug. 29, satellite imagery showed Hurricane Cristobal racing through the North Atlantic while losing its tropical characteristics.

Dolly Makes Landfall in Mexico

At 11 p.m. EDT on September 2, Dolly made landfall between Tampico and Cabo Rojo, near latitude 21.9 north and longitude 97.7 west.

NASA's unmanned Global Hawk aircraft flew over Tropical Storm Dolly on Sept. 2 and Sept. 3 and gathered wind and other data.

"We saw winds at low levels (near 850 millibars) up to about 35 to 40 knots (40 to 46 mph) and a reasonably depicted cyclonic circulation," Braun said. "The data at 150 millibars (high in the atmosphere) showed strong outflow from the storm to the east and southeast."

Edouard Became a Hurricane

NASA's HS3 mission pilots operated the unmanned Global Hawk aircraft on two-day flights on Sept. 11 and Sept. 15 into



ED13-0399-06

NASA/Tom Miller

NASA's unmanned Global Hawk was a key asset during the HS3 missions.

Hurricane Edouard and scored a bullseye by gathering information in the eye of the strengthening storm.

During the Sept. 11 - 12 flight over Tropical Storm Edouard, the wind field at 800 millibars (about 2 kilometers or 1.2 miles above the surface) showed a well-organized cyclonic circulation with winds of at least 35 knots (40.2 mph/64.8 kph) on the eastern side of the storm. A dropsonde near the center suggested low-level warming and drying associated with sinking air motions, suggesting the formation of a nascent eye. In addition, scientists saw how upper-level wind shear and dry air was limiting Edouard's ability to strengthen.

During the Sept. 14-15 flight, the data from the Global Hawk instruments revealed a storm that was quickly intensifying from a tropical storm to a Category 2 intensity storm. Compared to an earlier NOAA P-3 flight, the Global Hawk data showed a pressure fall at the center of more than 11 millibars and an increase in maximum winds of at least 10 knots (11.5 mph/18.5 kph) in just four hours.

The Global Hawk overflew the hurricane again on Sept. 16-17 when it was near maximum intensity as a strong Category 2 storm and one last time on Sept. 18-19 when the storm rapidly weakened into a tropical storm after crossing the Atlantic, affecting the western Azores Islands over the weekend of Sept. 20.

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