National Aeronautics and Space Administration

THE ARMSTRONG X-PRESS

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Pilots assist with wildfires

By Jay Levine
X-Press editor

An effort by multiple NASA centers to assist with suppressing California wildfires included capturing satellite data of the smoke plumes and aircraft flights over burned areas to collect information for recovery planning.

The California Air National Guard asked the NASA Earth Science Disasters Program for support with the wildfires that have destroyed more than 410,000 acres and 11 disaster program members arrived July 29. The NASA contingent coordinates NASA resources to provide detailed information, maps and images.

"Our goal is to provide the best support possible to our long-standing partners in the state of California," said Carver Struve, Emergency Management co-lead.

From Armstrong, a high-altitude aircraft and two pilots assisted in two separate efforts to collect infrared imagery of California's raging wildfires and the damage they caused.

AFRC2018-0176-33 NASA/Ken Ulbrich

An ER-2 based at Armstrong flew a mission over the state's wildfires Aug. 9 to validate instruments and to collect information to help U.S. Forest Service officials plan for recovery.

The most intense of those wildfires is in the Mendocino Complex, which became the largest wildfire in California history. The data collected through the two efforts were used to fight the current fires, to provide data to recover from them and to study future blazes.

NASA's ER-2 based at Armstrong flew a NASA thermal imaging camera to assess some of the fire damage to help officials estimate the resources needed to recover from the fire, as well as identify some potential dangers from challenges such as mudslides this winter, said Jeffrey Myers, manager of NASA's Ames Research Center Airborne Sensor Facility in California. The facility is managed by Universities Space Research Association.

The ER-2 was conducting a mission that uses airborne sensors to simulate future satellite data products by flying over large sections of California as part of a long-term study, Myers explained. The mission team's Aug. 9 flight tested a key component on the aircraft referred to as the MODIS-ASTER Simulator or MASTER. That instrument will be used for an intensive study of North American fires with the National Oceanic and Atmospheric Administration called the Fire Influence on the Regional to Global Environments and Air Quality (FIREX-AQ).

"The MASTER sensor is operated in support of principal investigators from NASA's Goddard Space Flight Center in Maryland and the Jet Propulsion Laboratory in Pasadena," Myers said. "It is used for earth

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Bridenstine makes first AFRC visit

By Jay Levine
X-Press editor

NASA Administrator Jim Bridenstine, during his first visit to Armstrong Aug. 28, said he supported new X-planes, increasing research into hypersonic flight and continuing to develop technology that will change people's lives.

Bridenstine made the remarks during an hourlong question and answer session with employees.

"You are part of a very impressive heritage that continues in the work you are currently doing," he said.

The center's founding and early work centered on iconic research vehicles such as the Bell X-1 that exceeded the speed of sound and the X-15 rocket plane. Soon that legacy will include the X-57 Maxwell that will validate distributed electric propulsion and the X-59 Quiet Supersonic Technology (QueSST) for the Low-Boom Flight Demonstration mission.

"X-59 will be faster than the speed of sound, but will do so with more of a rumble and less of a crack," Bridenstine said. "It has the potential

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Students make Prandtl fly

By Jay Levine
X-Press editor

Abbigail Waddell leaned over bundles of wires and circuit boards to see if a system she had helped develop with other interns for two summers at Armstrong was ready for testing.

Waddell, who attends North Carolina Agricultural and Technical State University, where she is studying electrical engineering, adjusted the electronic pressure measurement system, or EPM, and nodded it was ready. Chris Jensen, who is a mechanical engineering major at Embry-Riddle University in Prescott, Arizona, blew air through a large rubber tube and a gauge indicated the pressure was rising as Jensen continued to blow.

Nathaniel Boisjolie-Gair, who is studying mechanical engineering at North Dakota State University, monitored a computer screen to see if the system was measuring the pressure of Jensen's breath. Stephen Harris, who is studying electrical engineering at John Brown University in Siloam Springs, Arkansas, made sure data were recording. The test was a success.

Along with nine other interns, the students assisted Armstrong Chief Scientist Al Bowers with developing, testing and integrating the system into the subscale Preliminary Research Aerodynamic Design to Lower Drag, or Prandtl-D 3C glider. A flight series Aug. 1 demonstrated their system could measure pressure from the surface of the aircraft's wing, providing additional evidence that a wing design method using twist can dramatically increase aircraft efficiency.

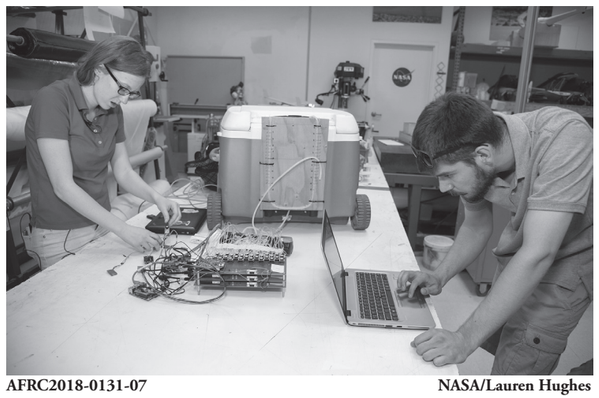
Before the aircraft was ready for flight, however, there was more work to do. With the system validated, students crafted a box for it with a 3D printer. Then the system was installed in the aircraft. Deborah Jackson, an aerospace engineering student at Embry Riddle, Prescott, Arizona, was one of the students who meticulously helped connect each of the 89 tubes from the system along the aircraft's wingspan. The small plastic tubes were also attached to transducers, which convert the air pressure on the wing to electronic data, and then to pressure points all along the wing.

AFRC2018-0182-42 NASA/Lauren Hughes

Deborah Jackson, Al Bowers and Abbigail Waddell successfully launch the subscale Prandtl-D 3C glider.

AFRC2018-0153-01 NASA/Lauren Hughes

Deborah Jackson integrates a pressure system she and other students developed for the subscale Prandtl-D 3C glider.



AFRC2018-0131-07 NASA/Lauren Hughes

Abbigail Waddell and Nathaniel Boisjolie-Gair test a pressure system they and other students developed for the subscale Prandtl-D 3C glider.

During the previous two summers Jackson worked on the Fiber Optic Sensing System (FOSS) flown on the aircraft, which gathered data last summer on strain on the aircraft's wing. This summer she is helping seek similar data through pressure on the wing. So far, it looks like the two methods are yielding the same answer.

"The variety of experience that I have been able to get is the best part," Jackson said. "I worked in the electrical engineering lab and now I am working as an aerospace engineering student. I have learned so many things that are going to make me a better engineer and a better individual. I can also see the bigger picture."

With all of the connections made and additional ground testing and the necessary preflight reviews complete, the students were ready for flight. The weight of the new system made the aircraft heavier toward the nose, and without a breeze the July 26 flight was limited, but data were acquired on the first try. The team tried again Aug. 1 and this time a light breeze helped the flight tests. After a few successful attempts, students carefully made measurements and computations and shifted the weight for the aircraft to fly even better.

"The wind picked up and it began flying faster, which allowed us to get clean pressure data for the whole wing," said flight operations lead Victoria Hawkins, who is a graduate student focusing on unmanned and autonomous systems engineering at Embry-Riddle in Daytona Beach,

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Administrator visits

By Leslie Williams
Armstrong News Chief

Arriving at one of the driest spots in North America, the Mojave Desert, NASA Administrator Jim Bridenstine toured Armstrong and visited the Mojave Air and Space Port Aug. 28.

The center is located in an ideal environment for flight research on Edwards Air Force Base. For over 70 years, Armstrong has collaborated with Edwards, starting with the X-1 program, to fly a plane faster than the speed of sound. This program kicked off the partnership to follow that tests aeronautical concepts on numerous experimental aircraft, known as X-planes, throughout the years to the present.

Bridenstine started his day meeting with Brig. Gen. E. John Teichert from Edwards. Discussion centered on how NASA has benefited from the partnership with access to established infrastructure, runways, tower and range access for flight test operations, often jointly.

Afterward, he met with Armstrong management and held a town hall for employees who asked the new administrator questions.

During his tour of the center, he listened to engineers talk about a number of aeronautical research projects at Armstrong. He also visited the mission control rooms that monitor flights and gather data, saw research support aircraft such as the F/A-18s and learned they are crucial as another set of eyes for safety to monitor flights and as research test platforms. As a former navy pilot, he looked comfortable back in the cockpit, where he did a Facebook Live.

Among the other stops along his tour was the Dale Reed Subscale Flight Research Lab that is used for rapid prototyping for flight testing on a smaller scale. Bridenstine also checked out the Flight Loads Lab where mechanical loads and thermal studies are performed on components or complete flight vehicles.

AFRC2018-0212-045 NASA/Ken Ulbrich

NASA Administrator Jim Bridenstine flies the X-57 Maxwell simulator at Armstrong. The simulator is designed to provide feedback to NASA test pilots based on the aircraft's unique design and distributed electric propulsion system.

AFRC2018-0212-099 NASA/Ken Ulbrich

Bridenstine talks to Armstrong's X-57 team and members of ES Aero, the prime contractor for the plane, about progress in modifying the Tecnam P2006T into an all-electric aircraft. A model of the aircraft's final configuration is in the foreground.

Bridenstine finished his center tour at the center's flight simulators for the X-59 QueSST (Quiet Supersonic Technology) and the X-57 all electric airplanes. These pair of aircraft are the first new NASA piloted X-planes since the X-53 Active Aeroelastic Wing in 2002.

When he left the center, Bridenstine headed to a meeting at the Mojave Air and Space Port to meet with commercial space industry representatives from companies such as Lockheed Martin, which is building the X-59.

Scaled Composites representatives hosted Bridenstine's press briefing in their Mojave hangar where the X-57 is undergoing its initial modification into an electric aircraft from a combustion Tecnam P2006T airplane. Scaled Composites is known for its unconventional aircraft design. The company was founded in 1982 by Burt Rutan.

News at NASA

Human computer turns 100

As Katherine G. Johnson's 100th birthday (Aug. 26) approached, many NASA Langley Research Center in Virginia employees expressed admiration for the woman whose math powered some of America's first triumphs in human space exploration.

Johnson did trajectory analysis for Alan Shepard's May 1961 mission Freedom 7, America's first human spaceflight. At a time when digital computers were relatively new and untested, she famously checked the computer's math for John Glenn's historic first orbital spaceflight by an American in February of 1962.

Those are just two bullet points in a brilliant career that stretched from 1953 to 1986.

Her 100th birthday was recognized throughout NASA and around the world. But at Langley, the milestone created an extra measure of pride and joy.

Graduate research assistant Cecilia Stoner, stopped on her way to Langley's cafeteria, said she admires how Johnson remained humble, even when showered with accolades ranging from the Presidential Medal of Freedom to toys made in her likeness.

Langley's acting chief technologist, Julie Williams-Byrd, echoed that thought.

"She opened the doors for the rest of us," Williams-Byrd said. "It's typical NASA culture, right? We have a mission. Everybody's going to jump in and do what they can to make that mission successful."

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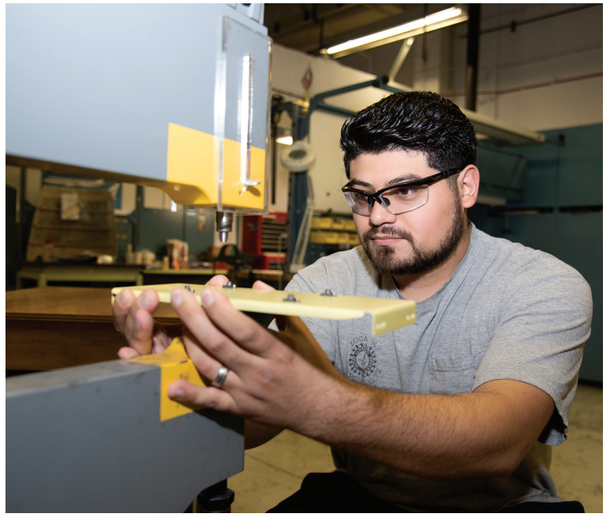
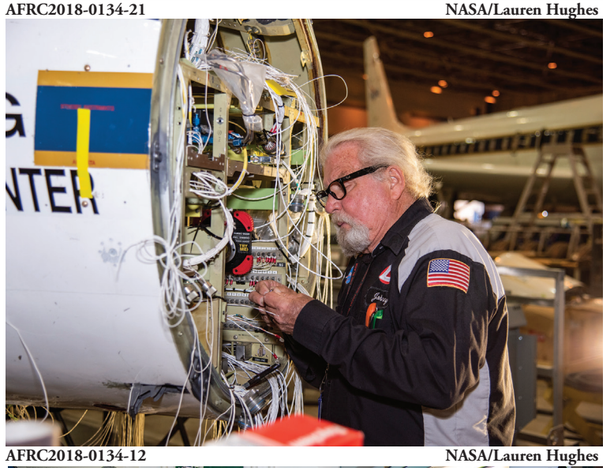
AFRC2018-0134-19 NASA/Lauren Hughes



AFRC2018-0134-21 NASA/Lauren Hughes

AFRC2018-0134-22 NASA/Lauren Hughes

Above, *Eric Nisbet works on a part for the ER-2 instrument panel.*



AFRC2018-0134-12 NASA/Lauren Hughes

AFRC2018-0134-5 NASA/Lauren Hughes

Above, *Herman Escobar works on a part for the ER-2 instrument panel.* ***At left****, Andrew Shaw also works on a component for the same project.*

AFRC2018-0134-1 NASA/Lauren Hughes

Avionics technicians David Johnson, in the ***above*** *photo, and Johnny Bryant,* ***middle photo at right****, both work on rewiring the fixed nose and cockpit.* ***Top middle****, Hector Rosas works on fabricating a part for the ER-2 instrumentation panel.*

CARE mod

ER-2 cockpit effort will enhance pilot safety

By Jay Levine
X-Press editor

It's all about the pressure, or in this case increasing the pressure.

The Cockpit Altitude Reduction Effort (CARE) modifications to the ER-2s at NASA Armstrong will enhance pilot safety. Once complete, the overhaul will increase cockpit pressure, which will reduce the effective cockpit altitude from 29,000 feet to 15,000 feet when the aircraft is operating at its cruise altitude of 65,000 feet.

Lowering the effective cockpit altitude reduces the chances of decompression sickness known to have short and long-term effects on the pilot. Decompression sickness is also suffered by divers, who refer to it as the bends, which causes such symptoms as dizziness, muscle and joint pain, cramps, numbness and even paralysis.

To accomplish the goal the cockpit frame, bulkheads in front of and in back of the pilot, cockpit sill, longeron tie fittings, windshield and instrument panel will be structurally reinforced, replaced or both. In addition, changes in the cockpit oxygen regulation system and environmental control system are planned.

The new instrument panel is an integral structural component requiring existing cockpit instruments to be relocated. The Armstrong Operations Engineering Branch designed the necessary adaptor plates and the Experimental Fabrication Branch team fabricated the parts. Those parts will be installed by the ER-2 maintenance team.

Team members continue to work through miles of wires that snake through the ER-2 to indicators and components in the cockpit, while removing legacy cockpit equipment that is no longer used.

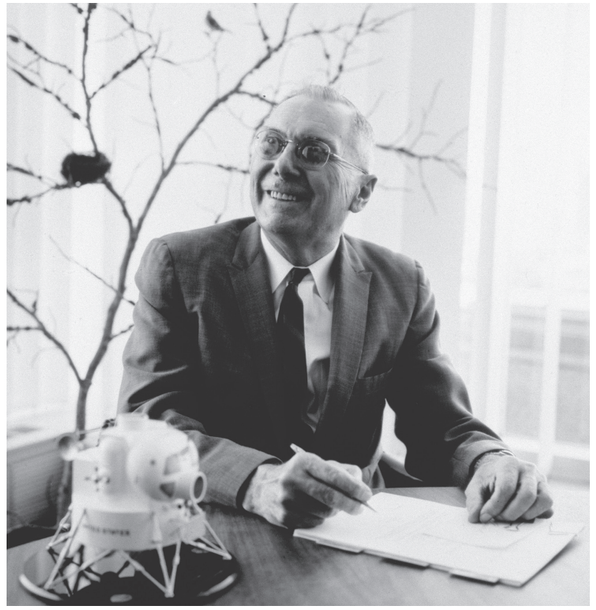
Lockheed Martin completed the structural modifications before NASA teams took over the current effort to reassemble the first of NASA's two ER-2 aircraft. Once ER-2 No. 809 is complete, the modifications are also planned for ER-2 No. 806.

Happy birthday, Hugh

By Christian Gelzer
Armstrong Chief Historian
and Jessica Arreola
Armstrong Social Media Manager

Hugh L. Dryden was a prominent aeronautical engineer for the National Advisory Committee for Aeronautics (NACA), NASA's predecessor. He also was key to transforming the core of the new agency, ensuring that NASA would become a worldwide leader in air and space exploration.

For those at Armstrong, where the center was named after him for more than 25 years and the Hugh L. Dryden Aeronautical Test Range carries his name, he is remembered on what would have been his 120th birthday. Dryden is perhaps best known at the center for his support of the X-15 rocket program that included 199 missions and his advocacy for flight research to "separate the real from the imagined" between theory and the reality of flight.



e76-29389 NASA

Hugh L. Dryden was a prominent aeronautical engineer for the National Advisory Committee for Aeronautics (NACA), NASA's predecessor.

Dryden's Youth

Dryden – born July 2, 1898, in Pocomoke City, Maryland – often boasted "The airplane and I grew up together." At 12 years old he saw an aircraft for the first time. It was an Antoinette, a 40-mph monoplane with a 50-horsepower engine. He wasn't impressed with its performance. A few days later he wrote an essay for his English class at school entitled "The Advantages of an Airship over an Aeroplane" in which he compared the greater passenger and cargo payloads an airship has over winged machines for commerce, exploration and recreation. His teacher thought the paper was "illogical." He received an "F."

Fast Start

At the age of 14 he entered Johns Hopkins University, graduated with honors three years later and earned a master's degree in 1918. His thesis was "Airplanes: An Introduction to the Physical Principles Embodied in Their Use." Dryden caught the attention of many prominent leaders in the aeronautic industry. He earned his masters at 20 and followed that with his doctorate degree while working on research that led to the design of low-turbulence wind tunnels. His data – used by the NACA – contributed to development of the laminar flow wings used on the famed P-51 Mustang fighter of World War II.

War Time

Dryden, who became a member of the NACA in 1931, saw much of his work at the Bureau of Standards switched to defense work as World War II loomed in the late 1930s. In 1940 he was named to head the fledgling guided missile section of the Office of Scientific Research and Development. There he was given charge of the Bureau of Ordnance Experimental Unit at the NBS where he worked on guided missiles for the Navy. The missile, called the Bat, consisted of an aircraft-launched gravity bomb capable of self-correction in flight.

In late 1945 Hugh Dryden joined Theodore von Kármán and Joseph Ames as part of the Scientific Advisory Group working for the Army Air Forces. The team visited recently uncovered flight research laboratories in Europe to scour them for documents and interview individuals associated with the facilities. The teams brought back an extraordinary collection of material even while the Army Air Forces gathered up an equally varied collection of German aircraft and rockets they shipped back for testing. Team members recovered some 3 million documents from one site alone, which were microfilmed and sent to the U.S.

NACA/NASA

In 1946 Dryden became assistant director of the bureau, followed in six months by his appointment as associate director. Within another six months, he was selected to succeed Dr. George W. Lewis as the NACA's Director of Aeronautical Research and by 1949 he had become the first person to hold the new position of Director of the NACA.

Dryden helped shape policy that led to development of the high-speed research program and its record-setting X-15 rocket aircraft. Dryden's leadership was evident in establishing vertical- and short-takeoff-and-landing aircraft programs, and he sought solutions to the problem of atmospheric re-entry for piloted spacecraft and ballistic missiles.

On Oct. 1, 1958, the NACA became the nucleus of NASA and Dryden was appointed its first deputy administrator. Dryden also served as chief U.S. negotiator for early historic agreements with the Soviet Union on the peaceful use of space.

Legacy

Dryden died Dec. 2, 1965, three and a half years before Neil Armstrong, a former Flight Research Center research pilot, became the first person to step onto the Moon's surface.

Dryden said in reference to the X-15 project: the purpose of flight research "is to separate the real from the imagined … to make known the overlooked and unexpected. For decades that was the center's motto.

The center was renamed in 2014, but Dryden's legacy will remain in the history of this center. He was considered a genius by his peers and will forever be known as one of America's most prominent aeronautical engineers.

Administrator... from page 1

to transform the airline industry."

QueSST could prove sonic booms can be reduced to a level most people would agree is acceptable, he said. "In conjunction with potential rule changes that currently prohibit overland supersonic flight, a new chapter in commercial air travel will follow that will save time and boost the economy as new opportunities for commerce emerge."

As a former Navy F/A-18 pilot, he took advantage of the opportunity to "fly" the X-57 and the X-59 in the simulator on his tour of Armstrong. Bridenstine also is a former congressman and executive director of a museum. The Administrator's day in the desert is detailed on page 3.

Concerning high-speed aircraft traveling faster than Mach 5, or hypersonically, he said NASA is uniquely situated to work on the basic research necessary to advance hypersonic research. Applications of the technology reach beyond NASA and potentially have relevance to multiple government agencies beyond science and discovery.

He also touched on another technology area called air mobility, or the idea of an air taxi. Autonomy and other technologies required to enable the idea are under development at multiple NASA centers including Armstrong.

Bridenstine said he hopes his legacy will be the same as NASA's – to improve the human condition and increase people's standard of living through developing and introducing new technologies.

Regarding technology, he said he is a strong supporter.

"We have to make the investments," he added. "We will receive dividends on those investments. We want to maintain the technological edge and our influence in the world and that's why we take risks."

While NASA is perceived to be a huge piece of the national budget, Bridenstine said it is less than half of 1 percent of the federal budget.

"The return on that investment is overwhelming," Bridenstine said. "We need to communicate why that investment is important."

The future looks promsing.

"There is strong bipartisan support for NASA and the budgets are headed in the right direction," he added.

NASA capabilities are being tapped in areas of disaster relief, weather prediction, climate study and even crop yields to help feed the world, he added. NASA technology also inspires young people to pursue careers in science, technology, engineering and mathematics.

Students... from page 2

Florida. "Doing flight research and not just writing a theoretical paper about how it will be tested is exciting, and being in charge of it, it's on me if the flight fails or not."

With the data in hand, the students were able to use computer programs they had scripted to see what story the data revealed.

"The box is recording all of the pressures along the wing for us and we are going to add them all up," Bowers said. "We are going to look at these and slice across the wing in various ways to see what the load is from the centerline all the way out to the wingtip and see if it matches the Ludwig Prandtl 1933 paper that details the best solution for aircraft wing efficiency. So far it looks really good."

Bowers said other data systems students developed will give additional information about what is happening to the aircraft in flight.

"We are looking at the aircraft's acceleration, the gyroscopes that tell you how quickly the aircraft is turning around its three axes, as well as the airspeed and altitude. That gives you the full picture of what's going on," he said.

Combined with the models, the FOSS data and now the pressure data, there is a compelling argument for wing twist.

AFRC2018-0182-28 NASA/Lauren Hughes

The subscale Prandtl-D 3C glider, carrying a pressure system developed and integrated by students, successfully flies.

"The comparison of this data and FOSS data are not complete yet, but the hairs on my arm are rising because I know we are going to go back to the 1933 paper and show that we have validated what Prandtl did," he said.

"We know the mechanics of what it has done before, we have seen the reaction of the vehicle that shows we get thrust at the wingtips, which was the focus of the previous paper that we wrote," Bowers said. "These tests validate that the aerodynamics are what we said they were and all of this matches Prandtl's work. These bricks in the wall make the argument irrefutable."

That's where the students will continue to have impact long after their internships are completed.

"A future generation will use this data to increase efficiency. This is the capstone. You now have all the information you need to go forward and use this. It goes beyond aircraft and the word is starting to get out."

"This will truly change the way the world works," he said. "The savings in energy, not just for aircraft but for ships, for fans, for pumps, turbines, compressors, all of those things are going to change because of this."

The wing efficiency from the method would be 12.5 percent, with the elimination of a tail increasing efficiency by another 30 percent. For propellers, efficiency would boost by 15.4 percent, Bowers said. Additional with engine components.

"We have cracked the door open," Bowers said. "We are looking forward with young people working in these areas to influence professors and get people to approach these areas differently and look at the world differently.

David Berger, Armstrong's University Affairs officer, said the opportunities are what the Armstrong Office of Education is all about and 10 students participated in this summer's Prandtl-D 3C effort.

"We are helping to provide opportunities for students," he said. It's meaningful not only as a learning experience, but also by contributing to NASA's mission. This answers the question of if theory matches reality. This flight series is validation of a major research initiative."

Wildfires... from page 1

science research in conjunction with the NASA Moderate Resolution Imaging Spectroradiometer (MODIS) and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) satellite instruments."

With as many as 18 wildfires burning in the state, NASA research pilot James Nelson was tasked with flying a 3.6-hour mission in the ER-2 at 65,000 feet Aug. 9.

"The two fires near Yosemite could clearly be seen from my altitude, but the Mendocino fire was obscured by smoke," Nelson said. "However, our instruments are multispectral and can see through much of the smoke in the infrared bands and we were able to collect data on all the fires."

The ER-2 aircraft flew a fire mission during the Thomas blaze in Ventura County, California, in December 2017.

Myers explained the mission focus.

"We were looking at the infrared data over the active burn area to evaluate the instrument performance," he explained. "We have colleagues in the U.S. Forest Service in Salt Lake City who wanted the data. They have an infrared mapping aircraft covering those fires, but they needed the information for their burned area emergency response plan. They have 48 hours from when the fire is declared contained to deliver a draft response plan about how to control erosion and begin revegetation. They also will look at severity of burn for areas that are most susceptible to mudslides."

In another area of California, NASA Armstrong pilot Scott Howe, who was serving as a part-time member of the California Air National Guard, was on duty the week of Aug. 6. He assisted with the blazes by piloting the guard's MQ-9 remotely piloted aircraft during launch and landing of aircraft used to monitor raging wildfires.

Howe explained the role of the California Air National Guard.

"The aircraft shows Cal Fire (the state's arm of the U.S. Department of Forestry and Fire Protection), where the biggest threats to people and property are located, the hottest areas and those parts of the fire that are most rapidly growing so they can deploy resources."

He was chosen for that role the week of Aug. 6 because of his familiarity with the MQ-9. Howe was one of the pilots of NASA's Ikhana aircraft, a civilian variant of the MQ-9 based at Armstrong until the aircraft was recently reassigned. One of the Ikhana's missions, while based at Armstrong, was to validate technologies that could be used to monitor and map fires as they were happening during the Western States Fire Missions in 2006 and 2007.

The hours leading up to his first shift Aug. 6 were eventful.

"The aircraft was coming back on my first night and the crew discovered a new fire between the Carr fire near Redding and the Mendocino fire," he said. "The blaze that the crew sited became known as the Eel fire. They were the first to spot it and report it to the Cal Fire commander."

Howe watched the infrared imaging on large screen monitors in the operations center, which is like a NASA control room, and saw how the fires were being mapped out and communicated to Cal Fire's command center.

"You can clearly see burn areas have a residual heat, even in the middle of the night, and the bright leading edge, like a string of jewels," Howe said. "At the hottest part, you can see the flames licking off the top of it. It's pretty intense."

NASA Worldview, Earth Observing System Data and Information System (EOSDIS)

California's Mendocino Complex fire is ongoing, as huge columns of smoke still rise from the fire complex and the smoke that has risen and drifted now clouds the skies above the state.

Armstrong research pilot Scott Howe assisted with monitoring California's wildfires by operating an MQ-9 for the California Air National Guard. The MQ-9 closely resembles the Ikhana aircraft, in the background, which he piloted at Armstrong.

AFRC2018-0143-01 **NASA/Carla Thomas**

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