NASA Facts

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FS-2002-04-046 DFRC

ER-2
High Altitude Airborne Science Program

ER-2 in flight. NASA photo EC98-44530-3

NASA is using two ER-2 Airborne Science aircraft as flying laboratories. The aircraft, based at NASA's Dryden Flight Research Center, Edwards, Calif., collect information about our surroundings, including Earth resources, celestial observations, atmospheric chemistry and dynamics, and oceanic processes. The aircraft also are used for electronic sensor research and development, satellite calibration, and satellite data validation.

Program History

In 1981, NASA acquired its first ER-2 aircraft. The agency obtained a second ER-2 in 1989. These airplanes replaced two Lockheed U-2 aircraft, which NASA had used to collect science data since 1971. The U-2s, and later the ER-2s, were based at NASA's Ames Research Center, Moffett Field, Calif., until 1997, when the ER-2 aircraft and their operations moved to NASA Dryden.

Since the Airborne Science program's inaugural flight Aug. 31, 1971, NASA U-2s and ER-2s have flown more than 4,000 data missions and test flights in support of scientific research conducted by scientists from NASA, other federal agencies, states, universities and the private sector.

The ER-2 set a new world altitude record for medium weight aircraft on Nov. 19, 1998, when the aircraft reached 68,700 feet. Although the ER-2 routinely operates at 70,000 feet and above, this was the first time the aircraft's performance was documented and made public.

Atmospheric Experiments

In 1991, NASA launched a comprehensive program, now called the Earth Science Enterprise, to study the Earth as an environmental system. By using satellites and other tools like the ER-2 to intensively study the Earth, NASA hopes to expand human understanding of how natural processes affect people and how people might be affecting the processes. Such studies may yield improved weather forecasts, tools for managing agriculture and forests, information for fisheries and local planners, and, eventually, the ability to predict how the climate will change in the future.

NASA ER-2s have played an important role in Earth Science research, like studying ozone depletion over Antarctica and the Arctic. In August and September 1987 an ER-2 traveled to Punta Arenas, Chile, to conduct overflights of the Antarctic. Results from this study provided information suggesting that human-made chemical compounds, specifically chloro-fluorocarbons, caused enormous ozone depletion over the Antarctic region. A series of flights from April to September 1997 originating in Fairbanks, Alaska, resulted in the first field study of summer ozone conditions in a polar region.

During the 1999/2000 winter, the ER-2, teamed with NASA's DC-8 flying science platform, participated in the SAGE III Ozone Loss and Validation Experiment (SOLVE). Based in Kiruna, Sweden, SOLVE was the largest field campaign conducted to measure ozone amounts in the Arctic strato-sphere. During this polar campaign the ER-2 acquired atmo-spheric data with an array of 17 sampling instruments on board.

Other atmospheric experiments provided more information about clouds and radiation that will help improve climate models. These experiments coordinated satellite, airborne and surface observations to investigate how cloud formation affects global temperatures.

The ER-2 team conducted missions to help determine the effects of a proposed fleet of high-altitude, high-speed trans-port aircraft. Background measurements of chemistry at high altitudes have been compared to measurements of exhaust plumes of high altitude aircraft like the Concorde and ER-2.

Hubbard Glacier on the coast of Alaska shows a spur of the glacier at the lower right temporarily blocking the outflow of Russell Fjord into Yakutat Bay.

Satellite Sensor Development and Simulation

Since Airborne Science's inception, the NASA U-2s and ER-2s assisted in developing satellite sensors by testing sensor prototypes or by simulating proposed configurations with existing systems.

The ER-2 has flown the Airborne Visible Infrared Imaging Spectrometer (AVIRIS), a 224 band hyper-spectral scanner designed by NASA's Jet Propulsion Laboratory, Pasadena, Calif. AVIRIS is a prototype of hyper-spectral scanners proposed for orbit on future satellite platforms. Experi-menters have acquired AVIRIS data from sites in the United States, Canada, Iceland, Switzerland, Austria, Germany, England, France and Italy. Collecting data with prototype instruments allows scientists to analyze and interpret the information future satellites will provide them.

The ER-2 also has flown the Moderate Resolution Imaging Spectrometer (MODIS) Airborne Simulator, a modified multispectral scanner built by Daedalus Enterprises and NASA. The simulator attempts to replicate the MODIS, an Earth Observing System imaging spectrometer in orbit on NASA's Terra satellite launched in December 1999. MODIS acquires digital imagery for measuring Earth biological and physical processes and atmospheric proper-ties. The simulator records 50 channels of 16-bit data in the visible, near infrared, mid-infrared and thermal portions of the spectrum. MODIS was flown during the Southern African Regional Science Initiative (SAFARI) based in

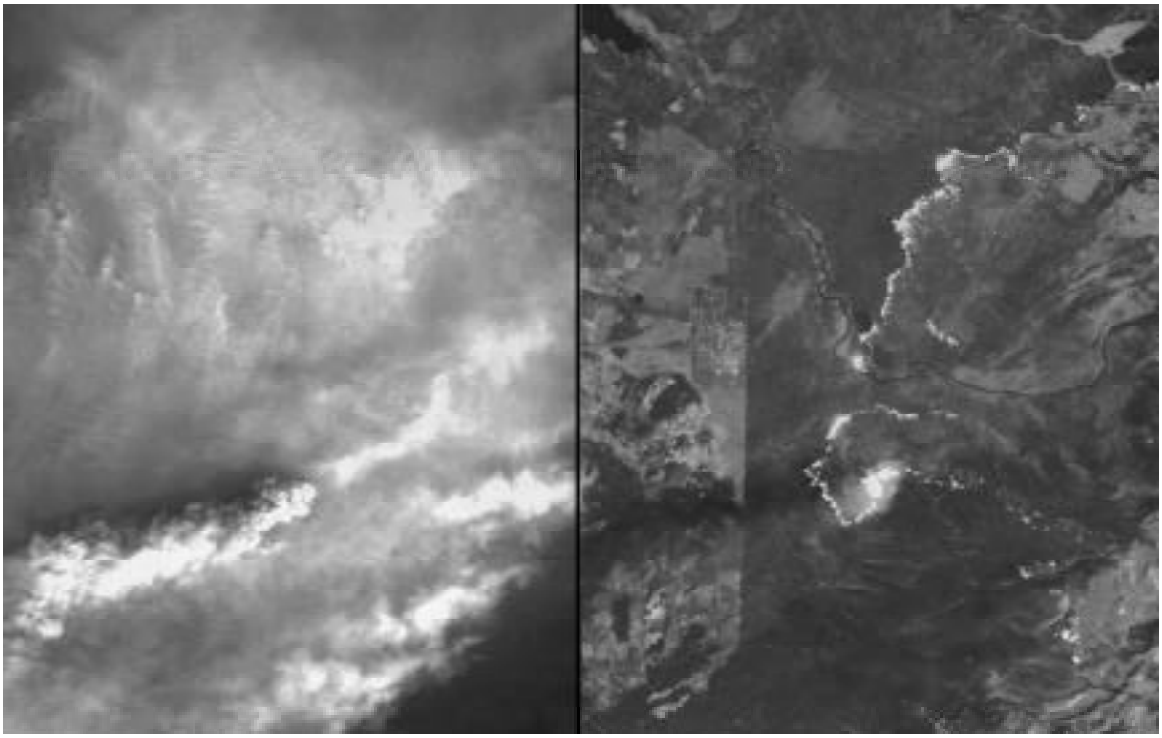
MODIS Airborne Simulator. Landforms at Atchafalaya Bay on the Louisiana coast.

Pietersburg, Republic of South Africa, during the summer of 2000. The science activity was designed to increase understanding of the southern African ecological and climate system. NASA's fourth Convection And Moisture Experiment (CAMEX) flew the MODIS to measure cloud microphysics during the 2001 study aimed at improving hurricane predictions.

ER-2 Deployments

The ER-2s have supported airborne research in the United States and around the globe. The aircraft have supported atmospheric research investigating global warming and ozone depletion from deployment sites in: Punta Arenas, Chile; Bangor, Maine; Townsville and Darwin, Australia; Christchurch, New Zealand; Stavanger, Norway; the Fiji Islands; and Kiruna, Sweden. Sites as far ranging as: Houston, Texas; Wallops Island, Va.; Alconbury, England; Fairbanks, Alaska; Brasilia, Brazil; Spokane,

An ER-2 pilot is assisted into a full pressure suit in preparation for flight. The suit ensures survivability at high altitude in the event of aircraft cabin depressurization.



Yellowstone fires. The two Thematic Mapper Simulator images at left are examples of data transmitted in real time from the ER-2. The image on the right is a thermal rendition of the ground scene portraying the extent of the fire. The image on the left shows the fire obscured by the smoke as imaged in the visible portion of the spectrum.

Wash.; and Topeka, Kan., have allowed the ER-2 systems to acquire extensive digital multispectral imagery and aerial photography. These imagery missions have tested prototype satellite imaging sensors and have acquired Earth resources data for application projects sponsored by NASA and federal agencies such as the Forest Service, Environmental Protection Agency, Fish and Wildlife Service, and the Army Corps of Engineers.

ER-2 Aircraft

The ER-2 is a versatile aircraft well suited to perform multiple mission tasks. The aircraft has four large pressurized experiment compartments and a high capacity AC/DC electrical system, permitting it to carry a variety of payloads on a single mission. The modular design of the aircraft permits rapid installation or removal of payloads to meet changing mission requirements.

Typically operating at 65,000 feet (19.8 kilometers) the ER-2 acquires data above 95 percent of the Earth's atmosphere. At this altitude the aircraft provides a stable platform for Earth imagery, atmospheric research, and electronic sensor development. Because the ER-2 can fly so high, its sensors mimic sensors carried aboard orbiting satellites.

ER-2 Capabilities

The ER-2 operates at altitudes between 20,000 feet and 70,000 feet. Depending on aircraft weight, the ER-2 reaches a cruise altitude of 65,000 feet within 20 minutes. Typical cruise speed is 410 knots. The range for a normal six-hour mission is 2,200 nautical miles (4,070 kilometers), which yields five hours of data collection at high altitude. The aircraft is capable of longer missions of up to eight hours and ranges of up to 3,000 nautical miles (5,500 kilometers). The ER-2 can carry a maximum payload of 2,600 pounds (1,179 kilograms) distributed in the equipment bay, nose area and wing pods.

ER-2 Payloads and Power