Dryden Flight Research Center

Fact Sheets

Text Size

ER-2 High Altitude Airborne Science Aircraft

NASA is operating two Lockheed ER-2 Earth resources aircraft as flying laboratories in the Sub-Orbital Science Program under the agency's Science Mission Directorate. 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. They 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.

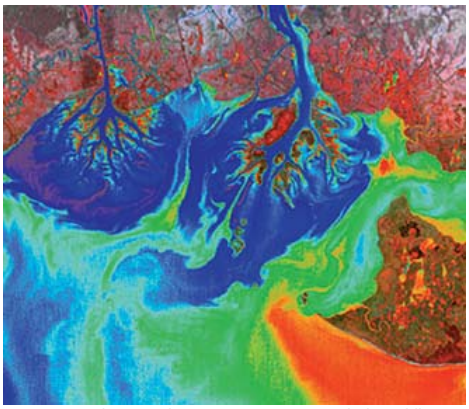
Since the airborne science program's inaugural flight on Aug. 31, 1971, NASA U-2s and ER-2s have flown more than 4,500 data missions and test flights in support of scientific research conducted by scientists from NASA, other federal agencies, states, universities and the private sector.

The ER-2 set a world altitude record for the class of aircraft with a takeoff weight between 12,000 and 16,000 kilograms 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 to study the Earth as an environmental system. By using satellites and 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 the ability to predict how the climate will change in the future.

NASA ER-2s have played an important role in Earth science research because of their ability to fly into the lower stratosphere at subsonic speeds, enabling direct stratospheric sampling as well as virtual satellite simulation missions. The aircraft's unique capabilities enable studies such as stratospheric ozone concentrations over Antarctica and the Arctic.



In August and September 1987, an ER-2 traveled to Chile to conduct overflights of the Antarctic. The direct measurements from the ER-2, combined with remote-sensing measurements from ground-based and satellite sensors, provided information suggesting that human-made chemical compounds, specifically chlorofluorocarbons, caused ozone depletion over the Antarctic region. The first field study of summer ozone conditions in a polar region took place during a series of flights conducted from Fairbanks, Alaska, between April and September of 1997.

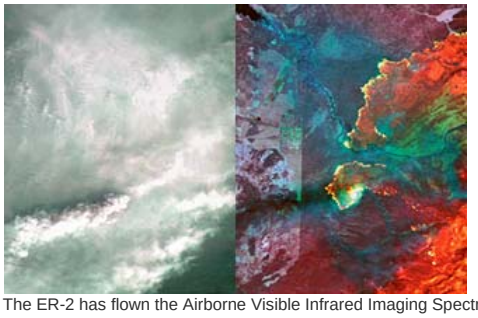
In another example of Earth Science research enabled by its high-altitude capability, the ER-2 has been an invaluable tool for studying tropical cyclone (hurricane) development, tracking, intensification, and landfall impacts.

The ER-2 participated in a series of collaborative NASA/NOAA field campaigns, including the Tropical Cloud Systems and Processes mission that was based in Costa Rica during July of 2005. The ER-2 carried instruments that measured the buildup and behavior of tropical storm systems over Mexico and Central America and in the Eastern Pacific, Caribbean, and Gulf of Mexico. It flew over several hurricanes, including Emily and Dennis, both violent category 4-5 storms, and collected detailed information on their entire vertical structure. Data were collected about the temperature, humidity, precipitation and wind related to tropical cyclones and other related phenomena that often lead to development of more powerful storms at sea.

Research based on the data from the ER-2 in these missions will lead to greater understanding of the processes of how hurricanes evolve, intensify and travel -- the key to developing earlier, more accurate warning systems.

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. Experimenters have acquired AVIRIS data from sites in North America, Europe and portions of South America. Collecting data with prototype instruments allows scientists to analyze and interpret the information future satellites will provide them.

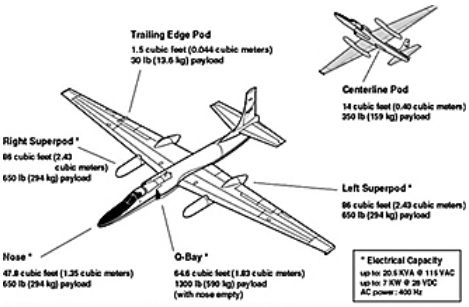
The ER-2 also has flown the Moderate Resolution Imaging Spectrometer (MODIS) Airborne Simulator, a modified multispectral scanner built by Daedalus Enterprises and NASA. The simulator attempts to replicate the MODIS, an Earth Observing System imaging spectrometer in orbit on NASA's Terra satellite launched in December 1999. MODIS acquires digital imagery for measuring Earth biological and physical processes and atmospheric properties. 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 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 Australia, Chile, Costa Rica, the Fiji Islands, Maine, New Zealand, Norway and Sweden. Sites as far ranging as: Fairbanks, Alaska; Brasilia, Brazil; Alconbury, England; Topeka, Kan.; South Africa; Houston; Wallops Island, Va.; and Spokane, Wash., have allowed the ER-2 systems to acquire extensive digital multispectral imagery for global climate change research and aerial photography. These imagery missions have tested prototype satellite imaging sensors and have acquired Earth resources data for research 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 Capabilities

The ER-2 is a versatile aircraft well-suited to perform multiple mission tasks.



The ER-2 operates at altitudes from 20,000 feet to well above 70,000 feet. Depending on aircraft weight, the ER-2 reaches an initial cruise altitude of 65,000 feet within 20 minutes. Typical cruise speed is 410 knots. The range for a normal eight-hour mission is 3,000 nautical miles, which yields seven hours of data collection at high altitude. The aircraft is capable of longer missions in excess of 10 hours and ranges in excess of 6,000 nautical miles. 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.

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) altitude, 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.

› Back To Top

Page Last Updated: March 1, 2008
Page Editor: Marty Curry
NASA Official: Brian Dunbar