



Airborne Science Operations at NASA Armstrong



NASA's Global Hawk carried atmospheric measurement probes during an airborne science mission over the Pacific Ocean.

NASA's Armstrong Flight Research Center operates a fleet of specialized aircraft of varied capabilities to support environmental and Earth science research missions under the Airborne Science Program of the agency's Science Mission Directorate.

As part of the directorate's Earth Science Division, NASA's Airborne Science Program uses these unique aircraft and sensors to conduct observations and collect atmospheric data, as well as advance the use of satellite data. The primary objectives of this program include:

- Conduct in-situ atmospheric measurements with varying vertical and horizontal resolutions.
- Collect high-resolution imagery for focused process studies and sub-pixel resolution for space-borne calibration.
- Develop new technologies, such as remotely operated unmanned aircraft systems, to expand the capability of aircraft to serve as platforms for Earth science.
- Test new sensor technologies in space-like environments.
- Calibrate/validate space-based measurements and retrieval algorithms.

A number of the science aircraft are based at the NASA Armstrong facility in Palmdale, California. They include a Douglas DC-8 jetliner converted into a flying science laboratory, two high-altitude Lockheed ER-2s and a Gulfstream C-20A (G-III). A Northrop Grumman Global Hawk and a General Atomics Predator B named "Ikhana," all unmanned remotely operated aircraft, are based at Armstrong's main facility at Edwards Air Force Base, as is a

Beechcraft B200 Super King Air.

NASA's DC-8 aircraft carries sensors that collect data in support of scientific projects serving the world science community. These studies include archaeology, ecology, soil science, geography, hydrology, meteorology, atmospheric chemistry, oceanography, volcanology and biology. The four-engine aircraft has been highly modified to support NASA's science missions, including sensor development and satellite sensor verification. The DC-8 flies at altitudes from 1,000 to 42,000 feet for up to 12 hours, although most science missions last between six and 10 hours. The aircraft has a range of 5,400 nautical miles. The DC-8 can carry 30,000 pounds of scientific instruments and equipment.

NASA also uses its two Lockheed ER-2 Earth resources aircraft as flying laboratories. The single-seat aircraft routinely operate at up to 70,000 feet altitude and acquire data above 95 percent of Earth's atmosphere. The ER-2s participate in studies of Earth, celestial observations, atmospheric chemistry and dynamics, and oceanic processes. The aircraft are also used for electronic sensor research and development, satellite calibration and satellite data validation. The aircraft fly missions of up to 10 hours and carry maximum payloads of 2,600 pounds distributed in the equipment bay behind the cockpit, the nose area and wing-mounted pods.

NASA's C-20A has been modified and instrumented as a platform for a variety of Earth science research experiments. The aircraft features a Platform Precision Autopilot designed by engineers at Armstrong and a centerline pod that can house various types of



DC-8 airborne science laboratory.

sensors such as the Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) developed by NASA's Jet Propulsion Laboratory in Pasadena, California. The autopilot enables the aircraft to follow a desired flight path with an accuracy of less than 10 meters at cruise speeds. This capability allows the aircraft to conduct repeat passes virtually identical to previously flown flight paths to obtain precision measurements using the radar instrument to compare with data obtained on prior passes over the same terrain.

hours. More than 400 pounds of sensors can be carried internally and over 2,000 pounds in external under-wing pods.



NASA's C-20A (G-III) with UAVSAR pod.

One Global Hawk aircraft is used on a variety of Earth science missions requiring high-altitude, long-endurance capabilities. The pre-production Global Hawk was transferred from the U.S. Air Force to NASA following the conclusion of the Air Force's Advanced Concept Technology Demonstration program.



ER-2 Earth resources aircraft.

The Global Hawk can fly at altitudes of 65,000 feet for more than 24 hours and cover 8,500 nautical miles. The flight and mission experiments are controlled from the Global Hawk Operations Center at NASA Armstrong. A second permanent ground control station is located at NASA's Wallops Flight Facility in Wallops Island, Virginia. Payloads are carried in internal bays and can total over 1,500 pounds. The ability of the unmanned Global Hawk aircraft to autonomously fly long distances and remain aloft for extended periods brings a new capability to the science community for measuring, monitoring and observing remote locations on Earth.

A General Atomics Predator B unmanned aircraft system named "Ikhana" is available for both environmental science and aeronautical research experiments. Ikhana is a word from the Native American Choctaw language that means intelligence, conscious or aware. The aircraft is designed for long-endurance, medium-altitude flight. A variety of atmospheric and remote sensing instruments, including duplicates of those sensors on orbiting satellites, can be installed to collect data during flights lasting up to 30

NASA Armstrong also operates a modified Beechcraft B200 Super King Air for use in both science and aeronautical research. Experimenter power is 28 Volt DC supplied through floor panels to hardware as well as to the forward and aft nadir ports. The aircraft is equipped with several antenna drops and has a satellite communications network to support payloads. The B200's upgraded engines enable operation at higher gross weights with payloads up to 1,700 pounds. Flight altitudes range from 1,000 to 28,000 feet with endurance of up to 5 hours. A mission flown at 28,000 feet with maximum fuel will have an approximate range of 1400 nautical miles.



NASA's Predator B "Ikhana."



NASA's B200 Super King Air No. 801.

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