



## C-20A Environmental Science Research Aircraft



The UAVSAR underbelly pod is mounted on NASA's C-20A environmental research aircraft to conduct data collection for a variety of geophysical research missions. (NASA / Lori Losey)

### Project Summary

NASA's Armstrong Flight Research Center operates a C-20A, a military version of the Gulfstream III business jet, as an environmental science research aircraft for a variety of geophysical research missions. The aircraft has been extensively modified and instrumented for the role, including installation of a sophisticated synthetic aperture radar in an underbelly pod, a self-contained on-board Data Collection and Processing System (DCAPS) and a precision autopilot that enables the aircraft to fly repeat passes over a target within 15 feet of the original flight path.

The twin-turbofan aircraft provides long-term capability for efficiently conducting airborne environmental science missions for NASA, other government agencies, academia and private industry.

### UAVSAR

The Uninhabited Aerial Vehicle Synthetic

Aperture Radar (UAVSAR) is sophisticated synthetic aperture radar system developed by NASA's Jet Propulsion Laboratory in Pasadena, California. Built initially for carriage by remotely operated unmanned aircraft, the UAVSAR is mounted on the C-20A in a specially designed pod that will be interoperable with unmanned aircraft in the future.

The UAVSAR uses a technique called interferometry to detect and measure very subtle deformations in Earth's surface. The sensor is designed to gather data for geological studies on earthquakes and volcanoes, ice and glacier movement supporting climate change studies, biological studies supporting ecology and carbon cycle science, and oceanography research.

Since the UAVSAR was installed in 2007, the aircraft has flown more than 2,500 data-collection flight lines, most from an altitude of 41,000 feet.

To support installation of the UAVSAR pod, the C-20A airframe was structurally modified

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to incorporate a MAU-12 ejector rack on the bottom of the fuselage. This unique modification will remain available for use by future projects. The modified rack, with electrical and data connectivity to equipment in the aircraft cabin, can accommodate a number of different external pods to carry specialized science instruments.

### Data Collection and Processing System (DCAPS)

NASA Armstrong's C-20A environmental science research aircraft is equipped with a self-contained on-board Data Collection and Processing System (DCAPS). This embedded instrumentation system allows for automated configuration setups to reduce required engineering support for each mission. Primary and backup systems assure mission reliability, with the backup system available for use concurrently as a parallel system when needed. DCAPS is designed to allow easy upgrades, addition of add-on systems for expansion, and can operate in both autonomous and manual modes.

The custom DCAPS system installed on the C-20A was developed to enable processing, distributing, displaying and archiving aircraft flight data and customers' experimental data in real time.

### Precision Platform Autopilot

The aircraft features a high-precision autopilot designed and developed by engineers at NASA Armstrong. The Precision Platform Autopilot guides the aircraft using a kinematic differential Global Positioning System developed by JPL and the aircraft's inertial navigation system to enable it to fly repeat paths to an accuracy of 15 feet or less. With the precision autopilot engaged, the synthetic aperture radar is able to acquire repeat-pass data that can measure land-surface changes within millimeters.

### Other Modifications

In addition, the aircraft features a video collection and distribution system, satellite communications systems including airborne Internet connectivity, satellite phones and an upgraded 115VAC, 60HZ electrical power system.



NASA's UAVSAR airborne radar carried in a pod underneath NASA's C-20A environmental research aircraft created 3-D maps of earthquake faults over wide swaths of Haiti (red shaded area) and the Dominican Republic (yellow shaded area) following the January 2010 Haitian earthquake. (NASA Image)

### Aircraft Description

NASA Armstrong's C-20A was obtained from the U.S. Air Force in September 2002. It bears tail number 502 and is based at the center's Building 703 in Palmdale, California.

The Gulfstream III / C-20A aircraft were built by Gulfstream Aerospace Corp. In its commercial version, the G-III's basic role is that of an executive business aircraft that can carry up to 12 passengers. The C-20B version currently flown by the Air Force serves in a similar capacity for high-level government and military officials.

The C-20A's maximum takeoff weight with full fuel and passengers or cargo is 69,700 pounds. The unmodified airplane weighs about 38,000 pounds empty. The aircraft has a wingspan of just over 77 feet, is about 83 feet long and just over 24 feet tall. Normal cruise for the aircraft is 527 mph (459 knots) and its top speed is 576 mph (501 knots; Mach 0.85). The C-20A's maximum operating altitude is 45,000 feet and it has a range with a full load of passengers or equipment of about 3,400 nautical miles (4,000 statute miles).

Two Rolls-Royce Spey Mark 511-8 turbofan engines, each producing 11,400 pounds (5,170 kilograms) of thrust, power the aircraft.

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