



NASA P-3 Airborne Science Laboratory



The P-3 in a typical mission configuration layout during a check flight.

P-3 Aircraft

The NASA P-3 Orion aircraft is a former U.S. Navy patrol aircraft extensively modified by NASA for use as an airborne science laboratory. The NASA Goddard Space Flight Center's Wallops Flight Facility Aircraft Office in Wallops Island, Virginia, operates the NASA owned aircraft. The P-3 is a NASA Airborne Science Program supported platform. The aircraft carries instrument payloads supporting scientific studies all over the globe.

The aircraft supports scientific investigations by NASA and visiting scientist from universities, other government agencies, and organizations worldwide. The P-3 supports scientific studies in ecology, geography, hydrology, meteorology, oceanography, atmospheric chemistry, soil science, biology, cryospheric research, and satellite calibration/validation. The P-3 also is a technology test bed for new airborne and satellite instrumentation.

The P-3 is a four-engine turboprop aircraft and in the 135,000-pound gross weight class. The aircraft is capable of long duration flights of 8-14 hours, large payloads up to 14,700 pounds, true airspeeds up to 400 knots, flight altitudes up to 28,000 feet, and requires a typical runway length of 7,000 feet. The aircraft is 117 feet long with a 100-foot wingspan and is 34 feet tall. It has many sensor ports, four feet of ground clearance for ease of access and calibration, and ample pressurized cabin space for user systems.

Aircraft Modifications

The P-3 has been extensively modified to support airborne science-related activities. Some of the science features include zenith ports, three nadir ports (aft of the wings), and seven P-3 and DC-8 style windows to mount experiments, a tail cone, nose radome and ten wing mounted locations.

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Most of the fuselage ports are contained within the pressurized cabin environment including the dropsonde launcher, which can deploy "A" size sonobuoys and dropsondes. The unpressurized lower fuselage bay converts into experimenter ports via a custom fairing. This fairing creates two large nadir ports and several oblique ports for installation of large sensors and antennas.

A data system is available that provides aircraft navigation data, meteorological information, and flight videos to experimenters. This system also connects to the IRIDIUM and INMARSAT satellite constellations, and provides real time uplink/downlink capability, internet access, flight tracking, and instant messaging between aircraft and ground assets. Available experiment electrical power includes 110V/60Hz AC, 110V/400Hz AC, and 28VDC.

Mission Support

The P-3 is a self-sufficient global reaching aircraft that can operate from commercial and government airports to remote areas of the world. Experiments are installed on the aircraft at the NASA Wallops Flight Facility hangar, which has various labs and support equipment available for experimenter use. Wallops access to nearby restricted airspace allows for conducting unique experiments with the P-3. Wallops mission managers, pilots, engineers, technicians, and aircraft mechanics provide an all-in-one comprehensive mission support team for all P-3 missions conducted locally or abroad.

Scientific Studies

The NASA P-3's first mission in the early 1990's consisted of cryospheric research flights over the Arctic region. The aircraft continues these missions today with annual flights to Greenland and other Arctic and Antarctic areas for the Operation IceBridge campaign. Operation IceBridge began in 2009 as a way to fill the gap between the end of the IceSat I satellite and the beginning of the IceSat II satellite mission. The critical areas observed and measured during the Operation IceBridge 10-year campaign are coastal Greenland; in particular, the sub-glacial lakes and certain fast moving glaciers, the southeast Alaskan glaciers, and Arctic sea ice thicknesses. The aircraft deployed to McMurdo Station, Antarctica in 2013 to perform Antarctic sea and land ice surveys. The P-3 was the first NASA aircraft to fly from the Antarctic continent. The aircraft is well suited for the low altitude flights over sea and land ice to map the topography of the ice, bedrock, and sea floor beneath. Supported by the NASA DC-8 and other aircraft in the Arctic and Antarctic regions in the past, the P-3 remains the main NASA aircraft for performing cryospheric research.

The other major area of P-3 scientific flights has been in the atmospheric chemistry regime. The P-3 flew several global campaigns called Global Troposphere Experiment

(GTE) during the late 1990's and early 2000's. These missions evolved over time to study specific atmospheric phenomena culminating in a return to the P-3 in 2008 for the Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (ARCTAS) campaign. In the spring of 2008, the P-3, along with several other NASA and other agency aircraft, converged on Fairbanks, Alaska, to study the effects of pollutants on the Arctic environment. The P-3 and DC-8 returned in the summer of 2008 to Yellowknife, Canada, to study the specific effect of boreal forest fires on the Arctic environment. The P-3 continued its long history of atmospheric chemistry research in 2010 with a 4-year campaign called Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality (DISCOVER-AQ). This campaign flew over several major U.S. cities to improve the use of satellites to monitor air quality for public health and environmental benefit. Following DISCOVER-AQ the P-3 is currently performing another 4-year campaign called Observations of Aerosols above Clouds and their interactions (ORACLES) to study key processes that determine the climate impact of African biomass burning by deploying from the countries of Namibia and Sao Tome and Principe and flying over the southern Atlantic Ocean.

Other notable scientific studies that the P-3 has conducted in the recent past include surface wind measurements for satellite validation from Goose Bay, Canada, and soil moisture measurements conducted over Oklahoma and the Delmarva Peninsula. The P-3 also has supported instrument technology demonstration flights from various universities and NASA Centers over the last several years.