Title: NASA DC-8 Airborne Research Laboratory

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Discipline: Medium Altitude Airborne Research

Since the summer of 1987 NASA Ames Research Center has been operating a DC-8 equipped with CFM 56 engines as a flying research laboratory. In this relatively short time the DC-8, with its tremendous capabilities, has made significant contributions to numerous scientific fields. Capable of staying aloft for over 12 hours, the DC-8 has flown directly over both the North and South Poles, gathering data relating to the Ozone Hole. Operating from a few thousand feet to over 40,000 feet above sea level the interchangeable payload capability of the DC-8 has made it a versatile scientific tool. In its short time in the operational mode, the DC-8 has been based at the following locations: Punta Arenas, Chile; Stavanger, Norway; Tokyo, Japan; Stuttgart, Germany; Melbourne, Australia; Prestwick, Scotland; and Christchurch, New Zealand to name just a few. The DC-8 also plays a vital role in the development of new satellite-borne sensors as very often those sensors are test-flown on the DC-8 before they are launched into space. The tremendous range and instrument carrying capability make the DC-8 an ideal flying laboratory. A few of the programs the DC-8 has participated in as well as a sampling of the instruments carried are outlined below.

OZONE HOLE

To aid in understanding the Ozone Hole problem the DC-8, in coordination with the NASA ER-2, has conducted two extensive field campaigns in order to better understand the ozone mystery. The first mission, the Airborne Antarctic Ozone Experiment (AAOE), conducted from the Southern tip of Chile in August and September of 1987, flew missions over the Antarctic continent. The second major campaign, the Airborne Arctic Stratospheric Expedition (AASE), was conducted in January and February of 1989 from Stavanger, Norway. The DC-8 carried a payload of ten separate experiments over the Norwegian and Greenland Seas as far north as the North Pole in order to investigate the ozone destruction phenomenon.

SYNTHETIC APERTURE RADAR (SAR)-JPL

The ability to "SEE" through clouds using C-, L-, and P- Bands gives the JPL-SAR a tremendous advantage over other sensors that are interfered with by science-hindering cloud cover. The range of the DC-8 gives the JPL-SAR the capability to cover even the remotest reaches of our planet and to map wide areas for evaluation of the biological processes in forests

and croplands, the hydrology of drainage basins, the geology of erosion and tectonic activity, the condition and motion of glaciers and sea-ice packs, and the motion of major ocean circulation patterns. The JPL-SAR has been flown extensively over Shuttle Imaging Radar (SIR) test sites in preparation for the upcoming SIR-C Shuttle flight.

LASERS

The use of lasers onboard the DC-8 has notably extended the aircraft's utility as a research platform. By looking directly up and down simultaneously an atmospheric profile can be obtained. When combined with in-situ measurements the lasers make the atmospheric picture much clearer. Lasers that have already flown on the DC-8 include: The Differential Absorption Lidar (DIAL) - LaRC, the Airborne Backscatter Lidar Experiment - JPL, Visible-Near IR Lidar - GSFC, Continuous Wave CO_2 Lidars - MSFC, and the Aerosol Lidar - LaRC.

Additional Instruments Carried Include: Measurement of Air Pollution from Satellites (MAPS) - LaRC, Airborne Backscatter Lidar Experiment (ABLE) - JPL, Loran-C Dropsonde - NCAR, Whole Air Sampler - ARC/NCAR, Lyman Alpha Hygrometer - NOAA, F.T. Interferometer - JPL, F.T. Spectrometer - NCAR, UV/Blue Spectrograph - NOAA, Microwave Radiometers - GSFC, Rain Mapping Radar (RMR) - Japan/GSFC and many others. It is the ability to vary the sensors it carries depending on the science required that gives the DC-8 its tremendous flexibility and utility as an airborne research laboratory.
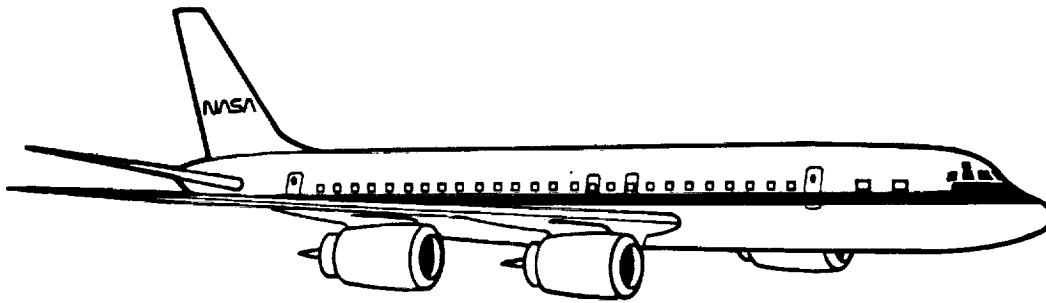
Additional Major Programs Supported Include: SAR/DARPA, Global Backscatter Experiment - GLOBE, Tropical Cyclone Motion - TCM, Tropical Rain Measuring Mission - TRMM, and Global Tropospheric Experiment - GTE.

Additional Fields Studied Include: Volcanology, Hydrology, Geology, Oceanography, Atmospheric Sciences, Meteorology, and many others.

With its host of on-board sensors, extraordinary range, and dedicated operators, the DC-8 stands ready to meet the scientific challenges posed by the research community well into the 21st Century.

DC-8-72, McDonnell Douglas

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Description:

Crew: Two Pilots, Flight Engineer, Navigator
Length: 157 feet
Wingspan: 148 feet
Engine: Four CFMI CFM56-2-C1 High Bypass Ratio Engines
Base: Ames Research Center, Moffett Field, CA

Performance:

Altitude: 30,000-40,000 feet (Cruise), 42,000 feet (Maximum)
Range: 5400 nautical miles (Nominal 2700 nautical miles)
Duration: 12 hours (Nominal 6.0 hours)
Speed: 425-490 knots True Air Speed (Nominal 450 knots)
Payload: 30,000 lb

Accommodations:

Sensor Viewports at Nadir, 8° and 62° Elevations, and Zenith
Wing Pylons (2)
Optical Windows
19-inch Panel Equipment Racks
Liquid Nitrogen Supply
Heliostate: Gyro Stabilized Mirror System
Dropsonde Delivery Tube
Air and Aerosol Sampling Probes
Laser Chiller Unit

Support:

Navigation Flight and Environmental Data: Distributed and
    Recorded for Each Flight By Central Computer System
Weather Radar
Inertial Navigation with DME update
Time Code Generator
Closed Circuit Television
Dual Intercom System
60 Hz and 400 Hz Power

Sensors:

Dew/Frost Point Hygrometer
Radar Altimeter
Surface Temperature Radiometer
Metric, Panoramic, and Video Cameras
Walk-on: Ten to Twelve Stations Provided for Investigators
    Supplied and Operated Sensors