Through thunderheads and ash clouds – the DLR Falcon research aircraft has been flying for 35 years

20 July 2011

Be it Spitsbergen, Greenland, the Tropics or the southern tip of the Americas – its deployment in the service of science has already taken the Dassault Falcon 20E research aircraft to an incredibly diverse range of places. The Falcon has been flying for the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) for the last 35 years. In this time it has contributed to answering many questions in atmospheric research, and has established a worldwide reputation. Nevertheless, retirement is still a distant prospect – many more missions are planned.

In the mid-seventies, DLR was looking for its own, highly capable test aircraft for atmospheric research. One particularly important consideration was the maximum achievable altitude, since the best meteorological observations and measurements are obtained at great heights. The Falcon can reach a maximum altitude of 12,800 metres, flying higher than most commercial aircraft. Another argument in favour of the jet was that it is extremely robust and agile – flying in the vicinity of thunderstorms and in turbulent wakes do not pose a problem. After extensive remodelling, the jet arrived at the DLR site in Oberpfaffenhofen on 16 July 1976. "The Falcon is still well suited to its scientific tasks, even today," explains Monika Krautstrunk, Head of Flight Operations at the DLR Flight Facility in Oberpfaffenhofen. "In 1995 the aircraft was given more powerful and environment-friendly engines, giving it a range of up to 3700 kilometres." Remote areas such as northern Sweden can be reached without a stopover.

Before embarking on its first mission as a research aircraft, the Falcon had to be extensively converted; among other things, it has three special windows on the roof and floor of the fuselage. This, for example, allows measurements to be taken using LIDAR (Light Detection and Ranging). LIDAR sends out a laser pulse and receives the signal scattered back from the atmosphere. The information obtained can be used to determine concentration profiles for water vapour, ozone or aerosol particles above or below the aircraft. The most obvious conversion was probably the nose boom; a five-hole sensor at its tip provides scientists with, among other things, very accurate information about the static and dynamic pressure in the atmosphere.

From heat to snow

The ASTAR (Arctic Study of Tropospheric Aerosol, Clouds and Radiation) and POLARCAT (Polar Study using Aircraft, Remote Sensing, Surface Measurements and Models, of Climate, Chemistry, Aerosols, and Transport) measurement campaigns took the Falcon and its crew to the Arctic in 2007 and 2009. Here, the researchers investigated the long-range transport of emissions from North America and Eurasia to the polar region. The aircraft was again able to prove its robustness in studies carried out in the tropics for TROCCINOX (Tropical Convection, Cirrus and Nitrogen Oxides Experiment) and SCOUT (Stratospheric-Climate Links with Emphasis on the Upper Troposphere and Lower Stratosphere); the investigation focused on the regions close to large thunderclouds, which can transport trace gases from layers close to the ground to great heights in a matter of only hours and in which lighting forms nitrogen oxides. DLR carried out what are probably its best-known flights in April 2010, when the eruption of the Icelandic volcano Eyjafjallajökull brought large parts of air traffic over Europe to a standstill. The Falcon was re-equipped in record time and approved for deployment over Iceland, England and Germany. The Falcon, the only aircraft in the sky, performed several measurement flights.

"The Falcon will continue to be in demand for international projects," confirms Hans Schlager from the DLR Institute of Atmospheric Physics, who has already led several Falcon campaigns.

"For example, we will fly to Malaysia in November 2011 to investigate the influence of biogenic halogen compounds on the distribution of ozone."

The Falcon is not just used by DLR atmospheric research specialists; often universities and other scientific institutions from Germany and abroad are involved in the missions. In addition, the aircraft is part of the European Fleet for Atmospheric Research (EUFAR) network, funded by the EU, which today comprises 46 research aircraft from 15 countries. Until 2009, the Falcon was the most frequently requested research aircraft from the entire EUFAR fleet.

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The Falcon 20E DLR research aircraft

The DLR Falcon 20E research aircraft was selected as the most appropriate aircraft for measurement flights. The Falcon has a full range of instruments to record flight dynamics and a nose boom that records the local incidence angle at the front of the aircraft in an undisturbed airflow.

Above the clouds

The Falcon 20E in flight. The DLR research aircraft can carry up to 1100 kilograms of scientific instrumentation payload. The instruments are installed inside and below the cabin, as well as under the wings. They include a flow measuring device, the nose boom, air intakes and under-wing pods. Among other things, they include a flow measuring device, the so-called nose boom and antennas which can be mounted on the exterior of the aircraft.

Measurement flight of the Falcon over the Eyjafjallajökull volcano on 1 May 2010

On 1 May 2010, the Falcon took off at 13:00 CEST for another measurement flight over Iceland and its plume of volcanic ash. Despite light cloud cover, measurement conditions were almost perfect. The flight took the Falcon directly over the Eyjafjallajökull volcano. At a distance of approximately 200 kilometres from the volcano, the Falcon flew several times over the volcanic ash cloud at an altitude of six kilometres.

During a flight in 1976

Flight with white gloves in 1976.

In front of the Falcon in Oberpfaffenhofen

Left to right: Monika Krautstrunk, Head of Flight Operations at the DLR Flight Facility in Oberpfaffenhofen, Ulrich Schumann, Director of the DLR Institute of Atmospheric Physics, Oliver Brieger, Chief Technical Officer of DLR Flight Experiments, Stefan Grillenbeck, DLR test pilot, and Robert Rahn, Falcon's leading pilot.

Flying into the sun

View from the cockpit of the Falcon during a research flight in 2002. The 1.8-metre nose boom has a five-hole sensor at its tip that provides scientists with very accurate information about, among other things, the static and dynamic pressure in the atmosphere.

Without the nose boom

The Falcon on 29 September 1975 at the acceptance flight in Bordeaux.

The Falcon at Spitsbergen airport

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December 1975

In December 1975 at Villaroche, France.

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