



Falcon – measurement flights in Malaysia

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Project SHIVA reveals presence of ozone-depleting halogen compounds

The coastal regions of Malaysia are major source areas of biogenic halogen compounds capable of damaging the ozone layer. This was the verdict reached by scientists from the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) together with partners from the SHIVA project (Stratospheric ozone: Halogen Impacts in a Varying Atmosphere). Measurement flights with the DLR Falcon research aircraft also showed that huge tropical storms lift these halogen compounds into the upper troposphere – from where they can reach the region of the ozone layer. The measurements were conducted in November and December 2011.

Research at 80 percent humidity

DLR project leader Hans Schlager from the DLR Institute of Atmospheric Physics and his team carried out 16 of these flights – at 35 degrees Celsius and 80 percent humidity. "The Falcon was stationed at Miri, Borneo, and set out on its research flights from there. The measurements ran very successfully – our flights into the storm clouds were able to verify that halogen compounds are transported into higher layers of the atmosphere by these tropical storms," explains Schlager. In this process, the scientists were investigating biogenic compounds that contain halogens such as chlorine, bromine and iodine, all of which have a detrimental impact on ozone. Aquatic plants like seaweed and macro algae release these halogens into the air. The data collected by SHIVA will form the basis for simulations of the future development of the ozone layer incorporating these natural sources of halogens. "We want to find out a number of things, including what damage these halogen compounds could do to the ozone layer in a changing climate, and what interactions might exist with other emissions, such as those from aviation," says Schlager. The Falcon flew into the air masses flowing out of storms at altitudes of up to 12 kilometres, where it was able to verify the presence of halogen compounds. Through a series of near-ground measurements along the coastline of Malaysia, important source areas for natural halogen compounds were found along the entire northern coast of Borneo and in the Strait of Malacca, to the south of the Malaysian peninsula.

Measurements were conducted at water level, from the air and from space. The Falcon was joined on location by the German research vessel 'Sonne', which performed measurements of surface water and air. Route management on board the 'Sonne' was in the hands of the GEOMAR Helmholtz Center for Ocean Research, based in Kiel. In addition, small boats operated by Malaysian partners were involved along the coasts of Langkawi, Johor and in the Strait of Malacca, as well as off the coast of Borneo in the vicinity of Kuching, Kota Kinabalu and Semporna. The SHIVA scientists employed satellite data to record the large-scale meteorological processes, the biological activity in the waters being studied and the distribution of ozone.

Financing and partners

SHIVA is financed by the European Union and various national funding organisations from Europe and Malaysia. DLR is a partner in a European-Malaysian consortium comprising 130 scientists and 17 institutions. Project coordination is in the hands of the University of Heidelberg's Institute of Environmental Physics. Other German partners include the GEOMAR Helmholtz Center for Ocean Research, the Alfred Wegener Institute for Polar and Marine Research, the University of Bremen and the University of Frankfurt. The most significant cooperation partners in Malaysia are the universities of Malaya, Kuala Lumpur, Sarawak,

Contacts

Lena Fuhrmann
German Aerospace Center (DLR)
Corporate Communications
Tel.: +49 2203 601-3881
Fax: +49 2203 601-3249
Lena.Fuhrmann@dlr.de

Dr Hans Schlager
German Aerospace Center (DLR)
Institute of Atmospheric Physics
Tel.: +49 8153 28-2510
Fax: +49 8153 28-1841
Hans.Schlager@dlr.de

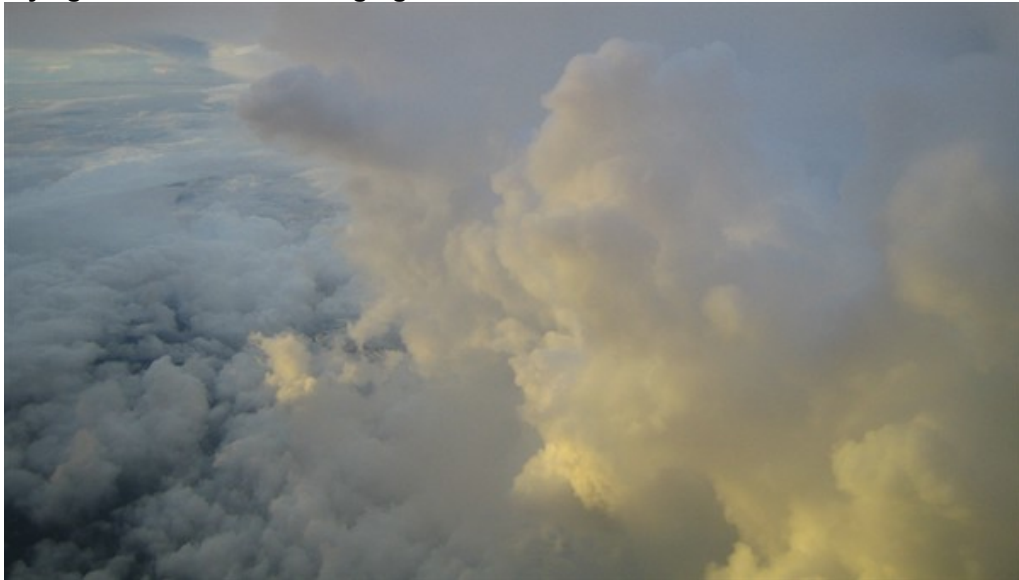
View from the cockpit



The DLR Falcon on a measurement flight. The nose boom is fitted with a five-hole sensor to measure such things as the static and dynamic pressures in the atmosphere. Through intakes on the fuselage exterior of the Falcon, scientists collected data relating to atmospheric trace gases during the SHIVA flights, which enabled them to demonstrate that biogenic halogen compounds can be transported into the higher layers of the atmosphere by tropical storms.

Credit: DLR (CC-BY 3.0).

Flying into air masses emerging from storm clouds



During the Falcon research aircraft flights in Malaysia, DLR scientist Hans Schlager flew into air masses emerging from storm clouds.

Credit: DLR (CC-BY 3.0).

Research ship 'Sonne'



A local boat meets the research ship 'Sonne' to exchange samples of seawater and air.

Credit: B. Grundmann, GEOMAR.

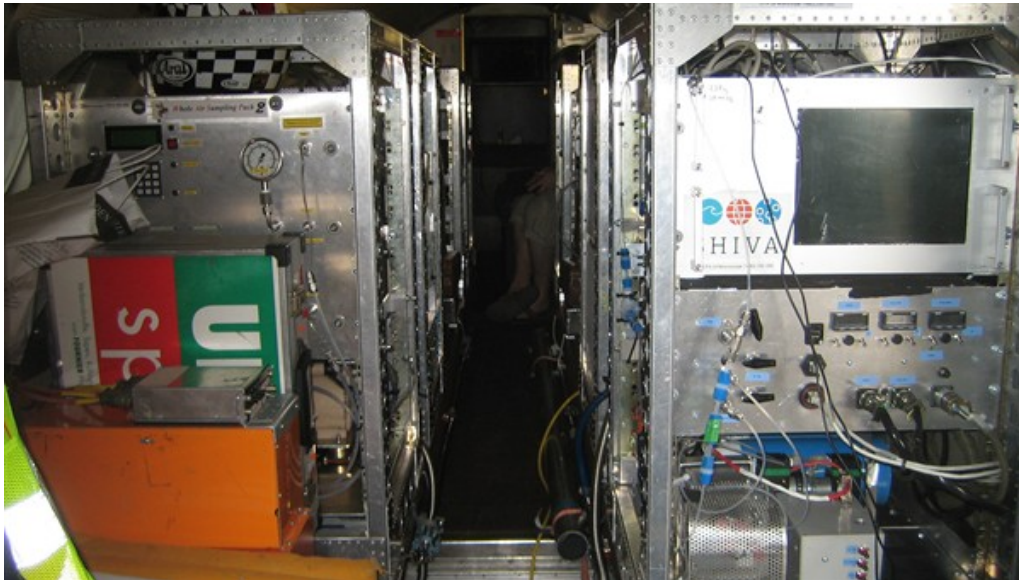
Home base of the Falcon in Miri, Borneo



The Falcon is towed out of its hangar in Miri, Borneo.

Credit: DLR (CC-BY 3.0).

Instrumentation on board the Falcon



For its research flights in Malaysia, the DLR Falcon research aircraft was equipped with special measuring instruments. Measurement flights showed that huge tropical storms lift biogenic halogen compounds into the upper troposphere – from where they can reach the region of the ozone layer.

Credit: DLR (CC-BY 3.0).

Falcon flying at low level



The Falcon during a measurement flight in Malaysia.

Credit: GEOMAR.

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