Do natural halogen compounds damage the ozone layer?

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DLR's Falcon research aircraft deployed in Malaysia

The industrial production of chlorofluorocarbons (CFCs) has been forbidden under international agreement, but it is also possible that natural chlorinated and brominated compounds might damage the ozone layer. These trace gases are produced by aquatic plants like seaweed and macroalgae in coastal areas and released into the atmosphere. Particularly strong sources of these compounds are thought to exist in the tropical western Pacific. But the role of these natural halogen compounds in ozone depletion is largely unexplored. What damage might they inflict on the ozone layer in a changing climate, both now and in the future? Could chemical interactions with other emissions, for example those from aviation, take place? Scientists from the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) are investigating questions such as these, in cooperation with a number of partners in Europe and Malaysia, in the SHIVA Project (Stratospheric ozone: Halogen Impacts in a Varying Atmosphere). DLR's Falcon research aircraft will be taking measurements in Malaysia for this project during November 2011. Additional data will also be collected by Germany’s research vessel, 'Sonne', by local boats and by satellites.

Falcon measurements at altitudes of up to twelve kilometres

Benefitting from severe weather conditions during the rainy season and the large-scale circulation of air masses in the western Pacific, short-lived natural halogen compounds may be able to reach the stratosphere, and thus have an impact on the ozone layer. The primary transportation of air masses from ground level into the stratosphere also takes place in the western Pacific. “We will be using the Falcon to measure the vertical transportation of natural halogen compounds from source regions to altitudes of 12 kilometres. We are also planning flights into air masses that flow out from powerful tropical storm systems,” explains DLR project leader Hans Schlager, from the DLR Institute of Atmospheric Physics in Oberpfaffenhofen. The Falcon will set off for Malaysia on 9 November 2011 and will be on site for four weeks. About 10 flight missions are planned, from Miri (Borneo) along the coastal regions of Malaysia, over the South China Sea and over the southern Philippines.

Measurements using ships and satellites

The oceanic research is primarily intended to identify the main source regions of the ozone depleting substances. Small boats belonging to the Malaysian partners will be deployed along the coasts of Langkawi and Johor, and in the Strait of Malacca, as well as off the coast of Borneo near Kuching, Kota Kinabalu and Semporna. The German research vessel 'Sonne' will be on site and will be taking measurements in the surface water and the air. Deployment of the 'Sonne' will be under the aegis of the Leibniz Institute of Marine Sciences (IFM-GEOMAR) in Kiel. The DLR Institute of Atmospheric Physics is also participating in these measurements. The Sonne's course will run from Singapore to Manila, the capital of the Philippines. At the same time, satellite data – for example, from the Envisat environmental satellite – will be used to capture the large-scale meteorological processes, the biological activity in the waters being studied and the distribution of ozone.

The results of the campaign will be analysed with the help of numerical models, with the aim of predicting the future development of the ozone layer.

Stratosphere

The second layer of the Earth's atmosphere is known as the stratosphere. It begins at an altitude of around eight kilometres at the poles and 18 kilometres at the Equator. The stratosphere is located above the troposphere, the lowest layer of the atmosphere.

Halogens / halogenated hydrocarbons

Halogens are a group in the periodic table consisting of six elements: fluorine, chlorine, bromine, iodine, astatine and ununseptium. They are non-metals and react with metals to form salts. Compounds containing the halogens fluorine, chlorine, bromine and iodine belong to a group known as ozone depleting substances, or ODS.

Financing and partners

SHIVA is funded by the European Union and various national funding agencies in Europe and Malaysia. DLR is a partner in a European-Malaysian consortium consisting of 130 scientists from 17 institutions. The University of Heidelberg's Institute of Environmental Physics is coordinating the project. Other German partners are the Leibniz Institute of Marine Sciences at the University of Kiel, the Alfred Wegener Institute, the University of Bremen and the University of Frankfurt. The major collaborating partners in Malaysia are the Universities of Malaya, Kuala Lumpur, Sarawak, Kuching, Sabah, Kota Kinabalu, the National Oceanic Department (NOD) and the Malaysian Meteorological Department (MMD).

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DLR Falcon research aircraft

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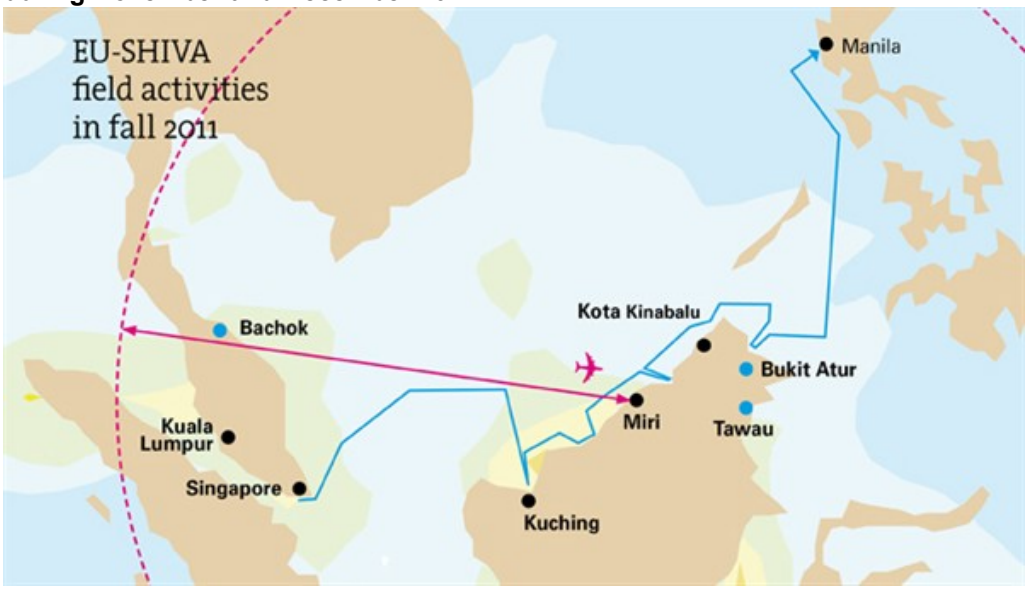
Credit: DLR (CC-BY 3.0).

Location of operations and measurement bases for the EU-SHIVA campaign during November and December 2011



Legend: blue circles: ground-based stations; blue line: route of RV Sonne; dotted red line: maximum operating range of DLR Falcon aircraft; aircraft (pink): Miri airport (operations base); black circles: alternative airports.

Credit: Institute of Environmental Physics of the University of Heidelberg.

Research vessel 'Sonne'

The oceanic research to be carried out is primarily intended to identify the main source regions of the ozone depleting substances. Small boats belonging to the Malaysian partners will be deployed along the coasts of Langkawi and Johor, and in the Strait of Malacca, as well as off the coast of Borneo near Kuching, Kota Kinabalu and Semporna. The German research vessel 'Sonne' will be on site and will be taking measurements in the surface water and the air. Deployment of the 'Sonne' will be under the aegis of the Leibniz Institute of Marine Sciences (IFM-GEOMAR) in Kiel. The DLR Institute of Atmospheric Physics is also participating in these measurements.

Credit: IFM-GEOMAR.

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