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## Solar activity reduces radiation exposure in the air

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At present, the Sun is very active – a surface covered with sunspots, frequent ejections of matter and a stronger solar wind blowing towards Earth. In the meantime, however, radiation exposure at aircraft cruising altitudes has reduced. This interesting phenomenon has now been confirmed by researchers at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) using the Falcon research aircraft.

"At DLR, we have been investigating radiation exposure at cruising altitudes since 2004," says Matthias Meier, Head of the Radiation Protection in Aviation group at the DLR Institute of Aerospace Medicine. "Already, previous measurements gave no cause for concern; now, we have been able to observe the lowest radiation levels so far."

### **Solar activity nearing a maximum**

The magnetic field of the wind from the Sun acts as a protective 'bubble' that shields galactic cosmic rays. "The solar wind is currently stronger, so fewer energetic particles from the galaxy reach the interior of the Solar system and Earth," explains Meier. The Sun goes through a natural cycle, in which, as is the case in 2013, it is particularly active approximately every 11 years.

The solar wind itself does not contribute to the radiation field at cruising altitudes, since the particles from the Sun are generally too low in energy to penetrate deeply enough into the atmosphere. High-energy cosmic rays, however, interact with air molecules in the upper layers of the atmosphere, high above the usual flight corridors, which are at an altitude of about 10 kilometres. "These interactions produce secondary particles, and using our detectors we can observe their interaction with matter," adds Meier.

### **Measuring flights over Bavaria and Norway**

In May 2013, the DLR Falcon flew over Bavaria and southern Norway. From its home base in Oberpfaffenhofen near Munich, the researchers first flew over Bavaria, then to Aalborg in Denmark and from there to Oslo. Measuring flights in the Bavarian and Norwegian airspace were performed at altitudes ranging from 9 to 12 kilometres. "The first results are now available," says Meier. "They show that radiation exposure at cruising altitudes, when compared to measurements carried out in late 2007 – near the solar minimum – has been reduced by about 10 percent due to the increased solar activity."

Cosmic radiation can be investigated particularly well in the polar regions of the Earth. "From the equator up to around 60 degrees latitude, shielding of galactic cosmic radiation by Earth's magnetic field is observable at flight altitudes," says Meier. Towards the poles, where the magnetic field lines reach the surface, high-energy cosmic particles enter the atmosphere, largely unaffected by this field.

Solar storms, strictly speaking solar particle events associated with the emission of high-energy particles, can in principle lead to significantly increased short-term exposures, especially in the polar regions. "However, this only occurs extremely rarely, and usually most of these space weather events even lead to a reduction in radiation exposure at cruising altitudes due to the magnetic field generated by the particles. An accurate statement in individual cases is only possible with comprehensive information," explains Meier.

The latest results show that, even on polar routes, the radiation exposure of aircrew is far below the dose limits. Nevertheless, researchers are working on the development of real time space

weather warnings and operational procedures for flight operations to keep the radiation exposure of aircrew and passengers as low as reasonably achievable.

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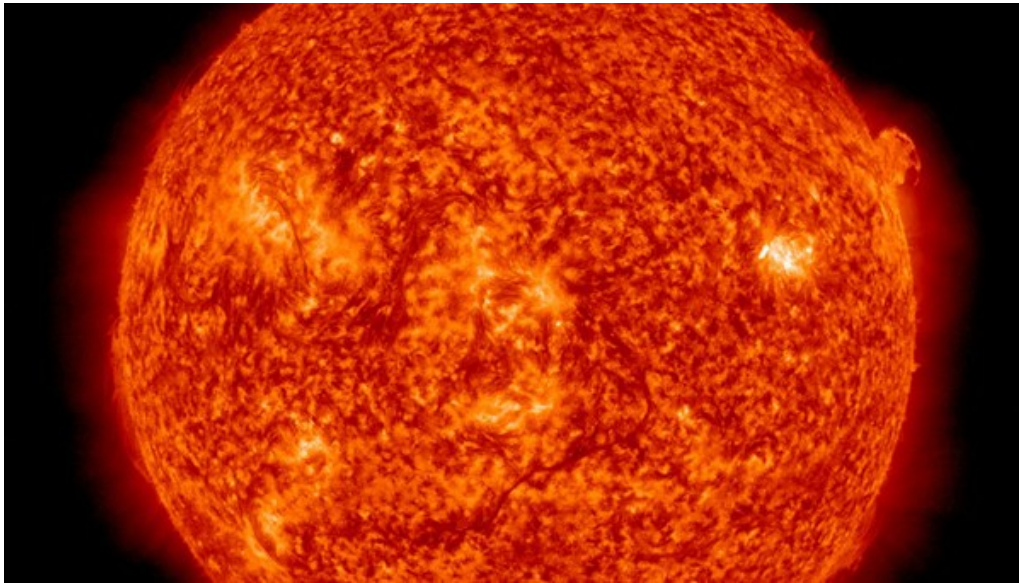
## Contacts

*Falk Dambowsky*  
German Aerospace Centre (DLR)  
Media Relations, Aeronautics  
Tel.: +49 2203 601-3959  
[falk.dambowsky@dlr.de](mailto:falk.dambowsky@dlr.de)

*Dr Matthias Meier*  
German Aerospace Center (DLR)  
DLR Institute of Aerospace Medicine  
Tel.: +49 2203 601-2789  
[Matthias.Meier@dlr.de](mailto:Matthias.Meier@dlr.de)

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## Active Sun



The Sun goes through a natural cycle, in which, as is the case in 2013, it is particularly active approximately every 11 years.

Credit: SDO/AIA.

## DLR's Falcon research aircraft in Aalborg



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### Research team



Matthias Meier (left), Head of the Radiation Protection in Aviation group at the DLR Institute of Aerospace Medicine with the flight campaign crew.

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