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DLR storm research: less nitrogen oxide in tropical weather than expected

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The DLR storm research program



Storms are more than just spectacular weather events; they also exercise considerable influence on atmospheric chemistry and Earth's climate. Lightning combines nitrogen and oxygen to form large amounts of nitrogen oxide. However, it is not known just how much nitrogen oxide is created by these events. Researchers from the German Aerospace Agency (Deutsches Zentrum für Luft- und Raumfahrt; DLR) Institute of Atmospheric Physics (Institut für Physik der Atmosphäre) in Oberpfaffenhofen have come up with some very surprising results: tropical storms create less nitrogen oxide than had been expected.

DLR's researchers from the Oberpfaffenhofen institute have been investigating extreme tropical storms in recent years with numerous missions using research aircraft and lightning-location equipment in four continents. The results were quite unexpected and cast a completely new light on processes inside extreme storm clouds: "Although tropical storms unleash a very large number of lightning strikes, they produce far less nitrogen oxide than we expected. Our detailed investigations demonstrate that not only the number of flashes is important, but also their length", says Dr Heidi Huntrieser, a meteorologist at the institute. "In short-lived tropical storms, lightning flashes are shorter, on average, than in our part of the world, where wind shear is more pronounced", Dr Huntrieser adds. The greater wind shear results in greater changes in wind strength and direction with increasing altitude. This separates the up- and down-draught zones of a storm cell and the storm is thus able to increase in intensity, grow in size and last longer. Work by NASA has confirmed the recently published results of the DLR institute's research programme.



The DLR research aircraft Falcon 20 E

Flying into the heart of the storm with DLR research plane Falcon

In recent years, the DLR Institute has flown numerous measurement missions in the context of EU tropical research programmes. It is in this part of the world, where most storms occur, that nitrogen oxide measurements were made by flights right into the heart of storm clouds. DLR set up a ground-based Lightning Detection Network (LINET) to measure lightning activity in the clouds. In 2004 and 2005, DLR's Falcon research plane was used for flights in Brazil and these were followed by missions in Australia and West Africa. In Darwin, at the tropical northern tip of Australia, one of the strongest and most regular storms in the world, Hector, was investigated in detail.

Storms possibly have only a limited effect on climate

Lightning creates nitrogen oxide, which can also form ozone, an important greenhouse gas. It has so far been assumed that stronger storms would occur in a warmer world, leading to more nitrogen oxide and ozone formation, which would in turn influence the climate in a feedback loop. According to the DLR researchers, the opposite is more likely to be true. Storms would be more violent in a warmer world, but they would be less frequent. This could even reduce the mean incidence of lightning flashes around the world as a whole. This hypothesis would also explain some long-term observations of lightning trends. The effect of storms on climate, according to these results, is likely to be the opposite of what has often been believed so far. The DLR Institute of Atmospheric Physics used the ECHAM global climate model in its research.

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