ETH zürich

Press Release

EMBARGO: TUESDAY, 6 FEBRUARY 2018, 7:00 AM CET

The ozone layer continues to thin

Zurich, 2. February 2018

The vital ozone layer has continued to deplete in recent years over the densely populated mid-latitudes and tropics, while it is recovering at the poles. This is documented by an international research team in the journal *Atmospheric Chemistry and Physics*.

The ozone layer protects life on earth from high-energy radiation. In the 20th century, when excessive quantities of ozone-depleting chlorinated and brominated hydrocarbons (e.g. CFCs) were released into the atmosphere, the ozone layer in the stratosphere – i.e. at altitudes of 15 to 50 km – thinned out globally. The Montreal Protocol introduced a ban on these long-lasting substances in 1989.

At the turn of the millennium, the loss of stratospheric ozone seemed to have stopped. Until now, experts have expected that the global ozone layer would completely recover by the middle of the century.

Further dilution in the lower stratosphere

An international team led by researchers from ETH Zurich and the Physikalisch-Meteorologisches Observatorium Davos have now made a troubling discovery: despite the ban on CFCs, the concentration of ozone in the lower part of the stratosphere (15 to 24 km) – where the ozone layer is at its densest – has contined to decline at latitudes between 60° S and 60° N. The scientists were able to demonstrate this using satellite measurements spanning the last three decades together with advanced statistical methods. They report on their work in the latest issue of the journal *Atmospheric Chemistry and Physics*.

Contrasting processes mask trend

Ozone is formed in the stratosphere, mainly at altitudes above 30 km in the tropics. From there it is distributed around the globe by atmospheric circulation. The scientists were somewhat surprised that the ozone is thinning out in the lower stratosphere because their models do not show this trend and CFCs continue to decline. Certain aspects of their findings are not completely unexpected, however. William Ball, an atmospheric researcher at ETH Zurich and the first author of the study, explains: “Thanks to the Montreal Protocol, ozone in the upper stratosphere – i.e. above 30 km – has increased significantly since 1998, and the stratosphere is also recovering above the polar regions.” Yet despite

these increases, measurements show that the total ozone column in the atmosphere has remained constant, which experts took as a sign that ozone levels in the lower stratosphere must have declined.

The negative trend had nevertheless not yet been demonstrated. This is partly due to the fact that ozone is also formed in the troposphere – at altitudes below about 15 km – by human activities. “This anthropogenic ozone, which causes summer smog, partially masks the stratospheric decline in the satellite measurements,” said Ball.

Circulation and short-lived chemicals

The reasons for the continuing decline are still unclear. However, the authors have two possible explanations. On the one hand, climate change is modifying the pattern of atmospheric circulation, moving air from the tropics faster and further in the polar direction, so that less ozone is formed.

On the other hand, very short-lived substances (VSLSs) containing chlorine and bromine are on the rise, and could increasingly enter the lower stratosphere, for example as a result of more intense thunderstorms. Ozone-depleting VSLSs are partly of natural and partly of industrial origin; some are substitutes for CFCs, and although they are less ozone-depleting, they are not neutral either. “These short-lived substances could be an insufficiently considered factor in the models,” says Ball.

Clarifying causes and impact

It is not yet possible to assess the consequences that this continuing lower stratospheric ozone depletion will have for humans and the ecosystem. For Thomas Peter, ETH Professor of Atmospheric Chemistry and co-author of the study, the findings are concerning but not alarming. “The decline now observed is far less pronounced than before the Montreal Protocol. The impact of the Protocol is undisputed, as evidenced by the trend reversal in the upper stratosphere and at the poles. But we have to keep an eye on the ozone layer and its function as a UV filter in the heavily populated mid-latitudes and tropics,” he says.

With the help of global climate models, the scientists now want to investigate the causes behind the continuing lower stratospheric ozone decline.

Further Information

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