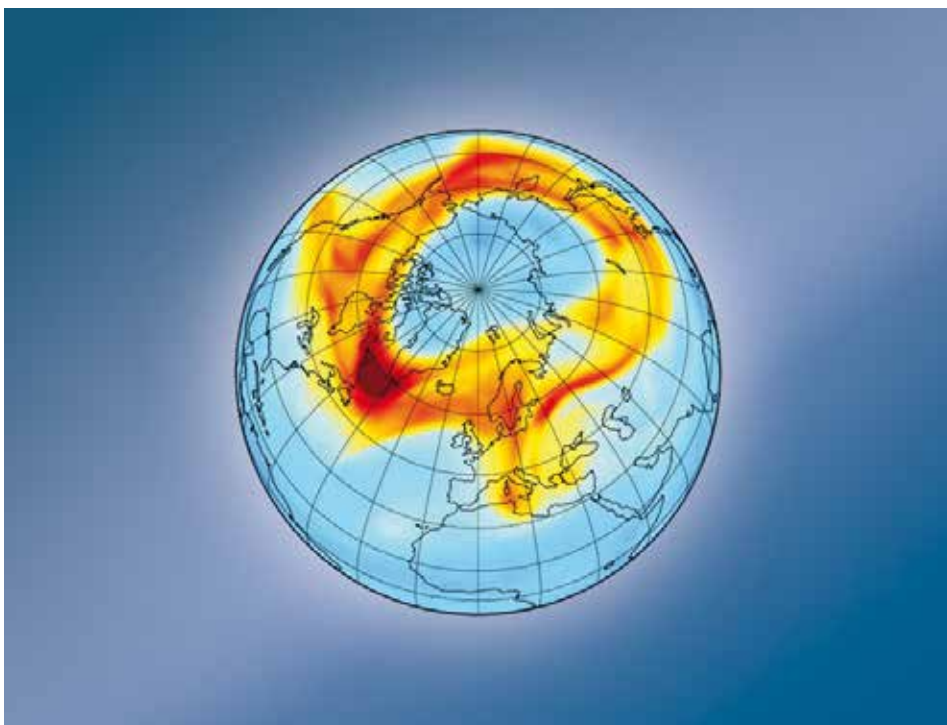


Ozone Hole Above the Arctic: A Signal of Climate Change?

Montreal Protocol as a Model of Success – Lessons that can be learned



The Arctic “ozone hole” on March 10, 2020: Above the Arctic, ozone column densities normally reach a maximum (red colors). Due to extremely low temperatures in the Arctic stratosphere, a deficit in ozone layer thickness developed this spring (blue colors above the Arctic). (Data from the analysis archive of the Copernicus Atmosphere Monitoring Service of the European Centre for Medium-Range Weather Forecasts)

For decades, chlorofluorocarbons (CFCs) have been used as propellants in sprays, coolants in air conditioners, or in insulating foams. However, CFCs damage the ozone layer. For this reason, they were banned from industry worldwide when the

Montreal Protocol was adopted in 1987. Still, they will remain in the atmosphere for a long time. In spring 2020, an unusually big “ozone hole” opened above the Arctic. “It takes a very long time for CFCs to be transported out of the stratosphere and

degraded. We will have to deal with them for decades,” says Dr. Björn-Martin Sinnhuber from KIT’s Institute of Meteorology and Climate Research (IMK-ASF). His colleague Professor Peter Braesicke points out: “Still, the Montreal Protocol is a success model. In the past twenty years, concentration of ozone-depleting substances in the atmosphere decreased considerably. But such extraordinary situations like the Arctic “ozone hole” remind us of the fact that we cannot sit back and relax.” Both KIT researchers are among the authors of the Scientific Assessment of Ozone Depletion 2018 by the World Meteorological Organization.

Meanwhile, the “ozone hole” has closed again. Or to be more precise, the air has mixed. This results in somewhat less ozone in the northern hemisphere, but this loss will be compensated by natural supply in summer. Braesicke says: “We do not have to be concerned about this single event. But it shows that it is important for the countries to further comply with the agreement. And we might learn from the Montreal Protocol something for our efforts to mitigate climate change.”

Climate change might also play an important role in the development of the Arctic “ozone hole.” Every year, the classical ozone hole forms above Antarctica, but it hardly occurs in the Arctic. This winter, very low temperatures in the stratosphere caused the ozone layer above the Arctic to become thinner. “One factor is the natural variability of warm and cold winters, the other factor is climate change,” Braesicke says.

The Earth’s atmosphere is subject to warming, but only in the bottom layer, the troposphere. The stratosphere, the second floor of the atmosphere, by contrast, is subject to strong cooling. In the past 30 years, a very cold winter that was colder than all winters before occurred every five to ten years. “At about minus 80C°, polar stratospheric clouds form. On their surfaces, chemical reactions take place, which lead to ozone depletion,” Sinnhuber explains. “The problem of the ozone layer is closely associated with climate change – the much bigger and even more complex problem.”

INDUSTRIAL RESOURCE STRATEGIES

THINKTANK Achieves First Success

About two years ago, the “THINKTANK Industrial Resource Strategies” started operation. Now, it is time to draw a first interim balance: “We have successfully completed two projects. Some projects initiated in the starting phase are still running, other new projects have been started. The results are very positive,” says Professor Jochen Kolb from KIT’s Institute of Applied Geosciences, who chairs the steering group.

Under the heading of “Surface Engineering,” researchers studied resource-efficient

production. Their finding: By the optimization of metal surfaces, corrosion resistance can be improved and the service life of tools can be increased. A second project focused on circular economy: Which reuse or recycling options are optimal for a product and its lifecycle? “Recycling, reuse, and remanufacturing must be studied holistically,” Kolb explains. “Here, economic, ecological, and social aspects play a role.”