

Global warming may delay recovery of stratospheric ozone

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Increasing greenhouse gases could delay, or even postpone indefinitely the recovery of stratospheric ozone in some regions of the Earth, a new study suggests. This change might take a toll on public health.

Darryn W. Waugh, an atmospheric scientist at Johns Hopkins University in Baltimore, and his colleagues report that climate change could provoke variations in the circulation of air in the lower stratosphere in tropical and southern mid-latitudes — a band of the Earth including Australia and Brazil. The circulation changes would cause ozone levels in these areas never to return to levels that were present before decline began, even after ozone-depleting substances have been wiped out from the atmosphere.

"Global warming causes changes in the speed that the air is transported into and through the lower stratosphere [in tropical and southern mid-latitudes]," says Waugh. "You're moving the air through it quicker, so less ozone gets formed." He and his team present their findings in the Feb. 5 *Geophysical Research Letters*, a publication of the American Geophysical Union (AGU).

Dan Lubin, an atmospheric scientist who has studied the relationship between ozone depletion and variations in the ultraviolet radiation that reaches the Earth, says Waugh's findings could bode ill for people living in the tropics and southern mid-latitudes.

If ozone levels never return to pre-1960 levels in those regions, "the risk

of skin cancer for fair-skinned populations living in countries like Australia and New Zealand, and probably in Chile and Argentina too, will be greater in the 21st century than it was during the 20th century," says Lubin, who is at Scripps Institution of Oceanography in La Jolla, Calif. and did not participate in the research.

Ozone is a gas which is naturally present in the atmosphere and absorbs ultraviolet radiation from the Sun that can harm living beings—for instance, by causing human skin cancer. This protective molecule has been in decline in the stratosphere since the 1970s due to an increase in atmospheric concentrations of human-made substances (mostly chlorofluorocarbon and bromofluorocarbon compounds) that destroy ozone. Since the late 1980s, most countries have adhered to the Montreal Protocol, an international treaty to phase out production of ozone-depleting substances.

Researchers at NASA Goddard Space Flight Center in Greenbelt, Md. collaborated with Waugh in the new study. The team forecast effects on ozone recovery by means of simulations using a computer model known as the Goddard Earth Observing System Chemistry-Climate Model.

Not all regions face worse prospects for ozone recovery as a result of climate change, the scientists find.

In polar regions and northern mid-latitudes, restoration of ozone in the lower stratosphere will suffer little impact from increasing greenhouse gases, their projections indicate.

Indeed, in the upper stratosphere, climate change causes a drop in temperatures that slows down some of the chemical reactions that destroy ozone. So, recovery might be reached in those parts of the atmosphere earlier than forecast, even decades before the removal of ozone-depleting gases.

While scientists have long suspected that climate change might be altering the dynamics of stratospheric ozone recovery, Waugh's team is the first to estimate the effects of increasing greenhouse gases on the recovery of ozone by region.

Waugh says his study will help scientists attribute ozone variations to the right agent.

"Ozone is going to change in response to both ozone-depleting substances and greenhouse gases," he says, "If you don't consider climate change when studying the ozone recovery data, you may get pretty confused."

Reference: Waugh, D. W., L. Oman, S. R., Kawa, R. S. Stolarski, S. Pawson, A. R. Douglass, P. A. Newman, and J. E. Nielsen (2009), Impacts of climate change on stratospheric ozone recovery, *Geophys. Res. Lett.*, 36, L03805, doi:10.1029/2008GL036223.
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