Antarctic ozone hole reaches record size

Chemical pollutants combined with unusually low temperatures high in the atmosphere to gnaw a record-breaking hole in Earth's protective ozone layer this year, according to measurements made in the frigid skies over Antarctica.

The stratosphere above both poles has grown colder in recent years for reasons not clear to researchers. The recent Antarctica temperatures, the lowest in 2 decades of measurements, raise concern that the ozone layer will not heal as quickly as scientists had predicted, even though nations are curbing the use of ozone-depleting chemicals.

"It may take longer to recover," says Paul Newman of NASA's Goddard Space Flight Center in Greenbelt, Md.

One fear among scientists is that greenhouse gases could be playing a role in lowering stratospheric temperatures. Carbon dioxide and other forms of pollution trap heat in the lower atmosphere, but they cool off the stratosphere—the layer between 10 and 50 kilometers in altitude.

The ozone hole above Antarctica starts forming in September, when springtime sunlight returns to the polar skies. The light energizes chlorine- and bromine-containing chemicals that break apart ozone molecules in the stratosphere. A key part of the chemical chain reaction takes place on the surface of frozen cloud particles, so cold temperatures worsen ozone destruction.

According to measurements by a NASA satellite, the ozone hole grew to 27.3 million square kilometers on September 19, larger than the North American Continent. The biggest previous ozone hole reached 26 million km^2 in 1996.

The satellite also showed that ozone concentrations in the worst section of the hole bottomed out at 90 Dobson units, only one-third of what should normally be there this time of year.

Balloon measurements over the South Pole recorded a value of 92 Dobson units, in good agreement with the satellite measurements, says David J. Hofmann of the National Oceanic and Atmospheric Administration in Boulder, Colo.

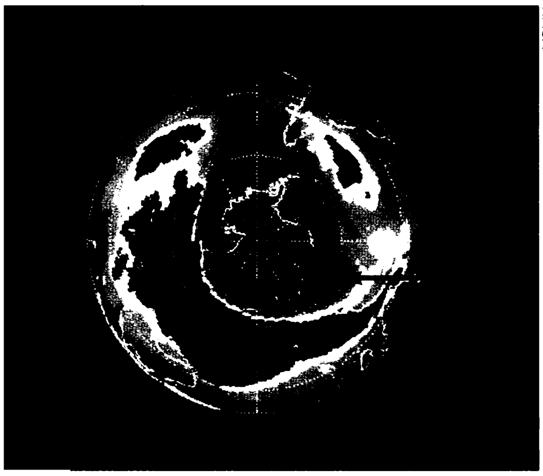
The cold temperatures this year helped the ozone hole reach new heights, according to Hofmann. "We saw some ozone loss all the way up to 24 km, which is higher than usual." Normally, temperatures are too warm at that altitude to allow the formation of frozen cloud particles.

Scientists trace some of the stratospheric cooling in recent years to the loss of ozone molecules, which absorb sunlight and heat up the surrounding air. But this process cannot explain the extremely low temperatures detected in August and September above Antarctica, before much sunlight had returned to the polar skies, says William J. Randel of the National Center for Atmospheric Research in Boulder.

One cause could be natural weather conditions in the lower atmosphere, which can sometimes send pressure disturbances rippling up into the stratosphere. These so-called planetary waves warm the polar stratosphere and slow ozone destruction. In recent years, however, few planetary waves have buffeted the Arctic and Antarctica during the critical season of springtime ozone loss.

Earlier this year, a computer model suggested that greenhouse warming would reduce the number of planetary waves hitting the Arctic and Antarctica (SN: 4/11/98, p. 228). Other computer models have come to the opposite conclusion, raising questions about the validity of this prediction, says Newman.

The recent cooling, he says, "increases our worry about this potential problem. But we certainly can't say that this is evidence for it." — *R. Monastersky*



NASA

Dark-blue ring (arrow) marks the boundary of the ozone hole in this satellite image. Colors indicate different ozone concentrations.

Medical Nobel prize says yes to NO

In the 1860s, Alfred Nobel invented dynamite, an explosive using the volatile compound nitroglycerin. Yet, when a doctor prescribed nitroglycerin to treat his heart disease, Nobel refused the treatment, believing it unlikely to work. Ironically, research that has helped explain how nitroglycerin can ease chest pains has now earned one of the famous prizes established by Nobel's riches.

Robert F. Furchgott of the State University of New York Health Science Center in Brooklyn, Ferid Murad of the University of Texas Medical School in Houston, and Louis J. Ignarro of the University of California School of Medicine in Los Angeles share the 1998 Nobel Prize in Physiology or Medicine for "discoveries concerning nitric oxide as a signalling molecule in the cardiovascular system," the Karolinska Institute in Stockholm announced this week.

In 1977, Murad found that nitroglycerin and related drugs induce nitric oxide (NO) formation and that this gas relaxes the muscle cells that narrow and dilate blood vessels. Around 1980, Furchgott found that endothelial cells, which line the interior of blood vessels, produce a signaling molecule that causes nearby muscle cells to relax, thus regulating blood pressure.

Scientists didn't initially connect the two discoveries. Like other so-called free radicals, the highly reactive nitric oxide, a common air pollutant, was largely thought a destructive molecule not normally employed by the body. But as Furchgott and Ignarro, working independently, analyzed the nature of the endothelium's relaxing factor, the gas became a prime candidate. At a conference in 1986, each laid out a compelling case that nitric oxide was indeed the factor.

"This was bold, to say the least, because there was no reason to suspect that there was machinery for making nitric oxide" in the human body, notes Jack R. Lancaster Jr. of the Louisiana State University Medical Center in New Orleans, an editor of the journal NITRIC OXIDE.

Research into nitric oxide has blossomed since. Scientists have found the enzymes with which cells make the short-lived gas and have shown that it plays a role in activities as diverse as memory formation, tumor suppression, and immunity. Some brain cells communicate using the gas, and immune cells let loose bursts of nitric oxide to kill infectious organisms or cancer cells. By increasing blood flow, nitric oxide even plays a role in penile erections; the celebrated drug Viagra amplifies the actions of the gas. Physicians are also exploiting the effects of nitric oxide in several other ways. They administer it to premature infants to stimulate blood flow to underdeveloped lungs, for example.

"The NO field has outgrown its original discovery," says Jonathan S. Stamler of the Duke University Medical Center in Durham, N.C., who studies nitric oxide's interactions with hemoglobin (SN: 3/23/96, p. 180). "The impact has been truly remarkable. The ramifications apply to every organ system and cellular response. You name it . . . and nitric oxide has been implicated."

Considering that too much nitric oxide can damage cells, "it's astounding nature chose it to perform so many functions," adds Lancaster. — *J. Travis*