Ozone Layer Succumbs to Assault

The global ozone layer is even more vulnerable to chemical pollutants than previously thought, a group of 80 researchers concluded last week after finishing a major study of the atmosphere. The new findings raise concern that ozone levels over the globe's populous middle latitudes could decline even faster than earlier estimates had warned.

"We have a remarkably different picture of this than we had before the mission," says James G. Anderson of Harvard University, the project scientist for the study, which involved observations by both aircraft and satellites.

Anderson and his colleagues embarked on the NASA-led project last October to examine the ozone layer both inside the Arctic region and over the more temperate parts of the Northern Hemisphere. The researchers set out to analyze the potential for severe ozone losses in the Arctic as well as to explain a disturbing ozone erosion occurring over much of the globe since 1970.

Data from the study indicate that chemical pollution destroyed significant amounts of ozone over the Arctic this winter and will most likely cause even larger depletions in the far north in coming years.

Even more important, the mission reveals that the atmosphere cannot defend itself against chlorine and bromine pollution as well as scientists had thought, says Anderson. Measurements made by NASA's high-altitude ER-2 plane overturned the long-held idea that chlorine and bromine play a minor role in controlling ozone concentrations above the middle latitudes.

Scientists had believed that natural chemical cycles involving nitrogen and hydrogen controlled the stratospheric ozone amounts in this part of Earth's atmosphere. But the ER-2 observations detected much lower levels of nitrogen oxides (NO_x) than scientists expected, suggesting they had overemphasized the importance of the nitrogen cycle. The measurements also showed higher-than-anticipated levels of chlorine monoxide (ClO), known to play a key role in destroying ozone in the polar regions.

These observations directly support laboratory experiments that suggest nitrogen chemicals undergo so-called heterogeneous reactions on the surface of atmospheric sulfate particles. When incorporated into computer models, such reactions lead to lower-than-expected levels of NO_x and higher-than-expected levels of ClO — the same relationship discovered by the ER-2.

Scientists now seek a consistent theory to explain the observed ozone loss over the middle latitudes. Although not proof, the new data indicate that heterogeneous reactions reduce the importance of the nitrogen cycle, allowing the chlorine and bromine cycles to destroy ozone there. The researchers have not yet calculated how much ozone may have succumbed, based on the observed amounts of ClO and bromine monoxide (BrO).

Satellite data do contain hints of ozone destruction. Measurements from February show that average ozone levels over the entire Northern Hemisphere were 10 to 15 percent below normal — the lowest in the 13-year record of such measurements. Scientists believe natural changes in air movement explain part of this year's thinning. But they also think that chemical destruction of ozone in the middle latitudes played a role.

In the past, scientists had thought that because the nitrogen cycle dominated the ozone chemistry of the middle latitudes, it provided a natural buffer system, limiting the destructive impact of rising pollution levels. "What's startling now is we don't have that buffer system. Ozone is exposed to increasing chlorine in a much more direct way," Anderson says.

While scientists cannot yet determine how much ozone destruction occurred over the middle latitudes, the situation in the Arctic is clearer. In February, Anderson and his colleagues reported that most of the chlorine in the Arctic stratosphere had converted from a safe form into ClO (SN: 2/8/92, p.84). They warned that if cold temperatures persisted, the return of sunlight to the region would energize chlorine reactions, causing major ozone depletion. The researchers reported last week, however, that the arrival of abnormally warm temperatures in late January hampered the destructive chemicals, preventing severe ozone loss.

During an average winter, conditions cold enough for ozone destruction persist for 68 days. This year, they lasted only 39 days. Even with the benign weather this year, the Arctic skies lost roughly 10 percent of their ozone, according to calculations based on the observed amounts of ClO, BrO and other chemicals.

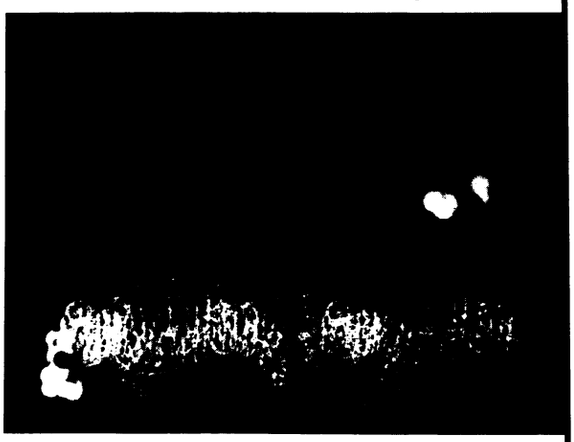
If temperatures next year follow the normal trend, ozone destruction will be much more significant, thinning the ozone layer by about 20 percent, estimates Anderson. While major, that would not constitute a true ozone hole, a term used to describe the extreme ozone loss above Antarctica each spring, he says.

Scientists with the project say that the eruption of Mt. Pinatubo last year may have enhanced ozone loss somewhat at middle latitudes but not at the poles.

— R. Monastersky

Getting a grip on HIV's crucial enzyme

The AIDS-causing virus HIV must copy its genetic material — composed of RNA — into DNA soon after it infects a cell. To do this, it employs reverse transcriptase, an enzyme that uses RNA as a template for making DNA and then destroys the RNA template. AIDS drugs such as zidovudine (AZT) and didanosine (DDI) work by blocking the action of this enzyme, but HIV can sometimes become resistant to these compounds.



Alfredo Jacobo-Molina/Rutgers

This computer model of the enzyme at work, created using X-ray crystallography data, may help scientists design drugs HIV can't elude. It shows how part of the ribbon-like reverse transcriptase enzyme (top right) interacts with a double helix (bottom) made of one strand of RNA and one strand of DNA. The spheres at right highlight the enzyme's site for digesting the RNA template. The spheres at left depict where another part of the enzyme (not shown) adds to the growing DNA chain. The model was created by two teams of researchers led by Edward Arnold at Rutgers University in Piscataway, N.J., and Stephen H. Hughes at the National Cancer Institute facility in Frederick, Md. They report their finding in the May 7 NATURE.

— C. Ezzell