The ozone hole over the south pole this past winter grew to be four times as large as the United States, the biggest it has ever been. Since 1970, the south-pole ozone hole has opened up each year between August and December, then closed up again as sunlight created a new supply of ozone, leaving Earth's entire ozone supply slightly more diminished each passing year.

The source of the problem is industrial chemicals (CFCs, halons and others containing chlorine and bromine), which waft upward into the sky where they break into smaller molecules. These smaller molecules remain in the stratosphere, nine to 18 miles above the earth, until they encounter frozen clouds. Frozen clouds break down the small molecules further, releasing pure chlorine and bromine which then begin to devour nearby ozone molecules that ordinarily protect Earth from deadly ultraviolet radiation, which is constantly streaming in from the sun. According to NASA [National Aeronautics and Space Administration] a one-percent reduction in the ozone shield produces a 2% increase in ultraviolet radiation on the ground.[1]

In early February this year, NASA announced that conditions were ripe for development of a huge ozone hole over the NORTH pole for the first time. In the northernmost region of the stratosphere, NASA scientists had measured chlorine monoxide levels higher than previously seen anywhere in the stratosphere. When chlorine monoxide encounters a frozen cloud, chlorine is released and ozone destruction begins immediately. At a hastily-called press conference February 3rd NASA scientists said this spring the north pole ozone hole might get big enough to cover most of Canada, northern New England, and northern Europe. This would place large human populations beneath an ozone hole for the first time. NASA said in February ozone losses up to 30% might occur this spring over Toronto and Boston. This would be a significant reduction indeed.

Fortunately, almost immediately after NASA's announcement, a warming trend melted the frozen clouds over the arctic and this year's ozone-depletion-season ended after ozone loss of only 10%. NASA called the 10% loss "quite significant" but said it should not be called a "hole." Ozone loss inside the south-pole ozone hole each year now routinely reaches 50% or more but relatively few humans are affected.

NASA says it now knows that ozone destruction depends on two main factors: the total amount of chlorine and bromine atoms in the stratosphere, and the length of the cold season when stratospheric temperatures dip below -78 Centigrade (-108 Fahrenheit), forming frozen clouds that release chlorine and bromine.

As soon as the cold season ends, pure chlorine and bromine change back into a less-destructive form, and sunlight proceeds to create a new batch of ozone at the rate of 350,000 tons per day, partially replenishing Earth's acutely depleted supply. But nature produces the same amount of new ozone each year whereas humans destroy MORE of the Earth's ozone each year, so Earth's total (average) ozone supply is being diminished, allowing slightly more ultraviolet light to reach Earth's surface each year.

Therefore the ozone problem has two parts: large short-term "holes" that can allow large amounts of ultraviolet light to strike the earth during spring and early summer (August-December over the south pole, February-June over the north). And the long-term depletion of ozone, producing smaller increases of ultraviolet light over much larger areas year-round.

Despite the reprieve from NASA's worst fears about a northern ozone hole, 1992 was not a good year for Earth's ozone shield:

** During January, February, and March, NASA's TOMS [Total Ozone Monitoring Spectrometer] satellite measured average ozone over the northern hemisphere lower than any previous year in the satellite's 13-year history.

** Over the north pole, ozone normally reaches a peak during late winter, but this year the late-winter peak was 10 to 15% lower than any peak previously measured.

"The threat of a northern "hole" will be with us for several decades. In 1991/92, frozen clouds in the north lasted only 39 days, saving us from a severe ozone hole over populous regions. But the average winter has 68 days of frozen clouds. In a cold year, frozen clouds can last considerably longer; for example, in 1988/89 frozen clouds lasted 79 days. Thus NASA says it expects large ozone holes over northern latitudes during many years in the next two decades.

** One major source of the problem, chlorine monoxide (derived from CFCs and a few other chemicals like carbon tetrachloride), is increasing in the stratosphere at about 5% per year, NASA said in April.

** Even if the Montreal ozone treaty of 1987 and its June, 1990, amendments are accepted world-wide, it will be 80 years before Earth's ozone returns to normal.


(a) During the period 1970 through the mid-'80s, ozone depletion got worse one year then better the next; every other year brought some relief. But in the late '80s through today, the situation has steadily worsened every year. Scientists are not sure why the pattern has changed, but it apparently has, Albritton said.

(b) In the 1970-1991 period total ozone depletion over northern mid-latitudes (where the U.S. population resides) ozone depletion occurred at the rate of 2.7 percent per decade. But during the later part of this period, 1979-1991, ozone depletion accelerated to 4.7% per decade. Thus total ozone destruction is accelerating. Albritton's picture of accelerating ozone loss was confirmed by new analyses announced in SCIENCE magazine April 17.

(c) In the 1970s and early '80s, ozone loss was restricted to winter time. However in recent years, ozone depletion has also been observed during summer. Over northern mid-latitudes during the period 1979-1991, summer ozone losses averaged 3.3%

NASA doesn't talk much about what ozone depletion means. For one thing, information is scarce. This scarcity did not occur by chance. Of all the money spent worrying about the ozone hole(s) during the past 20 years, less than 1% has been spent measuring effects of ultraviolet light on living things like plankton, peas, polar bears, and people. Over 99% of the money has been spent outfitting airplanes with special equipment, building satellites with special eyes for seeing ozone, and so forth.

As a result, effects of modest ozone loss are poorly understood. However, effects of severe ozone loss were studied in 1975 by the National Academy of Sciences (NAS) as part of an effort to understand the consequences of nuclear war. The Arms Control and Disarmament Agency in 1978 used the NAS study to assess effects of nuclear conflict. According to the Agency, a 50% reduction in Earth's ozone shield over mid-latitudes "would cause blistering after one hour of exposure. This leads to the conclusion that outside daytime work in the northern hemisphere would require complete covering by protective clothing.... It would be very difficult to grow many (if any) food crops, and livestock would have to graze at...
Besides severe blistering, ultraviolet light harms the immune systems of humans and animals (regardless of skin pigmentation); reduces crop yields; reduces the growth of phytoplankton (which form the basis of all oceanic food chains); and causes eye cataracts in humans and animals, leading to blindness.

Ozone losses less than 50% might cause blindness in domestic animals, thus disrupting agriculture in much of Asia which depends heavily on beasts of burden. Other complex, far-reaching negative effects are thought possible.

The Institute for Energy and Environmental Research (IEER), a private organization, has developed a practical plan for rapid phase-out of all ozone-destroying chemicals,[4] but the Bush administration has shown no real interest. After the NASA press conference in February, Mr. Bush speeded up the U.S. timetable for phasing out ozone-killing chemicals, but only by one year. In Washington, it's business as usual.

--Peter Montague

[1] "Press Briefing; End of Mission Statement; Second Airborne Arctic Stratospheric Expedition AASE-II." Washington, DC: National Aeronautics and Space Administration, April 30, 1992. The increased ultraviolet radiation may not all reach the ground because other pollution (for example, urban smog) may absorb it, but where the air is clear, a 1% reduction of stratospheric ozone will cause a 2% increase in ultraviolet on the ground, NASA says.


Descriptor terms: ozone; nasa; south pole; ozone hole; ozone depletion; national academy of sciences; ieer;