the first signs of weakness in 1985, after discovering that the stratosphere above Antarctica loses a large fraction of its ozone each year during September and October, a phenomenon dubbed the "ozone hole."

After several expeditions to Antarctica, scientists gathered proof linking the ozone hole to chlorofluorocarbons and other pollutants that carry destructive chlorine and bromine high into the stratosphere. In the frigid Antarctic, these chemicals eat away half the ozone in the sky during the southern hemisphere's springtime.

In 1987, researchers discovered a less obvious but more pervasive ozone thinning around the globe. The stratosphere over all regions except the tropics has lost a few percent of its ozone since 1979 – a trend also attributed by scientists to chlorine and bromine compounds.

Bojkov thinks that such chemicals caused much of the dramatic ozone thinning over the northern hemisphere this winter, but other factors also contributed, he says. Meteorological data suggest that air movement played a role in setting up the ozone pattern. Masses of tropical air, naturally low in ozone, spread north during winter, lowering ozone concentrations above Europe and other regions, Bojkov says.

U.S. scientists who monitor ozone-sensing instruments on several satellites confirm that northern hemisphere ozone concentrations, which normally increase in winter, did not rise as much as in previous years. Measurements made by the Upper Atmosphere Research Satellite (UARS) also support the idea that destructive chemicals helped thin this winter's ozone. From December through late February, the craft observed extremely high concentrations of ozone-eating chlorine monoxide over much of the Arctic and surrounding regions, says UARS scientist Joe W. Waters of NASA's Jet Propulsion Laboratory in Pasadena, Calif.

From past studies, atmospheric researchers have come to know chlorine monoxide as the chief villain that attacks ozone in the Antarctic. Normally, chlorine in the stratosphere is bound in inactive molecules that cannot destroy ozone. But the cold Antarctic stratosphere contains icy particles that provide a surface on which inactive chlorine compounds can convert to harmful chlorine monoxide.

In early February of last year, scientists involved in a major research project expressed dismay at finding extremely high concentrations of chlorine monoxide in the Arctic stratosphere – an indication that the atmosphere of the north was primed to destroy ozone. If temperatures were to remain cold for several weeks, they predicted, sunlight and chlorine monoxide could combine to munch away a significant fraction of the Arctic ozone, perhaps even generating an ozone "hole" in the north. Soon afterwards, however, the atmosphere warmed, saving the Arctic from major ozone loss at that time.

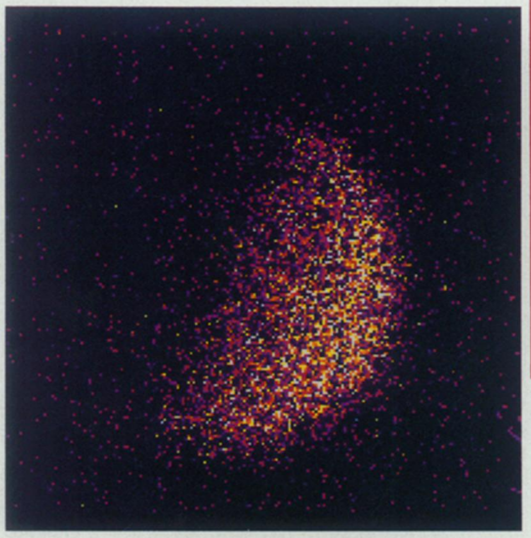
The events of this winter apparently vindicate predictions made last year. Temperatures in the polar stratosphere stayed cold a month longer than last year, and high concentrations of chlorine monoxide persisted longer as well. As if on cue, ozone levels remained well below normal, hitting record lows for the month of February.

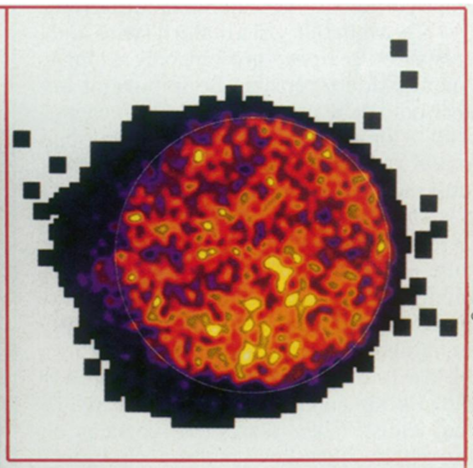
"Last year was the warning; this year it happened," says Mark R. Schoeberl of NASA's Goddard Space Flight Center in Greenbelt, Md.

The combination of destructive chemicals and meteorology, however, did not create an Arctic ozone hole, because ozone is normally quite abundant in the higher latitudes of the northern hemisphere during winter. Even with concentrations well below average for this time of year, ozone remained plentiful in the sky during the last few months, providing what was probably adequate protection against the weak winter sunlight, scientists say.

But the current deficit could leave ozone levels lower than normal later in the year, when more ultraviolet radiation streams through the northern hemisphere skies, Schoeberl says. *– R. Monastersky*

The moon beams in extreme ultraviolet





Images: Gladstone *et al.*

Scanning the cosmos for emissions in an elusive part of the electromagnetic spectrum, a U.S. spacecraft has captured the first images of the moon aglow in the extreme ultraviolet. Astronomers presented the images this week at the annual Lunar and Planetary Science Conference in Houston.

The Extreme Ultraviolet Explorer (EUVE), launched last June, detects this band of radiation, which can't penetrate Earth's atmosphere and is intermediate in energy between the near ultraviolet and X-rays (SN: 5/23/92, p.344). While the craft devotes most of its time to studying the atmospheres of stars many tens of light-years beyond the solar system, it has cast its eye on an object closer to home.

In August, the EUVE recorded extreme-ultraviolet light reflected from the first-quarter moon (see left image above). And in December, the Earth-orbiting craft recorded extreme-ultraviolet light reflected from the full moon (right). In both of these false-color images, yellow denotes the highest intensity, blue the lowest. In the full-moon image, the brightest areas coincide roughly with lunar highlands, while the dark areas align with lava-covered plains known as maria.

Randy Gladstone, a member of the EUVE research team at the University of California, Berkeley, notes that the extreme-ultraviolet glow stems from solar radiation striking the lunar surface.

The glow consists primarily of extreme-ultraviolet photons from the sun that bounce off the moon, he says. But some of the emissions might result from solar X-rays that are absorbed by atoms on the moon's surface, causing them to fluoresce at the lower energies associated with specific wavelengths in the extreme ultraviolet.

Gladstone says that spectra of the moon's ultraviolet emissions, already taken by the EUVE but not yet analyzed, should indicate how much of the moonglow comes from reflected light and how much from fluorescence. If fluorescence contributes significantly to the moon's ultraviolet emissions, then such images would provide a new tool for uncovering the relative abundance of elements on the lunar surface, Gladstone says. *– R. Cowen*