Ozone Layer Shows Record Thinning

Satellite measurements in 1992 and the first part of this year reveal that concentrations of protective ozone have dropped to record low levels in the stratosphere above much of the planet. Atmospheric scientists who detected the pronounced decline suspect it may represent a lingering legacy of the 1991 eruption of Mt. Pinatubo acting in concert with pollutants in the atmosphere.

They expect that ozone concentrations should creep back up as the volcanic acid droplets clear out of the atmosphere in the next year or two.

Ozone molecules in the stratosphere filter out ultraviolet radiation, which can cause skin cancers. The global ozone layer has been thinning slowly since the late 1970s due to chlorine and bromine pollution in the atmosphere, but the recent decline goes beyond the gradual erosion detected in the past. Measurements made by the Total Ozone Mapping Spectrometer (TOMS) on the Nimbus-7 satellite show that ozone amounts during the last 15 months have hovered well beneath the lowest levels recorded during the last 13 years.

"These are the lowest values we've ever seen," says James F. Gleason of NASA's Goddard Space Flight Center in Greenbelt, Md. Gleason and his colleagues announced their findings in the April 23 SCIENCE.

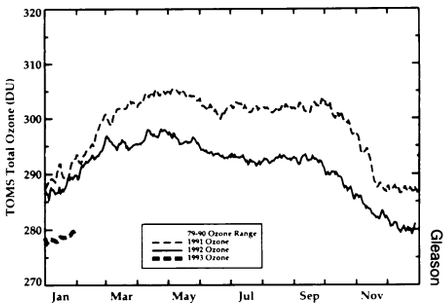
The TOMS data show that during 1992, ozone levels dropped 2 to 3 percent below the range of previously recorded values and have remained low into this year. Such changes are a marked departure from past average levels of ozone, which have kept within a narrow window of values since the launch of Nimbus-7 in 1979.

In atmospheric science, it is rare to find such a pronounced change, says Michael Prather at the University of California, Irvine. "What they've shown is something so far out of the statistics and such a powerful change in the atmosphere. And in a way, we did not expect it," he says.

The TOMS instrument started showing record low levels of ozone as far back as March of last year. The ozone levels continued to drop below normal until by December they reached 4.7 percent below the global average since 1979.

When they first observed the decline, NASA scientists wondered if the measurements were accurate. The TOMS instrument was designed to calibrate itself each week by taking readings from the sun. But the aging satellite carrying the device has gradually drifted into an orbit that prevents part of TOMS from viewing the sun at certain times of the year. With TOMS partially shaded, the instrument could not calibrate itself between February and September of last year.

When TOMS regained a view of the sun on Sept. 30, 1992, Gleason and his colleagues checked its earlier measurements by interpolating the calibration for that period, using the late September and early February calibrations as reference points. They also compared the TOMS data with measurements made by two other satellites and a ground-based network of ozone-sensing instruments. Such checks all indicate that TOMS has provided accurate ozone readings.



Gray shading shows the range of daily ozone amounts, averaged over most of the globe, from 1979 through 1990. Levels in 1992 (solid line) dropped well below that range. Wide dashes show 1993 levels.

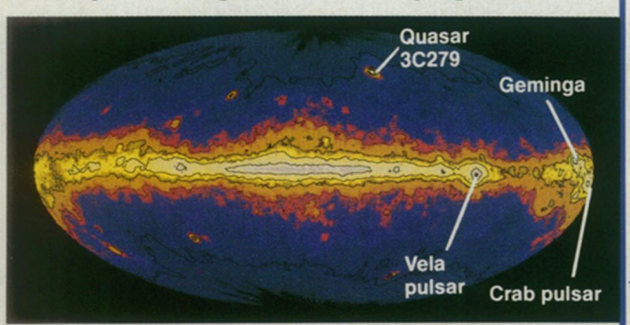
By reporting the record-low ozone concentrations, Gleason has thrown open the problem to theorists who must try to explain the findings by using computer models of the atmosphere. As a first guess, Gleason and his co-workers suggest the decrease stems from tiny droplets of volcanic sulfuric acid that have spread around the globe since the eruption of Mt. Pinatubo in June 1991. The minute droplets, or aerosols, can spur ozone loss both by enhancing the destructive power of chlorine pollution and by altering the circulation of air in the stratosphere.

Immediately after the eruption, some scientists predicted acid aerosols would cause ozone depletions of up to 10 percent during the winter. Others argued the eruption would have little effect. But the observed ozone drops do not match any expectations; they did not show up until well after the eruption and have continued far longer than anticipated. Scientists expect ozone levels to rebound as the aerosols drop out of the sky, but it remains unclear whether ozone will recover to preeruption levels, Prather says.

The low ozone values observed last year and now should not panic anyone, he adds. "Is it enough to mean that the sky is falling? No. But is it a worry? Yes, because it means that people, animals, and plants are going to suffer," says Prather. With each percentage drop in ozone, scientists estimate the strength of ultraviolet radiation increases by 1.25 percent.

— R. Monastersky

Limning full sky in a gamma-ray glow



Astronomers last week unveiled the first full-sky map of the heavens aglow in the light of gamma rays, the cosmos' most energetic radiation. Generated by data from the Compton Gamma Ray Observatory's (GRO) EGRET telescope, the map depicts emissions with an energy greater than 100 million electron-volts. White denotes highest intensity, blue the lowest. The horizontal swath shows gamma-ray sources, including several known pulsars, in our galaxy's plane. Above and below the plane, the map reveals more distant sources, mostly quasars and quasar-like objects called blazars. Carl E. Fichtel of NASA's Goddard Space Flight Center in Greenbelt, Md., presented the map at a meeting of the American Physical Society in Washington, D.C.

Researchers also reported that GRO had detected a champ among gamma-ray bursts: a flash with the highest energy and intensity ever observed. Dubbed the Super Bowl burst because of its discovery on Super Bowl Sunday (Jan. 31), this one-second cosmic flashbulb overwhelmed GRO detectors designed to record its intensity. Up to 100 seconds after the burst, EGRET detected a photon afterglow that at times reached energies of a billion electron-volts. Astronomers searched for evidence of a counterpart to the burst at other wavelengths, but the flash's origin, like others, remains a mystery.