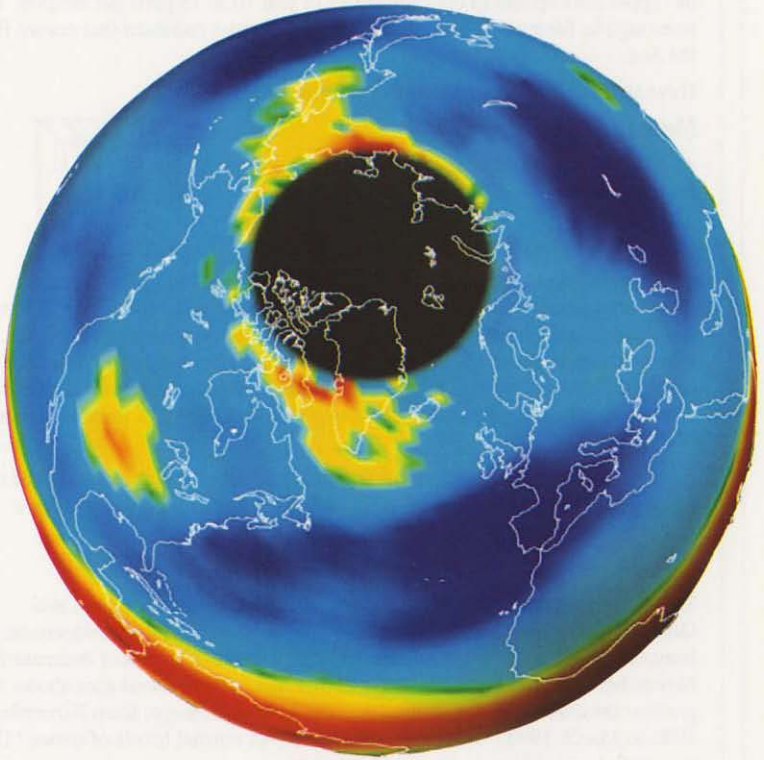
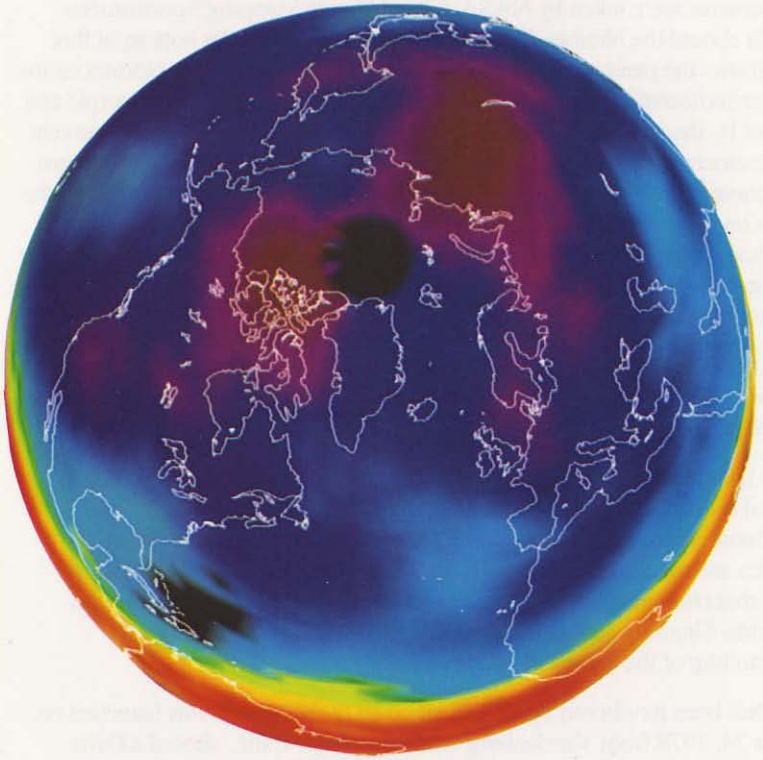
National Aeronautics and
Space Administration
Goddard Space Flight Center

TOMS Ozone- Difference from Climatology

November 1992



March 1993



Percent Difference

-25.0 -20.0 -15.0 -10.0 -5.0 0.0 5.0

TOMS Ozone – Difference from Climatology

Nimbus-7/TOMS: Total Ozone

This image shows how the total ozone levels in November 1992 and March 1993 are different from the 11-year, 1979-1990, average. The total ozone measurements were taken by NASA's Total Ozone Mapping Spectrometer (TOMS) aboard the Nimbus-7 satellite. The color scale at the bottom of this image shows the percent difference from the 11 years measured. Normal ozone levels are indicated by the color yellow, decreases by the color blue/purple and increases by the red colors. The November ozone levels are between 5 percent and 10 percent below the average level over the mid-latitudes of the Northern Hemisphere. The March ozone levels are between 10 and 15 percent below the average level over the mid latitudes of the polar regions. Only the equatorial region had ozone values above normal. The large black circle on the November image and the small black circle on the March image represents polar night where no measurements were made.

Ozone, a molecule made up of three atoms of oxygen, comprises a thin layer in the upper atmosphere that acts as a shield against harmful ultraviolet radiation from the sun.

Studies have shown that ozone depletion is caused by complex, coupled chemical reactions. Scientific data have indicated that man-made chlorofluorocarbons (CFCs) used in refrigeration, electronics and other industries are capable of altering the levels of atmospheric ozone. Scientists believe that continued buildup of CFCs could lead to additional ozone loss worldwide. Ongoing studies are essential to provide the necessary understanding of the causes of ozone depletion.

Ozone has been monitored by TOMS since 1979. Nimbus-7 was launched on October 24, 1978 from Vandenburg Air Force Base, Calif., aboard a Delta rocket. The Nimbus-7 operational life was to have been two years. The Nimbus-7 and TOMS are managed by NASA's Goddard Space Flight Center, Greenbelt, Md., for the Office of Mission to Planet Earth, Washington, D.C.

To ensure that ozone data will be available through the next decade, NASA will continue the TOMS program, using U.S. and foreign launches. On August 5, 1991, the former Soviet Union launched a Meteor-3 satellite carrying a TOMS instrument provided by NASA. A third TOMS, onboard an Earth Probe satellite, will be launched on a U.S. expendable rocket in 1994 and the Japanese Advanced Earth Observations Satellite (ADEOS) will carry a fourth TOMS when it launches in 1996.

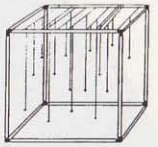
For the Classroom

1. Ozone is a special form of oxygen molecule that consists of three atoms of oxygen bonded together instead of the usual two. It is normally present in the upper atmosphere in concentrations of just 10 to 15 parts per million. This is enough to filter out most of the deadly ultraviolet radiation that comes from the Sun.

Have students make this **Parts Per Million (PPM) Model**.

Materials Needed:

12 Meter Sticks
Masking tape
Thread
Modeling clay



To illustrate the faction of the upper atmosphere that consists of ozone, construct a cube out of meter sticks and masking tape. Roll out 10 to 15 small spheres of modeling clay, each approximately one centimeter in diameter. Using thread, suspend each of the spheres at random locations within the cube. Have your students calculate how many cubic centimeters there are in a cubic meter. (Each sphere represents one part per million of the total volume of the cube.)

2. Ozone molecules are constantly being made, but they are fragile and they can be destroyed by interaction with human-made or natural gases. Have students name some of these gases and their sources.

Example: methane - swamps, rice paddies, termite mounds

3. Have students find Alaska, Florida, Korea, the Panama Canal, and Greenland on both images. Compare the percentages of increase/decrease from the 11 year average. Compare the percentages of increase/ decrease from November 1992 to March 1993. From this data, what general area shows the greatest decrease in ozone levels from the 11 year average; from November 1992 to March 1993? What general area shows normal levels of ozone? Did any area show an increase in ozone levels?

Have students discuss possible reasons for the differences in percentages.

4. The black areas on each image represent polar night. Have students answer the following questions:

What is polar night?

Why is the black area smaller on the March 1993 image than on the November 1992 image?

Investigate: Why is the Total Ozone Mapping Spectrometer (TOMS) unable to measure the ozone levels at night?

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