National Aeronautics and
Space Administration
Goddard Space Flight Center

MEASURING OZONE WITH THE SBUV/2

National Oceanic and
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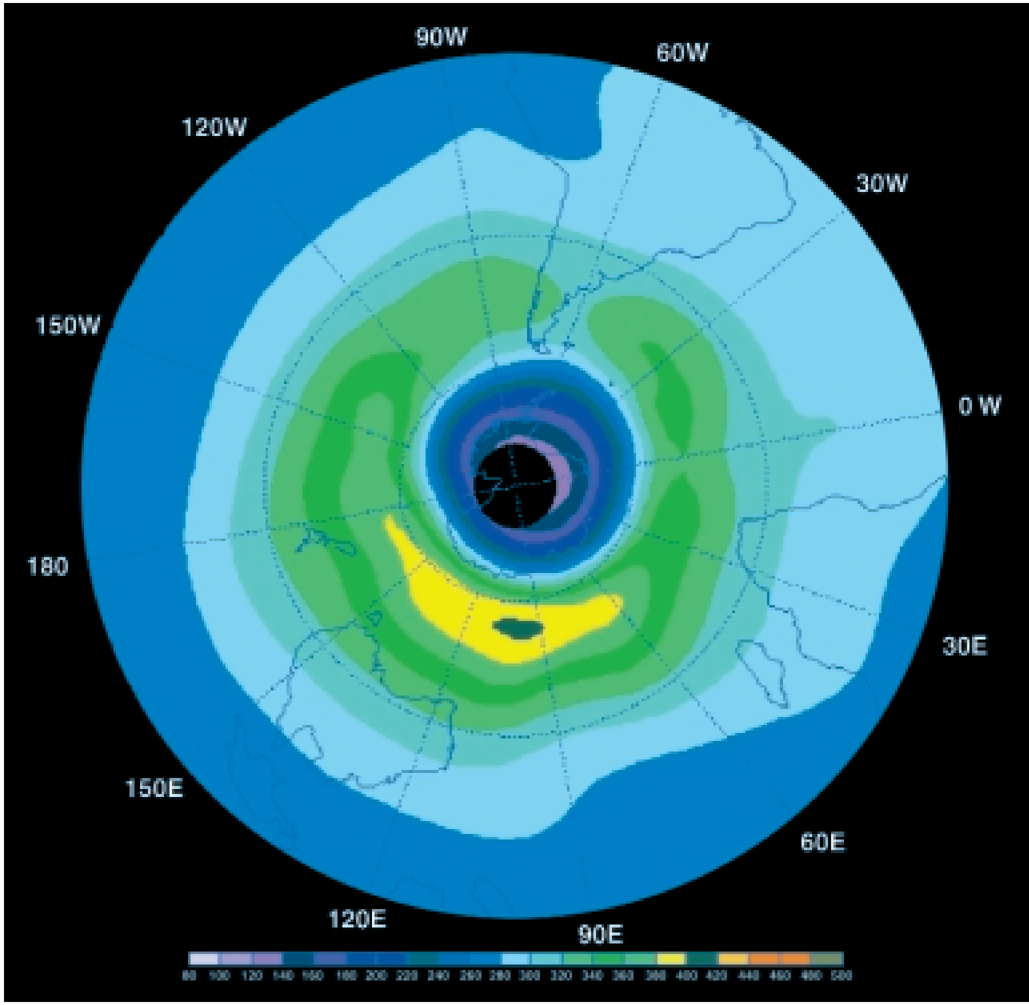

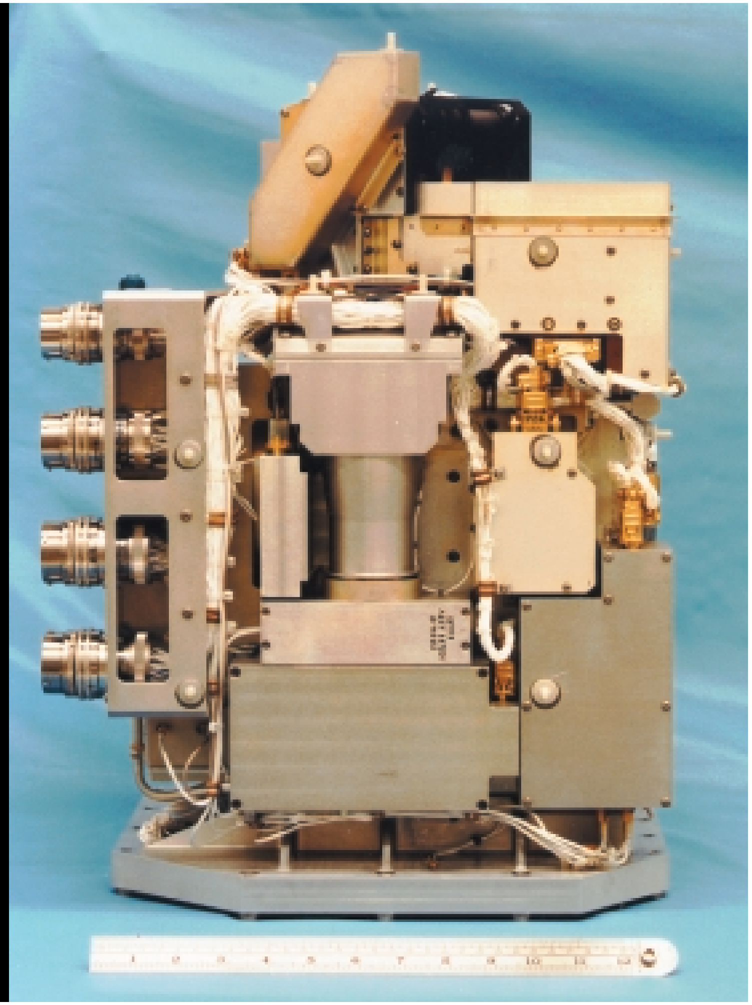

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The Solar Backscatter Ultraviolet Radiometer (SBUV/2 is a long-term monitoring device that takes global measurements and observes how elements in the atmosphere change over time.

The SBUV uses its 12 channels to measure the amount of radiation (or energy) that comes directly from the Sun (using a diffuser) and how much energy is reflected back from the Earth. This information is integrated into a scientific model that calculates the concentration and distribution of ozone in the stratosphere.

The primary use of the data from the SBUV, is determining the vertical distribution (or profile) of ozone over the global surface, or how it varies at various distances from the Earth's surface up to a distance of approximately 55 kilometers or 34 miles. (This can also be expressed as 0.03 millibar (mb) pressure.) The instrument also provides for the generation of layer ozone values, which represent the amount of ozone found in a "chunk" of the atmosphere.

Each channel on the SBUV detects a particular near-ultraviolet (UV) wavelength whose intensity depends on the ozone density at a particular height in the atmosphere. It is nadir-pointing, which means that it always points directly toward the center of the Earth and does not scan the atmosphere as the other NOAA Polar Operational Environmental Satellites (POES) instruments do. The SBUV has a device called a Cloud Cover Radiometer that provides information on the amount of cloud cover in an image and removes the effects of the clouds from the data.

The amount of ozone in the atmosphere is important because a lack of ozone allows harmful radiation or UV rays to reach the Earth. UV rays can cause sunburn in humans, and some people develop cancer from exposure to UV rays.

This image of the total ozone product, generated from NOAA-14's SBUV instrument, clearly depicts the Antarctic Ozone Hole in October 1999. The image is a composite that was produced from data obtained from many orbits of the spacecraft around the Earth. The colors in the scale beneath the image progress from left to right, with those at the left of the scale corresponding to areas with the least amount of ozone and those at the right representing areas with the most ozone. The values are expressed in Dobson units, which is a unit of measure for total ozone. Typically, values below 220 Dobson units are considered to comprise the "ozone hole." The round black area in the center of the image is an area of the Earth that the monitoring devices on the SBUV cannot see.

Since the 1960s, NASA and NOAA have been actively engaged in a cooperative program to develop and launch the NOAA Polar Operational Environmental Satellites (POES). NASA's Goddard Space Flight Center in Greenbelt, Maryland, is responsible for the construction, integration, and verification testing of the spacecraft, instruments, and unique ground equipment. The U.S. Air Force provides the Titan II launch vehicle. NASA checks out the satellite on-orbit performance to assure it meets its requirements. NASA turns operational control of the spacecraft over to NOAA after a comprehensive subsystem checkout.

These spacecraft monitor the entire Earth, providing atmospheric measurements of temperature, humidity, ozone and cloud images as they track weather patterns that affect the global weather and climate. The satellites send millions of global measurements daily to NOAA's Command and Data Acquisition stations in Fairbanks, Alaska, and Wallops Island, Virginia, and to its data processing center in Suitland, Maryland, adding valuable information to forecasting models, especially for ocean areas, where conventional ground-based data are lacking.

Currently, NOAA has two operational polar orbiters: NOAA-16, launched in September 2000, into a 2:00 p.m. local solar time orbit and NOAA-15, launched in May 1998, into a 7:30 a.m. local solar time orbit. NOAA-M will replace NOAA-15 in a 10:00 a.m. local solar time orbit. The new 10:00 a.m. orbit will allow NOAA-M to carry the same instruments as the 2:00 p.m. satellite (both cross the equator two hours away from noon), and allows for the generation of the same product suite from each orbit.

NOAA-M is scheduled to be launched in the summer of 2002 and will be renamed NOAA-17 after achieving orbit. The satellites receive a letter designation while under construction on the ground and are then renamed with a numerical designation after launch. This is done because the satellites are built in alphabetical order but are not necessarily launched in this same order. Therefore, to avoid confusion, they are numbered upon reaching orbit.

More information on the POES program can be found on the Internet at: http://poes.gsfc.nasa.gov and at http://www.osd.noaa.gov/POES/index.htm.

For the Classroom

One of the most vital tools scientists use to study the atmosphere is remote sensing. In this "long distance seeing" that will be performed by NOAA-M, researchers will use infrared, microwave, and visible spectral data to trace weather patterns and to image cloud cover. To be effective and provide the most accurate results, remote sensing must be performed over a long period of time. NOAA-M will collect data for at least two years and probably longer.

Why must these investigations be so comprehensive and continue for a long period of time? Try this investigation to find out.

Materials Needed:

Notebooks, pencils, paper, graph paper, if available, an instant camera or video camera, with film or videotape

Procedure:

Count the number of students at a central location in your school cafeteria or gym for a 1-minute period several times a day. You can do this by taking a photograph of the cafeteria or gym or by stationing yourself there and counting the number of students that you see. Draw a graph with the times shown on the horizontal axis and the numbers of students on the vertical axis.

Questions:

1. Is there a noticeable difference in numbers of students at various times?
2. Could you make accurate statements about how many students use the cafeteria or gym by looking at the results of only a single observation?
3. What does this tell you about the need for long-term observations from space?

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