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NASA SATELLITE FLIES HIGH TO MONITOR SUN'S INFLUENCE ON OZONE

by Goddard Space Flight Center

UARS Spacecraft

In October, the Upper Atmosphere Research Satellite (UARS) completed the first measurement of the solar ultraviolet radiation spectrum over the duration of an 11 year solar cycle, a period marked by cyclical shifts in the Sun's activity. This long measurement record by two instruments aboard UARS will give researchers better insight into how fluctuations in the Sun's energy affect ozone and the Earth's climate. In turn, the data set gives scientists tools to document the influence of man-made chemicals on ozone loss.

Though mission success was initially declared only 18 months after its launch in September 1991, UARS has continued to track ozone levels and atmospheric gases that react with ozone. The satellite has now also recorded the Sun's influence on ozone and other gases over an entire solar cycle.

During the 11-year solar cycle the Sun undergoes periodic changes in activity from the "solar maximum," to a period of quiet called the "solar minimum." During the solar maximum there are many sunspots, solar flares, and coronal mass ejections, which can affect communications and the atmosphere here on Earth.

"Having a complete solar cycle of data provides information necessary to distinguish the natural variations in the Earth's atmosphere from man-made variations," said Charles Jackman, UARS Project Scientist at NASA's Goddard Space Flight Center, Greenbelt, Md.

"UARS has lasted so long that we now have an 11 year mission with a single set of observations spanning the entire solar cycle," said Gary Rottman, a senior scientist at the University of Colorado and Principal

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Investigator for the SOLar Stellar InterComparison Experiment (SOLSTICE) instrument on UARS.

This complete solar cycle UV radiation dataset provides key measurements toward better determination of the roles of natural and man-made influences on ozone.

Also, by observing a full solar cycle, scientists hope to use the additional data to better understand the Sun's behavior.

Observatories on the Earth have found fewer sunspots in this solar cycle than the last one, but UARS measurements indicate the amount of UV radiation that struck Earth's atmosphere during each solar maximum was about the same.

"The expected correlation between sunspot activity and UV irradiance over the long term was not found," said Linton Floyd, a researcher working at the Naval Research Laboratory, Washington, and Project Scientist for the Solar Ultraviolet Spectral Irradiance Monitor (SUSIM) instrument on UARS. Floyd hopes that more long-term records will help clear up such mysteries about the Sun.

UARS includes ten instruments designed to understand the radiation, chemistry, and dynamics of the Earth's upper atmosphere. Of those ten, seven instruments still work.

The SUSIM and SOLSTICE instruments measure UV light from the Sun and provide insights into the relationship between UV radiation and atmospheric ozone. These two instruments were independently calibrated, each providing a check on the other. Another set of instruments measure gases like ozone, methane, water vapor, and chlorofluorocarbons (CFCs) in Earth's atmosphere. The third group measures winds in the stratosphere, mesosphere, and the lower thermosphere and help researchers understand the global movement of gases.

In January 2003, NASA will launch the Solar Radiation and Climate Experiment (SORCE) satellite, which will provide further measurements of the Sun. By having an overlap with UARS, NASA will have two satellites making essentially the same measurements simultaneously, thereby providing a "truthing" for comparisons and an even longer term data record, Floyd said.

When space makes you dizzy:
Landing a spaceship is not a good time for a pilot to feel dizzy.

It's easy to tell which way is up and which way is down...or is it? In the freefall of space travel, there's no pull of gravity to tell your body which way is which. Most astronauts and cosmonauts experience some motion sickness when they first arrive in orbit. NASA is studying why.

Download sound files of the sun from Stanford's Solar Center: The Singing Sun.

Go to theBBC SPACE Science Homepage & Weather Page for space events and forecasts.

UARS Spacecraft

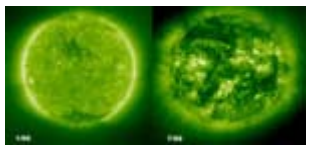
The Upper Atmosphere Research Satellite (UARS) has outlived its planned lifetime by operating for 11 years with seven of its 10 instruments continuing to function. UARS' primary mission is to measure ozone and chemical compounds found in the ozone layer, which affect ozone chemistry and processes. It also measures winds and temperatures in the upper atmosphere (stratosphere) as well as energy from the Sun.

The Sun-Earth Connection

Two of UARS' instruments measure small changes in the solar UV spectrum and a third records the Sun's total energy output. They contributed to discoveries such as finding a link between the energy given off by the Sun and Earthly wind patterns that facilitate climate changes. UARS let scientists take into account solar activity on the ozone layer and the chemistry of the upper atmosphere where it gets absorbed.

Earlier this year, UARS also allowed scientists to watch the same solar energy take a toll on the ozone layer by actually working to destroy a portion in the lower atmosphere and a small amount of the crucial upper atmospheric ozone layer. The energetic particles hitting the camera on the second image break down ozone molecules in much the same way as CFCs. These images of the Sun were taken with the Solar and Heliospheric Observatory (SOHO).

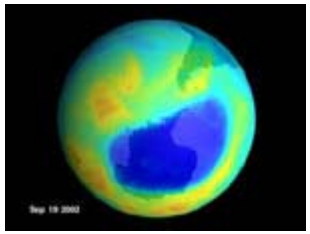
Solar Cycle



The Cyclical Sun

During the Sun's eleven-year cycle, it goes from a minimum (seen here in 1996) to a maximum (2000) period of activity that affects us everyday. When particularly active, solar storms can spew tons of radiation to Earth in the form of Coronal Mass Ejections (CMEs) that can affect power grids, spacecraft, and communication systems. Credit: NASA / ESA

Ozone Contributions



The image shows the Antarctic ozone hole maximum for 2002.

Pictured in the animation are the largest Antarctic 'hole' (2000) and the region of low ozone over the Arctic, which reached its high in 1999. In 2000 UARS scientists found that the Arctic ozone may not be recovering as quickly as previously thought. They attributed this to more than expected polar stratospheric clouds forming high above the Arctic. They provide the vehicles which convert benign forms of chlorine into reactive, ozone-destroying forms but they also remove nitrogen compounds that act to moderate the destructive impact of chlorine.

UARS also facilitated the first study to link greenhouse gases to increased ozone depletion over populated areas in 2001. Scientists detected increasing water vapor in the stratosphere resulting partially from greenhouse gases that may delay ozone recovery and increase the rate of climate change. The study worked because scientists were able to best simulate the behavior of temperature and ozone in the upper atmosphere when adding water vapor data from UARS into the climate model.

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