Satellites hint sun is growing stronger

A person wouldn't notice it by looking up in the sky, but the sunlight hitting Earth today is slightly brighter than it was a decade ago, according to a study of satellite instruments that monitor solar radiation. This discovery, if confirmed, raises the possibility that solar variation has caused a portion of the global warming detected in recent years and could either exacerbate or mitigate future climate change predicted as a result of greenhouse gas pollution.

Between 1986 and 1996, the intensity of solar radiation increased by 0.036 percent, reports Richard C. Willson of Columbia University's Center for Climate Systems Research in Altadena, Calif., in the Sept. 26 SCIENCE.

To put the change into perspective, Willson notes that the extra solar radiation absorbed by Earth over the last decade would equal roughly 70 times the amount of energy produced by all nations in 1990.

"If the sun really changed by 0.036 percent over 10 years, it would be a big deal for climate," says Judith Lean, a solar physicist at the Naval Research Laboratory in Washington, D.C. Her own analysis, however, suggests that the sun's strength in 1996 equaled or fell slightly below its 1986 value.

Satellites have been tracking the solar energy bathing Earth since 1978. In the 1980s, scientists realized that the total amount of solar radiation ebbs and surges in synch with the well-known 11-year cycle of the number of sunspots. At the peak of the cycle, hundreds of dark spots blemish the surface of the sun and bright regions pour out extra radiation. As the sun moves into the quiet phase, known as the solar minimum, sunspots largely disappear and the sun's energy flags by 0.10 percent.

Scientists have long wondered whether the sun varies even more substantially over many decades or centuries. Lean and other researchers have proposed that a long-term weakening of the sun in the 17th century helped cause the Little Ice Age, a period of intense cold in Europe.

Solar scientists have detected hints of these big swings in solar activity from ground-based observations, which track variations in sunspots, bright regions, and other solar characteristics. These measurements, however, are indirect indications of the total solar output, which has proved impossible to monitor accurately from Earth. Willson's report on satellite measurements of total solar radiation provides the first direct evidence that the sun's energy varies over spans longer than 11 years.

The data for his study come primarily from two satellite-borne instruments: ACRIM I, which functioned from 1980 to 1989, and the currently operating ACRIM II, launched in 1991.

Original plans for the ACRIM missions called for the replacement device to reach orbit before the first one ceased functioning, which would have allowed scientists to calibrate the new instrument. The Challenger disaster pushed back the launch of ACRIM II, leaving a gap in the measurements, says Willson, who designed the instruments.

Willson used measurements from another satellite monitor, called ERB, as a bridge between the two ACRIM instruments. To track total solar output, he compared the quiet phase of the last cycle, in the mid-1980s, with the current quiet phase. This procedure revealed that the sun's output had climbed from 1367.0 to 1367.5 watts per square meter at the satellite, with a range of error of 0.0082 watts per square meter.

Some solar scientists question Willson's use of the ERB data. In previous studies, two groups independently reported evidence that the ERB instrument suffered problems in 1989 and 1990, when its sensitivity may have jumped inexplicably. If these artificial shifts in ERB did indeed take place, "then there is little evidence for an increase in total solar irradiance," says Gary A. Chapman of California State University, Northridge. "Only time and more measurements will be able to settle the issue."

A solar strengthening of the size reported by Willson would have warmed Earth during the last decade, but its effect would have been dwarfed by greenhouse gas pollution, which exerted two to three times the amount of warming power over that period, says James E. Hansen of NASA's Goddard Institute for Space Studies in New York.

Climate scientists have forecast that greenhouse gases will raise Earth's temperature 1°C to 4.5°C by the year 2100. If the upward trend in solar radiation continues at its present rate, the sun could warm the globe by another 0.4°C, says Willson. —*R. Monastersky*

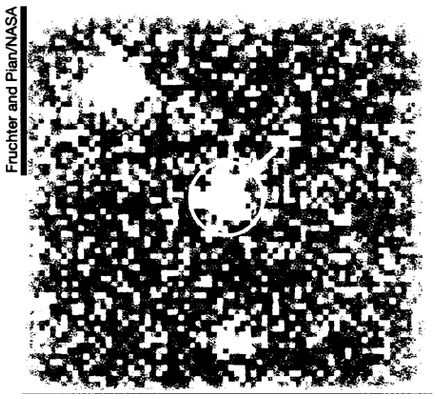
A gamma-ray burst's enduring fireball

It's the cosmic ember that keeps on glowing.

Last March, astronomers spied for the first time in visible light the smoldering remnant of a gamma-ray burst—a titanic explosion that unleashes its fireworks in a matter of seconds (SN: 5/17/97, p. 305). This afterglow has since faded substantially, but it remains visible in images taken Sept. 5 by the Hubble Space Telescope.

The duration of the afterglow and its slow decline provide further evidence that bursts originate far beyond the Milky Way rather than inside it, Hubble scientists assert. Astronomers have long debated the origin of gamma-ray bursts.

A nearby burst carries much less energy than a faraway burst of the same observed brightness. Therefore, if the fireball imaged by Hubble, called GRB 970228, had erupted in the Milky Way, it would have packed less of a wallop and faded drastically after a few days, says Mario Livio of the Space Telescope Science Institute (STScI) in Baltimore.



Fruchter and Pian/NASA

False-color image of the visible-light fireball from a gamma-ray burst (arrow). The burst lies at the edge of an object that could be a distant galaxy (circle).

"We've followed this [burst] for 6 months, and it continues to decay at the same rate," says Livio. "This strongly argues that the burst is distant." He points out that the fading fireball lies at the edge of a fuzzy blob that remains as bright as when Hubble imaged it in March. This suggests that the blob is a galaxy, perhaps the one in which the burst exploded, rather than material temporarily heated by the fireball.

Livio and his colleagues, including Andrew S. Fruchter and Kailash C. Sahu of STScI and Elena Pian of the Italian National Research Council in Bologna, reported the findings last week at a meeting in Huntsville, Ala., on gamma-ray bursts.

Last May, researchers measured for the first time the distance to a gamma-ray burst, called GRB 970508, proving that it resided far beyond the Milky Way (SN: 5/31/97, p. 335). Although scientists have compelling data on only 2 of the roughly 3,000 bursts detected, "there's no way to defend the [Milky Way] origin at the moment," says Bohdan Paczynski of Princeton University. The source of the bursts remains "anybody's guess," he adds.

With instruments on three spacecraft—the repaired BeppoSAX satellite, the Rossi X-ray Timing Explorer, and the Compton Gamma Ray Observatory—searching for flashes, an answer may not be long in coming. —*R. Cowen*