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Brightening Sun is Warming Earth

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May account for major part of global warming

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There is a better explanation for global warming than air pollution, two Harvard researchers say: the Sun is increasing in brightness and radiance.

"Changes in the Sun can account for major climate changes on Earth for the past 300 years, including part of the recent surge of global warming," claims Sallie Baliunas, an astronomer at the Harvard-Smithsonian Center for Astrophysics (CfA).

"We're not saying that variations in solar activity account for all of the global rise in temperature that we are experiencing," cautions her CfA colleague, astrophysicist Willie Soon. "But we believe these variations are the major driving force. Heat-trapping gases emitted by smokestacks and vehicles -- the so-called greenhouse effect -- appear to be secondary."

If that conclusion proves true, it promises a huge economic and political impact on the "third rock from the Sun." The Clinton Administration is trying to negotiate an international treaty to gradually reduce greenhouse pollutants without bringing economic havoc to industries that satisfy our enormous appetite for the energy that comes from burning oil, coal, and gas.

Other world leaders and environmentalists are pushing for immediate action, but Baliunas thinks there is time to carefully consider what action to take. "The best models of global warming call for a very slow temperature rise of less than two degrees in the next 100 years," she has told various congressional committees and briefings. "There is time for more research and a measured response because the penalty you pay in increased temperatures from greenhouse warming is small."

Anything that's cost-effective to cut emissions can be done right away, Baliunas says. Dramatic cuts with high economic

penalties might be postponed in the expectation that more effective and affordable technologies will become available in the next 25 years or so.

To ease the economic burdens, President Clinton has proposed various incentives. These include offering $5 billion in tax breaks for businesses to conserve energy and to develop new technologies, such as efficient electric cars and fuel cells that burn clean hydrogen. Vice President Al Gore described these incentives last Friday in a talk at the Kennedy School of Government.

A Bright Connection

Baliunas and Soon base their ideas about the cause of global warming on irrefutable evidence that sunlight is getting stronger. Since the late 1970s, three Sun-watching satellites recorded surprising changes in heat, ultraviolet radiation, and solar wind. The radiation alters the paths of winter storms; solar winds affect cloudiness and rainfall.

The increased activity, everyone agrees, is tied to a cycle that sees the Sun dimming, then brightening, every 11 years or so. From the late 1970s to mid-1980s, activity on Earth's star declined. Since then it has risen, declined, then risen again. The satellites measured an increase in brightness of as much as 0.14 percent on the latest rise.

Two unknowns, however, prevent Sun-watchers from making any useable forecasts about the next five years. No one knows why the Sun cycles like it does, or when it will reach its next maximum. The best guess is the year 2000.

Also, a 0.14 percent jump in brightness is not enough to account for the approximately 1 degree F rise in temperature on Earth in the past 100 years. What's more, various observations show that our planet is almost 2 degrees F warmer than it was around the year 1700.

Baliunas quickly points out that the satellite measurements apply to only one cycle, and evidence exists that the estimated jump in brightness over several previous cycles was almost four times as much -- 0.5 percent.

Also, looking elsewhere in the Milky Way reveals larger shifts in brightness of other Sunlike stars. Twenty years ago, when still a Harvard graduate student, Baliunas took over a project that has been recording brightness changes in such stars of between 0.1 and 0.7 percent.

"A change of 0.5 percent in brightness sustained over several past cycles could account for the 2 degree change in climate we have experienced since the beginning of the 18th century," Baliunas maintains. "We don't know if this actually happened, but it indicates that the Sun is a major driver of climate change. We cannot ignore its variations when accounting for the present global warming."

Sun Spots and Storms

What is more, these Baliunas-Soon assumptions consider only brightness changes. Also increasing during the maximum part of solar cycles are invisible but potent ultraviolet rays which heat up Earth's atmosphere and change the paths of winter storms.

This radiation hits oxygen molecules in the upper stratosphere and converts them to ozone. Some 25 miles above our heads, the ozone layer is best known for screening out ultraviolet radiation implicated in skin cancer, cataracts, and crop damage. However, researchers at Harvard's Department of Earth and Planetary Sciences have found that increased amounts of ozone interfere with movement of heat from the equator to the poles. That, in turn, shifts the pattern of jet streams that steer the storms around the planet.

Exactly how this contributes to warming Earth during maximum solar activity, and to cooling it during minimums, remains a mystery. "Our uncertainty is enormous," Soon admits, "but we can't omit ultraviolet forcing as a factor in global warming."

The most striking markers of the Sun's waxings and wanings are the coming and going of black spots on its face. Sunspots mark areas where strong magnetic fields exit and enter the surface of the Sun. They are about a thousand degrees cooler than the bright areas that surround them, but are still incandescently hot.

These spots not only follow an 11-year cycle; they also cycle through longer periods of high and low magnetic activity. When the Sun boasts a maximum of spots, cycle after cycle, Earth tends to be warmer than when its face is clear.

During the years from 1640 to 1720, for example, observers counted abnormally few sunspots and Earth's climate entered a period of unusually cold weather. Since the mid-1960s, solar magnetism has been increasing along with global temperatures.

At such maximums, the wind of magnetic fields and charged particles that normally wafts across the 93 million miles from Sun to Earth blows harder. These gusts can trigger colorful displays of auroral lights during long polar nights. The strongest winds may also disrupt long-range radio communications, cause power outages, and disturb the operation of satellites.

Solar winds also produce radioactive carbon atoms in the atmosphere that eventually rain down and become assimilated into tree rings. High solar winds lead to rings with fewer radioactive atoms and vice versa. Changing levels of radiocarbon provide a natural record of magnetic changes on the Sun that can be matched with weather records of coldings and warmings.

"There have been 19 cold periods in the past 10,000 years and a decrease in solar magnetic activity can be linked to 17 of them," Baliunas notes.

Exactly how this happens remains unknown. It probably involves both changes in energy and variations in electrical charges on drops of water in the atmosphere. The drops provide seeds for the formation of clouds which add to natural and greenhouse warmings.

Neither Baliunas nor Soon ties these changes to El Niño, the periodic warming of the tropical Pacific Ocean that brings mostly unwanted weather changes from India to Indiana. "There is no solar cycle with the same 4-to-7-year period and no known direct connection with changes on the Sun," Baliunas says.

"Over longer periods, both the ultraviolet radiation and the particles in solar winds alter the balance of energy in the atmosphere, affecting the movement of winds," Soon points out. "Together with changes in brightness, these mechanisms must affect longer-term changes in climate. All the records we have of climate tie it to variations in the Sun. It is reasonable to assume that that effect persists at the present time."

No one doubts this; but the magnitude of its influence on global warming remains in question. However, a significant number of researchers insist that solar changes are not great enough to produce the warming we are experiencing. They maintain that human activity is the main cause of rising temperatures that threaten widespread flooding, increased storminess, and potentially disruptive shifts in croplands. It is this group that wants to take immediate action to reduce heat-trapping air pollutants.

Baliunas and Soon maintain that interest in and understanding of solar effects will increase faster than rising temperatures, allowing time to study the Sun-climate relationships.

"But," Baliunas admits, "I am addressing scientific issues. Economic, political, and environmental considerations are quite another story."