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New instruments to plot solar radiation

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The latest instruments to gauge the energy Earth receives from the sun are onboard the International Space Station and expected to begin generating data by April. Scientists say data from the mission could be more important than any other in understanding not only the sun's effects on Earth's climate but people's influence on it as well.

Scientists have been taking measurements of the sun's energy from space continuously since 1978, but that record has been in jeopardy in recent years.

The instruments currently gauging total radiant energy from the sun, plus how the energy is distributed across the electromagnetic spectrum, are 10 years past their projected lifespan. Replacements bound for space in 2011 were lost when NASA's Glory satellite failed to reach orbit.

Staff at the University of Colorado's Laboratory for Atmospheric and Space Physics in Boulder have been putting NASA's existing satellite to sleep each night and manually waking it up each morning — with every orbit — to help preserve its failing battery.

"The value of this record is enhanced by its being continuous," says lead mission scientist Peter Pilewskie, who spoke with Aerospace America prior to the launch of the Total and Spectral Solar Irradiance Sensor, or TSIS-1, which consists of two instruments. "If there's a break, we lose accuracy in the measurements."

The unbroken, nearly 40-year record of total solar irradiance has revealed solar activity occurring in 11-year cycles, with energy output about 0.1 percent greater during a "solar maximum" than in the minimum phase. If that number seems small, consider that the sun is the planet's primary energy source. That 0.1 percent "still represents a lot of energy," Pilewskie says.

The higher energy output during a solar maximum is understood to correlate with temperatures 0.1 degree Celsius warmer. Pilewskie predicts that future data will chart wider swings in solar activity but doesn't think a corresponding temperature spike would absolve humans from having a hand in Earth's warming trend, which has occurred during a less active period for the sun overall.

The total solar irradiance record started as part of the Earth Radiation Budget experiment in 1978, continuing under the Active Cavity Radiometer Irradiance Monitor program. The new hardware includes upgraded versions of the monitors collecting data aboard NASA's Solar Radiation and Climate Experiment satellite.

NASA

▲ **Technicians at the Kennedy Space Center's Space Station Processing Facility** prepared the Total and Spectral Solar Irradiance Sensor-1 instrument in September to be launched to the International Space Station.

TSIS-1's Total Irradiance Monitor, or TIM, intended to extend the 40-year record, is slightly more accurate than its predecessor.

The TIM gathers solar radiation on a little black cone pointed at the sun. Solar energy heats up the sensor. Using electrical power, the instrument heats an identical cone facing away from the sun, determining its solar measurement based on the energy required to do so.

Continuing a 14-year spectral record, the new Spectral Irradiance Monitor, or SIM, works similarly but breaks up the light using a prism and measures wavelengths individually, Pilewskie says. The breakdown is useful in climatology because energy of different wavelengths behaves differently in different parts of the atmosphere.

NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the TSIS-1 project. Under a $90 million contract, the CU-Boulder lab has built and will operate TSIS-1 and distribute its data to the scientific community.

Launched from Kennedy Space Center atop a SpaceX Falcon 9 rocket Dec. 15, TSIS-1 traveled in a reused Dragon cargo capsule to the space station. The flight was SpaceX's first to reuse both a Dragon capsule and first-stage booster rocket.

Pilewskie anticipates that astronauts operating the ISS' robotic arm will install the TSIS-1 solar instruments on an ExPRESS Logistics Carrier platform after Dec. 25, with the first data returned by early April. ★