

Rocket flight to sharpen NASA's study of the sun

September 8 2021



The EVE payload is loaded onto a cart for transport at the White Sands Missile Range. Credit: NASA

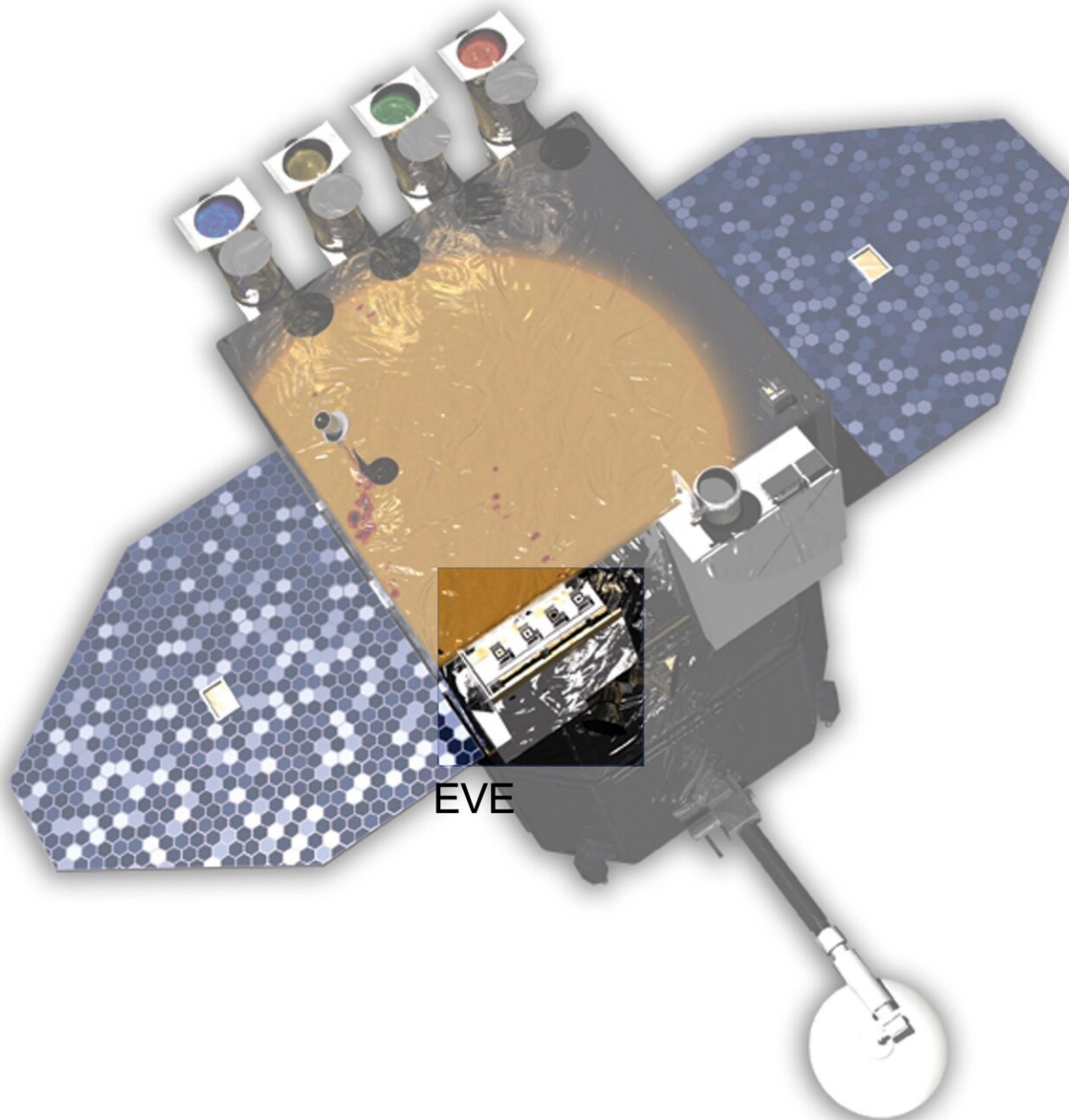
It's best not to look directly at the sun unless you're one of NASA's sun-observing instruments. And even then, doing so will cause some damage. Exposure to the sun degrades light sensors of all kinds, from the retinas in the human eye to instruments aboard NASA's Solar Dynamics Observatory satellite, or SDO. Fortunately, with periodic calibrations, the latter can continue transmitting high-quality data to researchers on Earth.

SDO's Extreme Ultraviolet Variability Experiment, or EVE, uses sounding rockets for calibration. During roughly 15-minute flights, these suborbital rockets carry a duplicate of the EVE instrument about 180 miles above Earth, where it records measurements to keep its twin instrument aboard SDO in tune. Tom Woods, a solar physicist at the Laboratory for Atmospheric and Space Physics at the University of Colorado Boulder, is the principal investigator of the EVE instrument.

The 30-minute launch window for the next EVE calibration flight opens at 11:25 a.m. MT on Sept. 9, 2021, at the White Sands Missile Range in New Mexico.

EVE is a space instrument that measures the sun's extreme ultraviolet light and the namesake for the EVE sounding rocket mission. The sun's activity causes huge variations in outputs of this powerful radiation, which is invisible to our eyes and is absorbed by Earth's atmosphere before it reaches the ground.

Solar flares, for example, unleash massive amounts of extreme ultraviolet light. EVE makes it possible for researchers to keep tabs on the sun in almost [real-time](#). It takes less than a second for SDO data to reach Earth and another 15 minutes for the data to be processed into a usable form.



An illustration of the SDO spacecraft with the EVE instrument highlighted.
Credit: NASA/SDO

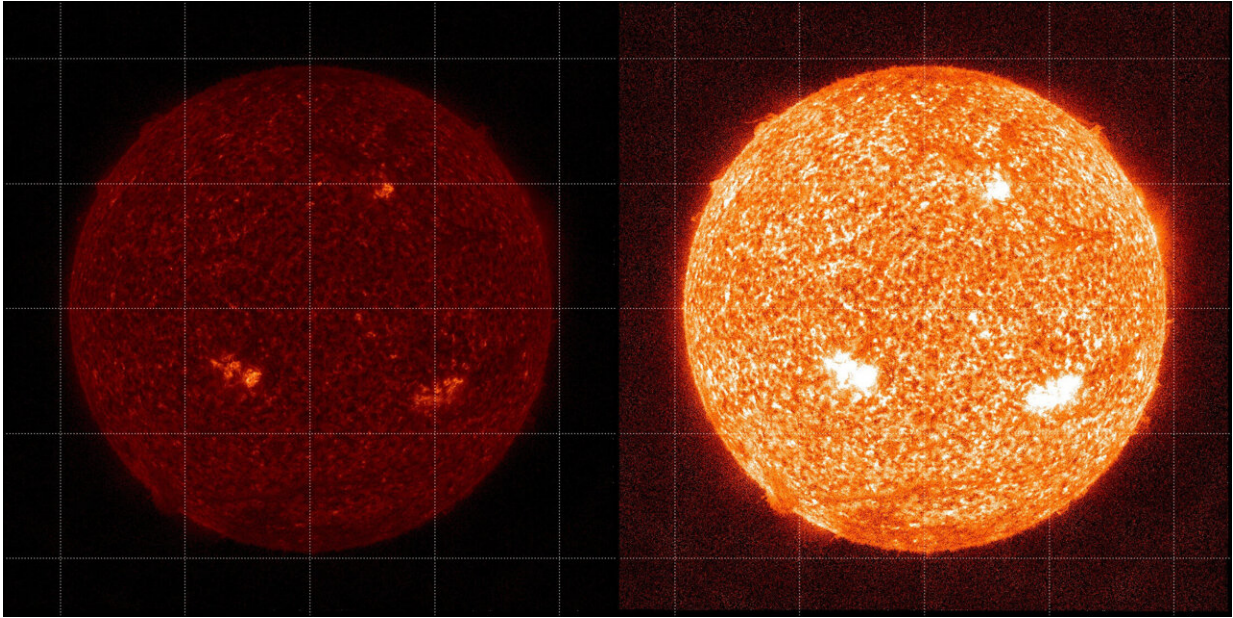
This speed is important because the impacts of this variation can

sometimes be felt on Earth. Bursts of extreme ultraviolet light can disrupt Earth's atmosphere and, as a result, the GPS or radio signals that travel through it. "Part of our science is providing these measurements for the space weather operators who worry about how our communication and [navigation systems](#) could be disrupted due to a solar flare," Woods said.

But solar radiation and the harshness of space degrade EVE's sensors over time. So, Woods' team and NASA send sounding rockets—from the nautical term "sound," meaning to measure—into space to recalibrate EVE and keep the data accurate.

From aboard the sounding rocket, the copy of the EVE instrument measures extreme ultraviolet light before parachuting back down to Earth for reuse. The instrument must be in space to record these measurements because the atmosphere absorbs most ultraviolet light.

Other than its brief and occasional forays into space, the duplicate instrument spends its time on Earth, protected from the harsh space environment and within reach of scientists for tune-ups. By comparing the measurements from this EVE instrument to those from its twin on SDO, researchers can correct for any degradation on the satellite version. The information will be used to validate the calibration of ten instruments aboard other spacecraft as well.



The images show the sun as seen by another SDO instrument, AIA, in 304 Angstrom light in 2021 before degradation correction (left) and with corrections from a sounding rocket calibration (right). Credit: NASA/SDO

After SDO launched in 2010, Woods and his team aimed to recalibrate the instrument every six months or so. Now, they shoot for about once every two years because the rate of degradation slows over time. However, the coronavirus pandemic delayed the last launch, so they are now over the three-year mark. "We're anxious to get this one launched and see how well everything's doing," Woods said. Once they have the new numbers, they will re-run data from the last few years to ensure the most accurate measurements possible.

Between sounding rocket launches, the EVE team also uses weekly calibration measurements from SDO's EVE instrument itself. But, Woods said, those calibrations are not as informative. "It doesn't give you a direct measure of degradation," he said. "The only way to really

nail down that degradation is to do this type of cross-calibration."

The Earth-dwelling EVE is being readied for its tenth trip into [space](#) in 15 years (it started flying before SDO was launched), and new questions are emerging. "How many times can you launch this before something breaks?" Woods said. "Launch vibration is hard on it, the landing is hard on it too."

The exact technology inside EVE isn't available anymore, having been replaced by newer versions, but Woods and his team are building a replacement in case something breaks in the next few years. "It is getting old," he said. "I don't know how many more missions it can survive, but so far—knock on [wood](#)—it's held up so many years already." During that time, it has enabled us to see our sun like never before. Woods hopes it will continue shedding light on the sun's activity for years to come.

Provided by NASA's Goddard Space Flight Center

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