Using a sounding rocket to help calibrate NASA's SDO

May 19 2015, by Karen C. Fox

Artist's concept image of the SDO satellite orbiting Earth. Credit: NASA

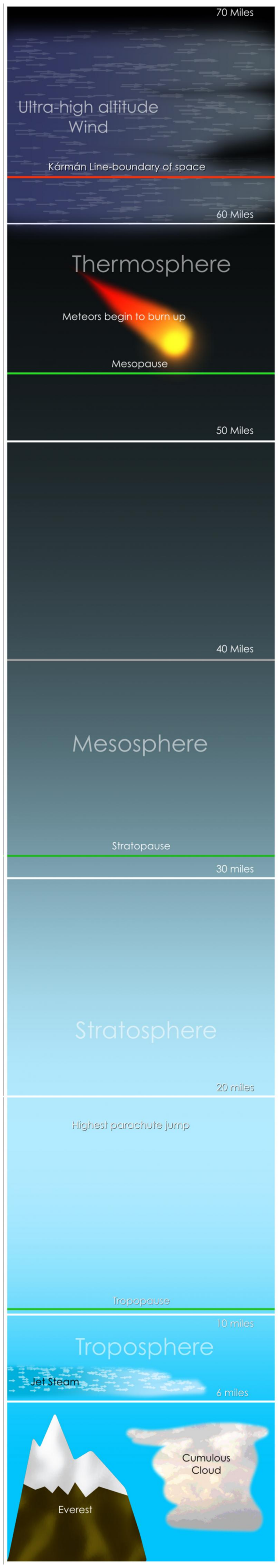
Watching the sun is dangerous work for a telescope. Solar instruments in space naturally degrade over time, bombarded by a constant stream of solar particles that can cause a film of material to adhere to the optics. Decades of research and engineering skill have improved protecting such optics, but one crucial solution is to regularly recalibrate the instruments to accommodate such changes.

In mid-May, the seventh calibration mission for an instrument on NASA's Solar Dynamics Observatory, or SDO, will launch into space onboard a sounding rocket for a 15-minute flight. The instrument to be calibrated is called EVE, short for the EUV Variability Experiment, where EUV stands for extreme ultraviolet. EVE's job is to observe the total energy output of the sun in EUV light waves. The calibration mission is scheduled to launch on May 21, 2015, on a Terrier-Black

Brant suborbital sounding rocket around 3 pm EDT from White Sands Missile Range, New Mexico.

"Parts of the optical coating can darken due to exposure to solar ultraviolet radiation and high energy particles in space, so the sensitivity of the EVE detector decreases over time," said Tom Woods, the principal investigator for this calibration mission as well as for EVE at the University of Colorado in Boulder. "By determining how much the instrument has degraded since last time, we can adjust data processing algorithms to account for that change."

EVE measures the total energy output of the sun, known as irradiance, for each wavelength of light in the extreme ultraviolet range. By tracking the irradiance, scientists can observe how it changes with different events on the sun. None of these wavelengths can penetrate Earth's atmosphere to reach humans on Earth, but each can have a profound effect on the air above our planet. Some of this light energy gets absorbed in the thermosphere, causing it to expand like a balloon when heated, which can create more drag on satellites in space. Other wavelengths of extreme ultraviolet light can have an effect on the composition of the charged ions in Earth's ionosphere, which can hinder radio communications or GPS navigation systems.


70 Miles
Ultra-high altitude Wind
Kármán Line-boundary of space
60 Miles
Thermosphere
Meteors begin to burn up
Mesopause
50 Miles
40 Miles
Mesosphere
Stratopause
30 miles
Stratosphere
20 miles
Highest parachute jump
Tropopause
10 miles
Troposphere
Jet Stream
6 miles
Cumulous Cloud
Everest

Earth's atmosphere consists of different layers made of different particles. The sun emits a variety of wavelengths of extreme ultraviolet light, which can each affect these layers in different ways. Credit: NASA

What's more, the total amount of each kind of light changes in different ways based on what's happening on the sun, including such things as the approximately 11-year solar cycle during which the sun ramps up to a time of more eruptions and magnetic activity - called solar maximum - and back down again to the quiet of solar minimum. While one wavelength of light might increase only by about 60 percent over this solar cycle, another wavelength might grow to be 100 times stronger. As scientists seek to understand how changes on the sun affect our home planet, they need to parse out the details of what causes an increase in the different kinds of light waves.

"We also study irradiance to better understand what types of energy the sun sends out during an eruption like a solar flare," said Woods. "We have used EVE to better categorize the phases of flares—- one of the discoveries is that there are peaks in the extreme ultraviolet emissions that occur one to five hours after the flare appears in X-ray images."

All of this research about events on the sun and potential effects at Earth, depend on accurate measurements of the total solar energy output. This, in turn, leads to the job of calibrating EVE approximately once a year. While launched with EVE in mind, the May sounding rocket will also, in fact, serve as a calibration tool for a number of solar EUV instruments currently in space.

The calibration mission flight lasts for approximately 15 minutes, affording five minutes of prime solar viewing time. Such short sounding rocket flights allow for solid research via relatively low-cost access to space.

Provided by NASA's Goddard Space Flight Center

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