



EUV Variability Experiment (EVE) – Sounding Rocket

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University of Colorado
- PI is Dr. Tom Woods
- The Solar Dynamics Observatory (SDO) was launched on
11 February 2010, and EVE, one of the three solar
instruments aboard SDO, began normal operations on 1
May 2010.
- As part of the planned SDO EVE program, sounding
rockets are flown regularly to provide underflight
calibrations in order to more accurately track instrument
degradation trends.



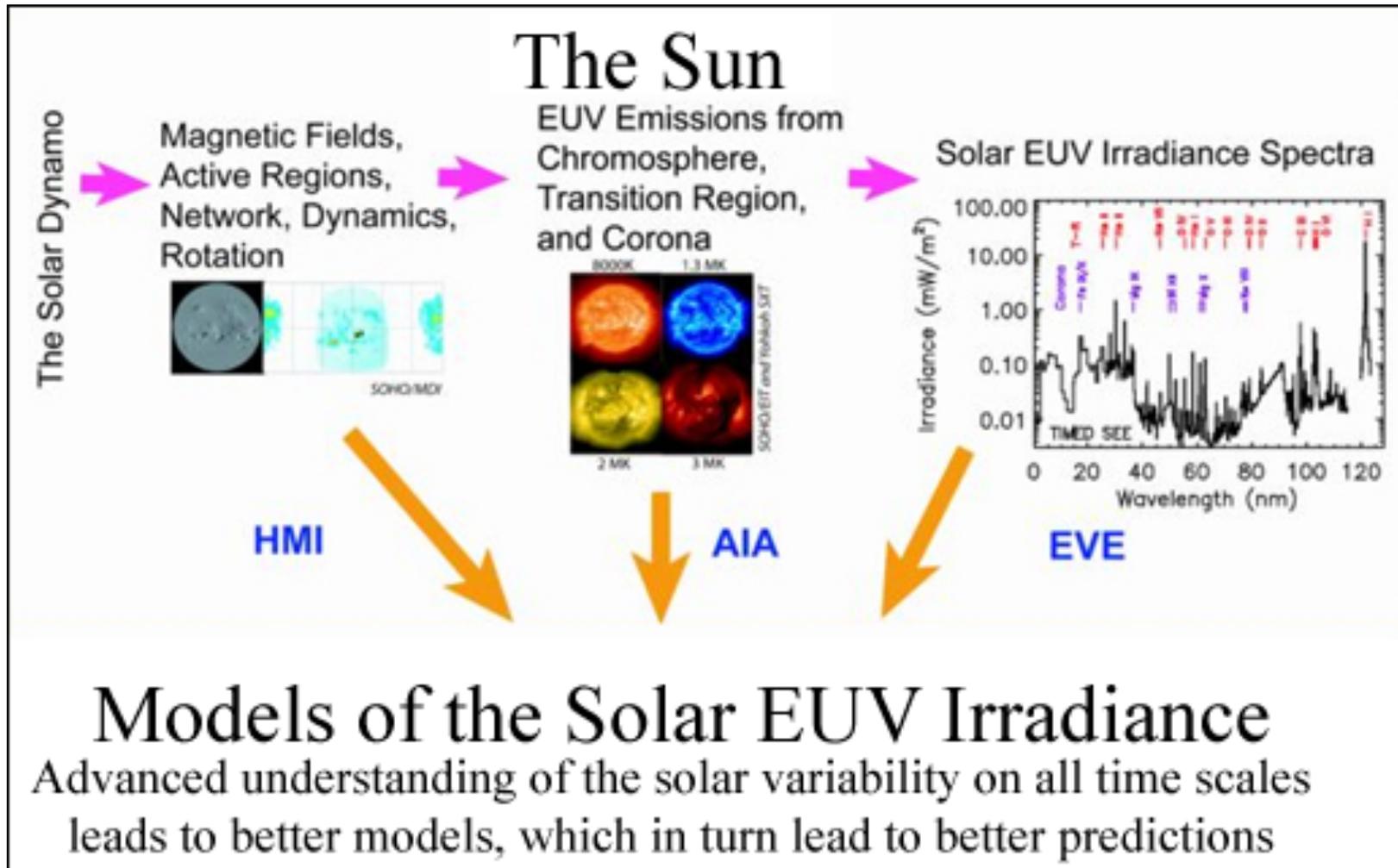


EVE Primary Science Objectives

- Specify the solar extreme ultraviolet (EUV: 0-120 nm) spectral irradiance and its variability on multiple time scales
- Advance current understanding of how and why the solar EUV spectral irradiance varies
- Improve the capability to predict the EUV spectral irradiance variability
- Understand the response of the geospace environment to variations in the solar EUV spectral irradiance and the impact on human endeavors



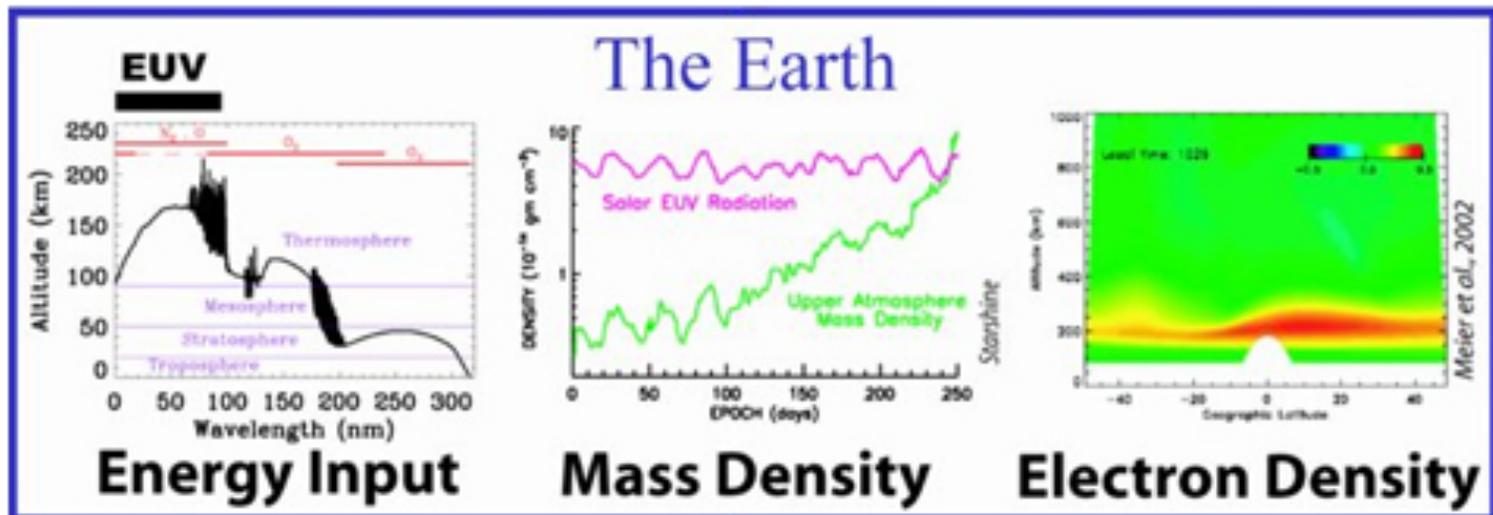
EVE Studies the Solar EUV Irradiance





EVE Connects the Sun to the Earth

Solar EUV Irradiances



Societal Impacts

Solar-induced atmospheric variability include spacecraft drag drag and communication / navigation disruption



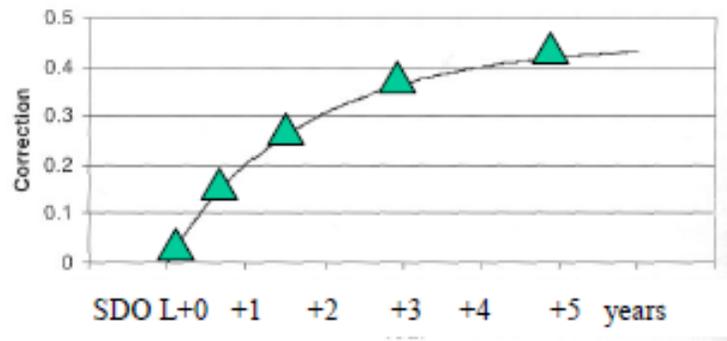
Underflight Calibrations = Sounding Rockets

- **EVE requires an in-flight channel with < 17% degradation between underflight (rocket) calibrations in order to meet the SDO 25% accuracy requirement for the solar EUV irradiance**
 - ESP and MEGS-P are these in-flight channels for MEGS
 - 5 calibration rocket flights are planned to meet SDO accuracy requirement
 - SOHO SEM degradation is good model for estimating frequency of flights



- 1st cal rocket: L+1 month: ASAP after SDO EVE begins solar observations in order to track degradation from last SURF calibration to post SDO launch
- 2nd cal rocket: L+7 months: degradation strongest during early mission
- 3rd cal rocket: L+18 months: decrease launch frequency as degradation rate slows down
- 4th cal rocket: L+3 years
- 5th cal rocket: L+5 y

SOHO SEM
Degradation
Correction



▲ Projected EVE
Cal Rocket Flights



Current Flight (SDO EVE Cal #3)

The next launch of our rocket payload is planned for June 23, 2012 from the White Sands Missile Range (WSMR). This flight's primary purpose is to provide the third underflight calibration for our [SDO EUV Variability Experiment \(EVE\)](#) satellite instrument. The SDO launch was on February 11, 2010, and the first underflight calibration flight was on May 3, 2010 (NASA 36.258) and second flight was on March 23, 2011.

Date / Time

Date: June 23, 2012

Time: 13:00 MDT (window 13:00 - 13:30 MDT)

This is near local noon to minimize the atmospheric absorption of the solar EUV radiation during the rocket observations.

Altitude ~300km

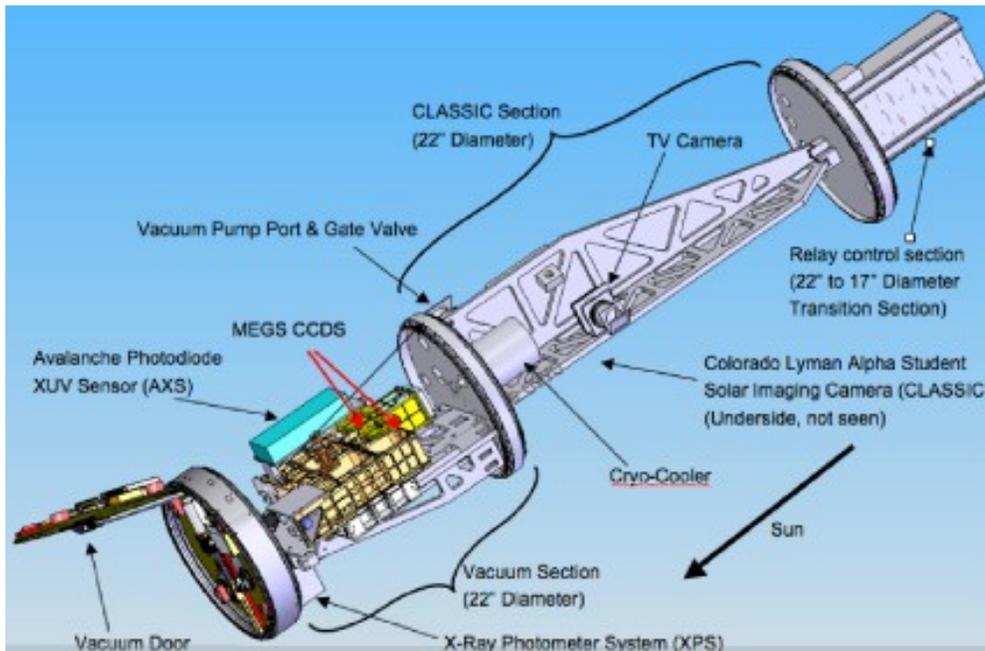
Location

The launch facility is the NASA sounding rocket facility at the [White Sands Missile Range \(WSMR\)](#) in New Mexico.

[NASA Sounding Rocket Operations Contract \(NSROC\)](#) supports this experiment along with their subcontractors at the WSMR Naval Research Rocket Support Office and Physical Science Laboratory (PSL/NMSU).



Payload



The payload was built in 2006 to accommodate the SDO EVE MEGS and ESP channels. This rebuild included larger rocket skins (22 inch diameter instead of 17 inch diameter). The NASA telemetry (TM) subsystem was updated to a 10 Mbps TM system to handle the higher volume of data from the CCDs on MEGS.

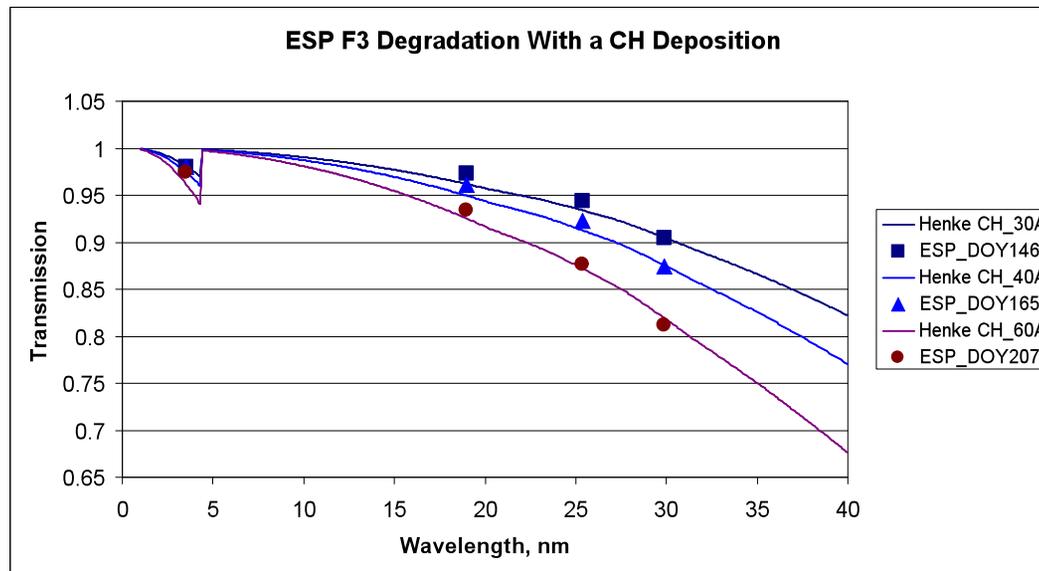
The payload was further updated with additional channels to measure the soft X-ray spectrum where EVE only can measure as a broad band (0.1- 6 nm). These channels includes prototype GOES-R XRS (0.05-0.8 nm, 2 bands), modified EVE-SAM (0.5-5 nm with 0.1 nm resolution), and Amptek X123 (0.05-3 nm, < 0.5 nm resolution). These last two are new for the June 2012 launch to better calibrate the EVE 0.1-6 nm band.



Understanding EVE Instrument Degradation

Filter degradation from hydrocarbon contaminants is seen at a rate of about 10% per year for some of the metal foil filters in EVE MEGS, EVE ESP, and SDO AIA. The underflight calibration rockets provide the required measurements to accurately understand the amount of instrument degradation and thus provide improved solar EUV irradiance results from the satellite version of the SDO EVE instrument.

This calibration rocket for SDO EVE also provides reference EUV spectra that are useful for the calibration of several other satellite instruments: SDO/AIA, TIMED/SEE, SORCE/XPS, SOHO/SEM, SOHO/EIT, SOHO/CDS, Hinode/EIS, Hinode/XRT, STEREO/EUVI, GOES/XRS, GOES/EUVS, GOES/SXI, ISS SOLAR/SOLACES, Proba-2/LYRA, and Proba-2/SWAP



Understanding the wavelength dependent degradation requires accurate underflight calibration rockets