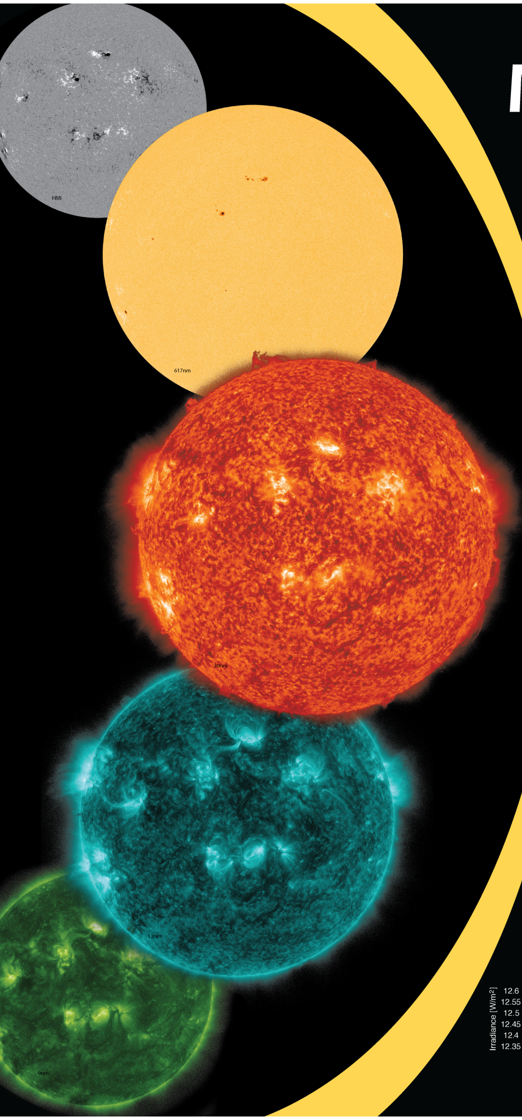

Measuring our changing Sun

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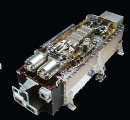
How we measure it

Spectral Irradiance Monitor (SIM)
SIM measures solar spectral irradiance (SSI) daily from 200 nm to 2400 nm. The SORCE SIM incorporates a single optical element, a Féry prism, that disperses the sun light on three photodiodes and an electrical substitution radiometer.



Total Irradiance Monitor (TIM)

TIM measures total solar irradiance (TSI) and consists of four null balance ESR's operating in pairs. The ESR's are thermally balanced in pairs via electric heaters, with one cone exposed to sunlight. The difference in electrical energy required for heating the ESR's can be directly translated to TSI.

Why do we care?

Climate and atmospheric scientists rely on SSI and TSI data records. Changes in TSI inform us about the difference in total solar power received by Earth. SSI helps us to understand where this power will be absorbed in our atmosphere.
Heating of the stratosphere is dominated by UV radiation absorbed by ozone where it influences temperature, circulation, and ozone production. Visible and near infrared radiation is absorbed at Earth's land and ocean surfaces and the lower atmosphere, influencing sea surface temperature, precipitation and cloud response. There are numerous proposed regional effects of Solar variability, e.g.: the Arctic and North Atlantic Oscillations (e.g. Kodera, 2002), El Niño-Southern Oscillation (Kodera, Coughlin and Arakawa, 2007), and the Indian Ocean Monsoon (Kodera, 2004). Furthermore, these measurements are necessary to further quantify the magnitude of anthropogenic contribution to climate change (Solomon et al., 2007).

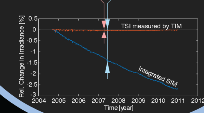
Challenge

SORCE SIM incorporates a single optical element, a Féry prism, that is directly exposed to unfiltered solar radiation. The direct EUV/UV radiation by the Sun photofixes hydrocarbons on the prism which results in changes in the prism transmittance. This degradation is a function of exposure time and wavelength and exceeds 30% in the UV (Béland, Harder and Woods, 2014). Correcting our measurements for this degradation is challenging.

A new correction

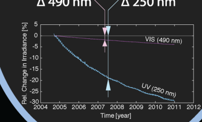
Quantifying the instrument degradation of SORCE SIM is performed by comparing the change in integrated Solar Spectral Irradiance (SIM instrument: **Δ SIM**) to changes in Total Solar Irradiance (TIM instrument: **Δ TIM**)

Δ TIM **Δ SIM**



Attributing the degradation to individual wavelength is performed by comparing the change in irradiance of all wavelengths to each other (for example **Δ 490 nm** to **Δ 250 nm**).

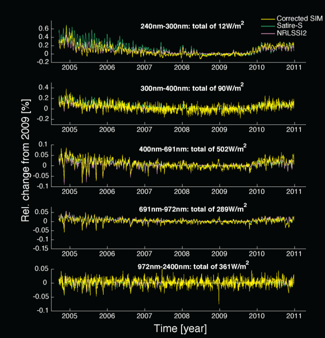
Δ 490 nm **Δ 250 nm**

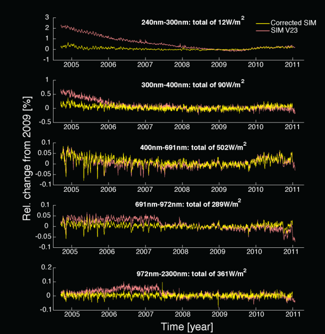


Now we correct the SIM measurements as a function of Time and Wavelength relative to our first observation until the difference between **Δ TIM** and **Δ SIM** is minimized.

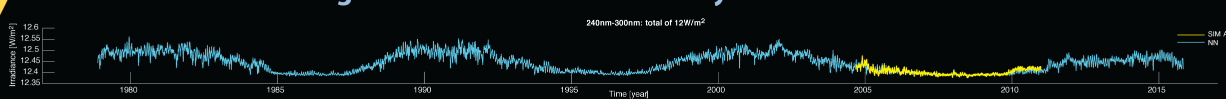
Finally, the data is calibrated with a Solar Irradiance Reference Spectra (SIRS - WHI) (Woods et al., 2009).

How we compare?





Future work: Extending the measurements over 40 years?



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Images:
Solar images: Courtesy of NASA/SDO and the AIA, EVE, and HMI science teams.
Earth image: https://www.pexels.com
Instrument images: http://lasp.colorado.edu/media/projects/SORCE/images

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