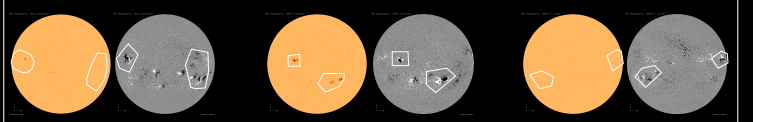
Analyzing Solar Spectral Irradiance (SSI) variability from SIM and Judith Lean's model on a short term scale.

Lois Smith, Mentor: Erik Richard
LASP, University of Colorado, Boulder, CO 80303

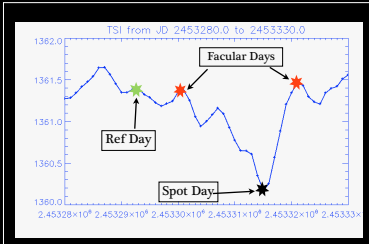
Abstract

As the sun cycles through Solar Minimum to Solar Maximum, the TSI (Total Solar Irradiance) fluctuates based on the presence of sunspots or facular brightening areas on the face of the sun directed towards Earth. While these changes may result in a dip (sunspots) or rise (facular brightening) in TSI, more noticeable changes are observed in the SSI (Solar Spectral Irradiance), which provides information about the solar emission of Ultraviolet, Visible, and Infrared wavelengths. Using data from SIM (Spectral Irradiance Monitor) and TIM (Total Irradiance Monitor) as part of the SORCE project and then using SOHO images corresponding to peak solar activity, SSI and TSI were compared over specific periods of about three weeks starting from January 2004 to present time. Two facular brightening days, one sunspot day, and a reference day of a quiet sun were selected for each of these comparisons. Moreover, the SIM data from 200 nm to 1600 nm was contrasted with data from Judith Lean's SSI models, also on a short term time frame. Although the integrated SSI between SIM data and Judith Lean's models is generally consistent, the spectral irradiance values vary, at some points up to .2%. SIM data and Judith Lean's SSI models were compared using different time of year and wavelength range parameters in order to fully capture the minute differences between the two data sets.

SOHO Images For November 2004[1]



First Facular Day | Sunspot Day | Second Facular Day



TSI values for November 2004

(W/m²)

First Facular Day: October 22, 2004

Spot Day: November 4, 2004

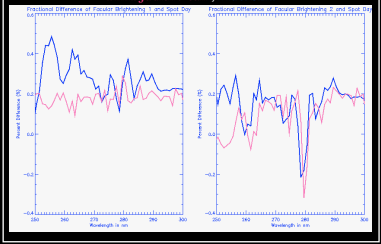
Second Facular Day: November 11, 2004

Reference Day: October 12, 2004

Fractional Difference

When comparing the two data sets, the fractional difference gives the percent difference of the absolute power for a certain wavelength range (during a specific time frame).

Fractional Difference at 250 to 300 nm
Pink: Judith Lean[2], Blue: SIM



Conclusions

For the November 2004 time interval, the fractional differences between Judith Lean's SSI models and SIM data at specific wavelength ranges were:

From 250 to 300 nm:
Facular Day 1: 4.86%
Sunspot Day: 4.78%
Facular Day 2: 4.81%

From 500 to 700 nm:
Facular Day 1: .773%
Sunspot Day: .797%
Facular Day 2: .775%

From 1200 to 1600 nm:
Facular Day 1: 2.38%
Sunspot Day: 2.39%
Facular Day 2: 2.41%

Judith Lean's model compared to SIM data on the entire spectrum from 200 to 1600 nm has only a .2% fractional difference. Therefore, further examination and testing of both the model and SIM data should occur to find the correlations and where the two data sets are incongruous.

Sources

1. "The SOHO Archive." Solar and Heliospheric Observatory Homepage. NASA. Web. 02 Aug. 2010. <http://sohowww.nascom.nasa.gov/data/archive.html>.
2. Lean, Judith. Evolution of the Sun's Spectral Irradiance Since the Maunder Minimum. 16th ed. 27 vols. Geophysical Research Letters. Web. 03 Aug. 2010.