SOLAR SPECTRAL IRRADIANCE: MEASUREMENTS VS MODEL

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SORCE (Solar radiation and climate experiment)
Photo credit: NASA

SIM (Spectral Irradiance Monitor)
Photo credit: LASP
**SIM & NRLSS12**
(Spectral irradiance monitor) and (Naval Research Laboratory Solar Spectral Irradiance)

**HOW SIM WORKS**

- [Diagram showing the process]

**NRLSS12 vs. SIM SSI at SD 453.6**

**SD**: Source Day  
**SSI**: Solar Spectral Irradiance – power density at a particular wavelength

Photo cred: LASP
INITIAL GRAPHS

Constant SD of 453, Wavelength vs. Irradiance

Constant Wavelength of 280nm, Source Day vs. Irradiance
Equation 1: prism_{deg} = (1-a) * \exp(-k*\text{sol}_{exp}*f') + a*\exp(-k*\text{sol}_{exp}*(f'/2))

Equation 2: prism_{deg} = \frac{\text{SIM uncorr}_{irr}}{\text{NRLSSI2}_{irr}}

- \text{sol}_{exp} = \text{solar exposure of the channel}
- a = \text{attenuation of light to the properties of the material through which light is traveling}
- k = \kappa; \text{function of wavelength; describes the properties of the prism due to the deposition of the hydrocarbons}
- F' = \text{function of time and wavelength; describes the changing properties of the prism}
METHODOLOGY

- Adjust units
- Interpolate
- Convolve

Method 1: Alter F function

\[
prism_{\text{deg}} = (1-a) \cdot \exp(-k \cdot \text{sol}_{\text{exp}} \cdot f') + a \cdot \exp(-k \cdot \text{sol}_{\text{exp}} \cdot (f'/2))
\]

\[
prism_{\text{deg}} = \frac{\text{SIM uncorr}_{\text{irr}}}{\text{NRLSSI2}_{\text{irr}}}
\]

Method 2: Alter Kappa

\[
prism_{\text{deg}} = (1-a) \cdot \exp(-k \cdot \text{sol}_{\text{exp}} \cdot 1) + a \cdot \exp(-k \cdot \text{sol}_{\text{exp}} \cdot (1/2))
\]

\[
prism_{\text{deg}} = \frac{\text{SIM uncorr}_{\text{irr}}}{\text{NRLSSI2}_{\text{irr}}}
\]
RESULTS : ALTER F FUNCTION

- A negative $f$ function indicates that: $\text{NRLSSI2} < \text{SIM irradiance}$
- A positive $f$ function indicates that: $\text{NRLSSI2} > \text{SIM irradiance}$
- A $f$ function of 0.0 indicates that: $\text{NRLSSI2} = \text{SIM irradiance}$
A negative $f$ function indicates that: $\text{NRLSSI2} < \text{SIM}$ irradiance
A positive $f$ function indicates that: $\text{NRLSSI2} > \text{SIM}$ irradiance
A $f$ function of 0.0 indicates that: $\text{NRLSSI2} = \text{SIM}$ irradiance
RESULTS: ALTER KAPPA

- A negative kappa indicates that: NRLSSI2 < SIM irradiance
- A positive kappa indicates that: NRLSSI2 > SIM irradiance
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A negative kappa indicates that: NRLSSI2 < SIM irradiance
A positive kappa indicates that: NRLSSI2 > SIM irradiance
A kappa of 0.0 indicates that: NRLSSI2 = SIM irradiance
PRISM DEGRADATION

When prism degradation equals 1.0: NRLSSI2 = SIM

\[ \text{prism}_{deg} = \frac{\text{SIM} \cdot \text{uncorr}_{irr}}{\text{NRLSSI2}_{irr}} \]
ACCURACY OF CALCULATIONS

\[
\text{SIM corr}_{irr} = \frac{\text{SIM uncorr}_{irr}}{\text{prism}_{deg}}
\]
SOURCES OF ERROR

- OBC period of shutdown
  - Shifting of hardware (epoxy)
  - ~15 events
- DO-OP (since 2014)
  - Change in temperature
- Photo diode
  - temp changes from do-op
  - bombardment of high energy particles
- Vacation
  - July 2013 to February 2014
- Quiet Sun
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