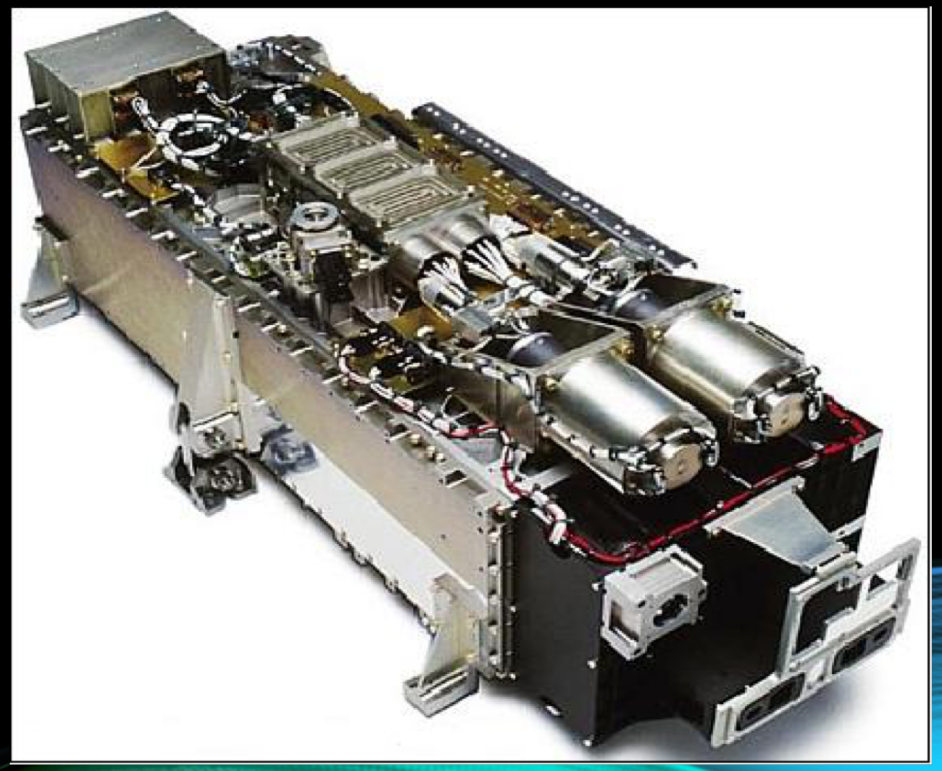
SOLAR SPECTRAL IRRADIANCE: MEASUREMENTS VS MODEL

BY: BAILEY DONALDSON – UNIVERSITY OF COLORADO BOULDER
MENTORS: LAURA SANDOVAL AND STEPHANE BELAND - LASP

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



SIM (Spectral Irradiance Monitor)
Photo credit: LASP

SIM & NRLSSI2

(Spectral irradiance monitor) and (Naval Research Laboratory Solar Spectral Irradiance)

HOW SIM WORKS

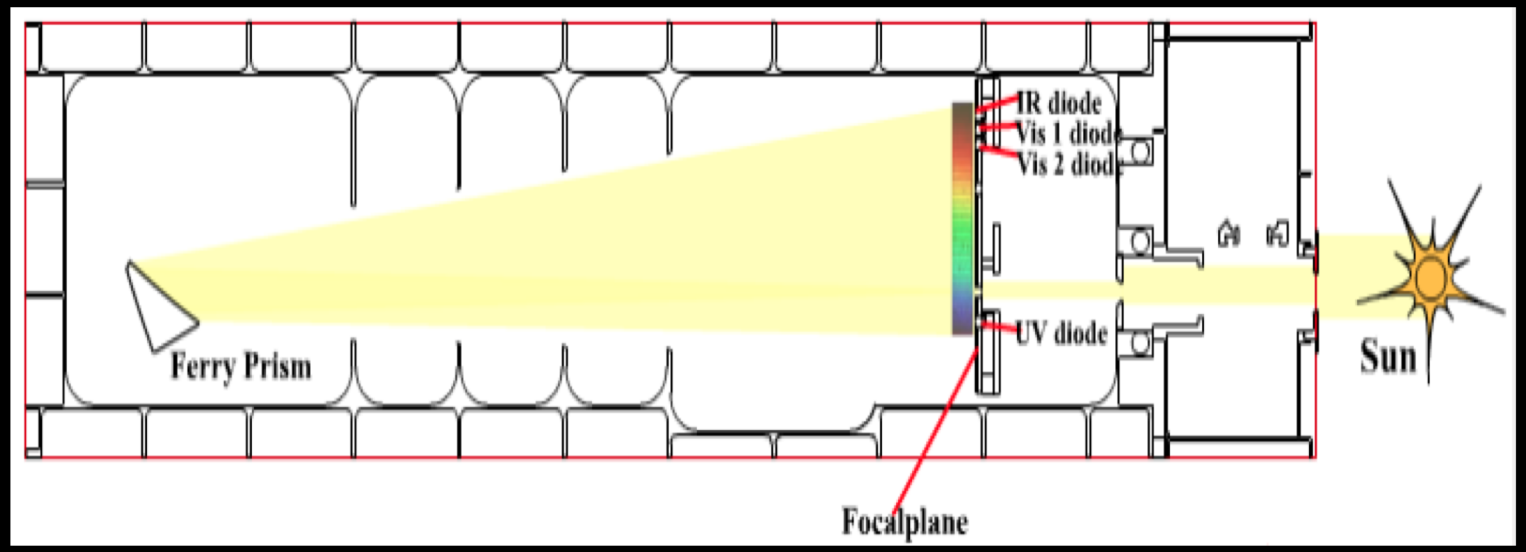
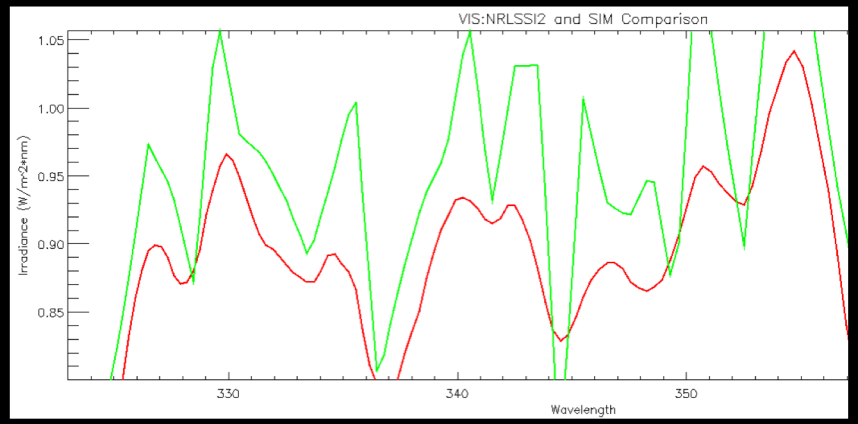


Photo cred: LASP

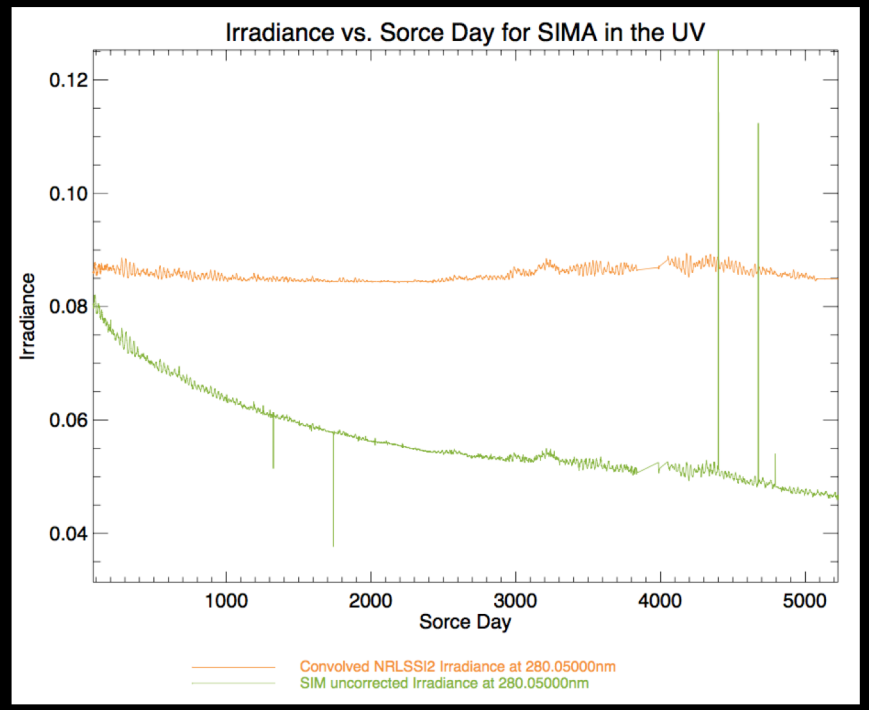
NRLSSI2 vs. SIM SSI at SD 453.6



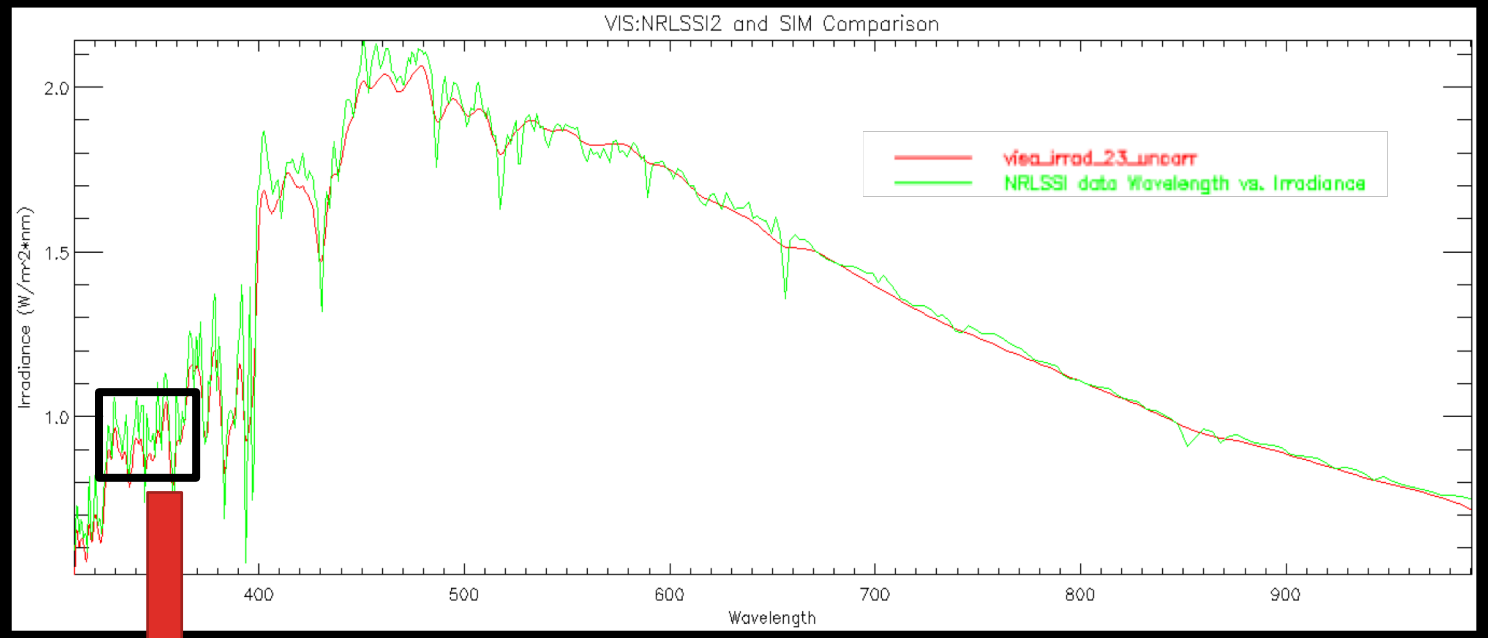
SD: Sorce Day
SSI: Solar Spectral Irradiance – power density at a particular wavelength

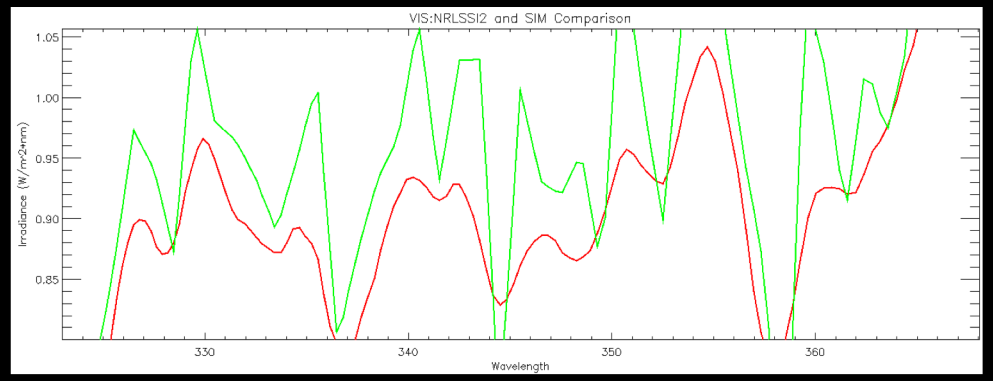
INITIAL GRAPHS

Constant Wavelength of 280nm, Sorce Day vs. Irradiance



Constant SD of 453, Wavelength vs. Irradiance





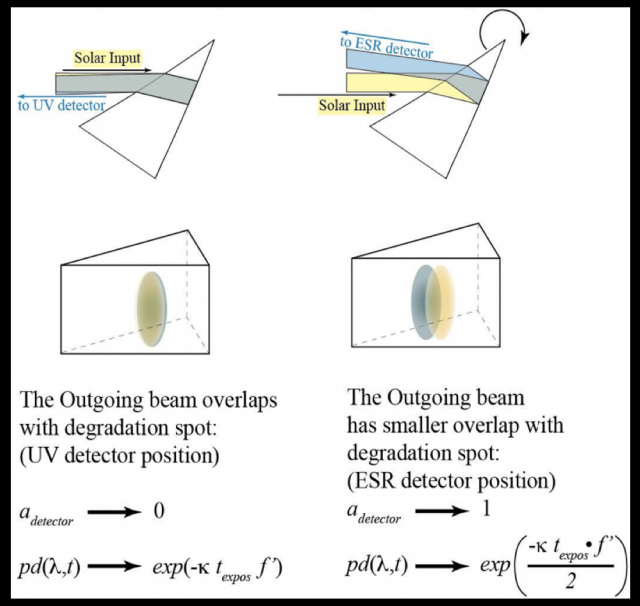
PRISM DEGRADATION

Equation 1: $prism_{deg} = (1-a) * exp(-k*sol_{exp}*f') + a*exp(-k*sol_{exp}*(f'/2))$

Equation 2: $\mathrm{prism}_{deg} = \frac{\mathrm{SIM\ uncorr}_{irr}}{\mathrm{NRLSSI2}_{irr}}$

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

FERRY PRISM



METHODOLOGY

- **Adjust units**
- **Interpolate**
- **Convolve**

Method 1: Alter F function

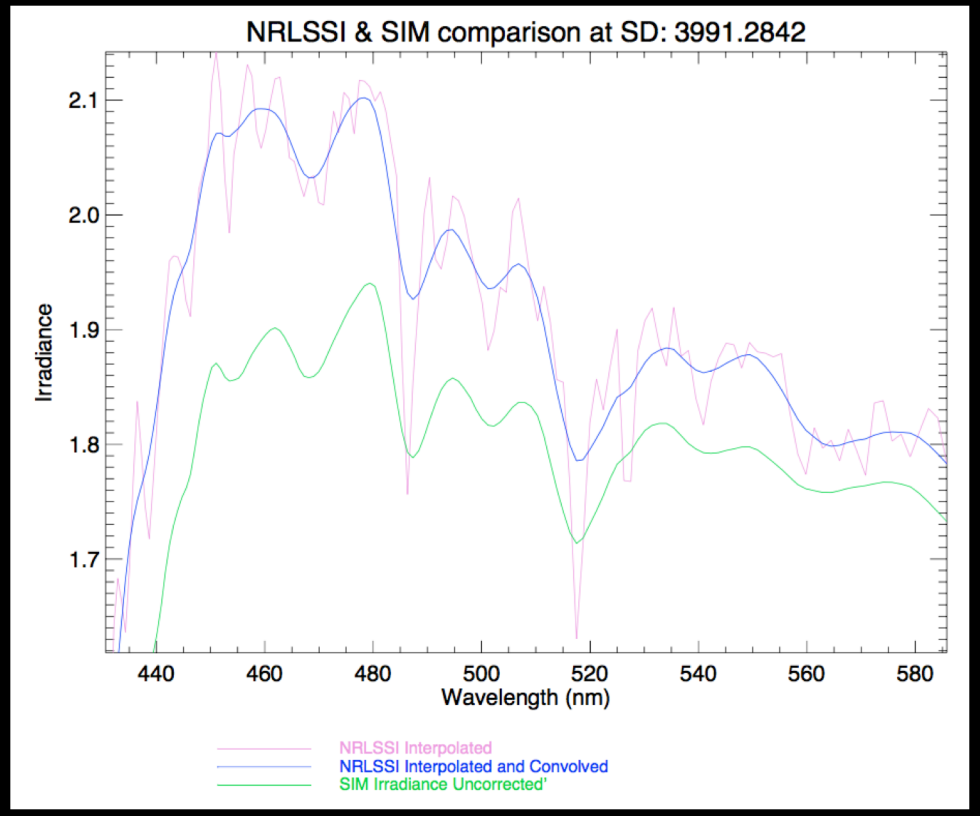
$$prism_{deg} = (1\text{-}a) * \exp(-k*sol_{exp}*f') + a*\exp(-k*sol_{exp}*(f'/2))$$

$$prism_{deg} = \frac{SIM\ uncorr_{irr}}{NRLSSI2_{irr}}$$

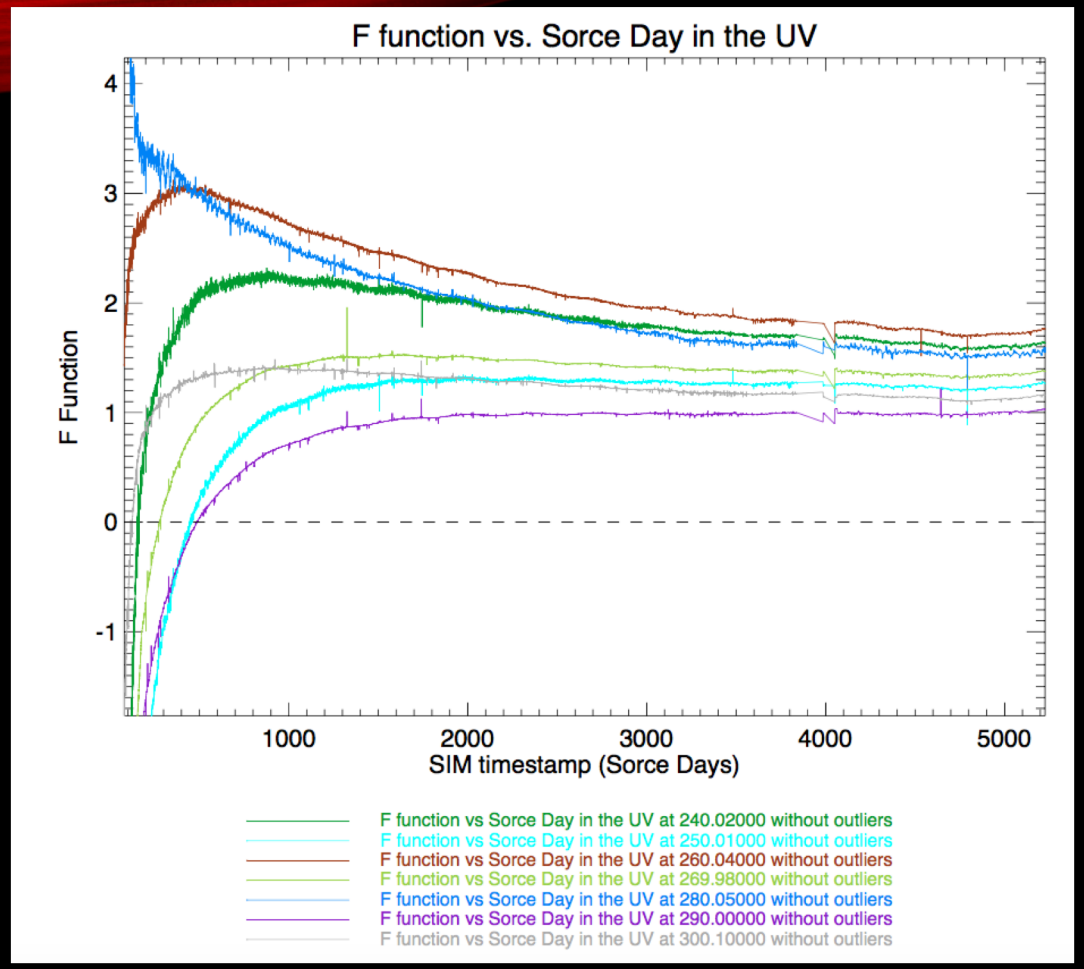
Method 2: Alter Kappa

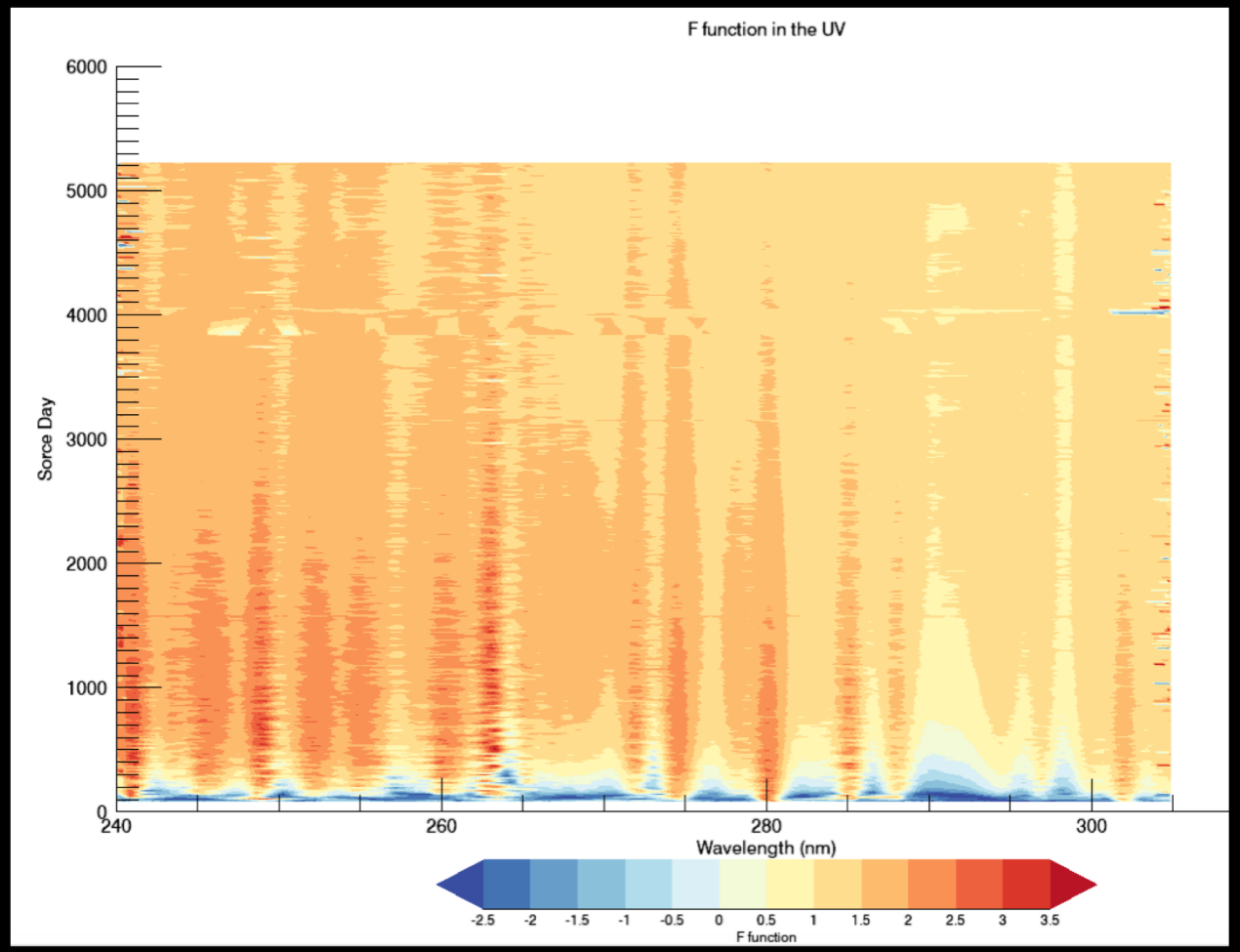
$$prism_{deg} = (1\text{-}a) * \exp(-k*sol_{exp}*1) + a*\exp(-k*sol_{exp}*(1/2))$$

$$prism_{deg} = \frac{SIM\ uncorr_{irr}}{NRLSSI2_{irr}}$$



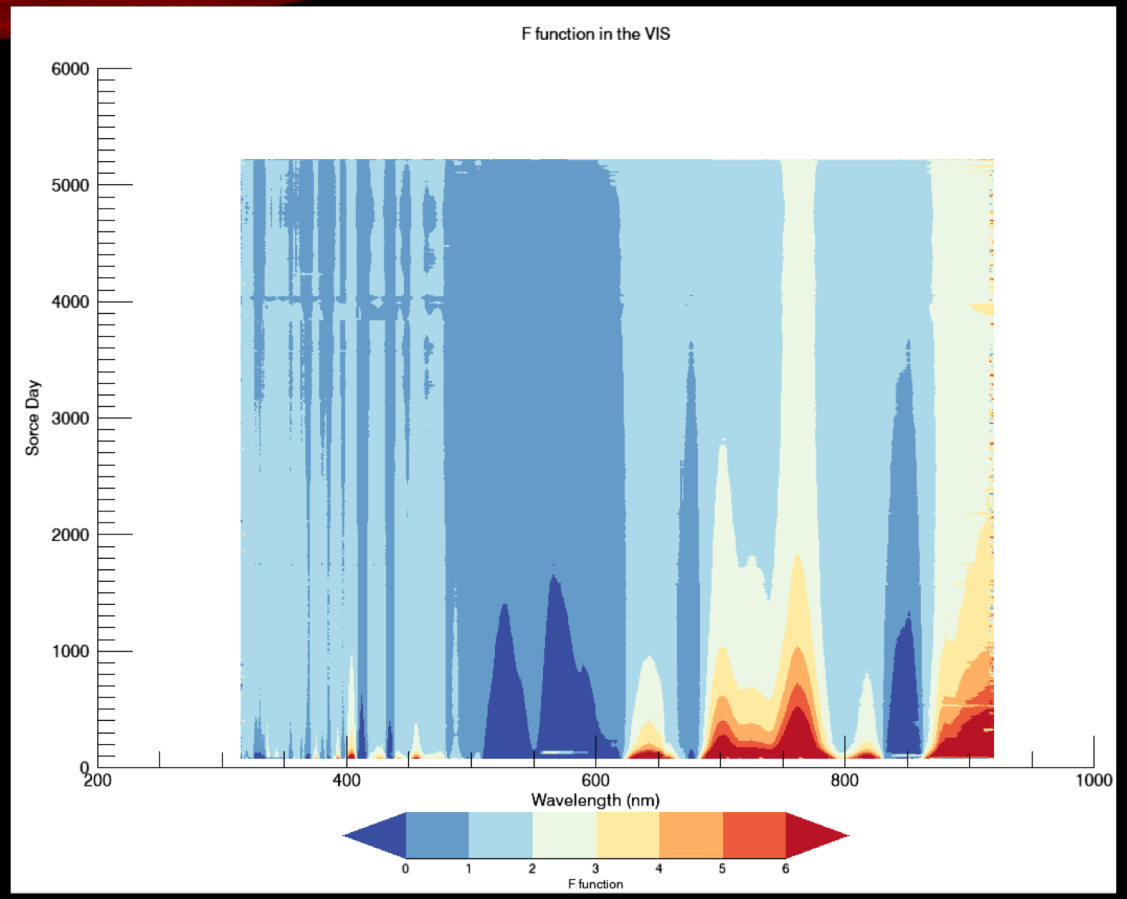
RESULTS : ALTER F FUNCTION

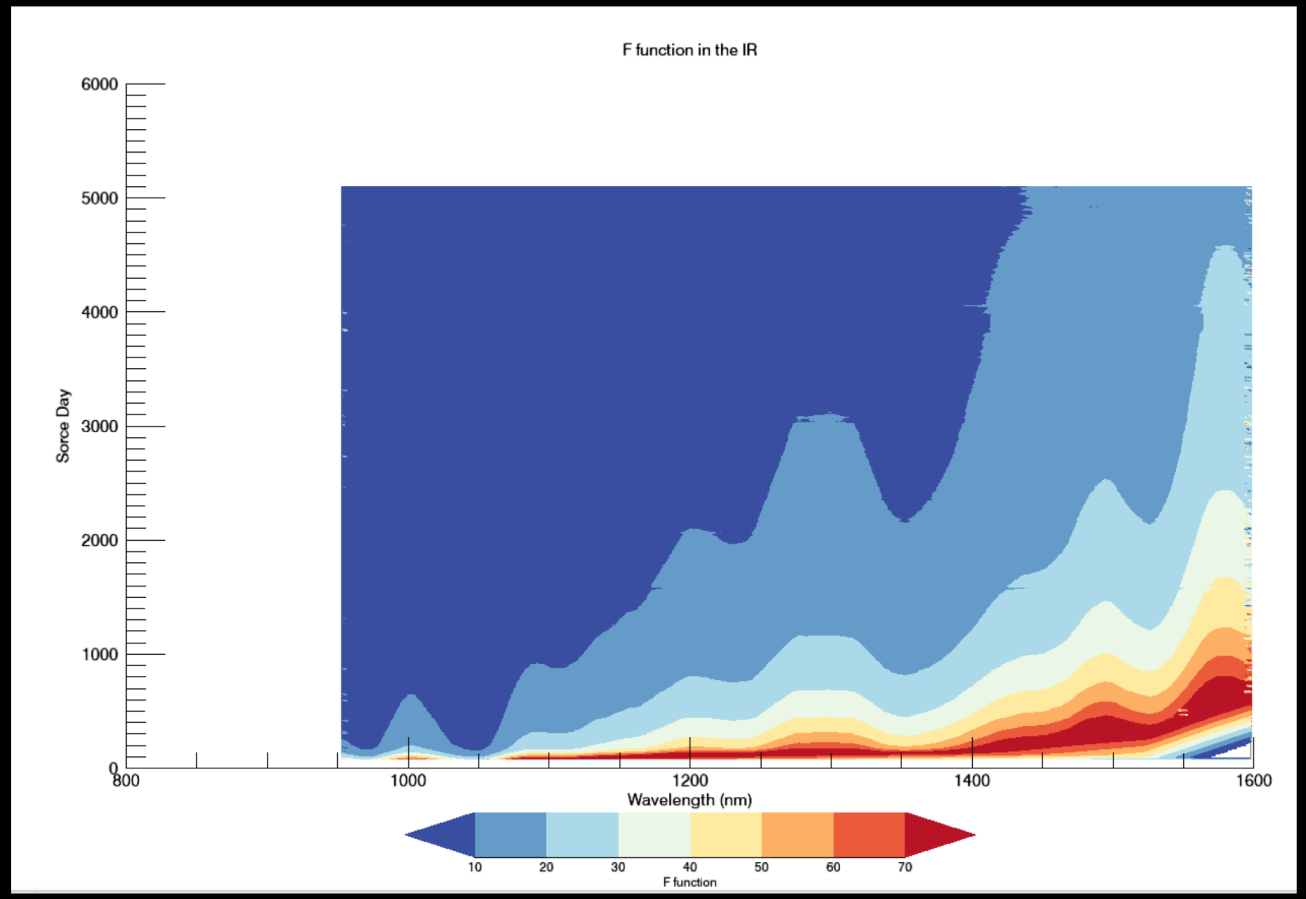




- A negative f function indicates that: NRLSSI2 < SIM irradiance
- A positive f function indicates that: NRLSSI2 > SIM irradiance
- A f function of 0.0 indicates that: NRLSSI2 = SIM irradiance

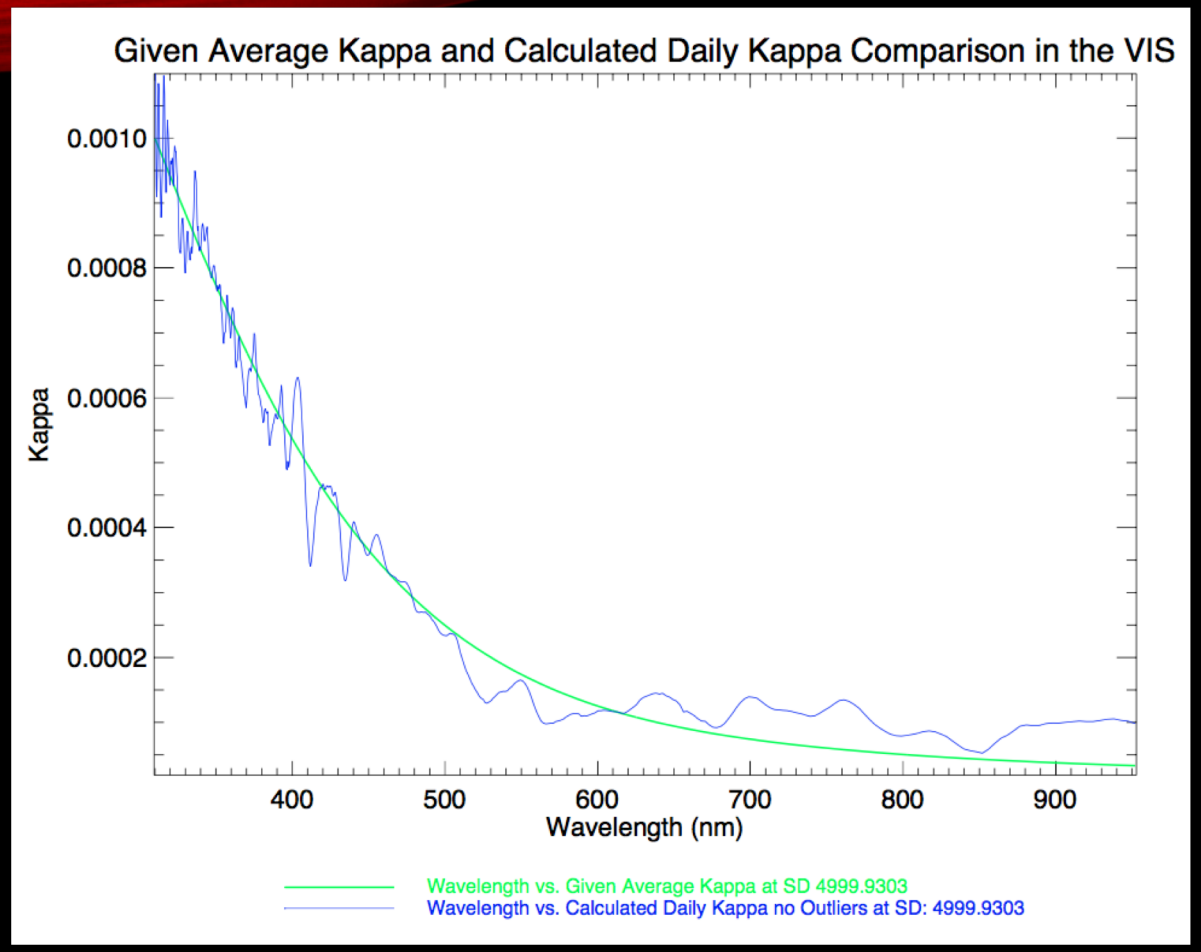
F FUNCTION GRAPHS CONTINUED

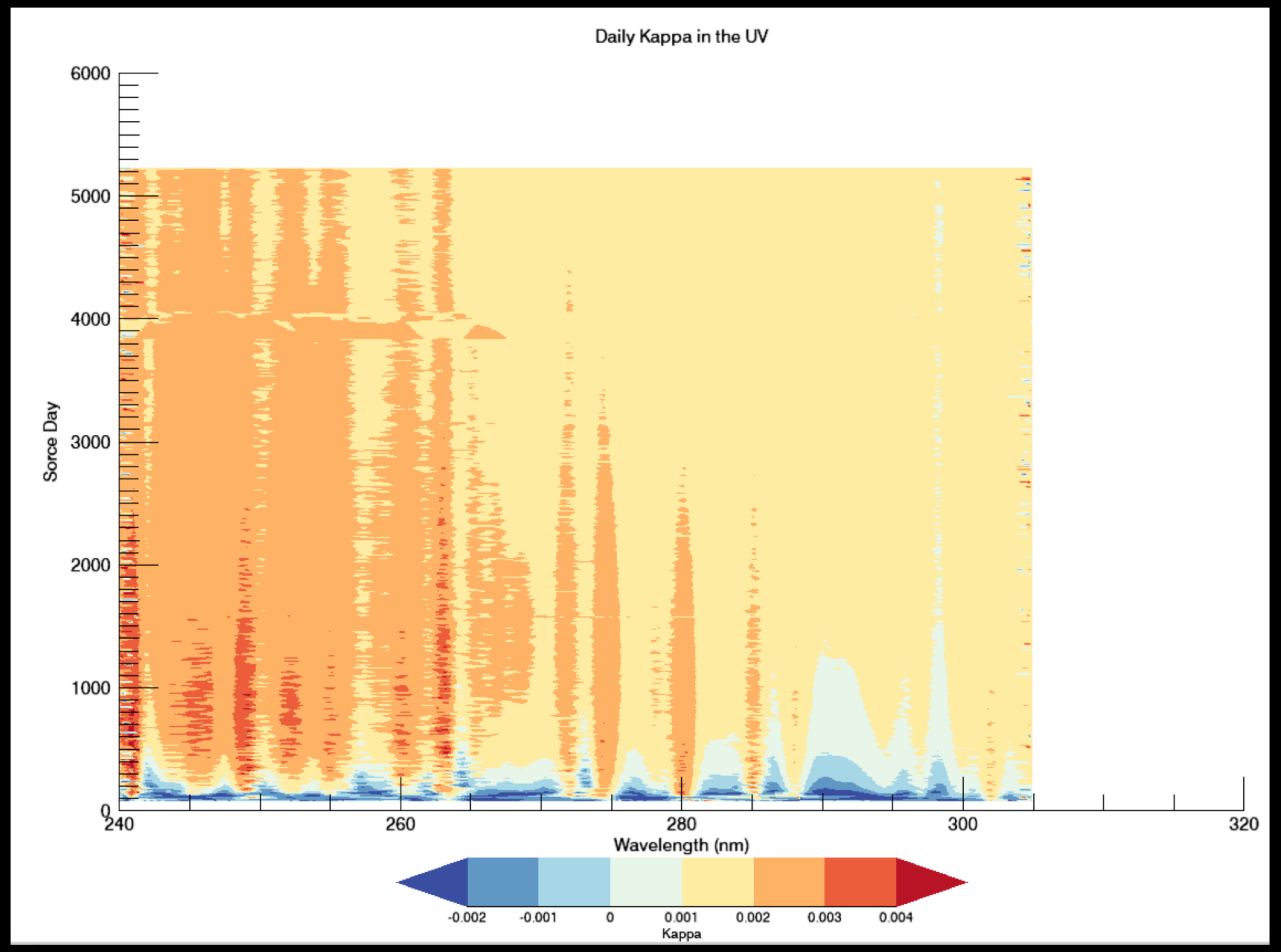




- A negative f function indicates that: NRLSSI2 < SIM irradiance
- A positive f function indicates that: NRLSSI2 > SIM irradiance
- A f function of 0.0 indicates that: NRLSSI2 = SIM irradiance

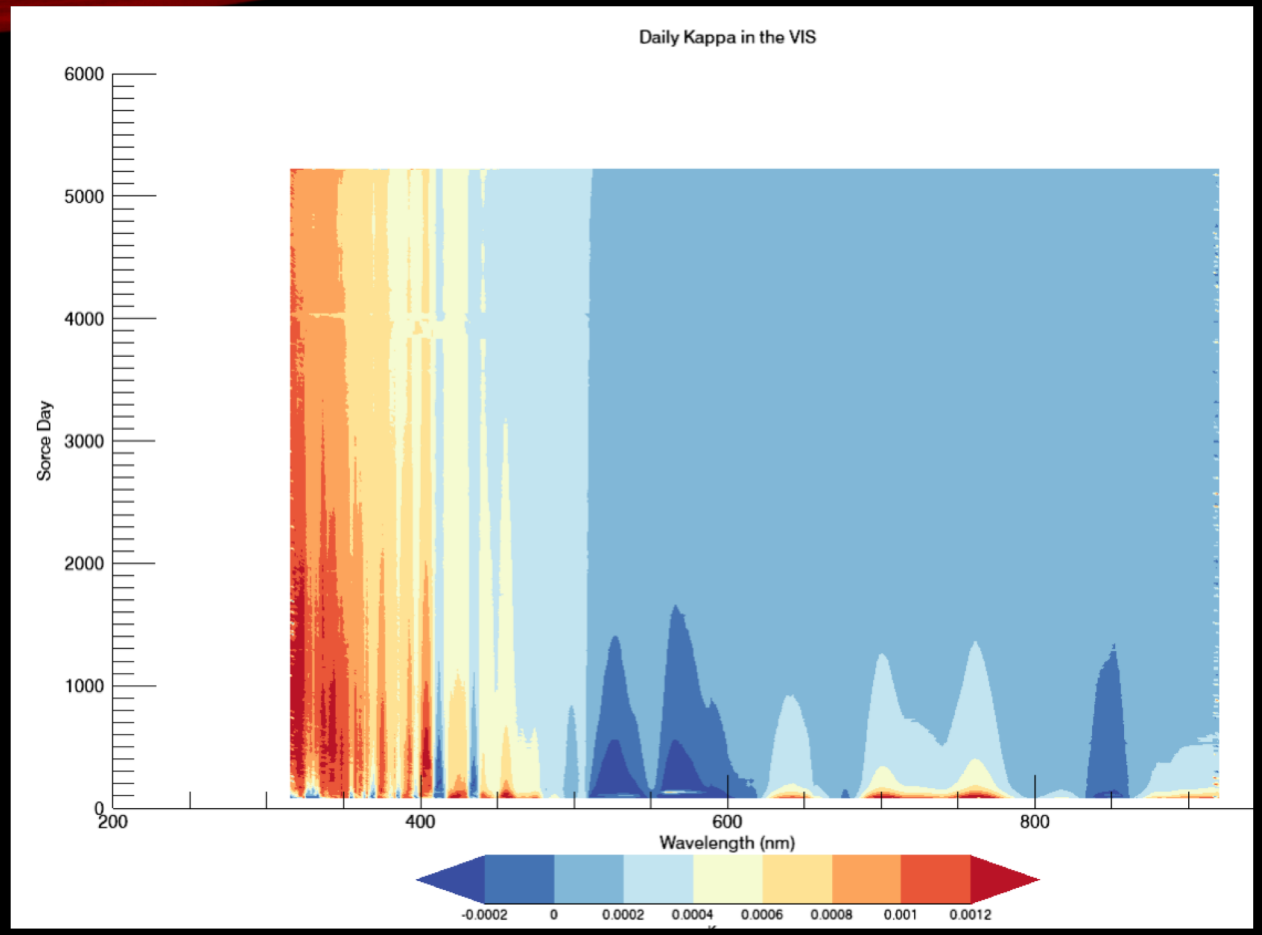
RESULTS: ALTER KAPPA

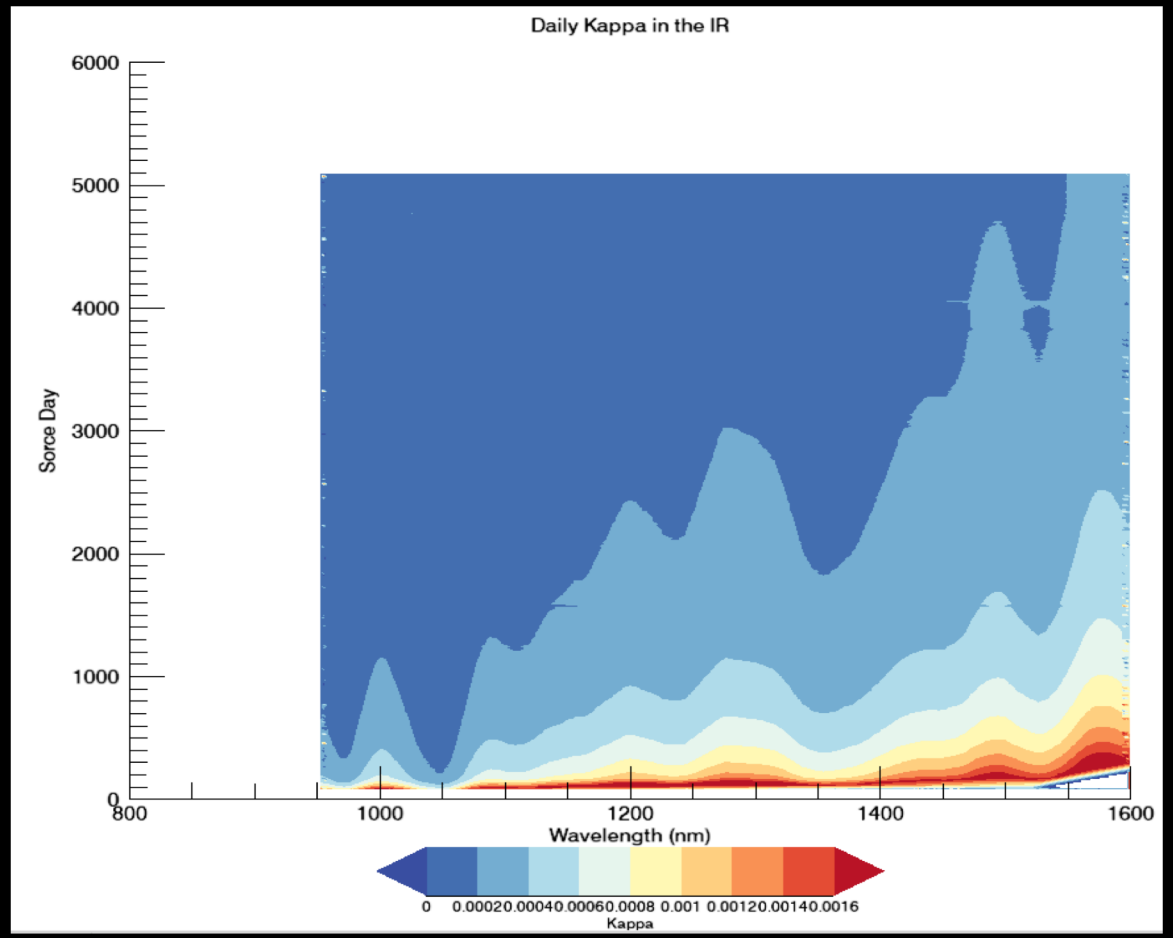




- A negative kappa indicates that: NRLSSI2 < SIM irradiance
- A positive kappa indicates that: NRLSSI2 > SIM irradiance
- A kappa of 0.0 indicates that: NRLSSI2 = SIM irradiance

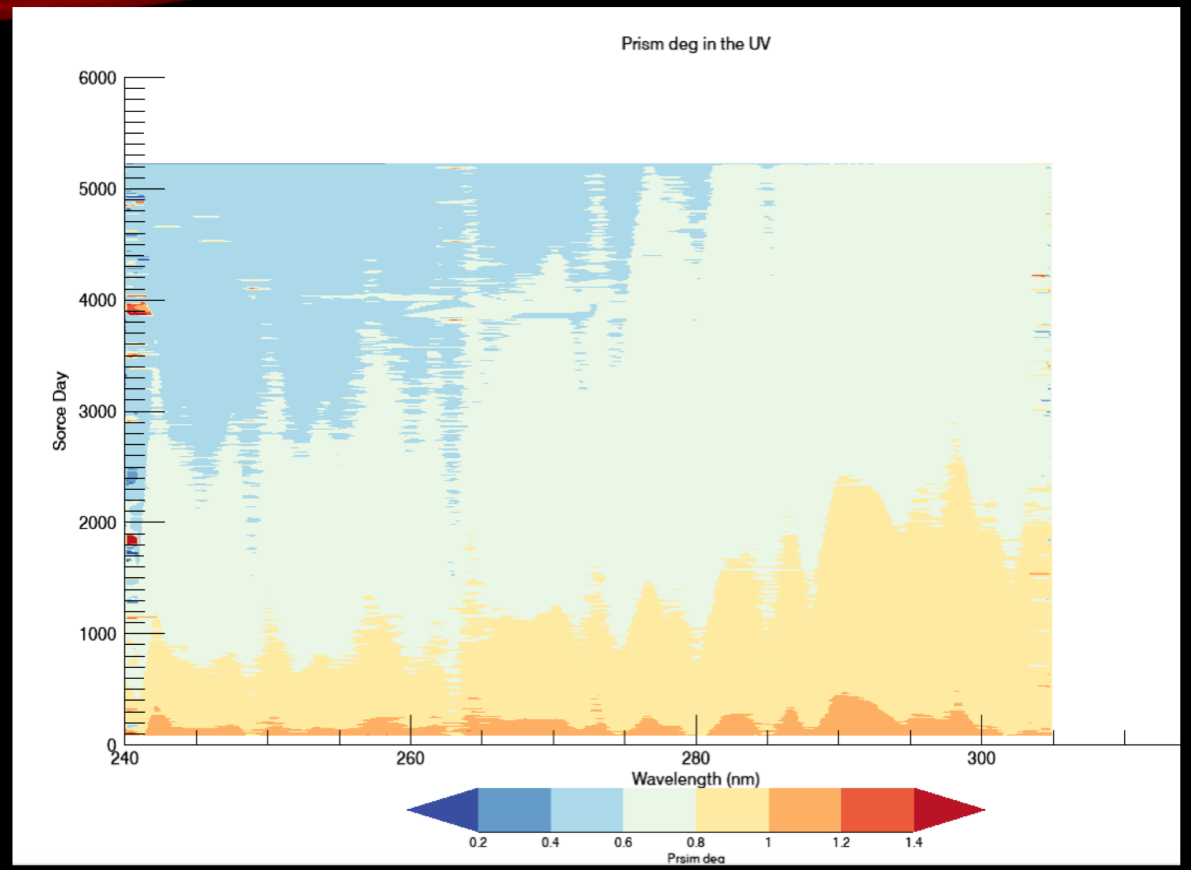
KAPPA PLOTS CONTINUED

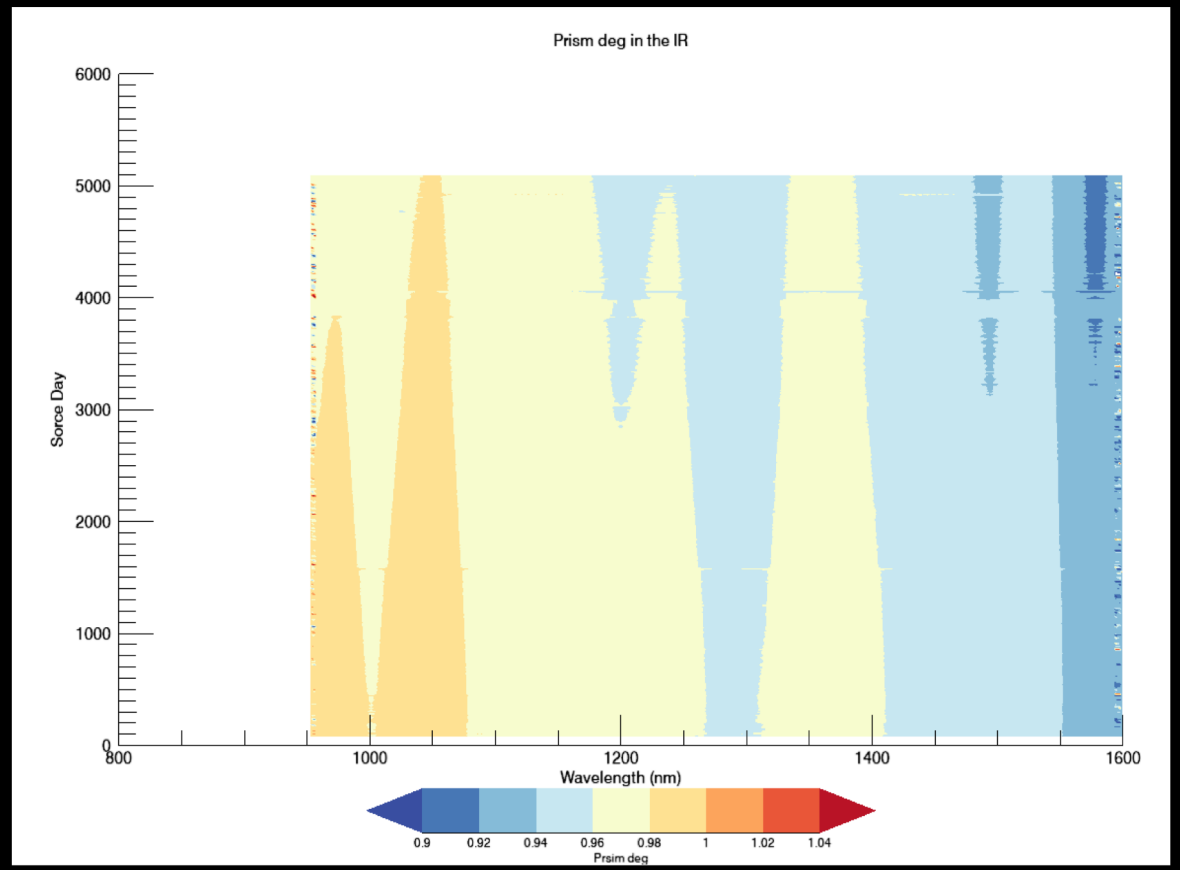




- A negative kappa indicates that: NRLSSI2 < SIM irradiance
- A positive kappa indicates that: NRLSSI2 > SIM irradiance
- A kappa of 0.0 indicates that: NRLSSI2 = SIM irradiance

PRISM DEGRADATION



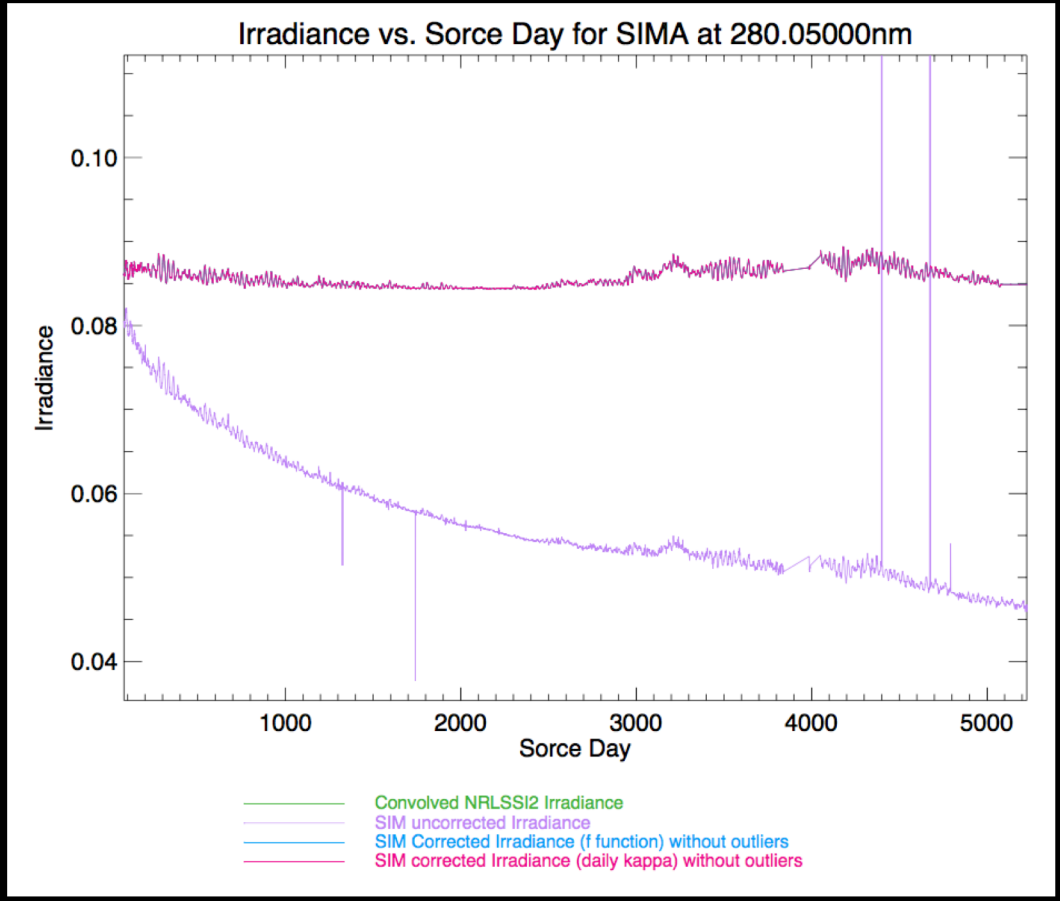


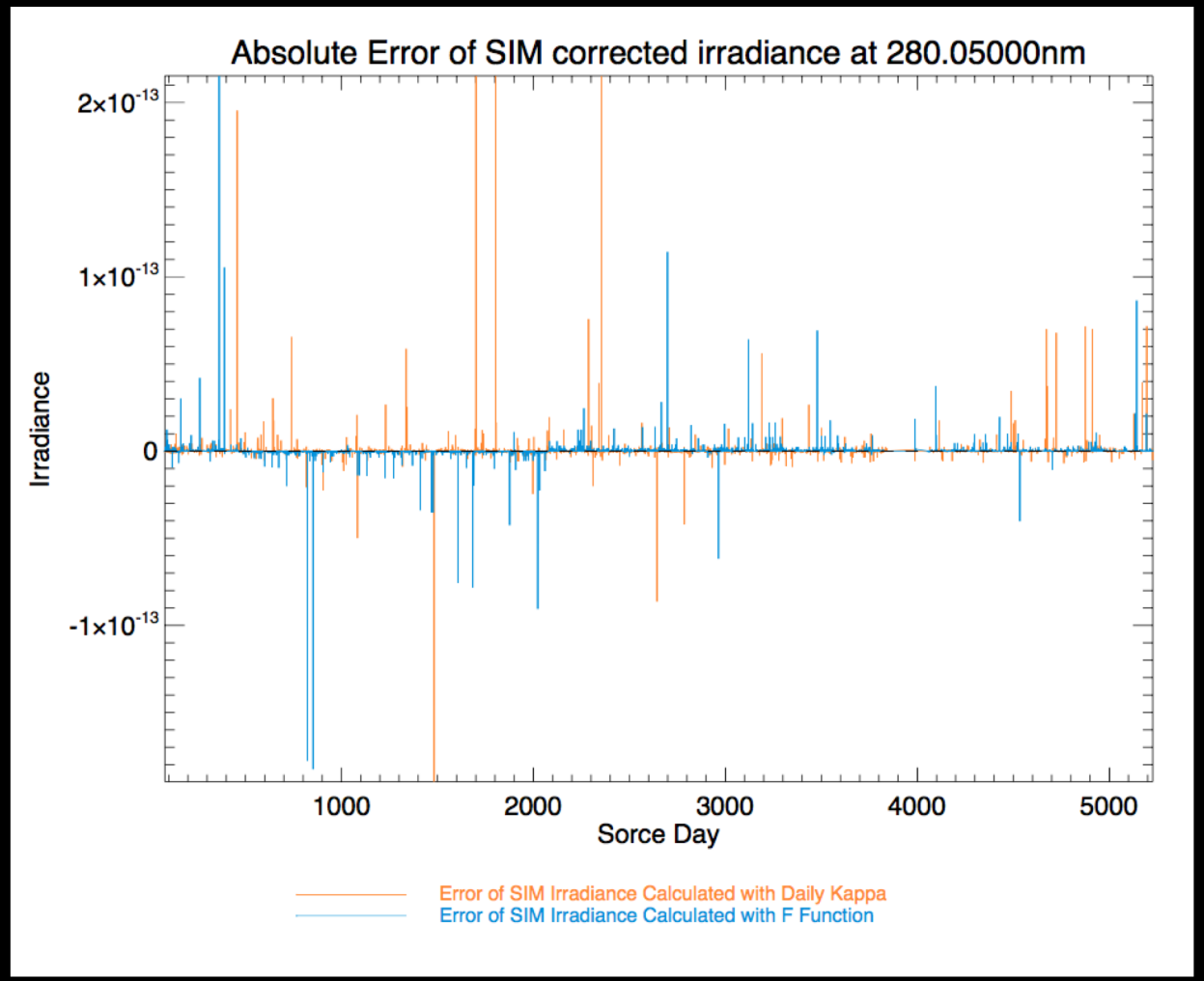
When prism degradation equals 1.0: NRLSSI2 = SIM

$$\text{prism}_{deg} = \frac{\text{SIM uncorr}_{irr}}{\text{NRLSSI2}_{irr}}$$

ACCURACY OF CALCULATIONS

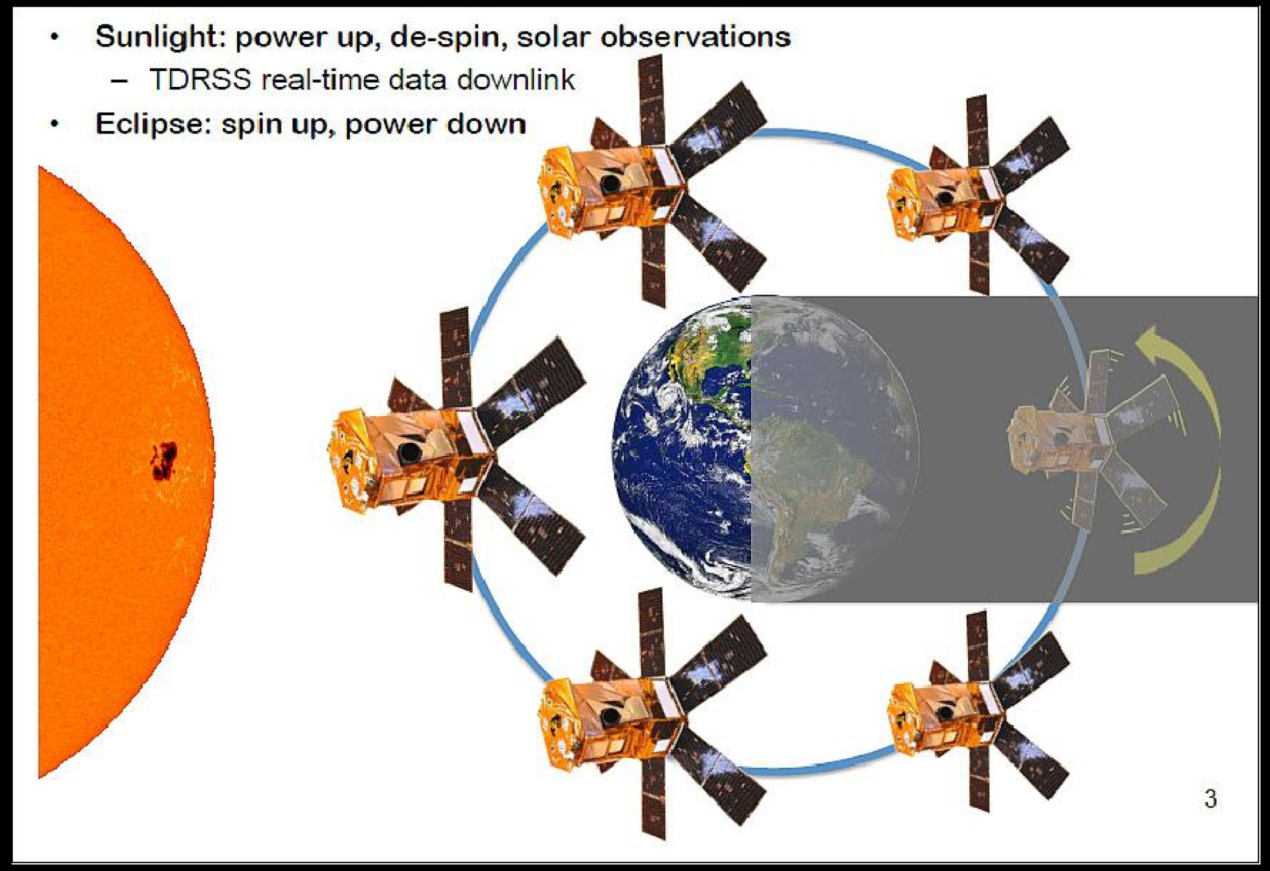
$$\text{SIM corr}_{\text{irr}} = \frac{SIM\ uncorr_{irr}}{prism_{deg}}$$





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



REFERENCES

Harder J. W., Lawrence G., Fontenla J., Rottman G., and Woods T.: 2005a, Solar Phys. 203, 141.

Harder J. W., Fontenla J., Lawrence G., Woods T., and Rottman G.: 2005b, Solar Phys. 203, 169.

Béland S., Harder J. W., Richard E., Snow M., Woods T., Sandoval L.. The SORCE Solar Irradiance Monitor: limitations of a two-instruments model

"SORCE (Solar Radiation and Climate Experiment)." *SORCE - EoPortal Directory - Satellite Missions*, EoPortal

"Multimedia." *Laboratory for Atmospheric and Space Physics*, LASP, lasp.colorado.edu/home/sorce/mission/multimedia/