Initial Comparisons between Solar EUV Spectral Irradiance Observations by SDO-EVE MEGS and TIMED-SEE

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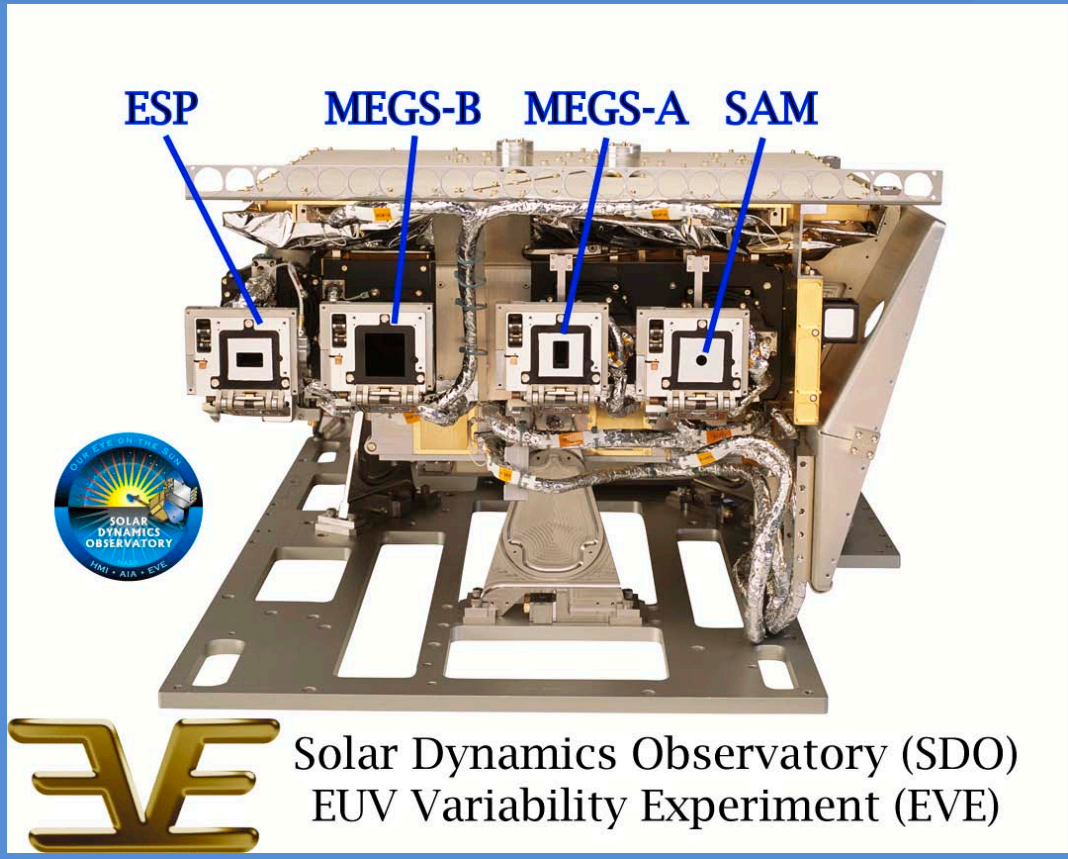
The Two Instruments

- EVE = EUV Variability Experiment
  - On NASA Solar Dynamics Observatory (SDO)
  - Making routine measurements since 03-May-2010
- SEE = Solar EUV Experiment
  - On NASA TIMED Mission
  - Making routine measurements since 22-Jan-2002

SDO-EVE Overview

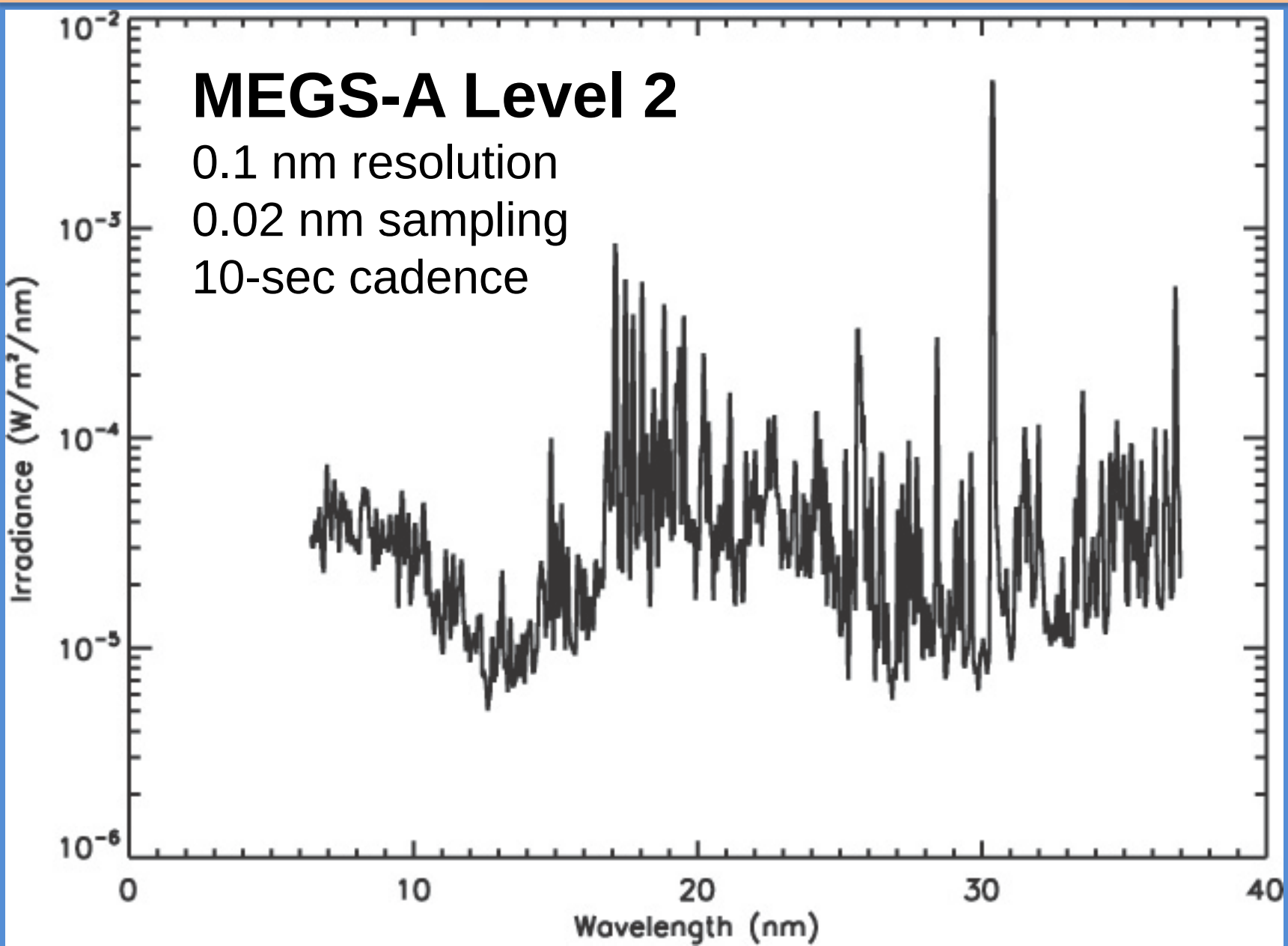
- **Multiple EUV Grating Spectrograph (MEGS)**
  - ***at 0.1 nm resolution***
    MEGS-A: 5-37 nm
    MEGS-B: 35-105 nm
  - ***at 1 nm resolution***
    MEGS-SAM: 0-7 nm
  - ***at 10 nm resolution***
    MEGS-Photometers: @ 122 nm
  - Ly-α Proxy for:
    H I emissions at 80-102 nm
    He I emissions at 45-58 nm
- **EUV Spectrophotometer (ESP)**
  - ***at 4 nm resolution***
    17.5, 25.6, 30.4, 36 nm
  - ***at 7 nm resolution***
    0-7 nm (zeroth order)
- In-flight calibrations from ESP and MEGS-P on daily basis and also annual calibration rocket flights



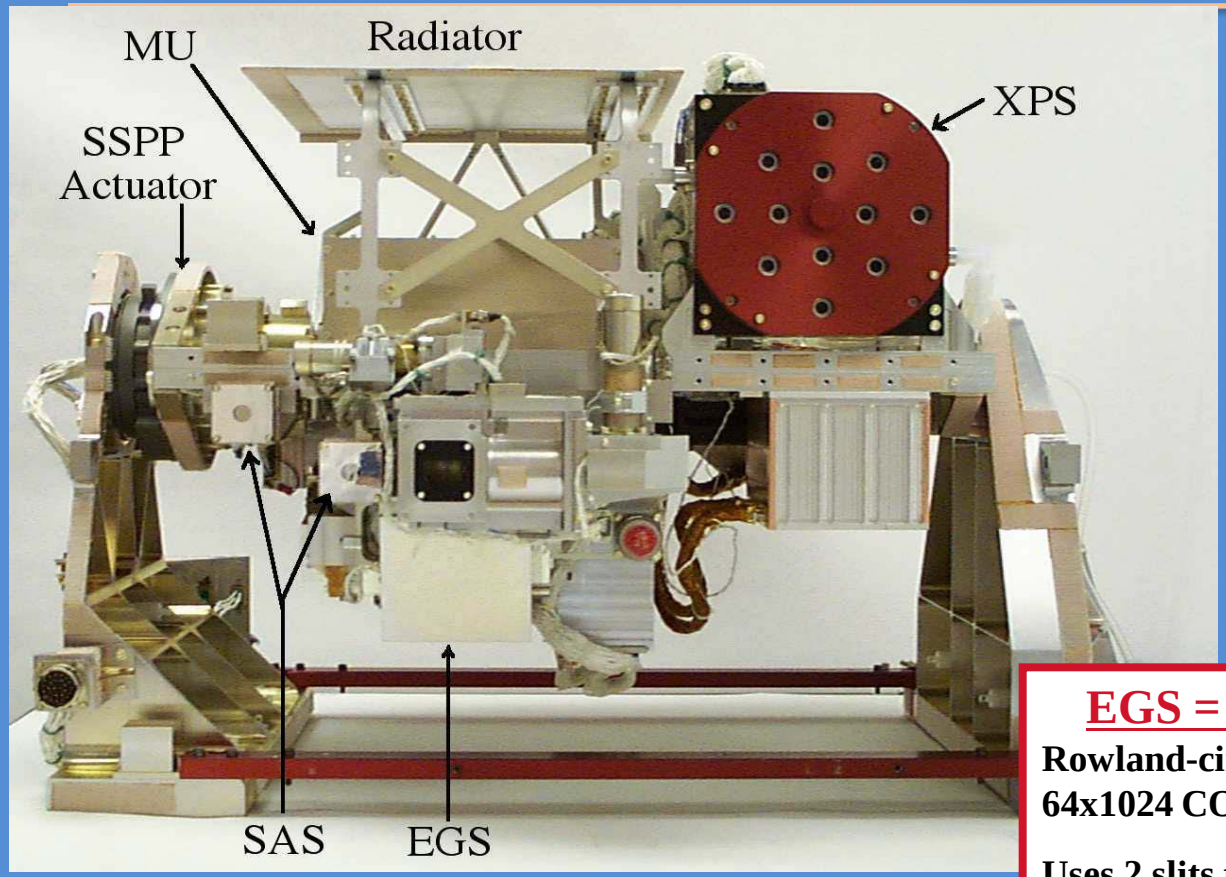
Measurement Cadence:

MEGS = full spectrum every 10-sec
ESP = broadbands every ¼-sec

MEGS-A Data


MEGS-A Level 2
0.1 nm resolution
0.02 nm sampling
10-sec cadence
Irradiance (W/m²/nm)
10⁻²
10⁻³
10⁻⁴
10⁻⁵
10⁻⁶
0
10
20
30
40
Wavelength (nm)

TIMED-SEE Overview



Measures the solar vacuum ultraviolet (VUV) irradiance

Range:

0.1-194 nm

Resolution:

0.4 nm EGS (27-194 nm)

5-10 nm XPS (0.1-34 nm)

Measurement Cadence:

10-sec integrations, but only for 3 min per orbit (96 min)

MU = Microprocessor Unit
SSPP = SEE Solar Pointing Platform
SAS = Solar Aspect Sensor (2)

EGS = EUV Grating Spectrograph

Rowland-circle grating spectrograph with 64x1024 CODACON (MCP-based) detector

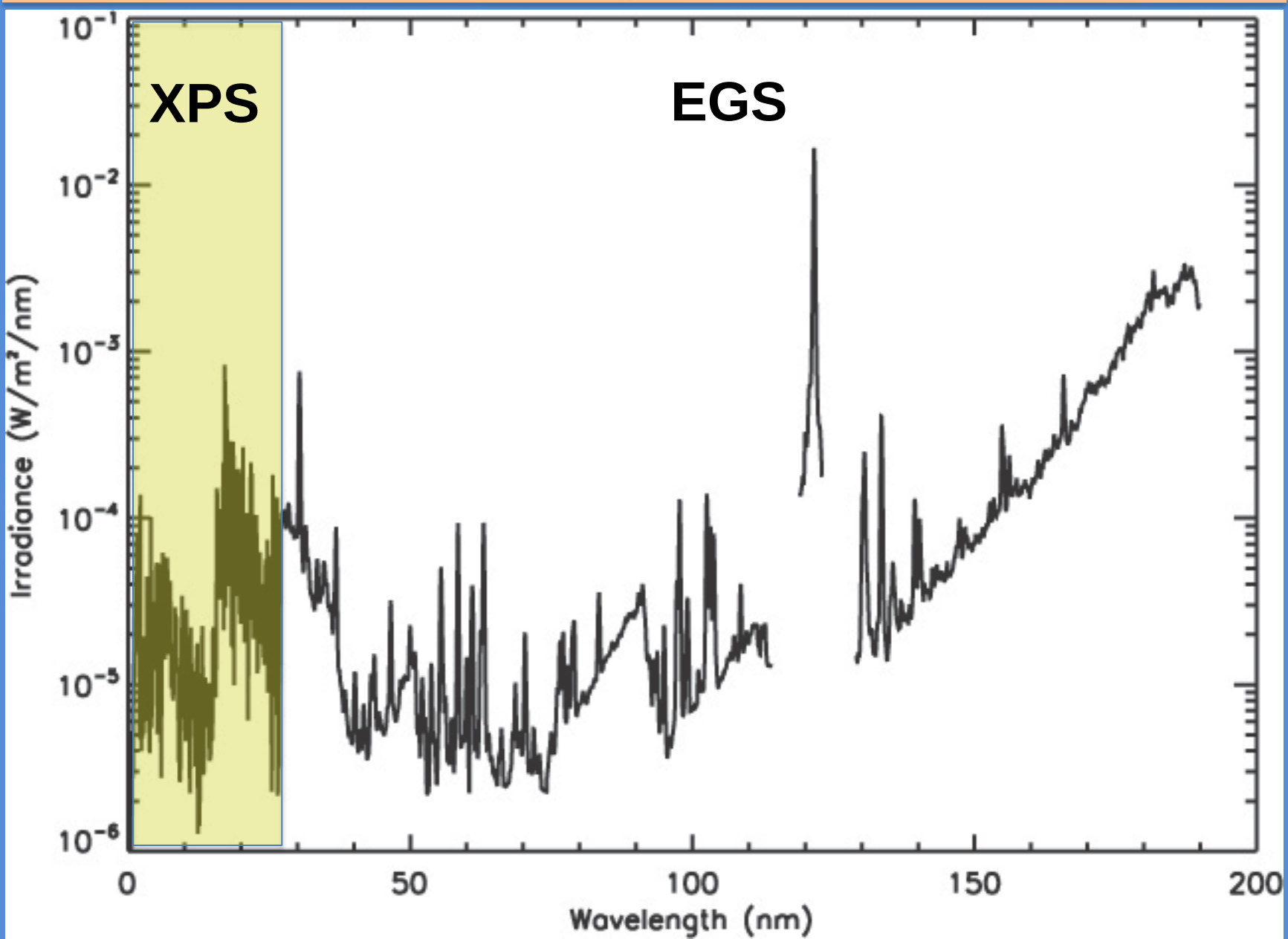
Uses 2 slits to provide redundant measurements

XPS = XUV Photometer System

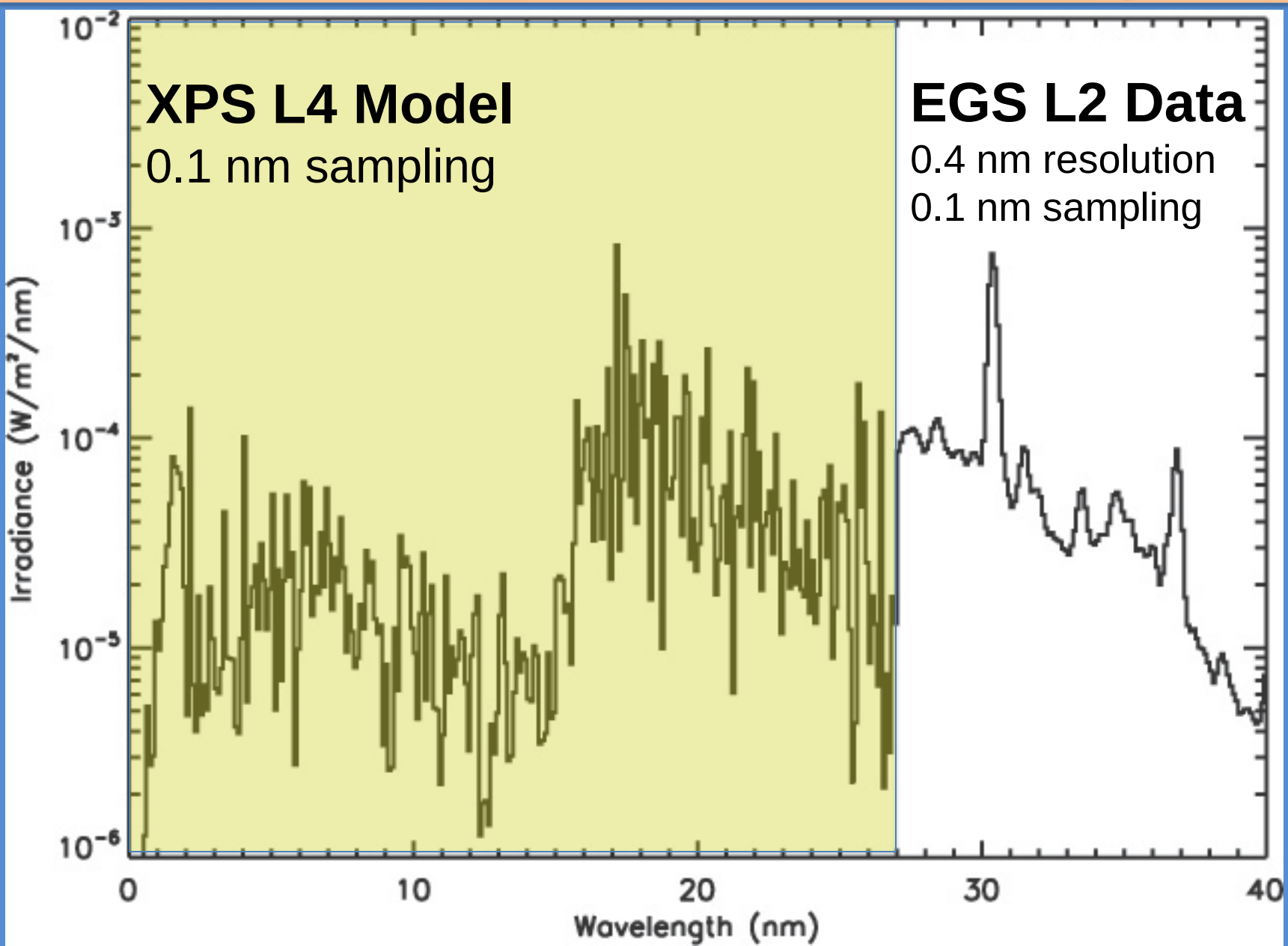
Set of 12 Si photodiodes - 8 for XUV, 1 for Ly-α, and 3 for window calibrations

Includes 3 redundant photodiodes

SEE Spectrum



SEE and MEGS-A Overlap Region

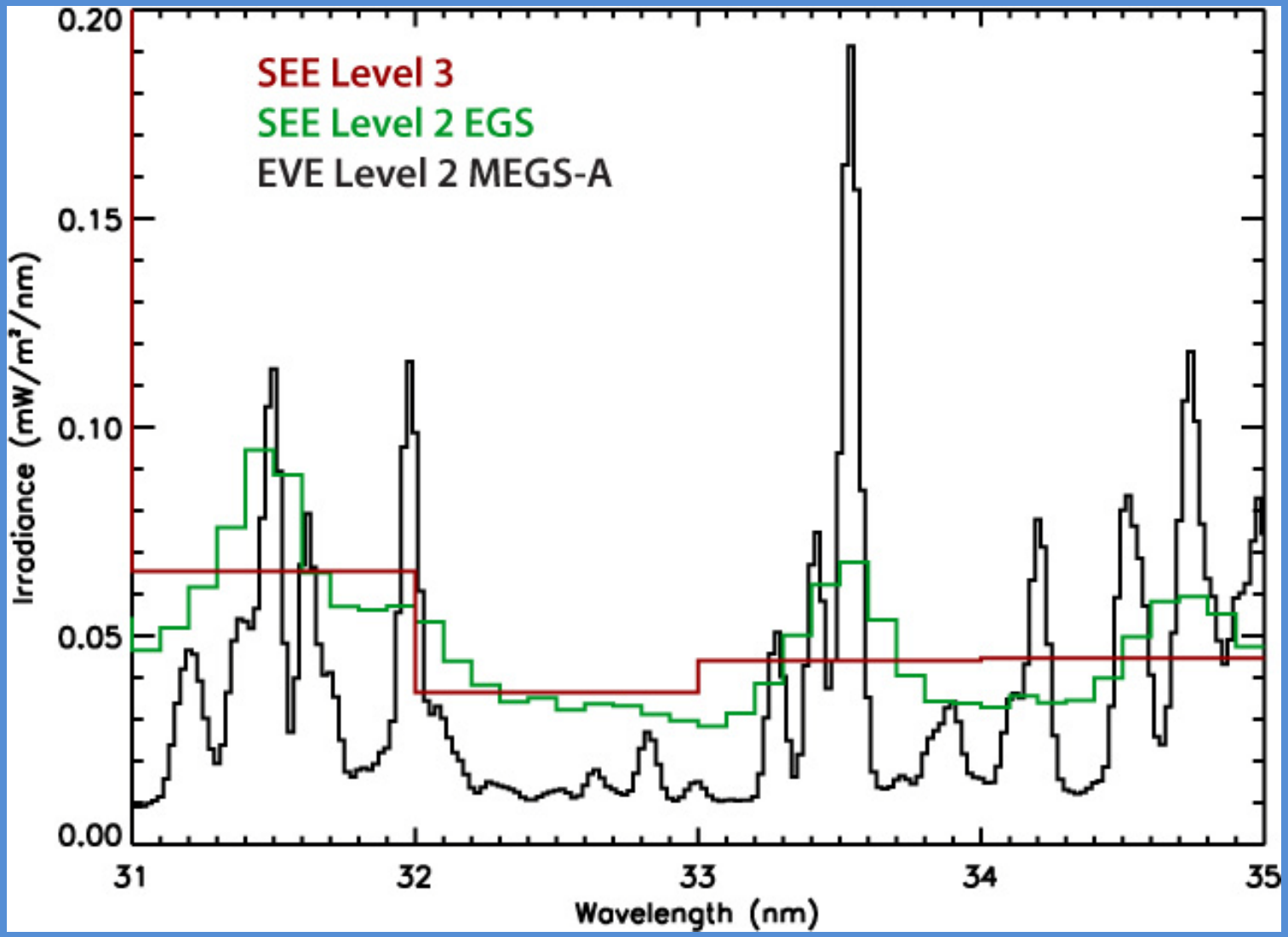


Comparing Two Different Instruments

- Not straight forward due to differences in:
  - Wavelength resolution
    - SEE EGS L2 spectral resolution = 0.4 nm, sampling = 0.1 nm
    - SEE L3 data product in 1-nm bins
    - EVE MEGS spectral resolution =0.1 nm, sampling = 0.02 nm
  - Time cadence
    - SEE Orbit Data (L2A, L3A, L4A) = 96-minutes
    - SEE Daily Data (L2, L3, L4) = 1-day (medianed)
    - EVE L2 data = 10-seconds

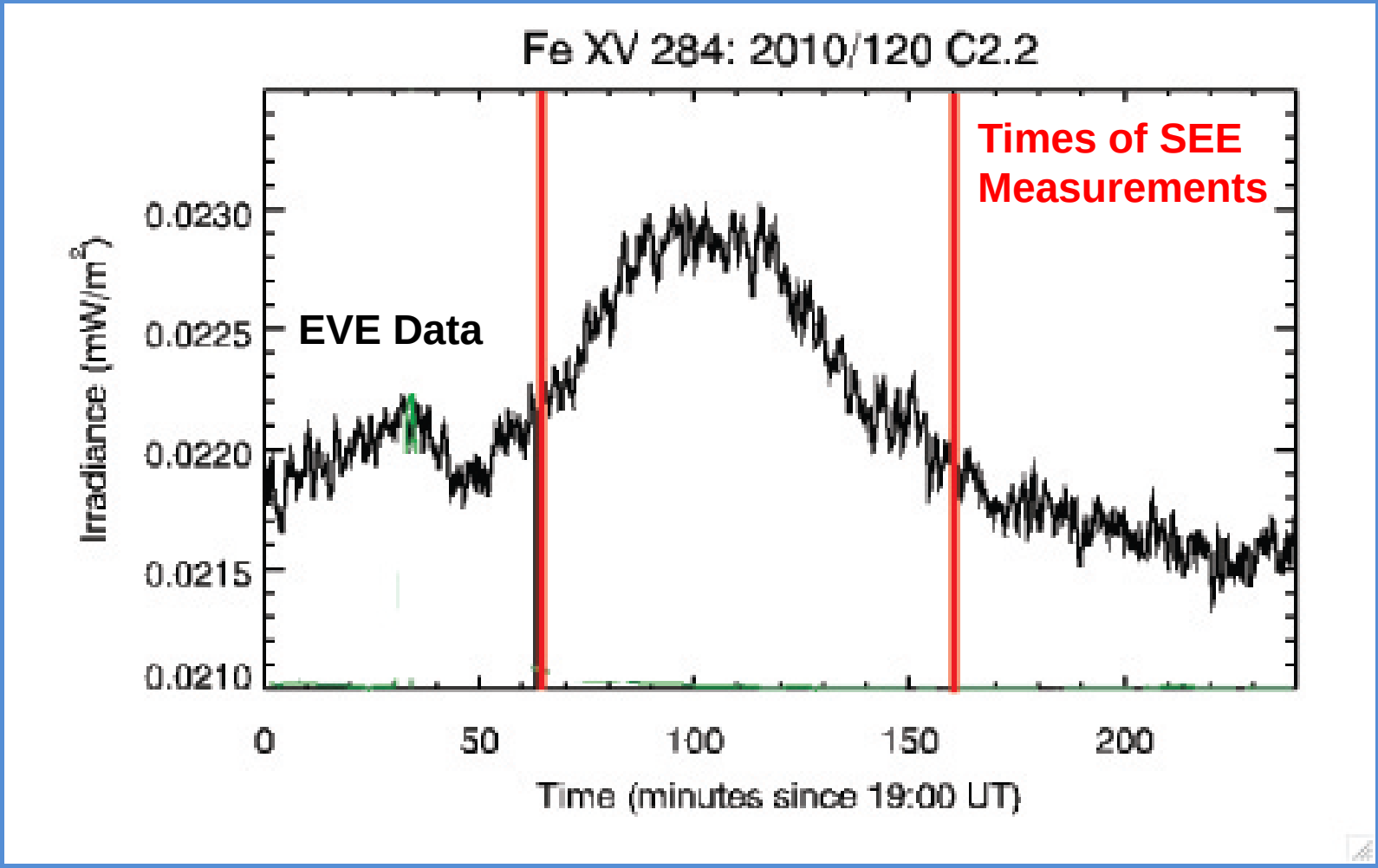
Different Wavelength Resolution/Binning

- Compare by binning? Convolving? Both?

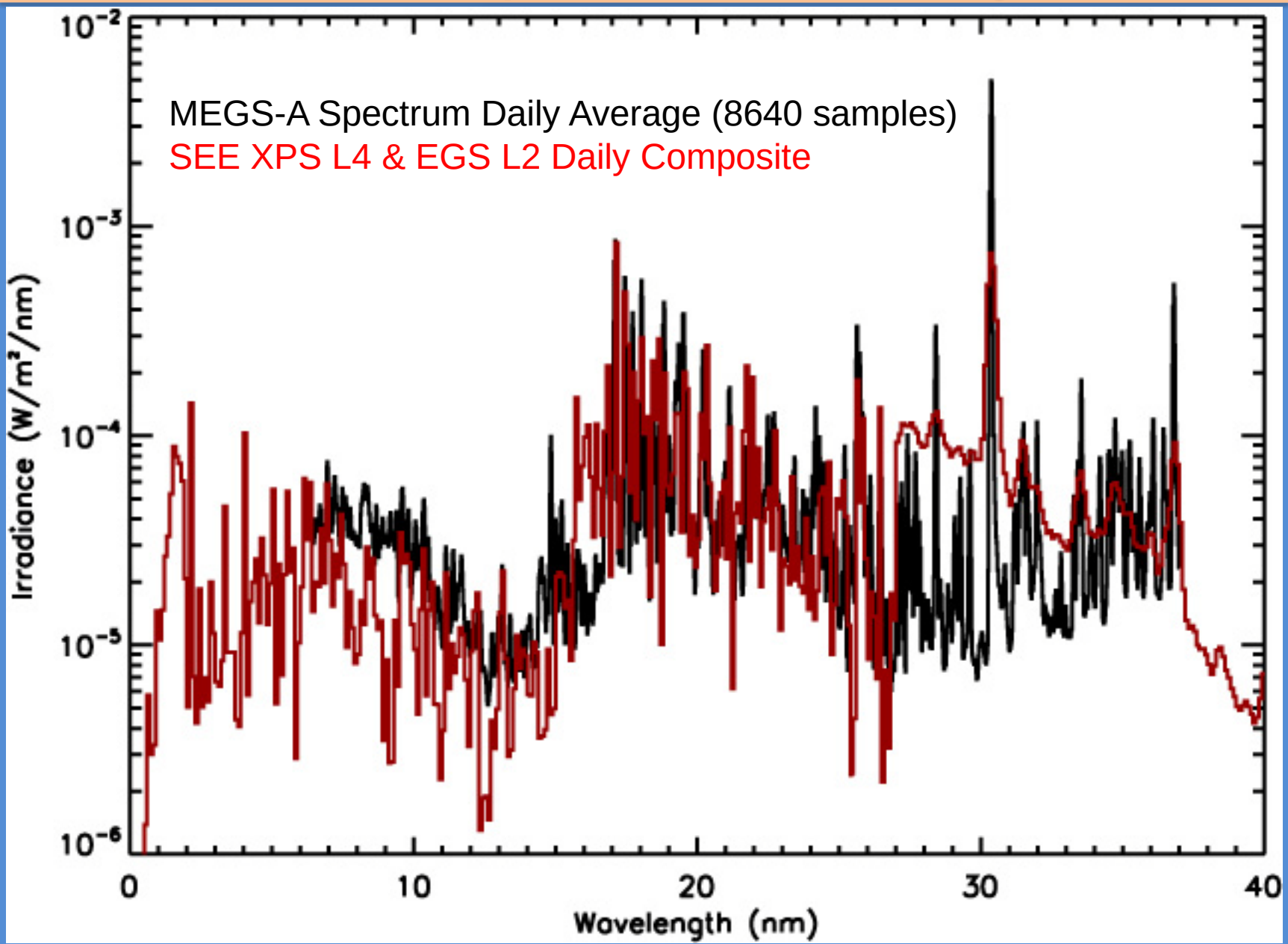


Different Time Sampling

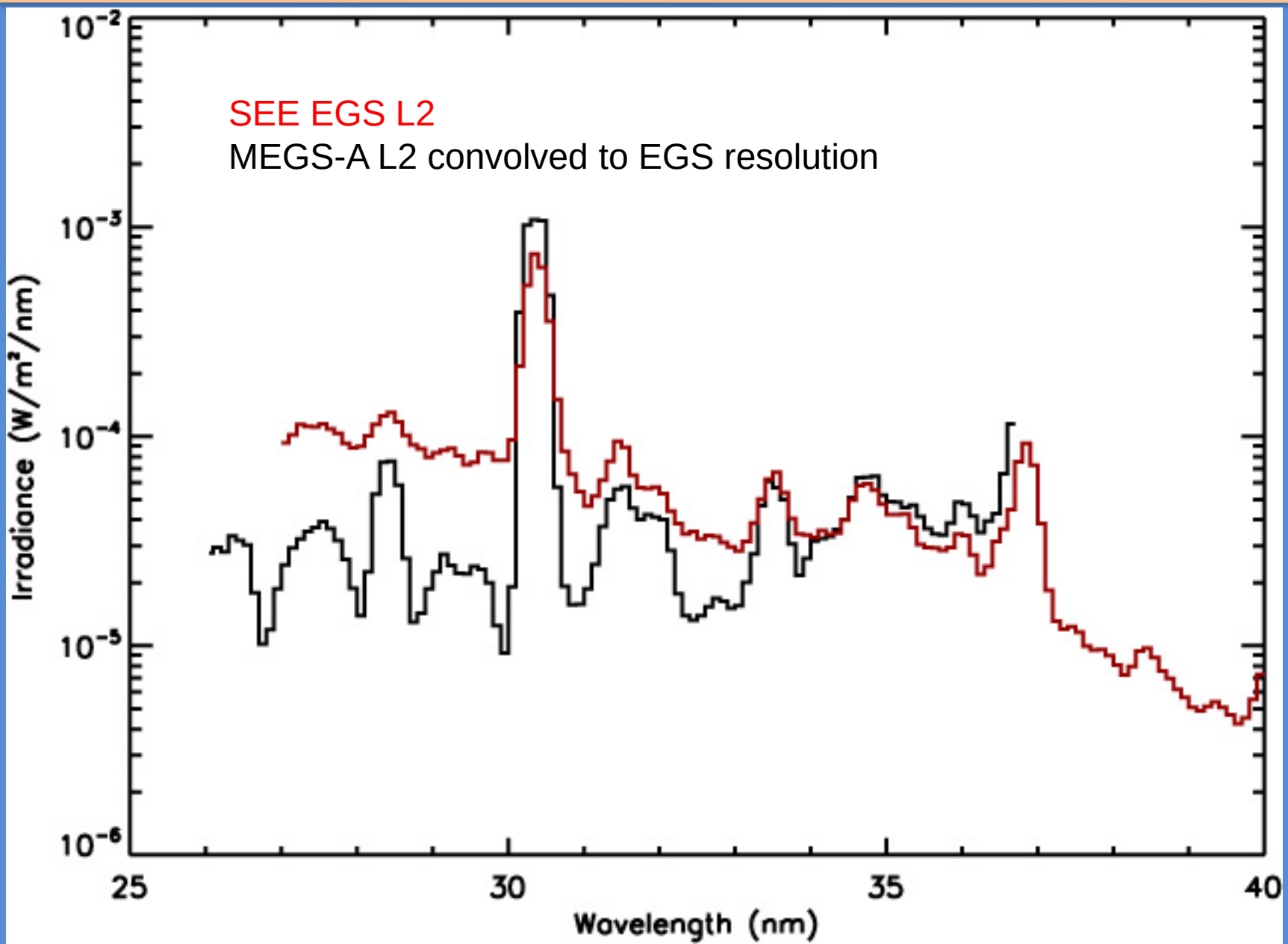
- Compare simultaneous samples? Daily averages? Weekly averages?



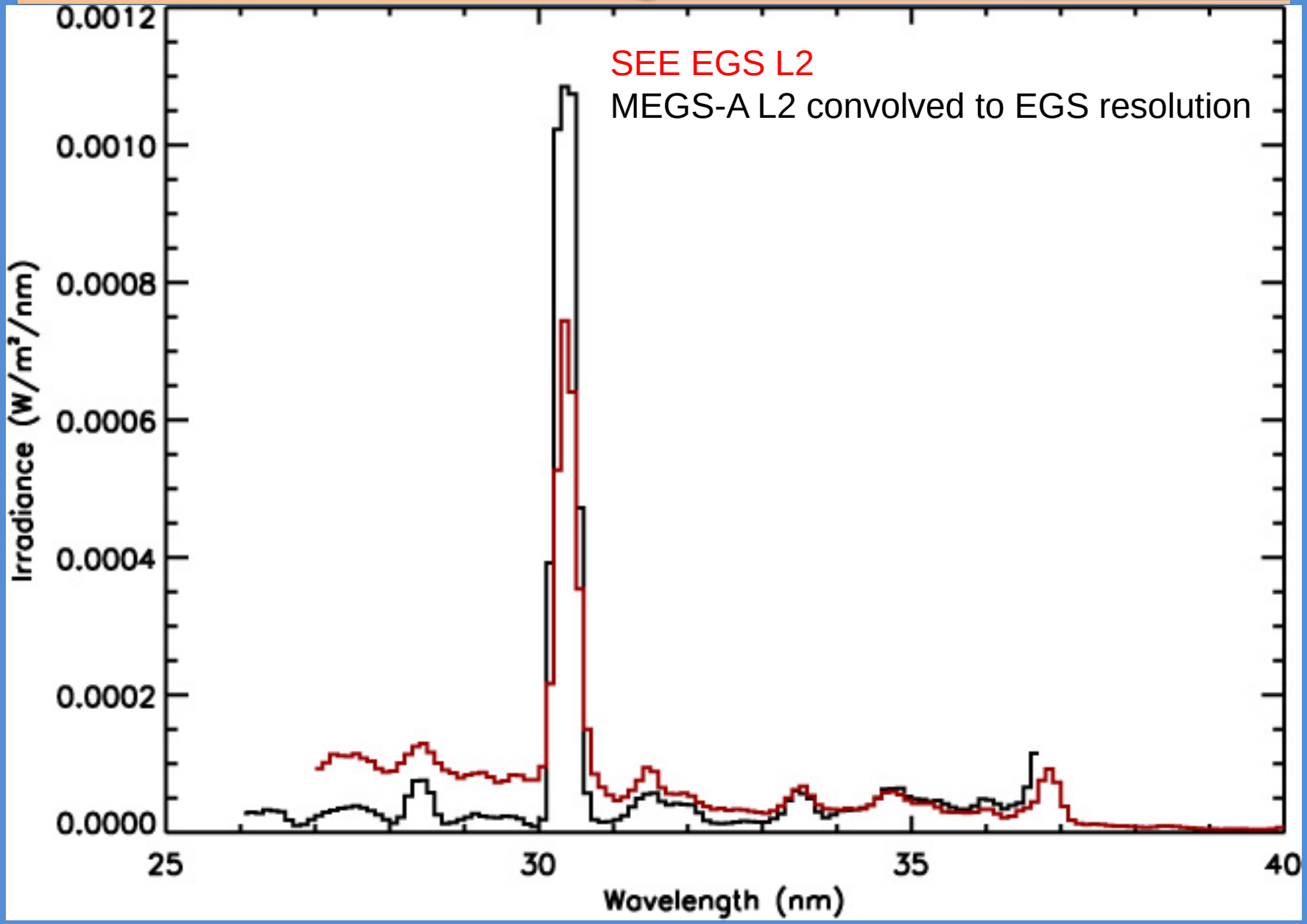
Simple Overplot for 03-May-2010



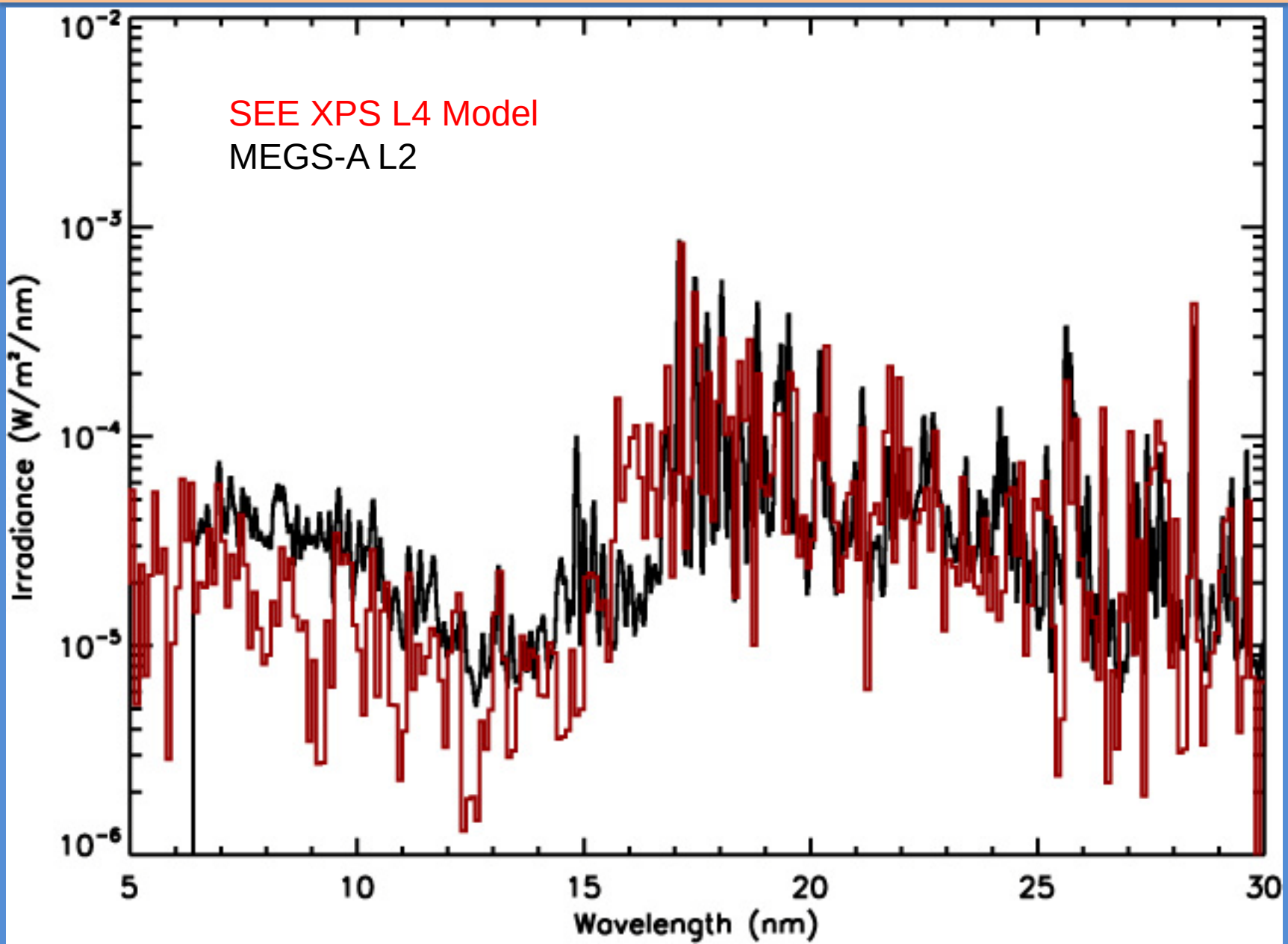
MEGS-A Converted to EGS L2



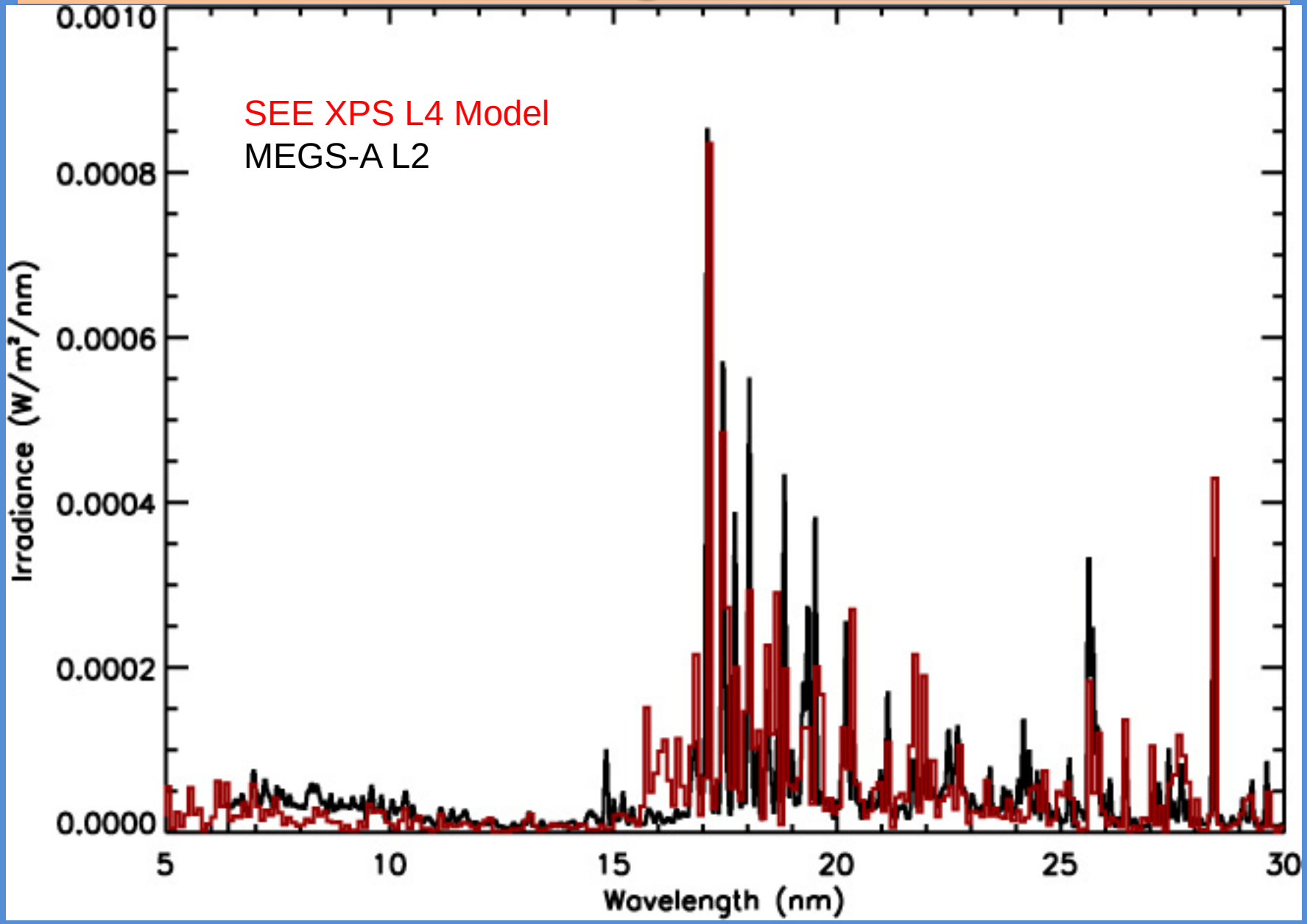
Same Thing, but Linear



MEGS-A and XPS L4



Same Thing, but Linear



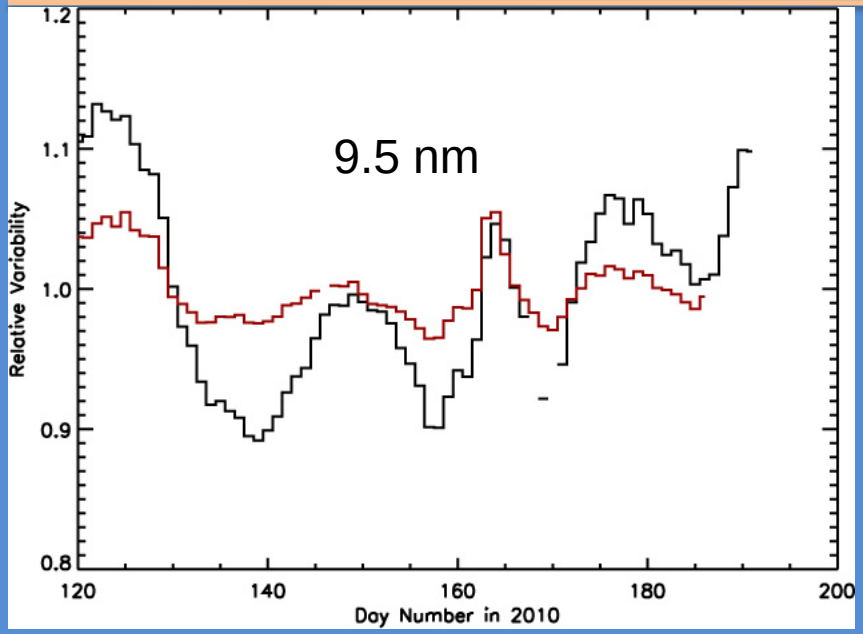
Conclusions to Spectra Comparison

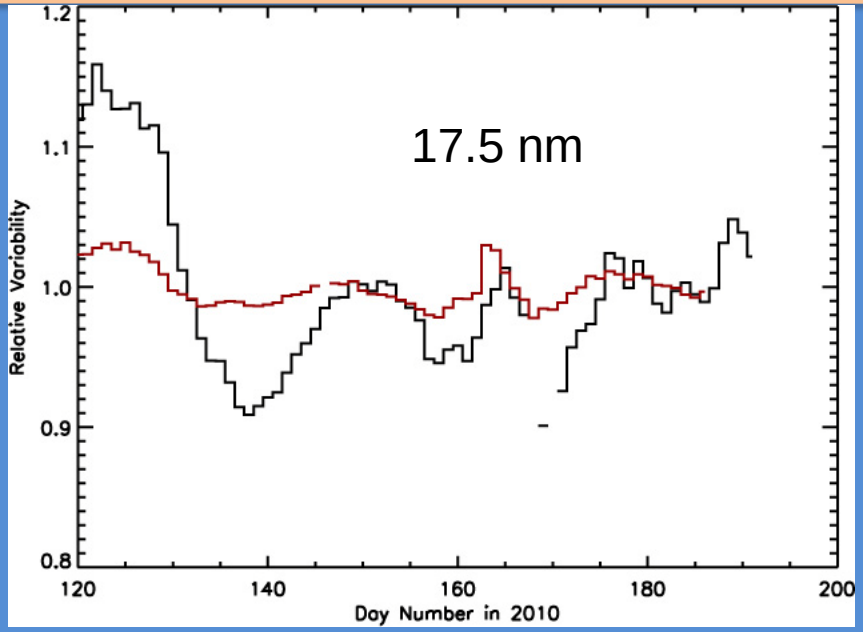
- SEE EGS probably has a scattered light subtraction issue shortward of 33 nm
- SEE 30.4 nm line is lower than EVE by ~50%, but other lines agree well
- SEE XPS Model does surprisingly well
  - Line strengths don’t match
  - This is a near solar minimum case only

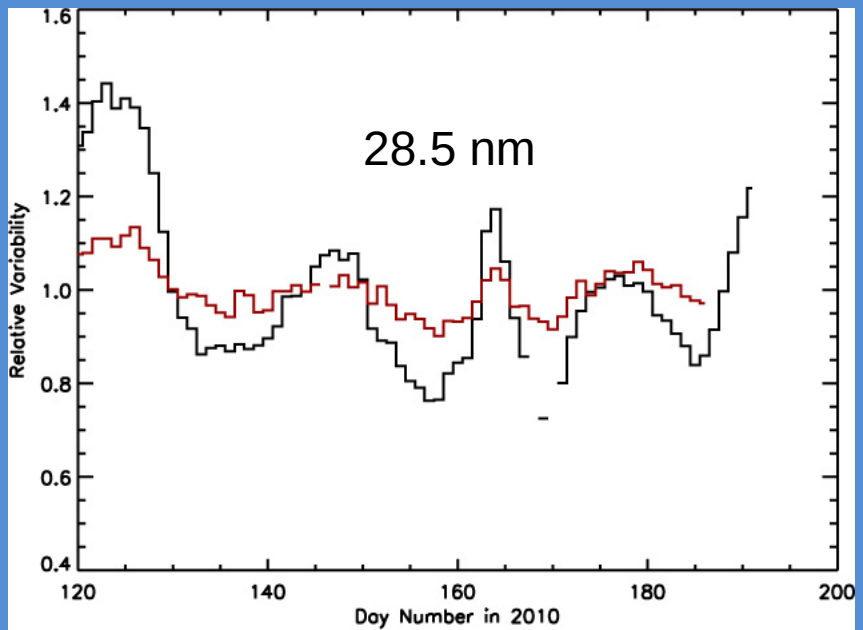
Next Look at Time Series

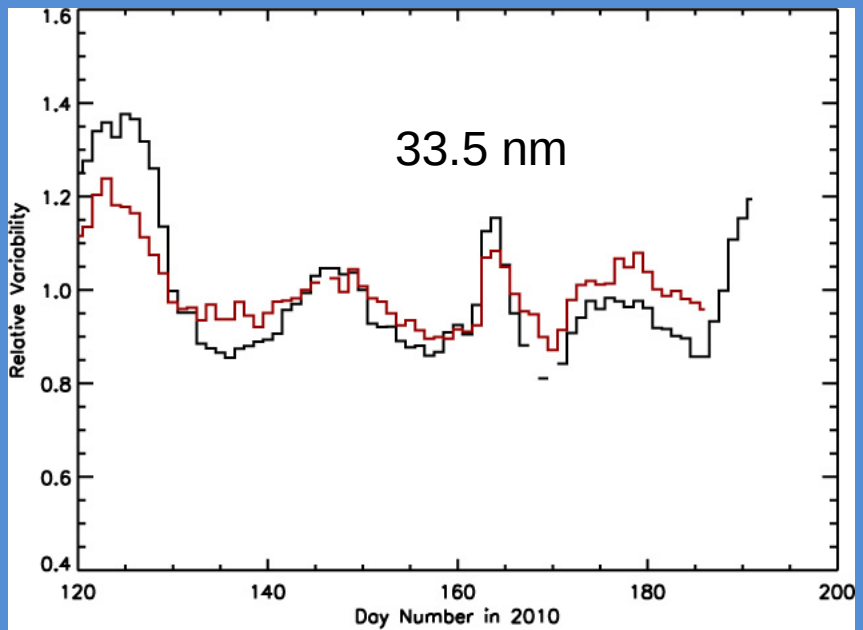
- Look at 1-nm binned data from both EVE and SEE
- Compare bins that are dominated by lines of similar variability (e.g. temperature)
- Normalize to mean value during period to show only variability

Coronal Line Bins

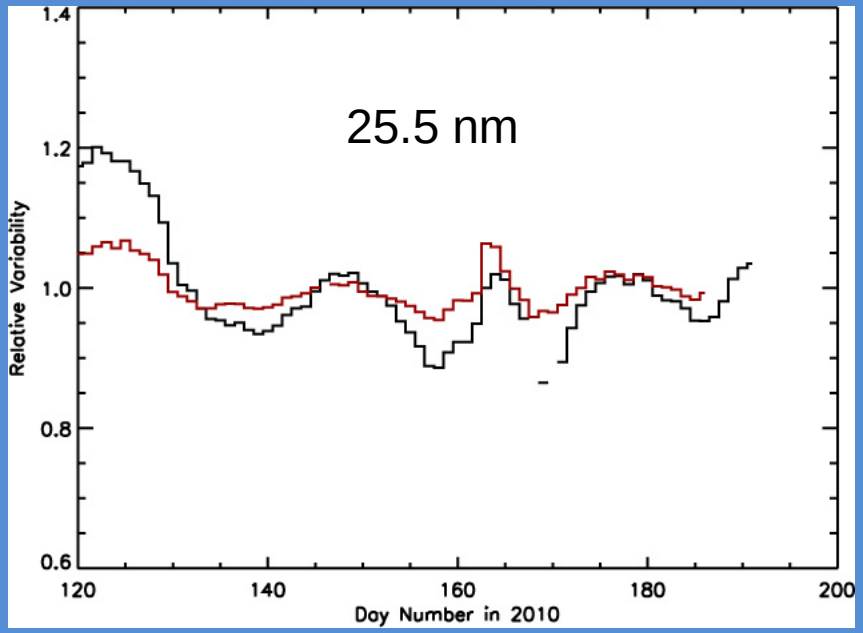


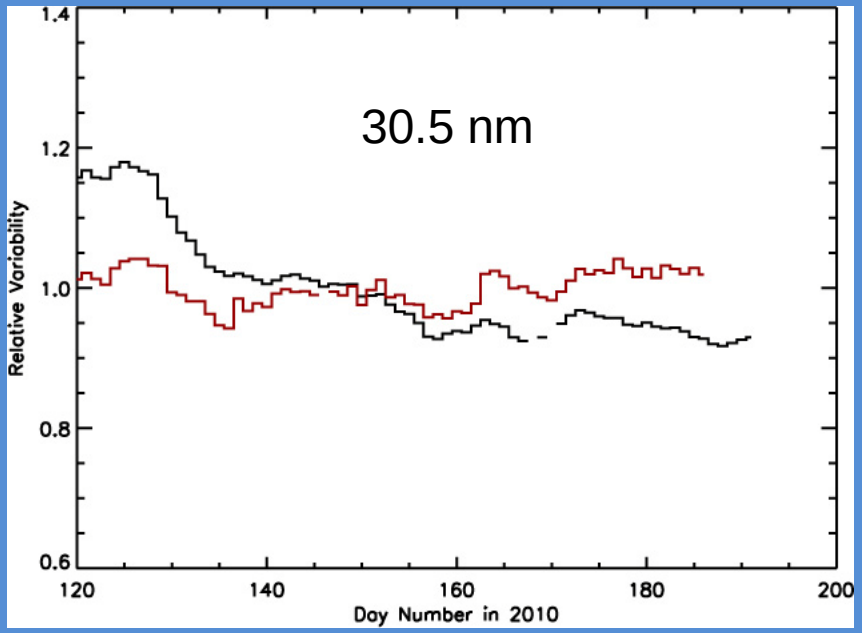






Transition-Region Line Bins





Conclusions to Time Series Comparisons

- Rotational variability matches better in general with EGS measured lines than XPS model
- There may be some degradation in MEGS at 30.4 nm, or SEE processing may be over-correcting 30.4 nm degradation (or both)

Summary

- Preliminary comparisons between SEE and EVE are pretty good.
- Differences seem to be more problems with SEE processing than with EVE.
- More comparisons with longer time series and with other instruments is needed for both EVE and SEE.
  - Unfortunately SEE is being turned off later this year.