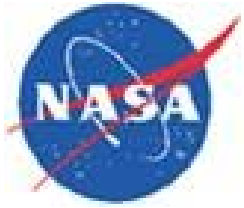

Improved Composite Solar Spectral Irradiance Product Using SBUV/2 and OMI Data

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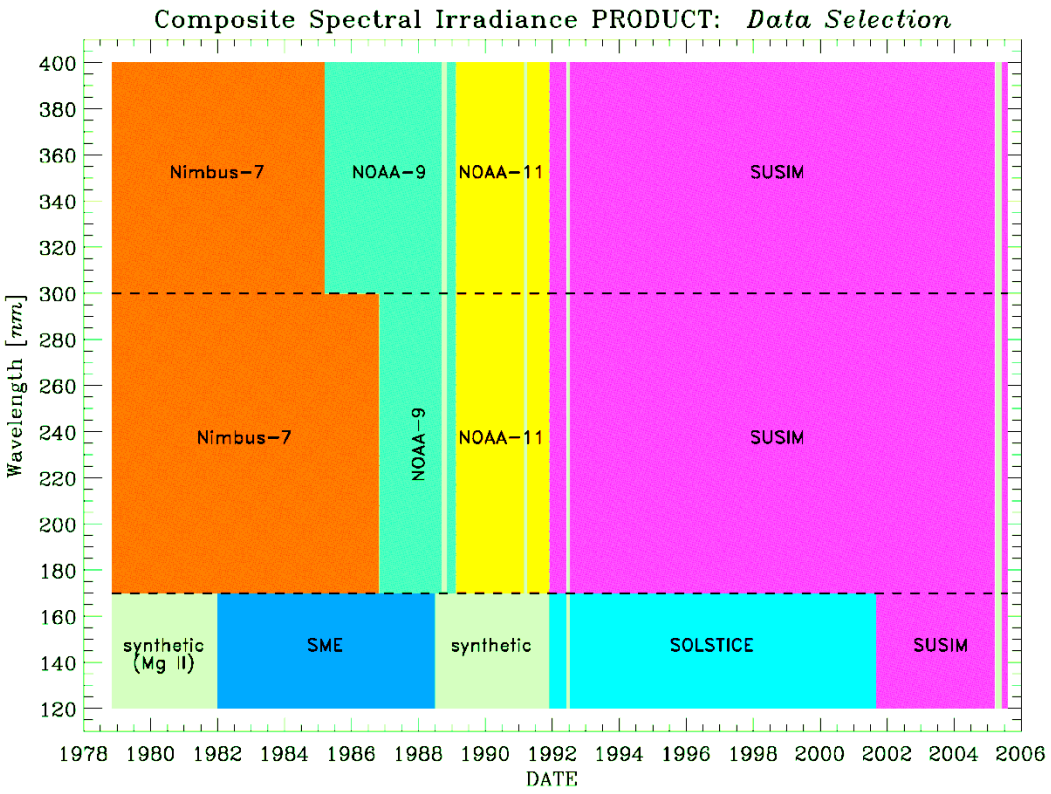
Overview of Proposed Work

- Begin with existing composite SSI data set [*DeLand and Cebula*, 2008].
- Address issues identified by other users (*e.g.* step changes) and review data to reduce outliers.
- Create UARS SUSIM reference spectra for 2000-2005.
- Use these data to create calibrated NOAA-16 and NOAA-17 SBUV/2 irradiance data for 2001-2007 (or longer).
- Develop daily irradiance product for Aura OMI covering 2007-2016.
- Add new SBUV/2 and OMI data sets to create extended composite SSI data set covering November 1978 – present.

Existing Composite SSI Product

- Use 1 nm binned products from each instrument.
- Normalize each data set to reference spectrum.
- Select single data set for each large spectral and temporal region.
- Fill data gaps with synthetic data.

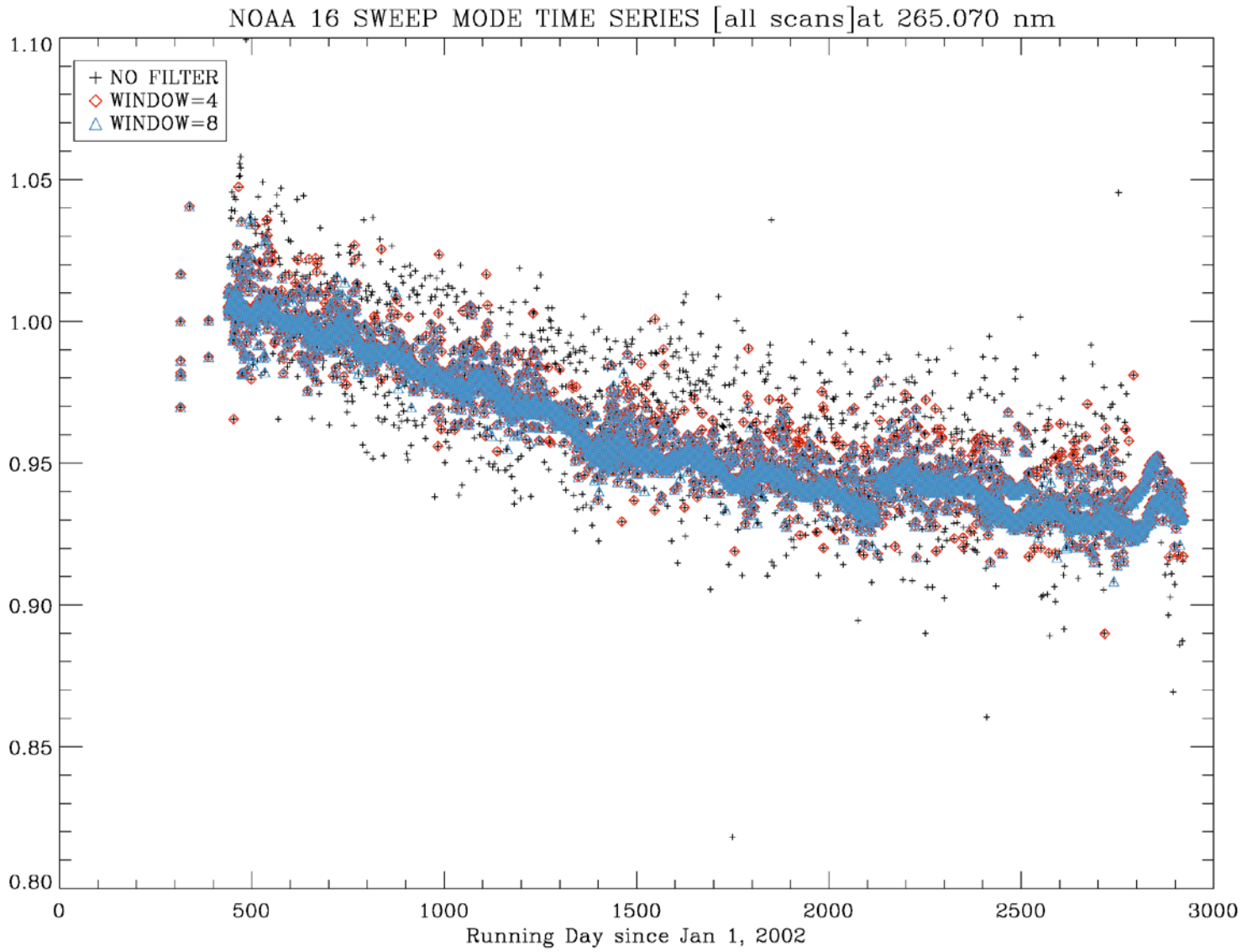


DeLand and Cebula, *J. Geophys. Res.* (2008)

Issues with Current SSI Product

- Data set stops in mid-2005. First look at extending with SORCE data showed many differences in mid-UV.
- Step changes noted by other users at some inter-instrument transitions that should be removed.
- Normalization spectrum (ATLAS-1) corresponds to high solar activity in 1992. Need lower activity level to best merge more recent data sets.
- Improve screening for outliers.

Outlier Screening



Calibration of SBUV/2 Data

- NOAA-16 daily spectra (170-400 nm) cover Mar 2001 – Sep 2007 [+ spring 2008] before significant orbit drift issues appear (shadowing of solar diffuser).
- NOAA-17 daily spectra cover Oct 2002 – Dec 2010 before shadowing starts.
- Use same long-term correction approach as applied to NOAA-9 and NOAA-11 in V1 composite SSI data set:
  - Use UARS SUSIM reference spectra in place of SSBUV flights as absolute reference
  - Create “Day 1” ratio between NOAA-16 and SUSIM to remove calibration bias
  - Compare concurrent NOAA-16 observations to reference spectra on selected dates to establish benchmarks for correction
  - Create smooth fits (wavelength, time) for degradation function to correct SBUV/2 data

Status of SBUV/2 Analysis

- Revive old software (last used in 2004) for NOAA-16 data.
- Create “Day 1” ratio between NOAA-16 [November 2000] and available SUSIM L3 reference data [July 2003] with solar activity correction (< 1% Mg II).
- Use SUSIM solar change curve to create L3 reference curve for July 2005, then make concurrent ratio plots with NOAA-16 spectra.
- Use smooth spectral fits to get data points for time dependence fits in 5 nm bands. Use simple function because only 3 points currently available (“Day 1”, July 2003, July 2005).

Solar UV Irradiance Changes

via SUSIM Reference Channels

SUSIM measured the UV solar spectral irradiance using infrequently exposed optical channels (Reference Channels, RC) that served to calibrate SUSIM's responsivity during its 14-years of operation.

Goal is to use RC measurements to calibrate SBUV responsivities over coincident portions of their operational time periods.

Ratios of RC solar scans on different days provide a measure of the "solar change" between those days.

For various reasons, measurement quality of each RC varies uniquely with respect wavelength and time periods.

A judicious combination of RC measurement of solar changes determines best estimates of the solar change for given wavelength regions and time periods.

The resulting solar changes provide a constraint on SBUV responsivity changes providing a basis for the SBUV responsivity evolution over time.

An improved SBUV responsivity model will be developed in part from these SUSIM Reference Channel constraints.

SUSIM REFERENCE SPECTRA

point of reference for spectral comparisons with SBUV instruments

SUSIM Reference Spectra (SRS) will be hased on its 1.1 nm resolution absolutely calibrated solar scans.

The reference day was chosen to be July 9, 2003 because of the number and quality of SUSIM reference scans on that day.

(At least) two types of reference spectra will be considered.

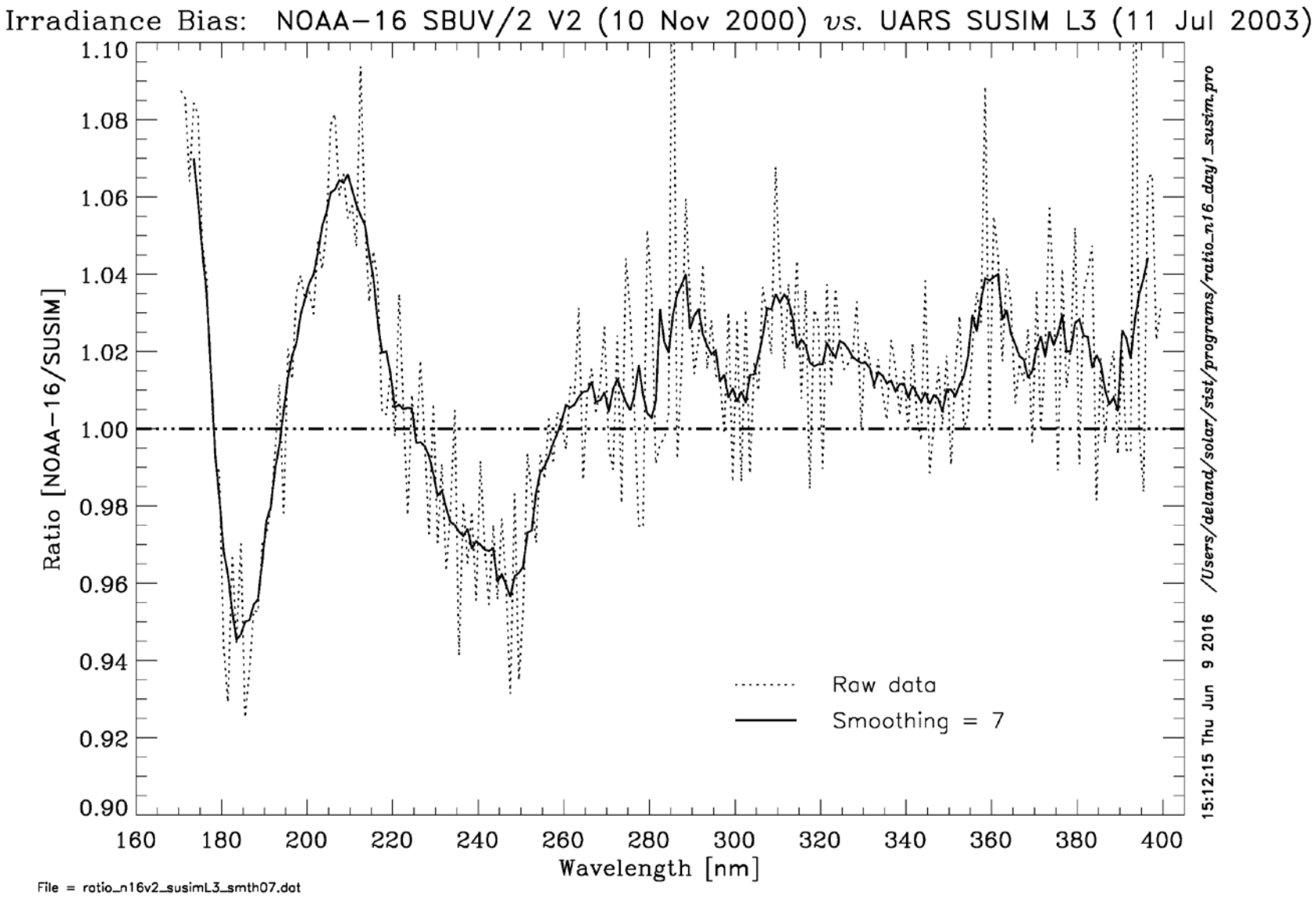
One is the "UARS-style" binned SUSIM irradiances centered on the half nm that has been provided as the SUSIM V23 level 3 product.

- one possible improvement is to use better reconvolution algorithms

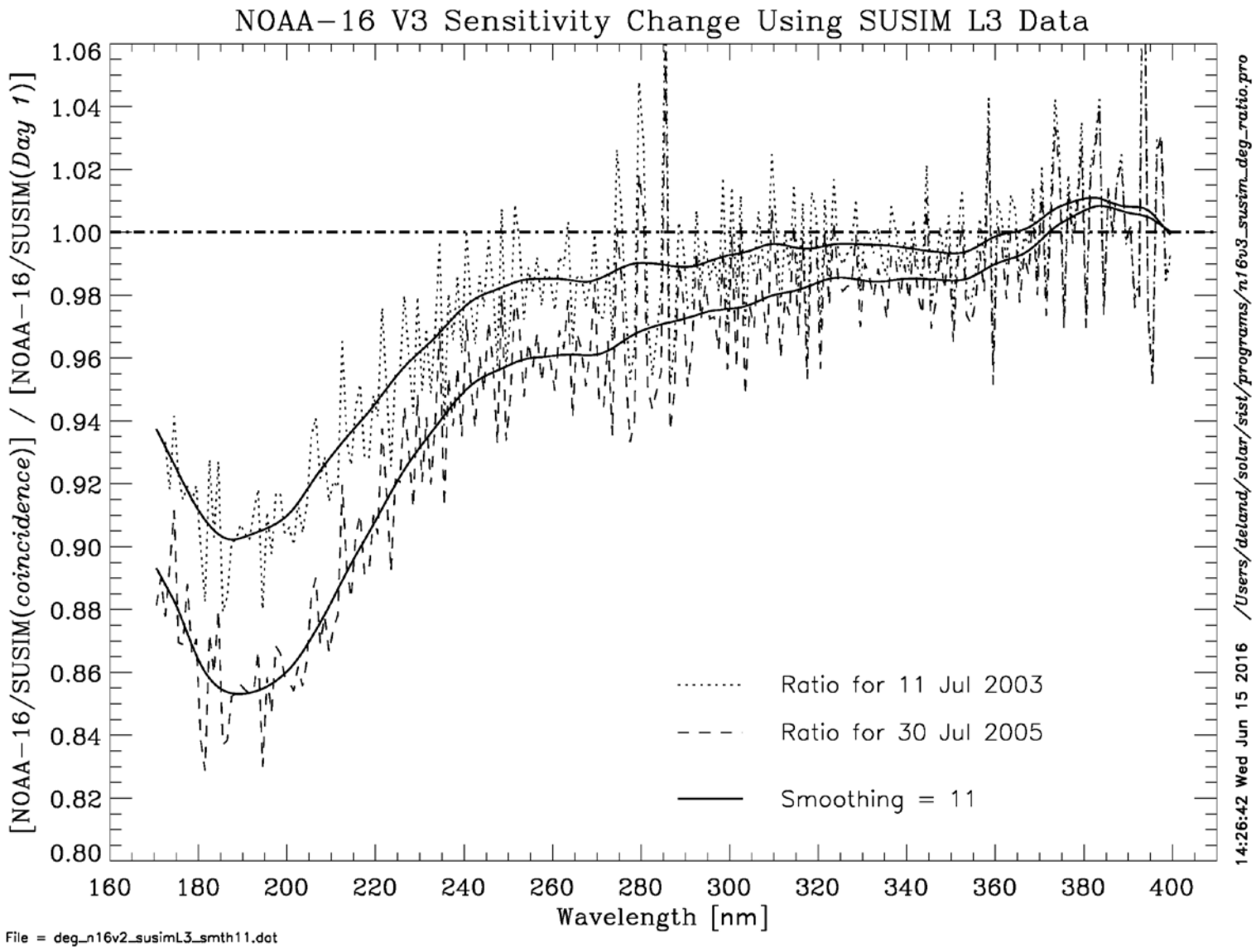
A second reference spectrum to be considered is that of UV spectral irradiance (i.e. not integrated, binned irradiance) on a very wavelength grid (e.g. 1 Å).

Impoved deconvolution of the instrument function especially at short wavelengths will be explored; available SUSIM high (0.15 nm) resolution scans support this.

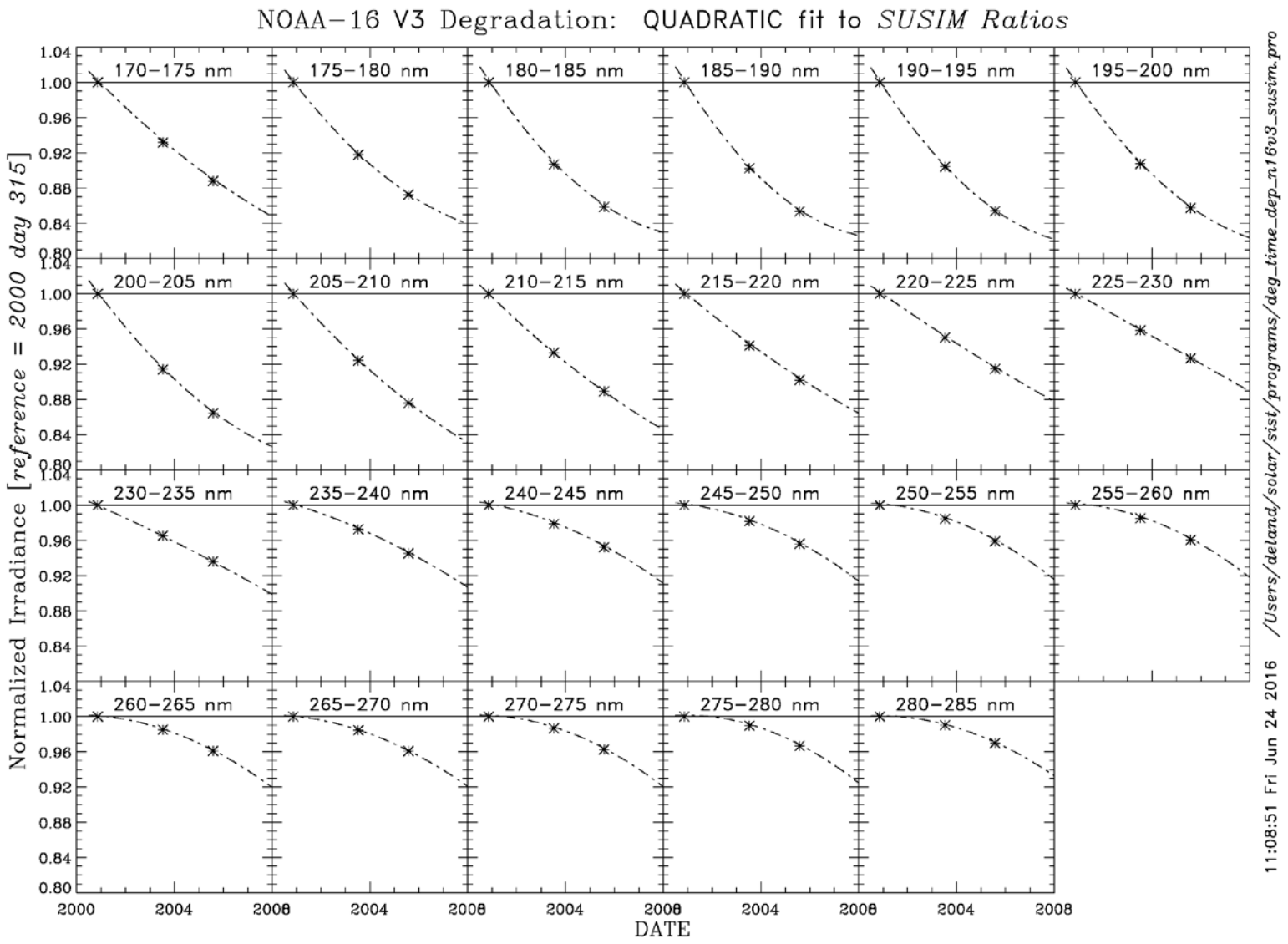
“Day 1” Ratio


Irradiance Bias: NOAA−16 SBUV/2 V2 (10 Nov 2000) vs. UARS SUSIM L3 (11 Jul 2003)
Ratio [NOAA−16/SUSIM]
1.10
1.08
1.06
1.04
1.02
1.00
0.98
0.96
0.94
0.92
0.90
160
180
200
220
240
260
280
300
320
340
360
380
400
Wavelength [nm]
Raw data
Smoothing = 7
15:12:15 Thu Jun 9 2016 /Users/deland/solar/sist/programs/ratio_n16_day1_susim.pro
File = ratio_n16v2_susimL3_smth07.dat

Concurrent Spectra Ratio



Time Dependence Fits



Next Steps for Project

- Apply revisions to individual data sets in current SSI product (treat NOAA-9, NOAA-11 data at scan level).
- Extend set of SUSIM reference spectra used for NOAA-16 SBUV/2 degradation analysis.
- Apply same degradation correction approach to NOAA-17 SBUV/2 data set.
- Begin evaluation of multiple data sets during overlap period in 2007-2009 to determine optimum transition between SBUV/2 and OMI data.