



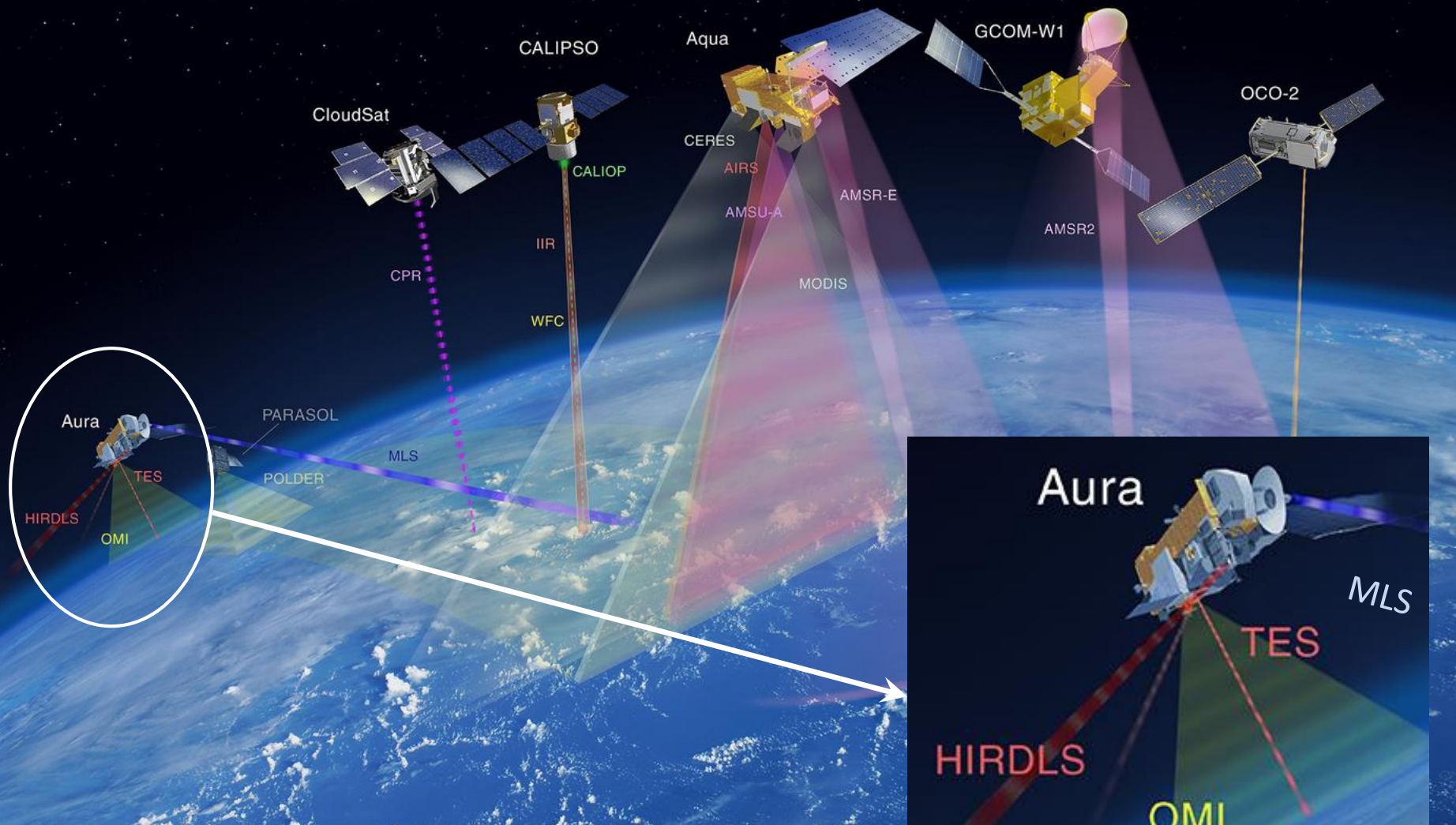
# **Spectral Irradiance Changes in Cycle 24: Inter-comparing *Aura/OMI*, *SORCE SIM* and *SORCE SOLSTICE***

**Marchenko, S., DeLand, M.  
SSAI/NASA GSFC**

## **Solar Spectral Irradiance (SSI) measurements with**

***Aura/OMI, SORCE SIM and SORCE SOLSTICE:***

- does the long-term (Cycle 24) SSI variability follows the short-term (rotational) patterns in the 265 - 500 nm range?**
- how unusual are the NUV-Vis SSI changes in Cycle 24?**



***Aura***, as part of the “A-train” constellation:

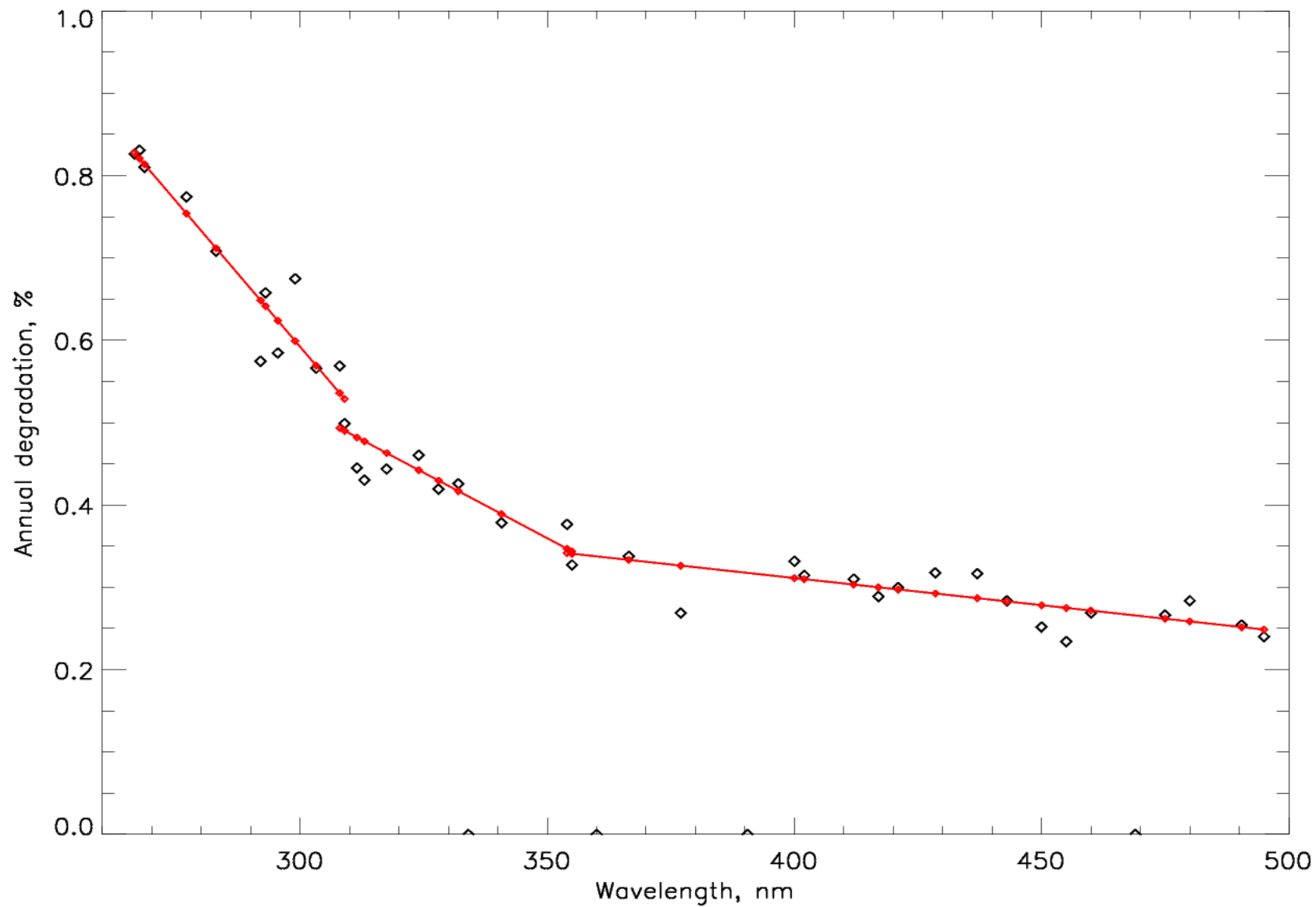
- launched July 15, 2004;
- lagging *Aqua* by 8-15 min;
- alt.=705km sun-synchronous orbit, ~13:45 LST equator-crossing time

# Ozone Monitoring Instrument (*OMI*)

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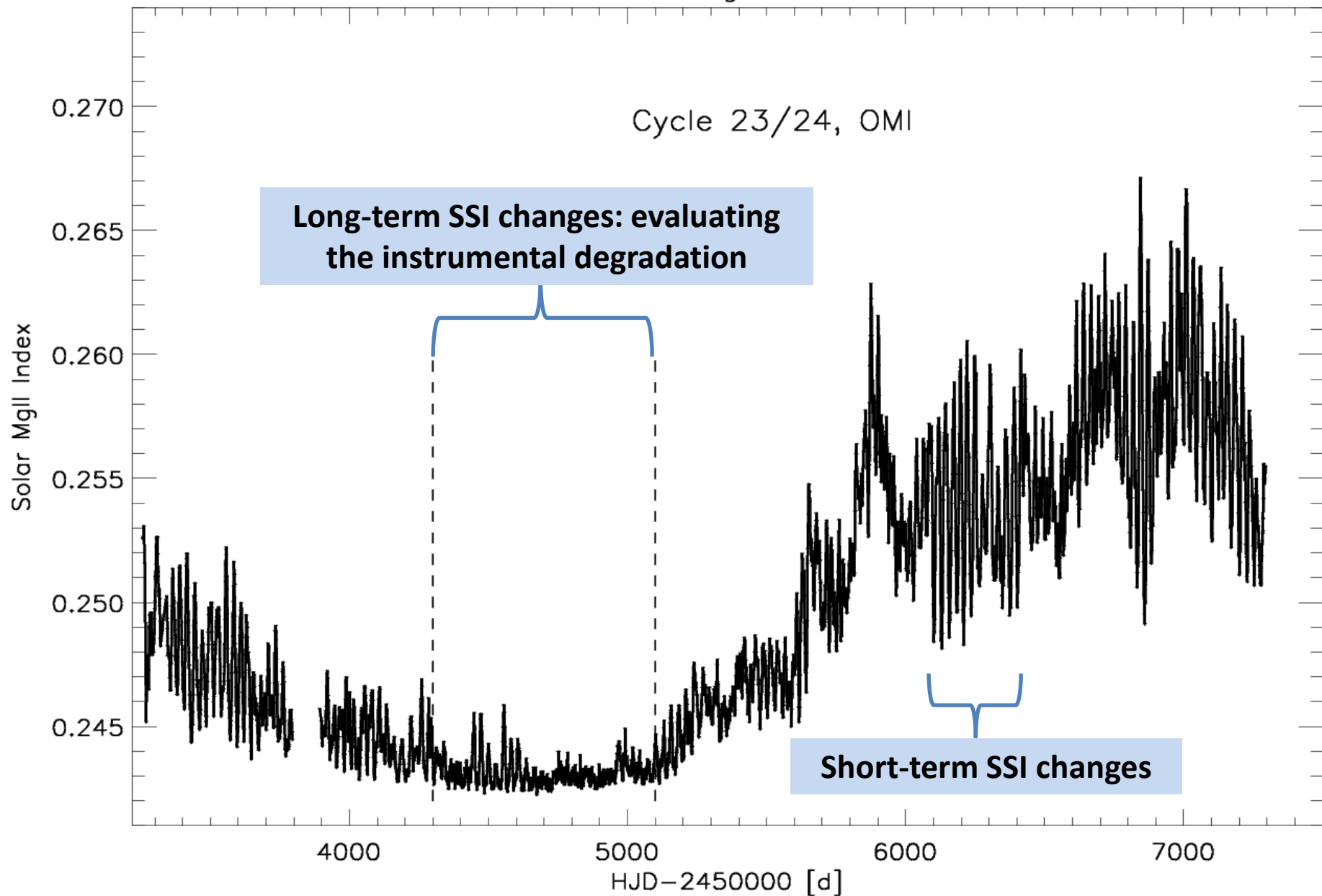
- Main goal: atmospheric trace gases ( $O_3$ ,  $SO_2$ ,  $NO_2$ , etc.).
- Nadir-viewing, 'pushbroom' single monochromator with a 2-D CCD:
  - 264-504 nm spectral range (2 UV and 1 Vis channel);
  - 0.4-0.6 nm spectral resolution;
  - 30-60 simultaneous x-track FOVs.
- Once/day solar measurements:
  - 30-60 disk-integrated solar spectra ('Sun-as-a-star').
- **Very stable instrument; over the mission lifetime (2004-present):**
  - 3-8 % change in the optical throughput;**
  - < 0.01 nm change in the wavelength registration.**

## OMP's annual degradation: irradiances



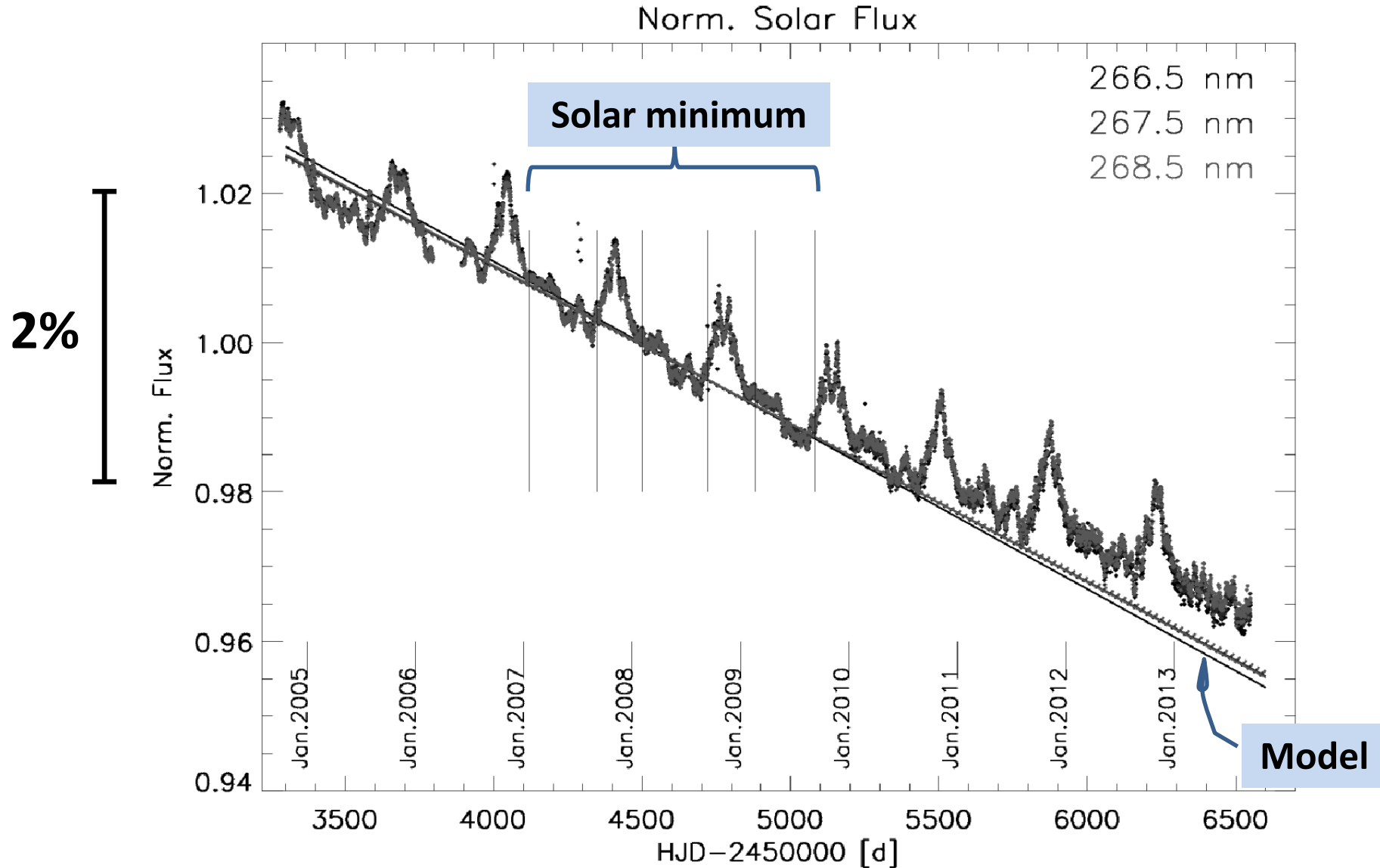
More details in: Marchenko & DeLand, 2014, ApJ, 789, 117

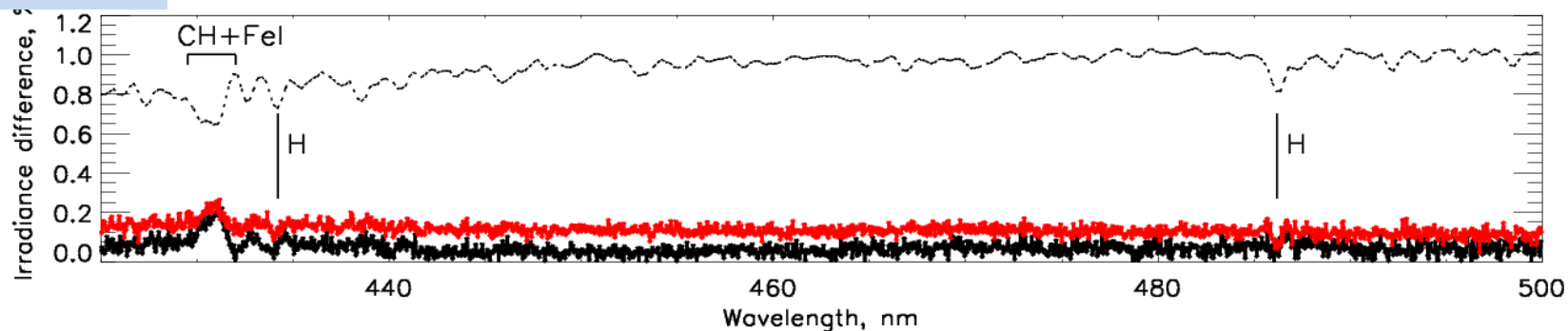
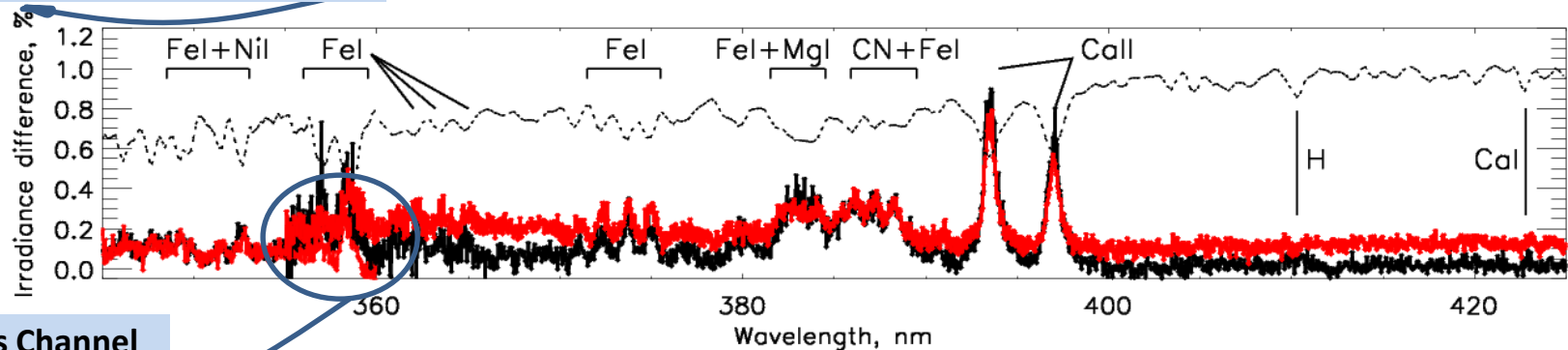
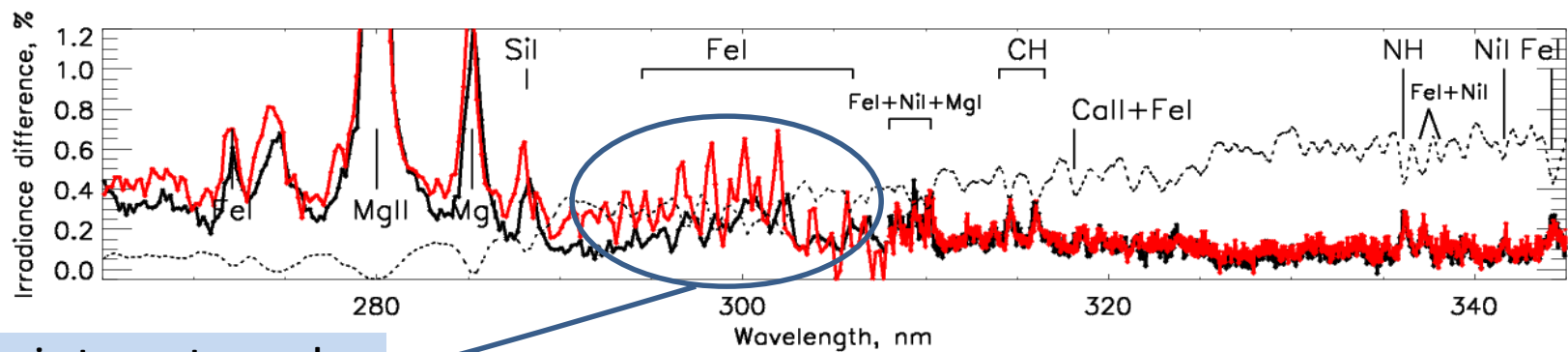
# Solar MgII Index



More details in: DeLand & Marchenko, 2013, JGR: Atmospheres, 118, 3415

# Building the degradation model for *OMI*

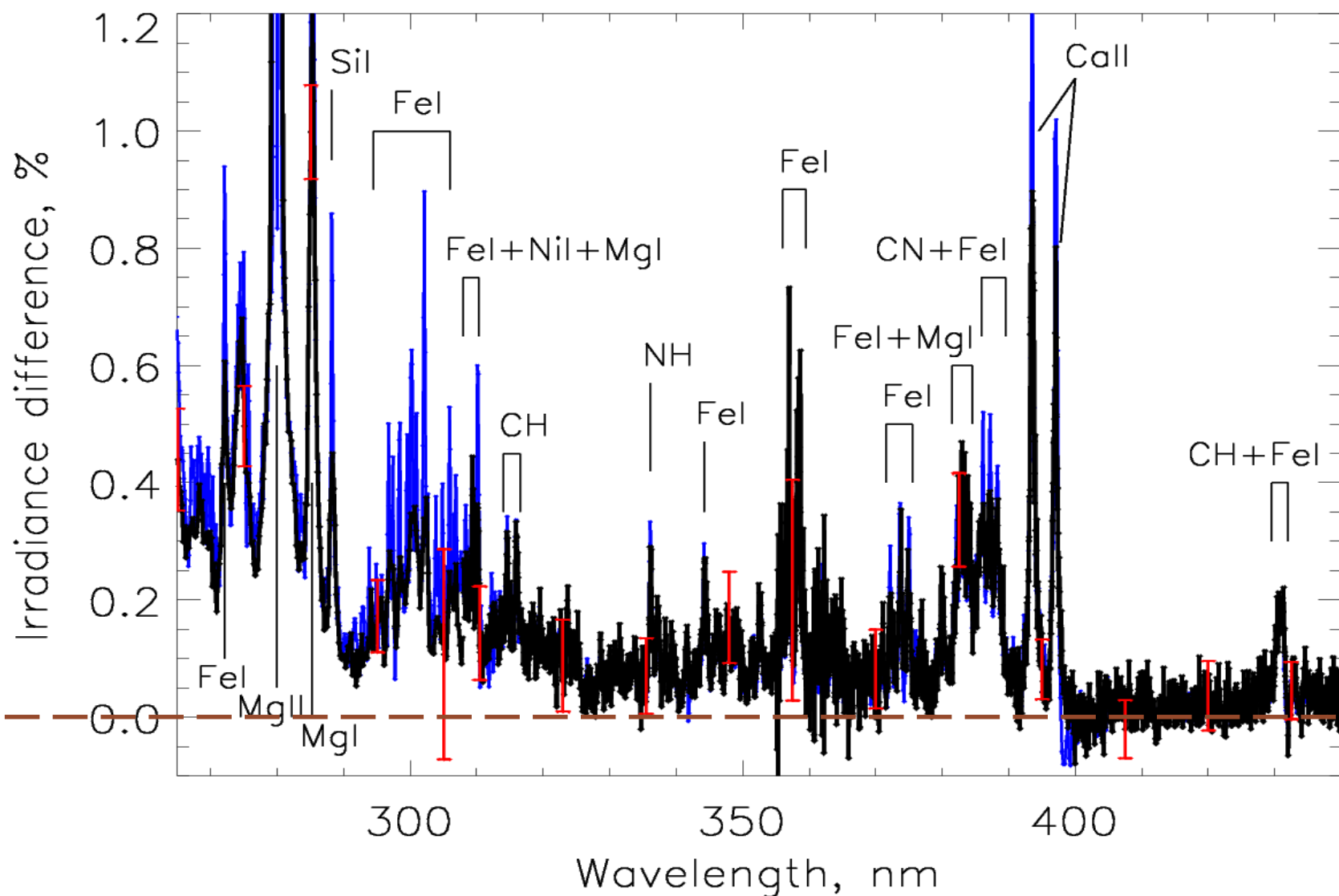




- Red line:** OMI, the long-term SSI changes (adjusted at the top of MgII), with a typical **~0.2% uncertainty**.
- Black line:** OMI, the short-term (rotational) SSI changes, with a typical **~0.05% - 0.10% uncertainty**.
- Dots:** OMI, a scaled solar spectrum.

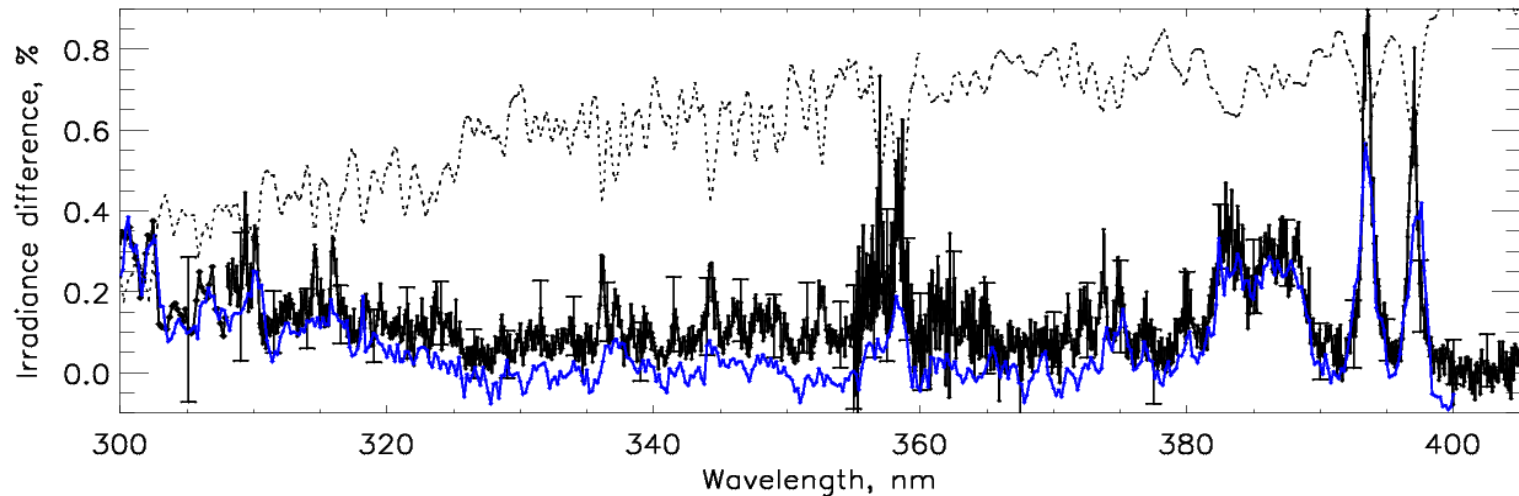
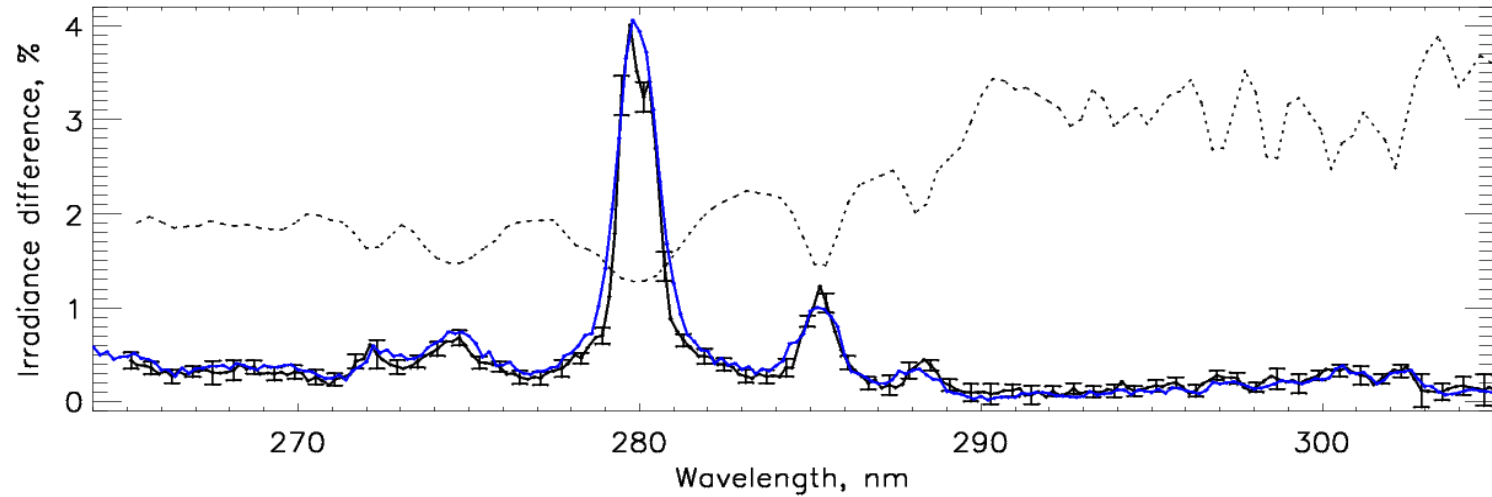


## Short-term (rotational) SSI changes in Cycle 24: *OMI* vs. *GOME-2*



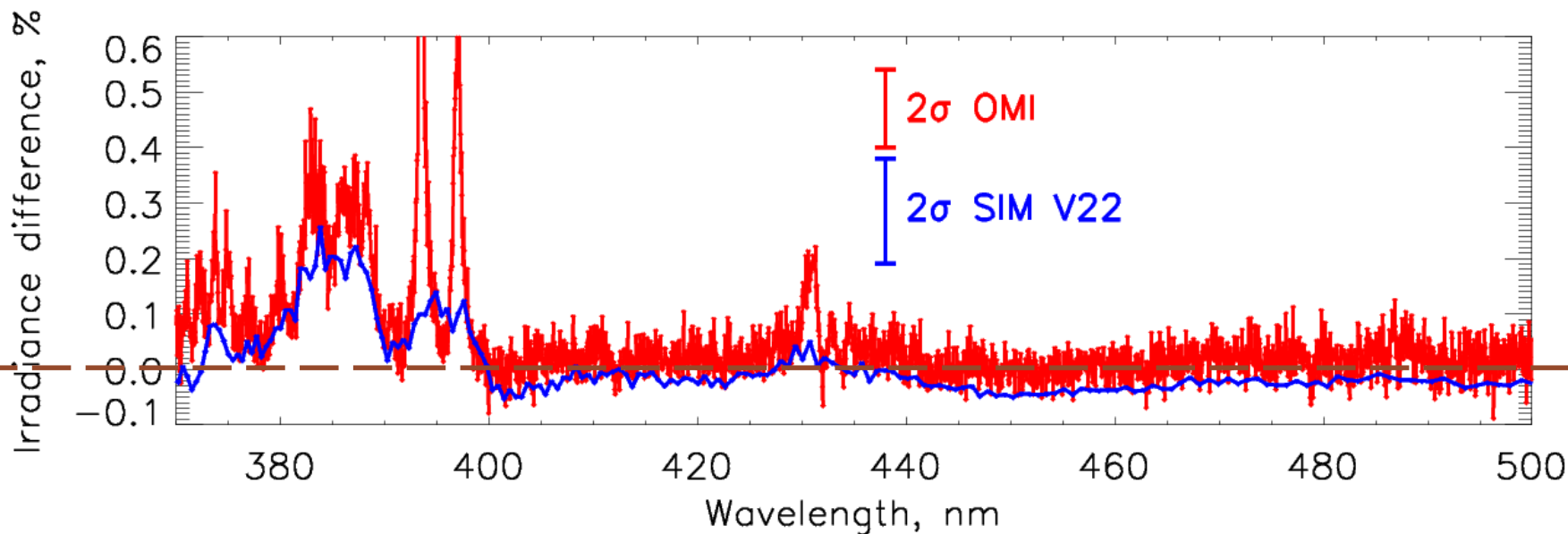
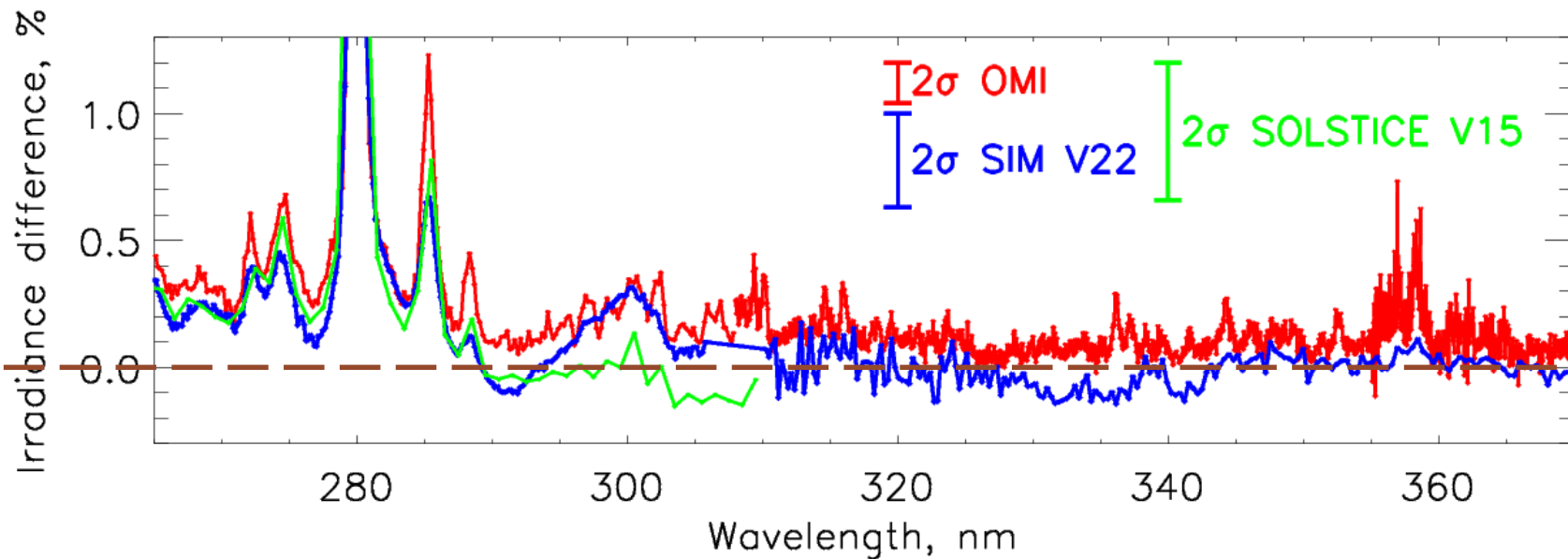
**Black:** *OMI*, with  $2\sigma$  uncertainties (red bars);  
**Blue:** *GOME-2* (2x higher spectral resolution cf. *OMI*)

# Short-term (rotational) SSI variations: *OMI* Cycle 24 vs. compilation from Cycle 21

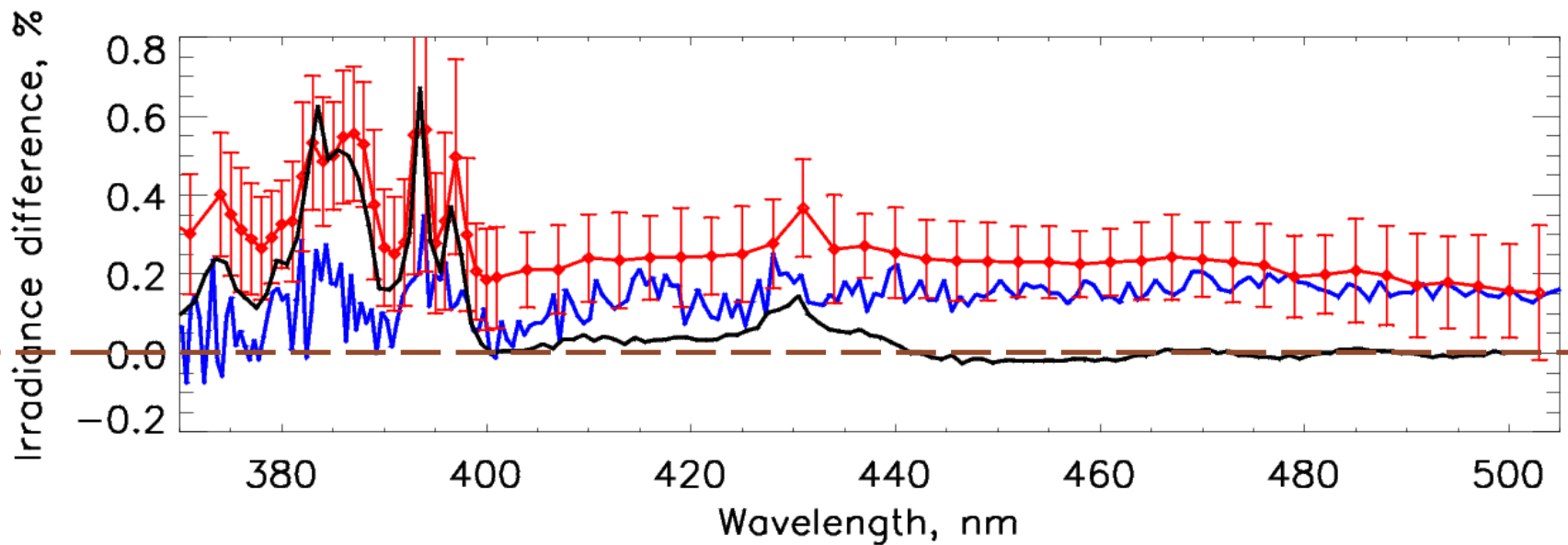
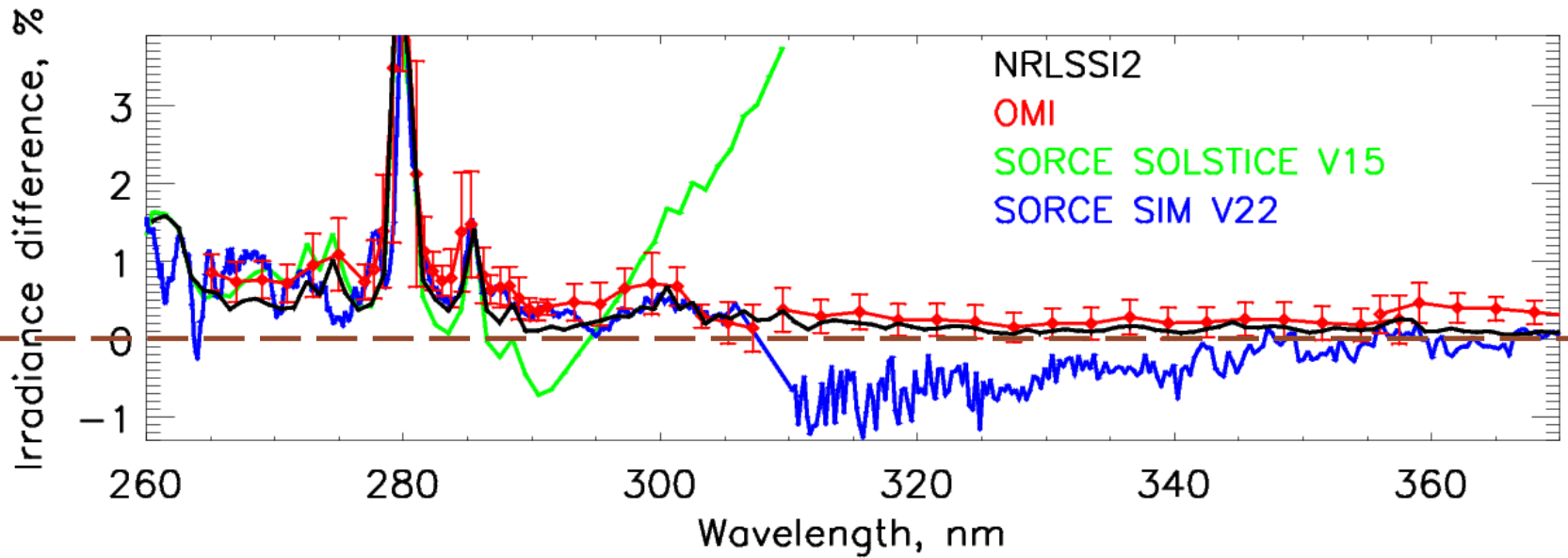


- Blue line:** the properly adjusted (peak of the MgII line) short-term (rotational cycle) SSI changes from DeLand and Cebula (1993).
- Black line:** the short-term Cycle 24 SSI changes (*OMI*).
- Dotted line:** a scaled solar spectrum

Short-term SSI changes (8 rotational cycles btw.  
June 2012 and April 2013) : *OMI* vs. *SORCE*

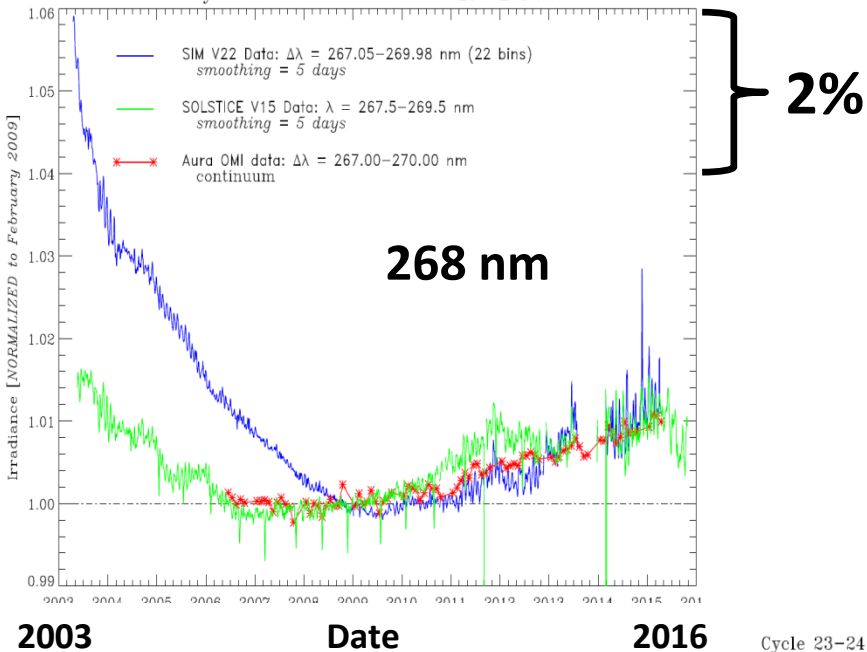


# Long-term SSI changes in Cycle 24: (Oct.2014 - Oct.2008) / Oct.2008

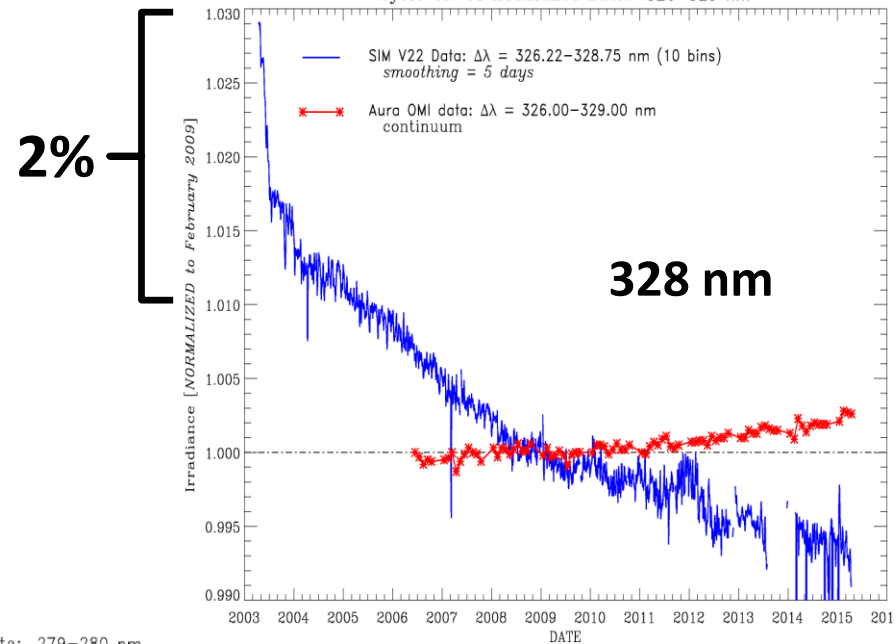


# Long-term SSI changes in Cycle 24

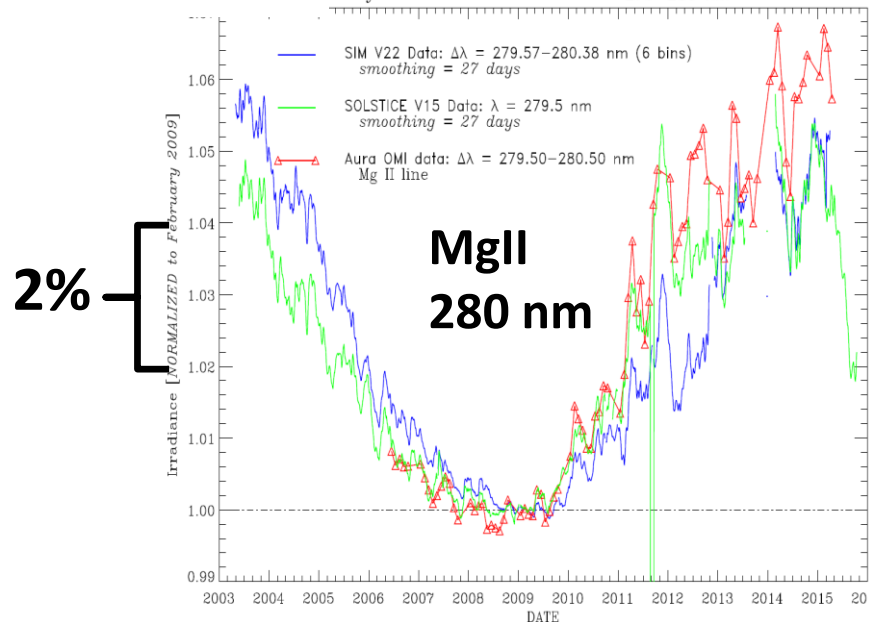
Cycle 23-24 Irradiance Data: 267-270 nm



Cycle 23-24 Irradiance Data: 326-329 nm



Cycle 23-24 Irradiance Data: 279-280 nm

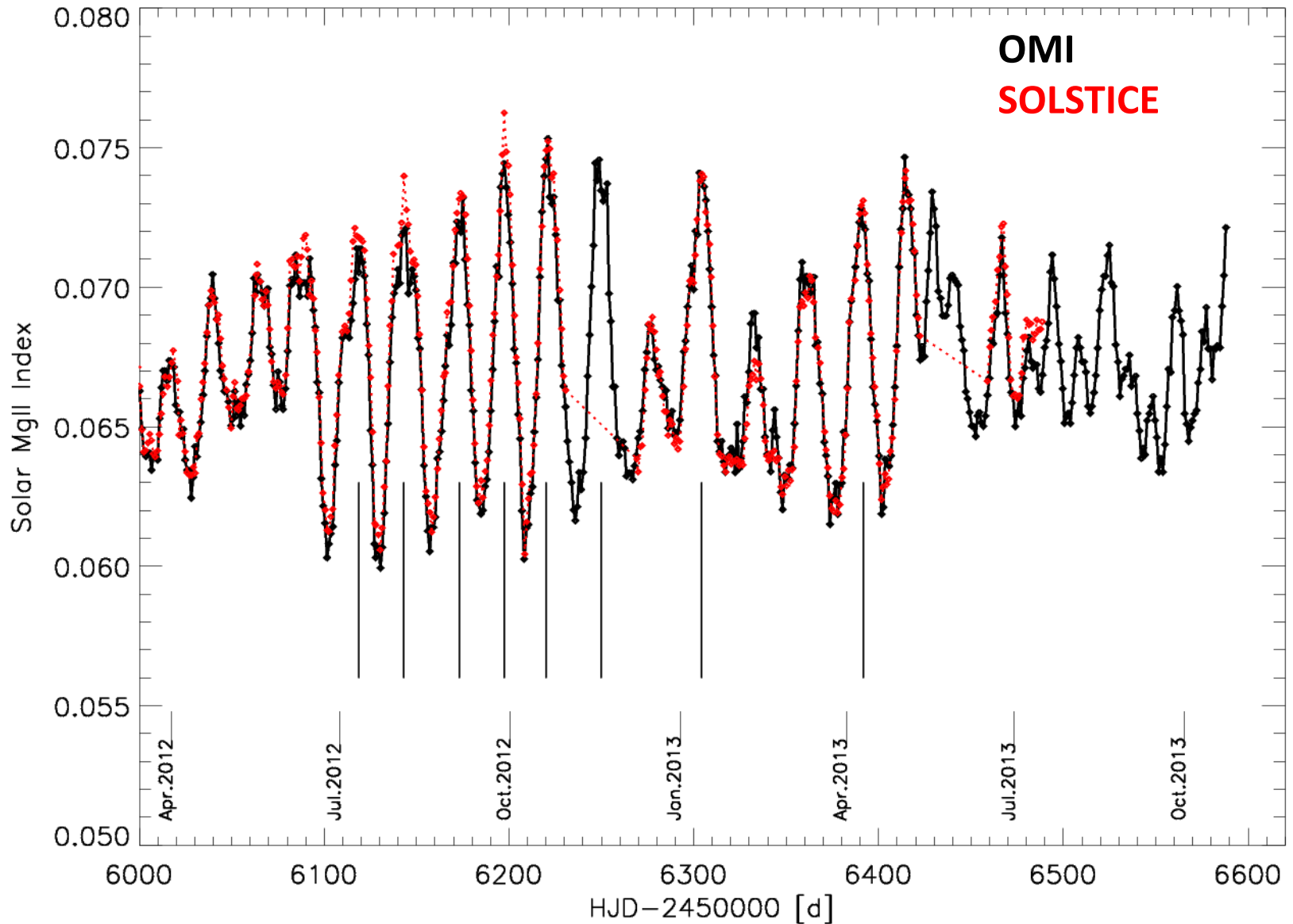


**SIM V22**  
**SOLSTICE V15**  
**OMI**

- Does the long-term (solar cycle) SSI variability follows the short-term (rotational) SSI patterns?
  - *fairly close, to within the quoted ( $\sim 0.1$ - $0.2\%$ ) OMI uncertainties and at OMI spectral resolution ( $0.4$ - $0.6$  nm);*
  - *though with some subtle differences (Marchenko & DeLand 2014)*
  
- How unusual is Cycle 24?
  - *nothing anomalous in the SSI changes btw. 265-500 nm, judging by the OMI results;*
  - *in-phase UV and Vis SSI variability.*

**Backup**

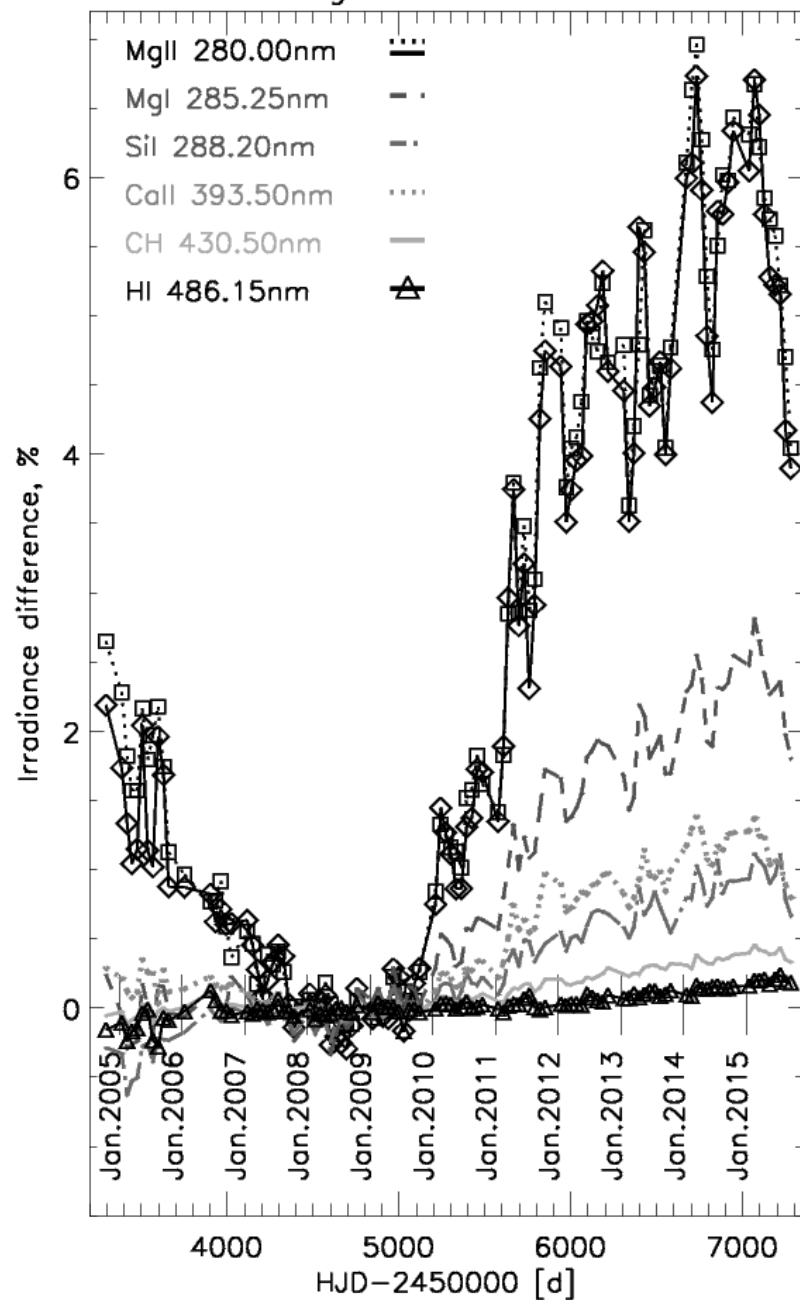
# Solar MgII 280nm Index



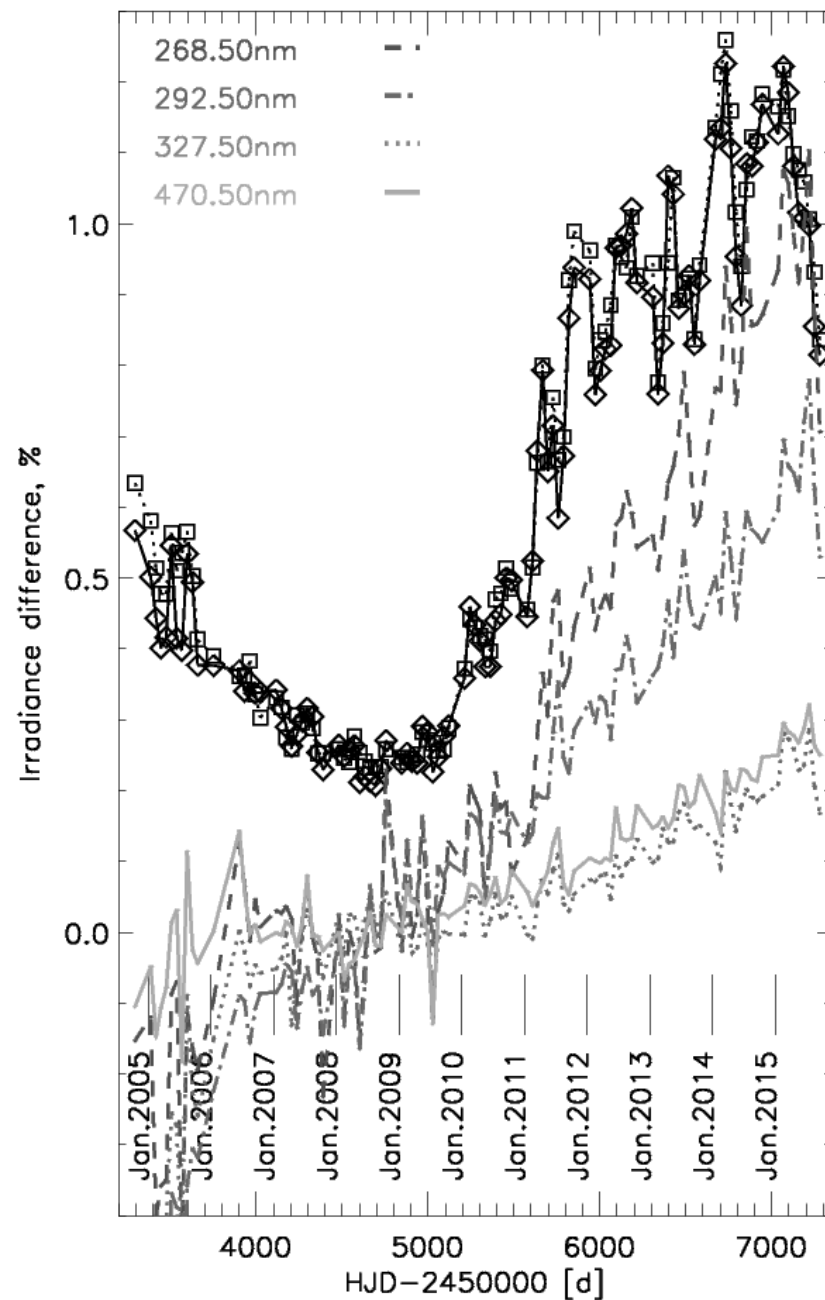
More details in: DeLand & Marchenko, 2013, JGR: Atmospheres, 118, 3415

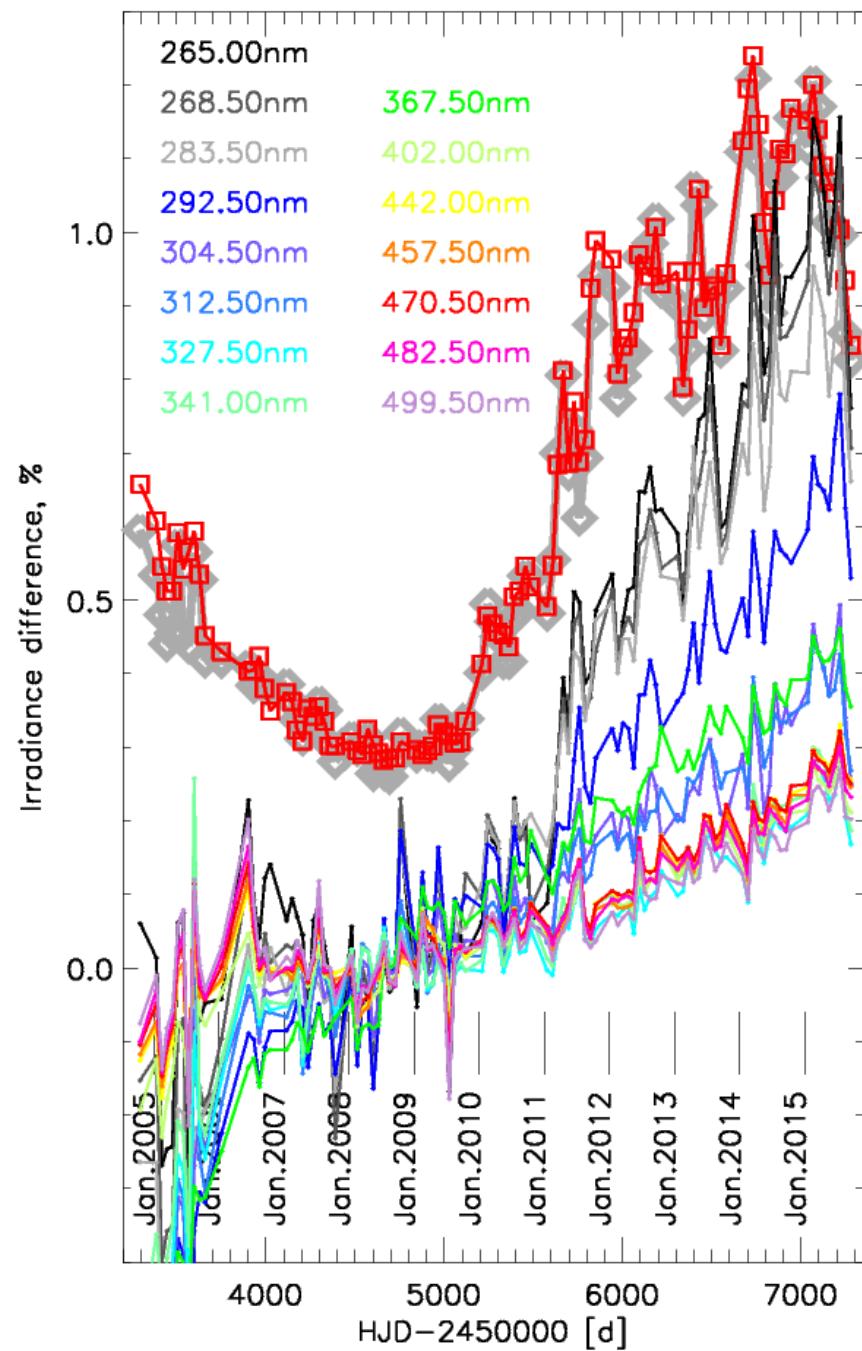
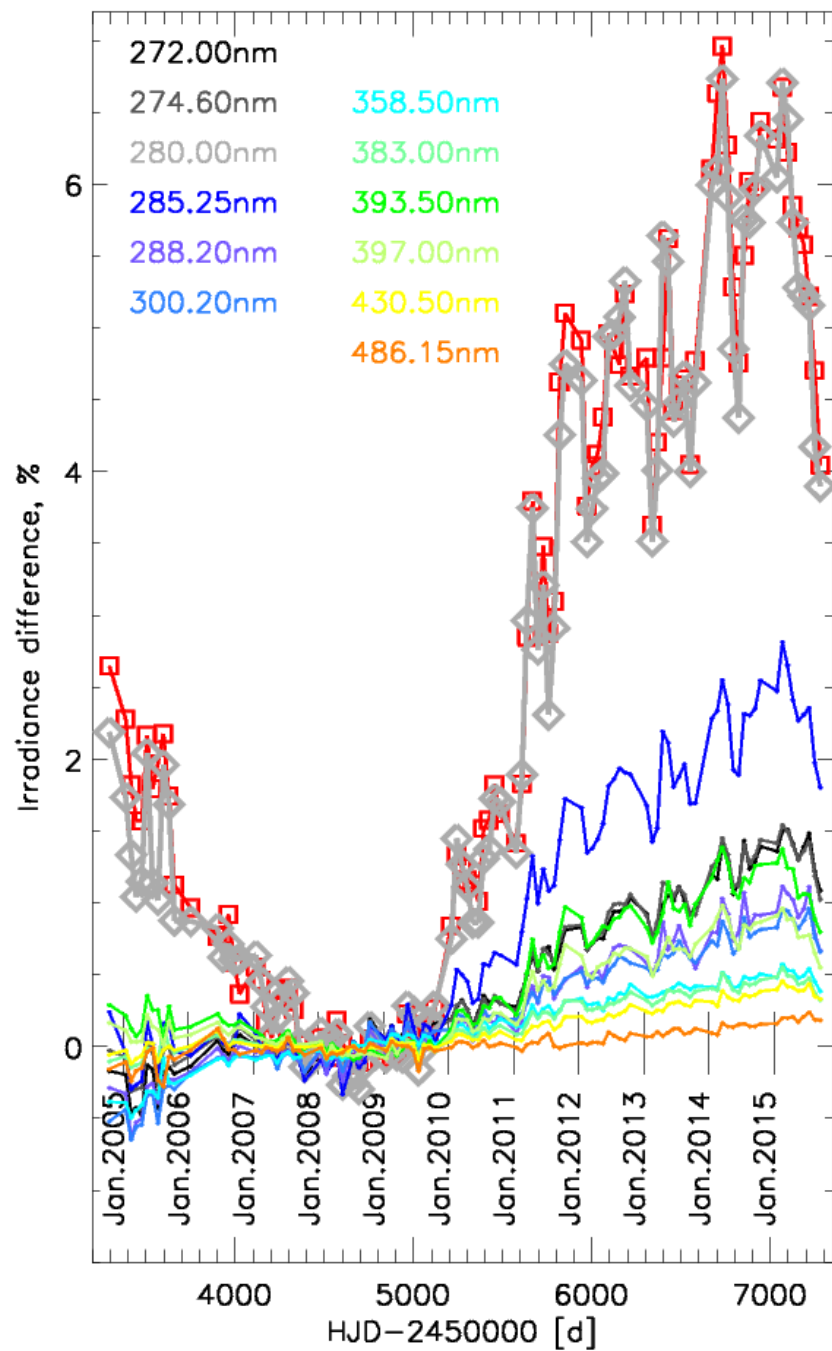


Strong lines and blends

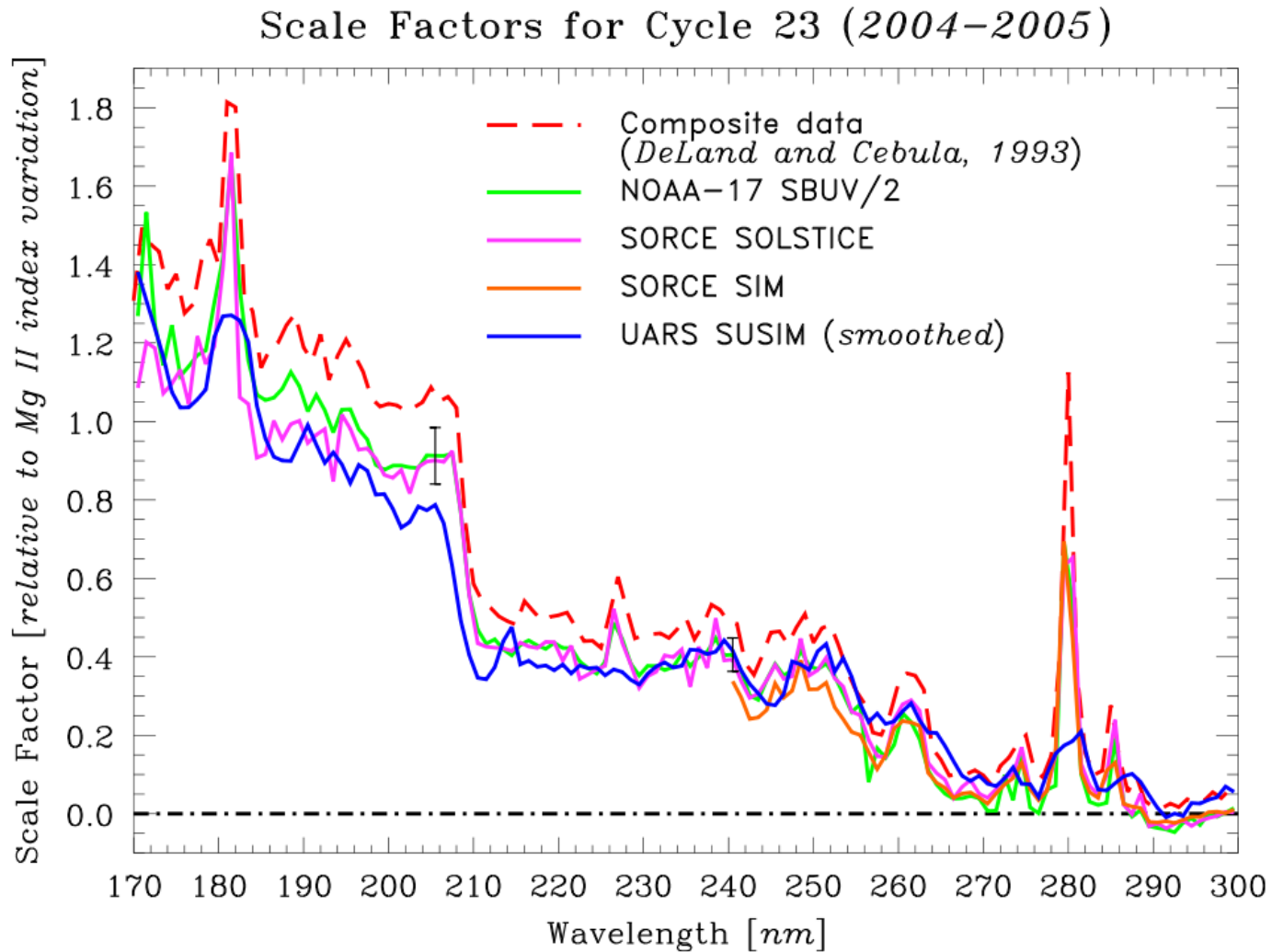


Weak lines

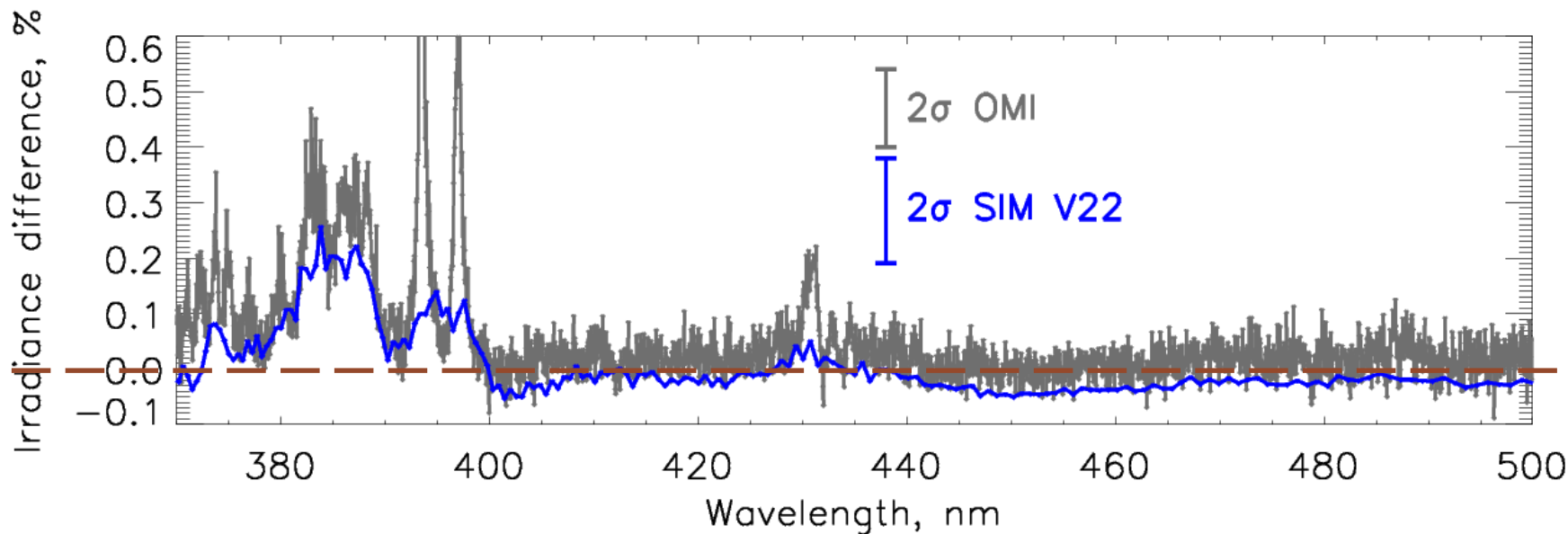
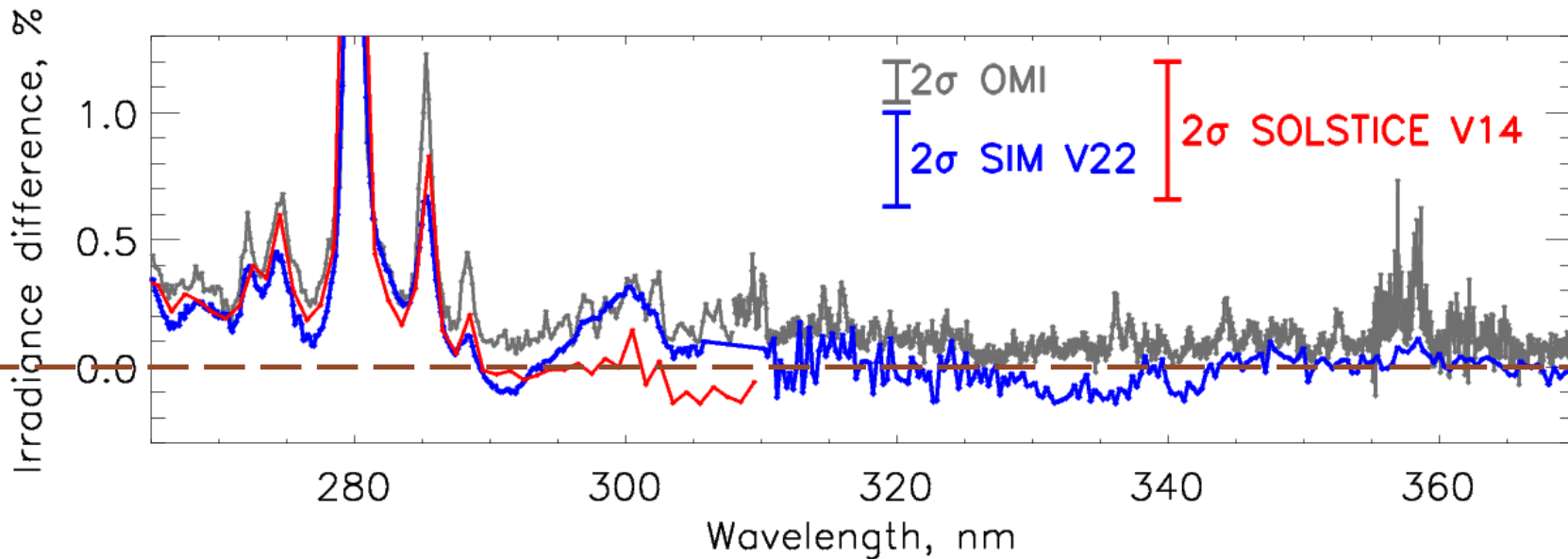




# Short-term SSI changes in Cycle 23



# Short-term SSI changes (8 rotational cycles btw. June 2012 and April 2013) : *OMI* vs. *SORCE*



# Long-term SSI changes in Cycle 24: (Oct.2014 - Oct.2008) / Oct.2008

