OMI Solar Data: Recent Developments

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SSAI/NASA GSFC

SIST Meeting, May 11-12, 2017

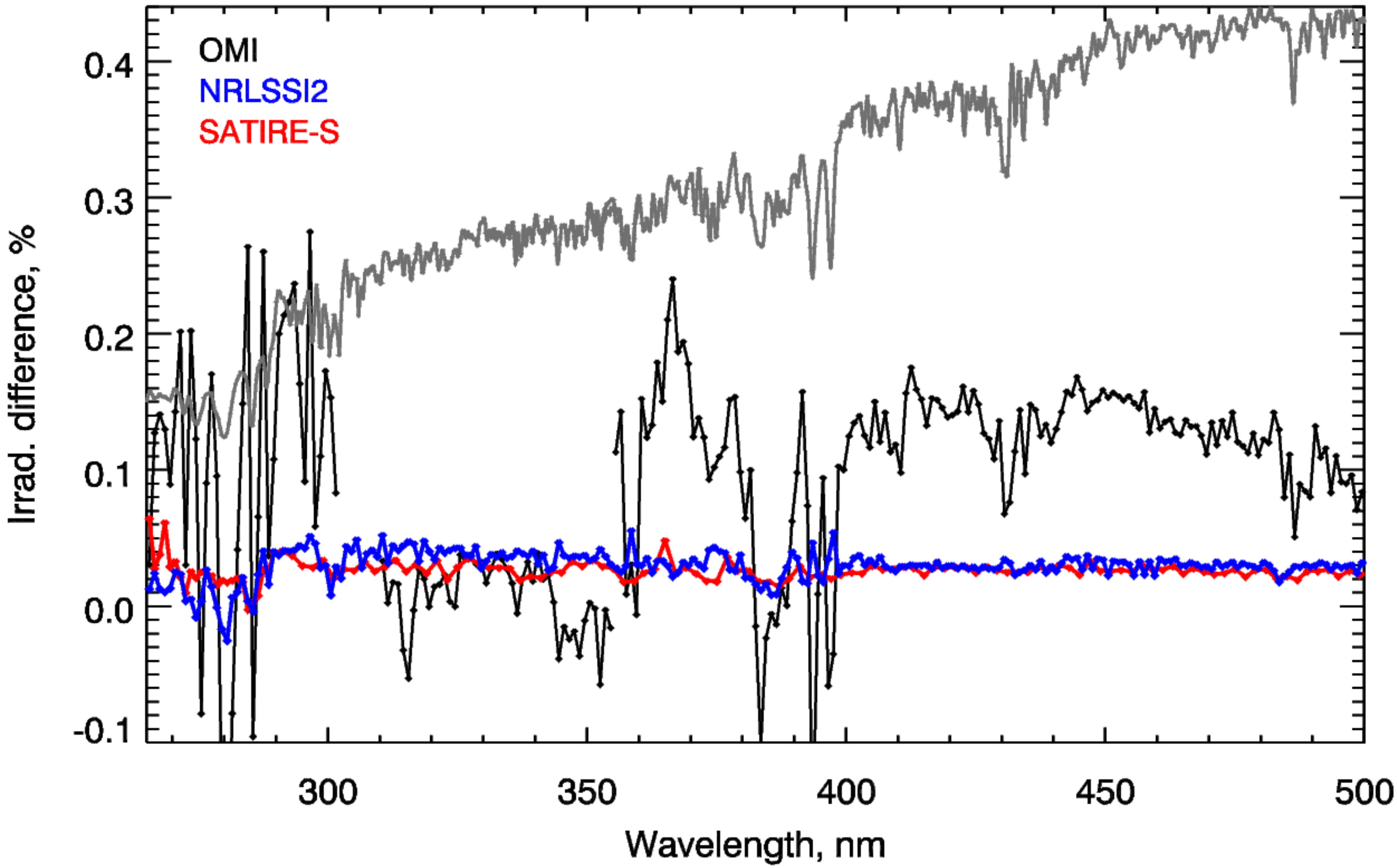
1. Solar data (OMI, SORCE, GOME-2A) and Solar models (NRLSSI2 and SATIRE-S).

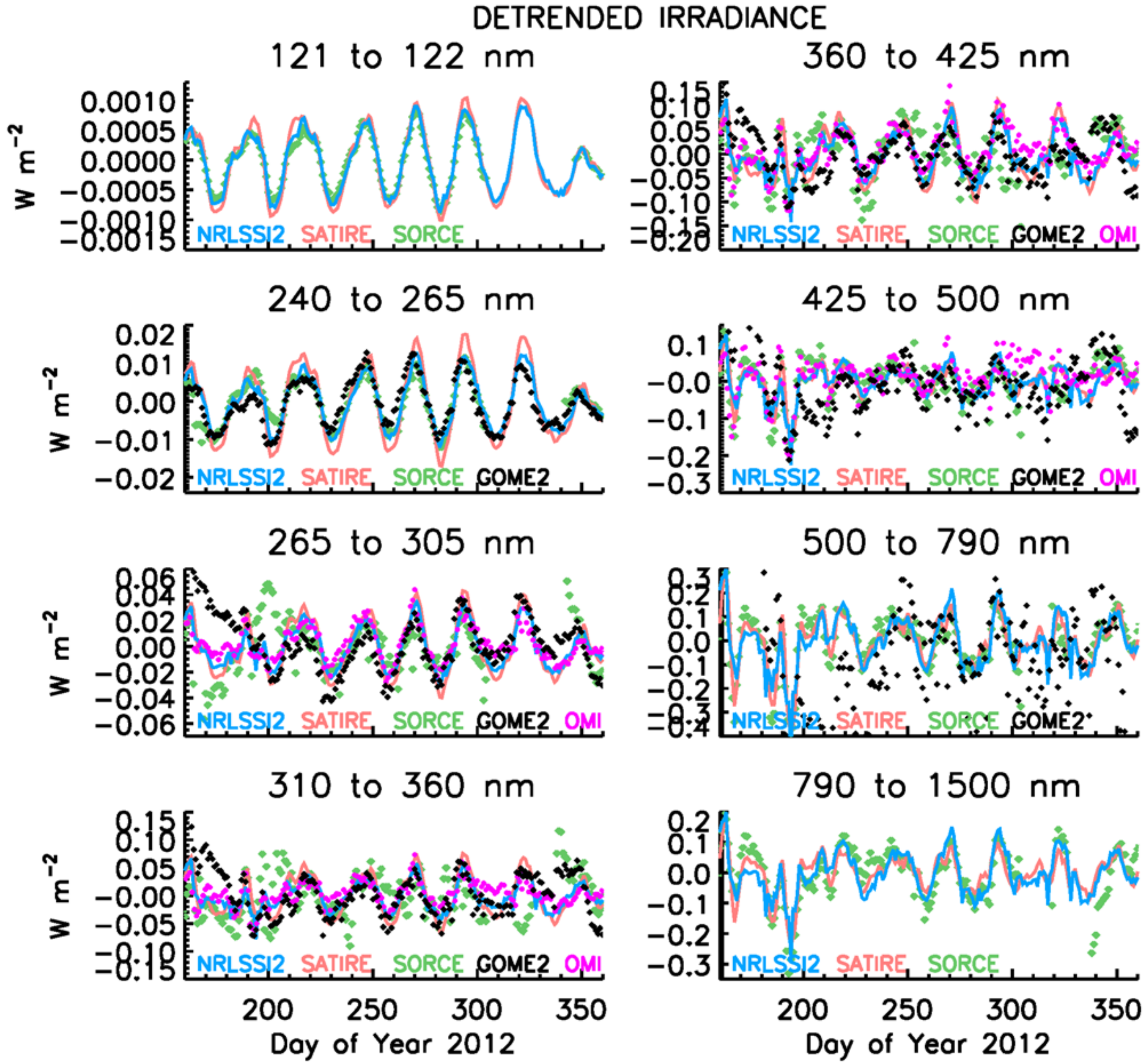
2. OMI degradation-free SSI.

3. OMI solar indices.

Difference btw. the long-term (yy2012-2014 vs. yy2007-2009) and short-term (8 rotational cycles in yy2012-2013) SSI changes

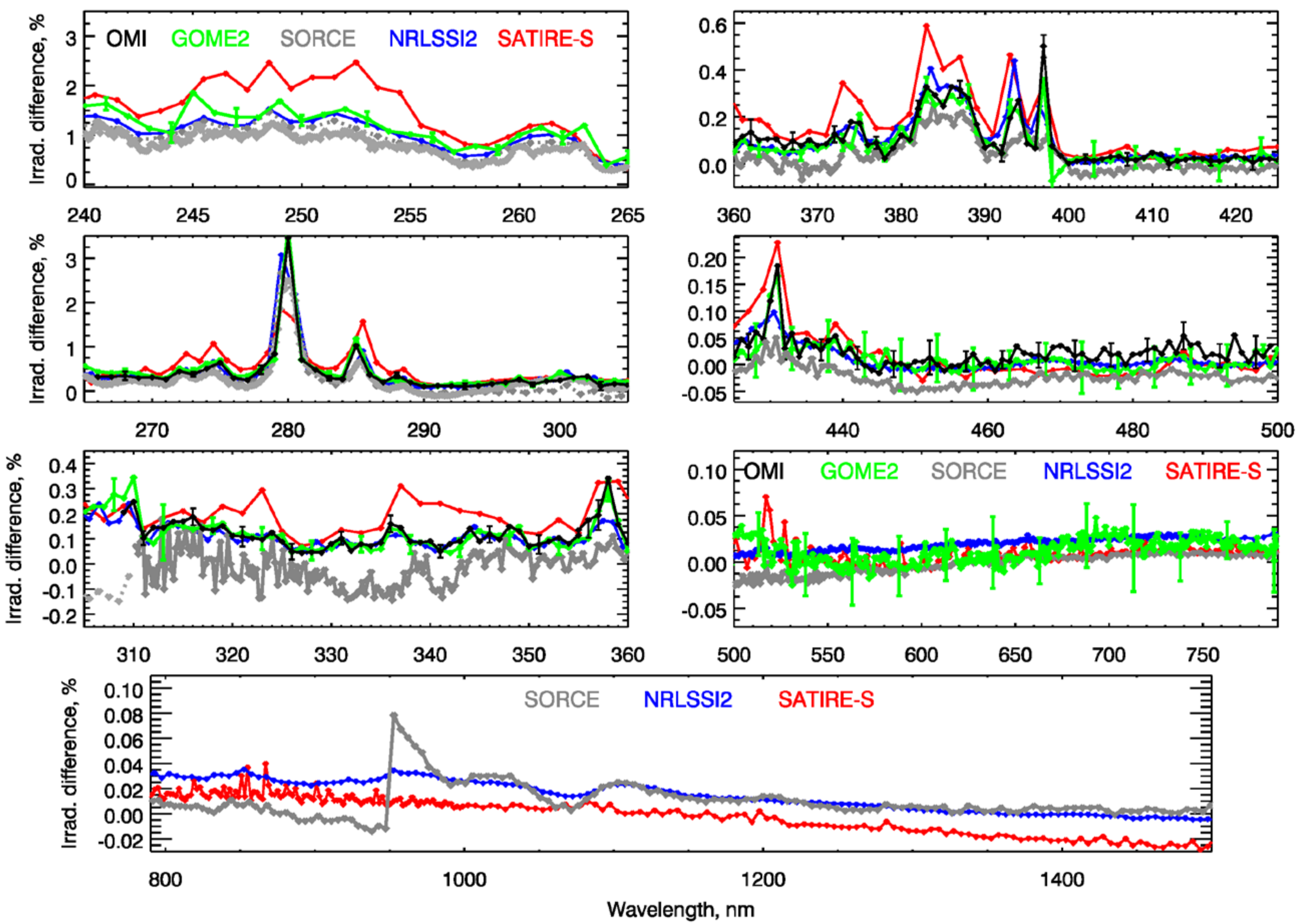
Marchenko, DeLand, Lean, JSWSC, 6, No. 27, A40 (2016)





DETRENDED IRRADIANCE
121 to 122 nm
240 to 265 nm
265 to 305 nm
310 to 360 nm
360 to 425 nm
425 to 500 nm
500 to 790 nm
790 to 1500 nm
W m^{-2}
NRLSSI2
SATIRE
SORCE
GOME2
OMI
Day of Year 2012

Observed short-term (rotational) SSI changes and model predictions



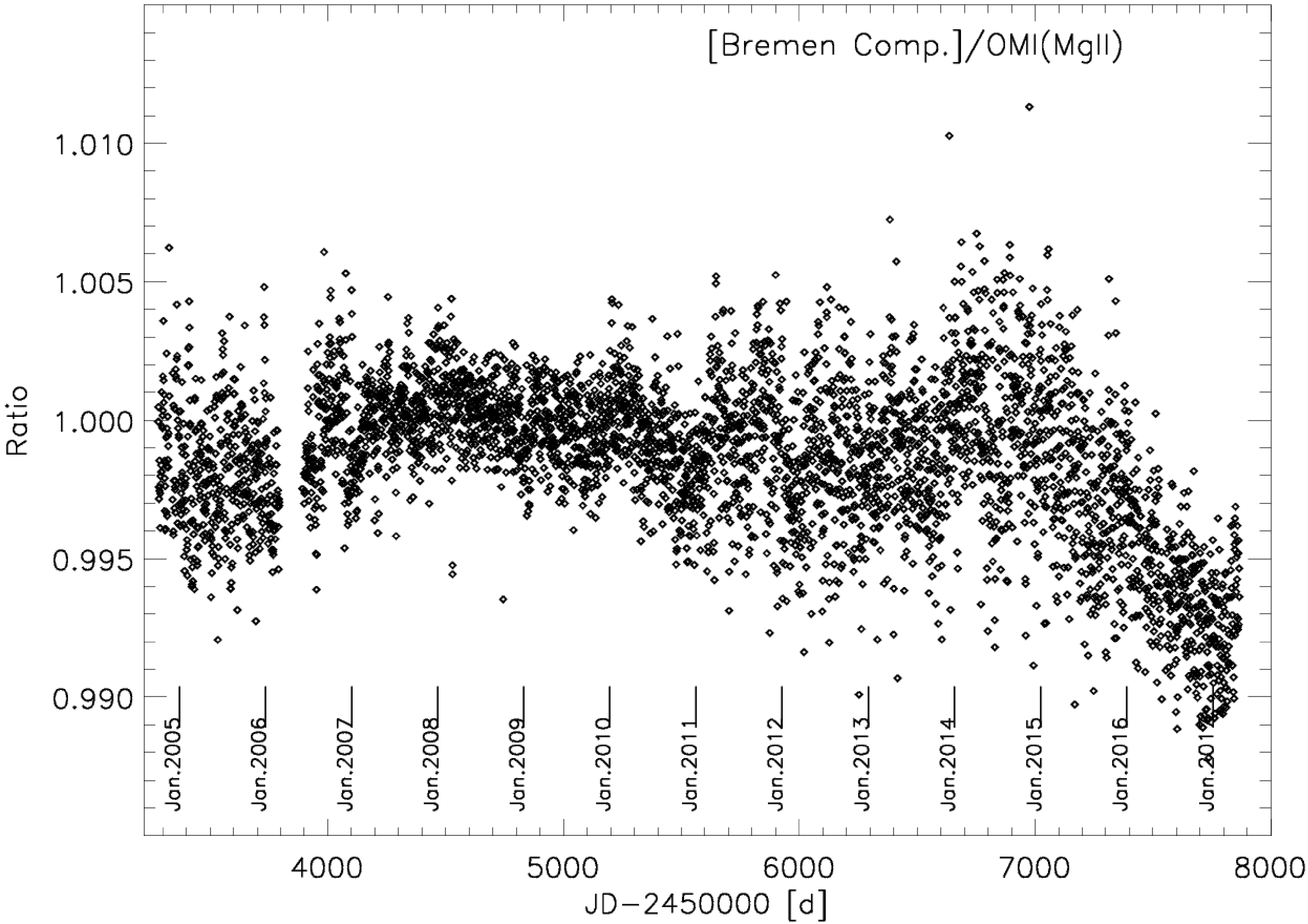
OMI degradation-free SSI and the degradation model:

- now the daily irradiances are coming from an alternative-reprocessing stream;
- improved spectral resolution;
- FOV-dependent degradation coefficients.

Once extrapolated on the y2017 data, the currently assumed time-independent degradation rates lead to ~0.1-0.3% systematic errors.

Path forward:

- using the weekly measurements from the regular solar diffusor;
- updating the degradation model with the data from the Cycle 24/25 minimum.


[Bremen Comp.]/OMI(MgII)
Ratio
1.010
1.005
1.000
0.995
0.990
JD−2450000 [d]
4000
5000
6000
7000
8000
Jan.2005
Jan.2006
Jan.2007
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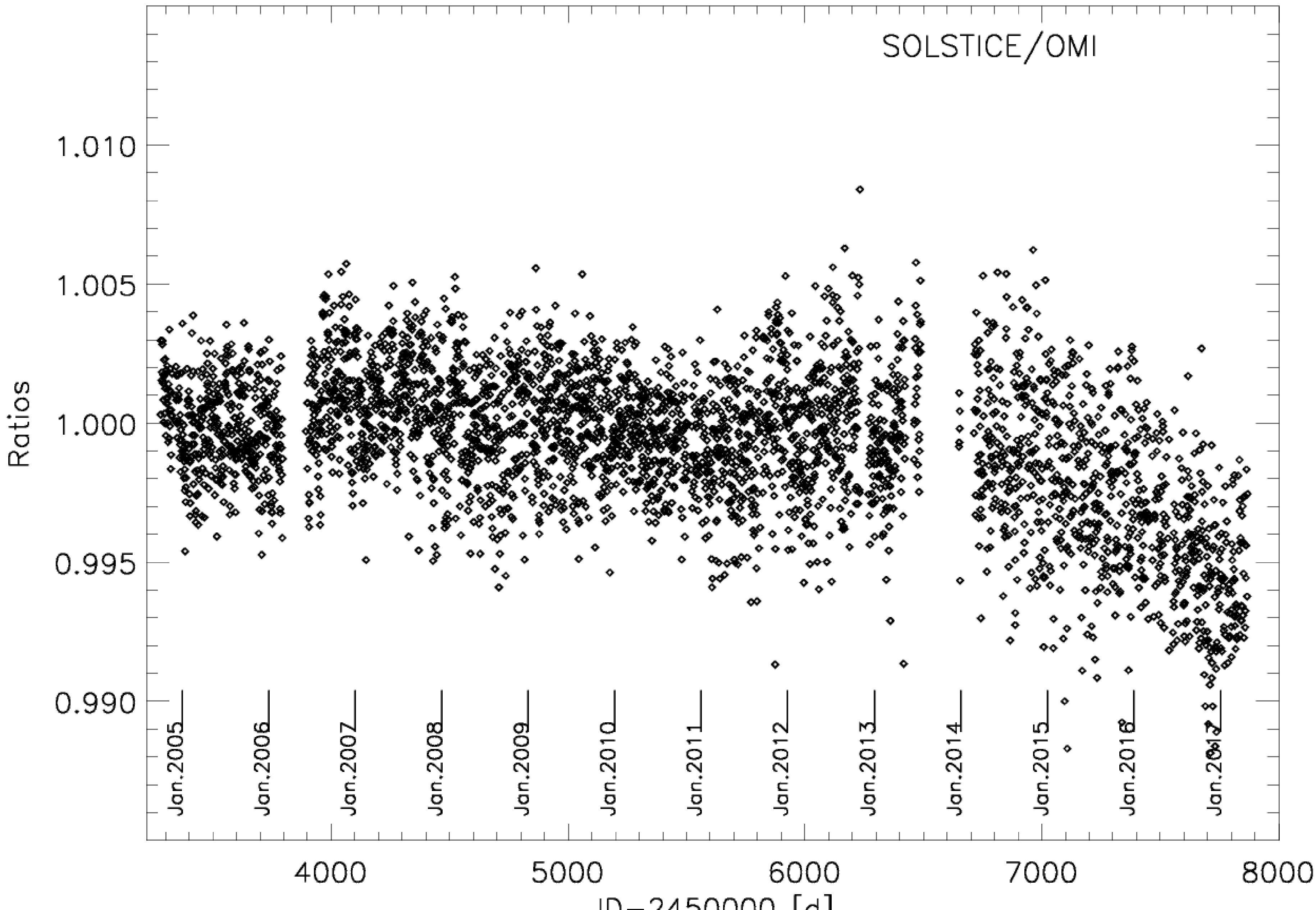
Jan.2010
Jan.2011
Jan.2012
Jan.2013
Jan.2014
Jan.2015
Jan.2016



SOLSTICE/OMI
Ratios
1.010
1.005
1.000
0.995
0.990
Jan.2005
Jan.2006
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Jan.2009
Jan.2010
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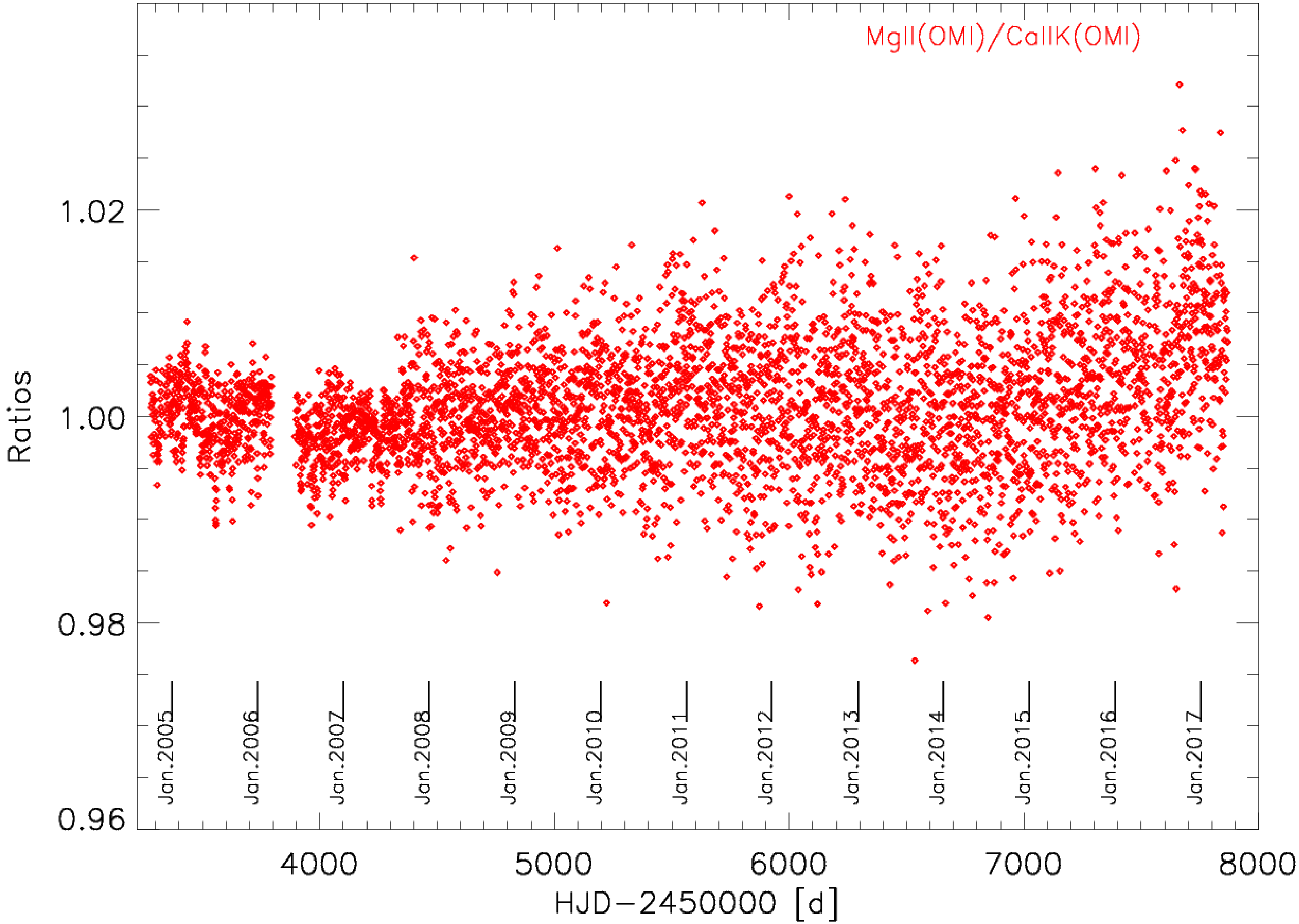
JD-2450000 [d]


MgII(OMI)/CaIIK(OMI)
Ratios
1.02
1.00
0.98
0.96
Jan.2005
Jan.2006
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Jan.2009
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Jan.2015
Jan.2016
Jan.2017
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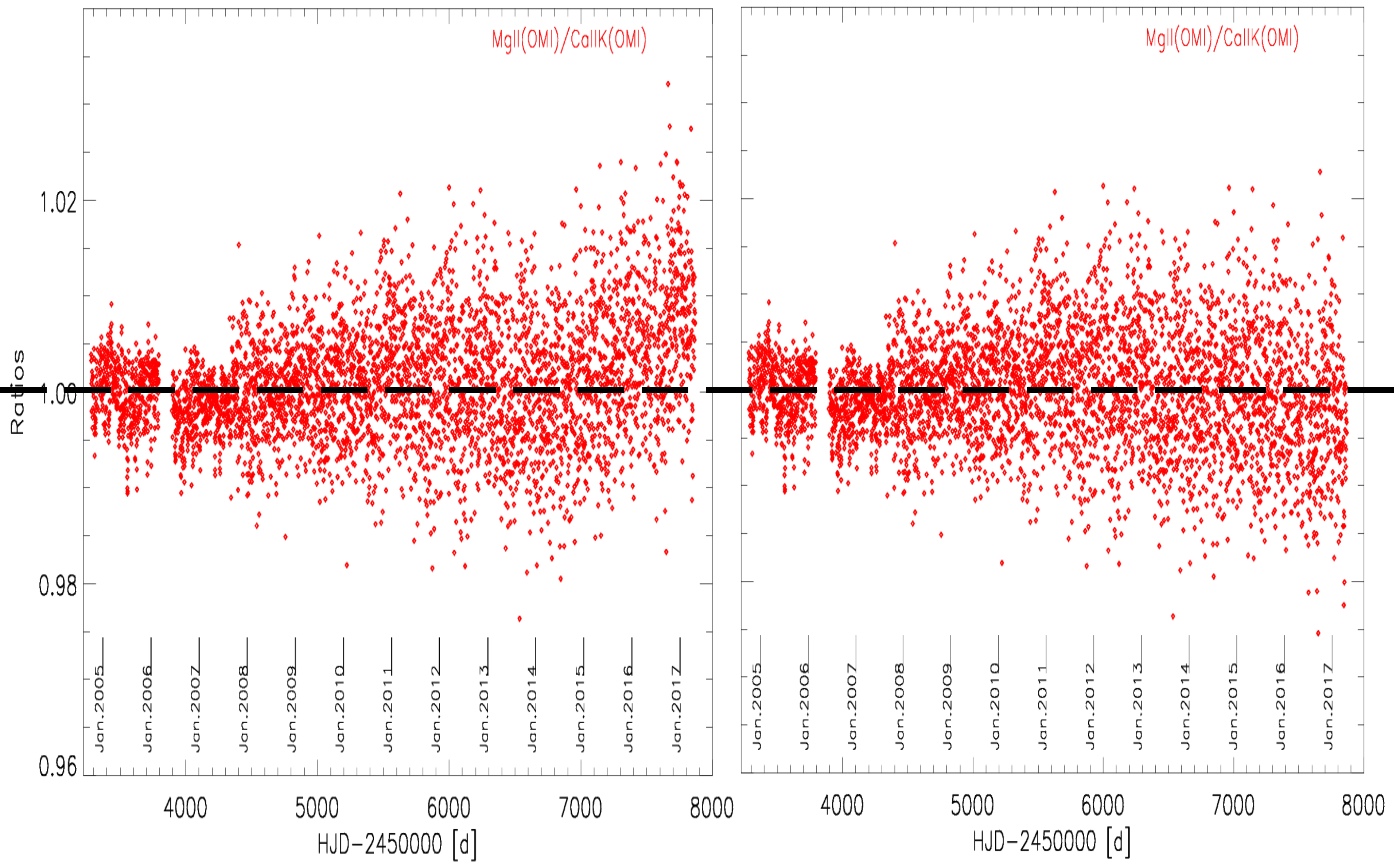
HJD−2450000 [d]



MgII(OMI)/CaIIK(OMI)
MgII(OMI)/CaIIK(OMI)
Ratios
1.02
1.00
0.98
0.96
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Jan.2009
Jan.2010
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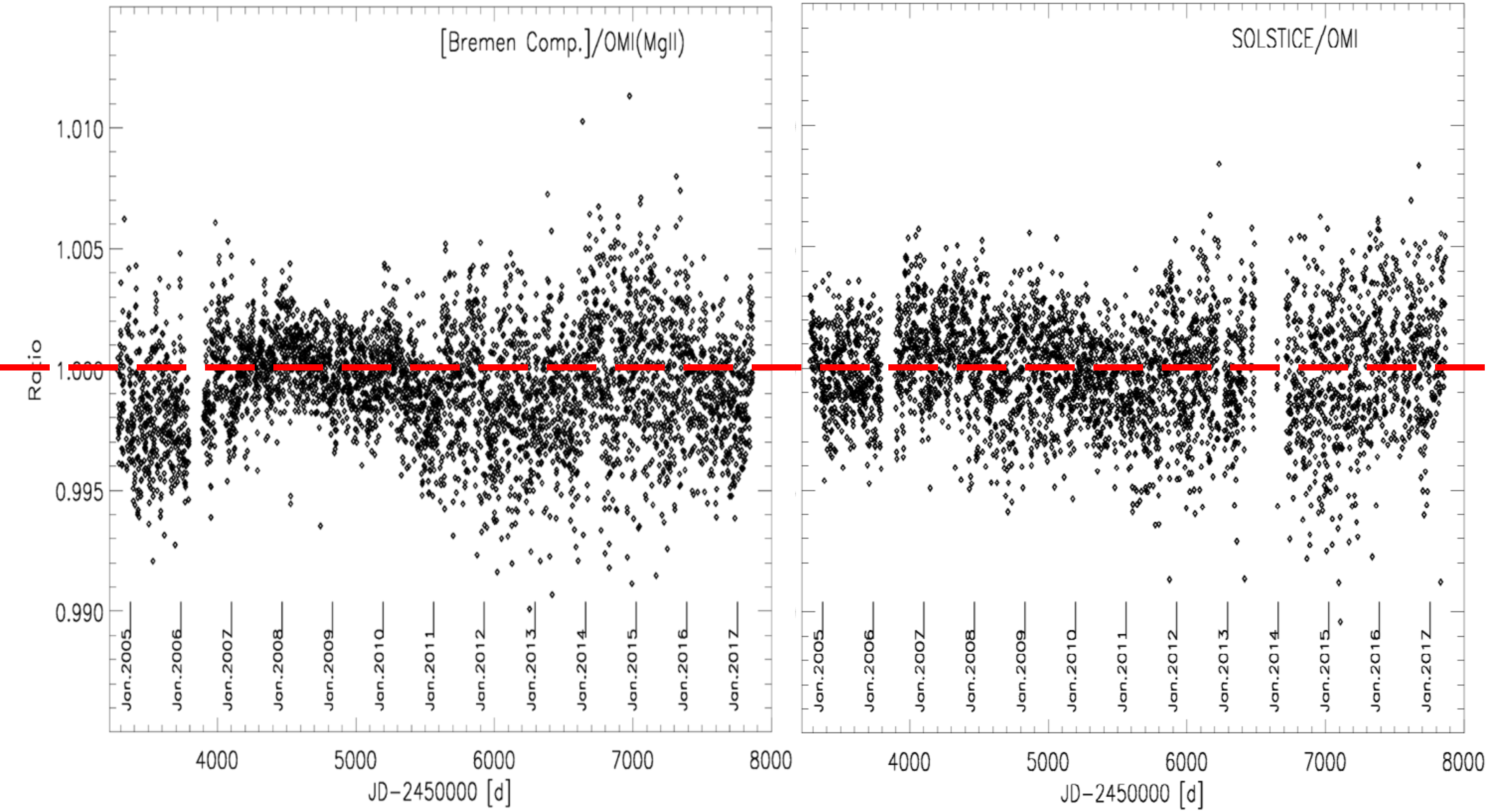
HJD-2450000 [d]
HJD-2450000 [d]



[Bremen Comp.]/OMI(MgII)
SOLSTICE/OMI
Ratio
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1.005
1.000
0.995
0.990
Jan.2005
Jan.2006
Jan.2007
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Jan.2017
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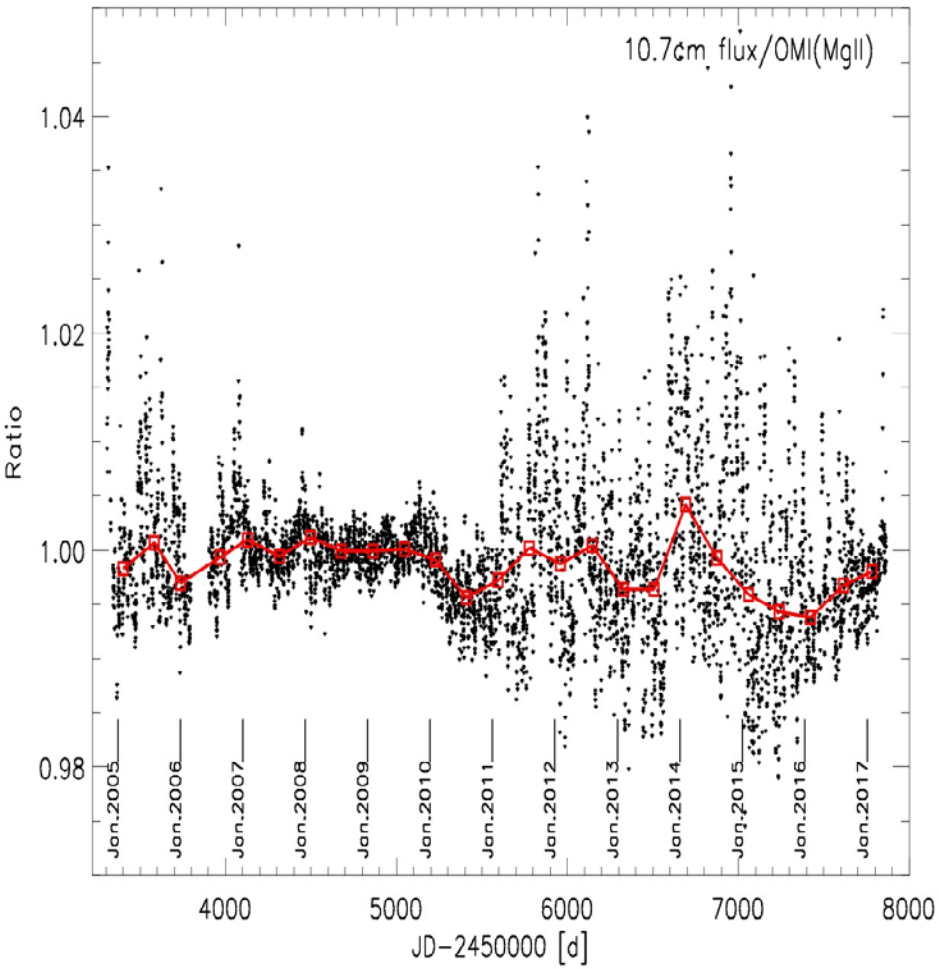
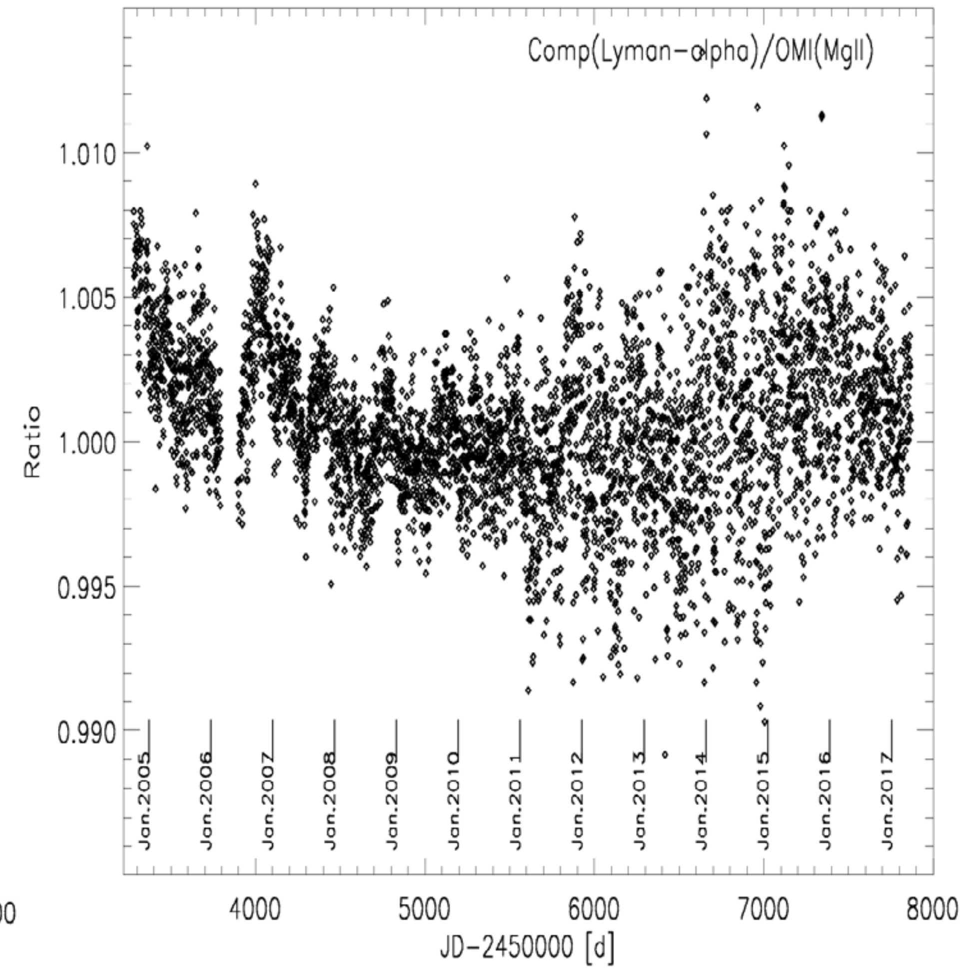
JD-2450000 [d]


10.7cm flux/OMI(MgII)
Ratio
JD-2450000 [d]
Jan.2005
Jan.2006
Jan.2007
Jan.2008
Jan.2009
Jan.2010
Jan.2011
Jan.2012
Jan.2013
Jan.2014
Jan.2015
Jan.2016
Jan.2017


Comp(Lyman-alpha)/OMI(MgII)
Ratio
JD-2450000 [d]
Jan.2005
Jan.2006
Jan.2007
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Jan.2011
Jan.2012
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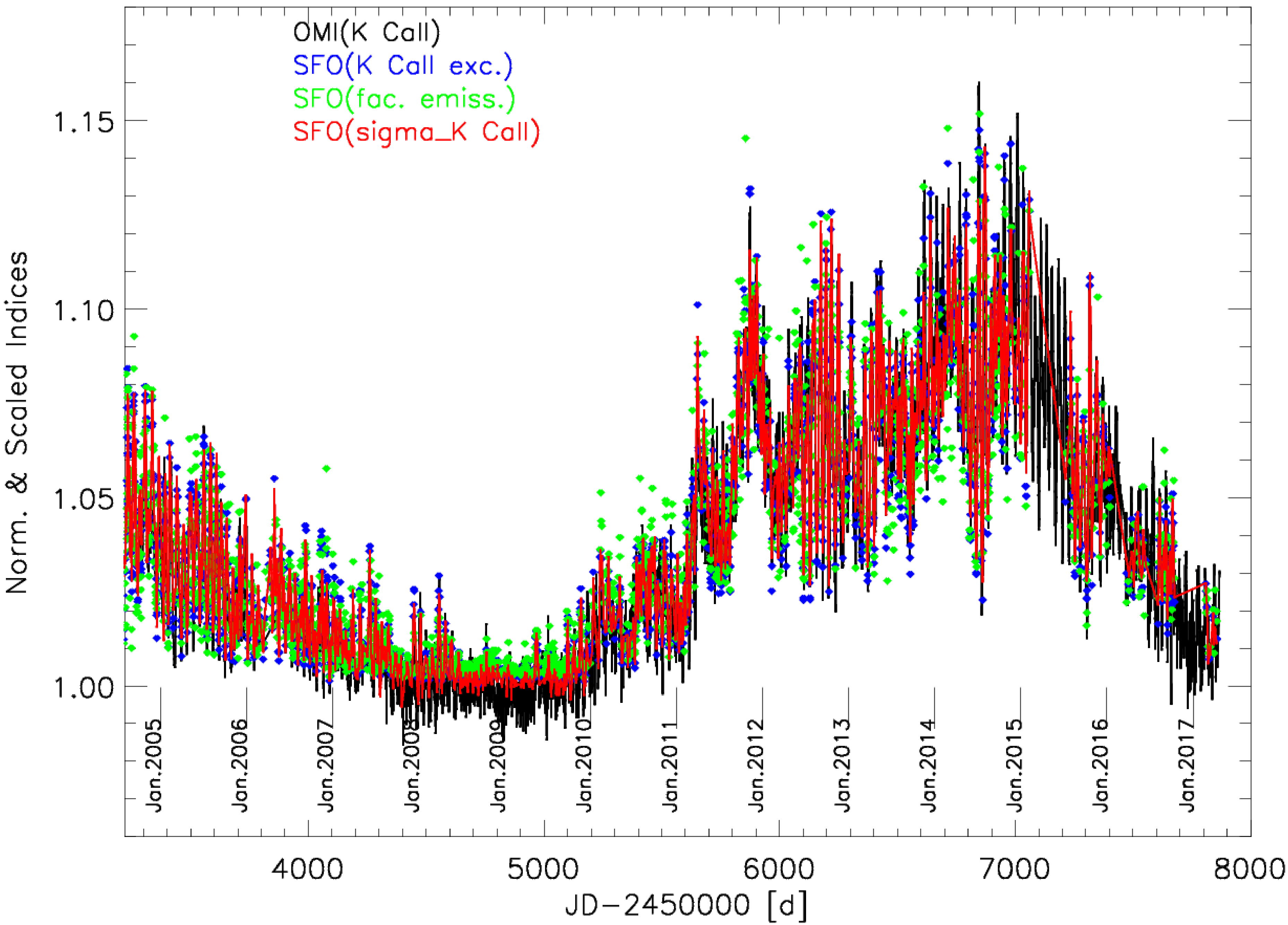
Jan.2016
Jan.2017


OMI(K CaII)
SFO(K CaII exc.)
SFO(fac. emiss.)
SFO(sigma_K CaII)
1.15
1.10
1.05
1.00
Jan.2005
Jan.2006
Jan.2007
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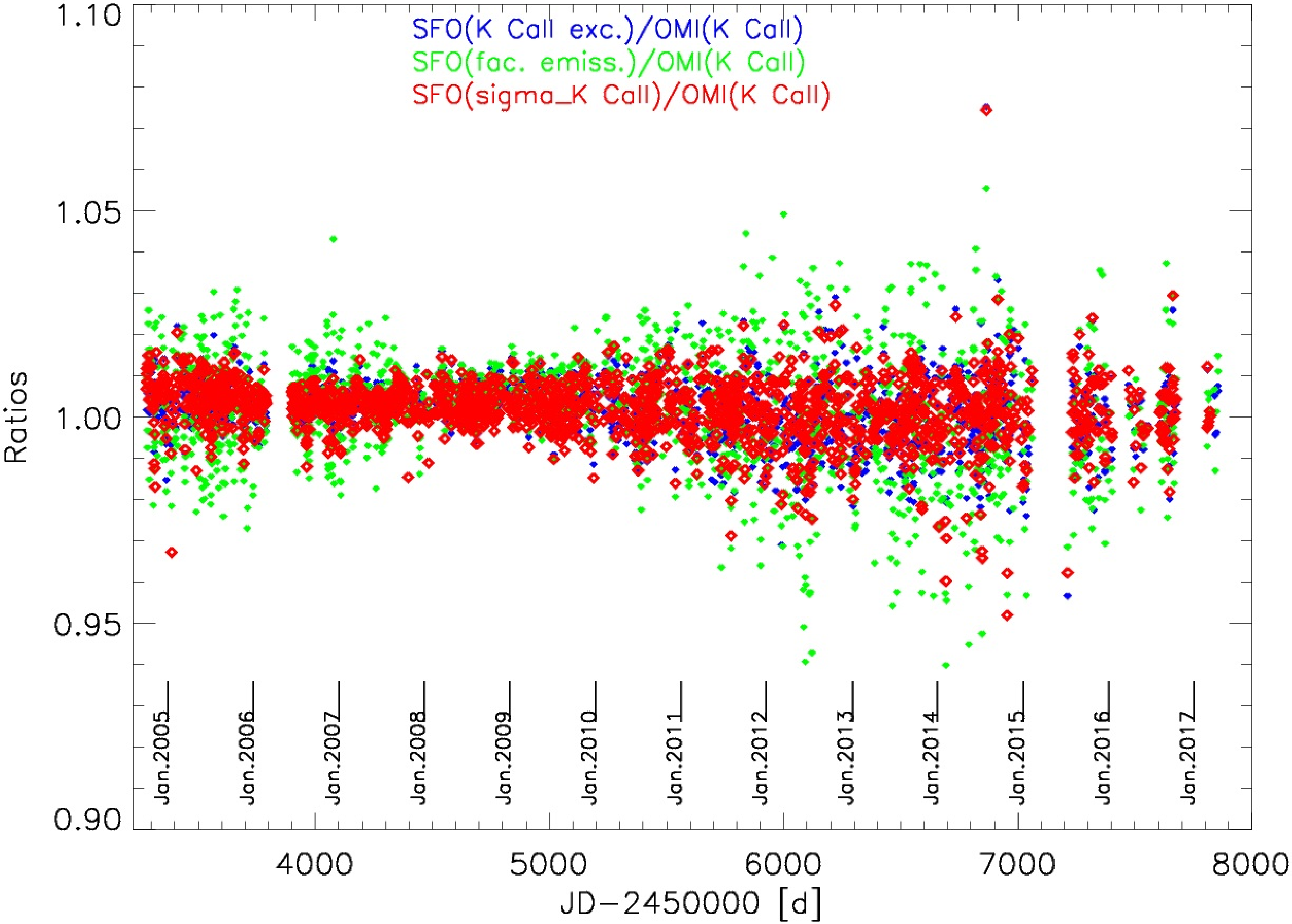
JD−2450000 [d]
Norm. & Scaled Indices


SFO(K CaII exc.)/OMI(K CaII)
SFO(fac. emiss.)/OMI(K CaII)
SFO(sigma_K CaII)/OMI(K CaII)
Ratios
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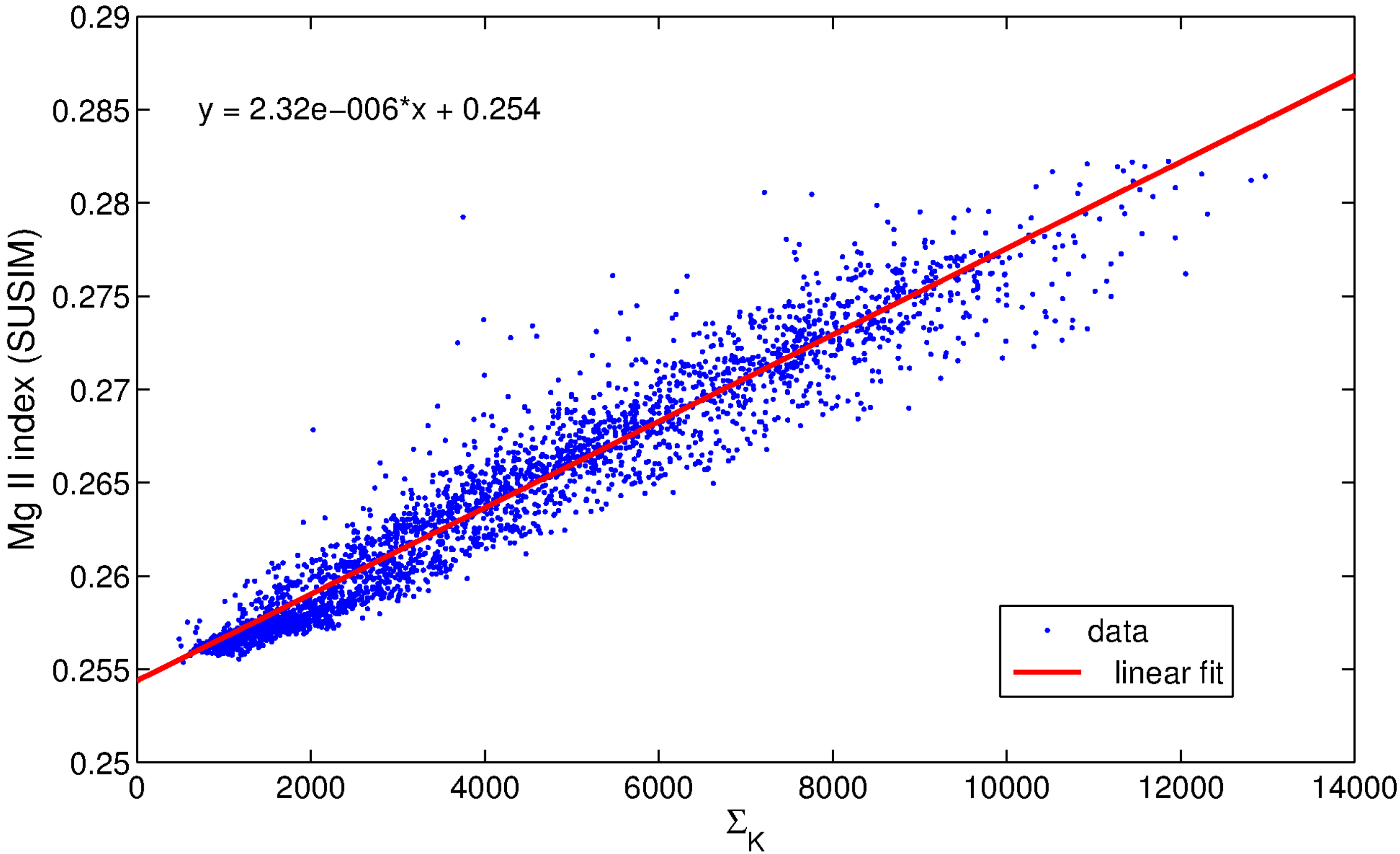
JD−2450000 [d]

SFO & UARS: r^2=0.924



1. Observations and models:
   - one may consider the short-term (rotational) SSIs scales as a viable proxy for the solar-cycle scale spectrum;
   - solar lines/line blends could (should?) be considered as important model-validation tool.

2. Degradation-free OMI SSI data:
   - pending further revision of the degradation model;
   - incorporation of the weekly solar observations from the regular diffusor;
   - TROPOMI (August 2017) may help…
   - assessing the impact and correcting for the two instrument anomalies (June 2016, March 2017).

3. OMI solar indices:
   - the y2015+ trends in the MgII and MgI indices are 'soft'-corrected by combining SOLSTICE, Composite-MgII (Bremen) and N-19 data;
   - alternative path forward may rely on the correction based on the OMI CaII indices and indices provided by the regular and backup OMI diffusors.

Our thanks to (data and feedback):

A. Cookson, G. Chapman, J. Lean, M. Snow

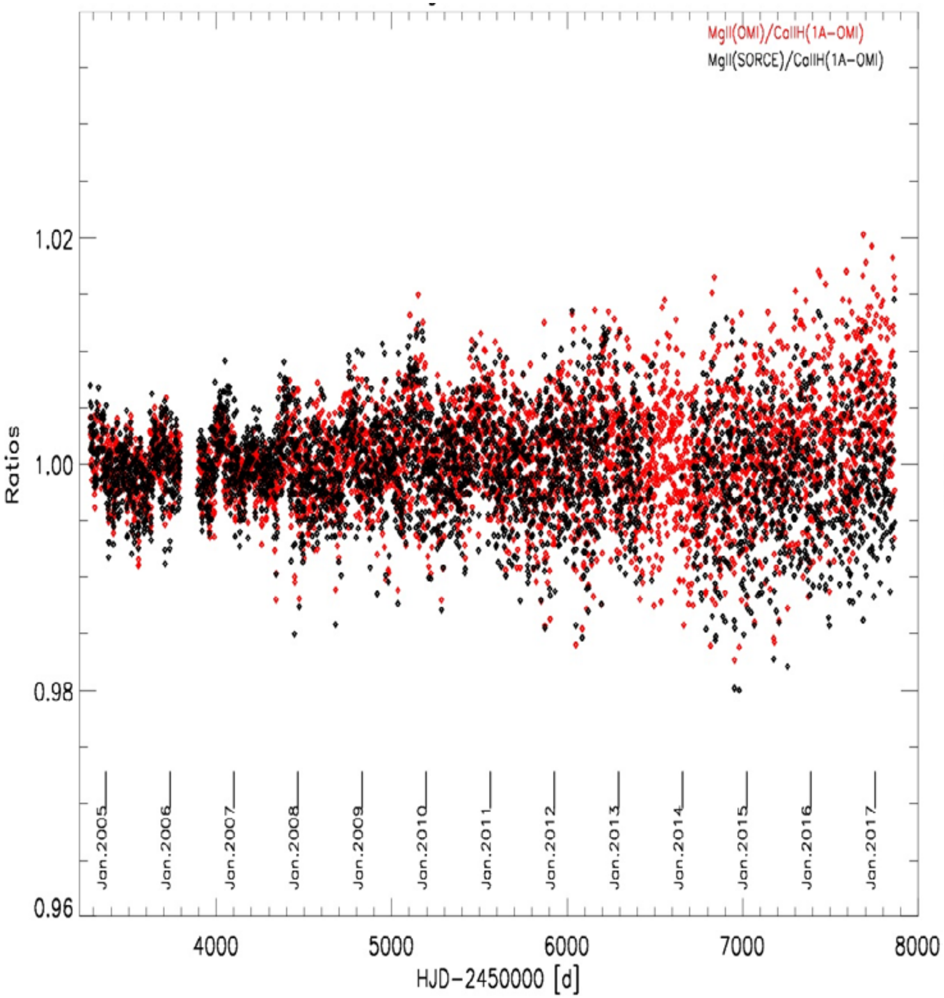
BACKUP

Ozone Monitoring Instrument (*OMI*)

- 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.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MgII(SORCE)/CaIIH(1A-OMI)
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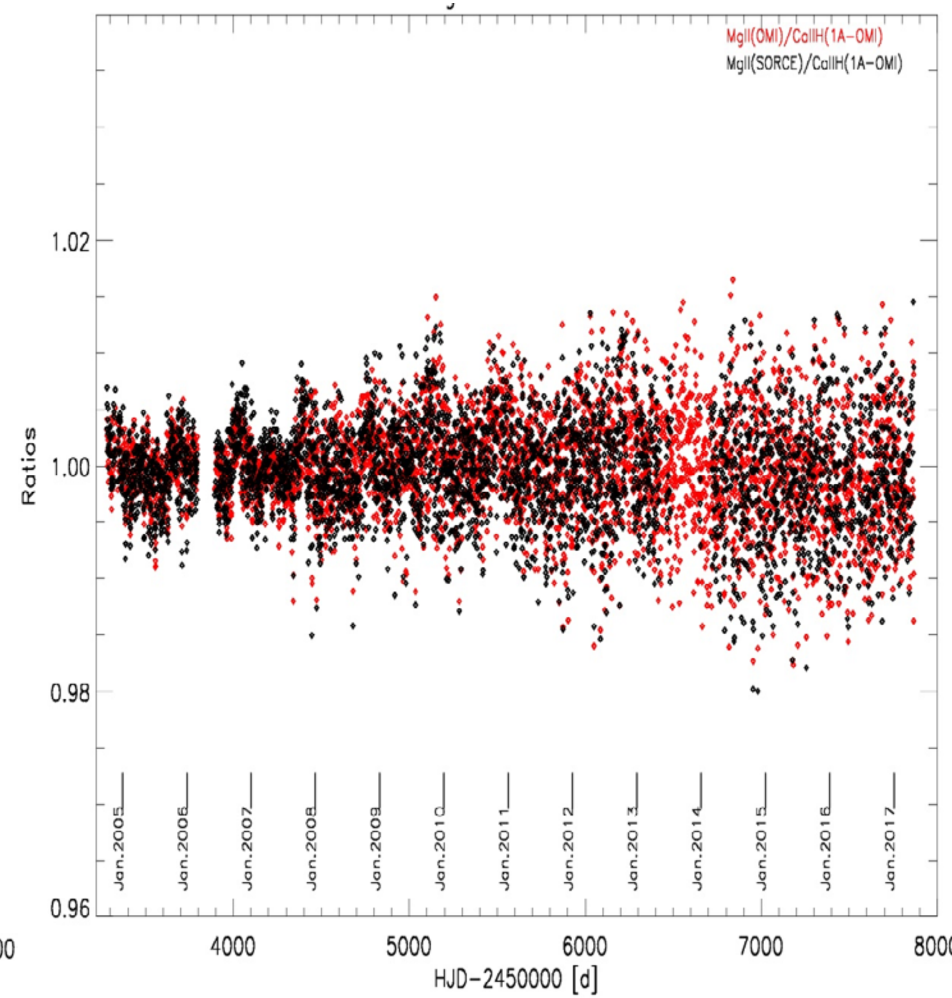
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MgII(SORCE)/CaIIH(1A-OMI)
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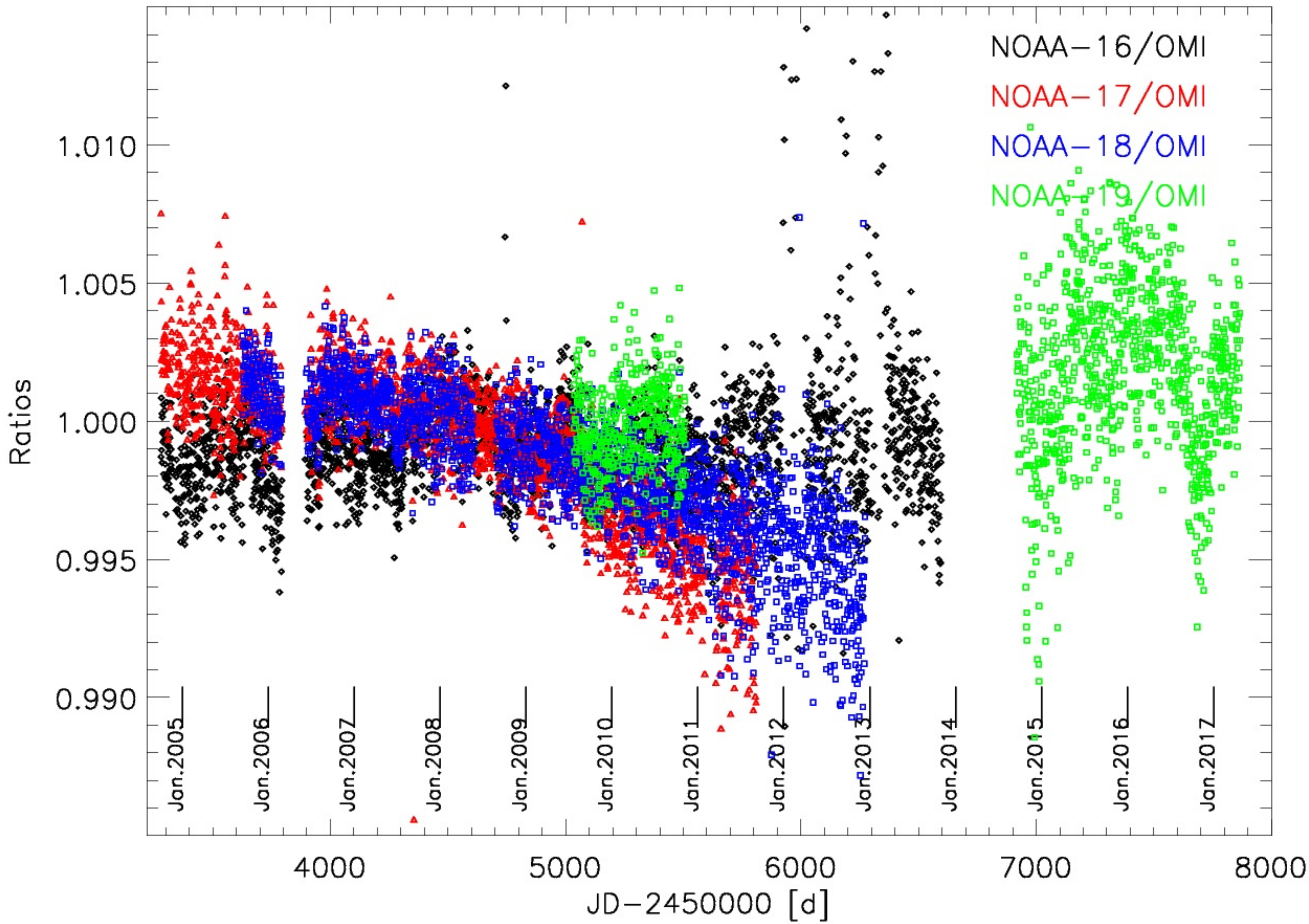
NOAA−16/OMI
NOAA−17/OMI
NOAA−18/OMI
NOAA−19/OMI
Ratios
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