CERES FM1 – FM5 Instrument Status

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CERES Instrument Operations

All CERES Instruments, Flight Models 1- 5 (FM1 – FM5) on Terra, Aqua and S-NPP are primarily in Cross-Track mode of operation.

Special Inter-comparison campaigns:

Terra/CERES FM2 – GERB: Dec 1 – 31, 2014

Terra/CERES FM2 – ScaRaB: March 22 – May 31, 2015

CERES Terra/FM1 – Aqua/FM3: June 1 – 30, 2015

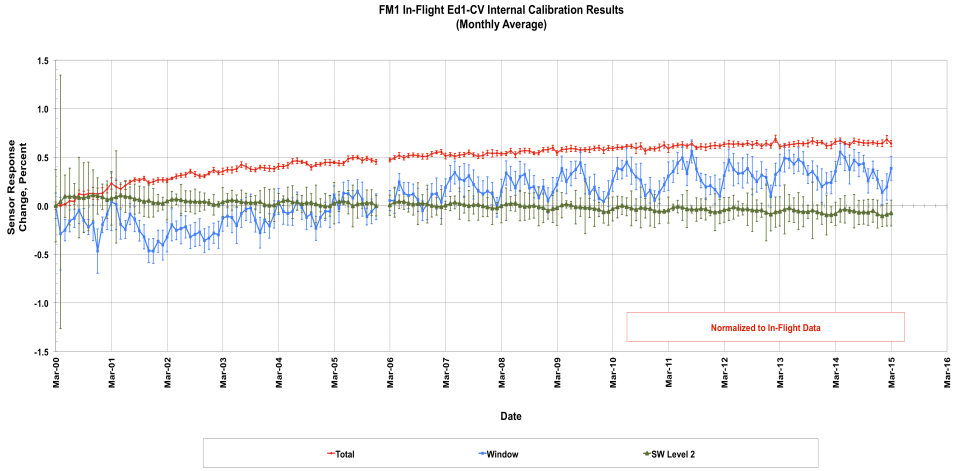
CERES Terra/FM1 – S-NPP/FM5: May 1 – July 31, 2015.

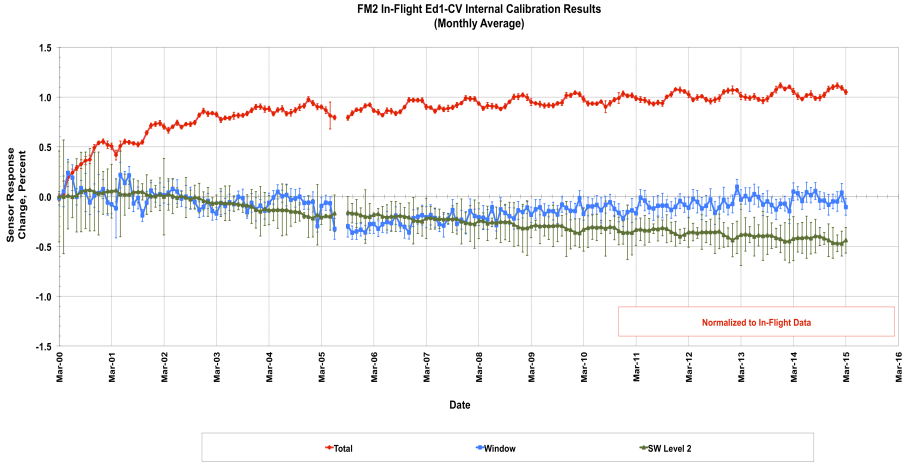
Terra/CERES FM2 – GERB: June 1 – 30, 2015

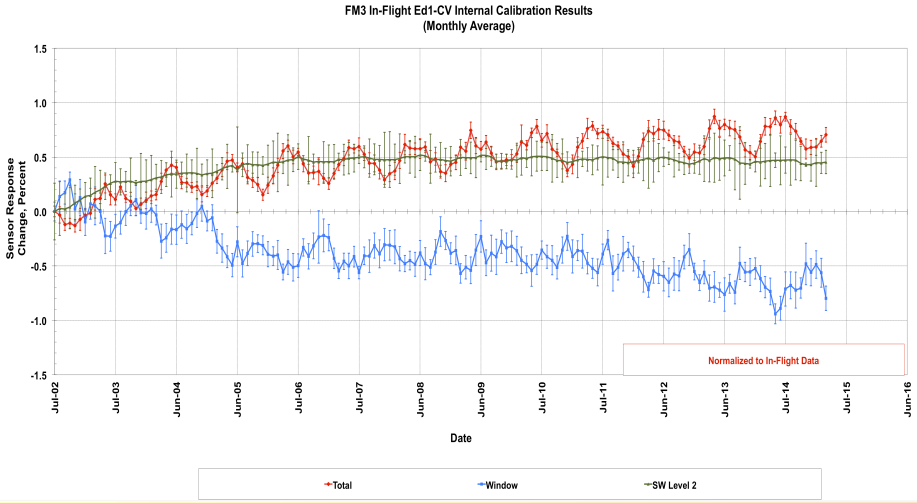
TERRA & AQUA INSTRUMENT STATUS

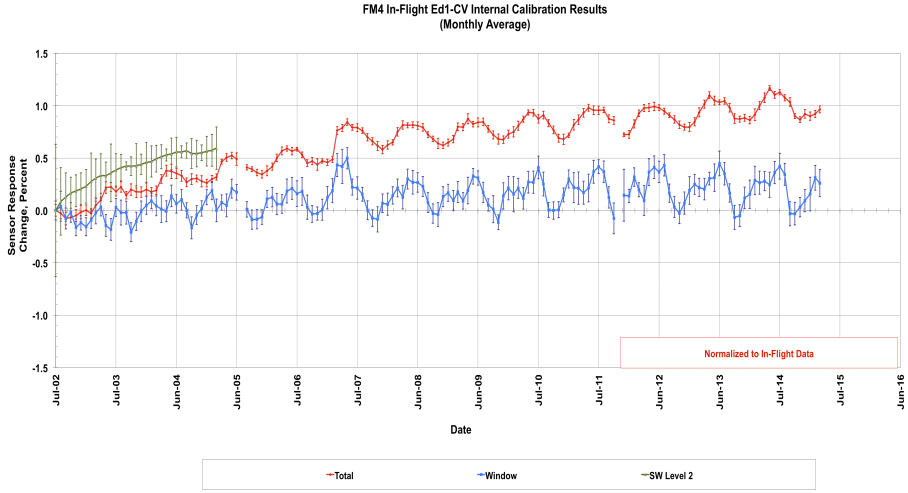
[CERES FM1 – FM4]

Terra – Aqua Sensor Performance







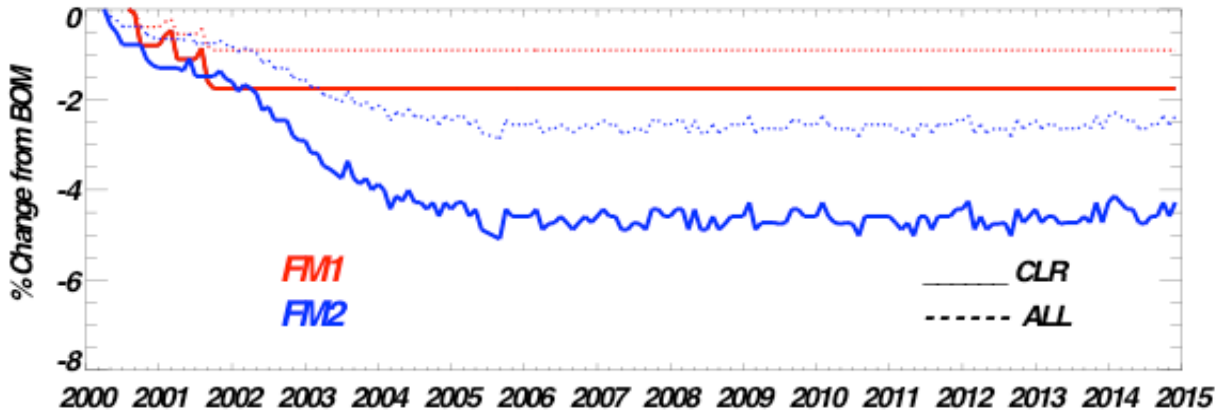


TERRA/AQUA EDITION-4: SW SENSOR

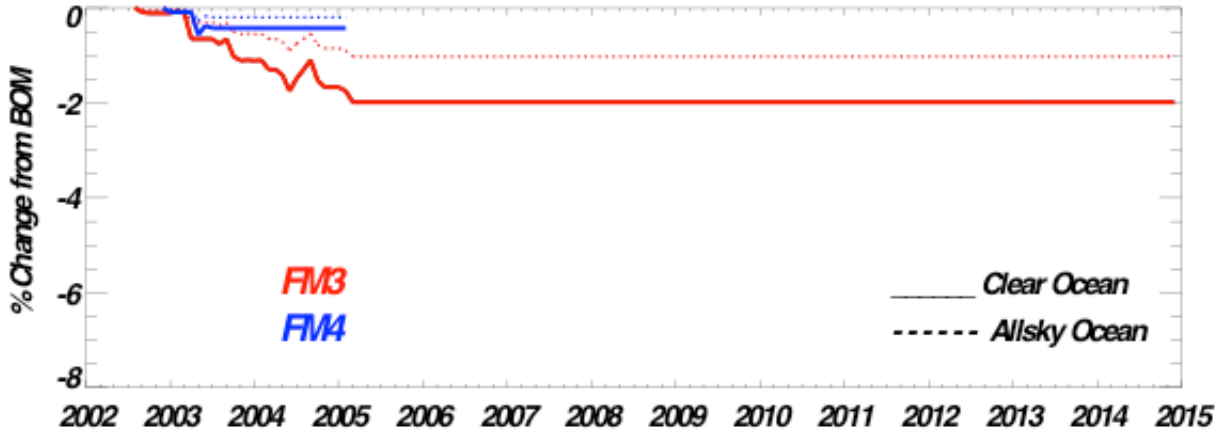
The SW sensor Spectral Response Function (SRF) for the instrument operating in RAPS mode is corrected based on the functional form: $D(\lambda) = [1 - e^{-\alpha\lambda}]$

SW 'Optimal' Throughput Change calculated with SCIAMACHY Clear/All Ocean Spectra

TERRA

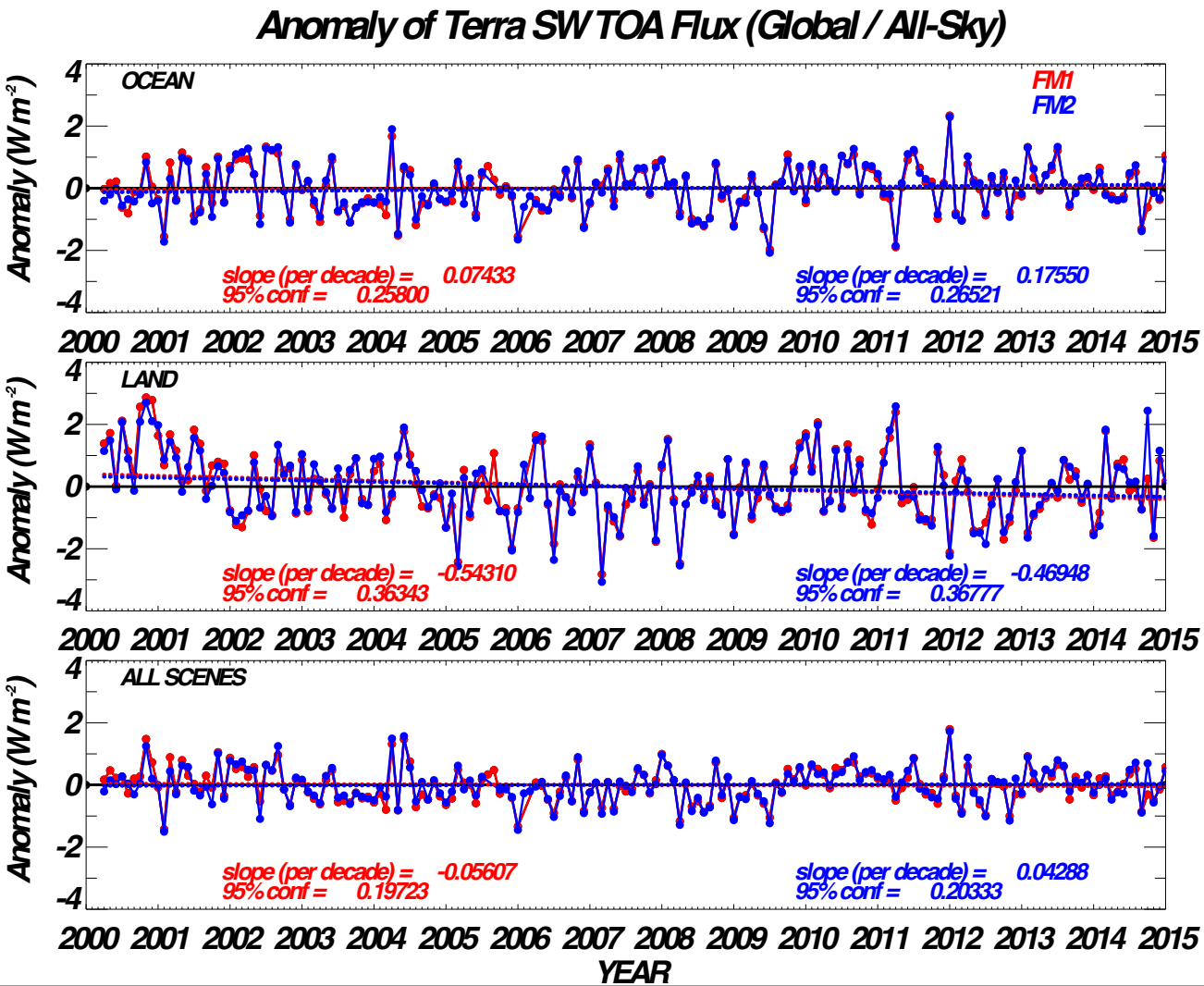


AQUA

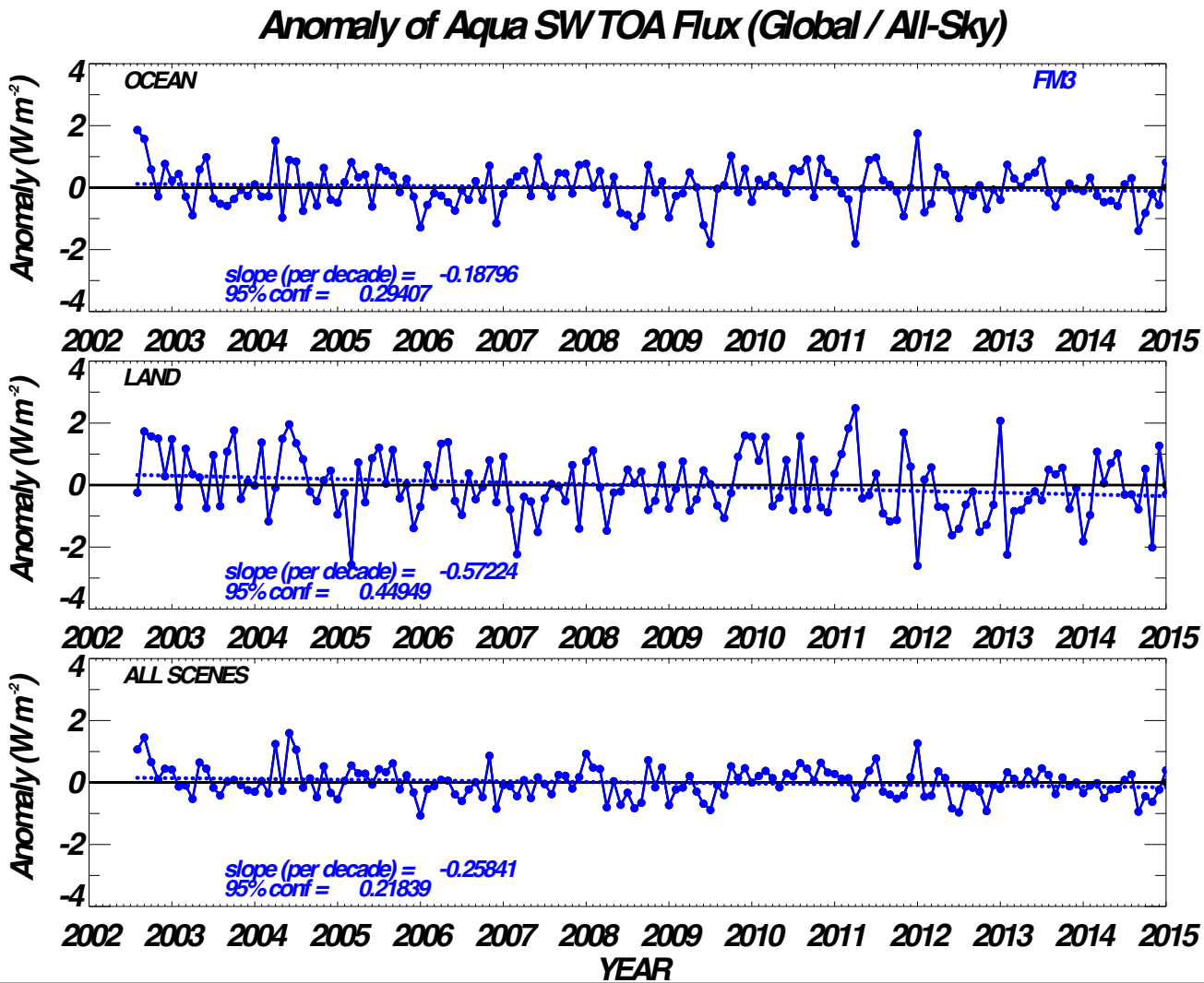


CERES Instrument Working Group

EDITION-4 VALIDATION: TERRA SW SENSORS



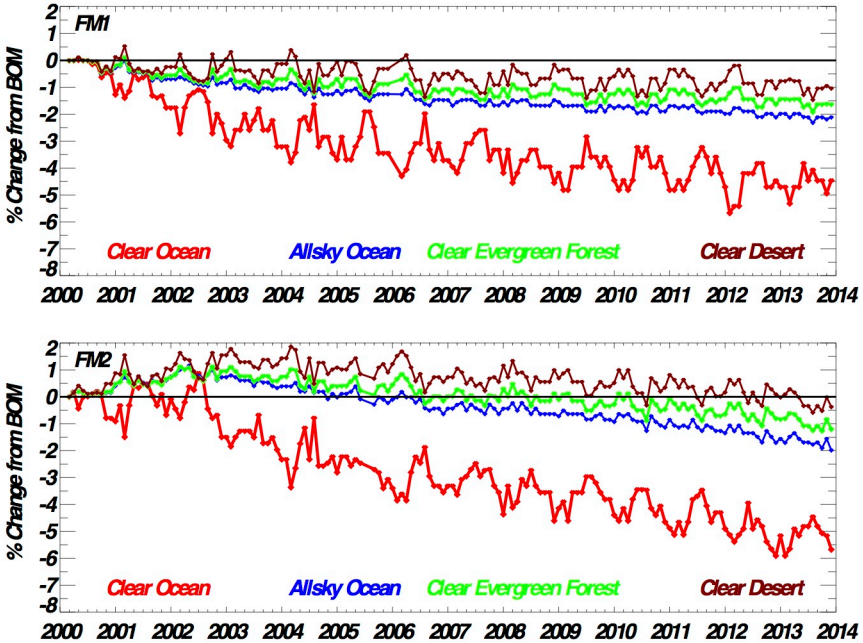
EDITION-4 VALIDATION: AQUA/FM3 SW SENSOR



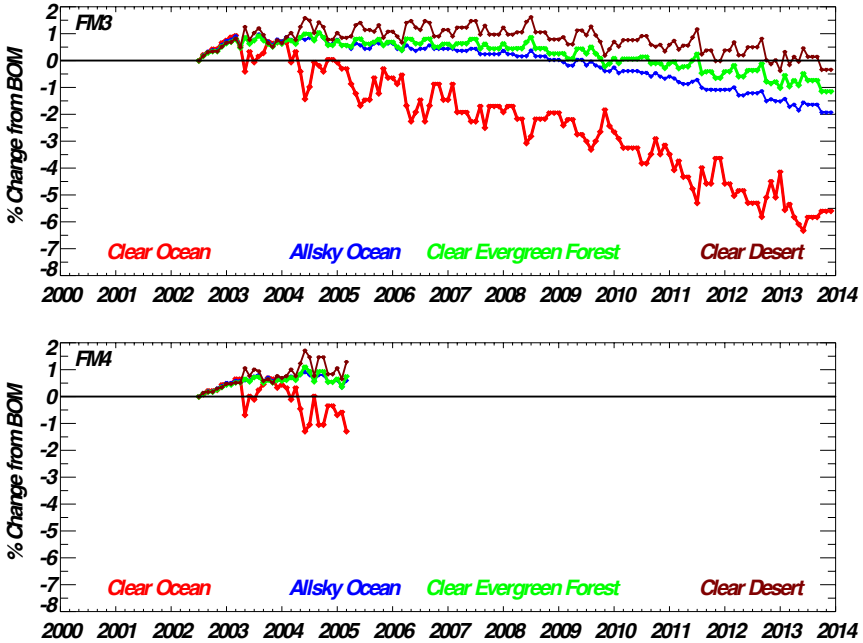
EDITION-4 TERRA/AQUA: SW/TOT SENSOR

- **Correction to SW/TOT sensor is based on the regression between LW(Day-Night) and WN (Day-Night) using Tropical Ocean and Land scenes. The corrections applied to SW/TOT SRF is of the functional form:** $D(\lambda) = [1 - e^{-\alpha\lambda}] + \beta$

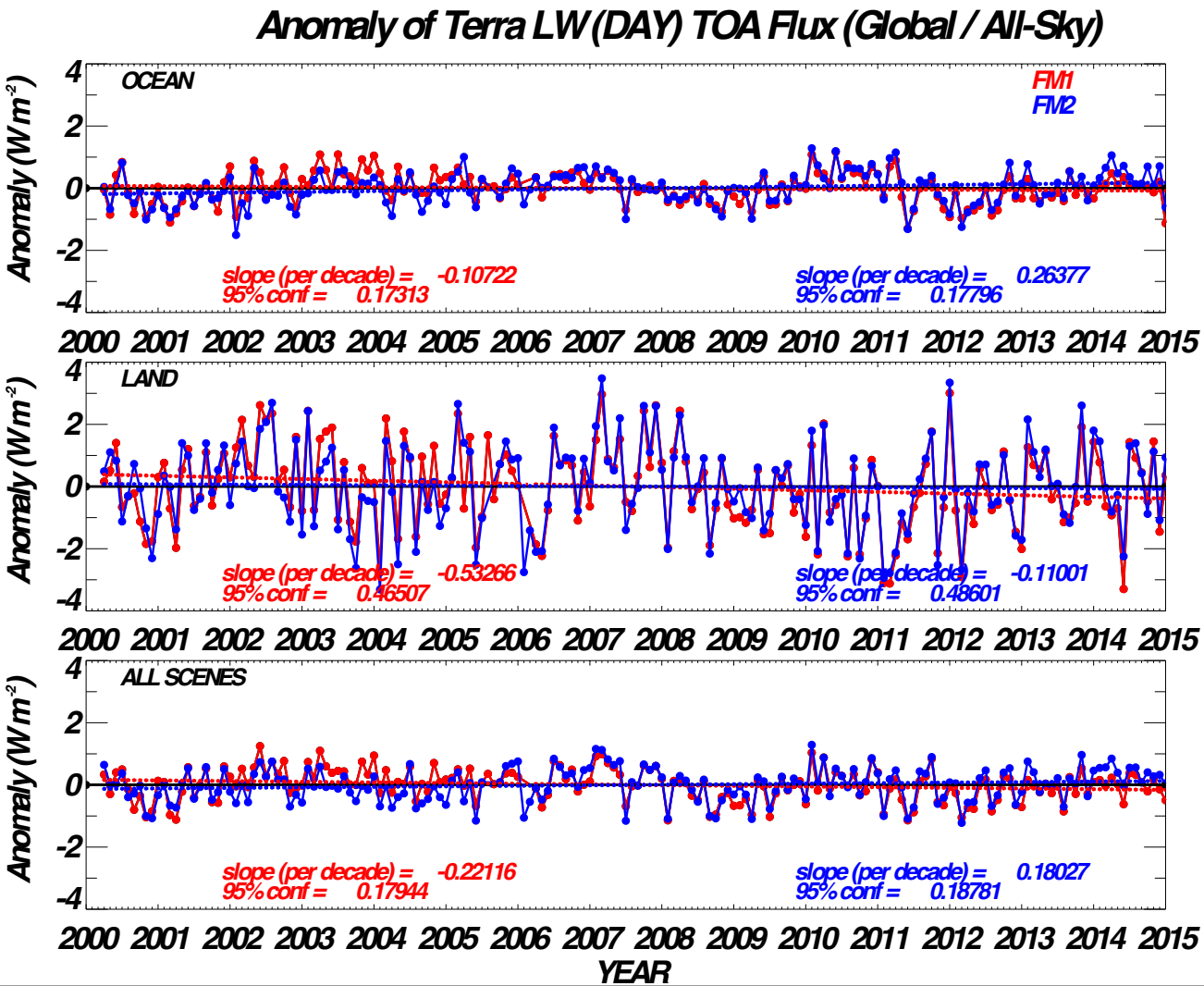
SW/TOT 'Optimal' Throughput Change for Terra (Terra SRF with SCIAMACHY Scene Spectra)



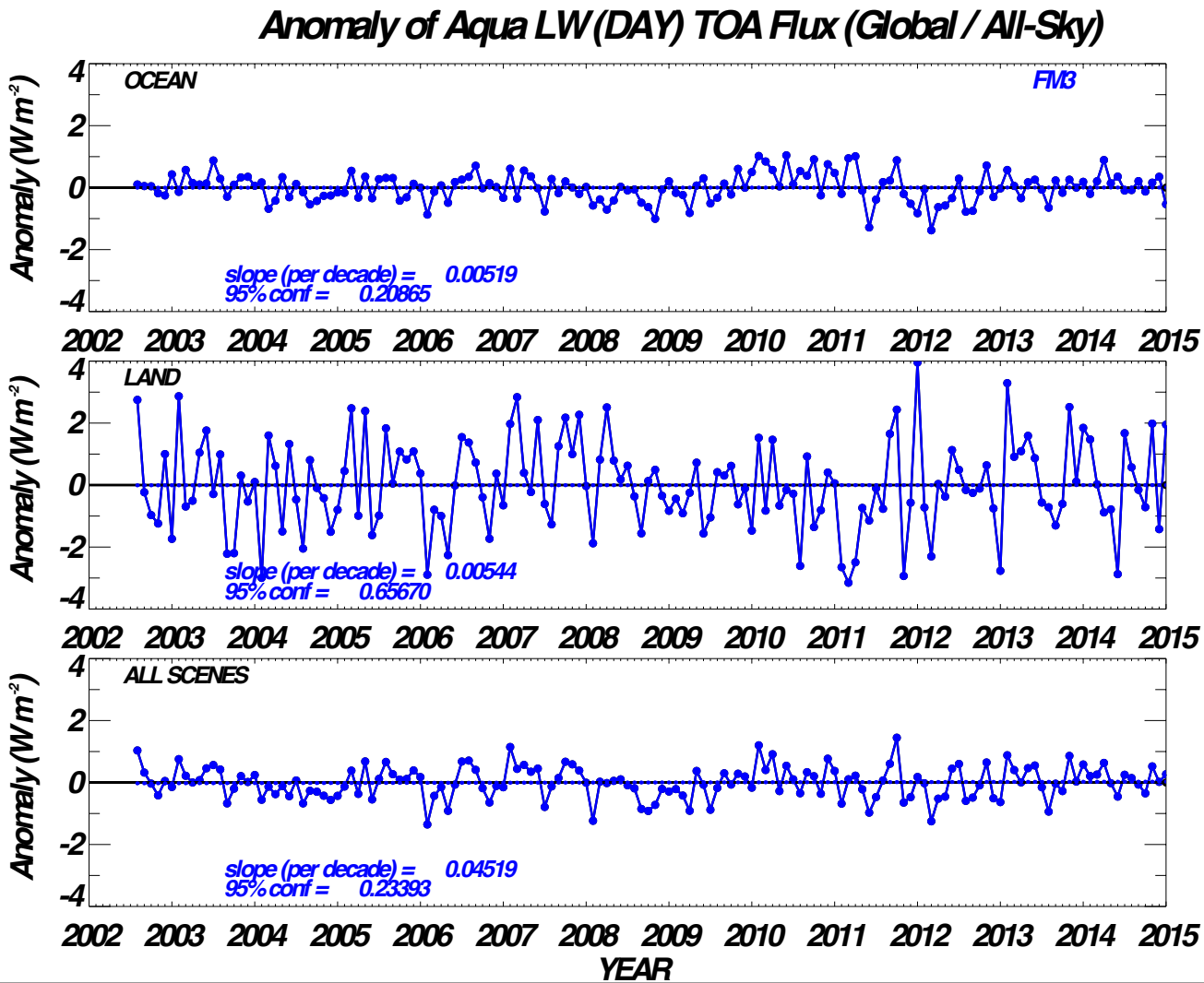
SW/TOT 'Optimal' Throughput Change for Aqua (Aqua SRF with SCIAMACHY Scene Spectra)



EDITION-4 VALIDATION: TERRA LW-DAY

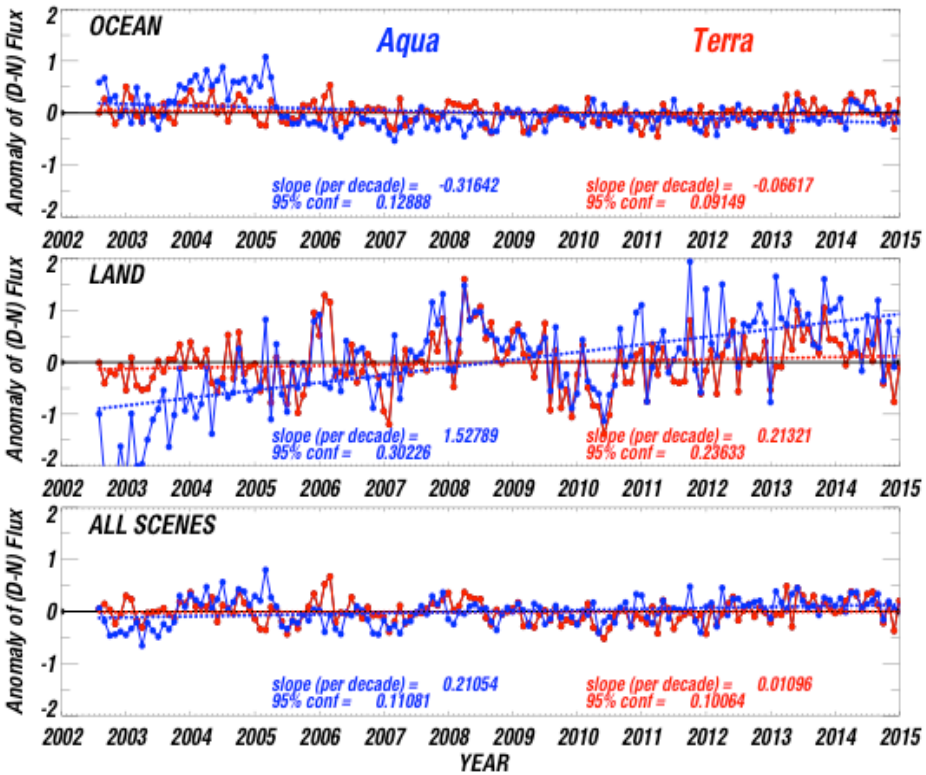


EDITION-4 VALIDATION: AQUA/FM3 LW-DAY

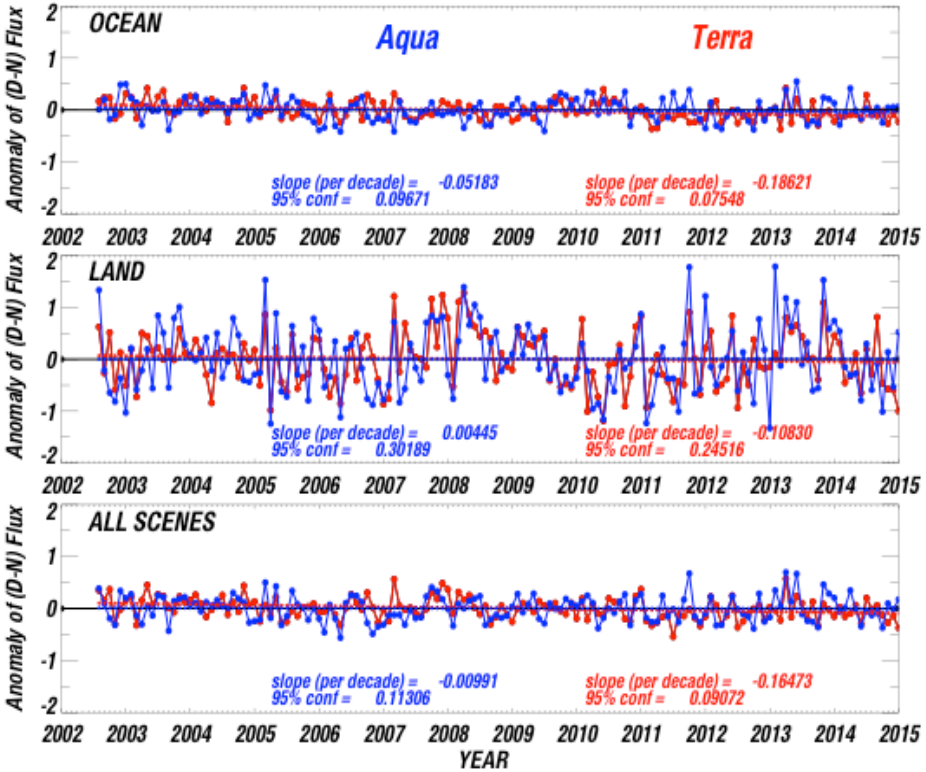


TERRA and AQUA (Day-Night) LW TOA Flux

Edition3 (Day-Night) LW TOA Flux (Global)



Edition4 (Day-Night) LW TOA Flux (Global)



TERRA/AQUA DATA AVAILABILITY

Edition3 Gains and Spectral Response Functions (SRF) :
Start of Mission – January 2015

Edition4 Gains and Spectral Response Functions (SRF) :

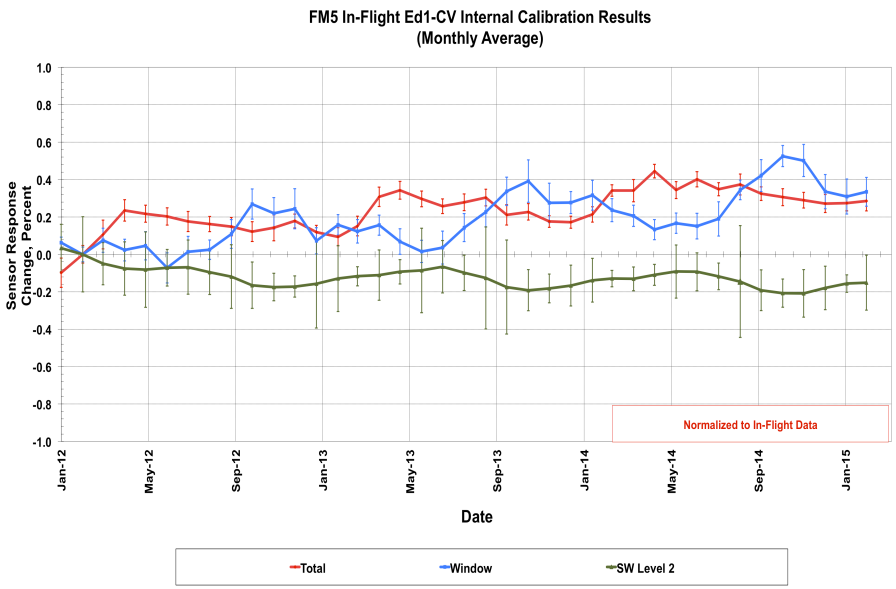
Terra and Aqua - Start of Mission to Dec 2014

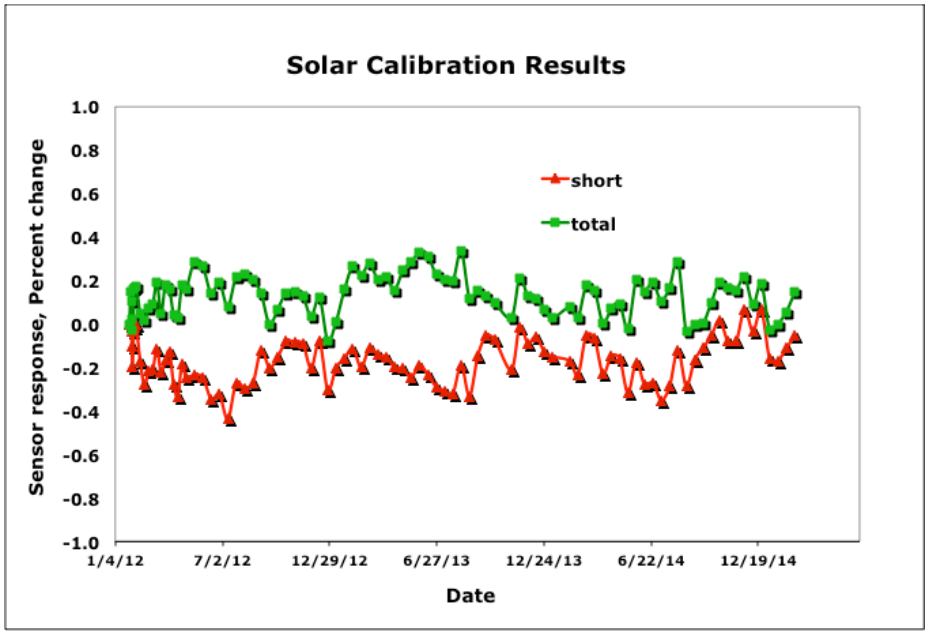
Edition1-CV Data Products (Instrument & ERBE-like):
Start of Mission – March 2015

Suomi-NPP/ CERES FM5 INSTRUMENT STATUS

S-NPP/CERES FM5 Instrument Calibration

The internal and solar calibration results show the instrument on-orbit performance are within the expected range.

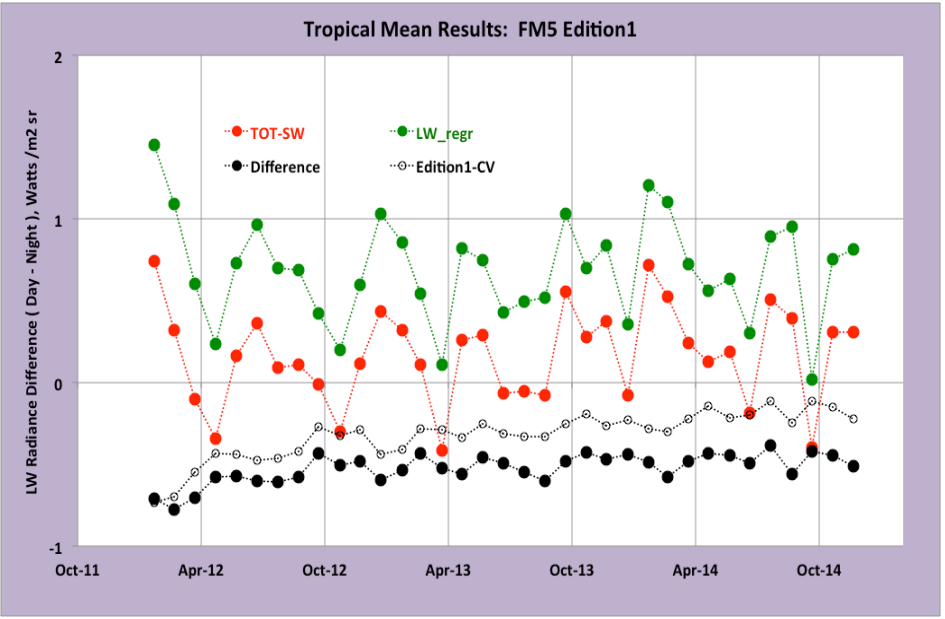


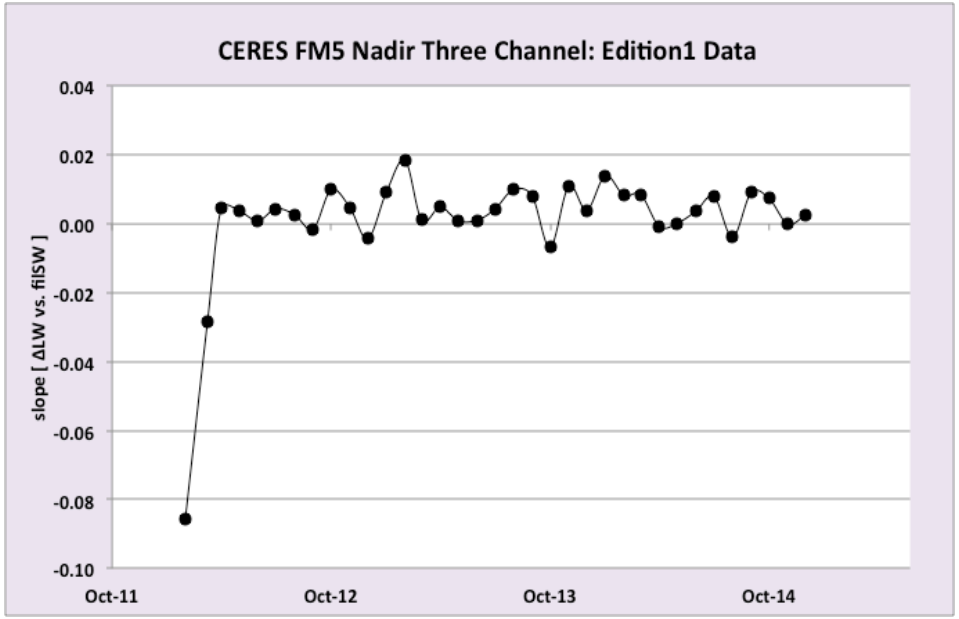


Sensor gain corrections based on ICM calibrations are applied to Edition1 data products.

Suomi NPP/CERES FM5 Validation: Tropical Mean

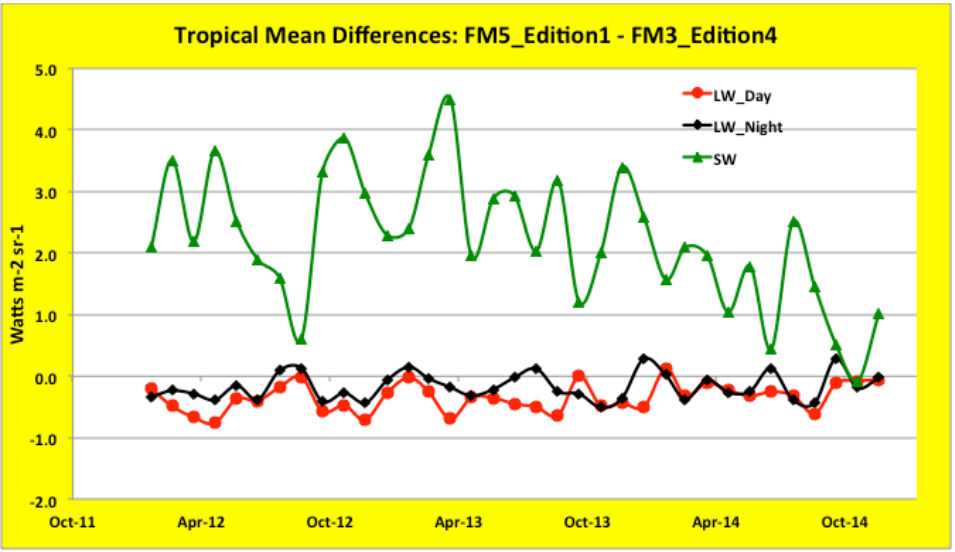
Validation Studies such as the Tropical Mean using Tropical All-sky Ocean radiances and Three Channel Comparisons with Deep Convective Cloud (DCC) Target do not show any trends in the Shortwave region of Total sensor.

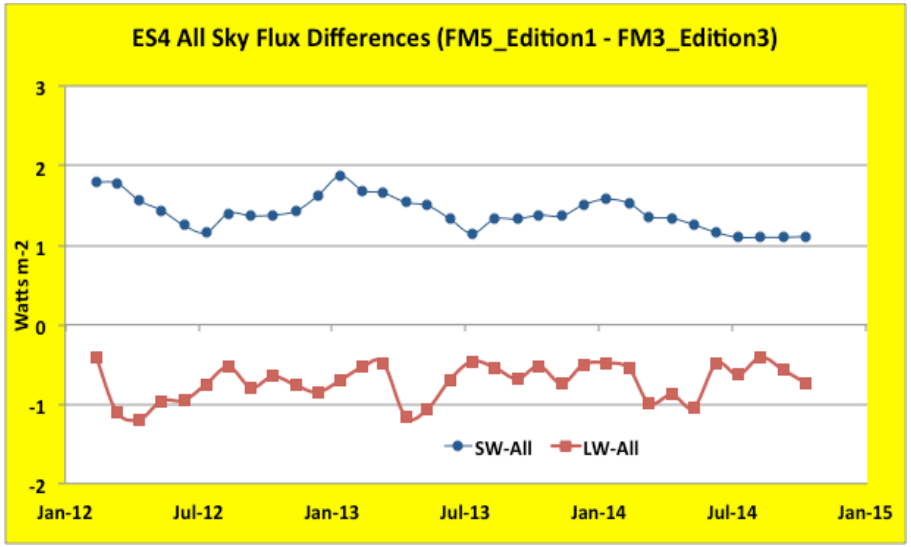




CERES S-NPP/FM5 – Aqua/FM3 Comparison

Tropical Mean Radiance Differences and the Global Flux Differences show that CERES FM5 SW measurements are higher than the corresponding CERES FM3 SW measurements.





CERES FM5 - FM3 Matched Footprint Comparisons

NPP and Aqua Simultaneous Observation comparison are performed based on 1° x1^o grid averages with relative VZA <15 deg and RAZ < 10 deg. Each grid has 20 -25 footprints.

All-Sky Comparison Results for 2012/2013/2014

ΔTime < 1min

(FM5-FM3)/ FM5	FM5 Radiance [W m^{-2} sr^{-1}]	Relative Error [%]	α-confidence [95%]	Number of samples
Shortwave	78.2/82.8/77.6	**3.41 / 2.50 / 0.81**	0.44/0.43/0.50	67/87/90
LW daytime	76.0/74.5/77.8	**-1.36 / -1.21 / 0.76**	0.11/0.12/0.12	68/88/90
LW nighttime	67.6/65.7/69.0	**-0.47 / -0.23 / 0.11**	0.12/0.11/0.08	86/101/100

CERES FM5 - FM3 Matched Footprint Comparisons

Clear Ocean Scene Comparison Results for 2012/2013/2014

(FM5-FM3)/ FM5	FM5 Radiance [W m^{-2} sr^{-1}]	Relative Error [%]	α-confidence [95%]	Number of samples
Shortwave	27.3/26.3/25.3	**11.13 / 8.57 / 4.17**	1.32/1.66/1.35	48/57/66
LW daytime	89.6/87.8/90.0	**-1.07 / -0.67 / 0.07**	0.14/0.17/0.11	53/64/67
LW nighttime	92.5/92.5/92.6	**-1.01 / -0.91 / -0.07**	0.16/0.17/0.11	47/46/53

Overcast Scene Comparison Results for 2012/2013/2014

(FM5-FM3)/ FM5	FM5 Radiance [W m^{-2} sr^{-1}]	Relative Error [%]	α-confidence [95%]	Number of samples
Shortwave	118.8/122.6/118.8	**1.74 / 1.22 / 0.43**	0.56/0.49/0.31	60/80/82
LW daytime	76.0/63.2/62.4	**-1.36 / -1.42 / -0.69**	0.11/0.19/0.19	68/83/82
LW nighttime	67.6/56.7/57.7	**-0.47 / -0.08 / 0.25**	0.12/0.15/0.10	86/97/94

CERES S-NPP/FM5 – TERRA/FM1 INTERCOMPARISONS

CERES FM5 and FM1 inter-comparison measurements around 68° N.

Instruments align their scans in a plane perpendicular to the local solar plane.

- 2012 campaign lasted 6 weeks: June 16 – July 31
- 2013/2014 campaigns lasted 3 months: May 1 – July 31

All-Sky Comparison Results for 2012/2013/2014

ΔTime < 5min

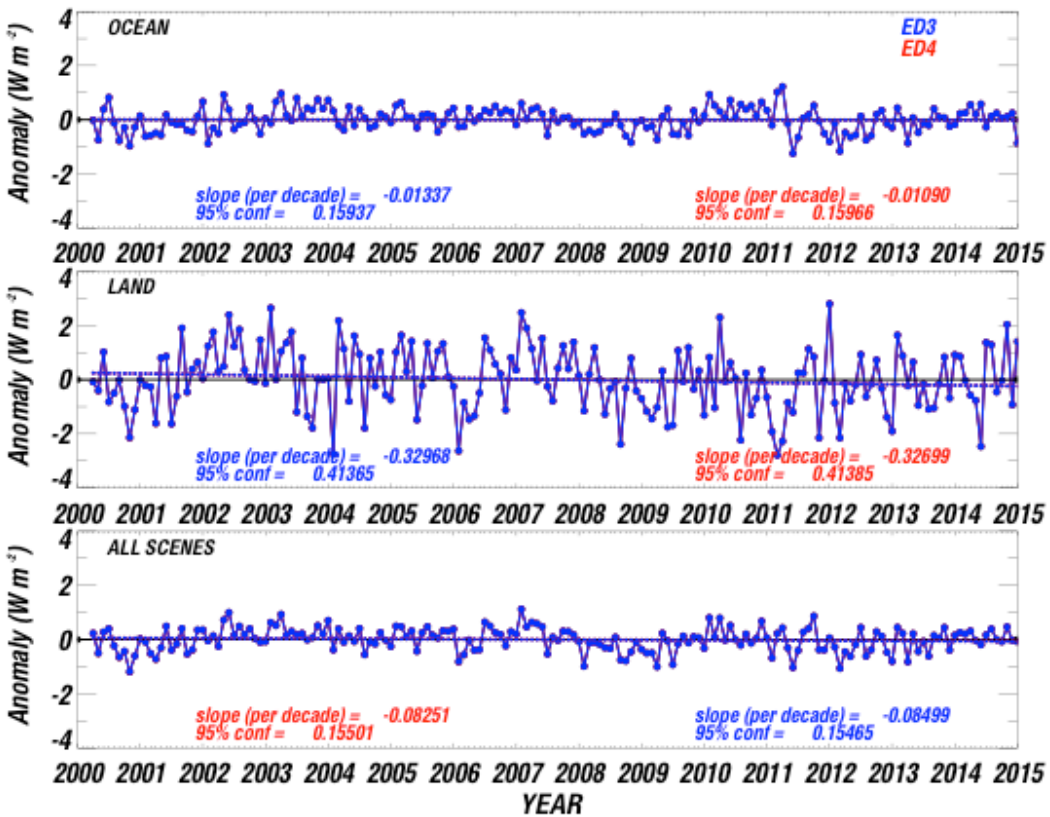
(FM5-FM1)/ FM5	FM5 radiance [W m^{-2} sr^{-1}]	Relative Error [%]	α-confidence [95%]	Number of samples
Shortwave	87.0/101.6/111.1	0.81 / 0.93 / 0.86	0.26/0.17/0.14	64/108/123
LW daytime	78.6/76.1/74.8	-0.46 / -0.16 / -0.81	0.13/0.09/0.12	68/112/130

SUMMARY

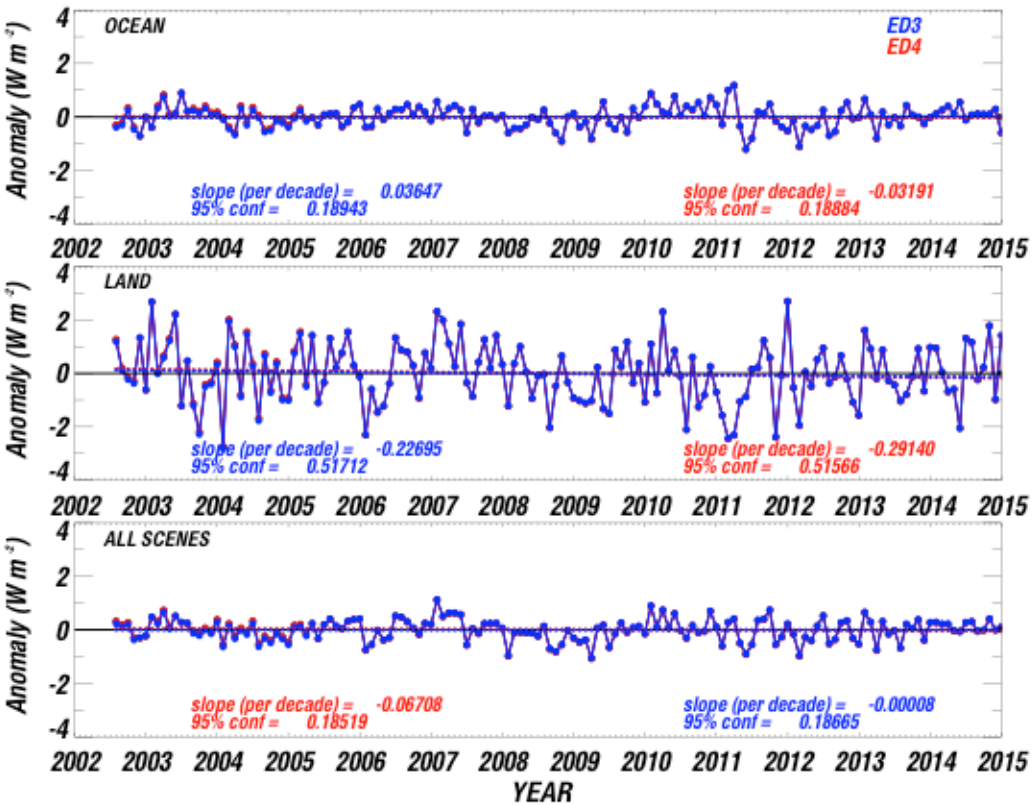
- Instrument Gain and Spectral Response Functions for the Edition3 and Edition4 processing were delivered through December 2014 for production processing.
- Validation studies have shown that the trends in ocean and land scenes for Terra and Aqua SW and LW-day measurements were corrected in Edition-4 products.
- CERES FM5 calibration results show the sensor performance trends are within expected range.
- FM5–FM3 SW radiances comparisons show FM5 is higher than the FM3 measurements, with differences decreasing in 2014.

BACK UP SLIDES

Anomaly of TERRA LW-NIGHT TOA FLUX (Global)



Anomaly of AQUA LW-NIGHT TOA FLUX (Global)



Direct compare of FM5 and FM1

Overcast 2012/2013/2014
ΔTime < 5min

SW differences for 2012/2013 are statistically significant

(FM5-FM1)/ FM5	FM5 radiance [W m^{-2} sr^{-1}]	Relative Error [%]	α-confidence [95%]	Number of samples
Shortwave	140.6/148.2/144.0	0.18 / 0.79 / 0.67	0.49/0.28/0.24	25/53/74
LW daytime	67.5/66.4/66.4	-0.59 / -0.10 / -0.96	0.36/0.20/0.20	32/66/85

Direct compare of FM5 and FM1

Clear Land 2012/2013/2014
ΔTime < 5min

Shown differences are not statistically significant

(FM5-FM1)/ FM5	FM5 radiance [W m^{-2} sr^{-1}]	Relative Error [%]	α-confidence [95%]	Number of samples
Shortwave	39.3/40.5/38.7	1.40 / 1.34 / 0.49	1.57/1.63/0.87	23/23/17
LW daytime	90.4/89.2/88.8	0.16 / 0.23 / 0.22	0.22/0.17/0.24	28/30/27