CERES FM1 – FM5 Instrument Status

Susan Thomas
CERES Instrument Working Group Team

Joint CERES, GERB and SCARAB Earth Radiation Budget Workshop
Toulouse, France
October 7 - 10, 2014

Instrument Working Group

WG Chair: Kory J. Priestley

Mission Operations/I&T

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- James Bailey -

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Nitchie Smith

Z. Peter Szewczyk

Robert Wilson

CERES Instrument Operations

CERES Instruments supported several intercomparison campaigns and special operations in the past six months.

Terra/FM1 – Aqua/FM3 Intercomparison: June 1 – 30, 2014

Terra/FM1 – S-NPP/FM5 intercomparison: May 1 –July 31, 2014.

Terra/FM2 – GERB Intercomparison: June 1 – 30, 2014

S-NPP/FM5 – Aqua/FM3 Comparison with Nadir Dwell: 6 sets

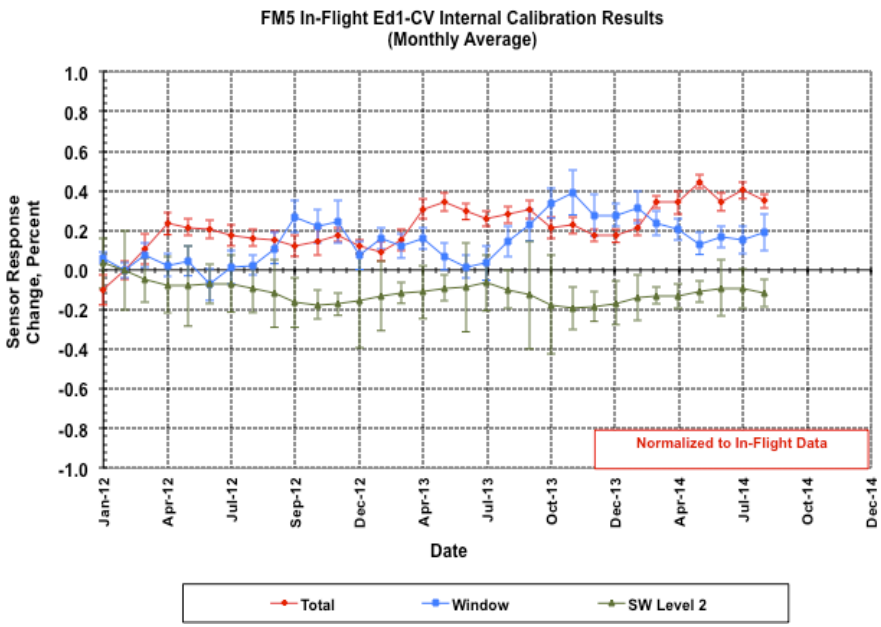
Artic Radiation – IceBridge Sea and Ice Experiment (ARISE) with Terra/FM2: Aug 26 – Sept 30, 2014.

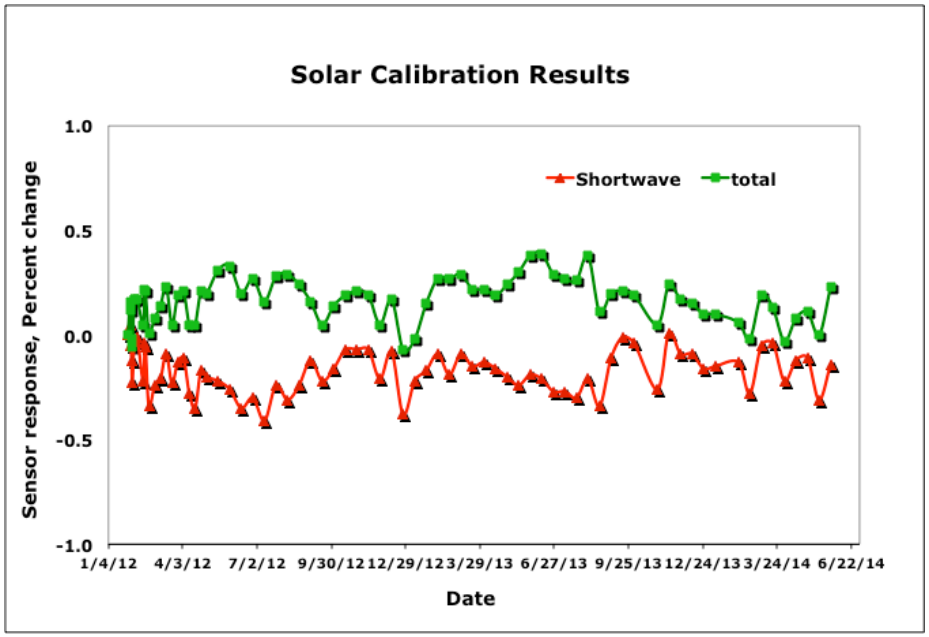
1/3 and ½ crosstrack scan rate with Terra/FM2: Sept 10-30, 2014

S-NPP/CERES FM5 INSTRUMENT STATUS

Suomi NPP/CERES FM5 Instrument Status

The calibration and validation results show the instrument on-orbit performance are within the expected range during this period.





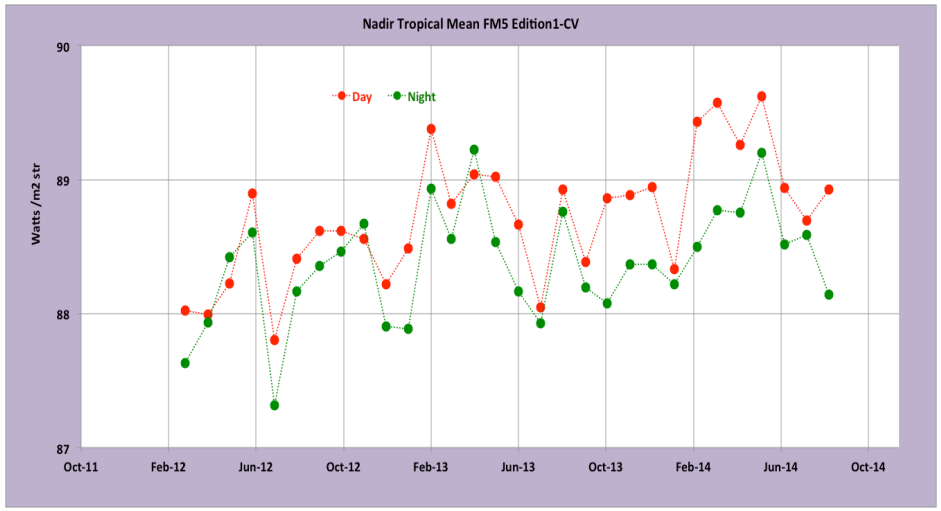
Sensor gain corrections based on ICM calibrations are applied to Edition1 data products.

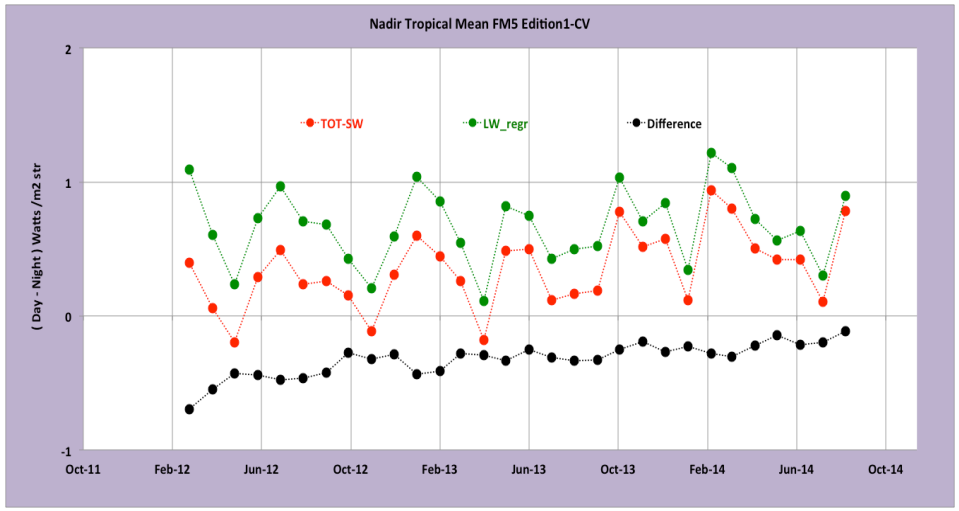
Suomi NPP/CERES FM5 Validation: Tropical Mean

Tropical Mean (TM): Average radiance of All-sky Tropical ocean(20°N-20°S) measurement

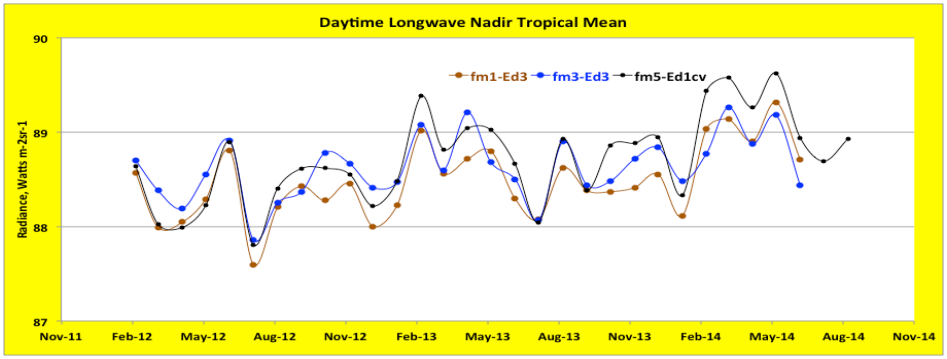
TM Day-Night Difference (DN) is calculated from the measured LW radiances and LW value derived from the Window channel.

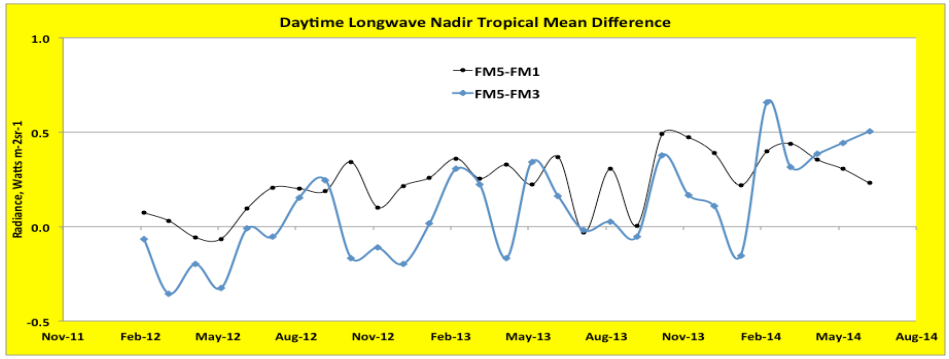
Difference in the DN value is monitored to evaluate any changes that may occur in the shortwave region of the total sensor.

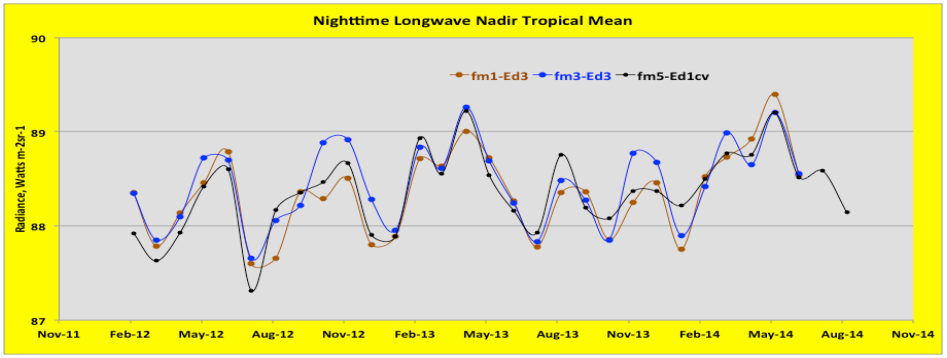


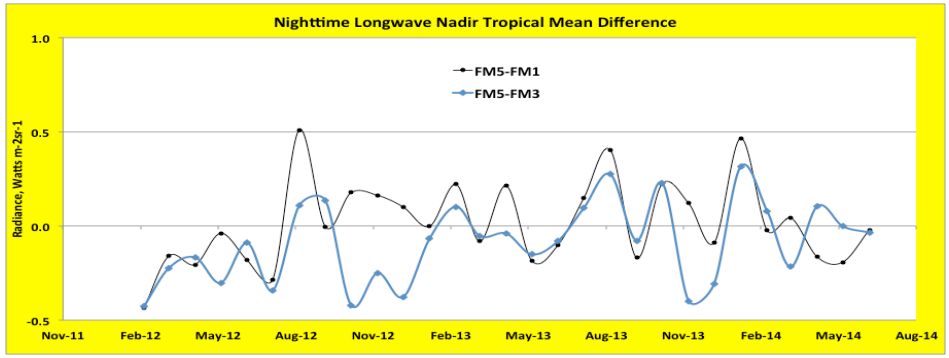


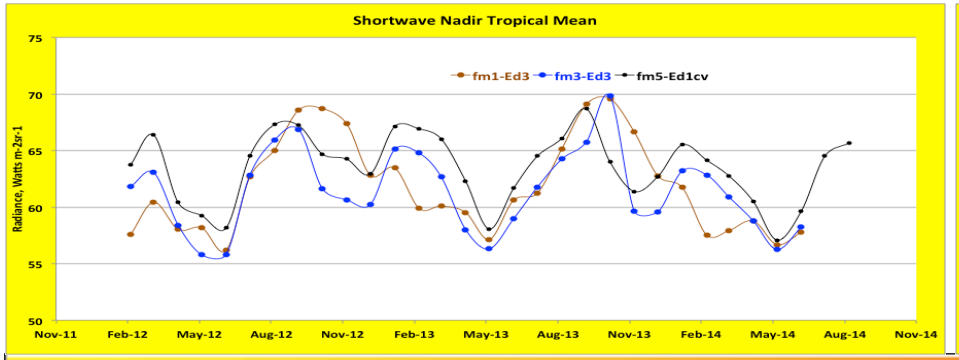
CERES FM5/FM3/FM1 Comparison: Tropical Mean

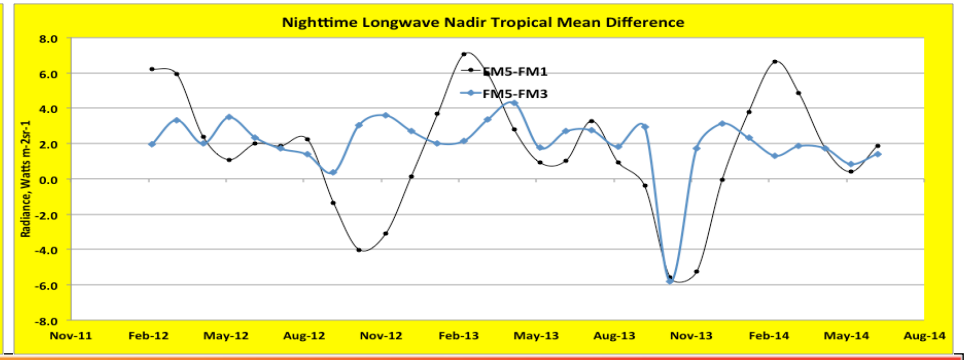






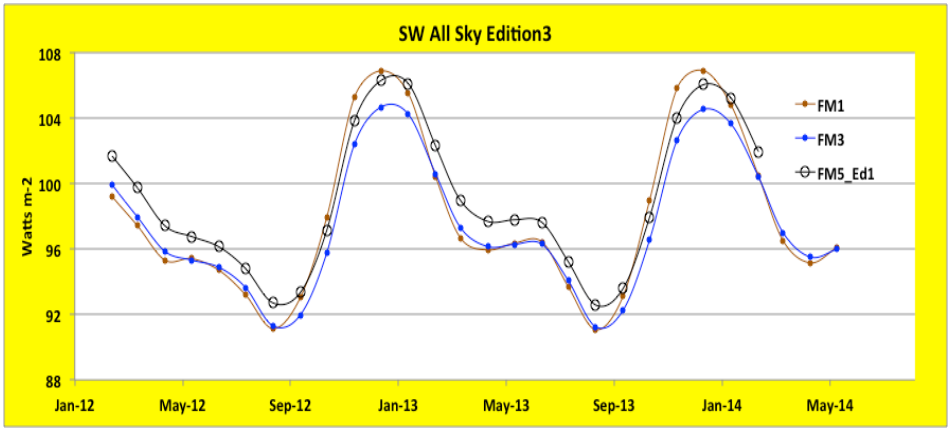


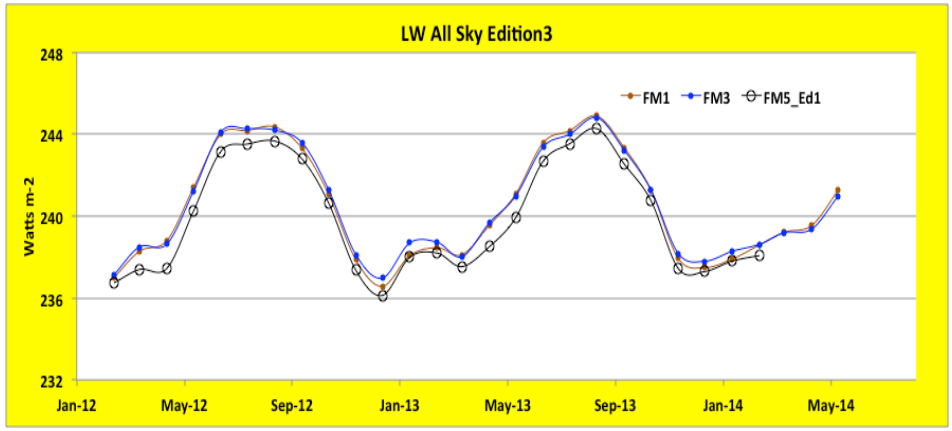


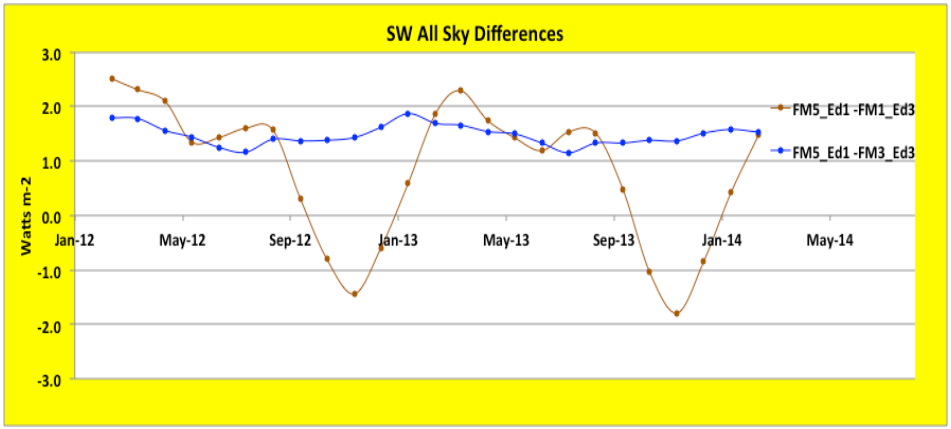


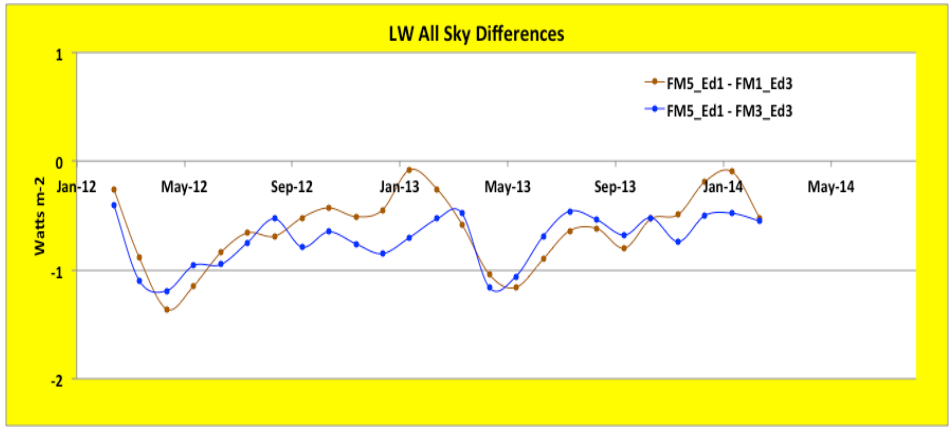
CERES FM5 – Global Flux Comparison (ES4)

Comparison with CERES FM1 and FM3[Feb 12 – June 14]



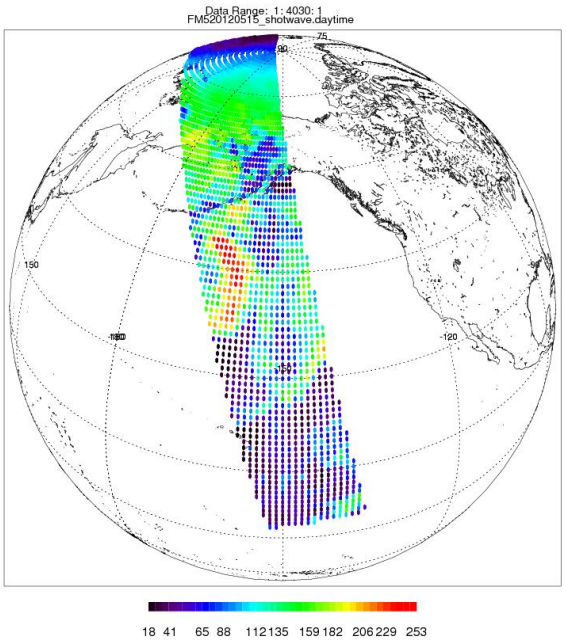




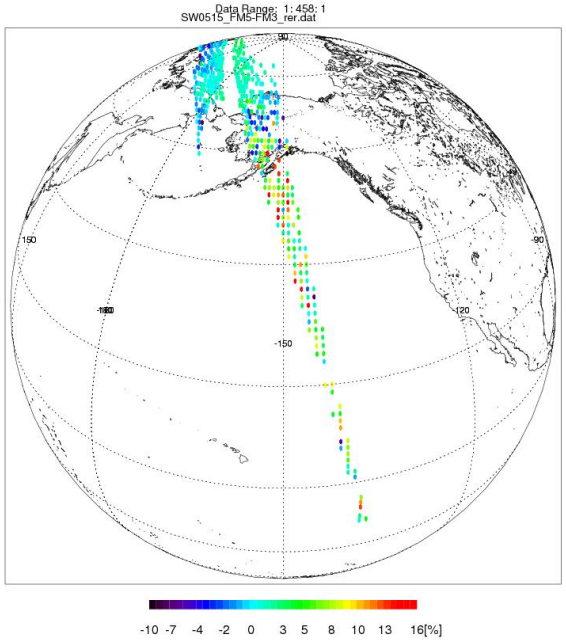


CERES FM5 - FM3 Matched Footprint Comparisons

NPP and Aqua Simultaneous Observation occur every 64 hours and last ~20 minutes with views about 20 seconds apart. Comparison based on 1° x1° grid averages with relative VZA <15 deg and RAZ < 10 deg. Each grid has 20 -25 footprints.



Averaged unfiltered radiance for 1°×1°grid



Relative difference for each matched 1°×1°grid

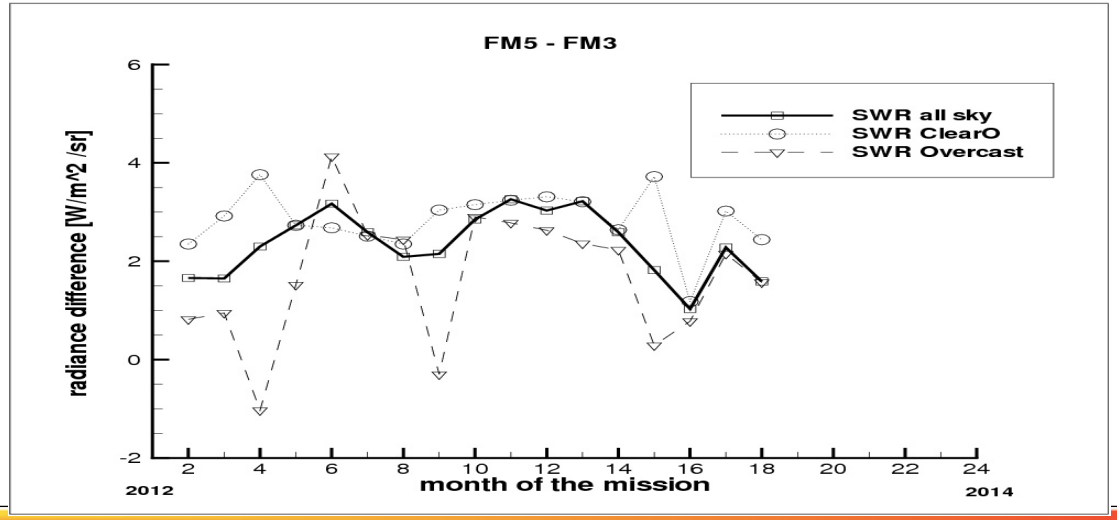
Z. P. Szewczyk

CERES FM5 - FM3 Matched Footprint Comparisons

All-sky Results: February 2012 – April 2013; First repeat cycle of 432 days

(FM5-FM3)/FM5	FM5 Radiance [W m^{-2} sr^{-1}]	Relative Error [%]	α-confidence [95%]	Number of samples
Shortwave	**79.10**	**3.15**	**0.45**	**99**
LW daytime	**75.04**	**-1.66**	**0.13**	**100**
LW nighttime	**66.78**	**-0.51**	**0.10**	**121**

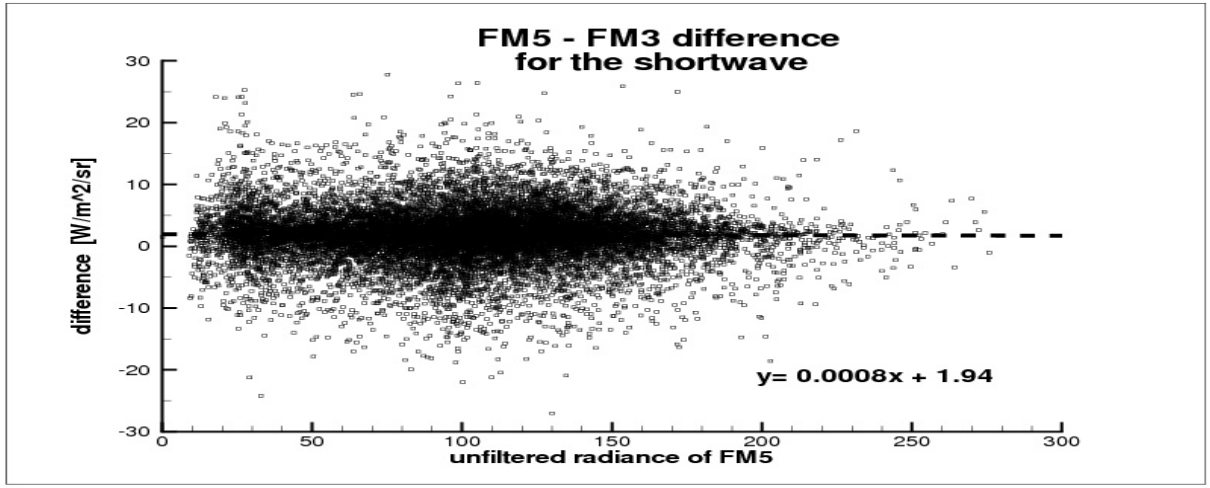
Monthly SW differences

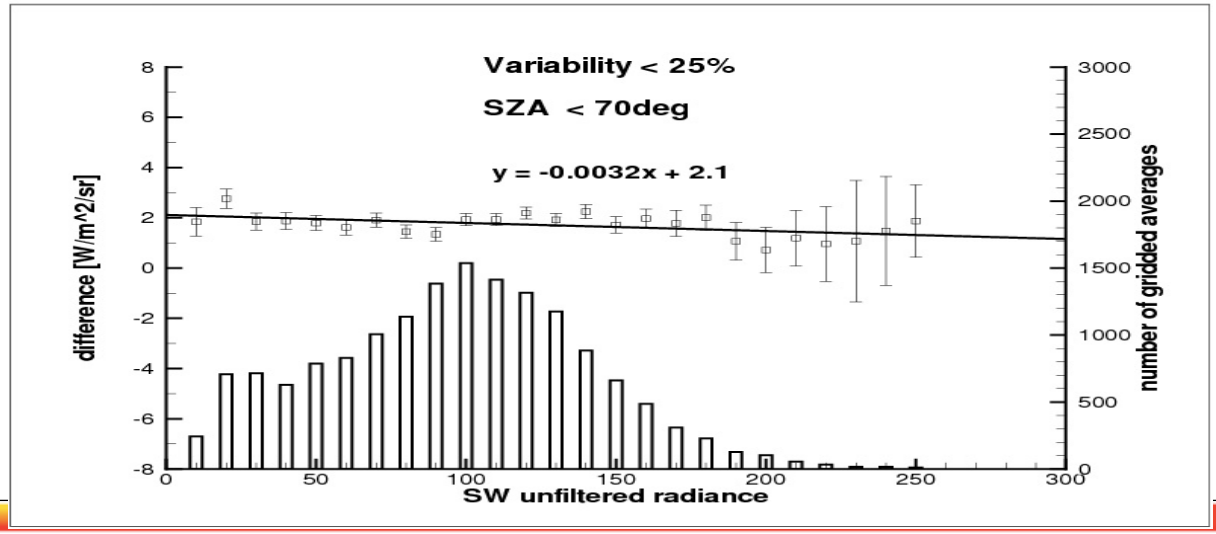


Z. P. Szewczyk

CERES FM5 - FM3 Matched Footprint Comparisons

Analysis of SW differences

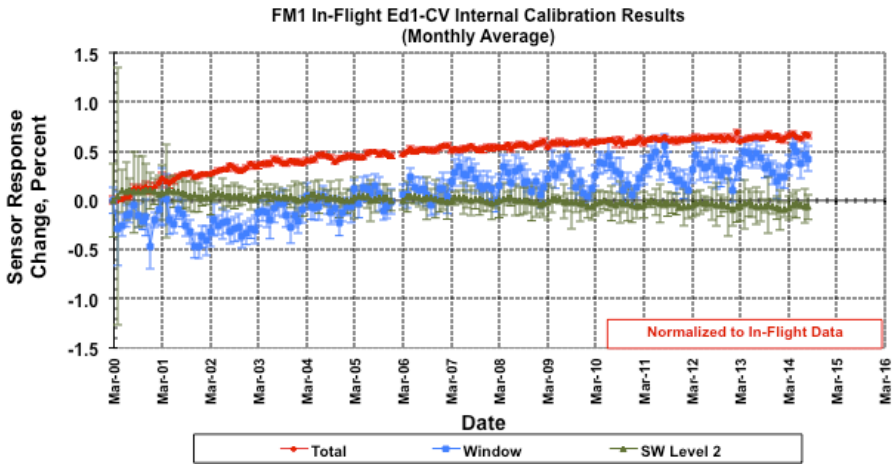


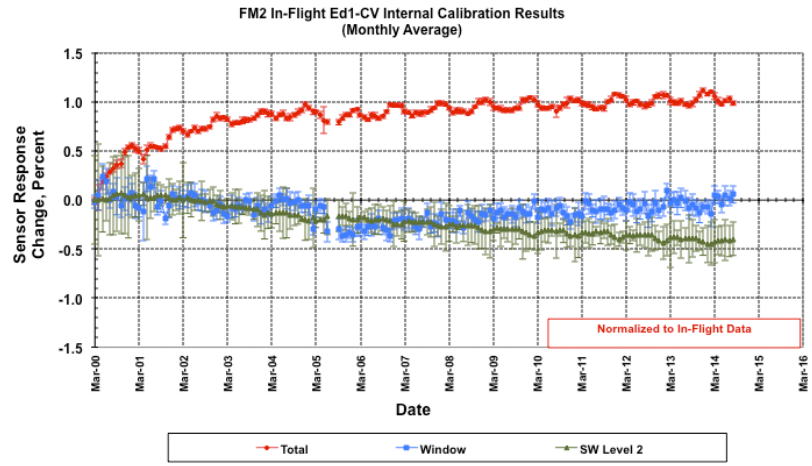


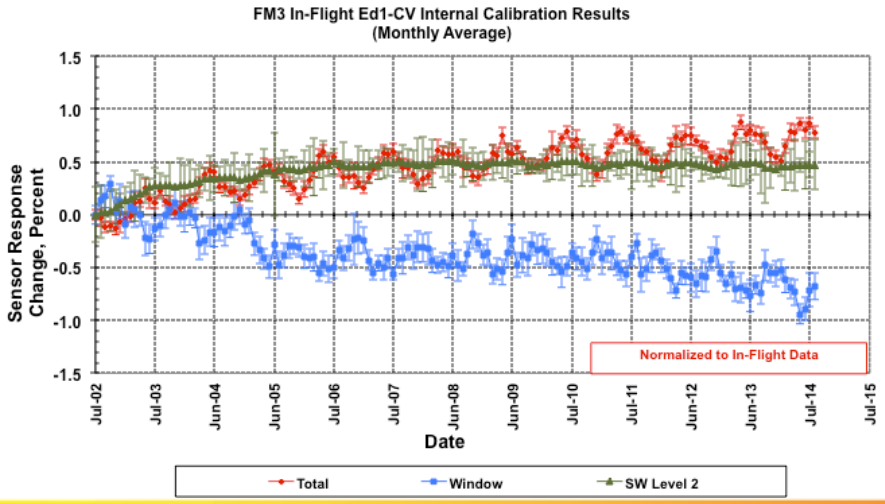
TERRA & AQUA INSTRUMENT STATUS

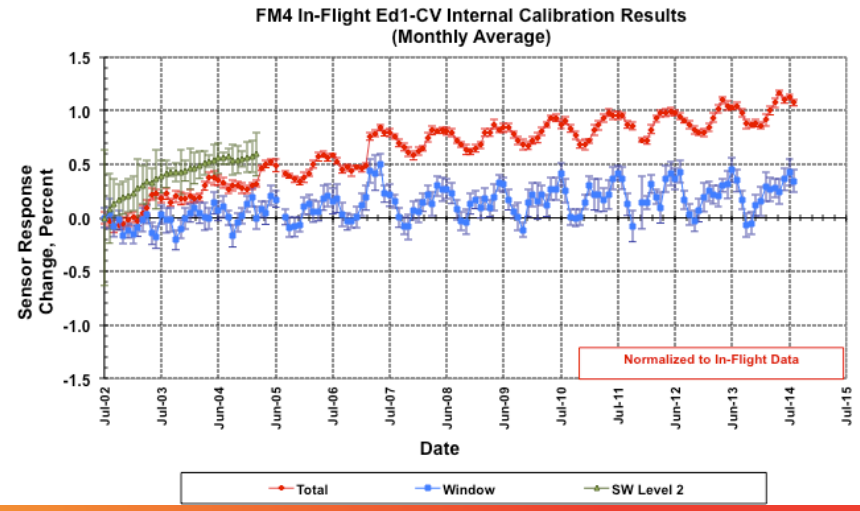
[CERES FM1 – FM4]

Terra – Aqua Sensor Performance









P.C. Hess, M. Shankar

TERRA/AQUA EDITION-4

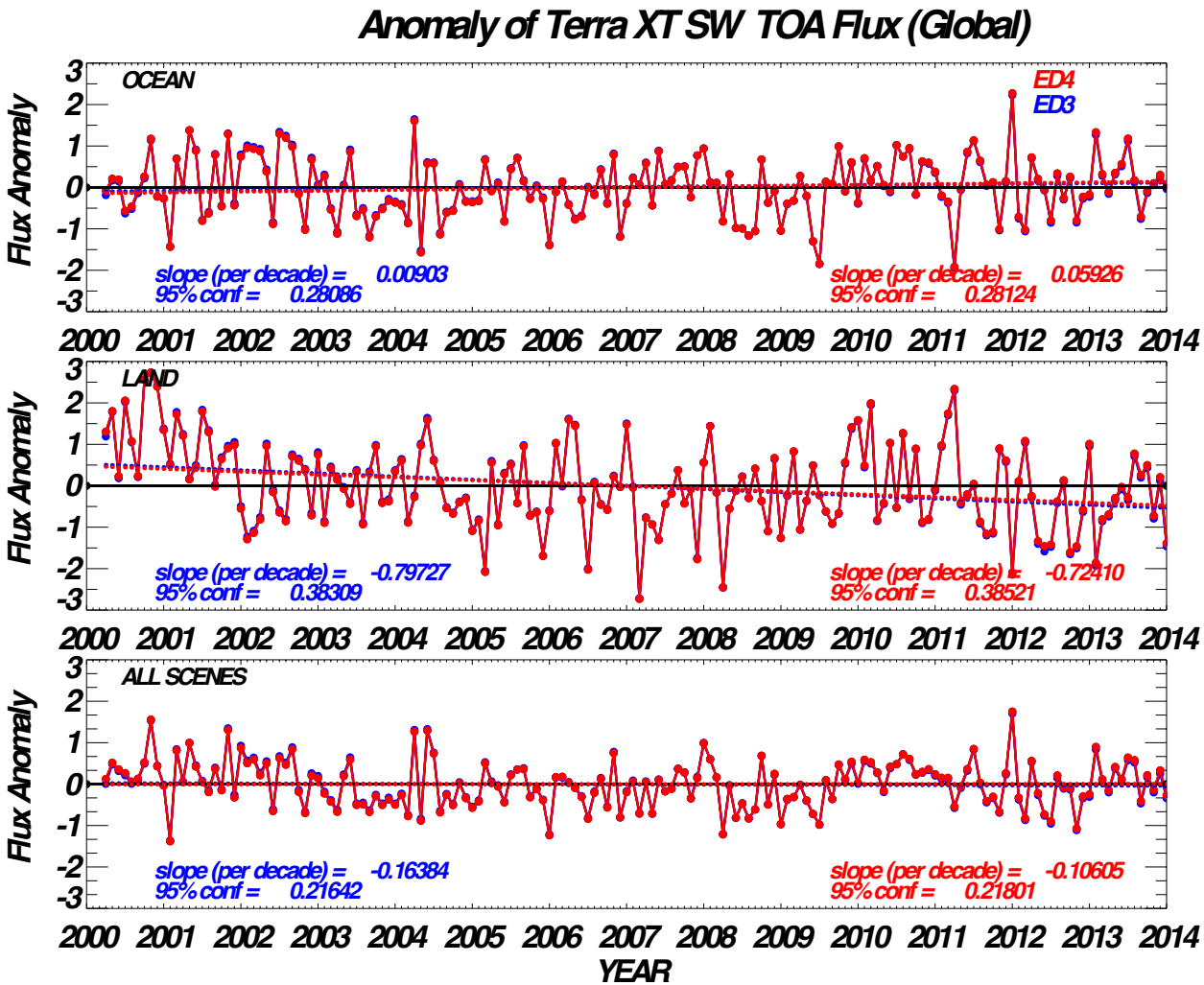
- The Beginning of mission (BOM) radiometric gain and spectral response (SRF) were determined from pre-launch calibrations. In Edition-4, the BOM SRF for FM3 SW and SW/TOT sensors were revised based on shortwave characterization data collected during ground testing.
- A common radiometric scale is established for all CERES instruments with FM1 as the standard.
- Ground to flight sensor gain shift is incorporated based on Internal Calibration Module (ICM) tests from pre-launch and 1st month of in-flight calibration.
- The monthly gain values for the Total, Window and Shortwave sensors are based on the in-flight ICM calibrations.
- The SW sensor SRF for the instrument operating in RAPS mode is corrected based on the functional form:

$$D(\lambda) = [1 - e^{-\alpha\lambda}]$$

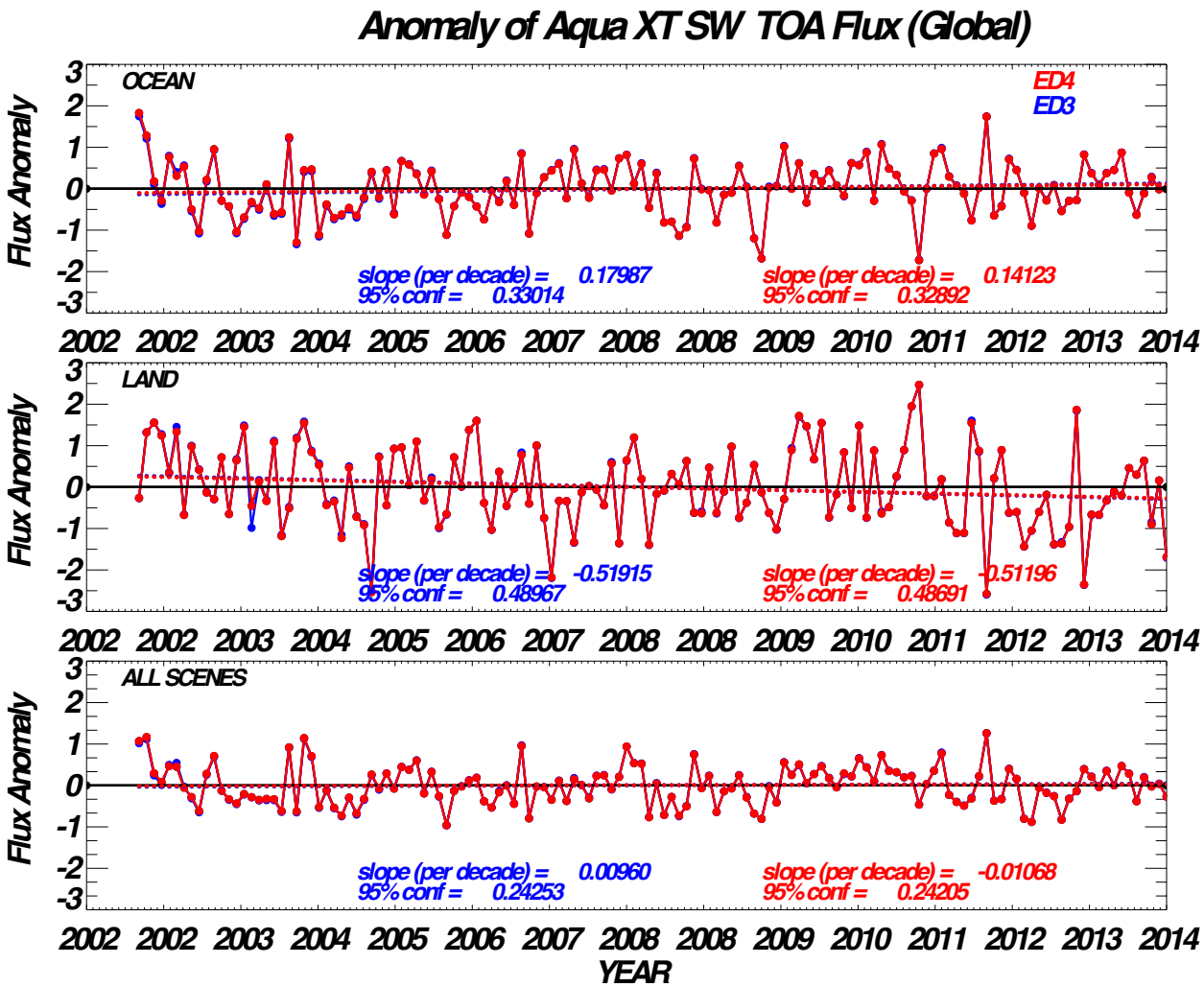
- The corrections applied to SW/TOT SRF is of the functional form

$$D(\lambda) = [1 - e^{-\alpha\lambda}] + \beta$$

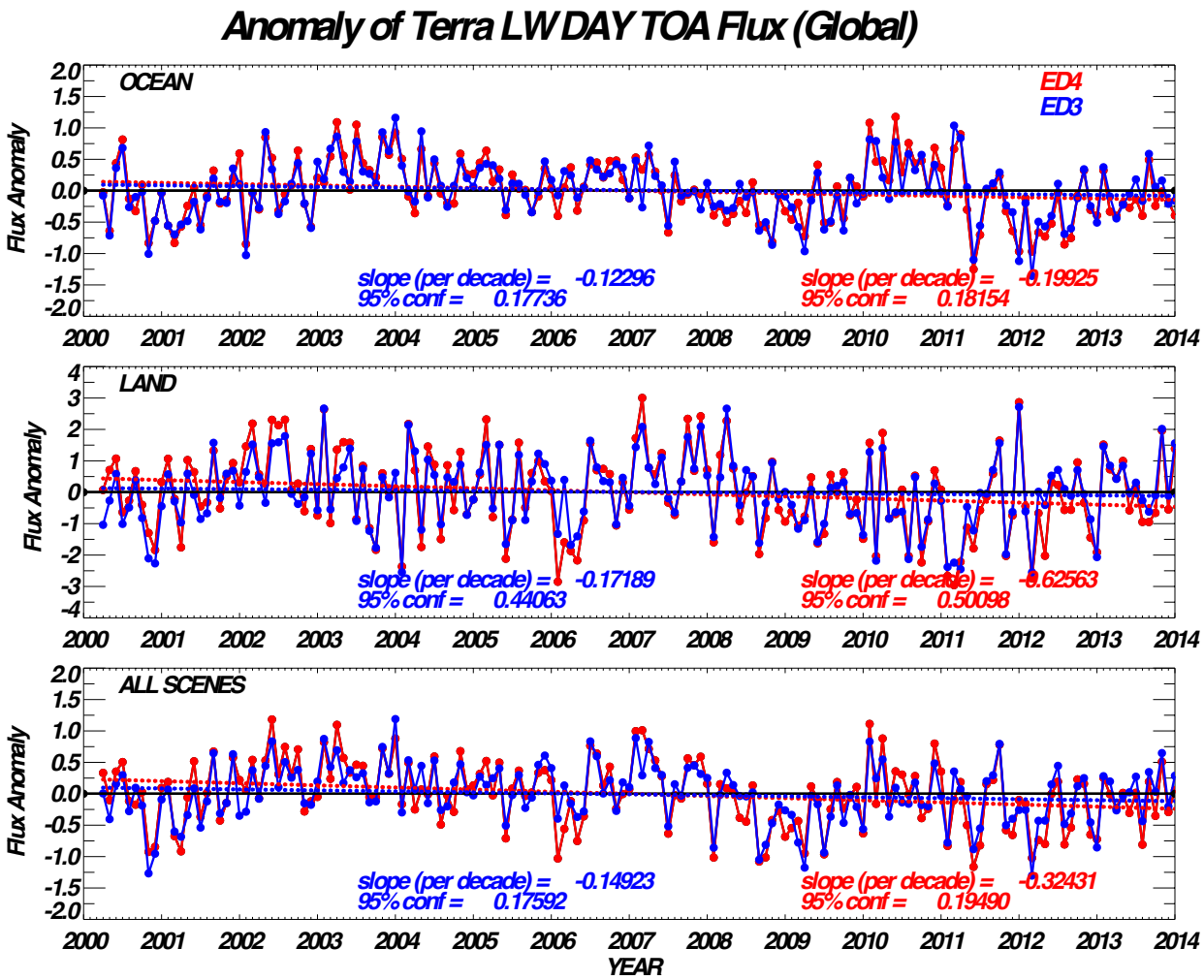
TERRA/AQUA EDITION-4 VALIDATION



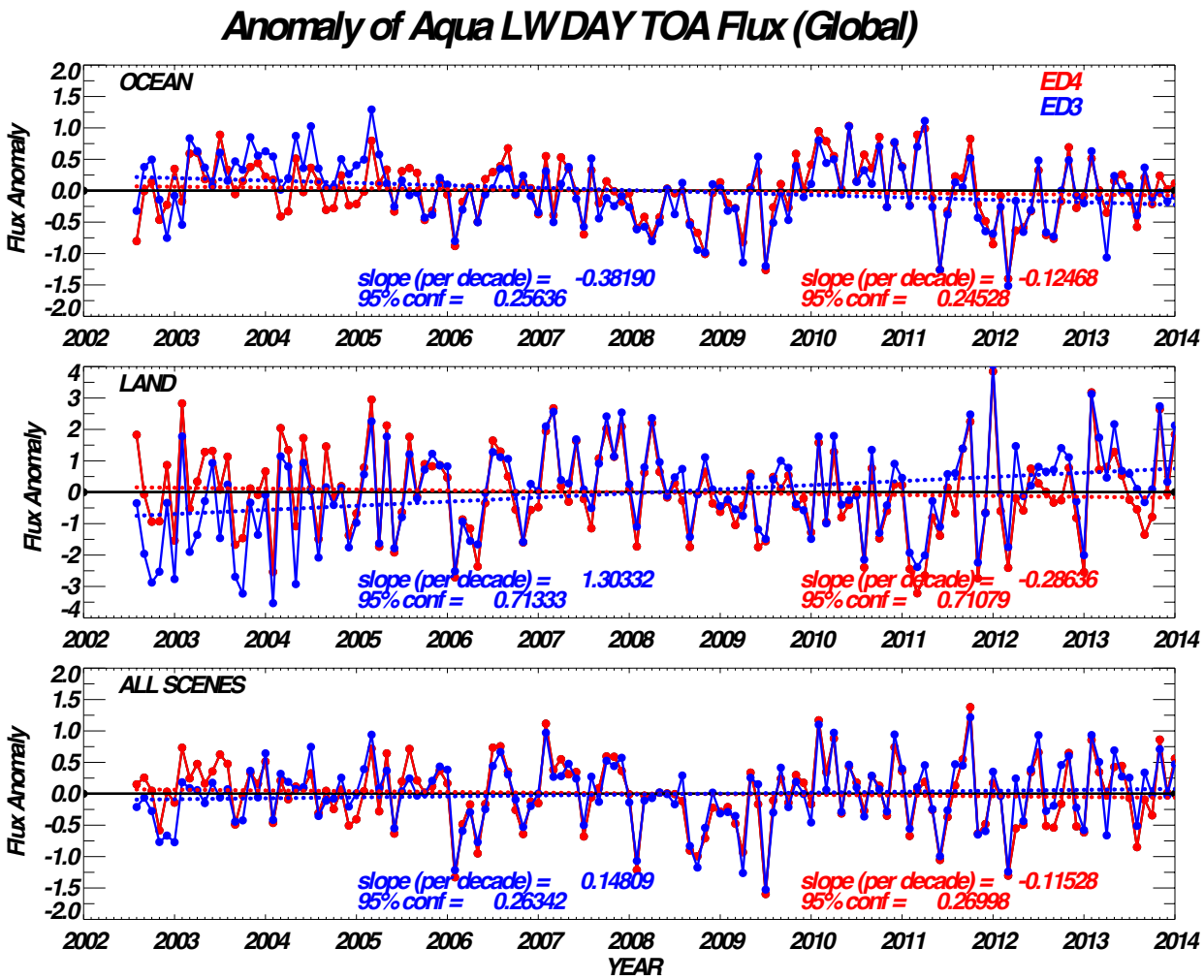
TERRA/AQUA EDITION-4 VALIDATION



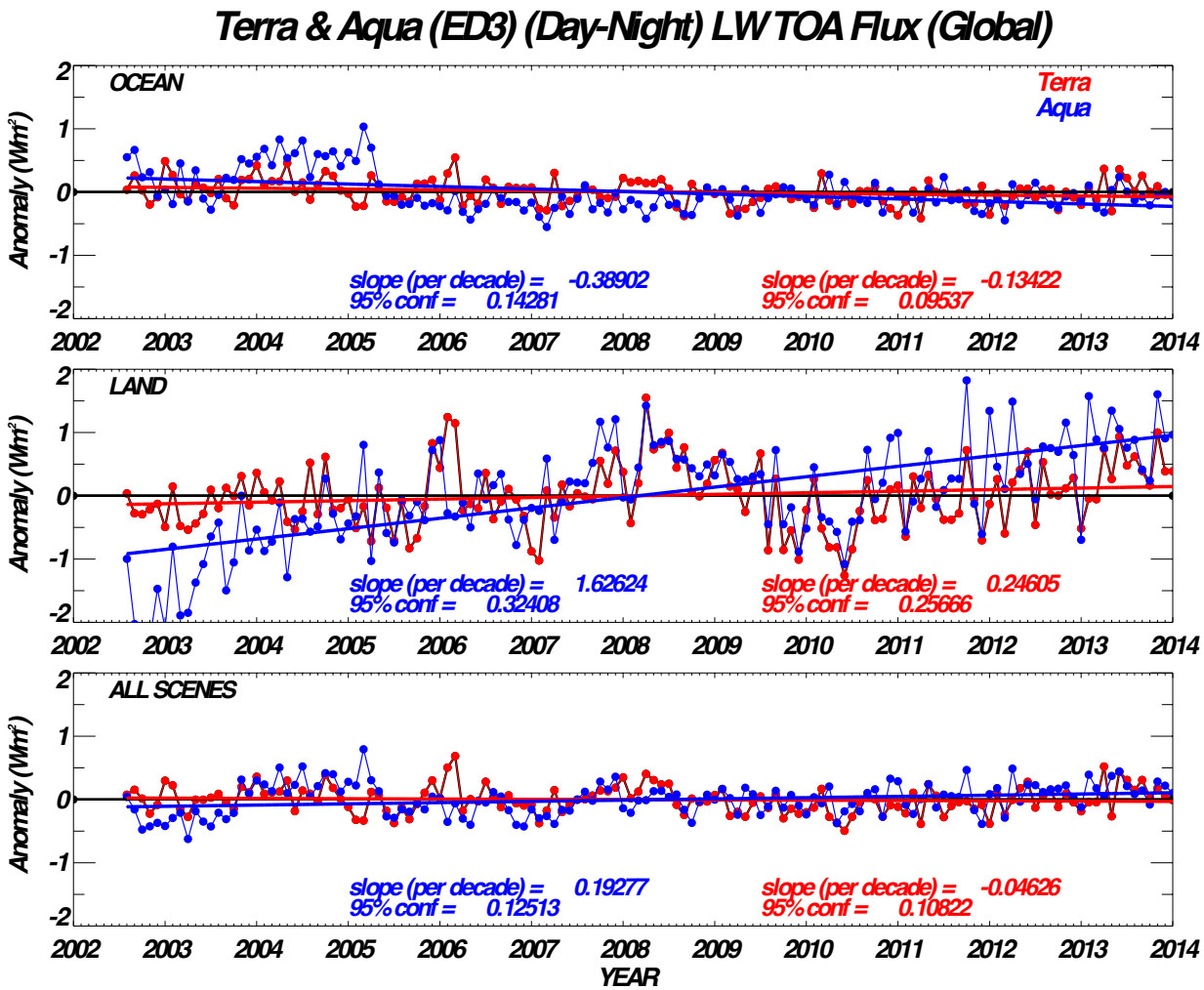
TERRA/AQUA EDITION-4 VALIDATION



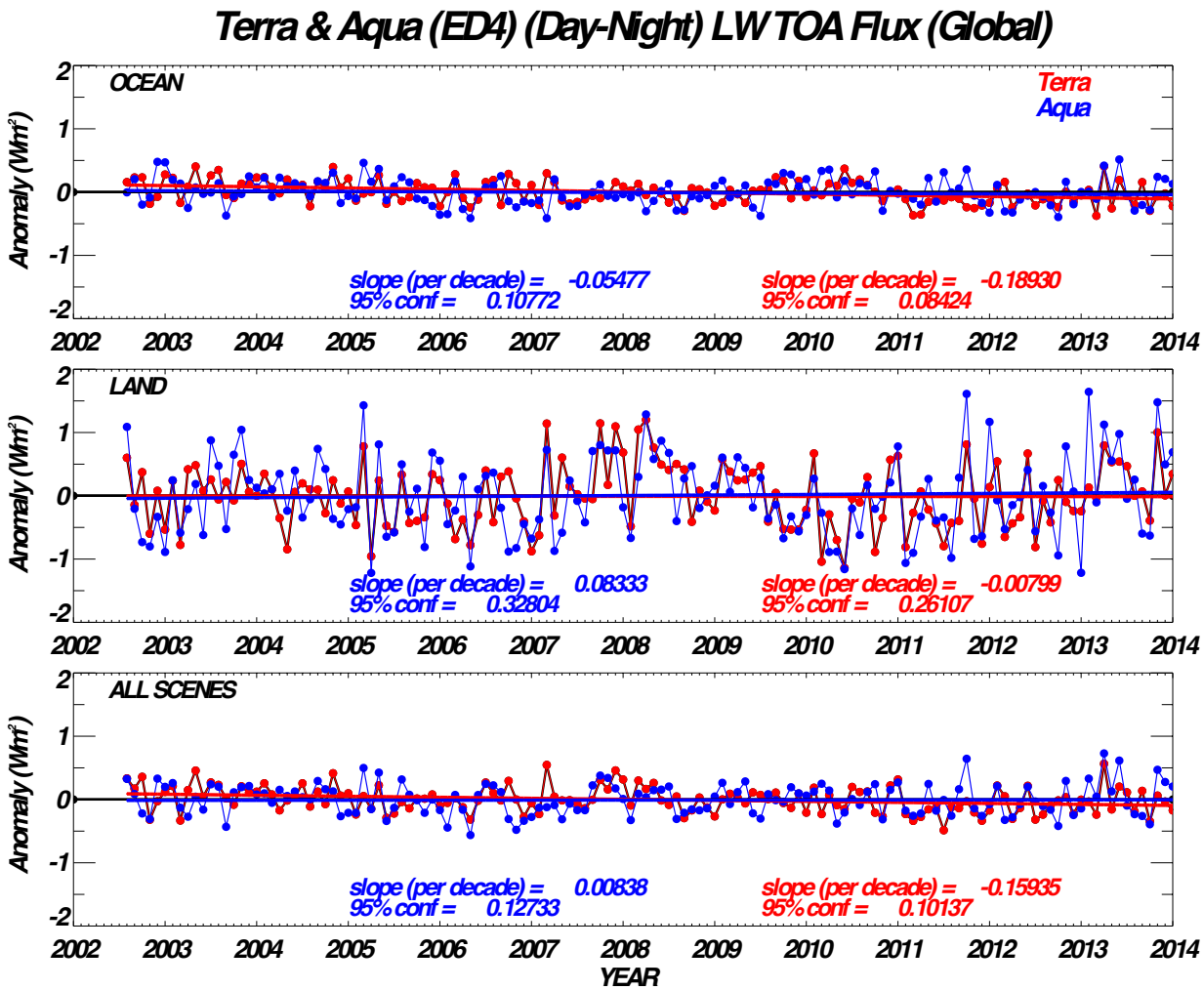
TERRA/AQUA EDITION-4 VALIDATION



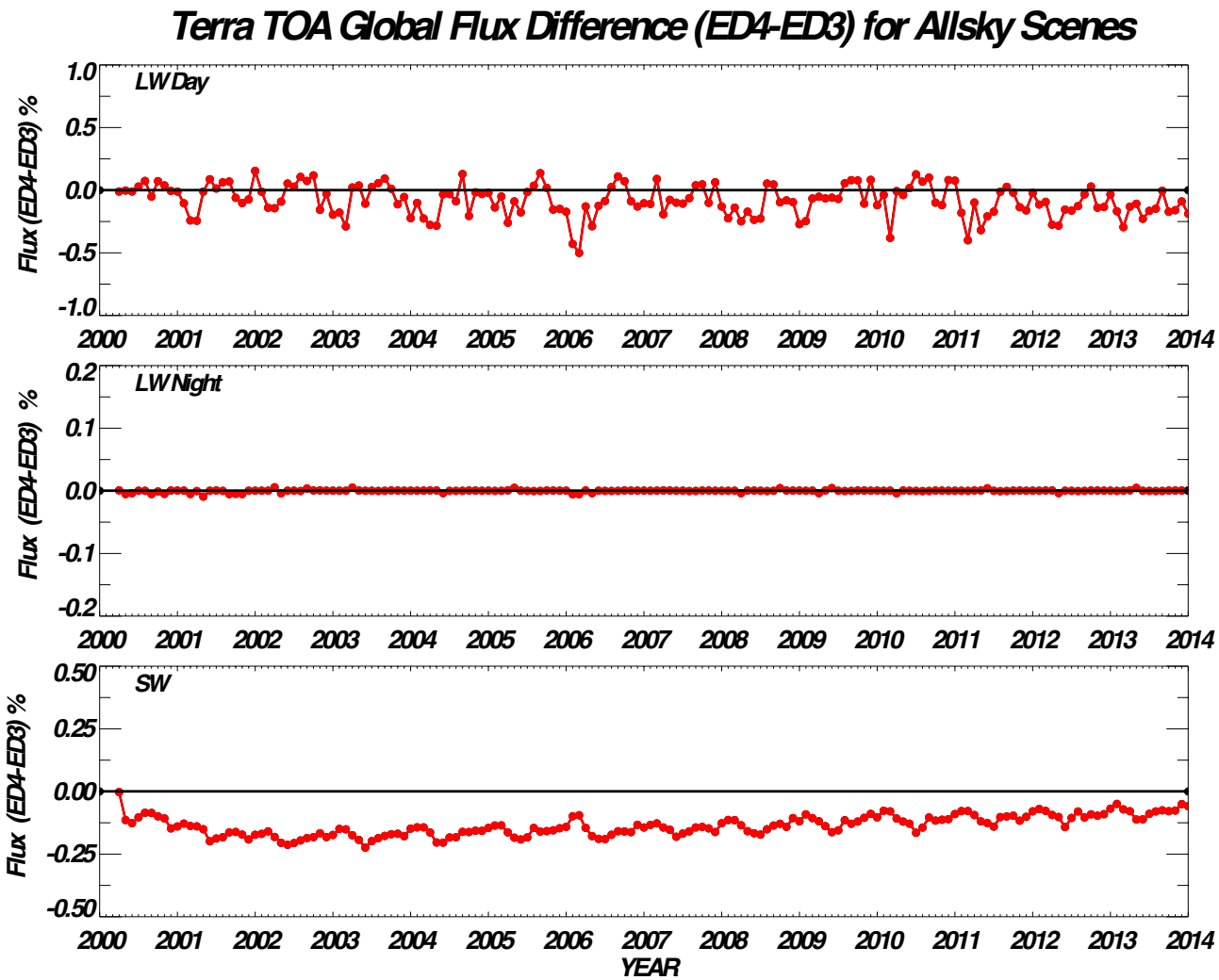
TERRA/AQUA EDITION-3 VALIDATION



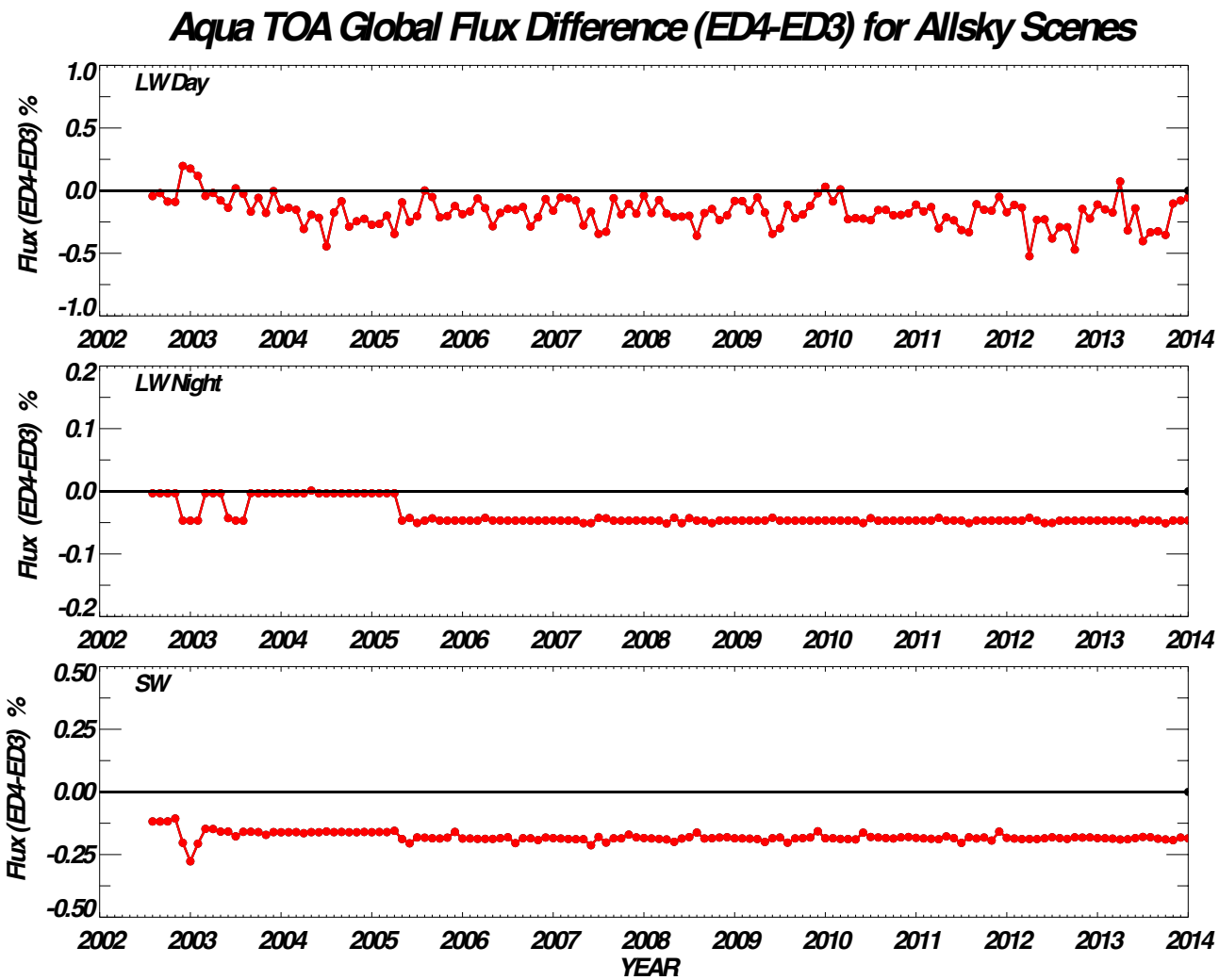
TERRA/AQUA EDITION-4 VALIDATION



TERRA/AQUA EDITION COMPARISON



TERRA/AQUA EDITION COMPARISON



TERRA/AQUA DATA AVAILABILITY

Edition3 Data Products (Instrument):

Start of Mission – June 2014

Edition4 Gains and Spectral Response Functions (SRF) :

Terra and Aqua BDS product - Start of Mission to Dec 2013

Edition1-CV Data Products (Instrument & ERBE-like):

Start of Mission – August 2014

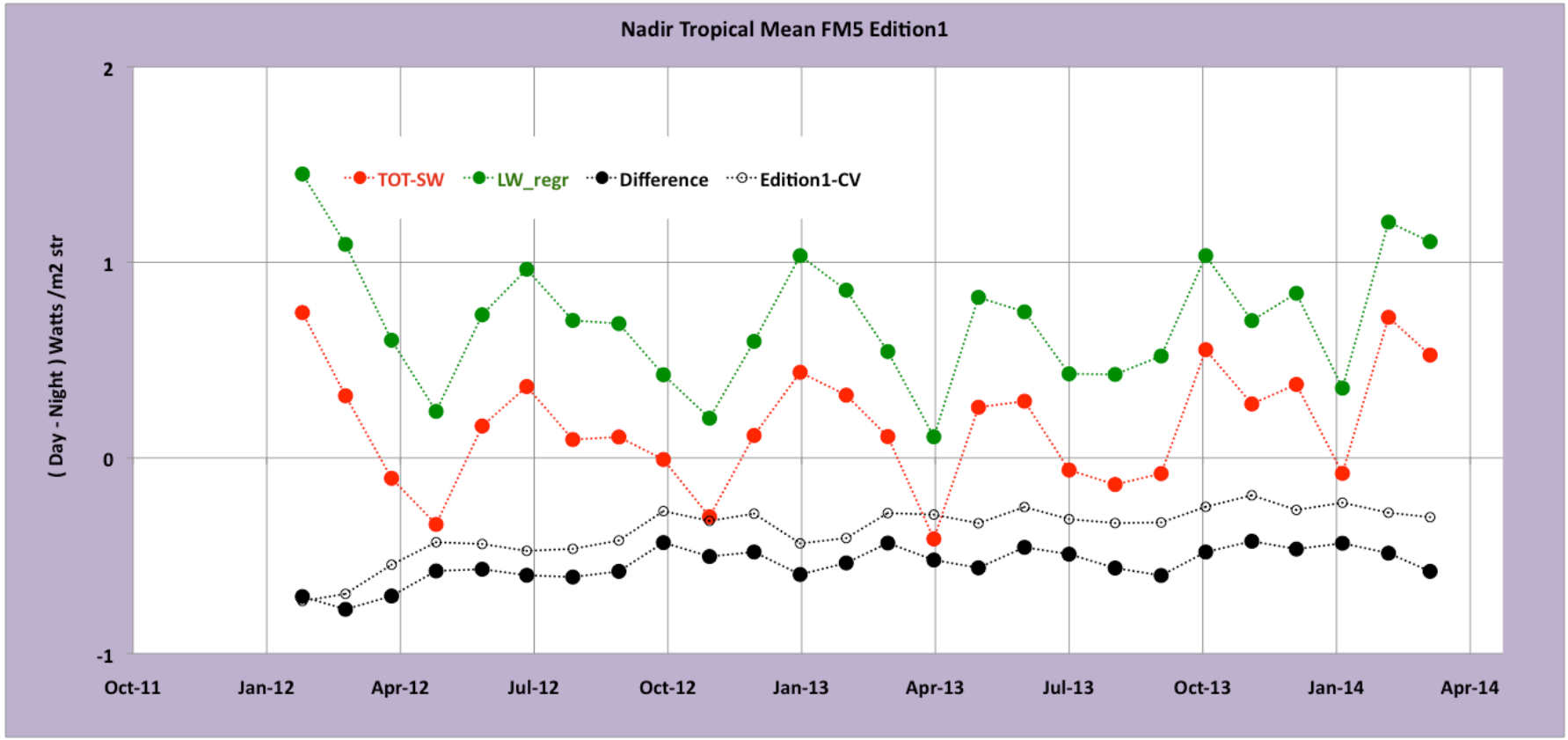
SUMMARY

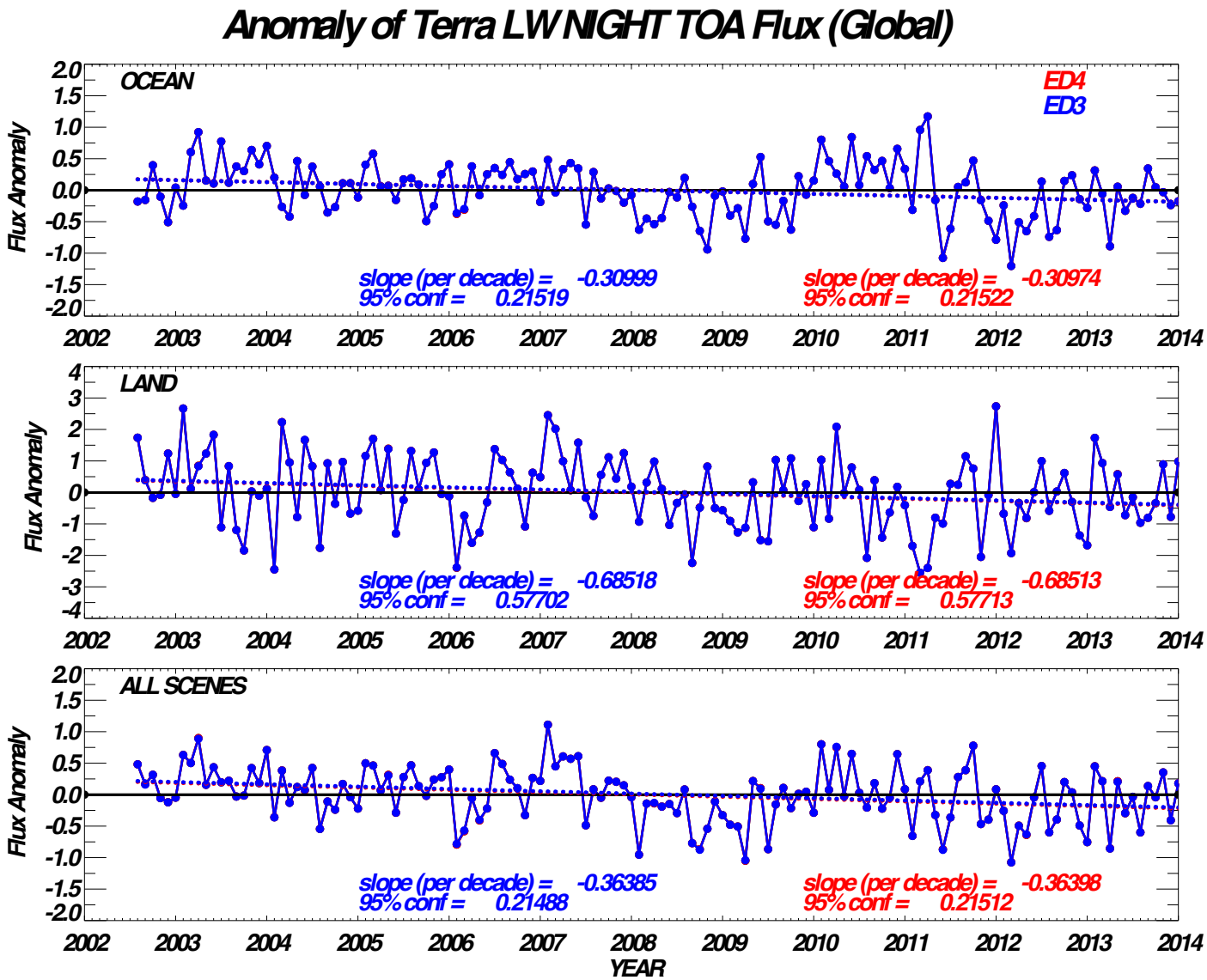
- CERES FM5 gains for Edition1 processing were delivered and are currently under production.
- FM5 SW radiances are higher than the FM3 measurements by ~2 W m-2sr-1.
- Instrument Gain and Spectral Response Functions for the Terra/Aqua Edition4 processing were delivered through December 2013.
- Validation studies have shown that the trend differences for ocean and land scenes in Aqua LW-day measurements was corrected in Edition-4 products.

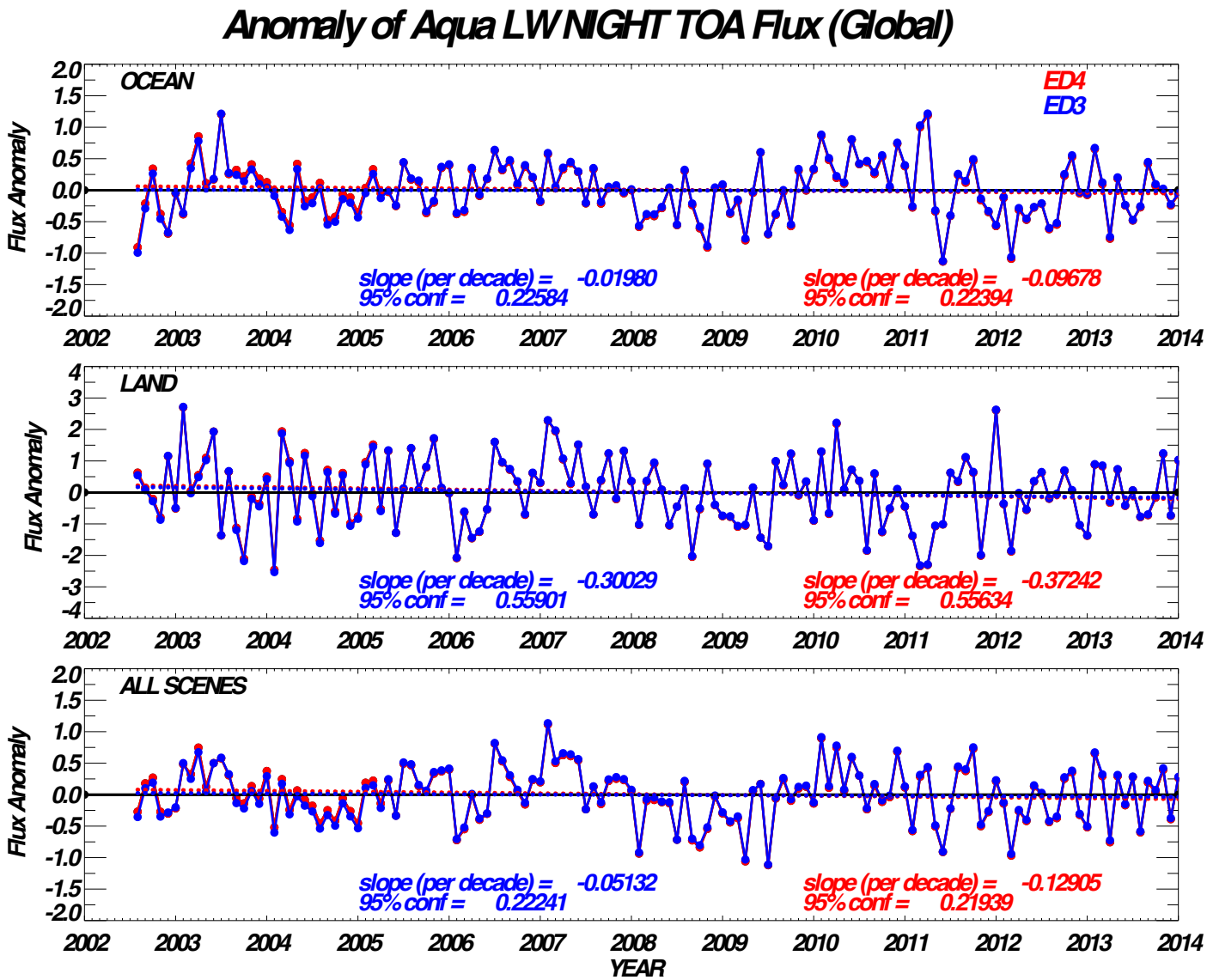
BACK UP SLIDES

CERES FM5 TM EDITION COMPARISON

Changes in FM5 Total and SW sensor gains for Edition1 have removed some of the trends in D-N Differences.




Anomaly of Terra LW NIGHT TOA Flux (Global)
OCEAN
ED4
ED3
slope (per decade) = -0.30999
95% conf = 0.21519
slope (per decade) = -0.30974
95% conf = 0.21522
LAND
slope (per decade) = -0.68518
95% conf = 0.57702
slope (per decade) = -0.68513
95% conf = 0.57713
ALL SCENES
slope (per decade) = -0.36385
95% conf = 0.21488
slope (per decade) = -0.36398
95% conf = 0.21512
Flux Anomaly
YEAR
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


Anomaly of Aqua LW NIGHT TOA Flux (Global)
OCEAN
ED4
ED3
slope (per decade) = -0.01980
95% conf = 0.22584
slope (per decade) = -0.09678
95% conf = 0.22394
LAND
slope (per decade) = -0.30029
95% conf = 0.55901
slope (per decade) = -0.37242
95% conf = 0.55634
ALL SCENES
slope (per decade) = -0.05132
95% conf = 0.22241
slope (per decade) = -0.12905
95% conf = 0.21939
Flux Anomaly
YEAR