CERES FM1 – FM5 Instrument Status

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CERES Science Team Meeting
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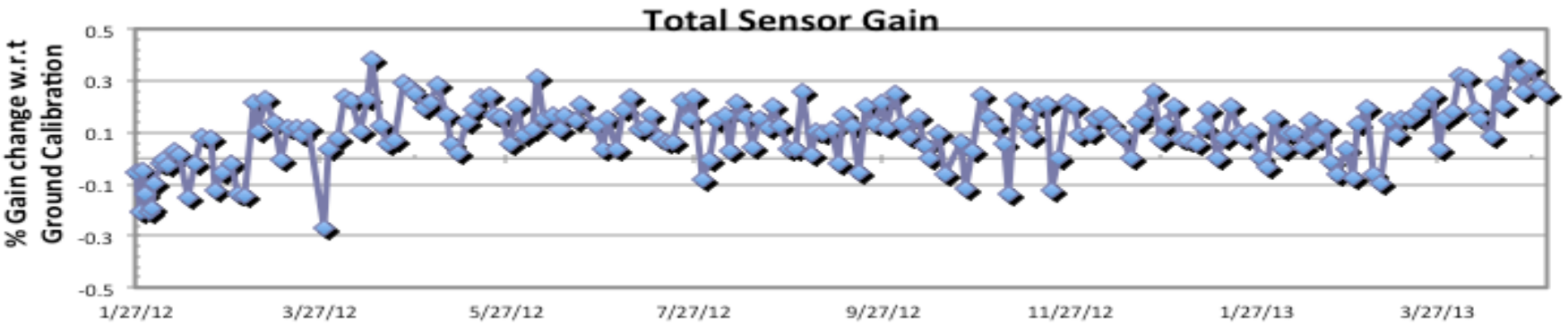
Suomi NPP/CERES FM5 Status

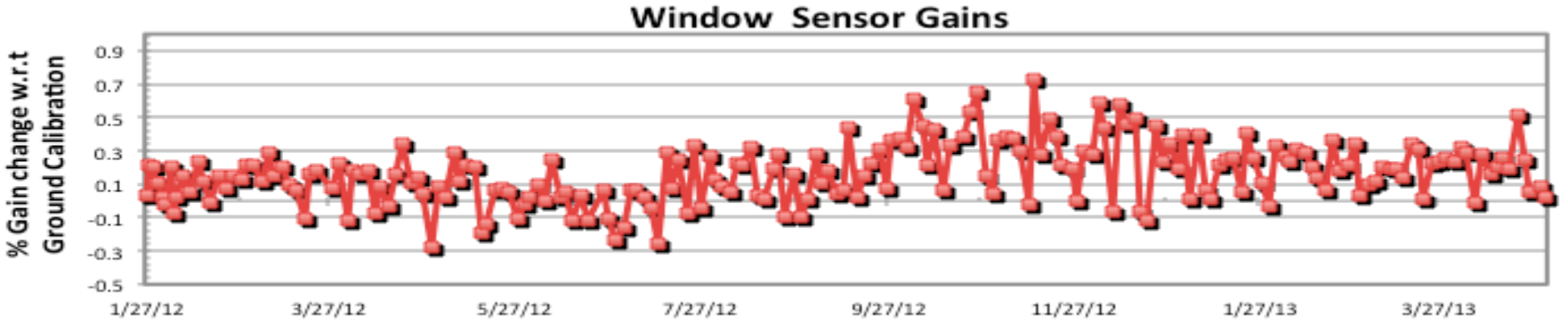
CERES Flight Model 5 Instrument completed first year of on-orbit operations.

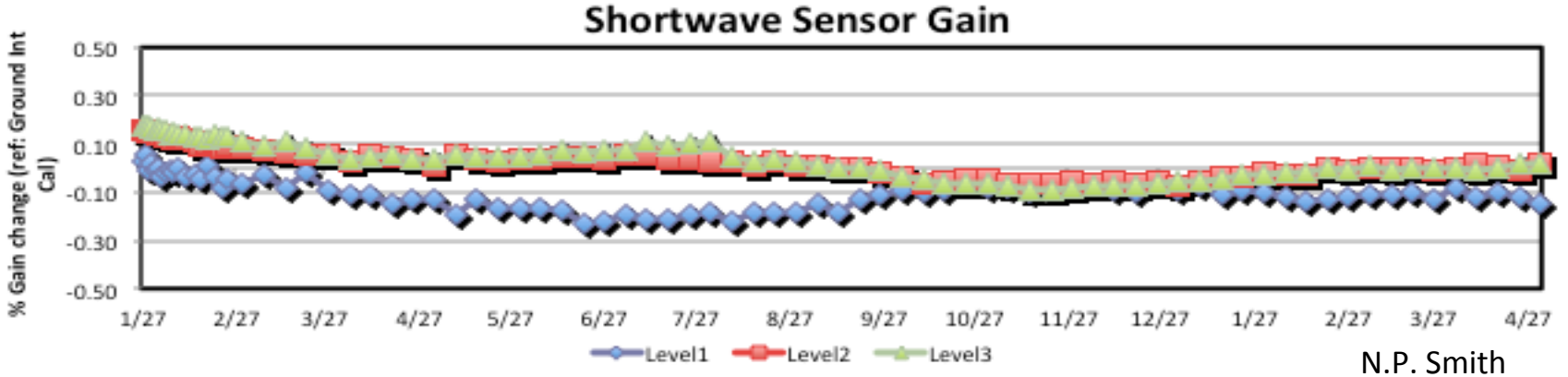
Sensor Performance is evaluated with ICM Calibrations using on-board sources (Blackbody – 3 times/wk, SWICS – weekly) and Solar calibrations (biweekly).

The on-orbit performance of all three sensors are within the expected range of +/- 0.5 percent during the first year in mission.

Suomi NPP/CERES FM5 ICM Calibrations



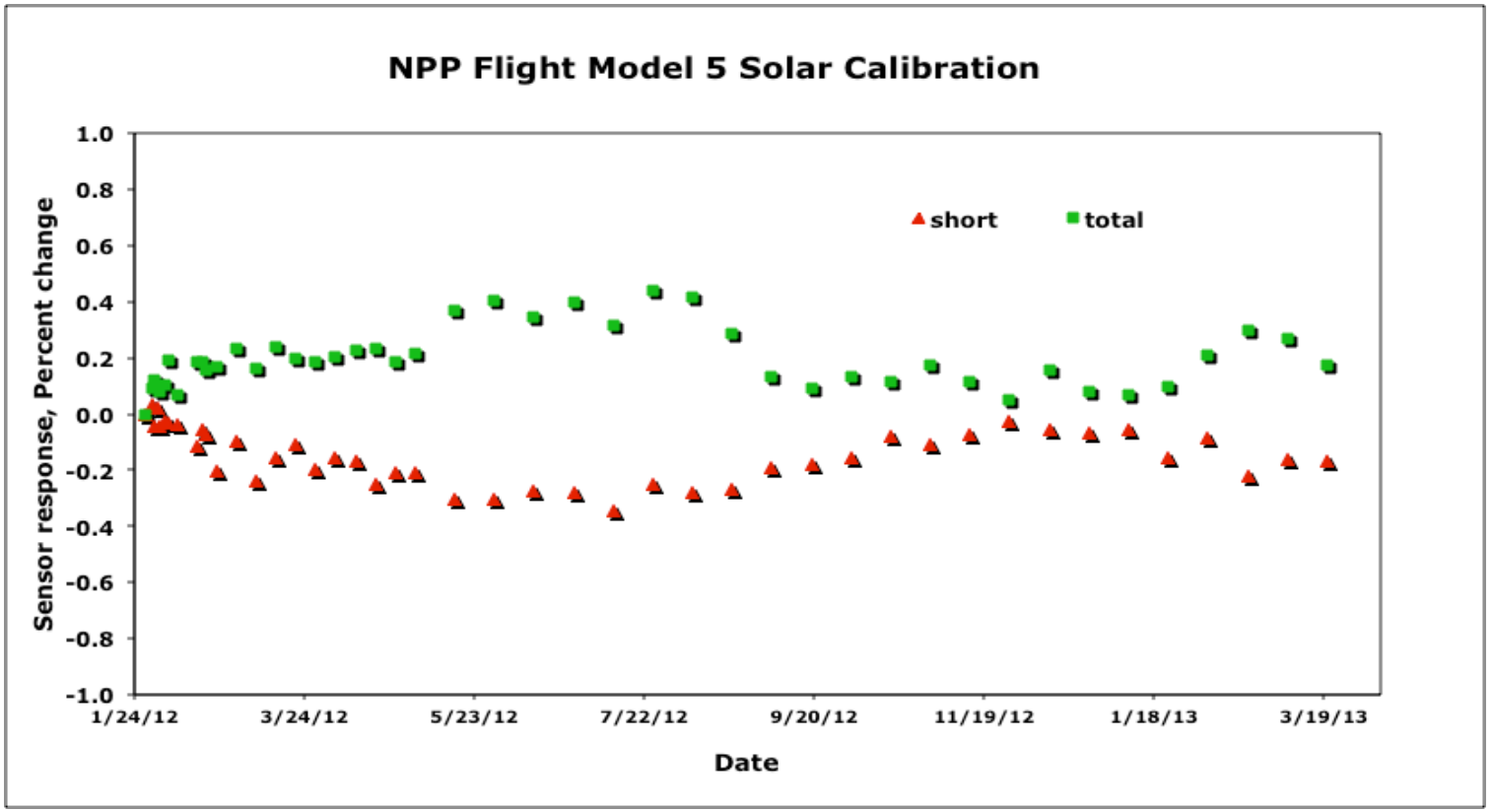




N.P. Smith

Suomi NPP/CERES FM5 Solar Calibrations

- Total and SW sensor results from the MAM calibrations are within the expected range of +/- 0.5%



CERES FM5 Validations – Flux Comparison

FM5 LW and SW Global Flux Average (Feb–Nov 12)

Comparison with CERES FM1 and FM3 [Edition3]

	FM5 Wm-2	FM1 Wm-2	FM5-FM1 Wm-2	FM3 Wm-2	FM5-FM3 Wm-2
LW_All	240.56	241.05	-0.49	241.1	-0.54
LW_Clear	268.56	267.74	0.82	267.93	0.63
SW_All	97.20	96.23	0.97	95.85	1.35
SW_Clear	50.20	48.85	1.35	49.39	0.81

CERES FM5 Validations

Tropical Mean: Average of All-sky tropical ocean (20°N-20°S) Radiance

FM5 Radiance average for Feb - Dec 2012 comparison with CERES FM1 and FM3 (Edition3) Results

	FM5 Wm-2sr-1	FM1 Wm-2sr-1	FM5-FM1 Wm-2sr-1	FM3 Wm-2sr-1	FM5-FM3 Wm-2sr-1
LW-night	88.13	88.16	-0.03	88.33	-0.20
LW-Day	88.33	88.27	0.06	88.48	-0.15

CERES FM5 (NPP) –FM3 (Aqua) Comparisons

- NPP and Aqua Simultaneous Observation Opportunities occur every 64 hours and last ~20 minutes with views < 1 minute apart.
- Comparison based on gridded 1^o x1^o averages with relative VZA <15 deg and RAZ < 10 deg.

All-sky Results: Feb – Dec 2012

(FM5-FM3)/ FM5	FM5 Radiance [W m^{-2} sr^{-1}]	Relative Difference [%]	α-confidence	Number of samples
Shortwave	**78.04**	**3.15**	**0.48**	**67**
LW day	**76.23**	**-1.40**	**0.15**	**68**
LW night	**67.57**	**-0.49**	**0.13**	**87**

- Additional scene comparisons – Clear Ocean, Clear Land, Overcast – showed FM5 SW is measuring higher between 2 – 2.9 Wm-2sr-1.

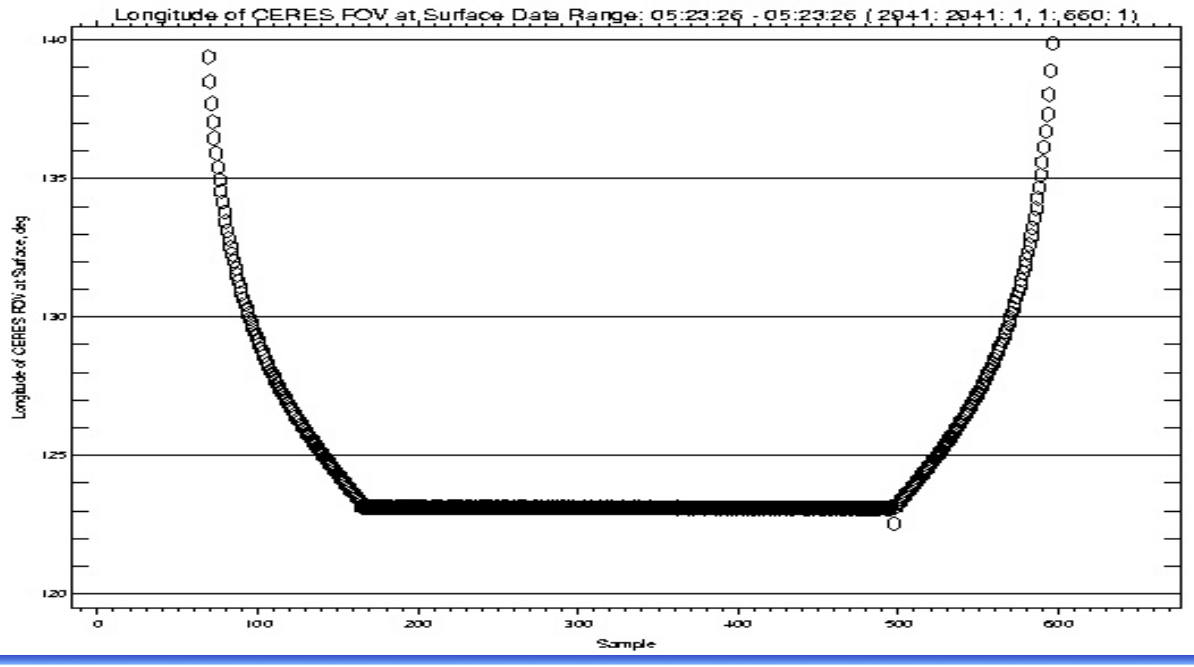
CERES FM5 (NPP) –FM3 (Aqua) Comparisons

Nadir dwell scan profile:

Radiance average is based on 330 samples.

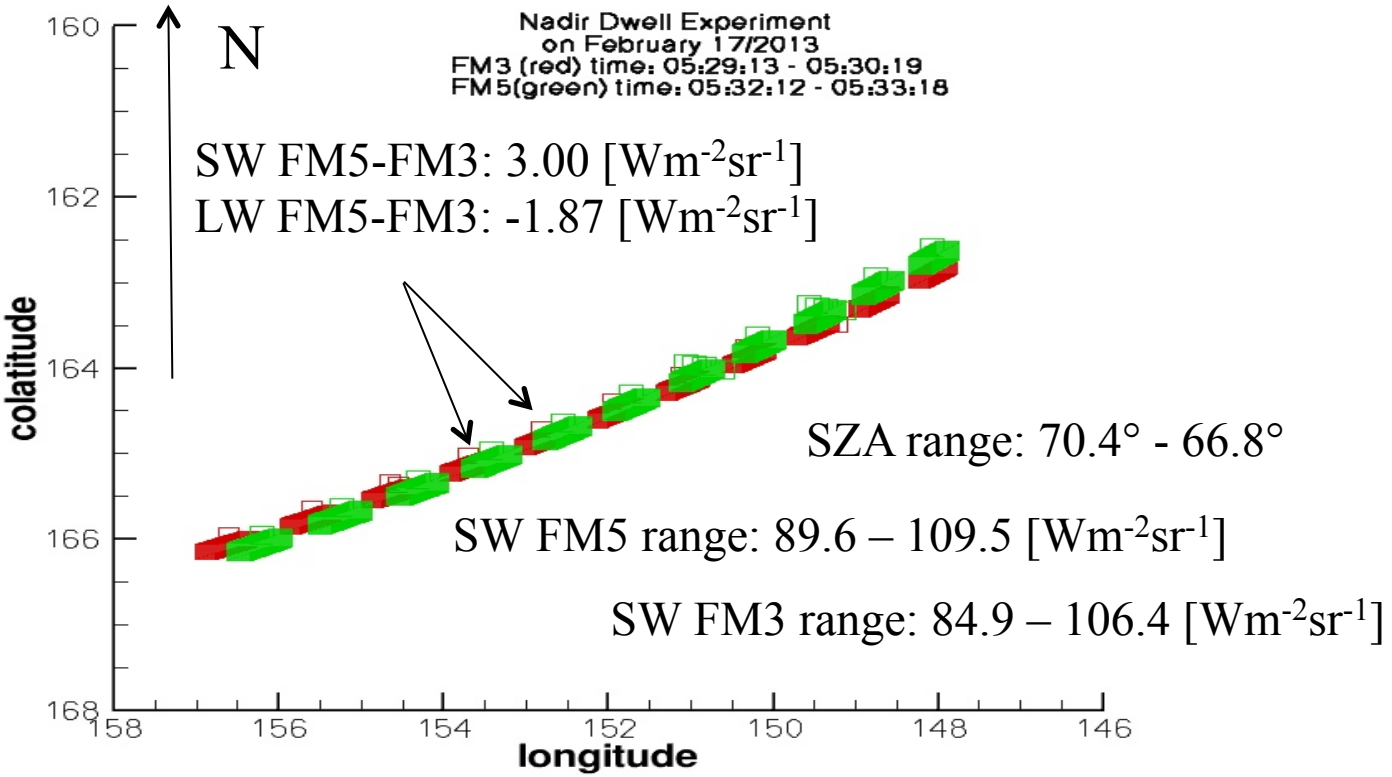
Azimuth gimbal is set same as the cross-track mode (180 deg)

Eight matched scans/min and up to 2 minutes of matched sites.



CERES FM5 (NPP) –FM3 (Aqua) Comparisons

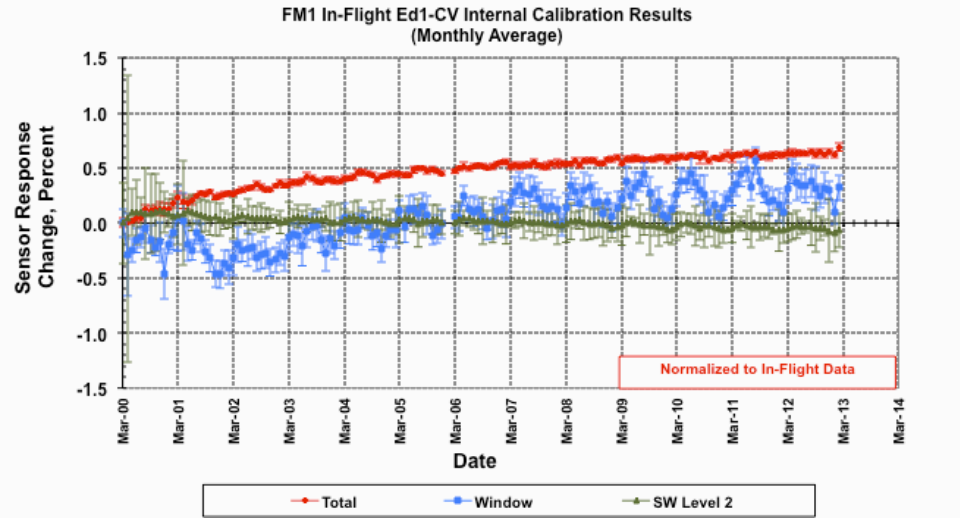
Nadir dwell scanning on 02/17 over Antarctica:

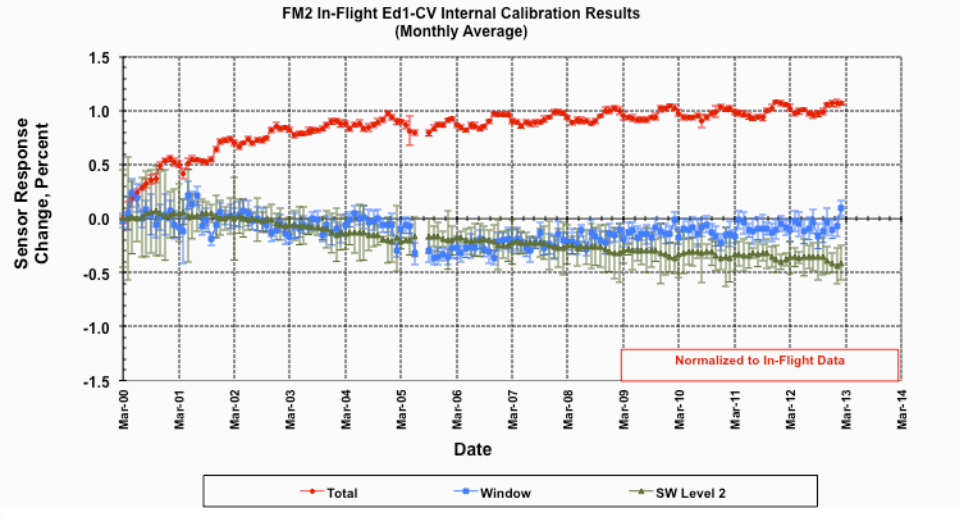


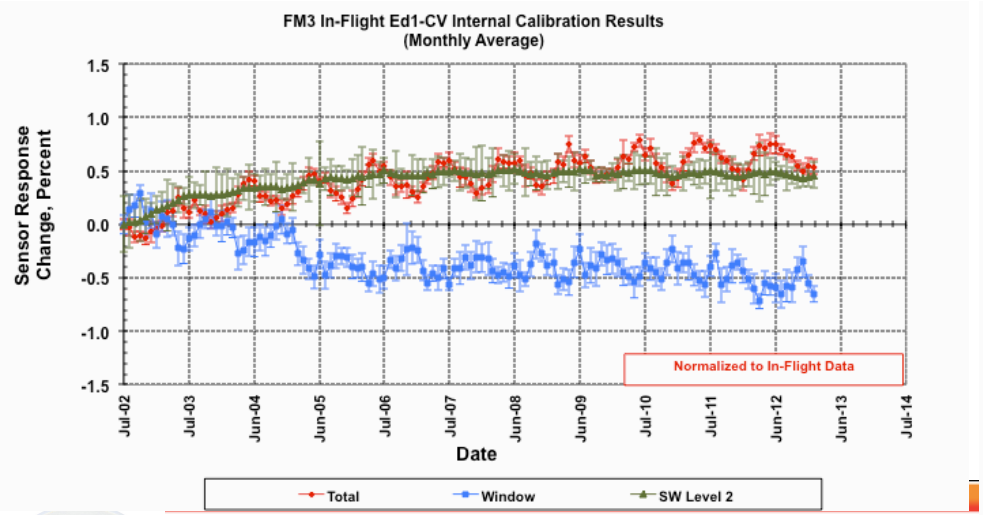
TERRA & AQUA INSTRUMENT STATUS

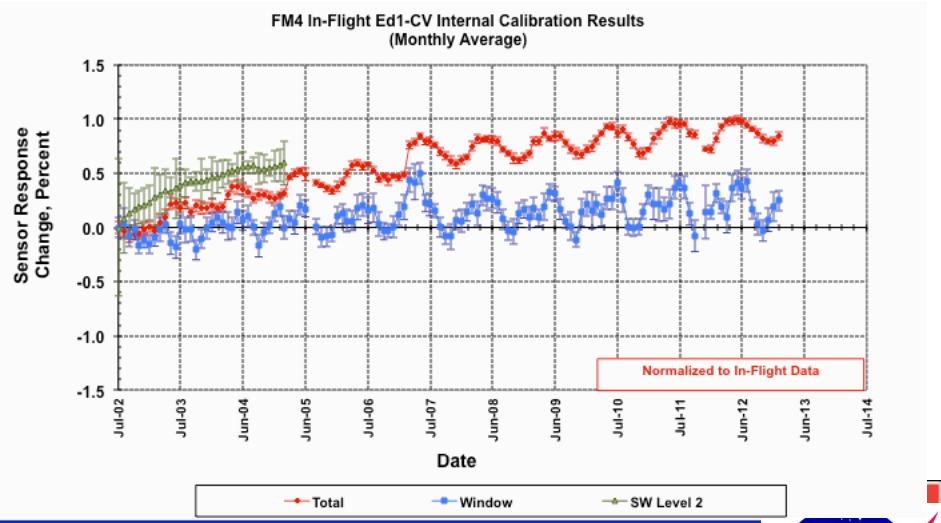
[CERES FM1 – FM4]

Terra – Aqua Sensor Performance









TERRA/AQUA DATA AVAILABILITY

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

Start of Mission – March 2013

Edition3 Data Products (Instrument):

Start of Mission – December 2012

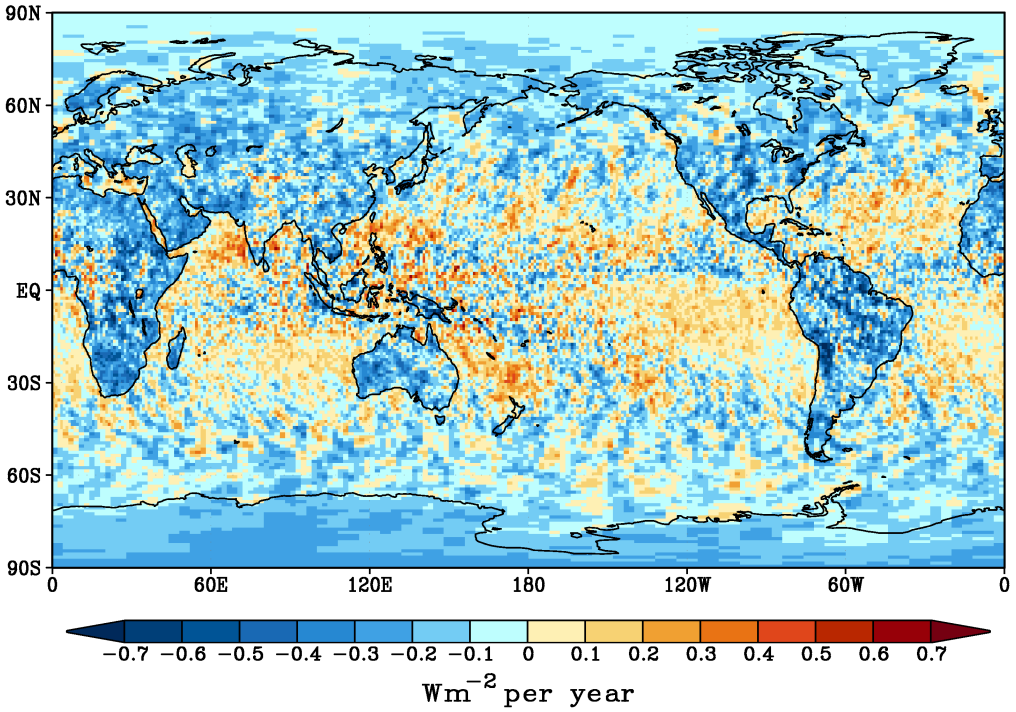
Edition3 Gains and Spectral Response Functions (SRF) in testing for Production Delivery: January – February, 2013

TERRA/AQUA EDITION-4 Updates

Validation studies for Edition3 data products have highlighted areas for further evaluation in Aqua LW-Day measurements.

1. **Dispersion in the Aqua/FM3 – FM4 LW-Day measurements between Ocean and Land Scenes: Beginning of Mission SRF corrections were applied.**
2. **Trend difference for Ocean and Land scene measurements: Slope of Terra minus Aqua All-sky LW TOA Flux anomaly showed a negative trend over Land and a positive trend over Ocean regions.**

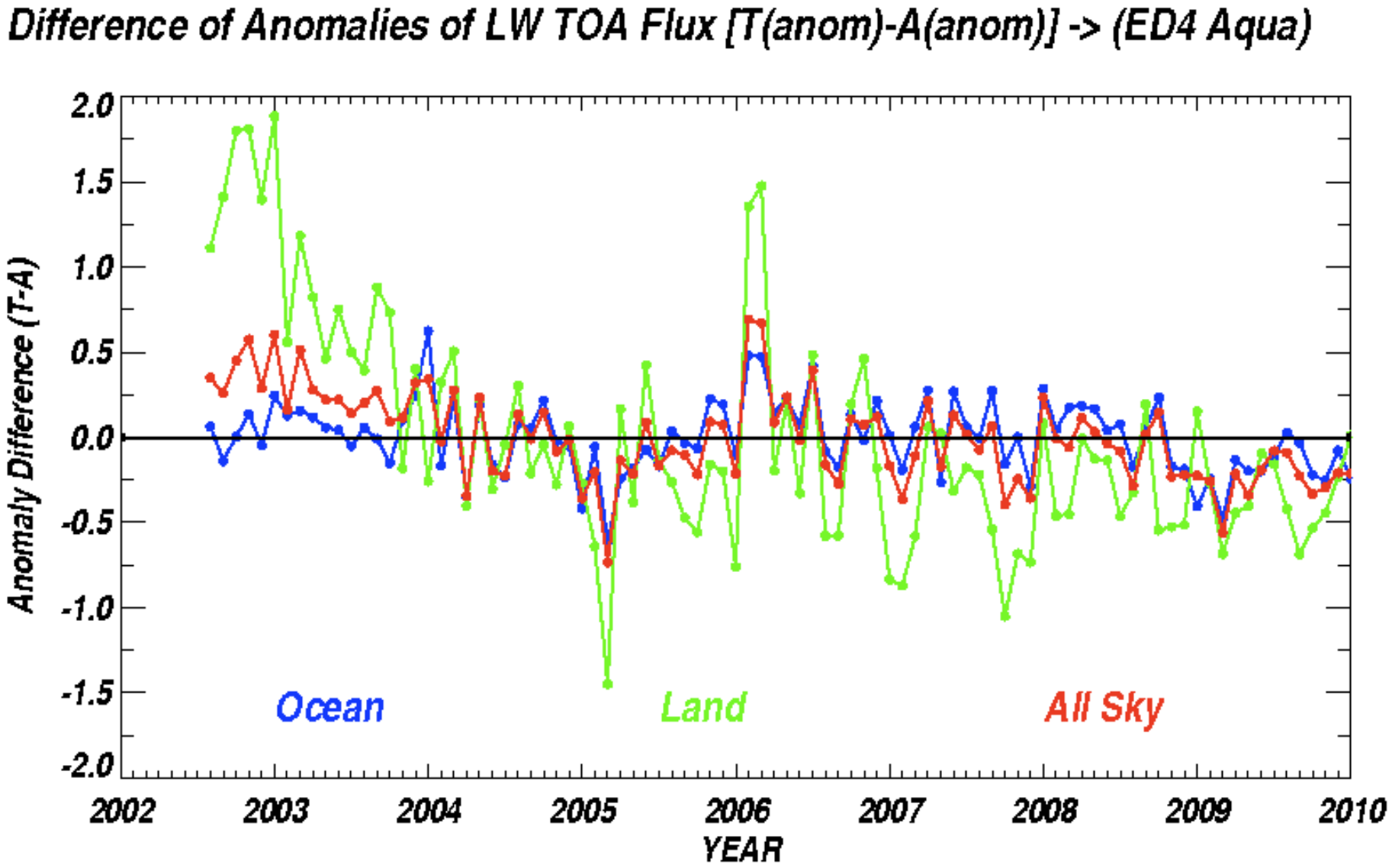
TERRA/AQUA EDITION-3 LW Flux Anomaly



Slope of Terra minus Aqua all-sky LW TOA flux anomalies for July 2002-June 2009 from SSF1deg-lite_Ed2.5. (Units: Wm^{-2} per year)

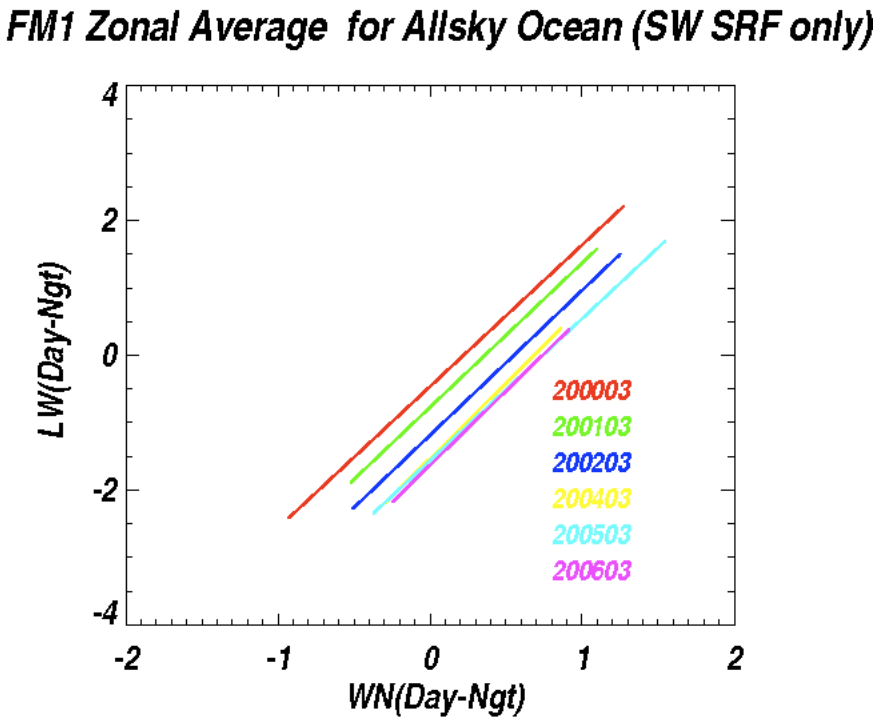
Negative trend over the Land and a positive trend over Ocean region

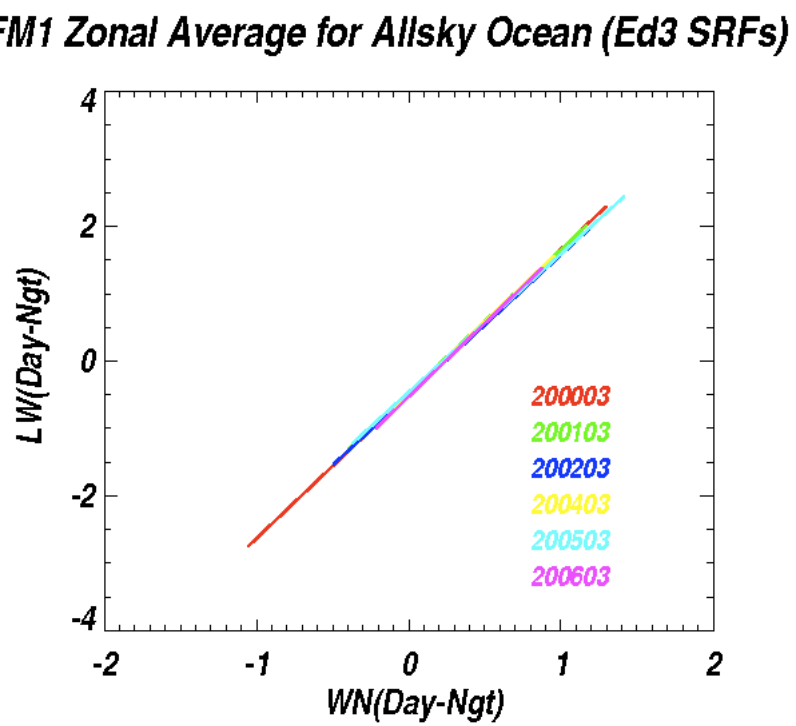
TERRA-AQUA EDITION-4 LW Anomaly Trends



TERRA/AQUA SW/TOT Spectral Response

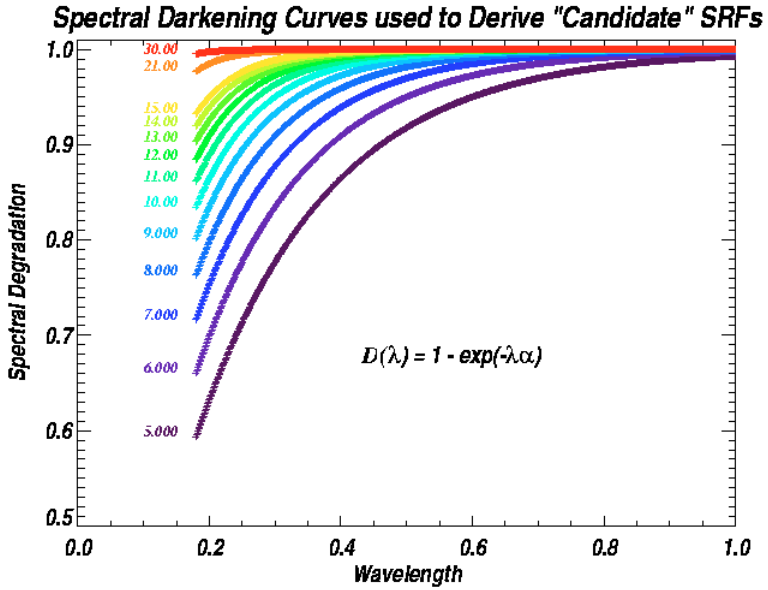
SW/TOT SRF Correction: All-Sky Ocean averages in the 30N – 30S region.
Window and LW Day - Night difference regression.

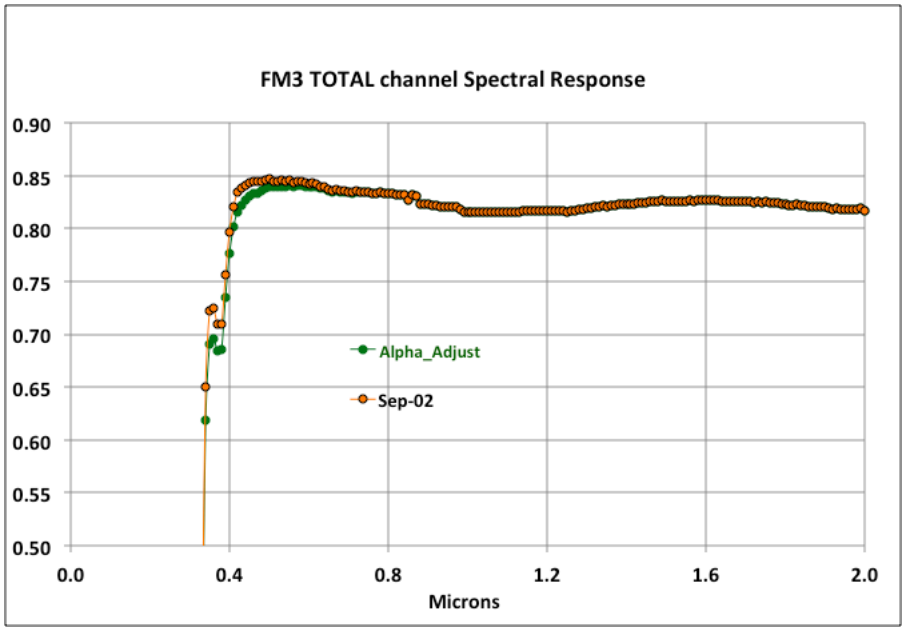




TERRA/AQUA SW/TOT Spectral Response

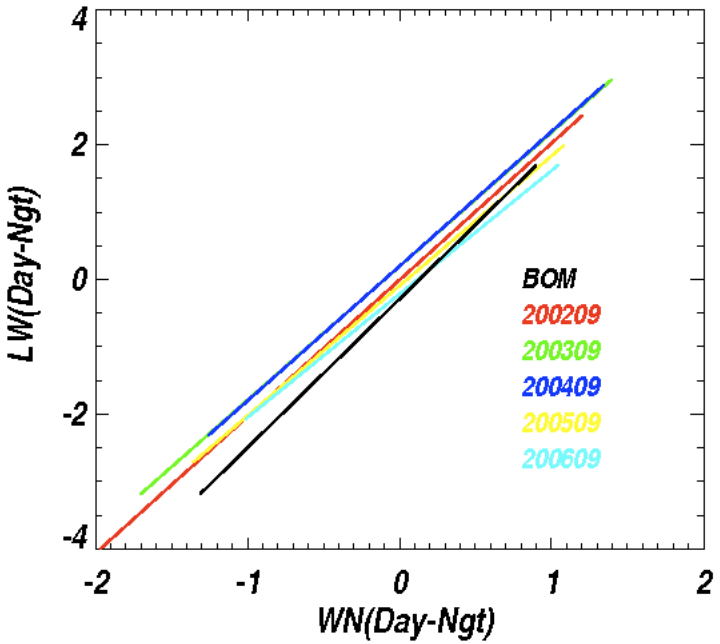
SW/TOT SRF Correction: The best SRF is selected from 'candidate' set of SRFs with the spectral darkening correction, which will eliminate the monthly offset from Beginning of Mission (BOM).



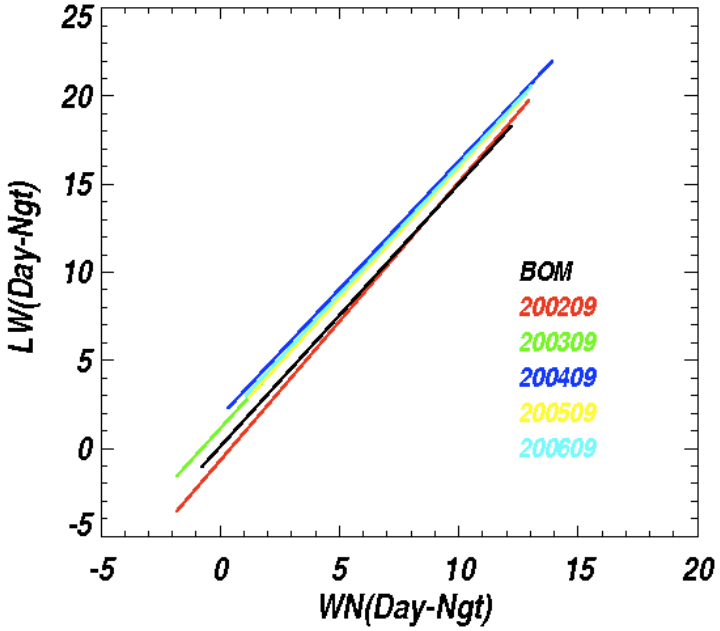


AQUA FM3 - Ocean and Land Scene Trends

FM3 Zonal Average (+/-30) for Allsky Ocean (SW SRF

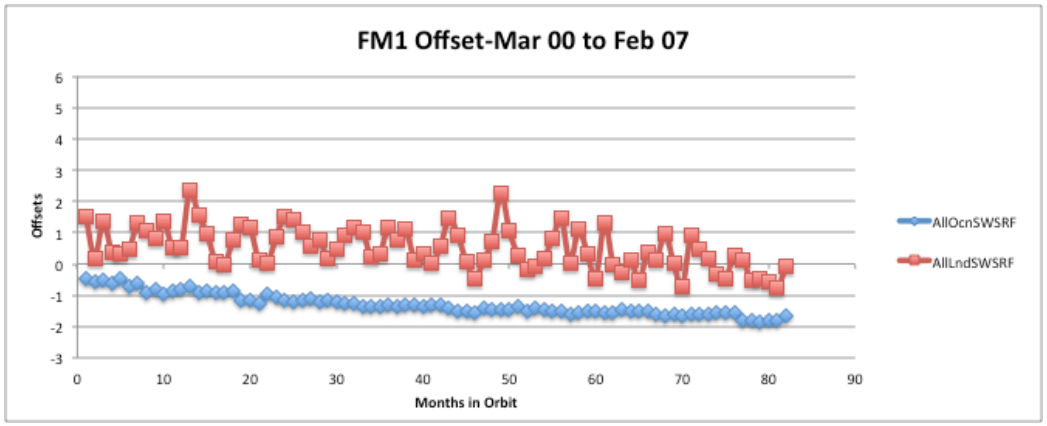


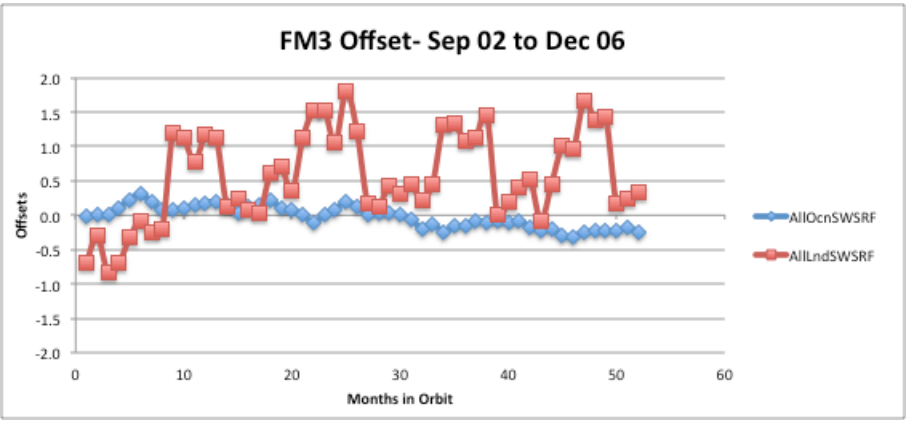
FM3 Zonal Average (+/-30) for Allsky Land (SW SRF only)

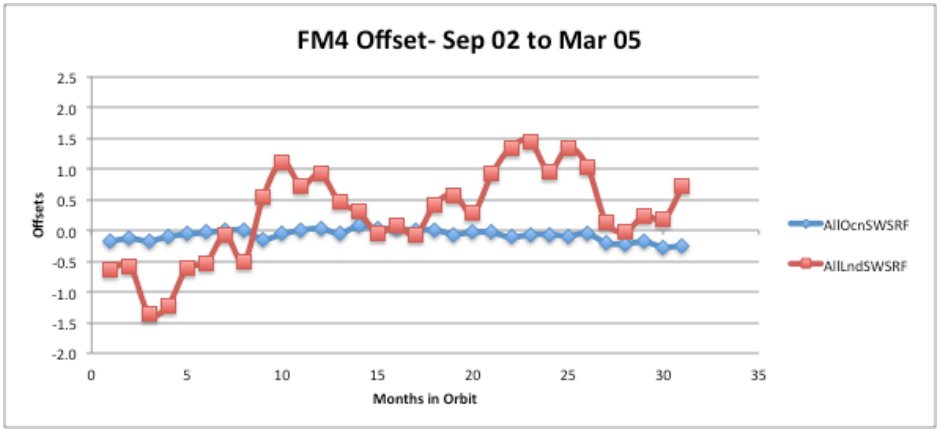


Regression slope for BOM (July 2002) show significant difference for Ocean scene due to non-uniform sampling.

TERRA and AQUA SW/TOT OFFSET Trends







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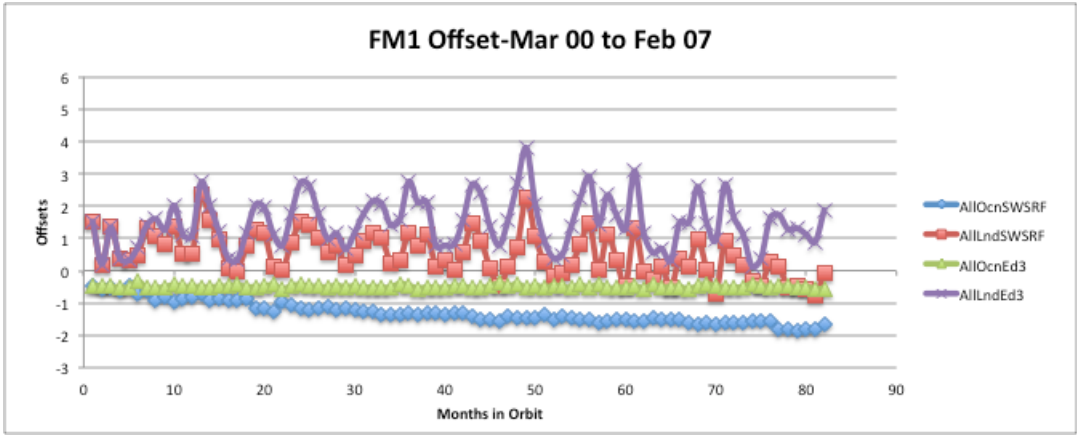
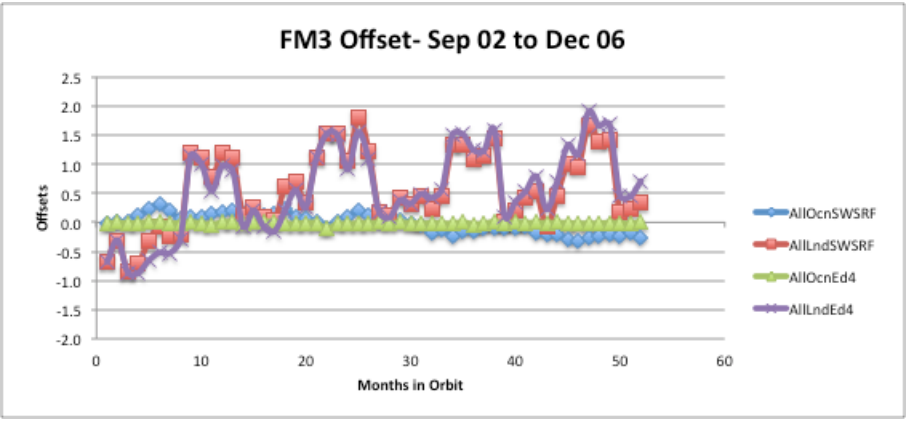
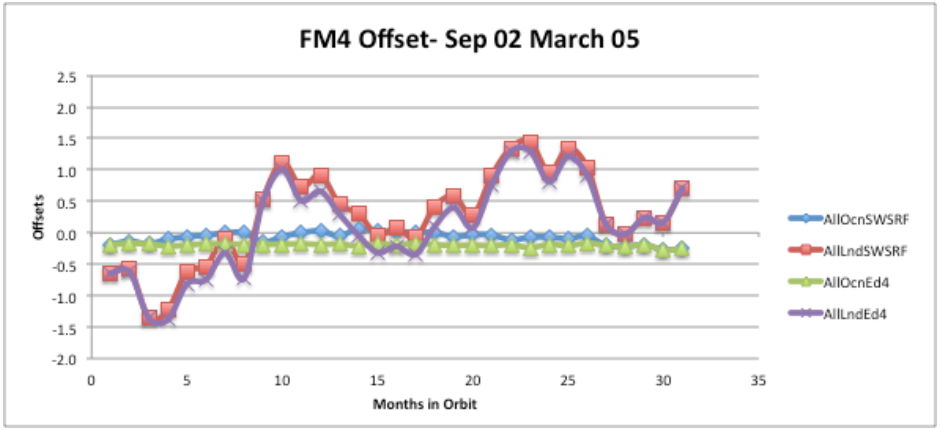
TERRA and AQUA SW/TOT OFFSET Trends







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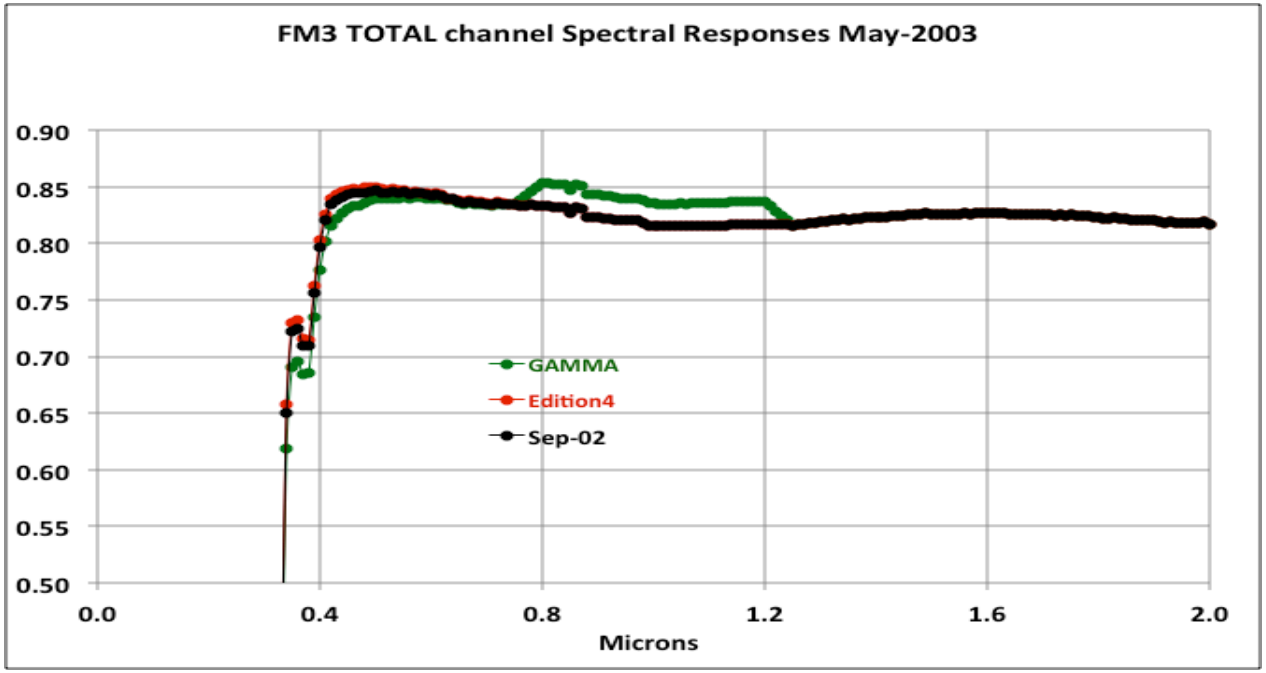
AQUA FM3 SW/TOT Spectral Response

To account for the increase trend in radiance for Land scenes seen in both Aqua FM3 and FM4 instruments, spectral response change at longer wavelength region is needed.



Team is evaluating any contamination that may have occurred during pre-launch instrument integration phase and it's influence on the mirrors through on-orbit conditions.

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CERES Inter-Comparison Campaigns

- CERES Terra/FM1 – NPP/CERES FM5

  Start of the campaign on May 7, 2013

  Minor plane scanning with 2-3 orbital crossing/day of 3 minute duration

- CERES Terra/FM1 – Aqua/FM3

  Plan to start the campaign in June 2013

  Minor plane scanning with 15 orbital crossing/day

- CERES Terra/FM2 – GERB

  Planning stage for start of campaign in June 2013

SUMMARY

- Suomi NPP/ CERES FM5 Instrument has completed the first year of on-orbit operations.
- Performance trends of FM5 instrument are within the normal range.
- CERES FM5 SW measurements are higher than corresponding FM3 and FM1 measurements.
- Investigation to correct the Edition-3 LW-day trends between Terra and Aqua measurements is on-going.