Suomi NPP Status
Jim Gleason NPP Project Scientist
May 7, 2012

Launch: Oct 28, 2011

Suomi NPP/VIIRS Instrument Status and Science Results”

Jim Gleason

NPP Project Scientist

JPSS VIIRS Operational Algorithm Team

VIIRS SDR

Changyoung Cao/NOAA/STAR

Frank DeLuccia/Aerospace

Jack Xiong/NASA

Robert Wolfe/NASA (Geo)

VIIRS EDR

Lead: Ivan Csiszar/NOAA/STAR

Clouds: A. Heidinger/NOAA/STAR

Ocean Color: W. Wang/NOAA/STAR

SST: S. Ignatov/NOAA/STAR

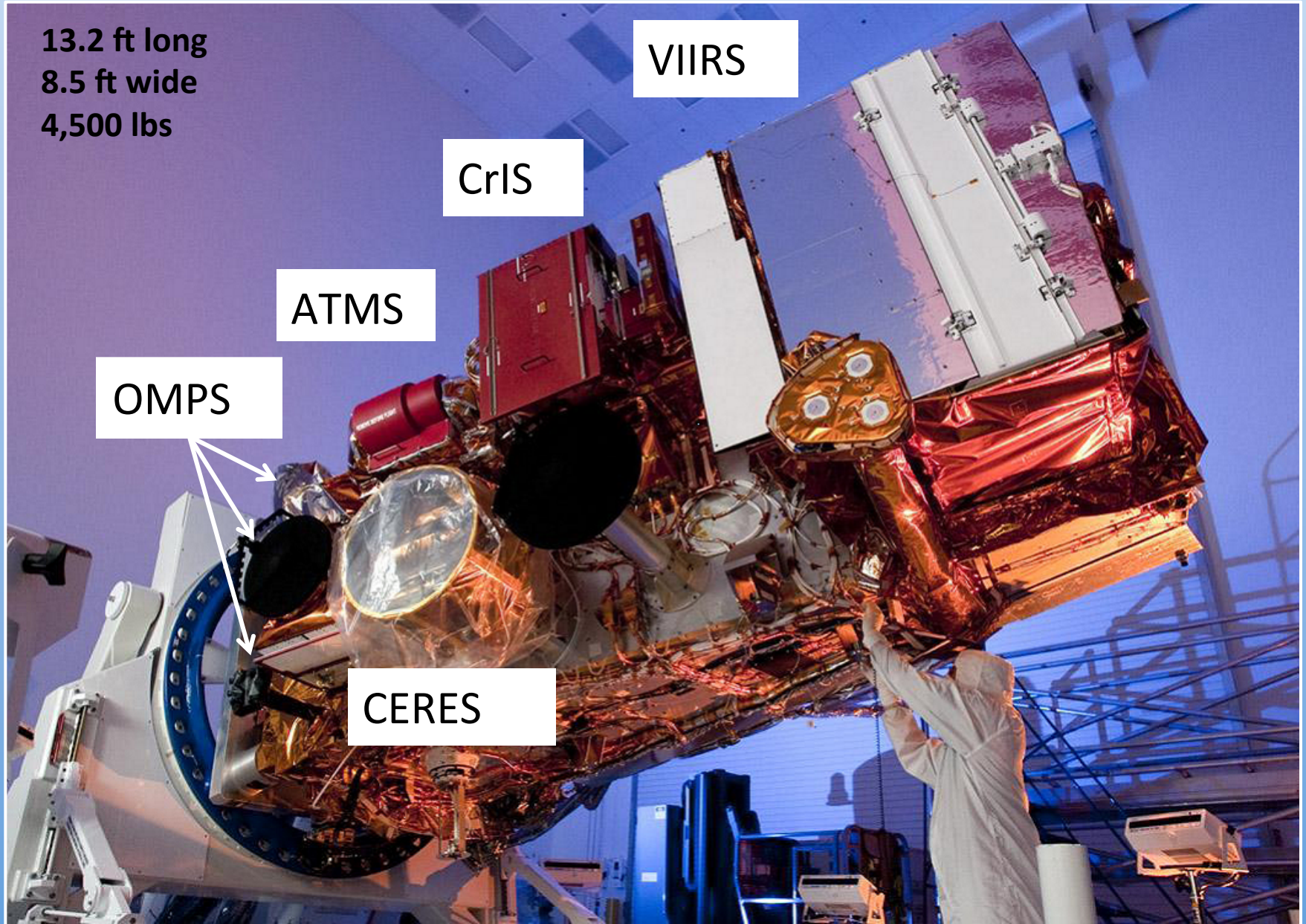
Imagery: D. Hilger/NOAA/STAR

Aerosol: I. Laszlo /NOAA/STAR

Land: I. Csiszar/NOAA/STAR

Cryo: J. Key/NOAA/STAR

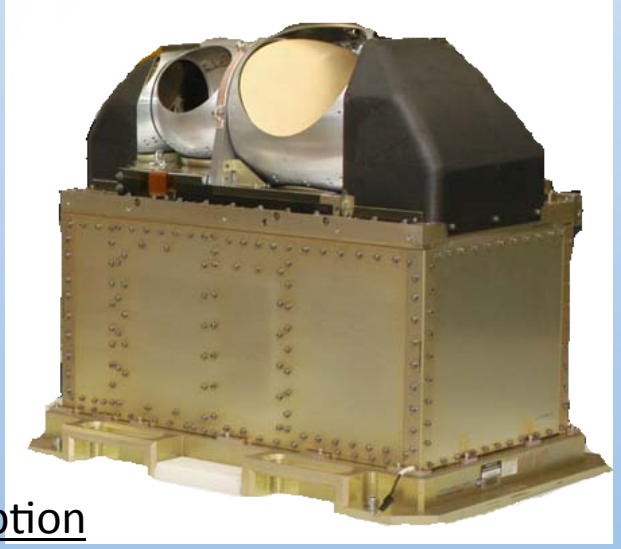
NPP with 5 instruments



NPP Status

- Spacecraft in normal Mission Mode, all systems nominal
- Ground System performance nominal with data flowing to NESDIS and AFWA Centrals and to CLASS archive
- All Instruments are in normal operational mode
  - ATMS SDR data declared provisional (ready for broader use)
  - ATMS SDR/TDR to be used operationally by NOAA NCEP in Spring of 2012
  - VIIRS, CrIS, OMPS SDRSs have reached beta status
    - Public Access through NOAA CLASS
  - Product Validation work ongoing.

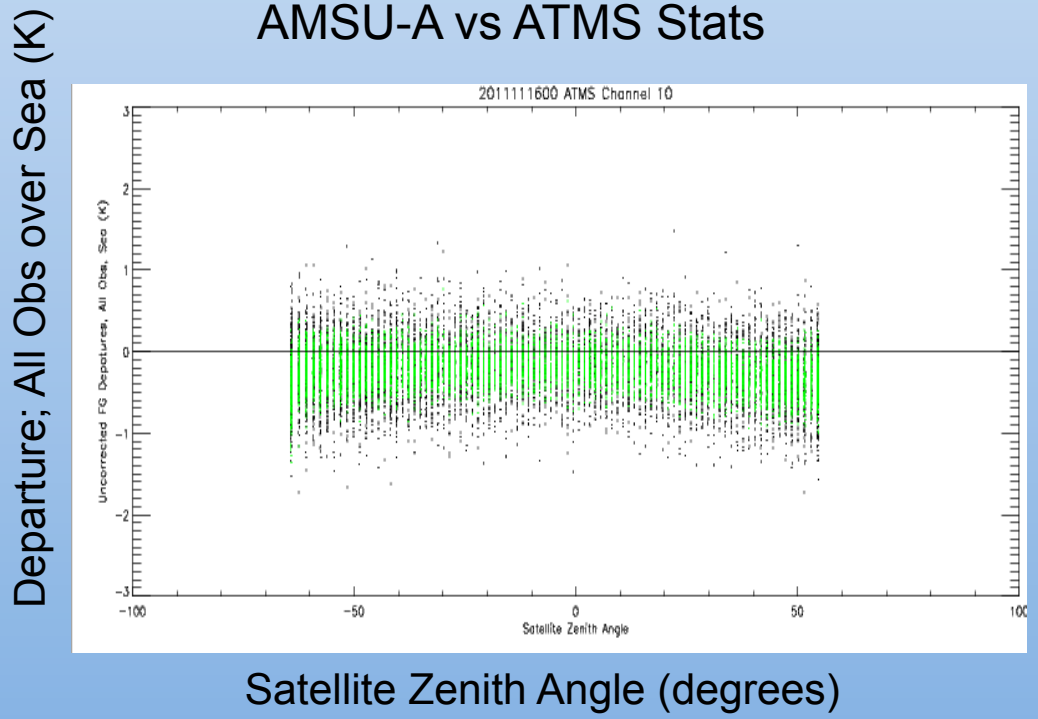
Advanced Technology Microwave Sounder
Northrop Grumman Electronic Systems



Description

- Purpose: In conjunction with CrIS, global observations of temperature and moisture profiles at high temporal resolution (~ daily).
- Approach: Scanning passive microwave radiometer
- 22 channels 23GHz - 183GHz
- Swath width: 2300 km
- ATMS SDR ready for Provisionally Release
- ATMS data to be used by NCEP Spring 2012

AMSU-A vs ATMS Stats



ATMS has much better scan-dependent bias and (after re-mapping) noise levels are equivalent

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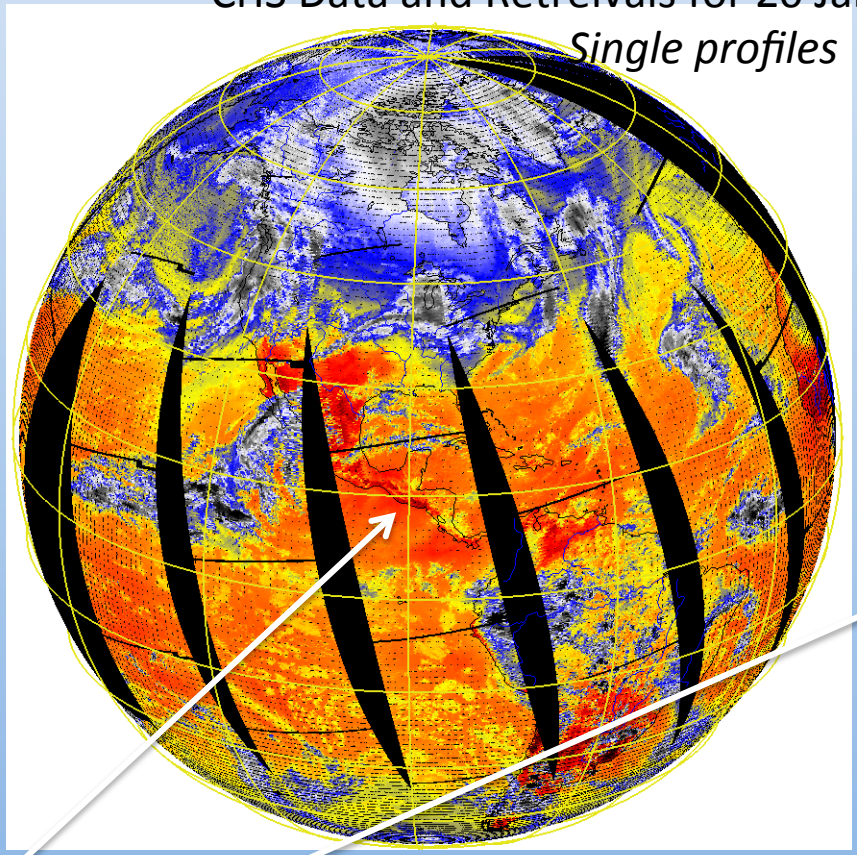
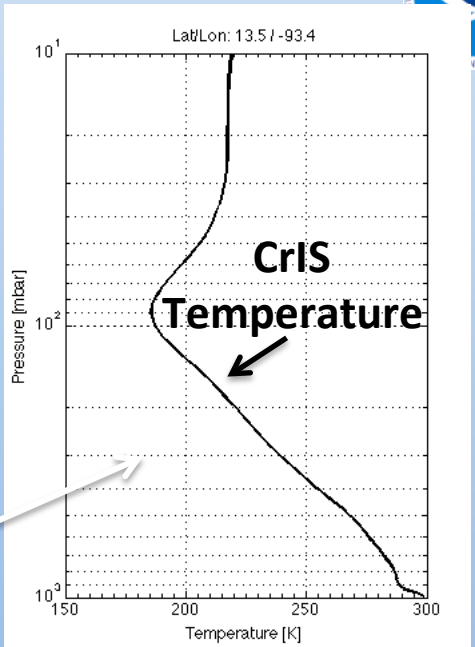
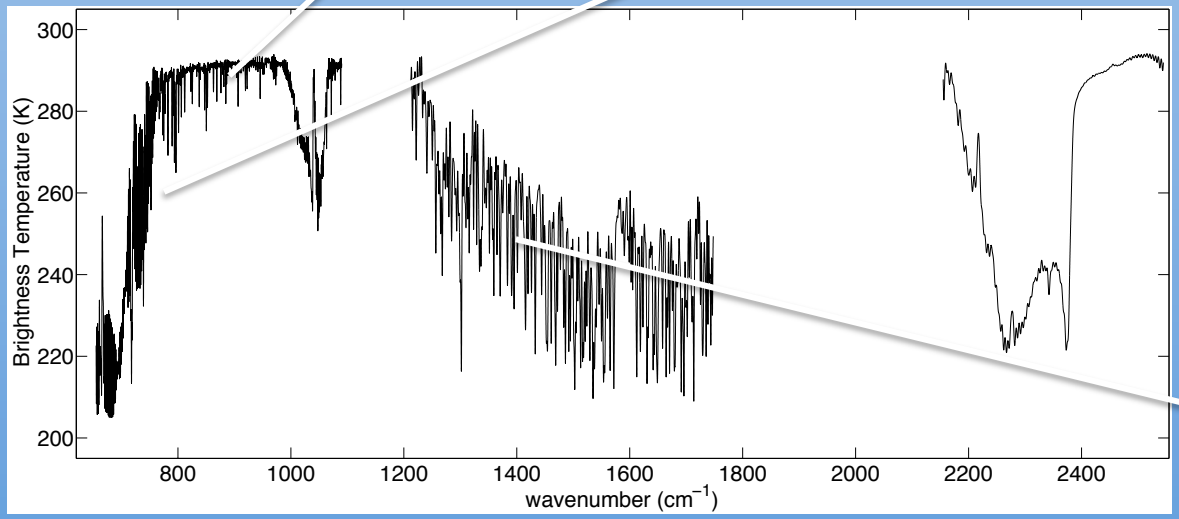
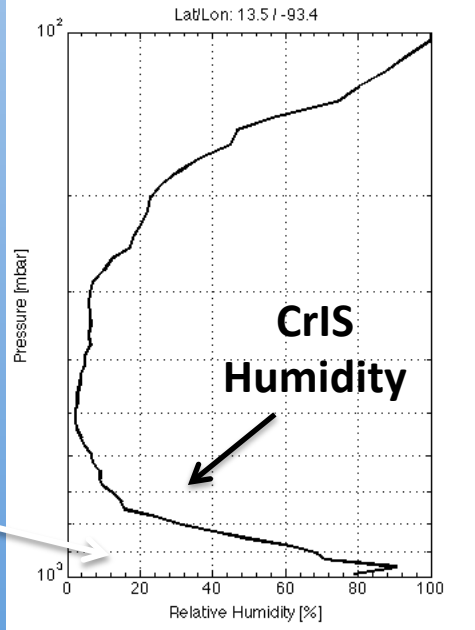
CrIS Data and Retreivals for 20 Jan 2012, t1910005

Single profiles



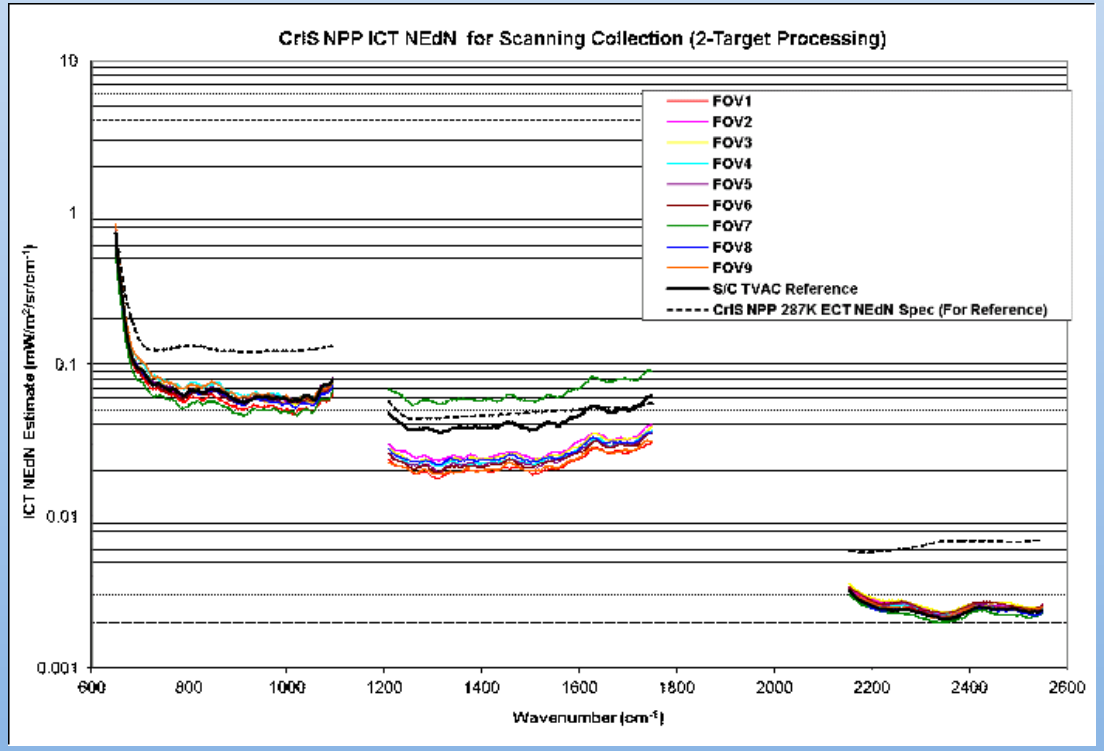






NPP CrIS Instrument Status

- Exelis successfully performed Early CrIS instrument checkout and tuning from 1/28/12 to 2/21/12
- Initial analysis shows that the instrument performance reaches and exceeds the pre-launch TVAC performance and specifications
- Calibration coefficient table (Engineering Packet) version 32 was uploaded to CrIS instrument on 1/31/12, which includes update of some calibration coefficients determined from on-orbit data
- Good Science RDR data started flowing from GRAVITE to the users on 1/20/12
- Full spectral resolution data collection was performed successfully on 2/22/12 and 2/23/12



NEdN On-Orbit Data is Consistent with Ground Test Data (Black Lines); Much Better Than Spec Limits (Dashed Lines); Performance is Excellent. The relatively poor performance of MW FOV 7 (Middle green curve) was noted during ground testing and understood.

CERES Flight Model 5
Regular Operations: January 24, 2012

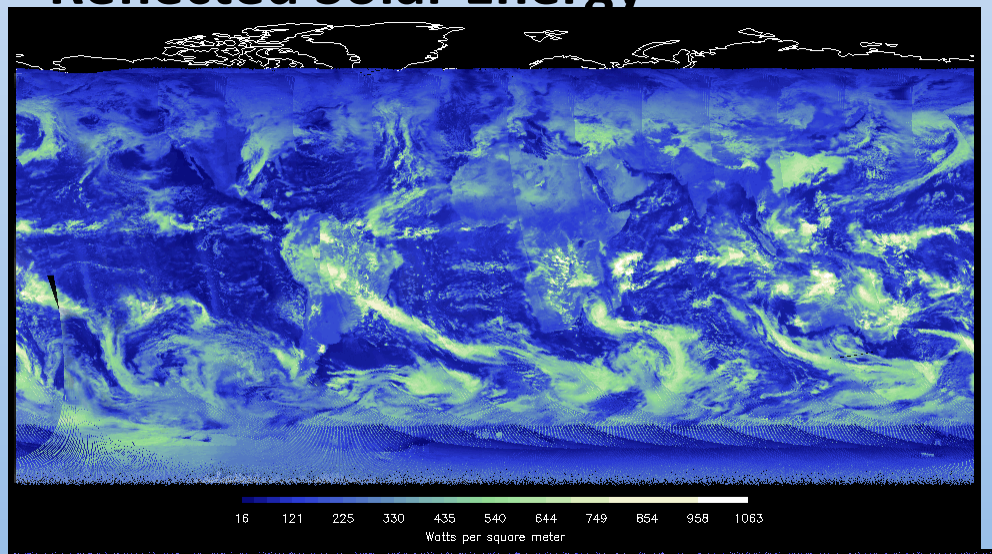
CERES scanning radiometer measuring three spectral bands at TOA

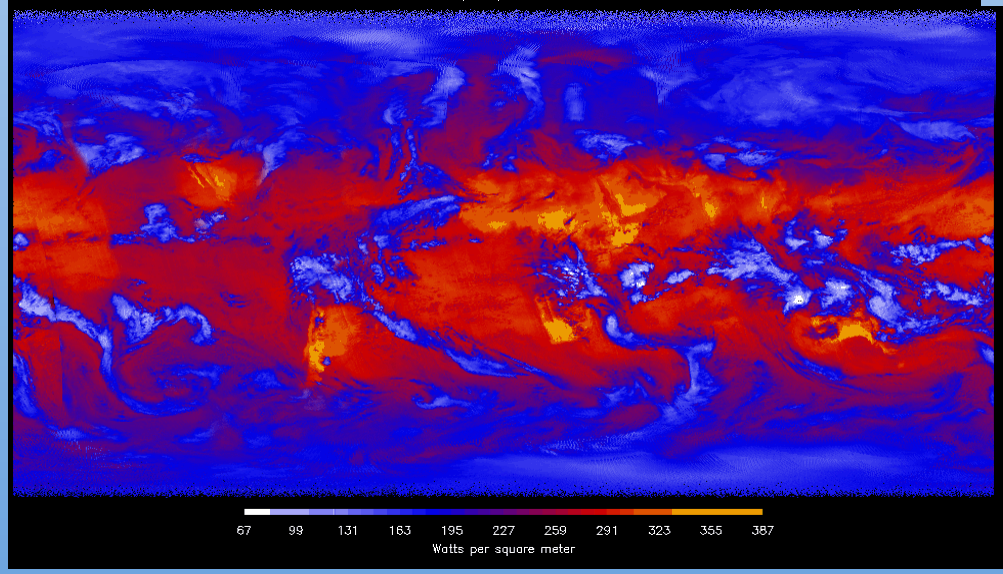
- Total (0.3 to >50 μm)
- Shortwave (0.3 to 5.0 μm)
- Longwave Bandpass (8 to 12 μm)

Operations, Data Processing, Products, and Science are a continuation of experience developed on

- TRMM (1), EOS Terra (2), EOS Aqua (2)

Reflected Solar Energy





Emitted Thermal Energy

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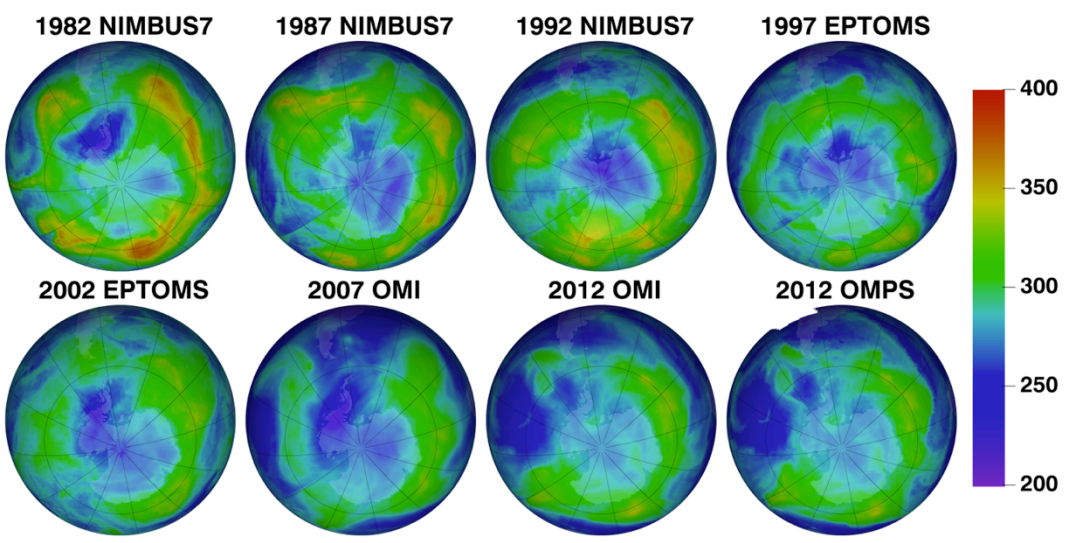
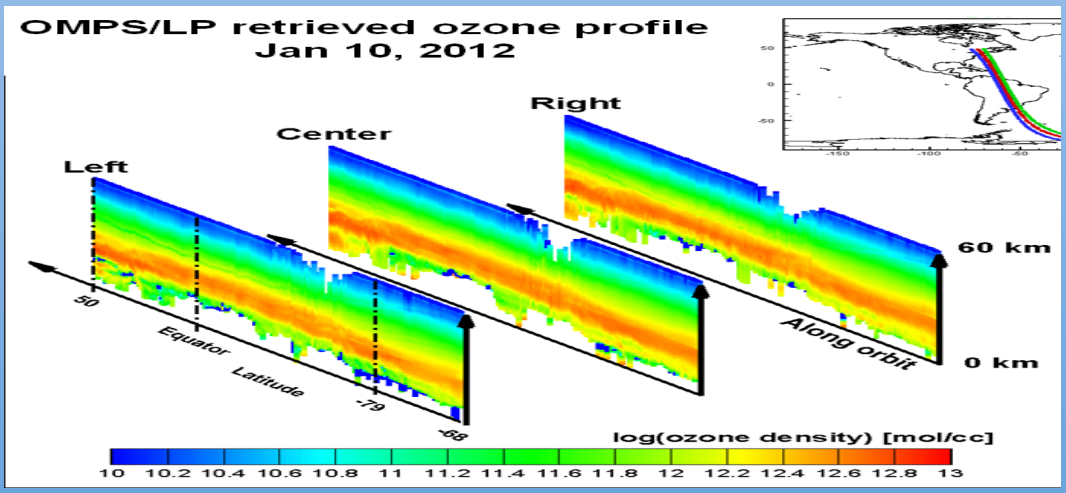
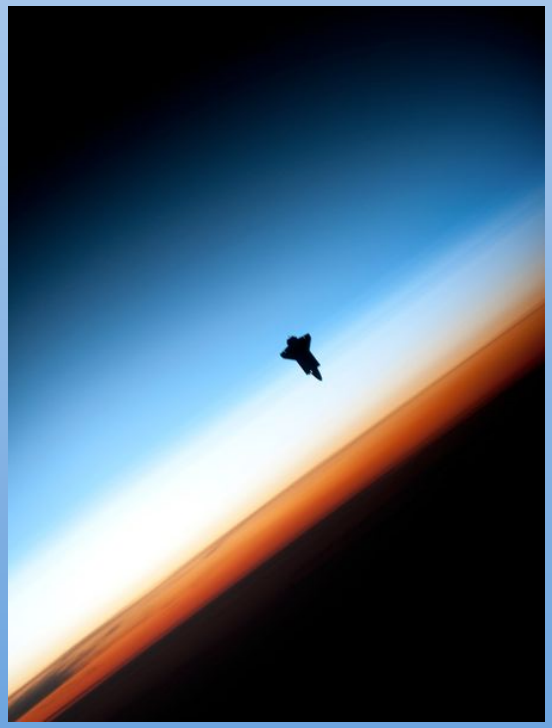
NPP Instrument Status: OMPS Nadir and Limb

Thirty Years of January 19th ozone







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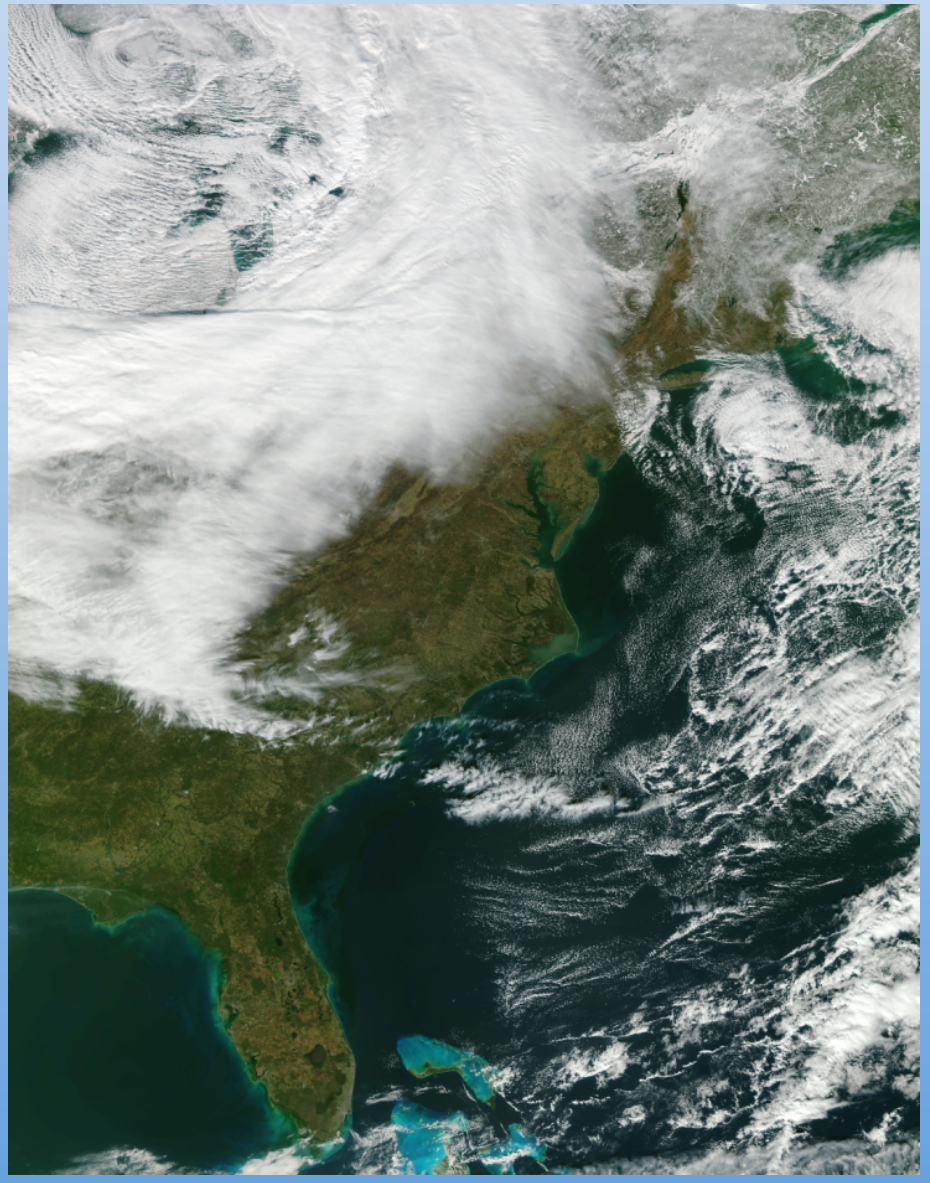
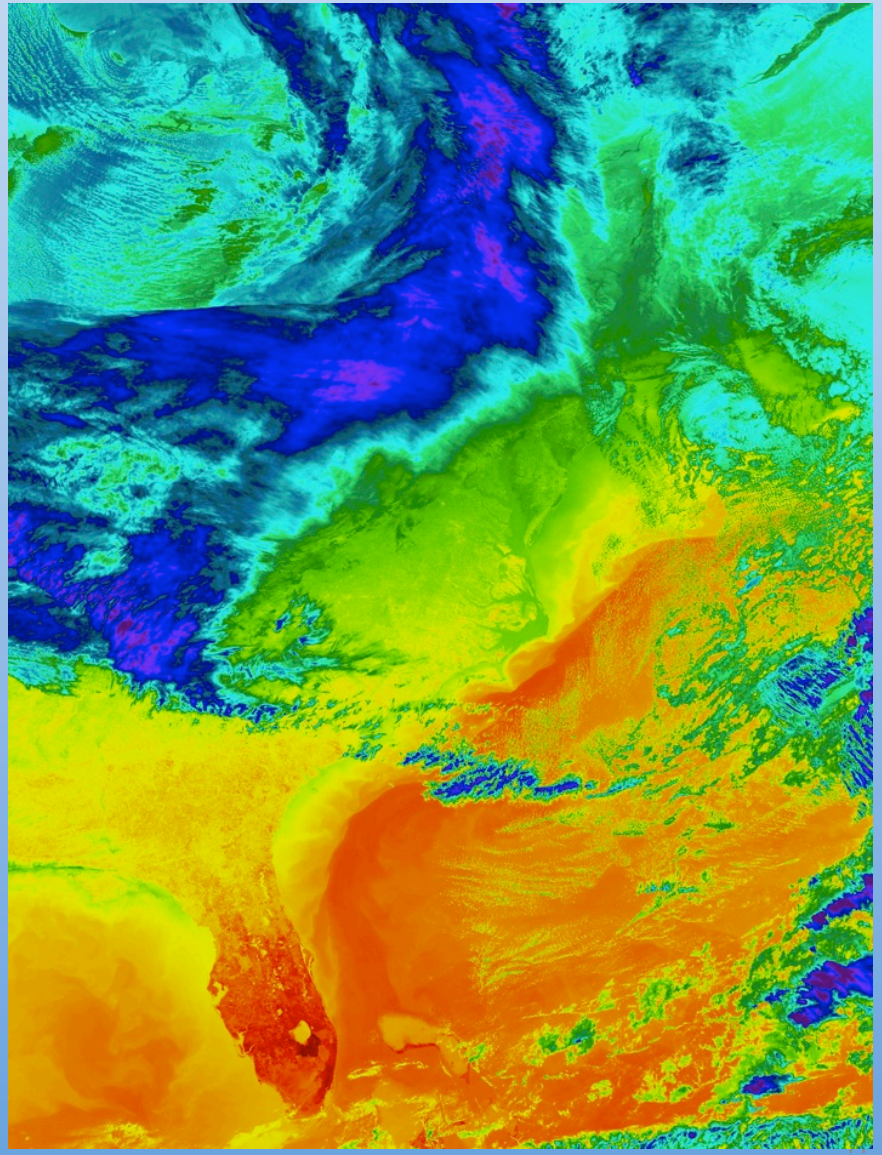
NPP Instrument Status: VIIRS SDR (1)

- All band are producing excellent images with expected quality
- All onboard calibrators (BB, SD, SDSM) are functioning normally, providing good quality data for SDR calibration
- Reflective Solar Band (RSB) LUT have been successfully updated on-orbit;
- VIIRS SDR Inter-comparisons show good agreement with Aqua/MODIS after the LUT updates
- Thermal Emissive Bands (TEB) response is stable, and consistent with pre-launch analysis



NPP Instrument Status: VIIRS SDR (2)

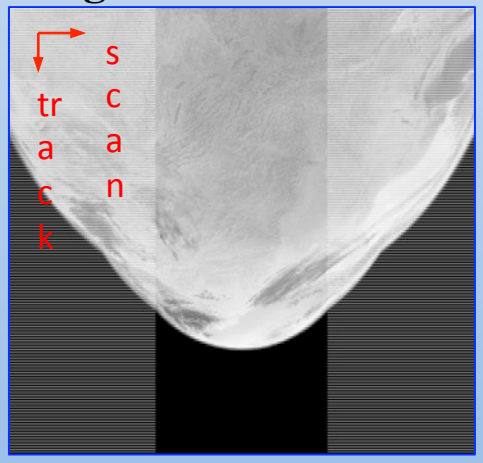
- Noise (NEdT) meets the sensor requirements for all detectors and all bands , consistent with pre-launch values;
- On-orbit calibration coefficients consistent with pre-launch values, except for M13 which is currently being updated
- Monitoring and trending shows all telemetry stable except the degradation in the NIR bands
- Geolocation LUT table was updated on 2/23, removed observed 1km offset
- An SDR Review meeting was held in April
- **VIIRS SDR is in (de facto) beta status**



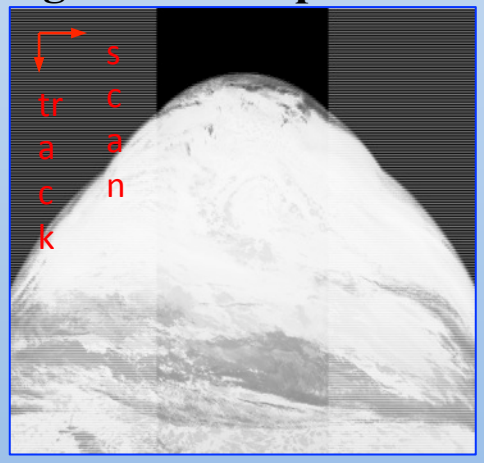
NPP Instrument Status: VIIRS Maneuvers

- The following maneuvers have been performed successfully:
  - Roll Lunar maneuver twice for RSB stability (1/4, 2/3)
  - Yaw maneuver for SD and sun screen characterization (2/15-2/16)
  - Pitch maneuver for TEB RVS characterization (2/20)

Images of Band I5 SDR Brightness Temperature

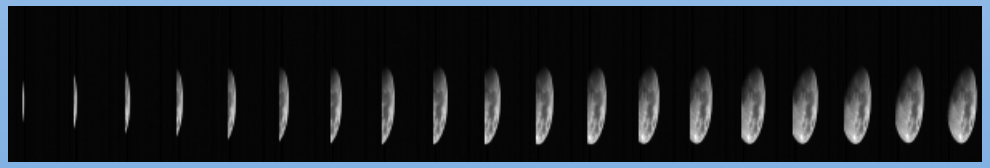


Pitch started at 18:15:34



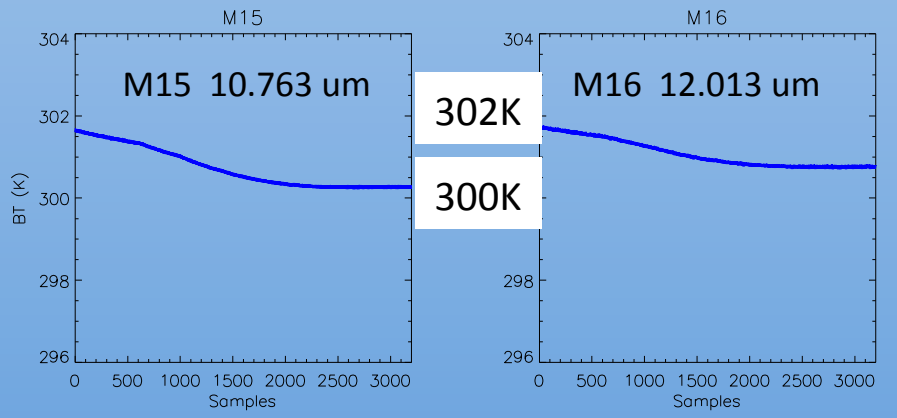
Pitch ended at 18:59:19

Lunar Roll Maneuver

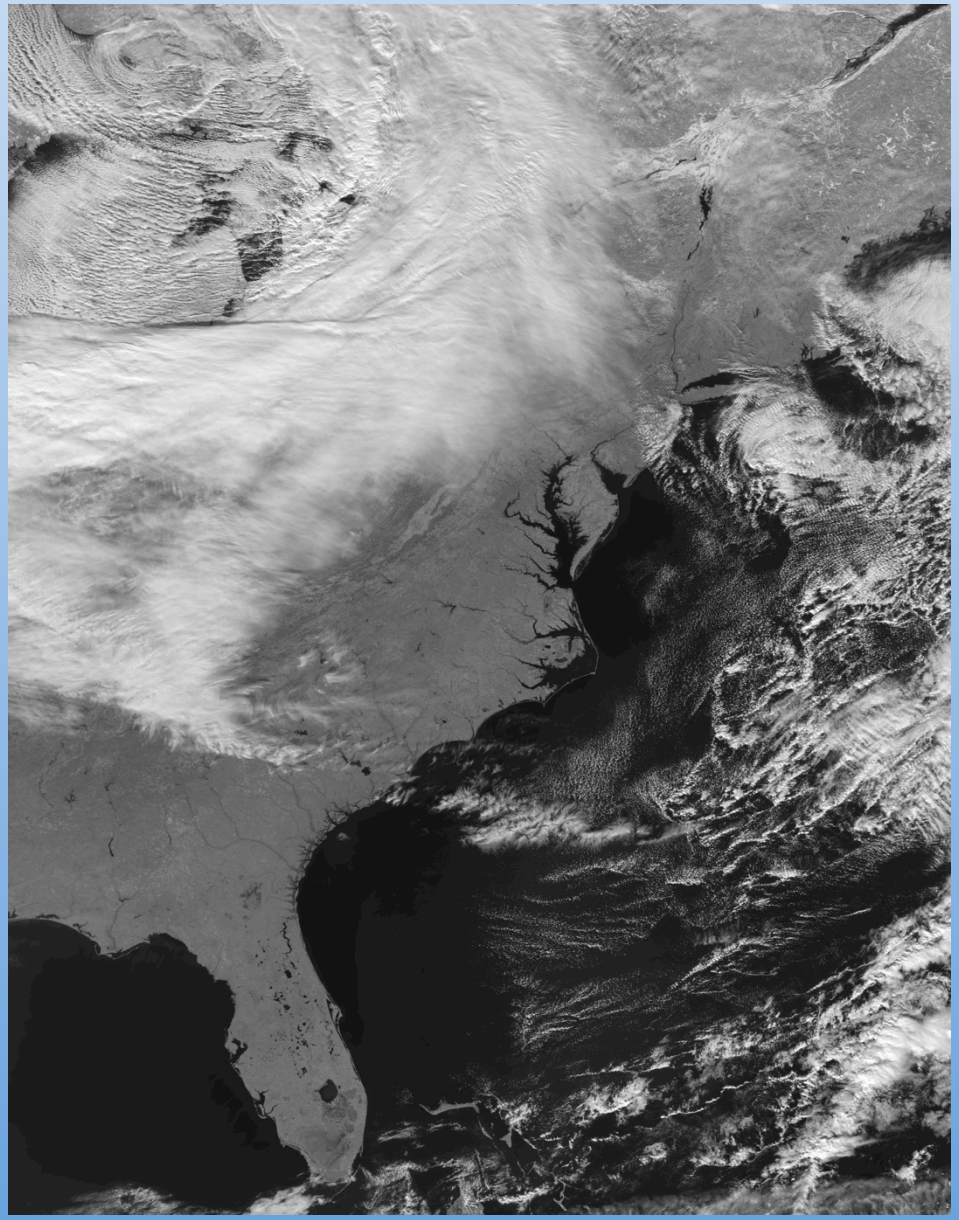


VIIRS Readout Timing modified for Lunar Rolls
Sector Rotation tested Feb 22, 2012

Response vs Scan Angle



VIIRS M07 (0.865 microns) grey scaled 19 January 2012



- **VIIRS Data Anomaly**

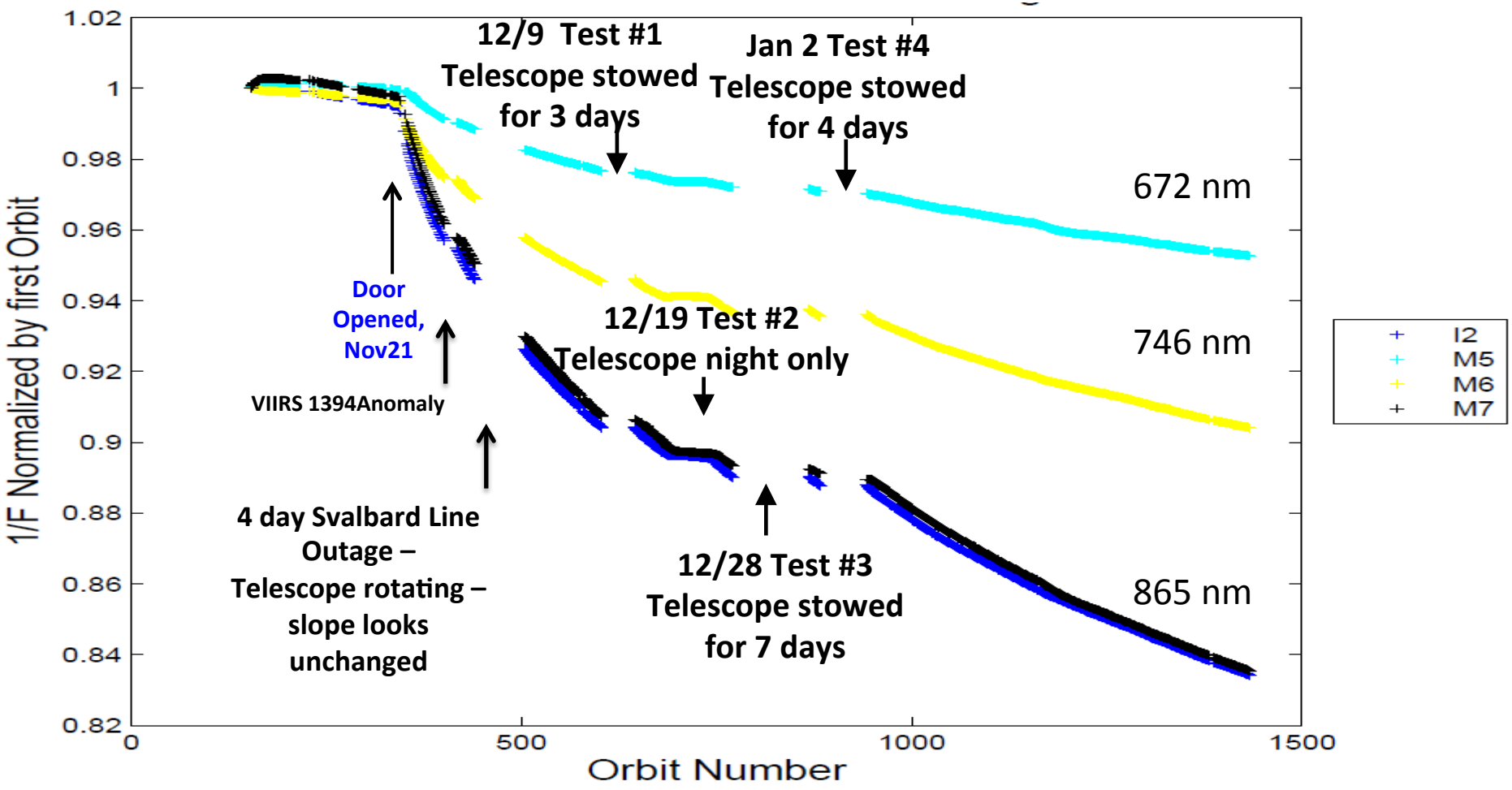
- **Degradation in M7/I2 observed after launch.**
- **Smaller effect in M6 & M5.**
- **Commissioning paused while anomaly was studied.**

- **Degradation believed to be caused by an error in mirror coating process. An inadvertent layer of tungsten film was put on telescope mirrors.**
- **Commissioning resumed Jan 18**

- **Degradation is slowing, should level off.**

- **No effect on VIIRS data products; VIIRS SNR in M7 expected to be above spec.**

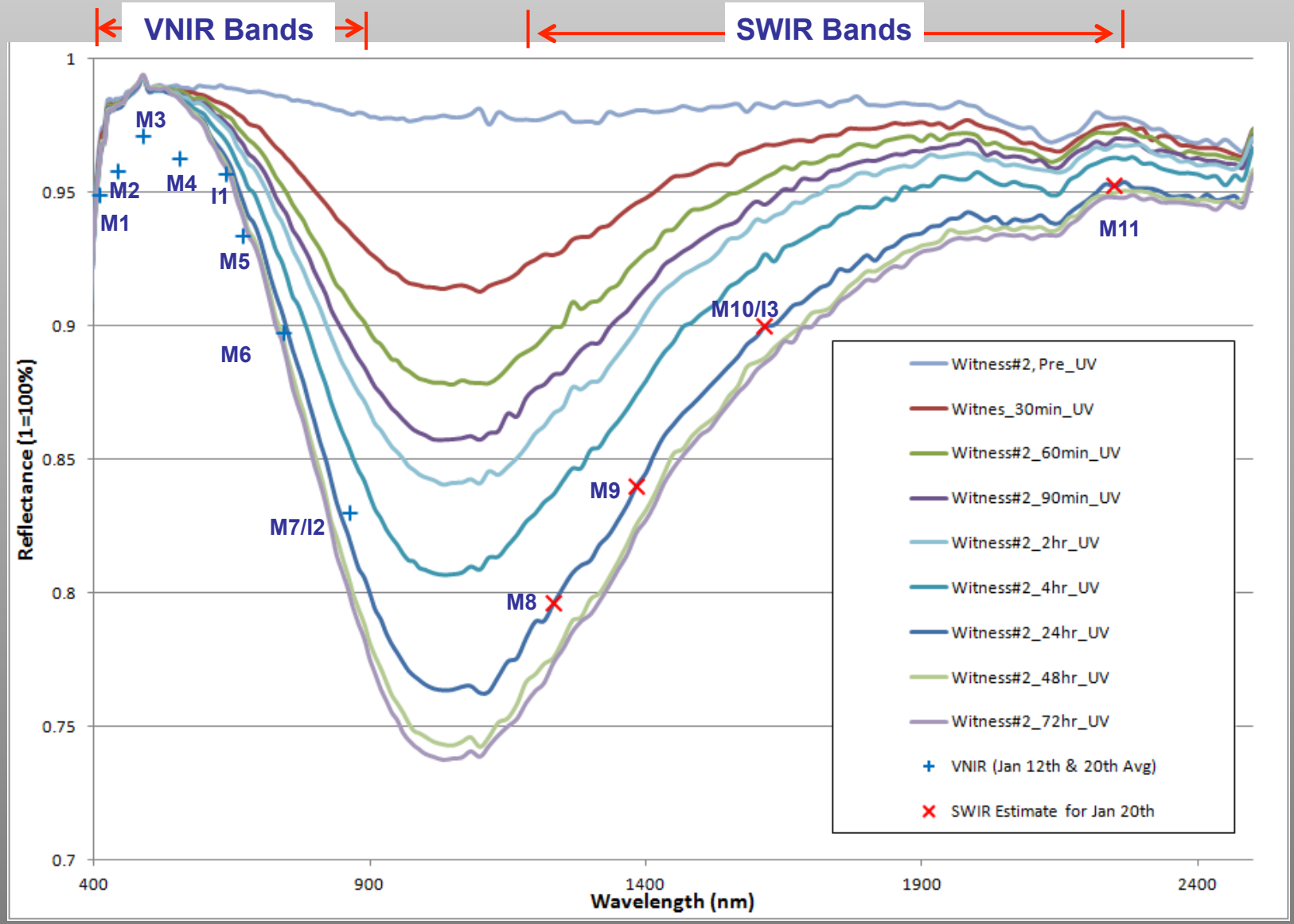
VIIRS Anomaly
Change in VIIRS Solar Data as a function orbit number



F is conversion factor that compares the measured VIIRS solar data to the predicted value.
Data shows 1/F-factor. Should be 1 for new instrument.
Test periods used to diagnose VIIRS anomaly.
Data show anomaly depends on solar exposure; increases with light; stops in dark.

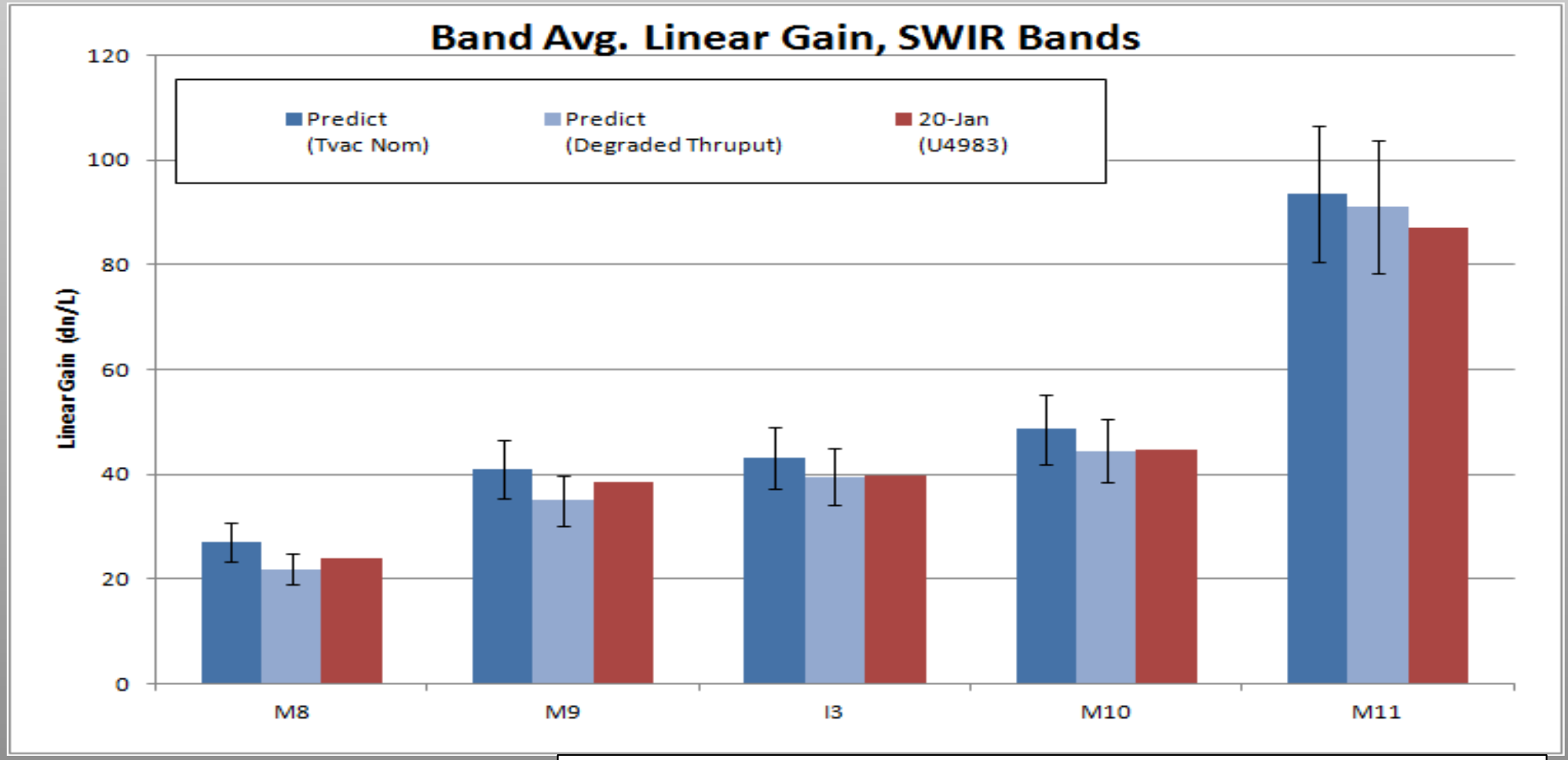
#2 Witness Mirror Degradation with UV Exposure

Raytheon
Space and Airborne Systems



SWIR Turn-on shows expected performance

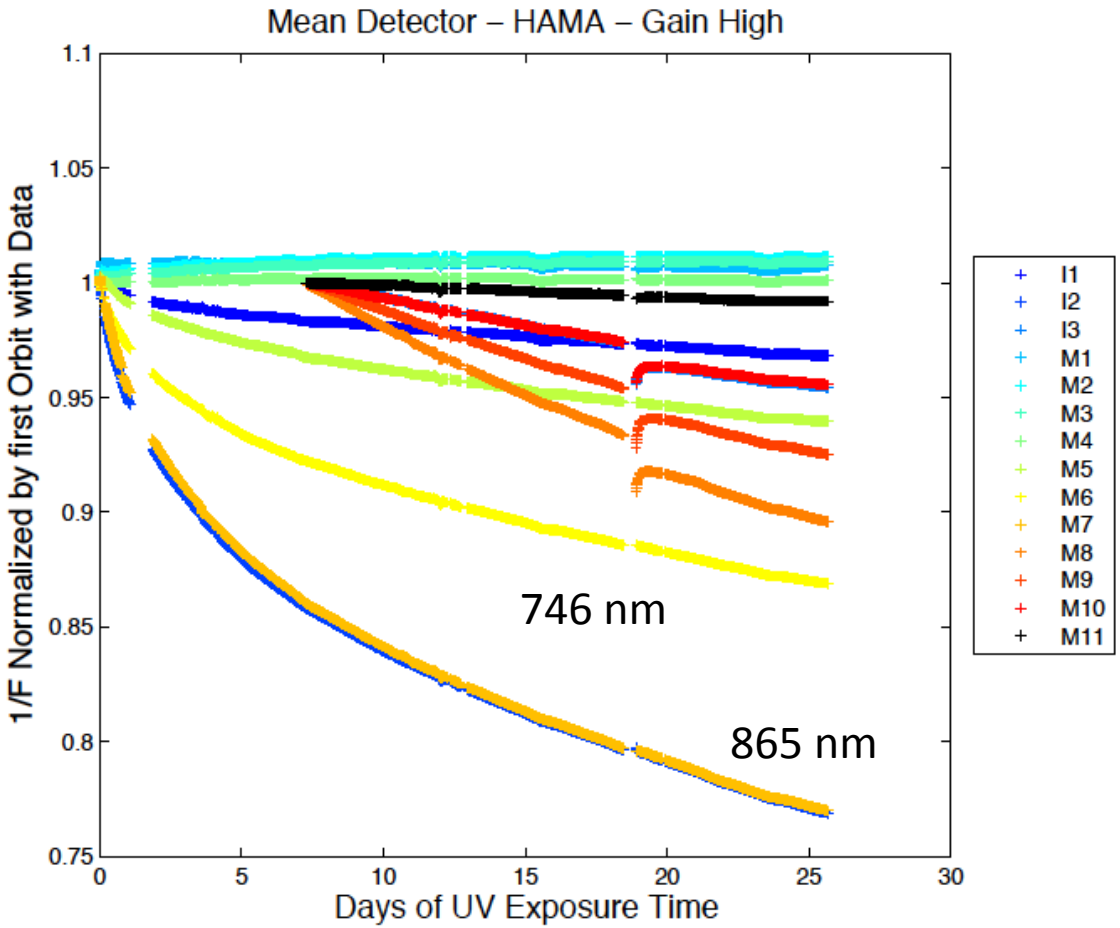
Raytheon
Space and Airborne Systems



Error Bars are +/-13% of predicted gain

- **Original based sensor-TV, nominal plateau RC2 P2**
- **Degraded thruput reduces original by 24 hr UV exposure results for Witness#2**

VIIRS Anomaly
Change in VIIRS Solar Data as a function of UV exposure



Anomaly depends on exposure to light, probably in the UltraViolet (UV) region.

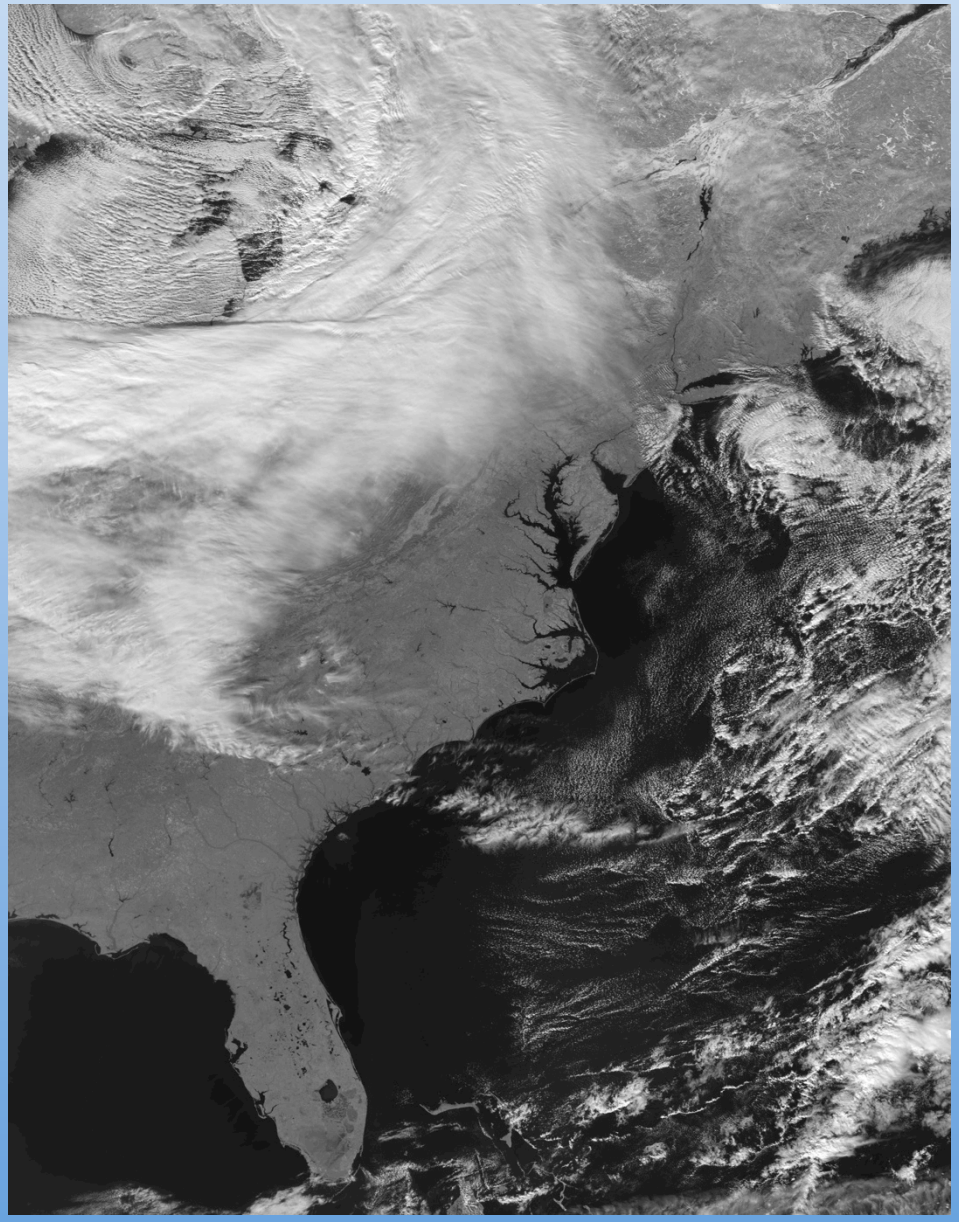
Calculate amount of UV exposure in each orbit. Replot data, converting x-axis from orbit number to UV exposure time.

1 day UV exposure = 6.5 calendar days.

Data shows smooth dependence on UV exposure.

May 5, 2012

VIIRS Anomaly Conclusions
VIIRS M07 (0.865 microns) grey scaled



- **Tungsten Mirror contamination identified as root cause. Limited to VIIRS FM1 mirror.**
- **Continuing to Monitor degradation**
- **Putting in weekly LUT updates**
- **Testing time-dependent predictive LUTs**
- **Bandpass effect (RSRs) studies ongoing**
- **VIIRS SNR in M7 expected to be above spec.**

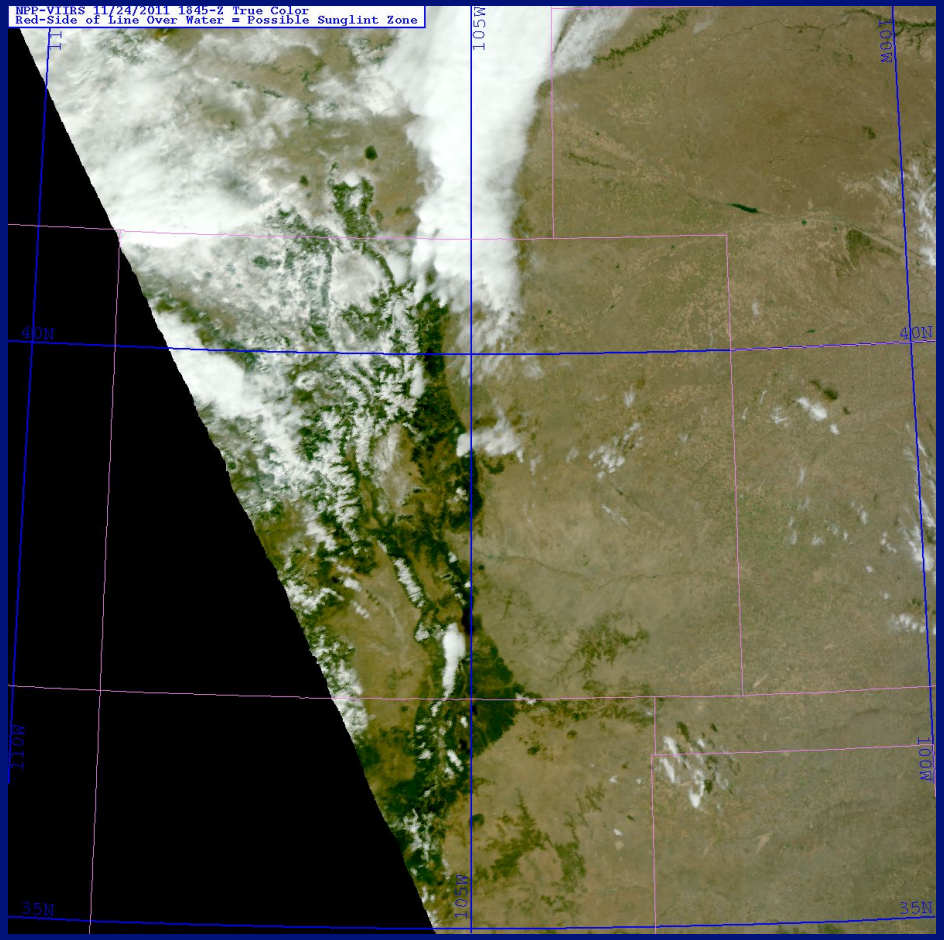
For M7/I2 865 nm High Gain SNR

	SNR	Margin
Specification	215	
Raytheon	419	95%

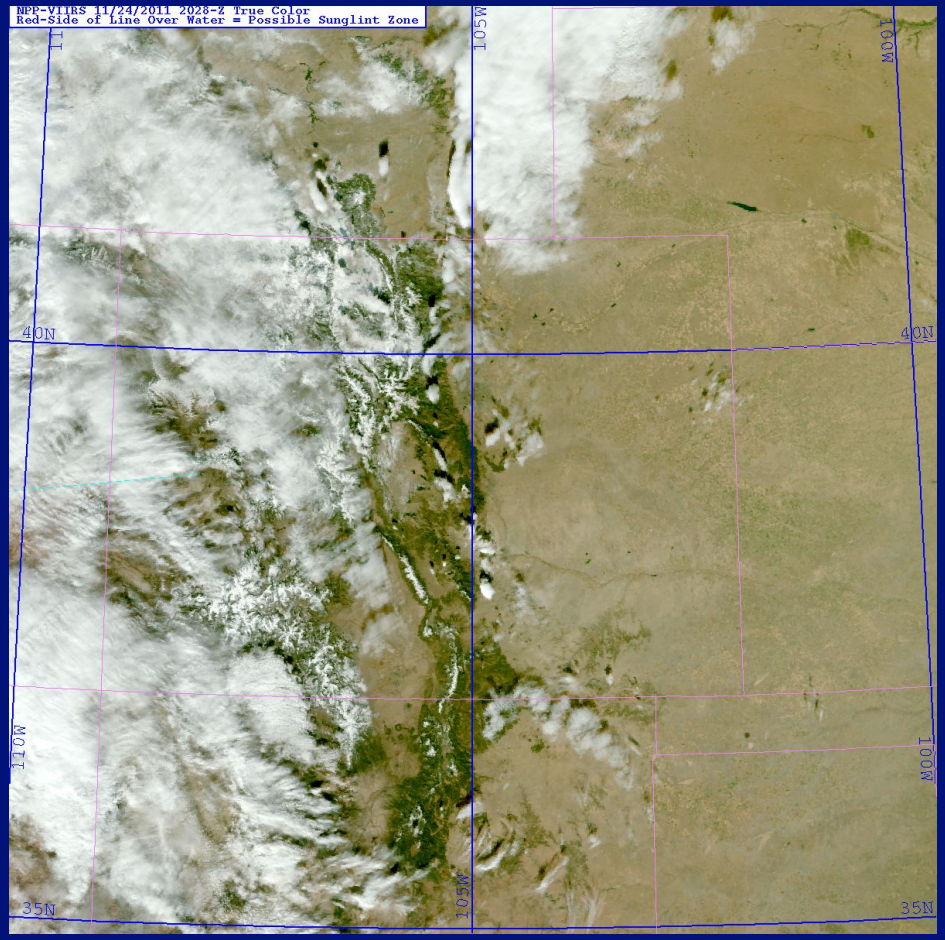
NPP VIIRS True Color Examples

Colorado

11.24.2011 1845 Z, Near Edge of Scan

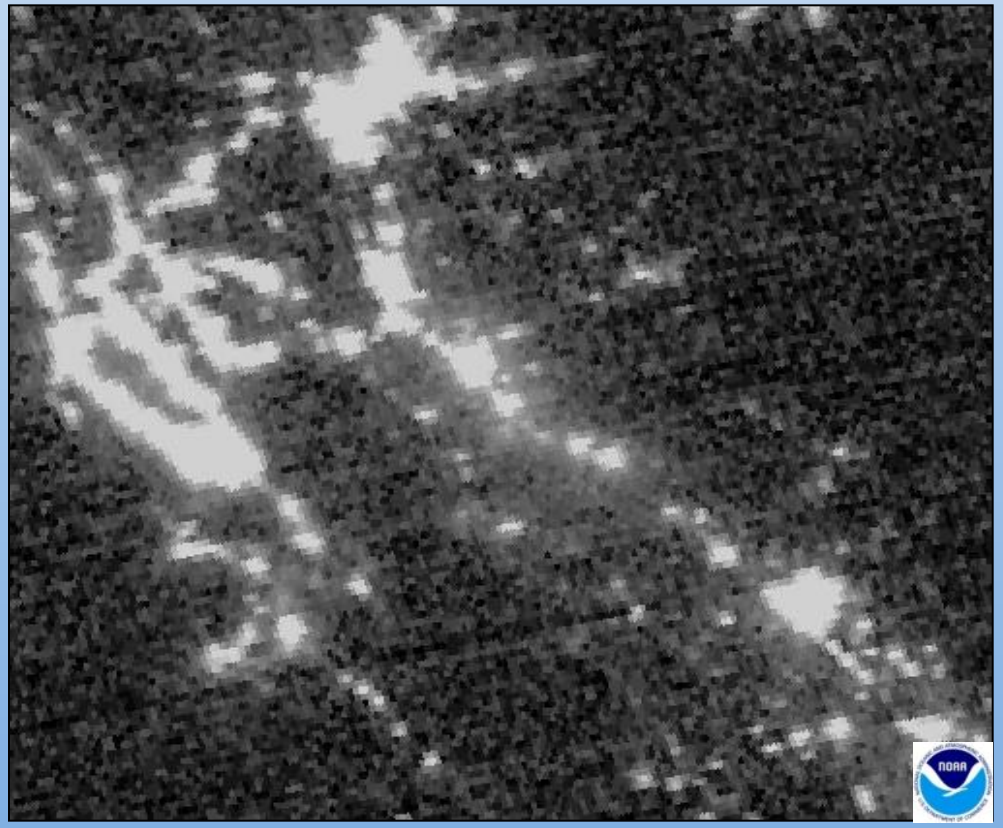


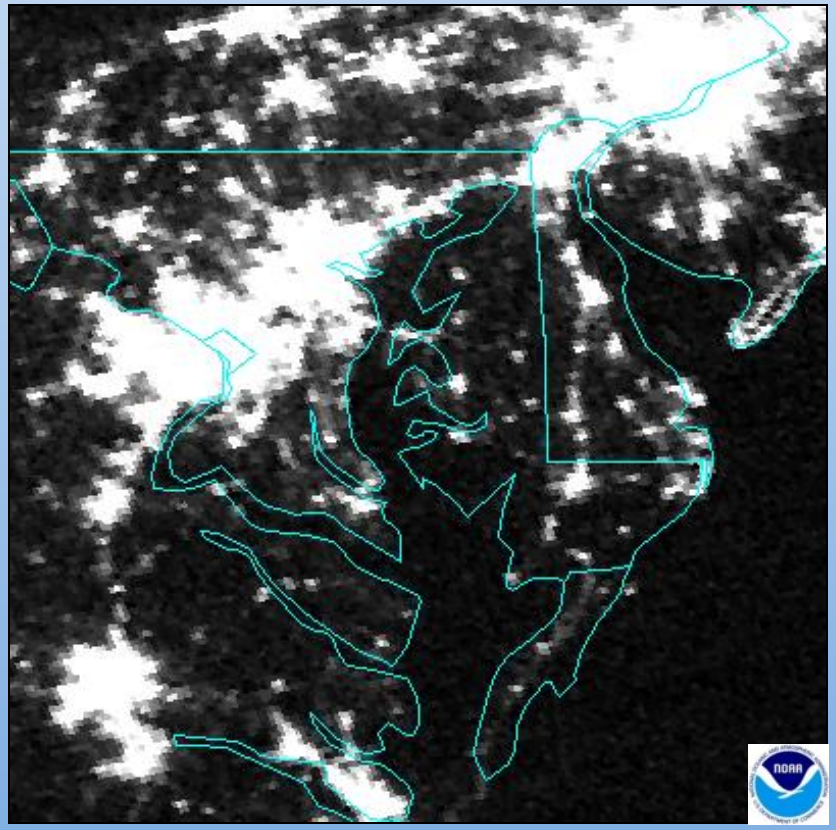
11.24.2011 2028 UTC, Near Nadir



→ VIIRS maintains similar spatial resolution quality at edge of 3000 km swath

Resolution Improvements: OLS vs. DNB





- 740 m instantaneous geometric field of view (DNB) vs. ~5 km for the OLS results in dramatic spatial resolution improvements.
- DNB Imagery courtesy of Steven Miller CIRA/CSU

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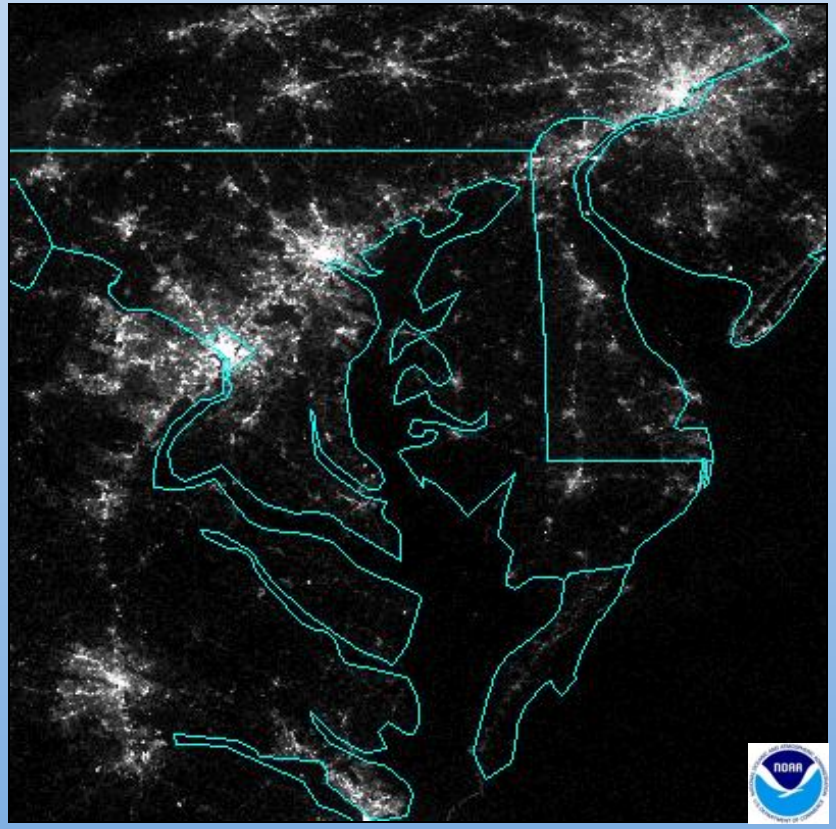
Resolution Improvements: OLS vs. DNB



- 740 m instantaneous geometric field of view (DNB) vs. ~5 km for the OLS results in dramatic spatial resolution improvements.
- DNB Imagery courtesy of Steven Miller CIRA/CSU

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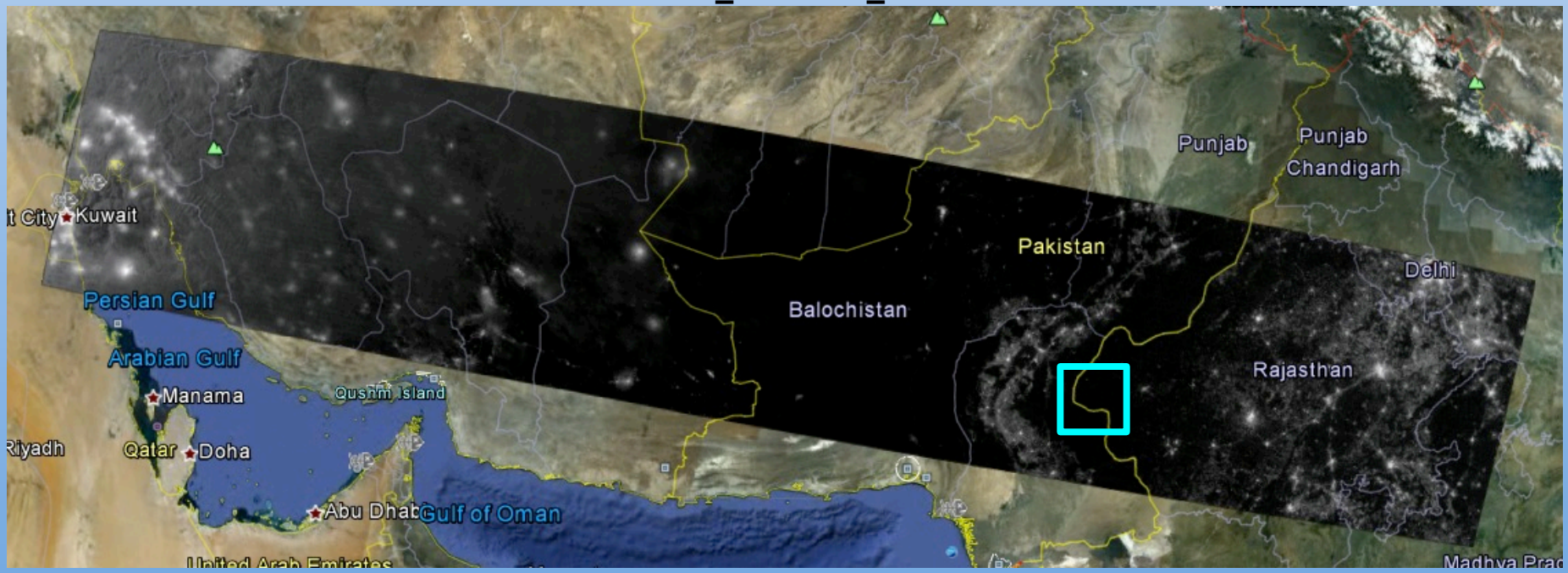
Night Time Scene – Pakistan/India Border

- Sodium Vapor lamps along Pakistan/India border show geolocation error of ~5 km to the east with Ops Geolocation
  - Rev 001 DNB Geo LUT used for Jan 31, 2012 granule
  - Highlighted region shown in detail on next slide

d20120131_t2128288_e2129530



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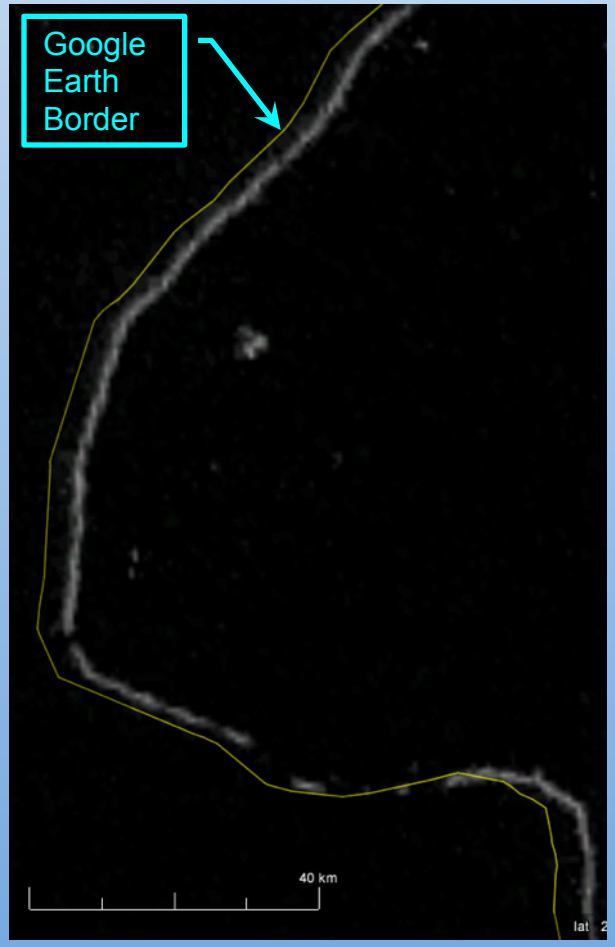
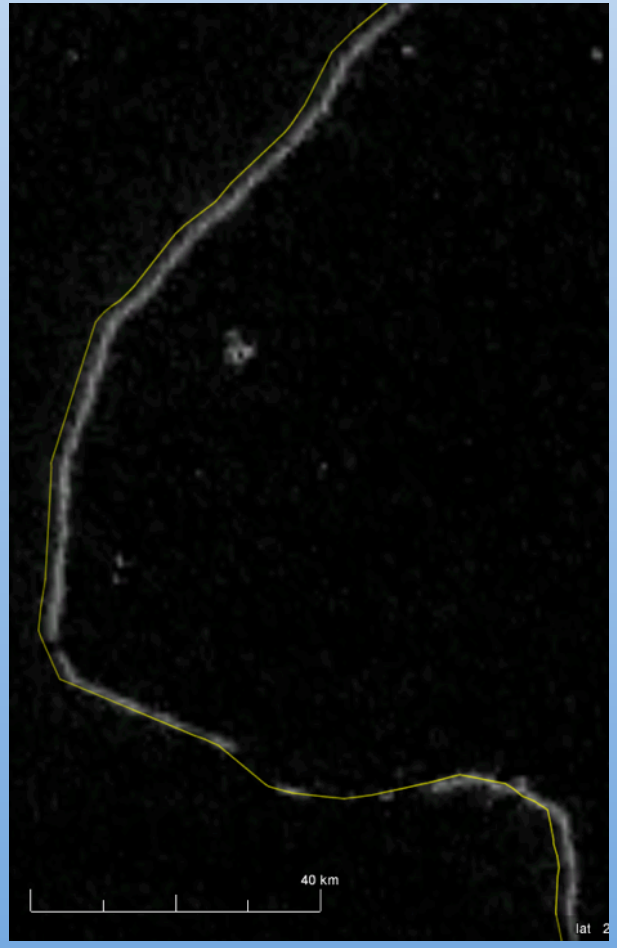
DNB Geolocation Improvement with LUT Revisions – Pakistan/India Border

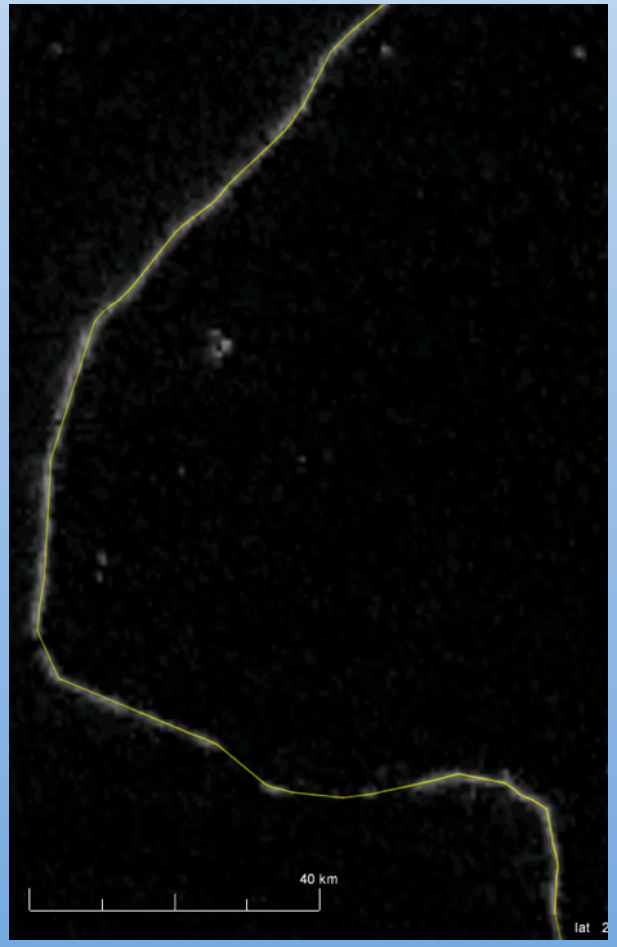
DNB Geo LUT Rev 001



DNB Geo LUT Rev 002



NGAS DNB Geo LUT Rev 003



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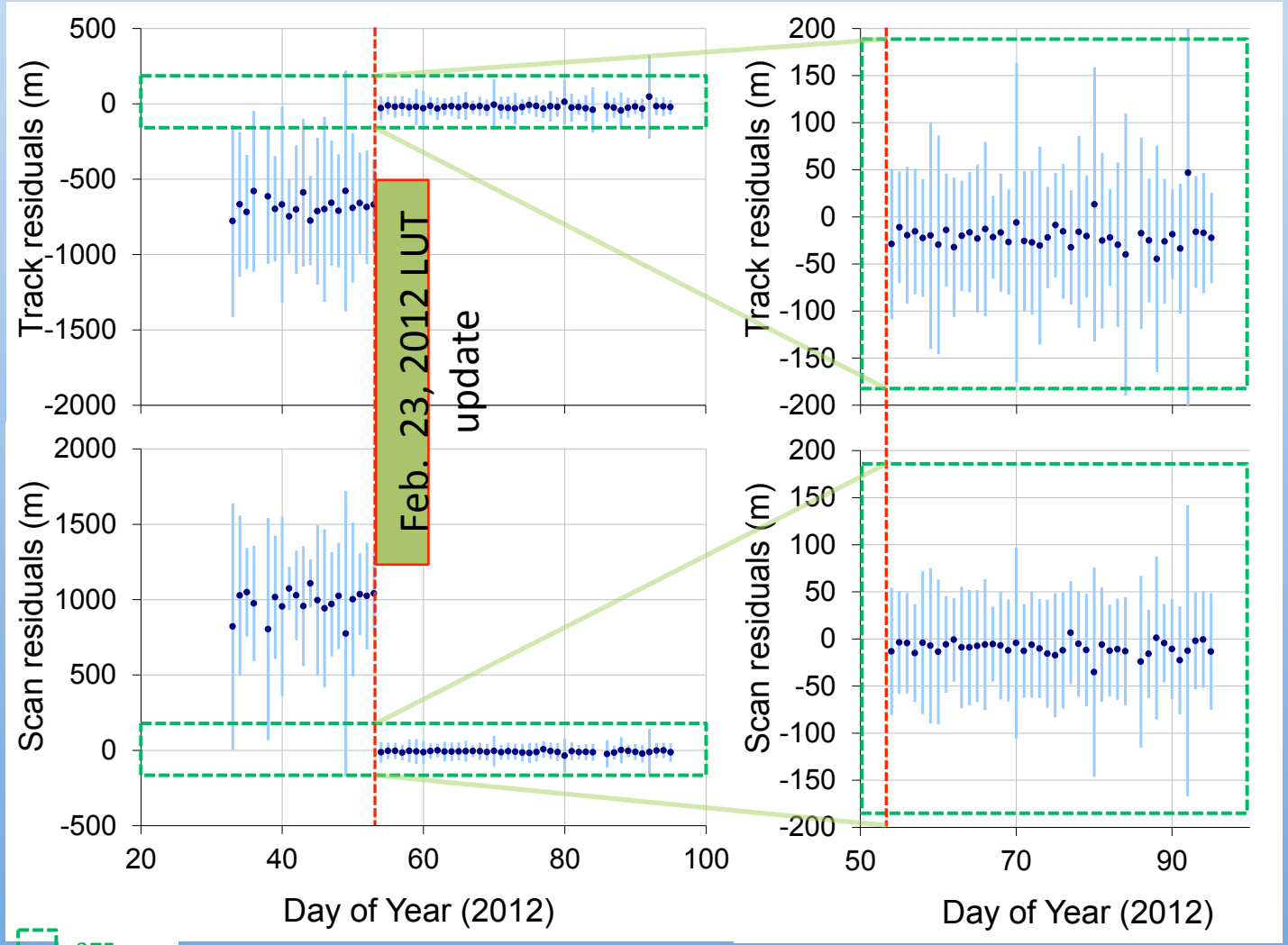
Geolocation Trending



Error after LUT update (2/23/2012, doy 54)

	Bias (m)	RMSE (m)
Track	-20	89
Scan	-9	64

41 days with average of 136 matchups/day (minus 11 outliers/day)

Nadir equivalent units; Cross-correlation > 0.7;
Outliers are filtered (removed) based on daily 5, 4 and then 3 sigma test

NICSE/GEO 24

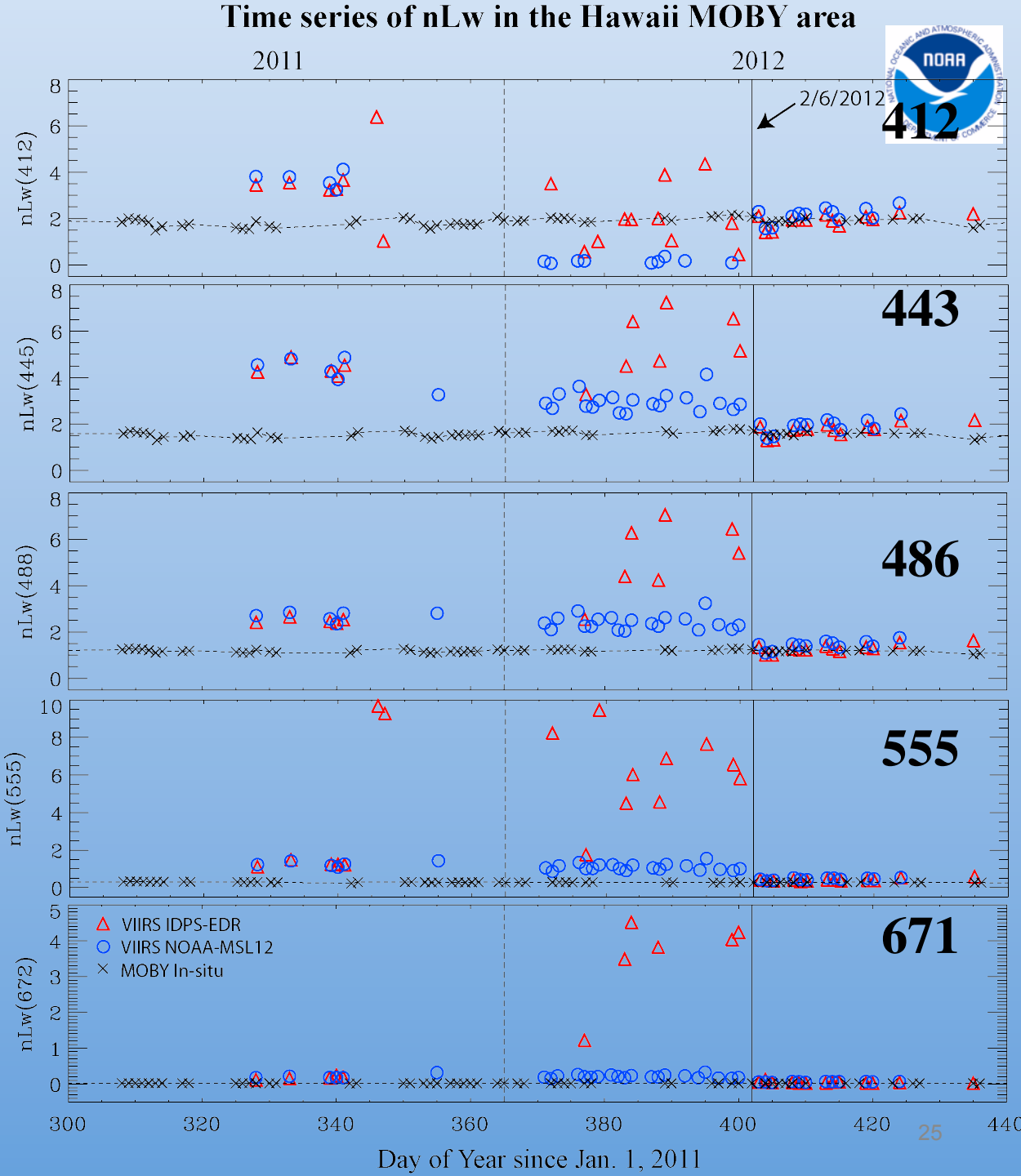
Wolfe et. al., Apr. 17, 2012

VIIRS vs. MOBY In Situ

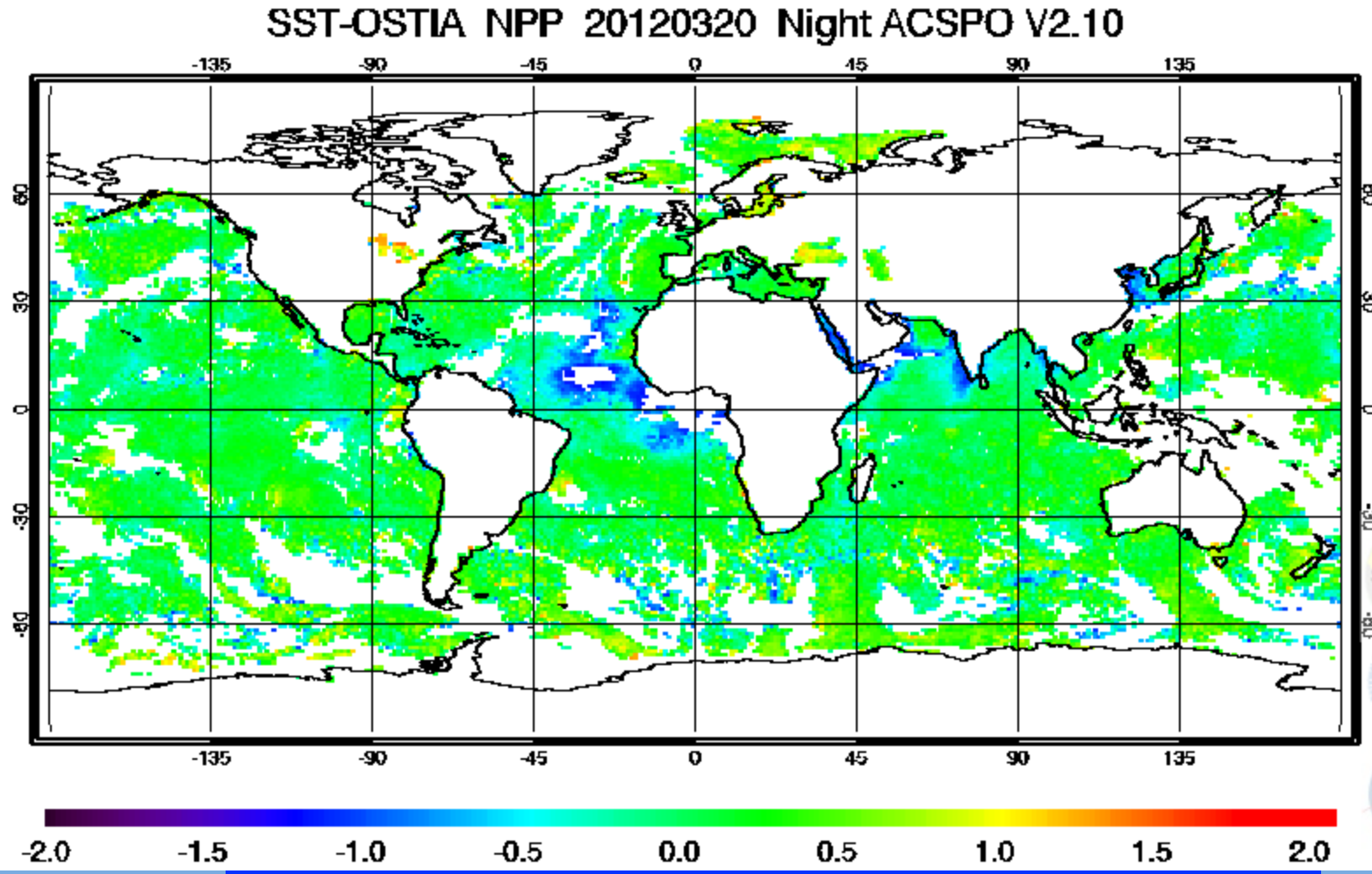
- VIIRS OC data compared with the **MOBY in situ data**, showing that SDR data since **2/6/2012** are good and reasonable, before that SDR date were **poor/not reliable**.
- VIIRS ocean color products are good and reasonable from **2/6/2012**.
- Vicarious calibration is needed and will further improve ocean color products.

Data from M. Wang

MOBY PI: Ken Voss



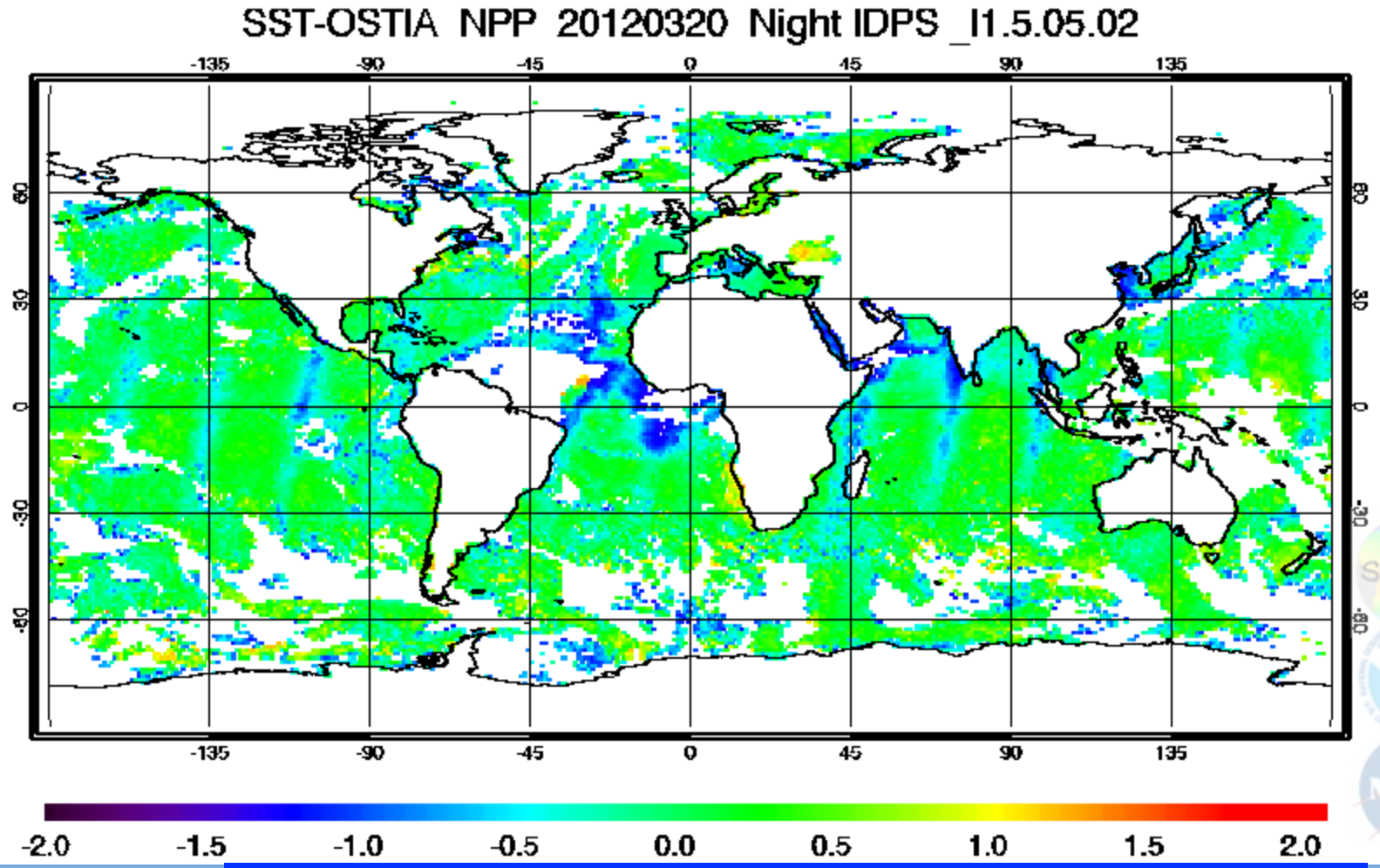
NIGHT: ACSPO minus OSTIA
'Confidently Clear' (No SST QFs are available in ACSPO)



- ***Overall, deviation from reference flat & close to 0***
- ***Residual Cloud/Aerosol leakages in the Tropics***

NIGHT: IDPS minus OSTIA

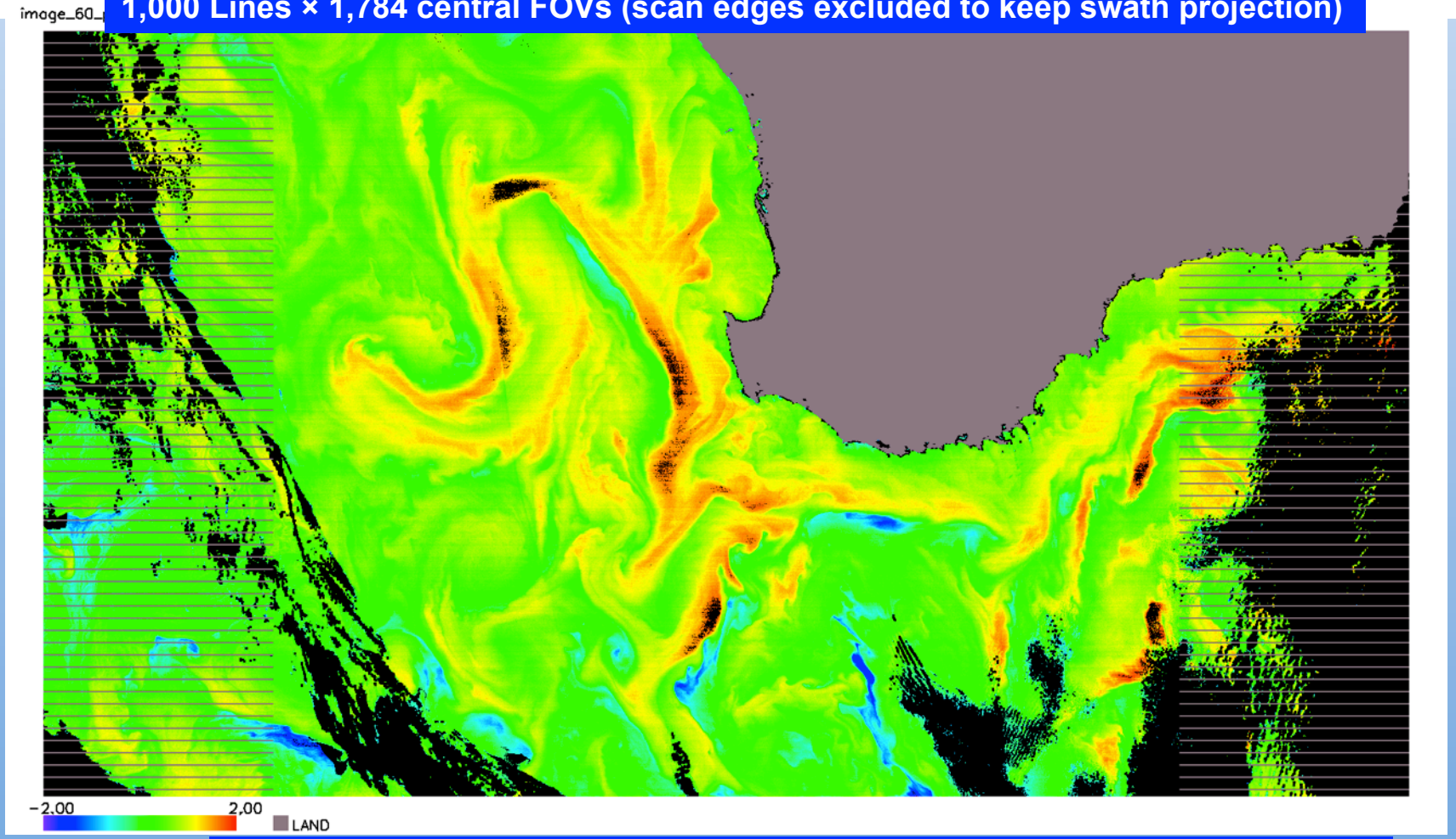
VCM = 'Confidently clear' (SST QFs are available but not used)



- *More Cloud leakages than in ACSPO (also in Hi Lat)*
- *Some clear pixels screened out (e.g., Amazon basin)*
- *"Limb Cooling" - Need recalculate SST coefficients*

NIGHT: ACSPO "Confidently Clear" - Reynolds SST
Swath Projection: South-East Australia, 17 March 2012

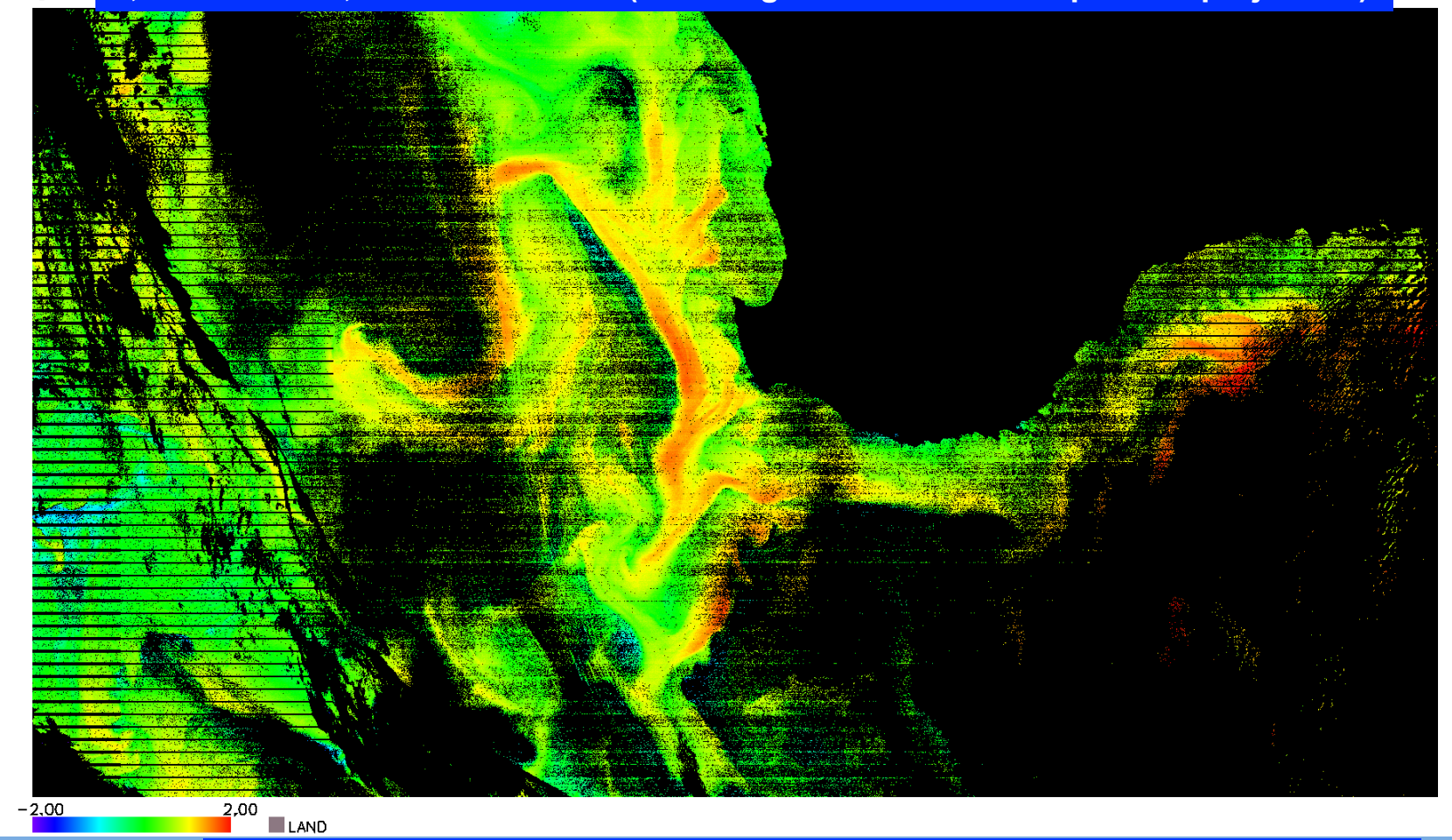
1,000 Lines × 1,784 central FOVs (scan edges excluded to keep swath projection)



- ACSPO shows a large cloud-free domain
- 0.25° Reference SST fails to capture high local dynamics
- ACSPO screens out large warm deviations from Ref

NIGHT: IDPS "Confidently Clear" - Reynolds SST
Swath Projection: South-East Australia, 17 March 2012

1,000 Lines × 1,784 central FOVs (scan edges excluded to keep swath projection)

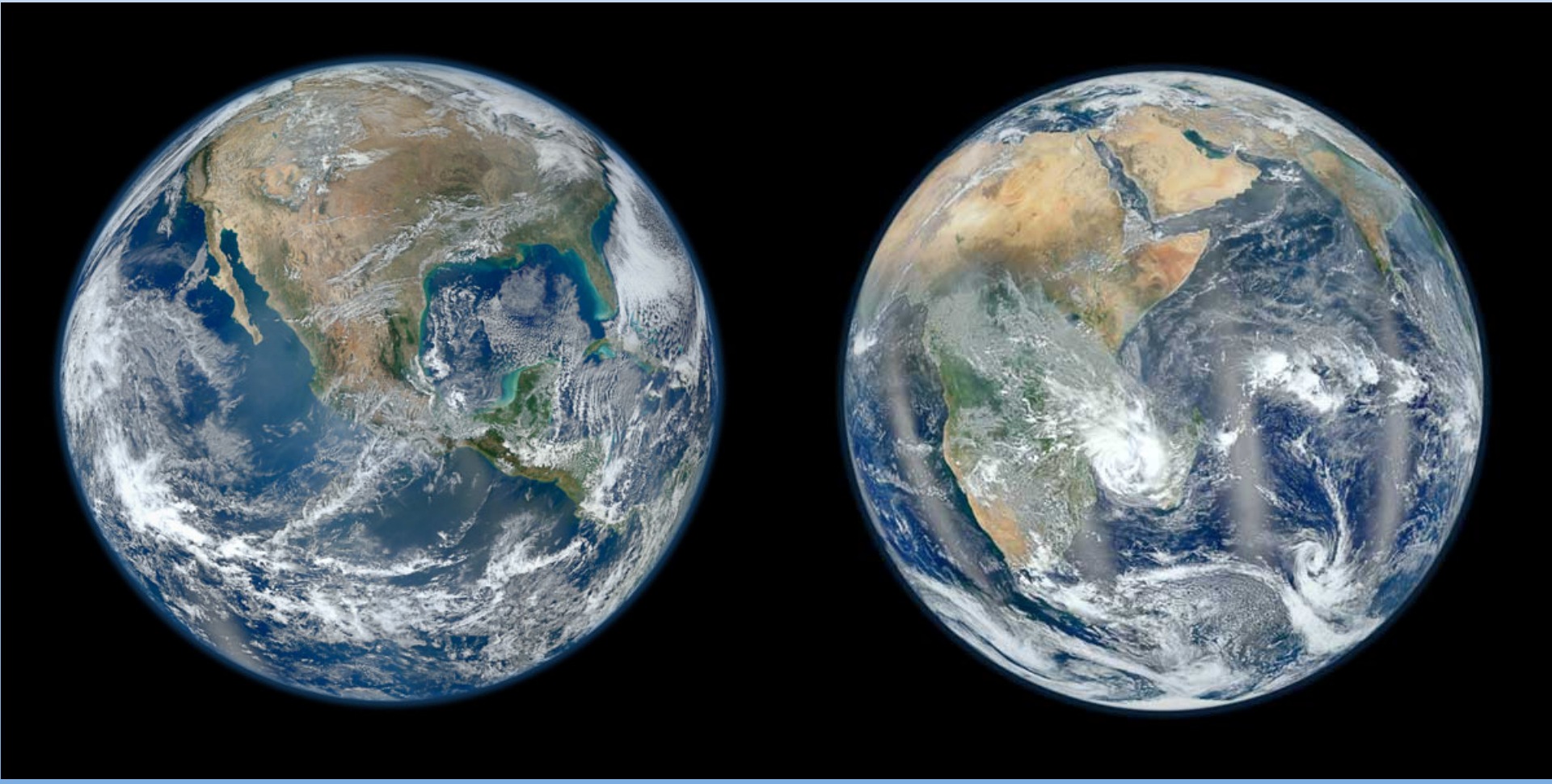


- IDPS VCM shows a much smaller cloud-free domain
- "Salt-N-Pepper", striping
- ..but preserves large warm deviations from Reference

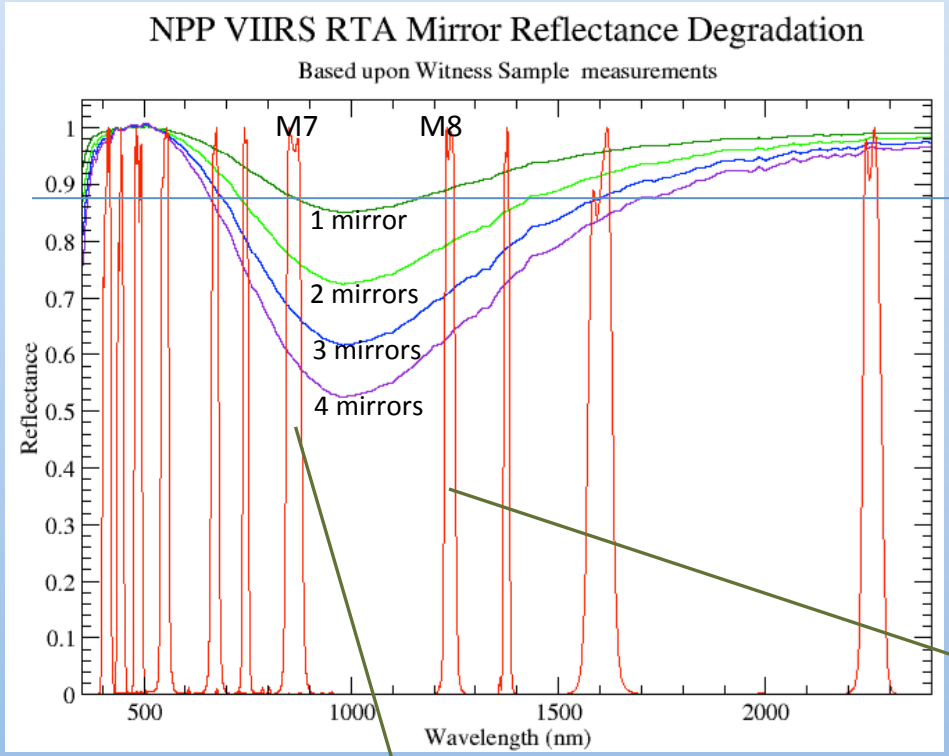
Conclusions

- Spacecraft in normal Mission Mode, all systems nominal
- Ground System performance nominal with data flowing to NESDIS and AFWA Centrals and to CLASS archive
  - –Get VIIRS data from http://www.class.ngdc.noaa.gov/
  - – VIIRS SDRs available shortly (*finishing README file*)
  - –VIIRS Radiometry and Geolocation are good.
- EDR Data Product Teams are busy.
  - –Tuning Cloud Mask
- Contact JPSS EDR team leads for more details.

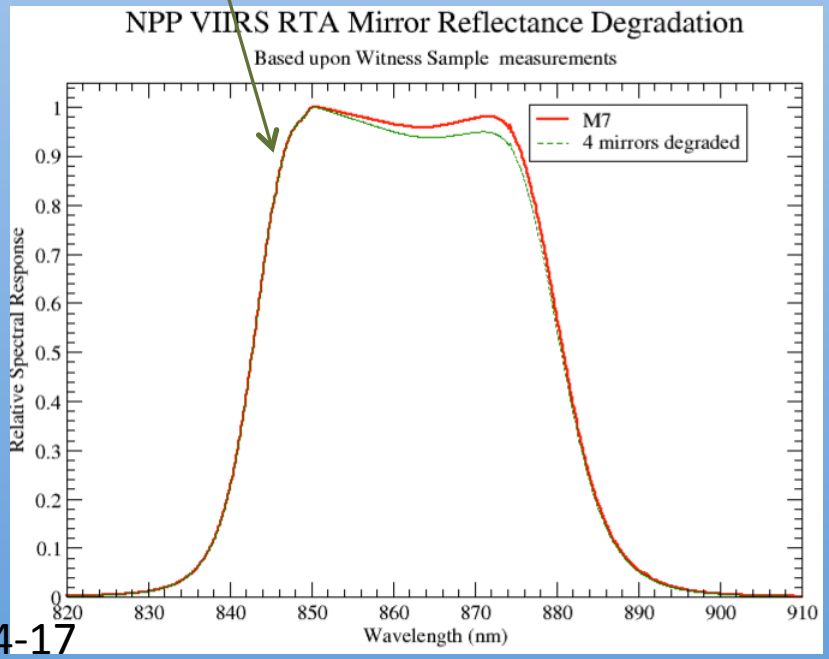
Questions?

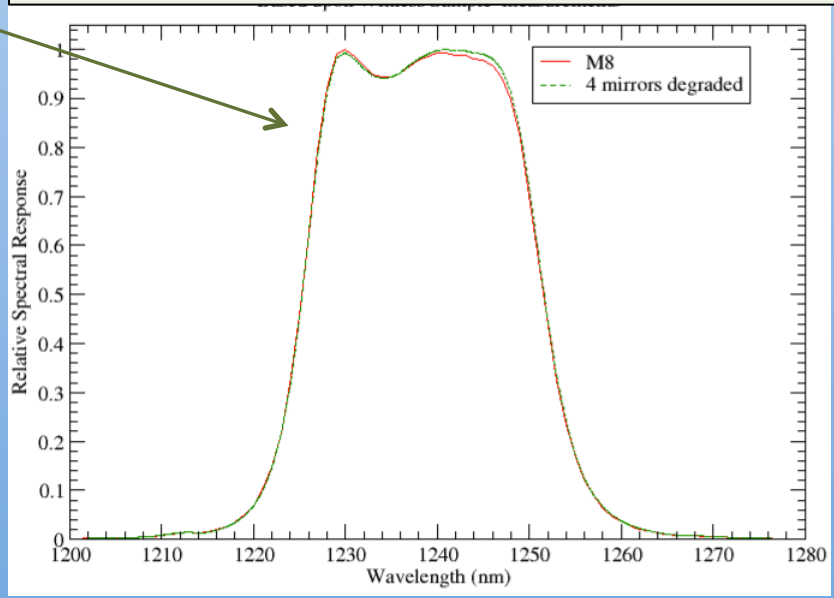


RTA Mirror Reflectance Degradation Anomaly



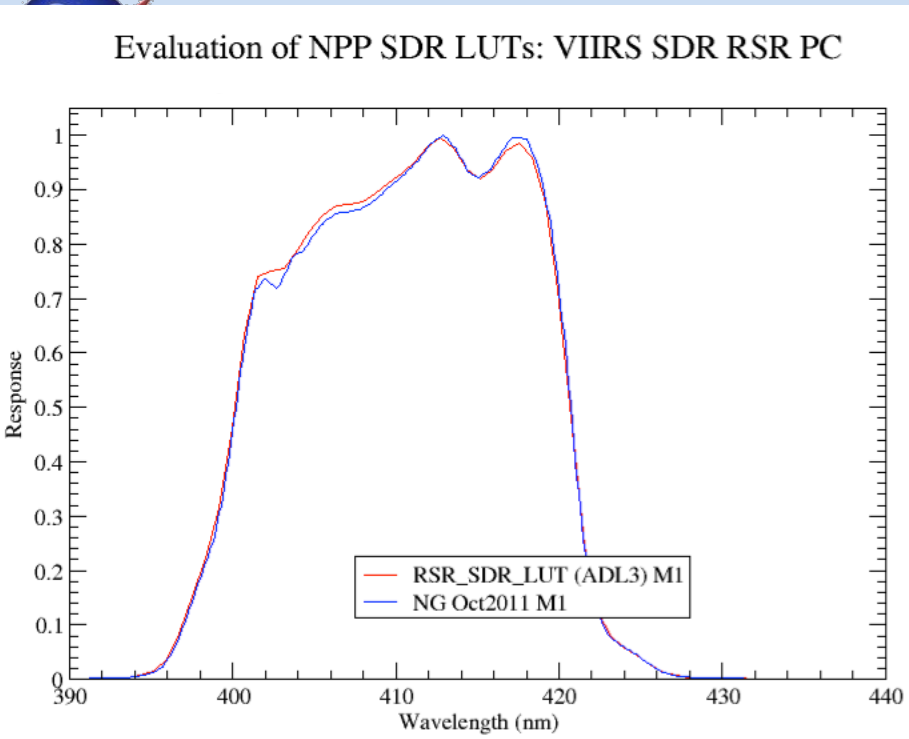
Degradation in the reflectance of the 4 RTA mirrors modulates VisNIR and SWIR RSR. Using NG Oct 2011 band averaged RSR, initial review suggests that radiometric impact <0.5%.

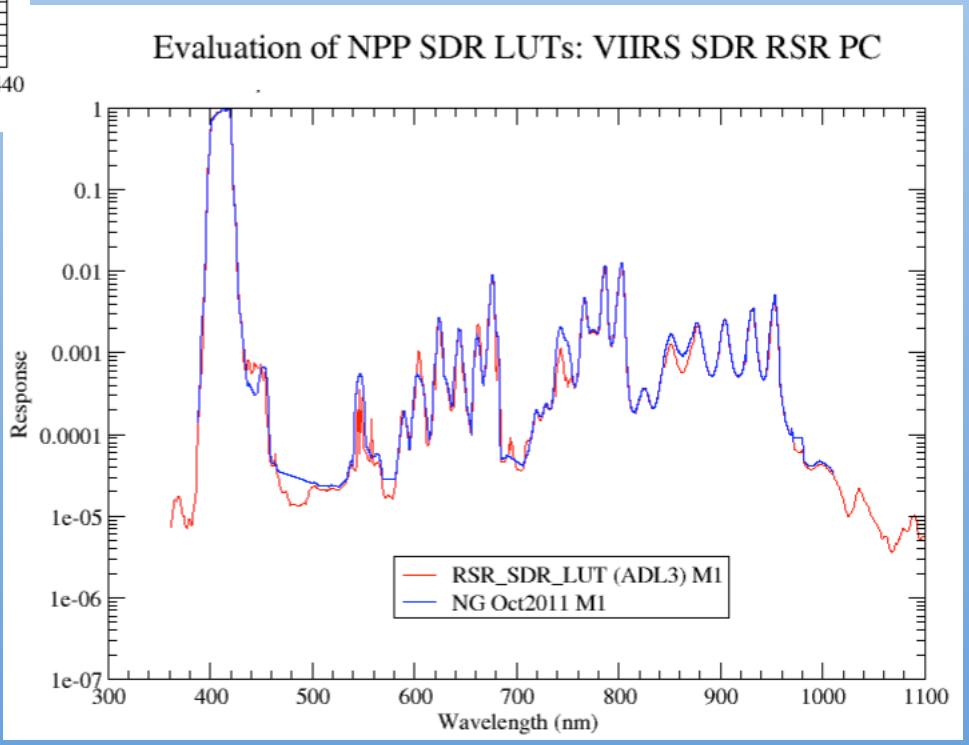




Reflectance degradation estimated using RTA primary mirror "TWM" witness sample measurements extrapolated to 4 mirrors by power law

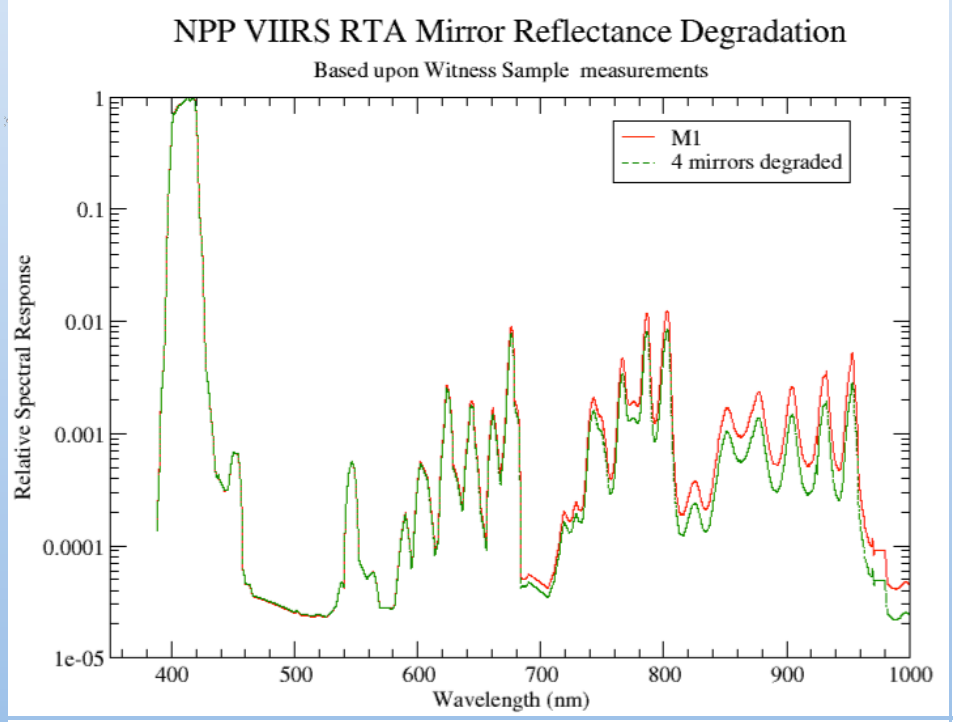
NPP VIIRS At-Launch VisNIR RSR based upon preliminary Spacecraft Level RSR

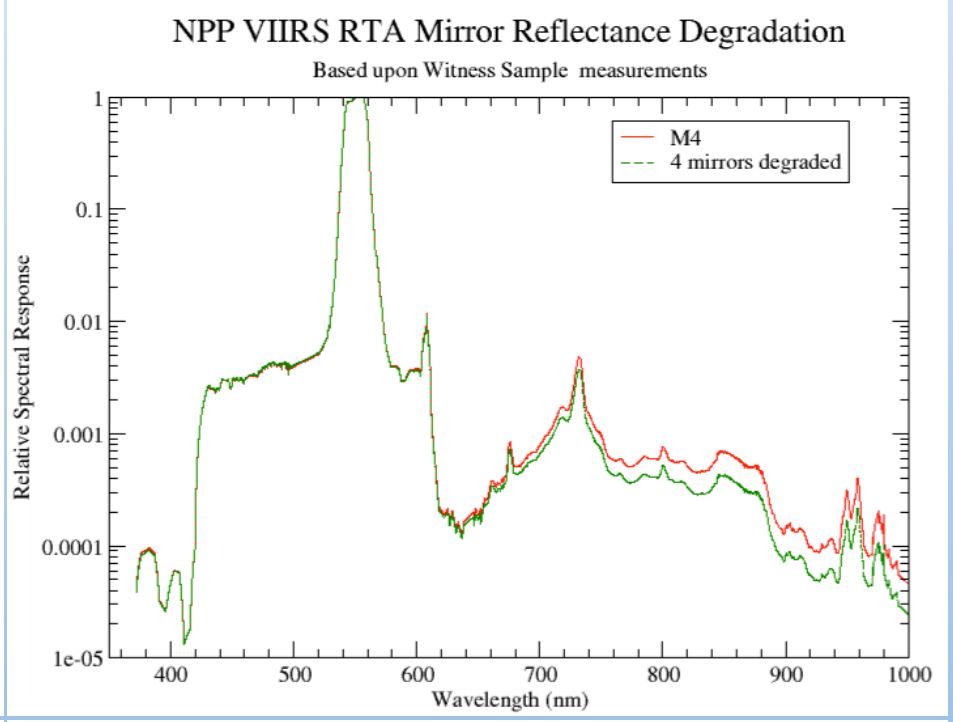


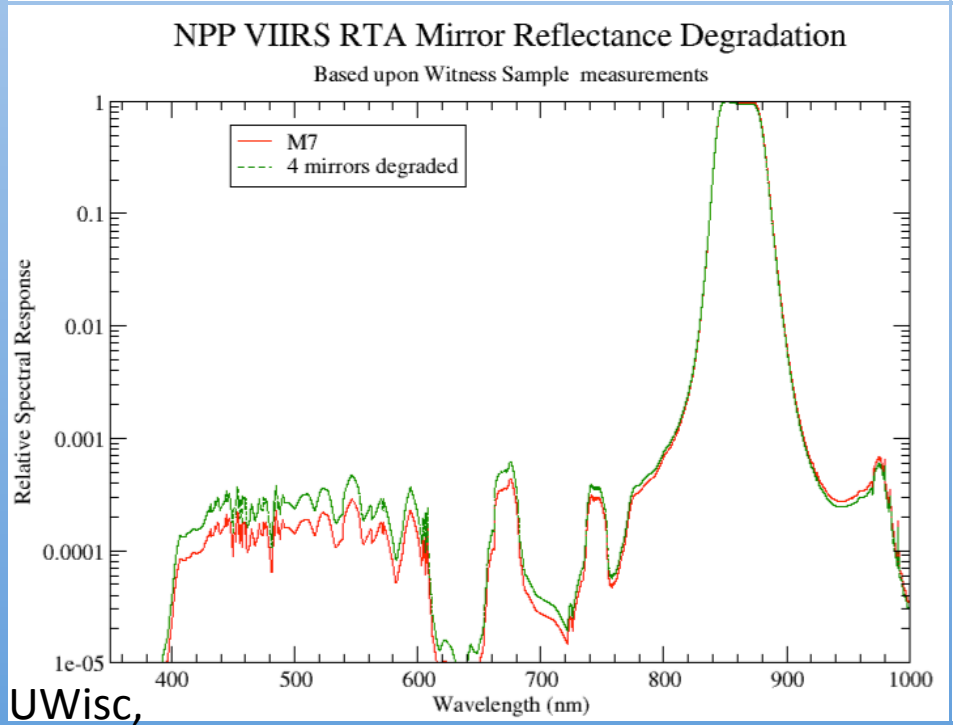


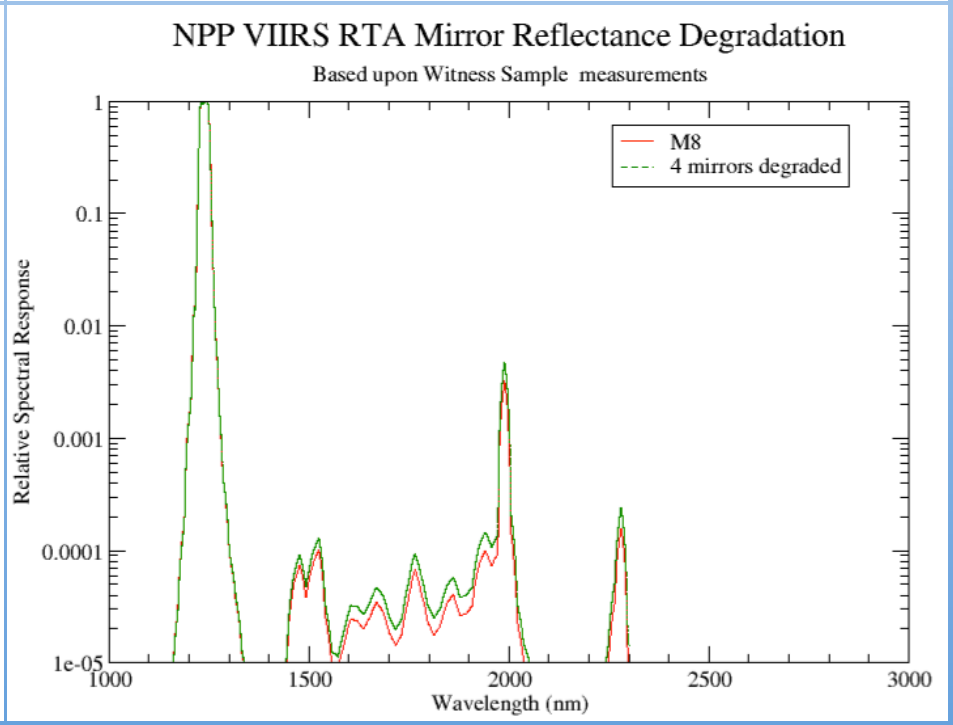
In Process: update at-launch RSR with NG Oct 2011 RSR release, which is based upon *final* Govt. Team Spacecraft Level RSR.

UWisc, 2012-04-17


NPP VIIRS RTA Mirror Reflectance Degradation
Based upon Witness Sample measurements
M1
4 mirrors degraded
Relative Spectral Response
Wavelength (nm)


NPP VIIRS RTA Mirror Reflectance Degradation
Based upon Witness Sample measurements
M4
4 mirrors degraded
Relative Spectral Response
Wavelength (nm)

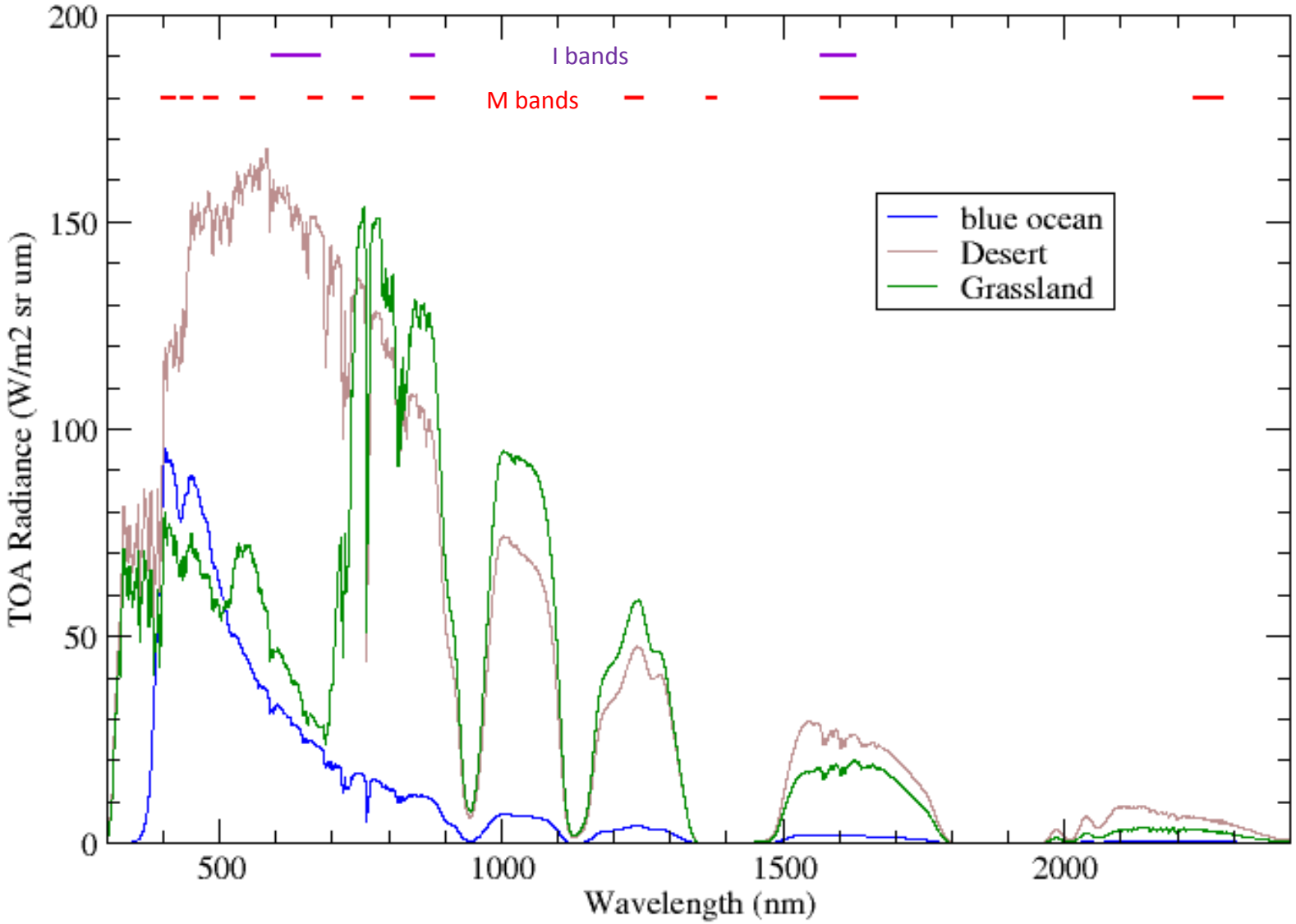

NPP VIIRS RTA Mirror Reflectance Degradation
Based upon Witness Sample measurements
M7
4 mirrors degraded
Relative Spectral Response
Wavelength (nm)


NPP VIIRS RTA Mirror Reflectance Degradation
Based upon Witness Sample measurements
M8
4 mirrors degraded
Relative Spectral Response
Wavelength (nm)

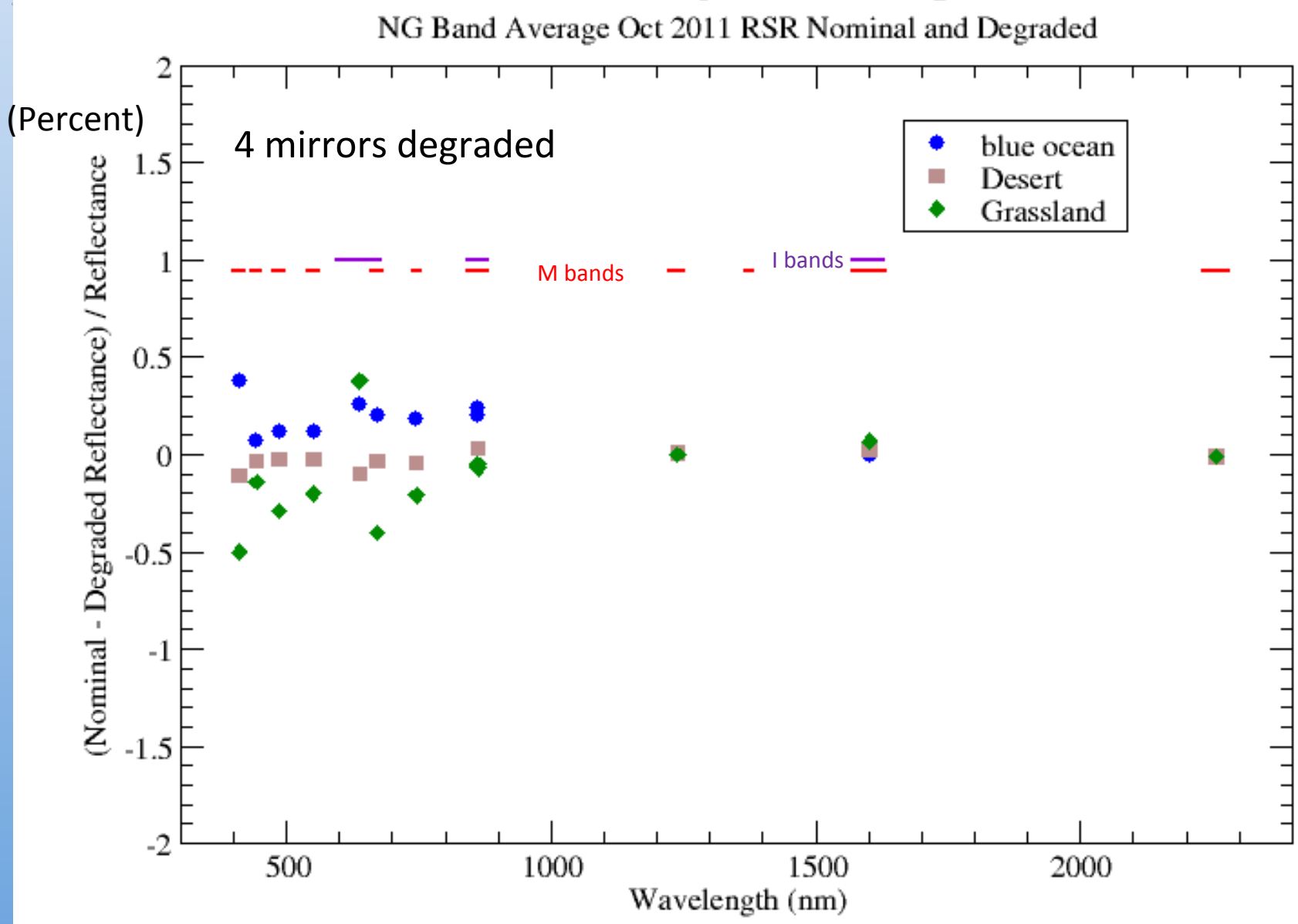
UWisc,

Modeled TOA Earth Spectra

(Spectra courtesy Bob Barnes, VOST)

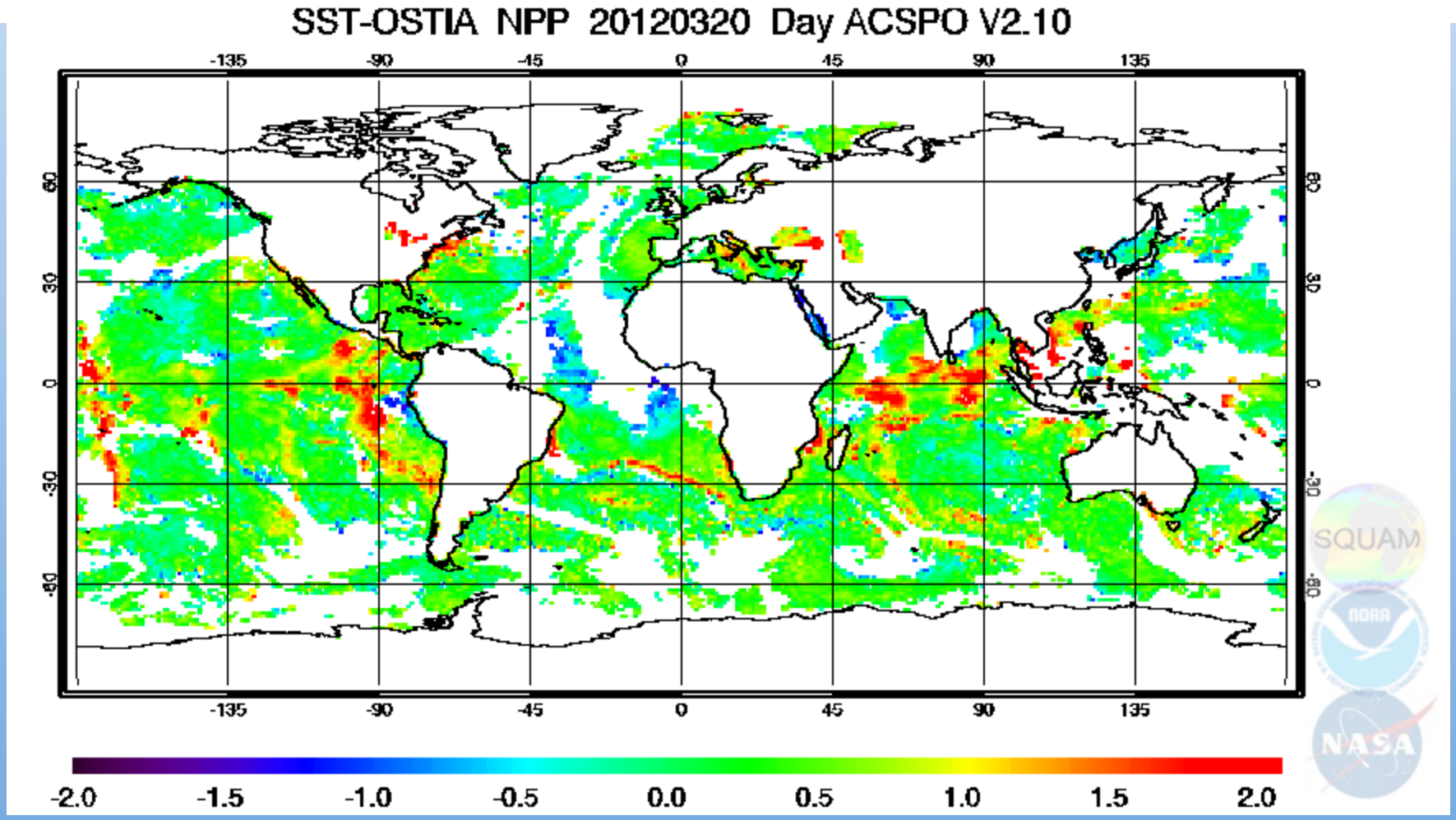


NPP VIIRS RTA Degradation Impact on RSR



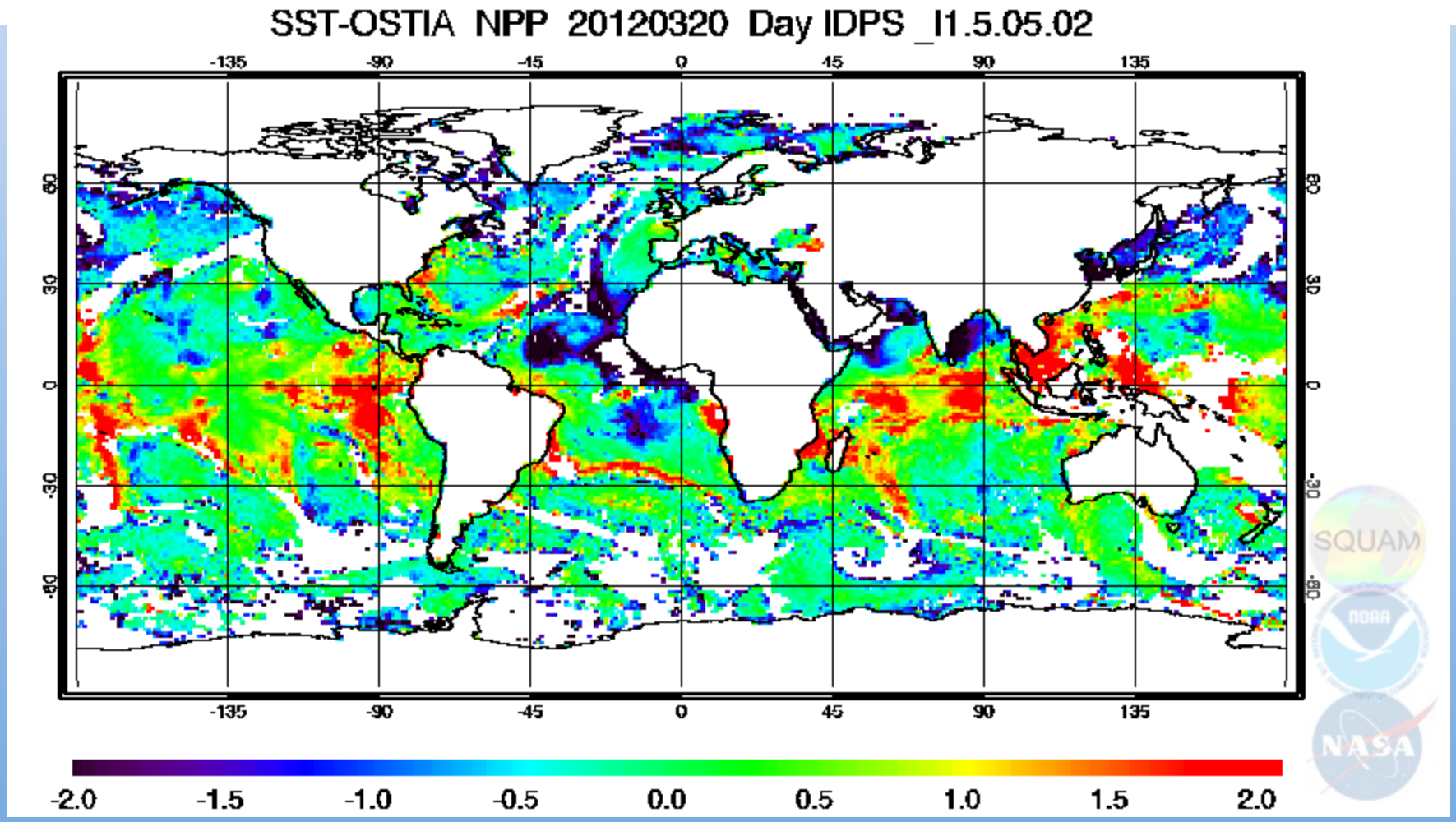
UWisc,
2012-04-17

DAY: ACSPO minus OSTIA
'Confidently Clear' (No SST QFs are available in ACSPO)



- *Over most ocean, the ΔTs field is flat and close to ~0*
- *Residual Cloud/Aerosol leakages seen in the Tropics*
- *Daytime positive anomalies – e.g., diurnal warming*

DAY: IDPS minus OSTIA
VCM = 'Confidently clear' (SST QFs are available but not used)

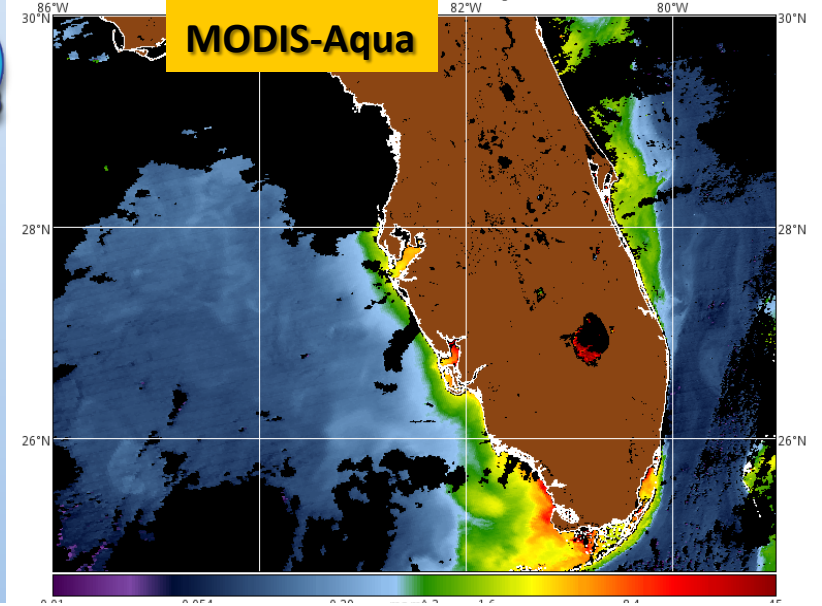


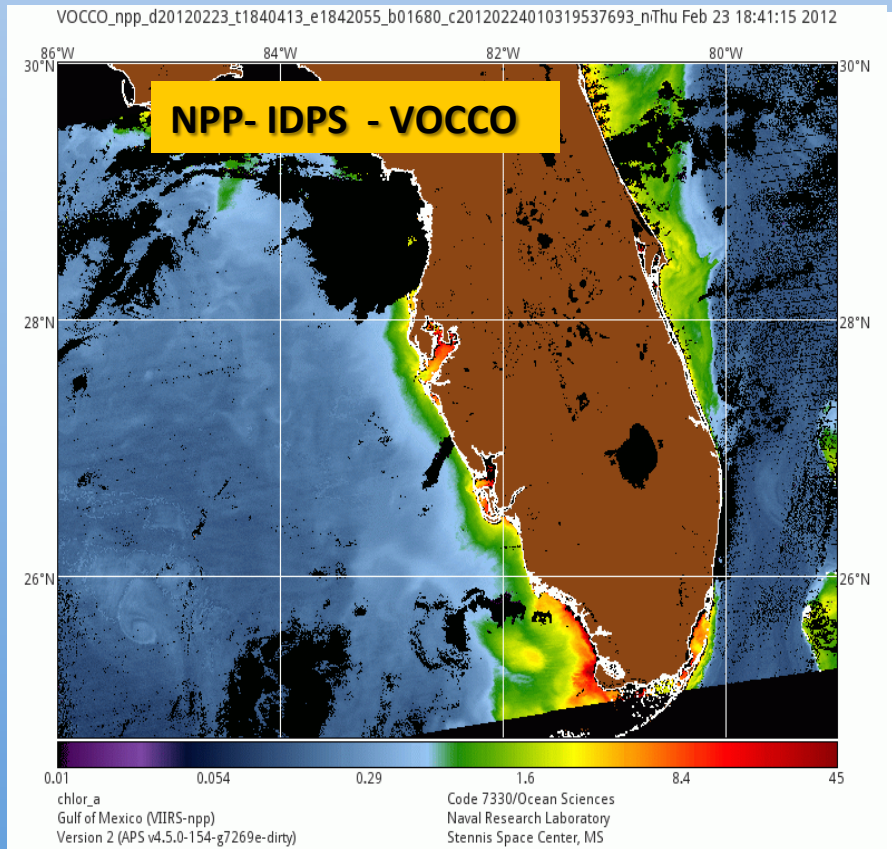
- *Larger "CC" domain than in ACSPO, but..*
- *Very significant Cloud leakages, all over*
- *Some Limb cooling - Need recalculate SST coefficients*

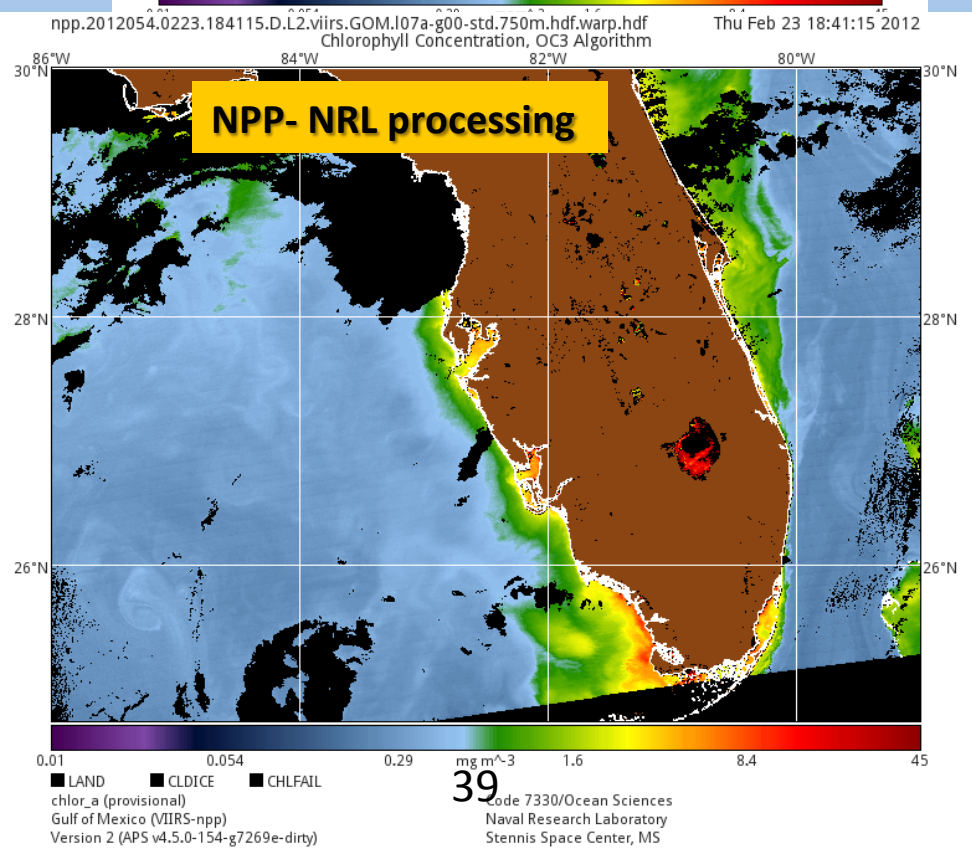
Example: Feb. 28, 2012

MODIS-Aqua, VIIRS (APS & IDPS) Satellite Comparison

Ocean features, retrieved nL_W and chlorophyll have been shown to provide similar quality.

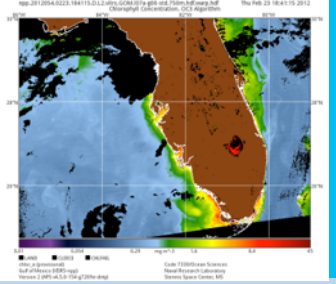






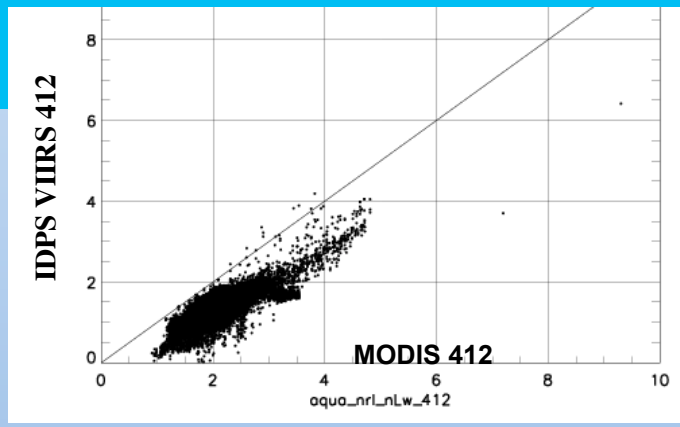
VIIRS products - Initial Evaluation
Feb 23, 2012 - Florida

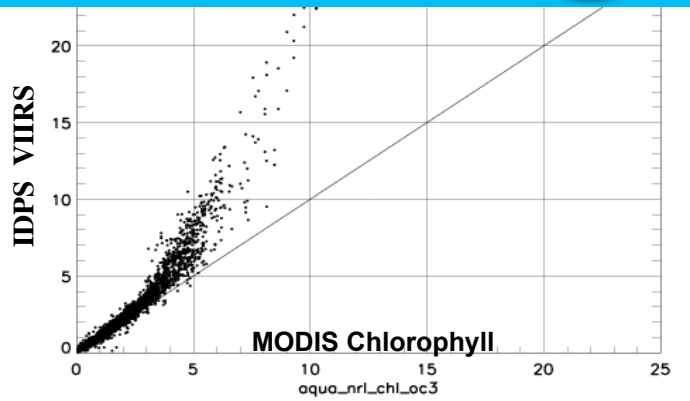
VIIRS products compare with existing MODIS Products



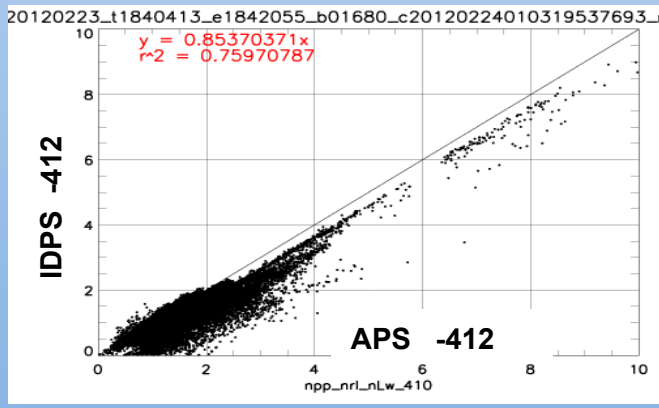
MODIS vs IDPS –EDR's

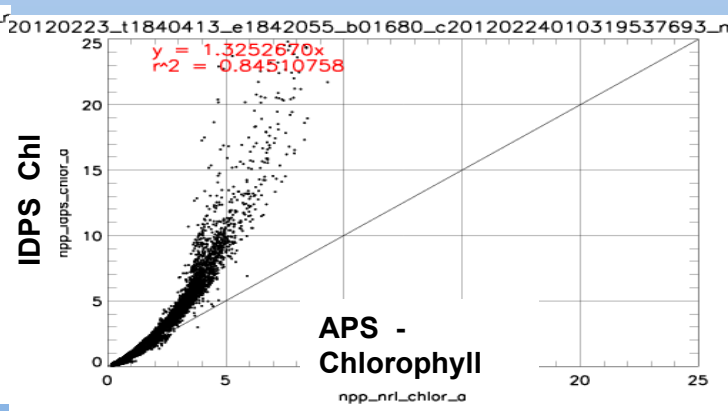
Feb 23 – 2012 – Florida





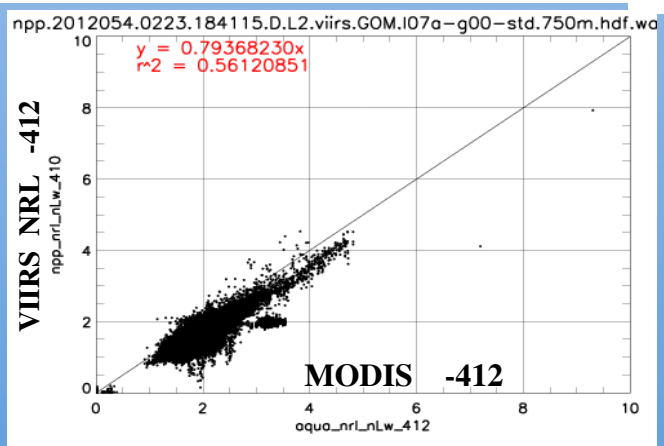
VIIRS Algorithms
IDPS vs APS

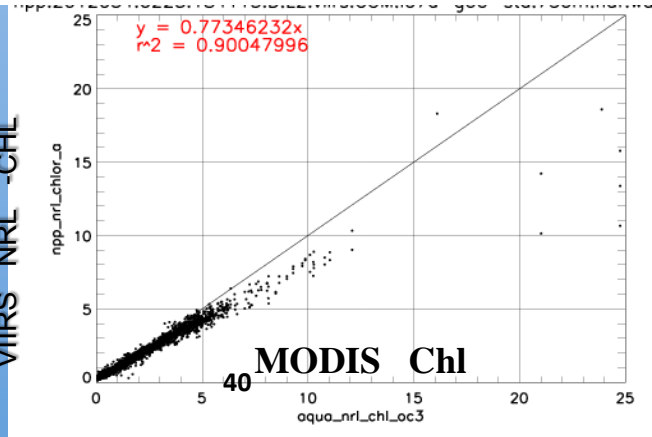


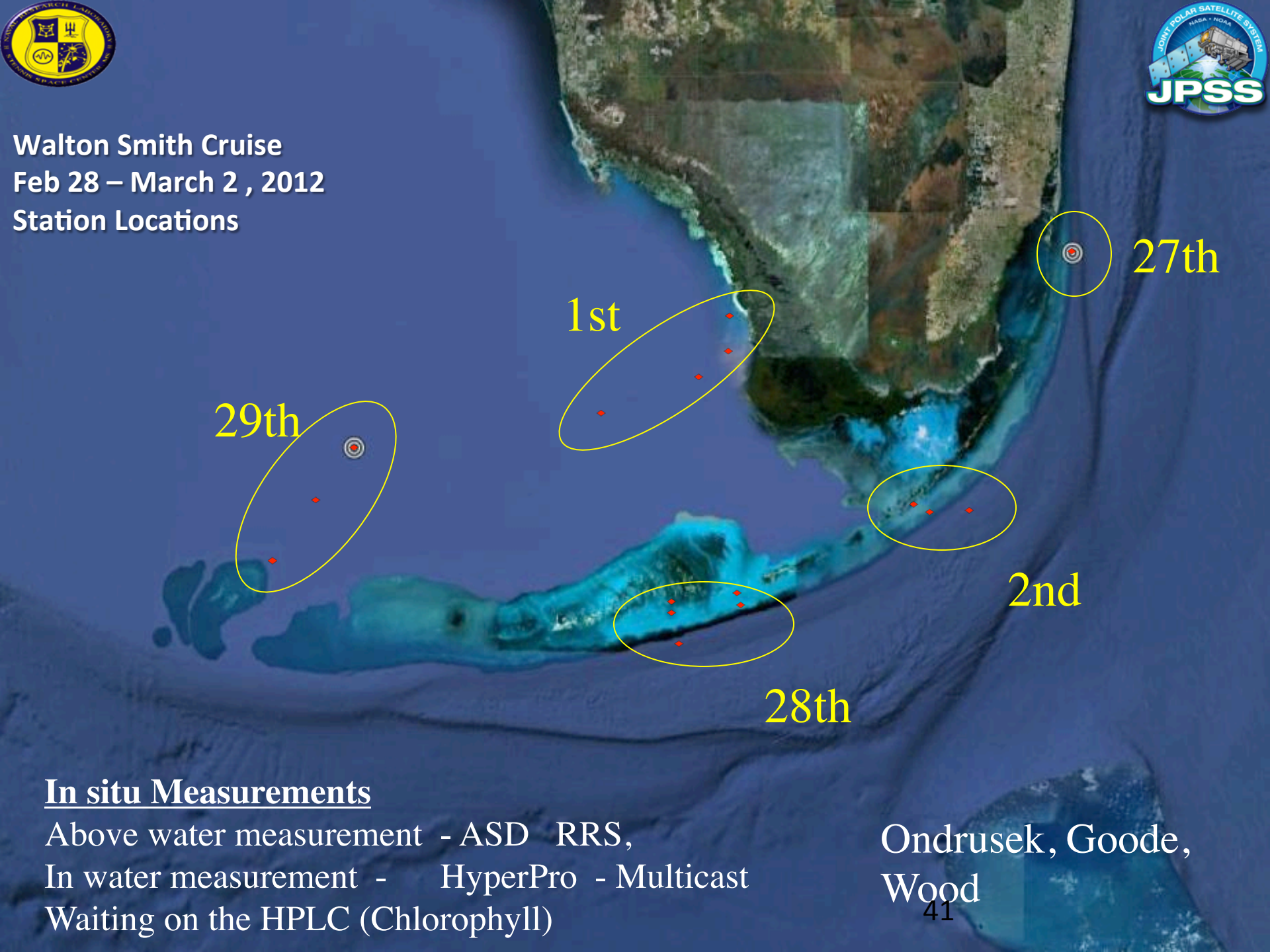


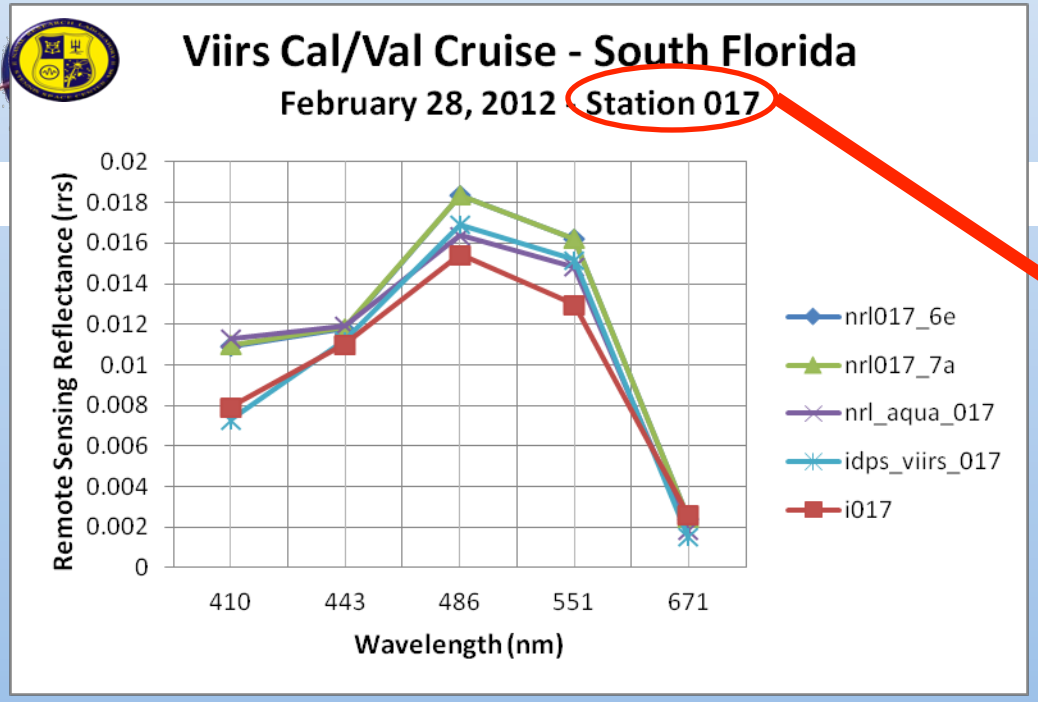
Government Processing

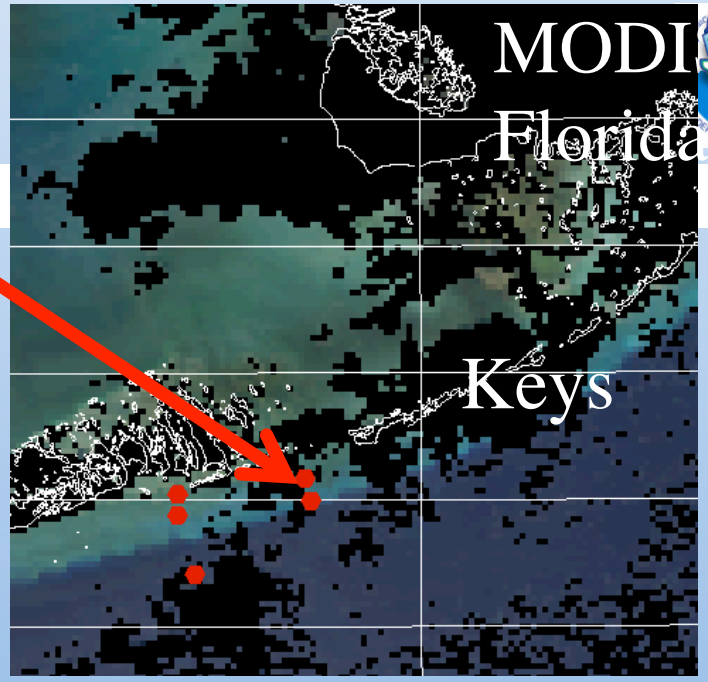
MODIS vs NPP APS

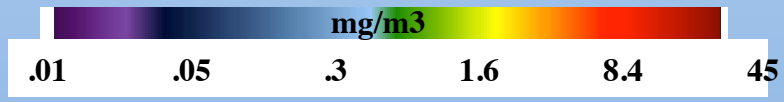


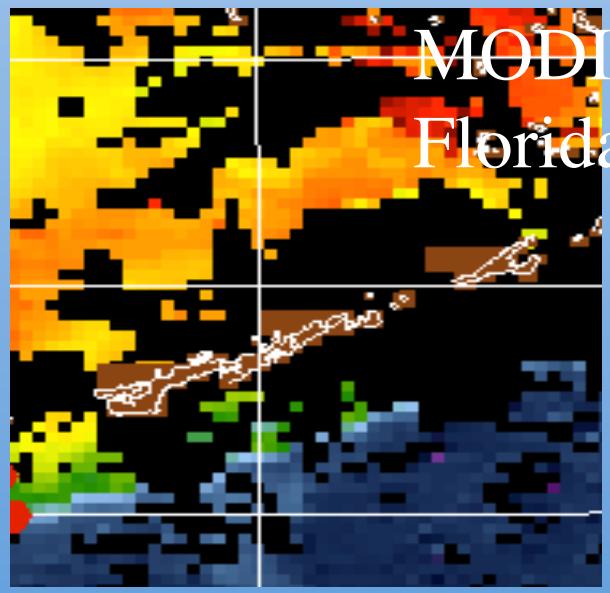


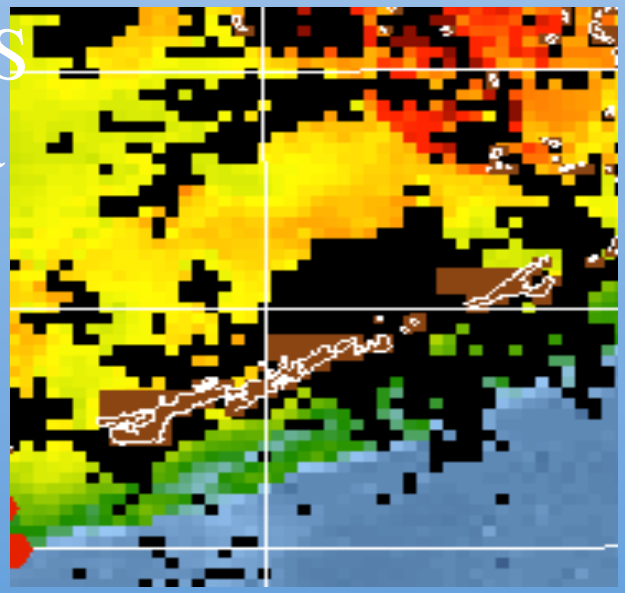

Walton Smith Cruise
Feb 28 – March 2 , 2012
Station Locations
27th
1st
29th
2nd
28th
In situ Measurements
Above water measurement - ASD RRS,
In water measurement - HyperPro - Multicast
Waiting on the HPLC (Chlorophyll)
Ondrusek, Goode, Wood

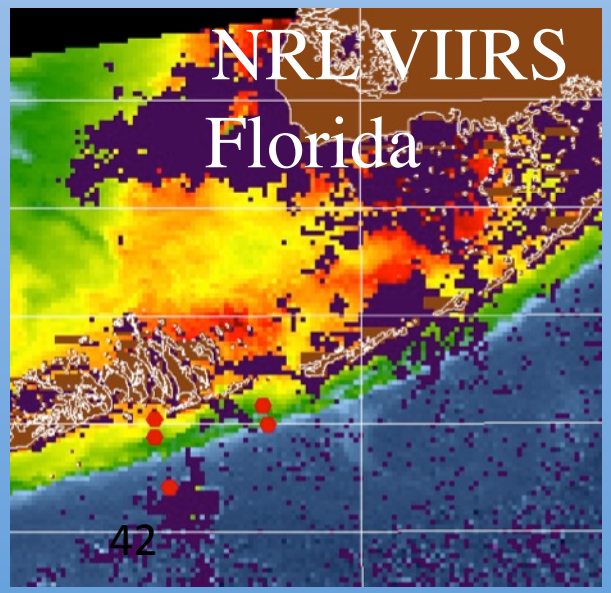

Viirs Cal/Val Cruise - South Florida
February 28, 2012 - Station 017
Remote Sensing Reflectance (rrs)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
410
443
486
551
671
Wavelength (nm)
nrl017_6e
nrl017_7a
nrl_aqua_017
idps_viirs_017
i017


MODI
Florida
Keys


mg/m3
.01
.05
.3
1.6
8.4
45

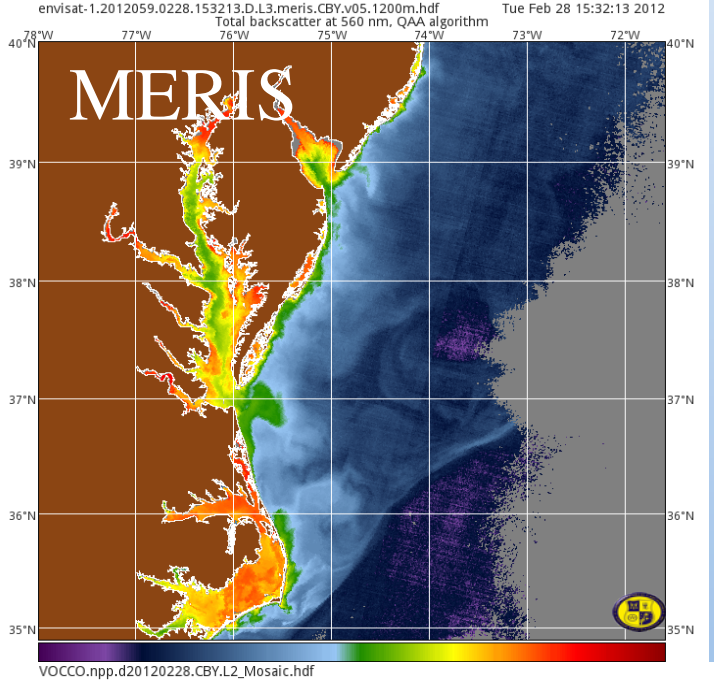

MODIS
Florida

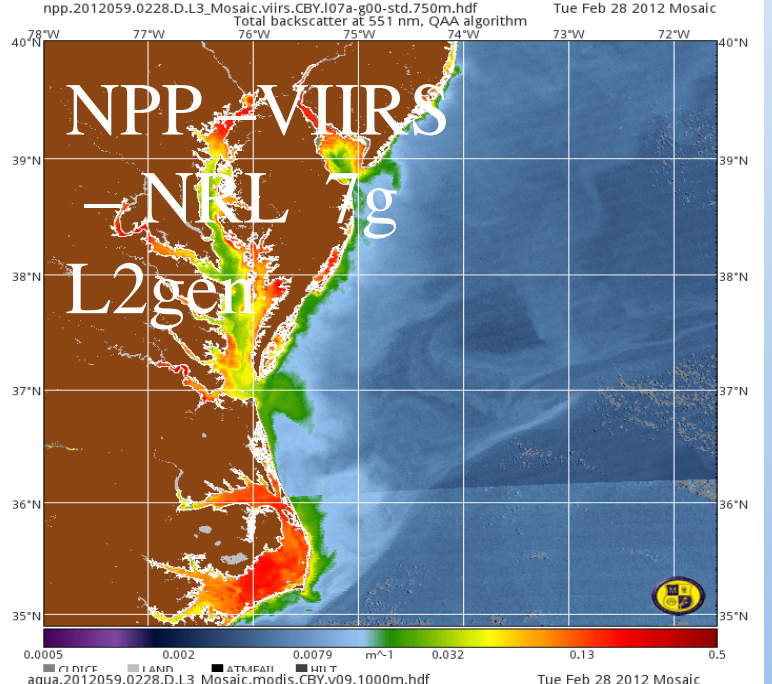


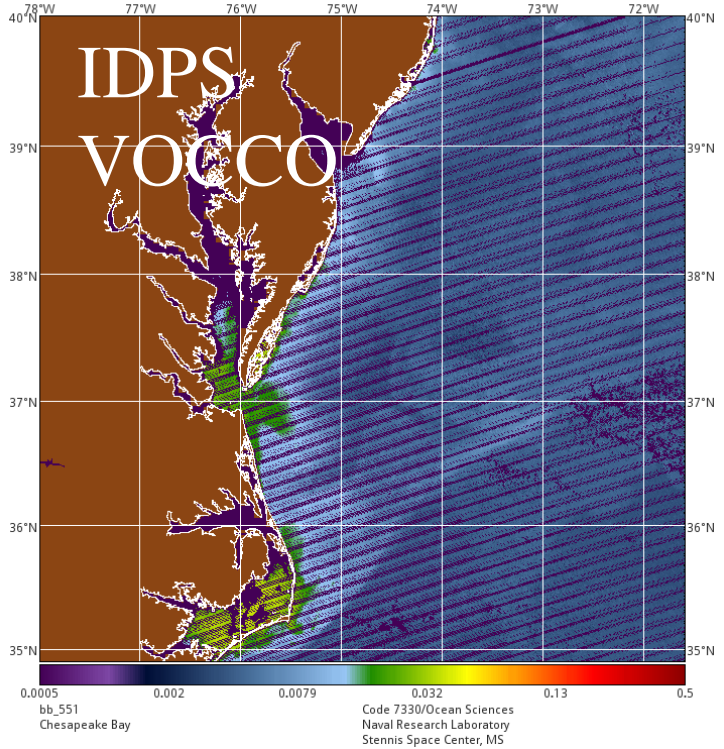

NRL VIIRS
Florida

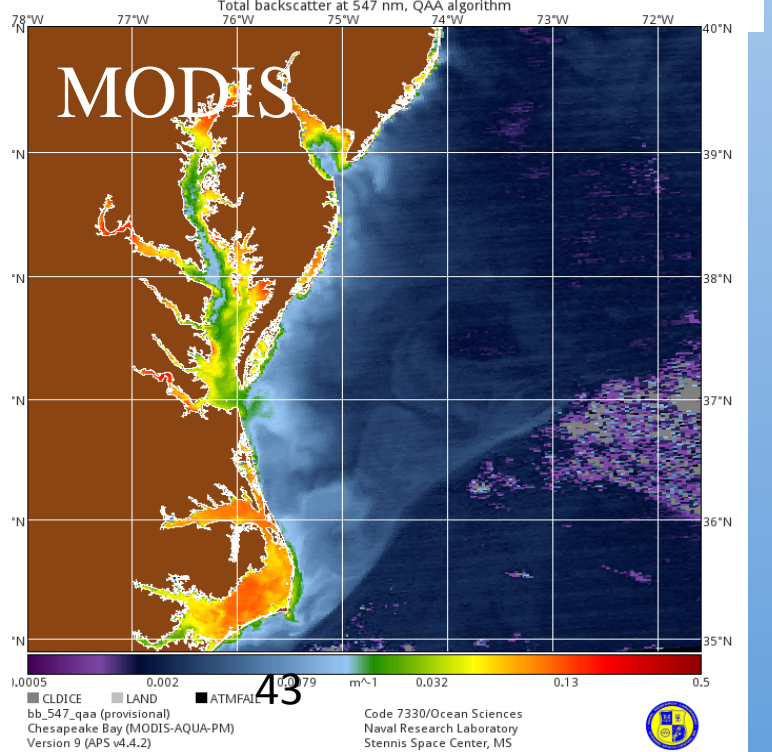
Inter–satellite comparison: Backscattering Particle at 551

Example:
Feb 28 , 2012









VIIRS products - Initial Evaluation
2-28 , 2012 - Chesapeake Bay

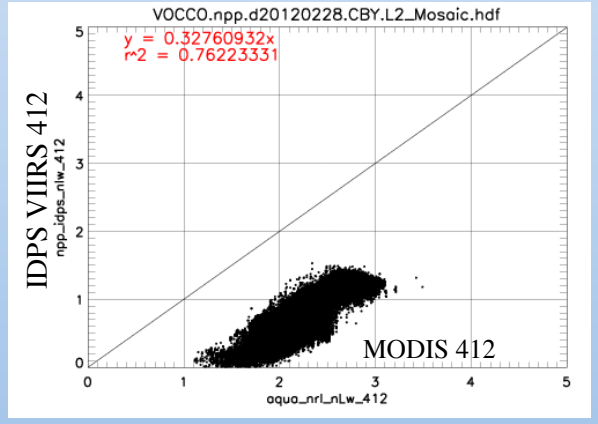
MODIS vs IDPS –EDR's

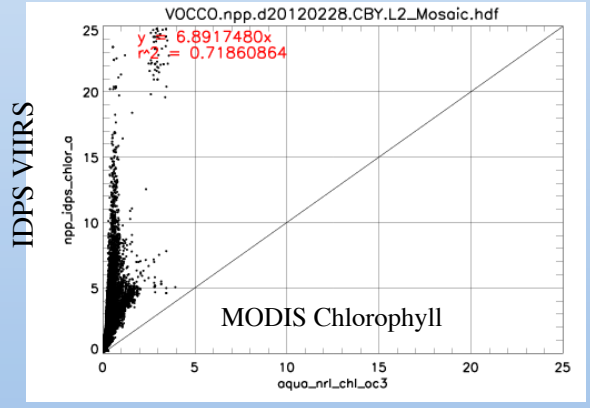
2-28 , 2012 - Chesapeake Bay

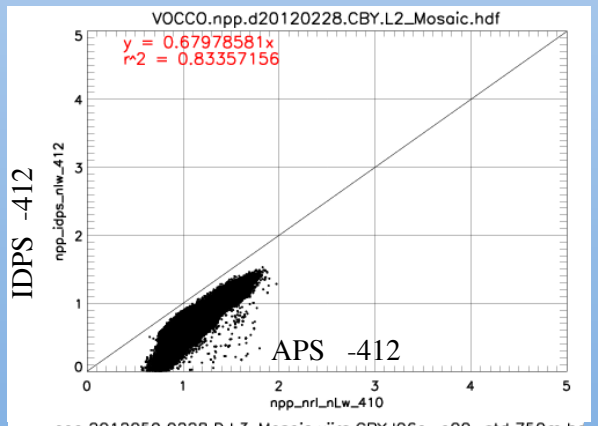
NPP - IDPS vs APS

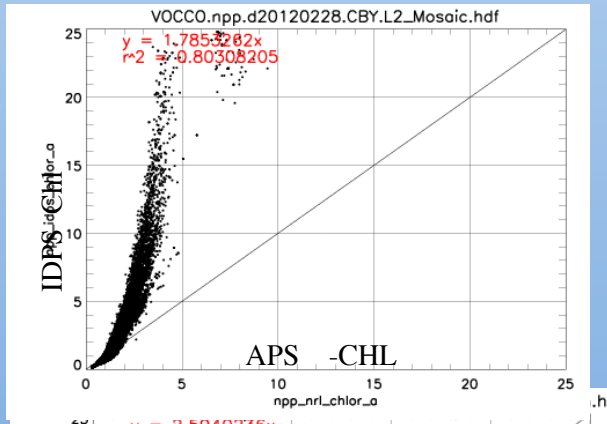
Government Processing

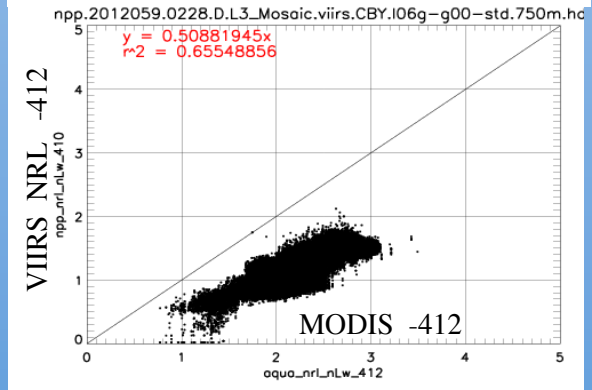
MODIS vs NPP APS

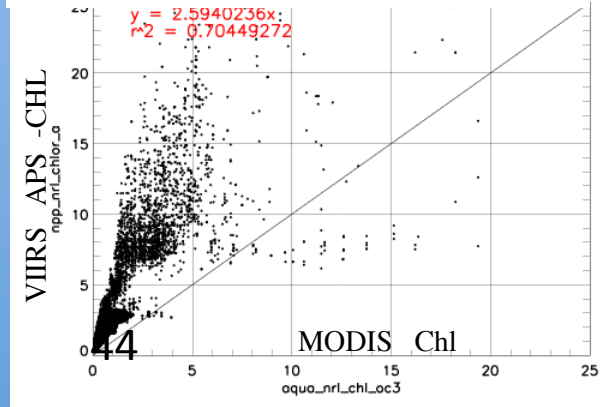




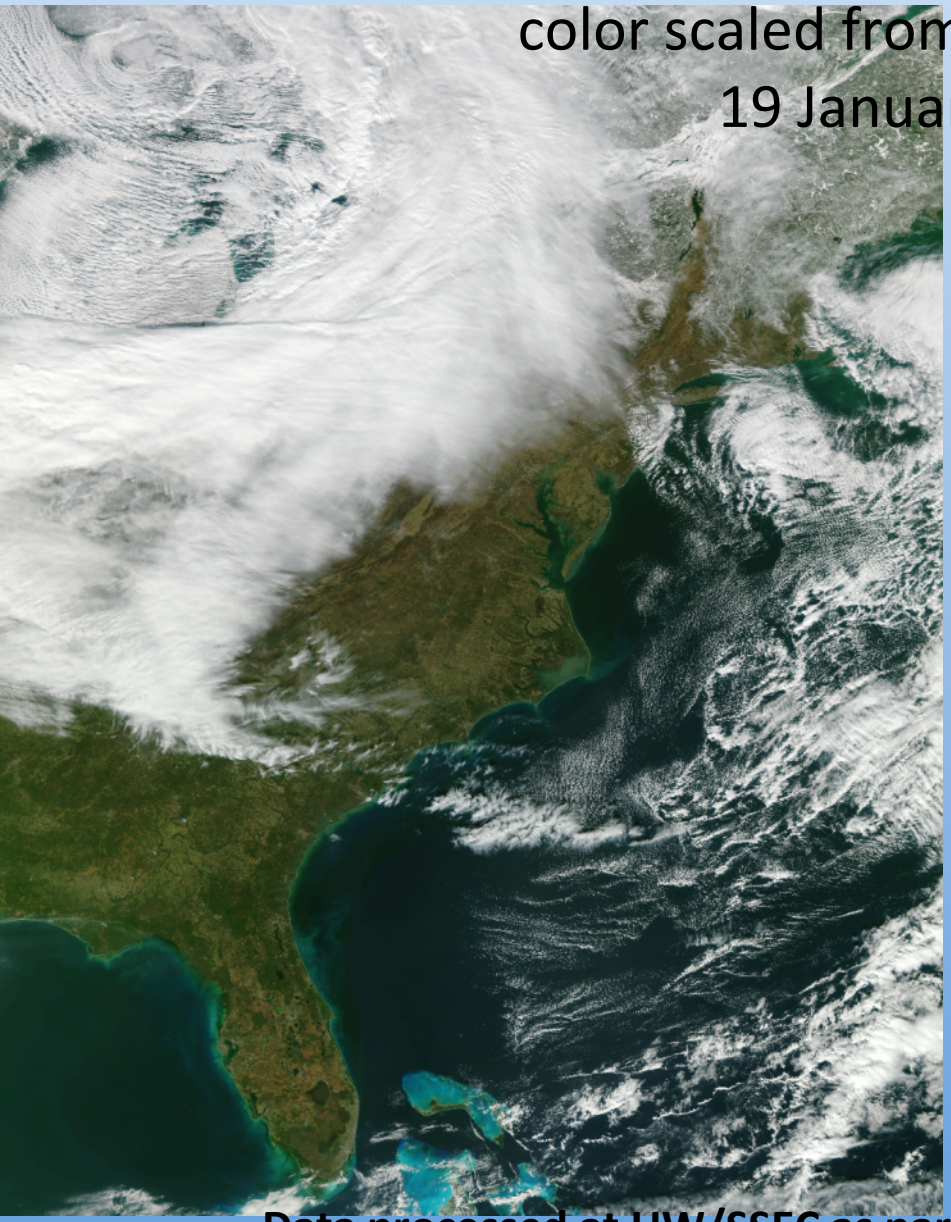


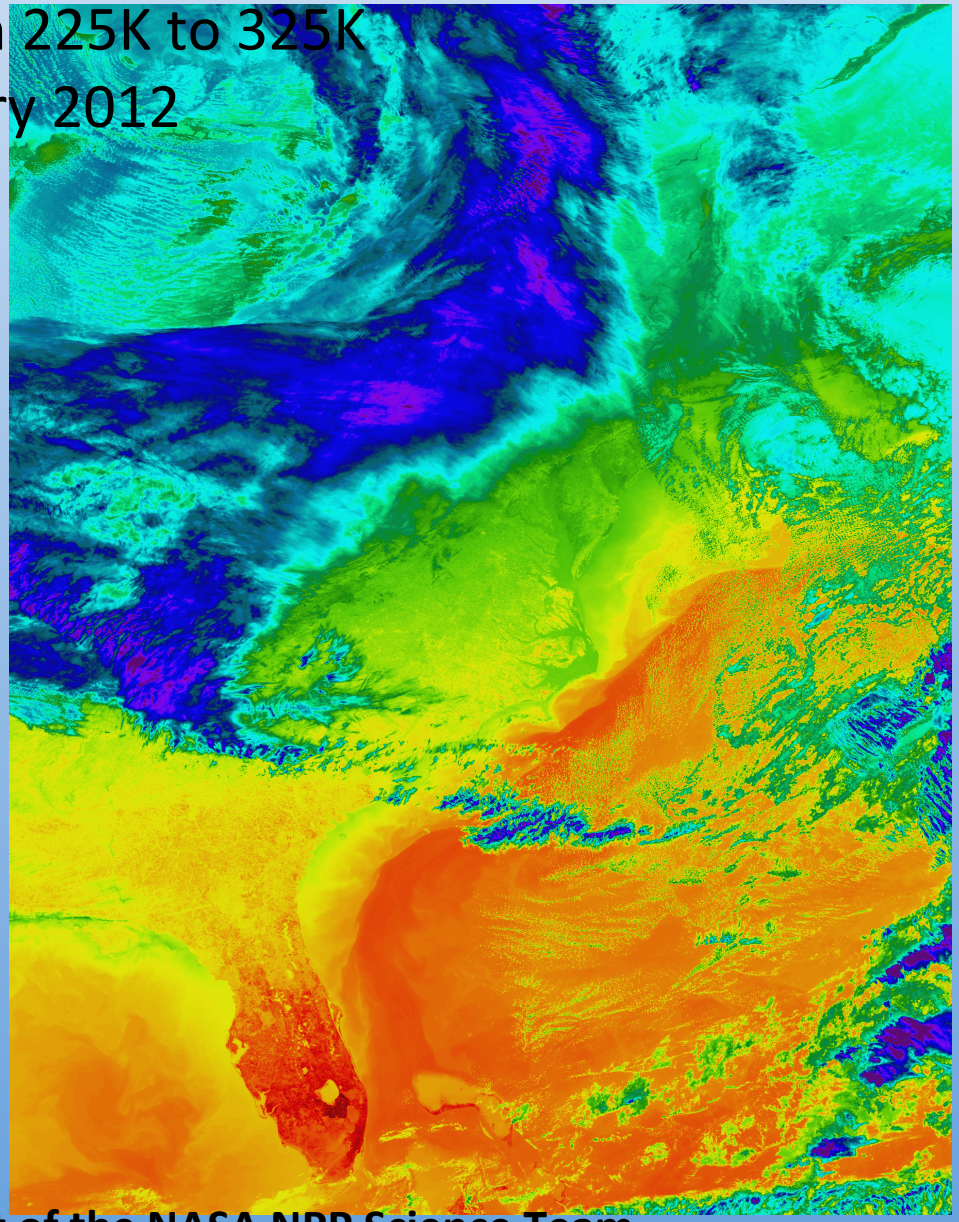






VIIRS M05/M04/M03 (red/green/blue)
VIIRS M15 (10.76 microns)
color scaled from 225K to 325K
19 January 2012





Data processed at UW/SSEC as part of the NASA NPP Science Team

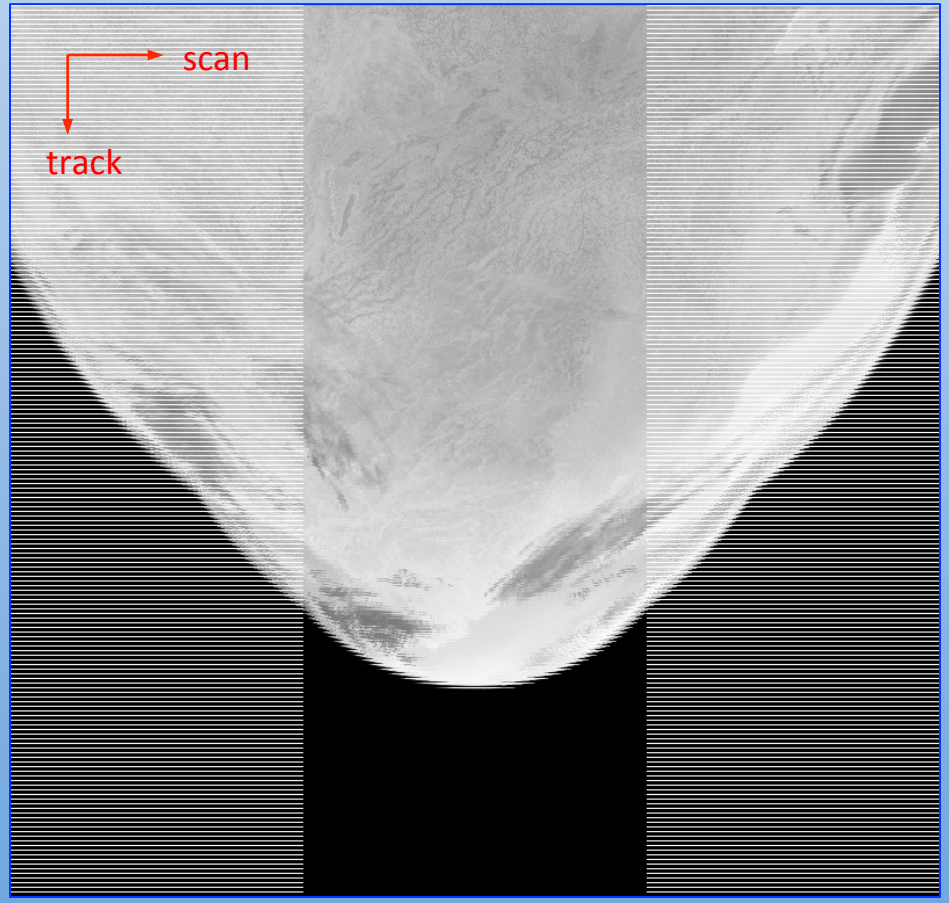
Backup Material

NPP VIIRS Pitch Maneuver on Feb 20, 2012, Orbit #1637

Images of Band I5 SDR Brightness Temperature

4 granules at the beginning

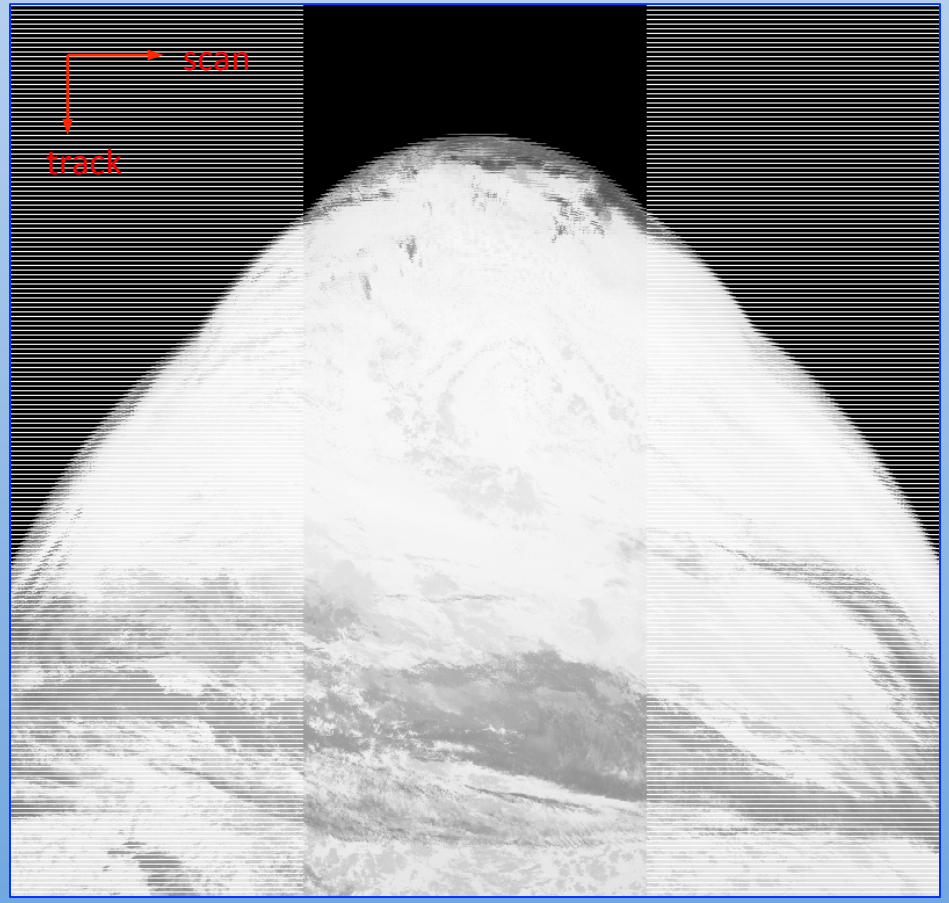
GMT 18:22:02 – 18:27:44



Pitch started at 18:15:34

4 granules near the end

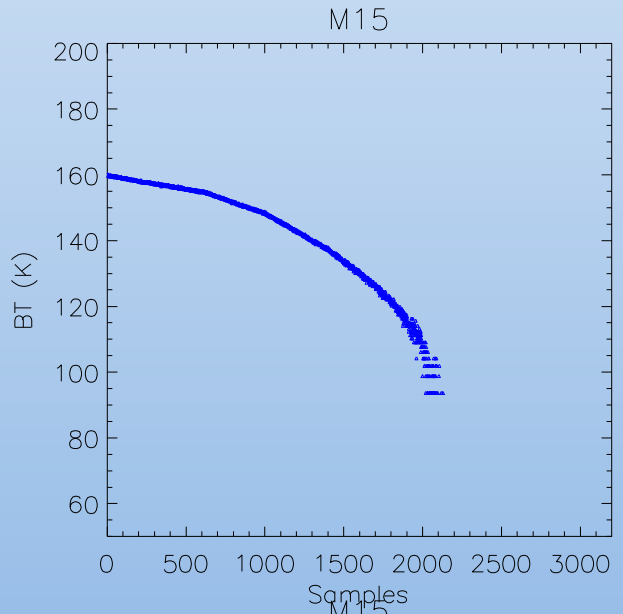
GMT 18:47:39 – 18:53:20

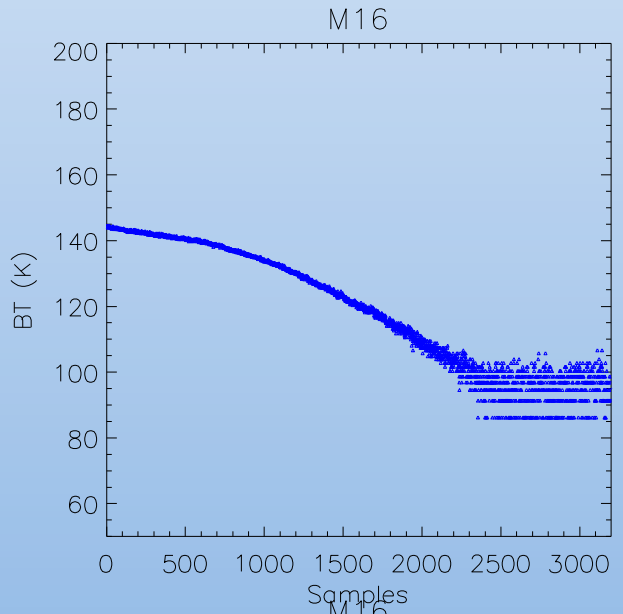


Pitch ended at 18:59:19

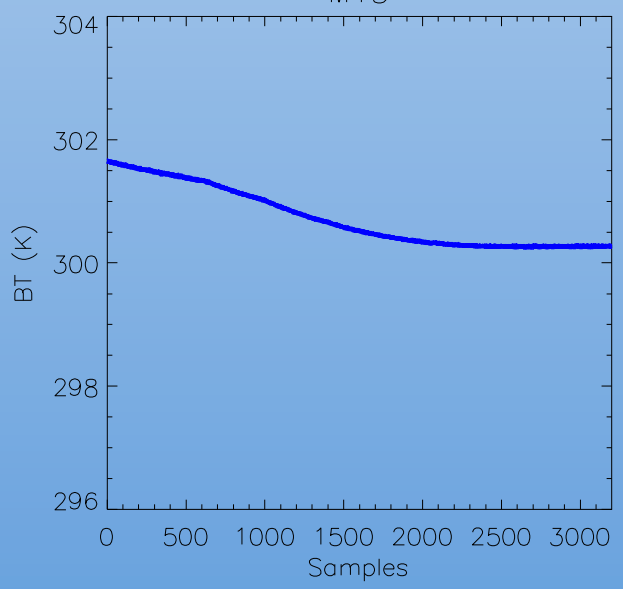
47

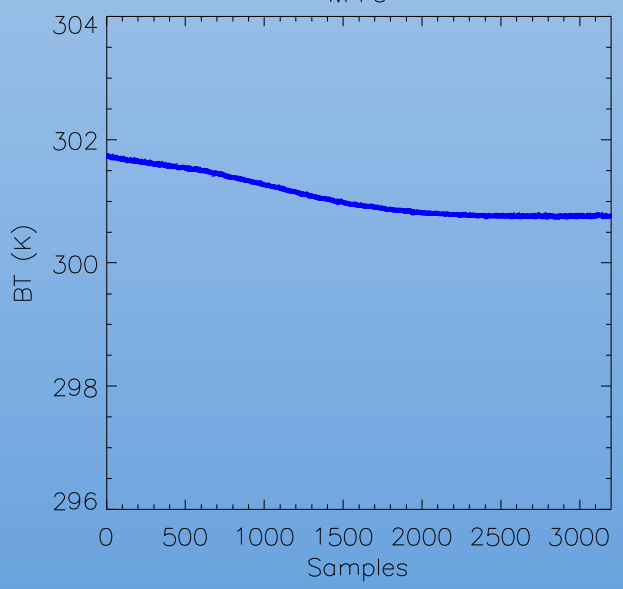
Brightness temperature profiles of pitch maneuver observed deep space for M15, M16 (no TEB RVS correction is applied)





Real deep space signals





Real deep space signals raised to Ltyp