JPSS VIIRS SDR SCIENCE OVERVIEW

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Outline

- The VIIRS SDR team
- Sensor/Algorithm/Product Overview
- Top accomplishments
- JPSS-1 Readiness
- Calibration reanalysis for reprocessing
- Summary and Path Forward

Cal/Val Team Members

PI	Organization	Team Members	Roles and Responsibilities
C. Cao	STAR		Team lead, calibration algorithms, SDR science
W. Wang/S. Blonski	STAR/ERT	J. Choi, Y. Gu, B. Zhang, A. Wald	VIIRS SDR calibration/validation for S-NPP, J1. (Prelaunch studies; software code changes and ADL tests; Postlaunch monitoring and LUT update)
I. Guch	Aerospace	G. Moy, E. Haas, and many others	RSB autocal maintenance
J. Xiong	VCST	J. McIntire, G. Lin, N. Lei,	VIIRS TV data analysis; prelaunch characterization; LUT development, geolocation
X. Shao$_{(PT)}$	UMD/CICS	Y.Bai, S. Uprety, W. Zhuo	DNB operational calibration, geolocation validation, intercomparisons, solar/lunar calibration
C. Moeller	U. Wisconsin	C. Moeller, J. Li	VIIRS RSR, DCC weekly calibration
JPSS	JPSS	R. Marley, C. Rossiter	Collaboration

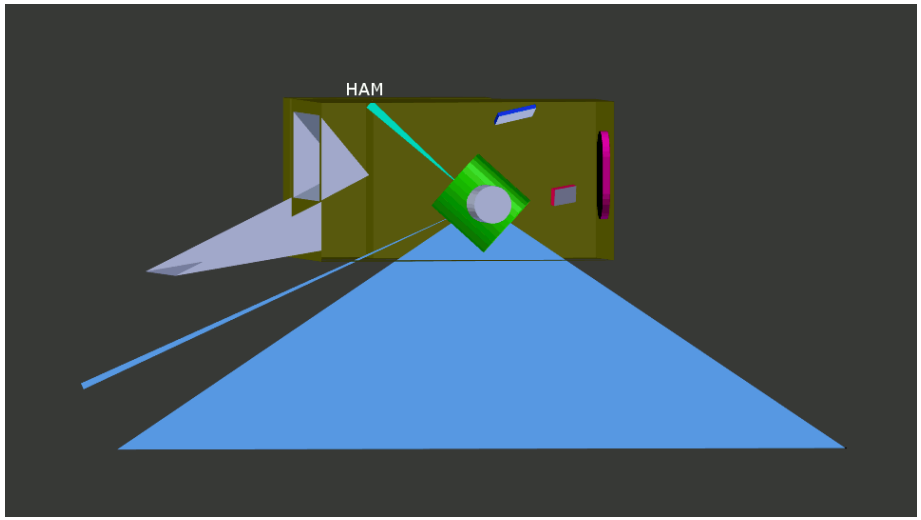
VIIRS Instrument Overview

•VIIRS is a scanning imaging radiometer onboard the Suomi NPP, and JPSS satellites in the afternoon orbits with a nominal altitude of 829km at the equator, with a swath width of ~3000km;

•VIIRS Onboard calibration relies on the solar diffuser (SD), solar diffuser stability monitor (SDSM), space view (SV), and the blackbody (BB);

•Vicarious calibration also used (lunar, dark ocean for DNB, and cal/val sites);

•Calibration is performed per band, per scan, per half angle mirror side (HAM), and per detector.



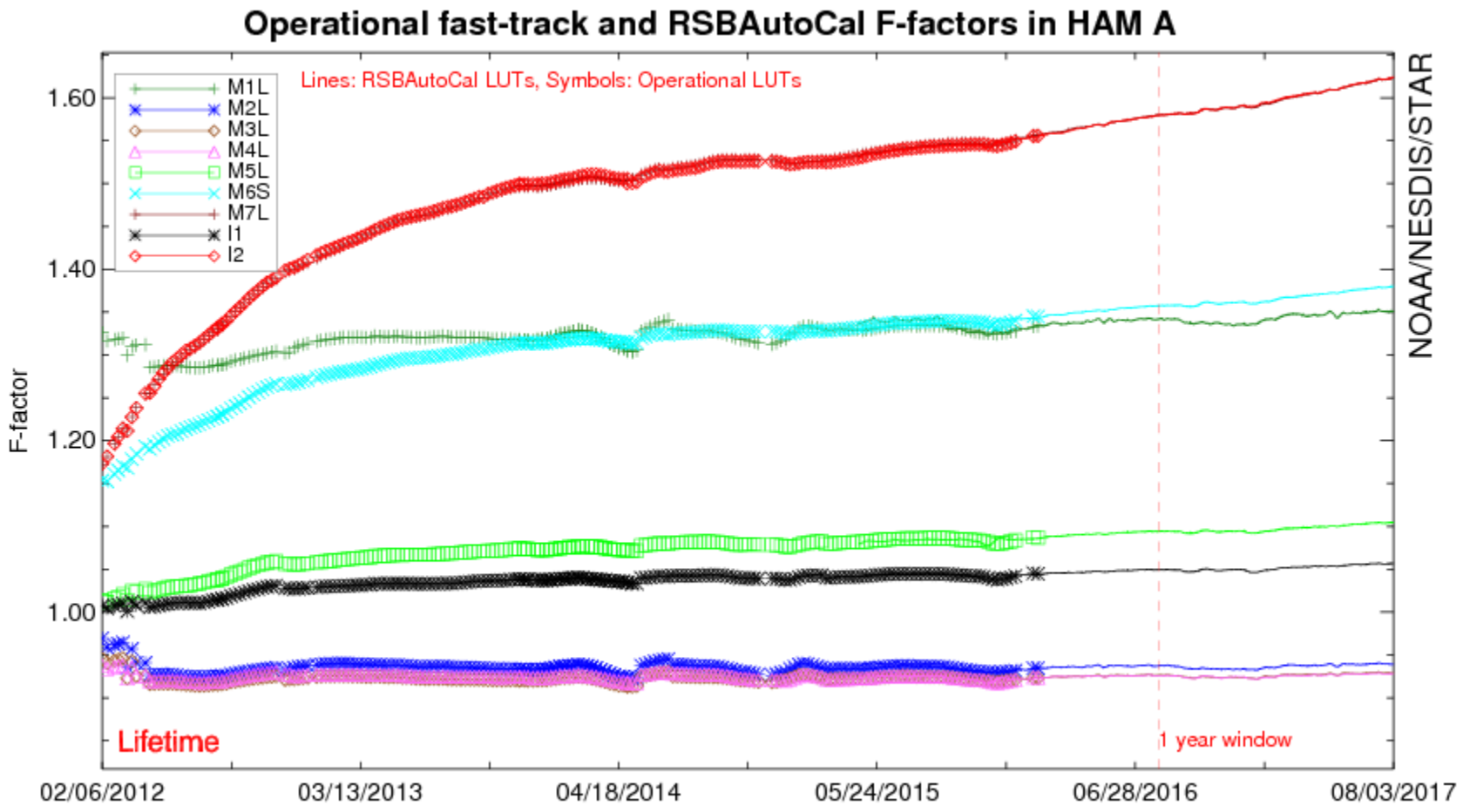
VIIRS has 22 types of SDRs:

- *16 moderate resolution (750m), narrow spectral bands (11 Reflective Solar Bands (RSB); 5 Thermal Emissive Bands (TEB))*
- *5 imaging resolution(375m), narrow spectral bands (3 RSB; 2 TEB)*
- *1 Day/Night Band (DNB) imaging (750m) broadband*

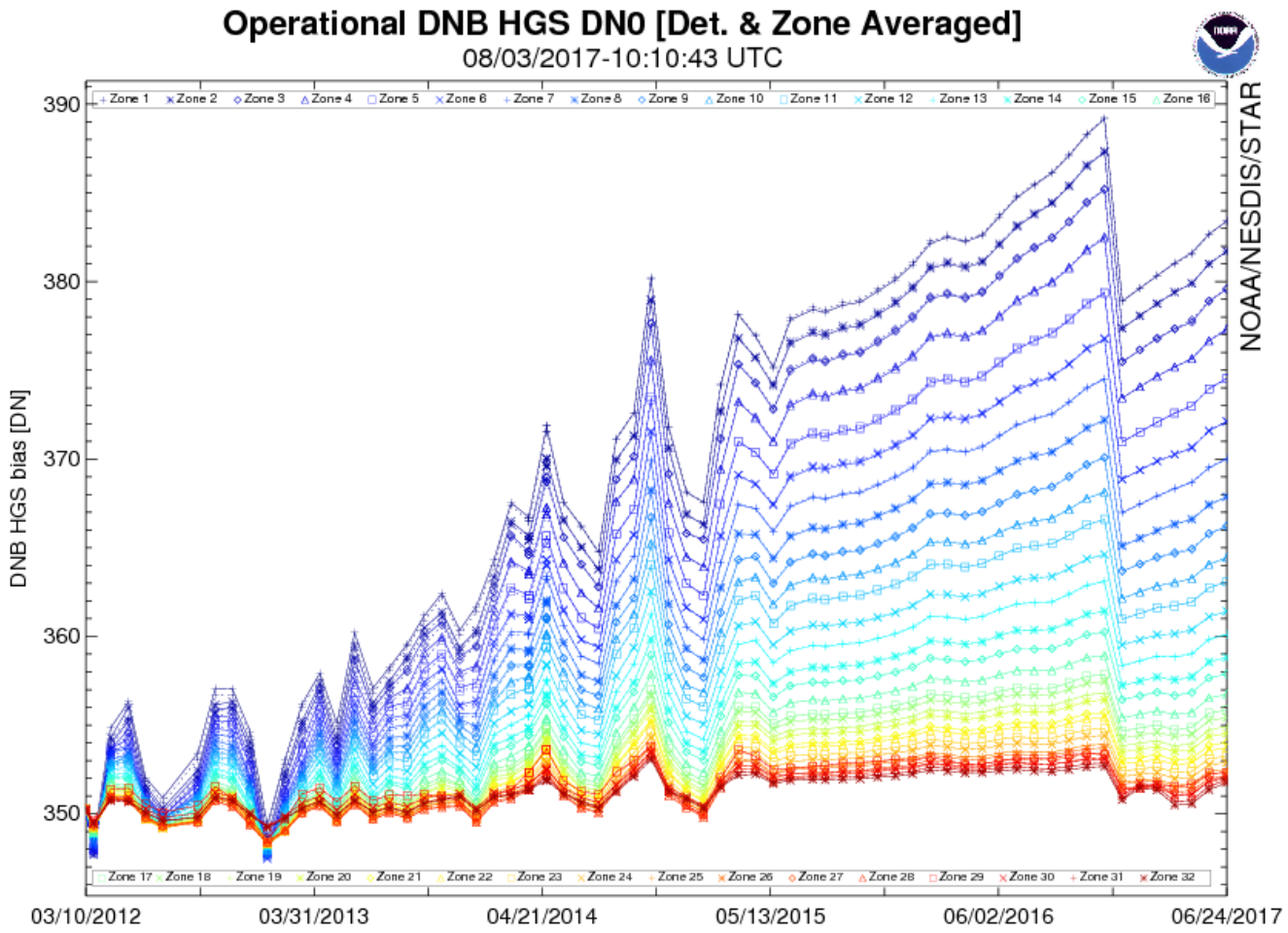
VIIRS SDR Product Requirements from JPSS L1RD

Attribute	Threshold	Objective
Center Wavelength	412 to 12,013 nm	412 to 12,013 nm
Bandpass	15 to 1,900 nm	15 to 1,900 nm
Max. Polarization Sensitivity	2.5 to 3.0 %	2.5 to 3.0 %
Accuracy @ Ltyp	0.4 to 30 %	0.4 to 30 %
SNR @ Ltyp or NEdT @ 270 K	6 to 416 or 0.07 to 2.5 K	6 to 416 or 0.07 to 2.5 K
FOV @ Nadir	0.4 to 0.8 km	0.4 to 0.8 km
FOV @ Edge-of-Scan	0.8 to 1.6 km	0.8 to 1.6 km
Ltyp or Ttyp	0.12 to 155 $W \cdot m^{-2} \cdot sr^{-1} \cdot mm^{-1}$ or 210 to 380 K	0.12 to 155 $W \cdot m^{-2} \cdot sr^{-1} \cdot mm^{-1}$ or 210 to 380 K
Dynamic Range	0.12 to 702 $W \cdot m^{-2} \cdot sr^{-1} \cdot mm^{-1}$ or 190 to 634 K	0.12 to 702 $W \cdot m^{-2} \cdot sr^{-1} \cdot mm^{-1}$ or 190 to 634 K

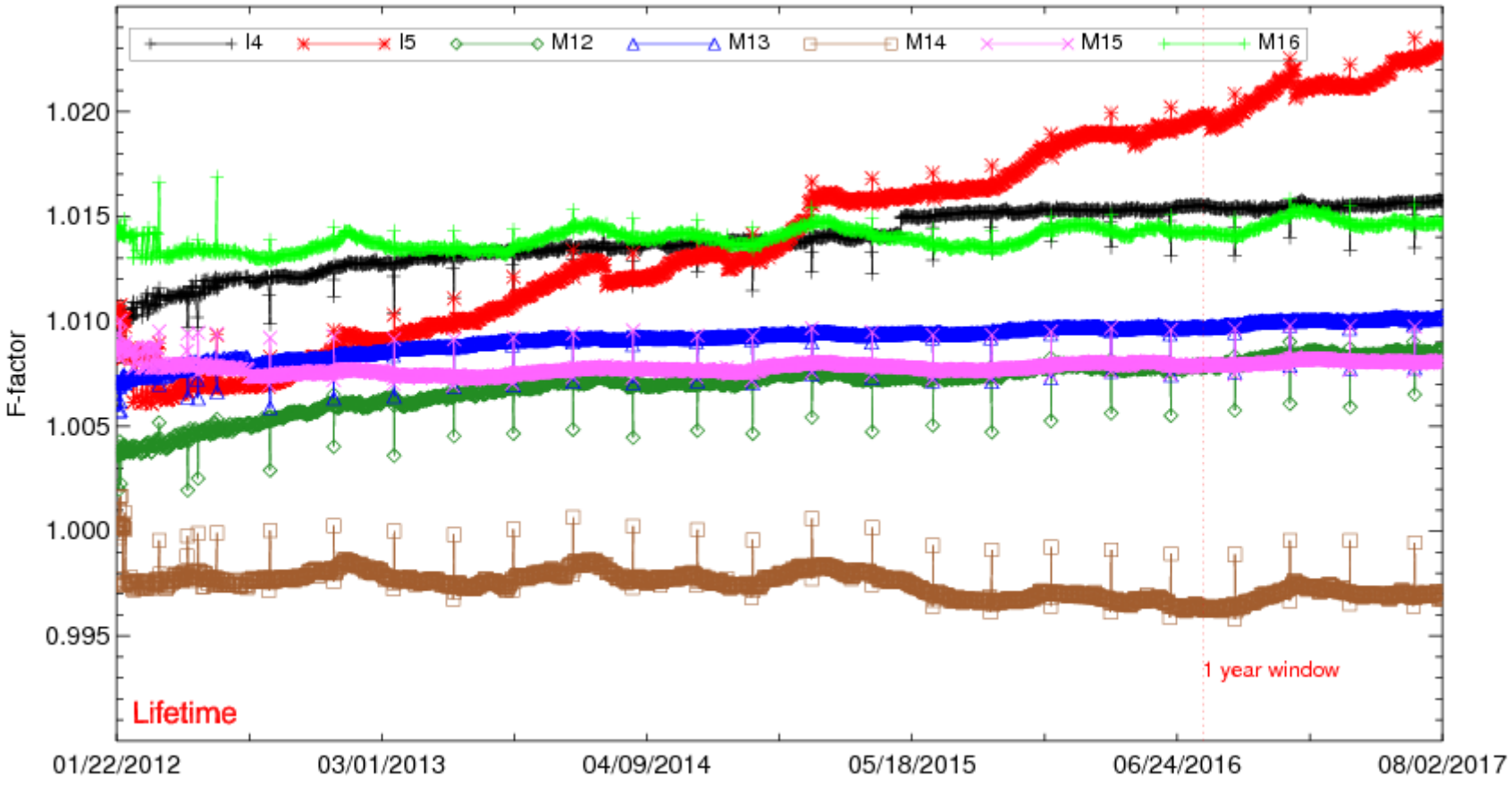
VIIRS RSB Longterm Trend



VIIRS DNB Offset Changes by Aggregation Zone

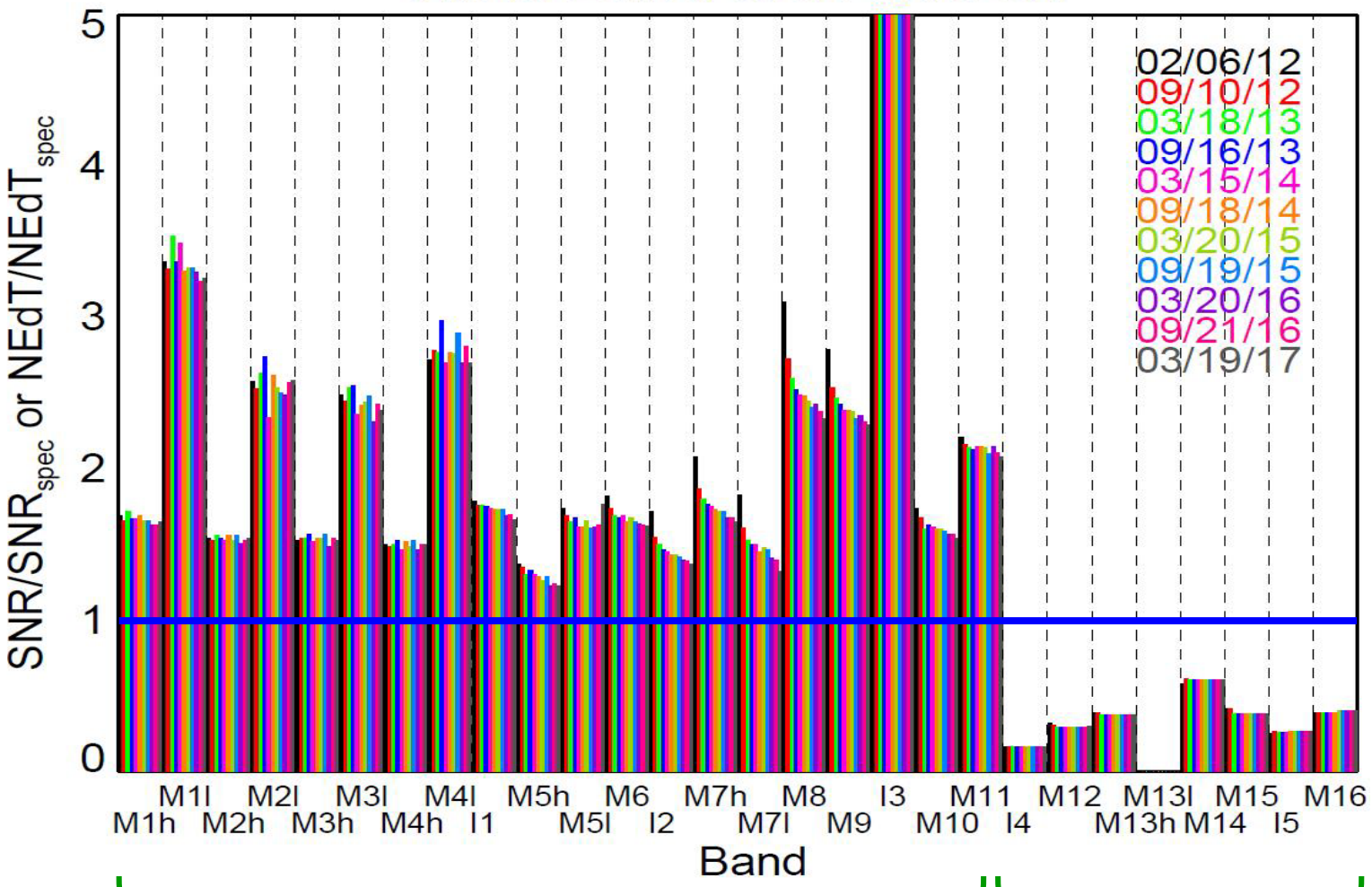


VIIRS TEB Responsivity Longterm Monitoring



VIIRS Noise Performance

$(SNR/SNR_{SPEC} > 1)$ or $(NEdT/NEdT_{SPEC} < 1)$: better performance



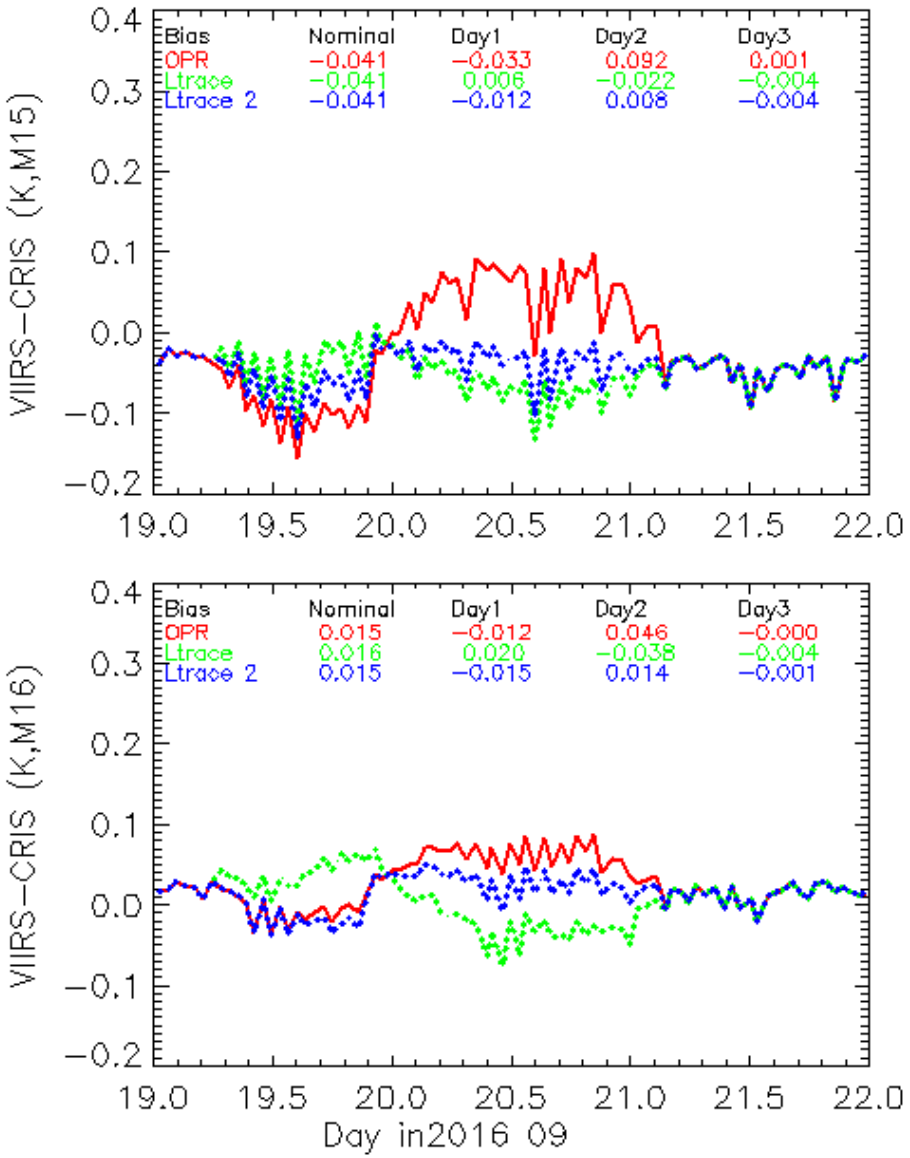
Courtesy of J. Xiong

VIIRS SDR Team Accomplishments (FY17)

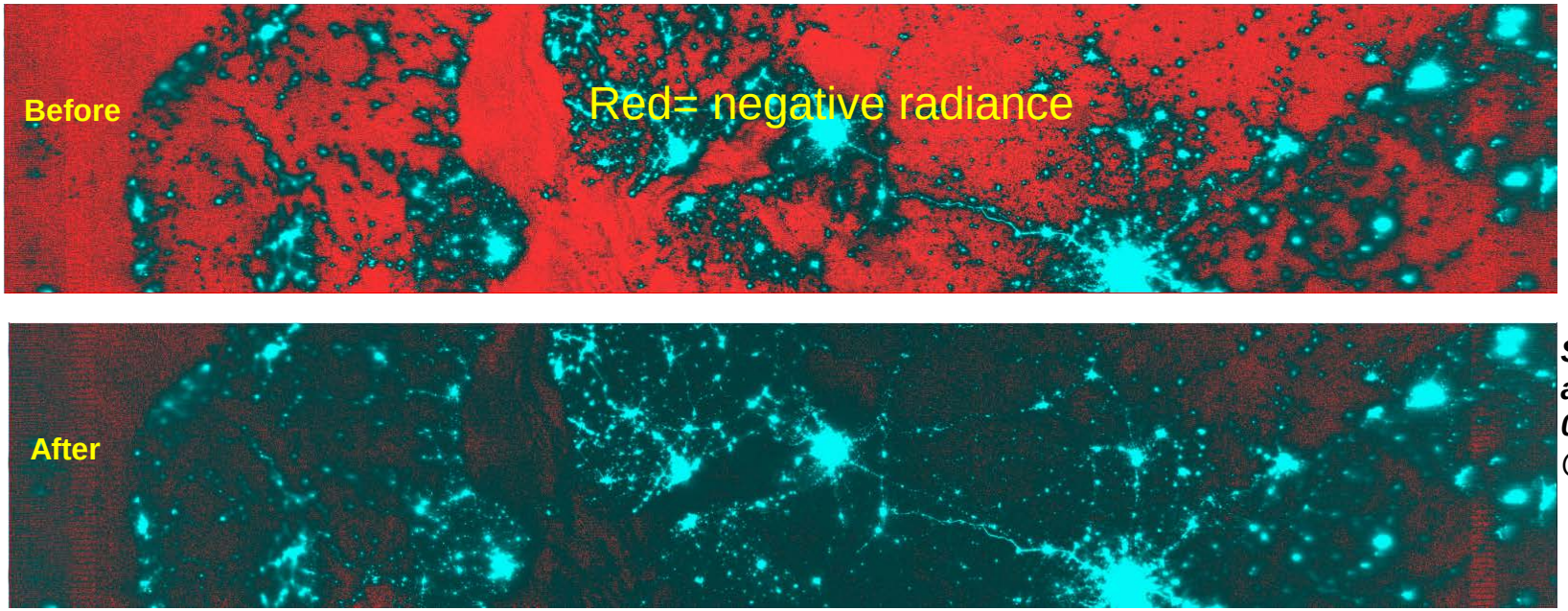
- VIIRS TEB band blackbody Warm/up Cool/down correction algorithm, implementation, validation which mitigates SST biases in time series;
- VIIRS DNB methodology change in offset determination which led to significant reduction in negative radiances;
- VIIRS RSB study of residual biases:
  - Collaboration with OC, VCST, and Aerospace teams;
  - Developed mitigation strategy using radiometric bias correction;
  - Developing Kalman Filter for real time forward predictive calibration;
  - Resolving M5/M7 biases through validation using multiple datasets;
- Developed super computing capabilities for VIIRS reprocessing;
- Reprocessed VIIRS SDR using the latest algorithms/LUTs from 2012 to fall 2016, significantly ahead of schedule;
- Well prepared for JPSS 1 VIIRS postlaunch cal/val;

WUCD Correction and Comparison with CrIS

- WUCD correction algorithm developed (Ltrace)
- Correction implemented in reprocessing, and results validated with CrIS:
  - Before: warm bias during blackbody cooldown;
  - After: bias removed during blackbody cool-down which becomes consistent with normal operations.
- Methodology published in peer reviewed journal (Cao et al., 2017, JGR);
- Ltrace v2 algorithm further improves performance for all TEB bands.



VIIRS/DNB 70% Reduction in Negative Radiance



Sample Data acquired: 01/03/2017 @00:31 UTC

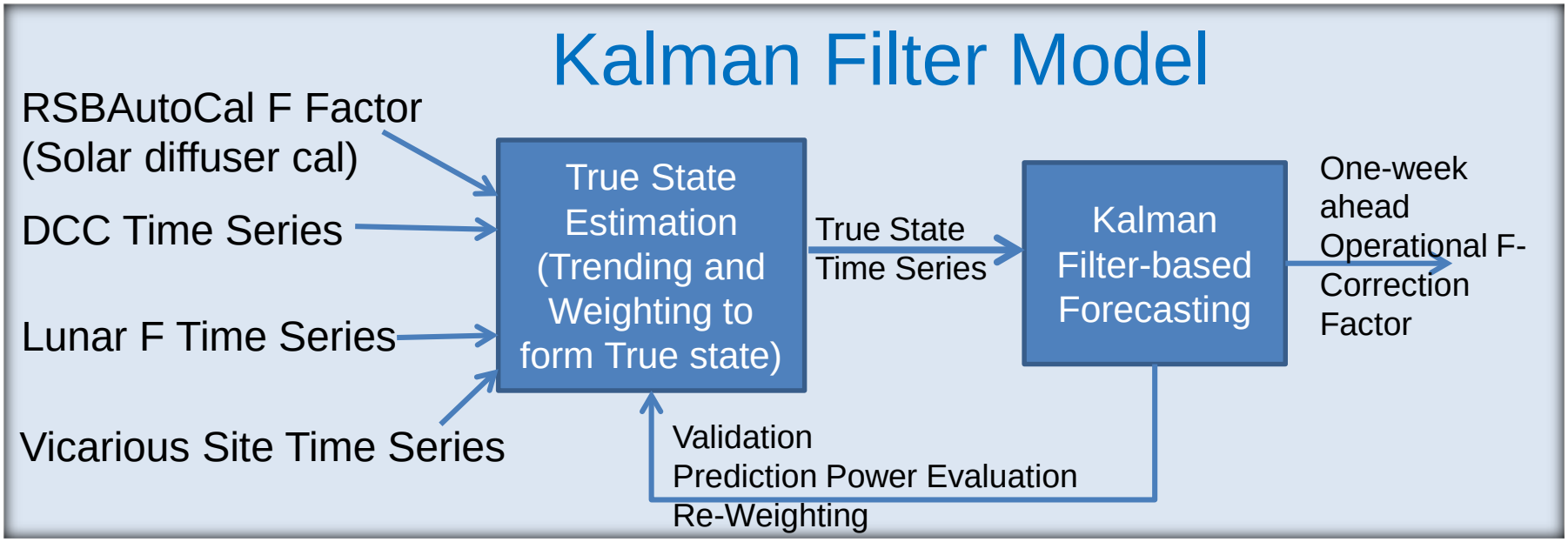
A success story:

- STAR VIIRS SDR team deep dive studies in collaboration with NASA/VCST;
- New calibration method reduced negative radiance by 70%;
- Advancing calibration science as well as supporting air glow science;
- Remarkable instrument low noise floor, thanks again to the vendor.

Notes to users

- *Improved operational VIIRS SDR data since Jan. 12, 2017*
- *Reprocessing using new method is near completion*

Going Forward: Improving Stability for Real Time RSB Processing



- Multiple inputs characterizing instrument response changes (subject to measurement uncertainty and noise)
- Different Time Resolution (some at irregular interval)
- Key steps:
  - Kalman Smoother for trending
  - True State estimation and Weighting Determination
  - Maximum likelihood state parameter estimation for Kalman Filter
  - Correction factor Prediction (Kalman filter prediction)

VIIRS will see you near Nashville for the unforgettable Solar Eclipse next week !