# NOAA-20 OMPS Beta Maturity Status Report

**January 26, 2018**

**OMPS SDR Team**

# Topics and Scopes

- Instrument performance
  - CCD performance
  - Spectral performance
- Current Status of N20 OMPS SDR
  - Calibration of SDRs
  - Issues and solutions
- Way forward towards the Provisional Level
- Summary

# NOAA-20 OMPS Instrument Status

- ✓ At the current stage, the NOAA-20 OMPS on-orbit performances are doing well. Main performance parameters were compared for before and after launch, as well as between SNPP and N-20. The results are consistent and are expected.
- ✓ CCD performance, in terms of electronic bias, readout noise, LED signal drifting, nonlinearity and change in dark currents are all normal.
- ✓ System nonlinearity is very stable before and after launch. The results are also comparable to the SNPP's number.
- ✓ Solar measurements were successful, meet signal to noise requirement, and have better performance than the S-NPP solar measurements.
- ✓ Pre-launch found degradation in NP short wavelengths, but on-orbit data analysis shows no evidence of any degradations in either NP and NM.
- ✓ Change of wavelength registration is slightly larger than what was seen in S-NPP, but about the same level, and is expected.
- ✓ New foreign object debris (FOD) was found at approximately [520,85] in reduced CCD frame coordinates, at ~315 nm channel and affects 312.5 nm and/or 317.5 nm. Impact of the FOD on the nonlinearity data analysis is eliminated by using a mask. Impacts on other images seems small. But more study is needed before a conclusion is reached.

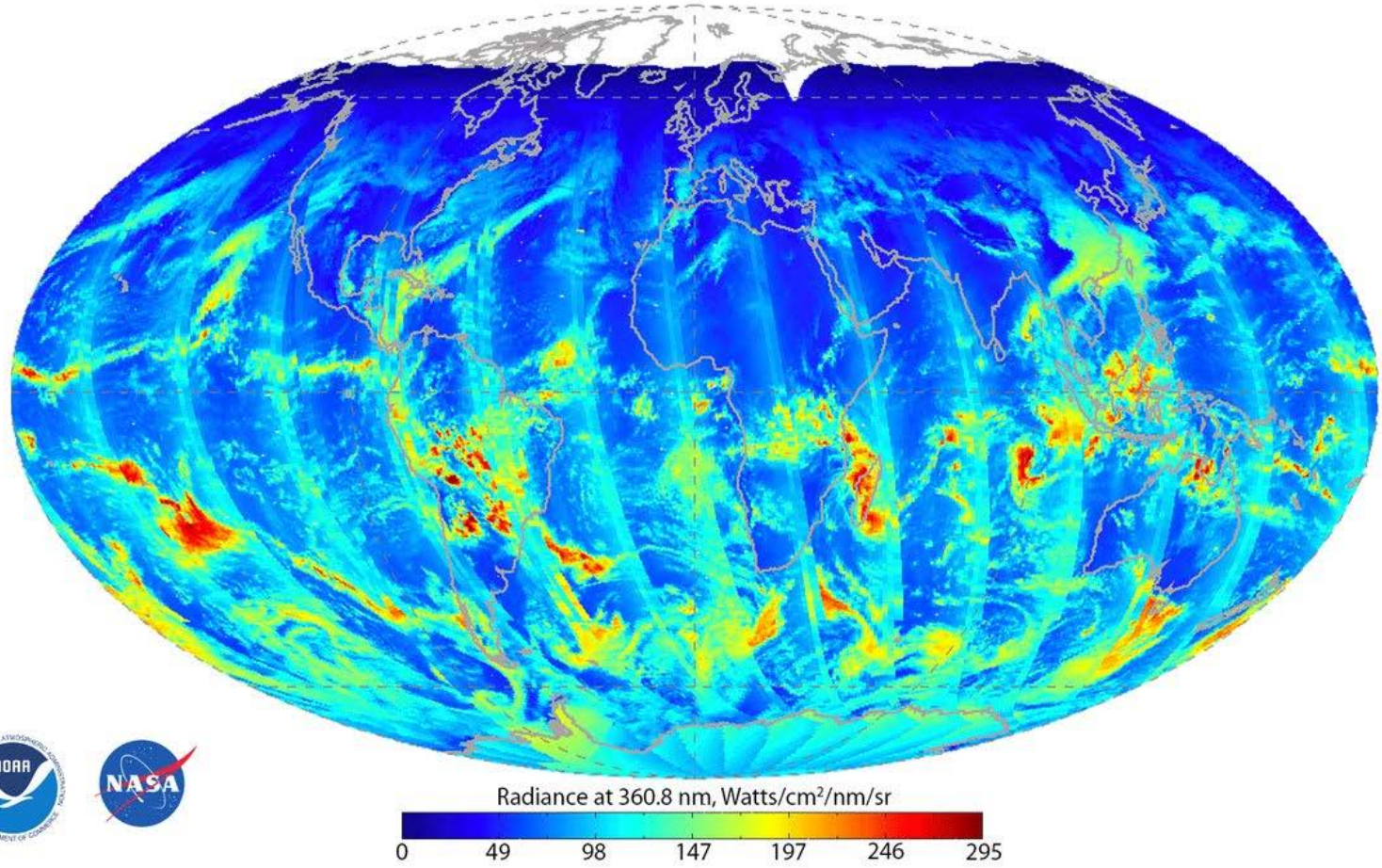
# NOAA-20 OMPS SDR Status

- ✓ NM SDRs have been collecting high/medium/low resolution data. IDPS system is able to process all types of data into low resolution SDRs, from which, the EDRs are successfully retrieved.
- ✓ NP and NM first light images were generated in-house ADL as well as from IDPS.
- ✓ Initial calibration is applied – weekly dark routine calibration, non-linearity calibration and stray light calibration. The weekly dark calibration activity is ahead of schedule many days.
- ✓ SDRs are available for users familiar with the data.
- ✓ Intensive calibration is underway: dark, nonlinearity, wavelength, stray light, day-one solar flux, geo-location.
- ✓ Issues and anomalies have been identified and are scheduled to be fixed: Foreign Object Debris, Field Angle Map, Spectral wavelength shifting, nominal sample table, mounting matrix.

# NOAA-20 OMPS Major Activity Time Line

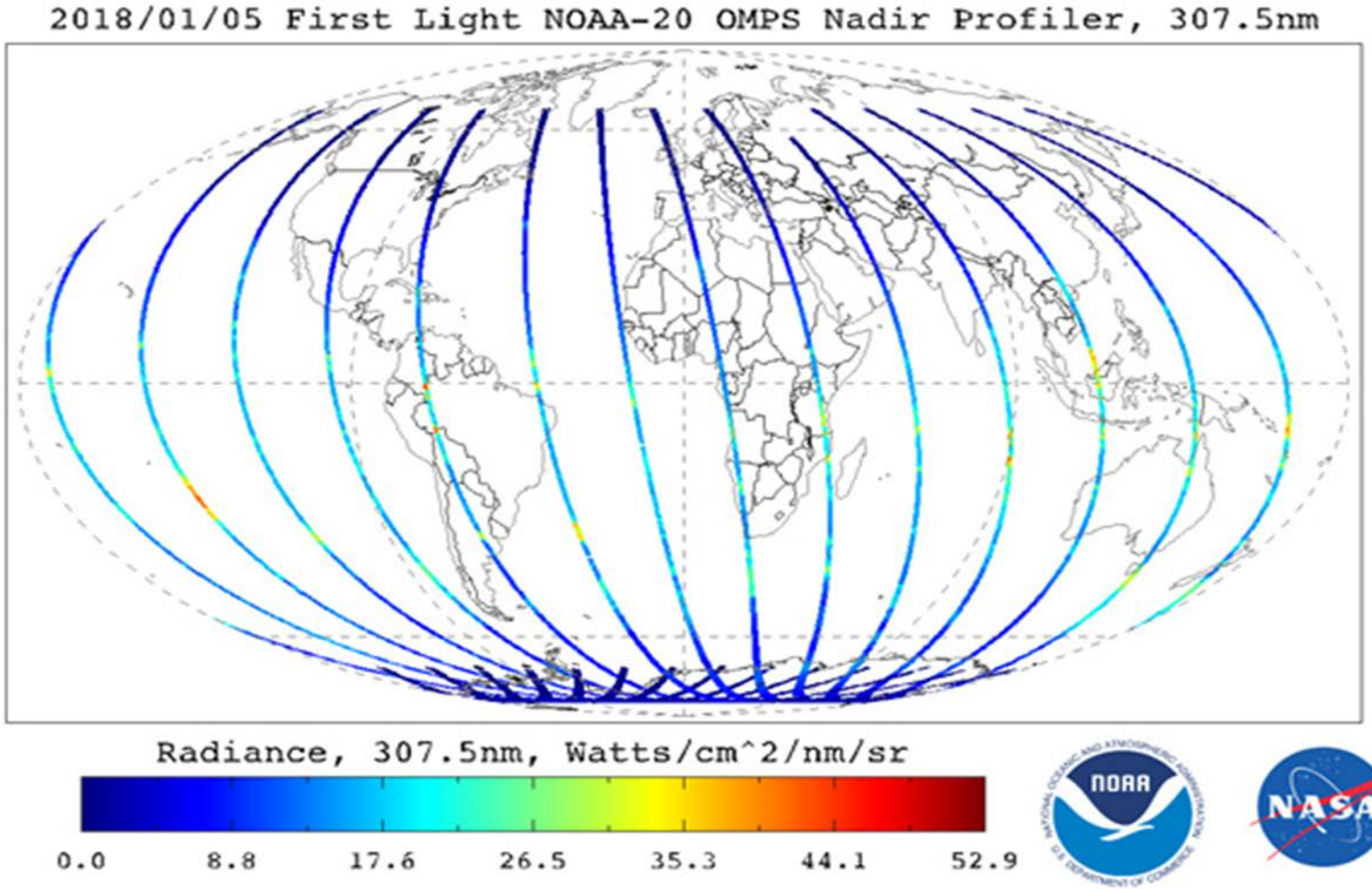
- The NOAA-20 OMPS instruments were activated on orbit #145, 11/28/2017, followed by a successful Aliveness Test on orbit #145 and #146.
- The Functional Test on orbit #162 and #163 on Nov. 29 was successful.
- OMPS outgassing ended on January 8th and the telescope aperture door opened the same day, started taking high resolution Earth view data.
- Medium resolution data starts 01/16 -01/17, 2018.
- Low resolution (nominal) data starts on 1/18/2018.

# NOAA-20 NM First Global Coverage Image




The NOAA-20 OMPS Nadir Mapper acquired its first data on January 5, 2018. This first-light image shows the radiance values for the cloud reflectivity channel. The highest radiances are associated with bright cloud tops. The cloud reflectivity channel is one of the five primary channels used to estimate total ozone concentration.

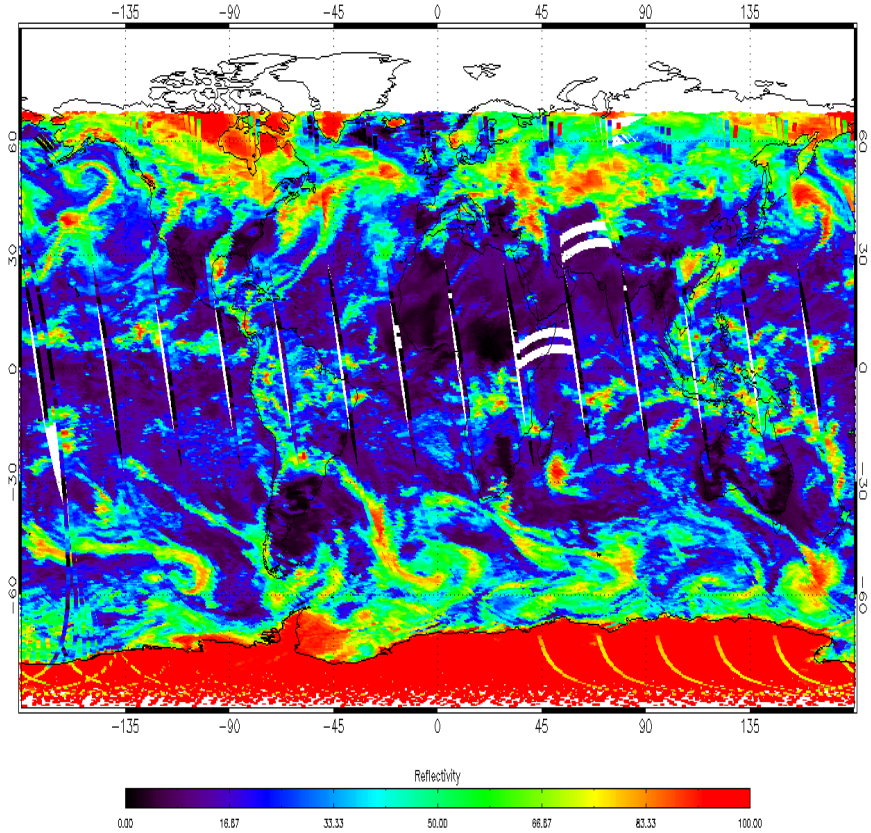
# NOAA-20 NP First Global Coverage Image



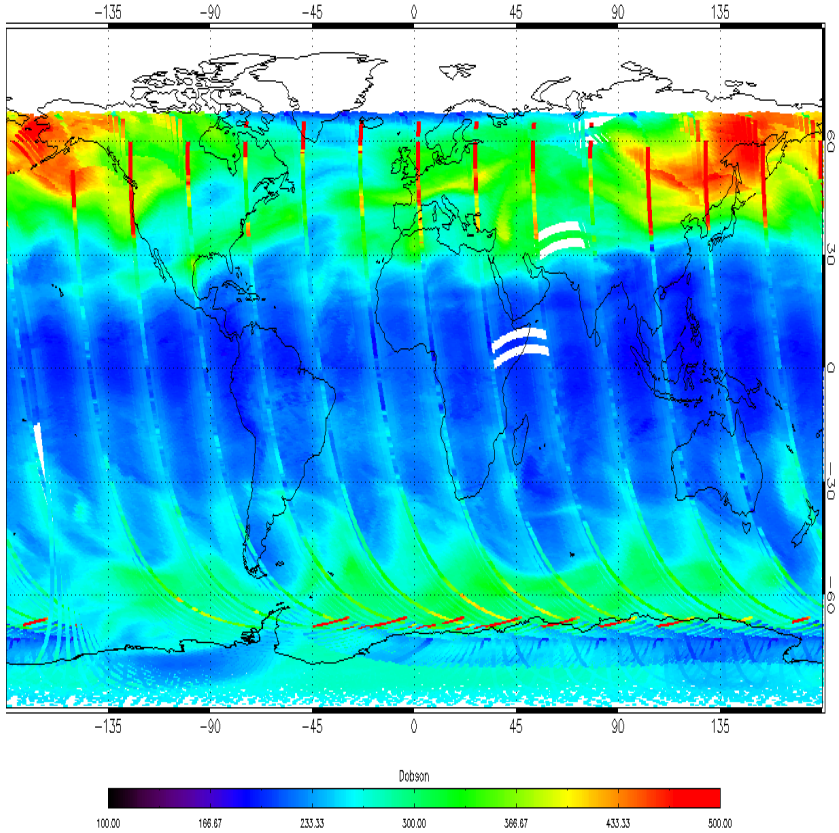

The NOAA-20 OMPS Nadir Profiler acquired its first data on January 5, 2018. This first-light image shows the radiance at 307.5nm, which is one of the 12 primary channels used to estimate the ozone at various levels in the atmosphere.

# NOAA-20 NM Retrieval Products

Reflectivity 20180119

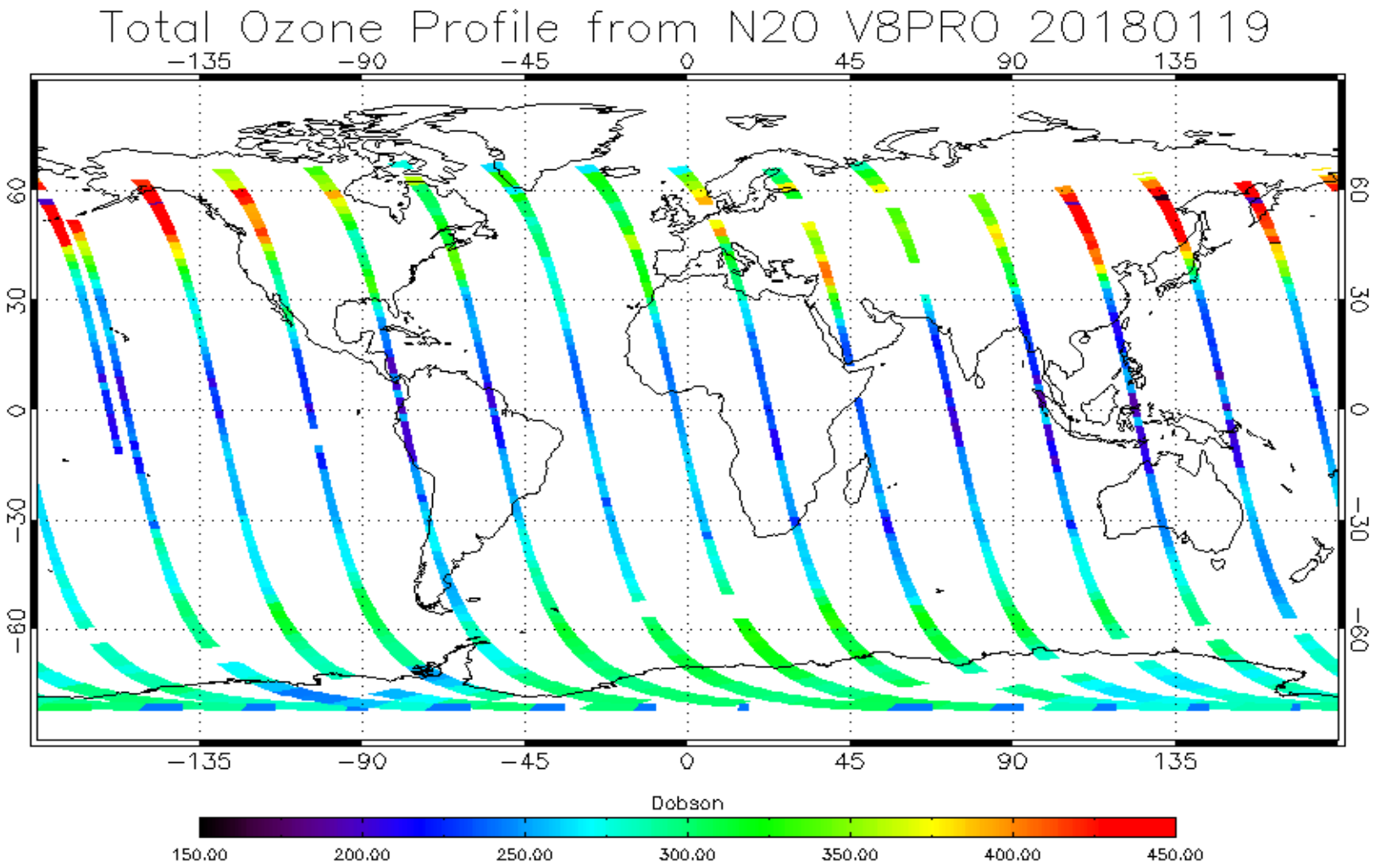



Total Column Ozone 20180119




Credit: STAR EDR Team

# NOAA-20 NP Retrieval Products

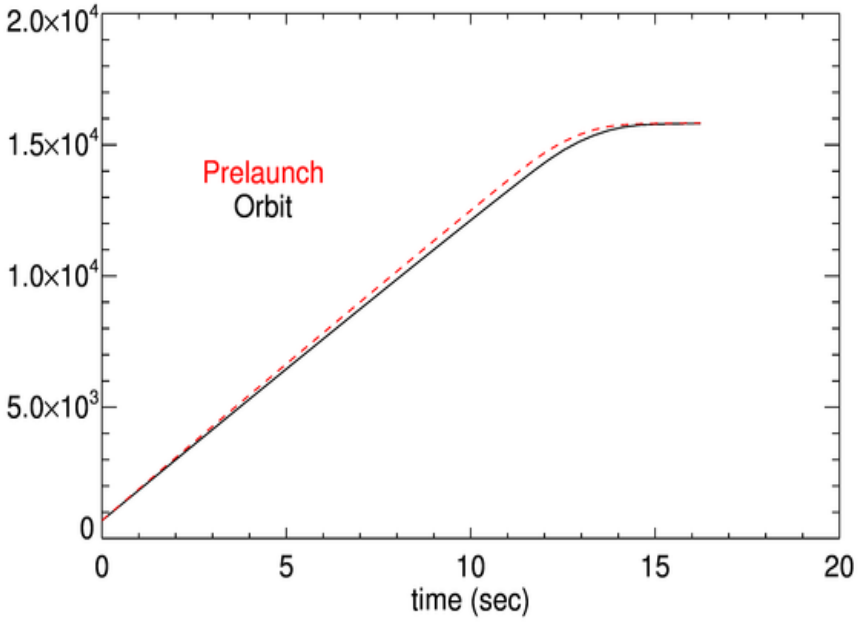



Credit: STAR EDR Team

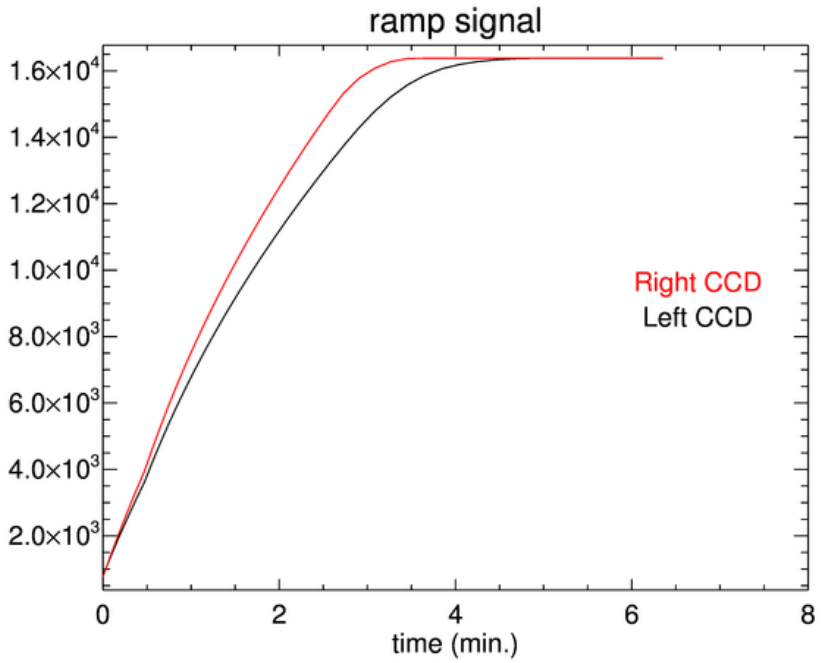
# NOAA-20 OMPS Signal Dynamic Range

Count level vs. Integration time

NP



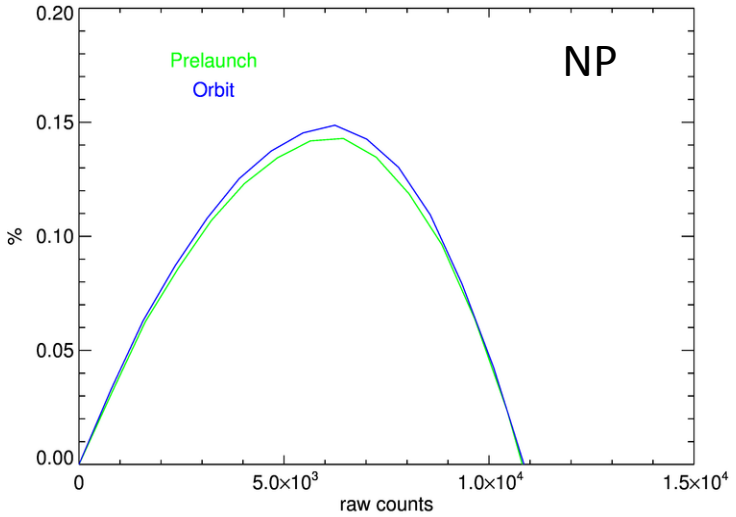

NM

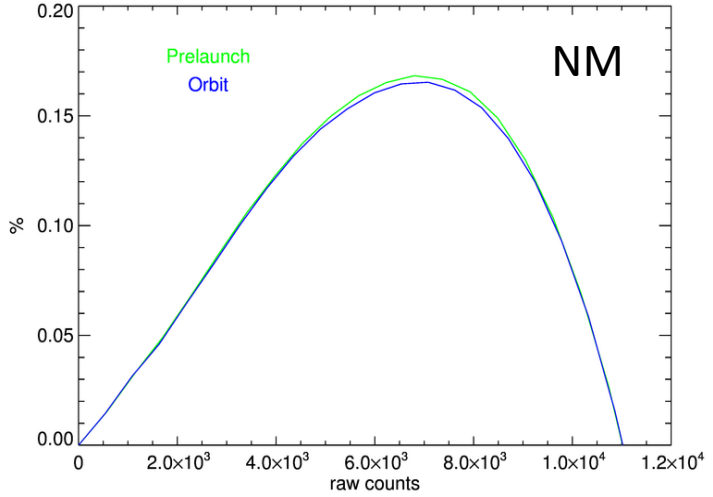



Raw counts dynamic range meets design criteria:
Saturation happens after 12000

# OMPS Nonlinearity Calibration

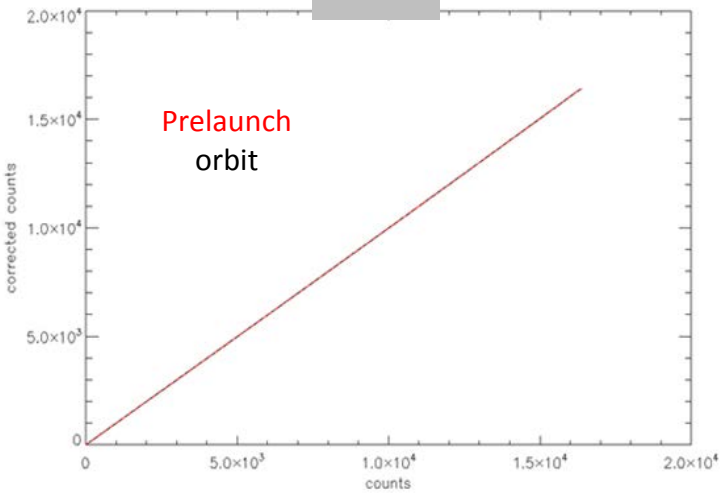
## Nonlinearity




- Example from NP and NM Left CCD
- NOAA-20 OMPS system linearity is nearly identical before and after launch, all meets the 2% requirement.
- The maximum difference of LUTs is at the lowest signal level, 0.08% for NP; and 0.1% for NM two halves CCD.
- SNPP nonlinearity is 0.3% for NP and 0.4% for NM (pixel data and algorithm are different than what were used in J1).

## LUTs

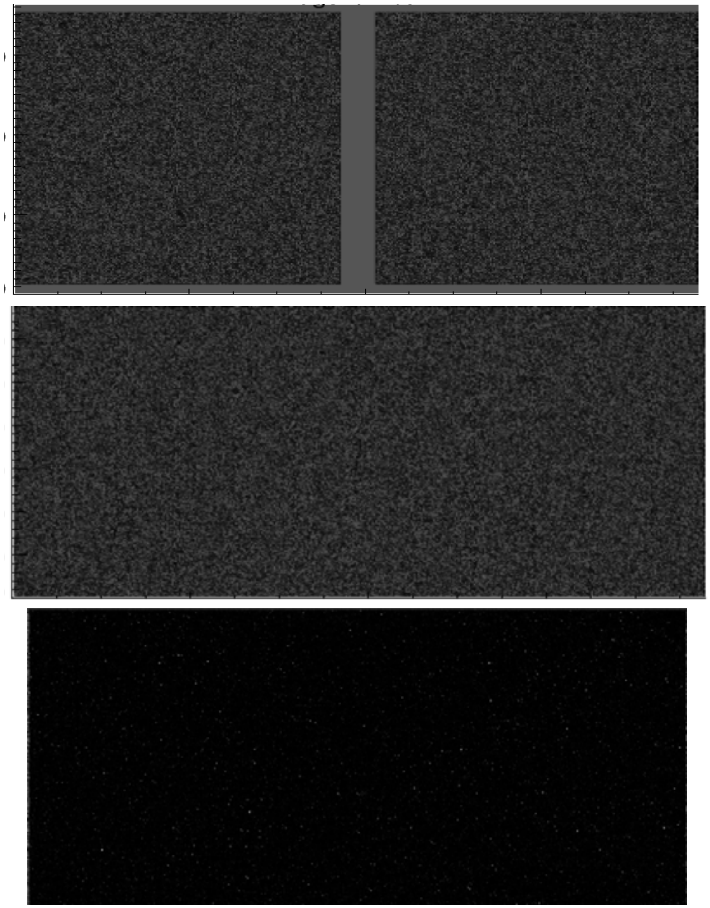


# OMPS Dark Calibration

- Example from NM

  Rates calculated from mean of only non-transient pixel values in sequence.

  Storage region rates are measured with a similar but shorter sequence.



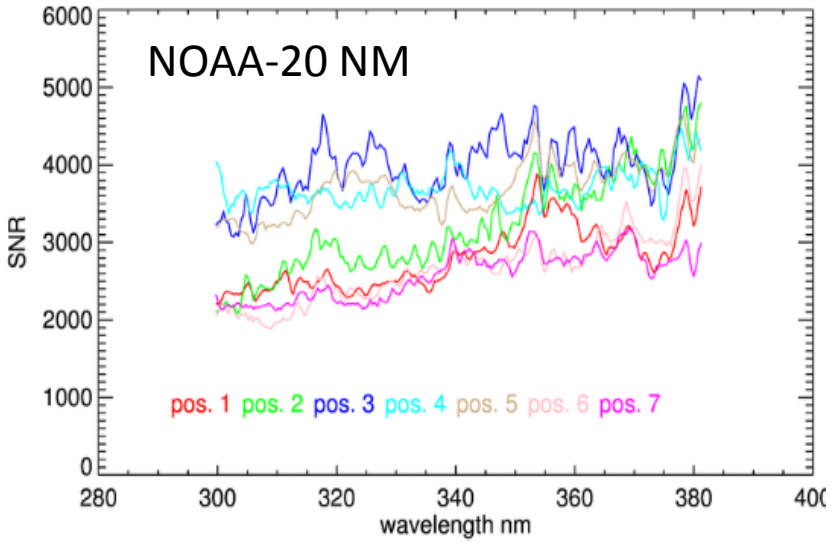
**Dark current correction:**

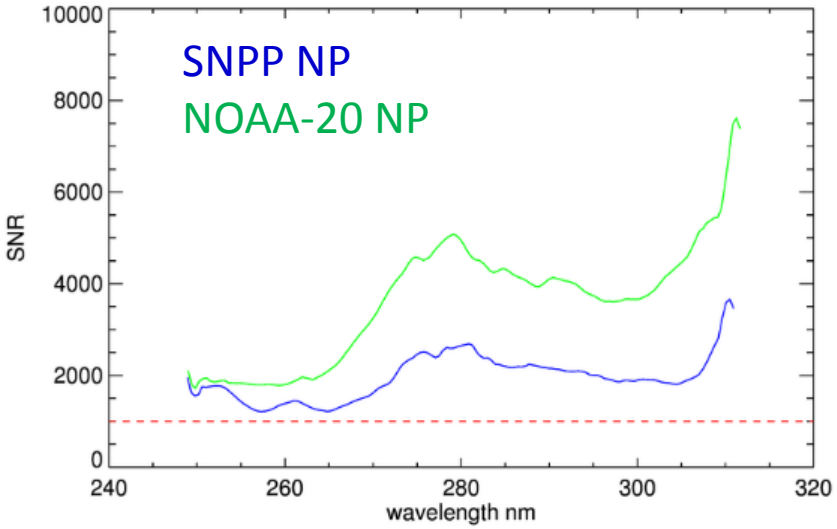
$$im(i,j) = im_i(i,j) * t_i - im_s(i,j)$$

Rates x integration time - dark current accumulated in storage region during CCD readout.

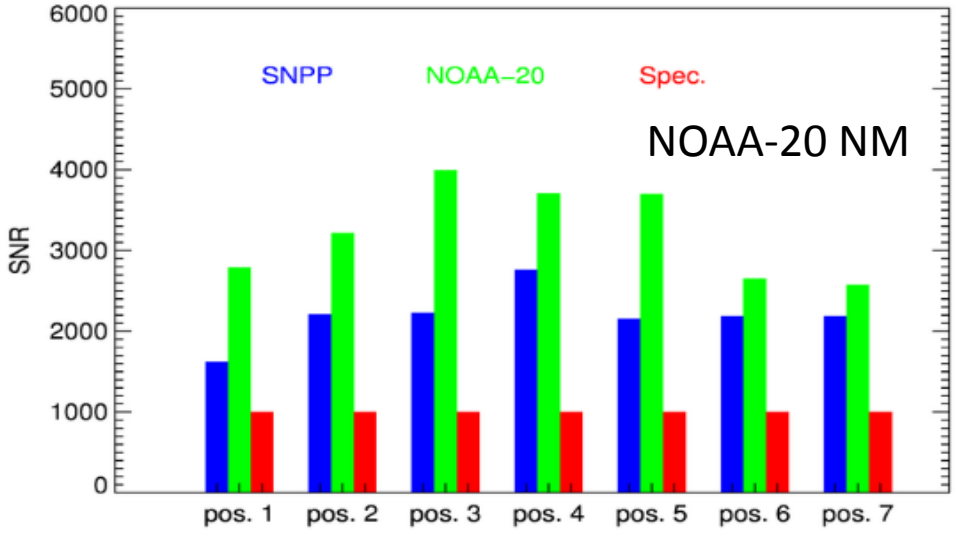
NOAA-20 OMPS weekly dark current calibration starts on 01/8/2018.
LUTs are generated by NASA SOC team.

# Solar View Noise Meets Requirement



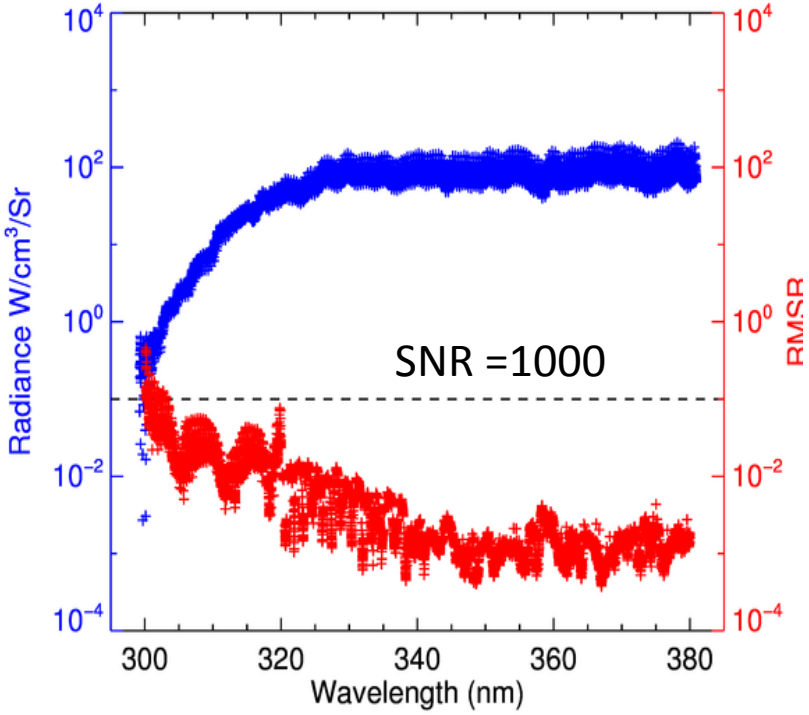




- Sensor SNR comparison with SNPP and Spec.
- Spec. SNR = 1000
- NOAA-20 shows a better performance

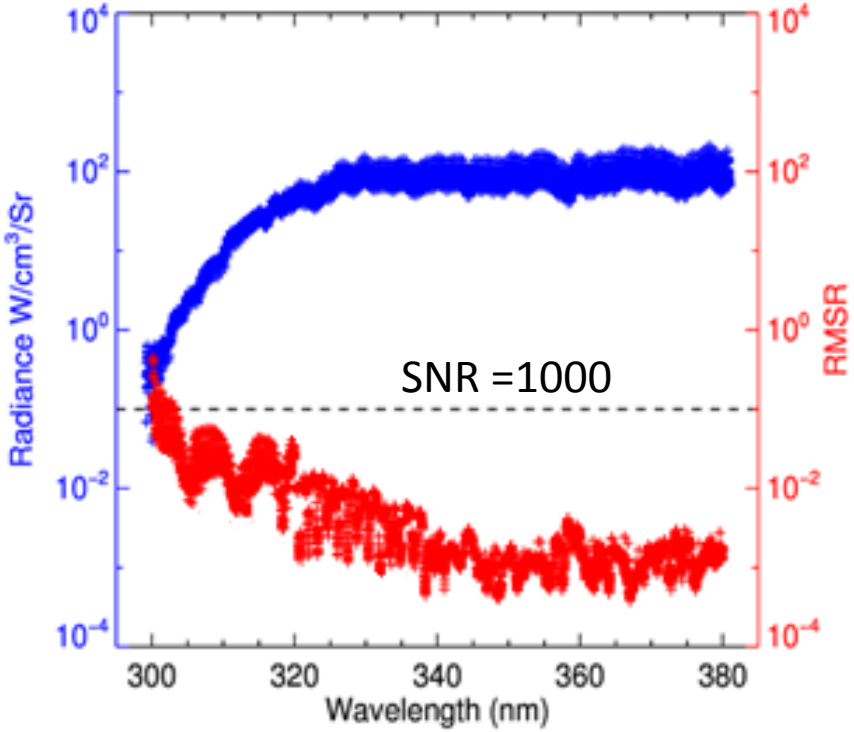


# Earth View Noise Meets Requirement

N20 Aggregated medium resolution data

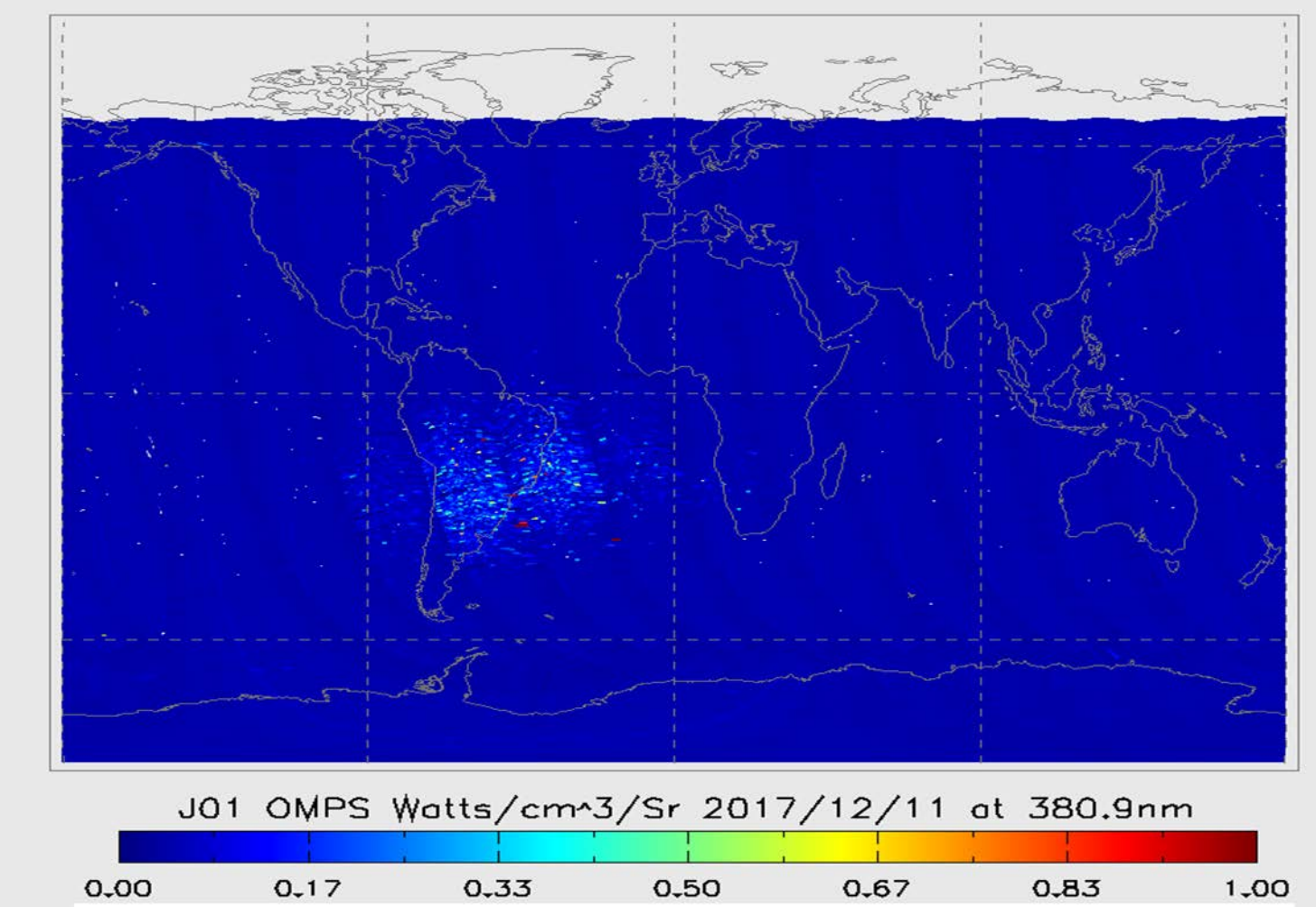



SNPP Low resolution data



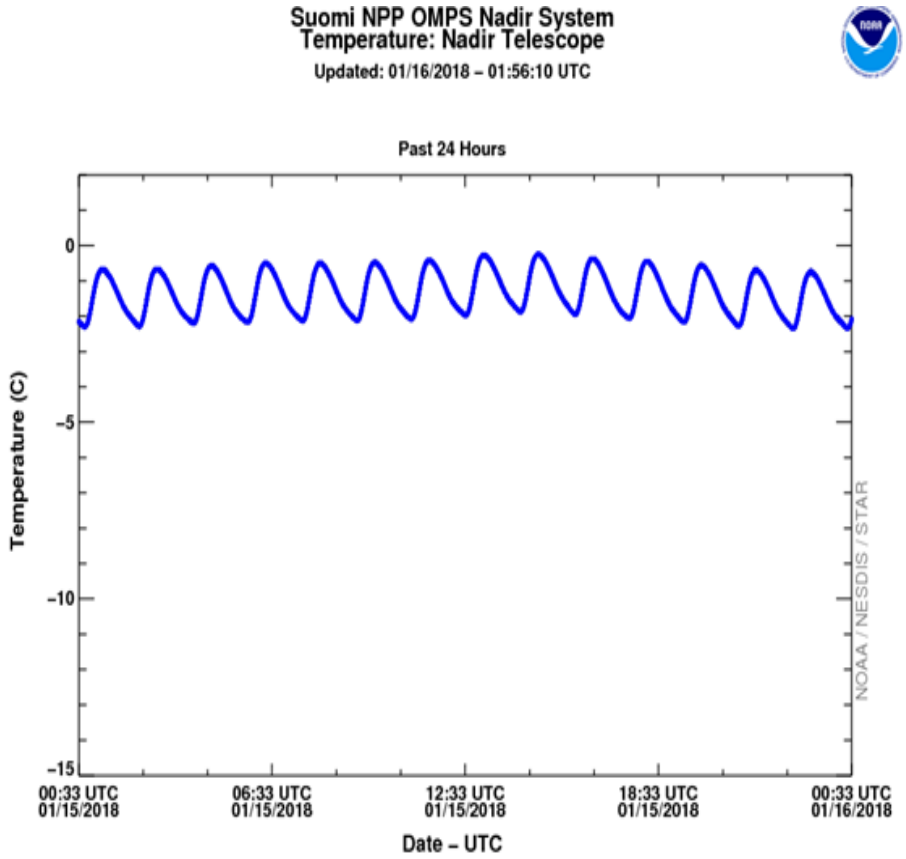

- Example from SNPP NM and NOAA-20 NM .
- The root-mean-square residual (%) from an empirical orthogonal function analysis where the six largest patterns were removed.

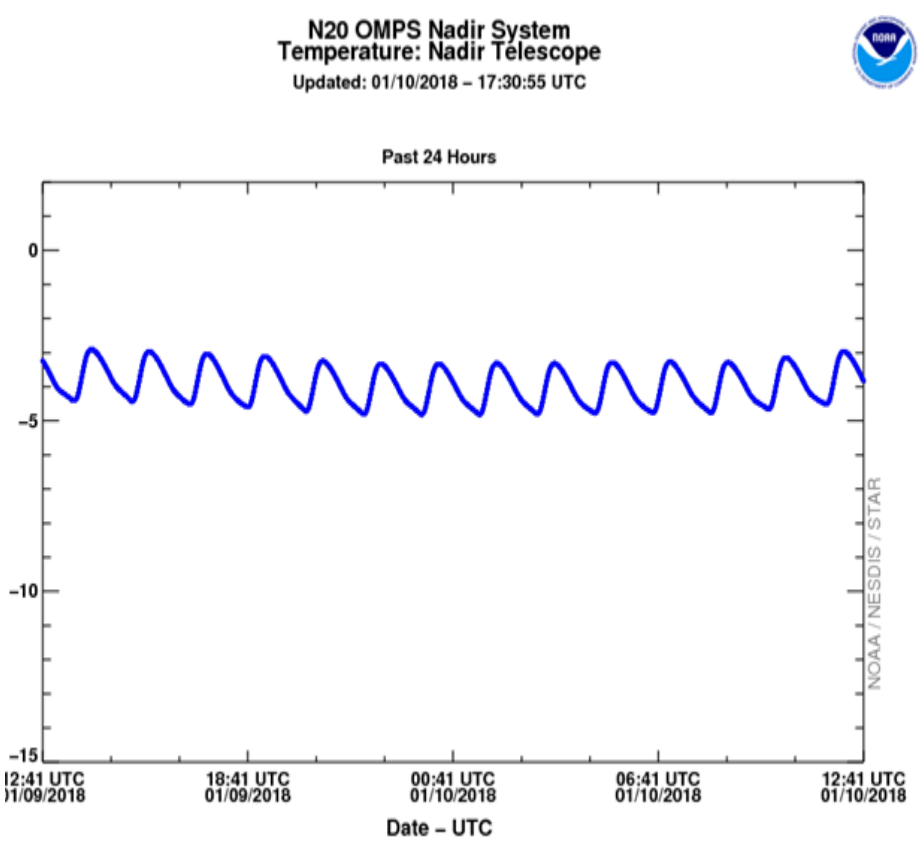
# SAA Impact on NM CCD Response




Similar impact of South Atlantic Anomaly (SAA) region has been observed in S-NPP OMPS.

# Example: Telescope Temperature



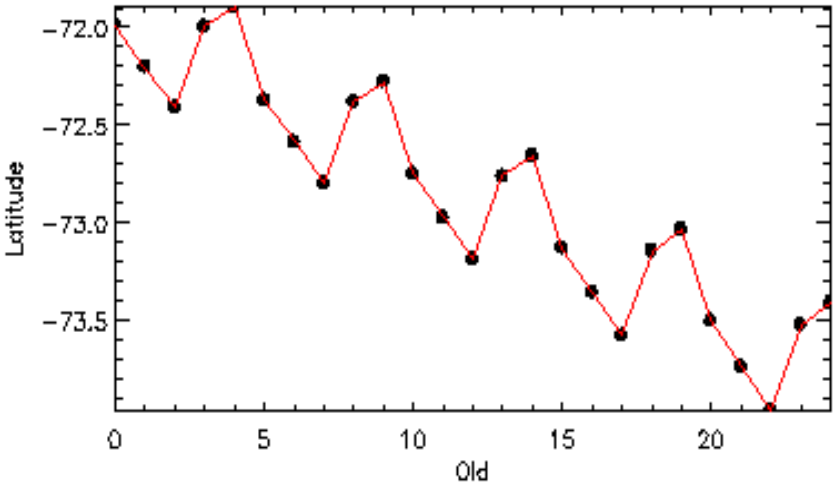

NOAA-20 housing temperature and telescope temperature are found lower than SNPP's value by ~3 deg. for the telescope temperature and 1.5 deg. For the TC housing.

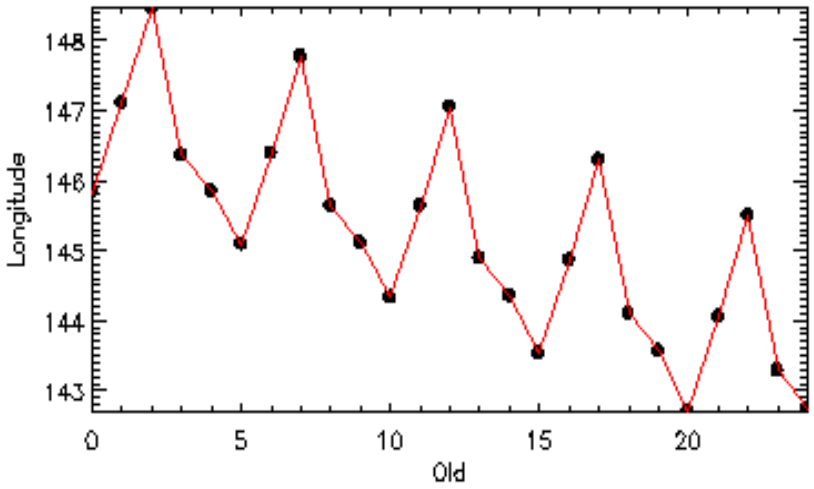
Credit: STAR ICVS

# FAM LUT Correction

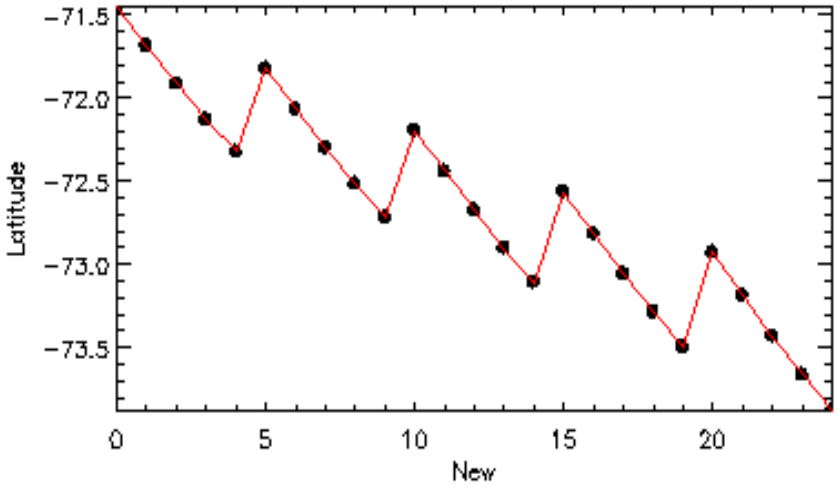
Example from NP

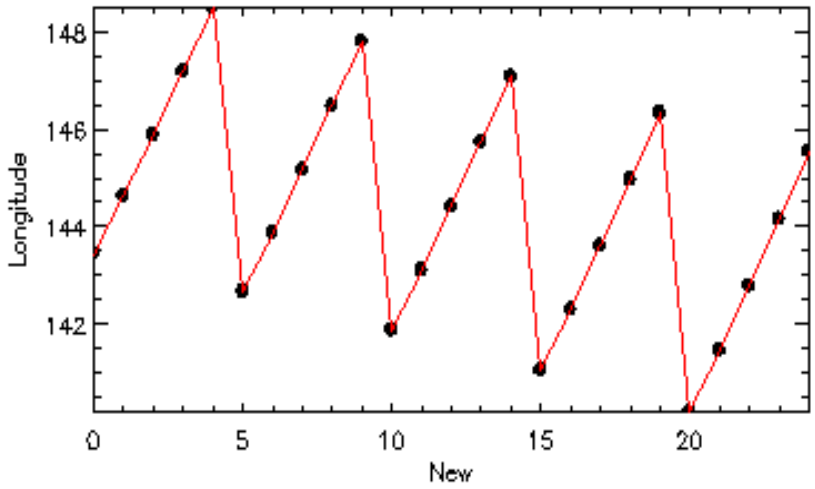
Before



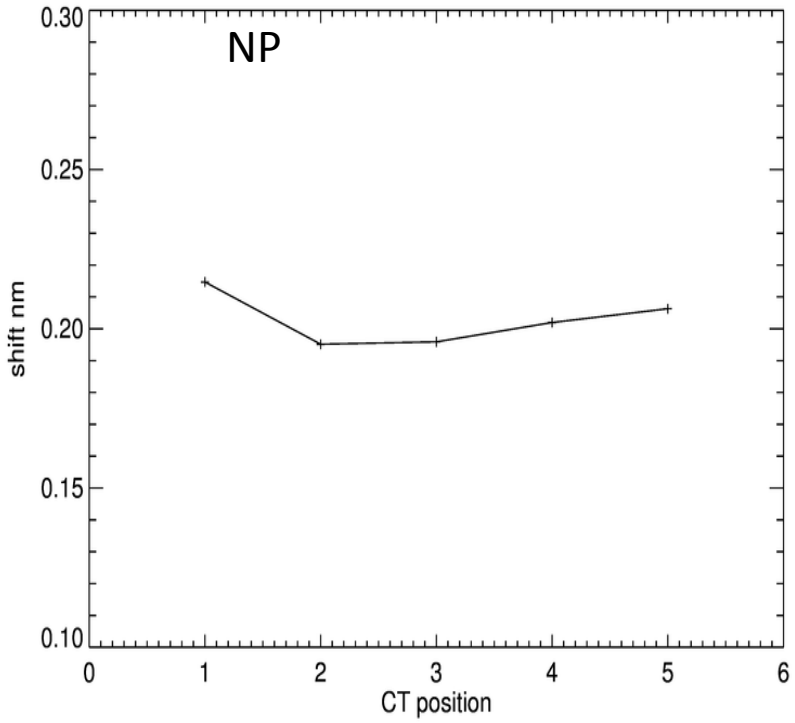

After

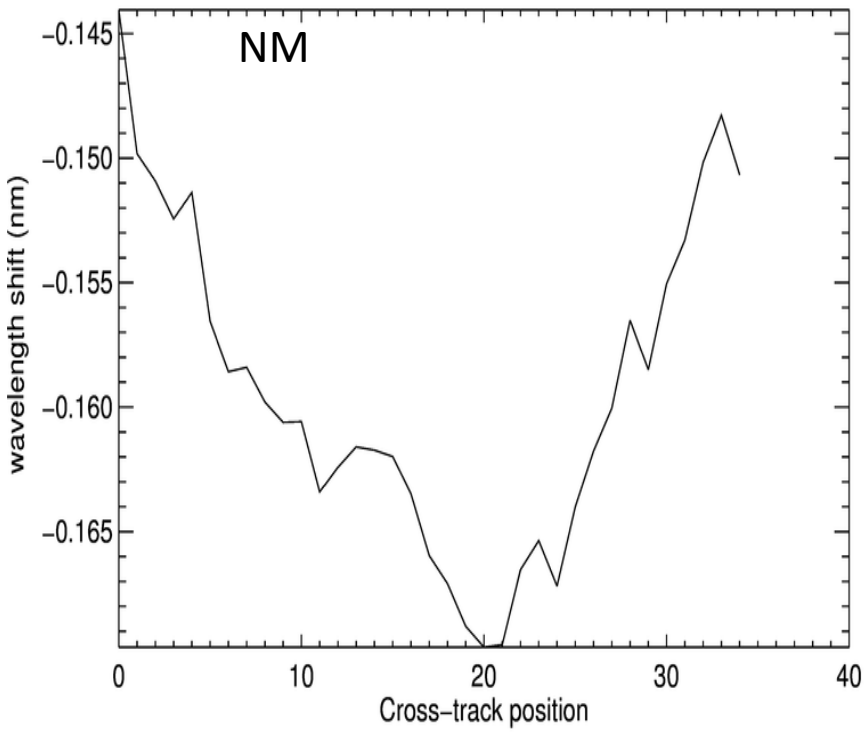



TC has a similar but much smaller changes

# Wavelength Registration Change



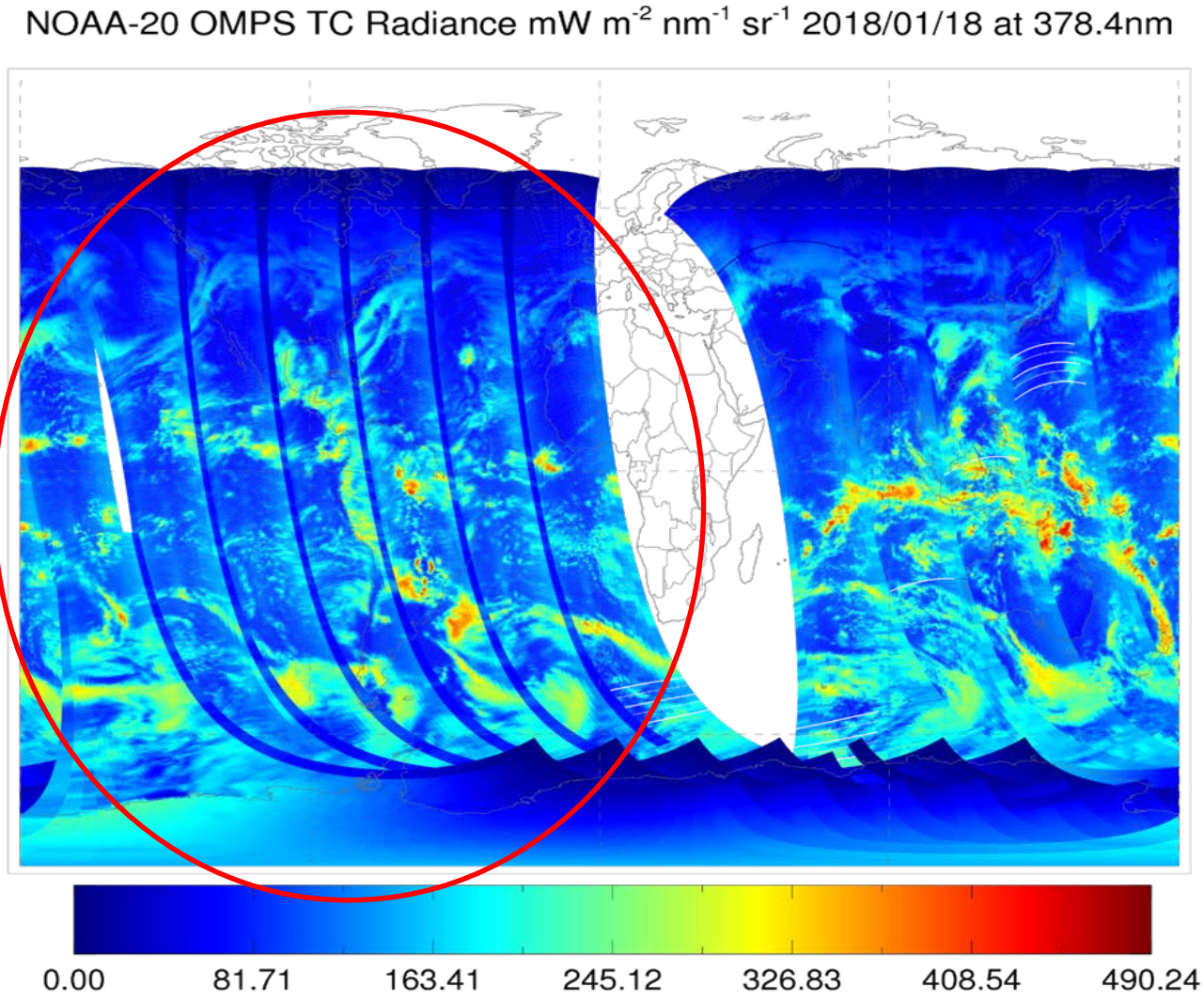




From ground to orbit, wavelength registration change relative to the prelaunch lab results: NP shifted +0.19 ~ +0.21 nm and NM shifted ~ -0.17 ~ - 0.14 nm. The day-one solar LUTs are updated respectively.

Credit: Raw flux data is provided by NASA. Data analysis is performed by STAR SDR Team.

# Error in NM Low Resolution Data

- NM radiance map on 1/8/2018 for channel 378.4nm. The 6 left orbits are low resolution (nominal) data and the 6 right orbits are high resolution data.
- Nominal data shows cross-track positions 1 and 35 have significant lower radiances, caused by the sampling problem when doing lowRes---> lowRes mapping.
- We have proposed a solution to fix this issue




Map Credit: STAR ICVS

# Way Forward to Provisional SDRs

- ✓ Updated Field Angle Map for NP – delivered.
- ✓ Updated Field Angle Map for NM – delivered.
- ✓ Updated NP wavelength and day one solar flux – tested, to be delivered.
- ✓ Updated NM wavelength and day one solar flux – tested. May need revise if sample table changes.
- Update nominal sample table & associated tables – see proposal presentation.

# Summary

- ✓ Engineering telemetry RDR data started from orbit 145 as scheduled.
- ✓ Calibration RDR data started from orbit 145 as scheduled.
- ✓ Science SDRs/GEOs (door open) started from orbit 154 as scheduled.
- ✓ EDRs are being successfully retrieved from the science SDRs/GEOs.
- ✓ Sensor aliveness test, functional test and outgassing were successful.
- ✓ Telemetry are being monitored via ICVS web pages.
- ✓ Sensor performs well.
  - ✓ Raw counts dynamic range > 12000 counts, meets sensor design criteria for both NP and NM.
  - ✓ SNR > 1000 from solar view, meets the requirement for both NP and NM.
  - ✓ System nonlinearity meets the requirement of 2% for both NP and NM.
  - ✓ Changes in dark current is within expectation.
  - ✓ Wavelength shifts from ground to orbit are ~ - 0.17 nm for NM and ~0.2 nm for NP, within expectation.
- ✓ SDR calibration towards provisional level is in progress.