Initial Assessment of the NOAA-21 CrIS Observations

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Outline

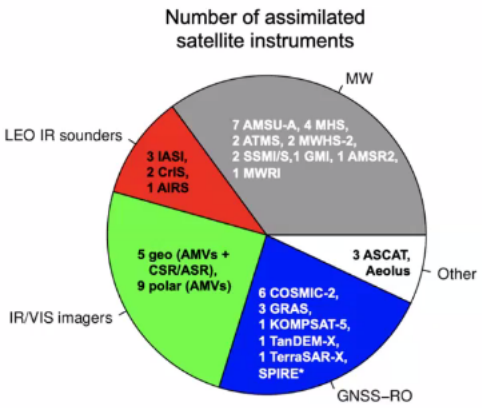
1. Impact and Value of CrIS Observations.
2. The NOAA-21 CrIS First Science Data.
3. Quality Assessment of the NOAA-21 CrIS Calibrated Observations.
4. Efforts Toward NOAA-21 CrIS Provisional Maturity Level.
5. Summary.

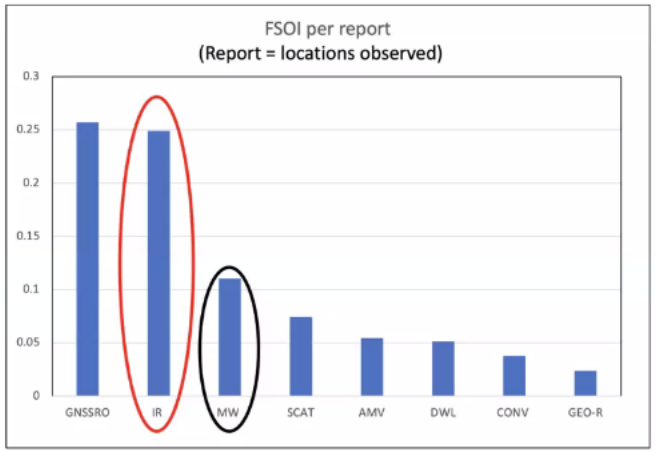
High Quality CrIS Observations are Essential to Numerical Weather Prediction: Providing Resilience and Robustness

CrIS Calibrated Observations are:

- **Essential for Improving Numerical Weather Prediction.**
- **Critical for Operational Assimilation 24/7 at NWP Centers.**
- **Highly Influential on the Weather Forecast Quality.**

Normalised IR vs MW impact per radiance spectrun

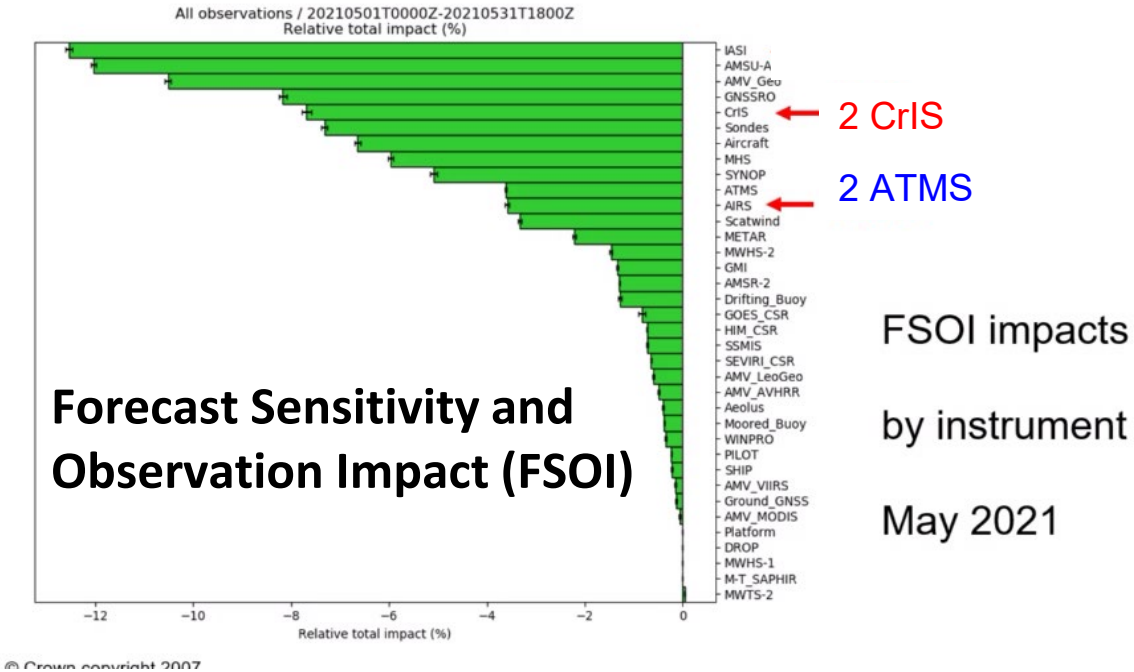




Due to the number of sensors microwave data have the largest total impact, but one infrared spectrum is significantly more influential than a microwave sounding.

Tony McNally (ECMWF), "Data Assimilation considerations for future infrared sounder deployment", NOAA Infrared Sounder Workshop, December 6, 2021.

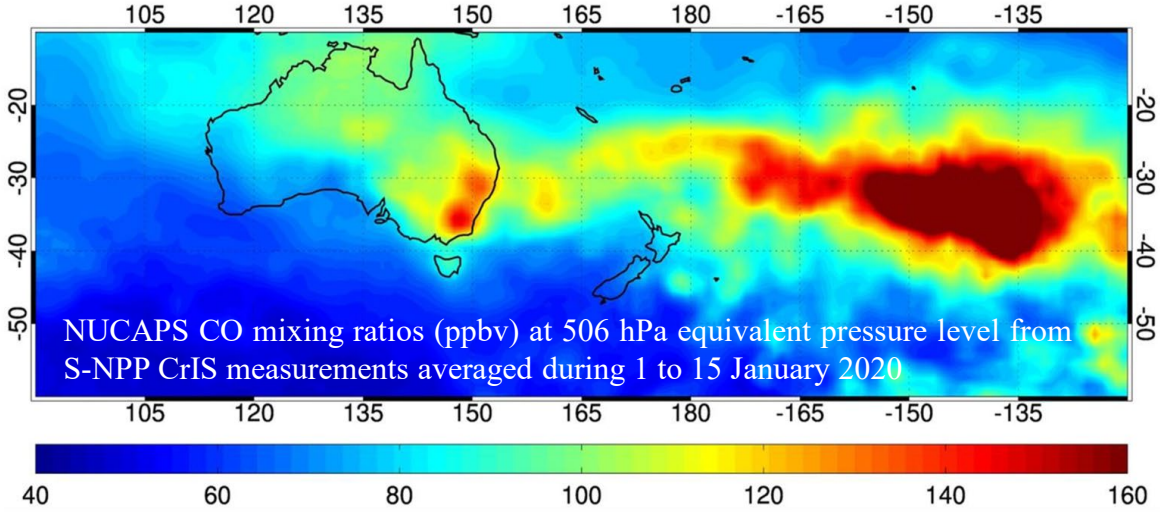
Infra-red soundings in NWP at the Met Office: impact (2)



John Eyre (Met Office, UK), "Infra-red sounding in NWP at the Met Office: Experience and suggestions for future systems", NOAA Infrared Sounder Workshop, December 6, 2021

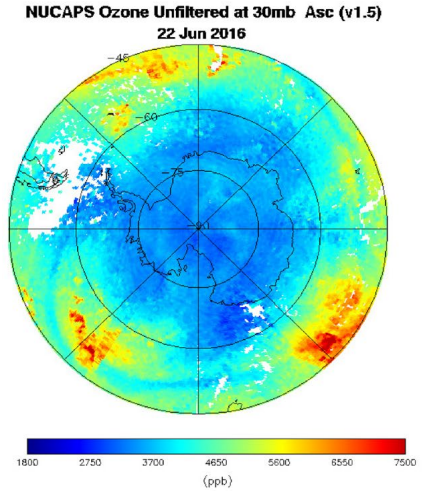
The Value of CrIS Observations for Environmental Monitoring and Generation of Geophysical Products to Better Understand Our Earth

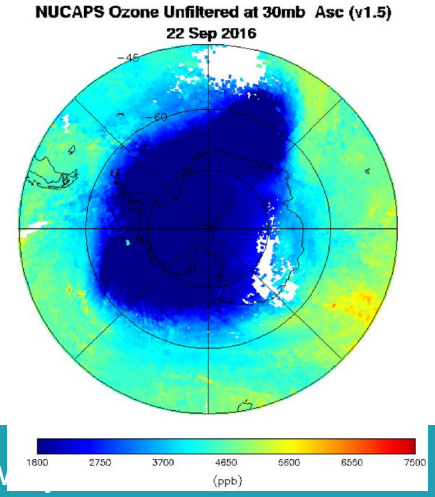
Tracking Carbon Monoxide from the Australian Fires in 2019 using CrIS observation applied to the NUCAPS System



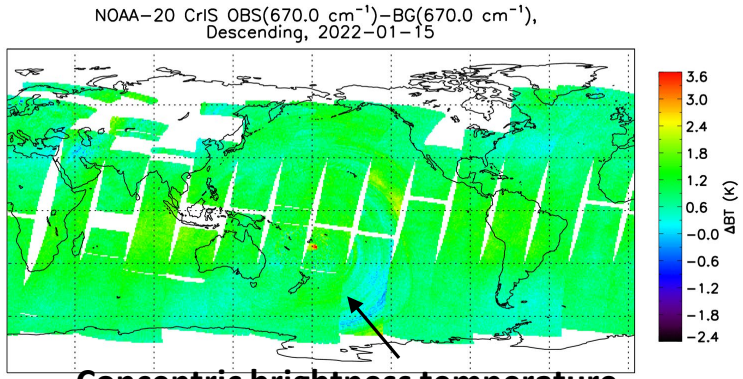
Kalluri et al., Validation and Utility of Satellite Retrievals of Atmospheric Profiles in Detecting and Monitoring Significant Weather Events, BAMS, 2021.

Monitoring the Seasonal depletion of Ozone from SH Winter to SH Spring

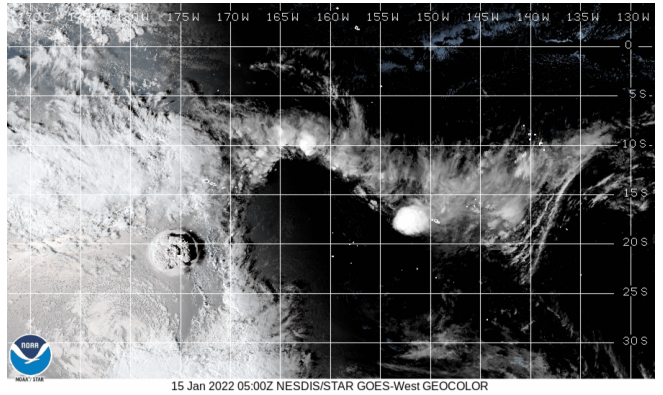




The Hunga Tonga Volcano Eruption on January 15, 2022



Concentric brightness temperature anomalies detected by CrIS

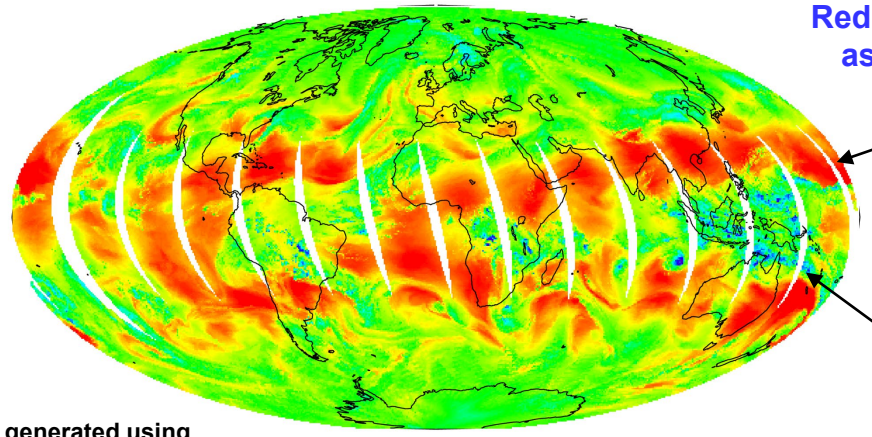


Volcanic plumes and shockwaves observed from the GOES-West Satellite

The NOAA-21 CrIS First Science Data

First Global Image From NOAA-21's CrIS Instrument at a channel sensitive to tropospheric water vapor

NOAA-21 CrIS Sensor Brightness Temperature, 1596 cm^{-1}
12 Feb 2023 Day Time

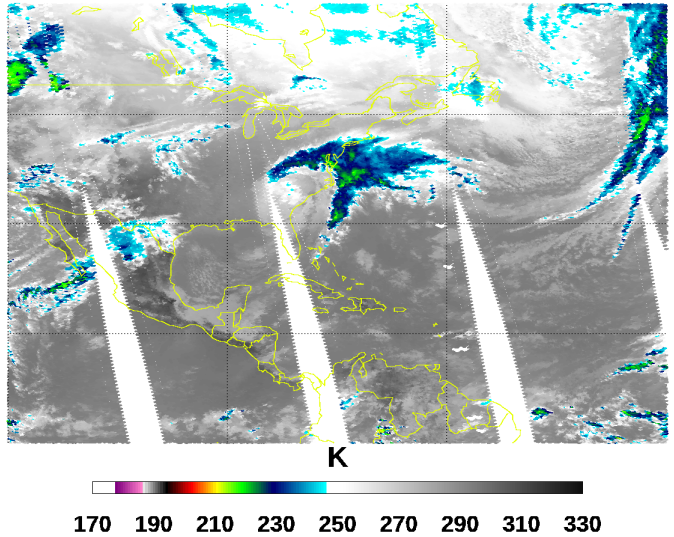


Red areas in the map are associated with drier atmosphere

Image generated using NOAA-21 Preliminary, Non-Operational Data

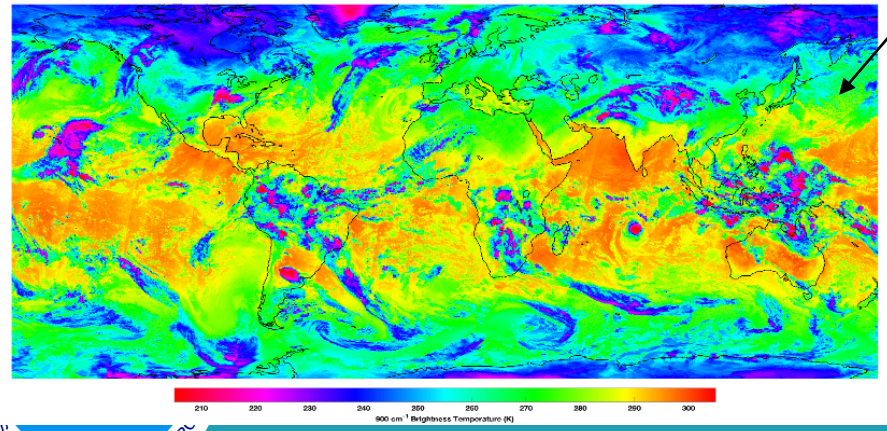
NOAA-21 CrIS observing different types of clouds at different vertical levels in the atmosphere

NOAA-21 CrIS Sensor Brightness Temperature Map, 900 cm^{-1}
12 Feb 2023 Day Time

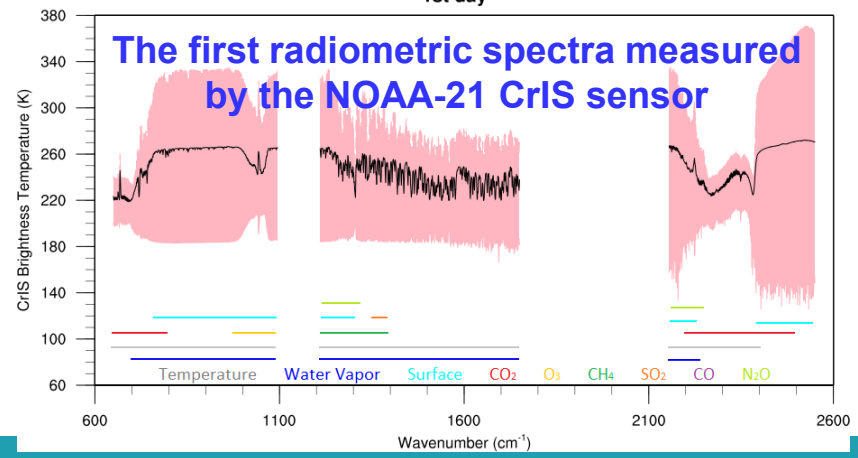


Removing CrIS Observational data gaps

Combining NOAA-20 and NOAA-21 CrIS Observations



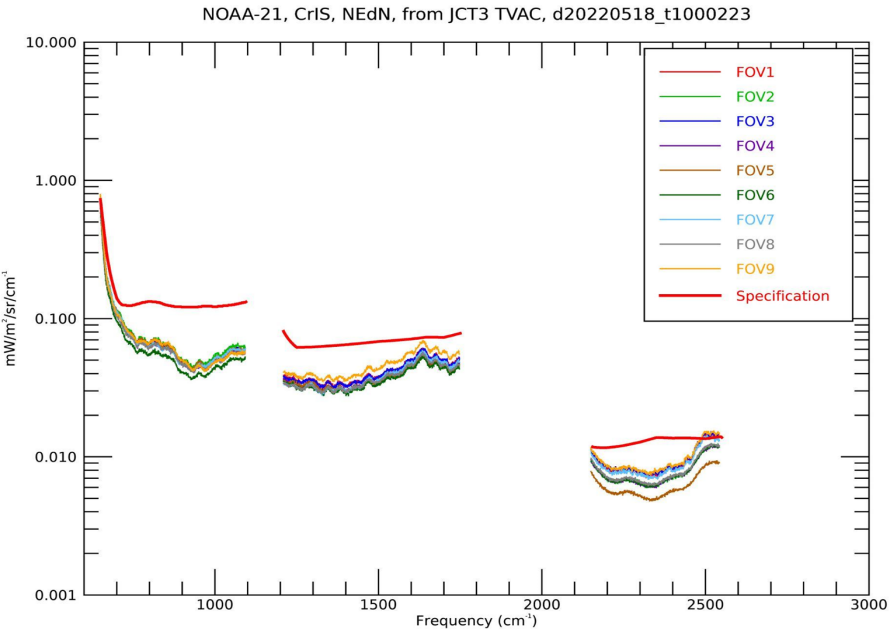
NOAA-21 CrIS Full Spectrum Resolution Brightness Temperature
1st day



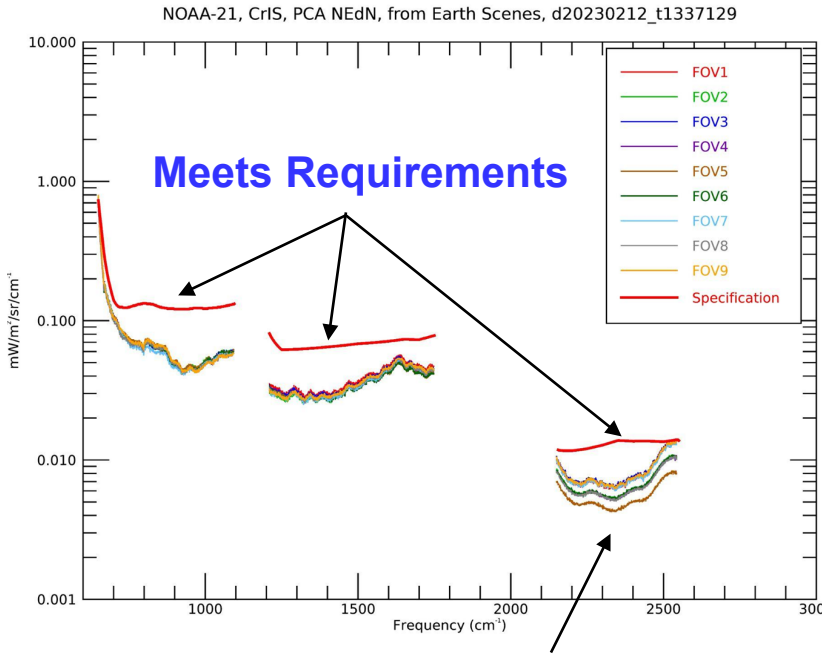
The measured spectra illustrates the abundant spectral information content of the CrIS observations and their sensitivity to the Earth's surface, atmosphere, clouds and trace gas variability.

NOAA-21 CrIS Noise: Pre-launch and On-orbit Performance

NOAA-21 CrIS TVAC 5/18/2022

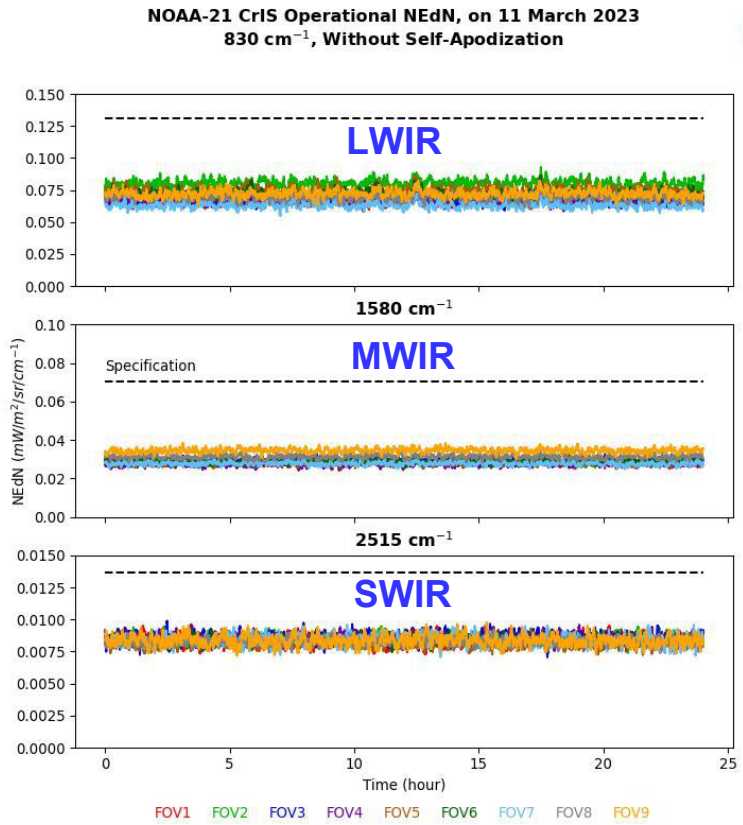


NOAA-21 CrIS On-Orbit, 2/12/2023



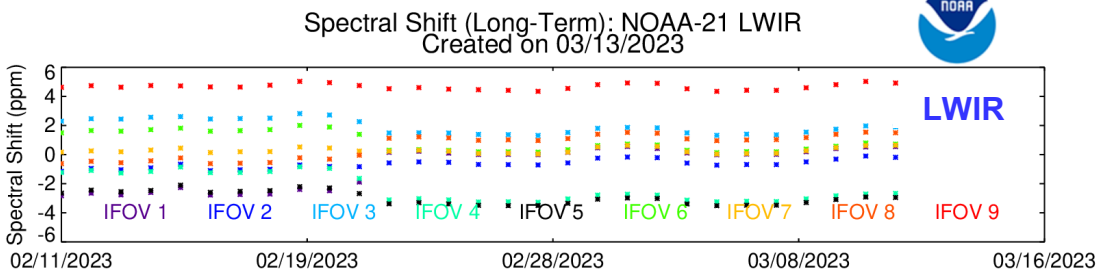
Noise spread associated with Self-apodization calibration correction

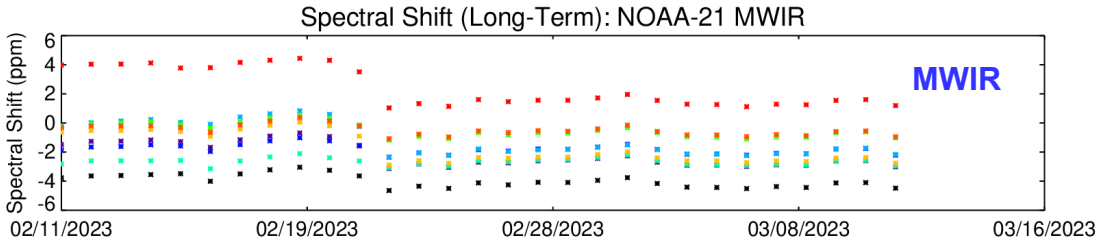
NOAA-21 CrIS Noise Stability

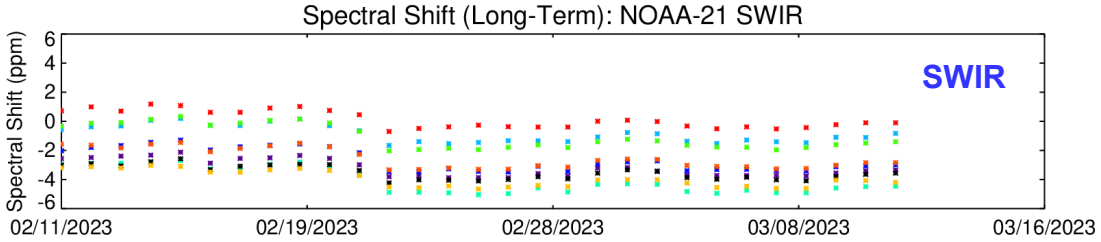


The On-orbit NOAA-21 CrIS Noise performance is comparable to pre-launch performance, consistent and stable among FOVs

NOAA-21 CrIS Spectral Performance

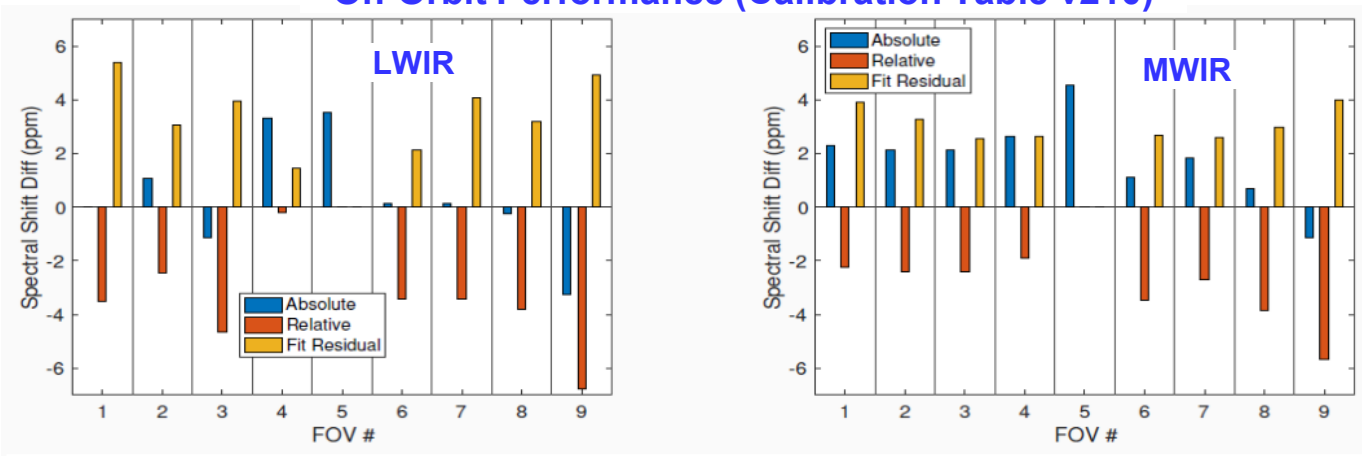




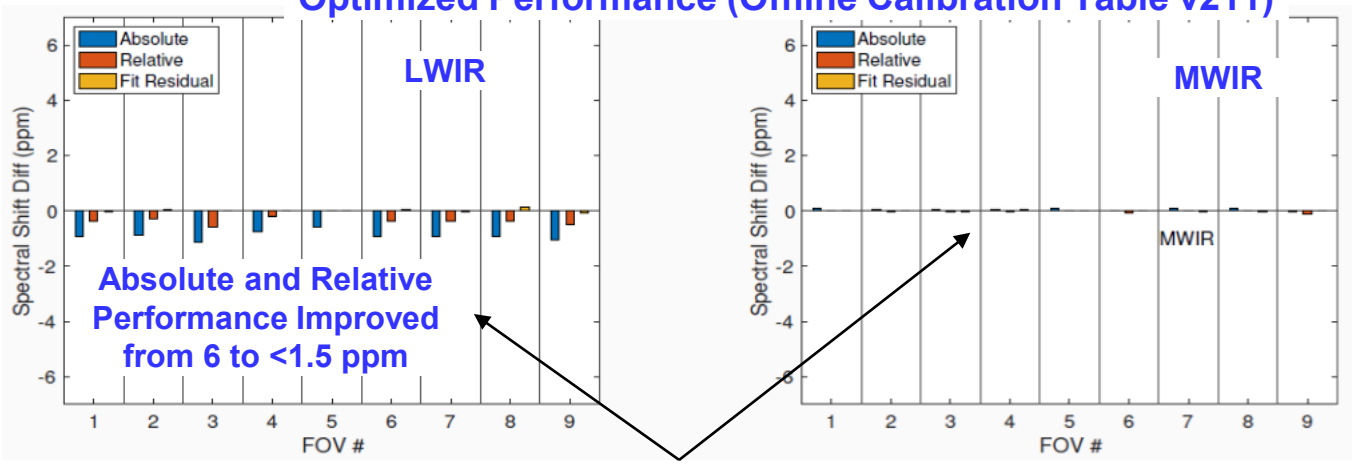


The On-orbit NOAA-21 CrIS Spectral Performance meet the Requirements (<10 ppm) for all FOVs since first science data on February 1O, 2023

On-Orbit Performance (Calibration Table v210)



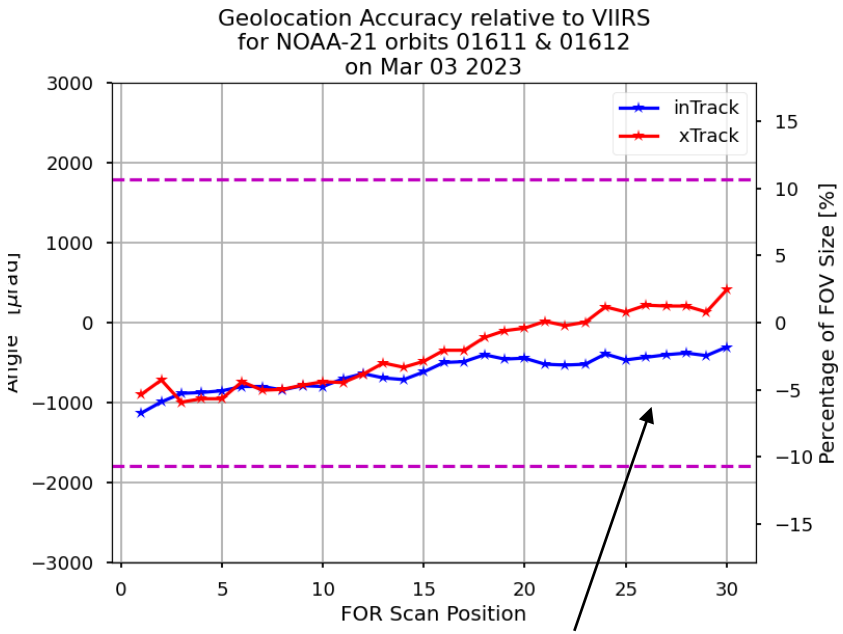
Optimized Performance (Offline Calibration Table v211)



Improvements are expected after upload of New Calibration Table v211 at the end of March 2023

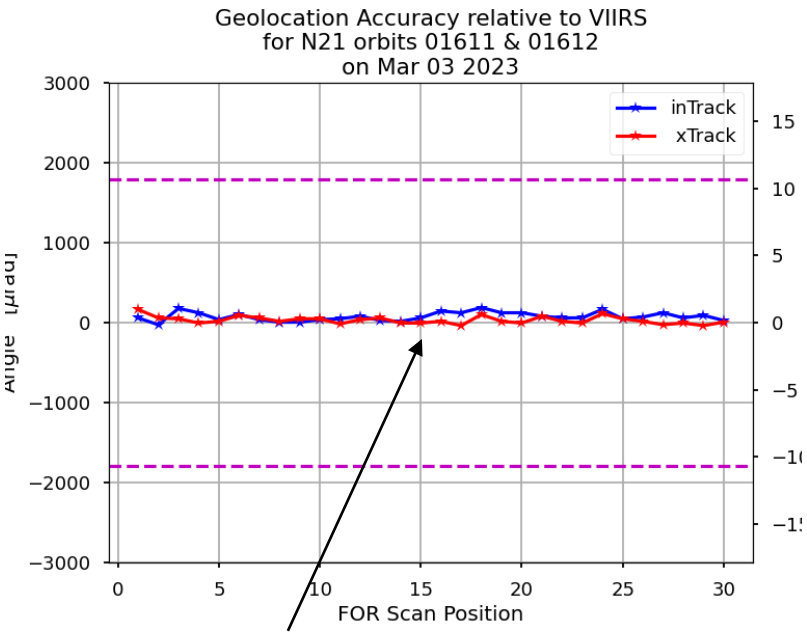
NOAA-21 CrIS Geolocation Performance

On-Orbit Accuracy Performance (Calibration Table v210)



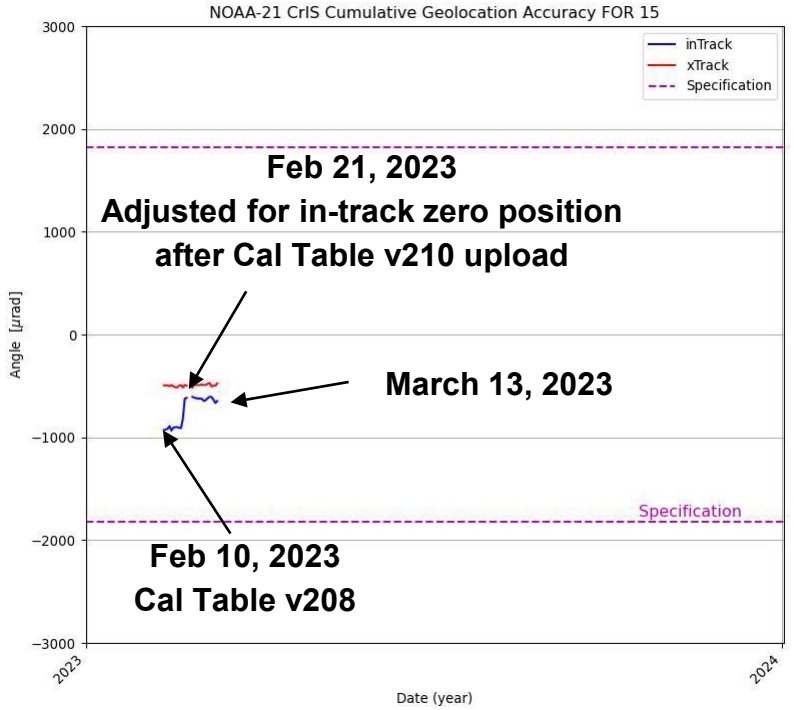
Geolocation meets the requirements; however, the performance is still a function of the sensor scan position

Optimized Accuracy Performance (Offline Calibration Table v211)



Geolocation meets the requirements and does not show dependency on the sensor scan position

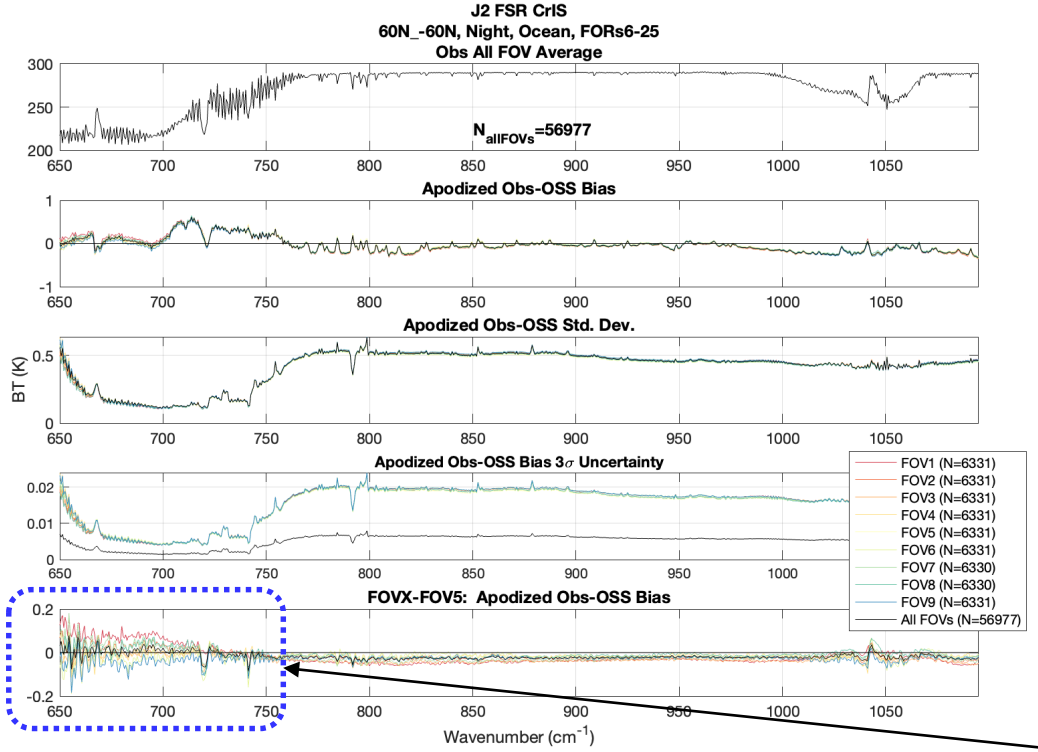
NOAA-21 CrIS Geolocation Accuracy Performance as a function of Time



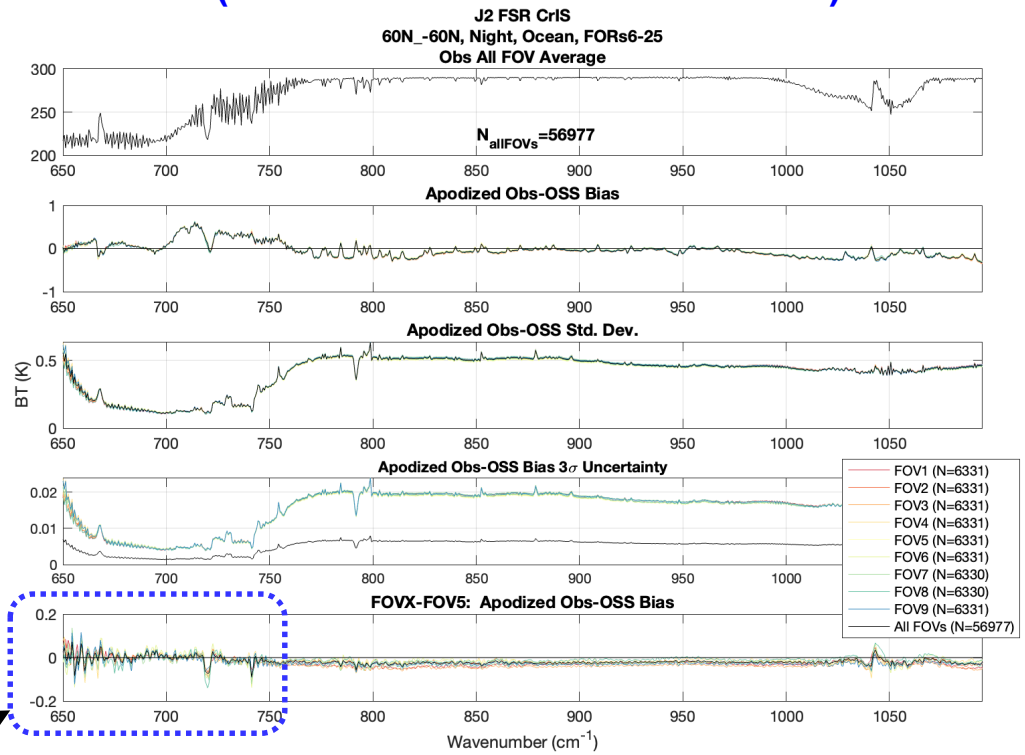
The On-orbit NOAA-21 CrIS Geolocation Performance is expected to be improved after the upload of New Calibration Table v211 at the end of March 2023

NOAA-21 CrIS Radiometric Performance

On-Orbit Radiometric Performance (Calibration Table v210)



Optimized Radiometric Performance (Offline Calibration Table v211)

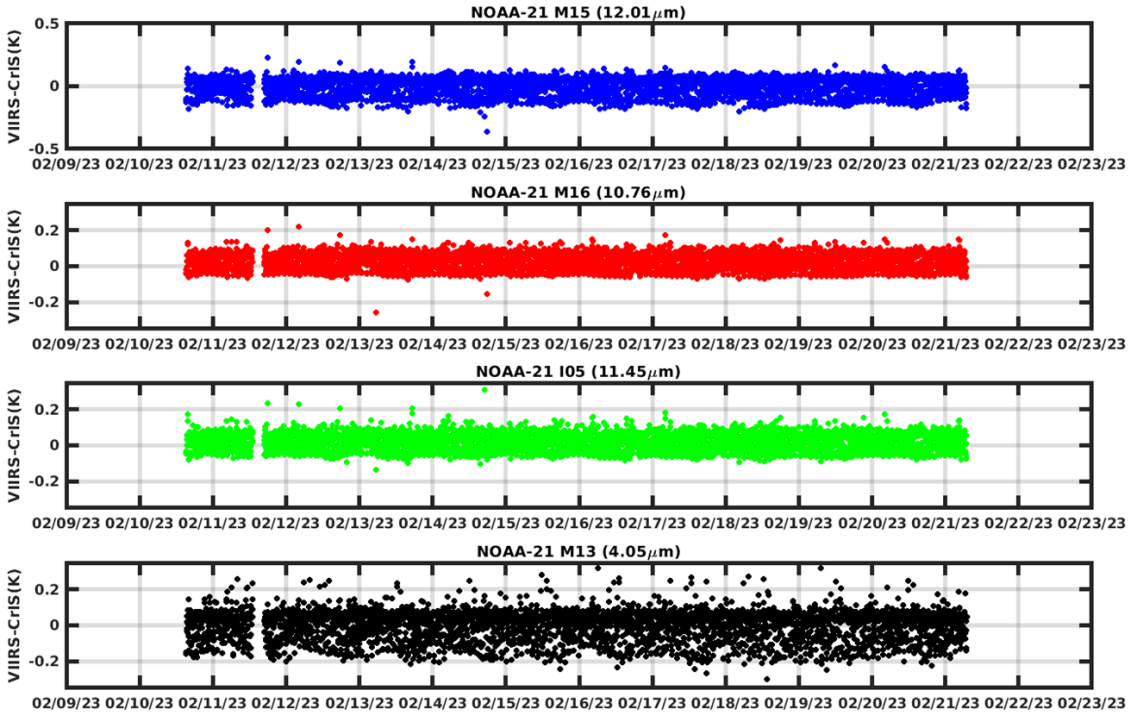


Inter-FOV Radiometric performance consistency to levels <0.1 K was achieved after proper optimization of nonlinearity correction coefficients

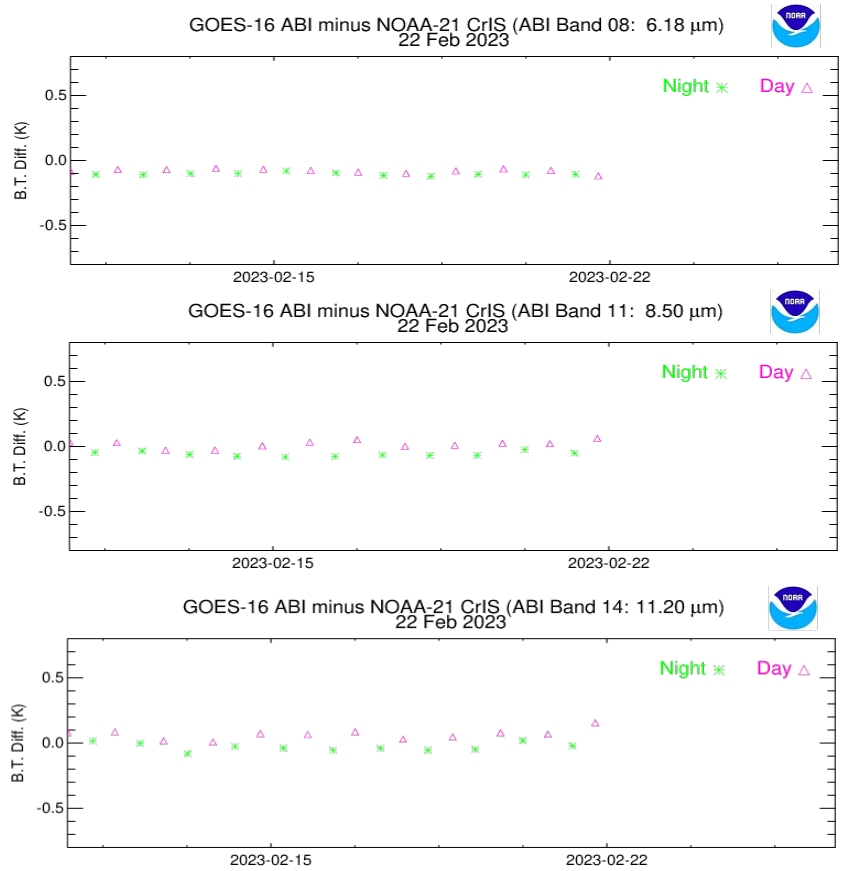
The Non-linearity optimization is expected to improve the FOV-to-FOV radiometric consistency of NOAA-20 CrIS Calibrated Data after the upload of New Calibration Table v211 at the end of March 2023

NOAA-21 CrIS Radiometric Inter-comparisons

NOAA-21 CrIS vs VIIRS



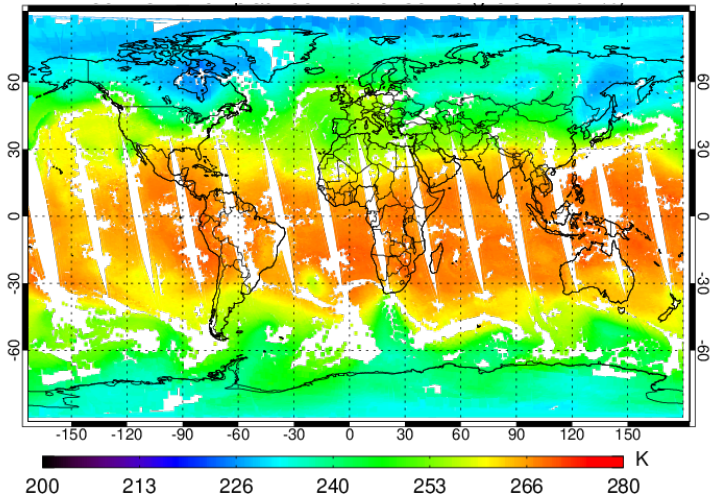
NOAA-21 CrIS vs GOES-16 ABI



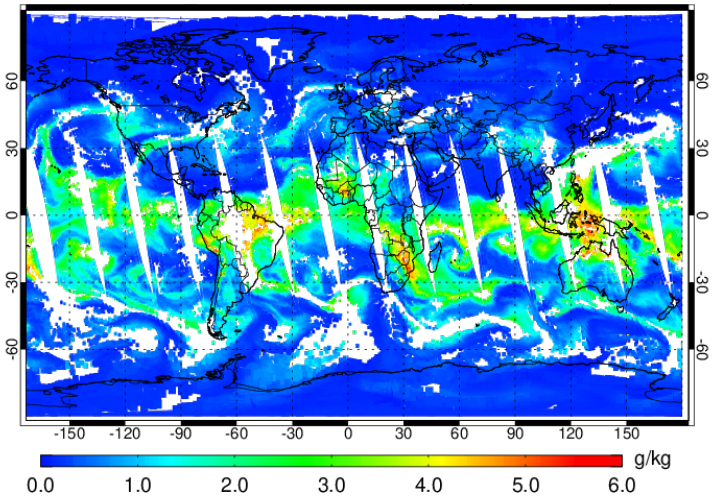
NOAA-21 CrIS Calibrated Radiances show consistent performance as a function of time and high agreement to the level of less than 0.2 K since sensor activation

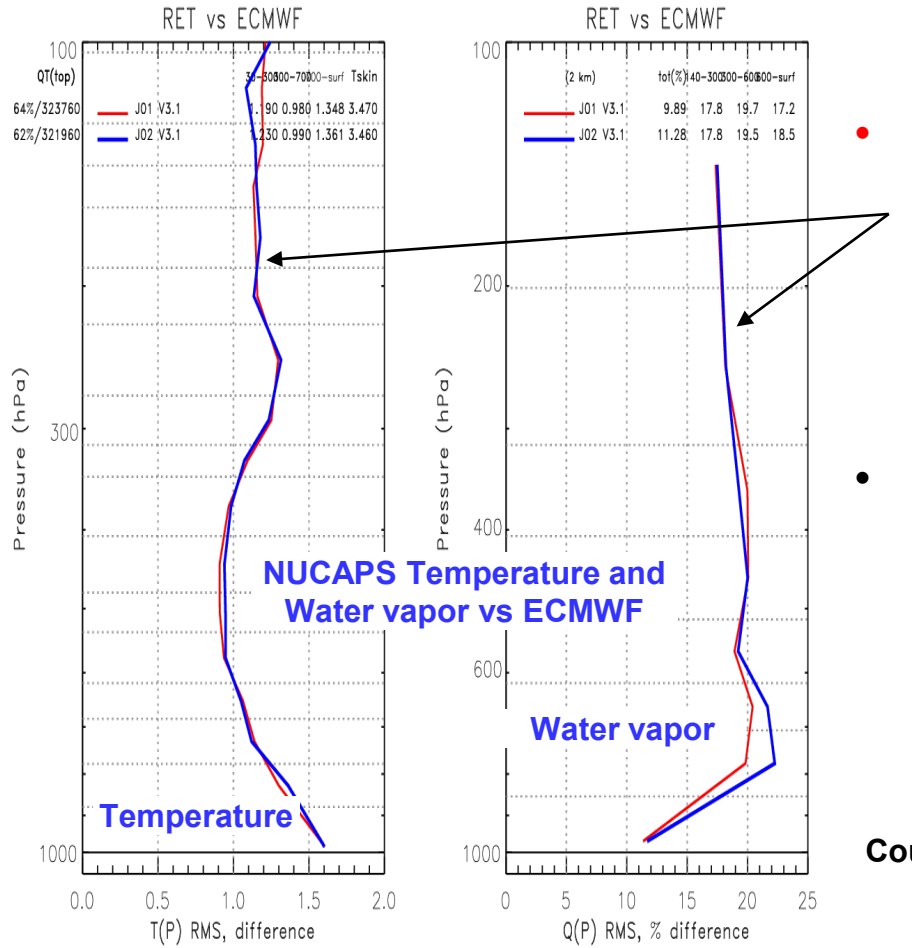
Geophysical Assessment of NOAA-21 CrIS Calibrated Radiances using the NUCAPS Retrievals System

NOAA-21 NUCAPS Temperature at 496 hPa



NOAA-21 NUCAPS Water Vapor at 506 hPa



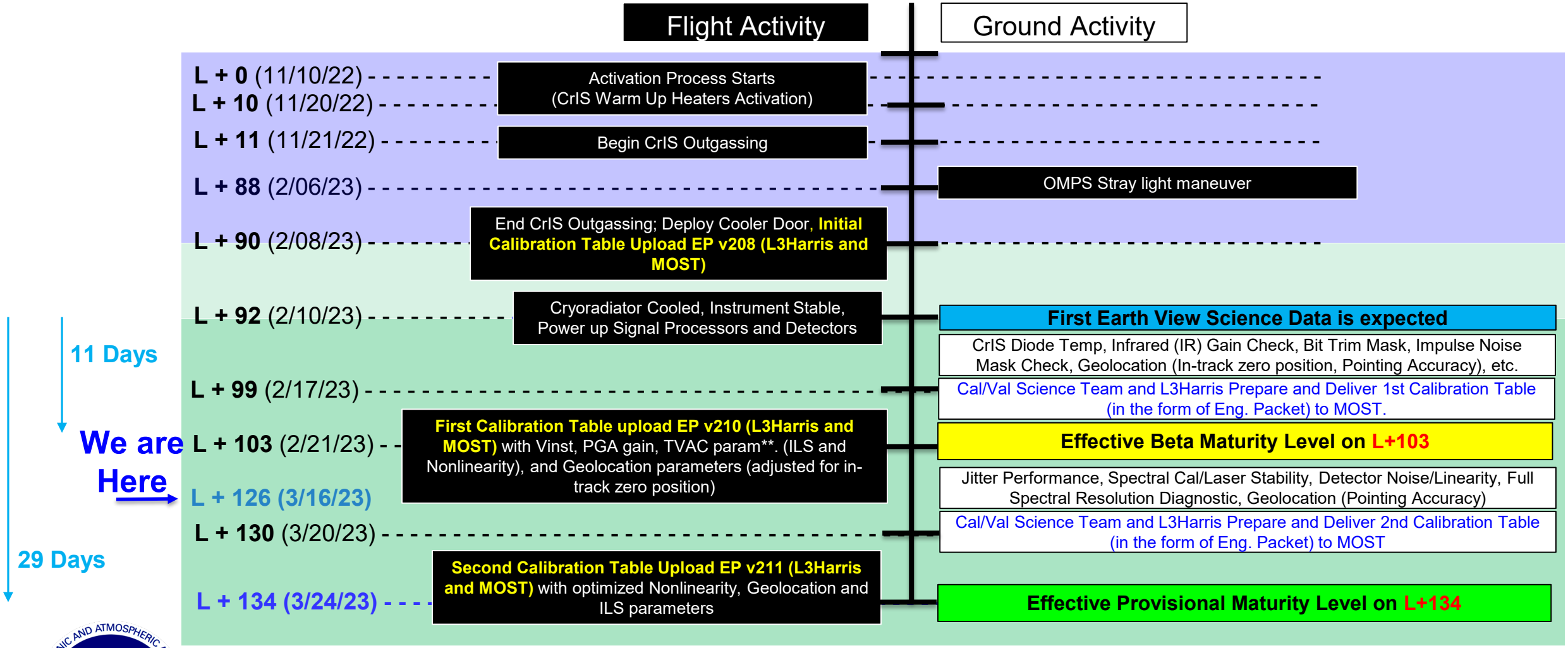


- NOAA-20 and NOAA-21 NUCAPS Temperature and Water Vapor RMS differences with matched ECMWF show very similar characteristics.
- Currently evaluating CO, CH4 and CO2 products with TROPOMI and OCO-2 observations.

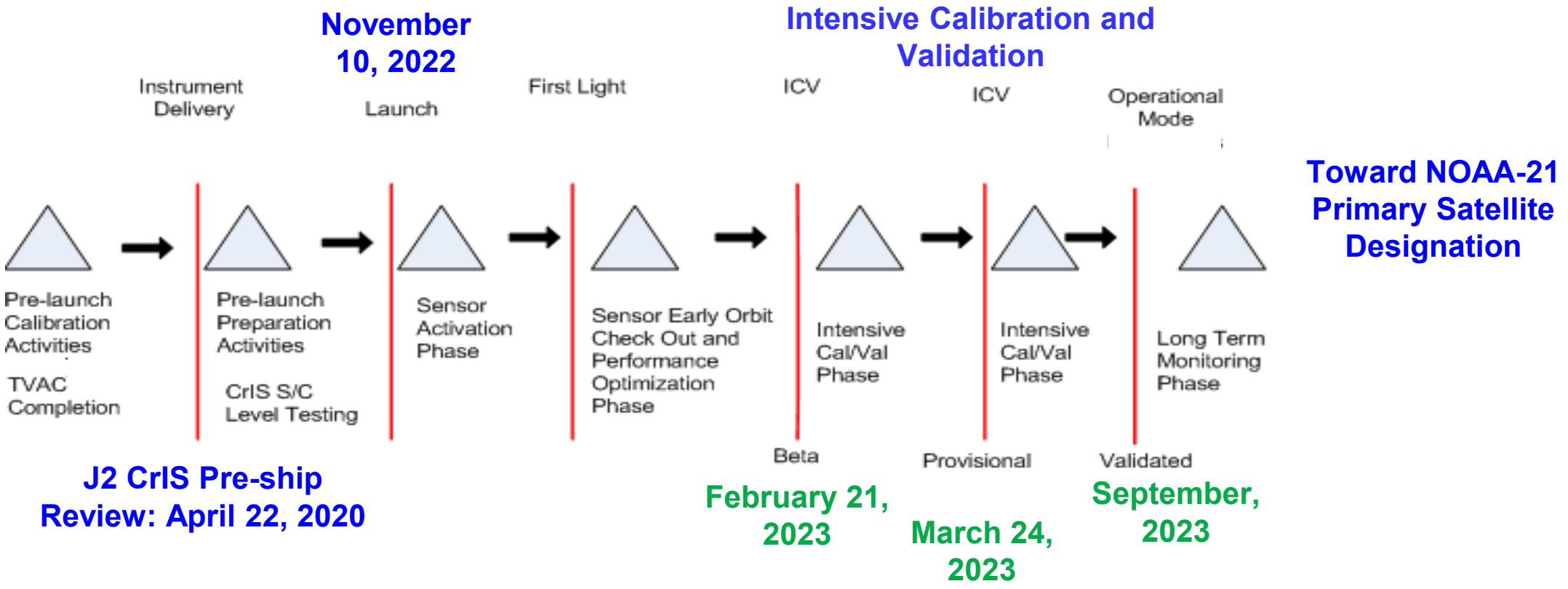
Courtesy of STAR NUCAP Team

Initial Assessment shows that NOAA-21 and NOAA-20 NUCAPS CrIS/ATMS Geophysical Products hold similar quality

NOAA-21 CrIS Post-Launch Commissioning and Cal/Val Timeline



NOAA-21 (JPSS-2) CrIS Cal/Val Phases and Key Milestones



Summary

1. The CrIS Calibrated observations are one of the most impactful observations providing critical information to support weather forecasting, environmental monitoring and climate studies.
2. The quality of the NOAA-21 CrIS Calibrated Radiances meets the JPSS Level-1 Requirements.
3. Present calibration efforts are dedicated to further improve quality and FOV-to-FOV performance consistency to make sure CrIS data users get the expected quality, comparable to SNPP and NOAA-20 CrIS.
4. The NOAA-21 CrIS Calibrated Radiances are expected to reach the Provisional Maturity Level by the end of March 2023.
5. Assessment results show that the excellence performance of the CrIS sensors and quality of calibrated observations found on SNPP and NOAA-20 will continue with the NOAA-21 CrIS sensor.

Disclaimer: The scientific results and conclusions, as well as any views or opinions expressed herein, are those of the author(s) and do not necessarily reflect those of NOAA or the Department of Commerce.