NUCAPS Atmospheric Sounding Product System for JPSS-CrIS and MetOP-IASI Hyperspectral Sounders: Products, Performance, and Recent Advances

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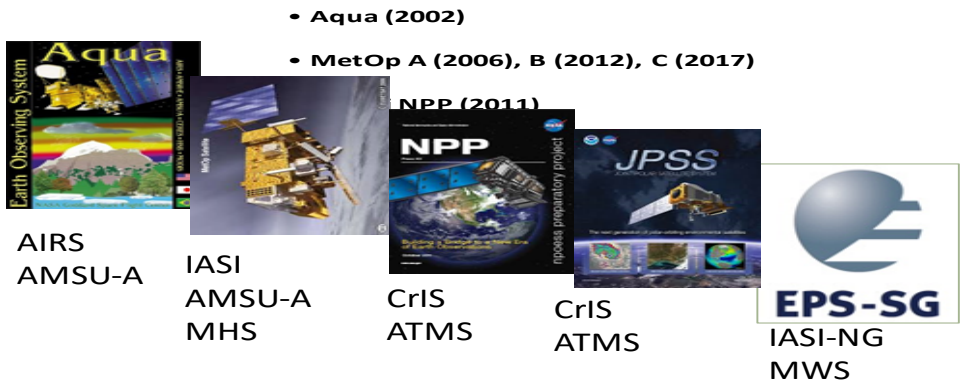
Science and Technology Corporation, Columbia, MD

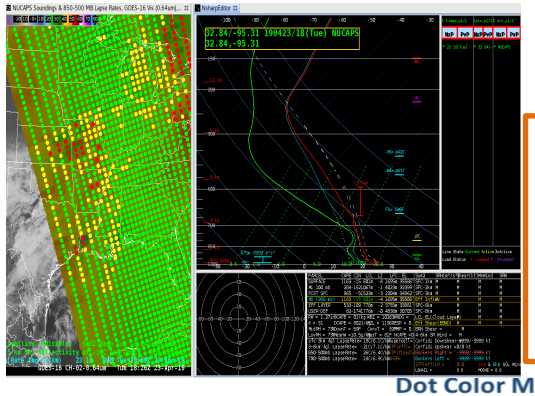
Virtual NASA Sounder Science Team Meeting
Thursday, October 8, 2020 (10:00 AM PDT)

NUCAPS Algorithm Background



- The NOAA Unique Combined Atmospheric Processing System (NUCAPS) is the NOAA operational hyper-spectral enterprise sounding product algorithm to derive hyper-spectral radiance products, vertical profiles of temperature, water vapor, ozone, and trace gas products (CO, CH4, CO2, Volcanic SO2).
- NUCAPS algorithm is built on the heritage from the AIRS Science Team algorithm. NOAA/STAR led the effort to develop, test, validate and refine the algorithm to work on JPSS (CrIS), MetOp (IASI) hyperspectral sounding instruments. NOAA STAR plans on augmenting the algorithm to EPS-SG IASI-NG sounding instrument.
- NOAA/STAR has been operationally running NUCAPS since 2009 and distributing NUCAPS products in near real time to the science community through CLASS.
- NUCAPS has been operationally running on the CSPP/Direct Broadcast (DB) network producing near real time products. NUCAPS products are available through AWIPS for Weather Forecast offices for many regional applications.

NUCAPS Products	Maturity Level
	SNPP/NOAA-20
AVTP/AVMP	✓ Validated
Ozone	✓ Validated
OLR	✓ Validated
CO	✓ Validated
CH4	✓ Validated
CO2	✓ Provisional*
OLR	✓ Validated



***CO2-Validated Maturity Review: December 2020**

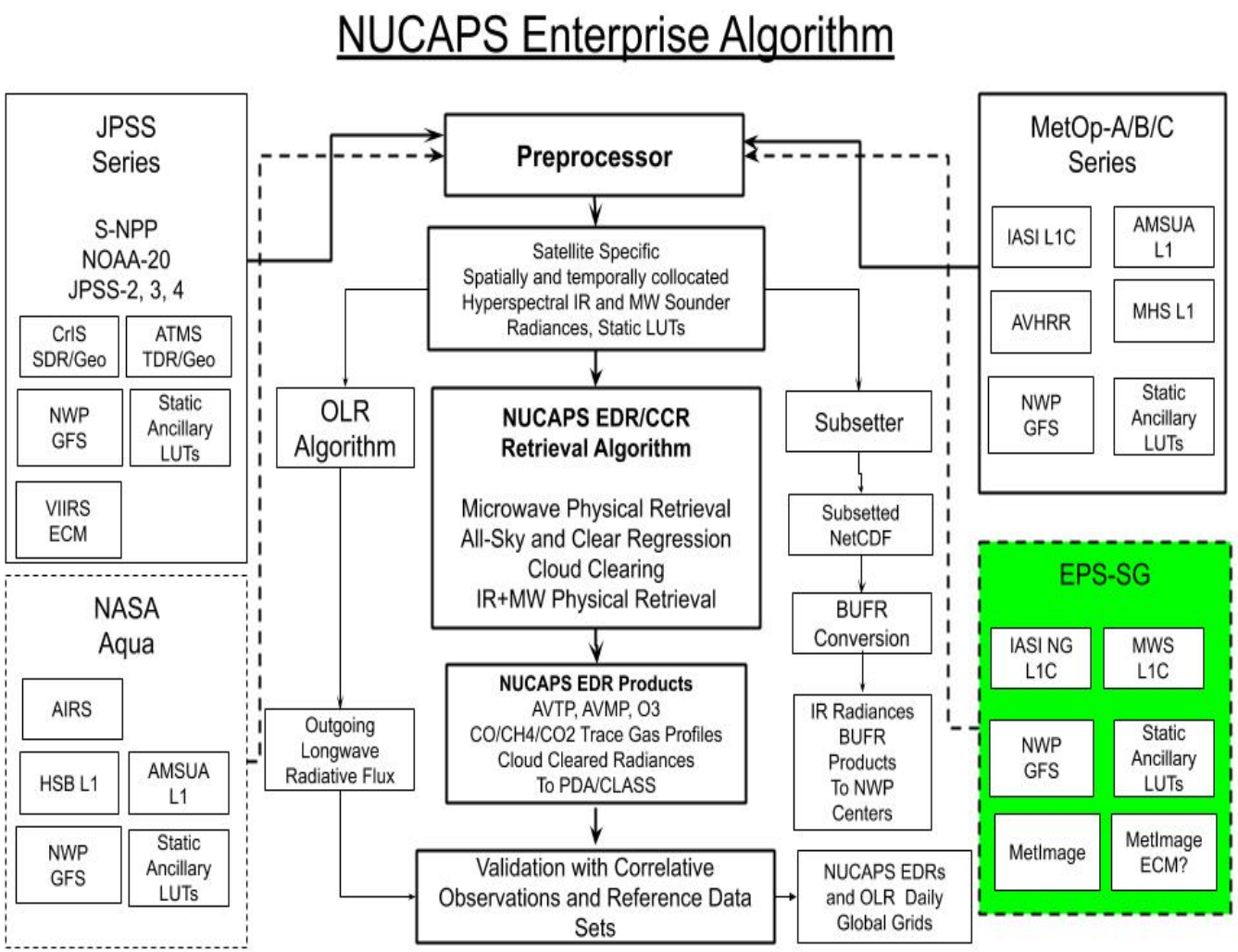
Gridded NUCAPS provides plan views at temperature, moisture, and stability indices (CAPE, lapse rate, etc.) at specific pressure level(s).

Dot Color Meaning

Green	Yellow	Red
Successful infrared (IR) + microwave (MW) NUCAPS retrieval under clear or partly cloudy conditions	Failed IR + MW NUCAPS retrieval. Successful MW-only NUCAPS retrieval under cloudy conditions	Failed IR + MW NUCAPS retrieval. Failed MW-only NUCAPS retrieval under precipitating cloudy conditions

NUCAPS High-level Flow Diagram

NUCAPS runs within the Hyper-Spectral Enterprise Algorithm Package (HEAP) and operationally produces AVTP, AVMP, O3, CO, CH4 and CO2 products from JPSS S-NPP/NOAA-20 CrIS and MetOp-A/B/C IASI Hyperspectral infrared sounding instruments.



The HEAP provides the pre and post-processing capability for The NUCAPS retrieved products and generates

1) NUCAPS products
1) Principal Components
2) OLR
3) Thinned radiance preparation
4) Daily grid generation
5) BUFR product file containing CrIS FSR (2211 channels) and IASI (8461 channels), collocated VIIRS cloud height and cloud fraction, thinned radiances CrIS FSR: 431 channel radiances; IASI: 616 channel radiances; CrIS collocated VIIRS cloud height and cloud fraction.
6) PC reconstruction scores for OSPO product monitoring/quality control tool.

Satellite	Instrument
JPSS (SNPP, NOAA-20, J2,J3)	CrIS/ATMS (currently SNPP/NOAA-20)
MetOp-A, B, C	IASI/AMSU-A/MHS (total 3 currently)
EPS-SG Augmentation	IASI-NG/MWS
Total data volume	2x 49GB/day (JPSS) + 3x 67GB/day (MetOp)

NUCAPS Product Validation Methodology Hierarchies

$T/H_2O/O_3$ Profiles

(e.g., *Nalli et al., JGR Special Section,* 2013)

1. **Numerical Model (e.g., ECMWF, NCEP/GFS) Global *Comparisons***
   - Large, truly global samples acquired from Focus Days
   - Useful as "transfer standard" (via double-differences), bias tuning and regression
   - Limitation: Not independent truth data
2. **Satellite Sounder EDR (e.g., AIRS, ATOVS, COSMIC) *Intercomparisons***
   - Global samples acquired from Focus Days (e.g., AIRS)
   - Limitation: Similar error characteristics
3. **Conventional PTU/O3 Sonde Matchup *Assessments***
   - WMO/GTS operational sondes (NPROVS) or O3-sonde network (e.g., SHADOZ)
   - Representation of global zones, long-term monitoring (*Reale et al.* 2012; *Sun et al.* 2017)
   - Large samples after a couple months (e.g., *Divakarla et al.,* 2006)
   - Limitations: Skewed distributions; mismatch errors; non-uniform radiosondes, assimilated into NWP
4. **Dedicated/Reference PTU/O3 Sonde Matchup *Assessments***
   - *Dedicated* for the purpose of satellite validation
   - Reference sondes: CFH, **GRUAN** corrected RS92/RS41
   - E.g., **ARM sites** (e.g., *Tobin et al.,* 2006), **AEROSE**, **CalWater/ACAPEX ,** BCCSO, PMRF; collocations facilitated via NPROVS (*Reale et al.* 2012; *Sun et al.* 2017)
   - Limitation: Small sample sizes, geographic coverage
5. **Intensive Field Campaign *Dissections***
   - Include dedicated sondes, some *not* assimilated into NWP models
   - Include ancillary datasets, ideally funded aircraft campaign(s)
   - E.g., **SNAP, AEROSE, RIVAL, CalWater**, JAIVEX, AWEX-G, EAQUATE

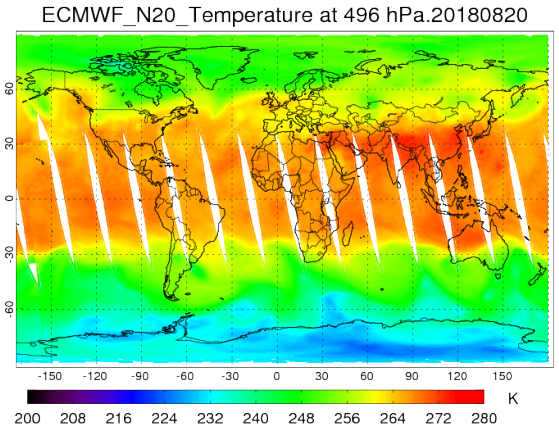
Carbon Trace Gases

1. **Numerical Model Global *Comparisons***
   - Examples: ECMWF CAMS
   - Large, truly global samples acquired from Focus Days
   - Limitation: Not independent truth data
2. **Satellite Sounder EDR *Intercomparisons***
   - Examples: **AIRS,** OCO-2, MLS
   - Global samples acquired from Focus Days (e.g., AIRS)
   - Limitation: Similar error characteristics
3. **Surface-Based Network Matchup *Assessments***
   - **Total Carbon Column Observing Network (TCCON)** spectrometers (*Wunch et al.* 2010, 2011)
   - **AirCore** balloon-borne *in situ* profile observations (*Membrive et al.* 2017)
   - Provide routine independent measurements representing global zones akin to RAOBs
   - Limitations: Small sample sizes, uncertainties in unit conversions, different sensitivities to atmospheric layers
4. **Intensive Field Campaign *In Situ* Data *Assessments***
   - Include ancillary datasets, ideally funded aircraft campaign(s)
   - **ATom**, WE-CAN, FIREX, ACT-America

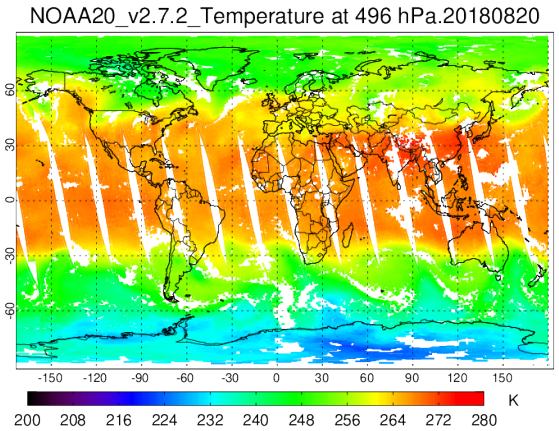
NUCAPS Temperature and Water Vapor Products (20180820) (Typical Yield: 71%)

496 hPa Temperature

ECMWF

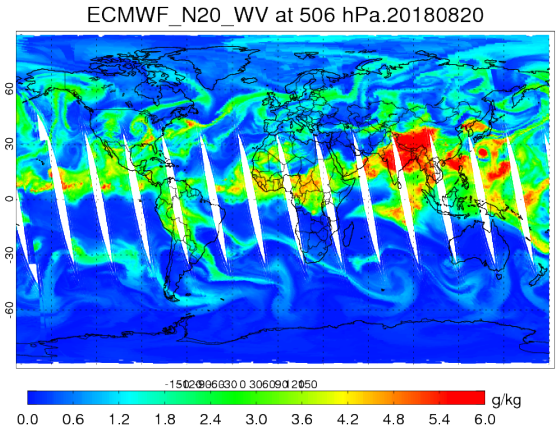


NOAA-20

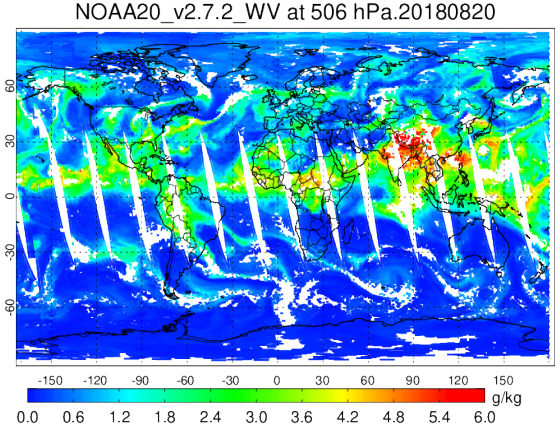


500 hPa Water Vapor

ECMWF

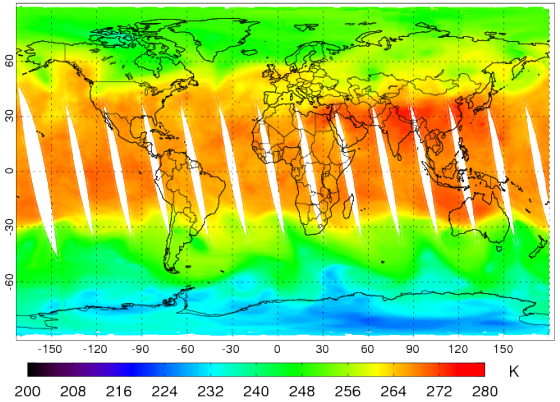


NOAA-20

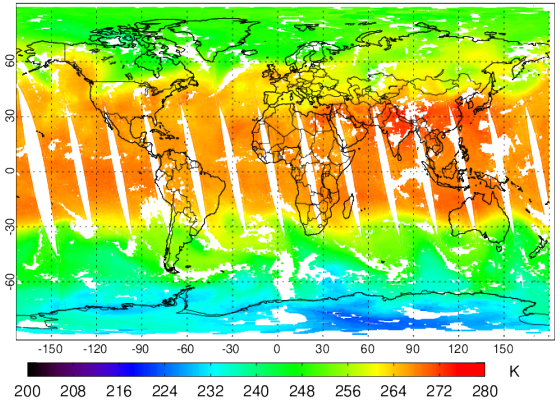


496 hPa Temperature

ECMWF

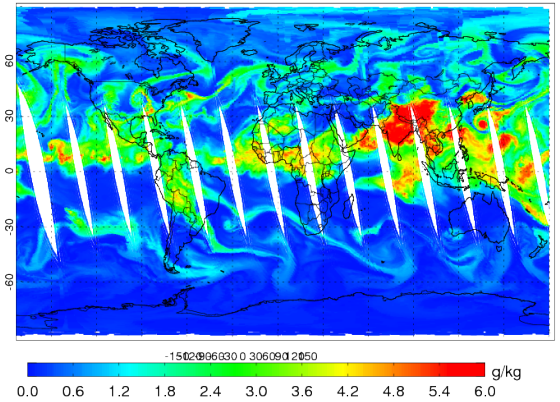


S-NPP

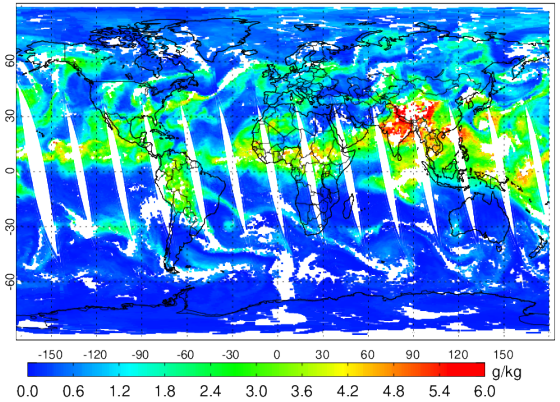


500 hPa Water Vapor

ECMWF



S-NPP

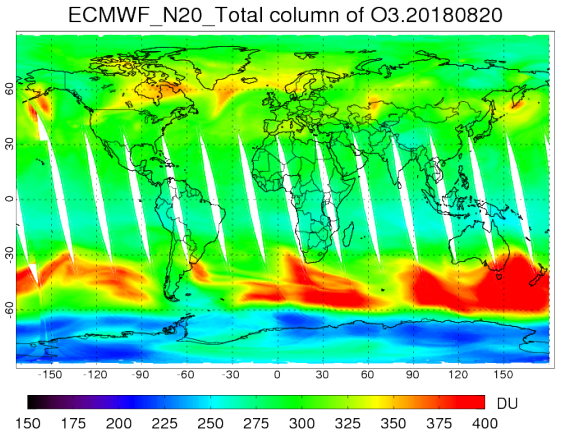


NUCAPS Algorithm produces consistent products from JPSS Suomi-NPP and NOAA-20 and have reached validated maturity. In addition to ECMWF, we use Copernicus Atmospheric Monitoring Service (CAMS) model and reference data sets (ATOM, TCCON) to evaluate CO, CO2, and CH4. Retrieved profiles (100 layers) span from surface to 0.01mb

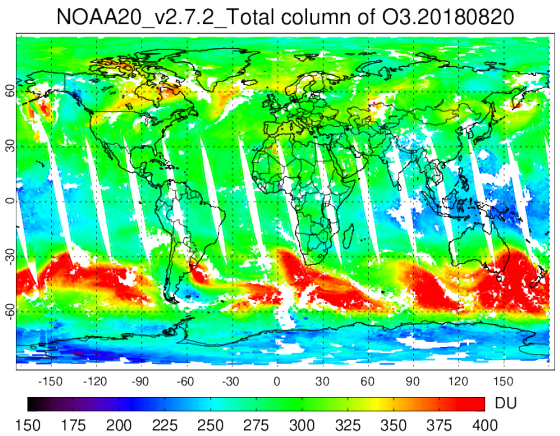
NUCAPS Total Ozone and TPW Products (20180820) (Typical Yield: 71%)

Total Ozone

ECMWF

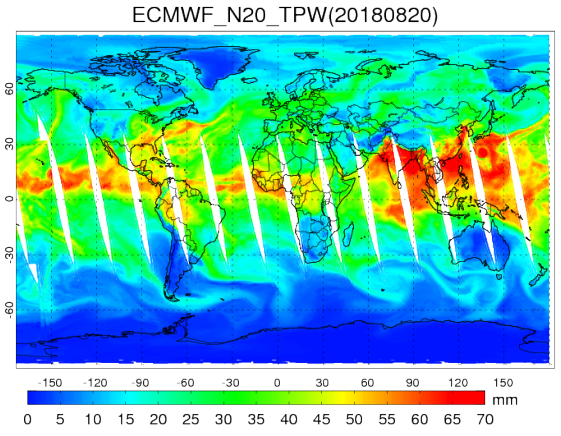


NOAA-20

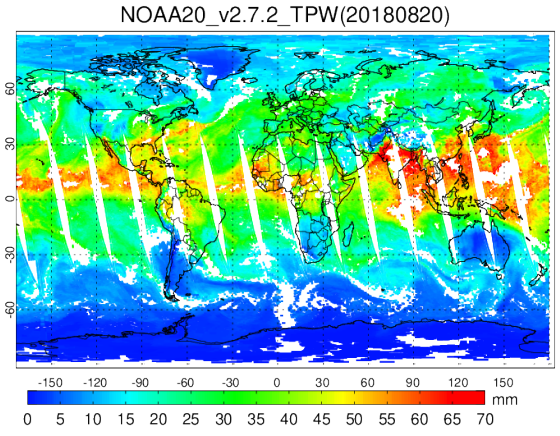


Total Precipitable Water

ECMWF

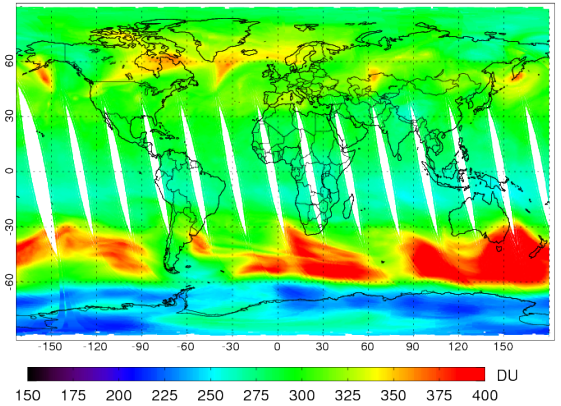


NOAA-20

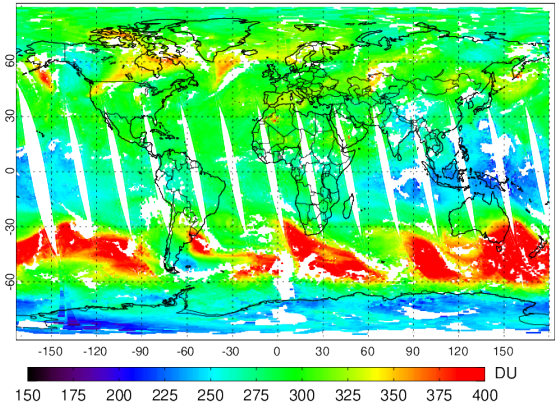


Total Ozone

ECMWF

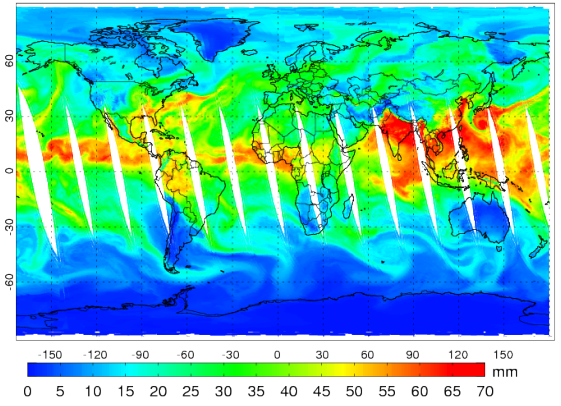


S-NPP

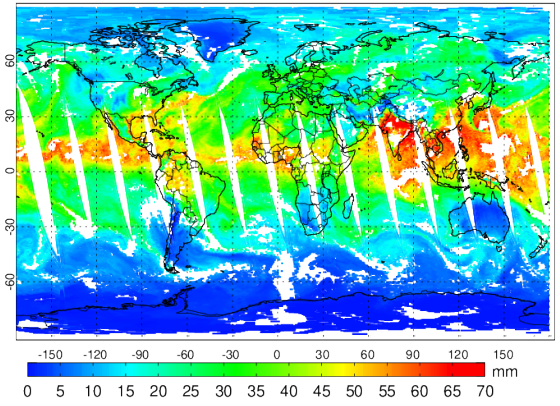


Total Precipitable Water

ECMWF



S-NPP



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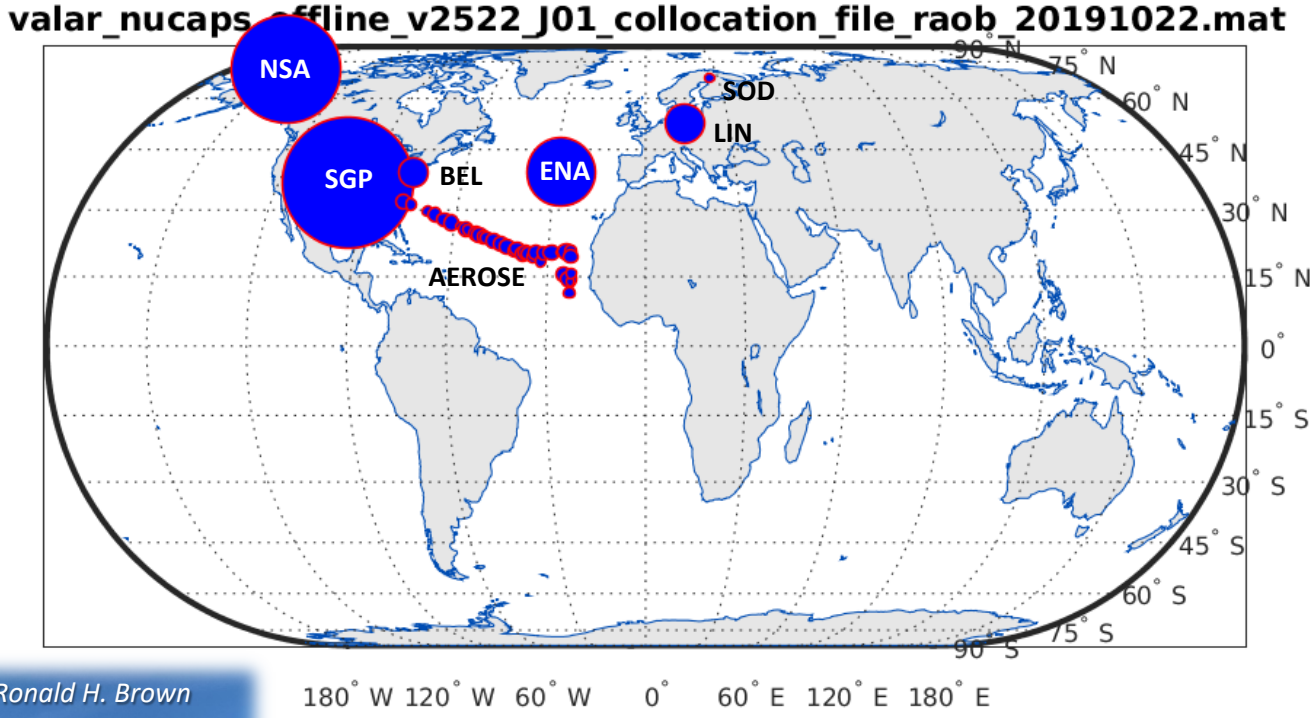
VALAR NUCAPS Dedicated RAOB Collocations

Validation Archive (VALAR)

- CrIS/ATMS granules SDR/TDR matched with truth data using NPROVS collocation files
  - **Atmospheric Radiation Measurement (ARM)** Sites (*Tobin et al.* 2006)
    - Eastern North Atlantic (ENA)
    - Southern Great Plains (SGP)
    - North Slope of Alaska (NSA)
    - Radiosonde Intercomparison and Validation (RIVAL) campaign
  - **GRUAN** Sites (Bodeker et al. 2016)
    - Lindenberg, Germany (LIN)
    - Sodankyla, Finland (SOD)
    - Beltsville, Maryland (BEL/HUBC)
  - **2019 NOAA AEROSE** campaign (*Nalli et al.* 2011; *Morris et al.* 2006)
    - Mar 2019, tropical Atlantic Ocean

Geographic Histogram of Dedicated RAOB NOAA-20 Collocations (Equal Area)

($\delta x \leq$ 100 km, $-100 < \delta t < +5$ min)

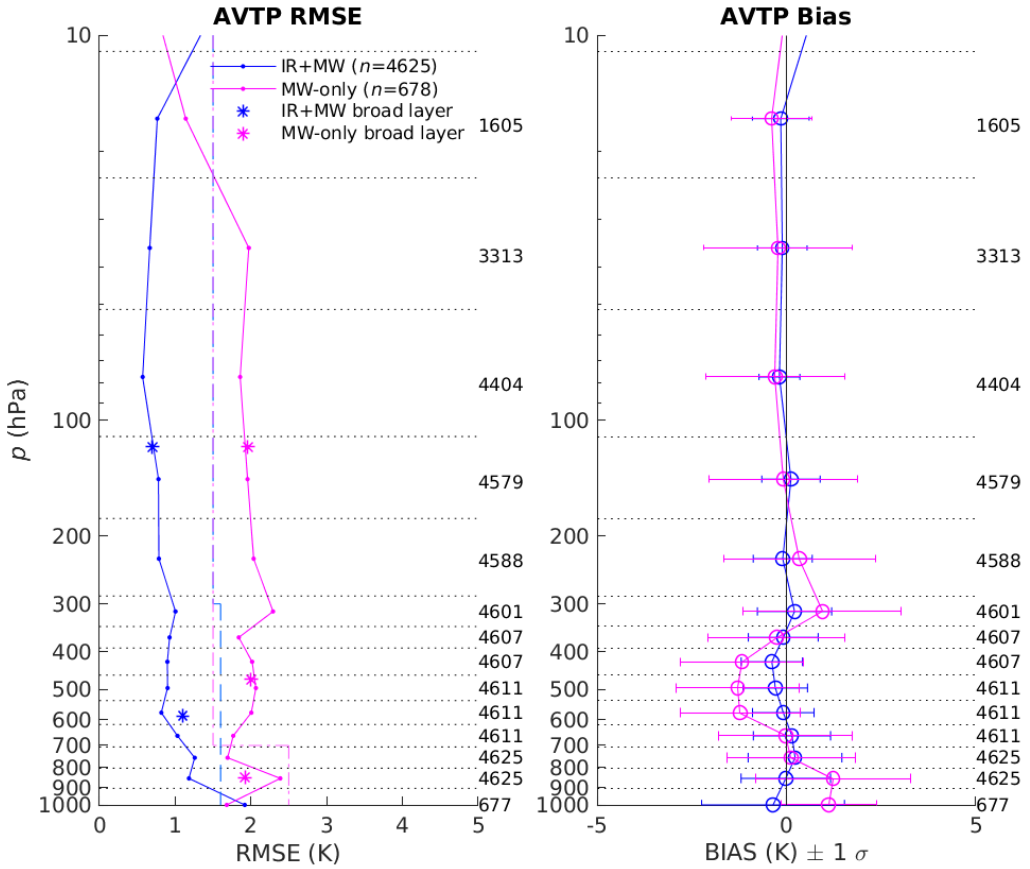


Rigorous zonal and land/sea surface area weighting are applied to VALAR collocation sample statistics.

NUCAPS NOAA-20 AVTP/AVMP vs Dedicated RAOB

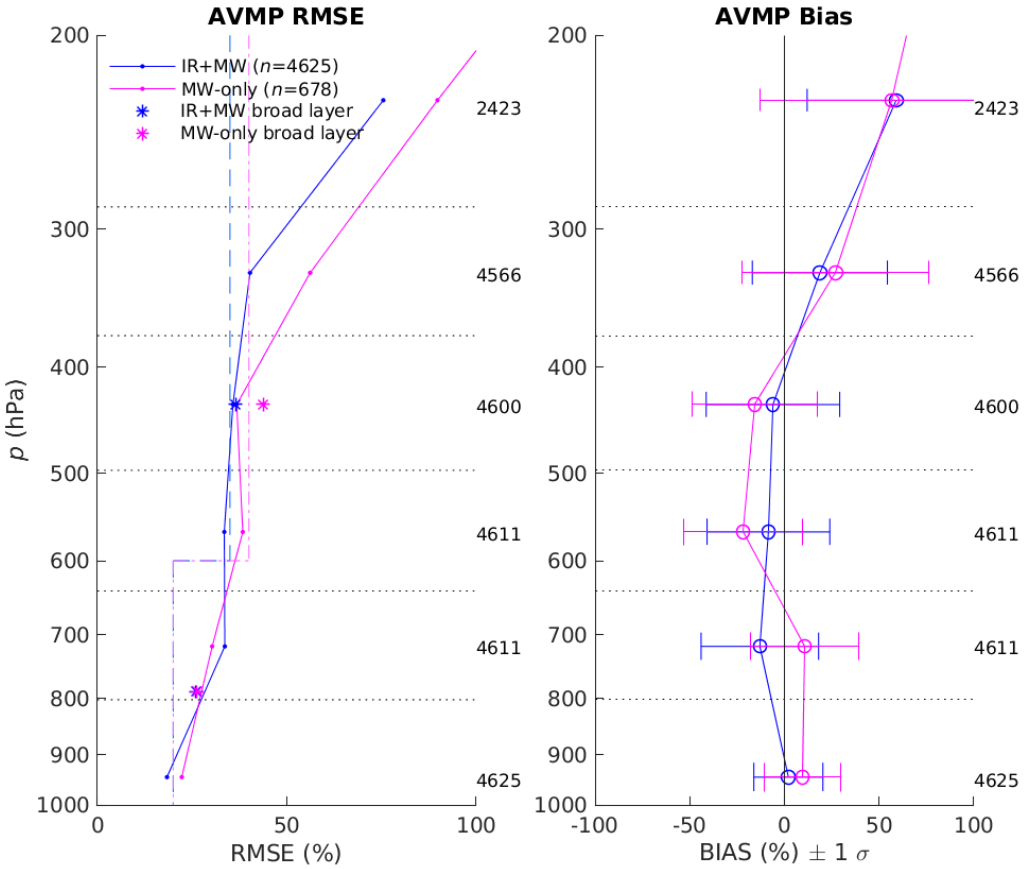
IR+MW
MW-Only

AVTP



IR+MW
MW-Only

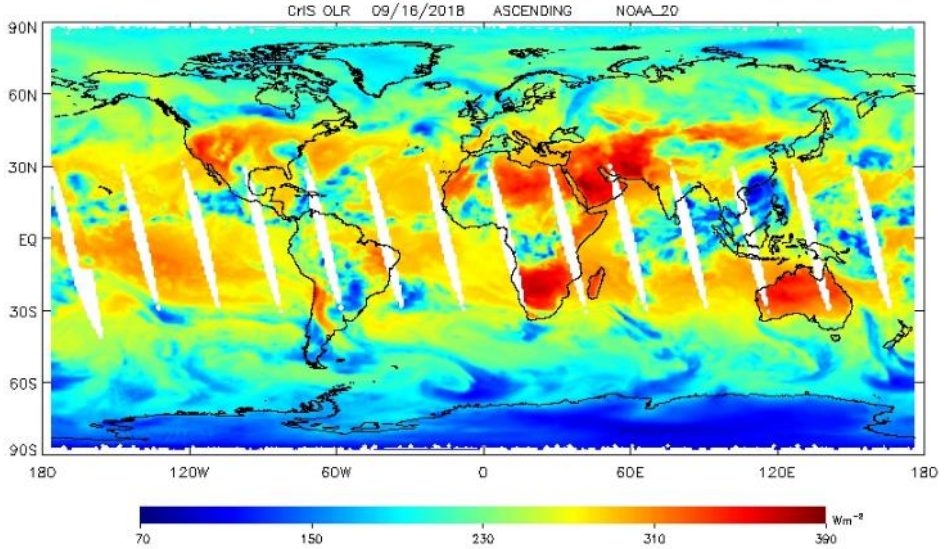
AVMP



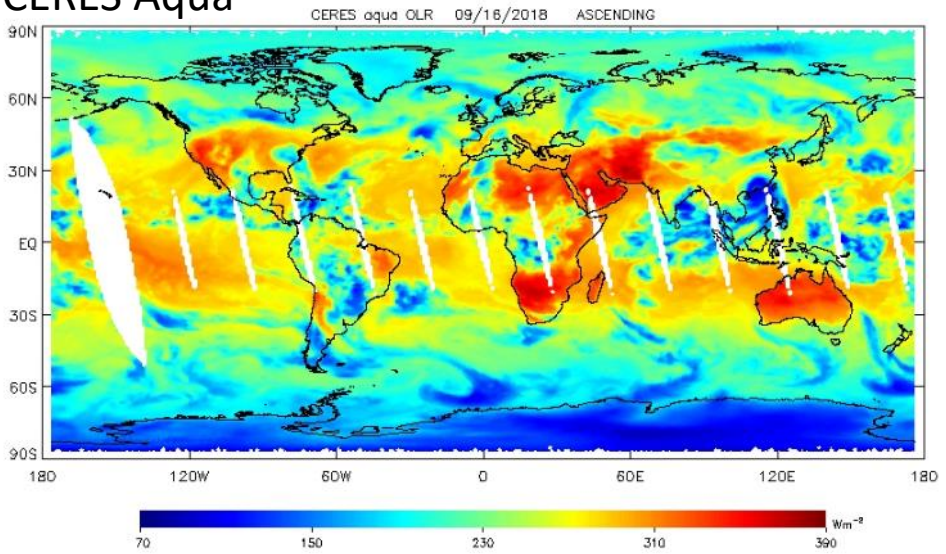
NUCAPS CrIS NOAA-20 OLR Validation –Daily OLR

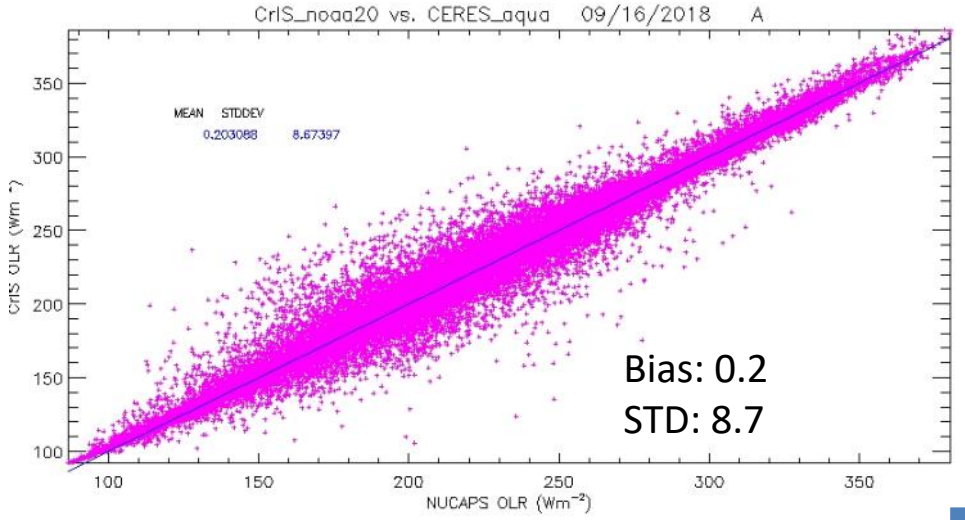
CrIS NOAA-20 OLR vs CERES Aqua OLR

CrIS NOAA-20



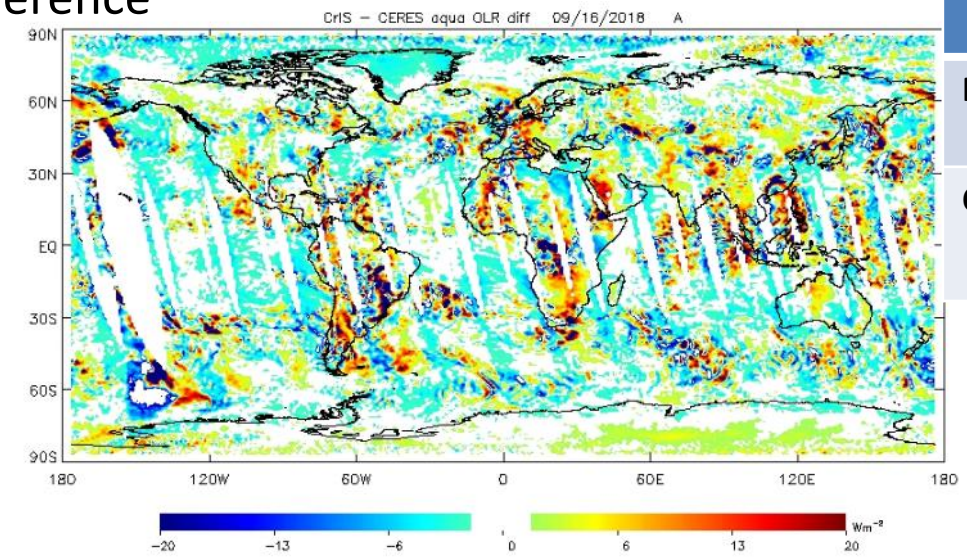
CERES Aqua





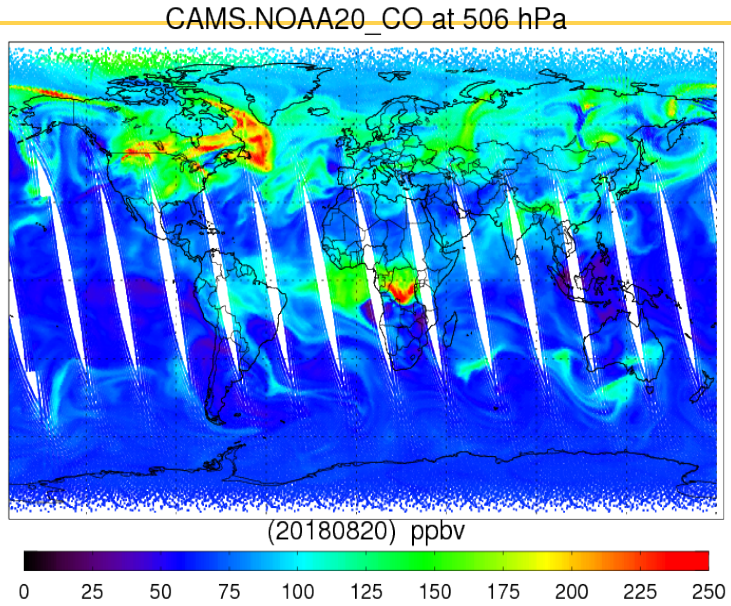
CrIS NOAA-20 agrees well with CERES Aqua and meets requirements

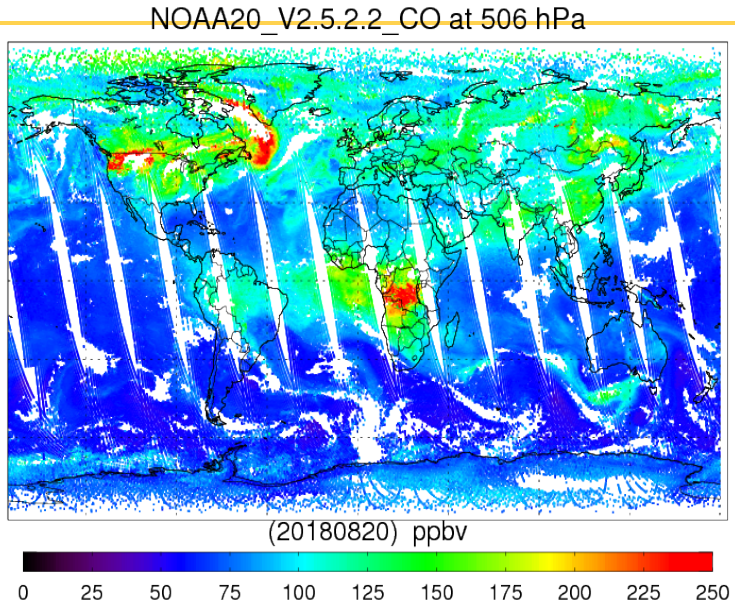
Difference



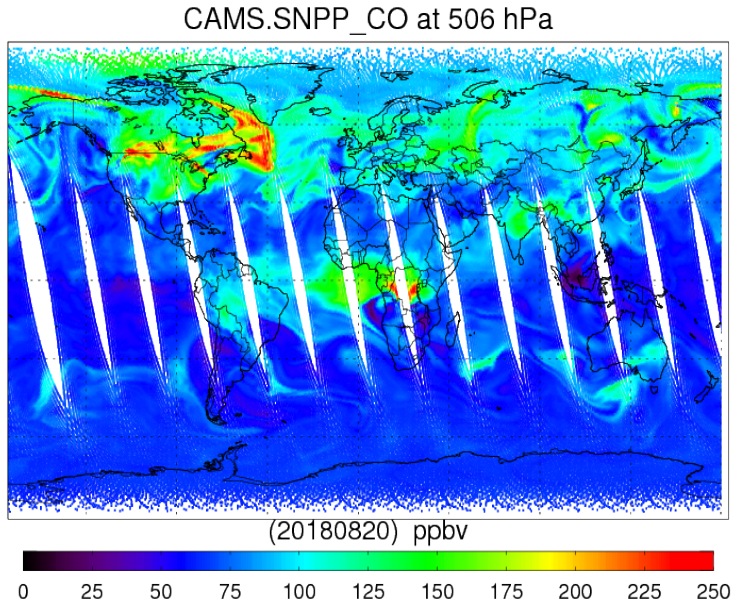
W/m²	BIAS	STD
Requirement	5.0	12.0
CrIS NOAA-20	0.2	8.7

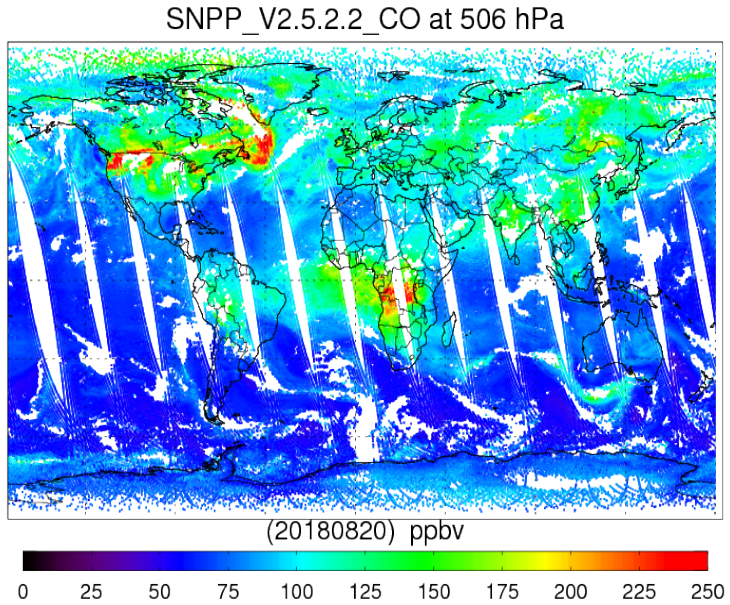
NUCAPS, CAMS and AIRS CO on 20-Aug-2018

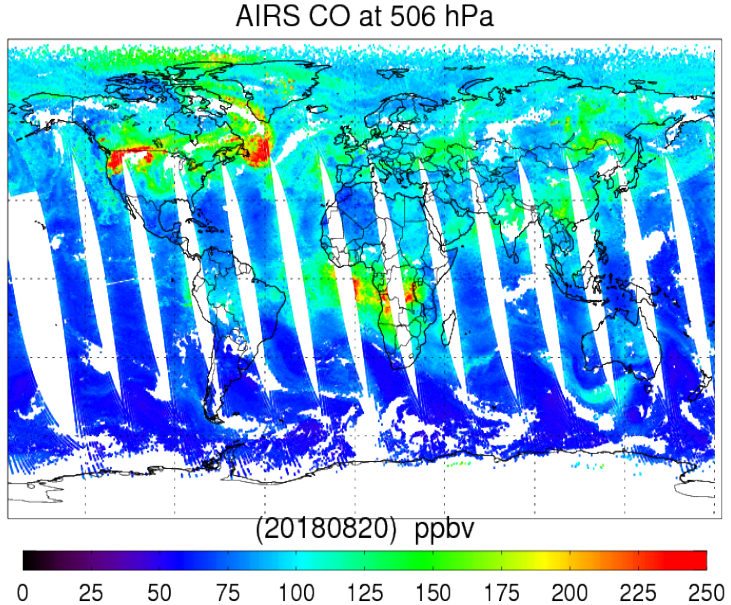




- The CO from NUCAPS, AIRS, Copernicus Atmospheric Monitoring Service (CAMS model) show similar patterns and magnitude.







NUCAPS Carbon Trace Gas EDR Reference data, Time Periods

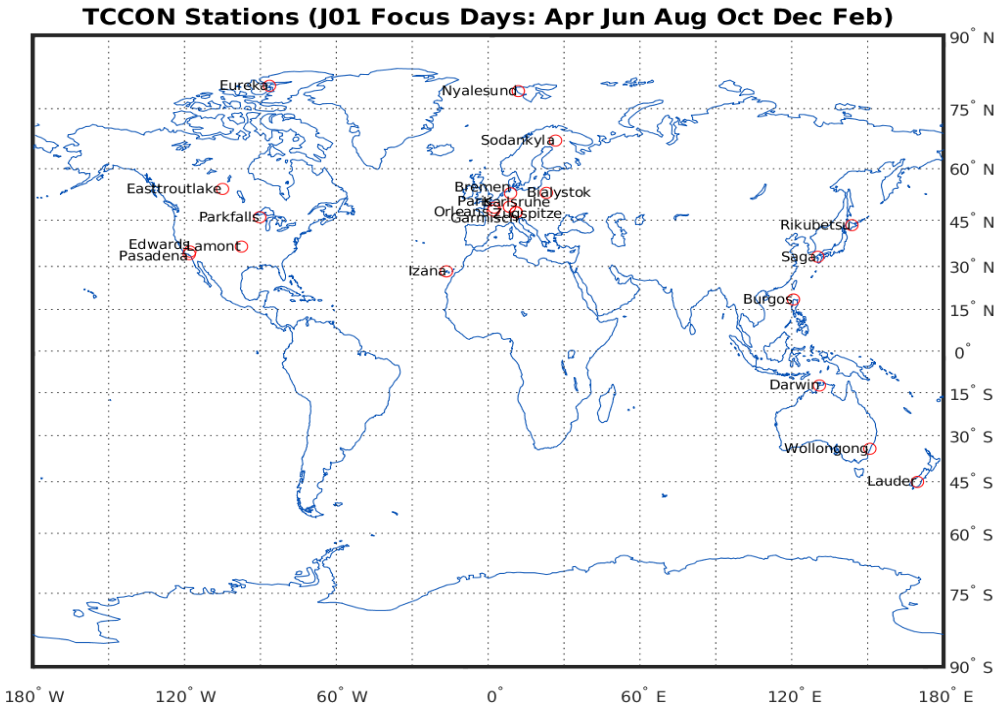
Observation Type	Reference Data	Time Period	Validation	Remarks
Atmospheric Tomography Mission (ATom)	• DC-8 aircraft based *in situ* air samples • Profiles of volume mixing ratios (ppmv) obtained using NOAA/ESRL Picarro G2401m analyzer	ATom-1,-2: Jul 2016 to Feb 2017 ATom-4: Apr-May 2018	✓ CO meets requirements in sensitive layers (where AKs peak) ✓ CH4 meets bias requirement throughout column ✓ CO2 meets bias and precision requirements throughout column	ATom (*Wofsy et al.* 2018) acknowledgment • Kathryn McCain, Colm Sweeney (NOAA/ESRL) • https://doi.org/10.3334/ORNLDAAC/1581
Total Carbon Column Observing Network (TCCON)	• Ground-based network of uplooking spectrometers • Total column DMF retrieved from near-IR solar spectrum	6 Focus Days: Apr, Jun, Aug, Oct, Dec 2018, and Feb 2019	✓ CO meets total column requirements ✓ CH4 meets total column bias requirement ✓ CO2 meets total column requirements	TCCON (*Wunch et al.* 2010, 2011) acknowledgment • Debra Wunch (CalTech)

TCCON and ATOM Data for NUCAPS Trace Gas Validations

https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php

Total Carbon Column Observing Network (TCCON Wunch et al., 2011)

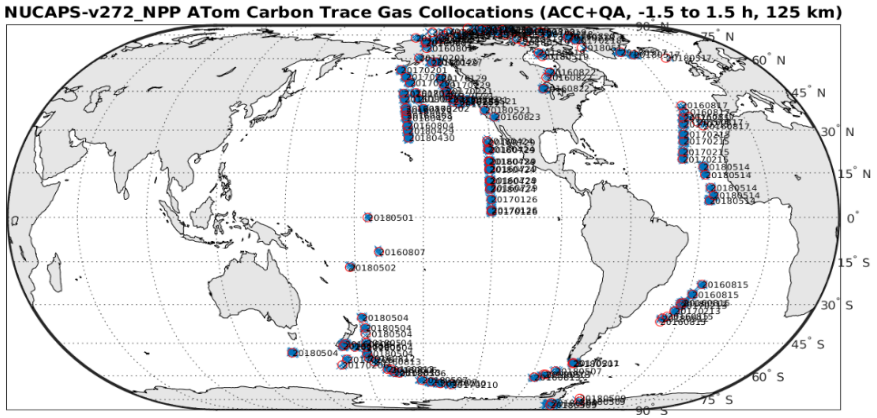
Collocated Focus Day Stations
NOAA-20 Trace Gas QA, ±2 hr, 125 km



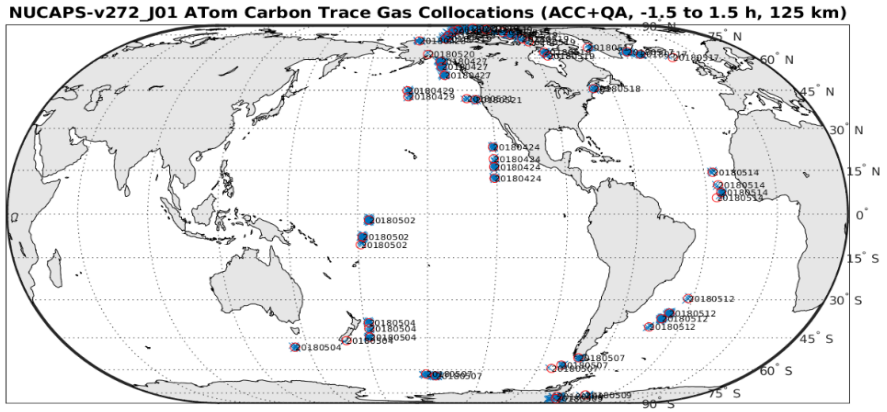
- **Global network of ground-based FTS** that accurately measure total column abundances of CO_2, CO, CH_4, N_2O trace gases
- Serves as **SNPP ↔ NOAA-20 transfer standard**, complementing the ATom analysis

Atmospheric Tomography (ATom) Mission (Wofsy et al. 2018)

- ATom deployed extensive gas and aerosol payloads on the NASA DC-8 aircraft for global-scale sampling of the atmosphere, profiling continuously from 0.2–12 km altitude
- We use the NOAA Picarro ATom-1, -2 and -4 datasets (2016-2018)



SNPP Extracted ATom Profile Collocations



NOAA-20 Extracted ATom Profile Collocations

NUCAPS *vs.* TCCON and NUCAPS *vs.* ATOM Statistical Summary

(https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php

NUCAPS *vs.* TCCON

Parameter	Stat	Raw Total Column		TCCON AKs applied	
		NUCAPS	Req	NUCAPS	Req
CO	Precision	7.4 (8.7)	15%	7.2 (8.4)	15%
	Accuracy	+6.1 (7.7)	±5%	+7.7 (8.8)†	±5%
CH4	Precision	2.0 (1.4)*	1%* (20 ppmv)	1.9 (1.4)*	1% (20 ppmv)
	Accuracy	−1.1 (+0.0)	4% (80 ppmv)	−1.0 (+0.0)	4% (80 ppmv)
CO2	Precision	1.5‡ (0.4)	0.5% (2 ppmv)	1.6‡ (0.4)	0.5% (2 ppmv)
	Accuracy	−1.0 (−0.4)	±1% (4 ppmv)	−1.0 (−0.4)	±1% (4 ppmv)

Values in ( ) indicates SNPP

- **Meets requirement**
- **Marginal (± 30%)**
- **Outside Requirement (with explanation)**

NOTES

*Precision requirements for CH4 are now known to be too stringent and will require waver.

†NUCAPS CO sensitivity peaks in mid-troposphere whereas TCCON peaks above 100 hPa.

‡ This includes some large NUCAPS outliers at one of the TCCON stations.

V2.7.2 Global Yields:

CO = 75.5 (74.3)%, *N* = 514 (472)

CH4 = 58.3 (66.5)%, *N* = 397 (422)

CO2 = 82.5 (85.0)%, *N* = 562 (540)

NUCAPS *vs.* ATOM

Parameter	Stat	Raw Total Column		NUCAPS AKs applied	
		NUCAPS	Req	NUCAPS	Req
CO	Precision	18.1 (15.4)	15%	9.5 (8.8)	15%
	Accuracy	+10.8 (+7.4)†	±5%	+2.4 (+1.8)	±5%
CH4	Precision	1.5 (1.6)*	1%* (20 ppmv)	1.4 (1.3)*	1% (20 ppmv)
	Accuracy	−0.2 (+0.0)	4% (80 ppmv)	+0.8 (+0.7)	4% (80 ppmv)
CO2	Precision	0.4 (0.4)	0.5% (2 ppmv)	0.3 (0.3)	0.5% (2 ppmv)
	Accuracy	−0.6 (−0.6)	±1% (4 ppmv)	−0.1 (−0.1)	±1% (4 ppmv)

Values in ( ) indicates SNPP

- **Meets requirement**
- **Marginal (± 30%)**
- **Outside Requirement (with explanation)**

NOTES

*Precision requirements for CH4 are now known to be too stringent and will require waver.

†NUCAPS CO sensitivity peaks in mid-troposphere, so the AK results are more reflective of the algorithm performance..

V2.7.2 Global Yields:

CO = 57.7 (63.6)%, *N* = 459 (1407)

CH4 = 37.7 (48.4)%, *N* = 300 (1072)

CO2 = 63.3 (67.9)%, *N* = 504 (1502)

NUCAPS vs. ATom Trace Gas Results

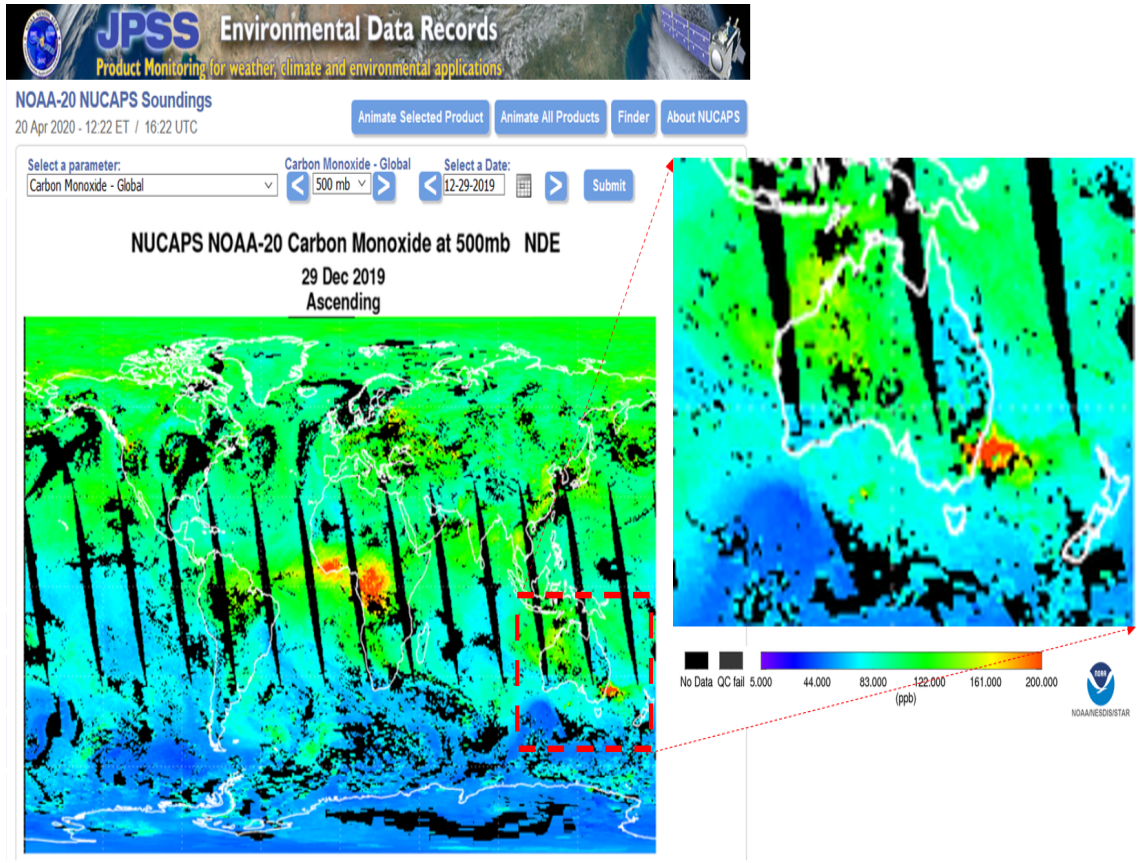
https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php

- **SNPP** and **NOAA-20** retrievals are comparable
- ***T*/H_2O/O_3** favorably compare with ATom truth, are comparable with OPS and have not suffered any degradation
- **SNPP OPS** and **v2.7.2 CO** retrievals are comparable to Oct 2019 results and have not suffered degradation
- **NUCAPS CO, CH_4** and **CO_2 trace gas retrievals improve the *a priori*** in the layers of sensitivity
- **CH_4 retrievals** are **slightly improved** over OPS (offline v2.5.2.2)
- **CO_2 retrievals** and ***a priori*** are **significantly improved** over OPS
- **CO** and **CO_2 retrievals** are "near-perfect" after applying AKs to the ATom data
- **With the exception of CH_4,** which does not meet the overly-stringent precision requirement of 1%, **NUCAPS trace gas retrievals** using averaging kernels (AKs) **meet JPSS L1 Requirements**

NUCAPS Trace Gas Products in Environmental Monitoring
Case Studies: (1) Australian Fires and (2) Corona Virus

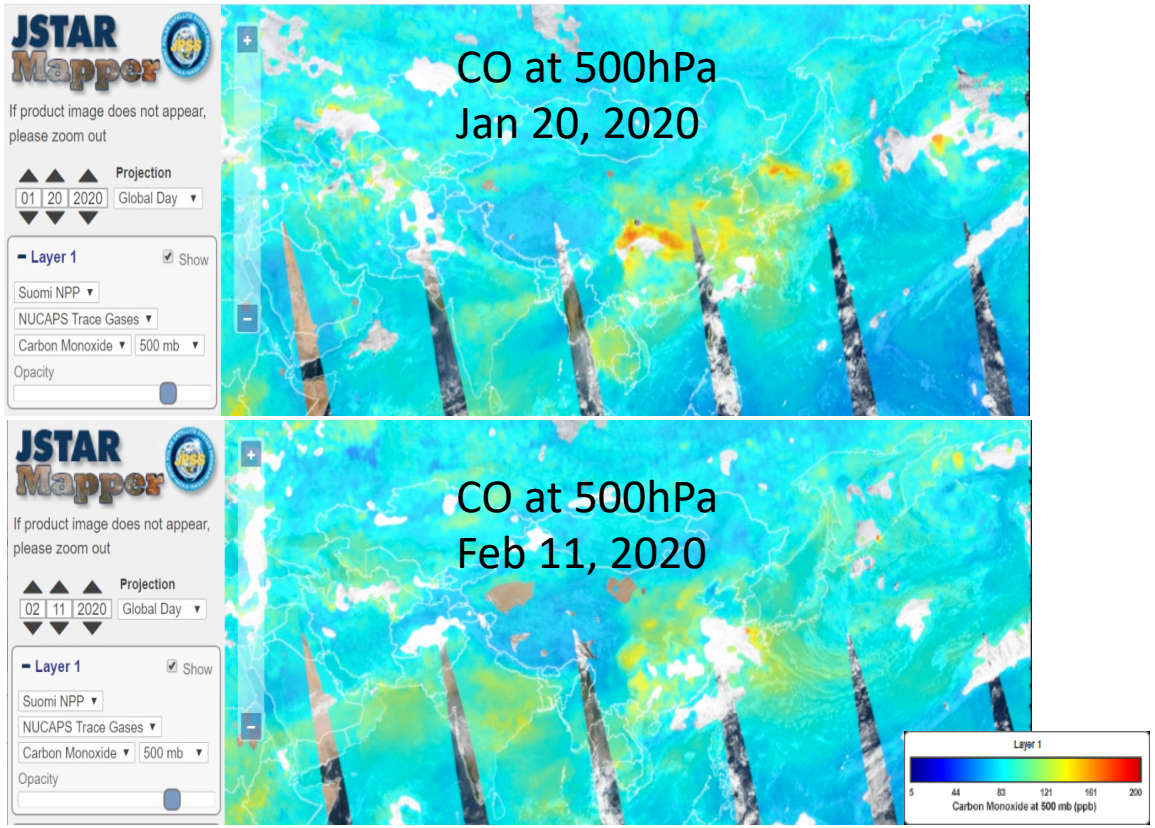
NUCAPS Retrievals on JPSS EDRs LTM
CO monitoring Australia Wildfire – Dec 29, 2019

https://www.star.nesdis.noaa.gov/jpss/EDRs/products_Soundings_N20.php

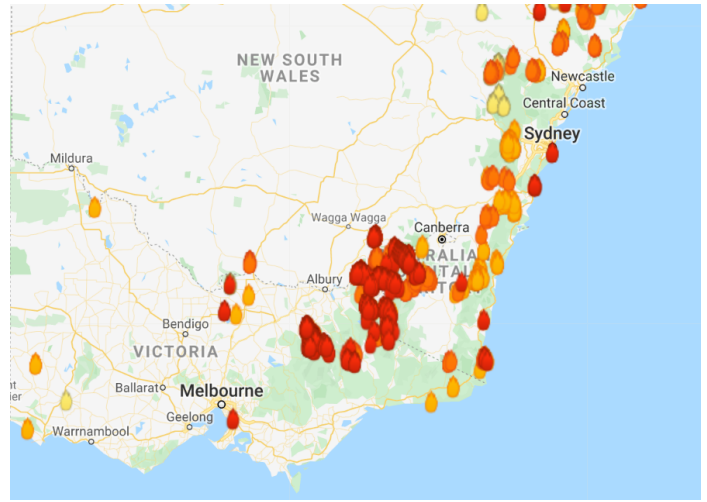


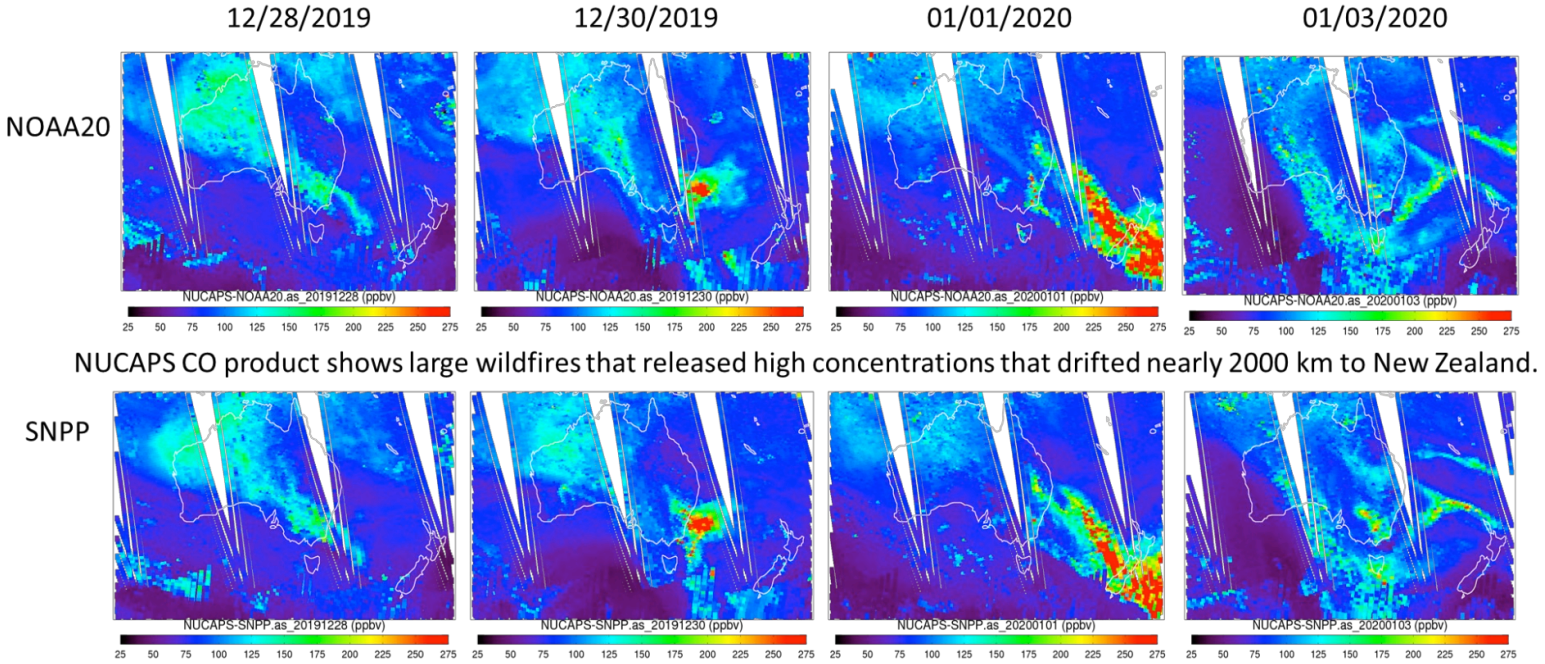
NUCAPS Retrievals on JSTAR Mapper
COVID-19 Impacts over China

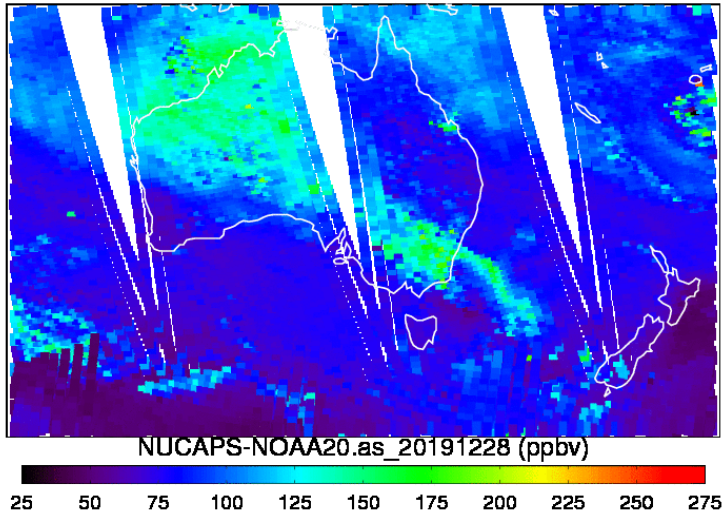
https://www.star.nesdis.noaa.gov/jpss/mapper



- NUCAPS has effectively measured carbon monoxide (CO) concentration and generated vertical sounding profiles over SE Australia and adjacent coastal waters in association with two widespread wildfire outbreaks:
  - 30 December 2019 – 1 January 2020
  - 5 -8 January 2020
- NOAA-20 and SNPP NUCAPS CO product captured a smoke plume that advected from the Australian Alps southeastward over the Tasman Sea toward New Zealand.





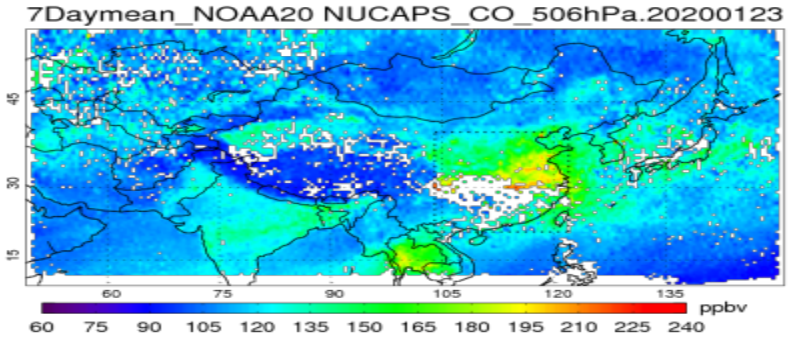


NUCAPS Trace Gas Products are also available on JSTAR Mapper https://www.star.nesdis.noaa.gov/jpss/mapper

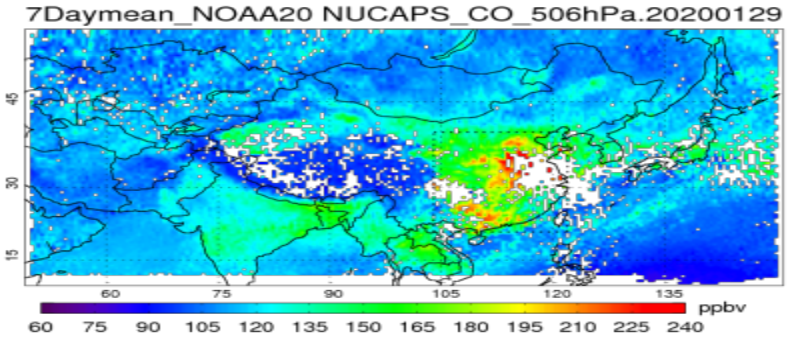
NUCAPS Case Studies and Applications: NUCAPS CO Over SE Asia During COVID-19 January – March, 2020

https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php

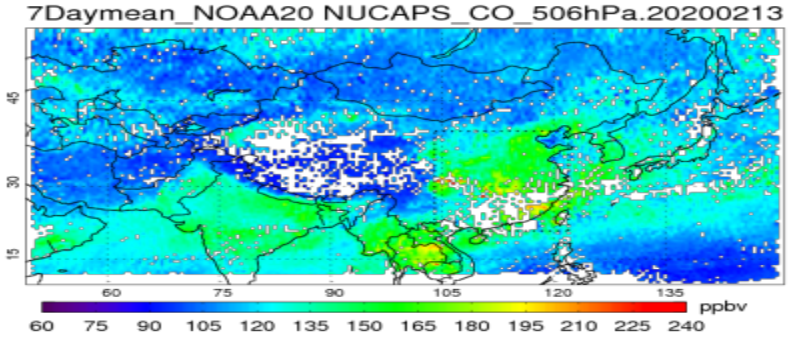
17 – 23 Jan 2020



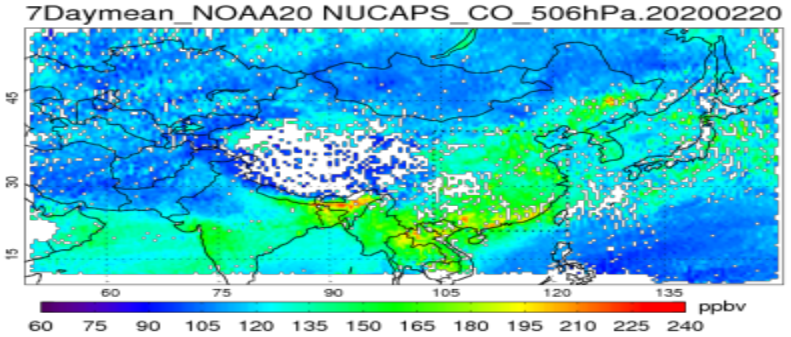
23 – 29 Jan 2020



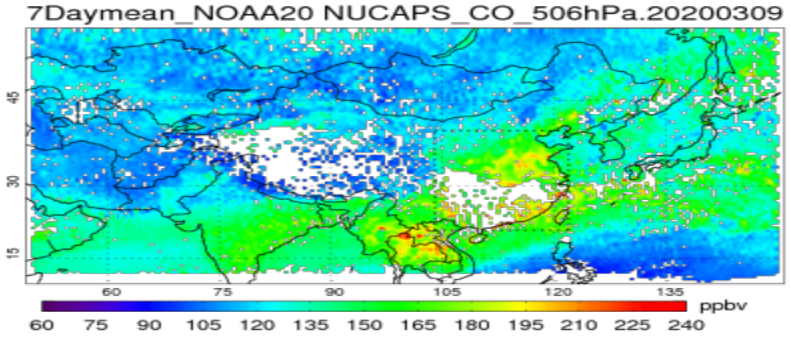
7 – 13 Feb 2020



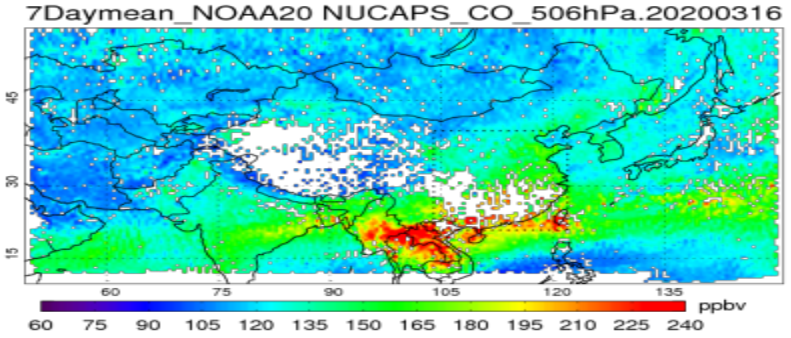
14 – 20 Feb 2020



3 – 9 Mar 2020



10 – 16 Mar 2020



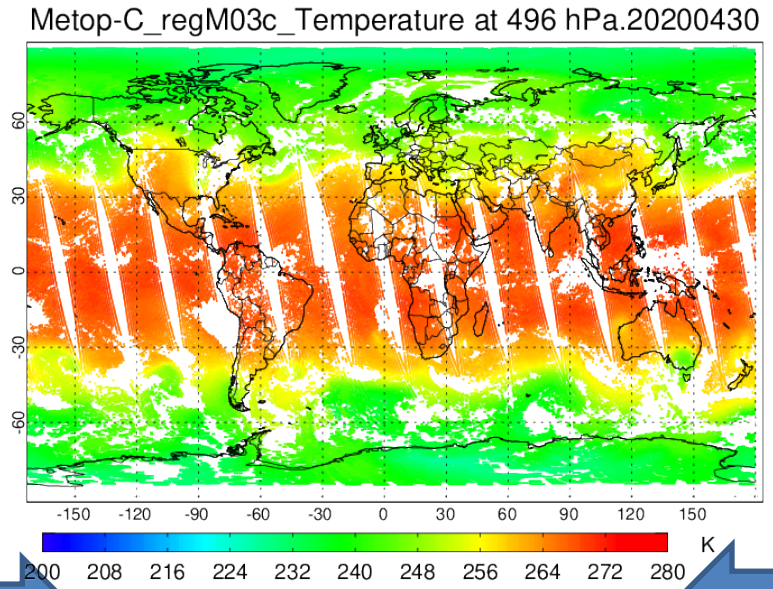
- COVID-19
  - Start lockdown of 4 cities in Hubei province on Jan 23, 2020
  - Lockdown expanded to 27 cities over Southeast China by Feb 4, 2020

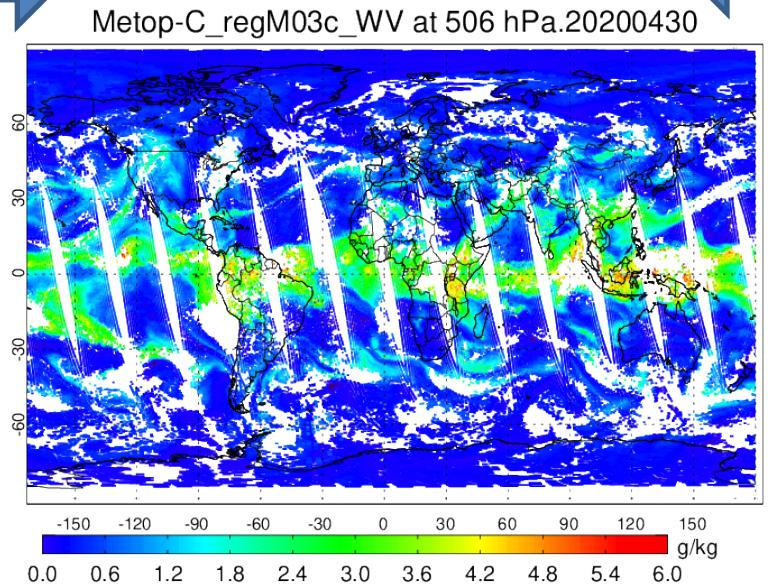
- Collected NOAA20 SDR data over 50E-150E, 10N-55N,
- Generated NUCAPS NOAA20 v2.7.2 retrieval for 90 days
- Analyzed NUCAPS CO retrievals at 506 hPa:

- 7-day composite CO(mean) figures
  - Time series of CO averaged over 104E-122E, 21N-40N
  - https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.ph

NUCAPS System Development for MetOp Series

- **NUCAPS Baseline**
  - ✓ Used NUCAPS v2.7.2 as the baseline to setup MetOp-C DAP.
- **Results**
  - ✓ Product consistency among MetOp-A/B/C
  - ✓ Product evaluation and statistical metrics
- **On-going Research**
  - ✓ Cloud-clearing efficiencies between IASI (2 FOVs x 2 FOVs) vs. CrIS (3 x 3 FOVs)
  - ✓ SNO studies
    - ➢ S-NPP vs. MetOP-A
    - ➢ Collaboration with the SDR team

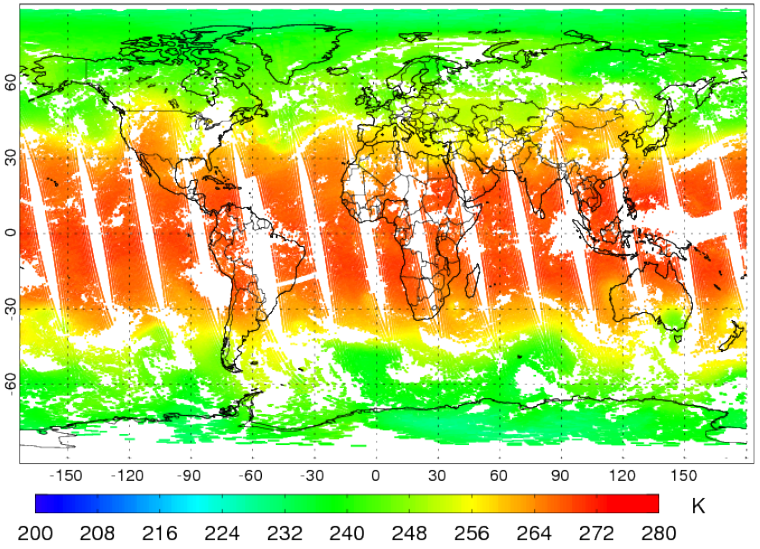




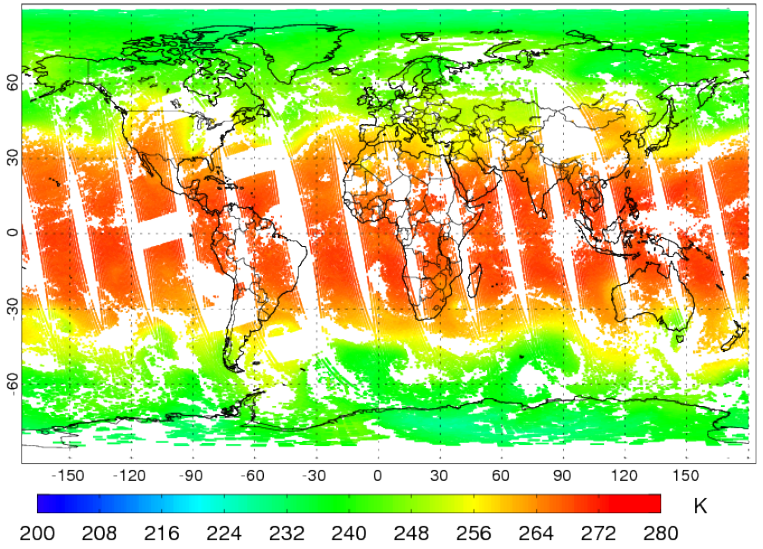
- **Focus Day: 04/30/2020**
  - **MetOp–C (MetOp-B/A)**
    - ✓ IASI, AMSU-A, MHS level-1 Data Sets
    - ✓ NUCAPS EDRs for each satellite configuration
    - ✓ ECMWF matches for each satellite configuration
    - ✓ Copernicus Atmosphere Monitoring Service (CAMS) model data matches for each satellite configuration
    - ✓ OLR products
  - **S-NPP/NOAA-20**
    - ✓ CrIS/ATMS SDRs
    - ✓ NUCAPS EDRs for both S-NPP/NOAA-20
    - ✓ CAMS model data matches for each satellite configuration
    - ✓ OLR Products

500 hPa Temperature Maps: MetOp-A/B/C, SNPP/NOAA20, ECMWF

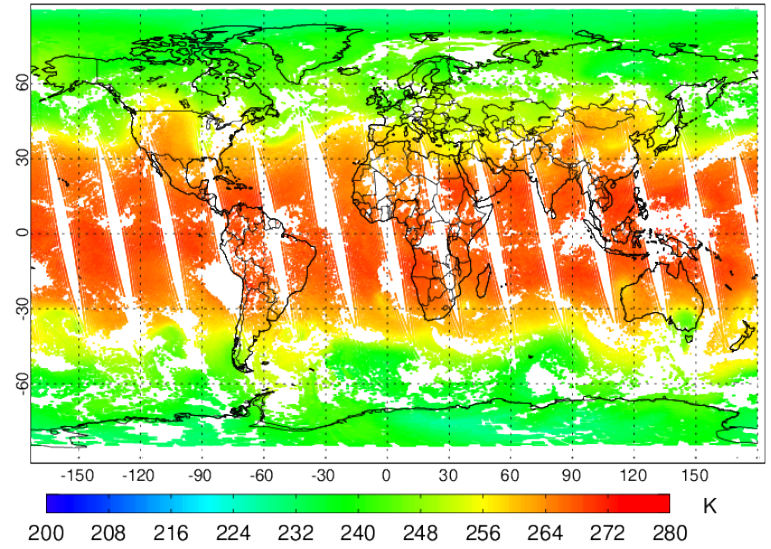
Metop-A_AVN_Temperature at 496 hPa.20200430



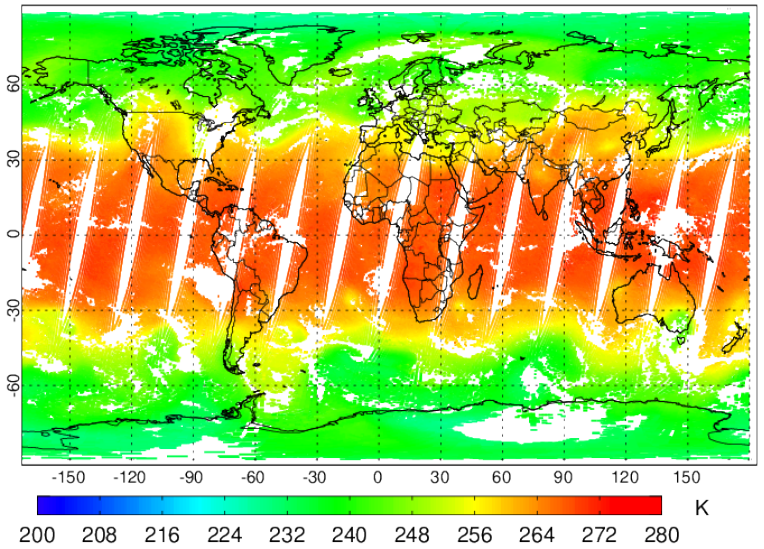
Metop-B_AVN_Temperature at 496 hPa.20200430



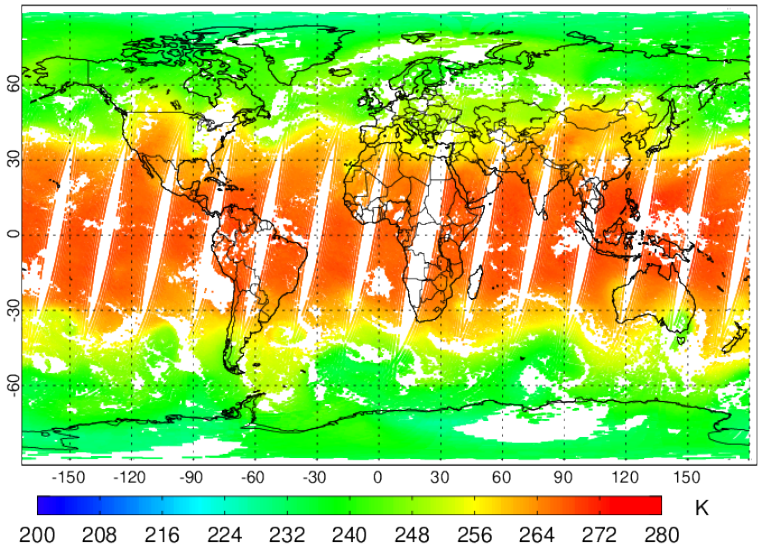
Metop-C_regM03c_Temperature at 496 hPa.20200430



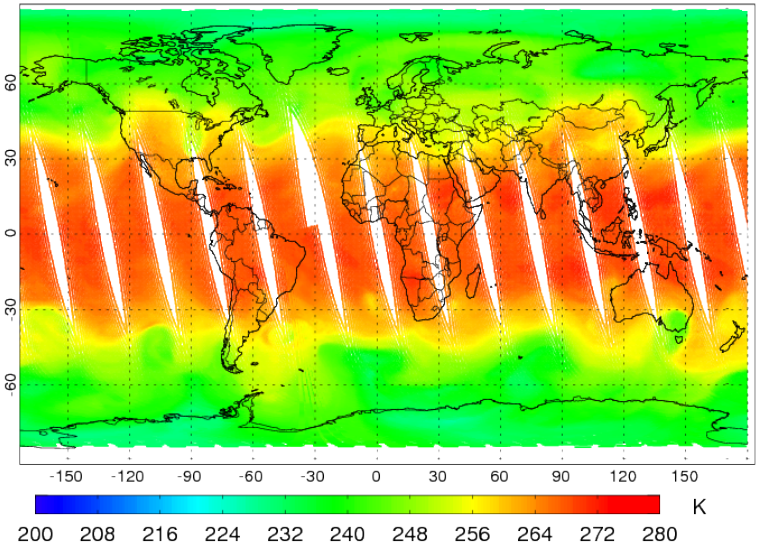
SNPP_v2.8b_Temperature at 496 hPa.20200430



NOAA20_v2.8b_Temperature at 496 hPa.20200430

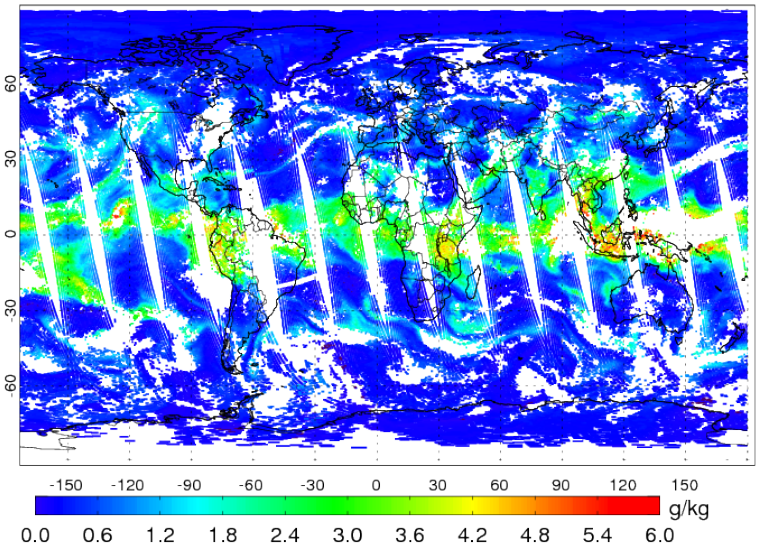


ECMWF_Met-C_Temperature at 496 hPa.20200430

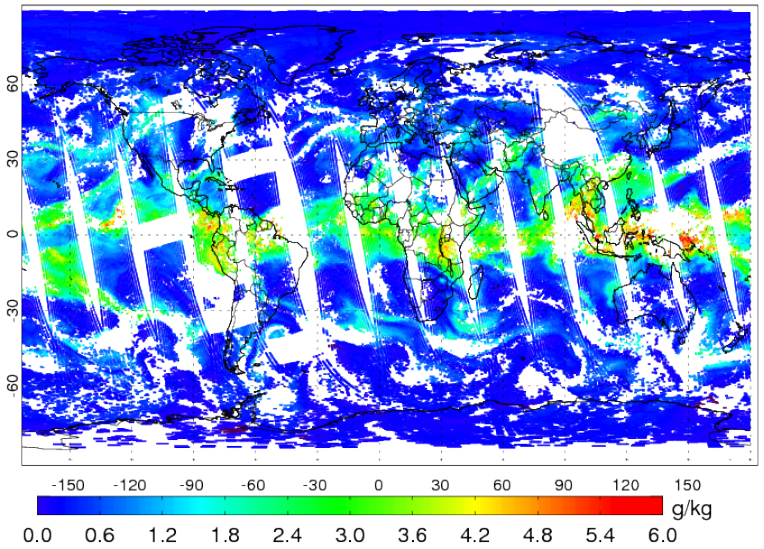


500 hPa Water Vapor Maps: Metop-A/B/C, SNPP/NOAA20, ECMWF

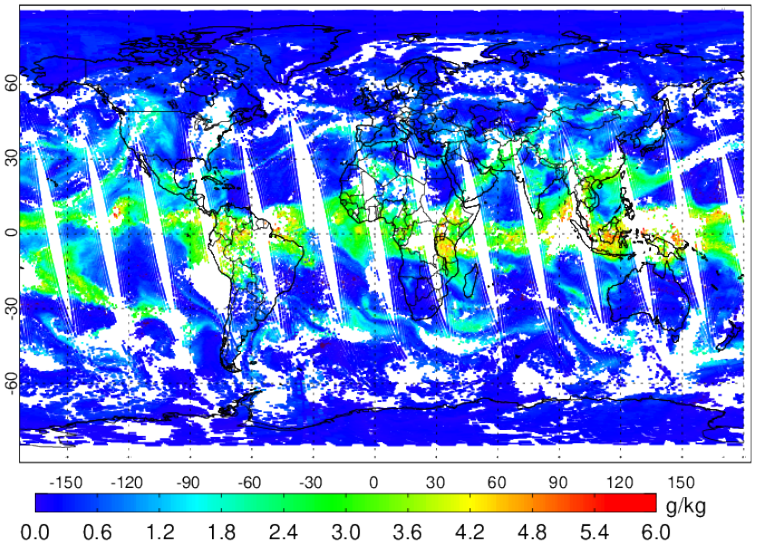
Metop-A_AVN_WV at 506 hPa.20200430



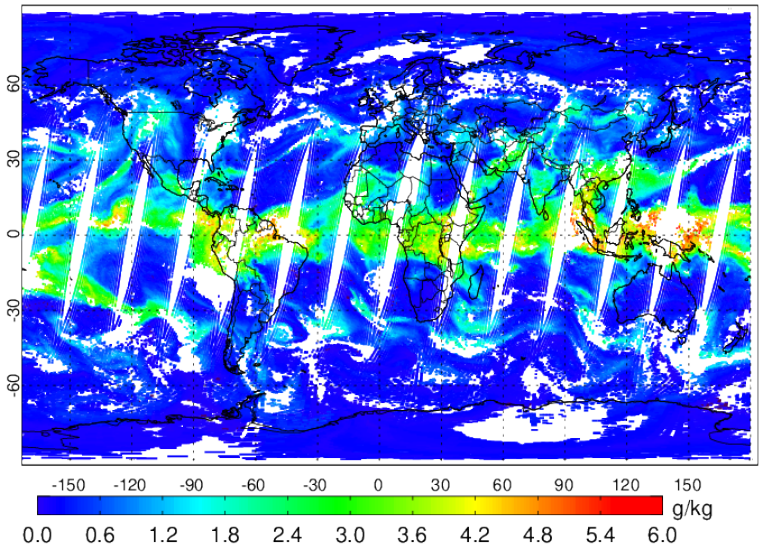
Metop-B_AVN_WV at 506 hPa.20200430



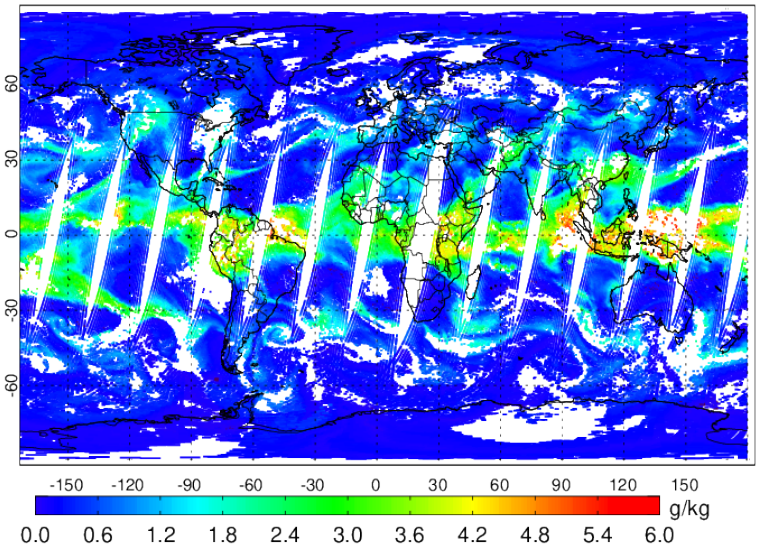
Metop-C_regM03c_WV at 506 hPa.20200430



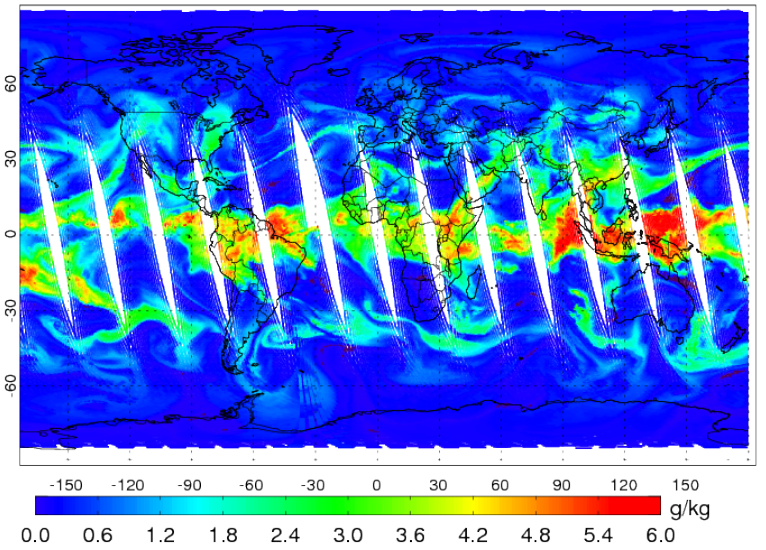
SNPP_v2.8b_WV at 506 hPa.20200430



NOAA20_v2.8b_WV at 506 hPa.20200430

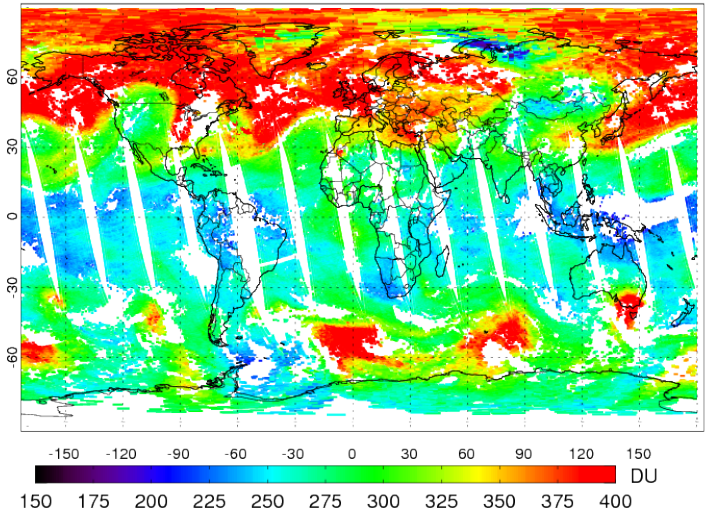


ECMWF_Met-C_WV at 506 hPa.20200430

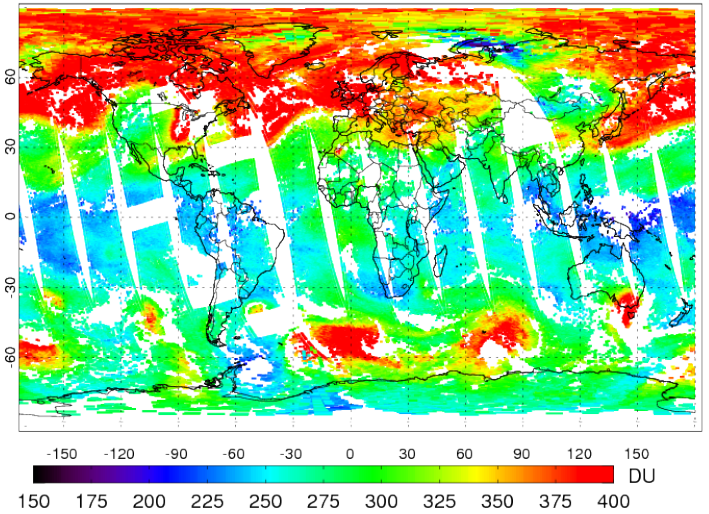


Total Ozone: Metop-A/B/C, SNPP/NOAA-20, ECMWF

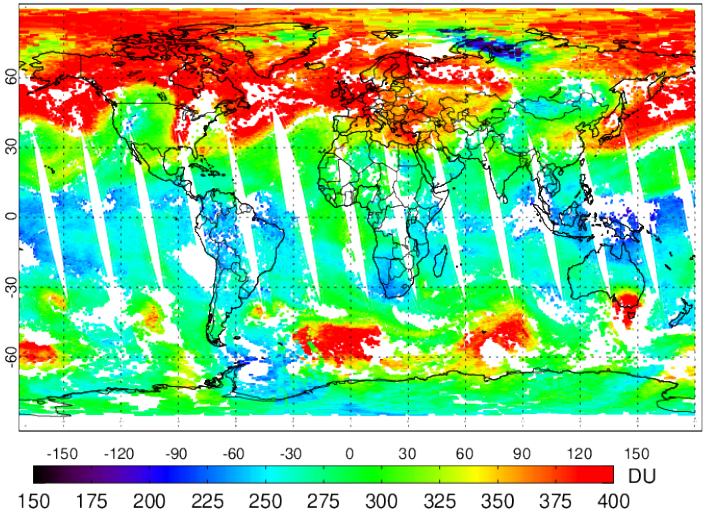
Metop-A_AVN_Total column of O3.20200430



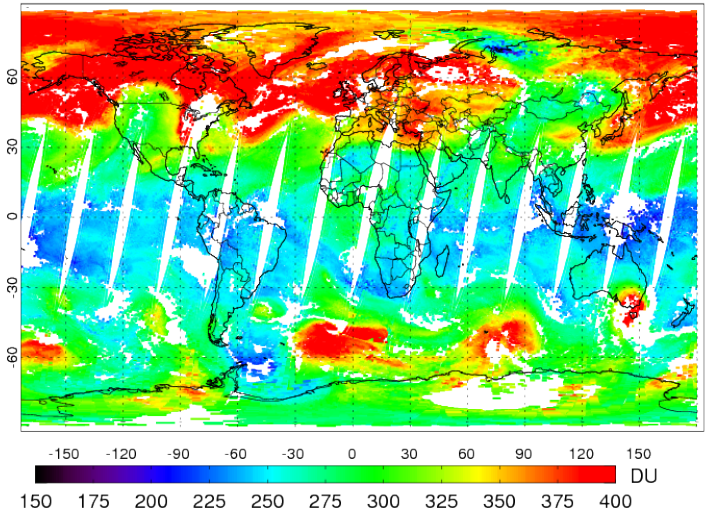
Metop-B_AVN_Total column of O3.20200430



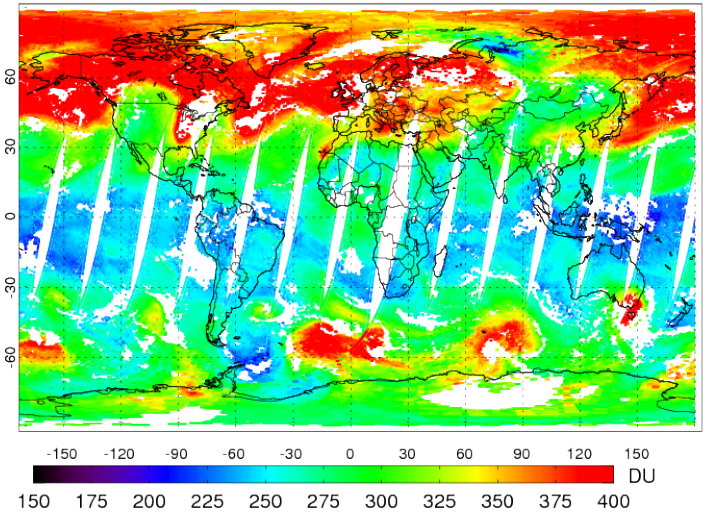
Metop-C_regM03c_Total column of O3.20200430



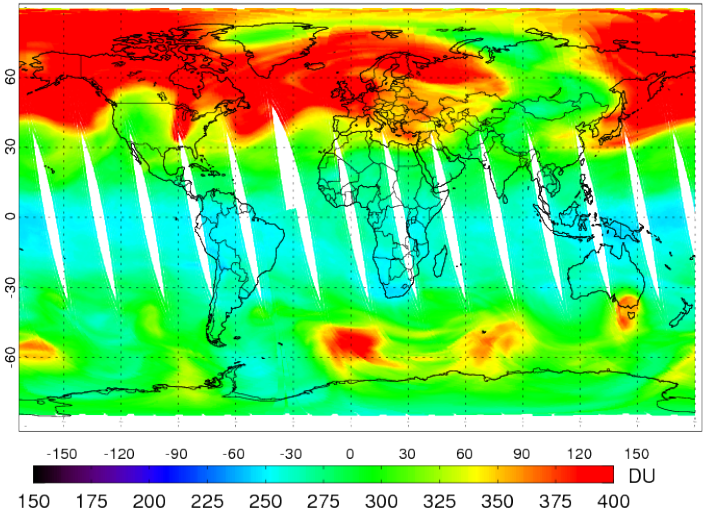
SNPP_v2.8b_Total column of O3.20200430



NOAA20_v2.8b_Total column of O3.20200430

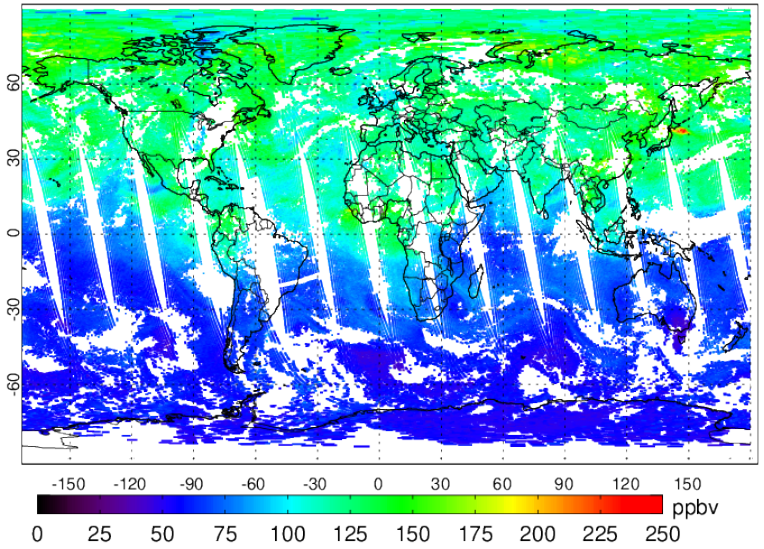


ECMWF_Met-C_Total column of O3.20200430

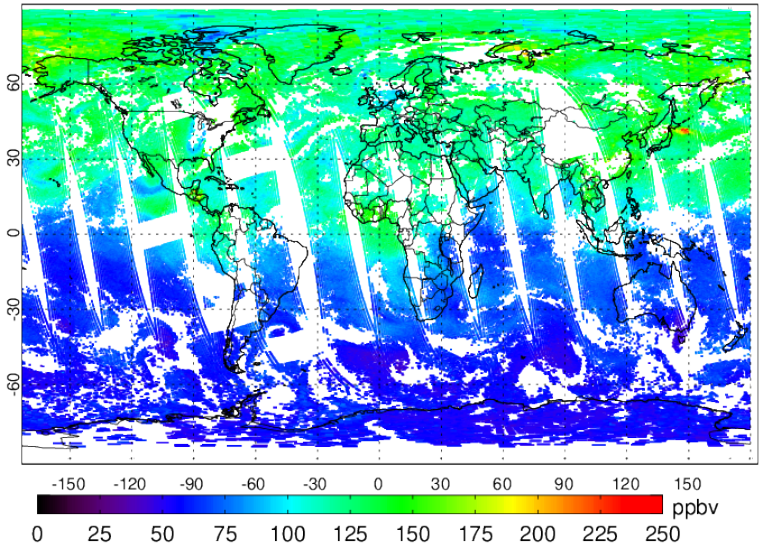


500 hPa Carbon Monoxide Maps: Metop-A/B/C, SNPP/NOAA-20, ECMWF

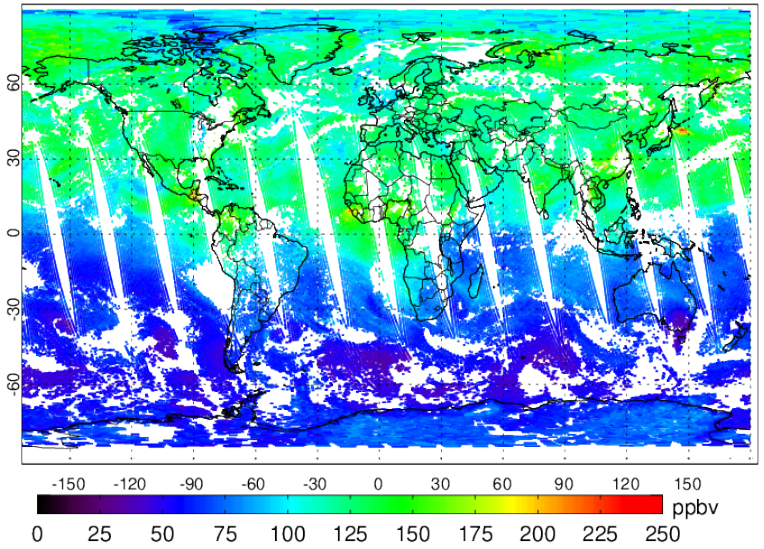
Metop-A_AVN_CO at 506 hPa.20200430



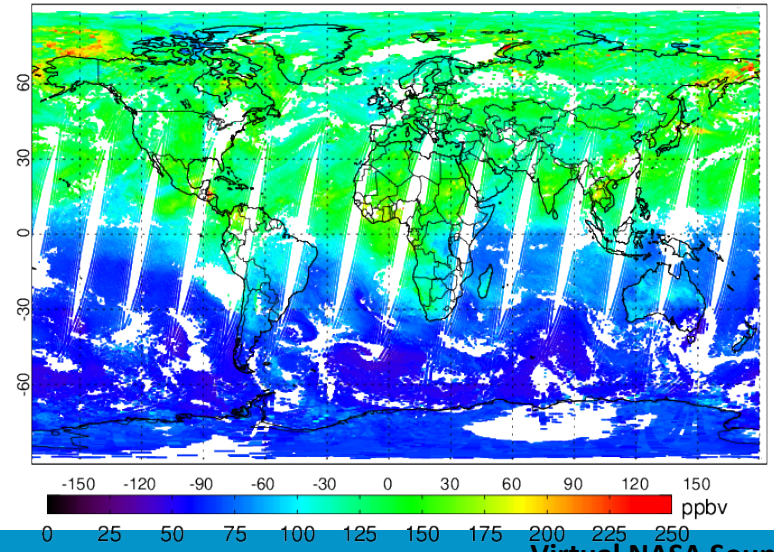
Metop-B_AVN_CO at 506 hPa.20200430



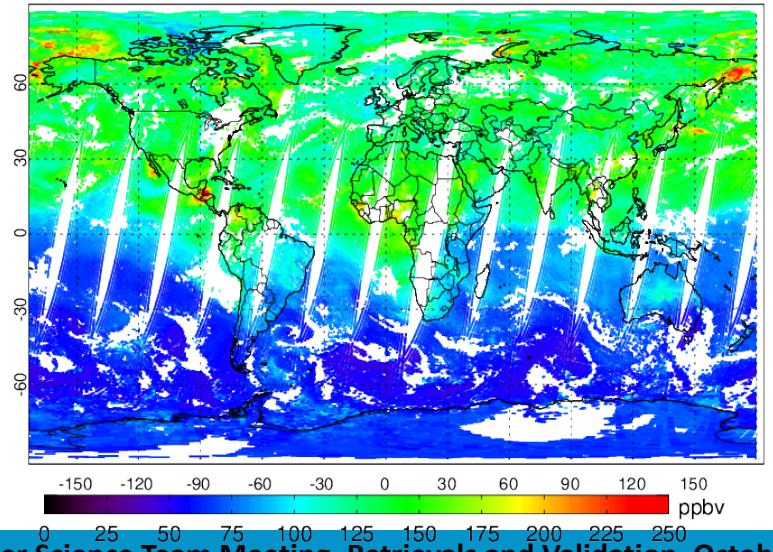
Metop-C_regM03c_CO at 506 hPa.20200430



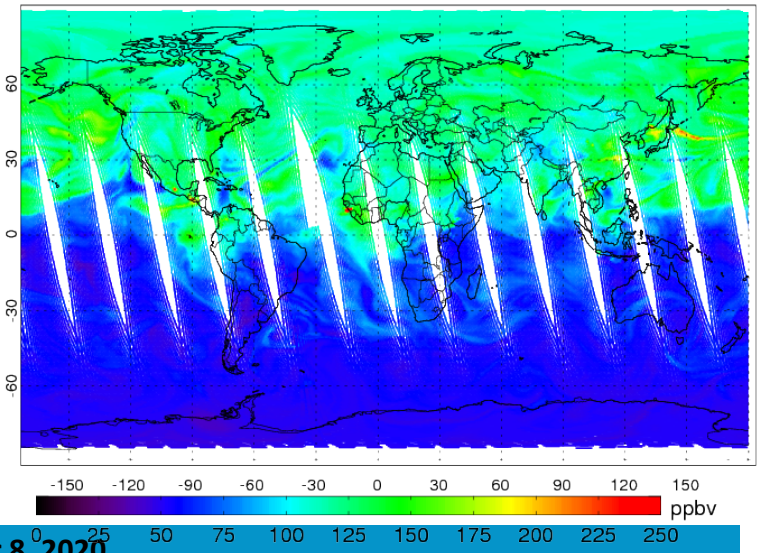
SNPP_v2.8b_CO at 506 hPa.20200430



NOAA20_v2.8b_CO at 506 hPa.20200430



MetC.cams_CO at 506 hPa.20200430



Collaborations NOAA-STAR/GML Collaborations
NUCAPS Team Participation

Theme 1: Enhancing NOAA's Greenhouse Gas (GHG) observing system in the free troposphere through collaboration with JPSS:

- POC(s): Nick Nalli, Juying Warner, Nadia Smith (STAR):NESDIS, Andy Jacobson, Bianca Baier (GML)
- Ken Pryor: NUCAPS SME

Theme 2: Enhancements in ozone and water vapor ground-based systems for NESDIS satellite observational requirements and priorities

- POC(s): Larry Flynn, Murty Divakarla (STAR), Irina Petropavlovskikh (GML)
- Ken Pryor (STAR): Stratospheric Intrusions and Cyclogenesis

Focus on:

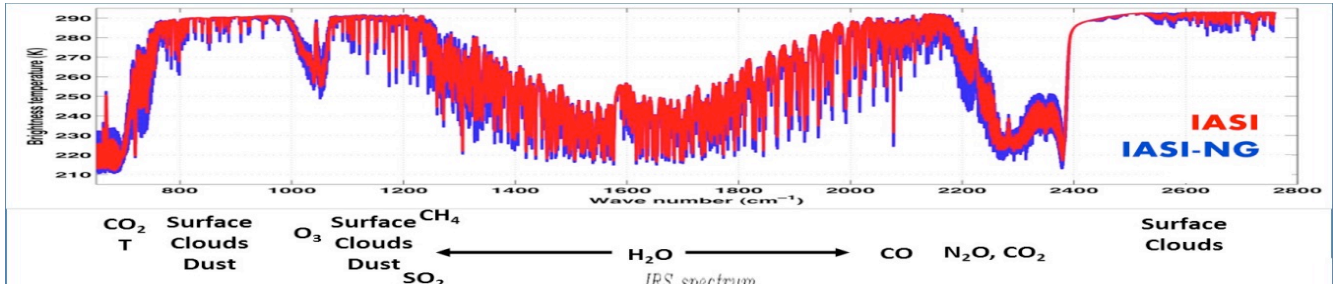
- How can we improve the validation and characterization of NESDIS satellite products?
- How can NESDIS satellite products be integrated with GML products to improve global monitoring and assessment?
- What opportunities we have to advance science by working together, and what JPSS can do for GML, and what GML can do for JPSS to improve upon what they are currently doing with specific examples of products, product visibility in terms of value of the products
- Address generic questions on current satellite products, QA and QC enhancements, identify any short falls on real time access of products, mitigations, reprocessing needs, and research on satellite products derivable in future from the existing and future satellite sensors

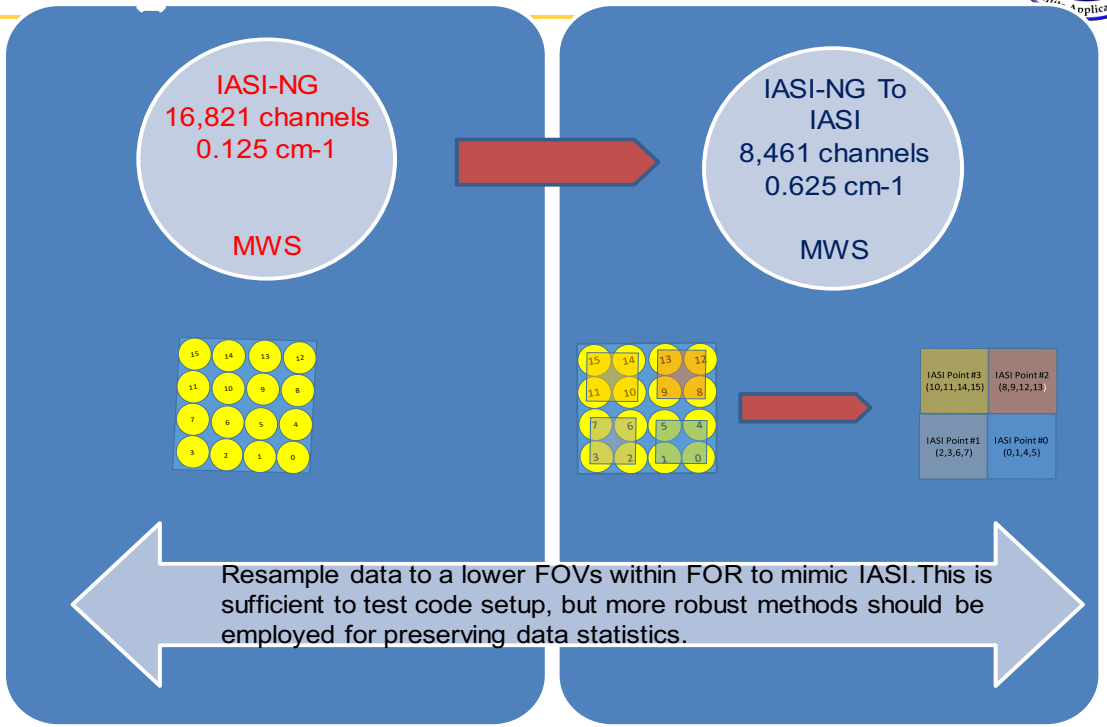
- **CLIMCAPS and NUCAPS Comparisons (requires coordination meeting)**
- **OMPS & CrIS Ozone and Trace Gas Validations (OMPS and NUCAPS EDR team coordination)**
- **GML measurements and independent validations by GML**

NUCAPS Updates to EPS-SG IASI-NG/MWS

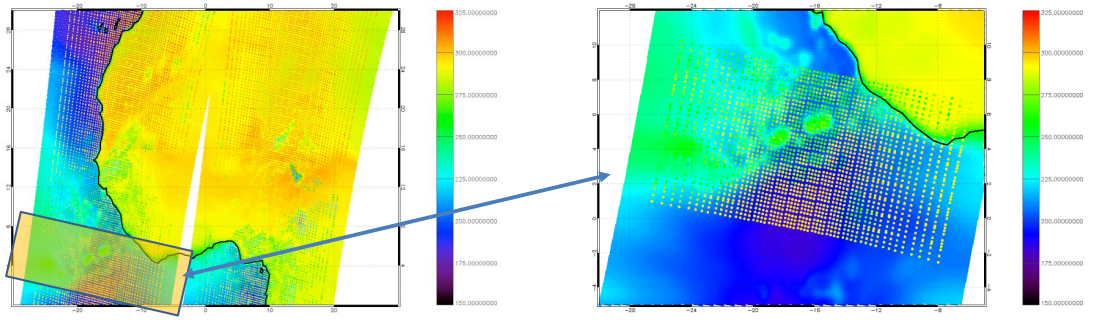
- LEO orbit, sun-synchro.
- Mertz interferometer
- 4x4 pixel detector
- 12-km pixel at Nadir
- 4 spectral bands
- Sampling 0.125 cm^{-1}
- Swath ~2000km
- Launch 2022

EPS-SG





- Covert IASI-NG spectrum into an IASI spectrum to generate Day-1 products with 95% of NUCAPS code functioning as is, including using the existing forward model, channel selections, and all downstream components (see slide 5 for details on reusability)
  - Follow MetOp-C system, use all usable components
    - Build Preprocessor for MWS/IASI-NG collocations
    - Build MW fast forward model for MWS
    - Use MetOp-C IASI SARTA RTA (Truncate IASI-NG to IASI)



EUMETSAT – IASI/MWS Overlay Zoom-in Two Orbits, September 12, 2017
MWS CH#1/IR 900cm-1 Dots are individual IASI simulated FOVs

Summary

NUCAPS System

- Produces consistent products from JPSS Suomi-NPP and NOAA-20
- Products from MetOp-A/B/C (IASI/AMSU-A/MHS) have similar accuracies.
- Products are available through CLASS for worldwide users
- Operationally running on the Direct Broadcast (DB) network and WFOs nationwide use NUCAPS temperature, water vapor, and cloud fraction products through AWIPS-2

On-going Activities/Plans

- Averaging kernels for T/H2O/O3/CO/CH4/CO2 - implementation into NUCAPS OPS code
- Augmenting the NUCAPS system for EPS-SG IASI-NG hyperspectral sounder.
- Mission-long reprocessing for S-NPP/NOAA-20 NUCAPS EDR products
- Ammonia algorithm into NUCAPS/NPP/N-20 CrIS
- Optimizing IR-only retrievals for risk mitigation and conceptual GEO-CrIS retrieval products

Positive User Feedback

- Many PGRR Initiatives use NUCAPS products and found them extremely useful for many applications.

S-NPP/NOAA-20 Validated Maturity Review presentations & STAR website links

- https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php
- https://www.star.nesdis.noaa.gov/jpss/mapper
- https://www.star.nesdis.noaa.gov/jpss/EDRs/products_Soundings_N20.php