2018 JPSS Annual Meeting
Sounding Session Opening Remarks

Chairs:
Antonia Gambacorta, Chris Grassotti, Larry Flynn

NCWCP August 28, 2018

Topics of this session

Part I: NUCAPS Session

Co-Chair: A. Gambacorta

1. Status of the NOAA Unique Combined Atmospheric Processing System (NUCAPS) – A. Gambacorta
2. Validation status of the NOAA Unique Combined Atmospheric Processing System (NUCAPS) - N. Nalli
3. How NUCAPS addresses the mesoscale challenge in now-casting applications – N. Smith

Part II: MiRS Session

Co-Chair: C. Grassotti

1. Microwave Integrated Retrieval System: Scientific Activities, Milestones, Future Plans – C. Grassotti

Part III: OMPS Session

Co-Chair: L. Flynn

1. NO2 and HCHO plans – P. Lee
2. Near Real Time Ozone EDR applications – C. Long
3. NOAA-20 OMPS ozone products – L. Flynn

Status of the NOAA Unique Combined Atmospheric Processing System (NUCAPS)

Antonia Gambacorta [1], Nick Nalli [1], Changyi Tan[1], Mike Wilson[1], Juying Warner[6], Callyn Bloch[1], Tish Suillard[2], Tom King[1] , Flavio Iturbide Sanchez[3] , Lihang Zhou[3]

With contributions from:
Larrabee Strow[4], Chris Barnet[7], Tony Reale[3], Bomin Sun[1], Mark Liu[3], AK Sharma[3], Walter Wolf[3], Mitch Goldberg[5]

2018 JPSS Annual Meeting – NUCAPS Session

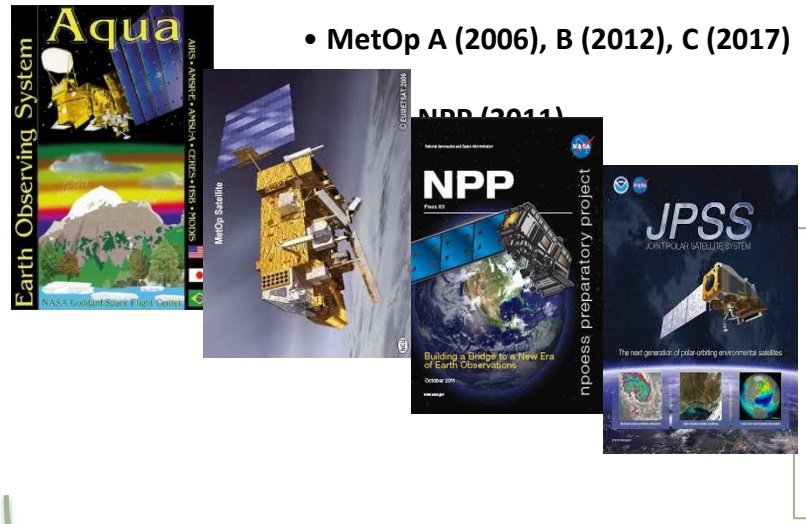
[1] IMSG [2]GAMMA; [3] NOAA/NESDIS/STAR; [4]UMBC; [5]NOAA JPSS; [6]U. Maryland; [7]STC

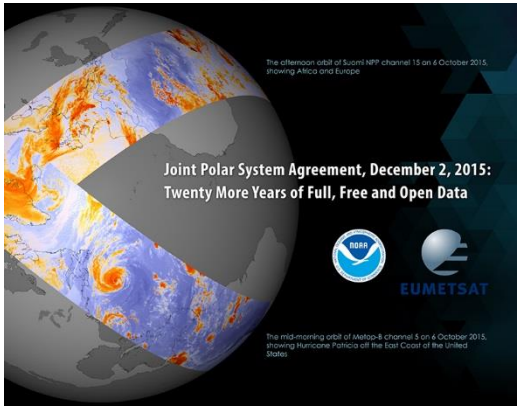
Outline of this talk

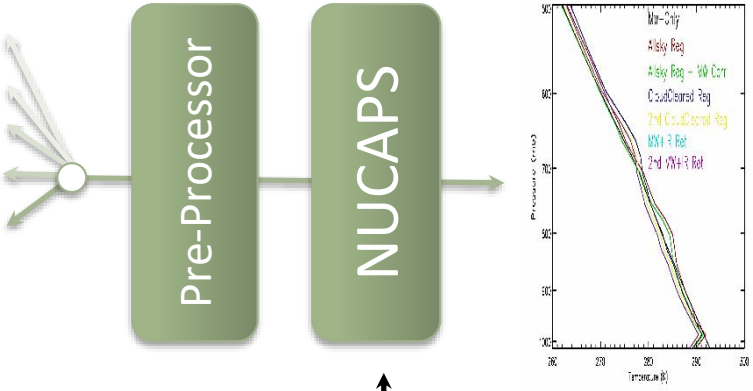
- Introduction to the NUCAPS system
- Overview of the past year's activities
- Current activities
- Future directions

NOAA Long term strategy of hyperspectral sounding

- Aqua (2002)
- MetOp A (2006), B (2012), C (2017)
- NPP (2011)







Same exact executable
Same underlying Spectroscopy
Same look up table methodology
for all platforms

Summary of current NUCAPS retrieval products

gas	Range (cm^{-1})	Precision	d.o.f.	Interfering Gases
T	650-800 2375-2395	1K/km	6-10	H2O,O3,N2O emissivity
H_2O	1200-1600	15%	4-6	CH4, HNO3
O_3	1025-1050	10%	1+	H2O,emissivity
CO	2080-2200	15%	≈ 1	H2O,N2O
CH_4	1250-1370	1.5%	≈ 1	H2O,HNO3,N2O
CO_2	680-795 2375-2395	0.5%	≈ 1	H2O,O3 T(p)
Volcanic SO_2	1340-1380	50% ??	< 1	H2O,HNO3
HNO_3	860-920 1320-1330	50% ??	< 1	emissivity H2O,CH4,N2O
N_2O	1250-1315 2180-2250	5% ??	< 1	H2O H2O,CO

http://www.class.ngdc.noaa.gov

Status of NUCAPS

Validated maturity status:

- ✓ SNPP NUCAPS Temperature, water vapor, ozone, OLR

Provisional maturity status:

- ✓ SNPP NUCAPS carbon trace gases
- ✓ NOAA-20 NUCAPS Temperature and water vapor

Beta maturity status:

- ✓ NOAA-20 NUCAPS OLR, ozone, carbon trace gases

One year has gone by…

August 7th, 2018
NUCAPS MetOp goes live in CSPP

June 22nd, 2018
Updated Enterprise NUCAPS Delivery of Algorithm Package (DAP) to ASSISTT
NUCAPS Enterprise algorithm delivery to UW for implementation in CSPP

June 15th, 2018
NUCAPS NOAA-20 Temperature and Water Vapor Provisional Maturity review

April 27th, 2018
First NOAA-20 NUCAPS Delivery of Algorithm Package (DAP) to ASSISTT

April 4th, 2018
Implementation of NUCAPS Enterprise Algorithm (SNPP, NOAA-20, MetOp) in the HEAP

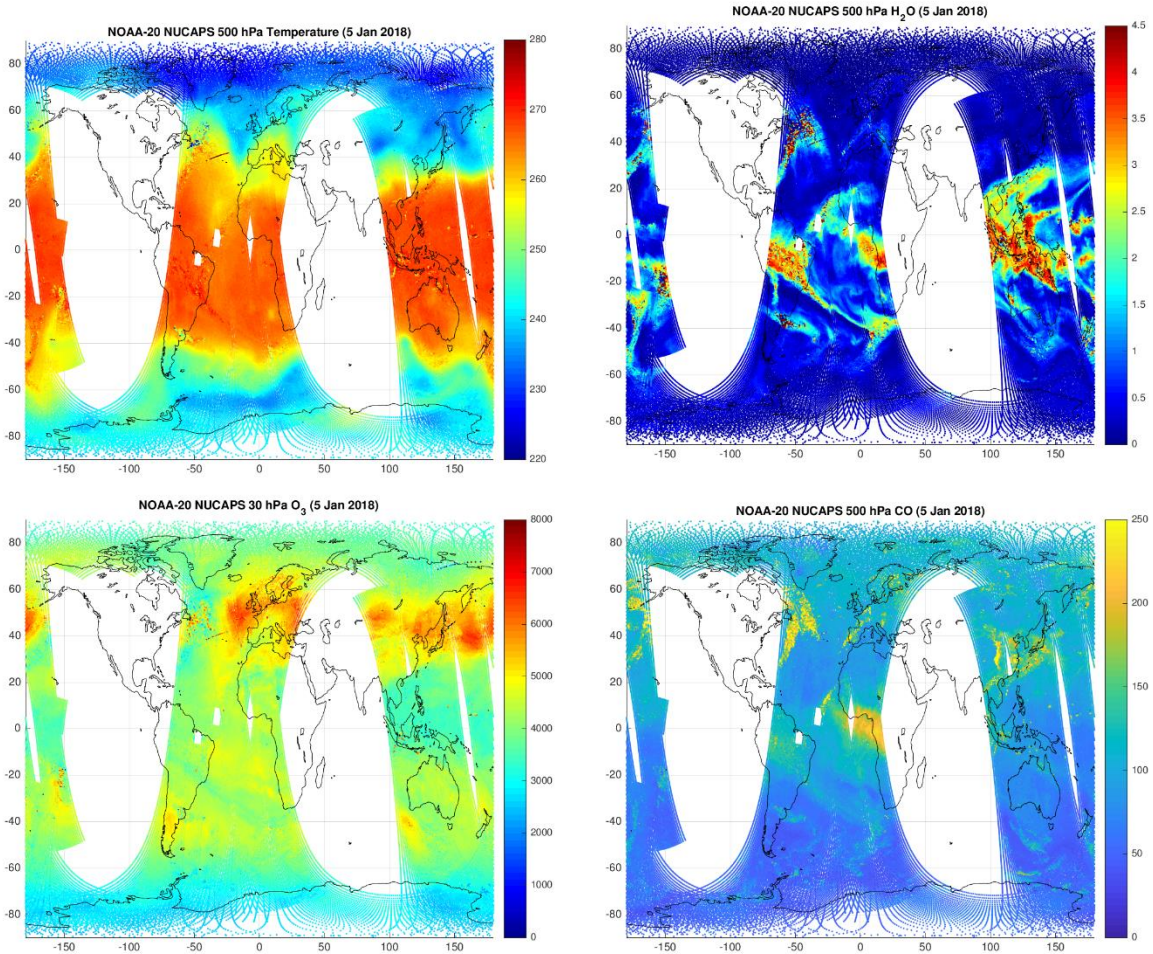
January 5th, 2018
NUCAPS NOAA-20 first Light results

August 31st, 2017
NUCAPS Phase 4 delivered to UW for implementation in CSPP

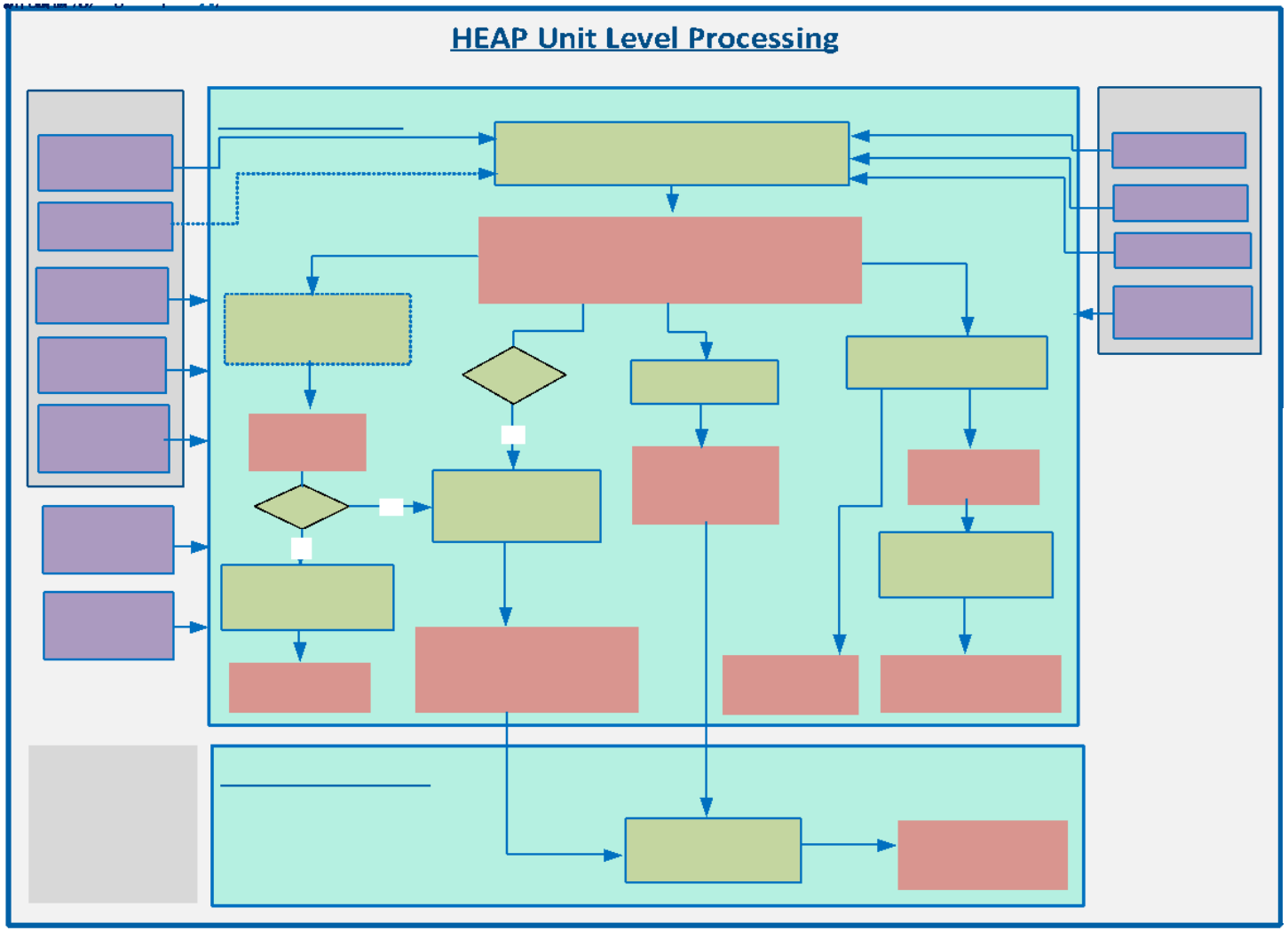
July 7th, 2017
NUCAPS Phase 4 Algorithm Readiness Review
NUCAPS Phase 4 Delivery of Algorithm Package (DAP) to ASSISTT

January 5th, 2018:
NUCAPS NOAA-20 First Light Results

CrIS signal processors and detectors powered up on **January 4th, 2018 at 23:47 UTC**. First Light NUCAPS NOAA-20 results were generated on **January 5th, at 21:00 UTC**.



April 4th, 2018:
NUCAPS is implemented in the Hyperspectral Enterprise Algorithm Package (HEAP)

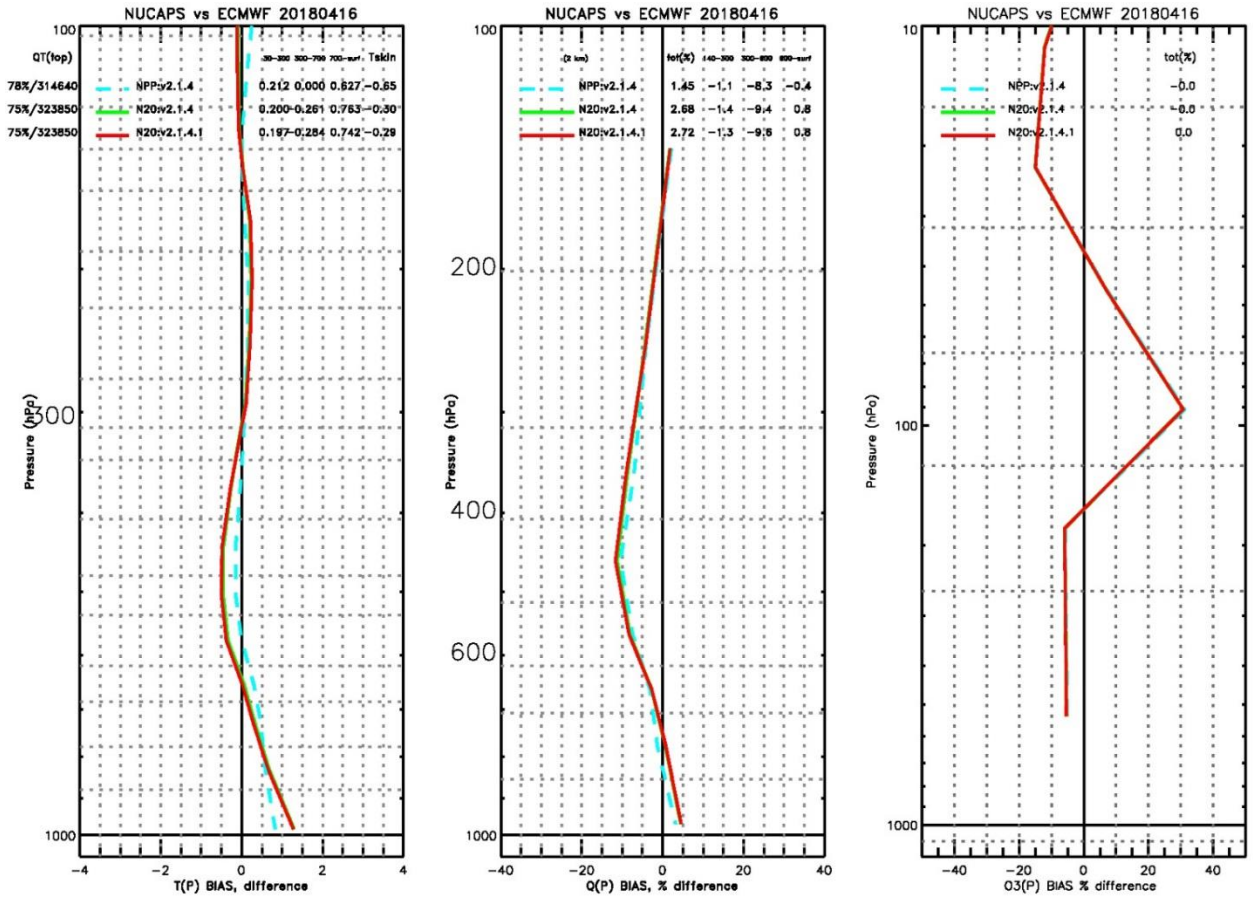


M. Wilson's Poster No. 61

April 27th, 2018 -NUCAPS NOAA-20 Preliminary DAP
June 15th, 2018 – NUCAPS NOAA-20 Provisional Maturity Review

SNPP Operational
First Light NOAA-20 (5th Jan. 2018)
NOAA20 DAP (27th Apr. 2018)

First global, multi focus days statistics results showing SNPP and NOAA-20 NUCAPS temperature (left), water vapor (center), ozone (right) remarkably consistent **since first light**, qualifying NOAA-20 NUCAPS temperature, water vapor and ozone for preliminary DAP to ASSISTT and reaching provisional maturity status.



Improvements since last operational delivery approved by NUCAPS Phase 4 Algorithm Readiness Review (July 2017)

NUCAPS Version 2.1.12d (June 2018):

✓ NOAA-20 CrIS and ATMS instrument noise files.

✓ Optimized temperature, water vapor, cloud clearing and carbon monoxide channel selection.

✓ An improved RTA bias correction in the carbon monoxide band.

✓ An improved carbon monoxide a priori climatology.

✓ An improved carbon monoxide quality control methodology.

Work in progress towards NUCAPS validated maturity status:

… improve methane, nitrous oxide and carbon dioxide retrieval modules.

… improve training methodology of statistical regression by removing cloud contamination and supersaturation cases.

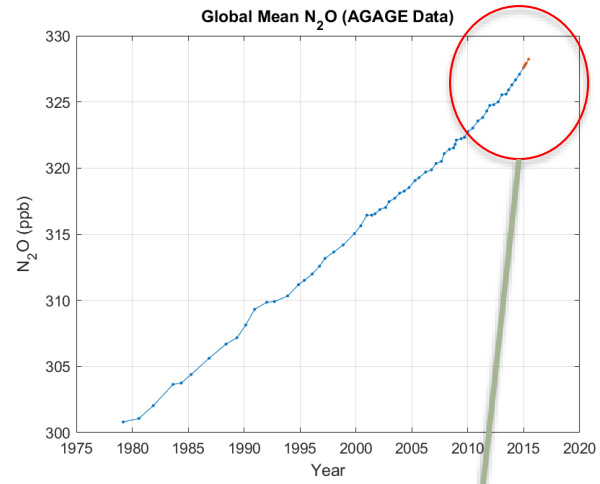
… improve surface emissivity regression algorithm.

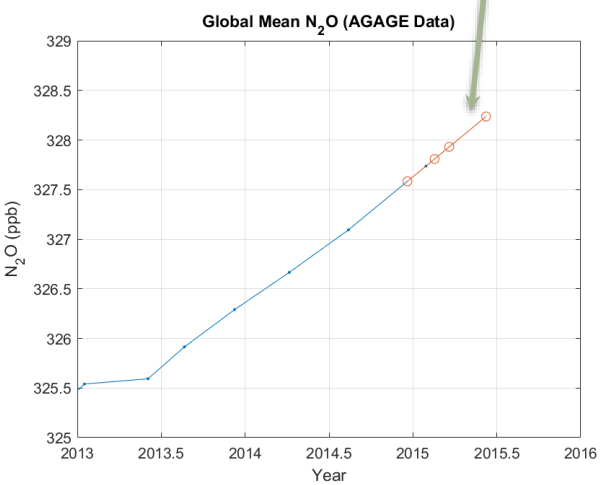
Towards NUCAPS validated maturity: what's needed?

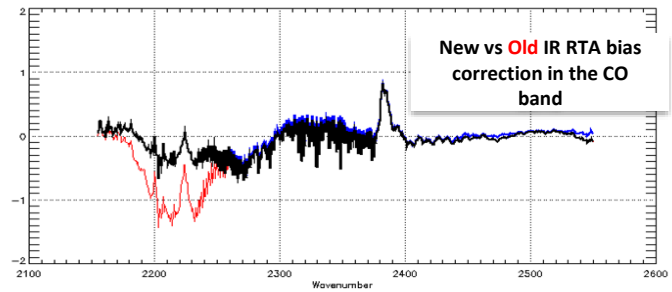
- Inter-consistency of NUCAPS SNPP, NOAA-20 (and MetOp): no requirement specified but inter-consistency is key to several applications of NUCAPS products
  - NUCAPS is in AWIPS and RealEarth: diurnal variability for regional weather forecasting
  - NUCAPS is in IDEA-I: diurnal transport and variability of species for air quality monitoring
  - NUCAPS data record is being reprocessed
  - NUCAPS is in several DA experiments (CO, CH4, CO2, SAL)

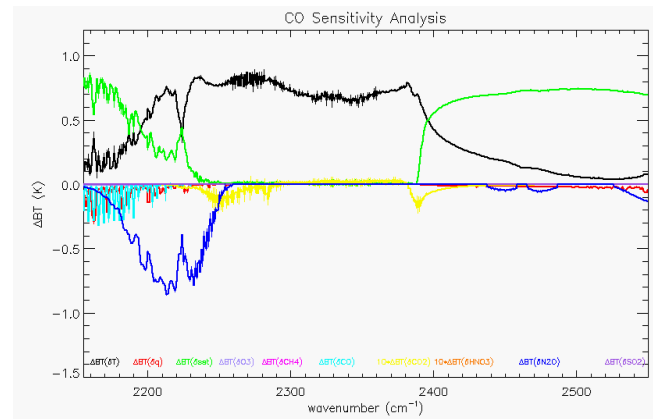
- We have built a robust framework, the HEAP, to provide consistency in the processing (same machine, same executable)
- We employ the same underlying spectroscopy, forward model and LUT methodologies to provide consistency in the scientific retrieval code
- We need very well inter-calibrated SDRs to fulfill NUCAPS mandate: NOAA's operational enterprise algorithm for hyper spectral sounding.
- **Next step**: fine tuning of the NOAA-20 CrIS and ATMS related LUTs.

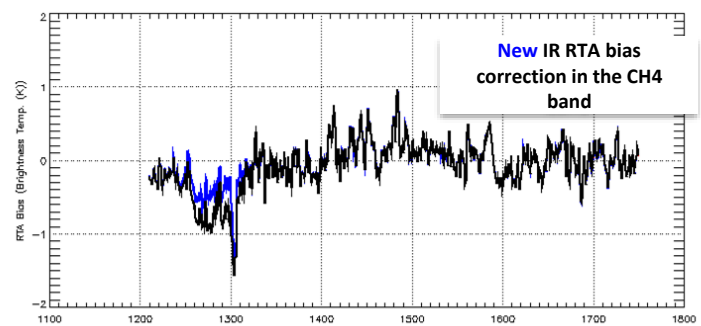
A game changer:
NUCAPS *version 2.1.12d* Carbon Monoxide



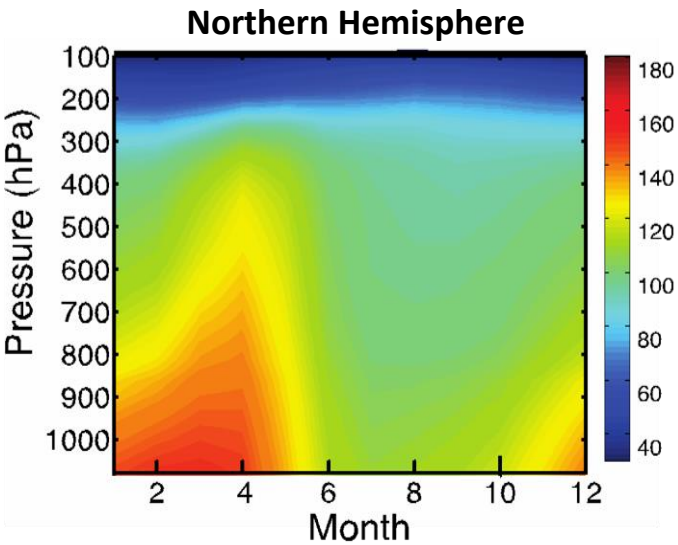


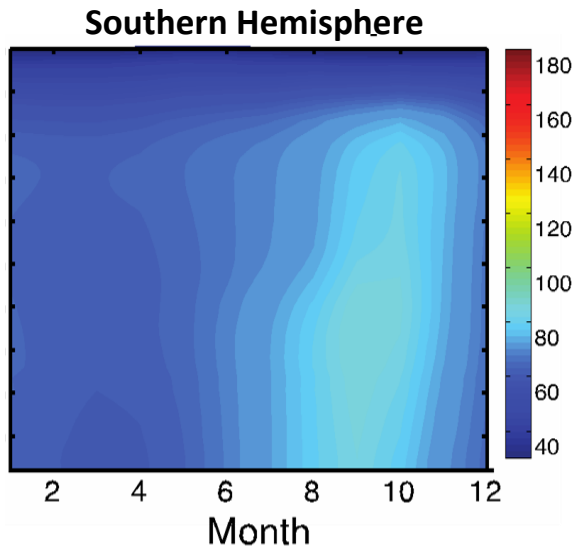


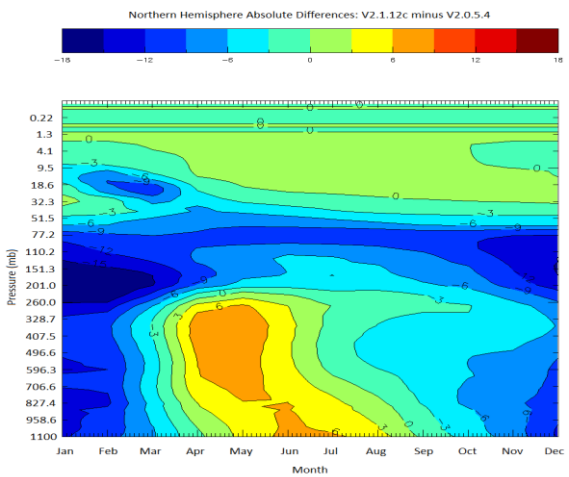


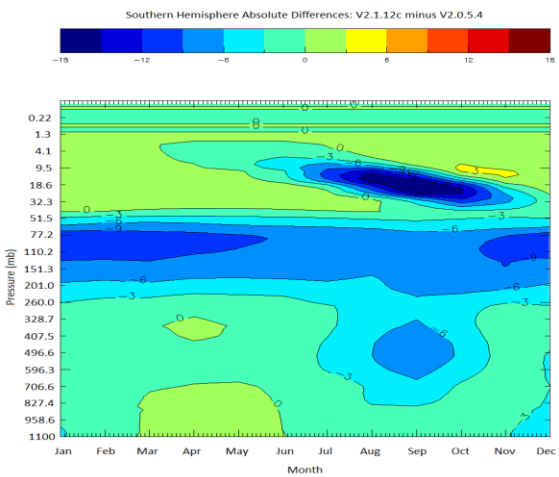


A game changer:
NUCAPS *version 2.1.12d* Carbon Monoxide (cont'd)





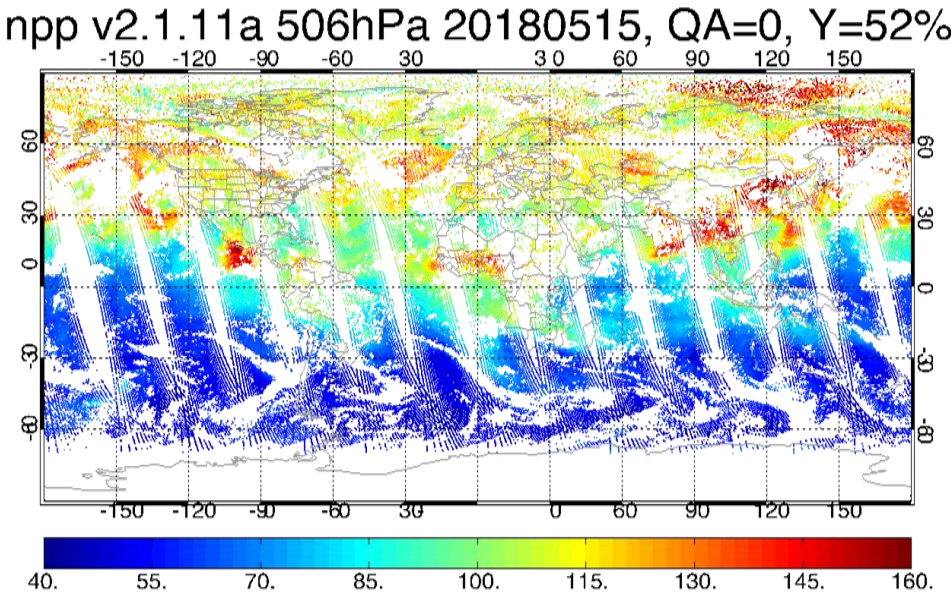




Top
NUCAPS 2.1.12d new CO A priori (ppbv) developed from NCAR MOZART-GEOS5 model
Linear transition between 15N and 15S;
Monthly varying, but no year-to-year variations;
Same approach as for previous version, but using a more updated time period.

Bottom
NUCAPS New - Old CO A priori

A game changer:
NUCAPS *version 2.1.12d* Carbon Monoxide (cont'd)



Module	Lower Limit	Upper Limit
Chi-square	0.0	1.0
DOFS	0.3	9.9
CO Retrievals	0.0	1.1
Cloud Amplifier Limit	0.3	1.8
Cloud-clearing residual	0.0	0.7
Number of iteration	0.0	5.0
Total cloud fraction	0.0	0.7

NUCAPS 2.1.12d new CO QC reduces cloud contamination, but yield is penalized

Significance to users applications

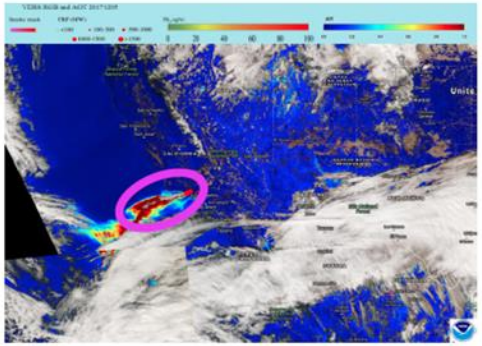
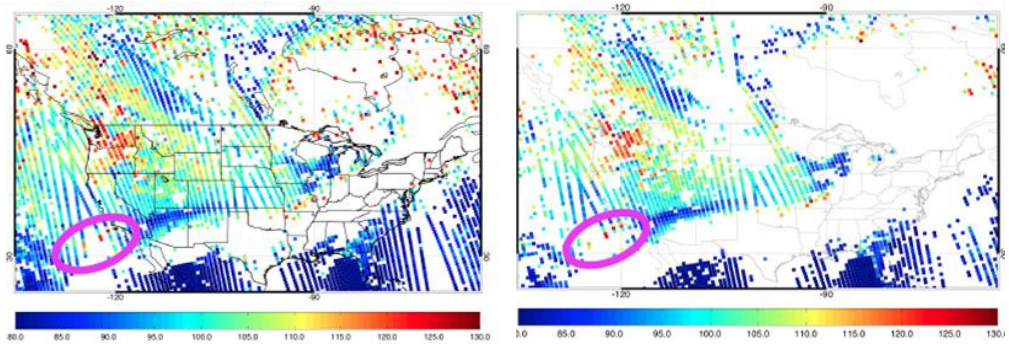


Figure courtesy of Shobha Kondragunta

NUCAPS
Version 2.0.5.4



NUCAPS
Version 2.1.12d

CA Thomas Fire, Dec. 5th, 2017

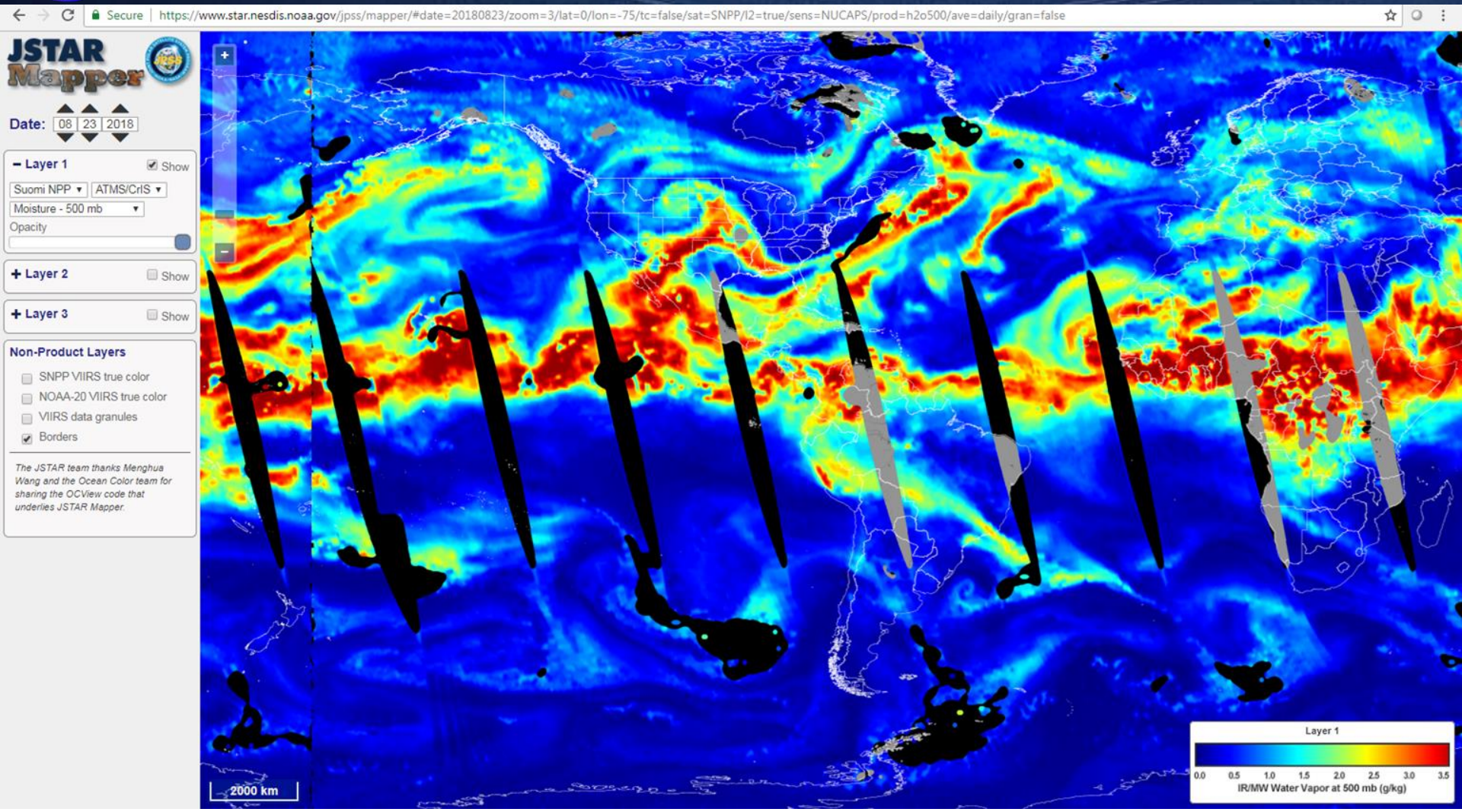
- CO chn selection and tailored QC remove spurious spikes in CO due to poor cloud clearing while preserving the real signal of interest
- CO new a priori and forward model bias correction remove consistent bias observed in previous version (see next talk by Nick Nalli).

Coming next…

- MetOp C, J2, EPS-SG activities are on the way
- NUCAPS validated maturity review: September 2019

	S-NPP	JPSS-1	JPSS-2
FY18	CO, CO2, and CH4 products validation	algorithm tuning for J1/SNPP CO, CO2, and CH4 products	
FY19	Maintenance and monitoring	SNPP and J1 EDRs comparisons; AVTP, AVMP, O3, and OLR validation	
FY20	Maintenance and monitoring	CO, CO2, CH4 validation	
FY21	Maintenance and monitoring	Algorithm implementation for new trace gases: ammonia (NH_3)	algorithm preparation for AVTP, AVMP, O3, OLR, CO, CO2, CH4
FY22	Maintenance and monitoring	Maintenance and monitoring	algorithm optimization for AVTP, AVMP, O3, OLR, CO, CO2, CH4

Where to find us



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