Enterprise EDR Validation at STAR

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STAR Seminar Series

Outline

A brief history of EDR assessment at NESDIS … role of the POP's

What is "Enterprise Validation" (EV)

Components of an EV Capability

Leveraging Developer Expertise and EDR Oversight … Why bother?

Examples of EV at STAR: NPROVS for T and H20 Soundings

Benefits for timely "sanctioning" of new products *… the first carrot*

EV feasibility for other EDR's … *more carrots*

STAR Plan

ORA (pre 2000)

Product Oversight Panels (POP's)

Soundings
Ozone
Clouds
Surface Temperature
Precipitation
etc.

Operational Sanction

EDR Development

Soundings (TOVS, ATOVS, DMSP …)
Ozone
Clouds
Surface Temperature (GOES, polar …)
Precipitation (Microwave …
etc.

STAR (post 2000)

EDR Development (*and Assessment*)

Soundings (NUCAPS, MiRS, …)
Gases
Clouds
Surface Temperature (GOES, polar …)
Precipitation (Microwave …
Fires
Aerosols
etc.

Operational Sanction

STAR (post 2018)

Quality Assurance

- Soundings
- Gases
- Clouds
- Surface Temperature
- Precipitation
- Fires
- Aerosols
- etc.

Enterprise Validation

Operational Sanction

EDR Development

- Soundings (NUCAPS, MiRS, GPSRO …)
- Gases
- Clouds
- Surface Temperature (GOES, polar …)
- Precipitation (Microwave …
- Fires
- Aerosols
- etc.

What is "Enterprise Validation" (EV)

Enterprise Algorithm: Same science used across different "sensors" to derive a given EDR suite

Enterprise Validation: Same targets used across different "EDR suites" to assess a given suite

Sensors and products of the same "family"… CrIS, IASI, AIRS, ATMS, AMSU, ATOVS, GPSRO … *Sounders*
… NUCAPS, EUMET, NASA, MiRS, ATOVS, COSMIC … *Soundings*

Other families … Gas, Surface temperature …

Components of an EDR EV capability

- Multiple “same-same” EDR product suites (internal, external)
- Ground-truth (or space-based) targets
- Models
- Strategy for collocating products, targets and models
- Data Management

- *Routine (quasi nrt) compilation of collocation (validation) datasets … dirty work*
- *Ongoing Monitoring, Back-processing, Re-processing, Stewardship … dirty work*
- *Seamless integration of new product suites and targets … dirty work*
- *Graphical Tools for Assessment … dirty work*
  - *Long term*
  - *Short term*
  - *Deep Dive*

- Program(s) of “dedicated (at satellite overpass)” targets
- Resources

Leveraging Developer Expertise and EDR Oversight at STAR …

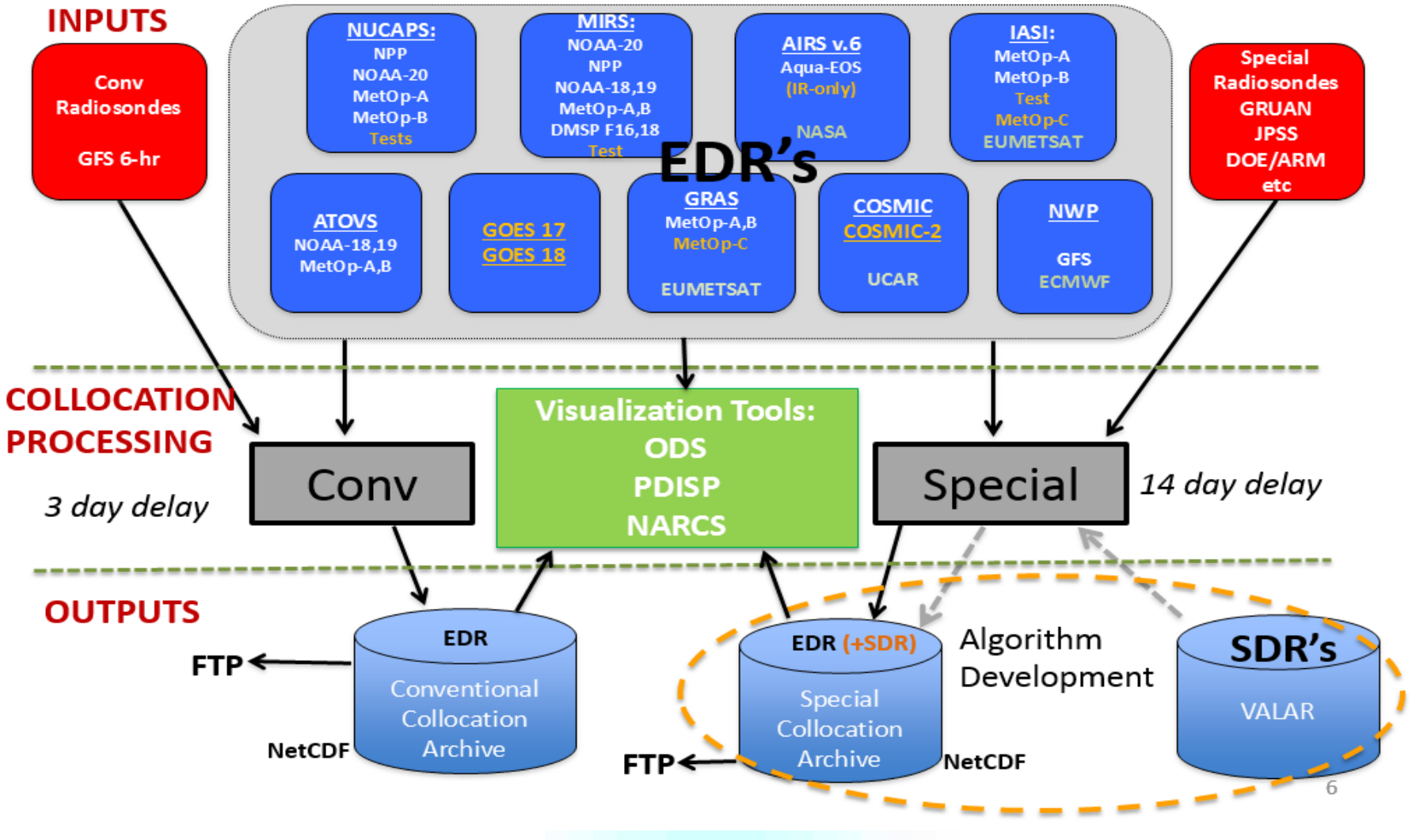
Why bother?

- Developer focused on a specific product suite (NUCAPS, MiRS … new product(s))
- Developer focuses on assessment in context of
  - corrective action
  - new science and products

- Oversight focused on multiple product suite monitoring … EV
- Oversight identifies respective areas for corrective action
- Oversight affirms corrective action, new science and products (from Developers, R2O)

- EV capability maintained by STAR to support / guide Developers
  - Comparing operational, test and new products on an equal playing field
  - Timely assessment of new products (i.e. small sats, COSMIC-2 …) from Developers

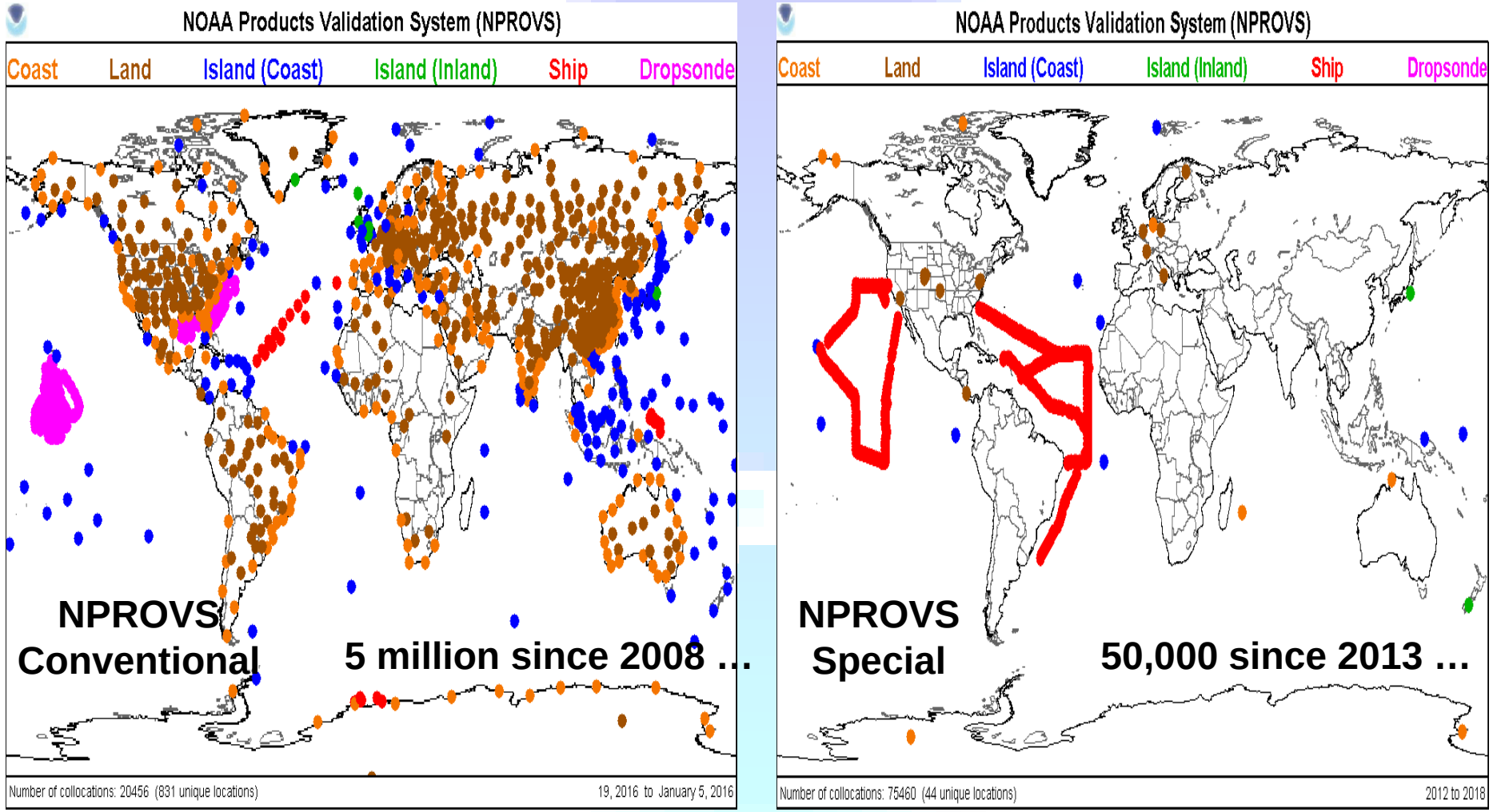
- **EV oversight provides "addition through subtraction" in the context of Developer priorities !**
- EV facilitates timely, meaningful assessment using mature, well managed protocols
- EV provides consistent baseline for Maturity Reviews and R2O (SPRB)



NOAA Products Validation System (NPROVS)

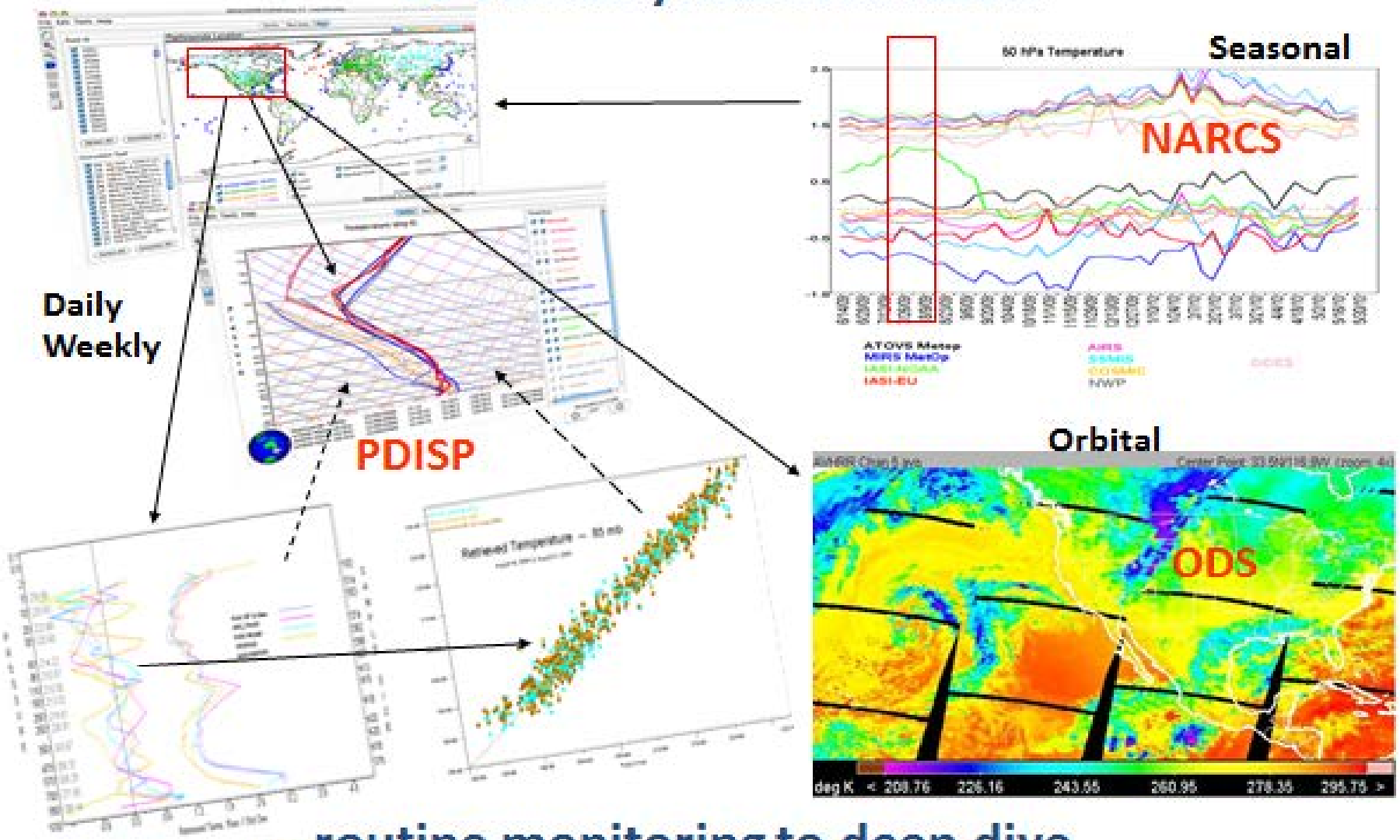
supported by JPSS Cal/Val program which also supports EDR Algorithm Development Team

(EV Template *for soundings*)



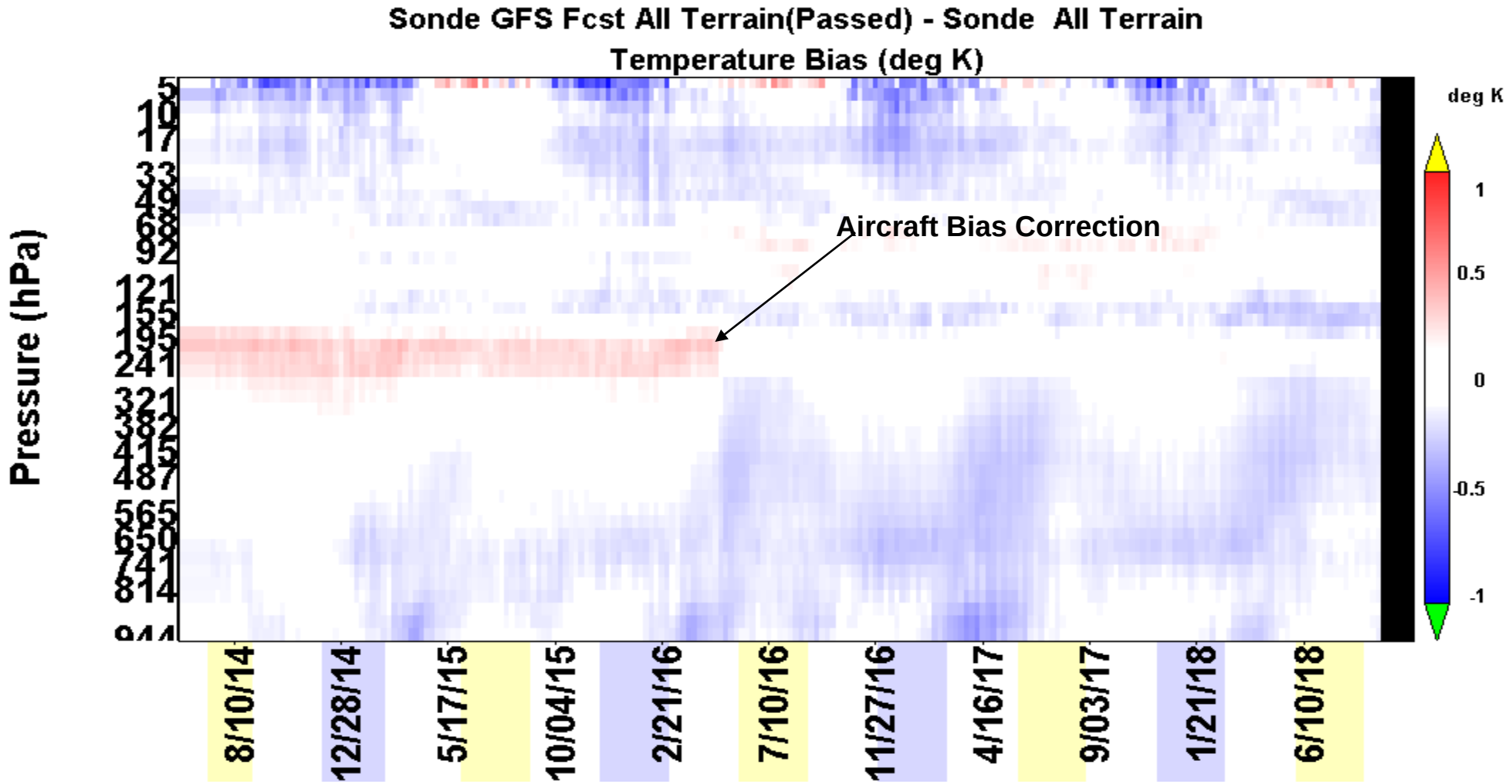
Maintain global datasets of collocated RAOB and Satellite Observations

EDGE Analytical Interface …



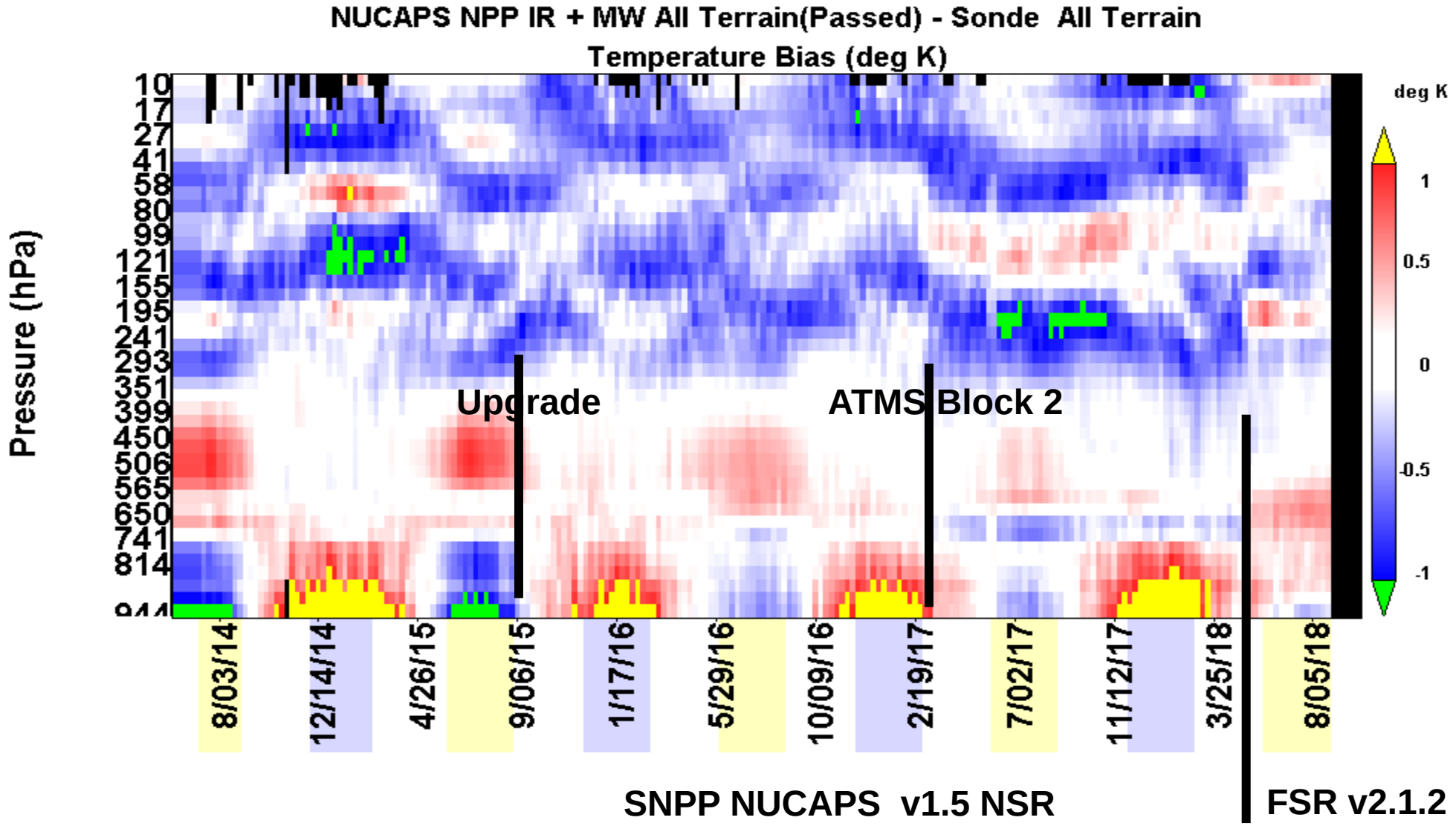
… routine monitoring to deep dive

Conventional NARCS

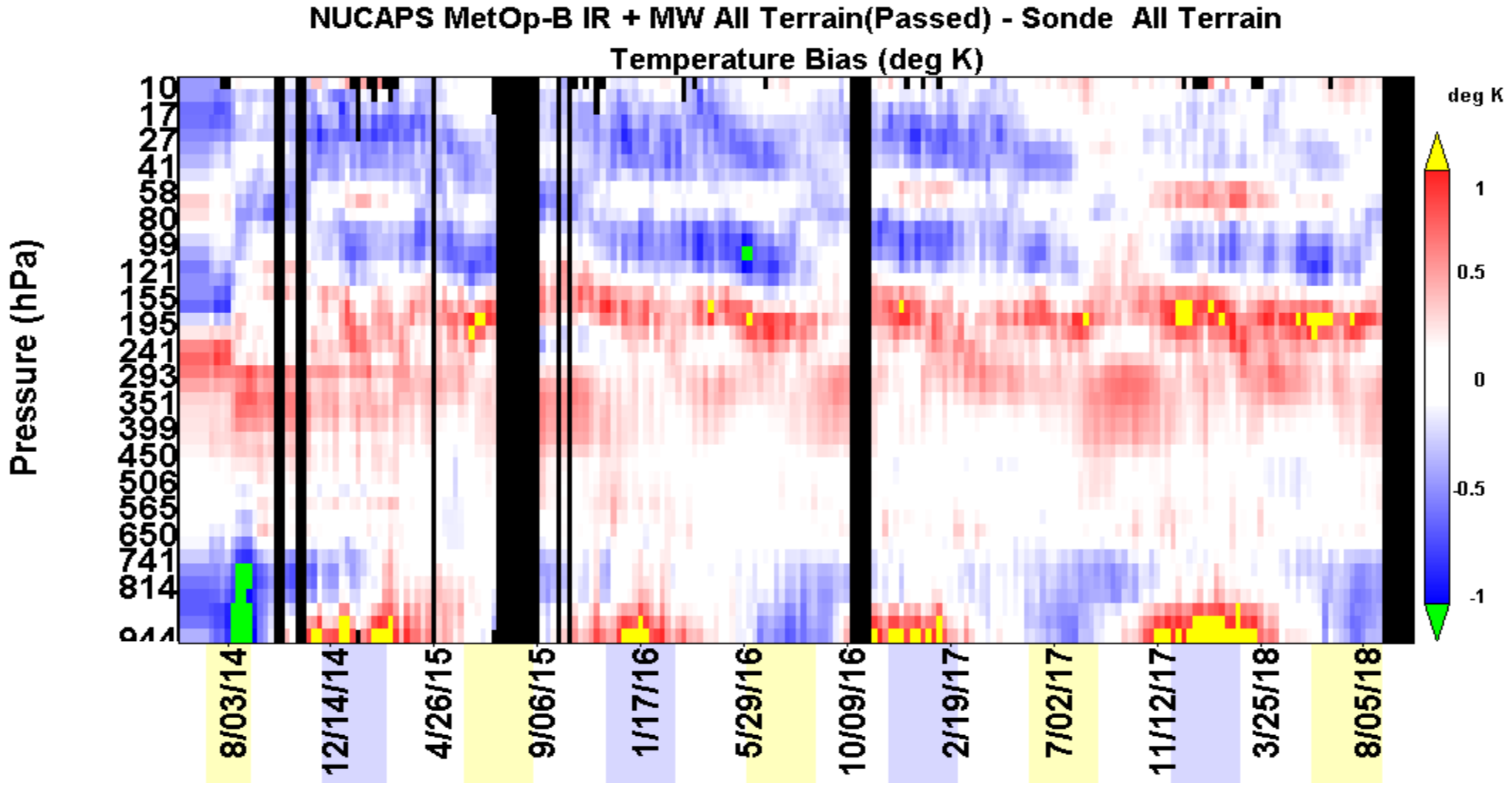


GFS 6-hour Forecast

Conventional NARCS

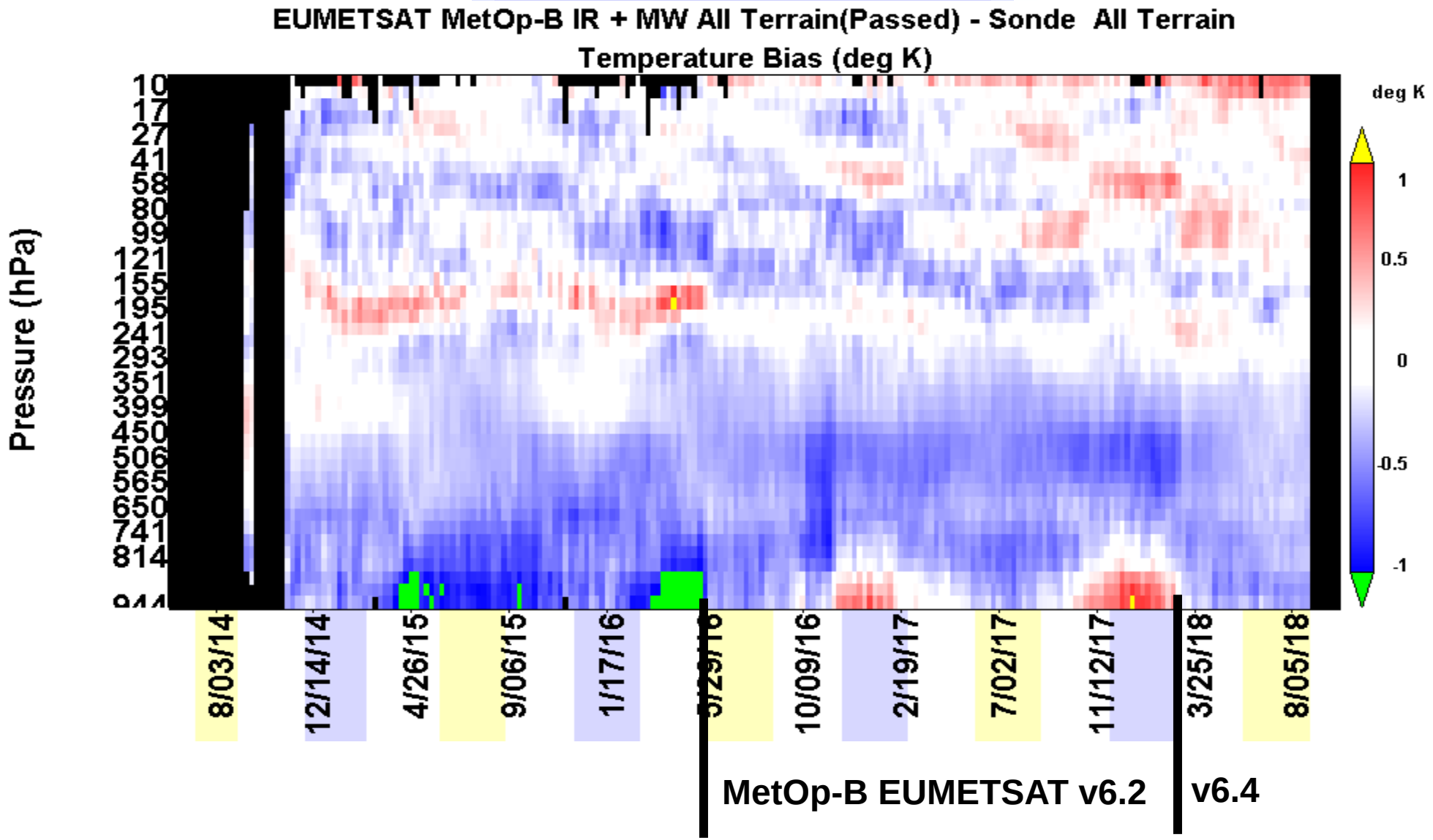


Conventional NARCS

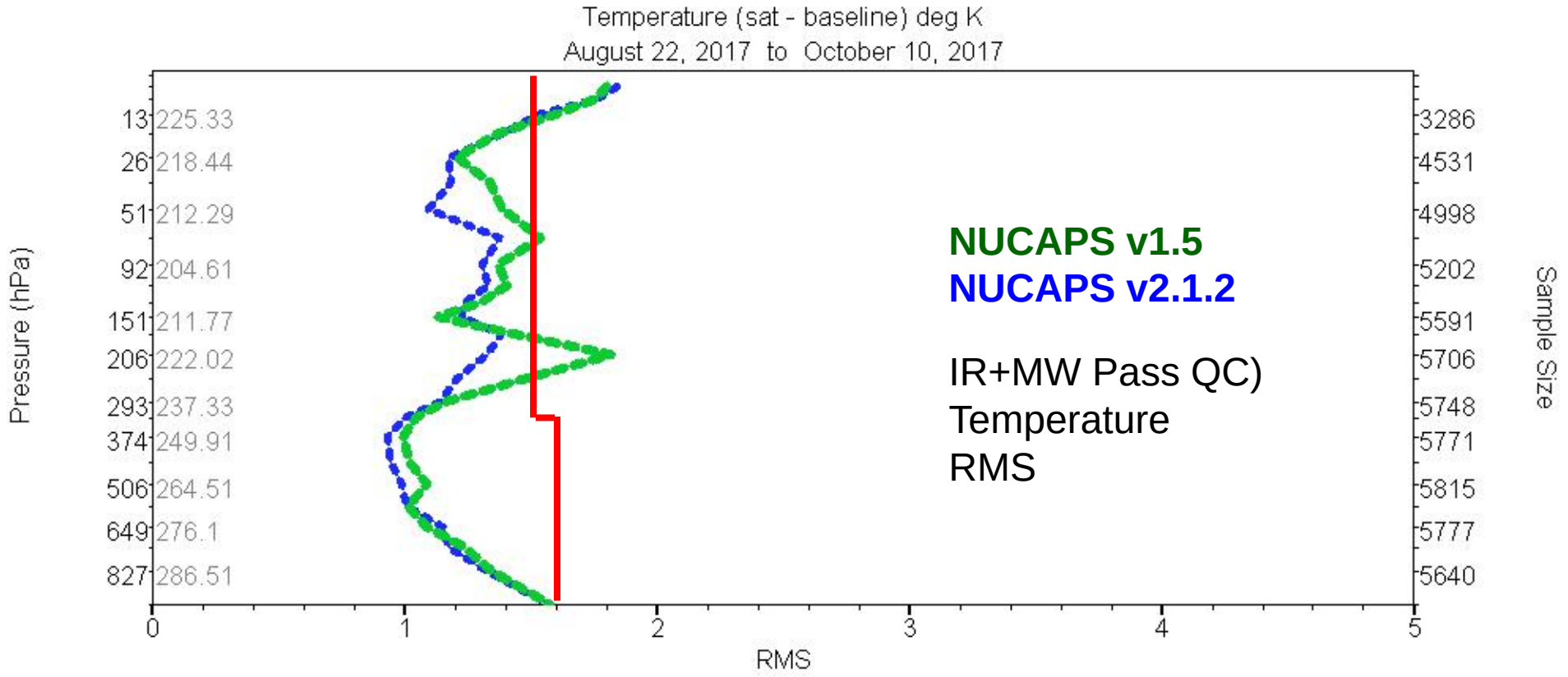


MetOp-B NUCAPS v1.5

Conventional NARCS

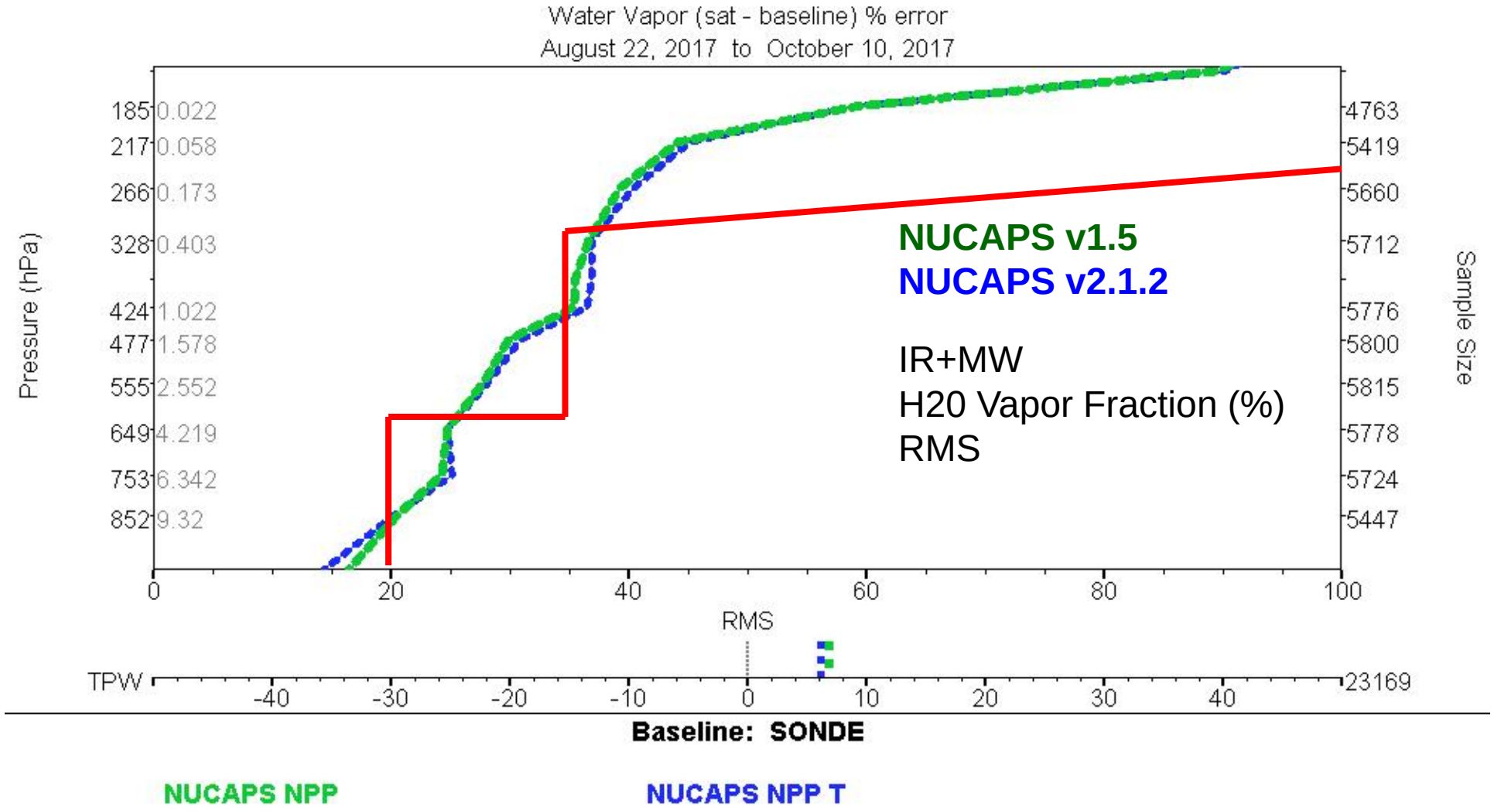


Conventional PDISP



Global Weighted Sample: IR+MW Pass QC; **Specification**

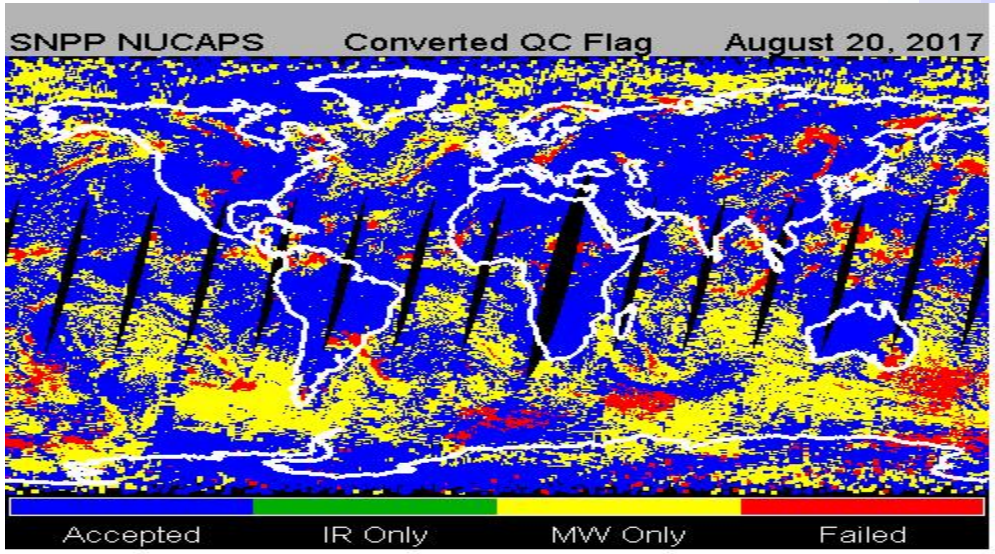
Conventional PDISP



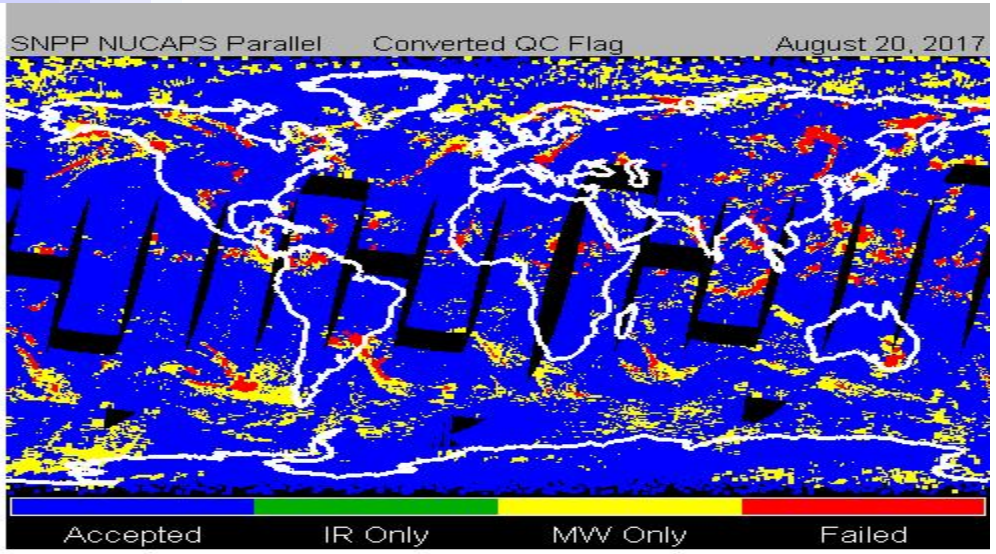
Global Weighted Sample: IR+MW Pass QC; **Specification**

IR-based sounding yields increase; August 2017 … ODS

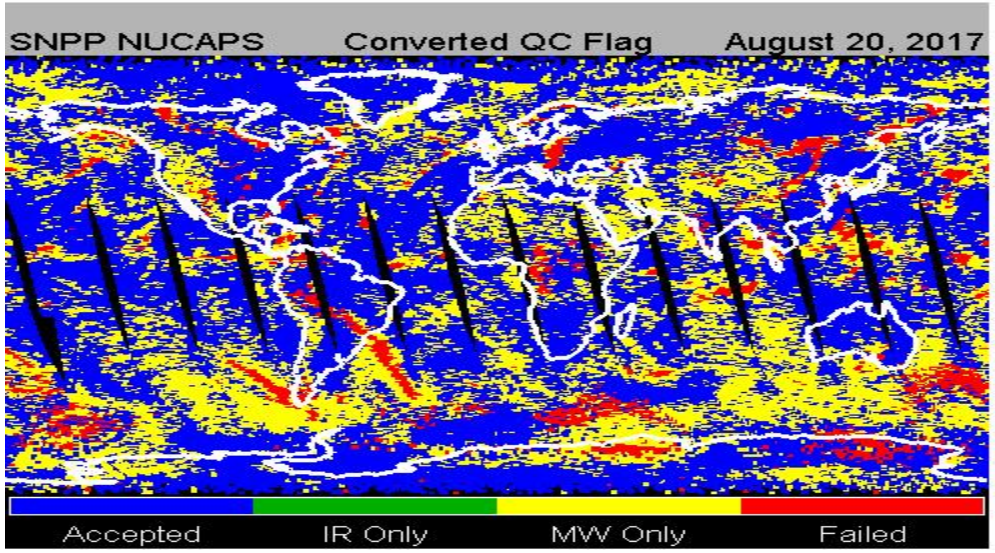
NPP v1.5



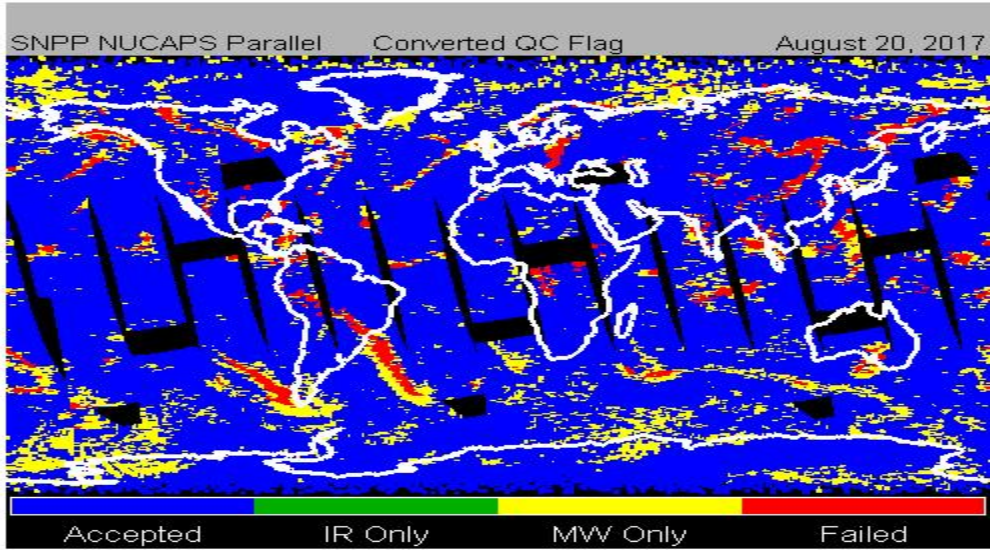
NPP v2.1.2



NPP v1.5



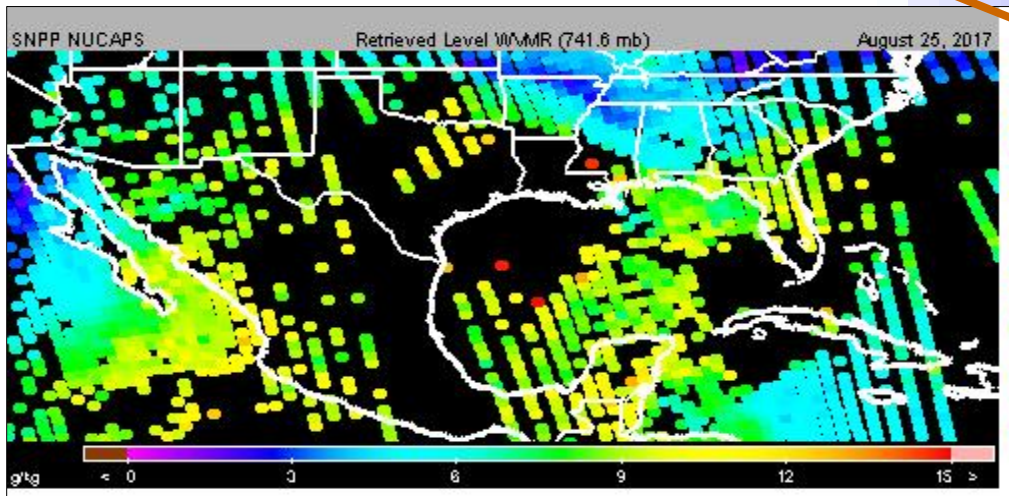
NPP v2.1.2



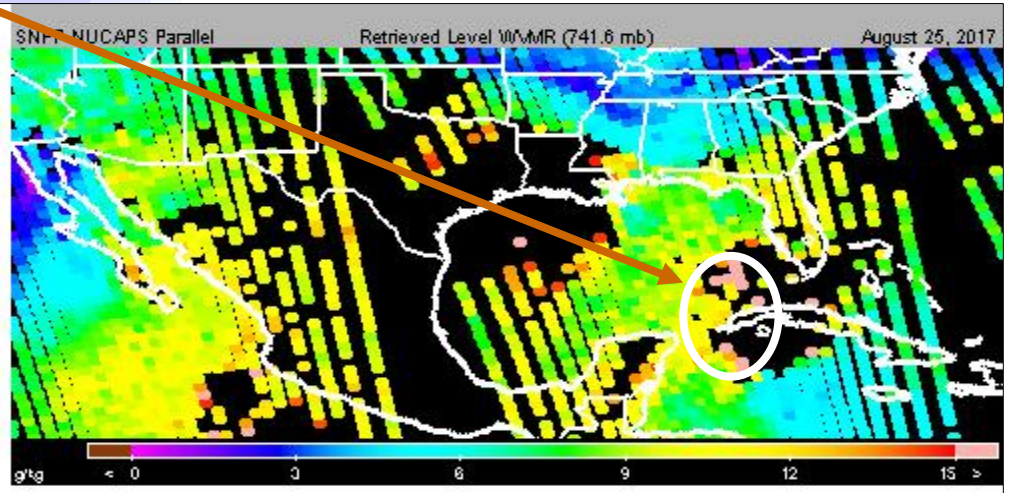
NUCAPS NSR (left) and FSR (right) **IR+MW pass QC (blue)** increase 60% to 85%; Good !!

however, super-saturated soundings "discovered" west of Florida; Harvey Case Study … ODS

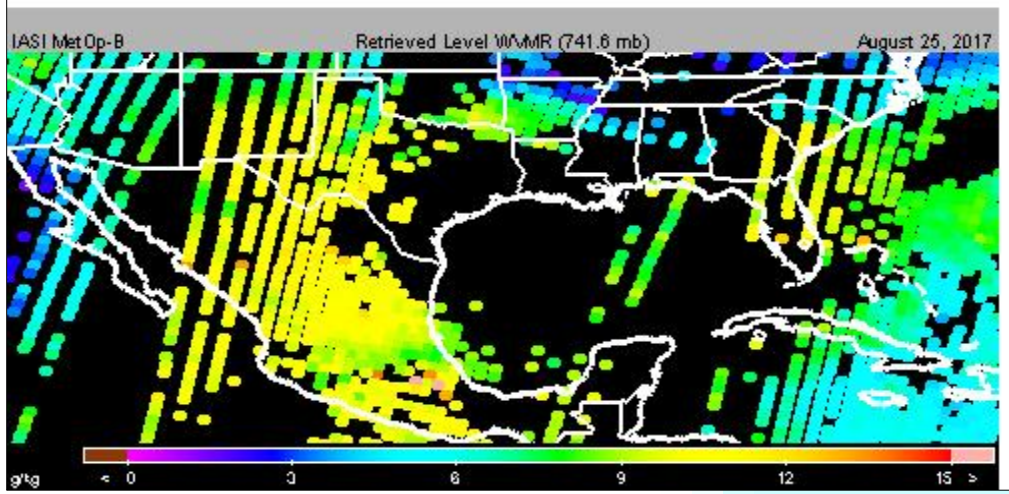
NPP v1.5



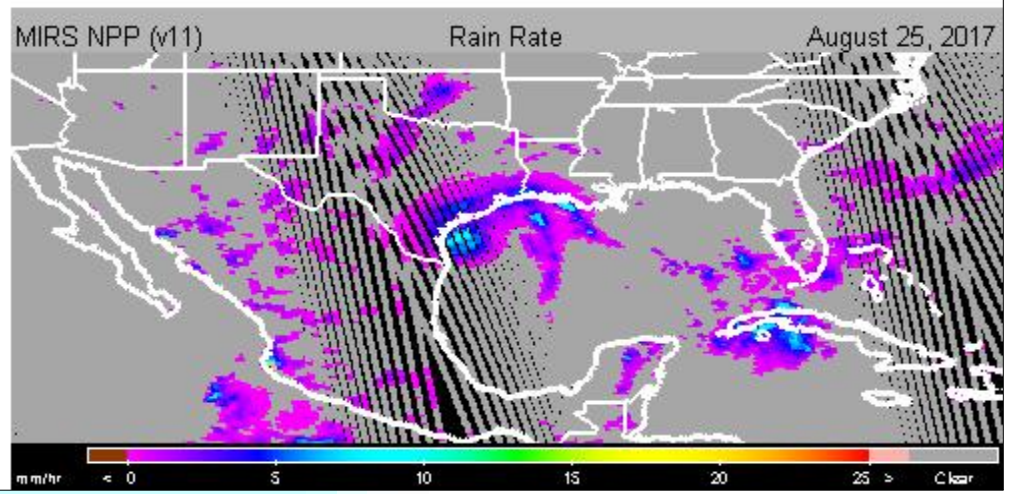
NPP v2.1.2



MetOp v1.5



MiRS NPP

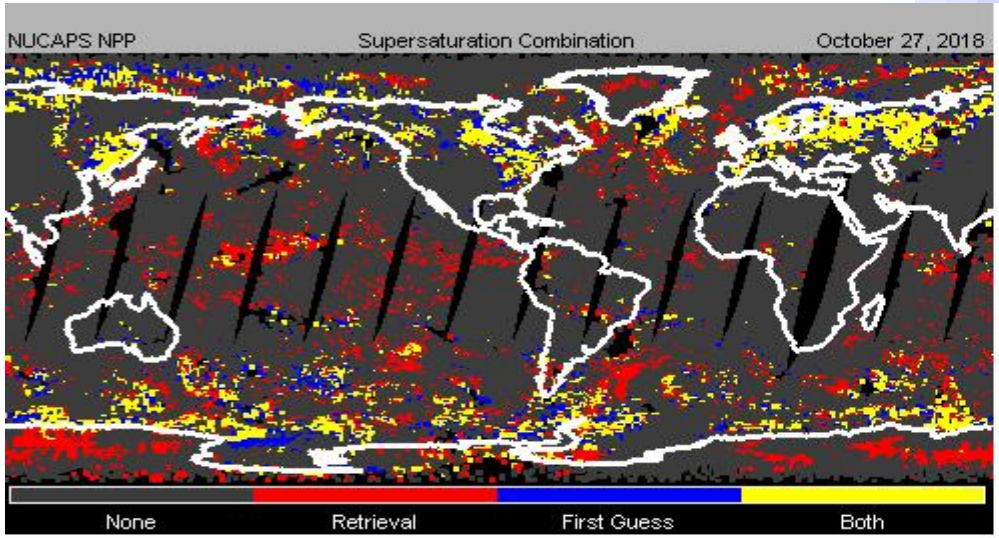


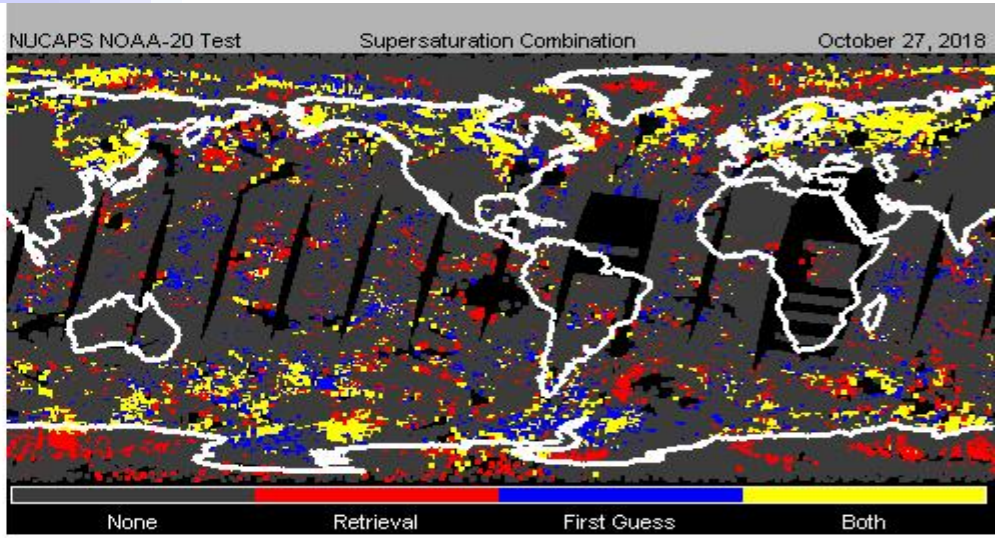
H20 Vapor (g/kg) @741 hPa for IR pass QC:
NUCAPS 1.5, NUCAPS 2.1.2,
NUCAPS IASI-B, MiRS (NPP) Rain Rate

1330 LST SNPP; 1030 LST MetOp; August 25th

NPROVS EV modified to track supersaturated retrievals … October 2018, ODS

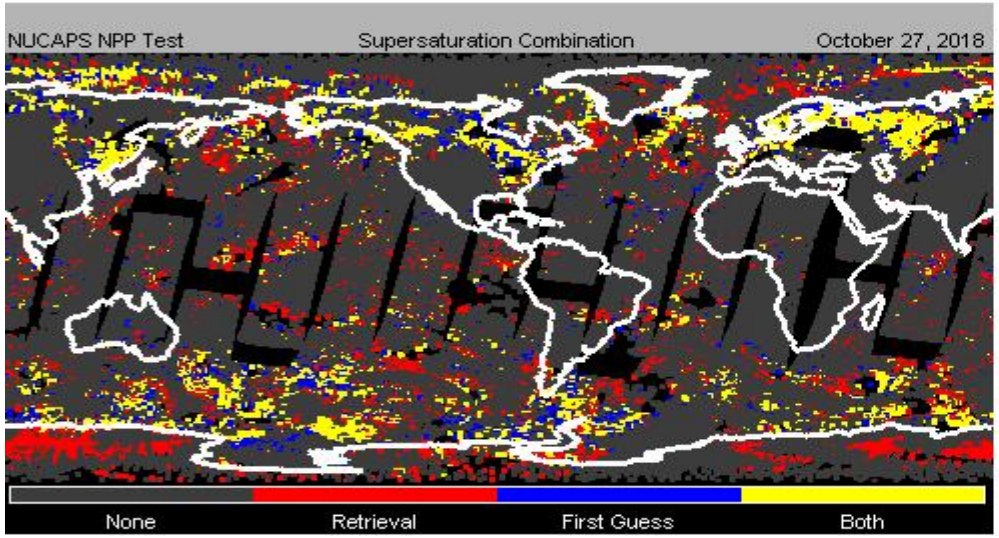
NPP v2.1.2

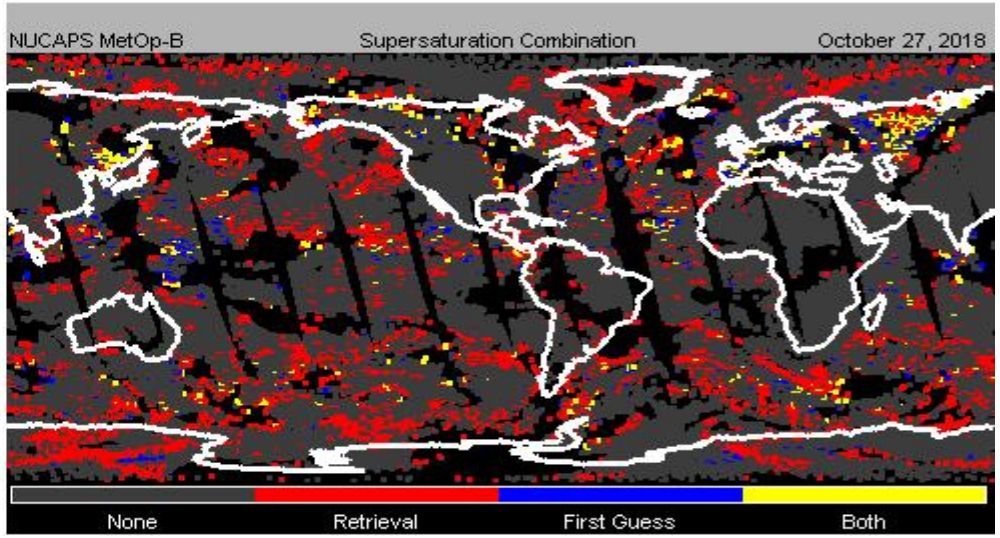




NPP v2.1.12c

NPP v2.1.12c



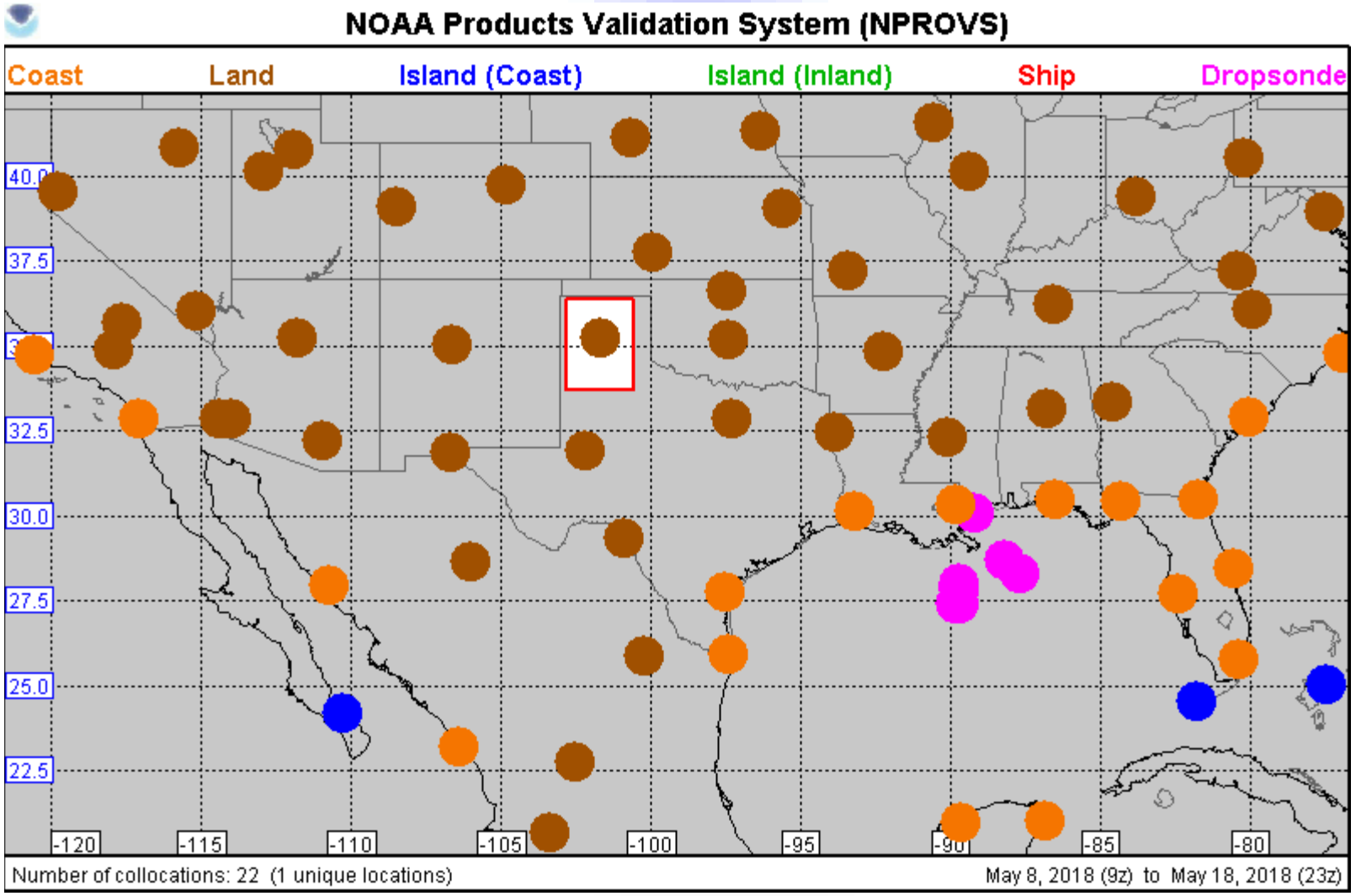


MetOp-B v1.5

Supersaturated: **Sounding**, **First Guess**, **Both** also increase; Bad

NWS Users via AWIPS-2: Spring 2018 HWTB Case Studies … Pre-frontal Convective

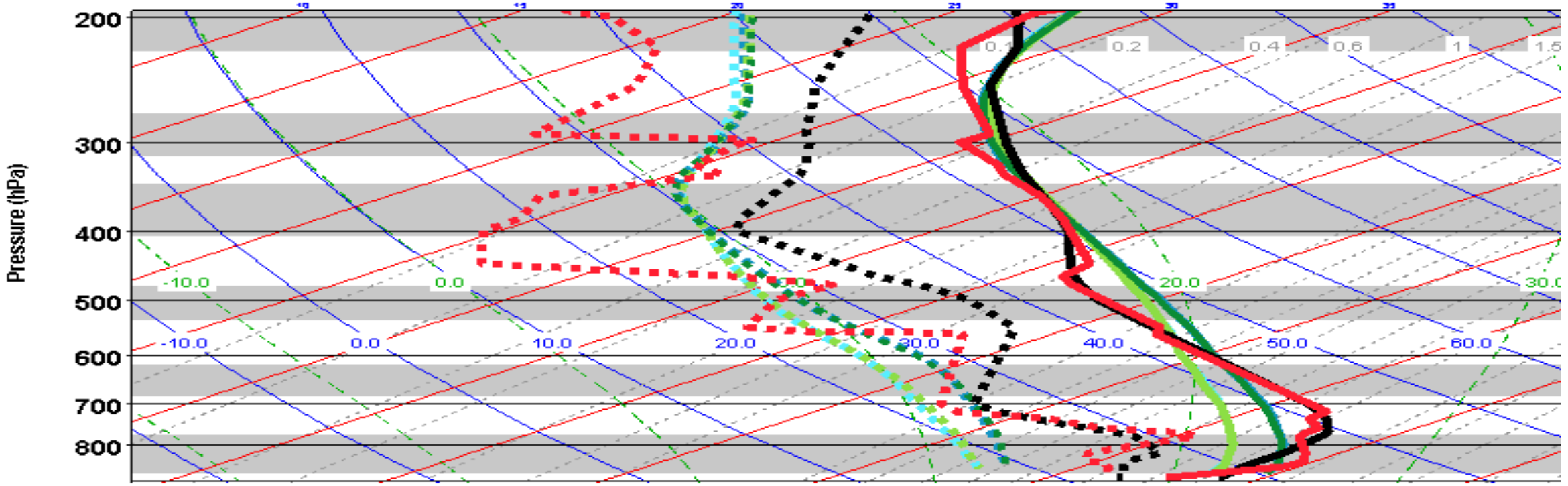
Week	Case #	Date	Weather Region	Product	Success/Failed	Details
1	1	5/3/2018	Albany, NY	CAPE	Success	• Overpass well timed for East Coasts • Modification was not necessary for this case
	2	4/30/2018	Amarillo, TX	CAPE	Failed	• Unusually high CAPE • Modification was too high as well
2	3	5/10/2018	Eastern Wyoming	Mid-Level Moisture	Success	• NUCAPS sounding captured higher moisture levels better than NAM12 • NUCAPS helped forecaster diagnose storm mode and indicating where the mixing is occurring ahead front
	4	5/9/2018	South Central Illinois	CAPE	Failed	• NUCAPS CAPE was very high, however severe storms did not occur • CAPE anomaly sounding near Newton, IL
3	5	5/14/2017	Texas panhandle up to Kansas City	CAPE	Success	• NUCAPS CAPE closer to high resolution guidance than AllSky CAPE
	6	**5/17/2018**	**Amarillo, TX**	**Lapse Rates**	**Failed**	• **Gridded NUCAPS lapse rates were not steep enough compared to models**
4	7	5/24/2018	North East USA	Lapse Rates	Success	• Lapse rate patterns in Canada and NE USA match GFS and NAM
	8	5/24/2018	North East USA	Lapse Rates	Failed	• NUCAPS lapse rates missed an EML (elevated mixed layer) moving from SD up into SW MN • Models suggest higher lapse rates



Collocations including at Amarillo on May 17 Case Study day

NOAA Products Validation System (NPROVS)

Dewpoint / Temperature (deg K)

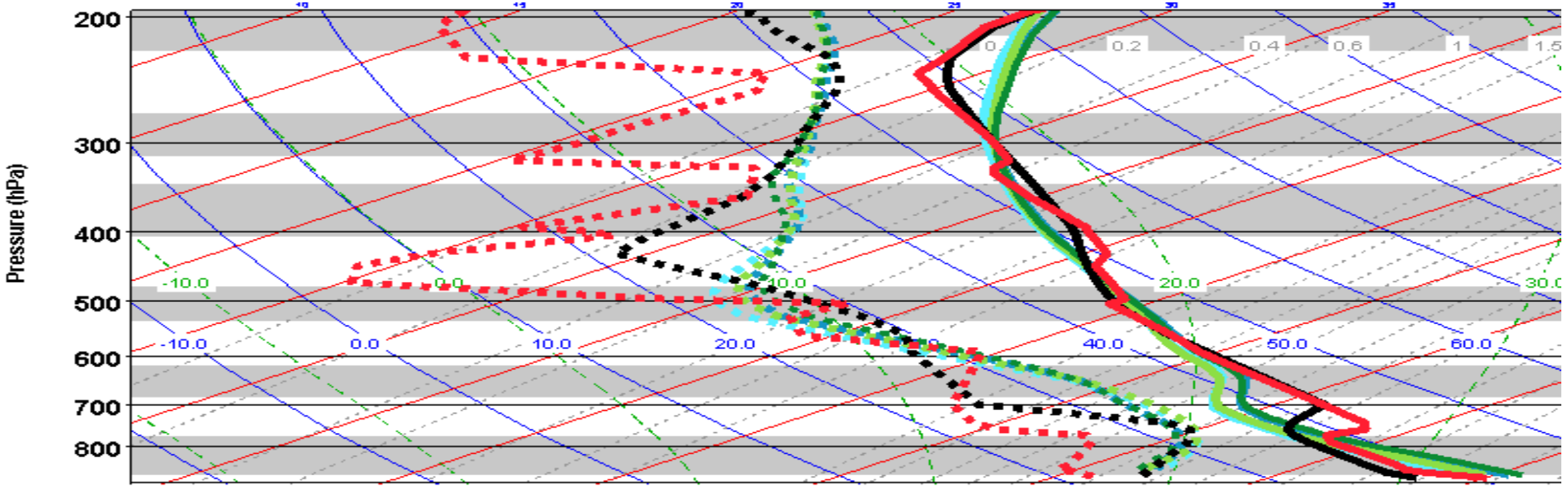


SONDE 72363 (182) SONDE	5/17/2018 11:06:00Z	35.2 N / 101.7 W
SONDE 72363 (182) GFS 6 Hour	5/17/2018 11:06:00Z	35.2 N / 101.7 W
NUCAPS NPP	5/17/2018 8:09:08Z (-2.9 hours)	35 N / 101.6 W (30.8 km)
NUCAPS NPP First Guess	5/17/2018 8:09:08Z (-2.9 hours)	35 N / 101.6 W (30.8 km)
NUCAPS NPP TEST	5/17/2018 8:09:08Z (-2.9 hours)	35 N / 101.6 W (30.8 km)

NUCAPS IR+MW pass QC

NOAA Products Validation System (NPROVS)

Dewpoint / Temperature (deg K)



SONDE 72363 (182) SONDE	5/17/2018 18:13:00Z	35.2 N / 101.7 W
SONDE 72363 (182) GFS 6 Hour	5/17/2018 18:13:00Z	35.2 N / 101.7 W
NUCAPS NPP	5/17/2018 19:28:57Z (1.2 hours)	35.5 N / 101.7 W (27.3 km)
NUCAPS NPP First Guess	5/17/2018 19:28:57Z (1.2 hours)	35.5 N / 101.7 W (27.3 km)
NUCAPS NPP TEST	5/17/2018 19:28:57Z (1.2 hours)	35.5 N / 101.7 W (27.3 km)

NUCAPS IR+MW pass QC

Dedicated (*at satellite overpass*) Ground Truth Programs

JPSS/ARM Dedicated Radiosonde Program conducts on average *two launches per week* at 3 ARM sites since 2006 … **$100K**

RIVAL leverages above program to provide *weekly*, dedicated, twin (RS41 and RS92) radiosonde launches, began February 2018 (2yrs) … **$0K**

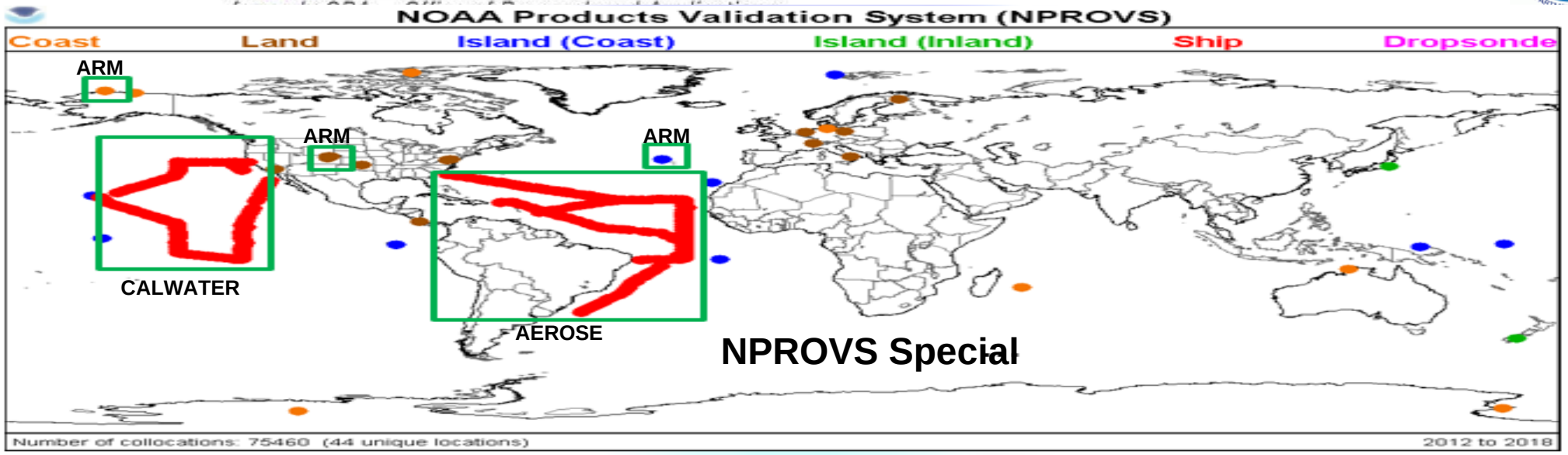
AEROSE dedicated radiosondes (NOAA Ship RHB) in conjunction with Saharan Air Layer since 2013 provides up to *4 launches daily* from tropics … **$30K**

CALWATER dedicated radiosondes monitor Atmospheric Rivers (RHB)… **$0K**

All above collocated with “multiple” satellite EDR and stored/assessed via NPROVS EV

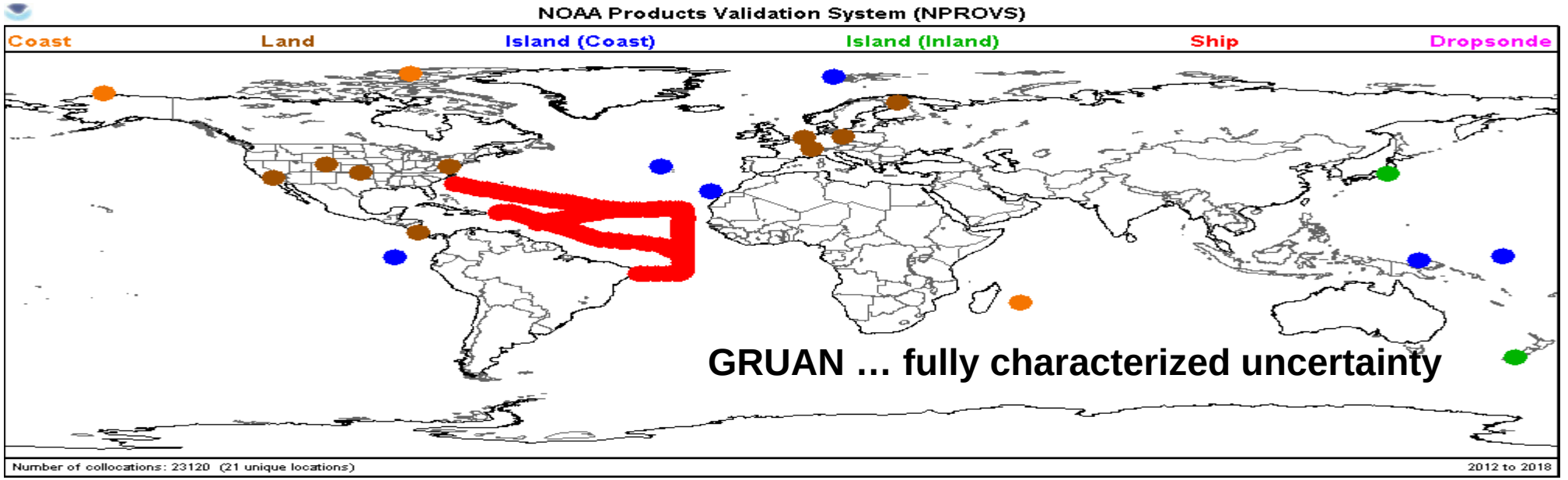
Promotes synergy across international satellite, weather forecast and climate communities:

- NOAA (STAR, SSEC, CICS …)
- DOE-ARM
- GRUAN
- GSICS

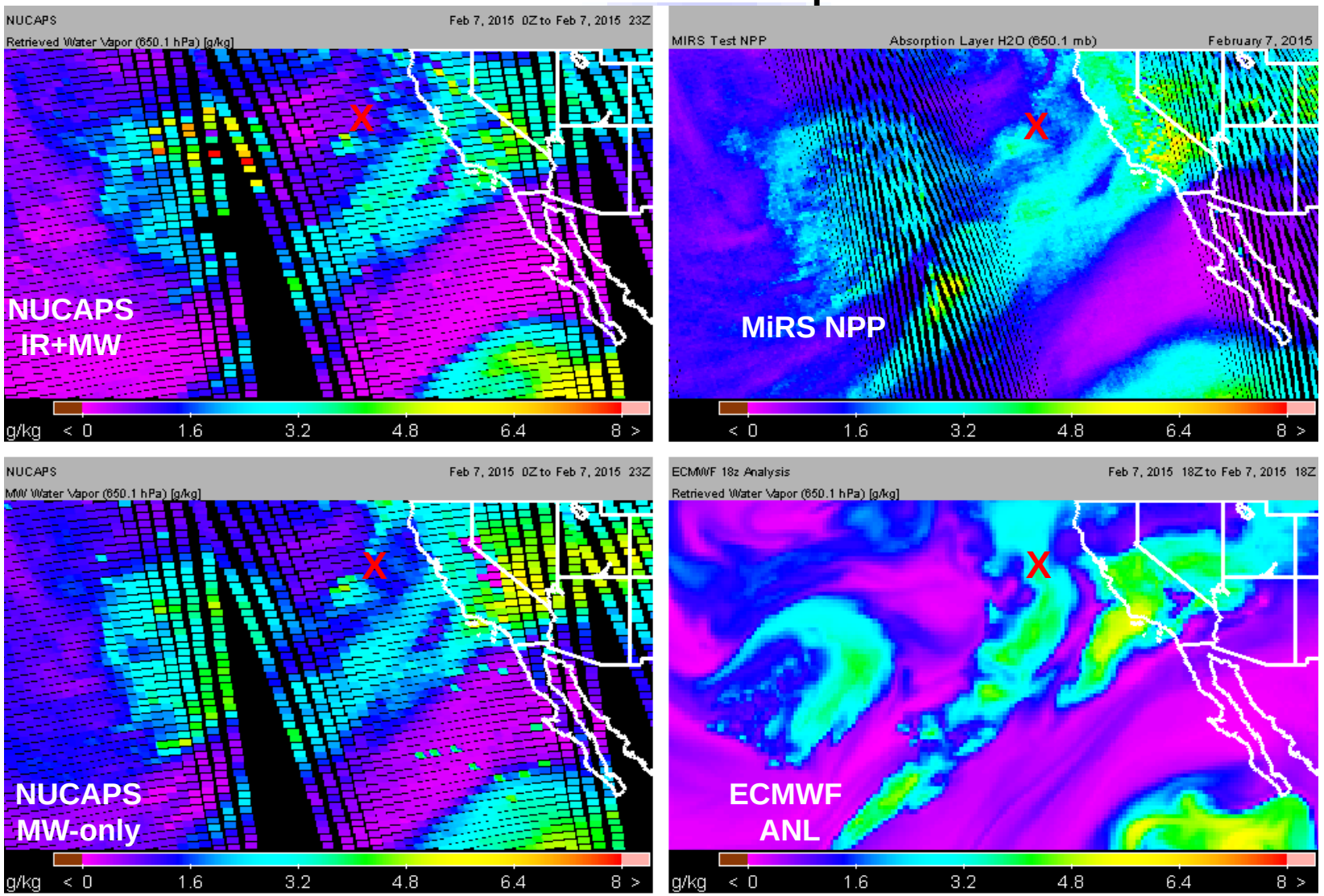


Global datasets of collocated Special RAOB and Satellite EDR; 50,000 since 2013

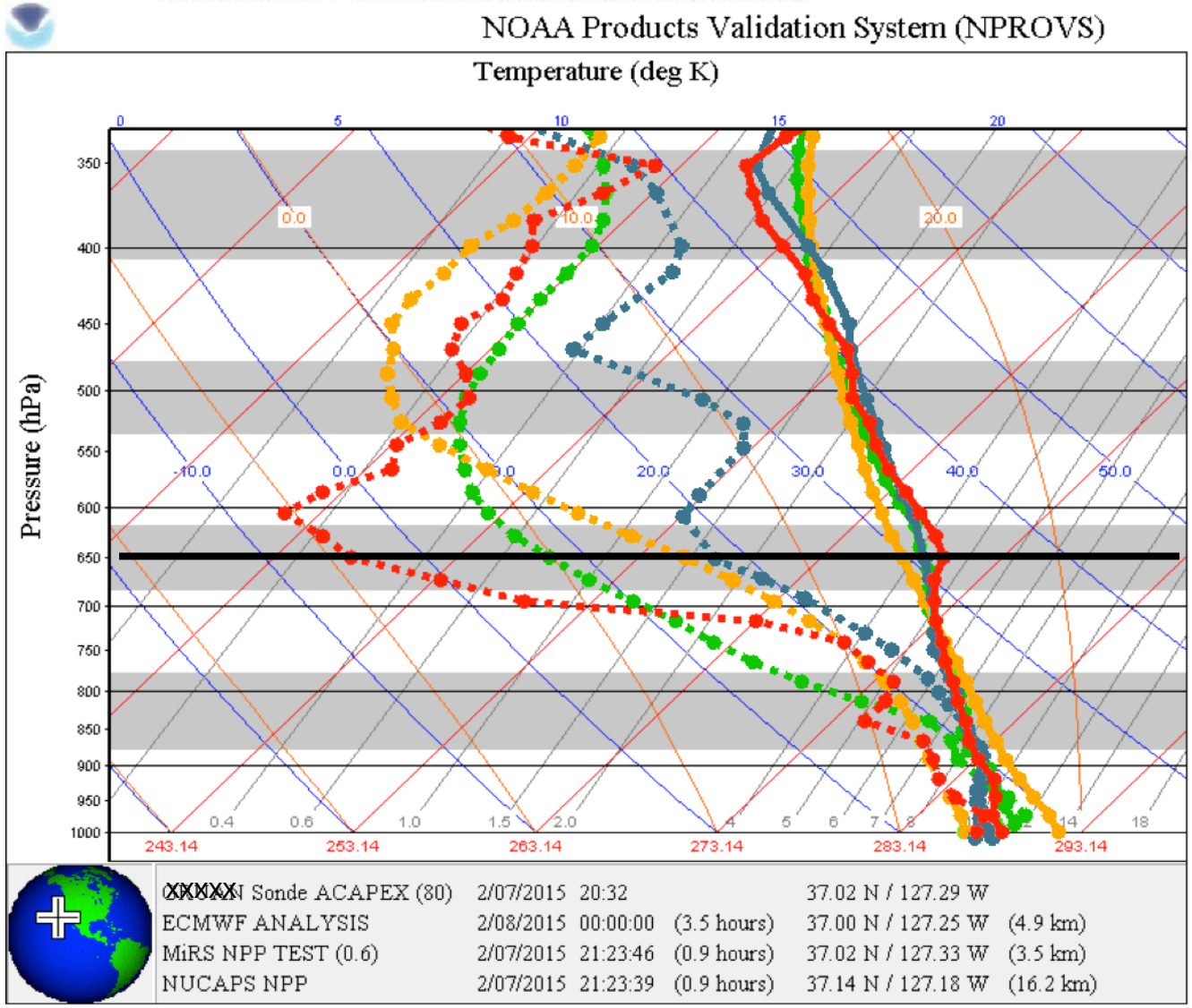
(ARM sites, AEROSE, CALWATER dedicated campaign in Green Boxes)



650 hPa H20 Vapor



CALWATER (ACAPEX) 2015 …. AWIPS-2

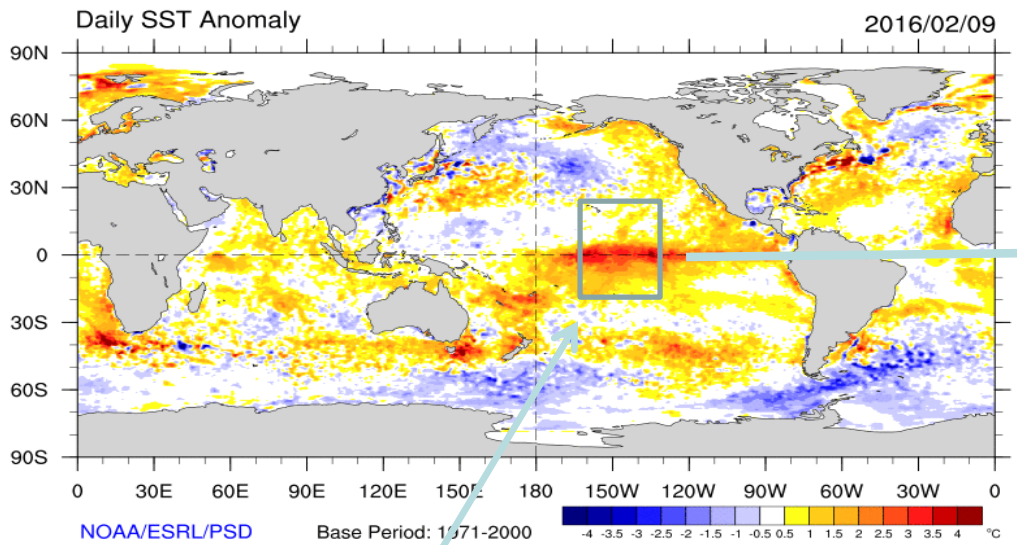


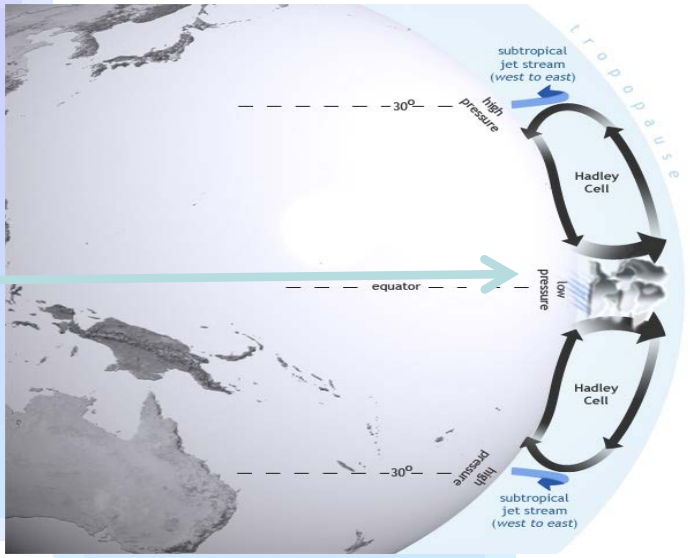
CALWATER RAOB
ECMWF Analysis
MIRS NPP
NUCAPS v1.5

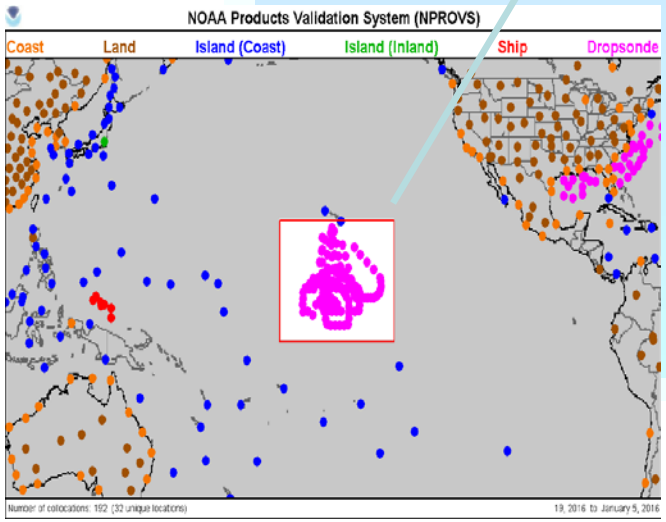
650 hPa

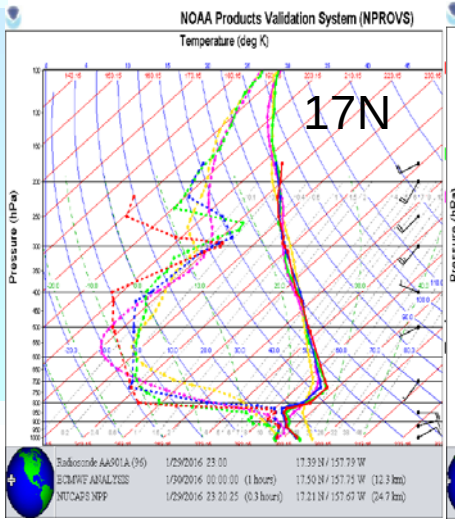
RAOB @ 2032Z … SAT @ 2123Z … ECMWF @ 00Z

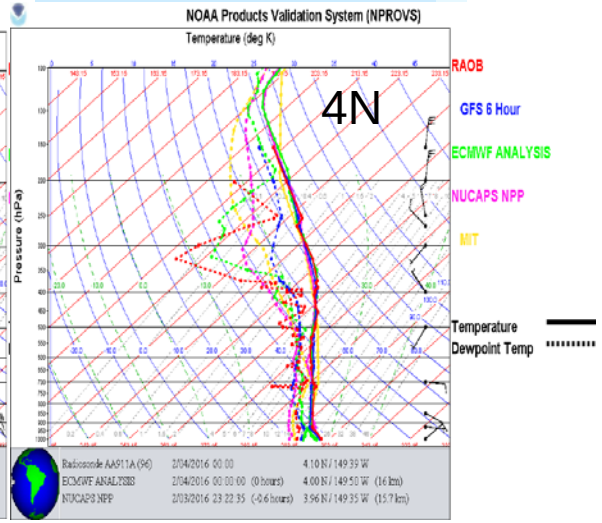
AWIPS-2 El-Nino Rapid Response 2016; Dropsondes



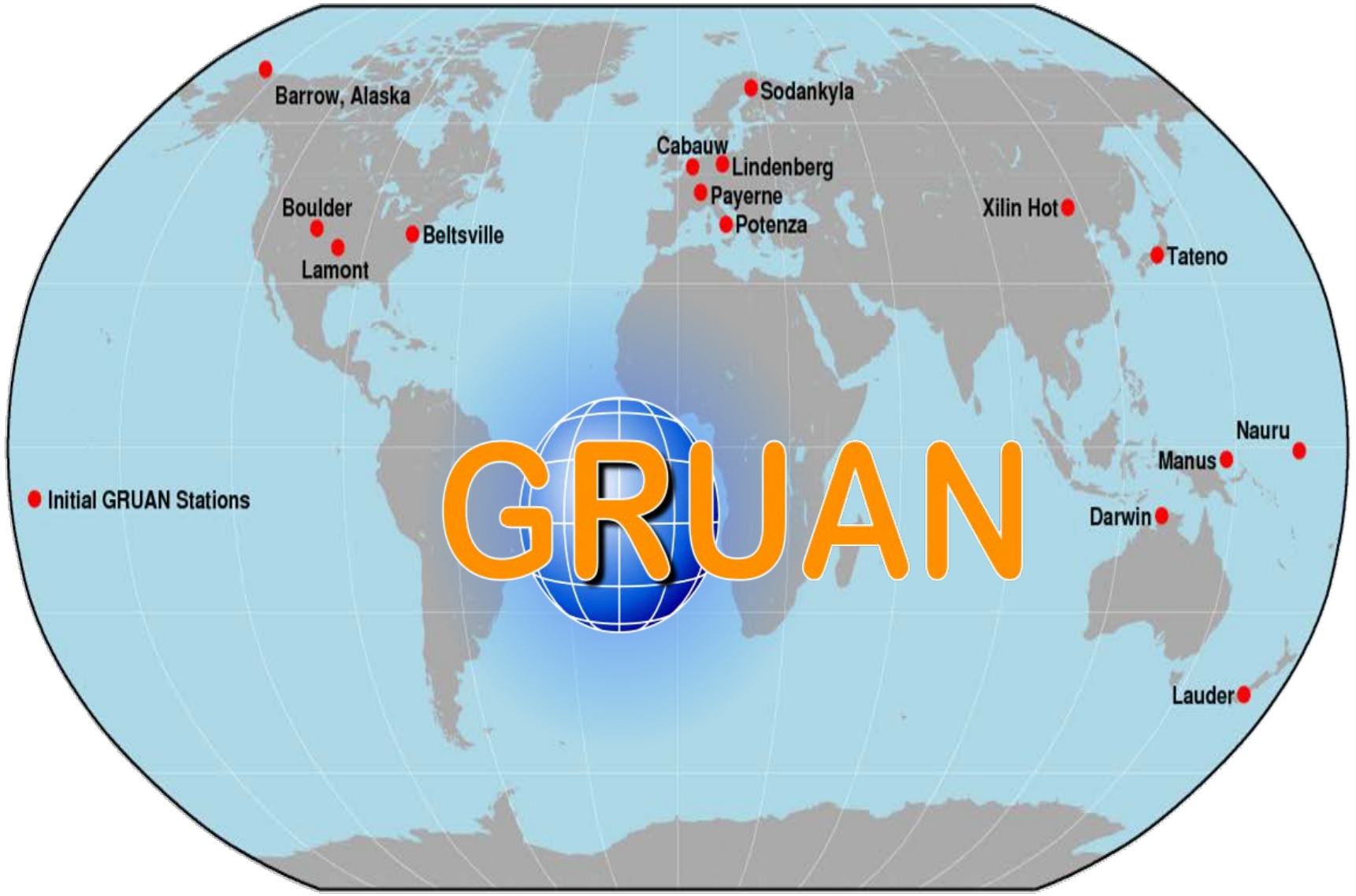








NUCAPS captures circulation regimes of the central pacific tropical/sub-tropical region



Reference radiosonde with fully characterized uncertainty

Benefit: Timely "sanctioning" of New Products (to be demonstrated for sounding)

- Small SATs
- Evolving AI systems
- KOMPSAT
- Identify/integrate new/existing dedicated target (radiosonde, etc.) programs

- *Routine (quasi nrt) compilation of collocation (validation) datasets … leveraged*
- *Ongoing Monitoring, Back-processing, Re-processing, Stewardship … leveraged*
- ***Seamless integration of new product suites and targets … leveraged***
- *Graphical Tools for Assessment … leveraged*
  - *Long term*
  - *Short term*
  - *Deep Dive*

- NPROVS leveraged

EV feasibility for "other" EDR

- Precipitation (TPW, rainfall rate)
- GAS (O3, CO2, CO …)
- Surface temperature (LST and SST)
- Associated Models per …
- Collocation Strategy per …
- Dedicated targets per …

- *Routine (quasi nrt) compilation of collocation (validation) datasets … needed*
- *Ongoing Monitoring, Back-processing, Re-processing, Stewardship … needed*
- *Seamless integration of new product suites and targets … needed*
- *Graphical Tools for Assessment … needed*
  - *Long term*
  - *Short term*
  - *Deep Dive*

- **Leverage Developer /NPROVS to create STAR EV per "*qualifying*" EDR**

STAR Plan

- RTMEE … Enterprise Validation (18 months)

- Expand NPROVS EV for Sounding to integrate / assess
  - AI retrieval (MW, IR)
  - Small Sats (as available)
  - GFS Analysis
  - KOMPSAT (GPSRO)

- Collaboration with Developers for EV for “other” EDR
  - TPW / Precipitation / Rain-Rate
  - Gas (Ozone, CO2, CO …)
  - Surface Temperature

- Demonstrate expanded EV for Soundings

- Demonstrate EV for selected “Other(s)”

Summary

Historical perspective of EDR assessment at NESDIS

What is “Enterprise Validation” and what does it entail

Enterprise Validation as addition through subtraction in context of Developer …

Examples of EV at STAR using NPROVS (Temp and H20 Sounding) … Long Term Global to Deep Dive

Timely assessment / sanctioning of new products (soundings) *… the first carrot*

EV feasibility for other EDR’s … *more carrots*

STAR Plan