Long Term Global Assessments Comparing NOAA, NASA and EUMETSAT Operational Soundings

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AIRS Science Team
October 2018

Outline

NPROVS Enterprise Validation

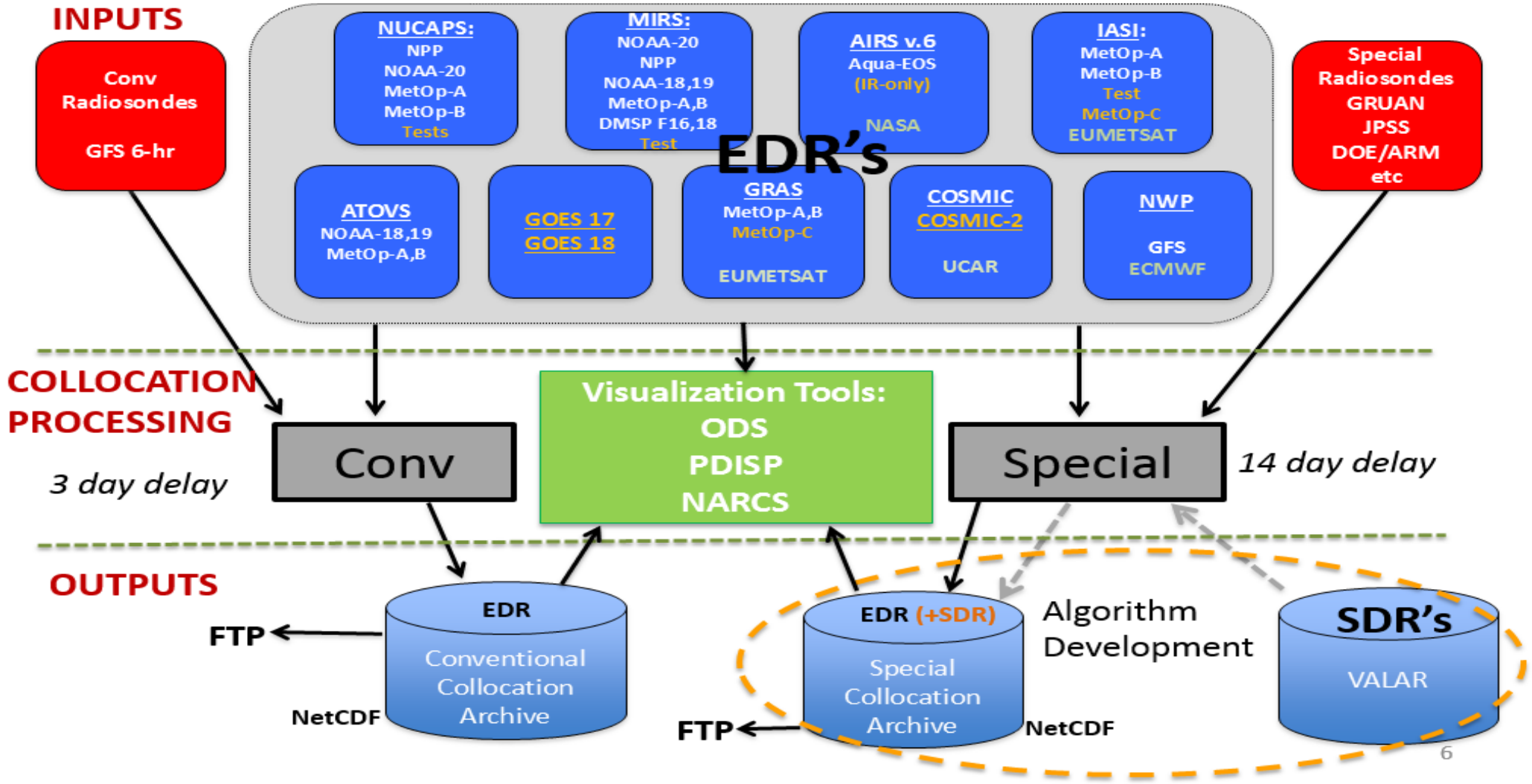
Impact of Spatial temporal windows

LTM for NUCAPS (v1.5) , AIRS (v6.1) and EUMETSAT (v6.2) products
- Temp (+gess)
- H20 vapor fraction (weighting?)
- IR+MW yield

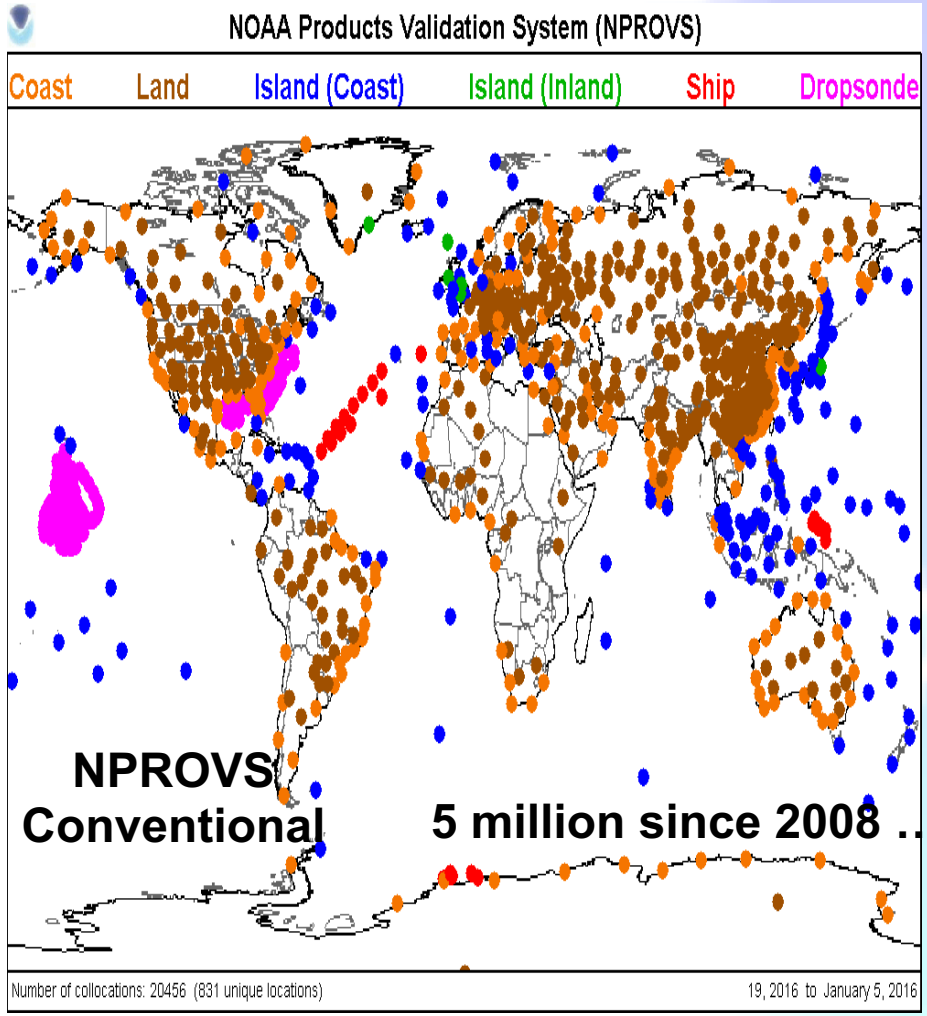
LTM for NUCAPS FSR
- S-NPP: v1.5 vs v2.1.2 vs v2.1.4 vs v2.1.12c
- NOAA-20: v2.1.4 vs v2.1.12c; Beta, Provisional

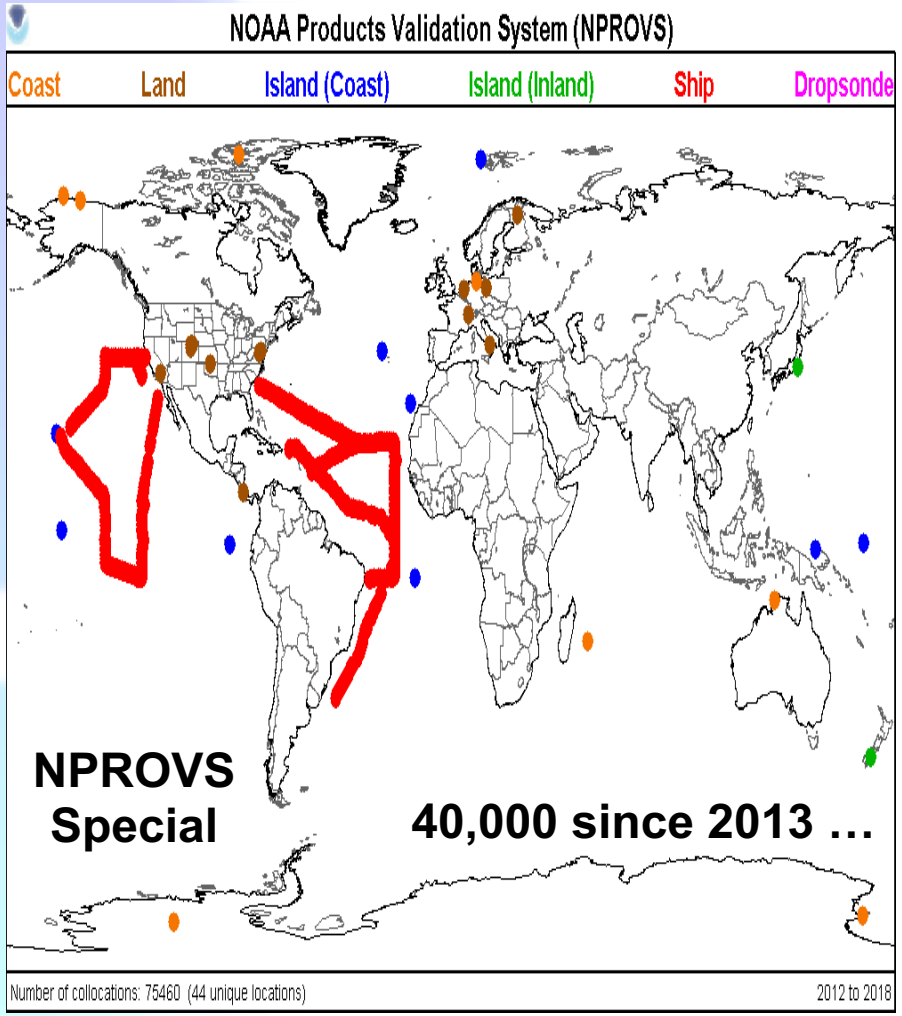
AWIPS-2 HWTB May 2018

Summary



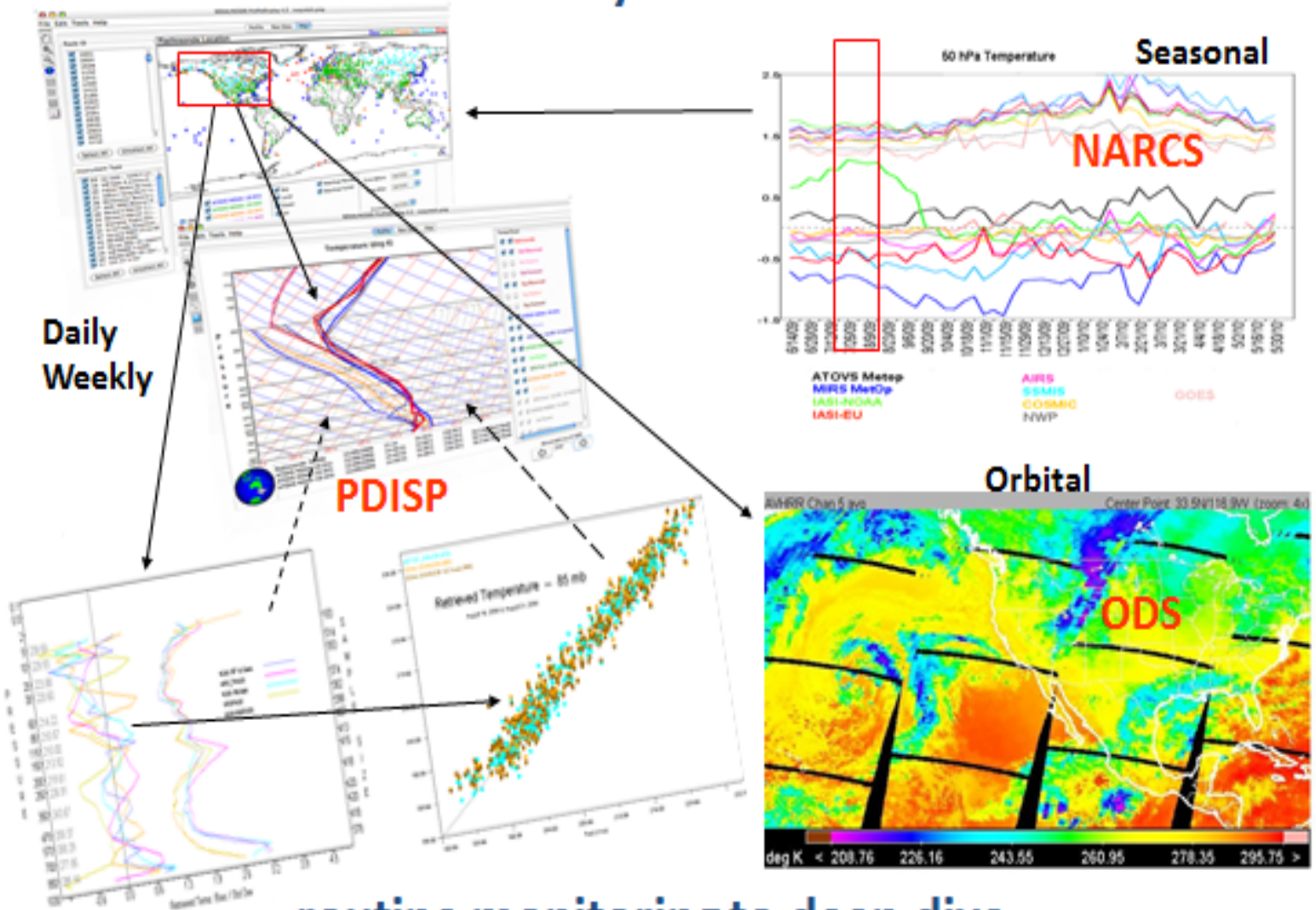
NPROVS Enterprise Sounding Validation





Maintain global datasets of collocated RAOB and Satellite Observations

EDGE Analytical Interface …



… routine monitoring to deep dive

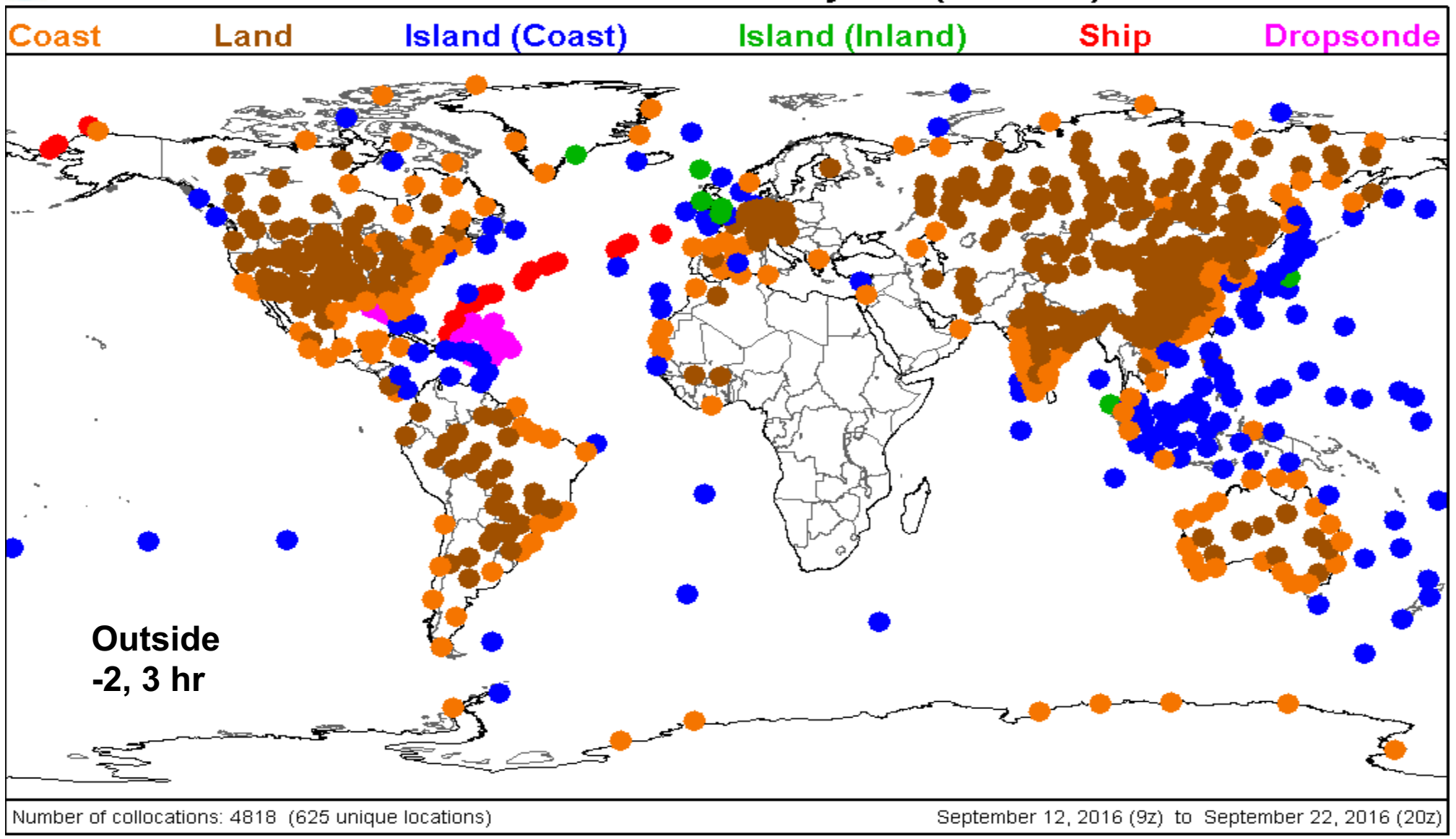
PDISP

collocation statistics for multiple product suites using *"common"* samples

Single closest SAT to given Raob …

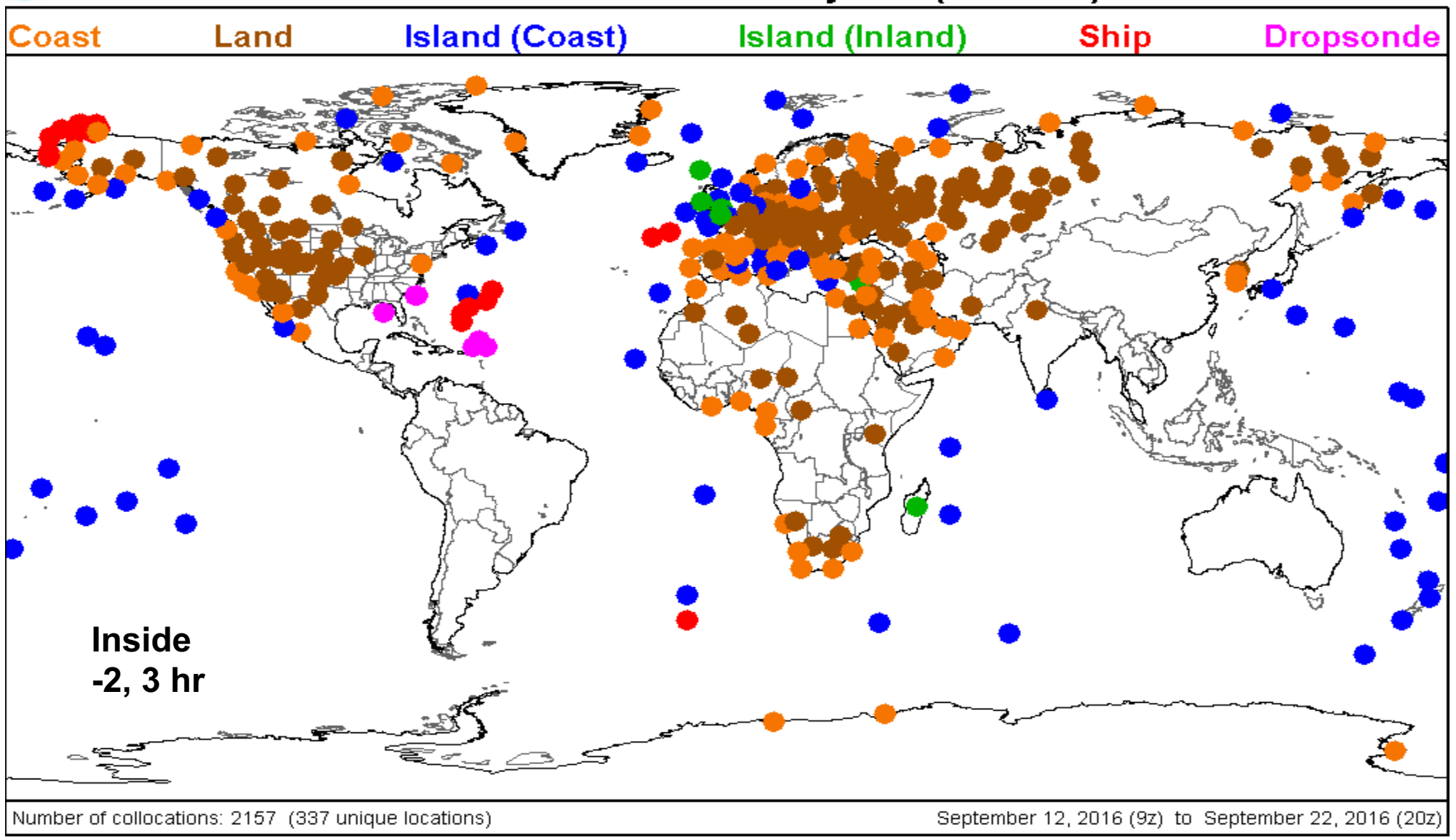
Why believe Stats at +/- 6hr?

NOAA Products Validation System (NPROVS)



10-day, September 2016; IR+MW pass QC

NOAA Products Validation System (NPROVS)



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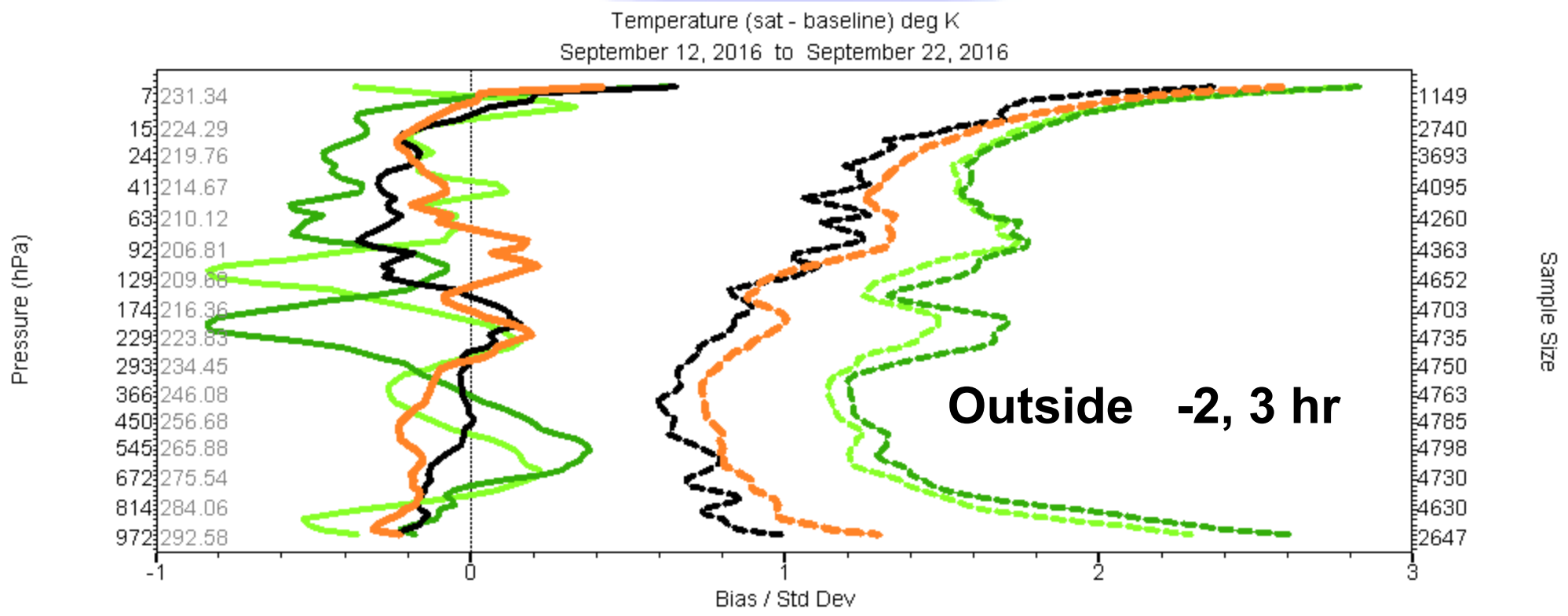

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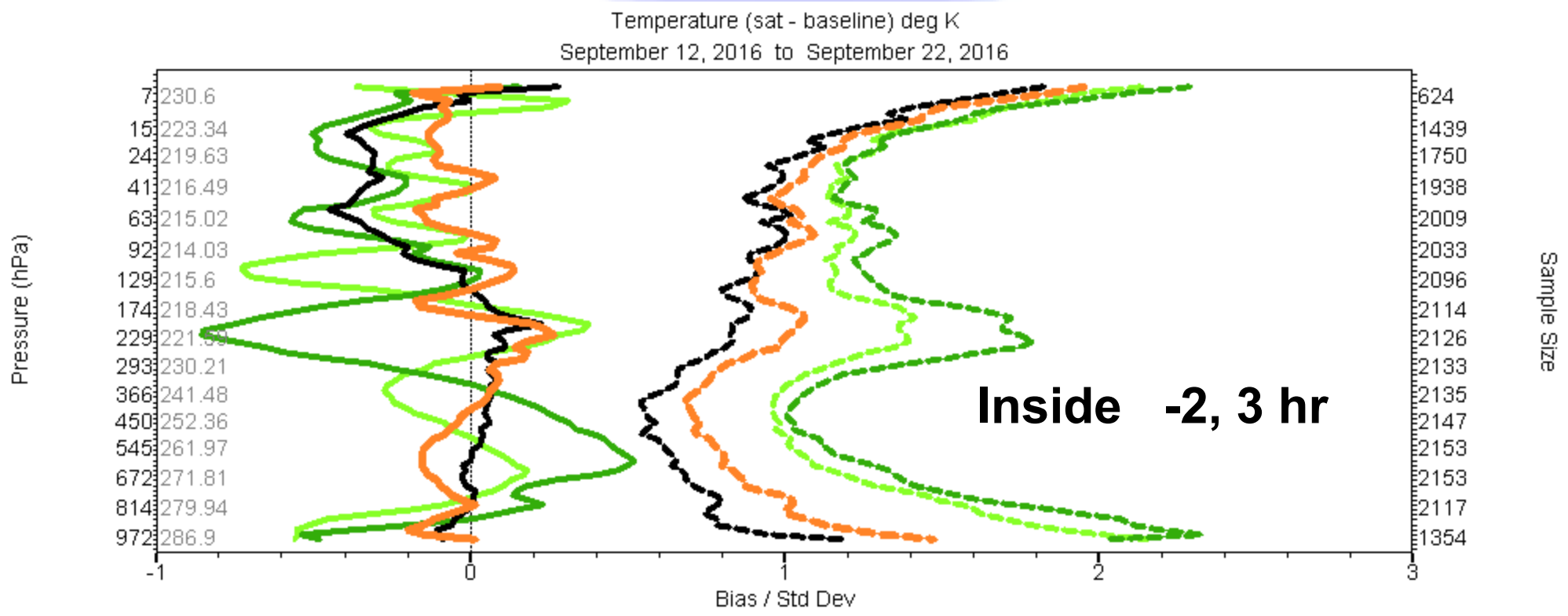
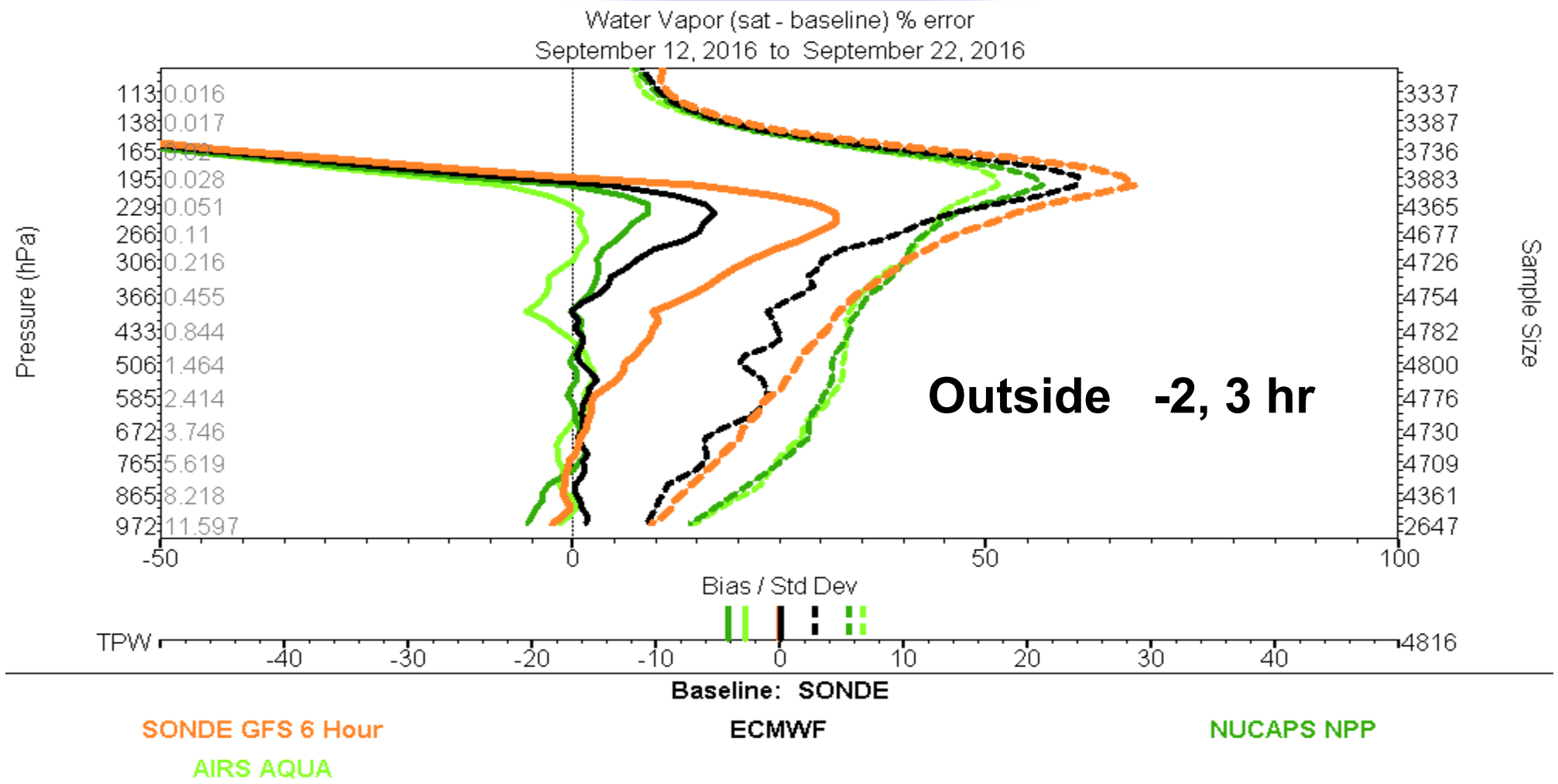


10-day, September 2016; IR+MW pass QC

Water Vapor Fraction (AIRS Science Team Method)

- W**2 weight for SD, RMS
- W**1 weight for bias



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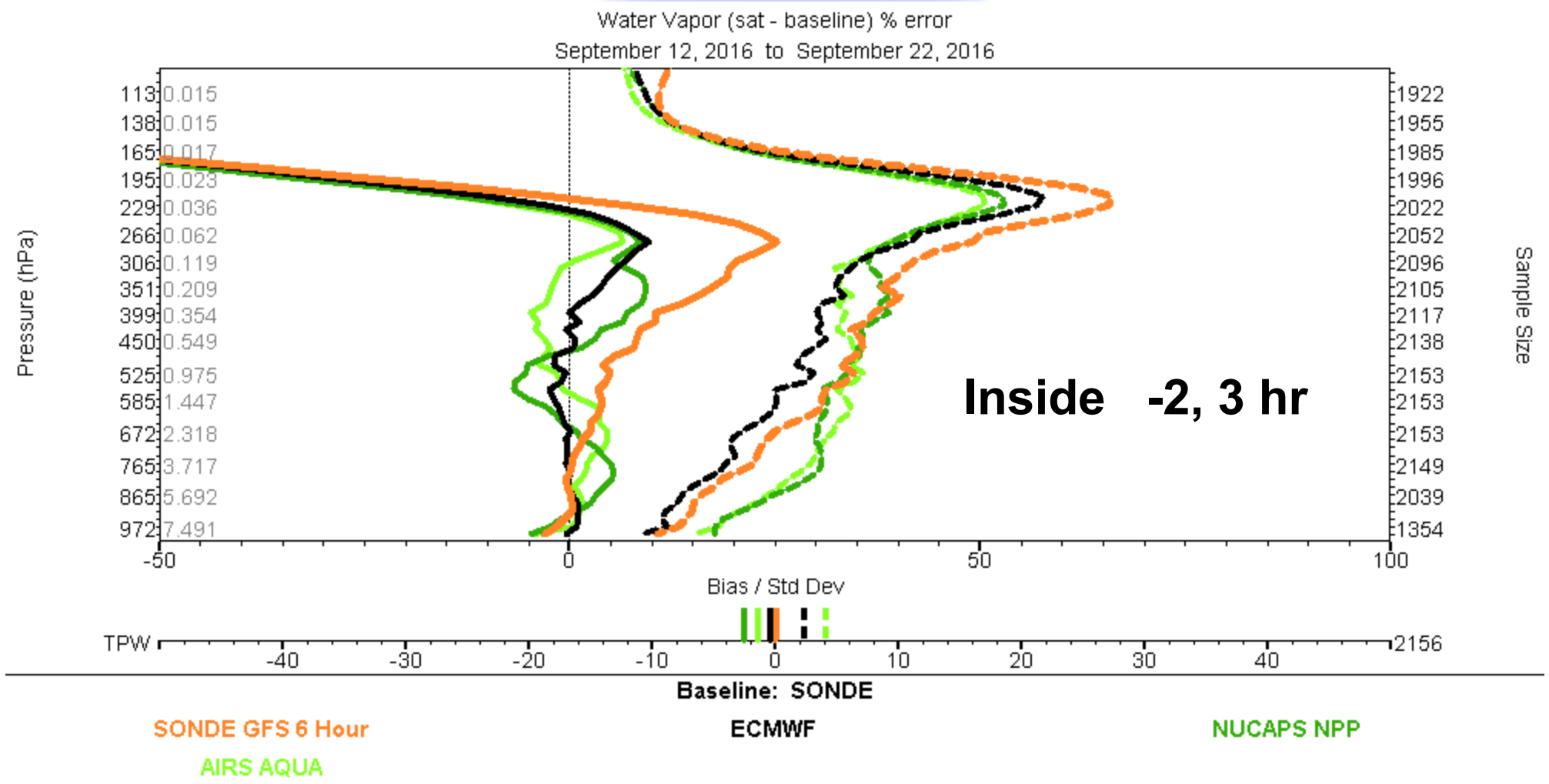

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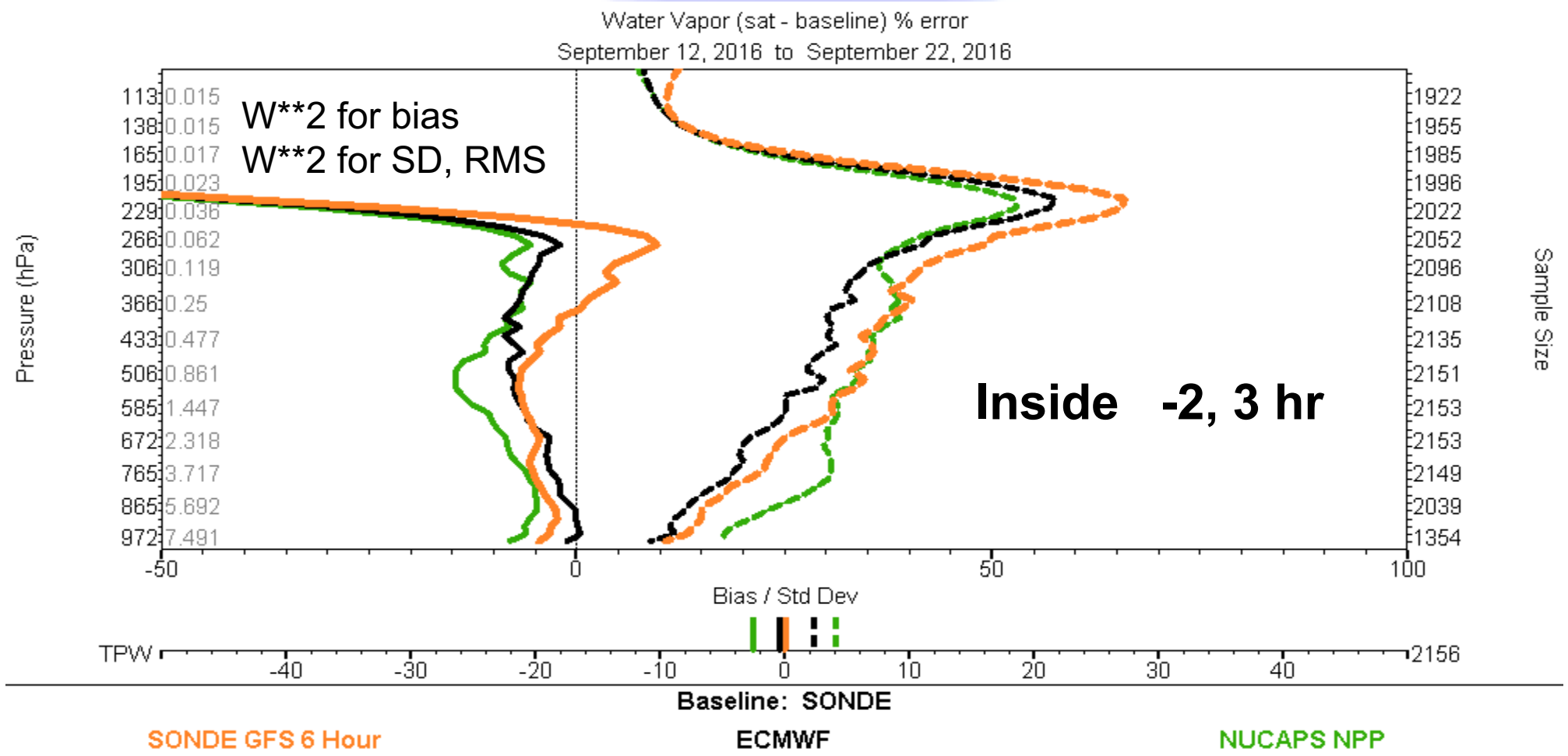
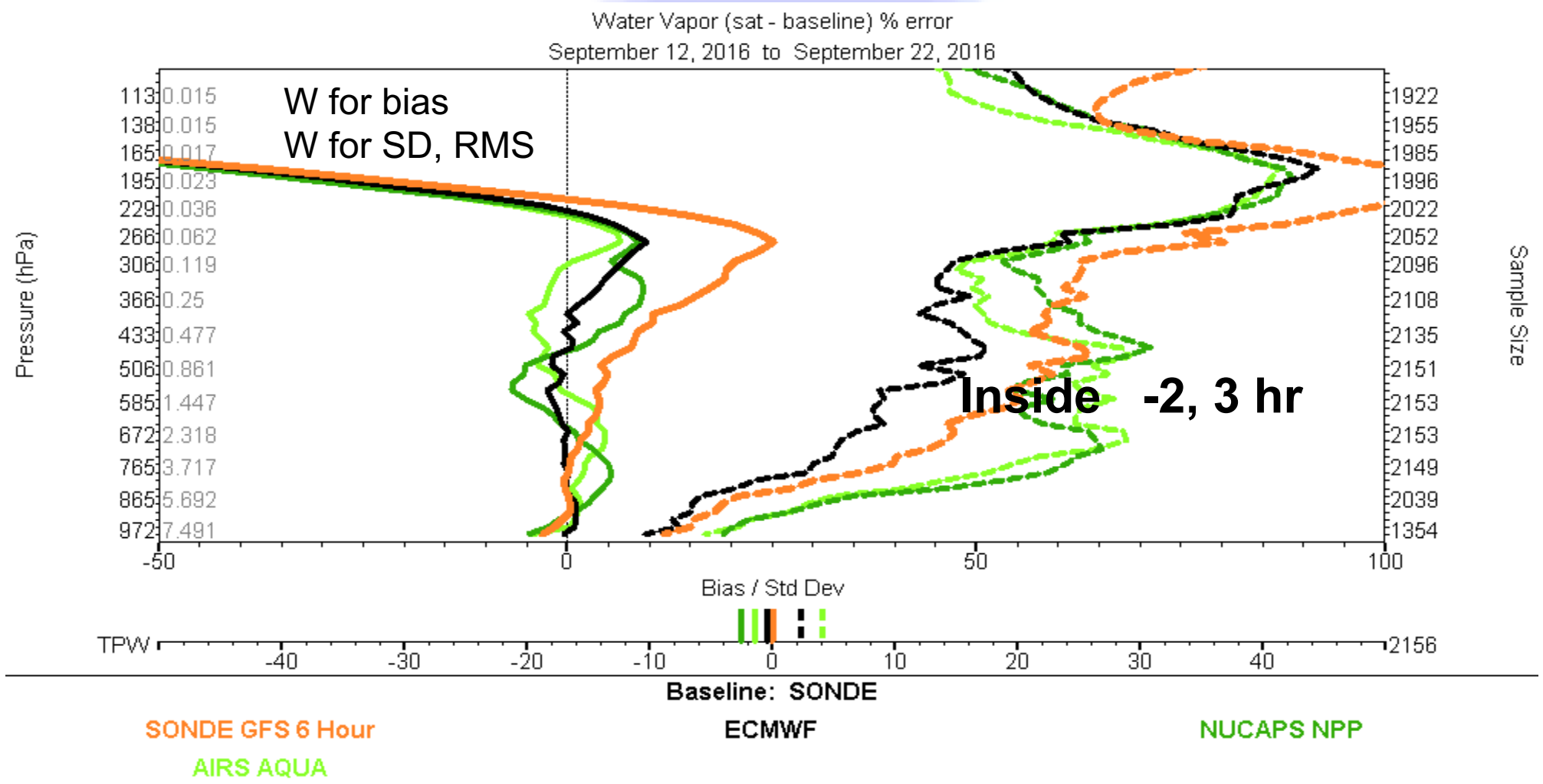
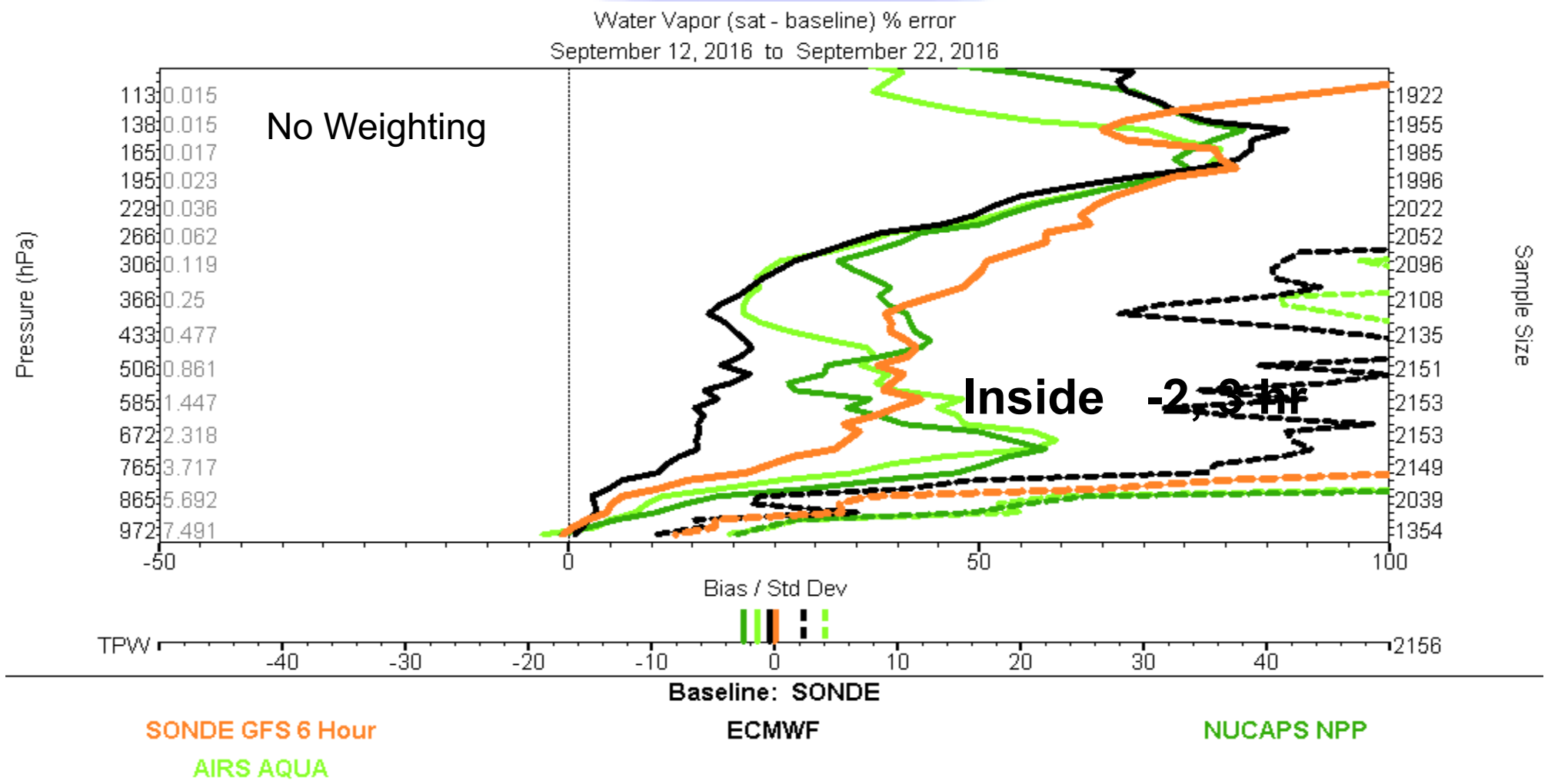


10-day, September 2016; IR+MW pass QC



10-day, September 2016; IR+MW pass QC



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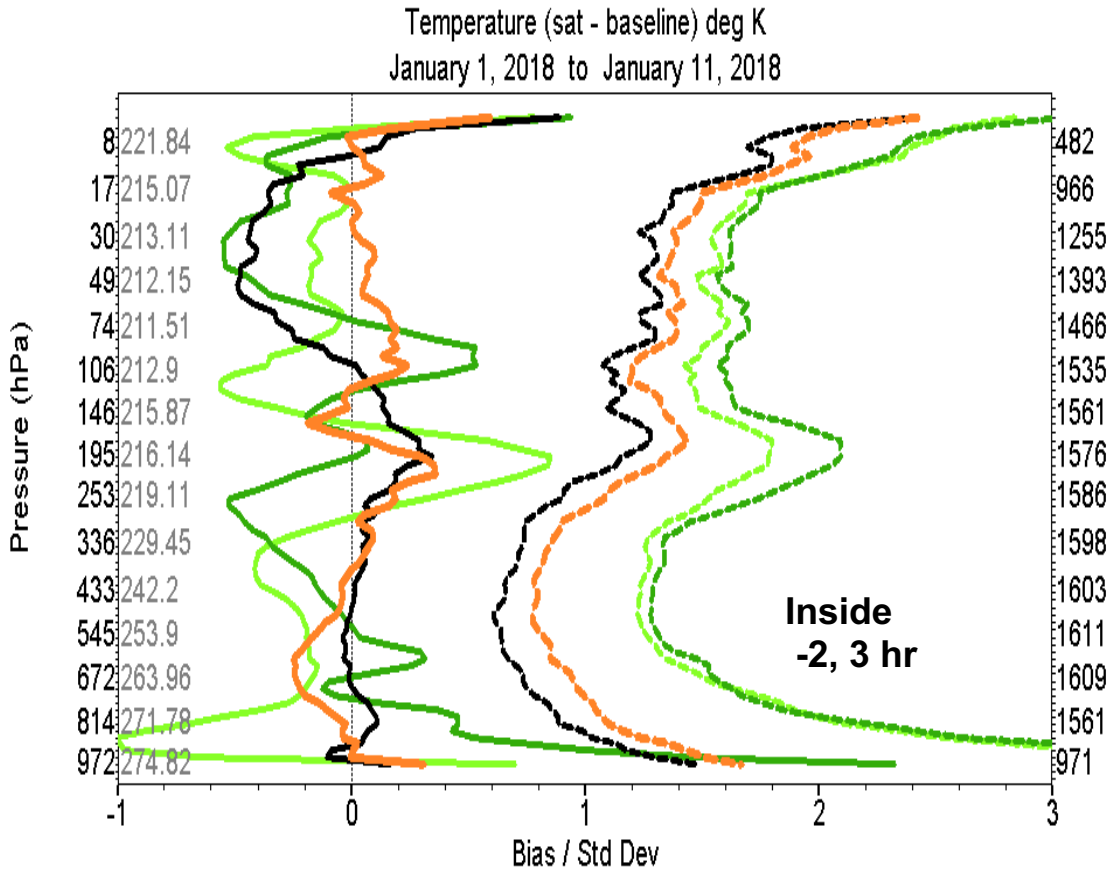
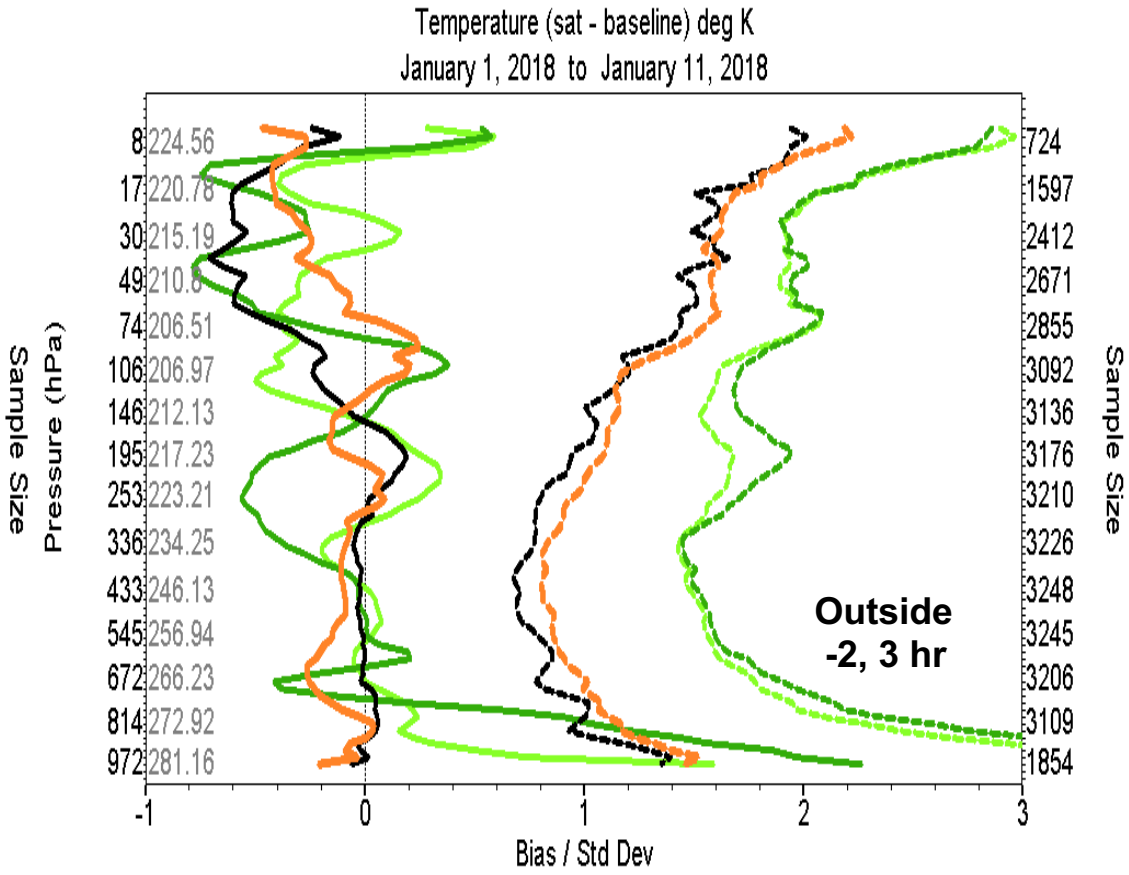




Baseline: SONDE

SONDE GFS 6 Hour

AIRS AQUA

ECMWF

NUCAPS NPP

Baseline: SONDE

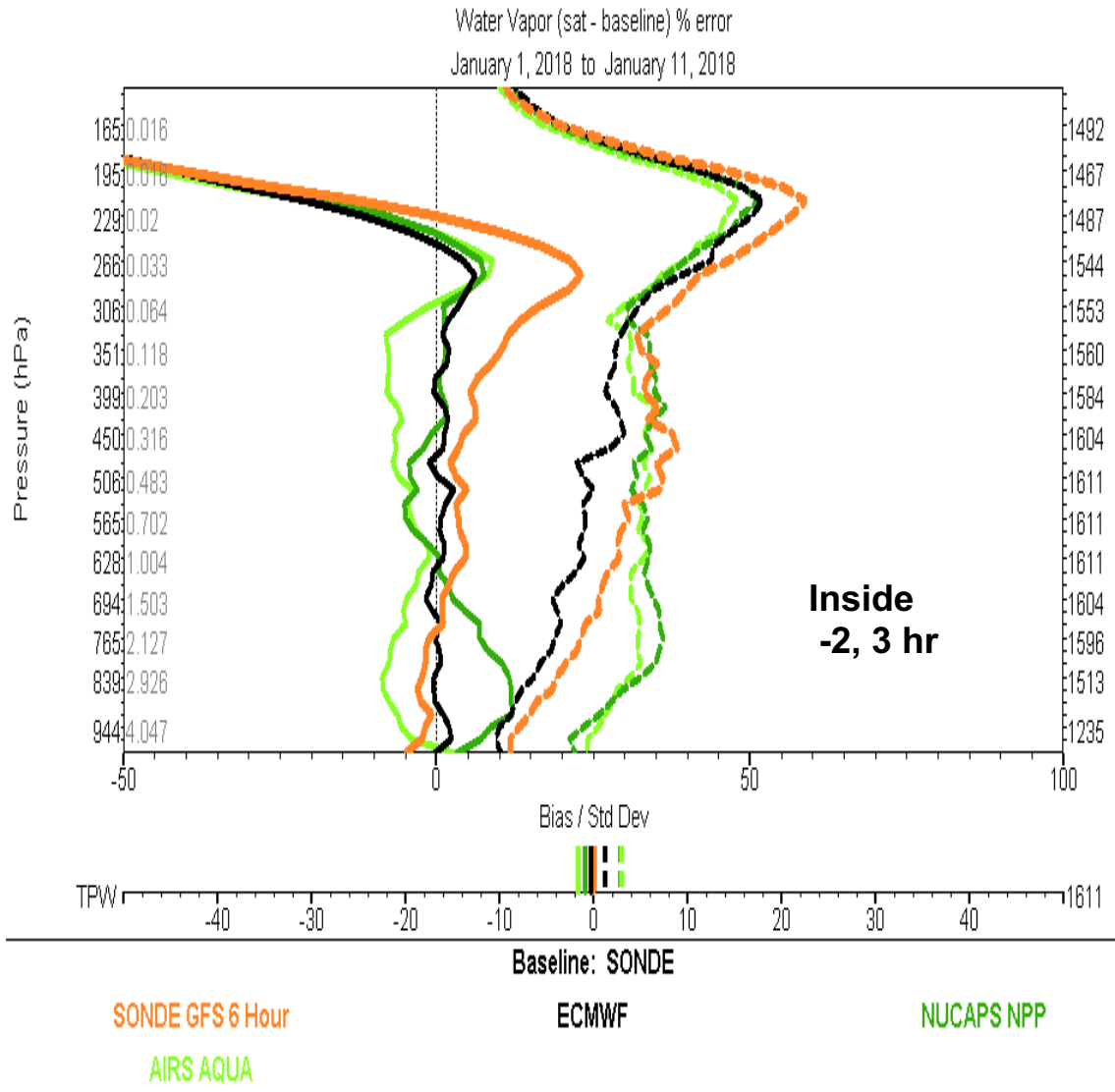
SONDE GFS 6 Hour

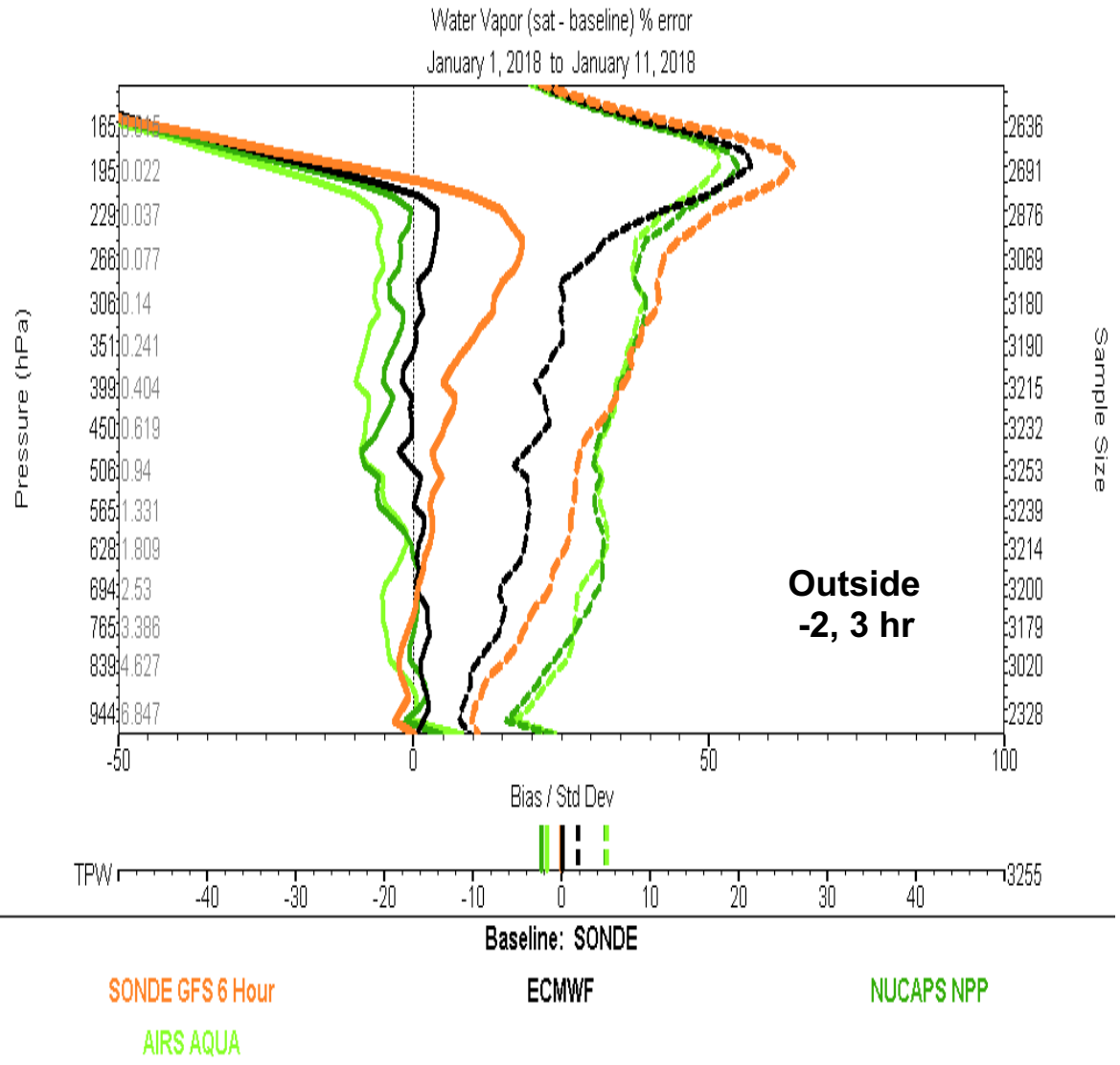
AIRS AQUA

ECMWF

NUCAPS NPP

10-day, January, 2018; IR+MW pass QC





10-day, January, 2018; IR+MW pass QC

NARCS

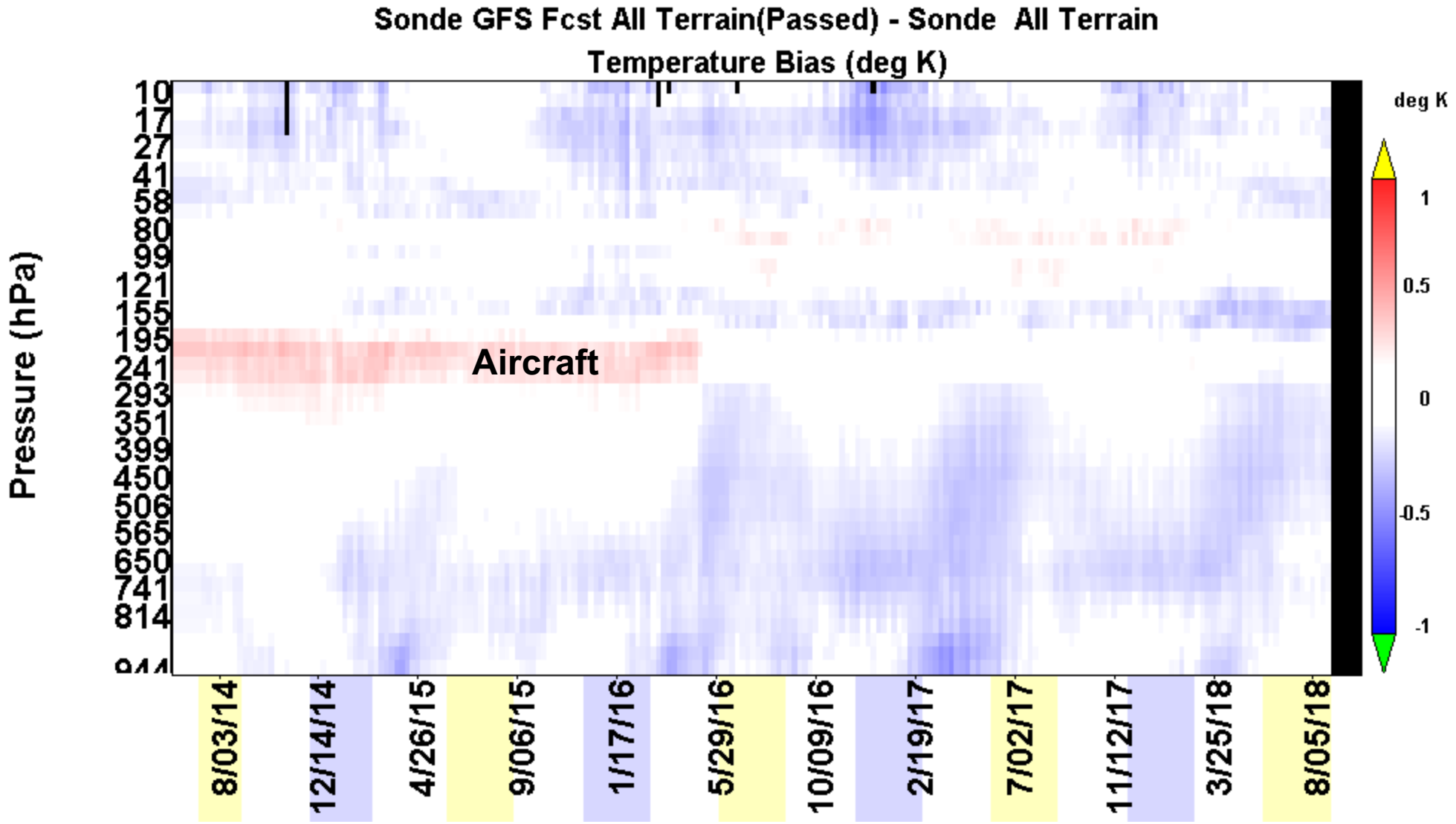
Vertical time series of SAT-minus-RAOB statistics for each product suite

- Daily, **Weekly**, Monthly

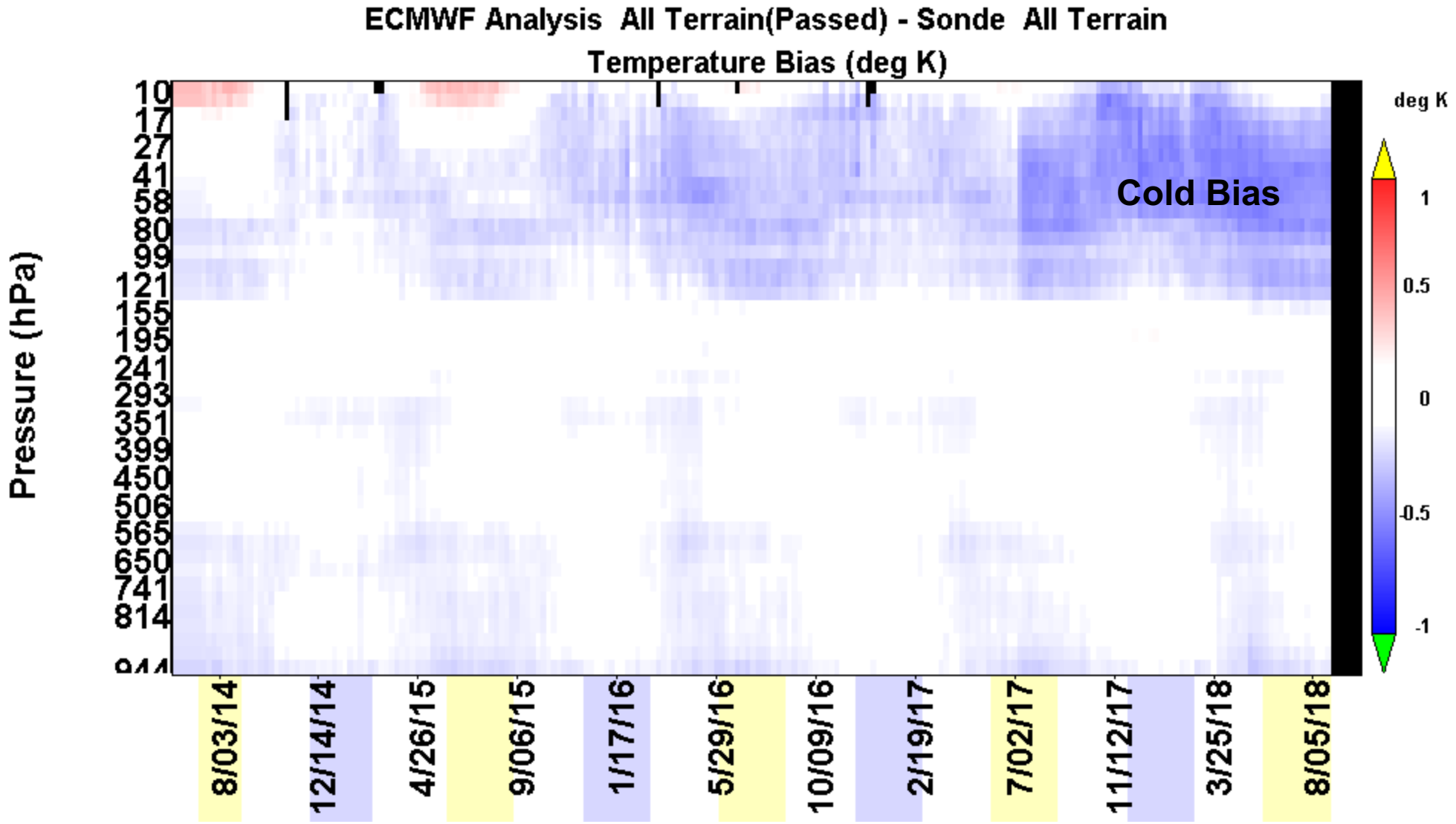
August 2014 to August 2018

Pre-computed, samples "*optimal*" per suite

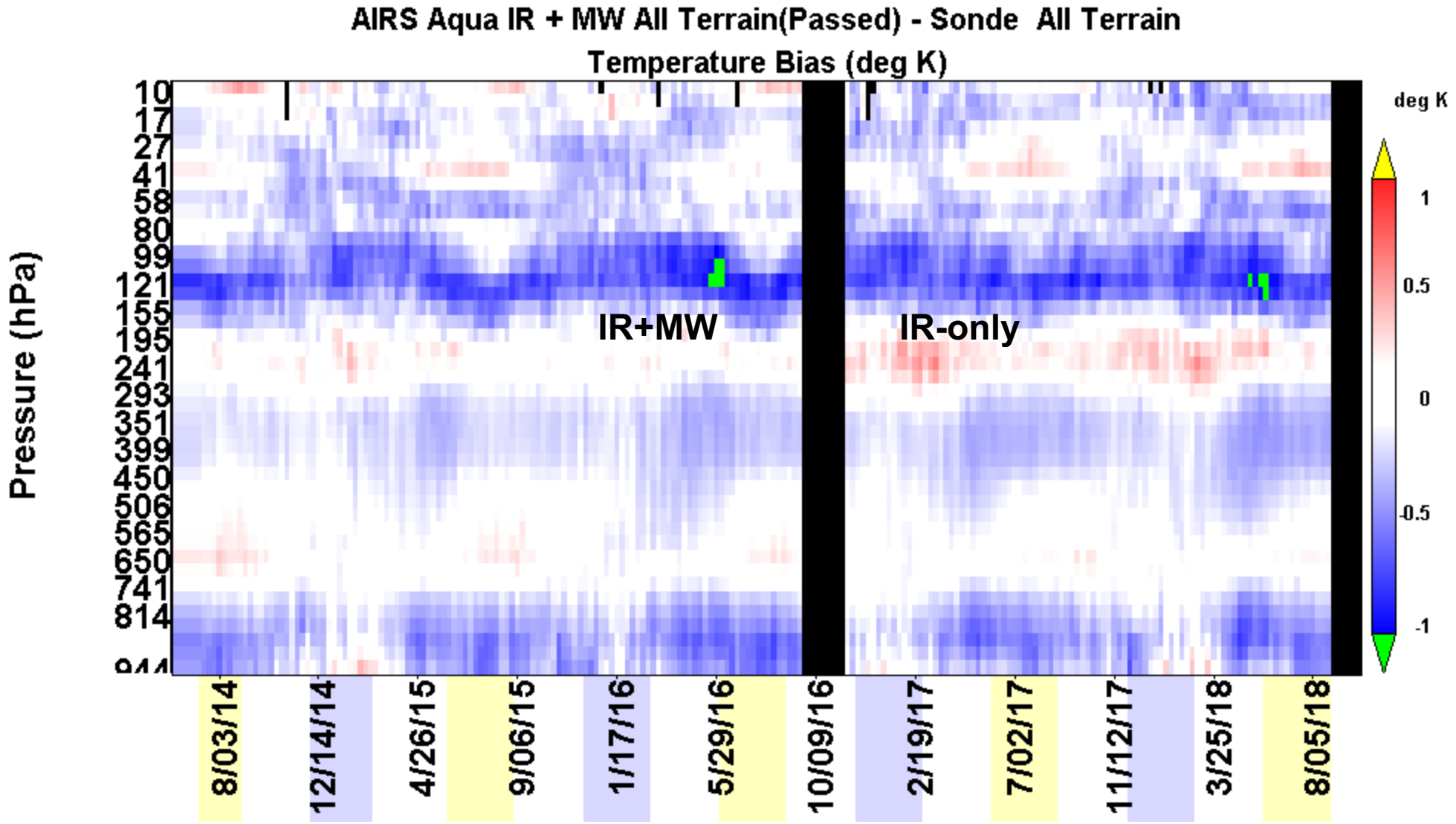
Temperature



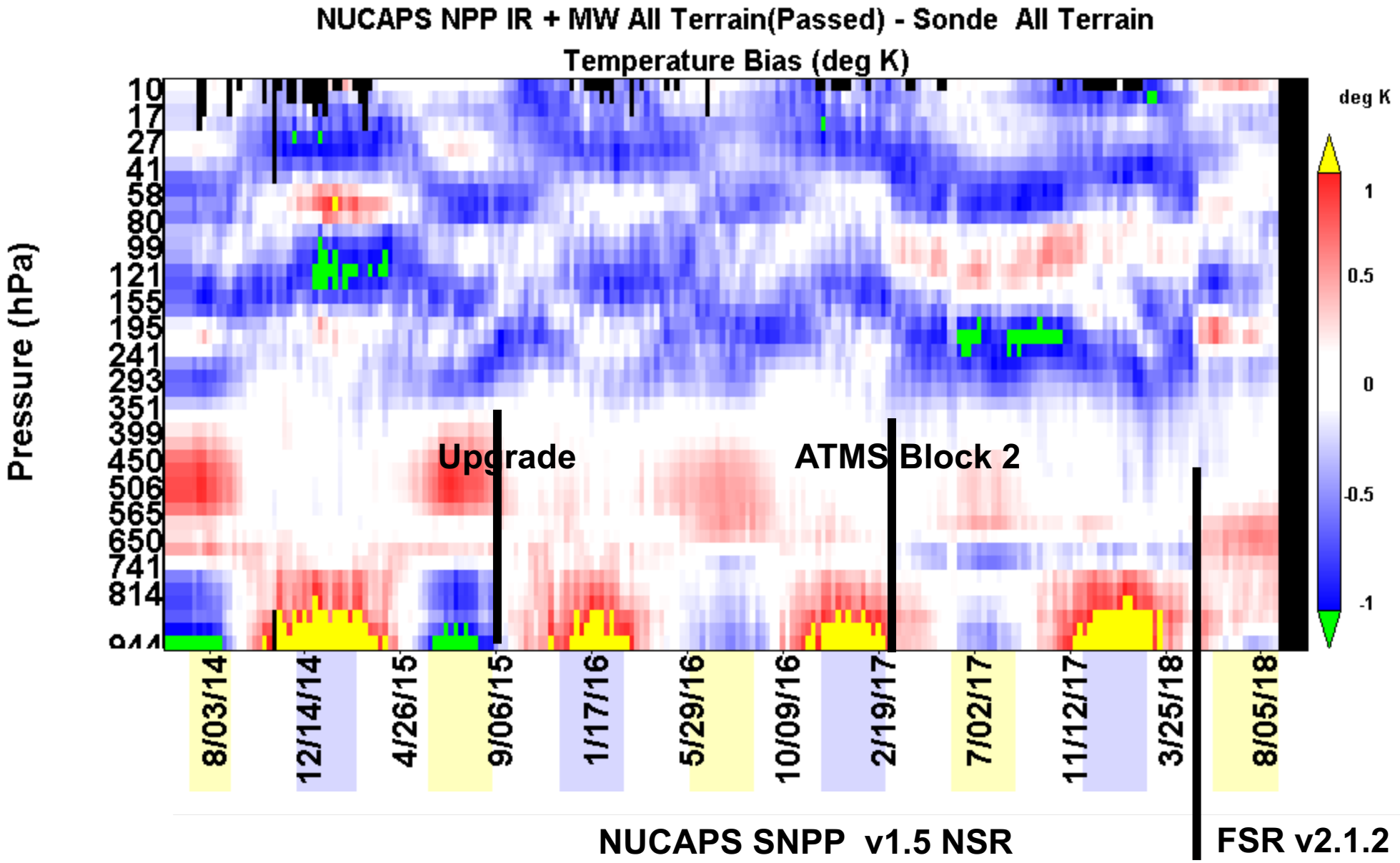
GFS 6-hour forecast

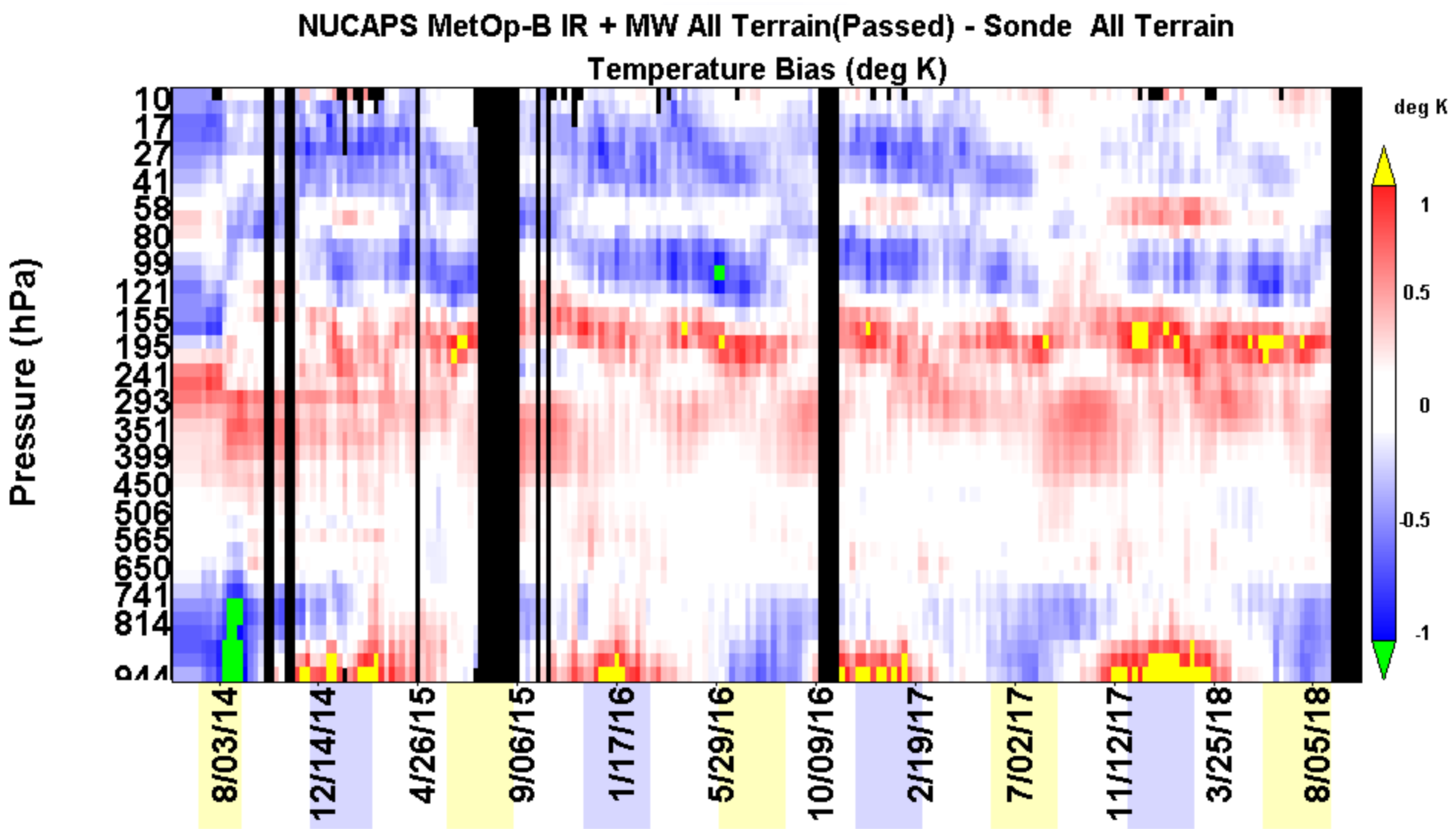


ECMWF Analysis

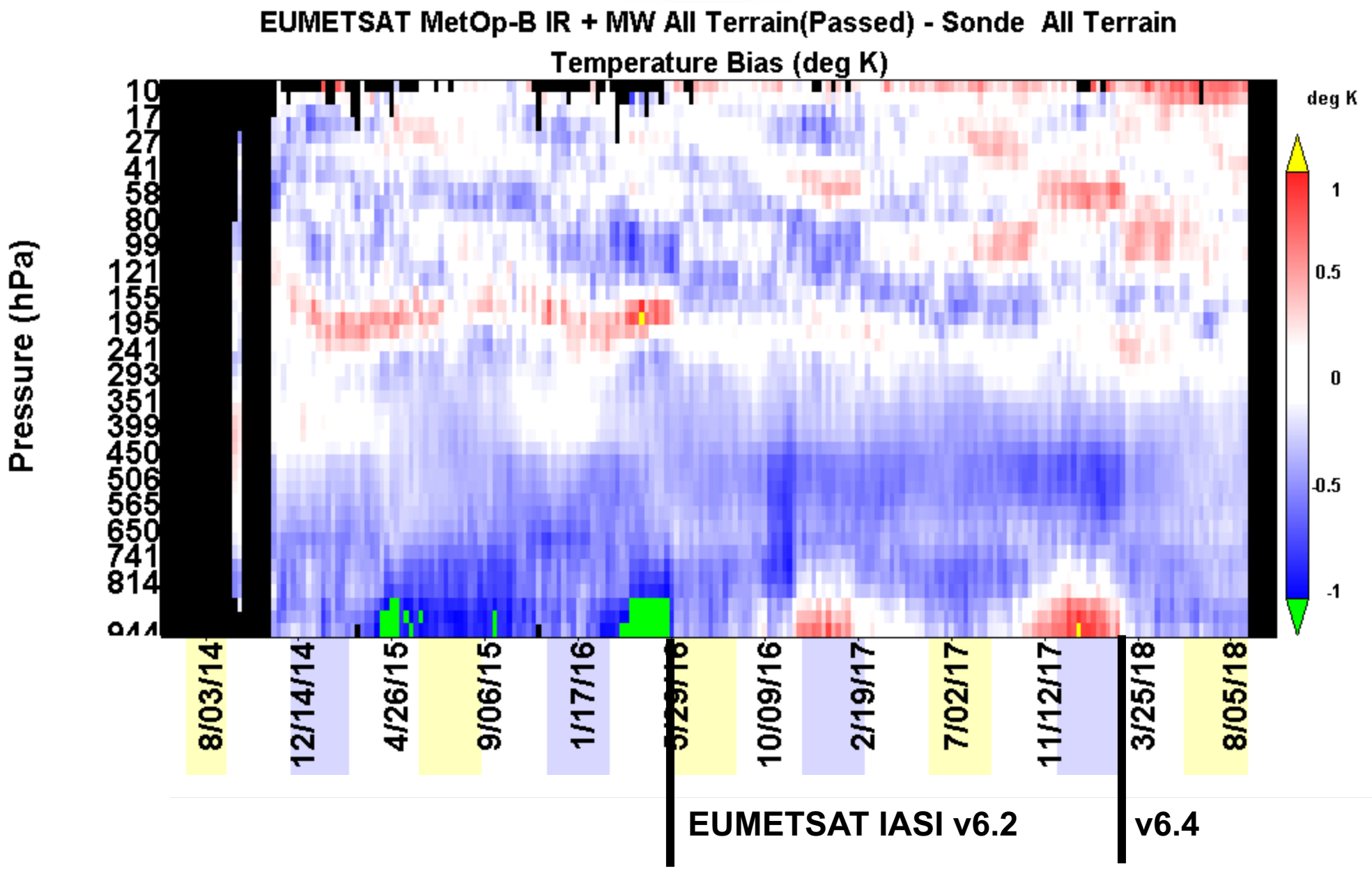


AIRS v6.1; IR+MW (or IR-only) Pass QC


NUCAPS NPP IR + MW All Terrain(Passed) - Sonde All Terrain
Temperature Bias (deg K)
Pressure (hPa)
10
17
27
41
58
80
99
121
155
195
241
293
351
399
450
506
565
650
741
814
deg K
1
0.5
0
-0.5
-1
Upgrade
ATMS Block 2
8/03/14
12/14/14
4/26/15
9/06/15
1/17/16
5/29/16
10/09/16
2/19/17
7/02/17
11/12/17
3/25/18
8/05/18
NUCAPS SNPP v1.5 NSR
FSR v2.1.2



NUCAPS MetOp-B v1.5; IR+MW pass QC


EUMETSAT MetOp-B IR + MW All Terrain(Passed) - Sonde All Terrain
Temperature Bias (deg K)
Pressure (hPa)
10
17
27
41
58
80
99
121
155
195
241
293
351
399
450
506
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741
814
deg K
1
0.5
0
-0.5
-1
8/03/14
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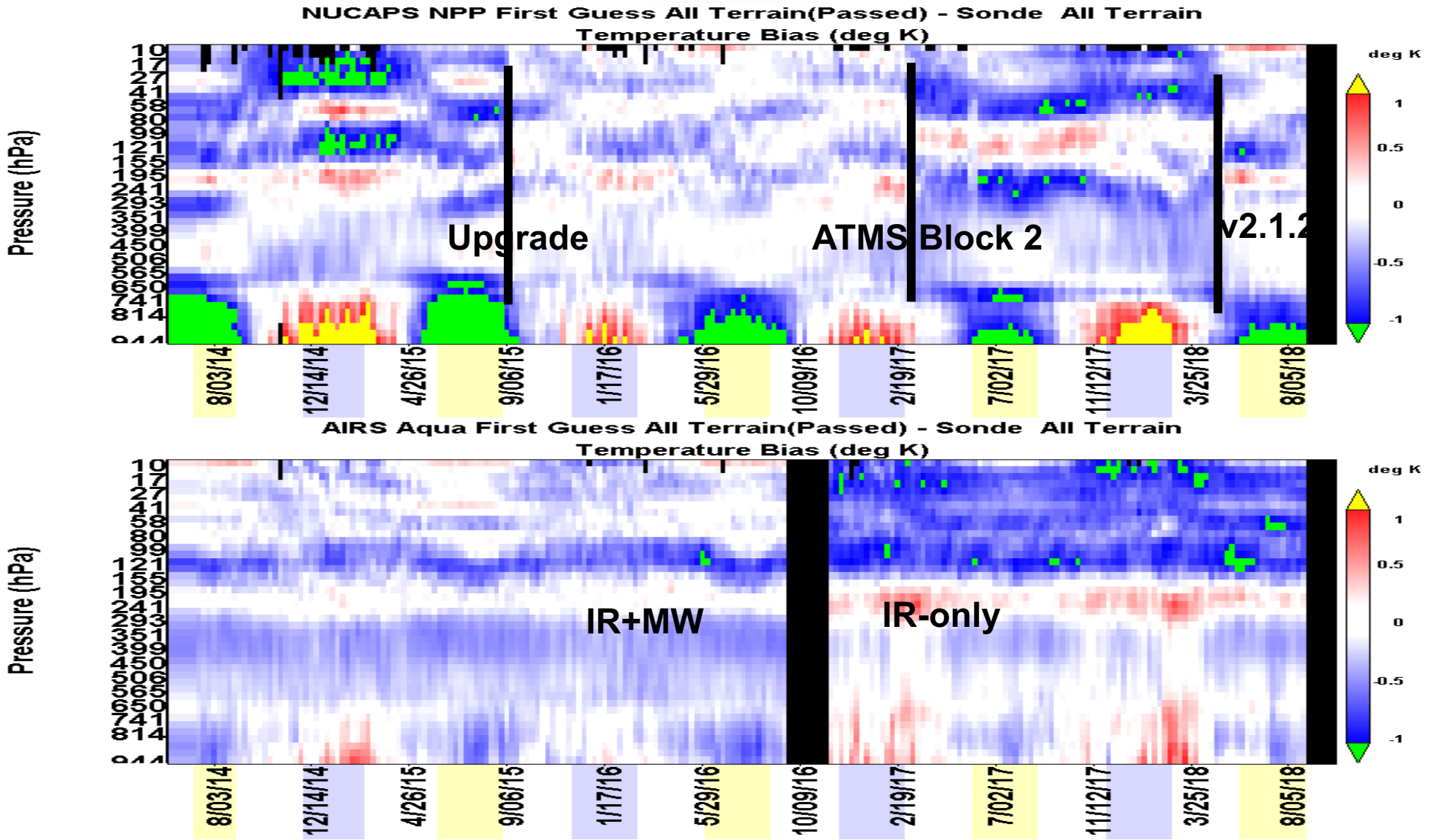
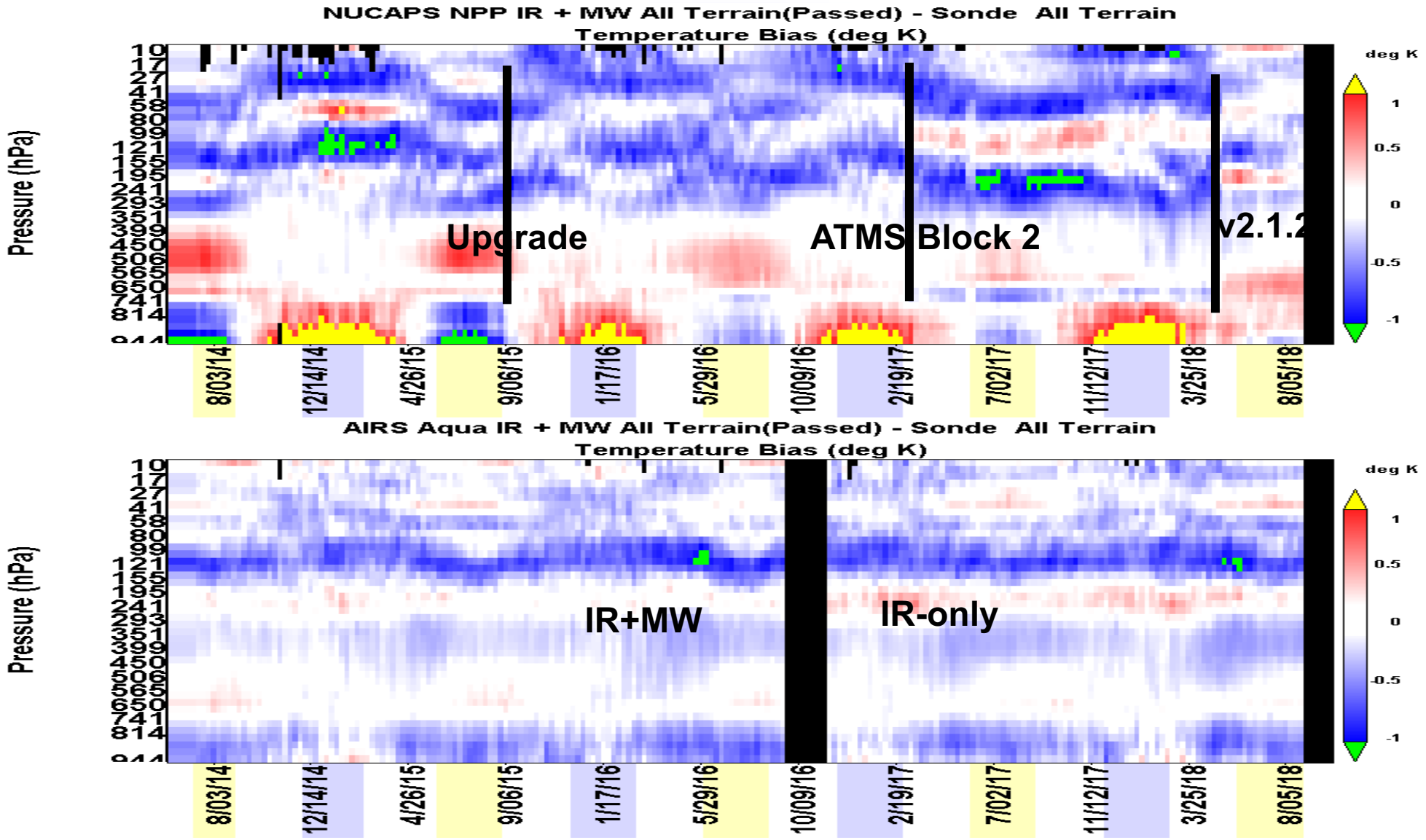
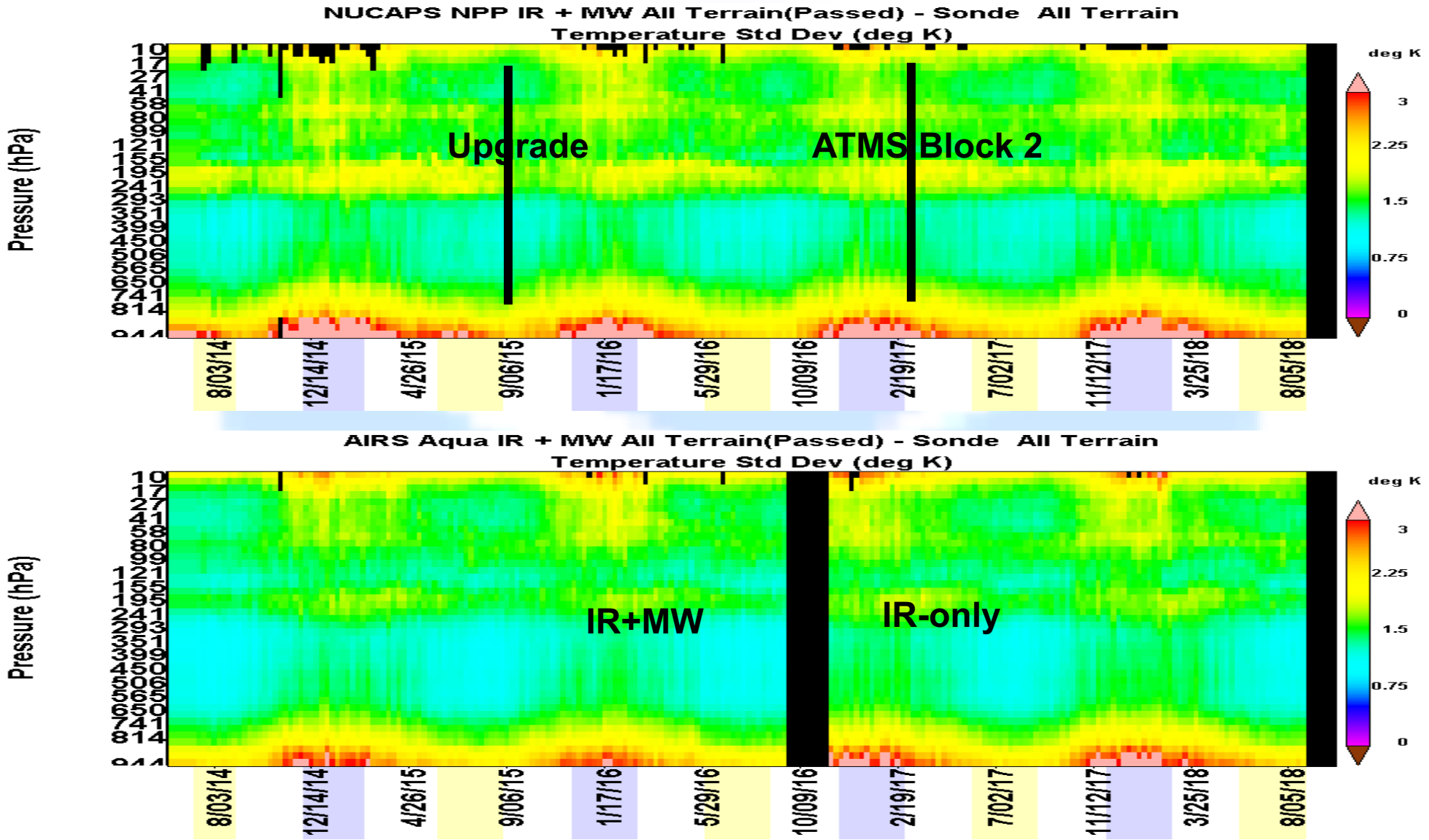
10/09/16
2/19/17
7/02/17
11/12/17
3/25/18
8/05/18
EUMETSAT IASI v6.2
v6.4



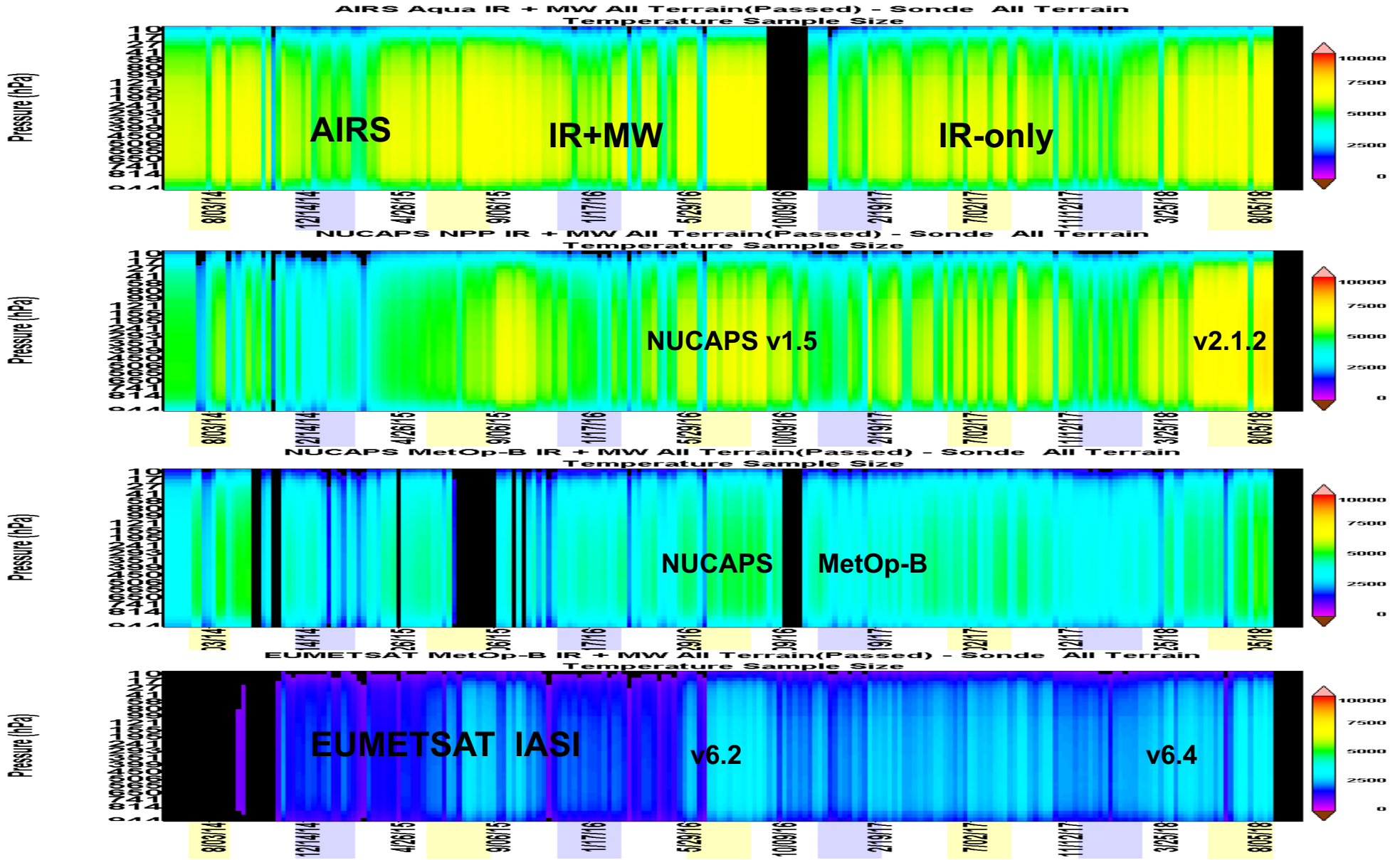
NUCAPS (Top) vs AIRS (bottom) First Guess



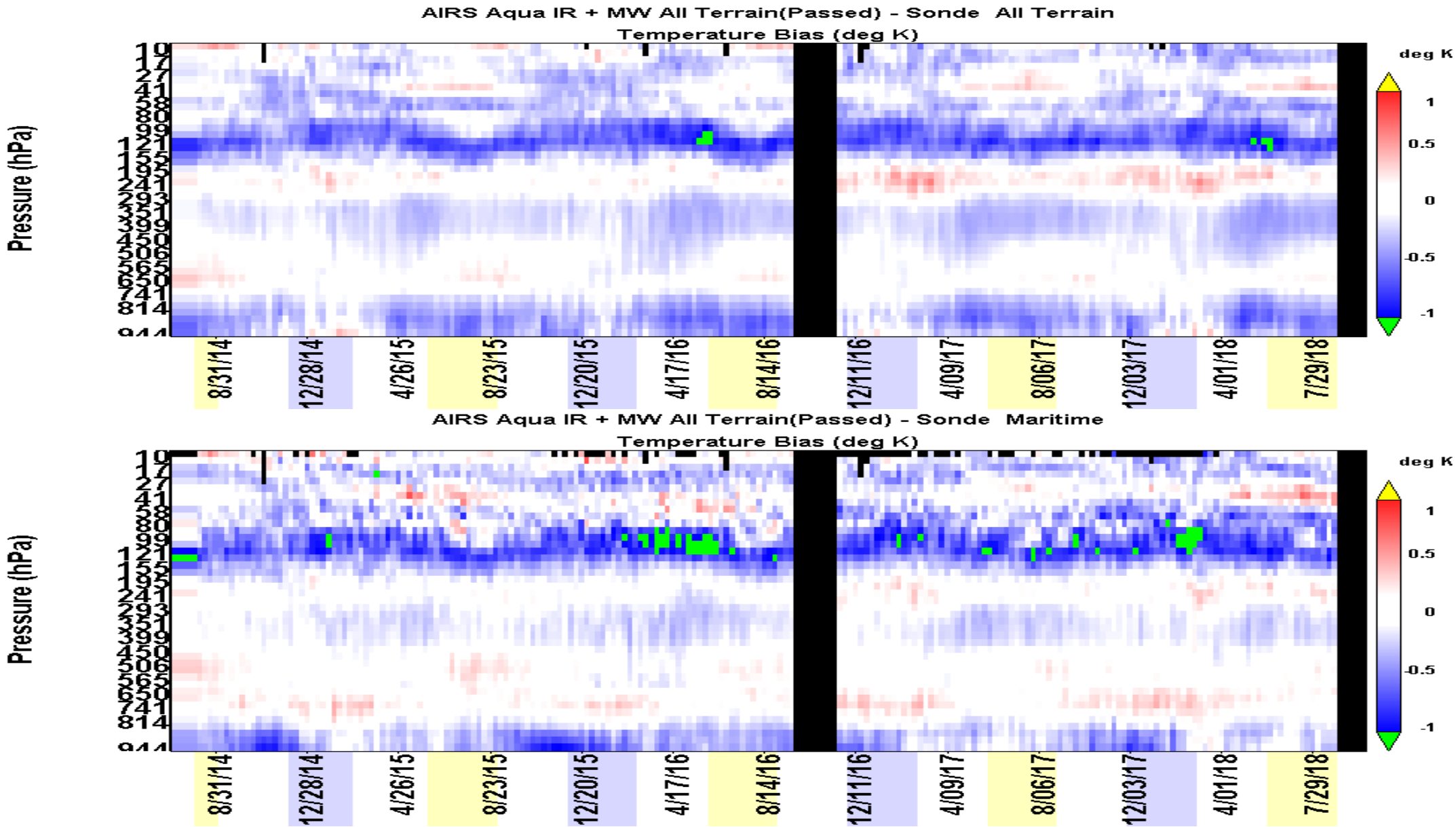
NUCAPS (Top) vs AIRS (bottom) Retrieval



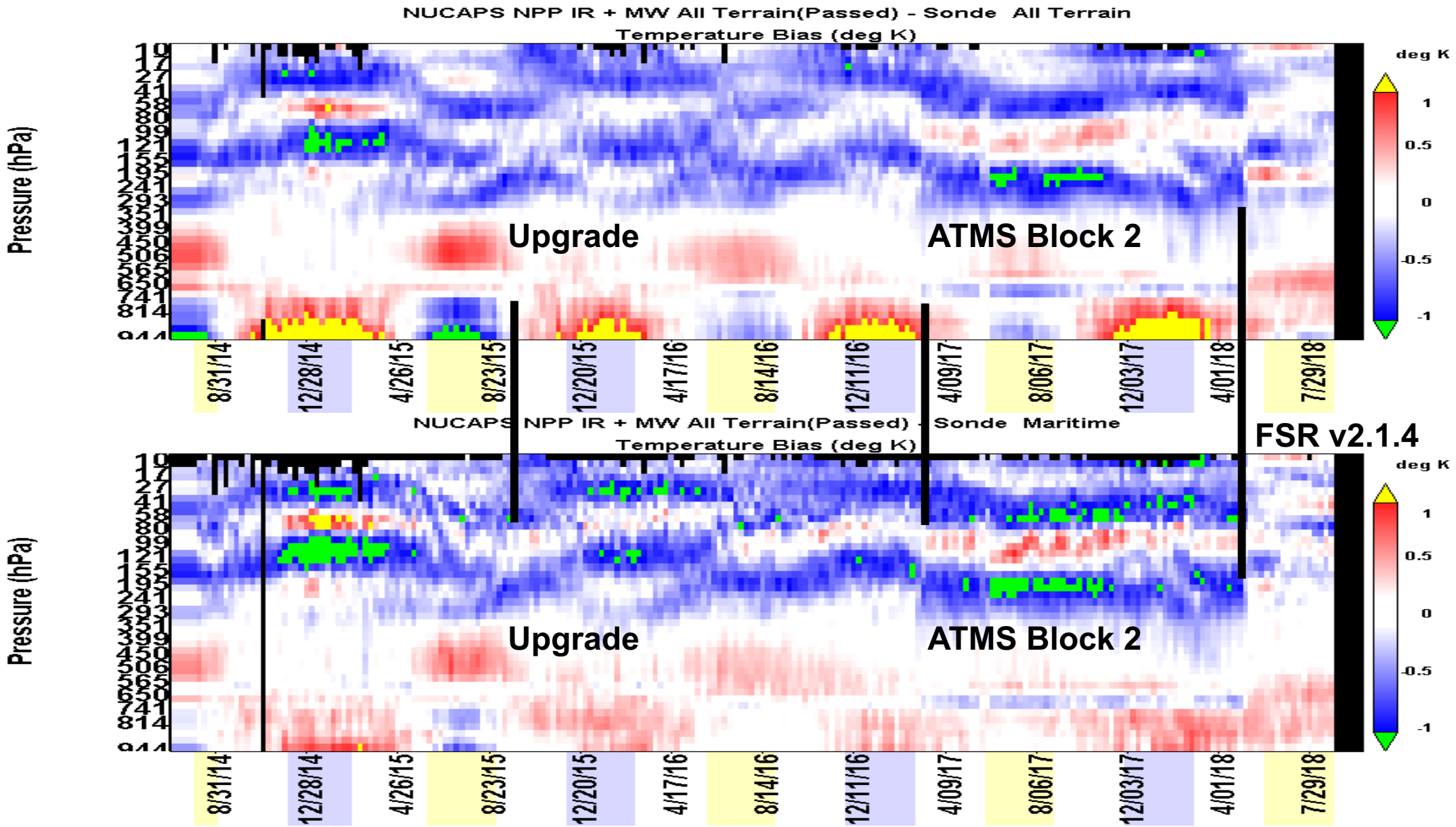
NUCAPS (Top) vs AIRS (bottom) Standard Deviation



Yields (yellow 7500/week) of successful IR+MW retrieval

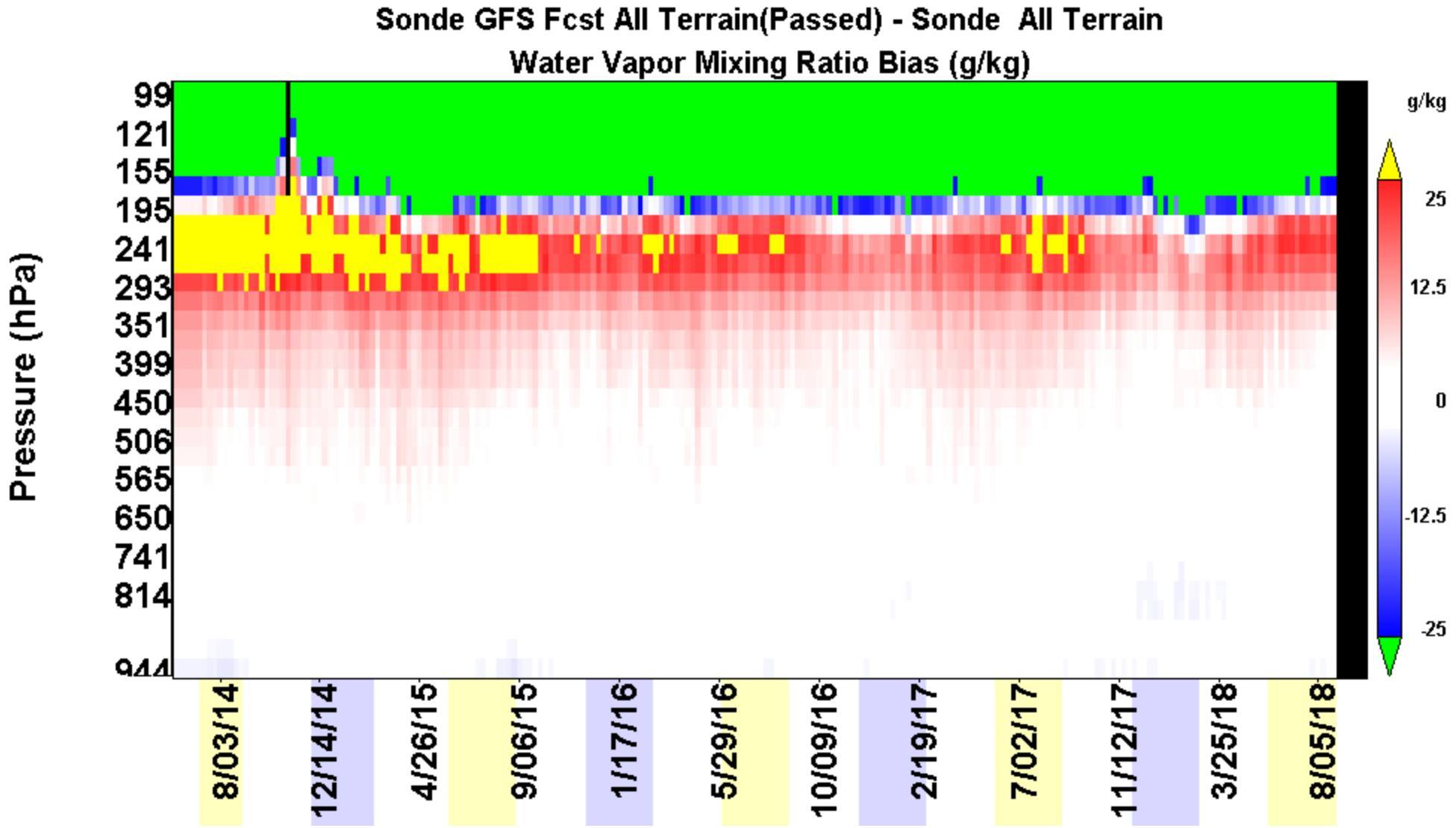


AIRS: ALL-Terrain (Top) vs Maritime (Bottom)



NUCAPS: ALL-Terrain (Top) vs Maritime (Bottom)

Water Vapor Fraction (AIRS Science Team Method)



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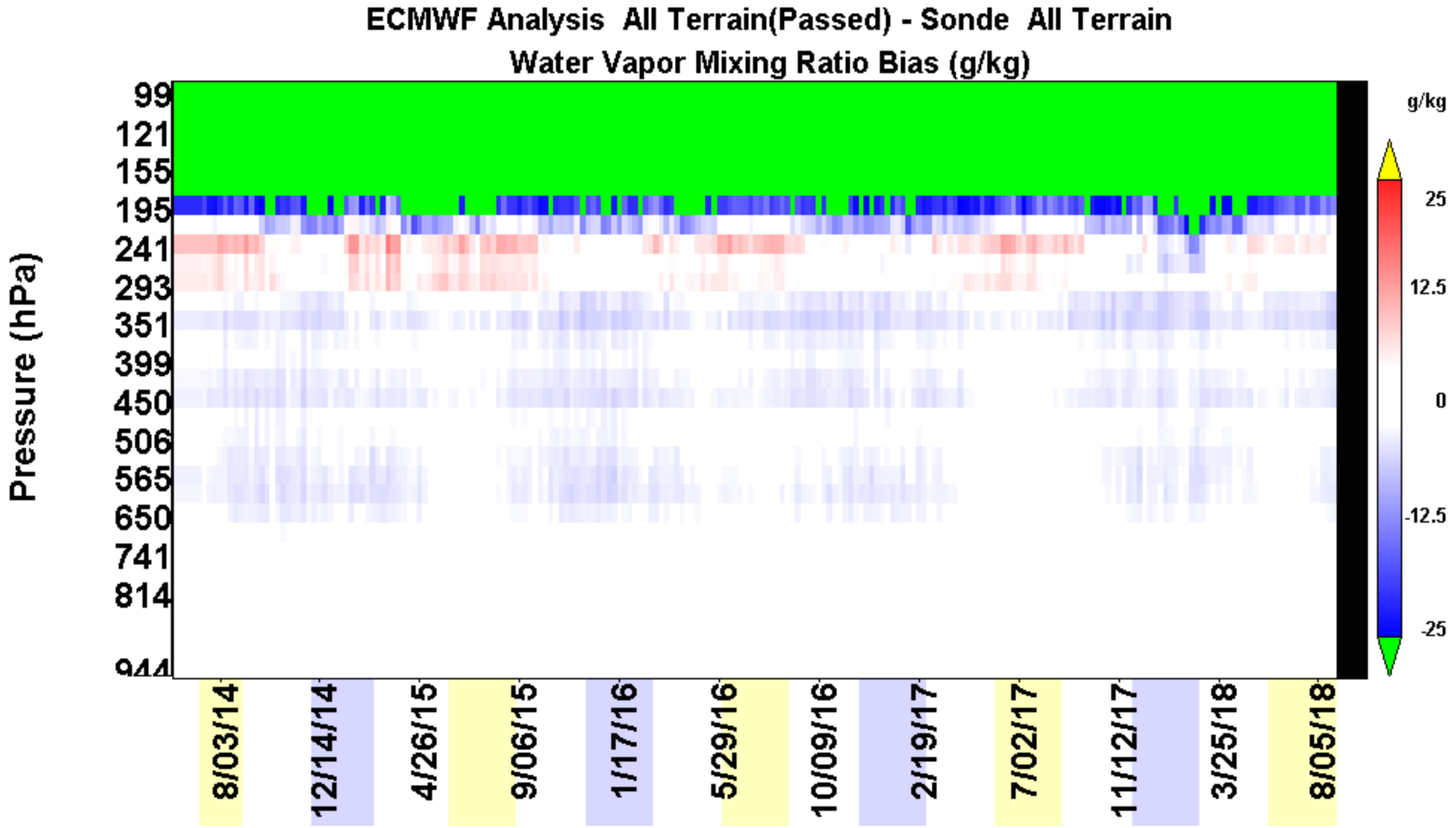

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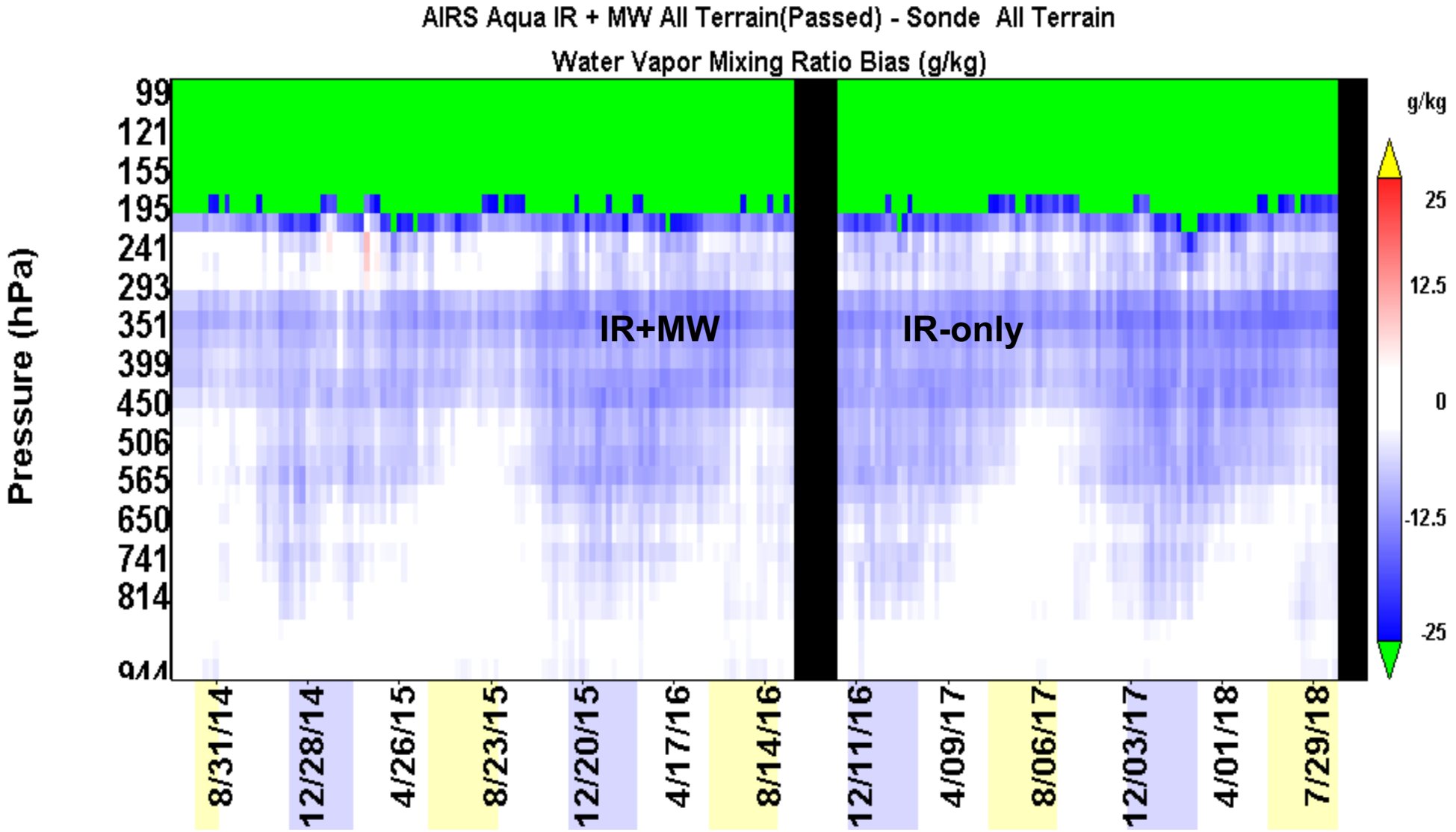
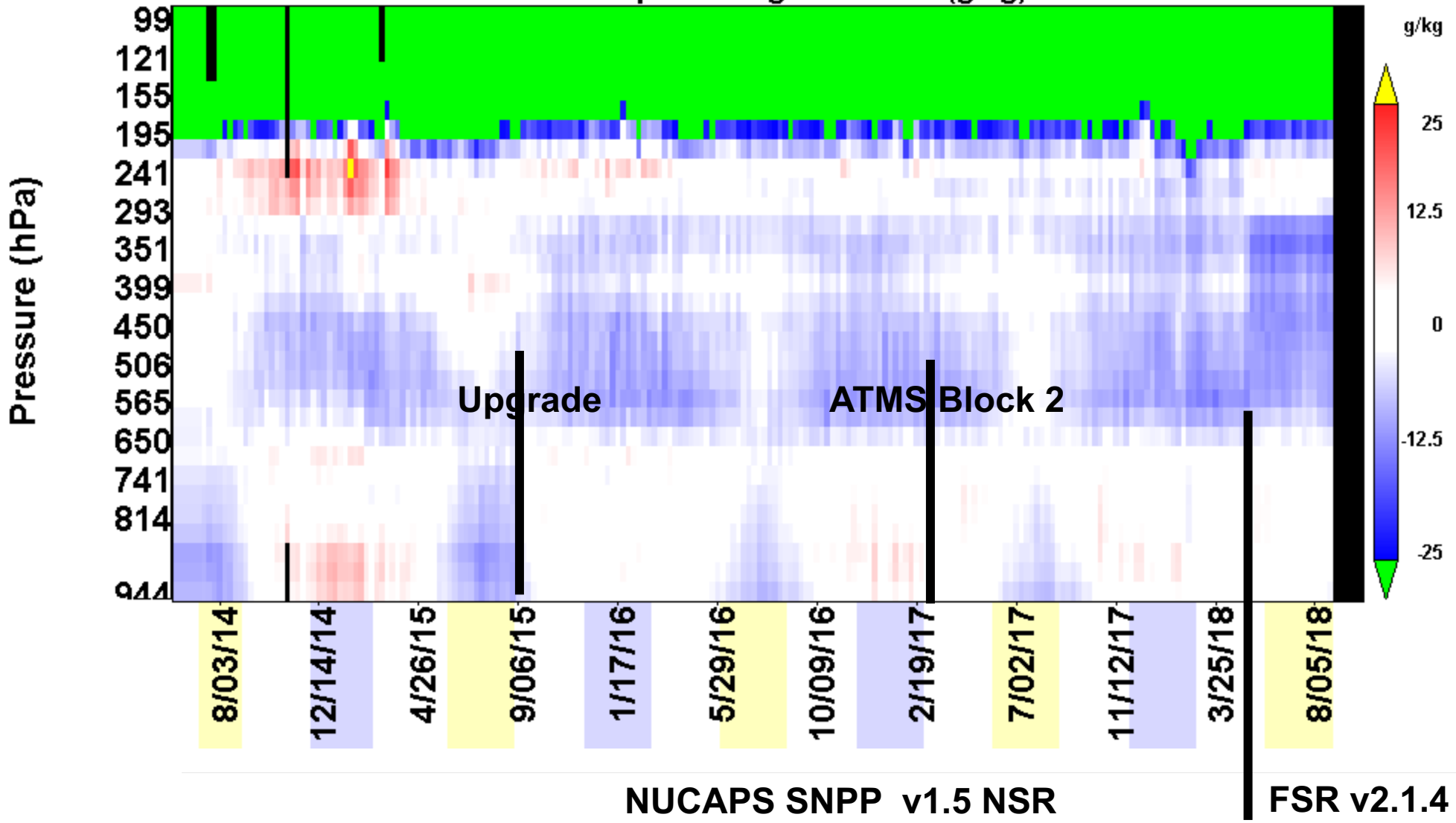
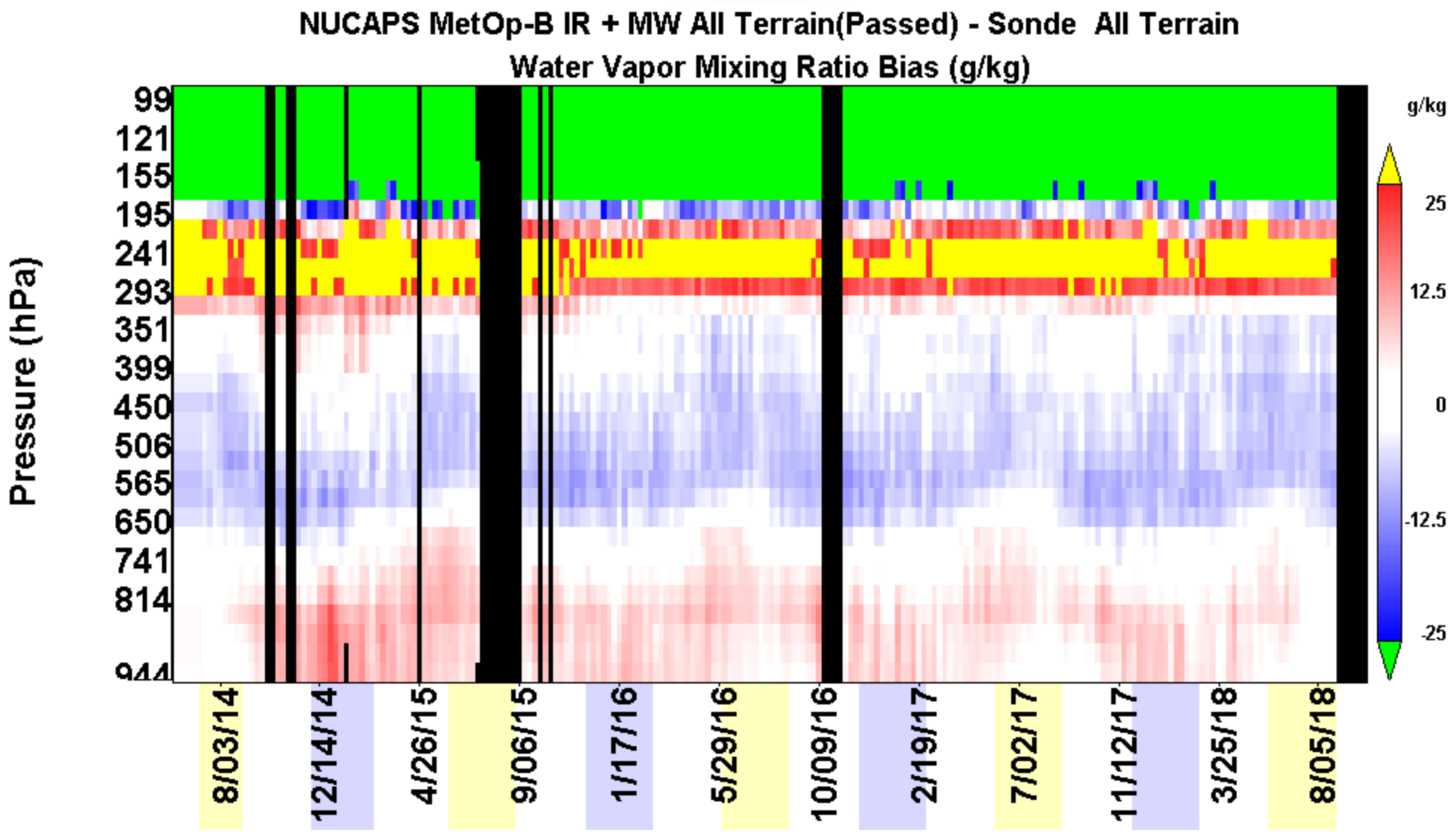


AIRS v6.1; IR+MW (or IR-only) Pass QC

NUCAPS NPP IR + MW All Terrain(Passed) - Sonde All Terrain

Water Vapor Mixing Ratio Bias (g/kg)

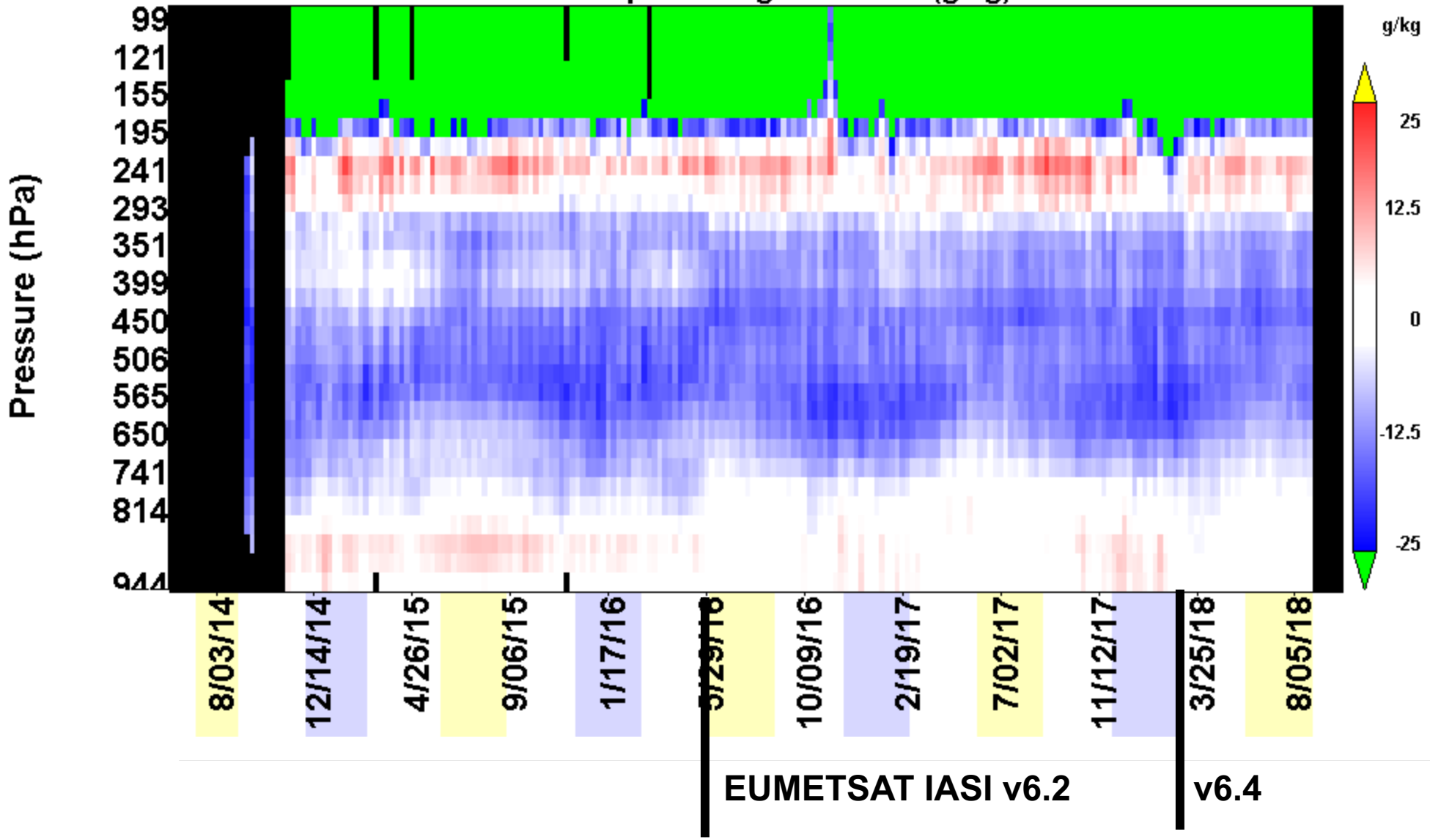




NUCAPS MetOp-B v1.5; IR+MW pass QC

EUMETSAT MetOp-B IR + MW All Terrain(Passed) - Sonde All Terrain

Water Vapor Mixing Ratio Bias (g/kg)



NUCAPS FSR and NOAA-20

NUCAPS Parallel Test/Operation

v1.9.3	*up to March 3, 2017*	
	March 8	***ATMS Block 1 to 2***
v2.0.1	*March 3-13*	*all-sky for MIT*
v2.0.2	*March 13-17*	*all-sky for MIT*
v2.0.4	*March 17-30*	*IR+MW*
v2.0.4.1	*March 30*	*IR-only*
v2.0.4	*April 21*	*IR+MW*
v2.0.5	***May 18***	***IR+MW new RTA tuning !!***
v2.0.5.4	***June 22 16Z***	***IR+WW Block 2 tuning***
v2.0.5.4	*July 14 19Z*	*IR-only*
	July 28	*Offline*
v2.1.1DB	*Aug 3*	*IR+MW (7FOV)*
v2.1.1	***Aug 11***	***IR+MW (previously 2.0.5.4)***
v2.1.1DB	*Aug 21*	*IR+MW (7FOV)*
v2.1.2	**Aug 22**	**IR+MW + new CCR; Operation**
v2.1.2	Sep 18 (19Z)	IR-only (new CCR)
v2.1.2	Oct 3 (15Z)	IR+MW + new CCR); Operation ?

2017

NUCAPS Parallel Test/Operation

v2.1.2	**Jan 5; 2018**	**NOAA-20 Beta (w/S-NPP tune) (2)**
v2.1.4	**March 14 (20Z)**	**S-NPP (1)**
v2.1.4	**March 14**	**NOAA-20 Beta (tuned w NPP) (2)**
v2.1.4	**April 30**	**NOAA-20 Prov (tune w N20); GFS**
0.5		
v2.1.2	**May 3 (9Z)**	**S-NPP; Operation**
v2.1.12c	**June 25**	**S-NPP (1) and NOAA-20 Prov (2)**
v2.1.12c	July 9	IR-only (1 and 2)
v2.1.12c	July 16 (10Z)	IR+MW (1 and 2)

2018

NARCS

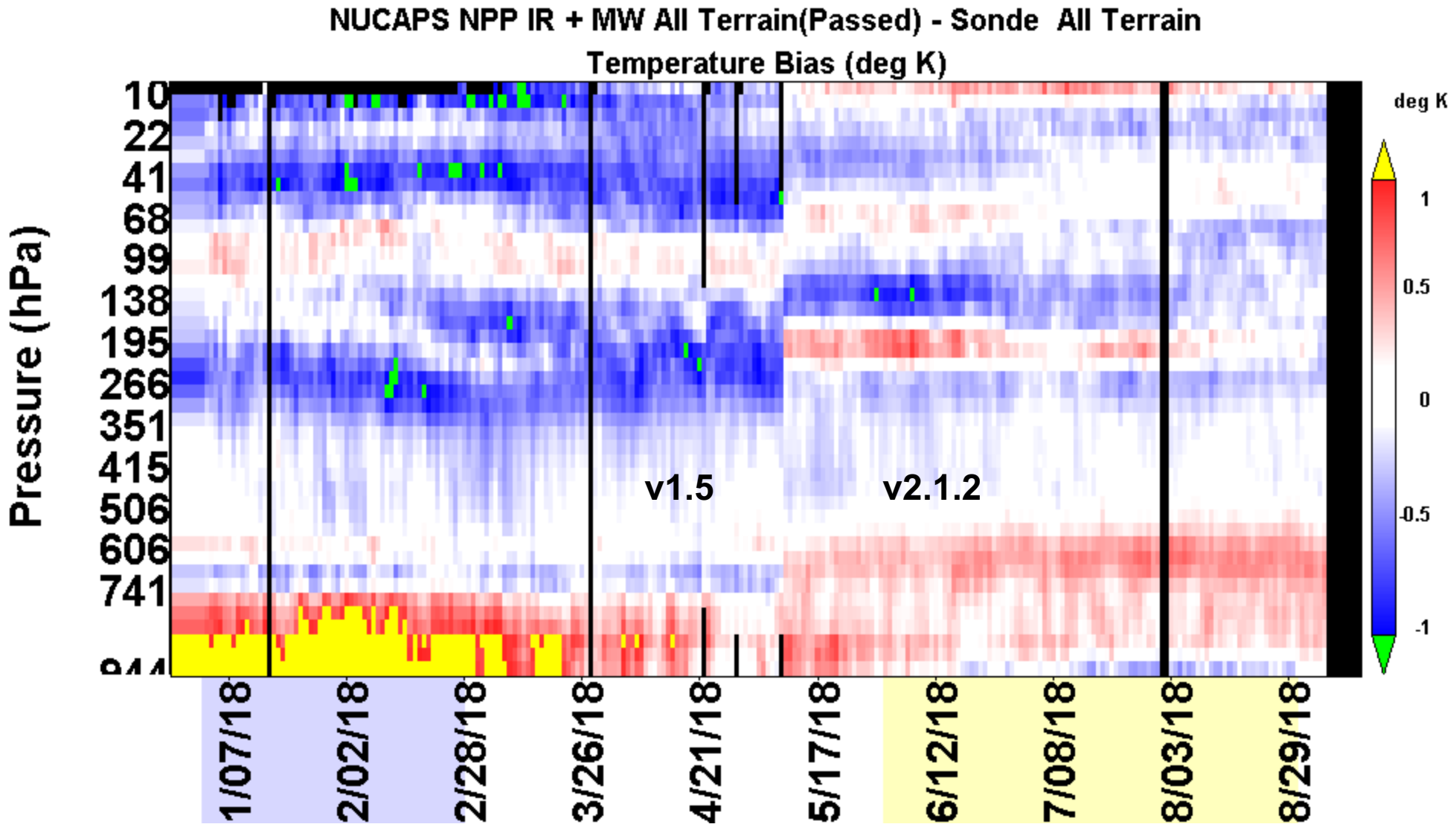
Vertical time series of SAT-minus-RAOB statistics for each product suite

- **Daily,** Weekly, Monthly

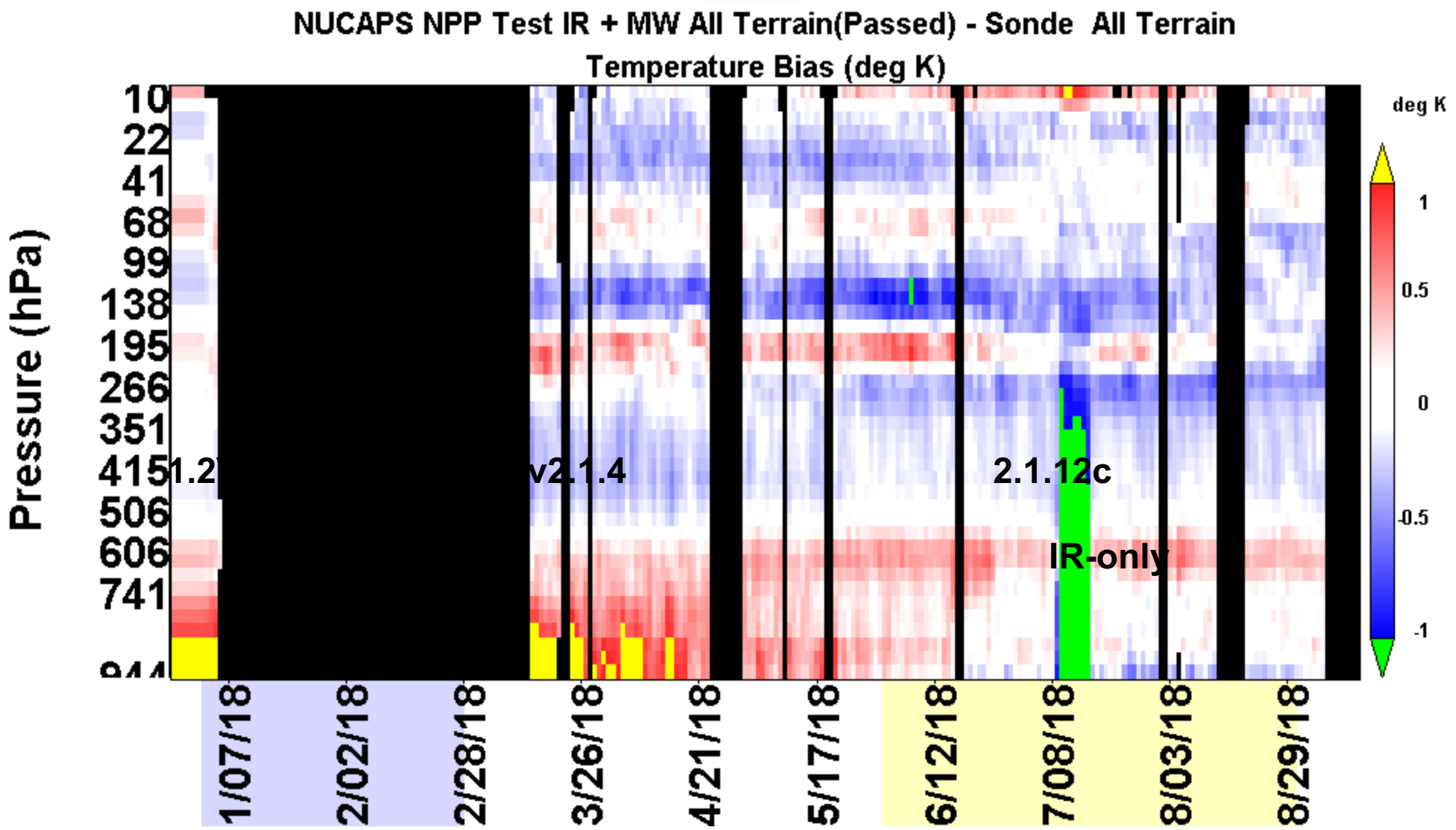
January 2018 to August 2018

Pre-computed, samples "*optimal*" per suite

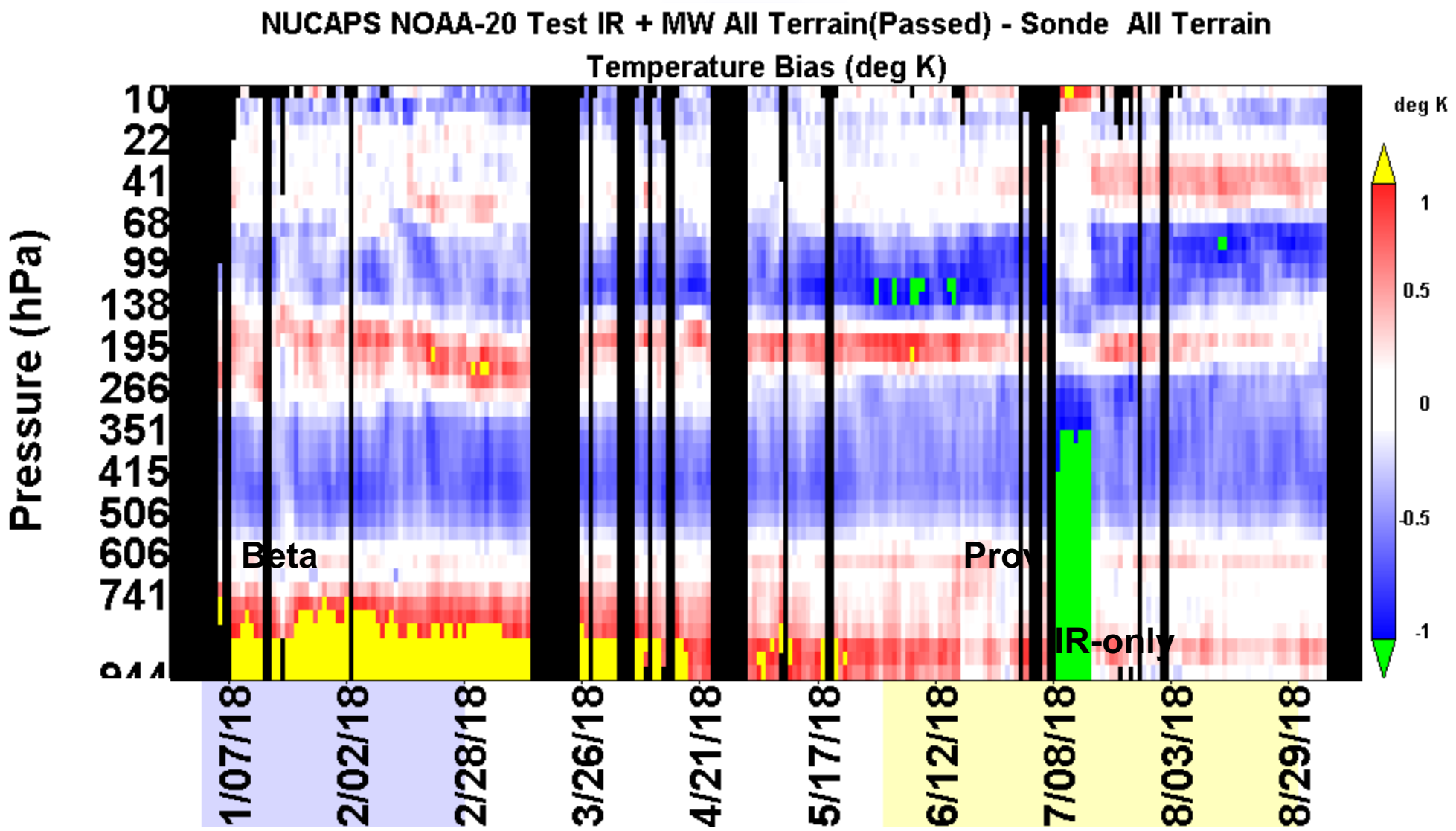
Temperature



NUCAPS Oper SNPP; IR+MW Pass QC

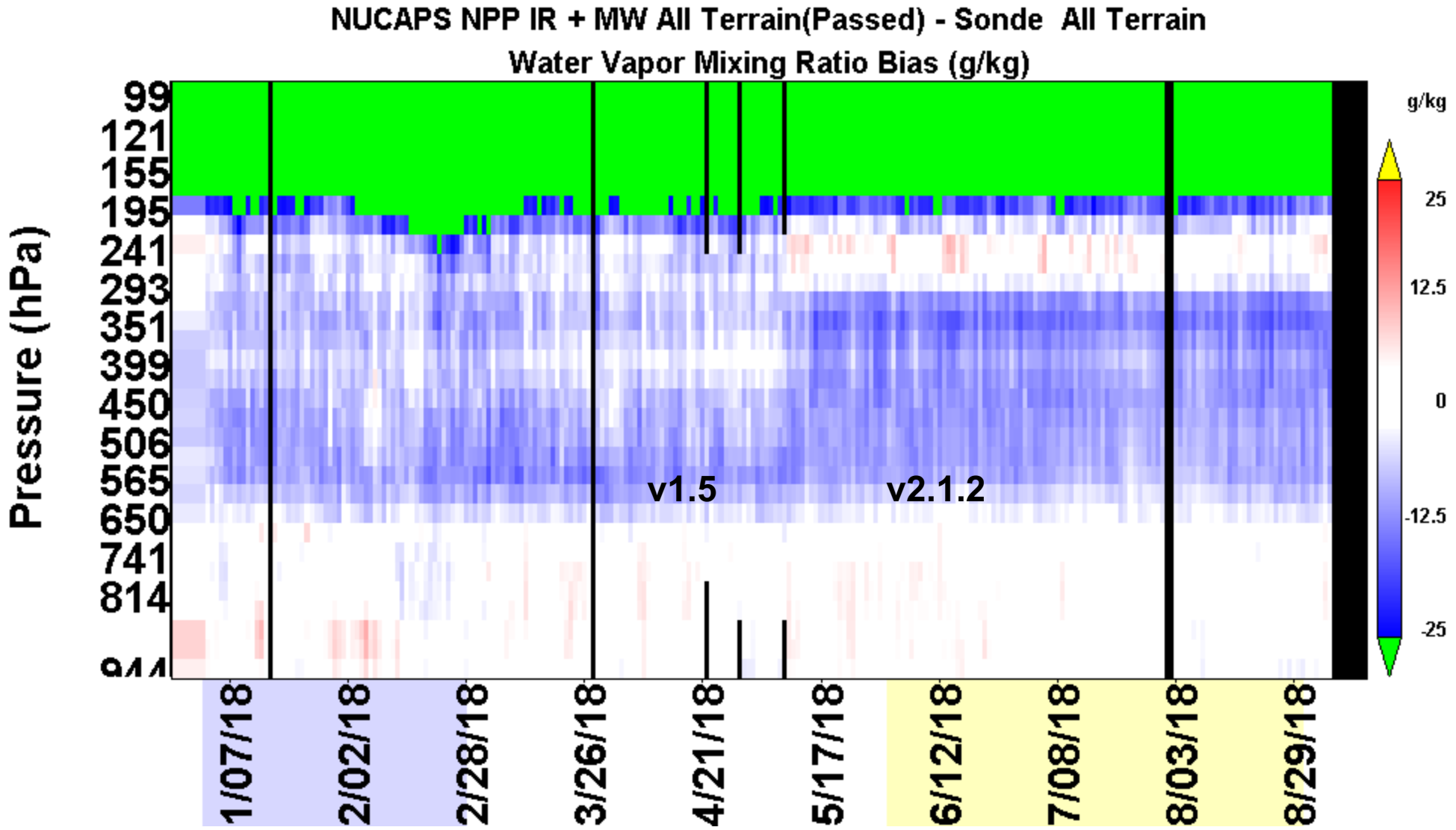


NUCAPS Test SNPP; IR+MW Pass QC

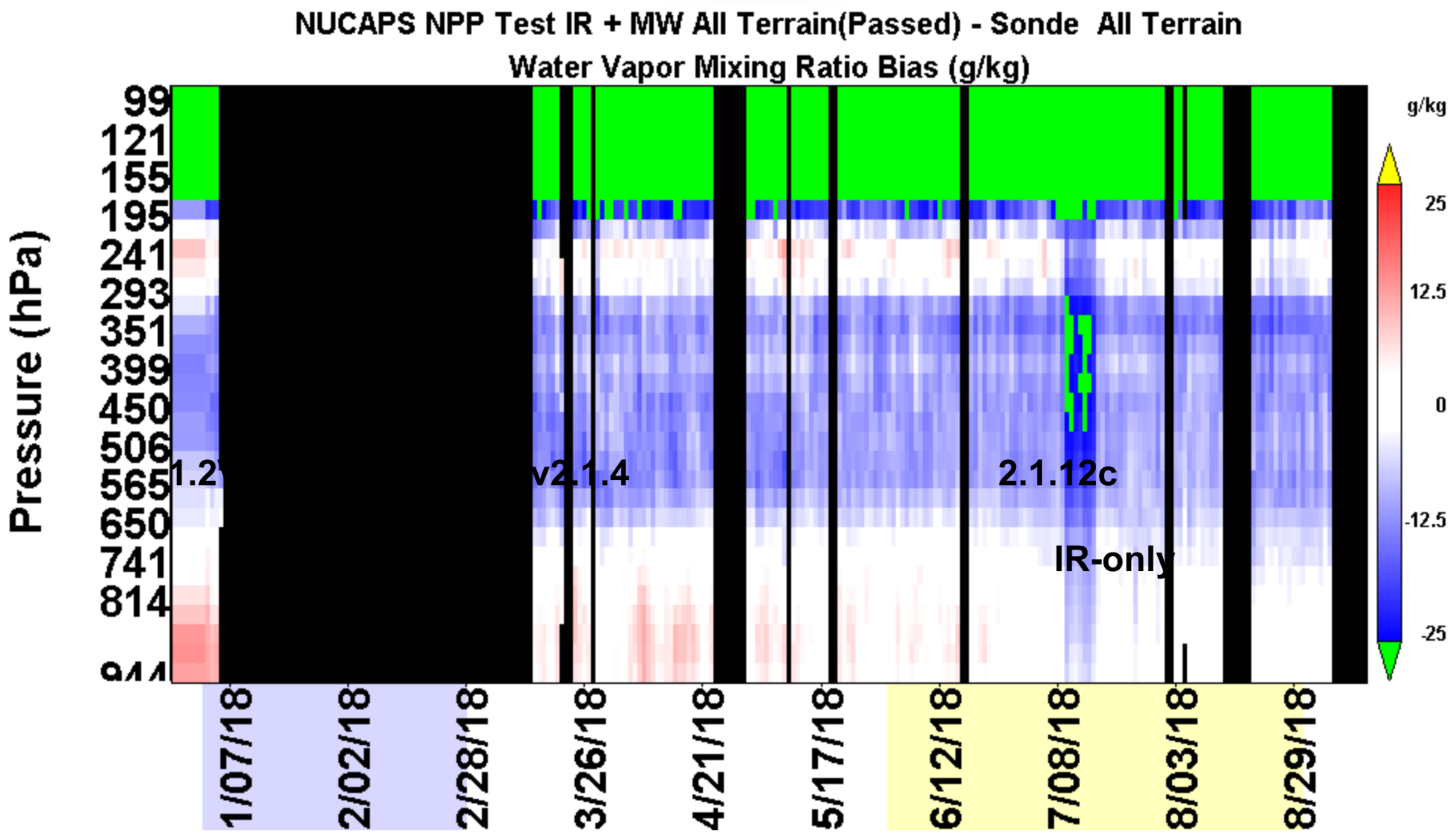


NUCAPS Test NOAA-20; IR+MW Pass QC

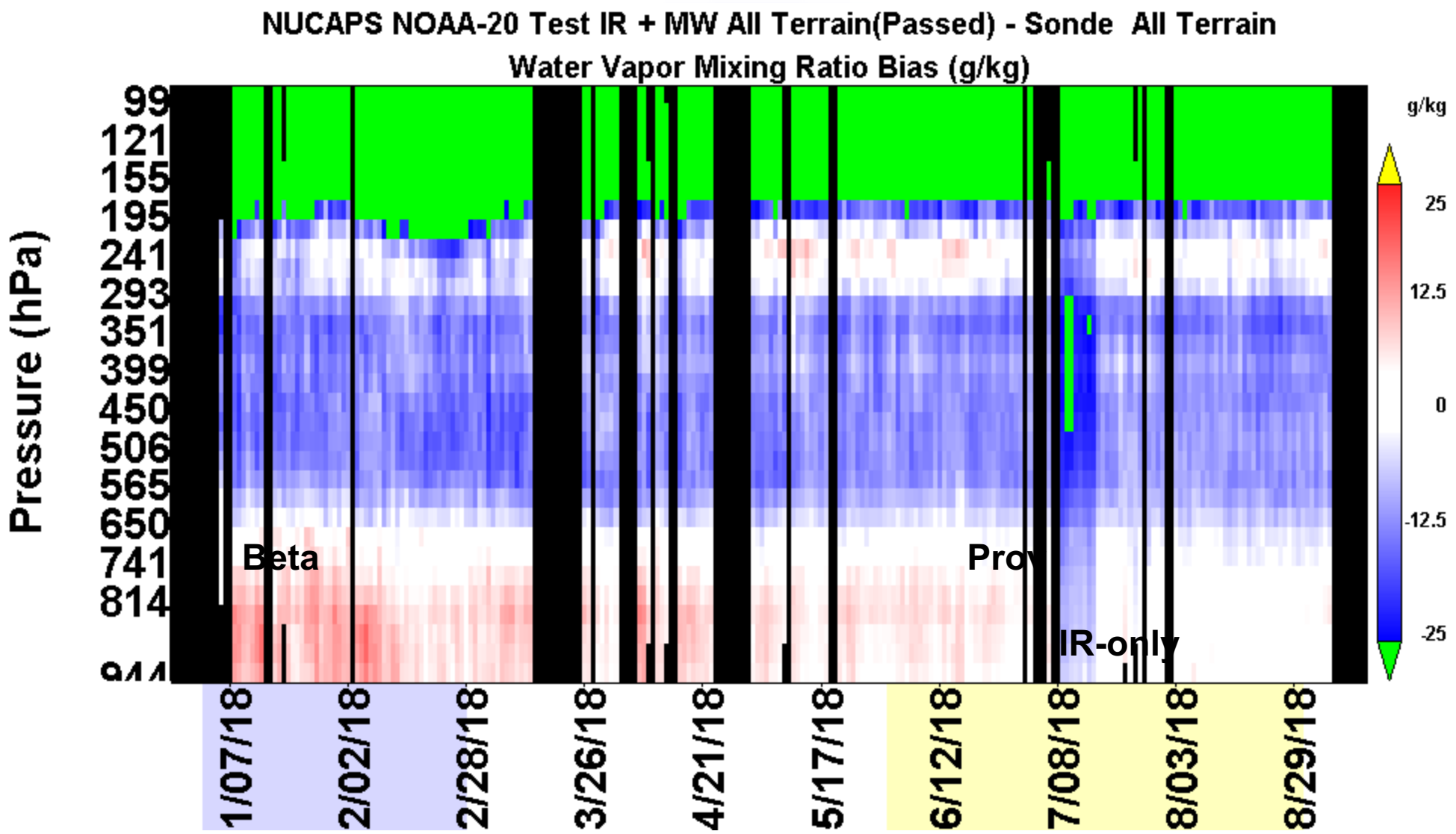
Water Vapor Fraction (AIRS Science Team Method)



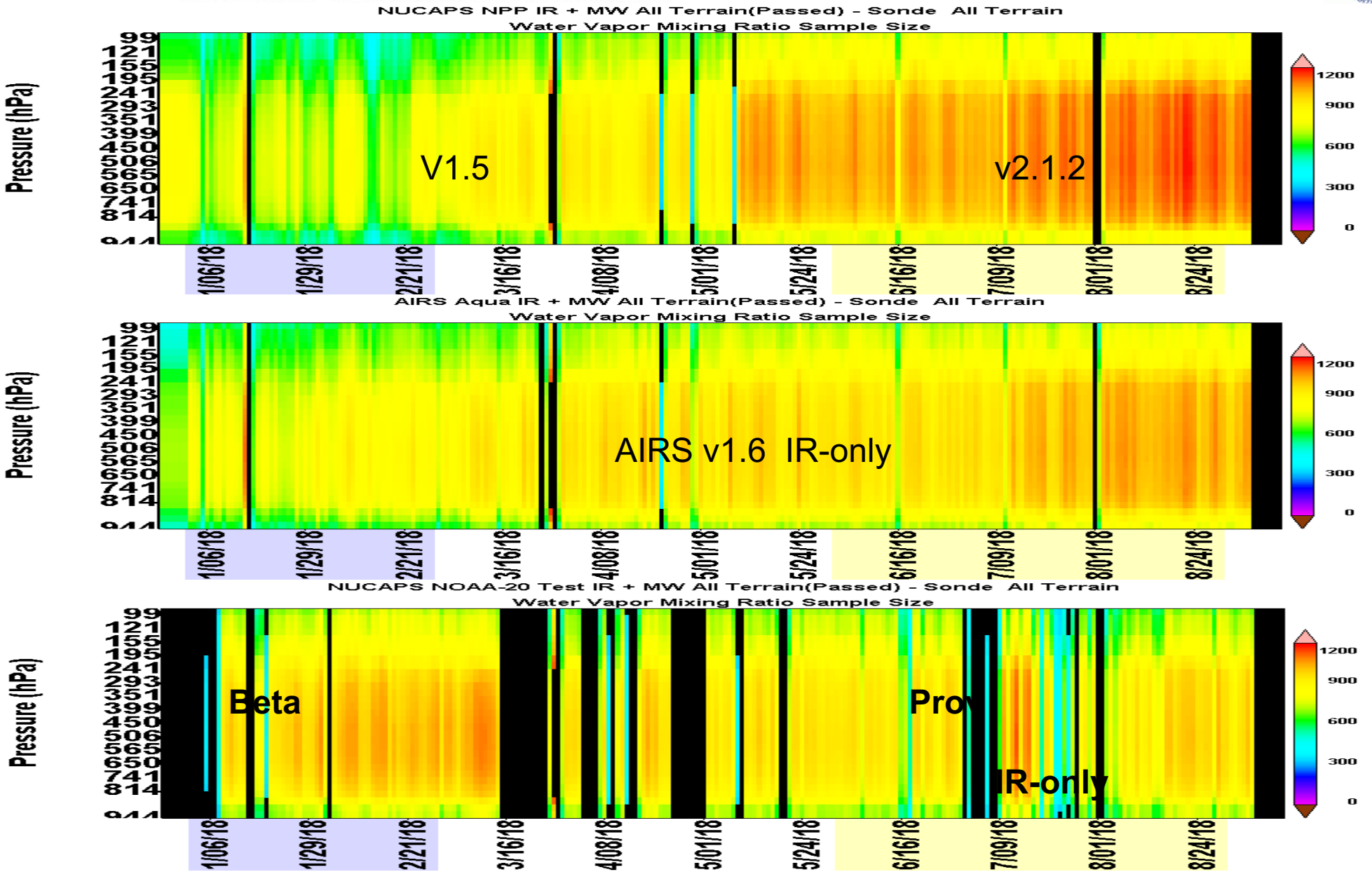
NUCAPS Oper SNPP; IR+MW Pass QC



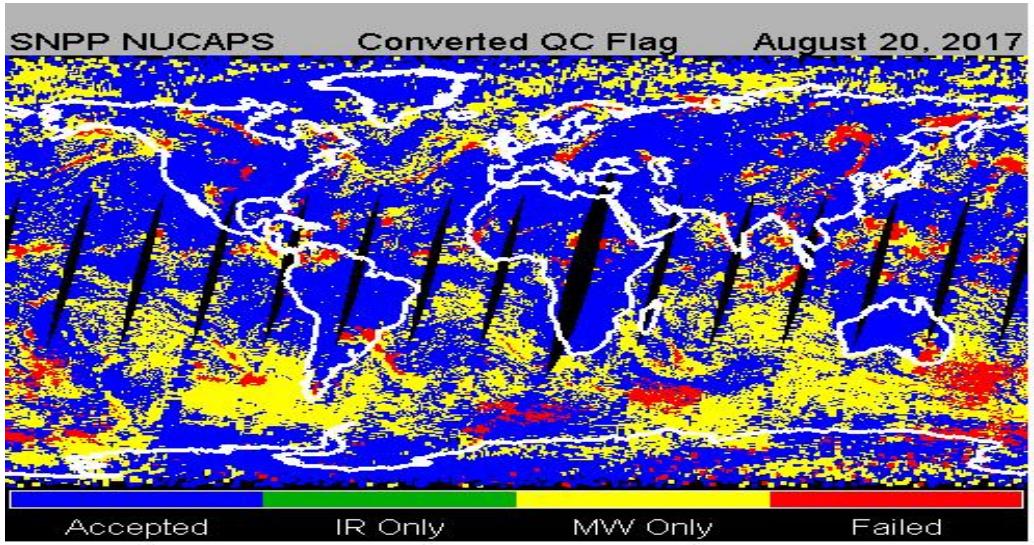
NUCAPS Test SNPP; IR+MW Pass QC



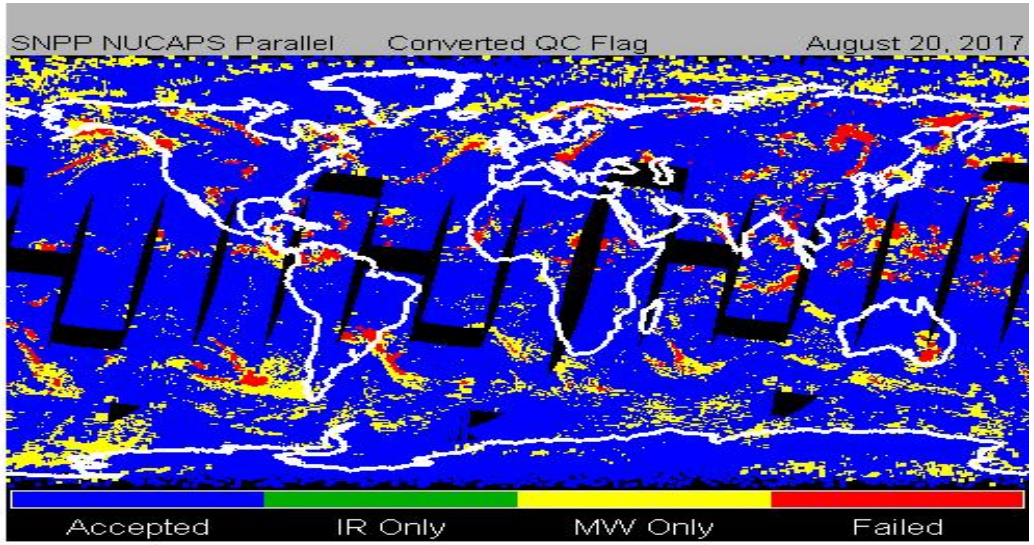
NUCAPS Test NOAA-20; IR+MW Pass QC


NUCAPS NPP IR + MW All Terrain(Passed) - Sonde All Terrain
Water Vapor Mixing Ratio Sample Size
Pressure (hPa)
V1.5
v2.1.2
1200
900
600
300
0
1/06/18
1/29/18
2/21/18
3/16/18
4/08/18
5/01/18
5/24/18
6/16/18
7/09/18
8/01/18
8/24/18
AIRS Aqua IR + MW All Terrain(Passed) - Sonde All Terrain
Water Vapor Mixing Ratio Sample Size
Pressure (hPa)
AIRS v1.6 IR-only
NUCAPS NOAA-20 Test IR + MW All Terrain(Passed) - Sonde All Terrain
Water Vapor Mixing Ratio Sample Size
Pressure (hPa)
Beta
Pro
IR-only

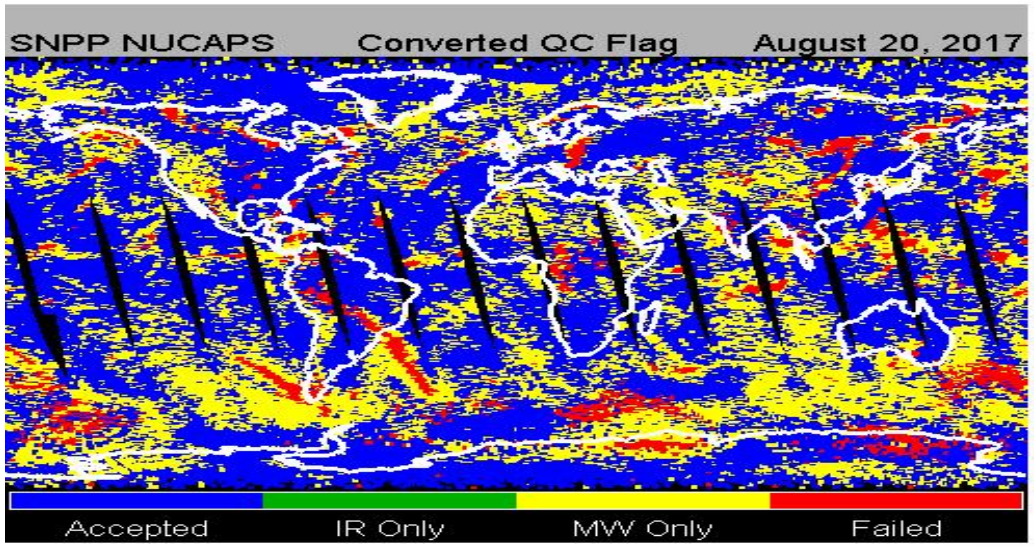
NPP v1.5



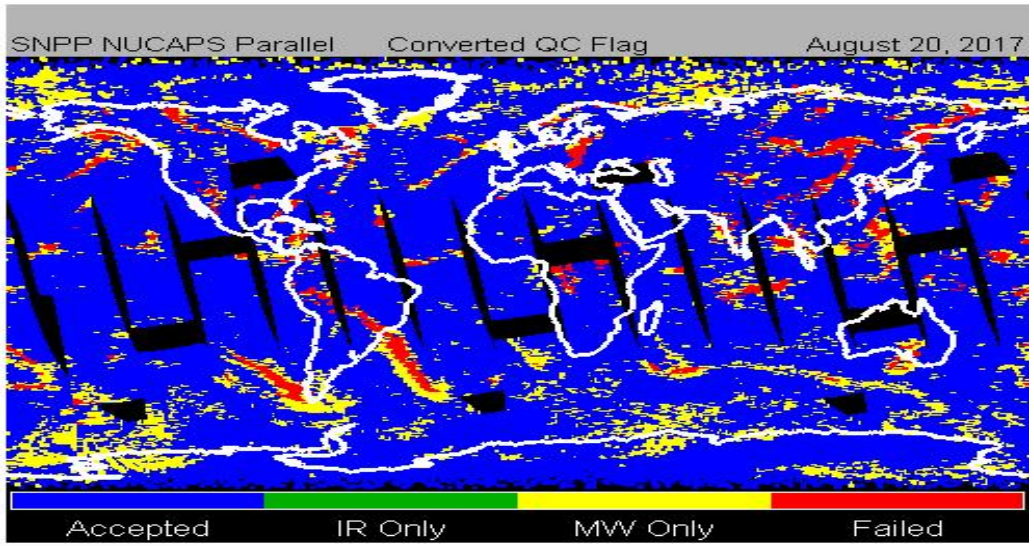
NPP v2.1.2



NPP v1.5

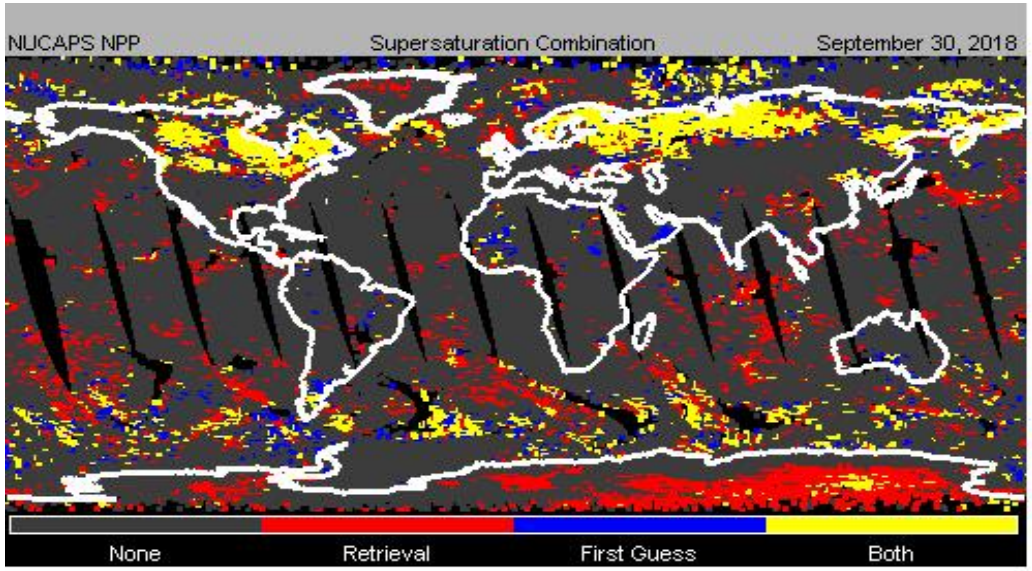


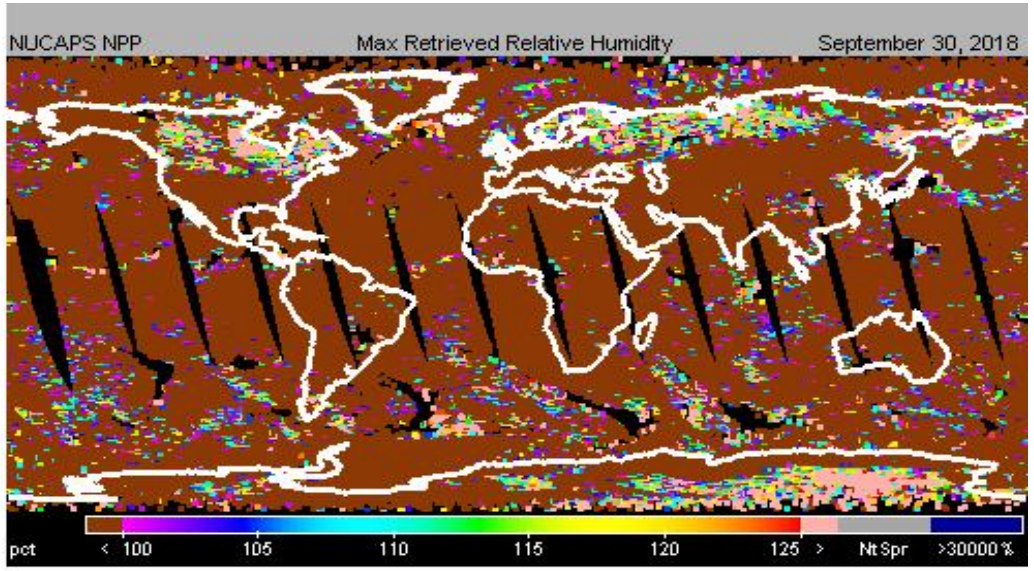
NPP 2.1.2



NUCAPS NSR (left) and FSR (right)
IR+MW pass QC (blue) expands 60% to 85%

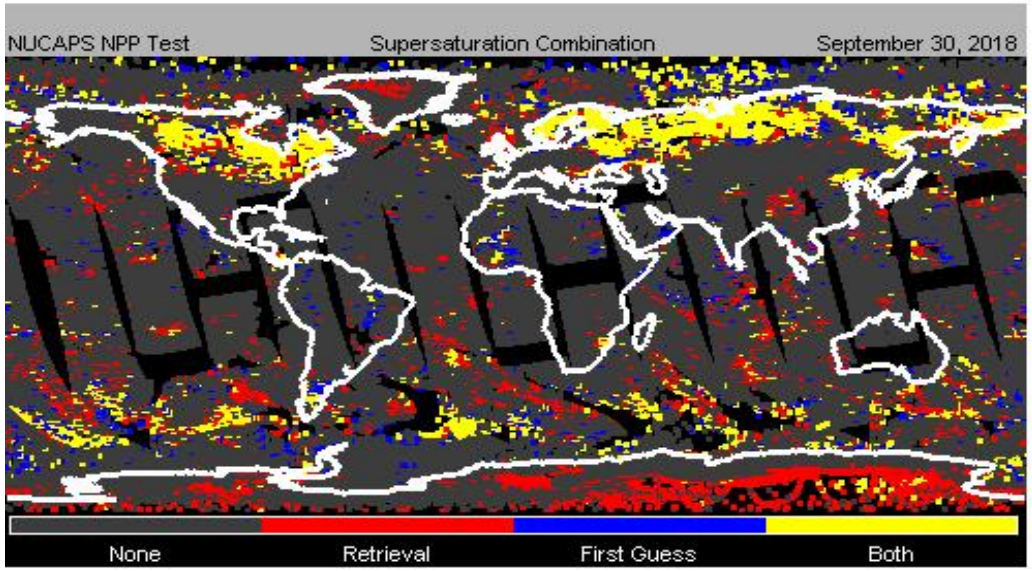
NPP v2.1.2

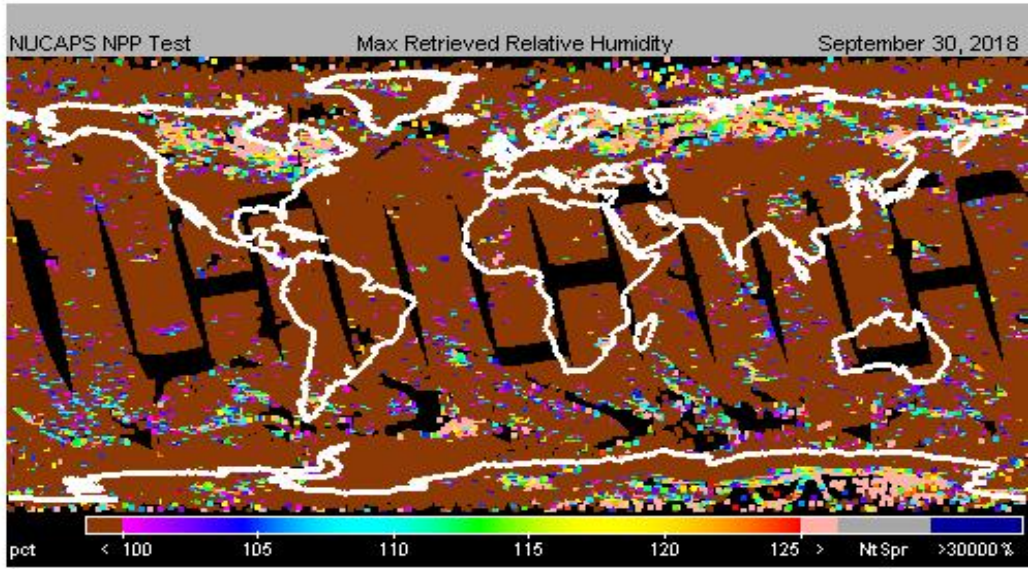




NPP v2.1.2

NPP v2.1.12c





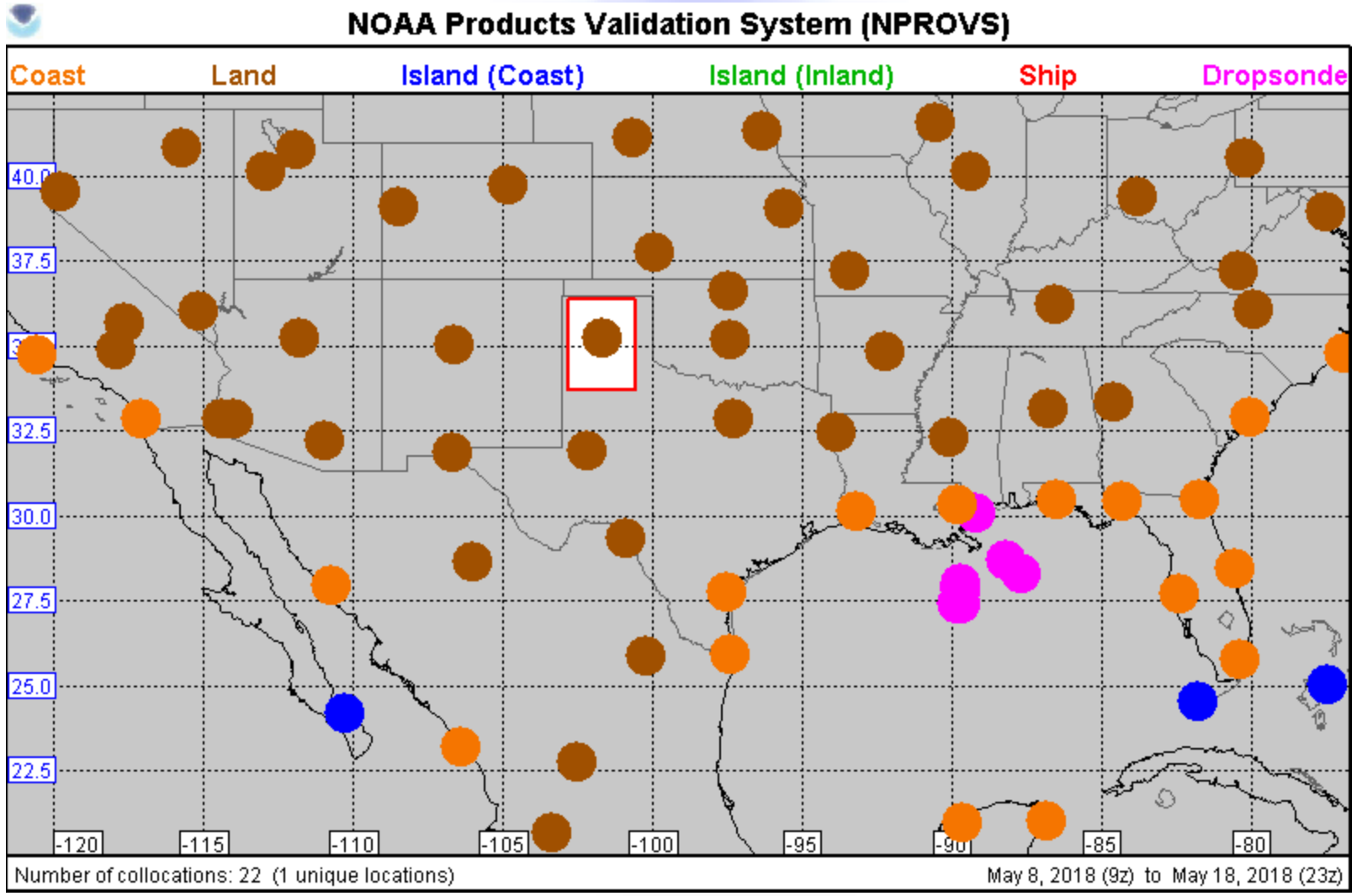
NPP 2.1.12c

… but supersaturated retrievals (and guess) increase up to 20%

NUCAPS FSR and NWS AWIPS-2 Users in the Field

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

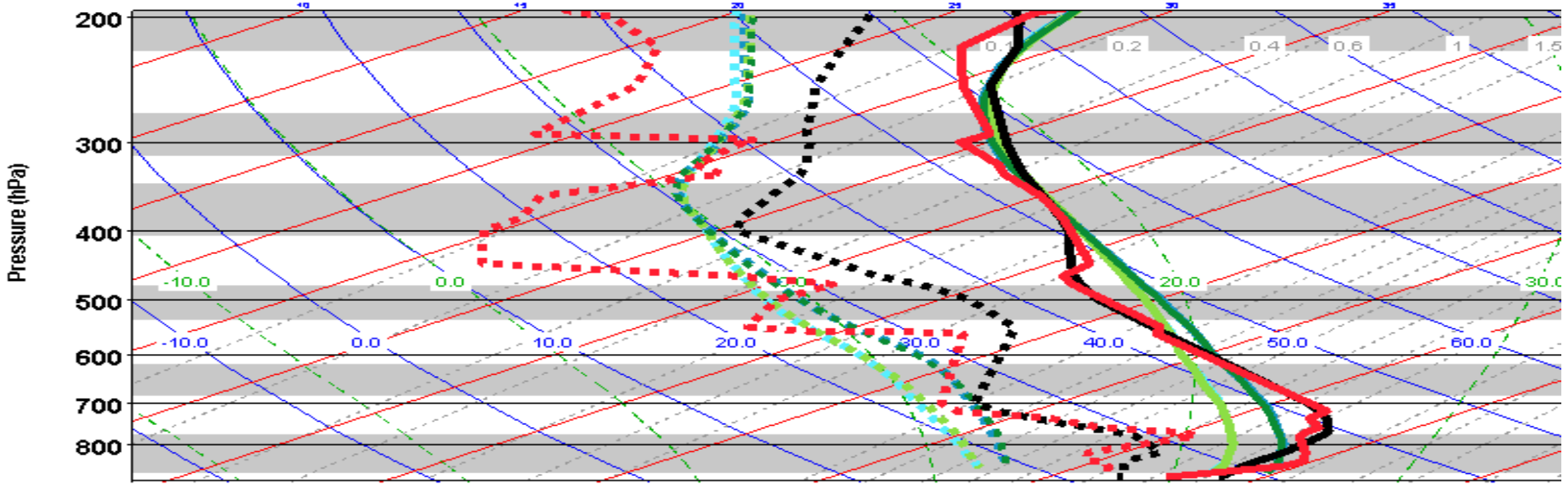
Spring 2018 HWTB Case Studies … convective



Collocations including at Amarillo on May 17 Case Study day

NOAA Products Validation System (NPROVS)

Dewpoint / Temperature (deg K)

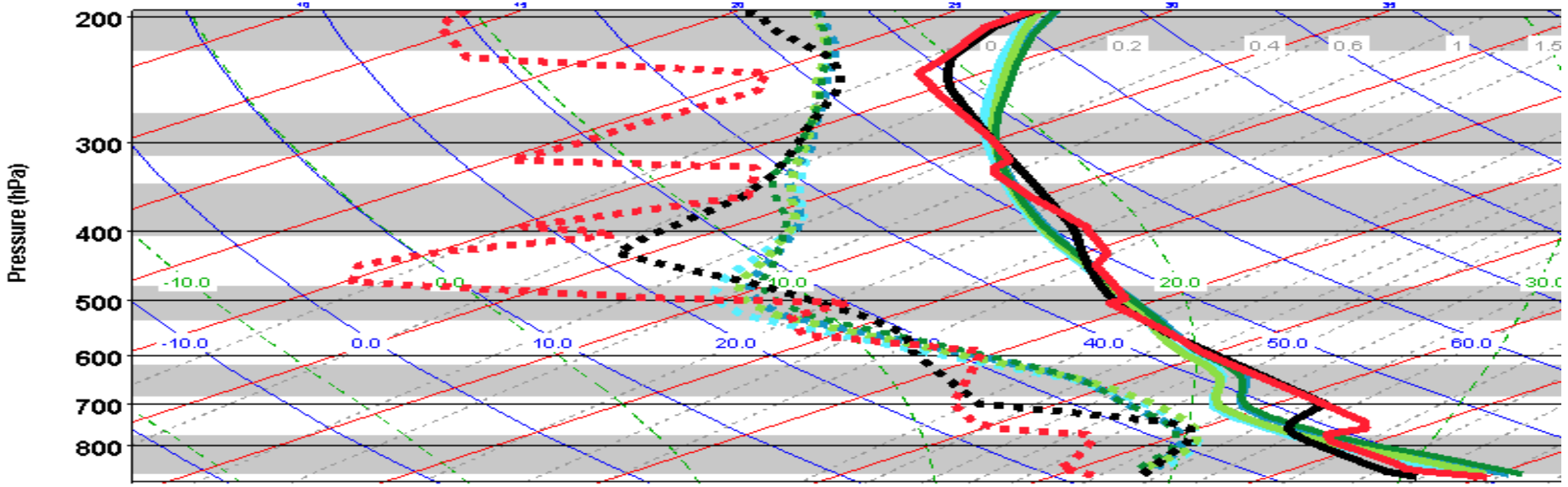


SONDE 72363 (182) SONDE	5/17/2018 11:06:00Z	35.2 N / 101.7 W
SONDE 72363 (182) GFS 6 Hour	5/17/2018 11:06:00Z	35.2 N / 101.7 W
NUCAPS NPP	5/17/2018 8:09:08Z (-2.9 hours)	35 N / 101.6 W (30.8 km)
NUCAPS NPP First Guess	5/17/2018 8:09:08Z (-2.9 hours)	35 N / 101.6 W (30.8 km)
NUCAPS NPP TEST	5/17/2018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

NUCAPS IR+MW pass QC

NOAA Products Validation System (NPROVS)

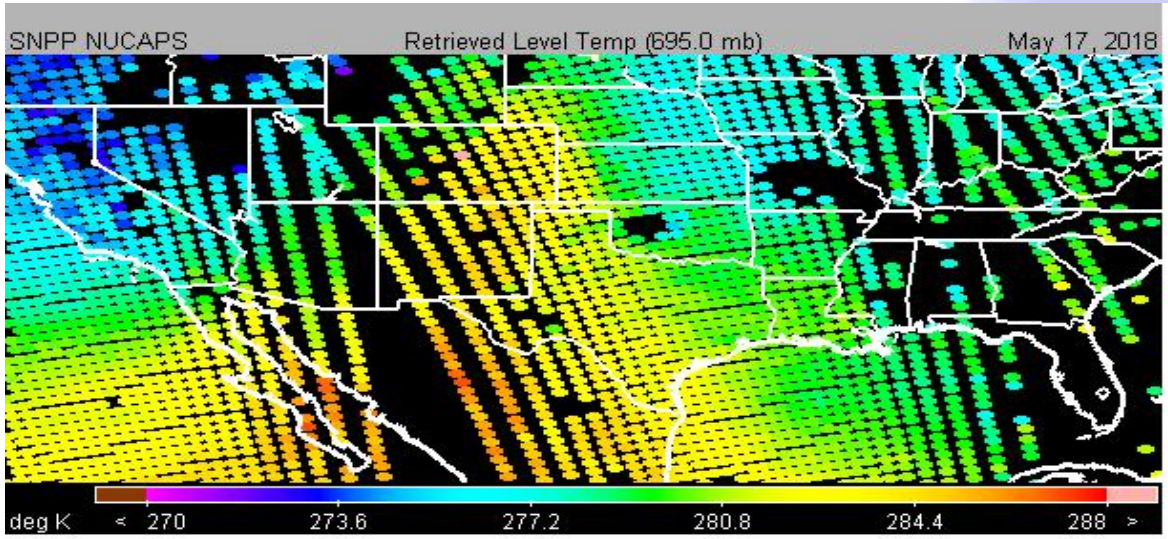
Dewpoint / Temperature (deg K)



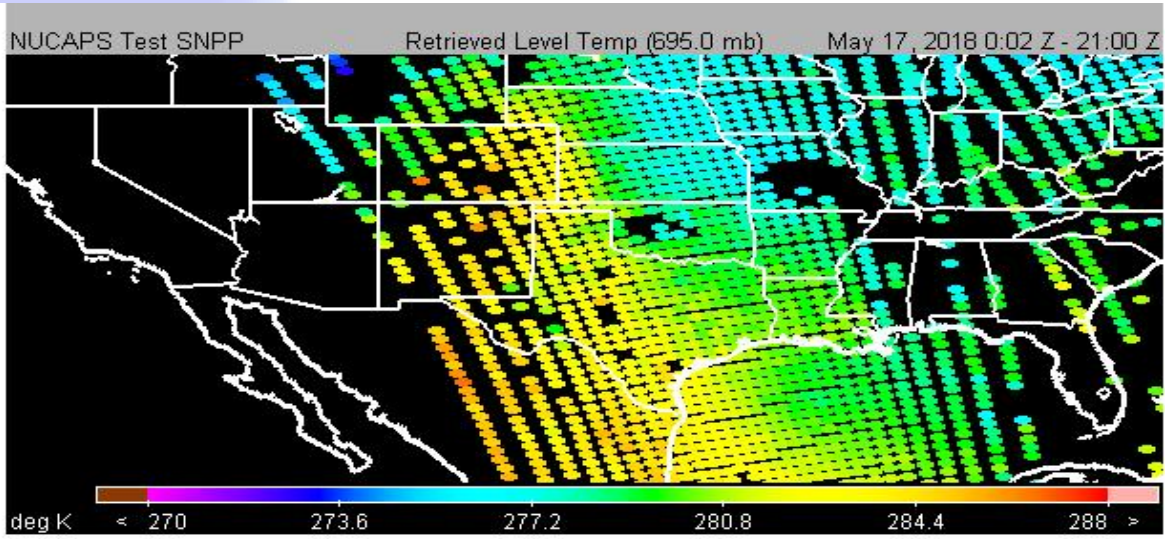
SONDE 72363 (182) SONDE	5/17/2018 18:13:00Z	35.2 N / 101.7 W
SONDE 72363 (182) GFS 6 Hour	5/17/2018 18:13:00Z	35.2 N / 101.7 W
NUCAPS NPP	5/17/2018 19:28:57Z (1.2 hours)	35.5 N / 101.7 W (27.3 km)
NUCAPS NPP First Guess	5/17/2018 19:28:57Z (1.2 hours)	35.5 N / 101.7 W (27.3 km)
NUCAPS NPP TEST	5/17/2018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

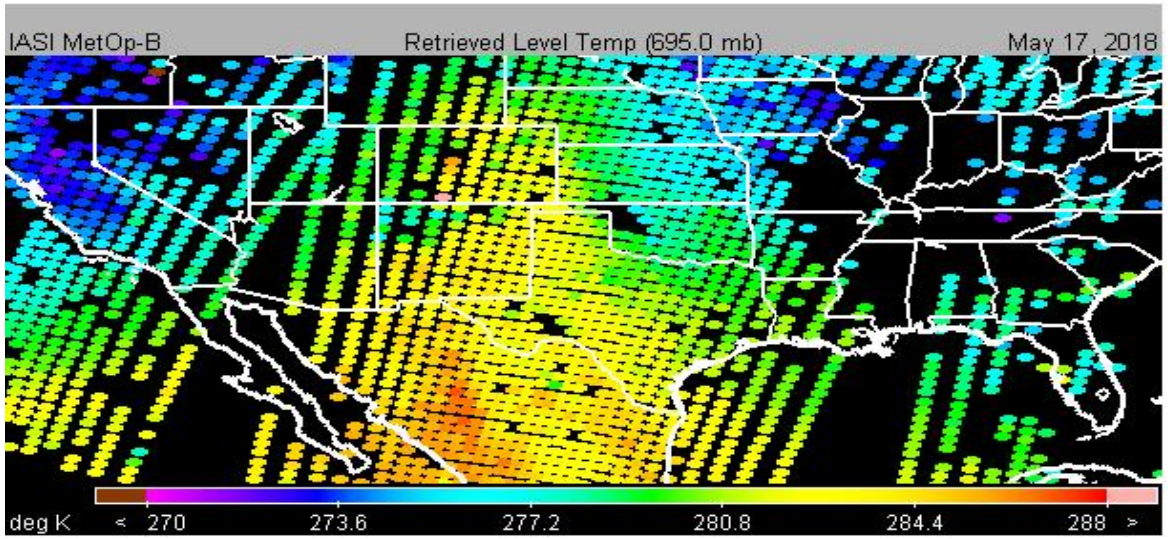
NUCAPS IR+MW pass QC

NUCAPS NPP v2.1.2 (Oper)

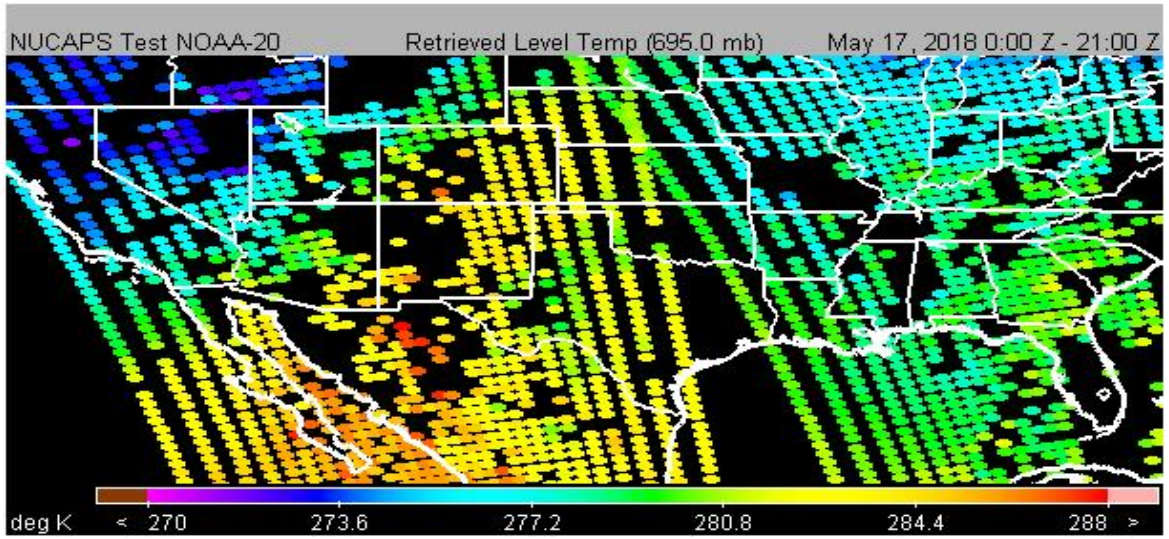


NUCAPS NPP v2.1.4 (Test)





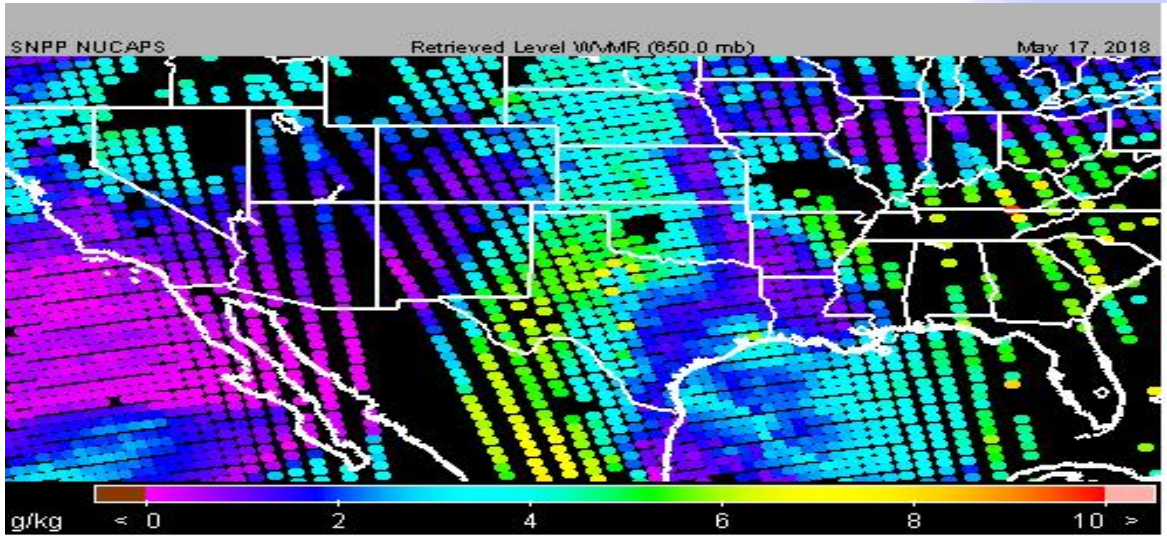
NUCAPS MetOp-B



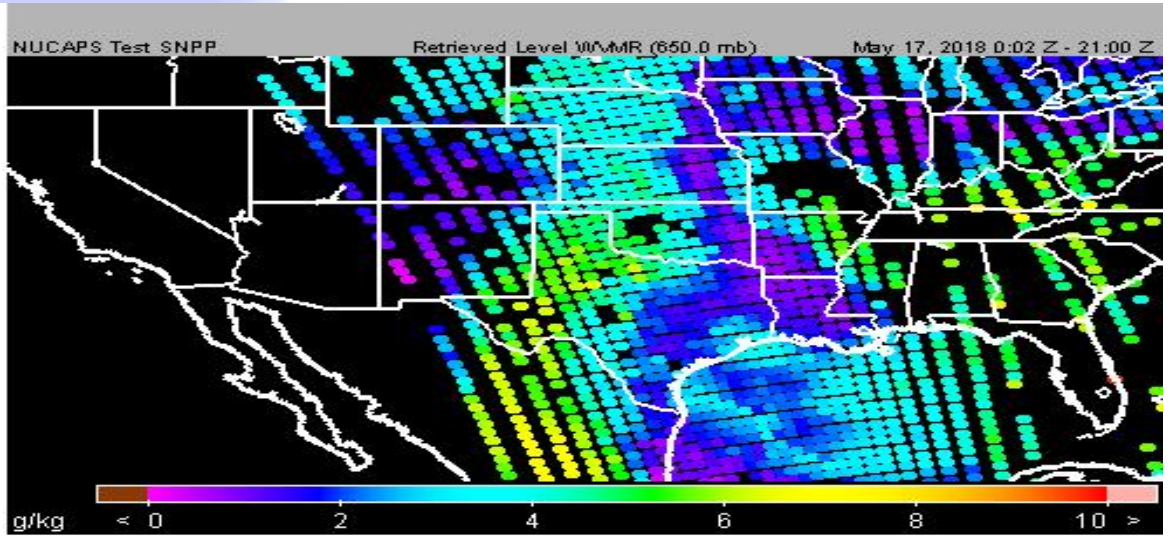
NUCAPS NOAA-20 v2.1.4 Provisional

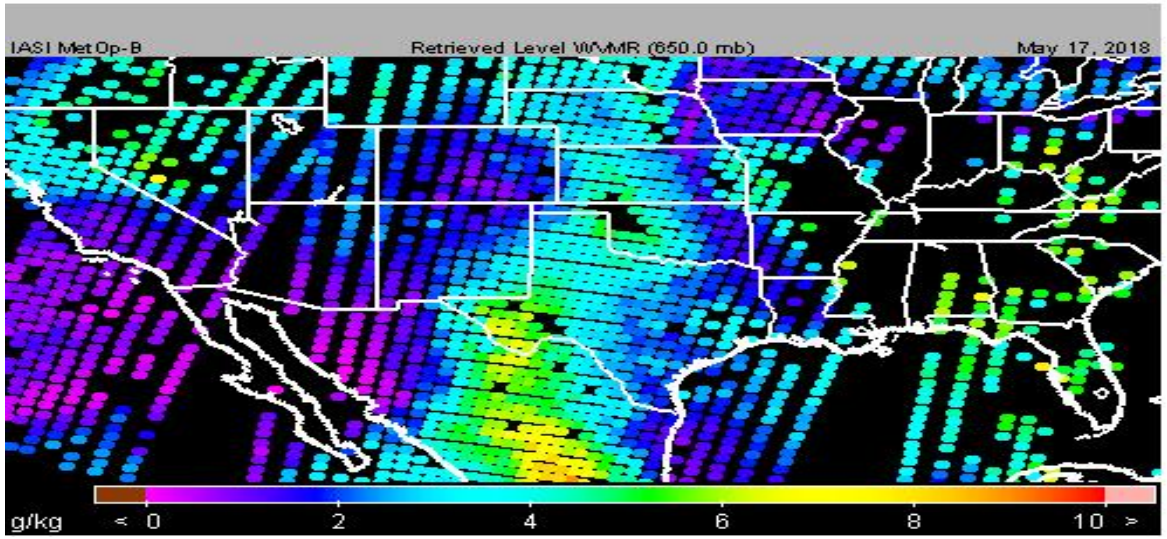
NUCAPS IR+MW pass QC

NUCAPS NPP v2.1.2 (Oper)

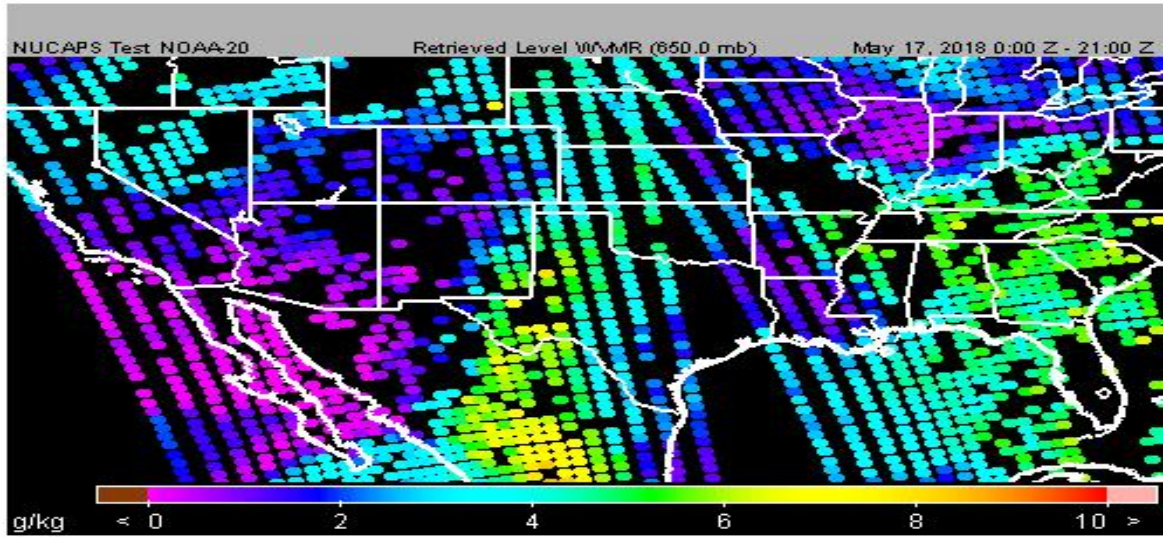


NUCAPS NPP v2.1.4 (Test)





NUCAPS MetOp-B



NUCAPS NOAA-20 v2.1.4 Provisional

NUCAPS IR+MW pass QC

Summary / *Path Forward*

NPROVS provides Enterprise Validation for Soundings ….

Spatial temporal windows mainly impact Sdev (20% per 3 hr); +/- 6hr appropriate for “global” assessments using “conventional” radiosondes

Bias as performance discriminator

LTM for NUCAPS (v1.5) , AIRS (v6.1) and EUMETSAT (v6.2) products indicate “significant” (1K) vertical bias shifts

LTM for NUCAPS FSR indicate improvements with staged upgrades v2.1.2 to 2.1.12c for S-NPP; NOAA-20 remains provisional

- too many IR+MW pass QC…

NWS forecaster use of NUCAPS via AWIPS-2 promising …

More exploitation of NPROVS internationally (ITSC 21 action) and internally (small (cube) Sats, COSMIC-2 , AIRS v7? …)