NOAA Products Validation System (NPROVS) and NPROVS+

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Alternative Title:

Standardized Validation at NOAA STAR

Message

Science is hard enough!

Why bother going through the extra effort of re-inventing the validation datasets again and again?

NPROVS / NPROVS+ does it for you.

Lets all use them!

Outline

- NPROVS
- NPROVS+
- Reference and Dedicated RAOB
- EDRs and SDRs
- Analytic Interface (EDGE)
- Collocation Strategy
- EDR Results
- “K” uncertainty Analysis
- GPSRO

EDR VALIDATION

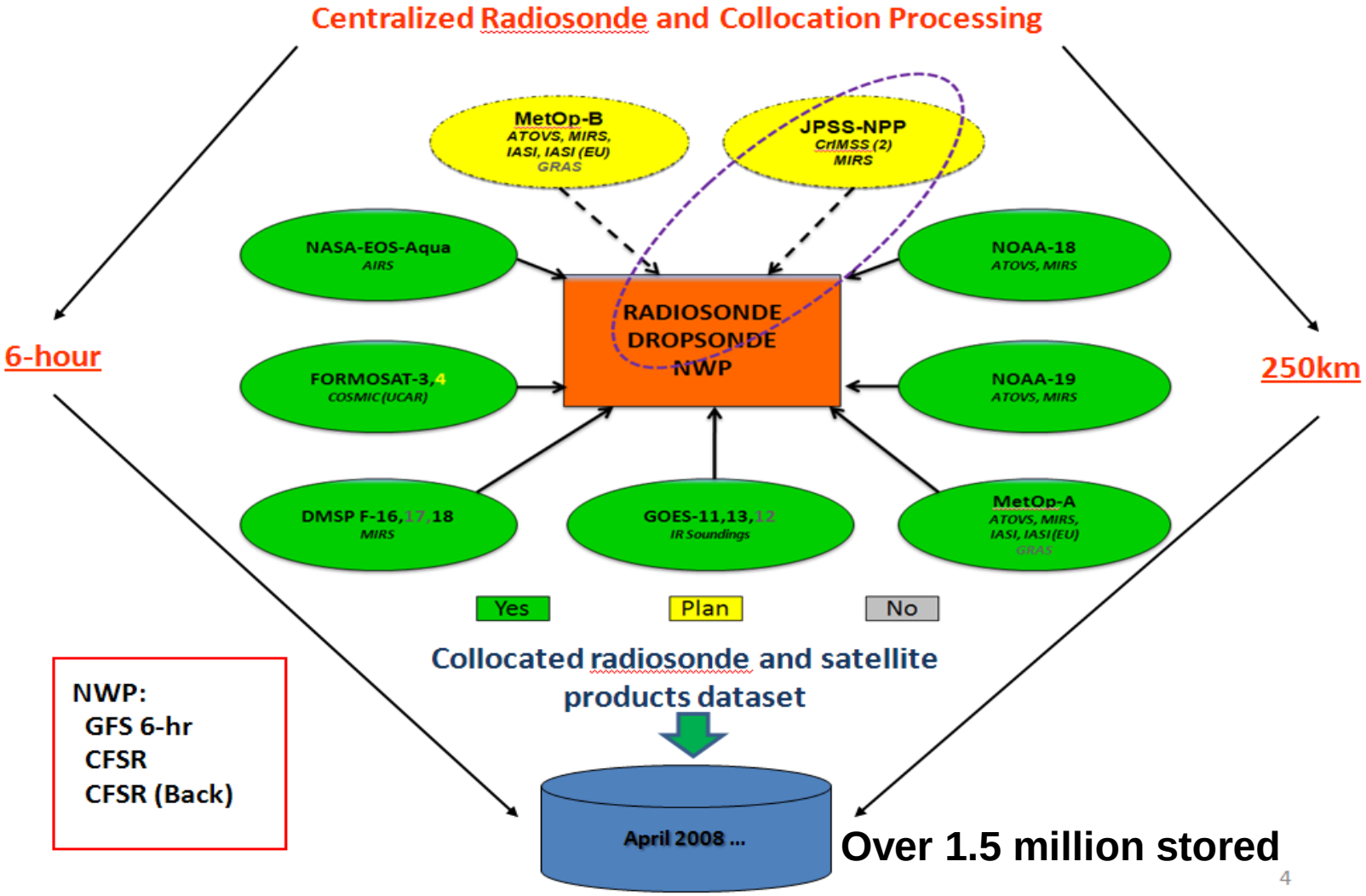
(hierarchial … *Nalli et al, JGR 2014)*

Dataset	Sampling	Characteristics
ECMWF/GFS	Global	±3 hour, model errors, select "Focus Days"
NUCAPS EDR	Global, exact match	NOAA Unique using CrIS/ATMS Significant diagnostic capability
AIRS EDR Products	Global, near exact	NOAA Unique / NASA v6 after April 2013; Orbits are aliased, 16d repeat, different instrument
IASI EDR Products	Global, not so exact (except polar)	NOAA Unique, 4 hour orbit difference, different instrument
GPSRO (COSMIC)	Global ~1000 daily; RAOB anchor	Non synchronous; UTLS (T and H20) and Stratosphere (T up to 5mb); tropopause
Op. RAOB	~200 matchup/day	±3 hours, ±100 km, regional w.r.t. op.systems
Dedicated RAOB	~600 matchup/year	Only a handful of locations

CrIMSS EDR cal/val Team has maintained an "off-line" capability to provide reprocessing for these data sets on many systems (e.g., Mx5.3, 6.4, 6.6, 7.1) including individual changes made for each DR

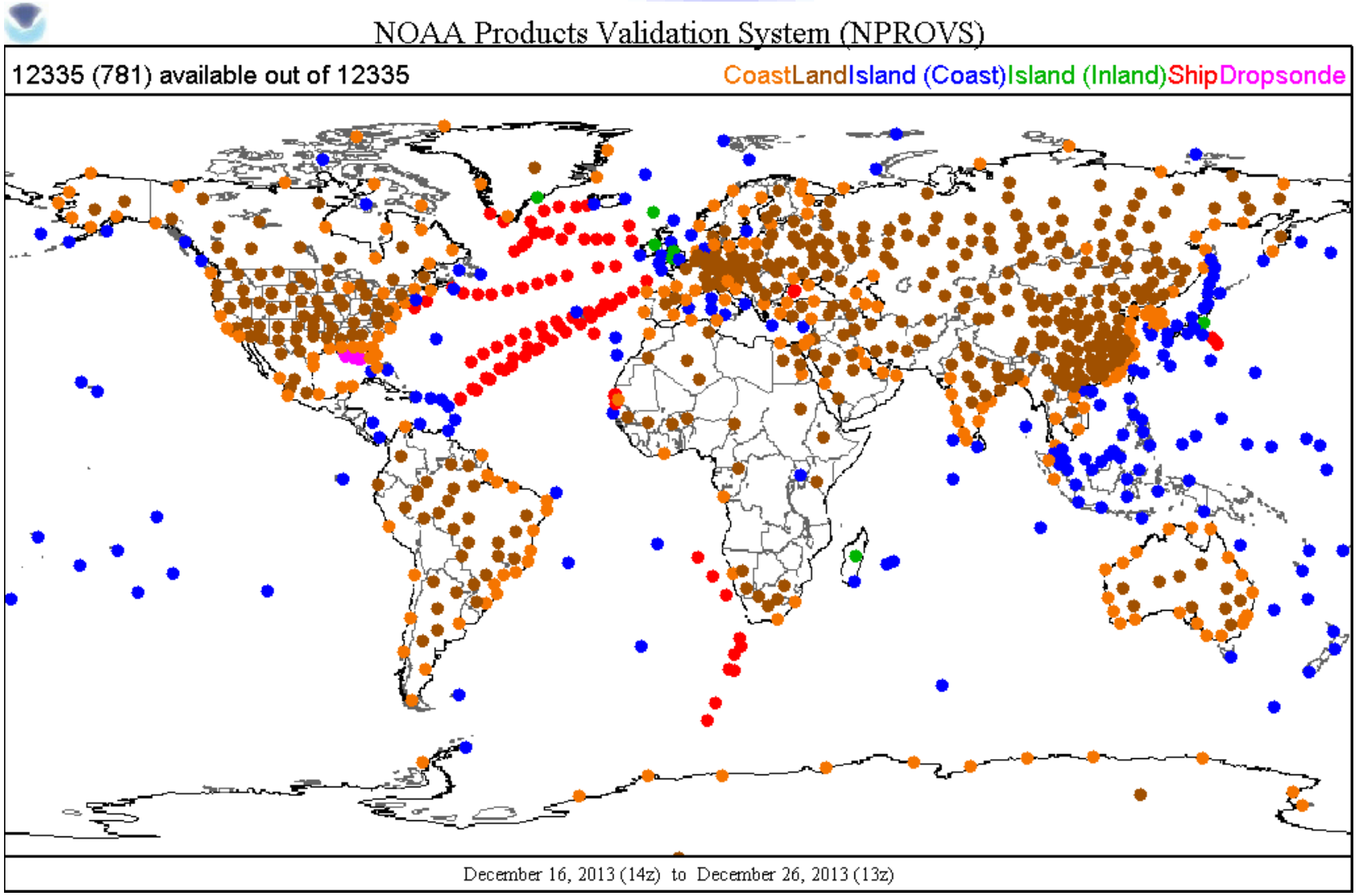
- Allows demonstration of improvements on historical datasets
- Allows maximizing the impact of the investment in "truth" datasets (Barnet, PROV)

NOAA Products Validation System (NPROVS)

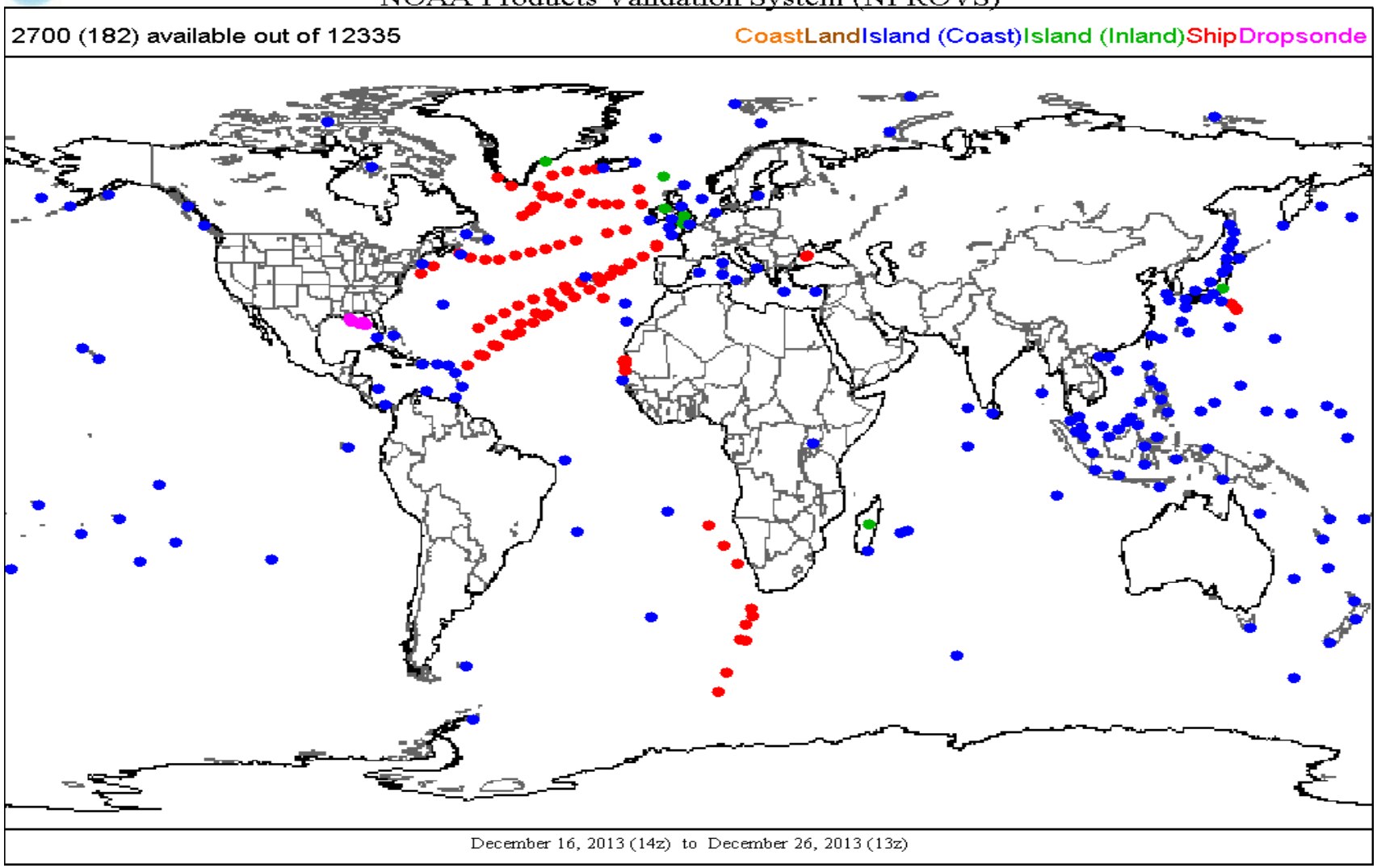


Conventional RAOB

Every Day !!

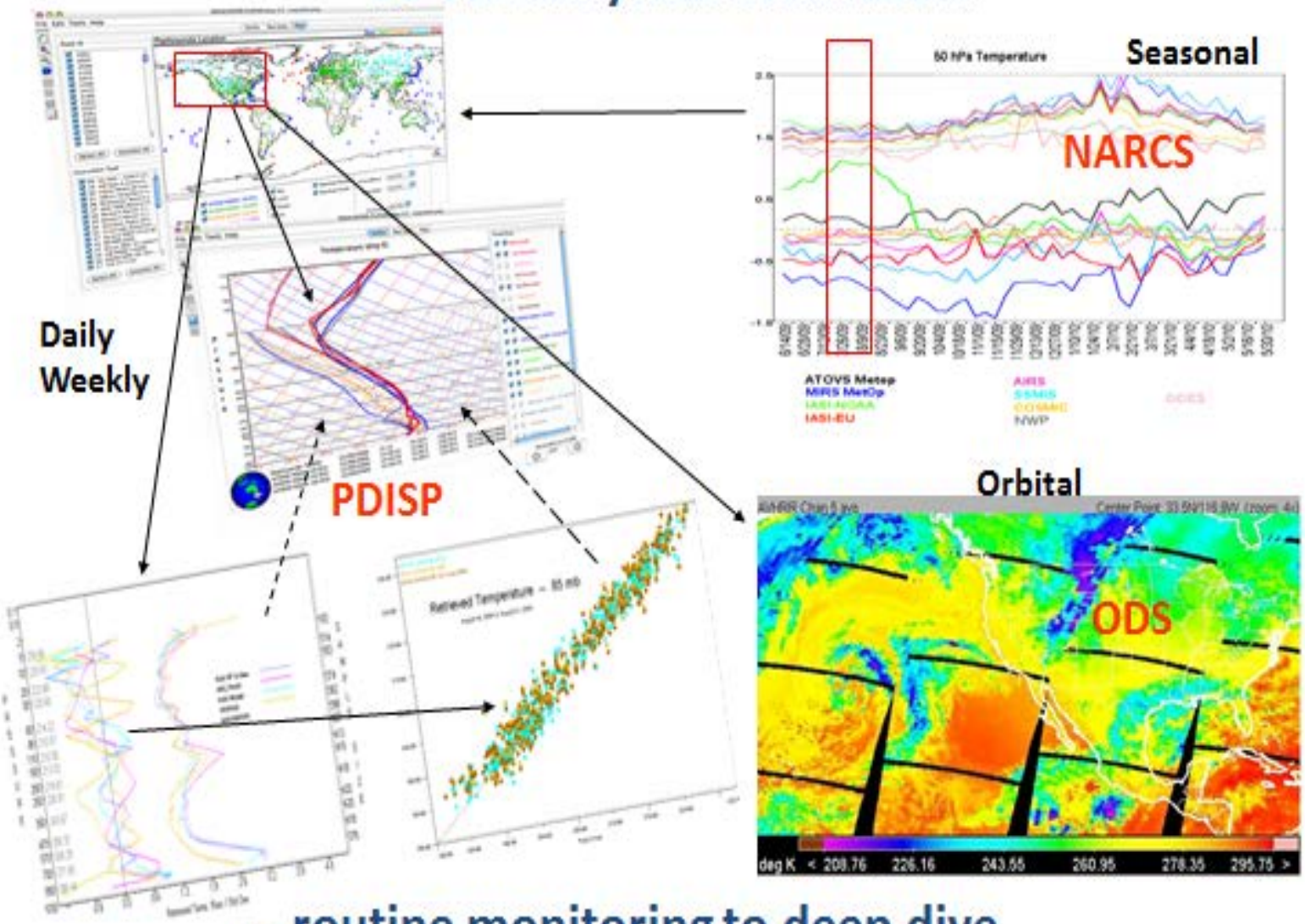


NPROVS Collocations 12/16 to 12/26 2013 … 12,335



Maritime Validation dataset …

EDGE Analytical Interface …

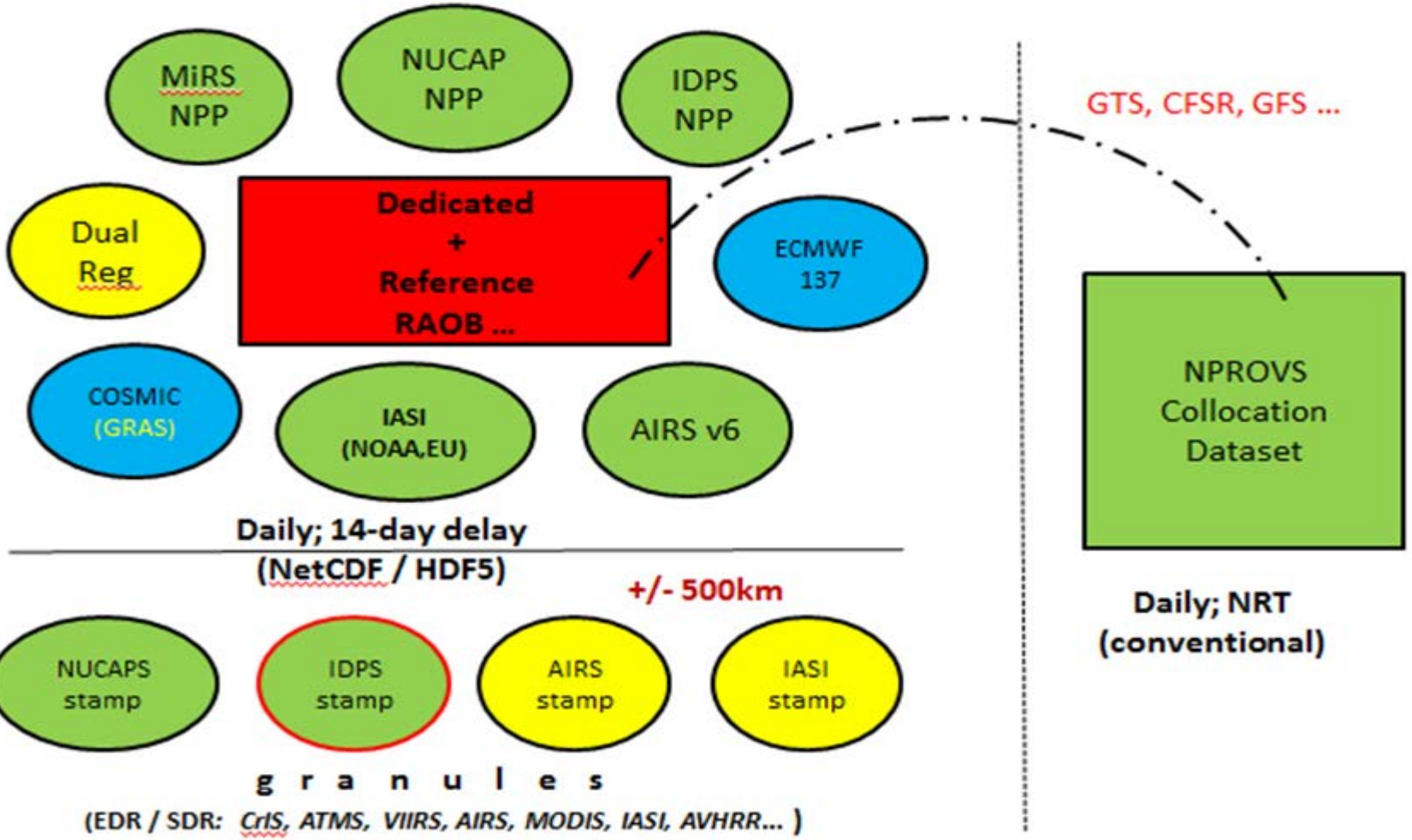


… routine monitoring to deep dive

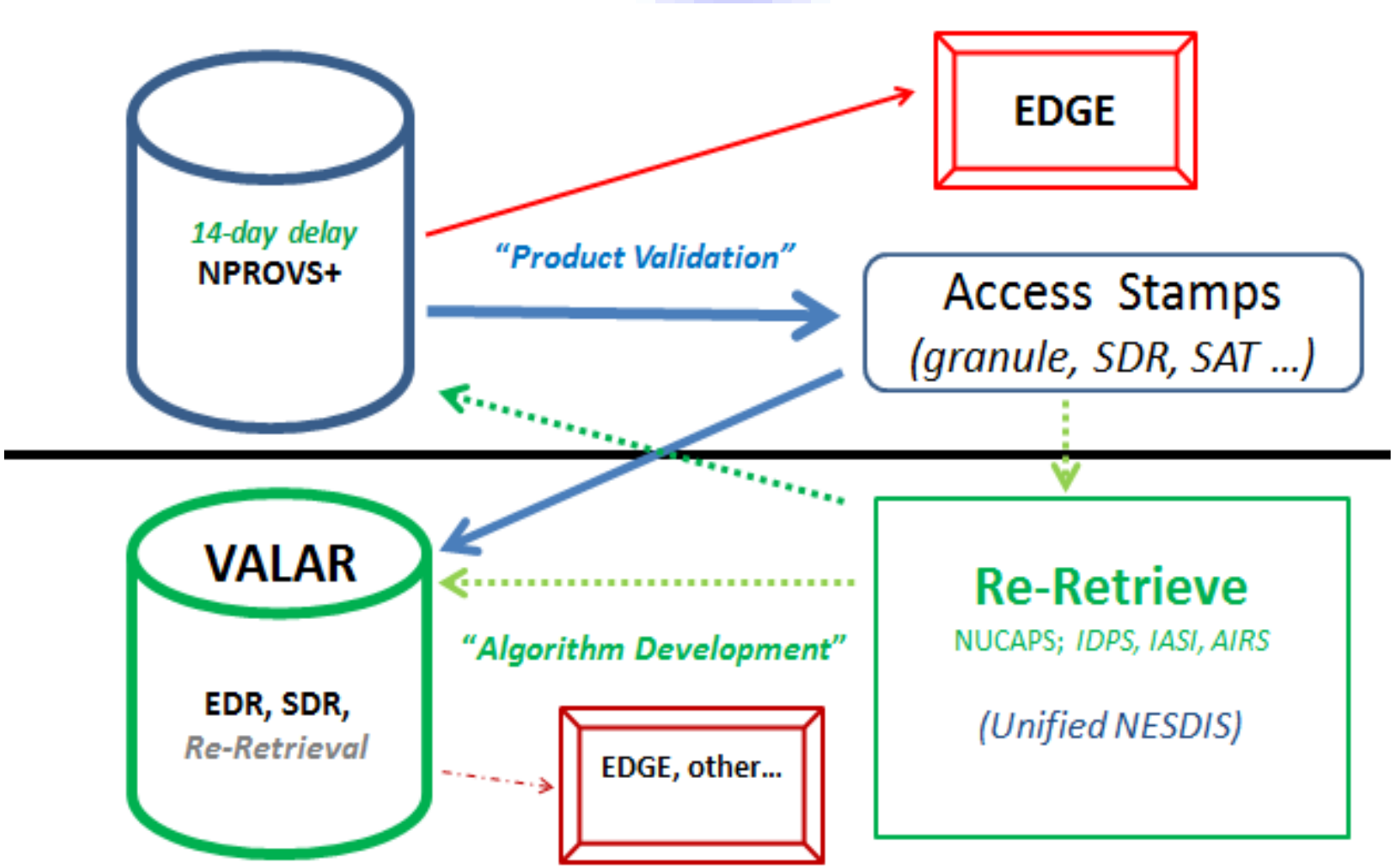
NPROVS web site provides
summary statistics,
validation datasets,
graphical applets (JAVA)
PDISP and **NARCS**

http://www.star.nesdis.noaa.gov/smcd/opdb/nprovs

NOAA Products Validation System + (NPROVS+)

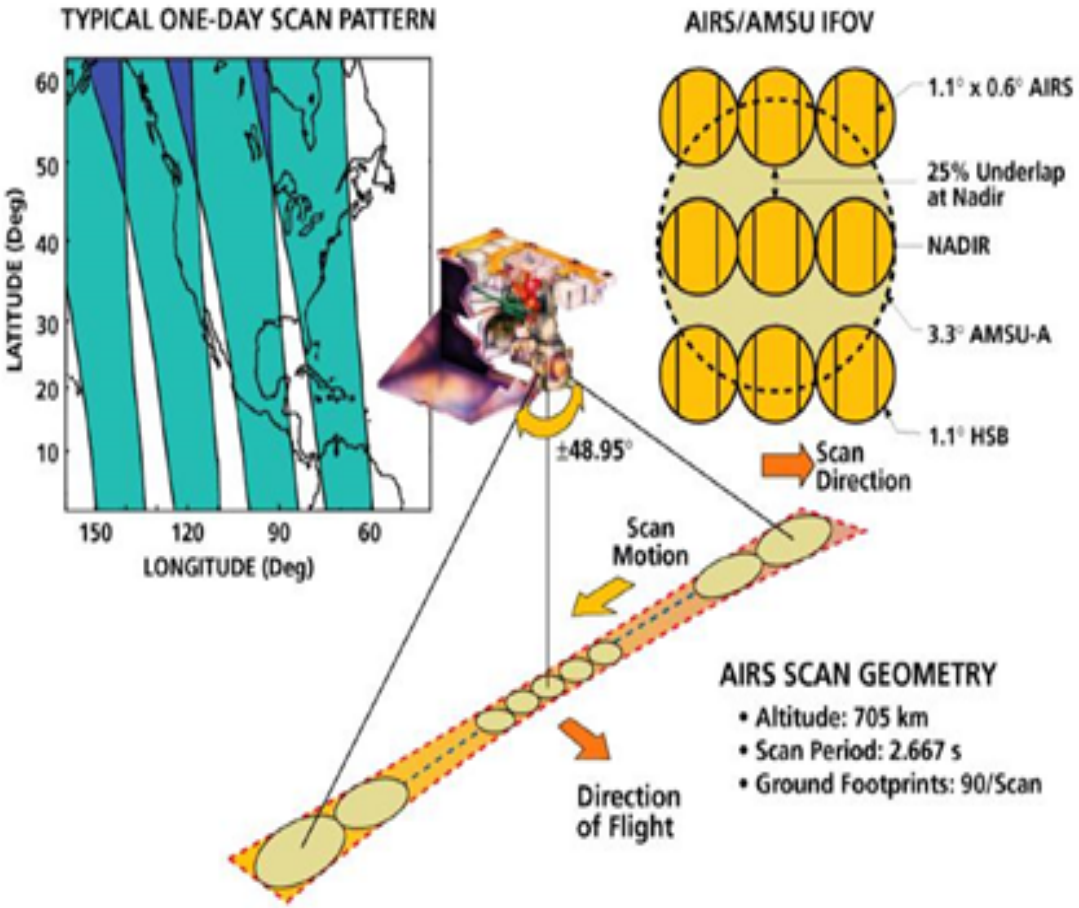


Every Day !!



Nick Nalli Presentation …

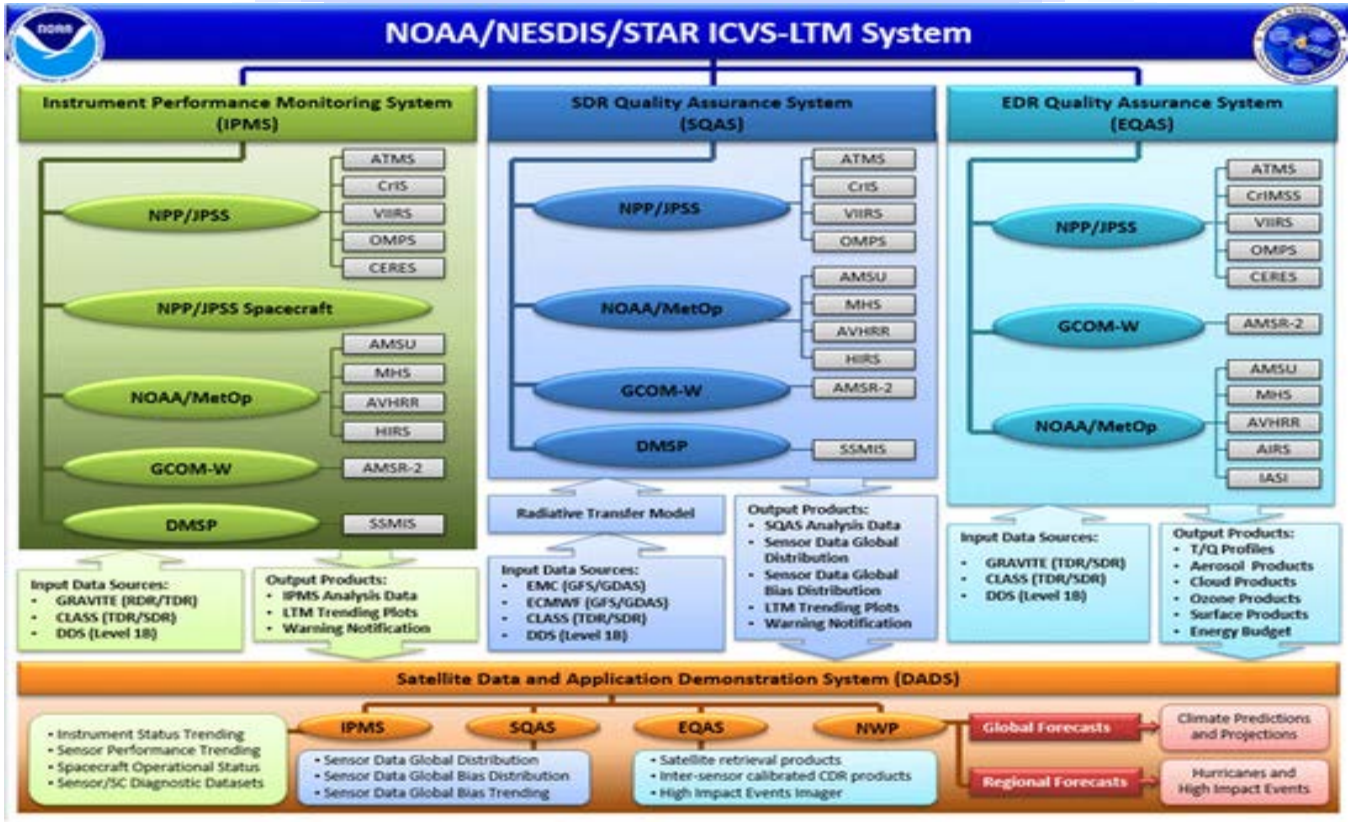
- Sounding is performed on 50 km field of regard (FOR).
- FOR is currently defined by the size of the microwave sounder footprint.
- IASI/AMSU has 4 IR FOV's per FOR
- AIRS/AMSU & CrIS/ATMS have 9 IR FOV's per FOR.
- ATMS is spatially over-sampled and can emulate an AMSU FOV.



... additional stamp info (500km area centered at RAOB) supports development

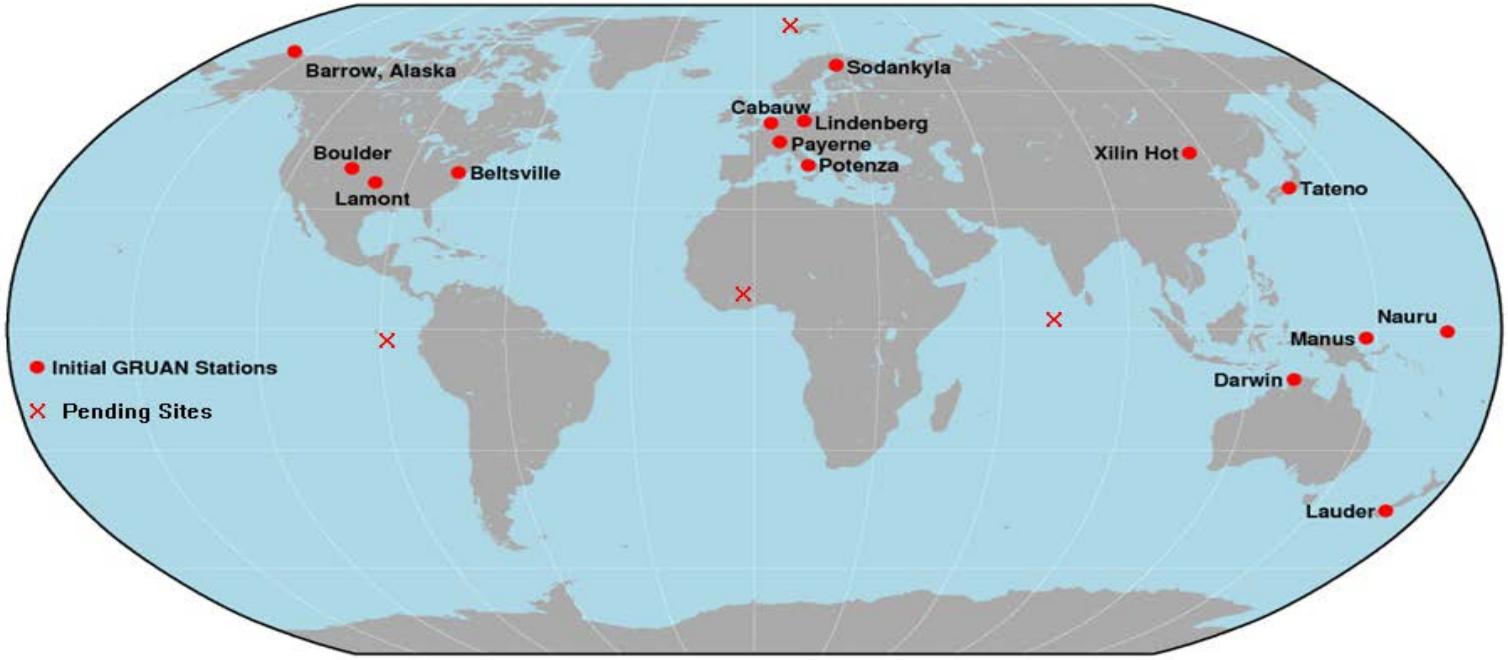
STAR ICVS Integrated Calibration / Validation System Long-Term Monitoring

Monitoring and characterizing satellite instrument performance in orbit for weather, climate and environmental applications



ICVS: Long-Term Sensor Calibration/Validation Monitoring (SDR) from Space
(http://www.star.nesdis.noaa.gov/icvs/index.php)

GCOS "Reference" Upper AIR Network (GRUAN)



GRUAN 6th International Coordination Meeting (ICM-6) March 10-14, GreenBelt

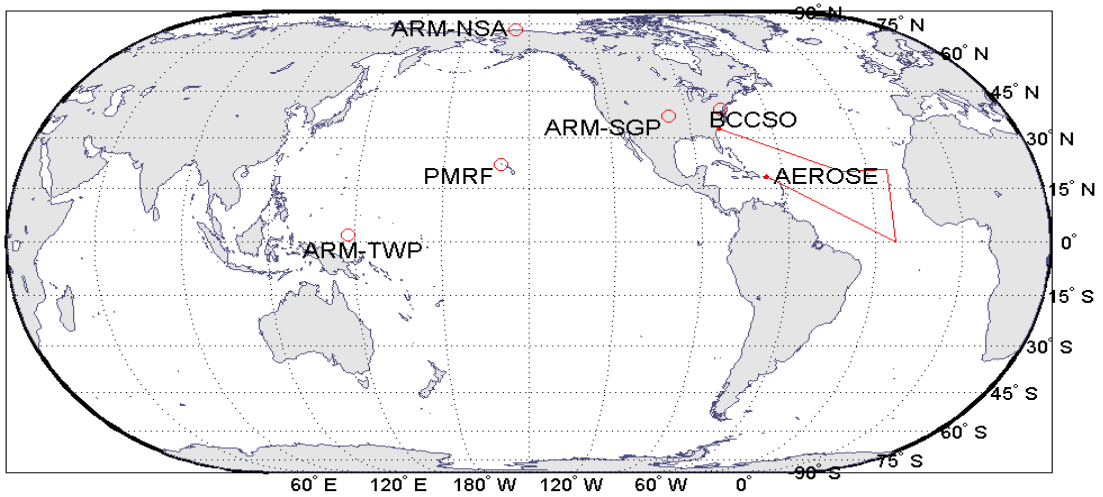
… special Tuesday session on satellite synergies

… sites provide reference radiosonde (RS92) plus ancillary ground (lidar, MWR, FTIR …) observations, adherence to best measurement practices GRUAN Manual and Measurement Guideline documents) including specification of "**Measurement Uncertainty**" with plans for up to 40 sites (5+ years)

	ARM-TWP	ARM-SGP	ARM-NSA		ARM-TWP	ARM-SGP	ARM-NSA	PMRF	BCCSO	NOAA AEROSE
Location	Manus Island, Papua New Guinea	Ponca City, Oklahoma, USA	Barrow, Alaska, USA	Location	Manus Island, Papua New Guinea	Ponca City, Oklahoma, USA	Barrow, Alaska, USA	Kauai, Hawaii, USA	Beltsville, Maryland, USA	Tropical North Atlantic Ocean
Regime	Tropical Pacific Warm Pool, Island	Midlatitude Continent, Rural	Polar Continent	Regime	Tropical Pacific Warm Pool, Island	Midlatitude Continent, Rural	Polar Continent	Tropical Pacific, Island	Midlatitude Continent, Urban	Tropical Atlantic, Ship
Planned N	90	180	180	Planned N	90	180	180	40	—	≈ 60–120
Launched n_1	**42**	**92**	**93**	Launched n_1	**42**	**92**	**93**	**40**	**23**	**2**
Launched n_2	—	**88**	**90**	Launched n_2	—	**88**	**90**	—	—	**0**
Time Frame	Aug–present	Jul–present	Jul–present	Time Frame	Aug–present	Jul–present	Jul–present	May, Sep	Jun–Jul, Sep–present	Jan–Feb 2013

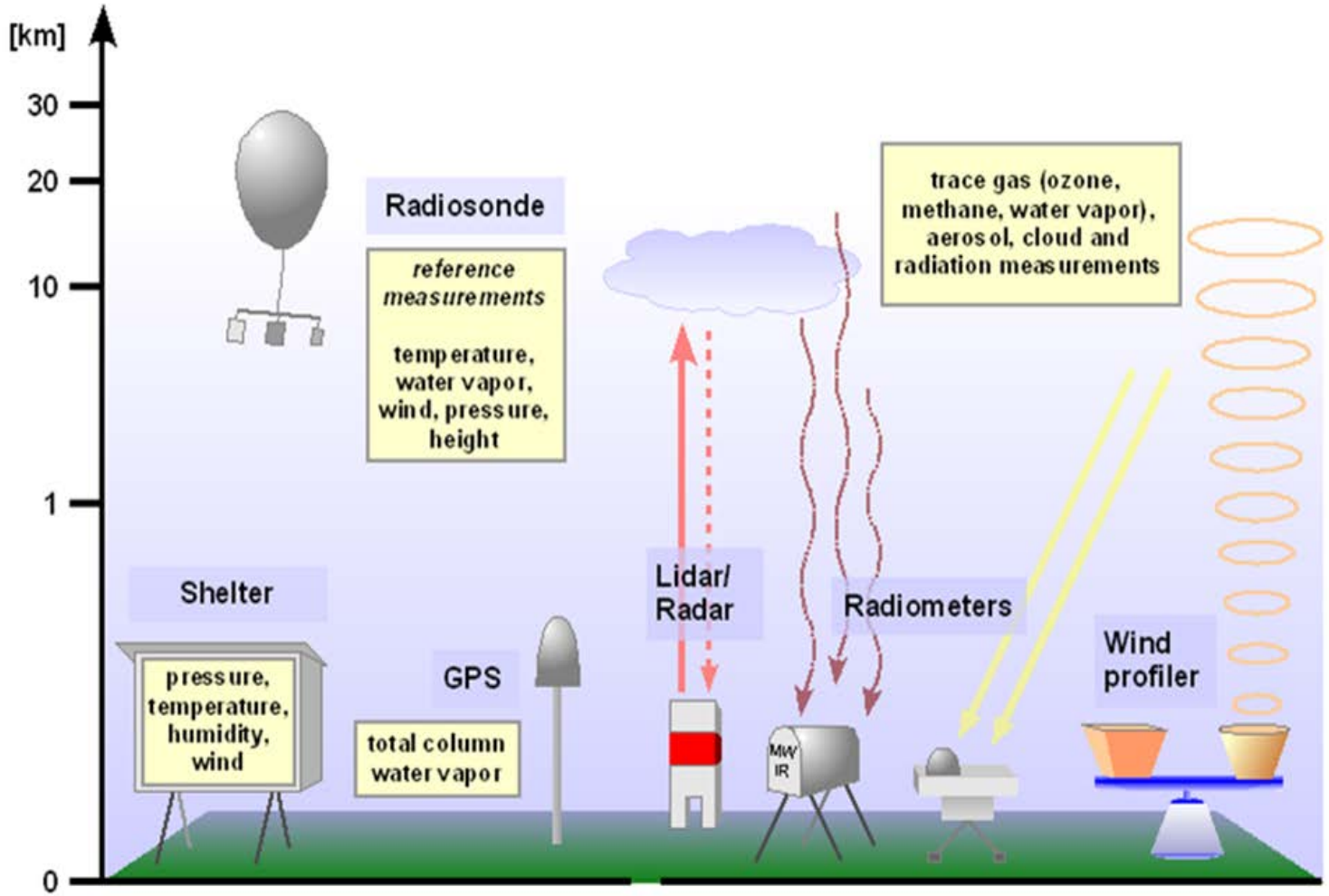
Dedicated S-NPP RS92 RAOB funded by JPSS CrIMSS Project

NPP CrIMSS EDR ICV Dedicated RAOB Sites



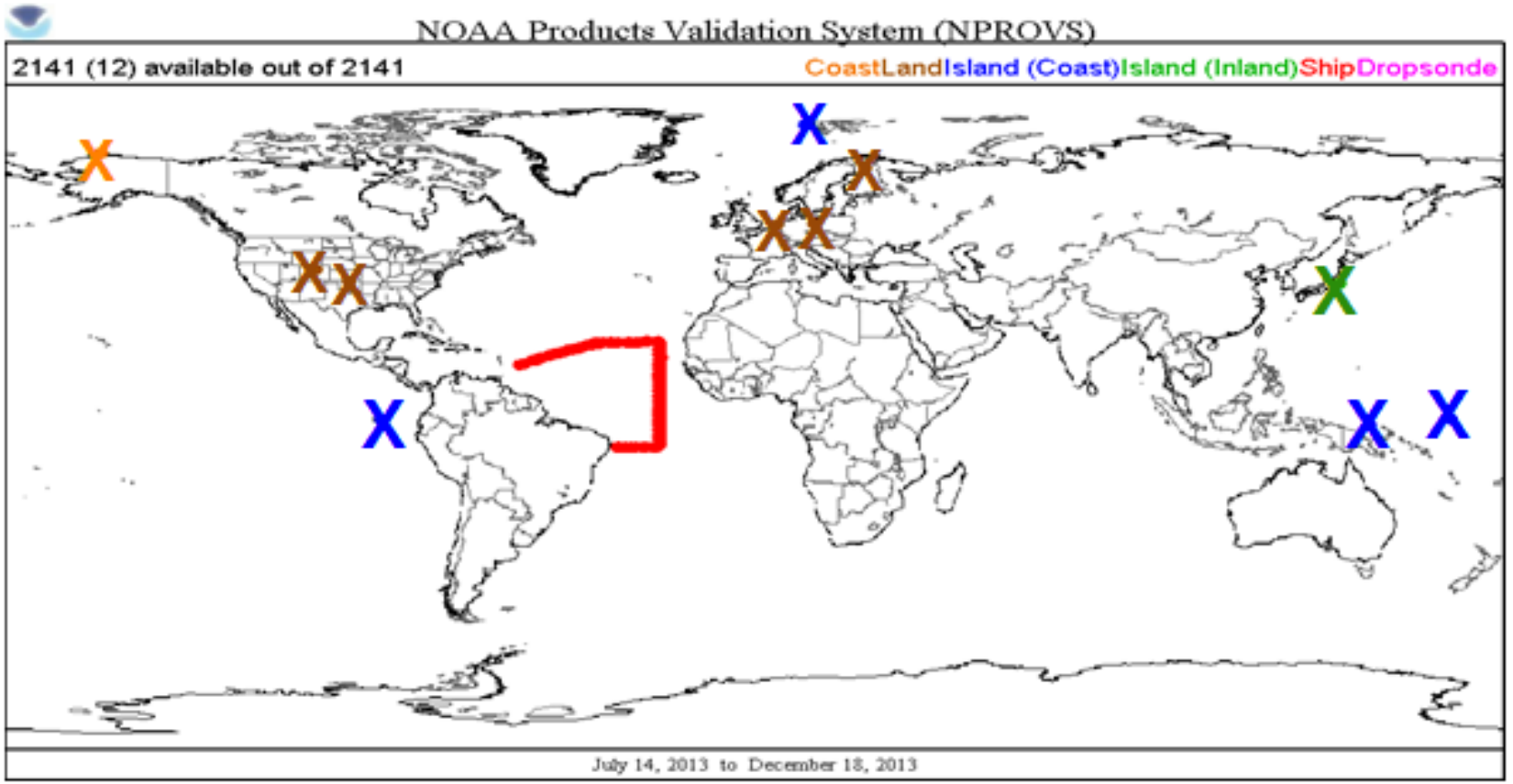
… ongoing re-structure of ARM scheduling to provide "sustained" year round coverage per 3 days … *Borg, Tobin, Mather …*

GRUAN Processed Dedicated RAOB !!



Characterization of atmospheric column well suited to assess satellite product

NPROVS+



2050 collocations (350 Dedicated, 1700 GRUAN) … 5mos

(3600 collocations and 1000 dedicated as of mid-April …)

Collocation Strategy

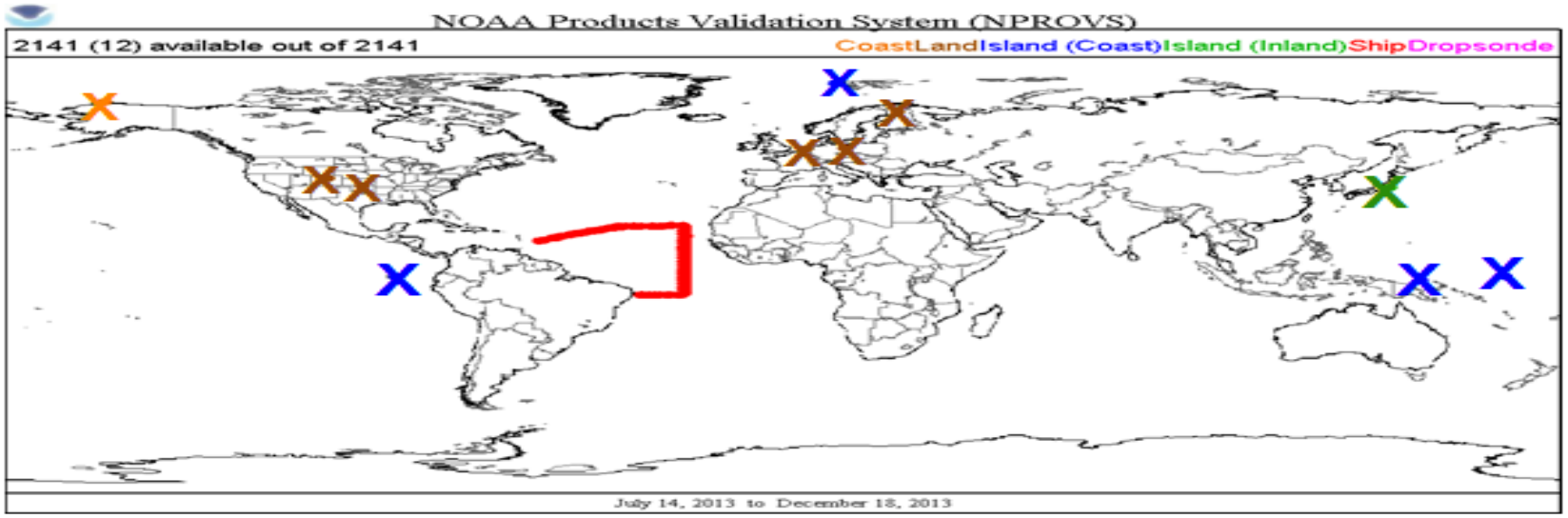
- Reference/dedicated RAOB (RS92) is anchor
- Digicora, GRUAN, GTS … (3 flavors)
- Append Ancillary (lidar, etc as available, retrospective …)
- Compress to 1km layers (also retain original hi-density)
- **Single closest satellite EDR within +/- 6hr and 150km (250km for COSMIC)**
- NWP (GFS 6-hr, CFSR and ECMWF Anal …)
- For hyperspectral (S-NPP, MeTop, Aqua) append all EDRs within 500km of RAOB … **VALAR**
- Append associated SDR (traceable to ICVS) … **VALAR**

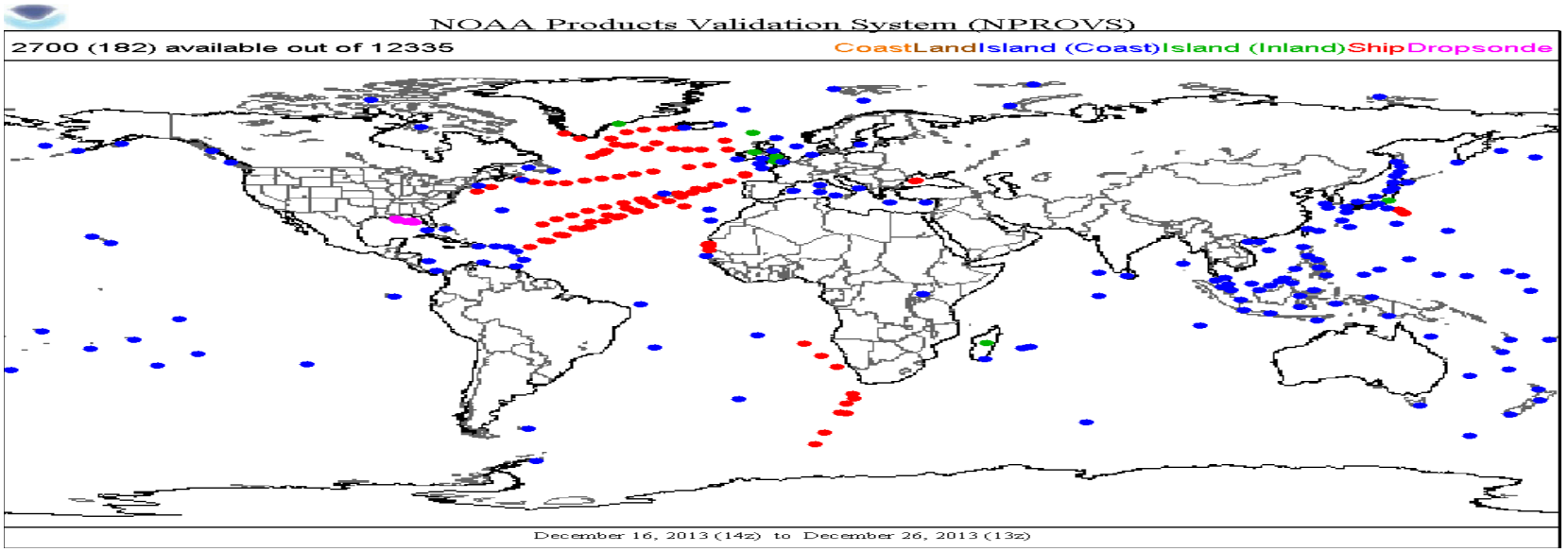
Results

- NUCAPS Validation
  - IR+MW
  - MW-only including MiRS
  - Trends
  - Yield, QC flag
- Integrating GRUAN Uncertainty
  - “K” statistics
  - AIRS v6 uncertainty analysis
- GPSRO
  - RAOB Radiation Correct

NPROVS+

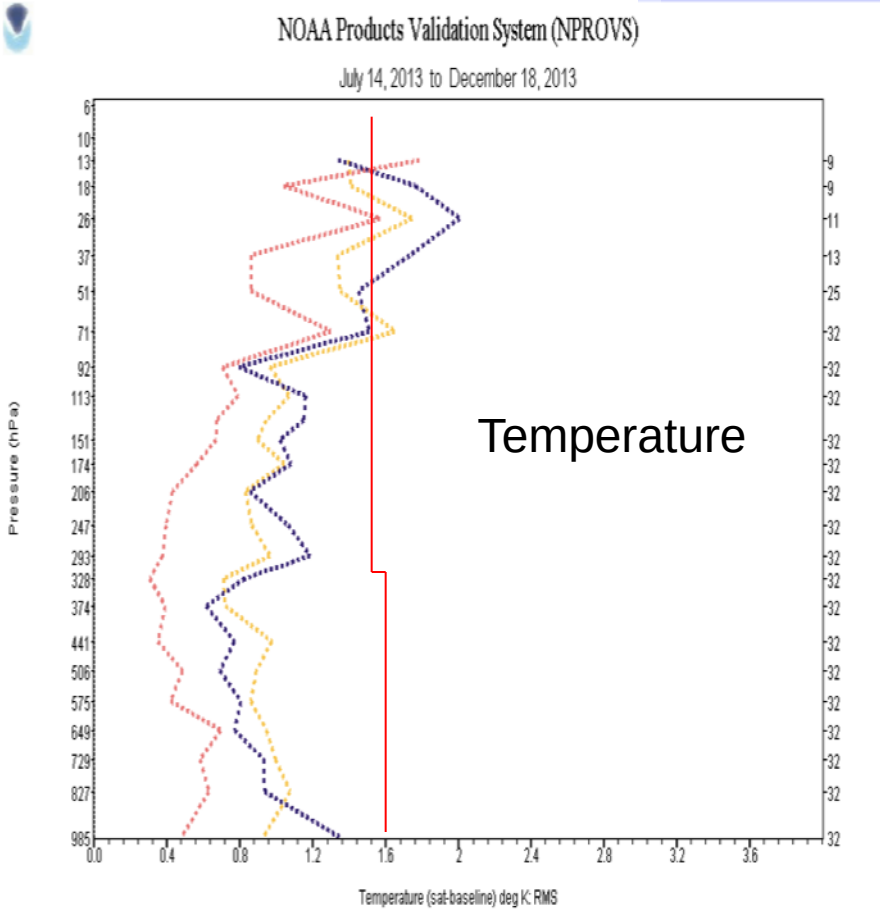
PDISP

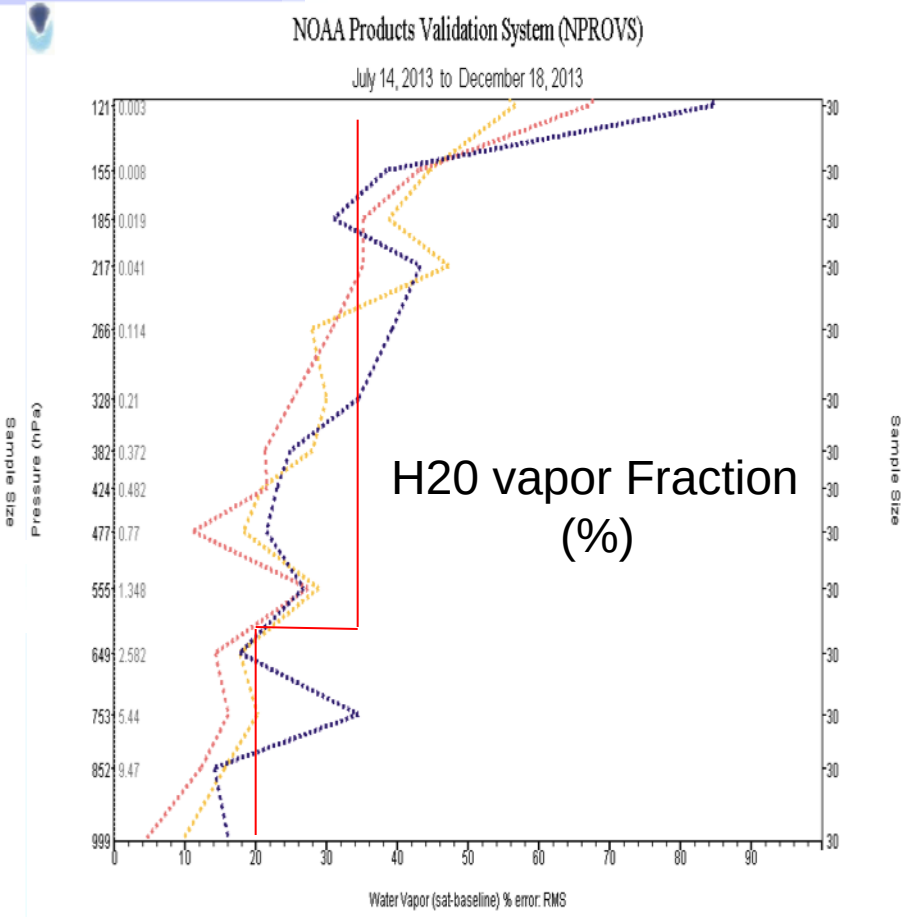




NPROVS Maritime

SAT-minus-RAOB Vertical Statistic (PDISP)

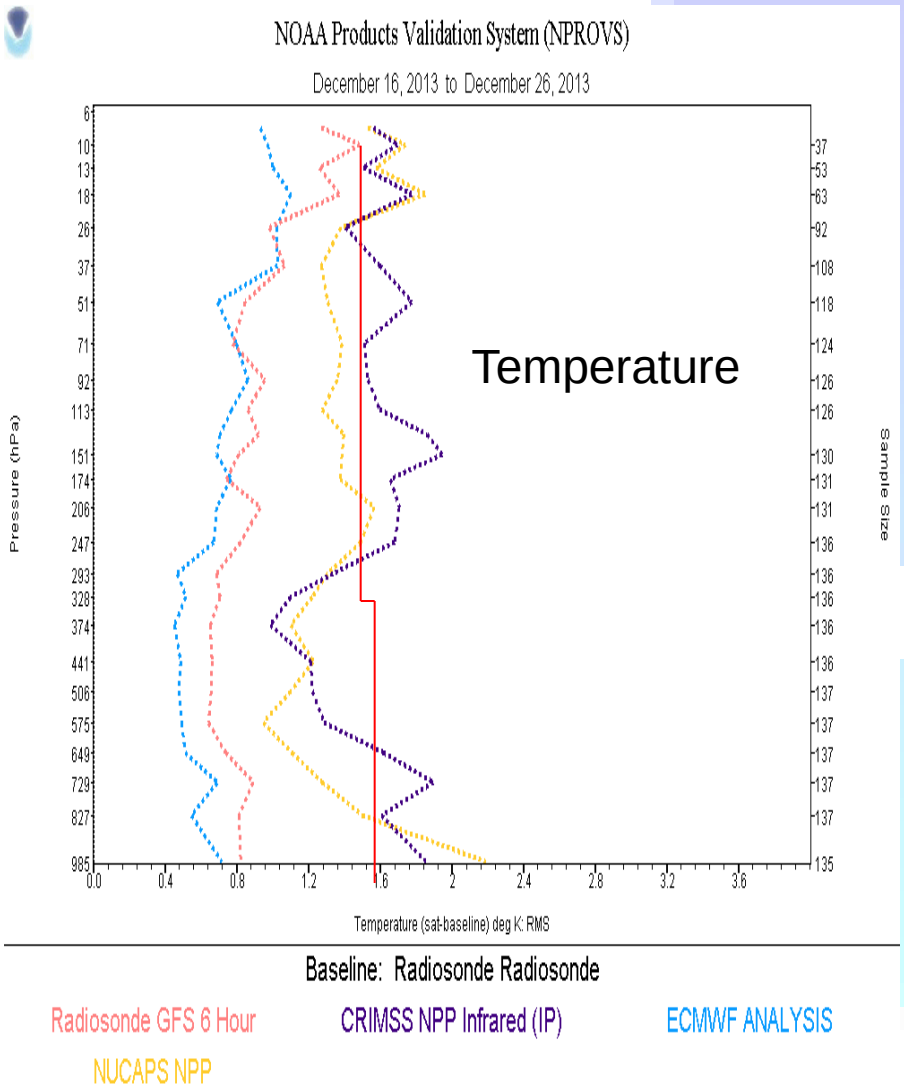


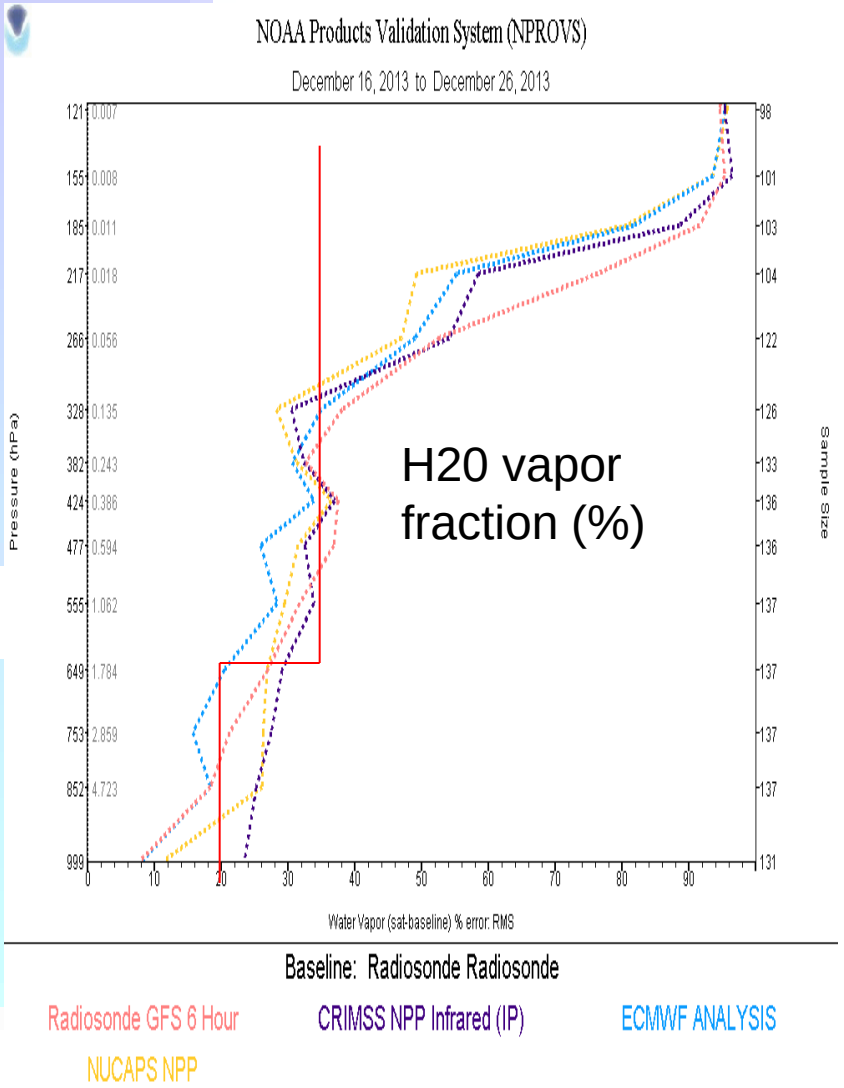


IR + MW Pass QC … AEROSE only

NPROVS+

SAT-minus-RAOB Vertical Statistic

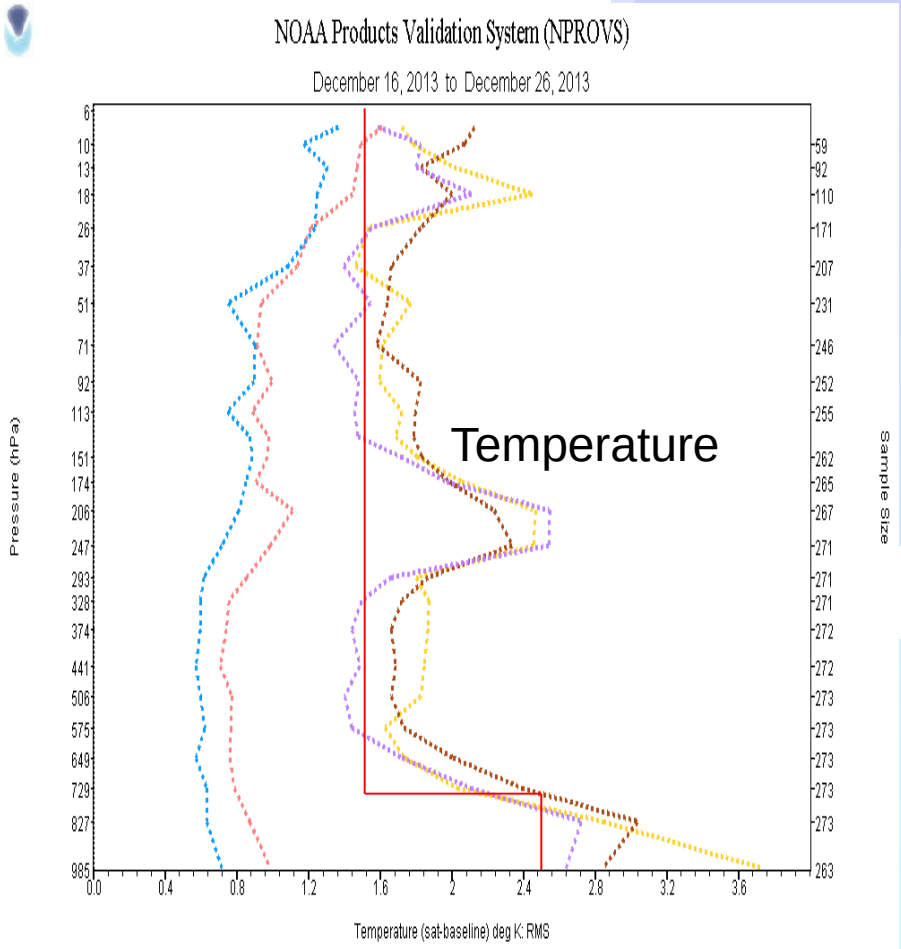


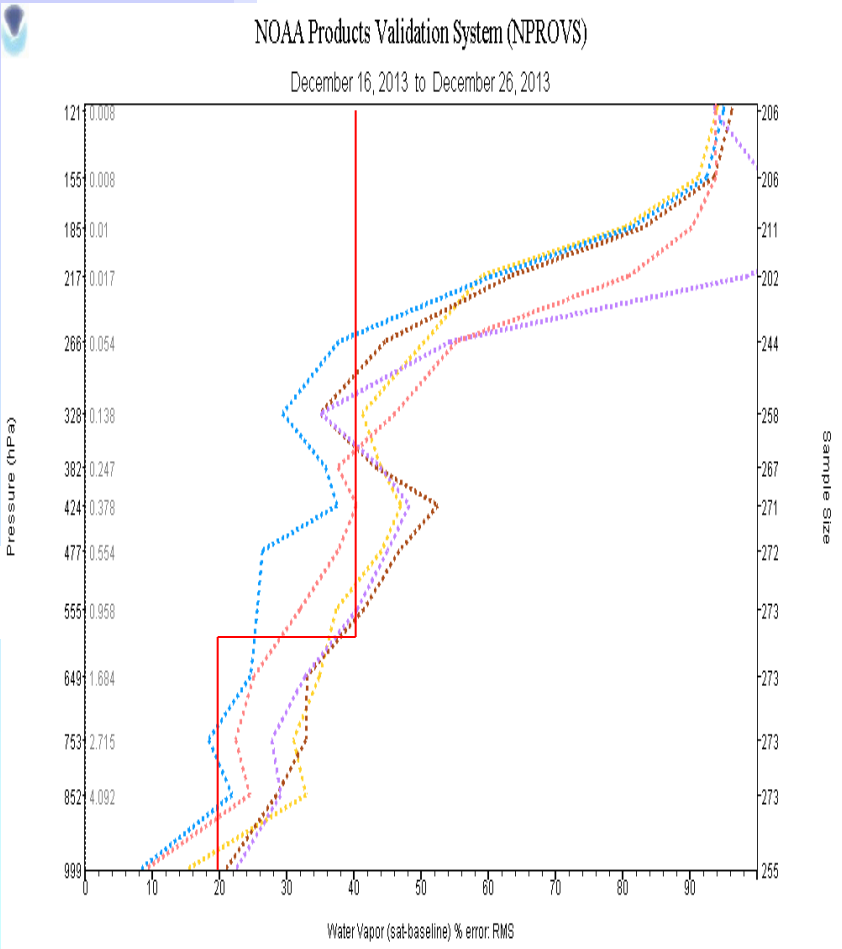


IR + MW pass QC, Maritime, +/- 3hr

NPROVS

SAT-minus-RAOB Vertical Statistic

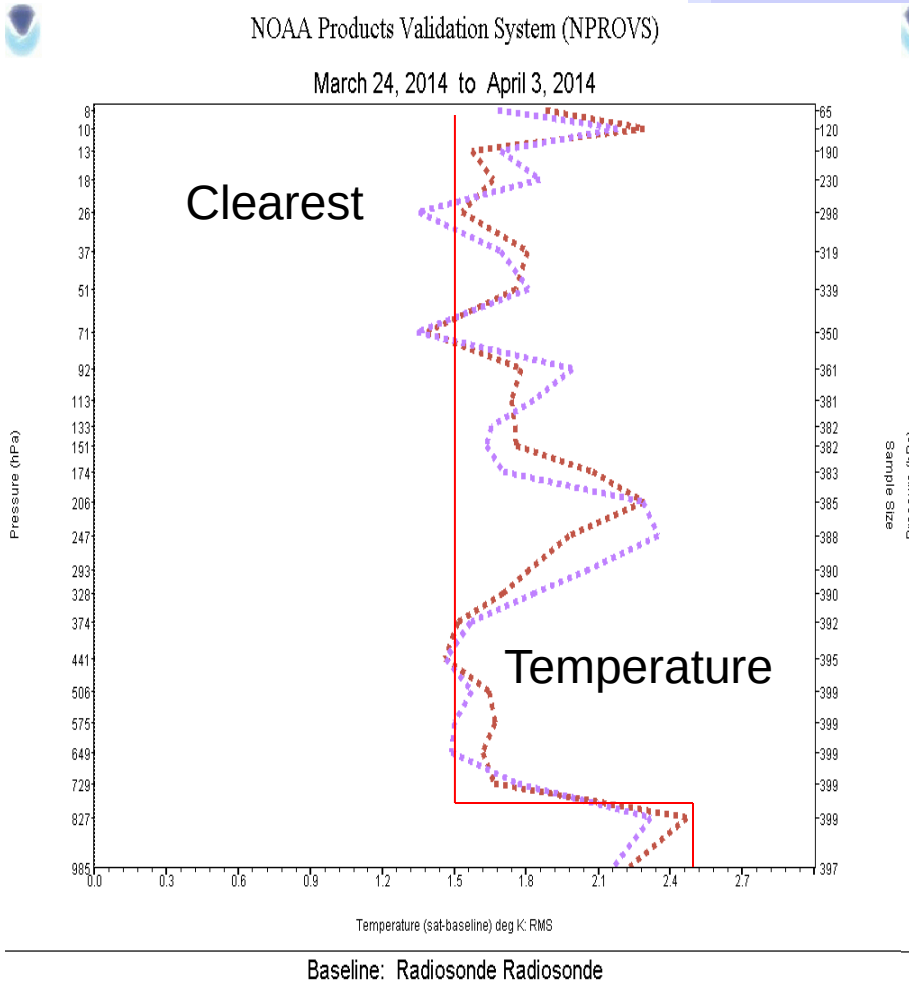


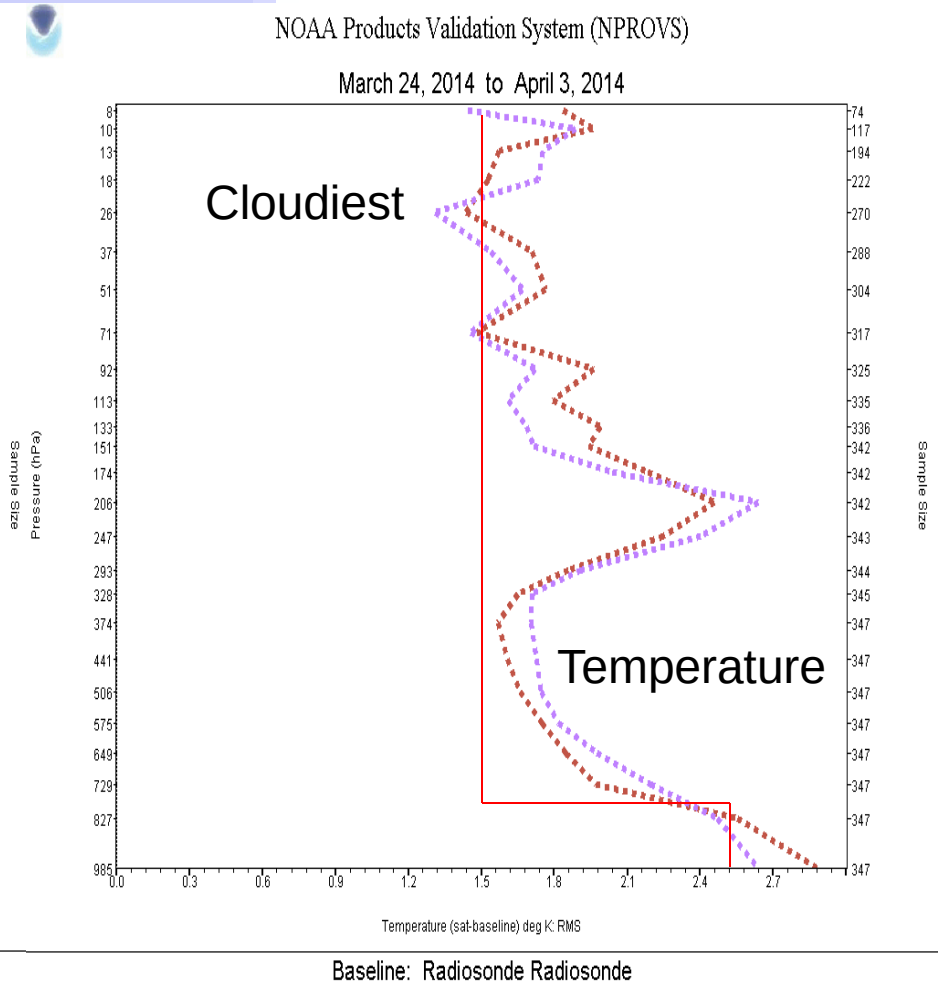


MW-only pass QC, Maritime (+/- 3hr)

NPROVS

SAT-minus-RAOB Vertical Statistic

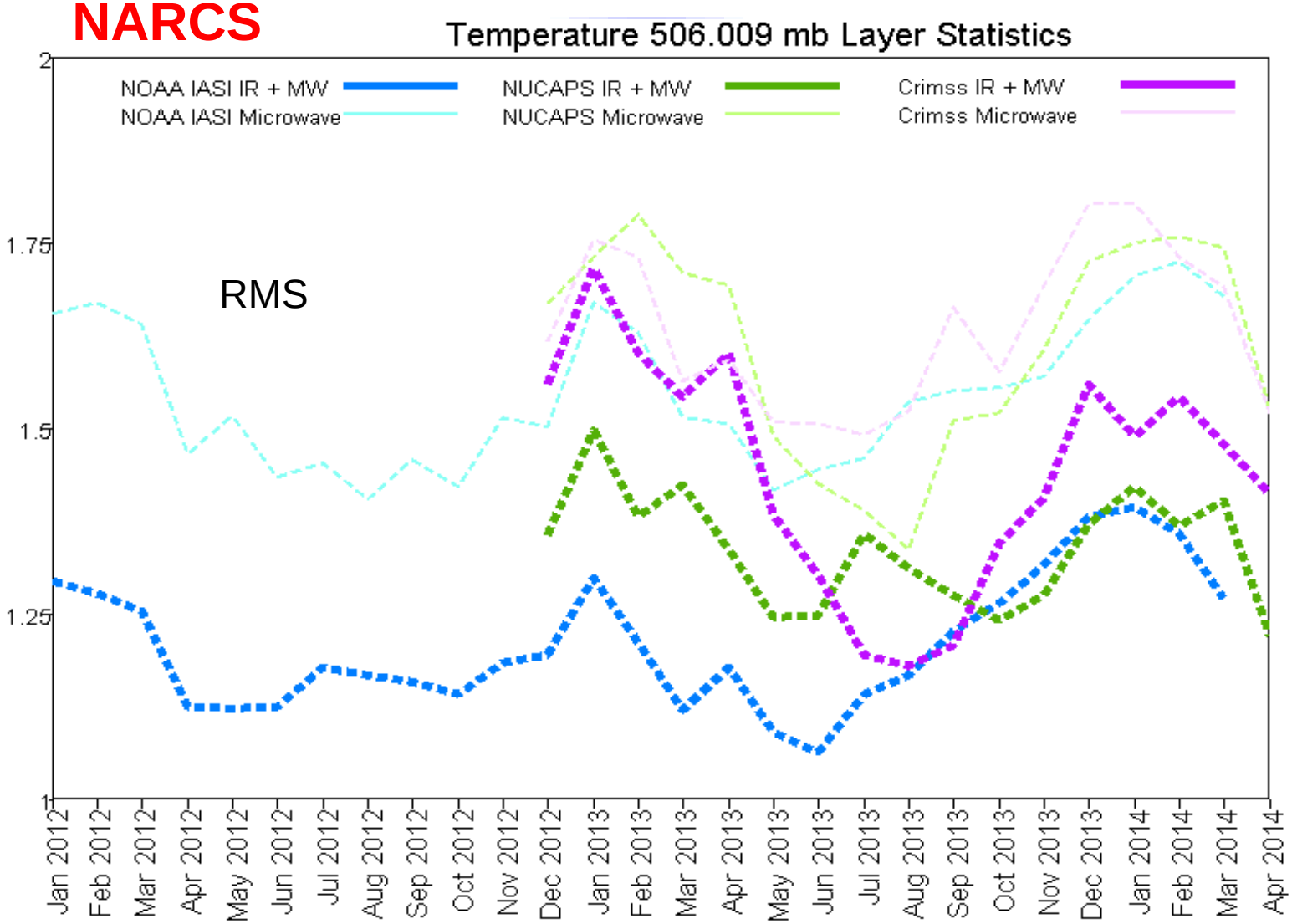




MW-only pass QC, Maritime (Sea-only retrieval)

NPROVS

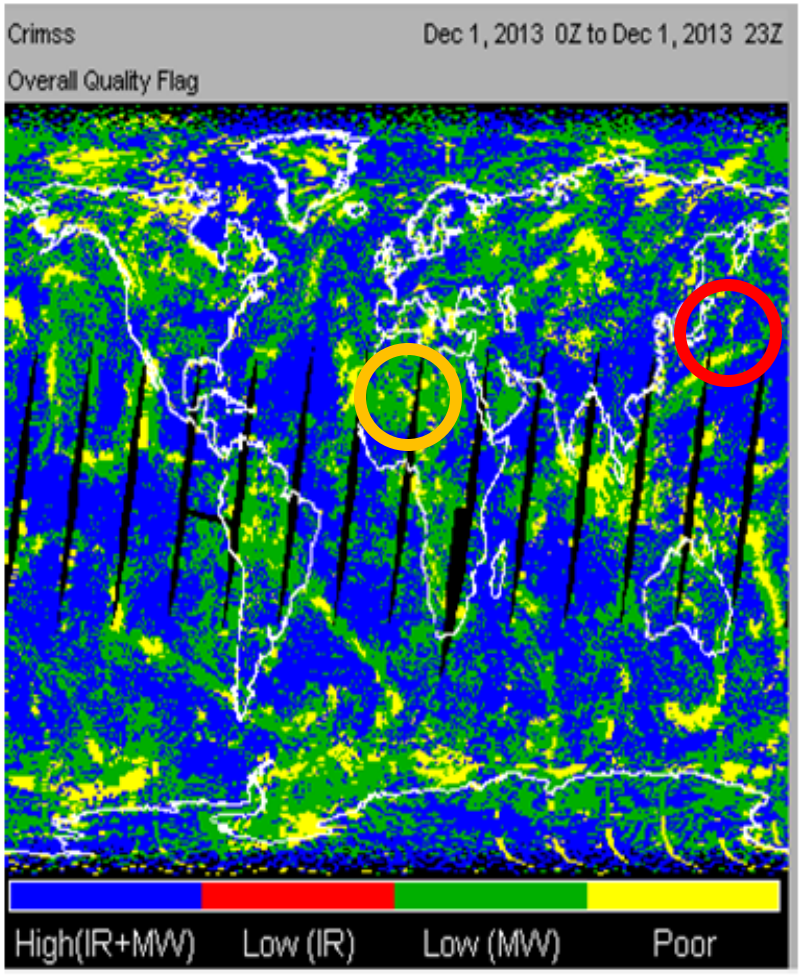
NARCS

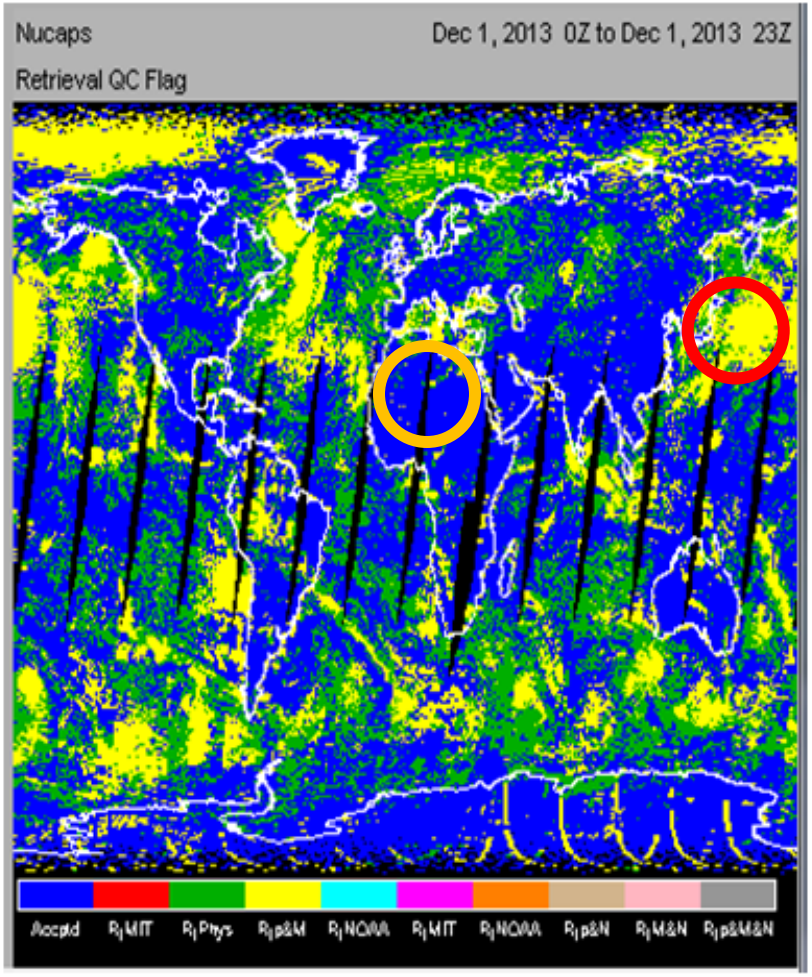


Global MARITIME: NPROVS

IDPS vs NUCAPS QC flag Analysis

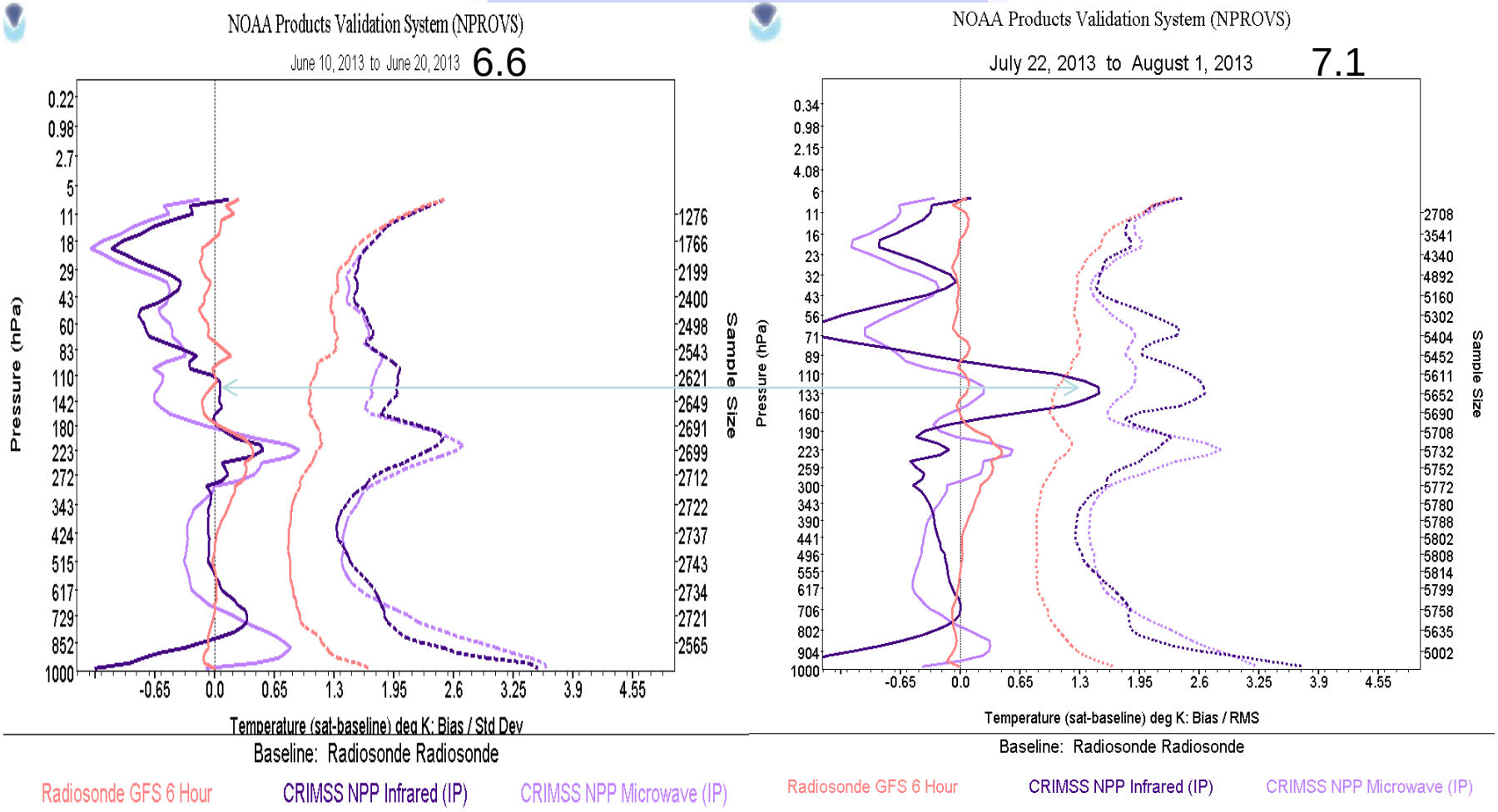
ODS





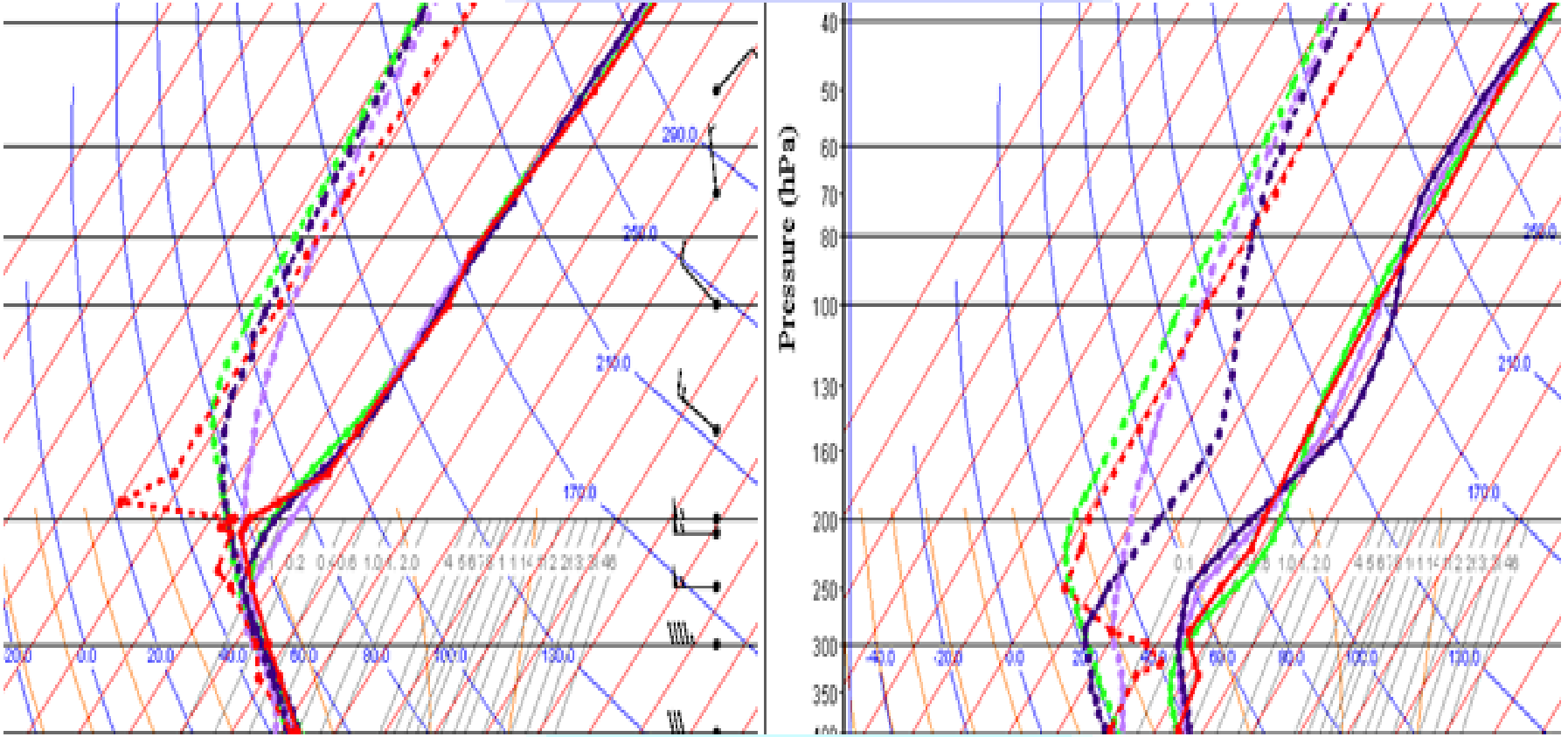
Blue: IR+MW pass **Green: MW-only pass** **Yellow: Both fail**

CrIMSS IDPS v7.1 IR+MW polar stratosphere problem



IR + MW pass, global, NPROVS

CrIMSS IDPS v7.1 IR+MW polar stratosphere problem



NUCAPS (IR+MW) IDPS (IR + MW) IDPS (MW)

GRUAN Reference Measurement Principles

Given RAOB uncertainty (u_2) and product uncertainty (u_1)

Given the variability (σ) of a variables (m) in time and space from measurement (RAOB) or model (Retrl),then

Two observations on different platforms are **consistent** if:

$$|m_1 - m_2| < k\sqrt{\sigma^2 + u_1^2 + u_2^2}$$

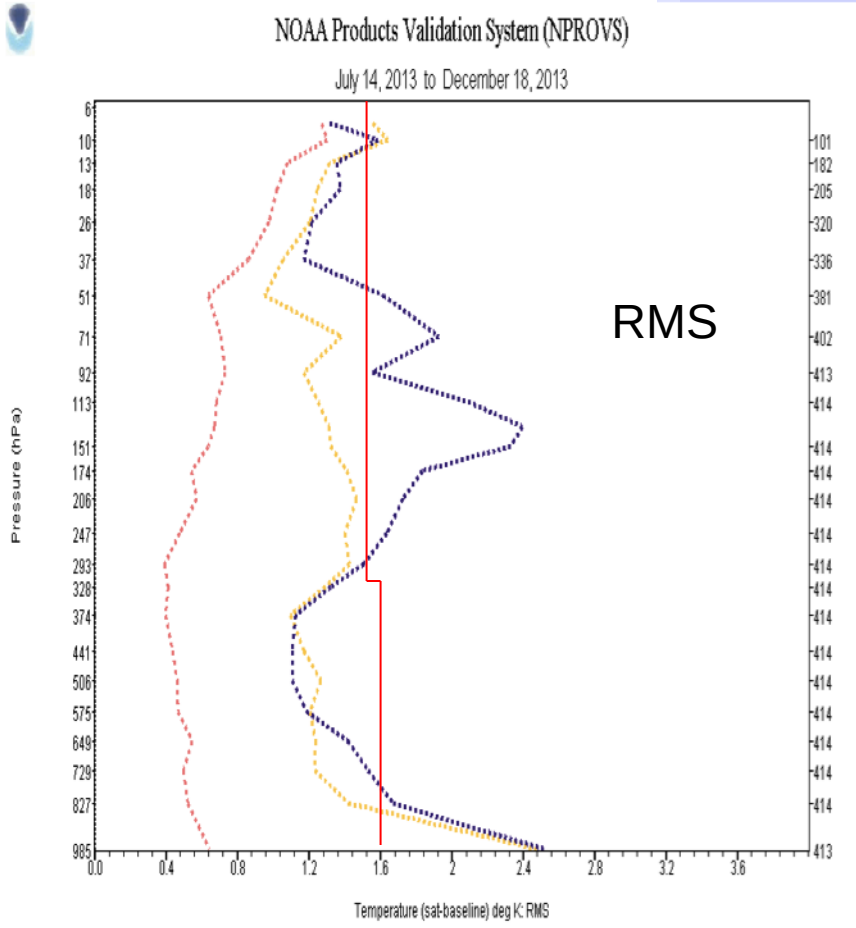
… at this preliminary stage:

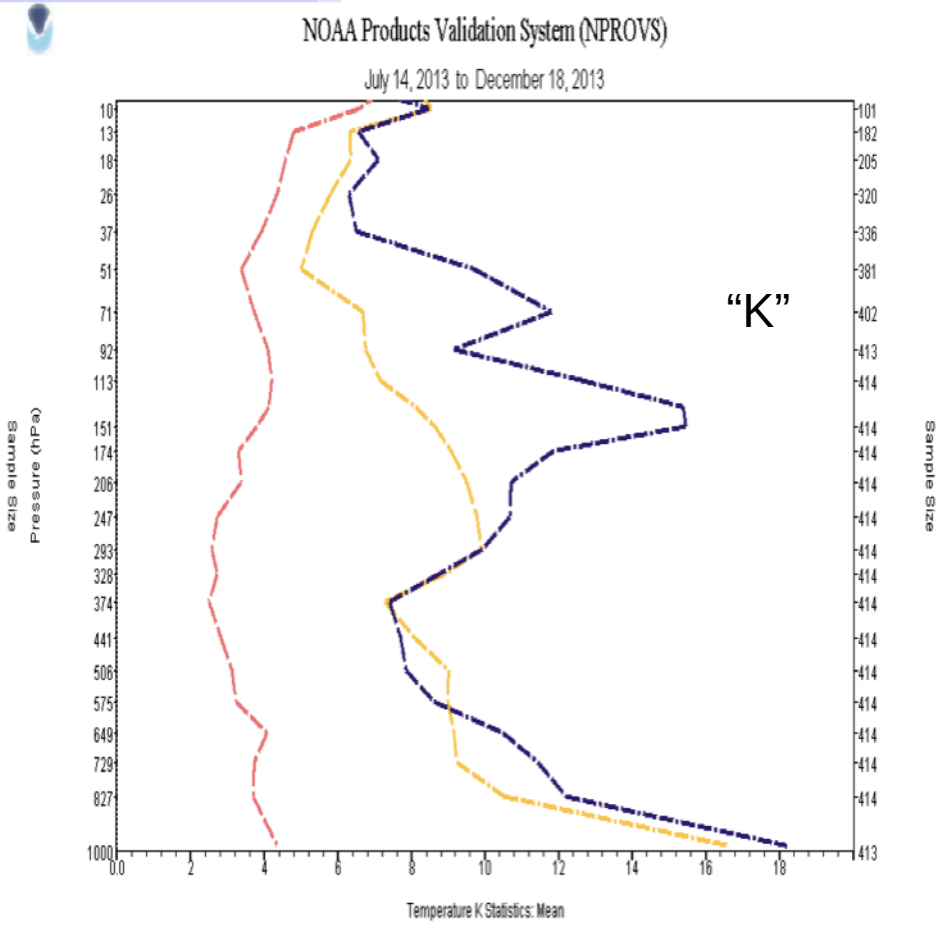
K = ABS(X – GRUAN) / u2

where “X” either SAT or NWP

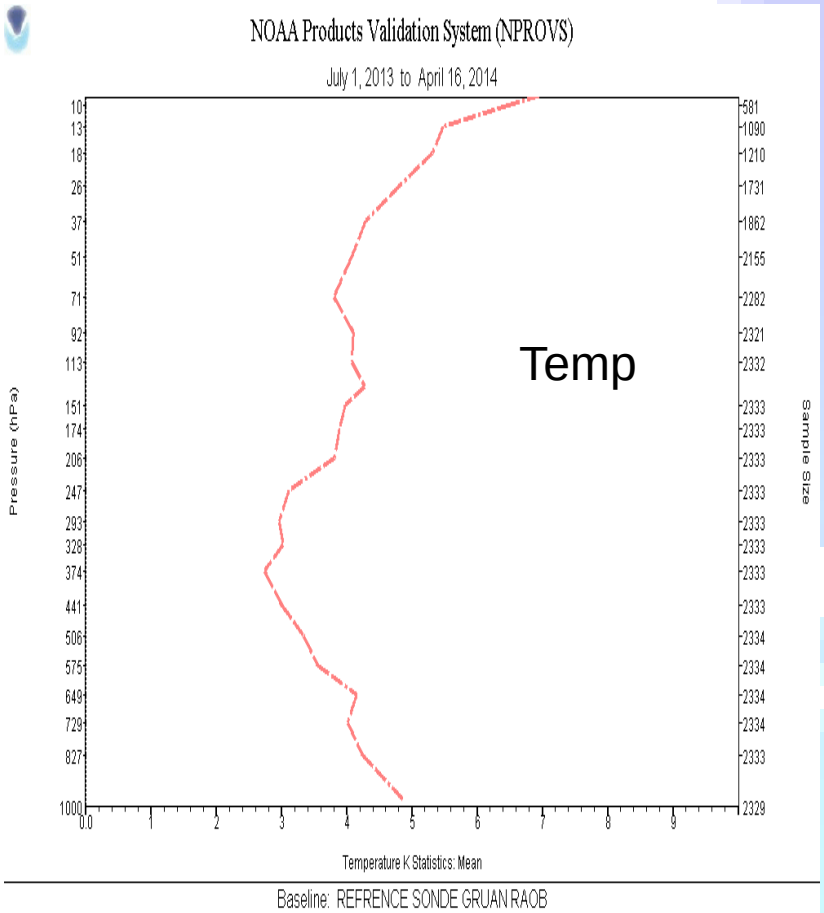
“need uncertainty estimates for EDR” !!

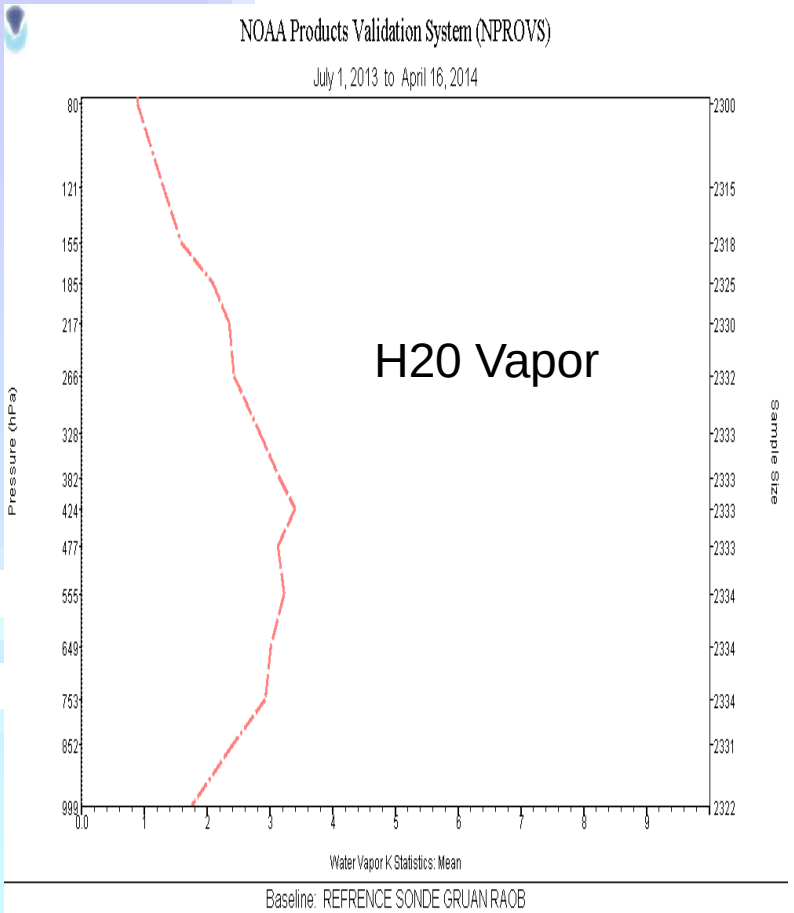
PDISP – NPROVS+





GRUAN only … Include Uncertainty Estimates … *"K" Profiles*

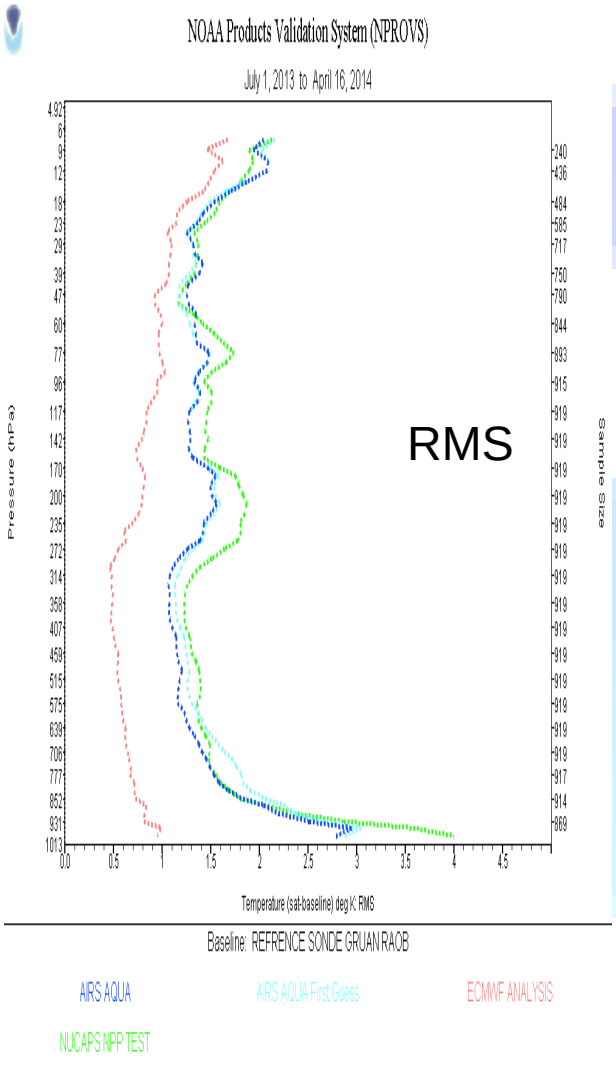


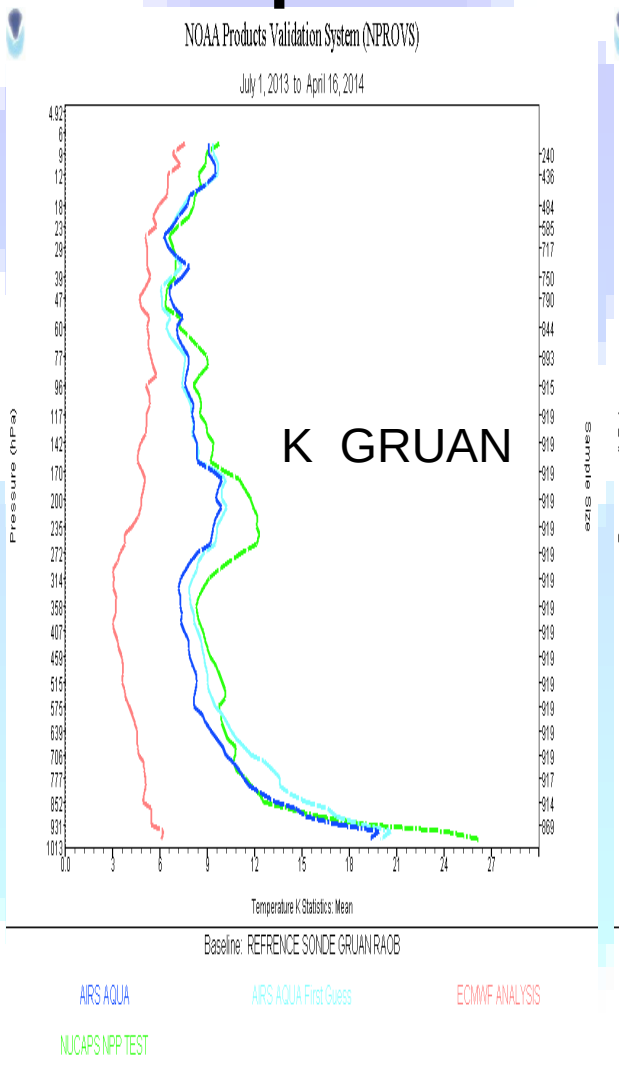


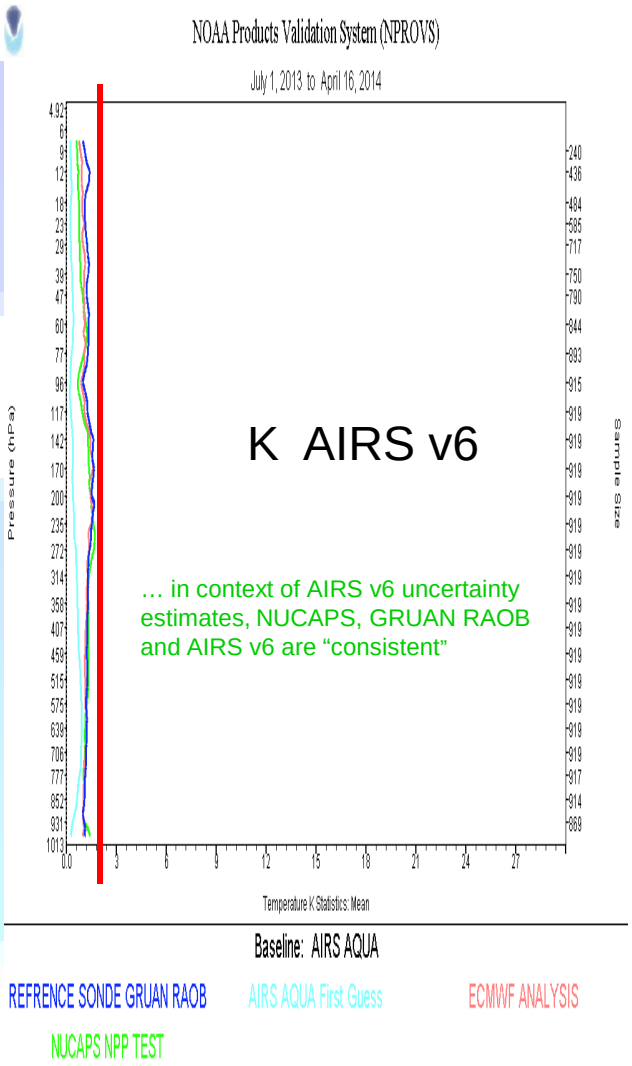
K analysis

Raobs better at measuring Temp than Moisture

Temperature

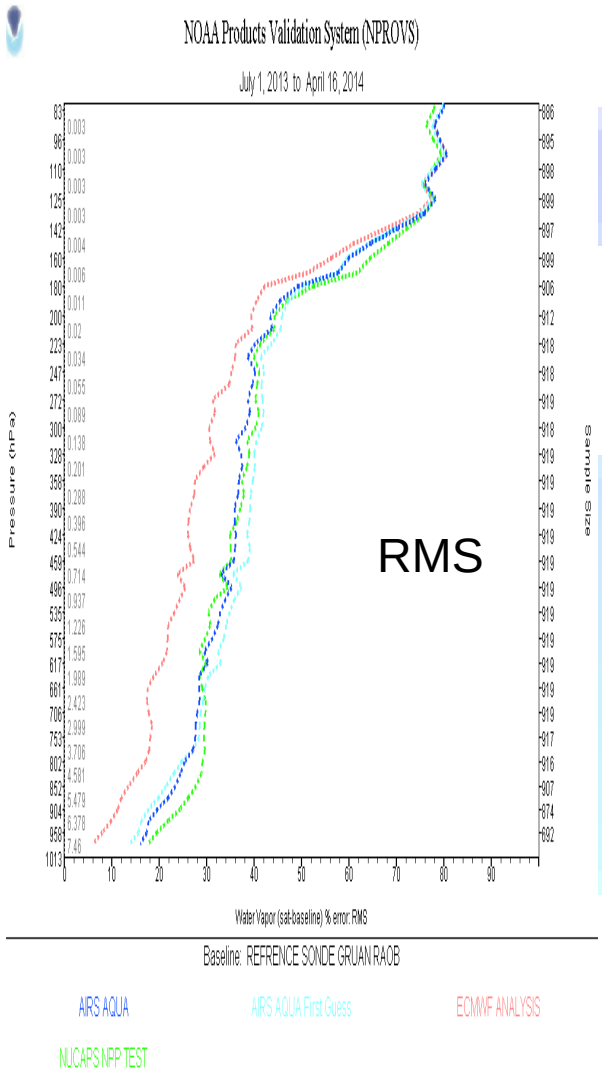




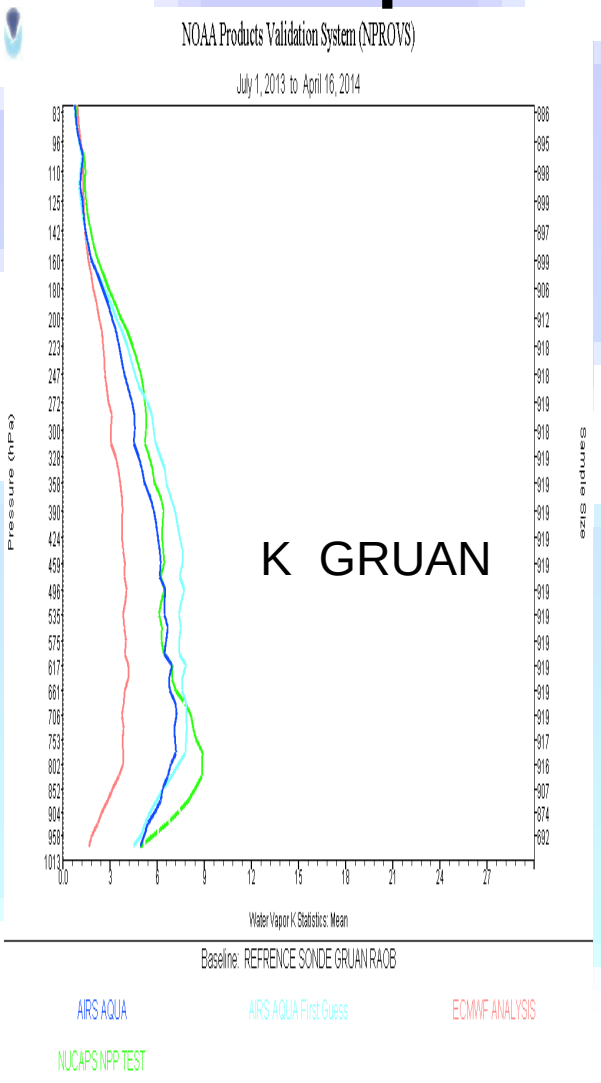


AIRS AIRS FG NUCAPS ECMWF (GRUAN RAOB)

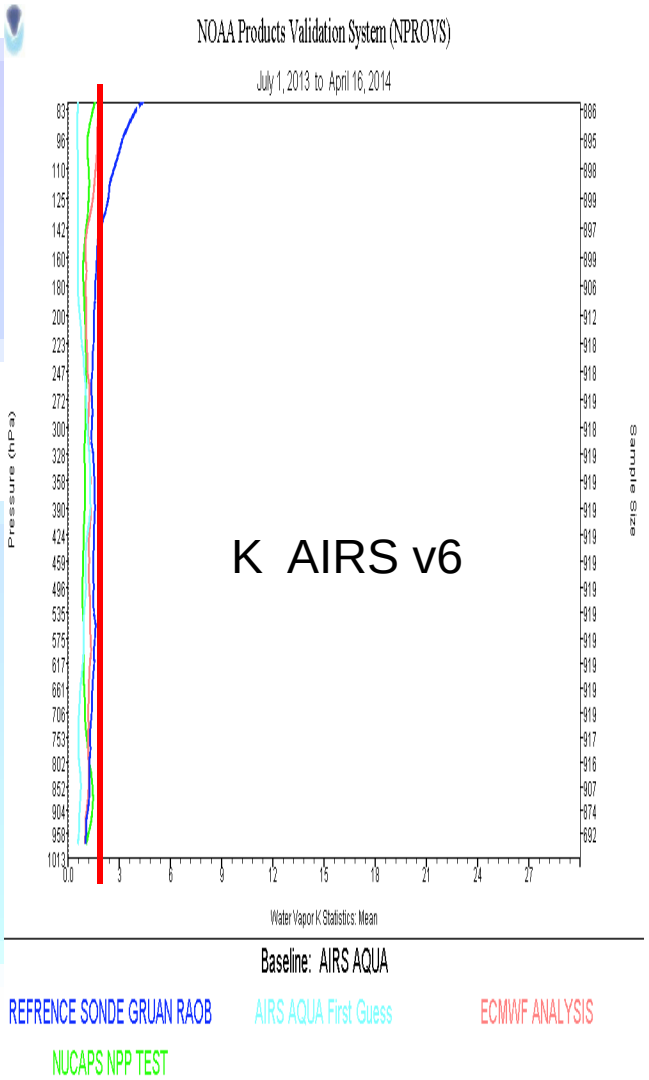
H20 Vapor



RMS



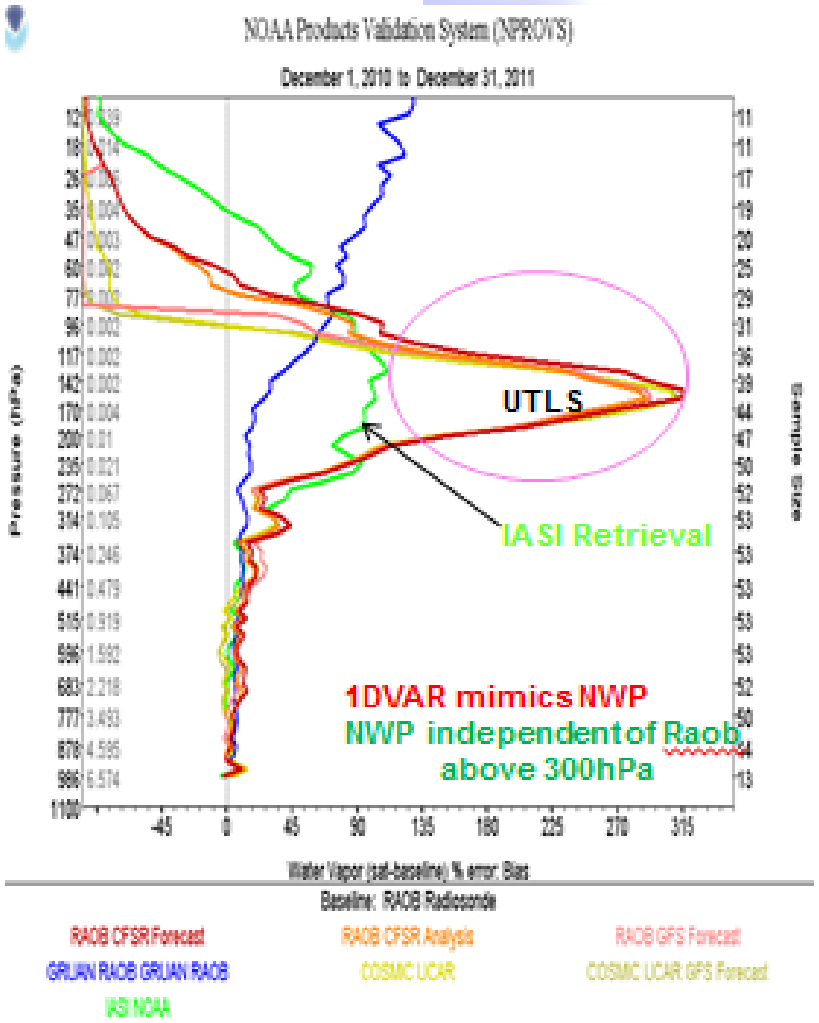
K GRUAN



K AIRS v6

AIRS AIRS FG NUCAPS ECMWF (GRUAN RAOB)

Mainly Vicinity of Lindenberg, Germany



GRUAN Sonde, NWP and COSMIC, respectively, -minus-GTS Sonde

NPROVS+

COSMIC / GRAS
(Stratosphere Reference Temp from Space …)

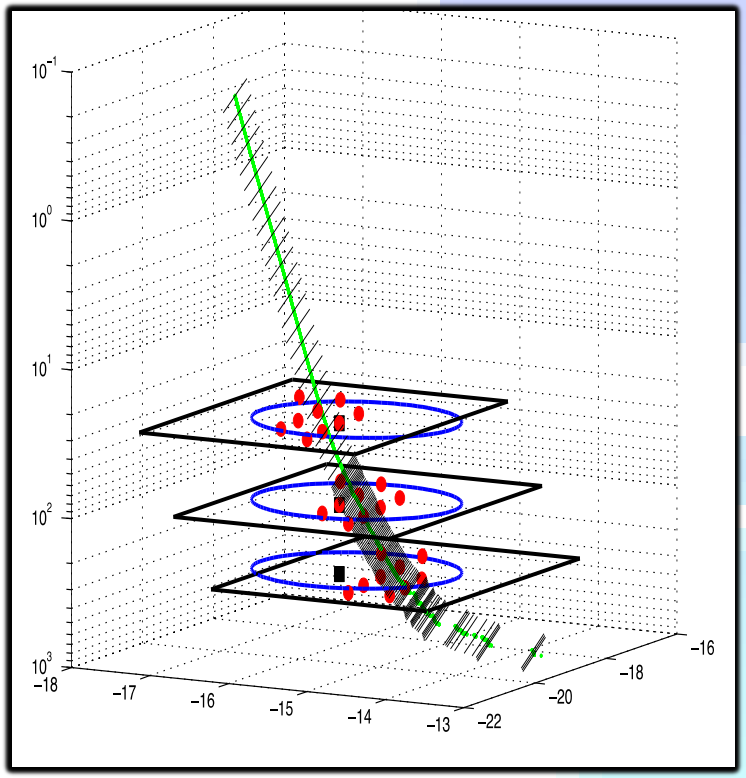
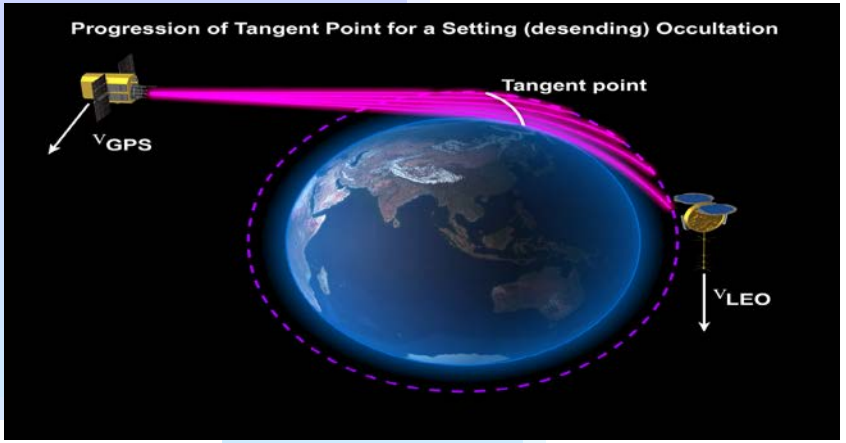
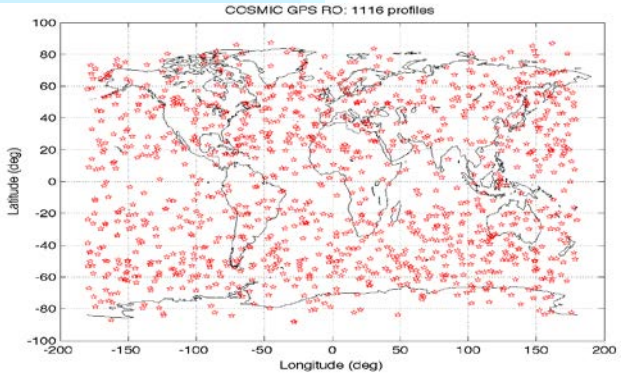


Illustration of the closest (black square), circular (blue circle), and ray path (red dots) methods for a single GPS profile (green) for the circle centered at the GPS RO level of 100 hPa

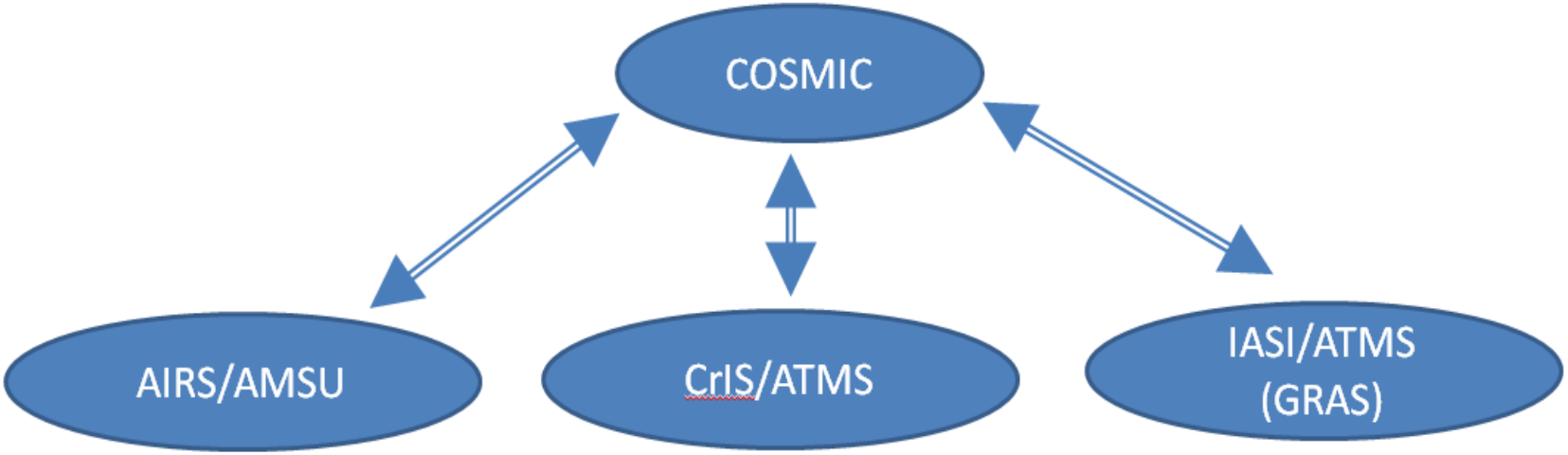


http://www.cosmic.ucar.edu/launch/GPS_RO_cartoon.jpg



One Day of COSMIC Profiles

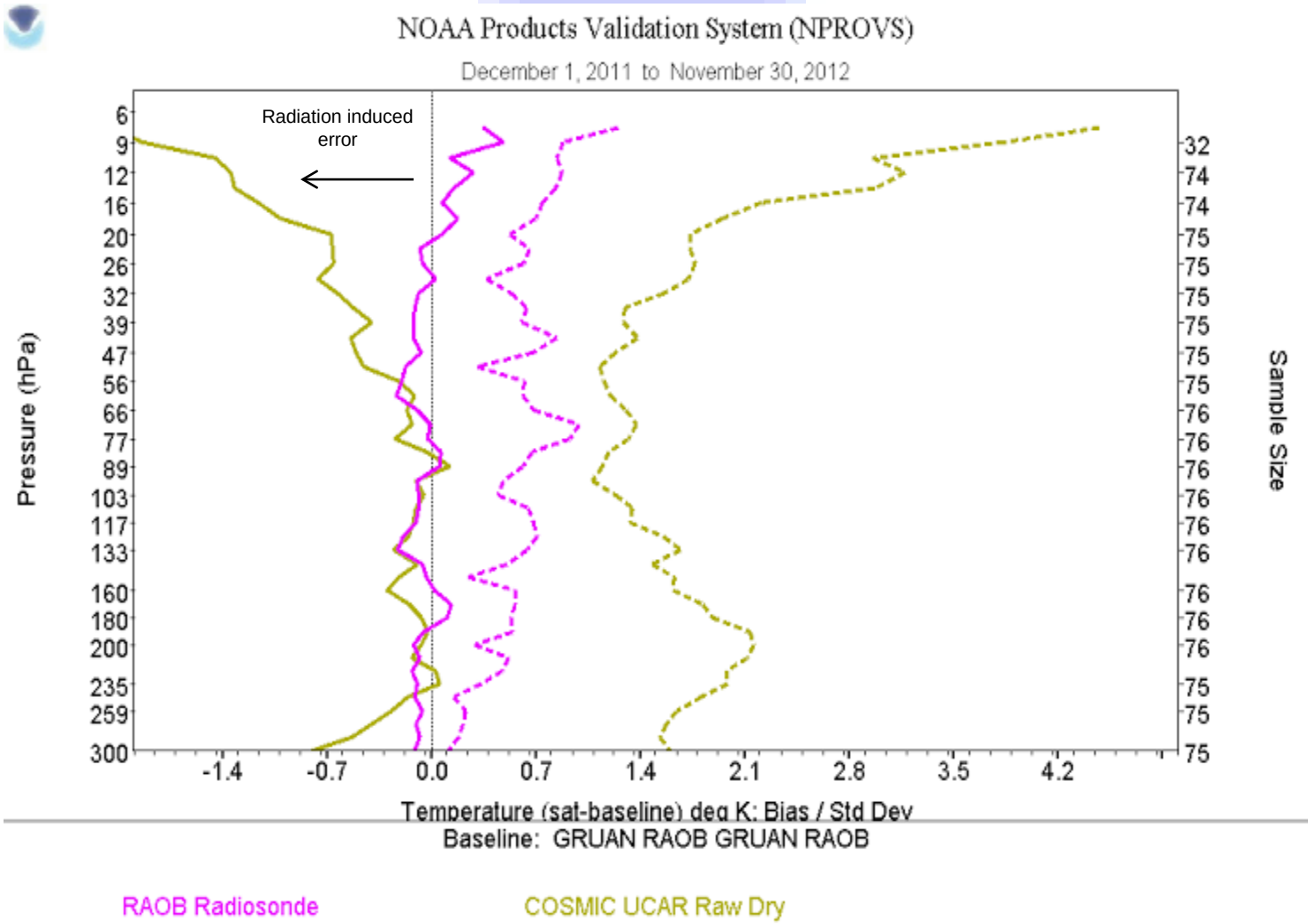
courtesy Knuteson / Feltz CIMSS



GPSRO Anchored Collocation

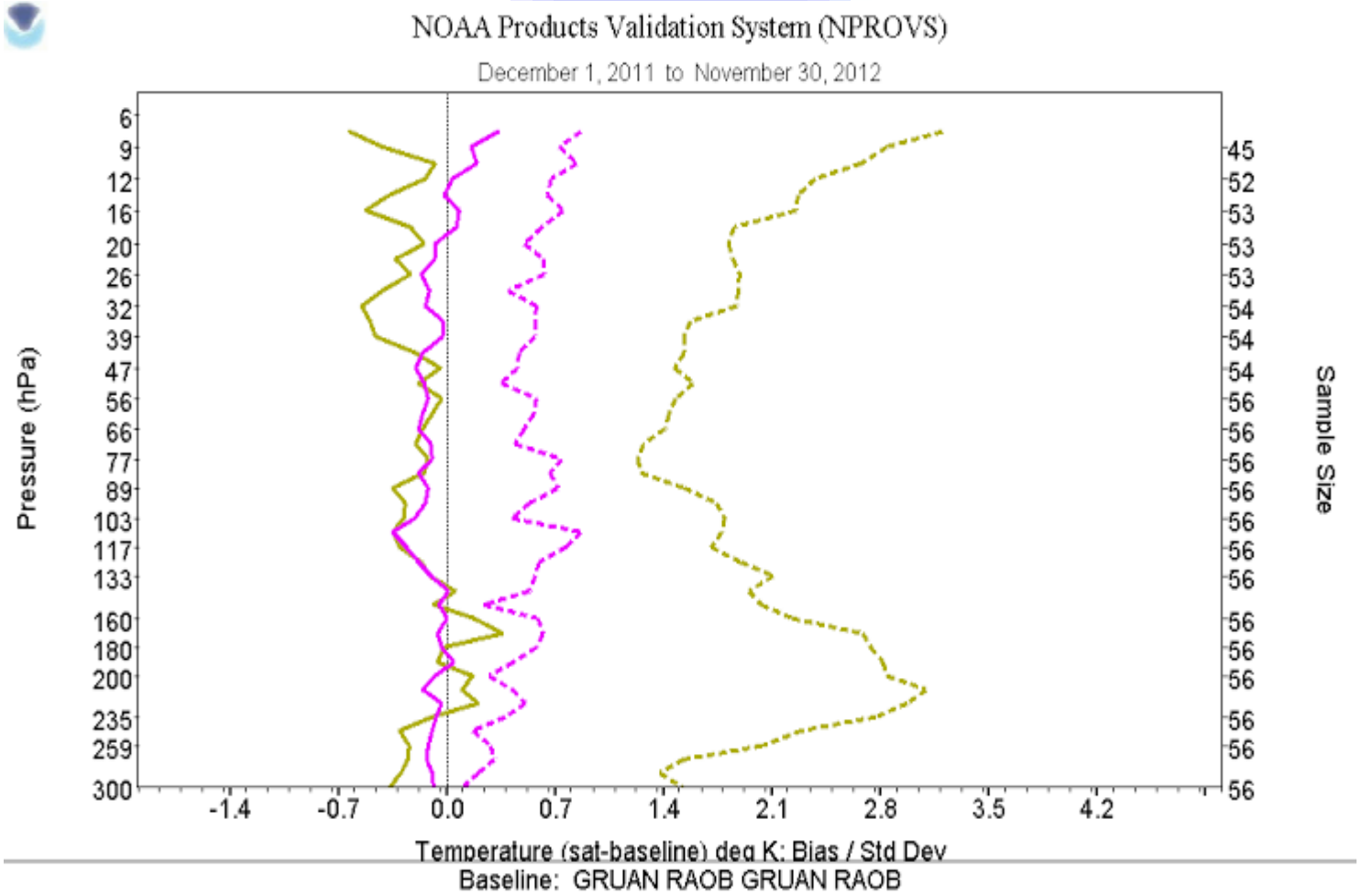
- Integrate STAR (Weng, Reale) and CIMSS (Knuteson / Feltz) approaches
- EDR and SDR
- GPS RO provides Reference for EDR, SDR and RTM

Lindenberg, Germany; 12Z (daytime)



(COSMIC Tdry)-minus-(GRUAN RAOB) … NPROVS+

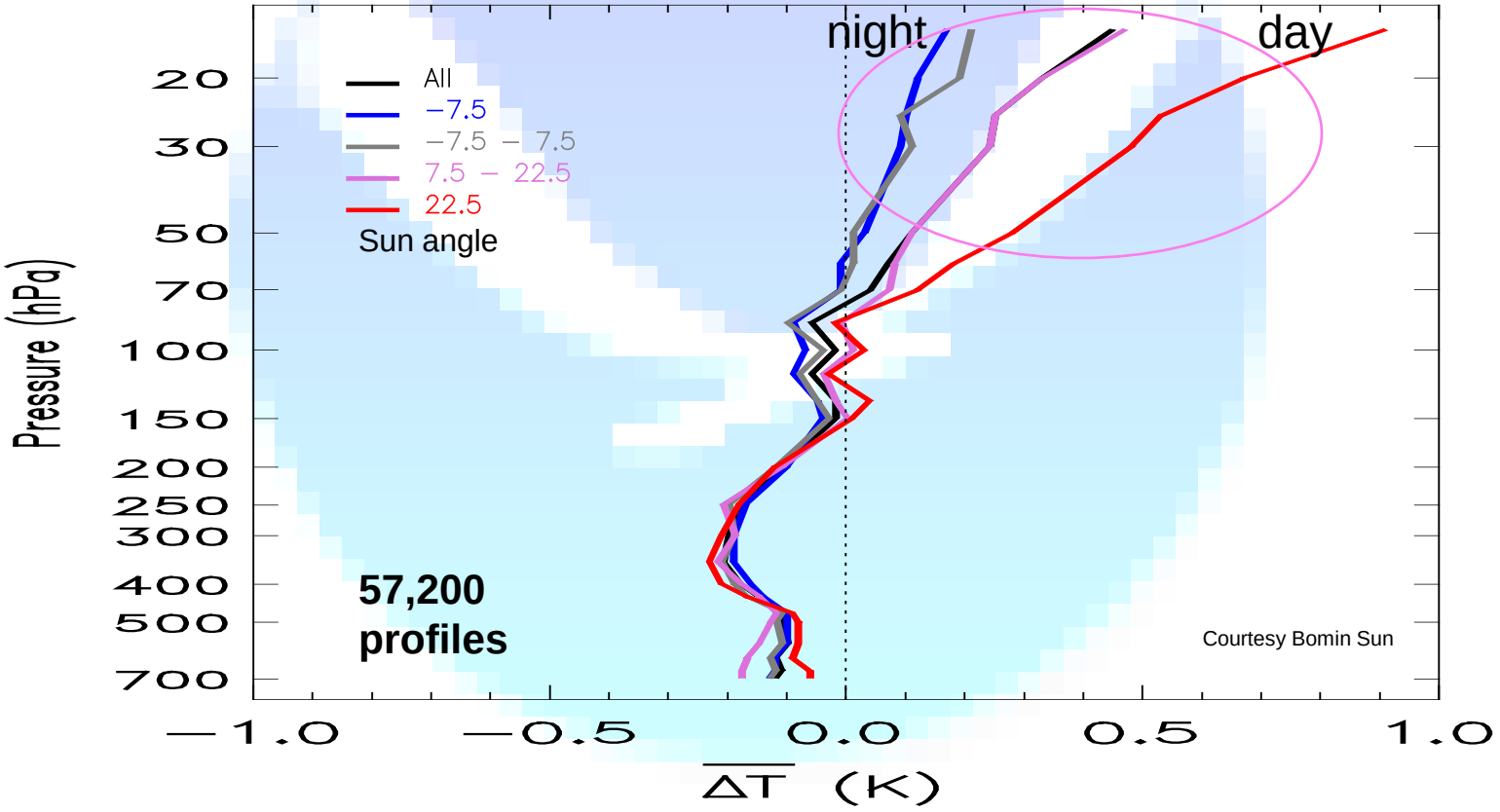
Lindenberg, Germany; 00Z (night)



COSMIC Tdry-minus-GRUAN RAOB … NPROVS+

Vaisala RS92
(radiation induced error)

(Conv Raob)-minus-(COSMIC Tdry) … NPROVS



Sun, B., A. Reale, S. Schroeder, D. Seidel, and B. Ballish, "Toward improved corrections for radiation-induced biases in radiosonde temperature observations". Journal of Geophysical Research, 2013, 118, doi:10.1002/jgrd.50369.

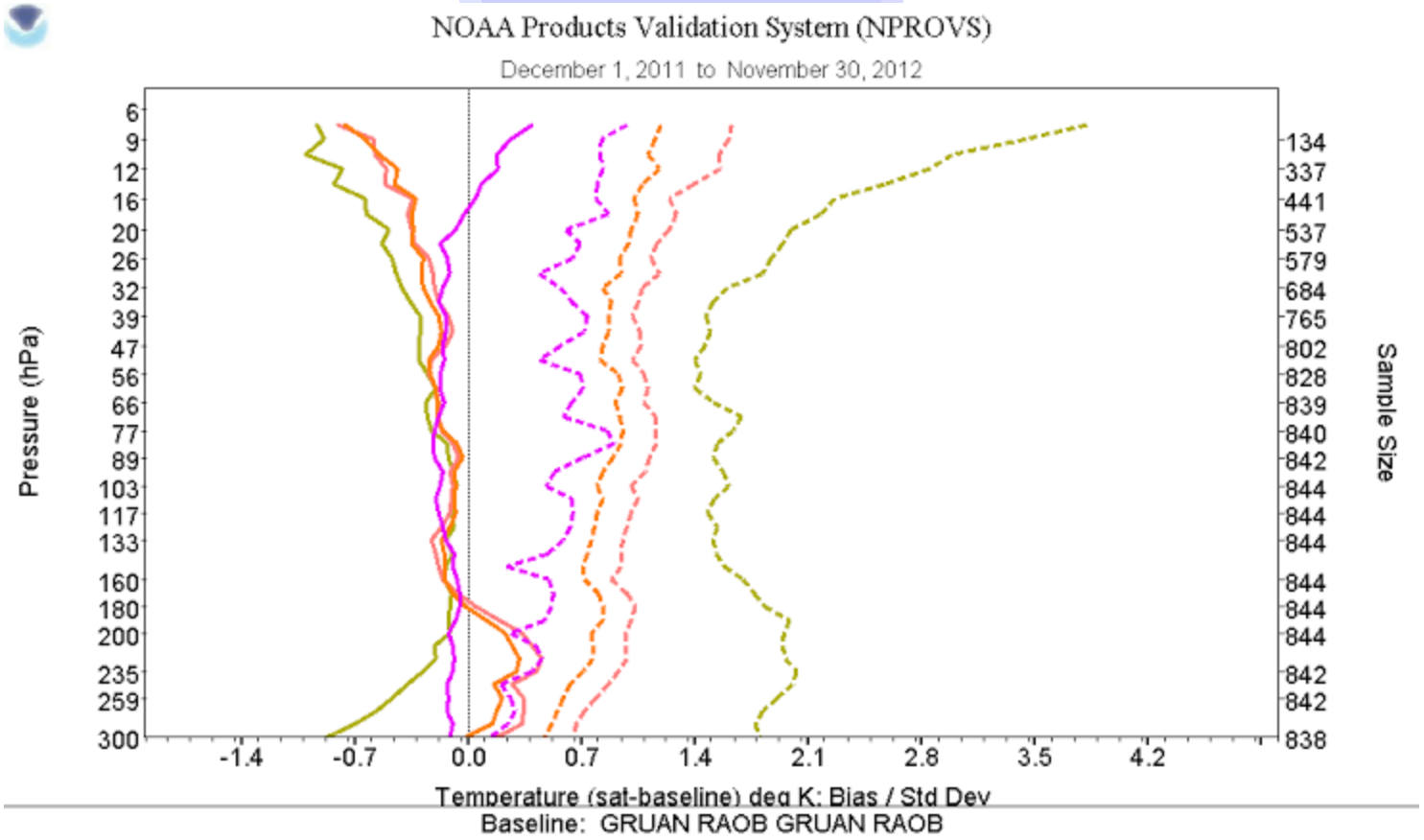
OUTREACH (NPROVS+):

- Copernicus, European Earth Observation Program (3.8 billion, 6 yrs)
- GEWEX Water Vapor Assessment (G-VAP)
- GCOS Reference Upper Air Network (GRUAN)
- GSICS/GRUAN/GNSSRO WIGOS Workshop (May, 2014, Geneva)

Summary

- NPROVS and NPROVS+ (to) provide standardized EDR sounding product validation *and oversight at STAR*
- JPSS funded dedicated RAOB sustained through March 2015 …
- NUCAPS troubleshooting and deployment of NESDIS Unique Retrieval across CrIS, IASI and AIRS (and AMSU/ATMS) main goals
- Integration of GRUAN Uncertainty (K) analysis … *requires sounding EDR uncertainty estimates (recommended for all EDR's)*
- GPSRO as a reference from space
- Validation datasets routinely available and recommended for distribution and use internal, external and international

Extras


NOAA Products Validation System (NPROVS)
December 1, 2011 to November 30, 2012
Pressure (hPa)
6
9
12
16
20
26
32
39
47
56
66
77
89
103
117
133
160
180
200
235
259
300
-1.4
-0.7
0.0
0.7
1.4
2.1
2.8
3.5
4.2
134
337
441
537
579
684
765
802
828
839
840
842
844
844
844
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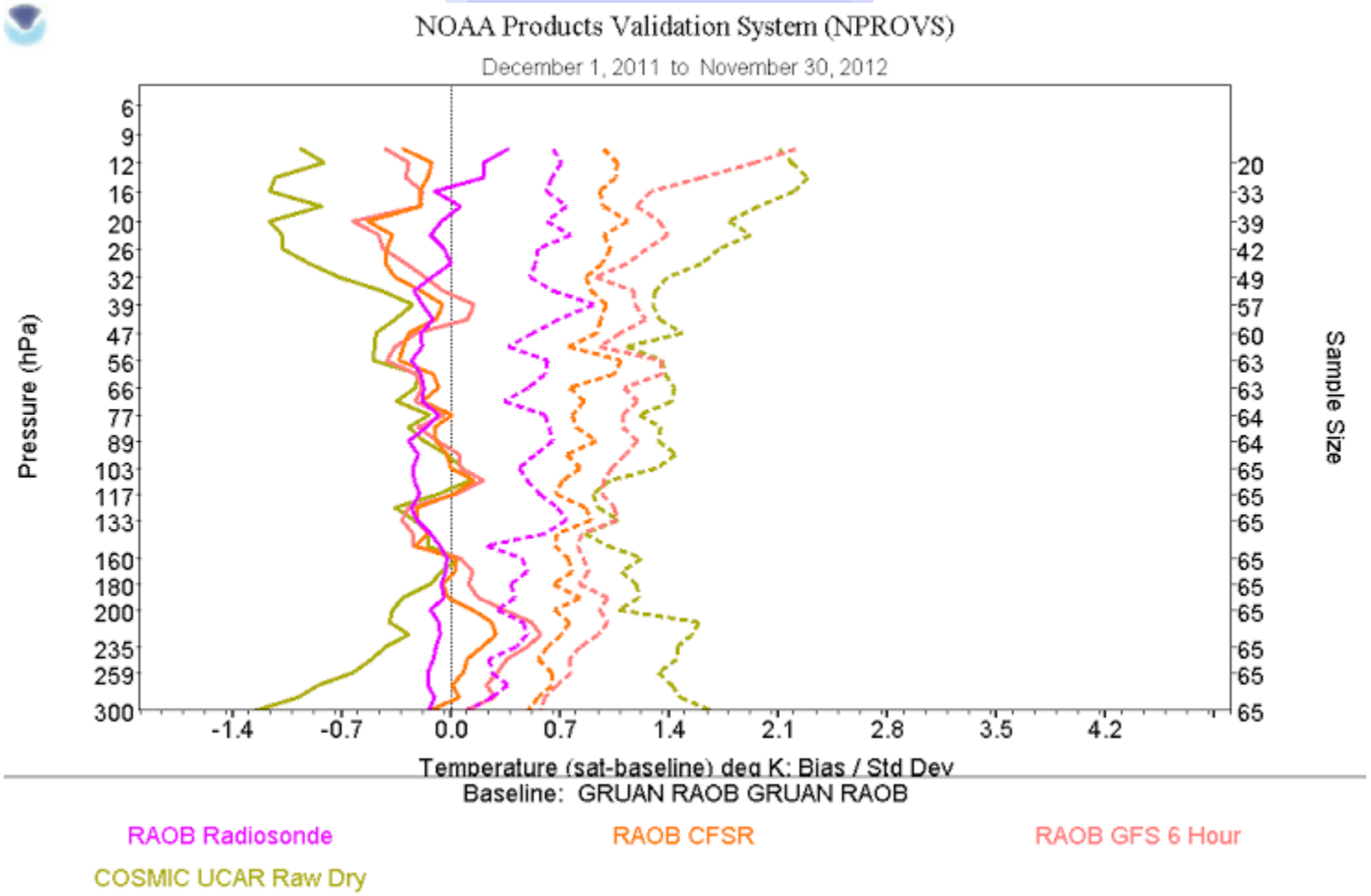
844
842
842
838
Sample Size
Temperature (sat-baseline) deg K: Bias / Std Dev
Baseline: GRUAN RAOB GRUAN RAOB
RAOB Radiosonde
RAOB CFSR
RAOB GFS 6 Hour
COSMIC UCAR Raw Dry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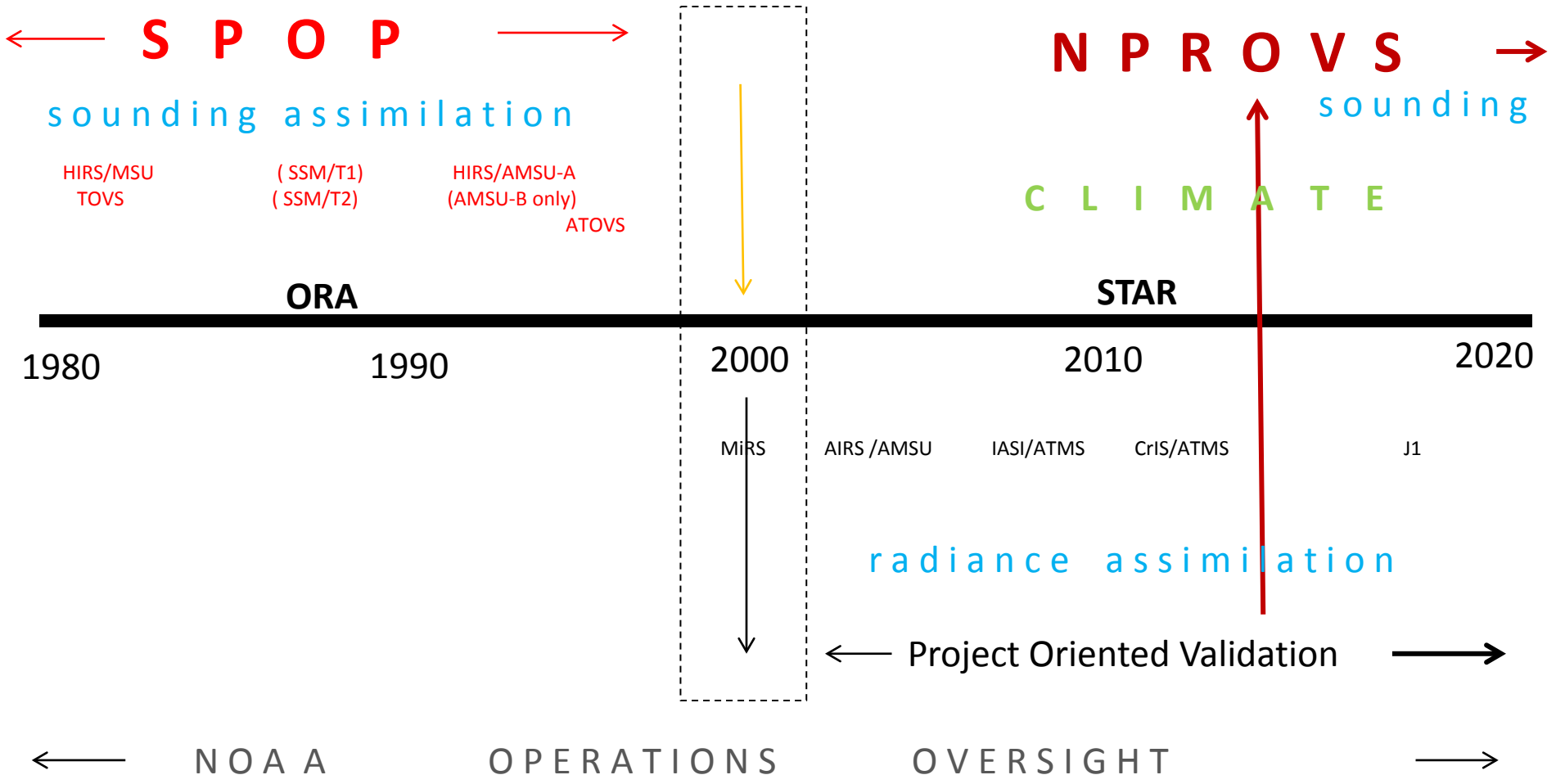
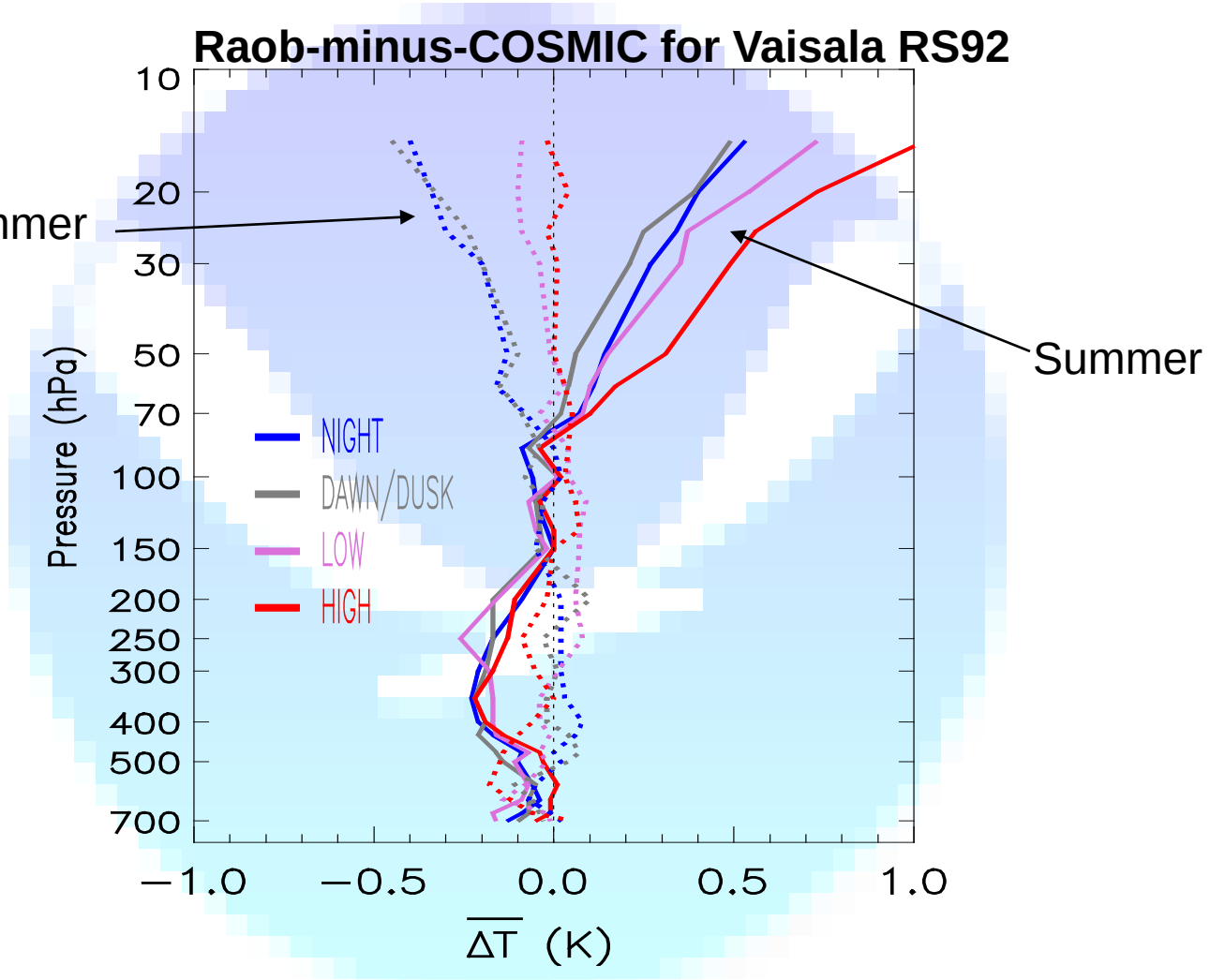
Sample Size
Temperature (sat-baseline) deg K: Bias / Std Dev
Baseline: GRUAN RAOB GRUAN RAOB
RAOB Radiosonde
RAOB CFSR
RAOB GFS 6 Hour
COSMIC UCAR Raw Dry

+/- 3 hr / 150km

Brief History NOAA Program for Soundings



Restore Project Independent **N**OAA **PRO**duct O**V**er**S**ight



Seasonal variation in bias is bigger at nighttime:
Summer relatively warmer than winter at night
(NPROVS)