



Procedures to Characterize Sounding Profiles using Conventional and Reference/Dedicated Observations --- NPROVS & NPROVS+

Tony Reale¹ and Bomin Sun²
... and many others

- 1 STAR/NESDIS/NOAA
- 2 IMSG at STAR/NESDIS/NOAA

**The 19th International TOVS Study
Conference (ITSC-19)
Jeju Island, South Korea
26 March – 1 April 2014**

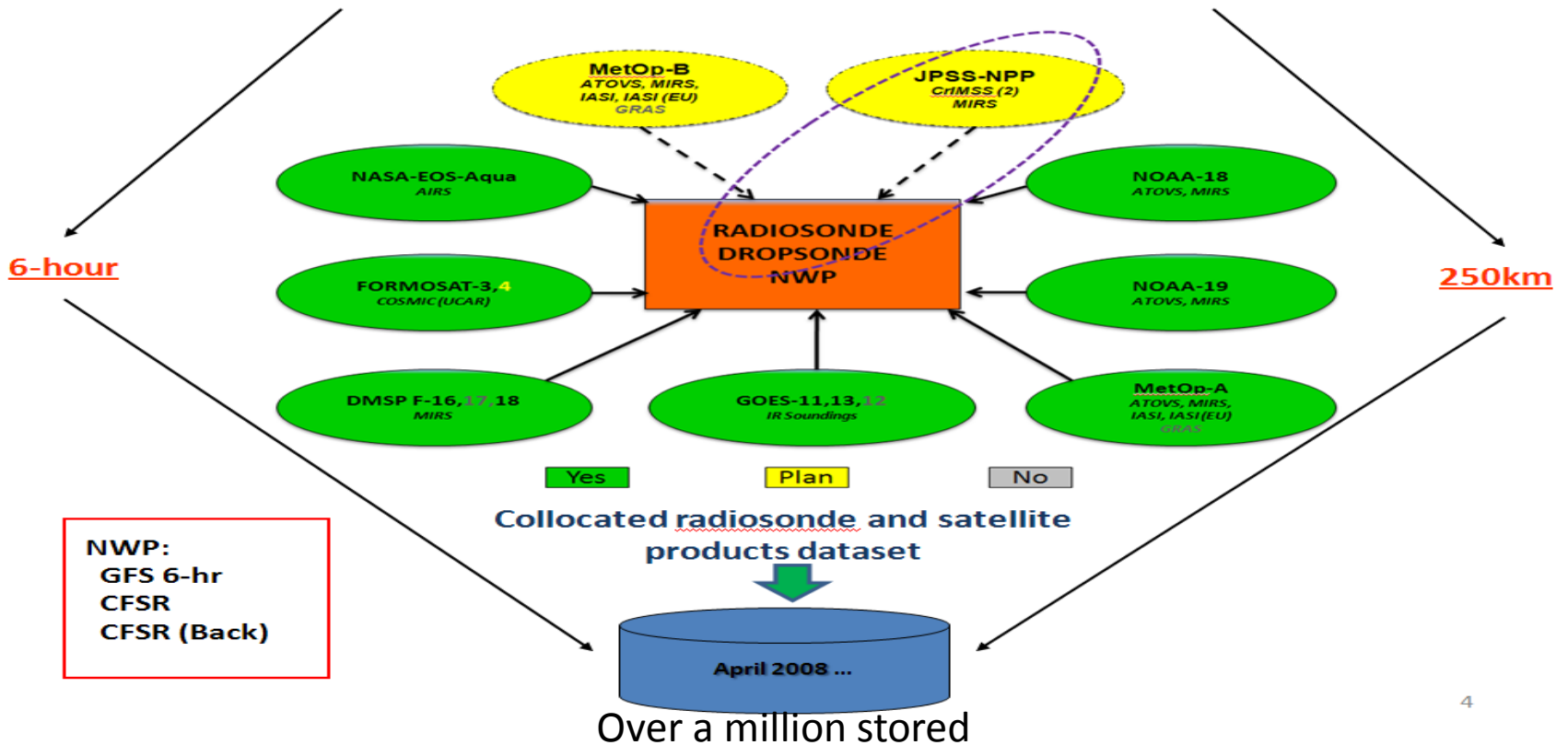




NOAA Products Validation System (NPROVS)



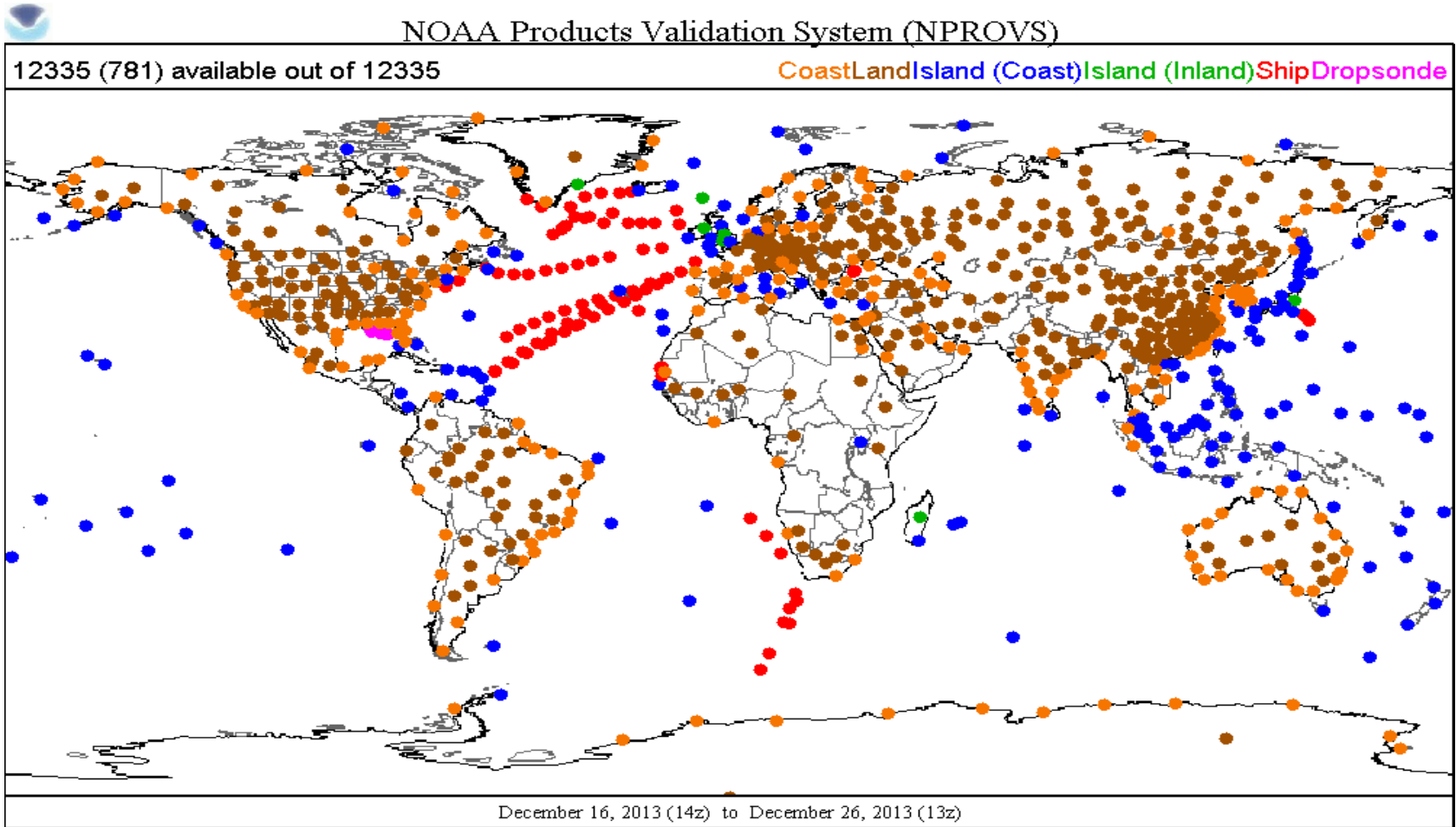
Centralized Radiosonde and Collocation Processing



NPROVS: Product (EDR) validation / monitoring from the ground
 (<http://www.star.nesdis.noaa.gov/smcd/opdb/nprovs/index.php>)



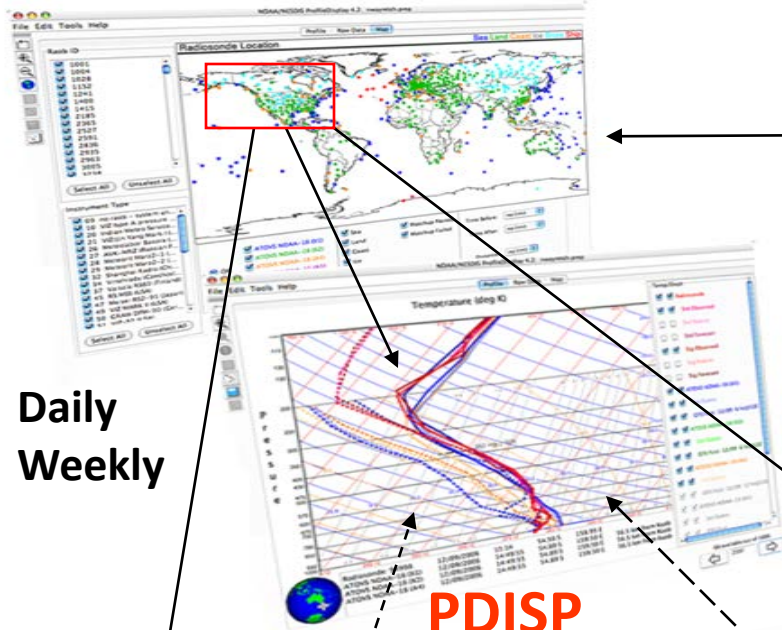
NPROVS



12/16 to 12/26 2013 ... 12,335 Collocations

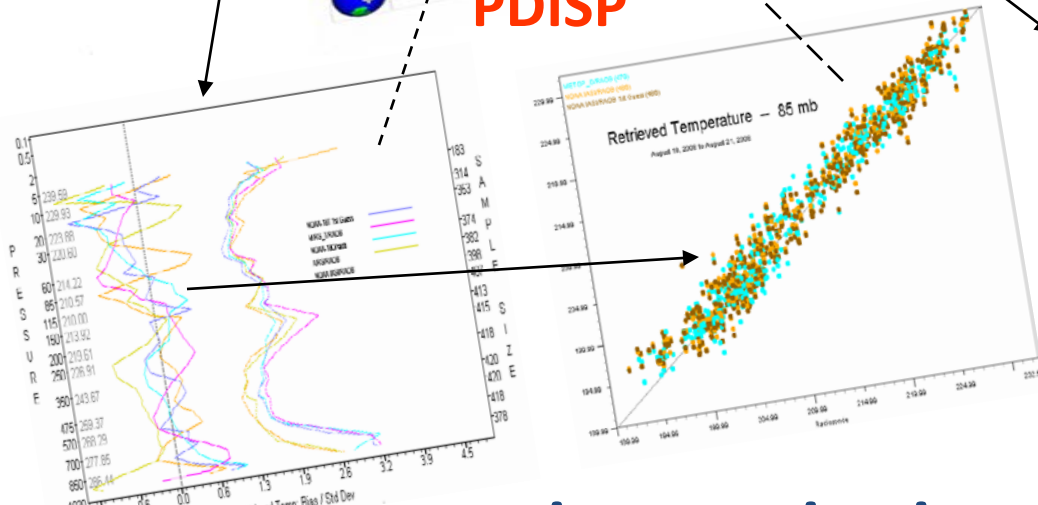
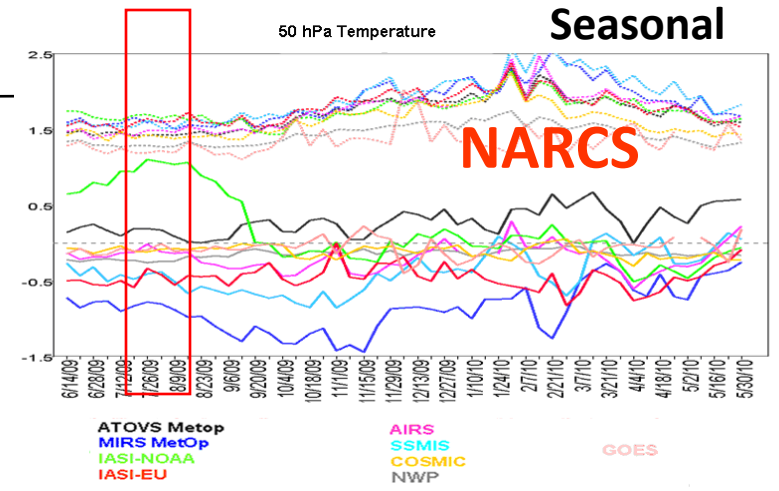


Environmental Data Graphical Evaluation (EDGE) Analytical Interface ...

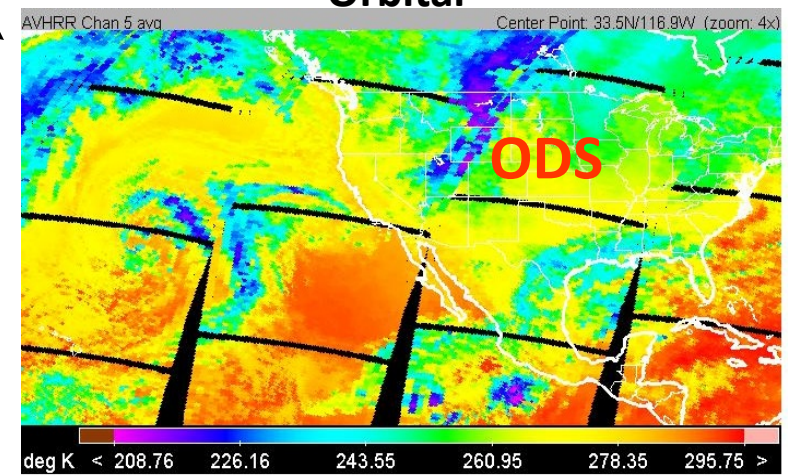


Daily
Weekly

PDISP



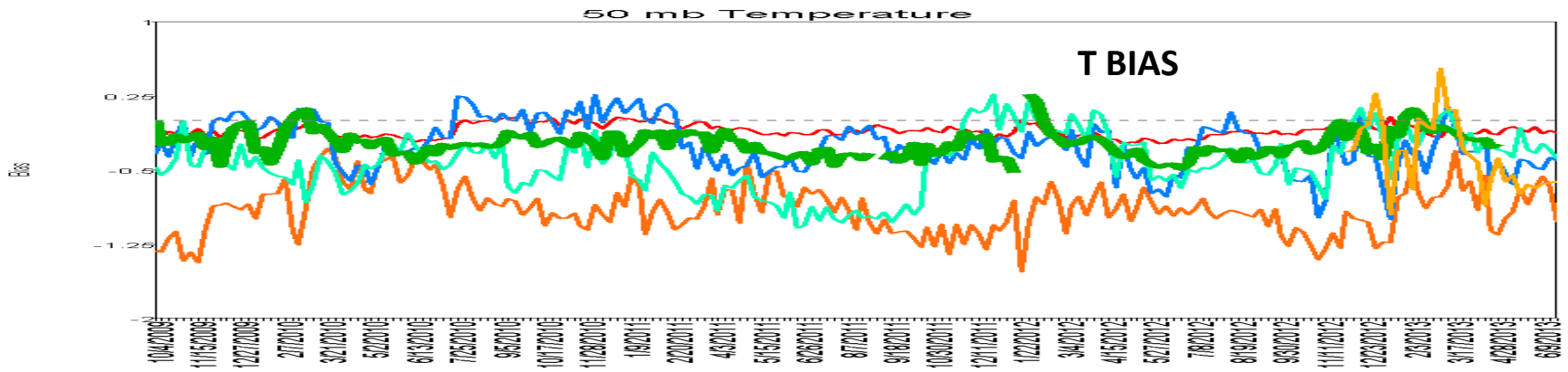
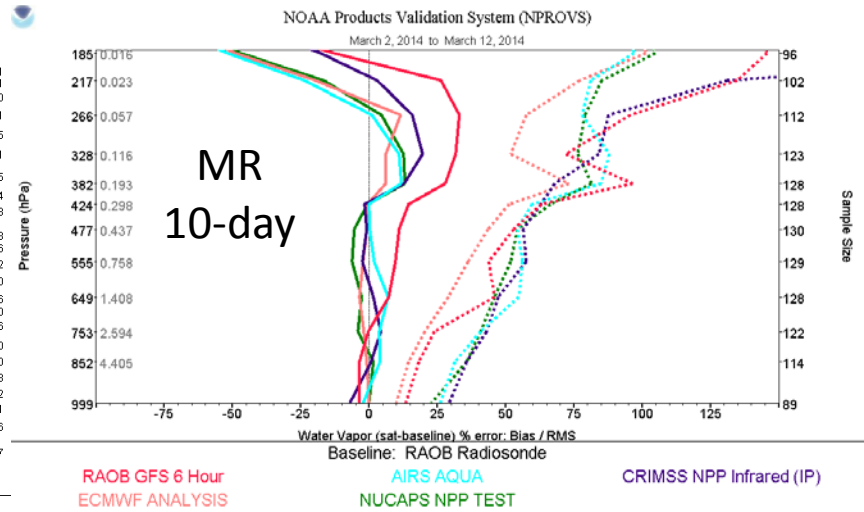
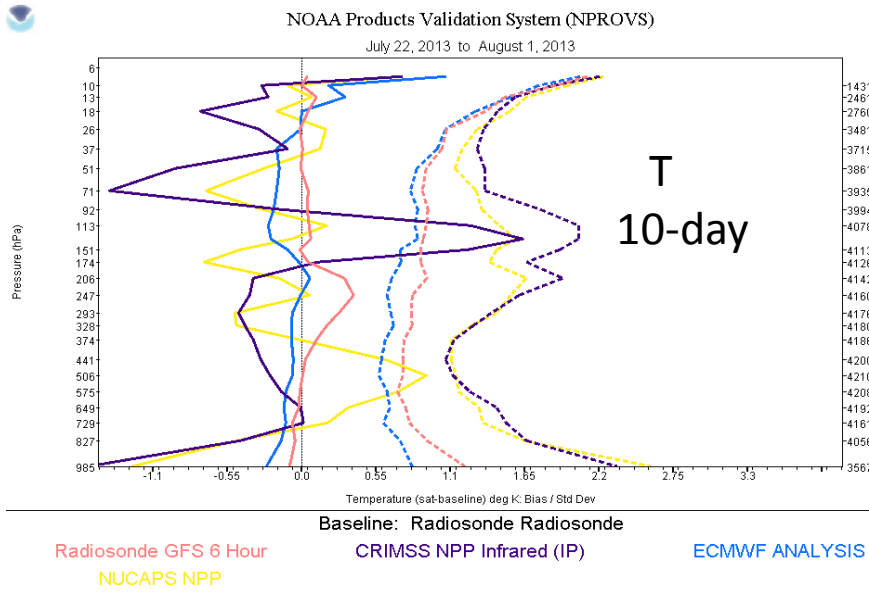
Orbital



... routine monitoring to deep dive



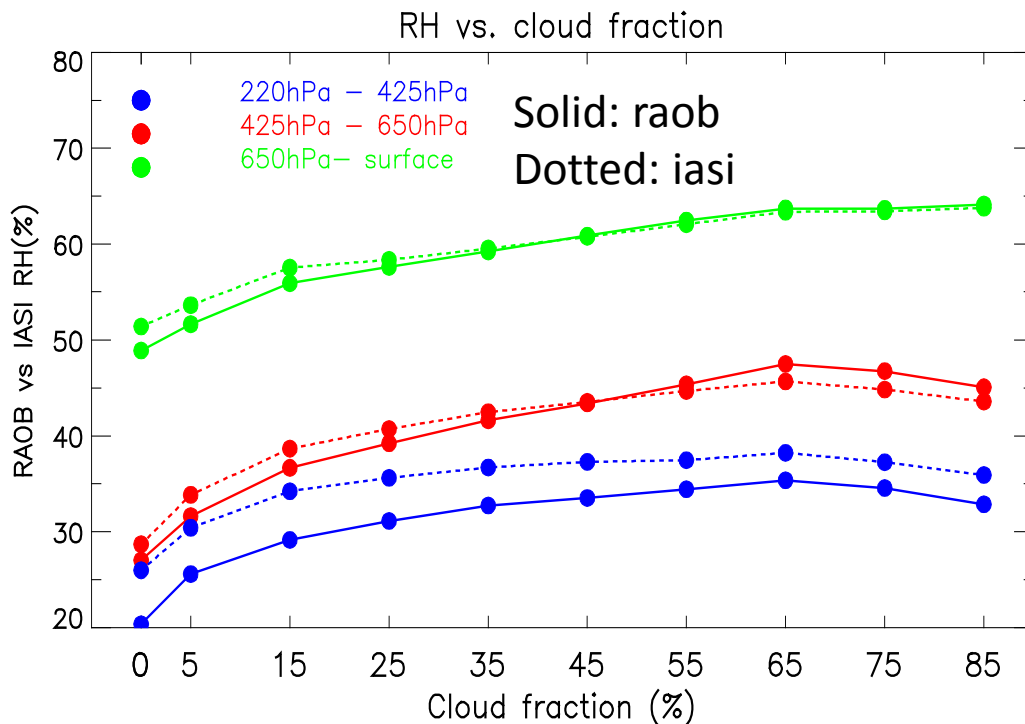
NPROVS routine monitoring & analysis



Routine monitoring can be efficiently conducted under different sampling sorting, e.g., land/sea, day/night, clear/cloudy, IR+MW/MW-only, etc.

NOAA IASI retrieval evaluation using 3-yr conventional RAOB-IASI collocations

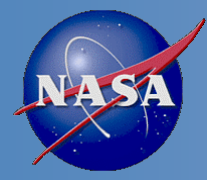
Effective cloud amount vs. relative humidity



Three yrs (2010-2012) of IASI-RAOB collocations from NPROVS are used.

The sample for collocations (3 hr and 100 km) with “accepted” IASI is ~314 000.

Major geophysical parameters in the IASI retrieval system are physically consistent to each other.



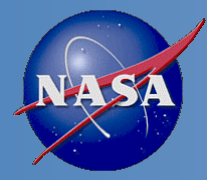
The 19th International TOVS Study Conference
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Characteristics of Conventional RAOBs and their Use in Satellite Sounding Product Validation

Bomin Sun, Tony Reale, Mike Pettey and Frank Tilley
(Poster # 8P.05)

Overview based on several of our recent journal publications on:

- RAOB measurement (T and H₂O) accuracy
- Special vertical profiles (eg, inversion, multiple changes) sampled by RAOB
- RAOB-satellite spatial and temporal mismatch impact
- Usefulness in satellite data validation

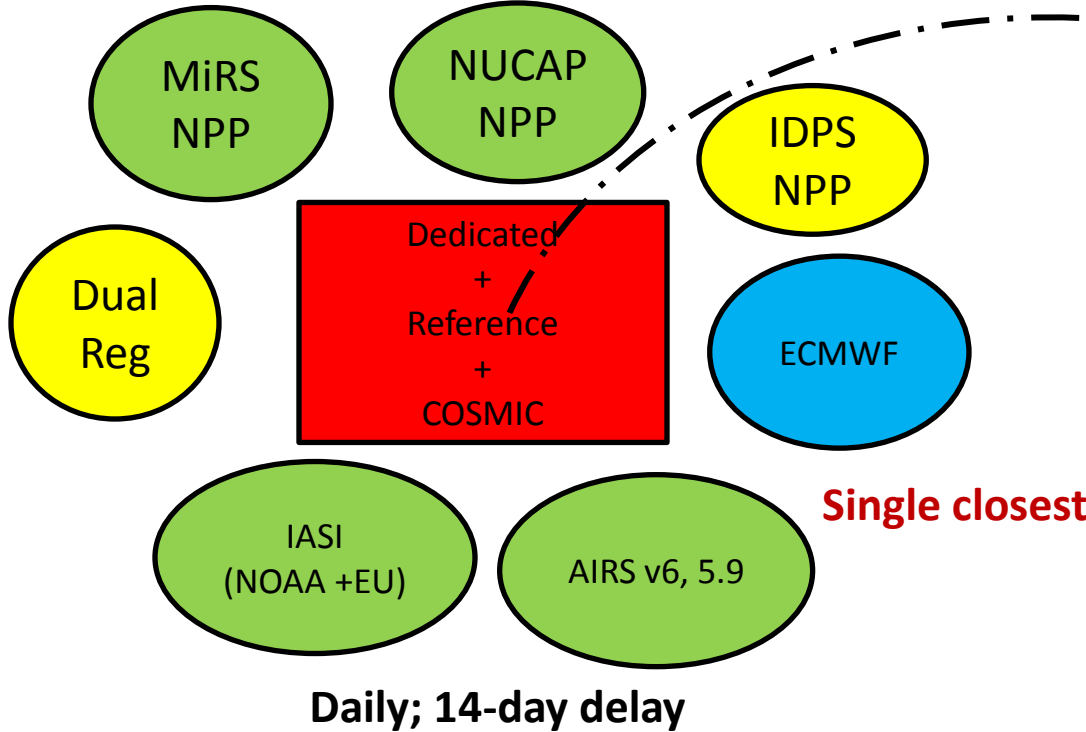


NPROVS+

(validation & algorithm development)

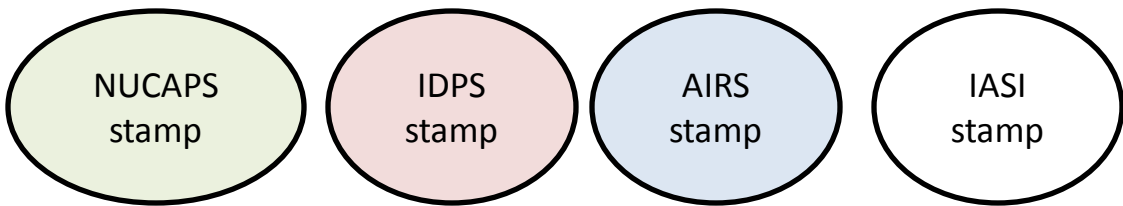


GTS (CFSR+GFS)



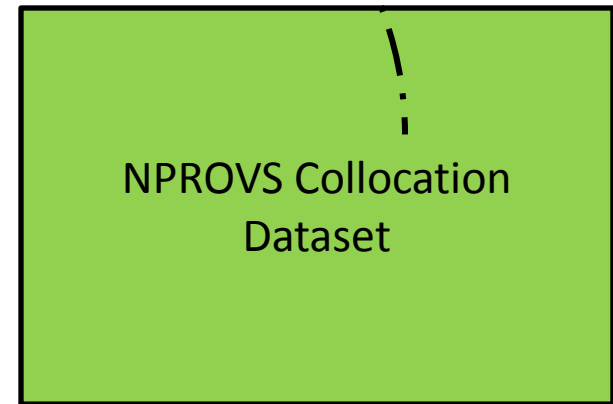
Daily; 14-day delay
(NetCDF / HDF5)

+/- 500km

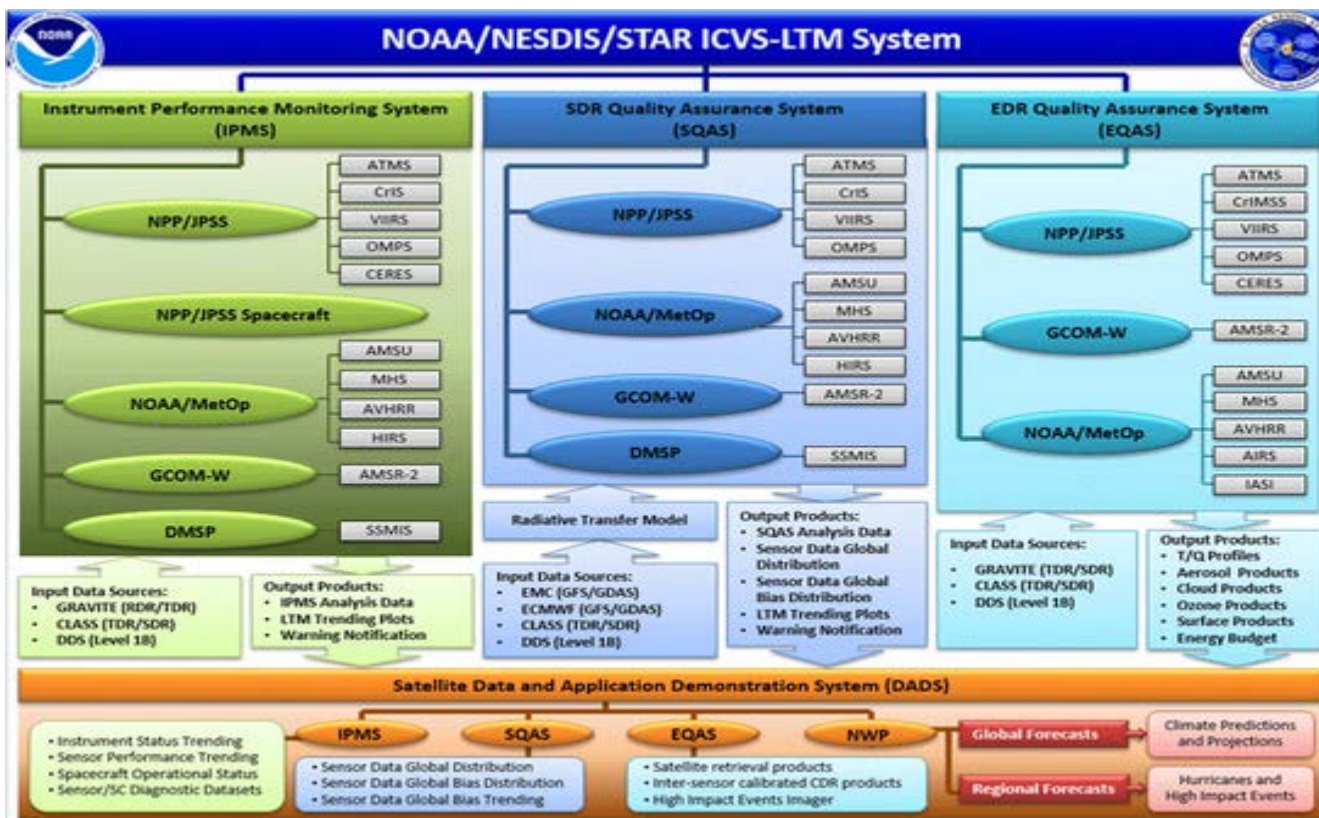


g r a n u l e s

SDRs: CrIS, ATMS, VIIRS, AIRS, MODIS, IASI, AVHRR...



Daily; NRT
(conventional)



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



NPROVS+ Program at STAR



Routine Compilation and Archive of Collocated
Satellite (SDR, EDR)

and

Reference / Dedicated Observations
(GRUAN / JPSS)

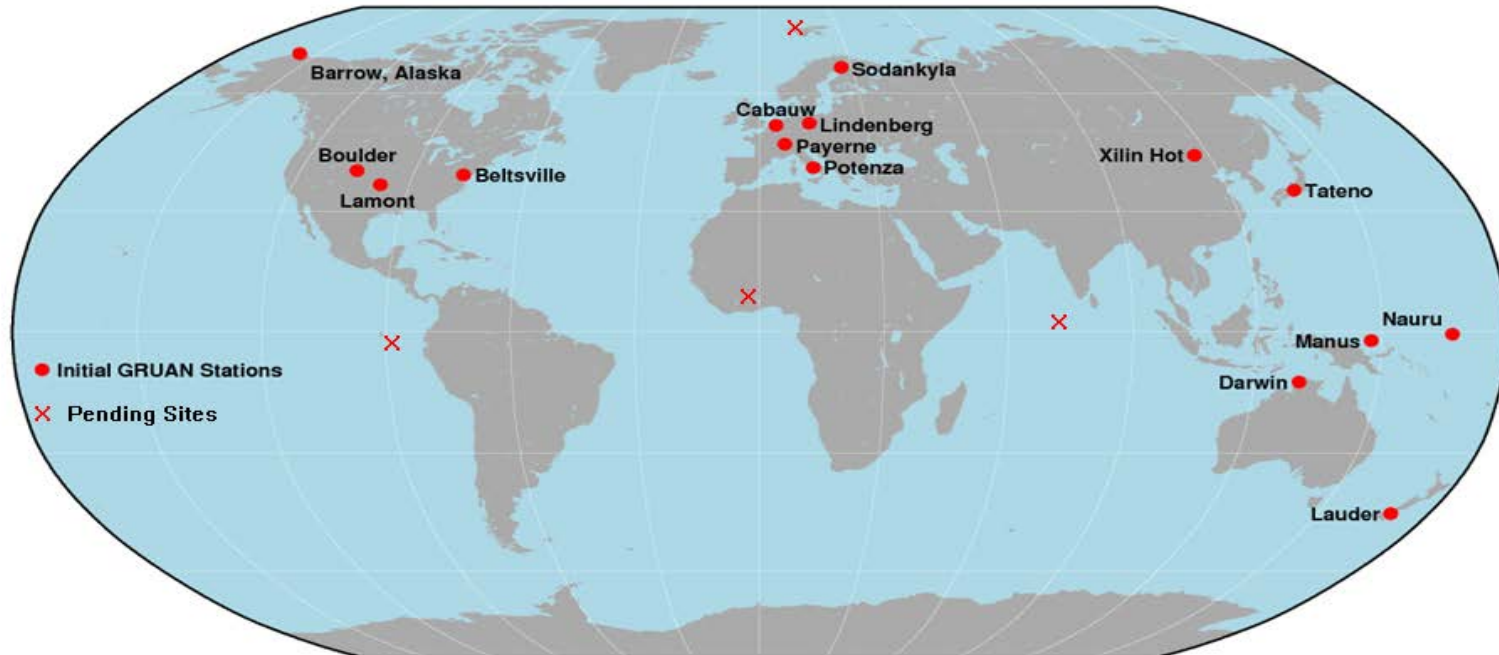
Provides NOAA / STAR Oversight

to guide

NOAA-Unique (Barnet, Gambacorta) Algorithm
and RTM

Monitoring and Development

Global “Reference” Upper Air Network (GRUAN)



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



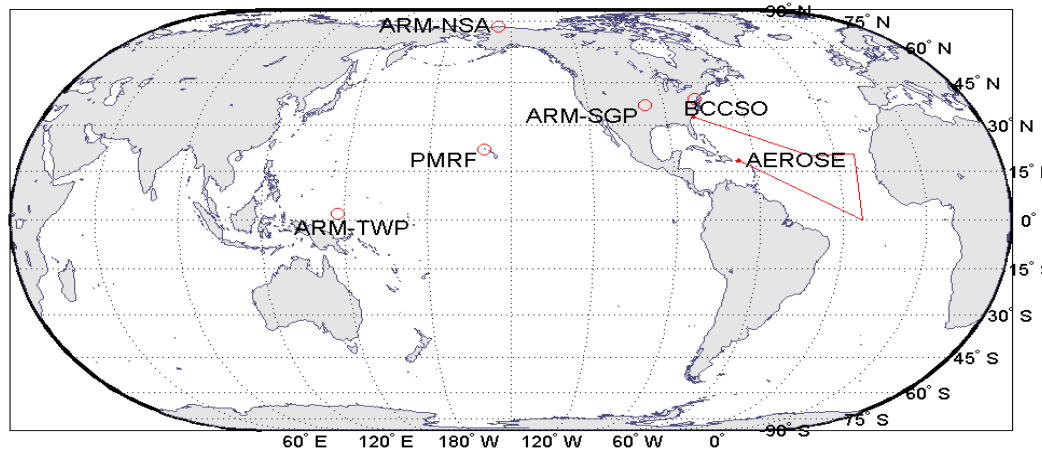
Dedicated Observations



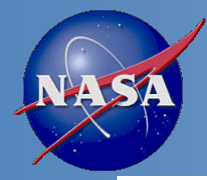
Dedicated S-NPP RS92 RAOB funded by JPSS (Mitch Goldberg)

	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

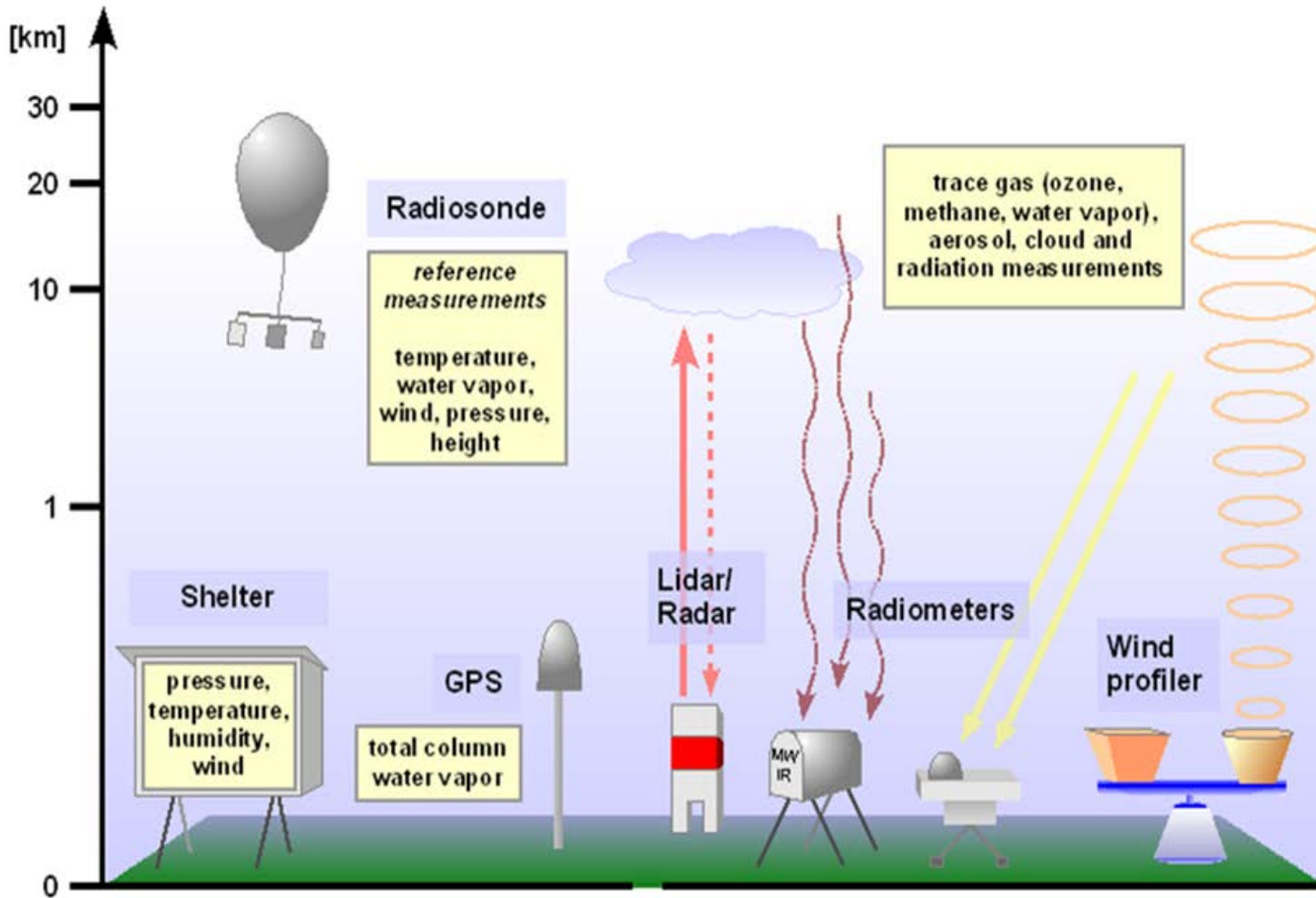
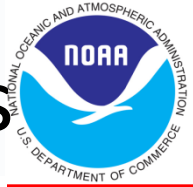
NPP CrIMSS EDR ICV Dedicated RAOB Sites



... ongoing re-structure of ARM scheduling to provide “sustained” year round coverage (Tony Reale)

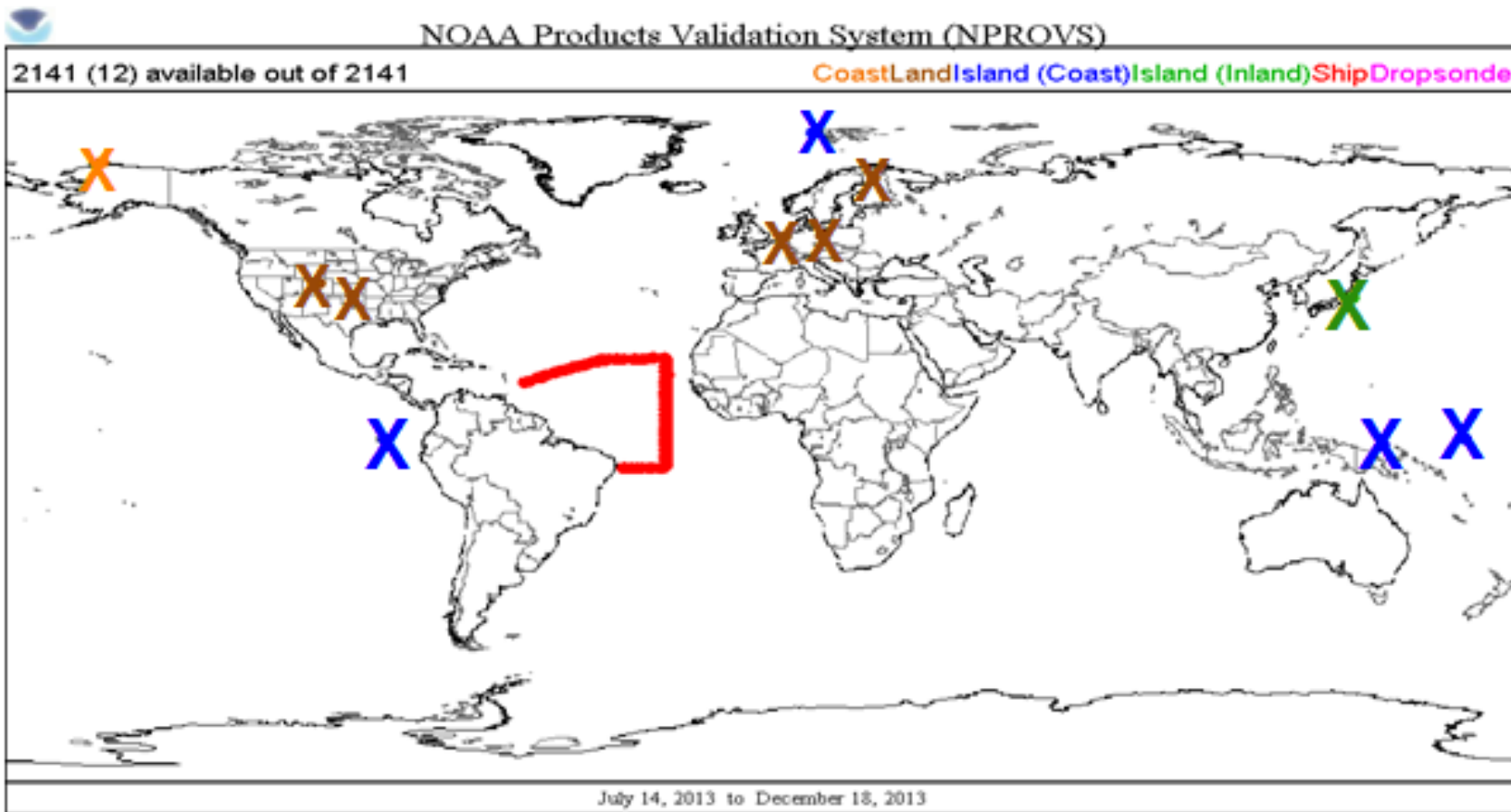


GRUAN Ancillary Ground Observations

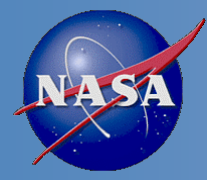


Characterization of atmospheric column well suited to assess satellite product

NPROVS+



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

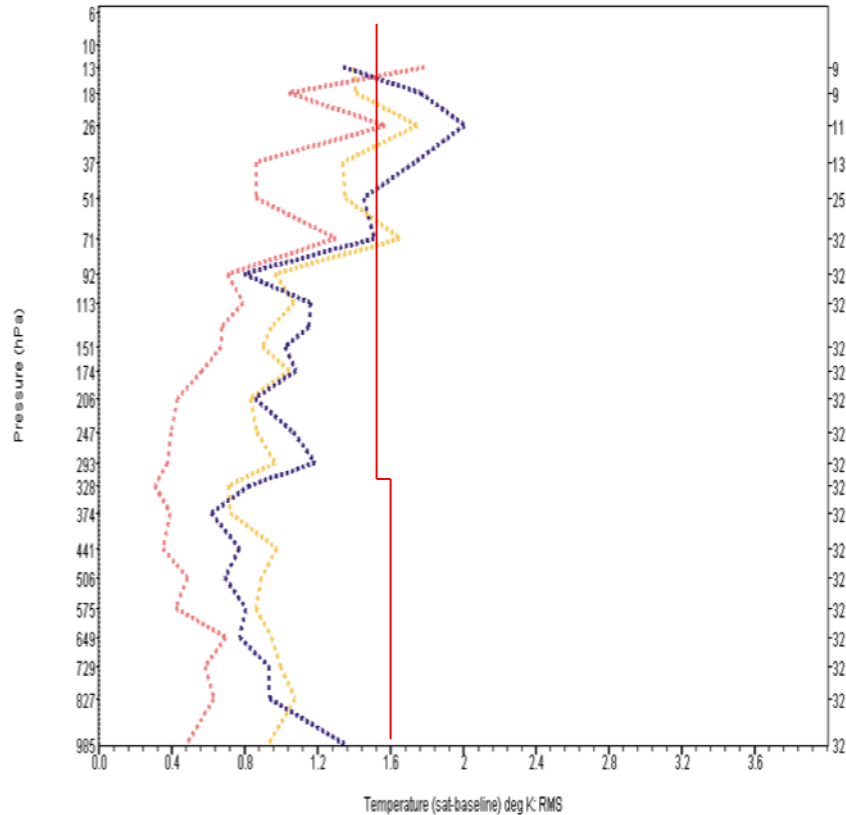


NPROVS+ EDR Validation Results



NOAA Products Validation System (NPROVS)

July 14, 2013 to December 18, 2013



Baseline: REFERENCE SONDE GRUAN RAOB

CRIMSS NPP Infrared (IP)

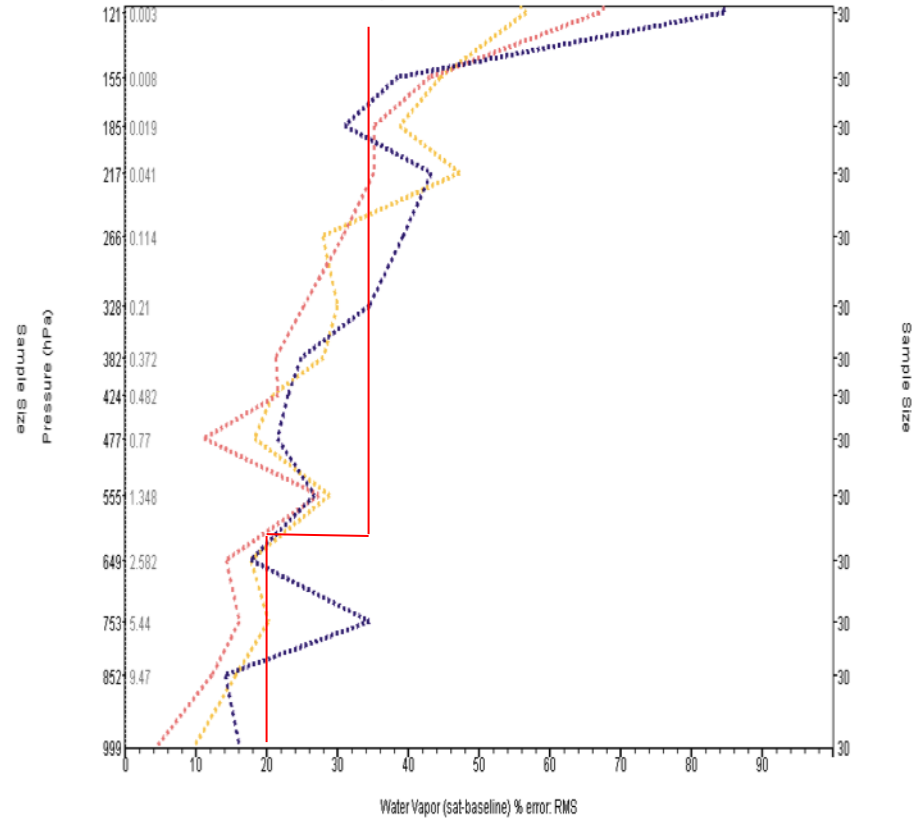
ECMWF ANALYSIS

NUCAPS NPP TEST



NOAA Products Validation System (NPROVS)

July 14, 2013 to December 18, 2013



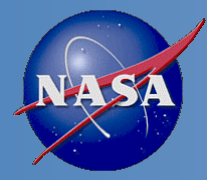
Baseline: REFERENCE SONDE GRUAN RAOB

CRIMSS NPP Infrared (IP)

ECMWF ANALYSIS

NUCAPS NPP TEST

IR + MW Pass QC ... AEROSE only



GRUAN Reference Measurement Principles



Two observations on different platforms are consistent or comparable if

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

Where (σ) is the atmospheric variability due to time/space mismatch, and u is the uncertainty of variable m .

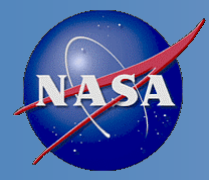
Normally, m_1 and m_2 are considered to be statistically consistent to each other if $k \leq 1.96$.

... at this preliminary stage:

$$K = \text{ABS}(X - \text{GRUAN}) / \text{Uncertainty } (u_2)$$

where "X" either SAT or NWP

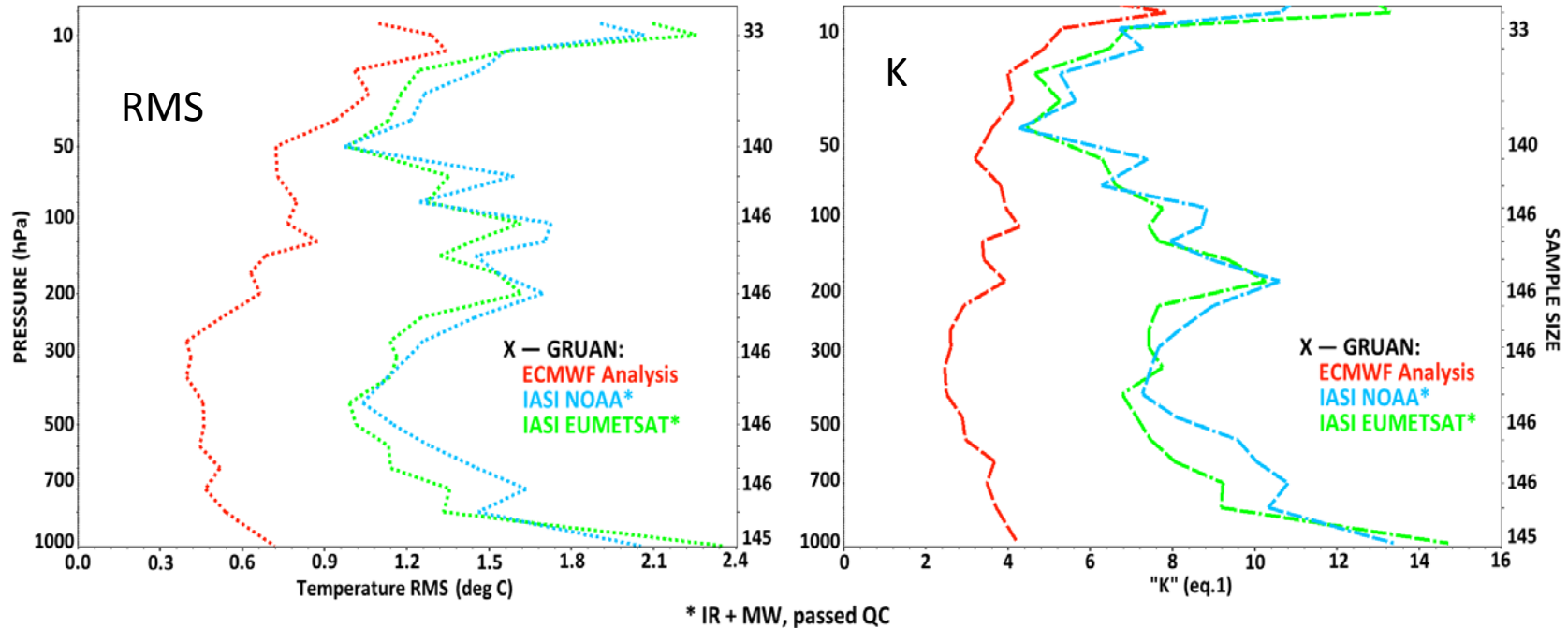
“need EDR uncertainty estimates for robust validation”



Satellite EDR Validation



NPROVS+ 14 July 2013 — 19 January 2014



... the common sample size of 146 in troposphere is reduced from over 1800 prior to subsampling based on the qc indicator and sensor combination. This reduction in yield was a factor of 3+ greater for IASI (EU) versus from NOAA and is among the many characteristics that must be considered in overall product comparisons. Furthermore, in computing "K", both the σ and u_1 terms (eq 1) were set to zero so the comparison is pessimistic. Work will be undertaken to bring in realistic values for these terms and enable comparable comparisons in the satellite sensor radiance space ... with realistic values, K of 1.96 indicate consistent observations.

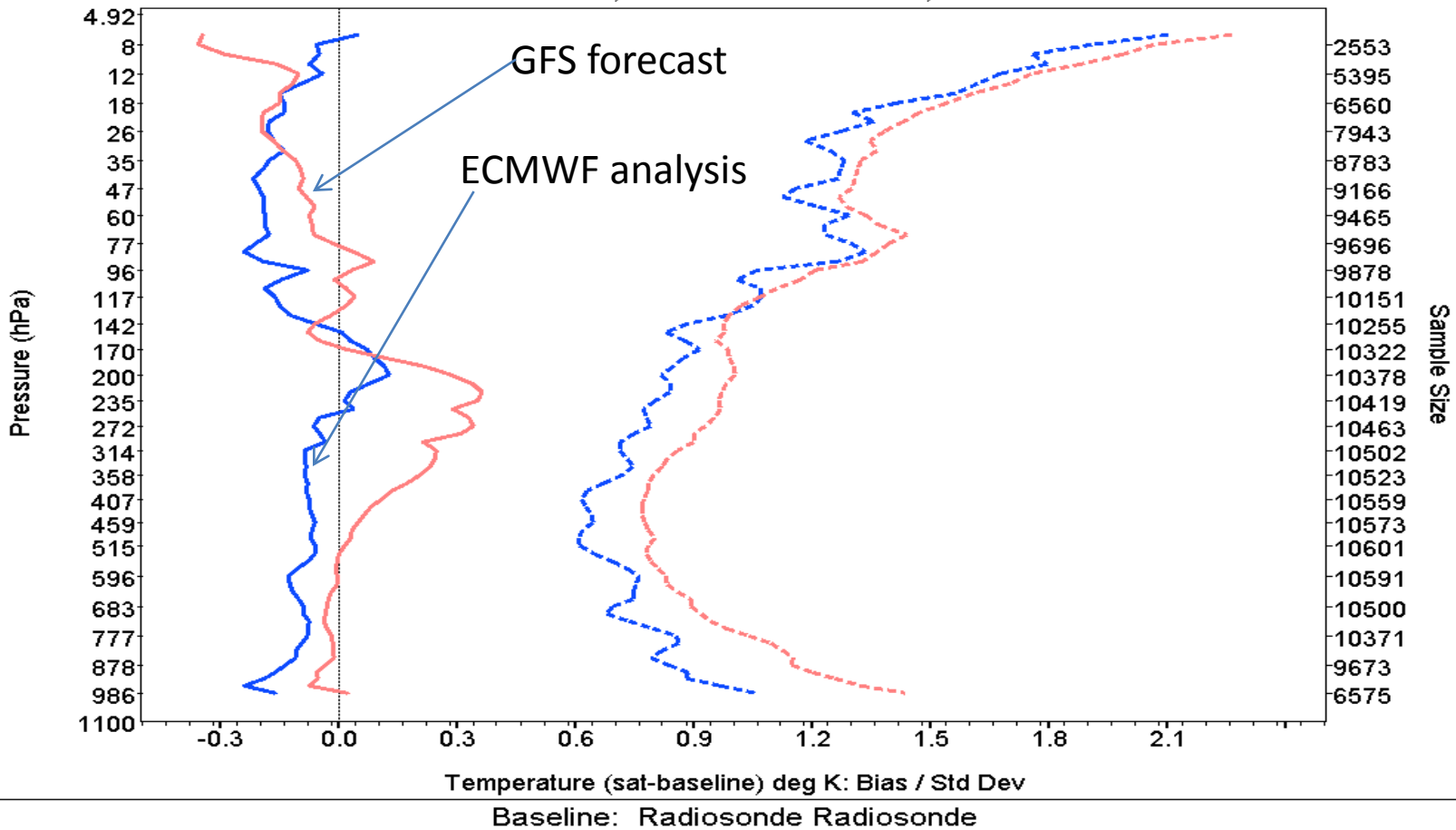


NWP Monitoring



NOAA Products Validation System (NPROVS)

October 15, 2013 to October 25, 2013

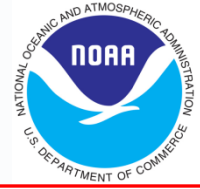


Radiosonde GFS 6 Hour

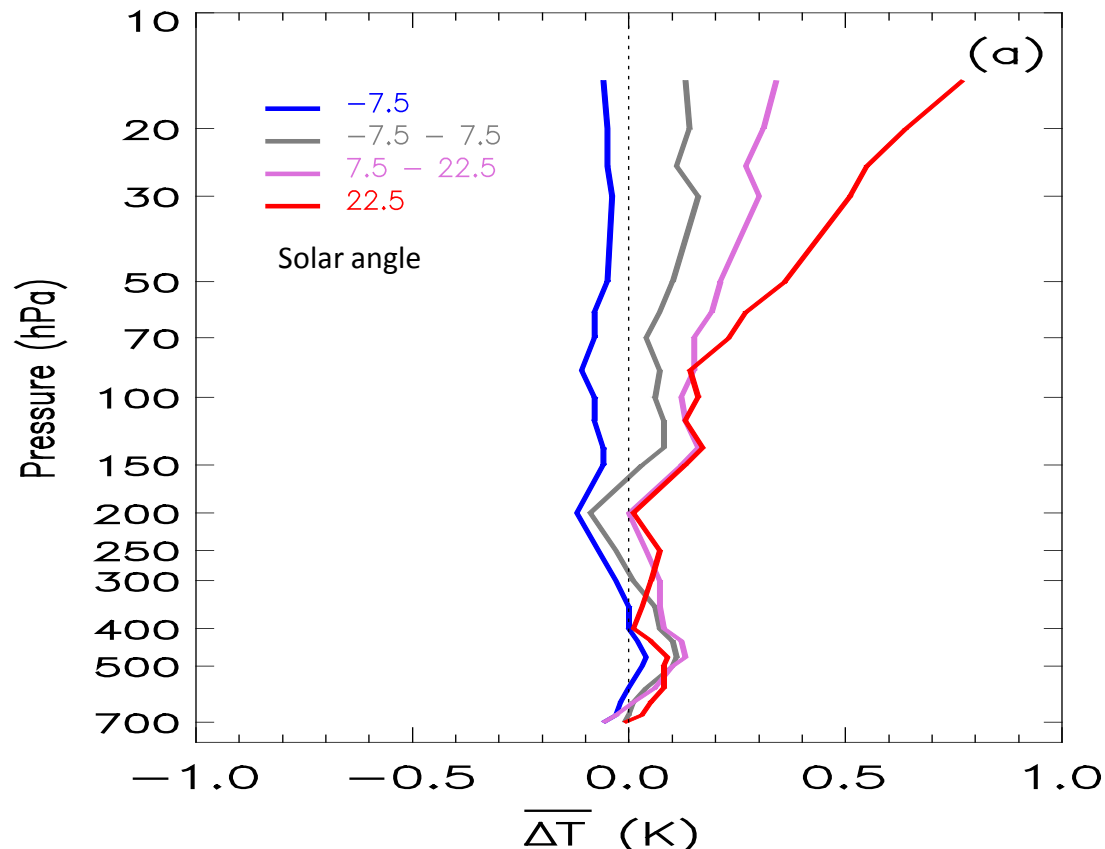
ECMWF ANALYSIS



Quantify Solar Radiation Induced RAOB Temperature Error In the UT/LS



Global RAOB (2008-2011) Difference from COSMIC Tdry (Sun et al. JGR 2013)



Sun, Reale, Ballish, Collard, Seidel ... propose updated "radcor" being tested for NOAA nwp assimilation



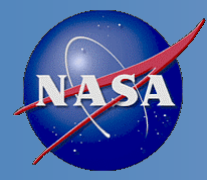
Summary



- **NPROVS and NPROVS+ operate daily at NOAA STAR**
- **NPROVS+ traceable to reference**
- **Satellite, Ground and NWP Monitoring/feedback**
- **“K” profiles supplement RMS for product performance**
- **Internationalization of NPROVS+ being considered (NOAA/Europe)**



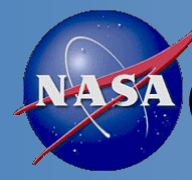
THANK YOU



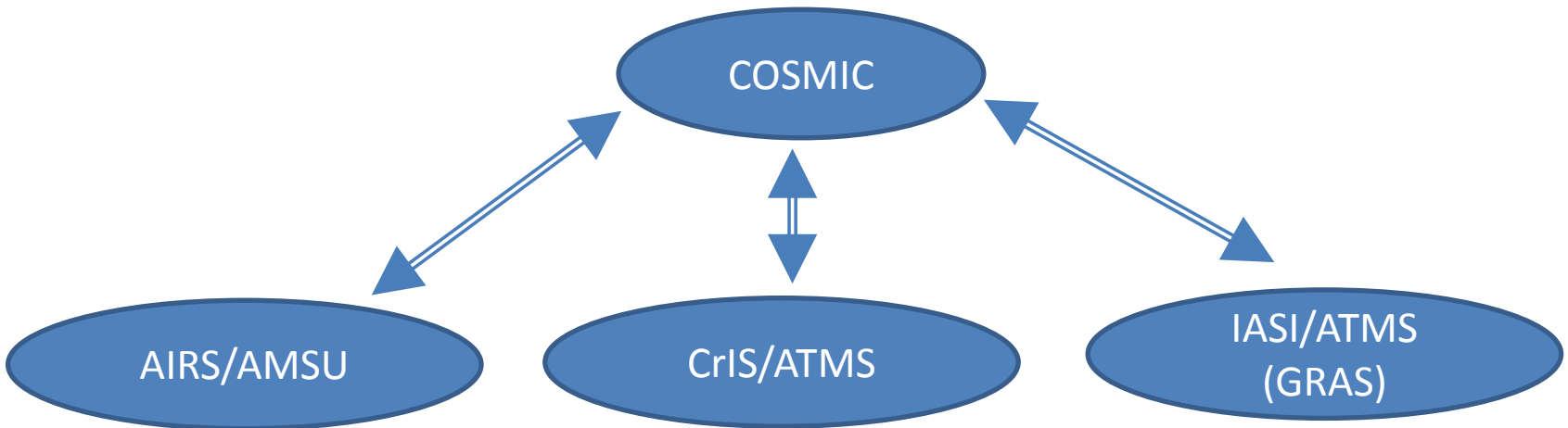
Collocation / Processing Strategy



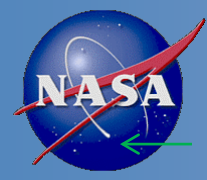
- Reference/dedicated RAOB (RS92) is anchor
- Raw, Digicora, GRUAN, GTS ... (4 RAOB flavors)
- Append Ground Ancillary (MWR, FTIR, Lidar...)
- Compress to 1km layers (AIRS Science team) ... also retain original hi-density
- Single closest satellite EDR within +/- 6hr and 150km (250km for COSMIC)
- NWP (GFS 6-hr, CFSR, ECMWF Anal ...)
- For hyperspectral (S-NPP, MeTop, Aqua) append all EDR / SDR within 500km



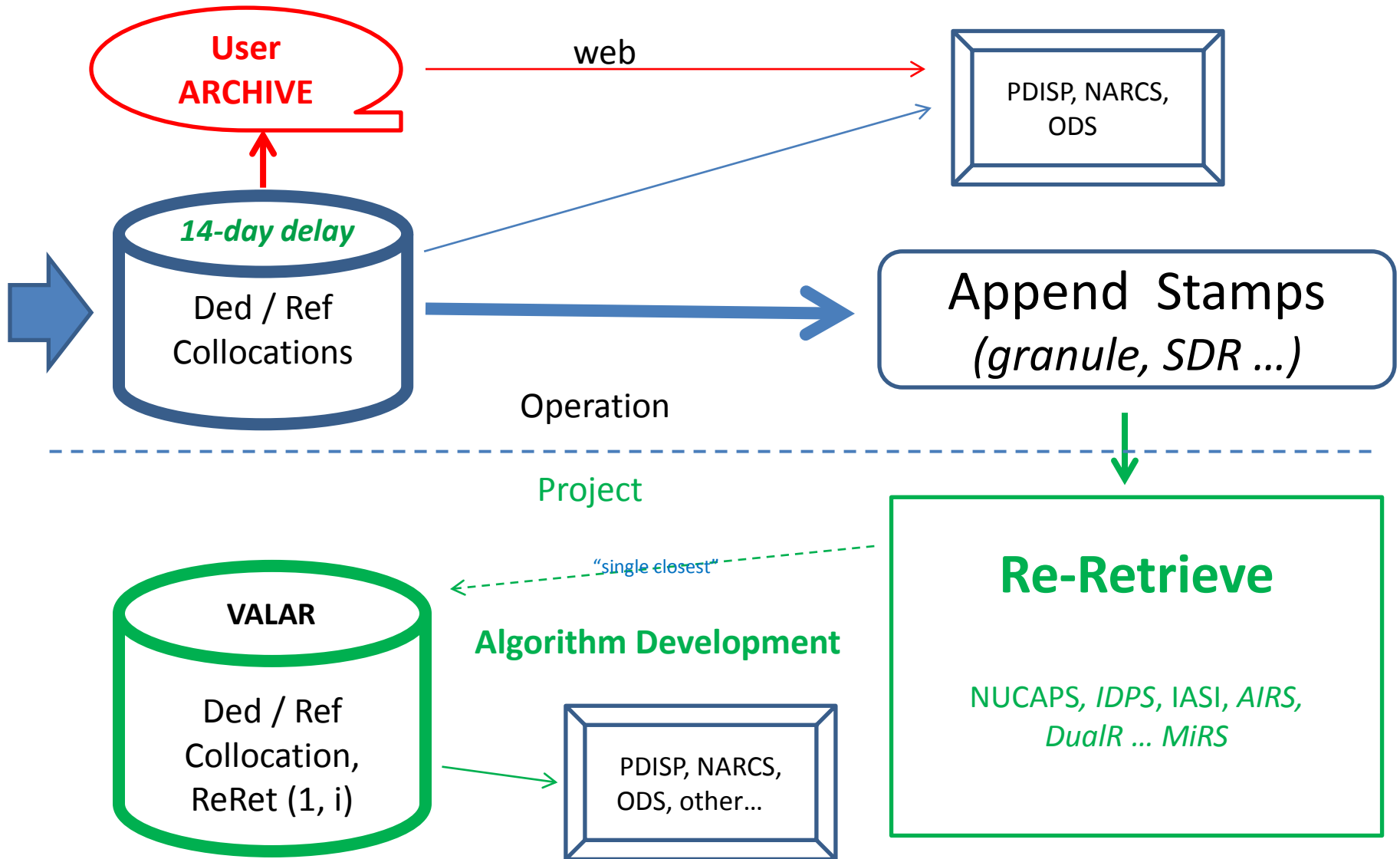
GPSRO Anchored Collocation Validation



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



Validation & Algorithm Development



NPROVS+ ... unified validation and development²⁴