2nd GRUAN Inplementation-Coordination Meeting (ICM-2)
Payerne, Switzerland, 2-4 March, 2010

NOAA PROducts Validation System (NPROVS) and Applications Relevant to GRUAN

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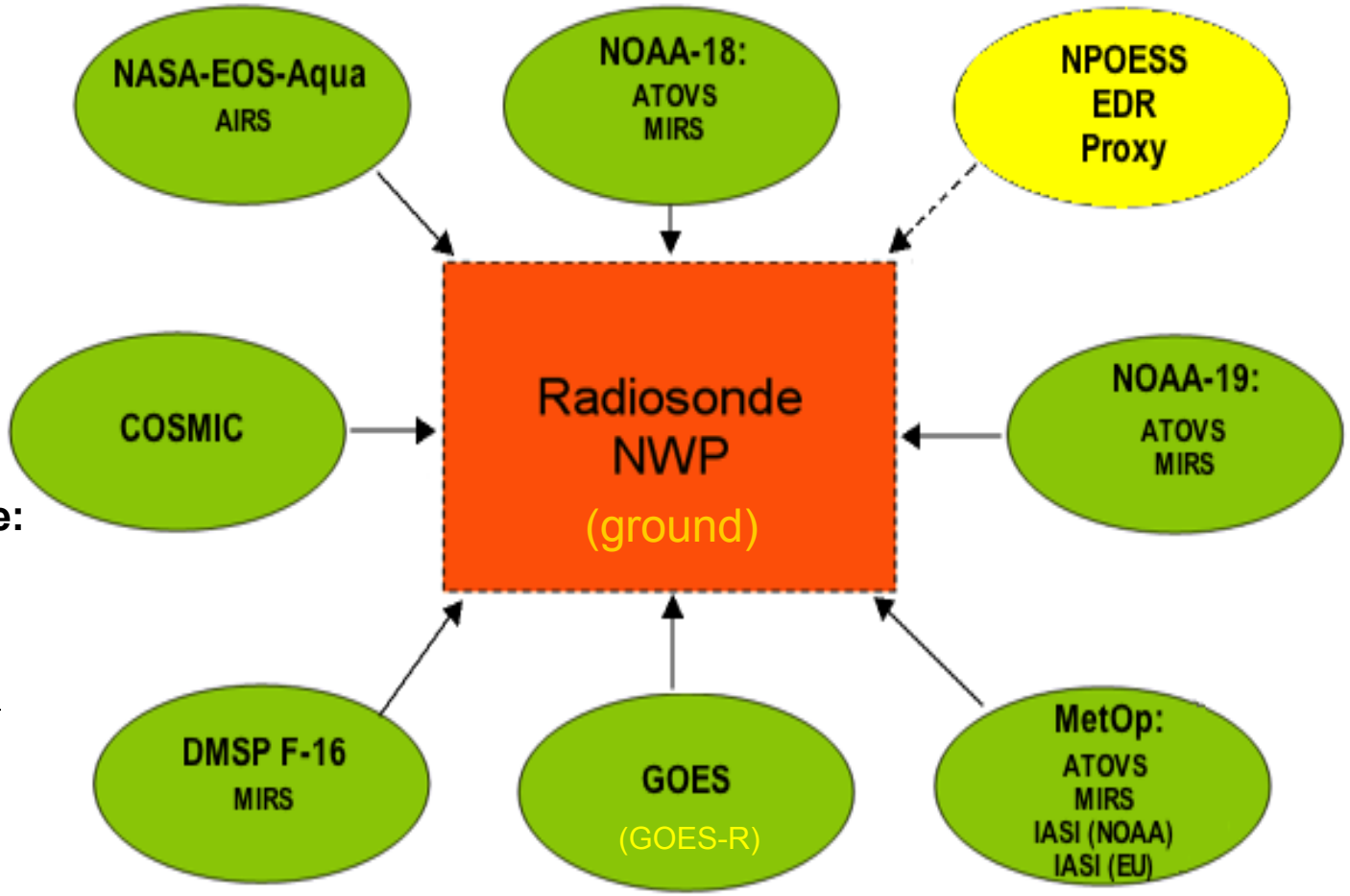
Bomin Sun, Michael Pettey and Frank Tilley

NOAA/NESDIS/STAR
IM System Group Inc

NPROVS

- Centralized NOAA-STAR facility to monitor / inter-compare (real-time) satellite derived product systems … QA/QC
- Support "NPOESS" *Product* (EDR) Cal-Val Program (Chris Barnet, PI)
- ***GRUAN Monitoring / Analysis Support***
  - ***Satellites (spectra, retrievals) as transfer standard for site monitoring***
  - ***RT model validation optimal at GRUAN***

NOAA Products Validation System (NPROVS)



Atmosphere:
Temp
H20
Sensor

Surface
Gas
TPW,CLW
Cloud
Precip

… collocation dataset

Environmental Data and Graphical Evaluation (EDGE) Analytical Interface

- Orbital Display System (ODS)
- Collocated Profile Display and Analysis (CPDAS)
- NPROVS ARChive Summary System (NARCSS)

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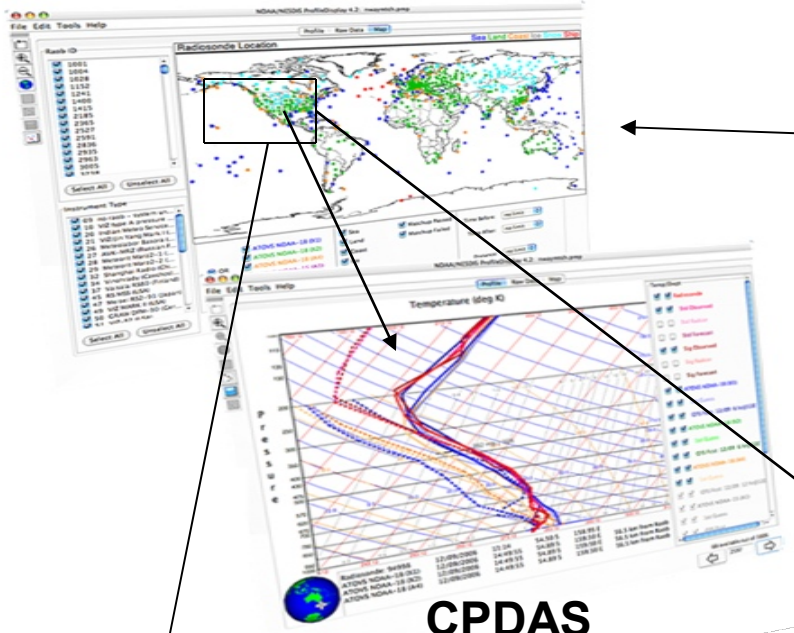
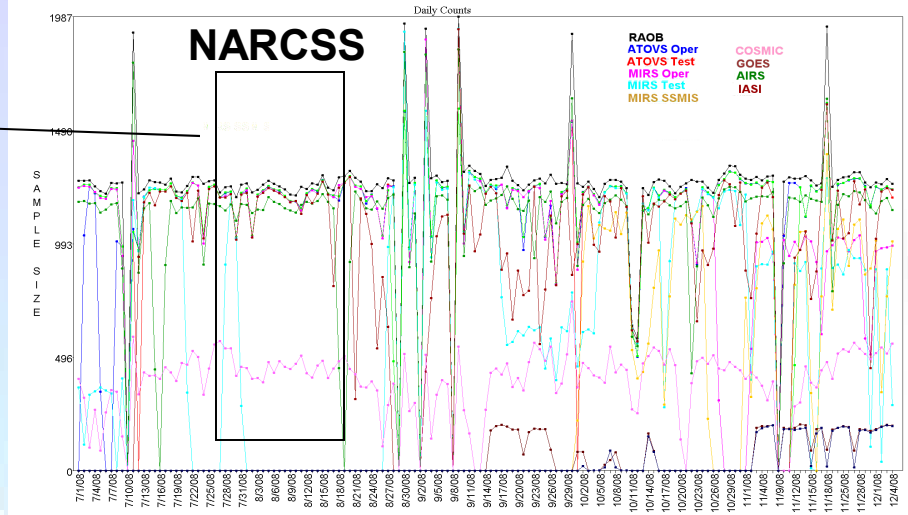
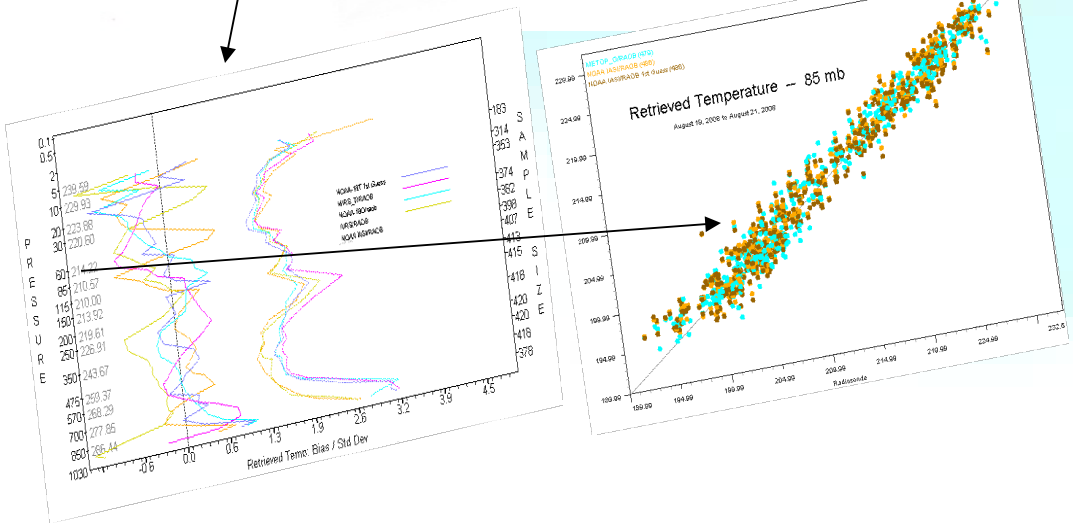
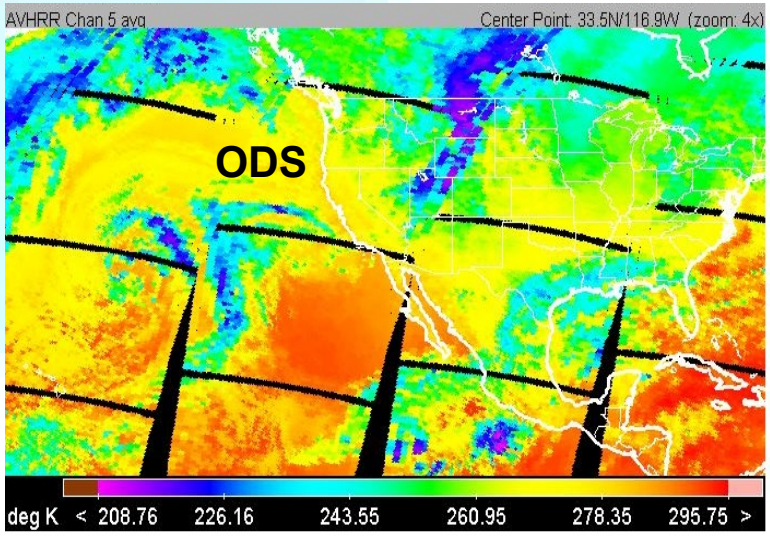
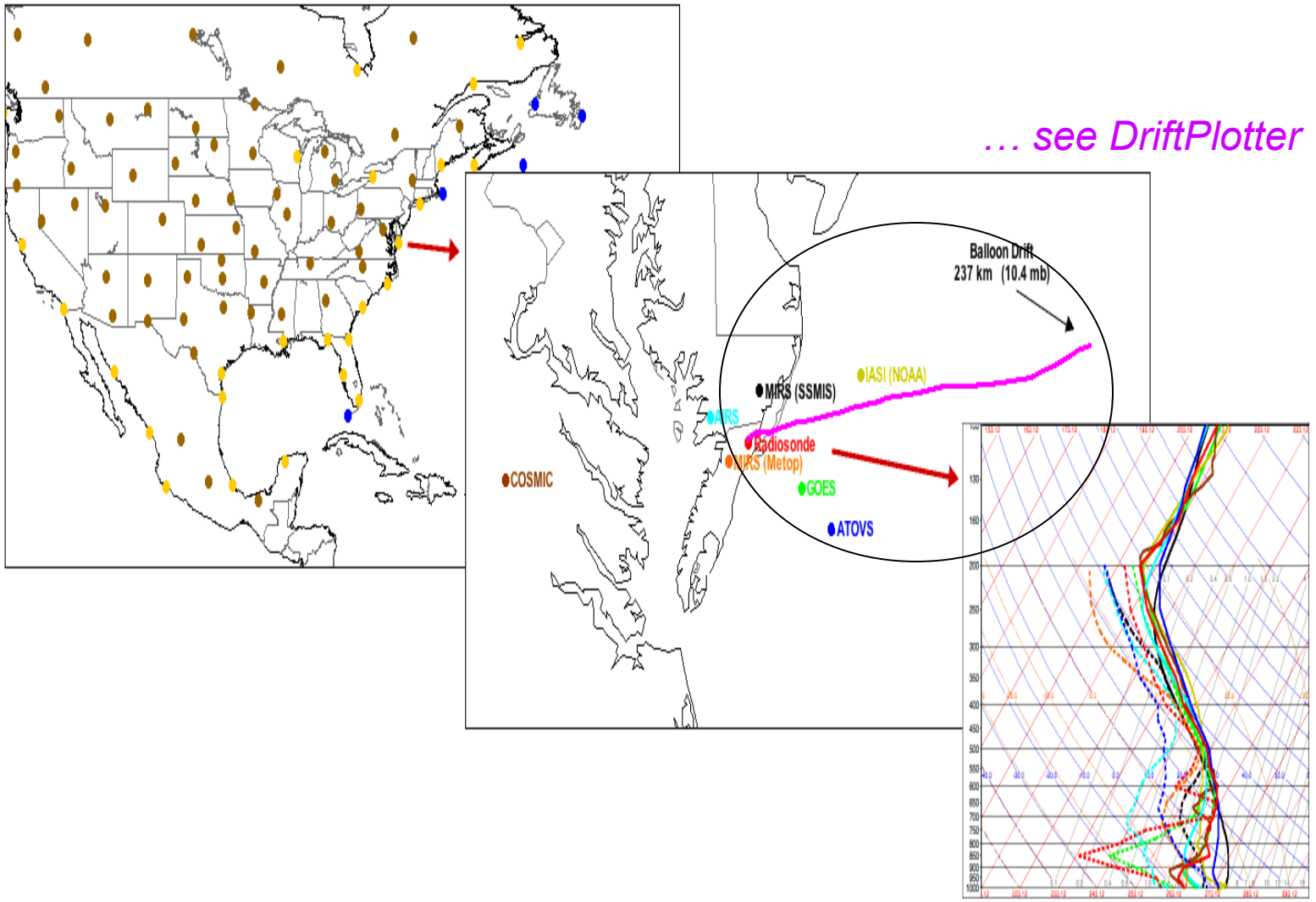
Environmental Data Graphic and Evaluation System *(EDGE)*











… see DriftPlotter

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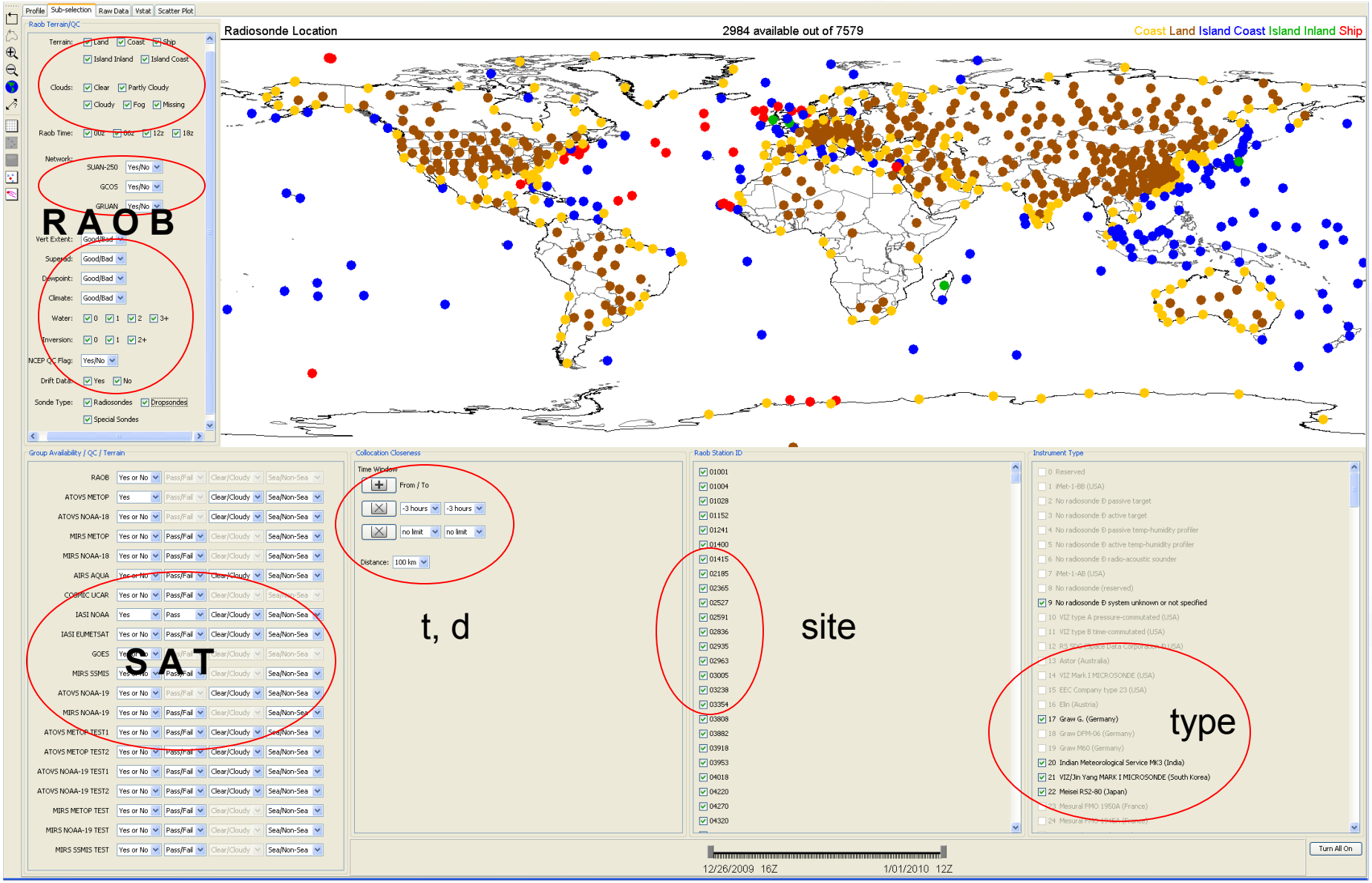
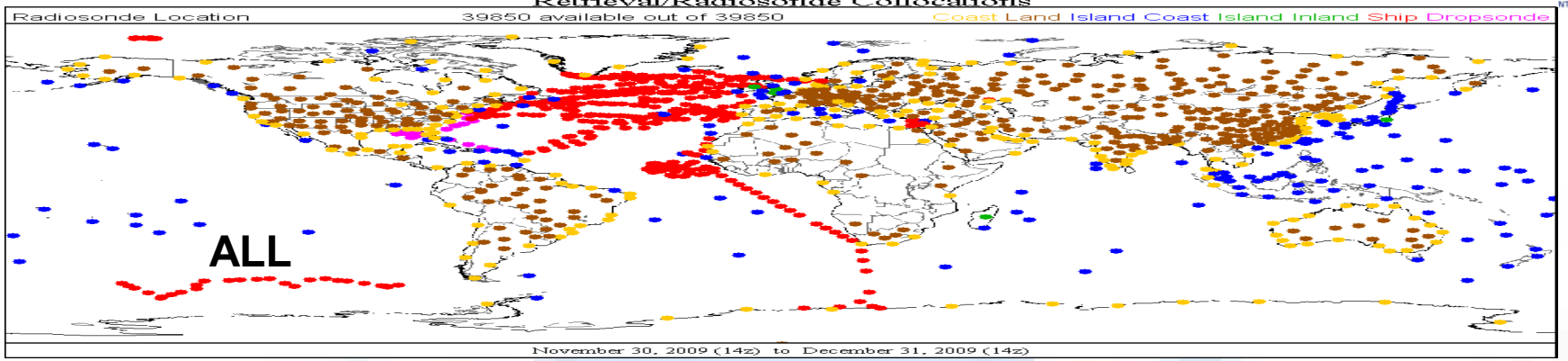
EDGE-CPDAS

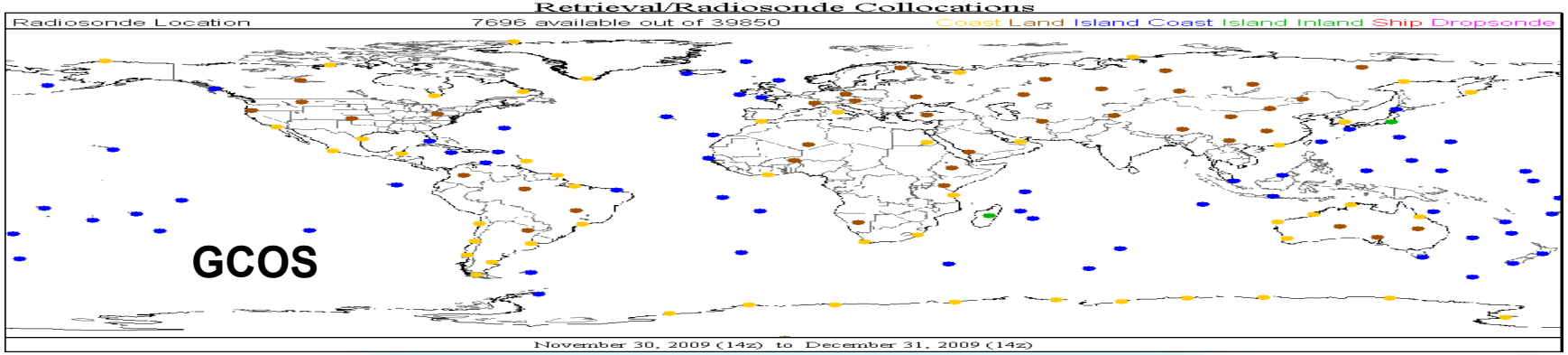


… user options for display and analysis of collocation datasets…

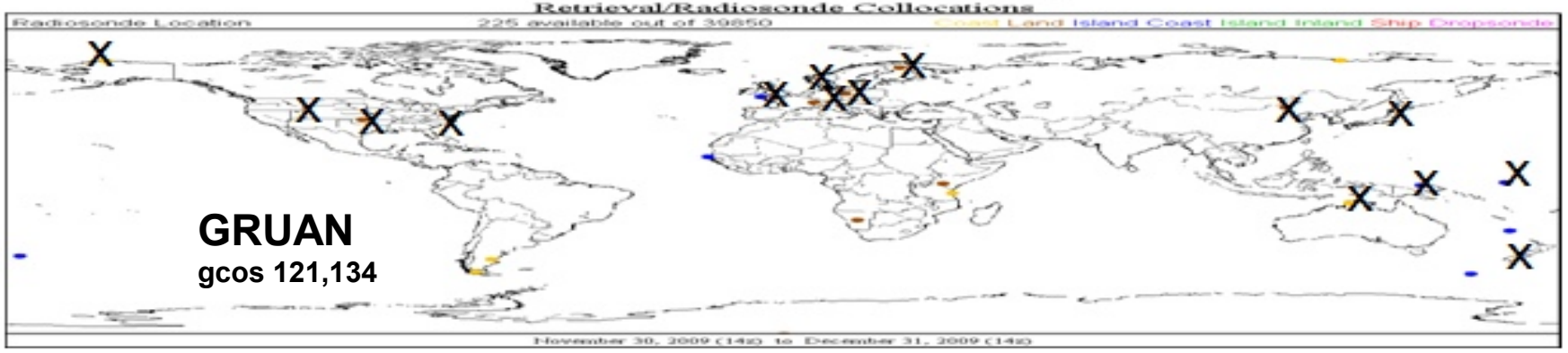
NOAA/NESDIS Collocated Profile Display
Retrieval/Radiosonde Collocations



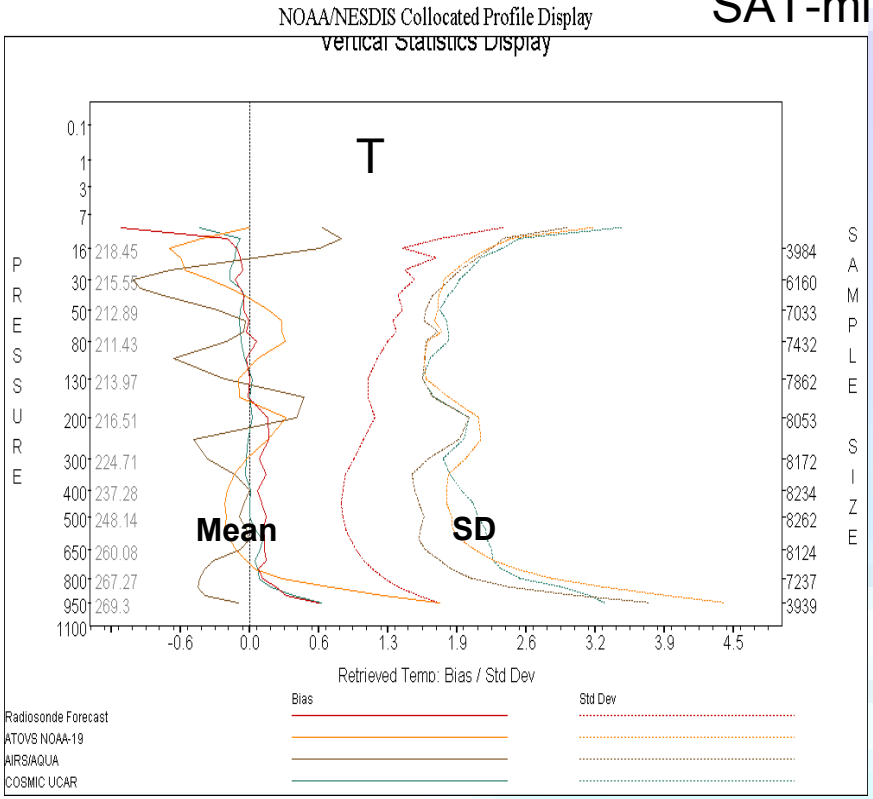
NOAA/NESDIS Collocated Profile Display
Retrieval/Radiosonde Collocations

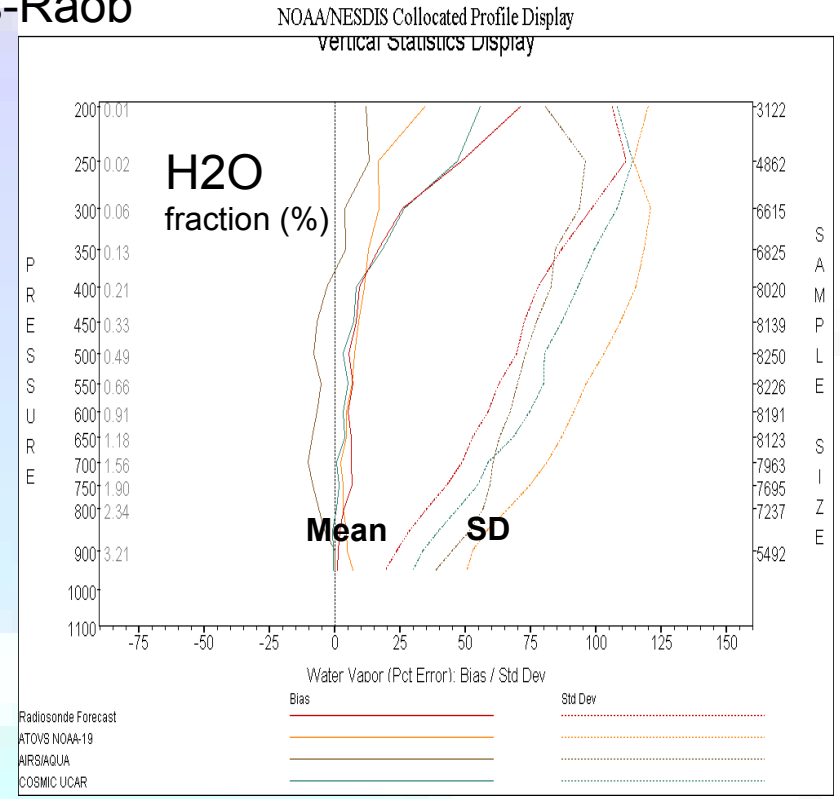


NOAA/NESDIS Collocated Profile Display
Retrieval/Radiosonde Collocations

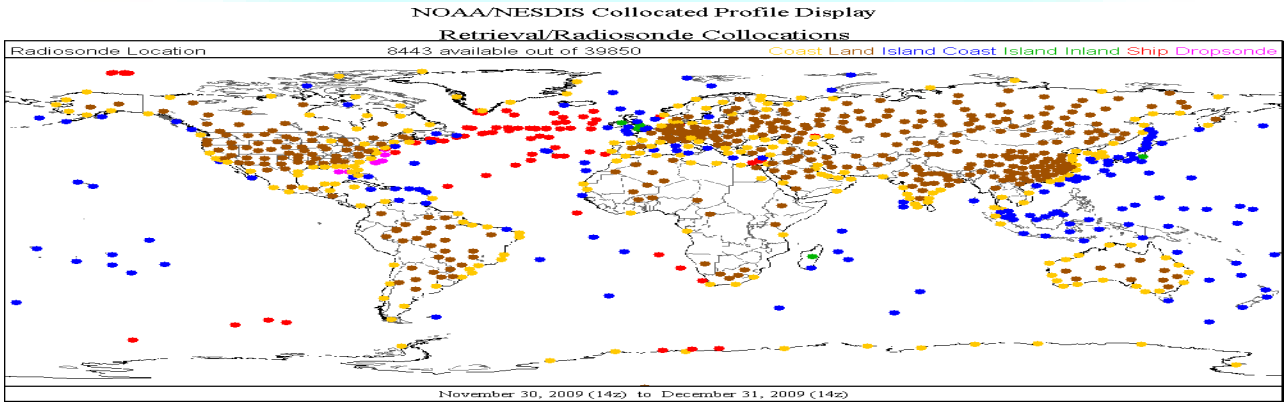


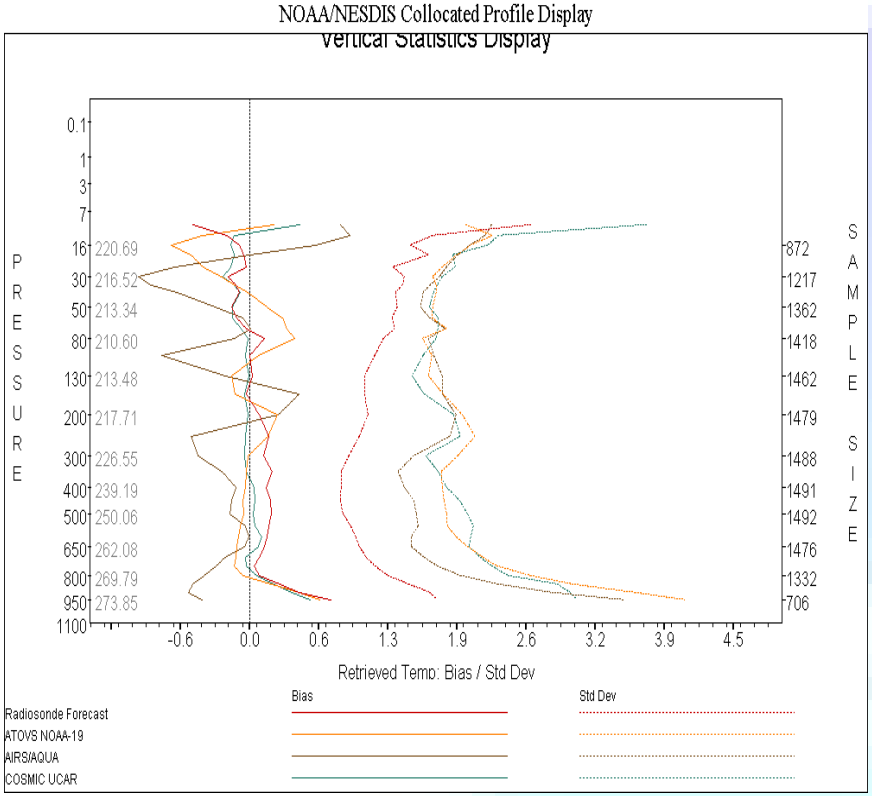
SAT-minus-Raob

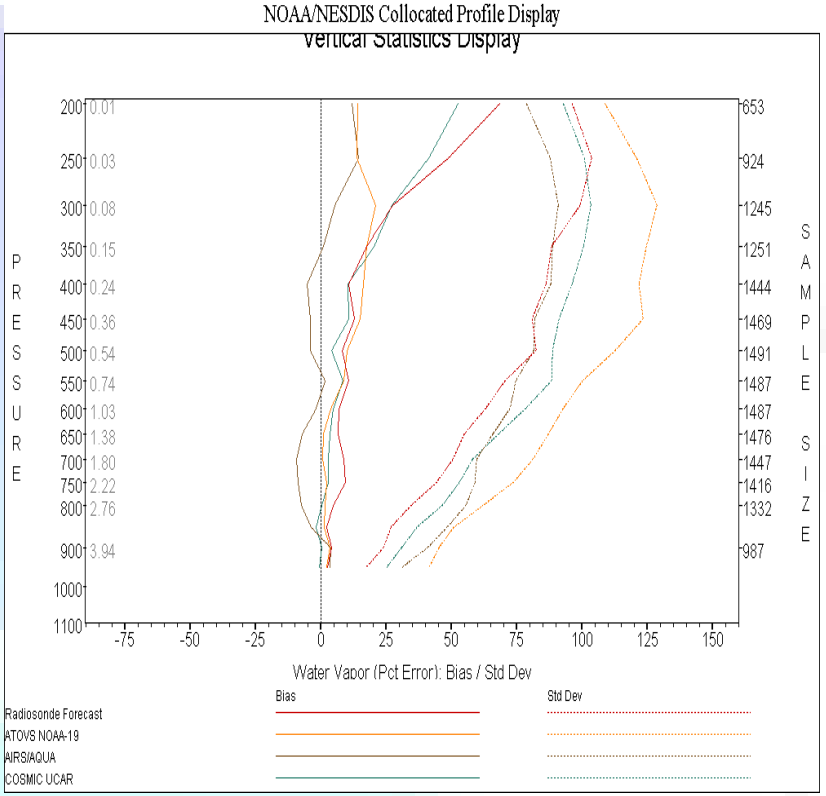




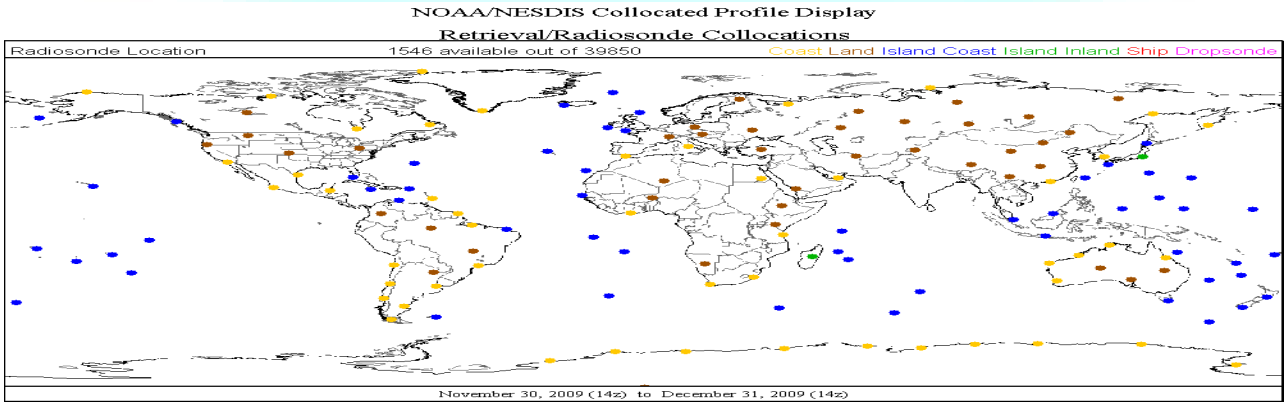
ALL



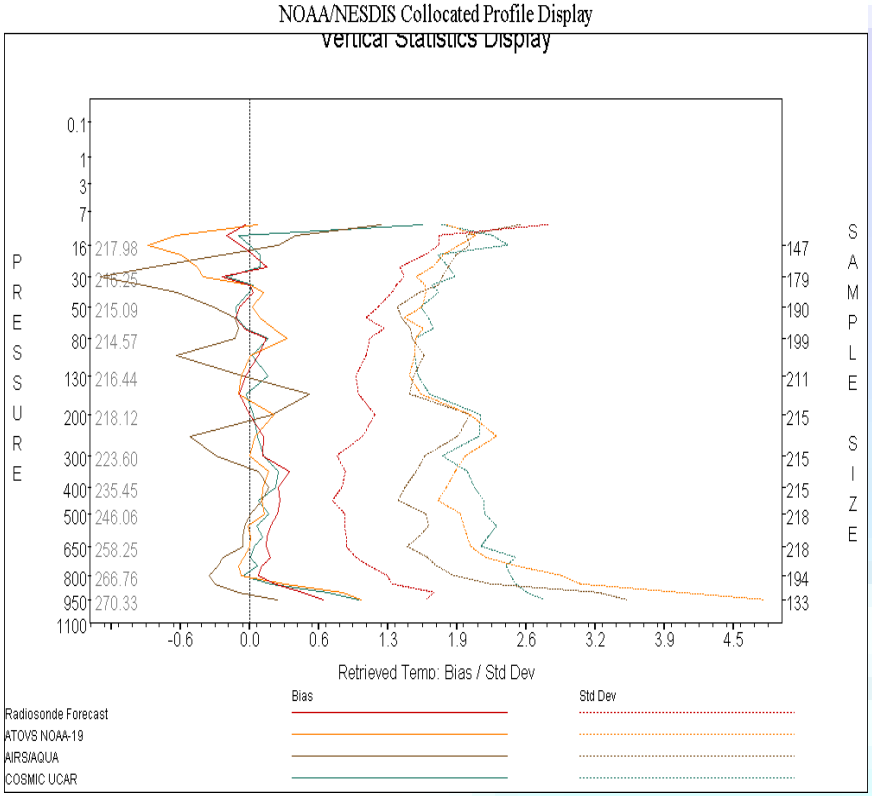

NOAA/NESDIS Collocated Profile Display
Vertical Statistics Display
PRESSURE
SAMPLE SIZE
Retrieved Temp: Bias / Std Dev
Bias
Std Dev
Radiosonde Forecast
ATOVS NOAA-19
AIRS/AQUA
COSMIC UCAR

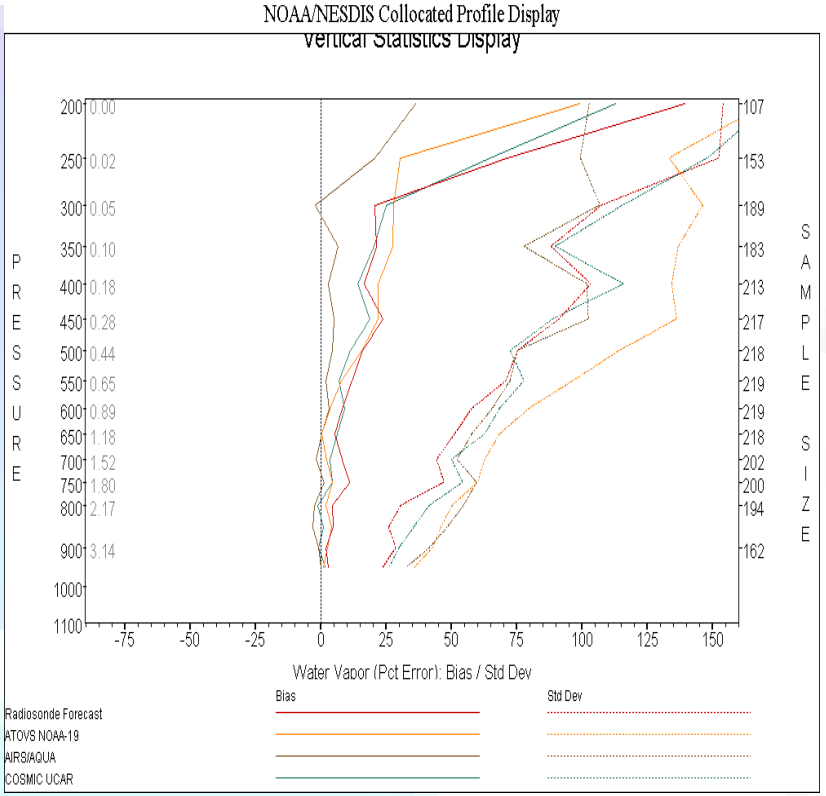

NOAA/NESDIS Collocated Profile Display
Vertical Statistics Display
PRESSURE
SAMPLE SIZE
Water Vapor (Pct Error): Bias / Std Dev
Bias
Std Dev
Radiosonde Forecast
ATOVS NOAA-19
AIRS/AQUA
COSMIC UCAR

GCOS

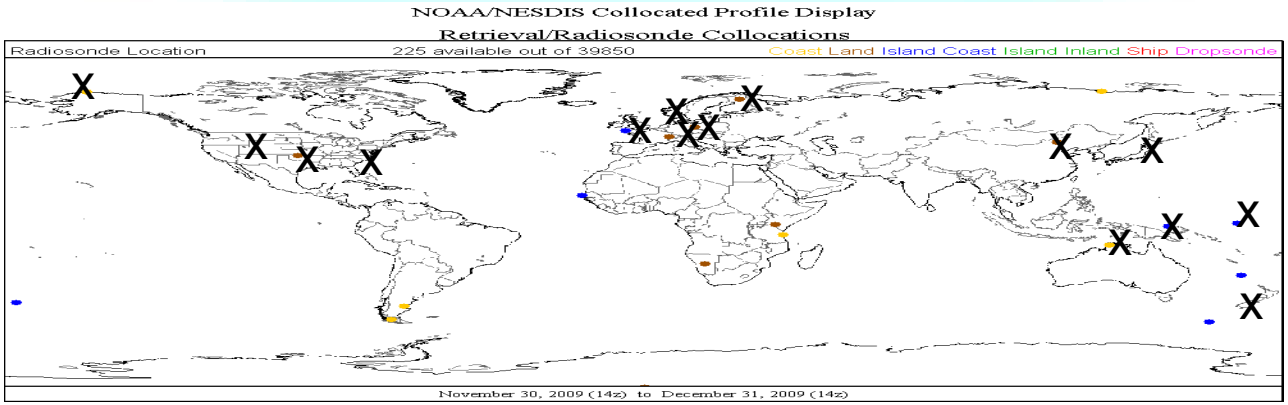

NOAA/NESDIS Collocated Profile Display
Retrieval/Radiosonde Collocations
Radiosonde Location
1546 available out of 39850
Coast Land Island Coast Island Inland Ship Dropsonde
November 30, 2009 (14z) to December 31, 2009 (14z)

GATNDOR Network Configuration





GRUAN
(gcos 121,134)



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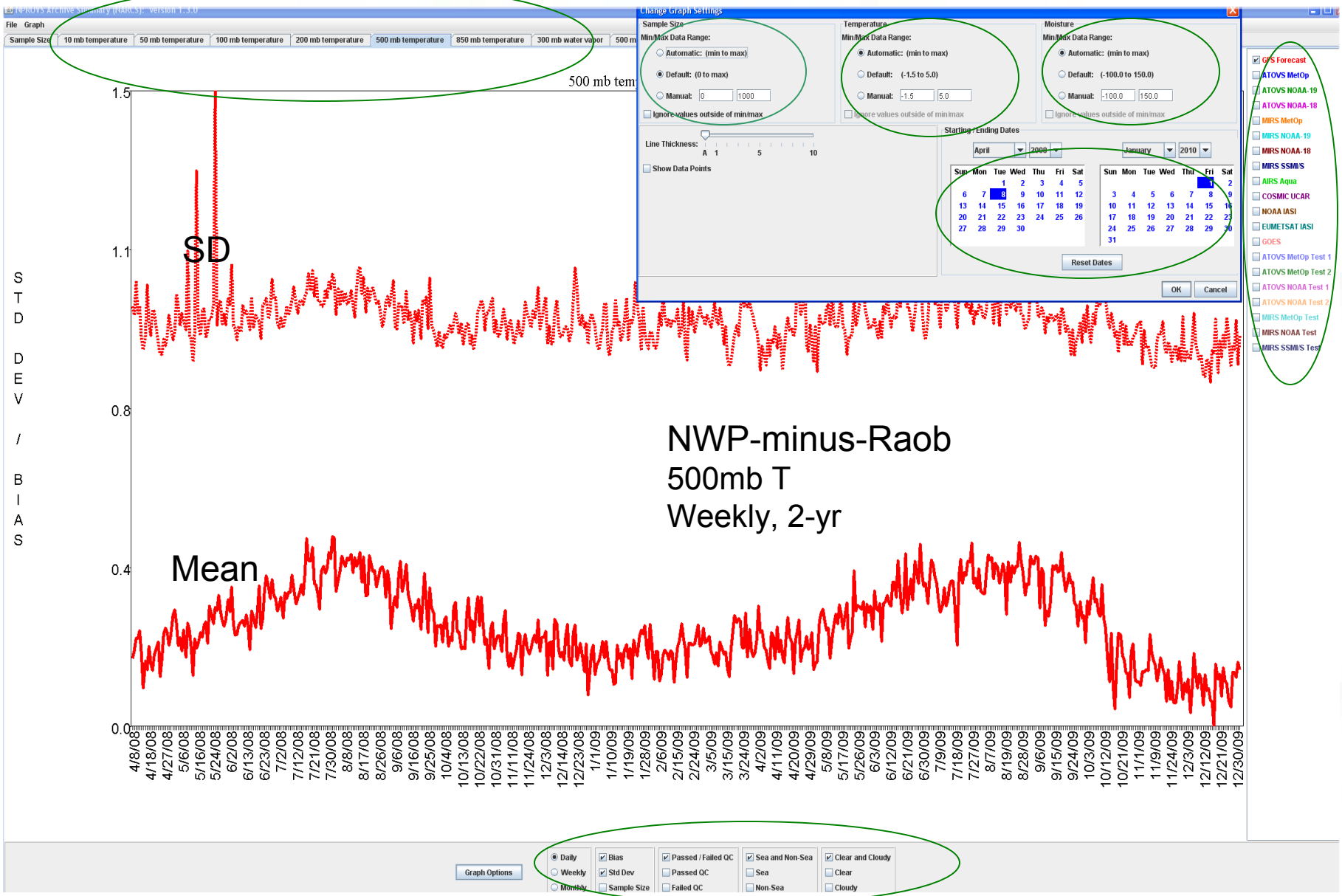
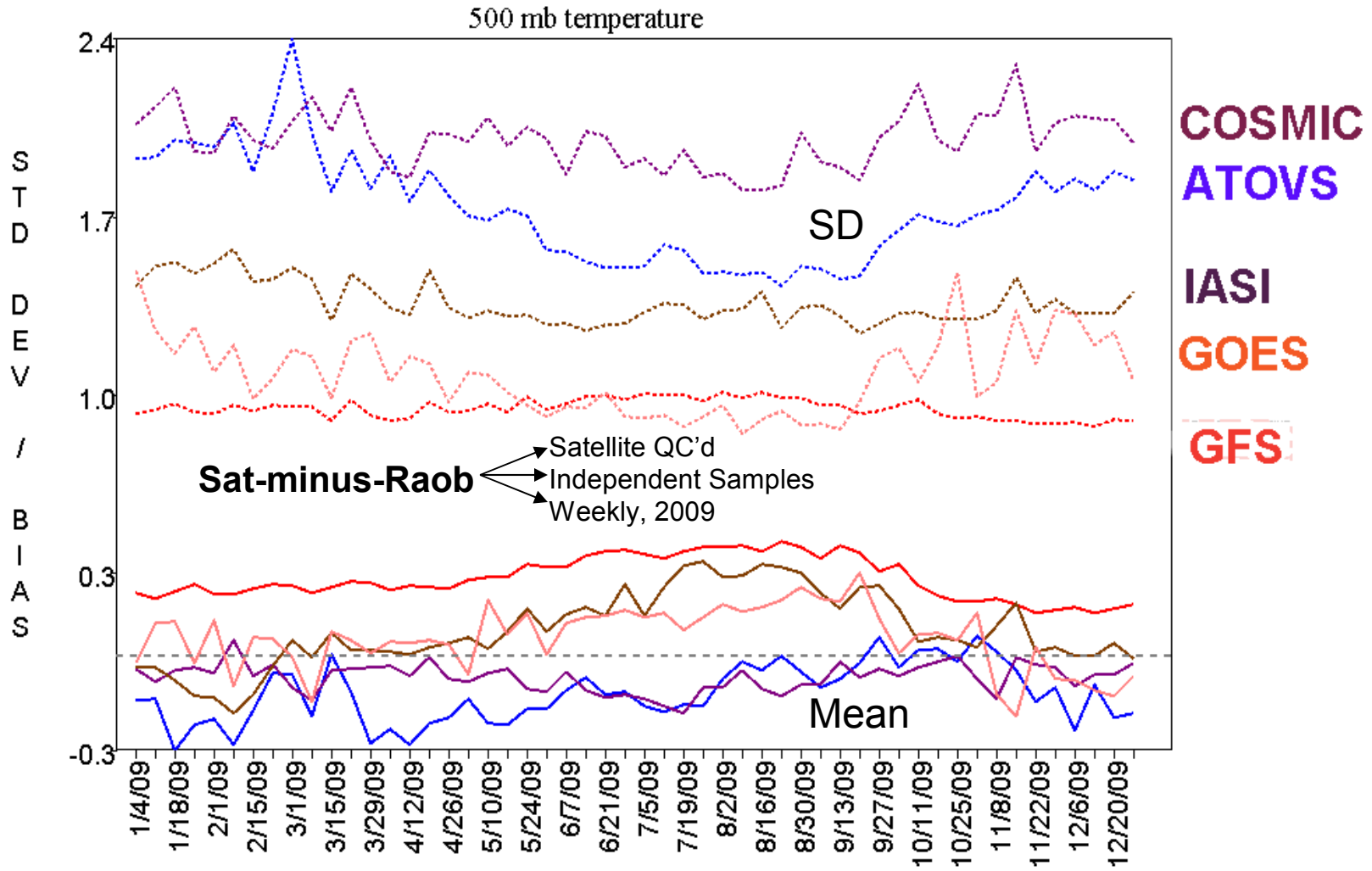
EDGE-NARCSS



… user options for display and analysis of trends …


500 mb temperature
STD DEV / BIAS
2.4
1.7
1.0
0.3
-0.3
SD
Mean
Sat-minus-Raob
Satellite QC'd
Independent Samples
Weekly, 2009
COSMIC
ATOVS
IASI
GOES
GFS
1/4/09
1/18/09
2/1/09
2/15/09
3/1/09
3/15/09
3/29/09
4/12/09
4/26/09
5/10/09
5/24/09
6/7/09
6/21/09
7/5/09
7/19/09
8/2/09
8/16/09
8/30/09
9/13/09
9/27/09
10/11/09
10/25/09
11/8/09
11/22/09
12/6/09
12/20/09

Quantify MisMatch Impact

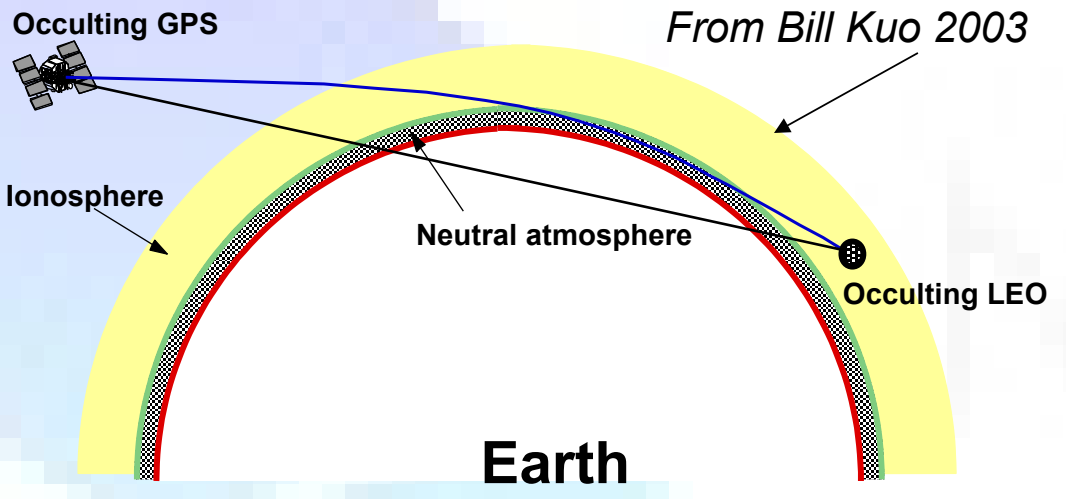
(w/Seidel)

- Analysis Approach
- Raob-COSMIC Collocation Data
- Temporal & Spatial Mismatch Sensitivity

Why COSMIC Data?

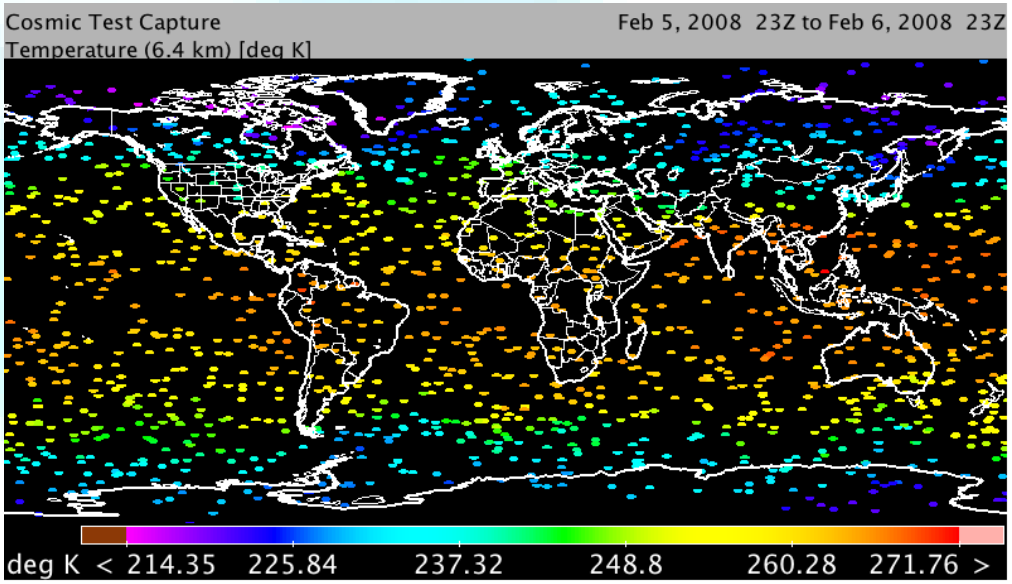
"Constellation Observing System for Meteorology, Ionosphere, and Climate"

- All-weather sounding capability
- High vertical resolution
- No calibration issues
- Good spatial and temporal distribution



Parameters of interest:

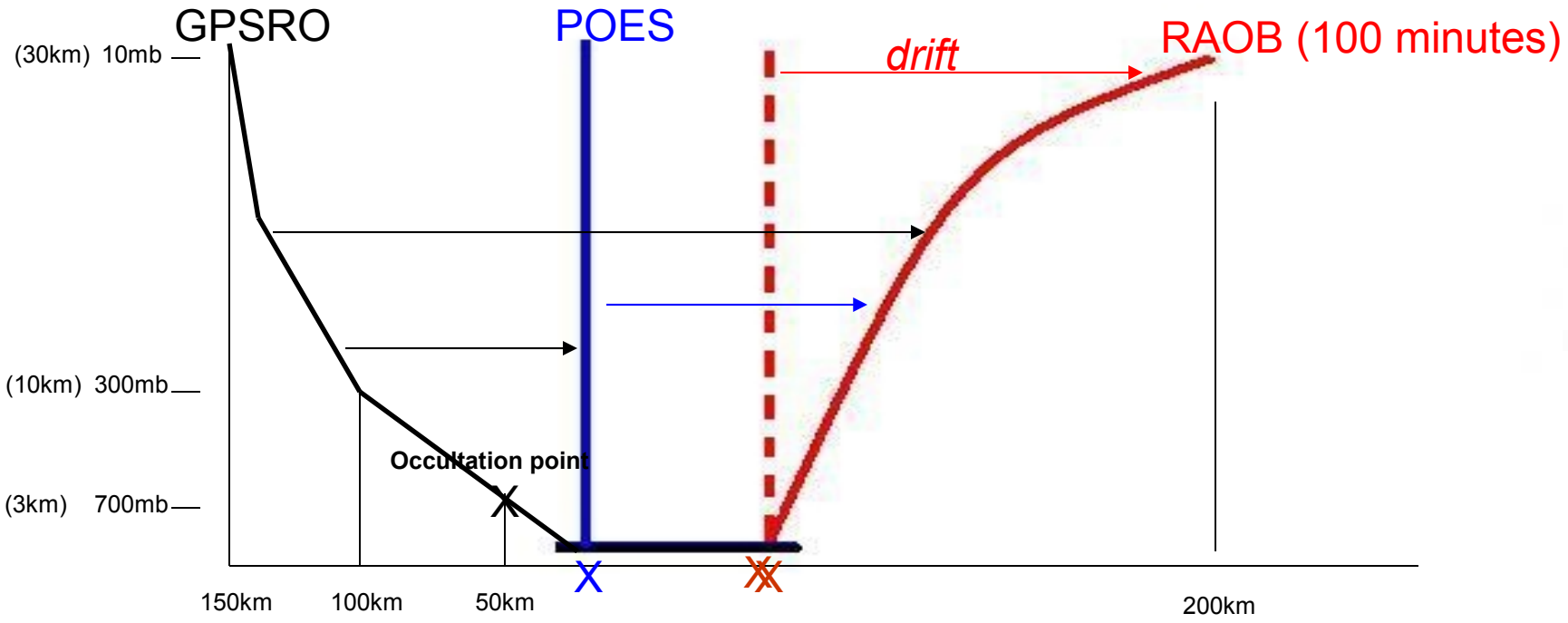
- Refractivity (N)
  - COSMIC: observed
  - Radiosonde: calculated
- Temperature (T)
  - COSMIC: derived
  - Radiosonde: observed
- Relative humidity (RH)
  - COSMIC: derived
  - Radiosonde: observed



Radiosonde refractivity calculation:

$$N = 77.6\frac{P}{T} + 3.73x10^5\frac{P_w}{T^2}$$

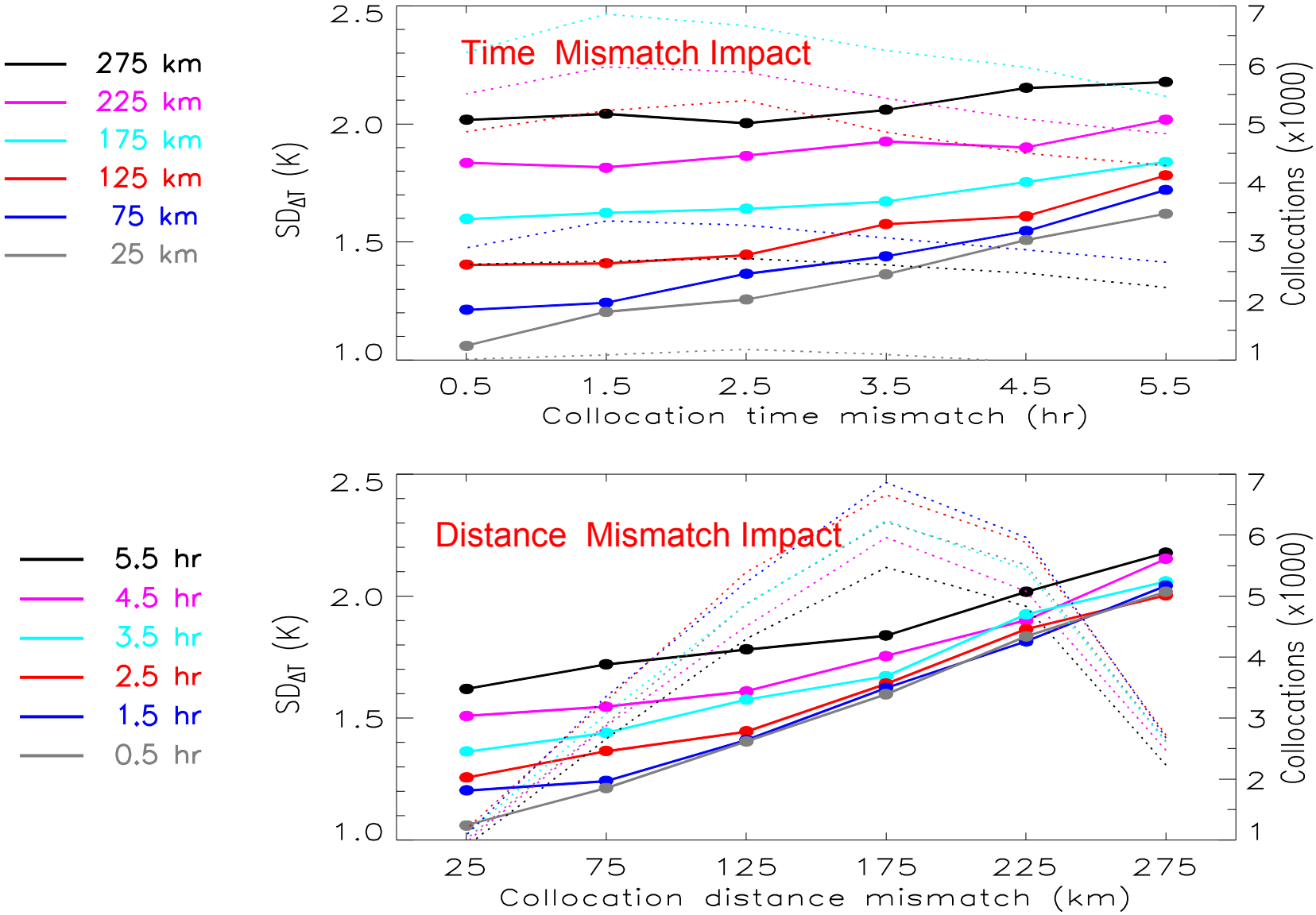
- ISSUE: Raobs are ambiguous as reference for anchoring satellite data
  - Spatial and temporal mismatch compounded by spatial / temporal drift
- GOAL: Quantify the sensitivity of satellite retrieval validation to spatial/temporal mismatch



Analysis Approach

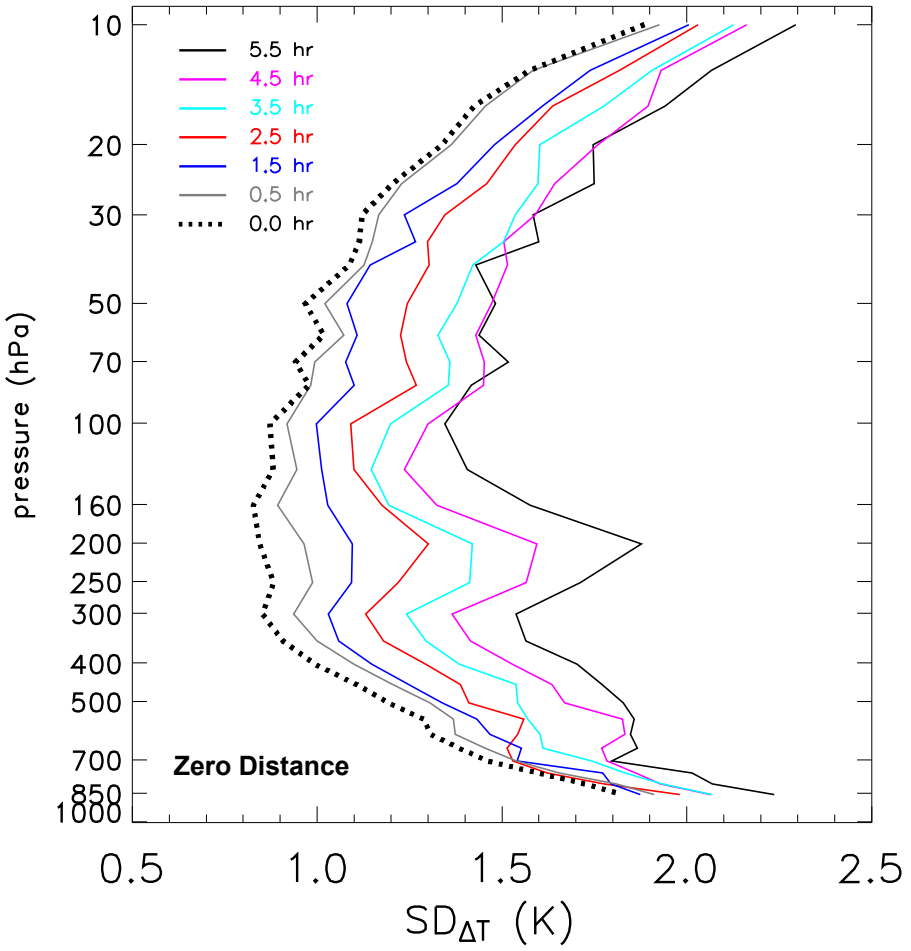
- Find all raob and COSMIC pairs that are within 6 hours and 250 km distance from each other;
- **These pairs are divided into 1-hr & 50-km bins … 36 bins;**
- The mean $\overline{\Delta X}$ and $SD_{\Delta X}$ of the difference of all pairs within each bin are computed;
- Regression technique is applied to estimate the mismatch impact:
  - Time: $\partial(\overline{\Delta X})/\partial t$; $\partial(SD_{\Delta X})/\partial t$
  - Distance: $\partial(\overline{\Delta X})/\partial d$; $\partial(SD_{\Delta X})/\partial d$

Mismatch Impact
(300 hPa Temperature)

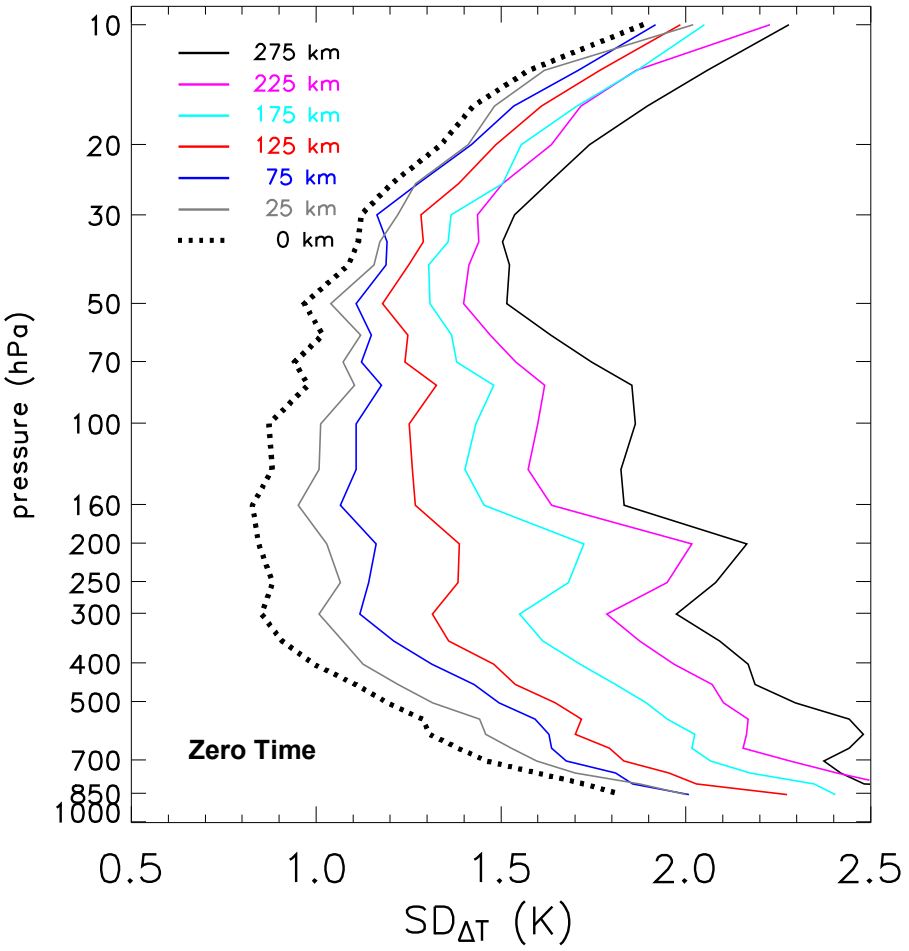


Mismatch Impact
(Temperature)

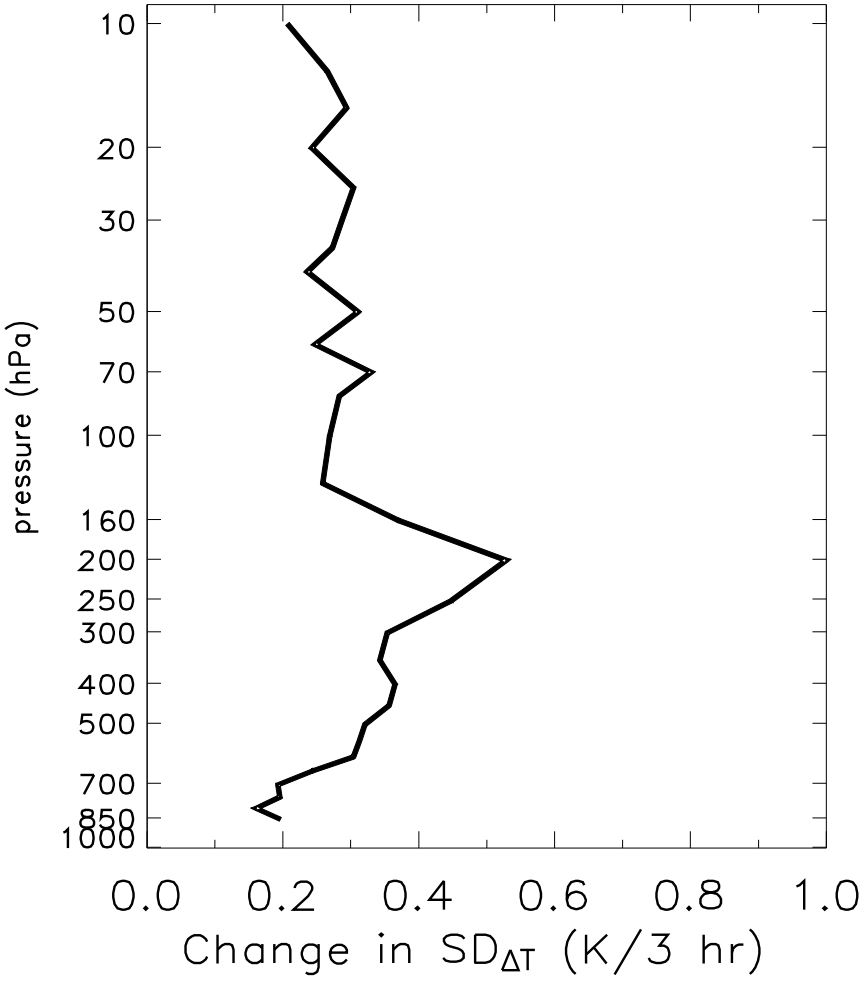
Time

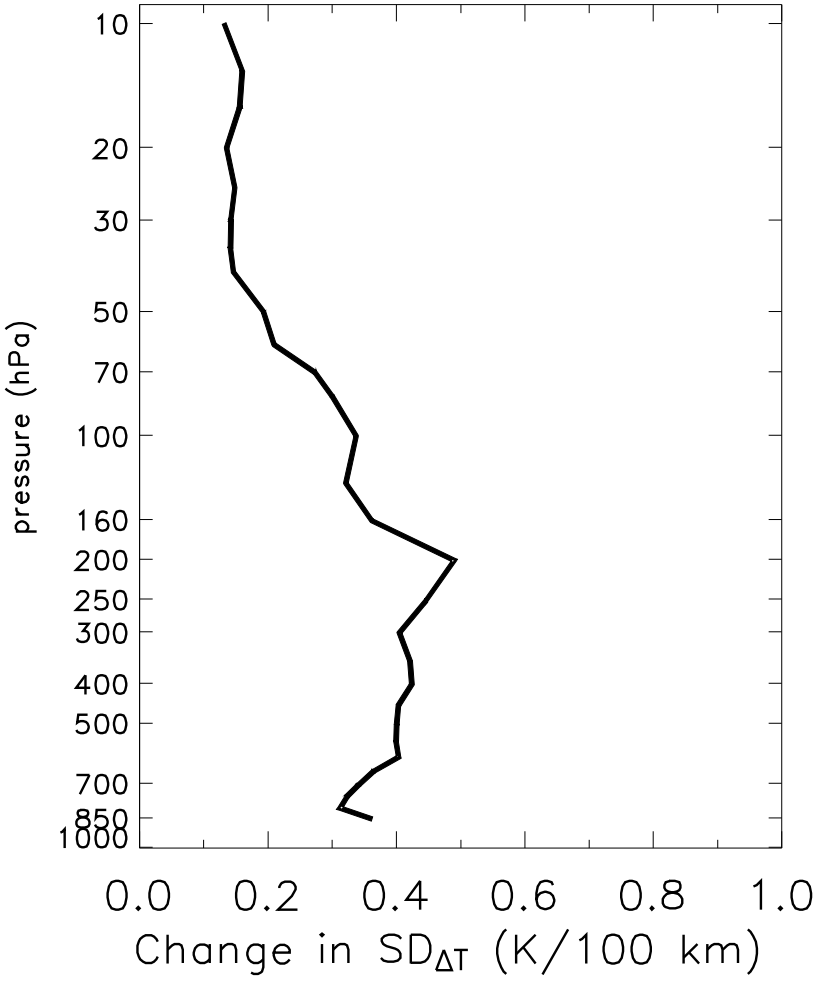


Distance



Spatial Temporal Sensitivity (Temperature)





Distance Mismatch Impact

$SD_{\Delta X}$ per 100 km

	T (K)	RH (%)	Fractional N (%)
Globe	0.42 (0.030) *0.22 (0.025)*	3.05 (0.290)	0.36 (0.023)
Mid-high Latitudes	0.46 (0.031) *0.22 (0.025)*	3.19 (0.298)	0.35 (0.021)
Low Latitudes	0.20 (0.048) *0.22 (0.052)*	2.58 (0.461)	0.32 (0.050)

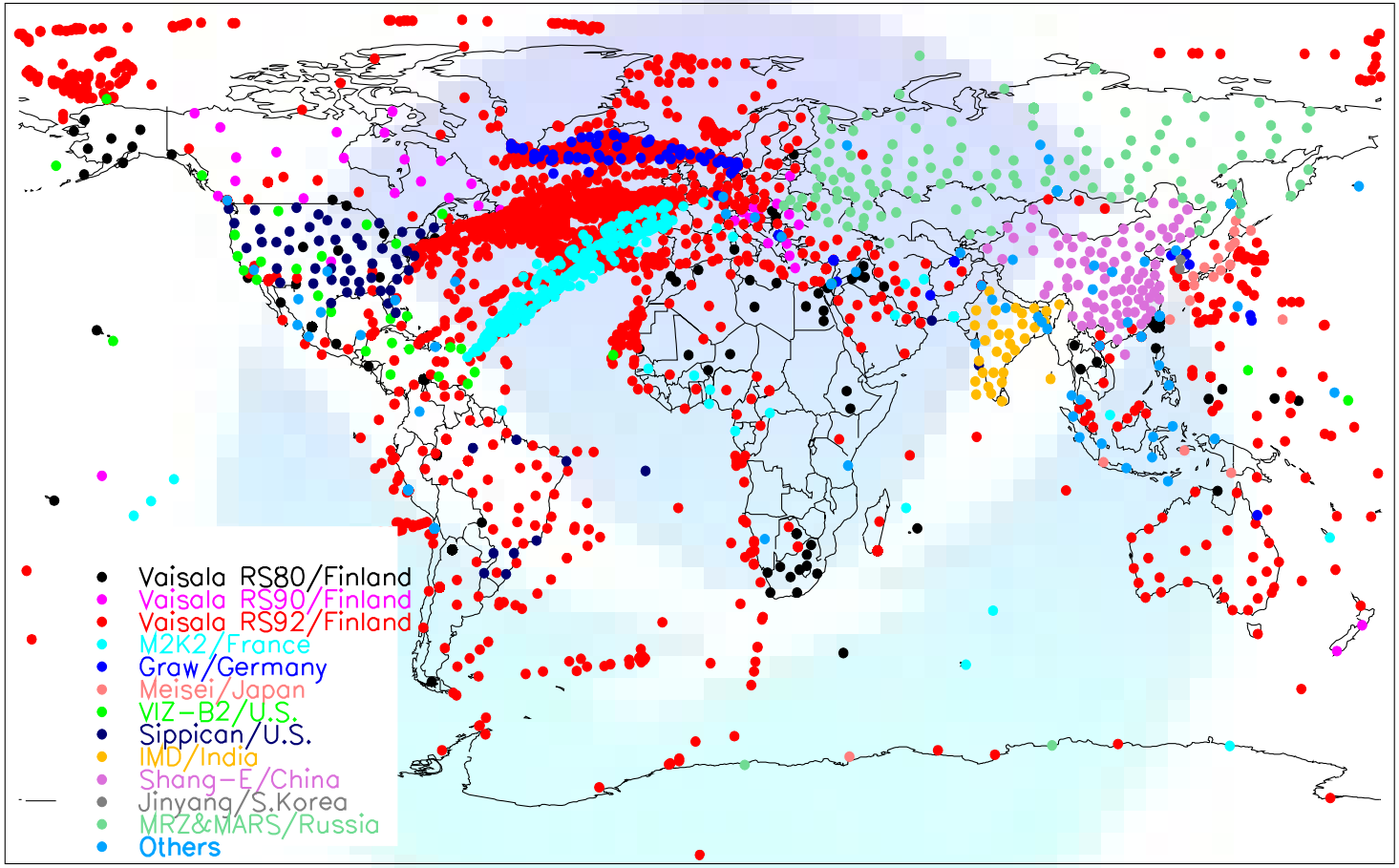
SD errors introduced by ***distance mismatch per 100 km*** averaged from 850 hPa to 200 hPa for the troposphere *(and 200 hPa to 10 hPa for the stratosphere T, second row*); values within the parentheses are the standard errors of the estimations; mid-high latitude is poleward 30°

Time Mismatch Impact

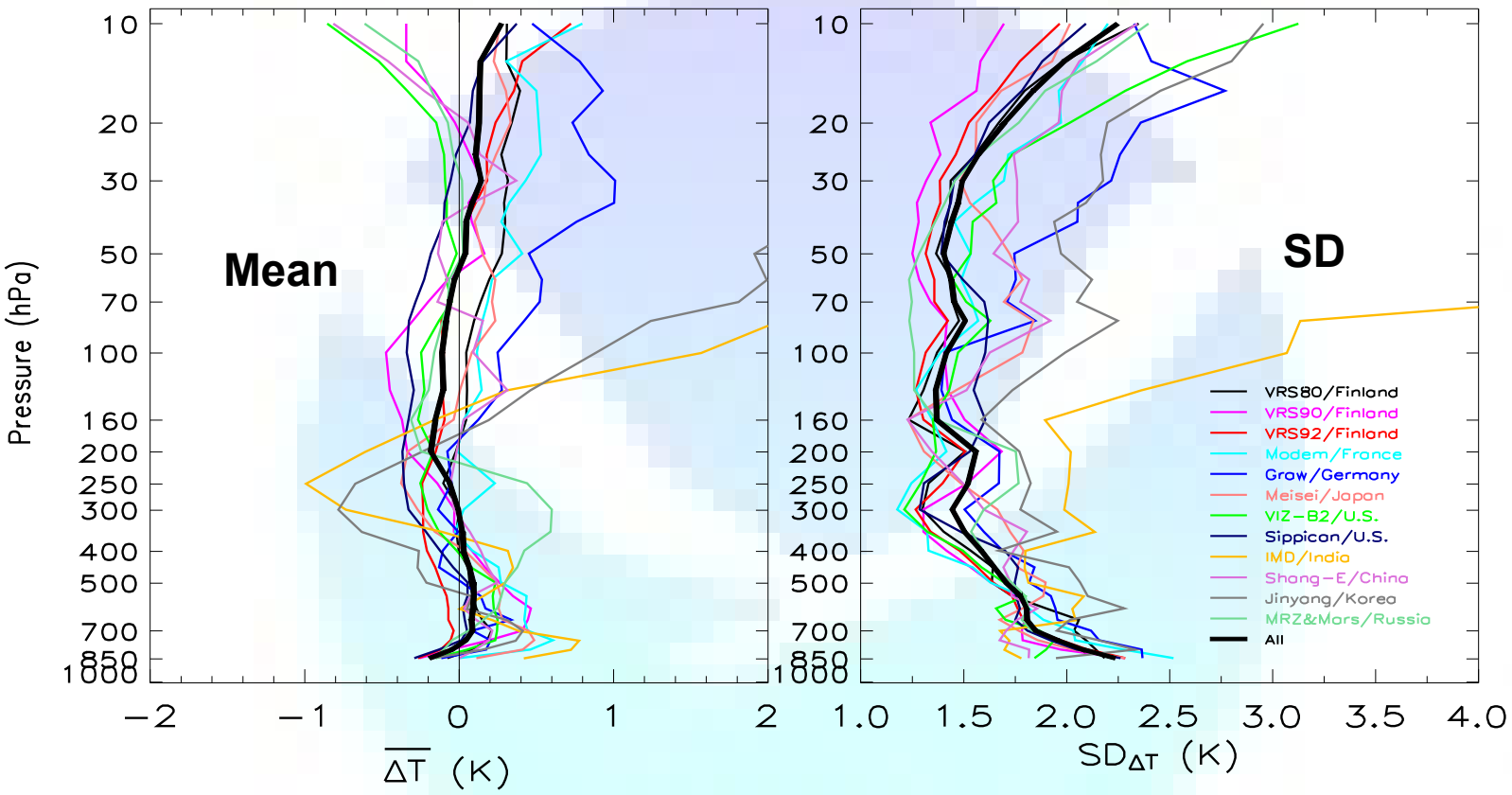
$SD_{\Delta X}$ per 3 hr

	T (K)	RH (%)	Fractional N (%)
Globe	0.35 (0.042) *0.30 (0.042)*	3.44 (0.507)	0.33 (0.038)
Mid-high Latitudes	0.40 (0.049) *0.27 (0.053)*	3.68 (0.549)	0.34 (0.036)
Low Latitudes	0.11 (0.121) *0.47 (0.139)*	2.45 (0.980)	0.22 (0.095)

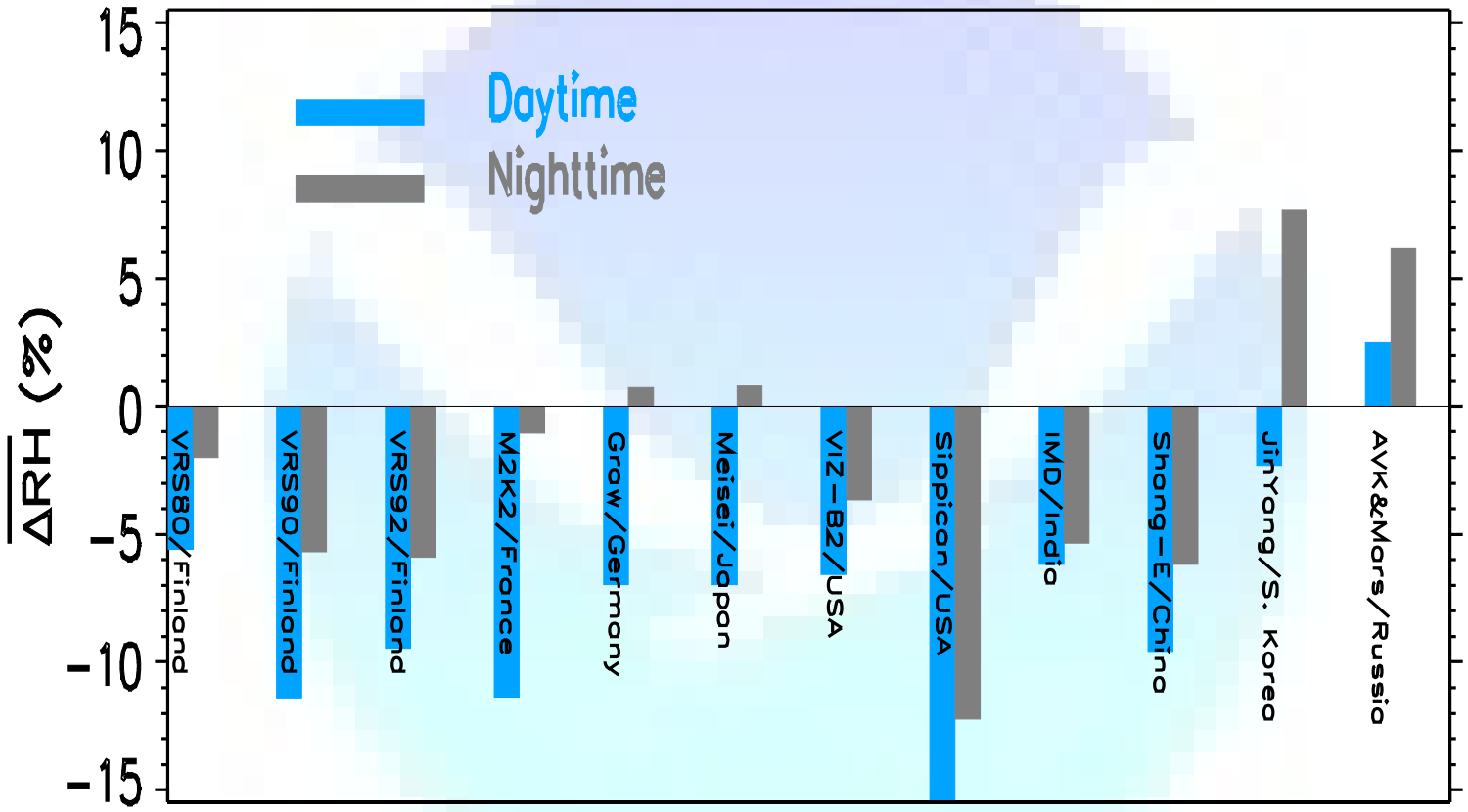
SD errors introduced by ***time mismatch per 3hr*** averaged from 850 hPa to 200 hPa for the troposphere (*and 200 hPa to 10 hPa for the stratosphere T, second row*); values within the parentheses are the standard errors of the estimations; mid-high latitude is poleward 30°



Radiosonde Instrument Type Inter-comparisons

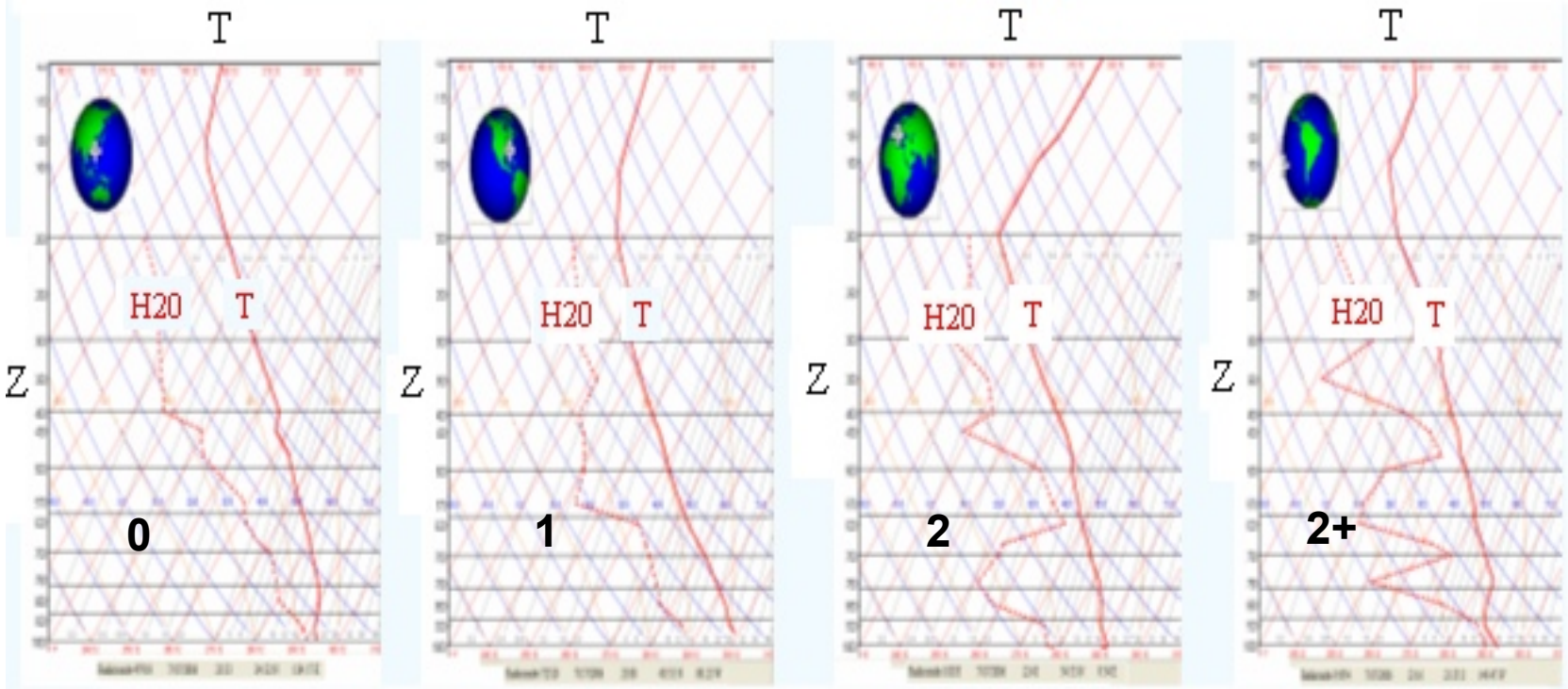


Temperature inter-comparison among radiosonde types based on Raob-minus-COSMIC difference

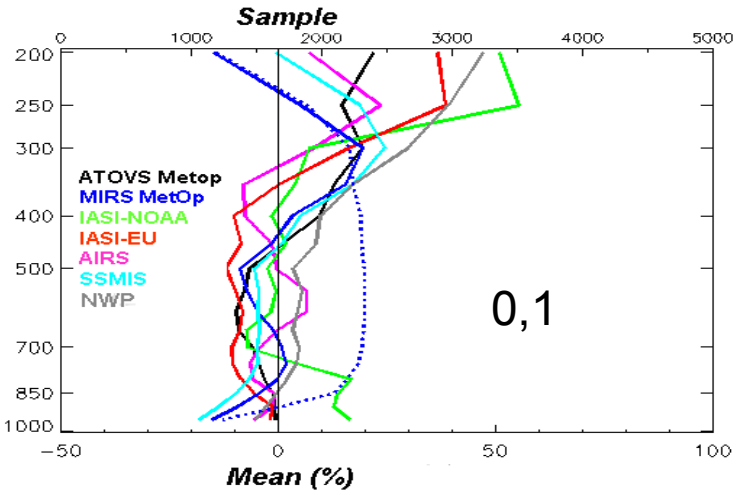


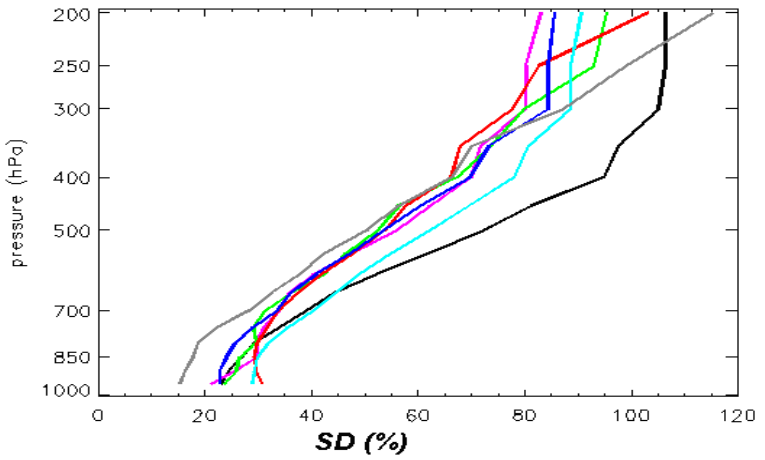
Mean raob-minus-COSMIC RH difference for different radiosonde types day versus night at 300 hPa.

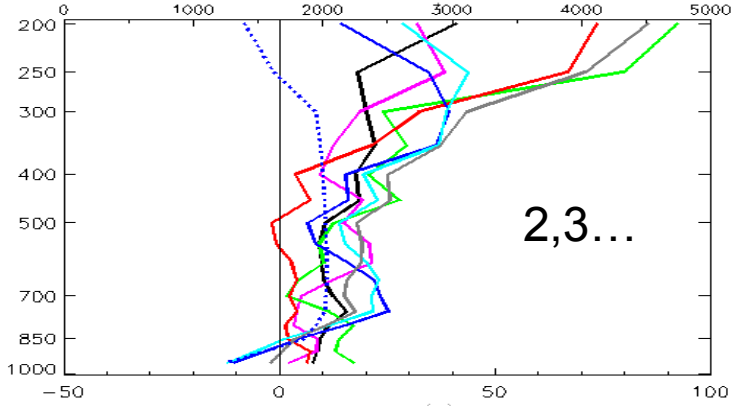
... new moisture screening approach

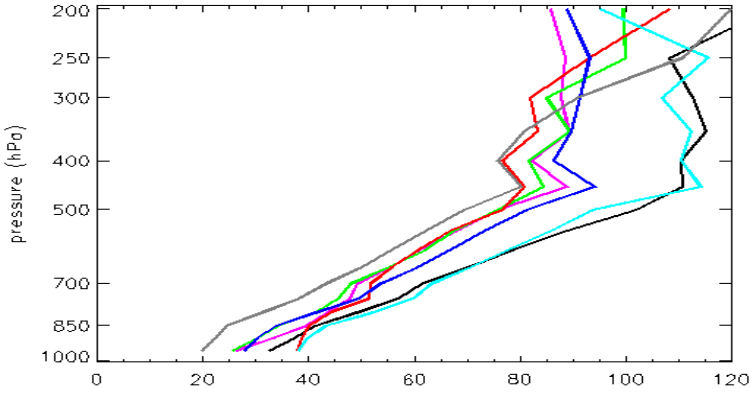


- Analyzes for abrupt changes in moisture profiles
- Scores each profile (0, 1, 2, 3 or more)









Examples of vertical plots of satellite-minus-radiosonde mean (left) and standard deviation (right) for fractional (%) WVMR for July-09 (31 days) for selected systems based on common denominator samples for the denoted systems and products which passed respective QC for all terrain and sky conditions segregated for radiosondes with WVMR scores of 0 and 1 (top) and 2 or more (bottom); the blue dashed curves on each plot indicate the sample size (top-most axis) at each pressure level (y-axis) and NWP profiles are the GDAS 6-hr forecast collocated with the radiosonde.

Summary & Discussion

- **NPROVS in support of GRUAN site monitoring … RT Validation**
  - **Integrate GRUAN Raob "*and ground*" into NPROVS**
- **Satellite-minus-Raob mismatch sensitivity … weather scale**
- **Raob Instrument Type Analysis**
- ***http://www.star.nesdis.noaa.gov/smcd/opdb/poes/NPROVS.php***

- Is mismatch sensitivity detectable on the *"climate scale"* ??
  - does SD error computed from "*monthly means*" change significantly (detectable) with mismatch?
  - **10-yr RO oriented collocation database** !!

THE END