The 10th GRUAN Implementation-Coordination Meeting
April 23-28, 2018
Potsdam, Finland

On the accuracy of Vaisala RS41 versus RS92 upper air observations: Implications for satellite data cal/val

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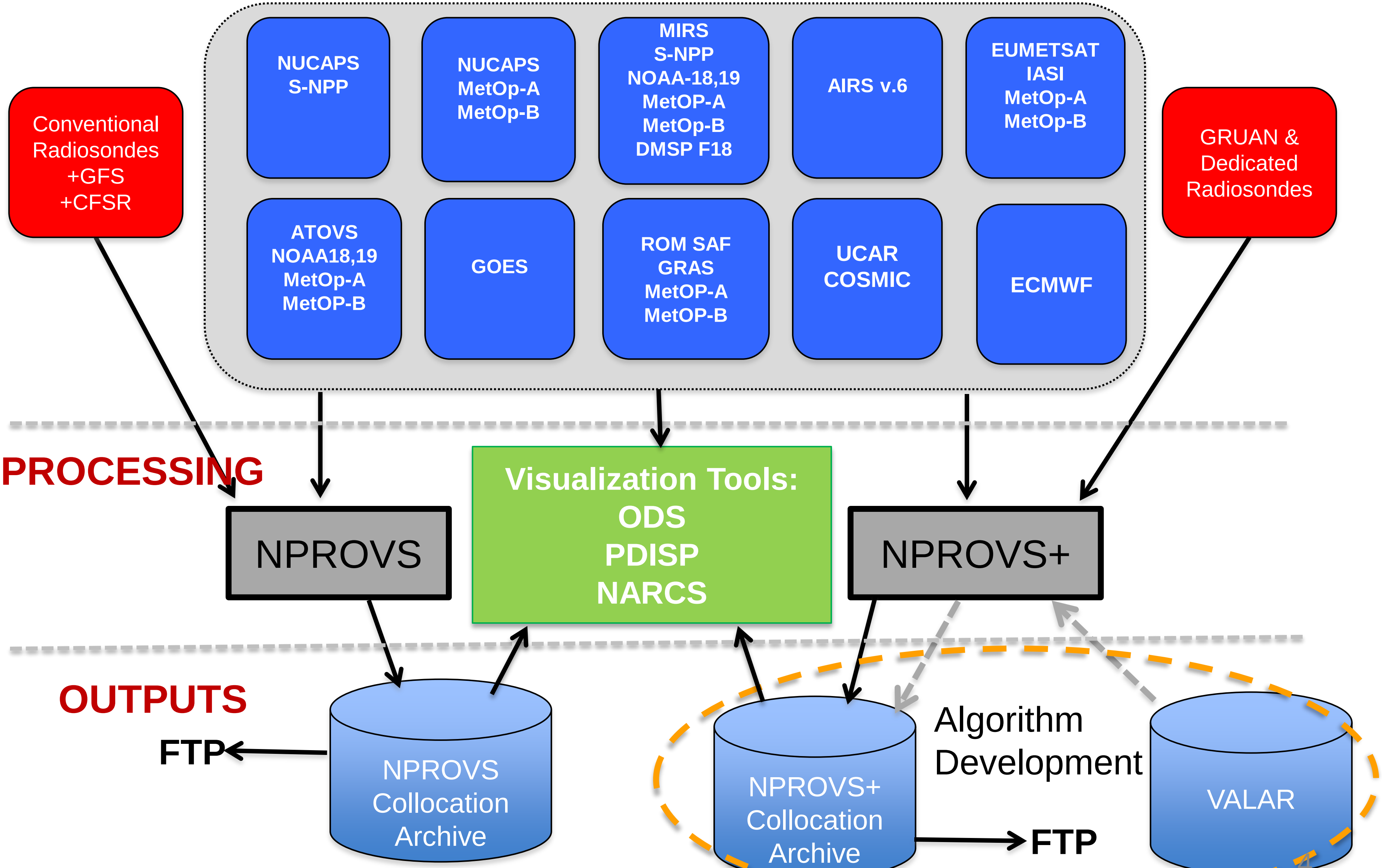
RS92 versus RS41 Data Comparison Methods

- Using NWP as the transfer medium (T, RH)
  – Compute OB-BG for RS92 and RS41
  – Compute OB-AN for RS92 and RS41
- Using GPSRO as the truth (T)
- Direct comparison using dual launches from 6 sites (T, RH)

Data (2015.01-2017.06)

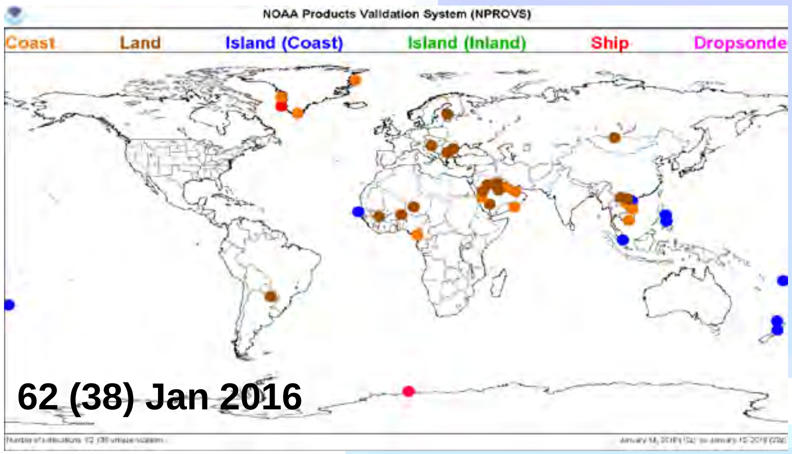
- Conventional radiosonde data
  - Vaisala RS41 (~65,000) and RS92 (~311,500)
- Dual (twin/simultaneous) launch data
  - 6 sites
- NWP data (used for OB-BG and OB-AN)
  - NOAA Climate Forecast System Re-analysis (CFSR) forecast background and analysis
  - ECMWF analysis
- GPSRO Tdry (used as the truth)
  - UCAR COSMIC
  - ROM SAF GRAS
- RS92 vs RS41 in satellite data validation:
  - NOAA sounding retrievals from S-NPP CrIS/ATMS
  - EUMETSAT sounding retrievals from MetOp IASI/AMSU

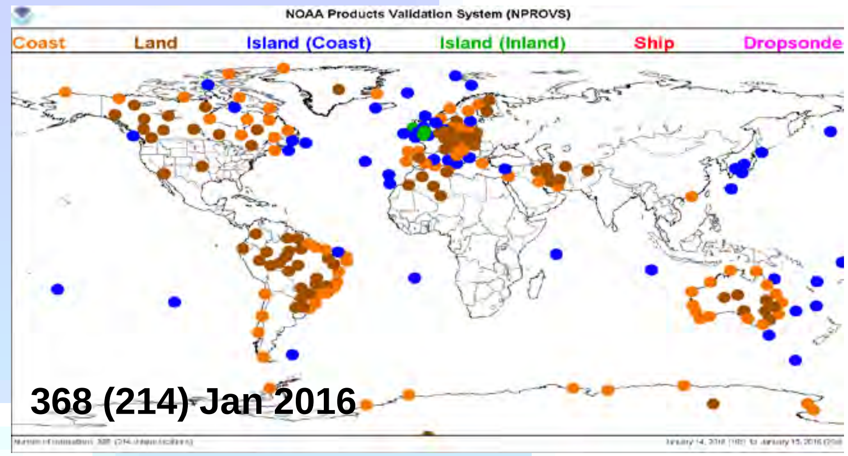
NOAA Products Validation System: NPROVS and NPROVS+

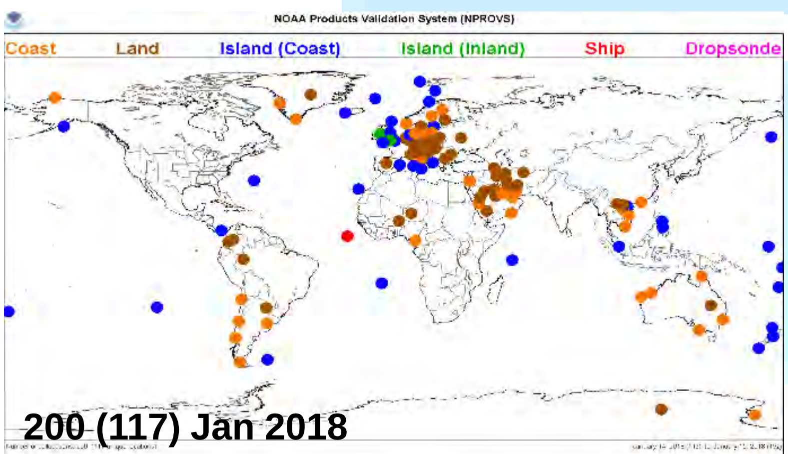


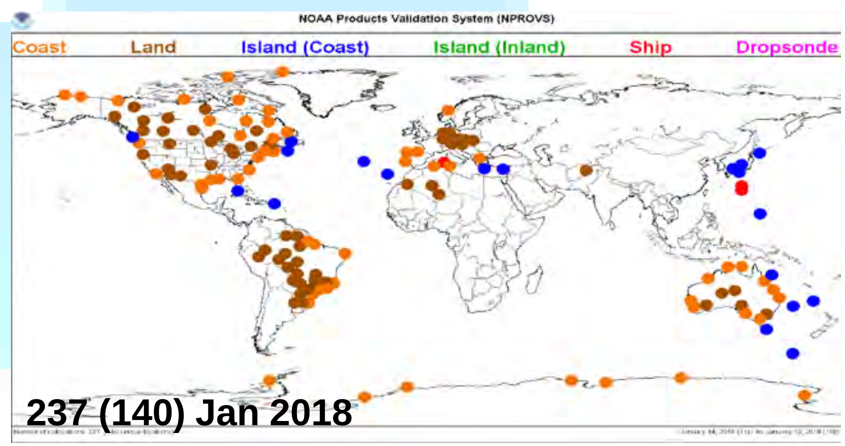
Satellite single closest matchup with a given raob

RS92 to RS41 transition in the conventional network



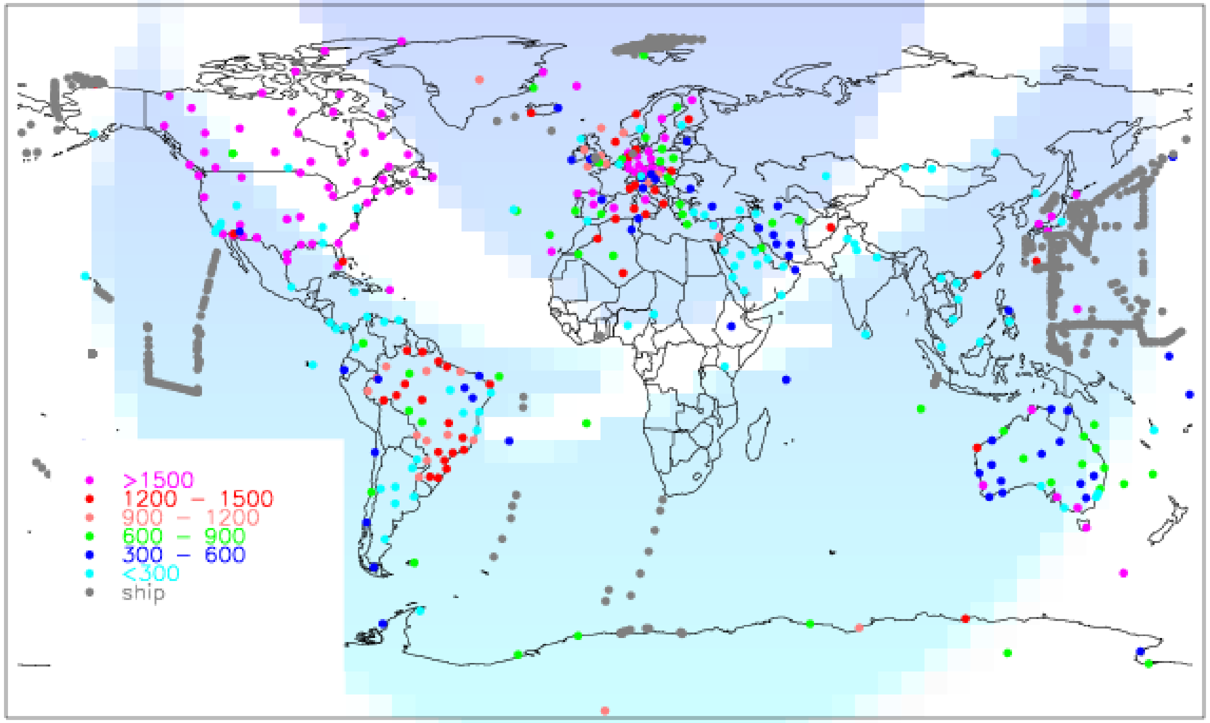




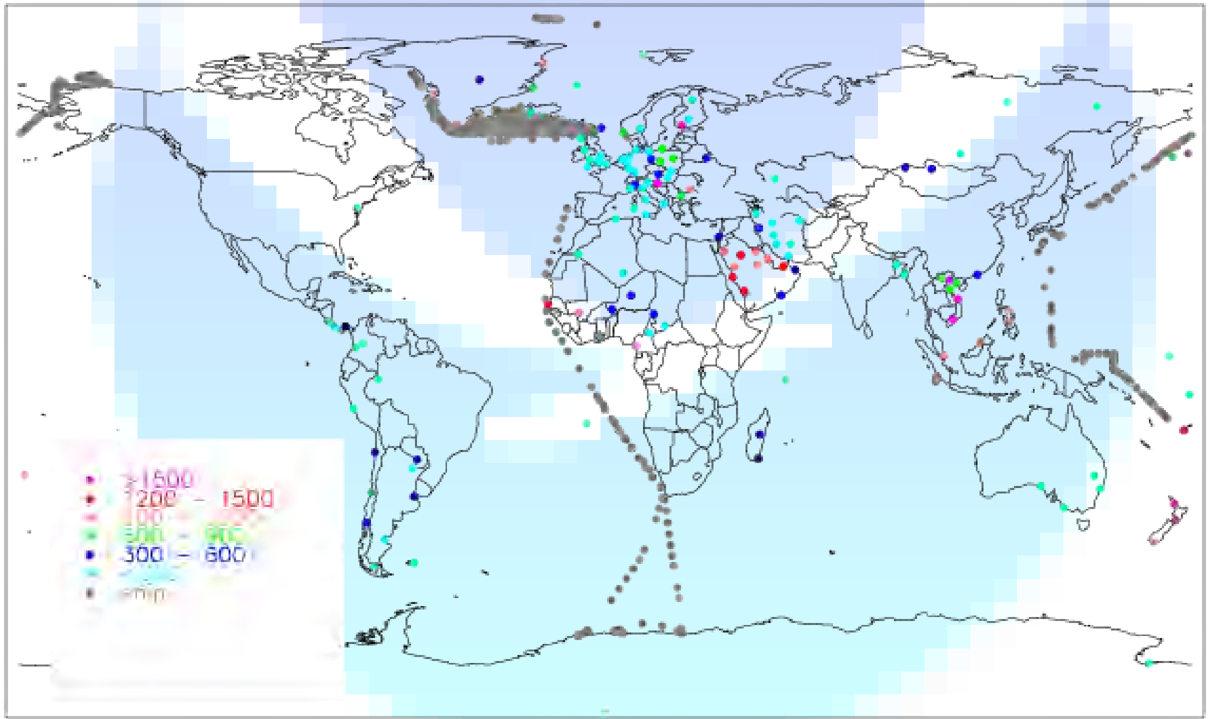


RS41 **RS92**

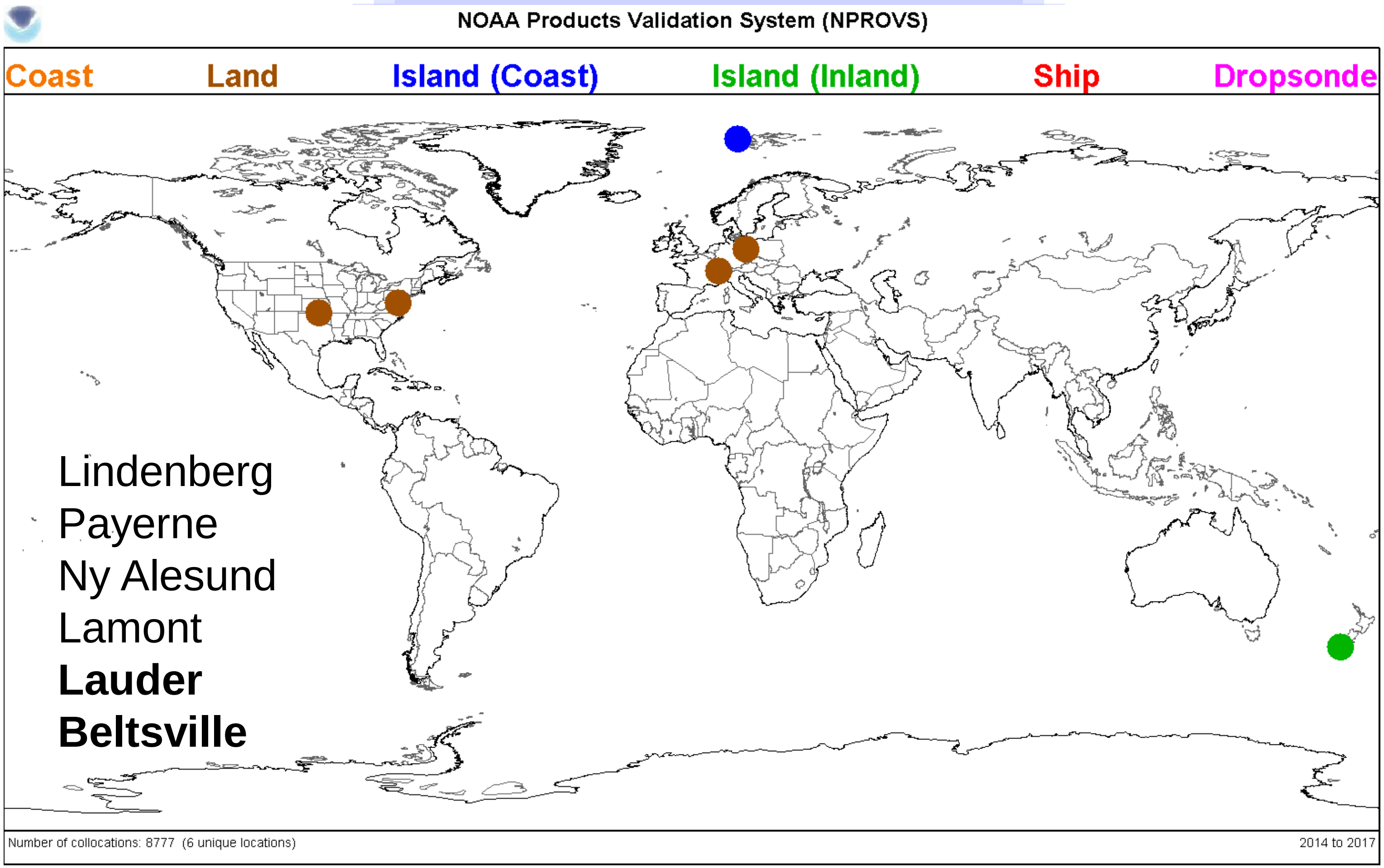
Conventional RS92 during 2015.01 – 2017.6 (~311500 profiles)



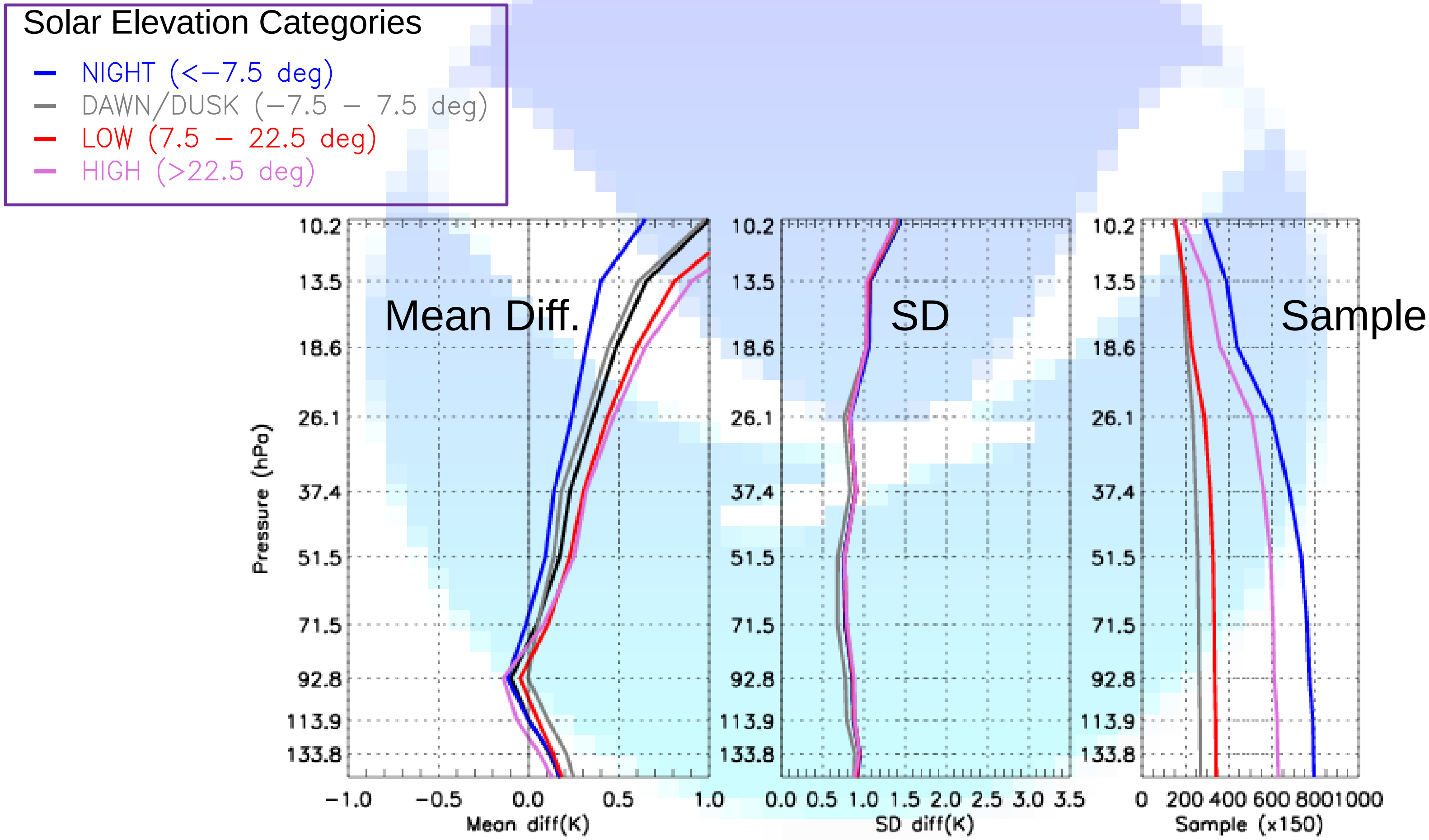
Conventional RS41 during 2015.01 – 2017.6 (~65900 profiles)



RS92 RS41 Dual sites

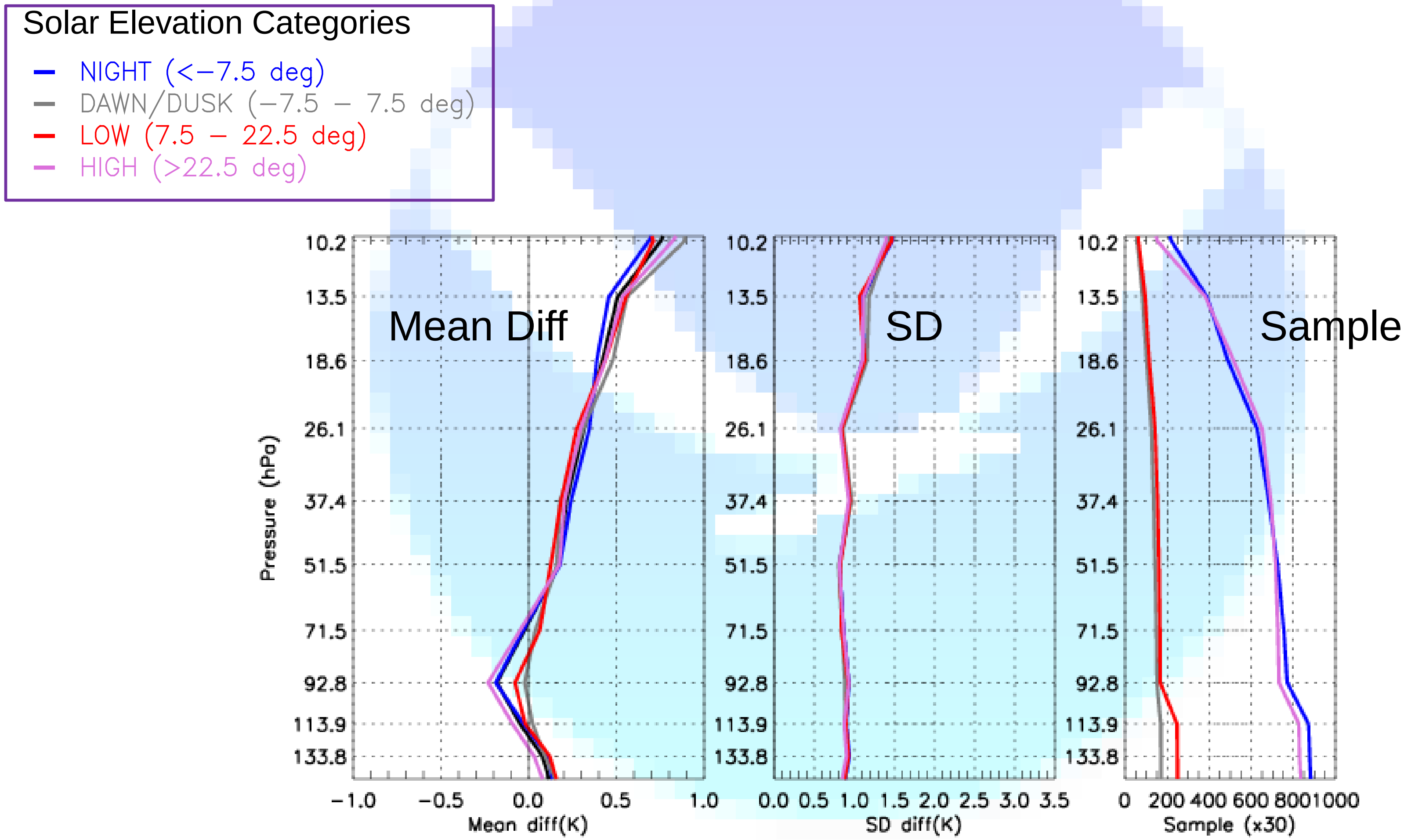


T, RS92-minus-BG CFSR

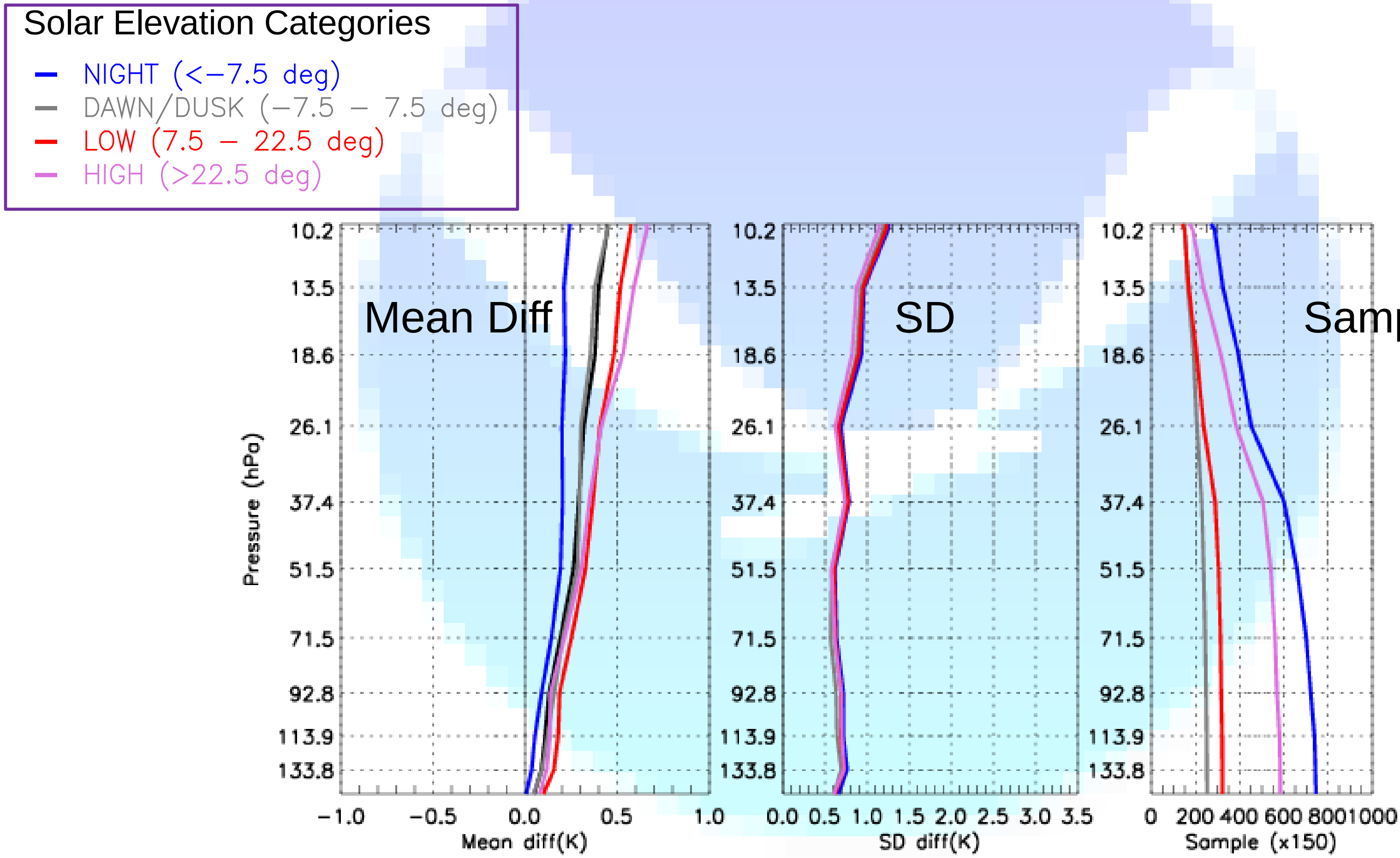


e.g., 12Z BG: 3-hr forecast made at 09Z

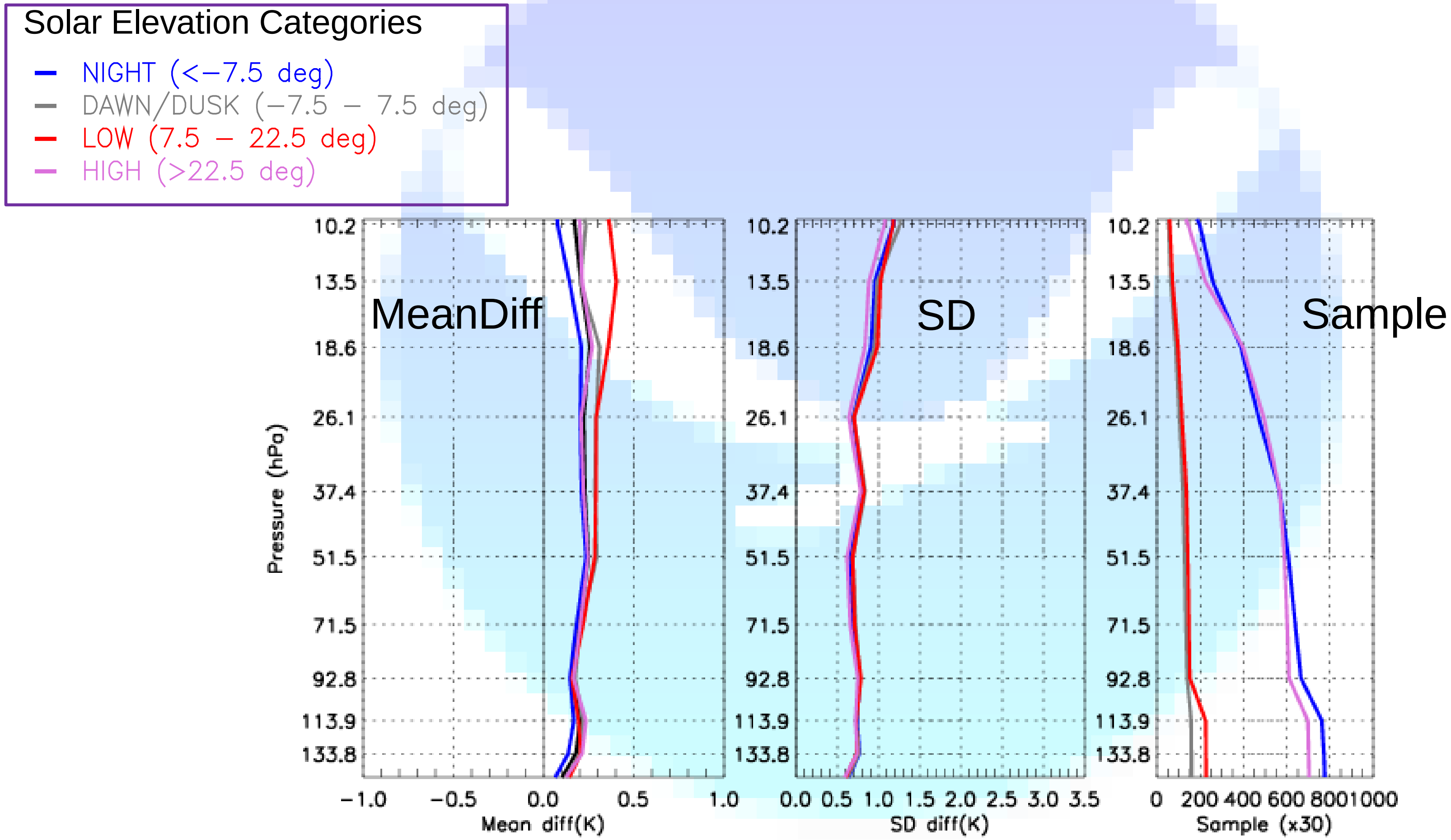
T, RS41-minus-BG CFSR



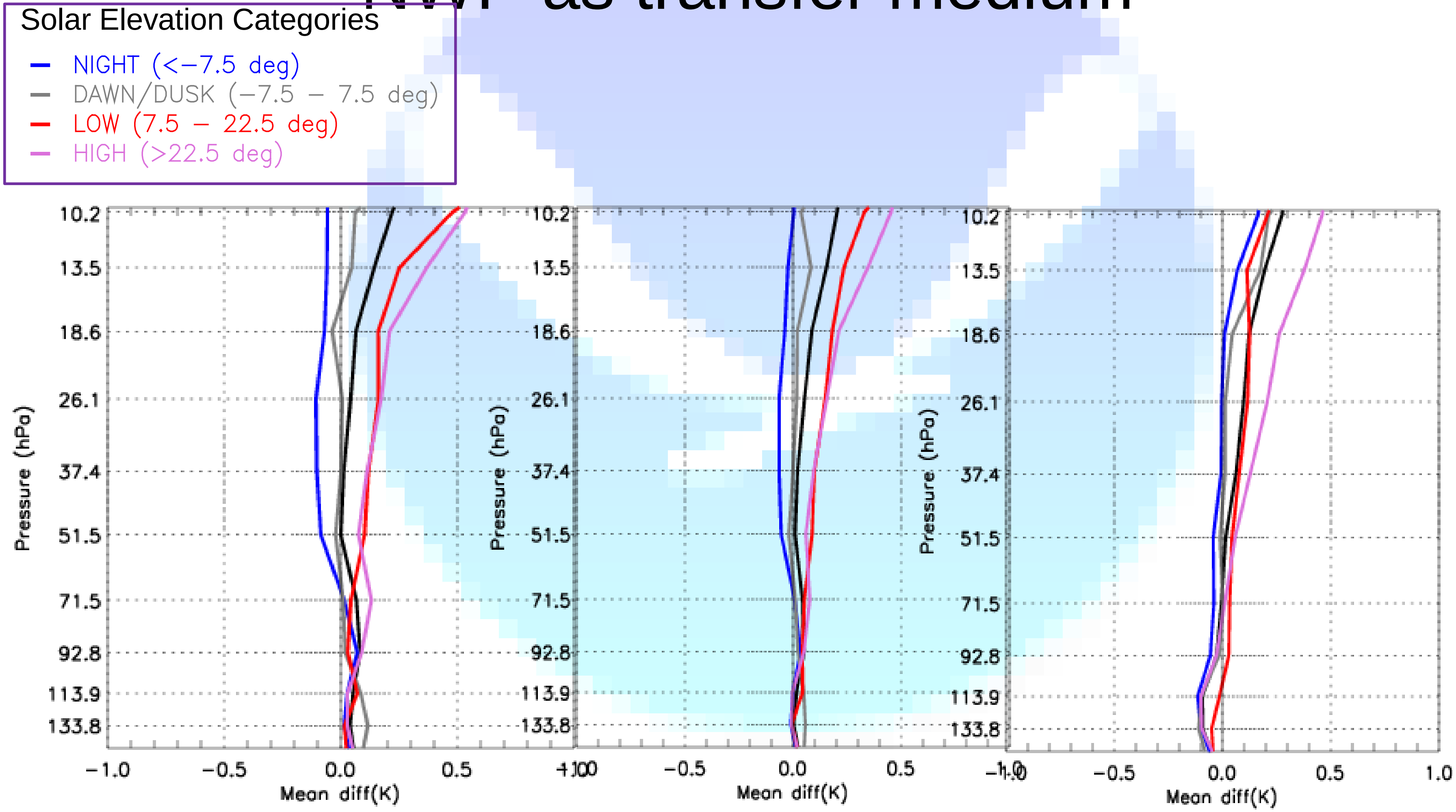
T, RS92-minus-AN ECMWF



T, RS41-minus-AN ECMWF



(RS92-minus-RS41) obtained using NWP as transfer medium



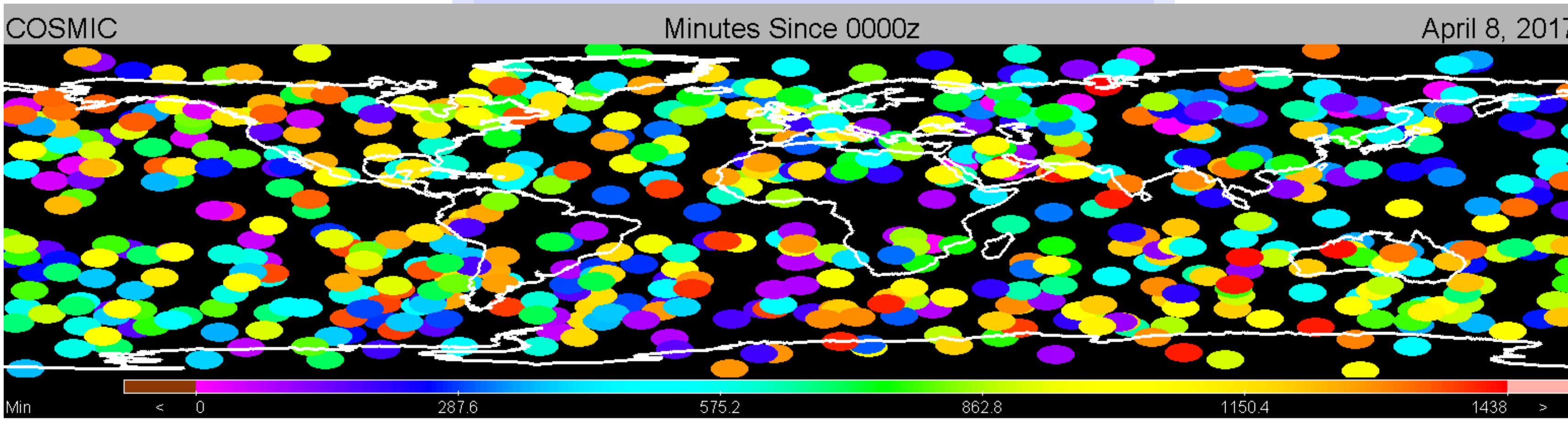
BG CFSR

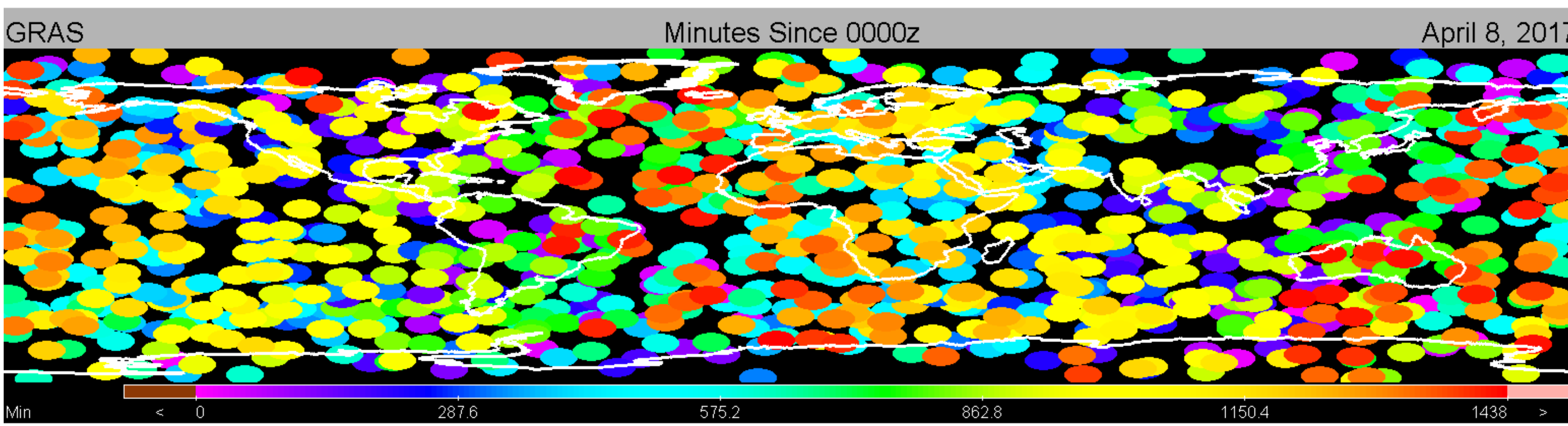
AN CFSR

AN ECMWF

COSMIC-1 and GRAS RO

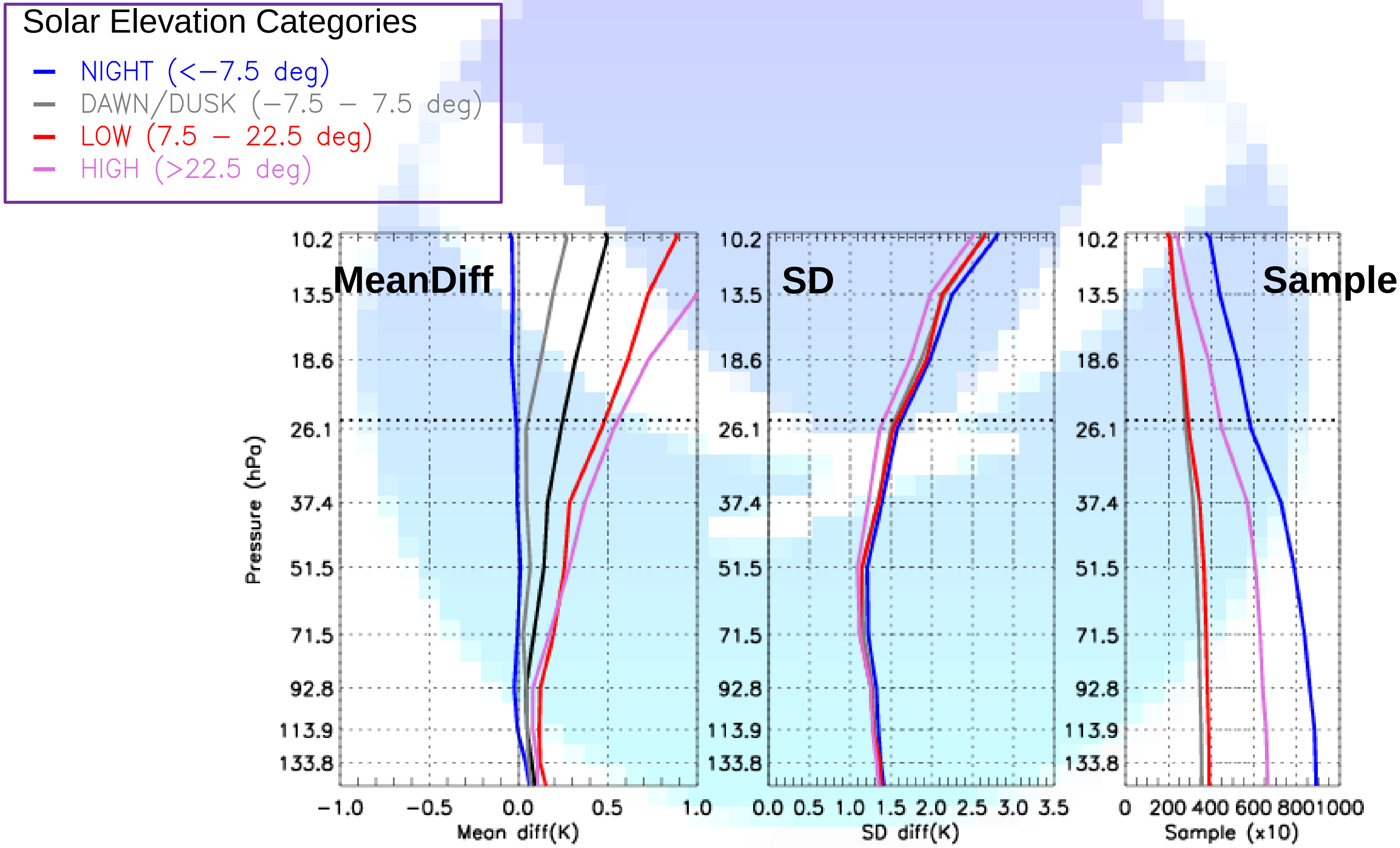
(April 8, 2017)





COSMIC RO profiles: 618
GRAS RO profiles: 1200

RS92-minus-Tdry COSMIC

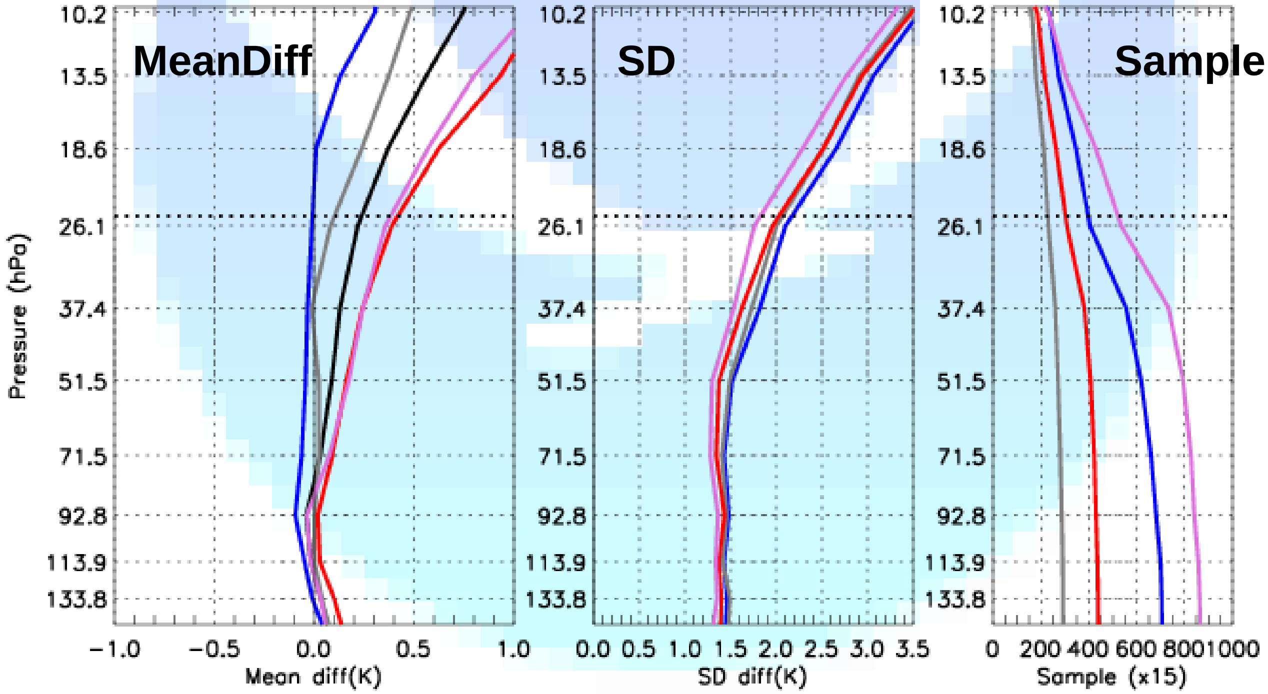


Similar to Sun et al. (2013, JGR) based on 2008-2011 data

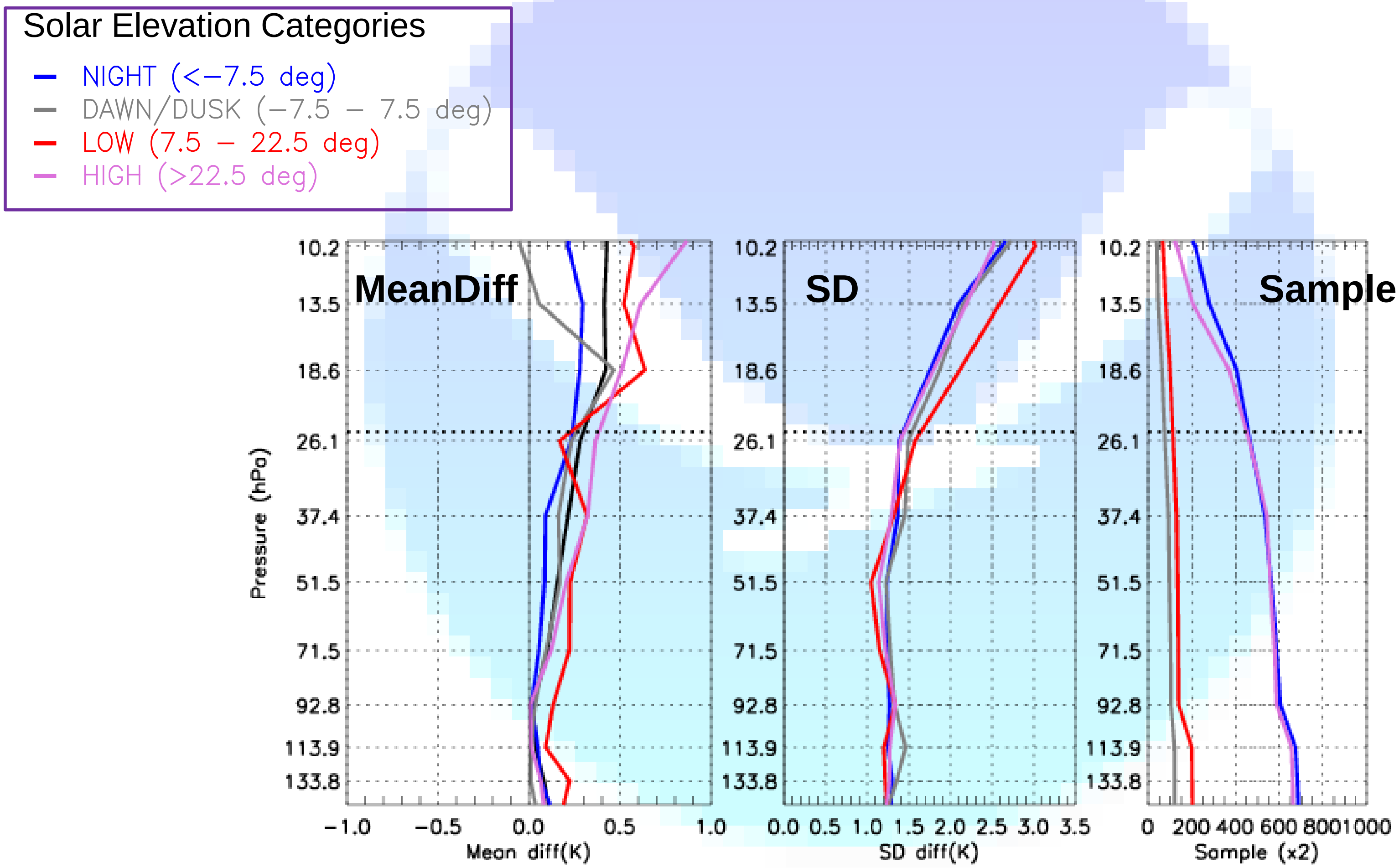
RS92-minus-Tdry GRAS

Solar Elevation Categories

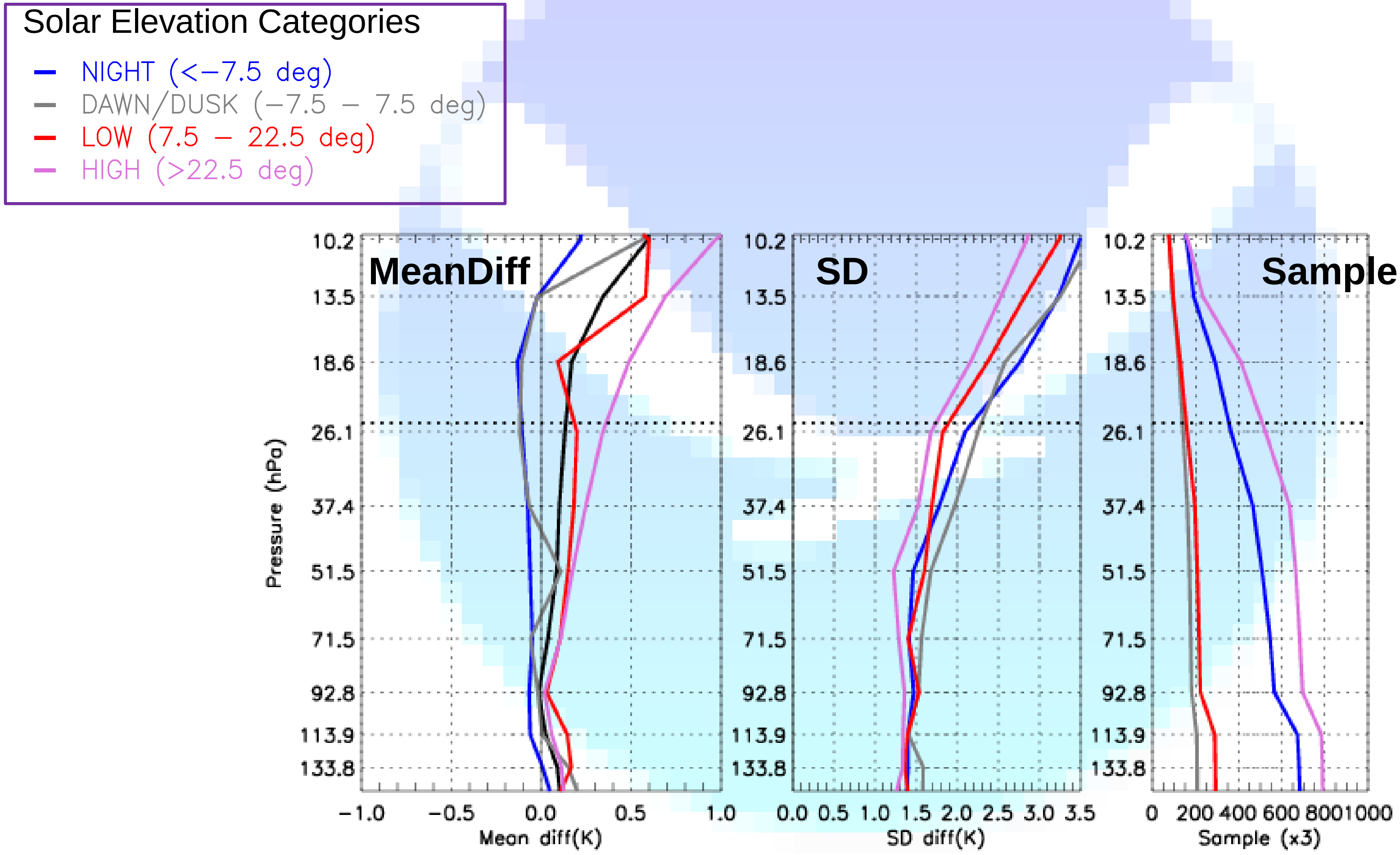
- NIGHT (<−7.5 deg)
- DAWN/DUSK (−7.5 − 7.5 deg)
- LOW (7.5 − 22.5 deg)
- HIGH (>22.5 deg)



RS41-minus-Tdry COSMIC



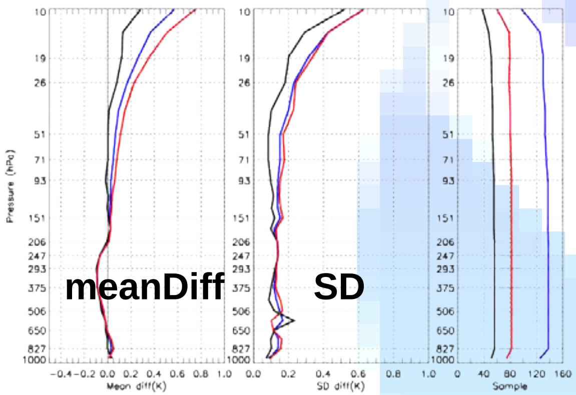
RS41-minus-Tdry GRAS



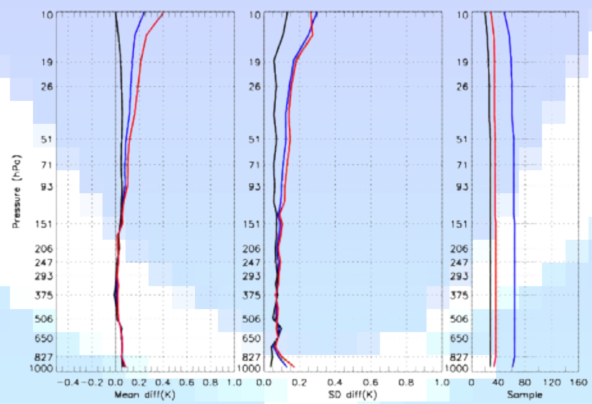
T RS92-minus-RS41 from duals

- NIGHT (<−7.5 deg)
- DAY (> 7.5 deg)
- ALL

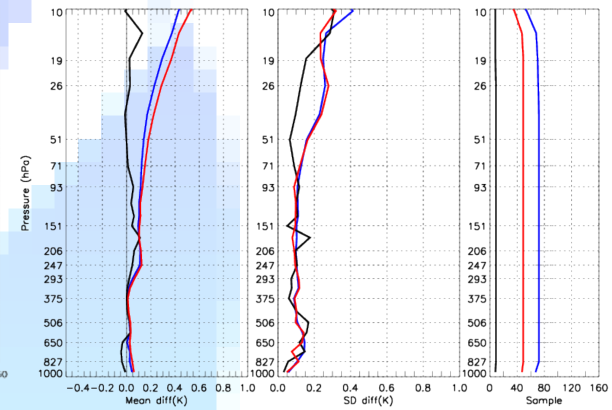
Lindenberg



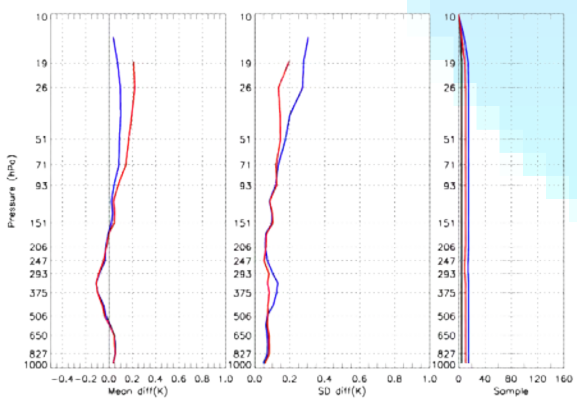
Payerne



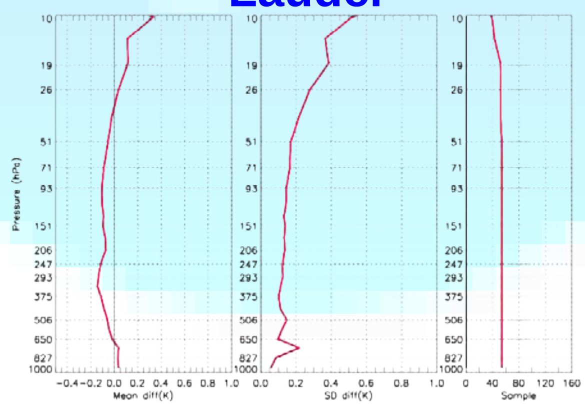
Ny Alesund



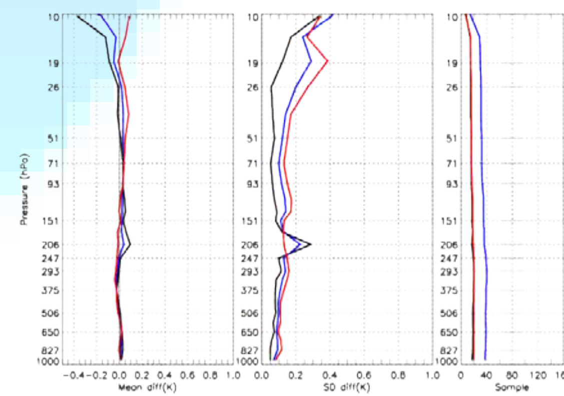
Lamont



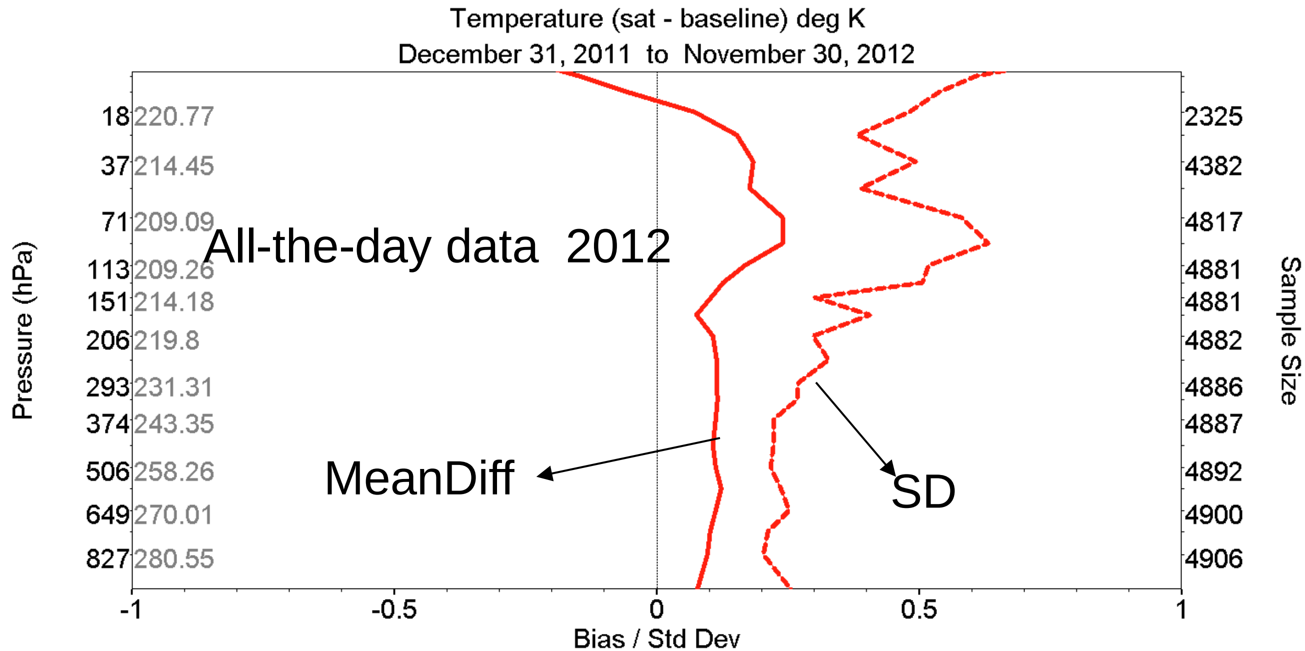
Lauder



Beltsville



RS92(GDP)-minus-RS92(standard)



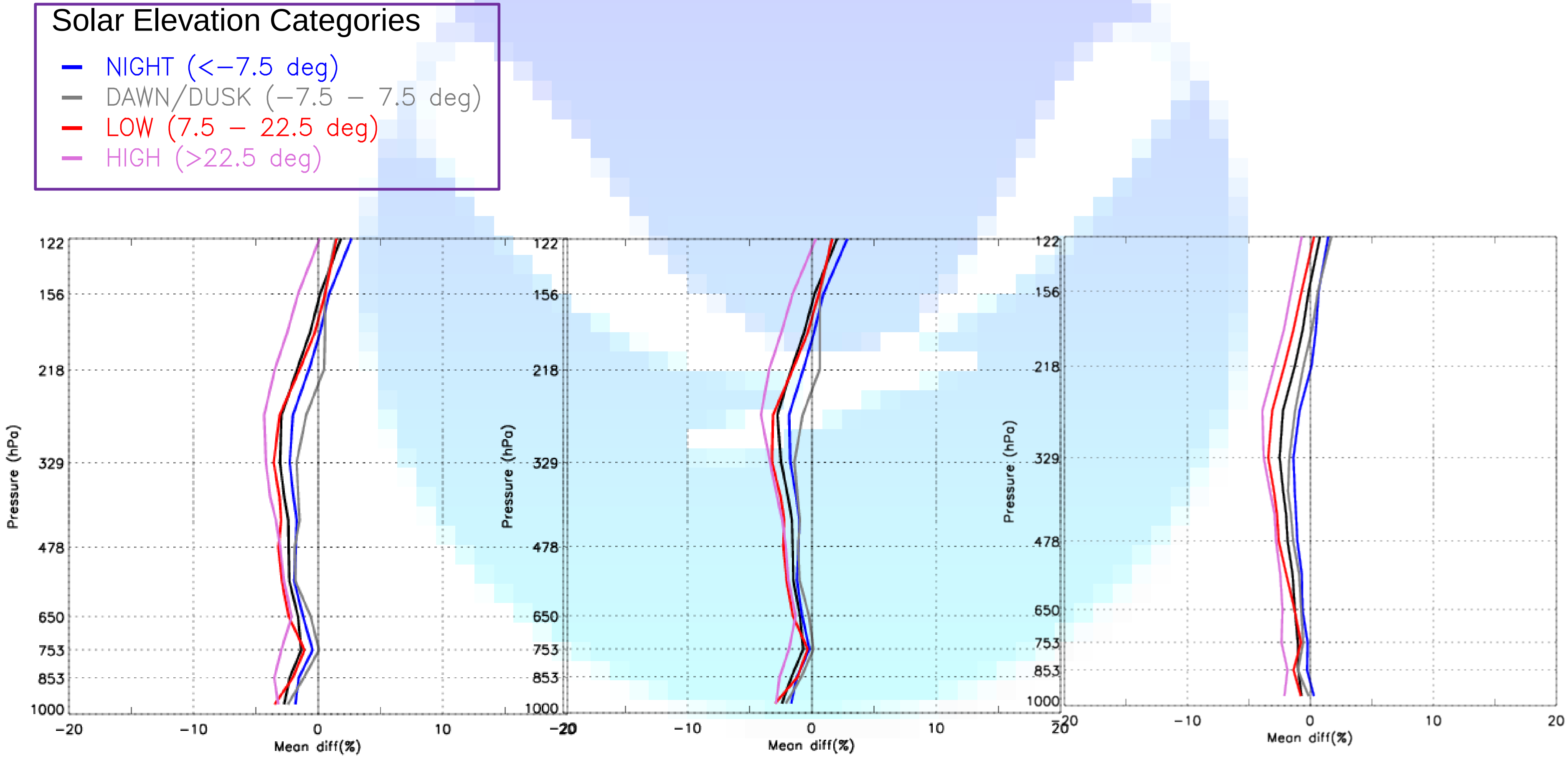
Ladstädter, F., A. K. Steiner, M. Schwärz, and G. Kirchengast, 2014: Climate intercomparison of GPS radio occultation, RS90/92 radiosondes and GRUAN over 2002 to 2013. *Atmos. Meas. Tech. Discuss.*, **7**, 11735-11769, 2014. doi:10.5194/atmd-7-11735-2014.

GDP RS92 is warmer than RO Tdry by < 0.2 K

T, RS92 vs RS41

- RS92 agrees with RS41 < 0.1-0.2 K in the lower stratosphere; RS41 appears to be less sensitive to solar elevation change than RS92.

RH (RS92-minus-RS41) obtained using NWP as transfer medium



BG CFSR

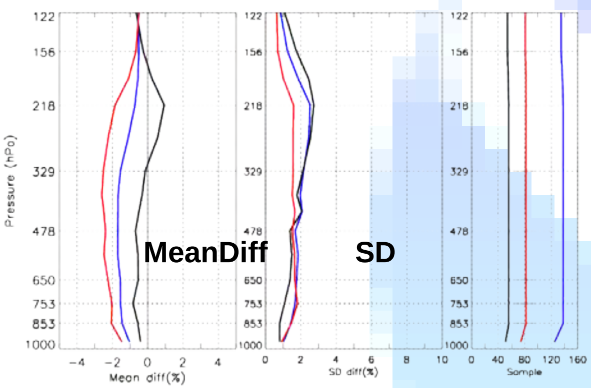
AN CFSR

AN ECMWF

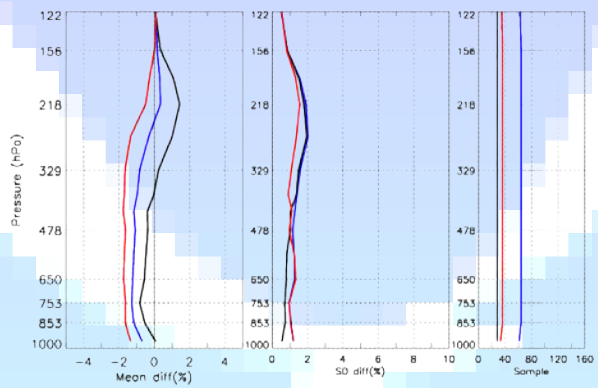
RH RS92-minus-RS41 from duals

NIGHT (<−7.5 deg)
DAY (> 7.5 deg)
ALL

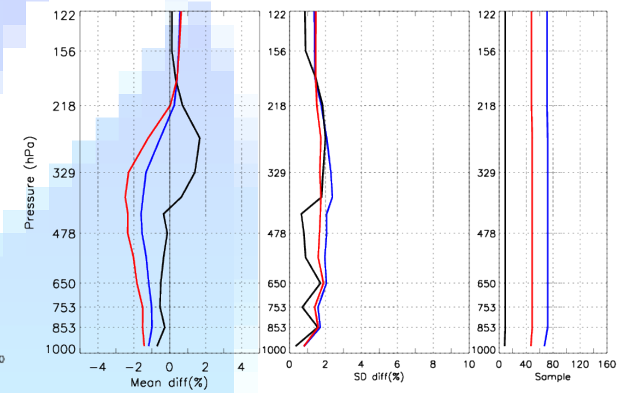
Lindenberg



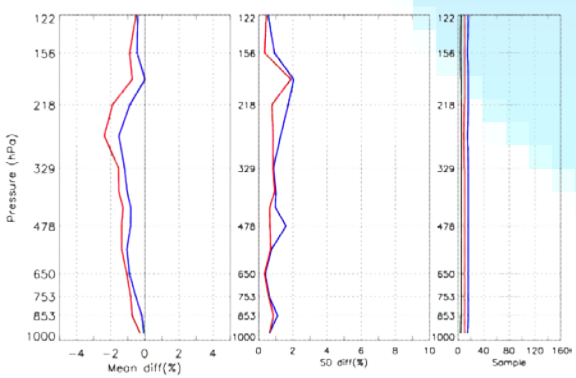
Payerne



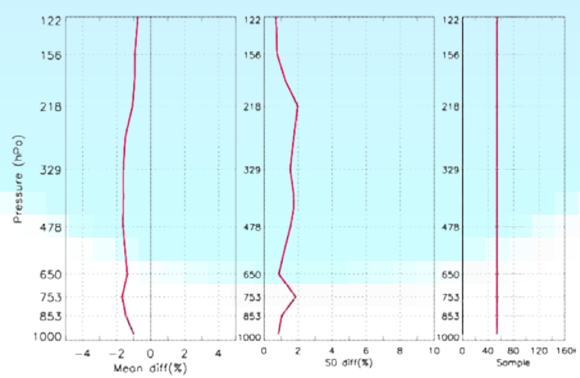
Ny Alesund



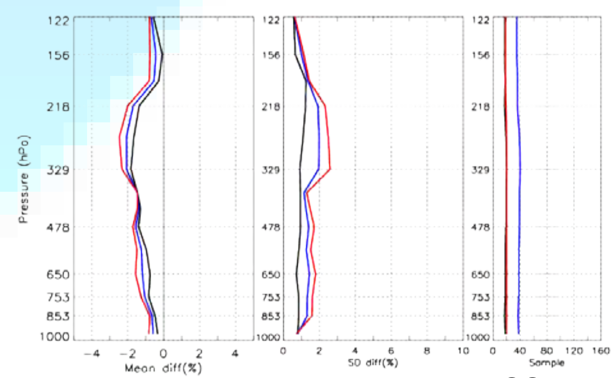
Lamont



Lauder



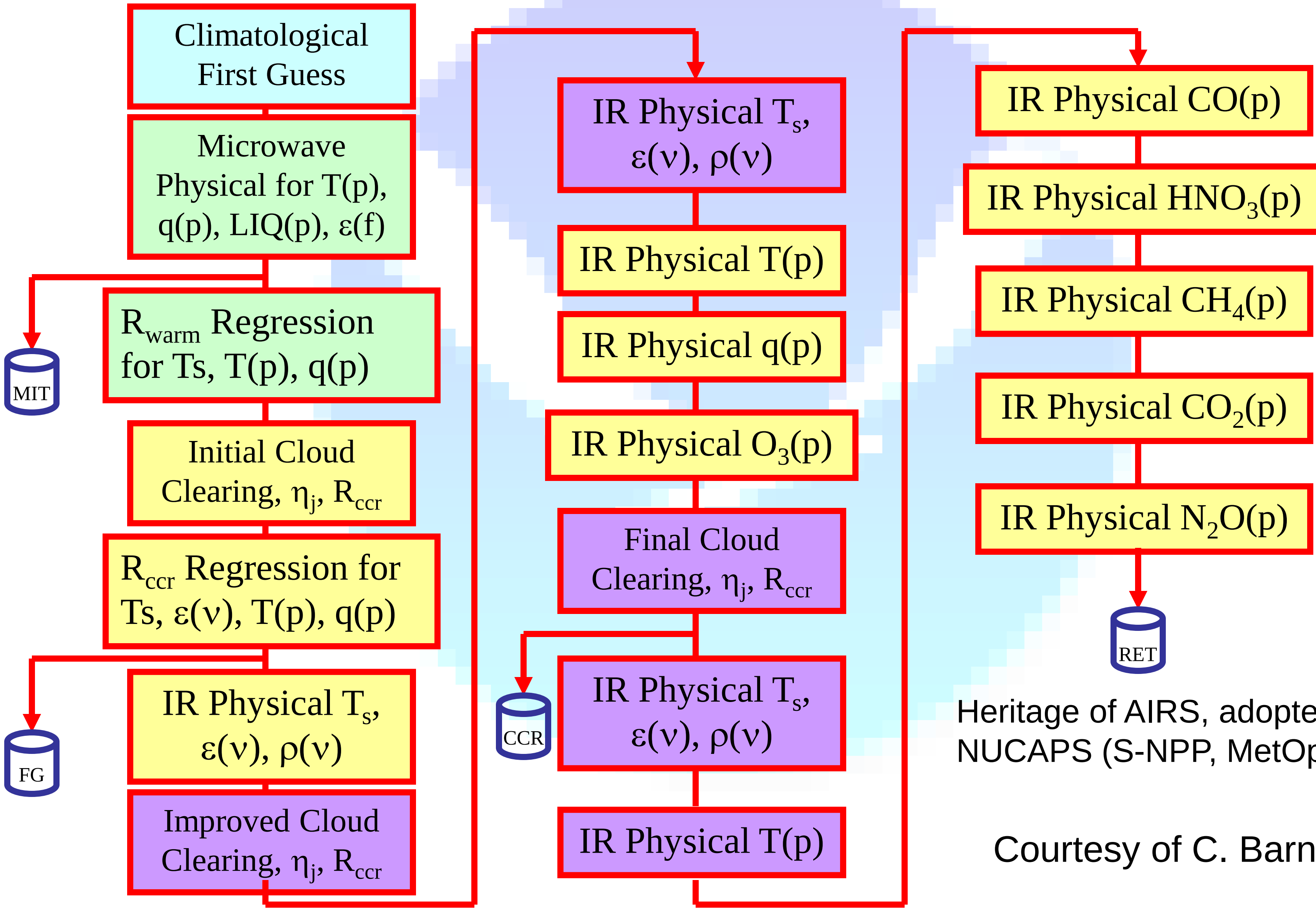
Beltsville



RH, RS92 vs RS41

- RS41 shows improvement over RS92 by ~2% in RH in the troposphere; still a challenge for measurements in the stratosphere.

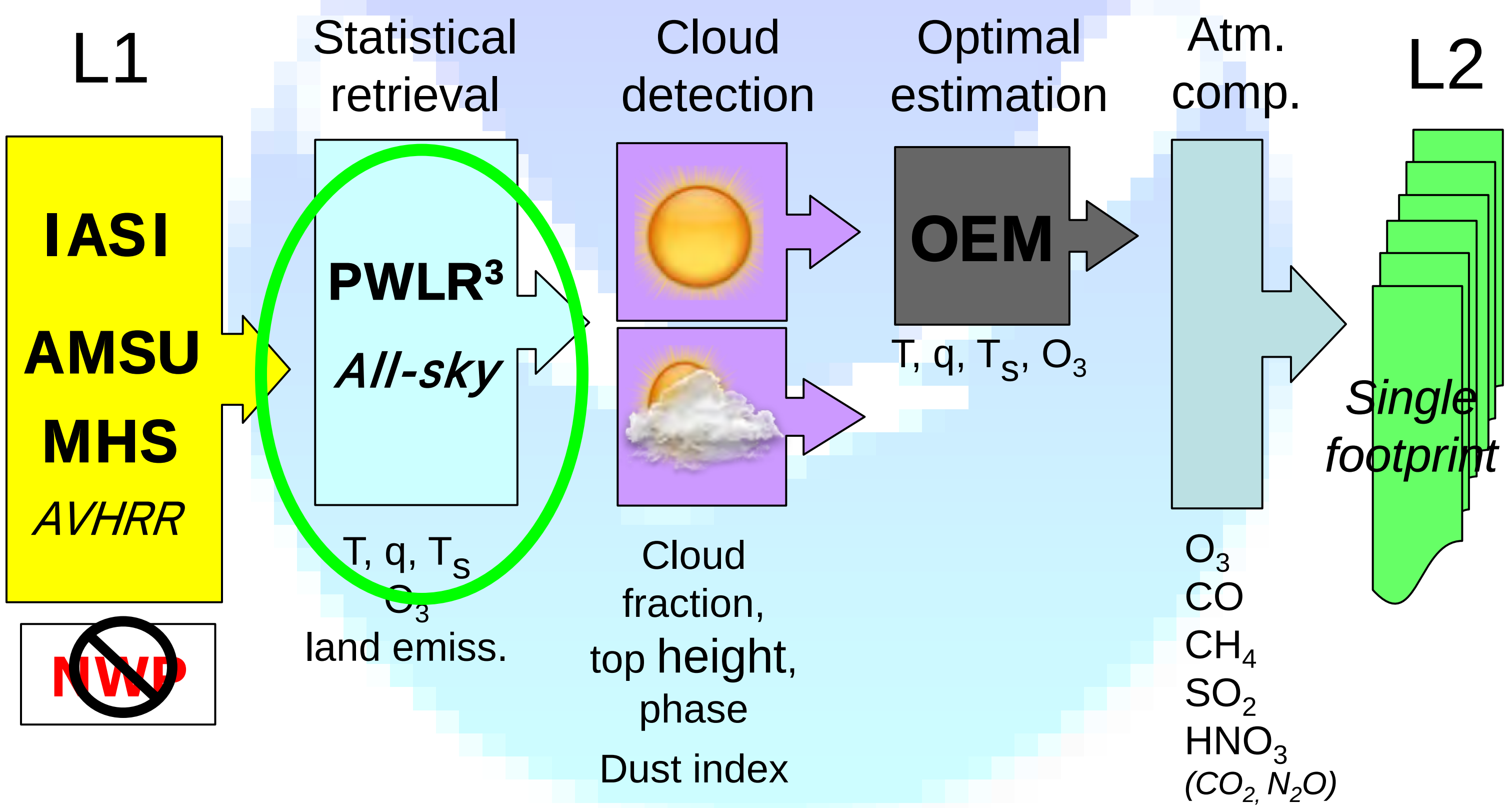
Simplified flow diagram of the NOAA NUCAPS retrieval algorithm



Heritage of AIRS, adopted by NUCAPS (S-NPP, MetOp-A,B)

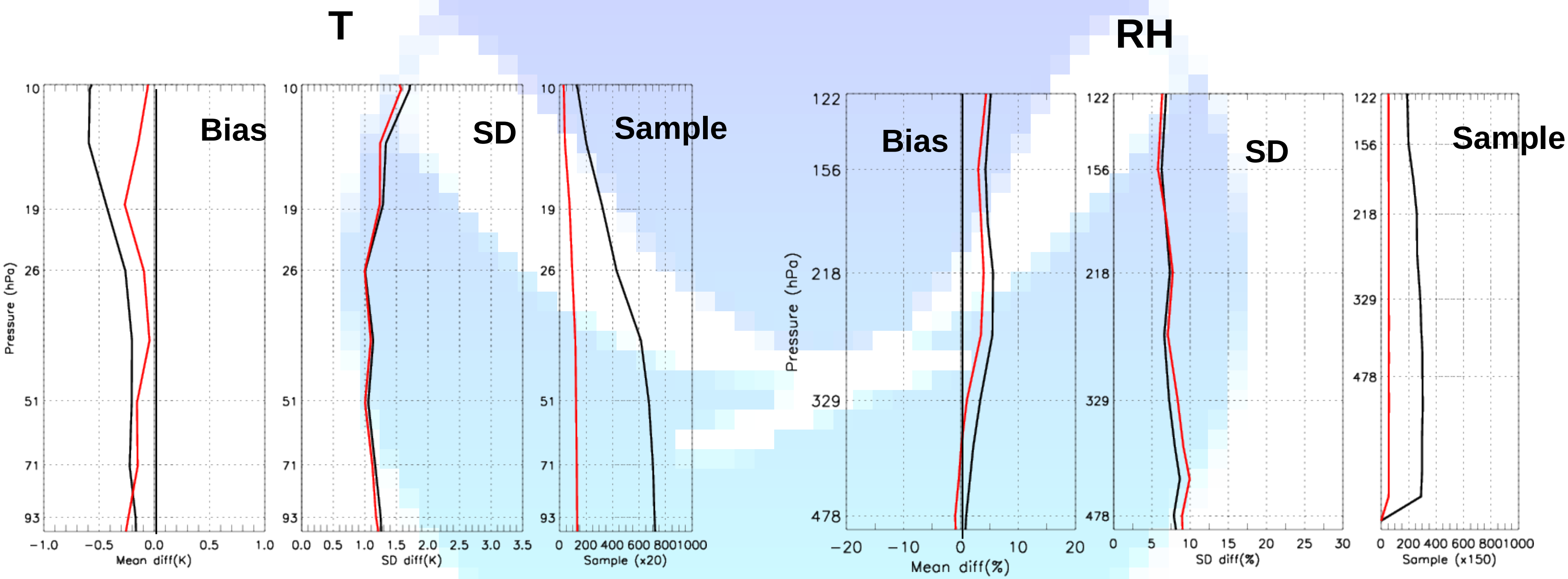
Courtesy of C. Barnet

EUMETSAT IASI L2 v6 High-level processor overview



Courtesy of Thomas August

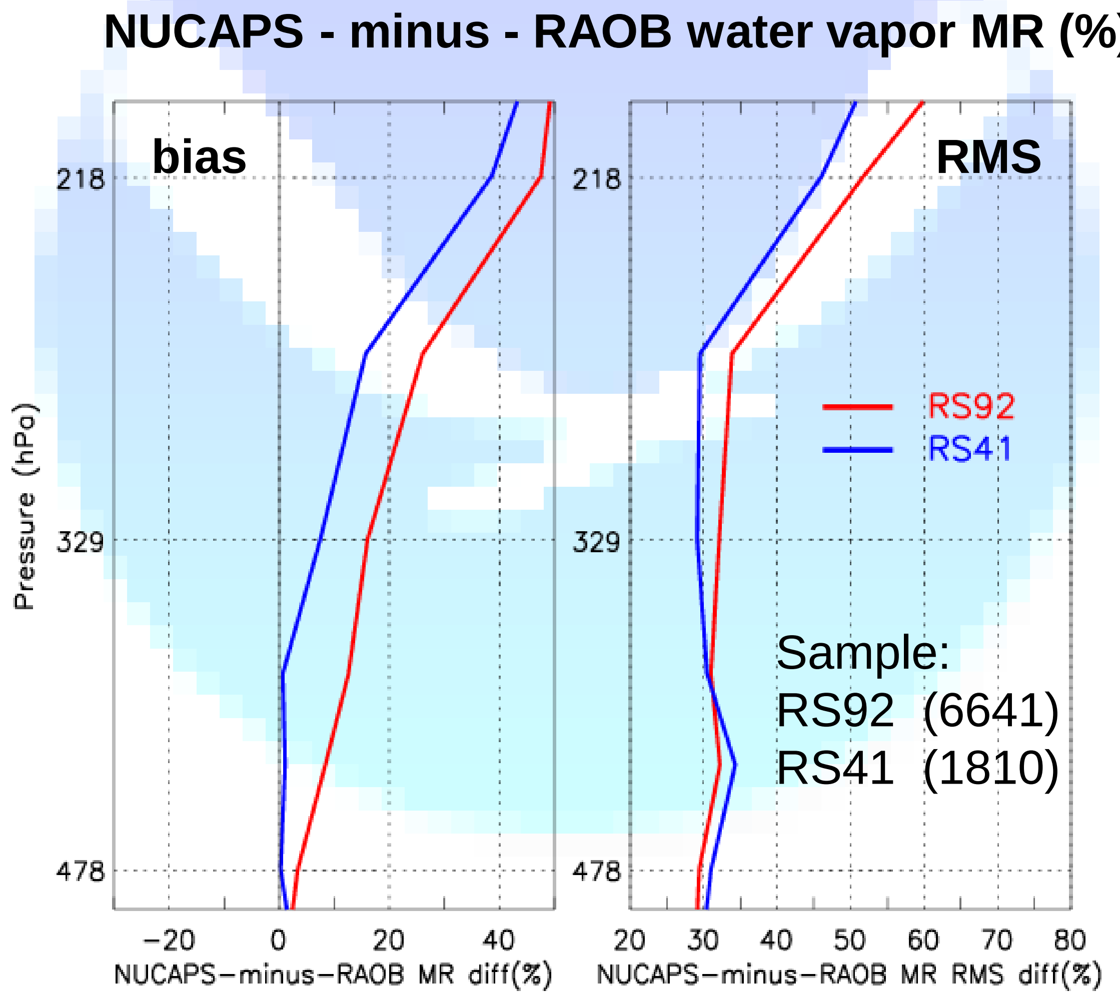
RS92 vs RS41 assessment of EUMETSAT IASI sounding product



EUMETSAT IASI -minus- RS92
EUMETSAT IASI -minus- RS41

Conventional RAOBs data for Jan 2015 to Jun 2017; collocations (1hr&50km)

RS41 makes NOAA NUCAPS S-NPP “look” better than RS92



STAR Center for Satellite Applications and Research
formerly ORA — Office of Research and Applications

Major Results

- Accuracy of RS92 versus RS41 global conventional radiosondes was assessed from Jan 2015 to Jun 2017 by
  - using NWP data as the transfer medium and
  - using GPSRO as the truth
  - The global assessment was then verified using data from dual launches
- RS92 agrees with RS41 < 0.1-0.2 K in the lower stratosphere; RS41 appears to be less sensitive to solar elevation change than RS92.
- RS41 shows improvement over RS92 by ~2% in RH in the troposphere; still a challenge for measurements in the stratosphere.
- RS41 makes the satellite retrievals “look” better than RS92.