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CrIS Cal-Val Readiness for NPP

Denise Hagan, Degui Gu, Gene Kratz,
Denis Tremblay, Chunming Wang

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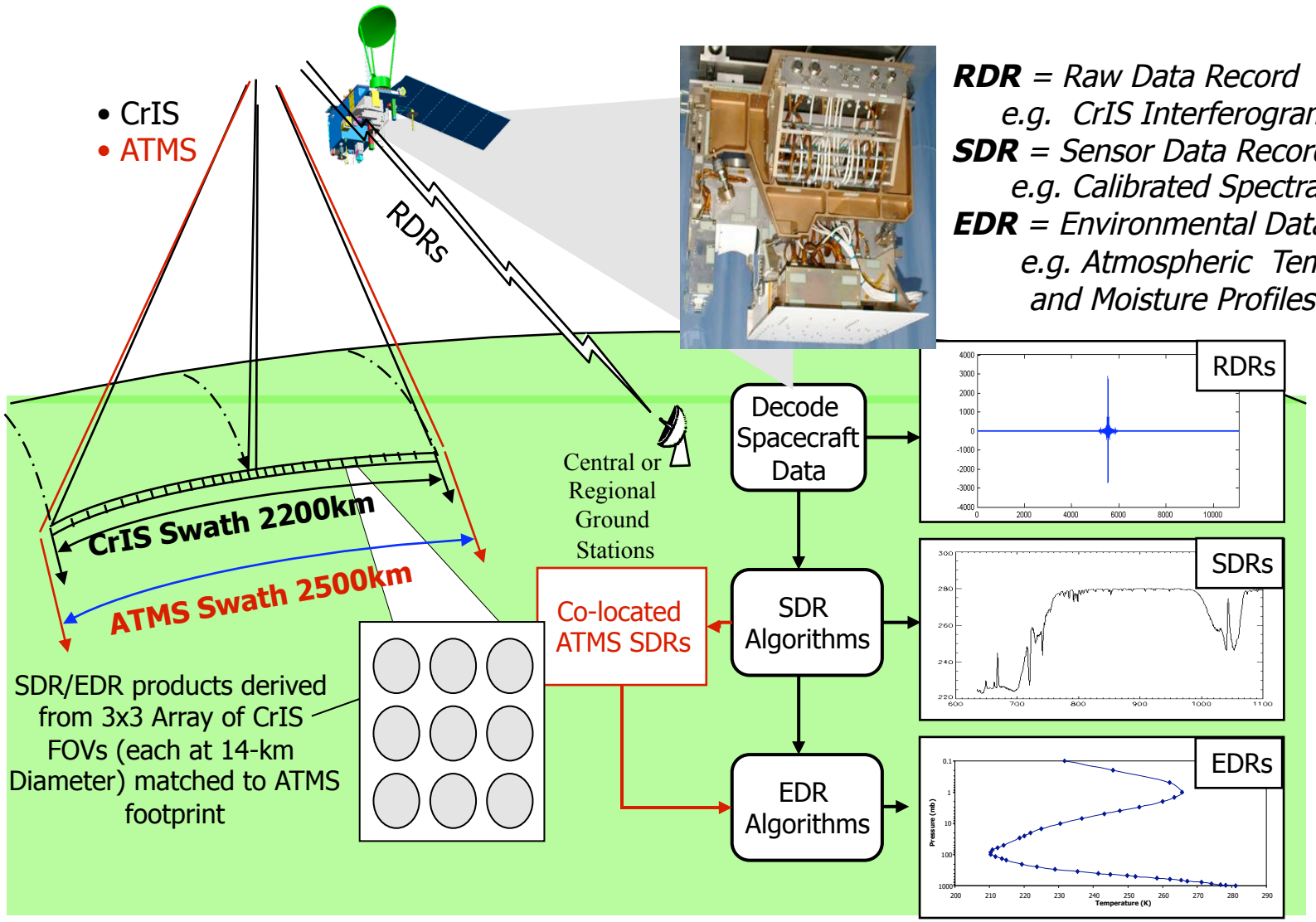
Outline

- Introduction: Calibration/Validation Work in Progress
  - Cal-Val work developed following NPOESS CrIS SDR Cal-Val Plan
    - NPOESS CrIS Sensor Data Record (SDR) Calibration and Validation Plan – NPP - D47856-01 – Rev B (10/01/2010)
    - Collaborative industry-government effort
- Cal-Val work described in three areas:
  - Cal/Val Match-up and Sensor Trending Products (PGEs) (flexible production tools)
  - Cal/Val Analysis Tools for RDR/SDR and PGE outputs
  - Algorithm Development Area Test and Verification
- Summary and Remaining Work

CrIS and ATMS Provide CrIMSS Products



RDR *= Raw Data Record*
e.g. CrIS Interferograms
SDR *= Sensor Data Record*
e.g. Calibrated Spectra
EDR *= Environmental Data Record*
e.g. Atmospheric Temperature and Moisture Profiles

CrIMSS Products

CrIMSS (Cross-track Infrared Sounder and Advanced Technology Microwave Sounder) Environmental Data Record (EDRs) products are derived from calibrated spectral radiances provided by the CrIS and ATMS Sensor Data Records (SDRs)

CrIMSS products support NWP weather forecasting

CrIMSS products include:

- CrIS SDRs and Noise (NEdN) Estimates
- Re-mapped ATMS SDRs
- Ozone Profile (Delivered IP)
- Three EDRs:
  - Atmospheric Vertical Temperature Profile (AVTP)
  - Atmospheric Vertical Moisture Profile (AVMP)
  - Atmospheric Vertical Pressure Profile (AVPP)

Primary Activities Transition from Pre-launch TVAC Analyses to On-orbit Cal/Val

Key Cal/Val Pre-launch Sensor Characterization Analyses:

Radiometric
- Verify Fringe Count Error (FCE) detection and correction
- Verify radiometric calibration and assess instrument internal emission
- Determine instrument NEdN
- Dynamic interaction analysis
- Scan scenario test analysis and long-term radiometric stability
- Short and long-term repeatability
- Linearity (ICT with ECT at various temperature)
- Onboard digital filtering verification
- Scene Selection Module (scan mirror) precision and variability
- ICT NIST traceability

Spectral
- Bench CO2 laser for ILS characterization and LWIR spectral calibration
- Spectral calibration with gas cell

Spatial
- Slit FOV and Spot FOV (co-registration of FOVs)
- Instrument to spacecraft boresight

CrIS Earth Scene Validation Approach (Following Heritage Methods):

Radiometric
- Clear FOV comparisons of spectra with modeled radiances
- Laser and neon lamp stability using atmospheric absorption lines as verification
- Radiance comparisons with other satellite instruments (AIRS, IASI, VIIRS)
- Radiance comparisons with aircraft underflight FTIR measurements
- Subsetting and trending of window radiances and skin temperature with SST.RTG
- Comparisons of cloud-cleared radiances with modeled clear sky radiances
- Subsetting and trending to establish scan angle effects, local and regional bias
- Calibration of ATMS retrievals (essential for quality CC radiance) - Bias correction from co-located RAOBs or NWP

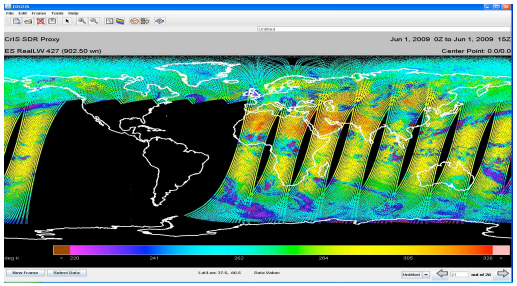
Spectral
- Clear FOV comparisons of spectra with modeled radiances - needed for updating forward model Optimal Spectral Sampling tables to match correct ILS
- Spectral comparisons (cross-calibration) with other satellite instruments (AIRS, IASI, VIIRS)
- Comparisons with aircraft underflight FTIR spectra

Geolocation
- Geolocation performance evaluation and co-registration with ATMS – update ATMS footprint matching coefficients; update local angle adjustment table
- Coastline crossings using clear FOVs and window channels; cross comparisons with VIIRS window channels

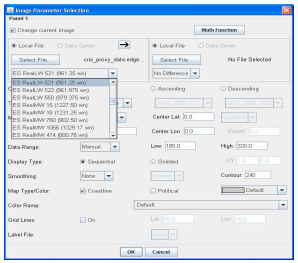
Cal/Val Match-up and Sensor Trending Products (PGEs)

Product Generation Executables (PGEs)

- 13 PGEs developed thus far to support CrIS Cal/Val
  - 10 PGEs tailored for SDR/EDR match-ups (tested on heritage data)
  - Integrated into NPOESS Science Investigator-led Processing System (NSIPS) at NSOFS
    - PGE0010 -- CrIS EDR/Radiosonde/NCEP GFS Match
    - PGE0020 -- CrIS clear fov detection and NCEP RTGSST/SDR match
    - PGE0030 -- CrIS clear fov detection and NCEP GFS/SDR match
    - PGE0040 -- CrIS EDR Skin temperature retrieval and NCEP GFS surface temp
    - PGE0050 -- CrIS SDR capture and subsetting for EDGEIS
    - PGE0060 -- IASI/radiosonde/NCEP GFS match
    - PGE0070 -- CrIS EDR/radiosonde/NCEPGFS/IASI match
    - PGE0080 -- ATMS SDR match to NOAA18 AMSU-A
    - PGE0090 -- ATMS SDR match to METOP AMSU-A
    - PGE0100 -- ATMS SDR match to NOAA19 AMSU-A

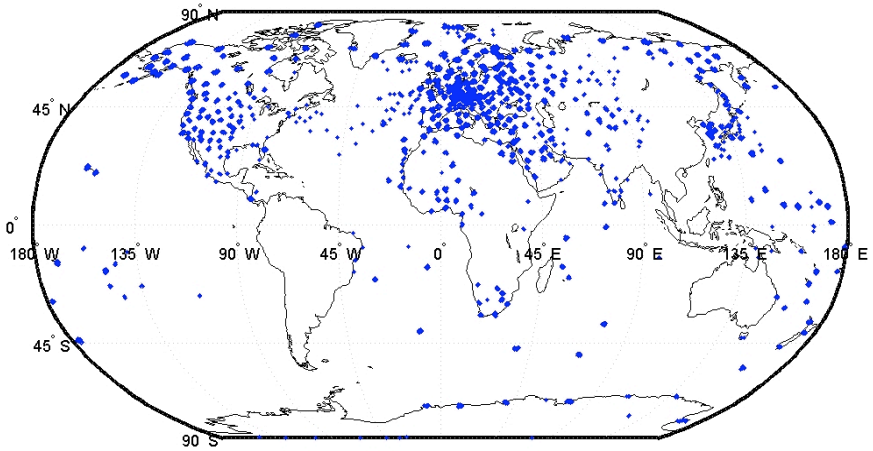


  - 3 PGEs tailored for trending sensor parameters and data quality flags
    - DQF-A (data quality flag with quality levels) (tested on TVAC data)
    - DQF-B (data quality flag with floating point values
    - CrIS SDR Trending (sensor telemetry parameters critical to radiometry, spectral calibration)



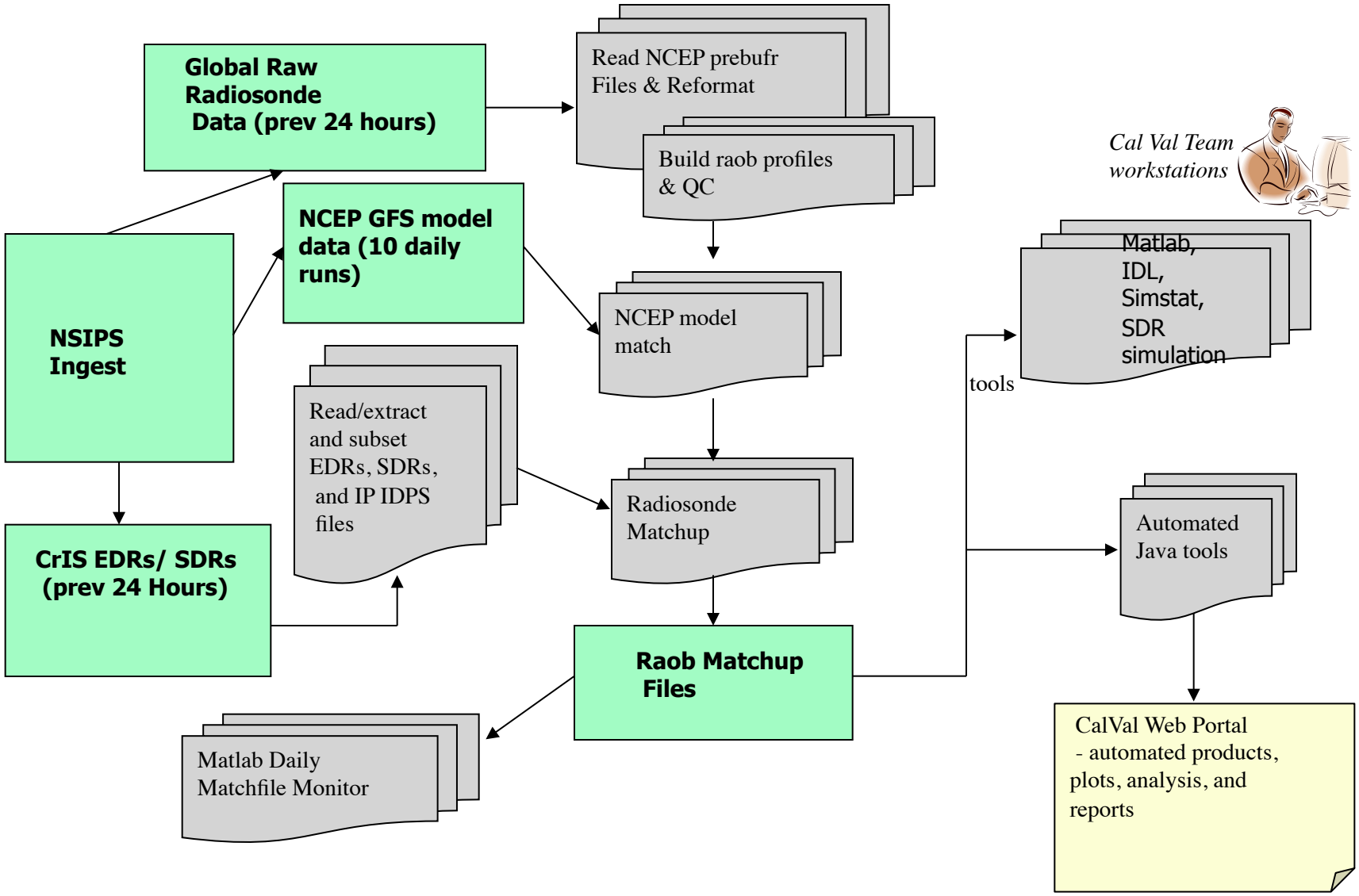
PGE001 for CrIS EDR/Radiosonde/NCEP GFS Match

- EDR matchups provide clues to help understand the **SDR radiometric calibration and accuracy**; anomalies in atmospheric profiles comparisons indicative of possible errors related to radiance bias tuning
- PGE Matches EDR AVTP/AVMP/AVPP profiles with global radiosonde data (PREPBUFR data) and with the NCEP weather forecast data
- PGE performs QC
- PGE performs statistical reduction
- PGE provides output file and graphics



Sites for Global Radiosonde Network

PGE Flow of CrIS EDR/Radiosonde/NCEP GFS Match



CrIS EDR/Radiosonde/NCEP GFS Match-up Criteria

EDRs, SDRs, ancillary data,
raw radiosonde data, and the ancillary data used to construct the final radiosonde profile –
data characterizing the matchup
temporal and spatial distances, surface characteristics, various IPs and QFs

Global radiosondes utilized by NCEP ingest (PREPBUFR files)
100 km and 3 hours of AIRS footprint
select only the closest match in the time/space windows
averaging 200-300 matches per day
RAOB treated as reference (AIRS retrieval and model matched to RAOB)

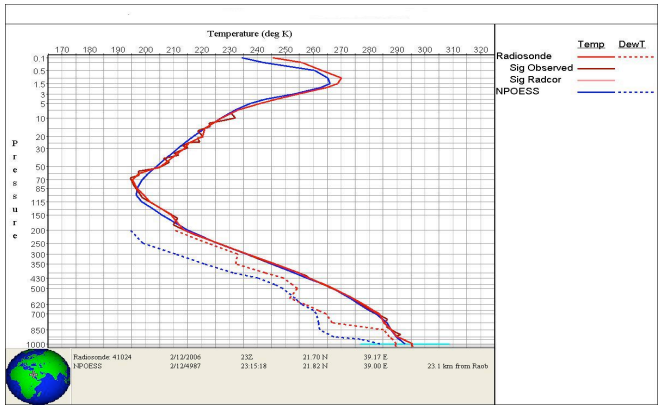
NCEP GFS model data interpolated to raob
1 degree global grid with temp, rh, surface temp and press
10 forecast files ingested daily (5 0z-03z runs)

Following QC is performed on the radiosonde data
vertical extent of data and extrapolation,
data gaps,
superadiabatic screening
unrealistic inversions
excessive departures from climatology
NCEP blacklist of RAOB sites (sw/lw radiation corrections done at NCEP)

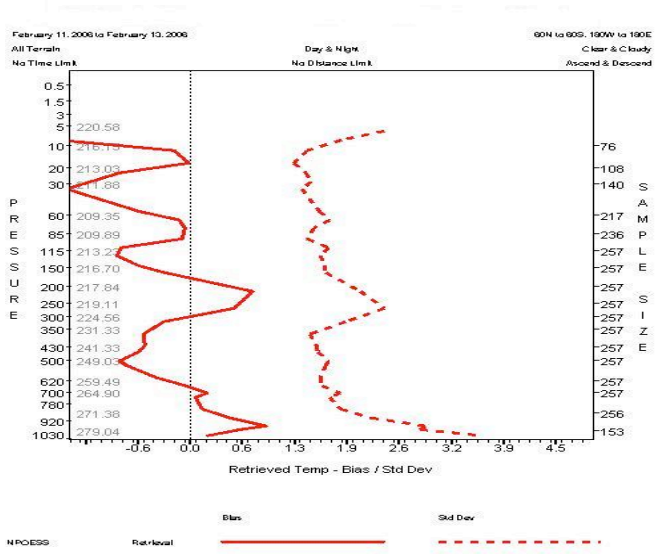
The Matchup data file contains matchup records which include radiosonde instrument type, launch site, surface type, product type

Sample Output from AIRS Global Radiosonde Matchup File

Byte	Word	Data Type	# of Values	Length	Scale	Description
51	26	Float	1	2		Difference in time (hours) between raob/retrieval
53	27	Int	1	2		Difference in distance (km) between raob/retrieval
55	28	Int	1	2		Closeness parameter
57	29	Int	1	2		Matchup utility index
59	30	Int	1	2		Radiosonde Data Radiosonde Station ID ASCII(1st char)*100 + ASCII(2nd char)
65	33	Char	1	6		Radio Station ID in ASCII format
71	36	Int	3	2		Radiosonde day of synoptic report (YYYY, MM, DD)
77	39	Int	1	2	100	Radiosonde observation time (hour)
79	40	Float	1	2	128	Radiosonde station latitude (-90 to +90)
81	41	Float	1	2	128	Radiosonde station longitude (-180 to +180)
83	42	Int	1	2		Radiosonde station elevation
85	43	Int	1	2		Radiosonde report type
87	44	Int	1	2		Radiosonde instrument type
89	45	Int	1	2		Radiosonde terrain (0=sea, 1=land, 2=coast)
111	56	Int	1	2		Radiosonde quality flags (0=pass,1=fail) Standard level dewpoint temperature not within limits flag

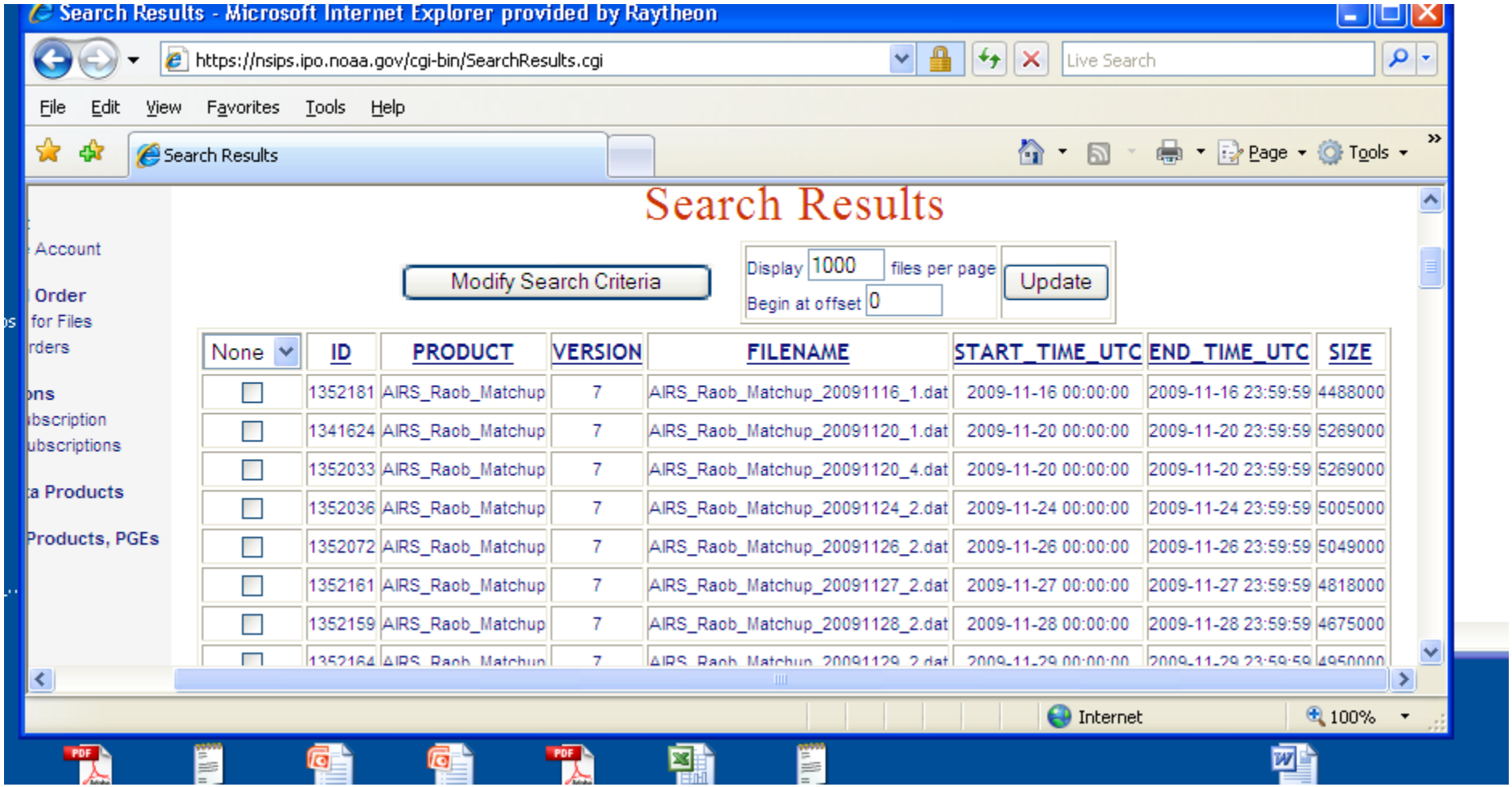


This graph shows an example of the PGE display of a single match up of CrIS retrieved profile (simulated) with a radiosonde within the bounded geographic coordinates shown in lower panel



This graph shows an example of the PGE display for the averaged difference (bias and rms) between multiple radiosondes matched with CrIS retrieved profiles (simulated) within the bounded geographic region for a time period of two days

Example Display for NSIPS Search Results Radiosonde Matchups

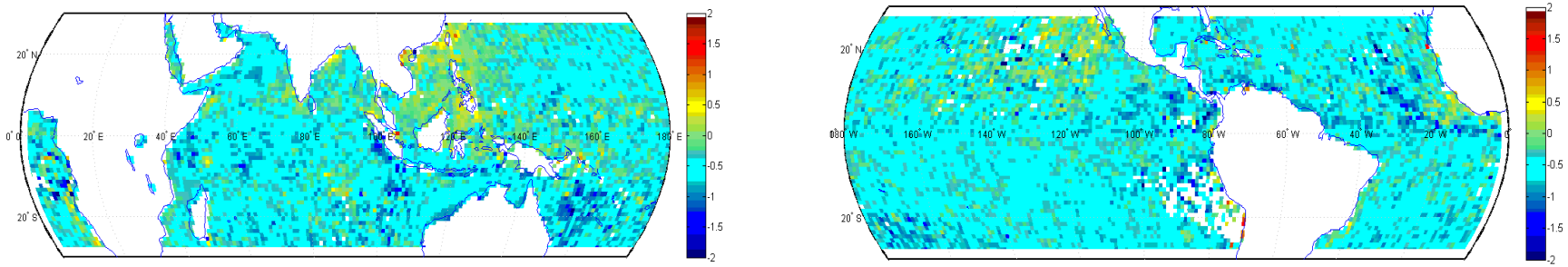


Typical Daily Radiosonde Matchup Log

Date	Total Raob reports	Raob reports after QC	Matched Raob reports	Sea	Land	Coast	Ice	Snow
7/1/2009	1919	1665	360	37	263	29	13	18
7/2/2009	1328	1152	265	17	198	31	11	8
7/3/2009	1329	1162	283	38	205	23	6	11
7/4/2009	1357	1178	273	38	196	19	6	14
7/5/2009	1337	1150	259	42	173	26	9	9
7/6/2009	1337	1175	289	38	208	29	5	9
7/7/2009	1300	1129	285	32	204	27	8	14
7/8/2009	1295	1142	296	37	211	34	7	7
7/9/2009	1347	1174	280	26	208	25	7	14
7/10/2009	1332	1177	282	33	202	30	6	11
7/11/2009	1353	1193	271	29	205	23	5	9
7/12/2009	1350	1184	256	31	181	28	6	10
7/13/2009	1346	1171	266	25	202	26	4	9
7/14/2009	1317	1151	285	38	206	21	9	11
7/15/2009	1316	1145	273	34	199	26	8	6

PGE002 for CrIS Clear FOV Detection and NCEP SSTRTG/SDR Match Using AIRS Data

- Matchups between NCEP model sea surface temperature fields and CrIS radiances are used for **radiometric validation and trending; also used for spectral validation**
- NCEP Real Time Global Sea Surface Temperature (RTGSST) – a blended product at 0.5 degree global grid
- AIRS window radiance at 2616 cm $^{-1}$ corrected for atmospheric/transmission and surface emissivity (evaluating other channels specific to CrIS since 2616 cm^{-1} not available)
- Requires cloud filtering using spatial coherence test and low status test
- Performed over tropical clear ocean, daytime, with scan angles less than 35 degrees



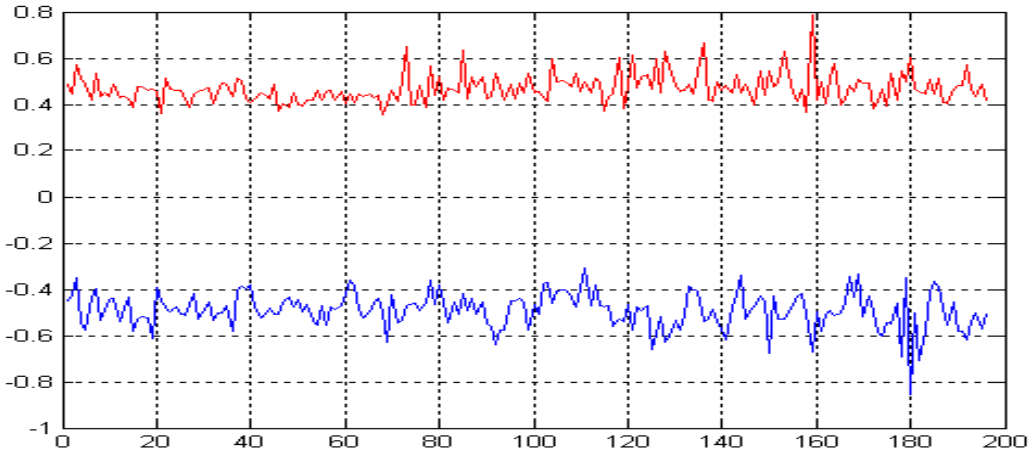
For 200 days of processing (1 degree bin averages), the bias and standard deviation of the difference between the window channel and SSTRTG (1.5 million matchups)

Mean = -0.488 K

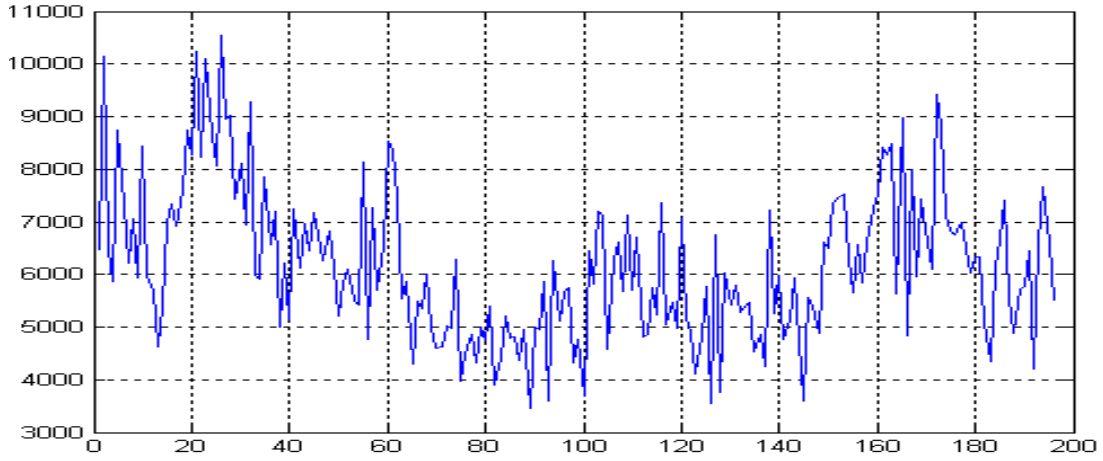
Std = 0.469 K

Largest differences occur in region of stratus and aerosol

CrIS Clear FOV Detection and NCEP SSTRTG/SDR Match PGE002 Output Using AIRS Data



Time series showing daily bias (blue) and std (red) of differences between AIRS and SSTRTG



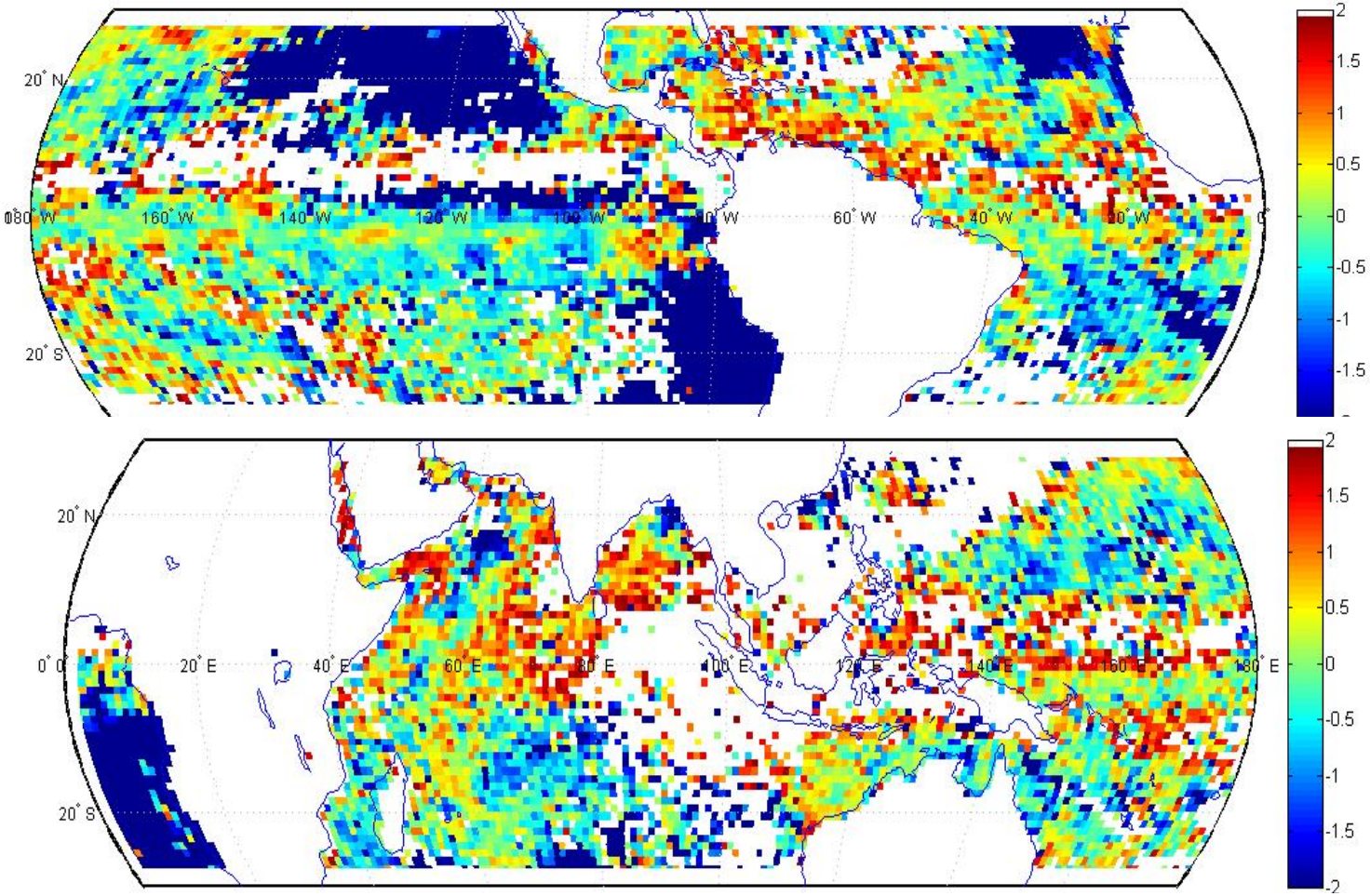
Time series showing daily number of matchups

Sample record over limited time – not for scientific interpretation

☐	2043603	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100515_1.dat	2010-05-15 00:00:00	2010-05-15 23:59:59	6000
☐	2064921	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100515_2.dat	2010-05-15 00:00:00	2010-05-15 23:59:59	26052000
☐	2043617	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100516_1.dat	2010-05-16 00:00:00	2010-05-16 23:59:59	6000
☐	2064551	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100516_2.dat	2010-05-16 00:00:00	2010-05-16 23:59:59	25230000
☐	2048321	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100518_1.dat	2010-05-18 00:00:00	2010-05-18 23:59:59	6000
☐	2064550	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100518_2.dat	2010-05-18 00:00:00	2010-05-18 23:59:59	35154000
☐	2059380	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100519_1.dat	2010-05-19 00:00:00	2010-05-19 23:59:59	6000
☐	2062986	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100519_2.dat	2010-05-19 00:00:00	2010-05-19 23:59:59	6000
☐	2062987	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100519_3.dat	2010-05-19 00:00:00	2010-05-19 23:59:59	6000
☐	2063003	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100519_4.dat	2010-05-19 00:00:00	2010-05-19 23:59:59	6000
☐	2063106	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100519_5.dat	2010-05-19 00:00:00	2010-05-19 23:59:59	6000
☐	2064115	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100519_6.dat	2010-05-19 00:00:00	2010-05-19 23:59:59	25380000
☐	2066602	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100520_1.dat	2010-05-20 00:00:00	2010-05-20 23:59:59	29076000
☐	2092170	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100521_1.dat	2010-05-21 00:00:00	2010-05-21 23:59:59	30882000
☐	2092379	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100522_1.dat	2010-05-22 00:00:00	2010-05-22 23:59:59	26514000
☐	2093788	AIRS-FVD-SSTRTG-Matchup	1	AIRS_ClearFov_sstrtg_20100524_1.dat	2010-05-24 00:00:00	2010-05-24 23:59:59	30486000

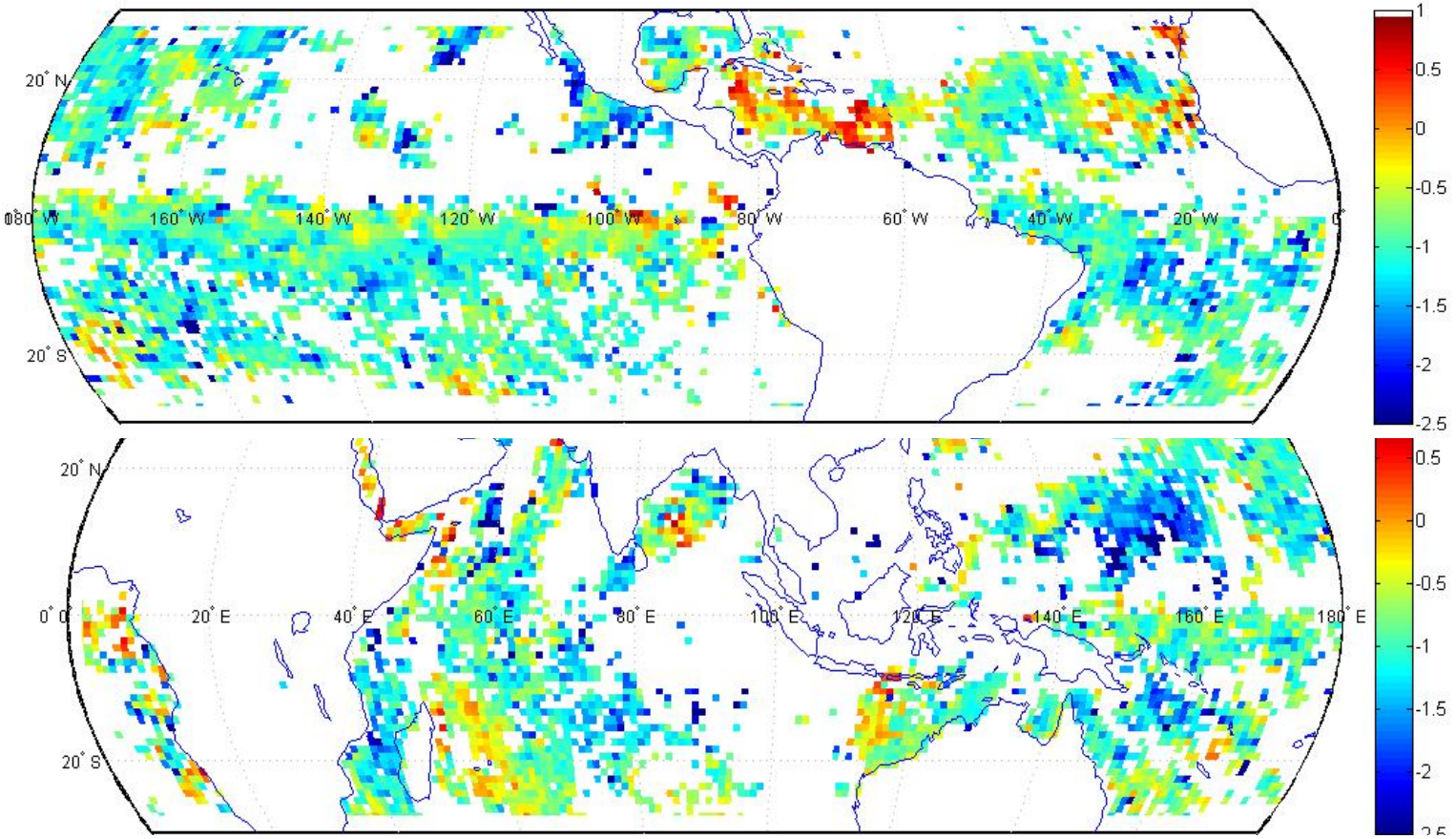
Screen shot of SSTRTG matchup files for selection on NSIPS

CrIS Clear FOV Detection and NCEP RTGSST/SDR Match Using GRAVITE CrIS Proxy Data



Cloud filtering threshold for IASI Obs-calc< 1.0 K test applied to FOVs passing spatial coherence test. Sample size = 126477 6/1 – 6/6, 2010)

CrIS Clear FOV Detection and NCEP SSTRTG/SDR Match Using GRAVITE CrIS Proxy Data



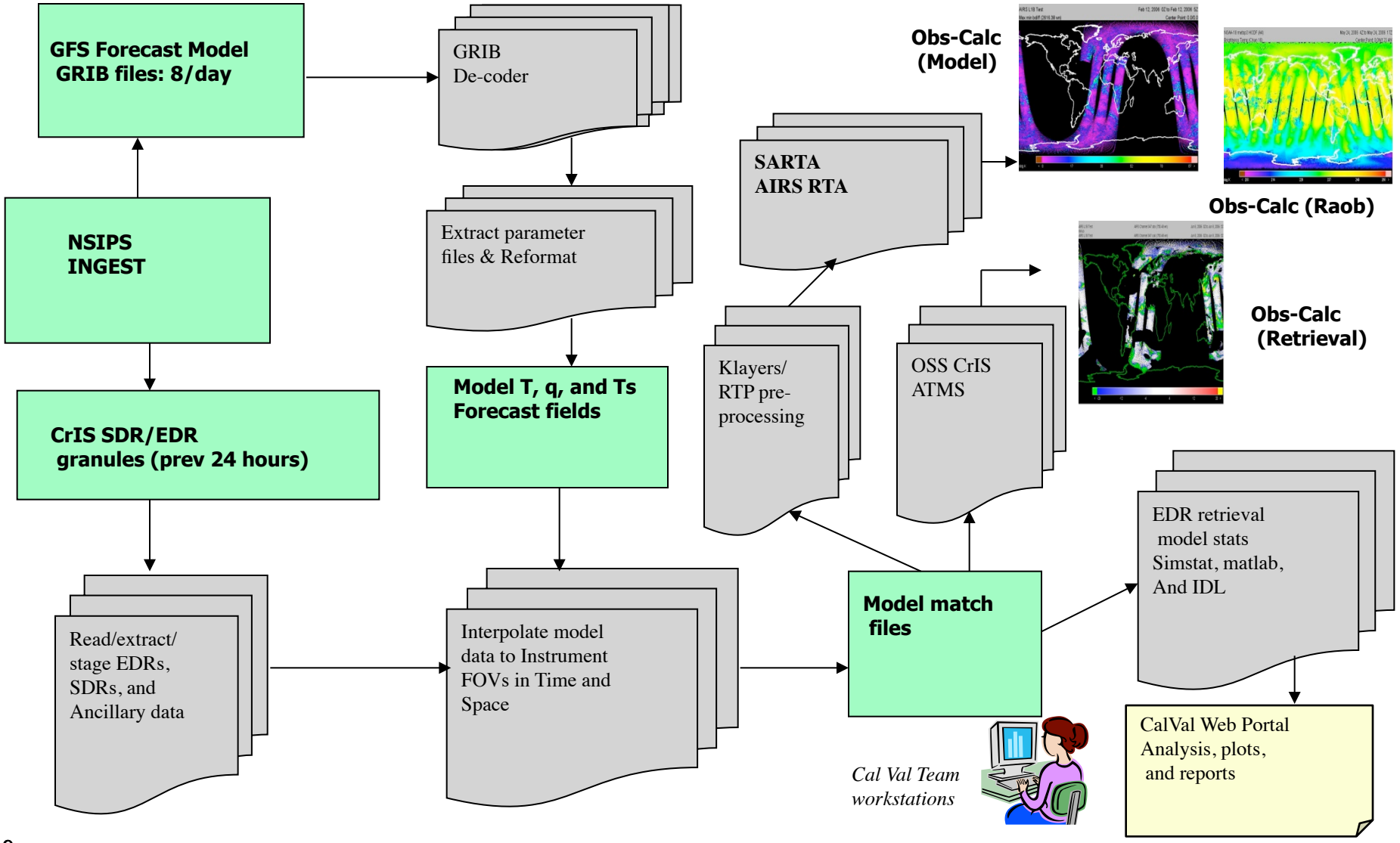
IASI Window radiance minus NCEP SST ~ 6/1- 6/6 2010 (1 degree bin averages)
54905 matchups
Mean (sst1231-RTGSST) = -0.89 K
Std (sst1231-RTGSST) = 0.51 K

Sample test results

PGE003 for CrIS Clear FOV Detection and NCEP GFS/SDR Match

- Matchups between NCEP forecast model and CrIS radiances under clear sky conditions are used for **radiometric validation and trending; also used for spectral validation**
- NCEP model surface temperature – use initialization and 3 hour forecast products (0Z and 03Z) at 1.0 degree global grid
- AIRS window radiance at 1231 cm^{-1} corrected for atmospheric transmission and surface emissivity
- Cloud filtering – performs spatial coherence test and low status test
- Tropical clear ocean, day and night time, with scan angles less than 35 degrees

PGE Flow for CrIS Clear FOV Detection and NCEP GFS/SDR Match



PGE for CrIS Clear FOV Detection and NCEP GFS/SDR Match

☐	1988370	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100506_1.dat	2010-05-06 00:00:00	2010-05-06 23:59:59	6000
☐	2004449	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100507_1.dat	2010-05-07 00:00:00	2010-05-07 23:59:59	6000
☐	1999467	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100508_1.dat	2010-05-08 00:00:00	2010-05-08 23:59:59	6000
☐	2005617	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100509_1.dat	2010-05-09 00:00:00	2010-05-09 23:59:59	6000
☐	2012468	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100510_1.dat	2010-05-10 00:00:00	2010-05-10 23:59:59	6000
☐	2017584	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100511_1.dat	2010-05-11 00:00:00	2010-05-11 23:59:59	6000
☐	2023693	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100512_1.dat	2010-05-12 00:00:00	2010-05-12 23:59:59	6000
☐	2029166	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100513_1.dat	2010-05-13 00:00:00	2010-05-13 23:59:59	6000
☐	2038724	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100514_1.dat	2010-05-14 00:00:00	2010-05-14 23:59:59	6000
☐	2045031	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100515_1.dat	2010-05-15 00:00:00	2010-05-15 23:59:59	6000
☐	2080331	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100515_2.dat	2010-05-15 00:00:00	2010-05-15 23:59:59	79866000
☐	2070594	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100520_3.dat	2010-05-20 00:00:00	2010-05-20 23:59:59	6000
☐	2093024	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100521_1.dat	2010-05-21 00:00:00	2010-05-21 23:59:59	84372000
☐	2093221	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100522_1.dat	2010-05-22 00:00:00	2010-05-22 23:59:59	82548000
☐	2094081	AIRS-FVD-GFS-Matchup	1	AIRS-FVD-GFS-Match_20100524_1.dat	2010-05-24 00:00:00	2010-05-24 23:59:59	80106000

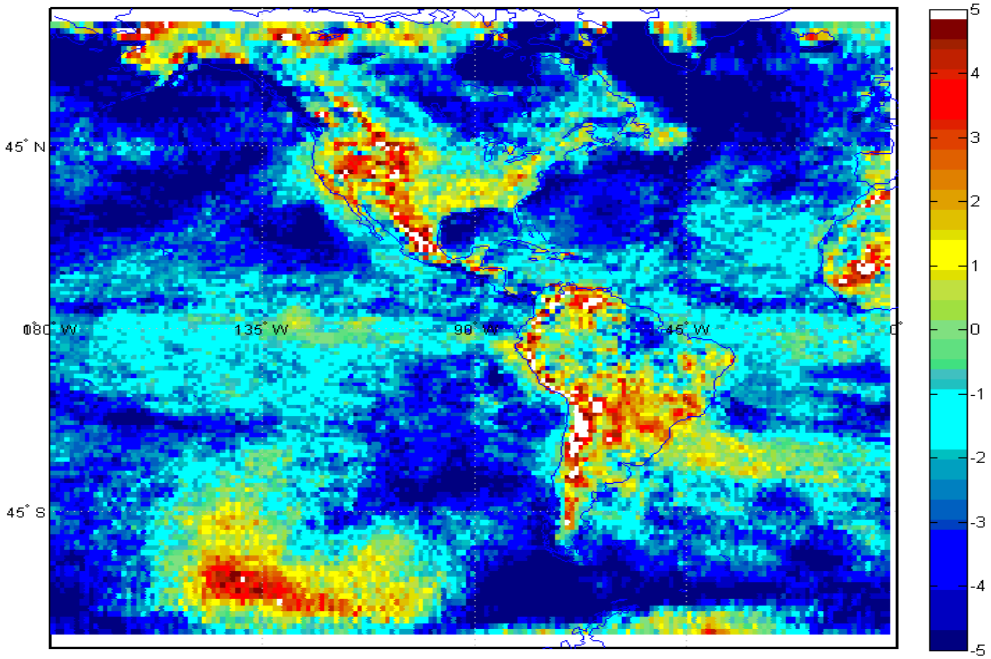
Order Selected Files

To save this search, create a bookmark to this link

Screen shot of SDR/GFS matchup files for selection on NSIPS

CrIS EDR Skin Temperature Retrieval and NCEP GFS Surface Temperature

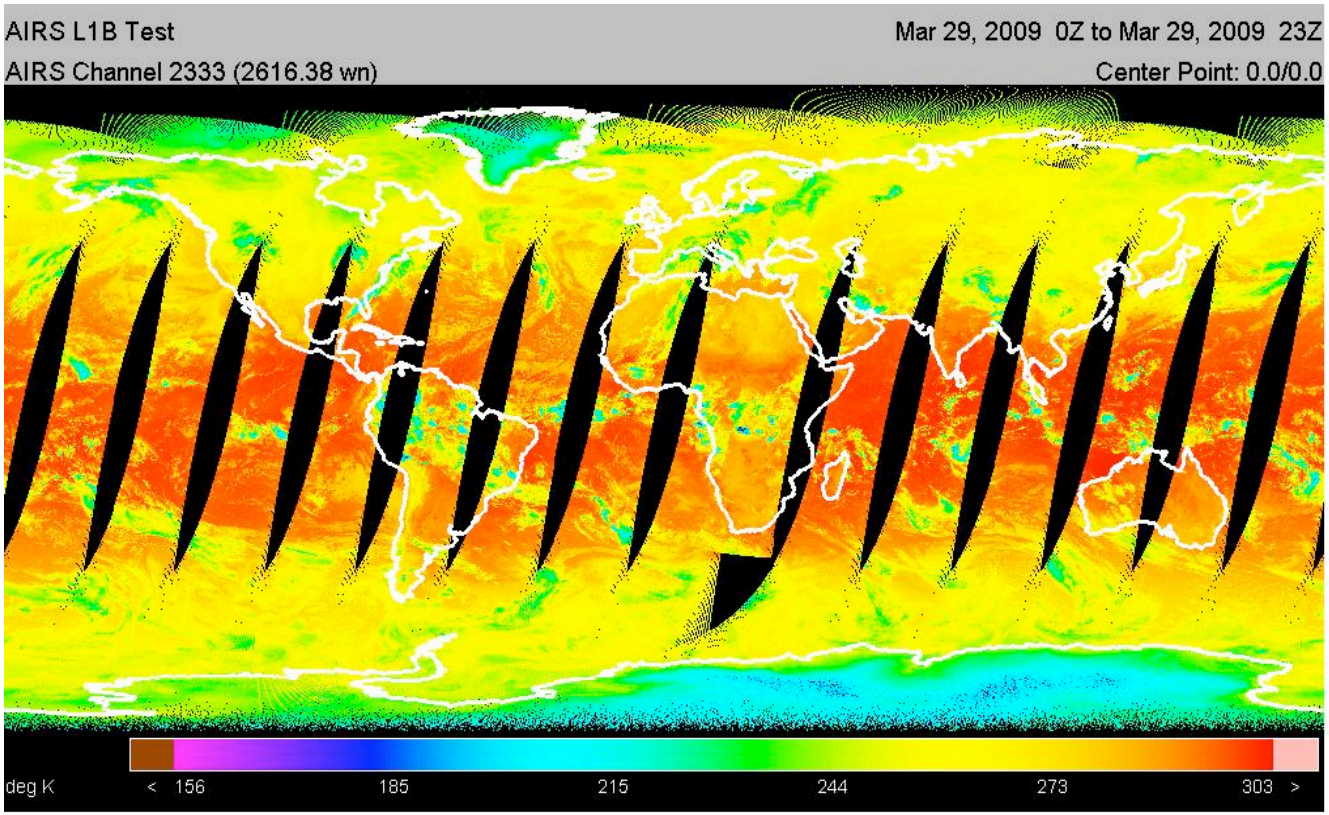
- PGE primarily for validation of EDR intermediate products of skin temperature and cloud-cleared radiance (retained IPs at NSIPS). Provides clues for **radiometric anomalies.**
- Compares the EDR skin temperature retrieval with the GFS model temperature for all sky conditions;



Sample subset
Graph shows 4 days
Mar. 26-30 2010
324,000 matchups
per day

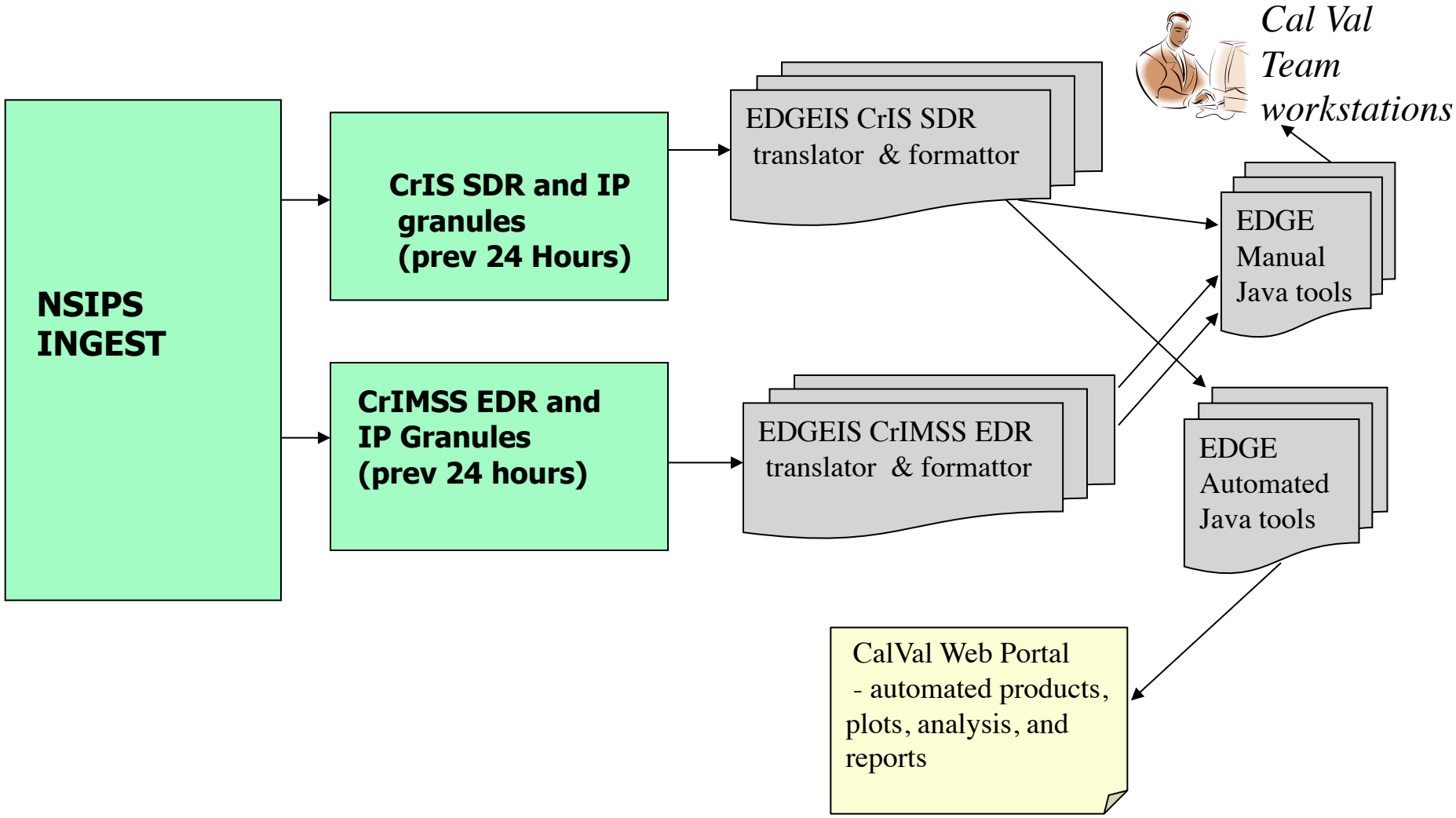
PGE005 for CrIS SDR Capture and Subsetting for EDGEIS (EDGEIS is a NOAA STAR Tool)

- Global quick look/browse capability for viewing channel radiances; **permits quick assessments of regional and zonal radiometric anomalies**, data gaps, etc.



Sample EDGEIS output for 2616 cm^{-1} window channel – hundreds of channels and associated data to select from

PGE Flow for CrIS SDR Capture and Subsetting for EDGEIS



PGE for IASI/radiosonde/NCEP GFS match

- PGE computes Temperature Statistics for 20 layers; can be easily tailored to specification requirements for layer statistics; useful for **forward modeling and validation of CrIS TOA measured radiances**

pressure range ... thickness ...			true ..... temp				
upper-lower	mean	bias	rms	mean	bias	rms	sdv	#pro
0.0 - 0.2	19.783	-1.884	1.910	250.755	-23.832	24.162	3.977	232
0.2 - 1.3	13.711	-0.396	0.427	265.143	-7.652	8.245	3.069	232
1.3 - 4.1	8.751	-0.247	0.304	260.307	-7.361	9.051	5.266	232
4.1 - 8.2	4.917	-0.156	0.208	241.472	-7.675	10.219	6.746	232
8.2 - 16	4.701	-0.106	.168	229.356	-5.173	8.195	6.356	232
16 - 32	4.346	-0.049	0.098 2	19.747	-2.465	4.940	4.281	232
32 - 52	2.922	-0.011	0.042	213.205	-0.826	3.090	2.977	232
52 - 83	2.926	0.002	0.021	208.335	0.141	1.471	1.464	232
83 - 134	2.899	-0.013	0.024	208.342	-0.939	1.694	1.410	232
134 - 212	2.898	0.003	0.023	215.066	0.238	1.694	1.677	232
212 - 314	2.597	0.005	0.025	225.574	0.456	2.181	2.133	232
314 - 359	0.923	0.001	0.007	236.324	0.355	1.737	1.700	232
359 - 407	0.901	0.001	.006 2	42.729	0.206	.624	1.611	232

.... Plus 7 more layers (truncated for graph)

CrIS EDR/radiosonde/NCEP GFS/IASI match

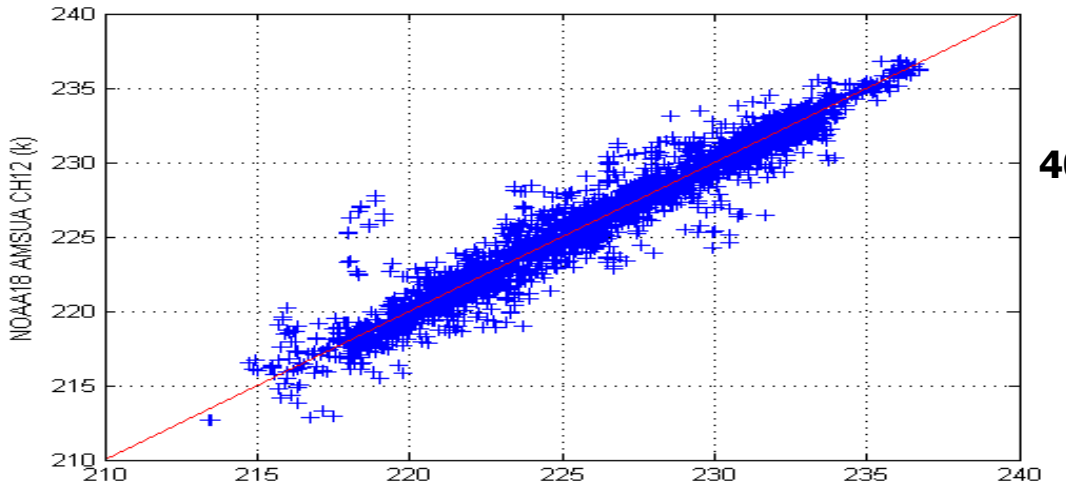
- PGE matches multiple datasets for cross comparison purposes and **TOA radiance validation**
- Utilizes the PGE0010 and PGE0060 output files
- Matches everything to the AIRS matched radiosonde
  - AIRS retrieval
  - IASI retrieval
  - NCEP GFS model profiles
- Creates input file to PDISP (A NOAA STAR tool)

PGEs for ATMS SDR Matchups

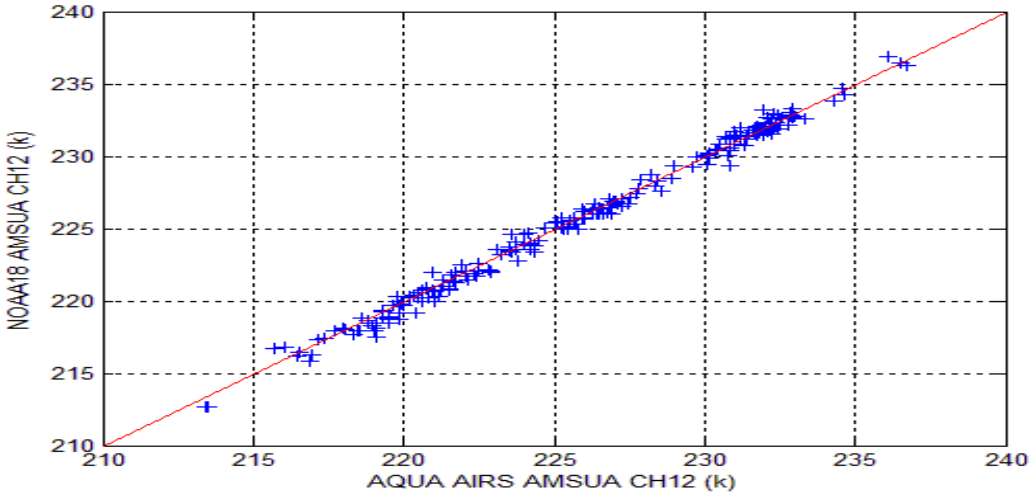
PGEs compare AMSU-A channels across several different satellite platforms to validate TOA ATMS radiances

- ATMS SDR match to NOAA18 AMSU-A
  - » NOAA18 amsu-a from NOAA CLASS in NOAA format- NSS.AMAX.NN.D09155.S2357.E0148.B2082324.GC
- ATMS SDR match to METOP AMSU-A
  - » Metop amsu-a from NOAA CLASS in EPS EUMETSAT format- NSS.AMAX.M2.D09155.S2246.E0030.B1362829.SV
- ATMS SDR match to NOAA19 AMSU-A
  - » NOAA19 amsu-a from NOAA Class in NOAA format- NSS.AMAX.NP.D09156.S0108.E0302.B0167273.SV
- ATMS SDR match to AQUA AMSU-A
  - » AQUA amsu-a from NASA DAAC in HDF-EOS format - AIRS. 2010.01.28.113.L1B.AMSU_Rad.v5.0.0.0.G10029102834.hdf

ATMS SDR match to NOAA18 AMSU-A



40 km window



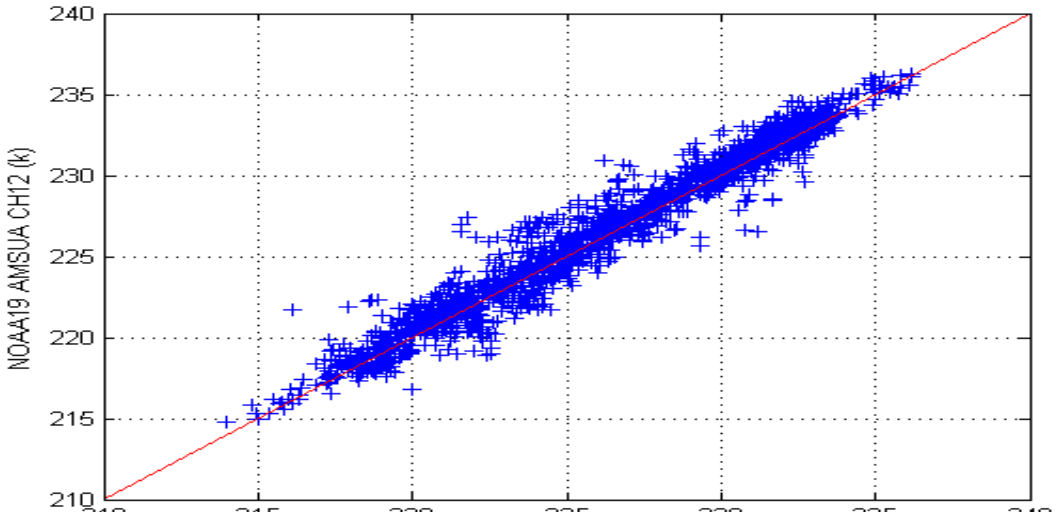
5 km window

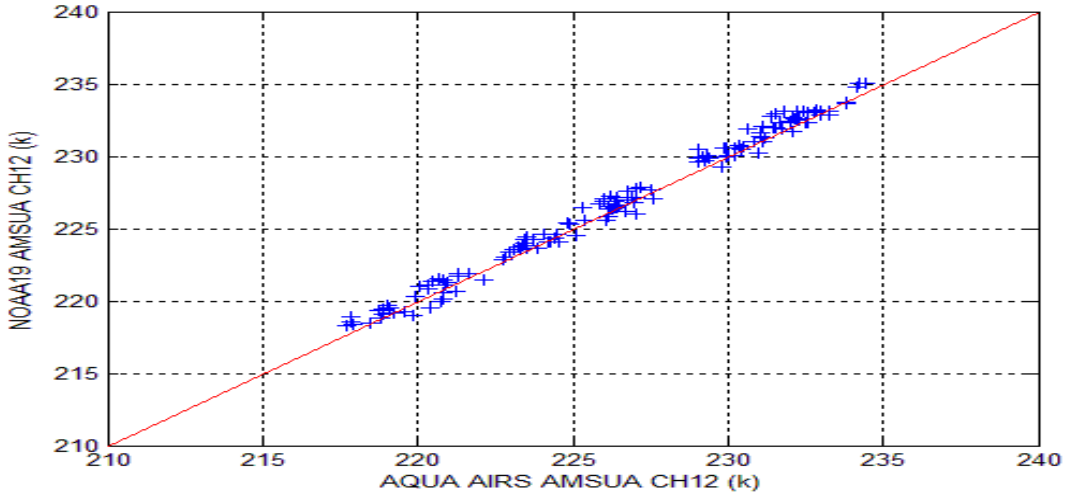
Sample test results

Matchups over the Polar regions

4 days – Mar. 26,27,28,and 29 2010 (Testing with Aqua AMSU-A)

ATMS SDR match to NOAA19 AMSU-A





Sample test results

40 km window

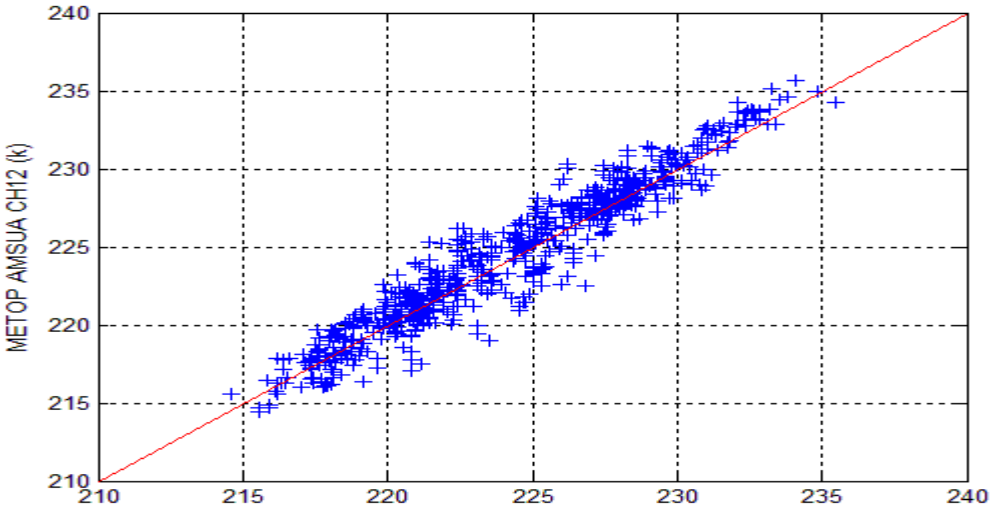
Matchups over the Polar regions

5 km window

4 days – Mar. 26,27,28,and 29 2010 (Testing with Aqua AMSU-A)

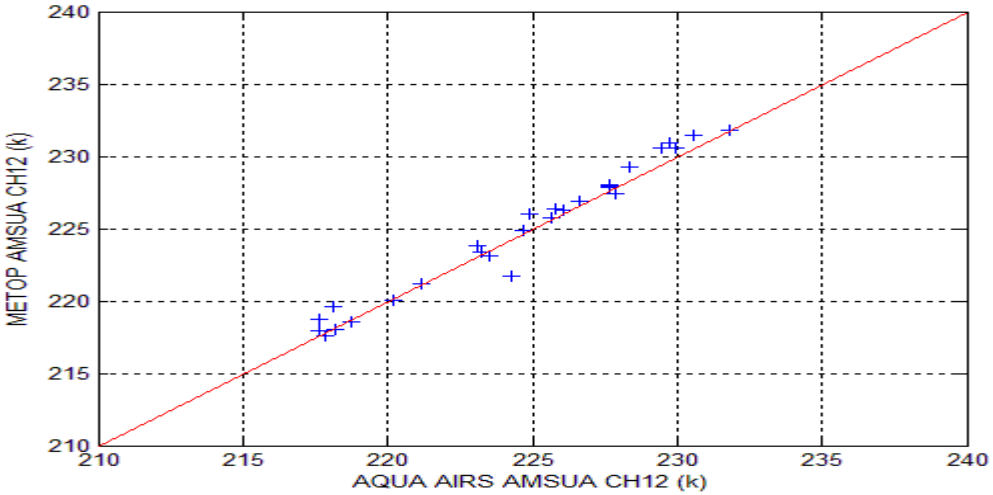
Mar. 30, 2010

ATMS SDR match to METOP AMSU-A



40 km window

Matchups over The Polar regions

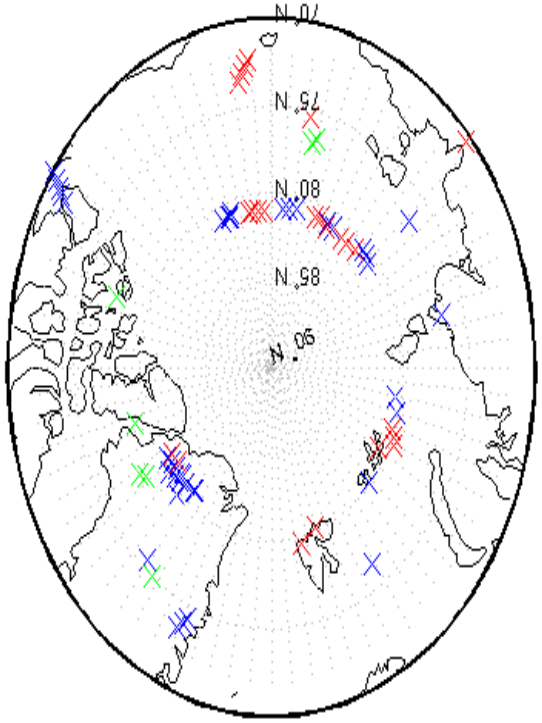


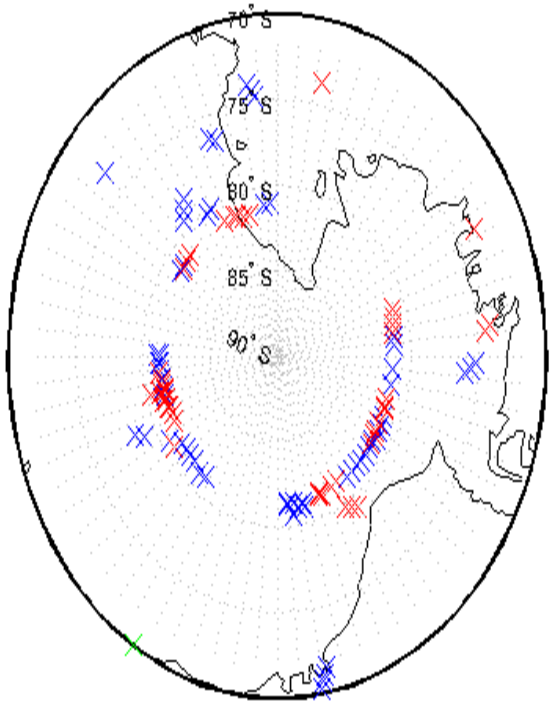
5 km window

4 days – Mar. 26,27,28,and 29 2010 (Testing with Aqua AMSU-A)

Mar. 30, 2010

ATMS SDR match to METOP AMSU-A





Green – AQUA-Metop matchup
Blue – AQUA-NOAA18
Red- AQUA-NOAA19

4 days – Mar. 26,27,28,and 29 2010 (Testing with Aqua AMSU-A)

PGEs for SDR Data Quality Monitoring

- Monitor the SDR Data Quality Flags that provide 'grade' type levels
- Accumulate the total number of Data Quality Flags that are contained in the CrIS SDR output files under fields that have quality levels (e.g. 'good', 'invalid', 'degraded', 'true', 'false', etc…); 18 values described in Sensor Trending Database
  - Extract and sum the DQF on a scan basis (8 seconds of data collection).
  - Keep the quality level of the DQF (e.g. good, degraded, invalid).
  - Populate the cumulative over the scan into a database.
  - Process all scans of desired day(s).
  - Extract and compute the daily cumulative DQF from the database
- Create output products
  - Ascii (text) file with table showing the daily cumulative of the DQF.
  - Ascii (text) file containing the "Overall degraded or Invalid DQF" listing as function of time/band/FOV/FOR.
  - Plots

PGEs for SDR Data Quality Monitoring

- Monitor the SDR Data Quality Flags that provide floating point values
- Values include such quantities as DS spectral stability, cumulative fringe count error, ICT spectral stability, ICT temperature stability etc. (12 values)
- Calculate daily min, max, means, range or cumulative numbers as appropriate to the quantity; described in Sensor Trending Database
- Populate the database and creates output ascii text files and plots
- Tested with IDPS HDF5 RDR files derived from TVAC data and synthetic data

Examples of SDR Data Quality Monitoring Output Products

Daily Summary Files & Logs

daily_table_dqf20081121.txt

impnoise_ascii_20020906.txt

log_message_dqf20081121.txt

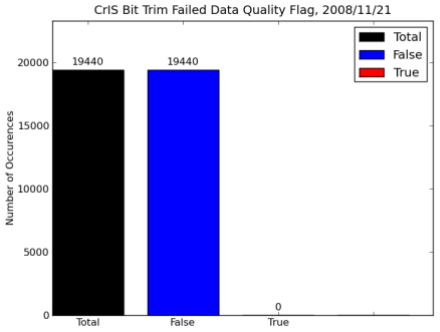
qf4_ascii_20081121.txt

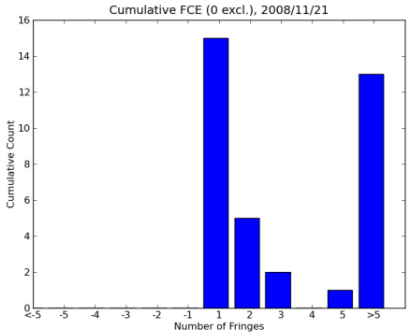
invspeccal_ascii_20081121.txt

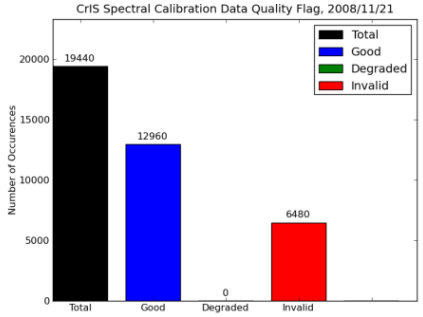
invradcal_ascii_20081121.txt

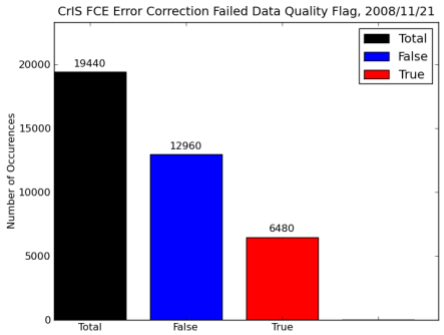
degoverall_ascii_20020906.txt

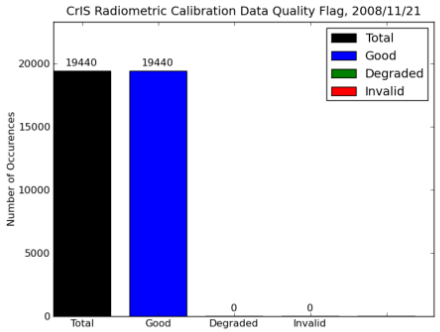
SDR Quality Flags: Plots and Ascii Output Files (part of CrIS NSIPS Database)

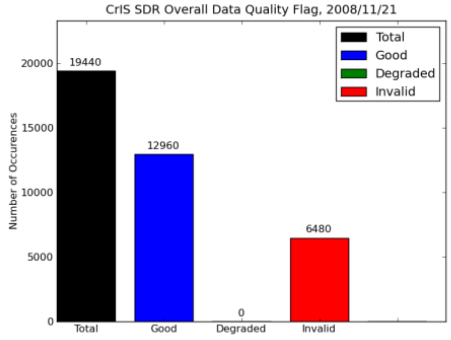










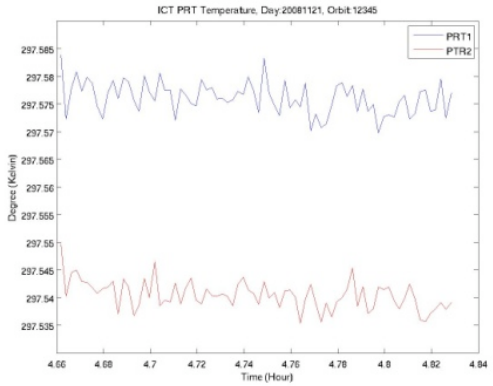


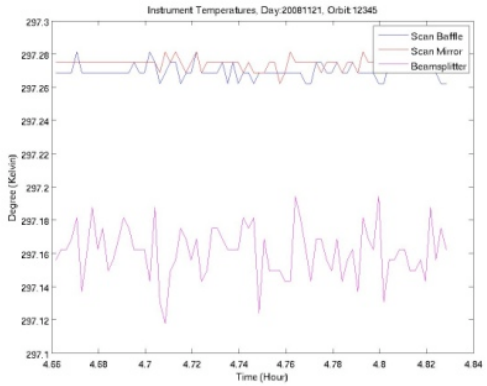
PGE for Sensor Telemetry Trending

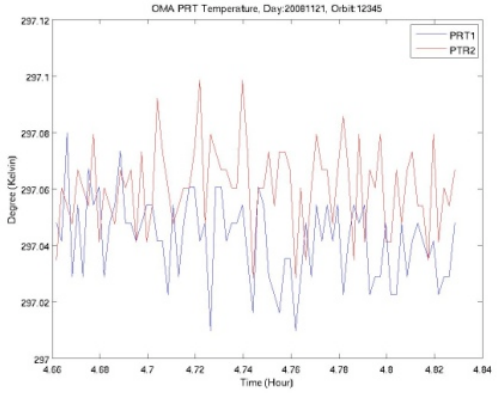
- Provides trending of science and some sensor parameters extracted from RDR science telemetry and housekeeping packets; detects updates to neon calibration parameters in engineering packet
- Converts all science related sensor measurements from counts to appropriate units of temperature, current, resistance etc.., using matlab lanquage
- Creates ascii output files and trending plots, using appropriate averaging or smoothing routines where necessary
- Tested with IDPS HDF5 RDR files created from TVAC3 data
- Operates in nearly autonomous mode as Product Generation Executable (PGE) software at NSIPS
- Will provide query database of science and sensor parameters at NSIPS as part of A&DP Common Tools development work
- Reviewed with Government team October, 2010

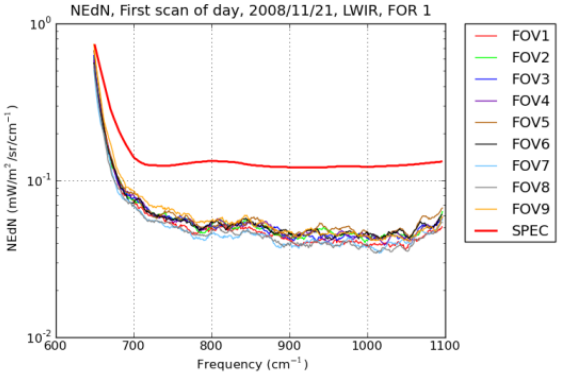
Examples of Science Telemetry Trending Products

RDR Sensor Trending Products: Plots and Ascii Output Files (part of CrIS NSIPS Database)









Daily Summary Files & Logs

neon_calibration_20081121_12345.txt
ict_oma_temperature_d20081121_b12345.txt
laser_temperature_current_d20081121_b12345.txt
crosstrack_pointing_error_d20081121_b12345.txt
scan_beam_temperature_d20081121_b12345.txt
intrack_pointing_error_d20081121_b12345.txt

daily_table_dqf20081121.txt
impnoise_ascii_20020906.txt
log_message_dqf20081121.txt
qf4_ascii_20081121.txt
invspeccal_ascii_20081121.txt
invradcal_ascii_20081121.txt
degoverall_ascii_20020906.txt

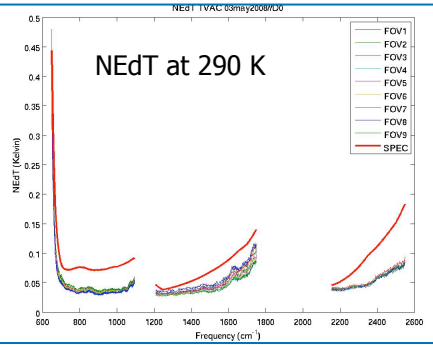
Cal/Val Analysis Tools for RDR/SDR and PGE outputs

Cal/Val RDR/SDR and PGE Output Analyses and Tools

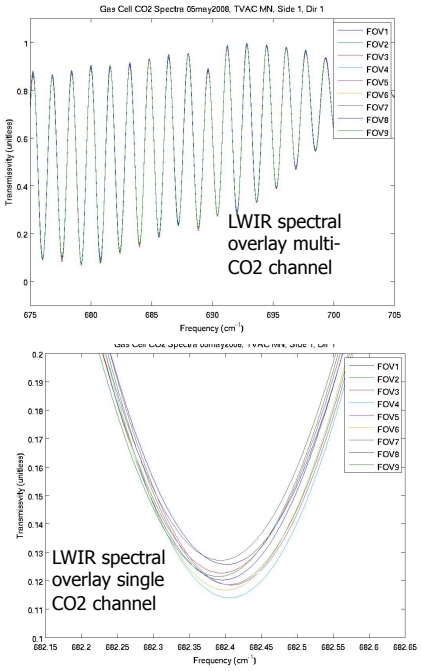
- Tools for analyses of PGE output in development
  - Extraction, trending, subsetting, statistical reduction etc.
- Methods and software tools developed to support sensor characterization and verification to performance requirements during CrIS TVAC also being adapted for on-orbit. These include
  - NEdN: using ICT and Deep Space
  - Spectral response: Verification of FOV center positions and ILS/spectral overlay
  - ICT environmental model verification of performance
  - Non-linearity on-orbit characterization, correction, error reduction and optimization using quadratic method and adjustments to linear in-band detectors
  - Cross-talk estimation
  - Radiance stability from orbit to orbit
  - Verification of Earth pointing parameters

Examples of RDR/SDR Analysis Tools

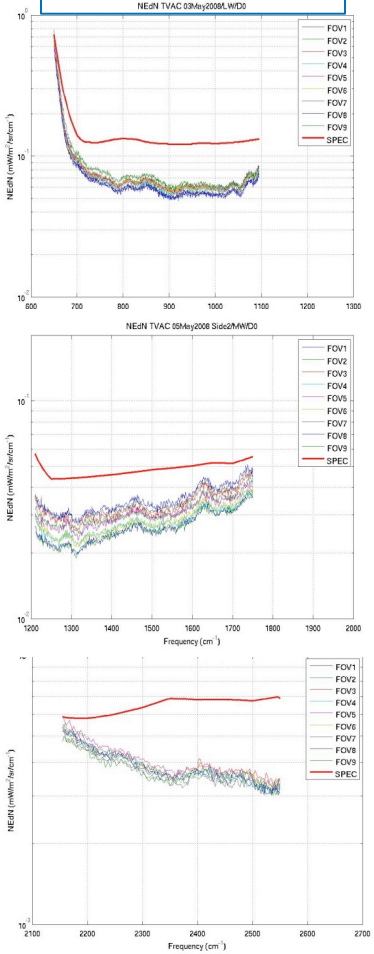
Noise Characterization

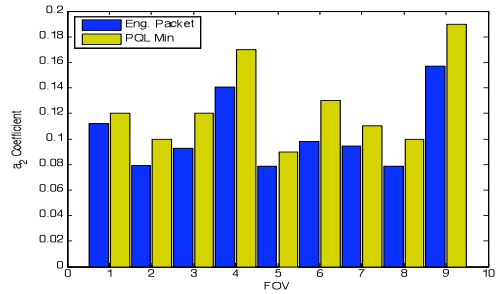


Spectral Validation



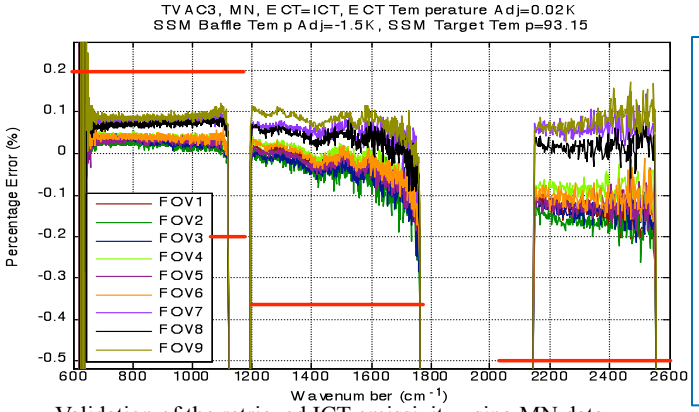
NEdN Spec. Verification





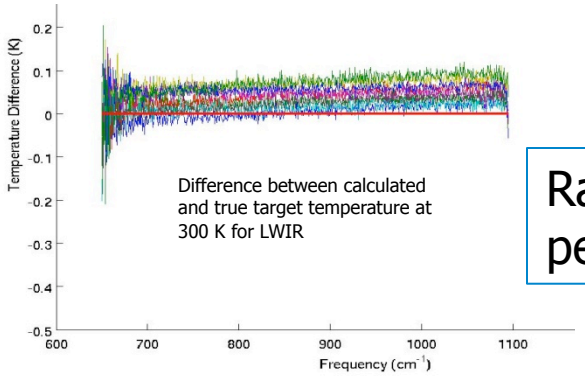
Derivation of Non-linearity a_2 coefficients

Comparison between a_2 coefficients retrieved by two different approaches



Validation of the retrieved ICT emissivity using MN data

Verification of derived Internal Calibration Target (ICT) emissivity

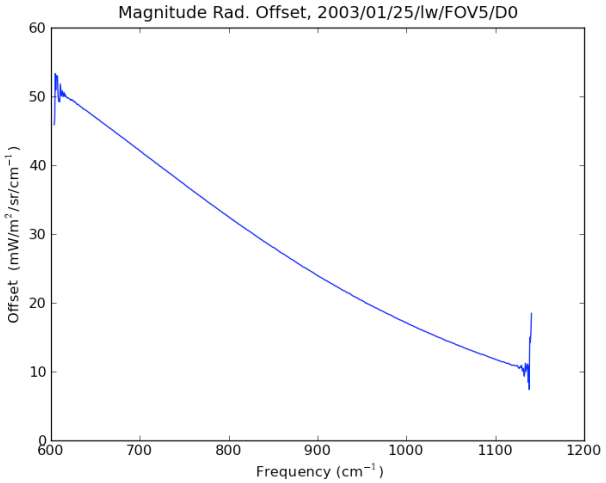


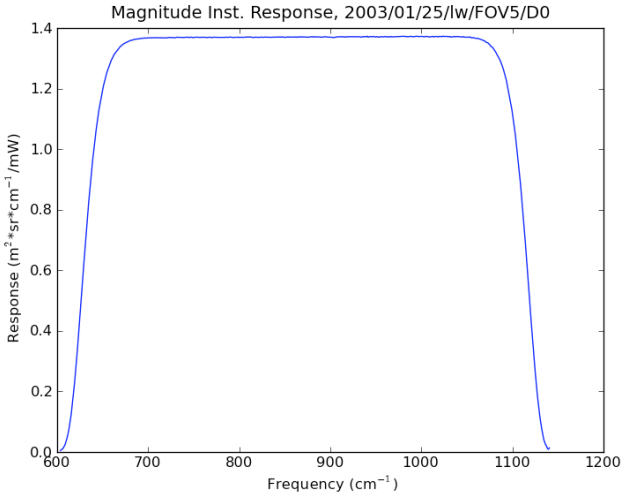
Radiometric performance

Algorithm Development Area
Test and Verification

Modified SDR Operational Code for Diagnostic Intermediate Products (1/2)

- The CrIS SDR resides offline at NGAS/NSIPS in the Algorithm Development Area, which resembles the operational AIX environment
- SDR code has been modified to extract intermediate products for diagnostic analyses
- Multiple products are extracted including instrument response, instrument radiometric offset, integrated magnitude, imaginary part of radiometric ration (mean and rms)





Modified SDR Operational Code for Diagnostic Intermediate Products (2/2)

- The extraction of additional intermediate products is planned including: raw ICT and DS running averages (30 samples), parts of CMO each time rebuild occurs, and ICT radiance
- The code normally operates for Golden Day assessments, could be elevated to PGE for limited daily processing

Summary of Analysis Tools for CrIS SDRs On-Orbit and Remaining Work (1/3)

CrIS SDR/EDR cal/val tools relatively mature but still operating on heritage, proxy and TVAC data

Tools developed to address radiometric, spectral and geolocation validation

Tools developed in three categories

(1) Matchups, SDR data quality and sensor trending PGEs

(2) Analysis tools for RDR evaluation, coefficient derivation, higher level processing of PGE outputs

(3) Diagnostic intermediate product generation from operational SDR code using ADA AIX operating environment

Functionality of PGEs for SDR matchups, data quality monitoring and sensor trending software in place; tested using TVAC, synthetic and CrIS proxy data

Additional tuning needed for CrIS-specific channels

Automation of double-differencing methods

More testing with GRAVITE CrIS proxy data – direct link from GRAVITE to NSIPS

Summary of Analysis Tools for CrIS SDRs On-Orbit and Remaining Work (2/3)

TVAC analysis tools in place; being adapted for on-orbit tuning, to include analysis software critical for diagnostic interferogram processing (not currently handled by operational SDR algorithm)

Calibration coefficients derived for:

- Non-linearity trending and tuning robustness
- ILS tuning and residual correction
- Sensitivity studies for SSM Baffle Contribution to Target Radiance

SDR production code modified in ADA environment to provide diagnostic intermediate products

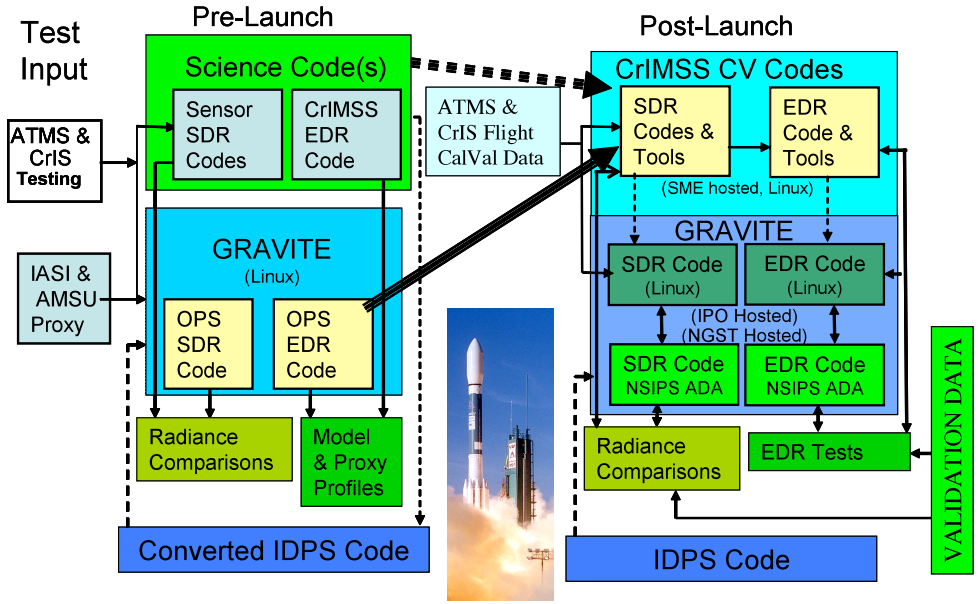
- Needs automation and additional testing;
- Mirror version of IDPS on NSIPS/local NG – test-bed for enhanced monitoring and trial tuning

Summary of Analysis Tools for CrIS SDRs On-Orbit and Remaining Work (3/3)

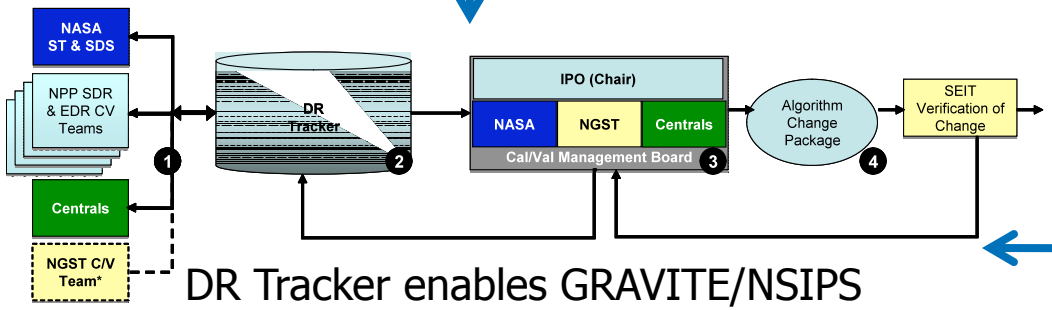
- Additional work in progress supporting geolocation validation (using VIIRS cross comparisons; convolution of VIIRS spectral response function (M15, M16 bands) with CrIS radiances
- Additional work in progress supporting spectral calibration using atmospheric lines from clear Earth scenes and OSS forward model calculations
- Planning for additional Government reviews of NSIPS PGEs for fine tuning
- PGEs presented subset of planned PGEs for launch readiness

BACKUPS

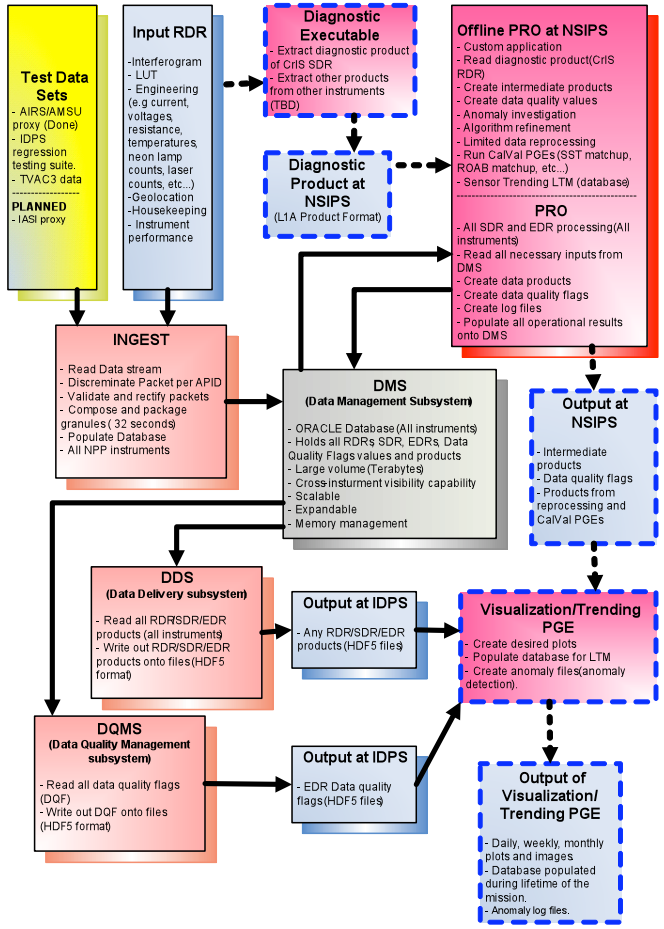
Robust Algorithm Test Plans Pre-launch to On-Orbit



GRAVITE for offline testing Linux version algorithms



DR Tracker enables GRAVITE/NSIPS recommended SW changes to IDPS Ops code



NSIPS ADA for testing Ops AIX version algorithm