STAR CrIS SDR CalVal Task Performance Status and Results

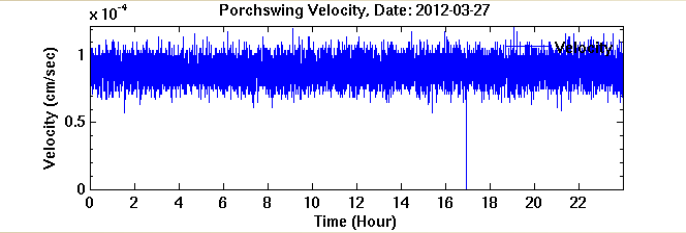
Yong Han, Denis Tremblay, Xin Jin, Yong Chen, Likun Wang

April 4, 2012, CrIS Review Meeting

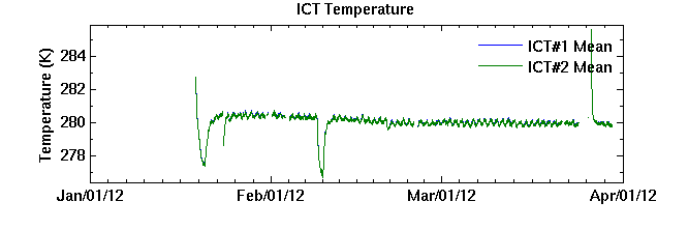
Task Performed at NOAA-STAR

Task Name	Description	Key People	Status
1. Trending and Monitoring	Monitor the CrIS instrument (RDR and SDR)	Xin Jin, Bi Li	Functional, continuous activity; 90% completion (still need minor update)
2. SNO Cross Calibration	SNO CrIS with AIRS and IASI	Likun Wang, Denis Tremblay	On-Track
3. Satellite Intercomparison	Radiance comparison with GOES/VIIRS	Mark Liu, Fangfang Yu	On-track
4. Double-difference Cross Comparison	Double Difference CrIS-AIRS/IASI-CRTM	Yong Chen, Yong Han	On-track
Software Update	Bug fix, update and refinement	Yong Han, Denis Tremblay, Xin Jin	On-track
Management	Coordination, Meetings, scheduling, DR, Budgeting, Risk Management	Yong Han/Denis Tremblay/Lihang Zhou/Fuzhong Weng/Laurie Rokke	Continuous activity

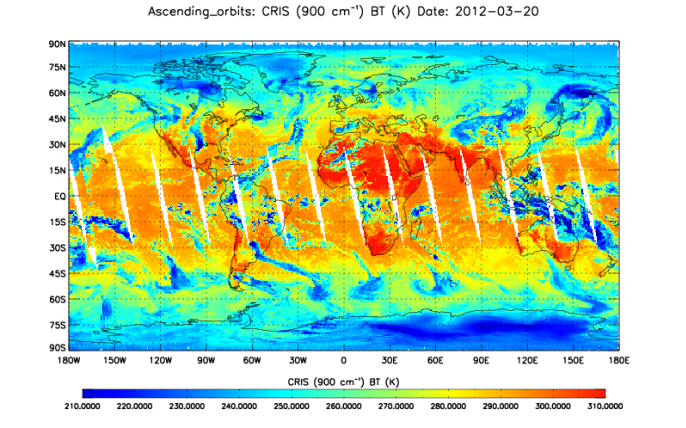
Web-based CrIS Trending and Monitoring System



Housekeeping RDR: Velocity, electrical currents … (5 par.)



Science RDR: Temperature, servo error … (12 par.)



SDR: Radiance, Quality Flags, Laser wavelength, … (38 par.)

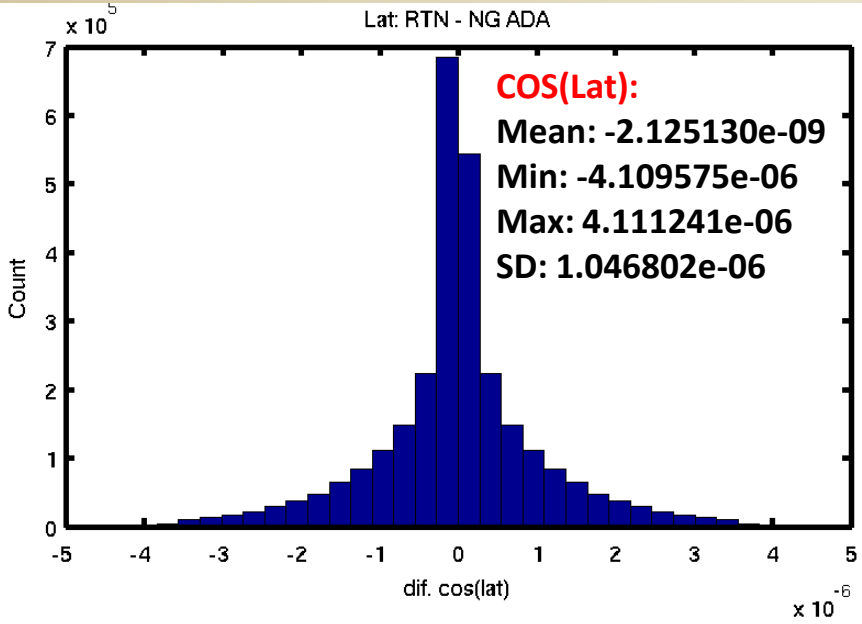
Total of 55 parameters are monitored on a continuous basis since the start of the mission.

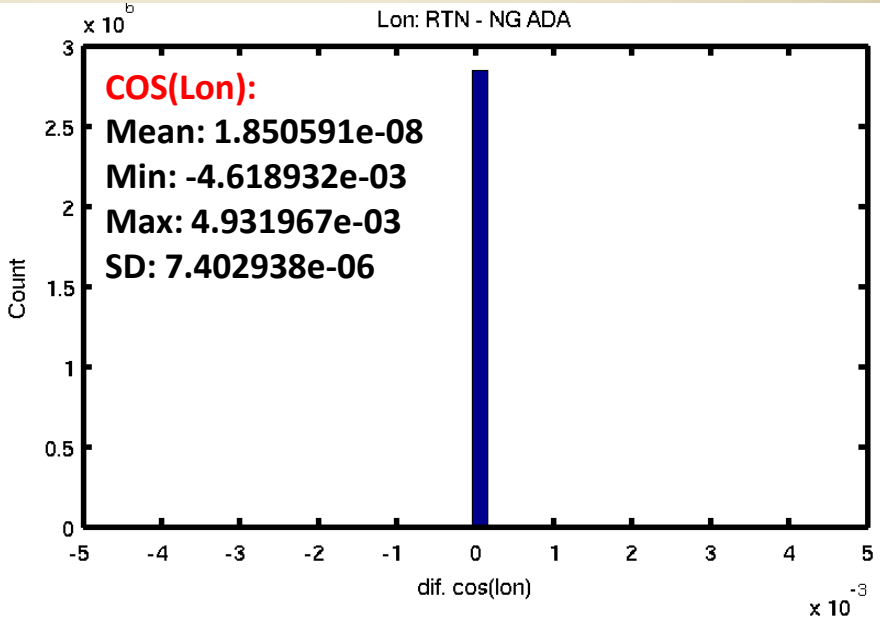
http://www.star.nesdis.noaa.gov/smcd/spb/xjin

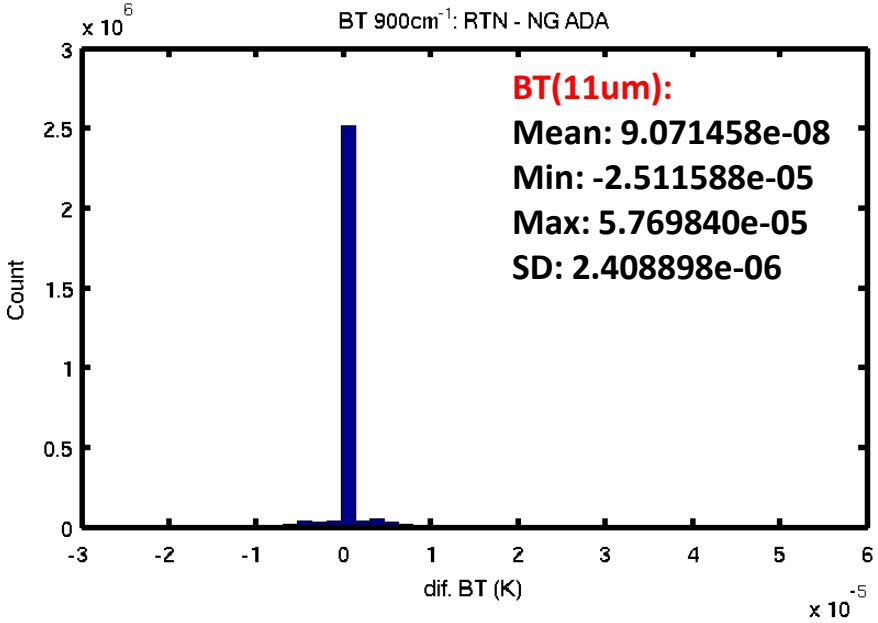
Comparison between RTN Factory, NG G-ADA, STAR-ADL of the Golden Day Data Acquired on 02/26/2012

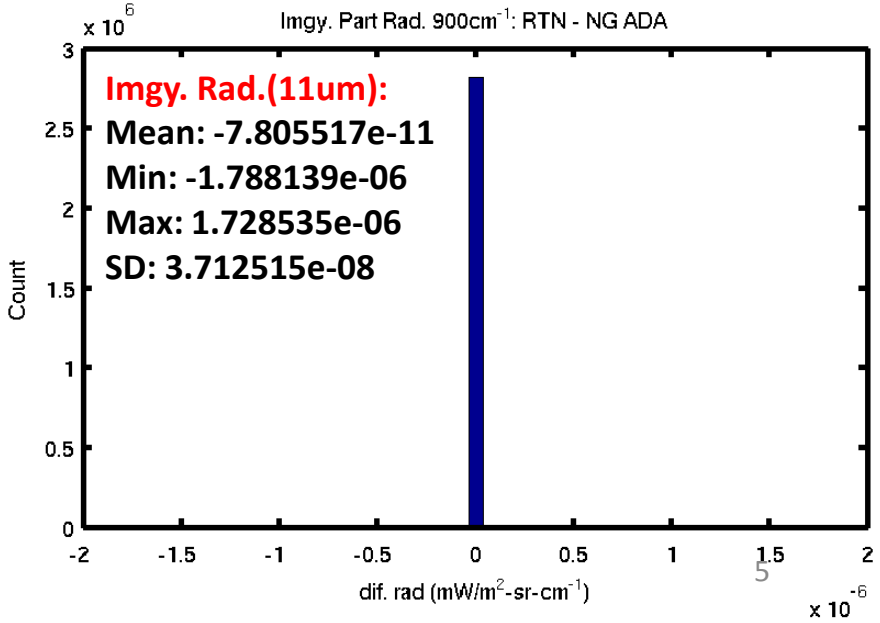
- Data
  - CrIS SDR products of Feb 26th 2012
  - Created by NOAA using ADL (**ADL**), NG using G-ADA (**ADA**), and Raytheon factory (**RTN**)
  - Total number of granules are: 2694 (**RTN**), 2689 (**ADA**), 2668 (**ADL**).
  - A total number of 10565 valid scans with same time stamps are found in all three data sets, i.e. 97.8% of the maximal daily coverage
- Methodology
  - Compare RTN and ADA
  - Compare RTN and ADL

RTN vs ADA


Lat: RTN - NG ADA
x 10^5
Count
dif. cos(lat)
x 10^-6
COS(Lat):
Mean: -2.125130e-09
Min: -4.109575e-06
Max: 4.111241e-06
SD: 1.046802e-06

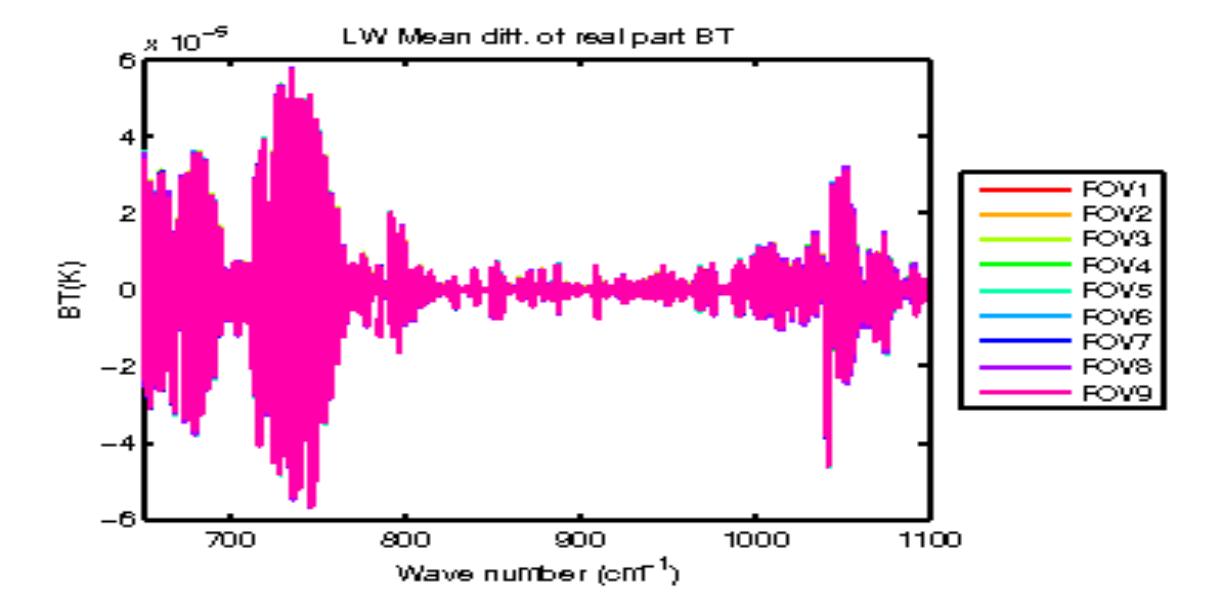

Lon: RTN - NG ADA
x 10^6
Count
dif. cos(lon)
x 10^-3
COS(Lon):
Mean: 1.850591e-08
Min: -4.618932e-03
Max: 4.931967e-03
SD: 7.402938e-06


BT 900cm-1: RTN - NG ADA
x 10^6
Count
dif. BT (K)
x 10^-5
BT(11um):
Mean: 9.071458e-08
Min: -2.511588e-05
Max: 5.769840e-05
SD: 2.408898e-06

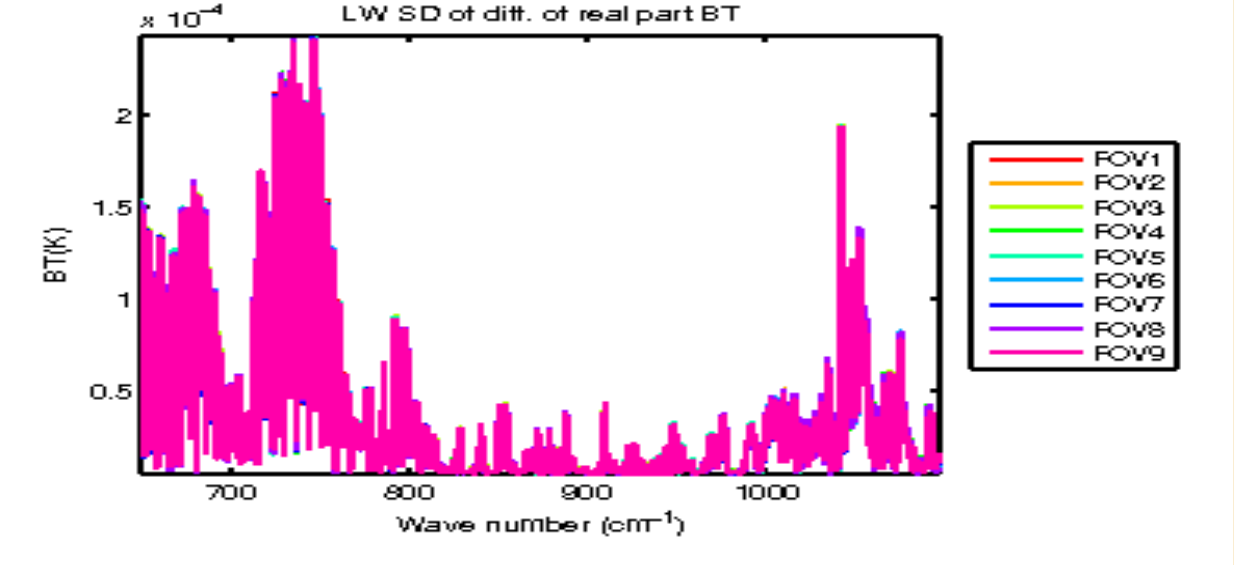

Imgy. Part Rad. 900cm-1: RTN - NG ADA
x 10^6
Count
dif. rad (mW/m2-sr-cm-1)
x 10^-6
Imgy. Rad.(11um):
Mean: -7.805517e-11
Min: -1.788139e-06
Max: 1.728535e-06
SD: 3.712515e-08

LW Unapodized BT difference RTN - NG G-ADA

Mean



SD



Differences between RTN and ADA, and between RTN and ADL (Overall Mean and STD)

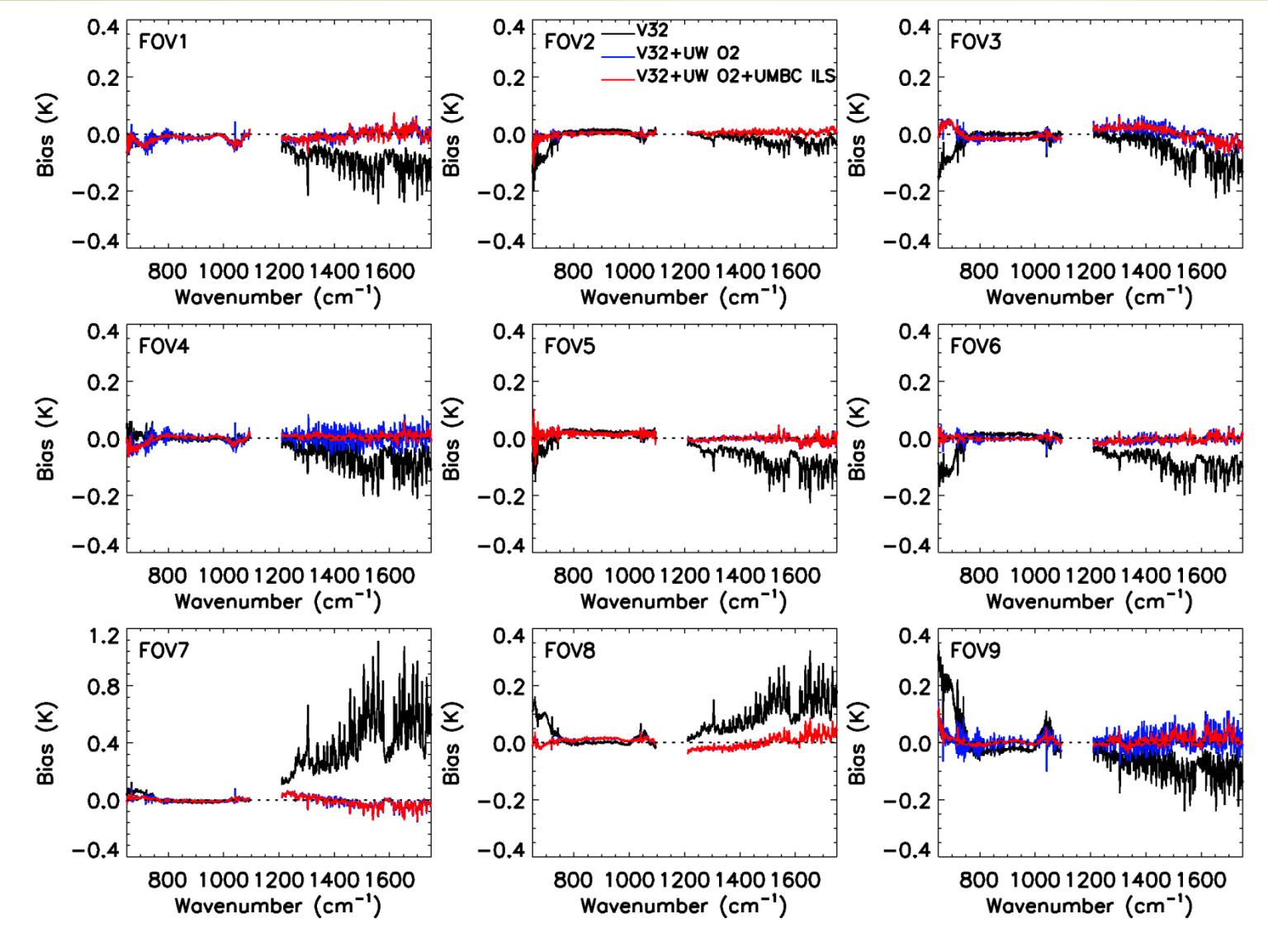
	Band	Radiance Real Part (STD)	Radiance Imaginary Part (STD)	BT (STD)
RTN – ADA	LW	10E-5 (10E-4)	10E-9 (10E-8)	10E-5 (10E-4)
RTN - ADL	LW	10E-3 (10E-3)	10E-5 (10E-4)	10E-3 (10E-3)
RTN – ADA	MW	10E-5 (10E-5)	10E-9 (10E-8)	10E-5 (10E-4)
RTN - ADL	MW	10E-3 (10E-4)	10E-6 (10E-5)	10E-3 (10E-3)
RTN – ADA	SW	10E-7 (10E-7)	10E-10 (10E-9)	10E-5 (10E-5)
RTN - ADL	SW	10E-5 (10E-5)	10E-7 (10E-6)	10E-3 (10E-3)

- (RTN-ADL) is larger than (RTN-ADA)
-All BT difference are less than 0.01 K.
-All 3 codes can be utilized for ICV.

CrIS Engineering Packet Evaluation

- Update Eng. Packet V32 with nonlinear coefficient a_2 from UW (referred as "UW O2", FOV-2-FOV) , rerun ADL to generate golden days 02/24/2012 and 02/25/2012 SDR.
- Update Eng. Packet V32 with ILS parameters from UMBC (referred as "UMBC ILS") in addition to a_2, and rerun ADL for the two golden days.
- Use the Community Radiative Transfer Model (CRTM) and ECMWF forecast data to simulate CrIS radiance, remove cloud scenes, and obtain clear channels over ocean.
- Evaluate the a_2 and ILS parameters impacts for the FOVs and FORs.
- Evaluate March 24 anomaly event impact.
- **Replacing V32 a_2 with "O2", the FOV-2-FOV spread is reduced significantly.**
- **Replacing the V32 ILS parameters with UMBC ILS, the improvements of the spectra are most significantly shown in FOVs 4 and 9.**
- **The improvements made with UW O2 and UMBC ILS are important to the NWP community.**

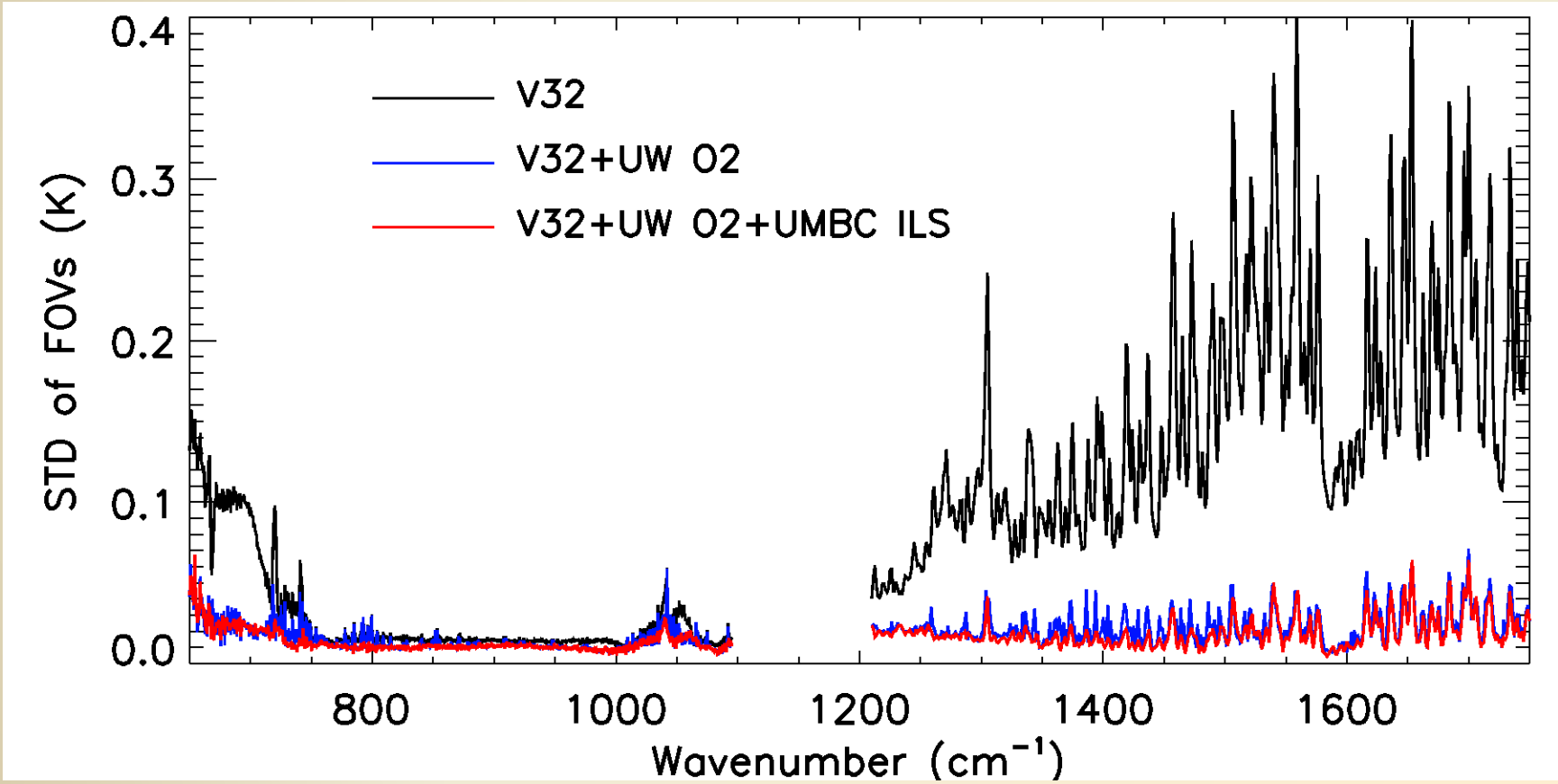
CrIS vs NWP CRTM Relative Bias for CrIS FOVs
(remove the mean bias between observations and CRTM simulations)



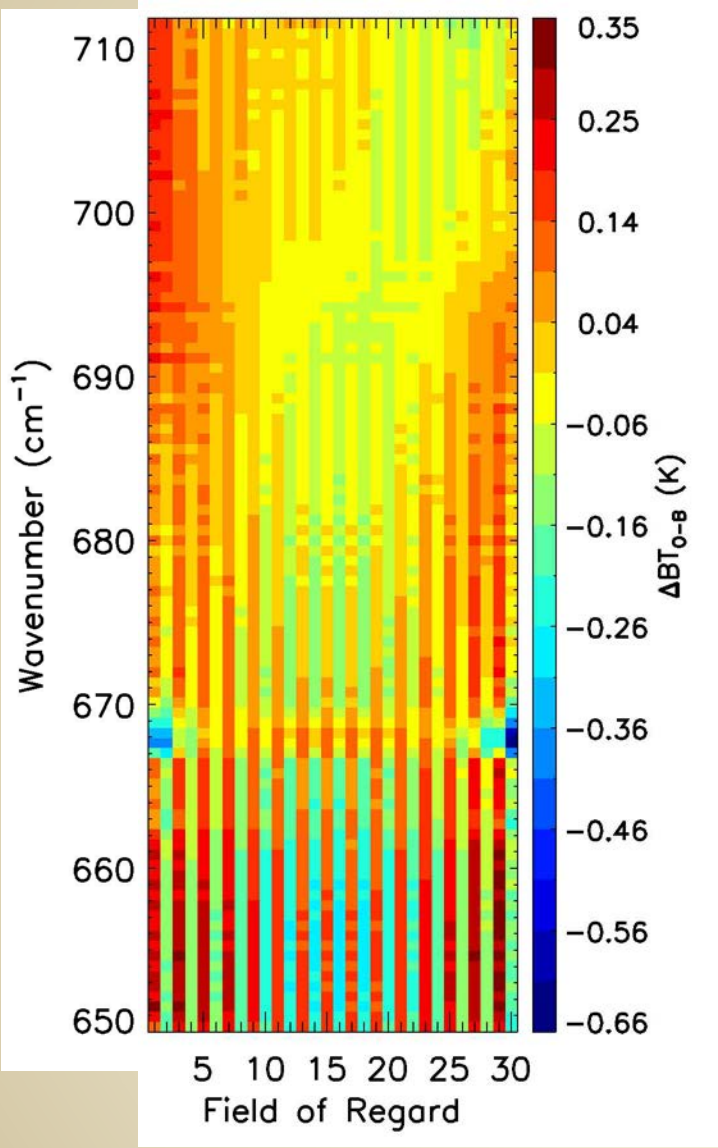
$$BIAS_{FOVi} = \overline{(Obs - CRTM)}_{FOV_i} - \overline{(Obs - CRTM)}_{all}$$

total clear sky observation points ~400000

Bias with UMBC ILS and UW Non-Linear a2
STD of Bias over 9-FOVs



Sweep Direction Bias: CrIS Observations compared with CRTM calculations



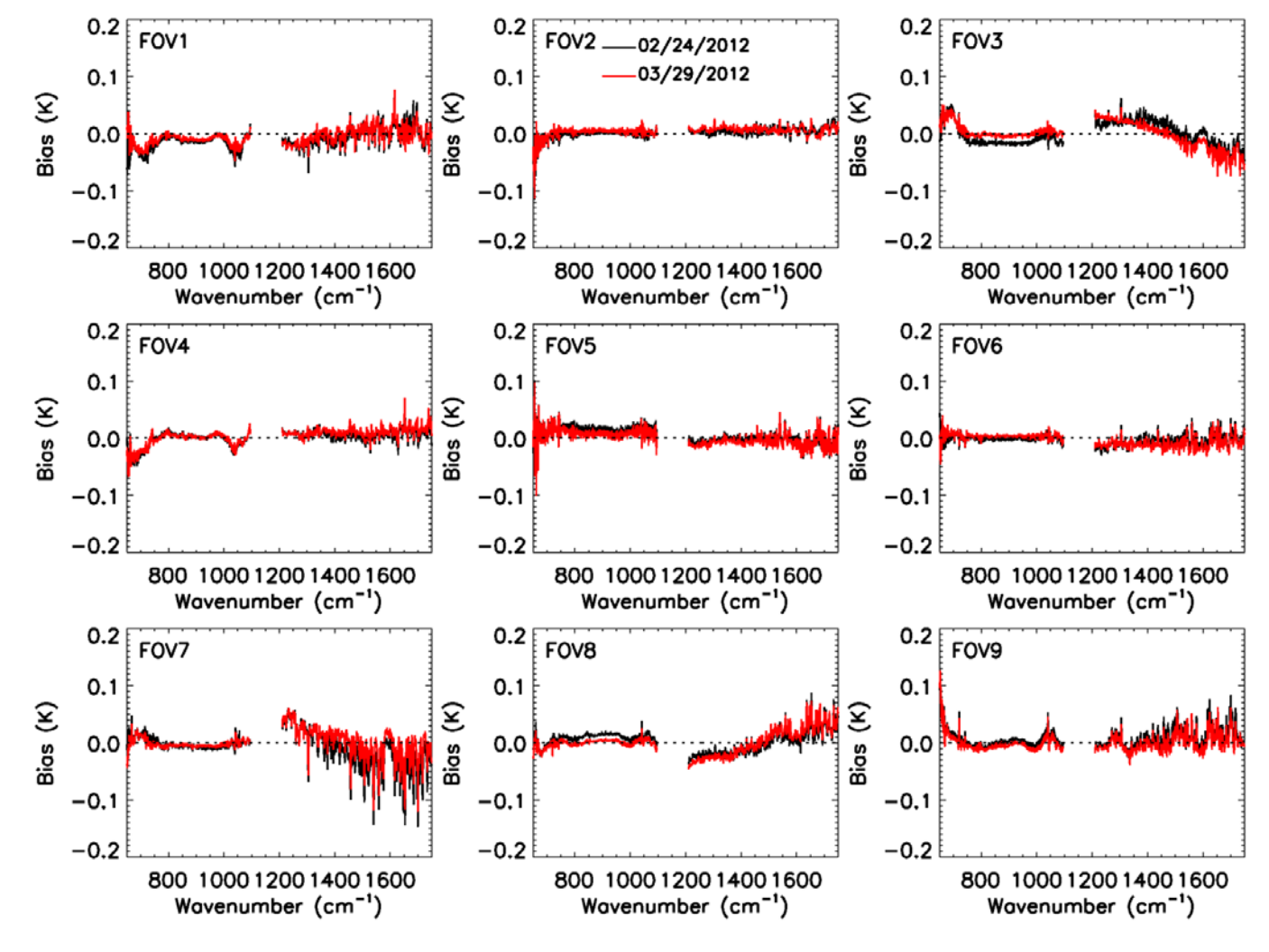
$$\Delta BT_{O-B} = \overline{(Obs - CRTM)_{FOR_i}} - \overline{(Obs - CRTM)_{all}}$$

CRTM – Community Radiative Transfer Model

Total clear sky observation points ~600000 within +-60 degree latitude over ocean

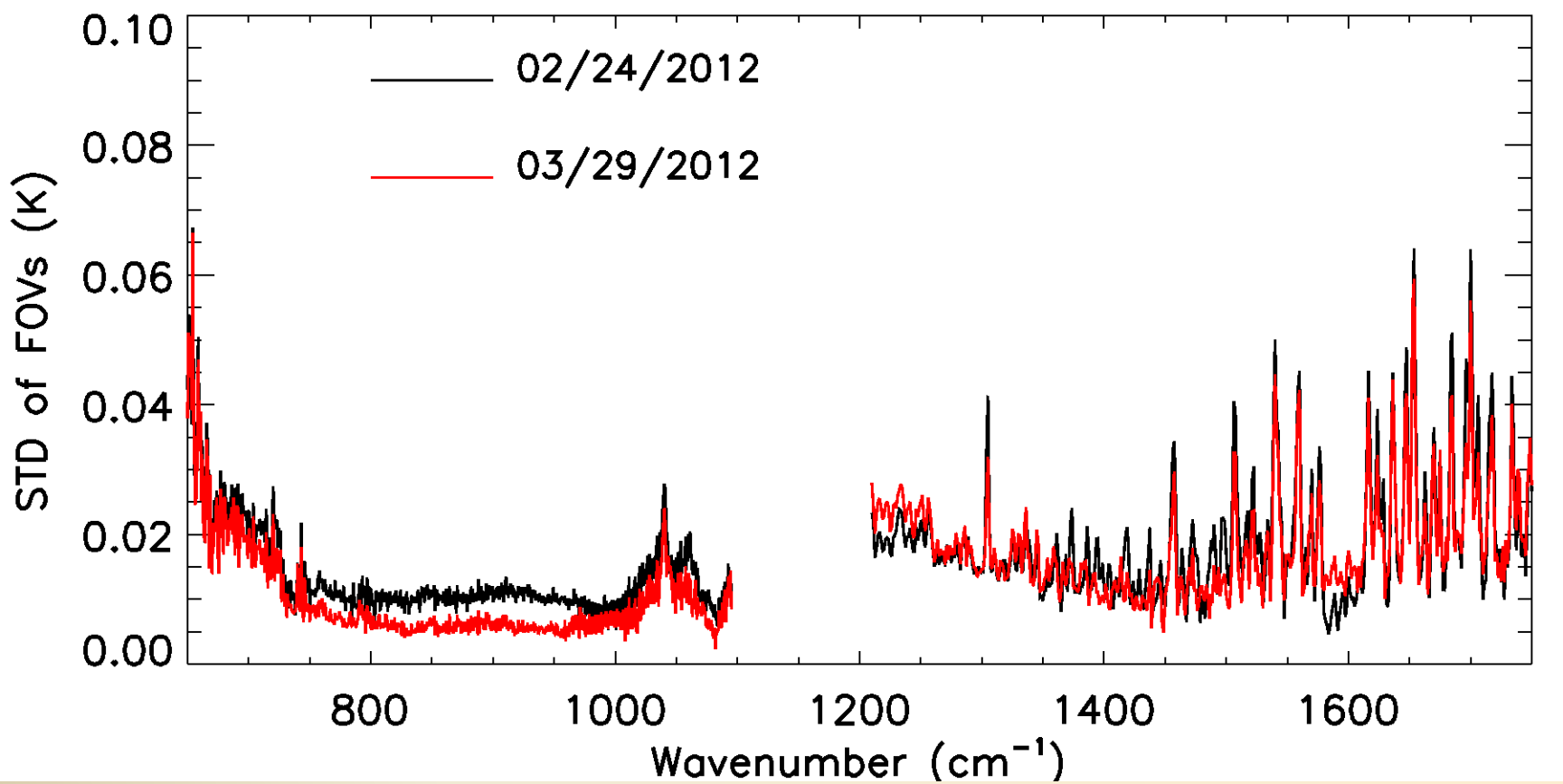
The difference between adjacent FORs can reach 0.4 K

Relative Bias for FOVs with UMBC ILS and UW Non-Linear a2 before and after 24 March Anomaly



The impact of the anomaly event is small

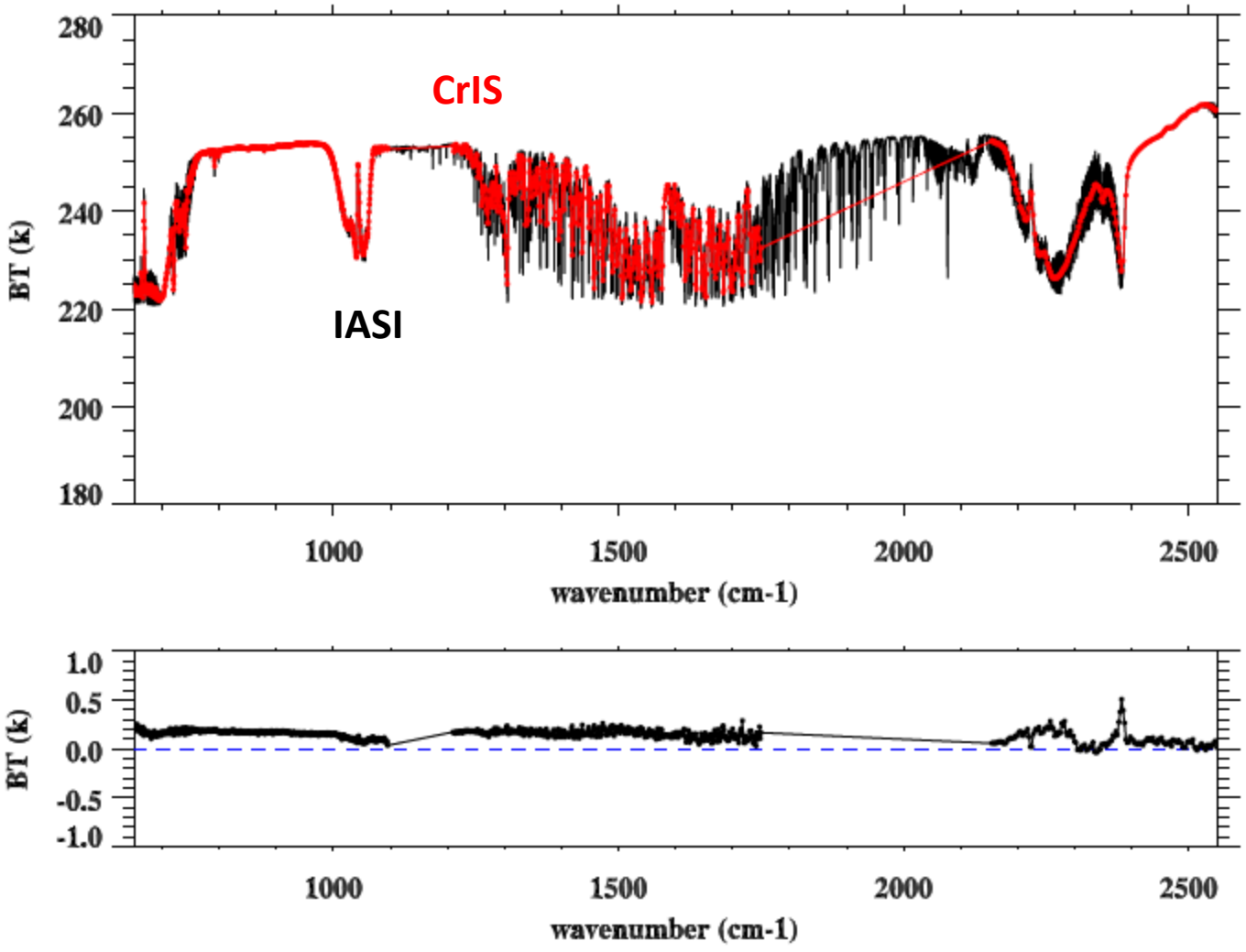
Bias with UMBC ILS and UW Non-Linear a2: STD of Bias over 9-FOVs before and after 24 March Anomaly

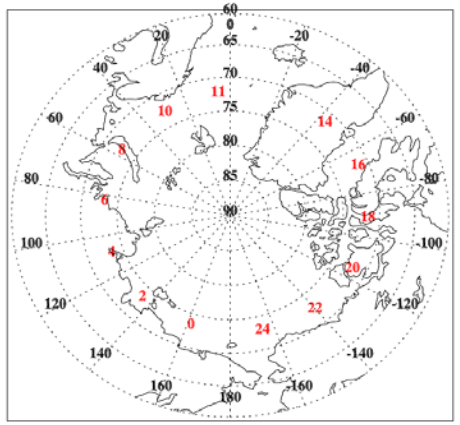


SNO and Satellite Intercomparison

- CrIS and IASI SNO shows that CrIS warmer than IASI about 0.1-0.2K (3/29-3/31).
- Intercomparison with GOES-13 imager to all the “Golden Day” data available (02/24/2012, 02/25/2012 and 03/11/2012 – 03/23/2012)
  - CrIS overall is very well calibrated with mean Tb bias difference to AIRS and IASI: <0.12K
  - The mean Tb bias to CrIS is in between AIRS and IASI at GOES-13 Imager Ch3 (6.5um) and Ch4(10.7um).
  - CrIS seems slightly warmer than AIRS and IASI at GOES-13 Imager Ch6 (13.3um)
  - Time-series of day-time Tb bias to CrIS is consistent at the three broad-band channels, as that to AIRS/IASI.
  - 15 days of GOES - CrIS vs. 29 days of GEO-AIRS and GEO-IASI (02/24/2012 thru 03/23/2012)
    - Continue monitoring the Tb bias

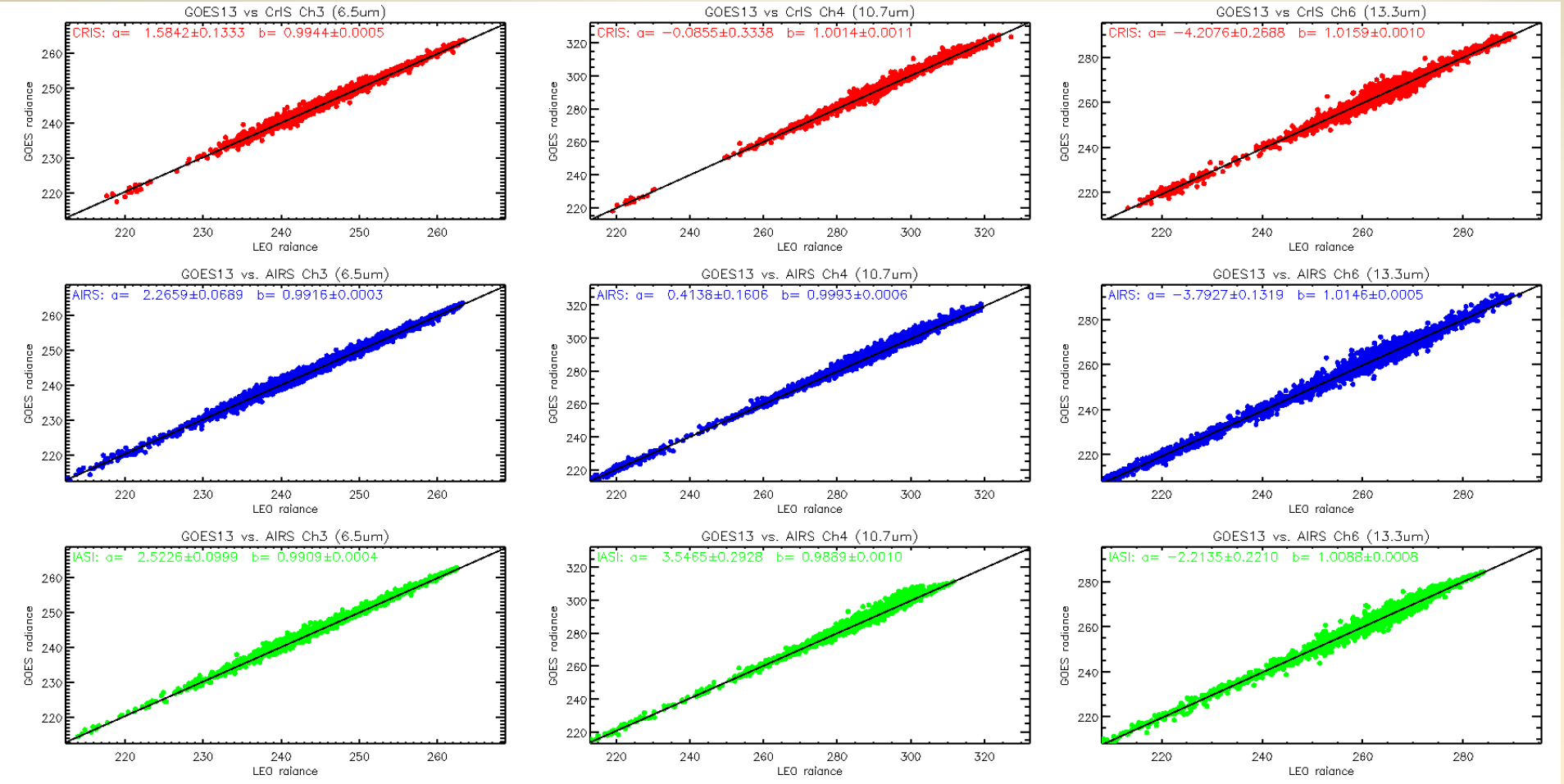
SNO Cross Calibration: CrIS vs IASI convolved CrIS (North Pole)





See Likun Wang's presentation this afternoon

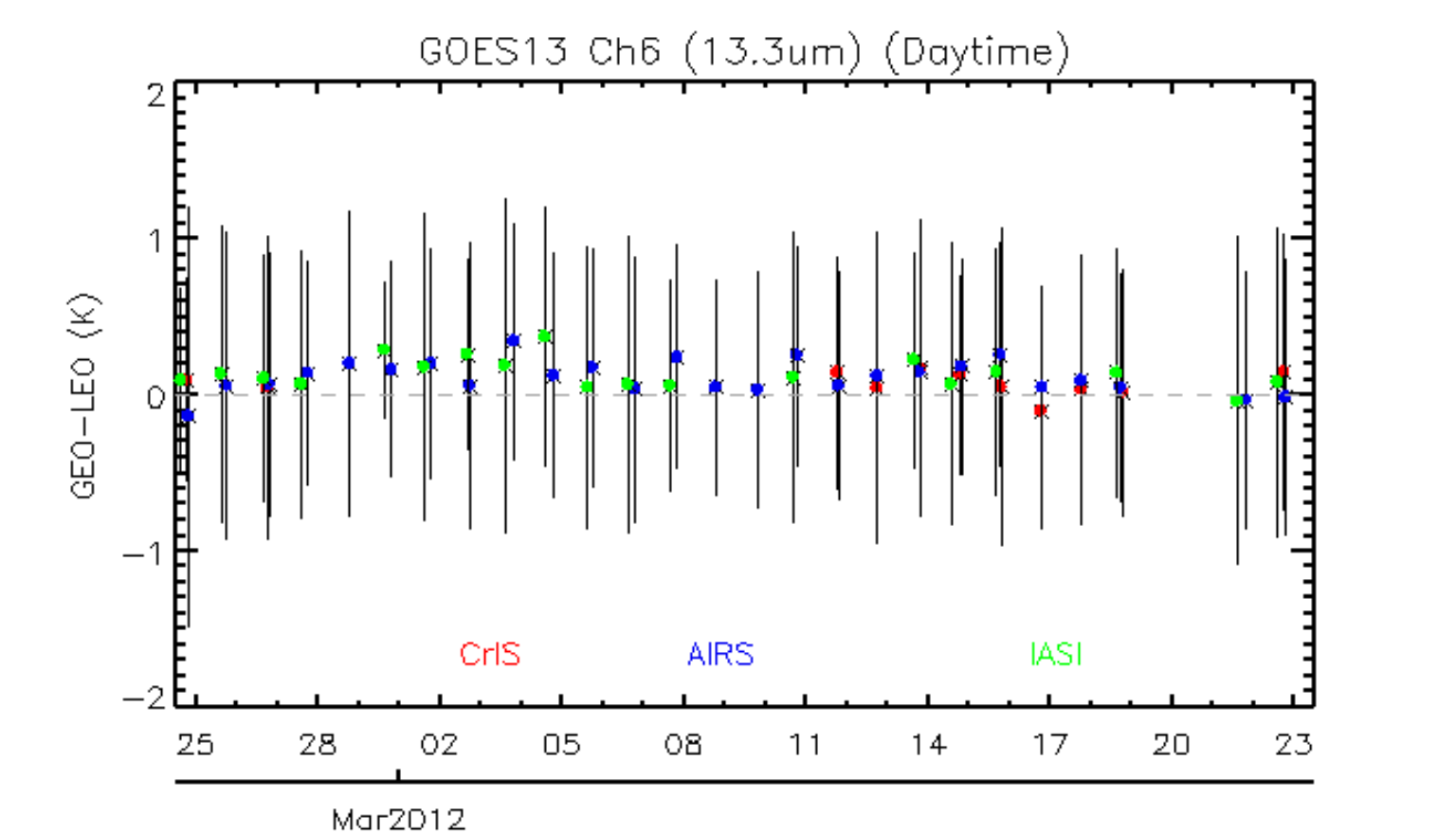
CrIS Radiometric Calibration Accuracy Evaluation using GSICS GEO-LEO Inter-calibration



Day-time collocated homogeneous scenes for GOES-13 imager

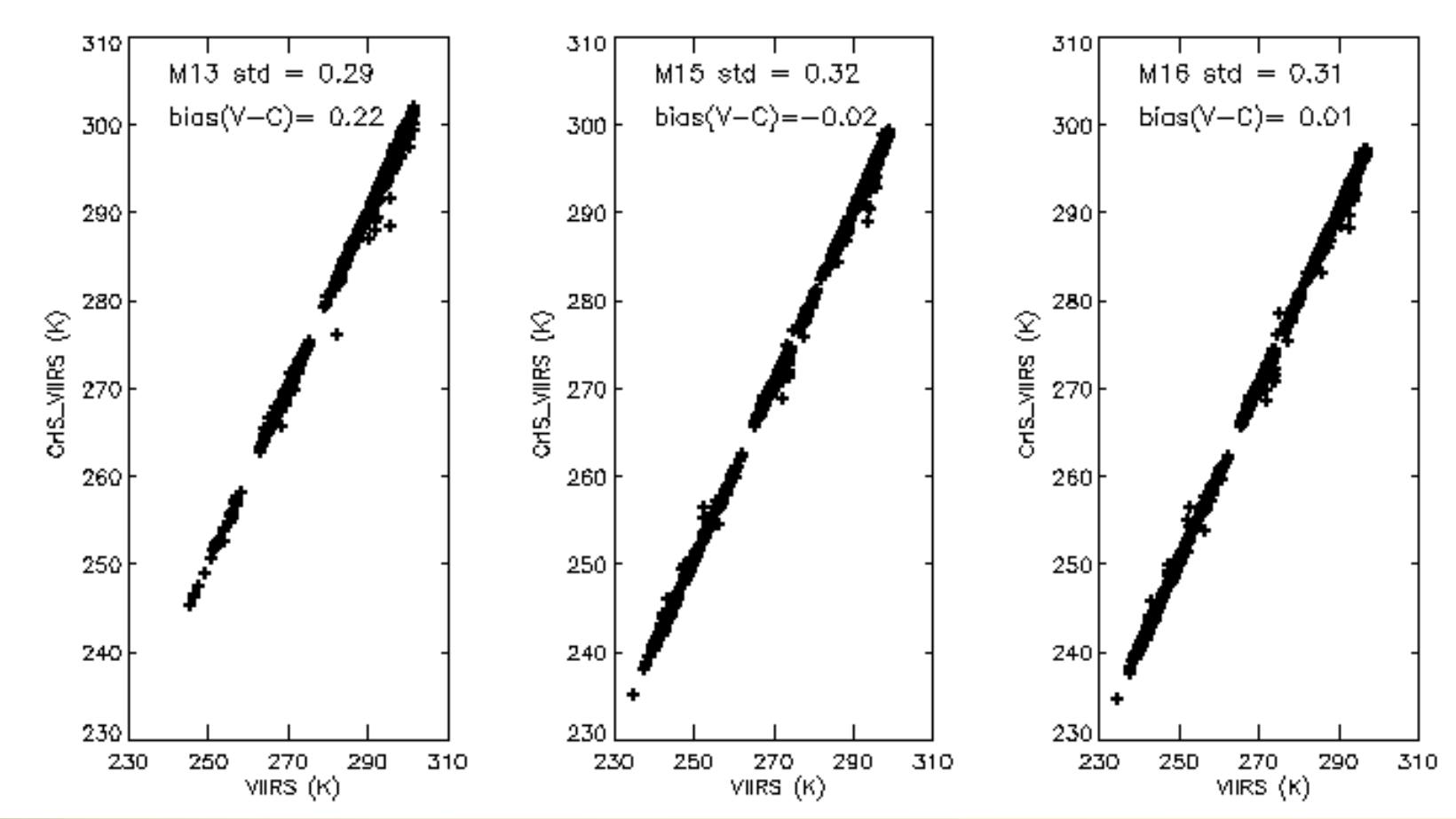
Courtesy of Fangfang Yu and Xiangqian Wu

Time-series of day-time Tb bias – Ch6 (13.3µm)



Courtesy of Fangfang Yu and Xiangqian Wu

Satellite Intercomparison:
CrIS Comparison With VIIRS (BB LUT updated)



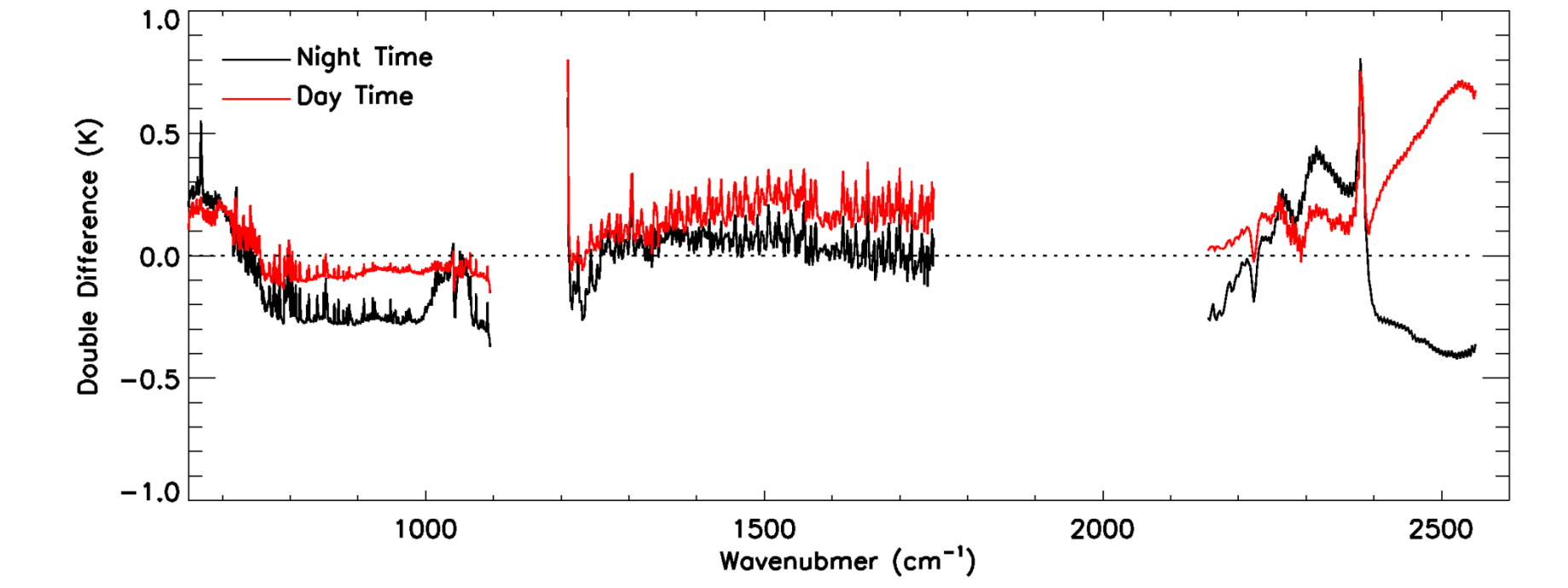
March 18, 2012

Courtesy of Mark Liu

Radiometric Validation: Double Difference between CrIS and IASI Convolved CrIS for Clear Sky over Ocean on Feb. 25, 2012

About 10% data are clear sky ~300,000 for CrIS and ~100,000 for IASI

$$DD = \overline{(Obs - CRTM)_{CrIS}} - \overline{(Obs - CRTM)_{IASI\,2CrIS}}$$



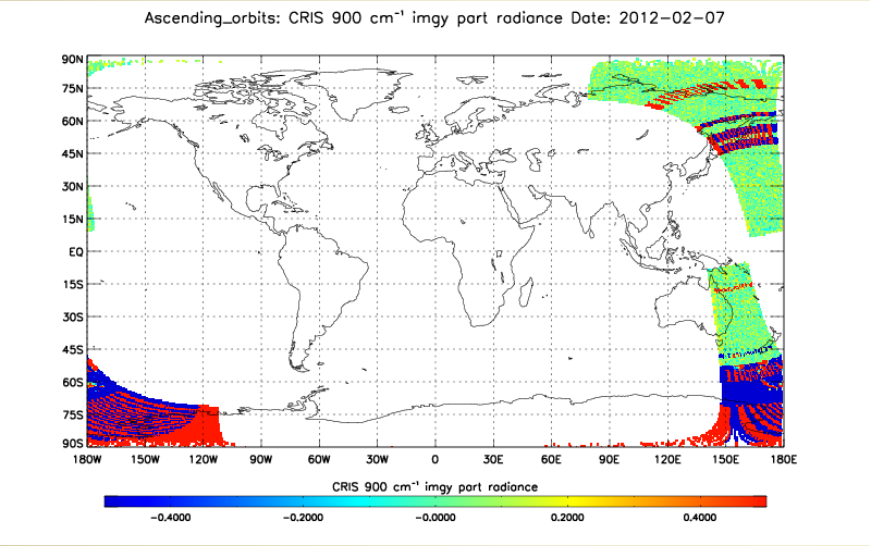
Summary of Code Change (1/3)
Severe bugs found in ADL v3.1/MX5.2

- Incorrect interferogram time stamp: Incorrect type casting of the time stamp bias (give +32583 millisec instead of -183 millisec). (NG and RTN)
- Warm load: ICT temperature set to 293.00K instead of PRT temperature readout of about 278K (NG)
- Incorrect conversion of IAR frame to SSMR frame, transformation of microradians to radians not done in the code. (NOAA-STAR)
- FCE algorithm has been turned OFF. (UW and NOAA STAR)
- Bit trim mask not updated in ADL. (NOAA-STAR and UW)

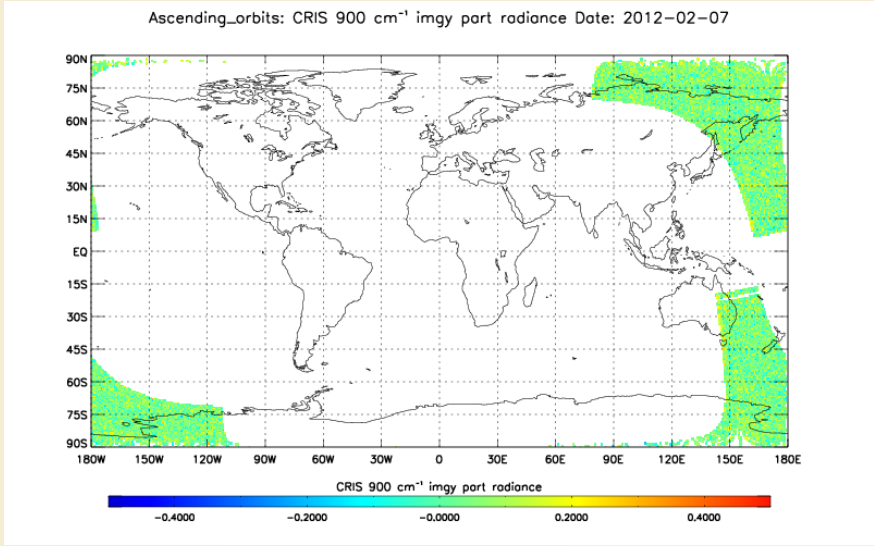
Summary of Code Change (2/3)
Severe bugs found in ADL v3.1/MX5.2

-The Fringe Count Error (FCE) algorithm has been turned OFF.
- Temporary code change has been implemented.

FCE turned ON

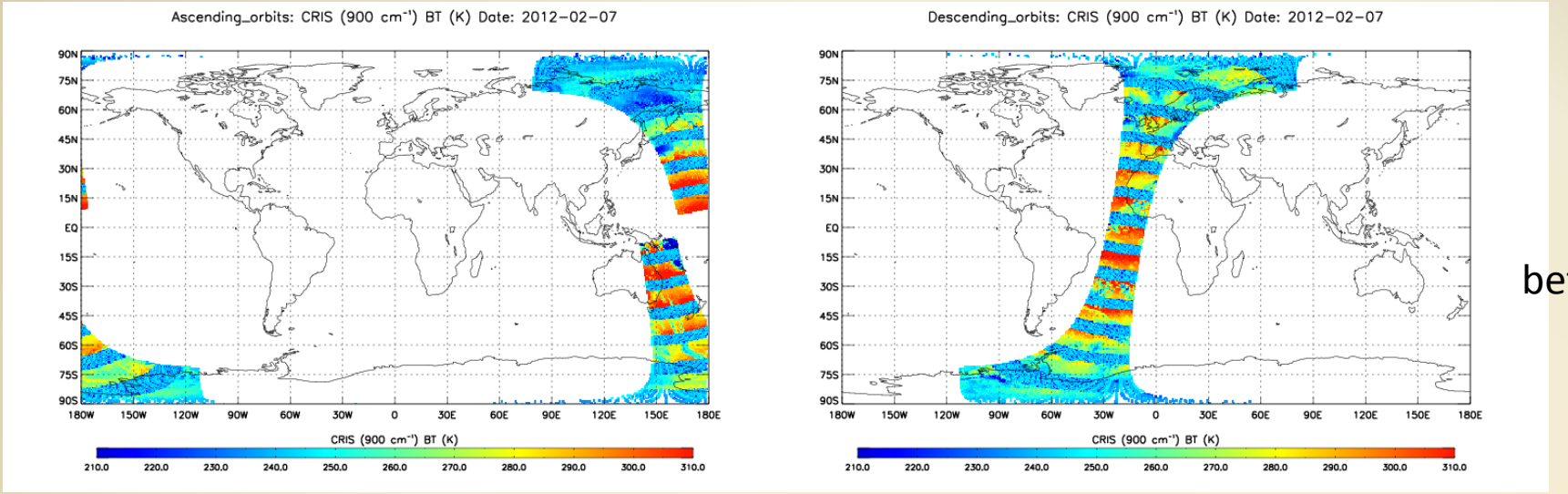


FCE turned OFF

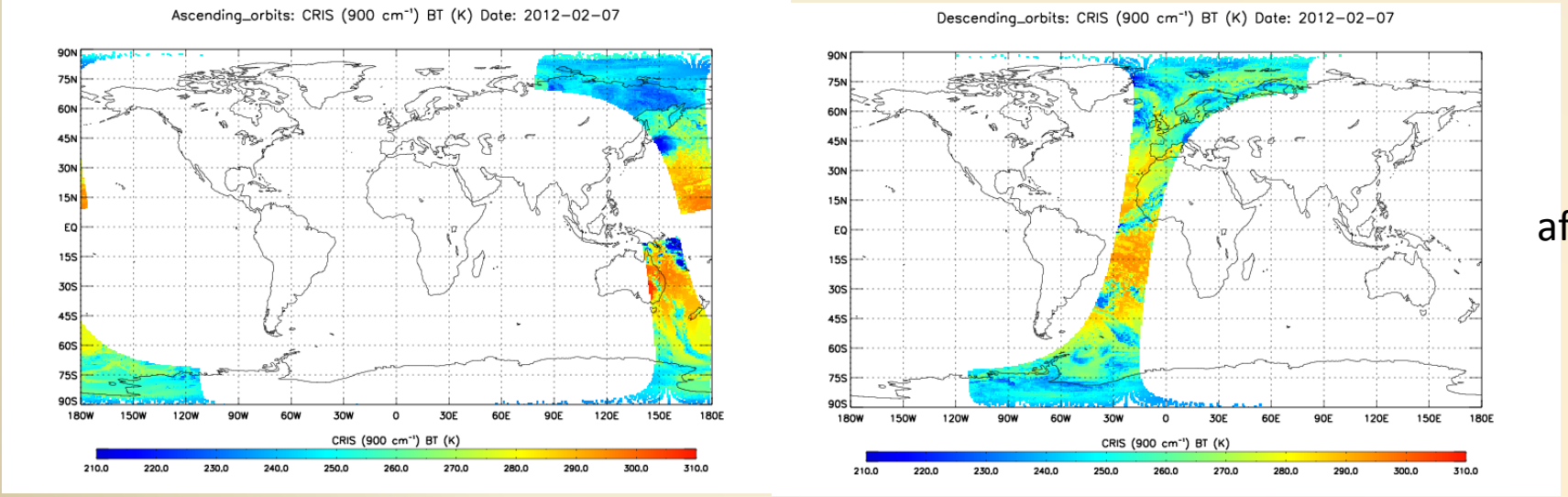


Summary of Code Change (3/3)

Radiance before & after the trim table problem fix (for EngPkt v32).
STAR results



before



after

High Priority Discrepancy Report (DR) Status

DR Number	Description	Date	Status
4646	Radiometric bias with sweep direction dependency	03/27/12	New
4557	CrIS IFGM packet with fill released to RDR/SDR	02/06/12	On-going
4534	Fringe Count Error reformulation	01/25/12	On-going
4481	FCE correction algorithm does not work for cold scenes (add DQF based on imaginary part)	12/06/11	On-going
4478	CrIS Overall DQF set to invalid for cold scenes	12/02/11	On-going
4407	Inconsistency with serialization	10/19/11	On hold

Summary

- The STAR CrIS RDR/SDR Trending and Monitoring system has been established and has played an important role in our Cal/Val process
- Comparisons between ADL and G-ADA and between G-ADA and RNT test run show that the three codes can produce similar SDRs
- Comparisons between observations and RTM calculations show that the SDRs have reach the level useful for NWP applications
- The inter-satellite/sensor comparisons showed good agreement between CrIS and AIRS/IASI/GOES, with CrIS slightly warmer