



GSICS IR Web Meeting for Hyperspectral Sounder Inter-comparison

FY-4A/GIIRS Performance and Inter-comparison Results

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August 22, 2019

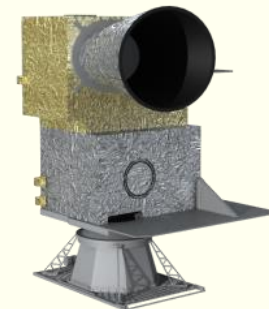


Outline

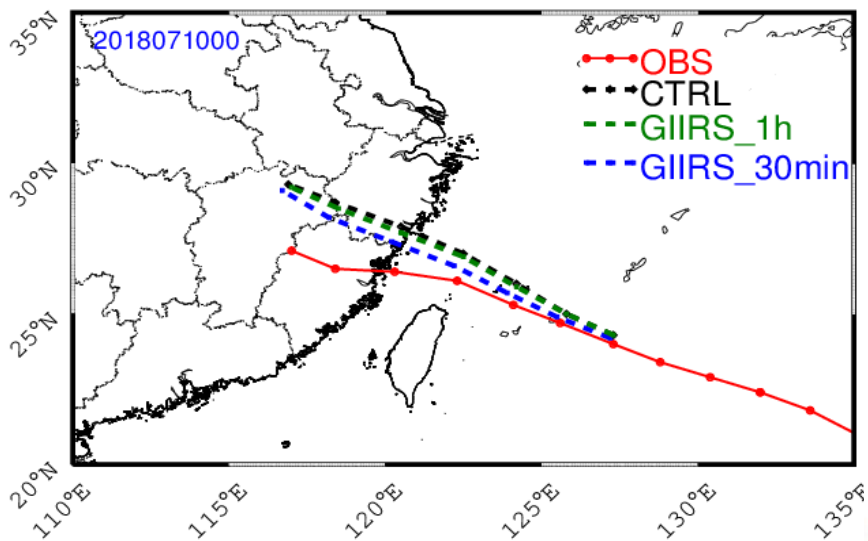
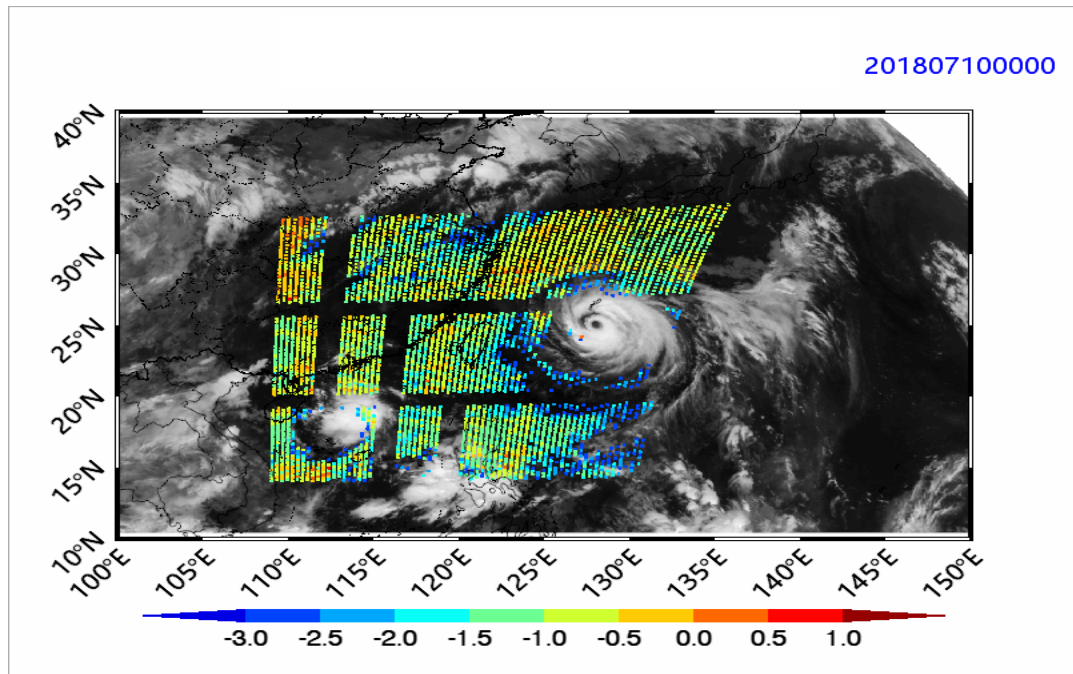
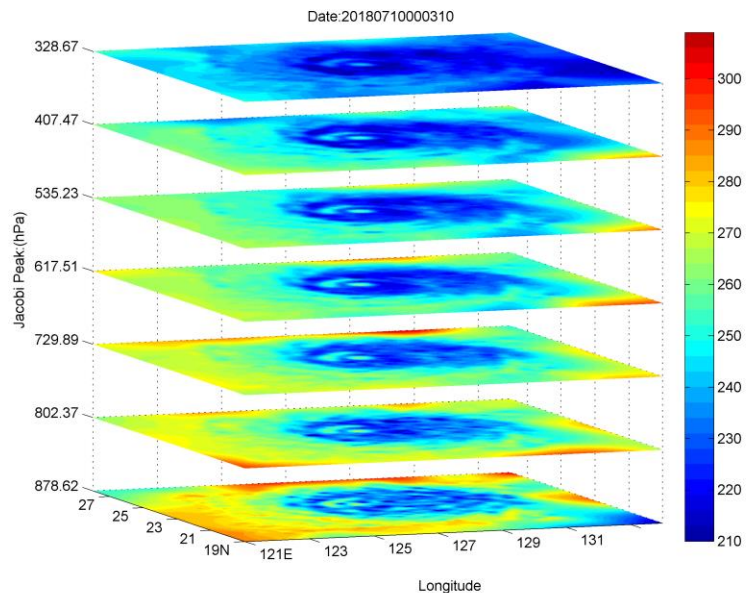
- 1. Background**
- 2. L1 data (V2) of GIIRS and related assessments**
- 3. GEO-LEO/Sounder intercomparison (GIIRS vs. IASI)**
- 4. Follow-up improvements**
- 5. Summary**

Main Specifications of GIIRS

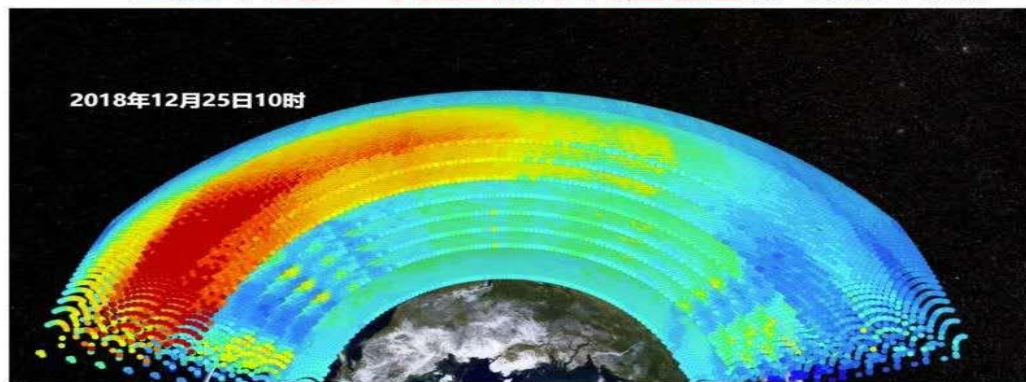
	Range	Resolution	Channels
Spectral Parameters (Normal mode)	LWIR: 700-1130 cm^{-1}	0.625 $^{-1}$	689
	MWIR: 1650-2250 cm^{-1}	0.625 $^{-1}$	961
	VIS : 0.55- 0.75 μm		
Spatial Resolution	LWIR/MWIR :	16 Km @ nadir	
	VIS :	2 Km @ nadir	
Operational Mode	China area	5000 \times 5000 Km^2	
	Mesoscale area	1000 \times 1000 Km^2	
Temporal Resolution	China area	<1 hr	
	Mesoscale area	<1/2 hr	
Sensitivity ($\text{mW}/\text{m}^2 \cdot \text{sr} \cdot \text{cm}^2$)	LWIR: 0.5-1.1	MWIR: 0.1-0.14	
	VIS:	S/N>200($\rho=100\%$)	
Radiometric Accuracy	1.5 K		
Spectral Accuracy	10 ppm		
Quantization Bits	13 bits		



Operational Application in GRAPES since Dec 25,2018



风云四号卫星高光谱探测仪GIIRS，已于2018年12月25日正式在GRAPES全球4D-Var中业务化，GIIRS监测到北极区平流层的爆发性增温和对流层寒潮



风云四号卫星高光谱探测仪GIIRS高时间分辨率三维温度探测信息的同化改进了寒潮预报

Announcement on Level-1 data update of Geostationary Interferometric Infrared Sounder onboard Fengyun-4A satellite

Source: Author: Issued Date:13 August 2019

To increase the observation quality of the Geostationary Interferometric Infrared Sounder (GIIRS) onboard Fengyun-4A (FY-4A) satellite, the related calibration algorithms of the Level-1 (L1) data of FY-4A/GIIRS have been updated completely. The new version L1 data (V2) is scheduled to be broadcast since 12:00 August 13, 2019 (BJT), where the main improvements include:

1. The improved spectral and radiometric calibration algorithms are utilized;
2. The apodisation processing upon GIIRS L1 data with Hamming function is adopted;
3. The version name of the L1 data file is changed from V1 to V2.

In general, the data format of GIIRS L1 data remains unchanged.

National Satellite Meteorological Center

Contacts: Qiang Guo(guoqiang@cma.gov.cn)

<http://www.nsmc.org.cn/en/NSMC/Contents/100327.html>

组织 打开 刻录 新建文件夹

名称 修改日期 类型 大小

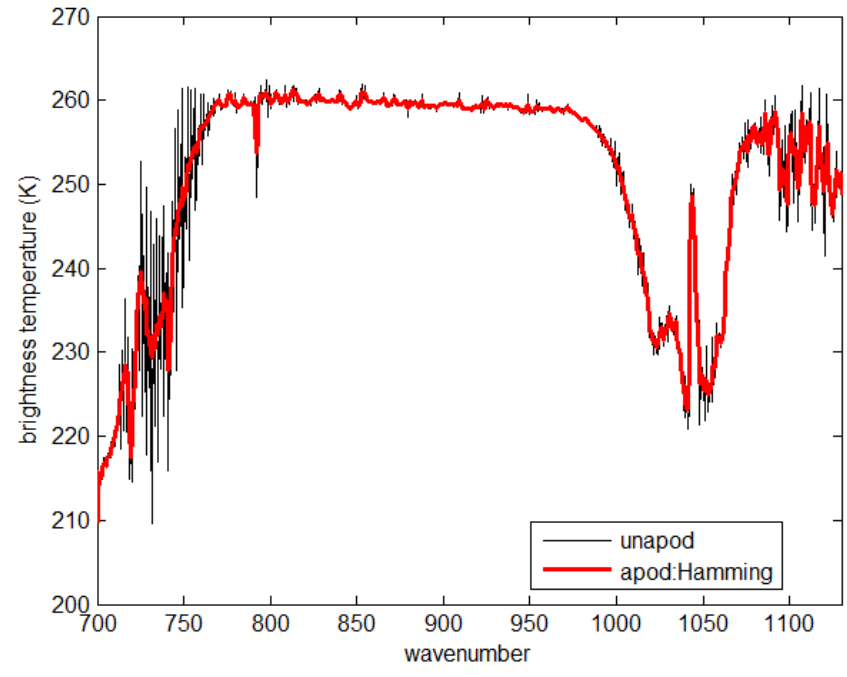
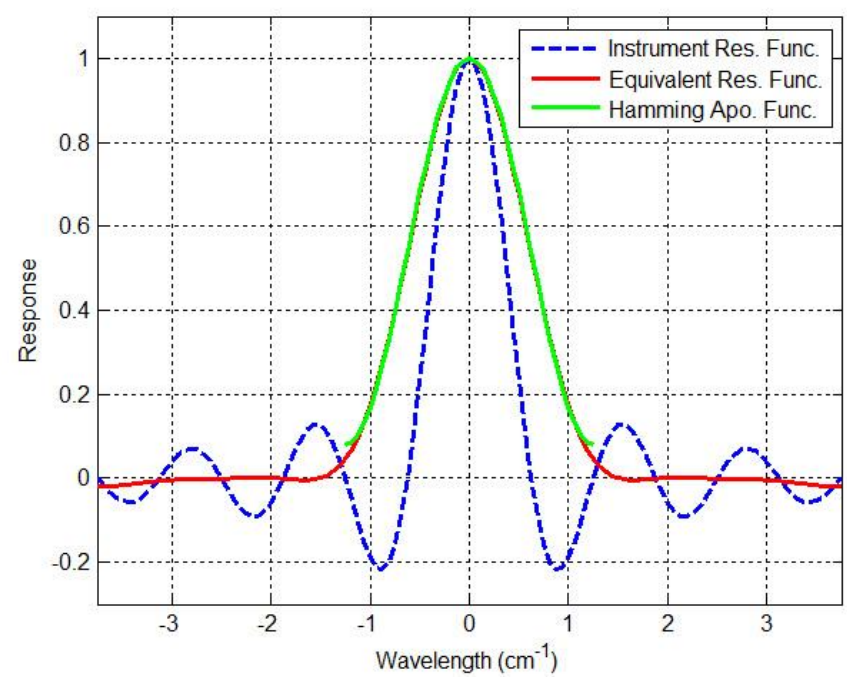
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 FY4A_GIIRS (E:)
 fy2 (\\10.24.33.93) (R:)
 fy4 (\\10.24.38.20) (S:)
 FY4A
 REFERENCE
 网络

V1

V2

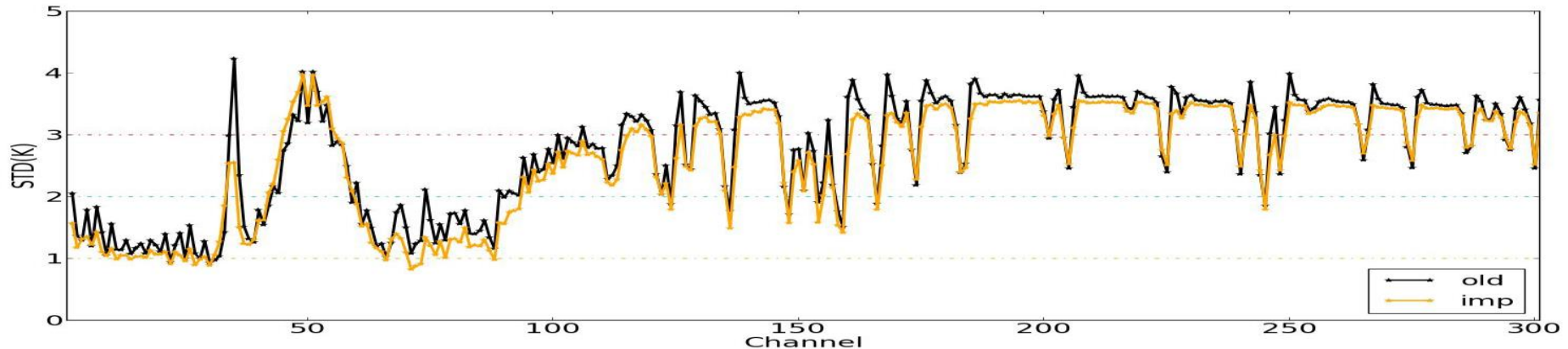
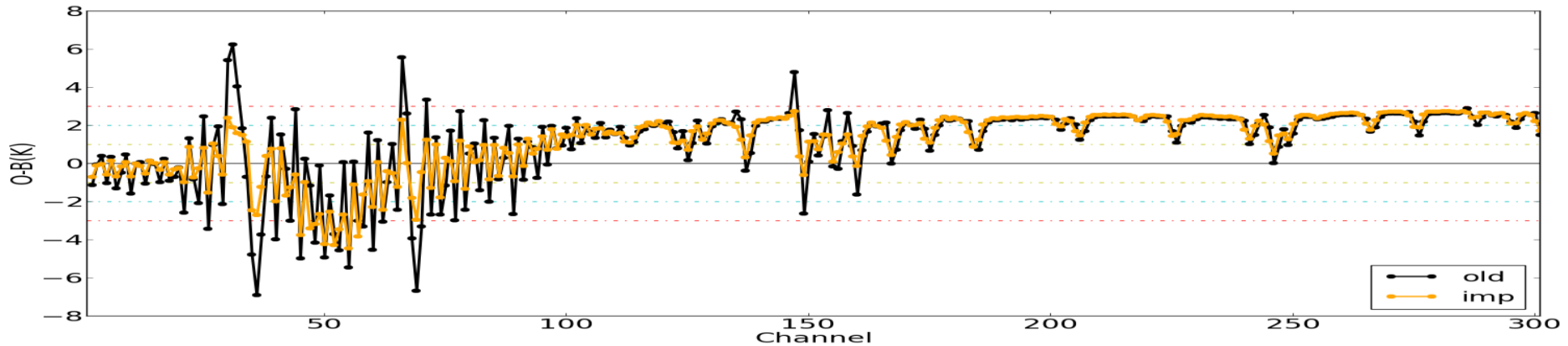
Data Resource



Sample Evaluation from GRAPES+RTTOVS

- ✓ Sample Data: 20181220, 4129files
- ✓ Experts: Ruoyin Ying and Wei Han
- ✓ Reports: 1 document

Effect Samples after QC : **110,000**

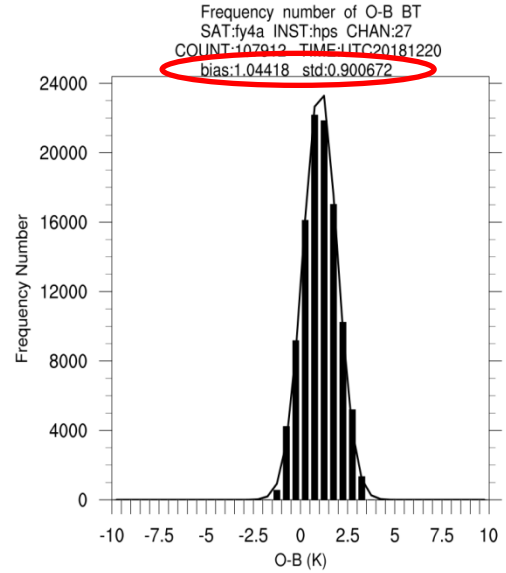
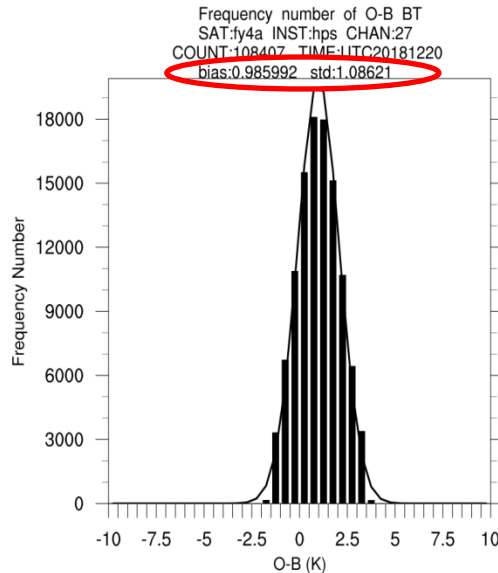
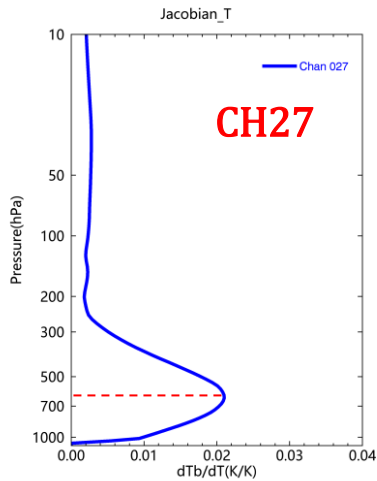
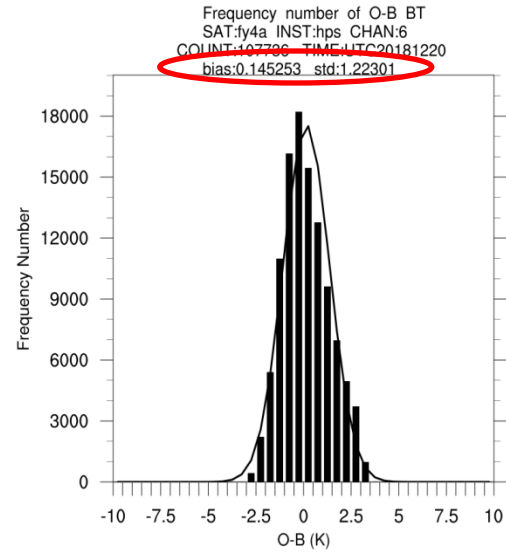
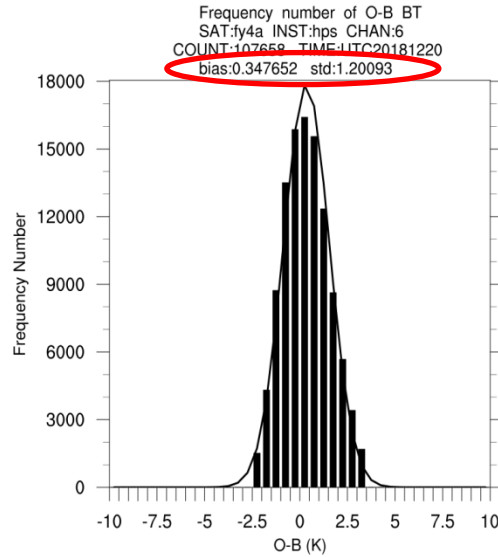
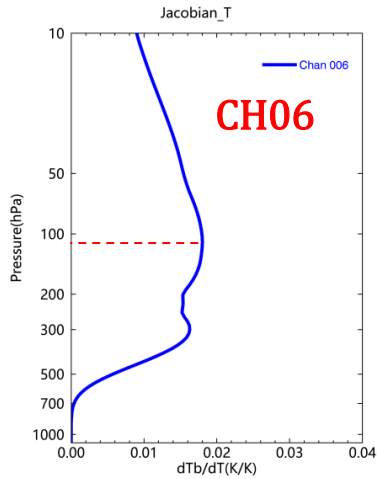


Note: old(V1); imp(V2)

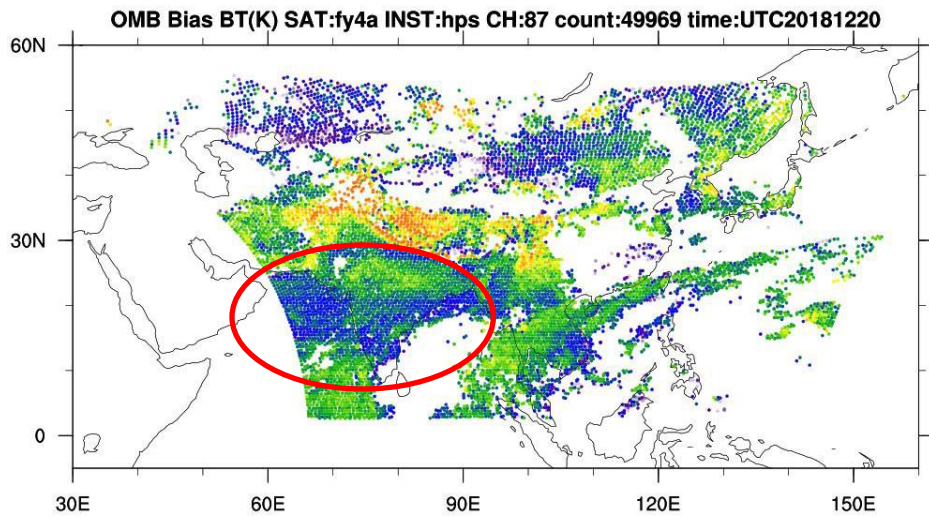
V2 better than V1

V1

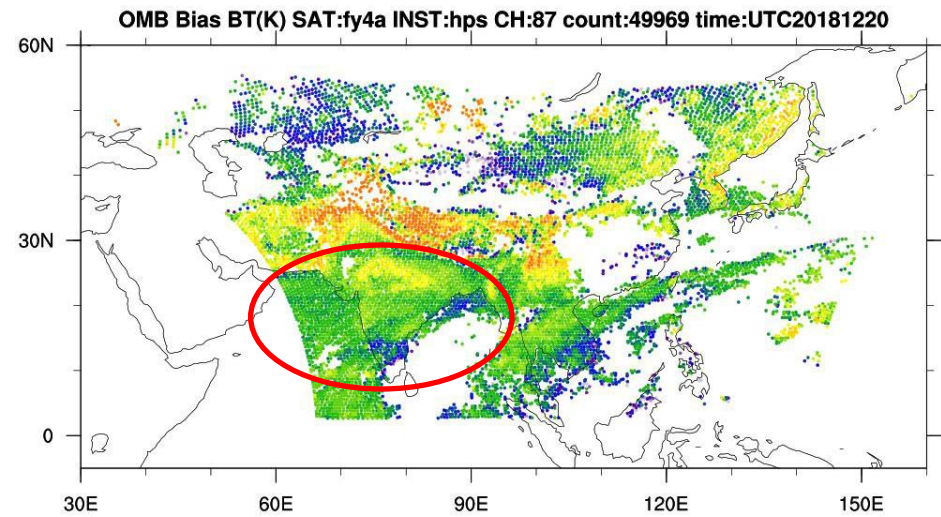
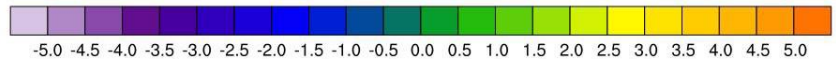
V2



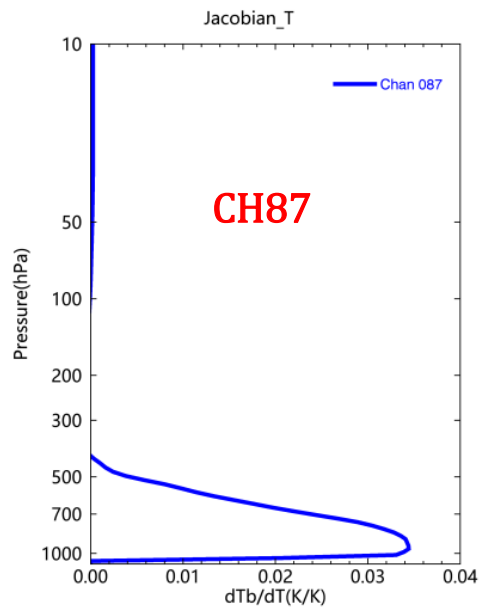
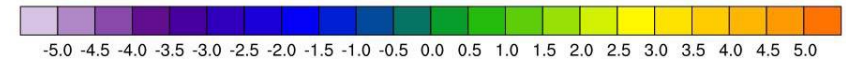
High level channel(ch06): comparable; Low level channel(ch27): V2 better



V1



V2



The regional O-B results in some window channel (CH87) from V2 is significantly better than those of V1

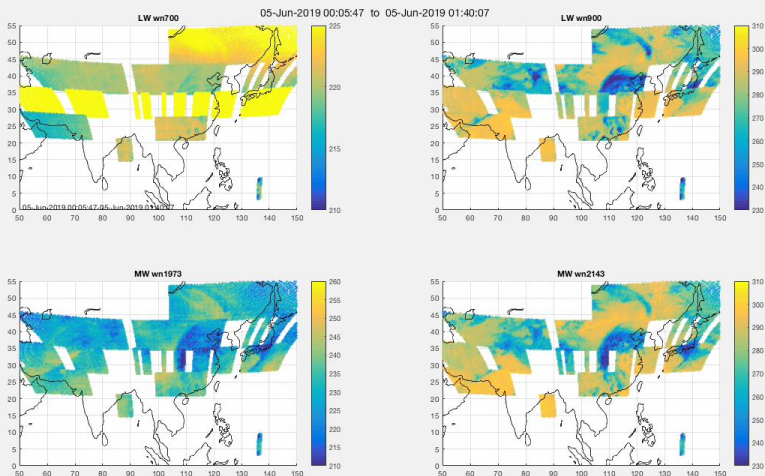
Independent Evaluations from International Counterpart (SSEC/UW)

- ✓ Sample data: 20190530~20190605, V1/V2(30031files for each)
- ✓ Experts: Paul Menzel, Hank Revercomb and Bob Knuteson
- ✓ Reports: 4 documents (doc/xls/mp4)

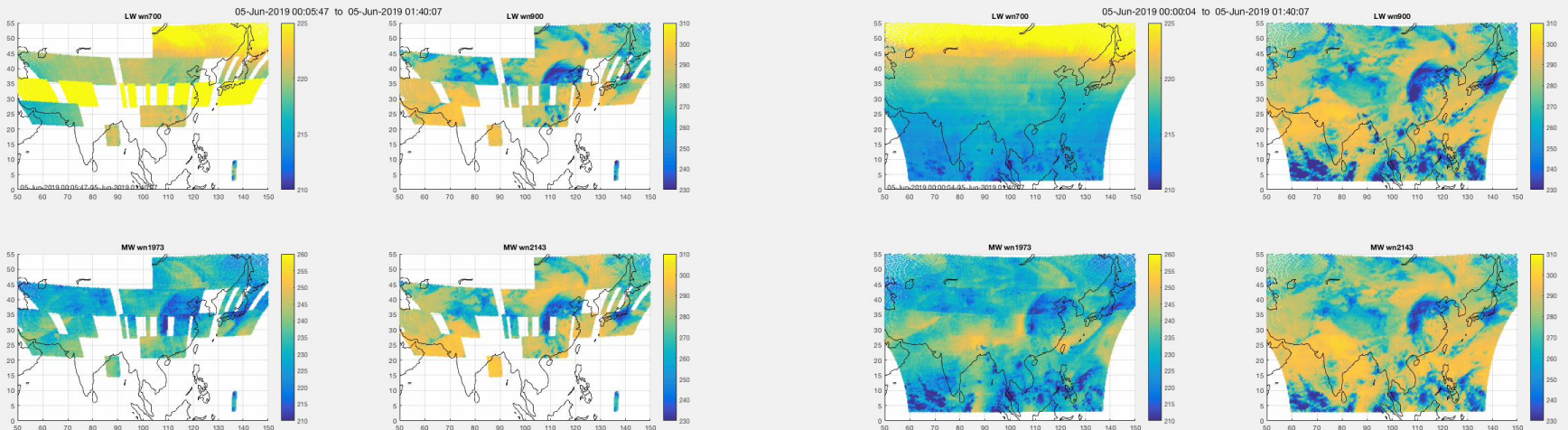
● Stability of Radiometric Feature

First, we want to acknowledge what appears to be an improvement of Version 2 in **fixing bad granules** from the original Version 1 data to **provide a more realistic regional field**. Can you explain what improvements you have made to the radiometric calibration between V01 and V02?

V01

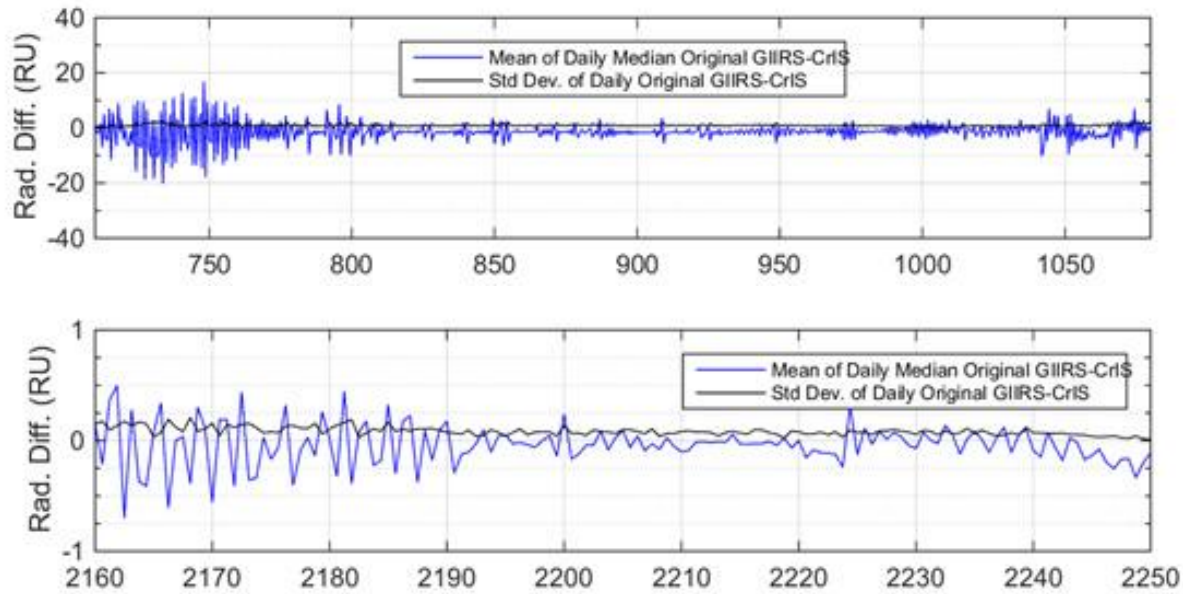


V02



• Radiometric Calibration (vs. CrIS)

We do see **similarities** to our CrIS radiometric comparisons. FY4A GIIRS V02 shows a cold bias relative to CrIS of about **1 Kelvin** for the warm window channels.

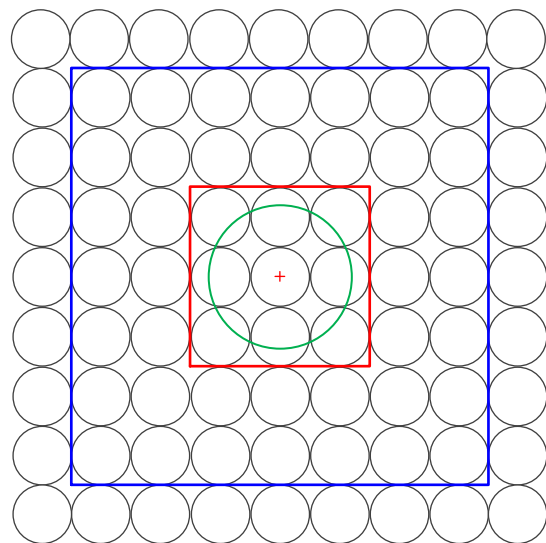


• Spectral Calibration (vs. CrIS)

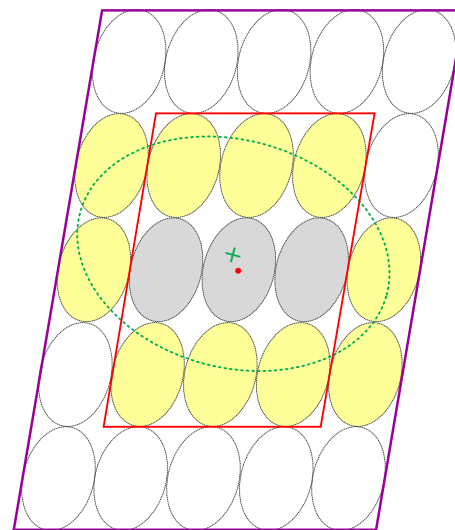
The basic conclusion is that the new version is **improved** in that the **spectral shift** of the longwave and midwave bands are **in better agreement**. The new Version 2 could be **greatly improved** by implementing a spectral scale that is shifted from the current scale..

Spatial Collocation: quasi-full-overlap (QFO) criterion

GEO-LEO/imager



GSICS: recommended overlap pattern (UW)

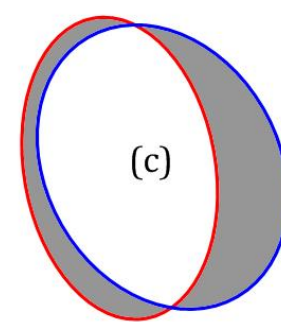
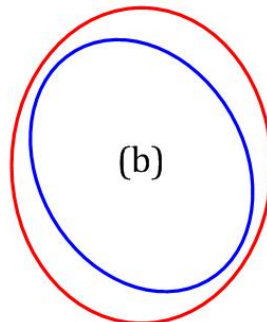
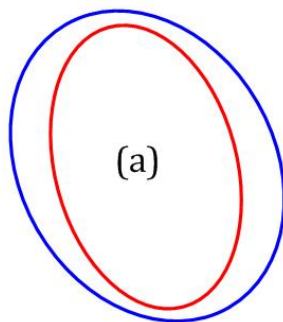


GeoCAVS: Overlap pattern far away from nadir (VW)



GEO-LEO/sounder

--- REF Sounder --- MON Sounder



Different overlap relationships of footprints between GEO and LEO sounders

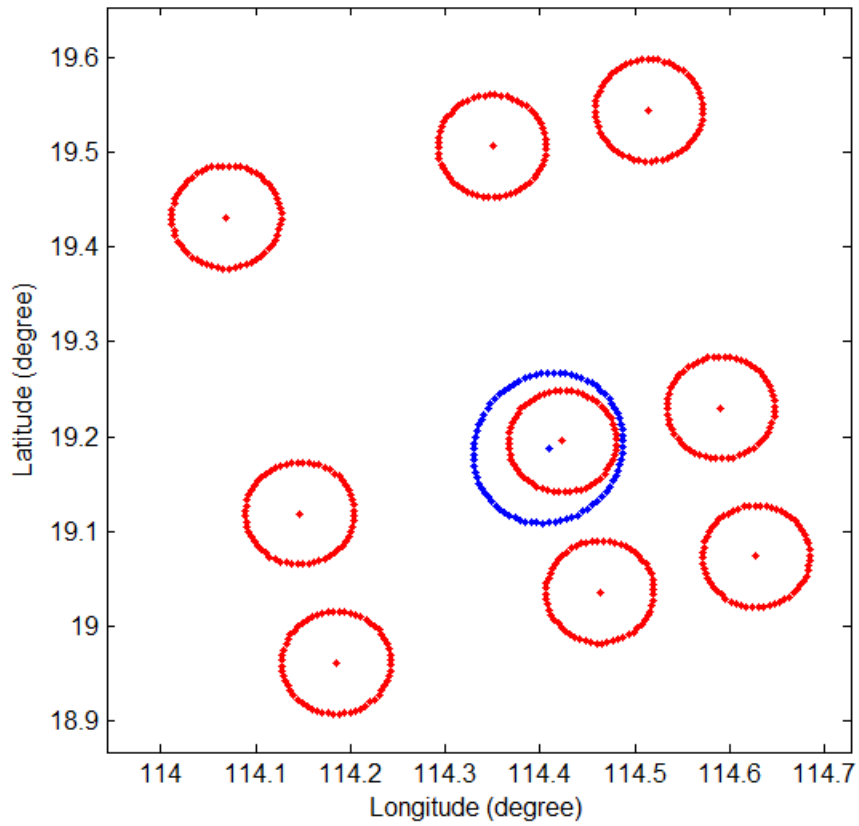
SNO Paired Results in LW band

Method	Time	Dwell Order	Detector Order	Time Difference	(LON, LAT)
IMP	13:00	38	56	888s	(114.408958, 19.187902)
		40	85	851s	(116.594940, 18.710238)
	13:15	32	62	3s	(106.880951, 14.252997)
		41	83	162s	(117.416008, 12.304740)
		43	20	191s	(120.543831, 12.543633)
SCC	13:00	38	56	888s	(114.408958, 19.187902)
		40	85	851s	(116.594940, 18.710238)
	13:15	32	62	3s	(106.880951, 14.252997)
		42	101	220s	(118.211487, 9.519010)

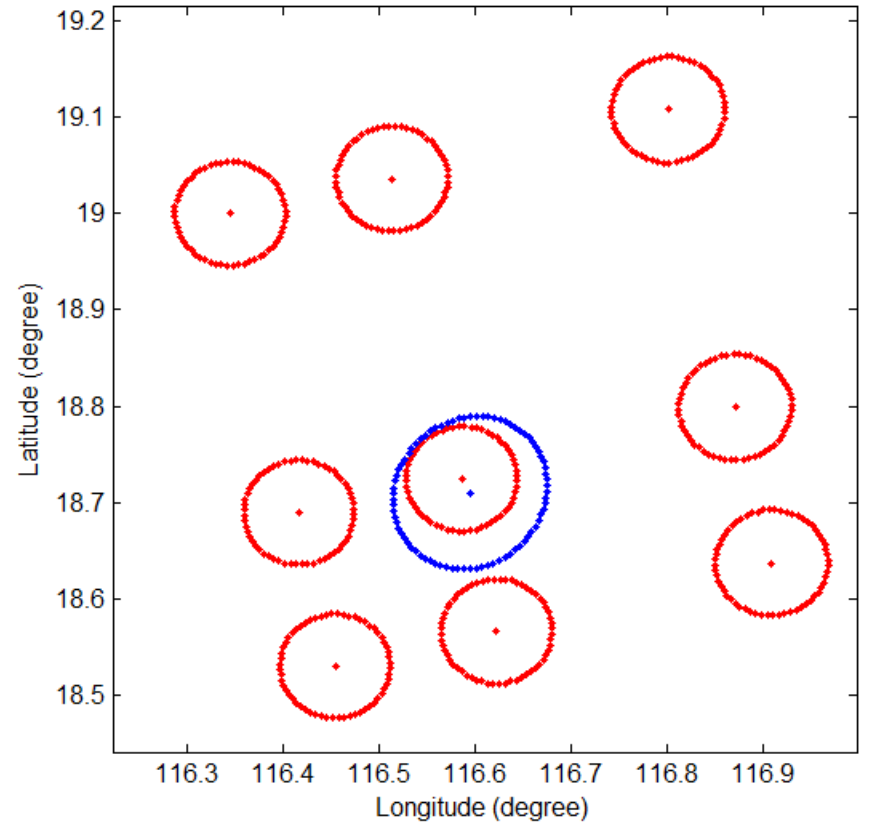
IMP: V2 *without* Spectral Correction

SCC: V2 *with* Spectral Correction

Footprint Size: IASI < GIIRS

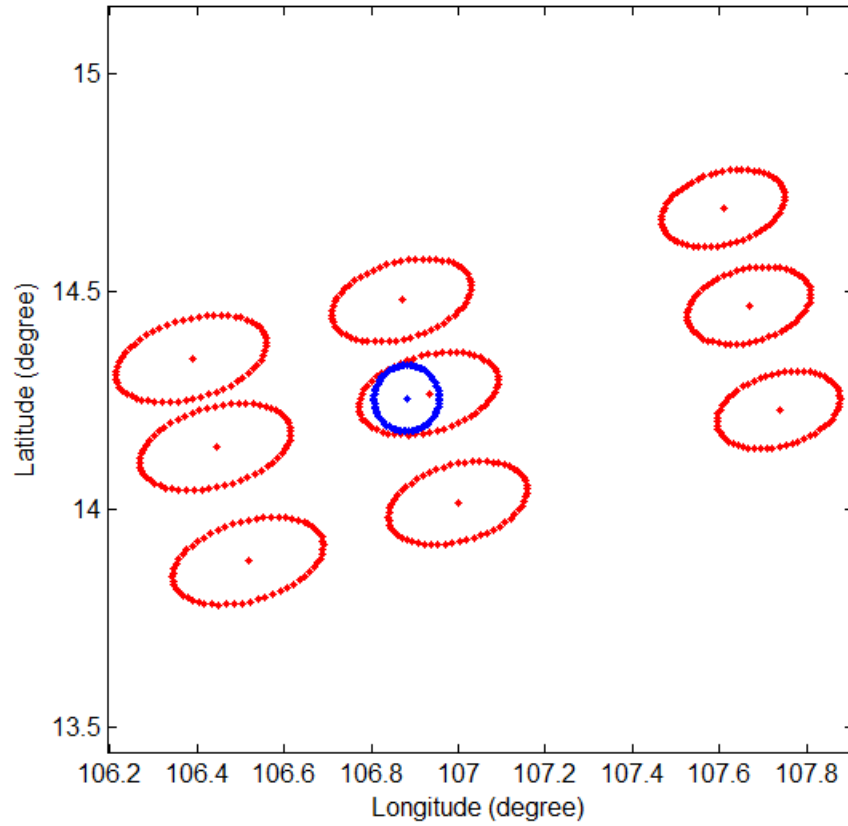


13:00/38/56



13:00/40/85

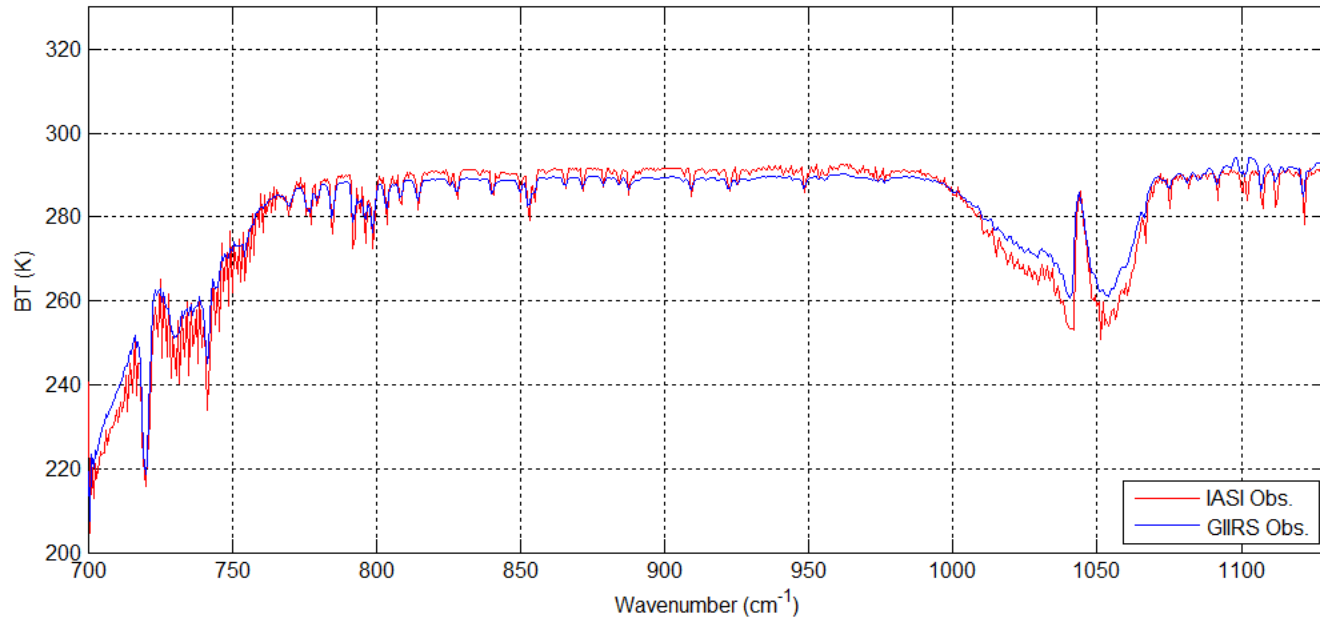
Footprint Size: IASI > GIRS



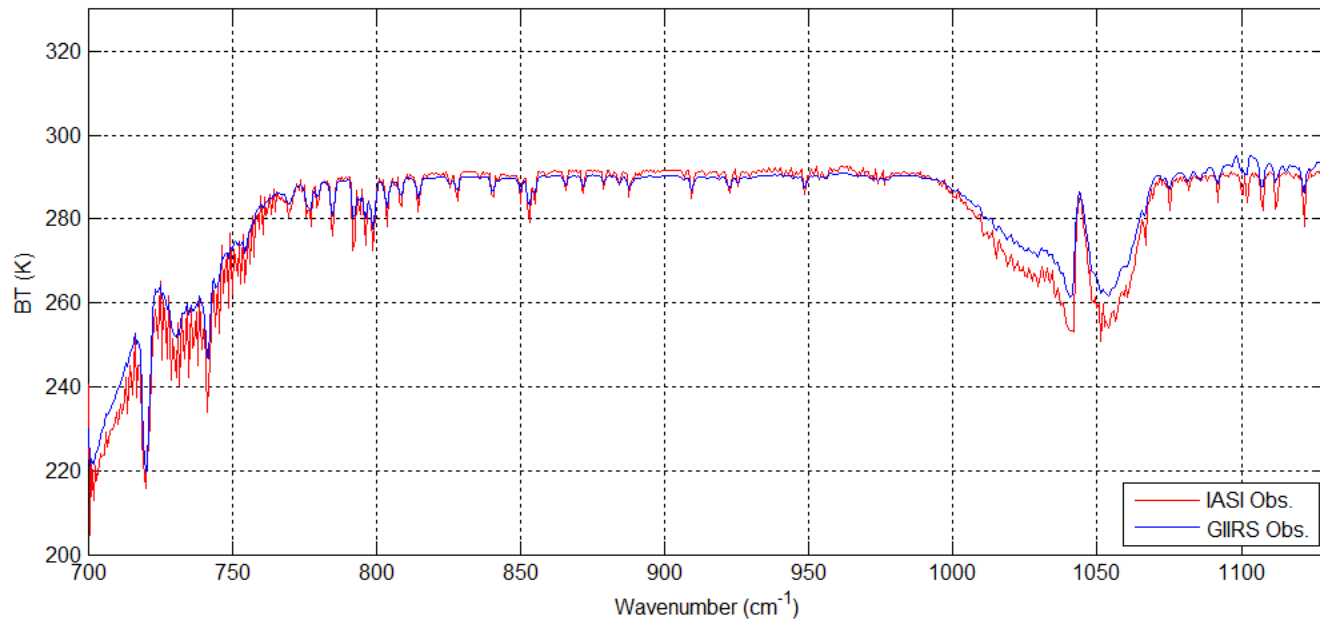
13:15/32/62

Example: 13:15/32/62

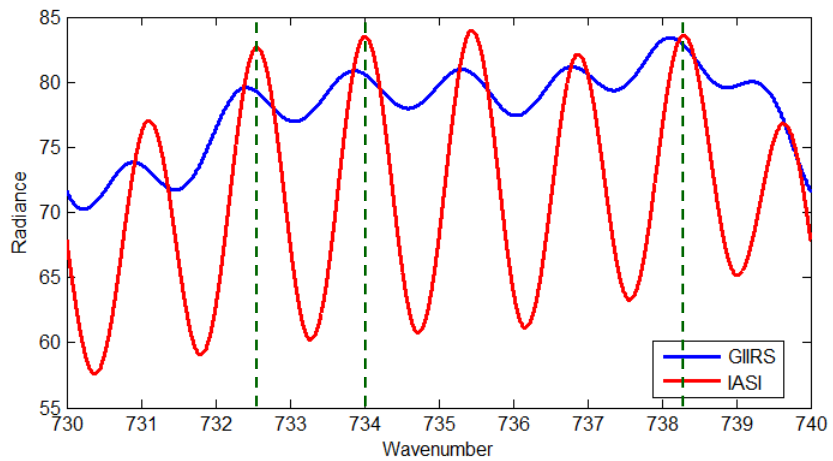
IMP



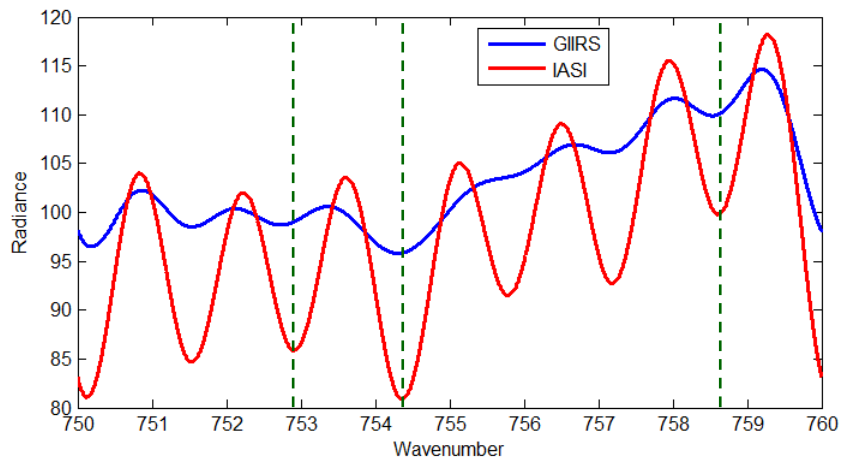
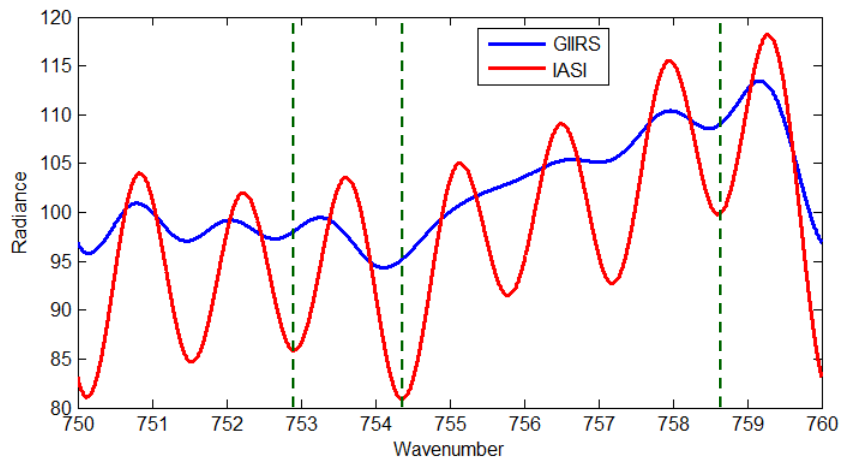
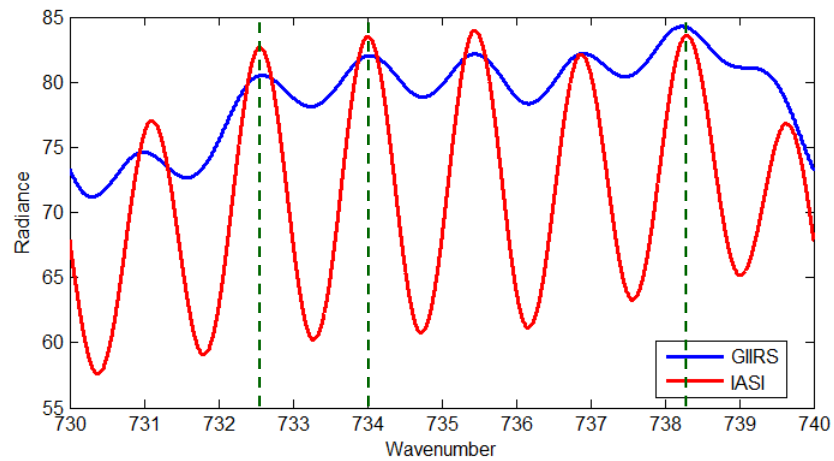
SCC



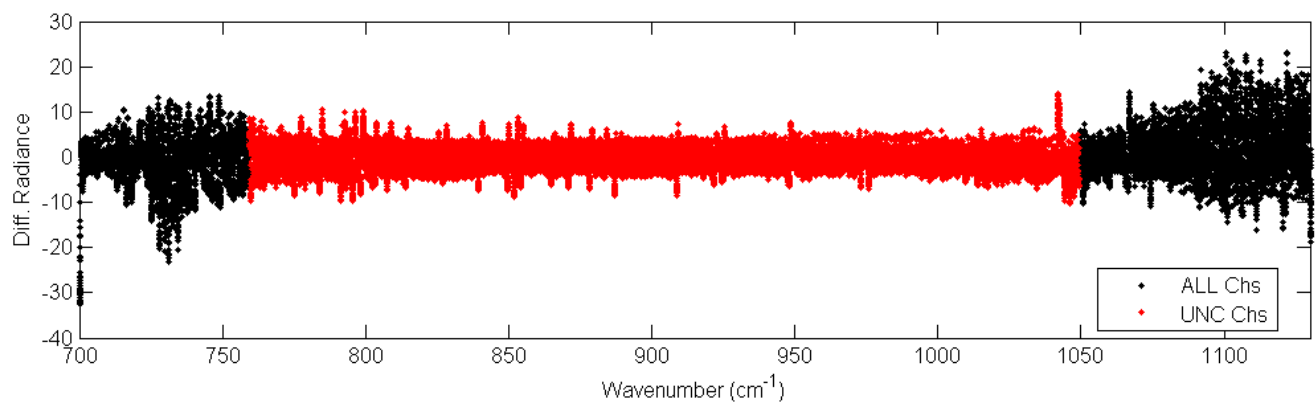
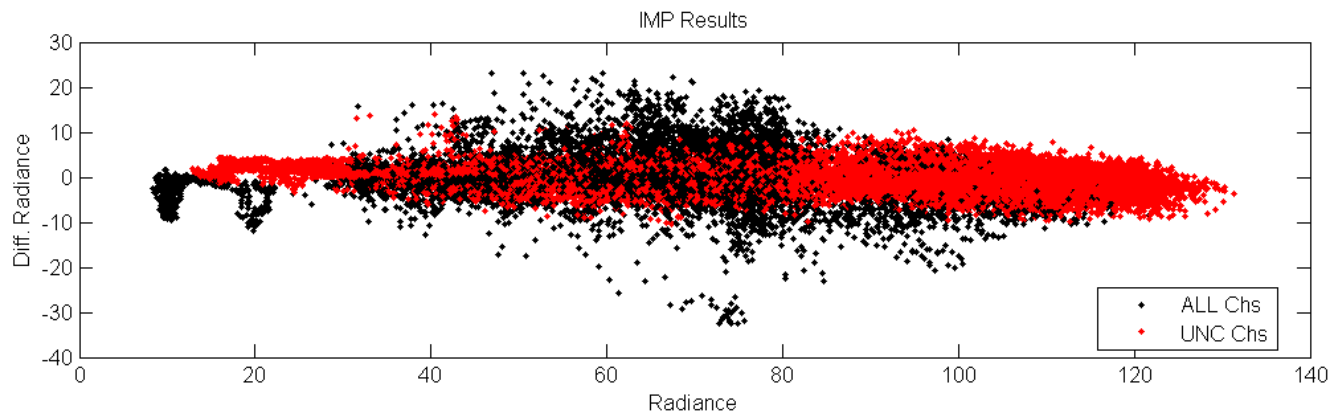
IMP



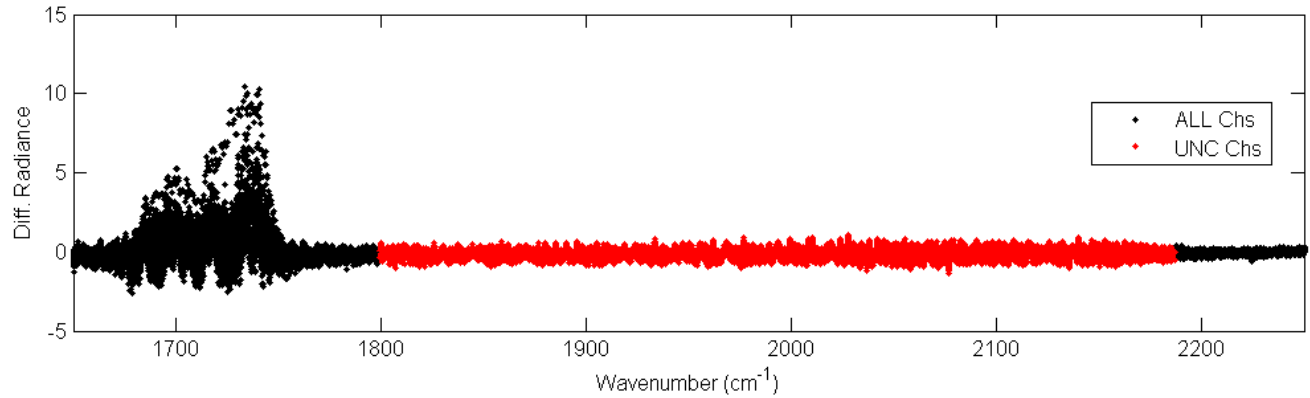
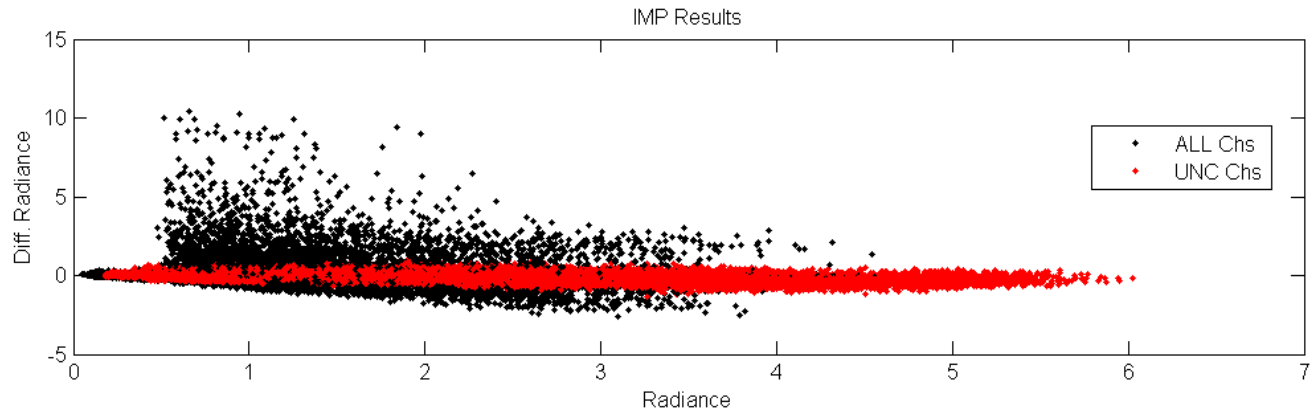
SCC



(20190530-20190605 vs IASI) in LW band



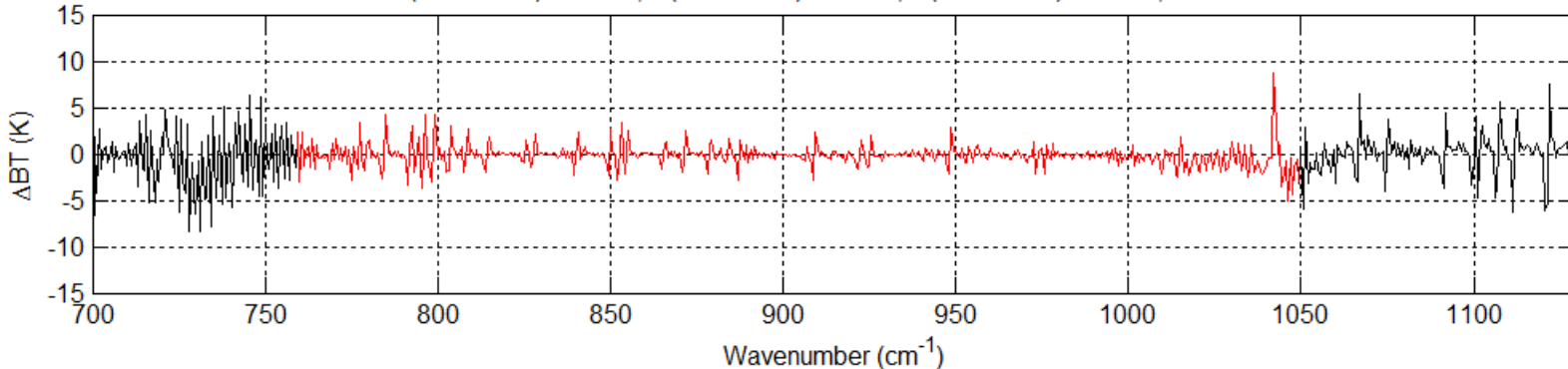
(20190530-20190605 vs IASI) in MW band



Radiometric Comparison Before and After Spectral Shift Correction for GIRS V02 in LW Band

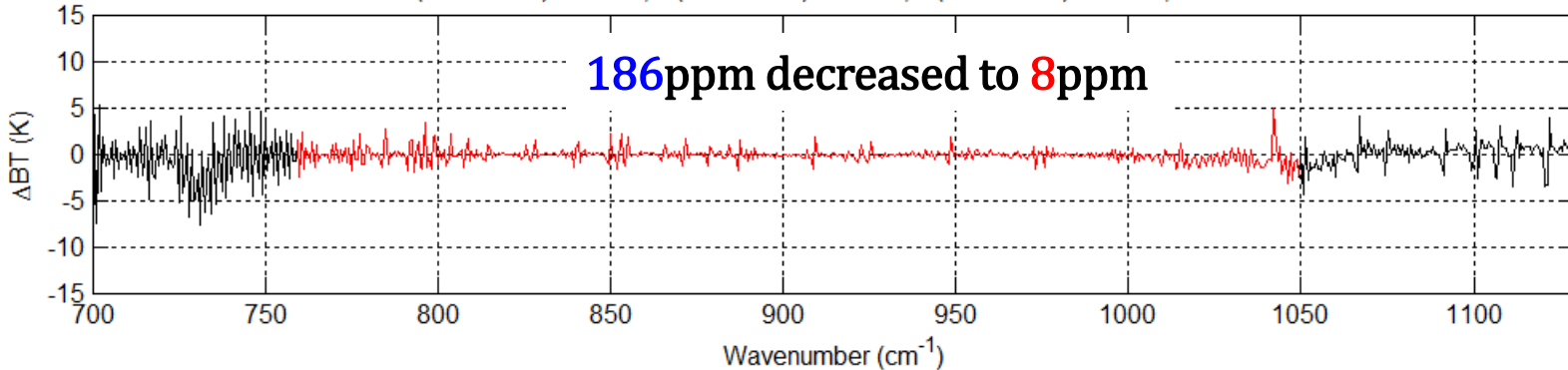
IMP: (Bias<0.5K):260 chs; (Bias<1.0K):347 chs; (Bias<1.5K):380 chs; total is:0465

Before

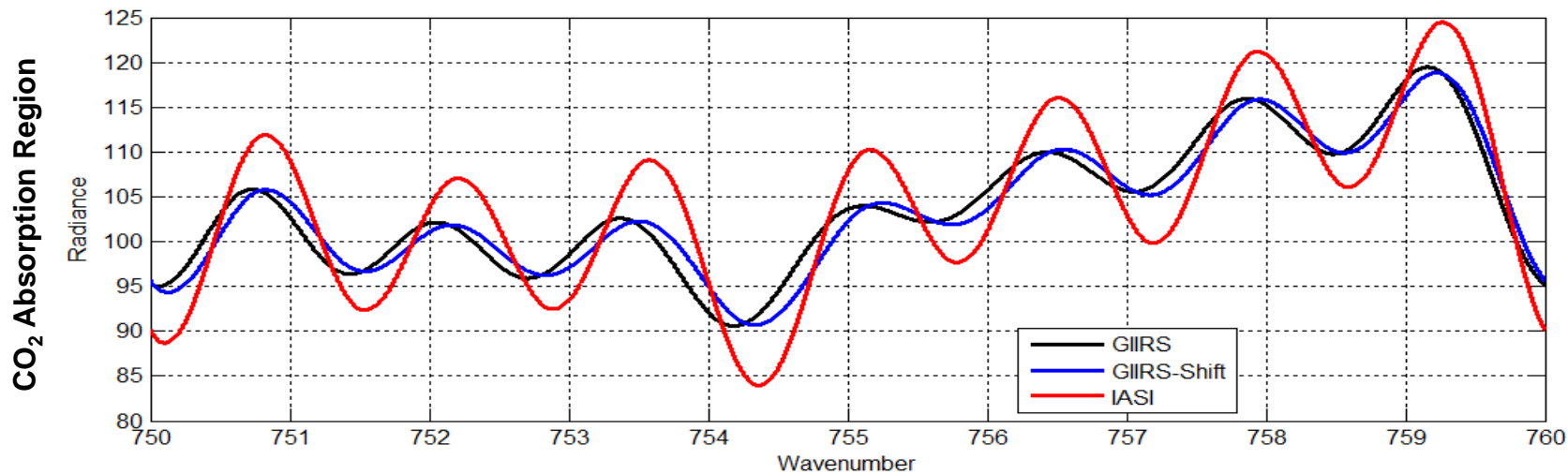
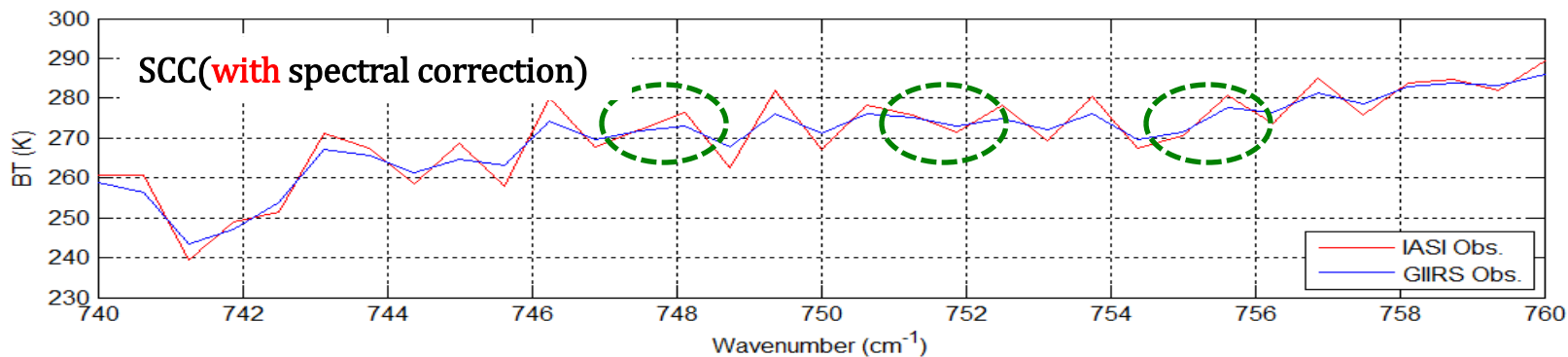
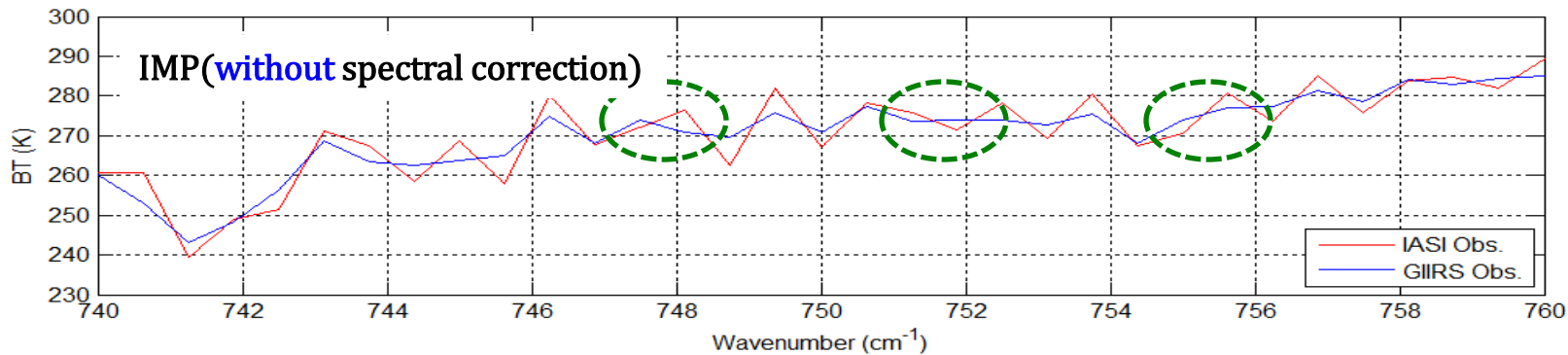


SCC: (Bias<0.5K):299 chs; (Bias<1.0K):376 chs; (Bias<1.5K):428 chs; total is:0465

After: corrected with averaged 186ppm



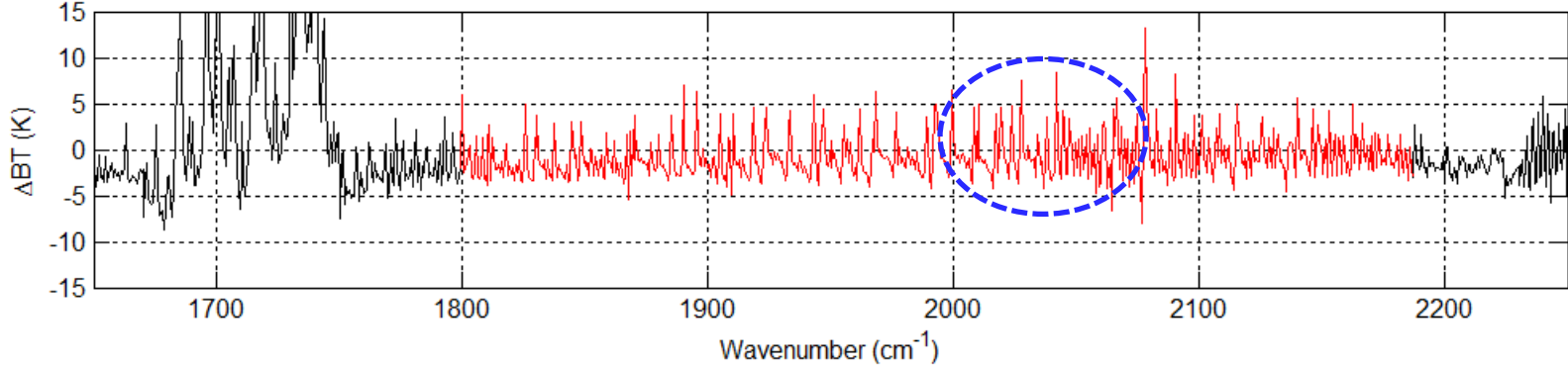
Radiometric Bias	IMP: V02 Before Correct (Channels/Percentage)	SCC: V02 After Correct (Channels/Percentage)
≤0.5K	260/55.9%	299/64.3%
≤1.0K	347/74.6%	376/80.9%
≤1.5K	380/81.7%	428/92.0%



Radiometric Comparison Before and After Spectral Shift Correction for GIRS V02 in MW Band

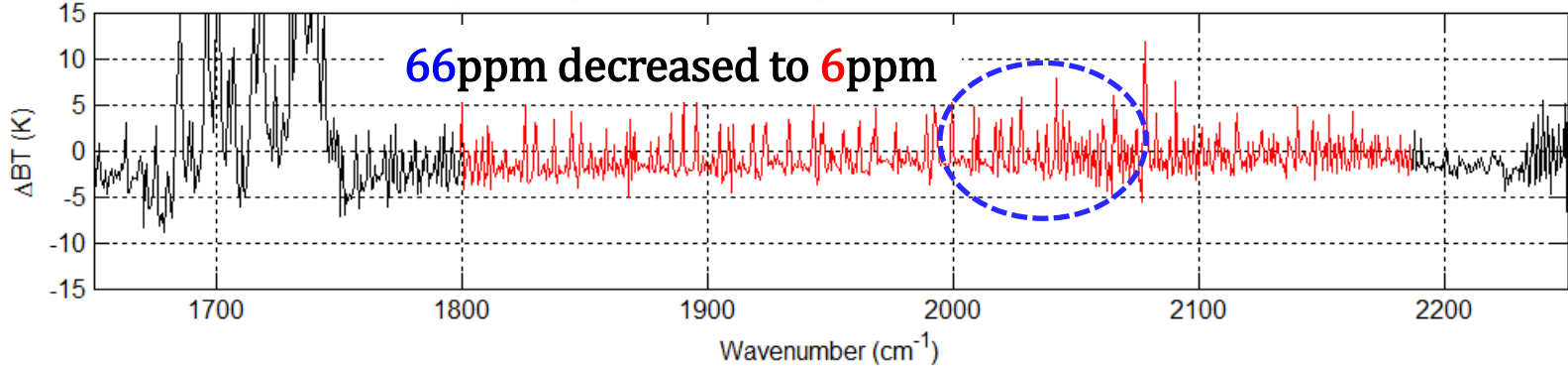
IMP: (Bias<0.5K):61 chs; (Bias<1.0K):152 chs; (Bias<1.5K):253 chs; total is:0621

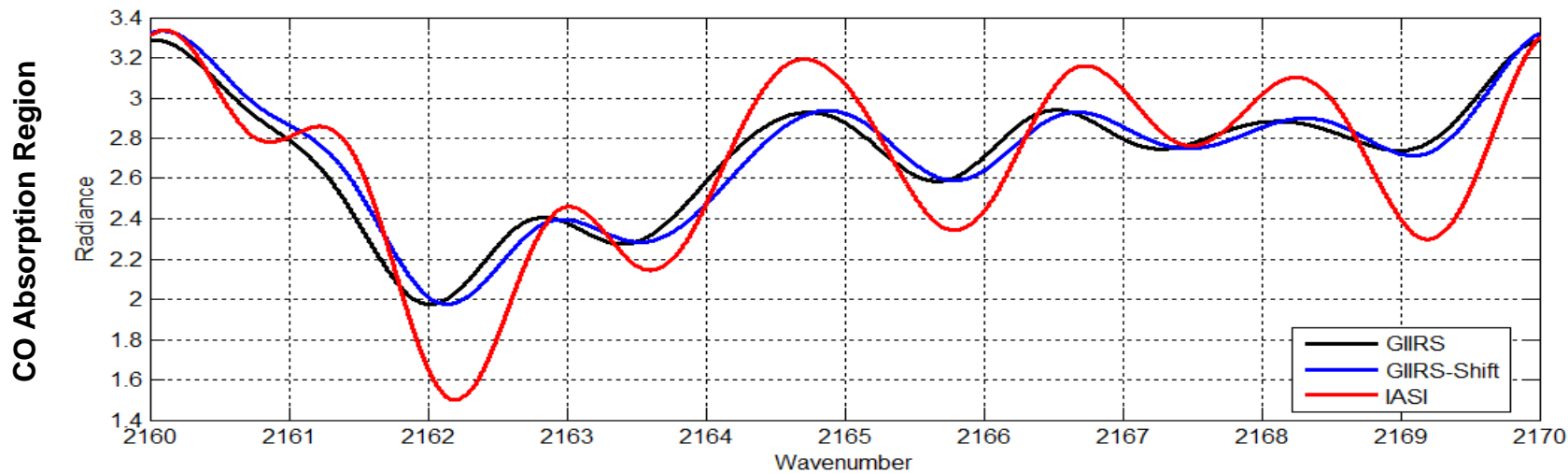
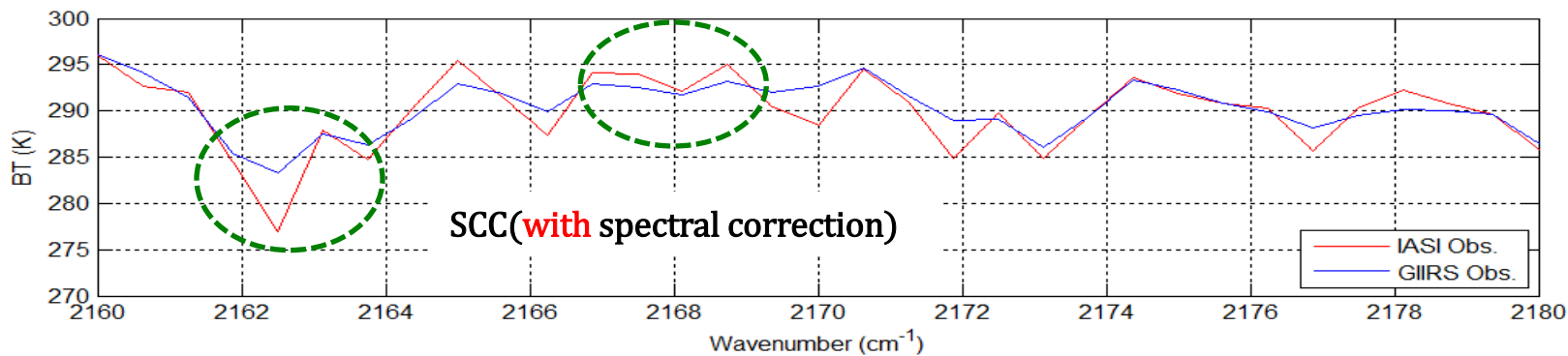
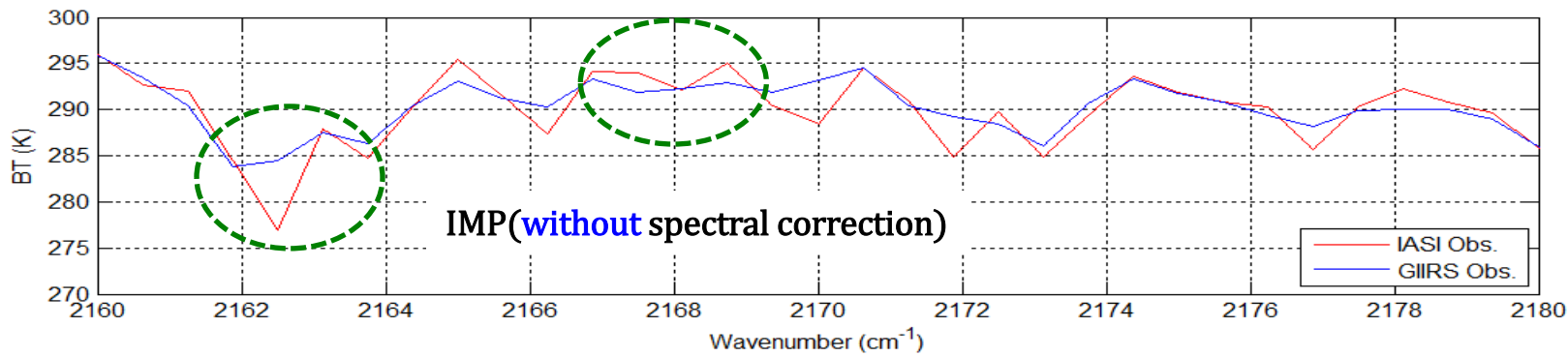
Before



SCC-066: (Bias<0.5K):64 chs; (Bias<1.0K):144 chs; (Bias<1.5K):244 chs; total is:0621

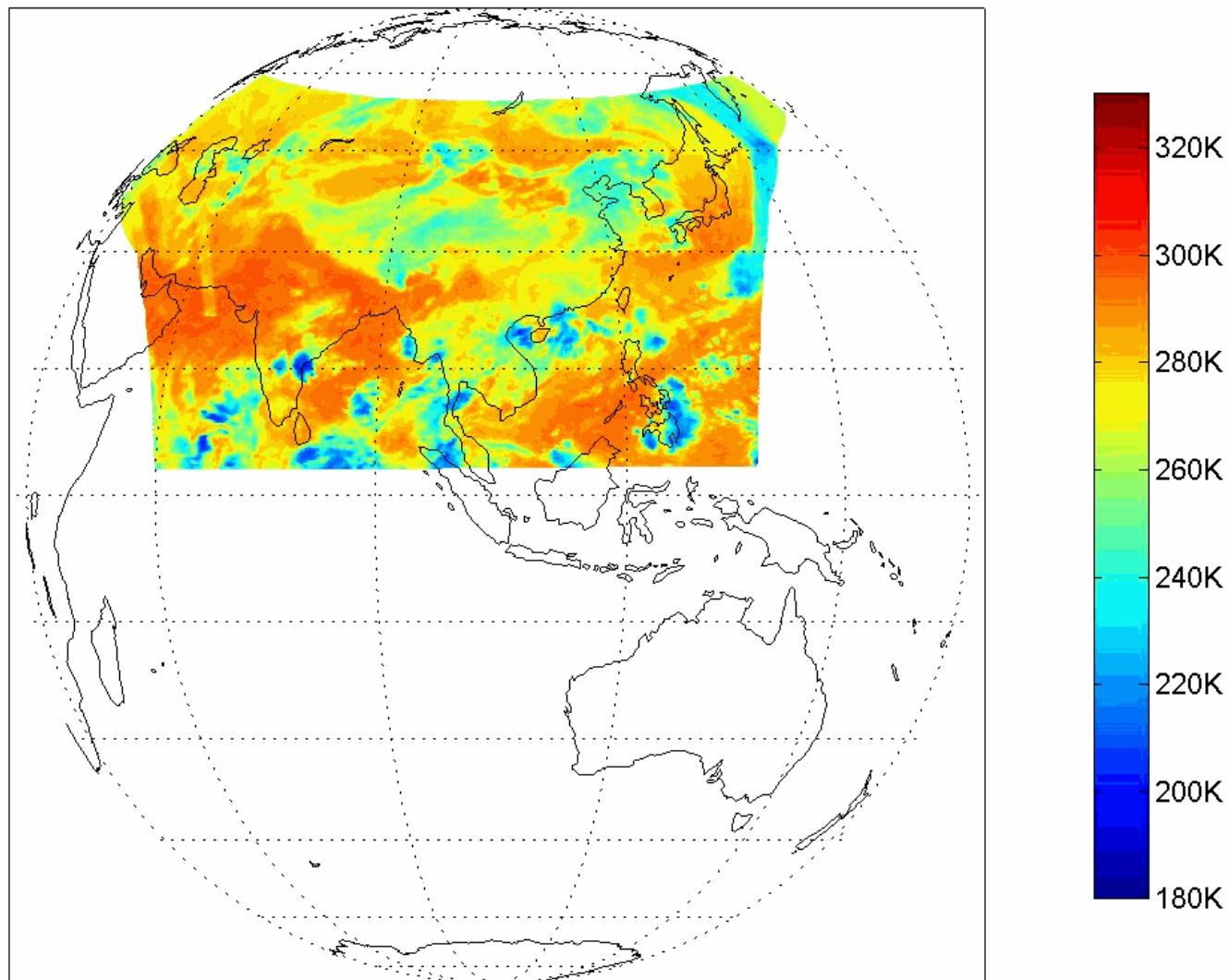
After: corrected
with 66 ppm





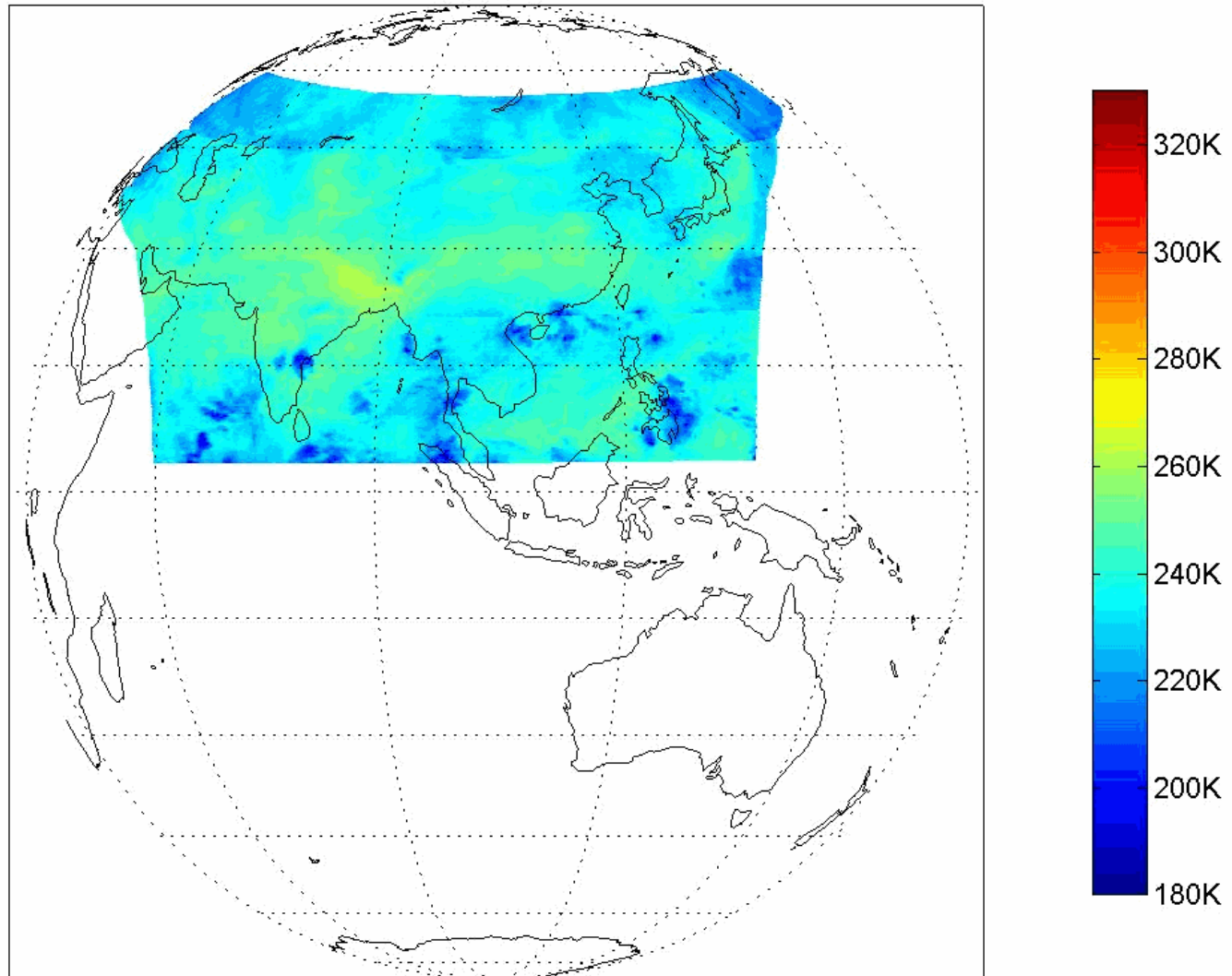
15-day Animation (LW: 0818.750cm⁻¹)

20190530000000-20190530013000:0818.750(cm⁻¹)

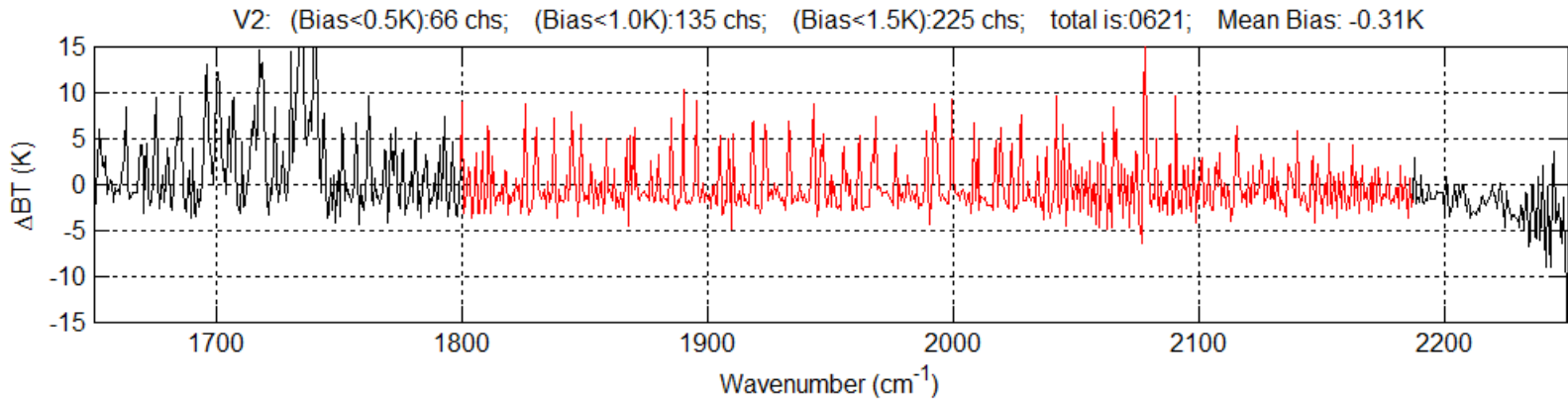
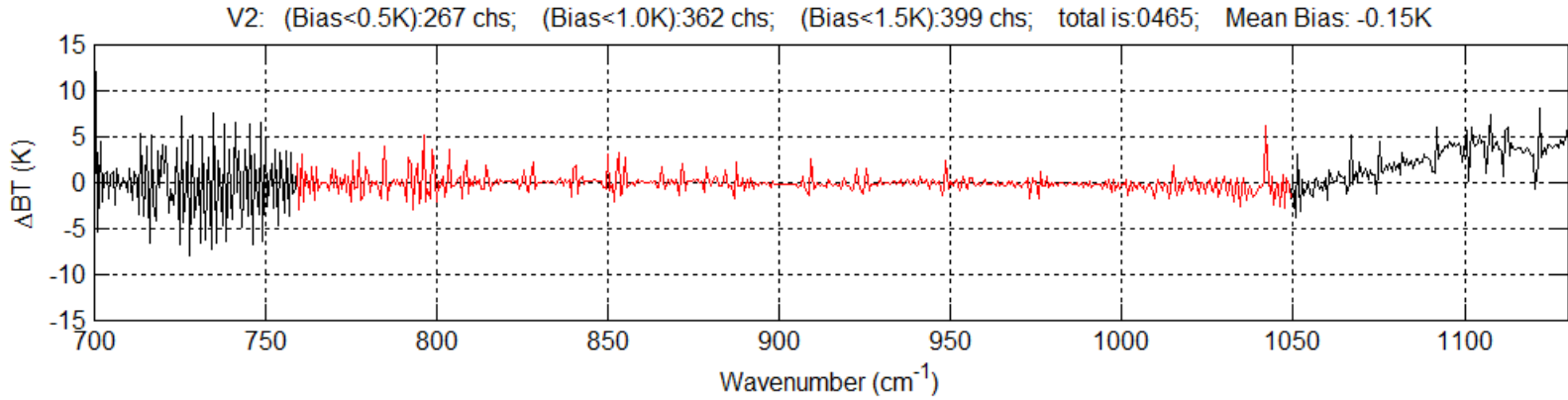


15-day Animation (MW: 1825.000cm⁻¹)

20190530000000-20190530013000:1825.000(cm⁻¹)

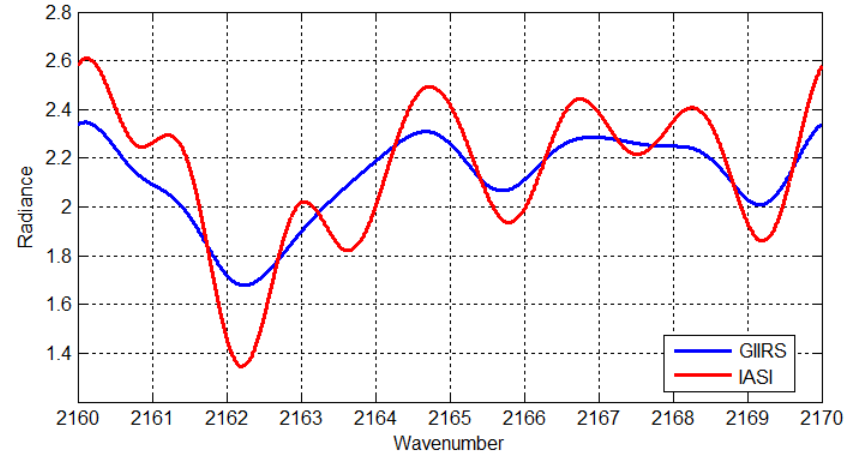
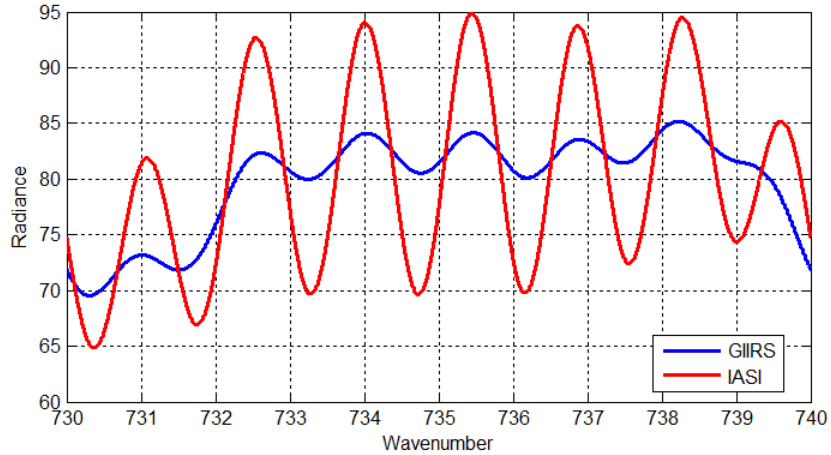


Inter-comparison between GIRS and IASI (20190814~20190818)



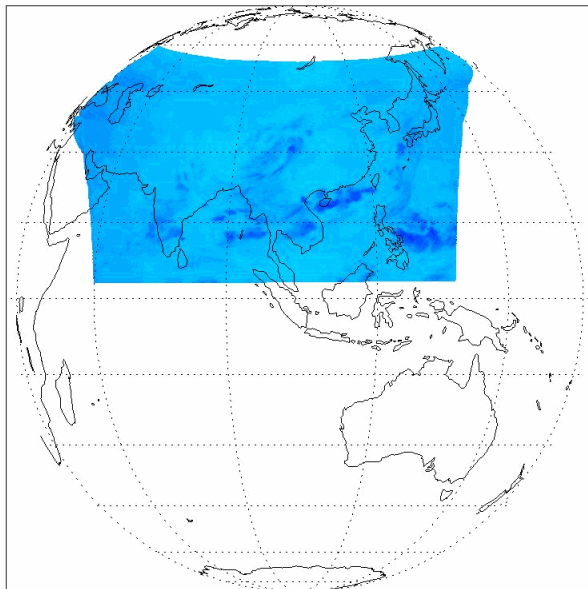
band	Radiometric Calibration				Spectral Calibration	
	≤0.5K	≤1.0K	≤1.5K	Mean Bias	Mean	STD
LW	267/465	362/465	399/465	-0.2K	6ppm	13ppm
MW	66/621	135/621	225/621	-0.3K	4ppm	15ppm

Results of Spectral Shifts Comparison

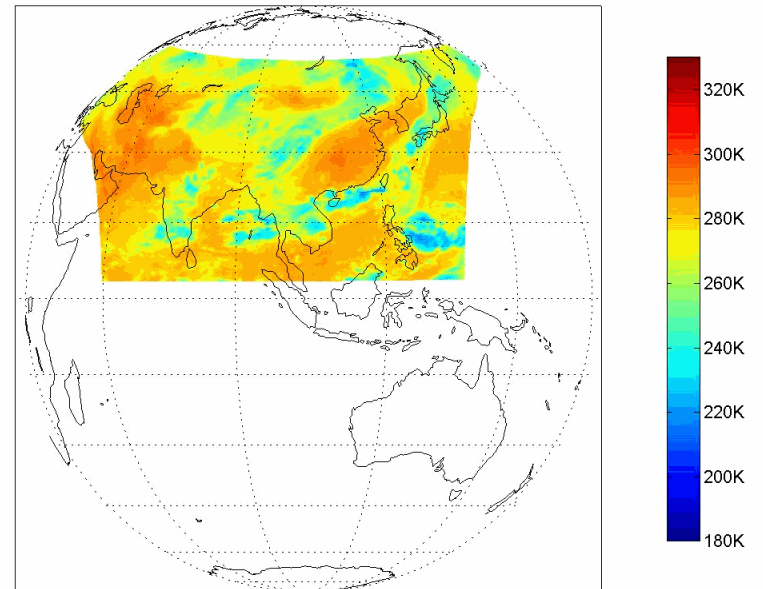


Latest 48h Animations of typical channels in both LW and MW bands

20190820000000-20190820013000:0703.750(cm^{-1})



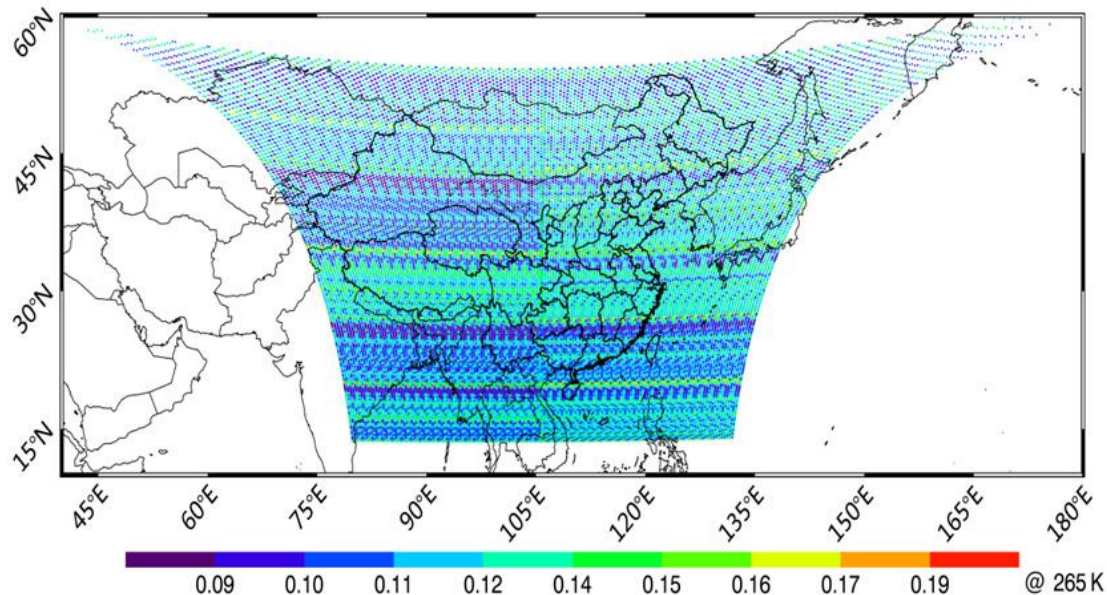
20190820000000-20190820013000:1996.875(cm^{-1})



Follow-up Improvements

- ❑ **Nonlinearity** correction for atmospheric absorption channels;
- ❑ **Diurnal** variation radiometric biases correction;
- ❑ **Angle-dependent** variation radiometric biases correction;

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Summary

- ✓ The new version (**V2**) L1 data of FY-4A/GIIRS is available since 0400 **August 13, 2019** (UTC), where the improved spectral and radiometric calibration method are utilized.
- ✓ The **Hamming apodization** function is adopted in V2 L1 data of FY-4A/GIIRS.
- ✓ Compared with **IASI**, the radiometric biases of GIIRS are less than **0.5K** for warm window channels, and its spectral shifts of both LW and MW bands are less than **8ppm**.
- ✓ More improvements, i.e. nonlinearity, diurnal and angle-dependent bias corrections, will be done in the near future.
- ✓ The proposed spatial collocation method (QFO) is widely suitable for two Fourier Transfer Sounders (FTSs) intercomparison with not only **GEO-LEO** but also **LEO-LEO** modes, and is believed to be benefit to GSICS community for the relevant applications.



Thanks for your attention

Question?

