



CMA Agency Report 2017

Xiuqing (Scott) Hu

GSICS 2018 Annual Meeting on March 19~23,
Shanghai, China

Outline



- **CMA' s GSICS Activities, Action & Achievements Summary**
- **CMA' s support to GDWG Activities**
- **CMA' s support to GRWG Activities**
- **Summary**

CMA' s GSICS Activities, Action & Achievements Summary

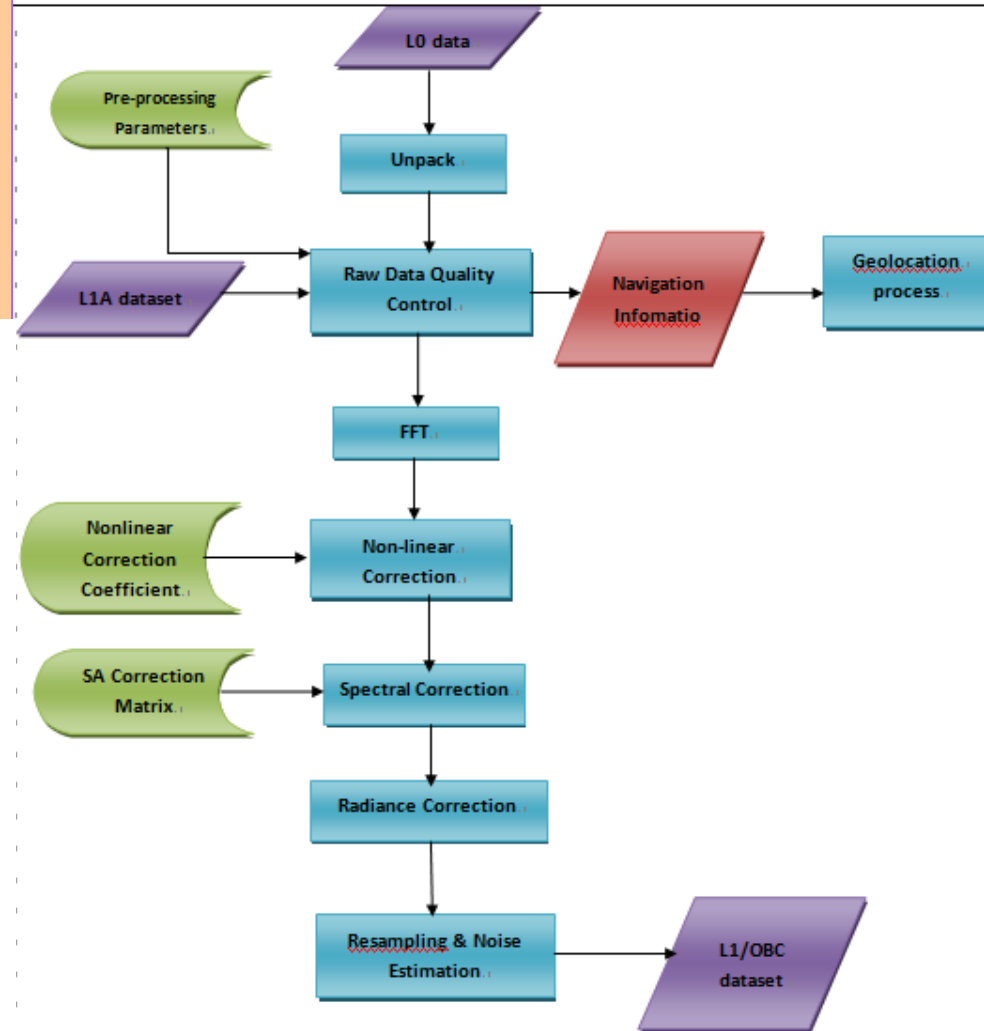
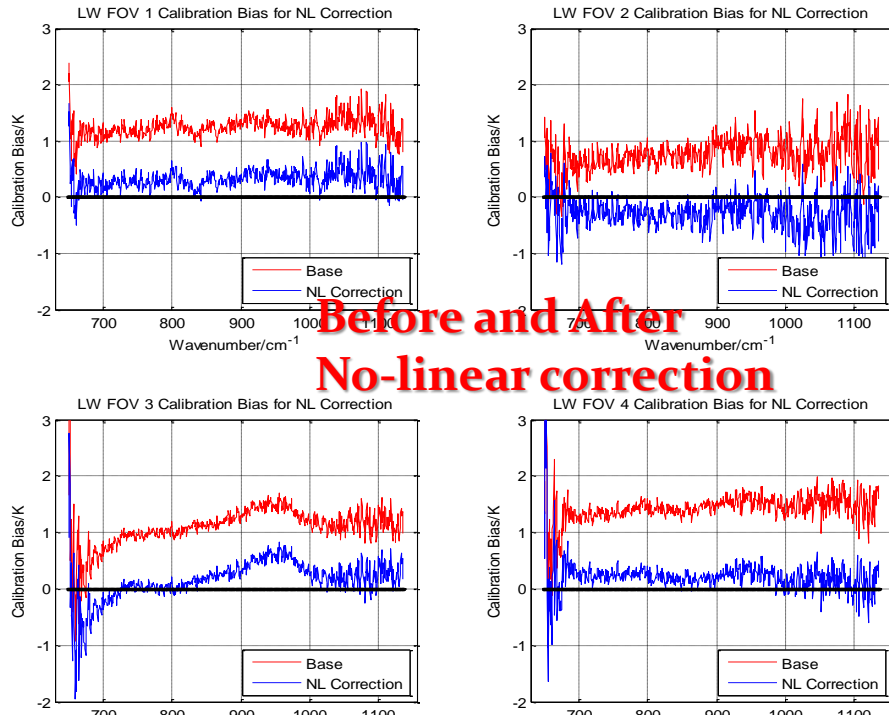


- ❑ FY-3D was successfully launched on November 15, 2017. Refine the Level 1 processing algorithms for FY-3D/MERSI-II, HIRAS and TanSat sensors.
- ❑ Post-launch Test for FY-4A, FY-3D and TanSat. Commissioning Test of FY-4A and TanSat was finished. FY-3D early test is ongoing (1f,1h,1k,3i,4g,4j,4l)
- ❑ L1 products validation for FY-4A/AGRI,GIIRS, FY-3D/MERSI-II,HIRAS and microwave sensors based on CMA GSICS platform (4m, 7m,9b,9c)
- ❑ Initiate the **retrospective** recalibration for the long term FY satellites data covering FY-1, FY-3, FY-2 serials.
- ❑ Second Lunar Calibration workshop was held in Xian (hosted by CMA and local hosted by XIOP). Four month ground-based Lunar observation at Lijiang was conducted again from October to February 2018. Data processing is ongoing.
- ❑ Dunhuang Vicarious calibration based on Automatic measurement made good progress and is tested using FY-3C/VIRR. Unmanned aerial vehicles (UAV) for surface reflectance measurement was tested successfully.

Refine the FY-3D/HIRAS SDR algorithm

Improvements:

- 1) ZPD determination;
- 2) Phase Alignment of DS, ICT and earth targets;
- 3) No-linear correction;
- 4) Resampling

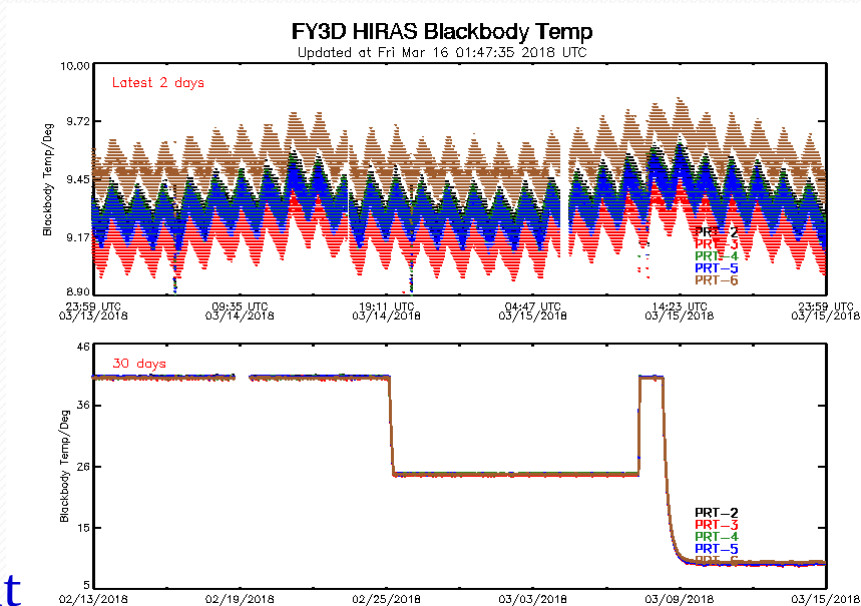


After No-linear correction, ICT bias is smaller than 0.5K @290K.

Latest Instrument status & SDR Processing

DAY 1: data analysis

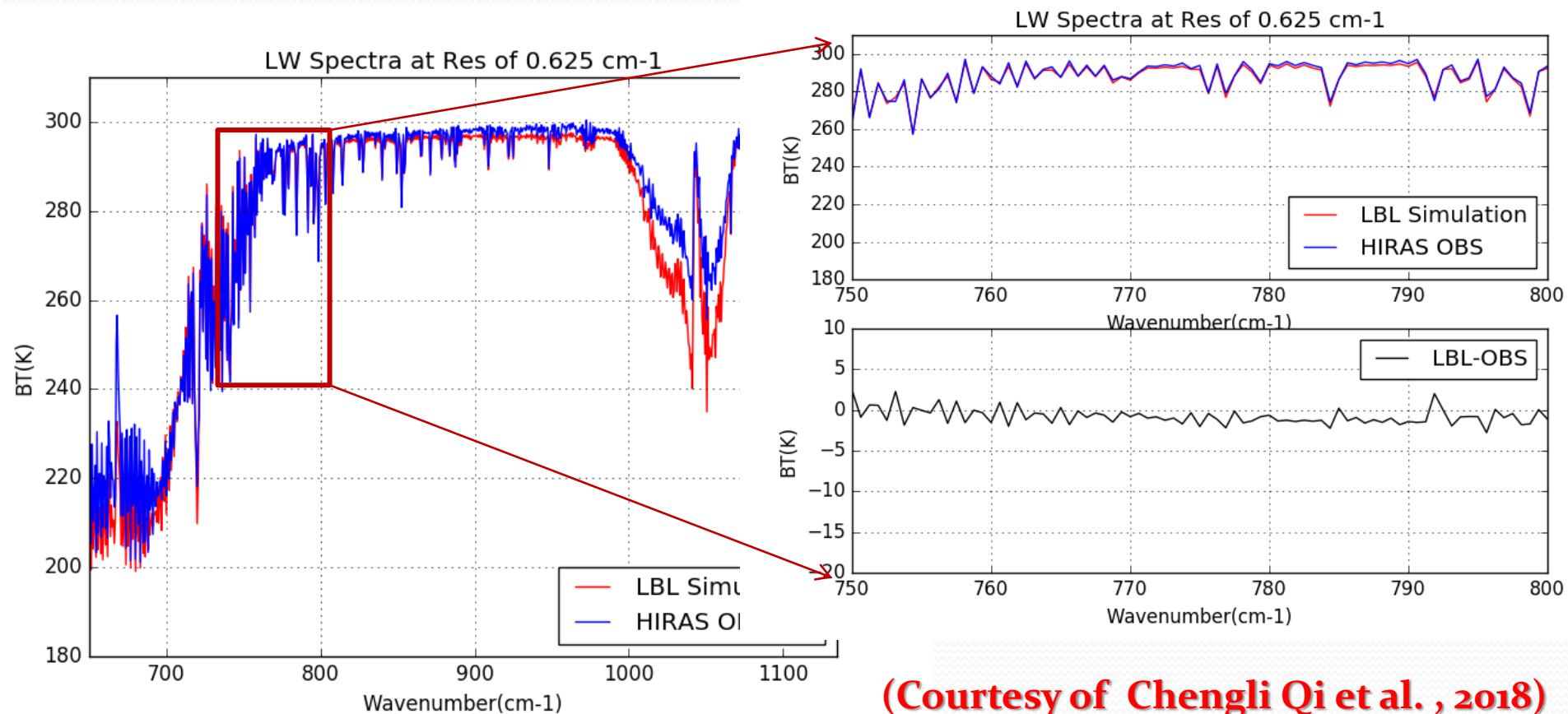
- **1, Mar**
 - HIRAS infrared detectors power on
 - Telemetry parameters check
 - 1st IGM check
 - Raw Spectra check
 - Calibrated spectra check
 - Pre-processing system operation
- **2-3, Mar**
 - Interferometer fixed-mirror alignment
- **5, Mar**
 - ZPD position tuning
- **6, Mar ~ present**
 - NEdT evaluation
 - Spectral Calibration comparison with LBL simulation
 - Radiance comparison with NPP/CrIS



(Courtesy of Chengli Qi et al. , 2018)

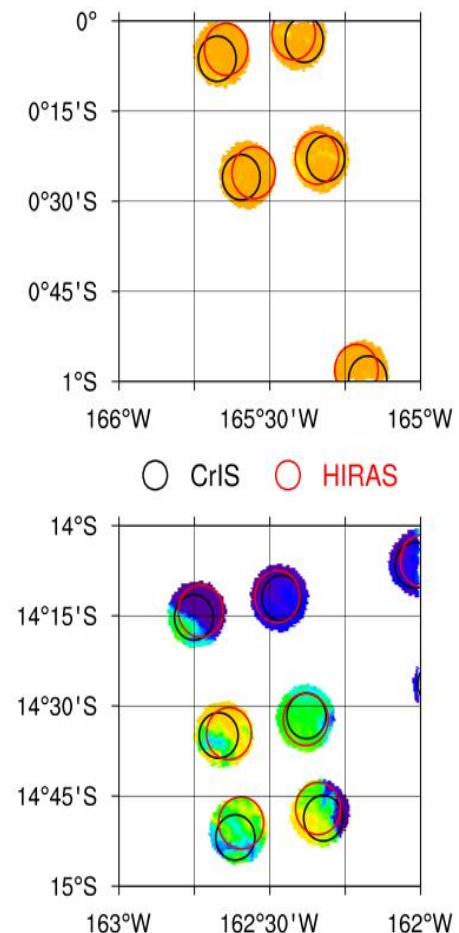
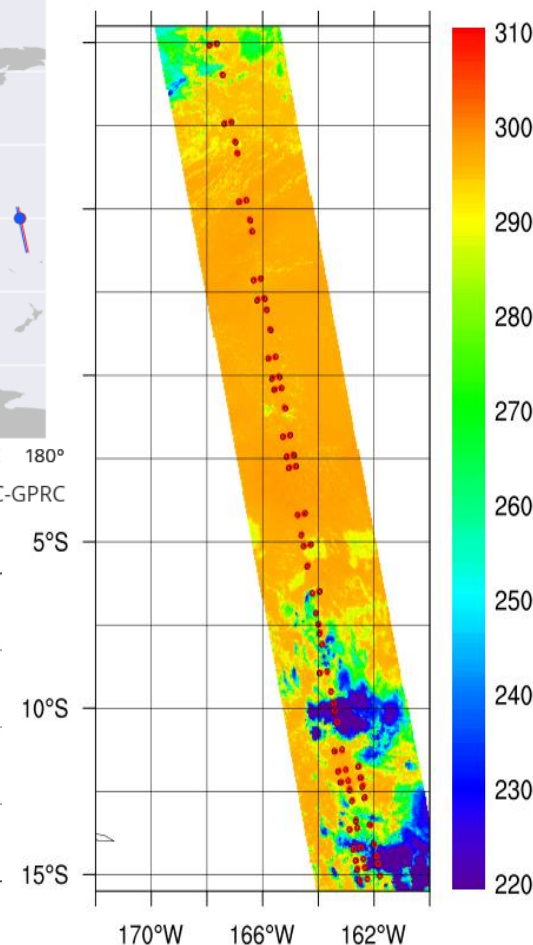
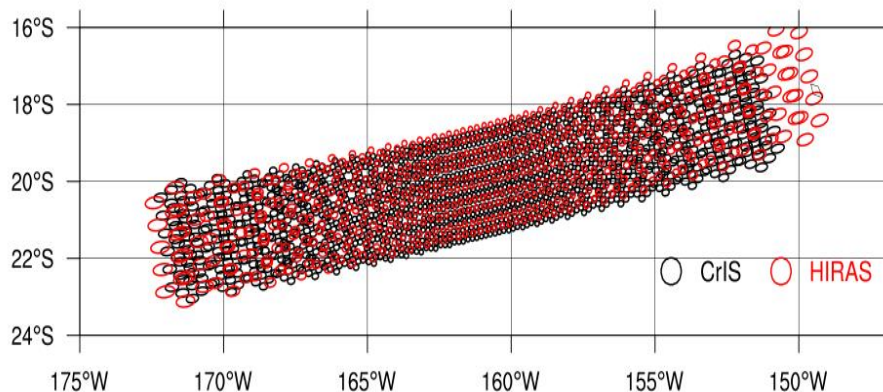
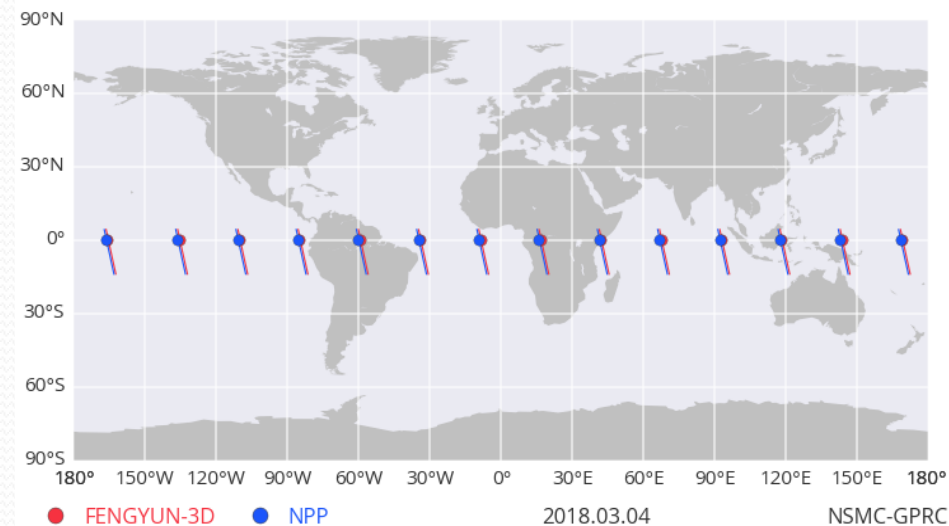
Preliminary Spectral Calibration Check

HIRAS OBS compared with
LBLRTM simulation (LW)



(Courtesy of Chengli Qi et al. , 2018)

Day1 HIRAS data compared with CrIS



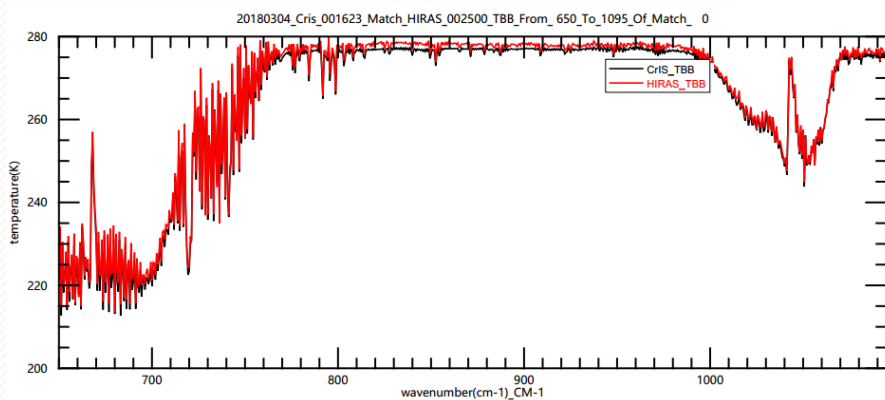
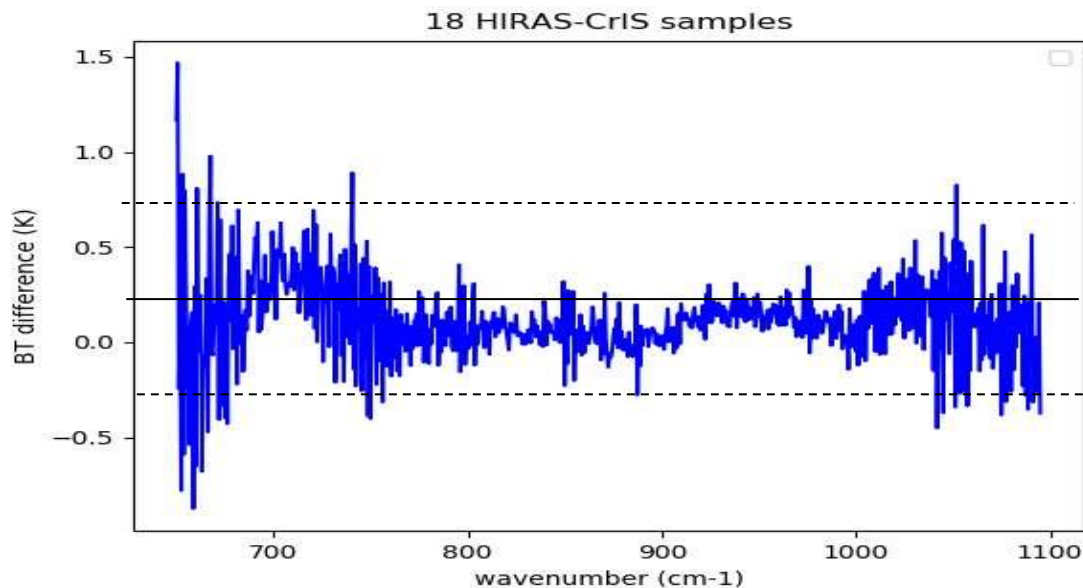
Collocation with CrIS using both overlap orbit

Reference to Likun Wang et al, 2016)

Bias between HIRAS and CrIS

□ Day 1 data evaluation

Difference between HIRAS and CrIS
After NL correction



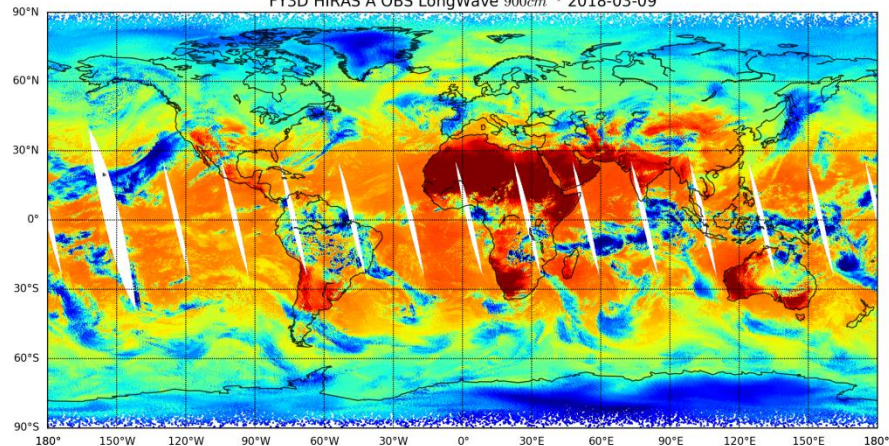
(Courtesy of Hanlie Xu et al. , 2018)

Day 1 Global BT

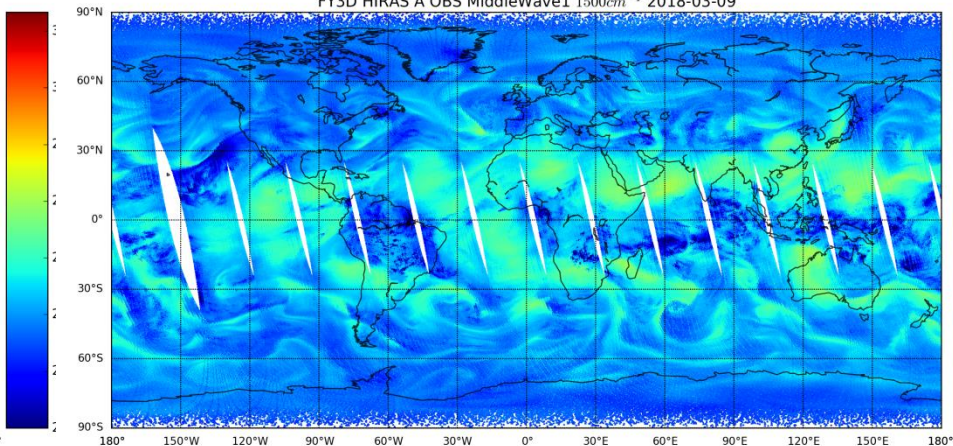
LW 900cm⁻¹

MW 1500cm⁻¹

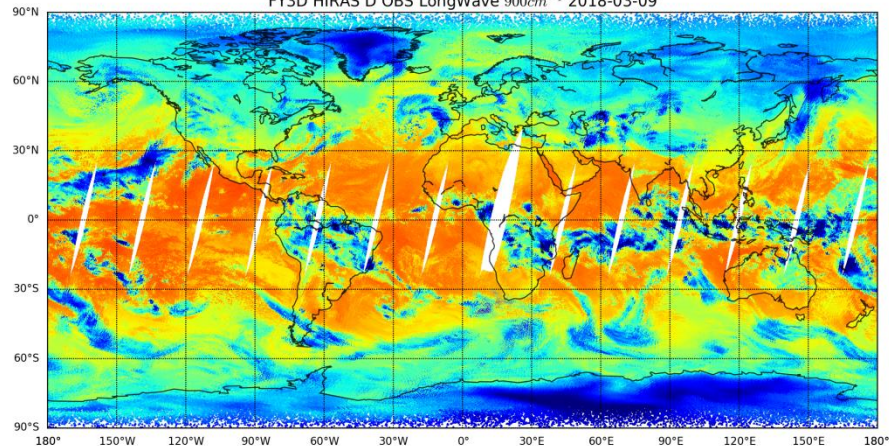
FY3D HIRAS A OBS LongWave 900cm⁻¹ 2018-03-09



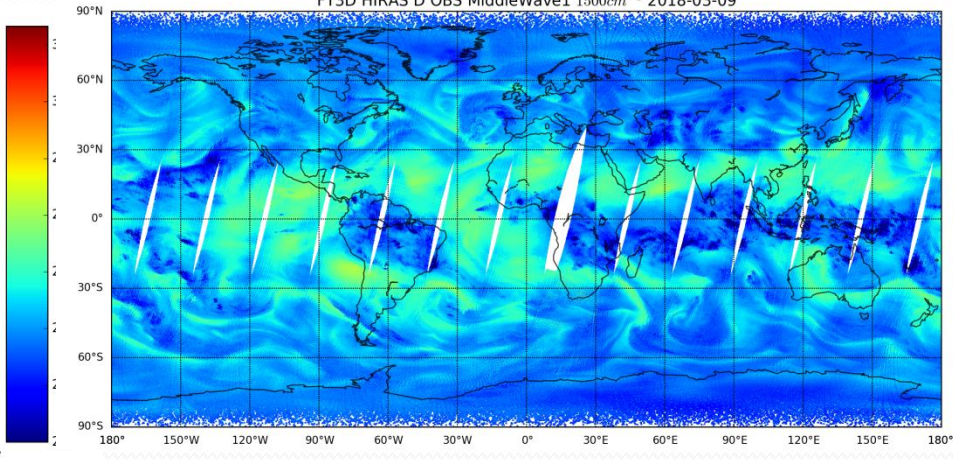
FY3D HIRAS A OBS MiddleWave1 1500cm⁻¹ 2018-03-09



FY3D HIRAS D OBS LongWave 900cm⁻¹ 2018-03-09

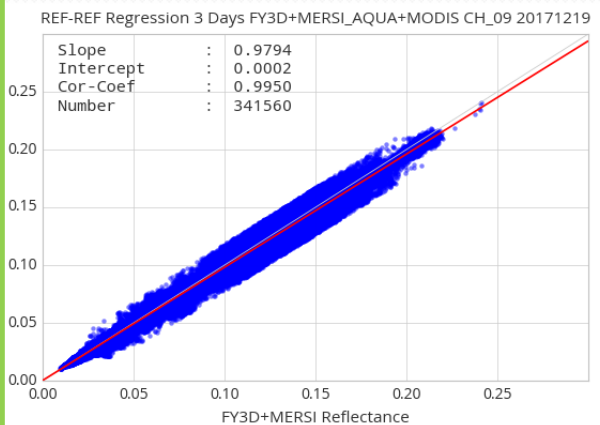
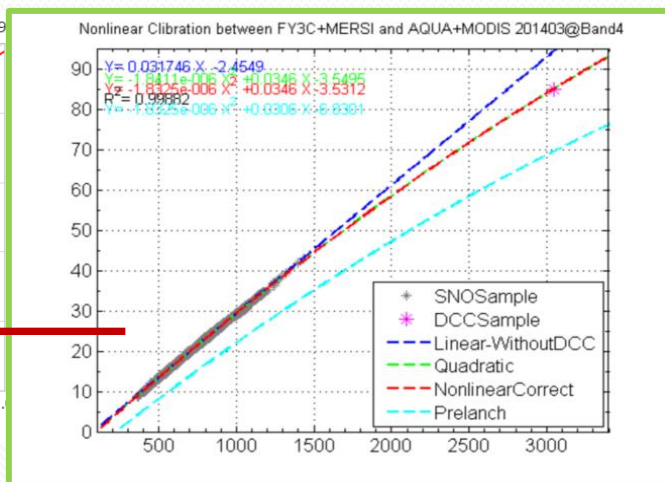
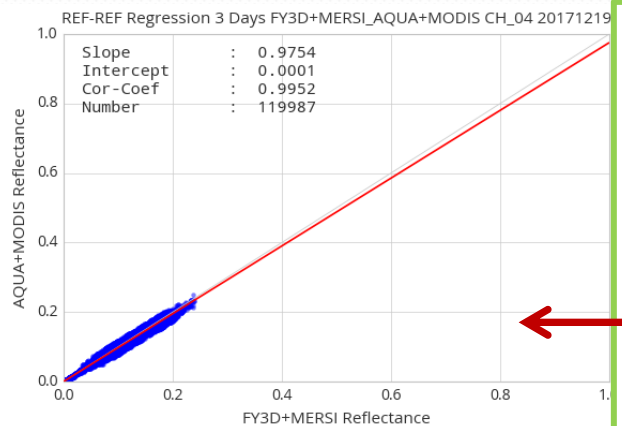
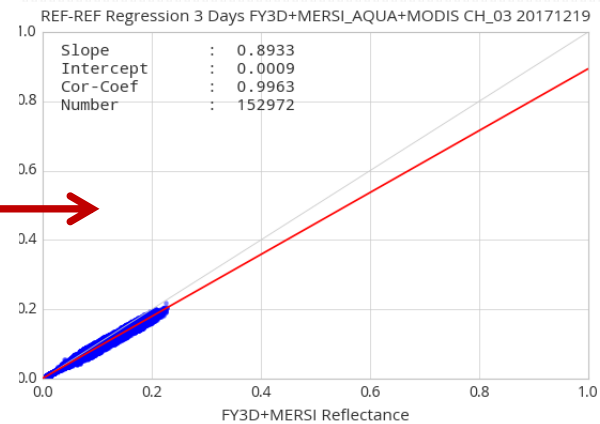
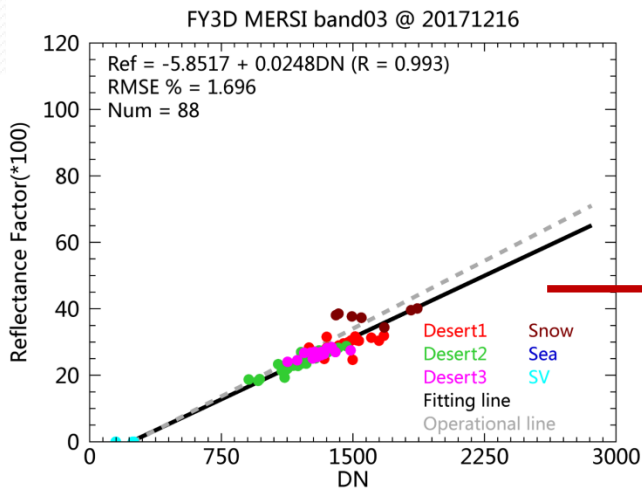
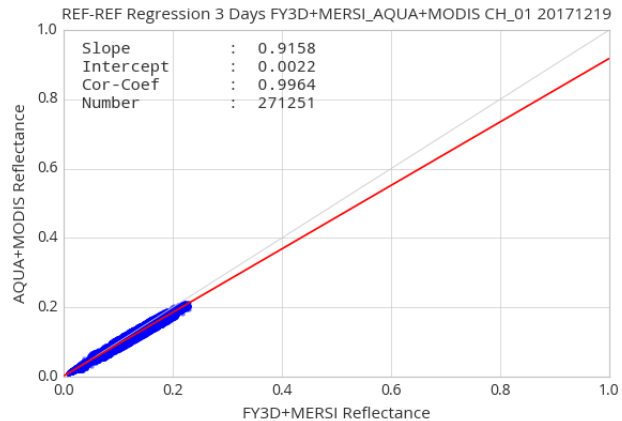


FY3D HIRAS D OBS MiddleWave1 1500cm⁻¹ 2018-03-09



Data Reception, Raw data combined and Lo data generation, decoding into L1A, SDR
Ground processing practice into L1 & OBC dataset.

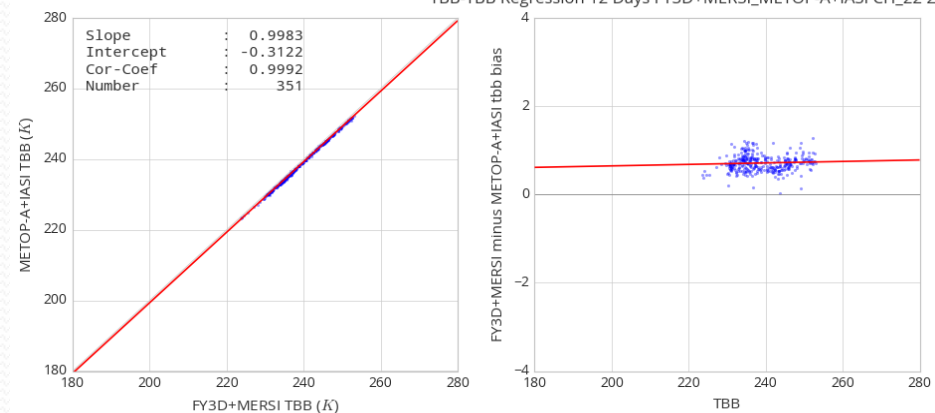
Preliminary evaluation of MERSI-II calibration with VC and MODIS



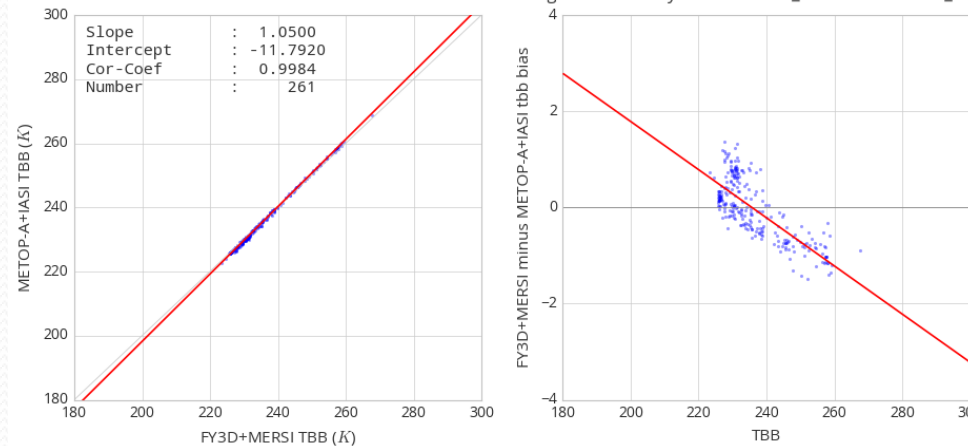


MERSI-II IR compared with IASI

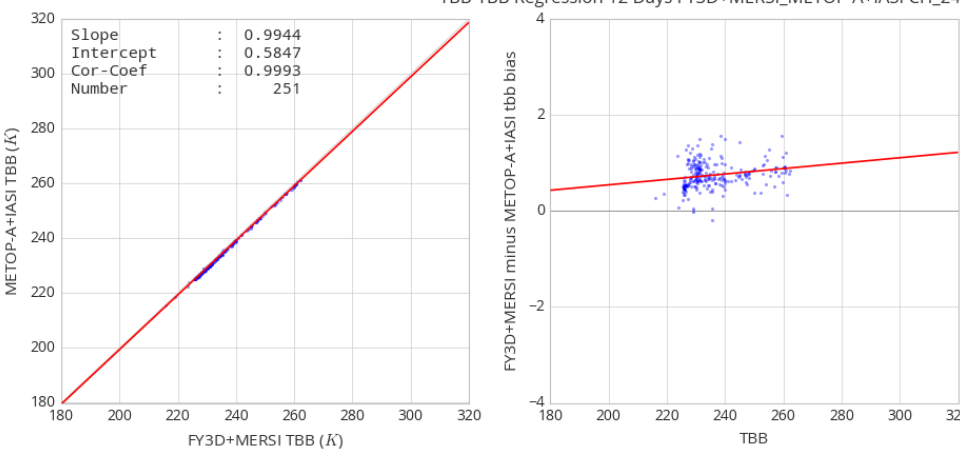
TBB-TBB Regression 12 Days FY3D+MERSI_METOP-A+IASI CH_22 20



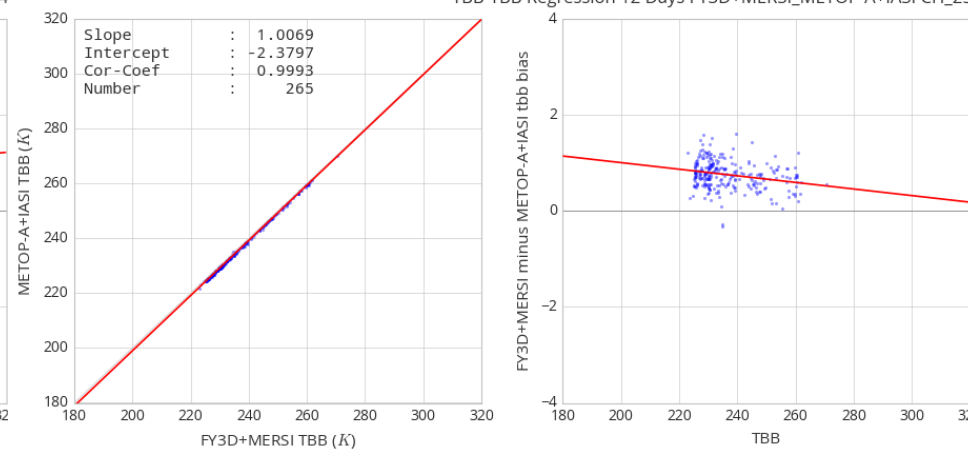
TBB-TBB Regression 12 Days FY3D+MERSI_METOP-A+IASI CH_22 21



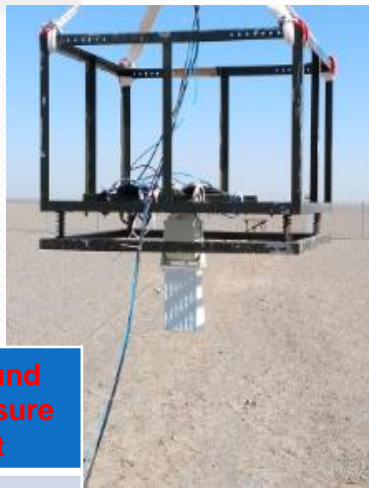
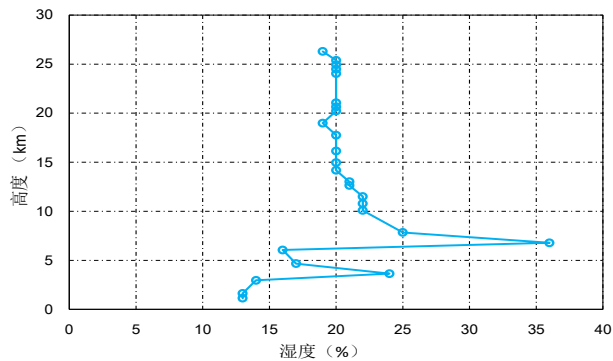
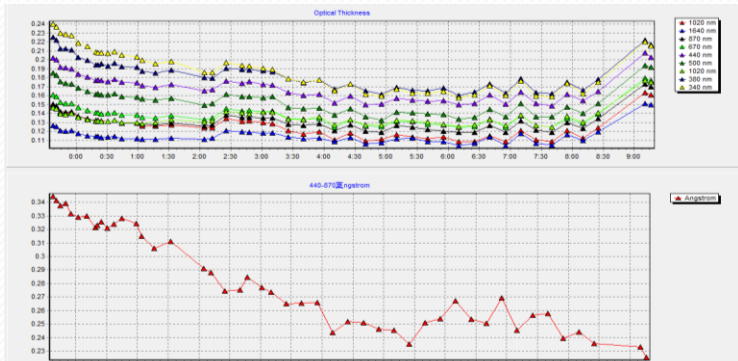
TBB-TBB Regression 12 Days FY3D+MERSI_METOP-A+IASI CH_24



TBB-TBB Regression 12 Days FY3D+MERSI_METOP-A+IASI CH_24 21

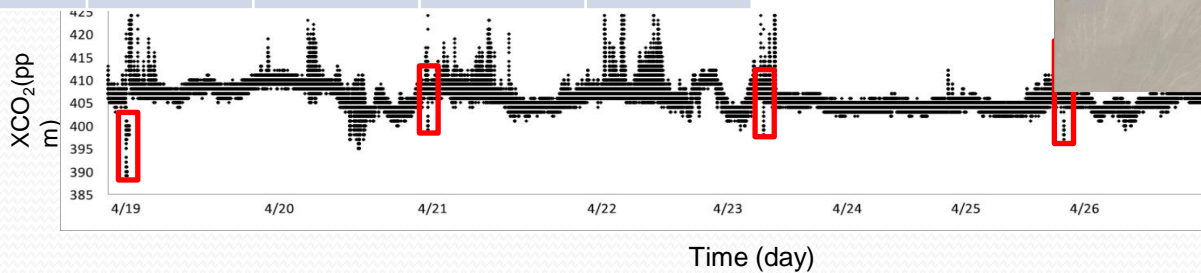


TanSat & FY-4 Vicarious Calibration at Dunhuang

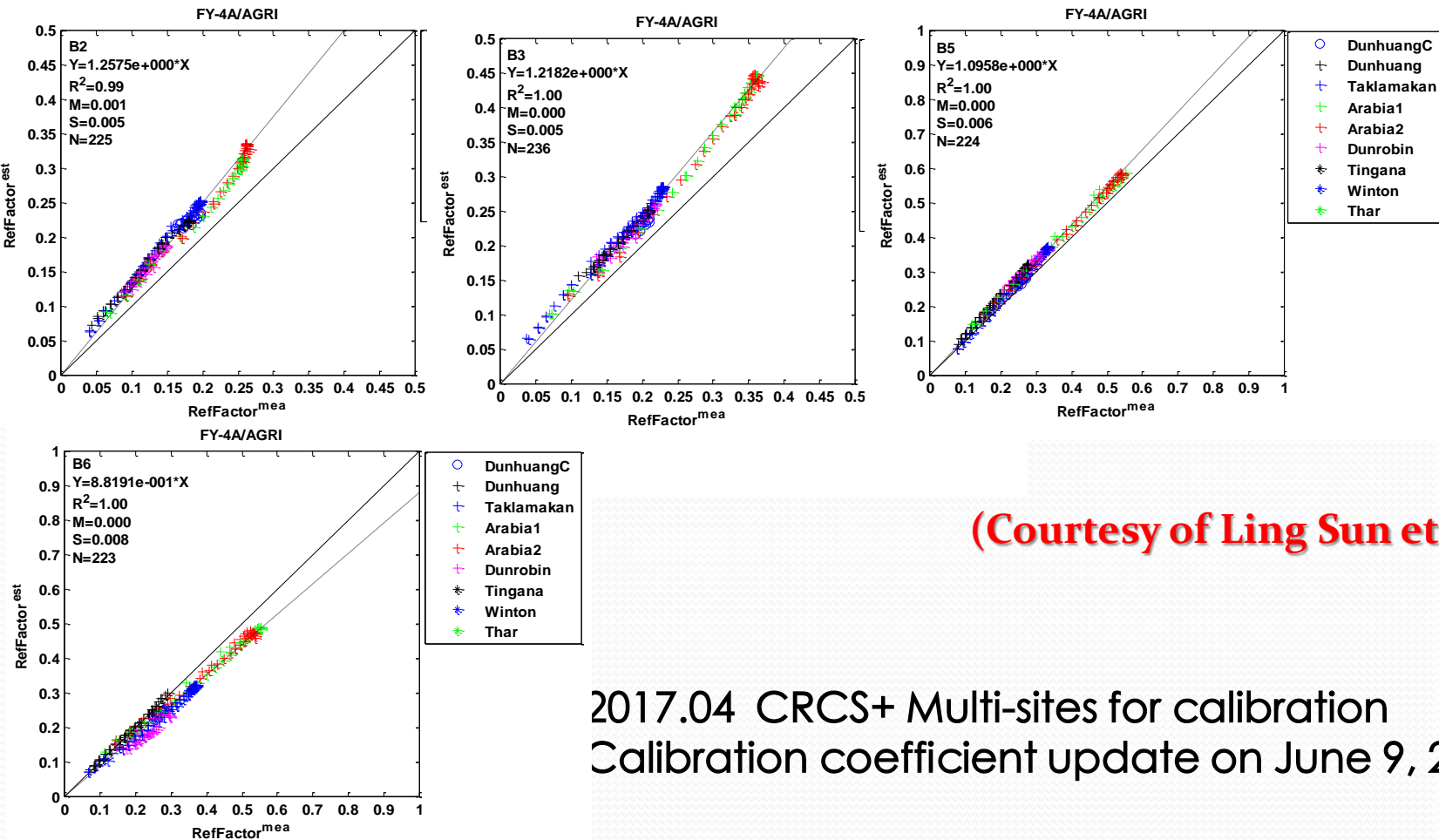


	TanSat	CAS-products	GF-products	Ground Measurement
XCO ₂ Mean /ppm	397.12	406.85	404.71	407.43

Data_GGA



FY-4A AGRI RSB VC results

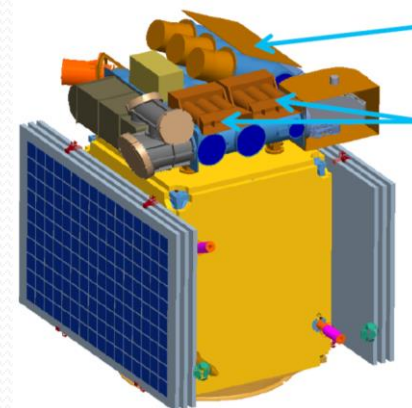
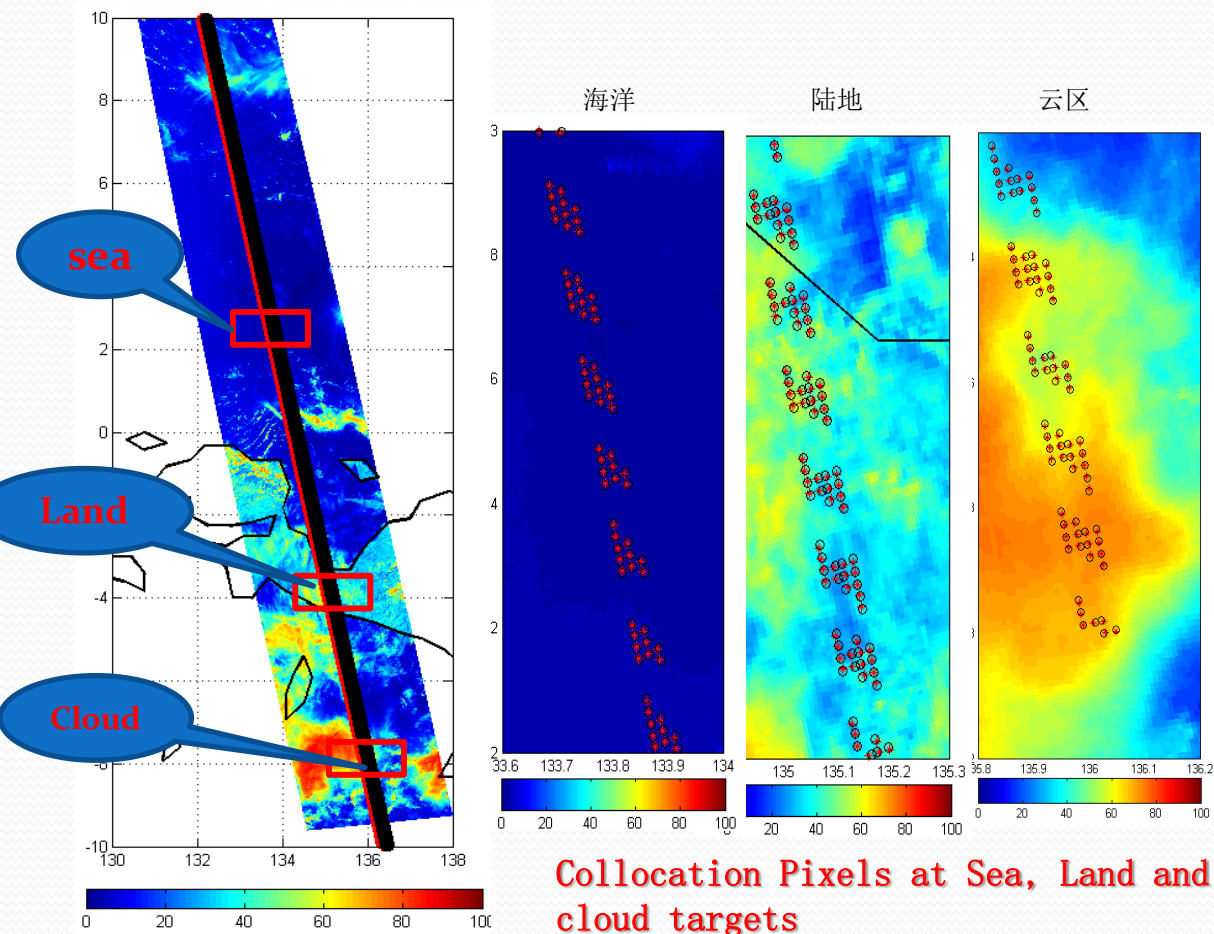


(Courtesy of Ling Sun et al. , 2017)

2017.04 CRCS+ Multi-sites for calibration
 Calibration coefficient update on June 9, 2017

Bands	1 472nm	2 606nm	3 810nm	4 1370nm	5 1615nm	6 2296nm
k	1.1615	1.1435	1.2002	1	1.1112	0.90593

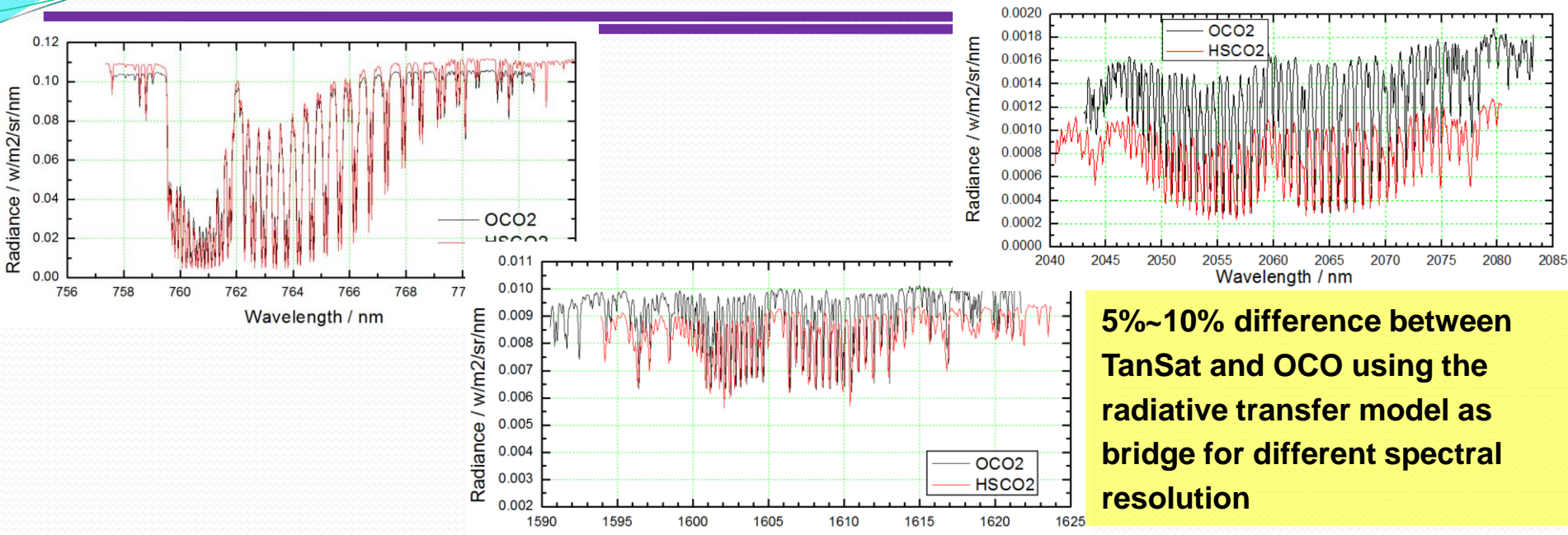
Spatial Collocation between TanSat and OCO



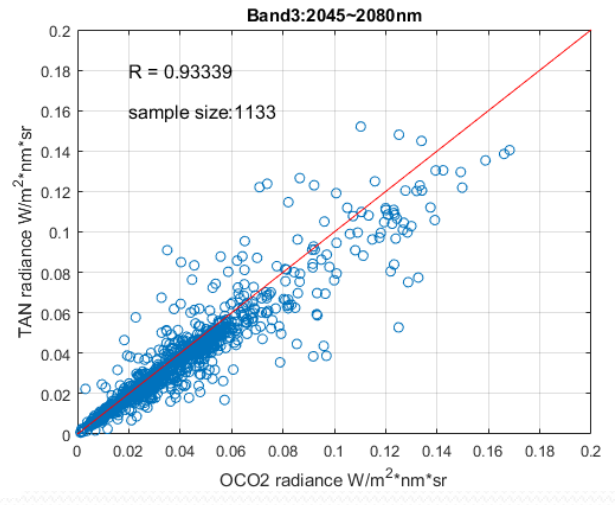
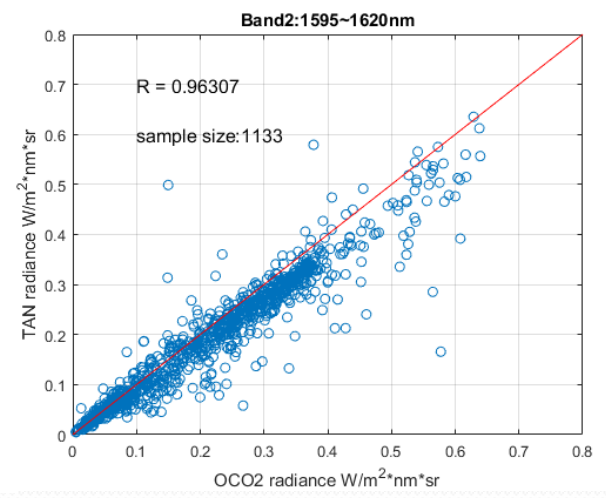
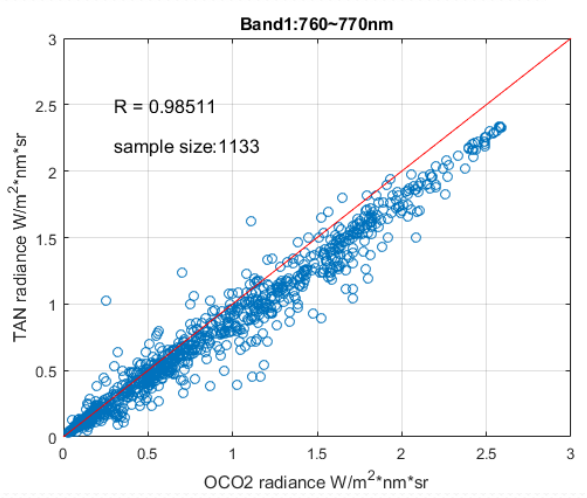
Key issues:

- Orbit selection (Nadir almost overlap)
- Targets Selected (Using imager for targets selection)
- Polarization processing based on polarization mirror normalization
- Spectral sample collocation (using RTM and double difference)

Intercomparison between TanSat and OCO



5%~10% difference between TanSat and OCO using the radiative transfer model as bridge for different spectral resolution



(Courtesy of Na Xu et al. , 2018)



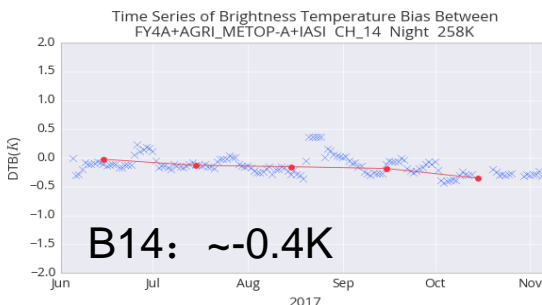
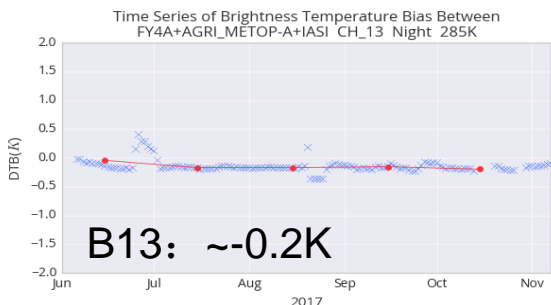
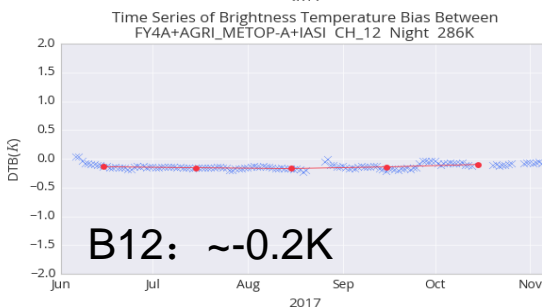
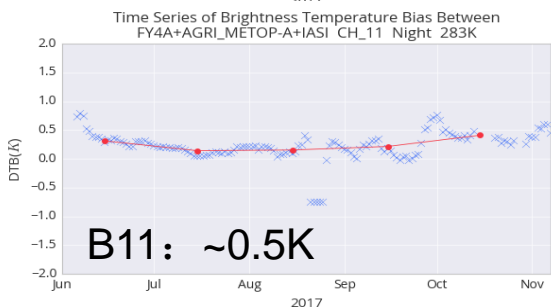
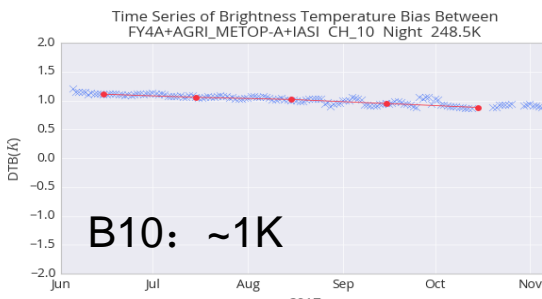
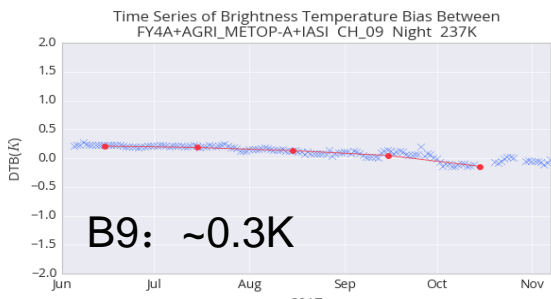
FY-4 L1 validation methods via GSICS

- ❑ IR bands validation of FY-4/AGRI based on GSICS GEO-LEO IR using IASI and CrIS;
- ❑ Solar bands validation of FY-4/AGRI based on NPP/VIIRS and Hamawari-8 SNO observation;
- ❑ Solar bands validation of FY-4/AGRI using DCC and VC from automatic measurement on Dunhuang site ;
- ❑ Validation of Radiometric and spectral calibration of FY-4 GIIRS using IASI and CrIS;
- ❑ Validation of spectral calibration of FY-4 GIIRS using LBL simulation in the clear sky sea observation ;
- ❑ Inter-comparison between AGRI and GIIRS on the same platform

This Job was carried on for 4 months: May~Sep,

Contributors: Na Xu, Lin Chen, Hanlie Xu, Chunqiang Wu, Chengli Qi, Ling Wang, Tianhang Yang, Fang Zhou

FY-4 AGRI IR bias wrt IASA

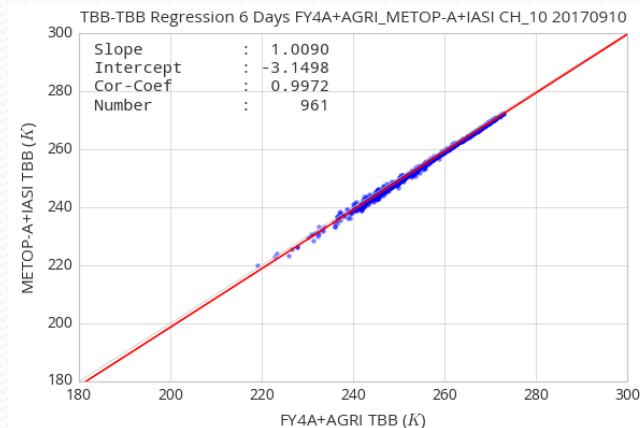


● Daily ● Monthly 20170605-20171107 NSMC-GPRC

● Daily ● Monthly 20170605-20171107 NSMC-GPRC

IR bands (3.8um not included)

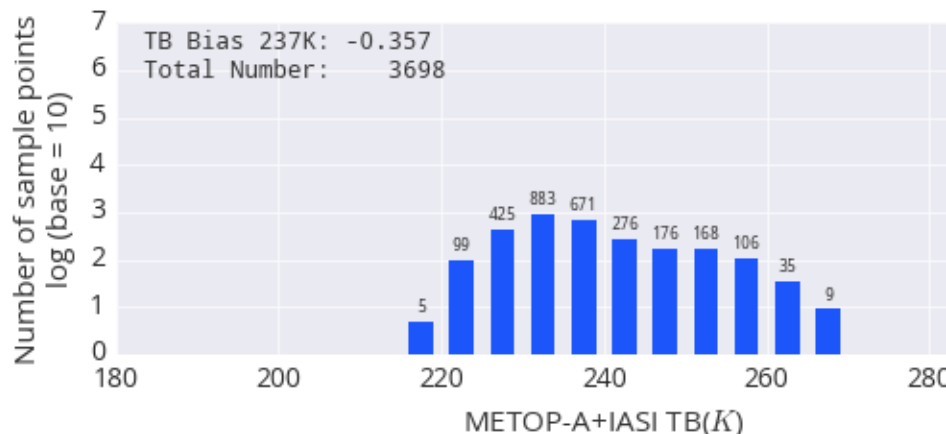
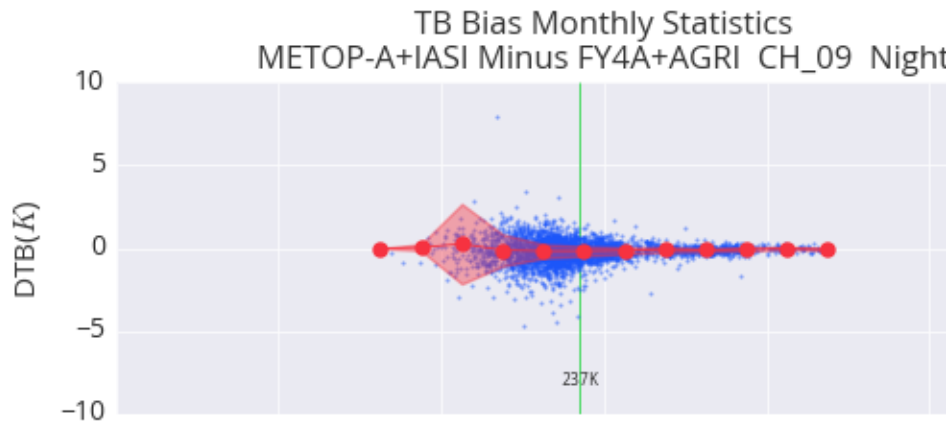
- Band 10 has 1.0 K higher than IASI;
- Less than 0.5K at other IR



IR band Bias Monitoring @290K

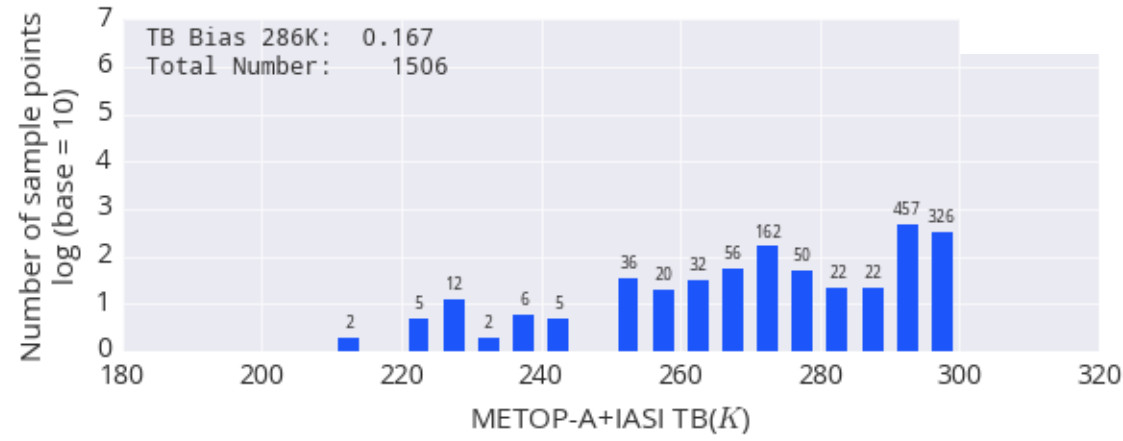
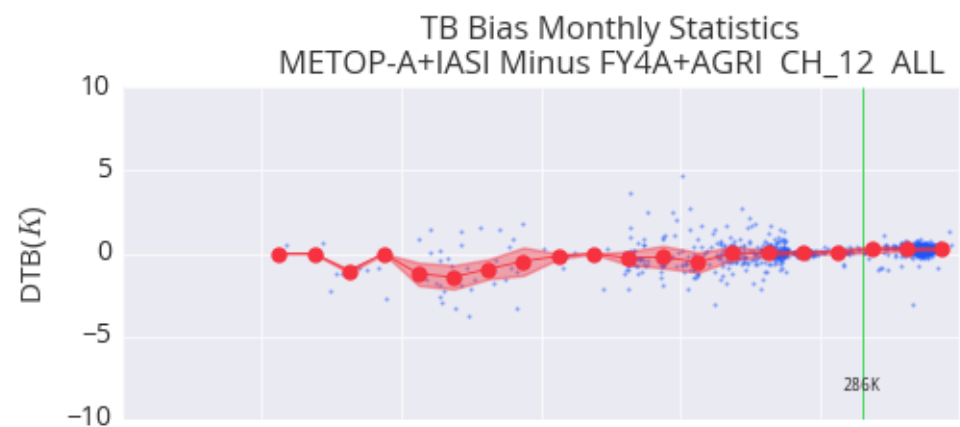


Bias dependence on the target temperature



201708 NS

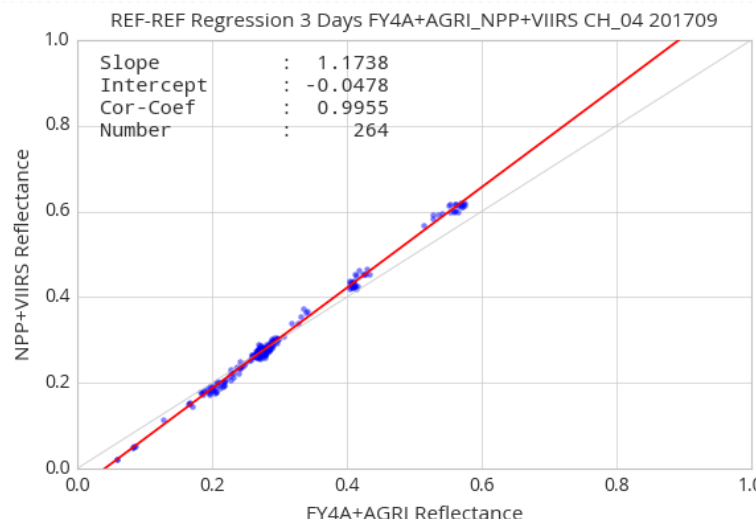
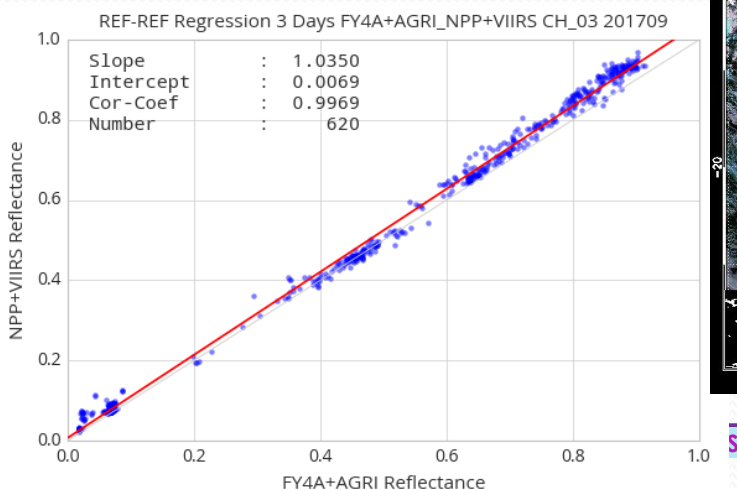
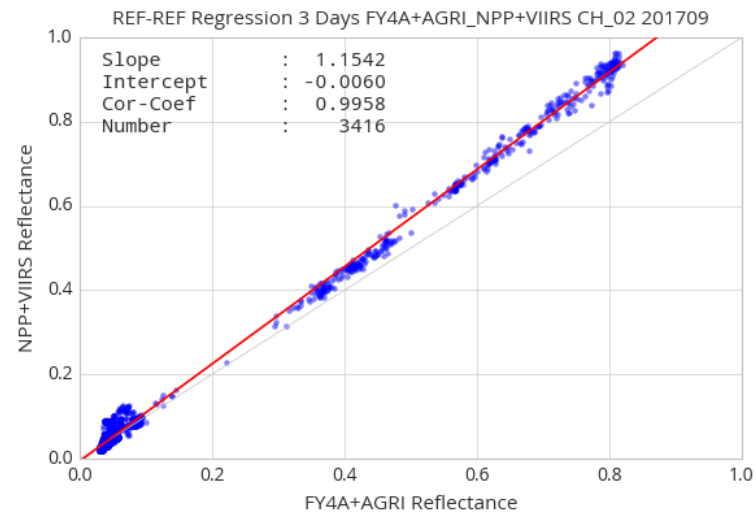
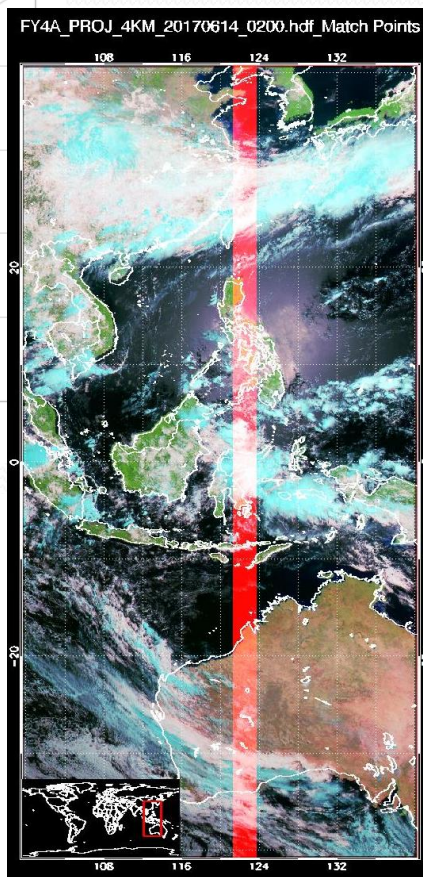
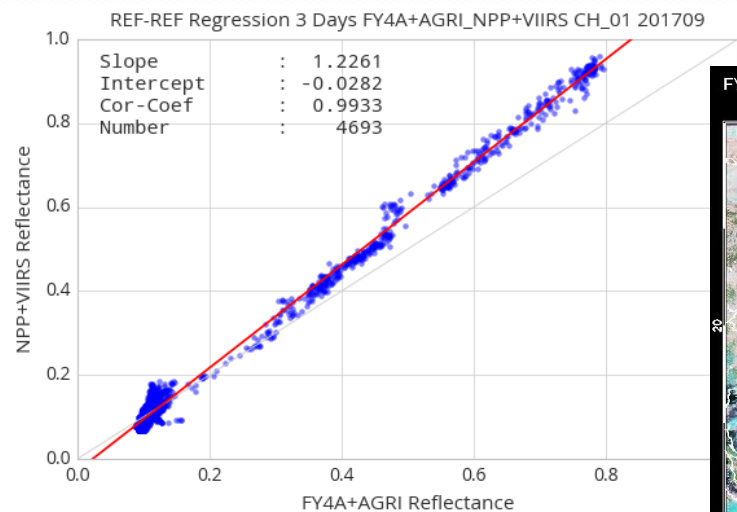
(Courtesy of Na Xu et al., 2018)



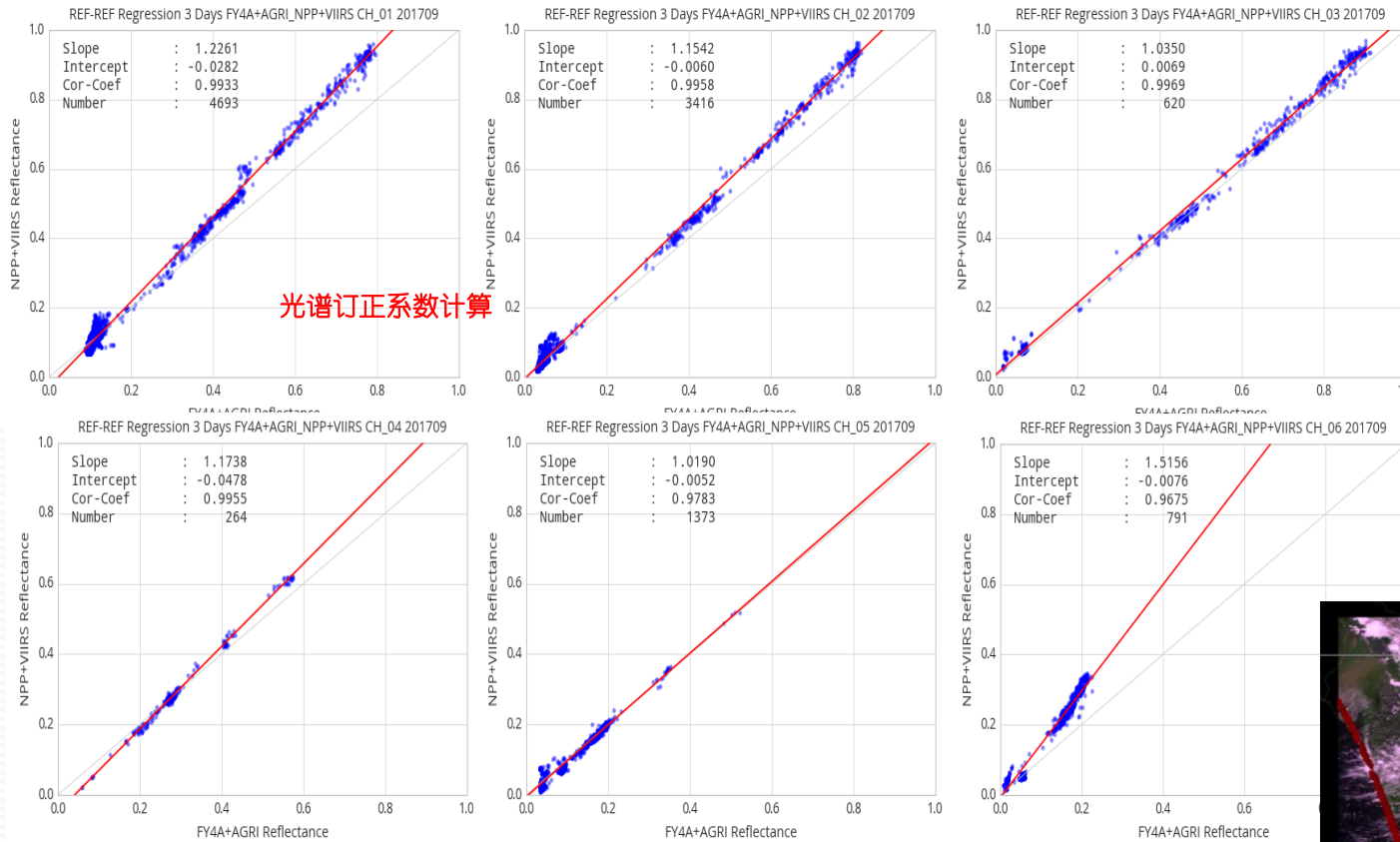
201708 NSMC-GPRC

Solar bands inter-comparison with VIIRS/H-8

□ Consideration time, geometry, IFOV and spectral matching

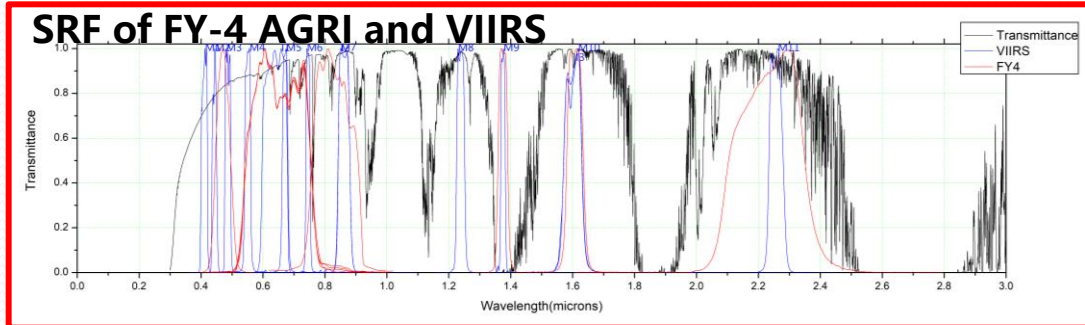
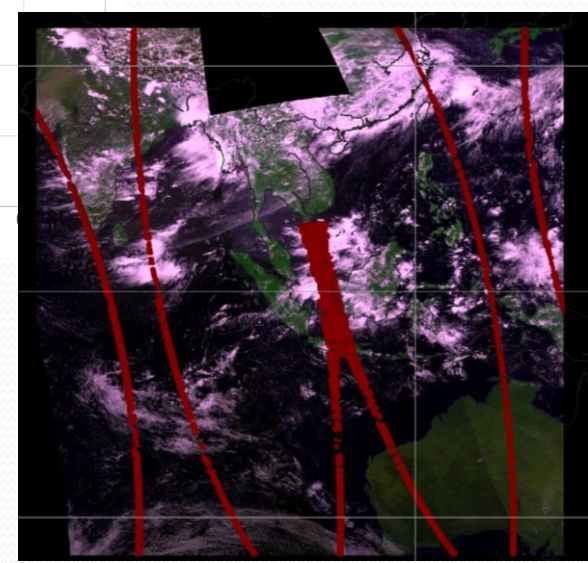


FY-4/AGRI via VIIRS



光谱订正系数计算

- Solar bands diff:
- B1-2 is less 8% than VIIRS @high signal ;
 - B3-4 is less 5% than VIIRS @ high signal ;
 - B5 is good consistence
 - B6 has large lower 30% than VIIRS



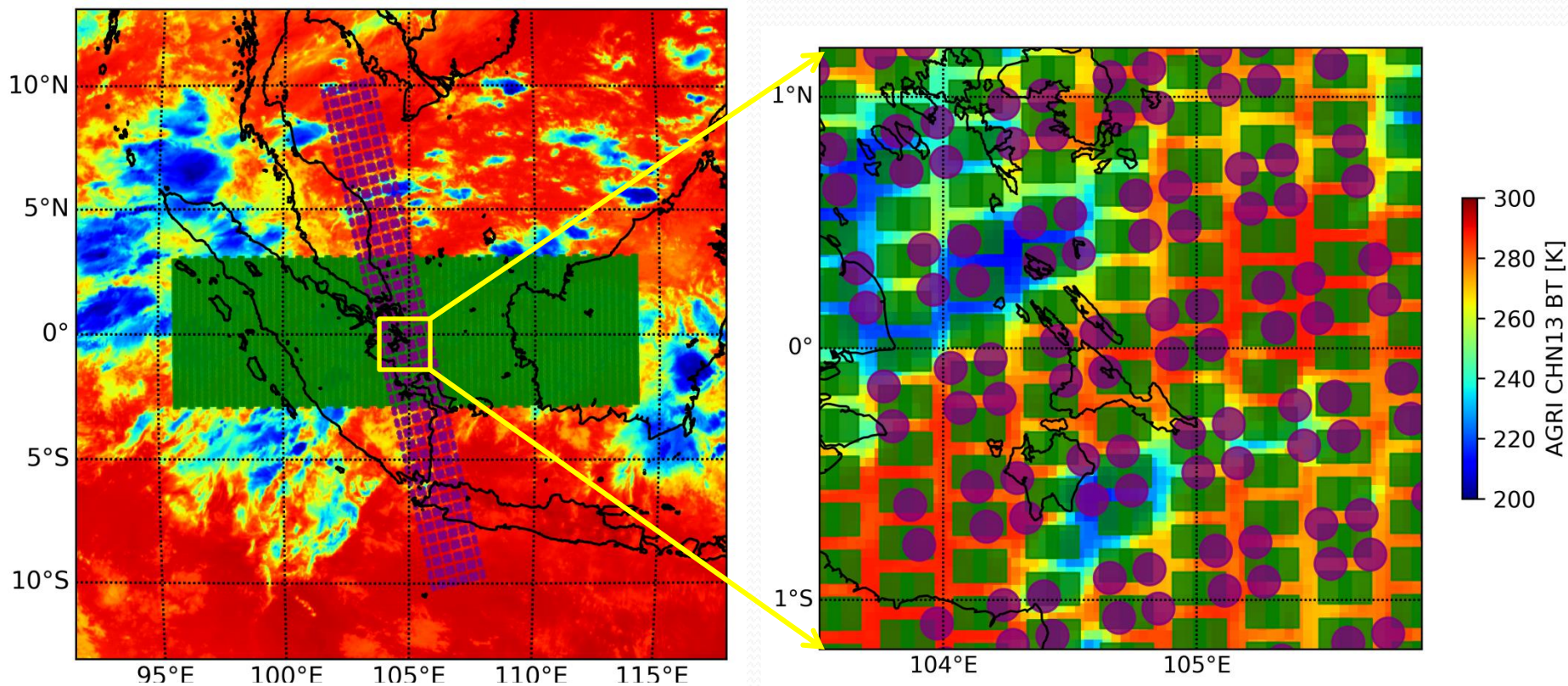
Matching between GIRS and IASI

Time Diff: 20 minutes

Center Distance : 4km

Zenith angle: $<10^\circ$, Path Diff $<1\%$

Targets homogeneity: AGRI CHN13 5x5 TB std ($< 0.05K$)

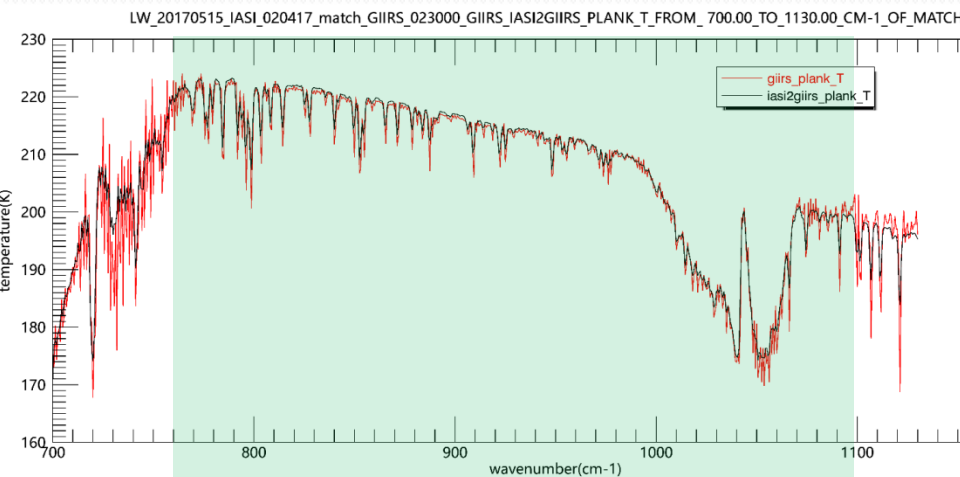


(Courtesy of Chunqiang Wu, 2018)

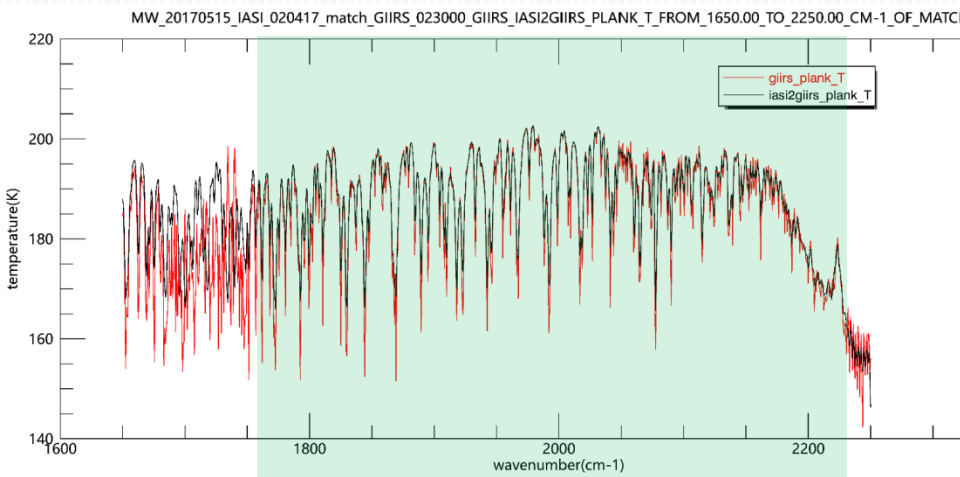
Annual Meeting on March 21-22, 2018, Shanghai, China
Pixel Matching



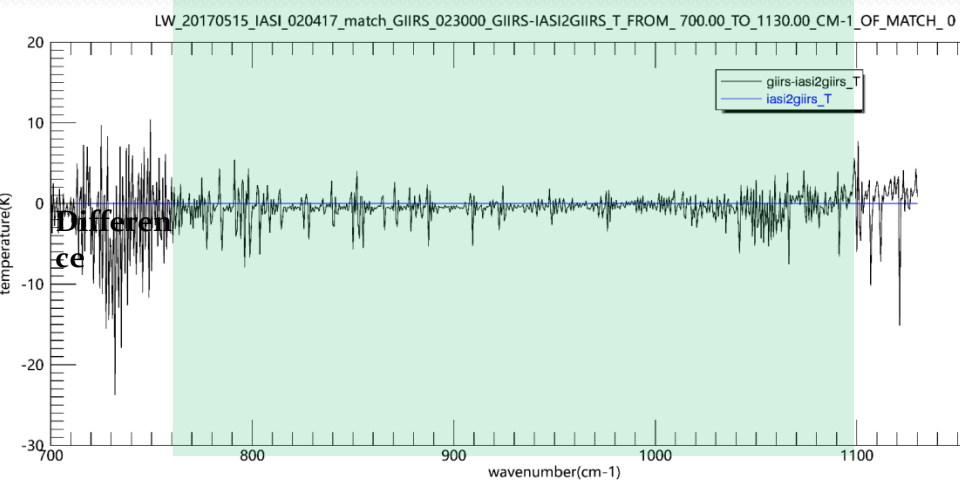
GIIRS validation using IASI



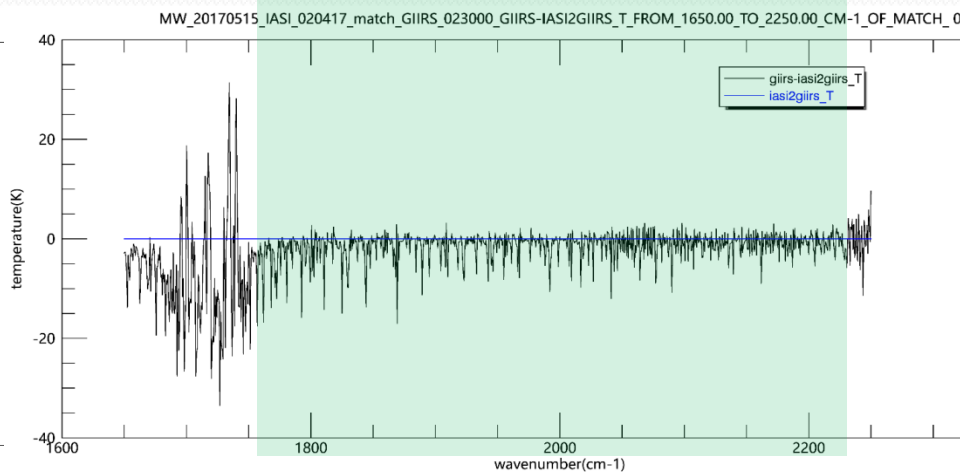
760—1100cm⁻¹



1750—2230cm⁻¹



Good Channels



Good Channels

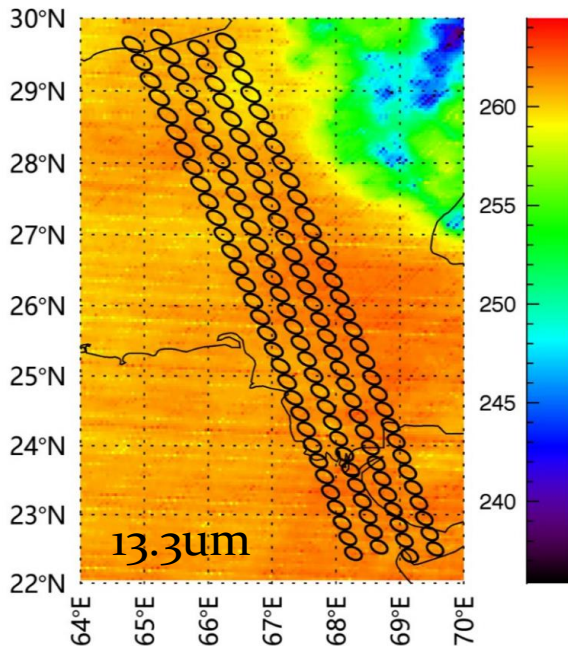
Inter-comparison between AGRI and GIIRS on the same platform



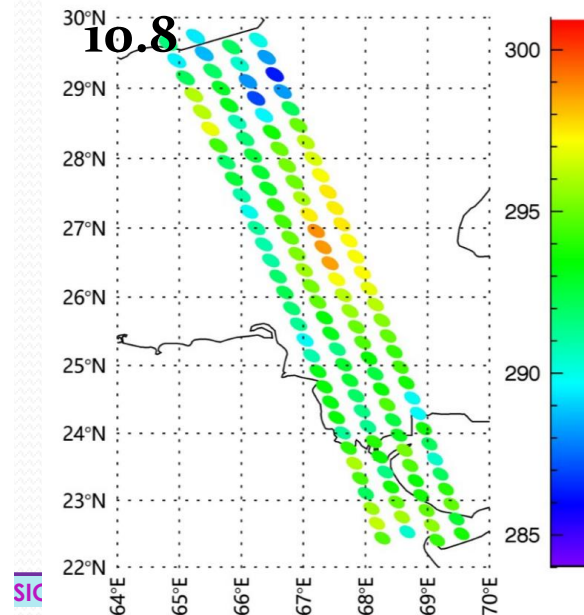
Method:

- ❑ Matching pixels: Find the nearest pixel of GIIRS center from AGRI imager
 - ❑ GIIRS pixel IFOV 16 KM, AGRI pixel IFOV 4KM, AGRI 5*5 pixels, Environment area 15*15 pixels;
- Time: $dif_time \leq 180s$
 - Homogeneity: ≤ 0.01

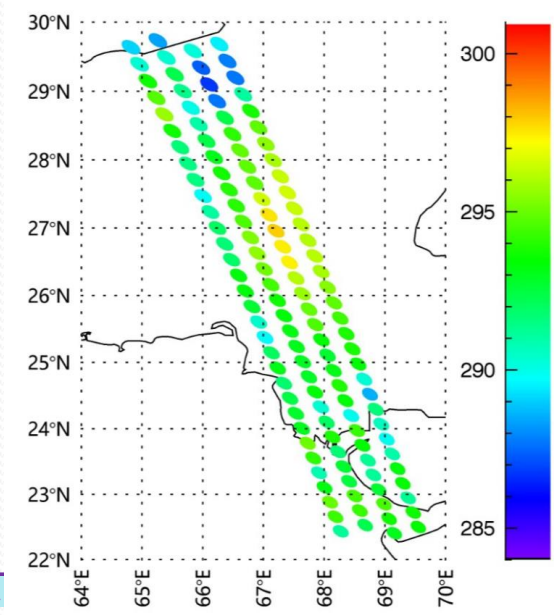
(Courtesy of Hanlie Xu, 2018)



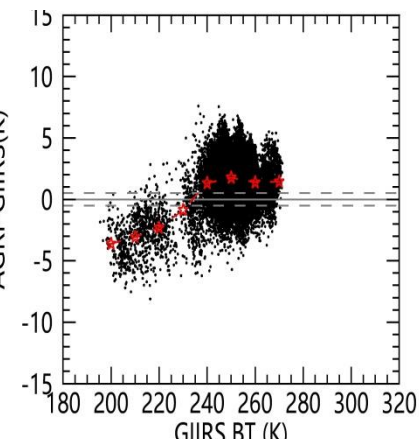
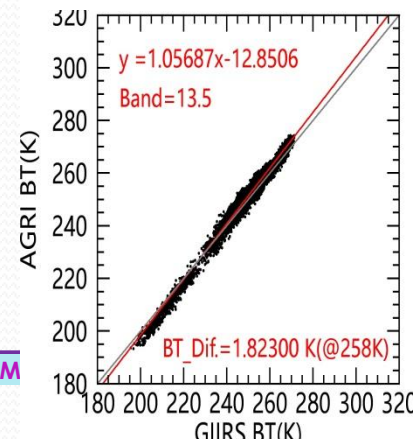
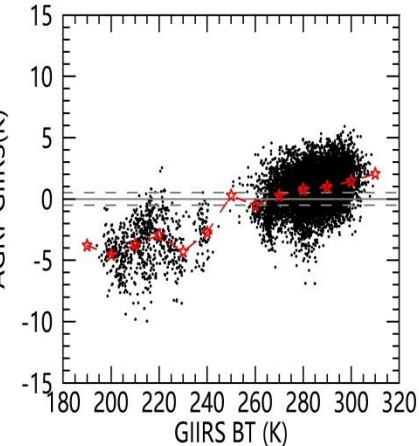
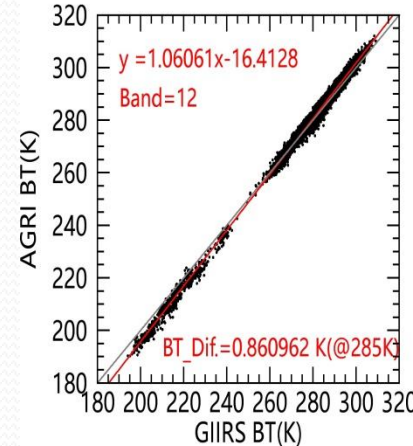
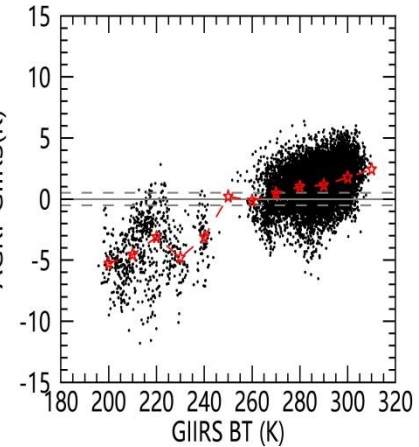
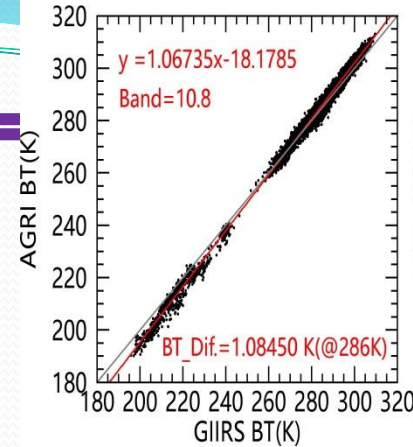
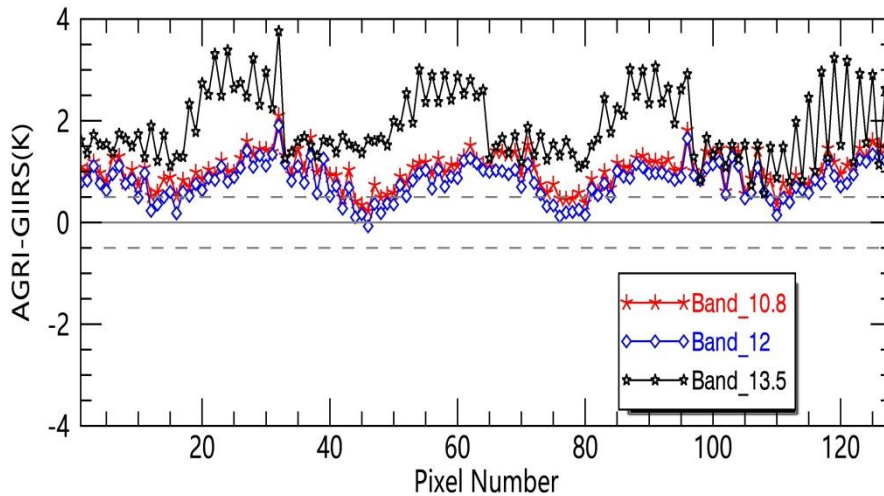
AGRI Observation



GIIRS Simulated 10.8



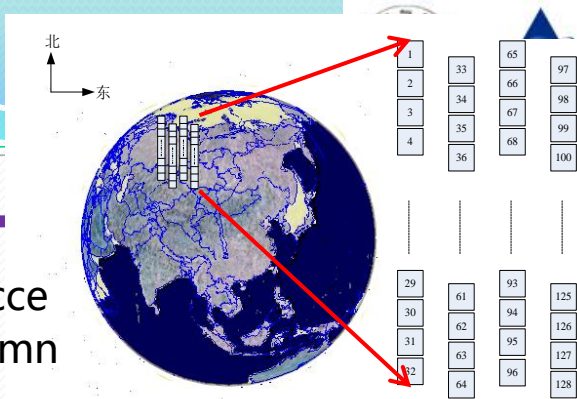
August 17, 2017



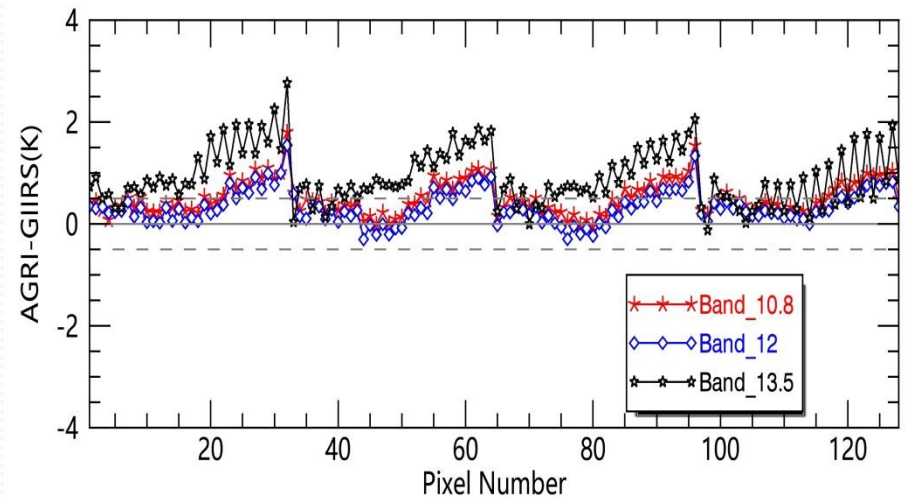
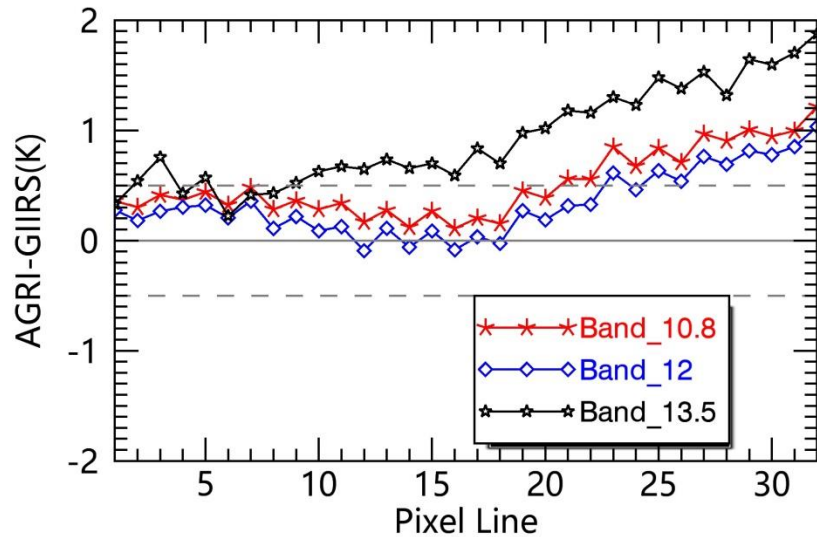
- GIIRS has higher than AGRI at cooler targets and lower than AGRI at warmer targets
- GIIRS has Bias Detector dependence of each of four column.

(Courtesy of Hanlie Xu, 2018)

Bias Detector dependence



- GIIRS has 32 pixels in each column and bias detector dependence
- Middle bias smaller, Larger bias in the end detector of each column



BT Difference (AGRI-GIIRS) K

Four column detectors bias distribution (mean in August, 2017)

(Courtesy of Hanlie Xu, 2018)



Preliminary conclusion of FY-4A L1 Validation

- **AGRI IR bands:**
 - Biases of most IR bands are smaller 1 k and keep stable for long term.
 - Biases of Middle IR bands (B7 and B8) are larger and need further validation

- **AGRI Solar bands :** B3 and B5 has high accuracy within 5%, other bands exist higher at low signal, and Lower @ high signal than VIIRS, B6 (2.3um) has a large lower.

- **AGRI degradation monitoring:** B1 (0.46um) has obvious degradation trend ,B2 and B3 are very stable, SWIR bands need further monitoring.

- **GIIRS Validation:**
 - Good consistence between GIIRS and IASI/CrIS (<1K) at most of spectral bands, But has a large bias in the smaller wavenumber in longwave and middle bands.
 - GIIRS has large bias in the cooler targets which small 200K
 - Finding the Bias Detector dependence using inter-comparison between AGRI and GIIRS on the FY-4 same platform.

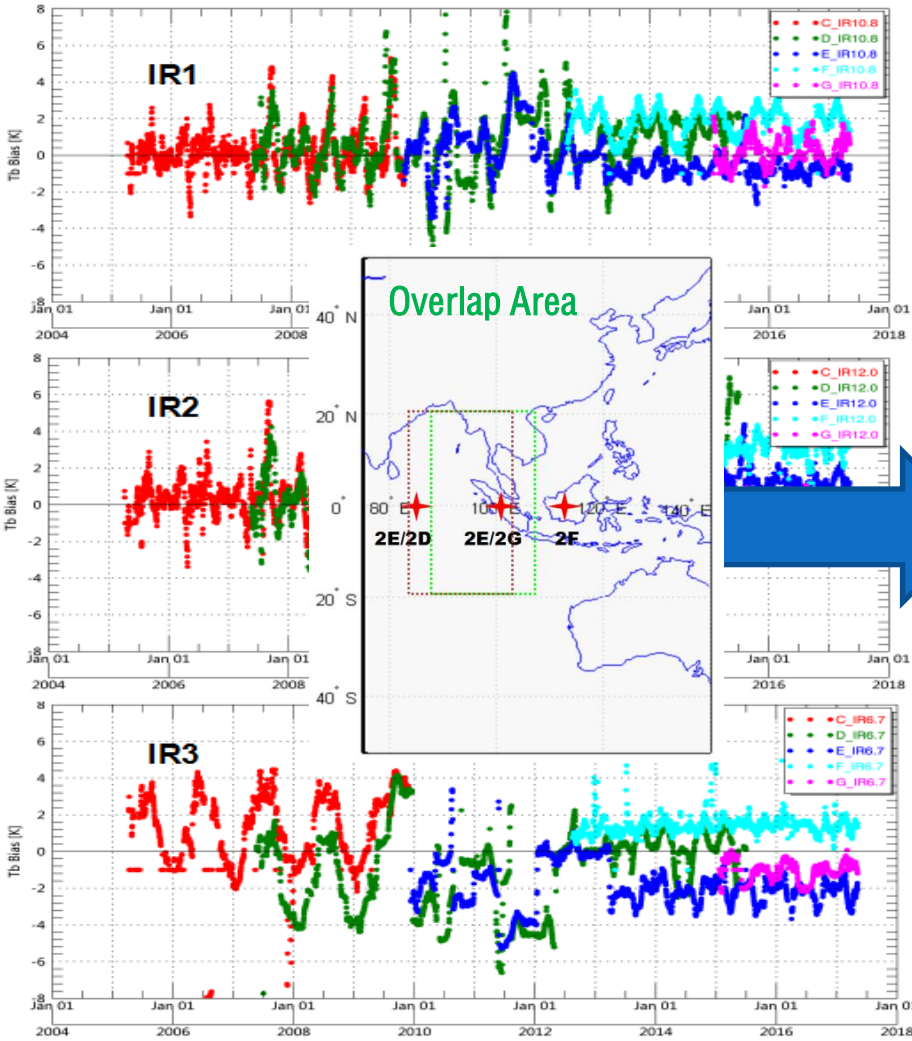
CMA Initiate the retrospective calibration for long term FY historical satellites data

- (1) National Major Project application (MOST 2018)
- (2) FY-3 FCDR and EDR begin to be established
- (3) FY-2 Fundamental CDR established
- (4) Other projects.....

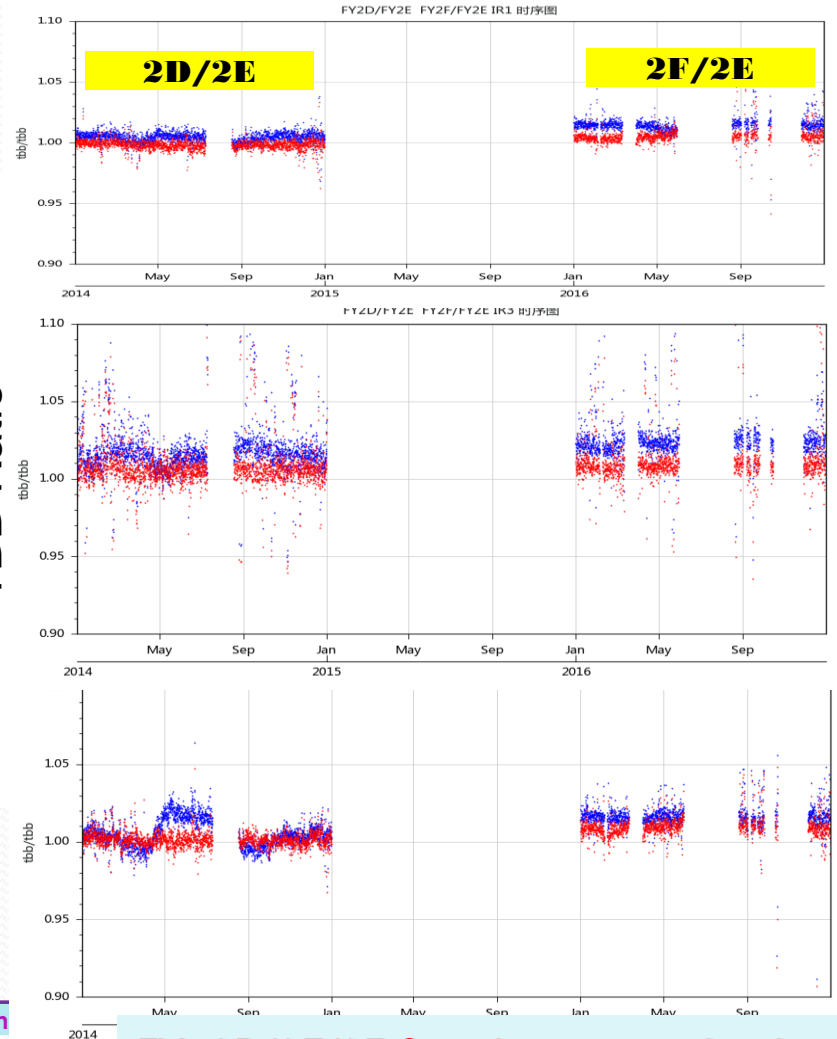
10 years FY-2 recalibration and FCDR (version 1.0)

FY-2 bias evaluation based on GSICS method

- 1) 观测偏差存在显著季节波动;
- 2) 不同卫星观测结果差异显著, 水汽通道最为显著



TBB Ratio



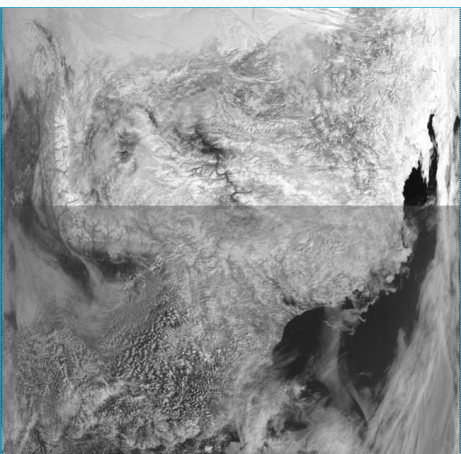
(Courtesy of Na Xu et al., 2018) CS 2018 Annual Meeting on

FY-2D/2E/2F Consistence evaluation

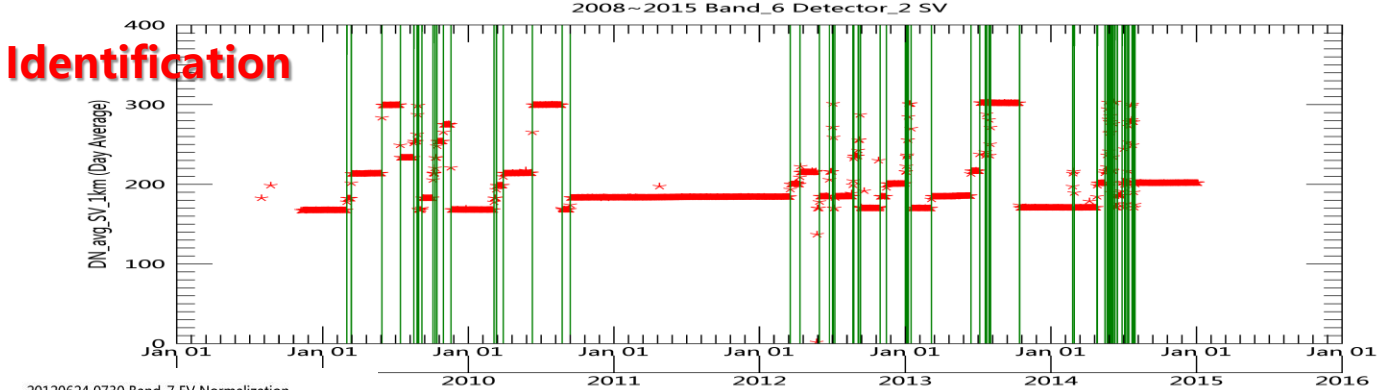
Gain jump on FY-3A MERSI SW bands

Robot Identify, Gain Normalized, Imager adjustment

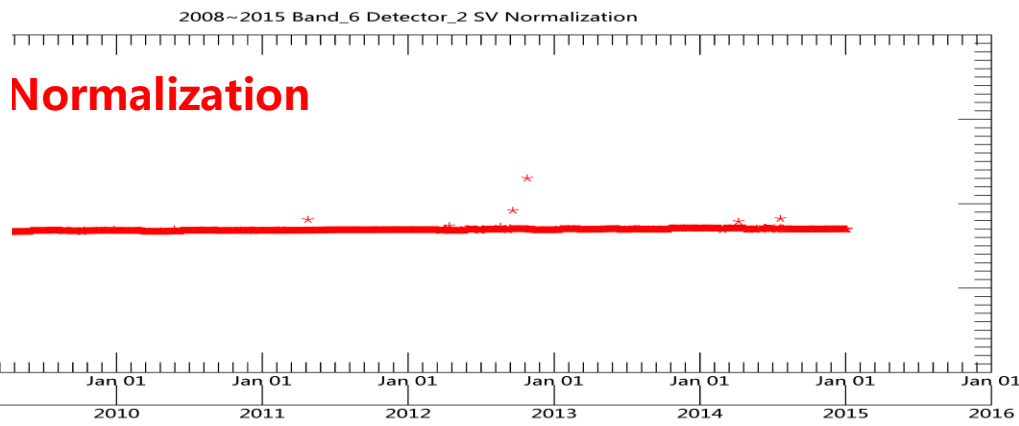
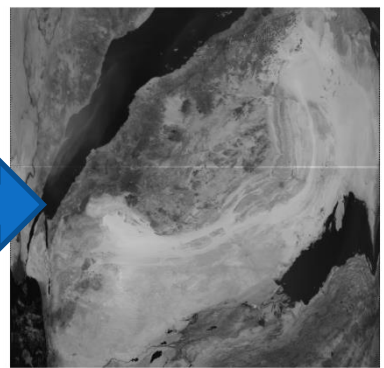
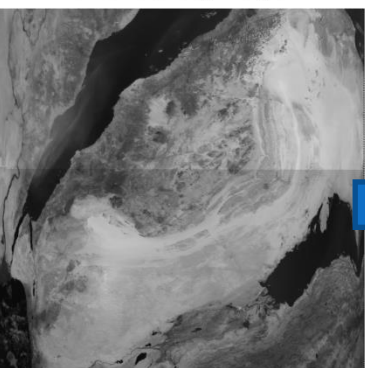
Jump identification of Band 6 during 2008~2015 using SV



20120624 0730 Band_7 EV Original



20120624 0730 Band_7 EV Normalization

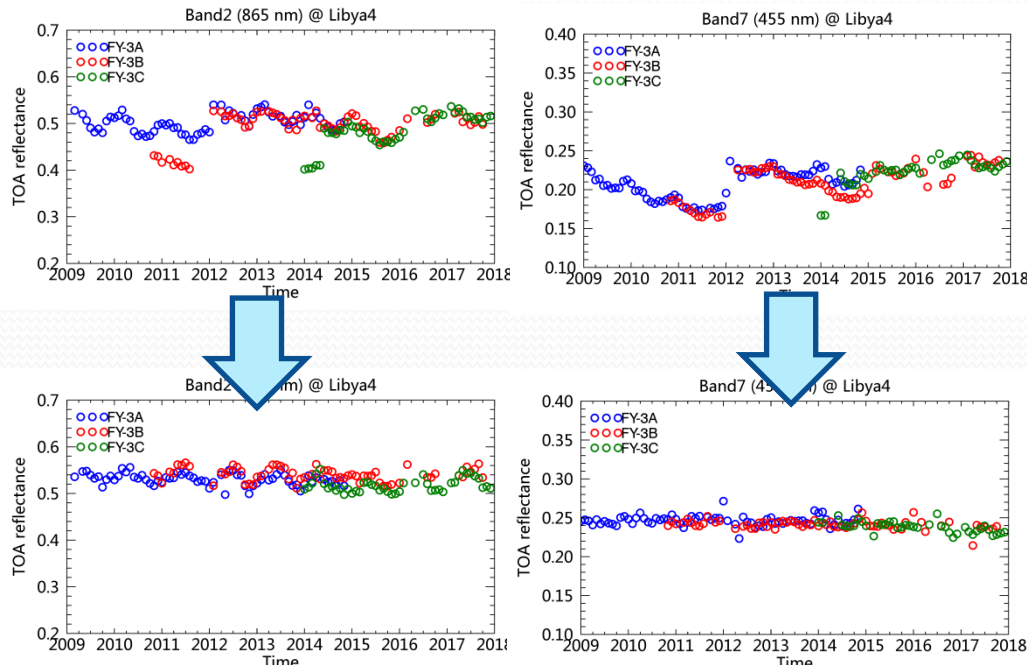


Jump events:
Band 6: 91 times,
Band 7: 18 times

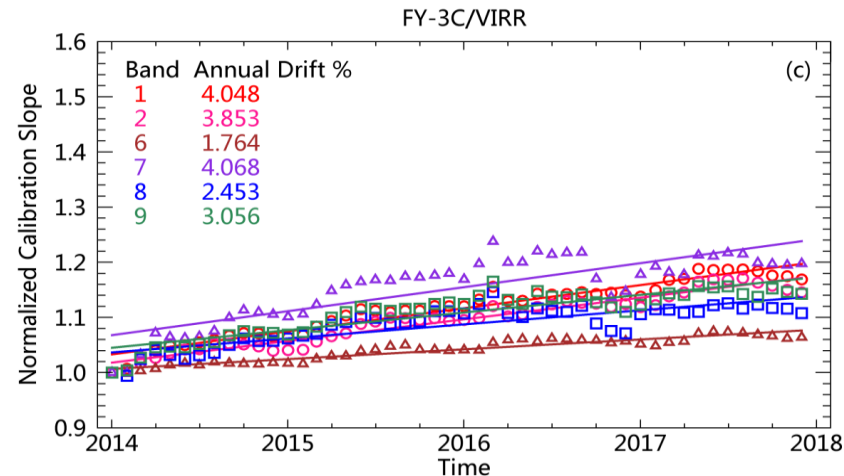
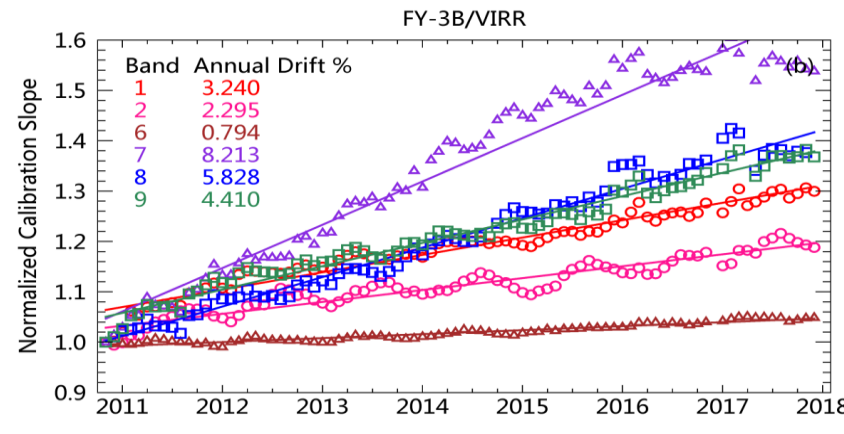
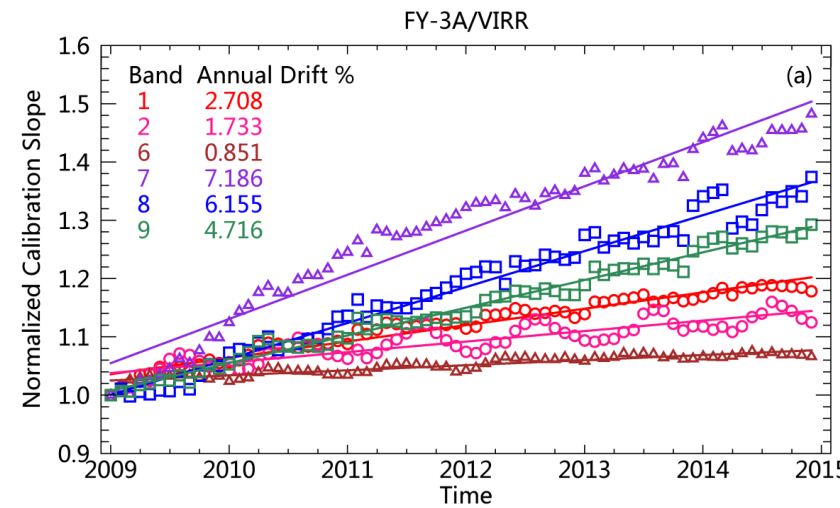
(Courtesy of Na Xu et al. , 2018)

FY-3A~3C VIRR Recalibration

1. VIRR flown on FY₃ satellite series are calibrated used a consistent approach.
2. Comparison between the solar reflectance data from VIRR onboard different FY₃ satellites before and after performing consistent calibration is presented.



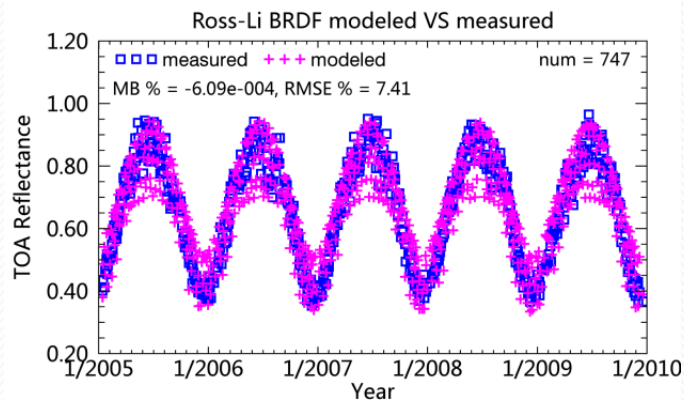
(Courtesy of Ling Wang et al., 2018) [Satellite Calibration Meeting on M](#)



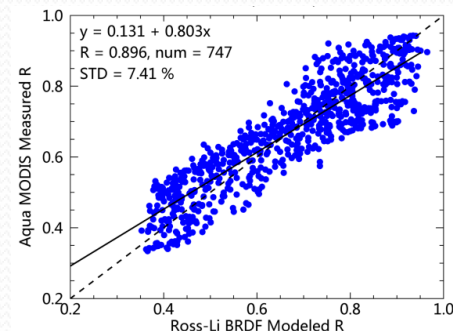
Tibet Glaciers TOA BRDF

Model selection

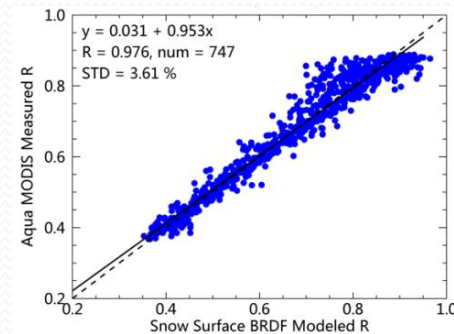
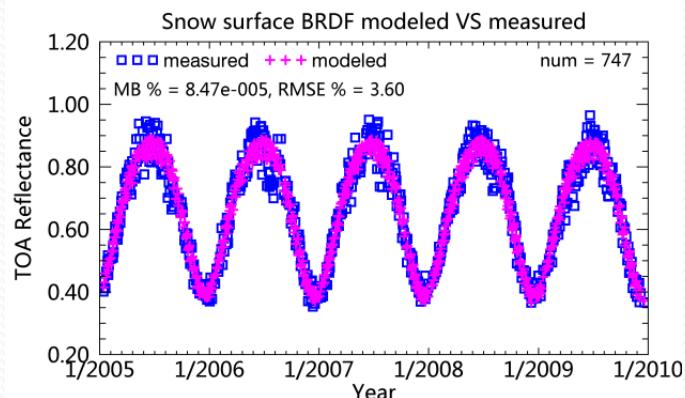
Ross-Li



Simulation and Observed

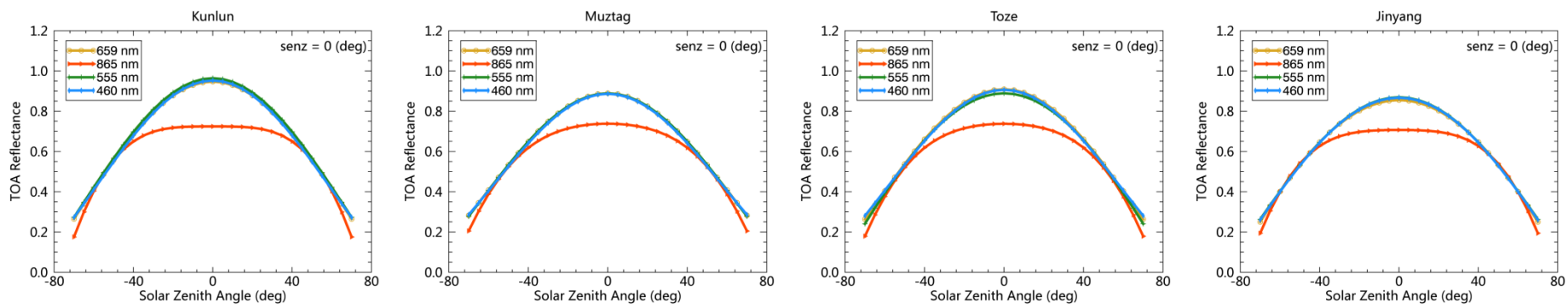


Snow-surface

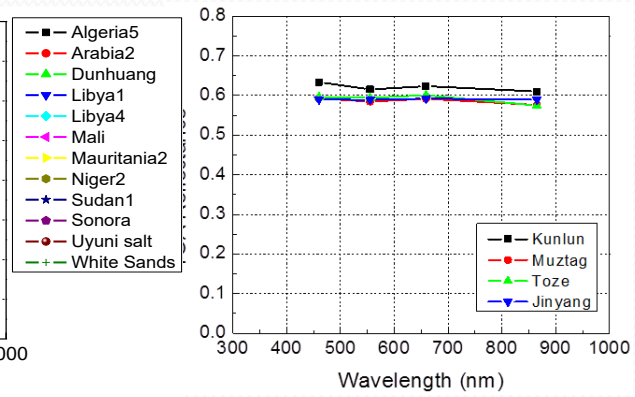
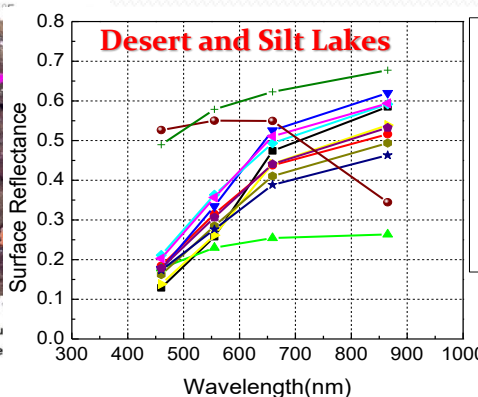
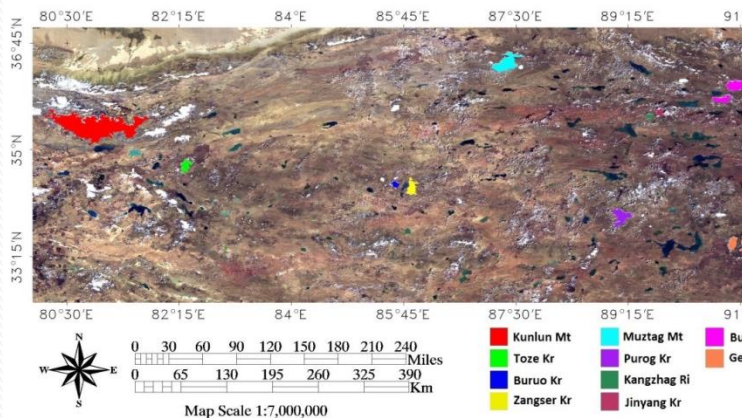
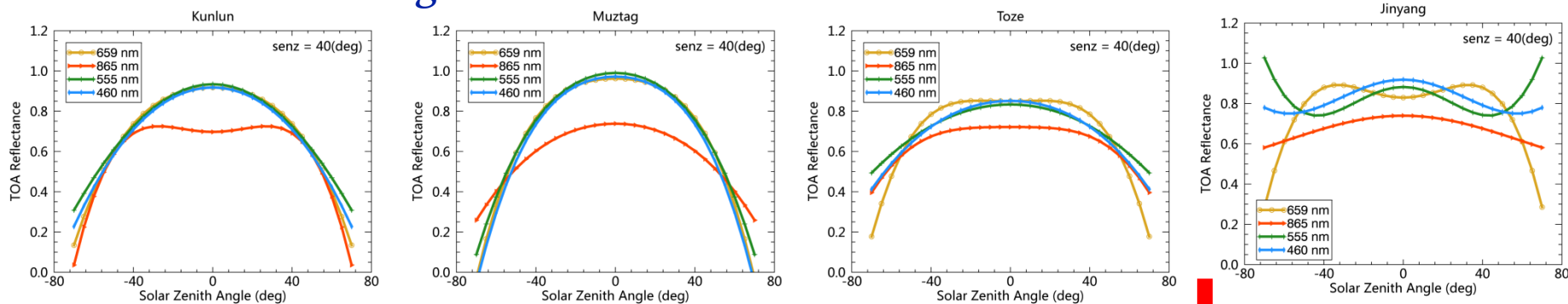


- Snow surface model has smaller bias than Ross-Li model with MODIS observation
- snow surface has smaller than 5% (~90% samples), but Ross-Li is near 10%

✓ Nadir looking



✓ Off-Nadir looking



GSICS/IVOS

2nd Lunar Calibration Workshop

November 13-16, 2017 Xi'an, China



GSICS/IVOS

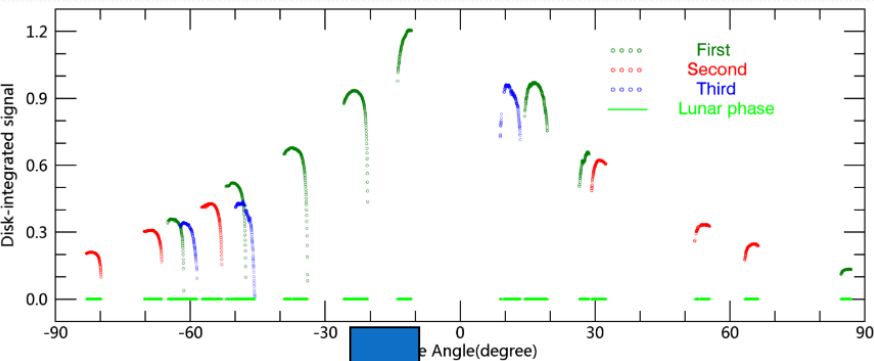
Lunar Calibration Workshop

2nd November 13-16, 2017 Hilton Garden Inn, Xi'an, China

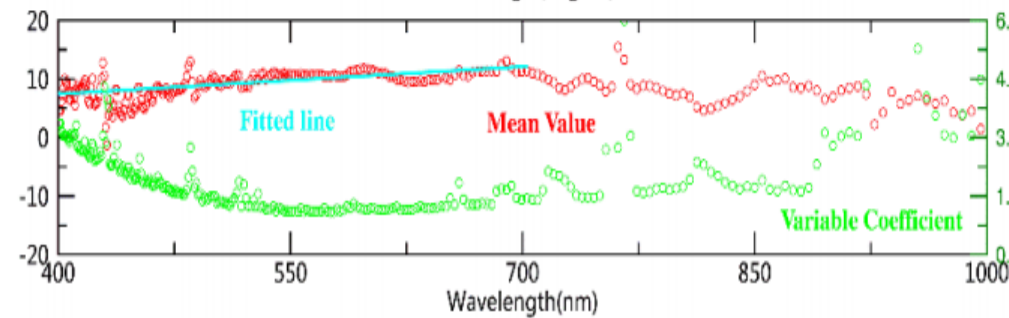
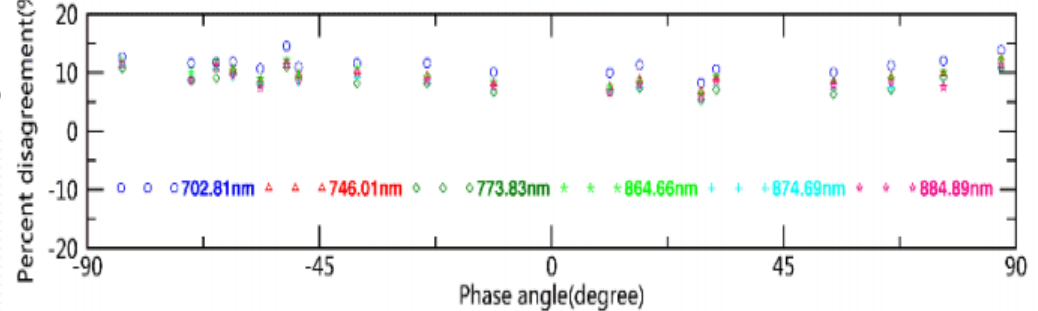
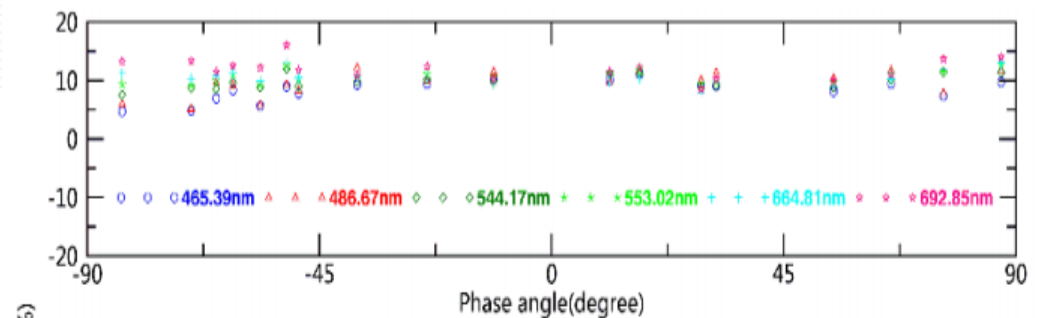
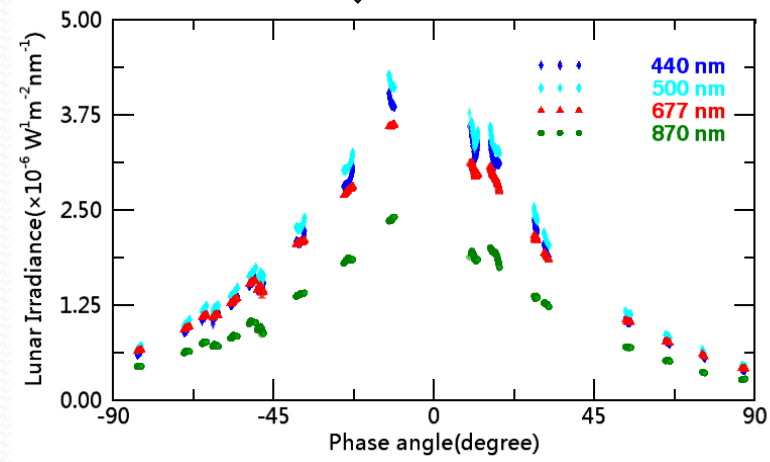
Partners:

- National Space Meteorological Center, China Meteorological Administration (NSM/CMA)
- Wuhan Institute of Optics and Precision Mechanics, Chinese Academy of Sciences (WIO/CMAS)
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)
- United States Geological Survey (USGS)
- National Oceanic and Atmospheric Administration (NOAA)

Ground-based Lunar Data processing and comparison with models



Atmosphere correction



Lunar observations in Lijiang:

Absolute: 7-12%, shape ~Mean value

Relative: 1-3% ~Variable coefficient

ROLO Over Time

(Courtesy of Yang Wang et al., 2018)



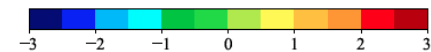
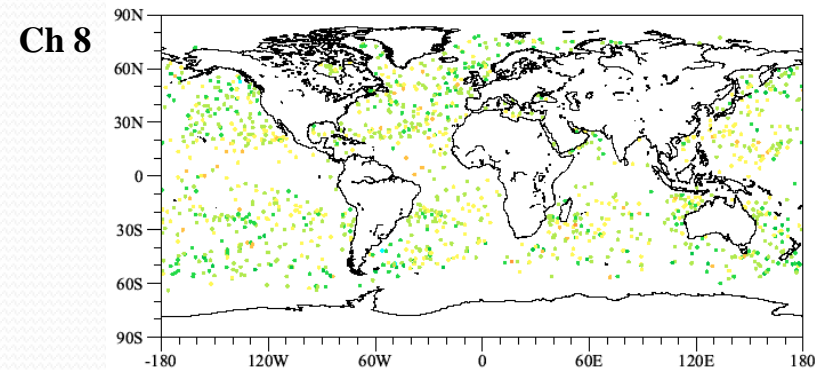
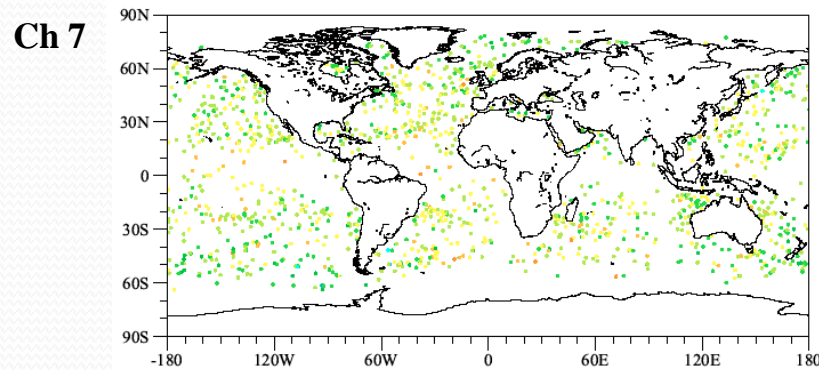
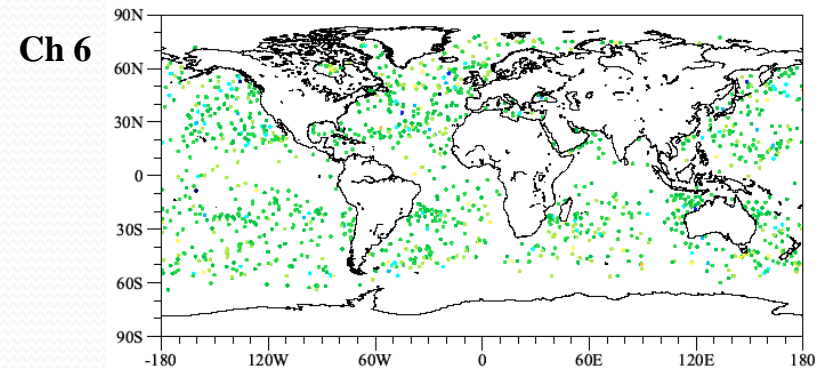
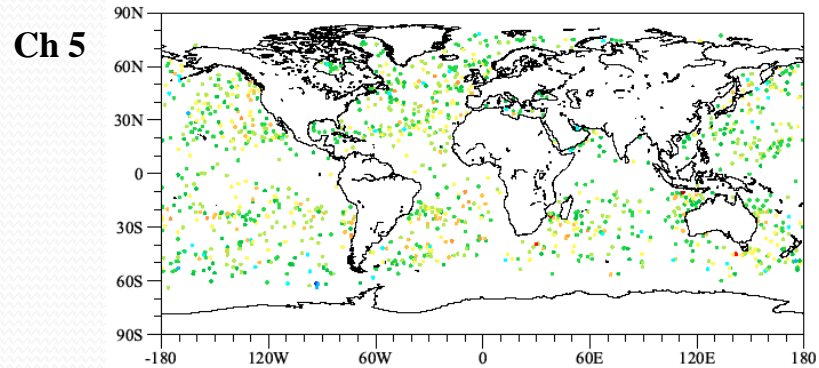
CMA Lunar observation activities

- ❑ CMA is leading an important activity in collaboration with other institutes from the Chinese Academy of Science on the development of new instruments and dedicated ground-based lunar measurement campaigns.
- ❑ The objectives are to develop new lunar calibration models both in irradiance and in radiance with a significantly reduced level of uncertainties and to achieve traceability to SI standards. Several campaigns took place in 2015, in 2016 and more recently in 2017-2018.
- ❑ The current outcome of those campaigns were presented together with the foreseen future activities. New measurement campaigns are planned, with greater capabilities (automated acquisitions, broader spectral coverage and long time series for instance).
- ❑ Measurements from space are also part of CMA's future developments.

Use of FY-3C/GNOS Data for Assessing Sounders



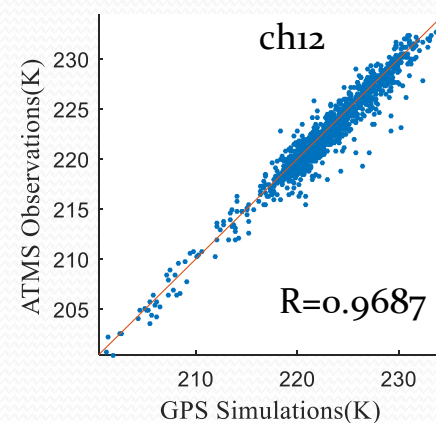
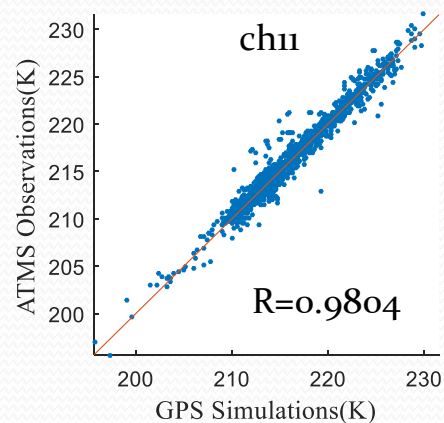
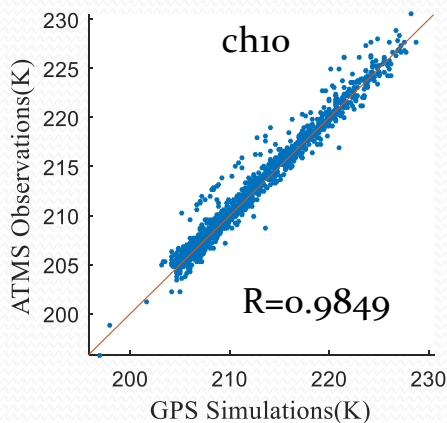
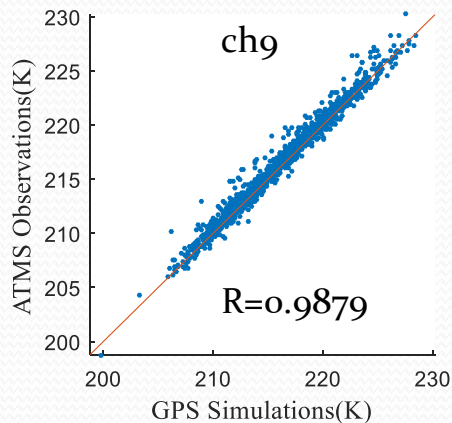
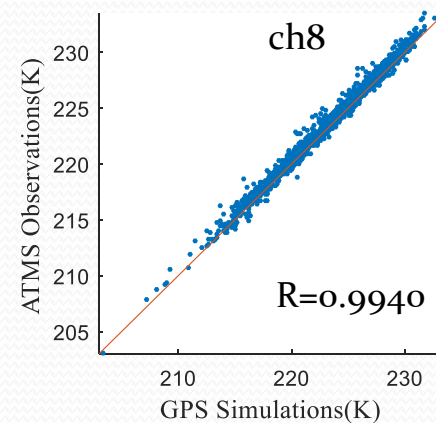
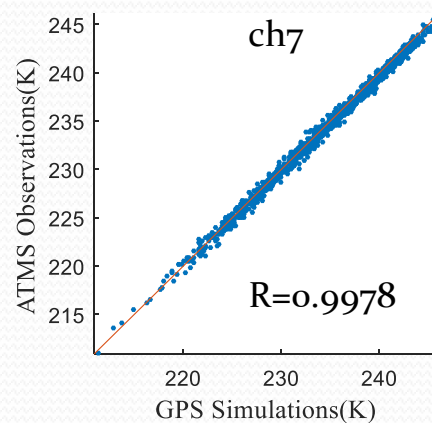
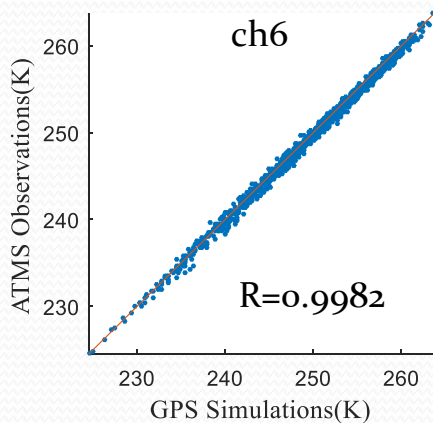
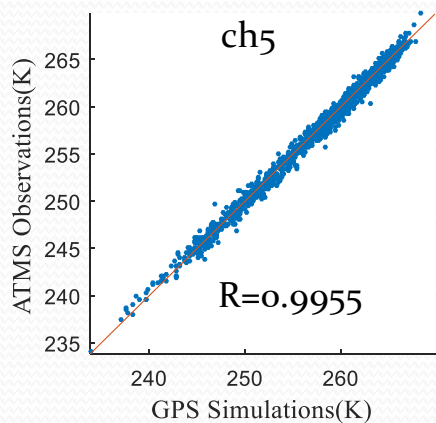
Global Distribution of $O^{(Obs)} - B^{(GNOS)}$ (Channels 5-8)



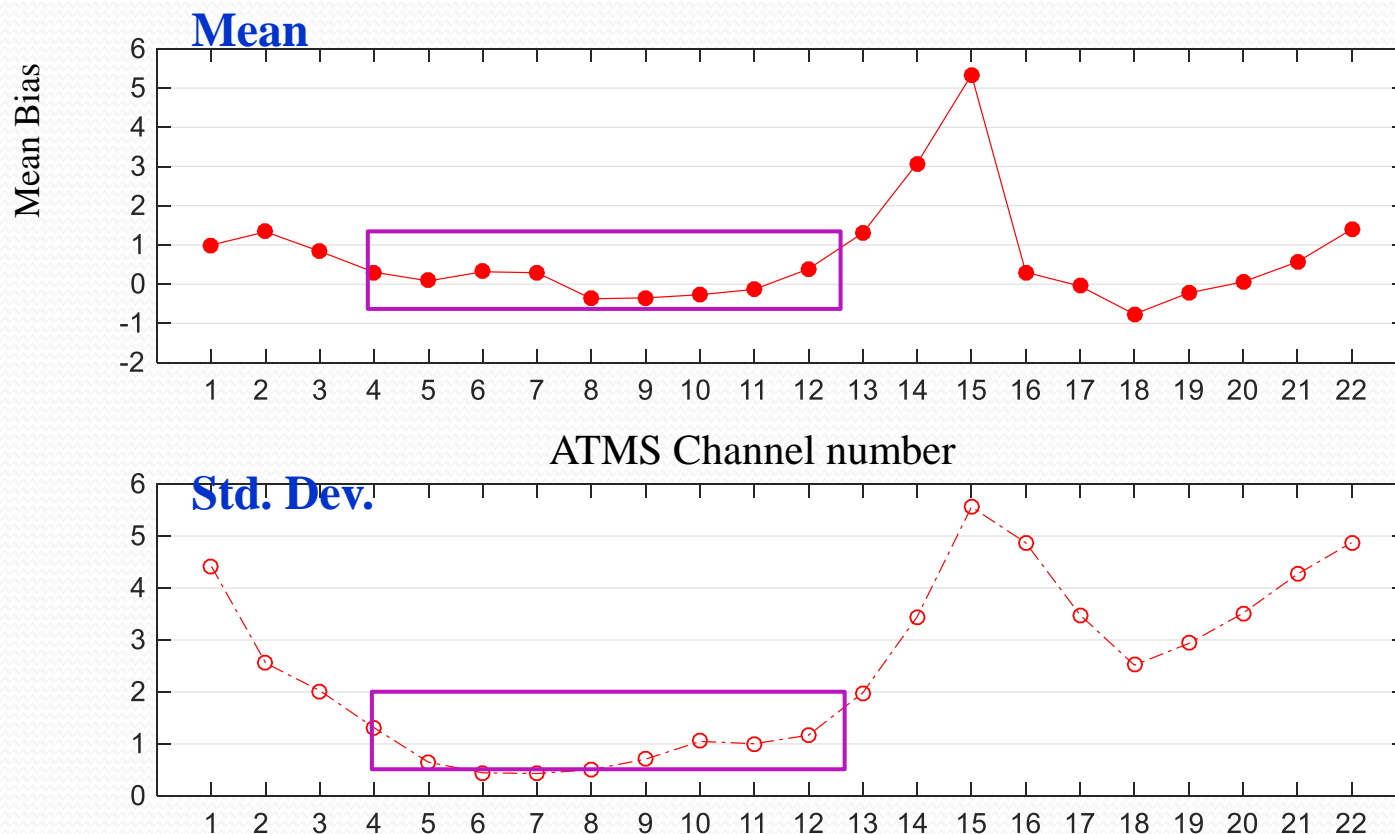
ATMS global bias is quite uniform and small, less than 0.5K



Scatter Plots of $O^{(Obs)} - B^{(GNOS)}$ (Channels 5-12)



ATMS Mean Bias and Standard Deviation



While brightness temperatures at Suomi ATMS 22 channels are simulated, the results for those channels affected by water vapor and surface emission are less reliable since RO profiles are less accurate. If we trust GPSRO as an absolute standard, the TDR bias must be zero or slightly negative.

Data Group: CMA GPRC Website Update

- ❑ Reviewed by GDWG Chair during 2017 annual meeting
- ❑ Fix error links, new webpage online <http://gsics.nsmc.org.cn>
- ❑ CMA GRWG: Content provider
- ❑ CMA GDWG: Website construction and operator
- ❑ Integrated into NSMC Web Portal, Servers operated by NSMC IT Dep.



CMA GSICS Website Review Results

Review Result:



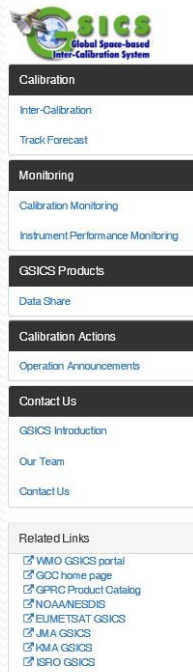
To fix:

- 2, NOAA/NESDIS Link is broken (<https://gsics.nesdis.noaa.gov/wiki/GPRC/WebHome>)
- 2, JMA GSICS link is wrong (<http://ds.data.jma.go.jp/mscweb/data/monitoring/calibration.html>)
- 2, No KMA GSICS link (<http://nsmc.kma.go.kr/html/homepage/en/gsics/gsicsMain.do>)
- 2, ISRO GSICS link is missing (http://122.252.237.243/GSICS_ISRO/)
- 4, Add links to EUMETSAT and NOAA GSICS collaboration servers.
- 7, Add link to Product Catalog (<http://www.star.nesdis.noaa.gov/smcd/GCC/ProductCatalog.php>)
- 8, Add link to GCC home page (<http://www.star.nesdis.noaa.gov/smcd/GCC/index.php>)



For discussion / Comment:

- 3, not sure where the bias monitoring graphs are or look like.
- 6, <http://gsics.nsmc.org.cn/documents>Actiontoexecute.action> available, need checking
- For the English website, please use English for News, CAL update.
- Please ensure the Chinese version is also updated where relevant.



GSICS Introduction

GSICS Processing and Research Center in CMA

— GSICS is one of the space components of the World Meteorological Organization (WMO). Its mission is to provide users with high-quality and inter-calibrated measurements from operational satellites. Please see the GSICS central homepage operated by NOAA/NESDIS in the U.S. for more details. [National Satellite Meteorological Center \(NSMC\)](#) under China Meteorological Administration (CMA) contributes to GSICS as a GSICS Processing and Research Center (GPRC) for the Fengyun series Meteorological Satellites including Geostationary FY-2X series and polar-orbiting FY-1X/3X series.

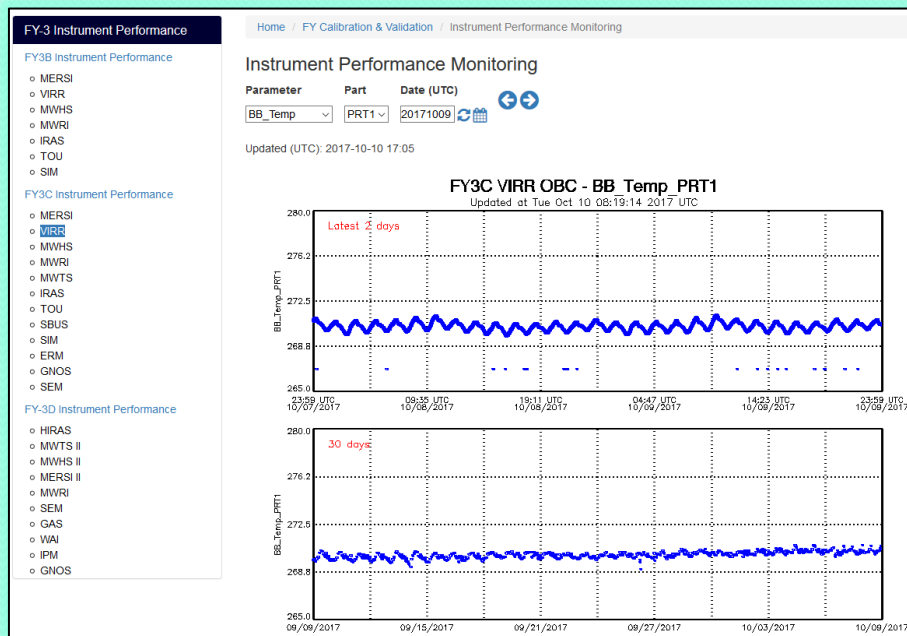
GSICS Inter-Calibration for FY-2X

— Within the GSICS framework, FY-2X infrared data are operationally compared with those from high-spectral-resolution sounders, such as the AIRS equipment on the AQUA satellite and the IASI instrumentation on the METOP satellite. CMA GSICS Processing and Research Center (GPRC) established GSICS GEO-LEO IR operational routine which adjusted JMA GSICS codes to the interface of the normal FY-2C/2D L1 data and their spectral response function (SRF) files. This operational processing begun in September, 2009 and provides [the real-time result on web](#). JMA spectral compensation method is also used for spectral gap filling of hyper sounders AIRS and IASI (Tahara, 2008; Tahara, 2009). IASI data is ordered and downloaded from NOAA CLASS, AIRS data from NASA GES DISC. GSICS GEO-LEO IR ATBD of CMA is almost same as JMA (Hirono, 2009) except for some collocation criteria. The baseline [collocation algorithms](#) used in this inter-calibration are determined by the GSICS research working group (Wu, 2008). To compare data between FY-2C/2D and hyper sounders, the information simultaneously observed is first collocated.

New Contents on CMA GPRC Website

- Instrument Performance Monitoring

- Instrument Status



Satellite Status

Home / FY Calibration & Validation / Satellite Status

FY Operational Satellite Status
Updated: 2017-05-04 08:31 (UTC)

Type	Satellite	Status
LEO	FY-3C	Operational with degraded performance
	FY-3B	Operational
GEO	FY-2G	Operational
	FY-2F	Operational
	FY-2E	Standby

Legend

Color	Meaning
GREEN	Operational or capable of operation
YELLOW	Operational with limitations or standby
ORANGE	Operational with degraded performance
RED	Not operational
BLUE	Functional, turned off
BLANK	No Status Reported

FY-3C Status

Description

Acronym	FY-3C
Full Name	Feng-Yun-3C
Altitude	836 km
ECT	02:00 desc (UTC)
Launch Date	2013-09-23

Payload Status

Acronym	Full Name	Status	IPM
MERSI-1	Medium Resolution Spectral Imager - 1	Functional, turned off	OBC
VIRR	Visible and Infra-Red Radiometer	Operational	OBC
MWHS-2	Micro-Wave Humidity Sounder - 2	Operational	OBC
MWRI	Micro-Wave Radiation Imager	Operational	OBC
MWTS-2	Micro-Wave Temperature Sounder - 2	Not operational	OBC

Look! CMA GSICS team!





Summary

- Only one sentence:
 - 2017 and 2018 are very busy for us! Thank everyone' s contribution to CMA GSICS

Thanks!



Email: huxq@cma.gov.cn

Tel: 68407463

Cell phone: 17710267179

National Satellite Meteorological Center, CMA