



CMA Agency Report in 2021

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CMA/NSMC

GSICS Annual WebMeeting, March 29, 2021



Presentation Overview

- ❖ Summary of Agency's GSICS Activities, Action & Achievements
- ❖ Agency's support to GDWG Activities
- ❖ Agency's support to GRWG Activities
- ❖ Agency's Instruments Updates & Planned launches (LEO/GEO/MEO) – relevant to GSICS
- ❖ Level 1 Reprocessing Activities



Summary of Agency's GSICS Activities, Action & Achievements

- ❖ **FY-2X, FY-4A and FY-3D instrument Cal monitoring:**
 - GEO-LEO, LEO-LEO for operational calibration monitoring
 - Add FY-4A AGRI & GIIRS monitoring system.

- ❖ **Prelaunch preparation for FY-3E and FY-4B:**
 - TVAC test data processing and instrument specification meet evaluation, calibration and validation system development.
 - FY-3E/HIRAS-II, MERISI-LL, WindRAD, MWTS/MWHS, GNOS...
 - FY-4B/AGRI, GIIRS, RSI

- ❖ **Recalibration/Reprocessing for long term FY sensors**
 - Optical imager: FY-1/3 VIRR, FY-3 MERISI, FY-2 VISSR
 - Optical sounder: FY-3/IRAS
 - Microwave sounder: FY-3/MWHS&MWTS
 - Microwave imager: FY-3/MWRI



Current LEO/GEO FY satellite and instruments status on orbit

<http://www.nsmc.org.cn/en/NSMC/Channels/100029.html>

Satellite		Launch	EO instruments					
FY-3B	(L)	2010-11-05	MERSI	VIRR	IRAS	MWTS	MWHS	MWRI
			SBUS	TOU	ERM	SIM	SEM	
FY-3C	(B)	2013-09-23	MERSI	VIRR	IRAS	MWTS	MWHS	MWRI
			SBUS	TOU	ERM	SIM	SEM	GNOS
FY-3D	(Op)	2017-11-15	MERSI	HIRAS	MWTS	MWHS	MWRI	IPM
			GAS	WAI	SEM	GNOS		

➤ Major calibration relevant events in 2020

- FY-4A AGRI reflective solar bands (RSB) calibration correction coefficients updates on 09/09/2020
- FY-3D/HIRAS third heating decontamination was done March, 2021. The degradation of LW and MW1 is recovered after that.

Satellite Status

Op = Operational
 P = Pre-operational
 B = Back-up, secondary
 L = Limited availability

Instrument Status

Operational (or capable of)
 Operational with limitations
 Operational with Degraded
 Not Operational
 Functional, Turned Off

Satellite		Location	Launch	EO instruments			
FY-2F	(L)	112 E	2012-1-13	S-VISSR			
FY-2G	(Op)	105 E	2014-12-31	S-VISSR			
FY-2H	(L)	97 E	2018-06-05	S-VISSR			
FY-4A	(Op)	104.7 E	2016-12-11	AGRI	GIIRS	LMI	SEP



Agency's Instruments Updates & Planned launches

❖ Planned Launches are determined

- FY-4A will be launched at end of May or earlier June, 2021
- FY-3E EM will be launched at earlier July, 2021

❖ Future Plan

- FY-3F AM plan to be launched at first half of 2022
- FY-3G Rainfall mission plan to be launched at second half of 2022
- FY-3H PM plan to be launched at 2024
- FY-4C plan to be launched at 2025



Agency's Instruments Updates & Planned launches

FY-3E Instruments configuration

There are totally 11 instruments onboard FY-3E satellite:

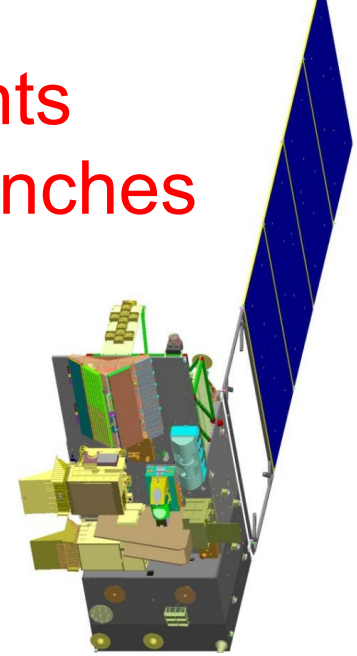
Three completely new instruments including

- Dual-frequency wind radar (WindRAD),
- Solar spectral irradiance monitor (SSIM) and
- Solar X-EUV Imagers (XEUVI).

Seven instruments be improved on the baseline of FY-3D.

- MERSI-LL with Low Light band
- MWTS-3 with more 4 channels
- HIRAS-II with several significant upgrades
- GNOS-II with GNSS-R
- SIM-II involved the international instrument from swiss
- SEM with adding the Magnetic Field Detector (MFD)
- IPM-II with the triple-angles (nightside-nadir-daytime side).

Only one MWHS-2 inherited from FY-3D with no specification change.



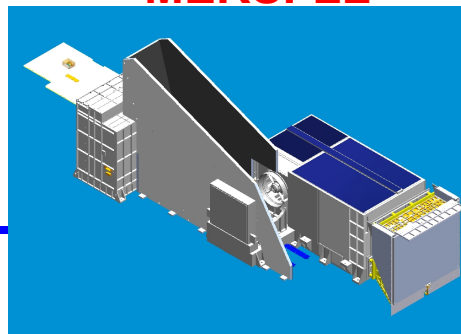
SIM-II



WindRAD



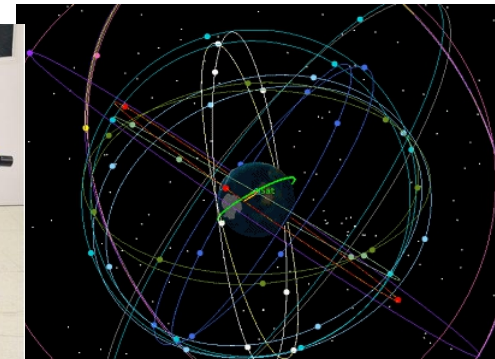
MERSI-LL



X-EUVI



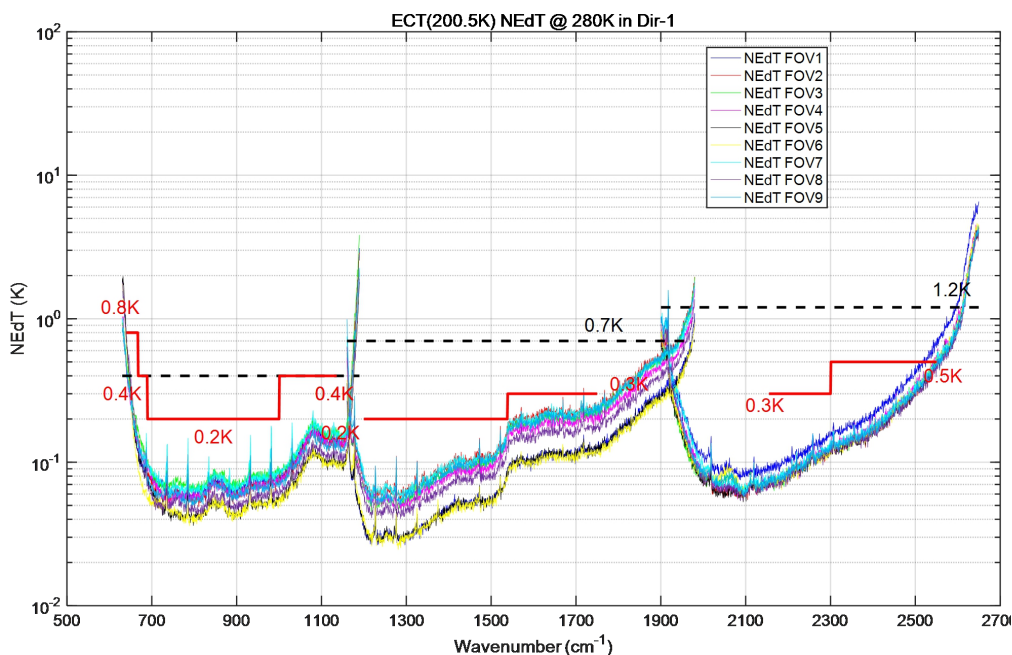
GNOS-II/GNSS-R



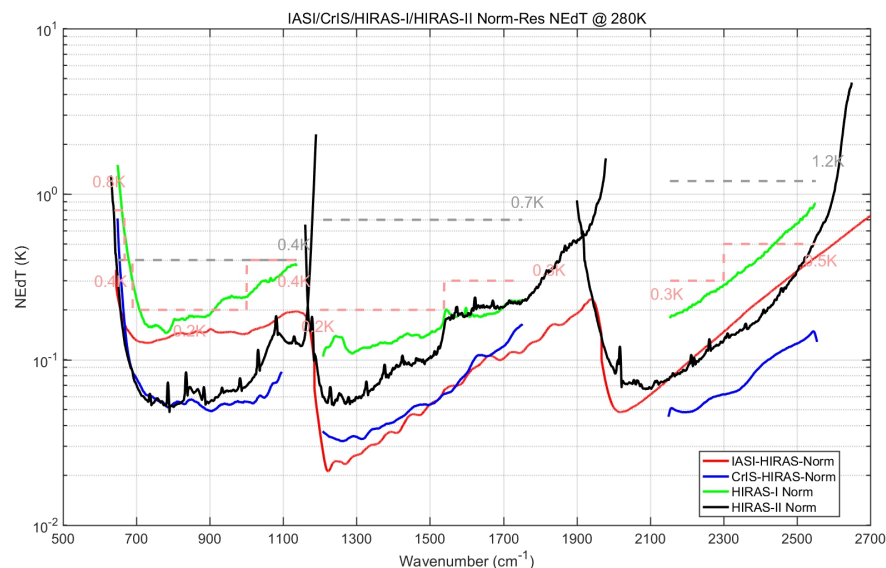


Agency's Instruments Updates & Planned launches

NEdT of FY-3E/HIRAS-II from TVAC



- NEdT of all channels for 3 bands get great improvement from 3D HIRAS and meet specification.
- Sensitivity of HIRAS in LW and SW are comparable to CrIS and IASI respectively.





Agency's Instruments Updates & Planned launches

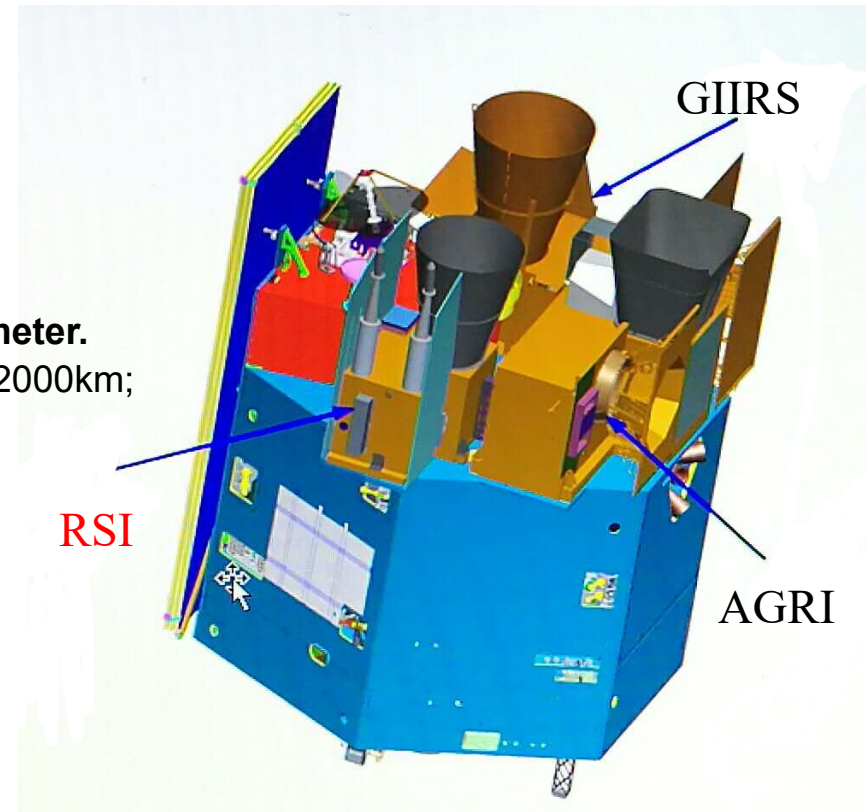
Instruments	FY-4A	FY-4B	FY-4C
(AGRI)	√	√	√
(GIIRS)	√	√	√
(LMI)	√		√
Geostationary Rapid Scan Imager (RSI)		√	

RSI IS experimental multi-spectral **flexible** imaging radiometer.

- ✓ Nominal scenario: 1 min continuous images of 2000km × 2000km;
- ✓ Ground resolution: 0.25km~0.5km(VNIR), 2km(LWIR);
- ✓ True color images of 0.5km from geostationary orbit;
- ✓ Full color band of 0.25km to perform star observations to determine the absolute LOS.

Channel/Band	Spectral (μm)	IFOV(μrad)	Focal Plane Array	
VNIR	1	0.45~0.75	7	2048×1
	2	0.445~0.495	14	1024×1
	3	0.52~0.57	14	1024×2
	4	0.62~0.67	14	1024×1
	5	1.371~1.386	14	1024×1
	6	1.58~1.64	14	1024×1
LWIR	7	10.3~12.5	56	256×4

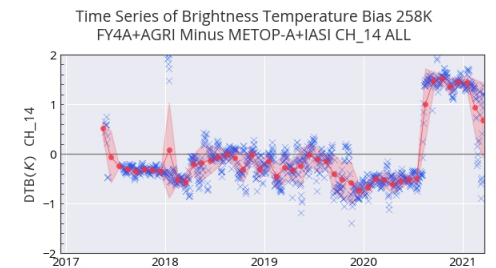
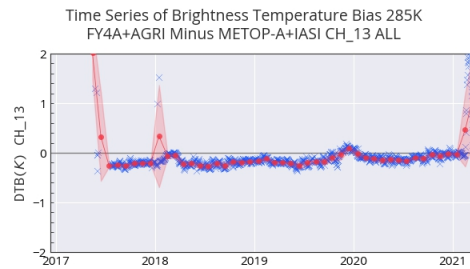
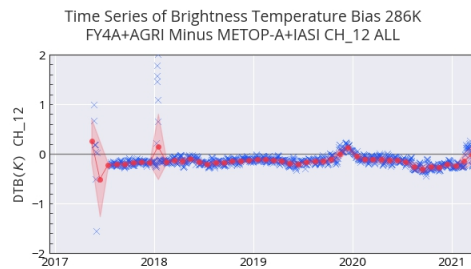
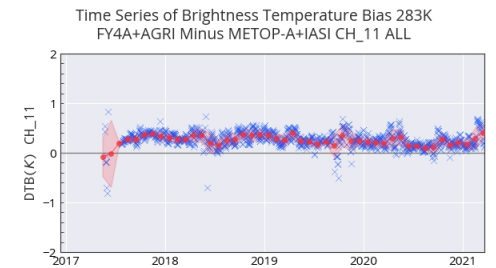
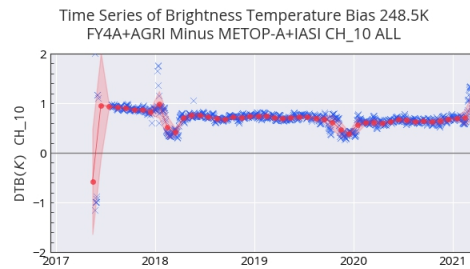
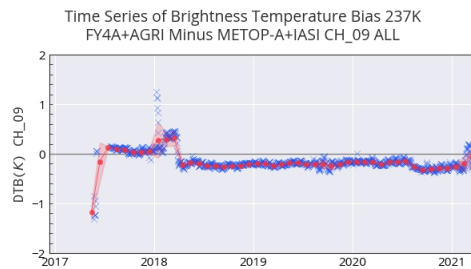
Profile of FY4B





FY-4A/AGRI IR Calibration Performance

	CH8_3.8 (286K)	CH9_6.25 (237K)	CH10_7.1 (248.5K)	CH11_8.5 (283K)	CH12_10.8 (286)	CH13_12.0 (285)	CH14_13.5 (258)
IASI-A	-4.1529	-0.2204	0.6307	0.1958	-0.1723	-0.0947	0.2434
IASI-B	-3.8784	-0.2355	0.6207	0.1901	-0.1904	-0.1265	0.1853



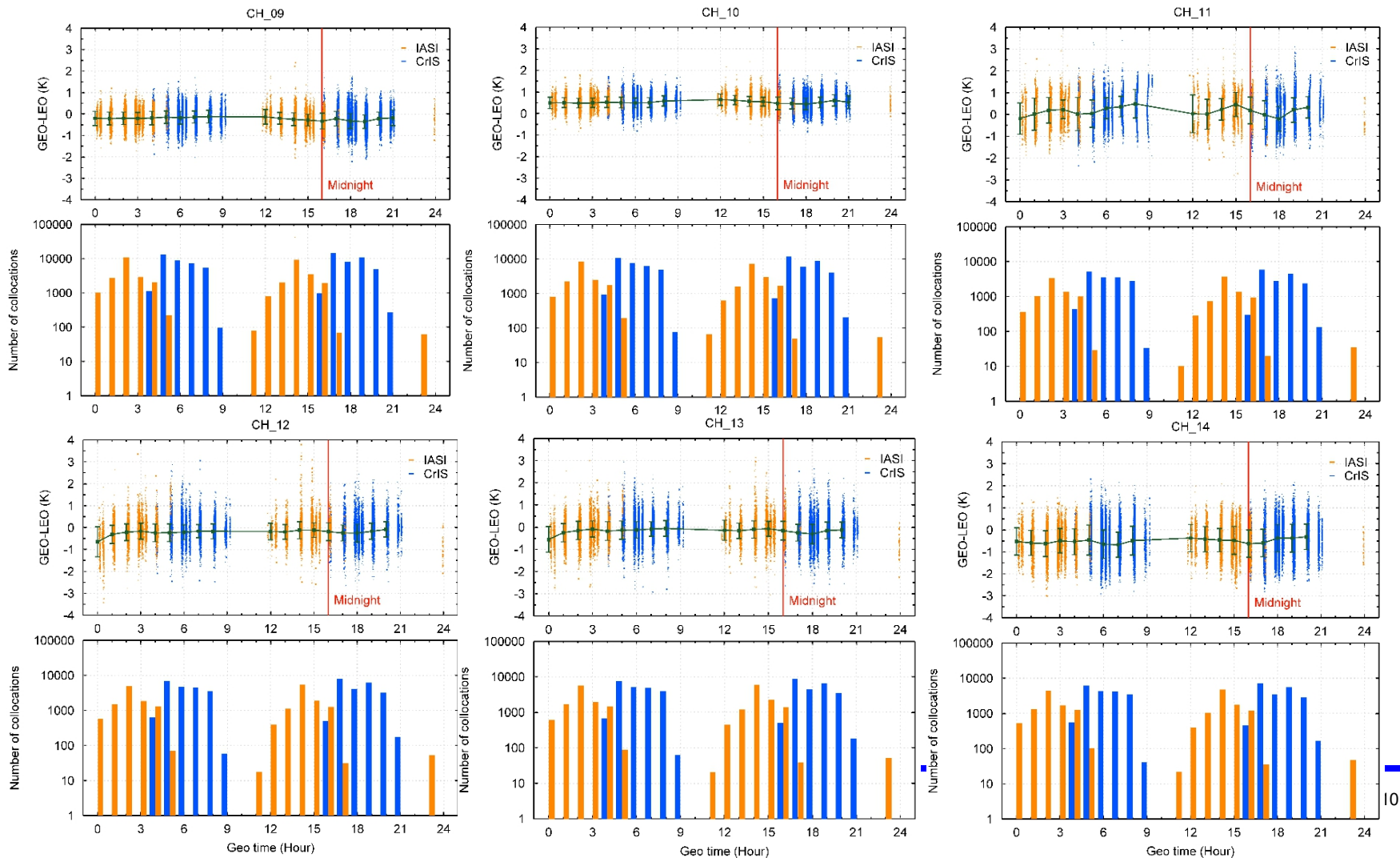
- Tb bias are less than 0.3 k (operation phase) except ch8 and ch10, No strong seasonal variation;
- Calibration parameter of CH14 was updated in Aug. 2020 and large bias appear;



Highlight FY-4A/AGRI IR Rad. Calibration Performance

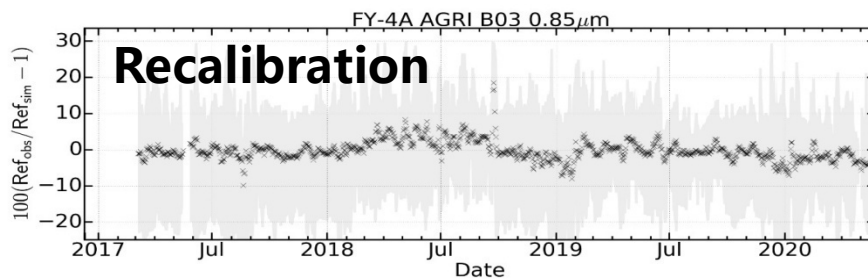
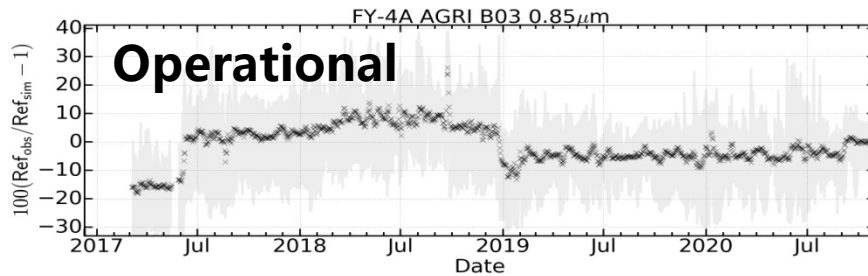
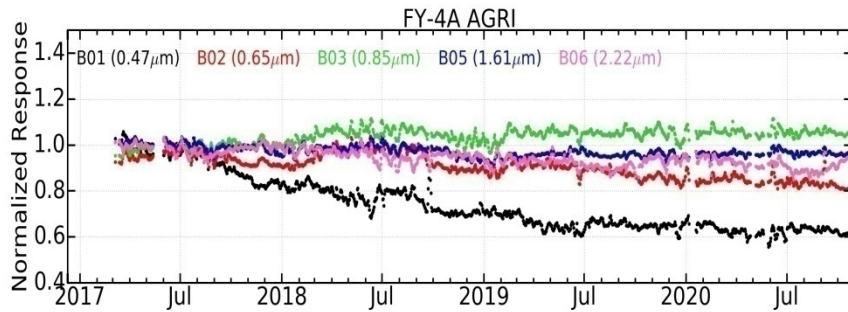
➤ Diurnal Variations of Bias

There is no significant diurnal variation seen in FY-4A AGRI



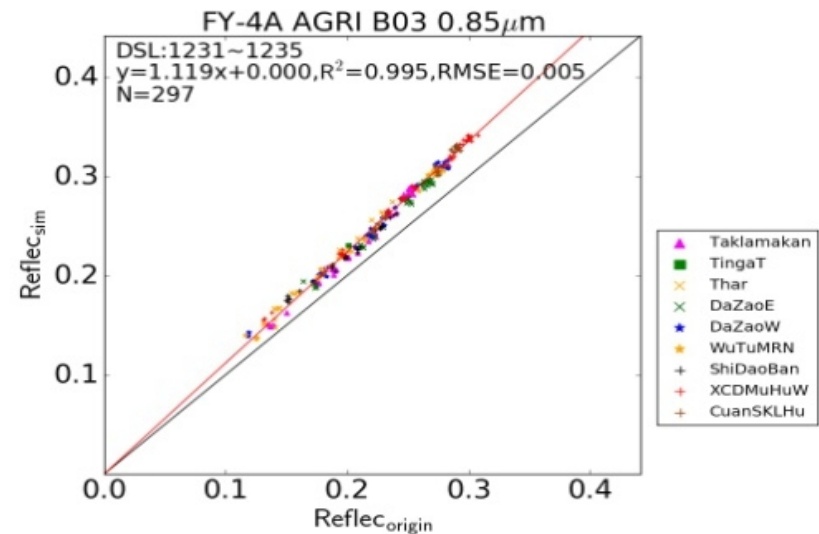


FY-4A AGRI RSB calibration updates



AGRI RSB radiance relative bias before and after updates

after	通道 1	通道 2	通道 3	通道 5	通道 6
mean	1.358	0.273	-0.258	-0.927	0.523
std	5.963	5.563	5.269	4.080	6.064
before	通道 1	通道 2	通道 3	通道 5	通道 6
mean	1.358	-19.067	-5.260	-5.901	-17.047
std	5.963	4.421	4.993	3.835	4.742

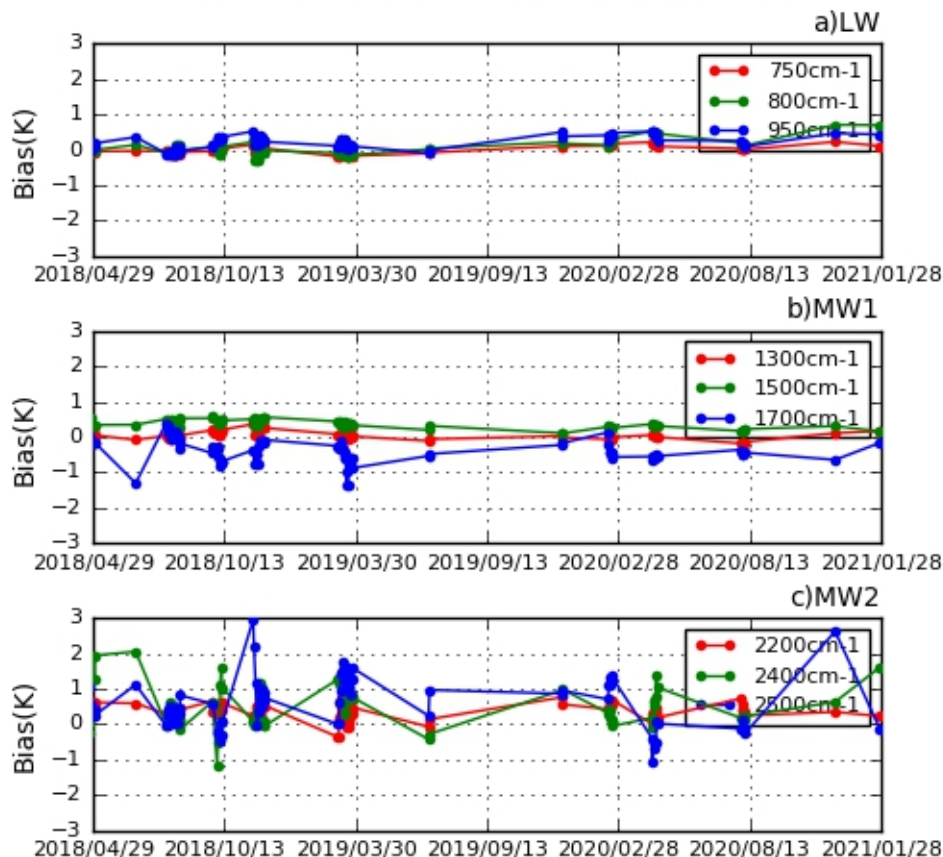


- B1 annual degrade 14%;
- After calibration update, relative bias less than 2%

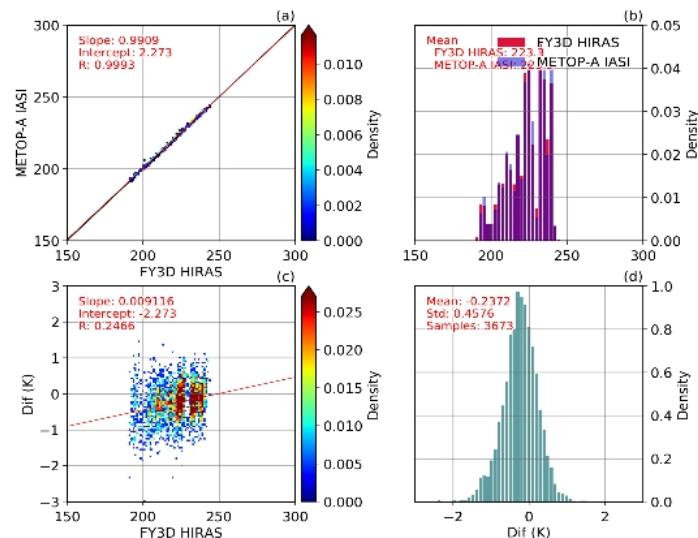


FY-3D/HIRAS vs IASI

HIRAS-IASI/A bias in Different Channel



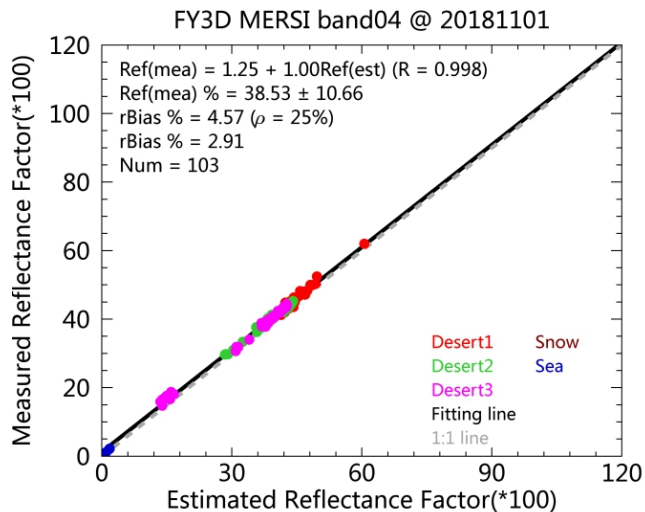
Correlation Analysis of Bright Temperature
FY3D_HIRAS_METOP-A_IASI_src 681.25nm



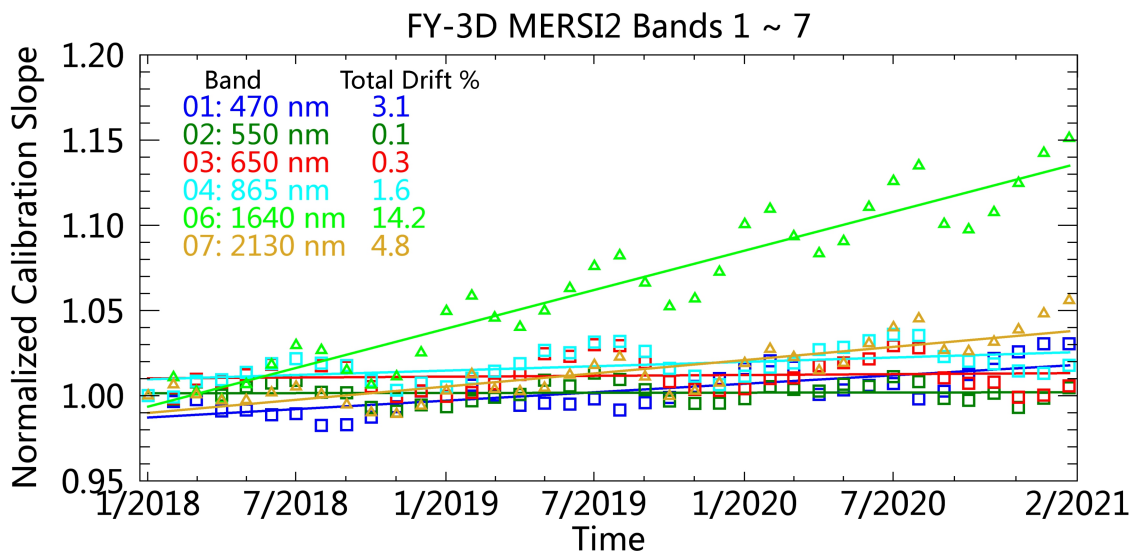
- FY-3D/HIRAS maintained stable operational status.
- Conducting the 3rd gas decontamination operation in 15~30 Mar, 2021.



FY-3D/MERSI-II Reflective Solar Bands calibration bias



- Based on stable sites RTM to monitor calibration bias.
- Calibration biases of 15 bands are less than 3%, other 4 channels exceed 3%: B6-8, B19.



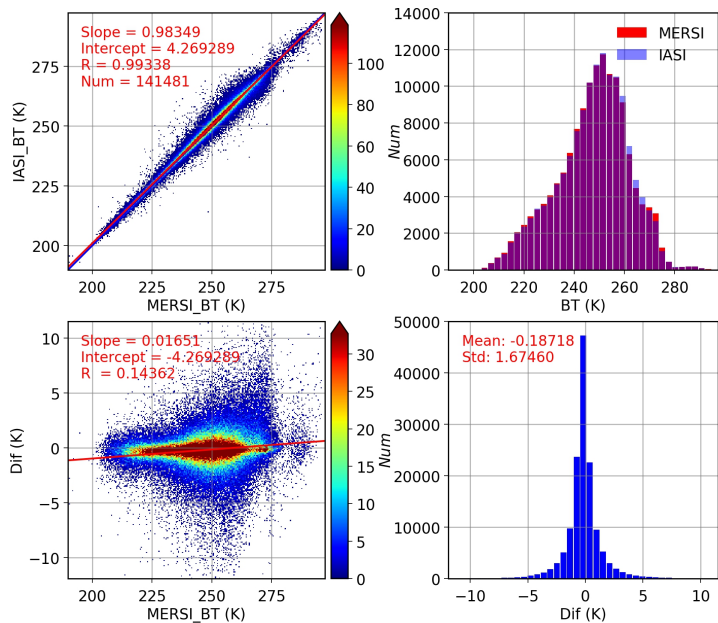
Band	Ch WL	Calibration Bias		Annual Degradation rate
		201902	202002	
1	470	-0.595	-0.103	0.700
2	550	1.532	0.033	0.087
3	650	4.053	0.061	0.370
4	865	2.041	-1.357	0.751
5	1380	--	--	--
6	1640	-4.467	-7.564	4.517
7	2130	-3.323	-5.962	1.332
8	412	-2.345	7.036	3.998
9	443	-1.856	1.667	1.729
10	490	0.458	0.218	0.529
11	555	6.115	-0.596	0.180
12	670	-0.548	0.238	0.235
13	709	1.15	2.046	-0.570
14	746	3.273	0.528	-1.082
15	865	-1.218	0.28	-0.264
16	905	2.591	-0.095	0.712
17	936	1.449	-1.301	0.655
18	940	1.826	0.089	1.546
19	1030	1.416	-4.411	1.908



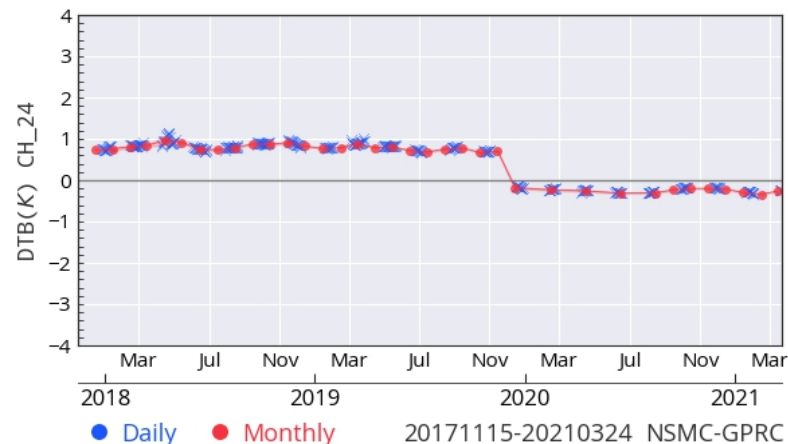
LEO-LEO FY-3D/MERSI vs IASI

Correlation Analysis of Bright Temperature
FY3D_MERSI_METOP-A_IASI_V0-0 CH_24

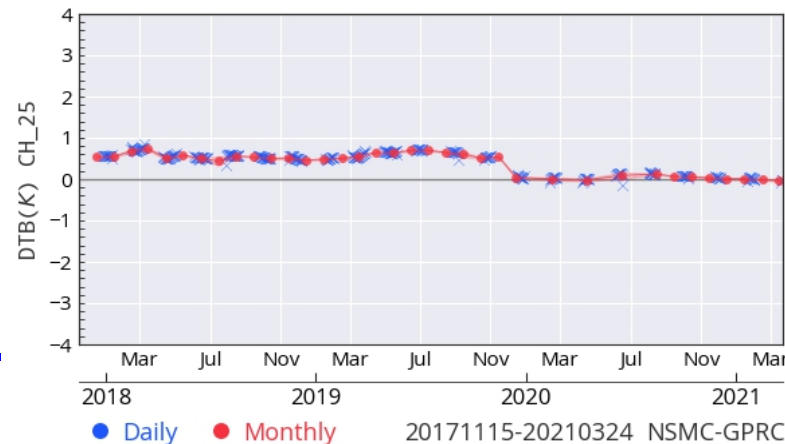
	CH20_3.8	CH21_4.05	CH22_7.2	CH23_8.5	CH24_10.8	CH25_12.0
IASI-B	-0.3760	0.3172	-0.0589	0.2617	-0.3051	0.0062



Time Series of Brightness Temperature Bias 250K
FY3D+MERSI Minus METOP-A+IASI CH_24 ALL



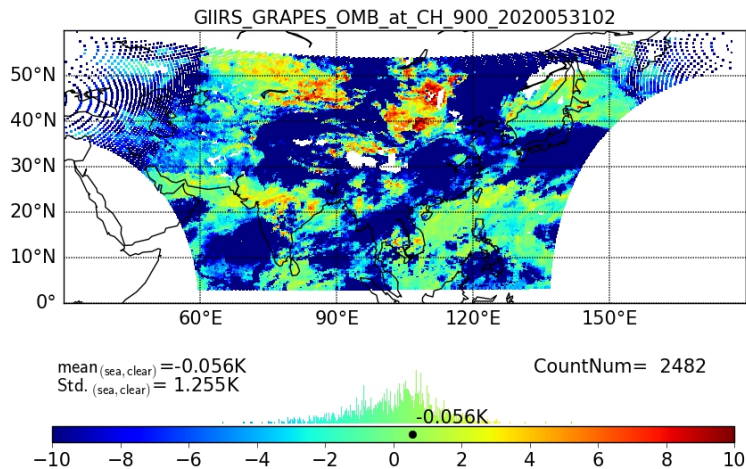
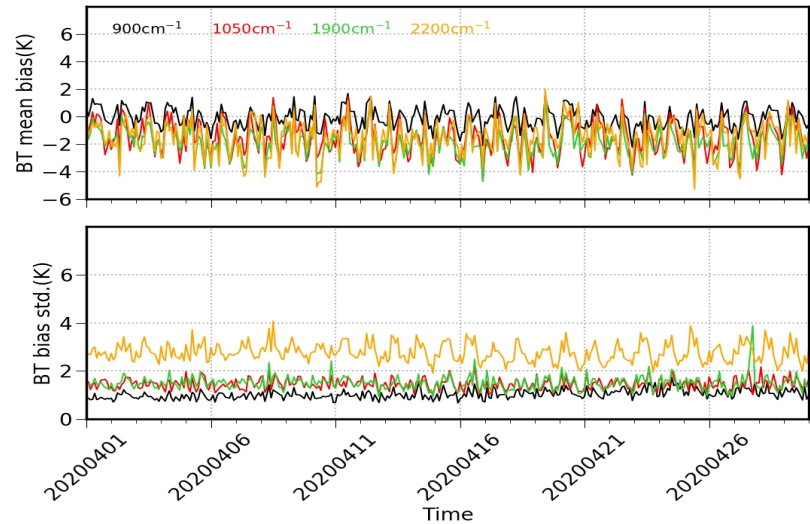
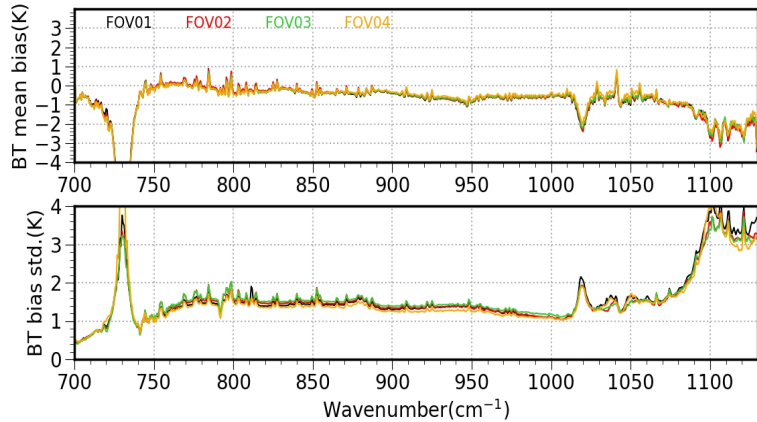
Time Series of Brightness Temperature Bias 250K
FY3D+MERSI Minus METOP-A+IASI CH_25 ALL



- ✓ Establishment of MERSI vs IASI LEO-LEO IR calibration monitoring system ;
- ✓ FY-3D/MERSI biases are less than 0.3K for IR bands after update operation at end of 2019.
- ✓ MERSI is in stable operational status.



GIIRS Calibration monitoring based on O-B



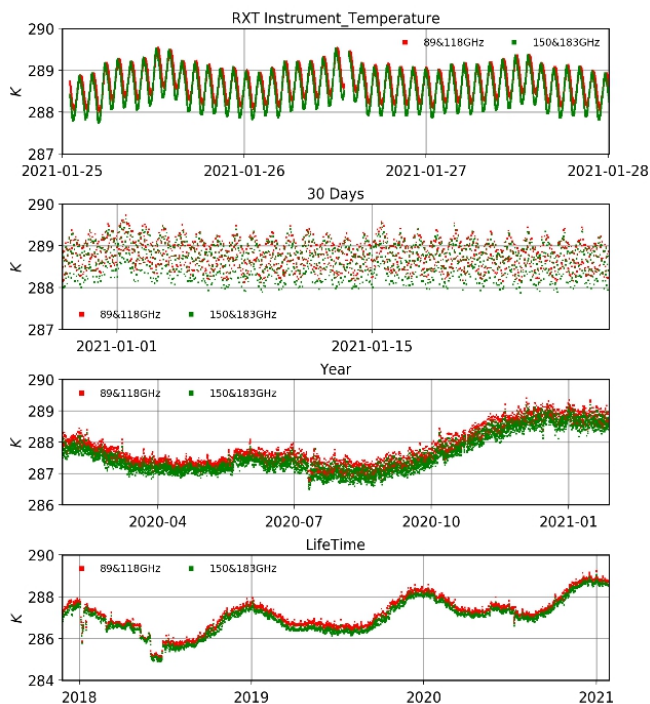
- Add FY-4A/GIIRS into OMB FY satellite operational monitoring system.
- GIIRS calibration biases are within 0.7 K in LW band and 2 K in MW band.
- GIIRS long term calibration biases exhibit diurnal variation.
- Stable Long term monitoring are still in development.



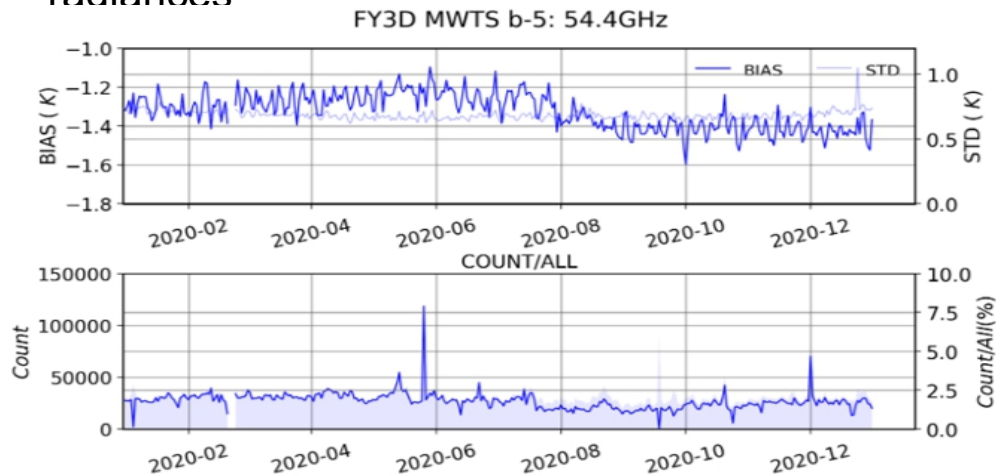
FY-3D Microwave Instrument Status monitoring

❖ Instrument Telemetry parameter monitoring

FY3D MWHS Time Series View For RXT

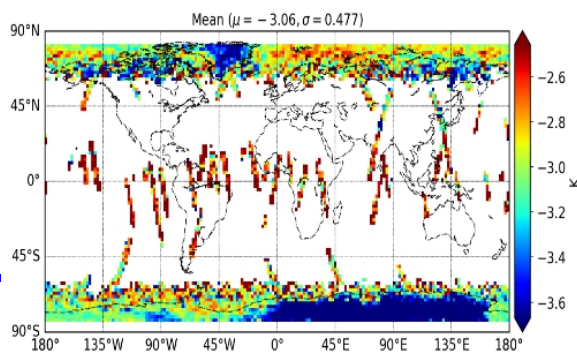


❖ Calibration quality monitoring based on the simulated radiances

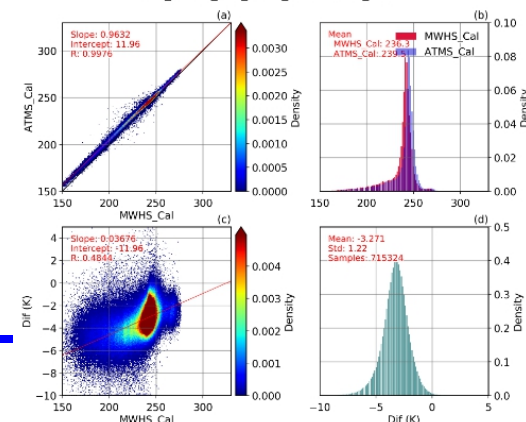


❖ Calibration quality monitoring based on the observations of similar instruments

Spatial Distribution of Bright Temperature Dif (MWHS_Cal vs ATMS_Cal)
FY3D_MWHS_NPP_ATMS_v0-0 183.31_1.8GHz



Correlation Analysis of Bright Temperature
FY3D_MWHS_NPP_ATMS_v0-0 183.31_1.8GHz





Fengyun FCDR ReCAL program



Version	V1 (beta)	V2 (trial)	V3 (formal)
Status	Completed in 2019	Partly completed	To be finished at 2021/12
Main concerns	Lifetime recalibration of each instrument using consistent calibration framework	Focus on the recalibration model improvement to achieve the accuracy and stability	Focus on the inter-instrument consistency, gridded climate dataset

Sensors included:

- **Optical imager: FY-1/3 VIRR, FY-3 MERSI, FY-2 VISSR**
- **Optical sounder: FY-3/IRAS**
- **Microwave sounder: FY-3/MWHS&MWTS**
- **Microwave imager: FY-3/MWRI**

- The beta version (V1) datasets have been finished through the lifetime recalibration of each instrument in 2019.
- At present, the trial version (V2) datasets are finished for MWRI, MWTS and VIRR solar bands, meanwhile others are still ongoing.



FY-3/MWRI FCDR V1/V2

SNO&DD VS. GMI

Operational

Diagram of Bright Temperature Dif (MWRI_Cal vs GMI_Cal)
MWRI_GPM_GMI_V0-0 10.7_TV

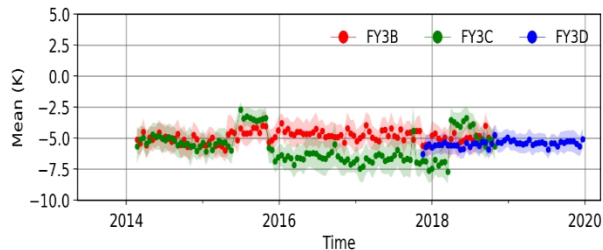


Diagram of Bright Temperature Dif (MWRI_Cal vs GMI_Cal)
MWRI_GPM_GMI_V0-0 18.7_TV

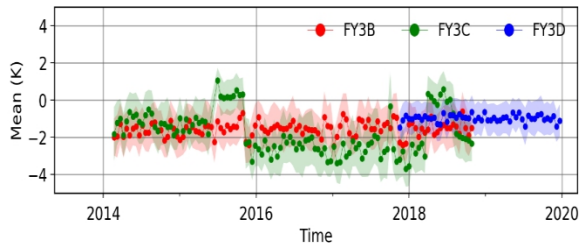
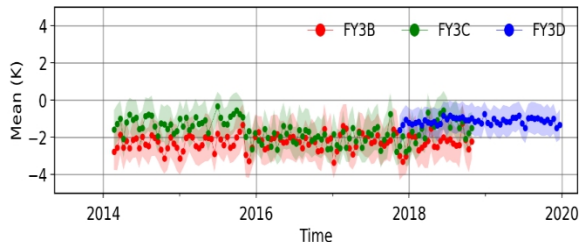


Diagram of Bright Temperature Dif (MWRI_Cal vs GMI_Cal)
MWRI_GPM_GMI_V0-0 23.5_TV



Sensor	Time range
FY-3B/MWRI	2010/11/11-2018/11/30
FY-3C/MWRI	2013/09/29-2019/06/30
FY-3D/MWRI	2017/11/25-present

- V1 and V2 datasets are finished, covering FY-3B/C/D from 2010 to 2019 .
- V2 dataset are processed using a full re-calibration algorithm including hot load reflector emissivity, back lobe of hot reflector, hot load efficiency, cold reflector RFI, and receiver non-linearity correction.

Re-processed V2

Diagram of Bright Temperature Dif (MWRI_Cal vs GMI_Cal)
MWRI_GPM_GMI_V0-1.2 10.7_TV

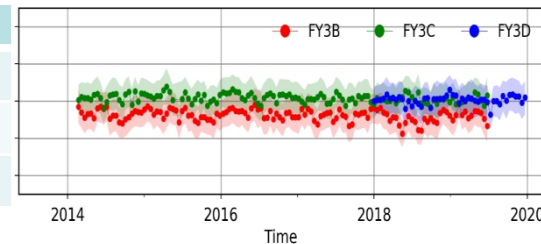


Diagram of Bright Temperature Dif (MWRI_Cal vs GMI_Cal)
MWRI_GPM_GMI_V0-1.2 18.7_TV

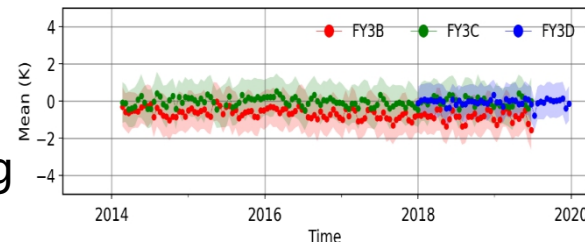
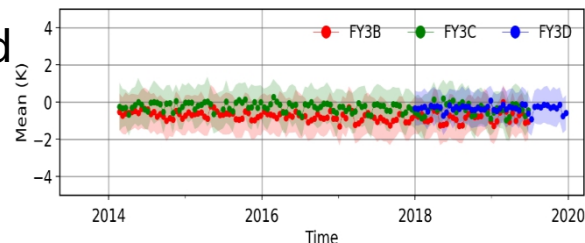


Diagram of Bright Temperature Dif (MWRI_Cal vs GMI_Cal)
MWRI_GPM_GMI_V0-1.2 23.5_TV

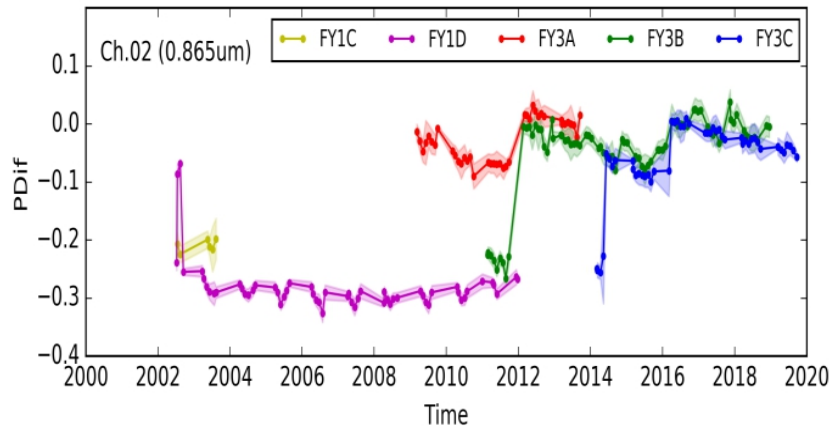
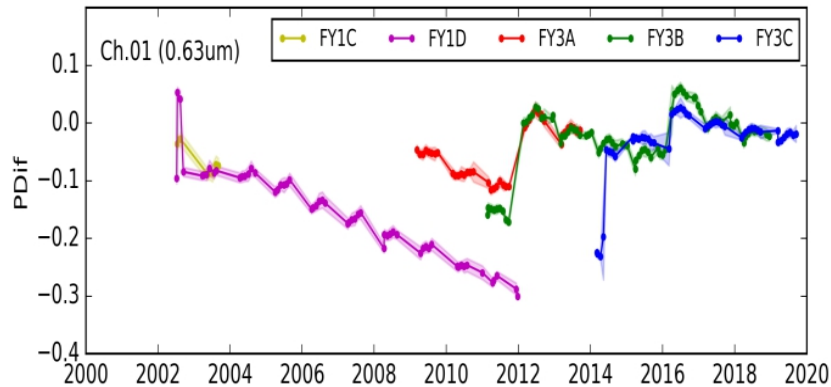




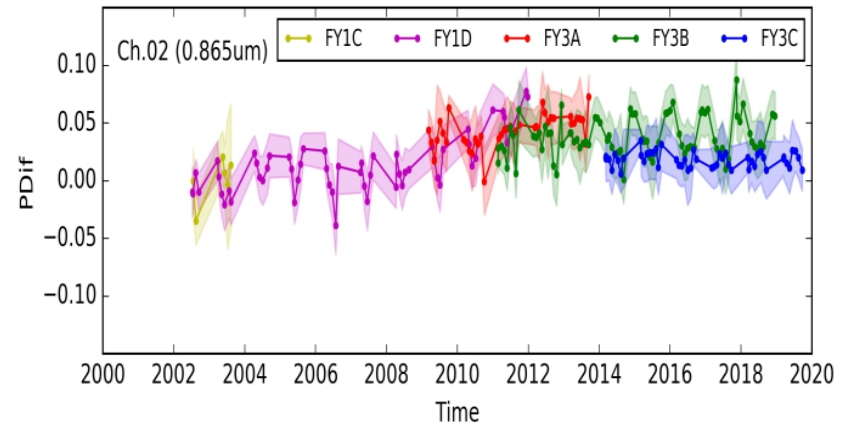
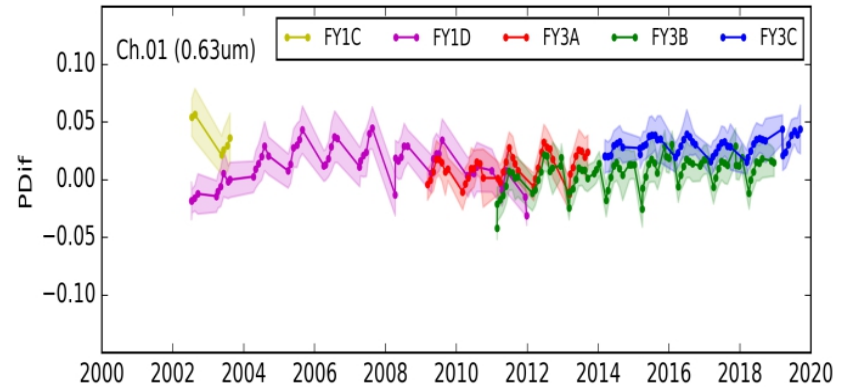
FY/VIRR FCDR V2 (RSBs)

SNO VS. MODIS

Operational



Re-processed V2



- Variation of sensor radiometric response both gradual and sudden degradation is corrected, and the radiometric stability and inter-platform consistency is improved after recalibration.
- Lifetime RMS of the relative difference is within 5% for Ch1, 2, 6, 7, 8, while relatively larger for Ch9 at low signal.



CMA Lunar Measurement Campaign in Lijiang Observatory

Four Instruments: 3 Lunar spectrometer imagers, 1 Hypspectral Lunar photometer

- (1) VisNIR Ground-based Lunar Imaging Spectrometer (GLIS) (2015.12-2020.04-Now)
- (2) ShortWave Infared Lunar Observed Infared Spectrometer (LOIS) (2019.12--Now)
- (3) VNIR **LeSIRB**-Lunar and **Earth Spectral Imager Radiometry Benchmark** (2019.12-Now)
- (4) VNIR-SW Hyperspectral Lunar photometer (2021.03--)

GLIS (400-1000nm)



Hyperspectral Lunar Photometer(400-1700nm)



LeSIRB (400-1000nm)



- LOIS (1000nm-2400nm)



CMA Ground-based Lunar observation Keep Ongoing Since 2015 and More and more Lunar instruments were involved



JiLin-1 Small Satellite Support Space-borne Lunar Imaging

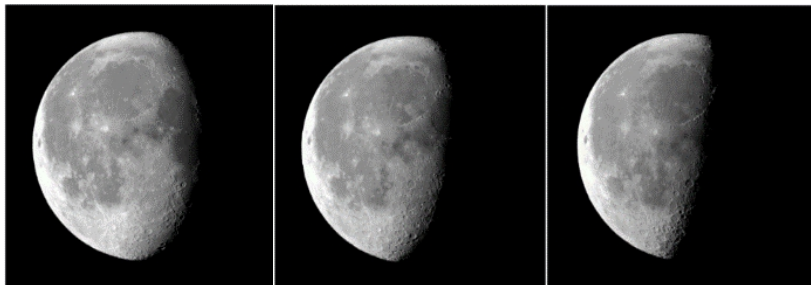
JILIN-01-09/B4 lunar image (559.61nm) June 2019



20190613_50.07° 20190614_37.52° 20190615_25.18° 20190616_12.26°



20190617_1.94° 20190618_11.65° 20190620_34.22° 20190621_45.25°

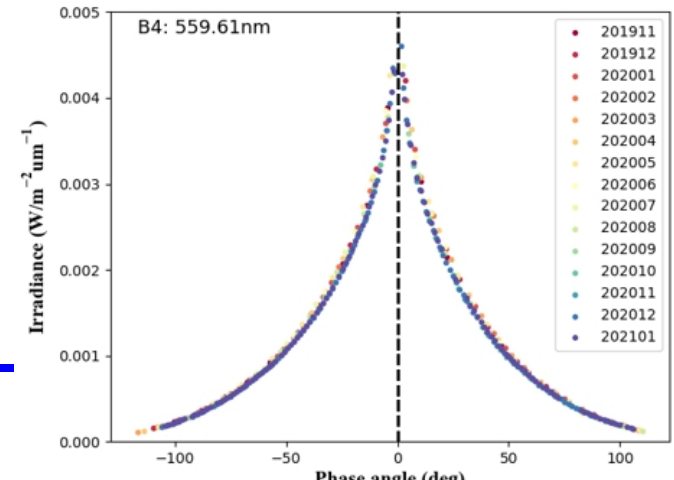
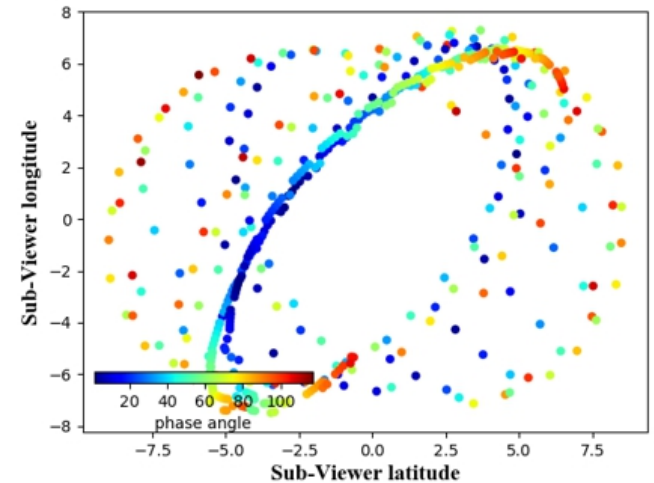


20190622_56.14° 20190623_67.67° 20190624_78.46°

Data_Phase
Angle

(19 bands in Visible to NIR)

JiLin-1 Lunar observation (22 months since April, 2019)





Agency's GSICS Activities, Action & Achievements Summary

❖ CMA presentation title list at GSICS annual meeting 2021 :

Xiuqing Hu	Plenary	<i>GRWG Report</i>
Chengli Qi		<i>CMA Agency report of 2020</i>
QiFeng Lu,		<i>Progress report from MW subgroup</i>
Chengli Qi	IR subgroup	<i>FY-3E/HIRAS-II pre-launch calibration and instrument performance</i>
Hanlie Xu		<i>FY-3/VIRR TIR recalibration</i>
Ling Sun	VISNIR	<i>A Fengyun consistent VIRR calibration record for inheritable solar bands</i>
Jing Wang	Subgroup	<i>Pre-launch analysis of Rapid Scan Imager aboard FY-4B from TVAC test</i>
QiFeng Lu	MW subgroup	<i>Way forward of MW subgroup</i>
Qifeng Lu		<i>FY-3 satellite data quality and assimilation in NWP</i>
Dawei An		<i>Progress on FY-3/MWTS FCDR</i>
Shengli Wu		<i>SNO and DD analysis of MWRI</i>
Yuan Li		UV subgroup
Qian Wang		<i>Comparison of spectral radiance for UV-VIS high-resolution spectrometers from GF-5/EMI and S5p/TROPOMI</i>
Zhe Xu	GDWG	<i>CMA GDWG Annual report 2020</i>



Support to GDWG Activities

❖ *A maximum of 1 slide highlighting your agency's support to GDWG.*

- *Summary of the tasks your agency's supports in the GDWG.*
- *Overview of the resources and time taken for this support.*
- *Identify issues with this support, if any.*



Introduce/Confirm the Agency's Personnel supporting GSICS

❖ EP

- *Peng Zhang*

❖ GRWG

- *Xiuqing (Scott) Hu, GRWG Chair*
- *Qifeng Lu, MW-subgroup Co-Chair*
- *Ling Sun, Recalibration*
- *Na Xu, IR and Solar band*
- *Lin Chen, Field Campaign*
- *Chengli Qi (new member) , IR Hyperspectral*
- *Shengli Wu(New member), Microwave subgroup*

❖ GDWG

- *Zhe Xu,*
- *Yuan Li*



Agency's GSICS activities to be discussed in this joint meeting.

❖ *A maximum of 2 slides summarising:*

- *Summarise the GSICS agenda items in this joint meeting that are especially of interest to your agency.*
- *Identify any agency's activities that are not directly relevant to GSICS but may be of interest to the GSICS community with links to websites as available.*



Thank you for your attention

WMO GSICS Portal

<http://gsics.wmo.int>

GSICS Coordination Centre

<http://www.star.nesdis.noaa.gov/smcd/GCC/index.php>

GSICS Product Catalog

<https://www.star.nesdis.noaa.gov/smcd/GCC/ProductCatalog.php>

GSICS Wiki

<http://gsics.atmos.umd.edu/wiki/Home>