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

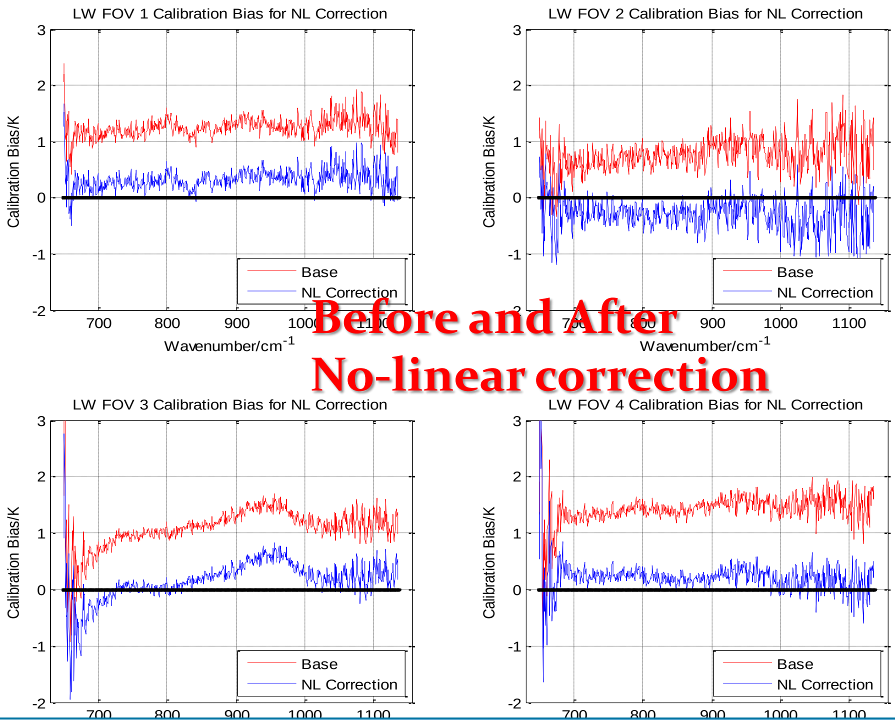
Improvements:

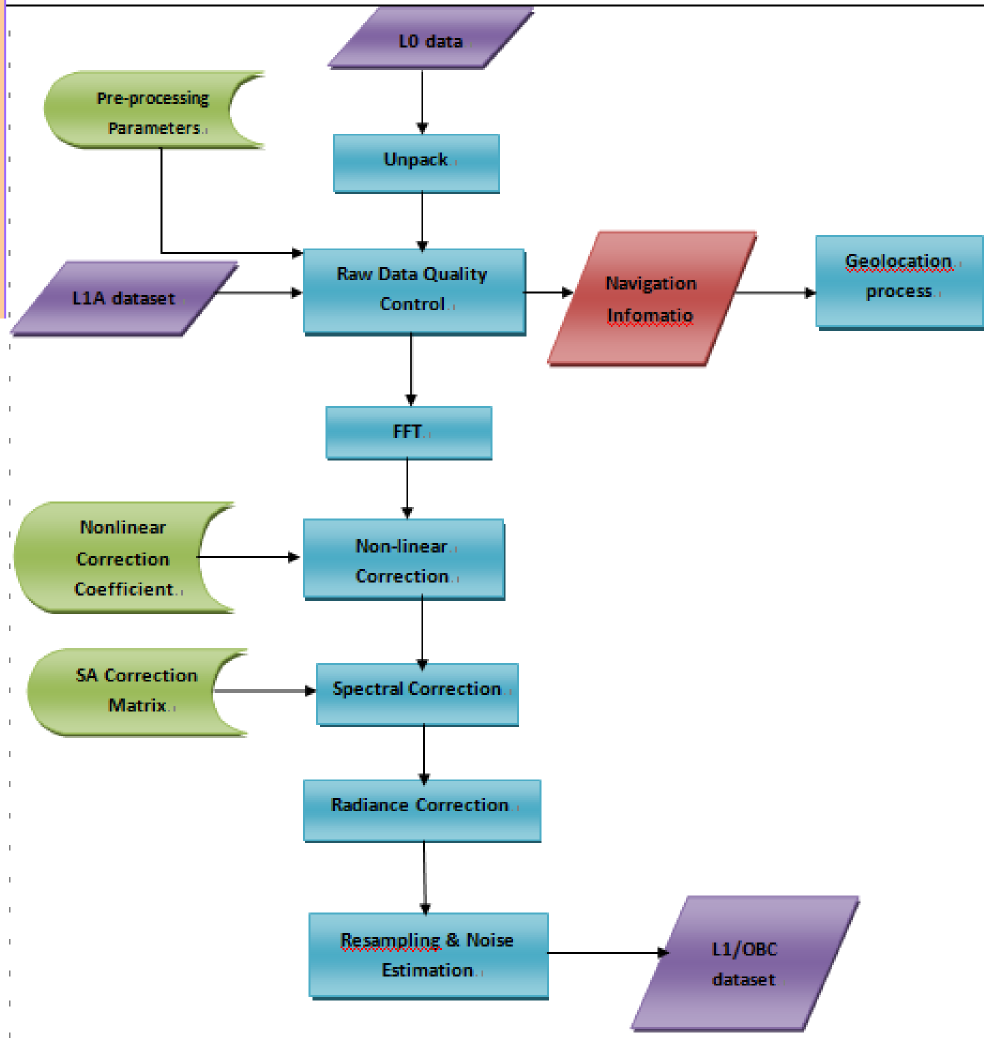
1) ZPD determination;

2) Phase Alignment of DS, ICT and earth targets;

3) No-linear correction;

4) Resampling



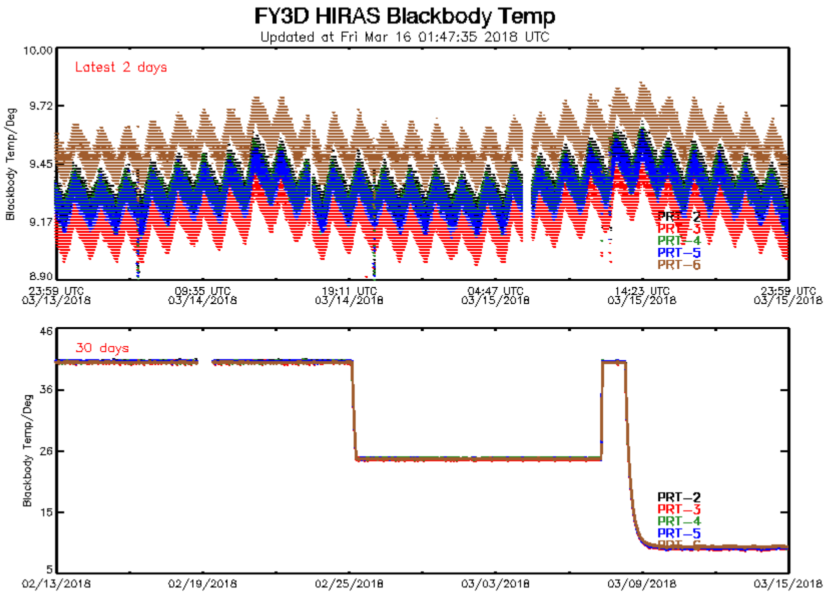


After No-linear correction, ICT bias is smaller than 0.5K @290K.

Latest Instrument status & SDR Processing

DAY 1: data analysis

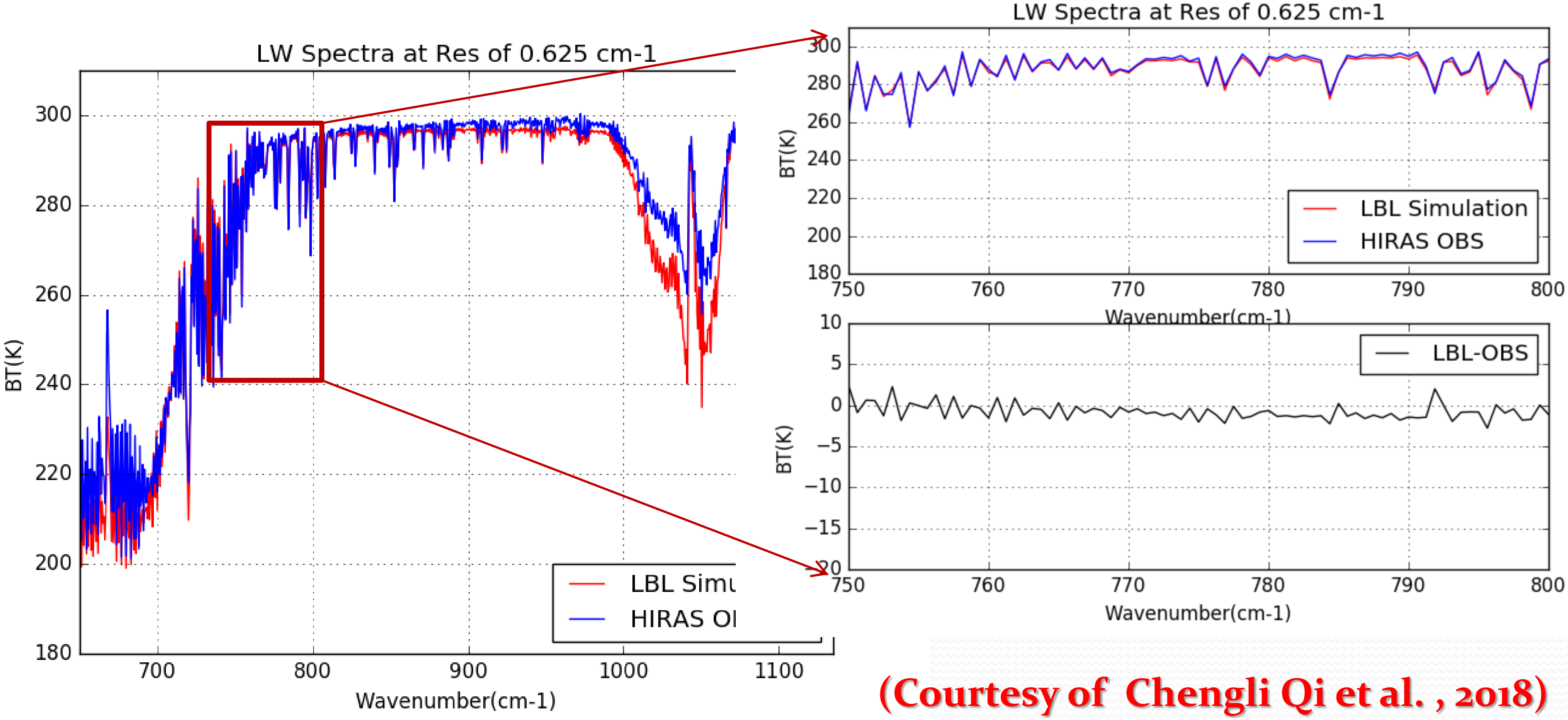
- 1,Mar
  - HIRAS infrared detectors power on
  - Telemetry parameters check
  - 1st IGM check
  - Raw Spectra check
  - Calibrated spectra check
  - Pre-processing system operation
- 2-3, Mar
  - Interferometer fixed-mirror alignment
- 5, Mar
  - ZPD position tuning
- 6, Mar ~ present
  - NEdT evaluation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



(Courtesy of Chengli Qi et al. , 2018)

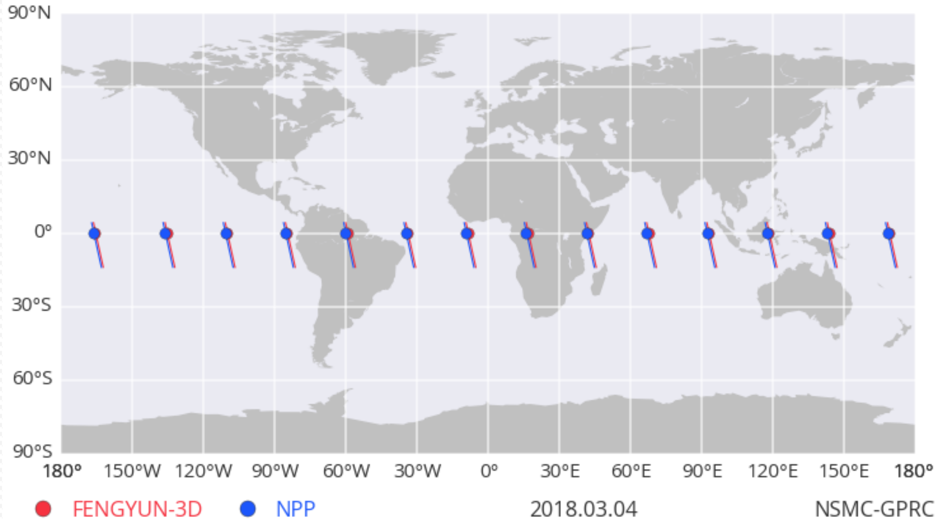
Preliminary Spectral Calibration Check

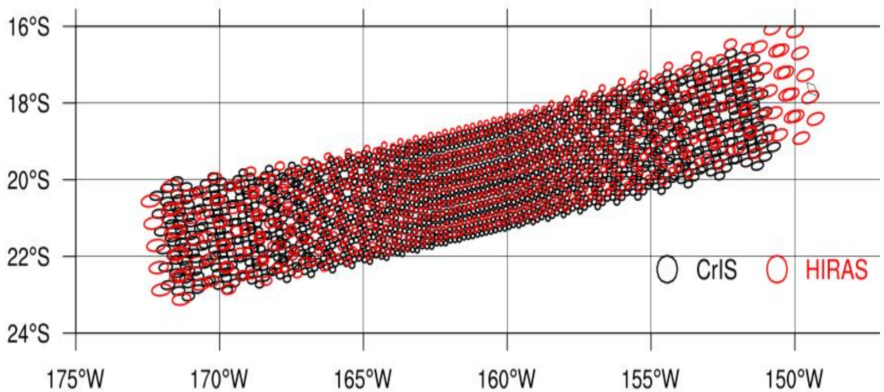
HIRAS OBS compared with LBLRTM simulation （LW）

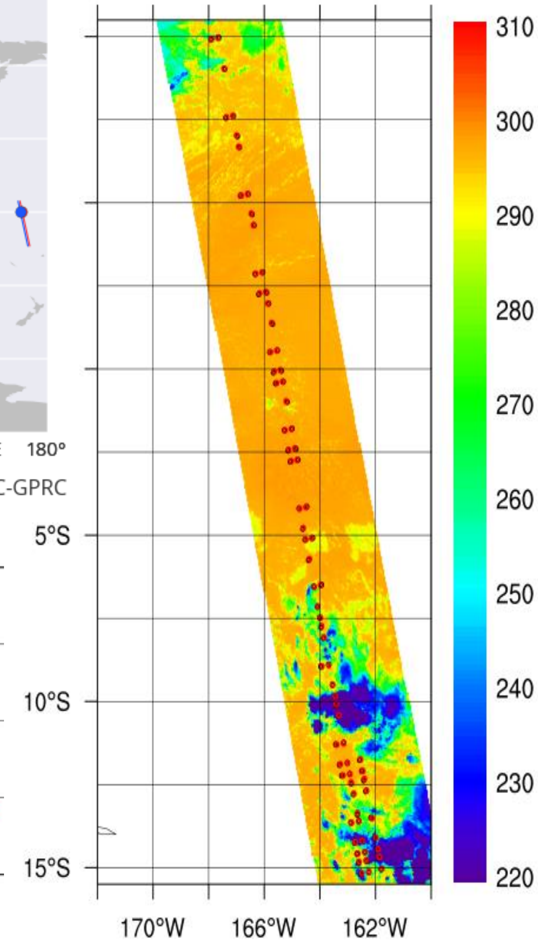


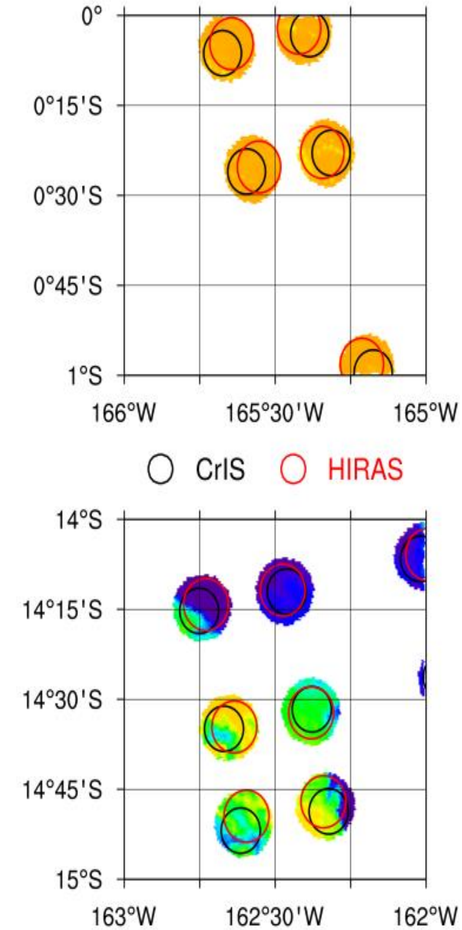
(Courtesy of Chengli Qi et al. , 2018)

Day1 HIRAS data compared with CrIS









Collocation with CrIS using both overlap orbit

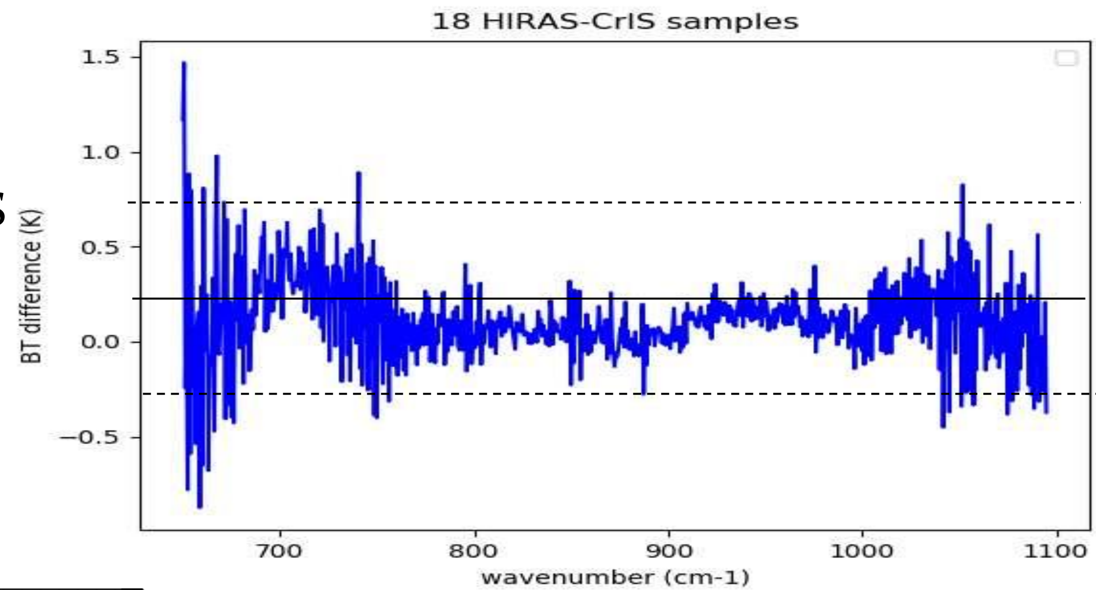
Reference to Likun Wang et al, 2016)

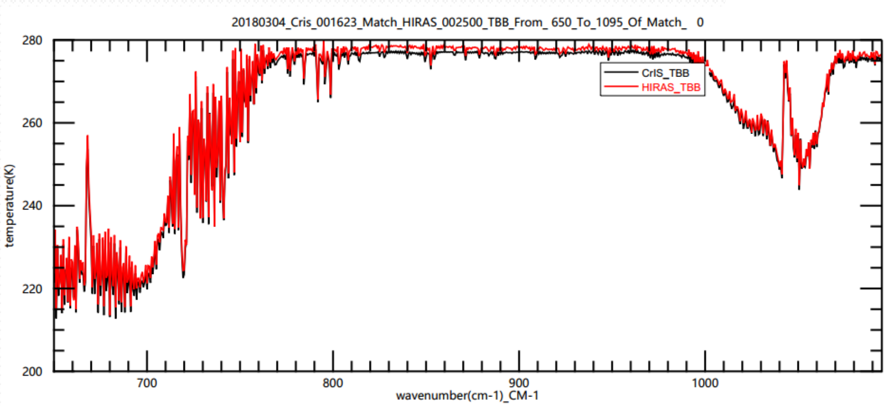
(Courtesy of Chunqiang et al. , 2018)

Bias between HIRAS and CrIS

- Day 1 data evaluation

Difference between HIRAS and CrIS
After NL correction

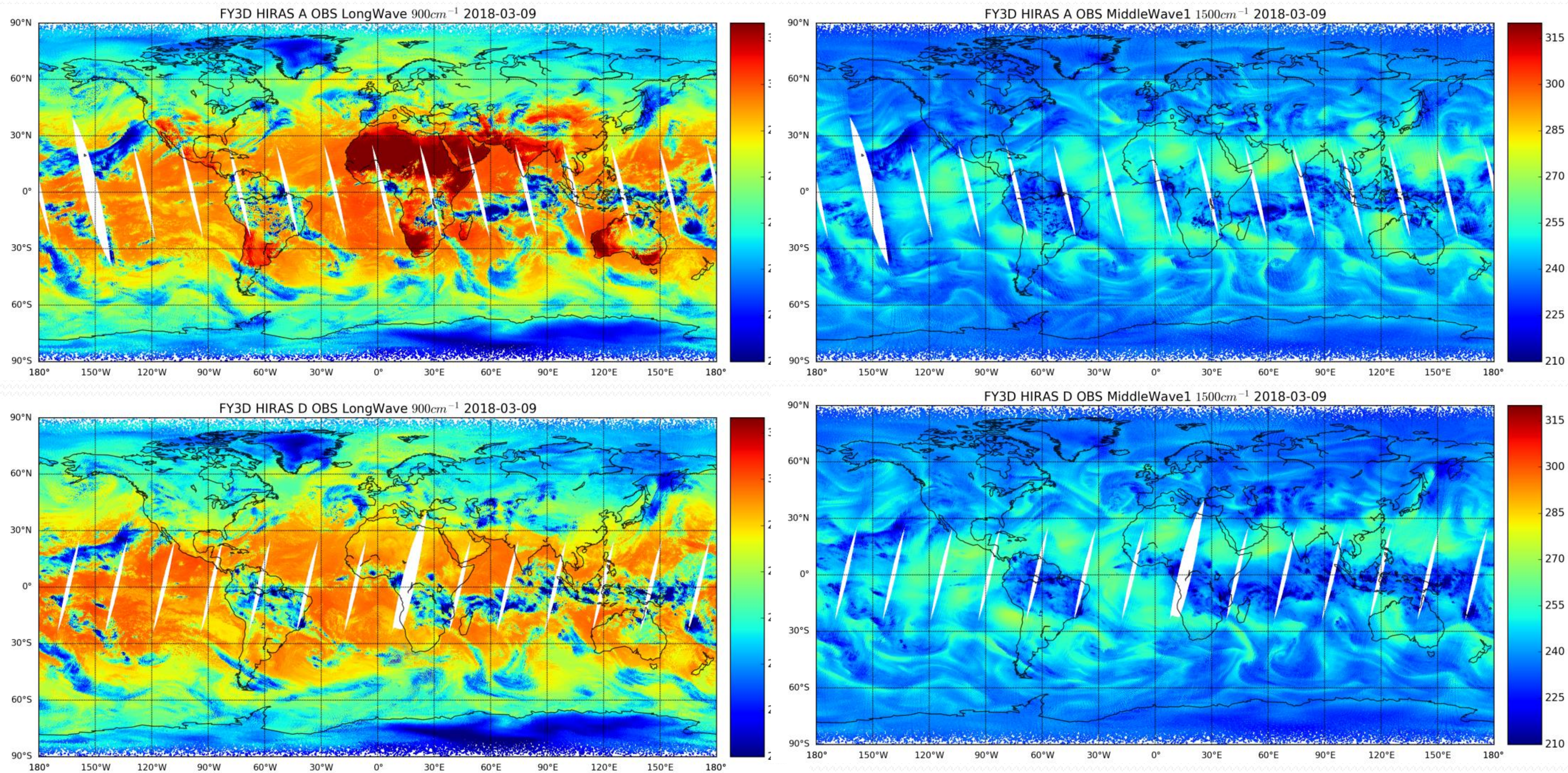




(Courtesy of Hanlie Xu et al. , 2018)

Day 1 Global BT

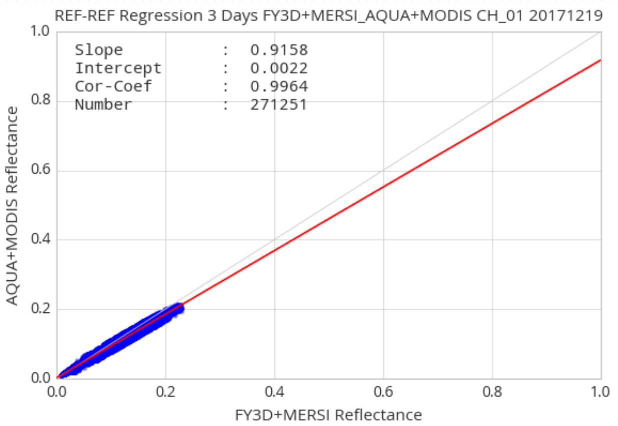
LW 900cm-1 | MW 1500cm-1

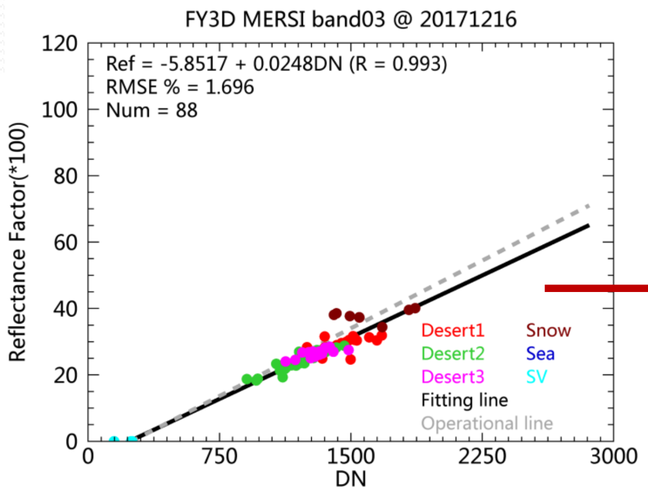


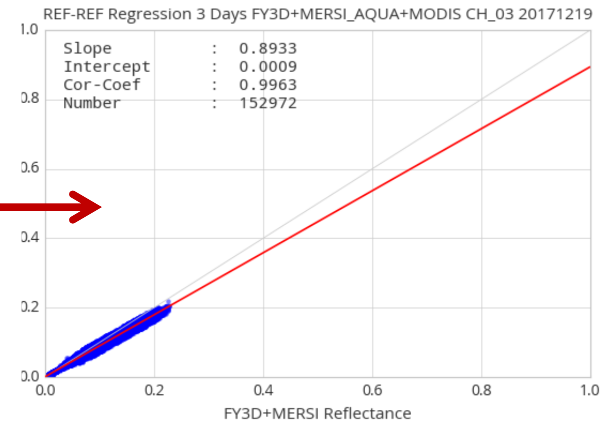
Data Reception, Raw data combined and L0 data generation, decoding into L1A, SDR Ground processing practice into L1 & OBC dataset.

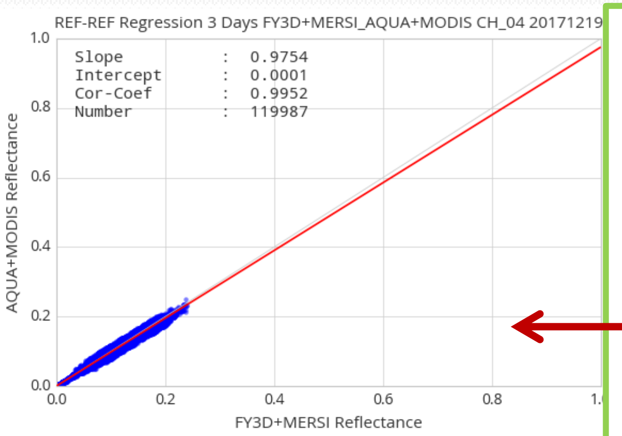
(Courtesy of Chengli Qi et al. , 2018)

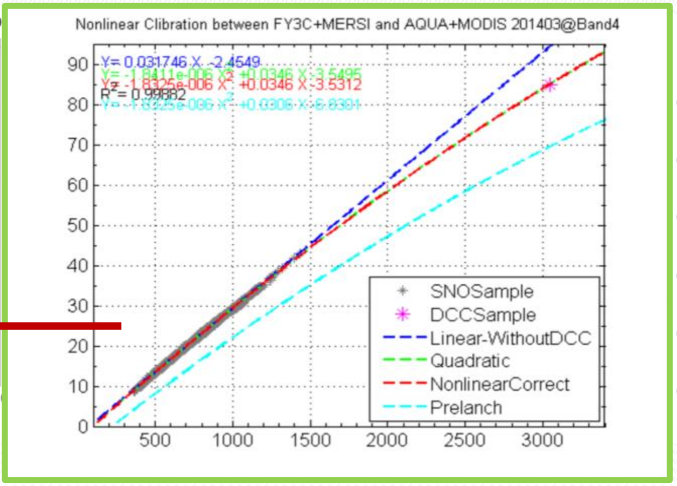
Preliminary evaluation of MERSI-II calibration with VC and MODIS

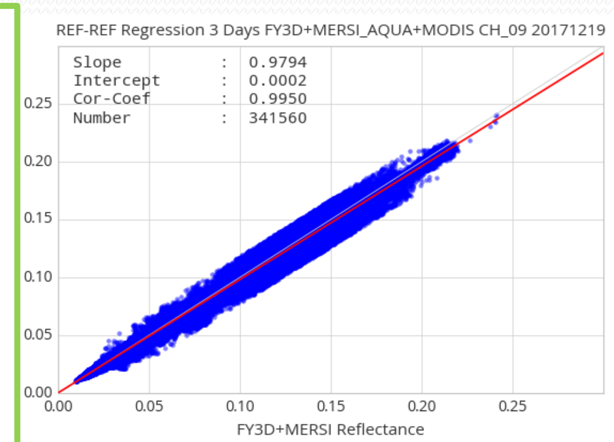




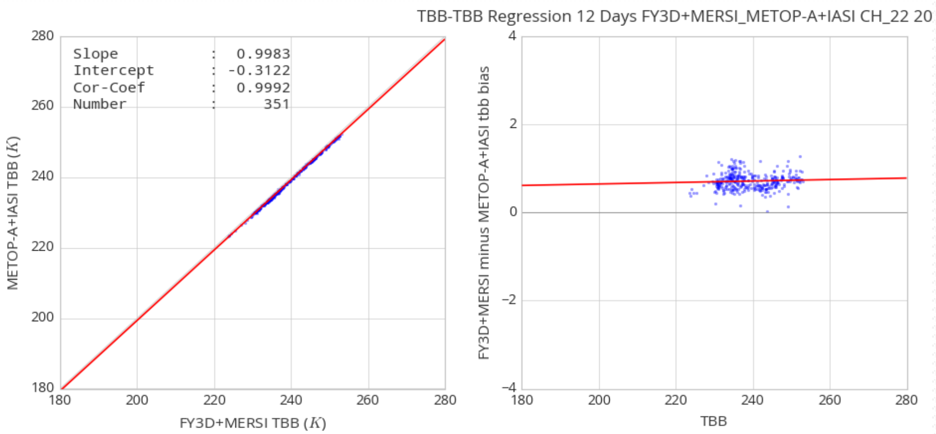


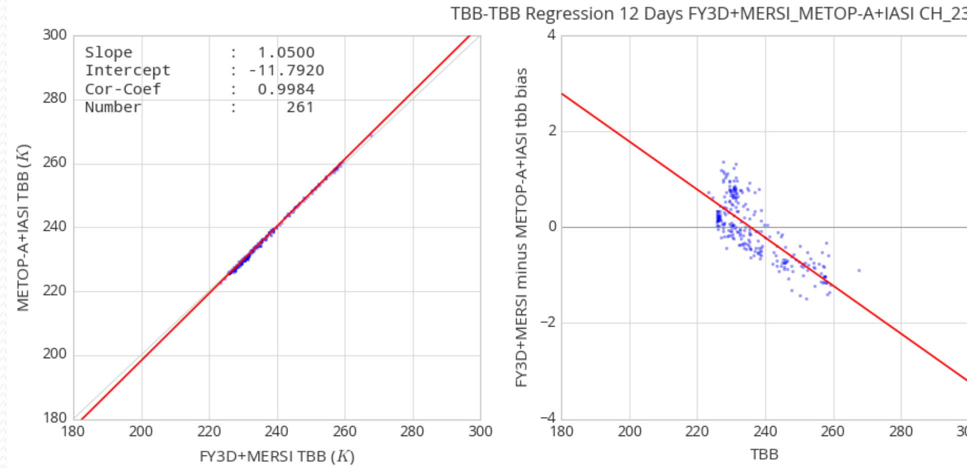


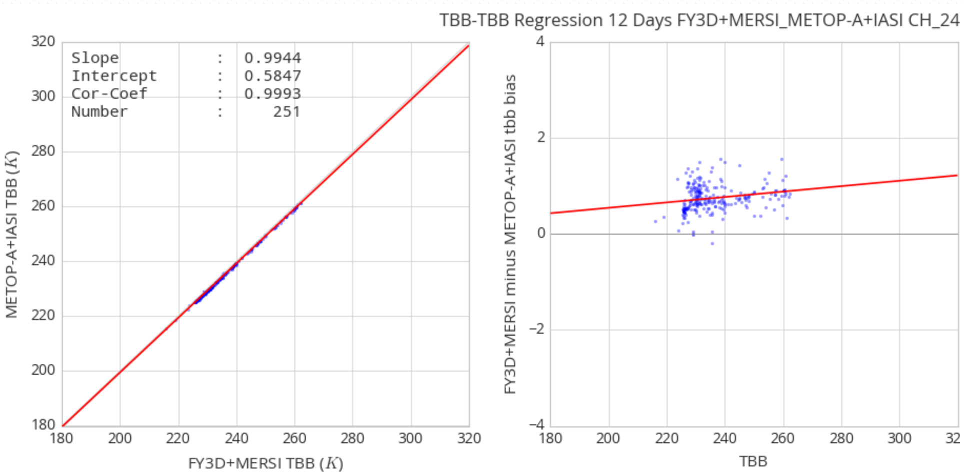


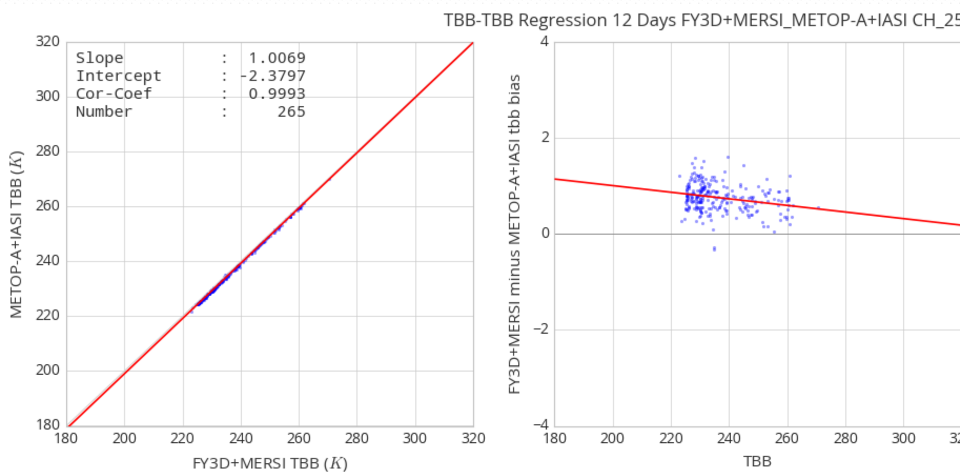


MERSI-II IR compared with IASI

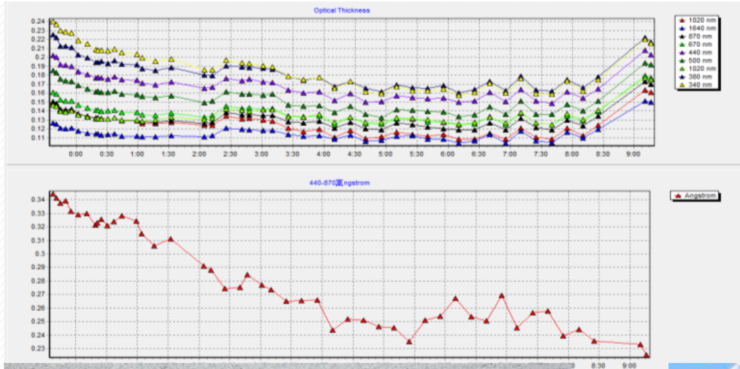


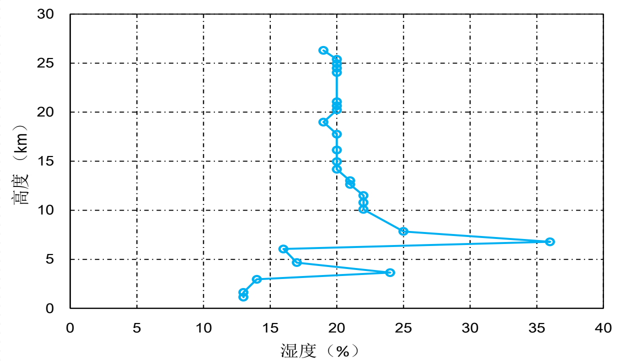






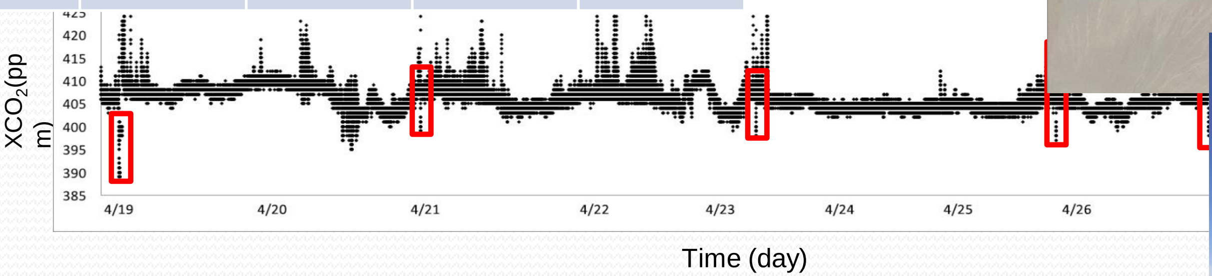
TanSat & FY-4 Vicarious Calibraiton at Dunhuang



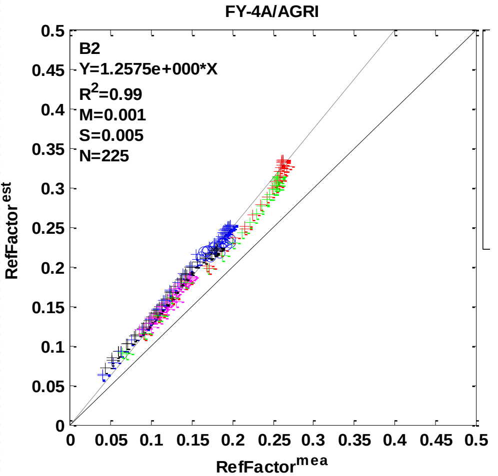


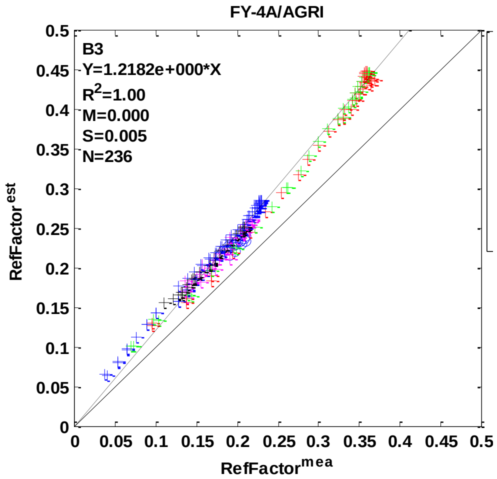
	TanSat	CAS-products	GF-products	Ground Measurement
XCO2 Mean /ppm	397.12	406.85	404.71	407.43

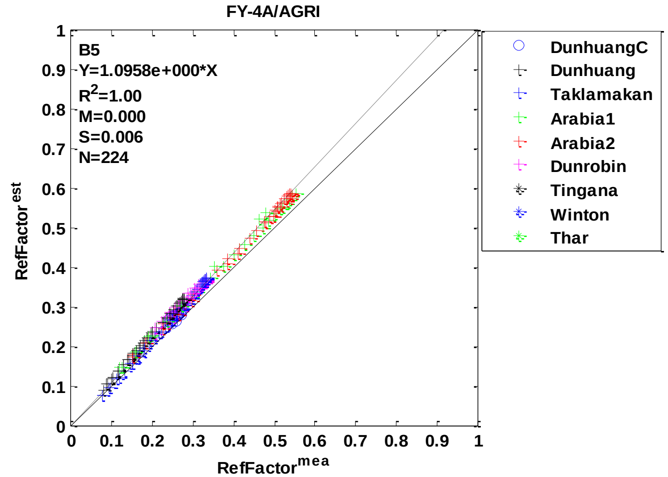
Data_GGA

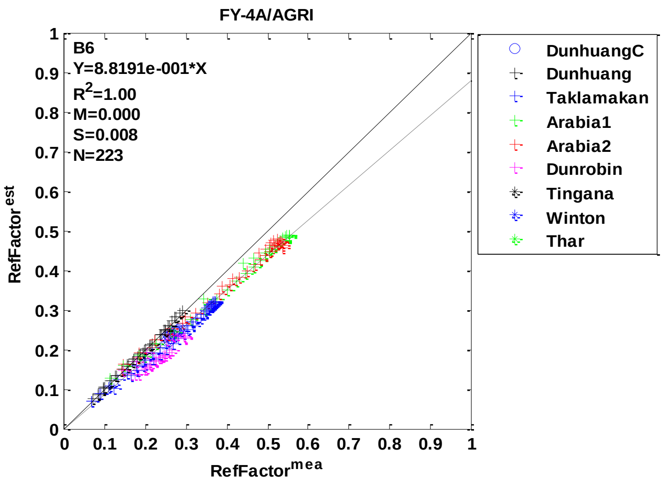


FY-4A AGRI RSB VC results









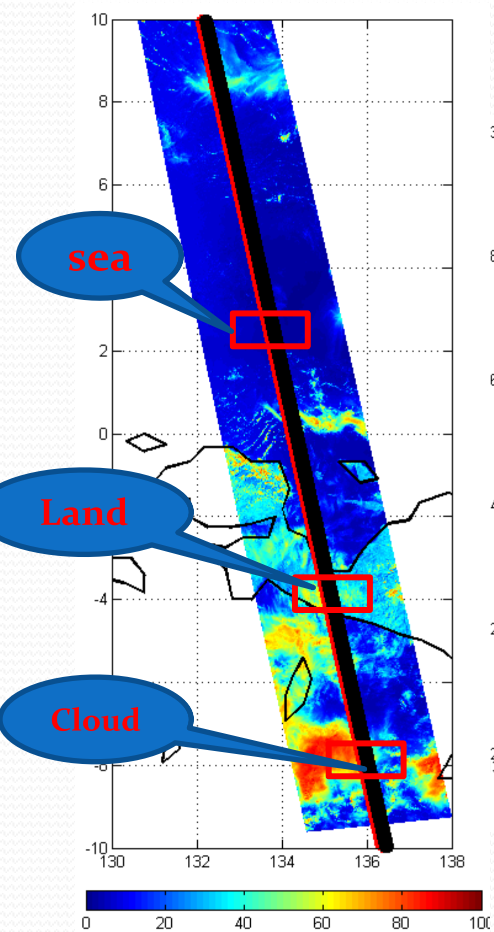
(Courtesy of Ling Sun et al. , 2017)

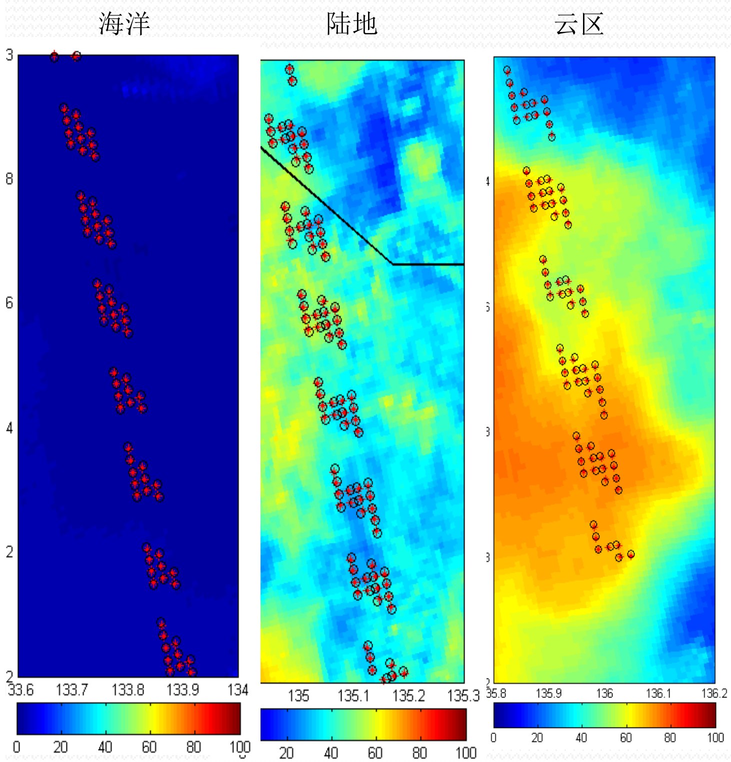
2017.04 CRCS+ Multi-sites for calibration

Calibration coefficient update on June 9, 2017

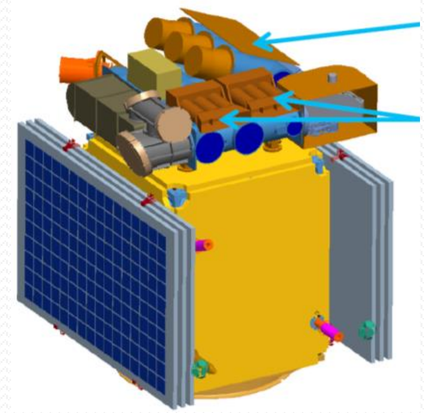
Bands	1 472nm	2 606nm	3 810nm	4 1370nm	5 1615nm	6 2296nm
k	1.1615	1.1435	1.2002	1	1.1112	0.90593

Spatial Collocation between TanSat and OCO





Collocation Pixels at Sea, Land and cloud targets

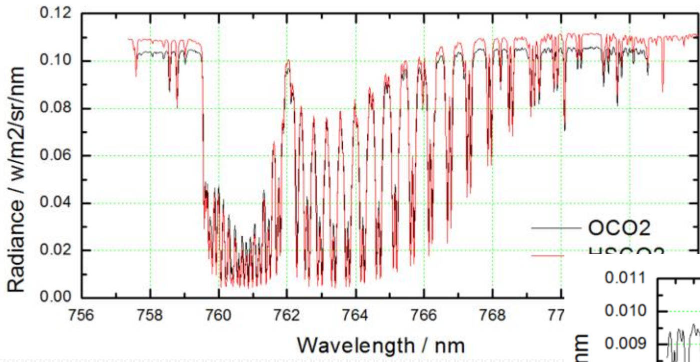


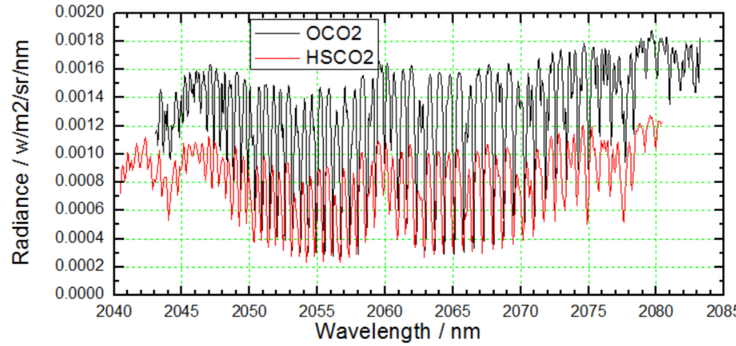
Key issues:

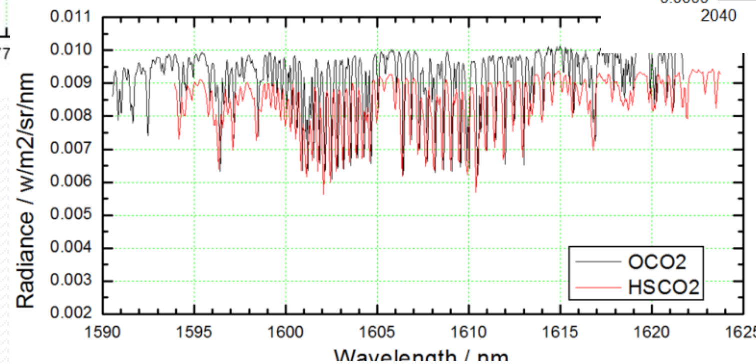
- Orbit selection(Nadir almost overlap
- Targets Selected（Using imager for targets selection）
- Polarization processing based on polarization mirror normalization
- Spectral sample collocation(using RTM and double difference）

(Courtesy of Na Xu et al. , 2018)

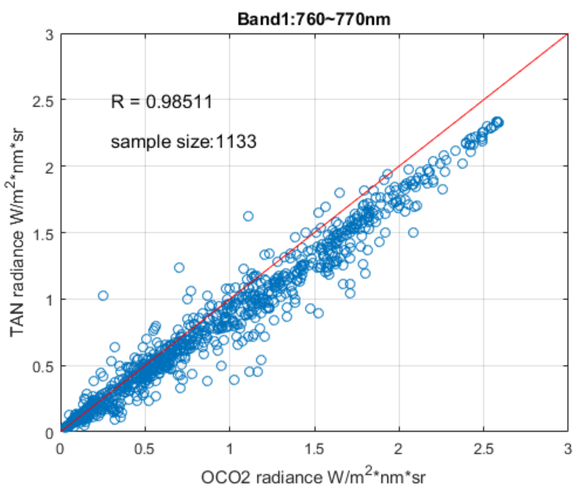
Intercomparison between TanSat and OCO

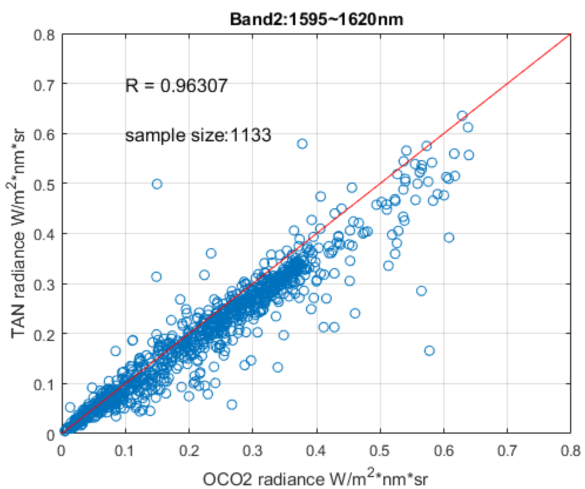


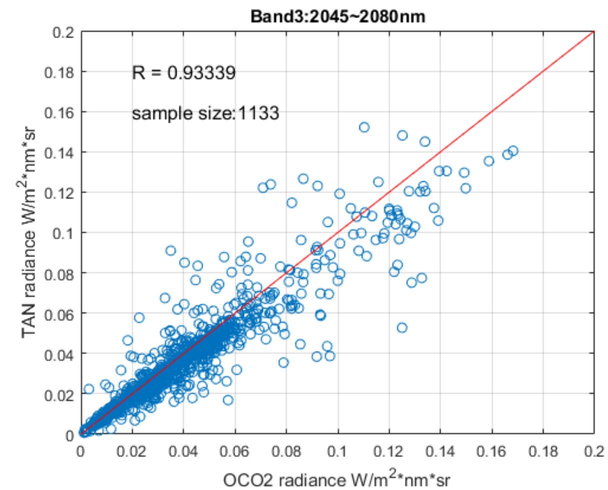




5%~10% difference between TanSat and OCO using the radiative transfer model as bridge for different spectral resolution







(Courtesy of Na Xu et al. , 2018)

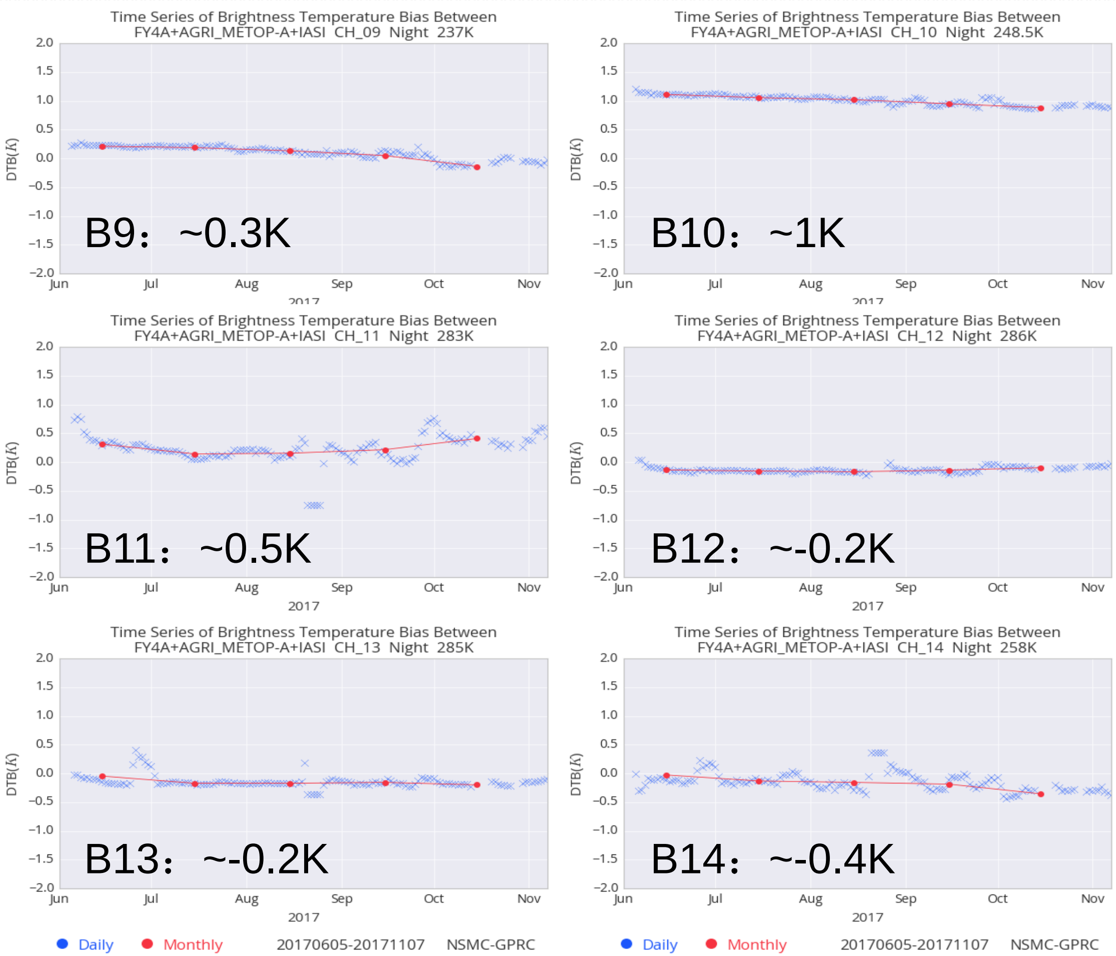
FY-4 L1 validation methods via GSICS

- 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/VIIRSand 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, 2017

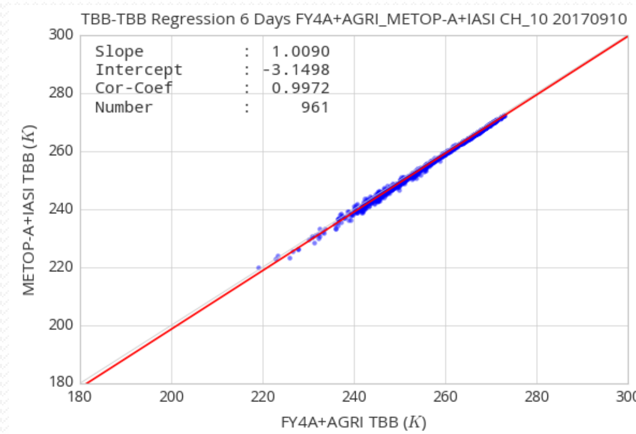
Contributors: Na Xu, Lin Chen, Hanlie Xu, Chunqiang Wu, Chengli Qi, Ling Wang, Tianhang Yang, Fang Zhou

FY-4 AGRI IR bias wrt IASA



IR bands (3.8um not included

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

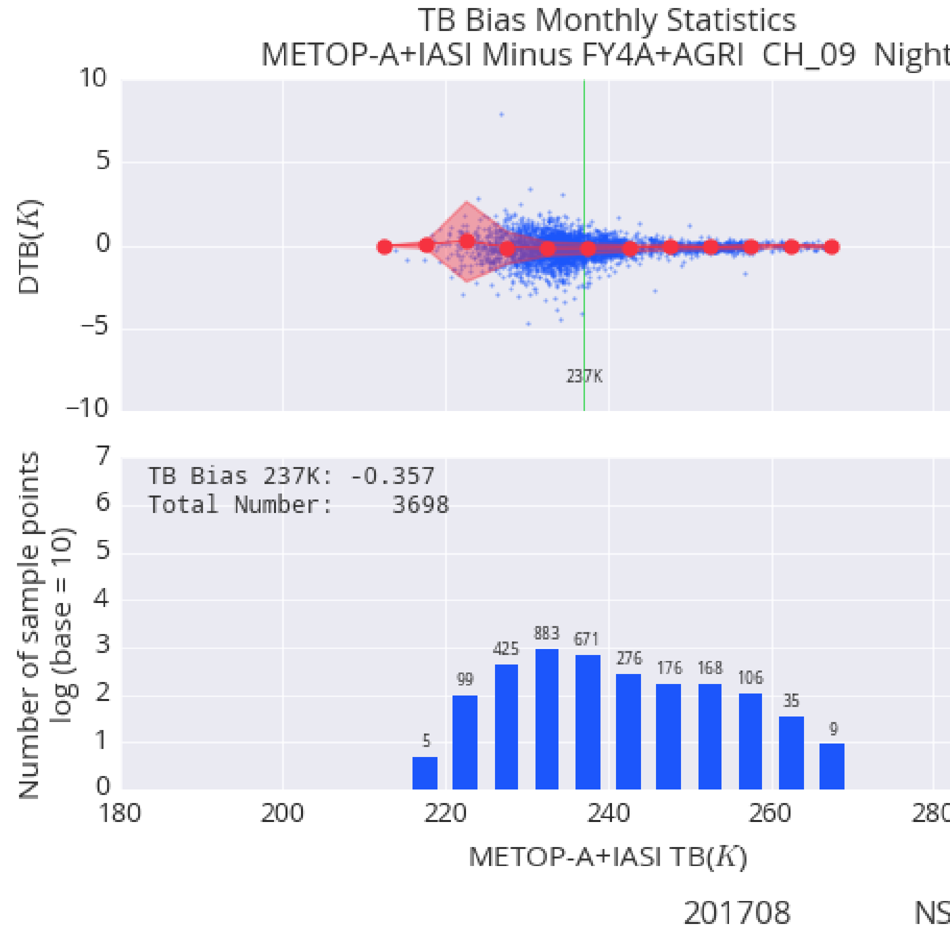


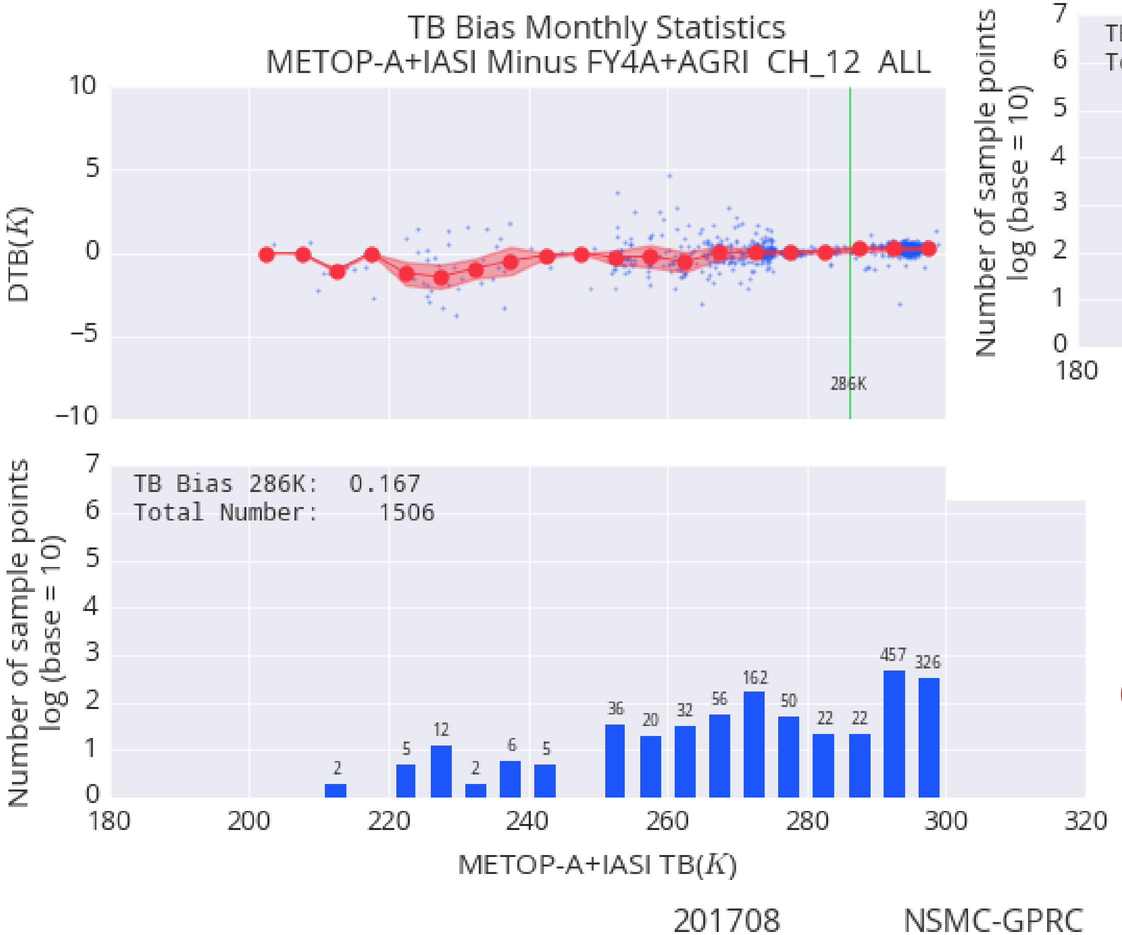
Global Space-based Inter-Calibration System

IR band Bias Monitoring @290K

(Courtesy of Na Xu et al. , 2018)

Bias dependence on the target temperature

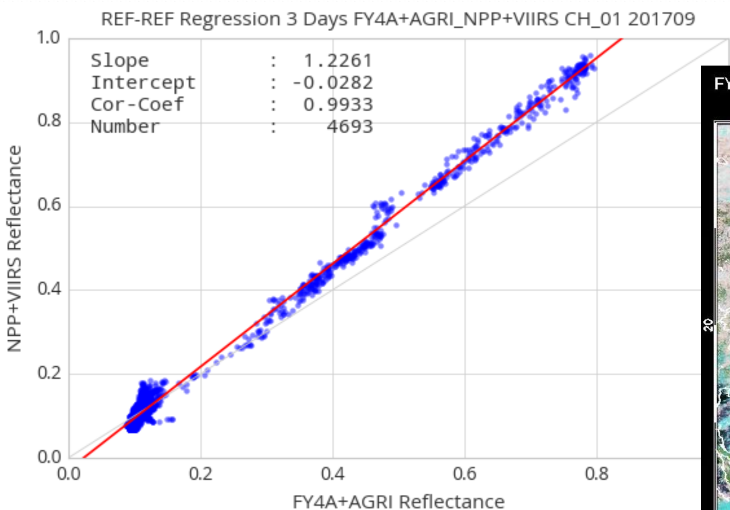


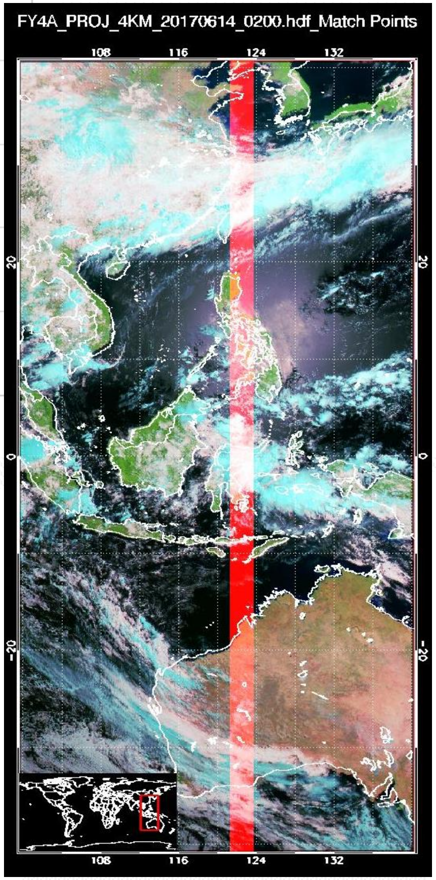


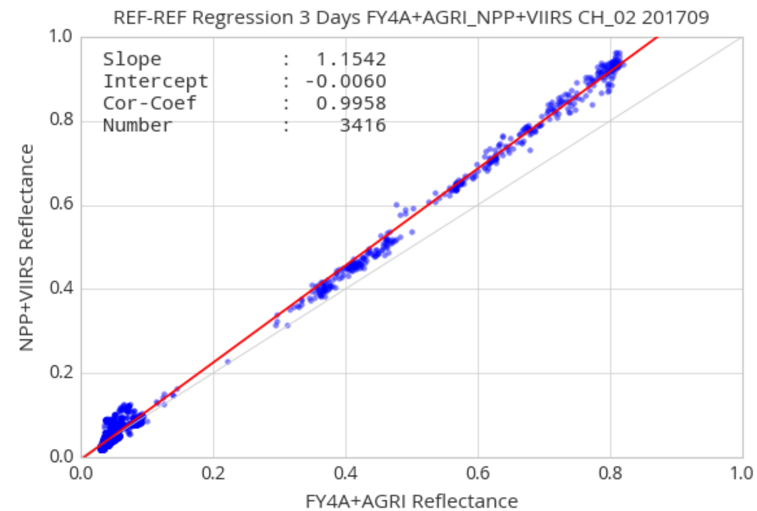
(Courtesy of Na Xu et al. , 2018)

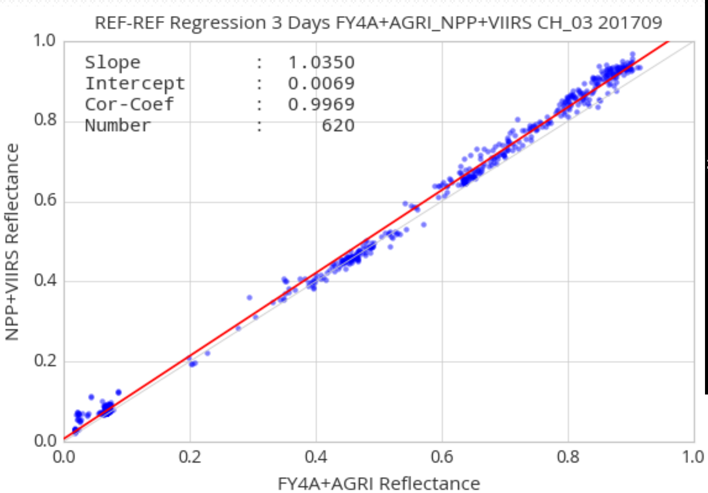
Solar bands inter-comparison with VIIRS/H-8

- Consideration time, geometry, IFOV and spectral matching

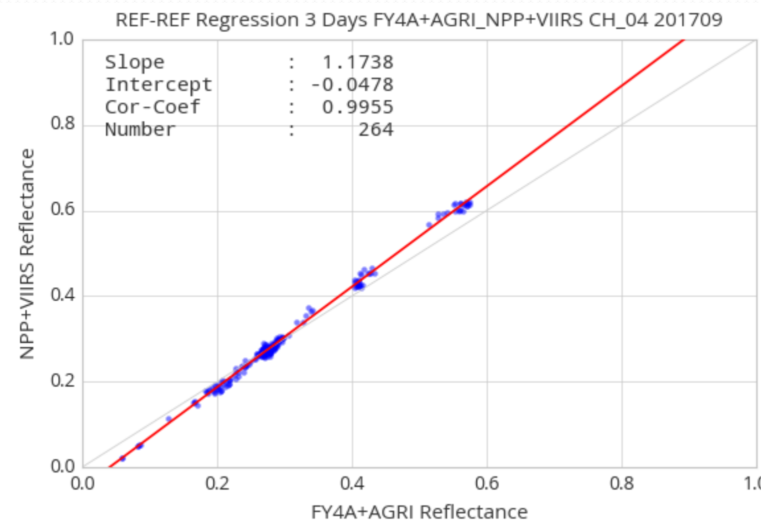




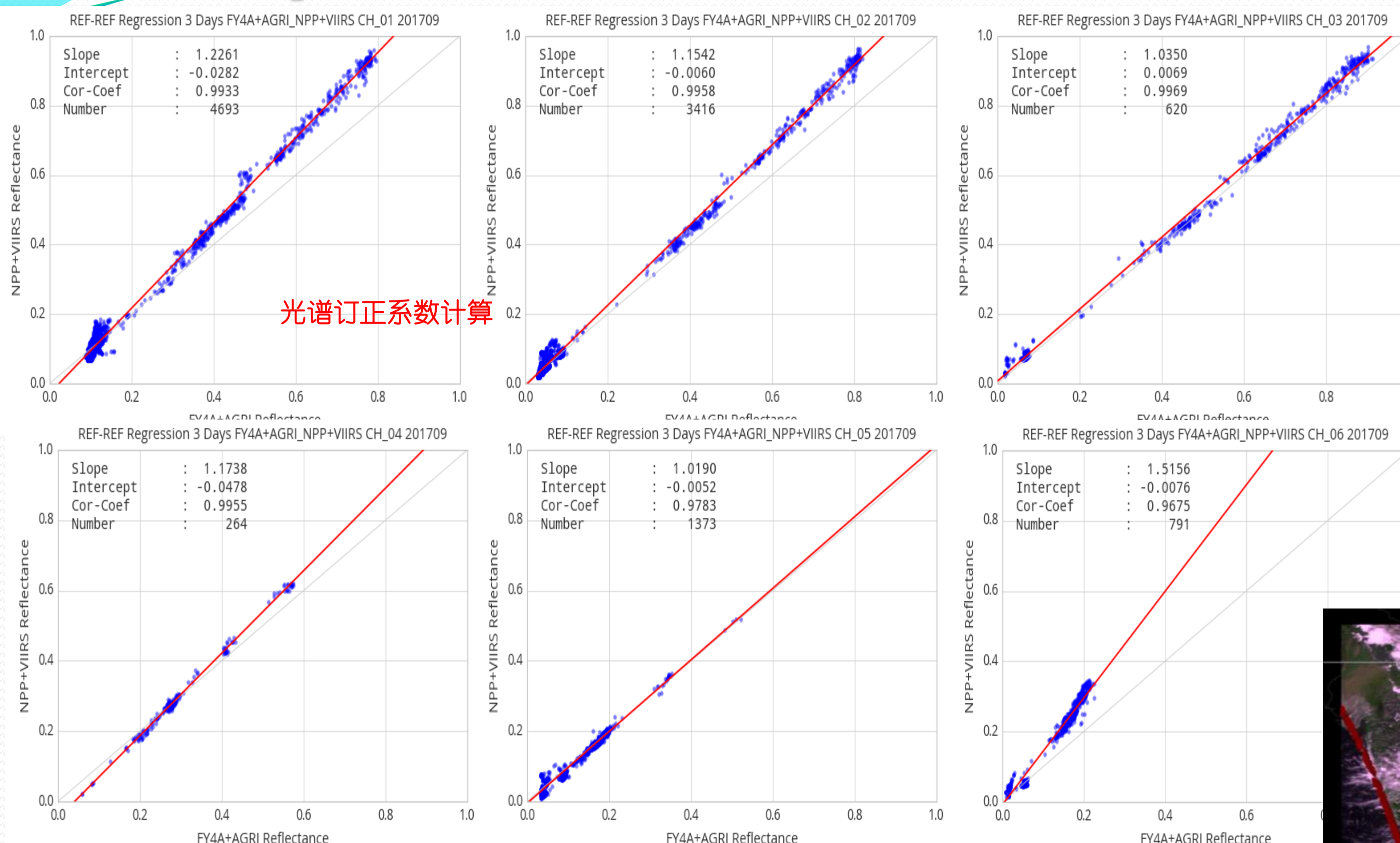




S 2018 Annual Meeting on March 1

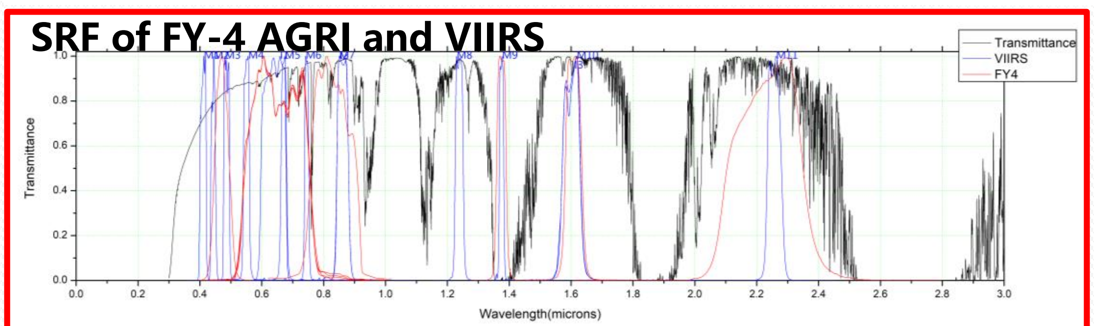


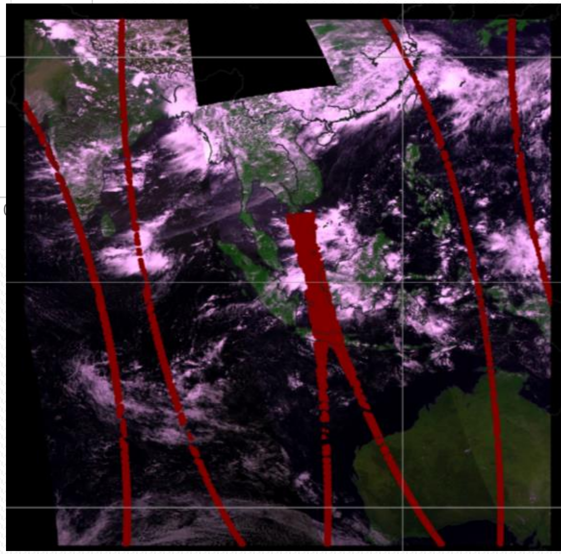
FY-4/AGRI via VIIRS



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



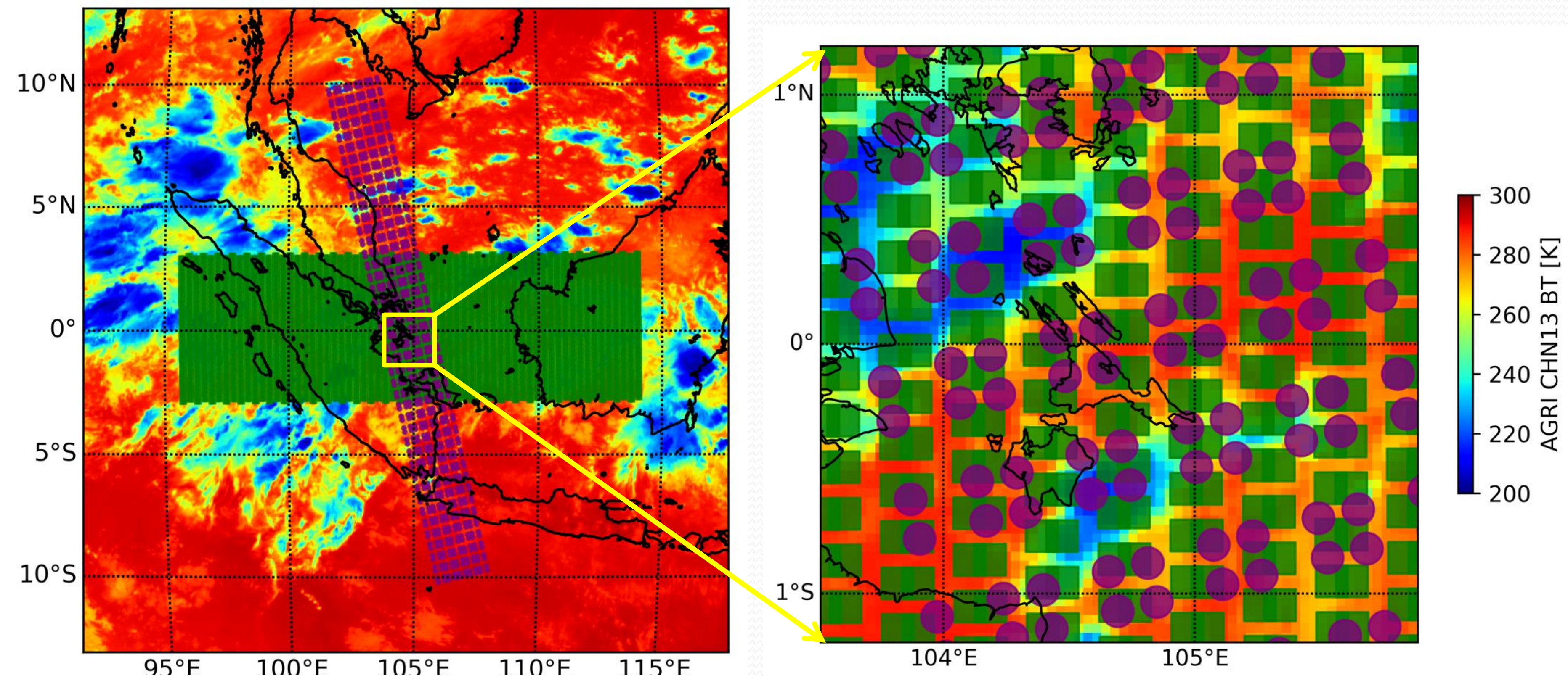


Thanks Doelling's team for providing the SBAF)

(Na Xu et al. , 2017)

Matching between GIIRS and IASI

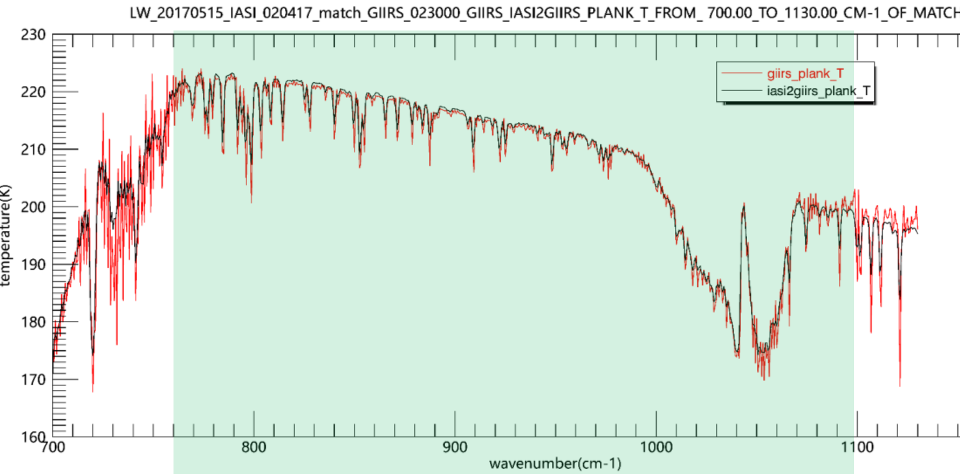
Time Diff： 20 minutes
Center Distance ： 4km
Zenith angle: <10°, Path Diff <1%
Targets homogeneity：AGRI CHN13 5x5 TB std（< 0.05K ）

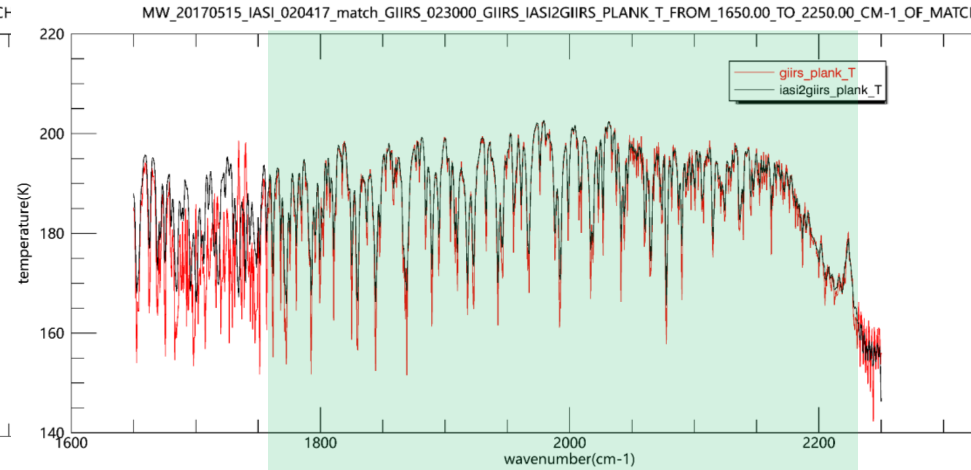


(Courtesy of Chunqiang Wu, 2018)

Pixel Matching

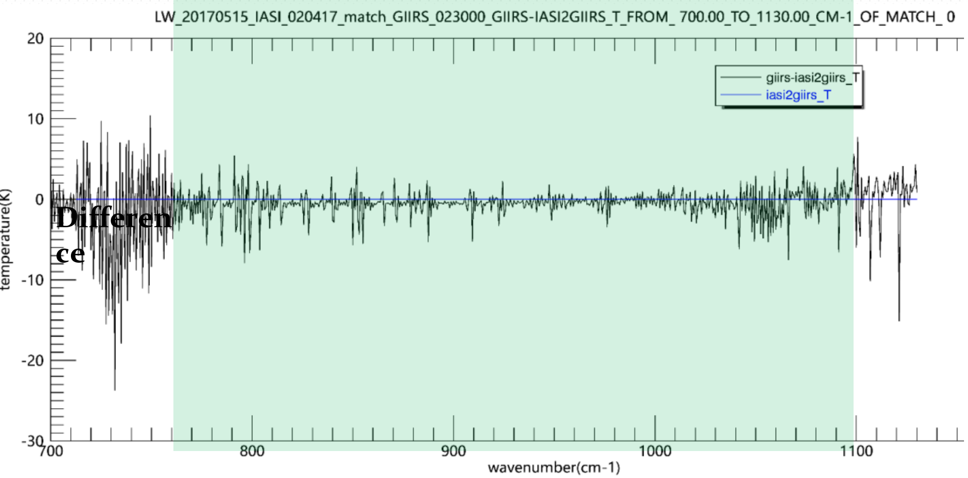
GIIRS validation using IASI

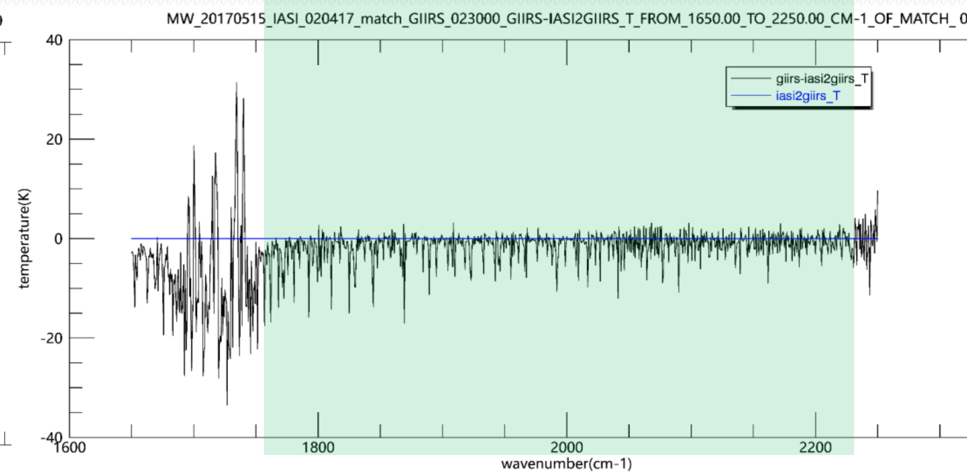




760—1100cm^{-1}

1750—2230cm^{-1}





Good Channels

Good Channels

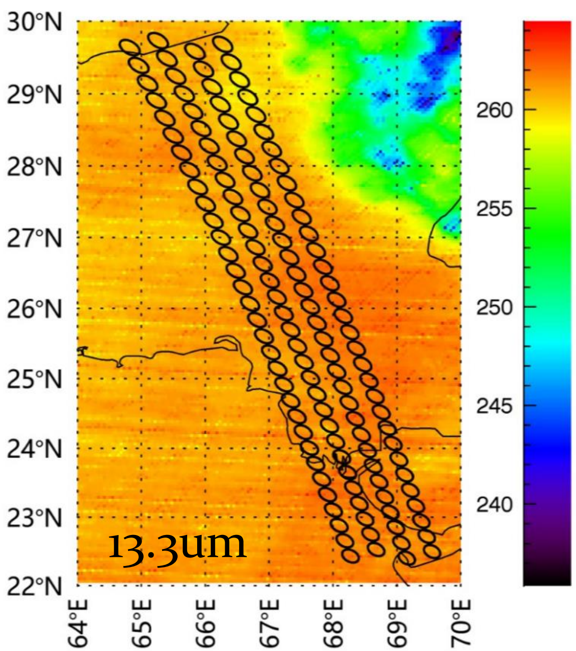
Inter-comparison between AGRI and GIIRS on the same platform

Method:

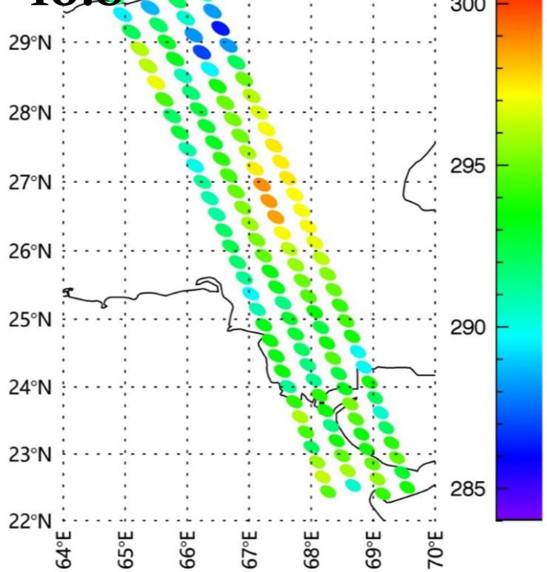
- Matching pixels: Find the nearest pixel of GIIRS center from AGRI imager
- GIIRS pixel IFOV 16 KM，AGRI pixel IFOV4KM，AGRI 5*5 pixels，Envirnment area 15*15 pixels；

- **Time：dif_time<=180s**
- **Homogeneity：<=0.01**

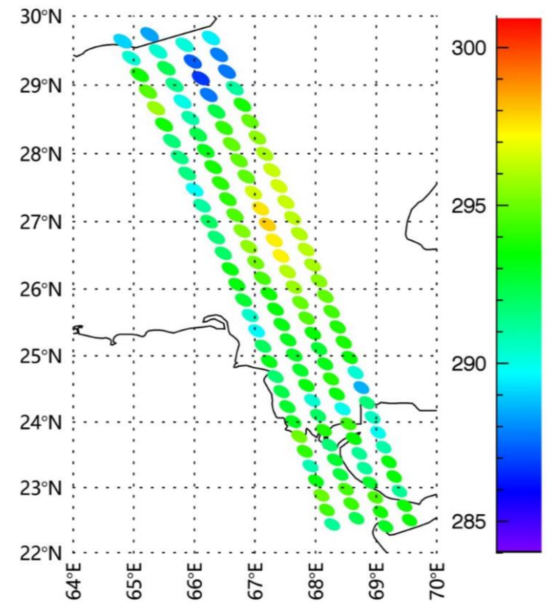
(Courtesy of Hanlie Xu, 2018)



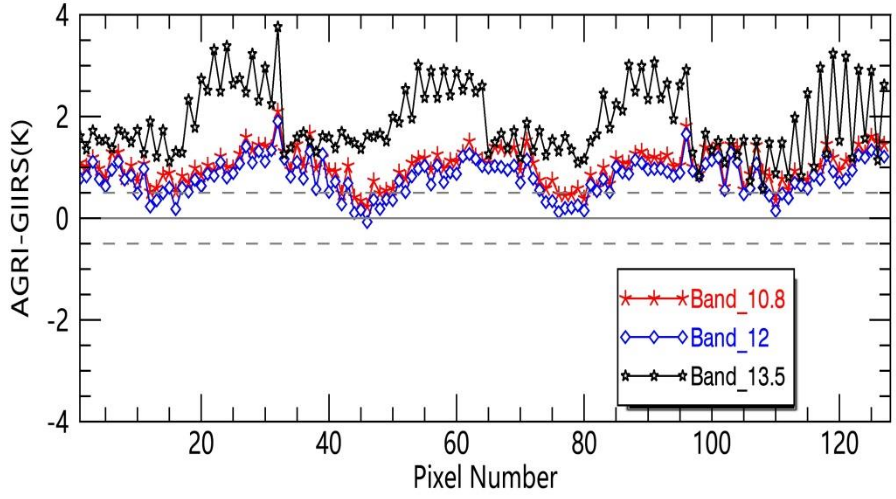
AGRI Observation 10.8



GIIRS Simulated 10.8

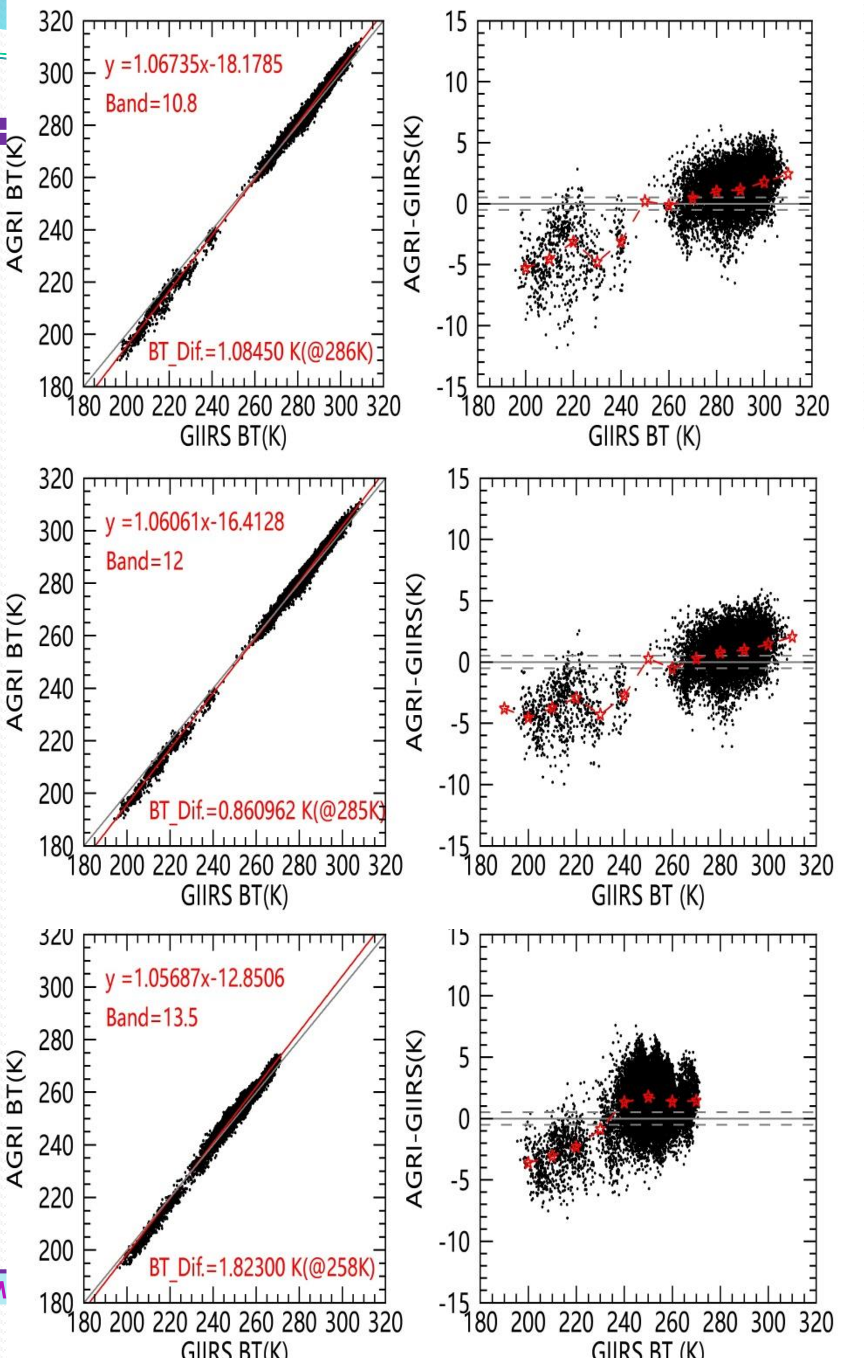


August 17, 2017

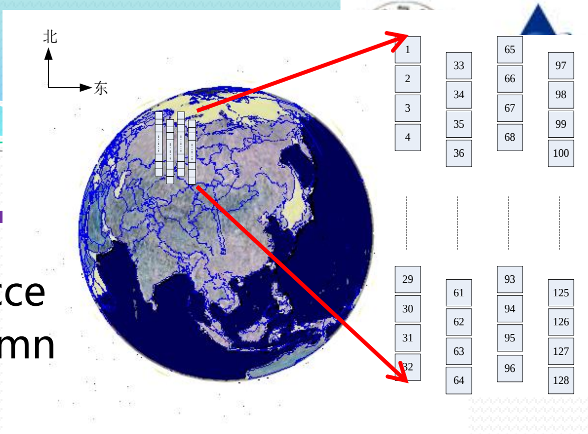


- GIIRS has higher than AGRI at cooler targets and lower than AGRI at warmer targets
- GIIRS has Bias Detector dependence of each of four column.

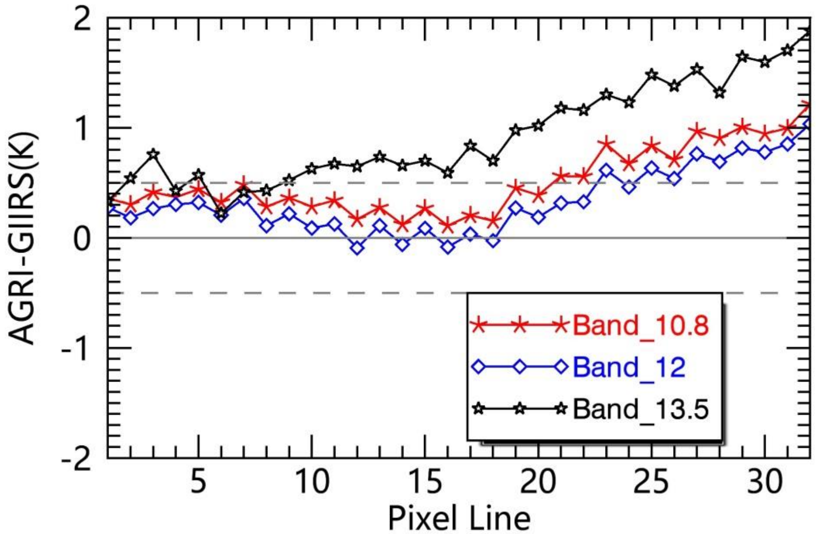
(Courtesy of Hanlie Xu, 2018)



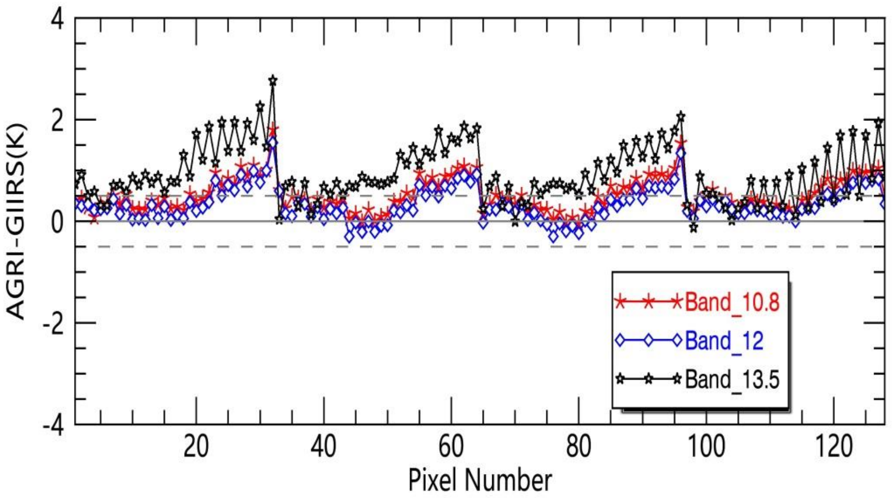
Bias Detector dependence



- GIIRS has 32 pixels in each column and bias detector dependencce
- 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。

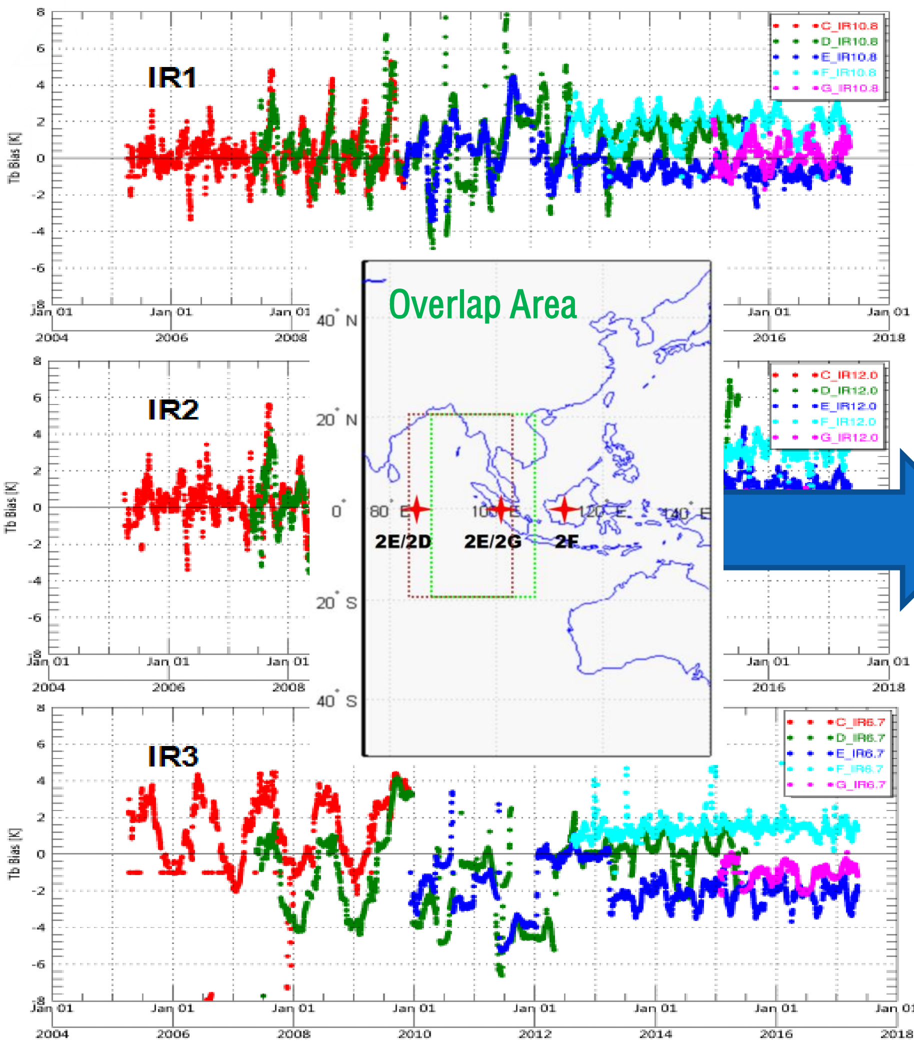
CMA Initiate the retrospective calibration for long term FY historical satellites data

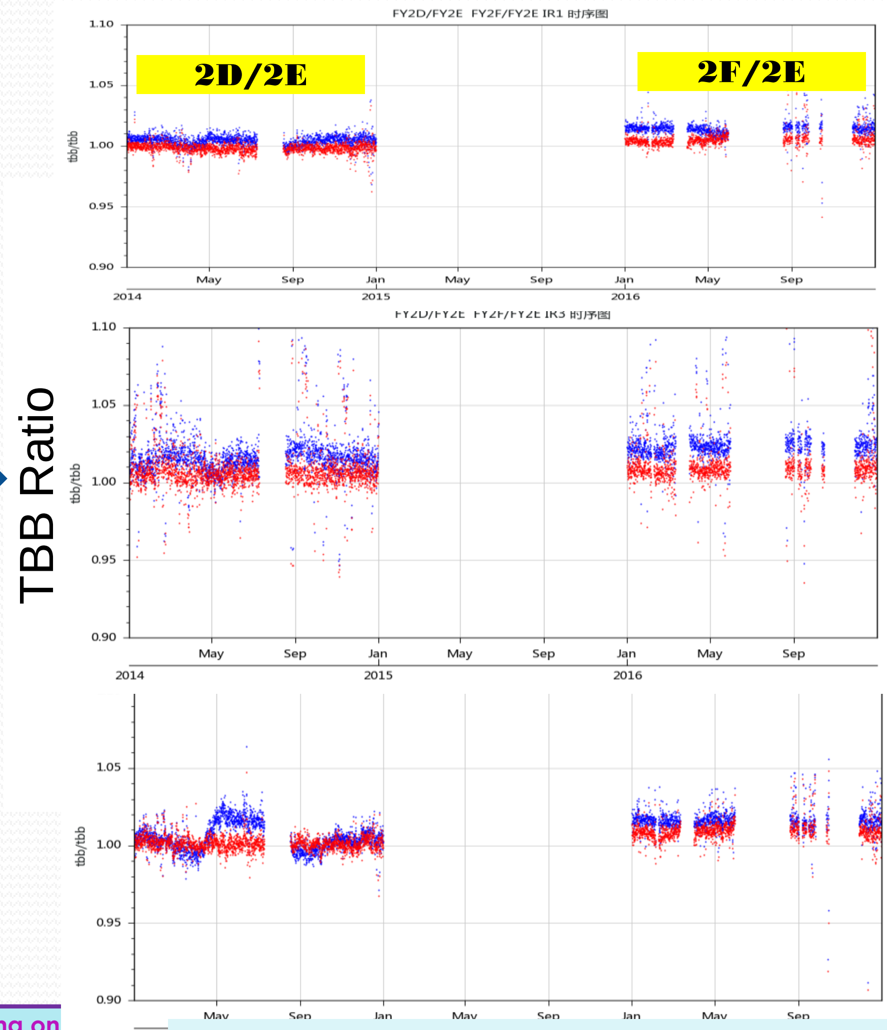
(1) National Major Project application (MOST 2018)
(2) FY-3 FCDR and EDR begin to be established
(3) FY-2 Fundamental CDR established
(4) Other projects…..

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

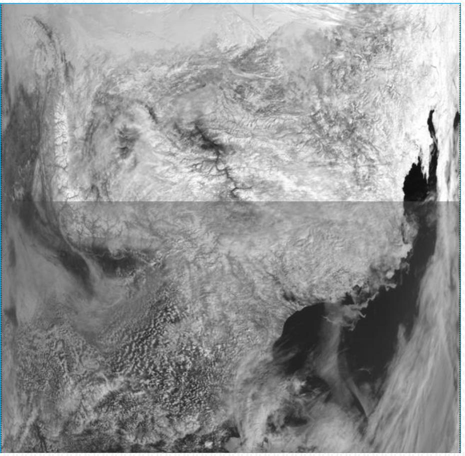




(Courtesy of Na Xu et al. , 2018)

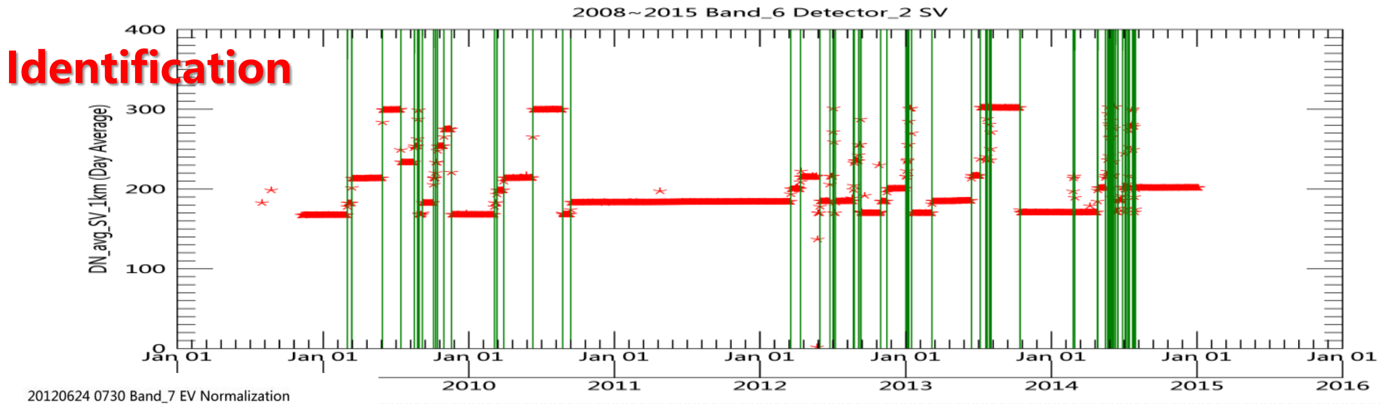
FY-2D/2E/2F Consistence evaluation

Gain jump on FY-3A MERSI SW bands

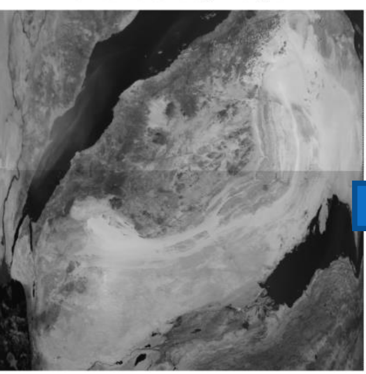


Robot Identify，Gain Normalized，Imager adjustment

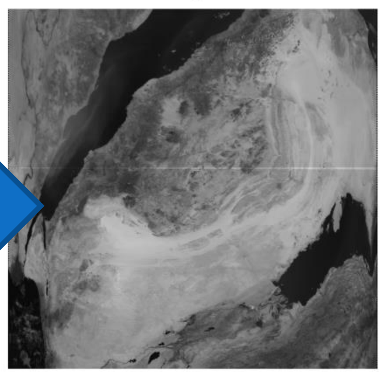
Jump indentification of Band 6 during 2008~2015 using SV

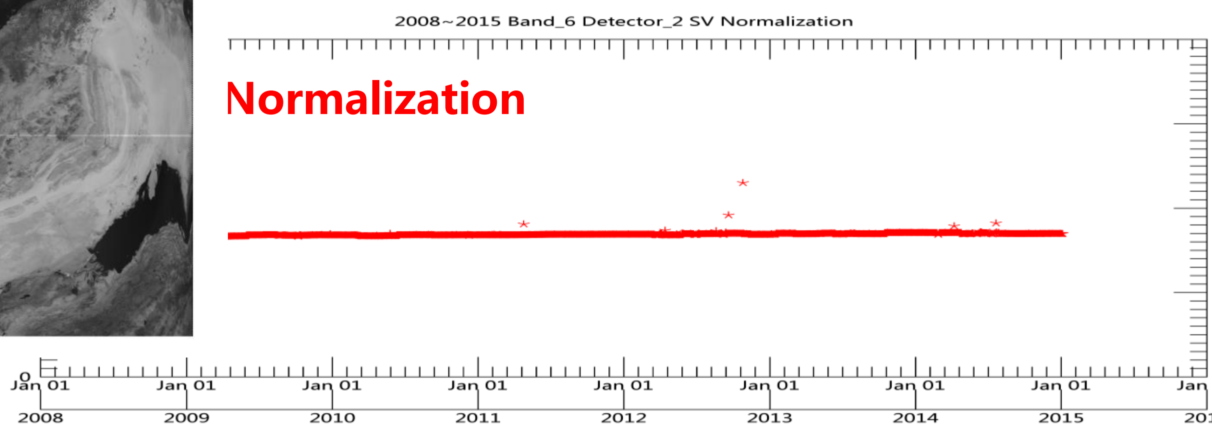


20120624 0730 Band_7 EV Original



20120624 0730 Band_7 EV Normalization



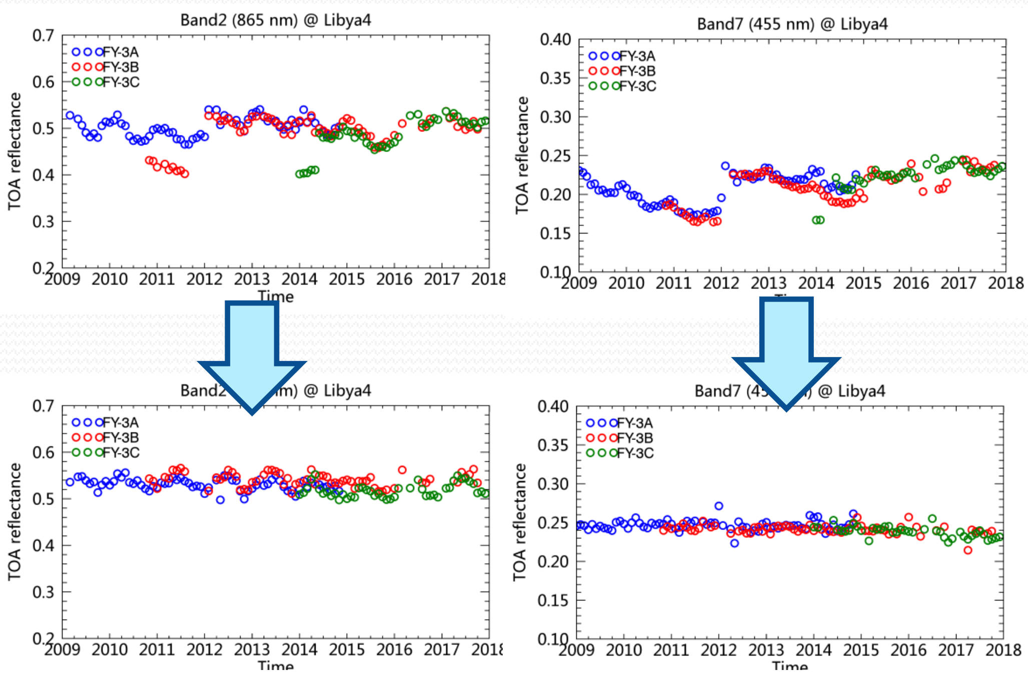


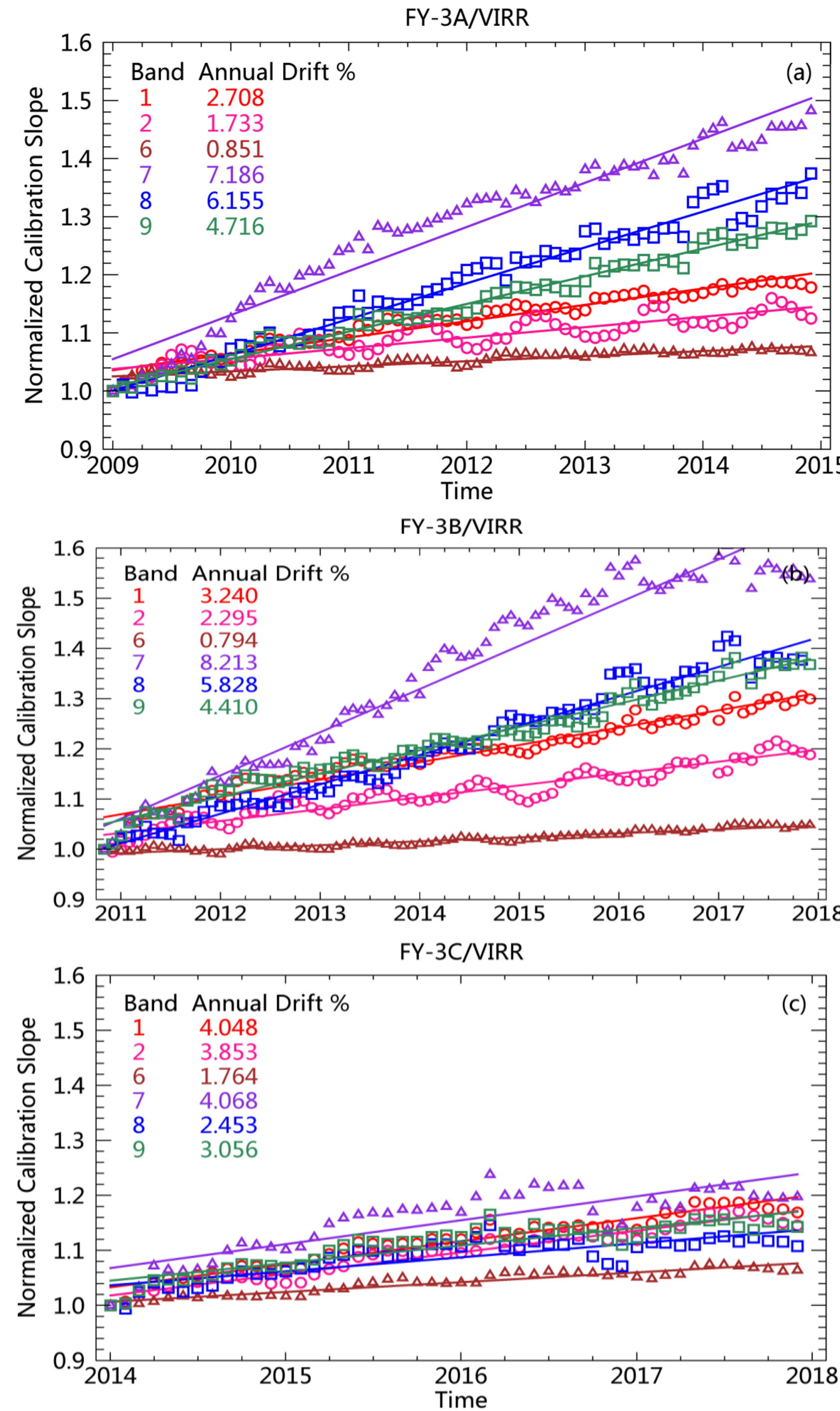
Jump events:
Band 6: 91 times,
Band 7: 18 times

(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.





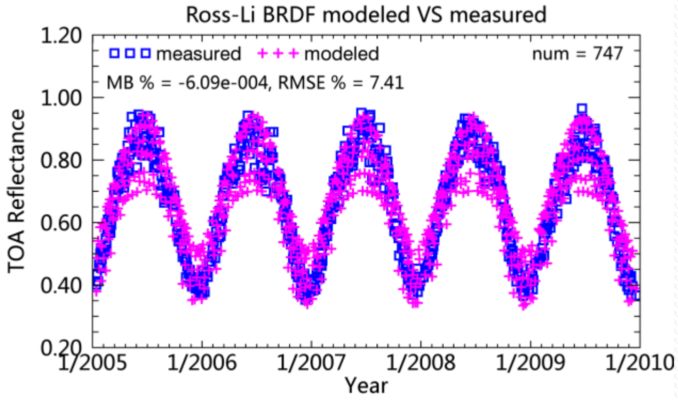
(Courtesy of Ling Wang et al. , 2018)

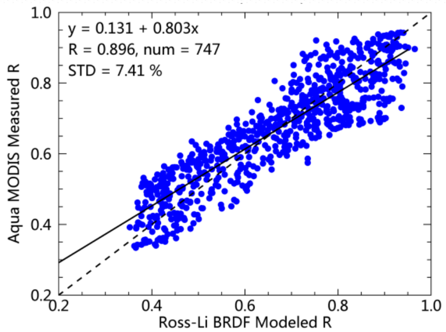
Tibet Glaciers TOA BRDF

Model selection

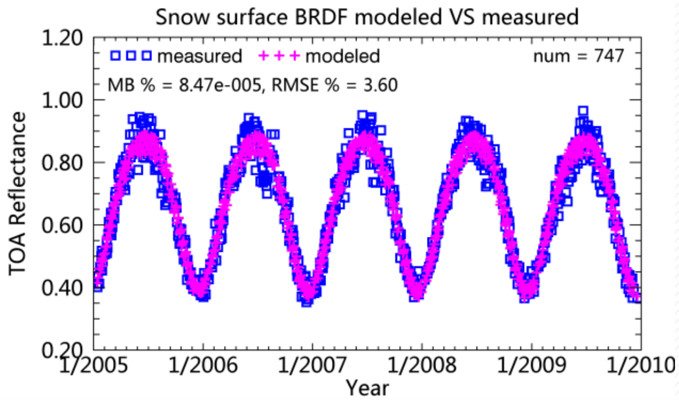
Simulation and Observed

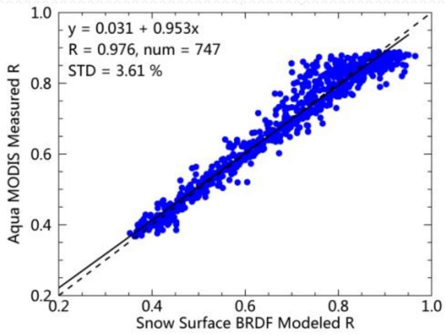
Ross-Li





Snow-surface

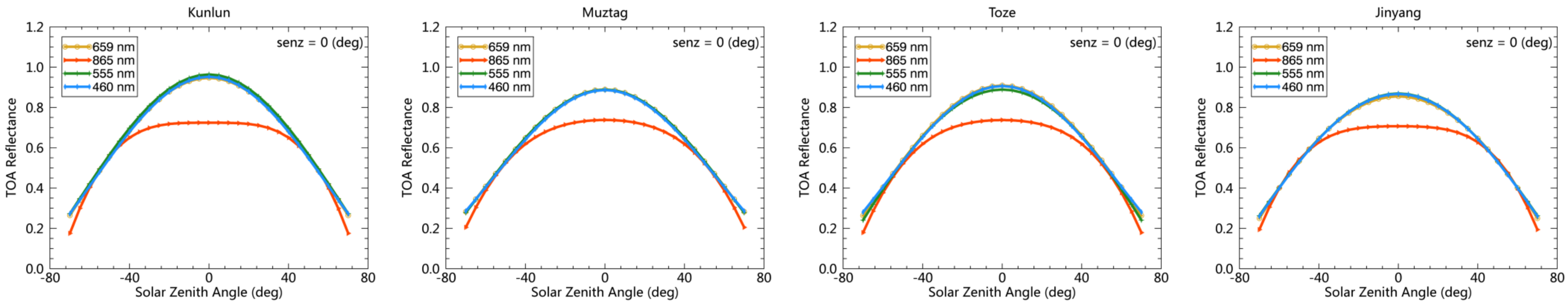




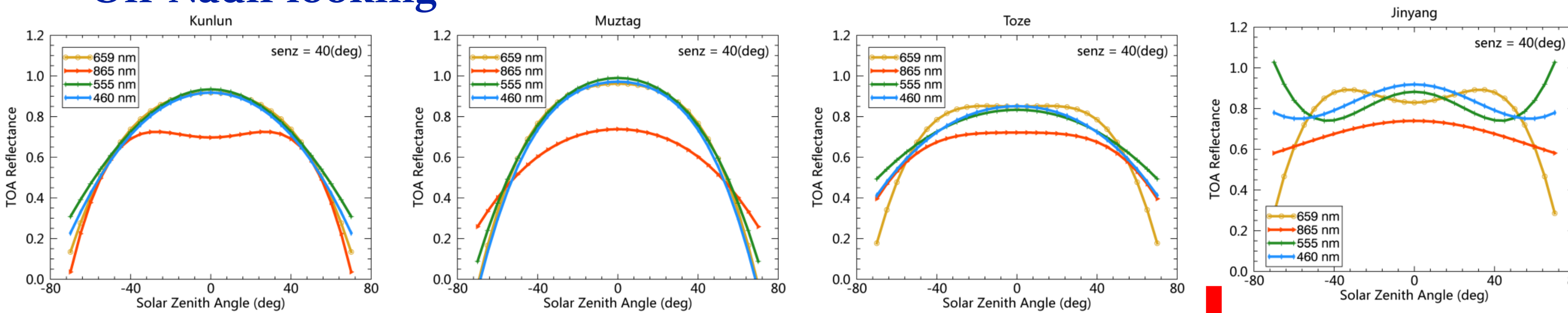
- Snow surface model has smaller bias than Ross-Li model with MODIS observation
- snow surface has smaller than 5% (~90% samples) , but Ross-Li is near 10%

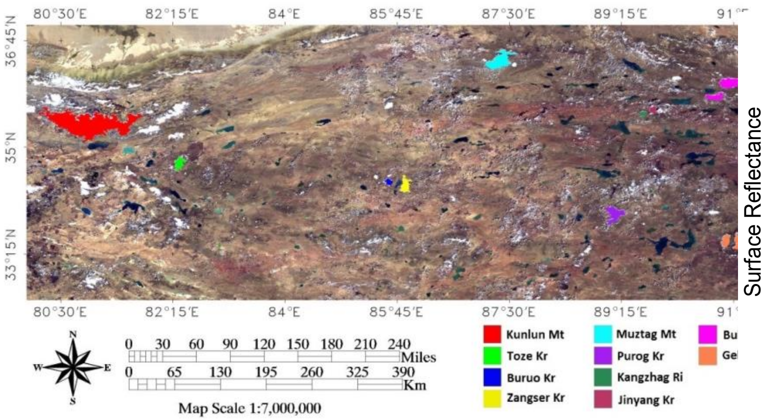
(Courtesy of Ling Wang et al. , 2018)

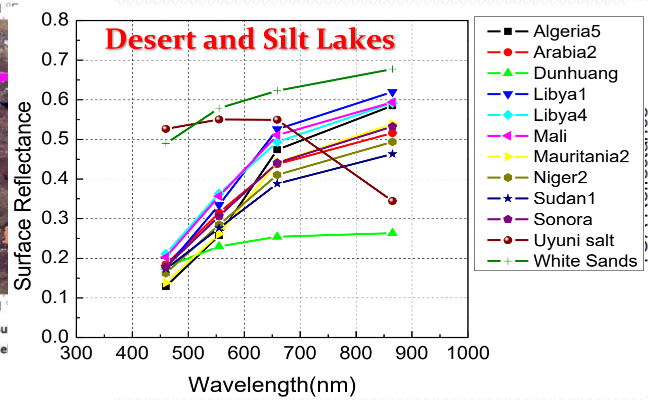
✓ Nadir looking

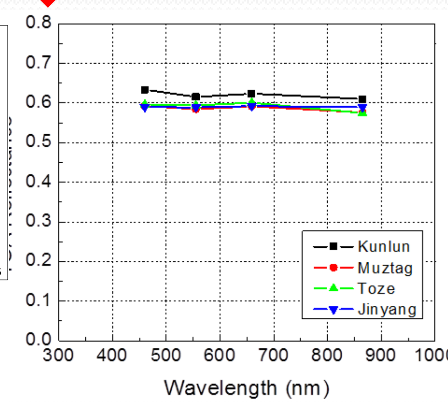


✓ Off-Nadir looking









(Courtesy of Ling Wang et al. , 2018)

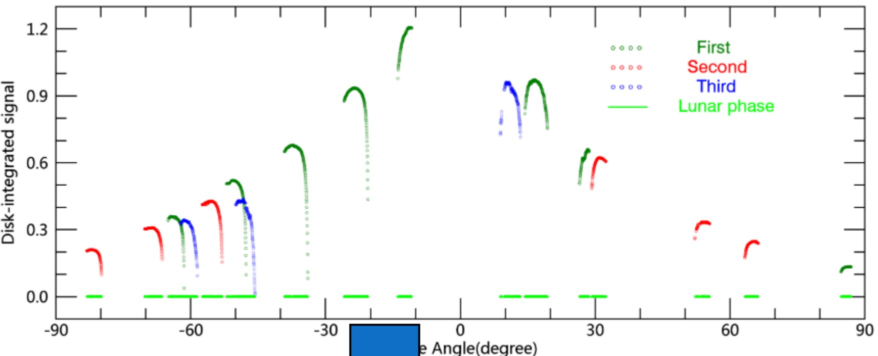
ScottHu Log out

GSICS/IVOS

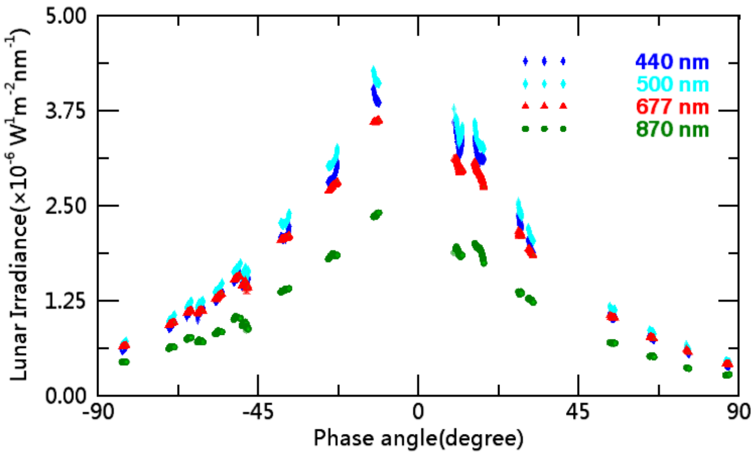
2nd Lunar Calibration Workshop

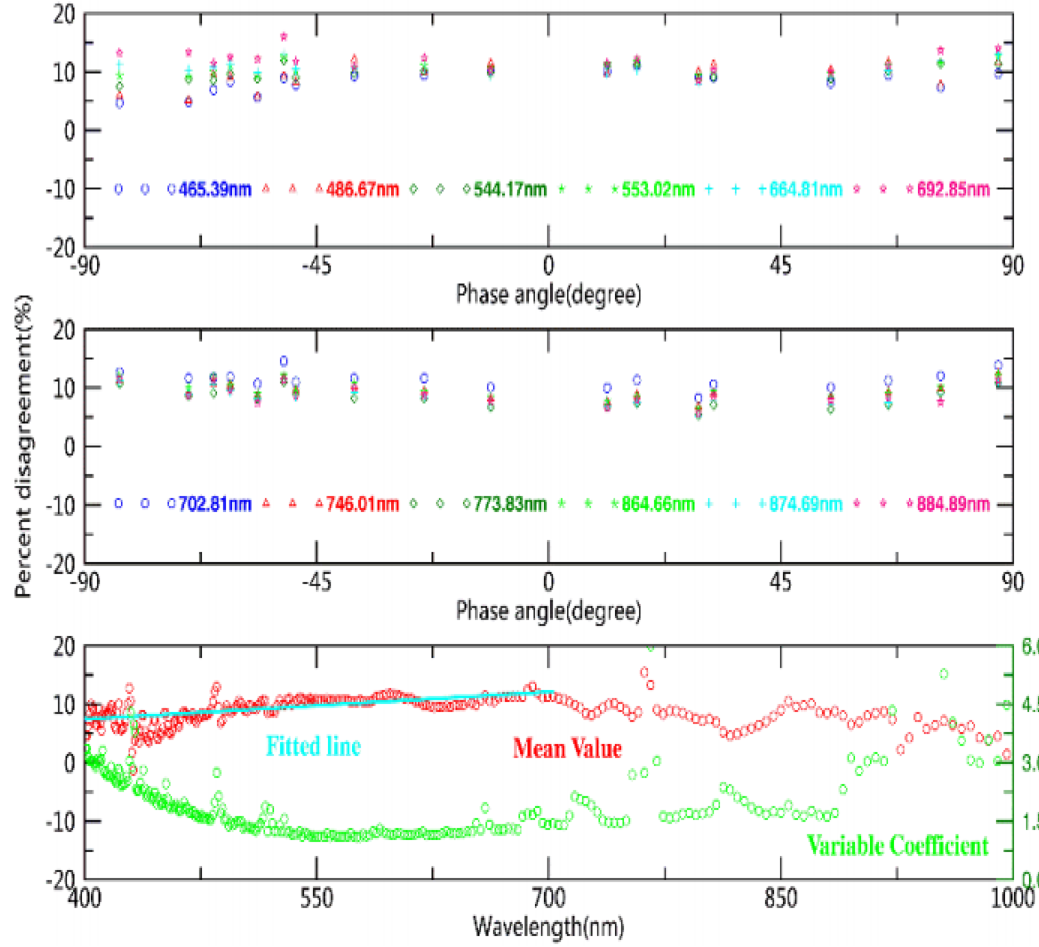
November 13-16, 2017 Xi'an, China

Ground-based Lunar Data processing and comparison with models



Atmosphere correction





(Courtesy of Yang Wang et al. , 2018)

Lunar observations in Lijiang:

Absolute：7-12%，shape ~**Mean value**

Relative：1-3% ~**Variable coefficient**

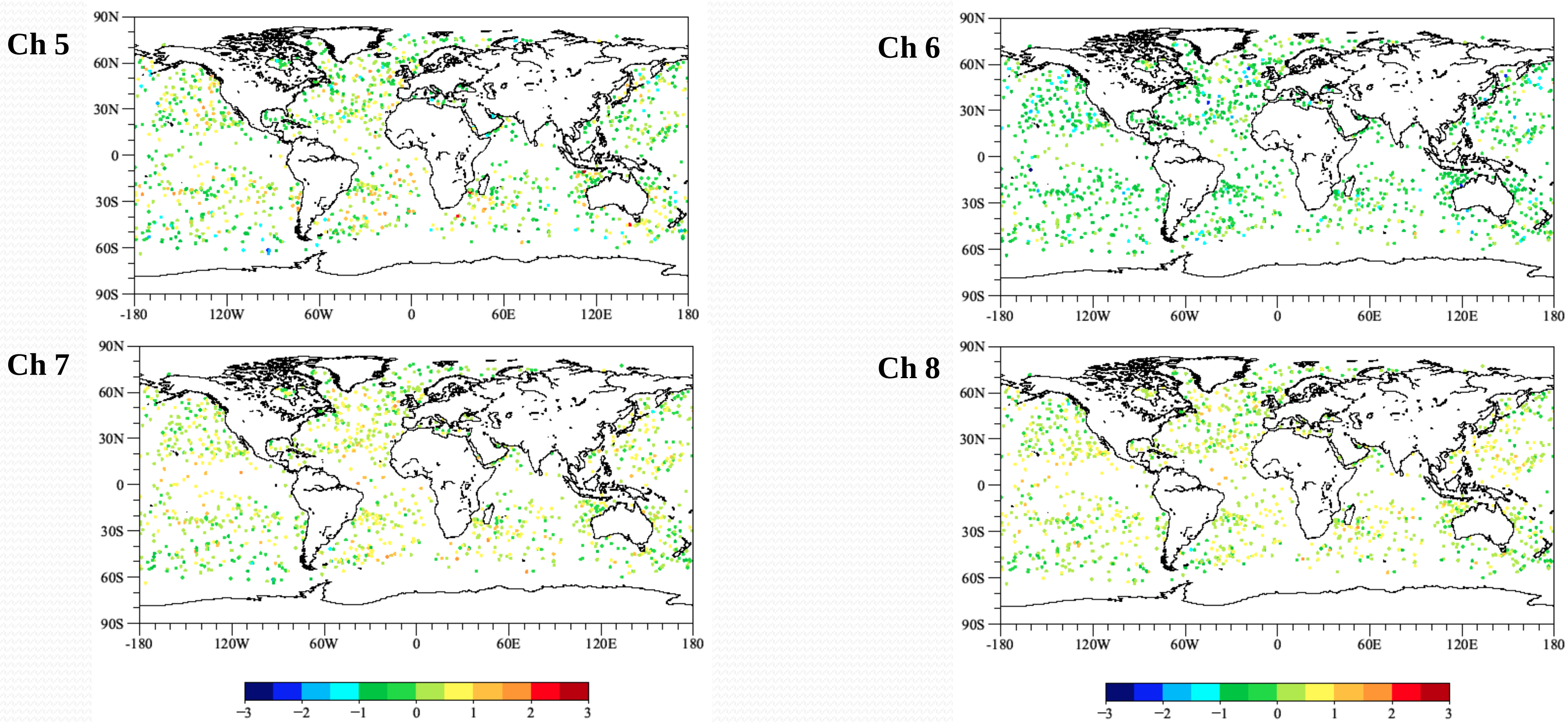
ROLO Over Time

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.

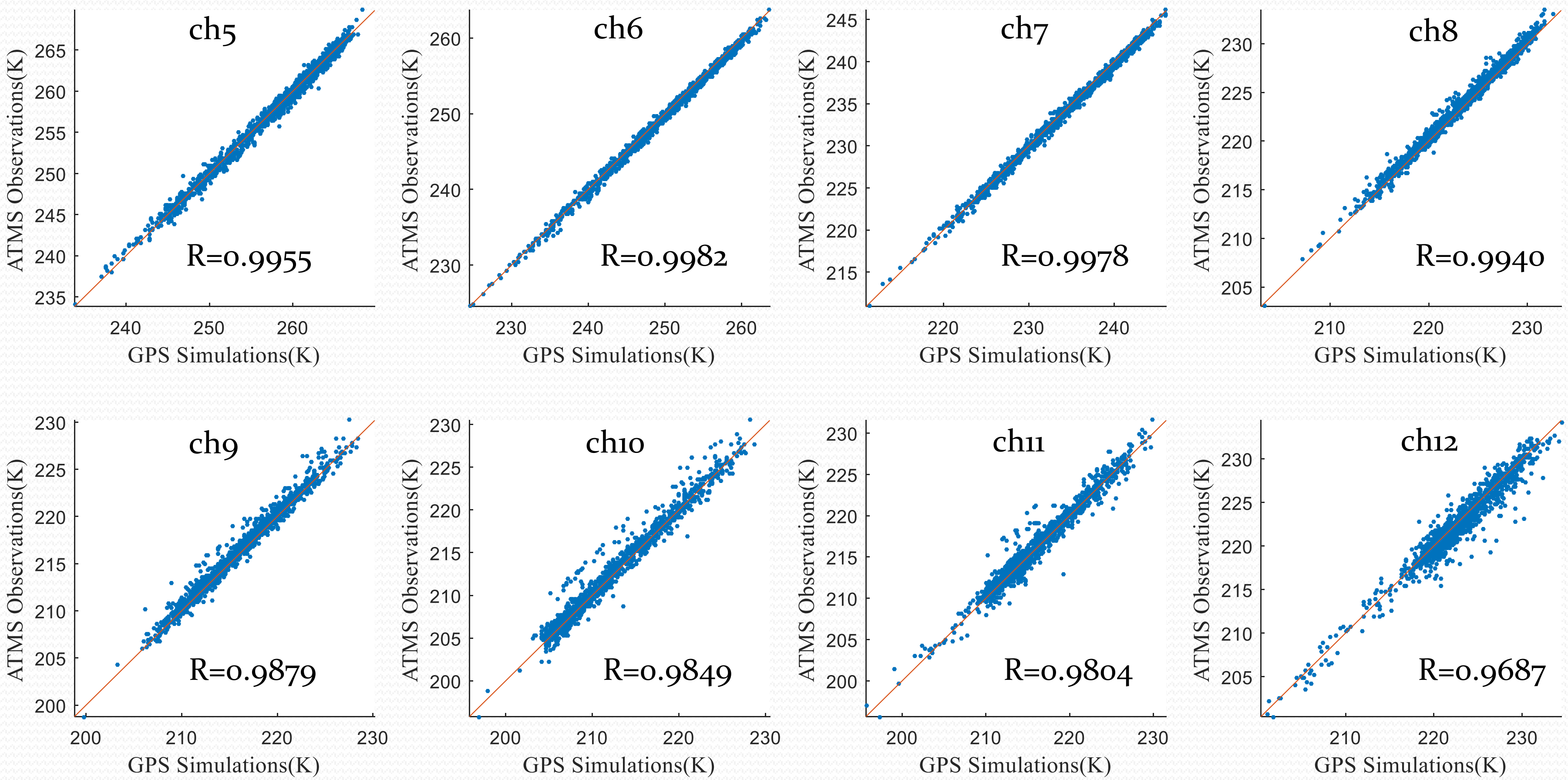
Use of FY-3C/GNOS Data for Assessing Sounders

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

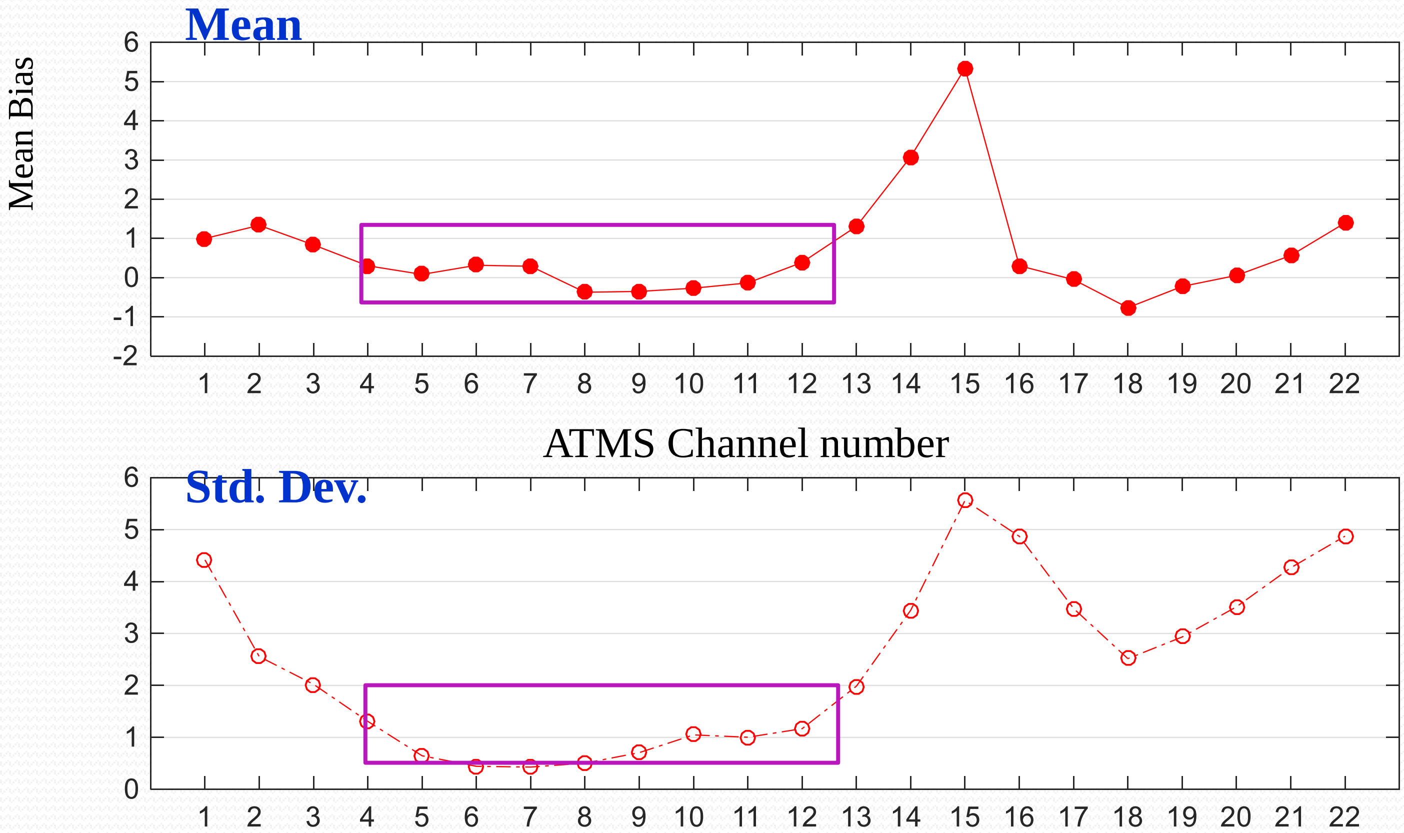


ATMS global bias is quite uniform and small, less than 0.5K

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



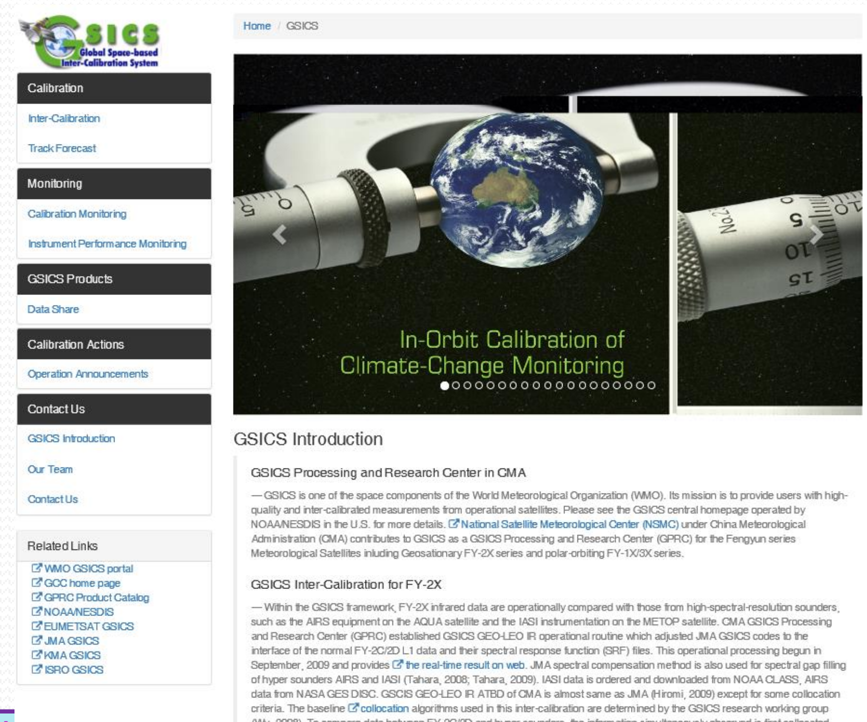
ATMS Mean Bias and Standard Deviation



While brightness temperatures at Suomi ATMS 22 channels are simulated, the results fo those channels affecting 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.

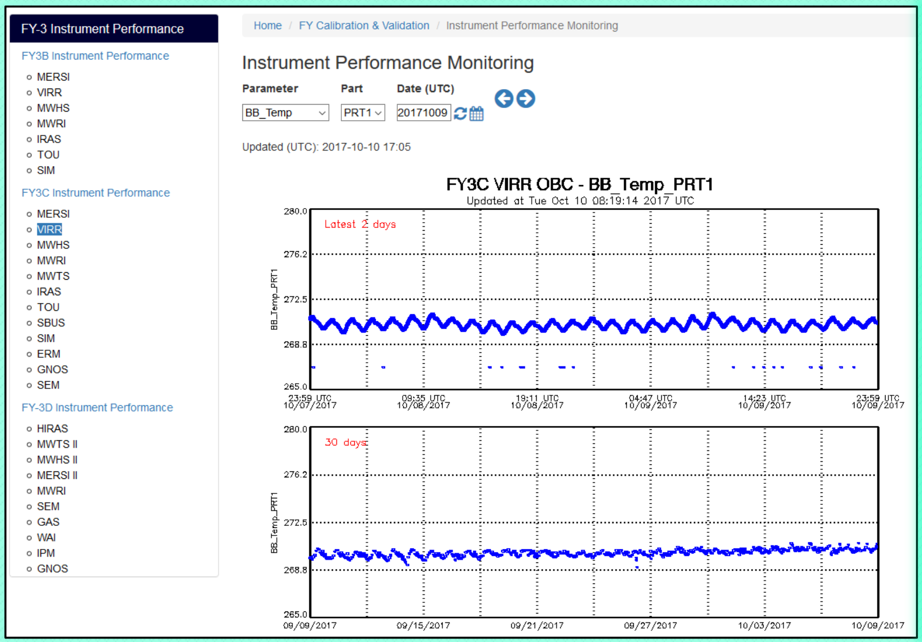
Data Group: CMA GPRC Website Update

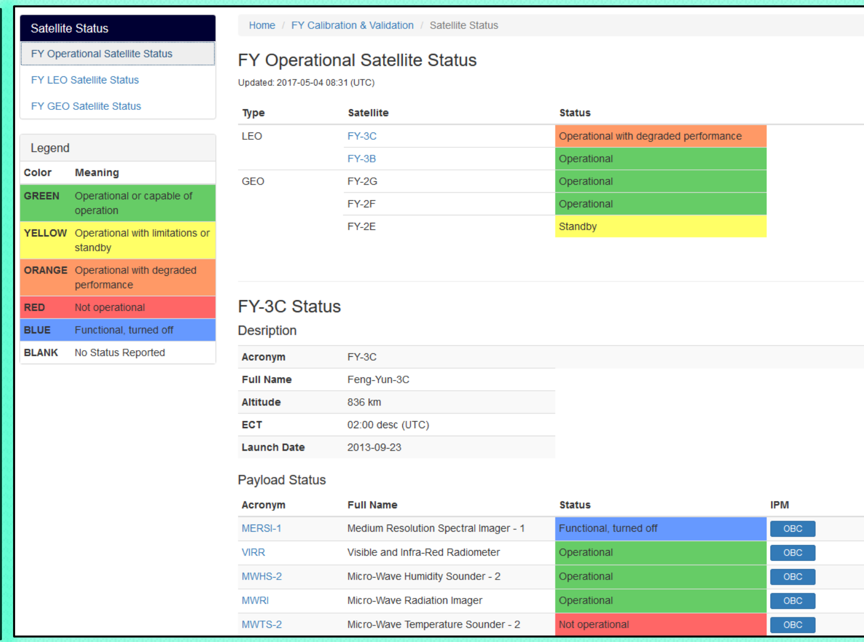
- Reviewed by GDWG Chair during 2017 annual meeting
- Fix error links, new webpage online http://gsics.nsmc.org.cn
- CMA GRWG: Content provider
- CMA GDWG: Website construction and operater
- Integrated into NSMC Web Portal, Servers operated by NSMC IT Dep.



New Contents on CMA GPRC Website

- Instrument Performance Monitoring
- Instrument Status



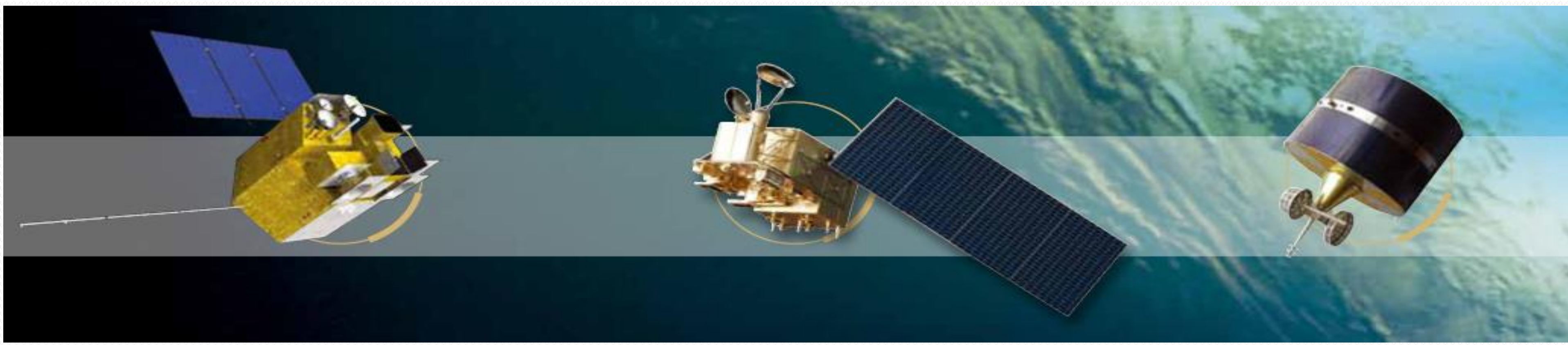


Look! CMA GSICS team!

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