



Committee on Earth Observation Satellites

Updated Status of CMA Satellite Programs

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CEOS Plenary 2017

Agenda Item # 4.15

Rapid City, South Dakota, USA

19 – 20 October 2017



GEO Programs

- FY-2D/E/F/G(op.)
- **FY-4A(R&D), new generation!**

LEO Programs

- FY-3A/B(R&D)
- FY-3C(op.), AM
- **FY-3D(op.), PM, coming soon!**

Others (cooperative missions)

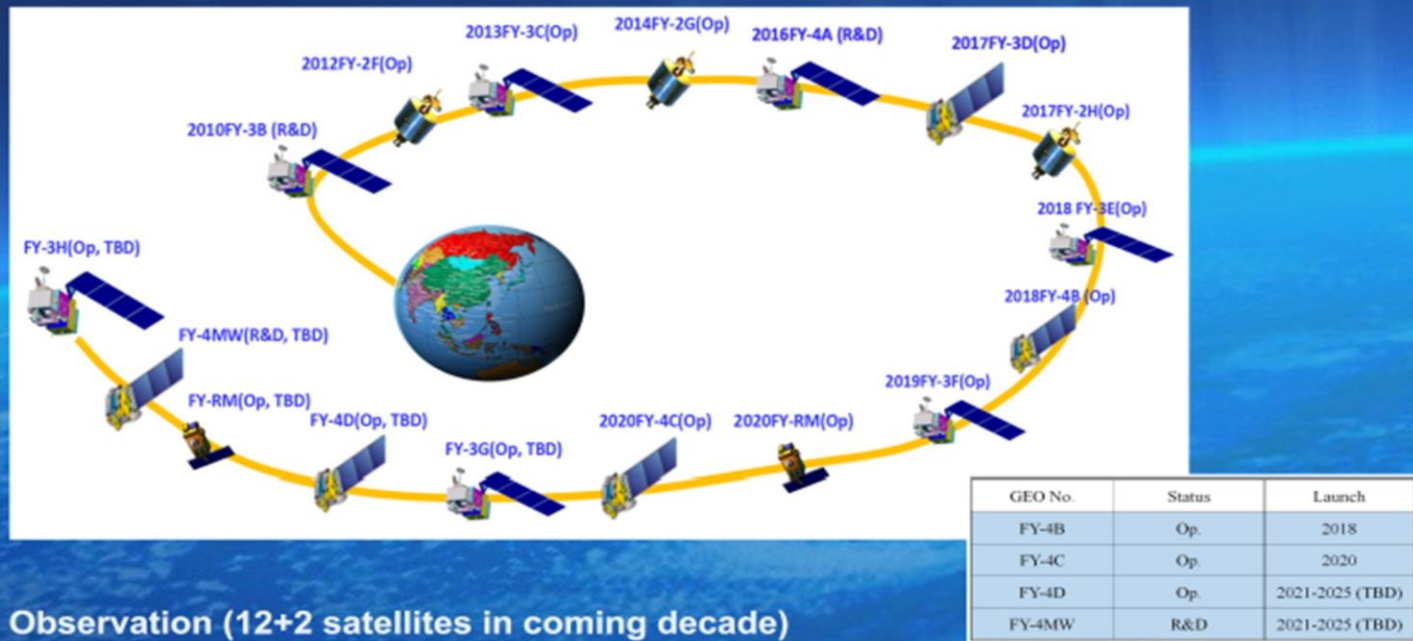
- **TANSAT(R&D), CO₂ & aerosol led by MOST**
- **GF-4 (R&D), High Spatial Res. Imaging In GEO led by CNSA**





Future Plan: National Space Infrastructure Plan (NSIP)

In 2015, the Chinese government has approved an extensive plan called NSIP, which will cover a number of earth observation satellite series including atmosphere, land, and ocean satellites in period of 2015-2025.



Atmosphere Observation (12+2 satellites in coming decade)

- Climate & Environment Monitoring Satellite series: FY-3 low earth orbit series (7)
- Weather Monitoring Satellite series: FY-4 geostationary orbit series (5)
- Air Quality Monitoring Satellite series : New Series (2)

LEO No.	Orbit	Status	Launch
FY-3D	PM	Op. planned	2017
FY-3E	EM	Op. planned	2018
FY-3F	PM	op. planned	2019
FY-RM	Inclined	R&D, Planned	2020
FY-3G	TBD	Op. planned	TBD
FY-3H	TBD	Op. planned	TBD



1. FY-4A

- The first GEO. meteorological satellite of new generation
- Launched on Dec.11, 2016

2. FY-3D

- The operational afternoon orbit LEO. satellite, will co-work with FY-3C in morning orbit.
- Launch date is scheduled in coming Nov. 2017!

3. TANSAT

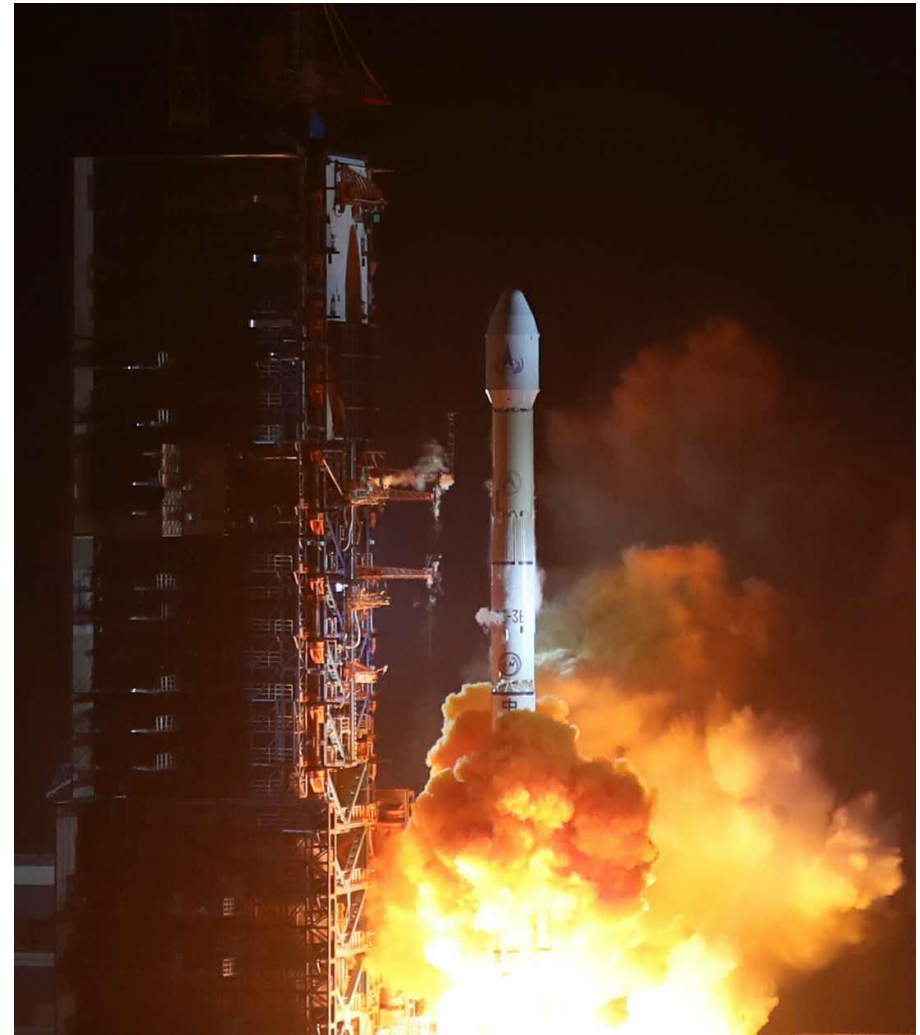
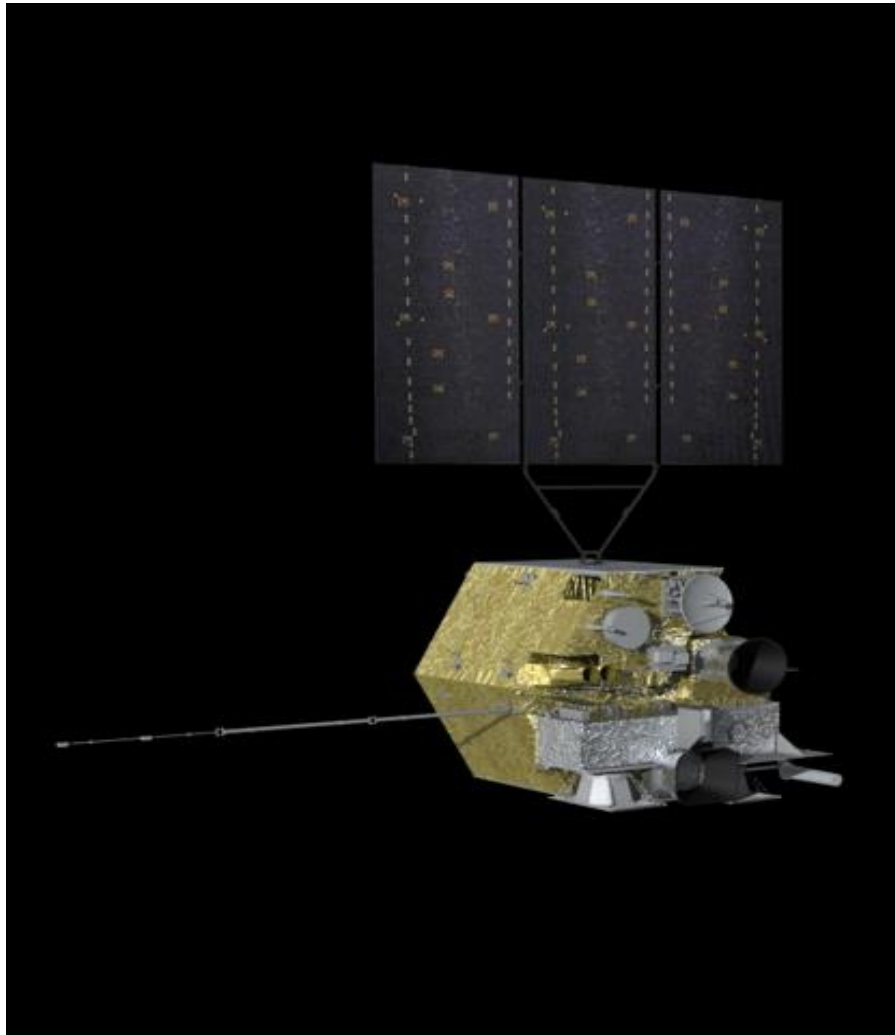
- A joint R&D satellite program initiated by MOST, and supported by CMA which is responsible for data reception, processing and distribution, taking advantage of current FY-3 ground segment resources.
- Launched successful on Dec.22, 2016

4. GF-4

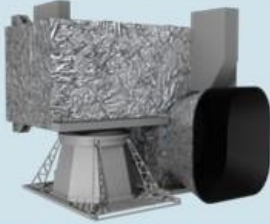
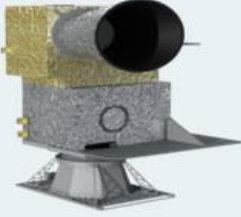


- The 4th satellite in High res. Earth Obs. Satellite Project led by CNSA, while CMA is responsible for data reception, transmission and preprocessing of MET mode.
- Launched in Dec. 29,2015
- Commissioning test finished and handover declared on June 1st, 2016

FY-4A: The First CMA New-generation Geostationary Meteorological Satellite

Launched on Dec.11,2016,Located at 105E , will be ready for operation soon!





Instrument	Purposes	
	<p>AGRI: <i>Advanced Geosynchronous Radiation Imager</i></p>	<p>14 -channel Earth images</p>
	<p>GIIRS: <i>Geostationary Interferometric InfraRed Sounder</i></p>	<p>Clear-sky atmospheric temperature and humidity profiles</p>
	<p>LMI: <i>Lightning Mapping Imager</i></p>	<p>Lightning distribution map in China area</p>
	<p>SEP: <i>Space Environment Package</i></p>	<p>Space electric and magnetic environment information</p>



FY-4A GEOSTATIONARY METEOROLOGICAL SATELLITE

The First Colour Composite Image of FY-4A AGRI

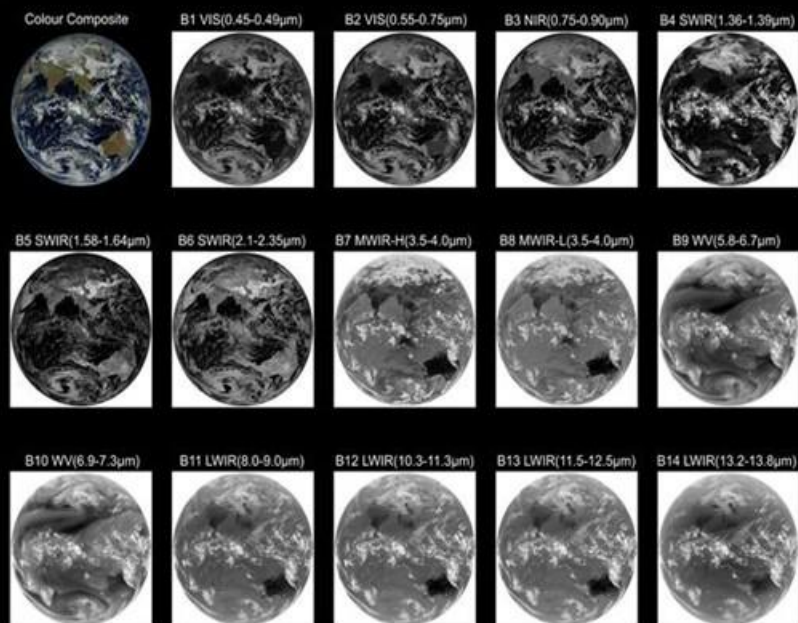


February 20th, 2017 05:15 (UTC)



FY-4A GEOSTATIONARY METEOROLOGICAL SATELLITE

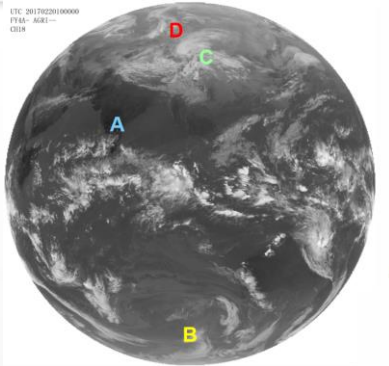
The First Images of FY-4A AGRI



February 20th, 2017 05:15(UTC)

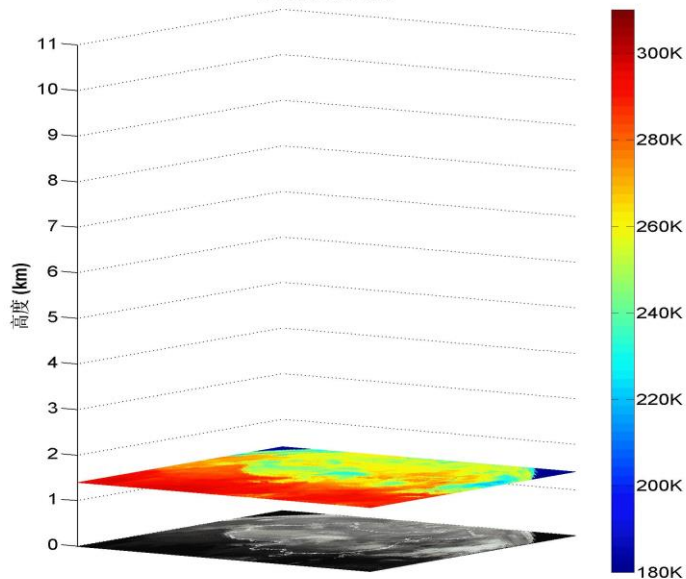


GIIRS: Geo. Interferometric Infrared Sounder

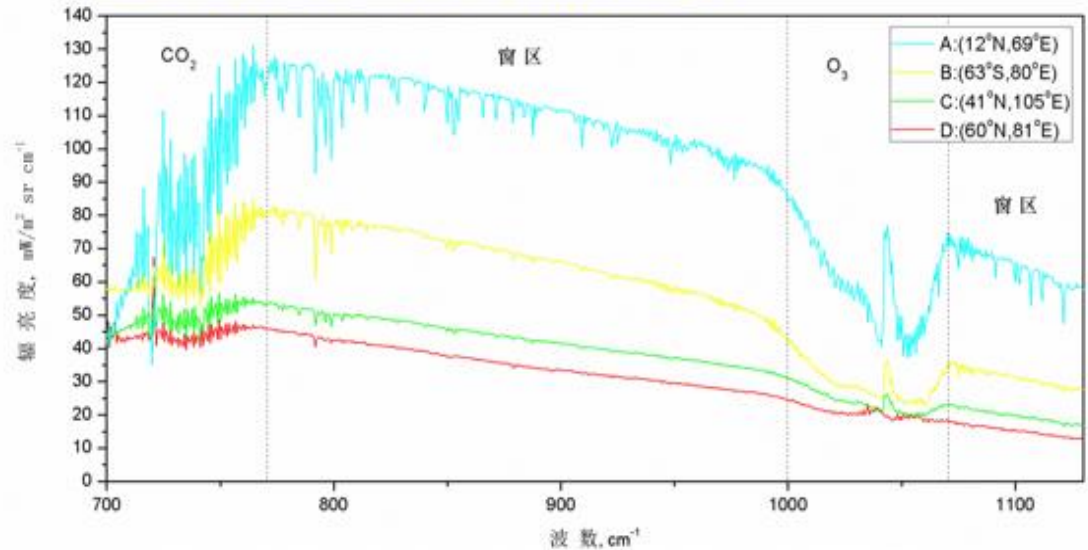


Spatial resolution: 16km,
Spectral resolution 0.625

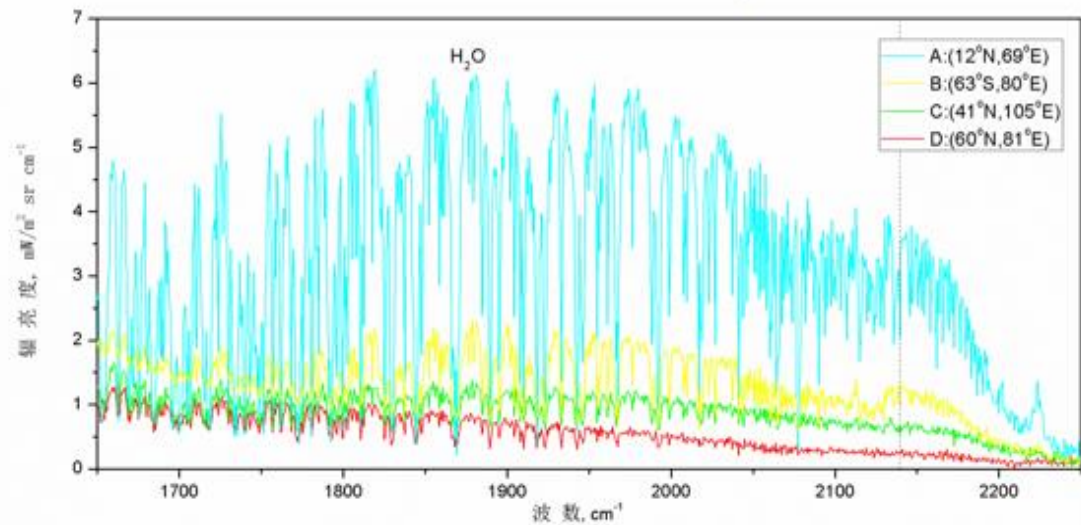
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Longwave IR 700-1130 cm^{-1} , 8.85-14.29 μm)



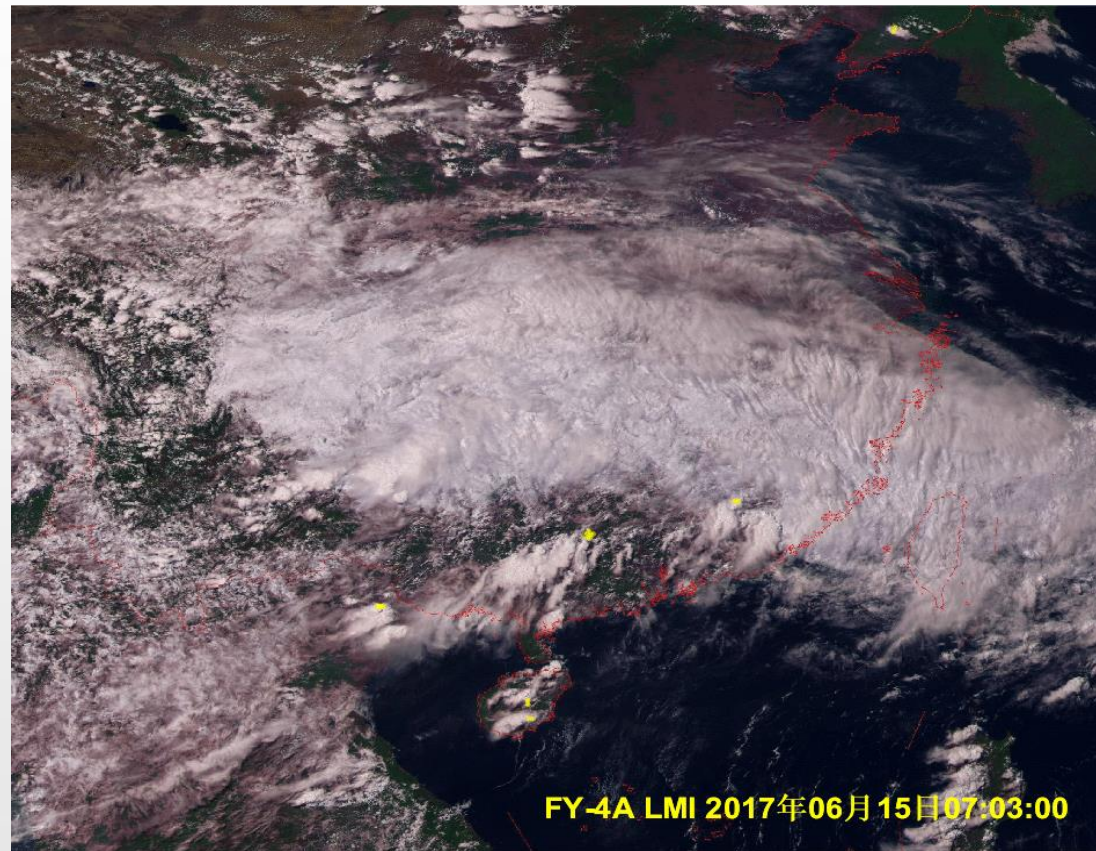
Middle Wave IR (1650-2250 cm^{-1} , 4.44-6.06 μm)





LMI

Acquire lightning
distribution maps over china
region



Spatial resolution	about 7.8 km at SSP
Wave-length at center	777.4nm
Band-width	1nm±0.1nm
Detection efficiency	>90%
False-alarm ratio	<10%
Dynamic range	>100
SNR	≥6
Frequency of frames	2ms (500 frames per sec.)
Quantization bits	12
Measurement error	10%



AGRI baseline products (25)

Clear Sky Masks

Cloud Type

Cloud Optical Depth

Cloud Liquid Water

Cloud Particle Size Distribution

Cloud Phase

Cloud Top Temperature

Cloud Top Height/Pressure

Fog Detection

Aerosol Detection

Aerosol Optical Depth

Tropopause Folding

AGRI baseline products (cont.)

Surface Solar Irradiance

Blackbody Brightness Temp.

Outgoing Longwave Radiation

Downward Longwave Radiation

Upward Longwave Radiation

Reflected Shortwave Radiation

Land Surface Temperature

Sea Surface Temperature

Land Surface Temperature

Land Surface Albedo

Land Surface Emissivity

Snow Cover

Fire/Hot Spot

GIIRS baseline products (10)

Temperature Profile

Moisture Profile

Ozone Profile

Total Ozone

Total Precipitable Water

Lifted Index

CAPE index

K index

SI index

TT index

LMI baseline products (3)

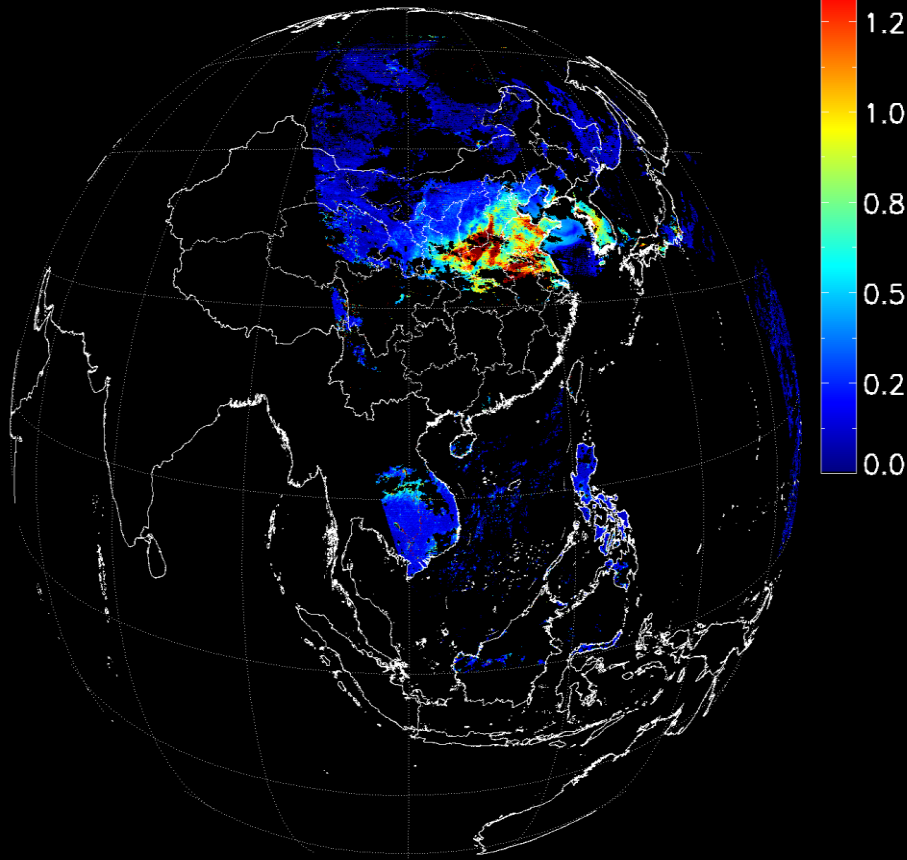
Flash

Group

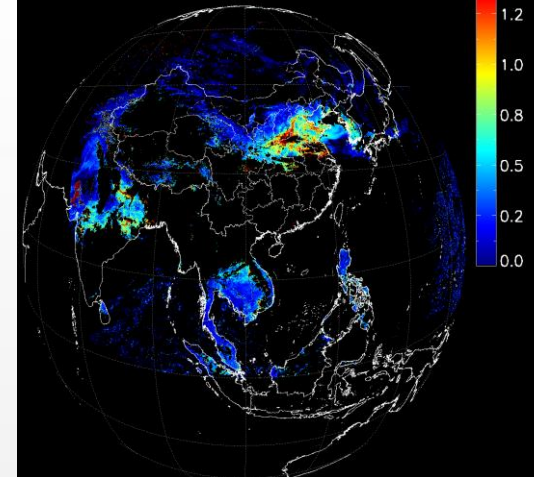
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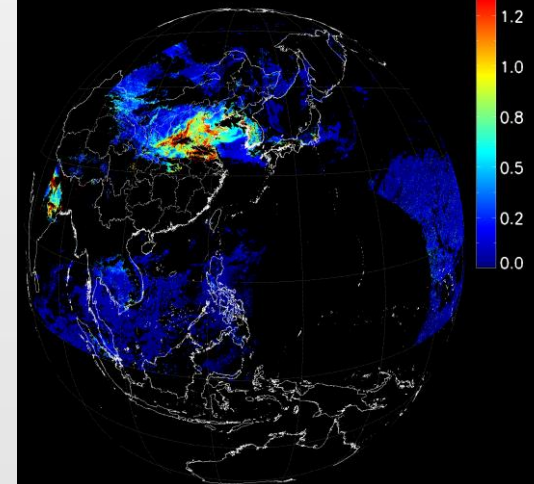
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FY-4A_Aerosol_Optical_Depth
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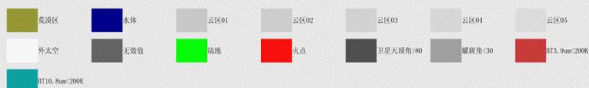
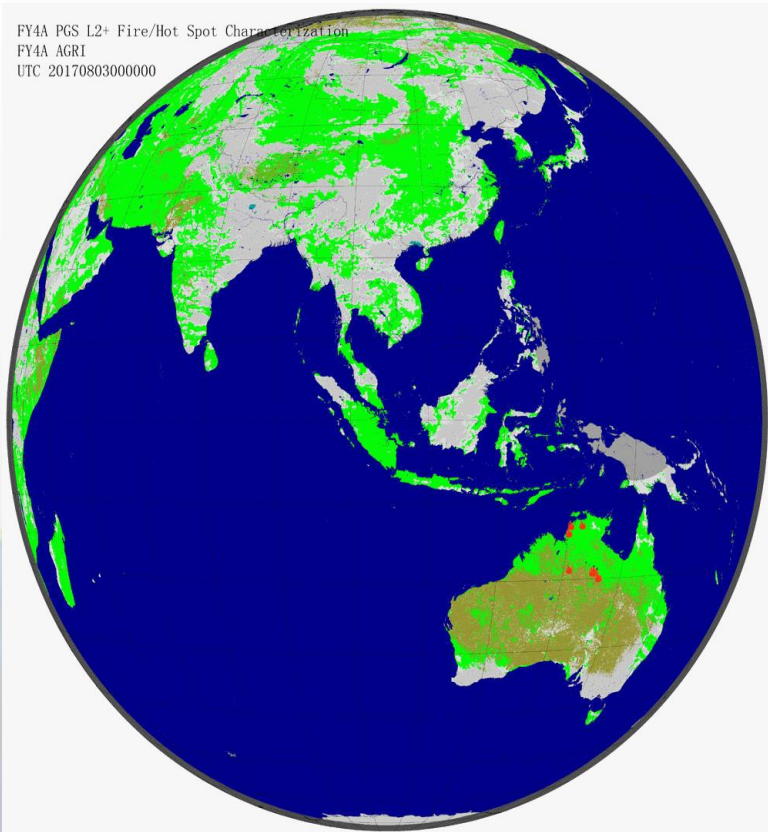


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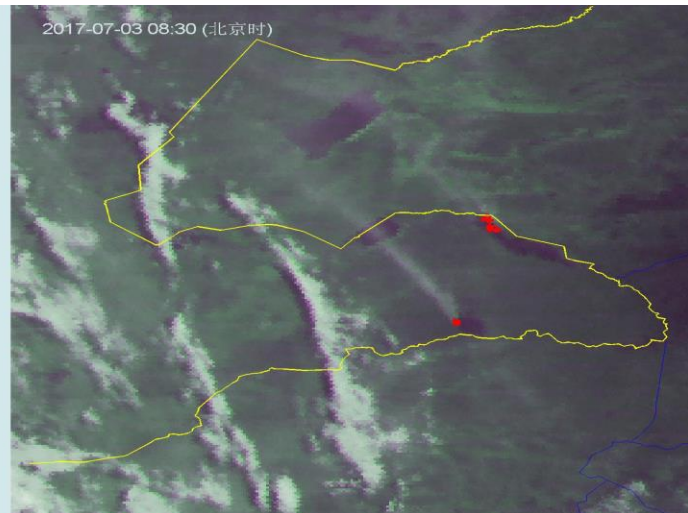




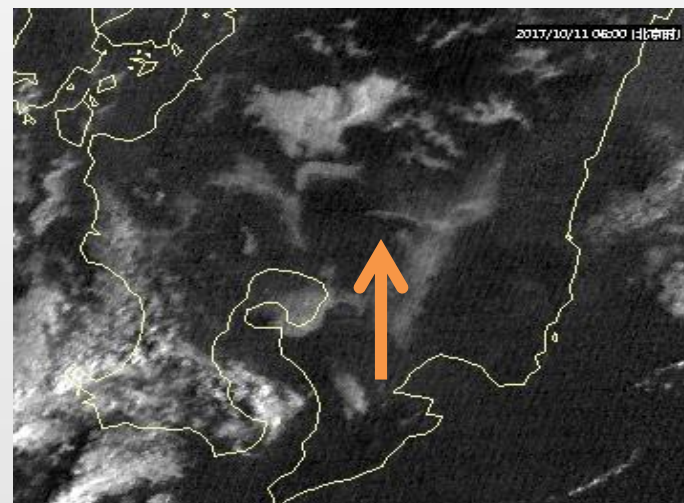
FY4A PGS L2+ Fire/Hot Spot Characterization
FY4A AGRI
UTC 20170803000000

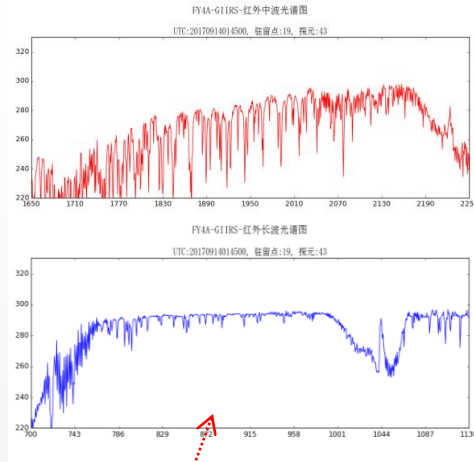


2017-07-03 08:30 (北京时间)

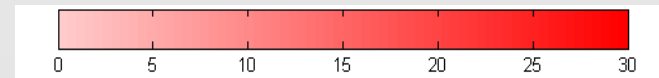
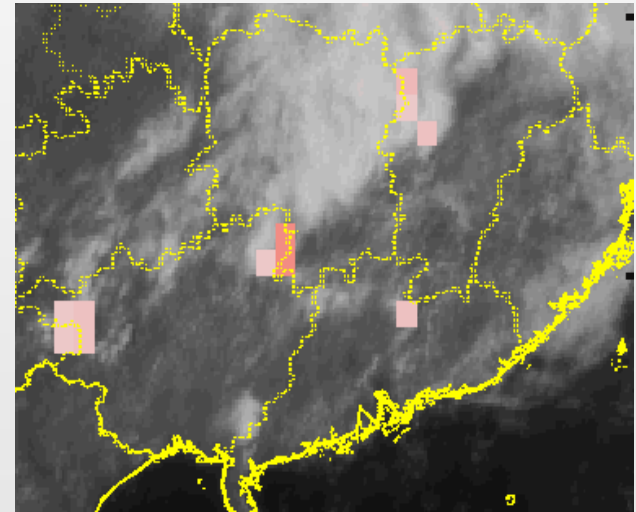
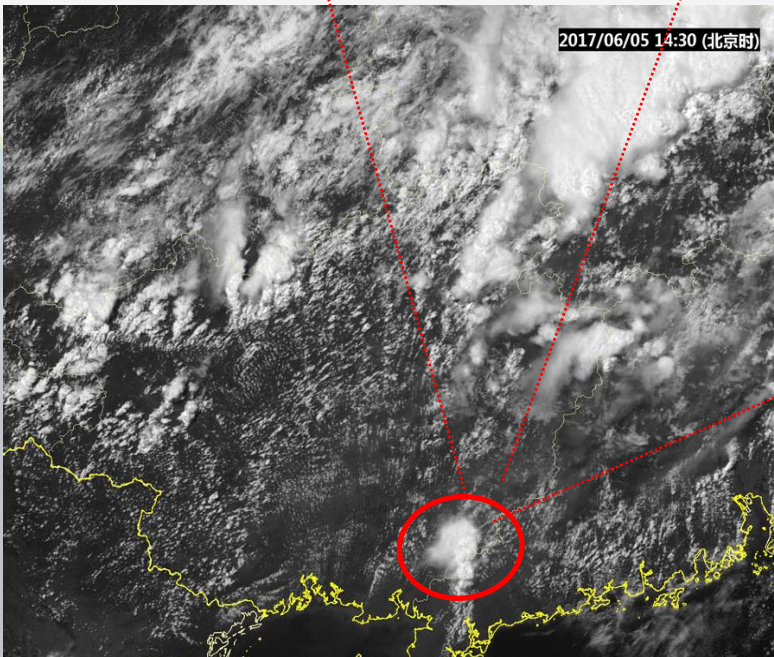


2017/10/11 06:00 [北京时间]





1. FY-4A lightning frequency map: strong convective cloud clusters often accompany with obvious lightnings.
2. FY-4A high spatial resolution imager: finer structure and texture of strong convective cloud cluster; and clearer small scale cumulus line.
3. Cloud free atmospheric profile acquired from GIIRS can be used for nowcast warning.



10 instruments on board FY-3D:

▣ Successive instruments:

MWTS-II: Microwave Temperature sounder

MWHS-II: Microwave Humidity sounder

MWRI: Microwave Radiation Imager

GNOS: Global Navigation Occultation Sounder

SEM: Space Environment Monitor

▣ Improved instruments:

MERSI-II: Improved from MERSI

HiRAS: Upgraded from filter-type spectrometer

IRAS

▣ New Instruments:

GAS: Greenhouse gases Absorption Spectrometer

WAI: Wide-angle Aurora Imager

IPM: Ionospheric Photometer



MERSI → MERSI-II

continuity and Evolution

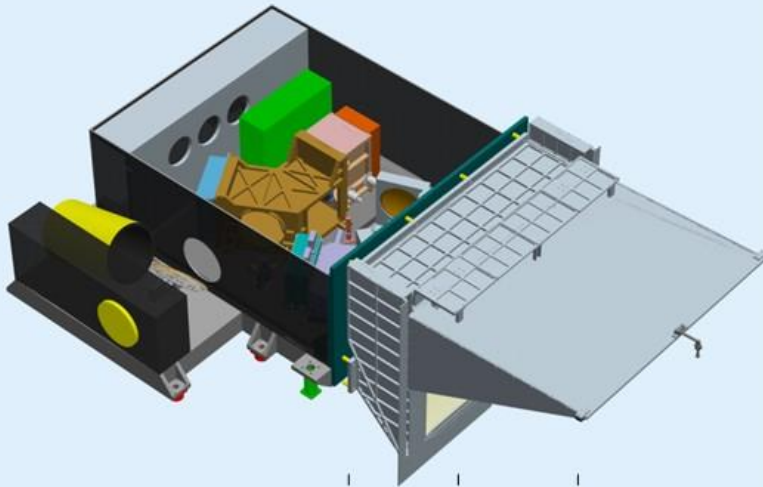


MERSI-2 Improvement:

- Cover all bands in FY-3A/B/C MERSI
- Five more IR bands
- Cirrus cloud band 1.38um
- Water vapor bands In NIR and 7.2um
- Two IR split windows with 250m spatial resolution
- Higher accuracy from onboard calibration
- Lunar Calibration capability

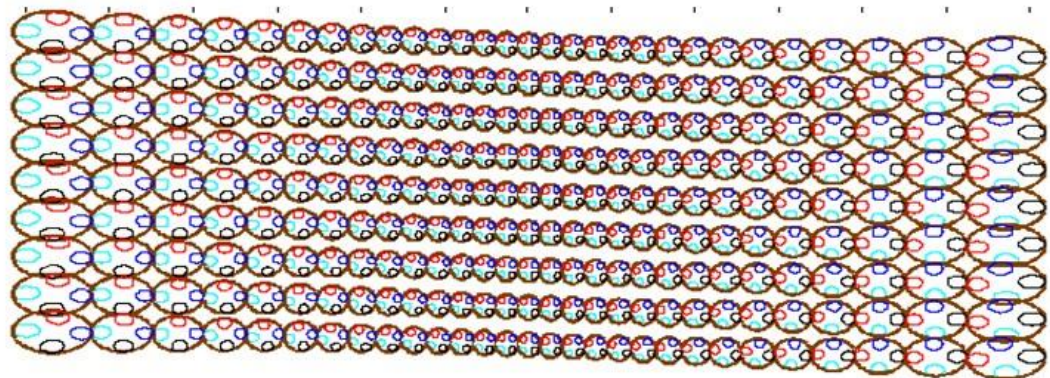
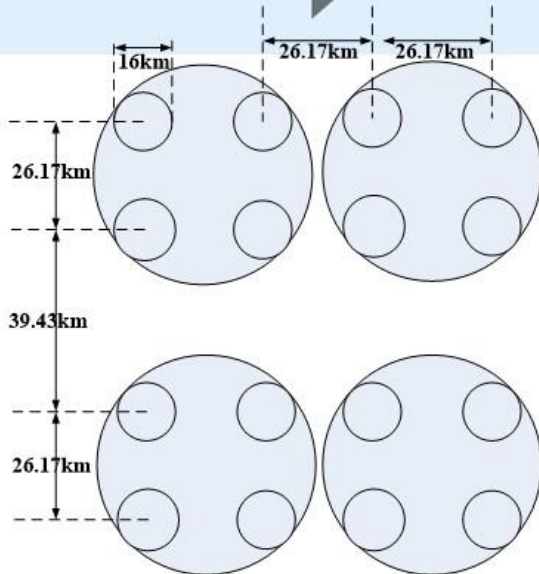
Band	SNPP VIIRS	FY-3D MERSI-II	FY-3A/B/C MERSI
1	DNB	0.470	0.470
2	√	0.550	0.550
3	√	0.650	0.650
4	√	0.865	0.865
5	×	1.03	11.25
6	√	1.64	1.640
7	√	2.13	2.130
8	√	0.412	0.412
9	√	0.443	0.443
10	√	0.490	0.490
11	√	0.555	0.520
12	√	0.670	0.565
13	√	0.709	0.650
14	√	0.746	0.685
15	√	0.865	0.765
16	×	0.905	0.865
17	×	0.936	0.905
18	×	0.940	0.940
19	√	1.38	0.980
20	√	3.8	1.030
21	√	4.05	
22	×	7.2	
23	√	8.550	
24	√	10.8	
25	√	12.0	

■ 250 m
■ 1000 m



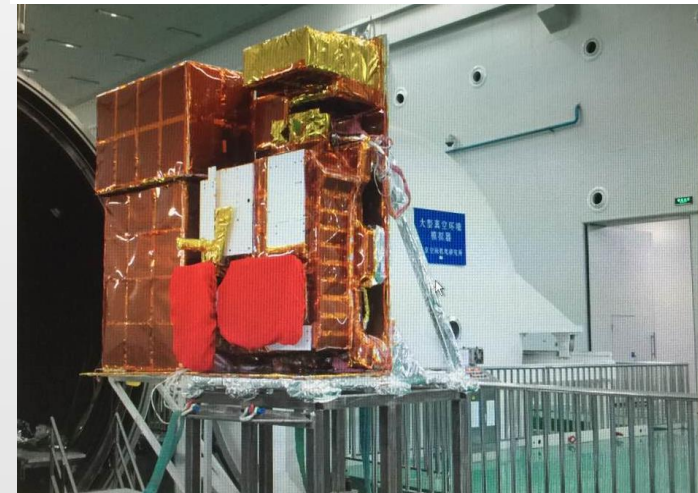
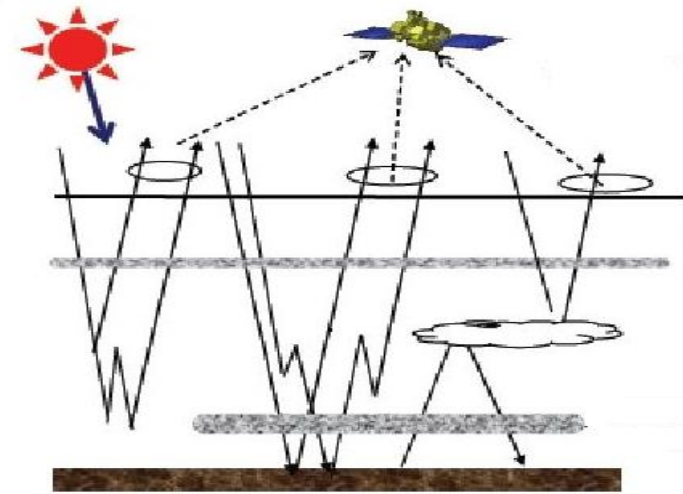
Items	Specification
Scanning cycle	10 s (33 FORs)
FOV	1.1° (16Km)
Scanning Line	29*4 FORs
Max Scanning Range	± 50.4°

Band	Spectral range (cm-1)	Resolution (cm-1)	NEΔT @250K	chs
Longwave	650 * – 1136 (15.38 μm-8.8 μm)	0.625	0.15K	778
Midwave1	1210 – 1750 (8.26μm-5.71 μm)	1.25	0.1K	433
Midwave2	2155-2550 (4.64μm-3.92 μm)	2.5	0.3K	159





- **Objectives:** to measure CO₂ and CH₄ column density by using a SWIR Interferometer
- **Spectral res.:** 0.2 cm⁻¹
- **Spatial res.:** 13km
- **Number of Bands:** 4

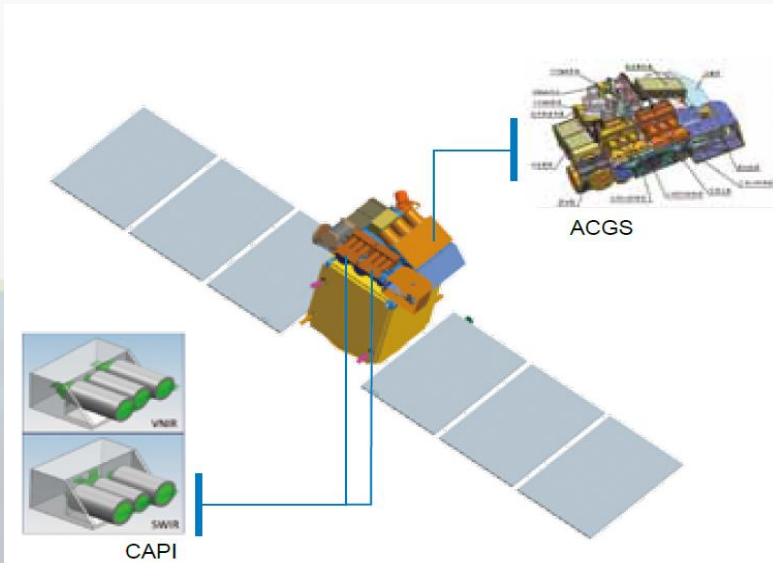


Specification	FY-3D GAS	FY-3G GAS-II	TanSat	OCO	
Spectral bands (μm)	0.76	√	√	√	√
	1.6	√	√	√	√
	2.0	√	√	√	√
	2.3	√	√	—	—
Spectral Resolution (nm) @1.6μm	0.073	0.07	0.12	0.0757	
Spatial Resolution (km)	13.2	< 3	2	1	
Swath(km)	----	>100	20	10	
Sample points	7	----	9	8	
Sample interval (S)	2.2	----	0.3	0.333	



TANSAT A joint mission by: **MOST**(Ministry Of Science and Technology), **CAS**(Chinese Academy of Science), and **CMA**.

Mission objective: To retrieve the atmosphere column-averaged CO₂ dry air mole fraction (XCO₂).



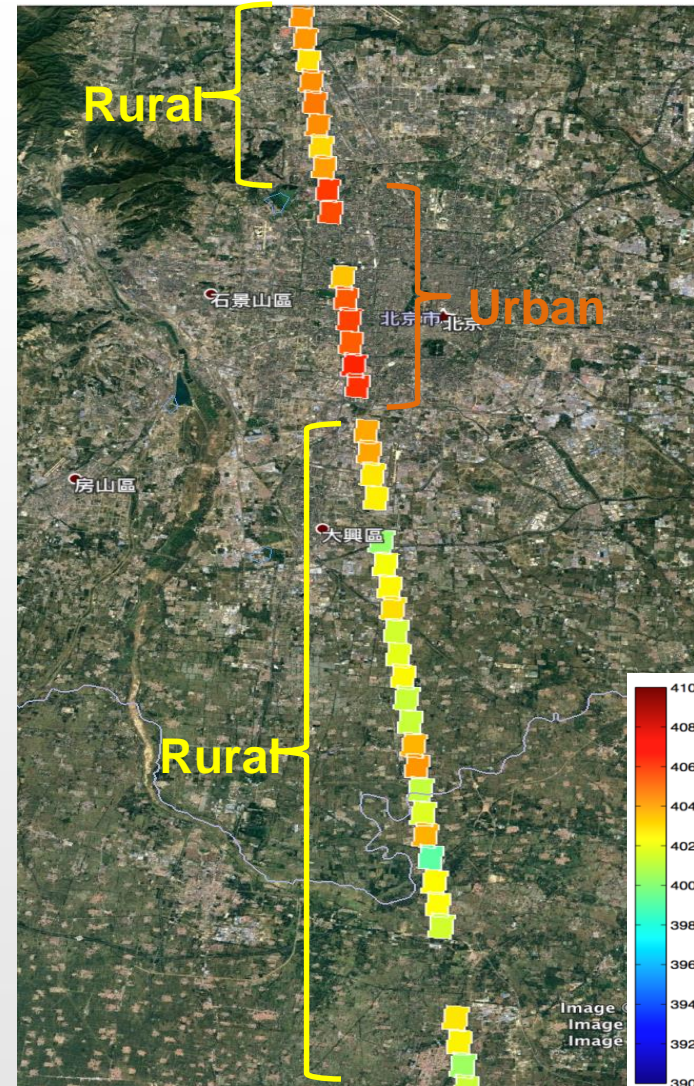
1)ACGS(Atmospheric CO₂ Grating Spectrometer) is mainly used to measure atmospheric CO₂. It has three spectral bands. One is the oxygen A-band with a centroid wavelength of 760nm. The other two are weak and strong carbon dioxide absorbing bands with centroid of 1610nm and 2060nm.

2)CAPI(Cloud and Aerosol Polarization Instrument) is a 5-channel UV/VIS/ NIR/SWIR radiometer with three polarizations in two channels

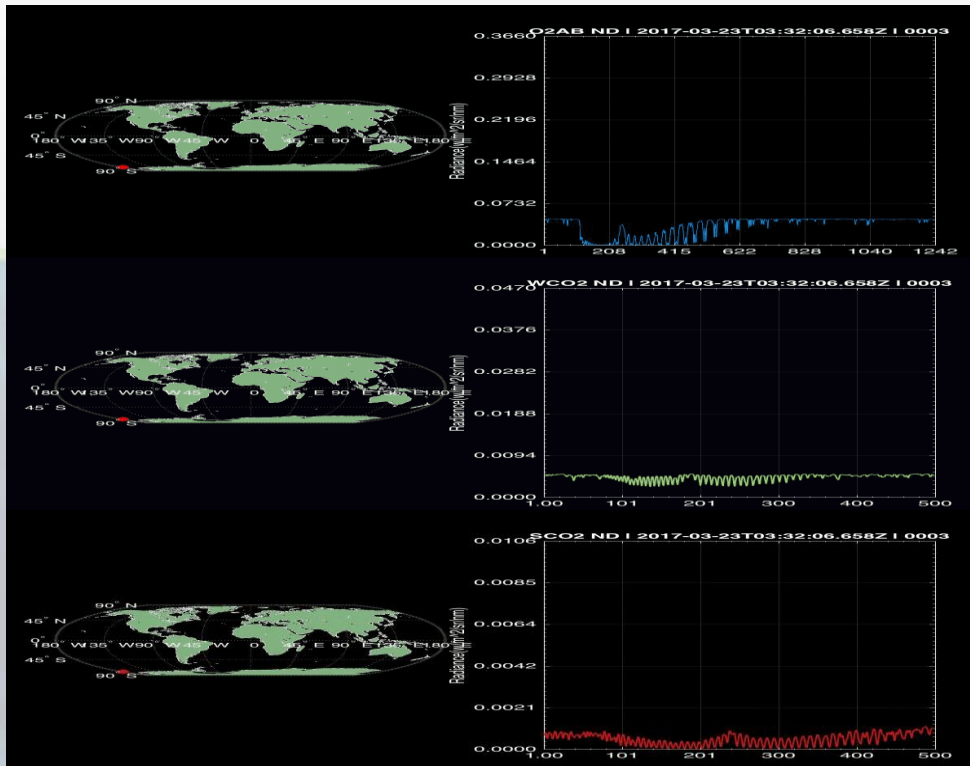
TANSAT satellite was
successfully Launched in
Dec. 22, 2016



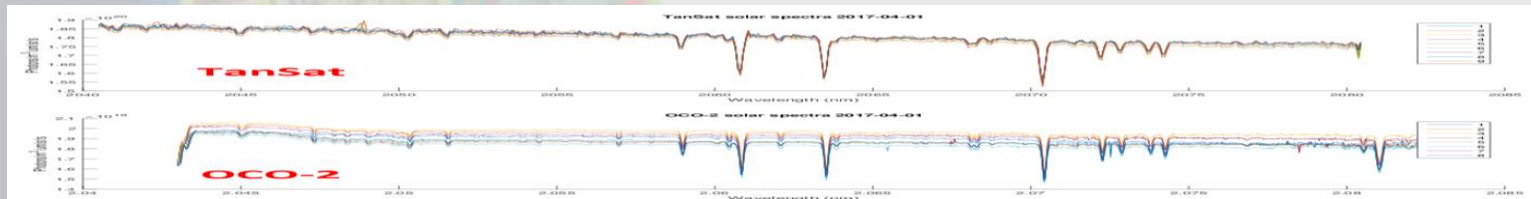
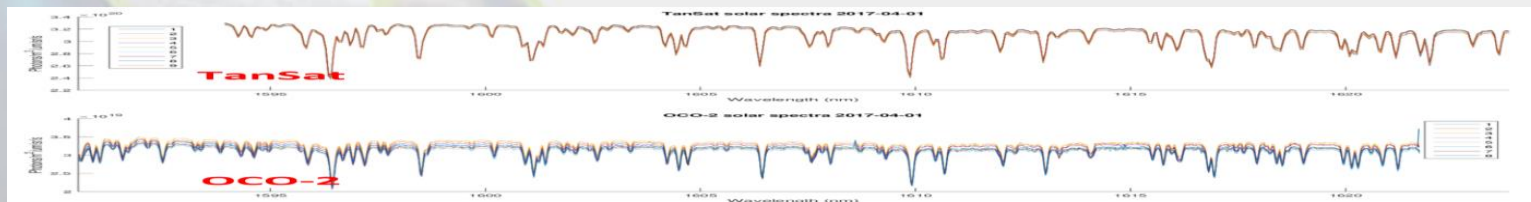
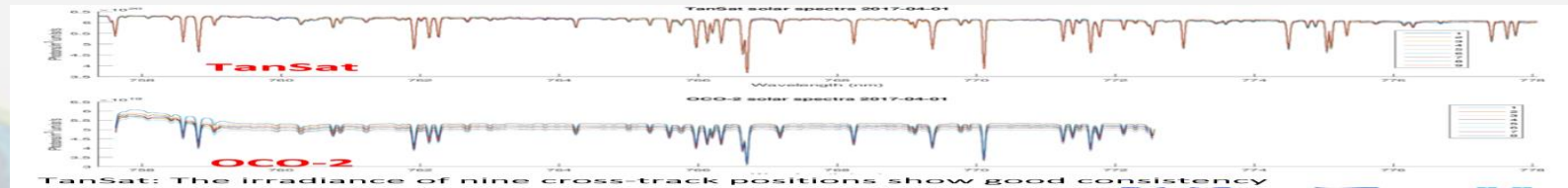
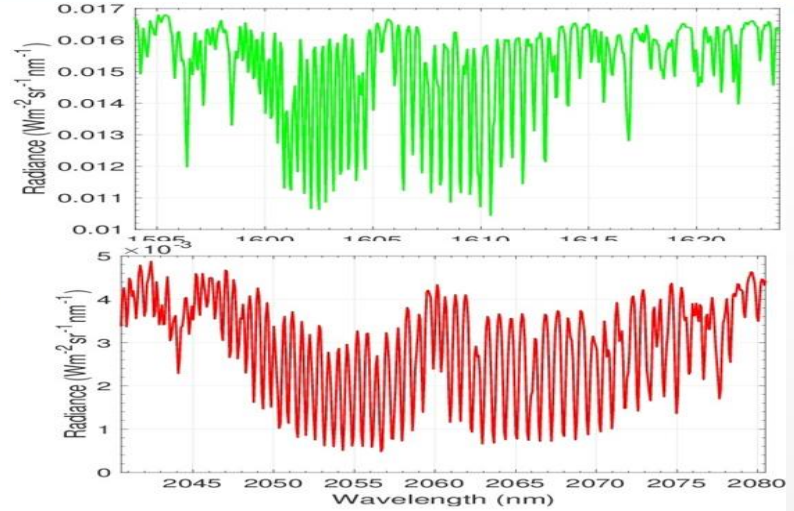
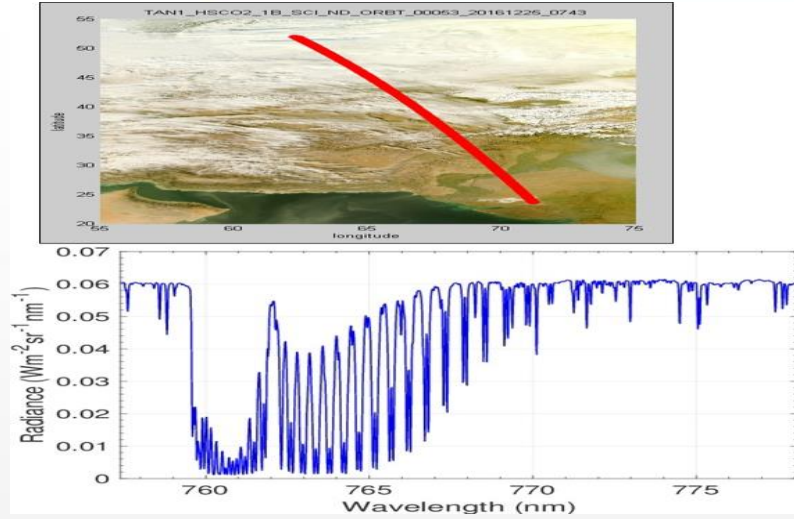
- TANSAT was successfully launched on Dec. 22, 2016.
- Commissioning test has been finished by June, 2017, and the Satellite was handed over to NSMC/CMA for operation
- All the data and products will be available soon.



XCO₂

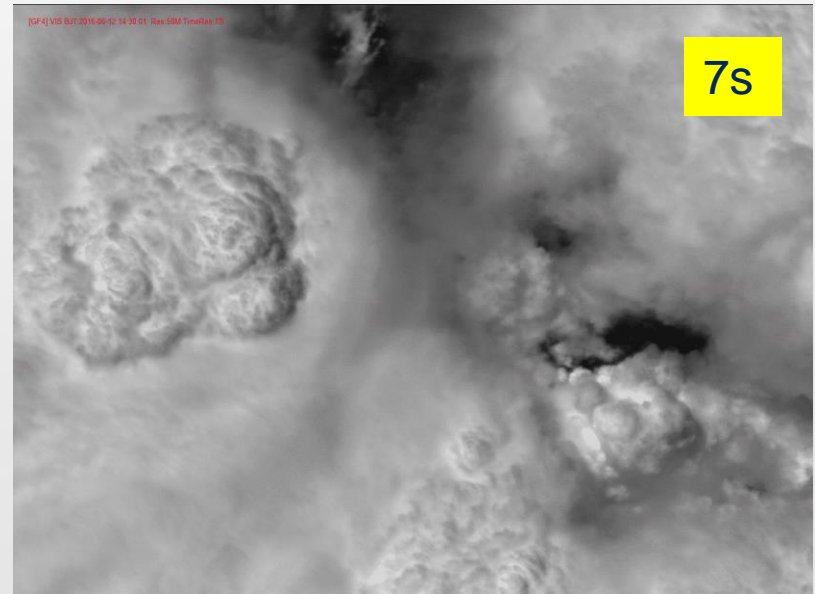
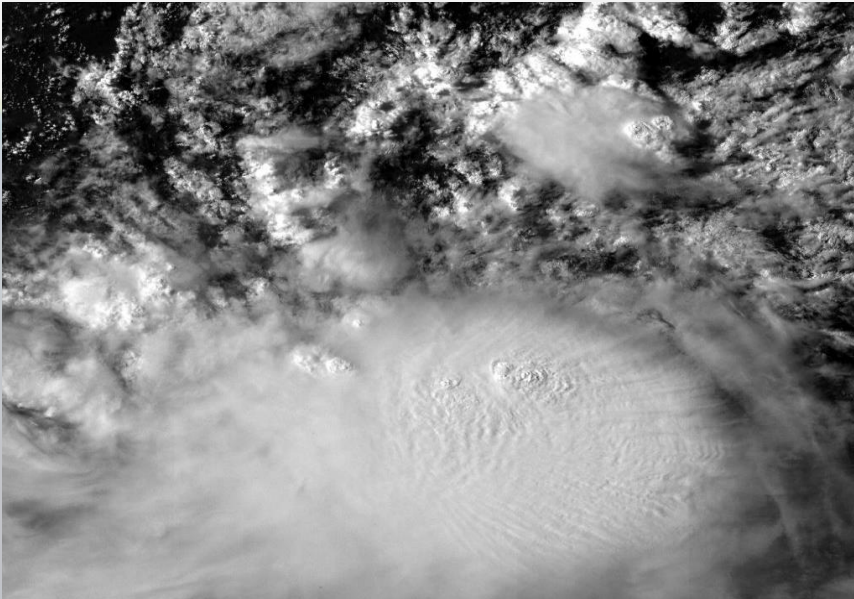


The first spectra of TanSat





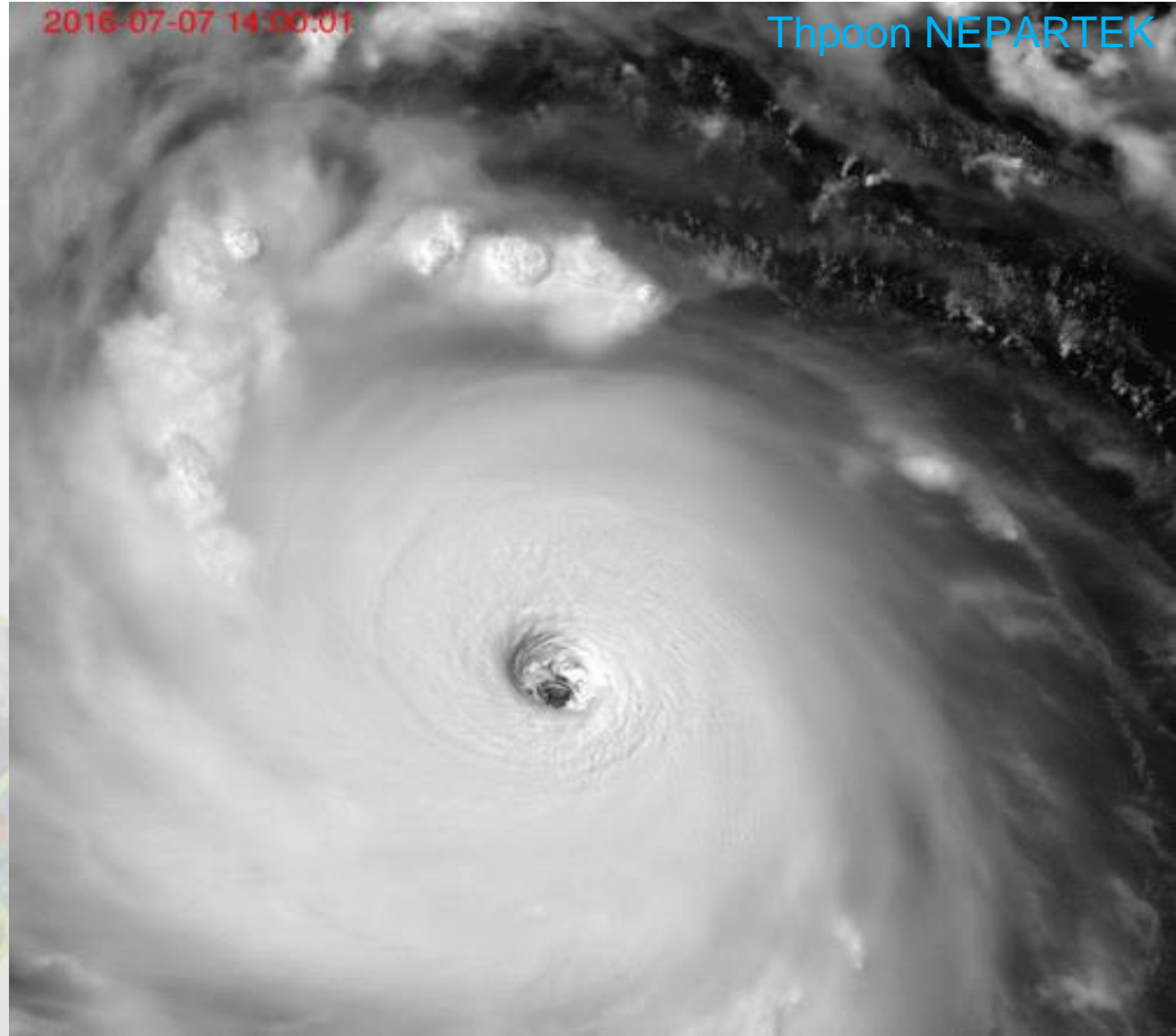
- Launched on 29 December 2015, Location at 105.6°E
- GF-4 is China's first high resolution geostationary satellite. Its spatial resolution is 50m at visible and near infrared band, and 400m at mid-infrared band. Its temporal resolution can reach several seconds.
- Useful for the monitoring of rapid growing meco-or small scale convective system.





2016-07-07 14:00:01

Thphoon NEPARTEK



Detector 10,000X10,000
Spatial res. 50 meters
Temporal res. 10, 20, 60s





Thank you for your attention

