



Fengyun Satellites : Current Status, Future Program and Challenge on Quantitative Measurement



Peng ZHANG

**National Satellite Meteorological Center,
China Meteorological Administration
(NSMC/CMA)**

**5th ISCC & 1st FYSUC
12-16 Nov, 2018, Chengdu, China**



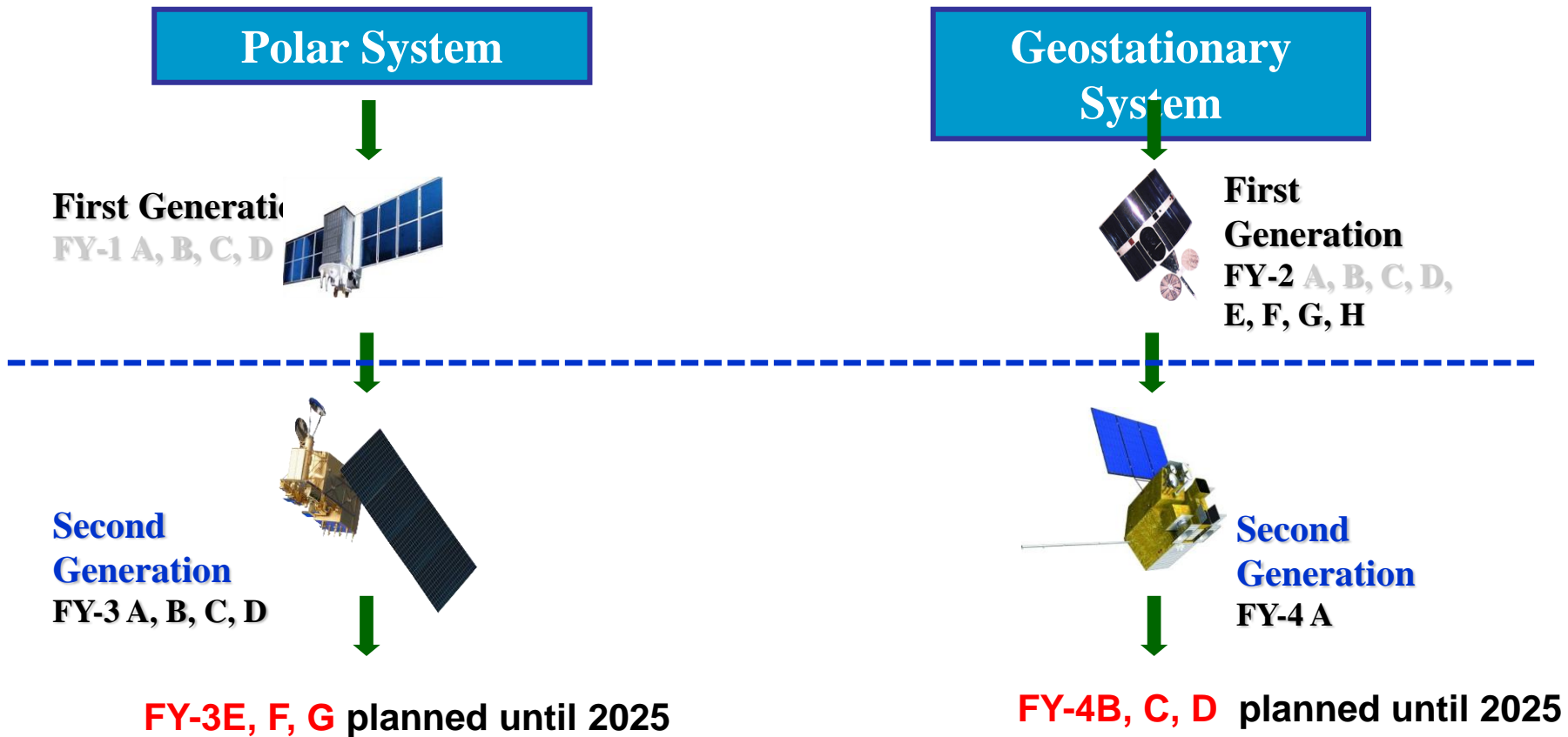
Outline

- ❑ **Fengyun Program Overview**
- ❑ **Current Missions and Services**
- ❑ **Latest Progress**
- ❑ **Future Programs**
- ❑ **Challenge on Quantitative Measurement**

1. Fengyun Program Overview



Chinese FENGYUN Meteorological Satellites



Launched Satellites



Since Jan. 1969, China began to develop his own meteorological Satellite

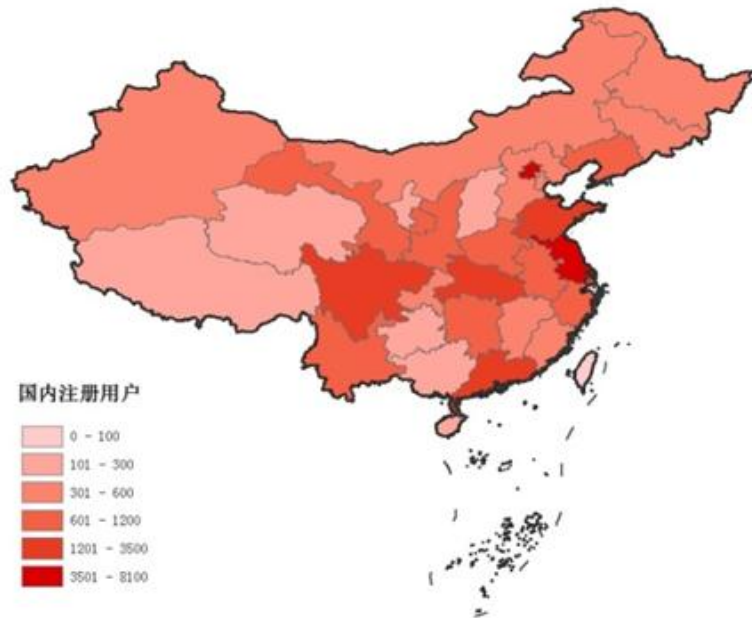
Leo	Launch Data		Geo	Launch Data
FY-1A	Sept. 7, 1988		FY-2A	Jun. 10, 1997
FY-1B	Sept. 3, 1990		FY-2B	Jun. 25, 2000
FY-1C	May 10, 1999		FY-2C	Oct. 18, 2004
FY-1D	May 15, 2002		FY-2D	Dec. 8, 2006
FY-3A	May 27, 2008		FY-2E	Dec. 23, 2008
FY-3B	Nov. 5, 2010		FY-2F	Jan. 13, 2012
FY-3C	Sept. 23, 2013		FY-2G	Dec. 31, 2014
FY-3D	Nov. 15, 2017		FY-4A	Dec. 11, 2016
			FY-2H	Jun. 5, 2018

Overall Development Strategy (4 stages):

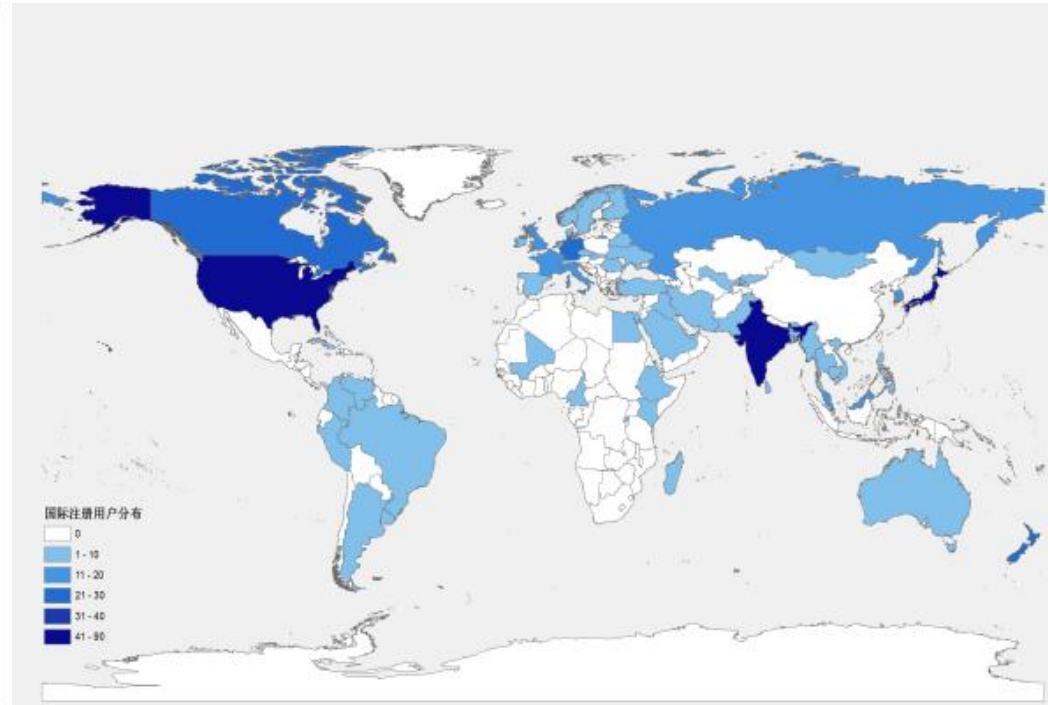
- 1) 1970 - 1990:** Conducting satellite research and development
- 2) 1990 - 2000:** Implementing transition from R&D to operational
- 3) 2000 - 2010:** Implementing transition from 1st generation to 2nd generation
- 4) 2010 - 2020:** Pursuing accuracy and precision of satellite measurements

Web-based User Location (Domestic)

风云卫星遥感数据服务网注册用户分布（国内，包含港澳台）



Web-based User Location (International)



Country: > 90

Global Data

Regional Data

ECMWF

About Forecasts Computing Research Learning Log In Search site Go



ECMWF starts using Chinese satellite data

29 September 2014

Who we are

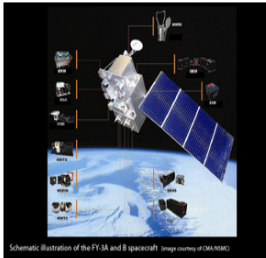
What we do

Jobs

News centre

Suppliers

Contact us



Schematic illustration of the FY-3A and B spacecraft (image courtesy of NSMC)

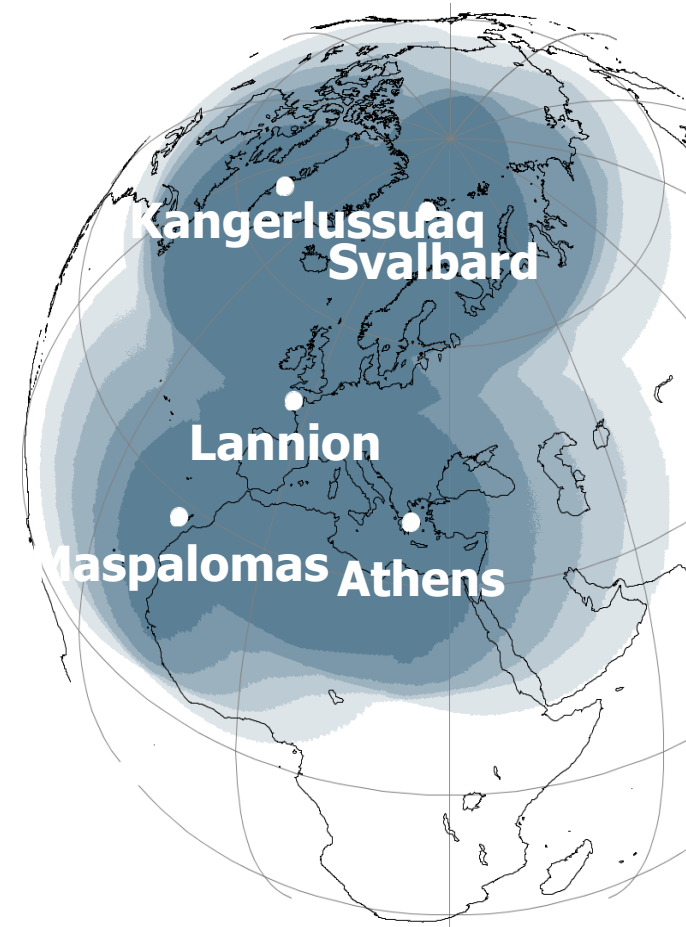
On 24 September 2014, ECMWF actively used Chinese satellite data for the first time in the operational forecasting system. This marks a milestone in ECMWF's fruitful cooperation with the Chinese Meteorological Administration (CMA) and the Chinese Institute of Atmospheric Physics (IAP) in the area of characterisation and use of Chinese satellite data. China is expected to play a leading role in providing meteorological satellite data in the near future, alongside Europe and the US, currently the main

providers of satellite sounding data used operationally. Activating the first Chinese satellite data in the ECMWF system is therefore an important step towards a much greater use of Chinese satellite data in the future.

The new data originates from the Microwave Humidity Sounder (MWS) on-board the Fengyun-3B (FY-3B) satellite. It contributes to an improved analysis of mid- to upper-tropospheric humidity, and adds robustness to the satellite observing system. Although FY-3B is an experimental satellite, the data has been found to be of sufficient quality to further improve ECMWF's atmospheric analysis. Keyi Chen, visiting scientist from IAP, explains: "Our work has shown the data is of reliable quality, and it has an impact comparable to similar European or US satellite instruments that have been used operationally for a long time."

The development is the result of a very constructive partnership with CMA and IAP to characterise Chinese satellite data. During regular visits to ECMWF, Qifeng Lu from CMA has significantly advanced our understanding of the performance of the instruments on the experimental FY-3A and B satellites. This work continues with the analysis of data from the latest Chinese satellite, FY-3C, performed together with CMA, ECMWF, and the UK Met Office. FY-3C is China's first operational meteorological polar-orbiting satellite, and it carries much improved instruments compared to the earlier FY-3A and B satellites. It was launched in September last year and Qifeng Lu is currently

FY-3C sounding data have been assimilated into CMA GRAPES, ECMWF, UK NWP model operationally.



EUMETSAT Advanced Retransmission Service

15 April 2011

Re: The Status of Data from China's FY-3 Satellite in ECMWF's Forecasting System

Dear Sir/Madam,

This brief letter outlines the status of ECMWF work on data from the FY-3A satellite.

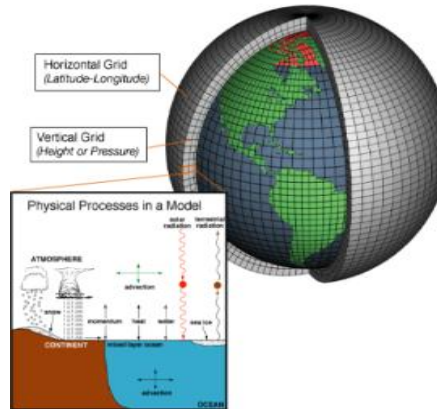
Data from the FY-3 series of meteorological satellites is set to become an increasingly important component of the global satellite observing system, supporting NWP centres worldwide. As part of a CMA-ECMWF co-operation agreement data from the first satellite in the series, FY-3A, was assessed at ECMWF during 2009-2011. Much of this work was carried out by a visiting scientist from China's National Satellite Meteorological Center, actively supported by staff from CMA and ECMWF. These ground-breaking investigations led to significant improvements in the quality of the data from the FY-3A Microwave Temperature Sounder (MWS) instrument. The data quality for the MWS instrument is now comparable to that from equivalent US and European meteorological satellites.

Pre-operational testing has shown the FY-3A data delivers measurable positive improvements in the ECMWF model, a very stringent test of the data given the global precision of the ECMWF forecast system. This represents a significant milestone for the FY-3A programme and cooperation with ECMWF. Final pre-operational testing of the FY-3A data is underway and ECMWF plans to use the data operationally in early summer 2011. The scientific work is well documented in a series of Technical Memoranda available from the ECMWF website, and in a series of journal articles.

ECMWF are very appreciative of the support provided by CMA and hope this programme of collaboration strengthens in order to support the continued success of the FY-3 series.

Yours faithfully,

Prof. Erland Kölln
Director of Research



Cost Function

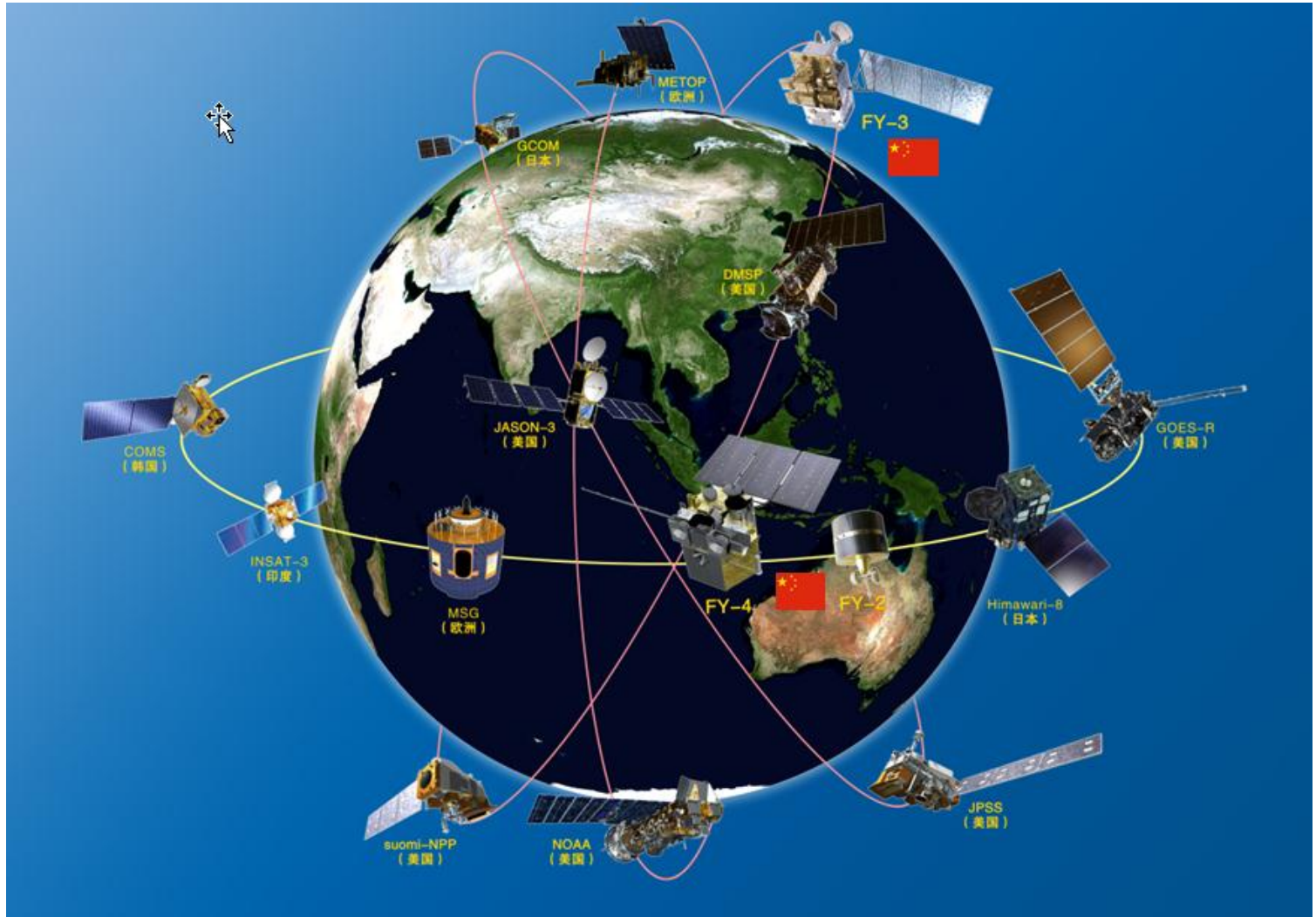
$$J = \frac{1}{2} (\mathbf{x} - \mathbf{x}^b)^T \mathbf{B}^{-1} (\mathbf{x} - \mathbf{x}^b) + \frac{1}{2} [\mathbf{I}(\mathbf{x}) - \mathbf{I}^o]^T (\mathbf{E} + \mathbf{F})^{-1} [\mathbf{I}(\mathbf{x}) - \mathbf{I}^o]$$

The data quality is now comparable to that from equivalent US and European meteorological satellites

Important Component of WMO Space Program



- reliable and sustained observation in operation
- open data policy to free access



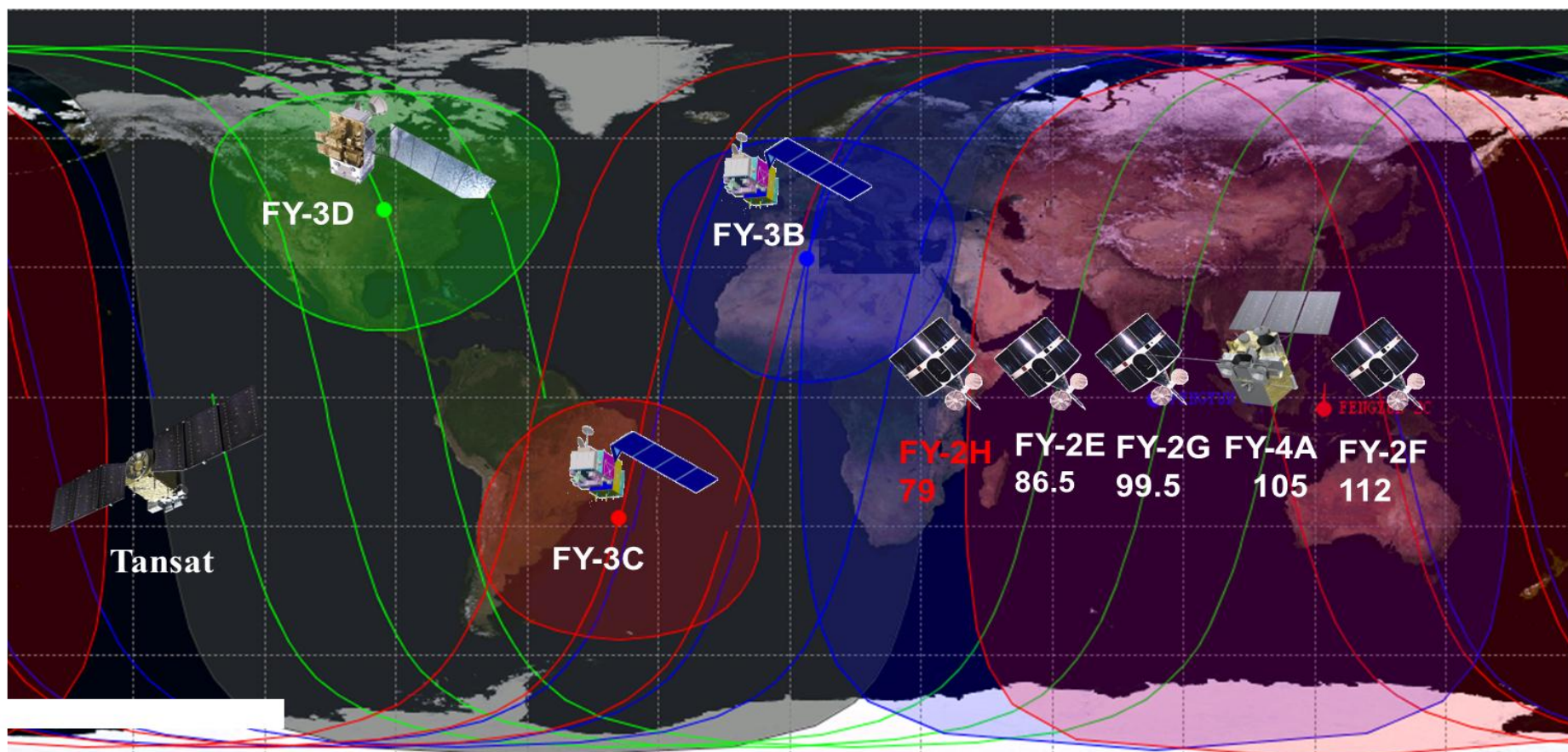
2. Current Missions and Services



Current FengYun Constellation

FengYun Programs: 8 in orbit, 7 in operation, 1 in orbital testing (FY-2H)

Joint programs: Tansat, GF-4



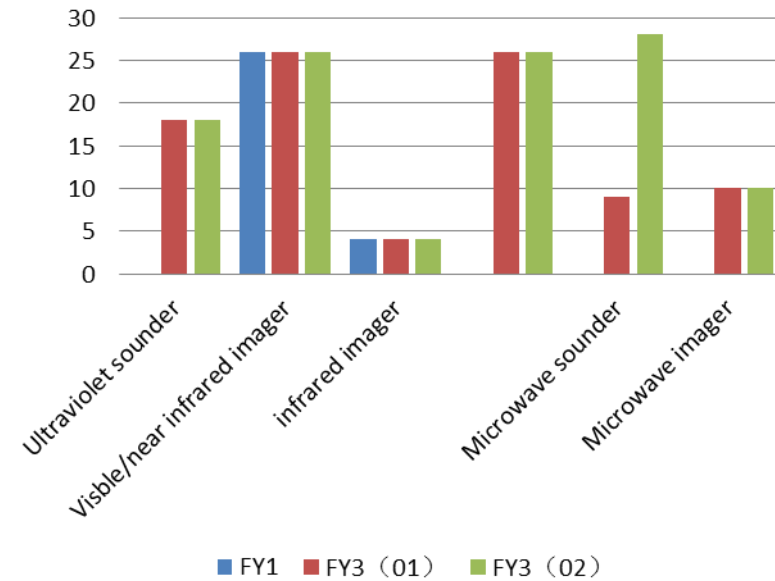
04 三月 2011 11:55:50.000 CST

2018/11/22

5th ISCC & 1st FYSUC, Chengdu, China

Current Instruments for EO

Satellite		No. of Instruments	Name in Abbrev.
FY-1	FY-1 A/B	2	5-channel VIRR
	FY-1 C/D	2	10-channel VIRR
FY-2	FY-2 A/B	1	3-channel VISSR
	FY-2 C/D/E	1	5-channel VISSR
FY-3	FY-3 A/B	10	10-channel VIRR
			MERSI
			IRAS
			MWTS
			MWHS
			MWRI
			SBUS
			TOU
			ERM
	SIM		
	FY-3C	11	GNOSS
FY-3D	10	HIRAS	
		GAS	
FY-4	FY-4A	3	AGRI
			GIIRS
			LMI



- Optical Imager
- Atmospheric Sounder
- Microwave Imager
- Atmospheric Composition Detector
- Radiation Budget Monitor

Fengyun GEO Constellation

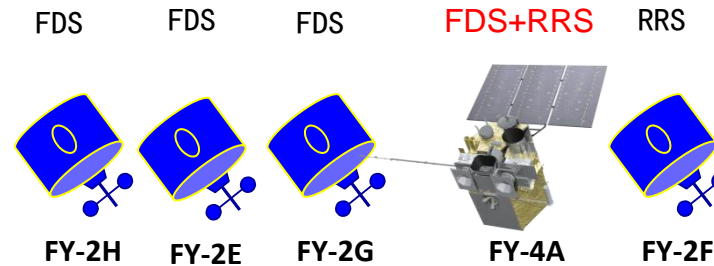
■ 4 in operation

FY-2E: Full Disk (86.5° E)

FY-2G: Full Disk (99.5° E)

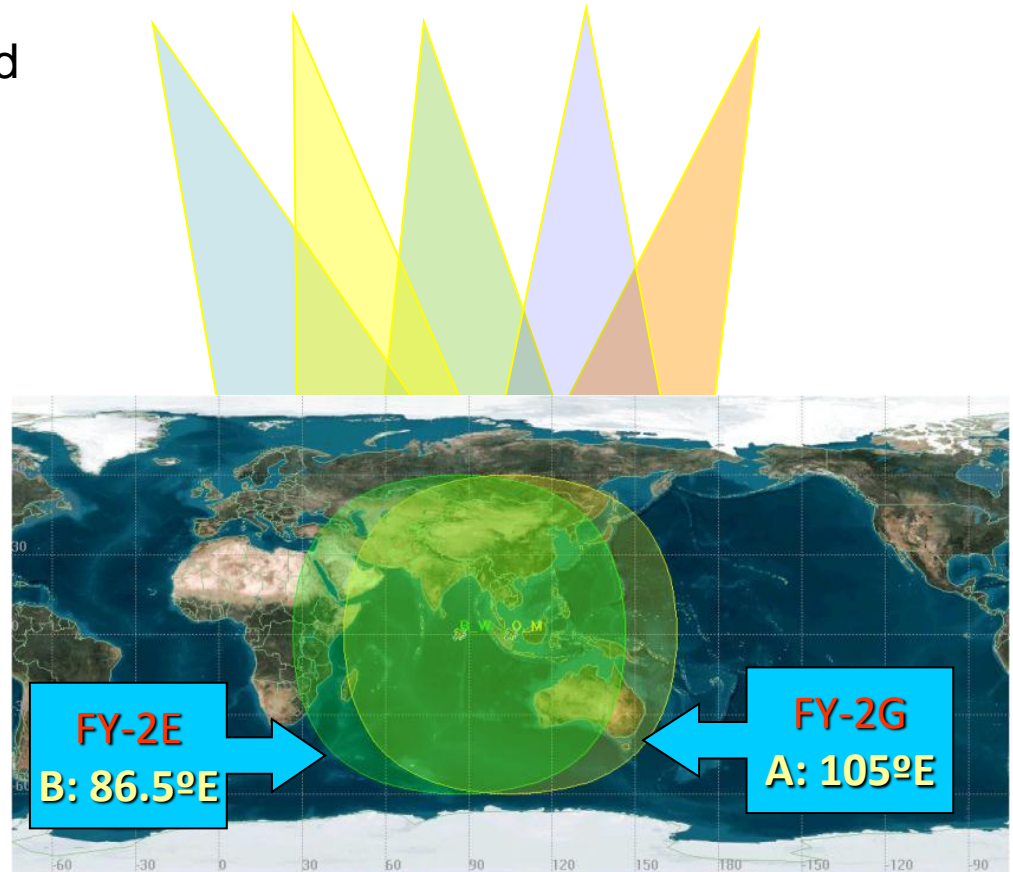
FY-4A: Full Disk + Regional Rapid (105° E)

FY-2F: Regional (112° E)



■ 1 in orbit test

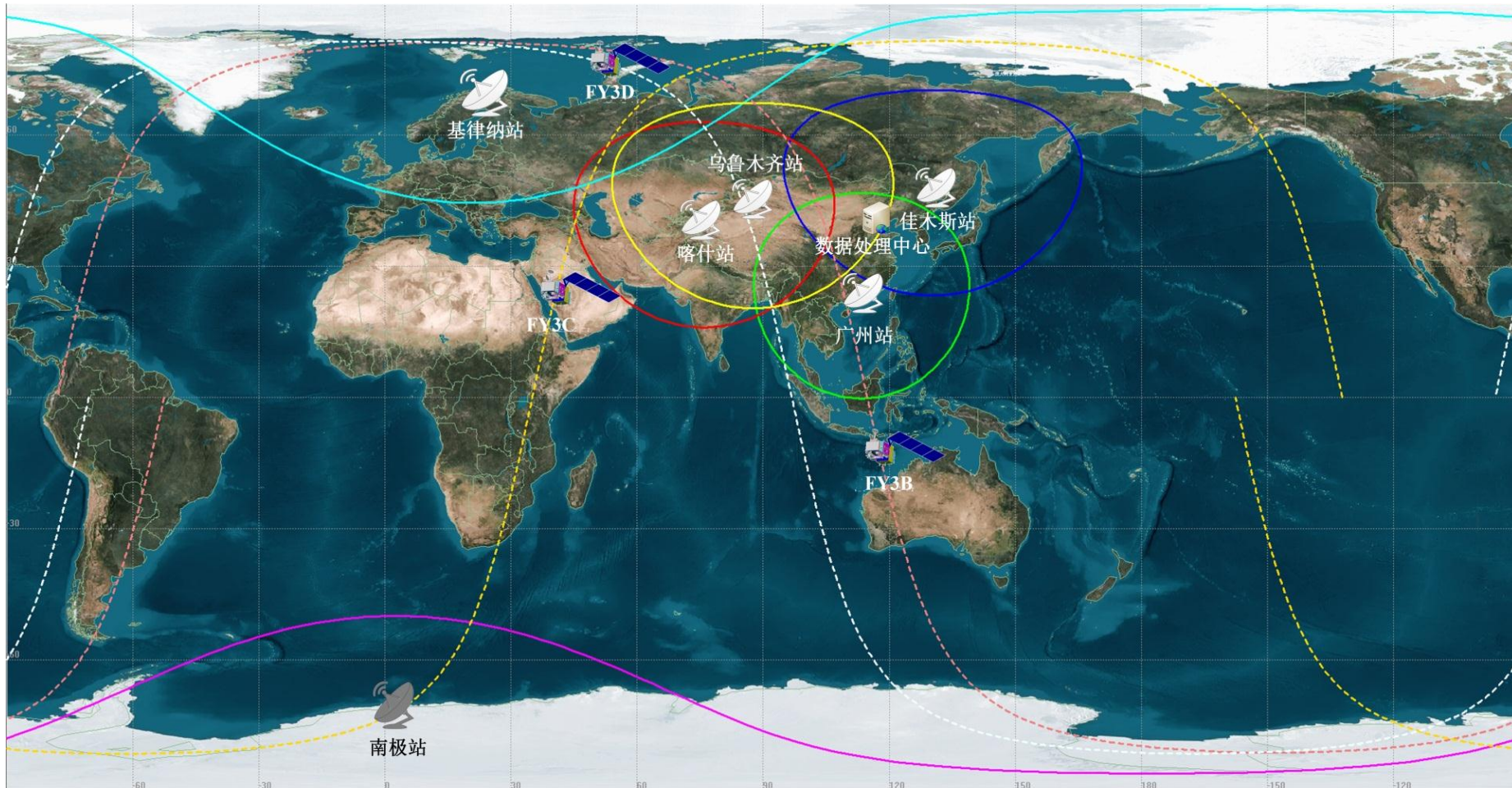
FY-2H (79° E)



Fengyun Polar Constellation



In Primary Operation (Global) : FY-3C + FY-3D, global coverage 4 times per day



FY-3C LTC 10:30 AM

FY-3D LTC 13:40 PM

FengYun Satellite Data Service

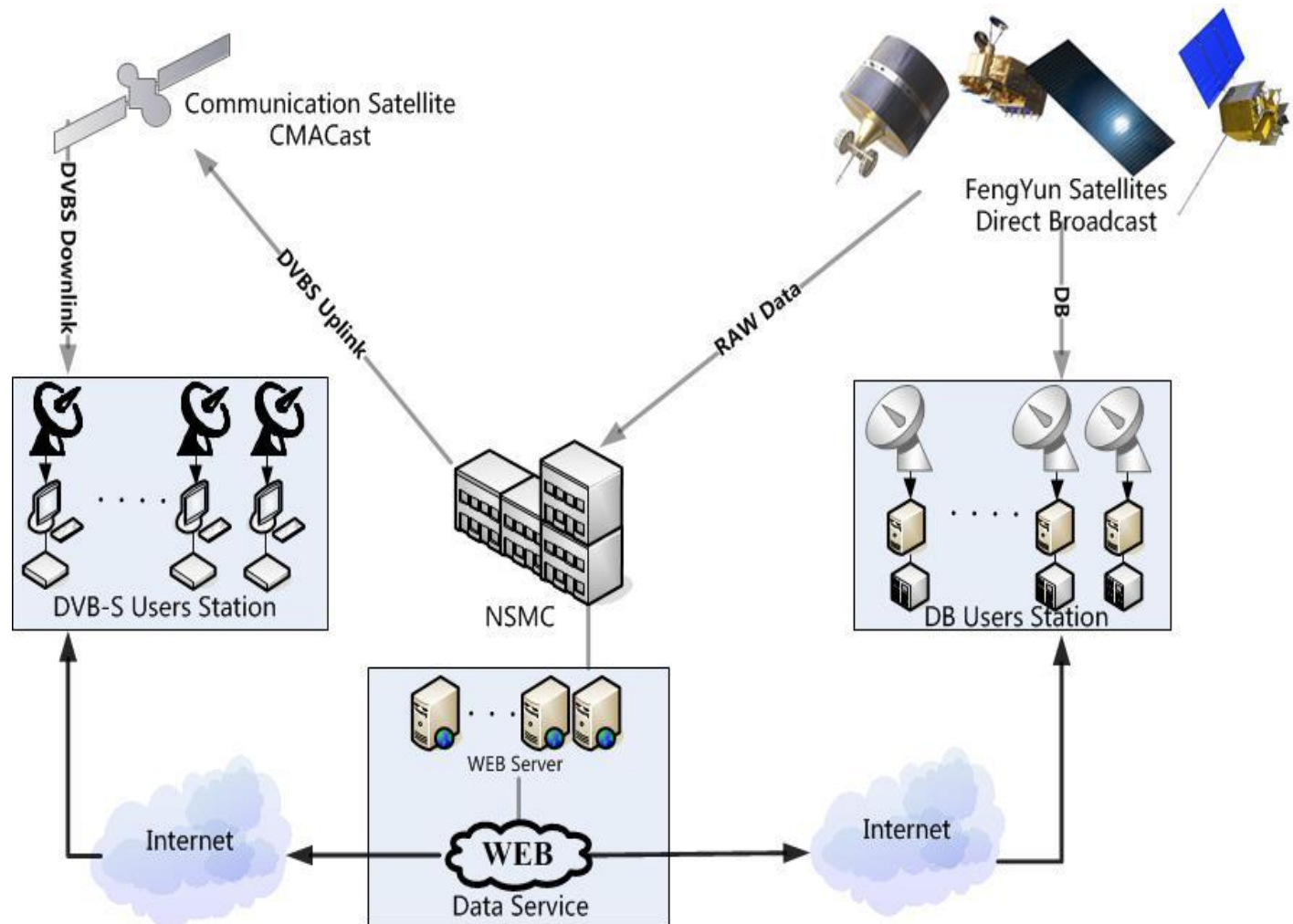


❖ Real time

- Direct Broadcast
- CMACast

❖ Non-Real Time

- Website
- Cloud Service
- FTP Service
- Manual Service



Fengyun DB Users



More than 45 International DB Users

Web Portal Service



NSMC National Satellite Meteorological Center
China Meteorological Administration

Home About NSMC Satellite Program Operation Imagery and Product Data Access Support

Welcome to FENGYUN Satellite Data Center, Please login Register NSMC Contact us Help 中文

FENGYUN Satellite Data Center

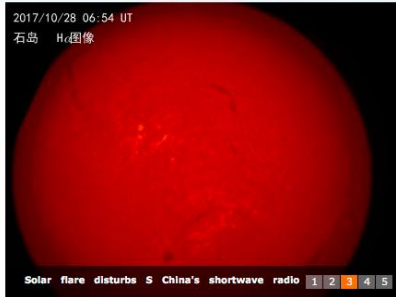
NATIONAL SATELLITE METEOROLOGICAL CENTER

SATELLITES DATA IMAGES PRODUCTS DOCUMENTS TOOLS

Fengyun Satellites

Legend

	FY-3A	TBUS	
LEO	FY-3B	TBUS	✓
	FY-3C	TBUS	✓
	FY-2E	Time Table	✓
GEO	FY-2F	Time Table	✓
	FY-2G	Time Table	✓



Space Weather NSMC Forecasts

Updated at: 29 October 2017 UTC

More ▾

Solar Flare

Time	0-24H	24-48H	48-72H
CLASS M:	20%	20%	10%
CLASS X:	1%	1%	1%

Geomagnetic Storm

Time	0-24H	24-48H	48-72H
minor	1%	1%	1%
major	1%	1%	1%

Solar Proton Events

Time	0-24H	24-48H	48-72H
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Fengyun Satellite Data and Application Service Survey (2017)

Your response to this survey will be rewarded with upgraded maximum daily download of 30GB. Don't hesitate, join now!

Archive

Satellite	File count	Volume(TB)
FY-3C	14895688	486.1
TANSAT	235342	25.1
FY-3B	31017932	1902.2
FY-3A	31753847	1613.9
FY-2G	2128117	19.0
FY-2F	3559028	35.8
FY-2E	5101881	47.5
FY-2D	4759430	58.3
FY-2C	2879072	39.8
FY-1D	270941	6.5

Data Overview >>

FY-LEO TANSAT FY-GEO

FY-3C
 FY-3B
 FY-3A
 FY-1D
 FY-1C

More...

Data Name:

Start Date: Start Time:

End Date: End Time:

Time Range: Each Day

Spatial Sel:

Coverage: Intersect Entirely Within

Availability Search

Sign In

User ID:

Password:

Verify: BF86

Stay Signed In

Forget Password? SIGN UP

Sign In

Announcements

- TanSat Data Opened to Public Use
- Announcement of FY-2G East-West Station Keeping
- A Notification on FY2F's Orbital Control
- FY-3B Solar Irradiance Monitor Switched off

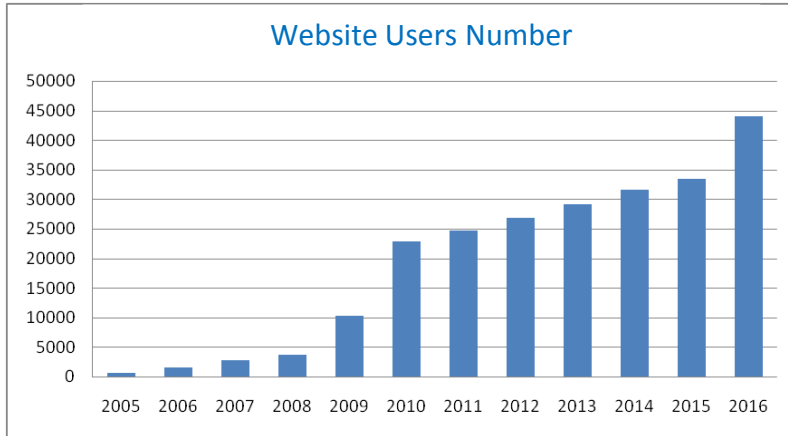
Highlights

TanSat Data Opened to Public Use

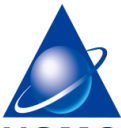
August 31, 2017, after in-orbit checkout had been conducted for 8 months, the Summary Report on TanSat Commissioning Tests was received and reviewed by CMA. The review committee unanimously...

View all

Announcement of FY-2G East-West Station Keeping



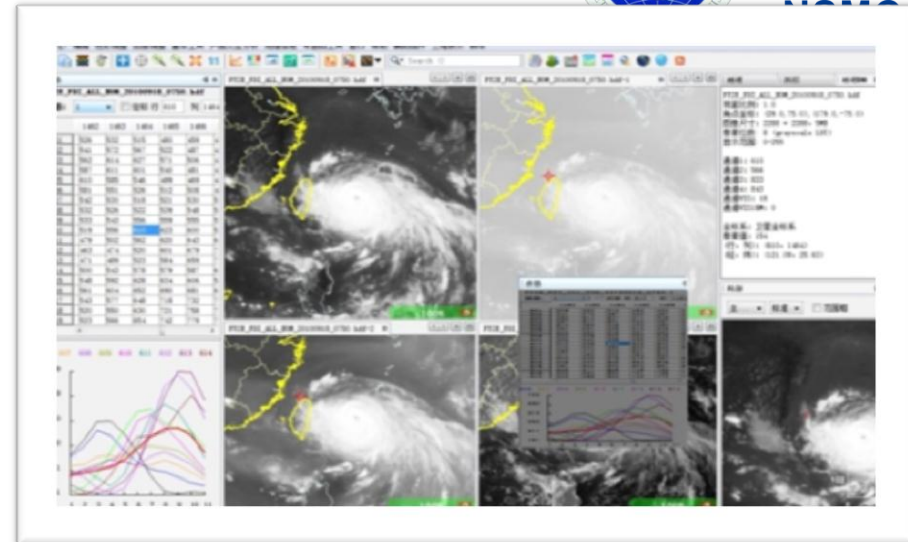
Application Tools



SATs: New Observation Capability

Weather monitoring and analysis
---Geostationary Satellite data (FY-2/FY-4)

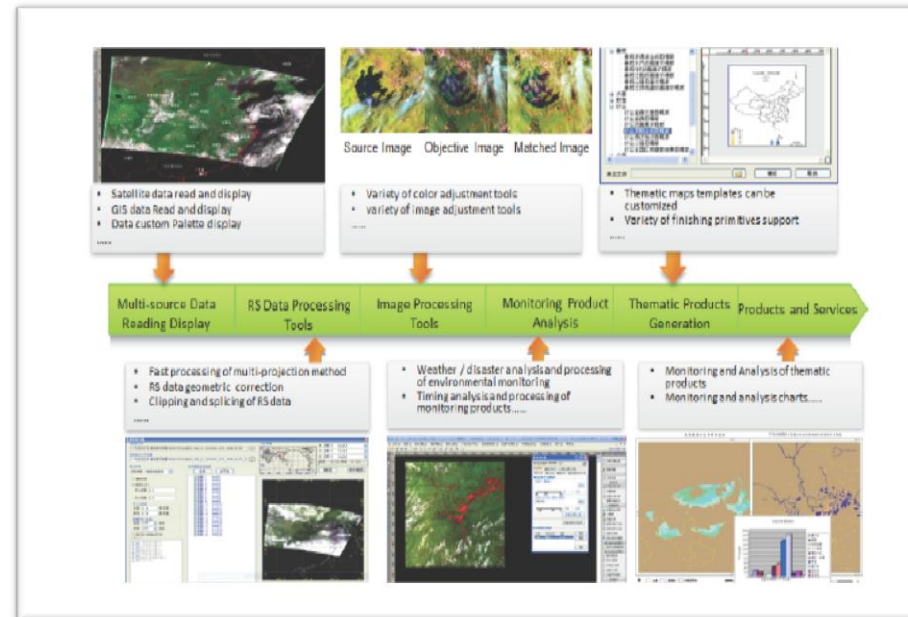
Satellite Weather Application Platform
SWAP



Application tools

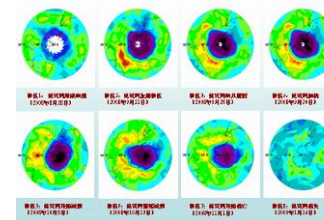
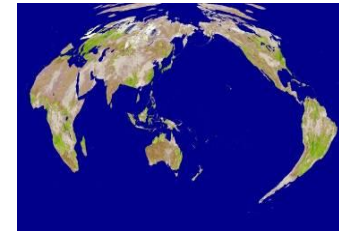
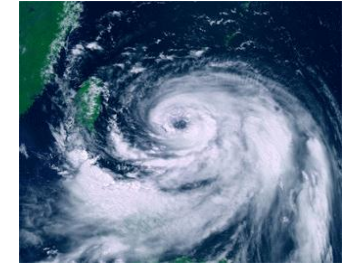
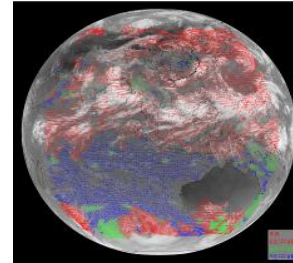
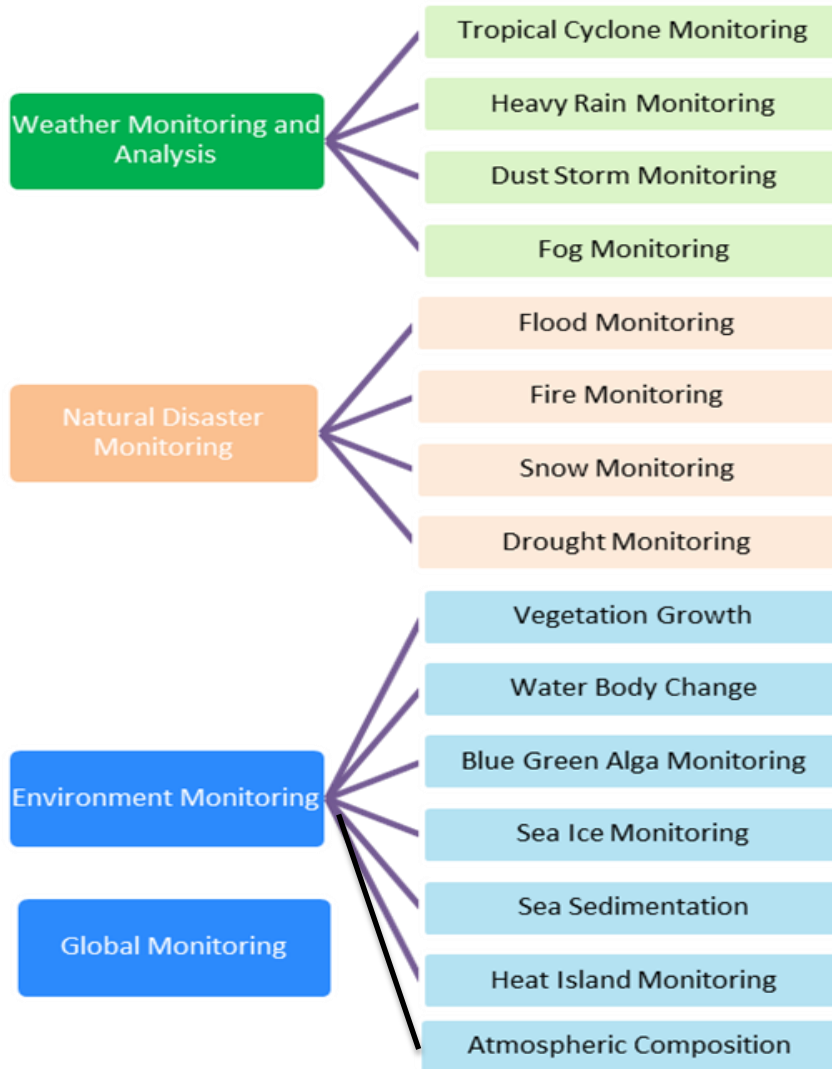
Natural disaster and environment monitoring and analysis
---polar orbiting Satellite data

Satellite Monitoring Application Remote sensing Toolkit
SMART



Users: New Applications

Application Area



3. Latest Progress



Latest progress on CMA satellite programmes

1. FY-4A

- The first GEO. meteorological satellite of new generation
- Launched on Dec.11, 2016
- Official operation on May 1, 2018

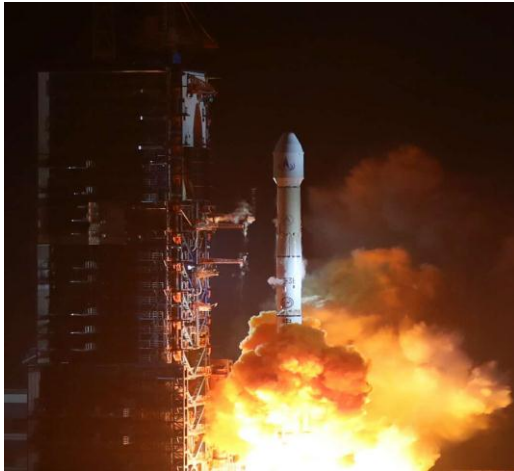
2. FY-2H

- The last one of FY-2 series
- Launched on June 5, 2018
- To support IOC and serve for the belt & road countries

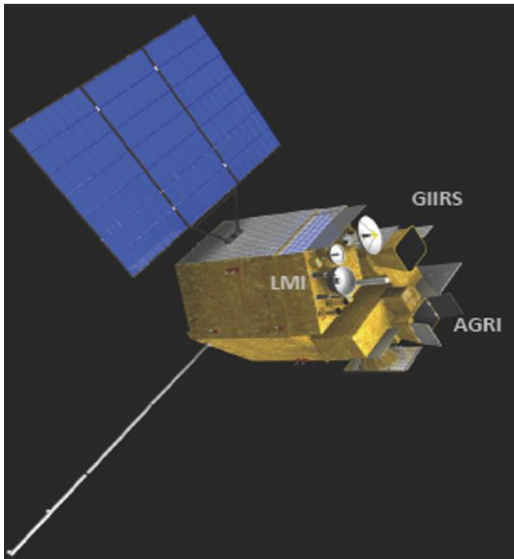
3. FY-3D

- A new operational afternoon orbit LEO. satellite, will co-work with FY-3C in morning orbit.
- Launched on Nov. 15, 2017.
- On-orbit commission test completion on Aug. 6, 2018

FY-4A: Launched on 11 Dec, 2016

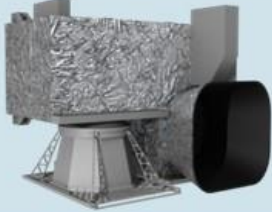
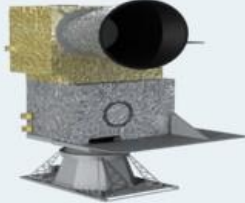




FY-4 is the CMA new generation meteorological geo-satellite series, expected to support various weather-related services, including weather forecasting, disaster prevention and reduction, and monitoring and warning of space weather.



Spacecraft:

1. Launch Weight: approx 5300kg
2. Stabilization: Three-axis
3. Attitude accuracy: 3''
4. Bus: 1553B+Spacewire
5. Raw data transmission : X band
6. Output power: $\geq 3200W$
7. Design life: over 7 years

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 observation mode



AGRI:

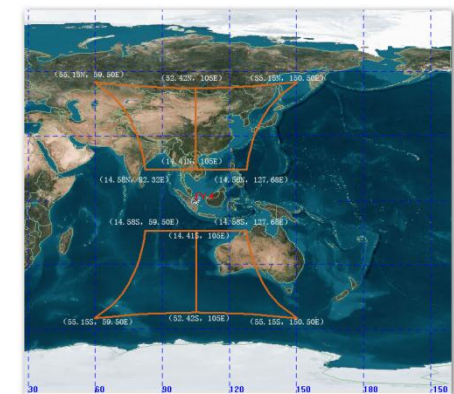
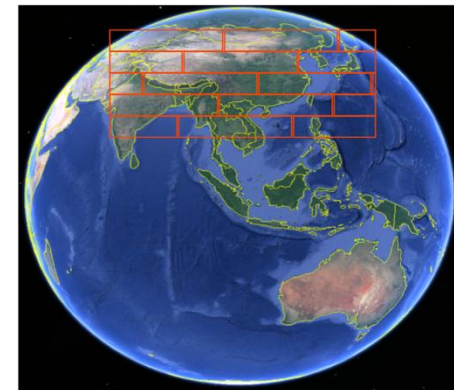
- Every hour: Full disk (00:00/01:00/02:00...23:00)
- Every 3 hour: 3 continuously Full disk(Eg.23:45-00:00-00:15)
- Rest: China area, (every 5 minutes)

GIIRS:

- Every 3 hour: Full disk clear sky observation
- Every 15 minutes: China area clear sky observation

LMI:

- 500 frames per second
- 21 Mar.-22 Sep: Northern Hemisphere
- 22.Sep-Next 21 Mar: Southern Hemisphere



FY-4A Baseline products



	FY-4A	FY-2
Cloud	Cloud Mask Cloud Top Temperature Cloud Top Height Cloud Top Pressure Cloud Type Cloud Phase Daytime cloud optical and microphysical properties Nighttime cloud optical and microphysical properties	Cloud Mask Cloud Top Temperature Cloud Classification Cloud Cover Ratio Cloud Total Amount
Atmosphere	Quantitative Precipitation Estimate Layer Precipitable Water Atmosphere Motion Vector Atmospheric Temperature Profile Atmospheric Humidity Profile Cloudy Vertical Temperature Profile Cloudy Vertical Moisture Profile Aerosol Detection Atmosphere Instability Index Convective Initiation Tropopause Folding Turbulence Prediction Total Ozone Amount Ozone Profile	Precipitation Index Quantitative Precipitation Estimate Clear sky Total Precipitable Water Atmosphere Motion Vector Cloudy Vertical Moisture Profile Upper Tropopause Humidity
Radiation	Outgoing Long wave Radiation Surface Solar Irradiance Downward Longwave Radiation Upward Longwave Radiation Reflected Shortwave Radiation	Outgoing Long wave Radiation Surface Solar Irradiance
Surface	Sea Surface Temperature (Skin) Land Surface Temperature Snow Cover Land Surface Albedo Land Surface Emissivity Evapotranspiration products	Sea Surface Temperature (Skin) Land Surface Temperature Snow Cover
Environment	Dust Smoke Detection Fire/Hot Spot Characterization Fog Detection	Dust Index Fire/Hot Spot Characterization Heavy Fog Detection
Lightning	One Minute Lightning Quantitative Product (including flash group event) Lightning Jump Identification Product Flash Daily Density	
Space	High-energy particle distribution Magnetic Field Intensity Space Environment Effect	

AGRI: Advance Geo. Radiation Imager



FY-4A GEOSTATIONARY METEOROLOGICAL SATELLITE

The First Colour Composite Image of FY-4A AGRI



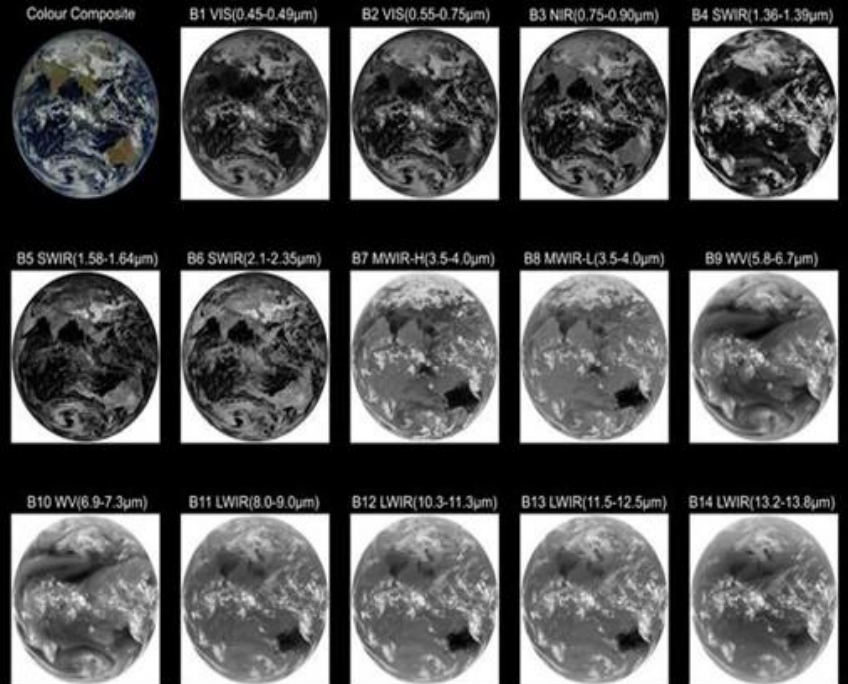
February 20th, 2017 05:15 (UTC)



Processed by NSMC

FY-4A GEOSTATIONARY METEOROLOGICAL SATELLITE

The First Images of FY-4A AGRI



February 20th, 2017 05:15(UTC)



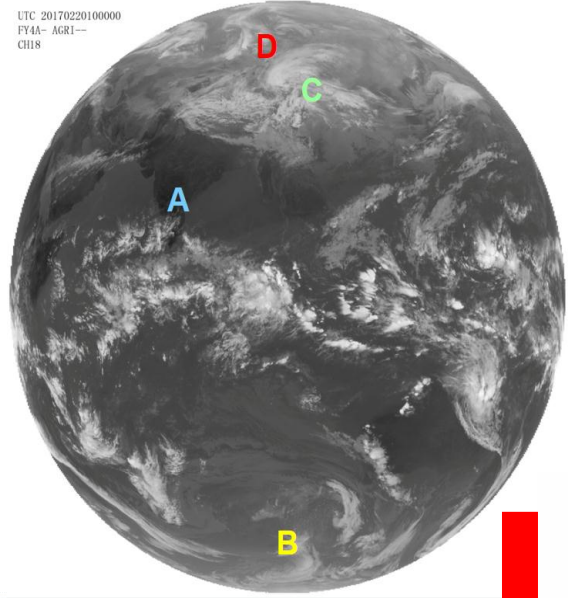
Processed by NSMC

GIIRS:

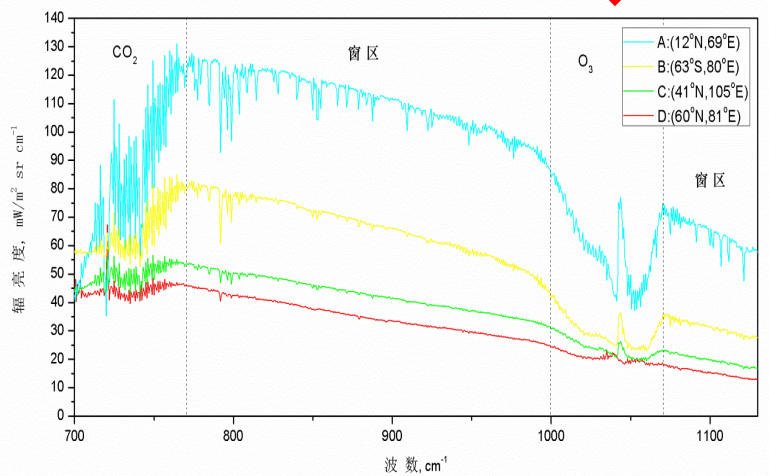
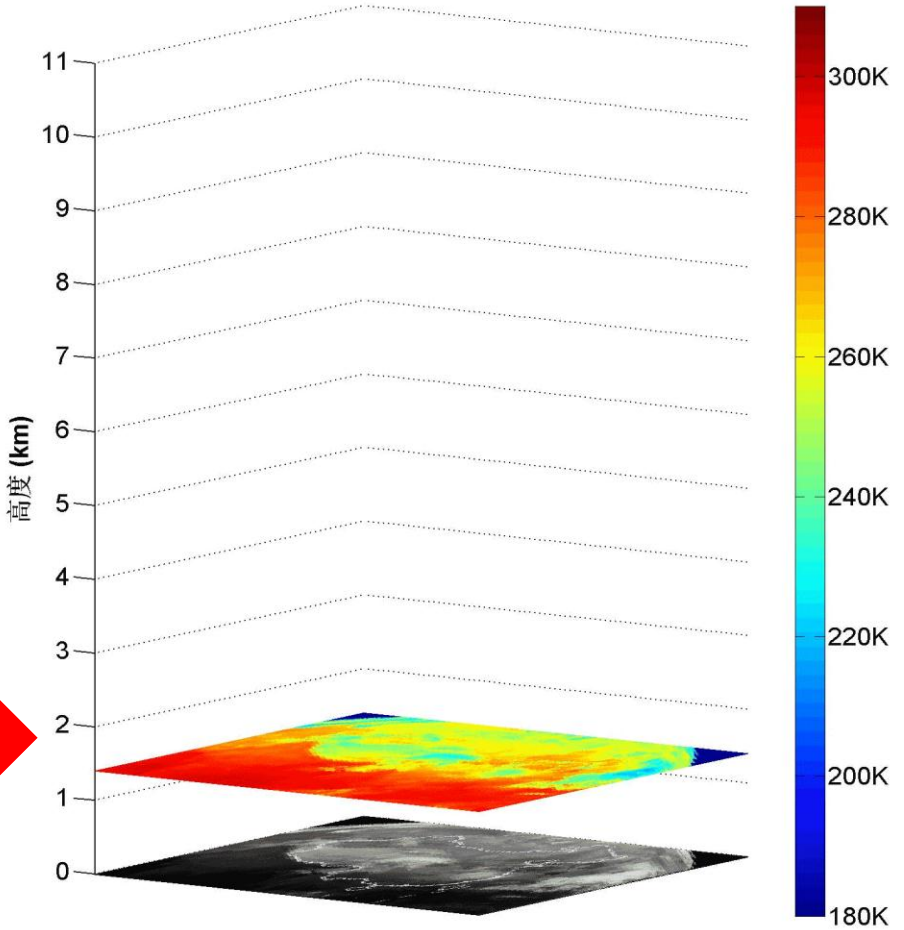
First Geo. Interferometric Infrared Sounder



UTC 20170220100000
FY4A-AGR1--
CH18



201702230115



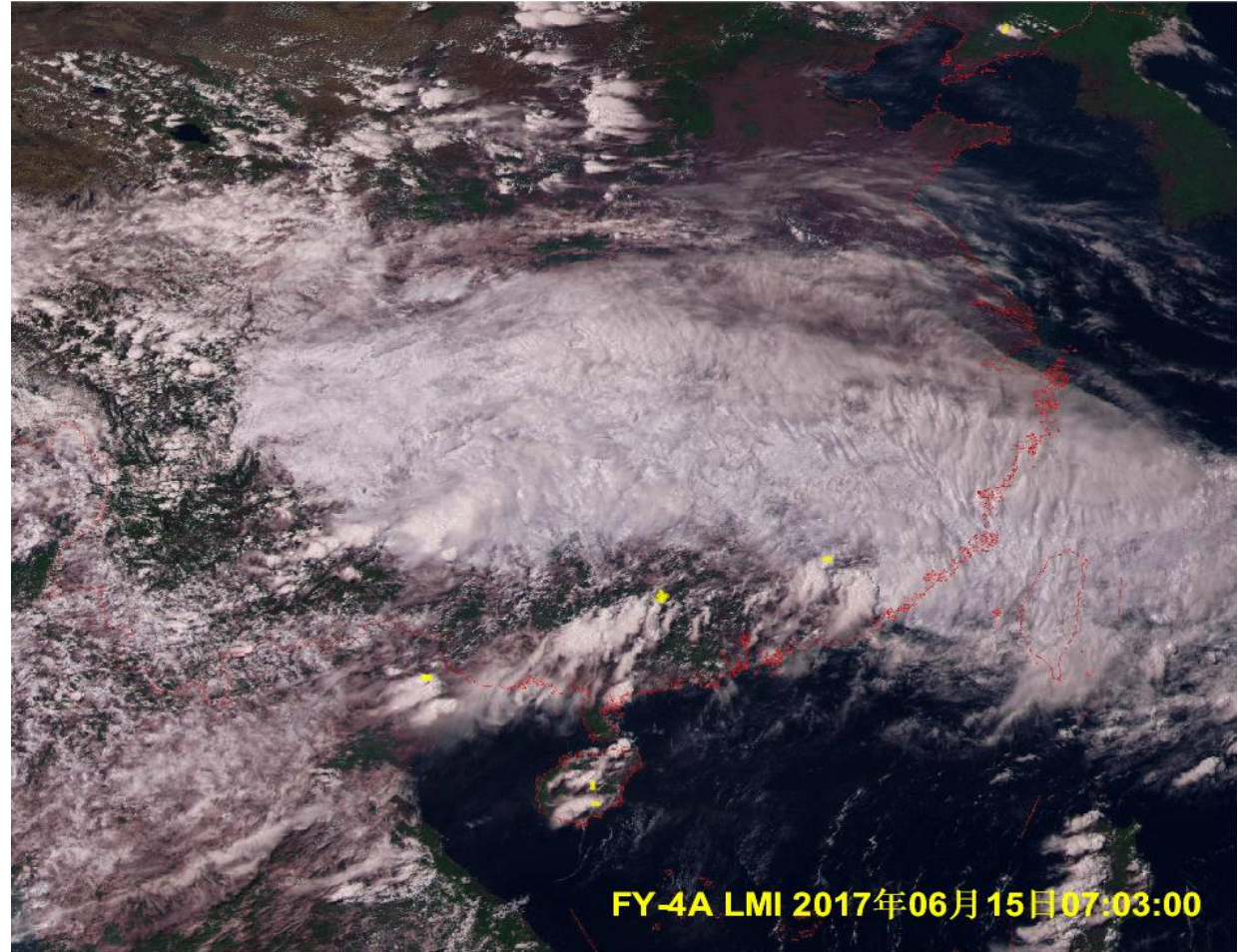
, Chengdu, China

LMI: Lightning Mapping Imager

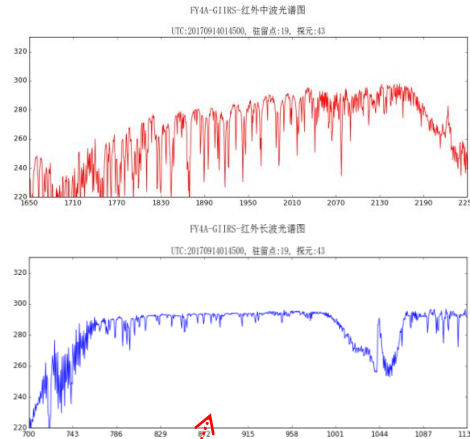


Acquire lightning distribution maps over specific region

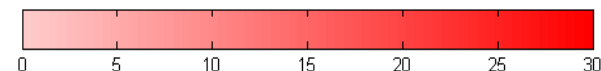
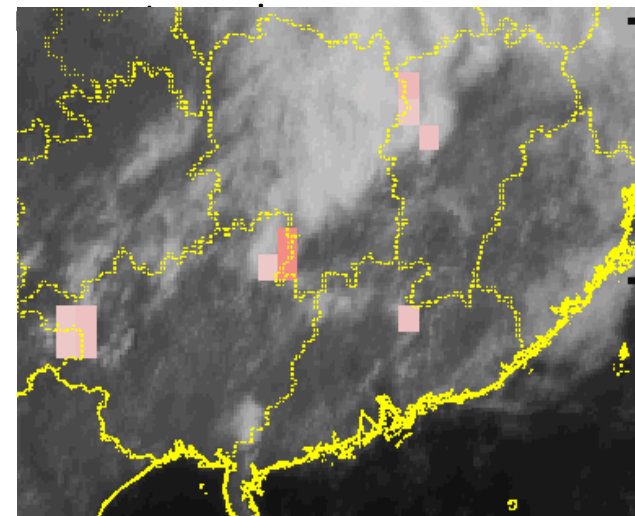
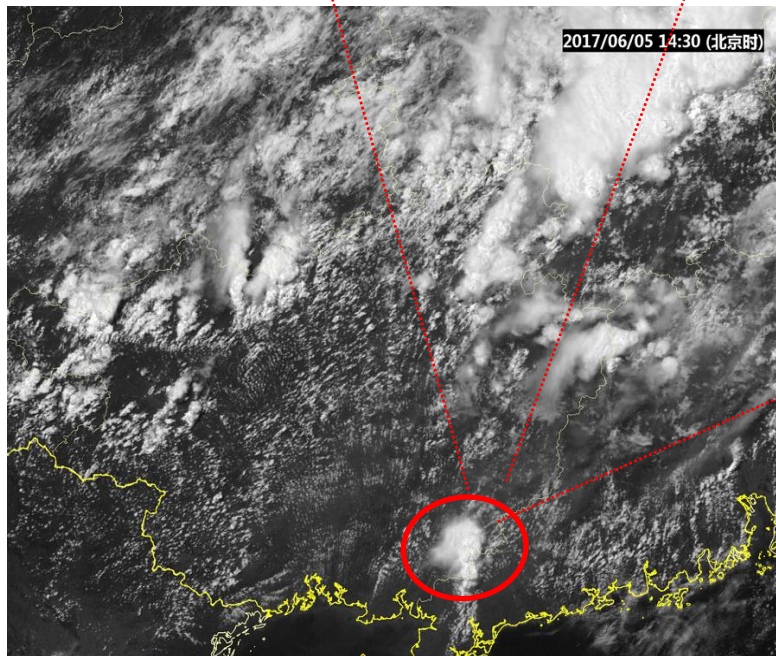
Spatial resolution	about 7.8Km at SSP
Sensor size	400×300 ×2
Wave-length at center	777.4nm
Band-width	1nm±0.1nm
Detection efficiency	>90%
False-alarm ratio	<10%
Dynamic range	>100
SNR	>6
Frequency of frames	2ms
Quantization	12 bits
Measurement Error	10%



AGRI + GIIRS + LMI

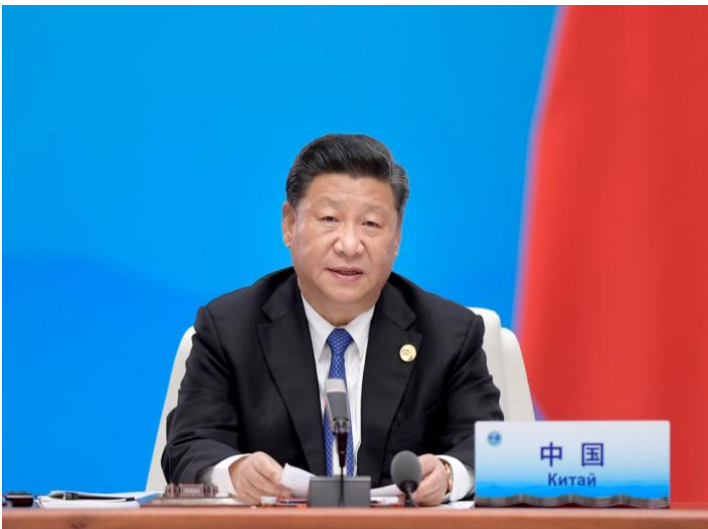


1. FY-4A lightning frequency map: strong convective cloud clusters often accompany with obvious lightnings.
2. FY-4A high spatial resolution imager: finer structure and texture of strong convective cloud cluster; and clearer small scale cumulus line.
3. Cloud free atmospheric profile acquired from GIIRS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



FY-2H: Launched on 5 Jun, 2018

FY-2H : To better support IOC and serve the Belt & Road countries

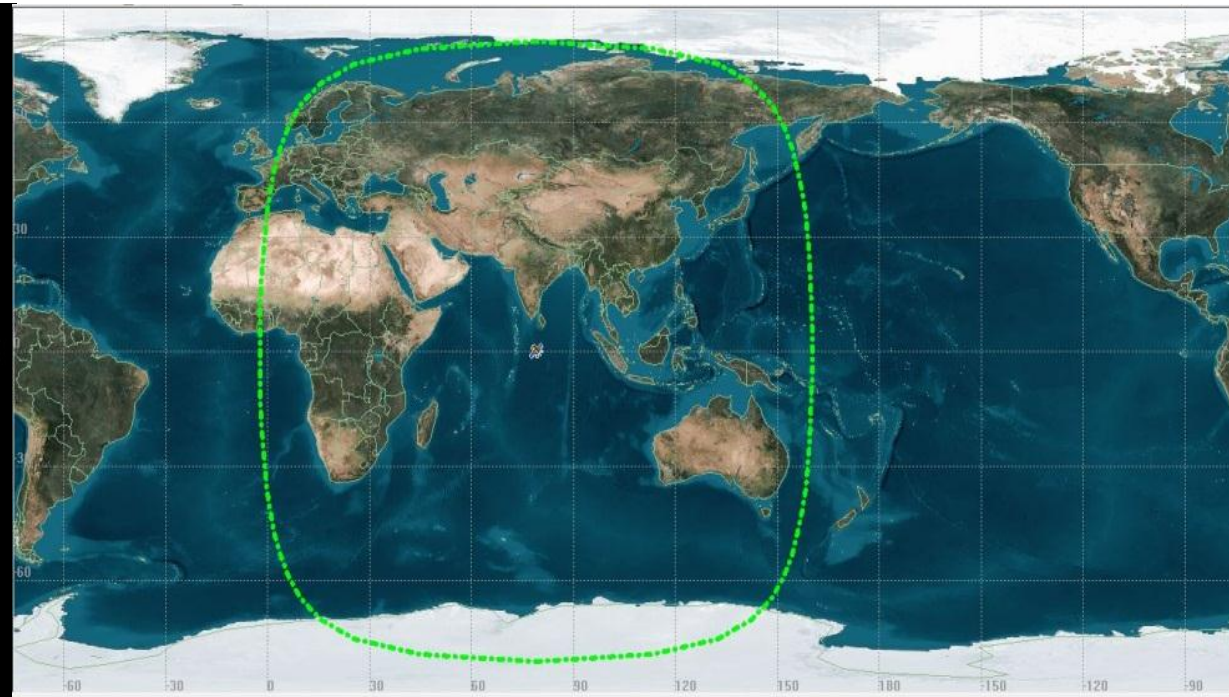
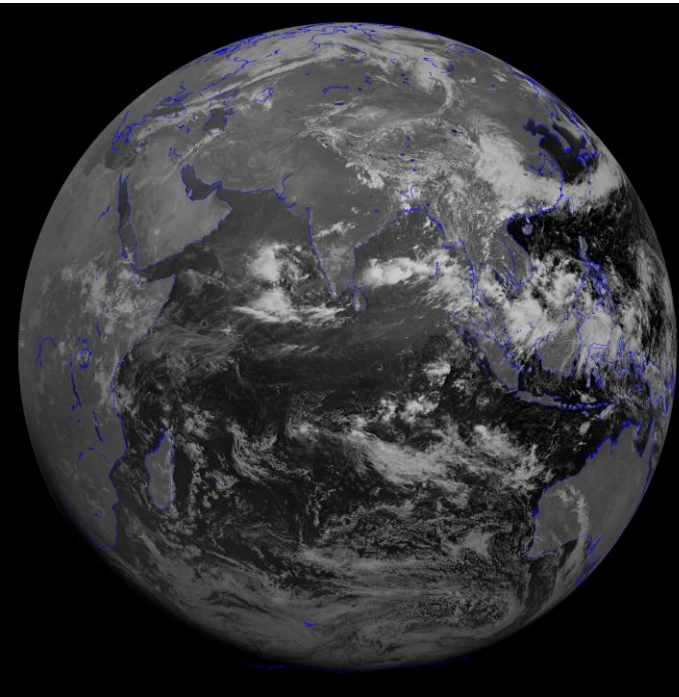


- Launched on June 5, 2018
- positioned at 79° E and operational *by September, 2018*

On June 10, at SCO summit in Qingdao, Chinese President Xi Jinping made a commitment that China will provide meteorological services by using FY-2 meteorological satellite.”



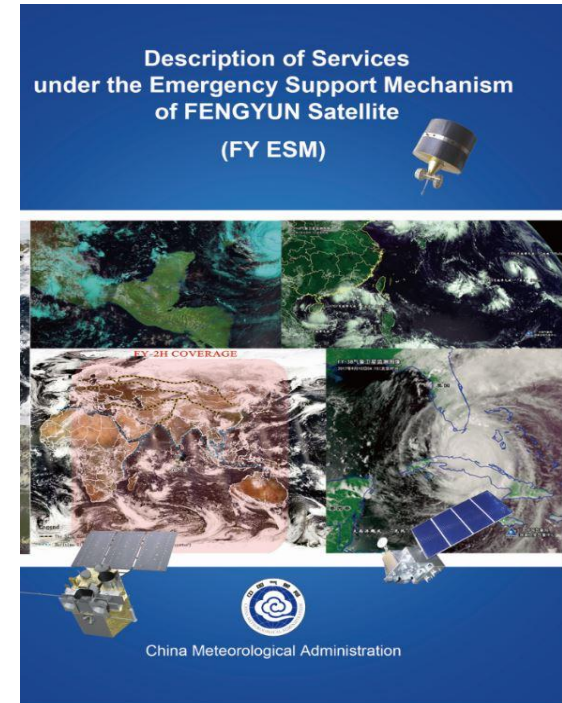
FY-2H coverage at 79° E





CMA Announced “Emergency Support Mechanism for International Users of Fengyun Meteorological Satellites in Disaster Prevention and Mitigation” on April 24, 2018

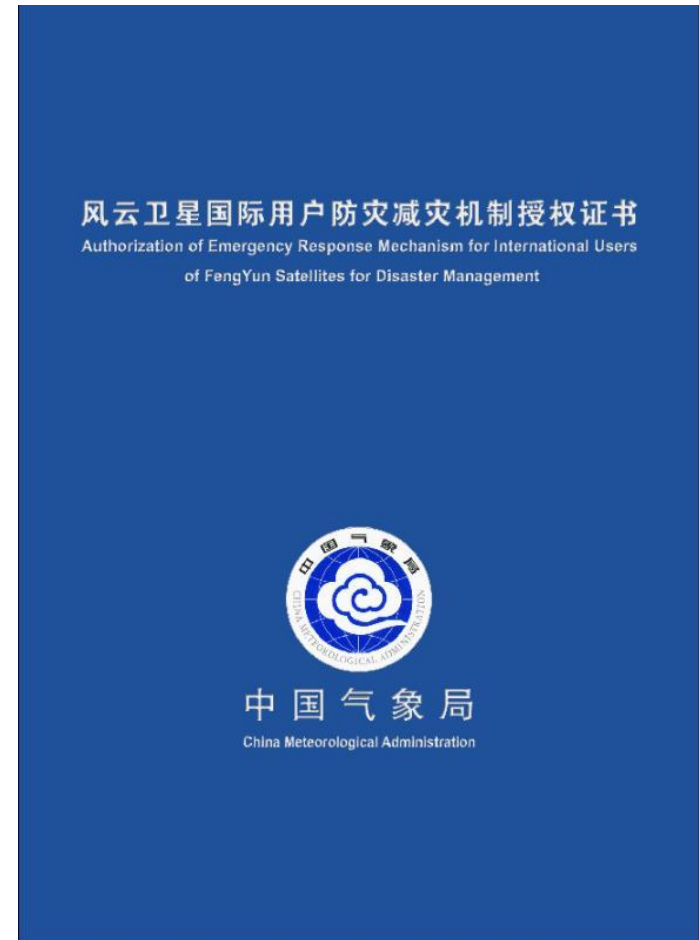
- To serve the countries along the “Belt and Road” in a timely manner. These countries may raise a request for the activation of the mechanism through their respective Permanent Representatives with WMO or their designated focal points.
- Once the request is approved, CMA will command the on-duty FY satellite for frequent and targeted observations per 5-6 minutes over affected areas.
- The images and products will be transmitted to the requesting applicant through CMACast, internet and direct satellite broadcast reception.





18 Authorized FY ESM Users

As of September 2018, there are 18 Authorized FY ESM users, including Indonesia, Vietnam, Laos, Myanmar, Thailand, Philippine, Malaysia, Singapore, Kazakhstan, Kyrgyzstan, Pakistan, Russia, Tajikistan, Uzbekistan, Afghanistan, Iran, Mongolia, Sri Lanka

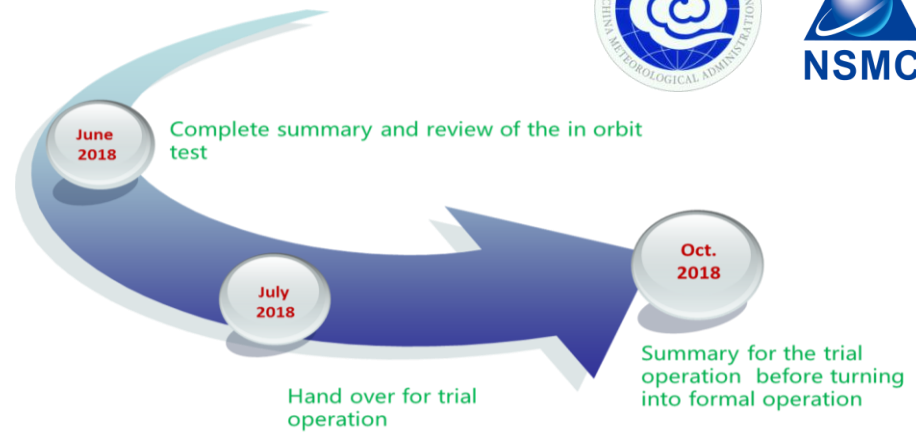


FY-3D: Launched on 15 Nov, 2017

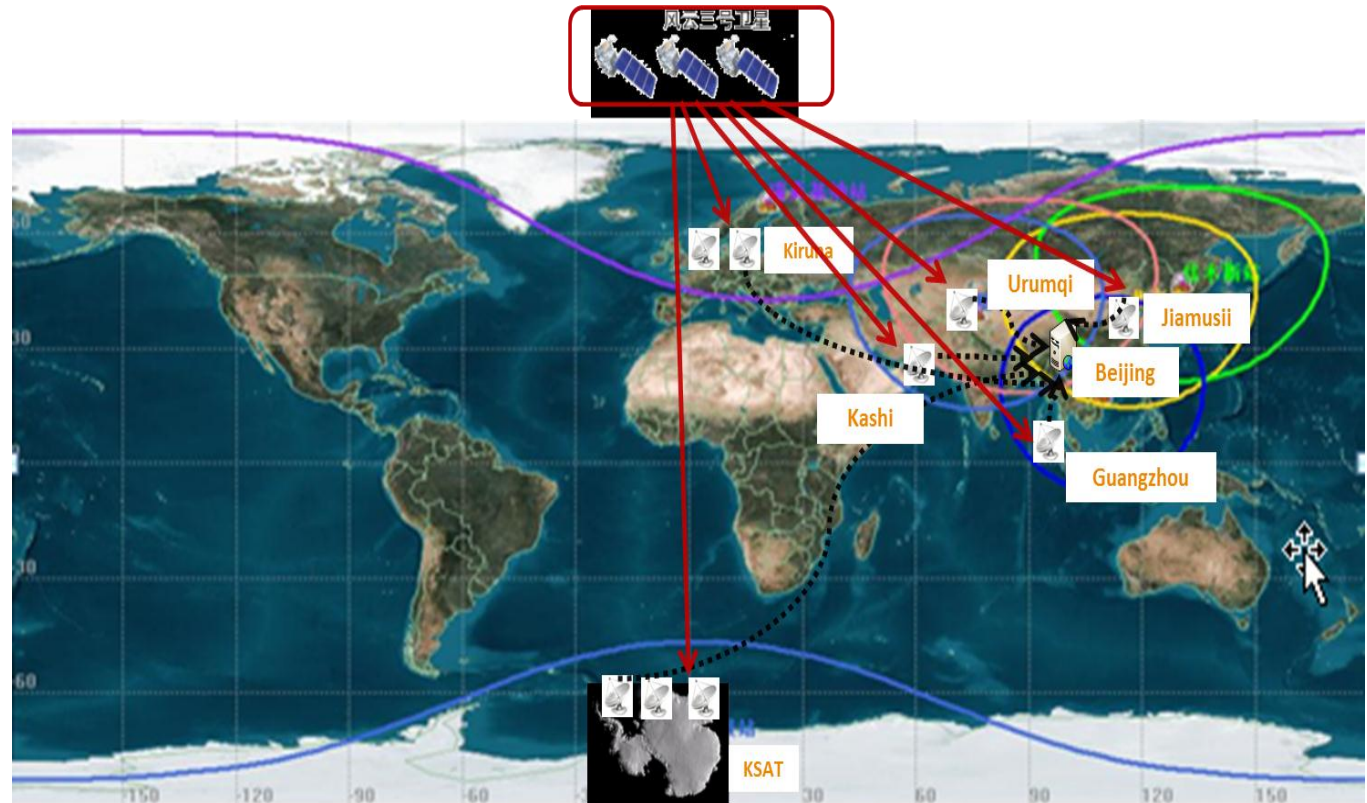


Parameters	Satellite Specification
Orbit type	Near-polar sun-synchronous orbit
Orbital altitude	836 Km
Orbital inclination	98.75°
Precision orbit	Semi-major axis deviation: $ \Delta a \leq 5\text{Km}$
	Orbital inclination deviation: $ \Delta i \leq 0.1^\circ$
	Orbital eccentricity ≤ 0.003
Repeat cycle	5.5d (Design range is in 4-10 d)
Eccentricity	≤ 0.0025
Local time drift at ascending node	15 min within 4 yrs
Launch window	local time at ascending node: 13:40 – 14:00
Design lifetime	5 yrs for design, 4 yrs for assessment

- ✓ In Orbit testing began on December 12th, 2017;
- ✓ the in orbital testing has been finished. The results show that the satellite platform and main payloads functions well, and meets the requirements;



Global data latency within 2 hours (80%) less than 1 hour



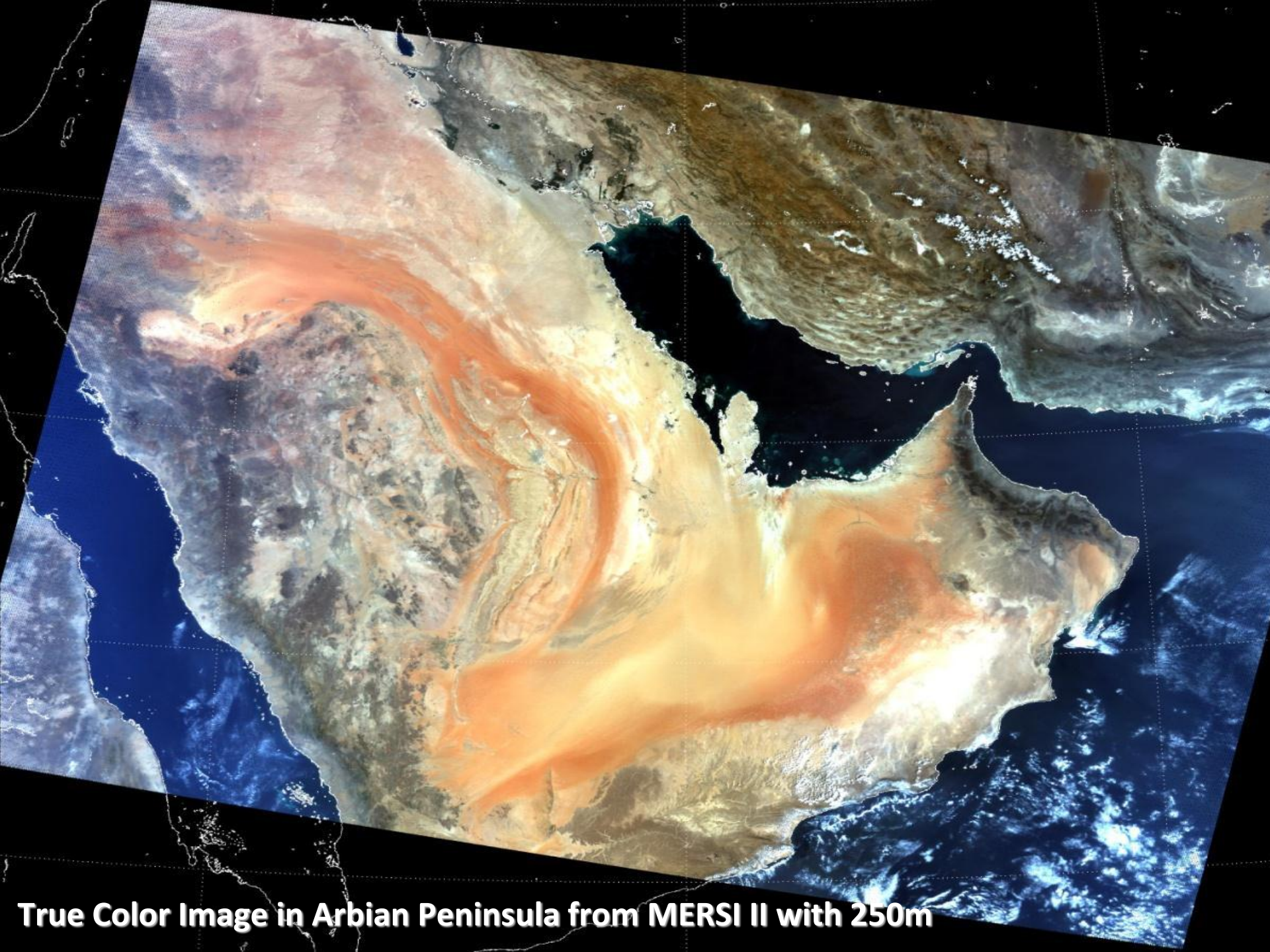
FY-3D Baseline products



Cloud & Radiation	Atmosphere	Land Surface	Sea Surface	Space Weather
<p>Cloud mask, Cloud amount, Cloud type, Cloud phase, Cloud top temperature, Cloud top height, Cloud optical depth, Cloud physical parameters, Cloud water content, Cloud liquid water, Ice water path, Outgoing longwave radiation</p>	<p>Atmospheric total precipitable water, Dust storm index, Aerosol optical depth, Rain detection, Atmospheric humidity profile (GNOS,VASS), Atmospheric temperature profile (GNOS,VASS), Precipitation, Microwave rain rate, Fog detection</p>	<p>Global fire detection, Land cover, Land surface reflectance, Land surface temperature, Soil moisture, NDVI, Snow cover, Snow cover fraction, LAI, FPAR, NPP, Albedo, Snow depth, Snow water equivalent</p>	<p>SST, Sea-Ice cover, Ocean color, Chlorophyll, Sea surface wind speed</p>	<p>radiation flux of high energy particles, surface electric potential radiation dose, GNOS Electron Density Profile, Ionospheric O/N2 Column Ratio, Aurora Mapping Products</p>

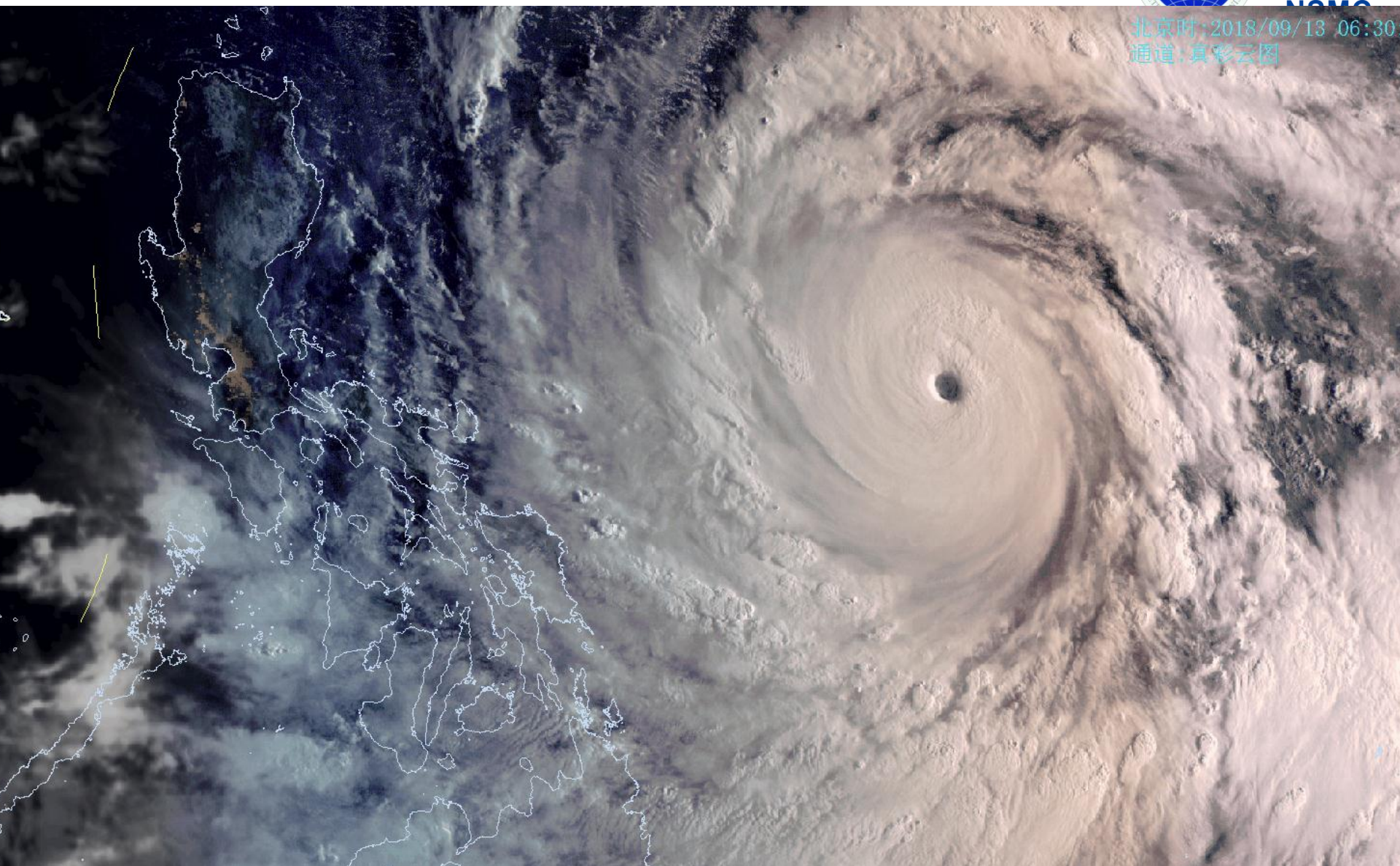


True Color Image in Caribbean Sea from MERIS II with 250m



True Color Image in Arabian Peninsula from MERIS II with 250m





Temperature Profile from HIRAS-MWTS-WMHS

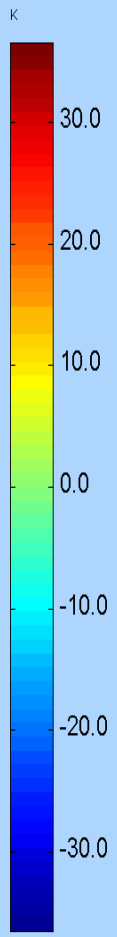
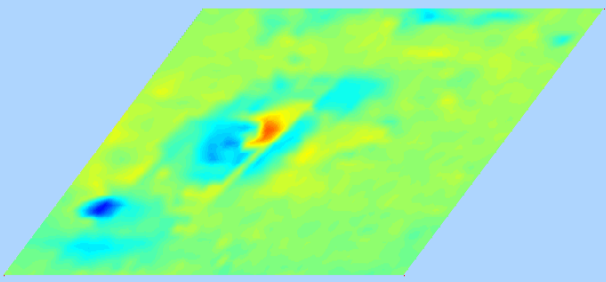


9月14日23:30

9月14日11:40

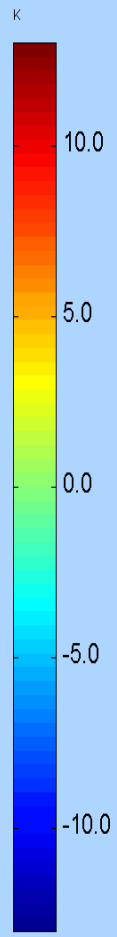
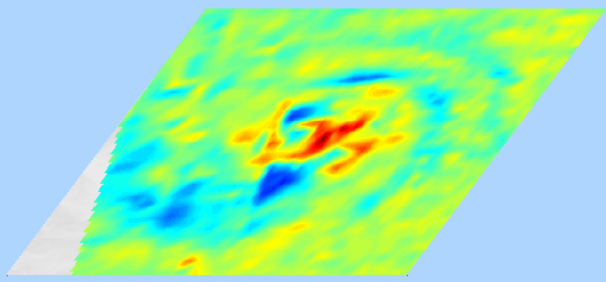
FY3D AVP
FY-3D (MANGKHUT)
2018/09/14 15:30 UTC

100.0
200.0
500.0
850.0
1000.0



FY3D AVP
FY-3D (MANGKHUT)
2018/09/14 03:40 UTC

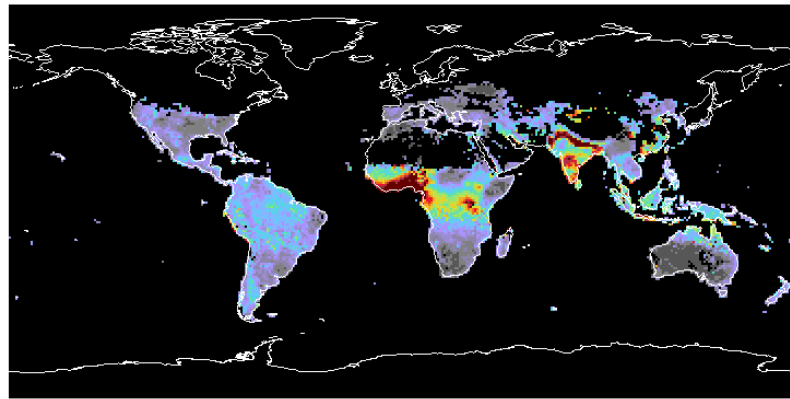
100.0
200.0
500.0
850.0
1000.0



Typhoon Mangkhut (1822) 2 hour before landing

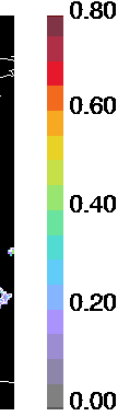
Global 8-day-mean product: MERSI II and MODIS land aerosols

Aerosol_Optical_Depth_Land_Mean_Mean



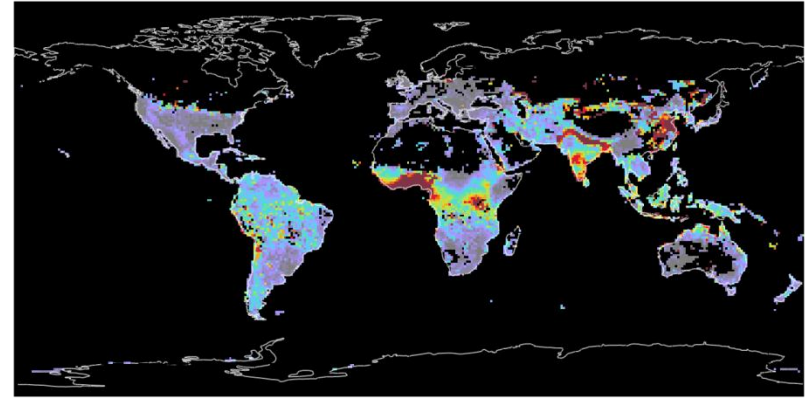
MODIS/Aqua MYD08_E3.A2018001.006.20180111145021.hdf

01Jan2018



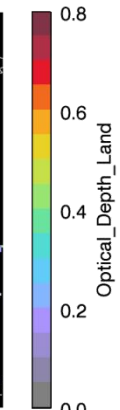
none

Aerosol_Optical_Depth_Land_Mean_Mean



MERSI2/FY3D FY3D_MERAOD_E1d.201801.Beta.hdf

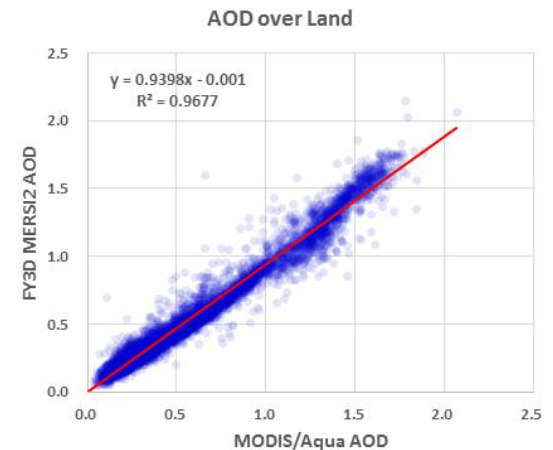
Jan2018



MODIS/Aqua

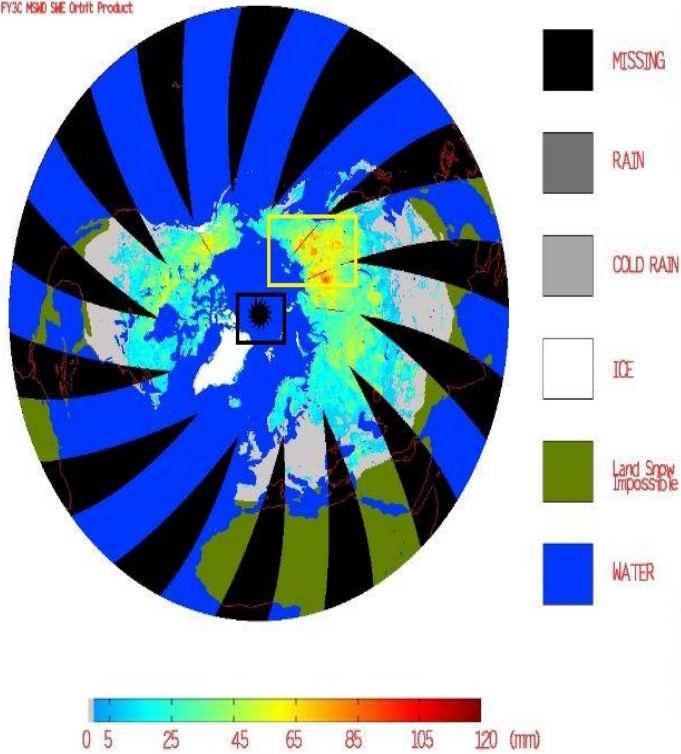
MERSI2/FY3D

Good consistency in global distribution and AOD of pollution sources.



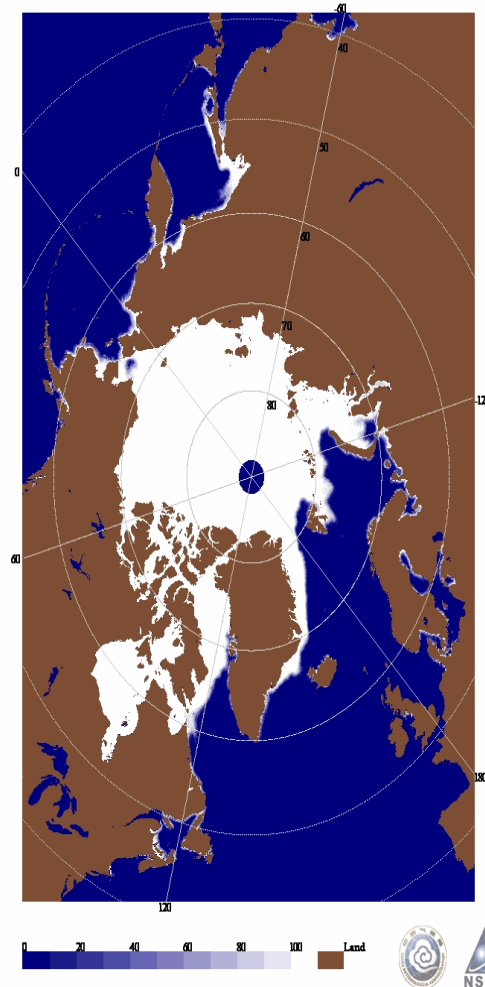
Snow depth/SEW

FY3C MSND SWE Orbit Product
NSMC

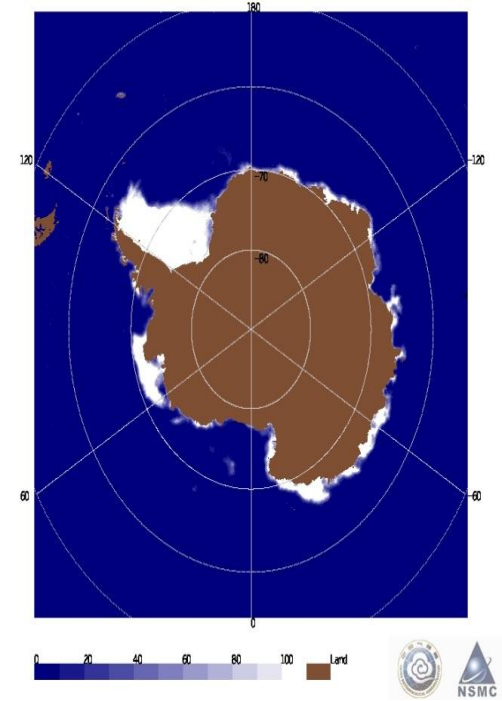


MWRI Sea ice

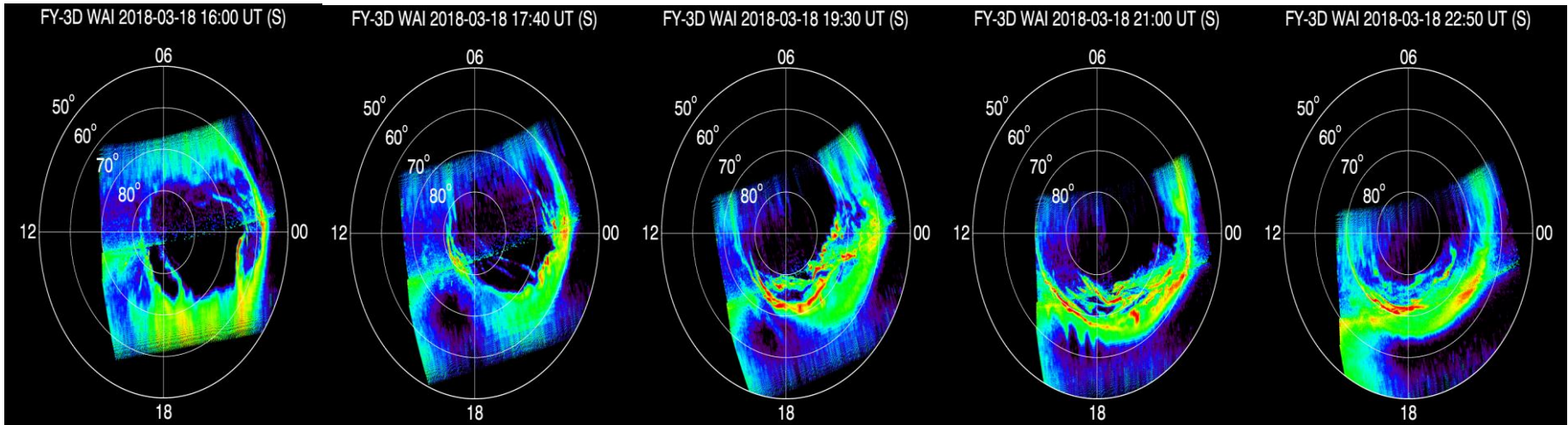
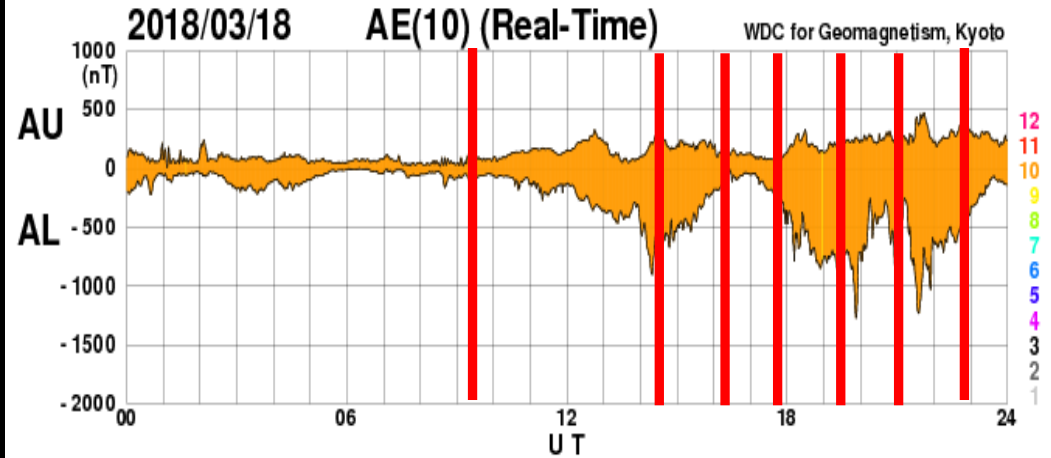
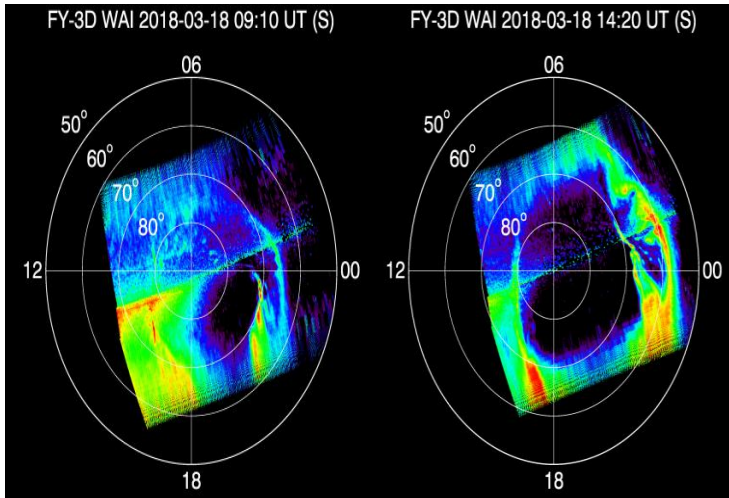
FY-3D MWRI SIC North Daily Product: 2018-01-01



FY-3D MWRI SIC South Daily Product



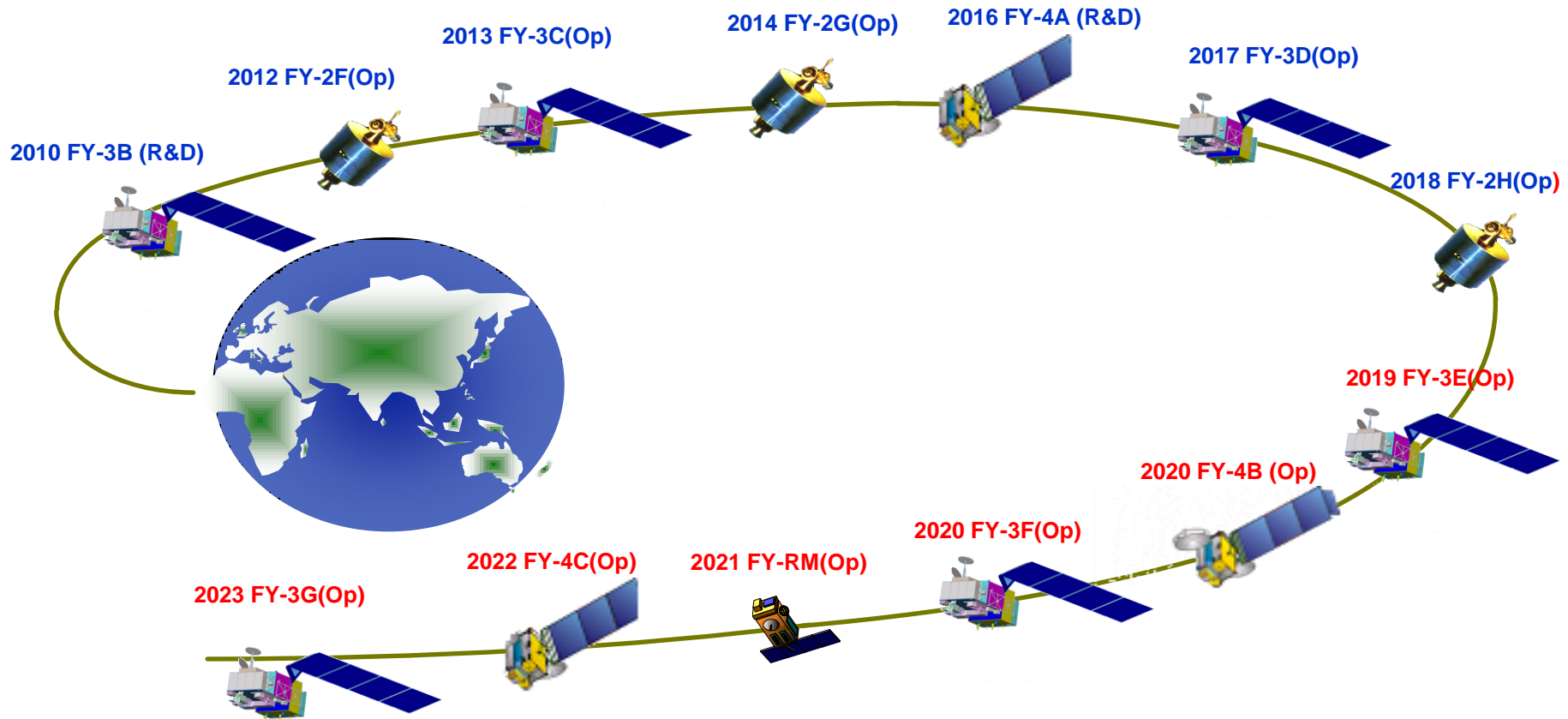
Aurora in the North Polar from WAI



4. Future Programs

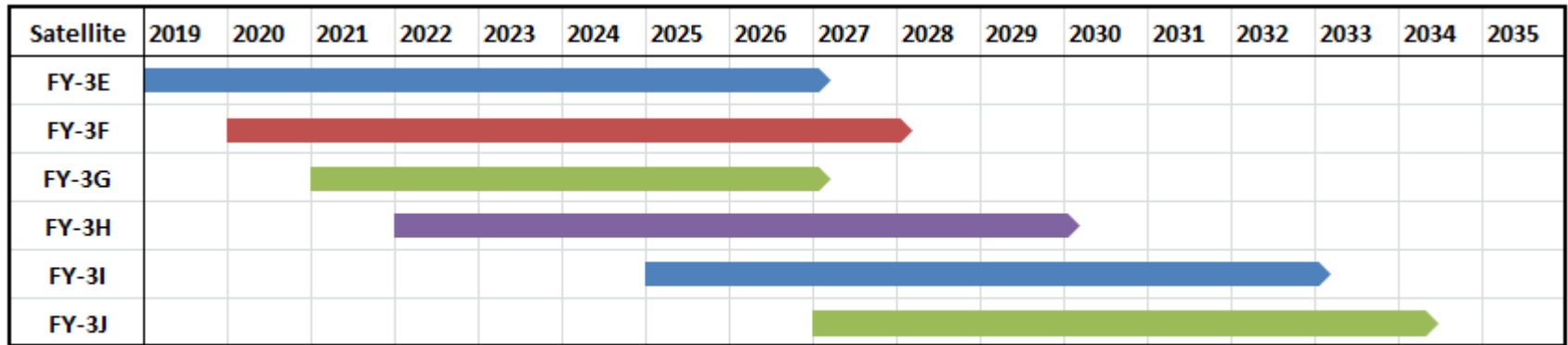
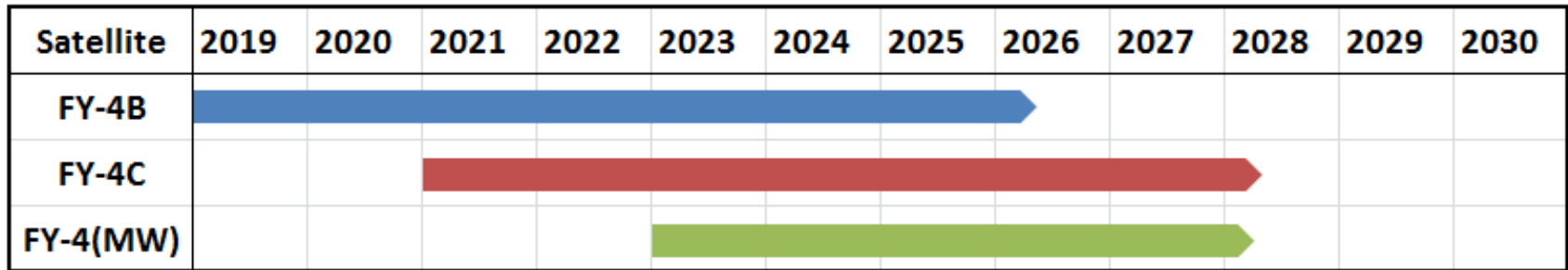


National Program for Fengyun Meteorological Satellite from 2011-2020

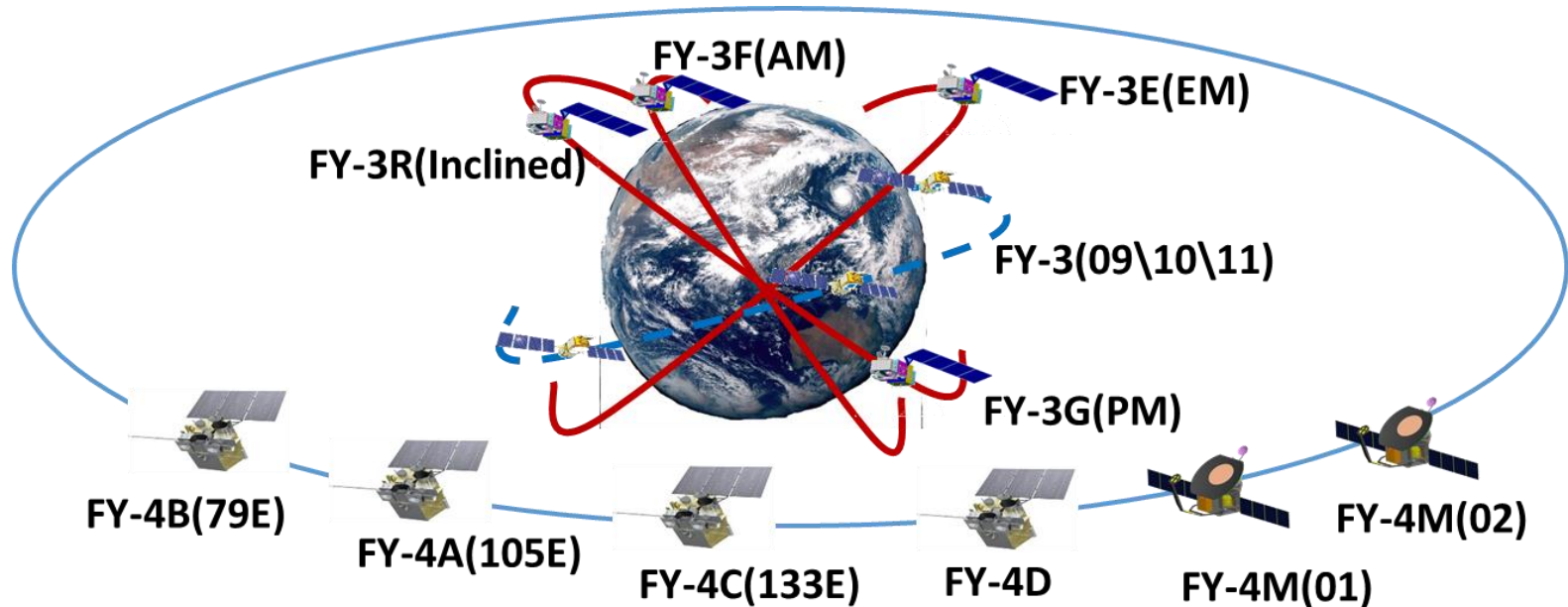


■ 6 satellites will be launched within this decade

National Space Infrastructure Program for Meteorological Satellites (from 2020 to 2025) approved by the State Council



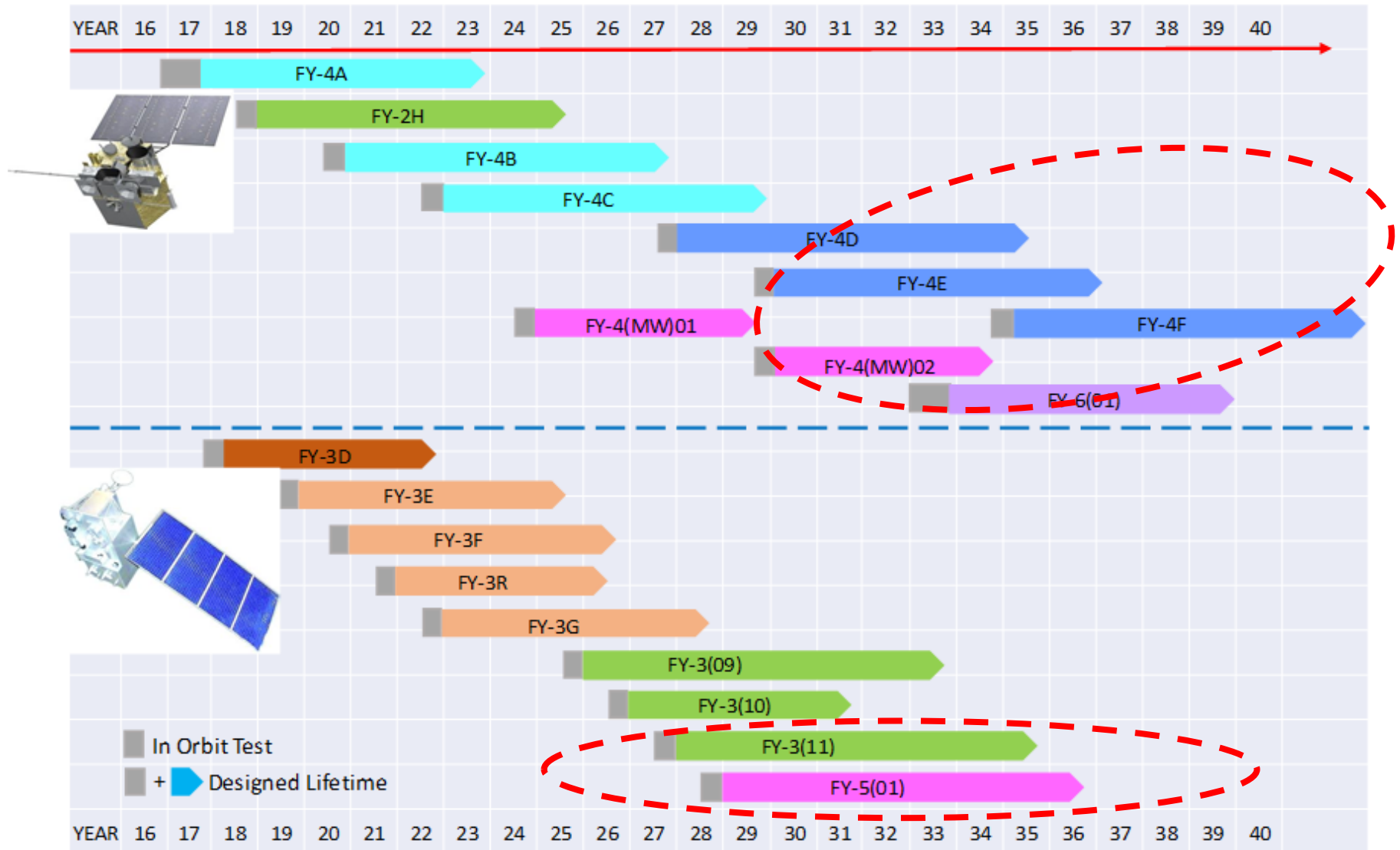
In the next 10 years, CMA will have 6 GEO and 7 LEO main operational satellites, which means the updates for the satellite observation network will be completed.



The LEO realizes the network of covering the EM, AM and PM satellite observation, and the time limit of global data updating has been raised from 6 hours to 3 hours. Fine detection of elements such as precipitation and greenhouse gas.

The new pattern of GEO observation: imaging, hyper-spectral and microwave sounding.
FY-4B: rapid scan(min), FY-4C: five minutes disk image, sounding abilities, whole disk lightning mapper.

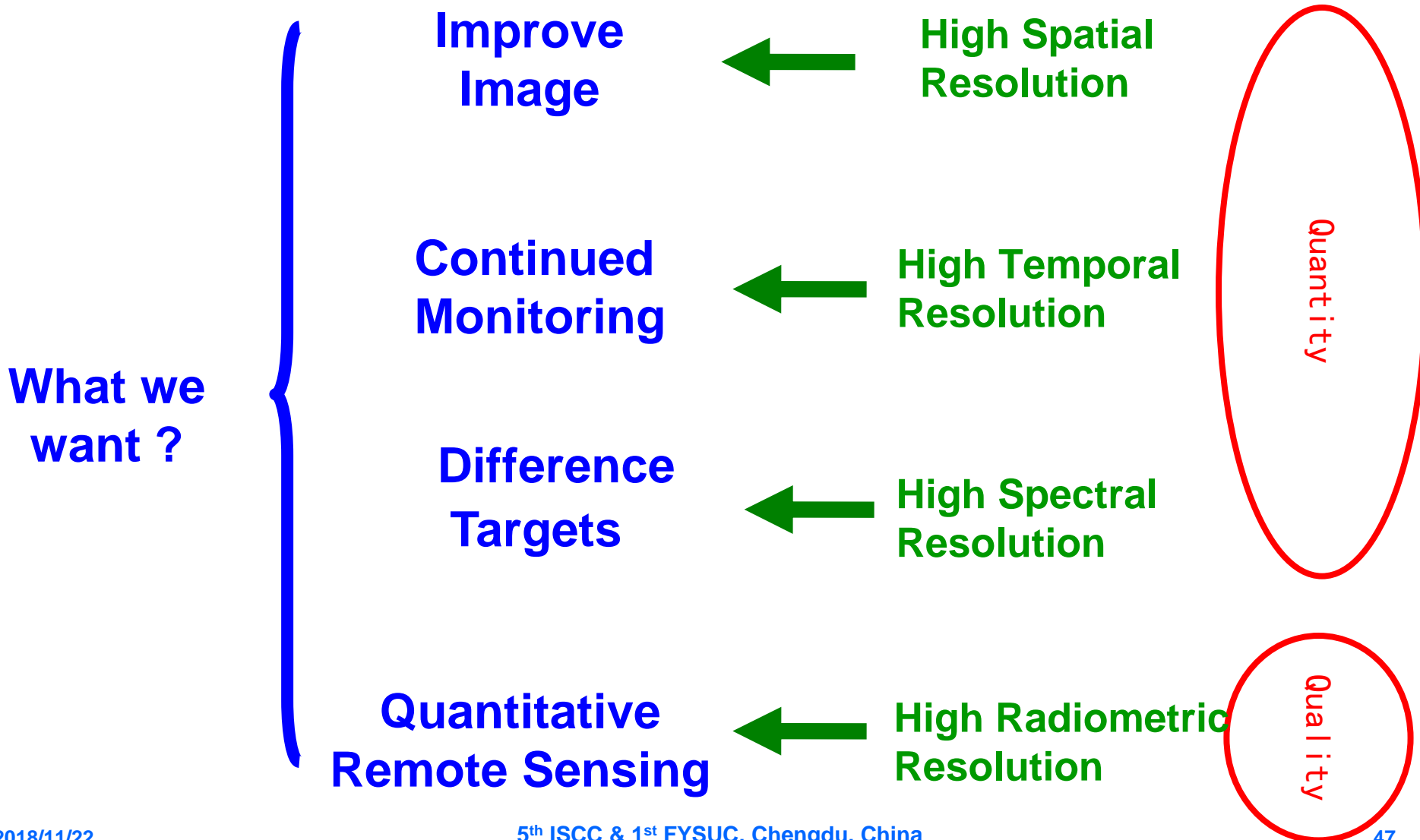
FengYun Vision for Meteorological Satellites Program in 2035



5. Challenge on Quantitative Measurement



Prospect on Satellite Capability

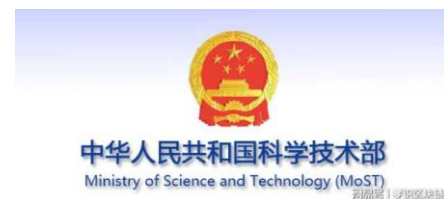


Projects on Space-based Radiometric Benchmark



Founded by

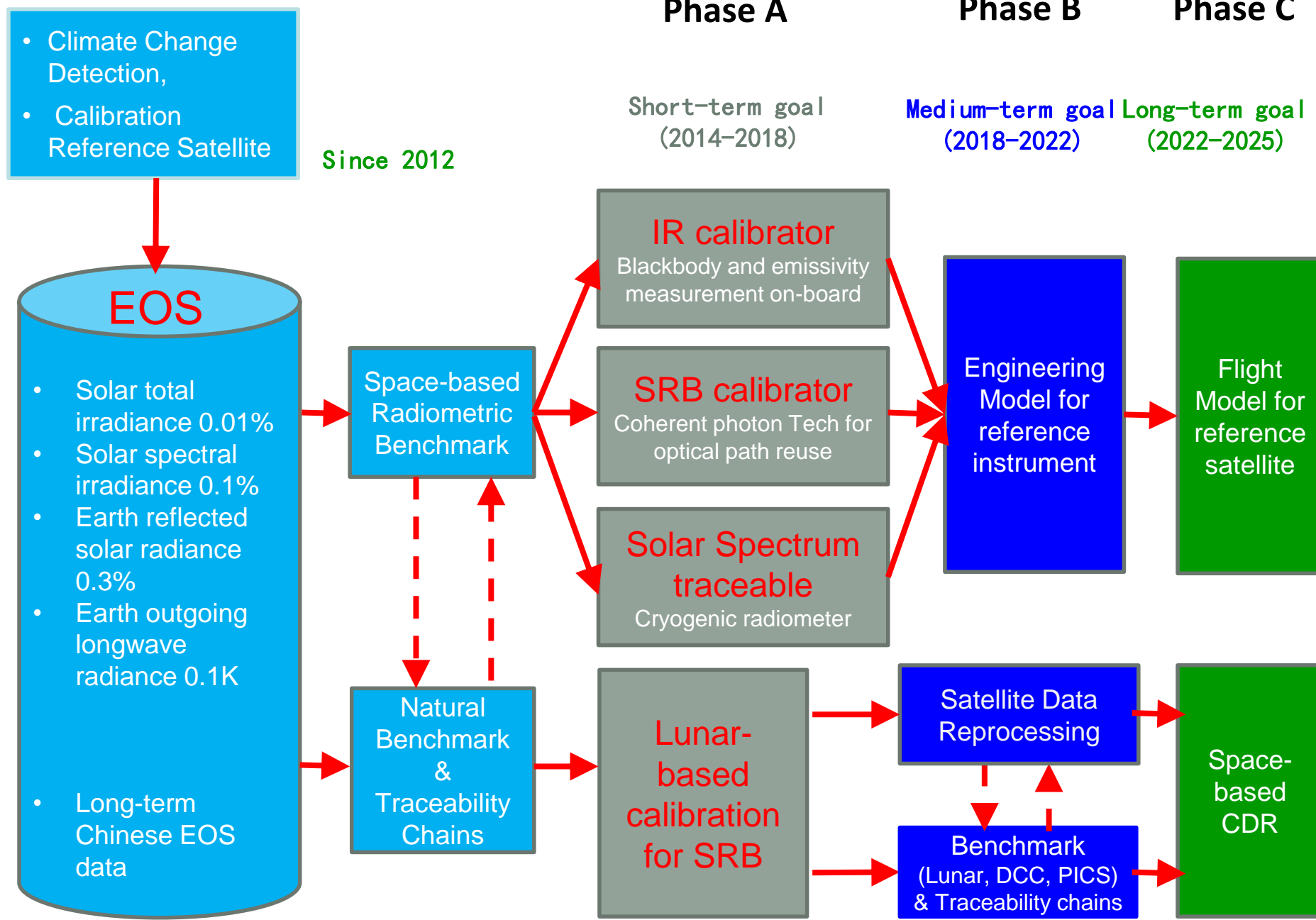
- National High Technology Research & Development Program of China (863 program) before 2018
- National Key R&D Program of China after 2018



Goal

- Chinese SI-traceable reference satellite
- Retrospective recalibration of historical Chinese EO satellite data

Projects on Space-based Radiometric Benchmark in China



Phase B (300 million RMB)

- National Key R&D Program of China
- Chinese FY Satellite Program
- Chinese HY Satellite Program
- Chinese ZY Satellite Program

Engineering Model for reference instrument



Shanghai Institute of Technical Physics (SITP), CAS



Anhui Institute of Optics and Fine Mechanics (AIOFM), CAS

Natural Benchmark (Lunar, DCC, PICS) & Traceability chains



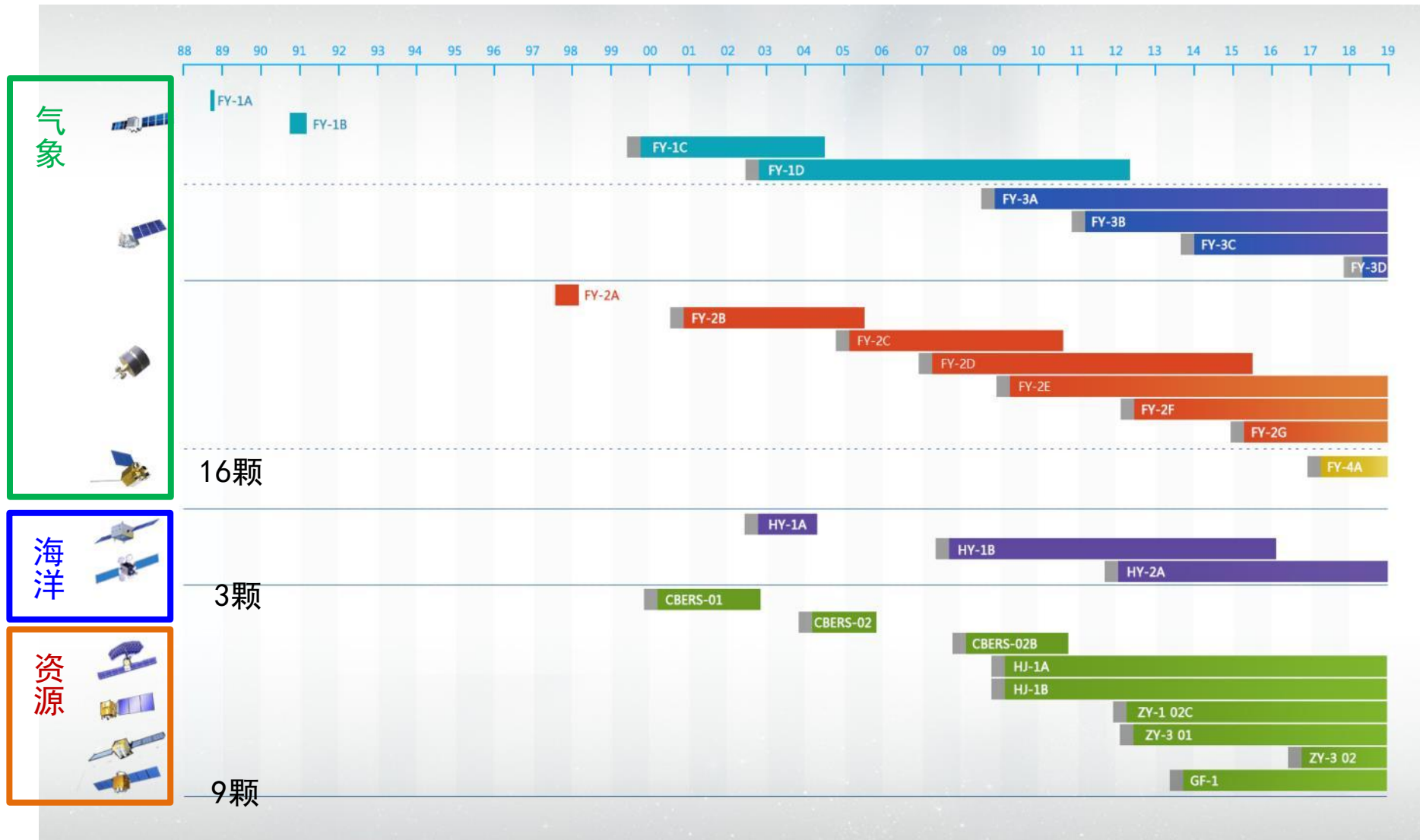
Academy of OPTO-Electronics (AOE), CAS

Satellite Data Reprocessing



National Satellite Meteorological Center (NSMC), CMA

30 years' Chinese historical Satellite data (2018-2022)



Conclusion



- With the improved instrument performance (NE Δ T), and traceable radiometric measurements, **FY series** can be one important components of global observation to enhance the support for the quantitative application.
- Current **FY-3** series are expected to work until 2035 with Early Morning orbit, Morning orbit, and Afternoon orbit and Rainfall mission.
- Current **FY-4** series are expected to work until 2040 with FY-4 East (133E) and FY-4 West (79E).
- Future **FY-5** and **FY-6** are expected to provide service since 2030 and 2035 respectively.
- **FY data** can be ordered through website <http://satellite.cma.gov.cn>



Together
For Better

谢

谢!