

Chinese Meteorological Satellite and its applications



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China Meteorological Administration
(NSMC/CMA)**



Outline

- ❑ **Current FY Status and future programs**
- ❑ **Data distribution and services**
- ❑ **Applications of FY data**

1. Current FY Status and future programs

FengYun Meteorological Satellites

Polar System

First Generation
FY-1 A, B, C, D



Second Generation
FY-3 A, B, C, D, E, F, G



Expected until 2025

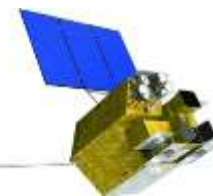


Geostationary System

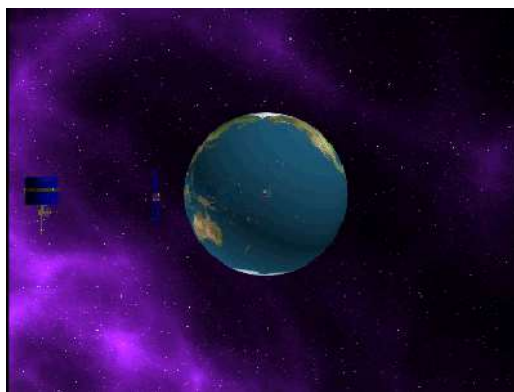
First Generation
FY-2 A, B, C, D, E, F, G, H



Second Generation
FY-4 A, B, C, D, E



Expected until 2030

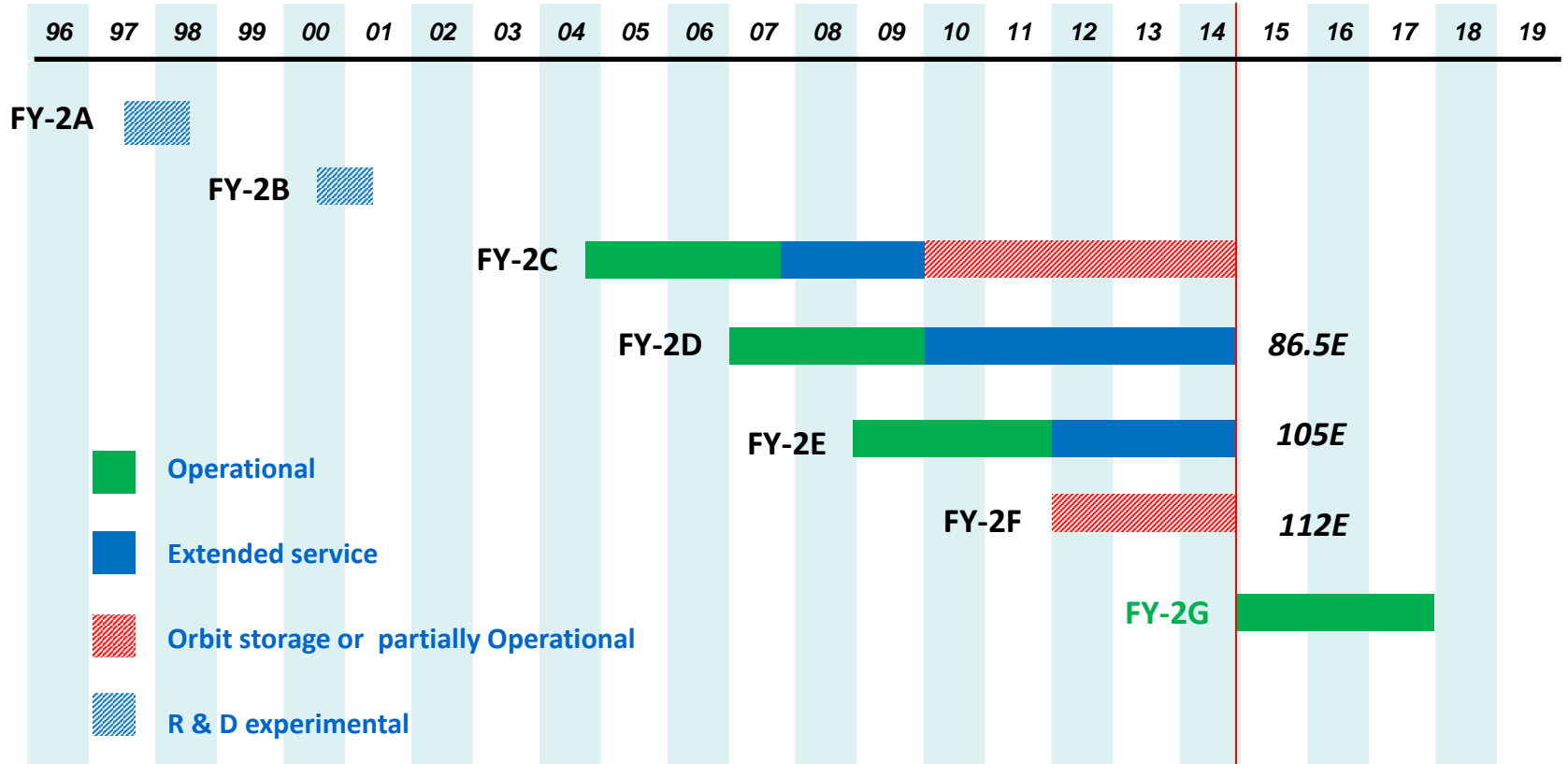


Launched Satellites

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

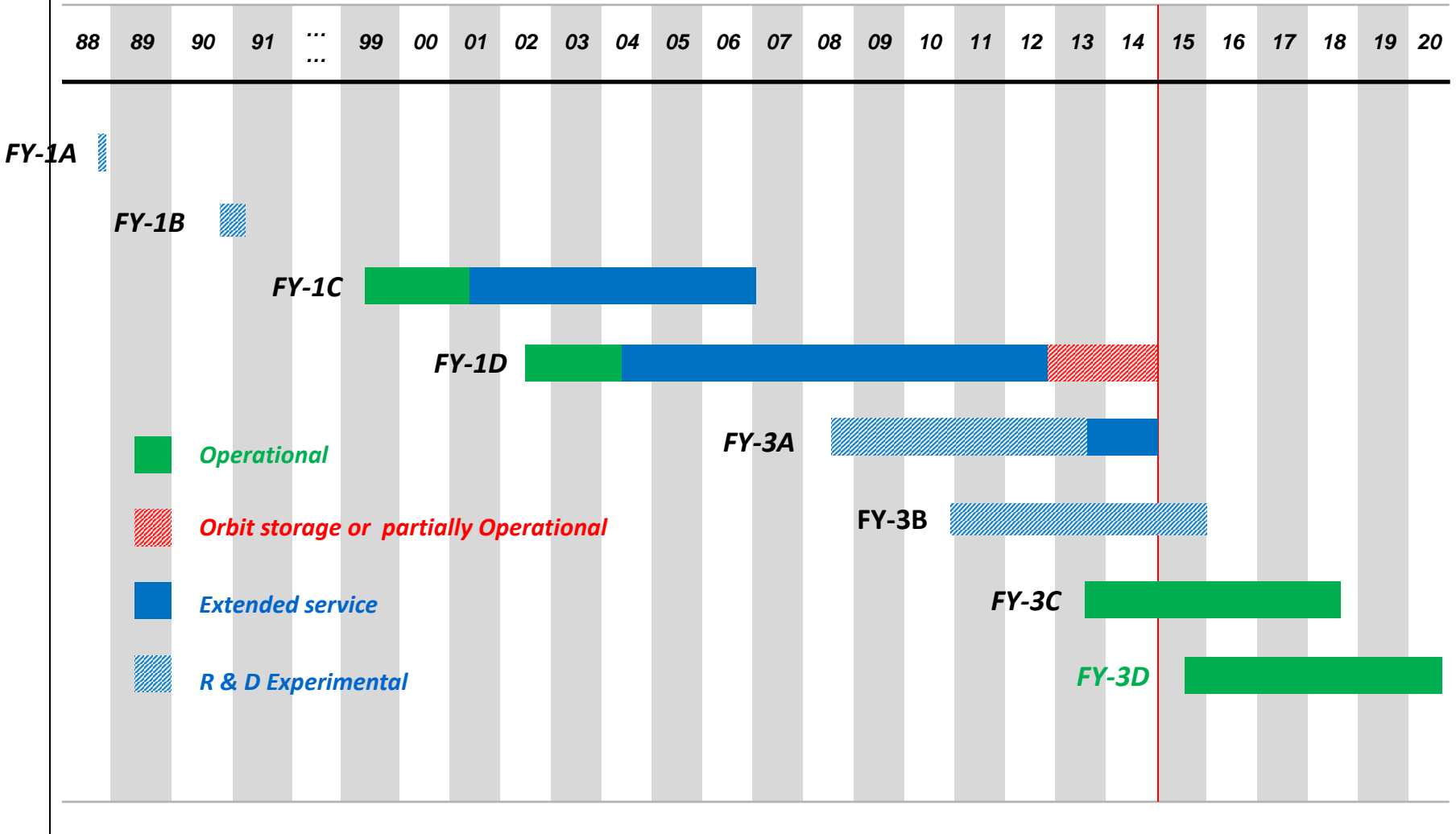
- China is one of the most active members of CGMS
- The Chinese meteorological satellites are now one of the critical contribution of WIGOS

CURRENT CMA GEO Program



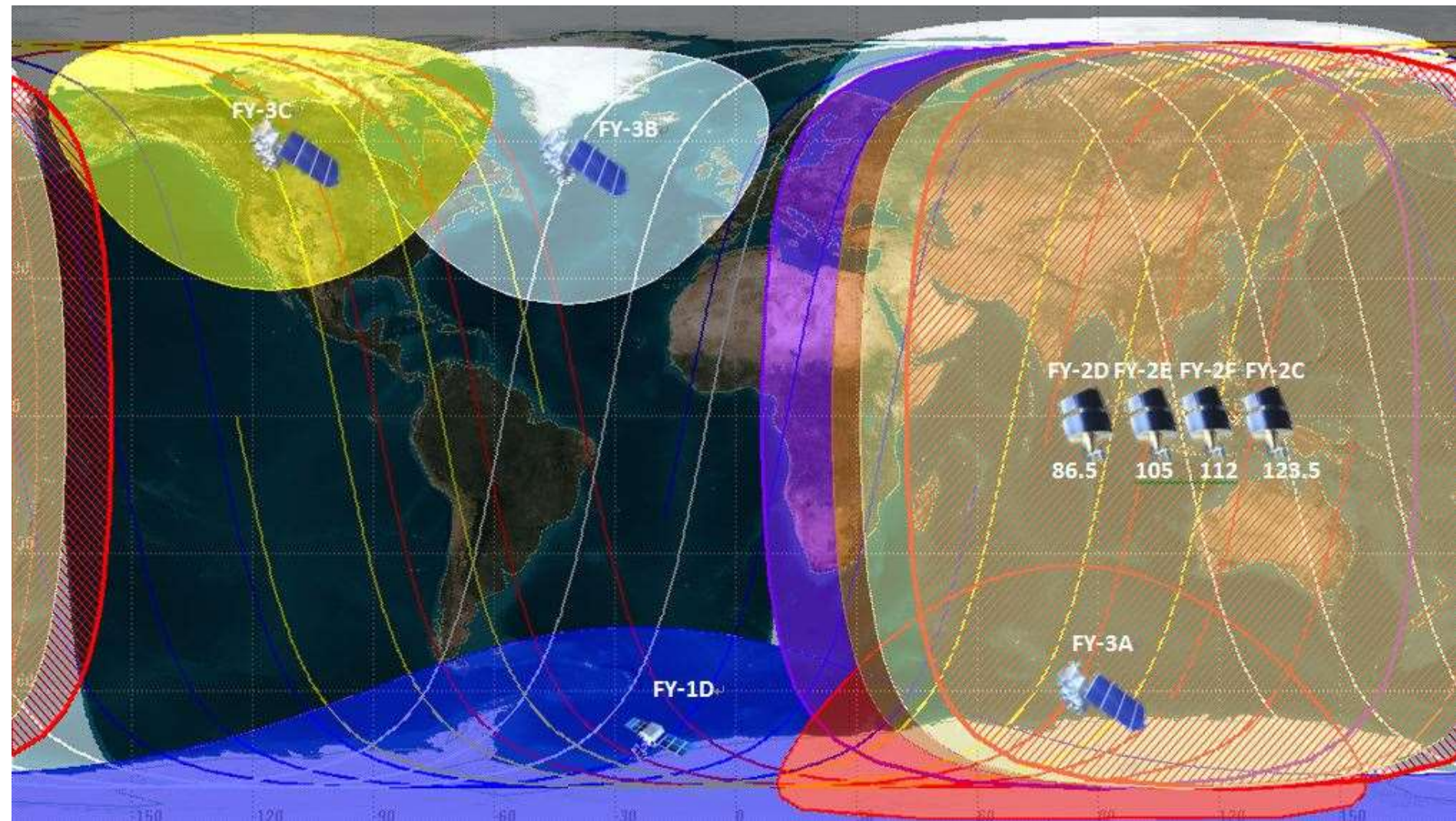
For CMA GEO satellite system. 105E is primary position and 86.5E secondary

CURRENT CMA LEO Program



Following FY-3C, FY-3D/E/F/G will be launched at the pace of one satellite every two years. The life time for each satellite is 5 years. Also, CMA is developing plan for rain observation satellite, FY-3R. The first scheduled launch of FY-3R is in 2020, life time 5 years.

On Orbit Satellite



Fengyun GEO

Decommission

FY-2C

In operation

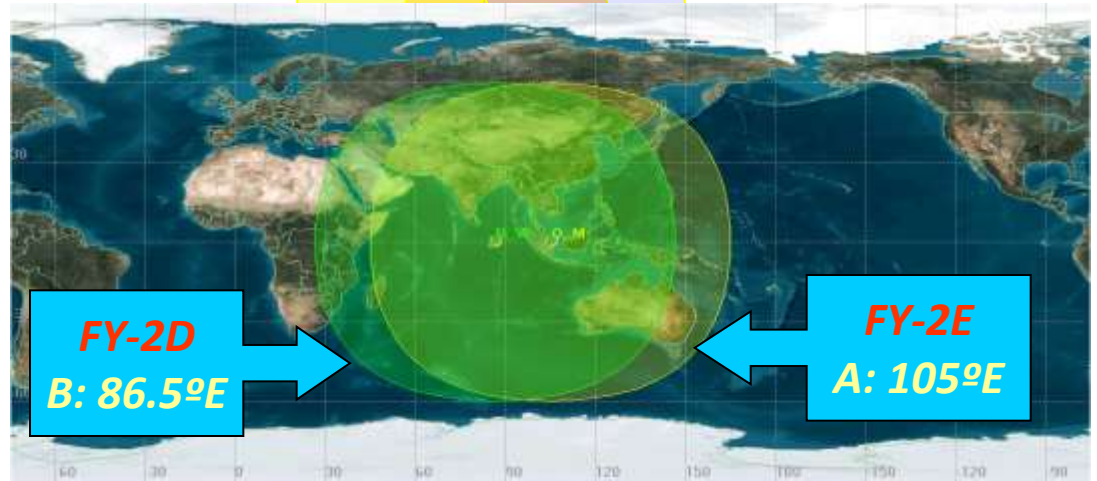
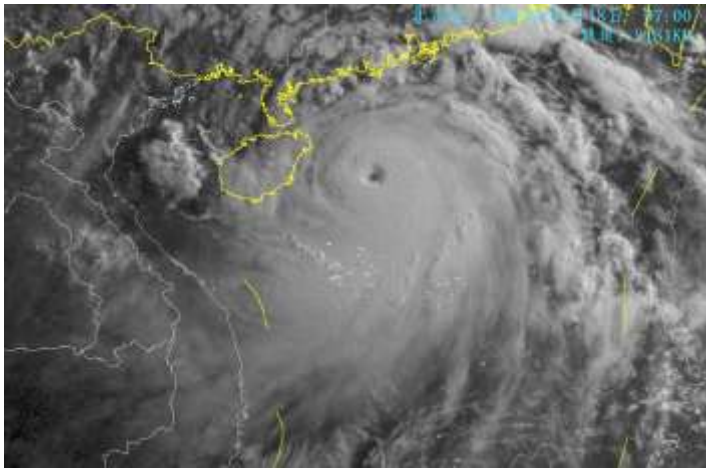
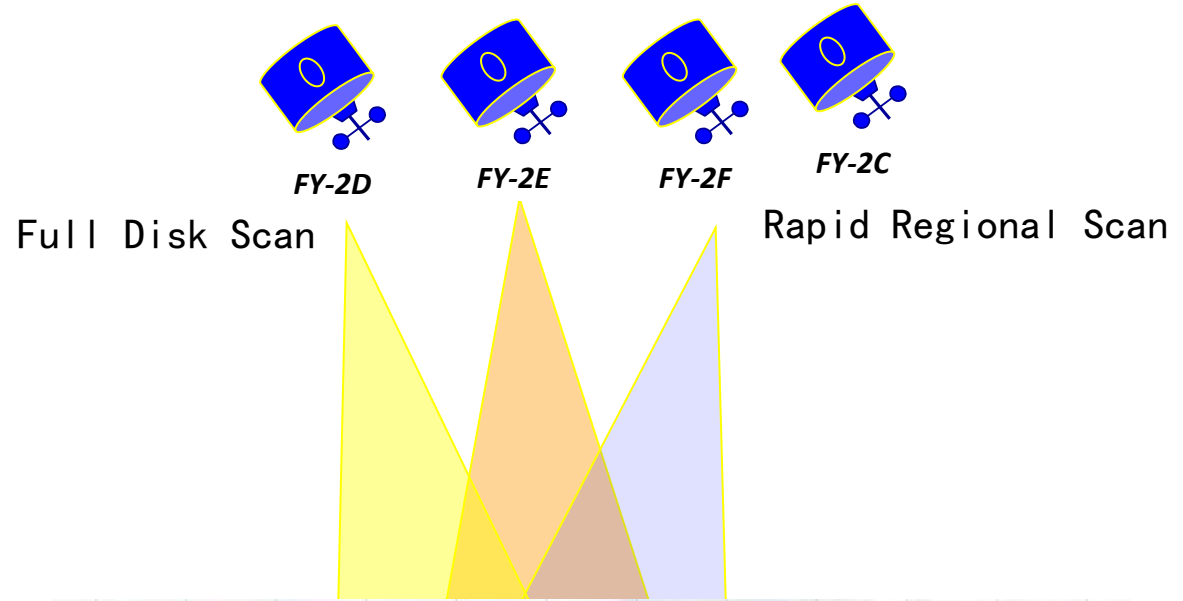
FY-2D: Full Disk

FY-2E: Full Disk

FY-2F: Regional

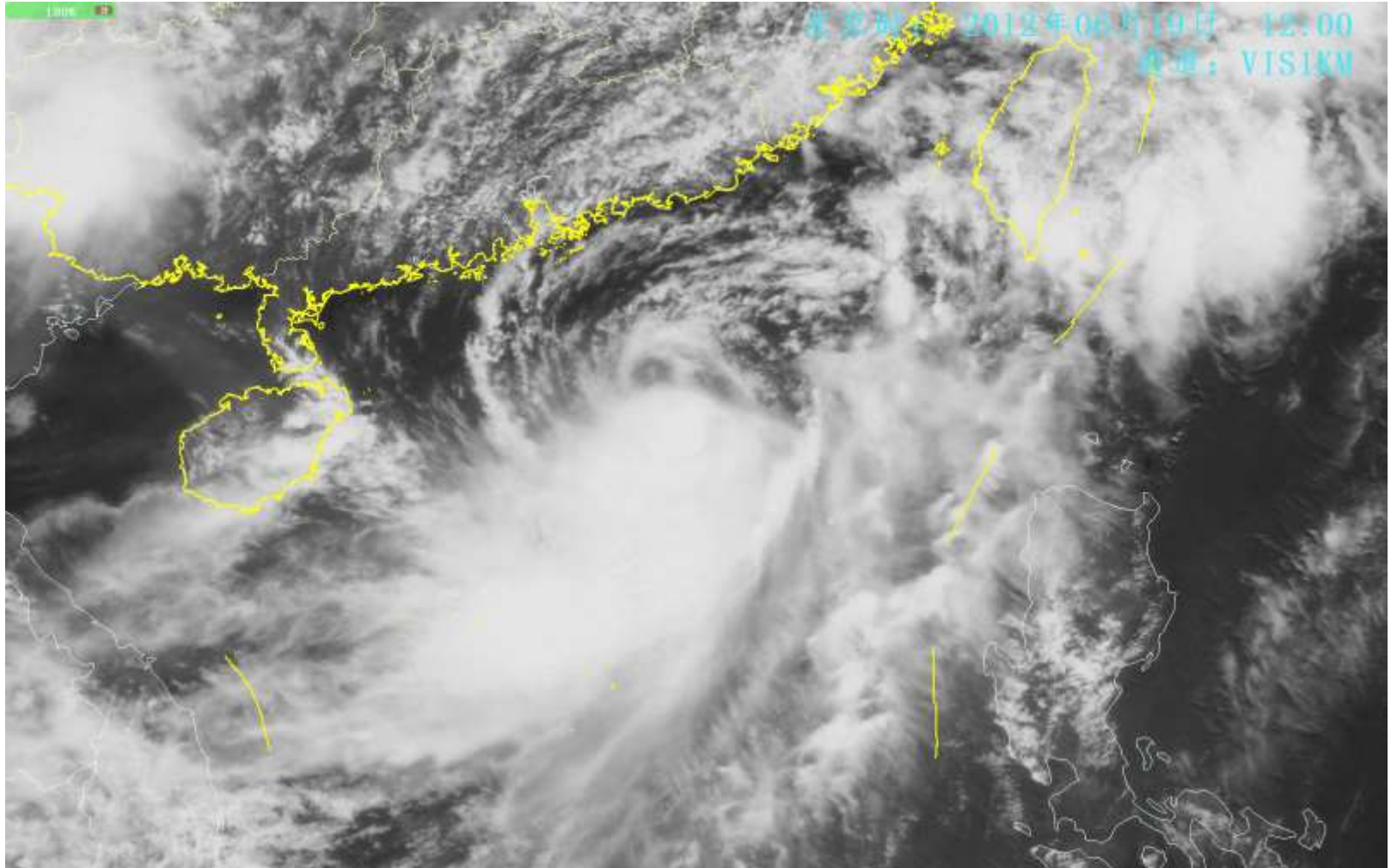
Operation

Back-up



Rapid Regional scan: per 6 minutes

Typhoon 1205 Talim (June 19 LTC12:00-18:00)

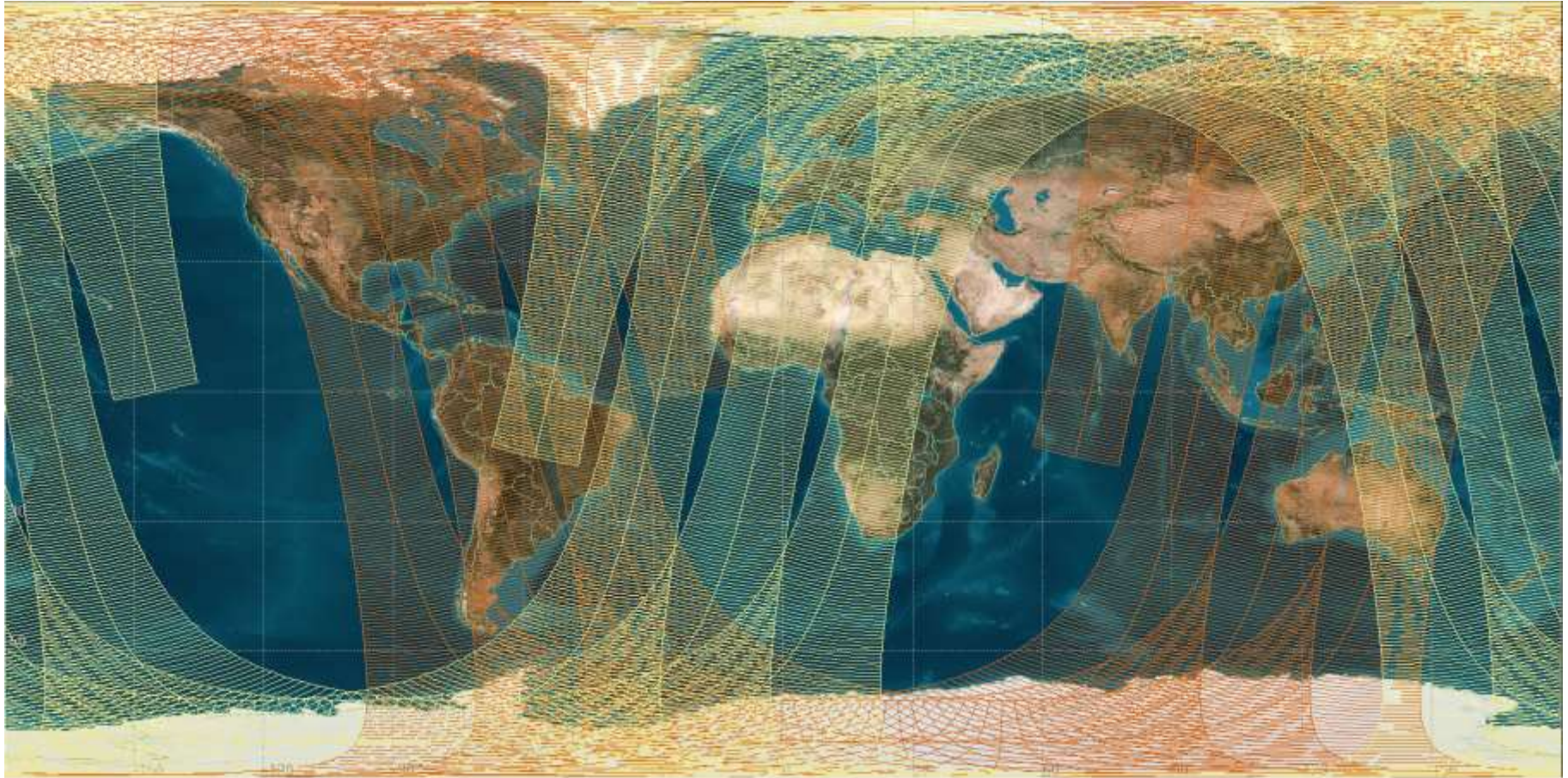


Fengyun Polar

■ Decommission: FY-1D

■ To be decommission: FY-3A

■ In operation: FY-3B + FY-3C **global coverage 4 times per day**

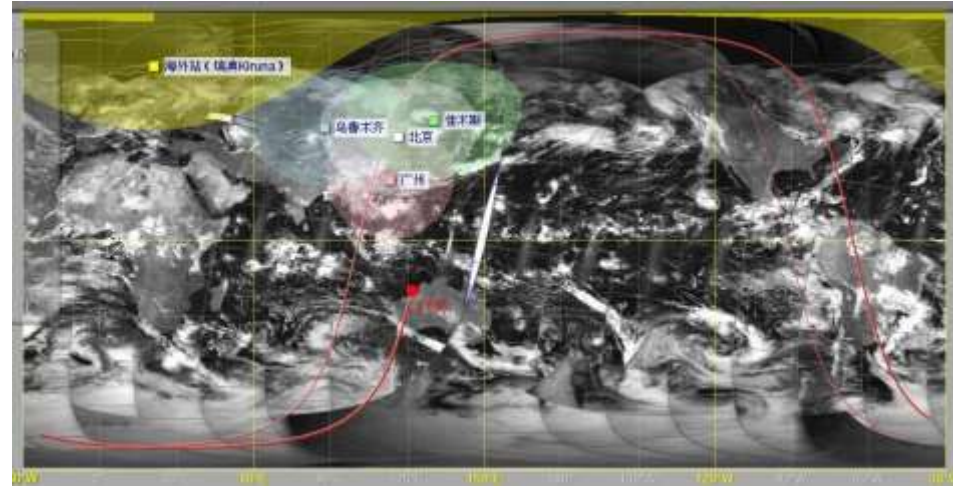


 FY-3C LTC 10:30 AM

 FY-3B LTC 13:40 PM

Global Data Latency within 4 hours maximum

80% data within 2 hours



<i>Station Name</i>	<i>Longitude</i>	<i>Latitude</i>
<i>Beijing Station</i>	<i>116 ° 16' 36" E</i>	<i>40 ° 03' 06" N</i>
<i>Guangzhou Station</i>	<i>113 ° 20' 20" E</i>	<i>23 ° 09' 52" N</i>
<i>Wulumuqi Station</i>	<i>87 ° 34' 08" E</i>	<i>43 ° 52' 17" N</i>
<i>Jiamusi Station</i>	<i>130 ° 22' 48" E</i>	<i>46 ° 45' 20" N</i>
<i>Kiruna Station</i>	<i>21 ° 02' E</i>	<i>67 ° 32' N</i>

Main Instruments

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			

Optical Imager

Atmospheric Sounder

Microwave Imager

Atmospheric Composition

Radiation Budget

After half year commission test, FY-3C shifted to operation as the primary a.m. satellite

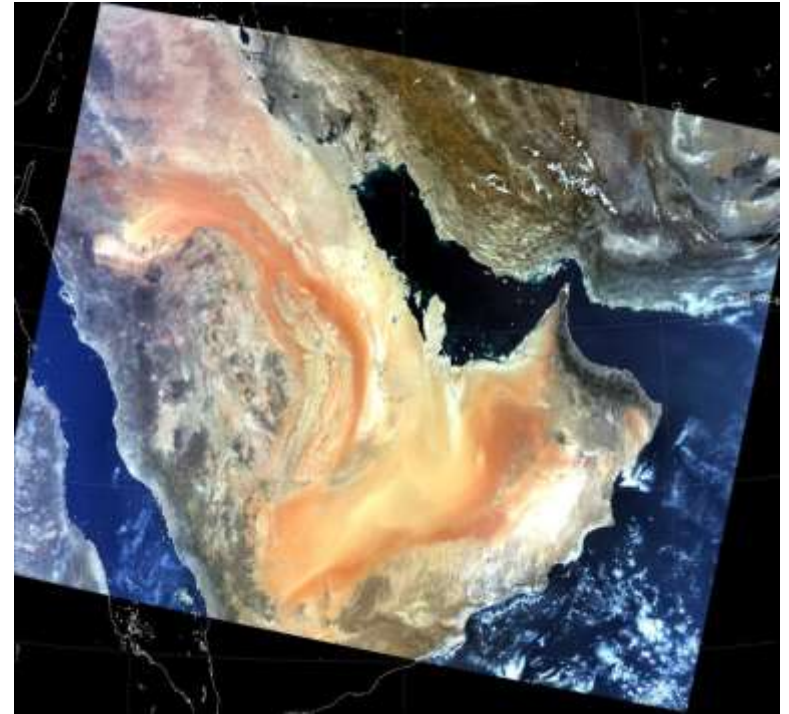
Good S/N Performance of FY-3C Image

Florida Peninsula
Low Reflectivity



2014-11-18

Arabian Peninsula
High Reflectivity



Improvements of FY-3C

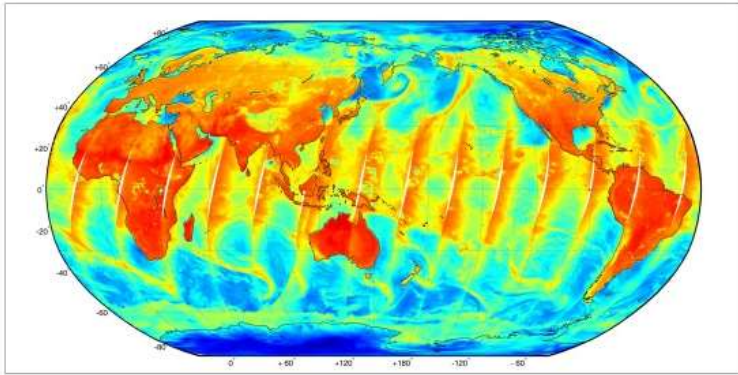
Launched on Sept 23, 2013

FY-3 OPERATIONAL SATELLITE INSTRUMENTS	FY-3C
<i>MERSI – Medium Resolution Spectral Imager (I, II)</i>	√(I)
MWTS – Microwave Temperature Sounder (I, II)	√(II)
MWHS – Microwave Humidity Sounder (I, II)	√(II)
<i>MWRI – Microwave Radiation Imager</i>	√
<i>WindRAD - Wind Radar</i>	
<i>GAS - Greenhouse Gases Absorption Spectromete</i>	
<i>HIRAS – Hyperspectral Infrared Atmospheric Sounder</i>	
<i>OMS – Ozone Mapping Spectrometer</i>	
GNOS – GNSS Occultation Sounder	√
<i>ERM – Earth Radiation Measurement (I, II)</i>	√(I)
SIM – Solar irradiation Monitor (I, II)	√(II)
<i>SES – Space Environment Suite</i>	√
<i>IRAS – Infrared Atmospheric Sounder</i>	√
<i>VIRR – visible and Infrared Radiometer</i>	√
<i>SBUS – Solar Backscattered Ultraviolet Sounder</i>	√
<i>TOU – Total Ozone Unit</i>	√

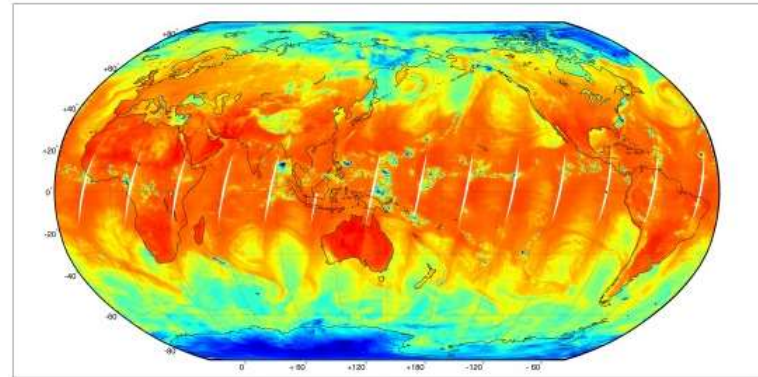
New Features:

- New instrument: GNOS
- Improving the microwave sounding capability: MWTS II and MWHS II
- Improving the Solar measurements: SIM II
- Inheriting all the instruments: 60% characteristics of the instruments specifications were improved twice than requirements

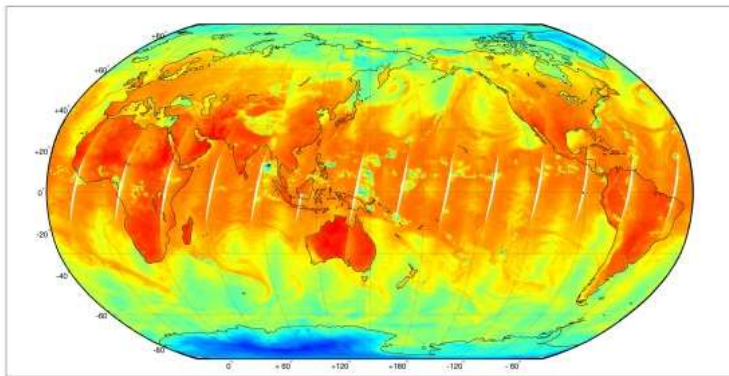
Global Image on Oct. 8, 2013 from MWHS



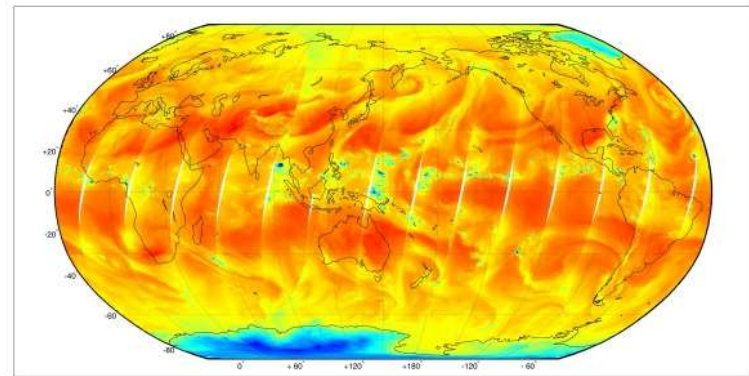
89GHz



150GHz



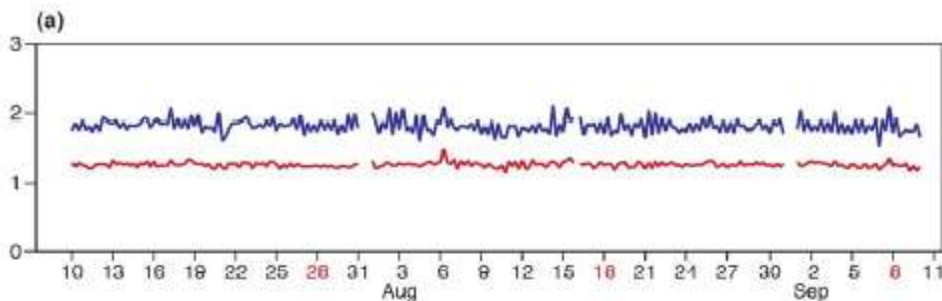
118GHz-8



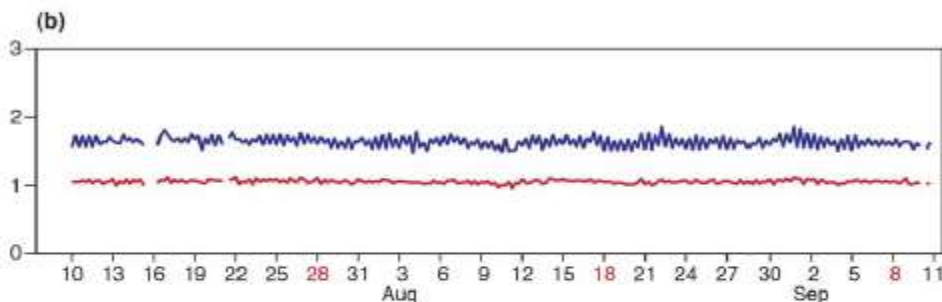
183GHz-4

Data Quality Assessment By ECMWF IFS

time series of O-B STD



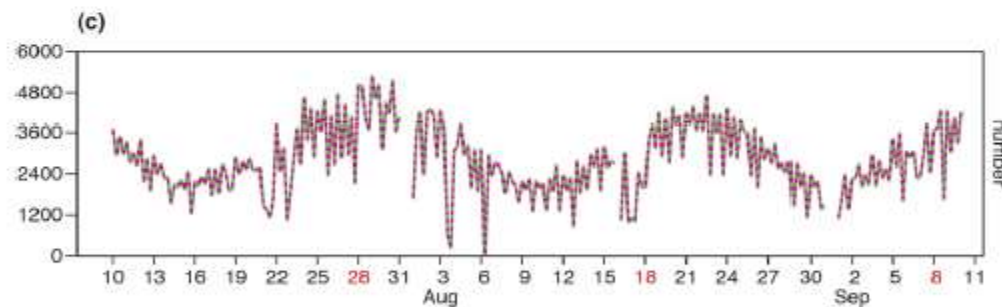
MWHS/FY-3B



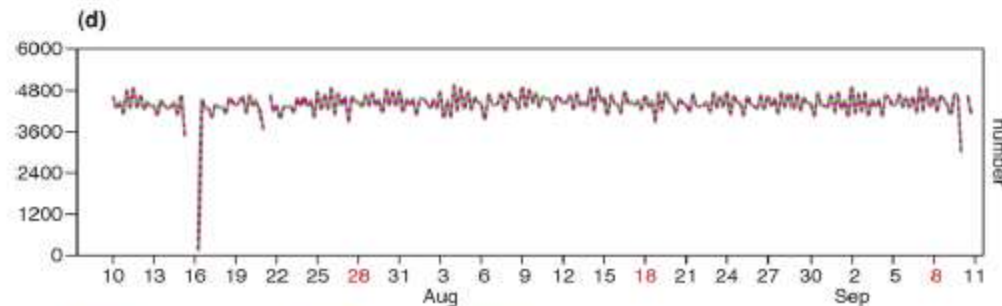
MHS/Metop-B

— stdv(OBS-FG) — stdv(OBS-AN)

Time series of 6-hourly sample number



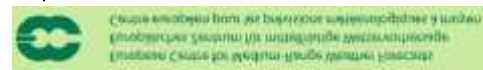
MWHS/FY-3B



MHS/Metop-B

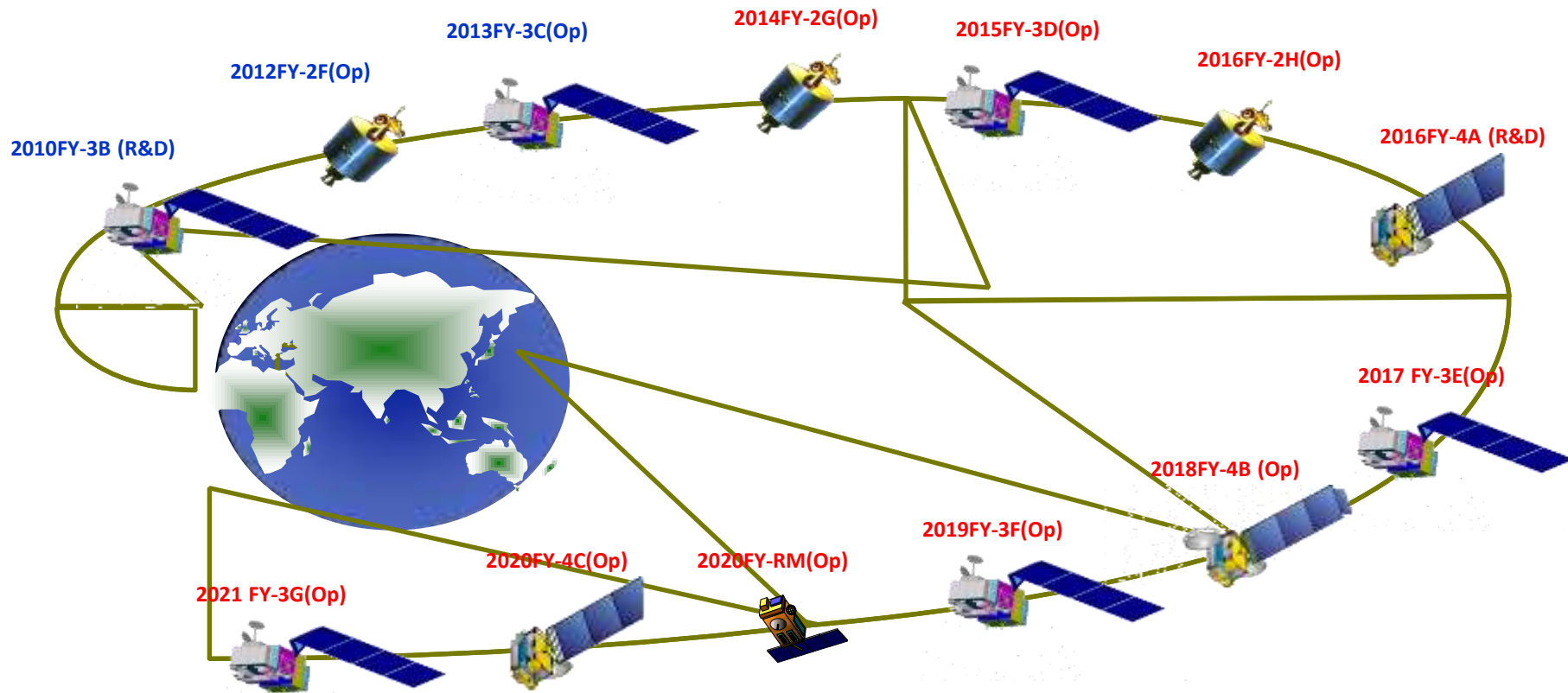
— n_displayed - - - n_all n_used

Quoted from ECMWF TM 734

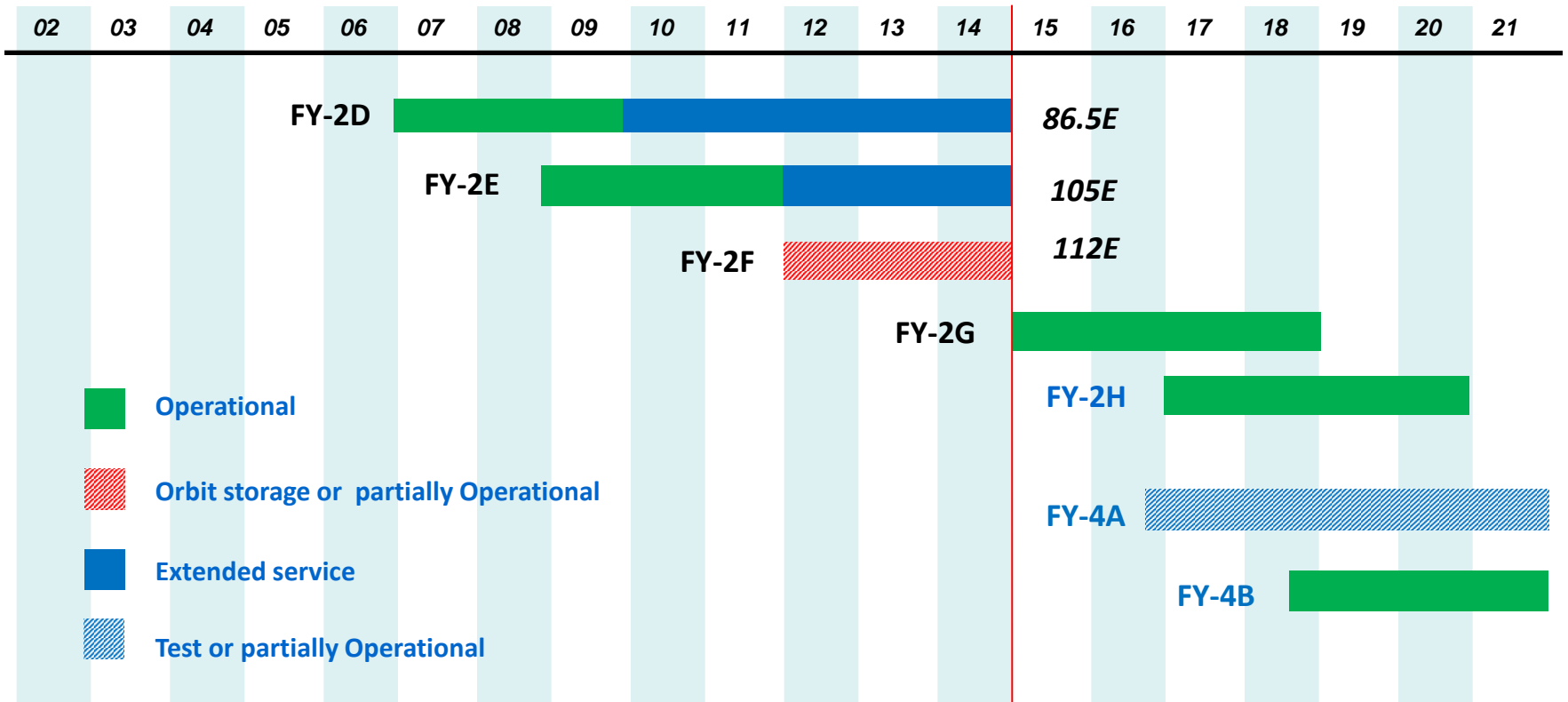


Future FY Program

National Program for Fengyun Meteorological Satellite from 2011-2020



FY-2 to FY-4 Transition



FY-2G has been launched in 2014, FY-2C/D is coming to the end of fuel life

FY-2F/G/H

S-VISSR --- 5 channel visible and infrared spin scan radiometer

VIS	0.50-0.75 μm	Changed! FY-C/D/E 0.50-0.9 μm
IR	6.3-7.6 μm	
WV	0.62-0.76 μm	
IR(Split windows)	10.3-11.3 μm 、 11.5-12.5 μm	

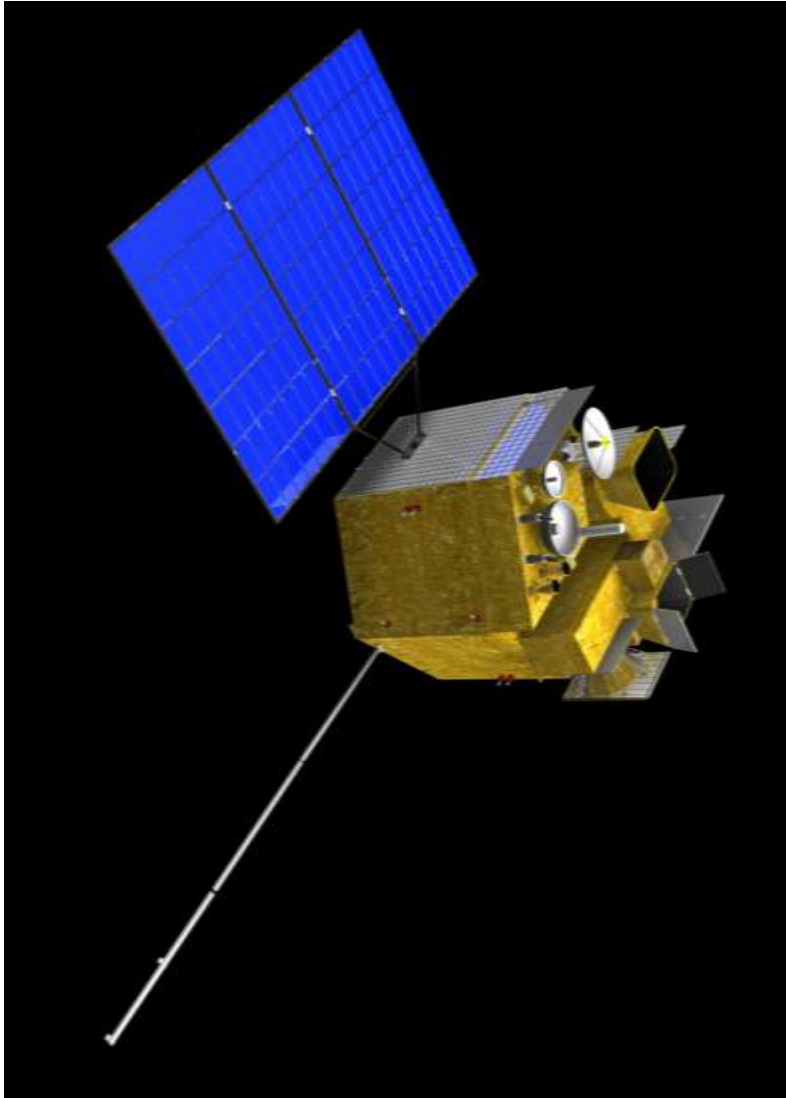
Space Environment Monitoring – solar particle in immediate vicinity of satellite

SEM Space Environment Monitor

DCPS – data collection service for 4,000 platforms at present capability

Domestic	401.1-401.4 MHz
International	402.0-402.1 MHz

FY-4A



Main Instruments

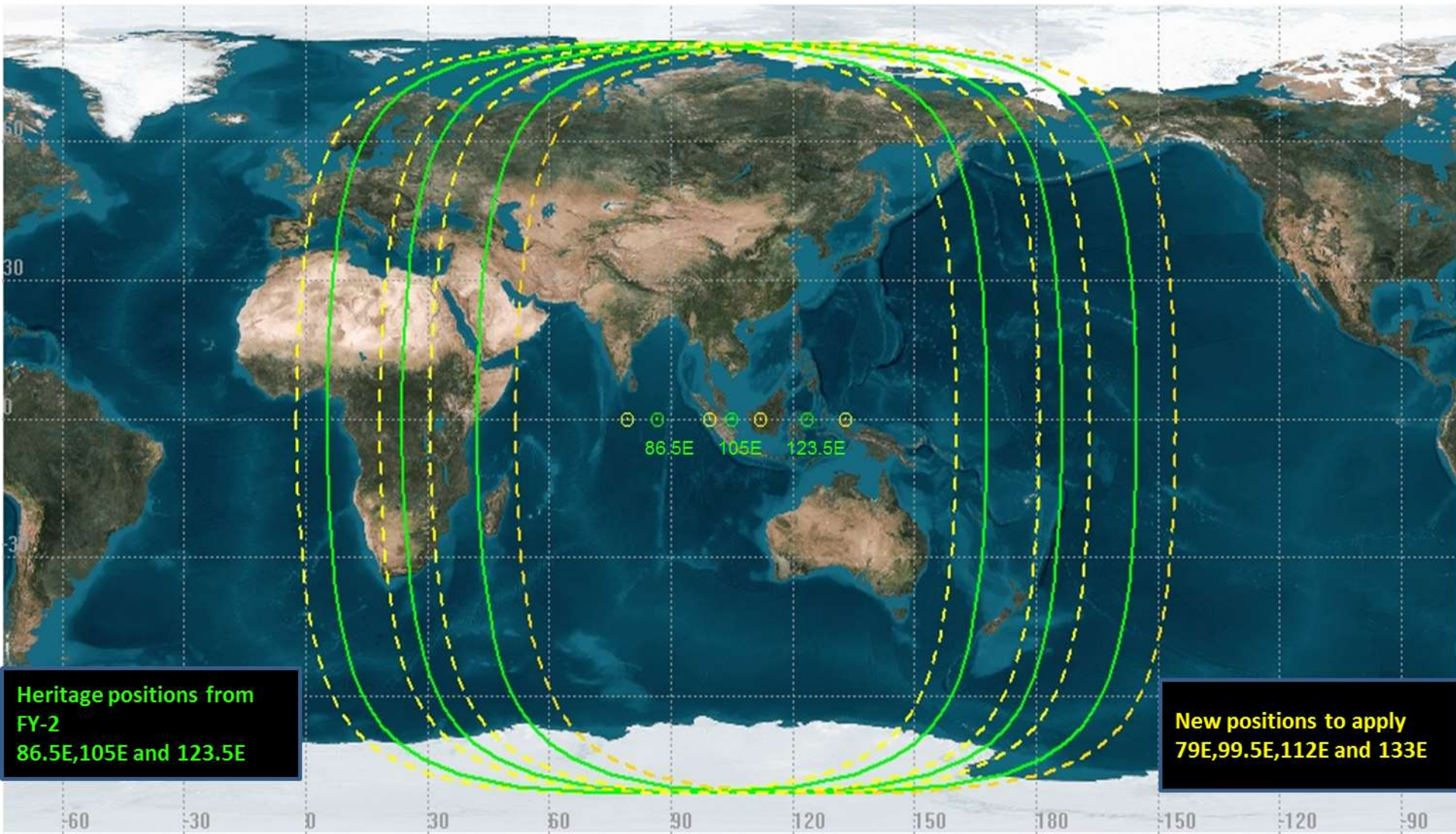
- 1) **GIIRS**: Geo. Interferometric Infrared Sounder
- 2) **AGRI**: Advanced Geosynchronous Radiation Imager
- 3) **LMI**: Lightning Mapping Imager
- 4) **SEP**: Space Environment Package

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: $\geq 3200W$

FY-4

Orbital Positions



Advancement of FY-4A compared with FY-2

	FY-4A	FY-2
Stabilization	Three-axis	Spin
Designed Life	5~7 Years	4 Years
Observation Efficiency	85%	5%
Observation Mode	Imaging +Sounding + Lightning Mapping	Imaging Only
Main Instruments	AGRI :14 channels SSP Resolution: 0.5~4Km Global imaging: 15min Flexible imaging : 2D	VISSR: 5 channels SSP Resolution: 1.25~5Km Global imaging: 30min Flexible imaging : 1D
	GIIRS:913 channels Spectral Resolution: 0.8,1.6cm-1 SSP Resolution:16Km	N/A
	LMI SSP Resolution:7.8Km	N/A
	SEMS High energy particles Magnetic field	SEM High energy particles Solar X ray fluxes

FY-4 Products

34 key operation products from **AGRI, GIIRS & LMI** defined and developed

No. .	Products	No.	Products	No.	Products
1	Clear Sky Masks	13	Downward Longwave Radiation: Surface	24	Fire/Hot Spot Characterization
2	Cloud Top Height & Temperature & Pressure	14	stratified water vapor	25	Land Surface Emissivity
3	Cloud Classification	15	Ozone Profile & Total	26	Snow Cover
4	Cloud Properties(Night)	16	Legacy Vertical Moisture Profile(Cloud)	27	High-energy particle distribution
5	Cloud Properties(Day)	17	Legacy Vertical Moisture Profile(Clear)	28	Magnetic field intensity
6	Aerosol Detection	18	Derived Motion Winds	29	Effects of the space environment
7、 8	Aerosol Optical Depth (Land/Ocean)	19	Rainfall Rate/QPE	30	Fog
9	Downward Shortwave Radiation: Surface	20	Convective Initiation	31	Land Surface (Skin) Temperature
10	Upward Longwave Radiation: Surface	21	Tropopause Folding Turbulence Prediction	32	Land Surface Emissivity
11	Reflected Shortwave Radiation: TOA	22	Lightning Detection	33	Image Product
12	Upward Longwave Radiation: TOA	23	Sea Surface Temperature (skin)	34	RGB

FY-3 02 batch to 03 batch Transition

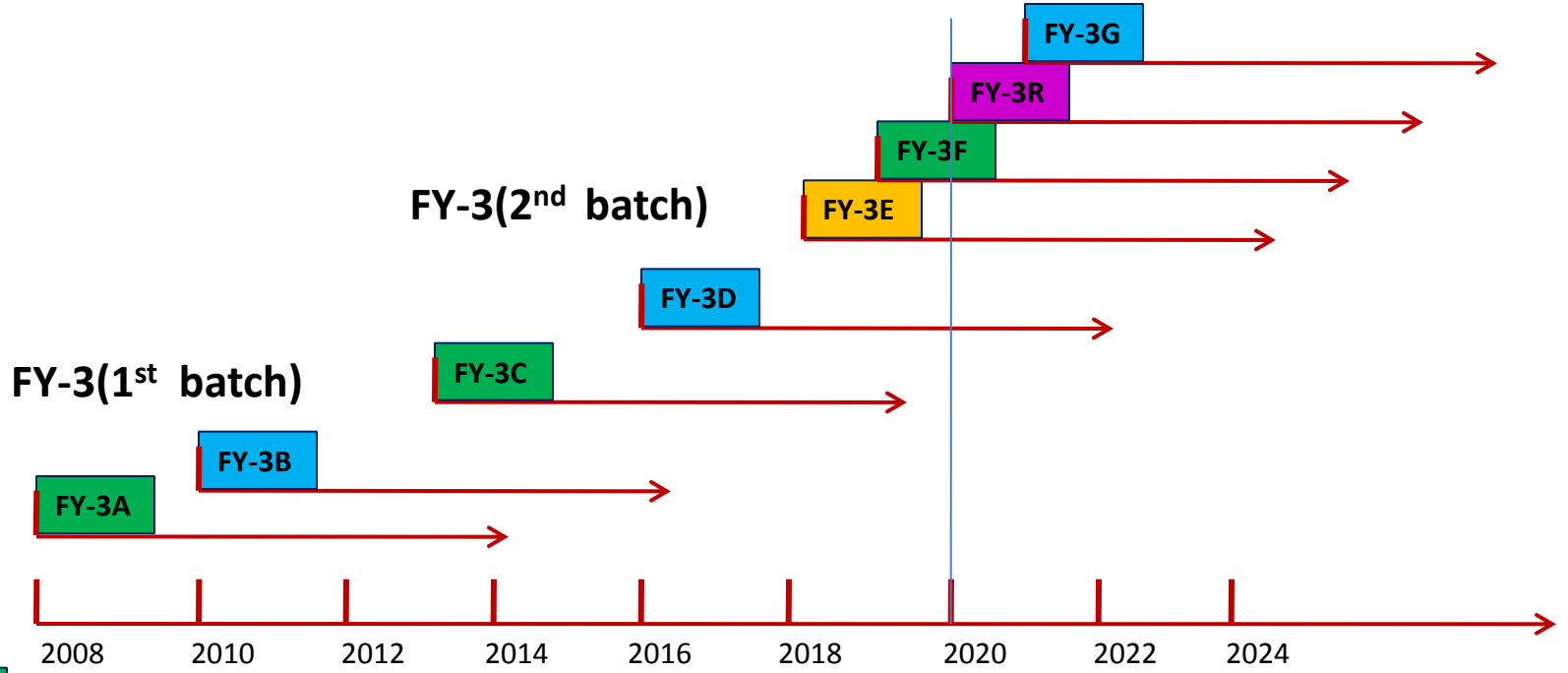
3 yrs

5 yrs

8 yrs

Designing lifetime

FY-3(3rd batch)



FY-1C/1D

AM

PM

EM

Rainfall

Payloads Configuration for FY-3E/F/G and Rainfall Mission

NO.	Sensor Suite	Satellite		FY-3E (05)	FY-3F (06)	FY-3G (07)	FY-3R (08)
		Sensor	EM Satellite	AM Satellite	PM Satellite	Rainfall Satellite	
		Scheduled Launch Date	2018	2019	2021	2020	
1	Optical Imagers	MERSI	√ (III-Low Light)	√ (III)	√ (III)	√ (III-Simplified)	
2	Passive Microwave Sensors	MWTS	√	√	√	√	
		MWHS	√	√	√	√	
		MWRI		√	√	√	
3	Occultation Sounder	GNOS	√	√	√	√	
4	Active Microwave Sensors	WindRAD	√	√			
		Rainfall RAD					√
5	Hyperspectral Sounding Sensors	HIRAS	√	√	√		
		GAS (Greenhouse Gases Absorption Spectrometer)			√		
		OMS (Ozone Mapping Spectrometer)		√			
6	Radiance Observation Sensor Suite	ERM		√			
		SIM	√	√			
		SSIM (Solar Spectral Irradiation Monitor)	√				
7	Space Weather Sensor Suite	SEM		√	√		
		Wide Angle Aurora Imager		√	√		
		Ionosphere photometer	√(Multi-angle)	√	√		
		Solar X-EUV Imager	√				

- Improved Medium Resolution Spectrum Imager (**MERSI II**) in FY-3D, 3E, 3F
- Greenhouse Gases Absorption Spectrometer (**GAS**) in FY-3D,3F
- Hyper-Spectral Infrared Sounder (**HIRAS**) will take replace of current **IRAS** in FY-3D,F
- Sea Surface Wind Radar (**WindRAD**) in FY-3E

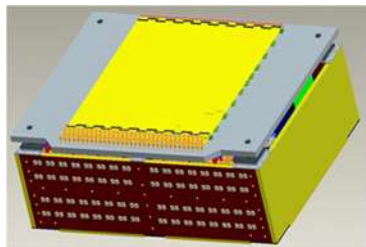


The main objectives of Rainfall Mission

- Consist a Global observation constellation system with FY-3 satellites, as well as GPM satellite
- Improve the severe convective system monitoring ability in china together with GPM satellite
- Provide 3D precipitation structure over both ocean and land
- Improve the sensitivity and accuracy of precipitation measurement over china and surrounding area



MWTS



KaPR



KuPR

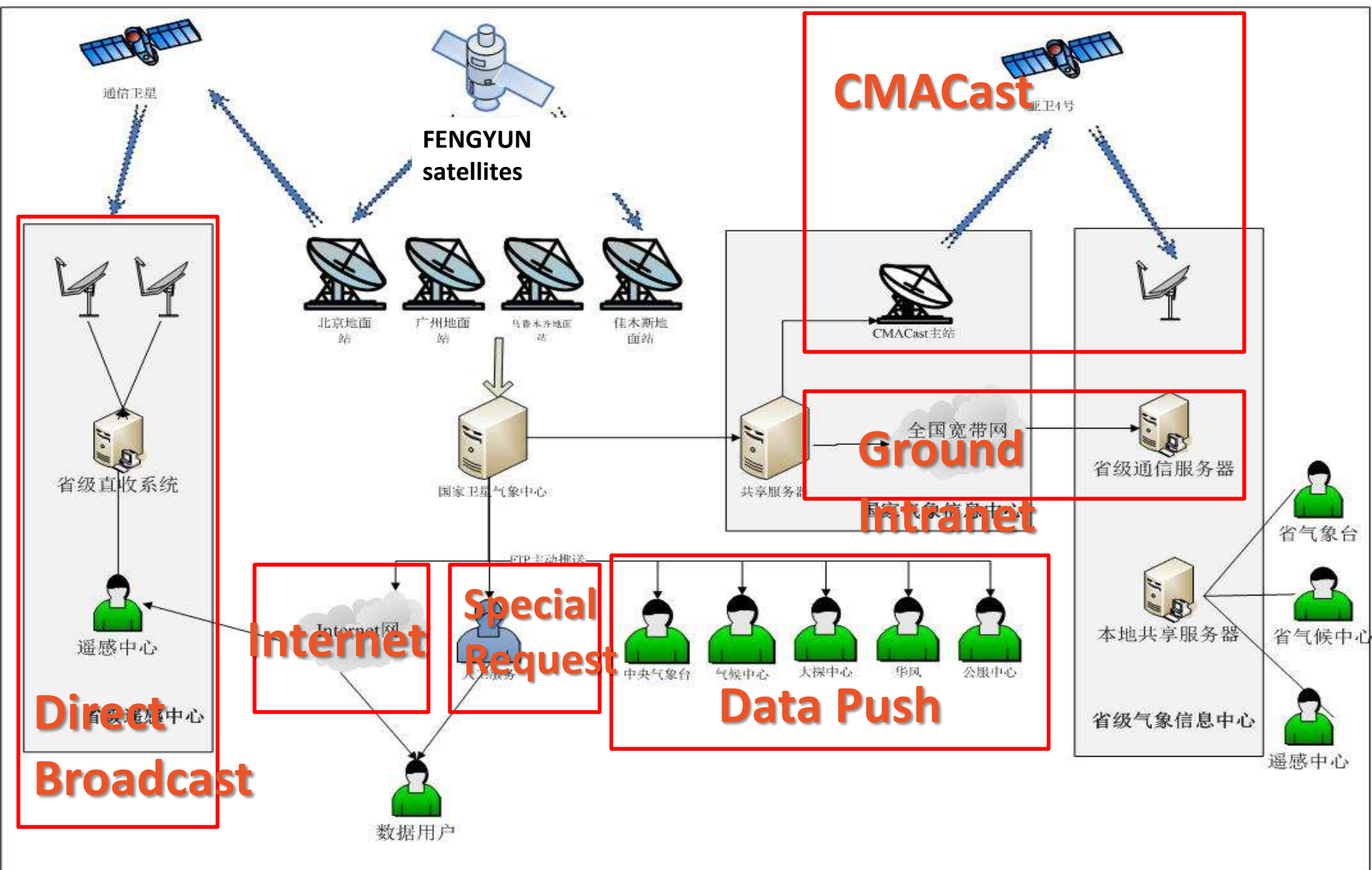


MWHS



MWRI

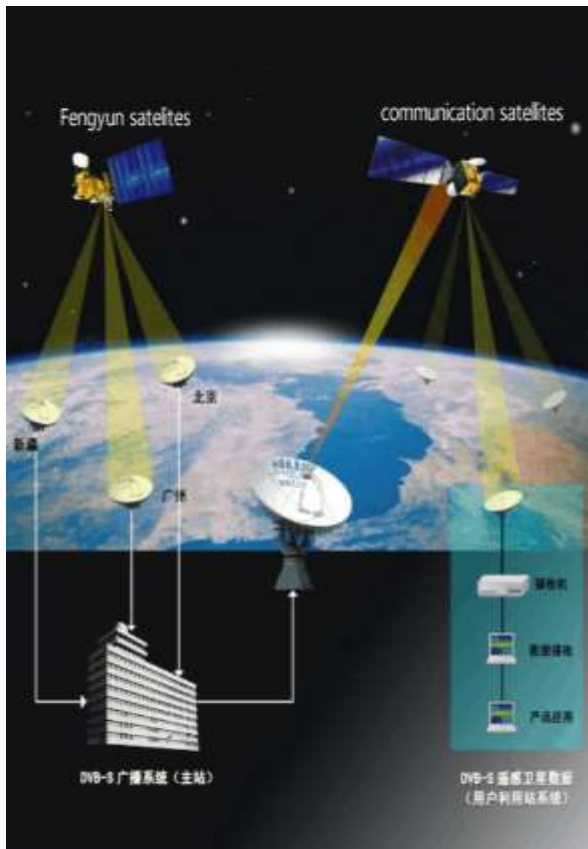
2. Data distribution and services



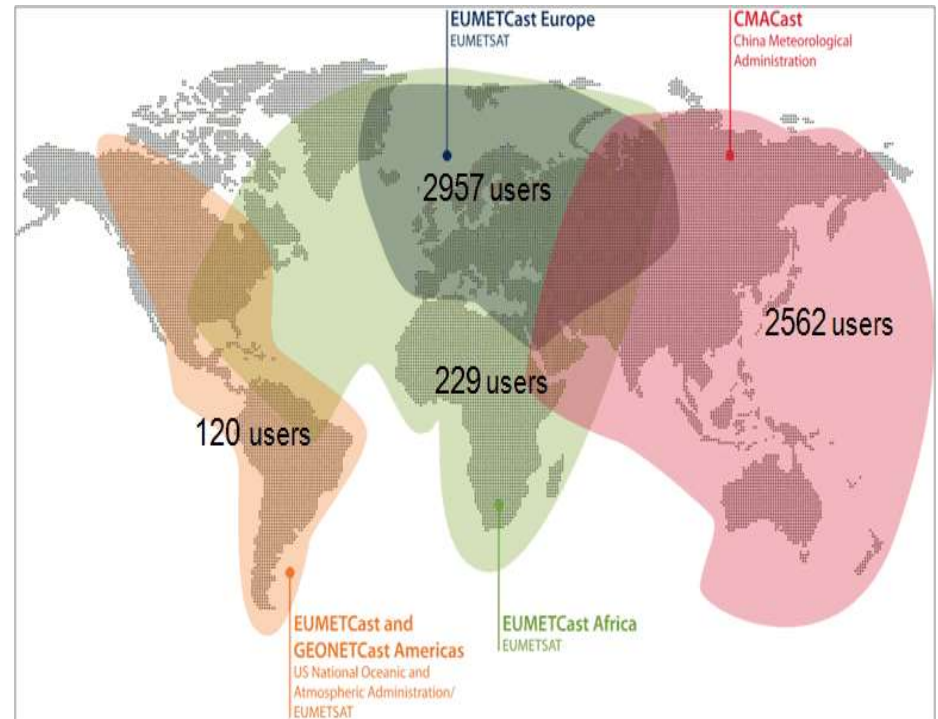
Data distribution and services

Real-time users

Direct Broadcast



CMACast





CMACast's coverage

AsiaSat 4 (122.2°E) C-Band EIRP (dBW)

AsiaSat 4

Location: 122 degrees East

Coverage: Asia, Middle East, CIS and Australasia

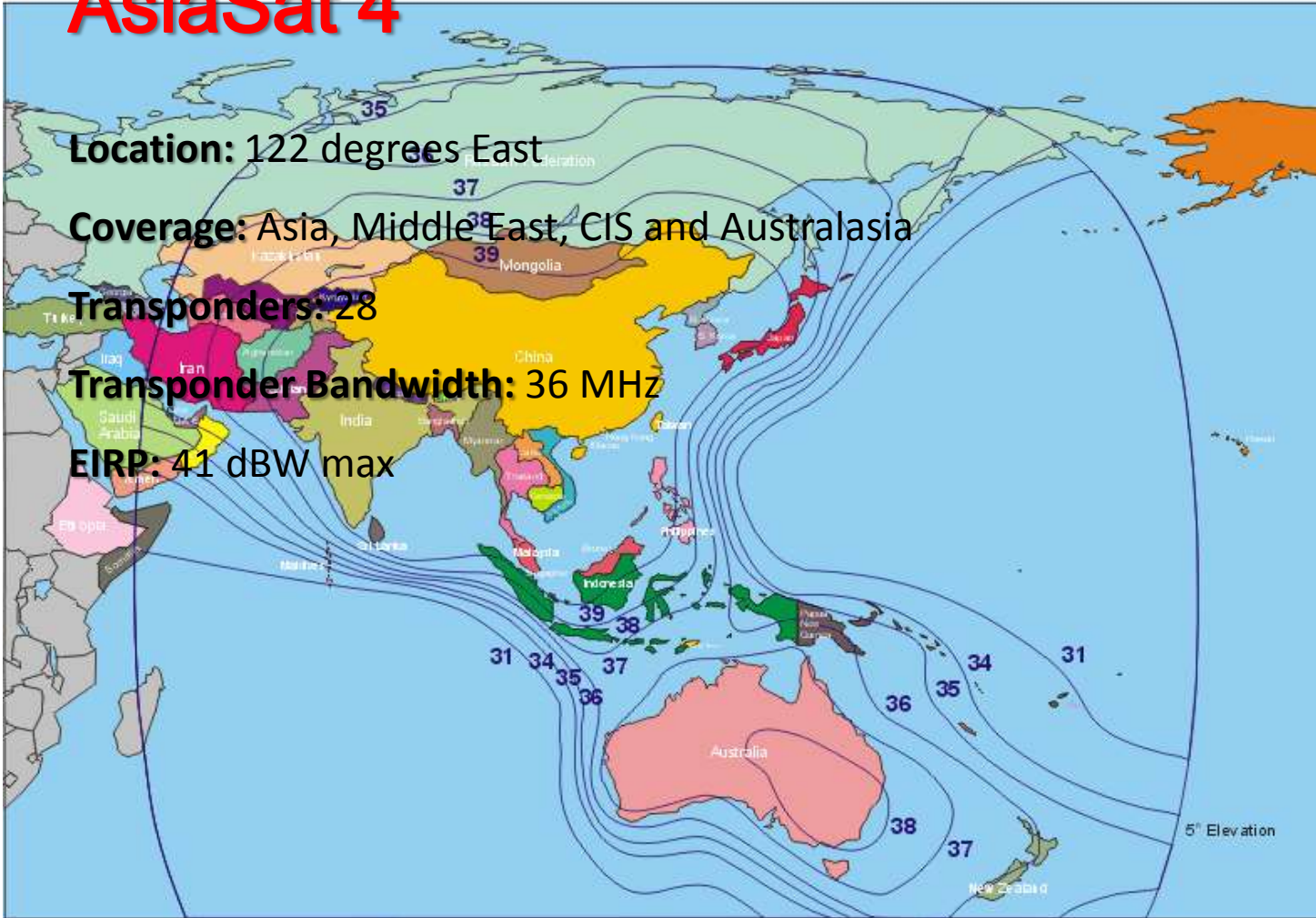
Transponders: 28

Transponder Bandwidth: 36 MHz

EIRP: 41 dBW max

Westest: Iraq

Southeast: New Zealand



7/10/2007

CMACast's Users

CMACast has been fully operating since June, 2012.

More than 2600 receiving stations in China.

25 overseas users in Asia Pacific Region.





Routine CMACast Data for oversea users

Category	Data and products	Timeliness
GTS data	Warnings Warning for tropical cyclone, tsunami, tornado, severe thunderstorm, volcanic ash clouds ...	10 seconds
	Observations SYNOP; TEMP; PILOT; SHIP; BATHY; BUOY; CLIMAT; AIREP; AMDAR; TRACKOB; TESAC; WAVEOB; SATEM; SARAD; and SATOB.	1 minute
	Model Products ECMWF, EDZW, RJTD, KWBC	20 minutes
	Fax charts BABJ, EDZW, RJTD	5 minutes
CMA Products	Model products T639G, T639R, GRAPES products	20 minutes
	Satellite data FY-2D/E images and products, FY-3A L1 product	10 seconds
Others	Satellite data from EUMETSAT MSG, METOP-A, METOP-B, NOAA19, JASON2	10 seconds

Data distribution and services - Website

Non real time users: NSMC Portal

The screenshot displays the NSMC (National Satellite Meteorological Center) website. The header includes the NSMC logo and navigation links: Home, About NSMC, Satellite Program, Operation, Imagery and Product, Data Access, and Support. A search bar is located on the right. The main content area features several sections:

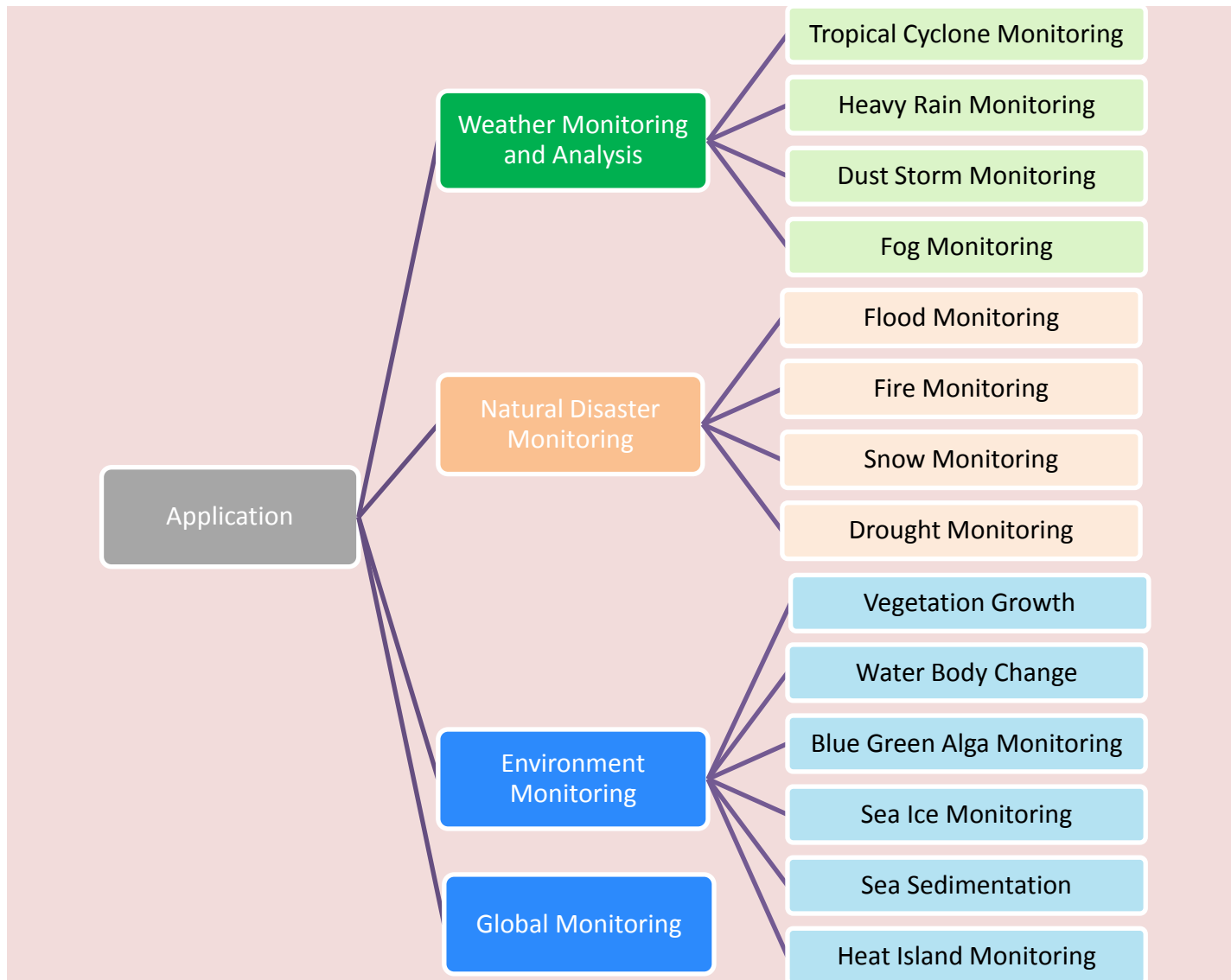
- Fengyun Satellites:** A table listing satellite status for FY-3A, FY-3B, FY-3C, FY-3D, FY-3E, and FY-3F, with columns for satellite name, status, and time table.
- Space Weather NSMC Forecasts:** A section for solar forecasts, updated on 2 November 2014 UTC, showing solar flare and geomagnetic storm forecasts.
- Announcements:** A list of recent news items, including updates on satellite ground segment and orbital control.
- Highlights:** A section for key news items, such as "FY-3D EIP to enter equinox season, some transmissions to be cancelled" and "Satellite Sees Hainan Strongest Rainfall since 1961".
- DCPC Products:** A section for data collection products, including Real-time Imagery, FY-3 Earth, and Image Gallery.
- International Cooperation:** A section for international partnerships, including the China-EMETSAT 2nd National Institute Meet in Cambodia and the May 2014 4th NSMC Conference.
- 5th AOMSUC:** A section for the 5th Asia-Ocean Meteorological Society Conference.
- Links:** A section for various social media and external links.

The footer contains contact information for NSMC, including the address: 44 Zhongguancun Nanjiajie Haidian District Beijing China, and the copyright notice: Copyright © NSMC 2014. All Rights Reserved.

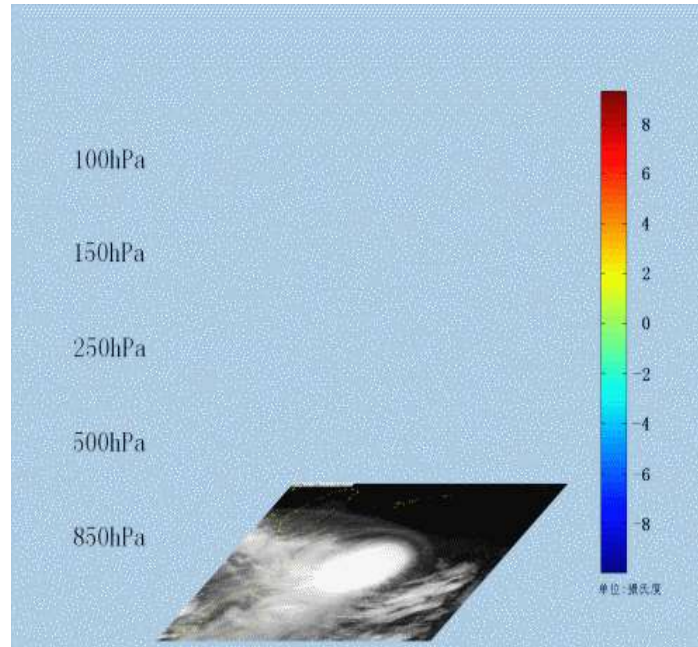
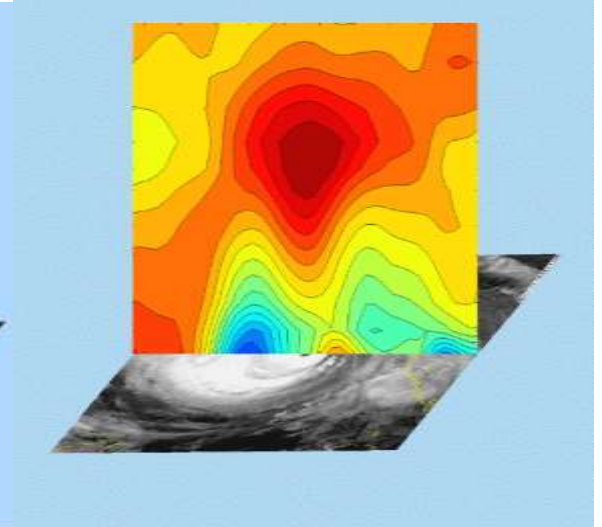
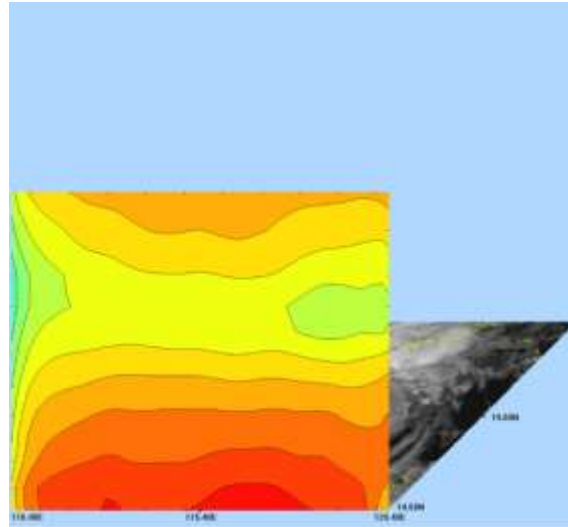
<http://www.nsmc.cma.gov.cn/en>

- Satellites' information
- Operational announcement
- Space weather information
- Cloud images and animation
- Data access entrance
- News

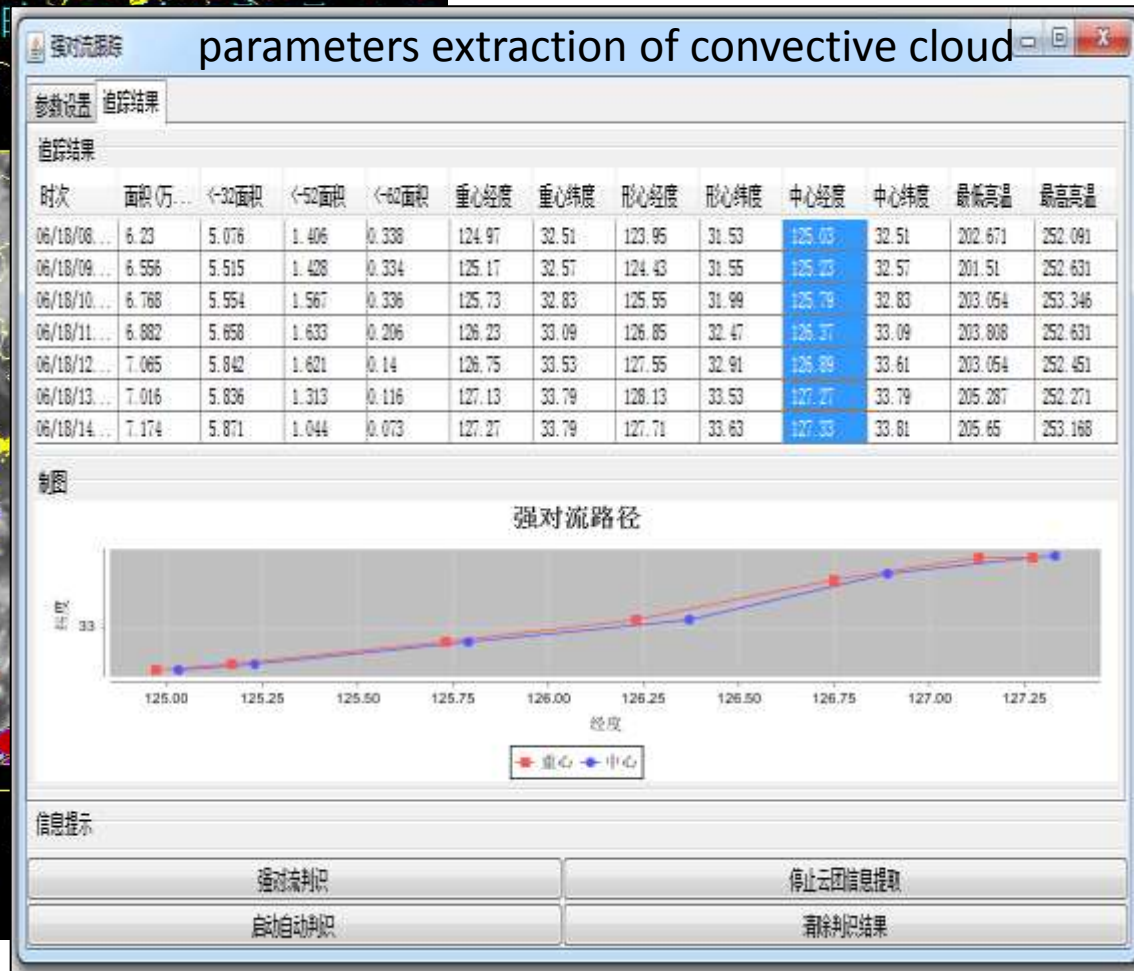
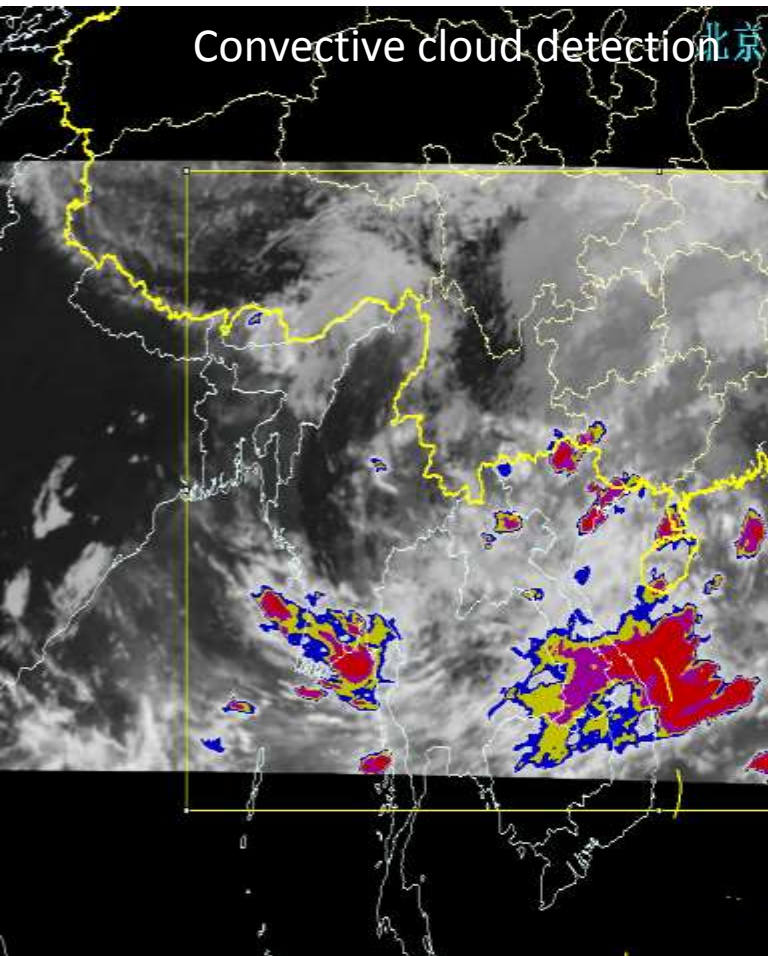
3. Applications of FY Satellite data



Typhoon 3-D Structure from FY-3 MWTs

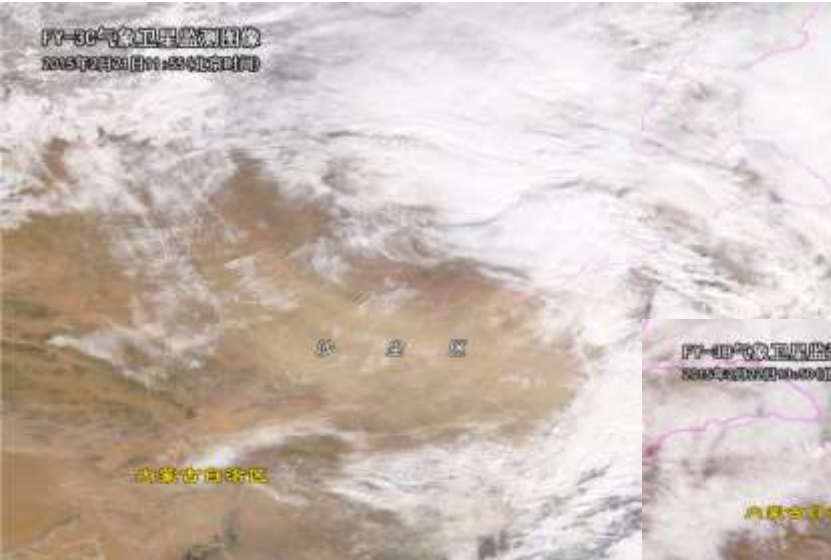


Monitoring and analysis of convective system

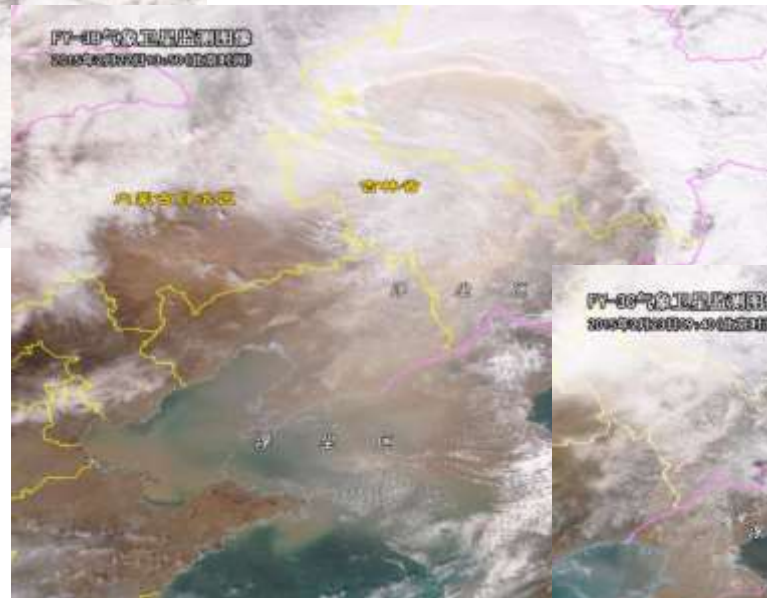


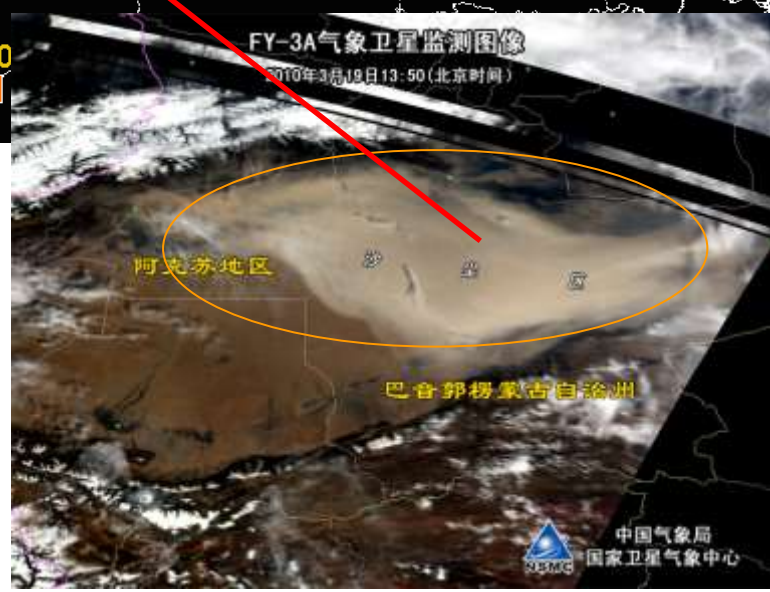
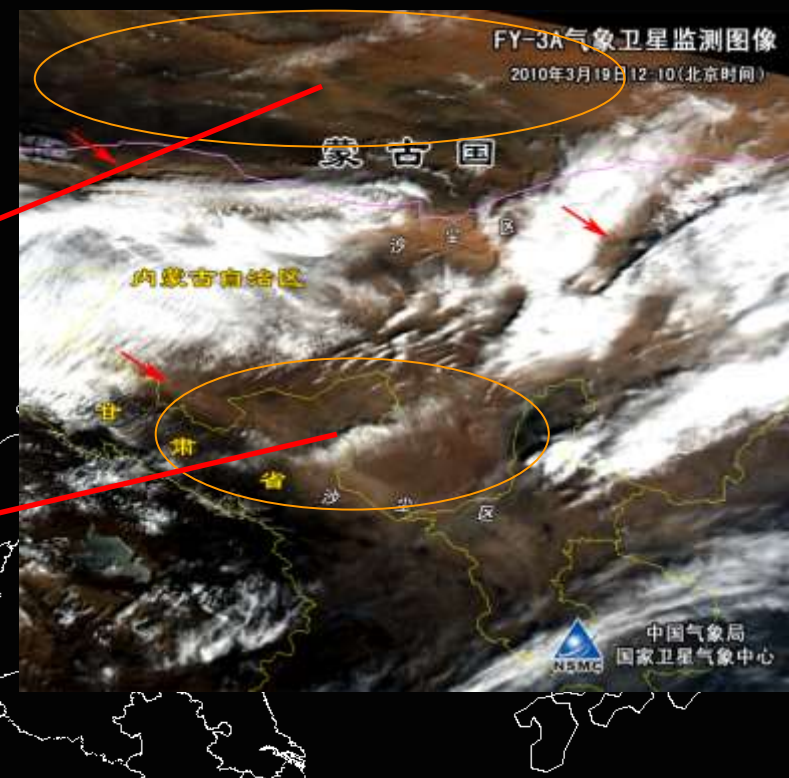
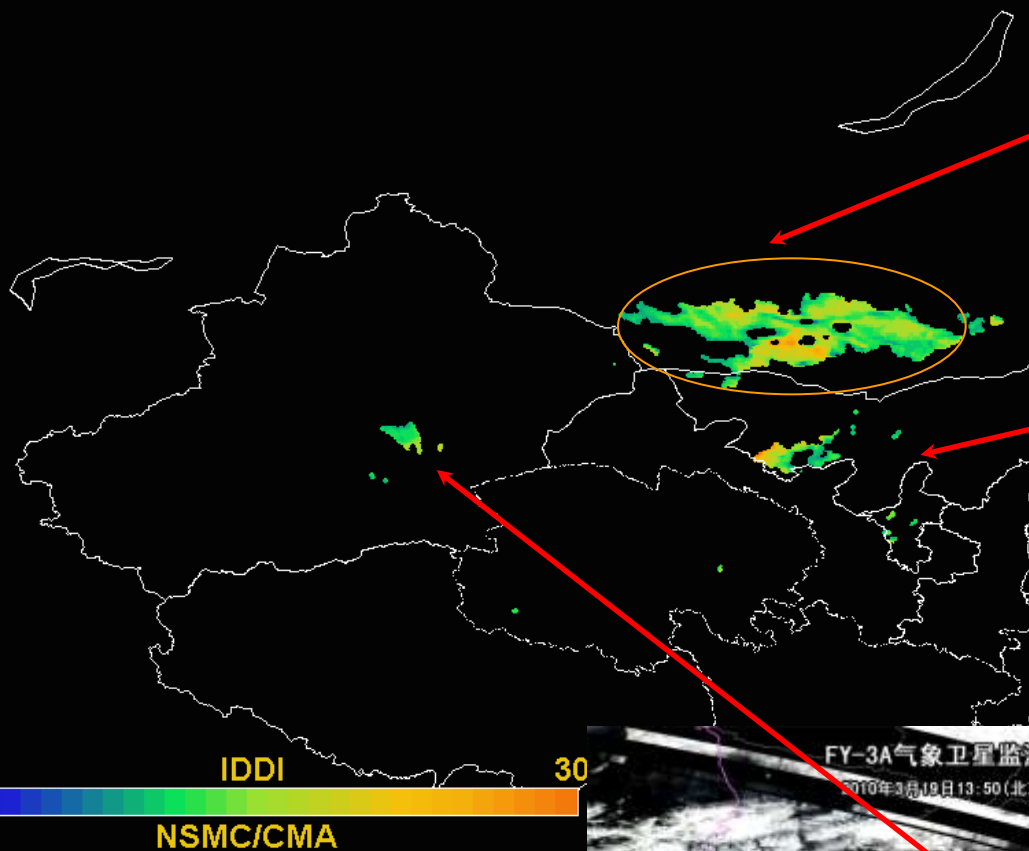
China Satellite – Polar orbit products

- RGB figure monitoring



The dust weather event occurred in southeast Mongolia, the middle of Inner Mongolia, the Bohai Sea and the Korean Peninsula caused by Mongolia cyclone during February 21-23, 2015.

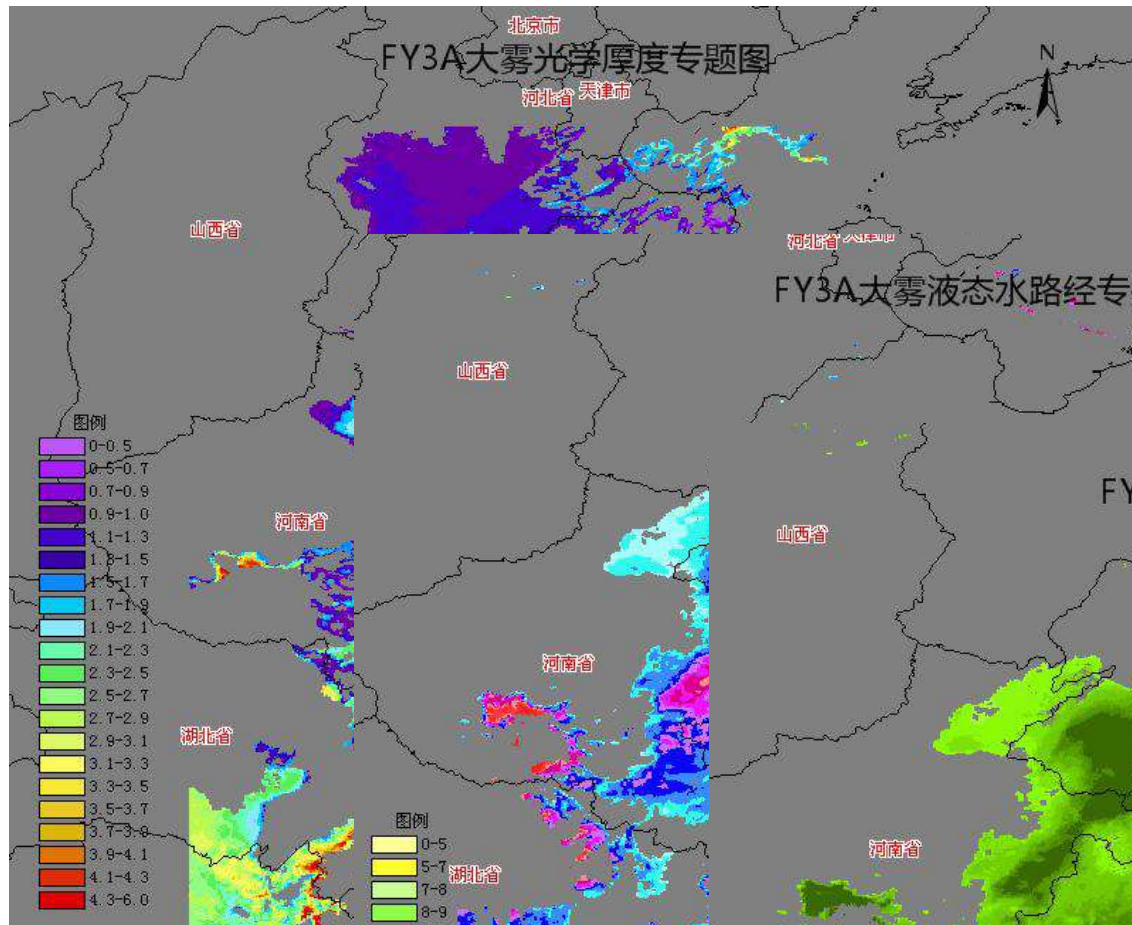




2010-03-19

Fog monitoring

quantitative analysis result
using FY-3A data



Optical T



Liquid Path

Particle Size



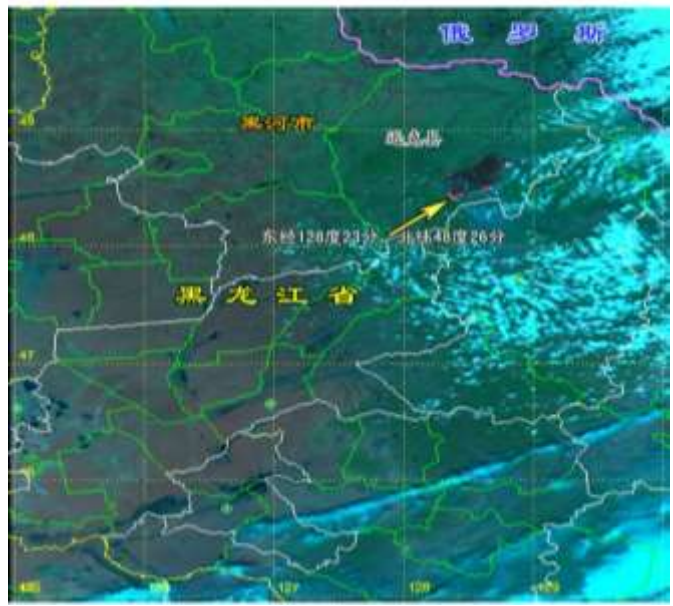
中国气象局
国家卫星气象中心

MAS系统制作

Fire Monitoring

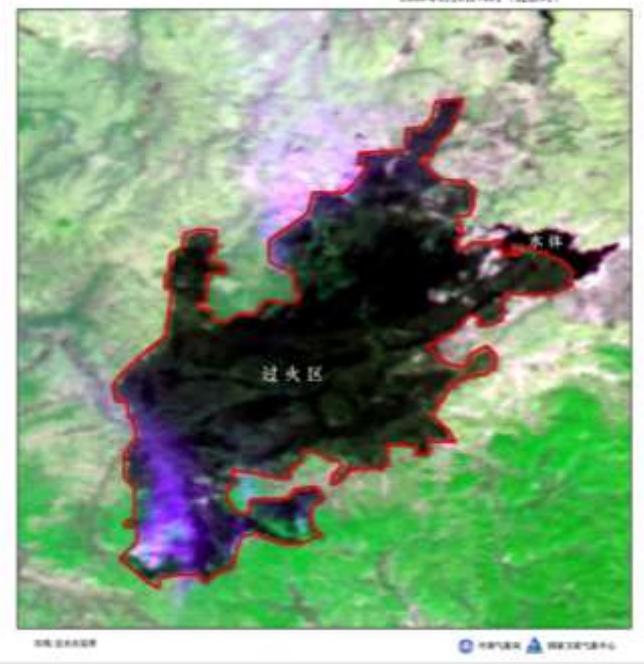
气象卫星黑河地区火情监测图

2009年4月30日12:38 (北京时间)



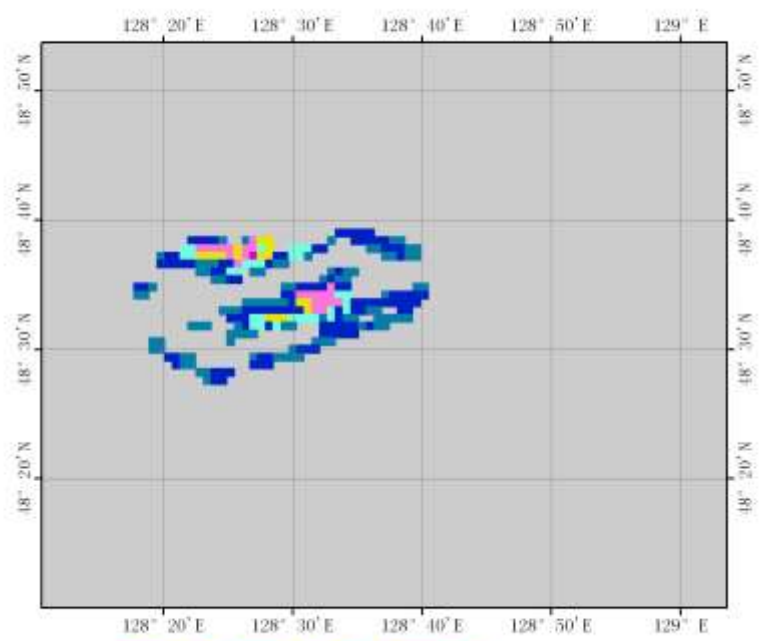
风云三号A星黑龙江省逊克县火场过火区监测图像

2009年5月5日10时 (北京时间)

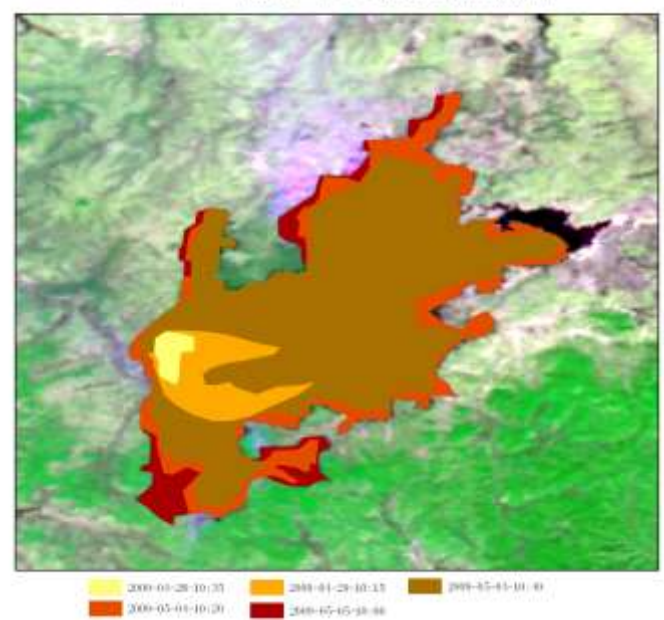


黑龙江逊克县火灾
090427—
090505)

卫星遥感火强度等级图 2009年4月29日12时47分



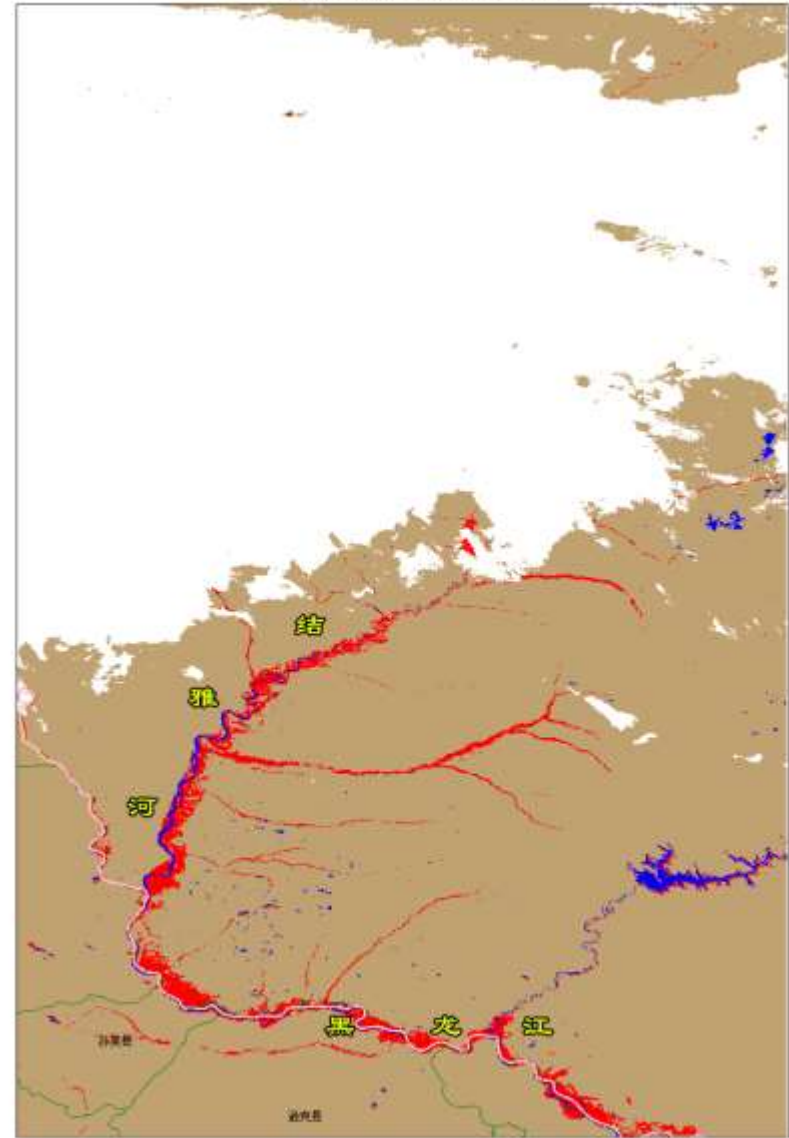
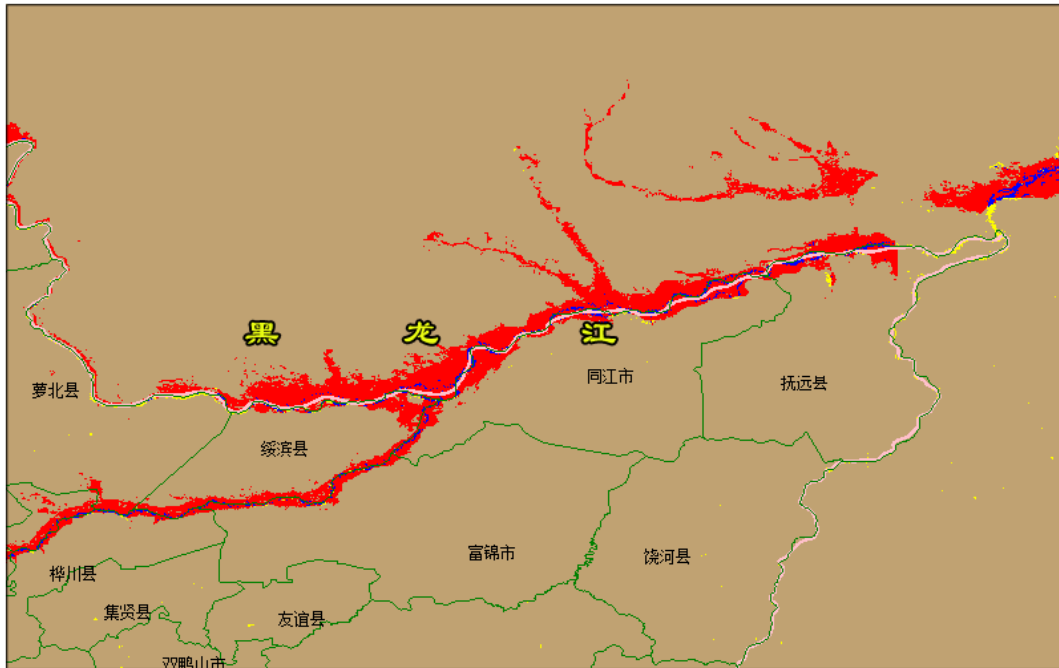
FY-3A/MERIS黑龙江省逊克县过火区监测图



Flood Monitoring

FY3A/MERSI黑龙江、结雅河水体变化监测专题图
2013年6月20日 vs 2012年6月16日

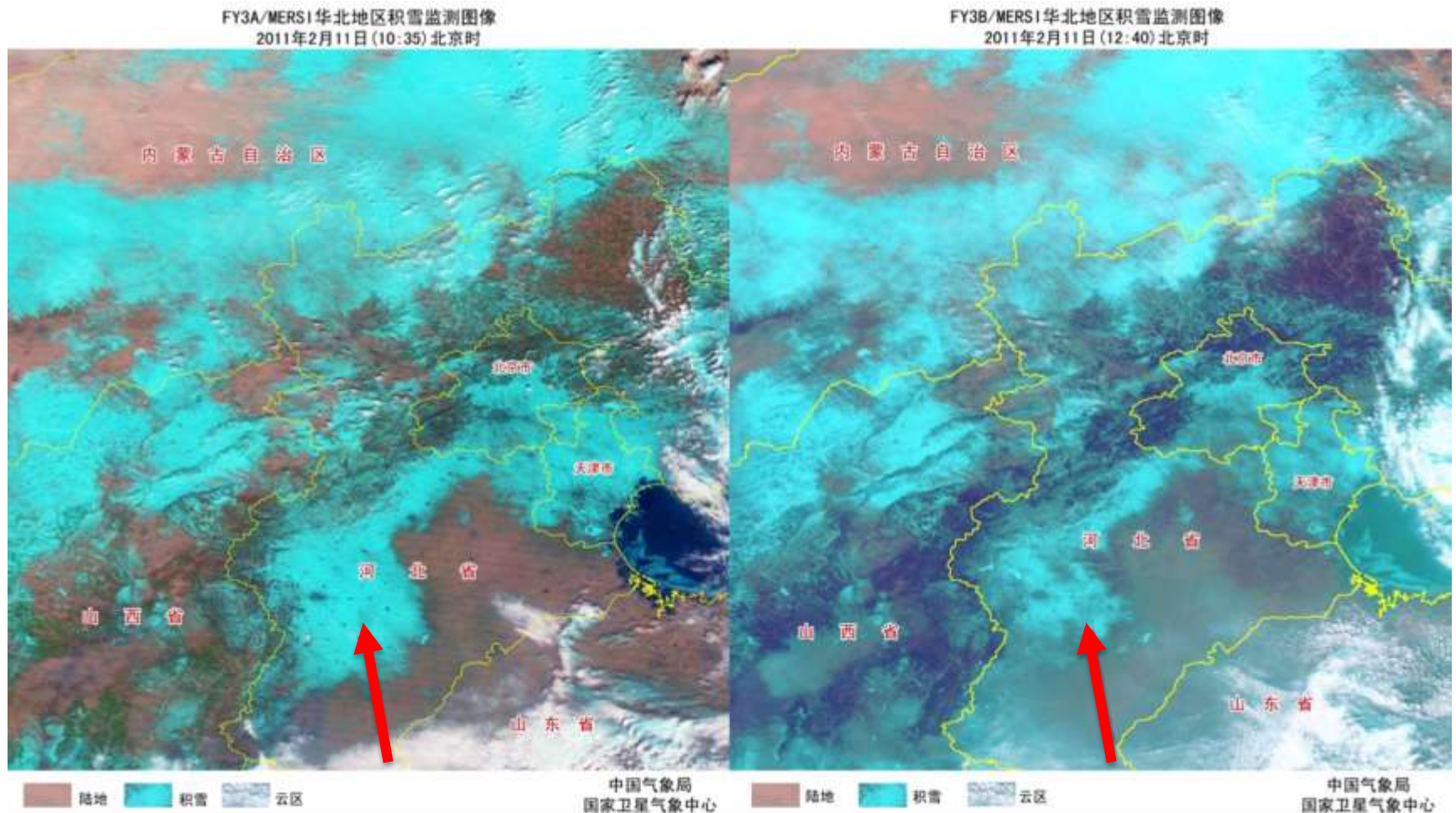
气象卫星黑龙江及松花江下游水体变化监测图
2013年8月20日 vs 2012年8月16日



Flood monitoring image of Heilongjiang river and Songhuajiang river using FY3A/MERSI data.

Snow monitoring by

FY-3B (afternoon) vs. **FY-3A** (morning)



The snow area in the morning

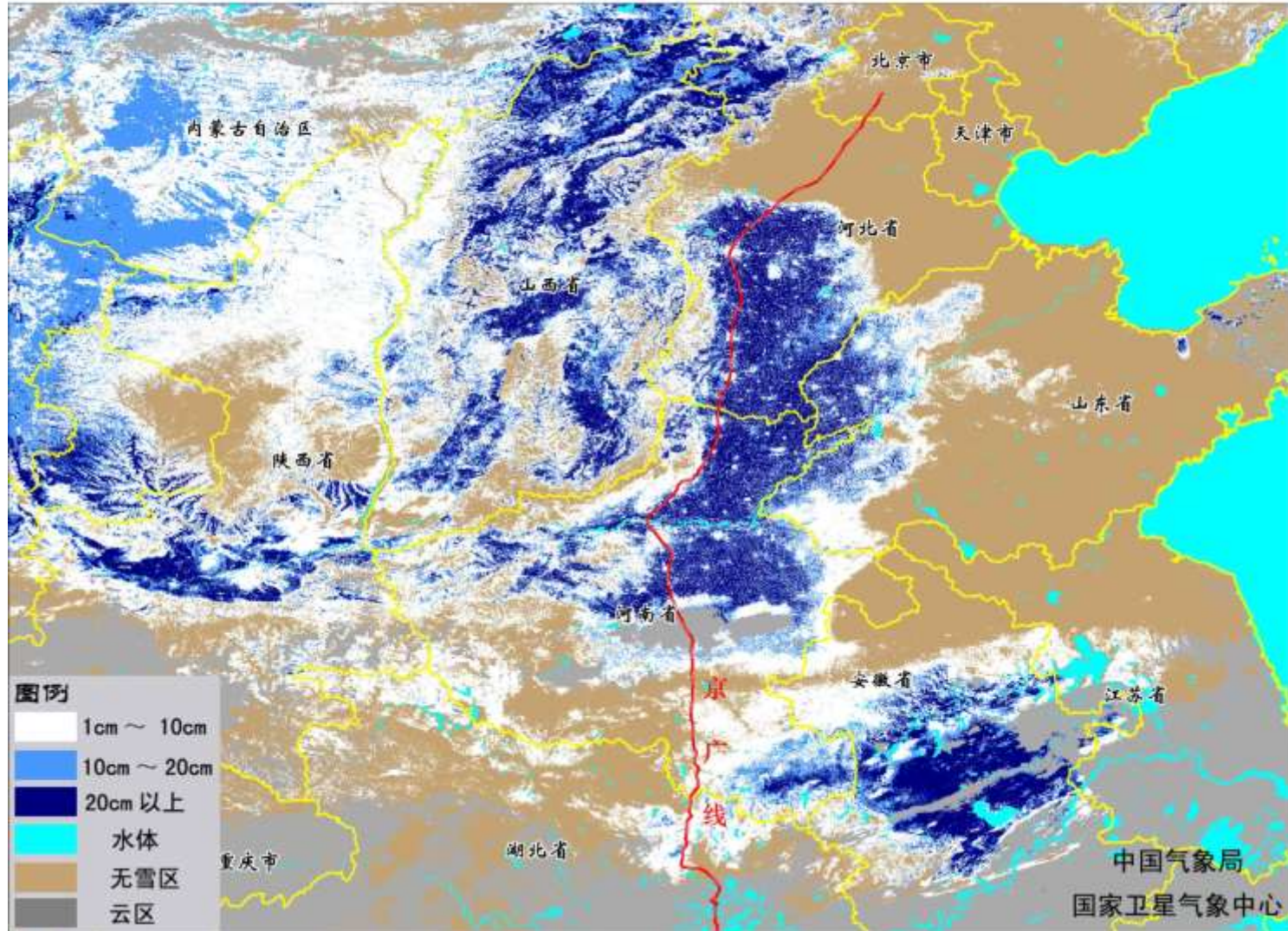
The snow has melted in the afternoon

Snow thickness estimation to the north and north west China in Nov.

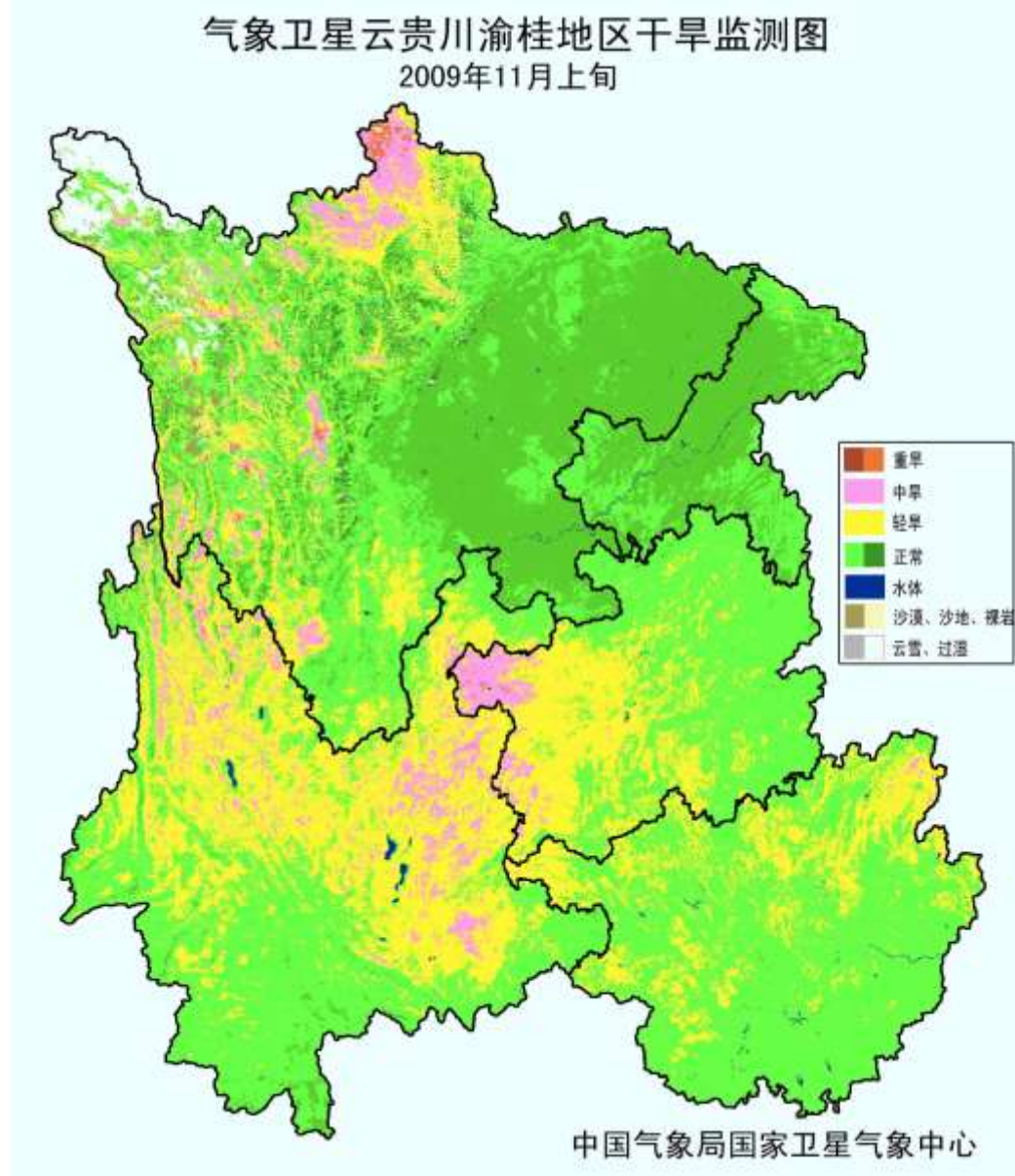
17. 2009

卫星遥感积雪深度估算图

2009年11月17日

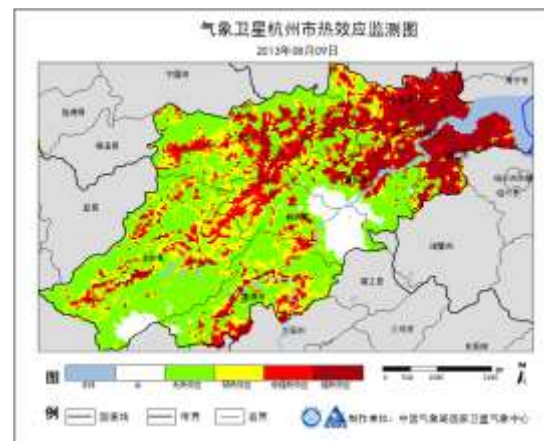
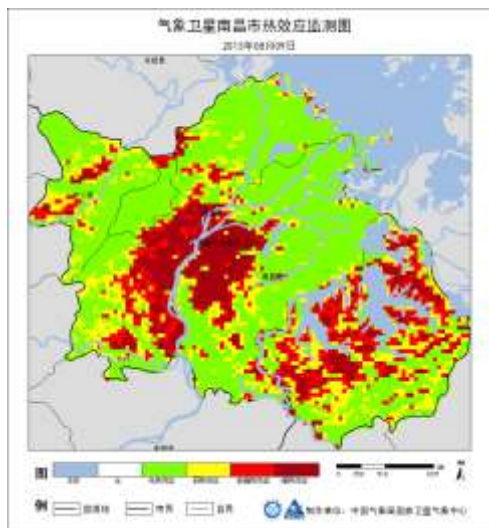
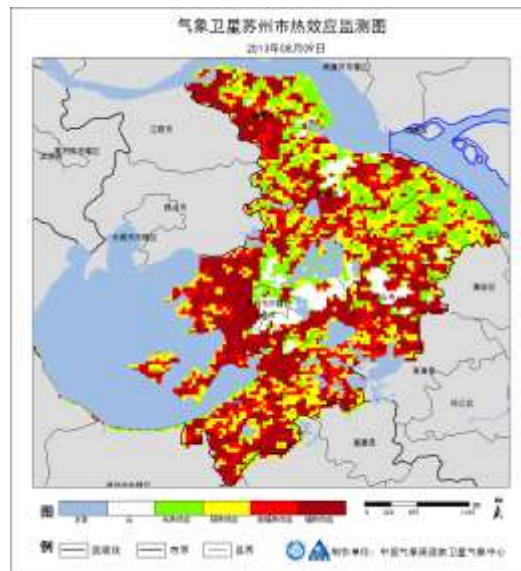
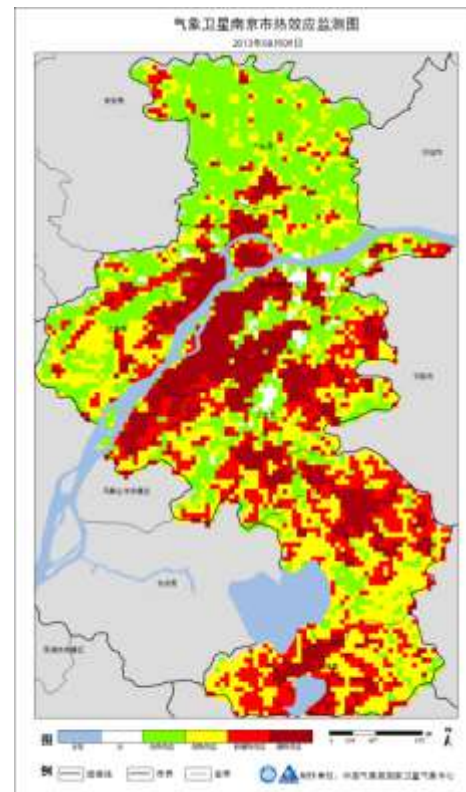
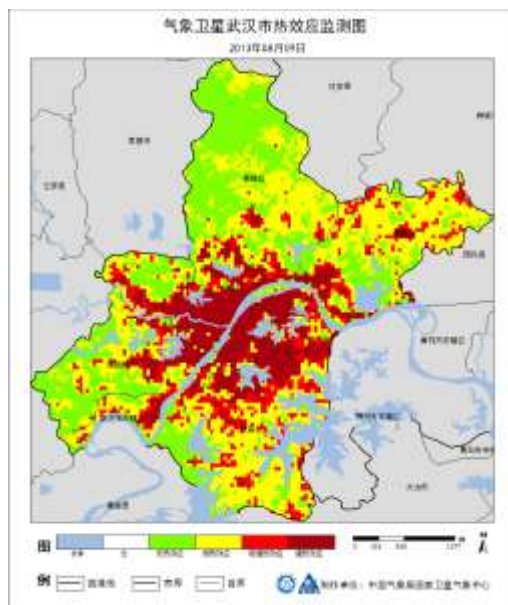
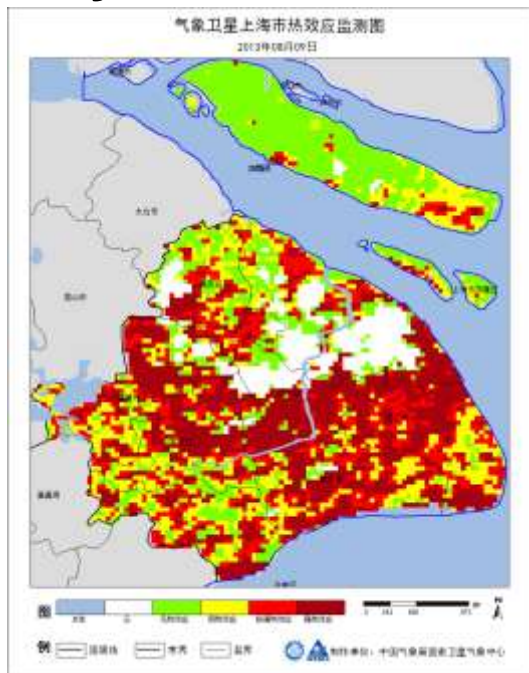


Drought



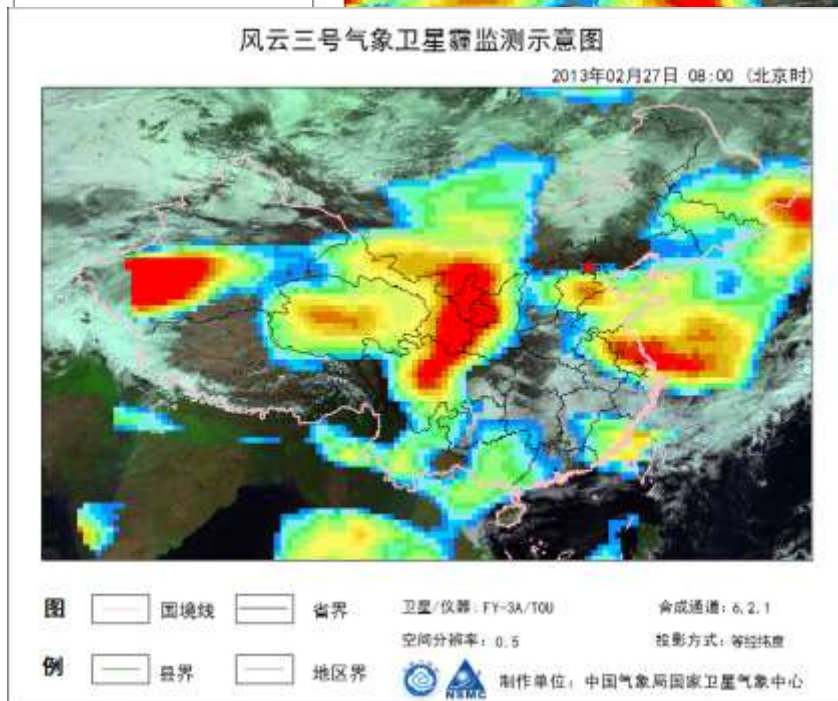
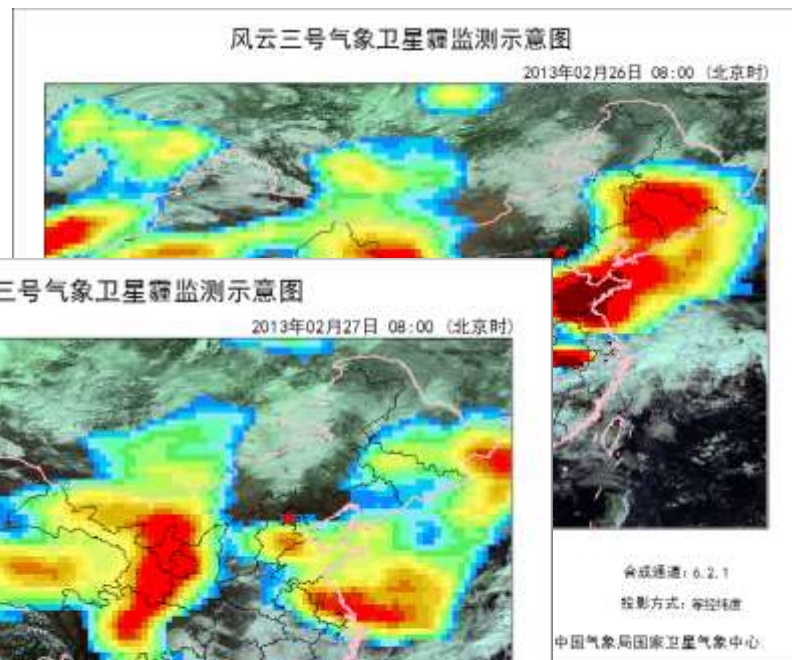
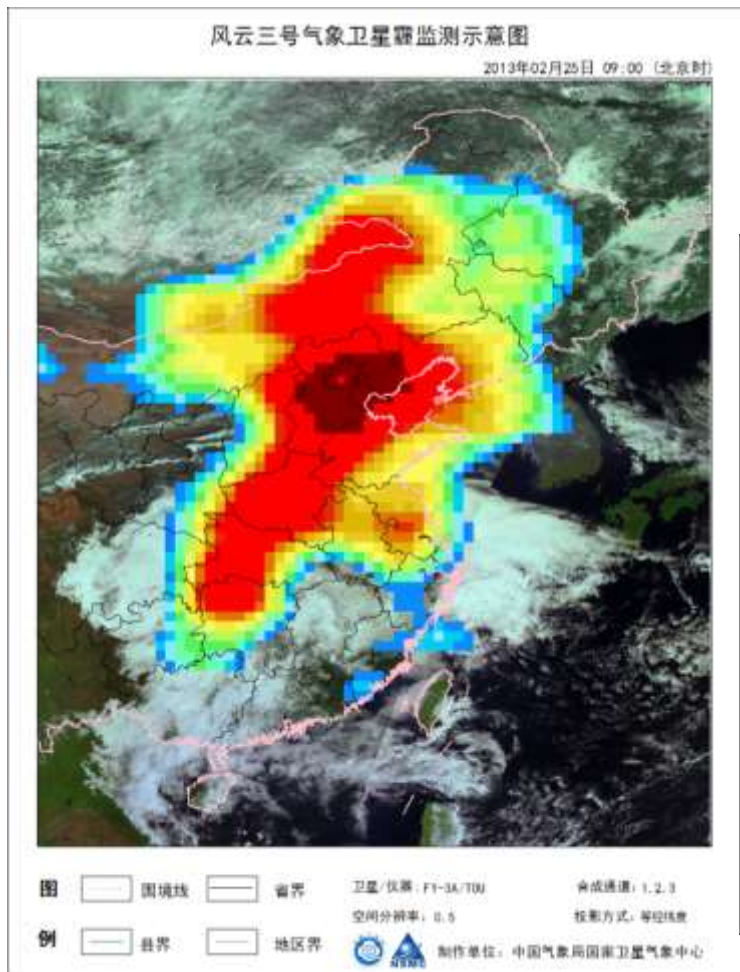
Severe drought of southwest China during the period from last autumn to this spring. According to the monitoring result of remote sensing, the drought in southwest of China began to develop since the first ten days of Nov. , intensifying rapidly in the Feb and peaking at the most severe point in the last ten days of Mar.

City Hot Island Monitoring



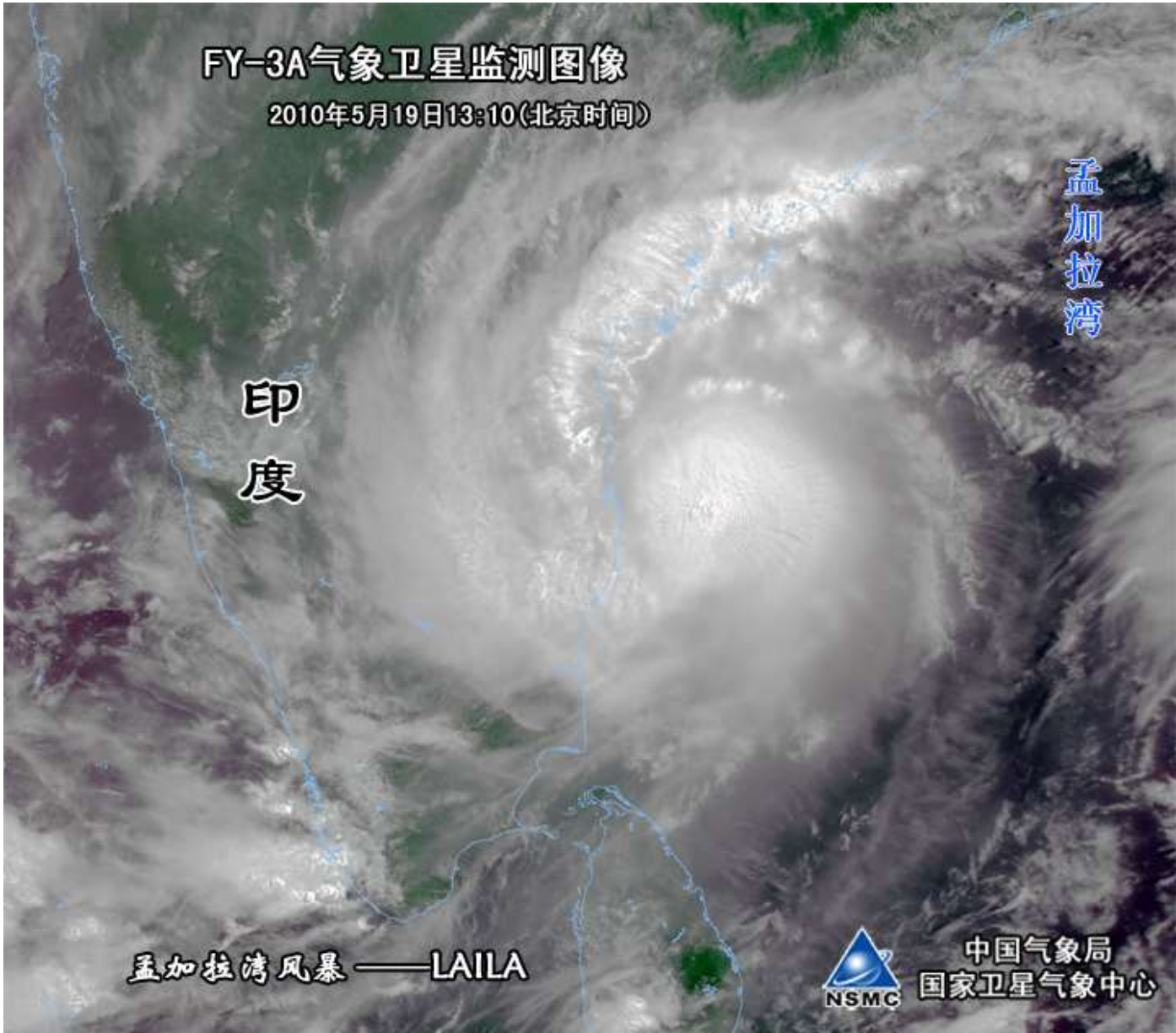
8月9日，上海大部、杭州东北部、武汉中部、南京中部及南部局部、苏州大部、南昌中部及东南部局部地区有强热效应。

Haze monitoring

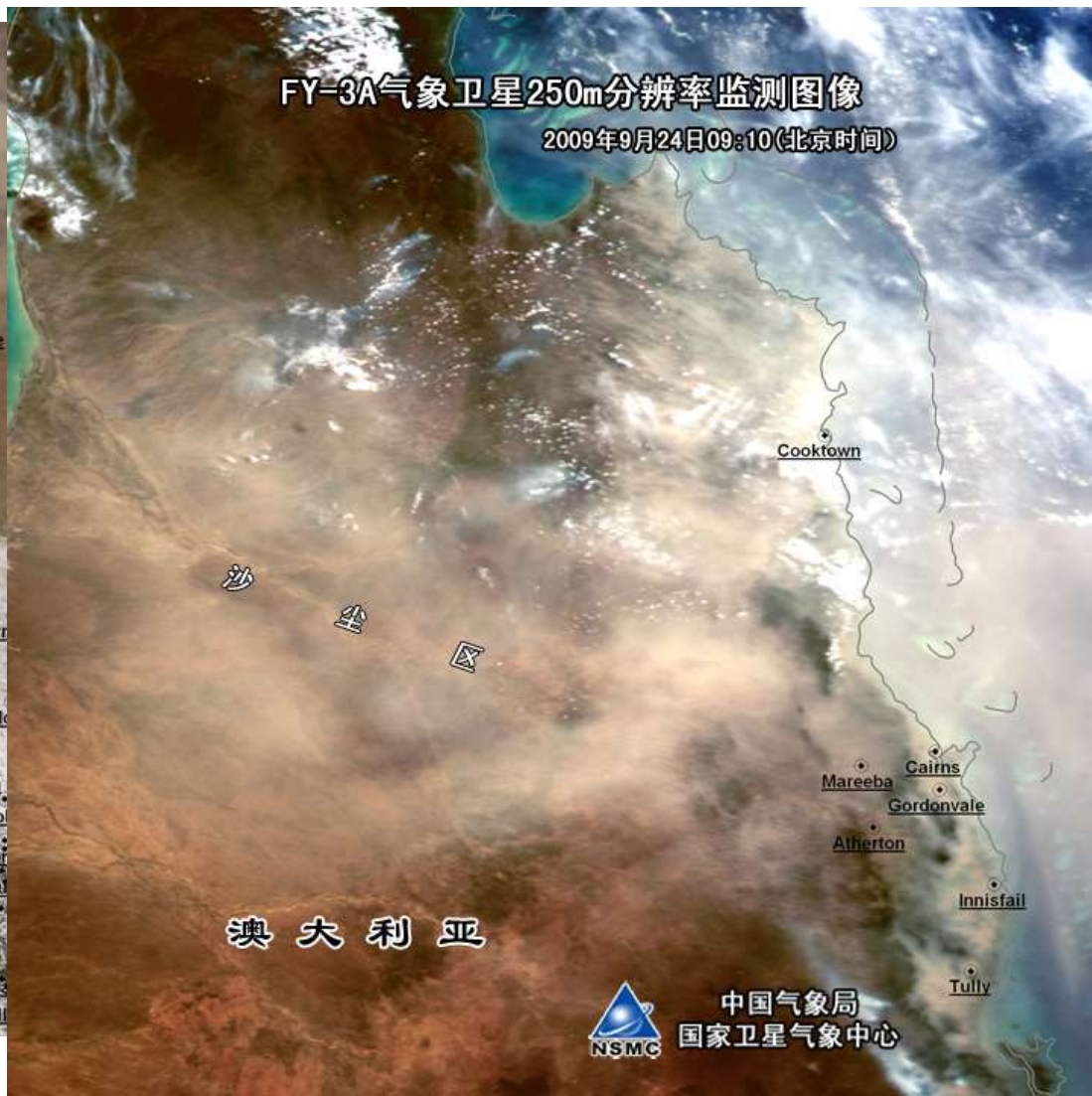
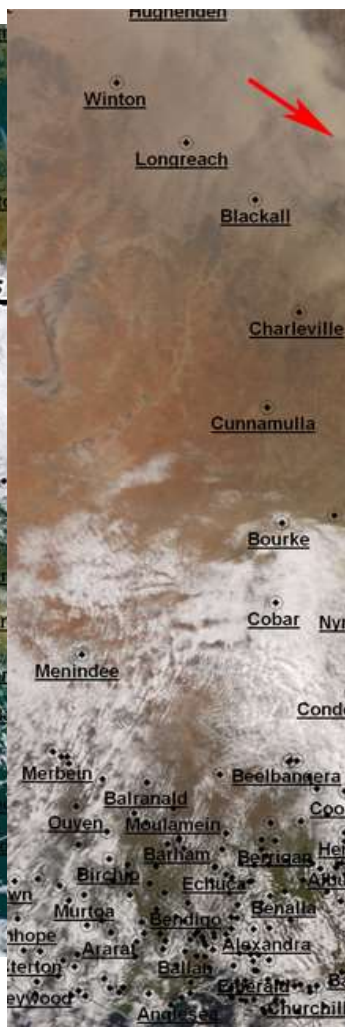
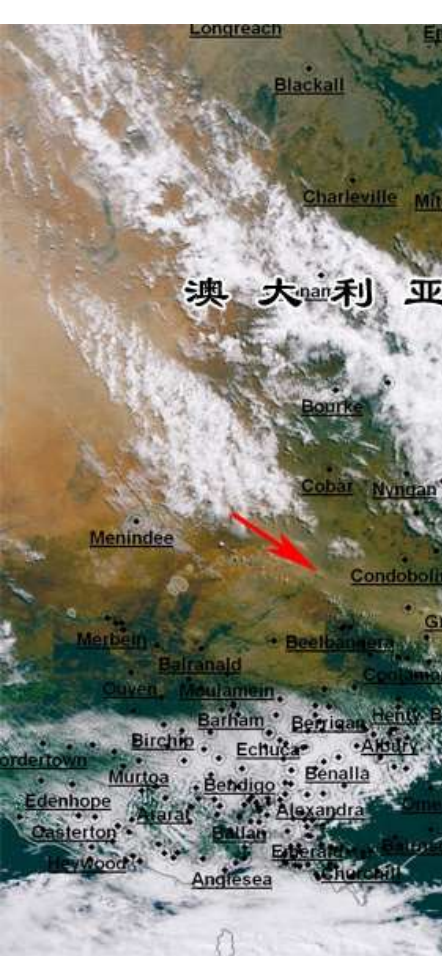


Global natural hazard and environment events monitoring by FY3

Tropical Cyclone in Bay of Bengal



Dust Storm in Australia

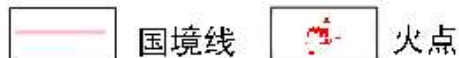


Fire in Indonesia

FY3A/MERSI 真彩色



图



例

FY-3A/MERSI 真彩色合成图与火点信息叠加

2013年06月25日 10:50 (北京时间)

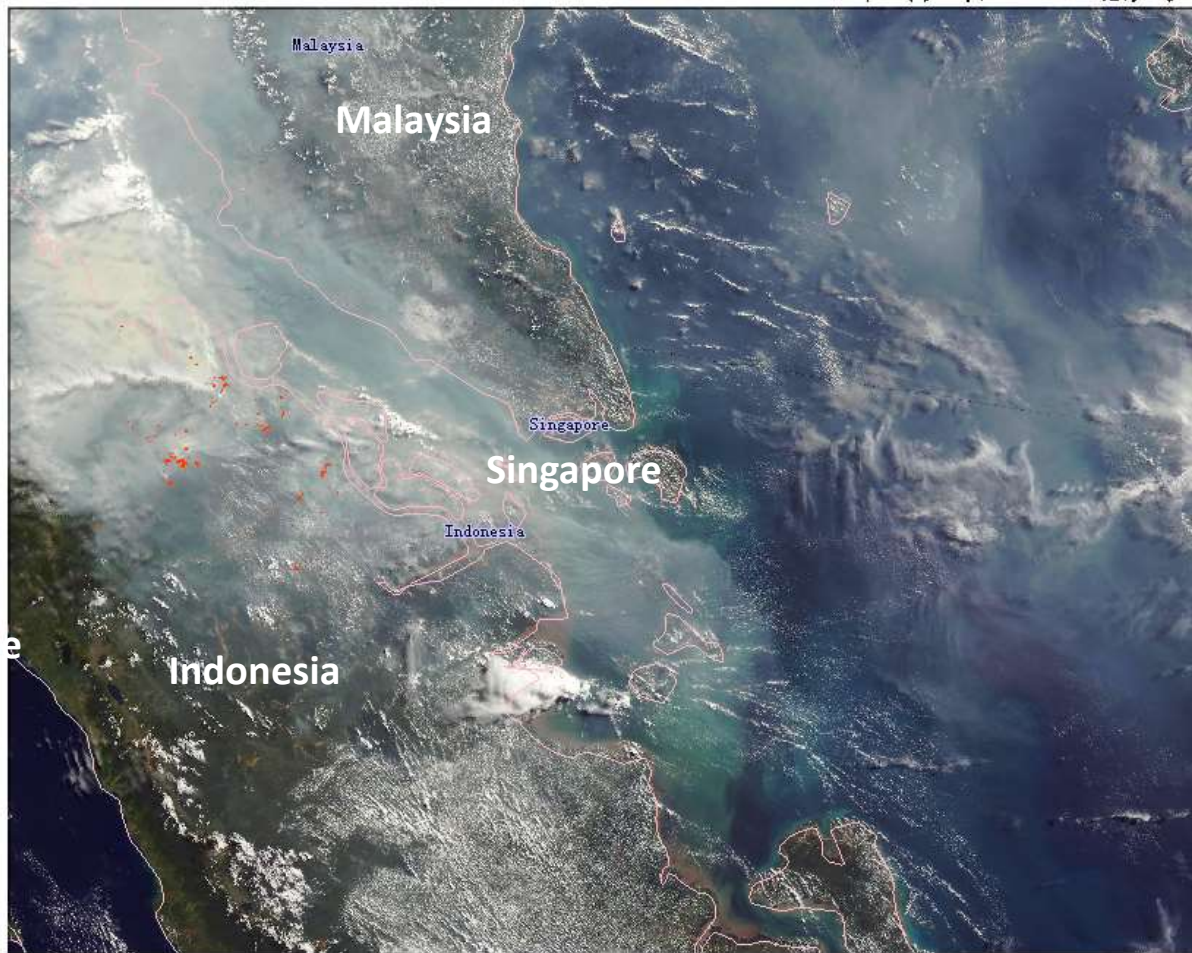


图 — 国境线 — 省界

例 — 地区界 — 县界

卫星/仪器: FY-3A/MERSI

空间分辨率: 0.0025

合成通道: 3, 2, 1

投影方式: 等经纬度

制作单位: 中国气象局国家卫星气象中心

Flood in India

FY-3A/MERSI 印度北部洪涝监测专题

2013年

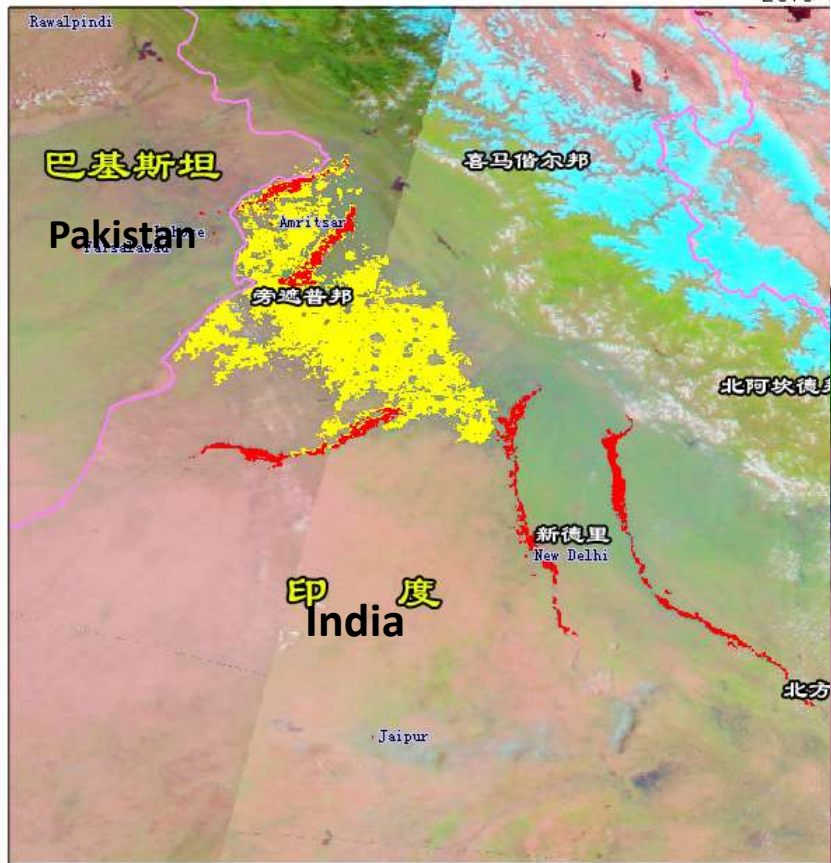


图 国境线

Waterlogging water 水涝水
Flood water 洪水

卫星/仪器: FY-3A/MERSI

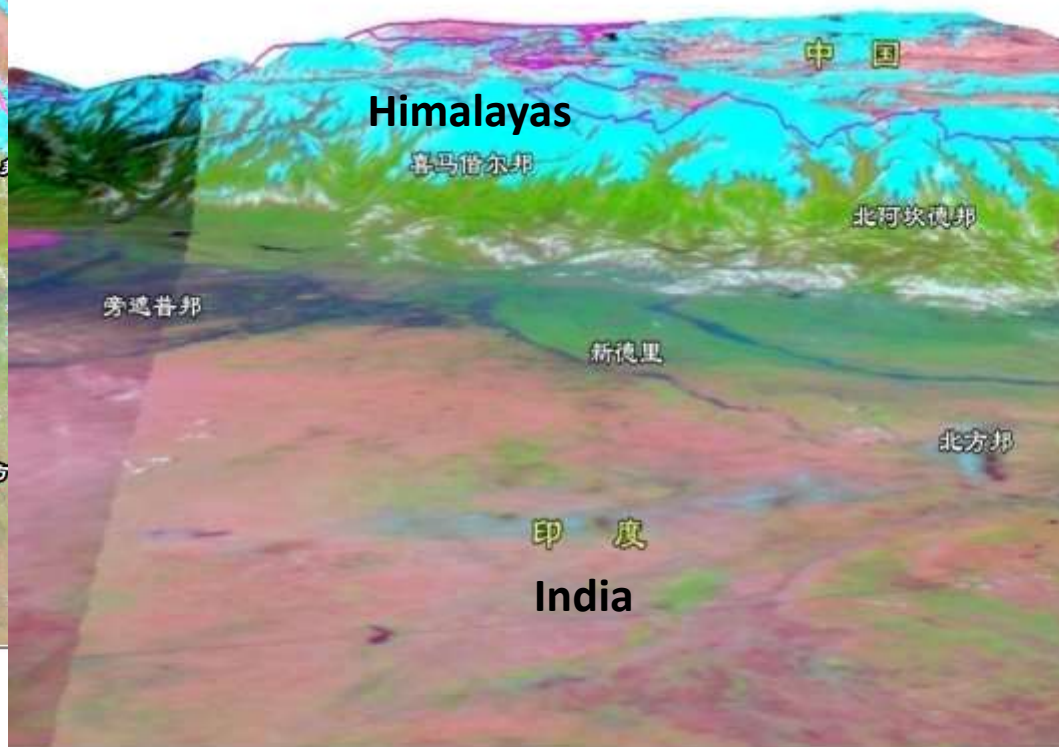
空间分辨率: 0.0025



制作单位: 中国

FY-3A/MERSI 印度北部水体监测3D图

2013年06月20日 13:30 (北京时间)



中国气象
国家卫星中心

Thank you for
your attention!