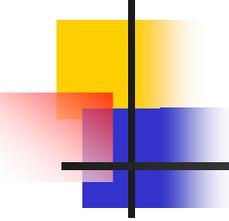


Current and Future Meteorological Satellite Program of China

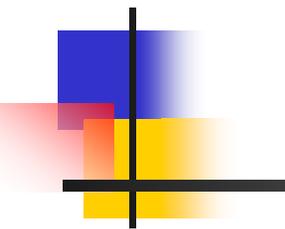
ZHANG Wenjian, DONG Chaohua
XU Jianmin, YANG Jun

China Meteorological Administration
May 30, 2005
Beijing, CHINA



Outline of the Presentation

1. Current Meteorological Satellites
2. Future Plans and Considerations for China's Met. Sat. Program
3. Conclusion



1. Current Chinese Meteorological Satellites

1.1 Polar

1.2 Geostationary

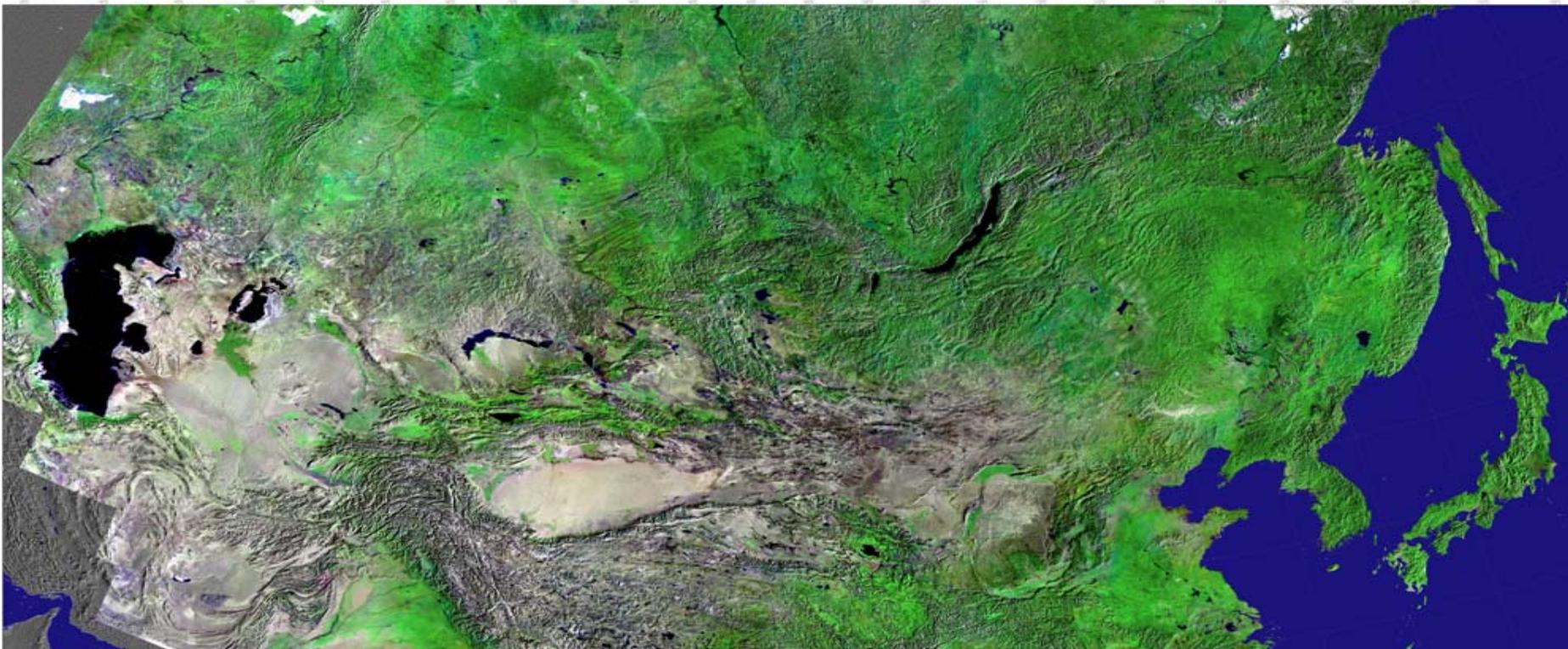
FY-1D: The Chinese Polar-orbiting Operational Satellite

- FY-1D was launched on May 15, 2002
- Operation is now over design life and still health in operation



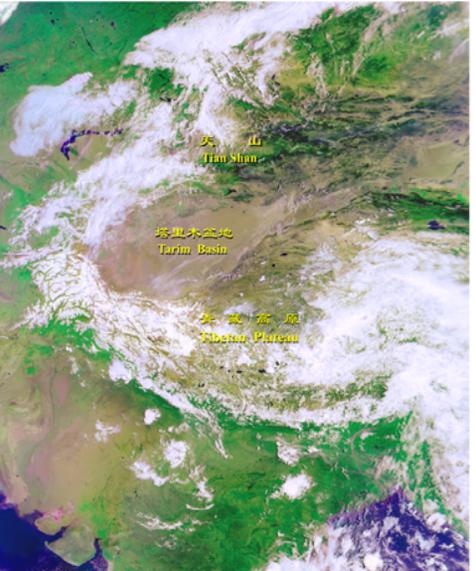
Characteristics of the 10-Ch. Radiometer of FY-1

Channel	Wavelength(μm)	Purpose
1	0.58-0.68	Channel 1-6 Close to current NOAA/AVHRR3
2	0.84-0.89	
3	3.55-3.95	
4	10.3-11.3	
5	11.5-12.5	
6	1.58-1.64	
7	0.43-0.48	Ocean color
8	0.48-0.53	Ocean color
9	0.53-0.58	Ocean color
10	0.90-0.965	Water vapor



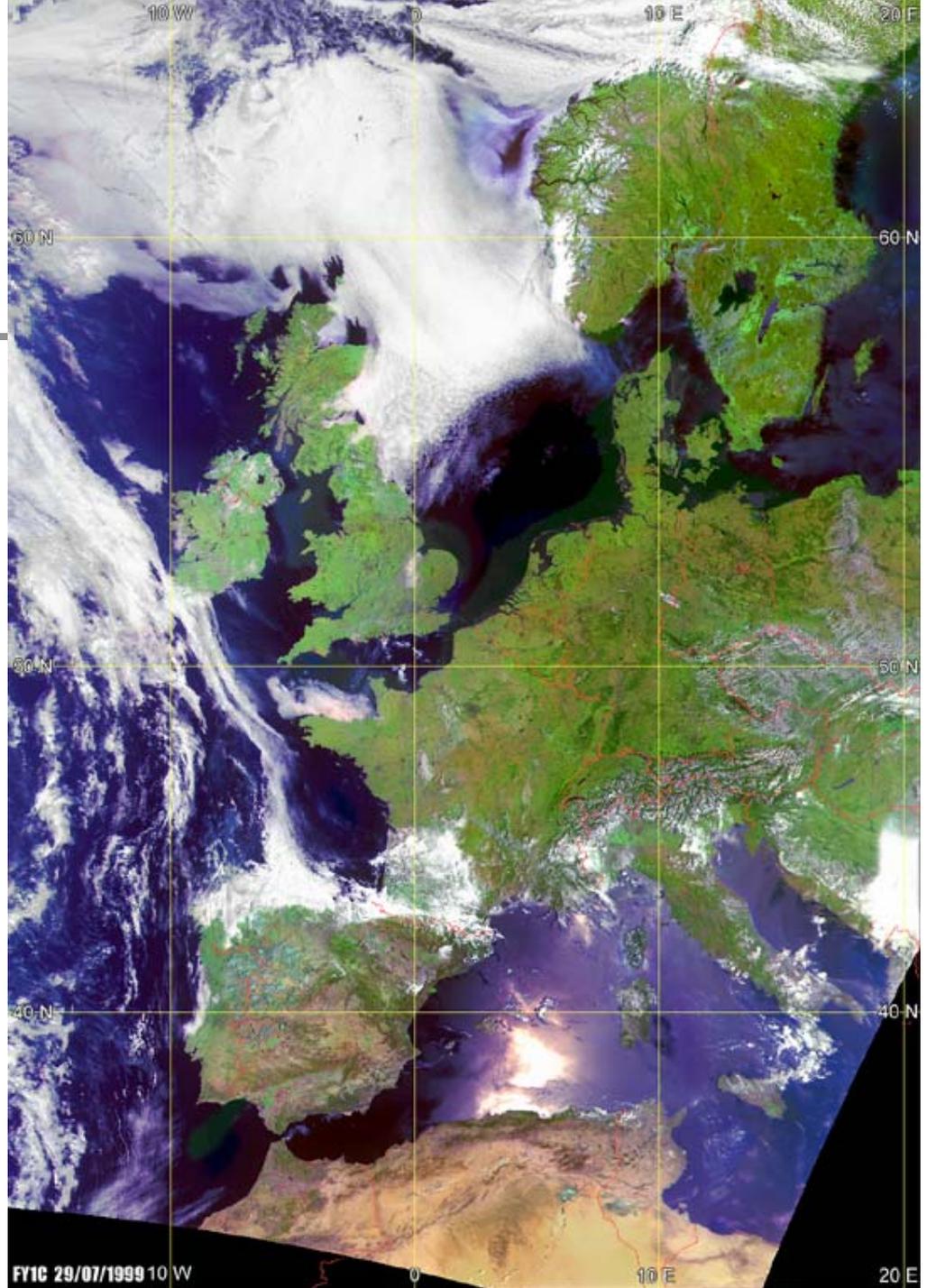
《风云一号》C星第一幅展宽云图

The First Stretched Cloud Image of FY-1C 1999.5.10. 03:17(UTC) / 11:17 (北京时间)

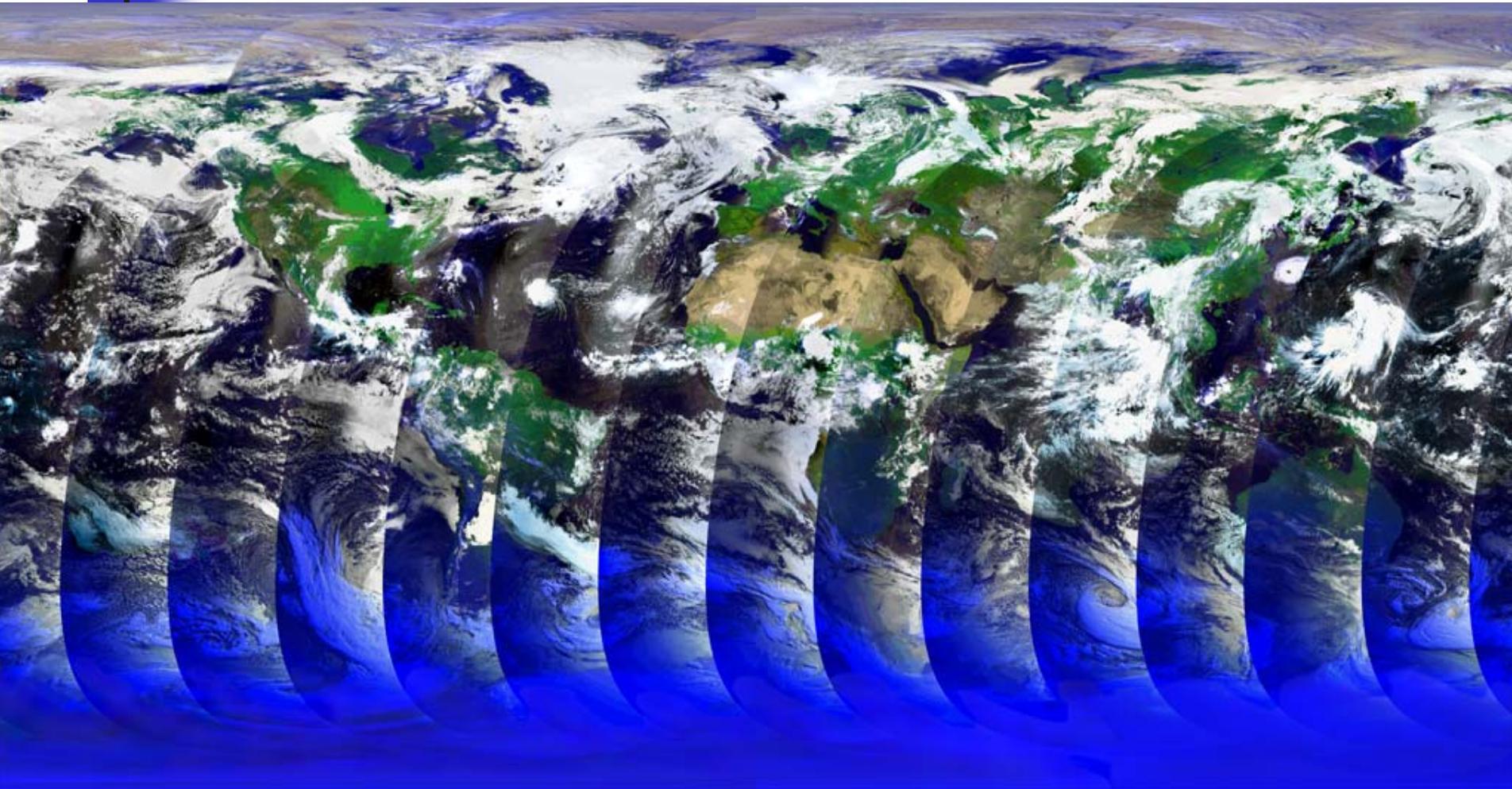


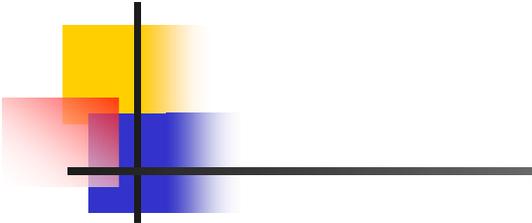


FY-1D
HRPT
Received
At Europe



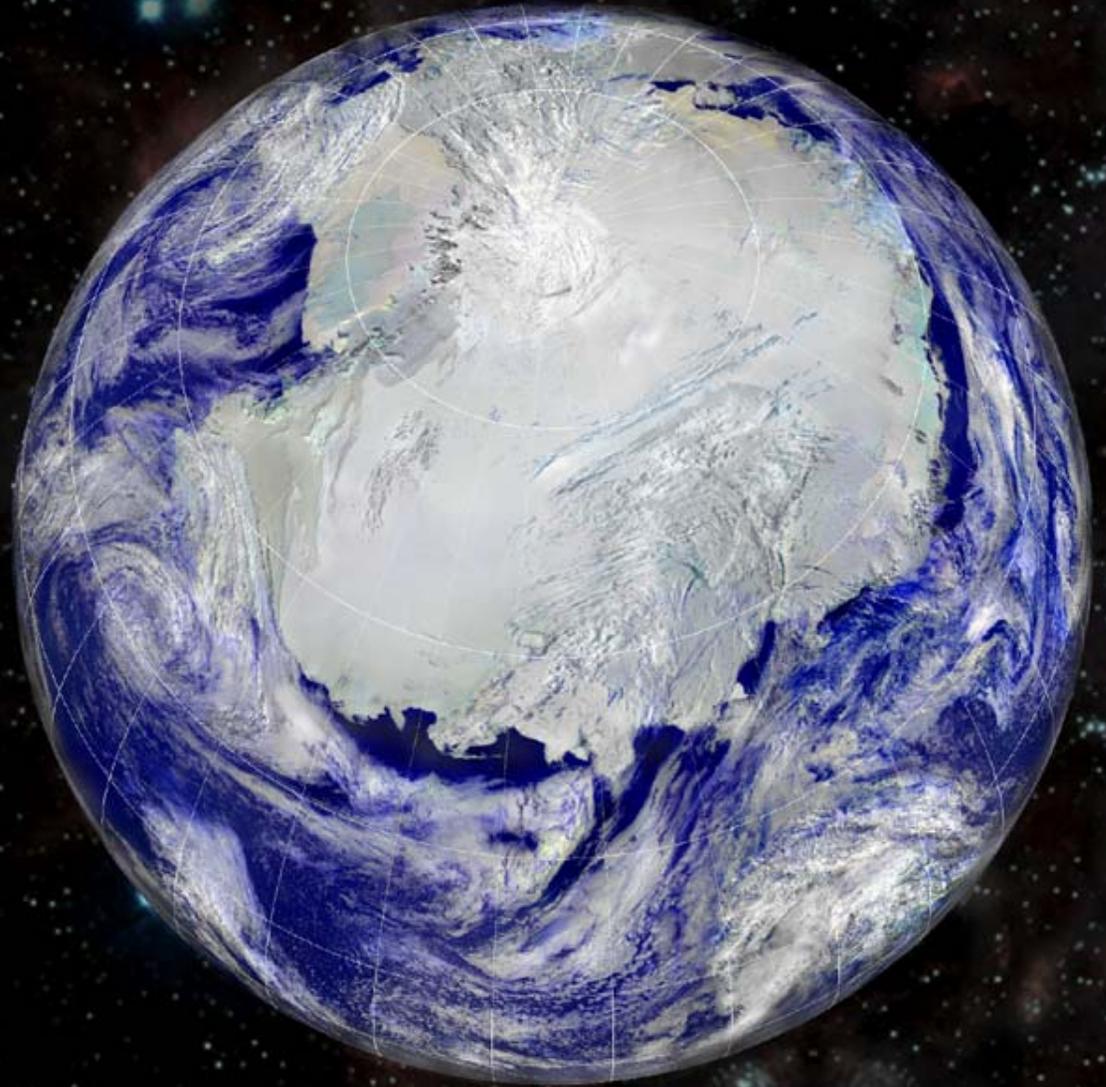
Global Multi-Orbit Mosaic Image



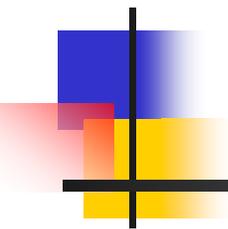


**Composite
Imagery of
Antarctic
Region by
FY-1D
GDPT**

(Ch. 1,2,3 Composite.)



Current Chinese Meteorological Satellites



1.1 Polar

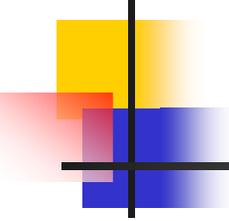
1.2 Geostationary

Successful launch of FY-2C

□ Launch and position

- ◆ FY-2C launched at 09:20 (BJ), Oct. 19, 2004;
- ◆ FY-2C Located at 105°E on Oct. 24, 2004





FY-2C/D/E/F/G: operational series

- FY-2 Op series is consists of FY-2C/D/E three satellites and 2 more satellites will be added (FY-2F&FY-2G) for connection to FY-4. The Op series is improved based on FY-2A/B with the major improvements on:
 - Five channel radiometers;
 - More products for widely use in meteorology and Environment (Dr. XU will have more slides to show)
 - More frequent observations during the main flooding season (June – August)
 - **half-hourly** image (48 images each day)

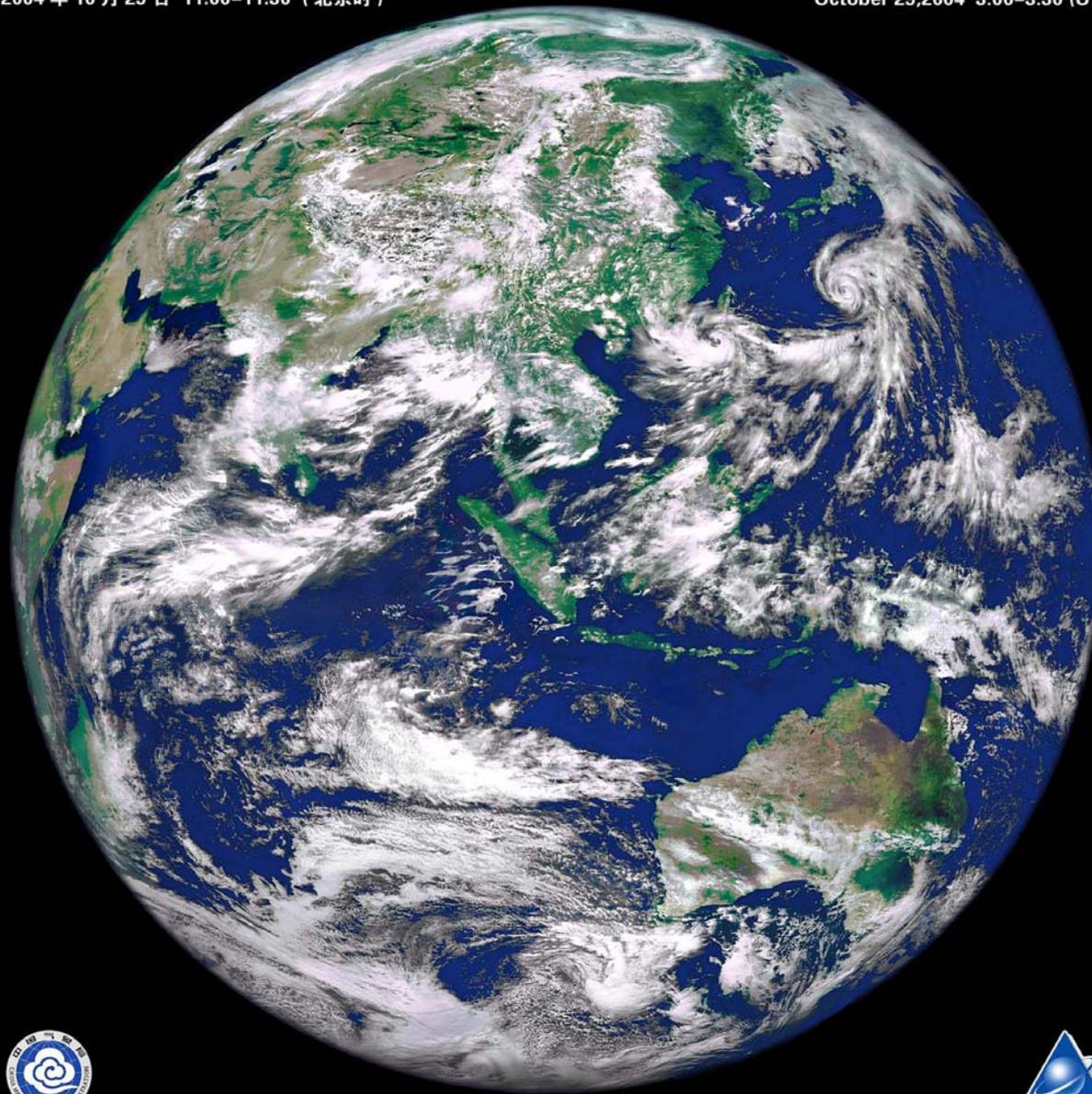
FY-2A/B (Exp)		FY-2C/D/E/F/G (Op)	
Channels	Wavelength (μm) (quantization)	Channels	Wavelength (μm) (quantization)
1	0.5-1.05 (6 bits)	1	0.5-0.9 (6 bits)
2	6.3-7.6 (8 bits)	2	3.5-4.0 (10 bits)
3	10.5-12.5 (8 bits)	3	6.3-7.6 (8 bits)
		4	10.3-11.3 (10 bits)
		5	11.5-12.5 (10 bits)

风云二号C星第一幅可见光图像

FIRST VIS IMAGE OF FY-2C

2004年10月29日 11:00-11:30 (北京时间)

October 29, 2004 3:00-3:30 (UTC)



中国气象局 国家卫星气象中心

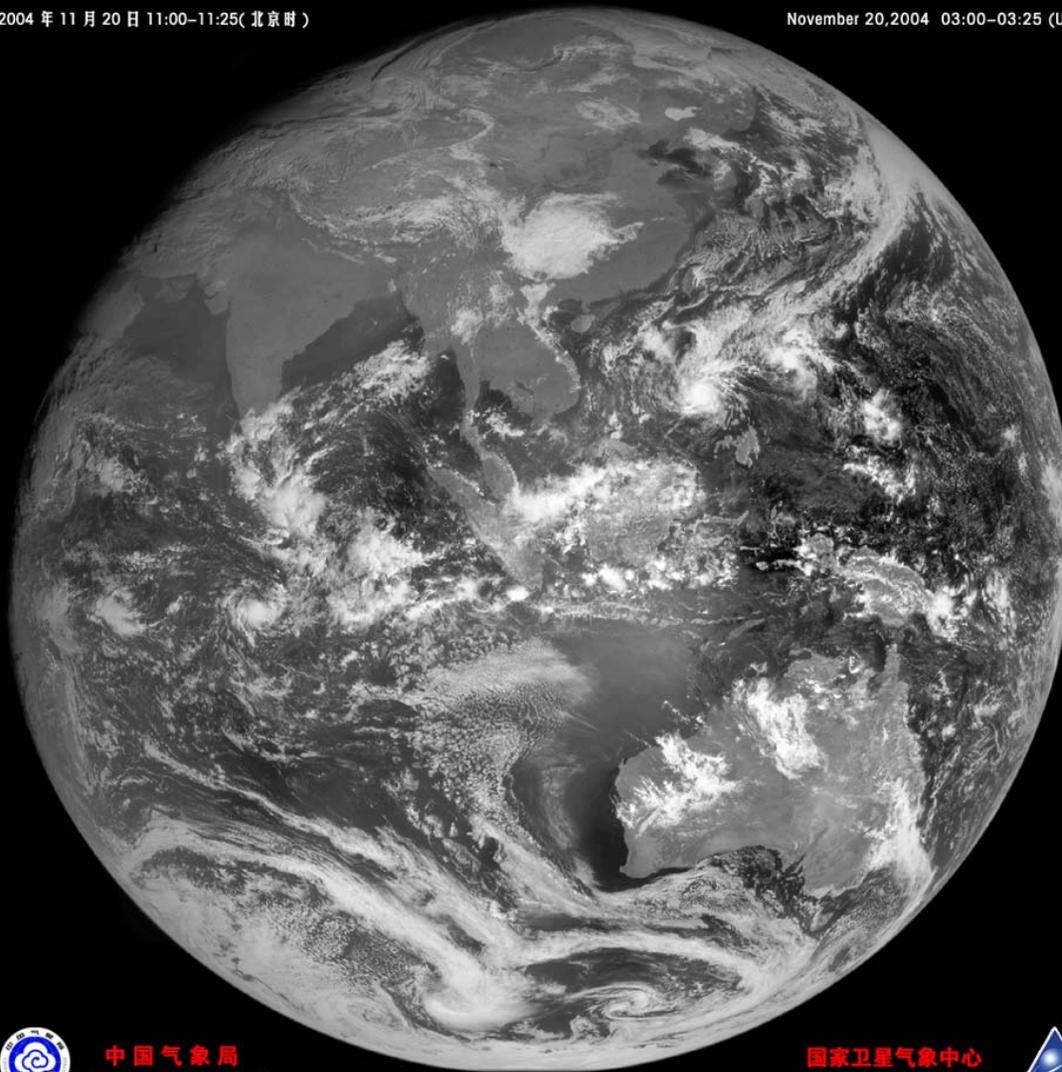
National Satellite Meteorological Center / China Meteorological Administration (NSMC/CMA)



FY-2C 可见光图像 (0.55-0.9 μm)

2004 年 11 月 20 日 11:00-11:25(北京时间)

November 20, 2004 03:00-03:25 (UTC)



中国气象局

China Meteorological Administration

国家卫星气象中心

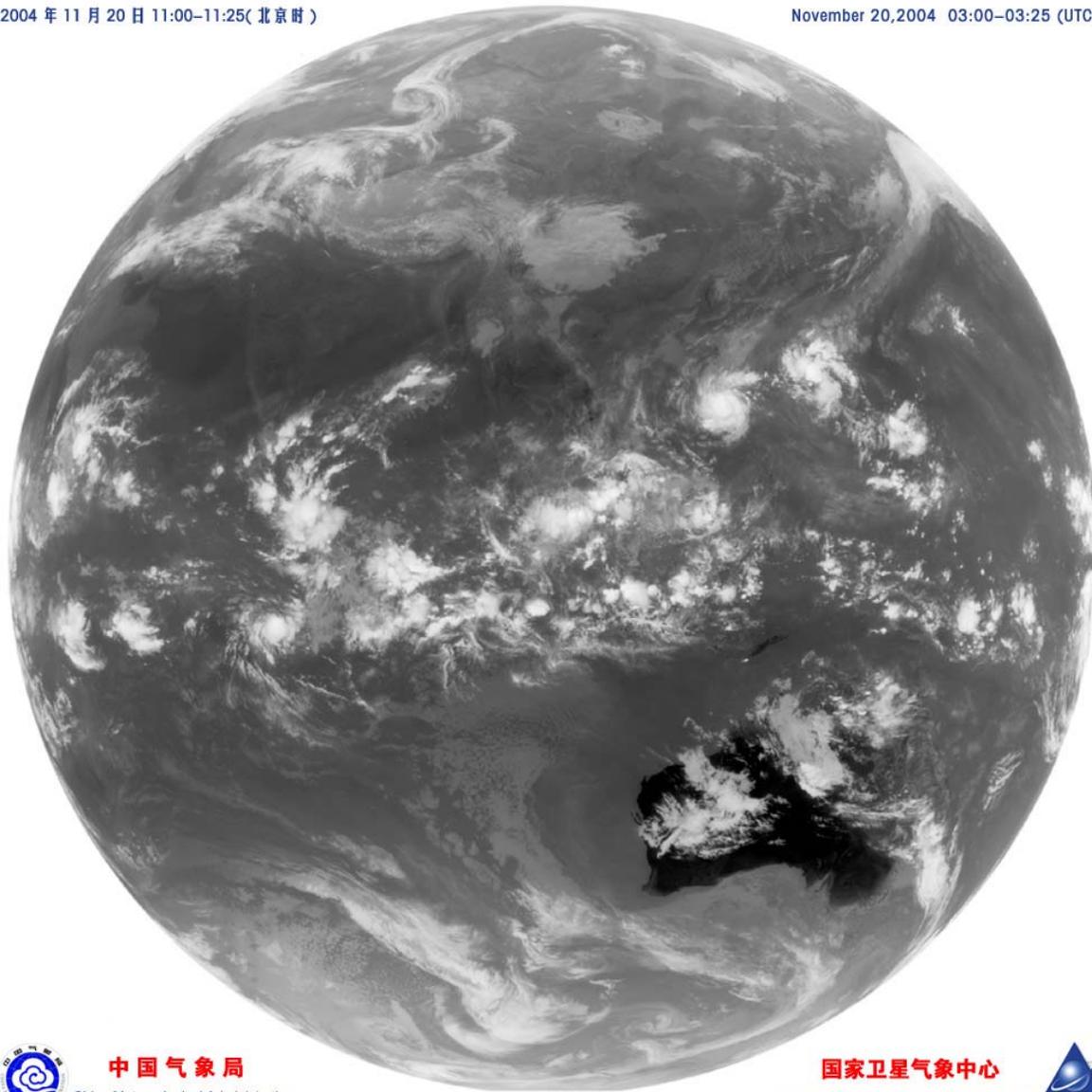
National Satellite Meteorological Center



FY-2C 长波红外图像 (10.3-11.3 μm)

2004 年 11 月 20 日 11:00-11:25(北京时)

November 20, 2004 03:00-03:25 (UTC)



中国气象局
China Meteorological Administration

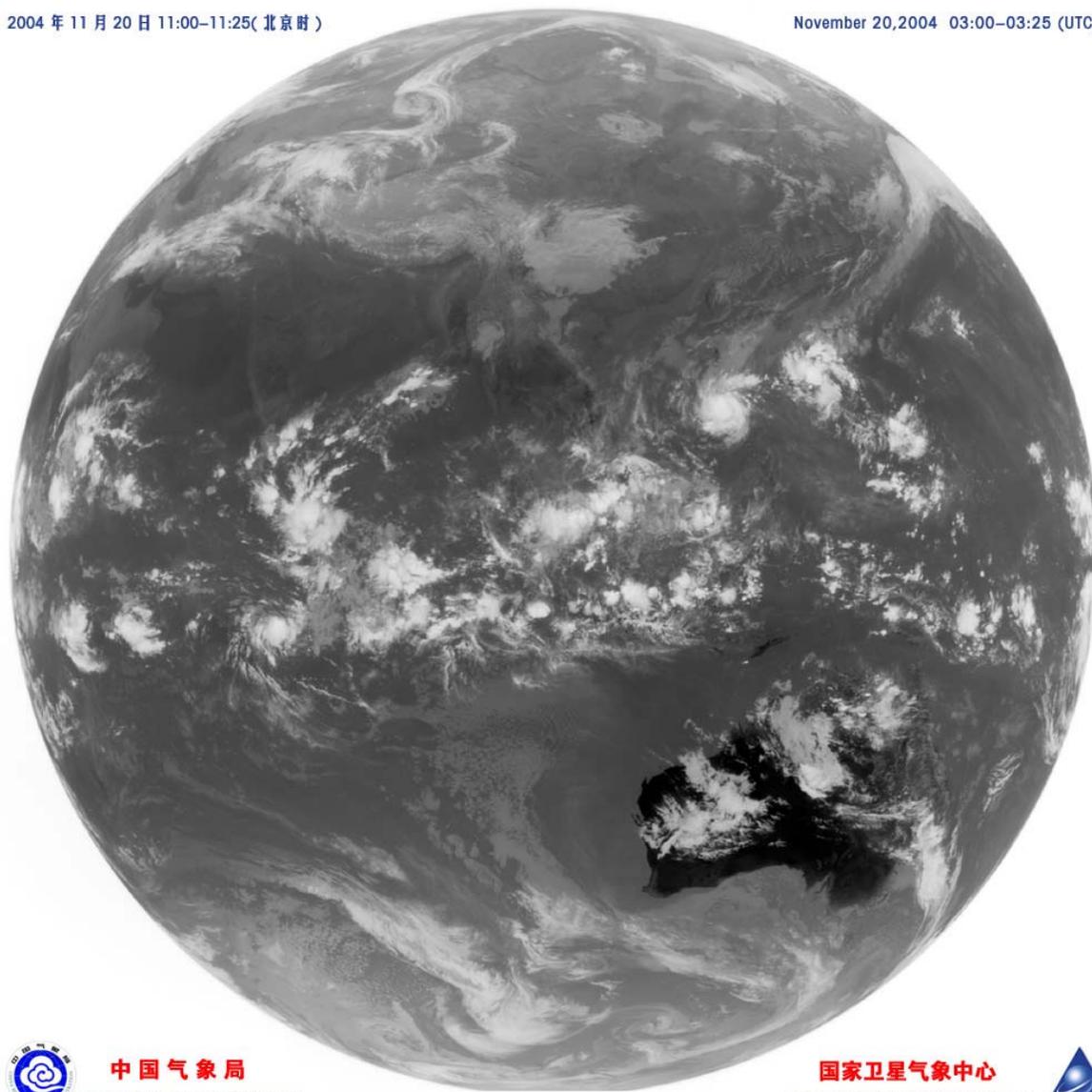
国家卫星气象中心
National Satellite Meteorological Center



FY-2C 长波红外分裂窗图像 (11.5-12.5 μm)

2004 年 11 月 20 日 11:00-11:25(北京时)

November 20, 2004 03:00-03:25 (UTC)



中国气象局
China Meteorological Administration

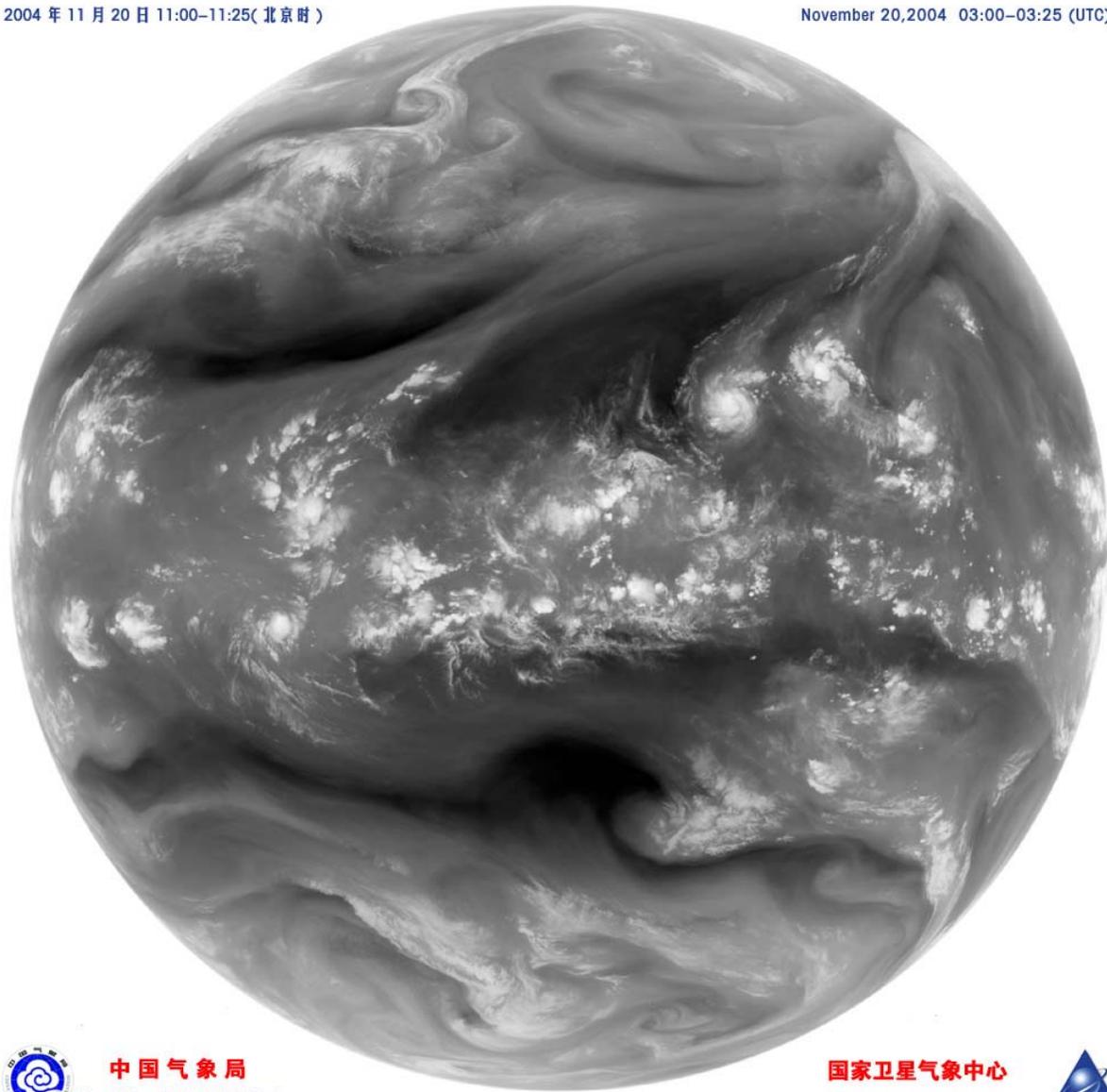
国家卫星气象中心
National Satellite Meteorological Center



FY-2C 水汽图像 (6.3-7.6 μm)

2004 年 11 月 20 日 11:00-11:25(北京时间)

November 20, 2004 03:00-03:25 (UTC)



中国气象局
China Meteorological Administration

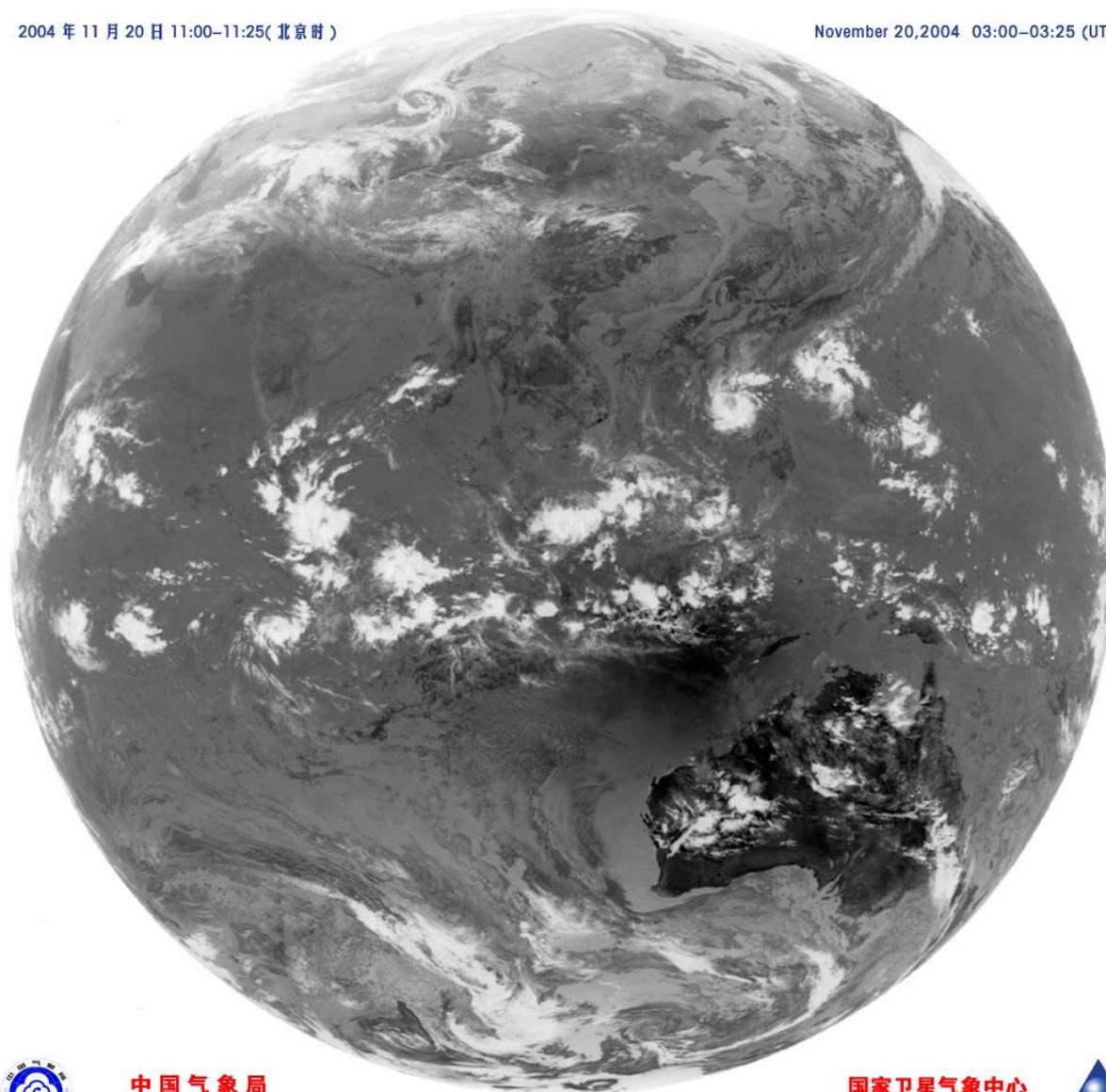
国家卫星气象中心
National Satellite Meteorological Center



FY-2C 中波红外图像 (3.5-4.0 μm)

2004 年 11 月 20 日 11:00-11:25(北京时)

November 20, 2004 03:00-03:25 (UTC)



中国气象局
China Meteorological Administration

国家卫星气象中心
National Satellite Meteorological Center

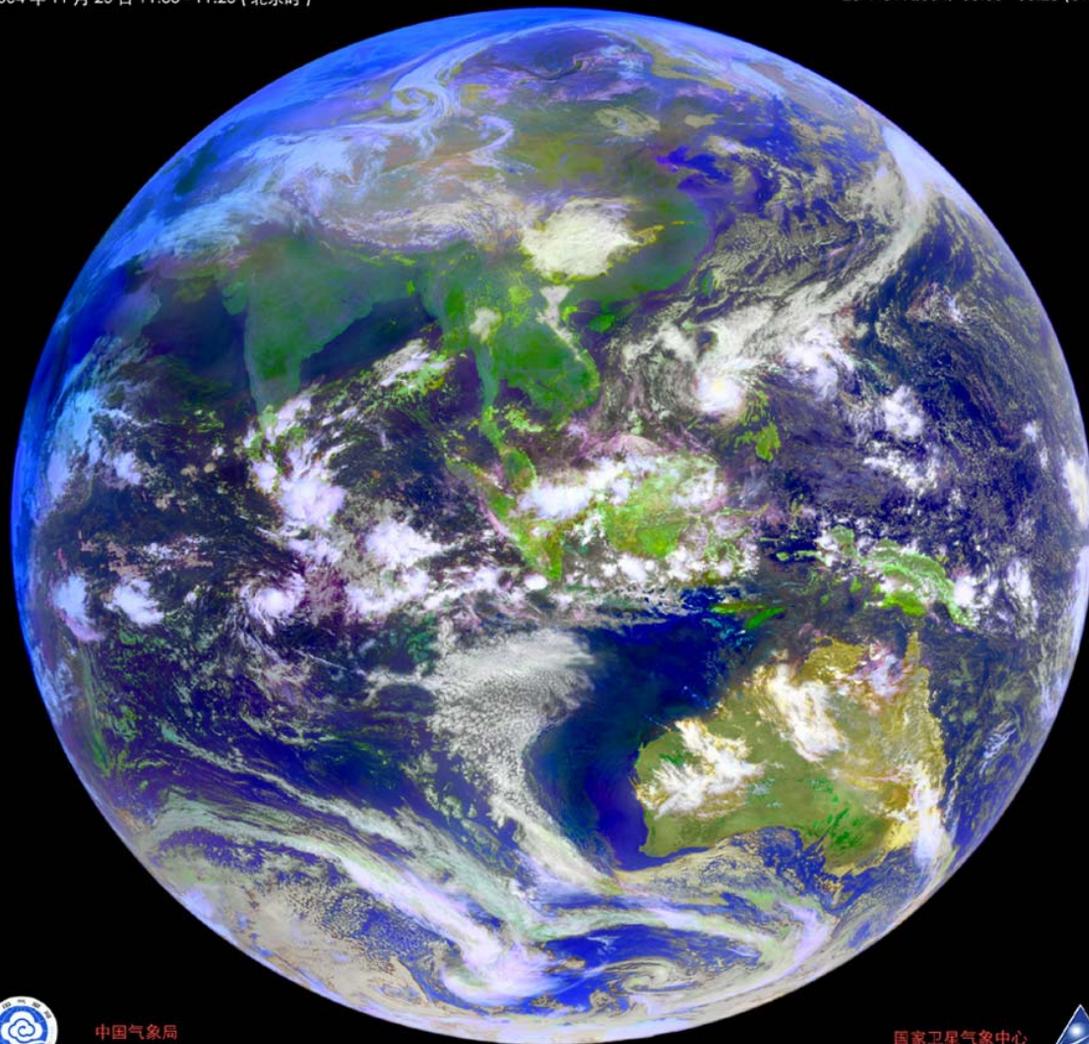


风云二号 C 星第一幅彩色合成图像

THE FIRST COLOR COMPOSITE IMAGE OF FY-2C

2004 年 11 月 20 日 11:00 - 11:25 (北京时间)

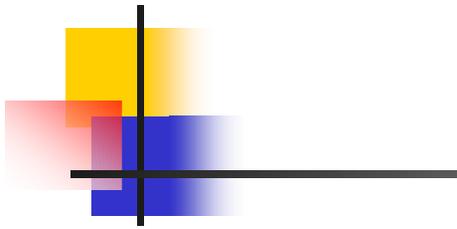
20 Nov. 2004, 03:00 - 03:25 (UTC)



中国气象局
China Meteorological Administration

国家卫星气象中心
National Satellite Meteorological Center





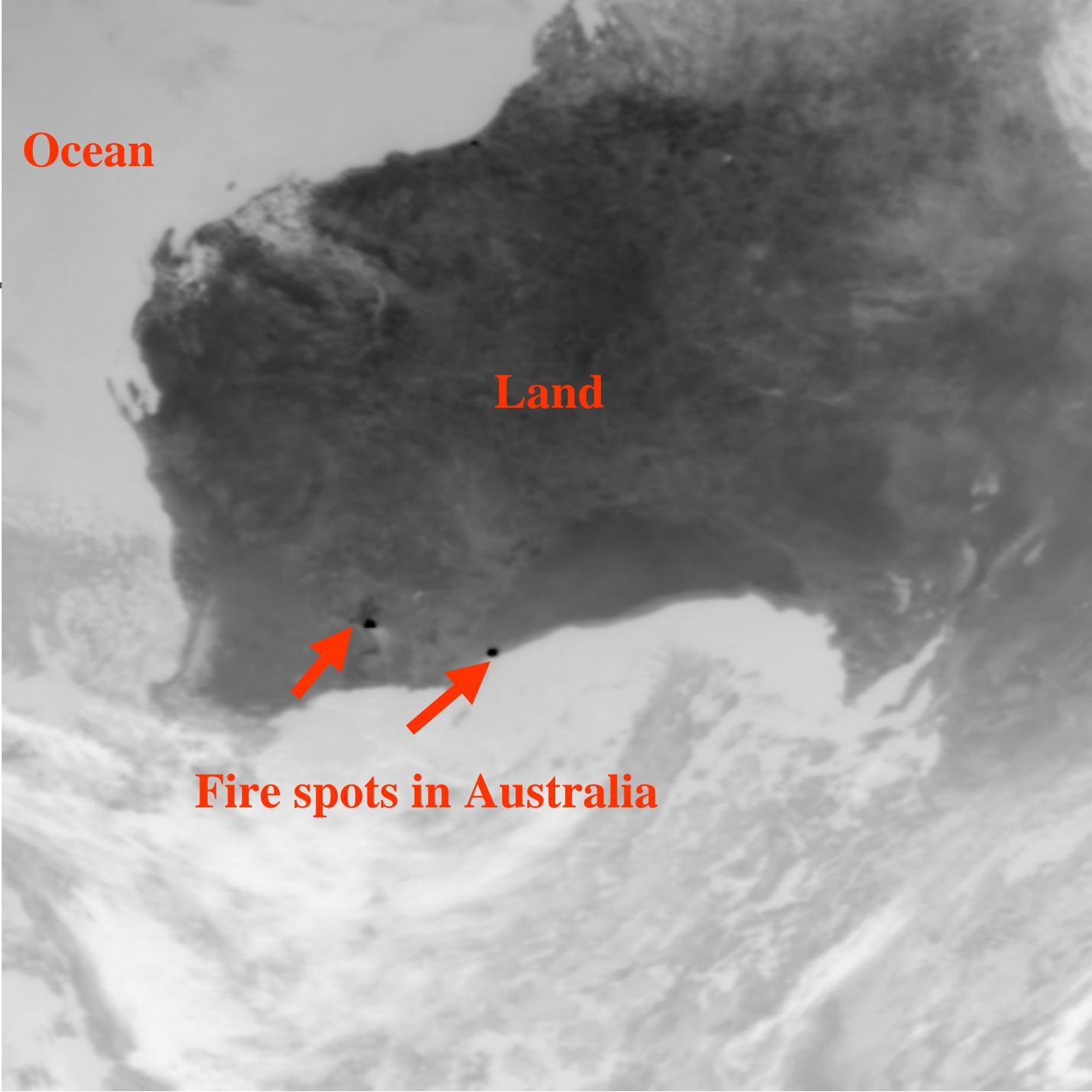
Ocean

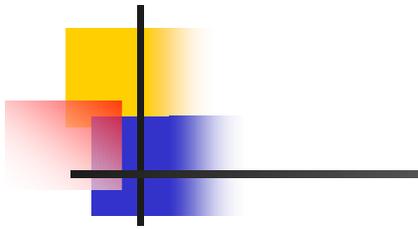
Land

FY2C
IR 3
3.9um

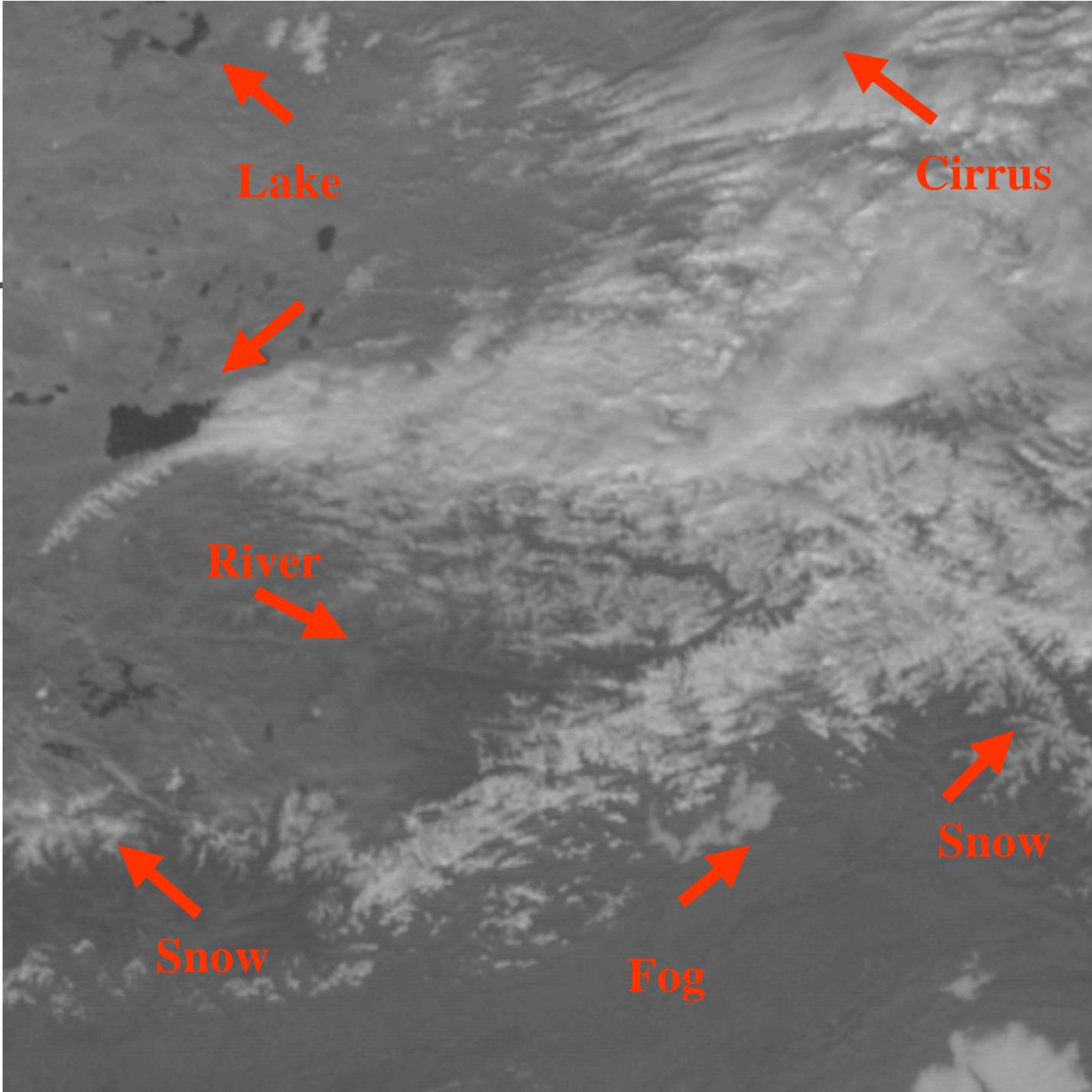


Fire spots in Australia





***FY2C
VIS***



Lake

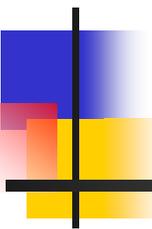
Cirrus

River

Snow

Fog

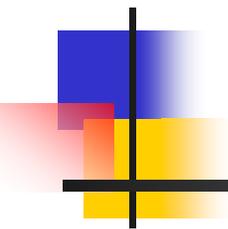
Snow



2. Future Plans and Considerations for China's Met. Sat. Program

2.1 Polar Satellites Program

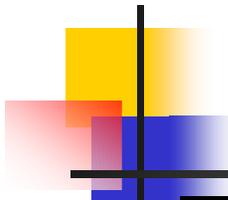
2.2 GEO Satellites Consideration



The 2nd gen. of polar satellites

Purpose of FY-3A/B (exp.)

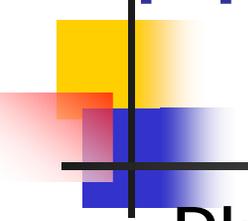
- Risk reduction in Engineering
- Products development and validation
- Utilization Demo in some area



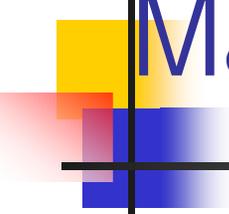
Two phase of FY-3 series

- There are two developing phases for FY-3: i.e..
 - Exp. Phase (2006-2009 in flight): 2 satellites with limited sounding capabilities
 - FY-3A Launch scheduled in Early 2007
 - FY-3B launched scheduled in Early 2009
 - Operational Phase (flight after 2009): Satellites Constellation is planned with expanded sounding and imaging capabilities

FY-3A Satellite: Progress



- Phase A (Design and Structure)
 - Sept. 2000- Nov. 2003
- Phase B (Engineering Model)
 - Dec. 2003- July 2005
- Phase C (Flight Model)
 - Aug. 2005 – Dec. 2006 (Ready for Launch)



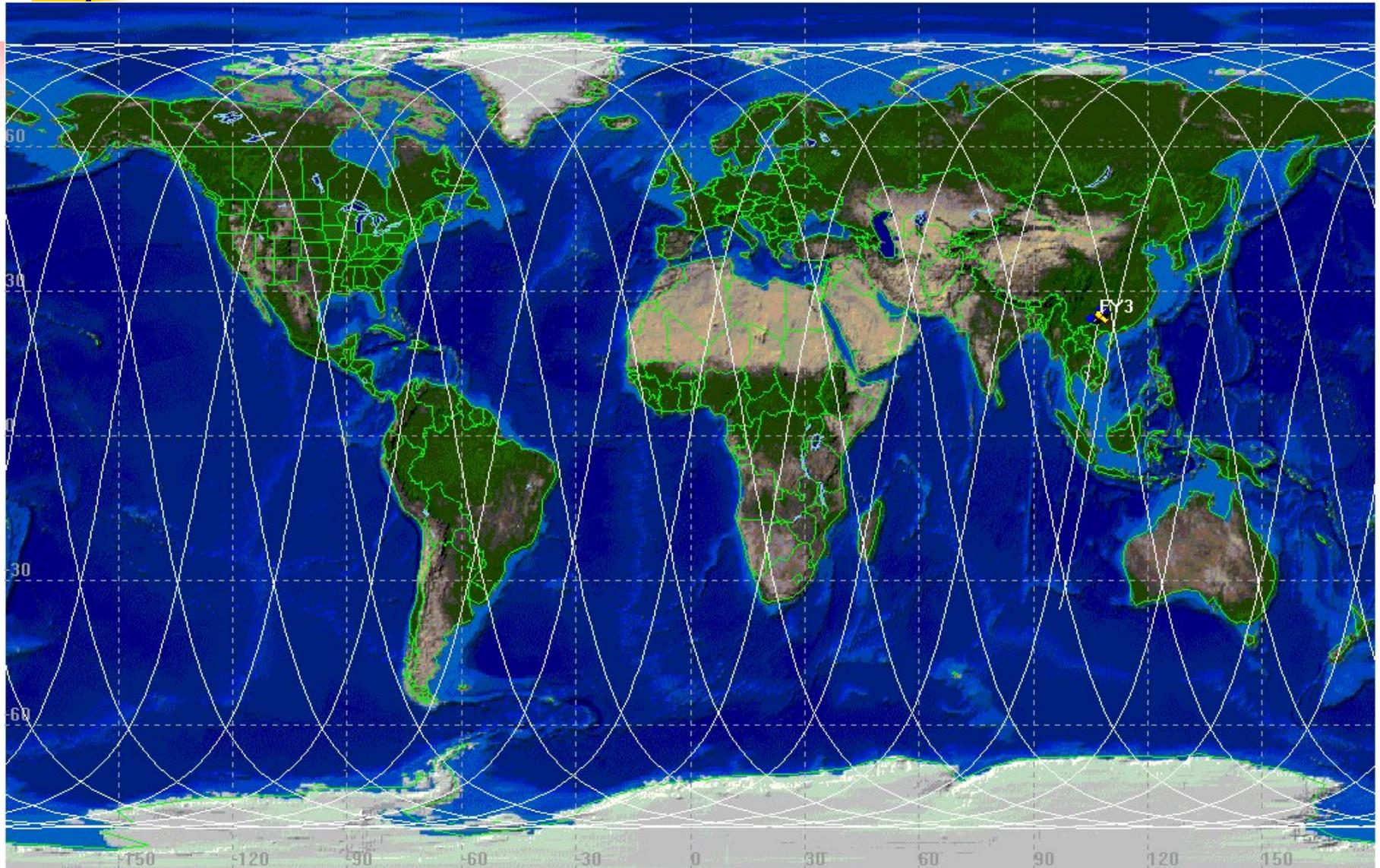
Main specifications of FY-3A

- Orbit: Sun-synchronous polar-orbiting
- Orbit altitude: 836 km
- Inclination=98.728 degree
- Eccentricity: better than 0.0034
- Nodal crossing time: **10:10-10:20 am** (LST, FY-3B could be at afternoon orbit)
- Orbit drifting: < 10 minutes (within 2 years)

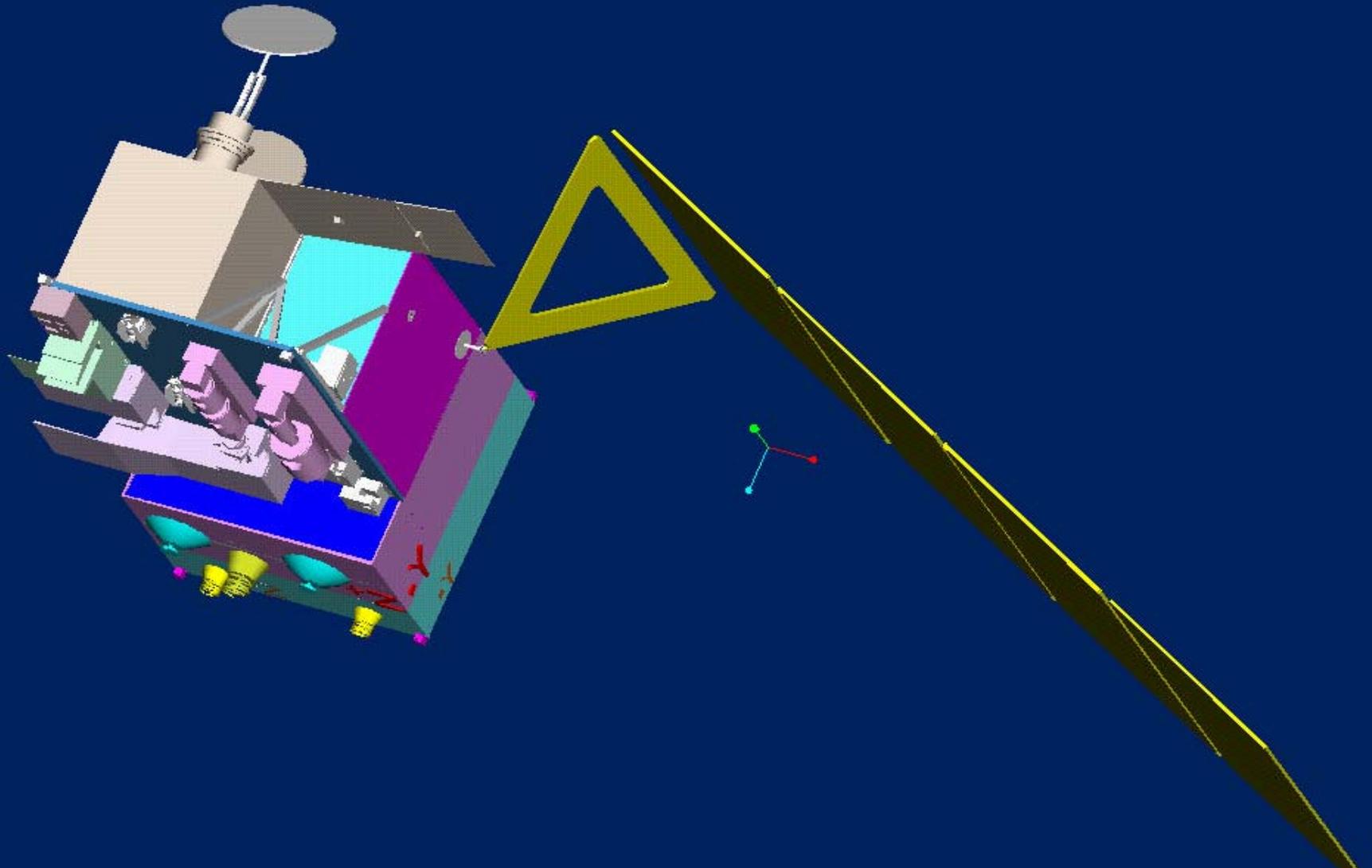
Main specifications of FY-3A (cont.)

- Power: 1100 watts (orbital average, estimated)
- Weight: 2200 kg (estimated now)
- Size : 4400*2000*2000 (X,Y,XZ :in stowed)
- : 4400*10000*2000 (X,Y,Z : in flight)
- Design life: ≥ 3 years

One-day orbital coverage



Satellite in flying mode



Main Instruments on FY-3

(1) Sounding Mission(5 instruments)

- Infrared Atmospheric Sounder (IRAS)
- MicroWave atmospheric Temperature Sounder (MWTS)
- MicroWave atmospheric Humidity Sounder (MWHS, AMSU-B like, onboard FY-3A/B)
- Multichannel Atmospheric Infrared Sounder (MAIRS, OP. phase)
- Solar Backscatter Ultraviolet and Total Ozone Sounder (SBUV/TOS)

Main Instruments on FY-3

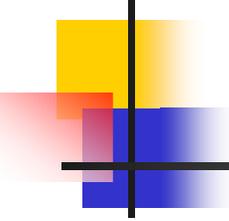
(2) Imaging Mission(3 instruments)

- Visible and Infrared Radiometer(VIRR, 10 channels, similar to radiometer aboard FY-1C)
- Medium Resolution Spectral Imager(MERSI)
- MicroWave Radiation Imager (MWRI)

Main Instruments on FY-3

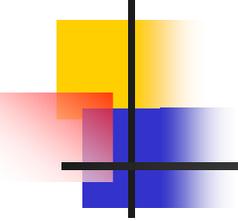
(3) Complementary Mission

- Earth Radiation Budget Unit (ERBU)
- Space Environment Monitor (SEM)
- Data Collection System (DCS)



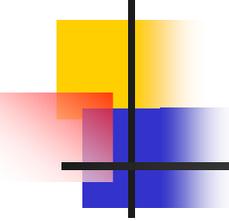
Data types: HRPT format

- Band frequency: 1698-1710 MHz
- Band Width: 5.4 MHz
- Modulation: QPSK
- Data rate: 4.2 Mbps
- Encoding: CONV(7, $\frac{3}{4}$)
- Broadcasting: Real time



Data types: **DPT** format

- DPT=Delayed Picture Transmission
- Band frequency: 8025-8215/8215-8140 MHz
- Band Width: 140 MHz
- Modulation: QPSK
- **Data rate: 110 Mbps**
- Encoding: CONV(7, $\frac{3}{4}$)
- Broadcasting: Within China capture area

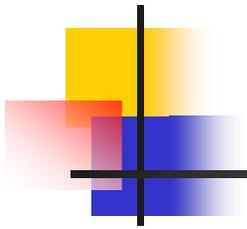


Data types: **MPT** format

- MPT=Mission Picture Transmission
- Band frequency: 7750-7850 MHz
- Band Width: 25 MHz
- Modulation: QPSK
- **Data rate: 20 Mbps**
- Encoding: CONV(7, $\frac{3}{4}$)
- Broadcasting: program controlled

Science Data Downlink Service Allocations

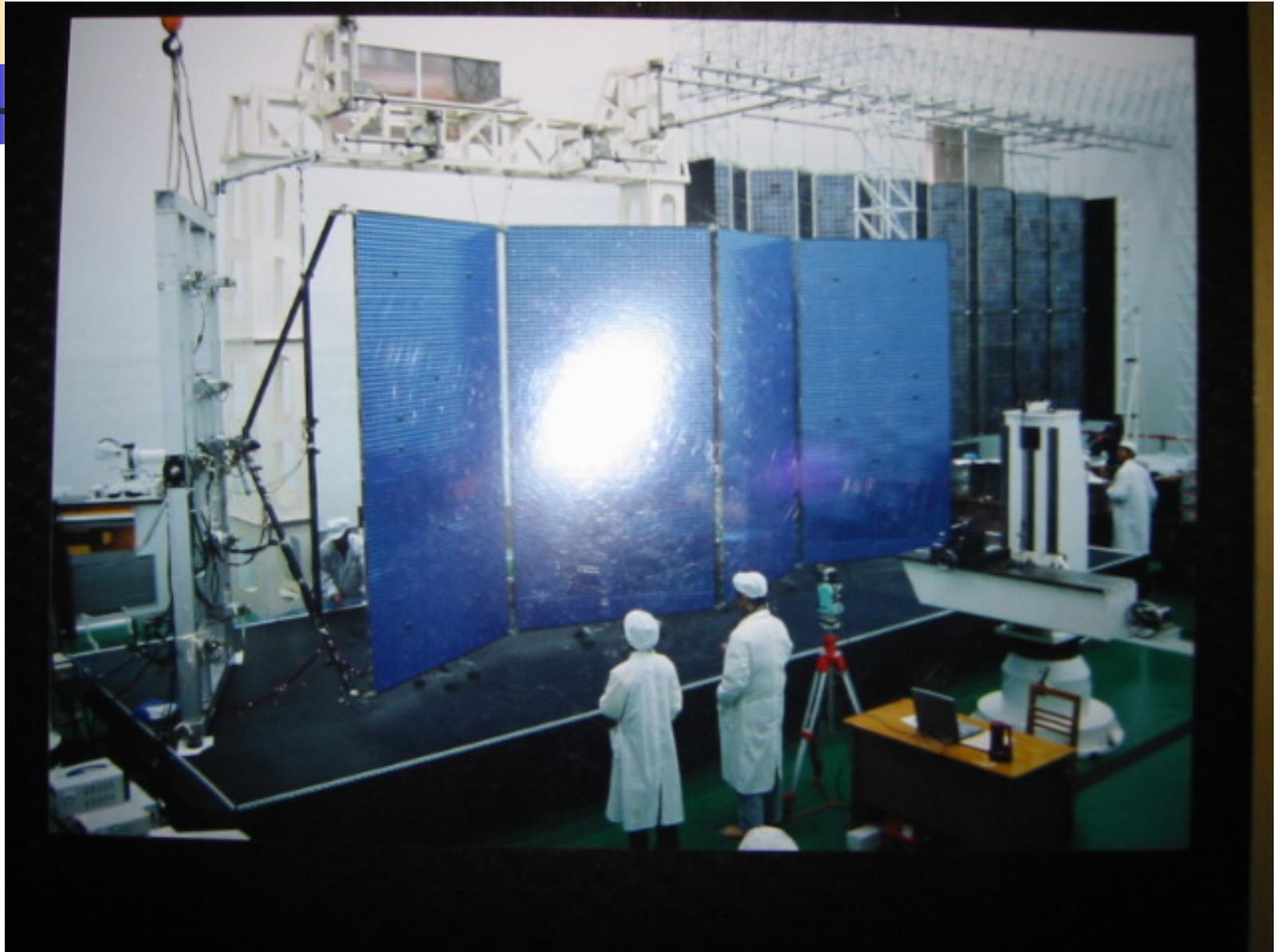
instrument	HRPT	MPT	Stored time	DPT
VIIR	√		810 min	√
IRAS	√		810 min	√
MWTS	√		810 min	√
MERSI		√	120 min	√
MWRI	√		810 min	√
TOMS/SBUV	√		810 min	√
SEM	√		810 min	√
ERBU	√		810 min	√
MWHS	√		810 min	√



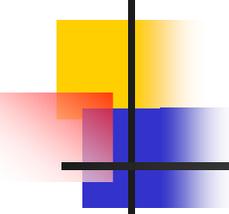
Larger Firing is needed for FY-3



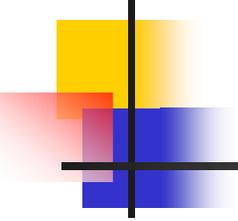
Solar panel testing of FY-3A



FY-3 Operational Constellation Considerations

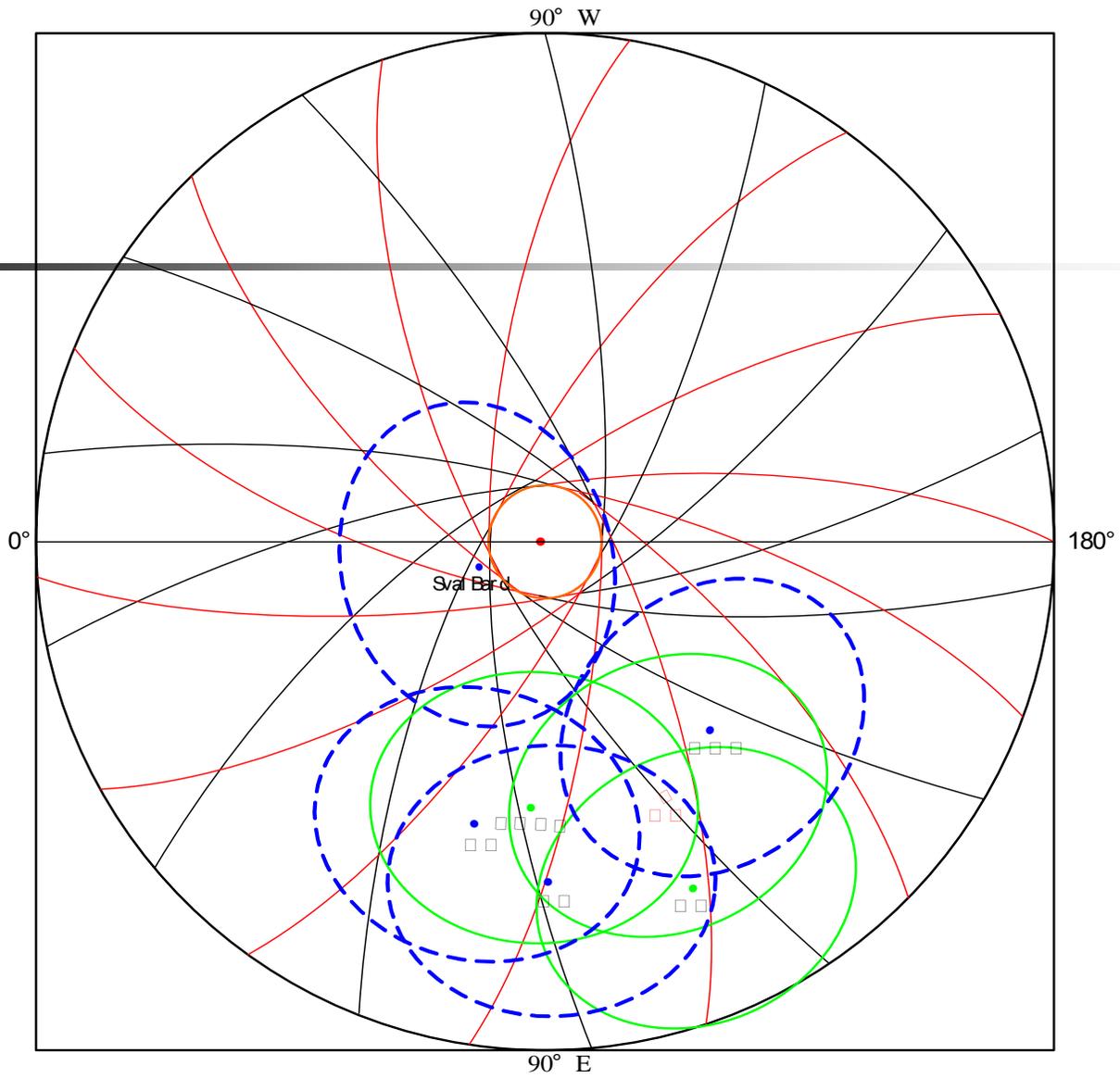
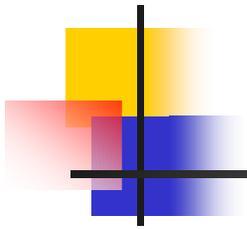


- Instruments on FY-3A/B will be improved and refined for FY-3 Op satellites
- Two polar satellites in operation (one in the AM and one in the PM orbit, payload will be different for AM/PM satellites, time slots could be coordinated through WMO)
- One low inclination orbit satellite is planning, mainly for precipitation measurement (mainly Radar, Passive Microwave measurement). Details is still in discussion



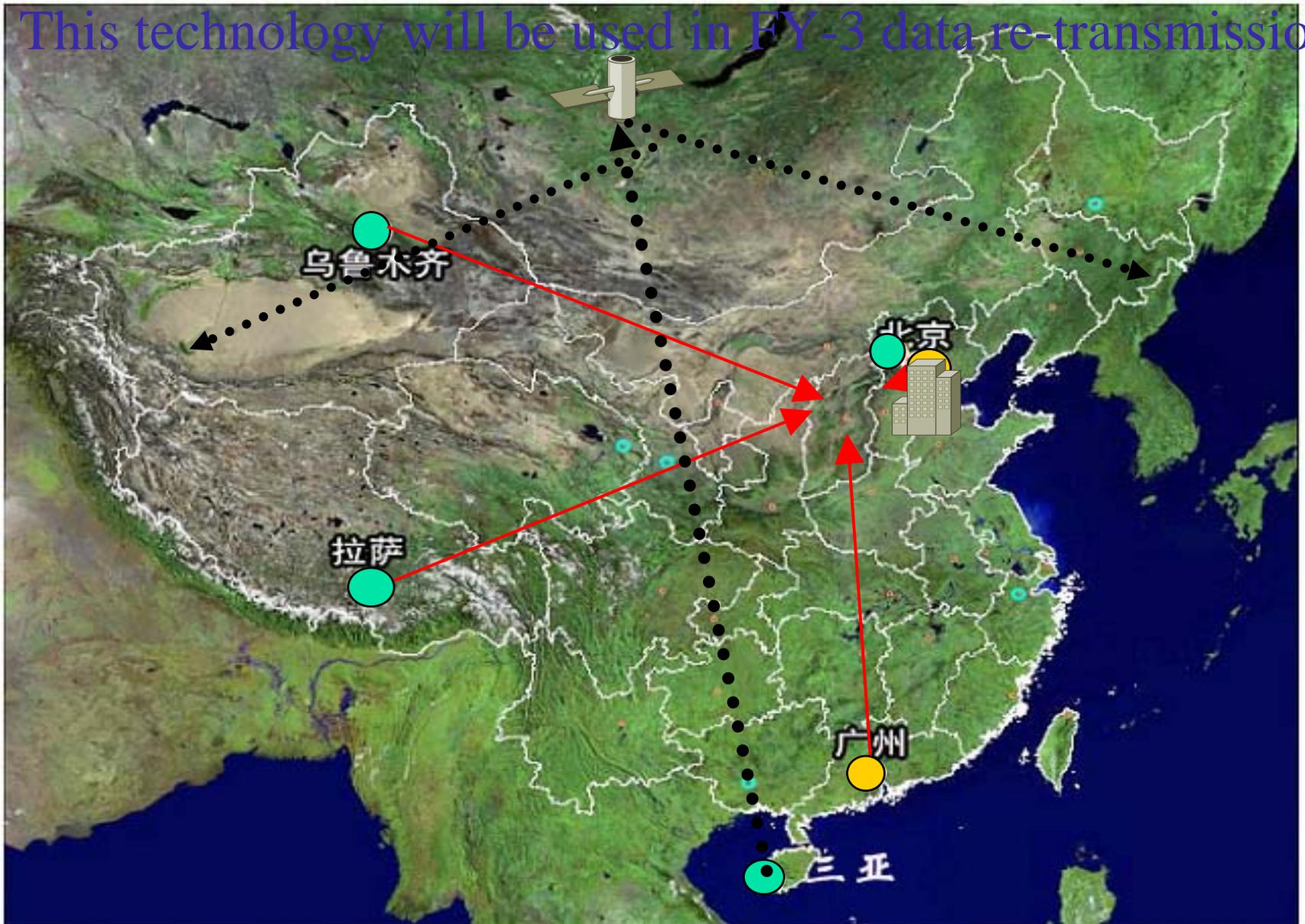
FY-3 Ground Segment

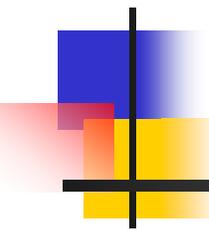
- 7 receiving stations, one of the stations will be in high latitude place (Svabald)
- Products from FY-3 will be broadcasted by DVBS



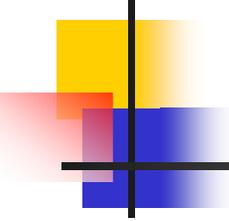
Data transmission to Beijing and then re-transmit (DVBS)

This technology will be used in FY-3 data re-transmission



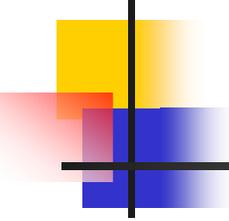


Future Geostationary Satellites



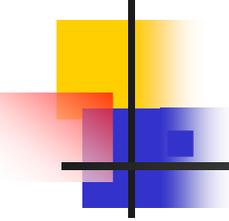
FY-2 D/E/F/G: launch schedule

- FY-2D will be launched in early 2007 with current plan
- By then FY-2C would be still health, then two GEO constellation will be formed:
 - Wider coverage (possible FY-2C in 123E, and FY-2D in 87.5E, also for contingency)
 - More frequent observations during the flooding season for overlap areas
 - New products (ex. Stereo cloud, new wind-height assignment, etc.)
 - FY-2E is plan to launch in early 2009 to replace FY-2C
 - FY-2F/G will replace FY-2D and FY-2E in 2011 and 2013, respectively



New Generation for Geo: FY-4

- Considerations on FY-4
 - Three-Axis Stabilization
 - More powerful imager and lightning mapper
 - Sounding capability (Spectrometer?)
 - More powerful Data Collection Platforms
 - Enhanced ground control capability
 - Enhanced application and services systems



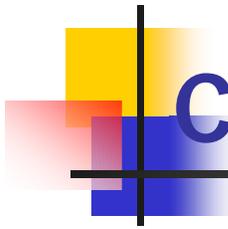
Constellation including two series:

refer to A series and B series

**A: VIS and IR satellites, early launch
around 2012**

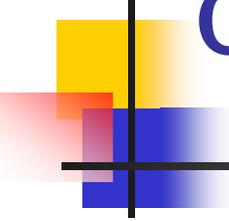
**B: Microwave satellites, early launch
around 2015**

- **Now FY-4 is at the Pre-Phase A stage, schedule to be developed during 2006-2012, and launch after 2012**



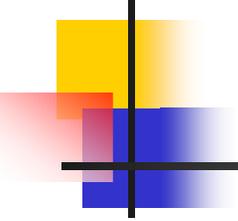
Consideration of “A” type payload

- **Powerful imager with more than 12 channels**
- **A hyper-spectral instrument is pursued on as the IR sounder with reasonable spatial resolution (China is very interested in IGEOLAB for GIFTS)**
- **Lightning mapper for locating the thunderstorm in flooding season**



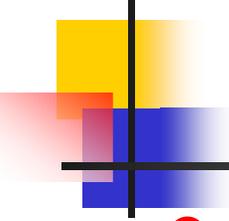
Consideration of “B” type payload

- **Microwave sounder working on higher frequencies for sounding the cloudy atmosphere(China is also interested in IGeoLab of Geo Microwave project)**
- **CCD camera with high spatial resolution for frequent high resolution imagery observation for the severe weather**
- **A Solar telescope and a SEM will be developed fro space weather service**



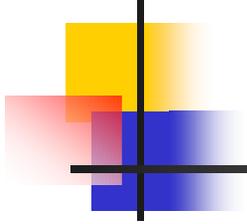
FY-4 ground segment

- **To have enhanced control capability**
- **Application will cover weather, climate and environment, as well as rapid response fields**



3. Conclusion

- To meet national requirements and modernizing the meteorological service of China and world meteorological community. China will continue her effort to develop two types of satellites (LEO and GEO).
- Chinese satellites, as a integrated part of the space component of WMO GOS, are not only benefit the nation of China, but also reflect the contribution to the international Earth Observation community.



The End

Thanks !