

# China's FengYun Meteorological Satellite Programs



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# Chinese Meteorological Satellite: FengYun Series

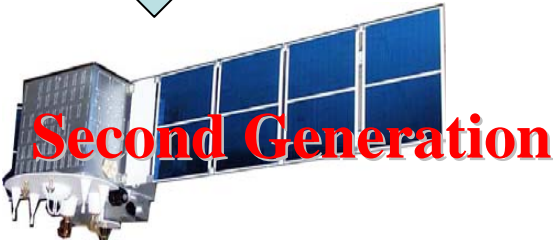
## Polar System

## Geostationary System

- FY
- |
- 1A
- 1B
- 1C
- 1D



- FY
- |
- 3A
- 3B
- 3C
- ...
- 3F



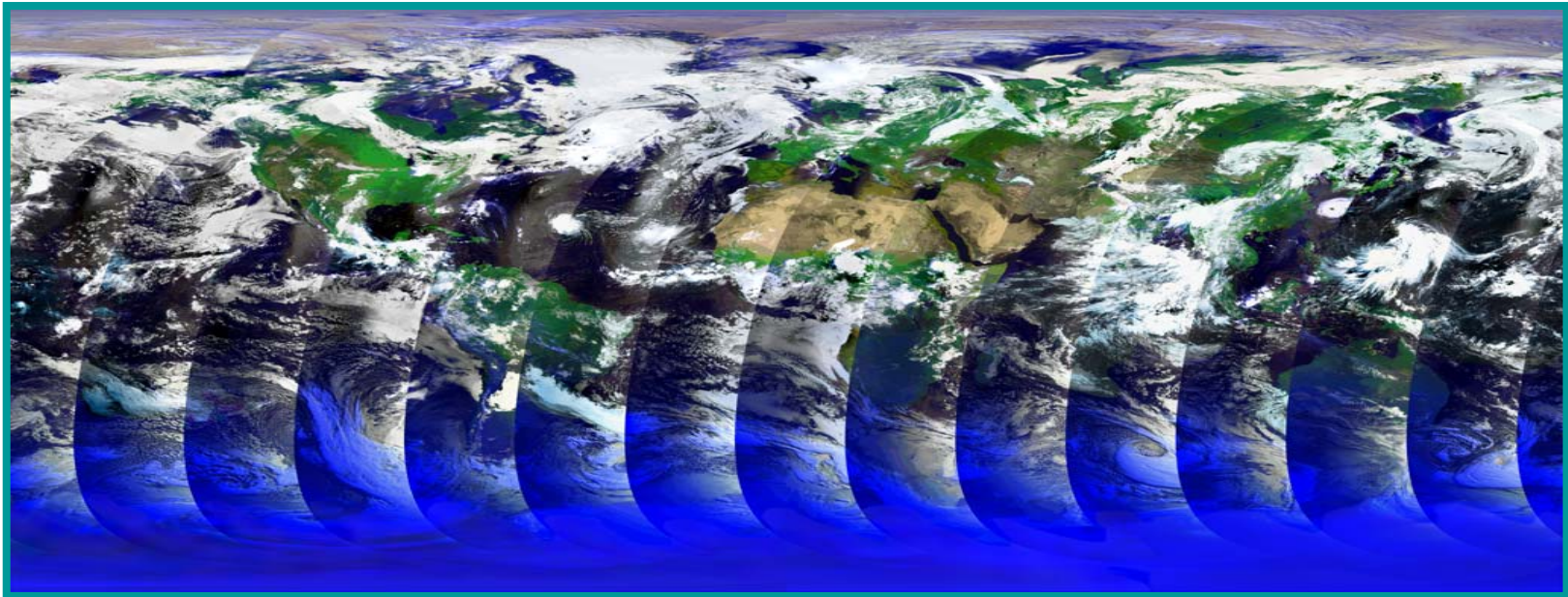
- FY
- |
- 2A
- 2B
- 2C
- 2D
- 2E



- FY
- |
- 4A
- 4B
- 4C
- ...
- 4F



# FengYun LEO. Satellites: FY-1



## Instruments:

- ✓ 10 chl. Visible and Infrared radiometer.
- ✓ Space Environment Monitor

## Transmission:

- ✓ HRPT: 1.3308Mbps (DB)
- ✓ GDPT: 1.3308Mbps

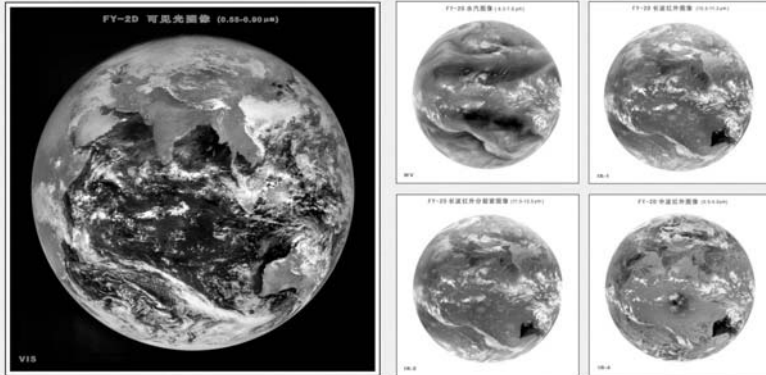
| No.   | Status        | Launch       | Druation |
|-------|---------------|--------------|----------|
| FY-1A | Exp. (dead)   | Sept.7, 1988 | 6 months |
| FY-1B | Exp. (dead)   | Sept.3, 1900 | 8 months |
| FY-1C | Op. (dead)    | May 10, 1999 | >7 years |
| FY-1D | Op. (working) | May 15, 2002 | >7 years |



# FengYun GEO. Satellites: FY-2

风云二号 D 星第一套图像  
THE FIRST IMAGES OF FY-2D SATELLITE

2007年1月12日 14:00 (北京时间)  
January 12, 2007 06:00(UTC)



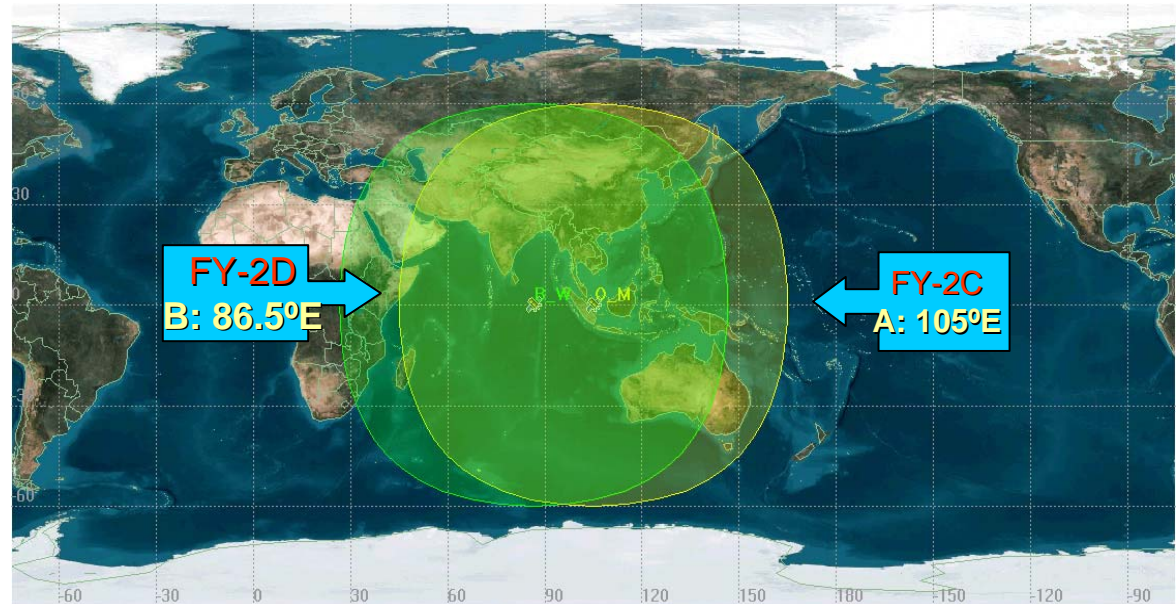
| No.   | Pos.  | Status        | Launch       |
|-------|-------|---------------|--------------|
| FY-2A | 105E  | Exp. (dead)   | Jun.10, 1997 |
| FY-2B | 105E  | Exp. (dead)   | Jun.20, 2000 |
| FY-2C | 105E  | Op. (working) | Oct.18, 2004 |
| FY-2D | 86.5E | Op. (working) | Dec.8, 2006  |
| FY-2E | 105E  | Op. (Stored)  | Dec.23,2008  |

Platform: Spin stabilization

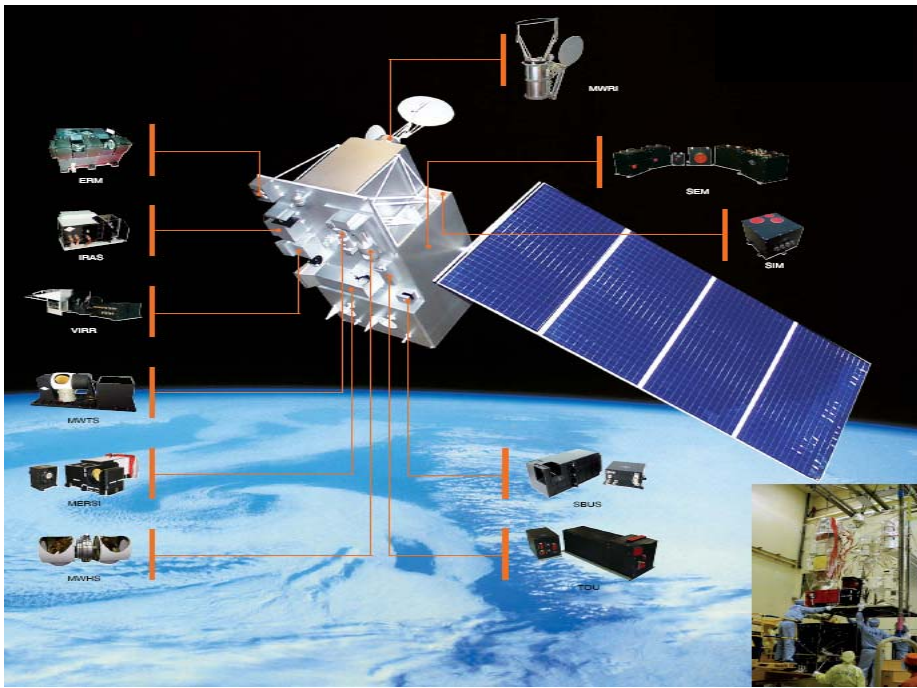
Payload: 5 chl. VISSR

Full Disc: every 30 min. at most

- ✓ FY-2C & FY-2D are working together to implement 15 min. interval obs.
- ✓ FY-2E is stored at 123.5E, will take over FY-2C this month!

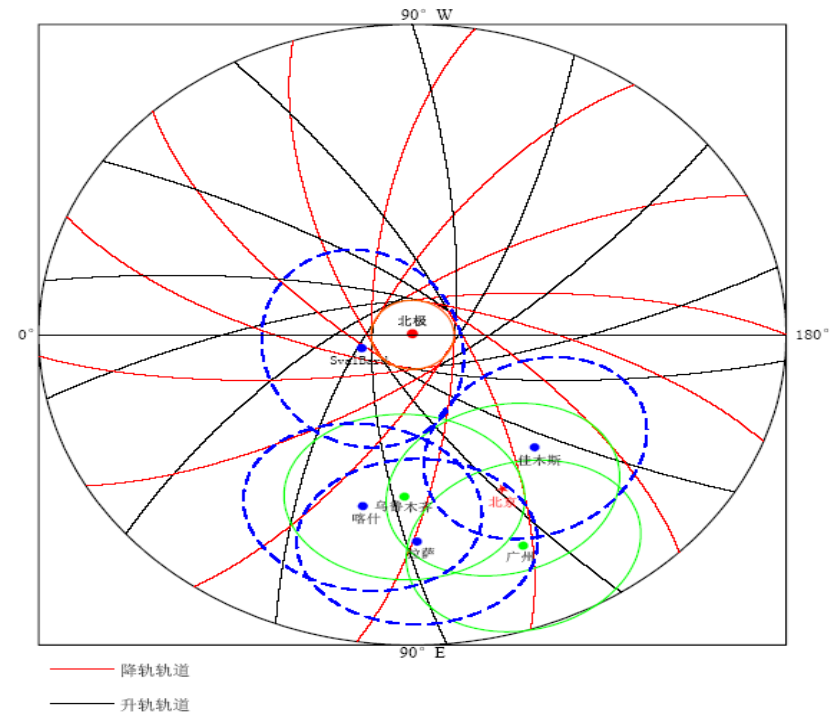


## 2<sup>nd</sup> Generation of LEO: FY-3



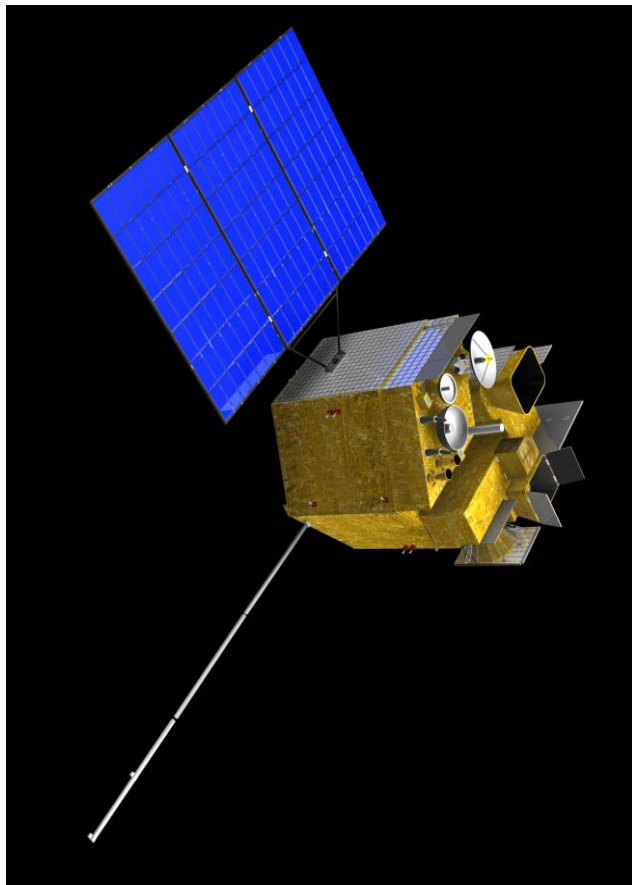
### 11 instruments onboard FY-3A, including:

- VIRR: Visible and Infra-Red Radiometer
- MERSI : Medium Resolution Spectral Imager
- IRAS : Infrared Atmospheric Sounder
- MWTS : MicroWave Temperature Sounder
- MWHS: MicroWave Humidity Sounder
- MWRI: MicroWave Radiation Imager
- SBUS: Solar Backscatter Ultraviolet Sounder
- TOU: Total Ozone mapping Unit
- SIM: Solar Irritation Monitor
- ERM: Earth Radiation Monitor
- SEM: Space Environment Monitor



| No.   | Launch       | Orbit | Status           |
|-------|--------------|-------|------------------|
| FY-3A | May 27, 2008 | M     | R&D              |
| FY-3B | 2010 (plan)  | A     | R&D              |
| FY-3C | 2012 (plan)  | M     | Op.              |
| FY-3D | 2014 (plan)  | A     | Op.              |
| FY-3E | 2016 (plan)  | M     | Op.              |
| FY-3F | 2018 (plan)  | A     | Op. <sup>5</sup> |

# Next Generation of GEO satellite: FY-4



Prototype structure of FY-4A

## 4 main instruments

Advanced Geo. Radiation Imager

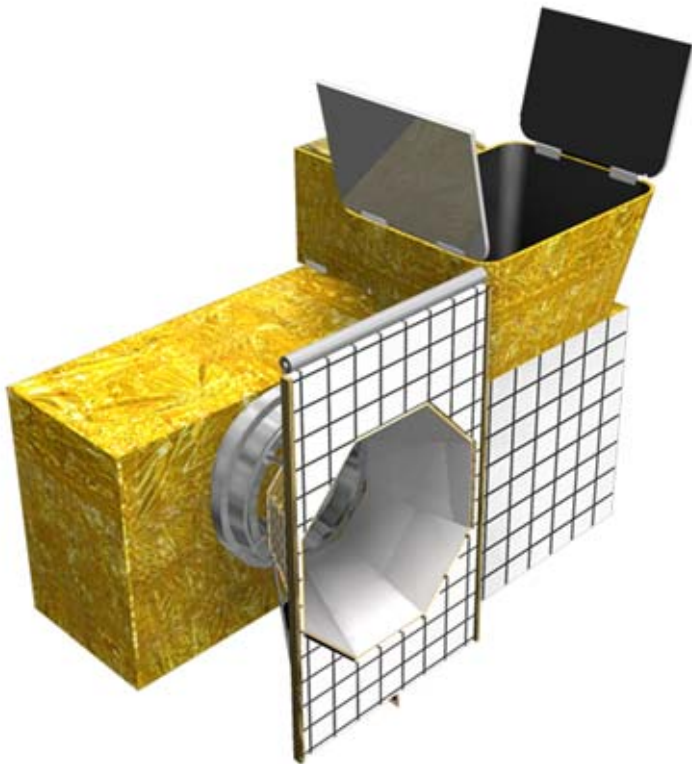
Geo. Interferometric Infrared Sounder

Lightning Mapping Imager

Solar X-EUV imaging telescope  
(not available on 1<sup>st</sup> satellite)

| No.   | Plan Launch | Design Life | Status |
|-------|-------------|-------------|--------|
| FY-4A | 2014        | 5 years     | R&D    |
| FY-4B | 2017        | 7 years     | Op.    |
| FY-4C | 2019        | 7 years     | Op.    |

# AGRI: Advanced Geo. Radiation Imager



1. Off-axis reflecting optics
2. Two independent scanning-mirrors for north-south and east-west directions respectively
3. Total 216 sensors for 14 bands from visible to long-wave infrared
4. Full-path on-orbit radiation calibration for all bands

**AGRI illustration**

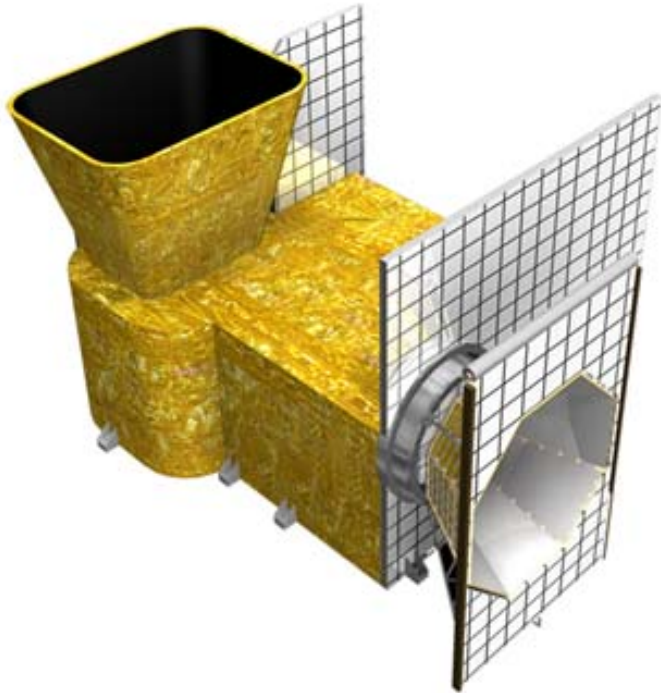
# AGRI Specifications

14 Channels within 0.55~13.8  $\mu\text{m}$  for first satellite FY-4A

| Channel                 | Band ( $\mu\text{m}$ ) | Spatial Resolution (Km) | Detection Sensitivity           |   | Main Application |
|-------------------------|------------------------|-------------------------|---------------------------------|---|------------------|
| Visible & Near-Infrared | 0.45 ~ 0.49            | 1                       | S/N $\geq$                      | 70( $\rho=100\%$ )                                | Aerosol          |
|                         | 0.55 ~ 0.75            | 0.5 ~ 1                 |                                 | 200( $\rho=100\%$ ),5<br>( $\rho=1\%$ )@0.5K<br>m | Fog, Cloud       |
|                         | 0.75 ~ 0.90            | 1                       |                                 |   | Vegetation       |
| Short-wave Infrared     | 1.36 ~ 1.39            | 2                       | S/N $\geq$                      | 200 ( $\rho=100\%$ )<br>5 ( $\rho=1\%$ )          | Cirrus           |
|                         | 1.58 ~ 1.64            | 2                       |                                 |   | Cloud, Snow      |
|                         | 2.1 ~ 2.35             | 2 ~ 4                   |                                 |   | Cirrus, Aerosol  |
| Mid-wave Infrared       | 3.5 ~ 4.0(high)        | 2                       | NE $\Delta$ T $\leq$ 0.7K(300K) |   | Fire             |
|                         | 3.5 ~ 4.0(low)         | 4                       | NE $\Delta$ T $\leq$ 0.2K(300K) |   | Land surface     |
| Water Vapor             | 5.8 ~ 6.7              | 4                       | NE $\Delta$ T $\leq$ 0.3K(260K) |   | WV               |
|                         | 6.9 ~ 7.3              | 4                       | NE $\Delta$ T $\leq$ 0.3K(260K) |   | WV               |
| Long-wave Infrared      | 8.0 ~ 9.0              | 4                       | NE $\Delta$ T=0.2K(300K)        |   | WV, Cloud        |
|                         | 10.3 ~ 11.3            | 4                       | NE $\Delta$ T=0.2K(300K)        |   | SST              |
|                         | 11.5 ~ 12.5            | 4                       | NE $\Delta$ T=0.2K(300K)        |   | SST              |
|                         | 13.2 ~ 13.8            | 4                       | NE $\Delta$ T=0.5K(300K)        |   | Cloud, WV        |



# **GIIRS: Geo. Interferometric Infra-Red Sounder**



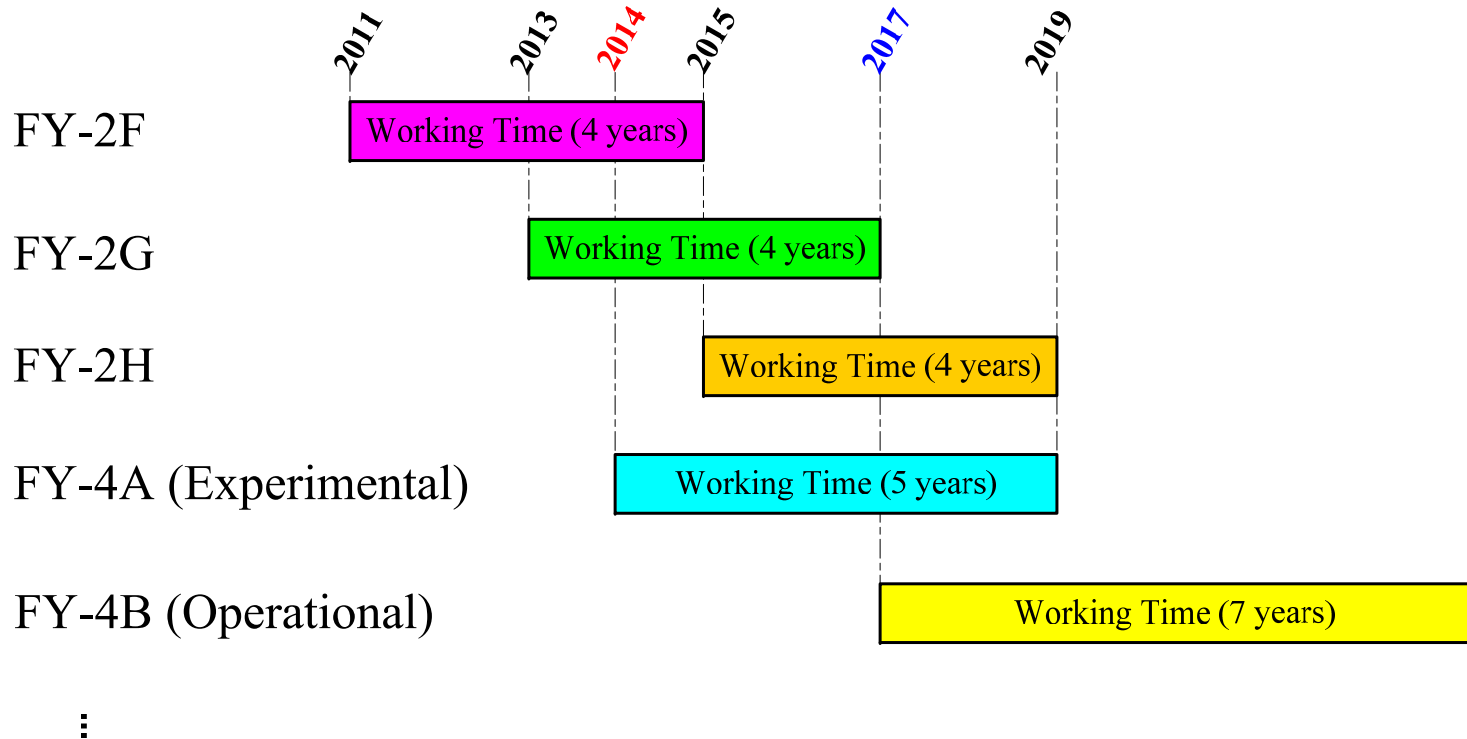
1. Off-axis reflecting optics
2. Two independent scanning-mirrors for north-south and east-west directions respectively
3. 16×16 focal plane arrays for mid-wave and long-wave infrared bands
4. Active and radiate coolers

**GIIRS configuration**

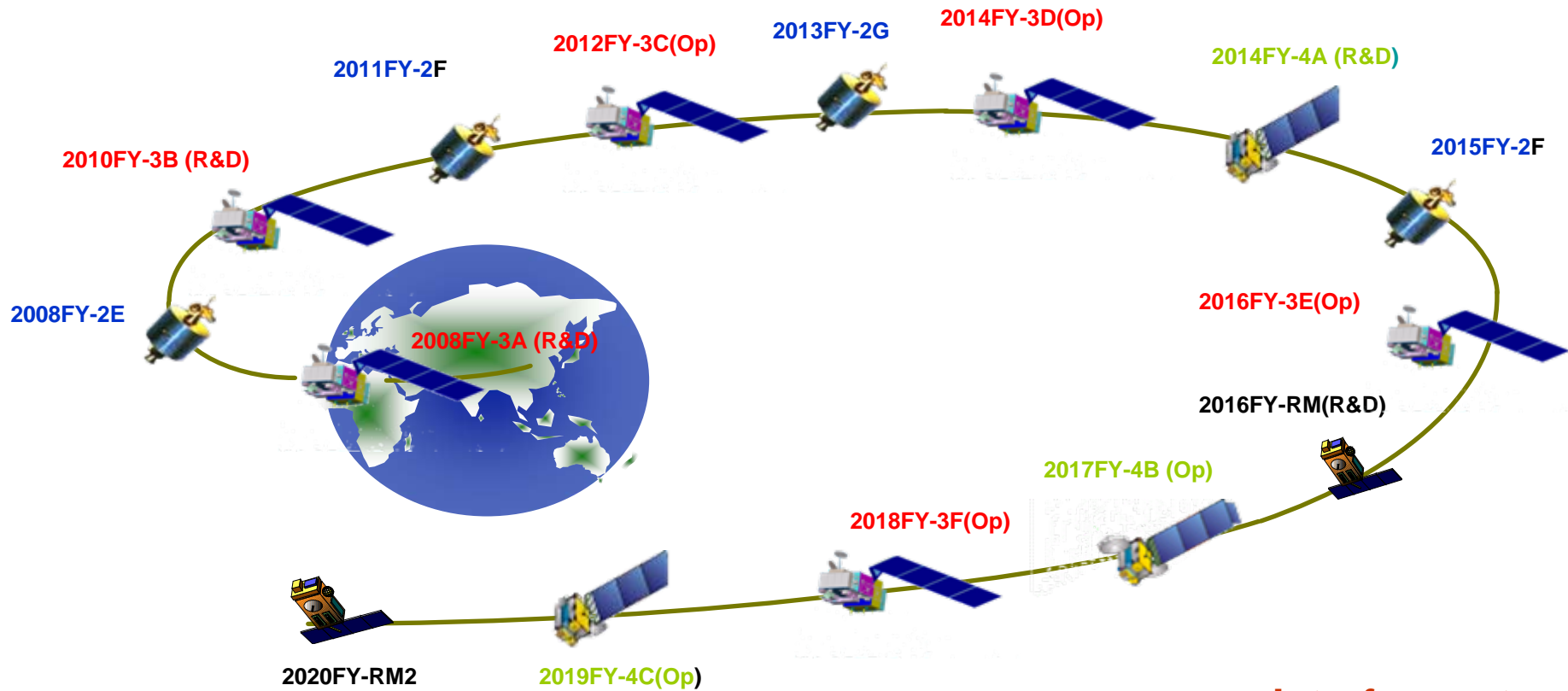
# GIIRS: Specifications

|  | R&D  |                          |                        | Operational  |                            |                        |
|--|--|--------------------------|------------------------|--|----------------------------|------------------------|
| Spectral Parameters (cm <sup>-1</sup> )              | Spectrum Range<br>LWIR: 700-1130<br>S/MIR:1650-2250                                  | Resolution<br>0.8<br>1.6 | Channels<br>538<br>375 | Spectrum Range<br>LWIR: 700-1130<br>S/MIR:1650-2250                                  | Resolution<br>0.625<br>1.2 | Channels<br>688<br>500 |
| Spatial Resolution                                   | At Nadir: 16Km IFOV: 448μrad   |                          |                        | At Nadir: 8Km IFOV: 224μrad  |                            |                        |
| Operational Mode                                     | China area 5000 × 5000 Km <sup>2</sup><br>Mesoscale area 1000 × 1000 Km <sup>2</sup> |                          |                        | China area 5000 × 5000 Km <sup>2</sup><br>Mesoscale area 1000 × 1000 Km <sup>2</sup> |                            |                        |
| Temporal Resolution                                  | China area 1 hr<br>Mesoscale area ½ hr   |                          |                        | China area about 1 hr<br>Mesoscale area about ½ hr                                   |                            |                        |
| Sensitivity (mW/m <sup>2</sup> sr cm <sup>-1</sup> ) | LWIR: 0.5 S/MIR: 0.1   |                          |                        | LWIR: 0.3 S/MIR: 0.06  |                            |                        |
| Calibration accuracy of radiation                    | 1.5k (3σ)  |                          |                        | 1.0k (3σ)  |                            |                        |
| Calibration accuracy of spectrum                     | 10 ppm (3σ)  |                          |                        | 5 ppm (3σ)   |                            |                        |
| Quantization Bits                                    | 13 bits  |                          |                        | 13 bits  |                            |                        |

# Transition from FY-2 to FY-4

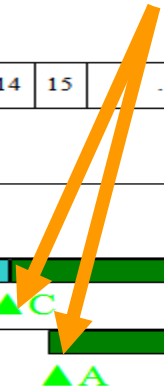


# Road Map of FENGYUN Meteorological Satellites Development by Year 2020



**Interferometer**

| Mission | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07    | 08    | 09 | 10    | 11 | 12 | 13    | 14 | 15 | ..... |       |       |
|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-------|-------|----|-------|----|----|-------|----|----|-------|-------|-------|
| FY1     | ■  |    |    | ■  |    |    |    |    |    |    |    |    |    |    |    |    | ■  |    |    |       | ..... |    |       |    |    |       |    |    |       |       |       |
|         | ▲A | ▲B |    |    |    |    |    |    |    |    |    |    | ▲C | ▲D |    |    |    |    |    | ..... |       |    |       |    |    |       |    |    |       |       |       |
| FY2     |    |    |    |    |    |    |    |    |    |    | ■  |    |    |    | ■  |    |    |    |    |       |       |    |       |    |    | ..... |    |    |       |       |       |
|         |    |    |    |    |    |    |    |    |    |    | ▲A | ▲B |    |    |    | ▲C | ▲D | ▲E |    |       |       |    | ..... |    |    |       |    |    |       |       |       |
| FY3     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | ■  |    |    |    |       |       |    |       |    |    | ■     |    |    |       | ..... |       |
|         |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | ▲A |    |    |    |       | ▲B    |    |       |    |    | ▲C    |    |    |       |       | ..... |
| FY4     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |       |       |    |       |    |    | ■     |    |    |       | ■     | ..... |
|         |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |       |       |    |       |    |    | ▲A    |    |    |       |       | ..... |







*Thank you*

International TOVS Study Conference, 17<sup>th</sup>, ITSC-17, Monterey, CA, 14-20 April 2010.  
Madison, WI, University of Wisconsin-Madison, Space Science and Engineering Center,  
Cooperative Institute for Meteorological Satellite Studies, 2011.