

## **DEVELOPMENT of FY-3A METEOROLOGICAL SATELLITE**

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### **Summary and purpose of paper**

FY-3s are the second generation of China's polar orbiting meteorological satellites. This satellite series will be operating during 2005 - 2020. This paper describes the mission and the status of development of FY-3A, the first satellite of the series.

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## DEVELOPMENT OF FY-3A METEOROLOGICAL SATELLITE

### 1. FY-3 Satellite Series

FY-3 is the second generation of Chinese polar orbiting meteorological satellite. It is a series including 7 satellites to be operated 2005-2020. The first two satellites FY-3A and FY-3B and the on-board instruments are being designed and manufactured.

### 2. Mission of FY-3 Series

The mission objectives of FY-3 include:

- To provide global 3-dimensional atmospheric thermal and moisture structures, cloud and precipitation parameters, in order to support global numerical weather prediction.
- To provide global imagery for monitoring large-scale meteorological and hydrological disasters and biosphere and environment anomaly.
- To derive geophysical parameters to support research activities in study global and regional climate change.

### 3. Payloads onboard FY-3A

The following primary instruments are considered as core meteorological payload:

#### 3.1 The Imaging Mission Payload:

##### 1) Visible and Infrared Radiometer (VIRR)

This is a copy of the Multi-channel Visible and Infrared Scanning Radiometer (MVISR with 10 channels) inherited from FY-1C/D satellites. For the sake of operational continuity and risk reduction, this instrument will basically remain the same as MVISR of FY-1 C and D. The major specifications of VIRR are shown in Table 1.

**Table 1. Major specifications of VIRR**

Ch	Band(•m)	NEDN (ρ/ k)	Dynamic Range (ρ OR k)
1	0.58-0.68	0.1%	0-100%
2	0.84-0.89	0.1%	0-100%
3	3.55-3.93	0.3k	180-350k
4	10.3-11.3	0.2k	180-330k
5	11.5-12.5	0.2k	180-330k
6	1.55-1.64	0.15%	0-90%
7	0.43-0.48	0.05%	0-50%
8	0.48-0.53	0.05%	0-50%
9	0.53-0.58	0.05%	0-50%
10	1.325-1.395	0.19%	0-90%

## 2) Moderate Resolution Visible and Infrared Imager (MODI)

With reference to MODIS on-board EOS satellite series, this instrument on the FY-3A will have 20 channels located mainly at VIS and near IR spectral range and be complementary to VIRR's IR channels. The major specifications of MODI are shown in Table 2.

Table 2 Major specifications of MODI

Ch	Central Wavelength (•m)	Band (•m)	Resolution (M)	NEDN (ρ/ k)	Dynamic Range (ρ OR k)
1	0.470	0.05	250	0.45	100%
2	0.550	0.05	250	0.4	100%
3	0.650	0.05	250	0.3	100%
4	0.865	0.05	250	0.3*	100%
5	11.25	2.5	250	0.4 K*	330k
6	0.412	0.02	1000	0.1	80%
7	0.443	0.02	1000	0.1	80%
8	0.490	0.02	1000	0.05	80%
9	0.520	0.02	1000	0.05	80%
10	0.565	0.02	1000	0.05	80%
11	0.650	0.02	1000	0.05	80%
12	0.685	0.02	1000	0.05	80%
13	0.765	0.02	1000	0.05	80%
14	0.865	0.02	1000	0.05	80%
15	0.905	0.02	1000	0.10	90%
16	0.940	0.02	1000	0.10	90%
17	0.980	0.02	1000	0.10	90%
18	1.030	0.02	1000	0.10	90%
19	1.640	0.05	1000	0.05	90%
20	2.130	0.05	1000	0.05	90%

## 3) Microwave Radiation Imager (MWRI)

This is a conical scanning microwave imager at 6 frequency points with 12 channels. This sensor measures thermal microwave radiation from land and ocean surfaces, as well as being sensitive to various forms of water and moisture in the atmosphere, clouds and surfaces. For microwave band, the wavelengths are much longer on the electromagnetic spectrum compared with visible and infrared and at some channels the wavelengths can be longer than one millimeter. At these channels the radiation can penetrate clouds, and provides forecasters with an all weather measurement capability. At higher frequency channels, the scattering signatures from the cloud and precipitation are also good indicators for detecting rainfall.

### 3.2 The Sounding Mission Payload

#### 1) Infrared Atmospheric Sounder (IRAS)

This is the primary sounder for FY-3A. The main characteristics are:

- Optical FOV 1.2 degrees, that makes the ground IFOV of 17 km in diameter.
- There are 26 channels in total. The first 20 channels are similar to HIRS/3 of NOAA. The rest six channels are aimed to measure aerosol, carbon dioxide content and cirrus, etc.

The major specifications of IRAS are shown in Table 3.

**Table 3. Major specifications of IRAS**

Channel	Central wavelength ( $\mu\text{m}$ )	Half-power Bandwidth ( $\text{cm}^{-1}$ )	Main absorber	Max. scene temperature (K)	Contribution peak(hpa)	NEDN (specified)	Main purpose
1	14.95	3	CO <sub>2</sub>	280	30	3.0	T(p)
2	14.71	10	CO <sub>2</sub>	265	60	0.67	T(p)
3	14.49	12	CO <sub>2</sub>	240	100	0.50	T(p)
4	14.22	16	CO <sub>2</sub>	250	400	0.31	T(p)
5	13.97	16	CO <sub>2</sub>	265	600	0.21	T(p)
6	13.64	16	CO <sub>2</sub> /H <sub>2</sub> O	280	800	0.24	T(p)
7	13.35	16	CO <sub>2</sub> /H <sub>2</sub> O	290	900	0.20	T(p)
8	11.11	35	Window	330	Surface	0.10	Surface
9	9.71	25	O <sub>3</sub>	270	25	0.15	Total ozone
10	8.16	25	H <sub>2</sub> O	290	900	0.15	Water vapor
11	7.33	40	H <sub>2</sub> O	275	700	0.20	Water vapor
12	6.52	80	H <sub>2</sub> O	265	500	0.20	Water vapor
13	4.57	23	N <sub>2</sub> O	300	1000	0.006	T(p)
14	4.52	23	N <sub>2</sub> O	290	950	0.003	T(p)
15	4.47	23	CO <sub>2</sub> /N <sub>2</sub> O	280	700	0.004	T(p)
16	4.40	23	CO <sub>2</sub> /N <sub>2</sub> O	265	400	0.004	T(p)
17	4.20	23	N <sub>2</sub> O	280	15	0.002	T(p)
18	4.00	35	Window	340	Surface	0.002	Surface T
19	3.76	100	Window	340	Surface	0.001	Surface T
20	0.69	1000	Window	100%	Surface	0.10%A	Cloud Detect
21	14.8	3	CO <sub>2</sub>	280	5	3.00	High Level T
22	0.659	TBD	Window	VIS	Surface	0.003	CO <sub>2</sub> /
23	0.885	TBD	Window	NIR	Surface	TBD	Aerosol
24	0.94	TBD	H <sub>2</sub> O	NIR	Surface	TBD	Cirrus
25	1.24	TBD	Window	NIR	Surface	TBD	Cirrus
26	1.64	TBD	Window	NIR	Surface	TBD	Cirrus

#### 2) Microwave Atmospheric Sounder (MWAS)

This is a 4-channel passive scanning microwave sounder for improving the temperature sounding in cloud-covered area. There are four channels around 50 GHz. Table 4 shows the major specifications of MWAS.

**Table 4. Major specifications of MWAS**

Ch.	Frequency (GHz)	Absorber	Band width (MHz)	NEDT (K)	Calibration Accuracy (K)	Resolution (Nadir, km)
1	50.30	Window	180	0.5	1.2	70
2	53.596±0.115	O <sub>2</sub>	2×170	0.4	1.2	70
3	54.94	O <sub>2</sub>	400	0.4	1.2	70
4	57.290344	O <sub>2</sub>	330	0.4	1.2	70

### 3) Microwave Humidity Sounder (MWHs)

This is a 5-channel passive scanning microwave radiometer for improving humidity sounding in atmosphere. There are 3 channels around 183 GHz. There are 2 channels in 150 GHz. Table 5 shows the major specifications of MWHs.

**Table 5 Major specifications of MWHs**

Ch.	Frequency (GHz)	Absorber	Band width (MHz)	NEDT (K)	Calibration Accuracy (K)	Resolution (Nadir, km)
1	150.(V)	Window	2000	0.9	1.5	15
2	150(H)	Window	2000	0.9	1.5	15
3	183.31±1	H <sub>2</sub> O	500	1.1	1.5	15
4	183.31±3	H <sub>2</sub> O	1000	0.9	1.5	15
5	183.31±7	H <sub>2</sub> O	2000	0.9	1.5	15

### 4) Total Ozone Mapper and Ozone Profiler (TOM/OP)

TOM is a 6-channel spectrometer whose wavelength ranges from 308nm to 360nm, resolution 50km at the nadir. The profiler is a 12-channel spectrograph with the wavelength locating from 252nm to 380nm. The spatial resolution of OP is around 200 km at Nadir.

## 4. The FY-3A Development

Design schemes for all subsystems of FY-3A, including fabric subsystem, attitude control subsystem, TT&C subsystem, OBDH, energy subsystem, thermal control subsystem, data transmission subsystem and payload have passed examination and evaluation phase. Prototypes in phase B are being designed and manufactured to prove the design schemes, and to prepare for the

electrical interface matching experiments among all subsystems at the same time.

The dynamic load satellite of FY-3A was manufactured, relevant experiments was completed at the end of 2001.

The electrical interface experiments among all subsystems of FY-3A were achieved in 2001.