CGMS

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Prepared by CMA
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Discussed in Plenary

Status of CMA Operational Geostationary Satellite System

Summary of the Working Paper.

CMA-WP-04 reports the status of current FY-2 geostationary programme. The programme has produced 5 satellites FY-2A/B/C/D/E capable of S-VISSR imagery observation. Currently ***FY-2D*** and ***FY-2E*** are operationally active. ***FY-2D*** was launched on November 15, 2006. It is positioned at 86.5E. ***FY-2E*** was launched on 23 December 2008 and it is positioned at 105E.

FY-2D and FY-2E alternatively observe and transmit S-VISSR image so that users can get an image every 15 minutes during rainy season from June-September, and every 30 minutes from October-May using two medium scale data utilization stations.

FY-2C has been moved to 123.5E since November 2009. In Aug 2011, It was activated again to transmit limited VISSR scanning images once every 10 minutes to Shen Zhen, the host city of world university games.

FY-2 Programme shall continue. Plan for FY-2F/G/H has been approved. The capability of FY-2F/G/H is identical with FY-2C/D/E. Launch of FY-2F is planned for 2012. The designed lifetime of each individual satellite of FY-2F/G/H is 4 years.

Status of FY-2 Geostationary Satellite Programme System

(as of 23 Sept. 2011)

I Introduction

The Chinese geostationary meteorological satellites FY-2 are spin stabilized spacecrafts. The current primary satellite FY-2E is stationed at 105E. The FY-2D, with identical capability of FY-2E, is stationed at 86.5E. The two satellites back up each other and alternatively make observations to transmit full disc imagery every 30 minutes (one image every 15 minutes, full or half hemisphere, during rainy season in June-September).

The primary instrument payload for the current series of FY-2 spacecraft is VISSR, a multi-channel instrument designed to sense radiant and solar reflected energy. It provides data for upper level wind estimation.

The FY-2 spacecraft also carries Space Environmental Monitor (SEM) to detect the space environment in proximity of the satellite, the solar activities, and relevant space phenomenon.

2 Chronology

Table 1 records the chronology of the FY-2 programme.

Table 1 - Chronology of the FY-2 GEO Programme *(in bold the satellites are operational as of Sept. 2011)*

Satellite	**Launch**	**End of service**	**Position**	**Status** (Sept 2011)	**Instruments**
FY-2A	10 Jun 1997	08 April 1998		Deorbited	S-VISSR, DCS, SEM
FY-2B	25 Jun 2000	Sept. 2004		Deorbited	S-VISSR, DCS, SEM
FY-2C	19 Oct 2004	22 Oct. 2009	123.5°E	Standby	S-VISSR (improved), DCS, SEM
FY-2D	**15 Nov.2006**	**expected 2011**	**86.5°E**	**Operational**	**S-VISSR (improved), DCS, SEM**
FY-2E	**23 Dec. 2008**	**expected 2014**	**105°E**	**Operational**	**S-VISSR (improved), DCS, SEM**
FY-2F	2012	expected 2015		To be launched	S-VISSR (improved), DCS, SEM
FY-2G	2013	expected 2017		Approved	S-VISSR (improved), DCS, SEM
FY-2H	2015	Expected 2019		Approved	S-VISSR (improved), DCS, SEM

FY-2E

FY-2E was launched on 23 December 2009, currently active as the primary operational satellite at the 105E, as of 23 September 2011.

FY-2D

FY-2D was launched on 15 November 2006. It had been positioned at 86.5E as the orbital-storage till June 2007 when the observation was switched on; together with FY-2E at 105E, formed a dual satellite constellation. The two satellites alternatively observe, enabling the ground stations to receive images once every 15 minutes during rainy season from June-September, and every 30 minutes from October-May.

FY-2C

FY-2C was launched on 19 October 2004 and had been stationed at 105E as the CMA primary operational GEO satellite before it was replaced by FY-2E in Oct. 2009 and moved to 123.5E. In

AUG 2011, FY-2C was activated again to make limited scanning and transmit the VISSR image every 10 minutes in special weather service for Shenzhen, the host city of the World University Games in August of 2011.

FY-2B

FY-2B was launched on 25 June 2000 and stationed at 105E. It started S-VISSR transmission and WEFAX on 1 January 2001. FY-2B has similar instrument of FY-2A.

On 28 February 2001, the transmission disrupted due to transponder failure. Later in June 2001 the transponder was back by carefully adjusting the satellite temperature. However, the EIRP (Effective Isotropic Radiated Power) was 8dBW below the normal level.

The temperature controlling imposed extra pressure upon power supply. During the eclipse period of the satellite when power was less supplied, S-VISSR transmission had to be switched off.

After 8 June 2003, the VISSR was made to scan only the northern hemisphere till it was demissioned and moved to 123.5E in September 2004. On 31 August 2006, FY-2B was de-orbited.

FY-2A

FY-2A was launched on 10 June 1997. It was stationed at the 105°E. The satellite was demissioned due to failure of the de-spun system and moved to 86.5°E in July 2000. It was de-orbited in 2006.

3 FY-2 Payloads

S-VISSR (Stretched Visible and Infrared Spin Scan Radiometer) – The version for FY-2A/B had three VIS/IR channels (0.5-1.05 m, 6.3-7.6 m and 10.5-12.5 m) the improved version for FY-2 C/D/E/F splits the IR channel in two and adds a 3.5-4.0 m channel (see table. 2) The resolution also is slightly improved: from 5.76 km (IR) and 1.44 km (VIS), to 5.0 km (IR) and 1.25 km (VIS). The image cycle is 30 min.

Data Collection Service (DCS) - Main features:

- uplink: two bands, frequencies 402.0-402.1 MHz for international DCPs (33 channels of bandwidth 3 kHz), 401.1-401.4 MHz for regional DCPs (100 channels of bandwidth 3 kHz); data rate 100bps, polarisation right-hand circular.

- ***SEM (Space Environment Monitor)*** – A space particle monitor and an x-ray monitor are mounted on FY-2 to detect the space environment in proximity of the satellite, the solar activities and relevant space phenomenon. The SEM measurement is transmitted via telemetry to the ground system.

Table 2. *The spectral channels of VISSR*

Channel	Wavelength(μm)
IR1	10.3～11.3
IR2	11.5～12.5
IR3	6.3～7.6
IR4	3.5～4.0
VIS	0.55～0.99

Table 3. *The characteristics of VIS channels of VISSR*

Channel	VIS
Wavelength (μm)	0.55～0.99
IFOV(μr)	35
Space resolution (km)	1.25
Dynamic range	0～98%
S/N	1.5 @ 0.5% albedo 50 @ 95%
Number of detectors	4 (primary) + 4 (backup)
Quantization level	64
Calibration	Solar calibration

Table 4. *The characteristics of IR channels of VISSR*

Channel	IR1	IR2	IR3	IR4
Wavelength(μm)	10.3～11.3	11.5～12.5	6.3～7.6	3.5～4.0
IFOV (μr)	140	140	140	140
Space resolution(km)	5	5	5	5
Dynamic range	180～330K		190～300K	180～340K
Temperature resolution	0.4～0.2K	0.4～0.2k	0.5～0.3K	0.6～0.5K
Number of detectors	1(primary)+1 (backup)	1(primary)+1 (backup)	1(primary)+1 (backup)	1(primary)+1 (backup)
Quantization level	1024	1024	1024	256
Calibration	Blackbody calibration			

4 Data transmission from FY-2

FY-2 data are transmitted in real time to be:

Command and Data Acquisition Station (CDAS) Main transmission characteristics: frequency 1681.6 MHz, bandwidth 14 MHz, linear polarisation, data rate 14 Mbps.

S-VISSR Data Transmission, compatible with MDUS acquisition stations. Main features:

- frequency: 1687.5 MHz; bandwidth: 2.0 MHz; polarisation: linear
- antenna diameter ~ 3 m, G/T ~ 12 dB/K, data rate 660 kbps.

WEFAX from FY-2 A/B, ***LRIT (Low Rate Information Transmission)*** from FY-2 C/D, similar to MSG, GOES, MTSAT and GOMS-N2. Main features of LRIT:

- frequency: 1691.0 MHz; bandwidth: 260 kHz; polarisation: linear
- antenna diameter ~ 1 m, G/T ~ 3 dB/K, data rate 150 kbps.

5 Future FY-2 Geostationary Meteorological Satellite

FY-2F/G/H plan has been approved. Capability of FY-2F/G/H is identical with FY-2C/D/E. Launch of FY-2F is planned for 2012. The designed lifetime of FY-2F/G/H is 4 years. Improvement can be expected especially of the observational instrument VISSR onboard.

The VISSR visible channel is changed from 0.55～0.9um to 0.55～0.75um, the spectral response is shown in Fig 1. Limits are set for the spectral response of infrared bands which is shown in Fig 2.

The Space Environment Monitors onboard FY-2F/G/H is improved significantly. In addition to the increased number of channels, better performance is also expected.

Solar soft X-ray detector (2 channels): SX1: 1.5～12.5 keV, SX2: 3.1～24.8 keV

Energetic electron detector (11 channels): E1: 0.2～0.3 MeV, E2: 0.3～0.4 MeV, E3: 0.4～0.5 MeV, E4: 0.5～0.6 MeV, E5: 0.6～0.8 MeV, E6: 0.8～1.0 MeV,E7: 1.0～1.5 MeV, E8: 1.5～2.0 MeV, E9: ＞2.0 MeV, E10: ＞3.0 MeV, E11: ＞4.0 MeV

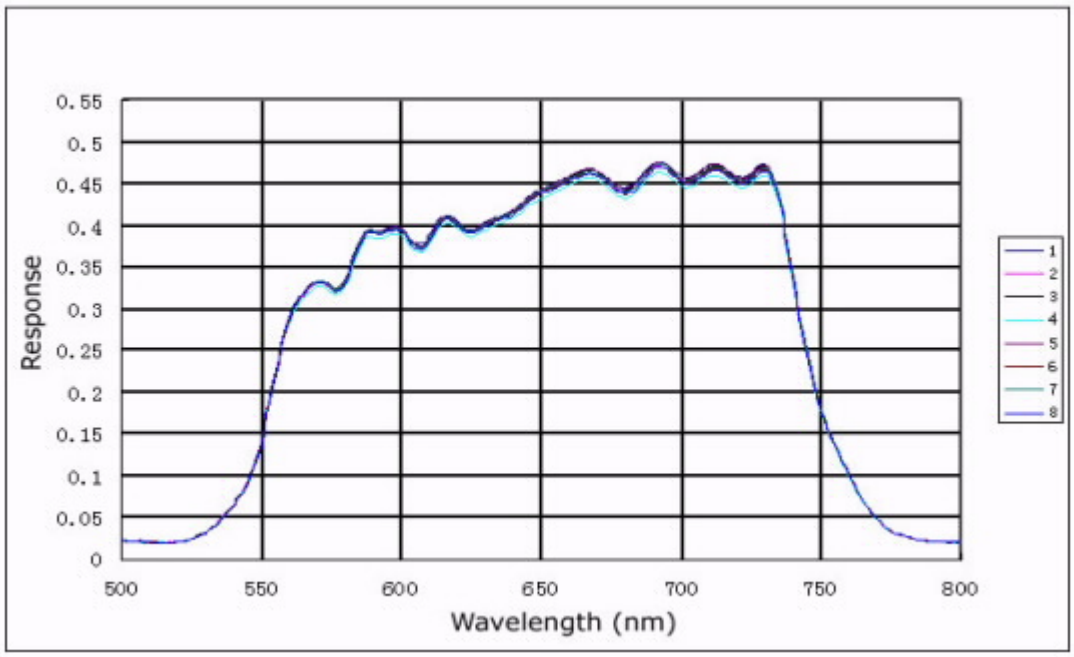

Fig. 1 Spectral response of VISSR visible band of FY-2F/G/H

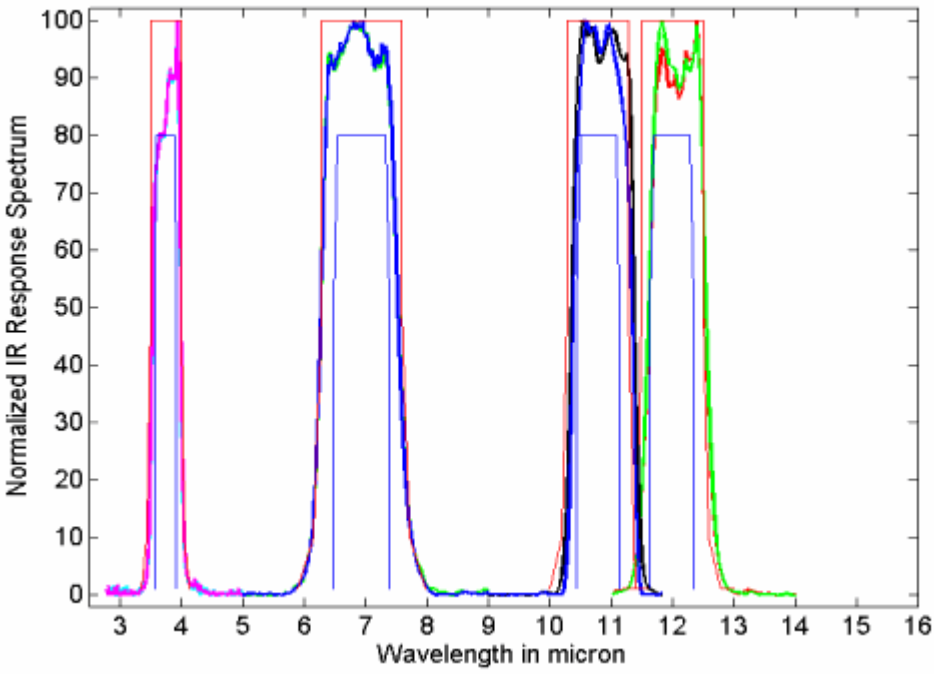

Fig. 2 Spectral response and limits of VISSR infrared bands on FY-2F/G/H

Energetic proton and heavy ion detector:

- **Proton (6 channels):** P1: 4～9 MeV, P2: 9～15 MeV, P3: 15～40 MeV,P4: 40～80 MeV P5: 80～165 MeV,P6: ＞165 MeV

- **He (3 channels):** HE1: 4～10 MeV/n, HE2: 10～20 MeV/n, HE3: ＞20 MeV/n