CGMS

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Status of CMA Polar-orbiting Meteorological Satellite System

Summary of the Working Paper.

The CMA reported on the status of Chinese polar orbiting meteorological satellite program. The program produced 4 satellites, namely FY-1A/B/C/D, all sun-synchronous, 3-axis stabilized; carrying the Multi-channel Visible and Infrared Scanning Radiometer (VIRR) for the earth environment monitoring at sub-point the resolution is 1.1km; and the Space Environment Monitor (SEM) for in-situ observation of charged particles in solar wind. Direct Readout Service is available through HRPT transmission. After having been flying in orbit for 9 years, the FY-1D is entering the end of its life. In May 2011, the operation was disrupted due to power supply that has become too weak to keep the satellite's stable attitude. If this situation maintains without improvement, official declaration of the end of FY-1D mission is possible in September, and it marks the finish of FY-1 Program.

The CMA FY-3 program has been implemented to substitute the FY-1. According to the program, 7 satellites shall be launched to cover duration from 2008-2021. The first satellite, FY-3A, was launched on 27 May 2008. It's 3-axis stabilized, sun-synchronous, LST 10:15am, the onboard instruments include the multi-channel Visible and Infrared Scanning Radiometer that flies on FY-1 series satellites, and the Medium Resolution Spectral Imager (**MERIS**), the Microwave Radiation Imager(**MWRI)**, and the IR and MW sounders, the Total Ozone Unit and Solar Backscatter Ultraviolet Sounder(**TOU/SBUS**), as well as an Earth Radiation Budget instrument. FY-3 transmits data in three modes: L-band AHRPT, X-band MPT, and DPT. Direct Readout Service of AHRPT is globally provided.

The FY-3B satellite, which is identical with FY-1A, was lunched in November 2010. The satellite is designed for lifetime of 3 years. The LST is 13:38pm as of AUG 26, 2011.

Status of CMA Polar Orbiting Meteorological Satellites

(As of 18 AUG 2011)

1. Report on status of FY-1 Satellite Program

1.1 Introduction

The FY-1 polar-orbiting meteorological satellite program started in 1988. The Program produced four satellites, namely FY-1A/B/C/D. The FY-1 satellites are 3-axis stabilized flying in circular orbits inclined at approximately 98 degrees. The instruments included the Multi-channel Visible and Infrared Scanning Radiometer (**VIRR**) with sub-point resolution 1.1km good for the earth environment monitoring, and the Space Environment Monitor (**SEM**) for in situ observation of charged particles in solar wind. Direct Readout Service was available with HRPT transmission.

Table .1 – Chronology of the FY-1 programme

Satellite	Launch	End of service	Height	LST	Status	Instruments
FY-1A	7 Sep 1988	16 Oct 1988	900 km	11.30	Inactive	VIRR, SEM
FY-1B	3 Sep 1990	5 Aug 1991	900 km	16.00	Inactive	VIRR, SEM
FY-1C	10 May 1999	26 April 2004	862 km	6.45	Inactive	VIRR, SEM
FY-1D	15 May 2002	6 May 2011	866 km	4.18	Opt. distrupted	VIRR, SEM

FY-1A was launched on 7 September 1988. It is the first meteorological satellite ever made by China due for the test of FY-1 program. The VIRR instrument onboard has five observational channels(0.58-0.68μm, 0.725-1.1μm,0.48-0.53μm,0.53-0.58μm,10.5-12.5μm). Satellite failure was announced not long after the launch when the satellite attitude became uncontrollable.

FY-1B was launched on 2 September 1990. It is a copy of the FY-1A. A series tests was made with FY-1B including the tests to improve the FY-1 ground component. The satellite is abandoned on August 1991 due to attitude failure.

FY-1C was launched on 10 May 1999. FY-1C has some improvements from its predecessor: the size of solar panel is enlarged; the VIRR has ten observational channels instead of five. Most importantly, the attitude stability is much improved. Data acquisition and archive at CMA/NSMC for the FY-1C ceased after 26 April 2004 due to obvious degradation of measurement, the satellite was de-missioned later after that.

FY-1D, whose function is identical with the FY-1C, was launched on 15 May 2002. The last satellite of FY-1 Program, FY-1D had been working for 9 years till 6 May 2011, when an operational disruption occurred due to power supply that has become too weak to maintain the stable attitude of satellite. The rescuing efforts helped little to improve the satellite with power

problem. If the situation continues in September, official declaration of FY-1D mission end is possible.

1.2 FY-1 Satellite Data Transmission

High Resolution Picture Transmission(HRPT): direct read-out for the whole information at full resolution in digital form at S-band frequencies. Main features:

- frequencies: 1700.4MHz; bandwidth: 5MHz; polarization: right-hand circular
- antenna diameter~ 2m, G/T~ 6.0dB/K, data rate ~ 1.33 Kbps

Delayed Picture Transmission(DPT): MVISR imagery is stored on board and transmitted to ground station in S-band. Main features:

- frequency 1708.5MHz; bandwidth: 3 MHz; data rate~ 1.33Mbps.

- DPT is capable of two forms of data format:
  - ·GDPT format: global data of 4 channels (0.58-0.68 m, 0.84-89 m,10.3-11.3 m,11.5-12.5 m) with resolution reduced to 3.3 Km;
  - ·LDPT format: limited-area data of 10 channels with 1.1Km resolution.

2. Report on Status of FY-3 Satellite Program

2.1 Introduction

The ***FY-3*** polar-orbiting series is developed to replace the FY-1 series. The FY-3 series include 7 flight models and is scheduled to cover the duration from 2008 to 2021. All satellites are 3-axis stabilised, in sun-synchronous orbit. In addition to the multi-channel Visible and Infrared Scanning Radiometer (VIRR) identical to that flying on FY-1 satellite, the FY-3A/B carries the Medium Resolution Spectral Imager (MERSI), the sounding instruments, Total Ozone Unit, and Microwave Radiation Imager. The following table records the chronology of the FY-3 programme.

2.2 Chronology of the FY-3 Programme

Table.2 Chronology of the FY-3 programme (as of 26 AUG. 2011)

Satellite	Launch	End of service	Height	LST	Status (AUG. 2011)	Instruments
FY-3A	27 May 2008	expected 2011	836 km	10.15	Trial operation	VIRR, MERSI-1, MWRI, IRAS, MWTS-1, MWHS-1, TOU/SBUS, ERM-1 ,SIM-1, SEM,
FY-3B	05 Nov 2010	expected 2013	836 km	13.38	Trial operation	VIRR, MERSI-1, MWRI, IRAS, MWTS-1, MWHS-1, TOU/SBUS, ERM-1 ,SIM-1, SEM,
FY-3C	2013	expected 2016	836 km	10.00	Planned	VIRR, MERSI-2, IRAS, MWTS-2, MWHS-2, MWRI,TOU/SBUS, ERM-1,SIM-2, SES
FY-3D	2015	expected 2018	836 km	14.00	Planned	MERSI-2, ASI, MWTS-2, MWHS-2, MWRI, (GAMI), GNOS ,SES
FY-3E	2017	expected 2020	836 km	10.00	Planned	MERSI-2, ASI, MWTS-2, MWHS-2, WindRAD,(OMS), ERM-2,SIM-2,GNOS,SES
FY-3F	2019	expected 2022	836 km	TBD	Planned	MERSI-2, ASI, MWTS-2, MWHS-2, MWRI, (GAMI),GNOS, SES
FY-3G	2021	expected 2024	836 km	TBD	Planned	MERSI-2, ASI, MWTS-2, MWHS-2, WindRAD,(OMS), ERM-2,SIM-2,GNOS,SES

2.3 Payload of FY-3A/B

VIRR (Visible and Infra Red Radiometer), flying on FY-3A/B, 10-channel VIS/IR radiometer for multi-purpose imagery, resolution 1.1 km, swath 2800 km.

MERSI (Medium Resolution Spectral Imager), flying on FY-3A/B, 20-channel radiometer (19 in VIS/NIR/SWIR + one TIR at 10.0-12.5 m) for ocean colour and vegetation indexes;

resolution 250m for 4 VIS/NIR and the TIR channel, 1 km for all other channels; swath 2800 km.

MWRI (Micro-Wave Radiation Imager), flying on FY-3A/B, 6-frequencies / 12 channels (all frequencies in double polarisation) for multi-purpose MW imagery. Conical-scanning radiometer, resolution 9.5 x 15 km at 90 GHz, 30 x 50 km at 19 GHz, swath 1400 km.

IRAS (Infra Red Atmospheric Sounder), flying on FY-3A/B, 26-channel IR radiometer (including one VIS) for temperature/humidity sounding, resolution 17 km, swath 2250 km.

MWTS (Micro-Wave Temperature Sounder), flying on FY-3A/B, 4-channel MW radiometer for nearly-all-weather temperature sounding, 54 GHz band, resolution 70 km, cross-track scanning, swath 2200 km.

MWHS (Micro-Wave Humidity Sounder), flying on FY-3A/B, 4-frequency / 5-channel (one frequency in double polarisation) MW radiometer for nearly-all-weather humidity sounding, 183 GHz band, resolution 15 km, cross-track scanning, swath 2700 km.

TOU/SBUS (Total Ozone Unit and Solar Backscatter Ultraviolet Sounder), flying on FY-3A/B, a suite of two UV spectro-radiometers, one (TOU) with 6 channels in the 308-360 nm range, resolution 50 km, swath 3000 km, for total ozone; the other one (SBUS) with 12 channels in the range 252-340 nm, resolution 200 km, nadir viewing, for ozone profile.

- ***SES (Space Environment Suite)*** flying on FY-3A/B, for *in situ* observation of charged particles in solar wind.
- ***ERM (Earth Radiation Measurement),*** flying on FY-3A/B, 2 broad-band channel radiometer for earth reflected solar flux and earth emitted thermal flux over total (0.2-50 m) and short (0.2-4.3 m) waveband; resolution 28km, cross-track scanning with 2 degree NFOV, swath 2300km; nadir viewing with 120 degree WFOV.
- ***SIM (Solar Irradiance Monitor),*** flying on FY-3A/B, 3-channel radiometer over 0.2-50 m waveband for the total incident solar flux; viewing the Sun near the north pole area.

Noticeable change of instrument payloads shall take place on FY-3D and afterward spacecraft models.

2.4 Data transmission from FY-3

The data rate of the MERSI instrument requires moving to X-band, both for global data recovery and for full information real-time transmission. Global data stored on board are transmitted as:

Delayed Picture Transmission (DPT): frequency 8146 MHz, bandwidth 149 MHz, data rate 93 Mbps.

Direct read-out is transmitted as:

MPT (Medium-resolution Picture Transmission), for full information in X-band. Main features:

- frequency: 7775 MHz; bandwidth: 45 MHz; polarisation: right hand circular
- antenna diameter ~ 3 m, G/T ~ 21.4 dB/K, data rate 18.7 Mbps;

AHRPT (Advanced High Resolution Picture Transmission) for selected information in L-band. Main features:

- frequency: in the range 1704.5 MHz; bandwidth: 6.8 MHz; polarisation: right hand circular
- antenna diameter ~ 3 m, G/T ~ 6.8 dB/K, data rate 4.2 Mbps.

2.5 Status of FY-3A/B Satellites

FY-3B was launched on 5 November 2010. It is of the same model as FY-3A. The designed lifetime is 3 years, 3-axis stabilised, sun-synchronous, taking the afternoon orbit. FY-3B carries the same instruments as of FY-3A.

FY-3A was launched on 27 May 2008. The designed lifetime is 3 years, 3-axis stabilised, sun-synchronous, taking the morning orbit. The ground stations received the L-band AHRPT data, X-band MPT data, and DPT data.