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INTER-PROGRAMME EXPERT TEAM ON SATELLITE UTILIZATION AND
PRODUCTS

ITEM: 5.2

FOURTH SESSION

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Preparation for FY-4A

(Submitted by Xiang Fang, CMA)

Summary and Purpose of Document

This document reports on the latest information about FY-4A, including navigation and calibration, product, operational observation modes, data broadcasting and user readiness. FY-4A has completed the in-orbit test, and will be put into operation in March 2018.

ACTION PROPOSED

The second session is invited to:

- (a) Take note of the current status of FY-4A;
 - (b) Strengthen the application of FY-4A.
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DISCUSSION

1. Introduction

FY-4A, the first spacecraft of Chinese second-generation geostationary meteorological satellites, was launched on December 11, 2016 from Xichang Satellite Launch Center. It is the first meteorological satellite with a three-axis stabilization structure on geostationary orbit for China.

The first satellite (FY-4A) of FY-4 series is considered experimental and will be followed by the operational FY-4 satellites. Four new instruments are aboard: the Advanced Geostationary Radiation Imager (AGRI), the Geostationary Interferometric Infrared Sounder (GIIRS), the Geostationary Lightning Mapping (GLM), and the Space Environment Package (SEP).

On Dec 26, 2016, The in-orbit test for FY-4A started, which had two stages, the first one is the payload testing, the second one is the verification of observation mode and product quality. After one year's test, FY-4A has completed the in-orbit test on Dec 31, 2017. All the indexes meet the design requirements. FY-4A ground and application system has the capacity for operation and provide data. FY-4A satellite is going to be fully operational by March, 2018.

2. Navigation and Calibration

FY-4A has a multi-sensor earth imaging matching system. By the integrated satellite-earth image matching method, heat deformation modeling and calculation, automated star observation and mass center extraction, multi-sensor integrated matching and matching bias correction, three payloads have achieved observation accuracy of 1 pixel, among which, AGRI matching accuracy is about 2Km, GIIRS is about 4Km.

As for the calibration accuracy, except for 13.2 μm channel (+0.1K@290K), 13 other AGRI channels have achieved design requirements, especially for the 10.8 μm channel, calibration accuracy is better than 0.06K@290K. Calibration result for all the IR channels is better than 1.0K, 10.8 μm channel is better than 0.3K@290K, which shows that AGRI has exceptional performance.

The spectral resolution for GIIRS longwave and midwave IR bands has achieved 0.625 cm^{-1} , which outperforms design specification (0.8/1.6 cm^{-1}), identical to that of the NPP/CrIS. Of all the 1650 channels, except from those contaminated channels, the accuracy of most bands is better than 0.1K, which satisfies design requirement. Longwave and midwave IR bands have same response envelope as benchmark instrument Metop-A IASI, relative calibration accuracy has achieved 0.64K and 0.99K respectively, spectral calibration accuracy has achieved 8ppm, which outperforms design requirements.

3. Products

FY-4A has four payloads, which will provide 36 atmosphere, surface, ocean, space weather products (table 1-4), all products are automatically generated and satisfy accuracy requirements, and they will be distributed for operational application.

Table 1: Baseline Products of AGRI

No.	Products	No.	Products
1	Cloud detection	15	Rainfall Rate/QPE

2	Cloud Type	16	Surface Solar Irradiance
3	Cloud Optical Depth	17	Blackbody Brightness Temp.
4	Cloud Liquid Water	18	Outgoing Longwave Radiation
5	Cloud Particle Size Distribution	19	Downward Longwave Radiation
6	Cloud Phase	20	Upward Longwave Radiation
7	Cloud Top Temperature	21	Ingoing Shortwave Radiation
8	Cloud Top Height/Pressure	22	Land Surface Albedo
9	Fog Detection	23	Land Surface Temperature
10	Aerosol Detection (AOD)	24	Sea Surface Temperature
11	Dust Detection	25	Land Surface Albedo
12	Convective Initiation/Deep Convection Detection	26	Land Surface Emissivity
13	Tropopause Folding Turbulence Prediction	27	Snow Cover
14	Atmospheric Motion Vector	28	Fire/Hot Spot

Table 2: Baseline Products of GIIRS

No.	Products	No.	Products
1	Atmospheric Temperature, Humidity and Ozone Profiles (Clear)	2	Atmospheric Temperature and Humidity Profiles (Cloudy)

Table 3: Baseline Products of LMI

No.	Products	No.	Products	No.	Products
1	Flash	2	Group	3	Event

Table 4: Baseline Products of SEP

No.	Products	No.	Products	No.	Products
1	Distribution of High Energy Particle	2	Intensity of Magnetic Field	3	Effects of Spatial Environment

4. FY-4A observation modes

FY-4A is located at 105° East on the geostationary orbit, and the planned observation mode is as follows:

AGRI performs full disk scan every hour, duration time is: hh:00 minutes – hh:15 minutes. 3 consecutive full disk scans every 3 hours (mainly for the atmospheric motion vector), duration time 00:00 /03:00 /06:00 /09:00 /12:00 /15:00 /18:00 /21:00, minus 15 minutes and plus 30 minutes, 45 minutes total. E.g. 3 consecutive full disk scans at 00:00, duration time is 23:45-23:59:59、 00:00-00:14:59、 00:15-00:29:59. The rest scanning time is reserved for China region, each scan takes 5 minutes, scanning range is 2.5° ~55° North, 65° ~140° East.

GIIRS scans China Region every 3 hours, there are 12 observation boxes in total, each box takes 15 minutes.

Typical LMI scanning duration is 10 minutes, including 9 minutes and 40 seconds of scanning time (2ms interval), 20 seconds of ground calibration target observation. From Spring Equinox to Autumn Equinox (Summer time in northern hemisphere), the LMI scans northern hemisphere. From Autumn Equinox to Spring Equinox (Winter time in northern hemisphere), the LMI scans southern hemisphere.

5. Data distribution and services

FY-4A data is distributed by four ways:

Direct satellite broadcast: 34 FY-4A direct data receiving stations (HRIT stations) have been constructed for province users, and 29 HRIT stations will be constructed for commercial and international users.

CMACast: L1 data and parts of L2 data of FY-4A are planned to be broadcast by CMACast, 2600 domestic and 24 international users are able to receive FY-4A data by CMACast. table 5 shows the first batch of data provided for international users.

Website: All users can download the FY-4A data via ordering on the website.

Data Sharing by China Integrated Meteorological Information Service System (CIMISS): CMA users can access FY-4A data via CIMISS directly.

Data access methods for different users are listed in table 6

Table 5 CMACast international broadcast for FY-4A Products (1st batch)

No.	Products	Format
1.	AGRI 1KM L1 Data	HDF
2.	AGRI 2KM L1 Data	HDF
3.	AGRI 4KM L1 Data	HDF
4.	Real time fast atmospheric correction product (Full disk / Nominal)	NC
5.	Real time cloud detection product (Full disk / Nominal)	NC
6.	Real time cloud type product (Full disk / Nominal)	NC
7.	Real time dust detection product (Full disk / Nominal)	NC

No.	Products	Format
8.	Real time outgoing IR longwave product (Full disk / Nominal)	NC
9.	Full disk real time rainfall estimation product (Northern Hemisphere / Nominal)	NC
10.	Real time ingoing solar shortwave product (Full disk / nominal)	NC
11.	LMI 1 minutes flash events product	NC

Table 6 FY-4A data access methods for different users

User Profile	Service Mode	Data Contents
National Operational Department	CIMISS satellite data pool	FY-4 L1-L3 real-time, historical data
Provincial and Domestic Professional Users	Direct receiving station	FY-4 L1 data
	CMACast broadcast	FY-4L1 L2 data
	CIMISS ground network	FY-4 L1-L3 real-time data
Domestic and International Scientific Users	Data service system/Manual service based on internet	FY-4 complete data
International Users	Direct receiving station /CMACast	Authorized data
Public Users	Website, New Media, APP	Visual product

6. User readiness

CMA has made several efforts for the FY-4A satellite data applications.

Strong efforts have been made for the application technology, including forming special application taskforce and assigning first-chair experts for weather analysis, numerical weather prediction, climate prediction, ecology and environment, artificial weather intervention, etc.

Cooperation improvements with researching organizations, including Atmospheric physics institution of Chinese Academy of Sciences, Chinese Weather Science Academy, NanJing University, and joint research centers have been established.

CMA has set up more than 30 demonstration projects in key application fields, such as weather analysis, environment monitoring, climate monitoring and NWP. Nearly all main national and

provincial user community are involved in these projects.

For the FY-4A data application training, NSMC and WMO Beijing training center have established close cooperation, providing various training courses, including special training for different application areas, special training for non-weather industries, special on-site training for international users, and VLab online training. In 2017 alone, there are four grades of FY-4 special training courses conducted, along with CMACast technical group, on-site trainings have been provided for Maldives, Tajikistan, Philippine, Kazakhstan, etc.