Preparing a seamless transition towards FY-4

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National Satellite Meteorological Center ,CMA

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NSMC

Motivation

That optimal utilization of new operational satellite systems should be assured and the risk of disruption for operational users be mitigated; **Planning an appropriate overlap period between the operation of current and new satellites to allow intercomparison and validation of products, smooth migration of operational applications and downstream service delivery;***

CBS-15/Doc. 4.2(1), APPROVED p. 9
http://www.wmo.int/pages/prog/sat/documents/SAT-GEN_CBS-15-GuidelineUserReadiness.pdf

Challenges

1)Observation capability continuality

2)Data service continuality

3)System &Products readiness

4)Application continuality

5)Promotion &training

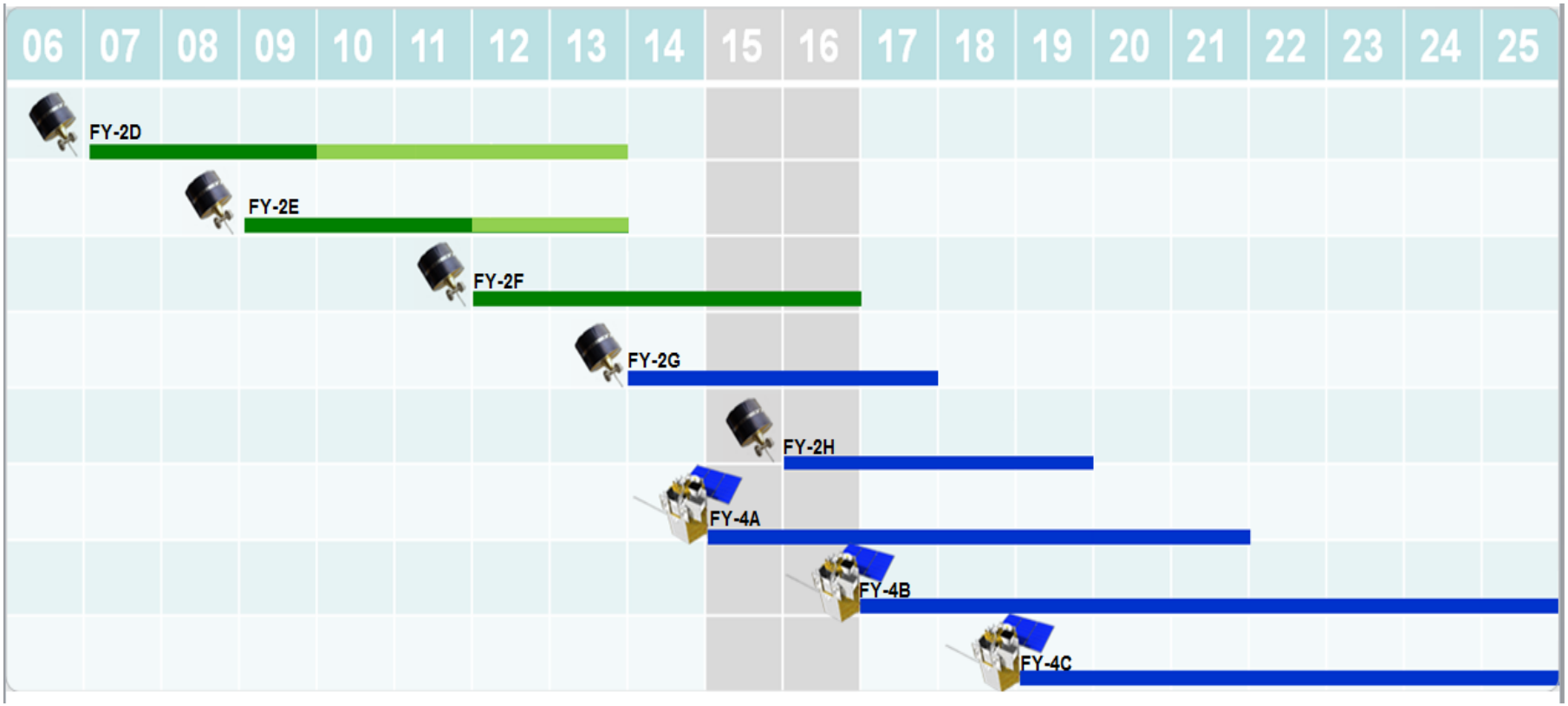
The Roadmap of CMA Fengyun Geo

FY-2 A/B (Exp)	FY-2 C/D/E (OP)	FY-2 /F/G/H (OP)	FY-4A (Exp)	FY-4B (OP)…
1)VISSR (3 channel)	2)VISSR (5 channel) 2)SEM	1)VISSR (5 channel) 2)SEM	1)AGRI (14 channel) 2)GIIRS 3)LMI 4)SEP	1)AGRI (14+ channel) 2)GIIRS 3)LMI 4)SEP
Spacecraft and Payload long-life design,	Good INR; 31 L1/L2/l3 OP products	Good Calibration; 33 L1/L2/L3 OP Products; Frequent observations	46 L2 candidates; 34 L2 OP Products;	TBD

*A FY-2 ranging station is operated by Australian Bureau of Meteorology(BOM)

Observation capability continuality

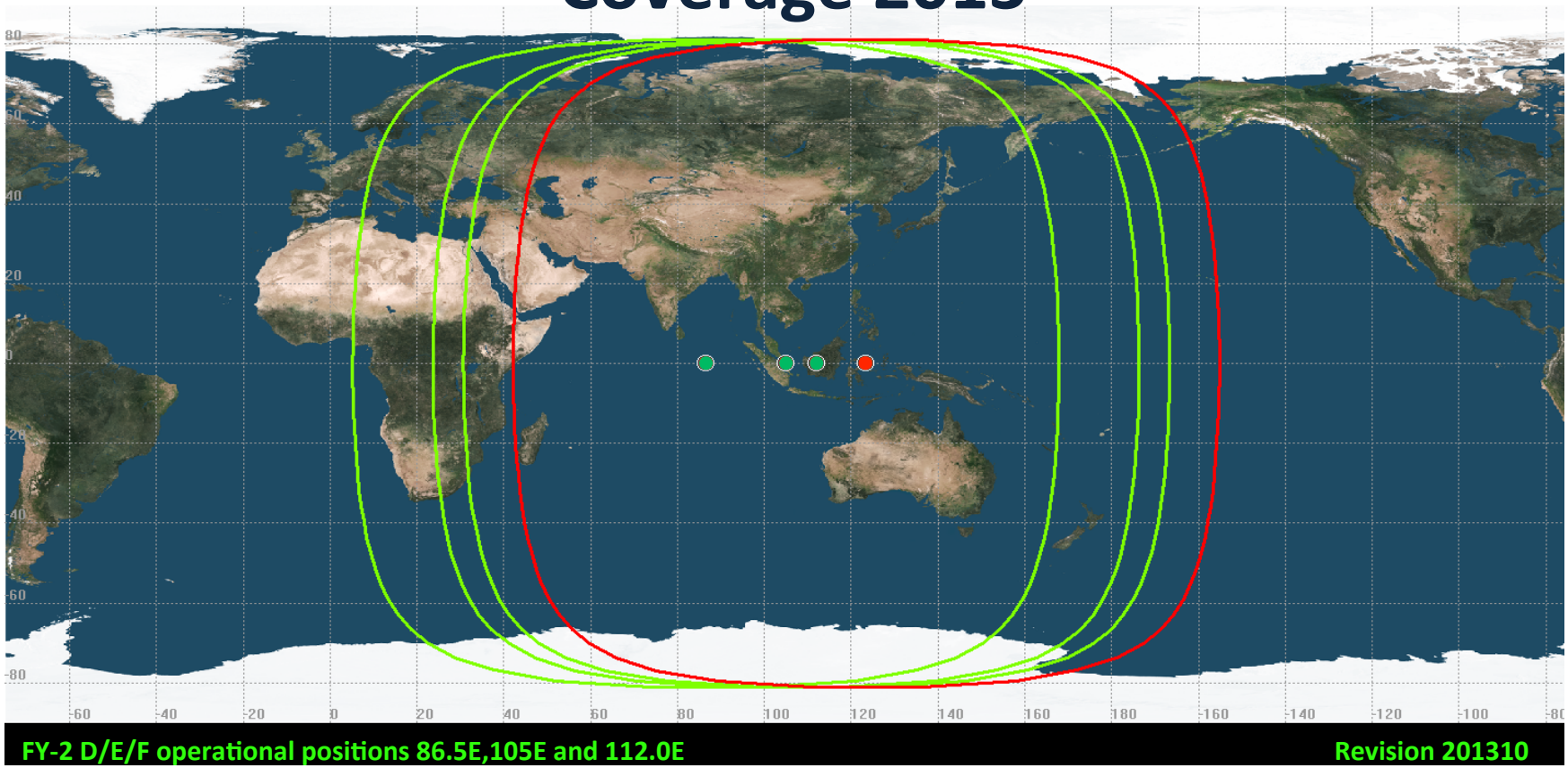
Current Status and Future Plan



Revision 201310

Observation capability continuality

Coverage 2013

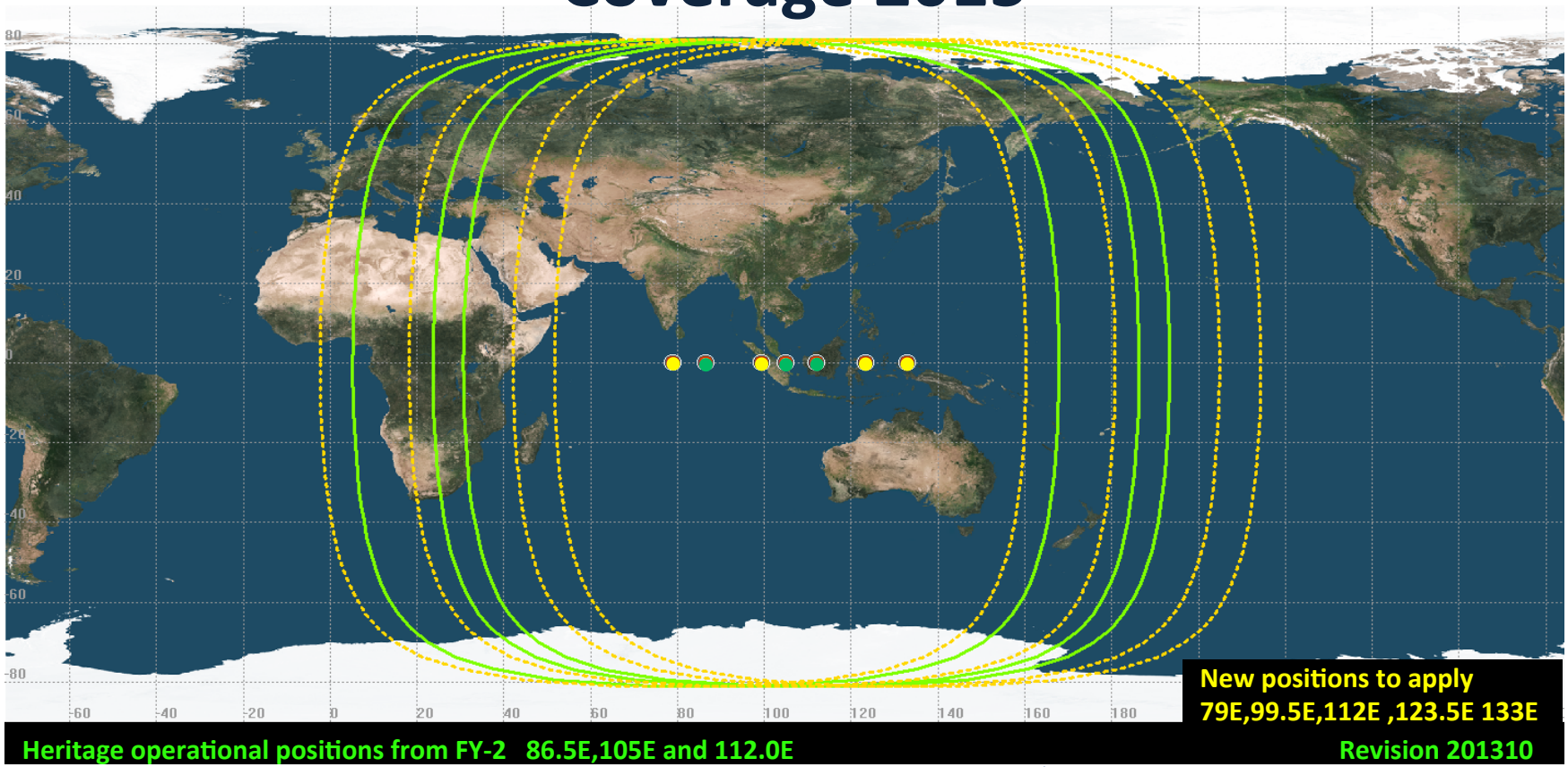


FY-2 D/E/F operational positions 86.5E,105E and 112.0E

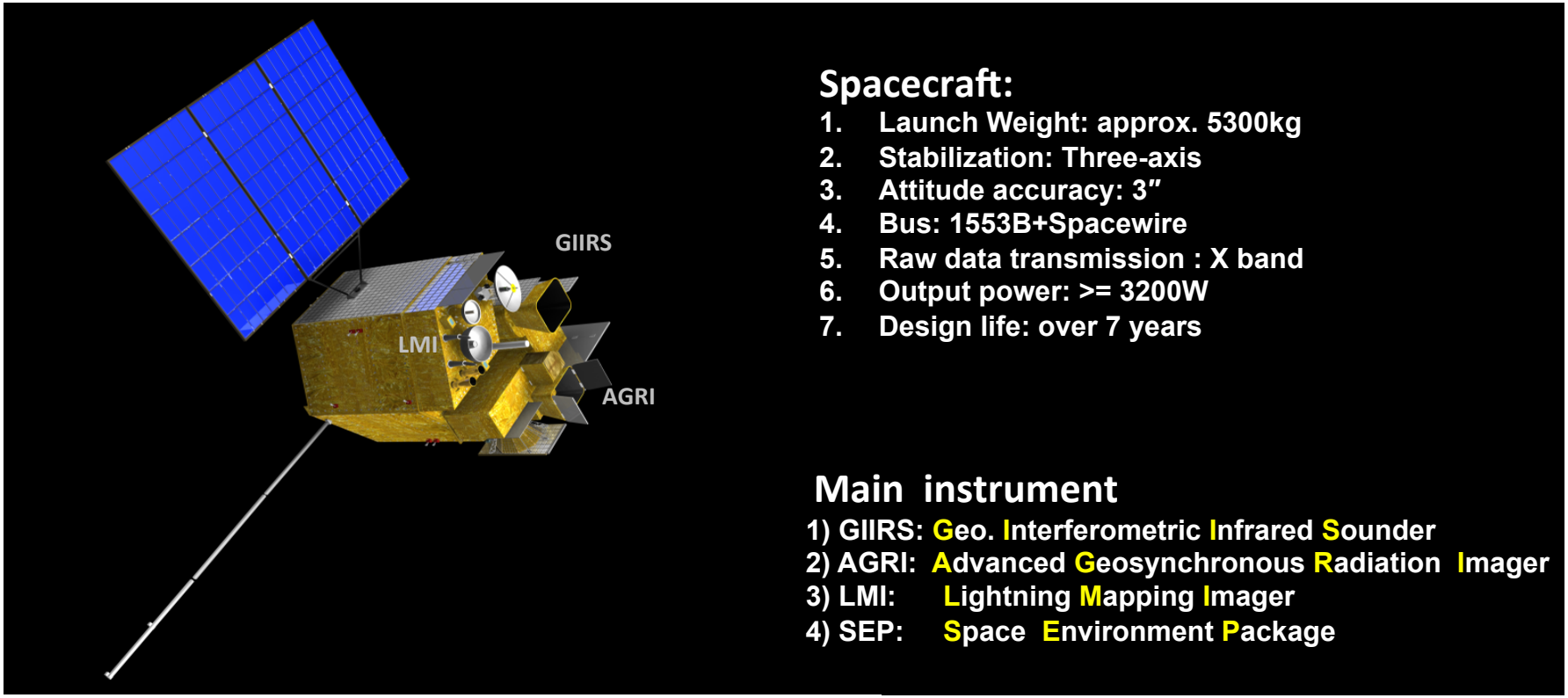
Revision 201310

Observation capability continuality

Coverage 2015



FY-4– The next generation FengYun GEO.



Spacecraft:

1. Launch Weight: approx. 5300kg
2. Stabilization: Three-axis
3. Attitude accuracy: 3″
4. Bus: 1553B+Spacewire
5. Raw data transmission : X band
6. Output power: >= 3200W
7. Design life: over 7 years

Main instrument

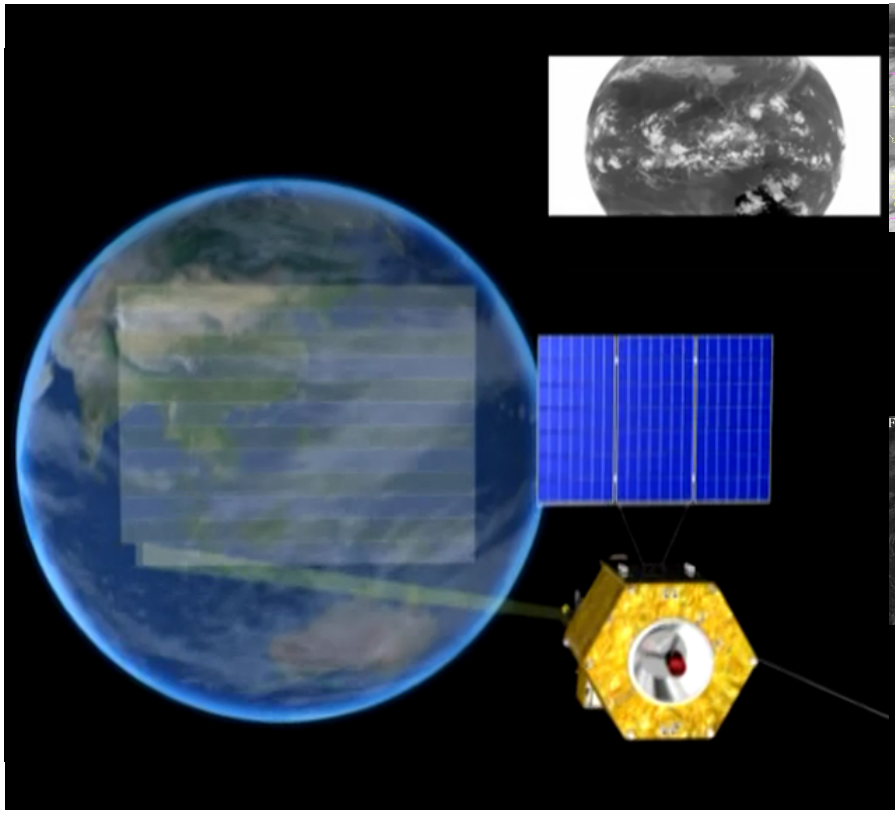
1) GIIRS: Geo. Interferometric Infrared Sounder
2) AGRI: Advanced Geosynchronous Radiation Imager
3) LMI: Lightning Mapping Imager
4) SEP: Space Environment Package

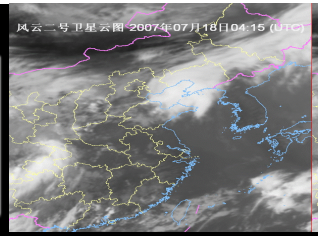
Advancement of FY-4A compared with FY-2

	FY-4A(EXP)	FY-2(OP)
Stabilization	**Three-axis**	**Spin**
Designed Life	**5~7 Years**	**4 Years**
Observation efficiency	**85%**	**5%**
Observation Mode	**Imaging +Sounding + Lightning Mapping**	**Imaging Only**
Main Instruments	**AGRI :14 channels** SSP Resolution：0.5~4Km Global imaging：15min Flexible imaging ： 2D	**VISSR: 5 channels** SSP Resolution：1.25~5Km Global imaging：30min Flexible imaging ： 1D
	GIIRS:913 channels SSP Resolution:16Km Spectral Resolution: 0.8,1.6cm-1	**N/A**
	LMI SSP Resolution:7.8Km	**N/A**
	SEP High energy particles Magnetic field	**SEM** High energy particles Solar X ray fluxes

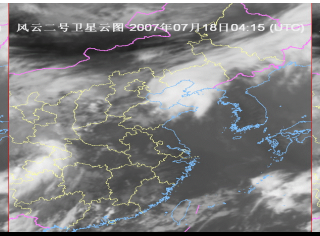
Observation capability continuality

Chinese FengYun Geo. imaging capability

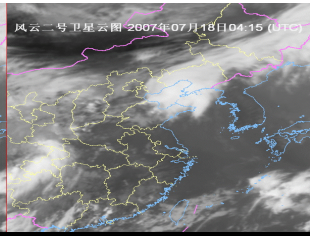




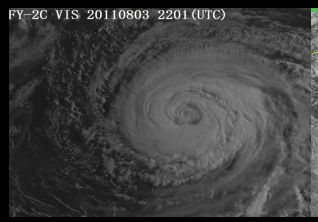
2005 FY-2C
FD 60min



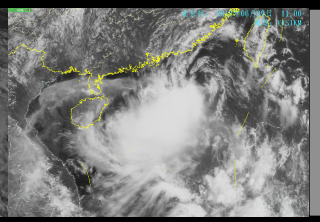
2006 FY-2C
FD 30min



2007 FY-2C+FY-2D
FD 30min
NH 15min



2011 FY-2C
RRS 10 min



2014-2015
FD: 30min
NH: 15min
RRS: 6min

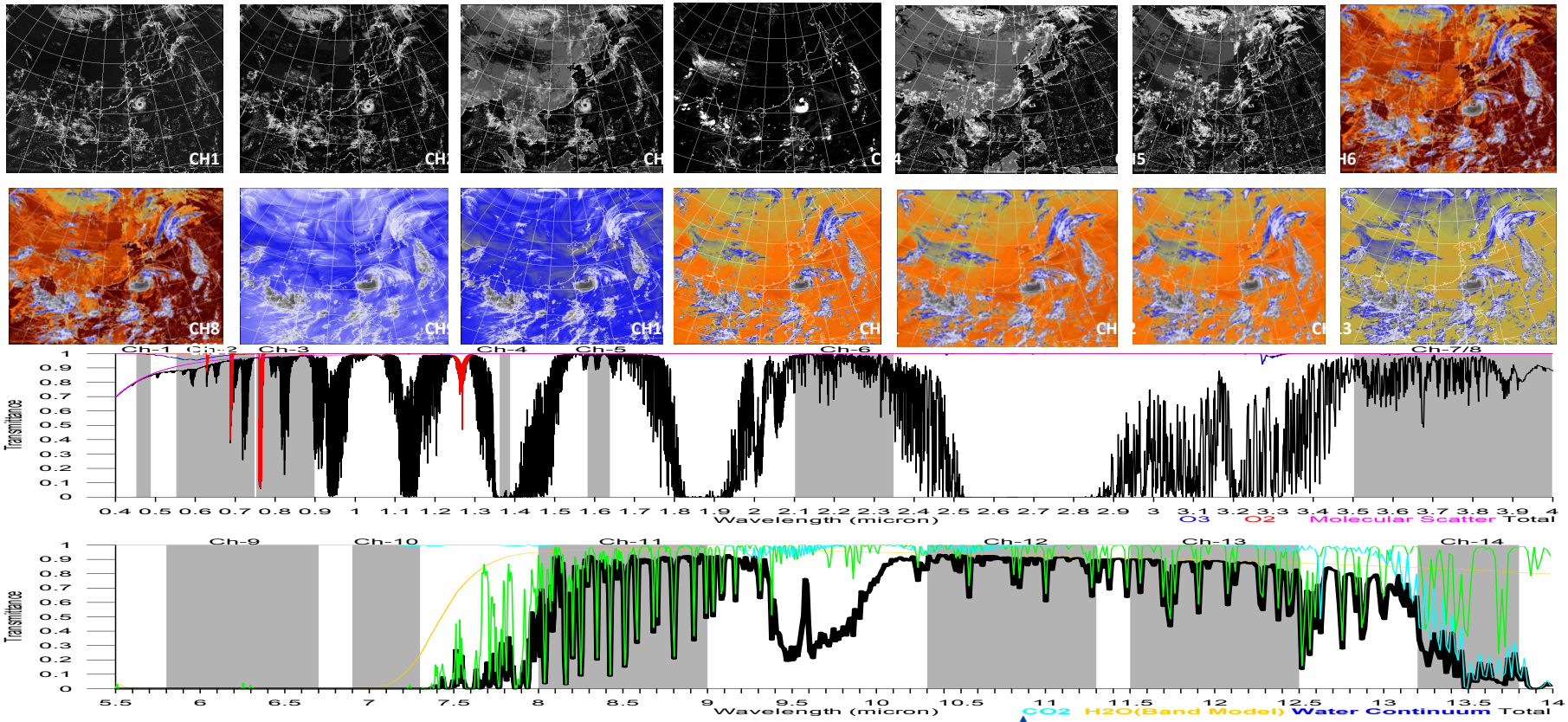
2015 FY-2+FY-4
FD: 15min
RRS: 1-5min

Observation capability continuality

Chinese FengYun Geo. imaging capability

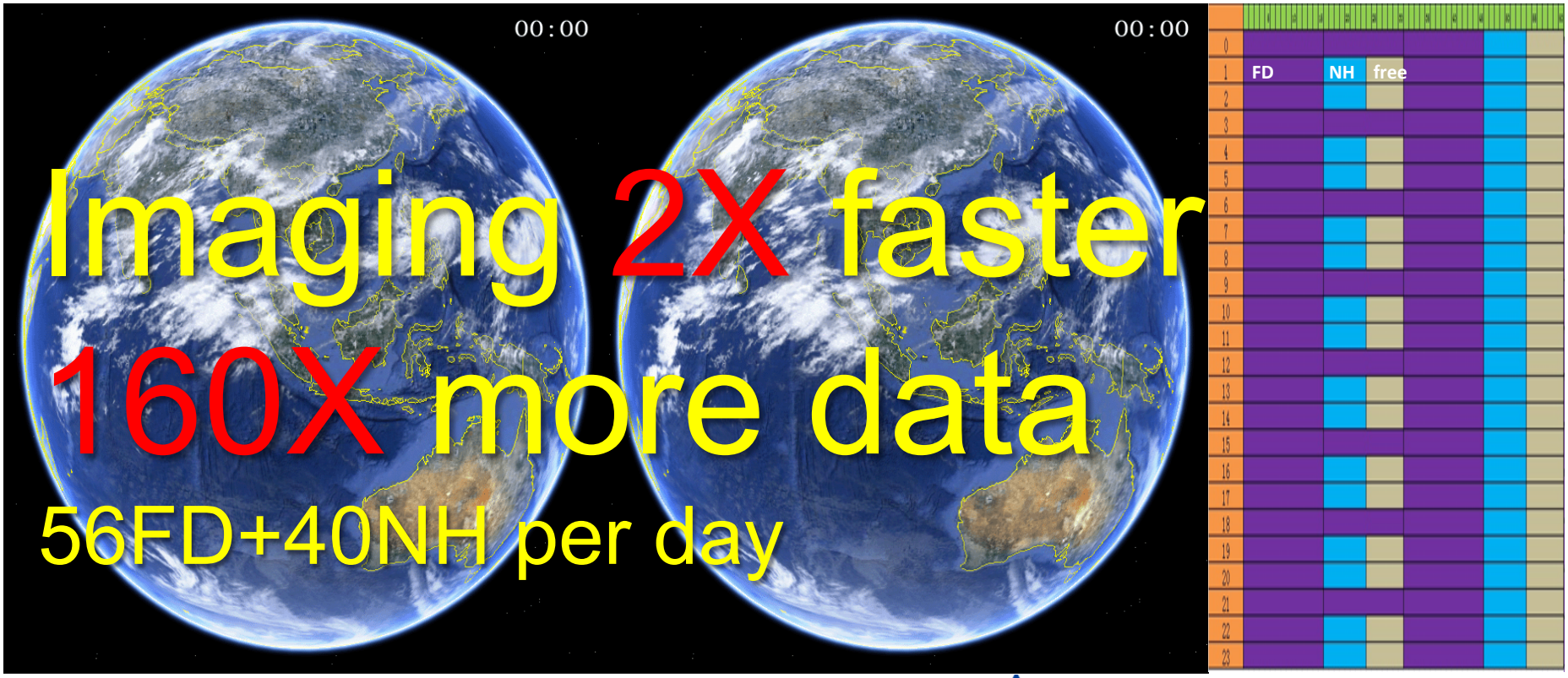
	FY-2 F/G/H VISSR			FY-4A AGRI			
Channel	Band	Spatial Resolution	Sensitivity	Band	Spatial Resolution	Sensitivity	Main Application
Visible & Near-Infrared				0.45～0.49	1	S/N≥90 (ρ=100%)	Aerosol
	0.55～0.75	1.25	2.3 @ρ=1%	0.55～0.75	0.5～1	S/N≥200 (ρ=100%)	Fog, Clound
				0.75～0.90	1	S/N≥5(ρ=1%)@0.5Km	Vegetation
Short-wave Infrared				1.36～1.39	2	S/N≥200 (ρ=100%)	Cirrus
				1.58～1.64	2	S/N≥200 (ρ=100%)	Cloud,Snow
				2.1～2.35	2～4		Cirrus,Aerosol
Mid-wave Infrared				3.5～4.0(High)	2	NEΔT≤0.7K(300K)	Fire
	3.5～4.0	5	0.22K@300K	3.5～4.0(Low) *	4	NEΔT≤0.2K(300K)	Land surface
Water Vapor				5.8～6.7	4	NEΔT≤0.3K(260K)	WV
	6.3～7.6	5	0.30K@260K	6.9～7.3	4	NEΔT≤0.3K(260K)	WV
Long-wave Infrared				8.0～9.0*	4	NEΔT≤0.2K(300K)	WV,Cloud
	10.3～11.3	5	0.12K@300K	10.3～11.3*	4	NEΔT≤0.2K(300K)	SST
	11.5～12.5	5	0.16K@300K	11.5～12.5*	4	NEΔT≤0.2K(300K)	SST
				13.2～13.8*	4	NEΔT≤0.5K(300K)	Clound,WV

FY-4A AGRI Channels

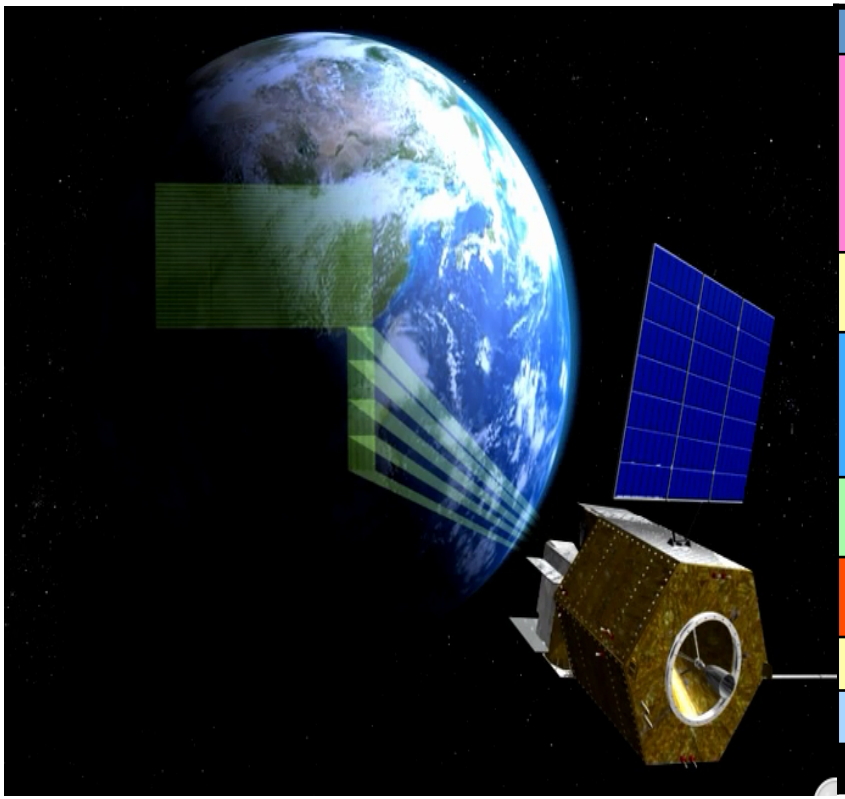


Observation capability continuality

FY-4A AGRI Observation Mode

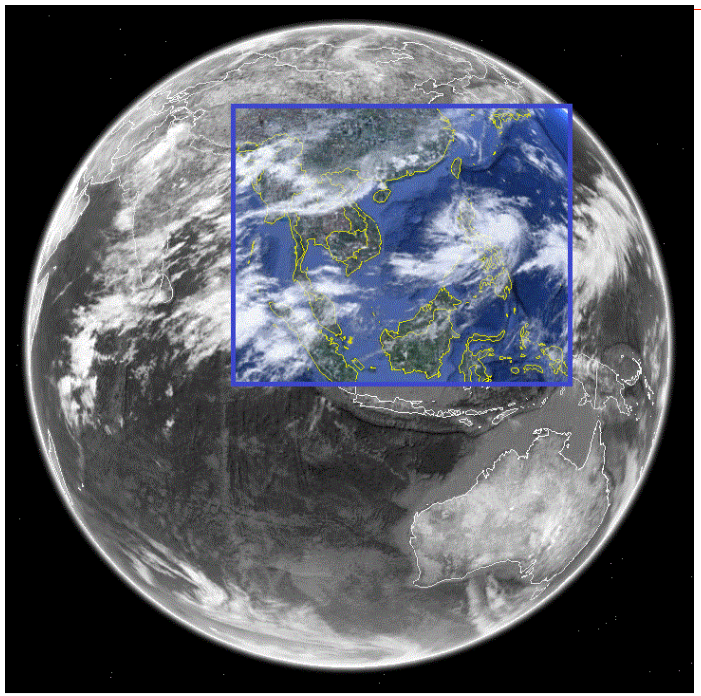


GIIRS: Geo. Interferometric Infrared Sounder

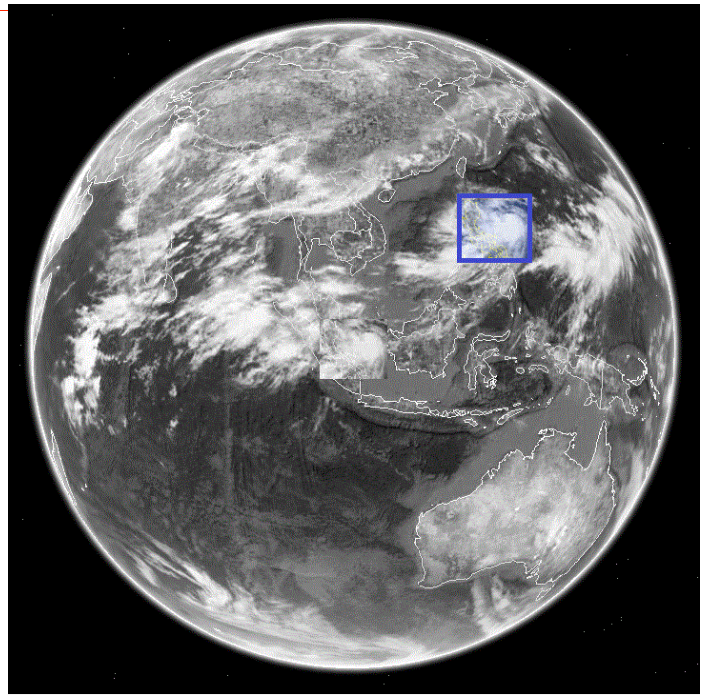


	FY-4A (R&D)	FY-4B (Operational)
Spectral Parameters (Normal mode)	Range Resolution Channels LWIR: 700-1130 Cm -1 0.8 538 S/MIR:1 650-2250Cm -1 1.6 375 VIS : 0.55-0.75 μm 1	Range Resolution Channels LWIR: 700-1130 0.625 688 S/MIR:1 650-2250 1.2 500 VIS : 0.55-0.75 μm 1
Spatial Resolution	LWIR/S/MIR : 16Km SSP VIS : 2Km SSP	LWIR/S/MIR : 8Km SSP
Operational Mode	China area 5000 × 5000 Km2 Mesoscale area 1000 × 1000 Km2	China area 5000 × 5000 Km2 Mesoscale area 1000 × 1000 Km2
Temporal Resolution	China area <1 hr Mesoscale area <½ hr	China area <1 hr Mesoscale area <½ hr
Sensitivity (mW/m2sr cm-1)	LWIR: 0.5 -1.1 S/MIR: 0.1-0.14 VIS: S/N>200(ρ=100%)	LWIR: 0.3 S/MIR: 0.06
Calibration accuracy	1.5k (3σ) radiation	1.0k (3σ)
Calibration accuracy	10 ppm (3σ) spectrum	5 ppm (3σ)
Quantization Bits	13 bits	13 bits

FY-4A GIIRS Normal observation mode

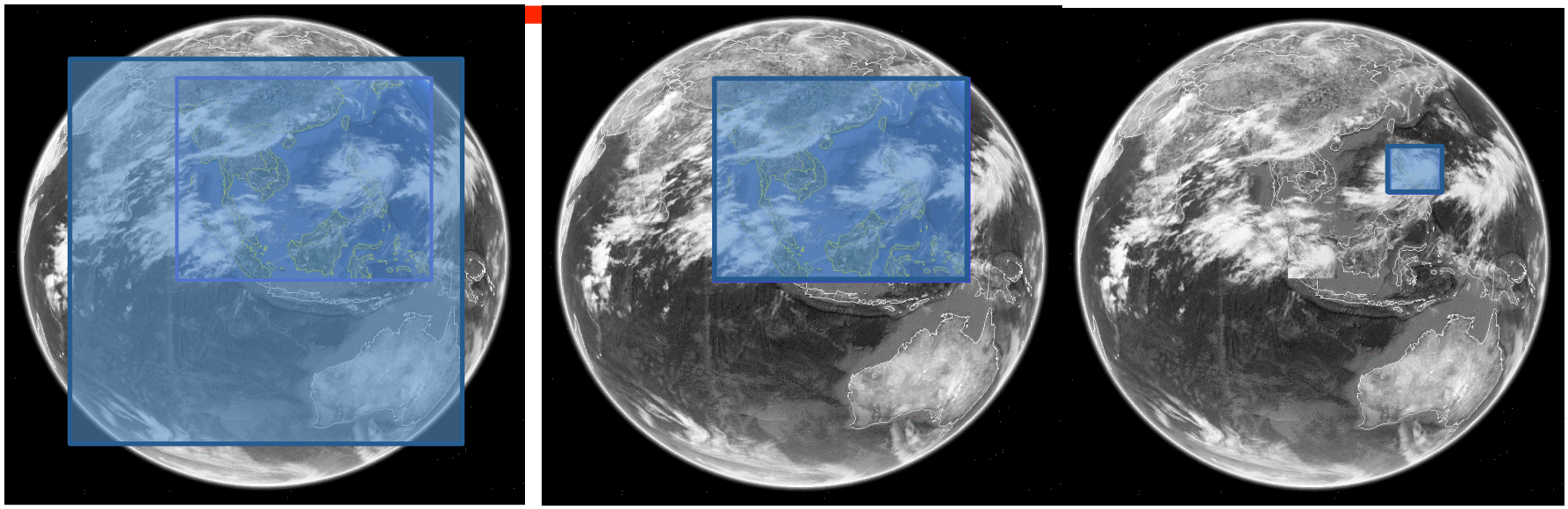


Regional:55 min 4500KMx4500KM



Meso-scale:30 min 1000KMx1000KM

Special Consideration on FY-4A GIIRS



Time sensitive mode

For Global Observation

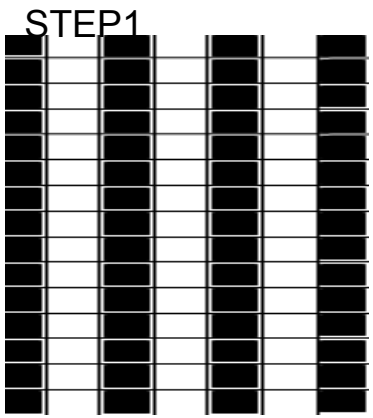
Normal mode
55 min intervals
4500KMx4500KM

HQ mode :
55 min intervals
1250X1500Km

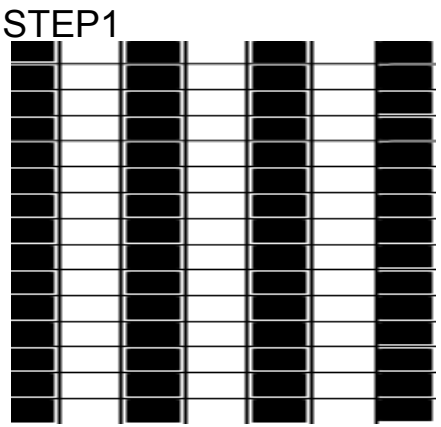
Special Consideration on FY-4A GIIRS

HQ mode				
Spectral Parameters (Normal mode)		Range	Resolution	Channels
	LWIR:	700-1130 Cm $^{-1}$	0.8	538
	S/MIR:1	650-2250Cm $^{-1}$	1.6	375
	VIS :	0.55-0.75 μm		1
Spectral Parameters (High Quality mode)		Range	Resolution	Channels
	LWIR:	700-1130 Cm $^{-1}$	1.6	538
	S/MIR:1	650-2250Cm $^{-1}$	3.2	375
	VIS :	0.55-0.75 μm		1

Time sensitive mode



Normal mode



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FY-4A Special Consideration on GIIRS

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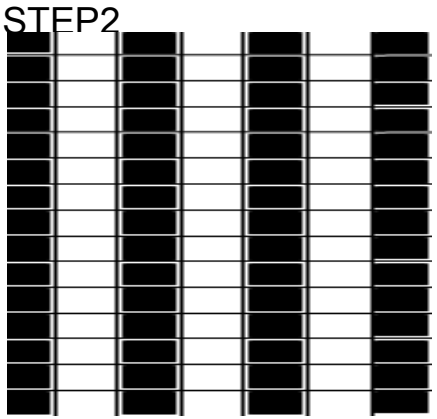
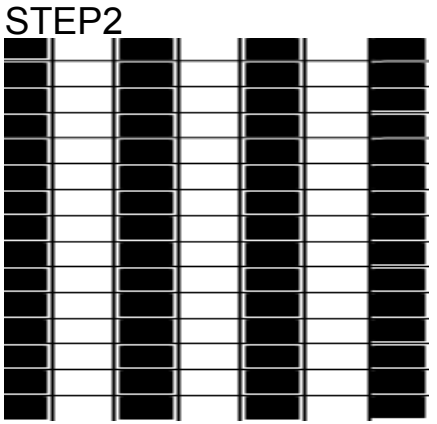
Time sensitive mode



Normal mode



Revision 201310

FY-4A Special Consideration on GIIRS

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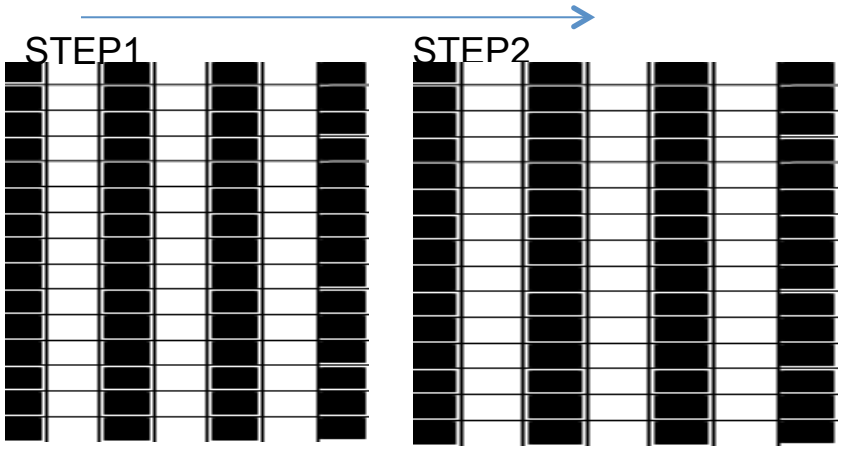
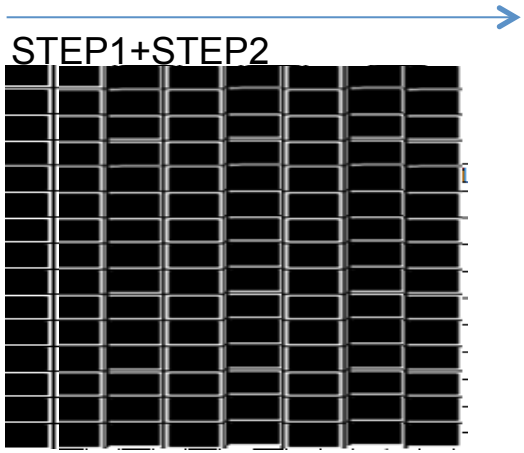
Time sensitive mode

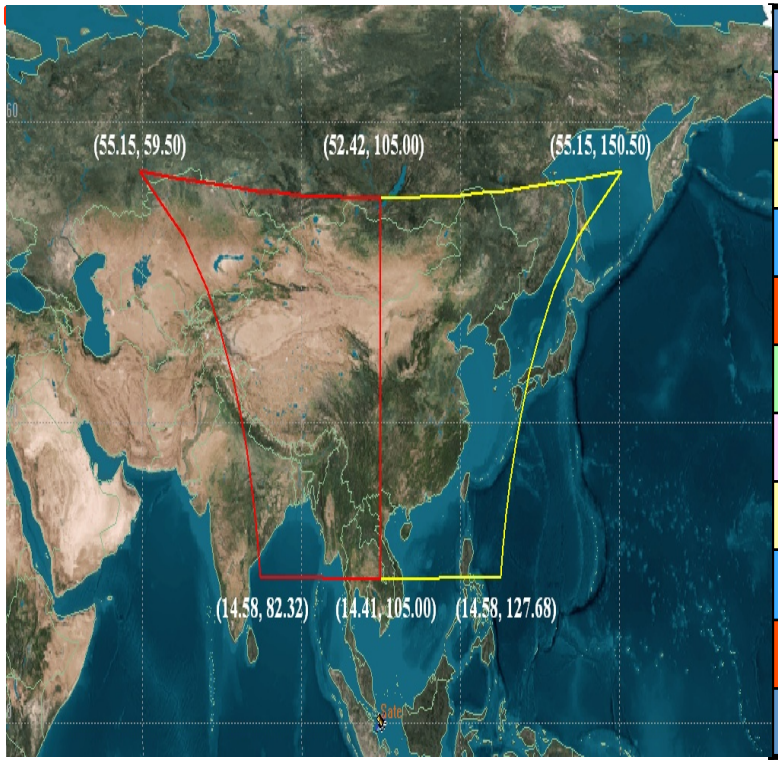


Normal mode



Revision 201310

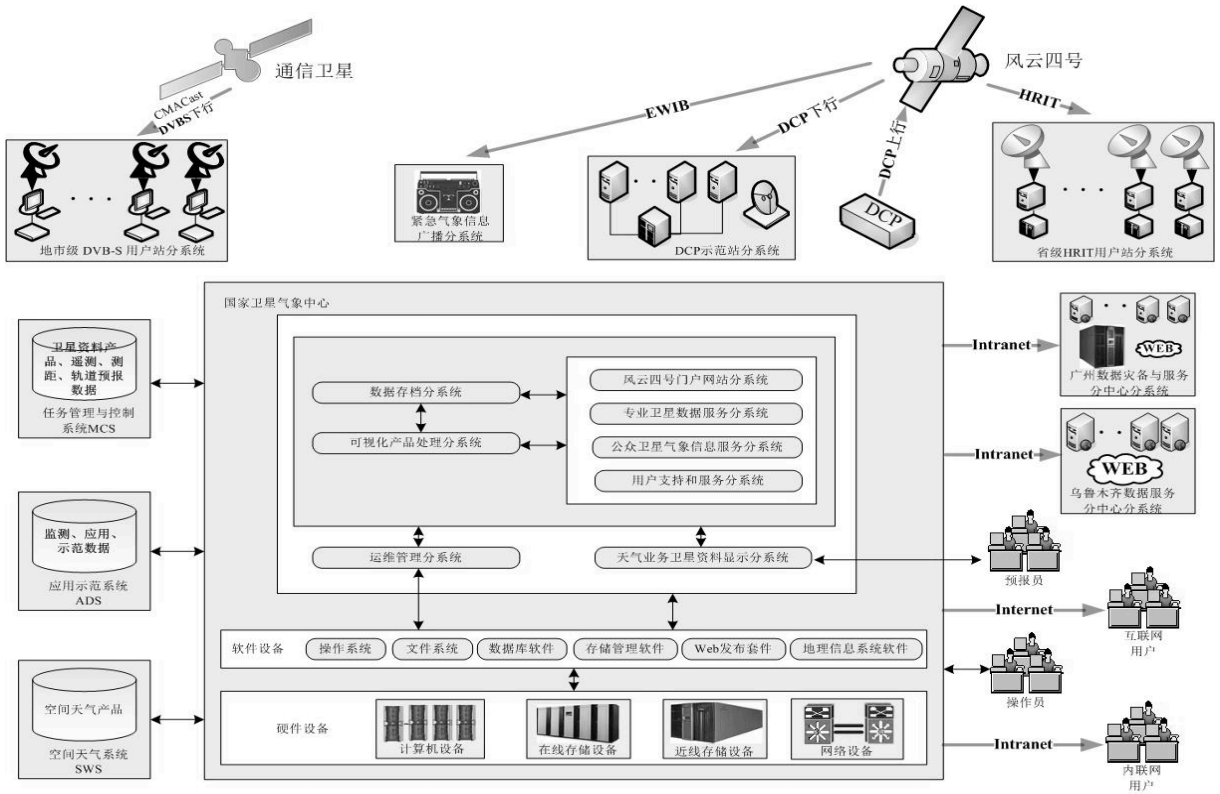
LMI: Lighting Mapping Imager



Spatial resolution	about 6 km at SSP
Sensor size	400×300 ×2
Wave-length at center	777.4nm
Band-width	1nm±0.1nm
Detection efficiency	>90%
False-alarm ratio	<10%
Dynamic range	>100
SNR	>6
Frequency of frames	2ms (500 Frames per sec.)
Quantization	12 bits
Measurement Error	10%

Data service continuality

FY-4 Data Distribution and Service



Main functions：

- To provide uplink data for DB users
- To make FY-4 data and products available via **CMACast， Internet, and dedicated links**
- To establish a stable and reliable data archiving and management system
- To build an **EWIB system** to response to significant weather events

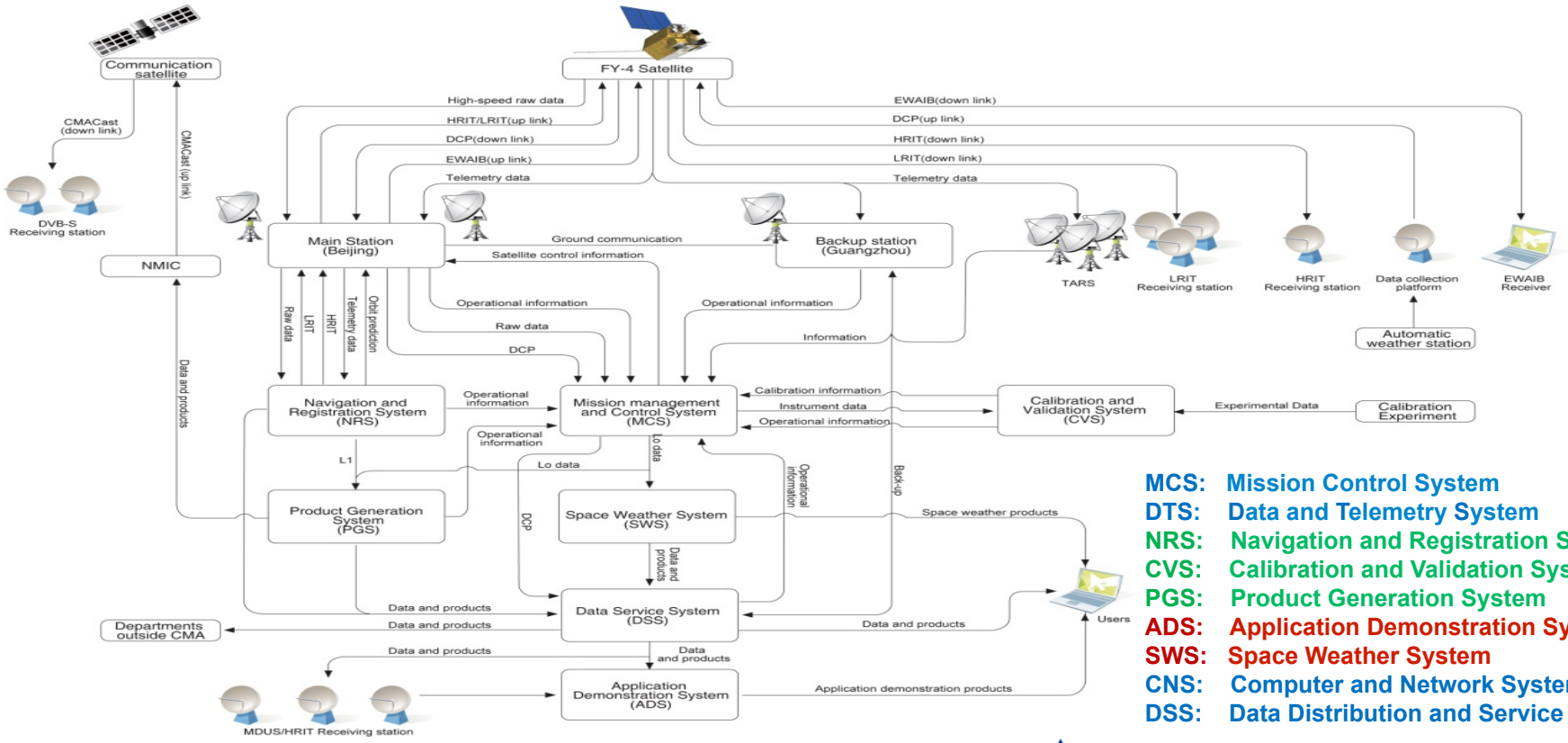
Data service continuality

Direct Broadcast Capabilities

	FY-2	FY-4				
	Channel	Channel		Band Width	Max. Data	Main Purpose
1	S-VISSR	HRIT	1	8Mbps	93.3GB	Full resolution AGRI & LMI data
			2a	3Mbps	38.9GB	Resampled AGRI data
			2b	1Mbps	11.67GB	GIIRS data
2	LRIT	LRIT		150Kbps	1.67GB	Low resolution information
3	DCP	DCP		600bps	6MB	Data collection

System &products readiness

FY-4 Ground System



MCS: Mission Control System
DTS: Data and Telemetry System
NRS: Navigation and Registration System
CVS: Calibration and Validation System
PGS: Product Generation System
ADS: Application Demonstration System
SWS: Space Weather System
CNS: Computer and Network System
DSS: Data Distribution and Service System

FY-4 Ground System Developing Status

PrePhase：

End user requirement analysis 2006-2009

Instrument requirement 2006-2009

Phase A: Science(Algorithm Development)

Product requirement analysis & tradeoff study 2008-2011

Algorithm Development 2009-2013

Phase B:

R&D system design 2011-2013

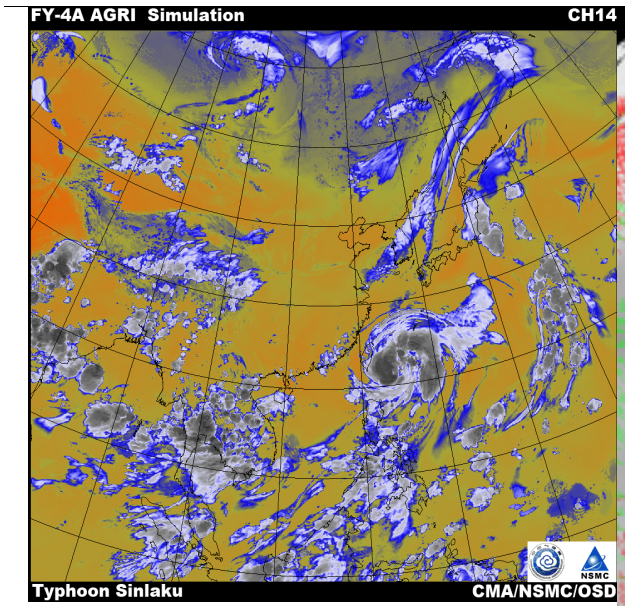
R&D system integration & test 2012-2014

Phase C: Enginnering (System Integration)

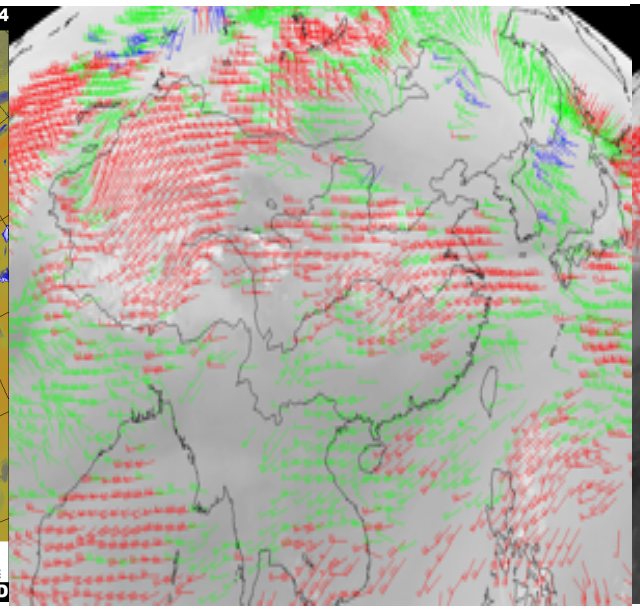
Operational system Design 2013-2015

Operational system integration & test 2014-2015

AGRI product development

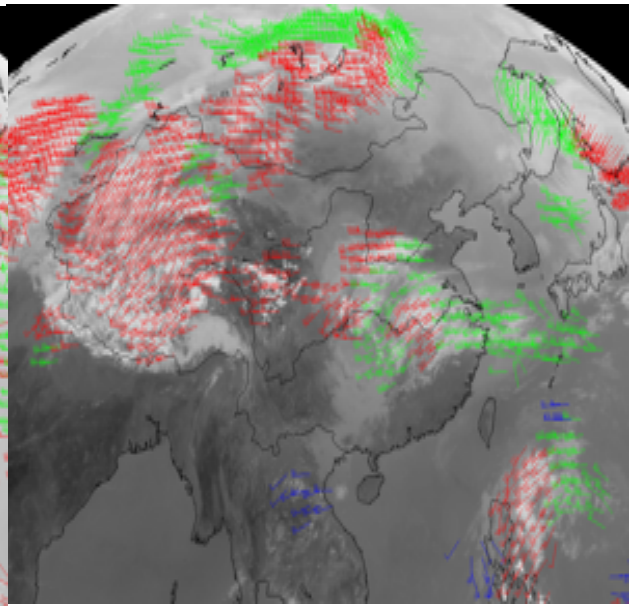


CH12	10.3～11.3	64km
CH10	6.9～7.3	64km
CH09	5.8～6.7	64km
CH02	0.55～0.75	16km



Long-wave IR Cloud-drift Winds

- Day and night; Lower, mid, and upper troposphere

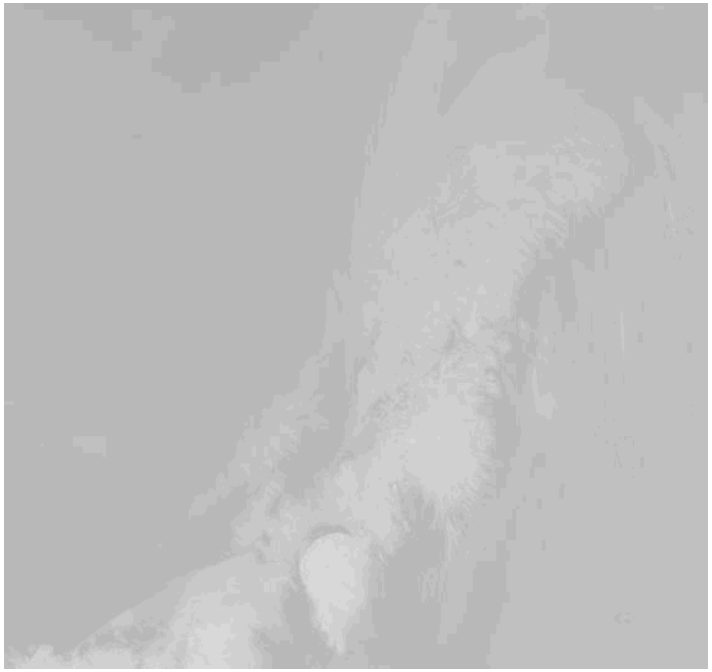


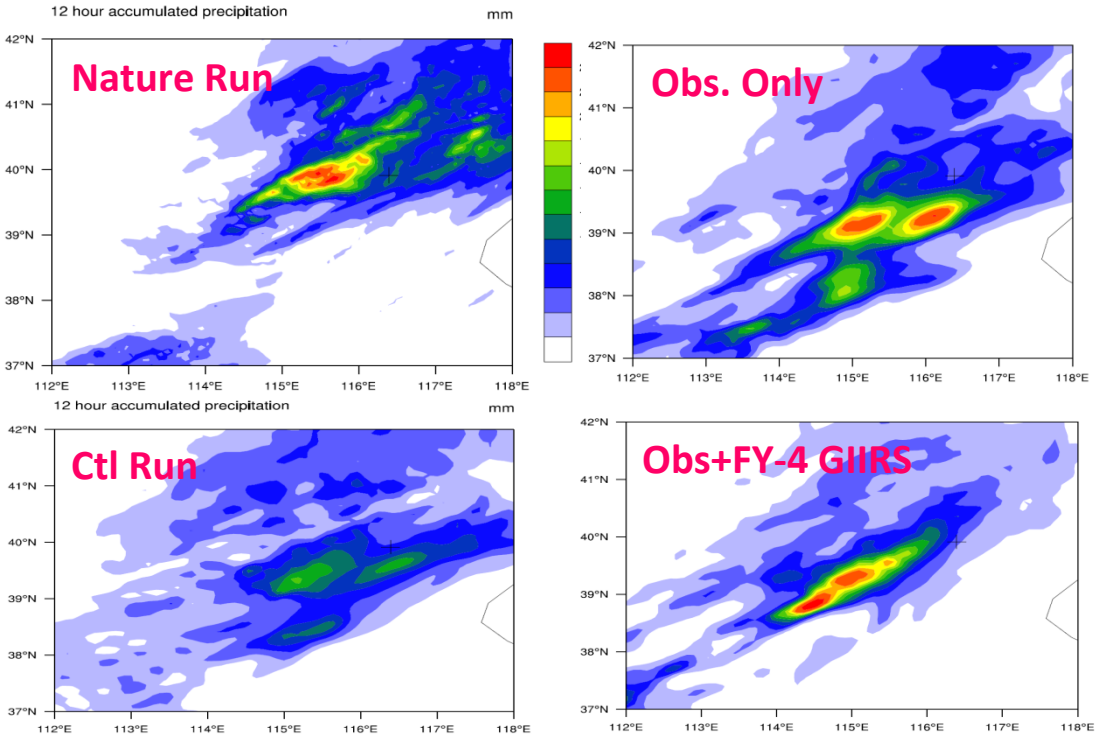
Water Vapor Winds

- Cloud-top and Clear-sky; Mid and Upper troposphere

Courtesy of Prof. Jianmin Xu &Xiaohu Zhang-NSMC FY-4 AWG

GIIRS product development

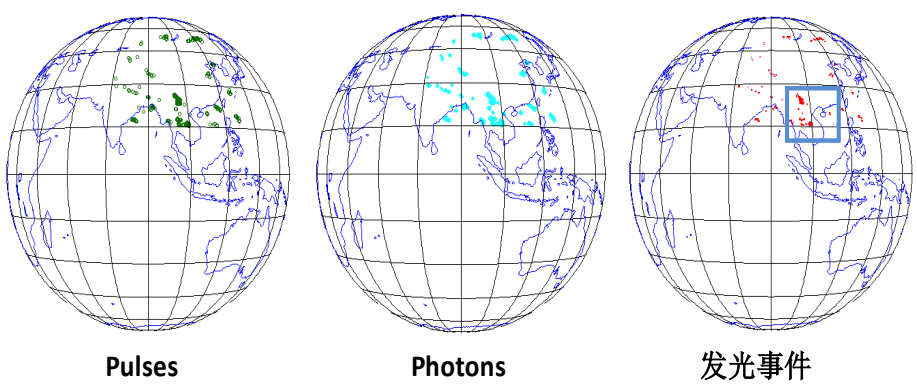


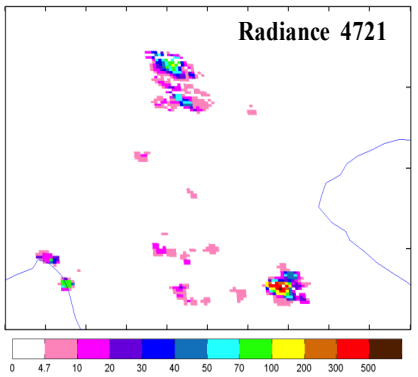


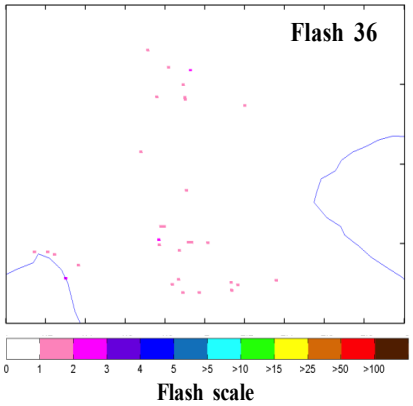
GIIRS simulation Jul.21,2012

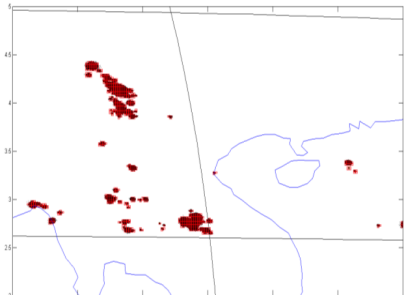
Courtesy of Dr. Jun Li-NSMC FY-4 AWG

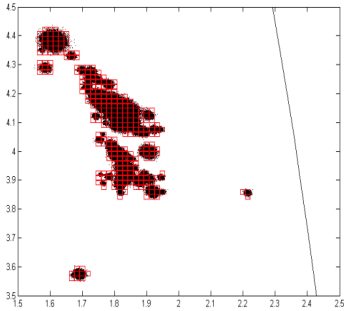
LMI product development

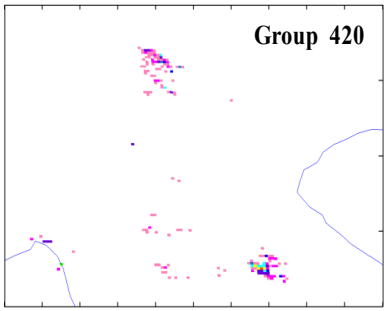


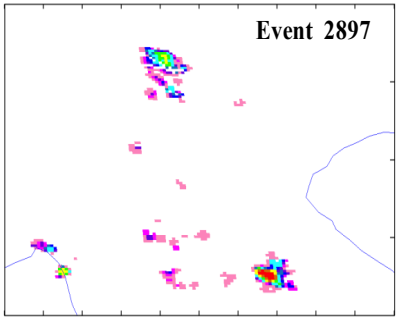






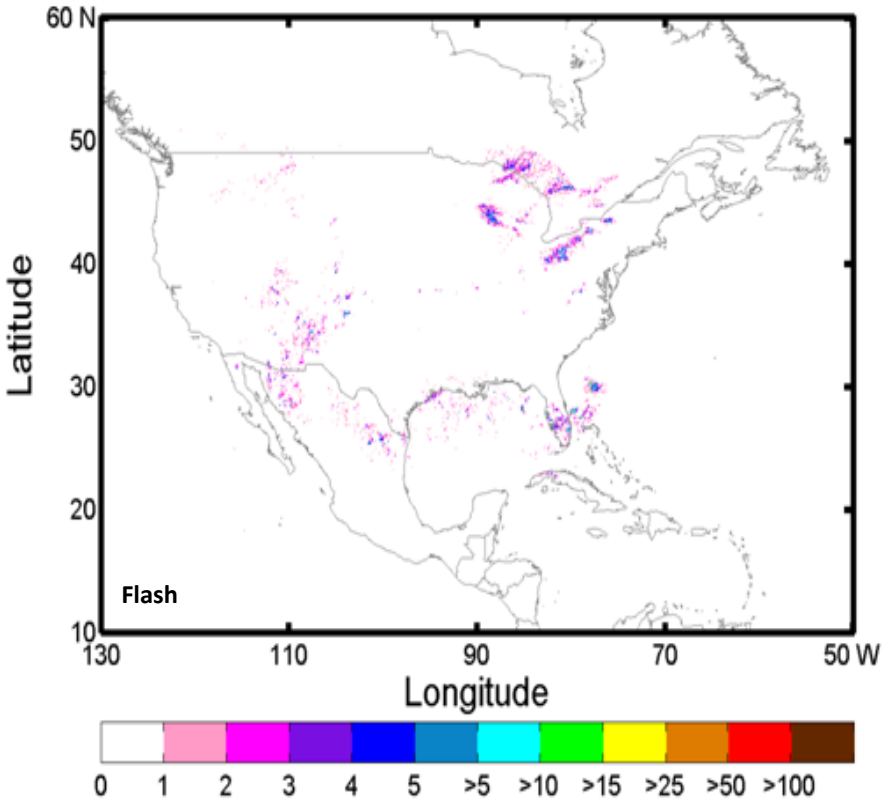


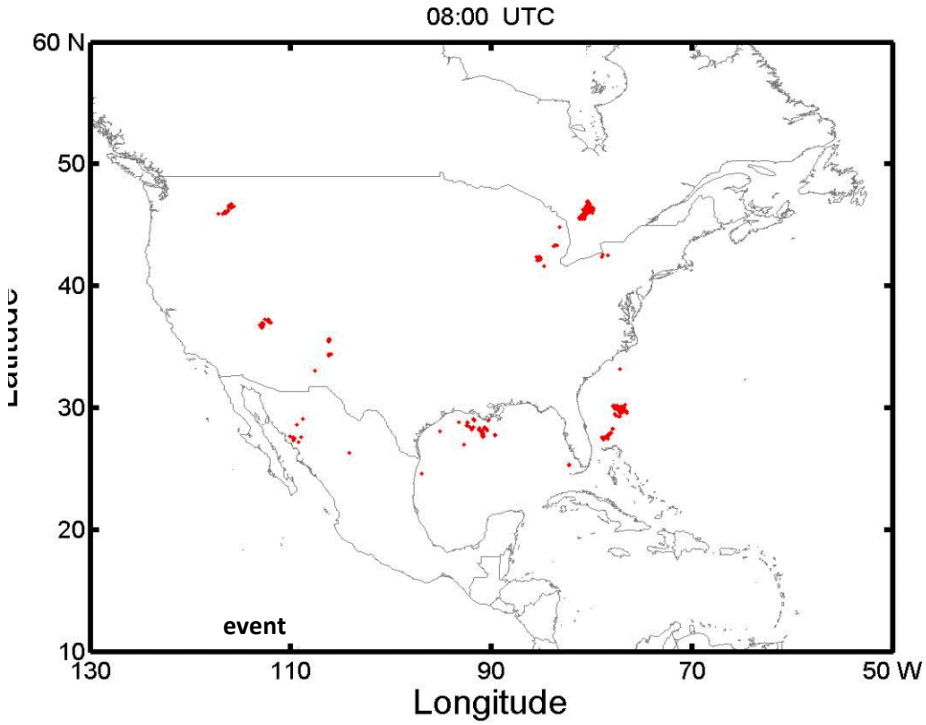




Courtesy of Dr. Dongjie Cao –NSMC FY-4 AWG

LMI algorithm validation





Courtesy of Dr. Dongjie Cao –NSMC FY-4 AWG

GLM proxy data from NOAA/NESDIS

Operational L2 Products of FengYun GEO.

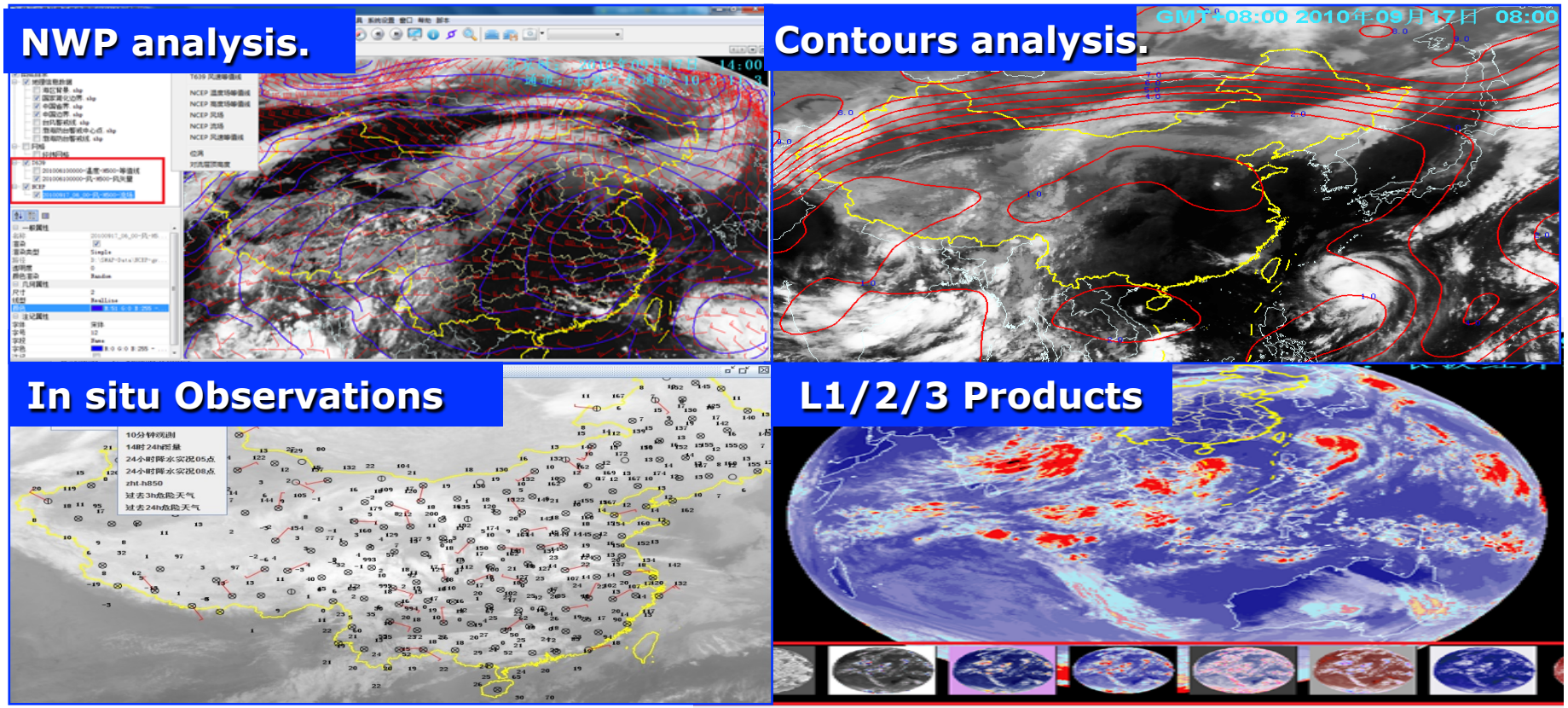
FY-2 C/D/E	FY-2 F/G/H	FY-4A
Cloud Detection	Cloud Detection	Clear Sky Masks
Cloud Classification	Cloud Classification	Cloud Type
Total Cloud Amount	Total Cloud Amount	
		Cloud Optical Depth
		Cloud Liquid Water
		Cloud Particle Size Distribution
		Cloud Phase
	Cloud Top Temperature	Cloud Top Temperature
		Cloud Top Height/Pressure
		Fog Detection
Dust Detection	Dust Detection	Aerosol Detection
		Aerosol Optical Depth
Humidity product	Humidity product	Vertical Moisture Profile
		Vertical Temperature Profile
		Ozone Profile & Total
Total Precipitable Water	Total Precipitable Water	Layer Precipitable Water
		Atmospheric stable Index
		Convective Initiation
		Tropopause Folding/Turbulence Prediction

Operational L2 Products of FengYun GEO. (cont.)

FY-2 C/D/E	FY-2 F/G/H	FY-4A
Upper Tropospheric Humidity	Upper Tropospheric Humidity	
Precipitation Estimation	Precipitation Estimation	Rainfall Rate/QPE
	Atmospheric Motion Vector	Atmospheric Motion Vector
		Lightning Detection
Surface Solar Irradiance	Surface Solar Irradiance	Surface Solar Irradiance
Blackbody brightness temperature	Blackbody brightness temperature	Blackbody brightness temperature
Outgoing Long wave Radiation	Outgoing Long wave Radiation	Outgoing Long wave Radiation
		Downward Long wave Radiation: Surface
		Upward Long wave Radiation: Surface
		Reflected Shortwave Radiation: TOA
	Land Surface Temperature	Land Surface (Skin) Temperature
Sea Surface Temperature	Sea Surface Temperature	Sea Surface Temperature (skin)
		Land Surface Temperature
		Land Surface Albedo
		Land Surface Emissivity
Snow Cover	Snow Cover	Snow Cover
		Fire/Hot Spot Characterization

Application continuality

Satellite Weather Application Platform(SWAP)



Promotion &training

- ✓ SWAP development and test was finished in March, 2013
- ✓ Current version(SWAP 1.0) works for FY-2, and will be upgraded for FY-4;
- ✓ Promotion and training activities have been organized by CMA
- ✓ The system has been installed in provincial weather services in China

Summary

1. FY-4 will be of inspiring capability to acquire hyper spectral sounding observations as well as imaging observations in geo. orbit over Asian-Oceania region. Hopefully it will greatly improve the weather forecast and NWP modeling, and make contributions to global user community.
2. In-depth research and demonstration efforts are encouraged for the applications of new data in weather analysis, NWP, etc., including AGRI， GIIRS and LMI data.
3. CMA will keep its commitment to open data policy for FY-4. A number of training activities are scheduled by CMA. Engagement of regional and global users in the application of FY-4 data are welcome.
4. In order to ensure the accessibility of FY-4 data , the CMACast will be upgraded to enable the near real-time data dissemination , and a Web-based product service system will be developed and make products available to users
5. DB data users need to replace their receiving stations for FY-4

Thank you