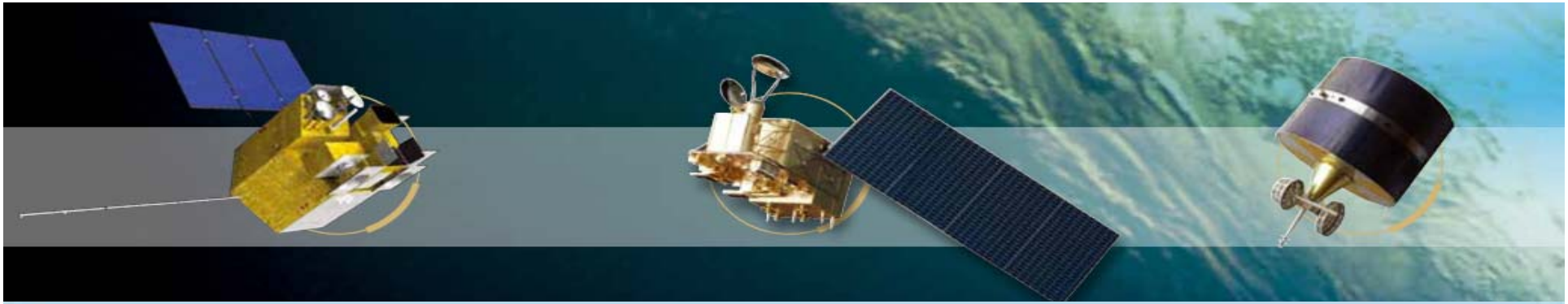


The Latest Progress of FY-3C

Peng ZHANG

National Satellite Meteorological Center ,CMA

19th International TOVS Study Conference
26 March – 1 April 2014, Jeju Island, Republic of Korea

Outline

- FY-3 program in general
- Improvements of FY-3C
- Results from the commission test
- Timetable in 2014

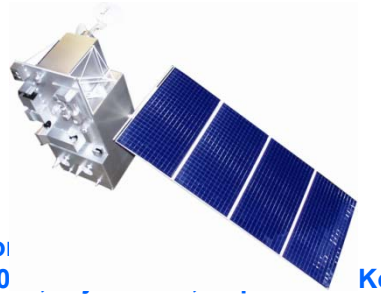
1. FY-3 program in general

Launched Satellites in FY Polar System

1988.09.07	FY-1A	Experimental	39 Days	CZ-4
1990.09.03	FY-1B	Experimental	158 Days	
1999.05.10	FY-1C	Operational	6.5 Years	
2002.05.15	FY-1D	Operational	>10 Years	
2008.05.17	FY-3A	AM Orbit	Operation	
2010.11.05	FY-3B	PM Orbit	Operation	
2013. 9.23	FY-3C	AM Orbit	Commission Test	

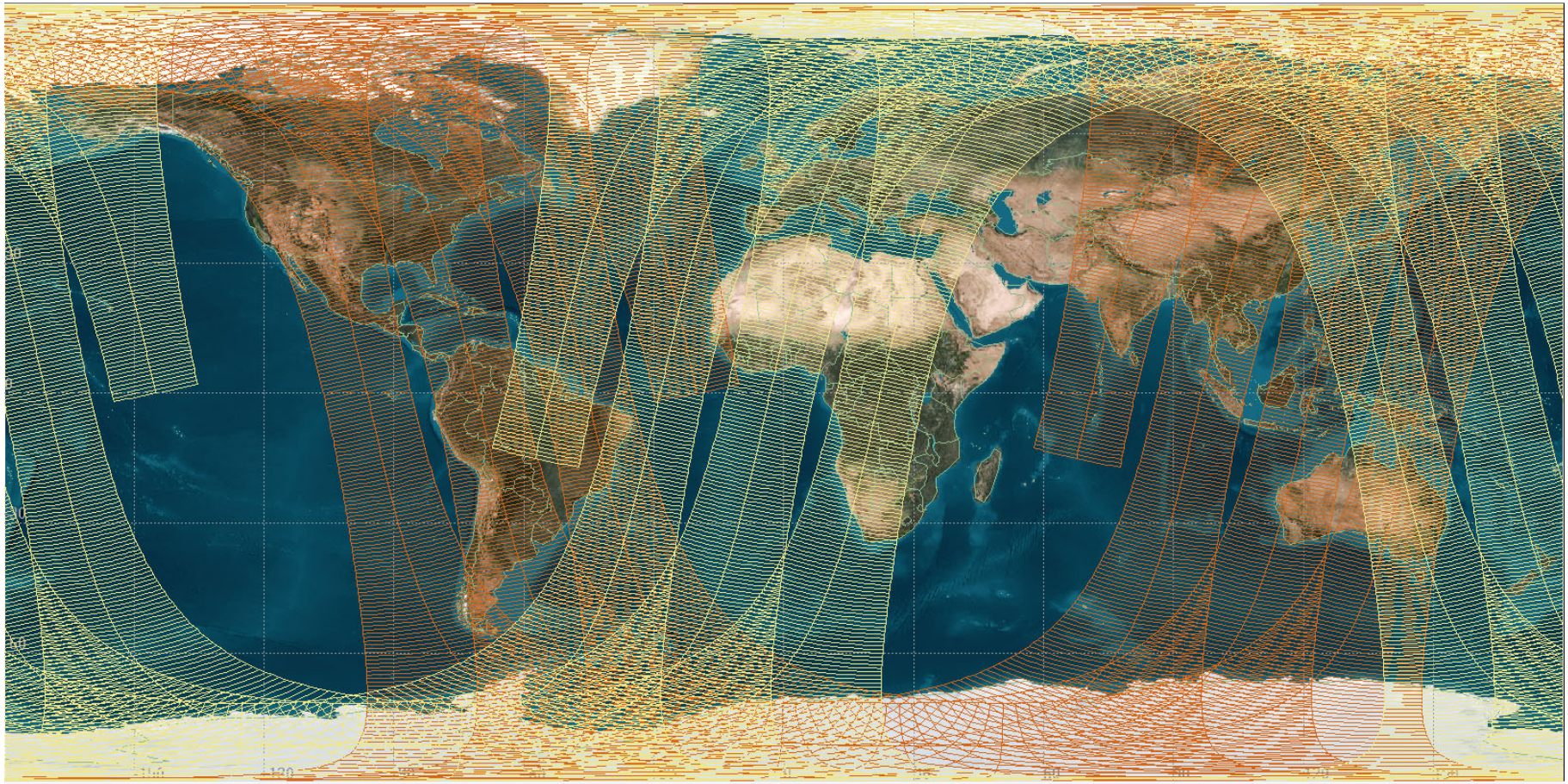
FY-3 is the second generation of Chinese meteorological polar-orbiting satellites. In the 1990s, the FY-3 series was designed in the concept to perform global, three-dimensional, quantitative and multi-spectral observations under all weather conditions (i.e., both cloud-free and cloudy conditions) with multiple sensors on board

First Generation **Second Generation**



Fengyun Polar

- Decommission: FY-1D
- In operation: FY-3A + FY-3B **Global Coverage per 6 hours**
- In trail operation: FY-3C

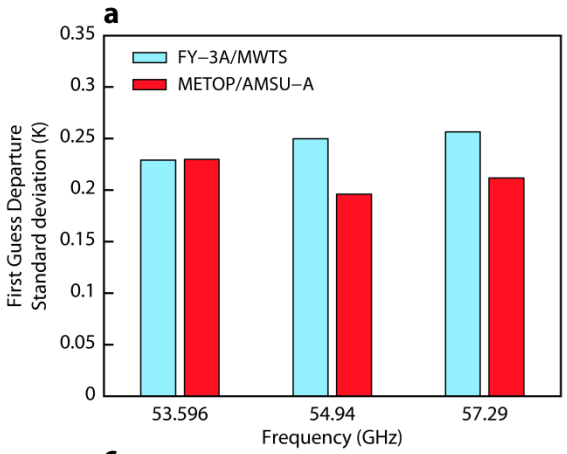


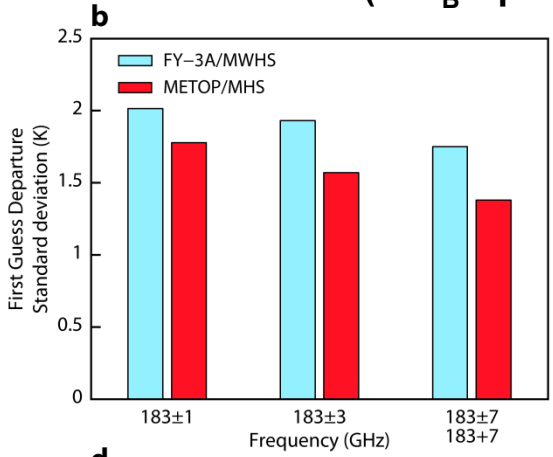
FY-3A LTC 10:00 AM FY-3B LTC 13:40 PM

Initial Data Quality Assessment at ECMWF: Comparison of FY-3A with MetOp & Aqua

STDEV (first guess departures):
measures the misfit between model & measurement (in T_B space)

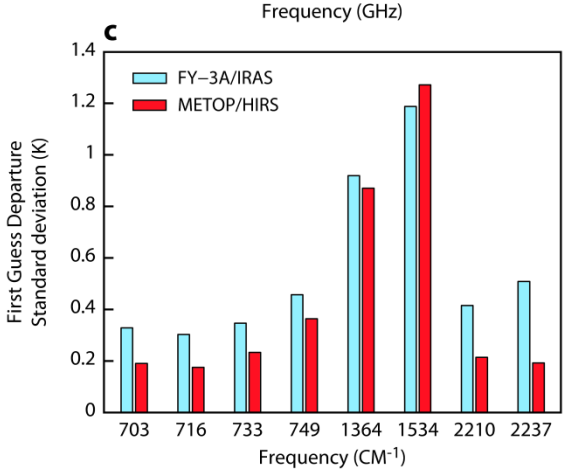
Microwave Temperature Sounder

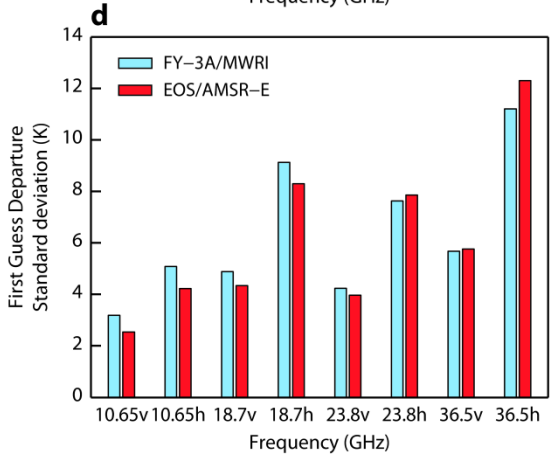




Microwave Humidity Sounder

Infrared Sounder





Microwave Imager

FY-3A data quality is comparable with MetOp/Aqua equivalents

FY-3A/B follow-on

FY-3 OPERATIONAL SATELLITE INSTRUMENTS	FY-3C	FY-3D	FY-3E	FY-3F
MERSI – Medium Resolution Spectral Imager (I, II, III)	√(I)	√(II)	√(III)	√(II)
MWTS – Microwave Temperature Sounder (II)	√	√	√	√
MWHS – Microwave Humidity Sounder (II, III)	√(II)	√(II)	√(III)	√(II)
MWRI – Microwave Radiation Imager	√	√		√
WindRAD - Wind Radar			√	
GAS - Greenhouse Gases Absorption Spectromete		√		
HIRAS – Hyperspectral Infrared Atmospheric Sounder		√	√	√
OMS – Ozone Mapping Spectrometer				√
GNOS – GNSS Occultation Sounder	√	√	√	
ERM – Earth Radiation Measurement (I, II)	√(I)			√(II)
SIM – Solar irritation Monitor (I, II,III)	√(II)		√(III)	
SES – Space Environment Suite	√	√	√	√
IRAS – Infrared Atmospheric Sounder	√			
VIRR – visible and Infrared Radiometer	√			
SBUS – Solar Backscattered Ultraviolet Sounder	√			
TOU – Total Ozone Unit	√			

FY-3 series is expected to last its measurements at least 15 years with additional four satellites. There are 16 improved or new instruments will be configured from FY-3C to FY-3F in the schedule.

FY-3C/D/E/F Payload Configuration

2. Improvements of FY-3C

Launched on Sept 23, 2013

FY-3 OPERATIONAL SATELLITE INSTRUMENTS	FY-3C
MERSI – Medium Resolution Spectral Imager (I, II)	√(I)
MWTS – Microwave Temperature Sounder (I, II)	√(II)
MWHS – Microwave Humidity Sounder (I, II)	√(II)
MWRI – Microwave Radiation Imager	√
WindRAD - Wind Radar	
GAS - Greenhouse Gases Absorption Spectromete	
HIRAS – Hyperspectral Infrared Atmospheric Sounder	
OMS – Ozone Mapping Spectrometer	
GNOS – GNSS Occultation Sounder	√
ERM – Earth Radiation Measurement (I, II)	√(I)
SIM – Solar irritation Monitor (I, II)	√(II)
SES – Space Environment Suite	√
IRAS – Infrared Atmospheric Sounder	√
VIRR – visible and Infrared Radiometer	√
SBUS – Solar Backscattered Ultraviolet Sounder	√
TOU – Total Ozone Unit	√

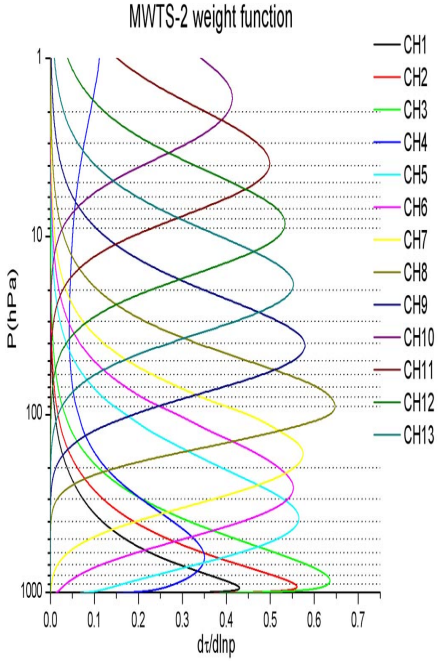
New Features:

- Inheriting all the instruments: 60% characteristics of the instruments specifications were improved twice than requirements
- New instrument: GNOS
- Improving the microwave sounding capability: MWTS II and MWHS II
- Improving the Solar measurements: SIM II

WMTS II

Parameter	Specification
Scan Angle	±49.5°
Pixels Per Scan Line	90
Quantization	13 bits

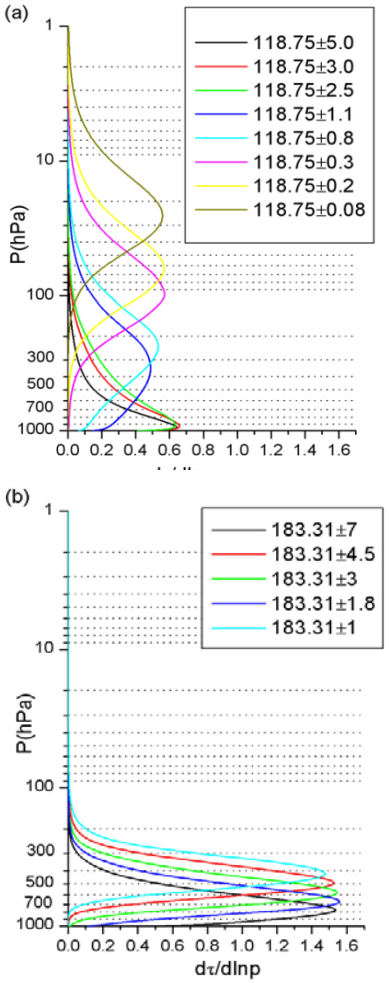
15



Ch No.	Central Frequency (GHz)	3dB Bandwidth (MHz)	NEΔT (K)	Main Beam Eff.	Dynamic Range (K)	Cal. Acc. (K)	Purpose
1	50.3	180	1.20	>90%	3～340	1.5	Surface Emiss.
2	51.76	400	0.75	>90%	3～340	1.5	Atmospheric Temperature Profile
3	52.8	400	0.75	>90%	3～340	1.5	
4	53.596	400	0.75	>90%	3～340	1.5	
5	54.40	400	0.75	>90%	3～340	1.5	
6	54.94	400	0.75	>90%	3～340	1.5	
7	55.50	330	0.75	>90%	3～340	1.5	
8	57.290344(fo)	330	0.75	>90%	3～340	1.5	
9	fo±0.217	78	1.20	>90%	3～340	1.5	
10	fo±0.3222±0.048	36	1.20	>90%	3～340	1.5	
11	fo±0.3222±0.022	16	1.70	>90%	3～340	1.5	
12	fo±0.3222±0.010	8	2.40	>90%	3～340	1.5	
13	fo±0.3222±0.0045	3	3.60	>90%	3～340	1.5	

WMHS II

Parameter	Specification
Scan Angle	±53.35°
Pixels Per Scan Line	98
Quantization	14 bits



Ch No.	Central Frequency (GHz)	Polarization	Band width (MHz)	Freq. Stability (MHz)	Dynamic Range (K)	NE ΔT (K)	Cal. Acc. (K)	Main Beam Width	Main Beam Eff.	Purpose
1	89.0	V	1500	50	3－340	1.0	1.3	2.0°	>92%	Surface and Precipitation
2	118.75±0.08	H	20	30	3－340	3.6	2.0	2.0°	>92%	Atmospheric Temperature Profile
3	118.75±0.2	H	100	30	3－340	2.0	2.0	2.0°	>92%	
4	118.75±0.3	H	165	30	3－340	1.6	2.0	2.0°	>92%	
5	118.75±0.8	H	200	30	3－340	1.6	2.0	2.0°	>92%	
6	118.75±1.1	H	200	30	3－340	1.6	2.0	2.0°	>92%	
7	118.75±2.5	H	200	30	3－340	1.6	2.0	2.0°	>92%	
8	118.75±3.0	H	1000	30	3－340	1.0	2.0	2.0°	>92%	
9	118.75±5.0	H	2000	30	3－340	1.0	2.0	2.0°	>92%	
10	150.0	V	1500	50	3－340	1.0	1.3	1.1°	>95%	Surface and Precipitation
11	183.31±1	H	500	30	3－340	1.0	1.3	1.1°	>95%	Atmospheric Moisture Profile
12	183.31±1.8	H	700	30	3－340	1.0	1.3	1.1°	>95%	
13	183.31±3	H	1000	30	3－340	1.0	1.3	1.1°	>95%	
14	183.31±4.5	H	2000	30	3－340	1.0	1.3	1.1°	>95%	
15	183.31±7	H	2000	30	3－340	1.0	1.3	1.1°	>95%	

H Removed

GNOS

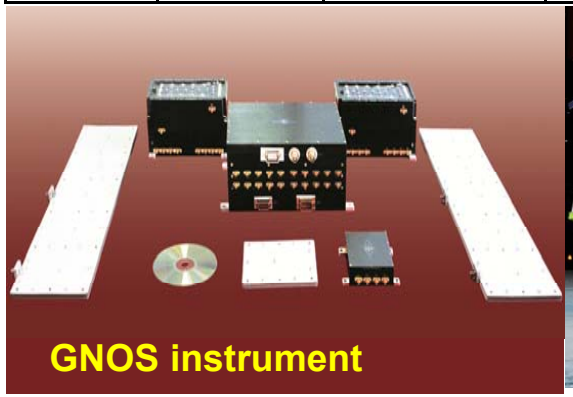
GNOS will receive two types of signal from GPS and China BeiDou-2. GNOS will observe over 1000 occultations per day with GPS and BD satellites,

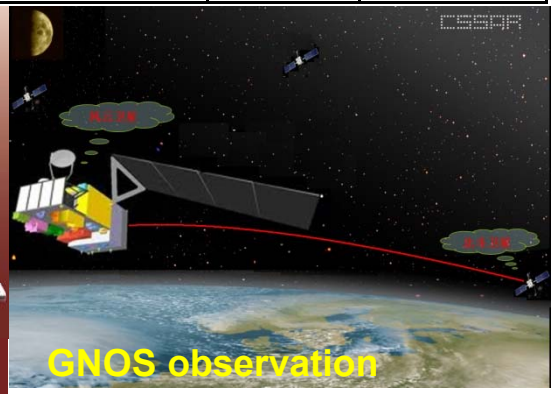
Expected Products

- Temperature profiles
- Humidity profiles
- Refractivity profiles
- Electronic content profiles

Frequency	GPS L1/L2; BD2
Receiver Channels	8 (Navigation) 4 (Occultation)
Sampling rate	1 ~ 50 Hz
Crystal oscillator	1e-11 (100s)
Real-time position	10m（RMS）
Real-time velocity	0.1m/s(RMS)
Phase center accuracy	2 mm (RMS)
Antenna number	1 (Navigation) 2 (Occultation)

		Temperature	Humidity	Refractivity	Electronic Content
RMS Accuracy	Low Tropos.	0.5-3 k	0.25-1.0 g/kg	0.1-0.5%	(100-600 km) < 20%
	High Tropos.	0.5-3 k	0.05-0.2 g/kg	0.1-0.2%	
	Low Stratos.	0.5-3 k	--------	0.1-0.2%	
	High Stratos.	0.5-5 k	--------	0.2-2.0%	


GNOS instrument

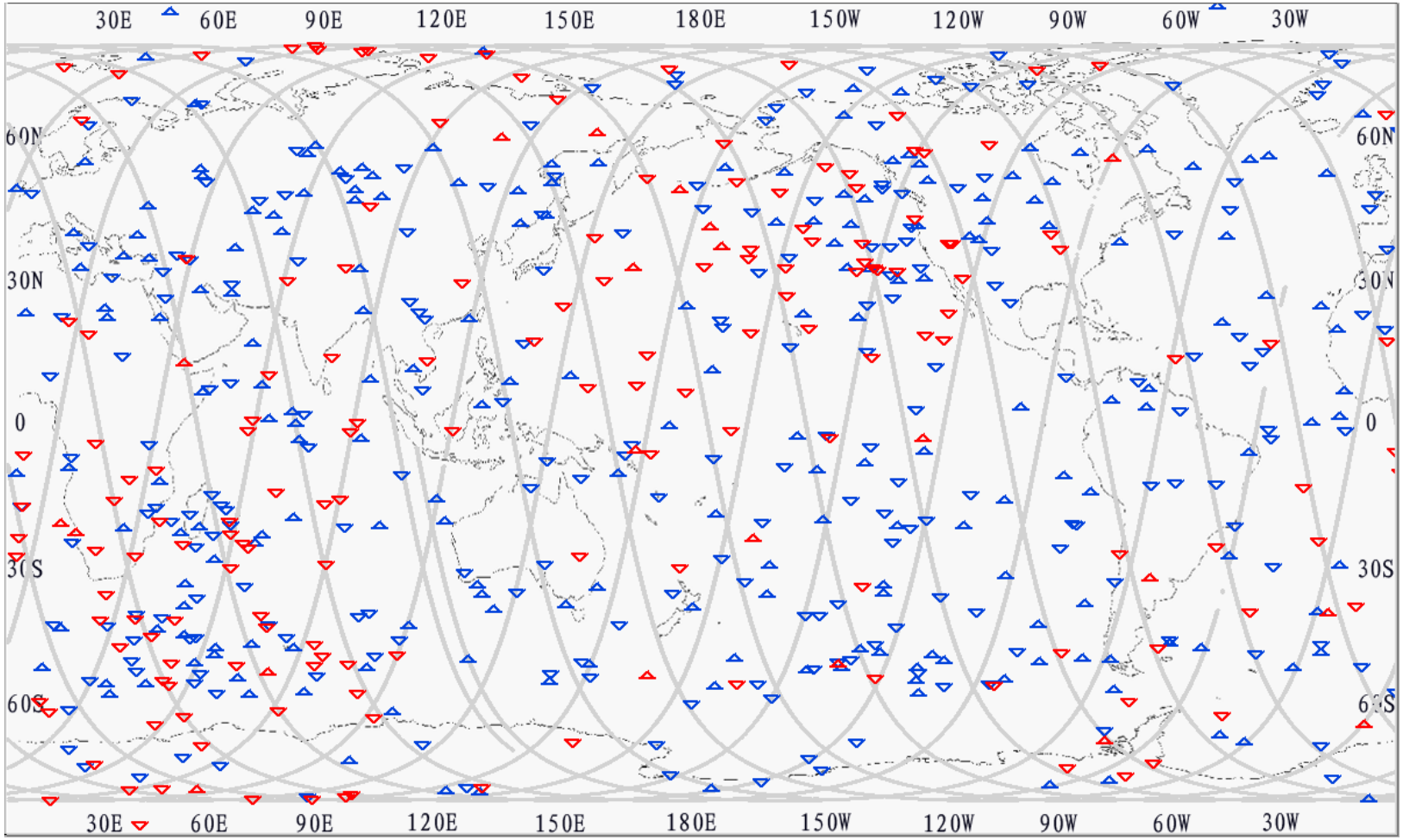

GNOS observation

GNOS

GPS Occultation Events: 426
Beidou Occultation Events: 184

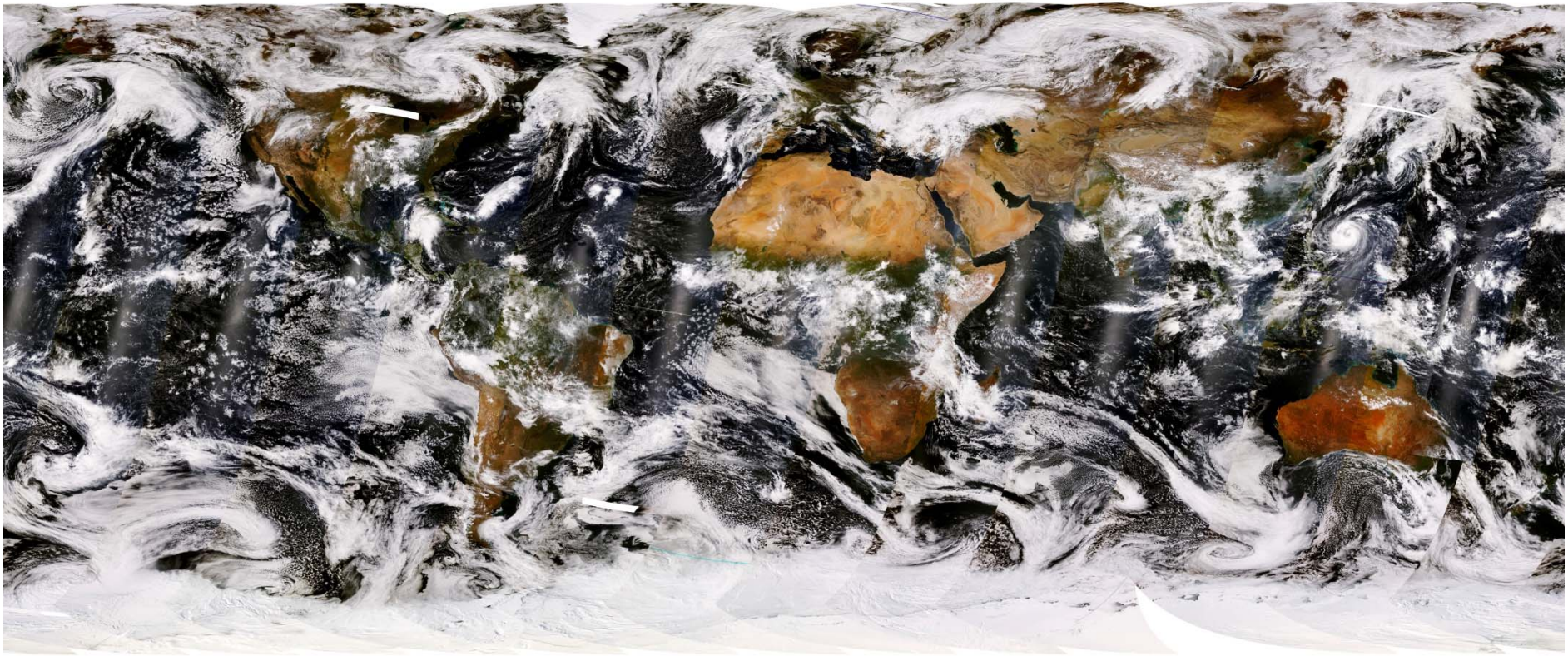
Products

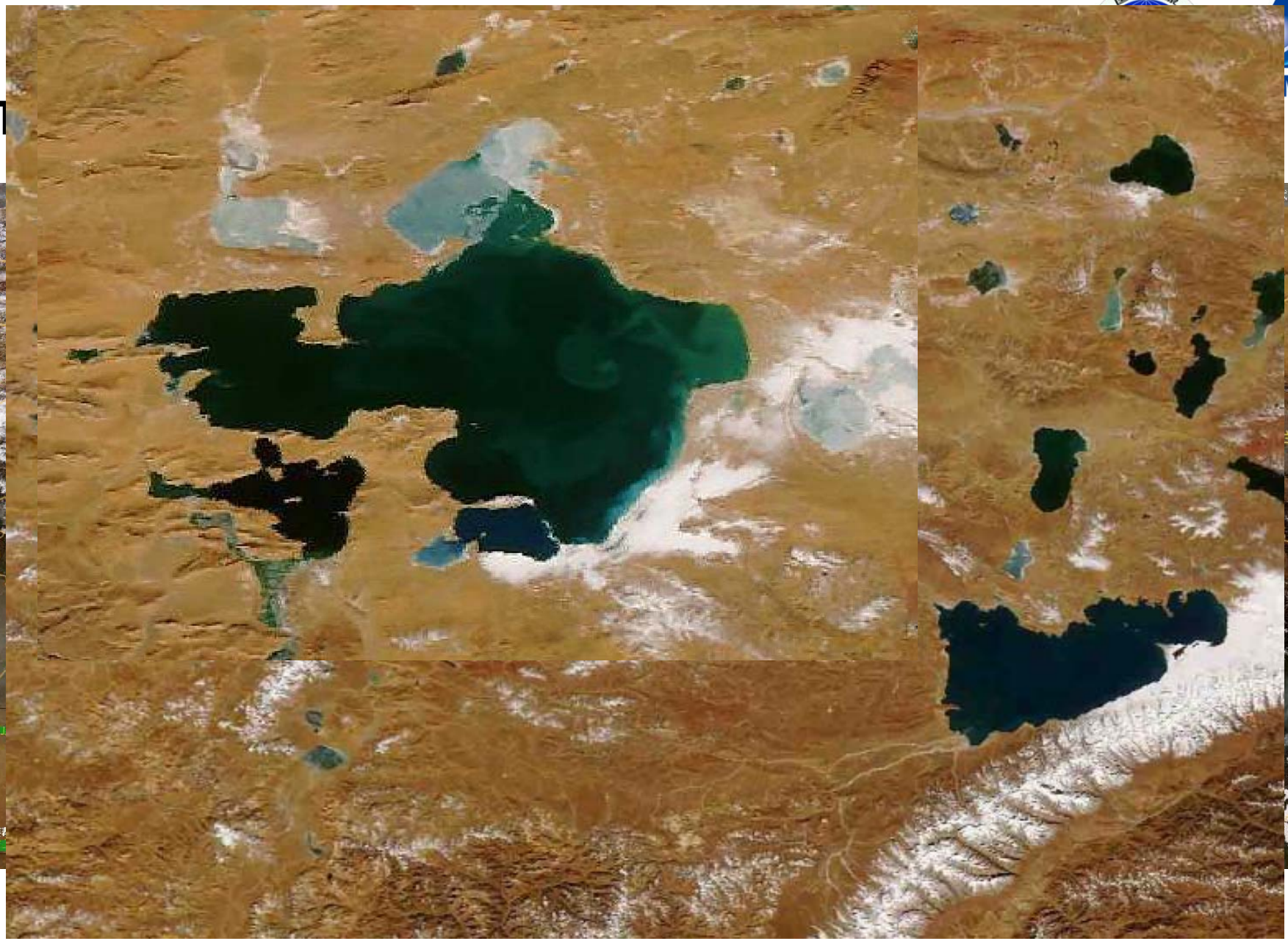
- Temperature profiles
- Humidity profiles
- Refractivity profiles
- Electronic content profiles



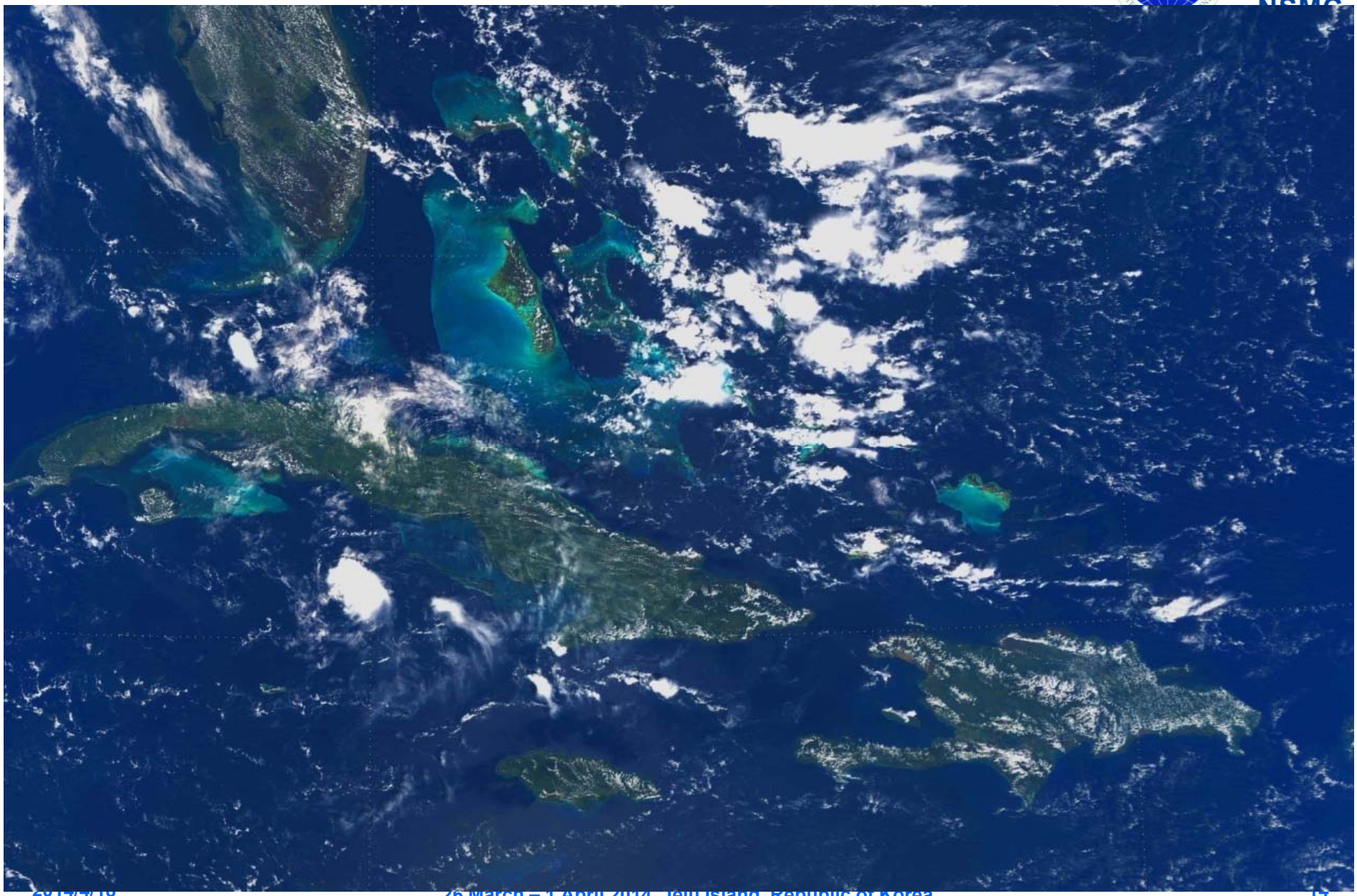
3. Results from the commission test

First Global Image on Oct. 2, 2013 from MERSI

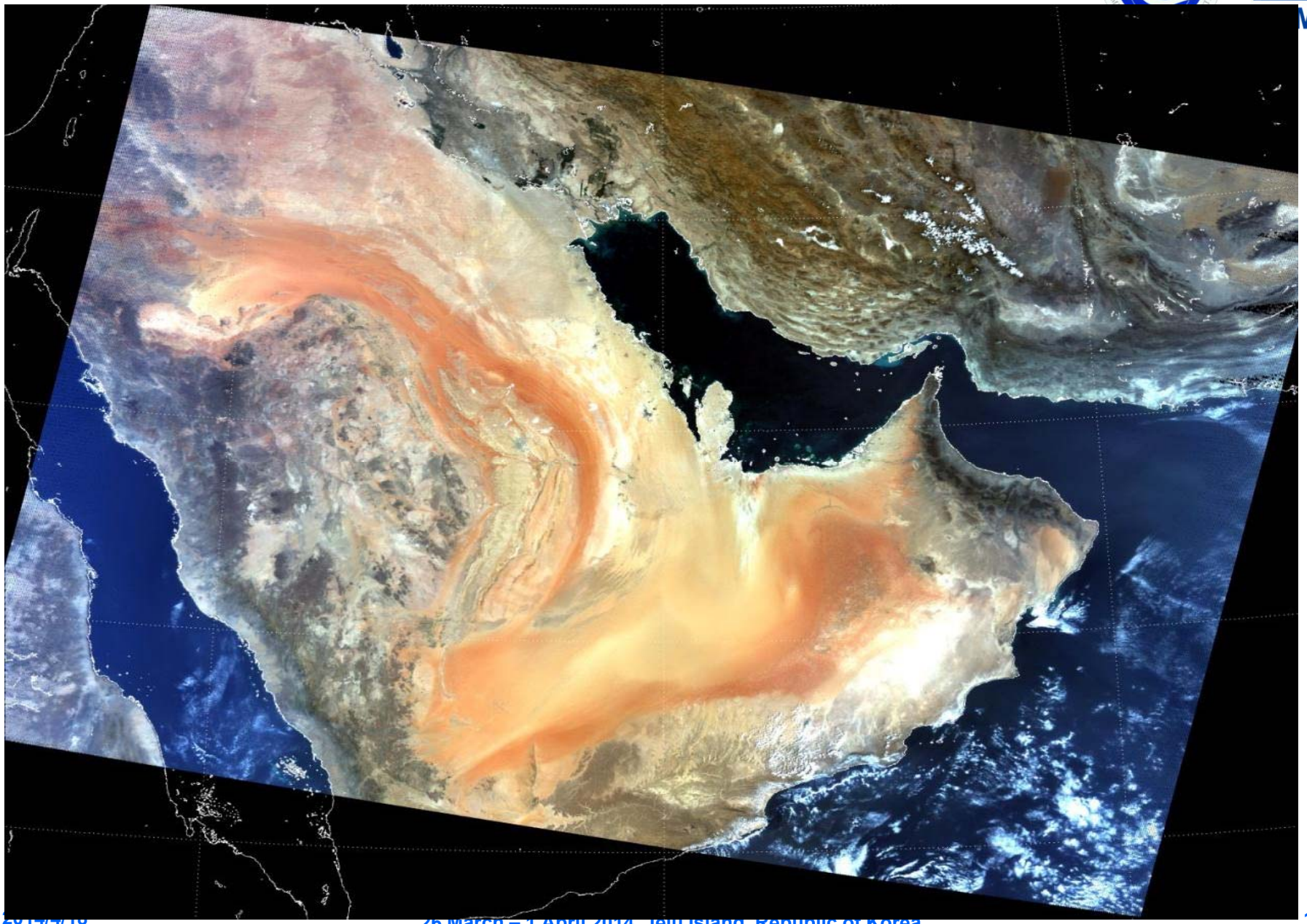




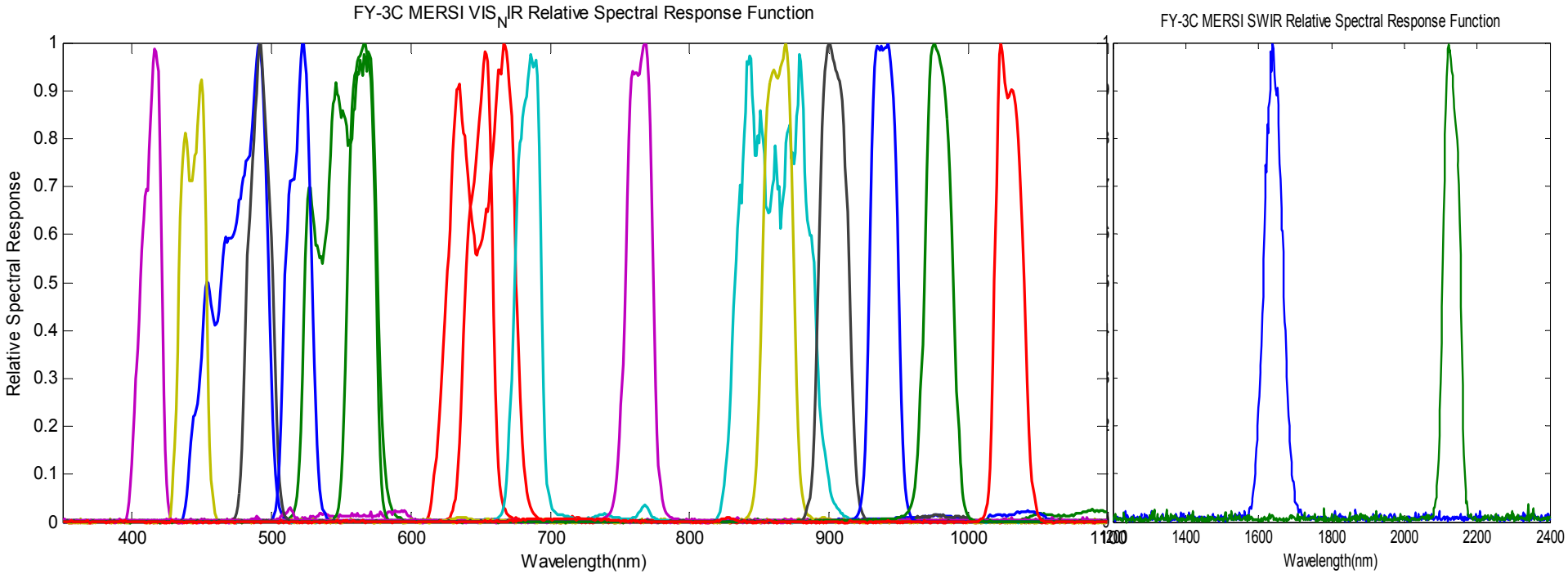
FY-3C MERSI: The Florida Peninsula

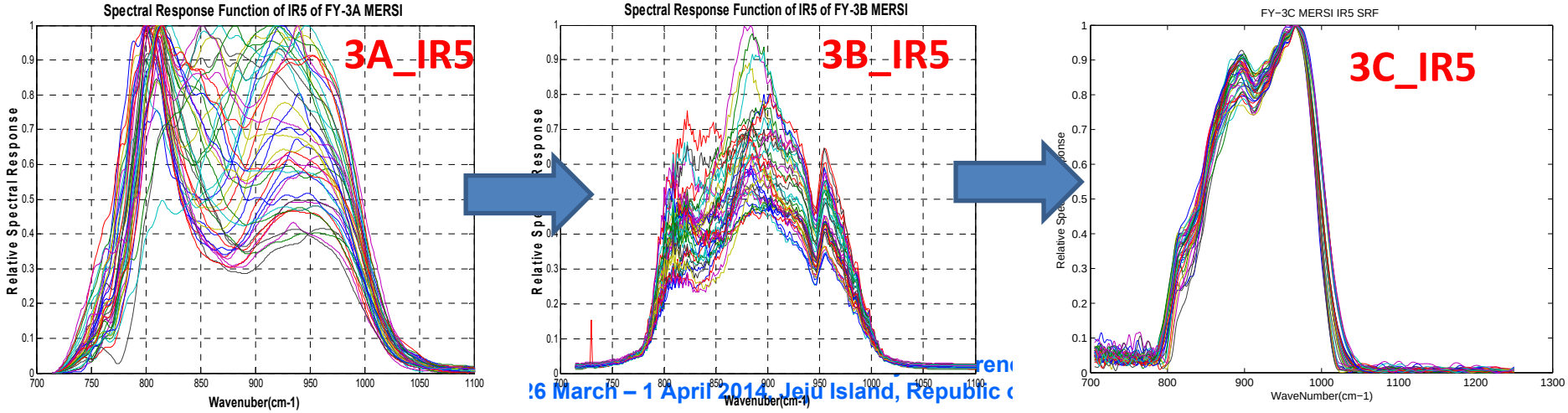


FY-3C MERSI: Arabian Peninsula

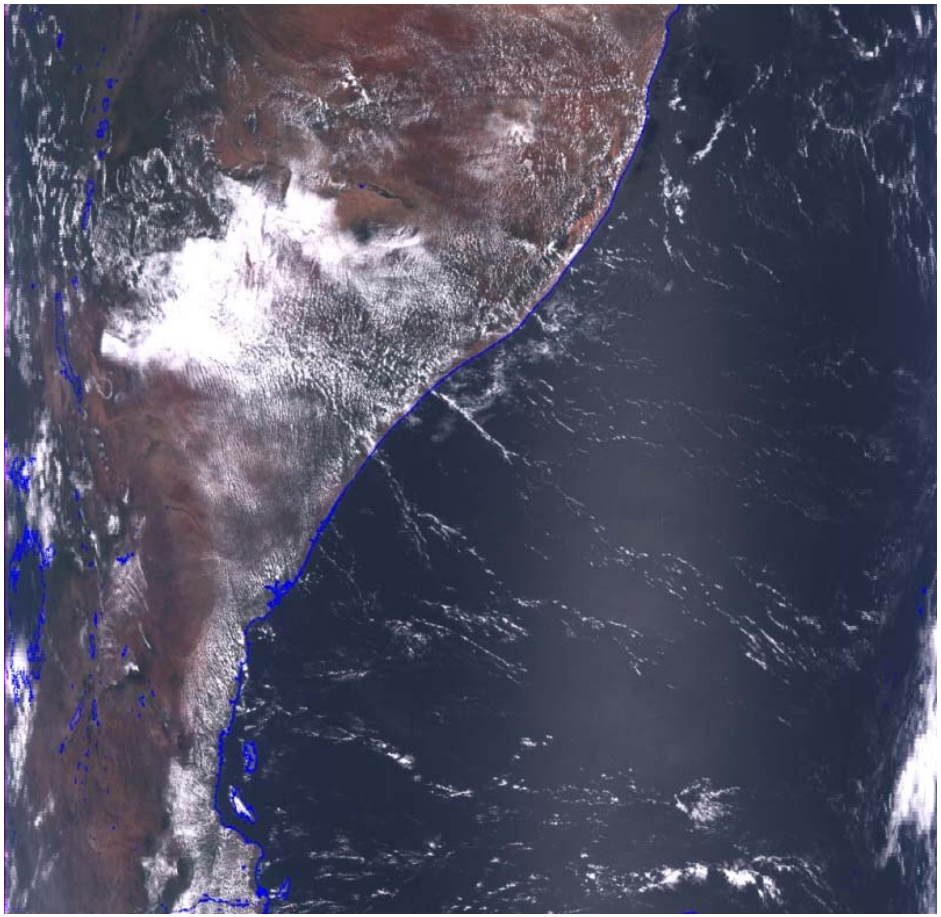


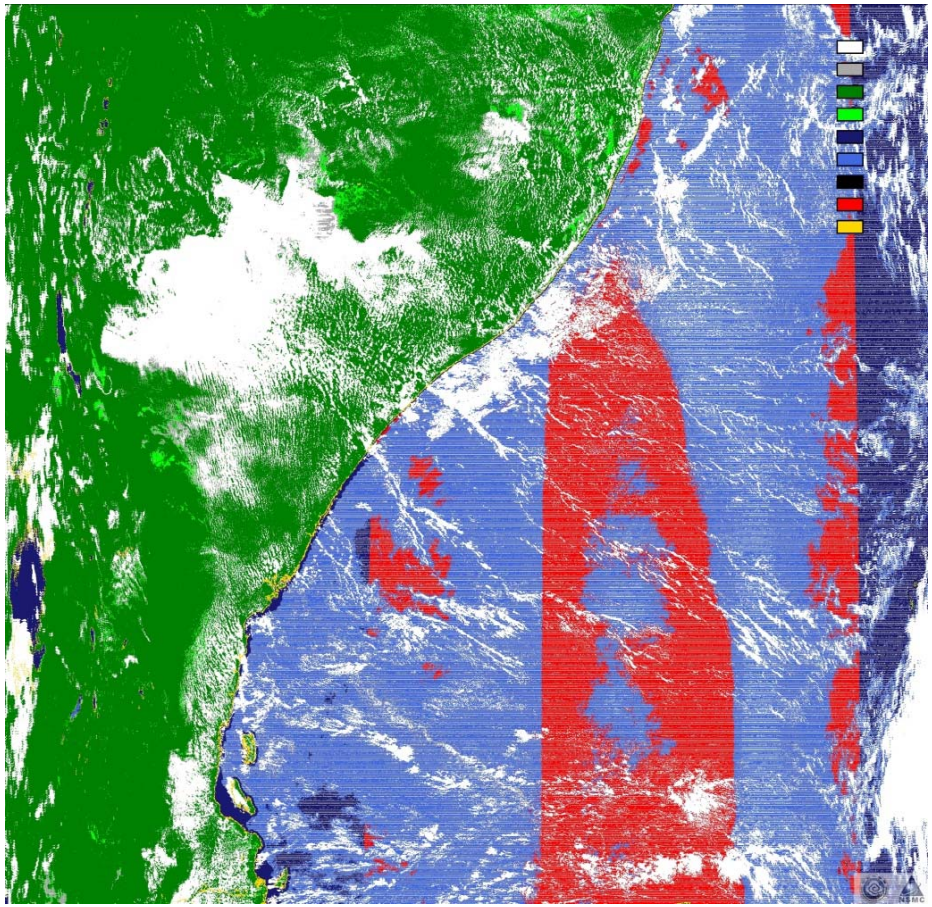
SRF homogeneity of the Multi detectors



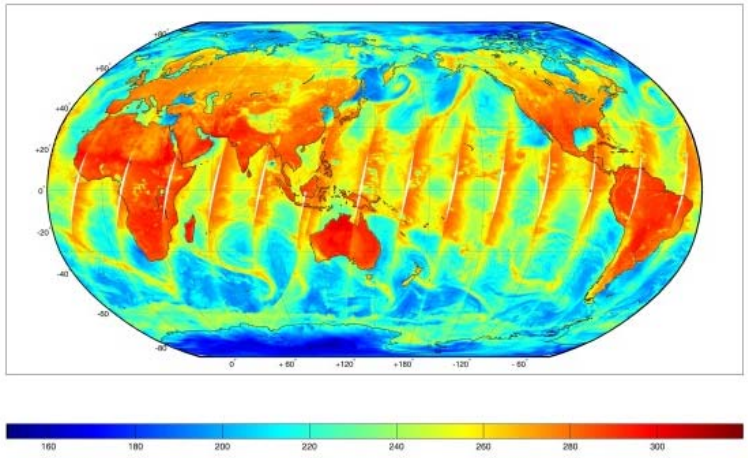


The improved detector homogeneity allows the improved cloud mask

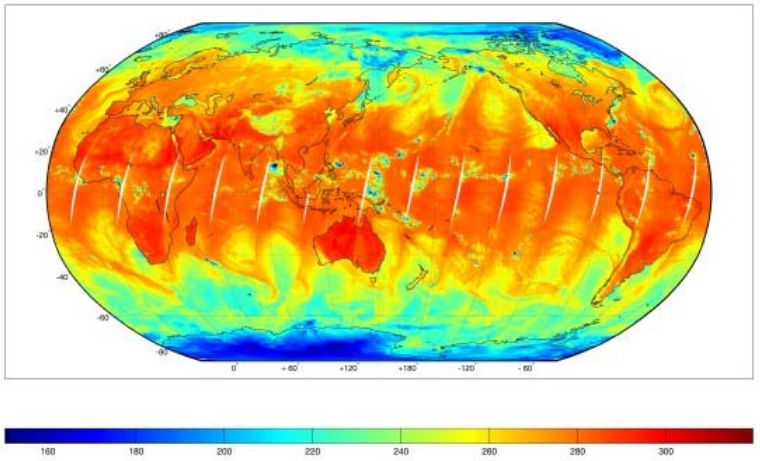




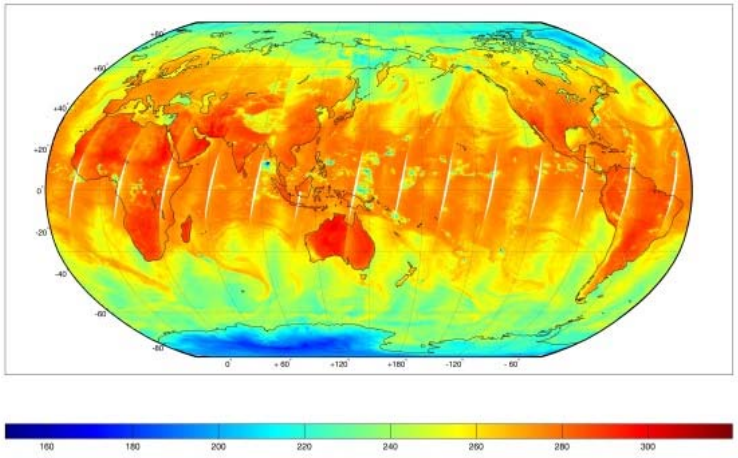
Global Image on Oct. 8, 2013 from MWHS



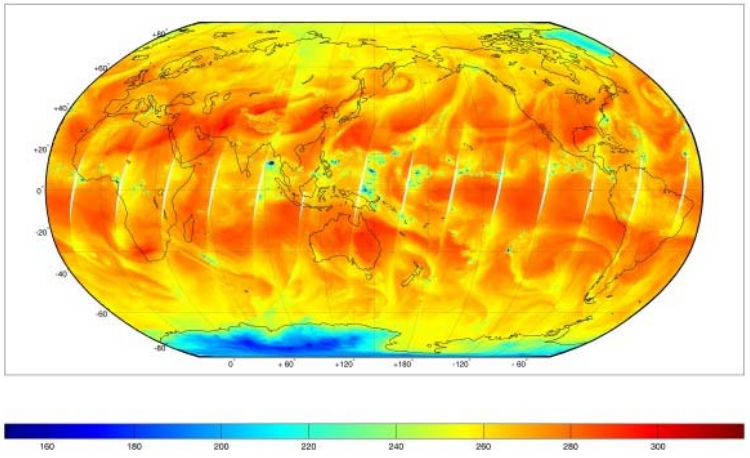
89GHz



150GHz

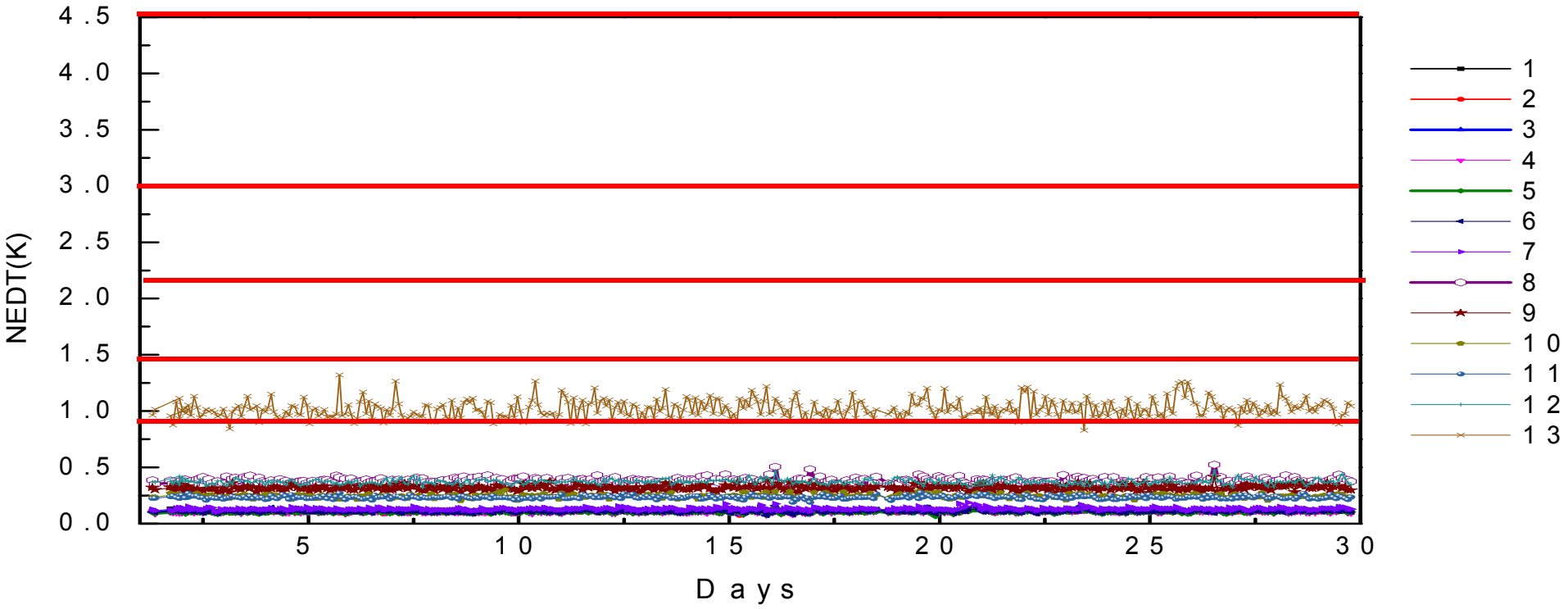


118GHz-8



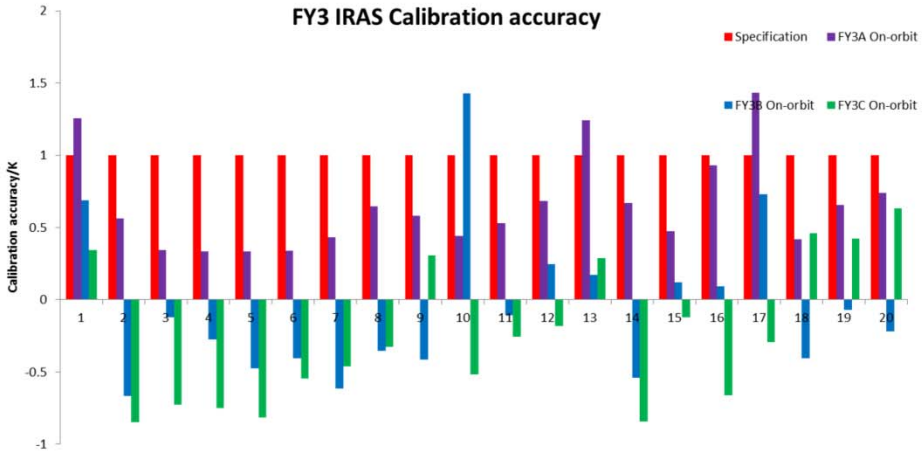
183GHz-4

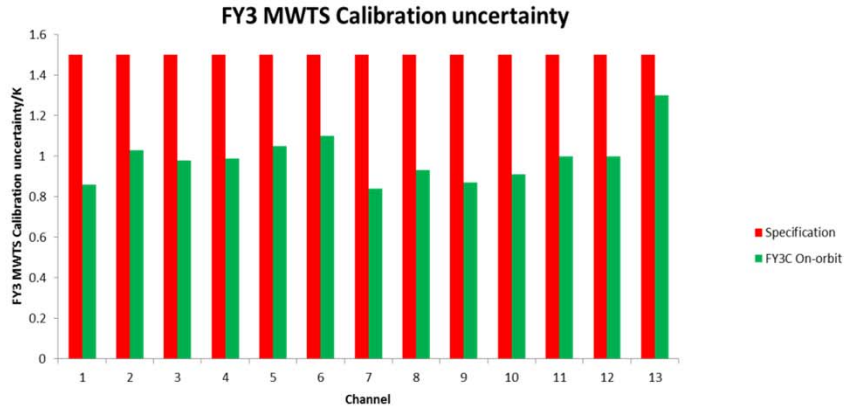
NEdT Stability of MWTS
2013.12.1-30

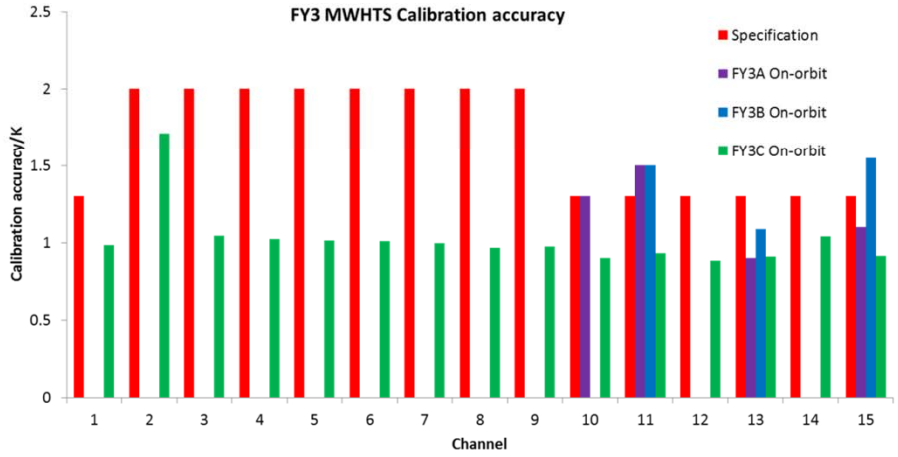


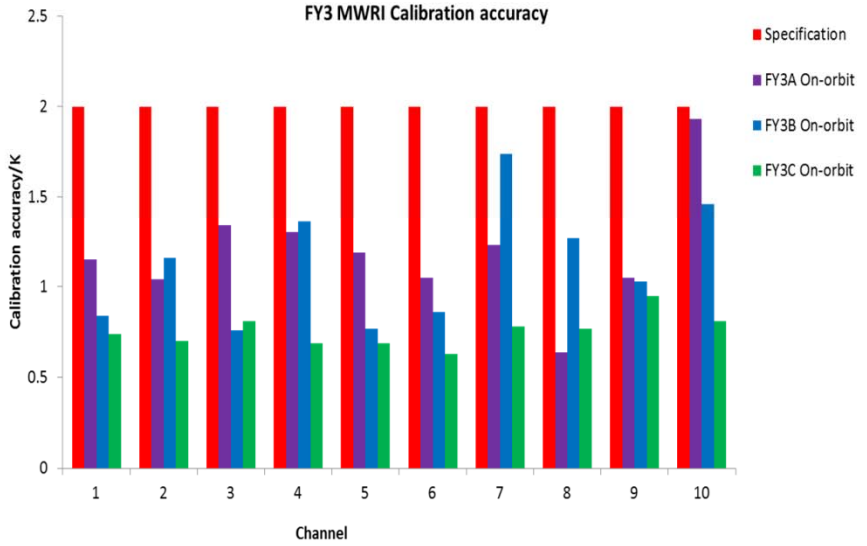
Uncertainty of Radiance Calibration

IR from inter-calibration
MW from uncertainty estimation of the on-orbit calibration system

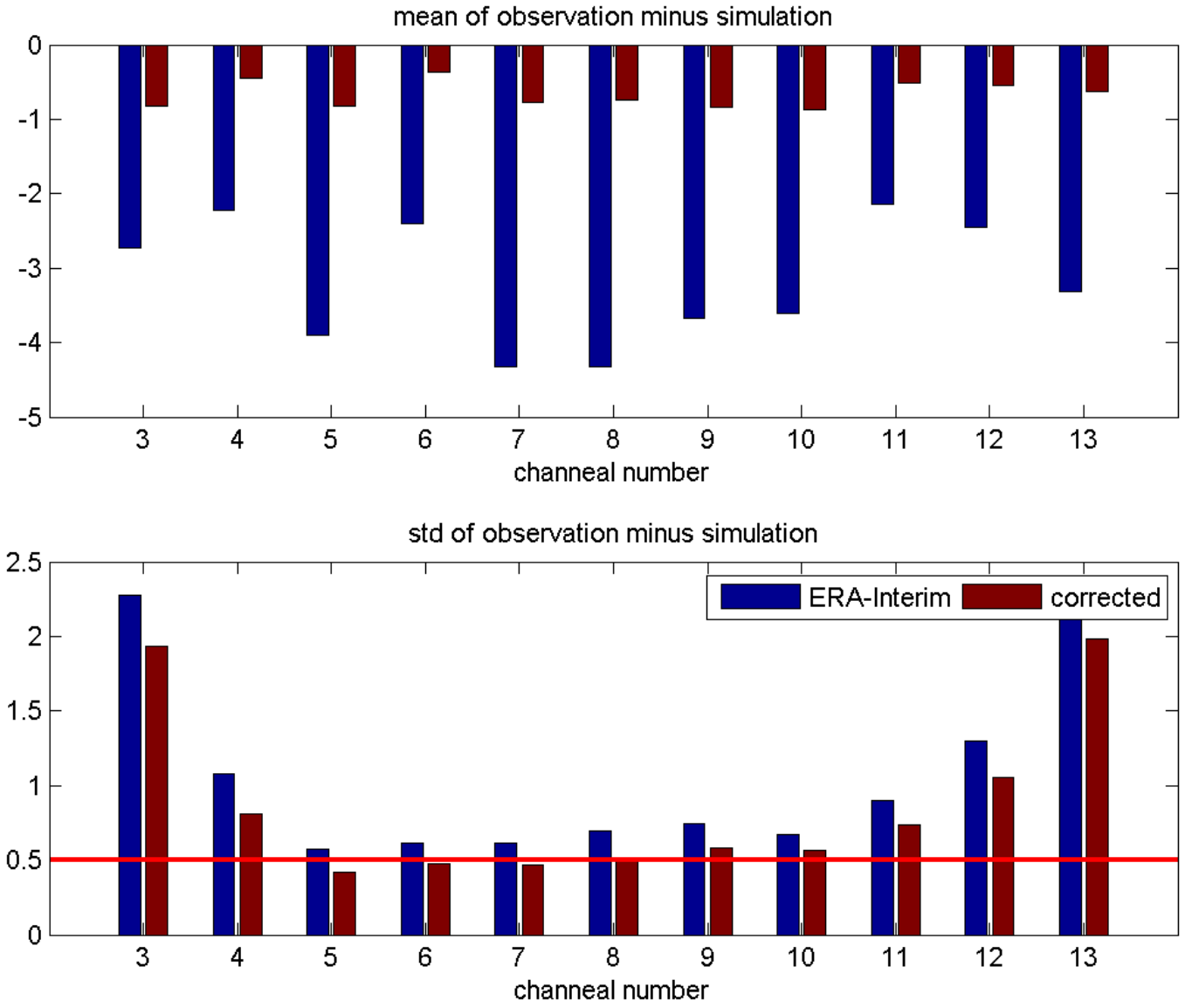








O-B of MWTS

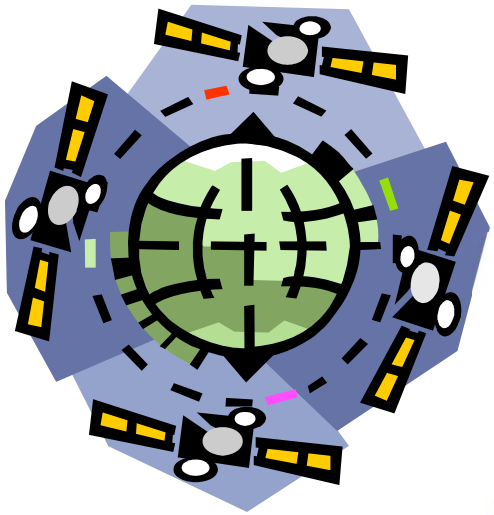

mean of observation minus simulation
0
-1
-2
-3
-4
-5
3
4
5
6
7
8
9
10
11
12
13
channeal number
std of observation minus simulation
2.5
2
1.5
1
0.5
0
ERA-Interim
corrected
3
4
5
6
7
8
9
10
11
12
13
channeal number

Conclusion of FY-3C

- One new instrument for occultation sounding
- Three instruments has been improved
- Good Image Quality
- Good Performance of the NEΔN and Calibration accuracy: 60% NEΔN of instruments on the FY-3C has been improve at least twice than on FY-3A/B
- Current in the trail operation

4. Timetable in 2014

- Launch : 23 Sept, 2013
- Commission Test : Until Feb., 2014
  - Instrument Performance test
  - SDR calibration
- Trail Operation : March to May, 2014
  - EDR validation
- Operation : Since June, 2014
  - Global data release
  - Fengyun View toolkit release
  - FY-3C IPP for DB users (since Sept., 2014)



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Thank you!