National Remote Sensing Center of China
Agency Report

Presented by Chuanrong Li

National Remote Sensing Center of China
Ministry of Science and Technology, P. R. China

May, 2015

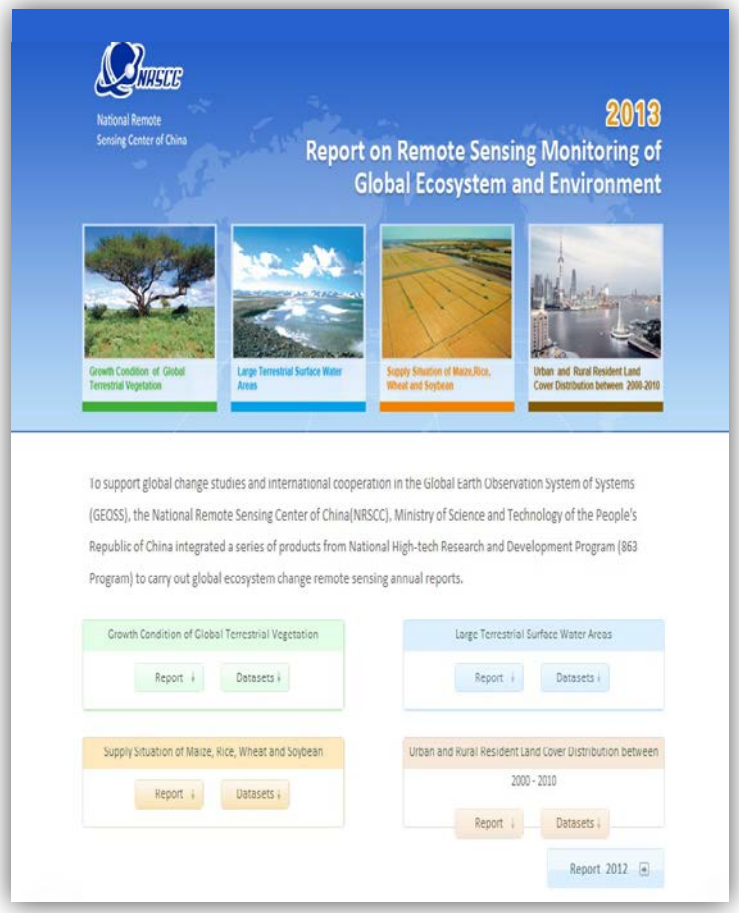
CEOS / WGCV-39 Plenary

Mission and Activities

1. The Reports on Remote Sensing Monitoring of Global Ecosystem and Environment
2. Aerospace Application Coordination System for Emergency Response and Data Sharing (ArcSer)
3. Data Sharing Service
4. Regional Collaborative Mechanism on Drought Monitoring and Early Warning
5. Flight Campaigns over Baotou Cal&Val Site

The reports on Remote Sensing Monitoring of Global Ecosystem and Environment

The reports on Remote Sensing Monitoring of Global Ecosystem and Environment have been issued since 2012. The datasets and analytical reports are available at the Website of China Spatial Data and Information Network (http://www.csi.gov.cn/index_en.html).



The report on supply situation of maize, rice, wheat and soybean

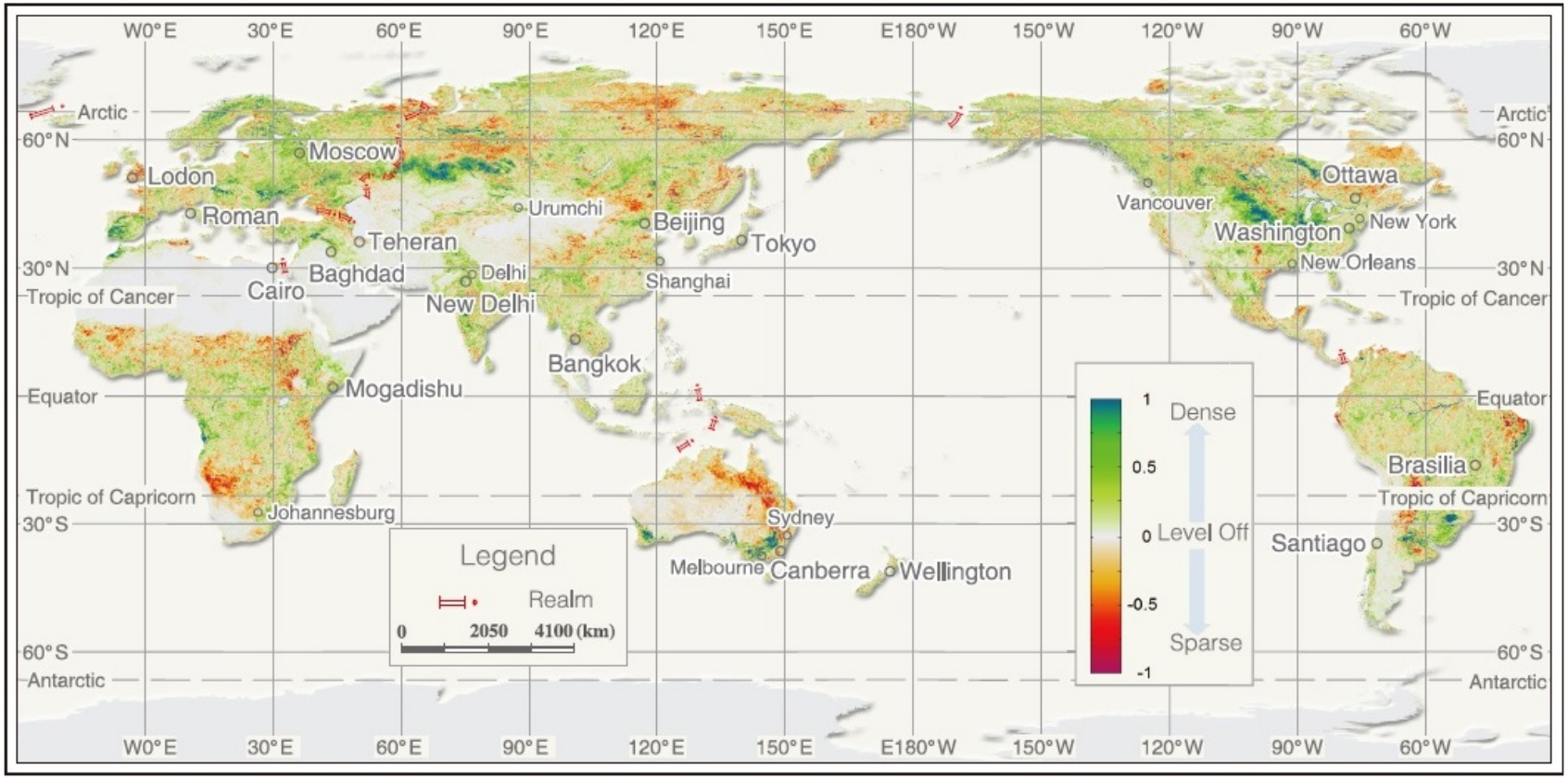
The report on growth condition of global terrestrial vegetation

The report on large terrestrial surface water areas

The report on urban and rural resident land cover distribution between 2000-2010

The reports on Remote Sensing Monitoring of Global Ecosystem and Environment

➢ ***Growth Conditions of Global Terrestrial Vegetation***



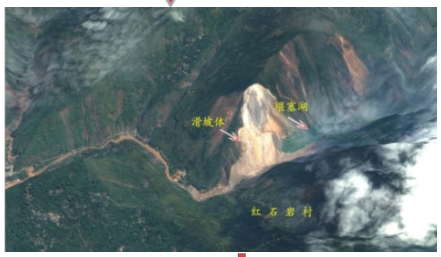
- **Global MLAI(Maximal Leaf Area Index) difference between 2012 and 2013**
- **Data source: MODIS reflectance product**
- **Spatial resolution: 1km**

Aerospace Application Coordination System for Emergency Response and Data Sharing

Inter-Ministerial Coordination Mechanism

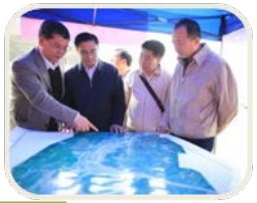
ArcSer Platform

Imagery data 65.5GB. Before disaster： 36.2GB after disaster： 29.3GB;
The data was distributed to 39 disaster reduction application agencies



Disaster relief on site

Disaster assessment



Technical support

Local Government

Ministries

Institutes & Organizations

➢ 2014 Ludian earthquake

Ludian 6.5 earthquake, 16:30, Aug 3rd,2014 (UTC+8)

Aug,3rd:

- KZ-1 satellite image acquisition.
- Request RESAP of ESCAP to trigger its established network for providing near-real-time satellite image.
- Acquire Indian satellite radar image before earthquake.

Aug,4th:

- ArcSer platform startup, sharing earthquake EO data.

Aerospace Application Coordination System for Emergency Response and Data Sharing

Image of Ludian earthquake-induced quake lake

In-situ operation based on decision supported by EO data

- Meanwhile, UAV was dispatched to a quake lake area on NiuLan River. Then the information extracted from the image was sent to the command on-site to guide quake lake's disaster rescue and relief.
- From the perspective of effectiveness on disaster reduction, UAV remote sensing system plays more and more important role in emergency response.

Aerospace Application Coordination System for Emergency Response and Data Sharing

- **Apeil, 2015 Nepal earthquake**

Date	**25 April 2015**
Time	14:11(UTC+8)
Magnitude	8.1 M
Depth	20 km
Type	Thrust

16:00, start KZ emergency response.

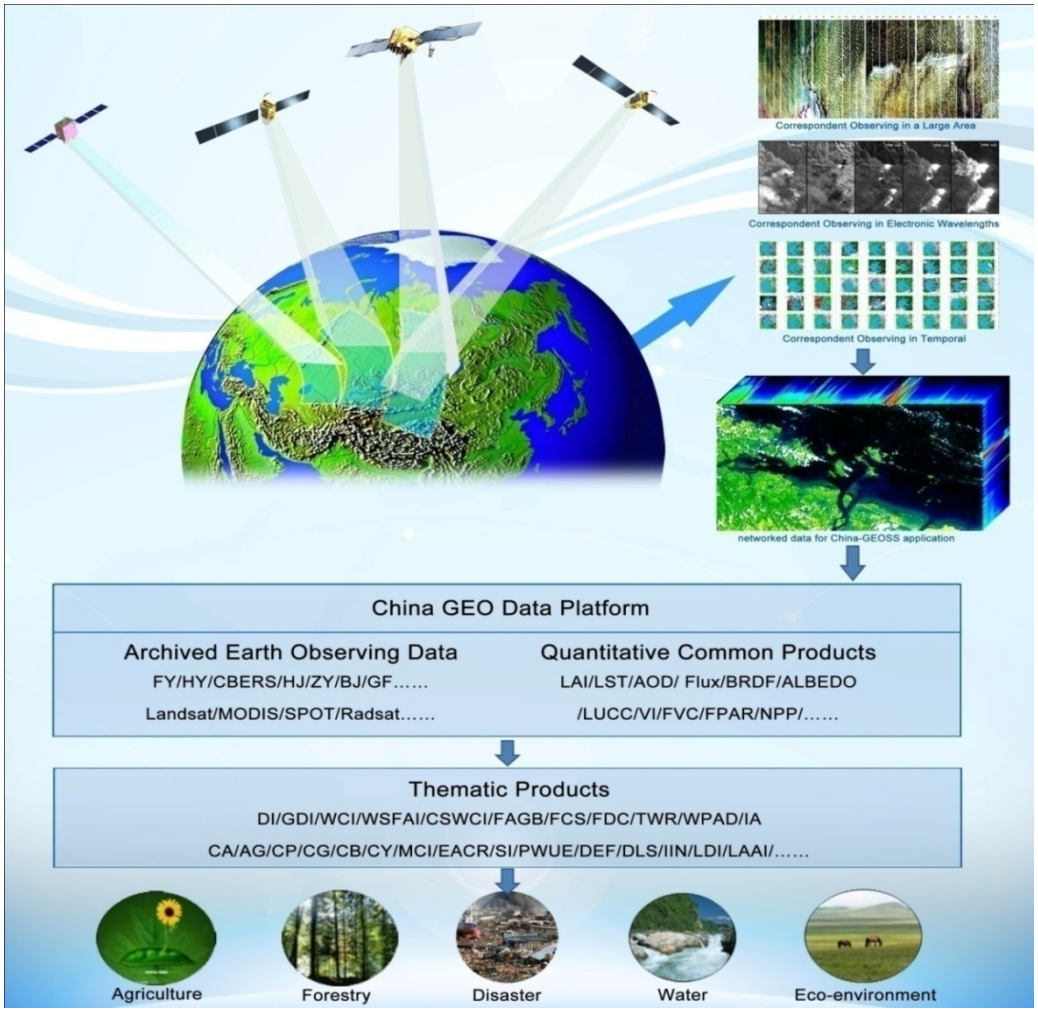
By Apr. 29, 150 scenes of KZ images were acquired.

Images of the tents which were set up at Jianggang village, China Tibet after the earthquake

Data Sharing Service

➢ *Promoting EO Data Sharing*

Framework of China-GEOSS Infrastructures



- Data sharing is a key component of GEOSS.
- At the 4th GEO Plenary, China and Brazil jointly announced that the China-Brazil Environment and Resources Satellite data would be shared free of charge.

- China is building a GEOSS Data Sharing Platform.
- It will also work as a portal for accessing China EO data(WIGGS task).

Data Sharing Service

➢ *China GEOSS Data Sharing Platform*

Capabilities of China GEOSS Data Platform

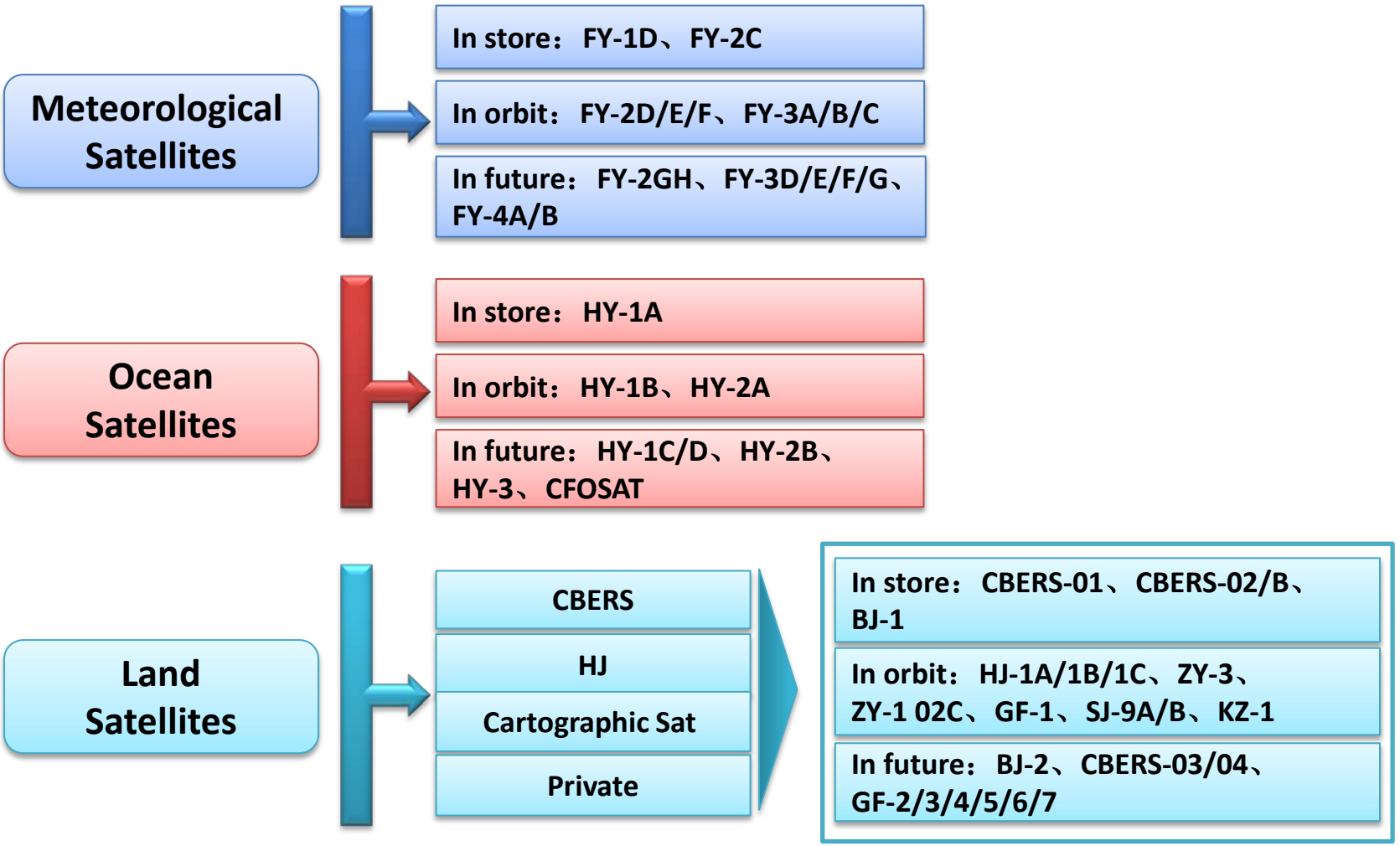
- 8 main satellite data centers integrated
- More than 30 China Coverage Datasets, 1990—now
- Metadata discoverable > 50,000,000 records
- Data accessible online > 2.5PB
- Supporting three GEO data sharing principles

High speed network connection among the centers

Long-term coverage

Data Sharing Service

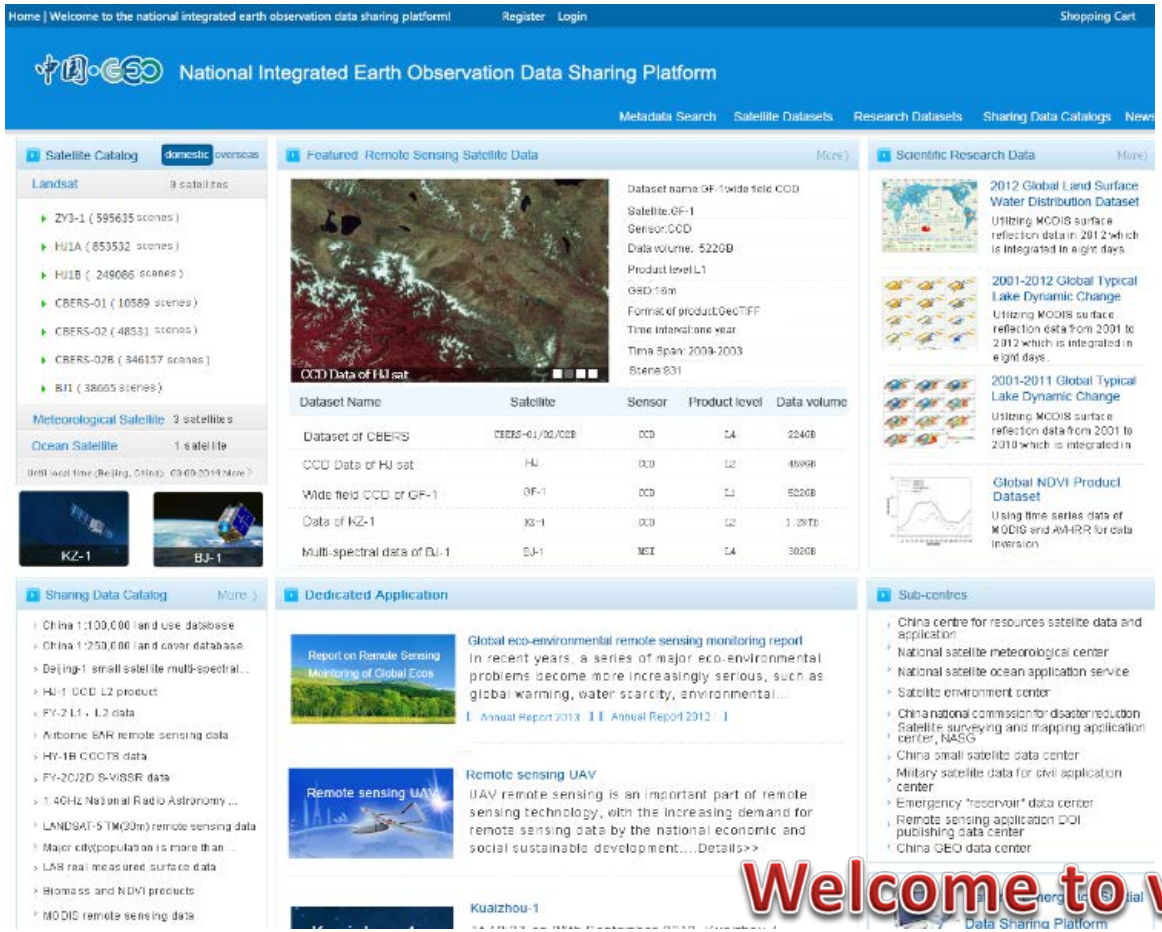
➢ ***EO Resources Integrated into China-GEOSS***



Data Sharing Service

- ***National Integrated Earth Observation Data Sharing Platform:***

www.chinageoss.org



Regional Collaborative Mechanism on Drought Monitoring and Early Warning

China activities:

- **Implementation of Pilot Project on drought monitoring and early warning for Mongolia and Sri Lanka.**
  - Providing remote sensing data and "Drought Watching System "
  - Performing in situ synchronous measurement for validation
- **During Oct 28-30, 2014, Training Course on Drought Monitoring organized by ESCAP and NRSCC in Beijing.**

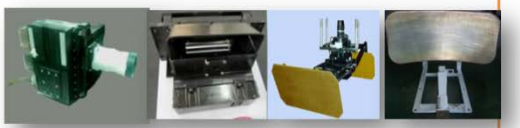
Flight Campaigns over Baotou Cal&Val Site

- **Baotou comprehensive Cal&Val site has been developed over the past several years for Cal&Val of high-resolution RS sensors.**

Site overview:

Ulansu Lake

Stepwise Cal&Val system



Airborne standard sensors

Ground test equipment

Comprehensive Cal&Val site with artificial target and natural scene reasonably matching

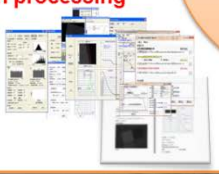
Artificial portable targets

Artificial permanent targets

Natural scenes

- **Advanced Cal&Val system**
- **Great contribution to RS application**
- **International platform for R&D**

Architecture of national **RS standards and quality evaluation processing system**



Exploration of **Automatic in-situ calibration mode**

Flight Campaigns over Baotou Cal&Val Site

- **In last year, the site has been enhanced in many aspects:**

Microwave/optical bar-pattern target

Color targets

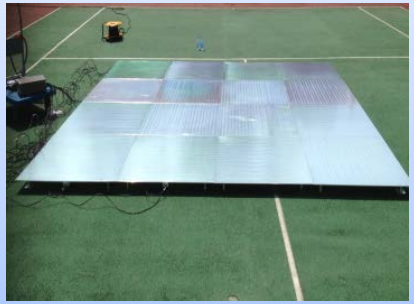
Fan-shaped

Grayscale

Array of point source targets

Corner reflectors

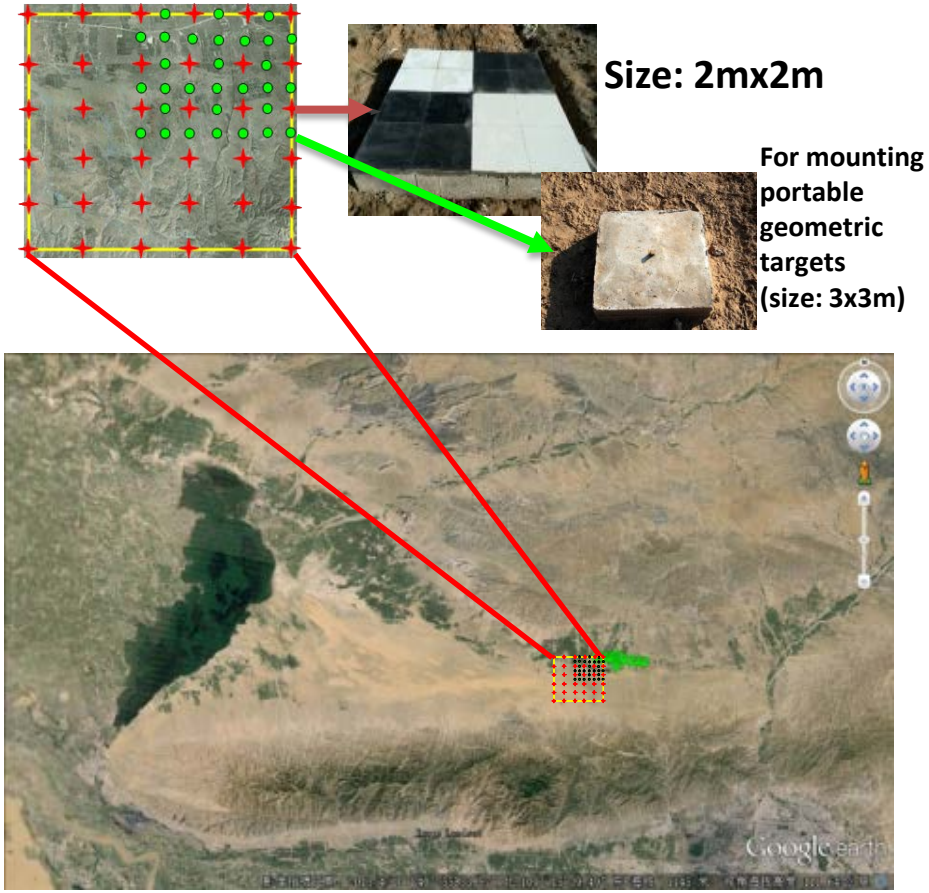
Low-emissivity target

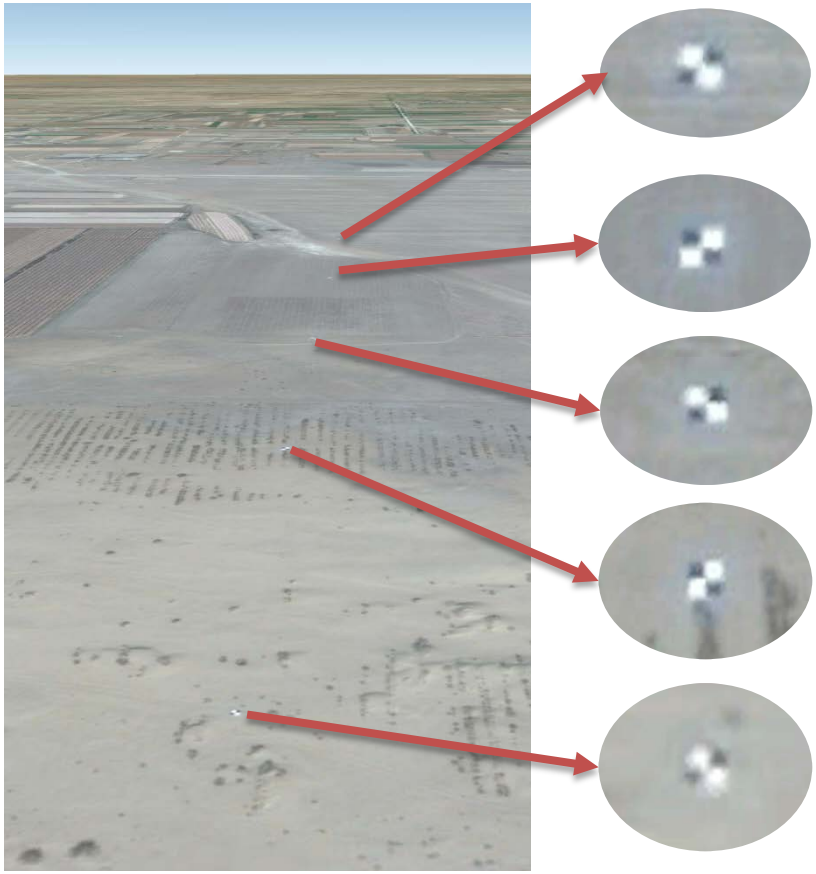


Automatic surface spectrum measurement system

Geometric Calibration

75 geometric control points with positional accuracy of 2cm(horizontal), 4cm (vertical).

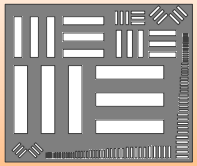




GCP Google Earth image(from Digital Global, 0.5m)

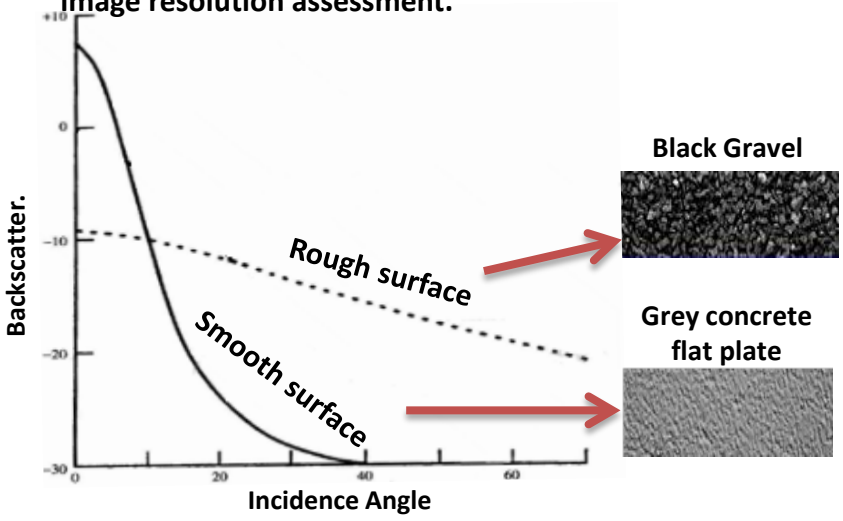
Microwave/optical bar-pattern target

1. "bar-pattern" design, rather than "point", benefiting for microwave image resolution assessment



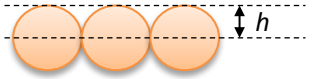
2. Intensity contrast between bars and the background is realized by their roughness difference

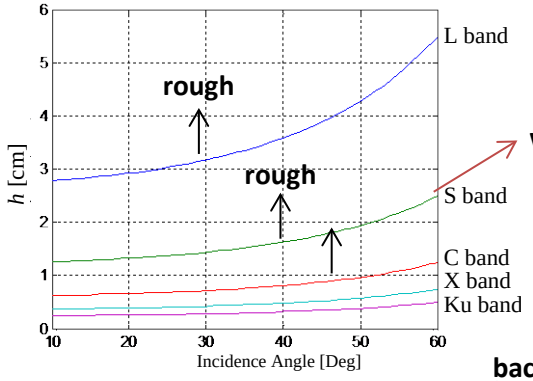
Black gravel and grey concrete flat plate were exploited to construct the target for both microwave and optical image resolution assessment.



3. The size of the gravel was calculated based on both Rayleigh roughness criterion and Oh surface radar backscatterering model, in order to exhibit sufficient contrast in Ku to S band radar image.

Rayleigh criterion: $h > \frac{\lambda}{8 \cdot \cos\theta}$

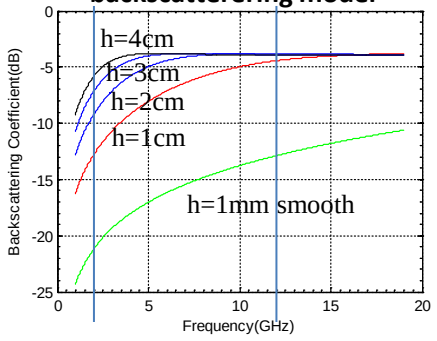




when h> 2.5cm, rough

when h=3 cm, contrast=12dB at 5GHz

Oh surface radar backscatterering model



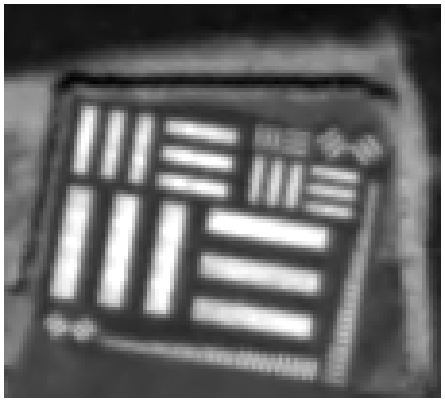
@20° incidence angle

Gravel size S=2h:

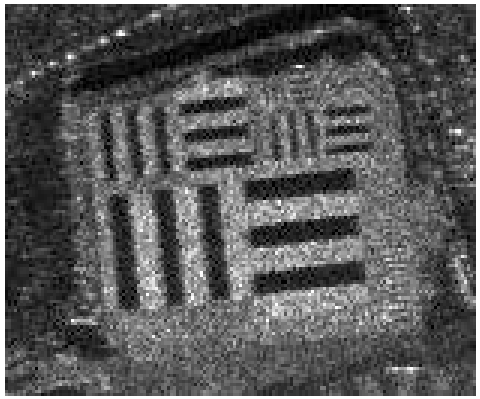
<0.4m width bars:
S=2cm±0.5;
>0.4m width bars:
S=5cm±1.

Microwave/optical bar-pattern target

Finished construction by the end of September, 2014

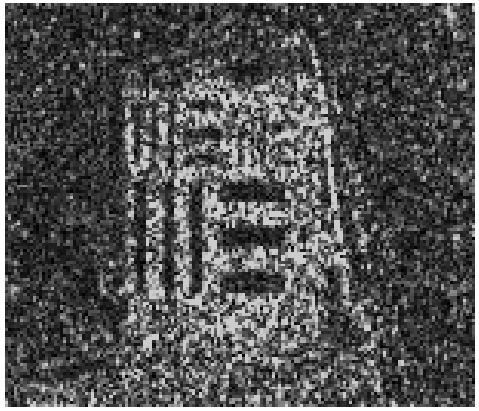


2014/10/13 GF-2 PAN image



2014/10/19 C-band airborne SAR image

2014/10/17 airborne SWIR image



2014/10/22 KOMPSAT-5 SAR image

SAR corner reflector base

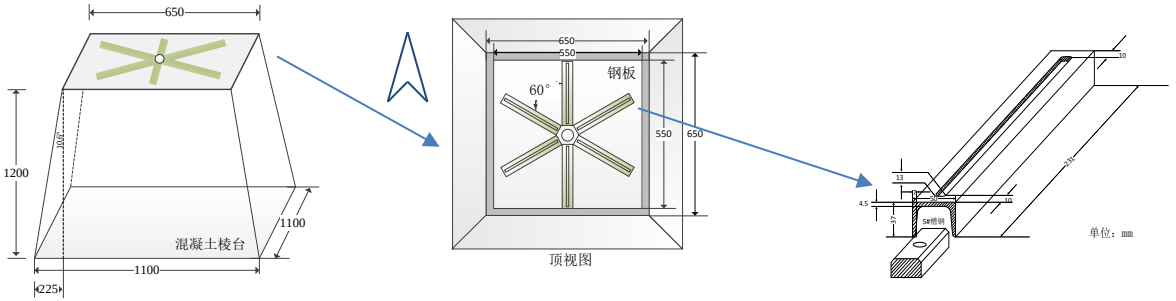
Distribution direction (east-west) is 95° to North, with compromise of transportation convenience and SAR flight direction:

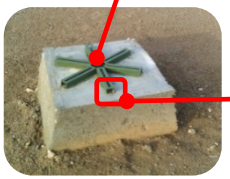
$$\beta = \arcsin\frac{\pm\cos\alpha}{\cos\xi} \approx 10^\circ$$

β: Azimuth
α: Latitude
ξ: Inclination

Satellite	Inclination
TerraSAR	97.44°
Radarsat-2	98.6°
Sentinel-1	98.18°
SkyMed	97.86°
HJ-1-C	97.37°

For quickly deploying corner reflectors and avoiding repeated measurement of position information





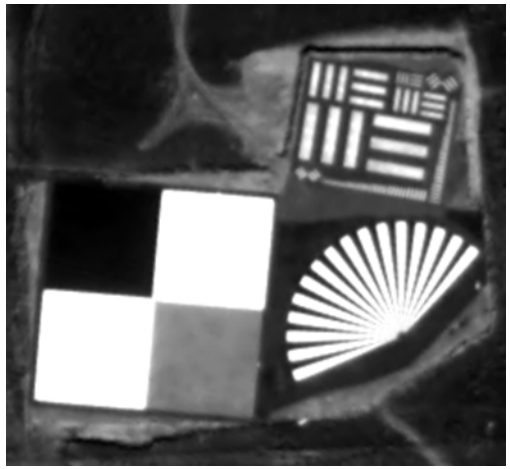
Flight Campaigns over Baotou Cal&Val Site

Flight Campaigns

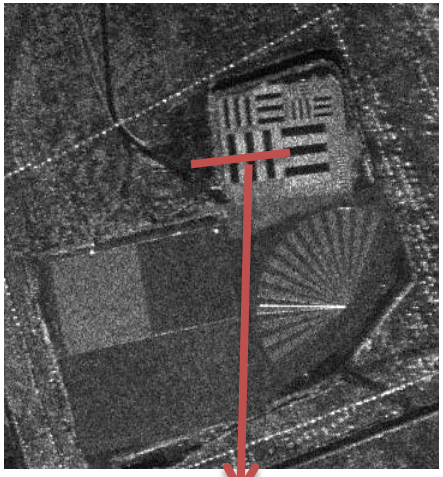
- In order to validate the availability of newly developed targets and improved instruments, flight campaigns were carried out over the site during Oct.9-23, 2015. The sensors include SAR and optical sensors.
- The performance of several satellite RS sensors were also assessed during the flight campaign, at the support of the synchronous field measurements.

- 1. Some RS images acquired during flight campaigns:

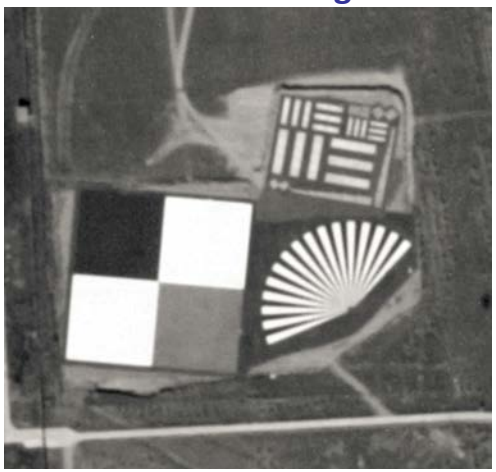
2014/10/13 GF-2 PAN image



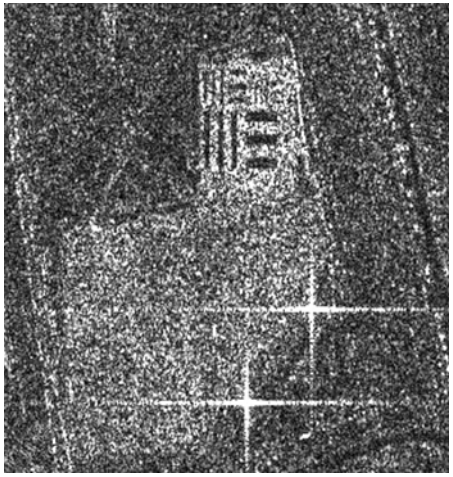
2014/10/19 C-band airborne SAR image



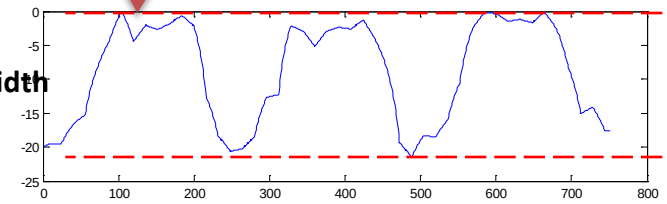
2014/10/17 SWIR airborne image



2014/10/22 KOMPSAT-5 SAR image



Data profile of the 5m-width bar

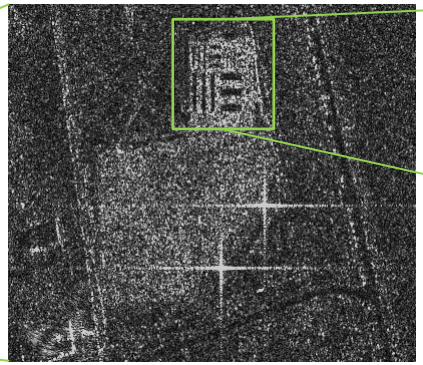


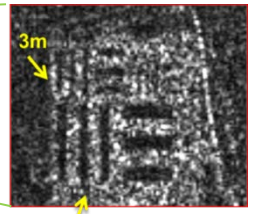
Corse bar and smooth bar exhibits sufficient contrast (~20dB)

Flight Campaigns over Baotou Cal&Val Site

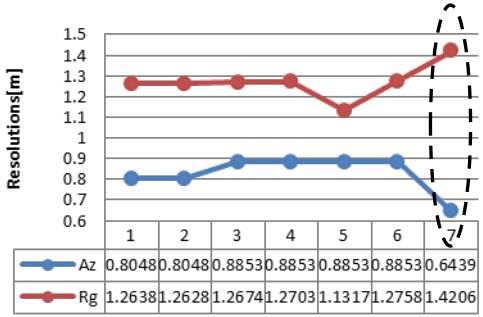
➢ 2. Image quality assessment for KOMPSAT-5 SAR sensor

KOMPSAT-5 SAR image on October 22, 2014(HH Polarization)





The "image resolution" is better than 3m.

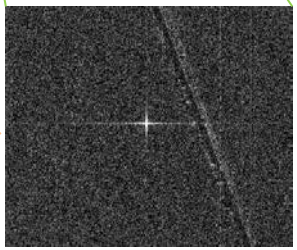


	1	2	3	4	5	6	7
Az	0.8048	0.8048	0.8853	0.8853	0.8853	0.8853	0.6439
Rg	1.2638	1.2628	1.2674	1.2703	1.1317	1.2758	1.4206

- Ground range instrument geometric resolution:1.21m
- Azimuth instrument geometric resolution: 0.90m

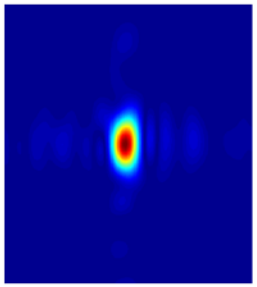
The resolution assessment results of the seven CRs are consist with each other except CR#7. The image of CR#7 is not a ideal point response image.

Corner reflector

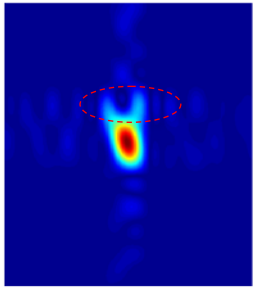


SAR image

CR #1

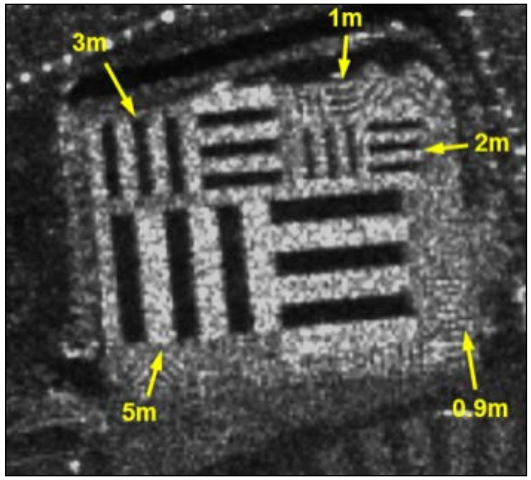


CR #7

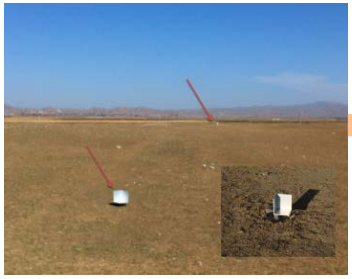


Flight Campaigns over Baotou Cal&Val Site

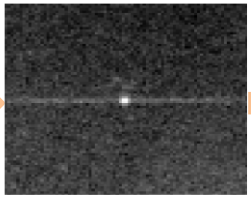
➢ 3. Image quality assessment for C-band airborne SAR



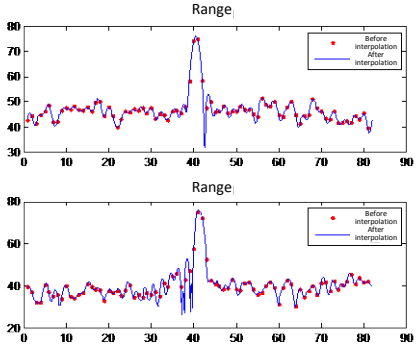
Range image resolution: 0.9m
Azimuth image resolution: 1m



Corner reflector



Point target image



Point target data profile

	CR No.	Signal Resolution[m]		PSLR [dB]		ISLR [dB]	
		Range	Azimuth	Range	Azimuth	Range	Azimuth
Observed	1	0.818	0.875	-27.846	-25.483	-16.845	-12.758
	2	0.779	0.711	-24.928	-18.393	-14.921	-11.569
	3	0.773	0.815	-26.347	-22.954	-16.198	-11.851
	4	0.709	0.714	-20.049	-17.673	-14.733	-10.612
	5	0.754	0.770	-20.916	-22.712	-14.423	-11.080
	6	0.798	0.662	-24.599	-17.420	-15.809	-10.552
	7	0.786	0.823	-23.888	-22.002	-14.187	-9.650
	8	0.733	0.723	-19.633	-18.416	-12.941	-9.482
	9	0.849	0.646	-21.266	-16.117	-13.386	-9.418
	10	0.742	0.702	-20.397	-18.135	-13.909	-10.121
	11	0.860	0.647	-25.628	-16.790	-12.985	-8.981
	12	0.816	0.783	-25.756	-21.243	-13.603	-8.903
	13	0.771	0.667	-22.739	-18.159	-13.472	-9.766
	14	0.699	0.814	-19.411	-21.941	-12.845	-9.289
	Mean	0.778m	0.739	-23.100	-19.817	-14.304	-10.288
Reference		0.6	0.6	< -13.26	< -13.26	<-9.8	< -9.8

Flight Campaigns over Baotou Cal&Val Site

➢ 4. Post-launch radiometric calibration of GF-2 satellite

Launched at Aug. 19th, 2014

Specification of GF-2/PMS		
Spectral range	Pan	0.45—0.90μm
	Multi-spectral	0.45—0.52μm
		0.52—0.59μm
		0.63—0.69μm
		0.77—0.89μm
Resolution	Pan	1m
	Multi-spectral	4m
Swath	45km	
Revisit period	5d (with side-sway observation); 69d (without side-sway)	

Calibration method: On-site personnel mode

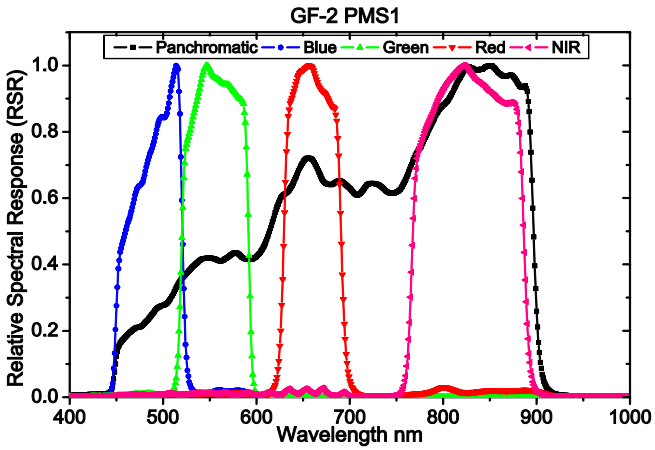
On-site measured surface spectral reflectance

Atmospheric parameters including:
- ✓ Aerosol optical thickness;
- ✓ Columnar water vapor;
- ✓ Absorption and asymmetry coefficients;
- ✓ Phase function…

Atmospheric radiative transfer model (MODTRAN)

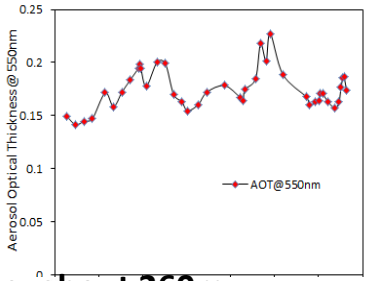
TOA spectral radiance

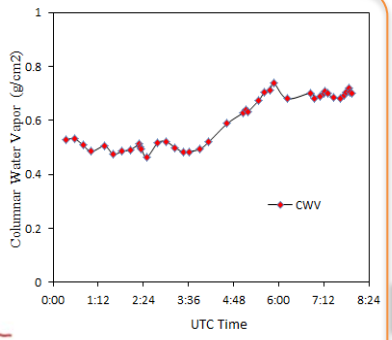
Calibration



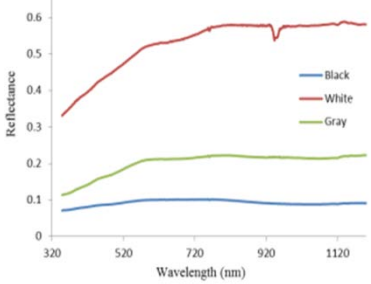
Flight Campaigns over Baotou Cal&Val Site

Calibration method: On-site personnel mode

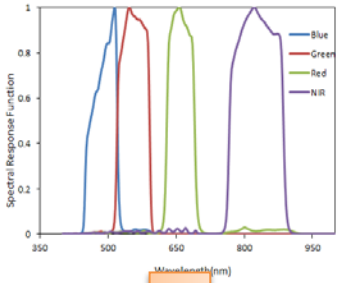


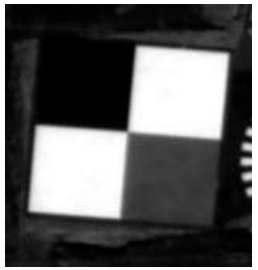


Distance: about 260m



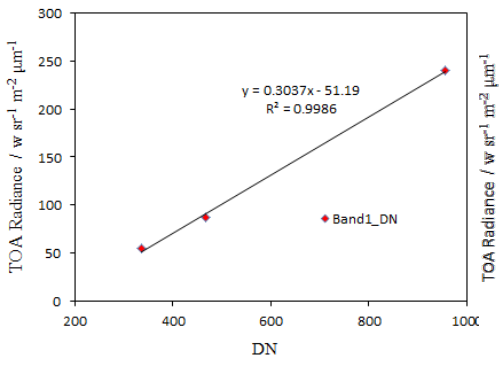
Overpass time: 2014-10-13 UTC 03:28:05

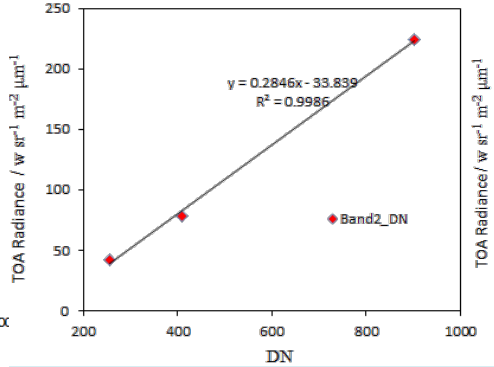


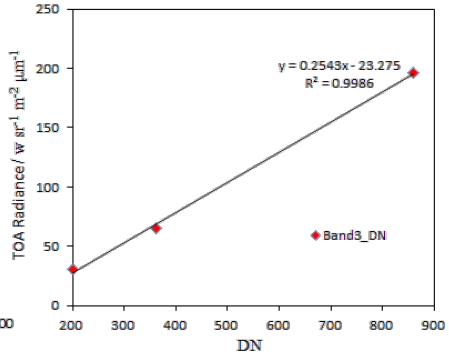


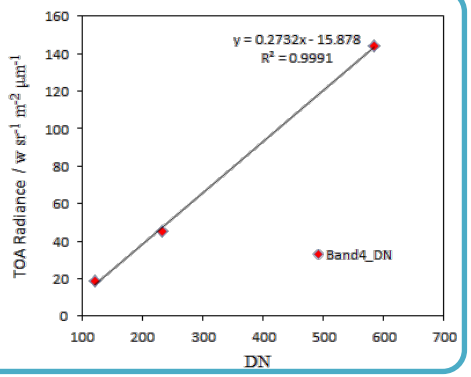
MODTRAN

TOA Radiance + **GF-2 image (DN)**









Flight Campaigns over Baotou Cal&Val Site

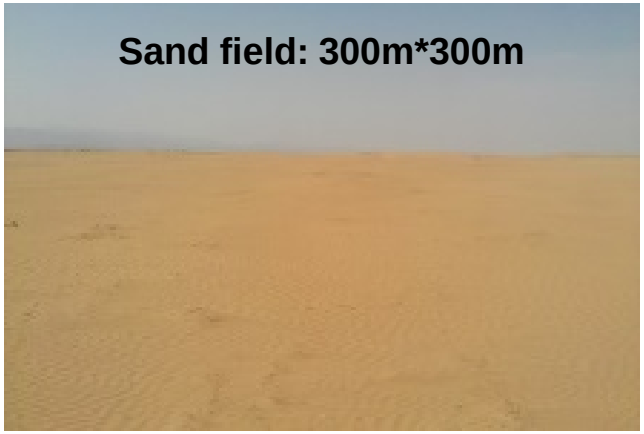
Calibration method: Automated mode

Radiometric calibration system development and field campaigns

In order to meet the demand of RadCalNet, several automated radiometric calibration models have been explored

The mode based on measured ground reflected spectral radiance is thought to be more suitable for the climate condition in Baotou

A case study for Landsat 8 has been conducted over a sand field 2km away from the sun-photometer.



Atmospheric parameters including:
- ✓ Aerosol optical thickness;
- ✓ Columnar water vapor;
- ✓ Absorption and asymmetry coefficients;
- ✓ Phase function…

Automated measured parameters

Atmospheric radiative transfer model (MODTRAN)

Ground reflected spectral radiance

- ✓ Ground-to-Sensor total transmittance;
- ✓ Path radiance.

Radiative transfer equation calculation

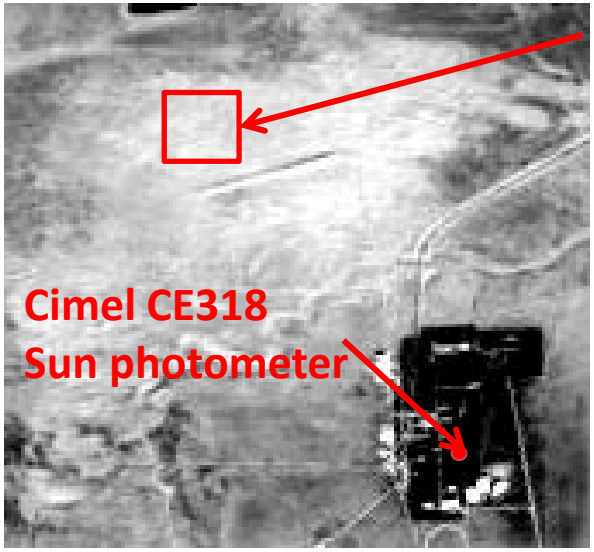
TOA spectral radiance → Calibration

Flight Campaigns over Baotou Cal&Val Site

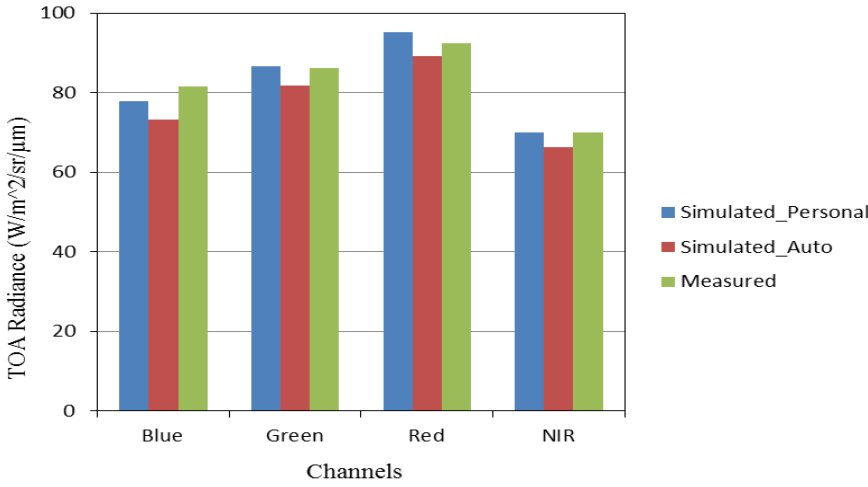
Calibration method: Automated mode

- Ground reflected spectral reflectance & radiance, atmospheric parameters were measured simultaneously;
- Both the automated and on-site personnel measured mode were tested.

Landsat 8 image (Mar. 27, 2015)



TOA radiance comparison

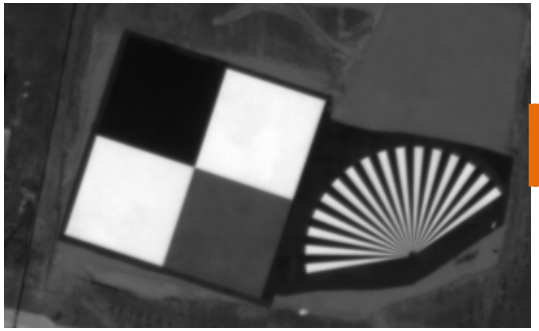


	Obs. Rad.	Automated mode		On-site personnel mode	
		Sim. Rad.	RE	Sim. Rad.	RE
Blue	81.59	73.19	10.2%	77.90	4.5%
Green	86.11	81.74	5.0%	86.71	0.7%
Red	92.38	89.13	3.5%	95.09	2.9%
NIR	70.10	66.25	5.4%	70.05	0.06%

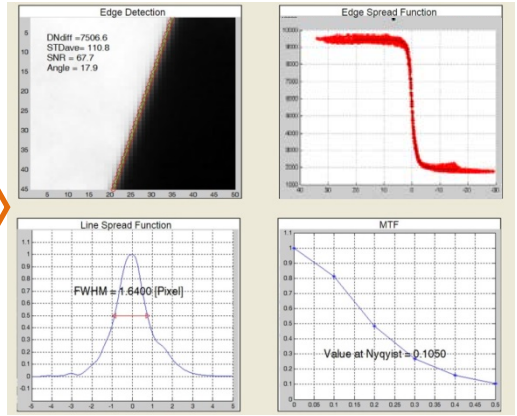
Flight Campaigns over Baotou Cal&Val Site

➢ 5. Image quality assessment of KOMPSAT-3 and GF-2 based on the optical permanent targets.

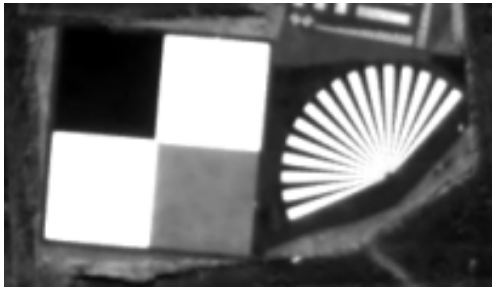
- **MTF**



KOMPSAT-3 PAN image on August 14, 2014



KOMPSAT-3	AOE's results	KARI's results
Along track	0.083	0.091
Cross track	0.105	0.106



GF-2 PAN image on Oct. 13, 2014
View zenith angle: 8.86°

	GF-2
Along track	0.0722
Cross track	0.0933

An improved "knife-edge" method is used, and has three aspects of improvements on the ISO 12233 method :

- The use of the Fermi function for edge detection.
- Filter the ESF curves using S-G filter for noise suppression.
- Process LSF curve with Hamming window for avoiding spectral leakage and making more LSF central symmetry.

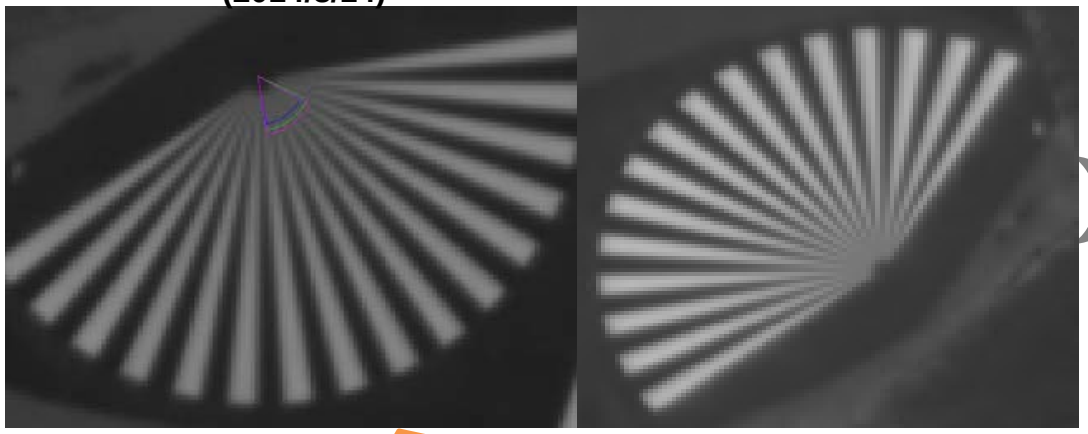
Flight Campaigns over Baotou Cal&Val Site

➢ 5. Image quality assessment of KOMPSAT-3 and GF-2 based on the optical permanent targets.

- **Spatial resolution**

KOMPSAT-3 panchromatic image (2014/8/14)

GF-2 panchromatic image (2014/10/13)
View zenith angle: 8.86°



	KOMPSAT-3	GF-2
GSD	0.7m	1m
Calculated resolution	0.79m	1.13m
Visual resolution	0.73m	1.05m

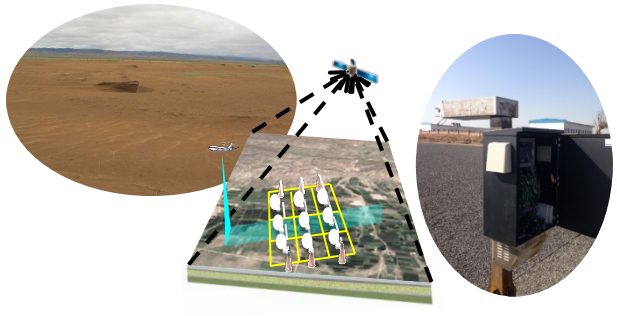
Automated detection algorithm for calculating resolution:

- Taking the maximum radius of the target as a reference radius r_2.
- Selecting an area containing 5 white segments .
- Detecting the number of white segment when DN differences between white and black segment <5 for a certain radius $r < r_2$, and the limited radius r_0 is acquired when number of white segment <4.
- Calculated resolution = $r_0 * \varphi$ (where φ is the angle of each segment).

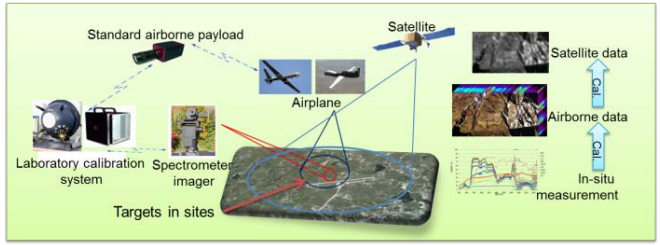
Flight Campaigns over Baotou Cal&Val Site

➢ Future work on Baotou Cal&Val Site

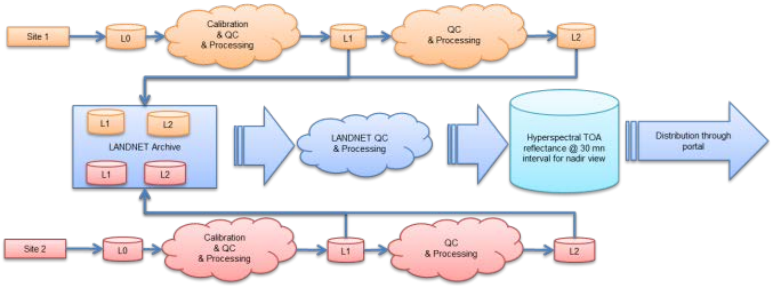
1. Strengthening the capability to support long-term calibration operation



2. Upgrading consistent traceable approach for quality control



3. Offering contribution to the "global calibration" of EO through RadCalNet



Thank you for attention!