IRSA Report to WGCV28

Calibration and Validation Work in IRSA

Dr. Gu Xingfa
Zhu L；Li X.; Gao H.
Institute of remote sensing applications, CAS
Email:guxingfa@irsa.ac.cn

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- 2. Research Work of Cal & Val in IRSA
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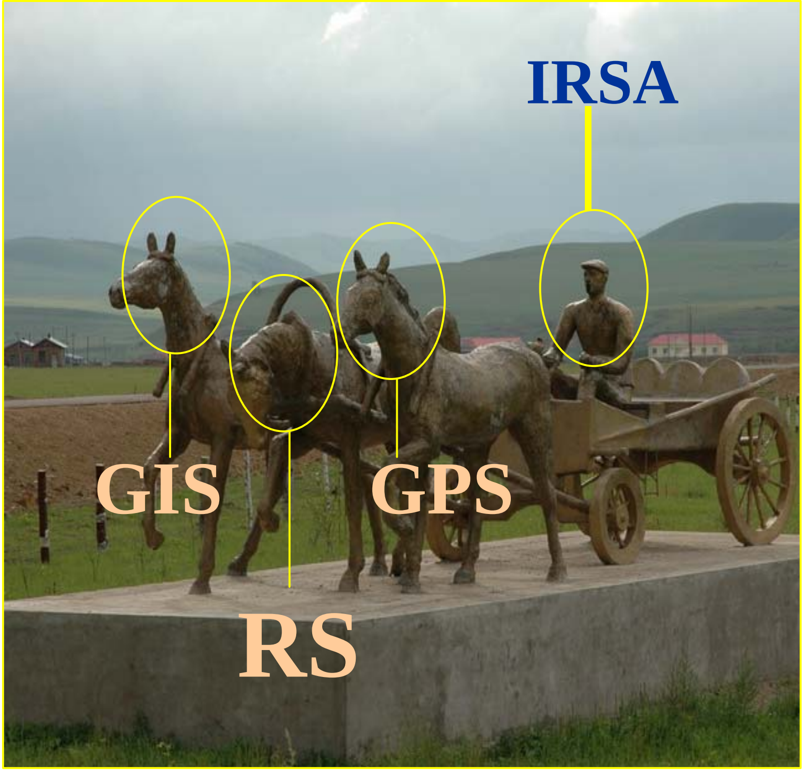
1.Introduction of IRSA

1. 1979 IRSA established
2. 1986 Airborne Remote Sensing Centre established
3. 1997 National Engineering Research Center for Geoinformatics
4. 2003 National Demonstration Center for Space borne Remote Sensing / National Space Administration (DCSRS)
5. 2004 State Key Lab for Remote Sensing Science
6. 2007 State Environmental Protection Key Laboratory of Satellite Remote Sensing



1.Introduction of IRSA

- **R&D scope: RS, GIS, GPS**
- **4 academicians, 58 senior researchers,**
- **230 staffs + 167 contracted staffs**
- **220 PhD students and post doctors**
- **140 Master students**

- **Funds in 2007: 16 millions Euros**

IRSA Organization Structure

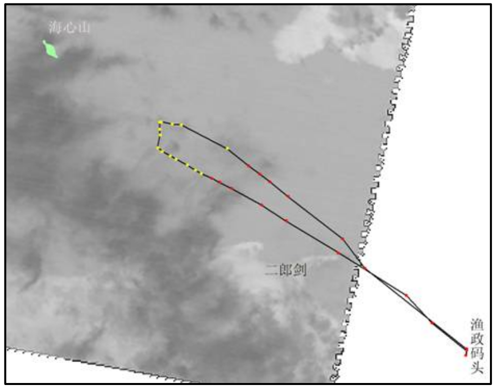
- **12 research units:**
  - **Laboratory of Radiative Transfer on Remote Sensing**
  - **Laboratory of Advanced Environment Remote Sensing**
  - **Laboratory of Hyperspectral Remote Sensing**
  - **Laboratory of Microwave Remote Sensing**
  - **Laboratory of Remote Sensing Calibration and Validation**
  - **Laboratory of Remote Sensing Image processing**
  - **Laboratory of Agriculture and Ecological Remote Sensing**
  - **Laboratory of Disaster and Emergency Remote Sensing**
  - **Laboratory of Land Resource Remote Sensing**
  - **Laboratory of Applied Environment Remote Sensing**
  - **Laboratory of Spatial Information System**
  - **Laboratory of Digital Earth and Navigation Positioning**

2.Reserch Work of Cal & Val in IRSA

- **2.1 Study on CBERS calibration in VIR/NIR and TIR bands (more details in the next presentation on Feb.28)**
  - **Absolute radiometric calibration for CBERS CCD and WFI camera**
  - **Radiometric cross-calibration for CBERS CCD with Terra MODIS**
  - **In flight MTF monitoring and compensation for CCD camera on CBERS-02**
  - **Absolute radiometric calibration for CBERS IRMSS thermal bands**

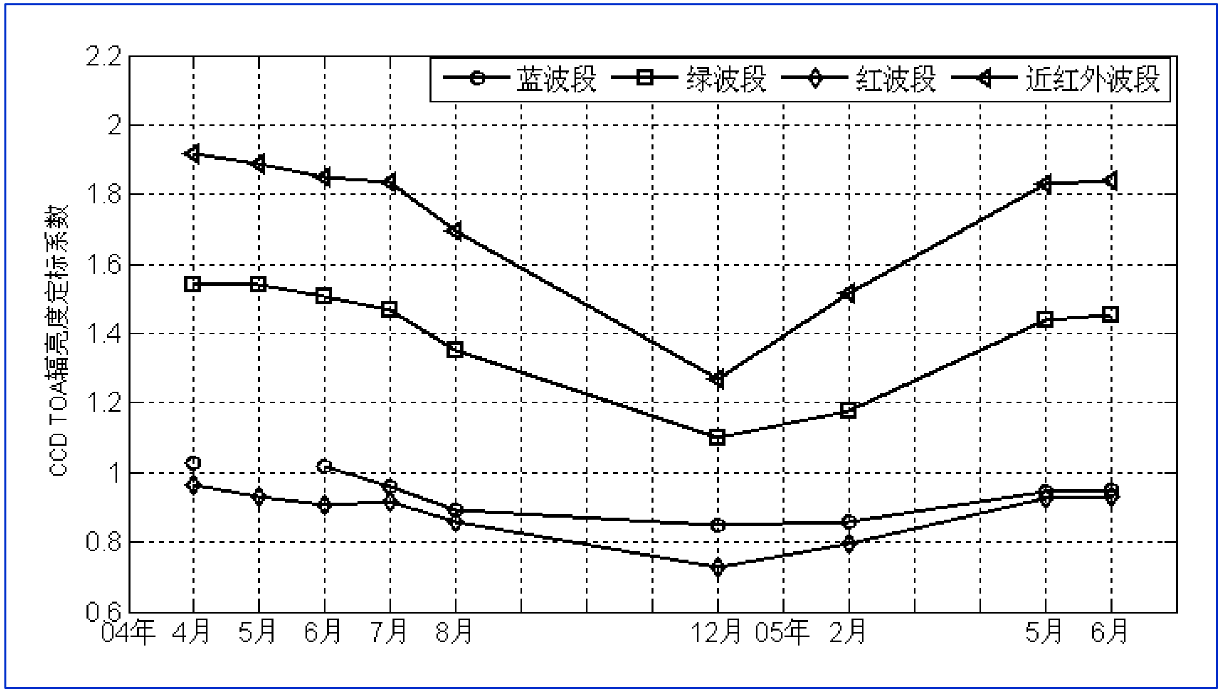
Dunhun calibration site

Hualai site



Qinhaihu site

Calibration Results of CCD and WFI

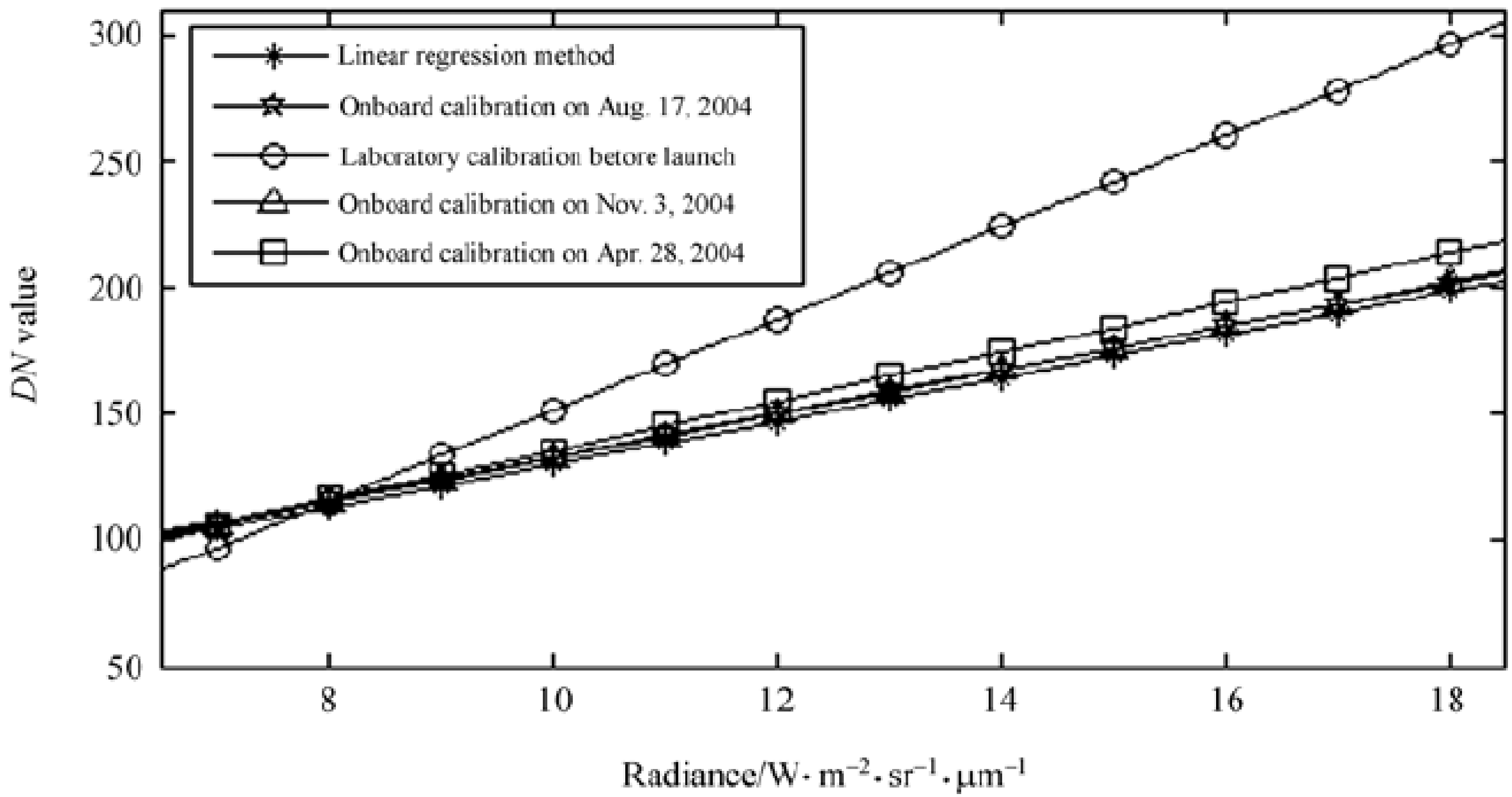


Calibration result for CCD VIR/NIR bands

	WFI band1	WFI band2
Cal coefficients for radiance	2.0275	1.7672
Cal coefficients for reflectance	870.12	508.27
Offset	42.33	21.023

Calibration result for WFI bands

Calibration Results of IRMSS TIR band



Absolute radiometric calibration results obtained from different methods and dates.

Published in 'Science in China'

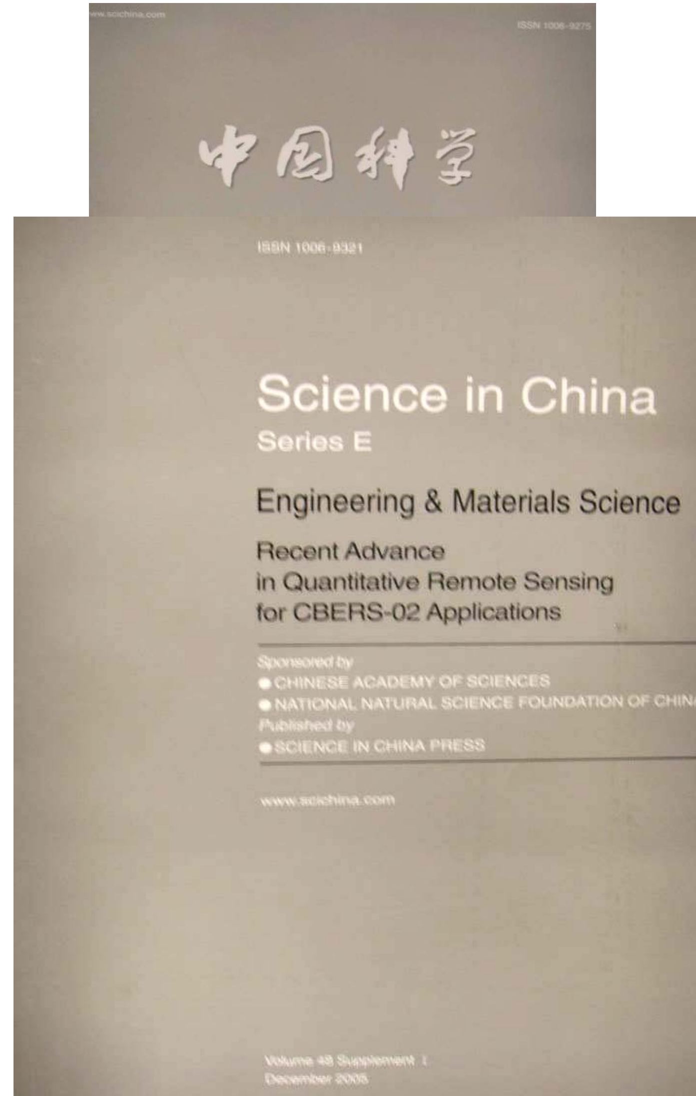
The Special Issue (12 papers):

1. A relative radiometric correction approach of CBERS02 CCD was presented.

2 .The new approach of the two-dimensional MTF was established to determine the in-flight MTF of CCD on CBERS02.

3. The calibration and Remote sensing quantification application were studied.

4. The radiometric calibration coefficients of CBERS02 IRMSS thermal infrared band was obtained firstly with the synthetical calibration approach.



2.2 Inner Mongolia Cal &Val work

- **Goals**
  - **to ascertain a new calibration and validation test site used for Chinese satellites, such as CBERS, HJ, Beijing-1 and so on .**
  - **to validate the MODIS calibration coefficients and MODIS products, conduct radiometric test and calibration for CBERS02B, and prepare for calibration and validation of HJ-1A,B,C in Summer of 2008.**
  - **to collect the information of experiment site for the past years and research in calibration without site.**

Field experiments

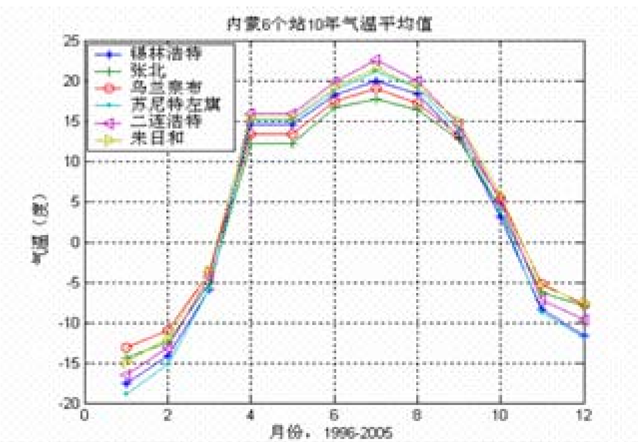
- **1. May 27-Jun 4, 2006**
- **2. Oct 25-Nov 3,2006**
- **3. May 19-Jun 4,2007**
- **4. Oct 8-15,2007**

Dali Lake test site

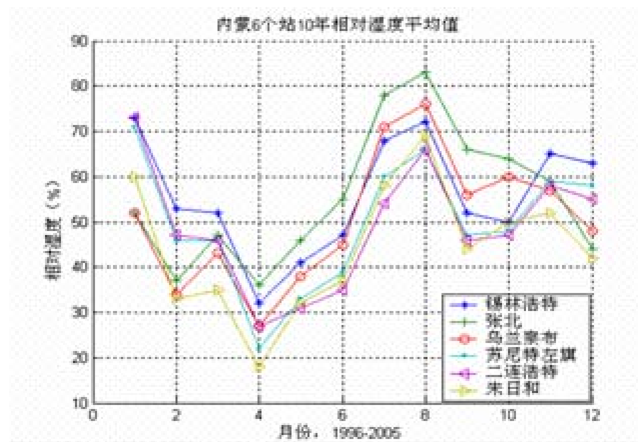
Lake Dali is located at 43° N, 116° E in the middle of inner Mongolia municipality of China.

- good atmospheric conditions
- good surface conditions
- convenient traffic for field campaigns.

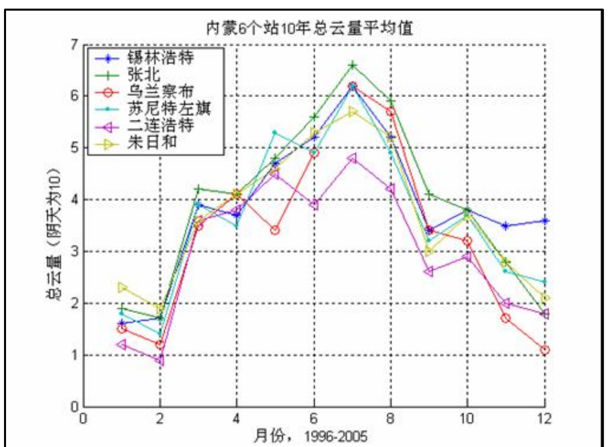
Statistical meteorological data of Inner Mongolia test sites in the past 10 years



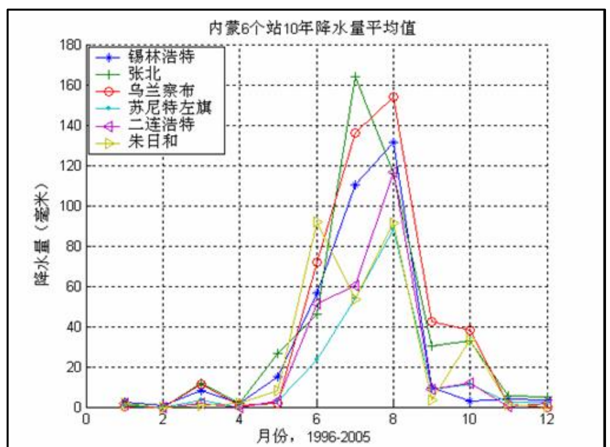
Monthly mean temperature



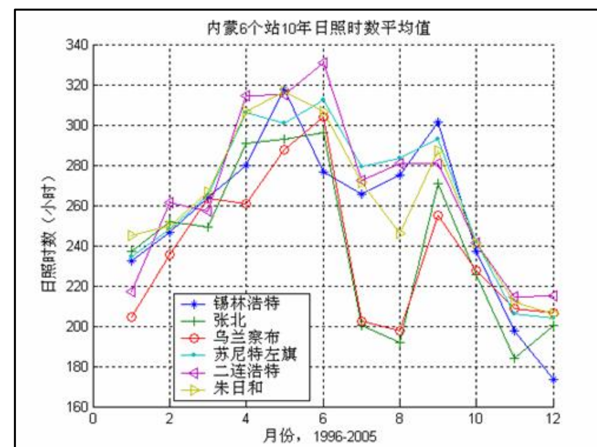
Monthly mean relative humidity



Monthly mean total cloud amount

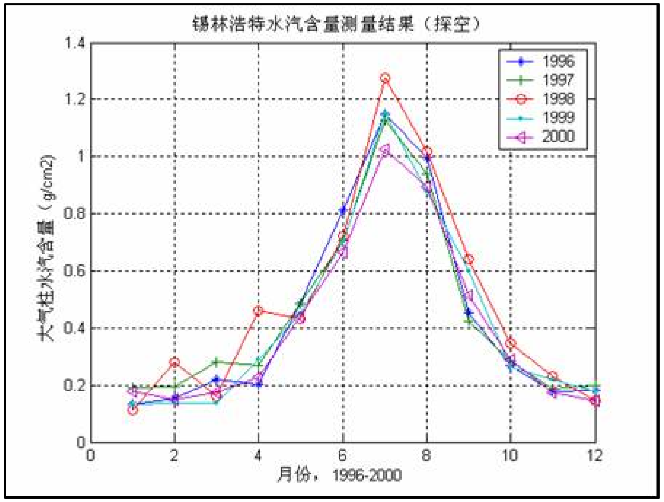


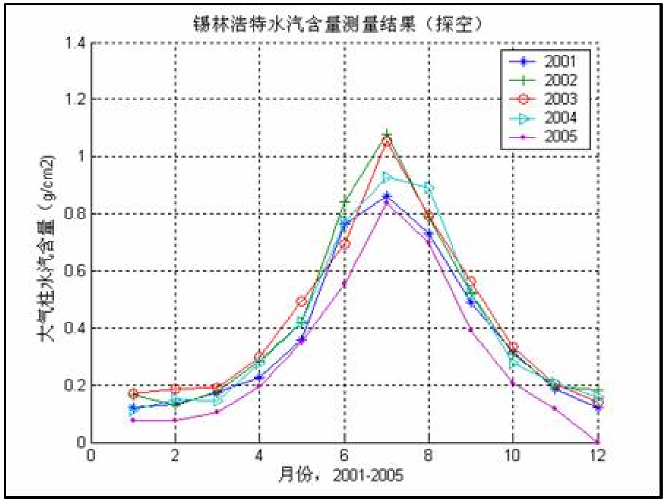
Monthly mean precipitation

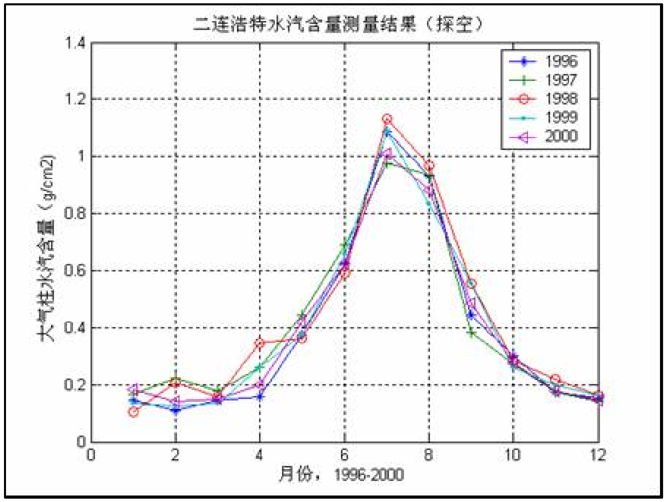


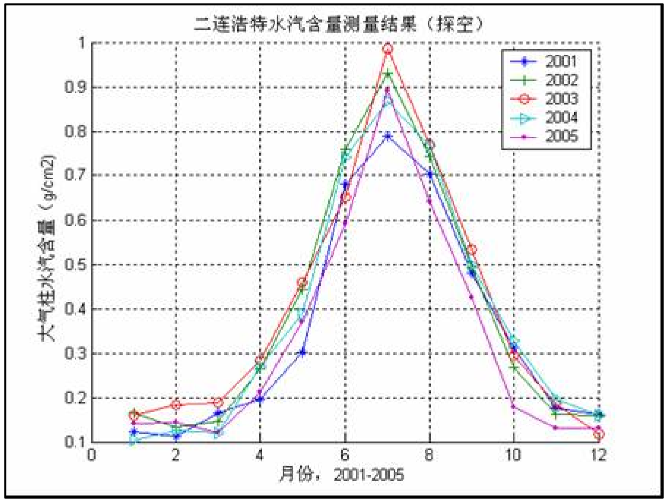
Monthly mean sunshine hours

Atmospheric water vapor content from sounding data

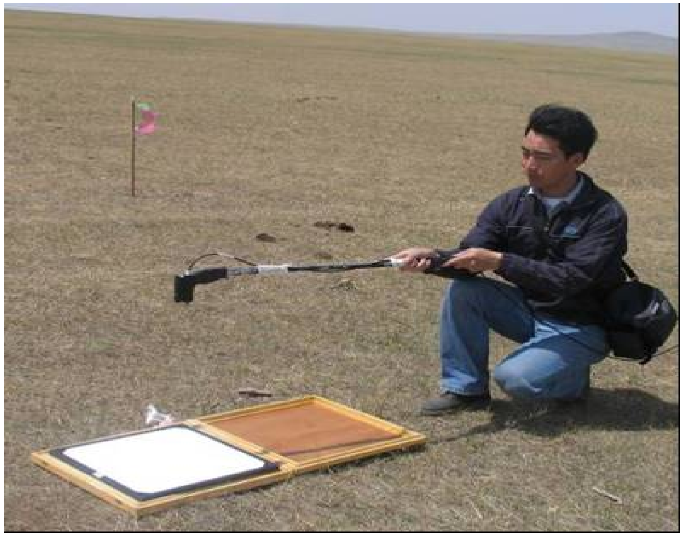


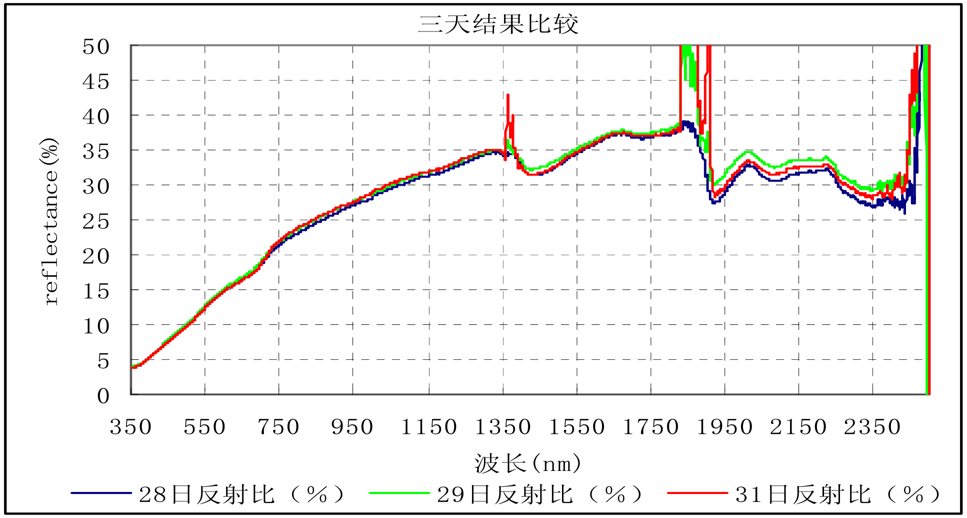




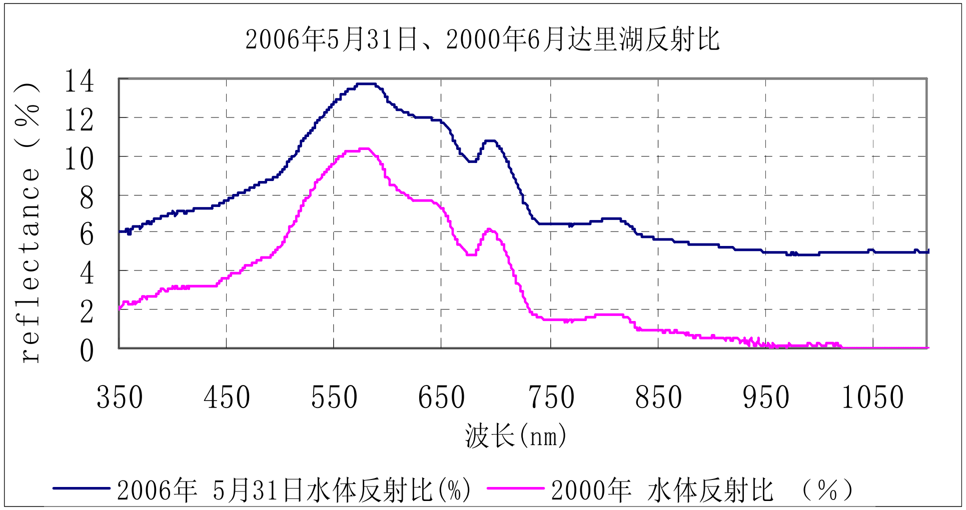


Spectral measurement using ASD



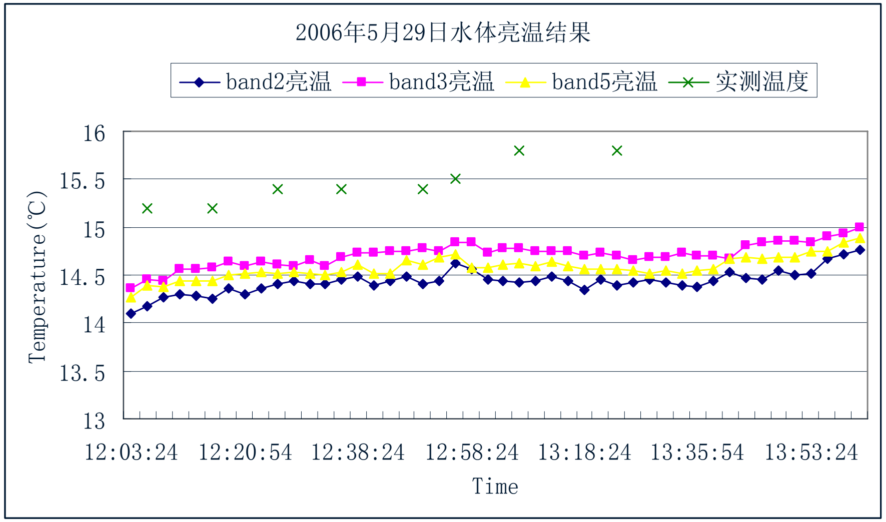


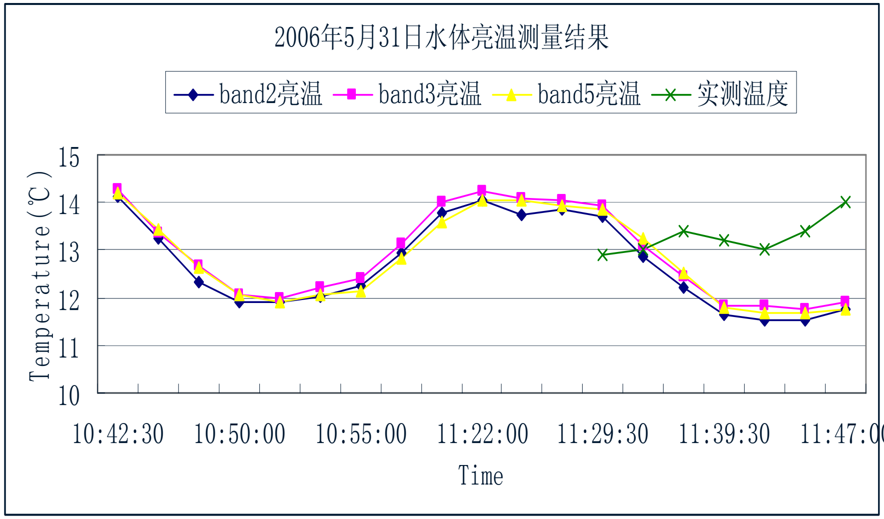
Spectrum curve of Gongger grassland on May28,29 and 31,2006



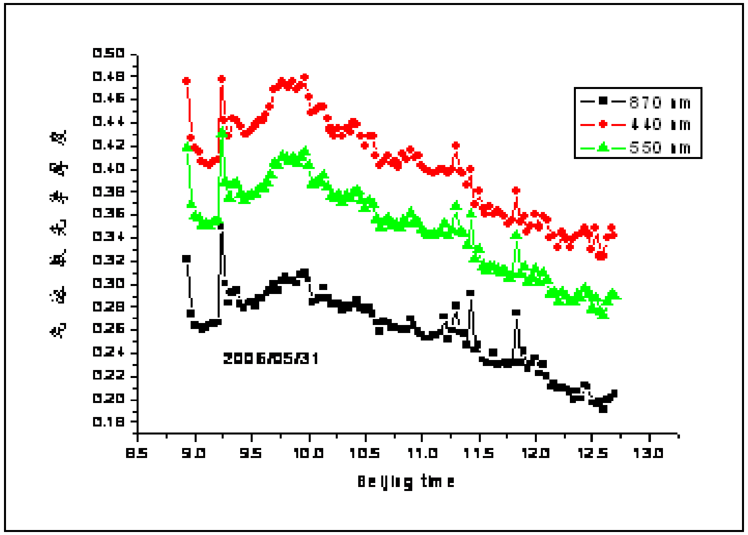
Comparison with the water reflectance between May 31, 2006 and 2000

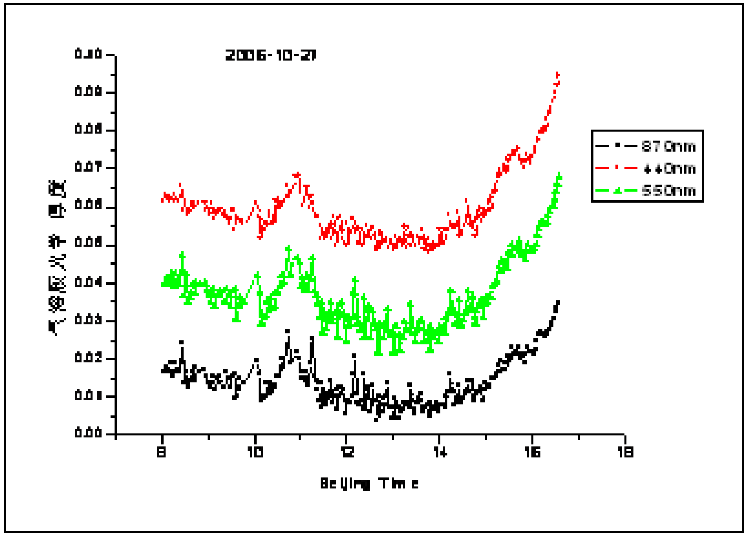
Water Brightness Temperature Measurement using CE312





Aerosol optical depth Measurements using CE318





Primary Result of MODIS VIR/NIR Calibration

Band	1	2	3	4	5	6	7
ρ_{TOA} from onboard	0.146	0.226	0.125	0.128	0.296	0.325	0.253
ρ_{TOA} from site-cal	0.147	0.221	0.126	0.127	0.290	0.317	0.262
Coefficients Onboard	5.26E-05	3.29E-05	3.50E-05	3.37E-05	3.77E-05	3.45E-05	2.81E-05
Coefficients from site-cal	5.30E-05	3.21E-05	3.55E-05	3.34E-05	3.70E-05	3.37E-05	2.90E-05
Relative Diff (%)	0.77	-2.39	1.55	-0.87	-1.90	-2.46	3.19

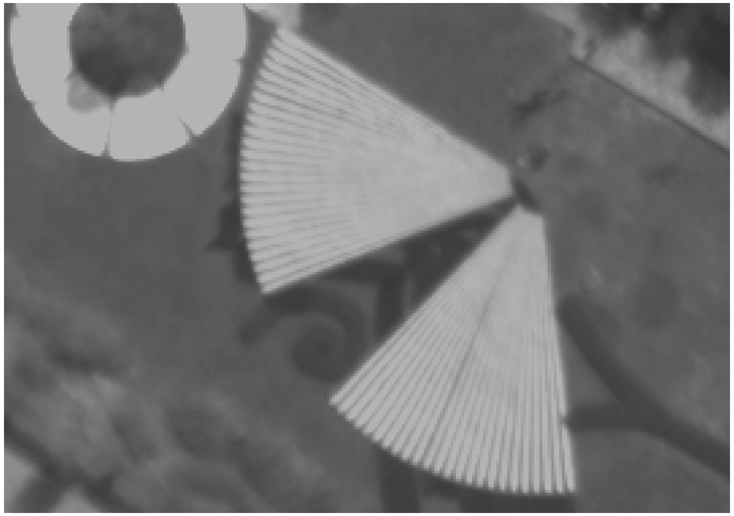
Primary Result of MODIS TIR Calibration

	Radiance （W/(m²·sr·μm)）		Brightness Temperature （K）		
	Site-cal	Onboard	Site-cal	Onboard	Diff
MODIS31	7.6781	7.652286	285.78	285.57	0.21
MODIS32	7.3369	7.233735	286.02	285.07	0.95

2.3 Beijing-1 Small Satellite

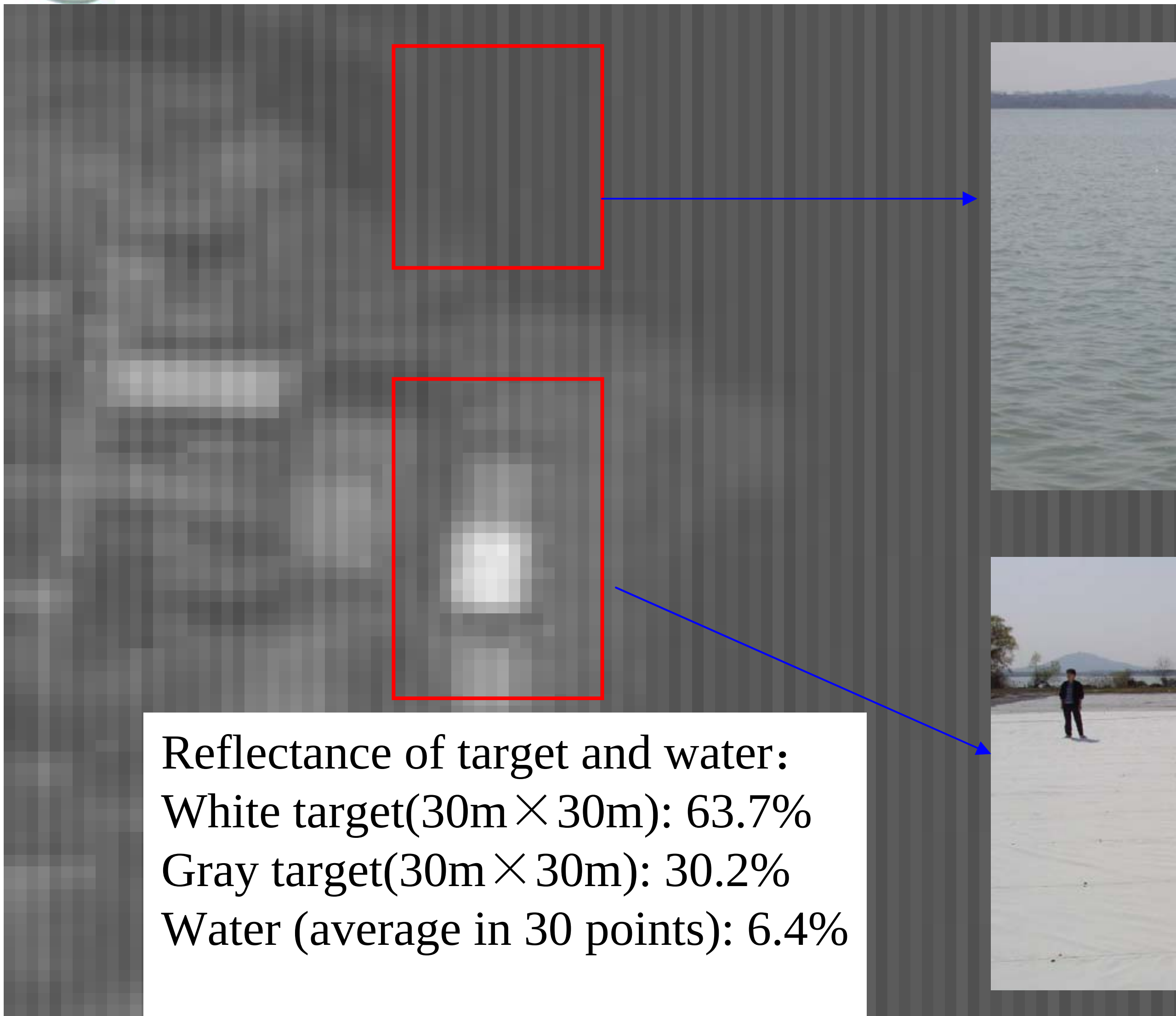
- **Aerial experiment pre-launch**
  - **Aerial experiment using man-made target before satellite launch in Shandong province, China**
- **Synchronous experiments in orbit Test**
  - **Dec.27-28,2005: Ming Tombs Reservoir and Yongding aerodrome in Being.**
  - **Dec.31,2005-Jan.2,2006:Heifei in An'hui province.**
  - **Jan.5-15,2006:Taihu Lake**
  - **March 4,2006:Huailai experiment site of IRSA in Hebei province.**
  - **March 13-15,2006: Heifei in An'hui province.**

Aerial experiment using simulated target in Shandong province



Preliminary Calibration of Beijing-1 Image in China

Calibration Campaign in Hefei, An'hui, China, March 2006



Reflectance of target and water：
White target(30m×30m): 63.7%
Gray target(30m×30m): 30.2%
Water (average in 30 points): 6.4%

In-flight field experiment for calibration of Beijing-1 4m resolution CCD on March,2006 in Hefei, An’hui province, China

2.4Serach for microwave radiometric calibration site for HJ-1C

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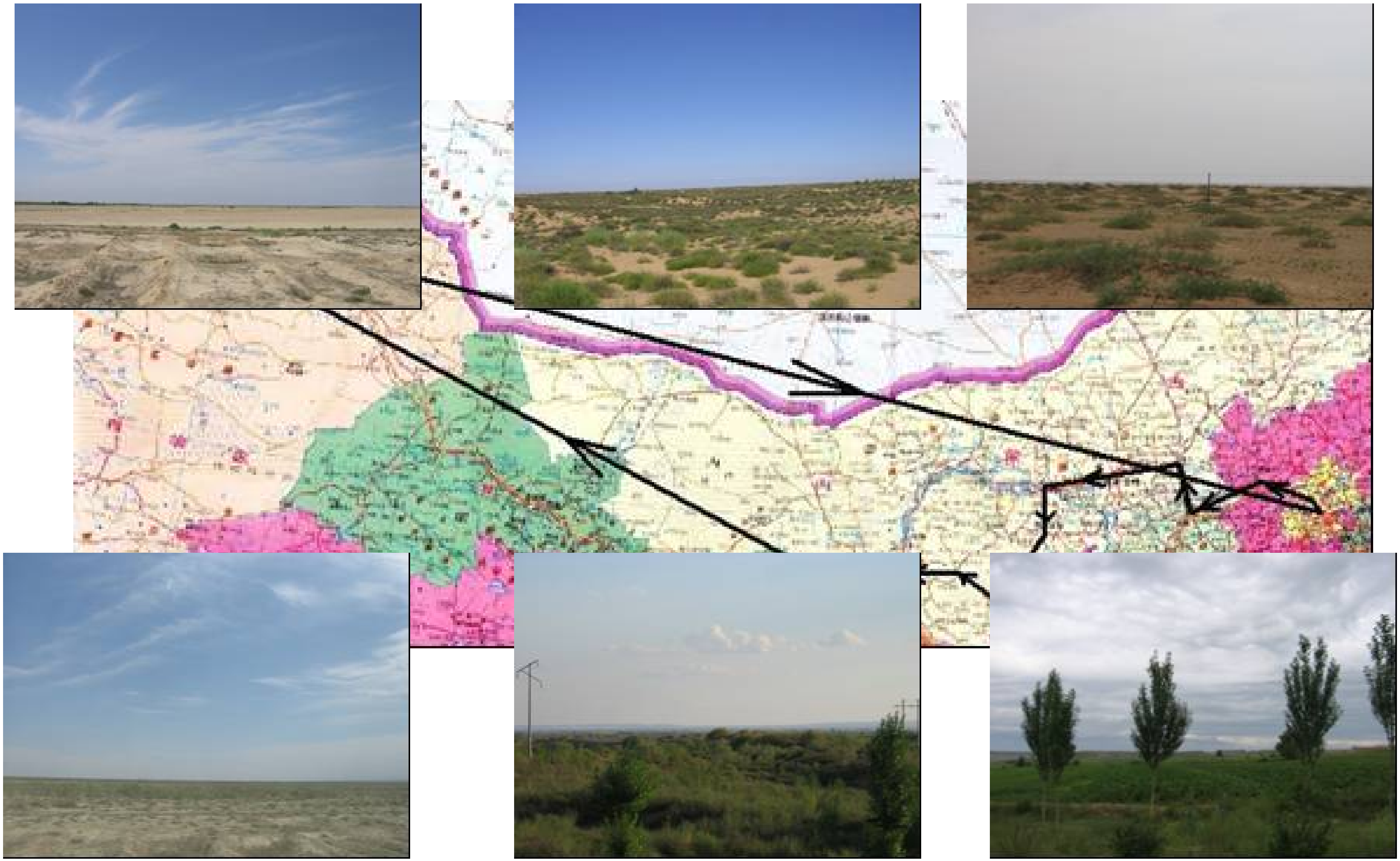


3. International Cooperation

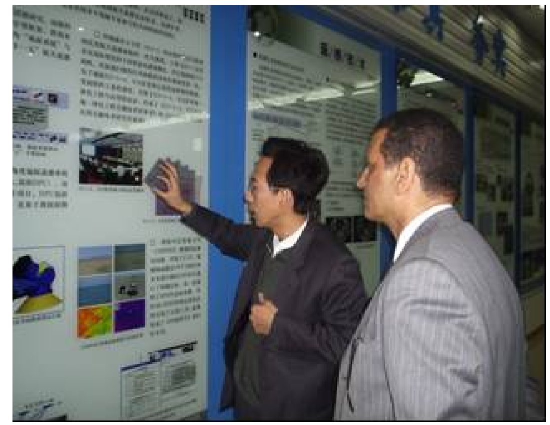
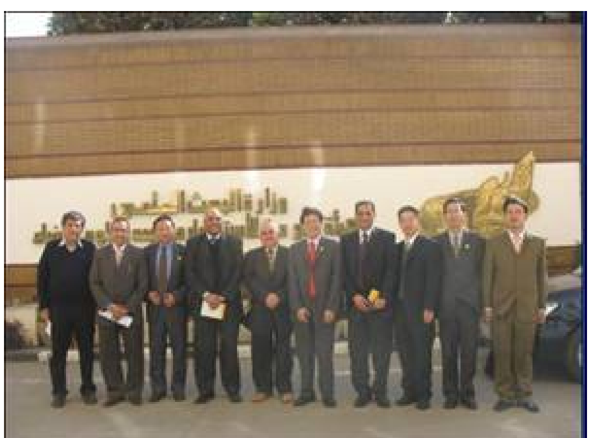
- **3.1 CSIRO of Australia**
  - **'Characterization of Australian and Chinese calibration sites for current and future satellite sensors and to validate applications' has been funded by Australia.**
  - **David.Jupp of CSIRO have attended the fourth Inner Mongolia Cal &Val field experiments on Oct, 2007**

Goals of the cooperation project

- **Enhance the collaboration between Australian and Chinese remote sensing scientists to improve the continuity and quality of remote sensing products for the two countries into the future for atmospheric, land and vegetation applications.**
- **Develop a complementary set of core mission-ready sites in China and Australia, in anticipation of their use in China's planned space activities as well as those of other countries.**
- **Develop improved methodologies to characterize the field sites that are used to validate remotely-sensed products.**

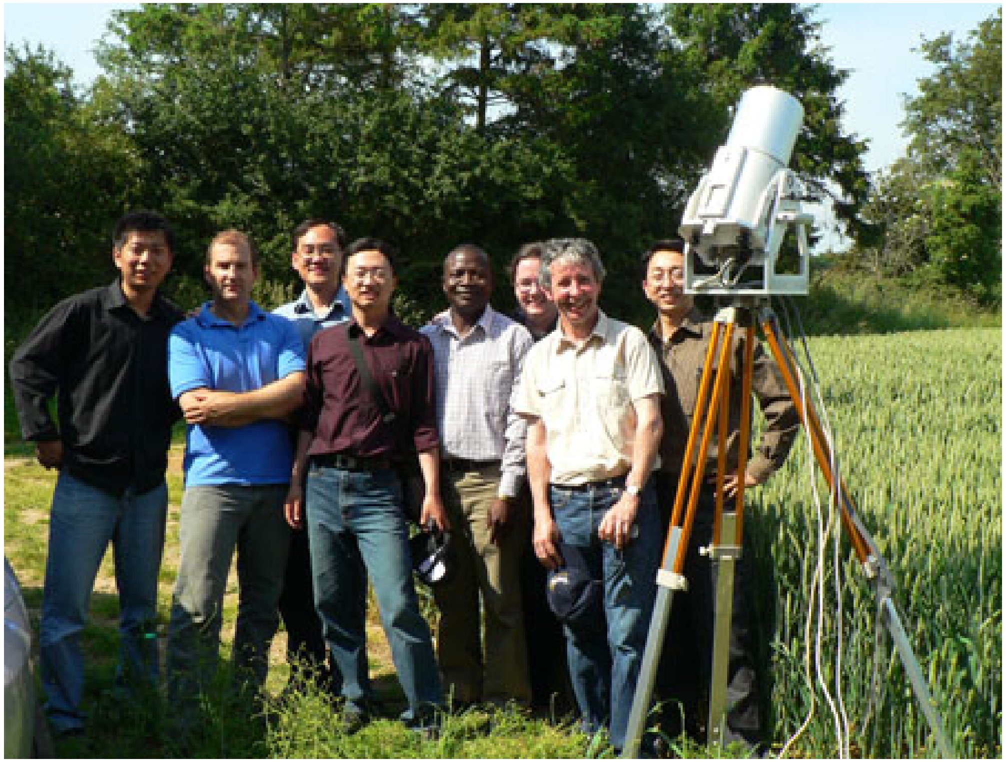
3. International Cooperation

- **3.2 NARSS of Egypt**

3.3 Calibration Campaign in UK, June 2006

- **Network for Calibration and Validation of Earth Observation Data (NCAVEO), 2006 Field Experiment in Chilbolton, UK**



3.4 GISTDA of Thailand

- **THEOS Calibration and Validation**
  - **Calibration and validation of THEOS (THai Earth Observation System) by using IRSA remote sensing satellite calibration and validation sites**
  - **Cooperation on calibration and validation with cross calibration technique between THEOS and satellites in China.**
  - **Training GISTDA staff on image calibration and validation**

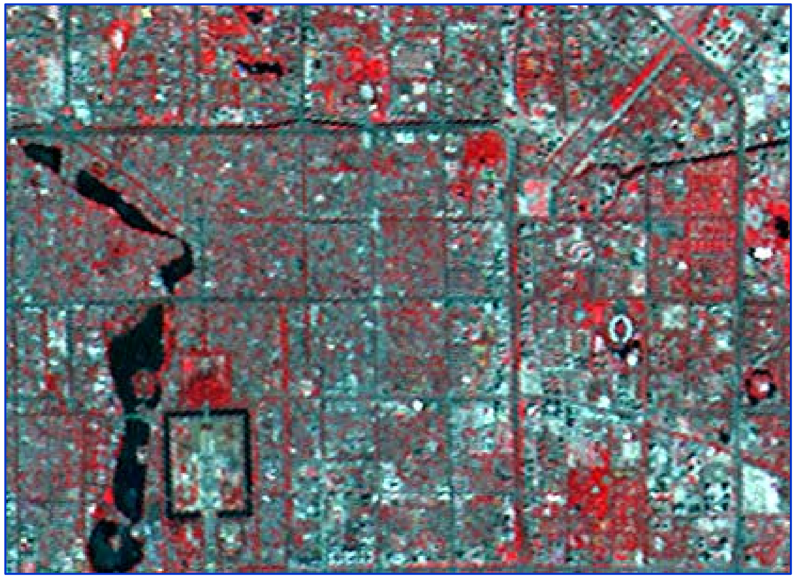
4. Recommendations

- **Calibration is not the final objective. It must meet the applications requirement。**
- **The method of vicarious calibration with test site required so much work and fund that it could not produce enough calibration coefficients and it could not be applied to history data.**
- **Cross-calibration and other methods such as energy integral radiometric calibration should be developed.**
- **Calibration and validation are key parts of quantitative remote sensing, however only absolute calibration is not enough for remote sensing applications. The atmospheric correction and topographic correction are very important for quantitative remote sensing.**

Calibration is for applications

4. Recommendations

Origin Image of CBERS CCD (band 4/3/2)



Calibrated Image

Calibration has to be Pixel level

4. Recommendations

- **The total radiation energy is very stable in long time in global area. So we can choose a certain spectrum range for radiometric calibration according a certain satellite sensor. The calibration would deal with three difficulties as following:**
  - **Shorten the time of integral for calibration;**
  - **Reduce the spatial range of integral for calibration;**
  - **Refine the spectrum range of integral for calibration.**

We need calibration for historic data

4. Recommendations

- **Wide cooperation prospect with WGCV**
  - **Promote academic communication between China and WGCV in calibration and validation research.**
  - **Use of international Test Sites Network for Chinese satellites calibration and validation.**
  - **Contribution of different Chinese test sites for the Calibration of world EOS**


THANK YOU!