Status and Development Plan of Baotou Comprehensive Cal&Val Site

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Outline

1 Goals of Baotou Comprehensive Cal&Val Site

2 Current Status of Baotou Comprehensive Cal&Val Site

3 Ongoing work and future plan

1. Goals of Baotou Comprehensive C&V Site

1. **In the pre-flight stage, comprehensively and accurately test the payload performances.**
2. **In the post-launch stage, frequently monitor the stability of the payload performances.**
3. **Provide experimental site for developing RS quantitative application models and validation of RS products**
4. **Promote data sharing according to international standards**

1. Goals of Baotou Comprehensive C&V Site

(1) Full set of artificial and natural targets

- Various ground targets for supporting geometric, radiometric and spectral calibration and performance testing for different payloads, so as to avoid transition between different sites in the pre-flight test stage.
- Permanent targets for satisfying the demand of test frequency in the post-launch stage.

Image quality test field (Sjökulla, Finland)

Product validation field (Barrax, Spain)

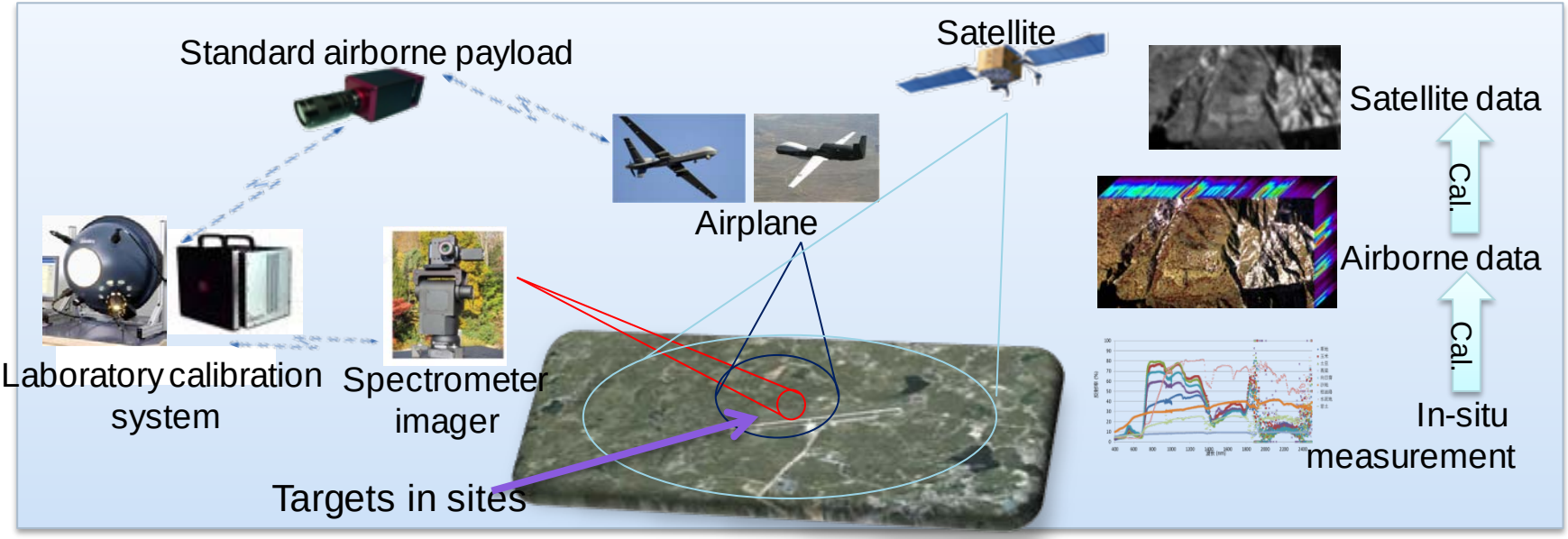
Geometric calibration test field (Pavia, Italy)

Comprehensive Cal&Val test site

1. Goals of Baotou Comprehensive C&V Site

(2) Traceable, muti-grade validation technique system

- **Traceable pre-flight payload performance test instruments**
- **Supporting post-launch payload performance test in different scale, namely, in-situ, airborne, satellite levels.**



1. Goals of Baotou Comprehensive C&V Site

(3) Opening site in accordance with international standards

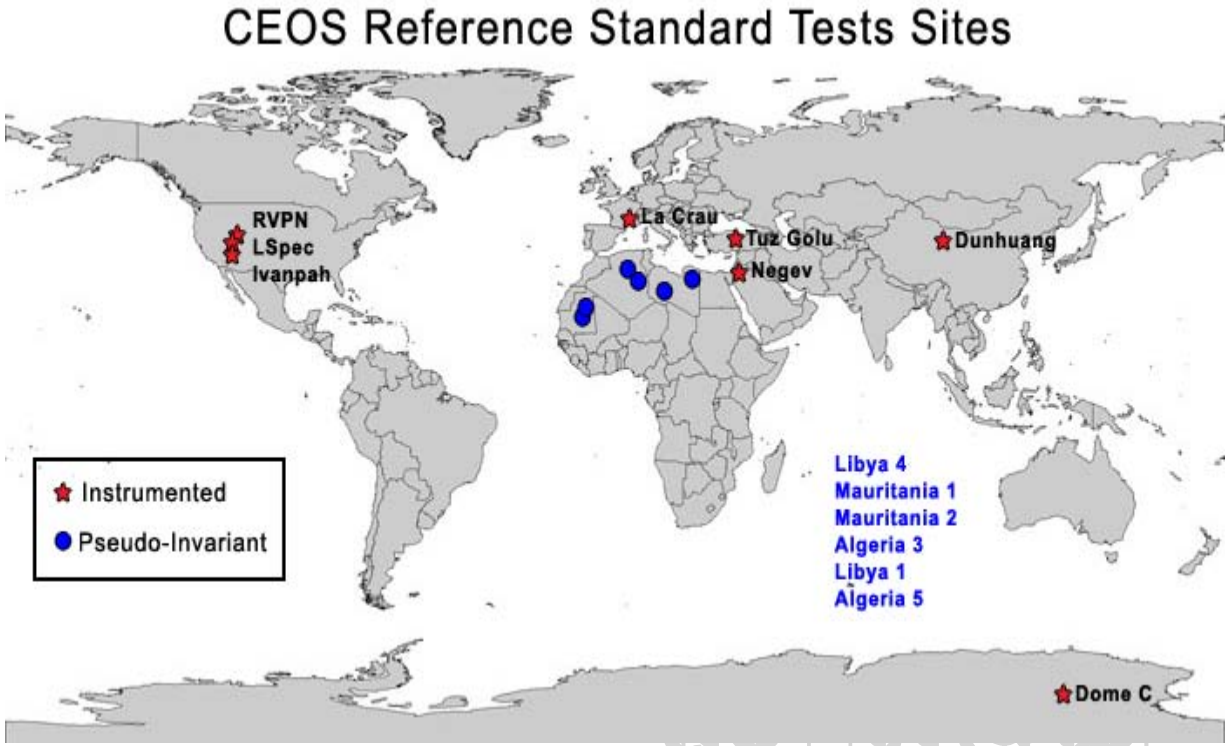
- Regularly renewed information database
- Data quality standard
- Carry out cross-validation with other countries' sites.

Dome C

Dunhuang

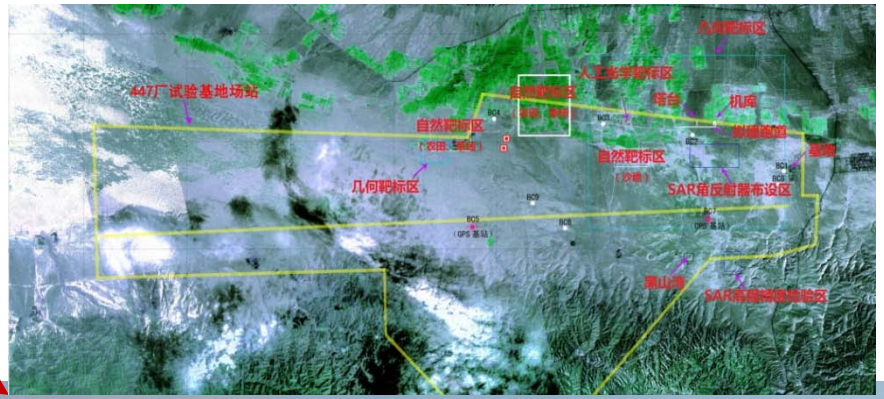
La Crau

Ivanpah Playa



2. Current Status of Baotou Comprehensive Cal&Val Site

- Established firstly in 2009 under the support of national 863 program.
- Located in Wulate Qianqi, Baotou City, Inner Mongolia, with latitude 40.84° N and longitude 109.46° E, 700km away from Beijing, with convenient transportation.
- Available flight space and convenient living facilities

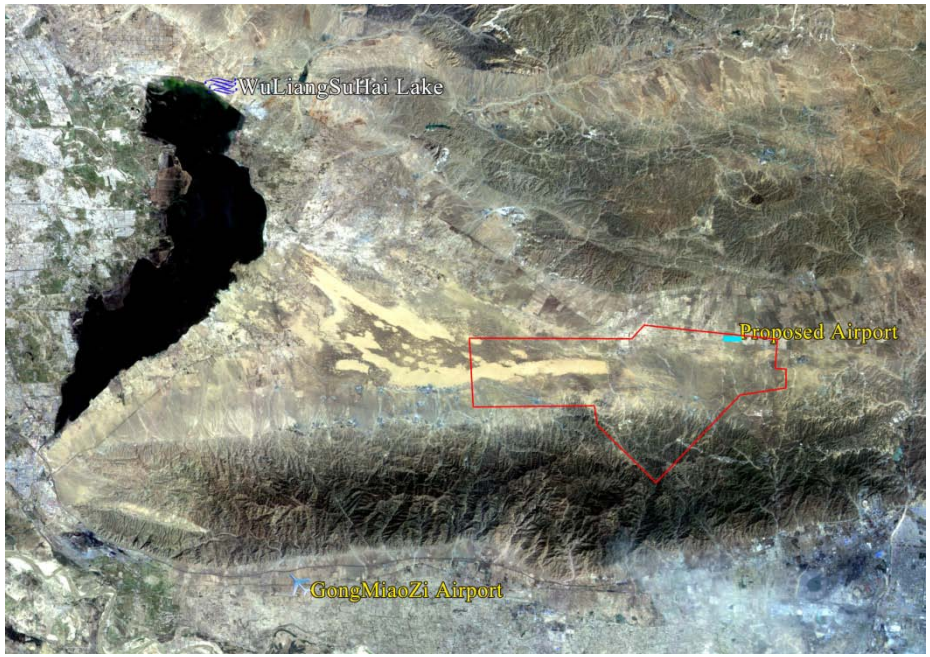


2. Current Status of Baotou Comprehensive Cal&Val Site

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
avg. Ta （℃）	-11.6	-6.4	0.4	9.3	16.5	21.6	23.6	21.1	15.0	6.9	-2.2	-9.6
Avg. Water vapor (g/cm^2)	0.32	0.36	0.45	0.71	1.11	1.90	2.61	2.36	1.67	0.94	0.53	0.35

sand

Bare land



Composite image by HJ-1/CCD (13May, 2003)

Farm land

2. Current Status of Baotou Comprehensive Cal&Val Site

- **Components**

(1) Standard targets

(a) artificial targets (b) natural ground scenes

(2) Multi-grade testing system

hyperspectral camera

large field multispectral camera

Ground test equipements

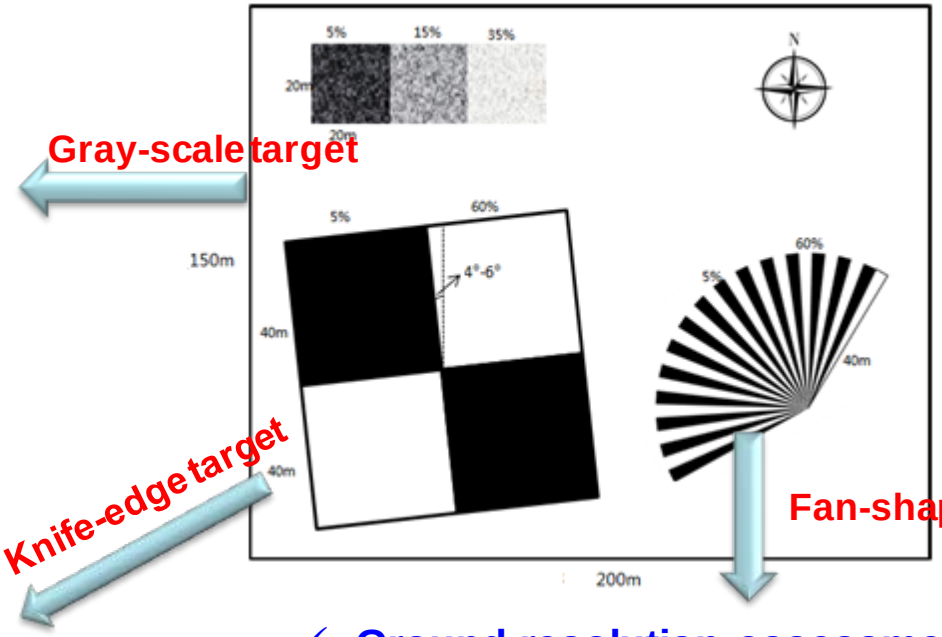
(3) Data Processing and Analyzing System

3. Ongoing work and future plan

- **Standard targets developing for long-term stable operation**

> ➢ **In order to frequently monitor the radiometric, spatial performances of high-resolution payloads, three permanent artificial targets are being developed.**

- ✓ **Absolute radiometric calibration, dynamic range and response linearity assessments;**
- ✓ **Made of weather resistant, spectrum stable gravel;**
- ✓ **Size: 20m×20m;**
- ✓ **Reflectance: 5%, 15%, 35%.**

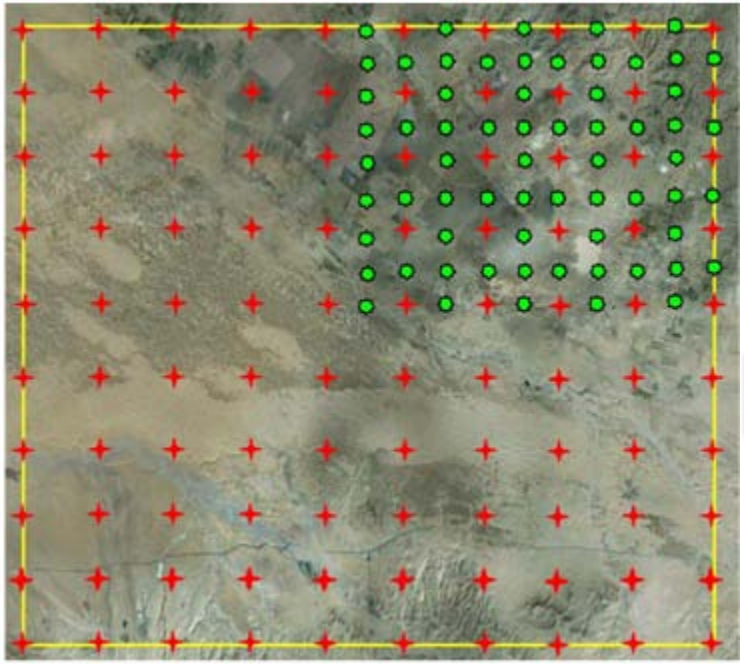


- ✓ **MTF assessment;**
- ✓ **Made of painted cement;**
- ✓ **Size: 40m×40m;**
- ✓ **Reflectance: 5%, 60%.**

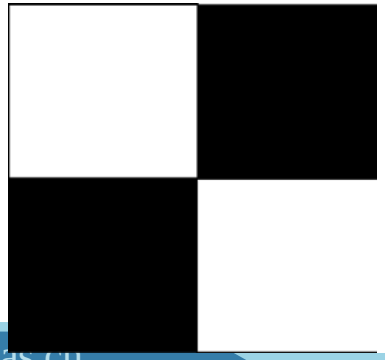
- ✓ **Ground resolution assessment;**
- ✓ **Made of painted cement;**
- ✓ **Arc length: 40m; radius angle: 110°**
  Reflectance: 5%, 60%.

3. Ongoing work and future plan

- **The construction of geometric calibration field**



Geometric calibration field



- An area of 10×10km², with 100 permanent marks (red points) uniformly distributed at an interval of 1000m ;
- 65 portable targets distributed within an small area of 5×5km², at an interval of 500m;
- Suitable for the geometric calibration of airborne images with an spatial resolution of 5cm-1m, and satellite-borne images with an spatial resolution of 0.1-10m.

3. Ongoing work and future plan

- **The SAR point targets**

Triangular Trihedral Corner Reflector Array

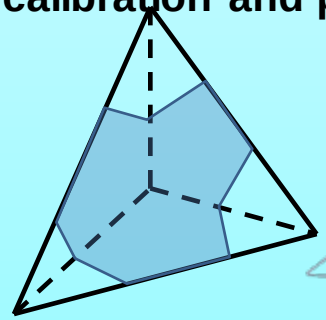
Dihedral Corner Reflectors

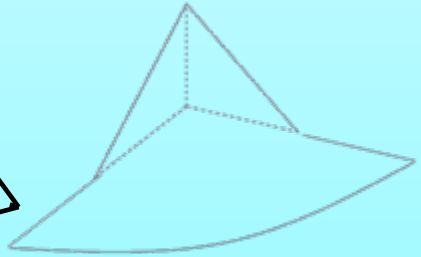
Ku/X band reflectors

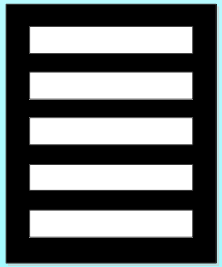
- **Larger reflectors suitable for C~P band SAR**
- **SAR corner reflector base suitable for mounting various reflectors, allowable for long-term monitoring of airborne and spaceborne SAR systems**

sketch

- **New type of reflectors for accurate SAR calibration and performance assessment**





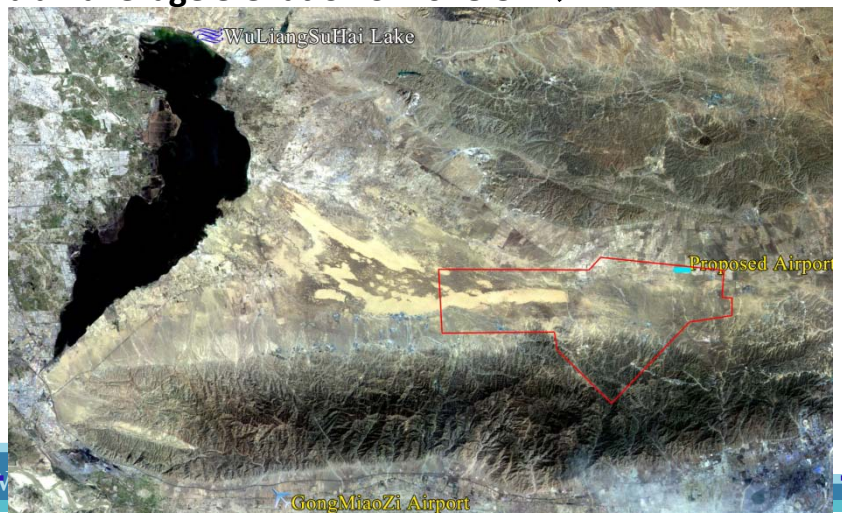


3. Ongoing work and future plan

- **The development of natural and artificial infrared targets**

Wuliangsuhai lake

（The largest lake in reaches of the Yellow River covering an area of more than 290 km2, with an depth of 0.5-2.5m and an average elevation of 1018.5m.）



Large infrared target board

- The Wuliangsuhai lake as a natural infrared target, and the artificial large infrared target, allowable for radiometric calibration of infrared payload；
- The large area infrared target allowable for radiometric calibration for mid-infrared and thermal infrared payloads.
- The temperature difference target allowable for radiometric resolution and geometric resolution assessments for infrared payloads.

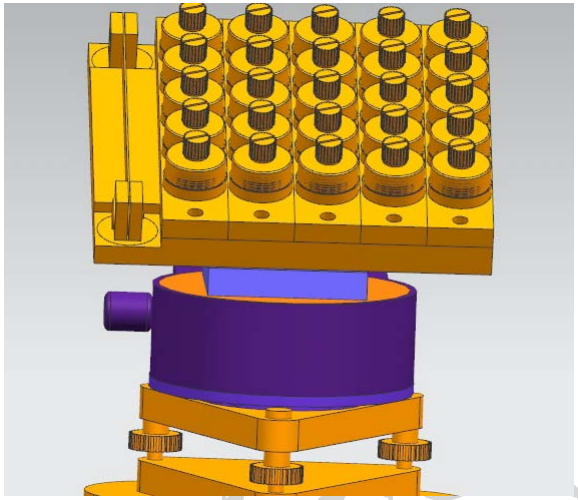
3. Ongoing work and future plan

- **The Improvements on ground testing system**

--- Reflect point source array target

- **Specular reflectors can be used as standard targets in radiometric calibration and MTF/point spread function assessments.**
- **Comparing with traditional optical targets, they have the advantages in:**
  - ✓ **No need of the BRDF measurement, only specular reflectance measured in lab.**
  - ✓ **Decreasing the dependence on the measurement of atmospheric environment and calculation of atmospheric radiative transfer process.**
  - ✓ **High precision, high efficiency, strong adaptability to environment.**

Point source array



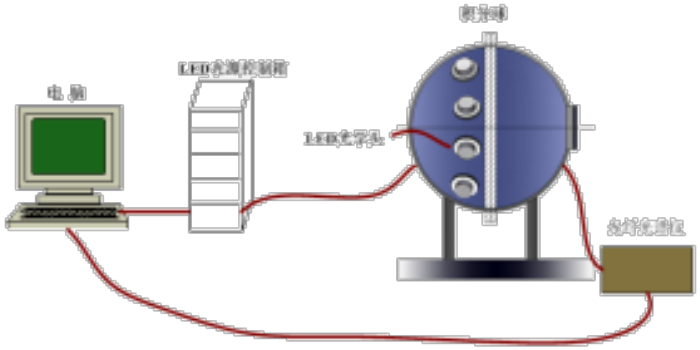
3. Ongoing work and future plan

- **The Improvements on ground testing system**

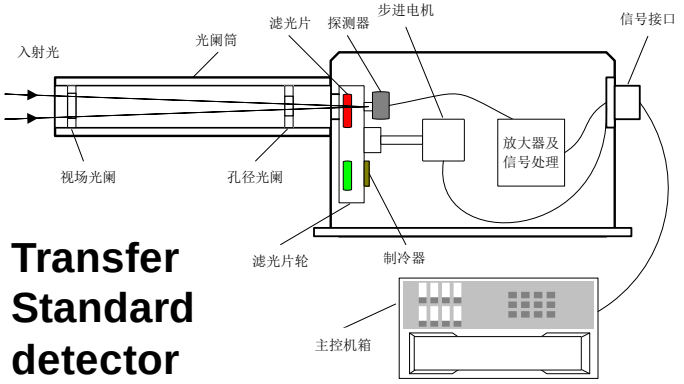
--- Pre-flight calibration and performance test

> **Considering the disassemble characteristic of airborne sensors, in-situ high-precision calibration and performance test system is being developed on the test site.**

Visible- SWIR：MTF、SNR、resolution、MRC、uniformity…
MIR-TIR：MDT、MRDT、MTF、NETD、SNR、uniformity…



Spectrum adjustable integrating sphere light source



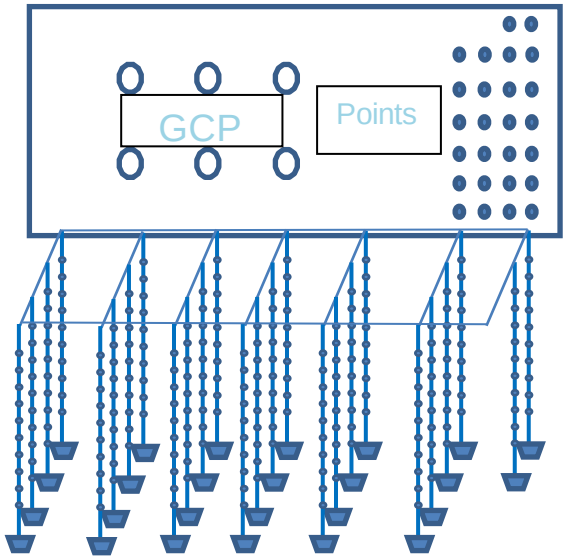
Transfer Standard detector

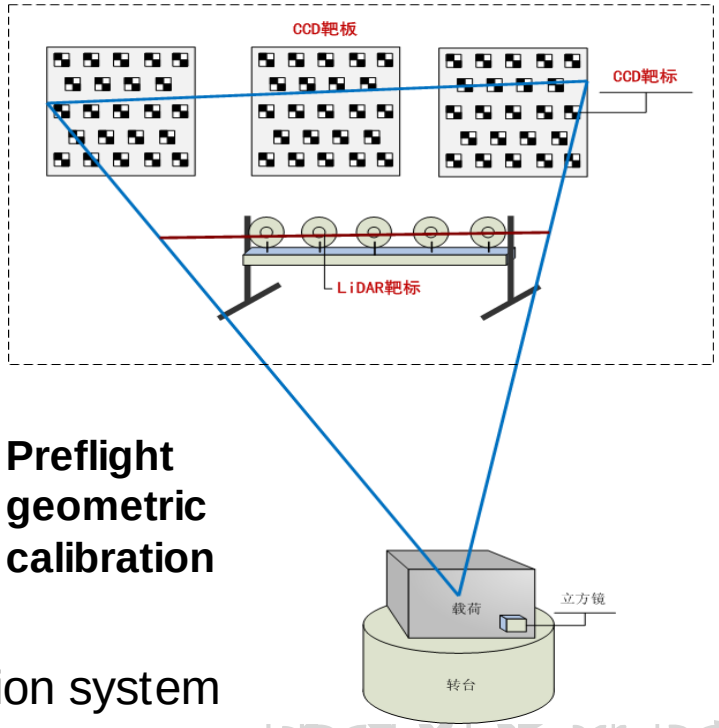
3. Ongoing work and future plan

- **The Improvements on ground testing system**

--- Pre-flight calibration and performance test

Provide accurate initial value for in-flight geometric calibration.
Intrinsic camera parameters : f（principal focus distance）, Principal point offset;
Distortion coefficients: Radial Distortion , Decentering Distortion,etc.





Preflight geometric calibration

3-D geometric calibration system

3. Ongoing work and future plan

- **The Improvements on testing system**

On-situ spectrometer imager

Covering VIS, NIR, SWIR and TIR , used in the field to simultaneously capture the temperature variations and emissivity and reflectivity

Airborne spectrometer imager

Covering VIS, NIR, SWIR and TIR

Temperature monitoring over different surfaces

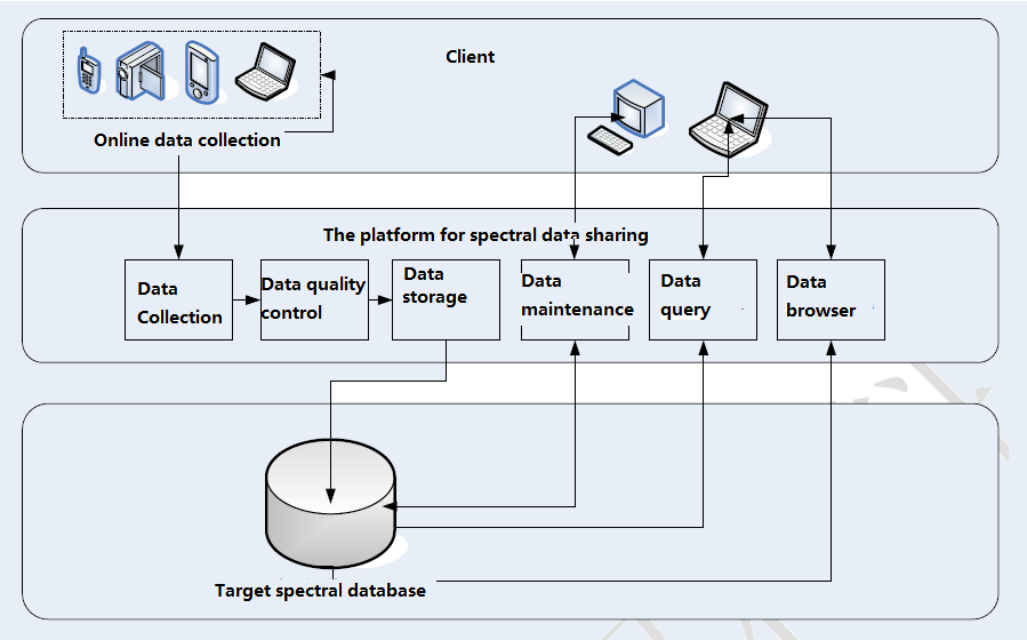
---Spectrum extension to TIR

in situ measurement auxiliary facilities

Anticipated traceable absolute radiometric calibration accuracy：5.0%(0.4-2.5μm); 1.0K(@300K)(8-12.5μm)

3. Ongoing work and future plan

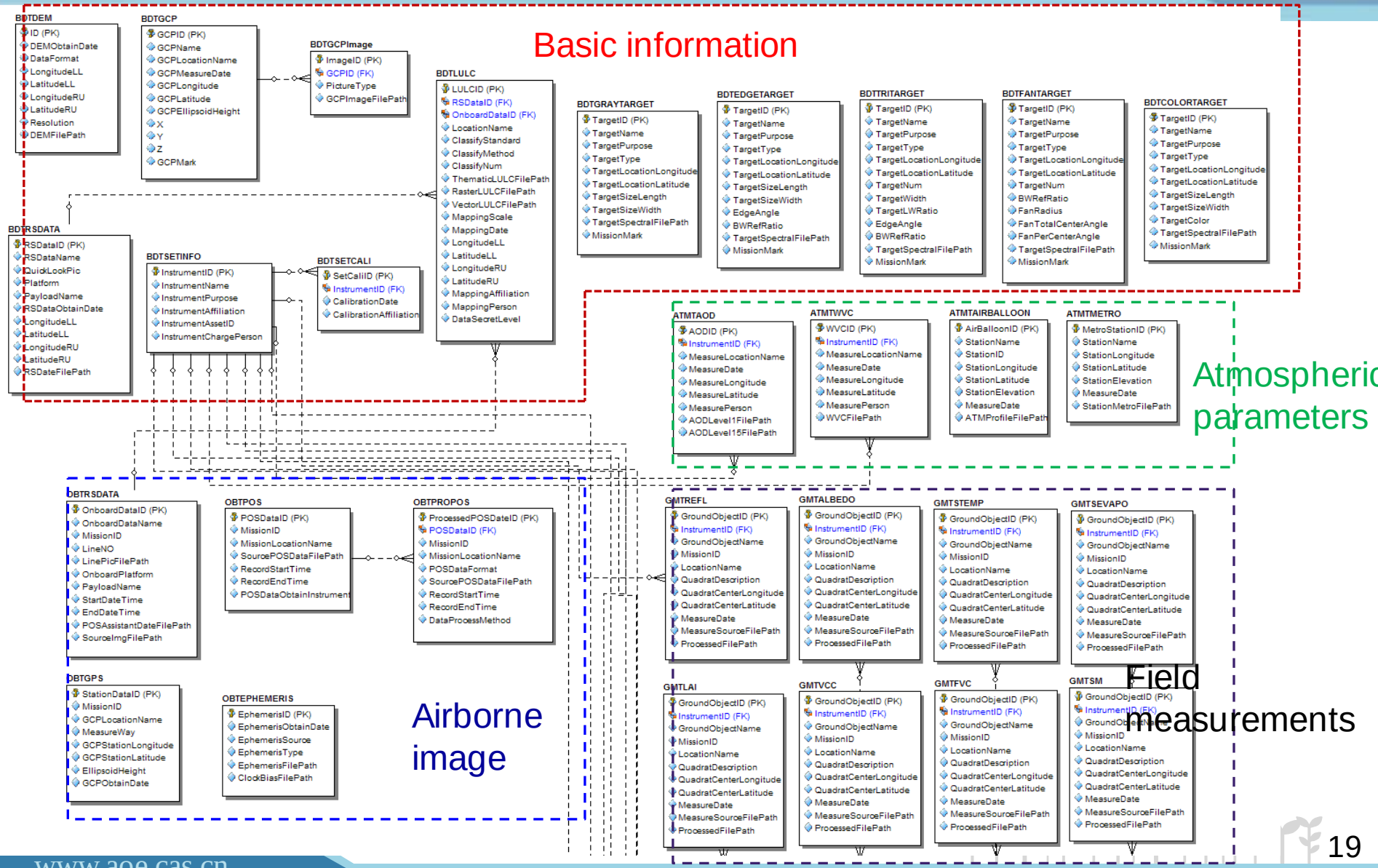
- **The construction of the extensible database**



The extensible database for the comprehensive C&V site

- Daily measured atmospheric parameters
- Meteorological parameters
- The atmospheric parameters
- Synchronously acquired during scientific experiments,
- High-precision DEM data,
- Multi-temporal high-resolution remote sensing images,
- Multi-temporal land cover data

3. Ongoing work and future plan



Advantages of Baotou Site:

- Full set of artificial and natural targets for testing radiometric, geometric and spectral performance of multi-/hyper-spectral imager, SAR, LiDAR, etc.
- A live testing site, that has auxiliary facilities, staff and is daily operational, etc.
- Fixed testing for airborne calibration and validation is always available in the site.

Summary

Contribute to Landnet:

- **Periodic targets' characteristics and uncertainty analyses**
- **Daily atmospheric parameters**
- **Operational targets and equipment system**
- **Database over Baotou sites**
- **Site data processing**

Supports from Landnet:

- **a series of standards, e.g., target construction, measurement, data processing, quality control, site maintenance**
- **information of other sites and satellite data used for cross-validation**


Thank you !