National Remote Sensing Center of China
Agency Report

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

Feb. 2014

CEOS / WGCV-37 Plenary

Outline

NRSCC Introduction

Important Mission and Activities

- EO mission — TANSAT
- New generation payload technology — Intensity Correlation Imaging Technology
- Calibration & Validation
- Data Sharing

Introduction

- NRSCC was one of branch centers of Ministry of Sciences and Technology of China (MOST), and established in 1981 with its mandate in domain of RS, GIS and Navigation:

✓ to guide and coordinate R&D activities,

✓ to manage China National Scientific project

✓ to facilitate the actions of Expert group of RS, GIS, Space explore and Navigation domain

- To support the development of innovation capacity and to foster the new industry
- Ten official staffs at present but many secondments
- The mode of “condensed kernel, wide network”

49 branches of NRSCC

- **Technical support from the 49 branches of NRSCC, involved in most remote sensing teams in China**

- **Specific expert teams**
  - ✓ **Consultant team**
  - ✓ **Technical development and application team**
  - ✓ **Operation team**

Data and Comprehensive Services

- Department of Research & Development
- Department of Information Service
- Department of Geographical Information System
- Department of Meteorological Satellite Remote Sensing
- Department of Remote Sensing Satellite Receiving
- Department of First Aerial Remote Sensing
- Department of Data Management and Industry Development
- Department of Ocean Remote Sensing
- Department of Environmental Remote Sensing
- Department of Earth System Science Data Service
- Department of Disaster Management
- Department of Satellite Surveying and Mapping
- Department of Geographic Information Engineering

Application Research

- Department of Land and Resources
- Department of Agricultural Application
- Department of Forest Resource and Ecological Environment
- Department of Remote Sensing Monitoring of Natural Disaster
- Department of Space Science Remote Sensing
- Department of Global Change and Sustainable
- Department of Remote Sensing for Natural and Cultural Heritage
- Department of Crust Dynamics and Deep Space Exploration
- Department of Urban Environmental Remote Sensing
- Department of Precision Agriculture Application
- Department of Hyperspectral Remote Sensing Technology and Application
- Department of Research for Wetland Remote Sensing
- Department of Nonferrous Metal Mineral Resources Remote Sensing
- Department of Land Remote Sensing

System and Equipment

- Department of System Integration
- Department of Remote Sensing System Equipment
- Department of Radar Armaments
- Department of Satellite Navigation System Equipment
- Department of Microwave Remote Sensing Technology
- Department of GNSS Service Performance Enhancement
- Department of Satellite Data Receiving
- Department of GNSS Signal Processing
- Department of Inertial Navigation System and Apparatuses

Technical Training

- Technical Training
- Department of Hong Kong Research, Development and Training
- Wuhan Technical Training Department
- Department of Proficiency Training

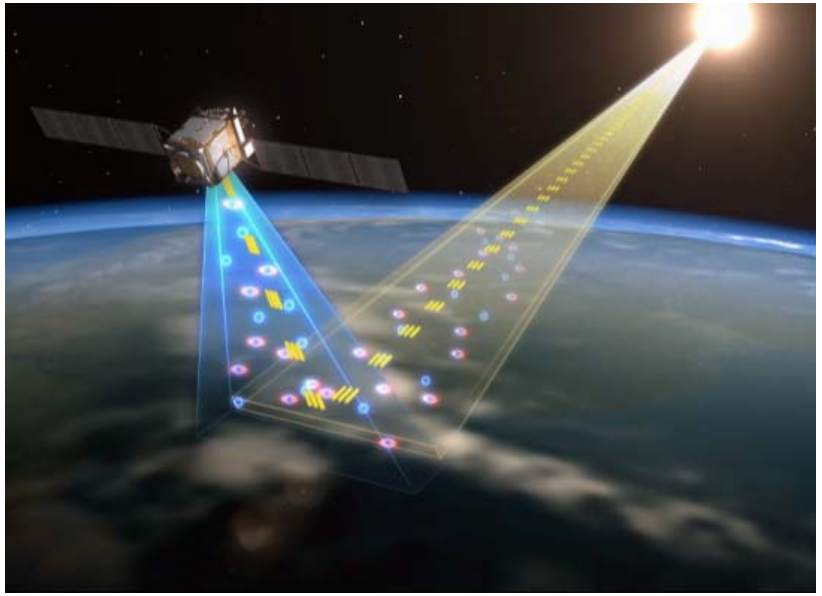
Local Division

- Department of Local Remote Sensing Contact Service
- Beijing Division
- Hunan Division
- Fujian Division
- Chongqing Division
- Jiangsu Division

Important Mission and Activities

Overview of TANSAT

- Global CO_2 observation and monitoring
  - ✓ 4ppm CO_2 retrieval accuracy
- Satellite Mass: ~600 kg
- Launch: expected in 2015
- Lifetime: 3 years



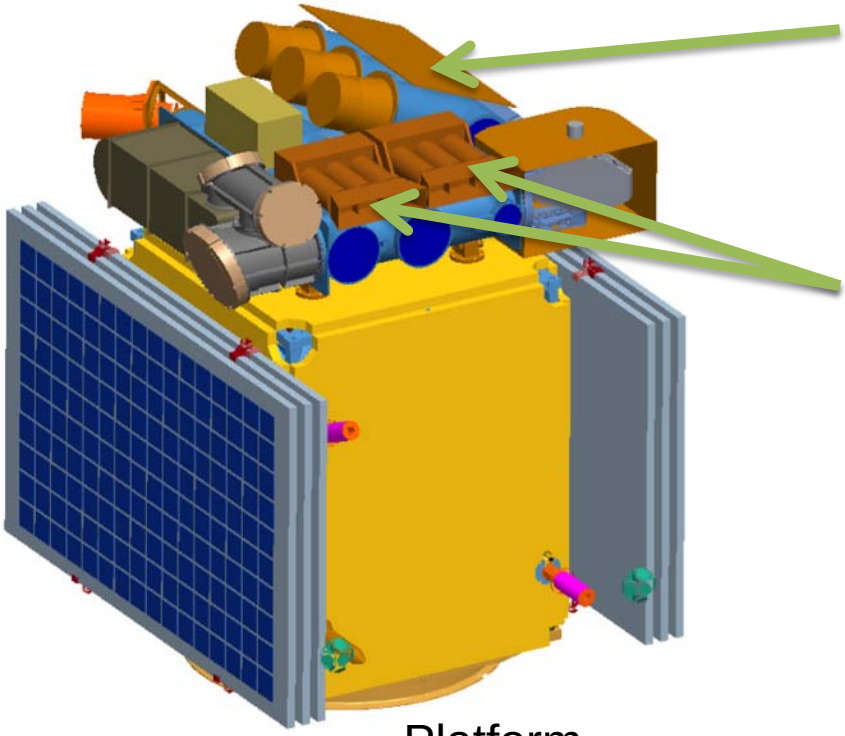
2011.01~2013.05
Phase B

2013.06~2014.06
Phase C

2014.06~2015.03
Phase D

TanSat

Payloads of TANSAT

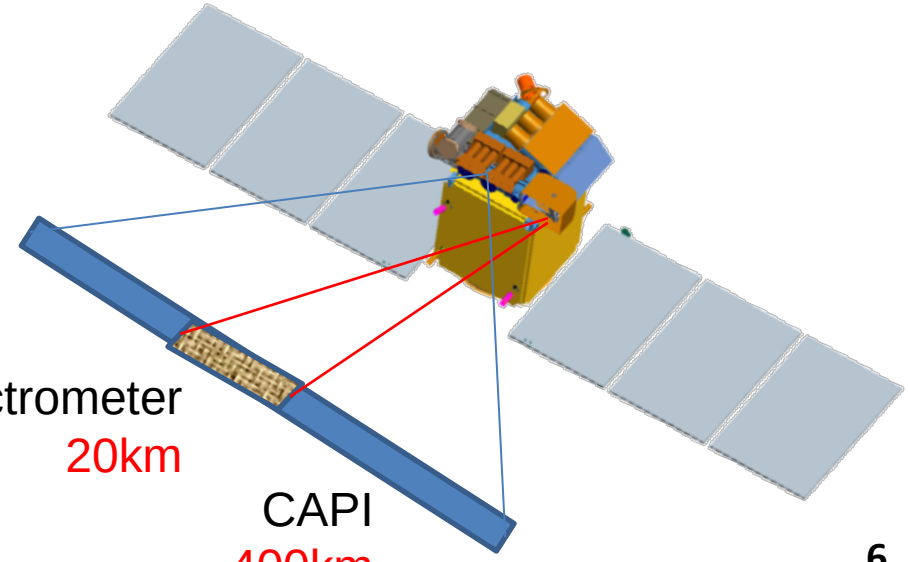


Platform

CO_2 Spectrometer

Cloud and Aerosol Polarimetry Imager (CAPI)

A wide field of view moderate resolution imaging spectrometer with polarization channel

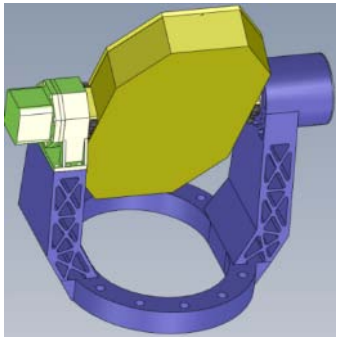


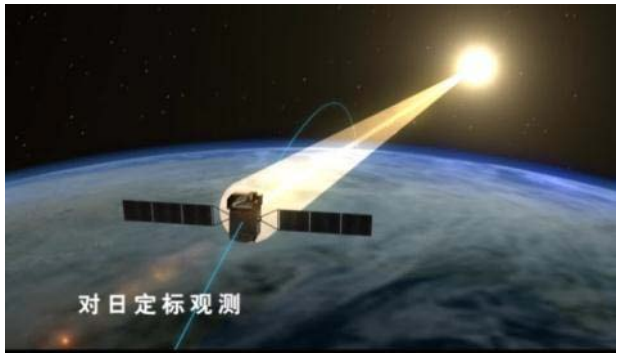
CO_2 Spectrometer
20km

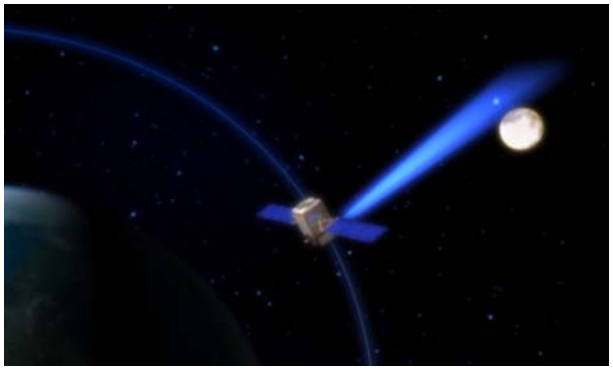
CAPI
400km

Cal/Val of TANSAT

- Specification
  - 5%(absolute), 3%(relatively)
- CO_2 Spectrometer(Once a day)
  - Cal:
    - LED in instrument for spectrometric
    - Sun Calibration (by diffuser)
      - Spectrometric: look through atmosphere(limb)
      - Radiometric: look directly to
  - Val: TCCON
- CAPI(radiometric, once a month)
  - Calibration
    - LED in instrument
    - Sun: for relative and absolute
    - Moon for redundancy of Sun
  - TCCON for Validation

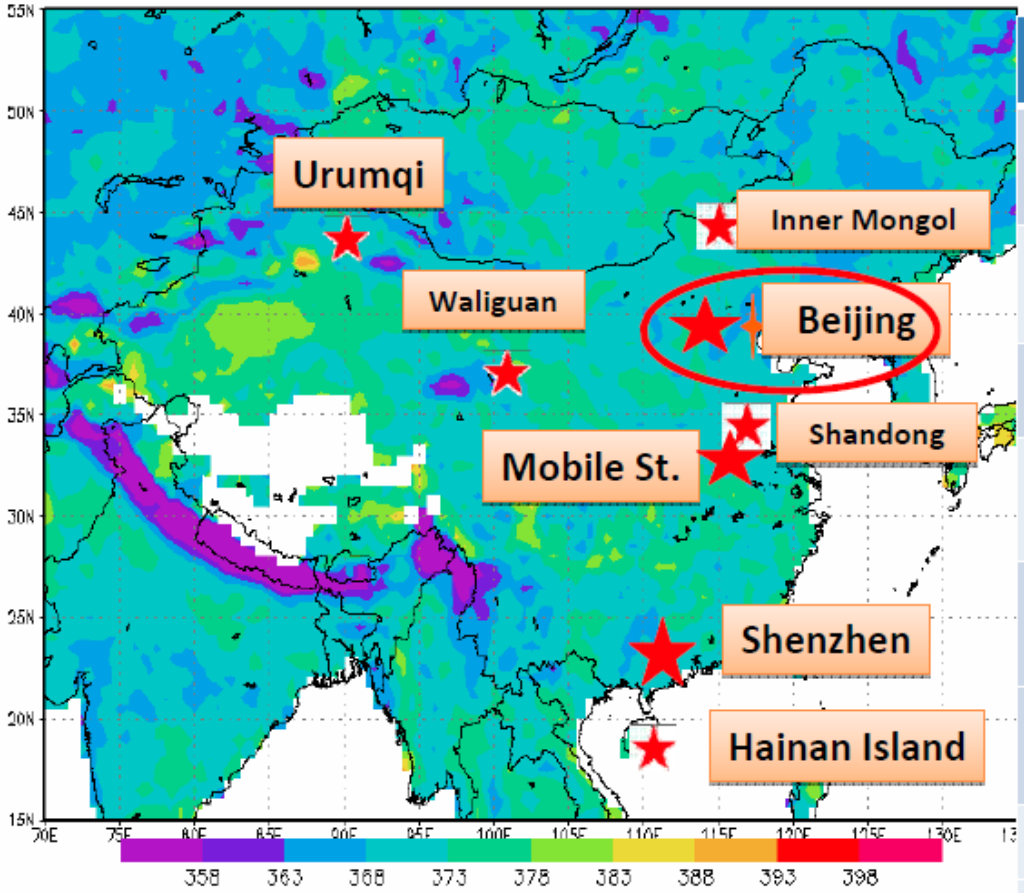






TANSAT Ground Validation Stations

Ground-based Measurement Sites in China



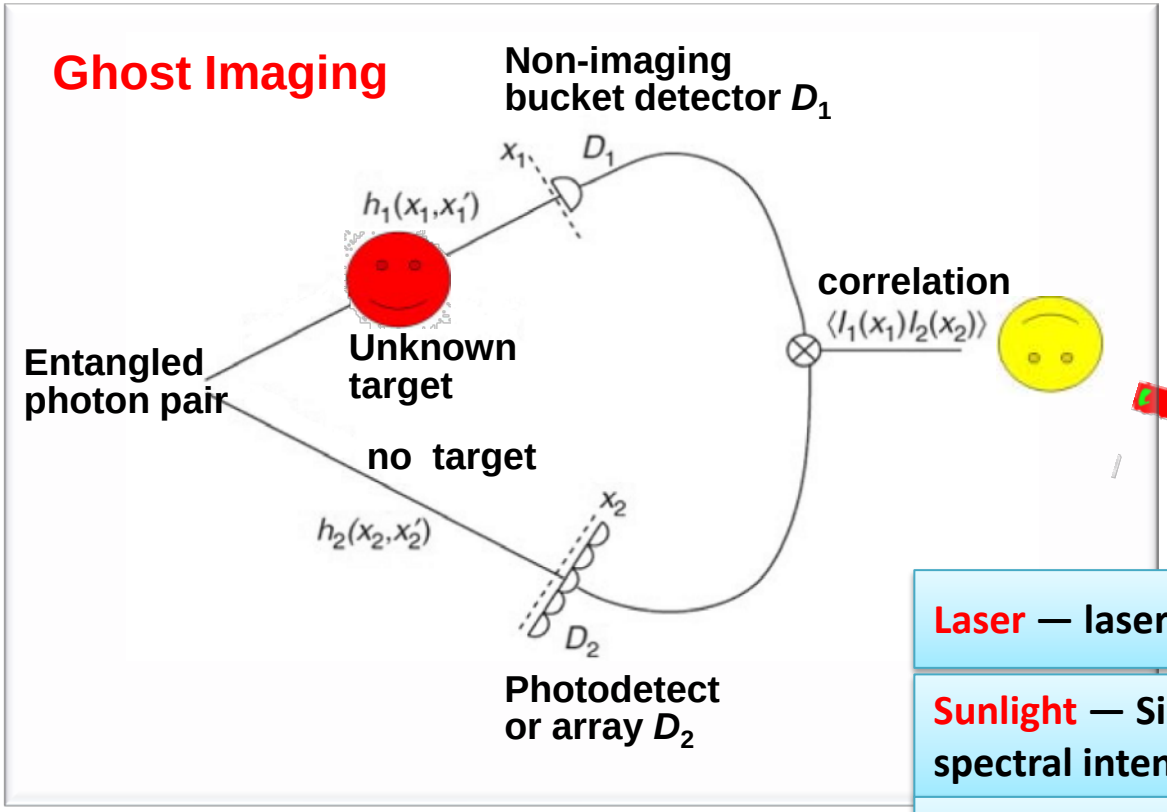
Ground sites

Site	Instrument
Beijing	IFS125/HR +325mTower+7 Licor
Shenzhen	IFS125/HR CIMEL+MWR
Mobile St.	IFS 125/M
Shandong	Optical Spectrum Analyzer(OSA)
Inner Mongol	Optical Spectrum Analyzer(OSA)
Hainan island	Optical Spectrum Analyzer(OSA)
Urumqi	FGGA/LGR
Waliguan	FGGA/LGR

Calibration, Validation & a priori information

New Generation Payload Technology

Intensity Correlation Imaging — an extension of GI



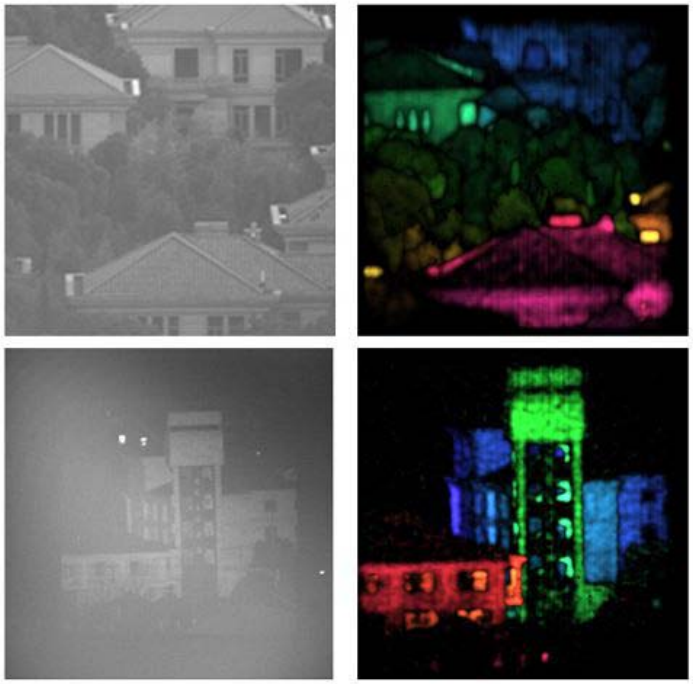
Laser — laser 3D intensity correlation imaging

Sunlight — Single frame exposure multi spectral intensity correlation imaging

Microwave — Microwave staring correlation imaging

Intensity Correlation Imaging

- The first laser 3D intensity correlation imaging engineering prototype system (single-pixel 3D camera)



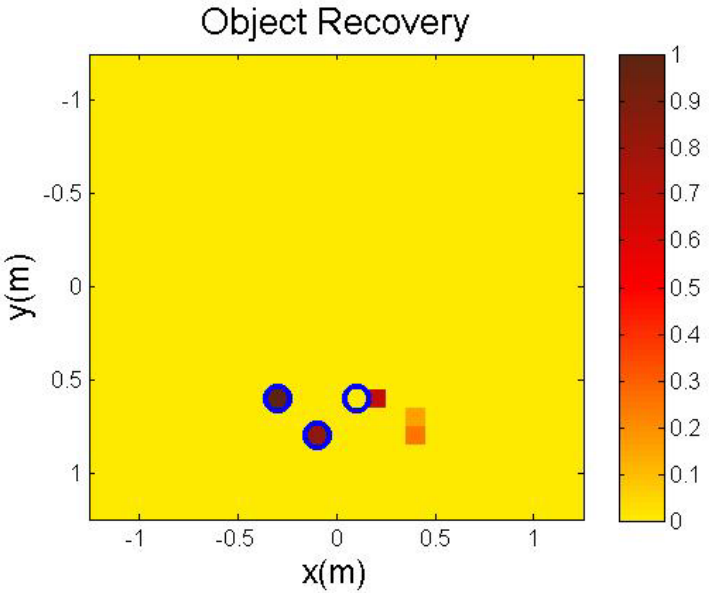
Left: normal image Right: 3D image

Engineering prototype system

Intensity Correlation Imaging

- **The first microwave staring correlation imaging verification experiment device**

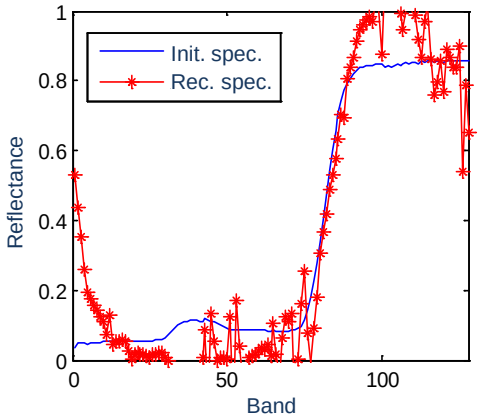
Verification experiment device



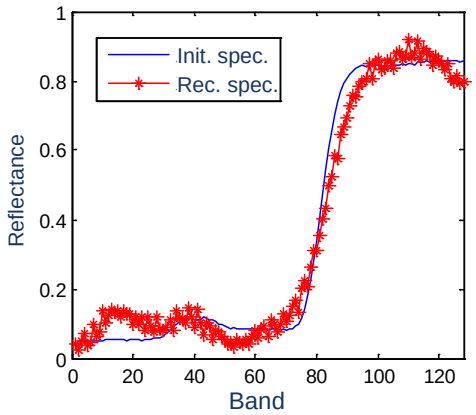
The acquired image is 10 times of the traditional real aperture imaging resolution according to the antenna size

Intensity Correlation Imaging

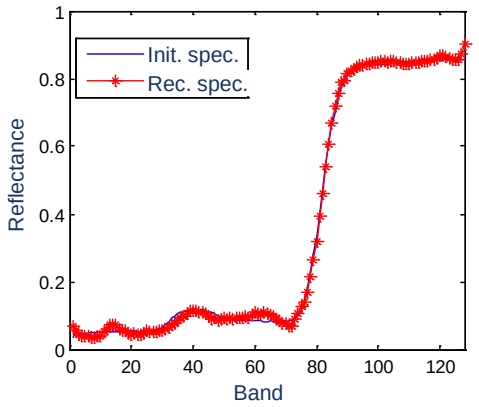
- **Hyperspectral imagery reconstruction based on sparse dictionary**



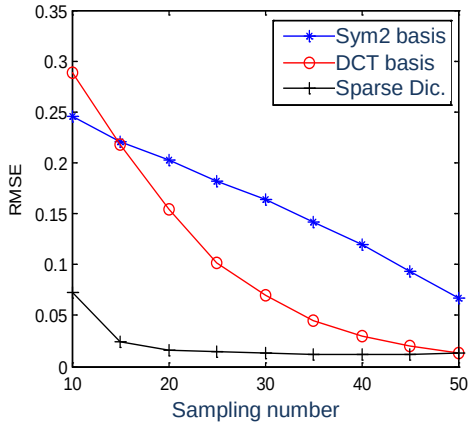
Reconstructed spectrum with sym2 wavelet basis



Reconstructed spectrum with DCT basis



Reconstructed spectrum with sparse dictionary



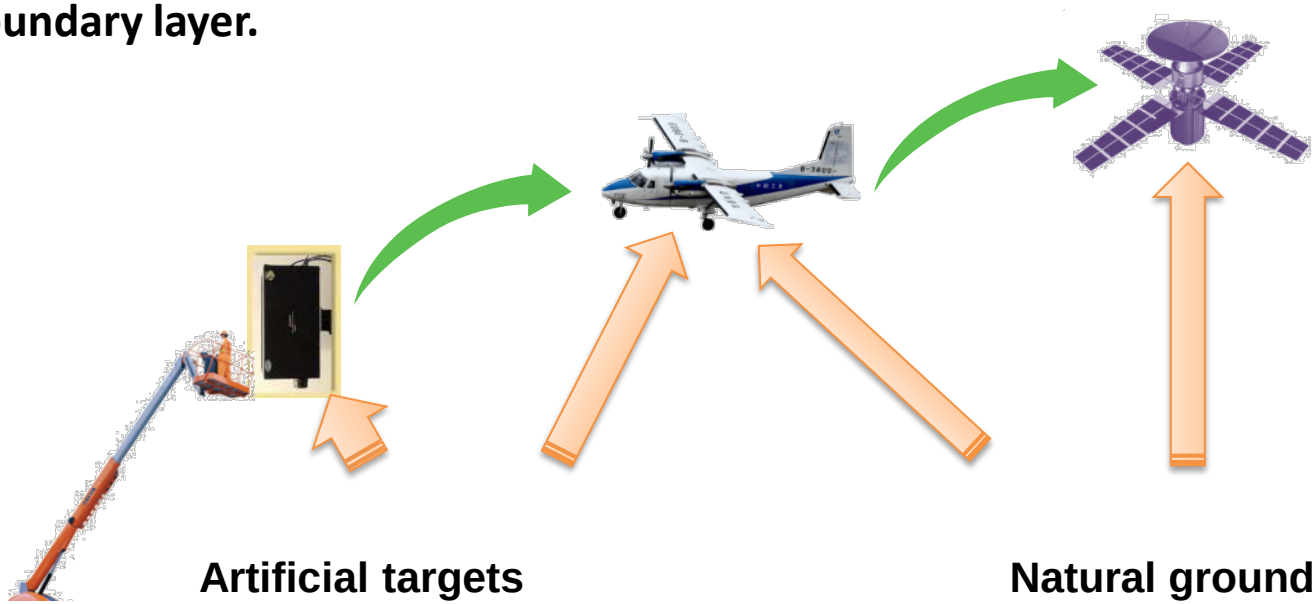
Reconstructed error under different sampling number

Red willow（20% sampling number）

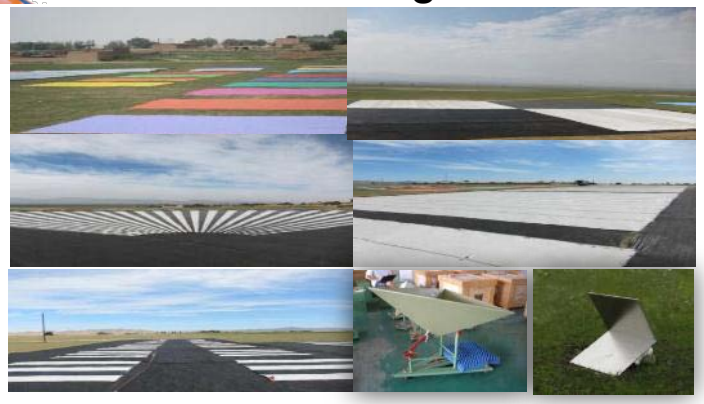
- **The hyperspectral imagery can be reconstructed with the intensity correlation imaging technique at the spectral-space**
- **It was found that the reconstruction with sparse spectral dictionary has better performance than those with sym2 and DCT.**

Calibration & Validation

Stepwise Cal&Val System — **To reduce the scale bias in linking the field measurement and RS data, and uncertainties of atmospheric RT simulation in the boundary layer.**



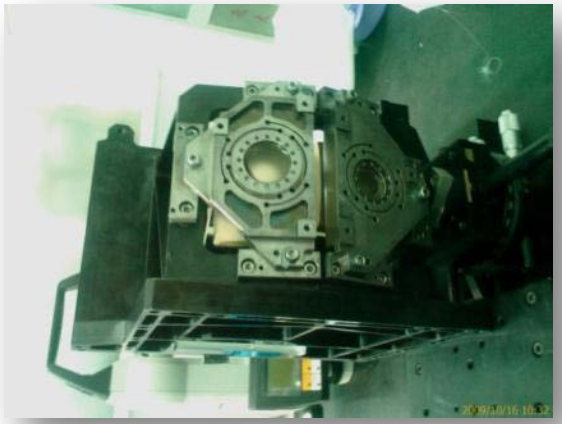
Artificial targets



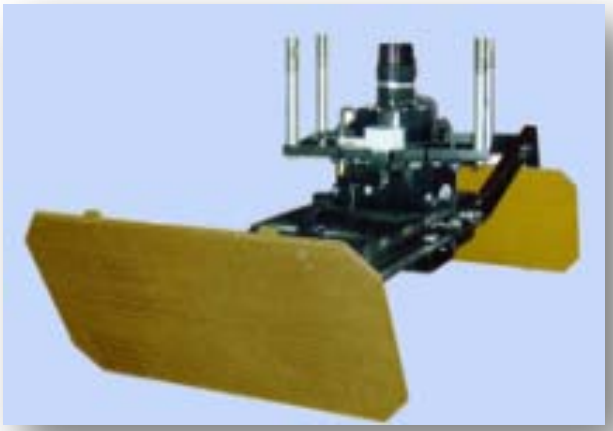
Natural ground scenes

Calibration & Validation

- **Standard airborne Payloads**



hyperspectral camera



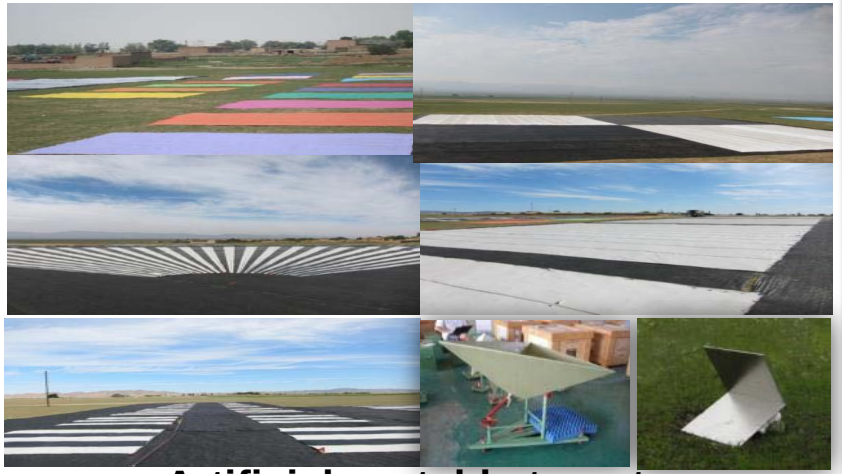
Interferometric SAR

Large field multispectral imager

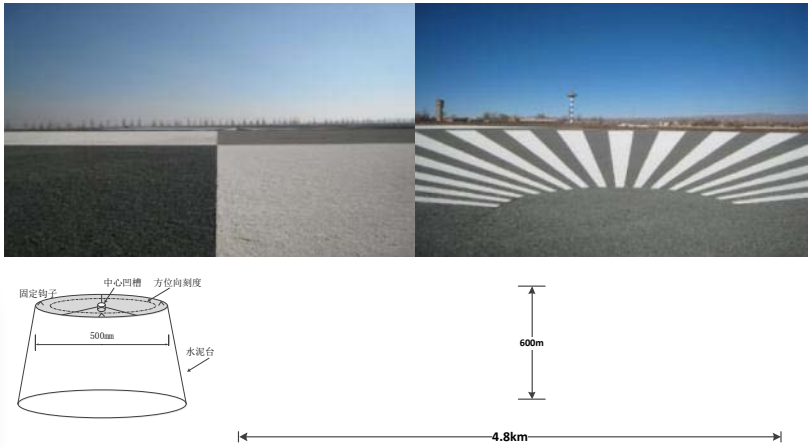
Polarimetric SAR

Calibration & Validation

- **Standard Targets — various targets are integrated in one site.**

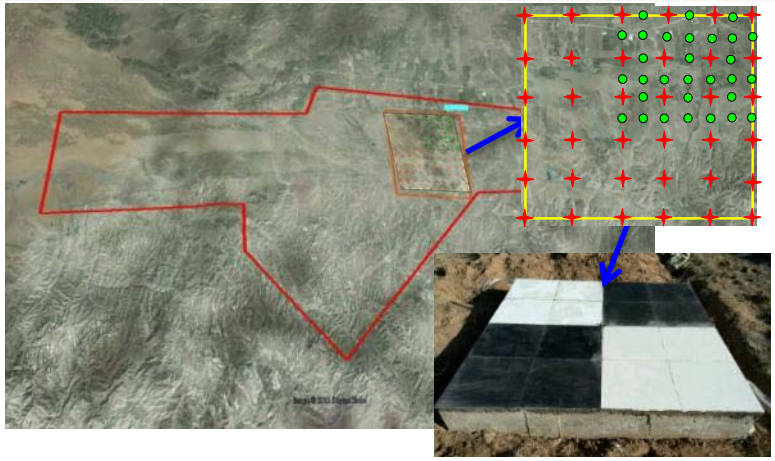


Artificial portable targets



Artificial permanent targets

Natural ground scenes



Geometric calibration field

Calibration & Validation

- **Ground measurement technical system**


VIS-IR Field Spectrometers

Total station and GPS

Water-leaving radiance measurement system

Automatic Meteorological Station

Multi-angle Observation System

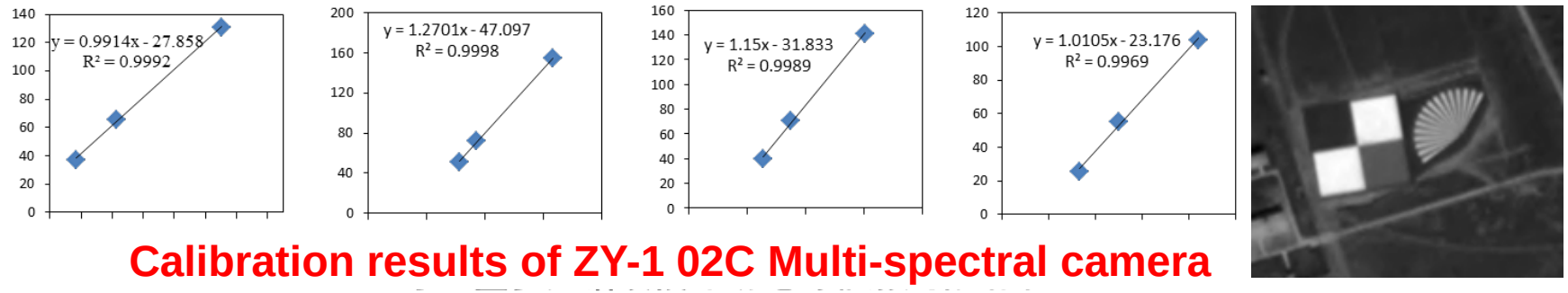
3-D geometric calibration system

Sun-photometer Cimel CE318

Upper-air meteorological radar system

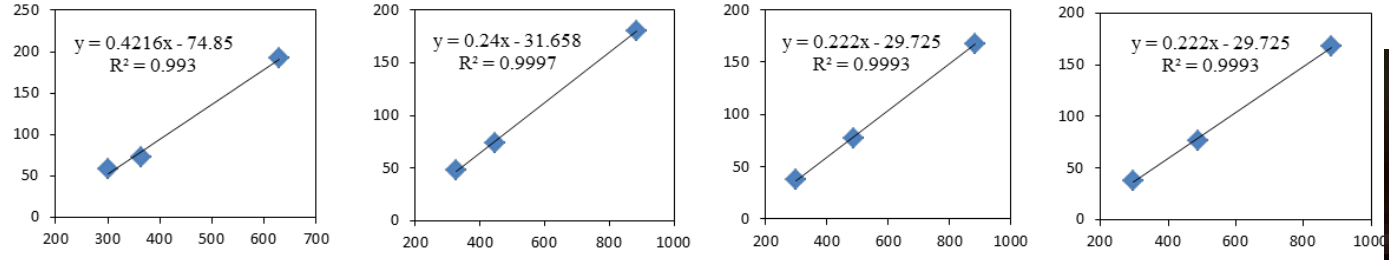
Calibration & Validation

Based on Cal&Val site, radiometric calibration and sensors' performance testing have been performed against several Chinese high resolution satellite.

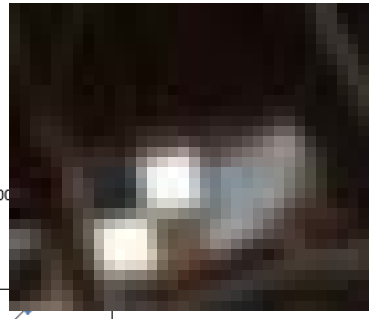


Calibration results of ZY-1 02C Multi-spectral camera

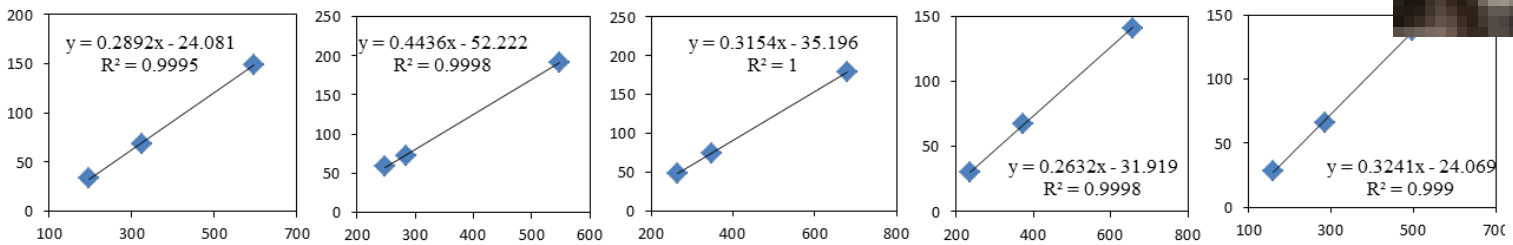
GF-1-Pan



Calibration results of SJ-9A Multi-spectral camera



GF-1-MSS



Calibration results of GF-1 Pan/Multi-spectral camera

Calibration & Validation

Participate in the form of RADCALNET

Aims at an prototype of "global calibration" traceable to SI, CEOS /IVOS WG agreed to set up the RADCALNET (Radiometric Calibration Network of Automated Instruments). The first RADCALNET WG meeting took place at ESTEC on 13th and 14th of January 2014.

- **Four sites to provide data to RADCALNET:**
  - ✓ **AOE Baotou site (China)**
  - ✓ **La Crau site(France)**
  - ✓ **Railroad Valley Playa site (US)**
  - ✓ **ESA Site TBD (ESA/CNES)**
- **NPL (UK) provides support in harmonization, traceability, instrument calibration and QA4EO**

AOE Baotou site

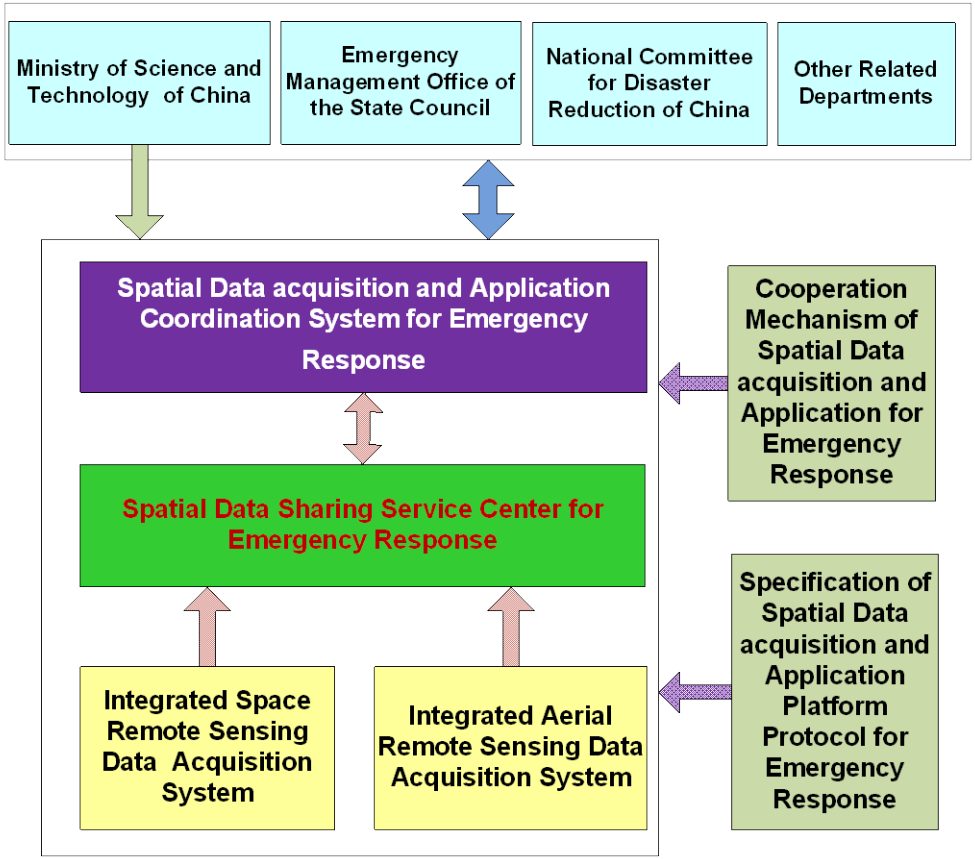
La Crau site

Railroad Valley Playa site

Remote Sensing Data Sharing

Aerospace application coordination system for emergency response and data sharing (ArcSer)

- ArcSer provides functions to schedule in harmony various civil aerospace resources to acquire aerospace remote sensing data of stricken area, and distributes the data to relevant institutions involved in disaster reduction as soon as possible.
- AOE acts as the Earth Observation Data Center for Emergency Response which is one of the most important supporting units of ArcSer.



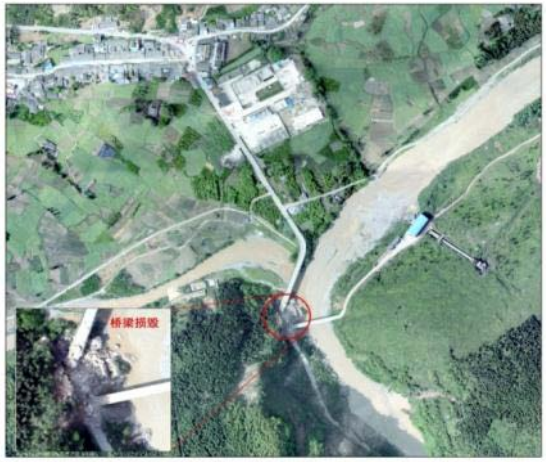
The structure of ArcSer

Remote Sensing Data Sharing

During the emergency response for the Ms7.0 earthquake happened in Lushan County of Ya'an, Sichuan Province at UTC 0:02 on April 20, 2013. AOE aggregated a huge amount of aerospace remote sensing data acquired before and after the earthquake, and distributed them to more than 45 institutions which are affiliated with 20 different Ministries.

Demonstration and discussion

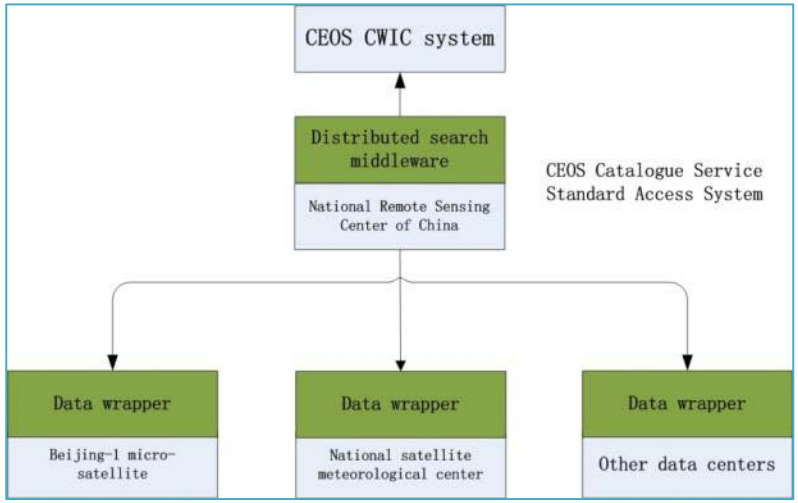
Before earthquake	After earthquake
• HJ-1A/1B/1C • ZY1-02C • ZY3 • SPOT2/4/5 • SJ-9 • Rapid eye • Radarsat-2	• HJ-1A/1B • UAV airborne image of YaAn • UAV airborne image of LuShan • RISAT • SJ-9



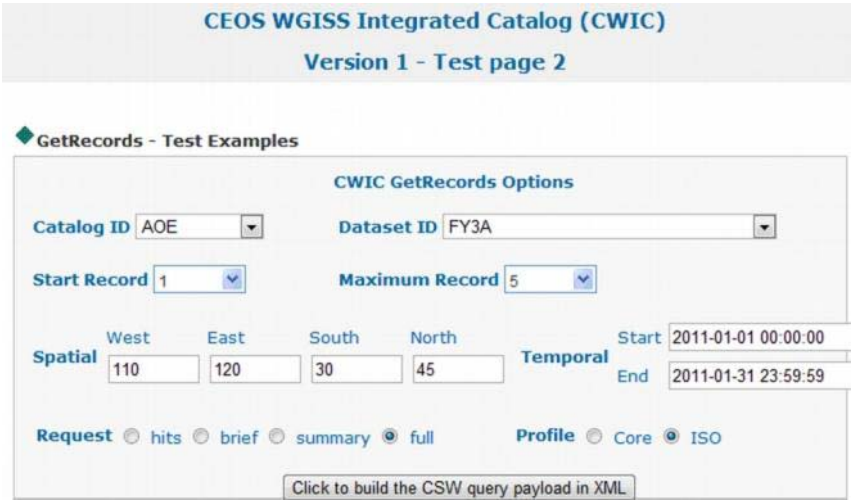
Remote Sensing Data Sharing

CEOS catalogue service standard access system

This system can integrate Chinese satellite data and provide information to CEOS/WGISS Integrated Catalogue (CWIC) System.



Distributed search framework of the CEOS Catalogue Service Standard Access System

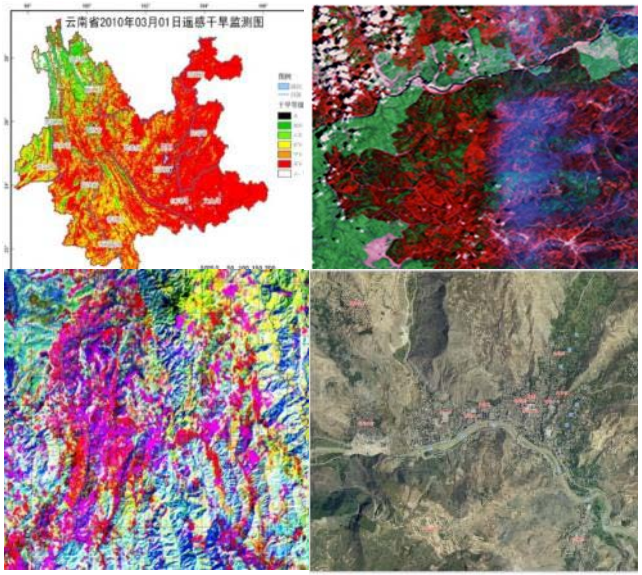


Integration to the CEOS CWIC System

- ✓ **Data service access system**
- ✓ **Conform to the OGC standards CSW and ISO 19115-2**
- ✓ **Promote international sharing and using of Chinese remote sensing satellite data**

Remote Sensing Data Sharing

Situation of EO for Emergency Response

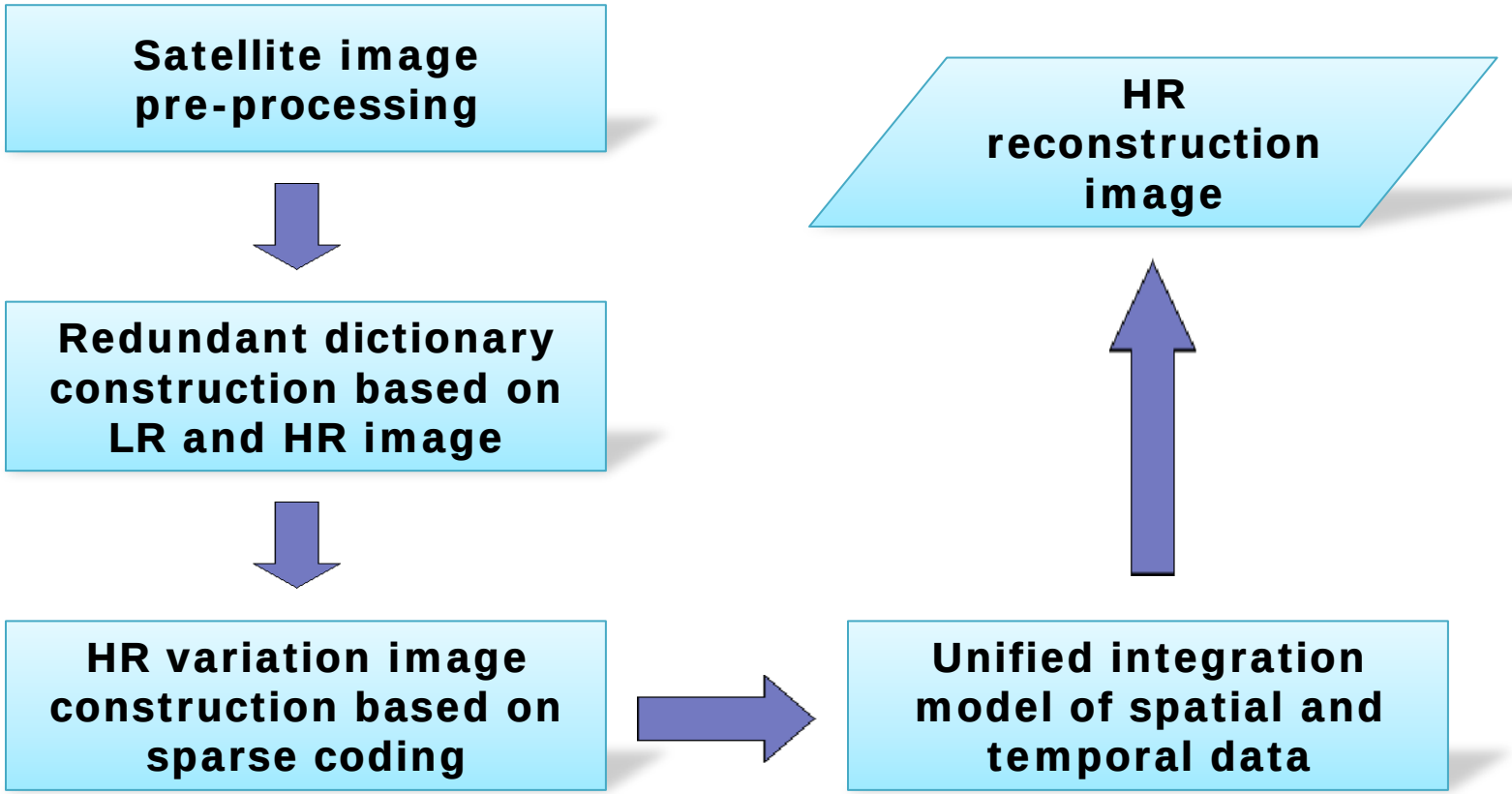


- *Temporal resolution*
- *Spatial resolution*
- *Spectral resolution*
- *Radiometric resolution*

- Hardly to be satisfied in single mission
- Technical requirements of the sensor are inter-restricted

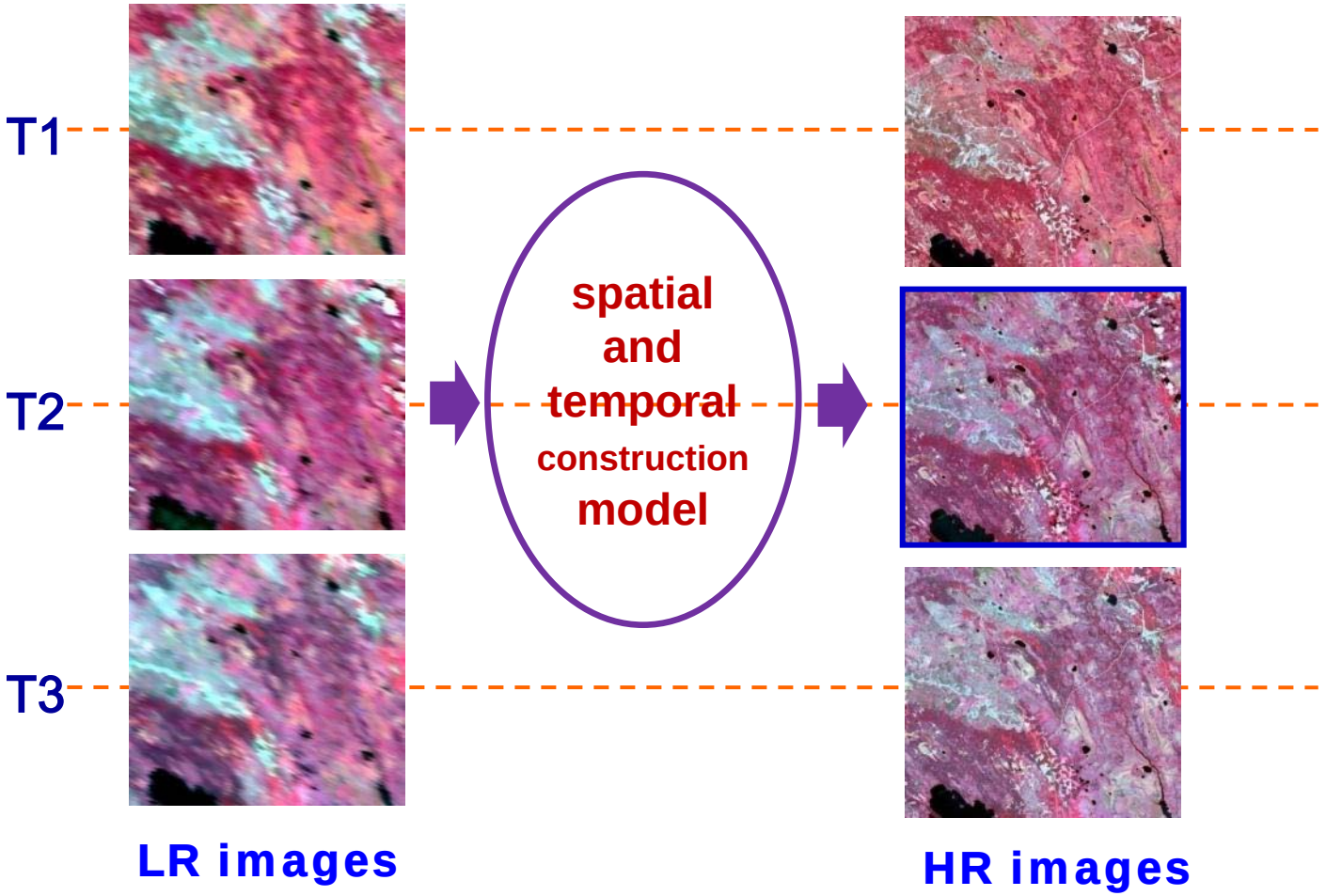
Remote Sensing Data Sharing

Virtual Image Construction Based on Sparse Coding



Remote Sensing Data Sharing

Virtual Image Construction Based on Sparse Coding



Remote Sensing Data Sharing

Virtual Image Construction Based on Sparse Coding

Observed MODIS Image

Observed LANDSAT Image

Predicted LANDSAT Image

Thank you for attention!