

International Data Sharing and Applications of China's Natural Resources Satellites





01

工作基础

Working Basis



02

目前成效

Progress

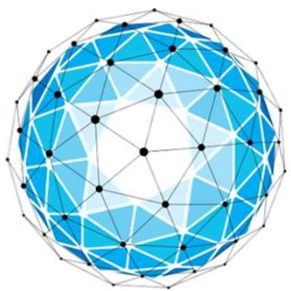


03

中非卫星中心建设

CACSA





01

工作基础

Working Basis



Analysis of Global Remote Sensing Satellites

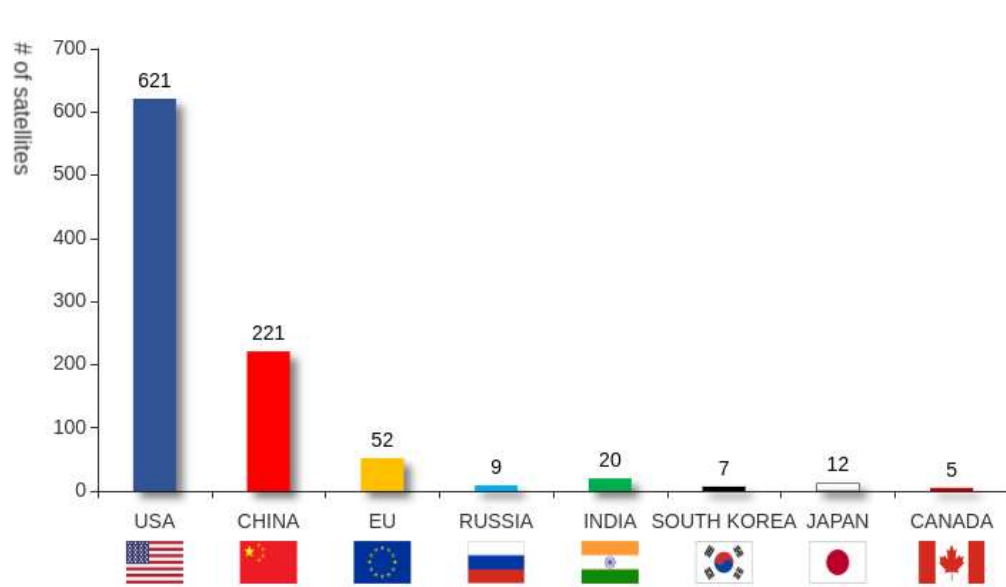


Figure 1. Global statistics of main operational land satellites (including micro satellites)

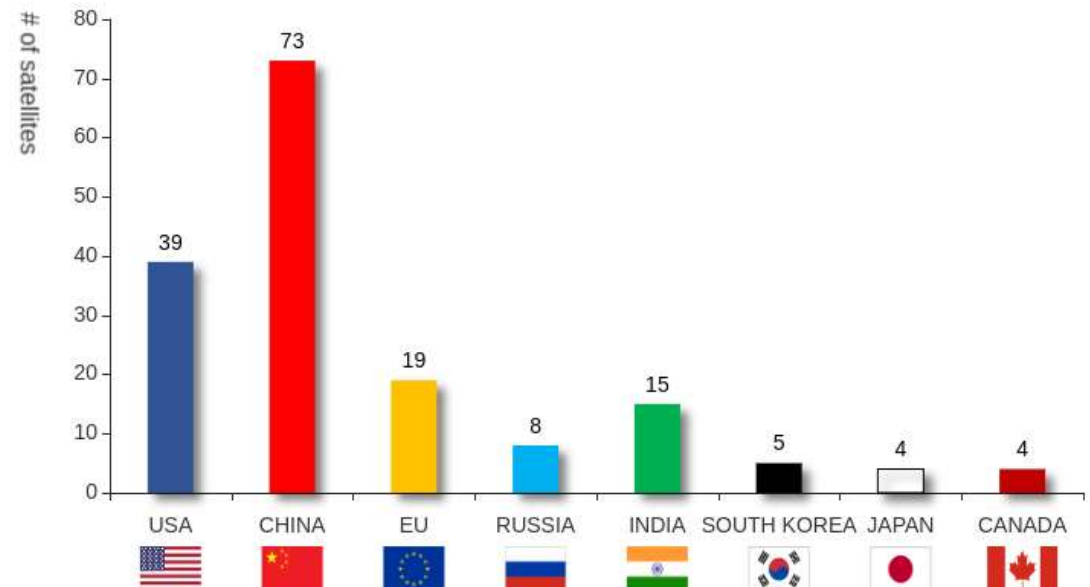


Figure 2. Global statistics of main operational land satellites (excluding micro satellites)

Analysis of Global Remote Sensing Satellites

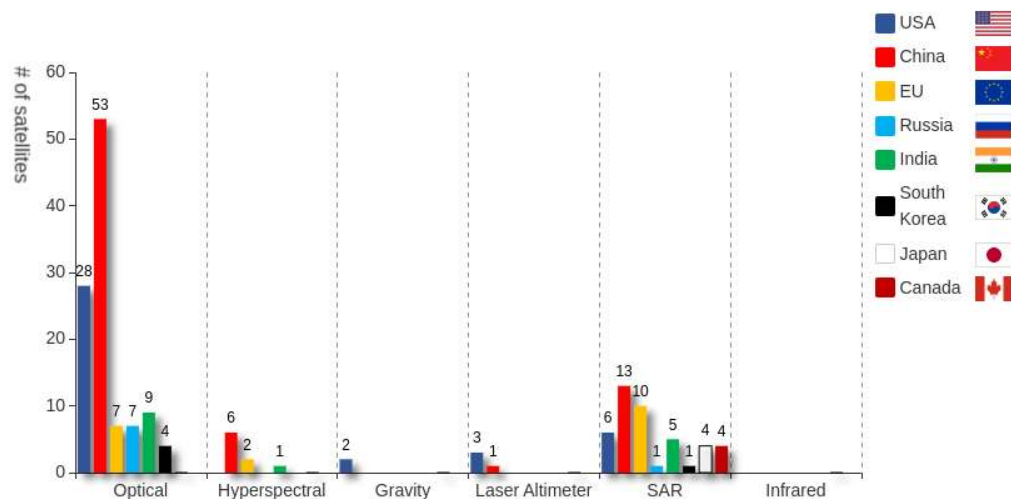


Figure 1. Global statistics of main operational land satellites by sensor and ownership (excluding micro satellites)

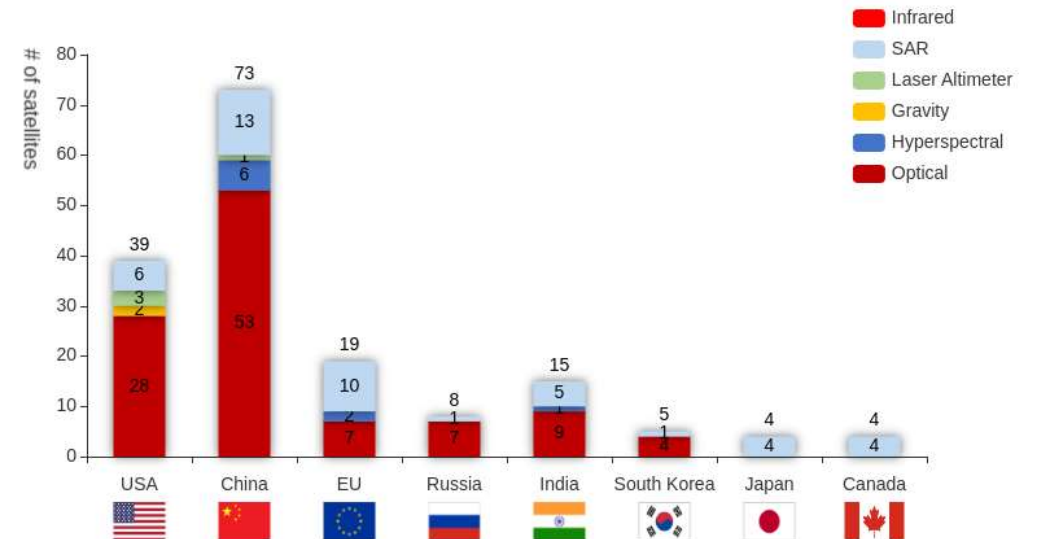


Figure 2. Global statistics of main operational land satellites by ownership (excluding micro satellites)

Satellite Remote Sensing Technologies

LT4
Geosynchronous 20 meter SAR

HJ-2A/2B
16mMUX, 48m AHSI/VNI

HJ-2E/2F
5m S-SAR

HJ-1A/B 30mMUX,
100mAHSI, 150m/300mVNI

HJ Satellites

GF7 1:10000 Stereo Mapping Satellite

GF Satellites

2m /8m Constellation
2mPAN, 8m MUX

GF5
first satellite observing land and atmosphere simultaneously in the world

GF-4
earth geostationary orbit satellite, 50m resolution

GF-3
1mCSAR

GF-2
0.8mPAN, 3.2mMUX

Ocean Satellites HY-1C/D, HY-2A/B/C/D, CFOSAT, 1mC-SAR/01

Meteorological Satellites FY-2F/G/H, FY-4A/B, FY-3B/C/D/E, TANSAT

LT1 Differential InSAR Satellite
3mL-SAR

ZY3-01

2.1mNAD, 5.8MUX, 3.5m DLC

ZY3-02/03

2.1m, 2.7m DLC

ZY Satellites

ZY1 02D/E, 2.5m/10mVIS/NIR, 30mAHSI

ZY1 02C, 2.36mPAN, 5/10m MUX

CBERS-04/04A

5m/10mPMS, 20mMUX, 73mWFI

BJ-2

0.8mPAN 3.2mMUX

BJ-3

0.5mPAN
2.0mMUX

JL-1

constellation
108 satellites

Commercial Satellite

GF-1, GF6

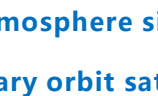
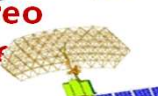
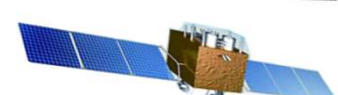
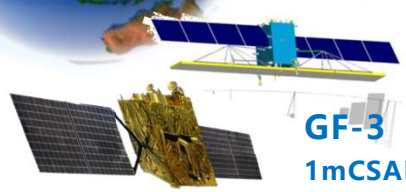
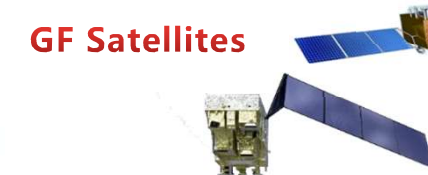
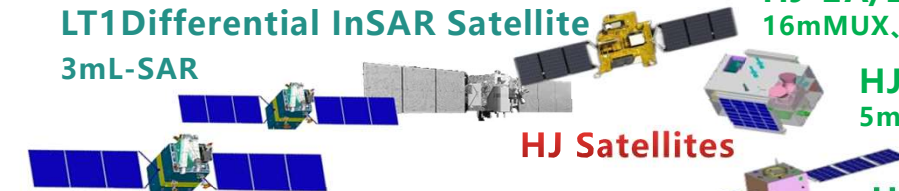
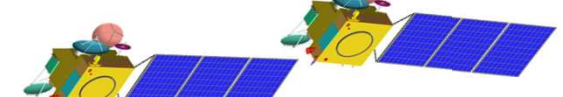
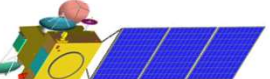
2mPAN, 8mMUX

ORBIT Constellation

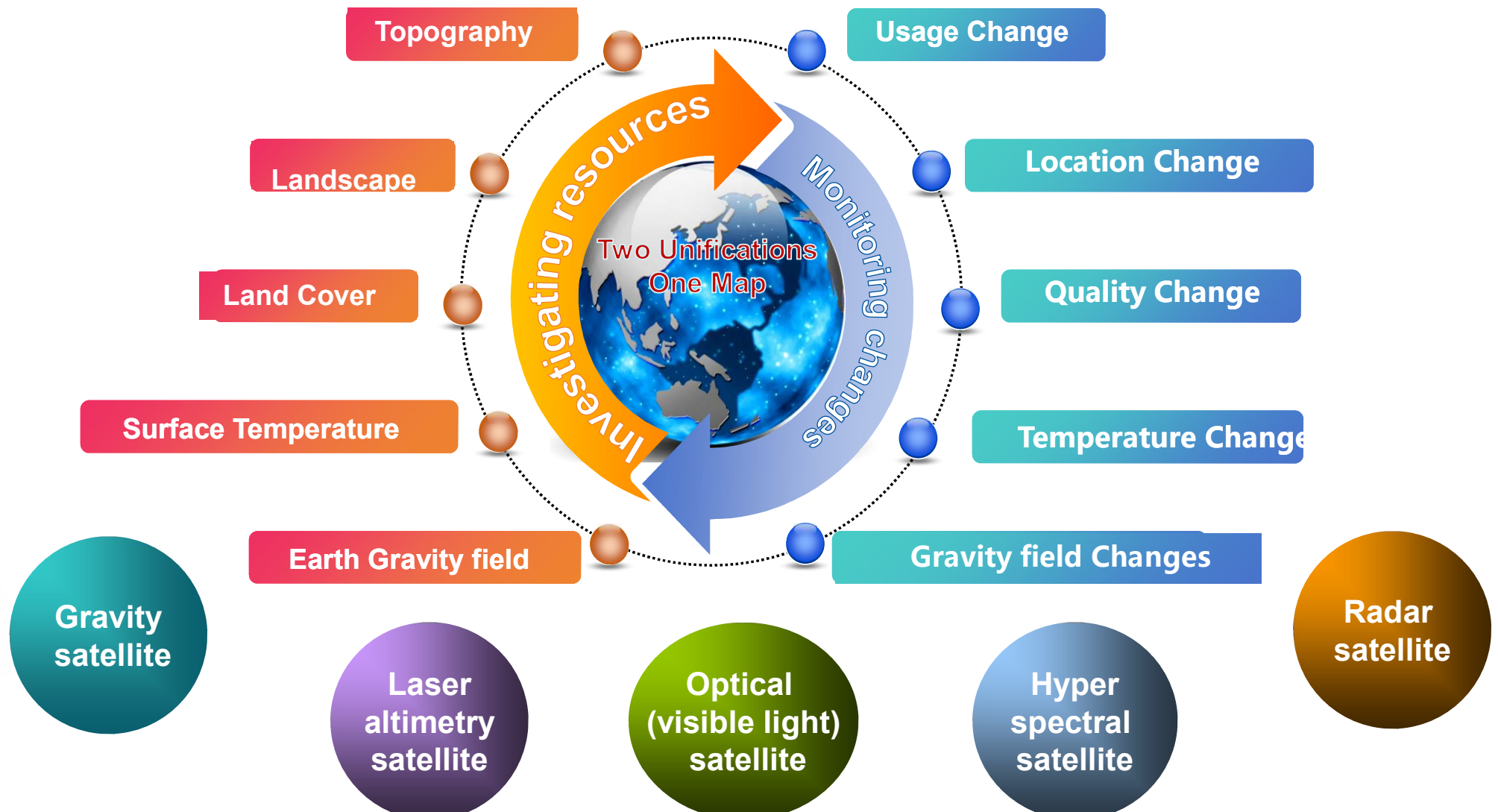
OVS/OHS 12 satellites network operation

SV1-01/02

0.5mPAN, 2mMUX



Satellites Types in MNR, China



China's Land Satellites

Type	Satellite	Quantity	Launch Time	Major Payloads	Resolution (meters)	Main Purposes
Optical	ZY3-01/02/03	3	2012, 2016, 2020	optical, near-infrared laser altimeter (02, 03 satellites)	2/8	1:50000 stereo mapping
	ZY1	1	2011	optical, near-infrared	2.36/10	natural resources monitoring
	GF1	4	2013, 2018	optical, near-infrared	2/8	feature update, natural resources monitoring
	GF2	1	2014	optical, near-infrared	0.8/3.2	feature update, natural resources monitoring
	GF7	1	2019	optical, near-infrared laser altimeter	0.65/0.79	1:10000 stereo mapping
	GFDM	1	2020	optical, near-infrared, polarization detection, atmospheric exploration	0.41/1.64	feature update, natural resources monitoring
Hyperspectral	ZY1 02D/02E	2	2019, 2021	optical, near-infrared, hyper-spectral	2/20	geological survey, vegetation fine classification
Radar	3m L-SAR	2	2022	L-SAR	3/6/12/30	topographic mapping

GF-7 Satellite and 1:10,000 satellite surveying and mapping

ZY-3 Without GCPs

Positioning accuracy → **10m**

Elevation accuracy ≤ **5m**

Directly meet the precision requirements of **1:50,000** in hilly, mountainous and alpine areas.

ZY-3 With GCPs

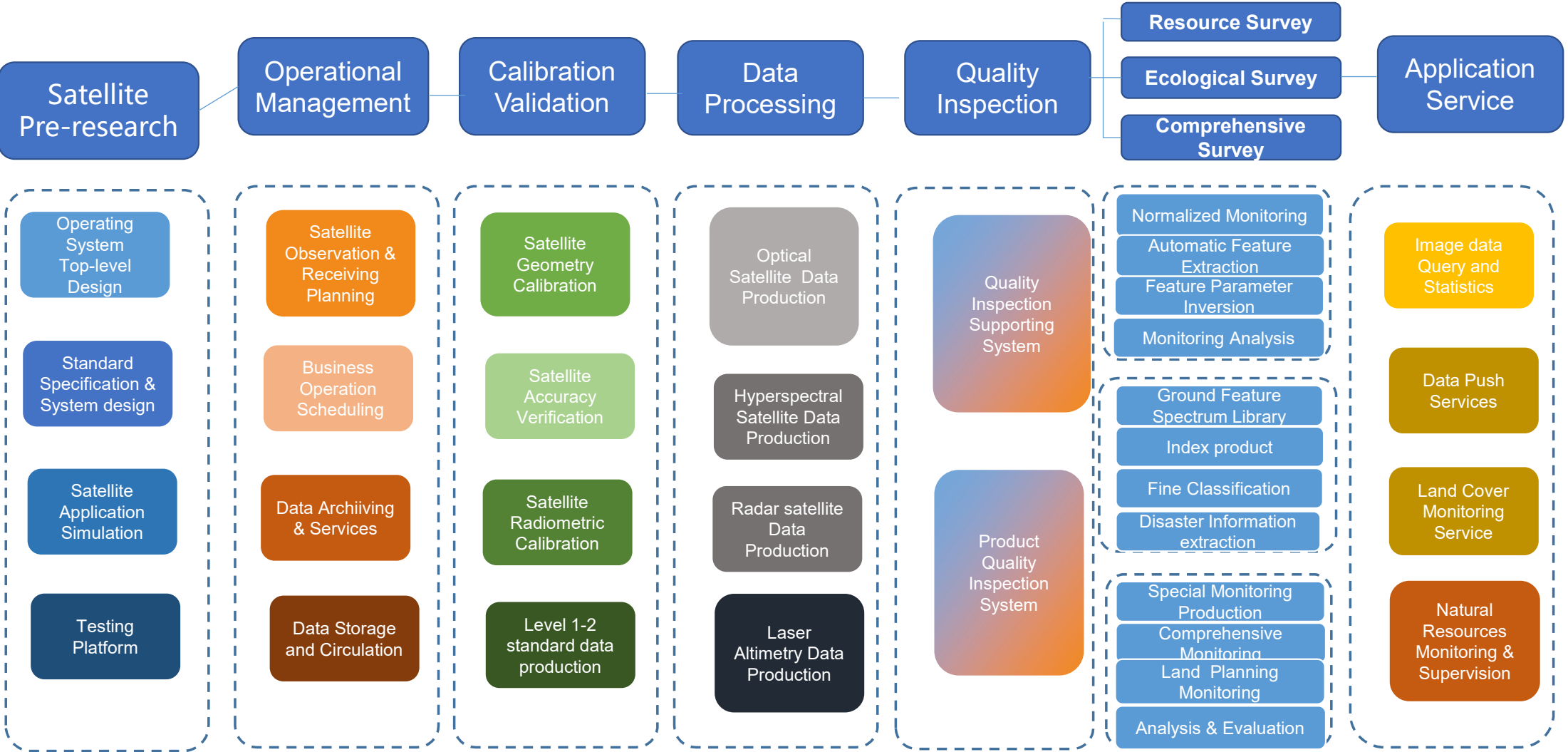
Plane precision ≤ **3m**, Elevation precision ≤ **2m**

Comprehensively superior to the parameters designed for **1:50,000** stereo mapping satellite

The Elevation Precision has been improved from 5m to 1.5m!

Technical Parameter		ZY3	GF-7
Resolution(m)		NAD 2.1 FWD/BWD 3.5	FWD 0.65 BWD 0.80
Baseline height ratio		0.882	0.6
Gray quantization value		10bit	10bit
None-control precision	Plane(m)	10	5
	Elevation(m)	5	1.5
Precision With Control Point	Plane(m)	3	0.8
	Elevation(m)	2-3	0.6

技术体系 Technology System



运行能力 Operation Capacity

Satellite in Orbit

- 8 2-meter optical Sats
- 3 submeter optical Sats
- 2 hyper spectral Sat
- 2 Radar Sat

Data Acquisition

- Average daily 80 passes
- Daily average of 9500scenes
- Daily average of 15TB

Data Processing

- Daily data processing: image data acquisition, processing and quality inspection and distribution at the same day
- Monthly conclusion: the monitoring images are archived monthly and uploaded to the cloud within the same month

Product System

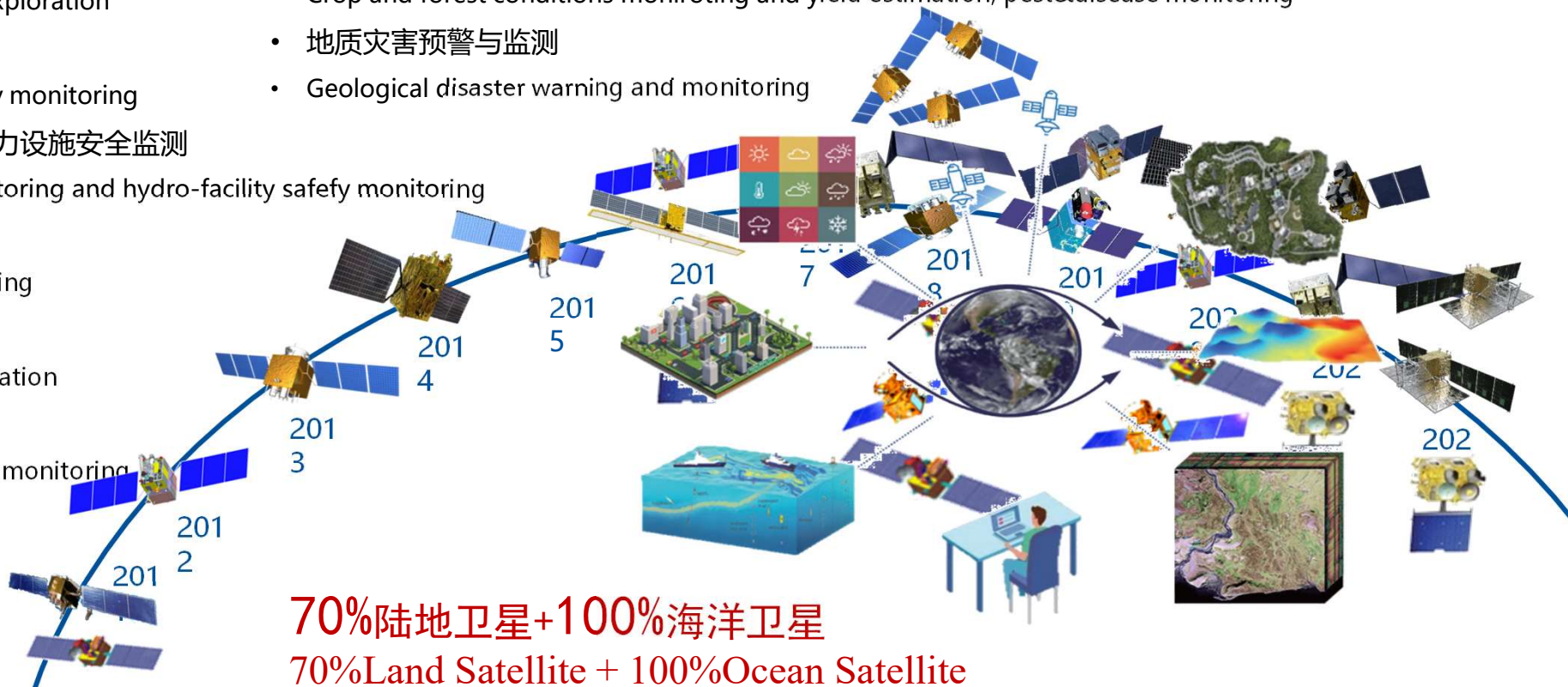
- Visible light product system: SC, DOM, DSM, DOM+...
- Hyperspectral product system: index products, vegetation growth products...

卫星遥感已应用在社会经济方方面面

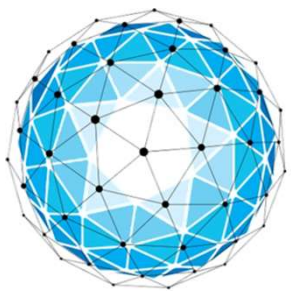
Satellite Remote Sensing Technology
Application in various aspects of our society

- 当前已经开发的空間遥感技术应用形式有100 余种 More than 100 kinds of satellite remote sensing technology application

- 土地管理与监测
- Land management and monitoring
- 矿产资源勘探
- Mineral resources exploration
- 交通路网安全监测
- Road network safety monitoring
- 洪涝灾害监测与水力设施安全监测
- Flood disaster monitoring and hydro-facility safety monitoring
- 地震灾害监测
- Earthquake monitoring
- 气象观测
- Metrological observation
- 海洋环境监测
- Ocean environment monitoring
-
- 大气环境与水环境污染监测
- Atmosphere environment and water environment pollution monitoring
- 农林业长势与病虫害监测和估产
- Crop and forest conditions monitoring and yield estimation, pest&disease monitoring
- 地质灾害预警与监测
- Geological disaster warning and monitoring



70%陆地卫星+100%海洋卫星
70%Land Satellite + 100%Ocean Satellite



02

目前成效

Progress



International Data sharing and Service

Home Platform **Satellites Galaxy** Query Statistics Image Service Monitoring Applications About Us

Chinese Satellites

- ZY1-02C
- ZY1-02D
- ZY3
- 2m/8m Optical Satellites
- GF-1
- GF-2
- GF-3
- GF-4
- GF-5
- GF-6
- GF-7
- TH-01
- BJ-2
- SV-1

ZY1-02C Satellite



Dynamic satellite query analysis
The development situation, parameter comparison and comprehensive analysis of global land remote sensing satellites

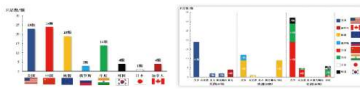


Image acquisition query analysis
More than 6 million global multi-source and multi-scale satellite remote sensing image metadata, enable diversified and comprehensive query of all sensors in any regions of the world within any time period since 2012



Satellite pass query analysis
Enable satellite pass query in any region, country, province, city and county at any time



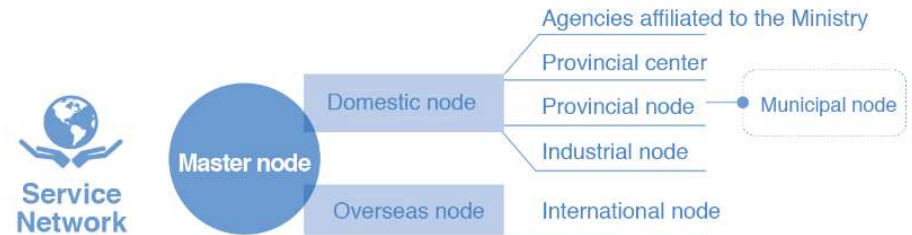
Spatial analysis of land cover change
Enable multi-category basic monitoring/thematic monitoring information sharing service



Time series analysis of land use change
Enable monitoring and comparative analysis of long time series remote sensing image change, and monitor the full life cycle management of patches



Orbit parameter



35 international nodes, 10229 batches, 294927 scenes, 385 TB data push in total, Covered 97 countries and 18 regions

<http://www.sasclouds.com/english/home>

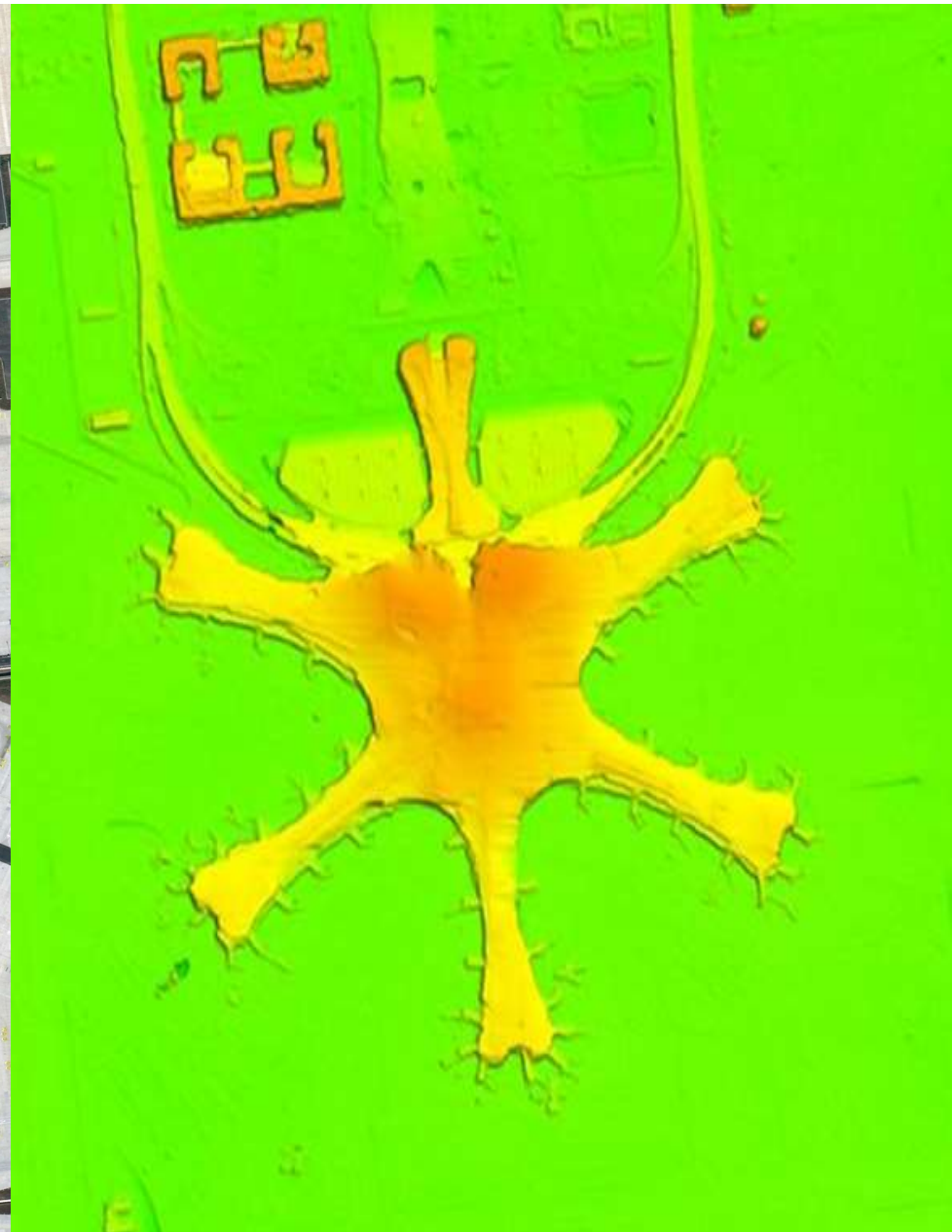
Software and hardware configurations	
Equipment	Basic Requirement
Server	8 Core, 16GB RAM
HHD	2TB to 10TB
Internet	>20MB/S
Operation System	WIN Server 2012 / 2016
Browser	IE 11 / Chrome 49.0
Client *	Query, Management, Receiving, Statistics

* Deployed by LASAC (can be configured remotely)

	国家Country	合作机构Cooperation Partners	开通时间Time	覆盖率% Coverage		国家Country	合作机构Cooperation Partners	开通时间Time	覆盖率% Coverage		国家Country	合作机构Cooperation Partners	开通时间Time	覆盖率% Coverage		
亚洲 A S I A 13	泰国 Thailand	泰国地理信息与空间技术发展局 GISTDA	2017	100	非洲 A F R I C A 12	乌干达 Uganda	乌干达国家公路局 Uganda National Roads Authority	2017	99	欧洲 E U R O P E 4	英国 UK	英国诺丁汉大学 University of Nottingham	2017	46		
	老挝 Laos	老挝内政部国家测绘局 NGD	2017	100		加纳 Ghana	加纳苏尼亚尼自然资源与能源大学 UENR	2018	100		奥地利Austria	维也纳大学地球科学地理和天文学学院 UNIVIE	2017	100		
	蒙古国 Mongolia	蒙古土地管理、大地测量和制图局 ALAMGC	2017	100		赞比亚 Zambia	赞比亚大学 University of Zambia	2019	100		挪威 Norway	挪威测绘地籍管理局NGO	2017	90		
	斯里兰卡 Sri Lanka	斯里兰卡测绘局 Survey Department	2018	97		卢旺达Rwanda	卢旺达航天局 RSA	2021	100		俄罗斯Russia	俄罗斯科学院空间观测科学研究所 AEROCOSMOS	2020	1.2		
	孟加拉 Bangladesh	孟加拉测绘局 Survey Department	2018	98		埃及 Egypt	埃及航天局 EgSA	2021	100	拉丁美洲 Latin Ameri- ca 4	委内瑞拉 Venezuela	委内瑞拉国家航天局ABAE	2018	96		
	尼泊尔 Nepal	尼泊尔国家土地管理、合作和减贫部测绘局 Survey Department	2018	100		埃塞俄比亚 Ethiopia	埃塞俄比亚空间科学与地理空间研究局SSGI	2023	100		秘鲁 Peru	秘鲁国家航空航天研究与发展委员会CONIDA	2021	99		
	柬埔寨 Cambodia	柬埔寨亚星资源集团有限公司	2018	100		尼日利亚 Nigeria	尼日利亚国家空间研究与发展局 NASRDA	2023	100		阿根廷 Argentina	阿根廷国家空间活动委员会 CONAE	2022	99		
	印度尼西亚 Indonesia	印度尼西亚国家航天局 LAPAN	2019	81		津巴布韦 Zimbabwe	津巴布韦国家地理空间和航天局 ZINGSA	2023	100		墨西哥 Mexico	墨西哥国家统计与测绘局INEGI	2023	100		
	约旦 Jordan	约旦皇家地理中心 RJGC	2019	100		塞内加尔 Senegal	塞内加尔国家空间规划局 ANAT	2023	100	国际组织 Int'l Organi- z- ations 3	非洲资源测绘发展区域中心 RCMRD		2016	97		
	亚美尼亚 Armenia	亚美尼亚共和国教育、科学、文化和体育部科学委员会、亚美尼亚共和国国家科学院 Science Committee MESCS RA, NAS RA	2022	100		科特迪瓦 Côte d'Ivoire	科特迪瓦国家技术和发展研究局 BNETD	2024	100		联合国空间科学技术教育西亚区域中心 RCSSTEWA		2019	100		
						佛得角Cabo Verde	佛得角国家土地管理局INGT	2024	100		联合国粮食及农业组织 FAO		2021	84		
	印度 India	德里大学 University of Dehli	2023	/		喀麦隆 Cameroon	喀麦隆国家气候变化观测站 ONACC	2025	99.95							
	塔吉克斯坦 Tajikistan	塔吉克斯坦国家科学院科学与新技术创新发展中心CIDSNT	2023								97					
	巴基斯坦															



Beijing Daxing Airport





Beijing National Stadium



GF-7 3D Scene



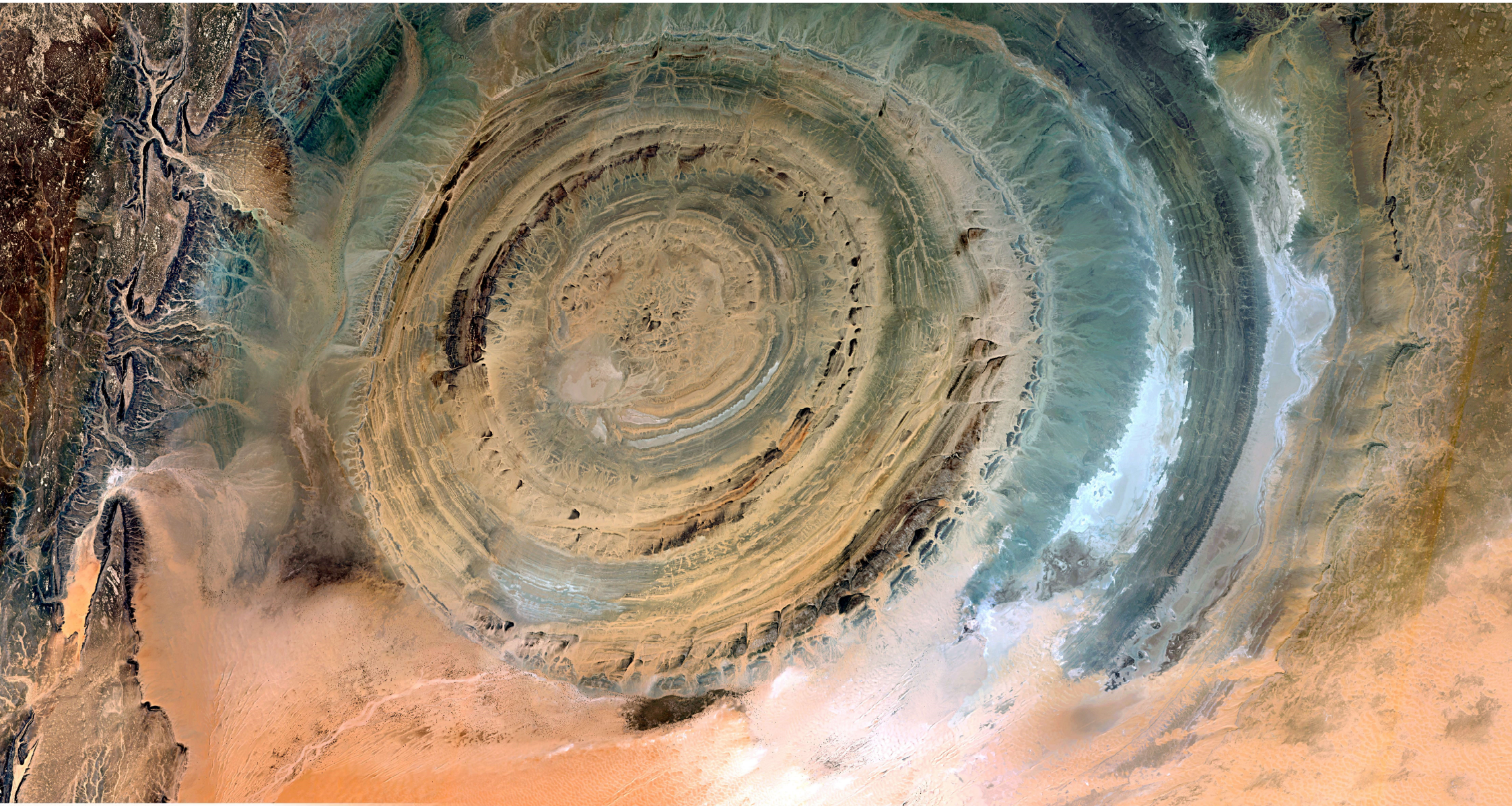
Winter in Songhua River



Zhongguancun, Beijing



Pyramid



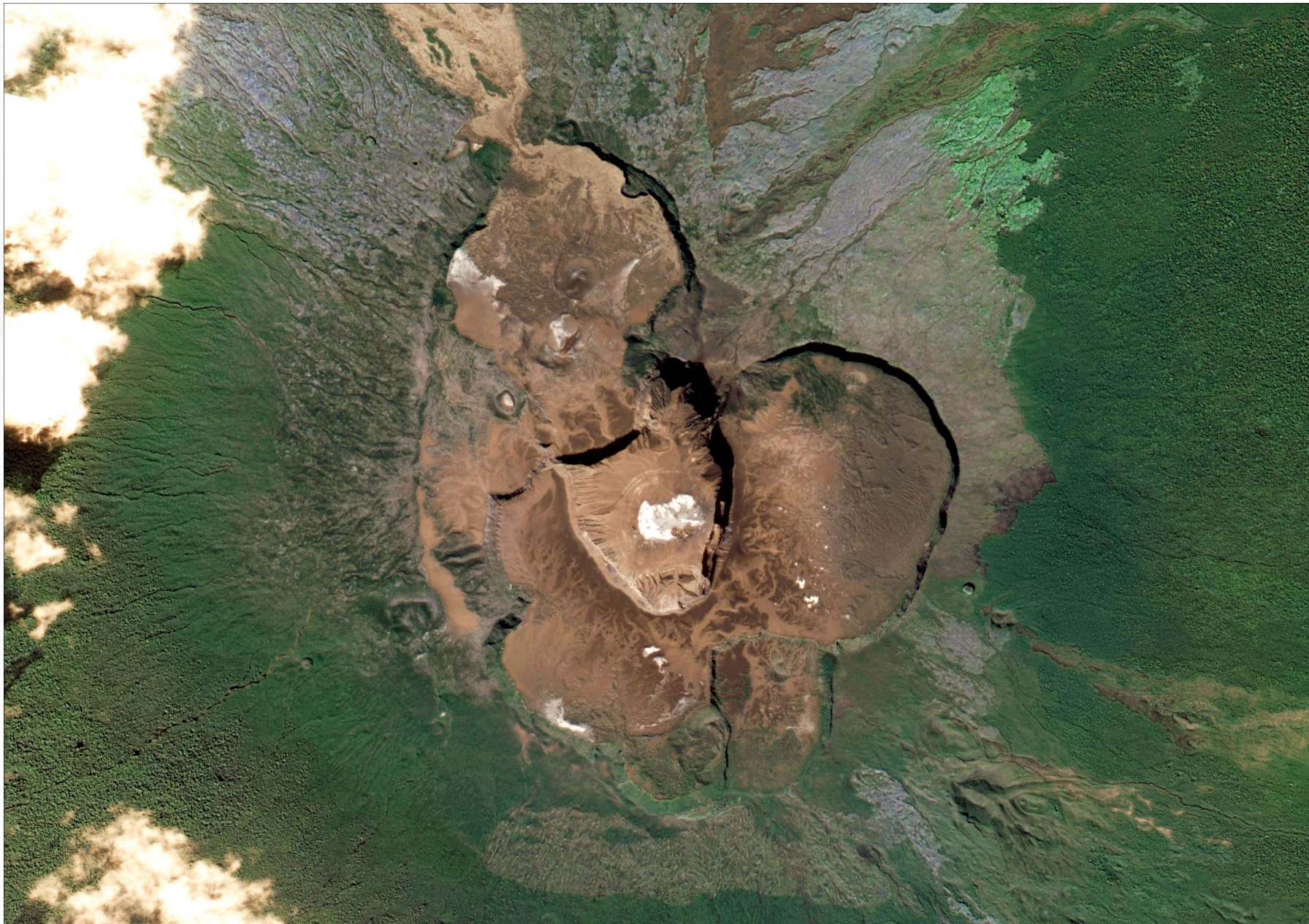
Eye of the Sahara





ANTIGUA AND BARBUDA

GF-1B 20220103
17.1°N, 61.7°W



SAO TOME AND PRINCIPE

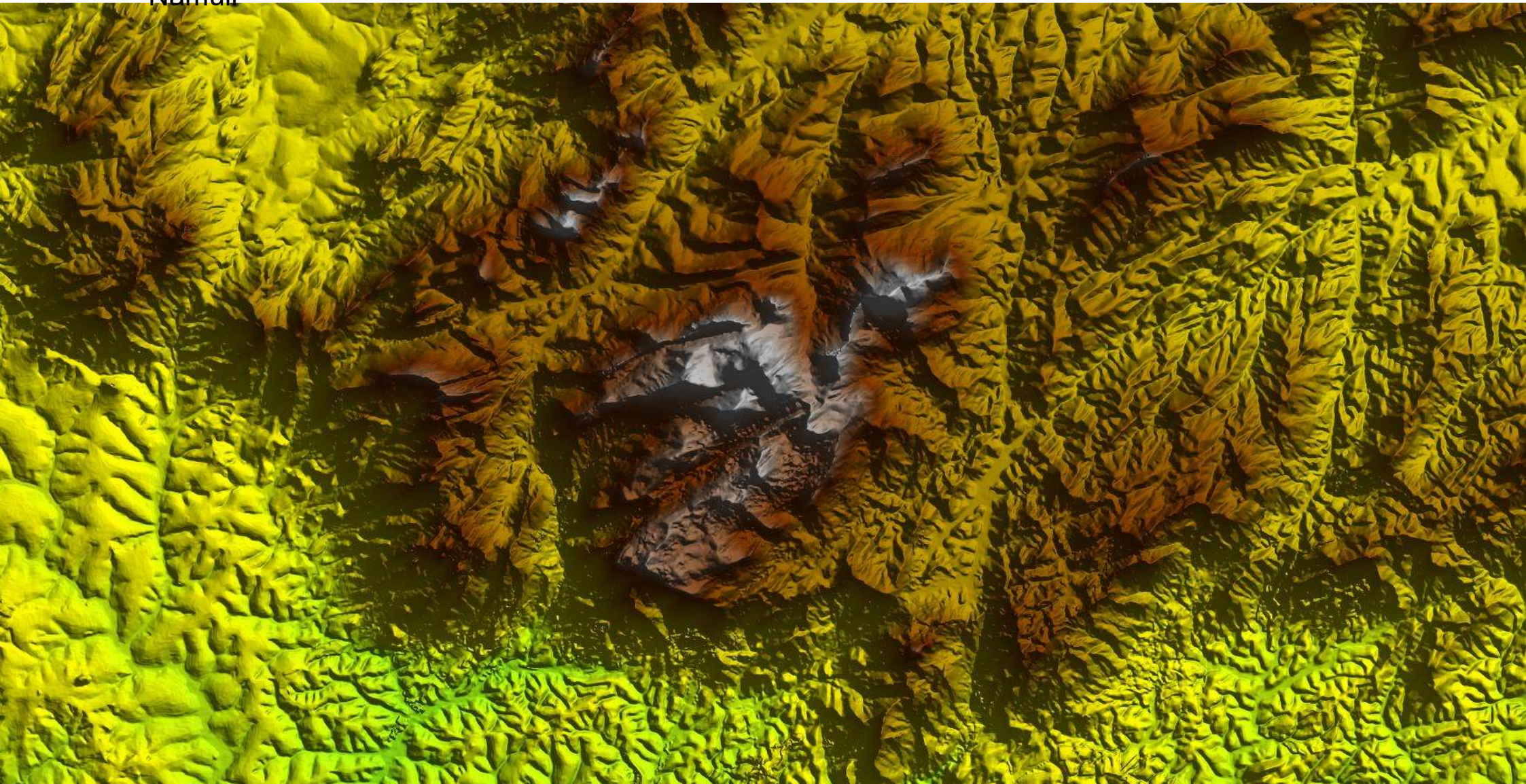


GF-2 20220125
0.4°N, 6.5°E

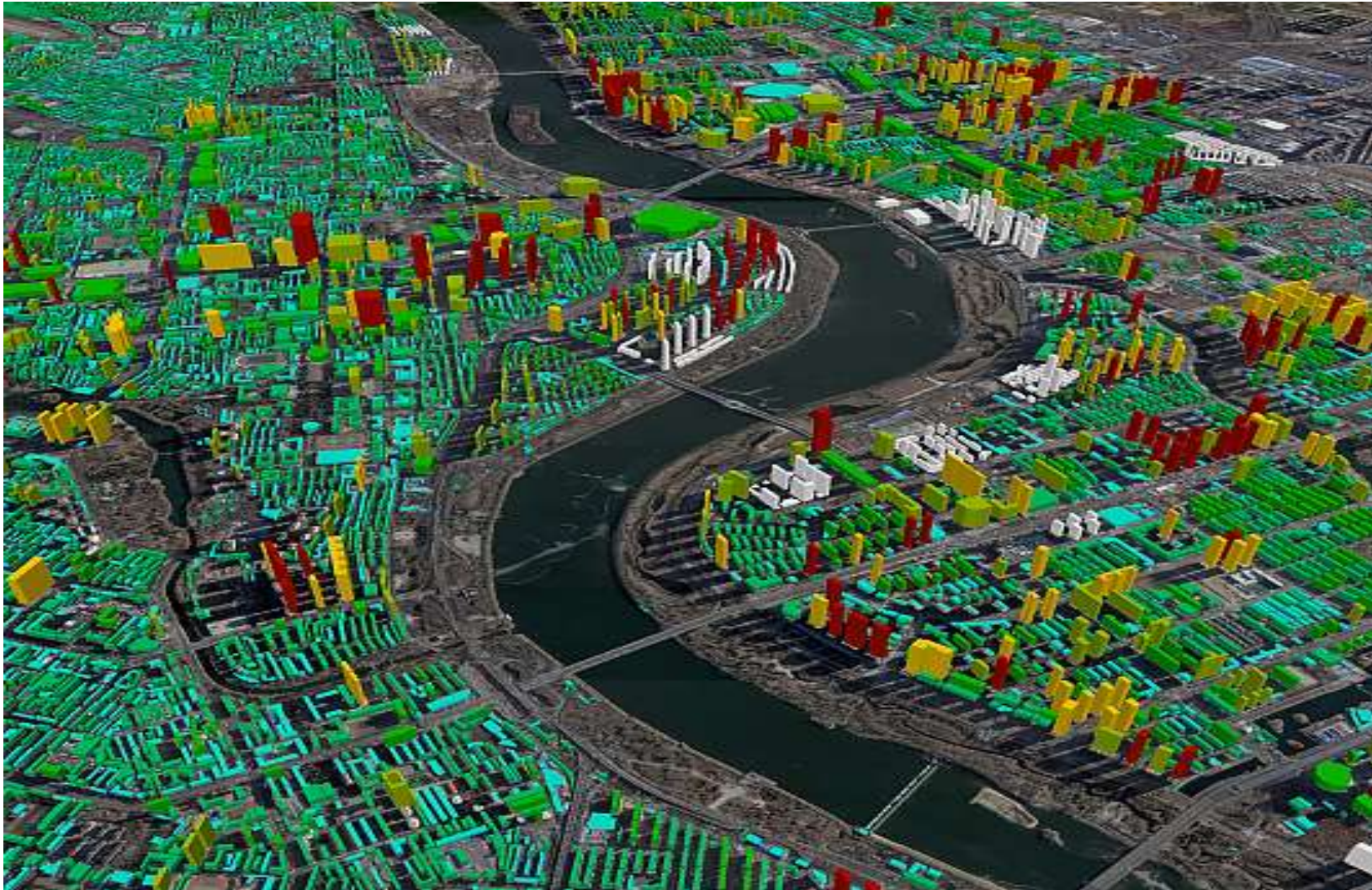
MALDIVES

GF-1D 20190126
4.4°N , 73.4°E

Namuli



GF-7 Satellite and 1:10,000 mapping



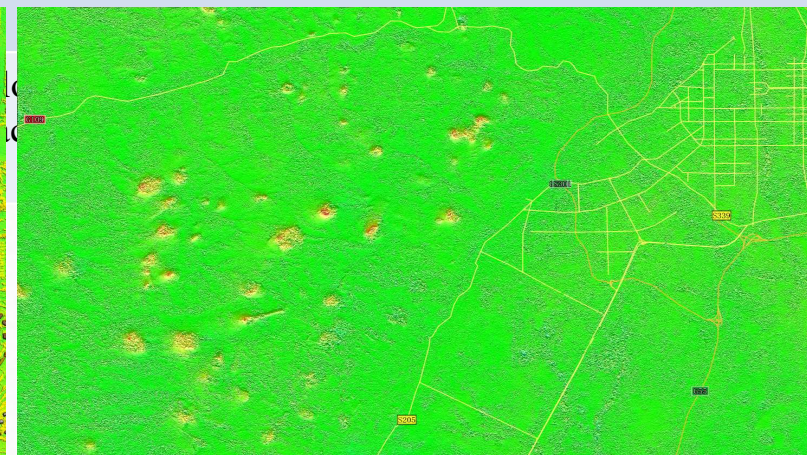
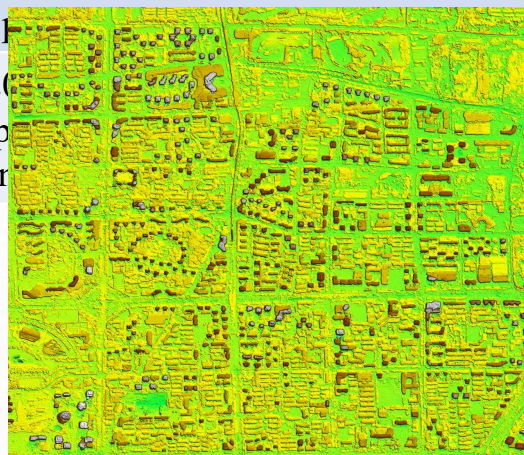
Elevation Accuracy:
3-5m (without laser)
1.5m (with laser
altimetry)



Remote sensing monitoring products

Satellite data products

S.N.	Product name	Processing capacity
1	Digital orthophoto DOM	It processes 800 scene pairs (about 2 million square kilometers) every day, and completes the national version of 2-meter standard framing products quarterly.
2	Digital Surface Model DSM	Production capacity of digital surface model products (rough editing) of 100 scenes per day (about 1 million square kilometers)
3	Hyperspectral	Large-scale radiation quality improvement and commercial production of surface reflectivity products to achieve daily clearing and monthly settlement of basic products
4	SAR data	With 800 scenes per day (about 2 million square kilometers), the production capacity of deformation products reaches 800 sets per day
5	Laser altimetry data	No less than 6 tracks per day, realizing the business automatic production of laser measurement and

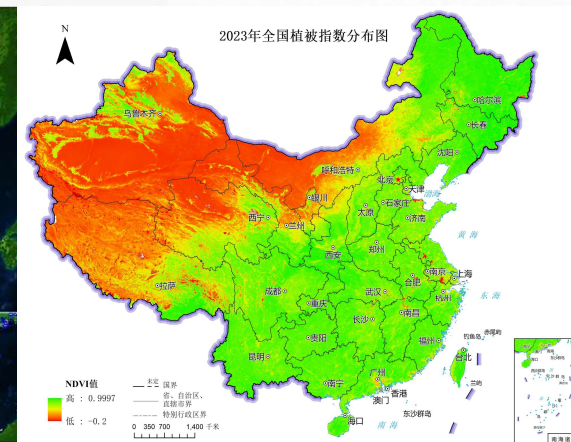
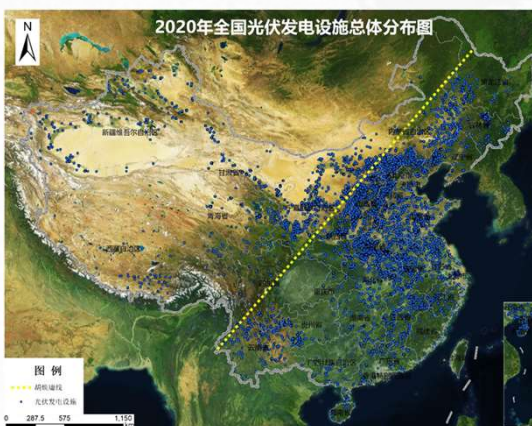




Remote sensing monitoring products

Survey monitoring data products

S.N.	Product name	Processing capacity
1	Changes in surface cover	The average daily extraction area of surface changes over 400 square meters reaches million square kilometers, with an average accuracy rate of more than 80%, forming an operational production operation capability of automatic change discovery and internal verification of human-computer interaction.
2	Extraction of thematic elements	The accuracy rate of automatic extraction of thematic elements of rivers, lakes, reservoirs, wind power, airports and aircraft reaches over 90%.
3	Quantitative parameter inversion	Scientific research and trial production of vegetation, water body, soil, surface temperature, etc., are updated as needed

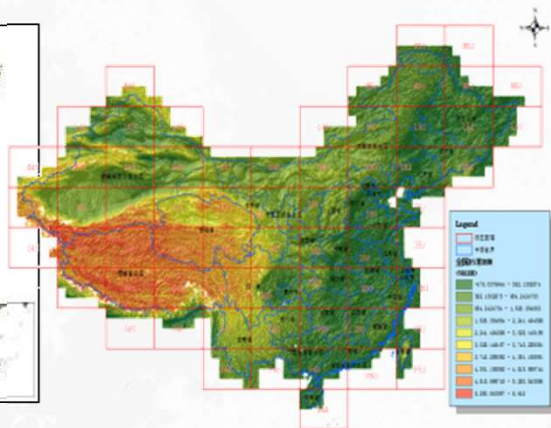




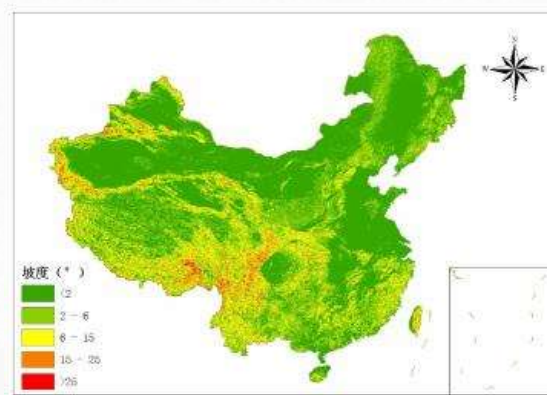
Serving Natural Resources Management | Basic Products



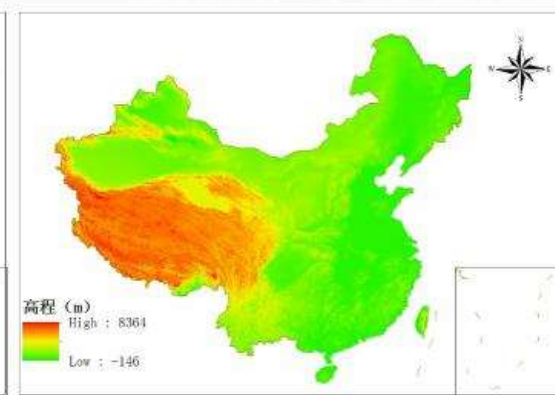
Digital orthophoto data



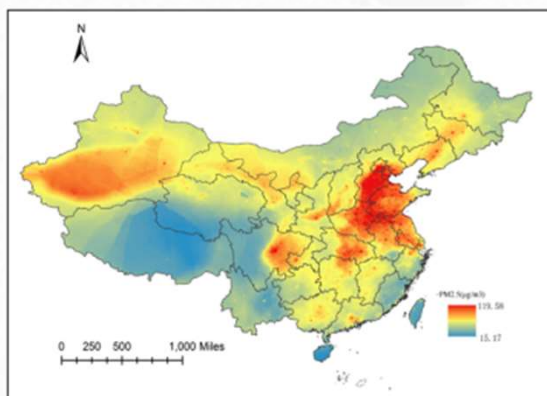
Digital surface model data



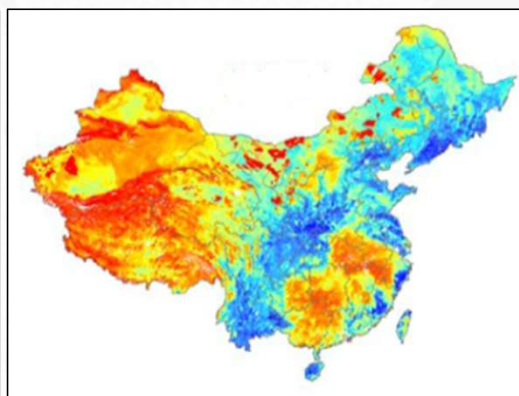
National slope image map



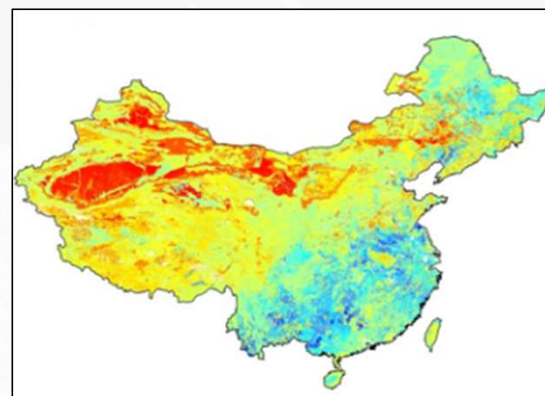
National aspect image map



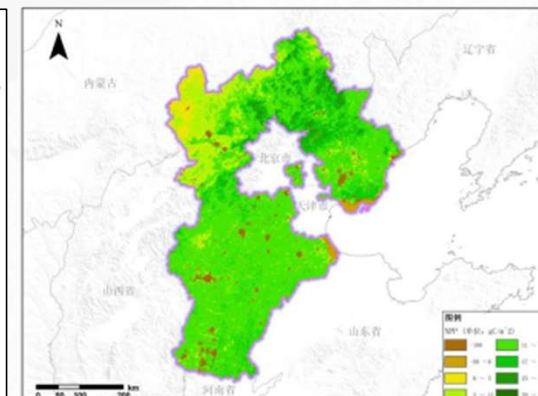
PM2.5 remote sensing inversion map



Temperature inversion map



Soil moisture inversion map



NPP inversion map

SDP

Stereo



DSM



**Point
Cloud**

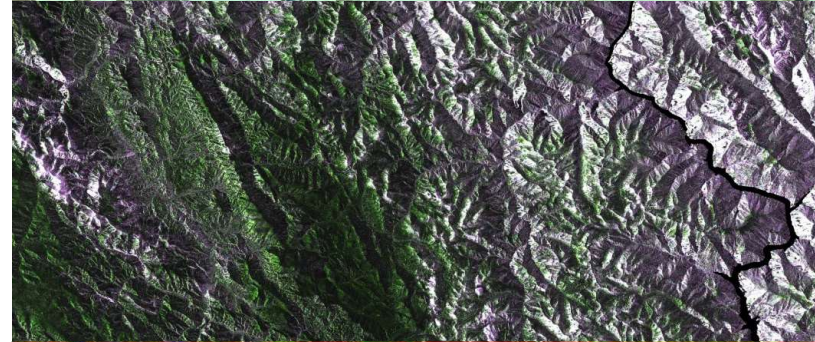


**3D
Model**

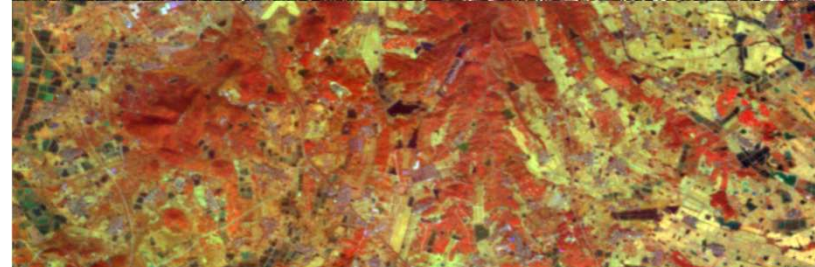
Non-Stereo



**Optical
DOM**



**SAR
DOM**



**Hyper-
Spectral
DOM**



LASAC

Feature Automatic Extraction

Automatic extraction of architectures, roads, water bodies and airports

AI Interpretation

Dynamic Change Detection

RS Quantitative Inversion

Monitoring and warning index system

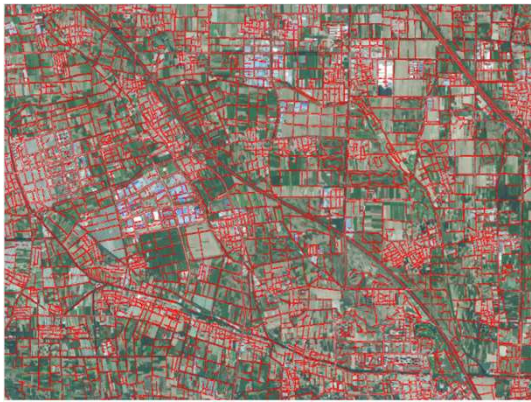
Land Cover Change | Topography Change | Changes of ecological characteristic parameters

Dynamic Perception

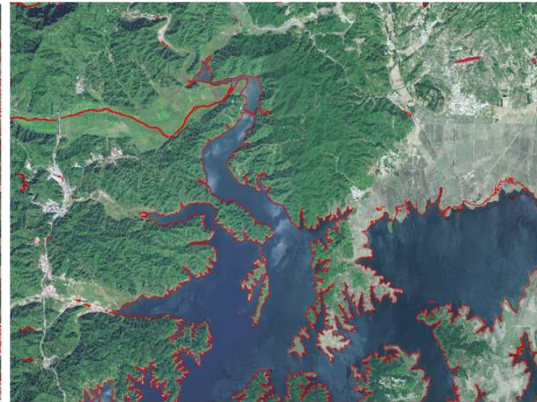
Forecast and Early Warning



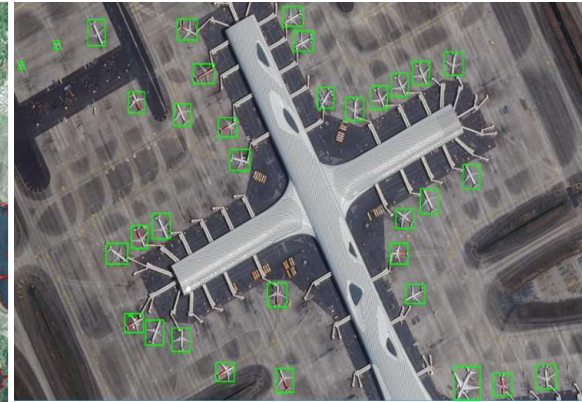
Architectures



Roads



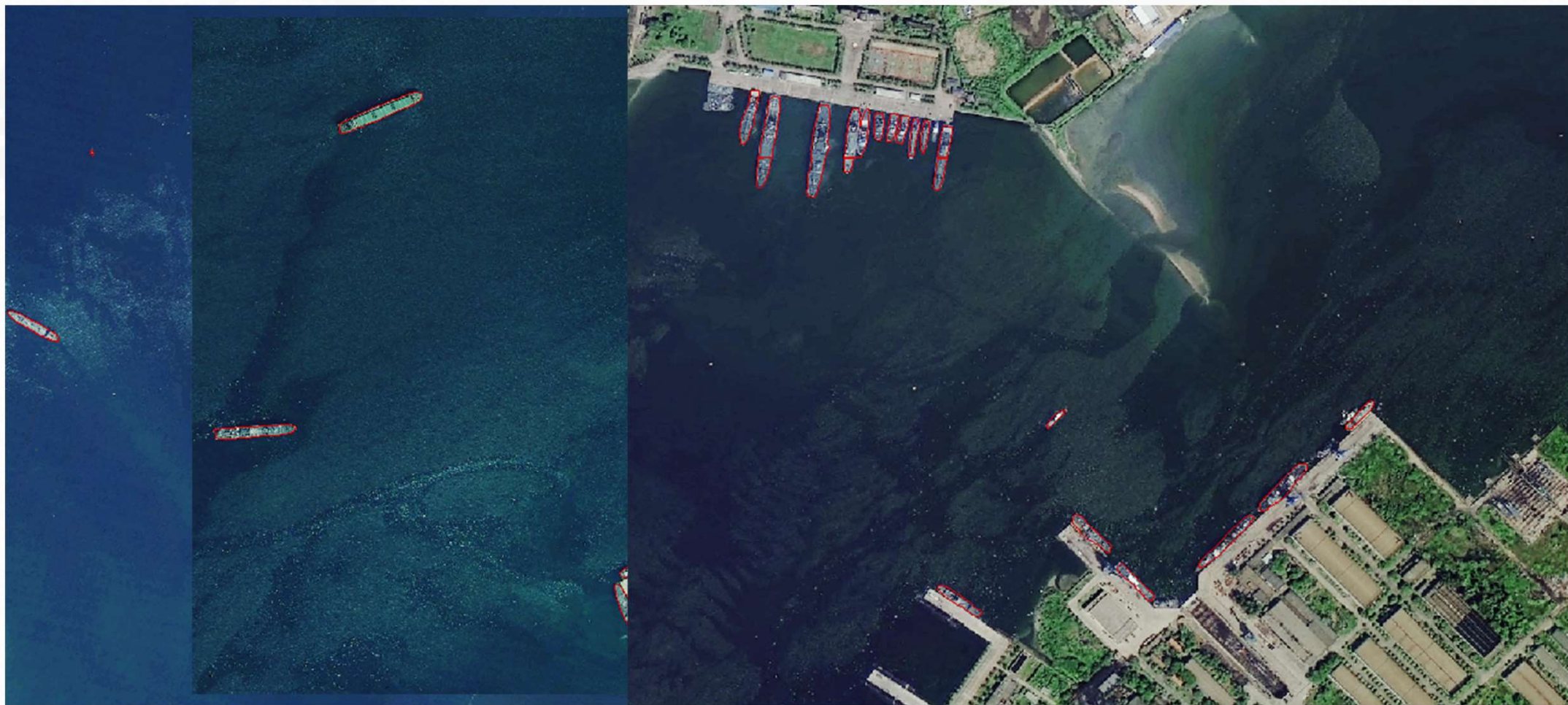
Water Body



Airports



RCNN-based remote sensing image target detection



Feature Automatic Extraction

Photovoltaic power monitoring



Onsite Photo

Image Feature

Wind power monitoring



Onsite Photo

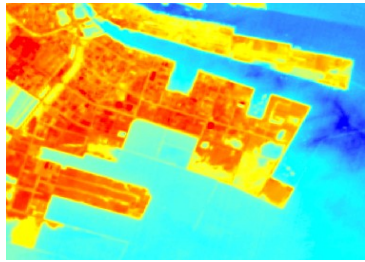


Image Feature

Temperature Monitoring

Thermal infrared remote sensing monitoring and temperature inversion

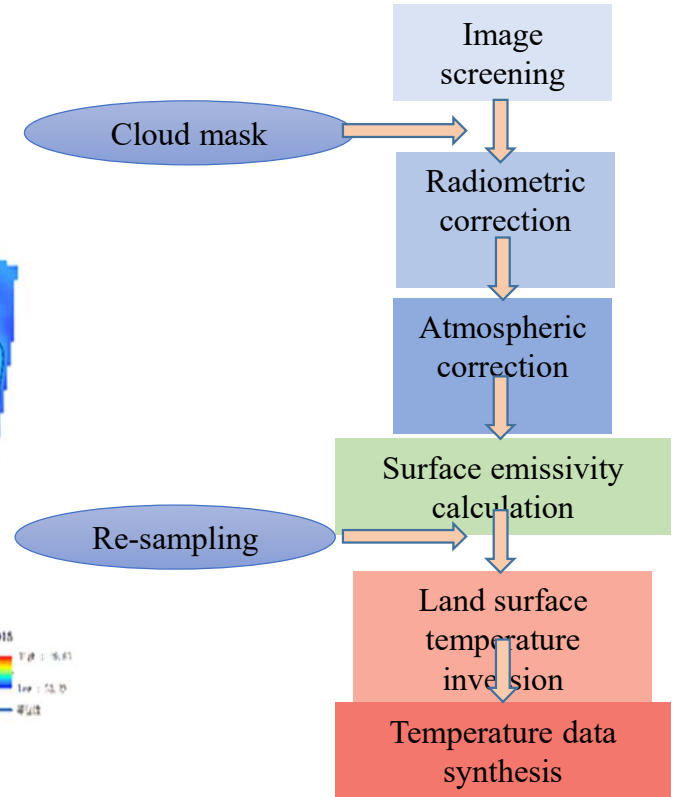
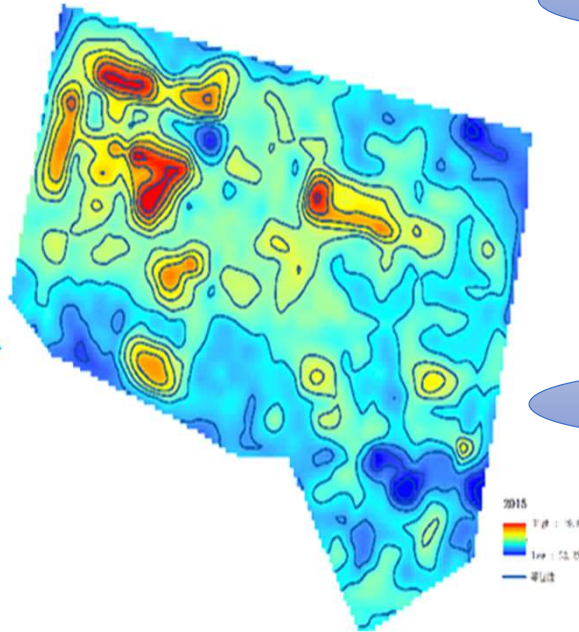
Thermal infrared data



ZY3



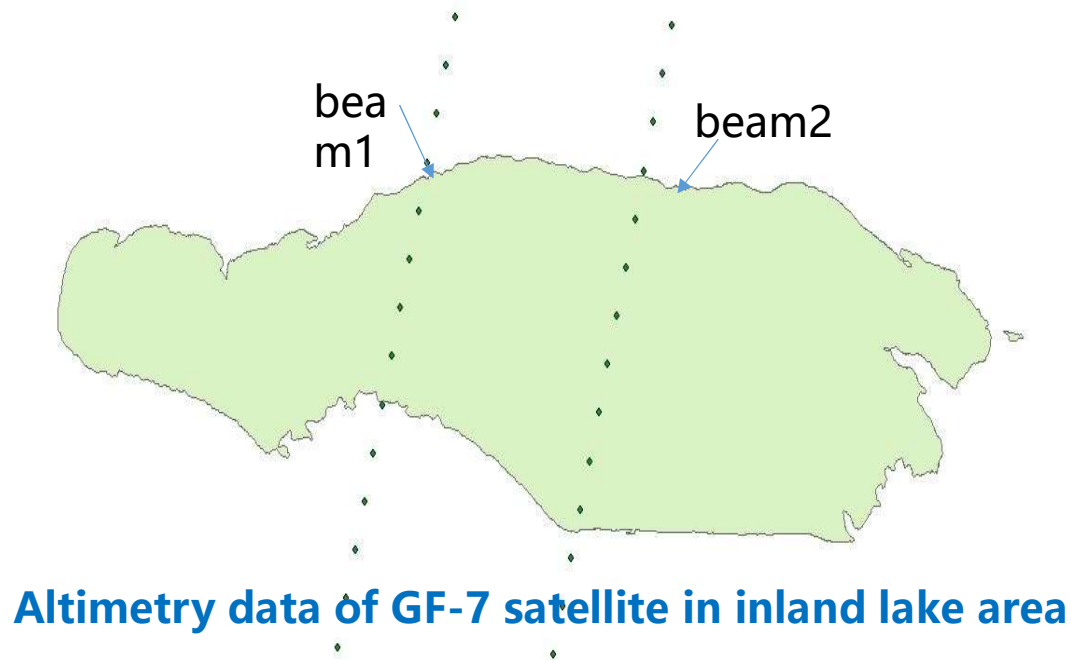
GF1



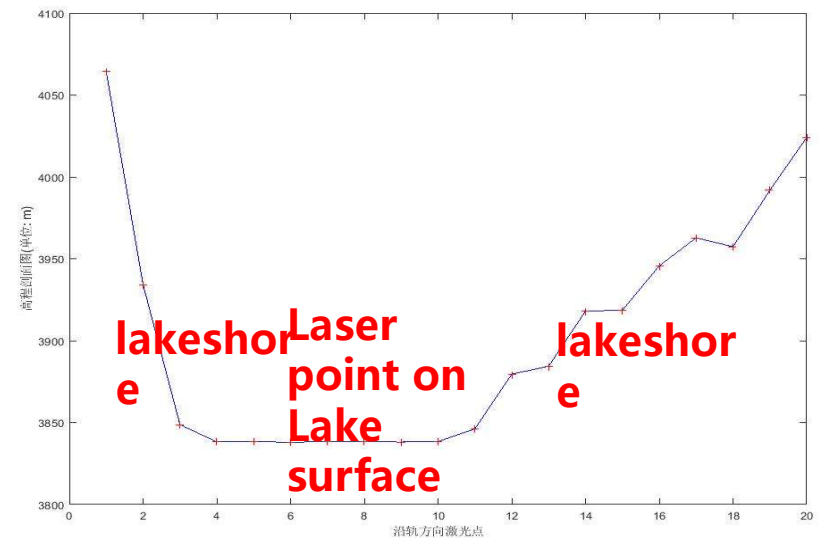
Many mature algorithms for the inversion of surface temperature exist from thermal infrared data. Through the fusion processing of optical and hyperspectral data, a more reliable inversion algorithm model is established to realize continuous monitoring of regional temperature.

Water Elevation Monitoring Application

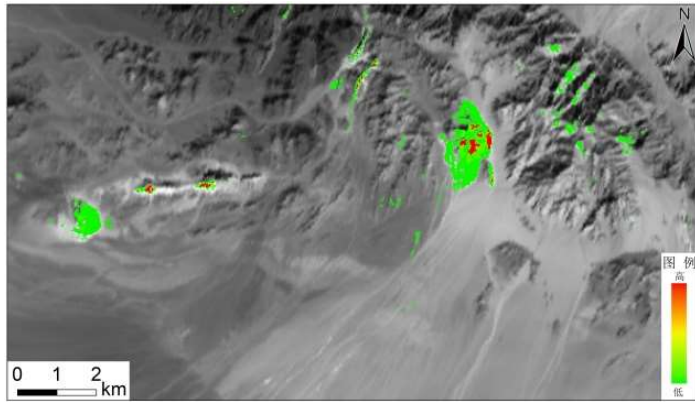
Lake Elevation Monitoring Demonstration



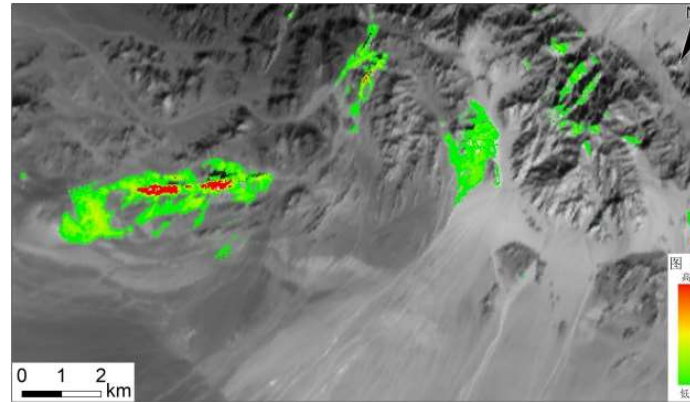
The relative elevation error of the laser points in the lake area is **0.11m**, which is expected to support the application of water level monitoring in large lakes and reservoirs.



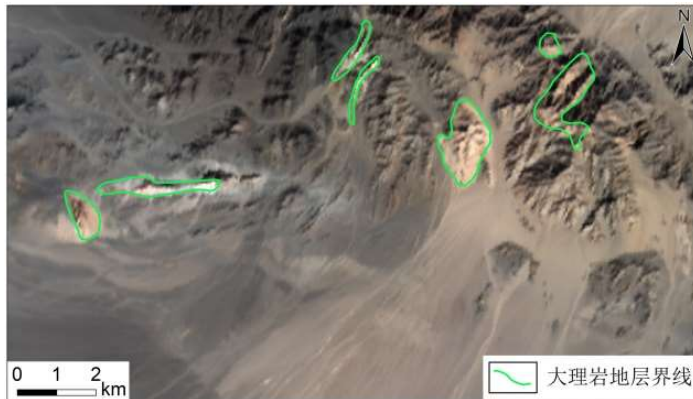
Evaluation of Basic Geological Remote Sensing Application



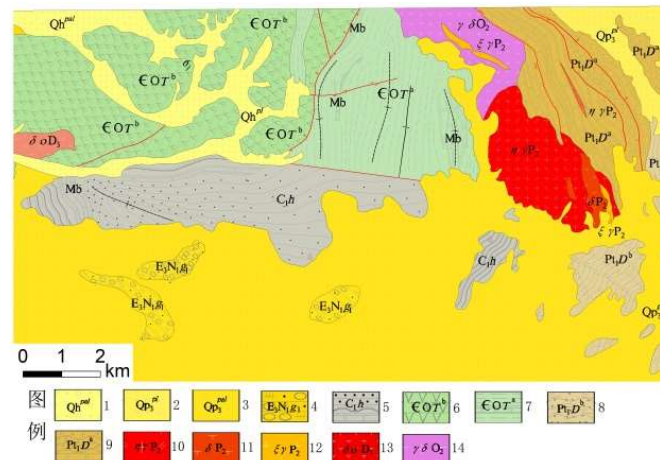
Calcite mineral information



Dolomite mineral information



Marble formation image



Geological Map of Northeast of Lenghu Lake East Demonstration Area

Mineral information extraction and analysis

The mineral information of calcite and dolomite can be found in the marble strata in the northeast of the demonstration area. The distribution and shape of calcite are consistent in 4 distributed sections concentratedly, and the concentration intensity of mineral information has fine consistency.

2. National Remote Sensing Monitoring of Water Resources

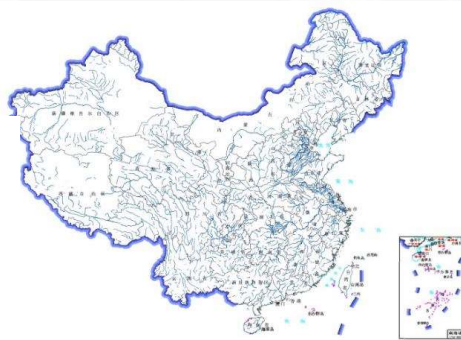
Monitoring objects

1,265 rivers of Level 3 and above, 2,128 associated reservoirs, and 2,953 lakes with above area of 1 square kilometer in China

In dry season of 2020, over 123,000 km² monitored.

In wet season, over 131,000 km² monitored.

Dry season



Wet season



Rivers

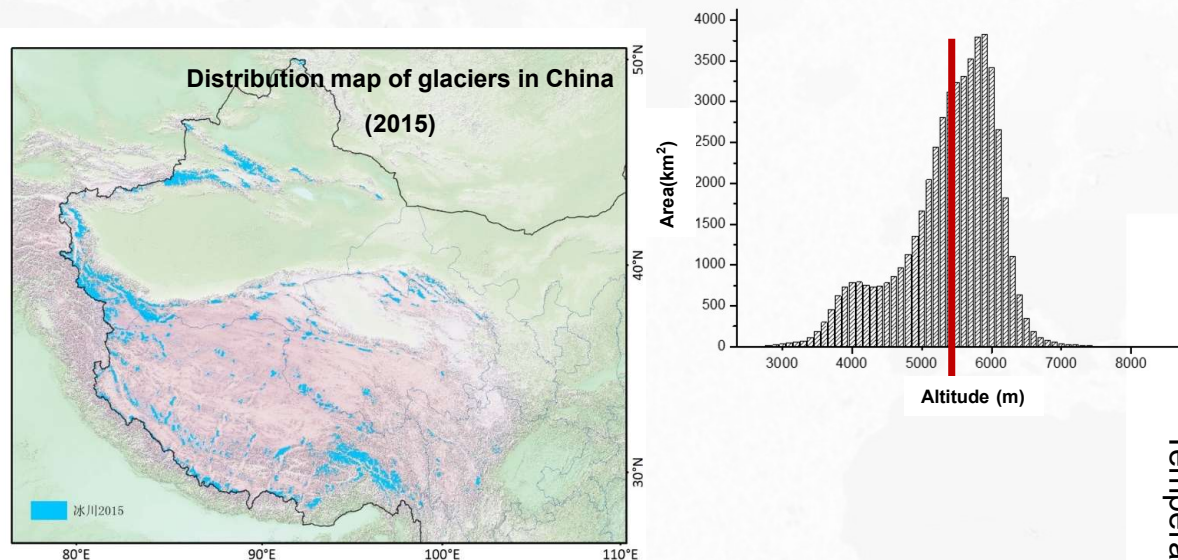
Reservoirs

Lakes

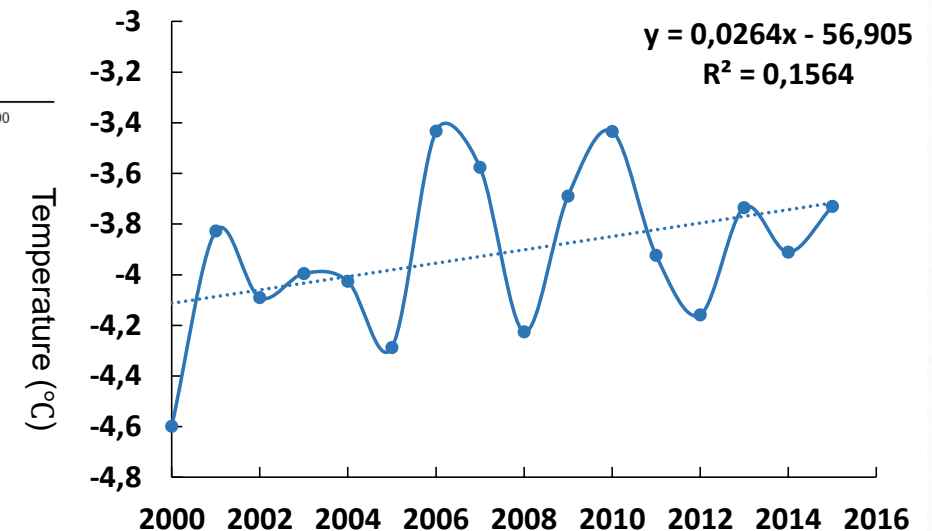
3. National Remote Sensing Monitoring of Glaciers

In 2015, there were 49,374 glaciers in China with the area of 47,569 km².

The average elevation is 5,381 meters.



The average temperature of the distribution area of glaciers in China is -3.92°C. The annual average temperature had a **trend of significant increase** from 2000 to 2015.



From 2000 to 2015, the glacier area in China had a decreasing trend. **The total area decreased by 14,44 km² and lost 2.95%.**

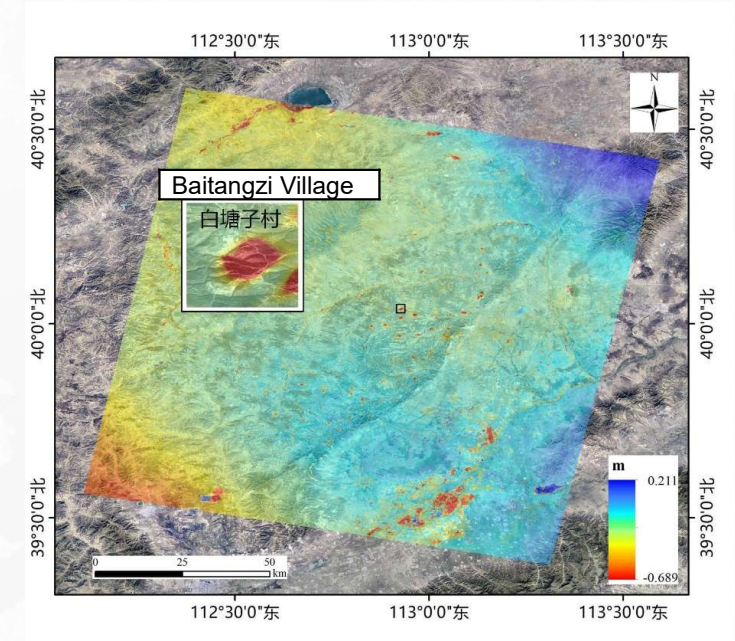
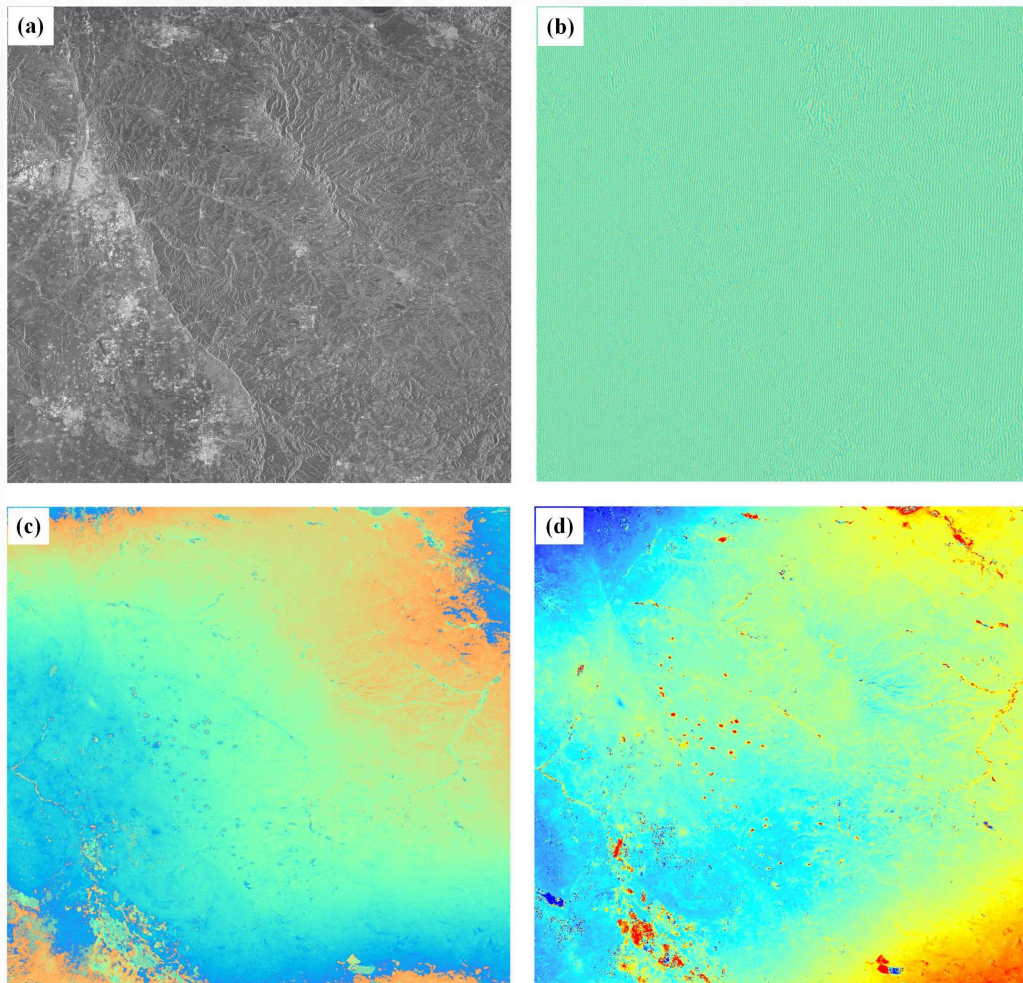
The glacier decrease rate was 0.20% each year.

The proportion of decrease of glacier area in the Hengduan Mountains was the biggest, which was up to 10.14%. The glaciers in the Gangdise Mountains, Nyenchen Tanglha Mountains, Tanggula Mountains, the Himalayas, and Tianshan Mountains changed fast. The decrease rate was higher than the national average value (2.95%).

4. SAR Satellite Deformation Monitoring

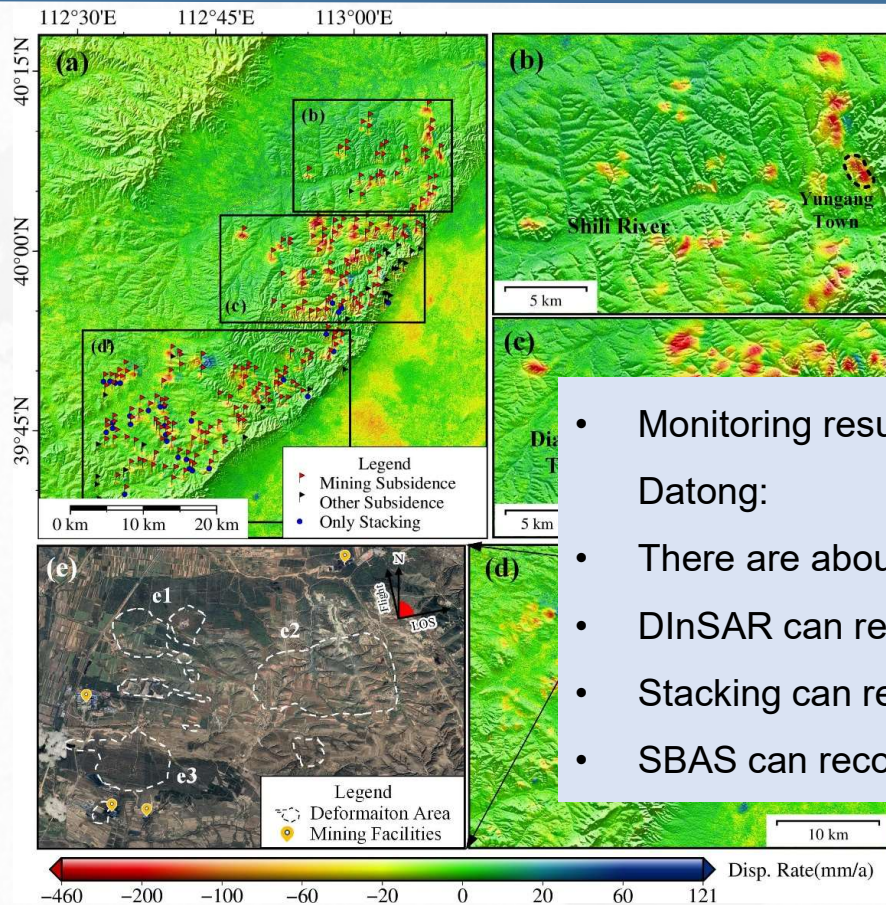


Mining area deformation monitoring of LT1 Interferometric Radar Satellite-deformation group near Datong



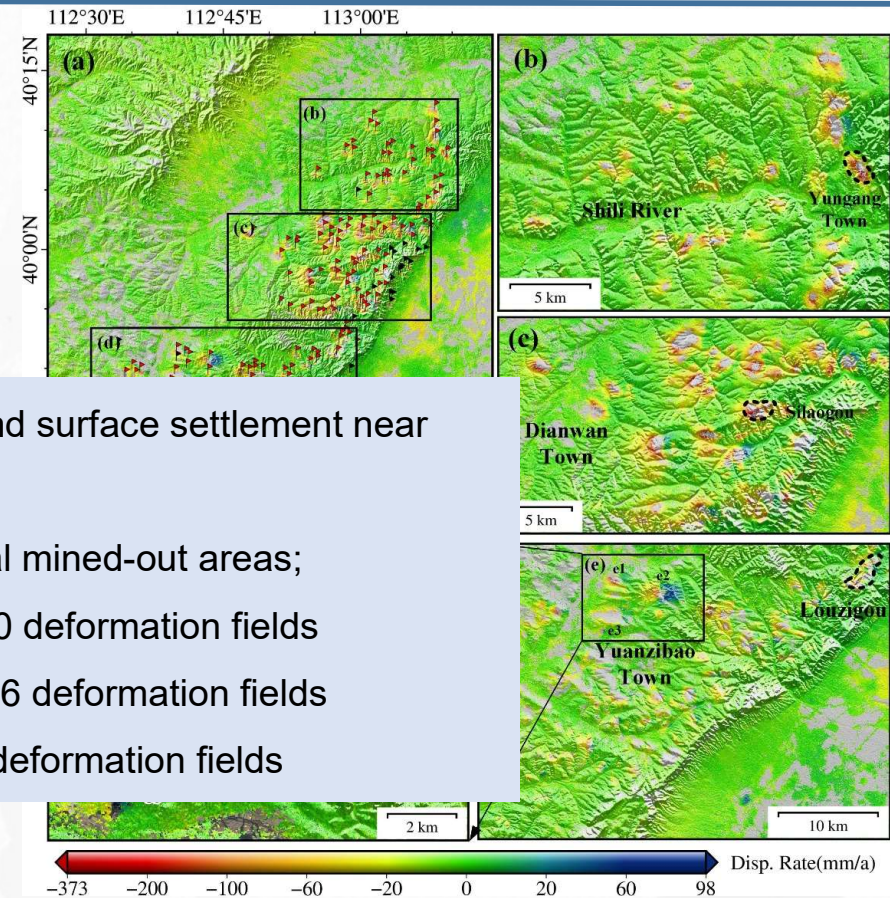
There is interference between Satellite A and Satellite B;
The spatial baseline is 171.0 meters;
The time baseline is 47 days (3.2-4.18);
The maximum vertical deformation is 68.9cm and there is a risk of collapse;
Region of Datong, Shanxi Province;
Ground subsidence caused by coal mining;

4. SAR Satellite Deformation Monitoring



Through Stacking analysis of Sentinel-1A data of 28 scenes from November 5, 2020 to October 31, 2021, the deformation rate field was obtained.

- Monitoring results of ground surface settlement near Datong:
- There are about 218 actual mined-out areas;
- DInSAR can recognize 130 deformation fields
- Stacking can recognize 256 deformation fields
- SBAS can recognize 226 deformation fields

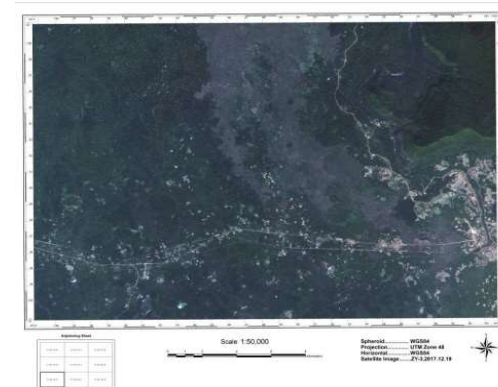
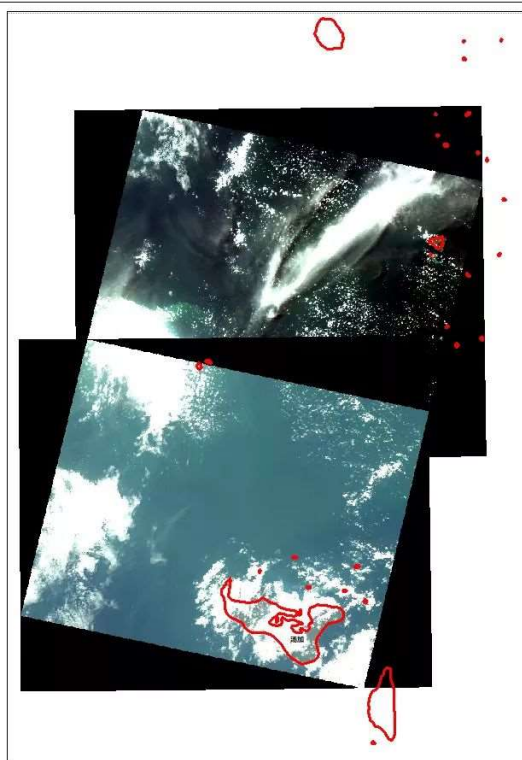


Through SBAS analysis of Sentinel-1A data from November 5, 2020 to October 31, 2021, the deformation rate field was obtained.

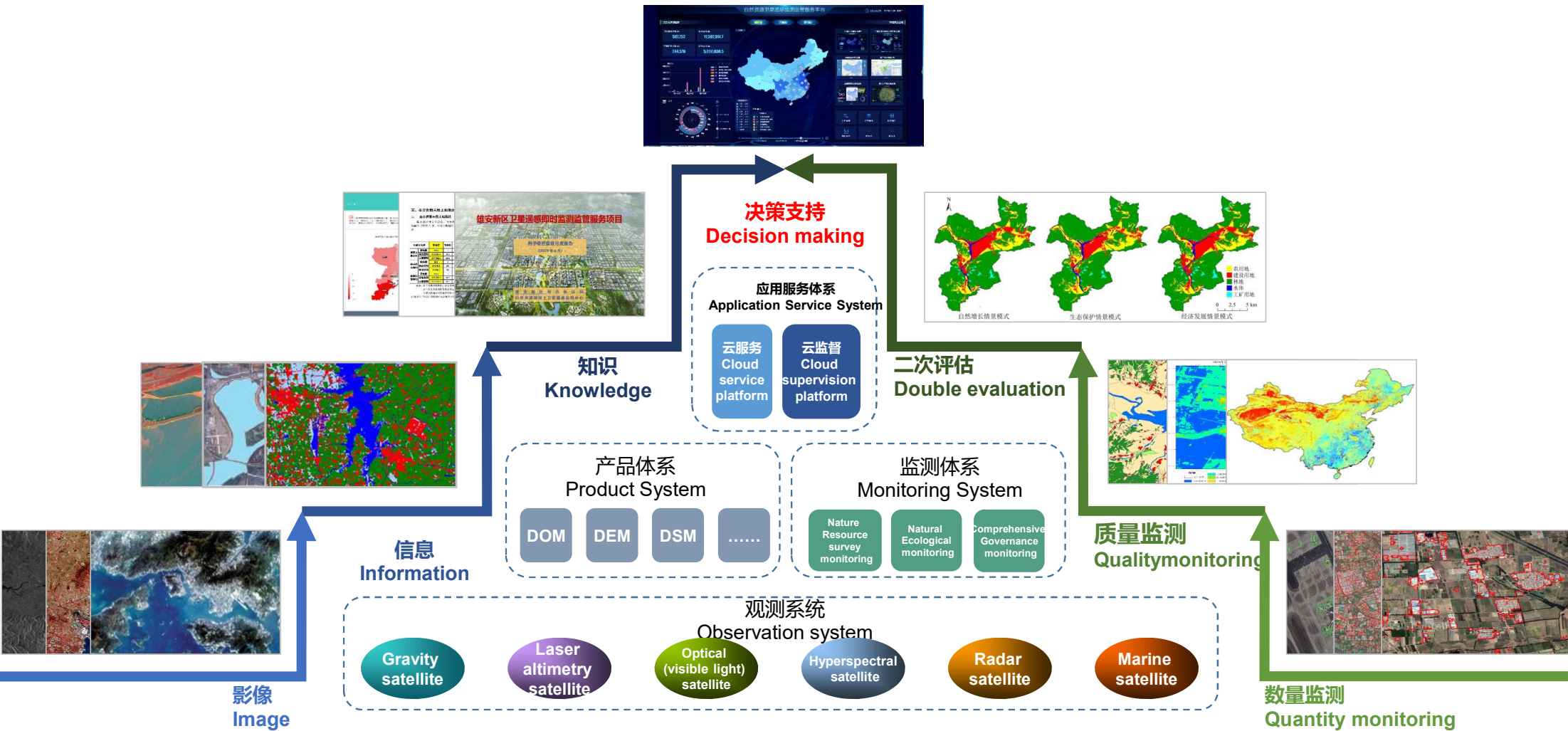
国际应急救援 International Emergency Response

- 向老挝、巴基斯坦、汤加、巴西、伊朗等国家提供洪水、溃坝、山火等应急救援影像及监测服务

Provide satellite remote sensing imagery of flood, dam break, bushfire and monitoring services to Laos, Pakistan, Tonga, Brazil, Iran and etc.



未来展望 Prospectives



Thank You !



2m resolution satellite data , for non-commercial use
Free of Charge for your country!

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