

Recent Progress of Earth Observation Satellites in China Since 2024

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Abstract Since 2024, China has continuously launched new Earth observation satellites, and now 33 satellites are operating stably in orbit. These satellites are equipped with optical, multispectral, infrared and radar payloads to produce rich remote sensing data. Their spatial resolution covers low, medium and high levels, enabling multi-spectral, all-time and all-weather observation across the globe. The remote sensing data are widely used in natural resource detection, environmental governance, disaster prevention and mitigation, urban mapping, agricultural and forestry investigation, geological exploration and ocean forecasting, bringing substantial social and economic benefits. This article summarizes the overall status of China's Earth observation satellites since 2024, focusing on satellite launch progress, data coverage and data distribution performance.

Key words Earth observation satellites, Remote sensing data, Data archiving, Data distribution, Data coverage

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1 Introduction

Earth observation satellites serve as an indispensable technical support for multiple fields including natural resource investigation, environmental monitoring and protection, disaster prevention and mitigation, urban planning and mapping, agricultural and forestry surveys, land surveying, geological exploration and ocean forecasting. The remote sensing data acquired by these satellites are of great significance to national economic development, social stability and national security.

At present, a total of 33 Earth observation satellites are operating in orbit. China has launched 3 new Earth observation satellites from 2024 up to now. Table 1 presents the catalogue of in-orbit satellites.

1.1 CSES 02

On 14 June 2025, at 15:56 UTC+8, the China Seismo-

Electromagnetic Satellite-02 (CSES 02) was successfully deployed into a sun-synchronous orbit via a Long March 2D launch vehicle from the Jiuquan Satellite Launch Center. The flawless launch and orbital insertion represent a significant advance in China's spaceborne geophysical observation infrastructure, strengthening the integrated space-air-ground monitoring network for natural hazard mitigation^[1].

As a flagship Sino-Italian collaborative project formalized by a Memorandum of Understanding witnessed by the heads of state of both nations in 2019, CSES 02 is the first operational satellite dedicated to geophysical field measurements under China's National Civil Space Infrastructure Development Plan (2021–2035). Equipped with nine state-of-the-art scientific instruments, including a co-developed electric field detector and an Italian-built high-energy particle detector, the satellite has a de-

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**Table 1 List of in-orbit satellites in China
(as of 31 May 2026)**

Number	Satellite	Launch date	Design life / a
1	GF-1	26 Apr. 2013	5–8
2	CBERS-04	7 Dec. 2014	3
3	GF-4	29 Dec. 2015	8
4	ZY-3 02	30 May 2016	5
5	GF-3	10 Aug. 2016	8
6	CSES	2 Feb. 2018	5
7	GF-1B	31 Mar. 2018	6
8	GF-1C	31 Mar. 2018	6
9	GF-1D	31 Mar. 2018	6
10	GF-6	2 Jun. 2018	8
11	ZY-1E	12 Sept. 2019	5
12	GF-7	3 Nov. 2019	8
13	CBERS-04A	20 Dec. 2019	5
14	GFDM	3 Jul. 2020	8
15	ZY-3 03	25 Jul. 2020	8
16	HJ-2A	27 Sept. 2020	5
17	HJ-2B	27 Sept. 2020	5
18	GF-5B	7 Sept. 2021	8
19	SCSY-1	14 Oct. 2021	3
20	GF-3B	23 Nov. 2021	8
21	ZY-1F	26 Dec. 2021	8
22	LT-1A	26 Jan. 2022	8
23	LT-1B	27 Feb. 2022	8
24	GF-3C	7 Apr. 2022	8
25	DQ-1	16 Apr. 2022	8
26	CM-1	4 Aug. 2022	8
27	HJ-2E	13 Oct. 2022	8
28	GF-5 01A	9 Dec. 2022	8
29	HJ-2F	9 Aug. 2023	8
30	JZ-1	13 Aug. 2023	8
31	CSES 02	14 Jun. 2025	6
32	ZY-3 04	16 Dec. 2025	8
33	DQ-2	17 Apr. 2026	8

signed operational lifetime of 6 years. Its primary mission is to perform continuous, quasi-real-time measurements of global electromagnetic fields, plasma parameters in the ionosphere, and neutral atmospheric properties. By detecting electromagnetic perturbations associat-

ed with crustal activities, anthropogenic sources, and atmospheric electrical phenomena, CSES 02 will enhance early warning capabilities for earthquakes, tsunamis, volcanic eruptions, and extreme weather events. Furthermore, it will provide valuable data products for emergency response, geodetic surveying, space weather forecasting, and international scientific cooperation under the Belt and Road framework.

The CSES constellation now has two satellites in a 180° phased configuration sharing the same orbit. Building upon the proven technology of CSES-01 (launched in 2018), CSES-02 features enhanced payload performance and expanded measurement capabilities. The dual-satellite configuration will substantially increase the temporal and spatial coverage of observations, enabling more comprehensive and timely monitoring of geophysical phenomena globally.

1.2 ZY-3 04

On 16 December 2025, at 11:17 UTC+8, the Ziyuan-3 04 (ZY-3 04) satellite, a high-precision stereoscopic mapping platform, was successfully deployed into a sun-synchronous orbit *via* a Long March 4B launch vehicle from the Taiyuan Satellite Launch Center. The flawless orbital insertion represents another milestone in China's space-based geodetic and remote sensing infrastructure^[2].

As part of China's National Civil Space Infrastructure Development Plan, ZY-3 04 carries three-line array stereoscopic cameras, a multispectral imager, and a high-precision laser altimeter, enabling simultaneous high-resolution stereoscopic and multispectral imaging. Operationally, it joins ZY-3 02 and 03 in orbit to form a stereoscopic Earth observation constellation. This capability significantly enhances large-scale topographic mapping and geographic information renewal, delivering high-accuracy data to support natural resource management activities including infrastructure development, resource inventory and monitoring, spatial planning, land use regulation, and compliance enforcement.

1.3 DQ-2

On 17 April 2026, at 12:10 UTC+8, the High-Precision Greenhouse Gas Comprehensive Exploration Satellite (DQ-2) was successfully deployed into a prescribed sun-synchronous orbit *via* a Long March 4C launch vehicle from the Jiuquan Satellite Launch Center. The flawless

mission execution represents a critical milestone in China's space-based atmospheric environment monitoring infrastructure^[3].

As an operational satellite specified in China's National Civil Space Infrastructure Development Plan, DQ-2 is equipped with five state-of-the-art scientific instruments, enabling multi-modal high-precision measurements of greenhouse gases and atmospheric trace pollutants. Its observational data will serve the operational needs of multiple national authorities, including the Ministry of Natural Resources, Ministry of Agriculture and Rural Affairs, National Forestry and Grassland Administration, and China Meteorological Administration, providing essential support for the implementation of the dual carbon strategy and the Beautiful China Initiative.

Upon commissioning, DQ-2 will operate in constellation with existing atmospheric monitoring satellites to establish a space-based environmental platform integrating laser, ultraviolet, visible, and infrared observation technologies. This constellation delivers integrated active-passive remote sensing with unprecedented hyperspectral and high temporal resolution for greenhouse gases, anthropogenic pollutants, and atmospheric aerosols. It provides a robust foundation for China's integrated space-ground environmental monitoring system, enabling synergistic observations of regional air pollution and greenhouse gas emissions. Furthermore, it will deliver sustained, high-quality spatial data to support ecological conservation, climate change governance, treaty compliance, energy efficiency improvement, and air pollution mitigation.

2 Data Coverage

This section describes the data coverage of Earth observation satellites acquired since 2024. Given that data products from atmospheric environmental monitoring missions and geophysical field monitoring missions cannot be effectively visualized in terms of spatial and temporal coverage, such data are excluded from the present analysis. Accordingly, the discussion covers only data coverage performance of optical and SAR remote sensing satellites.

2.1 Optical Satellites

Chinese optical satellites fall into three types: visible/multispectral, hyperspectral, and thermal infrared. Since 2024, 10 domestic optical satellites have operated with 2-meter-class payloads; valid data (cloud cover $\leq 20\%$) provided cumulative global coverage of $3.34 \times 10^8 \text{ km}^2$ (Figure 1). Two sub-meter-class satellites covered $7.6 \times 10^7 \text{ km}^2$ globally with valid data (cloud $\leq 20\%$) (Figure 2). Six hyperspectral satellites achieved $8.6 \times 10^7 \text{ km}^2$ coverage (Figure 3), and six thermal infrared satellites reached $1.05 \times 10^8 \text{ km}^2$ (Figure 4).

2.2 SAR Satellites

Eight SAR satellites operate in C, S, and L bands. They have accumulated $4.68 \times 10^8 \text{ km}^2$ of global coverage since 2024 (Figure 5).

3 Data Distribution

China's Earth observation satellite data are distributed to research institutions, governments, commercial firms, and individuals. As of 31 May 2026, cumulative dis-

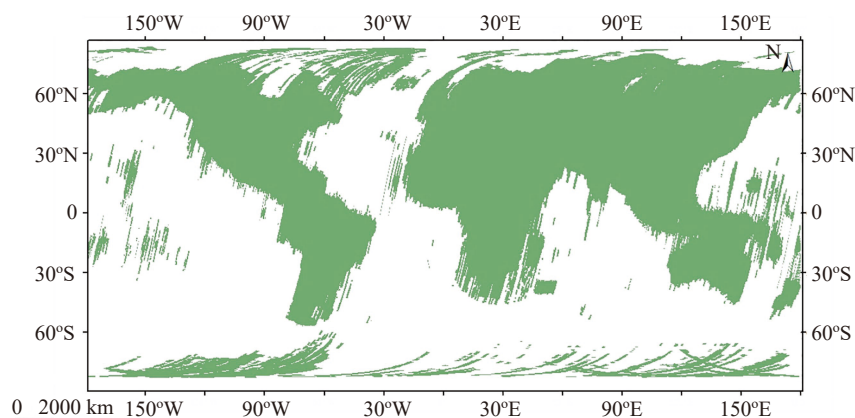


Fig. 1 Global valid data coverage of 2-meter class resolution optical satellites (cloud cover $\leq 20\%$)

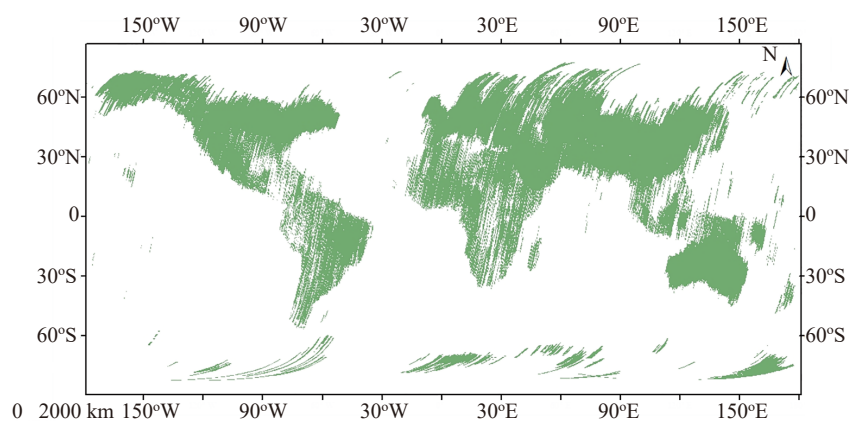


Fig. 2 Global valid data coverage of sub-meter class resolution optical satellites (cloud cover $\leq 20\%$)

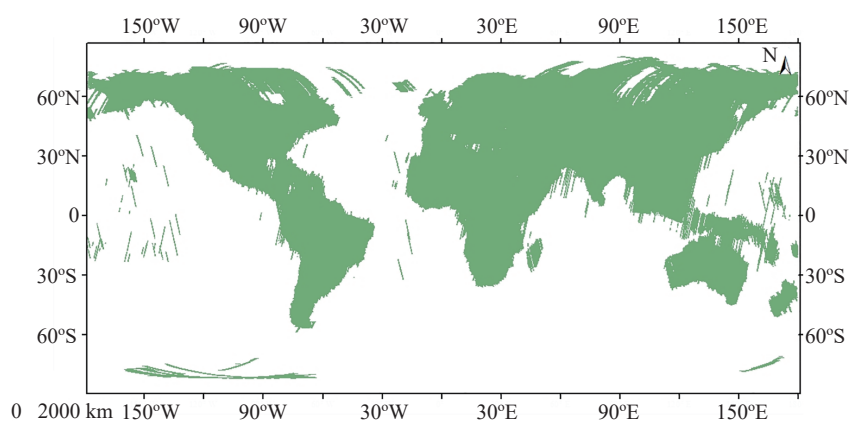


Fig. 3 Global valid data coverage of hyperspectral optical satellites (cloud cover $\leq 20\%$)

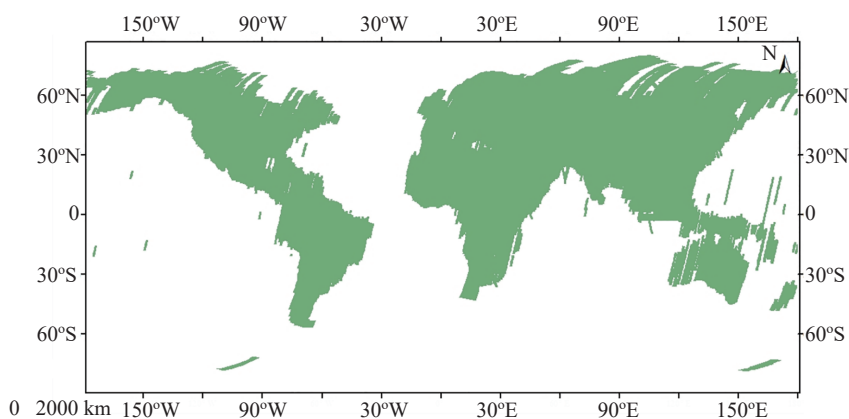


Fig. 4 Global valid data coverage of thermal infrared optical satellites (cloud cover $\leq 20\%$)

tributed imagery reached 121707293 scenes; 69416044 are high-resolution (≤ 2.5 m) products (Table 2).

4 Conclusion

Over the past three decades, China's Earth observation

satellite program has evolved into a comprehensive operational system with multi-spectral, all-time and all-weather global observation capabilities, and has made remarkable progress in constellation-based collaborative observation and on-orbit intelligent information processing^[4-8]. As of mid-2026, a substantial fleet of civilian

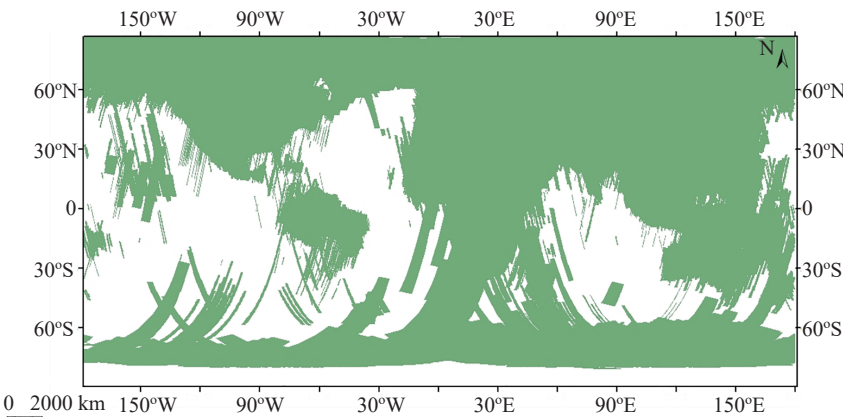


Fig. 5 Global coverage of SAR satellites

Table 2 Statistics of imagery data distribution (as of 31 May 2026)

Satellite (Payload)	Distribution / scenes	Satellite (Payload)	Distribution / scenes
CBERS-01/02	331001	ZY-1E	1111389
CBERS-02B	806966	GF-7	2790774
HJ-1A	4016256	CB04A	231850
HJ-1B	1662455	ZY3-03	1293772
SJ-9A	997632	HJ-2A	3020296
HJ-1C	382011	HJ-2B	3005590
GF-5	1009098	GF-5B	5141788
ZY-1 02C	1811628	GF-3B	1678766
ZY3-01	3202018	ZY-1F	1434835
GF-1	26284427	LT-1A	589715
GF-2	26592631	LT-1B	576664
CB-04	1914055	GF-3C	1669067
GF-4	4203039	DQ-1(WSI)	1023839
ZY3-02	3502655	CM-1(DMC)	2465881
GF-3	4630961	HJ-2E	873163
GF-1B	2691566	GF-5 01A	1315333
GF-1C	2470165	HJ-2F	609021
GF-1D	2507470	JZ-1	68580
GF-6	3723628	ZY3-04	67308
Total	121707293		

Earth observation satellites are operating stably in orbit with increasingly diverse payload configurations, which have greatly expanded the breadth and depth of remote sensing applications.

Commercial aerospace growth transformed indus-

try development through mass production, frequent launches, and vertical integration. Mission costs decreased substantially, development cycles shortened, and applications expanded to agricultural insurance, commodity trading, infrastructure monitoring, and cultural heritage protection. Demand for quality remote sensing services drove improvements in payload specifications, radiometric accuracy, and data delivery efficiency, accelerating coordinated space and ground segment development.

By 2030, China will establish a globally leading Earth observation constellation across multiple orbital types and modalities. The system will feature sub-meter spatial resolution, 1-day global revisit for key regions, and full-spectrum hyperspectral detection. Integrated capabilities include autonomous mission planning, on-orbit real-time interpretation, automatic target recognition, and intelligent information delivery, reducing data-to-service cycle times. These advances will provide high-precision Earth observation data and services to support ecological civilization construction, dual carbon strategy implementation, disaster risk reduction, and global sustainable development goals, deepening integration between remote sensing technology and the digital economy.

Conflict of Interests The authors declare that there is no conflict of interests

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