Update on Chinese missions

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China Meteorological Administration (CMA)
Ministry of Science and Technology (MOST)
Ministry of Ecological Environment (MEE)

CHINA'S GREENHOUSE-GAS OBSERVING CONSTELLATION

Comprehensive • Complementary • Coordinated

DQ-1

Integrated GHG & Aerosol/Cloud Observation

- Active lidar vertical profiling
- GHG column and profile
- Aerosols and clouds
- CO_2, CH_4, aerosols, clouds

DQ-2

High-Precision Integrated GHG Observation

- Active + passive synergy
- Nadir, limb & 3D observation
- High-precision column & profile
- CO_2, CH_4, aerosols, clouds

TanSat-2

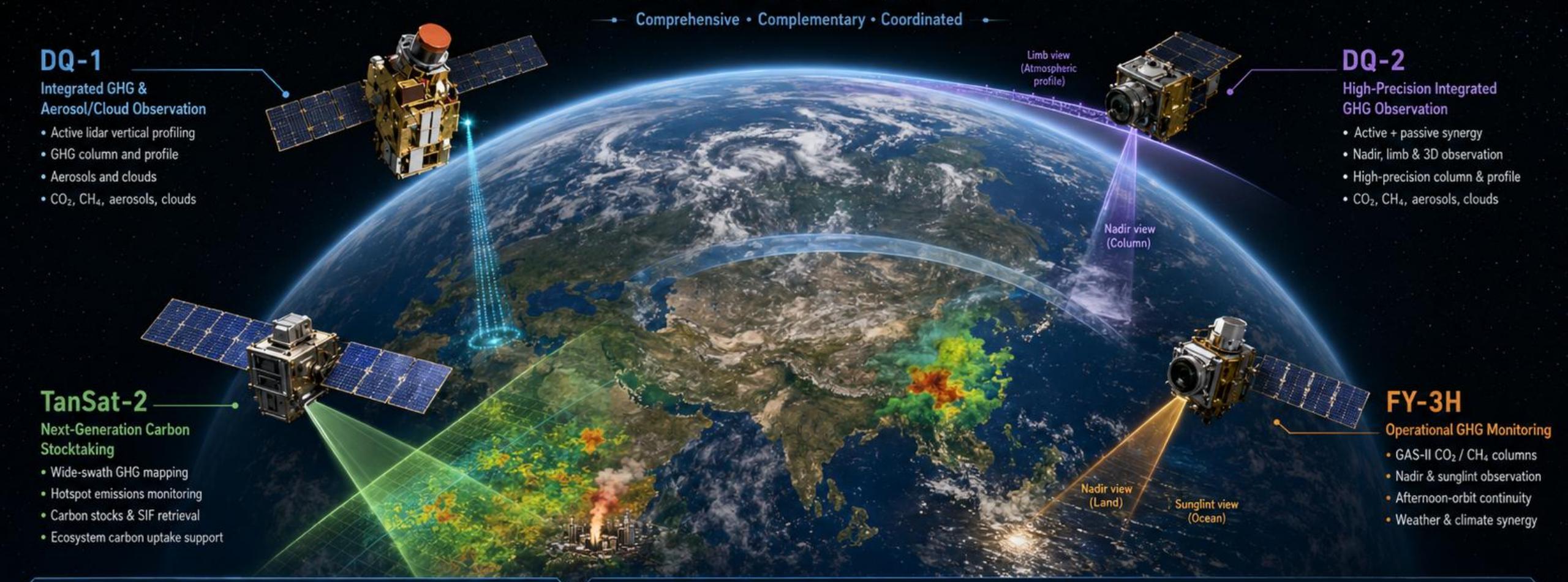
Next-Generation Carbon Stocktaking

- Wide-swath GHG mapping
- Hotspot emissions monitoring
- Carbon stocks & SIF retrieval
- Ecosystem carbon uptake support

FY-3H

Operational GHG Monitoring

- GAS-II CO_2 / CH_4 columns
- Nadir & sunglint observation
- Afternoon-orbit continuity
- Weather & climate synergy



JOINT GREENHOUSE-GAS OBSERVATION VALUE

1. Global CO_2 / CH_4 monitoring
2. Carbon source-sink assessment
3. Point-source and hotspot emission detection
4. Aerosol / cloud correction & atmospheric profile support
5. Improved temporal coverage, cross-validation, and multi-scale synergy

COMPLEMENTARY CONSTELLATION

DQ-1	DQ-2	TanSat-2	FY-3H
Active lidar + Aerosol/Cloud + GHG profile	Active + Passive Nadir / Limb / 3D High precision	Wide-swath mapping Hotspot monitoring SIF / Carbon uptake	Operational monitoring Nadir + Sunglint Afternoon-orbit
Research High vertical sensitivity	**Research** Precision & 3D composition	**Research** Wide coverage & ecosystems	**Operational** Continuity & services

= **Multi-Mission Carbon Observing Constellation**

Active + Passive
Wide-swath + Hotspot
Research + Operational

Global coverage | Multi-scale synergy | Cross-calibration & validation | Science & applications for climate, environment and society

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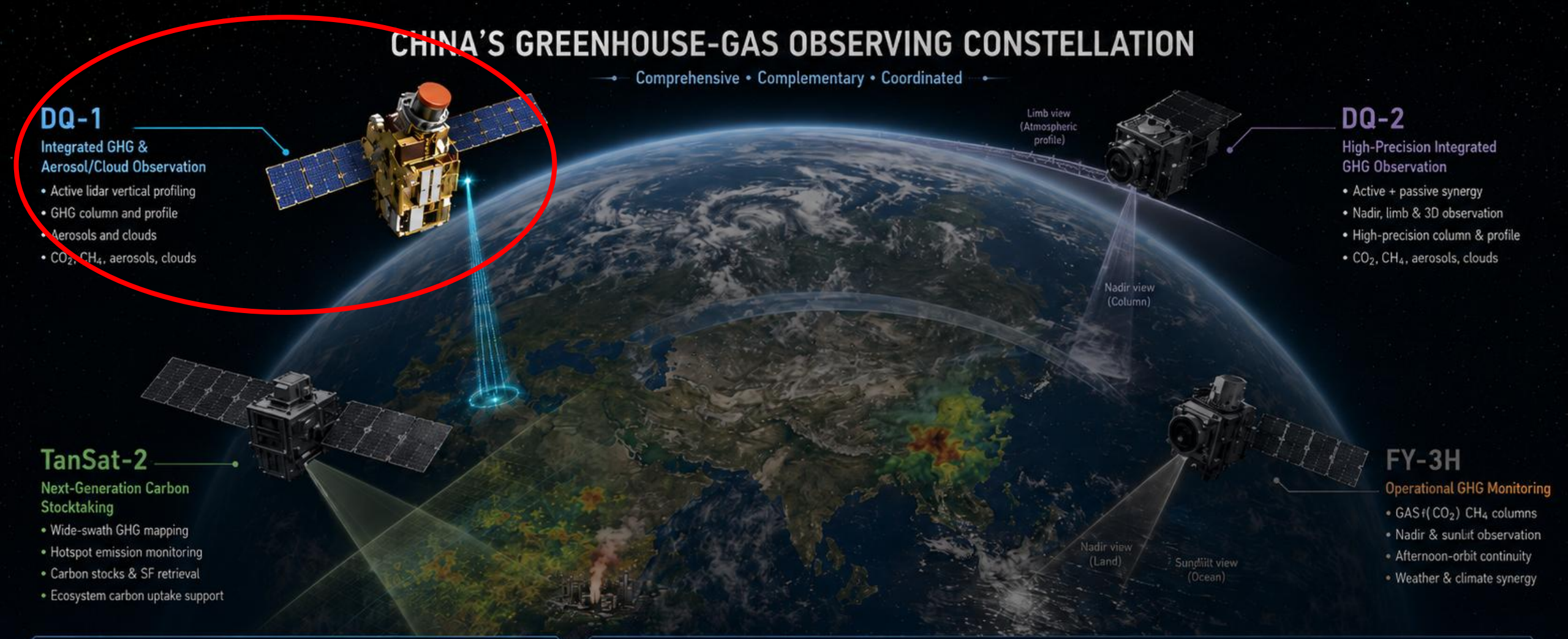

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The DQ-1 mission (2022-)

1 Satellite and mission overview

- **Name:** DQ-1 (Atmospheric Environment Monitoring Satellite / Daqi-1)
- **Launch date:** 16 April 2022
- **Orbit:** Sun-synchronous orbit
- **Altitude:** 705 km
- **Local overpass time:** about 13:00–13:30 ascending node
- **Inclination:** about 98.2°
- **Design life:** 8 years
- **Core mission:** coordinated observations of greenhouse gases, trace pollutants, aerosols and clouds

World's first spaceborne active lidar mission for coordinated CO_2 and aerosol observation

2 Major payloads

ACDL
Atmospheric Carbon Dioxide Lidar / Atmospheric Detection Lidar

CORE PAYLOAD

- **Core role:** active sensing of XCO_2 and aerosol/cloud vertical structure
- **Key wavelengths:** 532 / 1064 / 1572 nm
- **Technology:** IPDA + high-spectral-resolution lidar
- **Advantages:** day/night observations, high-latitude capability, less affected by clouds and aerosols

EMI
Ultraviolet Hyperspectral Atmospheric Composition Instrument

- Spectral range: 240–710 nm
- Role: monitoring NO_2, SO_2, O_3, HCHO and other trace gases
- Spatial resolution: about 24 × 13 km

DPC
Directional Polarization Camera

- Spectral range: 433–920 nm
- Role: multi-angle polarized aerosol retrieval
- Retrieves AOD, particle size, aerosol type, etc.

POSP
Precision Orbiting Scanning Polarimeter

- Representative bands: 380 / 410 / 443 / 490 / 670 / 865 / 1380 / 1610 / 2250 nm
- Role: high-accuracy polarization and aerosol/surface auxiliary information

WSI
Wide Swath Imaging Spectrometer

- Spectral range: 0.415–12 μm
- Role: wide-swath multispectral and thermal infrared background, cloud and surface support

Target–Payload Relationship

- CO_2 → ACDL
- Aerosols / clouds → ACDL + DPC + POSP + WSI
- Trace pollutant gases (NO_2, SO_2, O_3, HCHO, etc.) → EMI

3 Data and product chain

L0 / L1
Raw and calibrated data

- Lidar echoes
- Radiance, polarization
- Multispectral observations

L2 Retrieval products

- XCO_2
- Aerosol backscatter and extinction
- Depolarization ratio
- Lidar ratio
- AOD
- Cloud / aerosol classification
- NO_2, SO_2, O_3, HCHO

L3 Integrated products

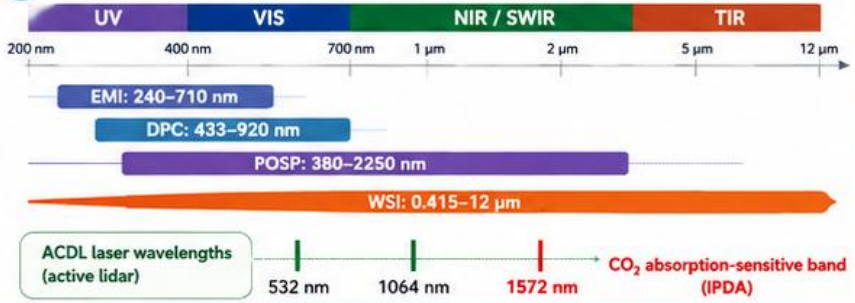
- Global / regional trace-gas distributions
- Monthly global XCO_2
- Aerosol and cloud environmental products

DQ-1 ACDL Global Monthly XCO_2 Product

- Time span: 2022.06–2023.12
- Grid: 1° × 1°
- Separate day and night products
- Unit: ppm

ACDL retrieves column-averaged CO_2 (XCO_2) from the 1572 nm differential absorption signal.

4 Spectral coverage and observation modes

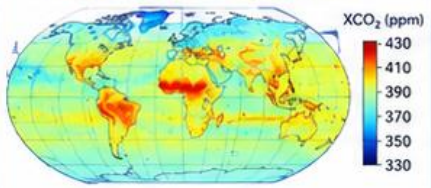


Observation modes

- **Active observation:** ACDL lidar
- **Passive observation:** EMI / DPC / POSP / WSI

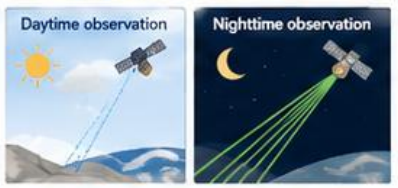
5 Representative results and applications

Global XCO_2 distribution (schematic)



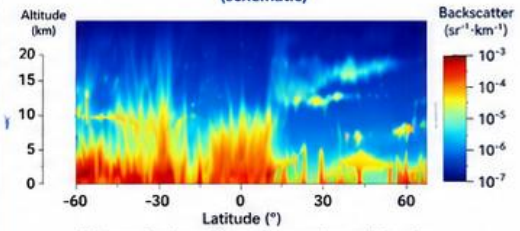
First global XCO_2 results from spaceborne lidar observations.

Day, night and high-latitude capability



Lidar active sensing enables day and night observations, including high-latitude regions.

Aerosol and cloud vertical structure (schematic)



Lidar vertical profiling of aerosols and clouds from the surface to the lower stratosphere.

Application domains

- Carbon source / sink assessment
- Point-source emission monitoring
- Pollution–climate interaction studies
- Support for climate models and data assimilation

- First global XCO_2 results from spaceborne lidar
- Nighttime and high-latitude XCO_2 observations complement passive satellites
- Coordinated observation of CO_2, aerosols and clouds
- Aerosol optical property retrieval and validation studies underway
- Supports carbon source/sink assessment, point-source emission monitoring, and pollution–climate studies
- Complementary to passive missions such as TanSat and OCO-2

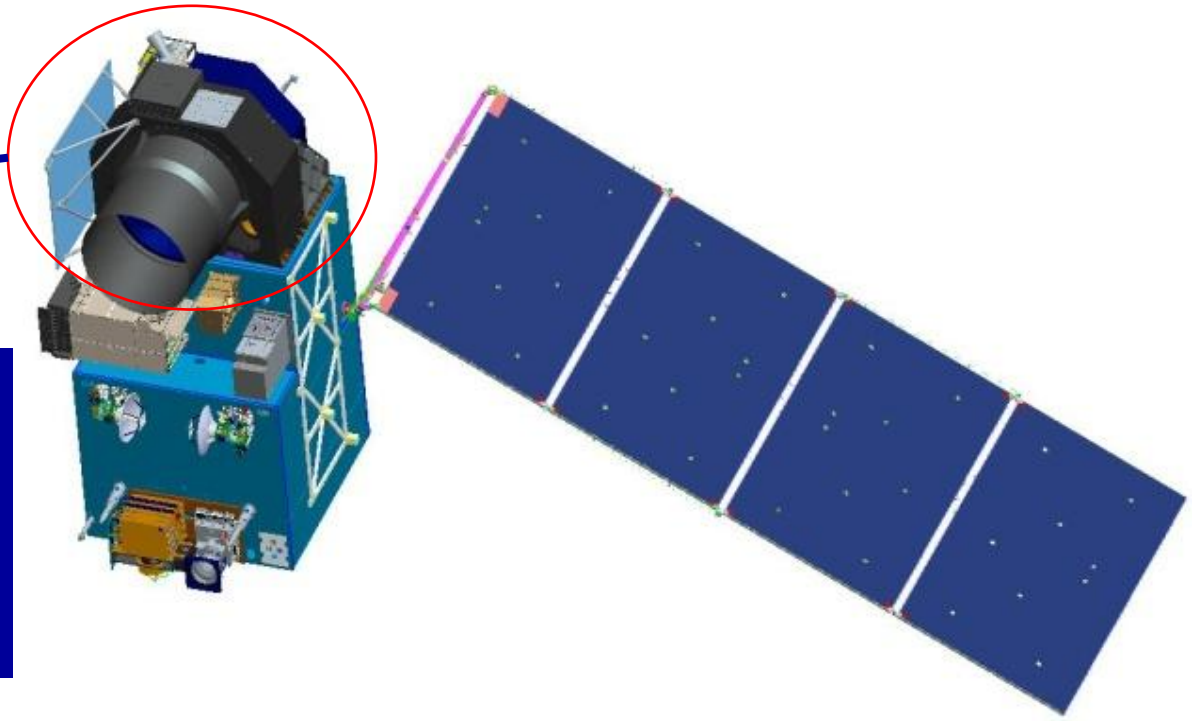
Mission of ACDL development

ACDL major development goal for DQ-1(Daqi-1) satellite

Measure XCO_2 and aerosol profiles from the same space Lidar .

XCO_2 accuracy→1ppm

ACDL



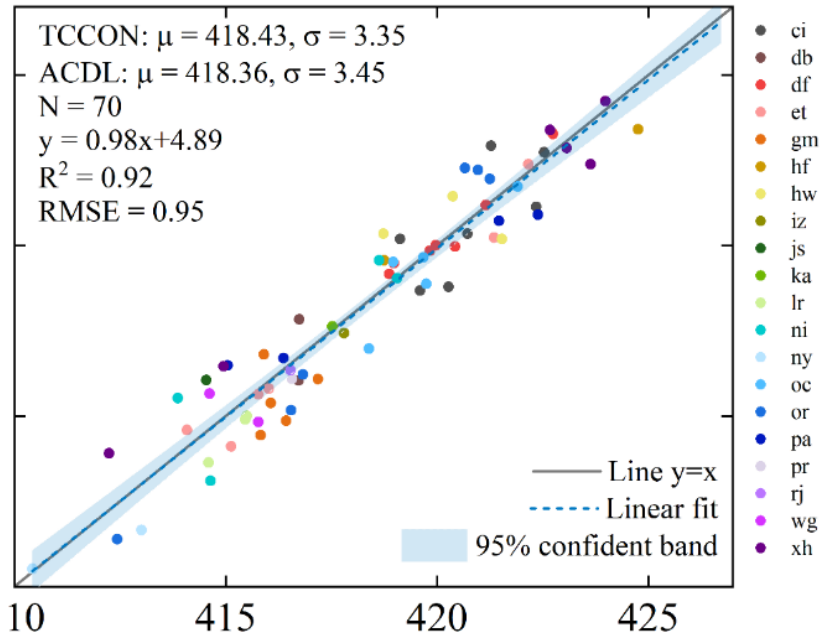
Orbit altitude: 705 km;
Incline angle : 98.2°;
Ascending time: 13:30 PM.
Launch time: April 16, 2022

The decetion of DQ-1 ACDL

Introduction

- The DQ-1 equipped with the ACDL payload was successfully launched on 16 April 2022 with local time of around 13:30 p.m.,The ACDL is the world's first space-borne integrated path differential absorption (IPDA) lidar instrument. It was designed to measure XCO2 and aerosol

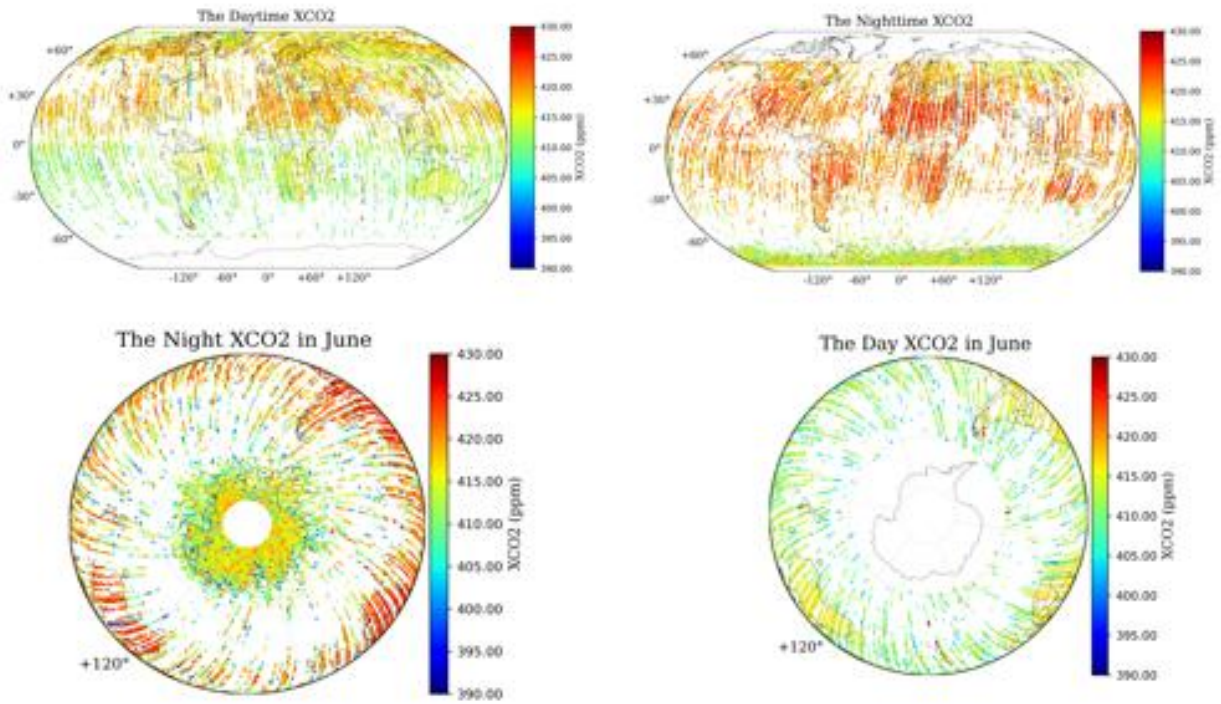
Validation



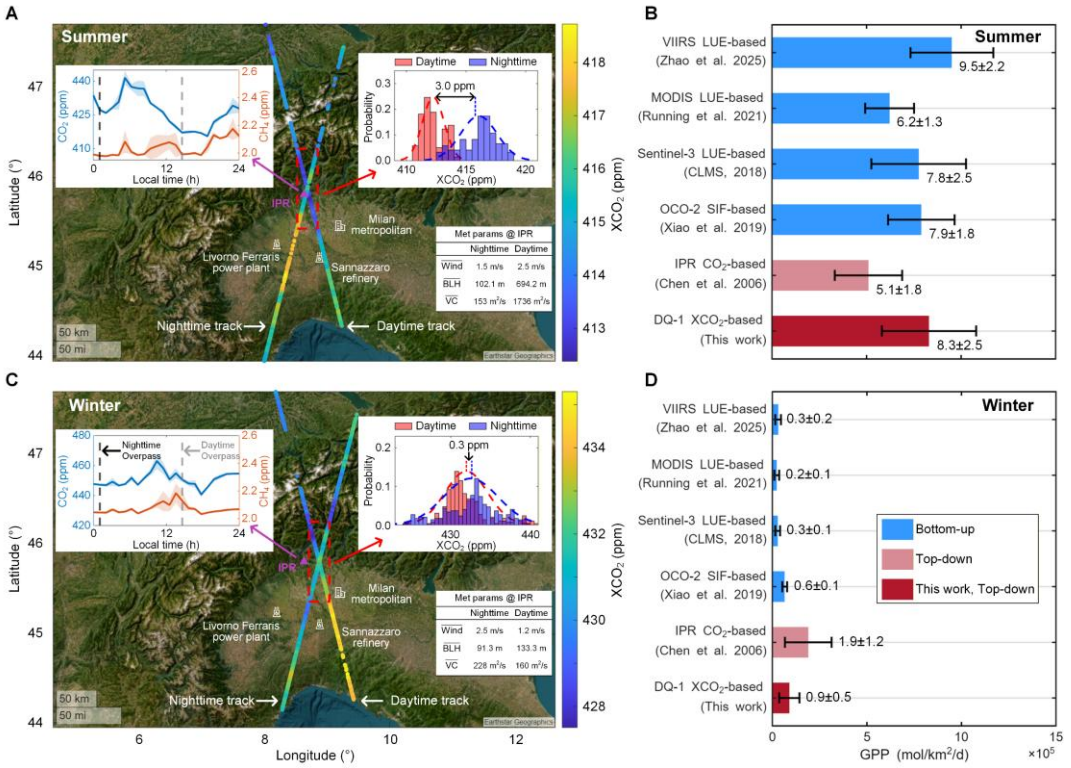
- Validated with the TCCON, the RMSE is 0.95 ppm.

Observation over global and local emssions

Global measurement: day and night



Local measuremnt



- The DQ-1 captures critical diurnal variations in the carbon cycle, distinguishing between daytime photosynthetic uptake and nighttime ecosystem respiration.

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- CO_2, CH_4, aerosols, clouds

DQ-2

High-Precision Integrated GHG Observation

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- Nadir, limb & 3D observation
- High-precision column & profile
- CO_2, CH_4, aerosols, clouds

TanSat-2

Next-Generation Carbon Stocktaking

- Wide-swath GHG mapping
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- Ecosystem carbon uptake support

FY-3H

Operational GHG Monitoring

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- Nadir & sunglint observation
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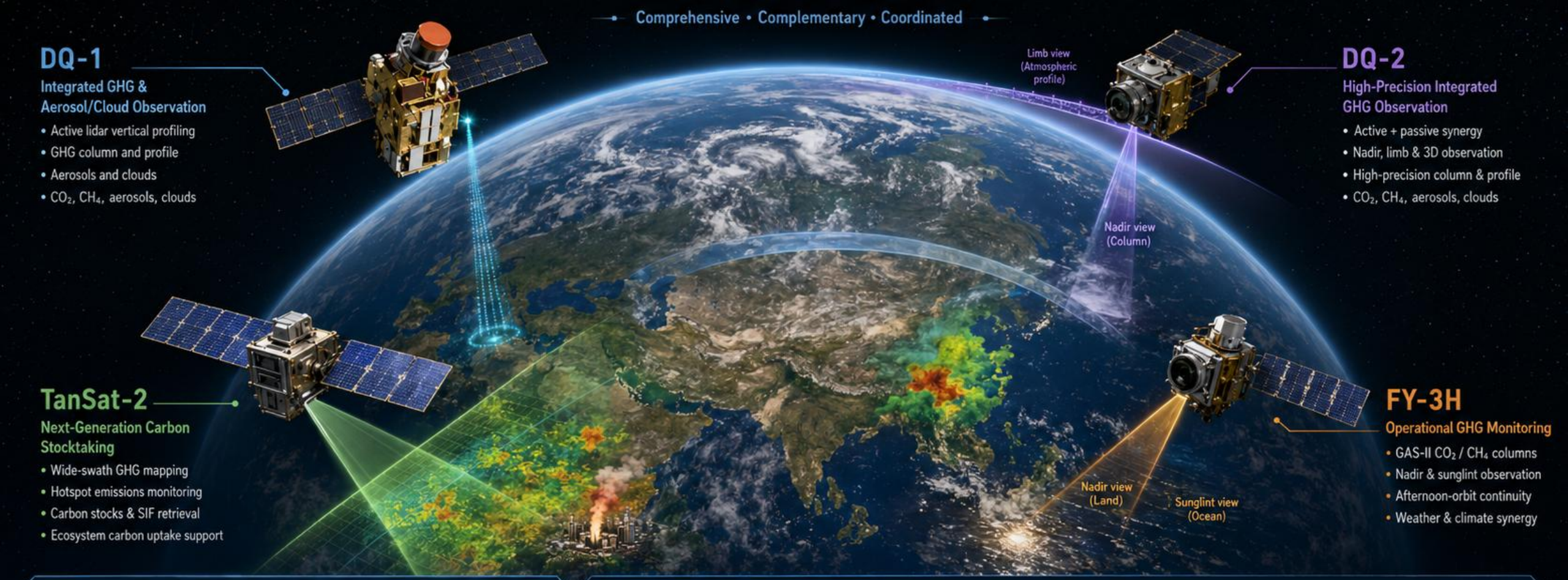

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COMPLEMENTARY CONSTELLATION

DQ-1	DQ-2	TanSat-2	FY-3H	Multi-Mission Carbon Observing Constellation
Active lidar + Aerosol/Cloud + GHG profile	Active + Passive Nadir / Limb / 3D High precision	Wide-swath mapping Hotspot monitoring SIF / Carbon uptake	Operational monitoring Nadir + Sunglint Afternoon-orbit	*Active + Passive Wide-swath + Hotspot Research + Operational*
Research High vertical sensitivity	**Research** Precision & 3D composition	**Research** Wide coverage & ecosystems	**Operational** Continuity & services	

Global coverage | Multi-scale synergy | Cross-calibration & validation | Science & applications for climate, environment and society

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Limb view (atmospheric profile)

Nadir view (column)

TanSat-2

Next-Generation Carbon Stocktaking

- Wide-swath GHG mapping
- Hotspot emission monitoring
- Carbon stocks & SF retrieval
- Ecosystem carbon uptake support

FY-3H

Operational GHG Monitoring

- GAS (CO_2)+ CH_4 columns
- Nadir & sunlit observation
- Afternoon-orbit continuity
- Weather & climate synergy

Nadir view (Land)

Sunlit view (Ocean)

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COMPLEMENTARY CONSTELLATION

DQ-1
Active lidar
• Aerosol/Cloud
• GHG profile
Research
High vertical sensitivity

+

DQ-2
Active + Passive
Nadir / Limb / 3D
High precision
Research
Precision & 3D composition

+

TanSat-2
Wide-swath mapping
Hotspot monitoring
SF / Carbon uptake
Research
Wide coverage & ecosystems

+

FY-3H
Operational monitoring
Nadir + Sunlit
Afternoon-orbit
Operational
Continuity & services

=

Multi-Mission Carbon Observing Constellation
Active + Passive
Wide-swath + Hotspot
Research + Operational

Global coverage | Multi-scale synergy | Cross-calibration & validation | Science & applications for climate, environment and society

DQ-2 mission (2026-)

1 Satellite and mission overview

- **Name:** DQ-2 (High-Precision Greenhouse Gas Composite Monitoring Satellite)
- **Launch date:** 17 April 2026
- **Launch site:** Jiuquan Satellite Launch Center
- **Mission concept:** active–passive integrated observation of greenhouse gases, pollutant gases, aerosols and clouds
- **Constellation role:** forms a morning–afternoon coordinated observing constellation with DQ-1
- **Core value:** high-precision global atmospheric composition monitoring for environment, climate and carbon applications
- **Current status:** in-orbit commissioning / initial mission phase

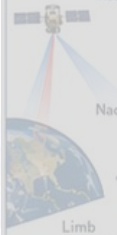
Coordinated DQ-1 + DQ-2 atmospheric composition constellation

2 Major payloads

Atmospheric CO_2 Lidar (ACDL / Atmospheric Detection Lidar)

- Active lidar for high-precision global CO_2 column sensing
- Uses IPDA for day/night CO_2 observation
- Also retrieves aerosol and cloud vertical structure using high-spectral-resolution lidar capability

EMI-NL
UV Hyperspectral Atmospheric Composition Instrument



- Simultaneous nadir + limb imaging
- First such simultaneous imaging capability
- Retrieves 3D distributions of trace pollutant gases
- Target gases: NO_2, SO_2, O_3, HCHO, etc.

CAPC
Cloud and Aerosol Imaging Camera

- Multi-angle, multispectral, polarization radiance observations
- Retrieves cloud and aerosol optical / microphysical properties
- Provides atmospheric correction support for other payloads

Wide-Swath Hyperspectral Greenhouse Gas Monitor

- Wide swath, high spectral resolution, high sensitivity
- Designed for high-precision global greenhouse gas mapping
- Broad coverage and quantitative greenhouse-gas observation

Infrared Hyperspectral Atmospheric Composition Sounder

- China's first spaceborne Fourier-transform spectrometer for atmospheric pollutant gases and greenhouse gases
- Retrieves atmospheric composition profiles / columns and temperature-humidity profiles
- Sensitive from upper troposphere to lower stratosphere

Target–Payload Relationships

Greenhouse gases	Lidar + Wide-Swath GHG Monitor + IR Sounder
Trace pollutant gases	EMI-NL + IR Sounder
Aerosols / clouds	Lidar + CAPC
Atmospheric correction / context	CAPC

3 Data and product chain

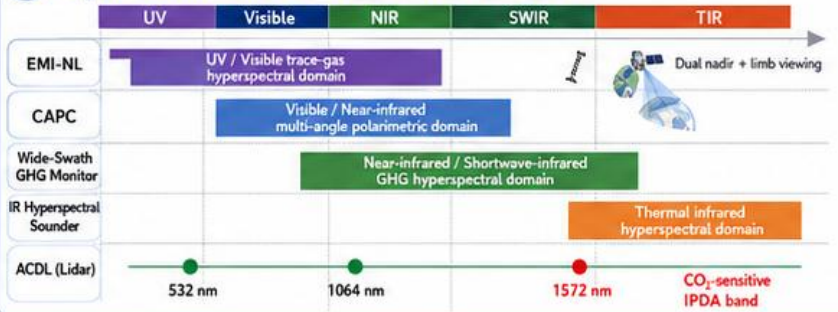
L0 / L1 Raw observations
- Lidar echoes
- UV spectra
- Multi-angle polarized radiances
- Hyperspectral greenhouse-gas spectra
- IR interferometric observations

L2 Retrieved products
- XCO_2
- Aerosol / cloud vertical profiles
- Trace-gas columns and profiles
- Aerosol / cloud optical properties
- Greenhouse-gas columns
- Atmospheric composition / temperature / humidity profiles

L3 Integrated products
- Global greenhouse-gas maps
- Air-quality products
- Climate and environmental datasets
- Joint DQ-1 / DQ-2 composite products

Mission phase
- Initial on-orbit testing and calibration
- Product generation chain being established
- Future coordinated DQ-1 + DQ-2 data synergy

4 Spectral domains and observation modes

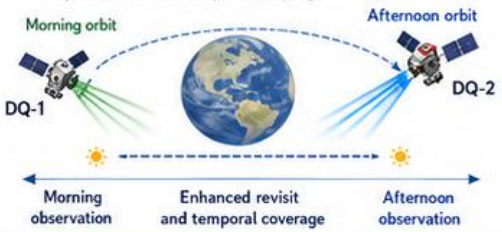


Observation modes
- Active observation: ACDL lidar
- Passive nadir observation: GHG monitor, CAPC, EMI-NL
- Passive limb observation: EMI-NL
- Passive IR sounding: IR hyperspectral sounder

5 Mission highlights and application domains

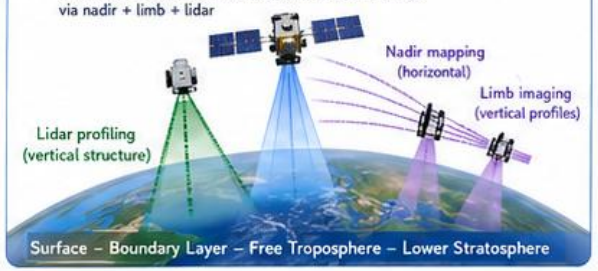
A Constellation value with DQ-1

Morning–afternoon coordinated orbits improve revisit and temporal sampling



B 3D atmospheric composition capability

Simultaneous horizontal mapping and vertical profiling via nadir + limb + lidar



C Expected application domains

- Carbon monitoring
- Emission source attribution
- Air-quality assessment
- Aerosol–cloud–climate studies
- Climate / chemistry model support
- Environmental operational services

D Early-mission value and advantages

- Active–passive integrated greenhouse-gas observation
- Simultaneous nadir and limb imaging via EMI-NL
- Coordinated greenhouse gases, pollutant gases, aerosols and clouds
- First Chinese spaceborne FTIR instrument for atmospheric pollutant and greenhouse-gas sounding
- DQ-1 + DQ-2 constellation improves temporal coverage
- Supports environmental, climate and carbon applications

Compiled from official mission and institute releases (2026): CAS / AIOFM / SITP / related mission announcements.

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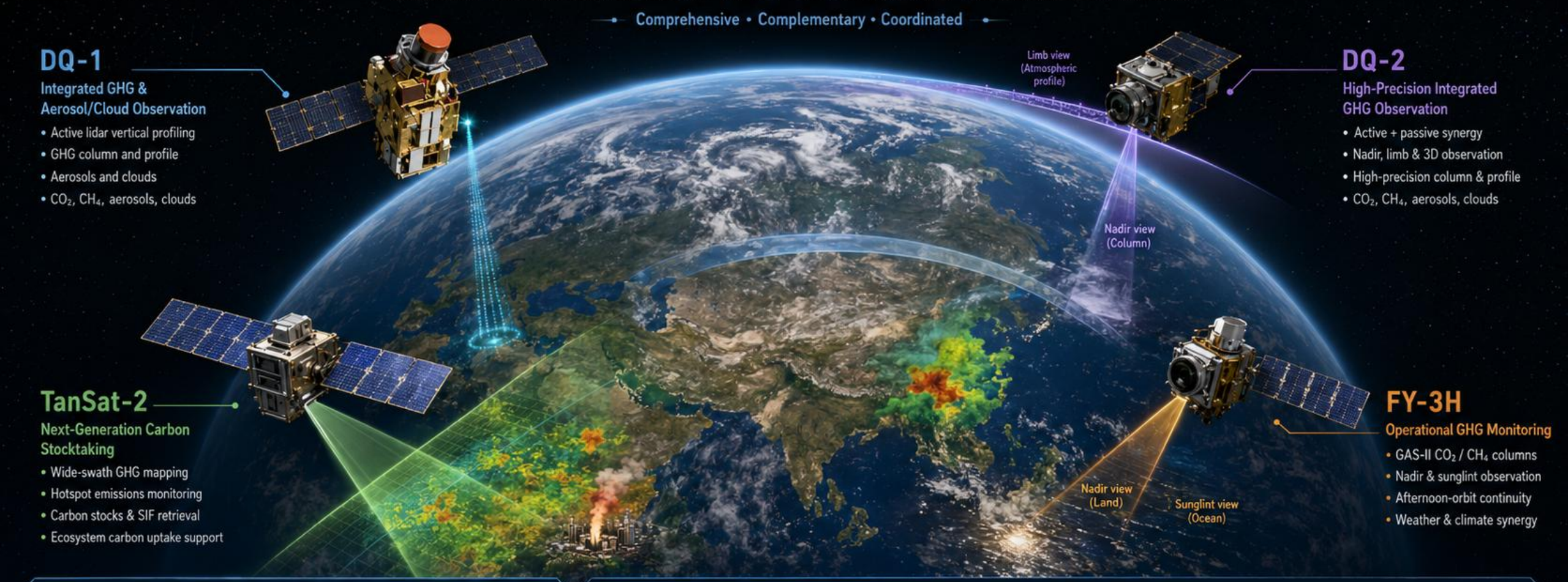

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Research	Research	Research	Operational
High vertical sensitivity	Precision & 3D composition	Wide coverage & ecosystems	Continuity & services

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FY3-H meteorological satellite (2025-)

1 Satellite and mission overview

Afternoon-orbit FengYun platform for refined global greenhouse-gas observation

- **Name:** FY-3H (FengYun-3H)
- **Series role:** 8th flight unit of the FY-3 series
- **Launch date:** 27 September 2025
- **Orbit:** Sun-synchronous orbit
- **Altitude:** 836 km
- **Equator crossing time:** 14:00 ascending node
- **Mission role:** operational meteorology with refined global greenhouse-gas monitoring
- **Status:** commissioning / in-orbit testing
- **Planned service life:** to at least 2033

2 Major greenhouse-gas related payloads

GAS-II
Greenhouse-gases Absorption Spectrometer-II

- Primary FY-3H greenhouse-gas payload
- Measures total columns of CO_2, CH_4, CO and N_2O
- Four NIR/SWIR bands
- Spatial resolution: 3 km
- Swath width: 100 km
- Observation modes: nadir and sunglint
- Wide-band high spectral resolution for greenhouse-gas retrieval

Four spectral bands (μm)

0.75–0.77	1.56–1.72	1.92–2.08	2.20–2.38

MERSI-III
Medium Resolution Spectral Imager-III

- 205 channels
- 250 m / 1 km resolution
- 2800 km swath
- Cloud mask, surface and scene context
- Supports greenhouse-gas retrieval screening and atmospheric correction

HIRAS-II
Hyperspectral Infrared Atmospheric Sounder-II

- 3053 channels
- 14 km resolution
- 2300 km swath
- Temperature and humidity sounding
- Provides atmospheric-state support for greenhouse-gas analysis

GNOS-II
GNSS Radio Occultation Sounder-II

- Radio occultation profile support
- Pressure, temperature and humidity structure
- Improves prior information and validation support

Target–payload relationships

Greenhouse-gas columns	→ GAS-II
Cloud / surface screening	→ MERSI-III
Atmospheric state support	→ HIRAS-II + GNOS-II
Mission continuity	→ FY-3D + FY-3H

3 Data and product chain

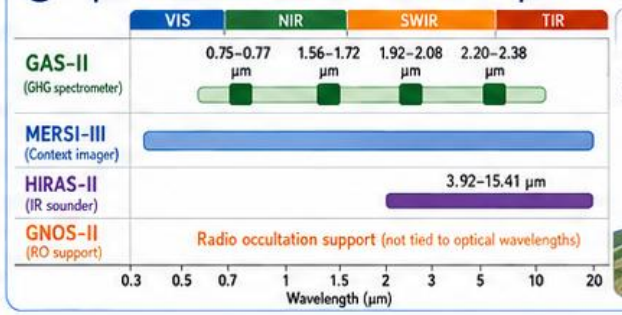
L0/L1 Raw observations:
- Hyperspectral NIR/SWIR radiance
- Nadir and sunglint geometry
- Calibration information
- Cloud / scene imagery
- Atmospheric sounding observations

L2 Retrieved products:
- XCO_2
- XCH_4
- XCO
- N_2O / trace-gas potential
- Cloud mask and quality flags
- Temperature / humidity support fields

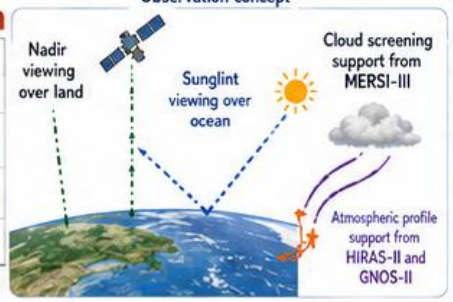
L3 Integrated products:
- Global greenhouse-gas maps
- Regional composites
- Carbon-cycle and climate datasets
- Cross-mission FY-3D / FY-3H continuity products

Mission phase
- In-orbit testing and calibration
- Validation and product-chain establishment
- Early public service preparation
- Future operational greenhouse-gas data services

4 Spectral domains and observation concept



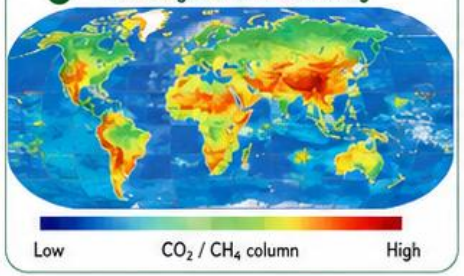
Observation concept



Observation modes
- Passive nadir GHG spectroscopy
- Sunglint ocean observation
- Broad context imaging
- Infrared sounding / profile support

5 Mission highlights and application domains

A Refined global GHG monitoring



Afternoon-orbit global greenhouse-gas monitoring for land and ocean scenes.

CO_2 / CH_4

B Land–ocean observing strategy

Nadir and sunglint observations deliver improved coverage and sensitivity over both land and ocean surfaces.

C Carbon cycle and emission applications

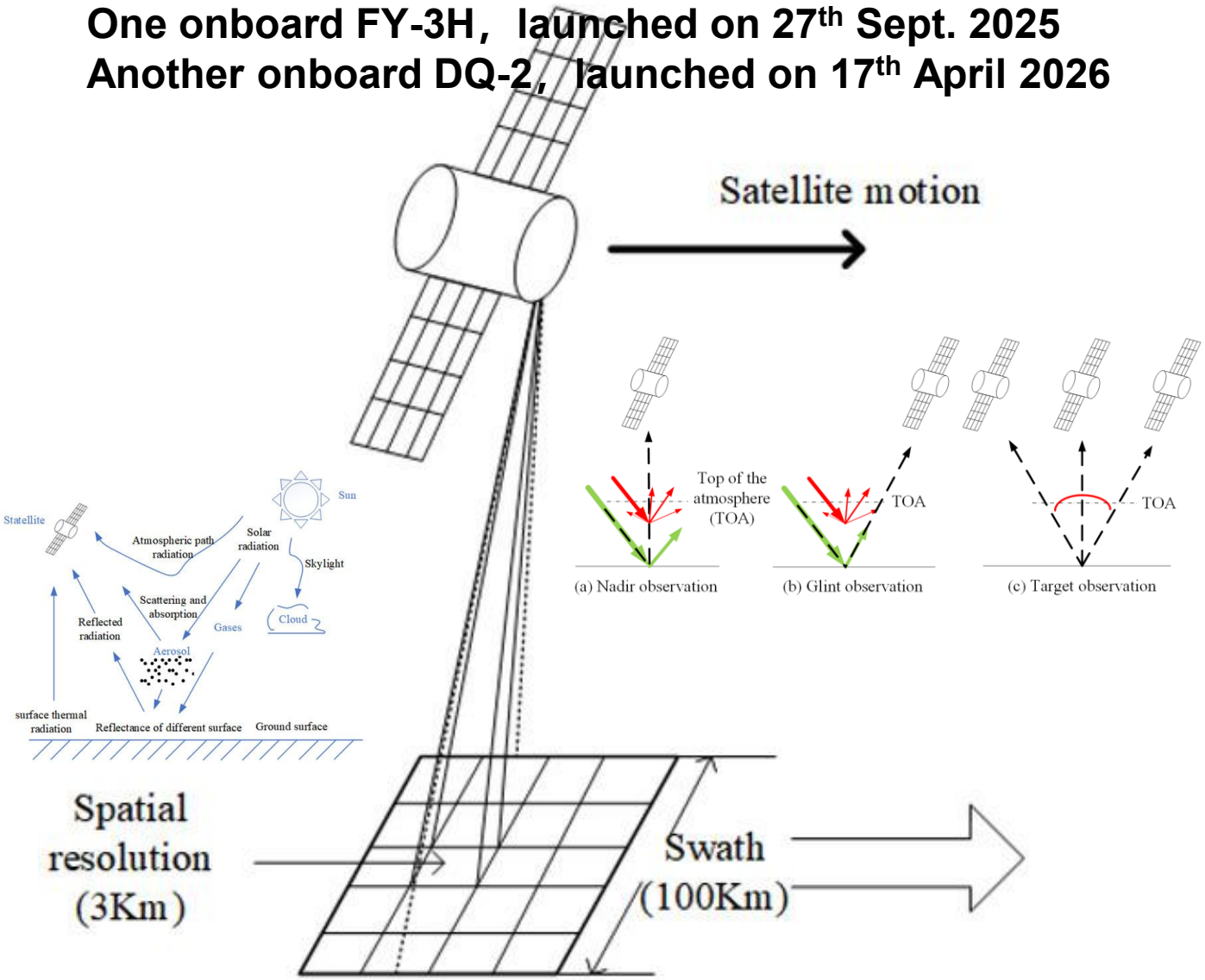
Supports carbon-cycle studies, source–sink analysis, and greenhouse-gas trend monitoring.

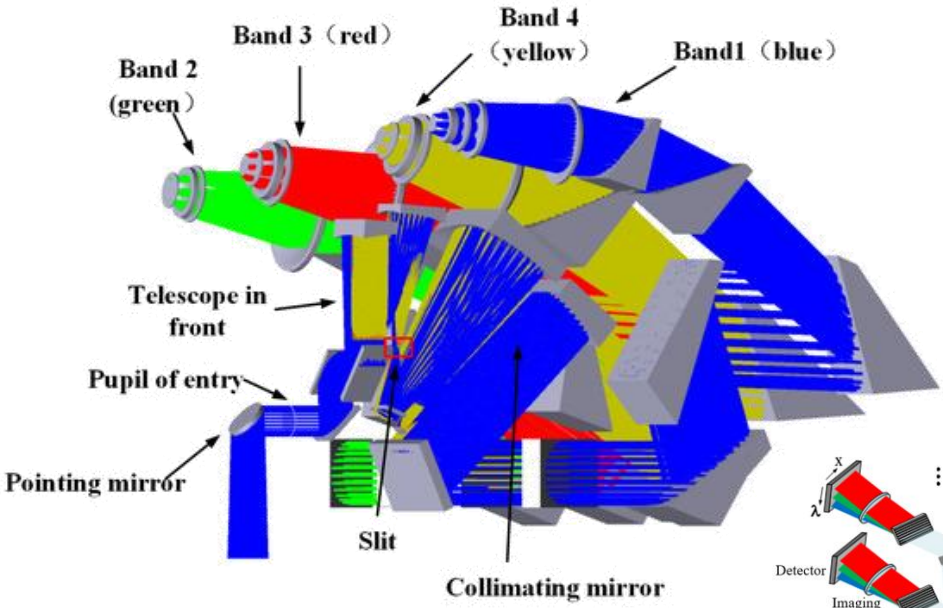
D Early mission value and advantages
- Strengthens FY-3 greenhouse-gas capability
- Continues afternoon-orbit GHG observation after FY-3D
- 3 km greenhouse-gas measurements with 100 km swath
- Integrated support from MERSI-III, HIRAS-II and GNOS-II
- *Useful for climate, carbon and environmental services*

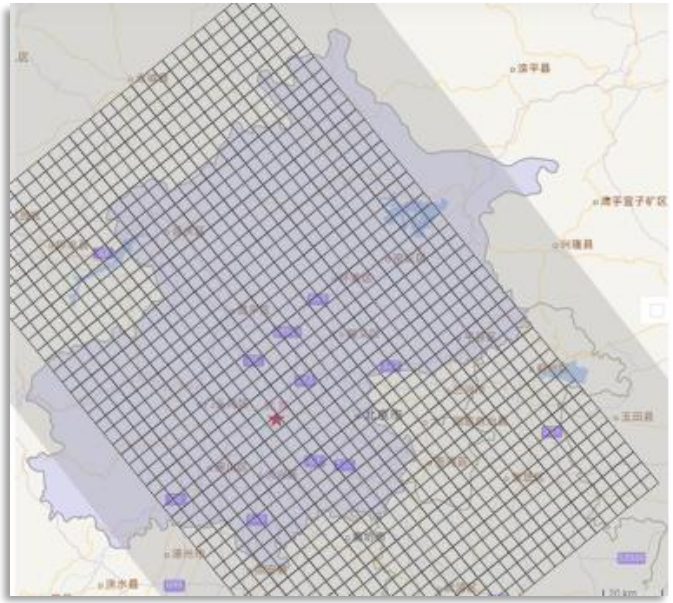
Compiled from FY-3H / GAS-II official mission and instrument information.

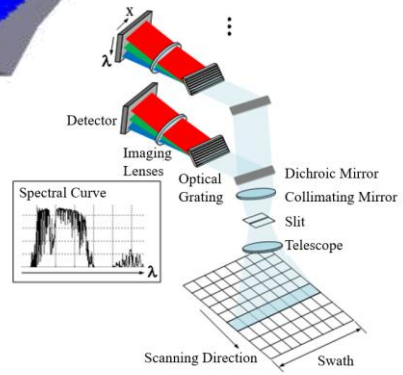
FY3: Greenhouse-Gases Absorption Spectrometer-2

One onboard FY-3H，launched on 27th Sept. 2025
Another onboard DQ-2，launched on 17th April 2026









- **Same instrument (GAS-II) onboard FY3H and DQ-2(The difference is due to the orbital altitude, gray shadow is FY3H) Black grid is DQ-2)**

System Design for GAS

➢ **GAS (Greenhouse-Gases Absorption Spectrometer-2) with large swath**

Technical parameters	Technical specifications			
	Band 1	Band 2	Band 3	Band 4
Central wavelength	0.76μm	1.61μm	2.06μm	2.3μm
Spectral band width	≥15nm	≥30nm	≥40nm	≥50nm
Spectral resolution	0.04nm	0.07nm	0.09nm	0.1nm
Spational resolution	≤3km			
Swath	100km@834km, (field of view angle :7°)			
Wavelength calibration accuracy	Better than Δλ/10			
ILS measurement accuracy	1%			
Absolute calibration accuracy	5%			

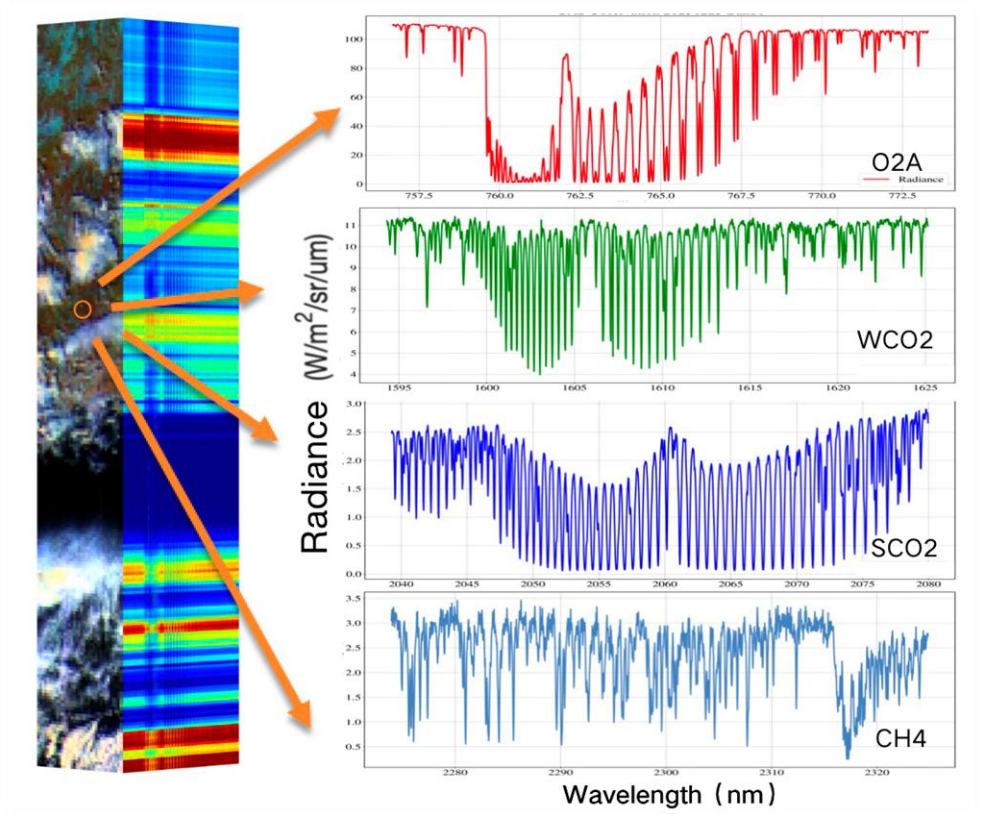
The characteristics of GAS :

- Wide Field of View: The total field of view angle has increased, and the payload size, full-field image quality correction, weight, and development difficulty have significantly increased.
- Observation Capability: 2.3 μm spectral band added for CH_4 monitoring. High spectral resolution with spectral sampling rate better than 3.
- To effectively improve the data inversion accuracy, the polarization sensitivity is less than 2%, and a depolarizer has been added.

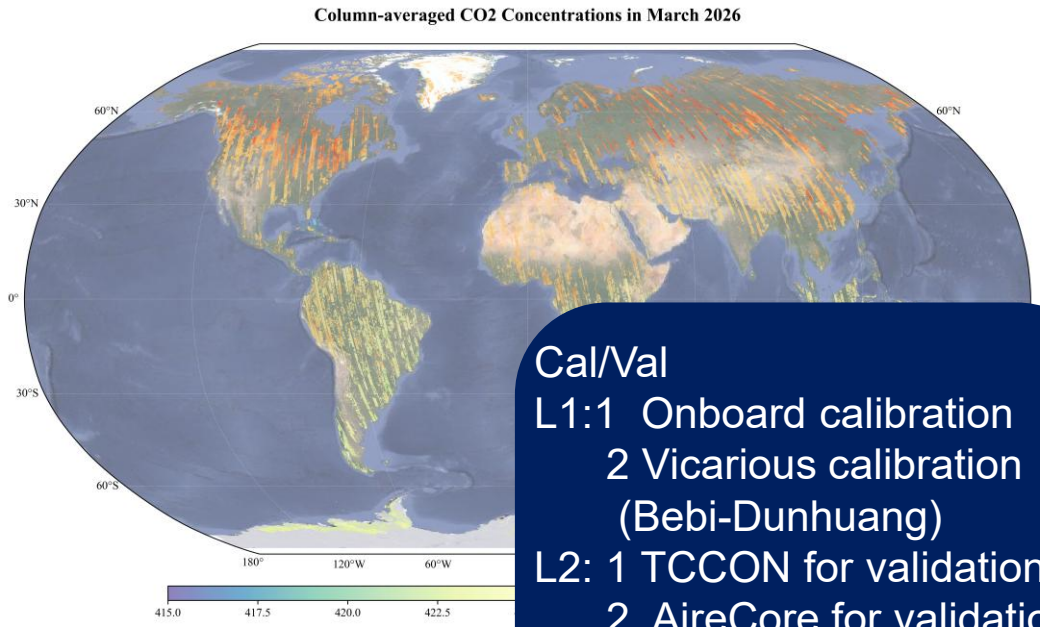
Preliminary results from GAS-II/FY3H

Observation capability is greatly improved, with a shortened coverage cycle and simultaneous CO2、CH4 detection. Its spectral performance is comparable to advanced international payloads.

GAS-II onboard FY3H spectrum



Primary Result



Cal/Val
L1:1 Onboard calibration
2 Vicarious calibration (Bebi-Dunhuang)
L2: 1 TCCON for validation
2 AireCore for validation
3 Groundbased Lidar for validation
4 Inter-validation with DQ-1/DQ-2 Lidar

CHINA'S GREENHOUSE-GAS OBSERVING CONSTELLATION

Comprehensive • Complementary • Coordinated

DQ-1

Integrated GHG & Aerosol/Cloud Observation

- Active lidar vertical profiling
- GHG column and profile
- Aerosols and clouds
- CO_2, CH_4, aerosols, clouds

DQ-2

High-Precision Integrated GHG Observation

- Active + passive synergy
- Nadir, limb & 3D observation
- High-precision column & profile
- CO_2, CH_4, aerosols, clouds

TanSat-2

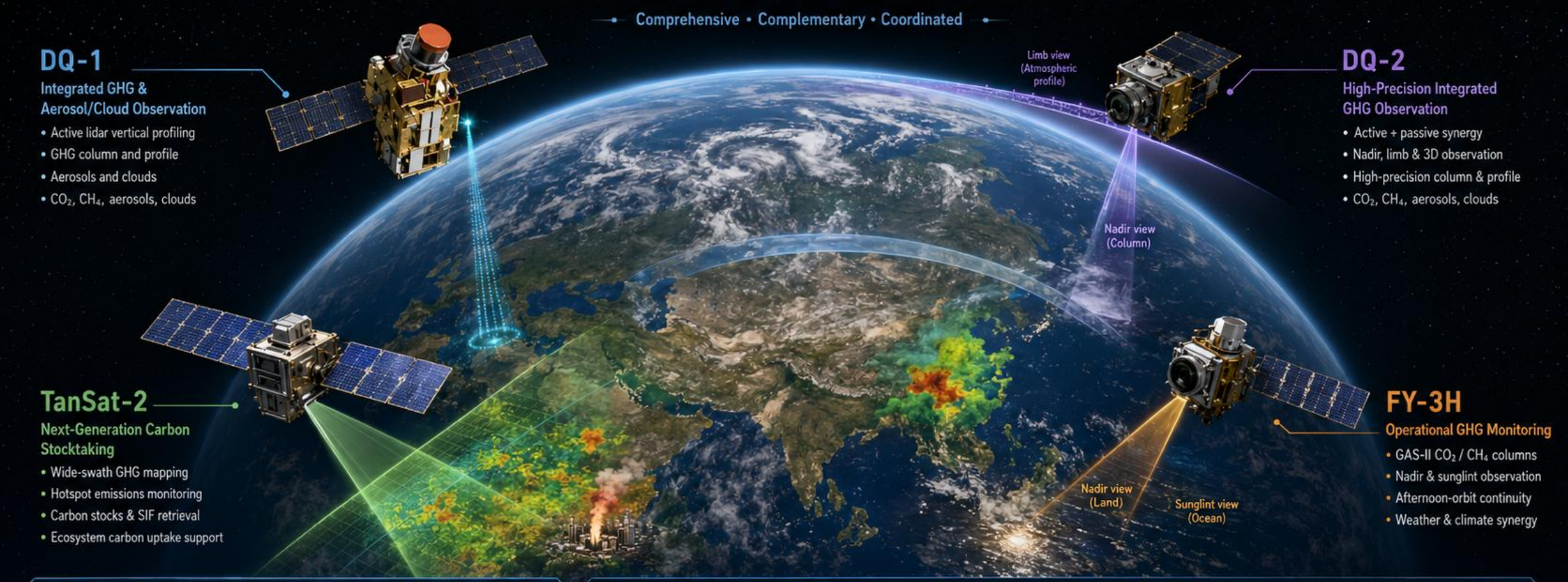
Next-Generation Carbon Stocktaking

- Wide-swath GHG mapping
- Hotspot emissions monitoring
- Carbon stocks & SIF retrieval
- Ecosystem carbon uptake support

FY-3H

Operational GHG Monitoring

- GAS-II CO_2 / CH_4 columns
- Nadir & sunglint observation
- Afternoon-orbit continuity
- Weather & climate synergy



JOINT GREENHOUSE-GAS OBSERVATION VALUE

1. Global CO_2 / CH_4 monitoring
2. Carbon source-sink assessment
3. Point-source and hotspot emission detection
4. Aerosol / cloud correction & atmospheric profile support
5. Improved temporal coverage, cross-validation, and multi-scale synergy

COMPLEMENTARY CONSTELLATION

DQ-1	DQ-2	TanSat-2	FY-3H
Active lidar + Aerosol/Cloud + GHG profile	Active + Passive Nadir / Limb / 3D High precision	Wide-swath mapping Hotspot monitoring SIF / Carbon uptake	Operational monitoring Nadir + Sunglint Afternoon-orbit
Research High vertical sensitivity	**Research** Precision & 3D composition	**Research** Wide coverage & ecosystems	**Operational** Continuity & services

= **Multi-Mission Carbon Observing Constellation**

Active + Passive
Wide-swath + Hotspot
Research + Operational

Global coverage | Multi-scale synergy | Cross-calibration & validation | Science & applications for climate, environment and society

CHINA'S GREENHOUSE-GAS OBSERVING CONSTELLATION

Comprehensive • Complementary • Coordinated

DQ-1

Integrated GHG & Aerosol/Cloud Observation

- Active lidar vertical profiling
- GHG column and profile
- Aerosols and clouds
- CO_2, CH_4, aerosols, clouds.

DQ-2

High-Precision Integrated GHG Observation

- Active + passive synergy
- Nadir, limb & 3D observation
- High-precision column & profile
- CO_2, CH_4, aerosols, clouds

Limb view (temperature profile)

Nadir view (Ice/land)

TanSat-2

Next-Generation Carbon Stocktaking

- Wide-swath GHG mapping
- Hotspot emission monitoring
- Carbon stocks & SE retrieval
- Ecosystem carbon uptake support

FY-3H

Operational GHG Monitoring

- GAS (CO_2) + CH_4 columns
- Nadir & sunlight observation
- Afternoon-orbit continuity
- Weather & climate synergy

Nadir view (Land)

Sunlit view (Ocean)

JOINT GREENHOUSE-GAS OBSERVATION VALUE

1. Global CO_2 / CH_4 monitoring
2. Carbon source-sink assessment
3. Point-source and hotspot emission detection
4. Aerosol / cloud correction & atmospheric profile support
5. Improved temporal coverage, cross-satellite and multi-scale synergy

COMPLEMENTARY CONSTELLATION

DQ-1	DQ-2	TanSat-2	FY-3H
Active lidar + aerosol/cloud + GHG profile	Active + Passive Nadir / Limb / 3D High precision	Wide-swath mapping Hotspot monitoring SE / carbon uptake	Operational monitoring Nadir + Sunlit Afternoon orbit
Research High vertical sensitivity	Research Precision & 3D composition	Research Wide coverage & ecosystems	Operational Continuity & services

= Multi-Mission Carbon Observing Constellation

Active + Passive
Wide-swath + Hotspot
Research + Operational

Global coverage | Multi-scale synergy | Cross-calibration & validation | Science & applications for climate, environment and society

Generated by ChatGPT for illustrative purposes; satellite images and labels may be inaccurate.

TanSat-2 next generation GHG satellite mission

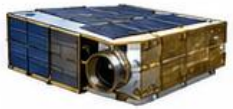
1 Satellite and mission overview

Designed for wide-swath, high-frequency carbon monitoring from space

- **Name:** TanSat-2 (next-generation Chinese carbon-monitoring satellite)
- **Mission goal:** global carbon stocktaking and verification
- **Mission concept:** multi-scale monitoring of greenhouse gases, NO_2, aerosols/clouds and vegetation fluorescence
- **Orbit concept:** critically inclined sun-synchronous orbit, *inclination about 116.6°*
- **Orbit altitude:** about *7000 km*
- **Coverage:** near-daily global baseline coverage, especially strong over the Northern Hemisphere
- **Mission-scale capability:** wide-swath observations with kilometer-scale sampling
- **Status:** next-generation planned mission / concept stage

2 Major payloads

Uwhigo
Ultra-wide-swath hyperspectral imager for co-monitoring GHG and NO_2.



- Large-area baseline mapping
- Monitors greenhouse gases and NO_2
- 1500 km swath
- ~4 km resolution

H3imager
High-resolution hyperspectral imager for hotspot emissions.

- Localized hotspot and point-source monitoring
- Urban and industrial plumes
- 50 km swath
- 500 m resolution

CAPHI
Cloud and aerosol polarization hyperspectral imager.

- Multi-angle aerosol/cloud properties
- Atmospheric correction support
- Improves GHG retrieval accuracy

DuSIFIS
Dual-band SIF imaging spectrometer.

- Red and far-red solar-induced chlorophyll fluorescence
- Vegetation photosynthesis and terrestrial carbon uptake

Target–payload relationships

GHG baseline mapping	→	Uwhigo
Hotspot emissions	→	H3imager
Aerosols / clouds	→	CAPHI
Carbon uptake / SIF	→	DuSIFIS
Anthropogenic attribution (NO_2 + GHG synergy)	→	Uwhigo + H3imager

3 Data and product chain

L0/L1 Raw observations

Hyperspectral radiance, polarization, geometry, calibration data.

L2 Retrieved products

XCO_2, XCH_4, NO_2 columns, SIF, aerosol optical depth, cloud properties.

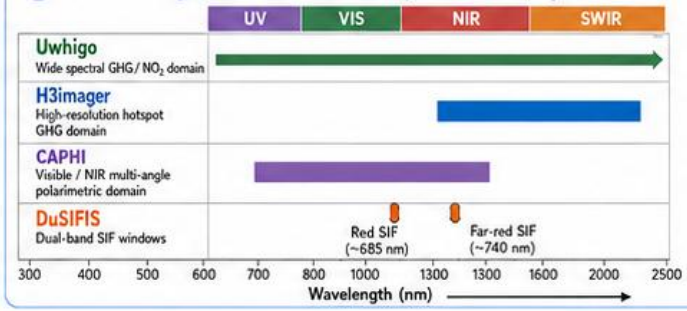
L3 Integrated products

Global greenhouse-gas maps, urban hotspot products, carbon stocktake layers, ecosystem photosynthesis indicators, inversion-ready datasets.

Mission design targets

- ✓ Effective mission coverage: ~2900 km
- ✓ Mission-scale spatial sampling: ~2 km
- ✓ Near-daily global coverage
- ✓ Multi-scale baseline + hotspot observing concept

4 Observing architecture and spectral concept



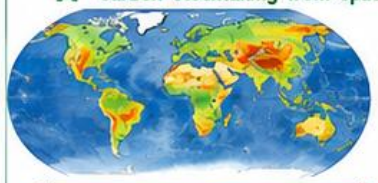
Critically inclined sun-synchronous orbit
Inclination ~116.6°
Altitude ~7000 km

Observation modes

- Wide-swath baseline mapping
- High-resolution hotspot sensing
- Aerosol / cloud correction
- Dual-band vegetation fluorescence mapping

5 Mission highlights and application domains

A Carbon stocktaking from space

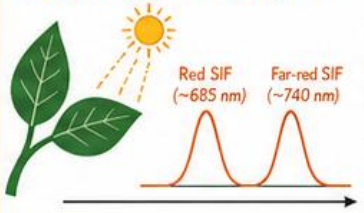


Supports regional to national greenhouse-gas assessment.

B Anthropogenic emission attribution

Combines GHG and NO_2 for point-source and urban plume interpretation.

C Ecosystem carbon uptake



Dual-band SIF constrains photosynthesis and terrestrial carbon uptake.

D Expected value and advantages

- ✓ Successor to the original TanSat mission
- ✓ Wide swath + fine sampling + high revisit
- ✓ Multi-scale baseline and hotspot observations
- ✓ Joint monitoring of GHGs, NO_2, aerosols/clouds and SIF
- ✓ Supports emission verification, flux inversion, climate and policy applications

Compiled from published mission concept studies and open scientific literature on TanSat-2.

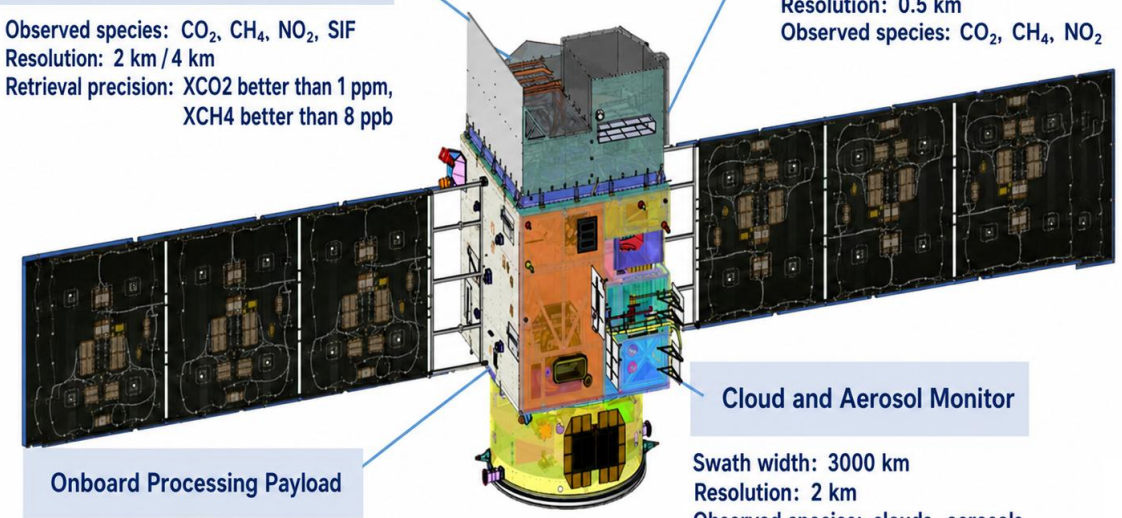
Satellite design

Ultra-Wide-Swath Carbon–Pollution Synergistic Monitor Infrared & Visible Channels

Observed species: CO_2, CH_4, NO_2, SIF
Resolution: 2 km / 4 km
Retrieval precision: XCO2 better than 1 ppm, XCH4 better than 8 ppb

High-Resolution Hotspot Greenhouse Gas Emissions Monitor

Swath width: 50 km
Resolution: 0.5 km
Observed species: CO_2, CH_4, NO_2

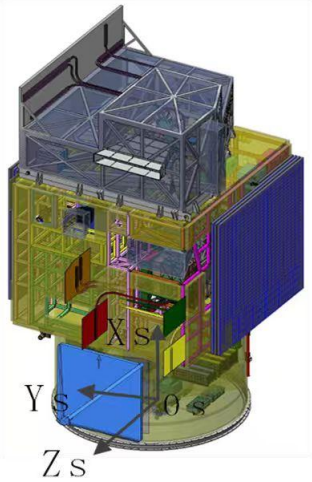


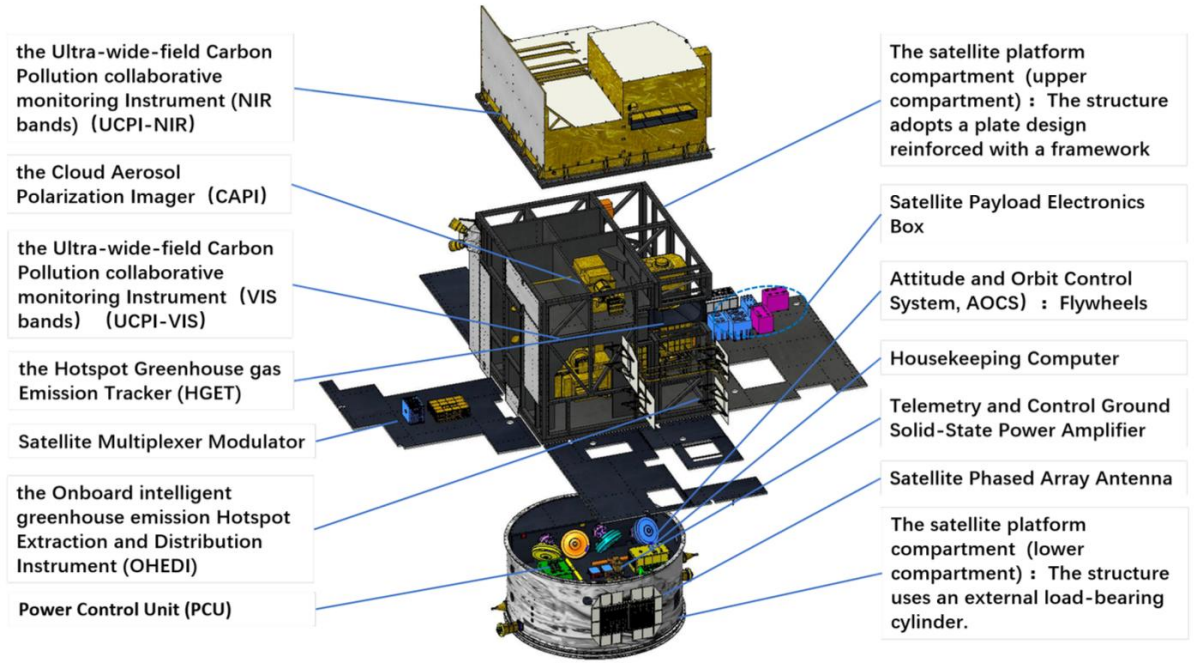
Cloud and Aerosol Monitor

Swath width: 3000 km
Resolution: 2 km
Observed species: clouds, aerosols (AOD, particle size distribution, SSA, scattering phase function)

Onboard Processing Payload

Configuration: FPGA + CPU;
Processing algorithms: supports on-orbit CO_2 and CH_4 retrieval





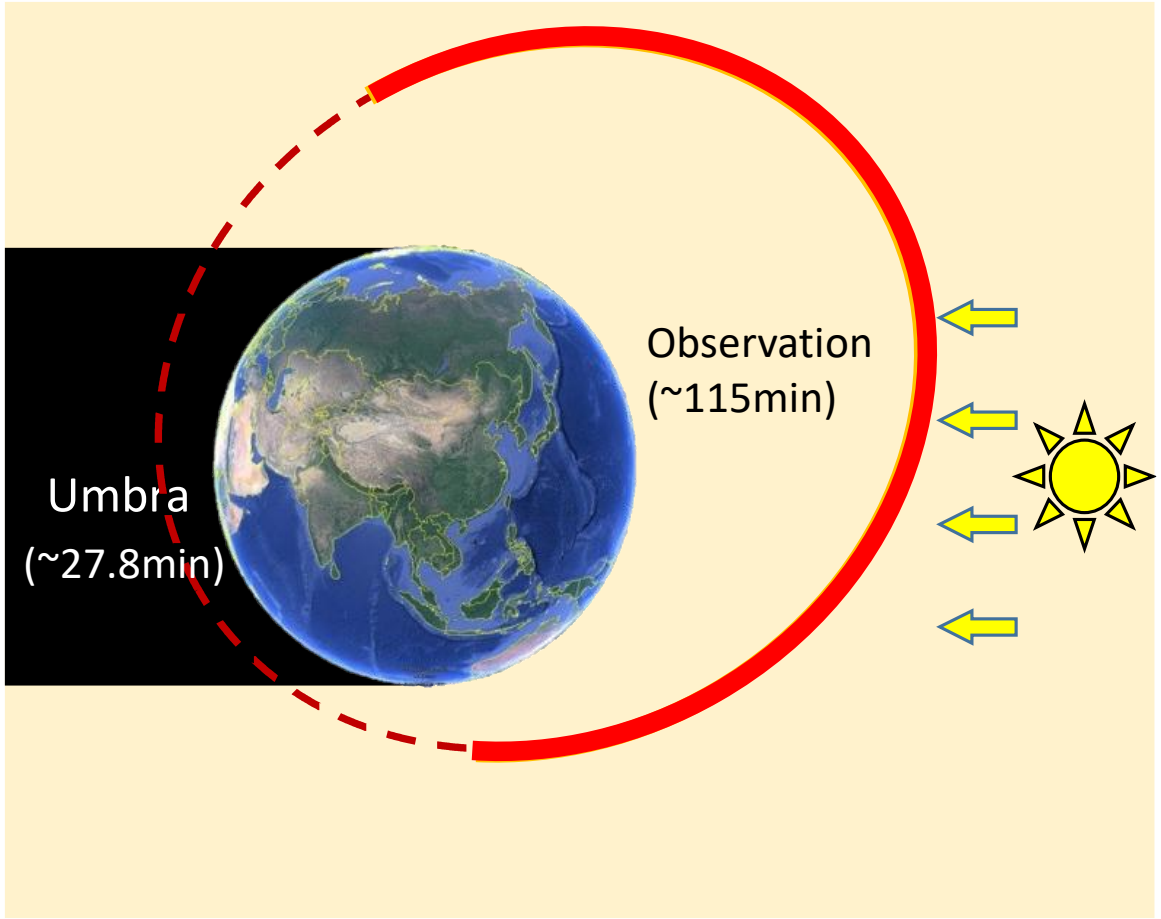
- The satellite has entered the flight-model development phase.
- Key technologies have been achieved, including SWIR detectors, ultra-wide-field optics, high-resolution hotspot monitoring, and MEO radiation-hardening.
- The platform flight-model units have been completed, payload integration is underway, and the factory review is expected in October 2026.

Yin et al., 2026

TanSat orbit

Orbit type：Critically Inclined, Sun Synchronous

Parameters	Value
Perigee altitude	~522km
Apogee altitude	~7840km
Inclination	116.565°
Latitude at Apogee	35°N
Argument of Perigee	210°
Revisit Period	1 day



Band design of TanSat-2 uwhigo

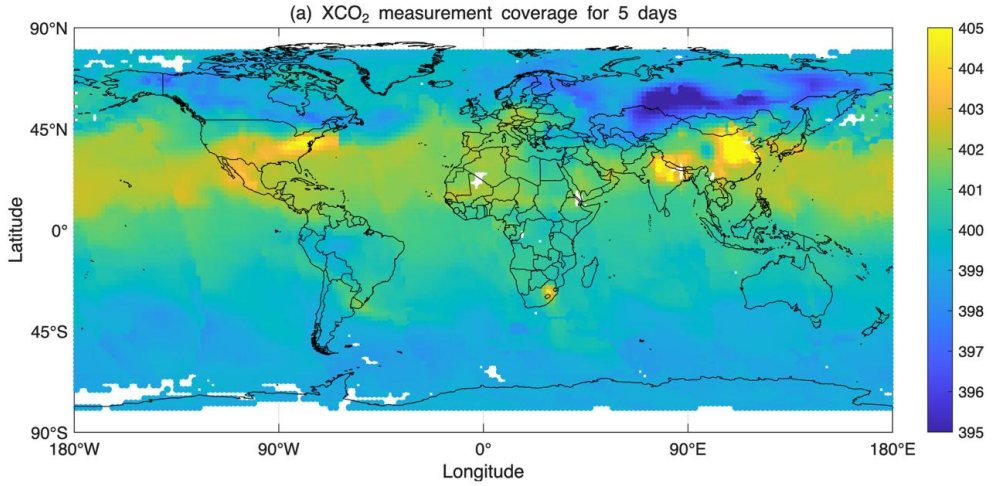
Technical parameters	Technical specifications			
	Band 1	Band 2	Band 3	Band 4
Band	O_2A	Weak-CO_2	CH_4	Strong-CO_2
Central wavelength (μm)	0.76	1.61	1.65	2.06
Spectral resolution (nm)	0.04	0.13	0.13	0.13
SNR	500	400	400	400
Wavelength calibration accuracy	Better than Δλ/10			
Absolute calibration accuracy	4%			
Spational resolution	4km/2km@Spogee 7443km			
field of view angle	10°			

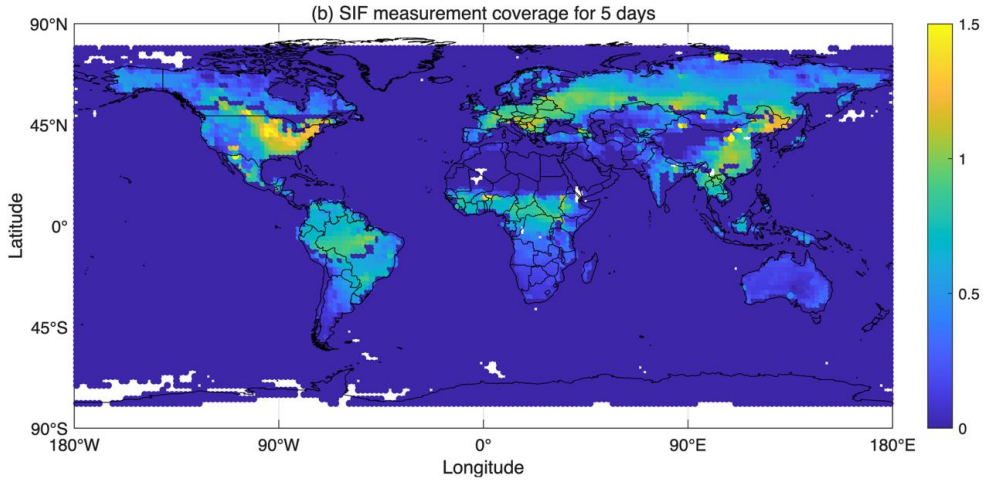
- **Achieving ultra-wide swath, hyperspectral, and high-precision detection has always been an international challenge in the field of optical remote sensing. This project features a spectral resolution of 0.04-0.13 nm, a spatial resolution of 2 km/4 km, and a swath width exceeding 1000 km per single field of view, amaing at the internation level.**
- **The spectral calibration accuracy reaches the picometer level. The project aims to establish a multi-element highly consistent calibration reference system.**

TanSat-2 observaiton simulator

TanSat-2 observaiton simulator

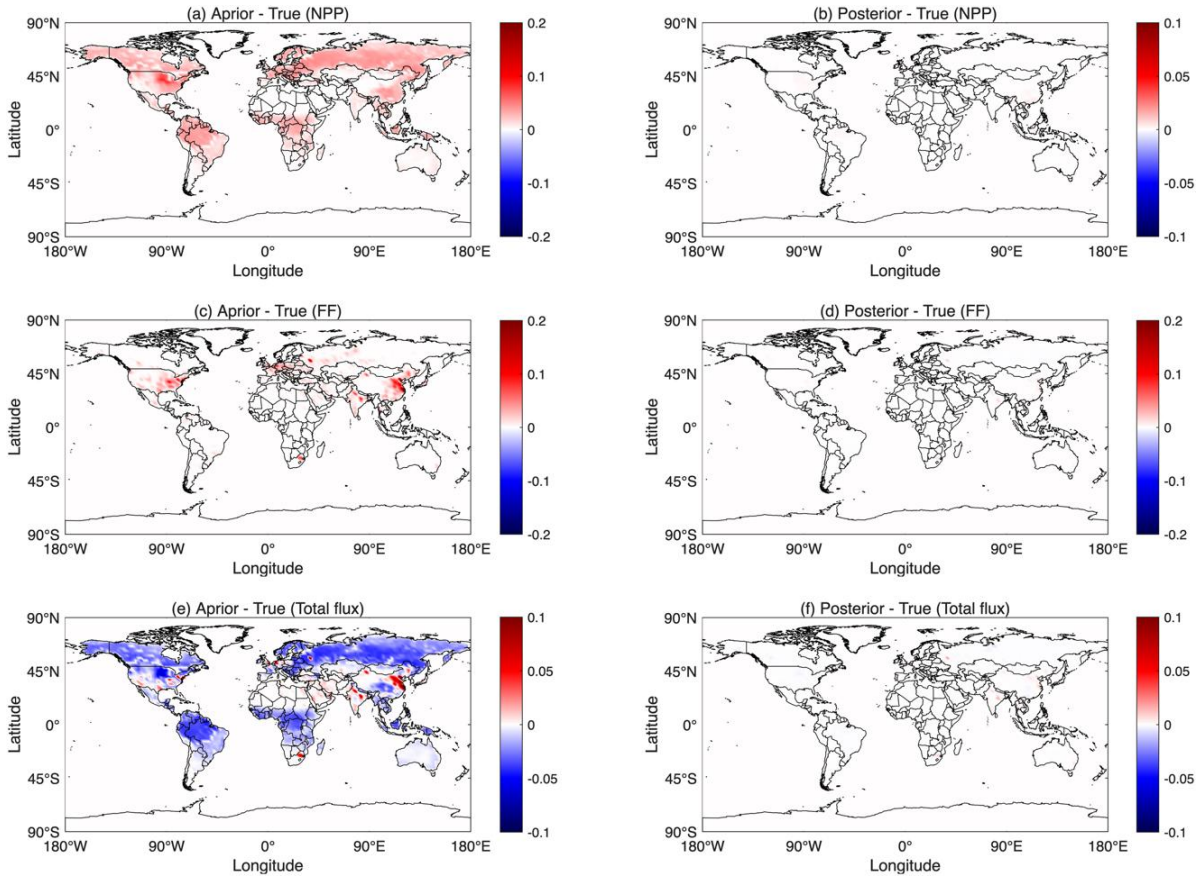
- Footprint geolocation
- Arosol and cloud impact
- XCO2 and SIF meaurments
- Orbit characters adjust
- solar zenith and azimuth
- Noise and bias simulation





The capablity of regional bias correction

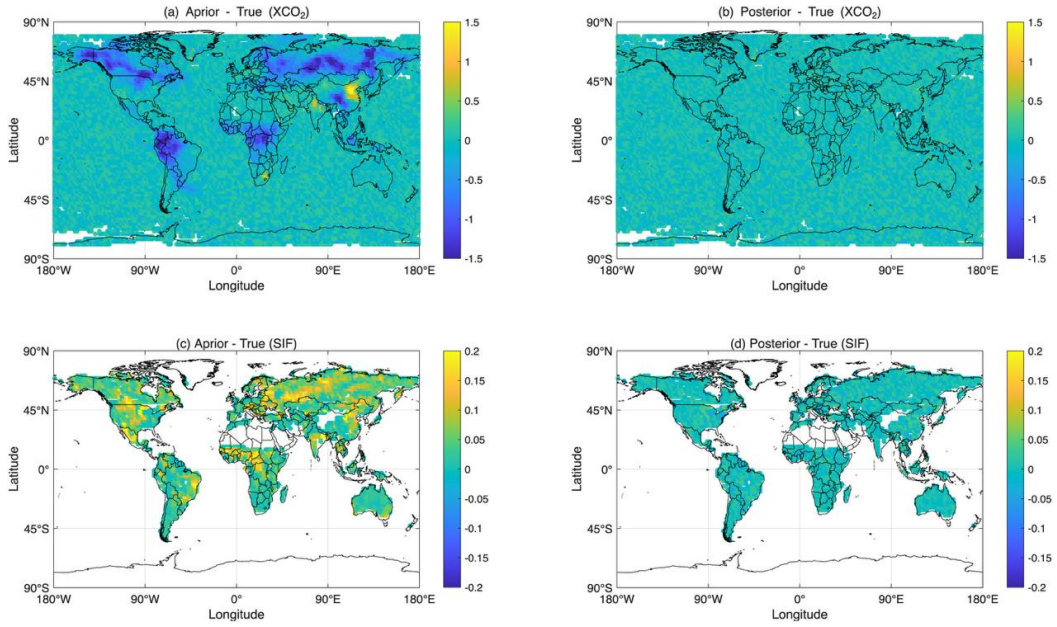
Flux bias corrected after assimilation



Biased a prior

Yang et al., 2025

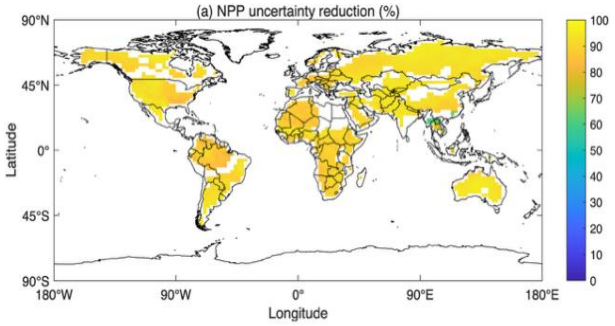
Fitting quality: measurment filed

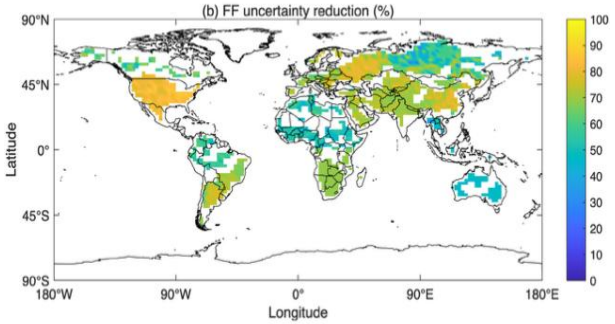


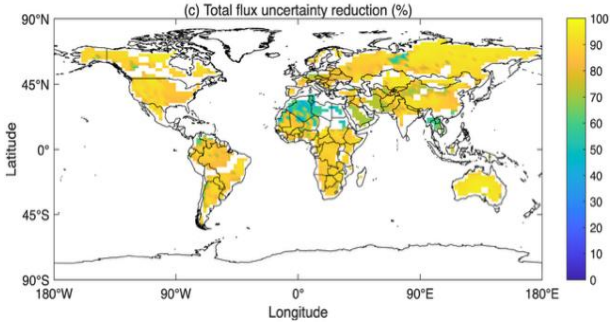
Biased a prior

The truth observation → Biased a prior → optimize a prior

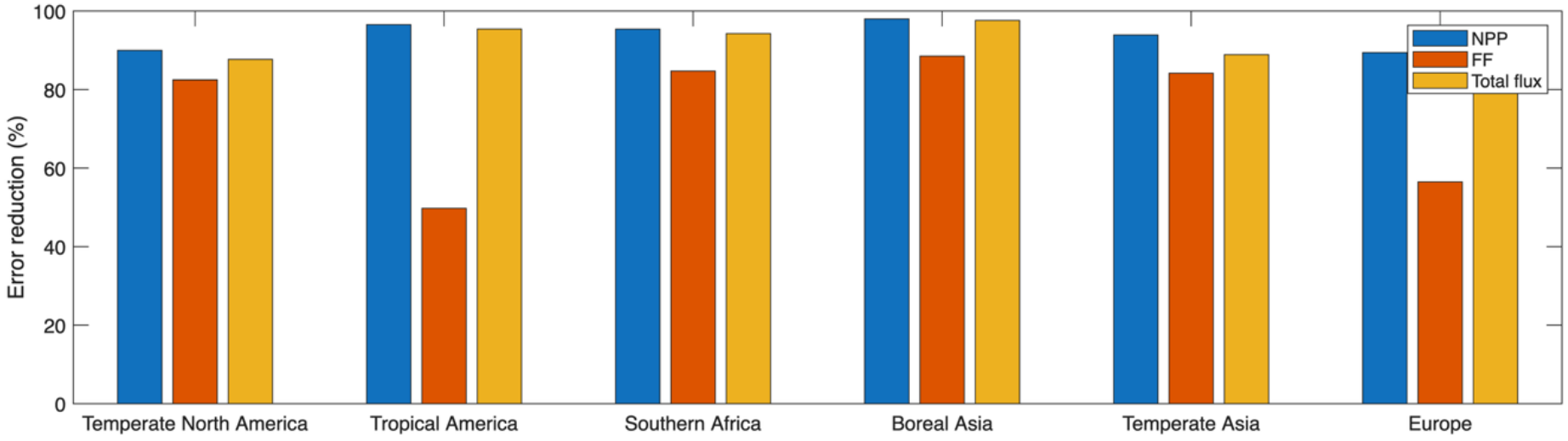
Error reduction over interesting regions

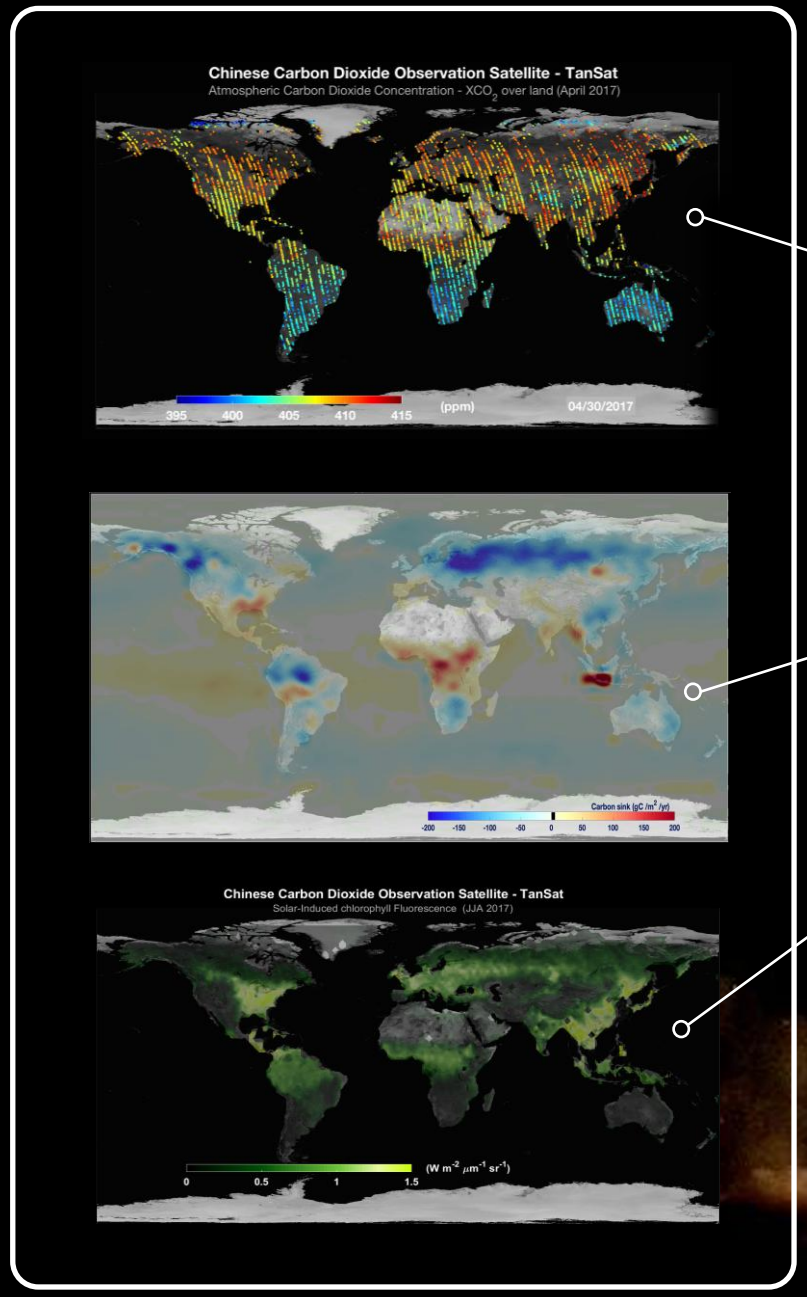






Error reduction over interesting regions





22 Dec. 2016

Thank you!

title