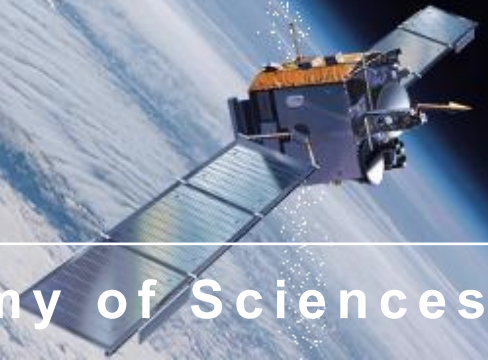




Meteorological Remote Sensing: Industry Service Trends & Practices

Speaker: Gu Mingjian
October 30, 2025





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- 1 Current Status of Fengyun Satellites**
- 2 Meteorological Technology System**
- 3 Industry Service Applications**
- 4 Future Prospects**



Current Status of Fengyun Satellites



1. Background

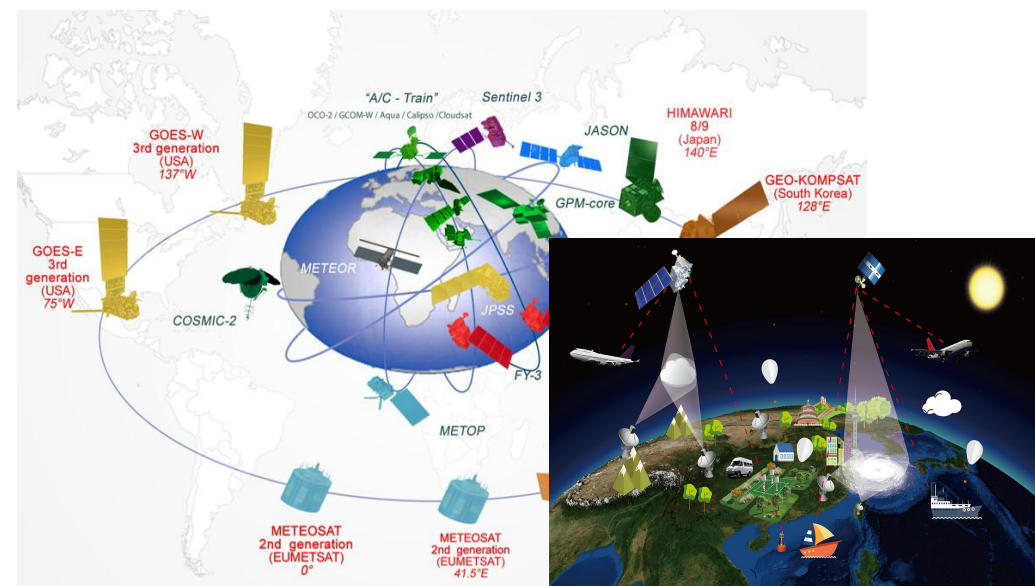


Climate Challenges



- Global **climate** change intensifying
- Extreme weather events increasing

National Strategy



- Build independent, **integrated** space-ground observation system
- Strategic shift from following to leading in remote sensing

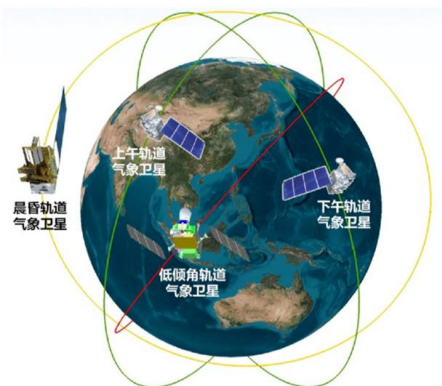
More accurate, timely monitoring and early warning to support the country's carbon neutrality goal, national security, and economic growth.

2. System Architecture & Capabilities

Integrated **active** and passive remote sensing enables multi-resolution nested observation and comprehensive 3D land-sea-air monitoring.

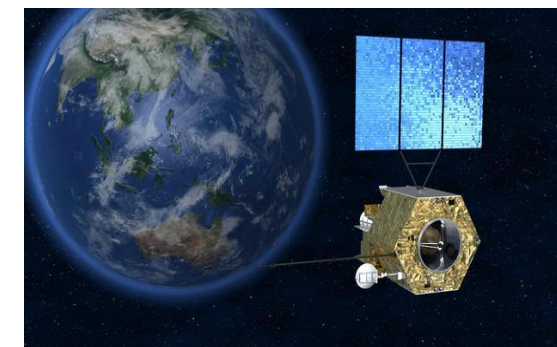
Polar Orbit Series:

- Morning
- Afternoon
- Dusk-Dawn
- Inclined



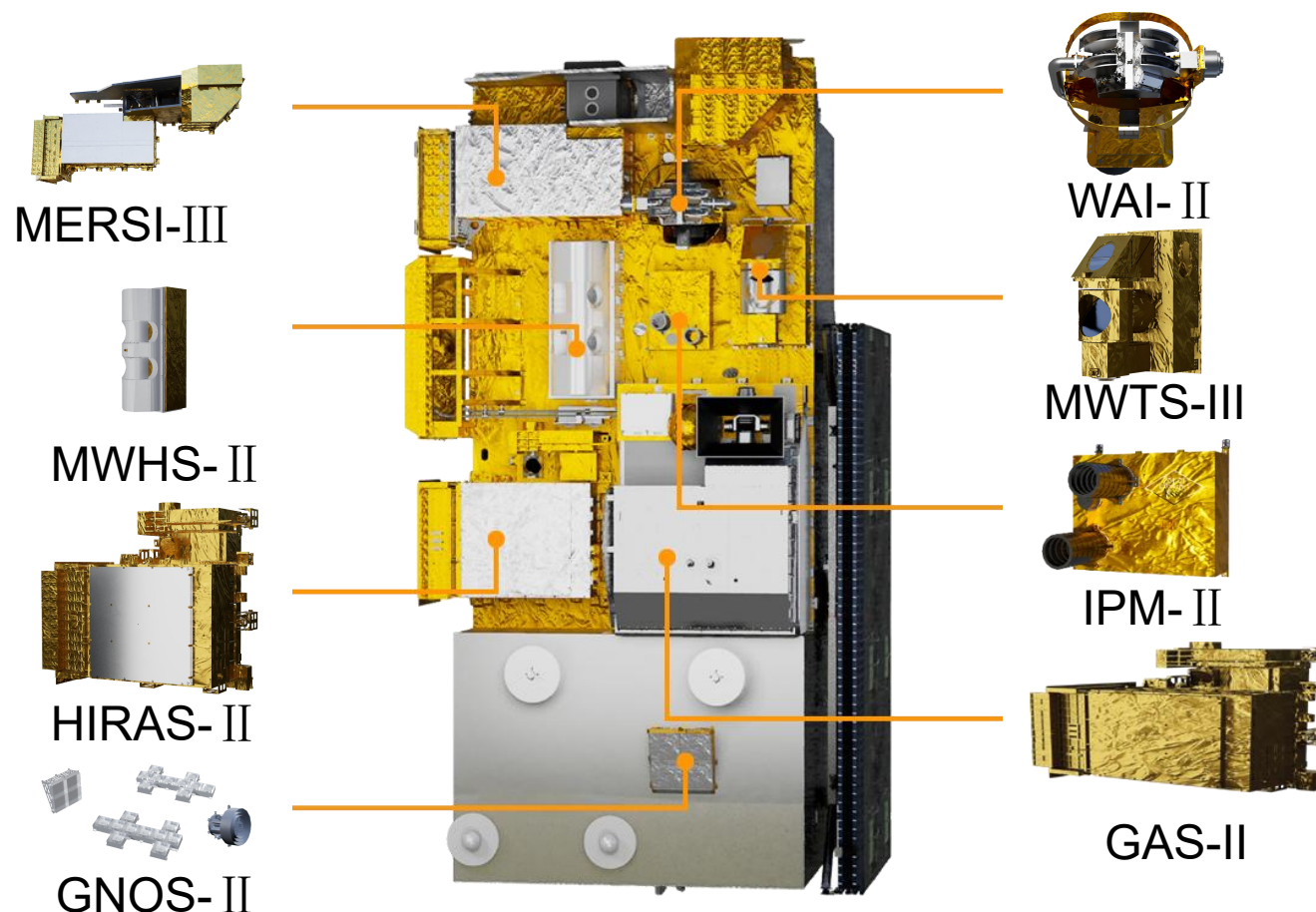
Geostationary Series:

- Strategic East-West deployment



3. Primary Payloads: Geostationary Series

Fengyun polar-orbiting satellites enable multi-orbit collaborative observation, and establish a comprehensive, **high-precision** system for monitoring atmospheric vertical structure and global greenhouse gas concentrations.

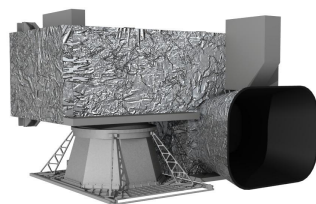
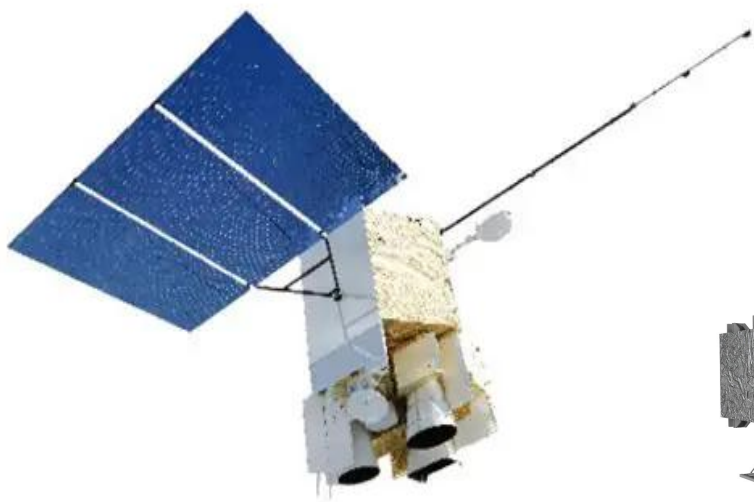




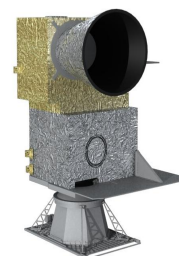
3. Primary Payloads: Geostationary Series



Fengyun **geostationary** satellites provide both global imaging and regional rapid-scan capabilities, establishing a continuous “fixed-point” monitoring system that significantly enhances weather warning and forecasting performance.



**Advanced Geostationary
Radiation Imager(AGRI)**



**Geostationary
Interferometric Infrared
Sounder (GIIRS)**

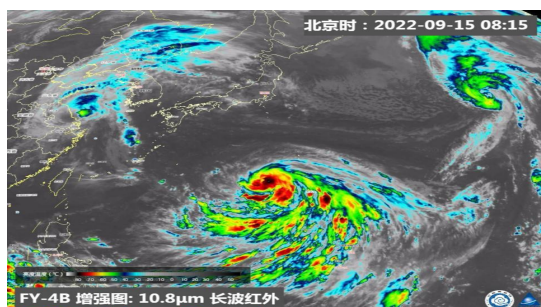


**Lightning Mapping
Imager (LMI)**

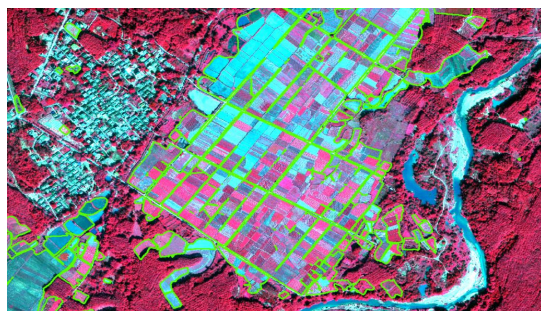
4. Application Services



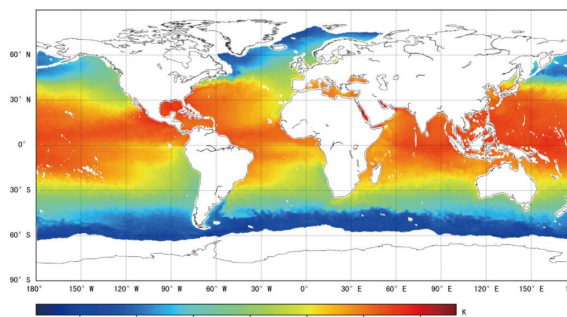
- Weather Monitoring and Forecasting



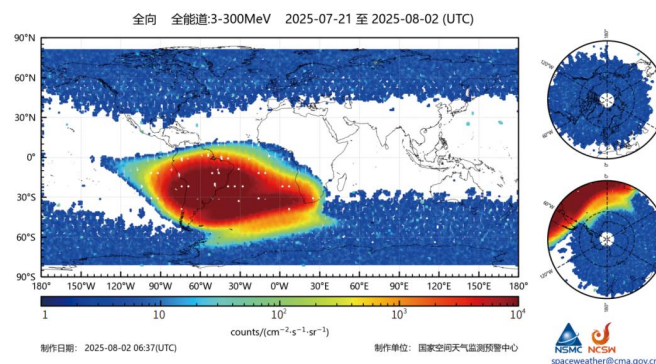
- Meteorological Support for **Ecological** Civilization Construction



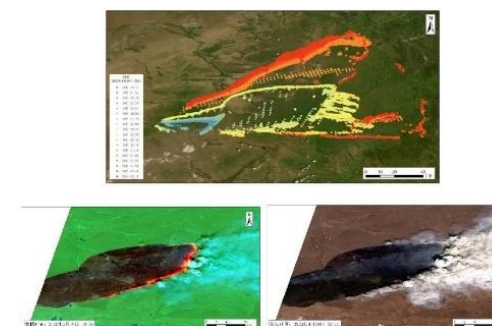
- Climate and Climate Change



- Space **Weather** Monitoring and Forecasting



- **Meteorological** Disaster Prevention and Mitigation



- International Services of Fengyun Meteorological Satellites





Meteorological Technology System

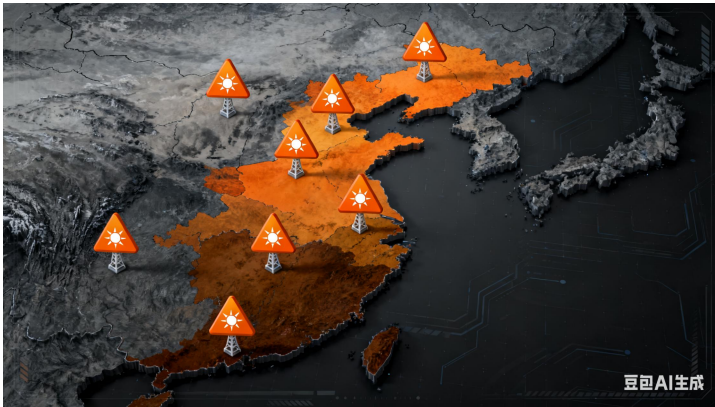


1. Conventional Meteorological Techniques



Conventional meteorological monitoring and early warning typically are constrained by sparse station distribution and discontinuous observations.

Ground Observation & Interpolation



Radiosonde Data Extrapolation Method



Quadrat Survey and Visual Interpretation



Spaceborne remote sensing addresses spatiotemporal continuity gaps, enabling access to atmospheric parameters, 3D temperature-humidity profiles, and vegetation monitoring.

2. High-Resolution Satellite Physical Retrieval



2.1 Quantitative Greenhouse Gas Retrieval

Technology:

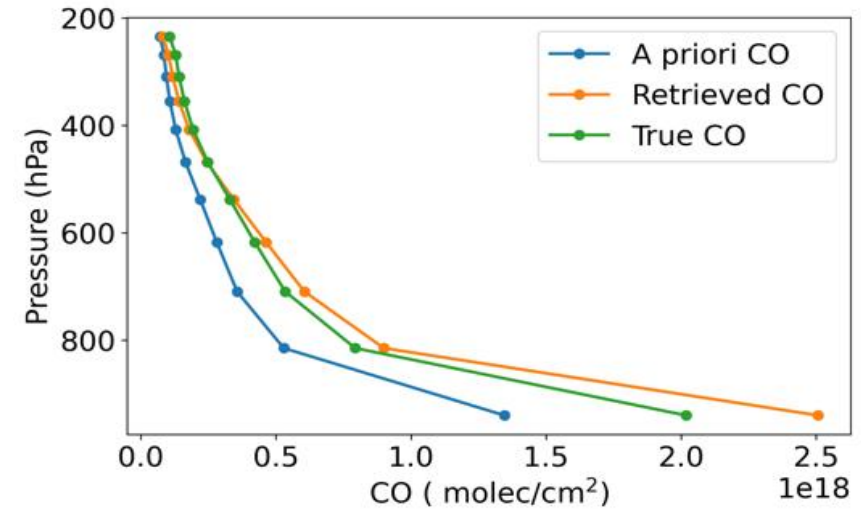
FY-3F/HIRAS-II hyperspectral physical retrieval

Validation:

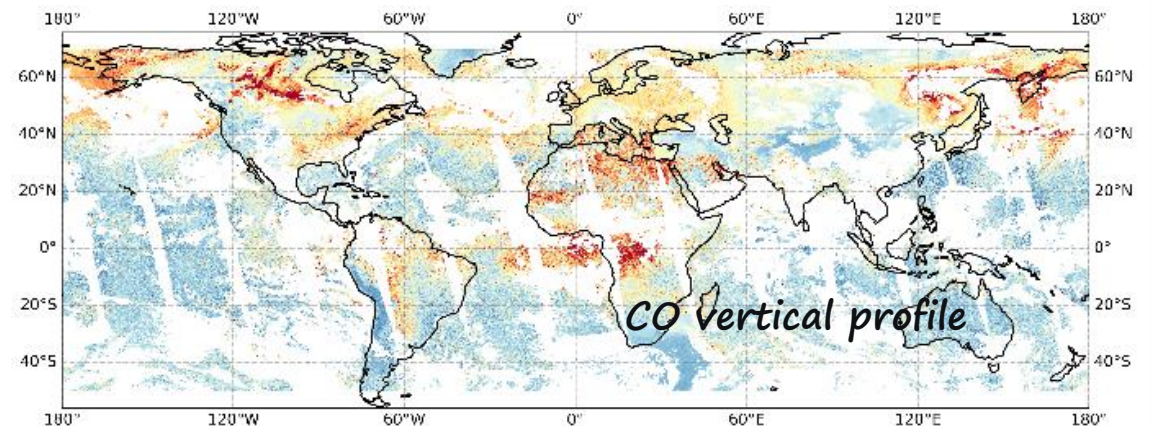
Retrieved CO vertical profile shows closer alignment with actual measurements.

Collaboration:

Joint research with Prof. Zeng Zhaocheng's team at Peking University



CO vertical profile



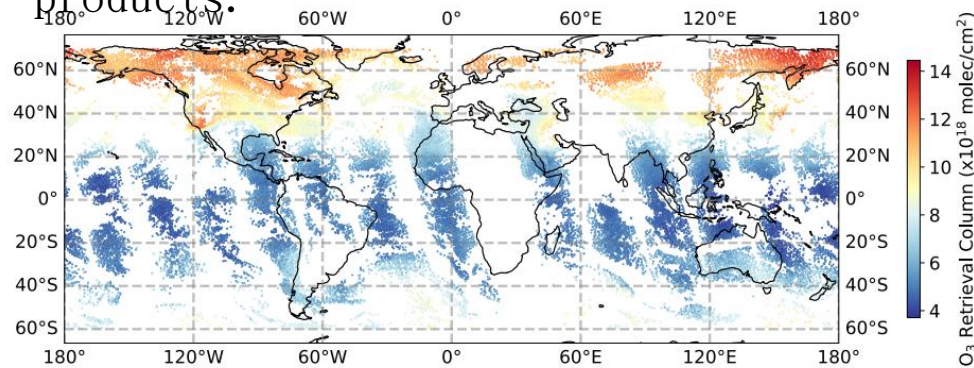
Global CO Column Concentration Distribution

2. High-Resolution Satellite Physical Retrieval

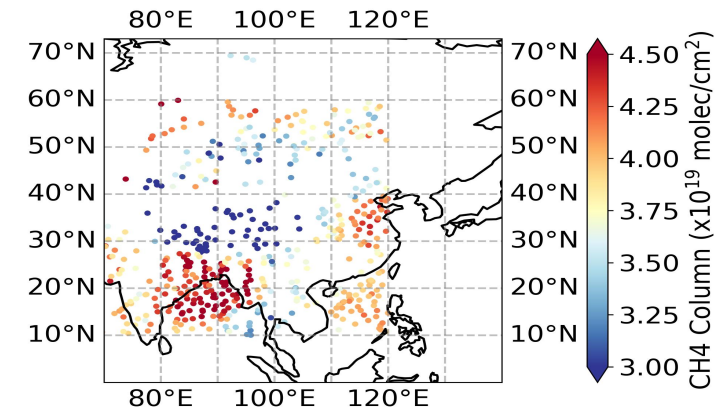


2.2 Retrieval Products

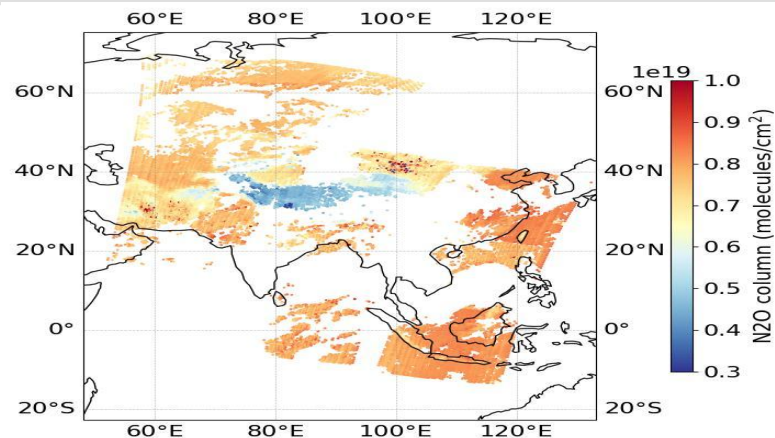
Meanwhile, we can also generate global continuous atmospheric & environmental parameter products.



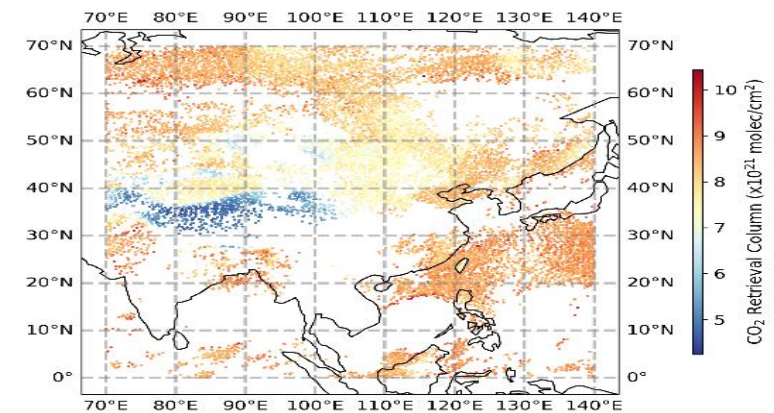
O₃ Column Concentration distributions



CH₄ Column Concentration distributions



N₂O Column Concentration distributions



CO₂ Column Concentration distributions



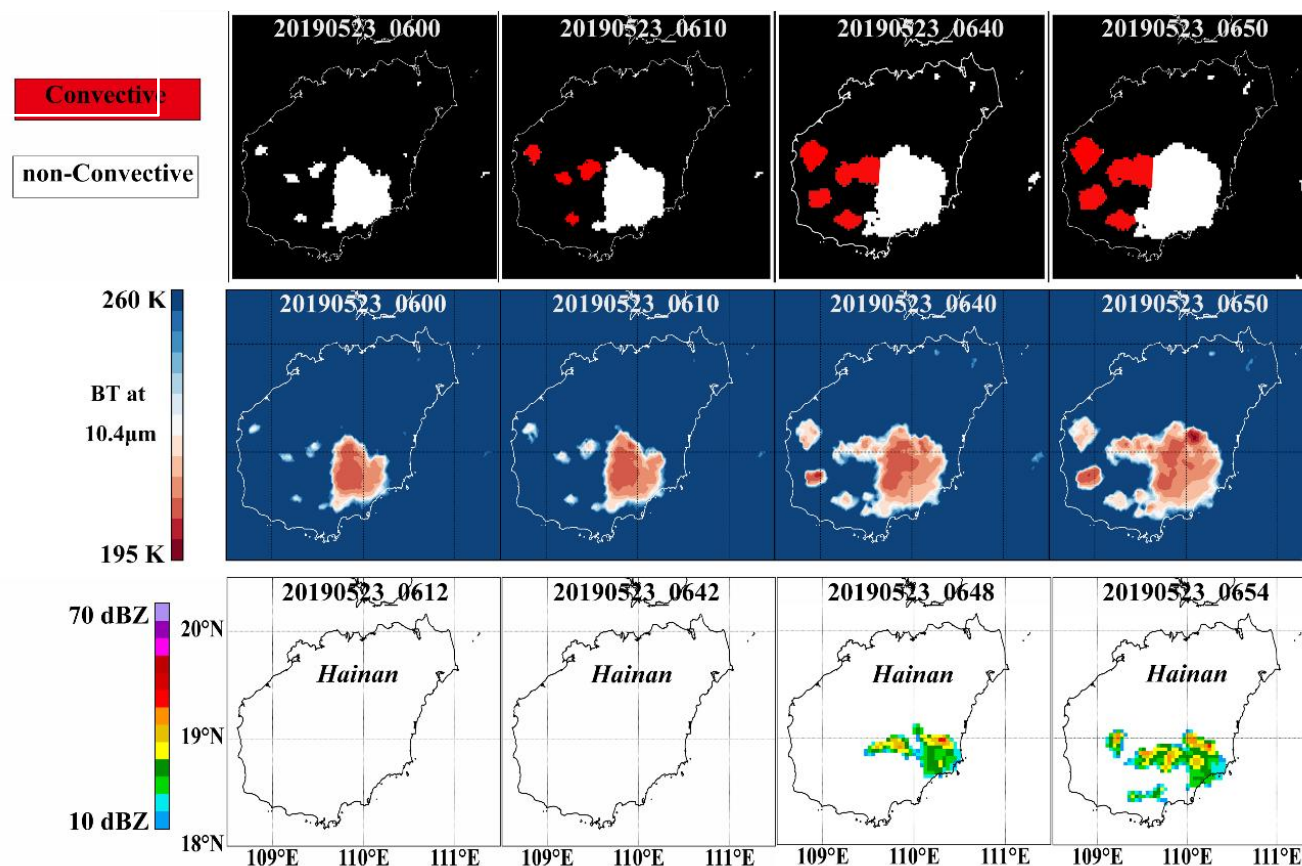
3. Satellite Data & AI



3.1 Severe Convective Nowcasting

A physically interpretable warning model has been developed, enabling 0–2 h nowcasting of severe convective weather in South China.

	POD	FAR	CSI
Our Method	0.85	0.22	0.68
Traditional Method	0.75	0.62	0.35



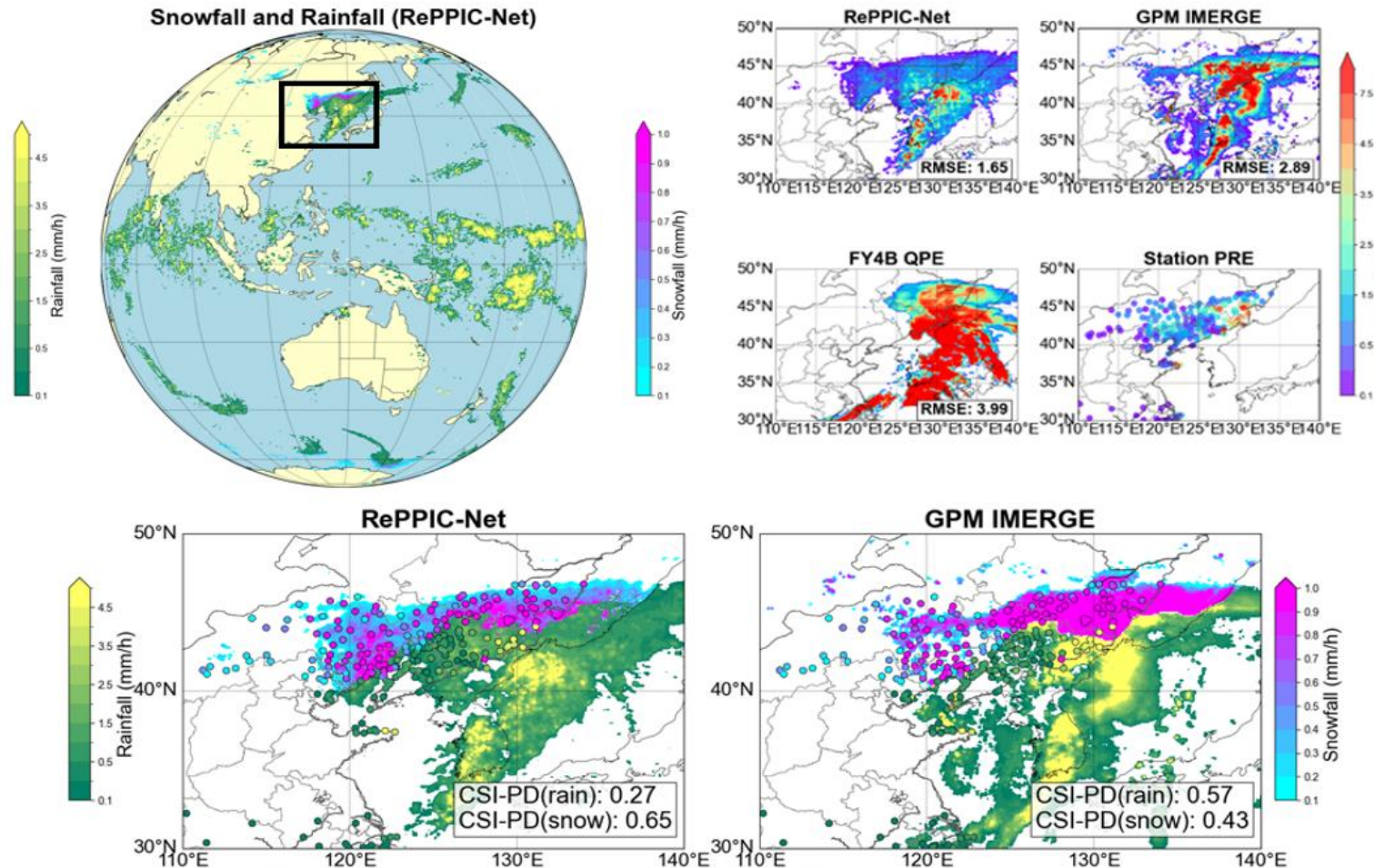
44 minutes ahead of Radar



3. Satellite Data & AI



3.2 Precipitation Monitoring & Forecasting



A heavy **snow** event in Northeast China

“Joint research with Prof. Zhang Feng's team at Fudan University”

Only intensity
No heavy snow
monitoring
capability

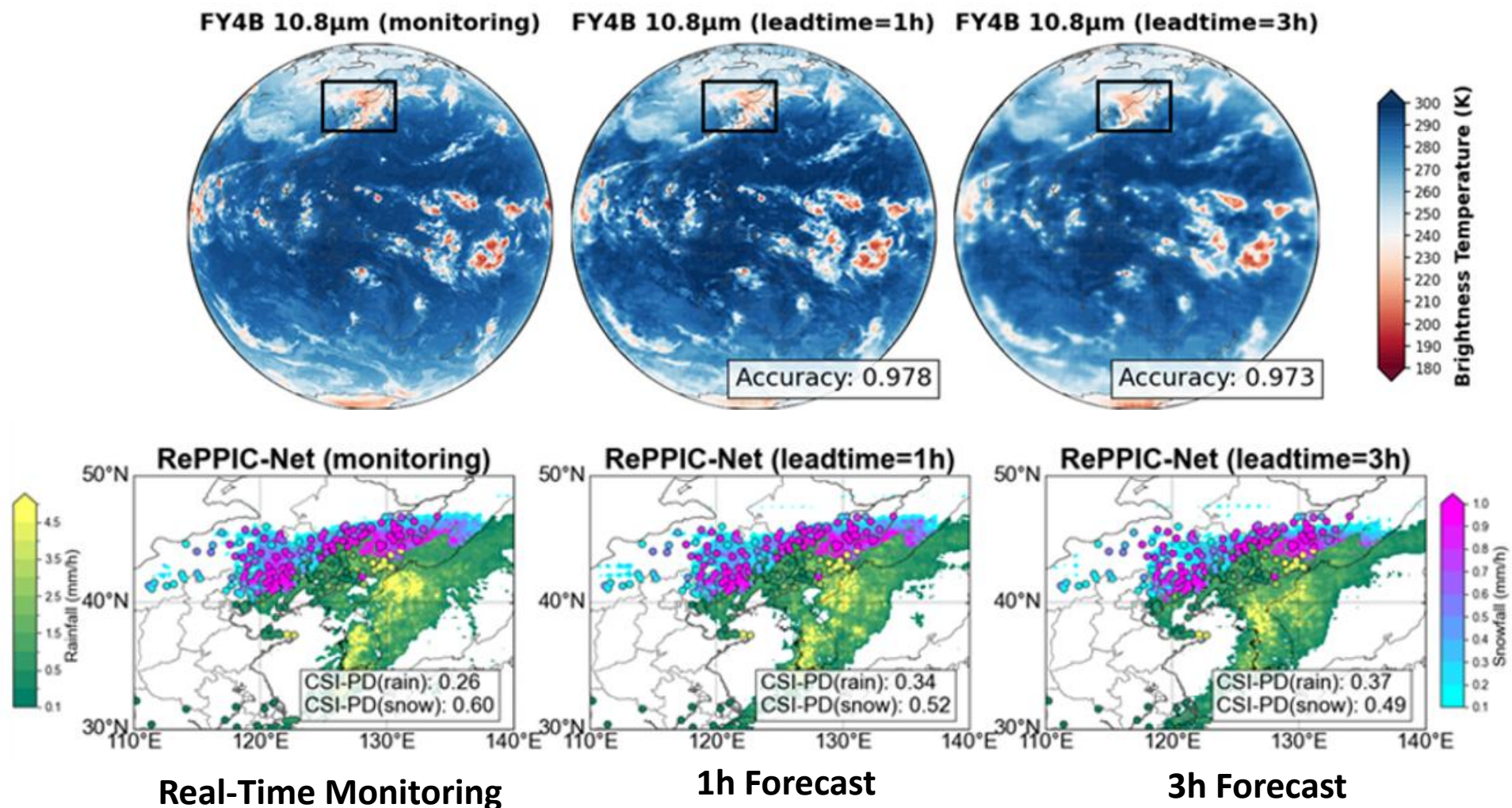
Phase-resolved
Heavy snow
monitoring
capability



3. Satellite Data & AI



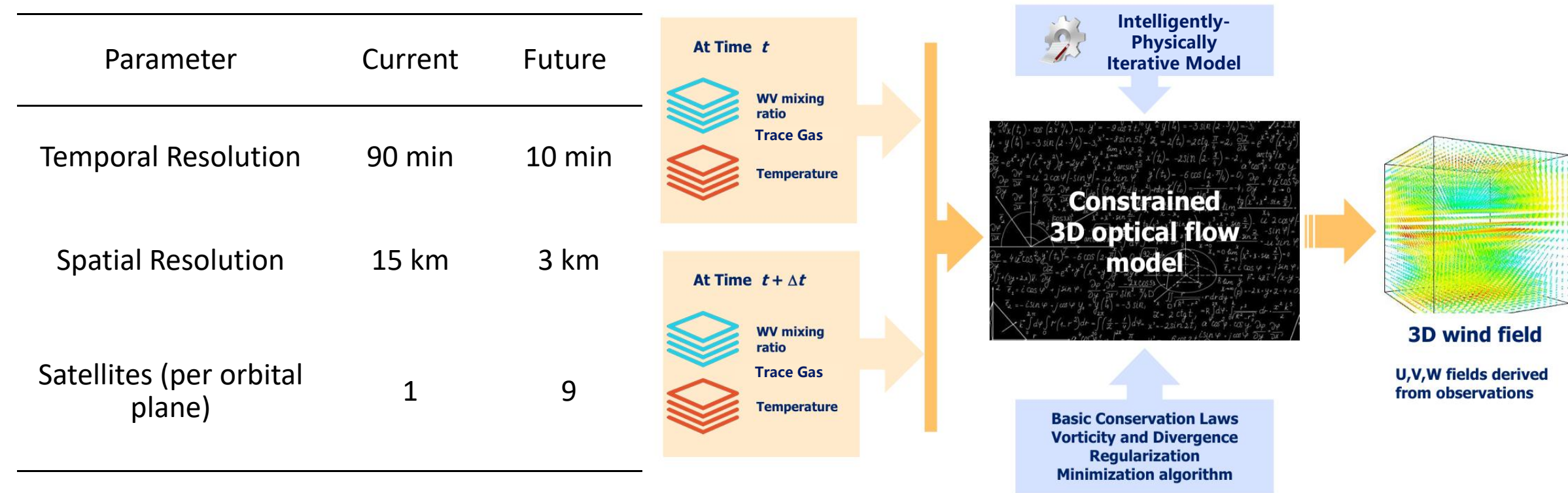
3.2 Precipitation Monitoring & Forecasting



“Joint inversion research with Prof. Zhang Feng's team at Fudan University”

3.3 3D Wind Field Retrieval

Develop an integrated physical-AI framework for intelligent physical-iterative big data processing, balancing computational efficiency and high-accuracy 3D wind field retrieval.





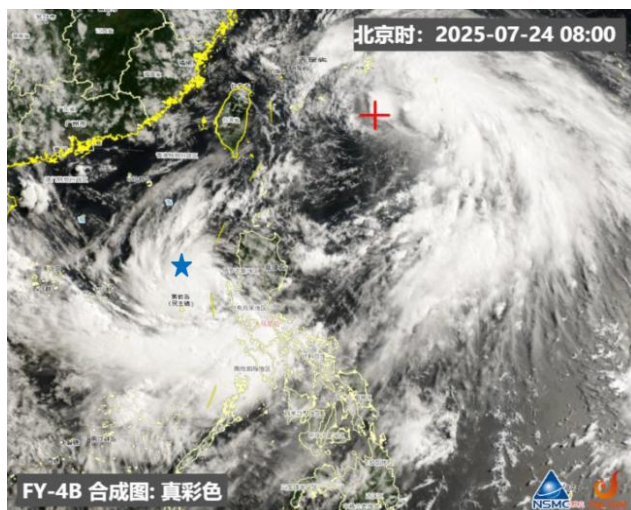
Industry Service Applications



1. Industry Service Trends

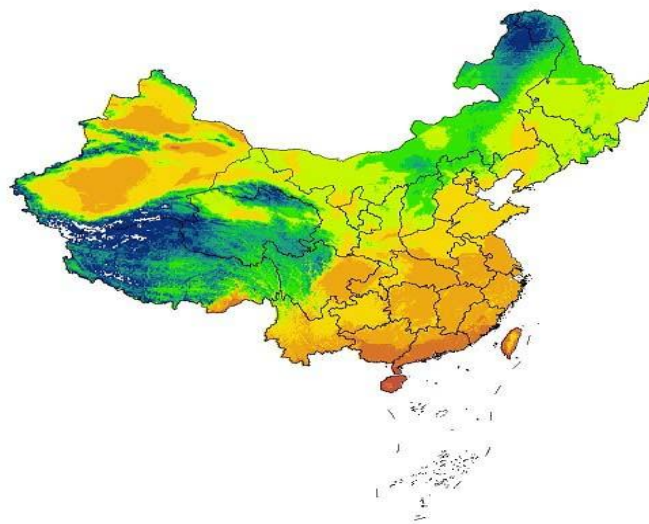


High-Frequency Real-Time Monitoring



1min frequency / 250m resolution

Fine-Resolution Grid



1-km resolution gridded products

Industry-Deepened Applications

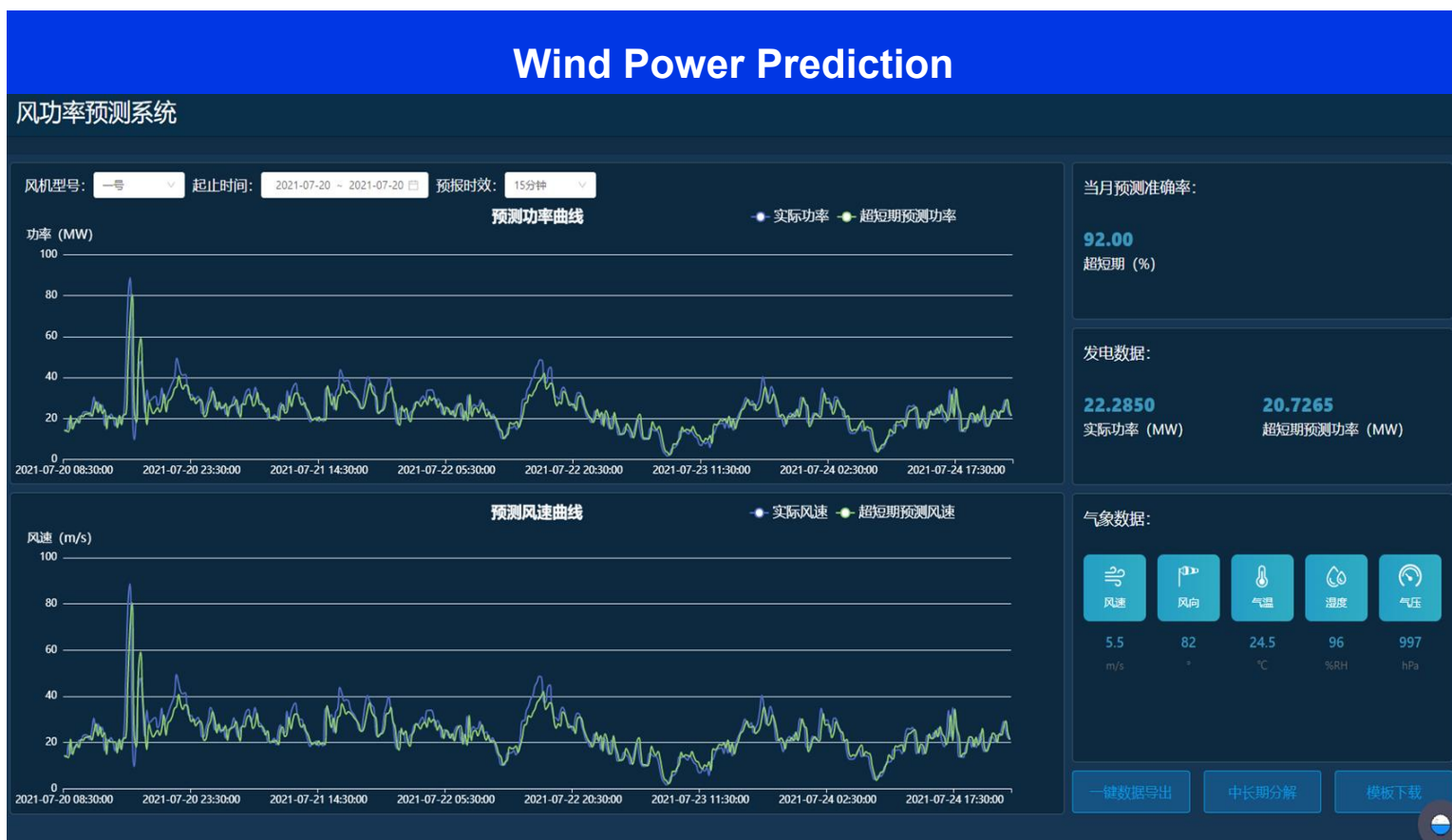


Integrated into Industry Decision-Making

2. Industry Applications



2.1 Renewable Energy



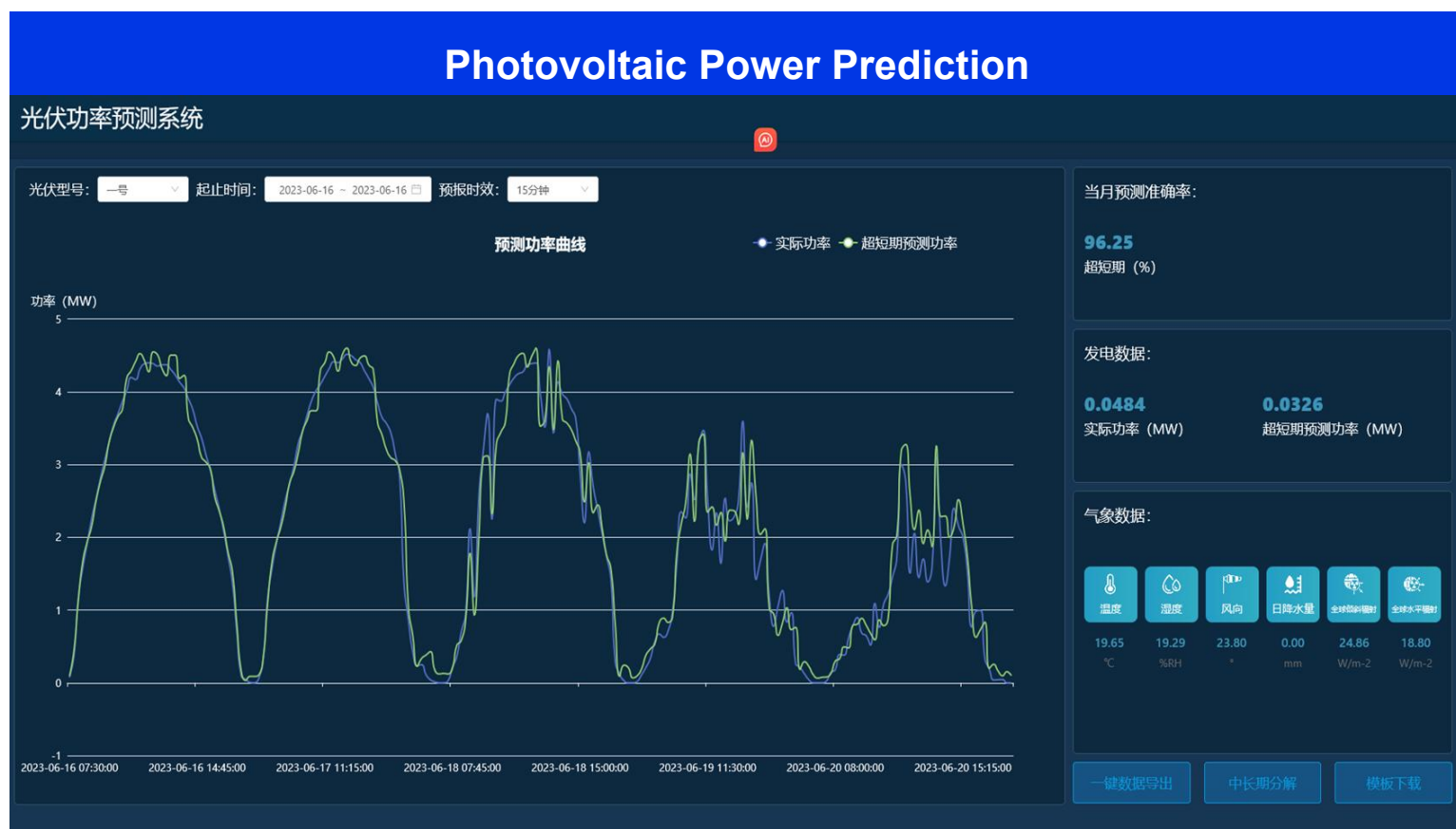
Forecast Horizon	Correlation Coefficient
1h	0.910
2h	0.855
3h	0.712

Ultra-short-term power forecasting for grid dispatch and energy optimization

2. Industry Applications



2.1 Renewable Energy



Forecast Horizon	RMSE	Correlation Coefficient
15min	0.429	0.966
4h	1.012	0.829
72h	1.046	0.788

Enhance grid dispatch intelligence and energy management

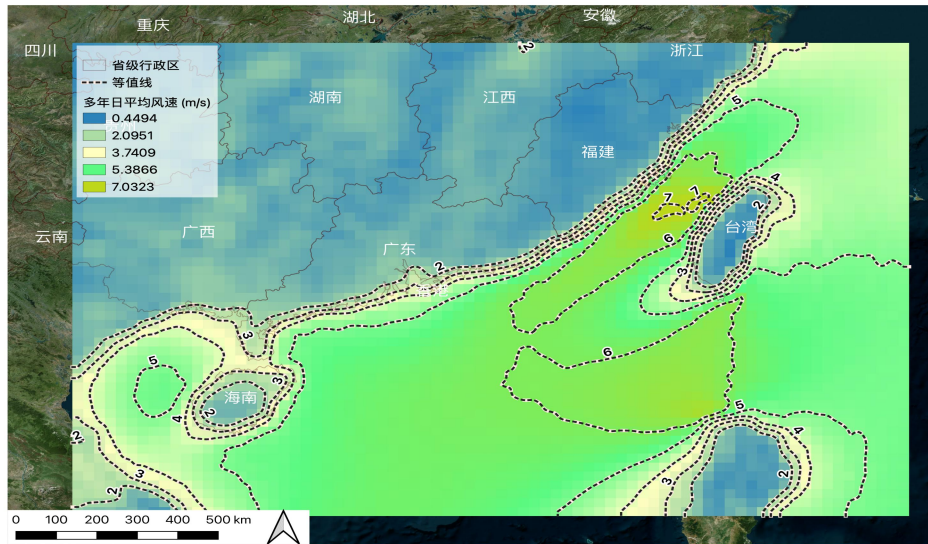


2. Industry Applications



2.2 Marine Shipping

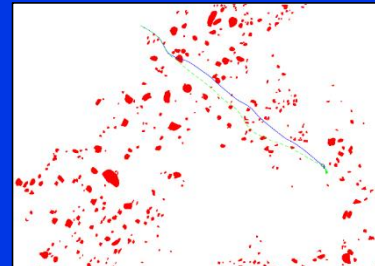
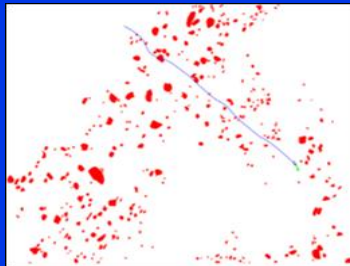
Wind Speed Retrieval



Typhoon Track Prediction



Route Planning



Enabling efficient and safe shipping through wind speed retrieval, typhoon track prediction, and route optimization.

3. Industry Applications

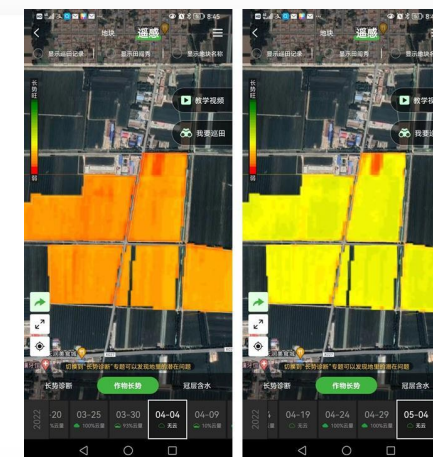


3.1 Landscape Maintenance

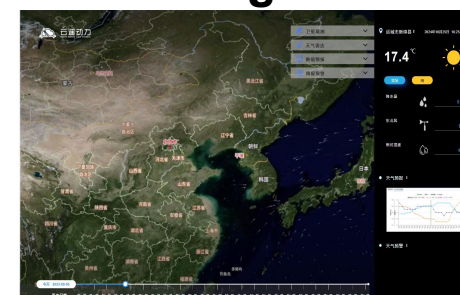
Data Support



Vegetation Ecological Data



Meteorological Element Monitoring



Disaster Warning Information



‘Multi-method collaborative monitoring’ & ‘Multi-variable correlation analysis’



3.2 Landscape Maintenance

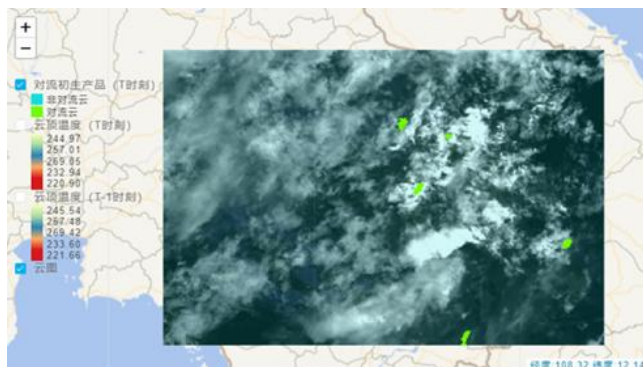
Scenario 1: Precision Irrigation



Scenario 2: Pest and Disease Identification



Scenario 3: Extreme Weather Warning



Scenario 4: Vegetation Growth Monitoring





3. Industry Applications

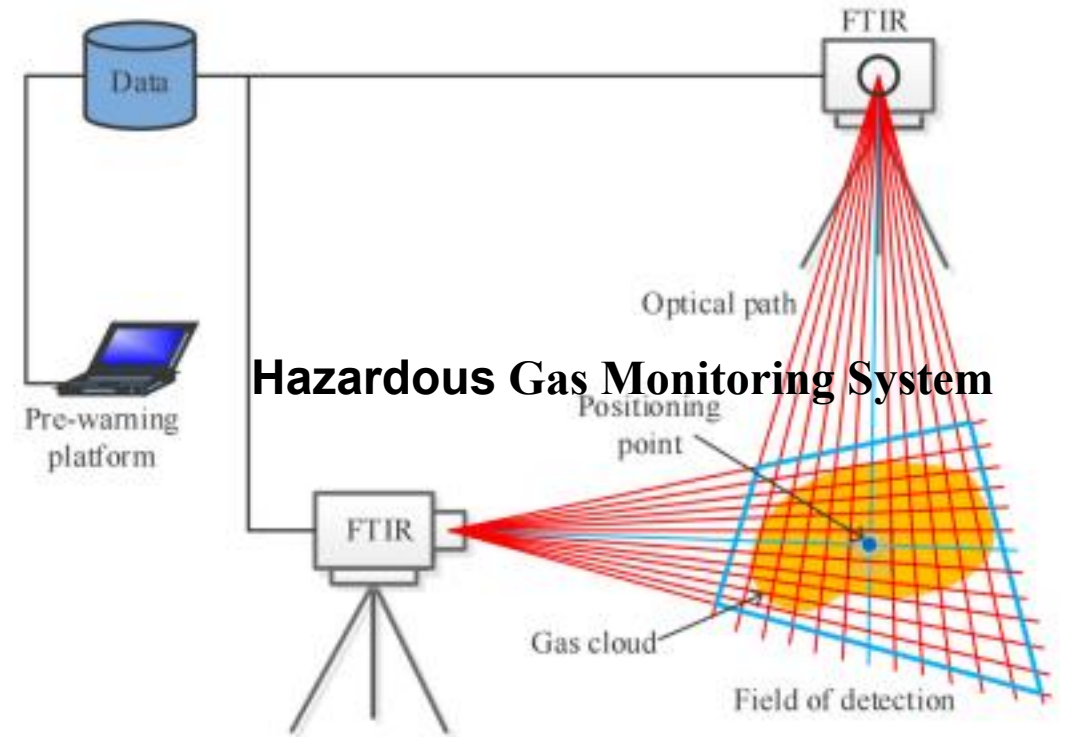


3.3 Urban Environmental Security

Enable simultaneous quantitative monitoring of toxic gases using Fourier transform spectrometers, supporting urban air quality monitoring and protecting residents' environmental safety.



Fourier Transform Spectrometer



Satellite payloads 'Space-based observation & Ground application'



Future Prospects



1. Applications of Wind Field in Disaster Early Warning

- **Extreme Weather Monitoring:** severe convective weather, typhoons, sandstorms, heavy rain and other disasters.



- **Secondary Disaster Prevention and Control:** the speed and direction of fire spread and pollutant diffusion.

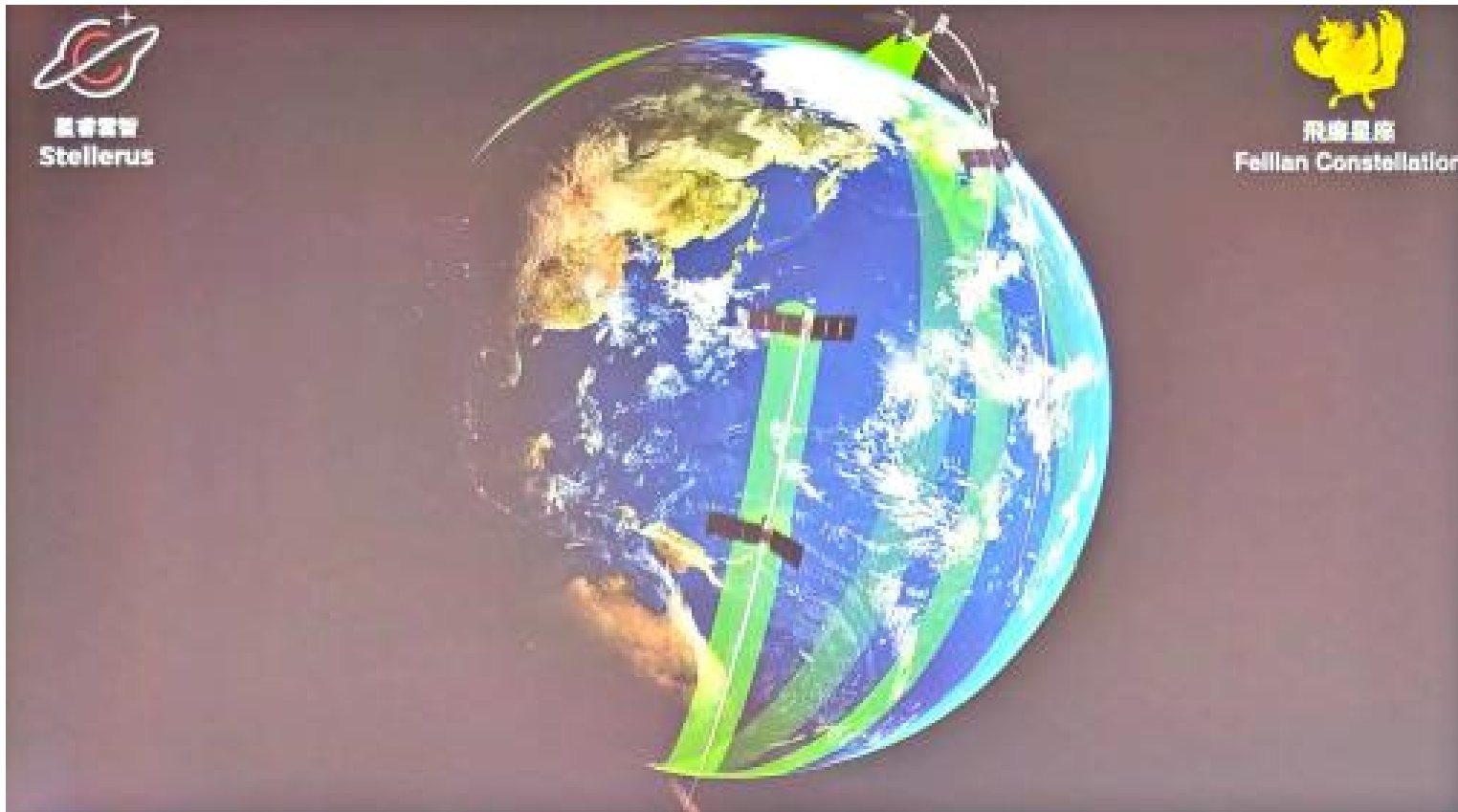




Future Prospects



2. Wind Field Constellation Initiative

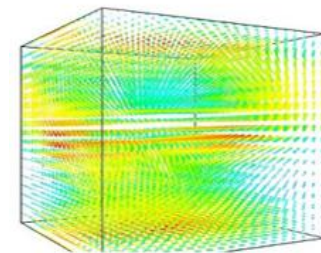


Address a critical gap in global three-dimensional wind field observation.

Twin-Satellite Co-orbital Design



Acquisition of high-resolution 3D wind field data (1 km resolution)



3D wind field

U,V,W fields derived from observations

“Collaboration with the Hong Kong University of Science and Technology”



3. Wind Field Constellation Initiative

- **Two-Satellite Networking:** The co-orbital FY-3(08) and FY-3(04) satellites form a constellation, reducing revisit time and enabling precise tracking of wind field variations.
- **Synergistic Observation:** Joint observations by FY-4C and FY-4B satellites will achieve high-temporal-resolution monitoring of dynamic wind field processes.



Achieving global high-precision, high-efficiency observation through integrated polar-geostationary satellite networking.



Future Prospects



3. Wind Field Constellation Initiative

Technological Breakthroughs

- Ultra-precision 3D wind field (sub-km resolution)



- AI-powered disaster chain prediction (accuracy >90%)



Application Expansion

- Smart City: Microclimate optimization, pollution control



- Carbon Neutrality: Wind-driven carbon flux monitoring





Trends

Hybrid Space Observation

- Multi-orbit synergy
- Small satellite constellation
- Inter-satellite links



AI Intelligent Agents

- Autonomous perception
- Perception-thinking-action cycle
- Paradigm shift

Practices

Customized Industry Solutions:



Agricultural Drought



Marine Disaster

Data-Driven Service Ecosystem:





Future Prospects



Multi-source data

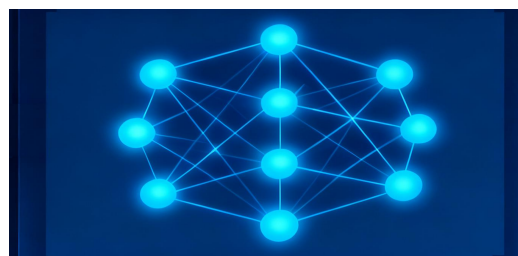


Physics-AI Fusion

Physical Inversion Model

$$Y = aX^3 + bX^2 + cX + d$$

Data Fusion - Training - Output



AI Algorithm

Closed-loop Workflow



A closed loop from data and algorithms to services has been formed, enabling applications in multiple fields.



THANKS!