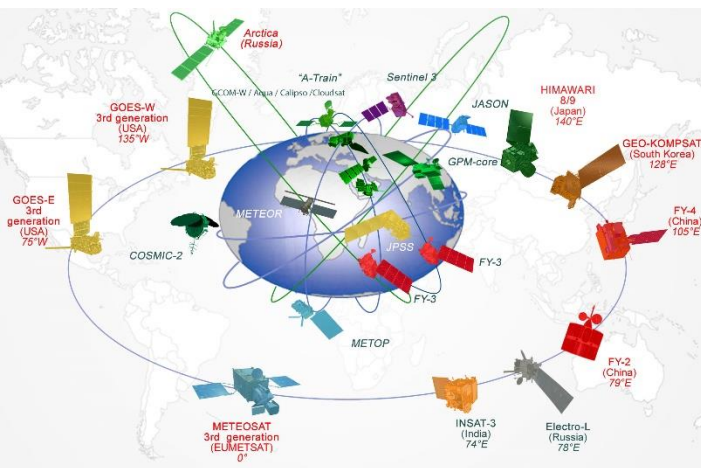




CMA and the commercial sector

National Satellite Meteorological Center
(National Center for Space Weather),
CMA

April 22, 2024

Coordination Group for
Meteorological Satellites



Outline

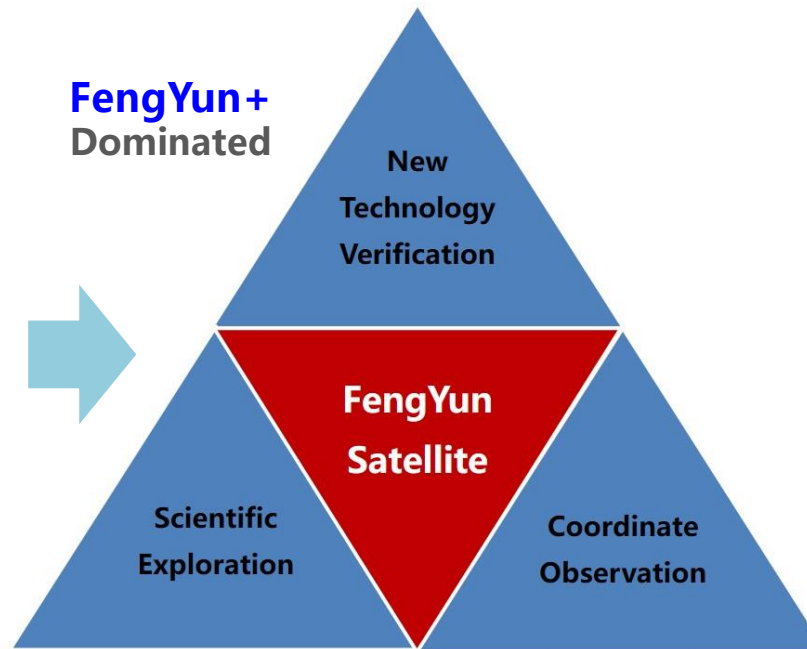
- 01 Chinese Meteorological Small Satellites**
- 02 YunYao Aerospace Constellation**
- 03 TianMu-1 Meteorological Constellation**

FengYun +

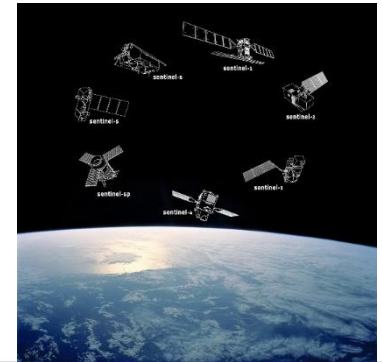
□ Concept

**FengYun
Constellation**
Owned

**FengYun+
Dominated**



Copernicus
Europe's eyes on Earth



**Coordination Group for
Meteorological Satellites**

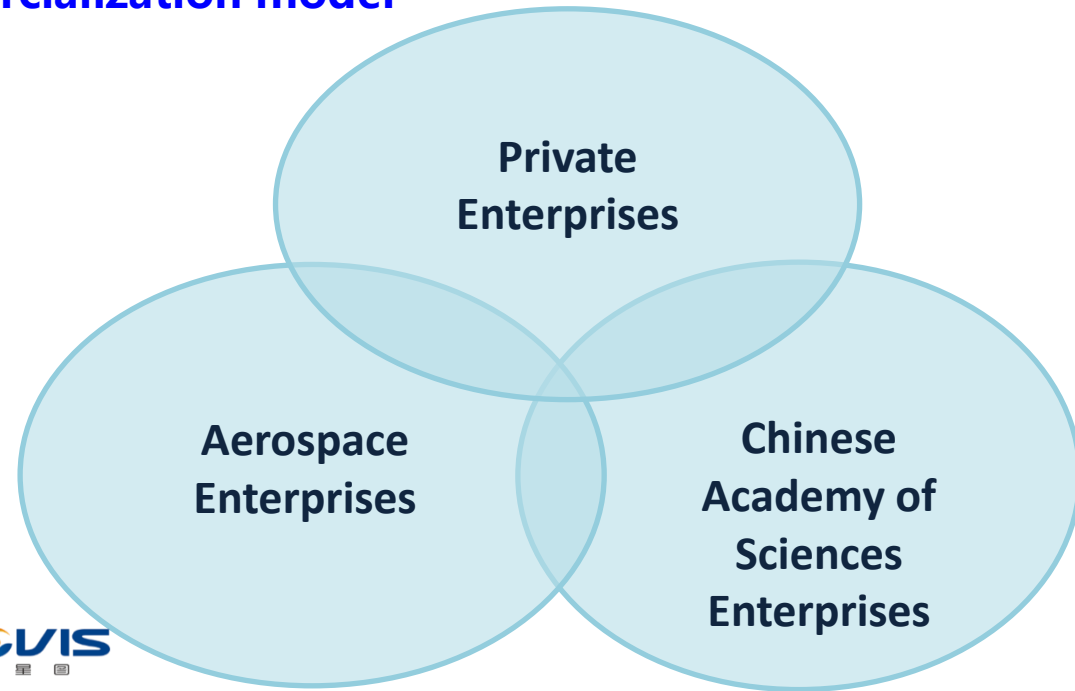


CGMS

Chinese Meteorological Small Satellites

□ Chinese small satellite commercialization model

- **Yun Yao** : 16 satellites
- **Tianmu-1**, 23 satellites
- **The Jilin-1** ,138 imaging satellites.
- **Zhuhai-1**, 34 imaging satellites
- **Catcher-1**: A/B satellite



Yunyao Aerospace Constellation | Complete Constellation Plan

GNSS-RO Constellation:

97°inclination 12 orbital plane 6 satellites

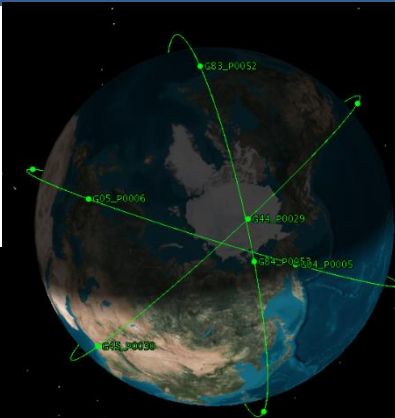
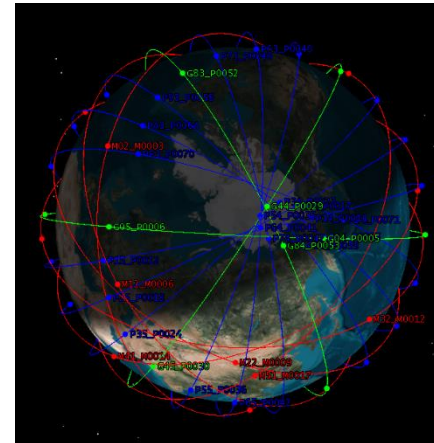
50°inclination 6 orbital plane 3 satellites

GNSS-R Constellation:

97°inclination 3 orbital plane 6 satellites

Sun-synchronous orbit				
NO.	No. of Plane	Number of Satellites	Height/km	Inclination/°
1	1	6	535	97.4
2	2	6	535	97.4
3	3	6	535	97.4
4	4	6	535	97.4
5	5	6	535	97.4
6	6	6	535	97.4
7	7	6	535	97.4
8	8	6	535	97.4
9	9	6	535	97.4
10	10	6	535	97.4
11	11	6	535	97.4
12	12	6	535	97.4

GNSS-RO



GNSS-R

View from Space above Arctic Pole

Low-inclination track				
NO.	No. of Plane	Number of Satellites	Height/km	Inclination/°
13	13	3	800	50
14	14	3	600	50
15	15	3	500	50
16	16	3	800	50
17	17	3	600	50
18	18	3	500	50

Yun Yao Products

- Atmospheric Occultation Products (0~60km)**

elements	resolution	
	vertical	horizontal
Atm Bending Angular Profile	$\leq 0.1\text{km}$	200km
Atm refractive index profile	$\leq 0.1\text{km}$	
Atm temperature profile	$\leq 0.1\text{km}$	
Atm humidity profile	$\leq 1.0\text{km}$	
atm pressure profile	$\leq 0.1\text{km}$	

- Ionospheric Occultation Products**

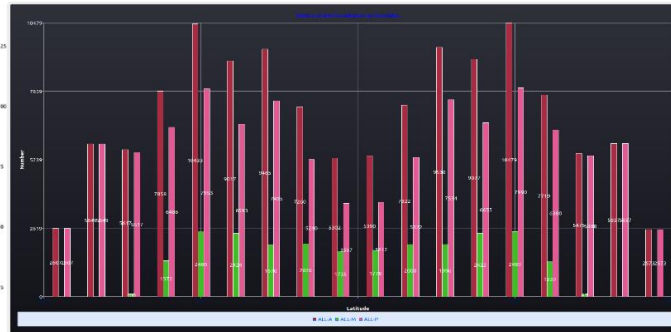
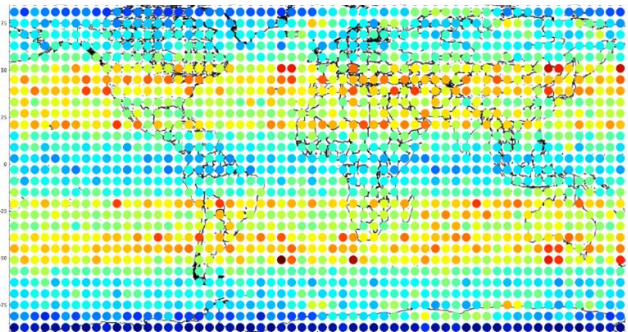
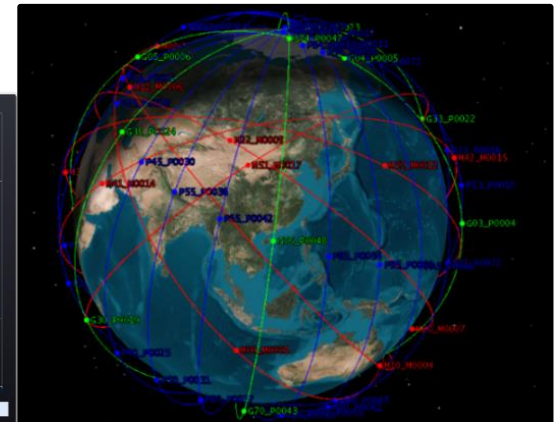
elements	vertical resolution	norm
electron density	$\leq 4\text{km}$ (60km~500km)	relative average deviation between NmF2 and vertical measuring instrument < 10%
TEC	$\leq 4\text{km}$ (60km~500km)	/
ionospheric scintillation S4 index	/	/

- GNSS-R data products**

elements	Threshold range	norm
effective wave height	/	$\leq 0.5\text{m}$
Sea surface wind speed	Wind speed < 25m/s	$\leq 2\text{m/s}$
	Wind speed $\geq 25\text{m/s}$	10%
sea ice identification	/	> 95%
Sea Surface Height、Soil moisture...	/	/

Yun Yao Aerospace Constellation | Complete Constellation Plan

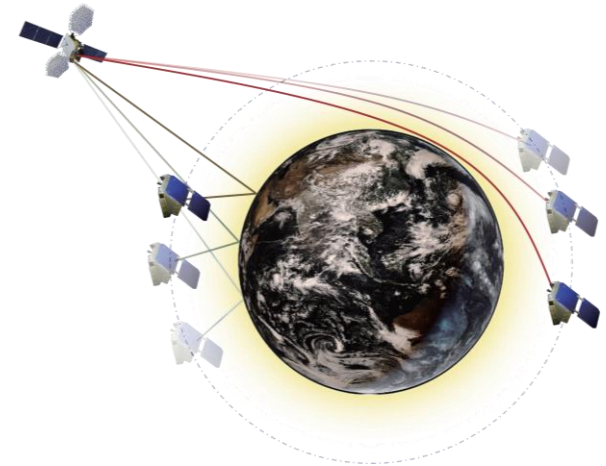
- By the end of 2025, a meteorological constellation of 90 satellites in orbit will be completed.
- Effectively enhancing China's meteorological observation capabilities through rapid networking of low orbit meteorological satellites.
- More than **150000** atmospheric occultation profiles and over **60000** ionospheric profiles can be obtained **every day**.
- **Global-scale** data with a spatial resolution of **200 km x 200 km** and time resolution of **12~20min**.



TianMu-1 meteorological constellation

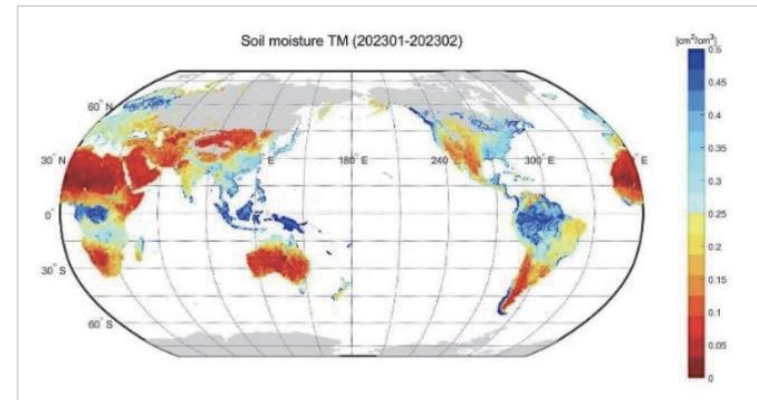
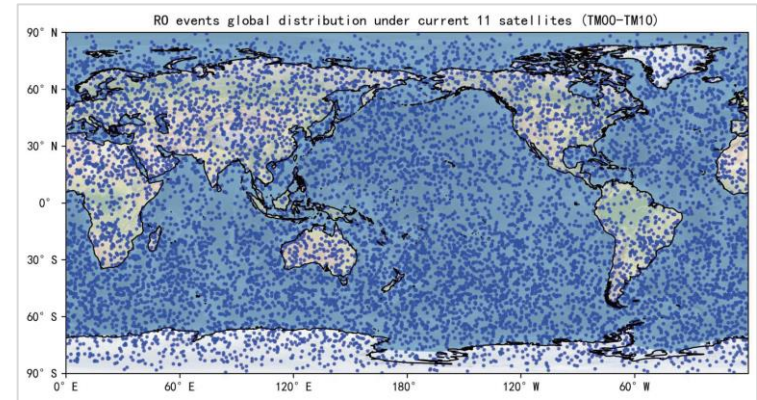
Tianmu-1 constellation consists of a sun-synchronous orbit sub-constellation and a low-inclination orbit sub-constellation.

By the end of 2023, the Sun-synchronous orbit Sub-constellation has been successfully completed, with **23 Tianmu-1 satellites** in orbit, which can provide **26,000 atmospheric profiles data daily**.



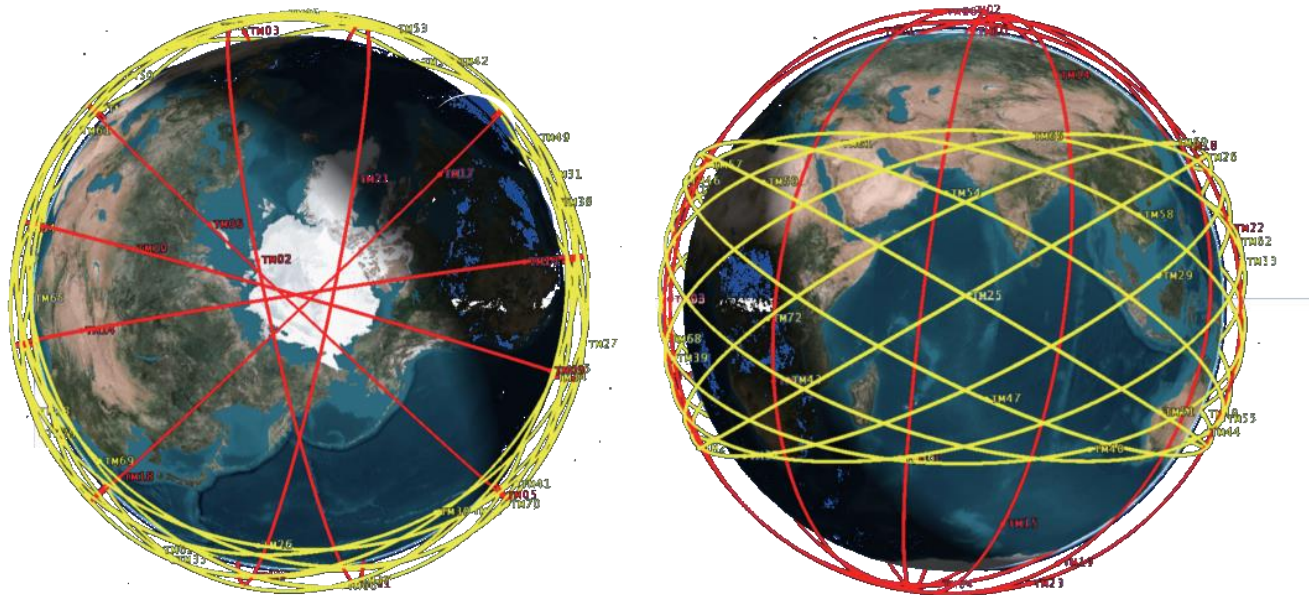
TianMu-1 Products

1. Atmospheric Refractivity Profile
The mean bias: $\leq 1\%$ (0-5km) ;
 $\leq 0.5\%$ (5-30km)
2. Atmospheric Temperature Profile
The mean bias: $\leq 1\text{k}$ (0-5km) ;
 $\leq 0.5\text{k}$ (5-30km)
3. Sea Surface Wind Speed
Root Mean Squared Error: $\leq 2\text{m/s}$
4. Electron Density Profile
Mean deviation of peak density: $\leq 20\%$
5. Orbital Atmospheric Density Profile
Mean relative deviation: $\leq 10\%$



TianMu-1 meteorological constellation

By 2025, the constellation construction will be completed, which can provide **80000 atmospheric profiles/day**, enabling global coverage of the sea surface within 3 hours and providing 3D atmospheric detection data with a grid resolution of 200 kilometers within 6 hours.



Thanks for your attention!