

China's Earth Observing Satellites

GUO Huadong

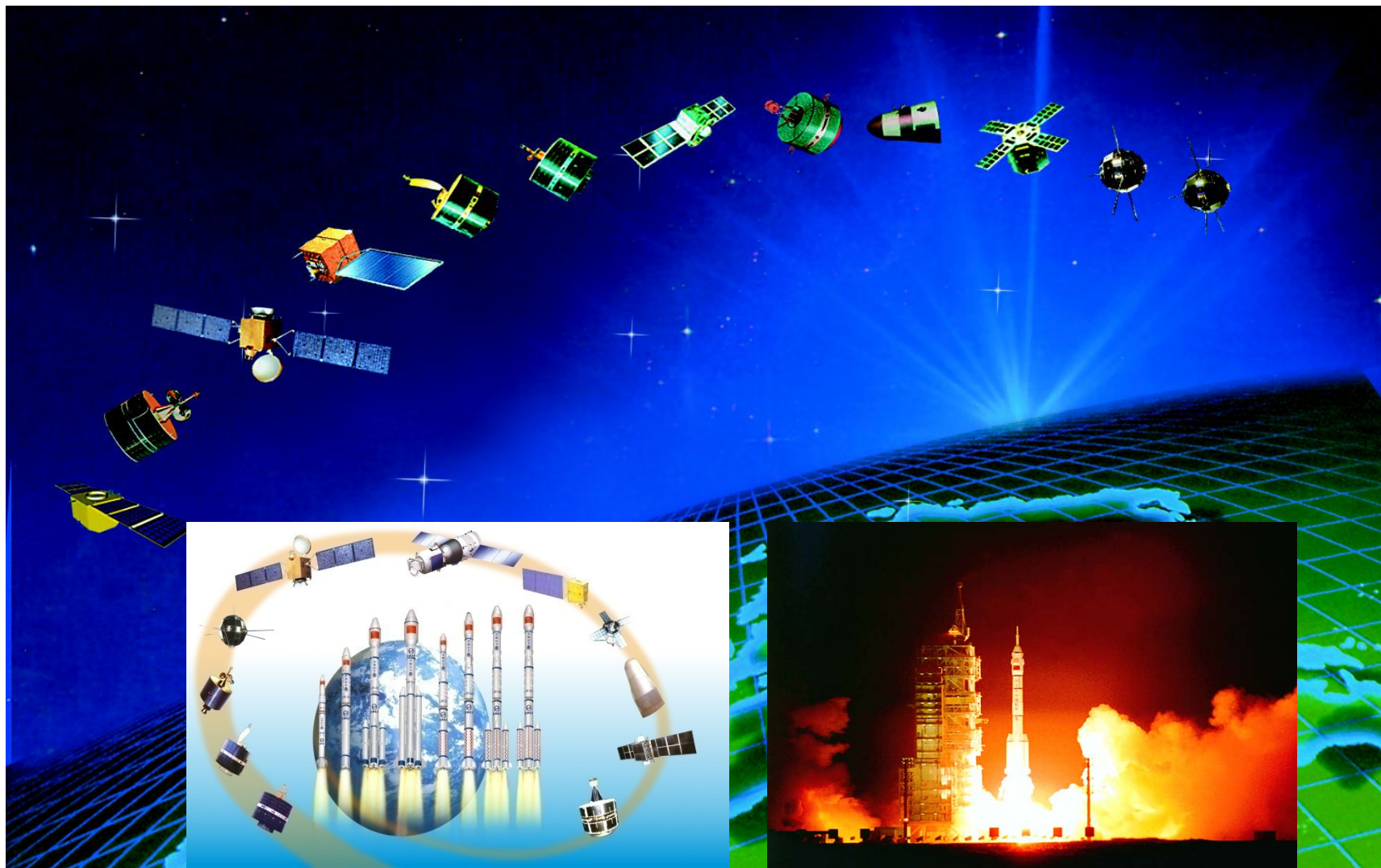
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EO Satellite Development



Chinese Satellites and Spacecrafts



<input type="checkbox"/> Meteorological Satellite	
Polar Orbit FY-1 A, B, C, D	4
Geo-stationary FY-2A, 2B, 2C	3
<input type="checkbox"/> Marine Satellite HY-1	2
<input type="checkbox"/> Resource Satellite (CBERS, Beijing, Tsinghua)	9
<input type="checkbox"/> Environmental and Disaster Monitoring Satellite	2
<input type="checkbox"/> Communication Satellite	7
<input type="checkbox"/> Navigation Satellite Beidou -1	9
<input type="checkbox"/> Return Land Satellites	17
<input type="checkbox"/> Scientific experiment Satellites	15
<input type="checkbox"/> Spacecrafts SZ-1, 2, 3, 4, 5, 6,7,8,9	9
<input type="checkbox"/> Tiangong-1	1

Four EO satellite Series in China



Satellite Type	Satellite	Payload	Spectral ranges	Spatial resolution (m)	Swath width (km)	Revisit rate (d)	Launch time
Resource-Series	CBERS-1-01/02	CCD/WFI	VIS/NIR	20/258	120/890	26/5	14.10.1999/21.10.2003
		Infrared Scanner	VIS/SWIR/TIR	78/156	120	26	
	CBERS-1-01/02B	CCD/WFI	VIS/NIR	20/258	113/890	26/5	29.10.2007
		High-Resolution Camera	VIS	2.36	27	104	
ZY-3-01	CCD	VIS/NIR	6/2.1	52/51	59/5	09.01.2012	
		Forward/Back-looking Camera	VIS	3.5	52		59/5
Environment-Series	HJ1-1A	CCD/Hyperspectral Imager	VIS/NIR	30/100	700/50	4	06.09.2008
	HJ1-1B	CCD	VIS/NIR	30	700	4	
		Infrared Multispectral Camera	IR	150/300	720	4	
HJ-1C	Synthetic Aperture Radar	-	5 (single look) * 20 (4 looks)	40-strip mode/ 100-scan mode	4	-	
Meteorological-Series	FY-1A/B	MVISR	VIS/NIR/TIR	1100/4000	2860	-	06.09.1988/03.09.1990
	FY-1C/D	MVISR	VIS/IR	1100/4000	3100	12	10.05.1999/15.05.2002
		HEPD	-	-	-	-	
	FY-2A/B/C/	VISSR	VIS/IR	1250/5000/5760	-	30/25.5	10.06.1997/25.06.2000/
	FY-3A/B	IRAS/VISSR/MERSI	VIS/IR	17km/1100/250-1000	2800	5.5	27.05.2008/04.11.2010
		MWTS	EHF/U-band	15km/50-75km	2700	-	
		MWRI	X/Ku/K/Ka/W-band	15-85km	1400	-	
		ERM/SIM	UV/VIS/IR	-	-	-	
SBUS/TOU		UV	200km/50km	-	-		
Space Environment Monitor	-	-	-	-	-		
Ocean-Series	HY-1A/B	COCTS/CZI	VIS/IR/NIR	1100/250	1600/3000/500	3/1/7	15.05.2002/11.04.2007
		Radar Altimeter	C/Ku-band	-	-	14	
	HY-2	Microwave Scatterometer	Ku-band	-	1350/1700	1	16.08.2011
		SMR/CMR	C/X/K/Ka-band	-	1600	1	

Note: VIS: Visible; SWIR: Short-wave Infrared; IR: Infrared; NIR: Near Infrared; TIR: Thermal Infrared; EHF: Extremely High Frequency; UV: Ultraviolet; WFI: Wide Field Imager; IRMSS: Infrared Multispectral Scanner; MVISR: Multichannel Visible and IR Scanning Radiometer; HEPD: High Energy Particle Detector; VISSR: Visible and Infrared Spin Scan-Radiometer; IRAS: Infrared Atmospheric Sounder; MERSI: Medium Resolution Spectral Imager; MWTS: Microwave Temperature Sounder; ERM: Earth Radiation Measurement; SIM: Solar Irradiation Monitor; SBUS: Solar Backscattering UV Sounder; TOU: Total Ozone Unit; COCTS: Chinese Ocean Color and Temperature Scanner; CZI: Coastal Zone Imager; SMR: Scanning Microwave Radiometer; CMR: Calibrated Microwave Radiometer.

CBERS:China-Brazil Earth Resources Satellites



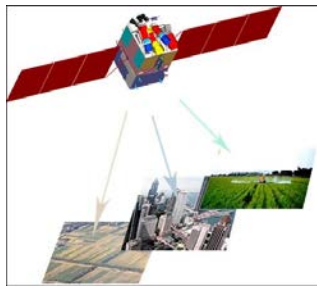
- **ZY-1 (ZiYuan-1)**, also known as **China-Brazil Earth Resources Satellite (CBERS-1)**, is an earth observation satellite developed by China and Brazil jointly, launched Oct., 1999.
- **CBERS-02A, 02B** had been launched in past years
- **CBERS Instruments:**
 - Five bands CCD Camera; 20-m resolution; 113 km swath;
 - Four bands IR Multi-Spectral Scanner; 80-160-m resolution; 120-km swath;
 - Two bands Wide-Field Imager (WFI); 260-m resolution; 900-km swath.



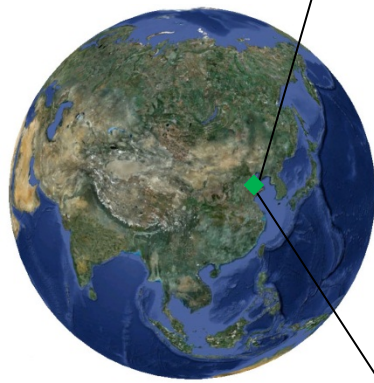
“Resource - 3” Satellite



It is the *first* high-resolution 3D mapping satellite in China, provides a new data source for the national basic geographic mapping and data updating.

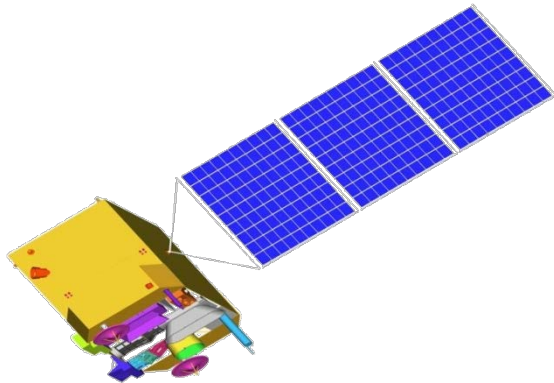


- 3-line array mapping camera, providing front, rear ground resolution of 3.5m panchromatic image;
- Face image with a ground resolution of 2.1m panchromatic;
- Multispectral camera, providing face image with the ground resolution multi-spectral 5.8m;
- High accuracy geometry positioning, high-quality imaging satellite images.



11 Jan. 2012, 2.1m resolution image map of Dalian, China (NASMG), Location for Google Earth Screenshot

- Life : 3years ;
- Power of end of life is 2300W;
- CCD: resolution 5m 、 10m and 20m;
- Infrared: resolution 40 / 80m;
- WFI: resolution 73m;
- CBERS-03 will be launched in 2013;
- CBERS-04 will be launched in 2015



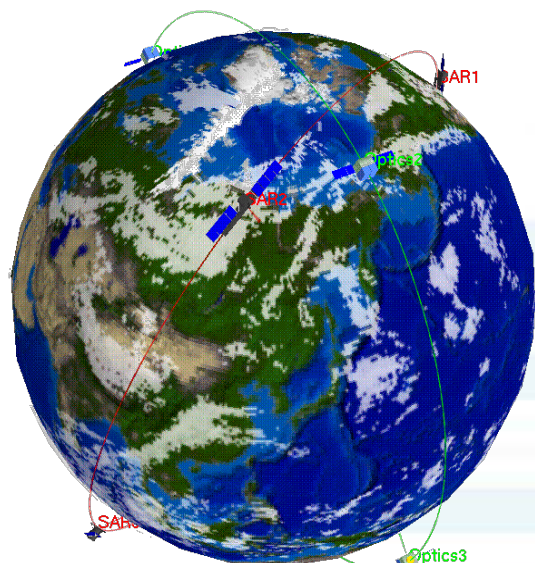
HJ Sat.: Small Satellite Constellation



The first stage: **3 satellites**

2 optical satellites+ 1 SAR satellites

HJ-1-A/B、HJ-1-C



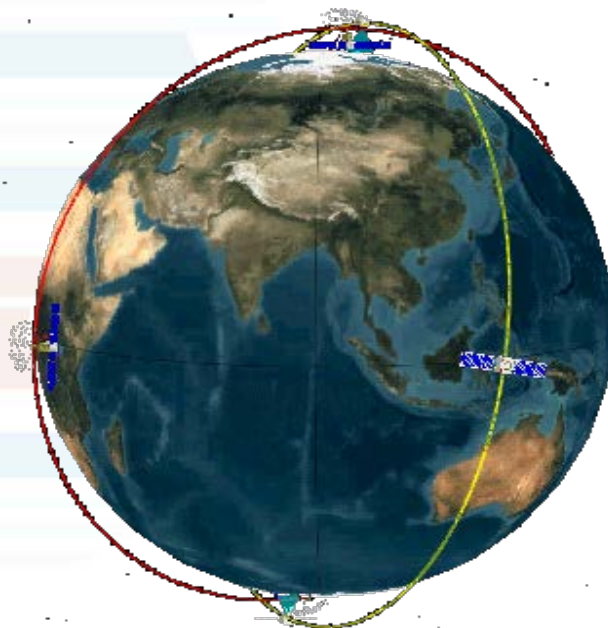
HJ-1-A/B



HJ-1-C

The second stage: **8 satellites**

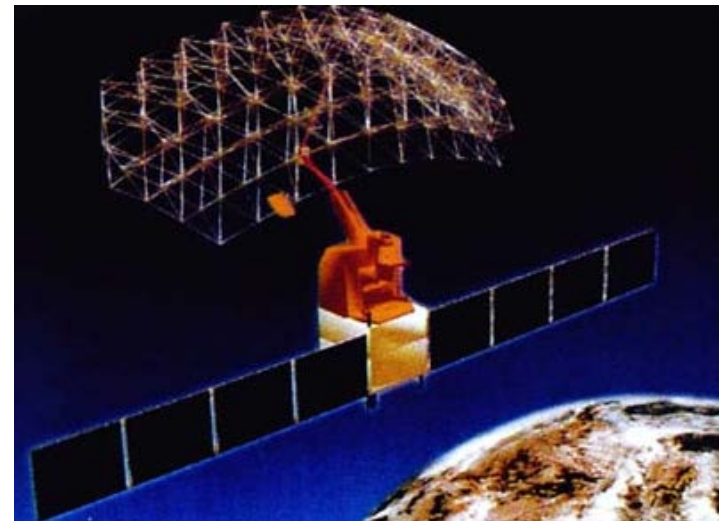
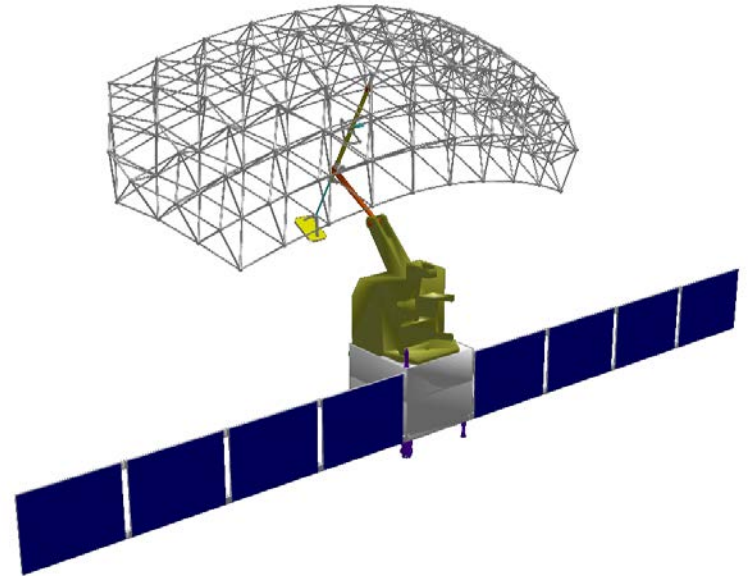
4 optical satellites+4 SAR satellites



HJ - 1C

Parameters of HJ - 1C

item	Performance
Orbot hight	~500km
□weight	~690kg
□size	1200mm×1200mm×3000mm
□band:	S band
□Ground resolution:	5m (single) , 20m (4 view)
□Band width:	40km (strip) , 100km (scan)
□Radiation resolution:	3dB
□polarization	VV
□Incident angle:	25~47°
□life:	3 years







Oceanic Satellites-HY Series



HY-1 Satellite

To detect the marine environmental parameters of the China Seas

-  chlorophyll concentration
-  suspended sediment concentration
-  dissolved organic matter, pollutants
-  sea surface temperature

Orbit type	Near Circular and near sun-synchronous
Equator crossing time	8:53-10:10am (descending node)
Altitude	798km
Inclination	98.8 deg
Period	100.8 minute
Repeat observation period	3days for COCTS, 7days for CCD
Mass	367kg
Payload	COCTS and CCD
Attitude control	3 axis stabilized
Downlink frequency	X-band
Design life	2 years
Memory recorder on board	80Mbyte (can record 18 minute COCTS data)






- **10-band Chinese Ocean Color and Temperature Scanner (COCTS) , 8VNIR, 2TIR, 1.1km**
- **4-band CCD – 0.42-0.89 μ m, 250m**
- **Launched on 15th May, 2002**

Oceanic Satellites-HY Series

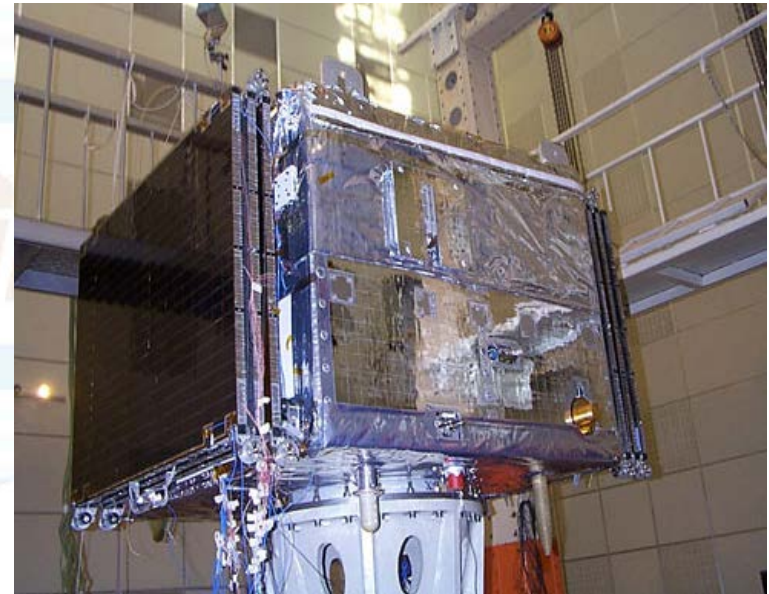
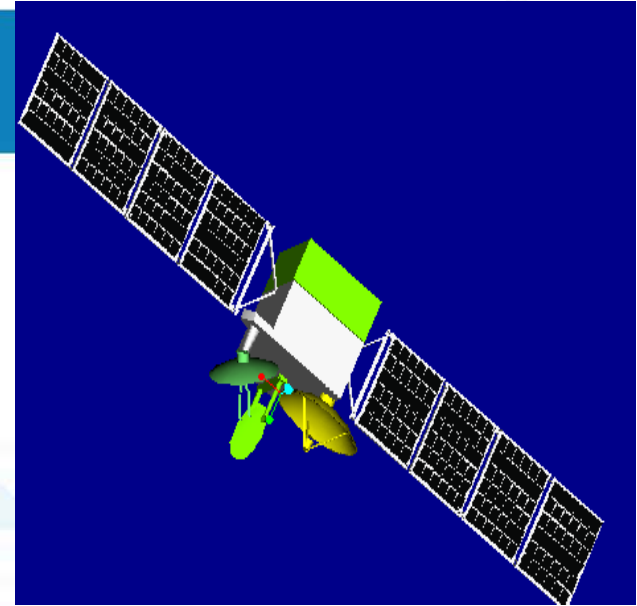
HY-2 Satellite

To globally observe dynamic ocean environment parameters

FOUR microwave instruments into

-  The HY-2 satellite altimeter provides sea surface height, significant wave height and sea surface wind
-  The HY-2 scatterometer provides SSW fields.
-  Also, it can provide sea surface temperature , water vapor and liquid water content

 ***Launched on 16th August, 2011***





- “Scientific Experiment Satellite for Global CO₂ monitoring
- Monitoring and Application Demonstration” launched by the National High-Tech Development Program
- Payload of the satellite:
 - High spectra of CO₂ detector
 - Aerosol detector

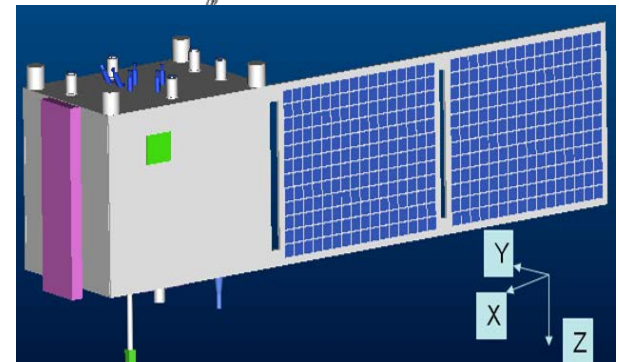
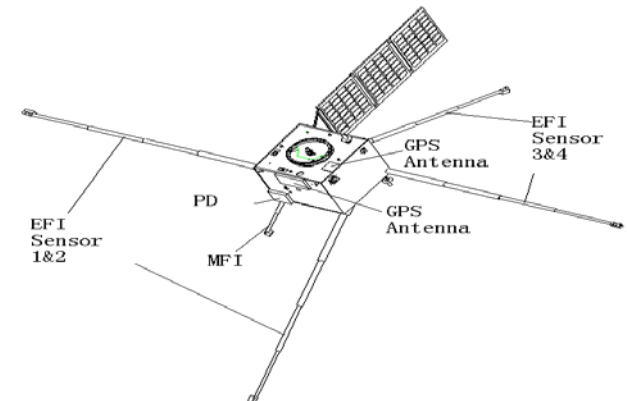
It is China's **first** satellite for global CO₂ monitoring, and scheduled for launch in **2014**.

(MOST)

Electromagnetic & Earthquake Satellite

Electromagnetic & earthquake satellite used for monitoring electromagnetic field changes to forecast the earthquake.

- Small satellite platform;
- 3 weight magnetic monitor and 3 weight electronic monitor;
- Electron feature monitor and proton feature monitor;
- GPS monitor in ionization.

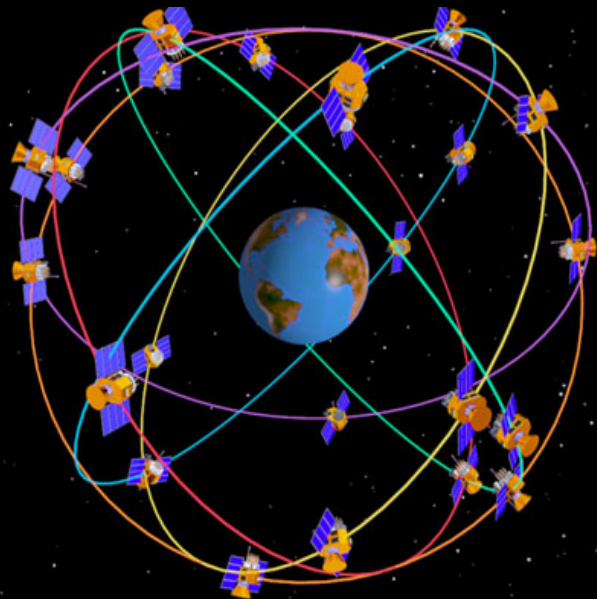


“Beidou” Satellite Navigation System

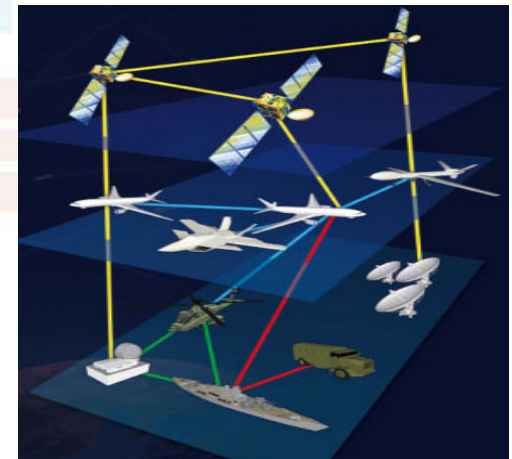


- Providing continuous navigation information and timing.
- 10 satellites have been launched with positioning accuracy 10m.
- Till 2020, the system will form a network with a **5** geostationary orbit and **30** non-geostationary orbit satellites to achieve global coverage.

“Beidou” Satellite Navigation System Diagram

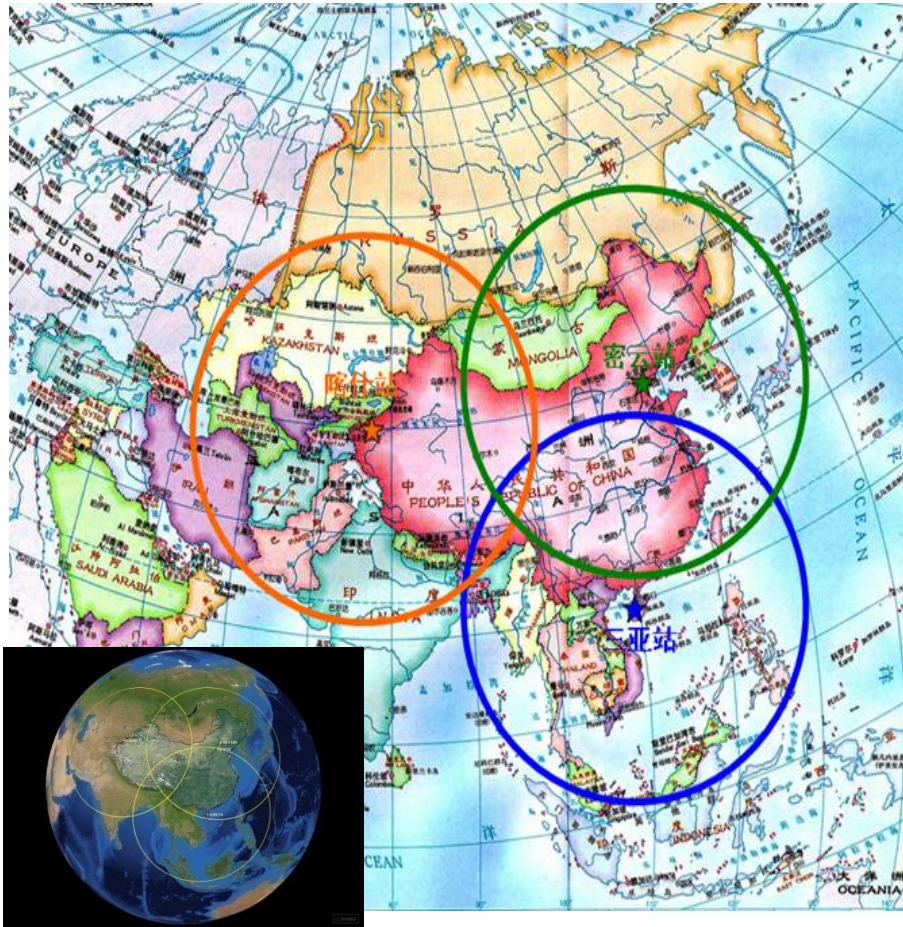


Compass Operational Concept



“Beidou” Satellite Navigation Operation Diagram

Satellite Data Receiving Stations



Area covered by Miyun Receiving Station (upper-right), Kashgar Receiving Station(middle-left) and Sanya Receiving Station (lower-right)

CEODE:EO Data Acquisition & Archiving



Over 2.50 million scenes of satellite data have been acquired and preserved at CEODE since 1986, providing a precious database for the earth observation .

		Satellite	Country	Period	Reception Station
Satellite Data Received by CEODE: past and present	International Satellites	LANDSAT-5	USA	1986-	Miyun, Kashgar
		JERS-1 SAR	Japan	1993-1998	Miyun
		ERS-1	ESA	1993-2000	Miyun
		ERS-2	ESA	1996-2011	Miyun
		SPOT-1	France	1998-2002	Miyun
		SPOT-2	France	1998-2009	Miyun, Kashgar
		RADARSAT-1	Canada	1999-	Miyun
		SPOT-4	France	2000-	Miyun, Kashgar
		LANDSAT-7	USA	2000-2004	Miyun
		SPOT-5	France	2002-	Miyun
		ENVISAT	ESA	2003-2012	Miyun
		RESOURCESAT-1	India	2005-	Miyun, Kashgar
		RADARSAT-2	Canada	2008-	Miyun, Kashgar, Sanya
		THEOS	Thailand	2011-	Miyun, Kashgar, Sanya
		Domestic Satellites	CBERS-01	China	1999-2003
CBERS-02	China		2003-2008	Miyun	
CBERS-02B	China		2007-2010	Miyun	
HJ-1A	China		2008-	Miyun, Kashgar, Sanya	
HJ-1B	China		2008-	Miyun, Kashgar, Sanya	
ZY-02C	China		2011-	Miyun, Kashgar, Sanya	
ZY-3	China		2012-	Miyun, Kashgar, Sanya	

Spacecraft Program



任务路线图



1999年

1999年11月20日6时30分，神舟一号飞船在酒泉卫星发射基地顺利升空，经过2...



2003年

2003年10月15日，我国第一艘载人飞船神舟五号成功发射。中国首位航天员杨利伟...

1992年

1995年

1997年

1999年

2001年

2002年

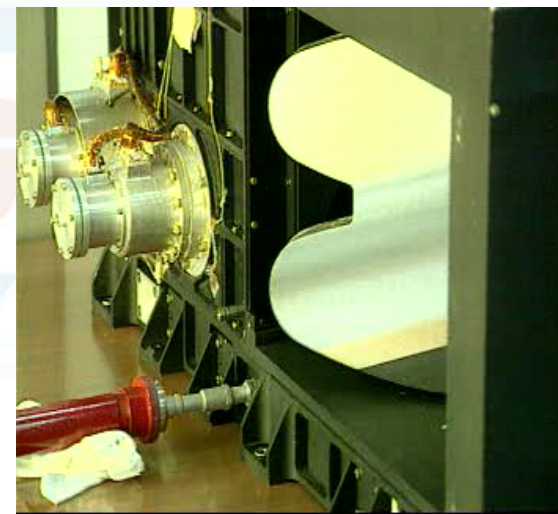
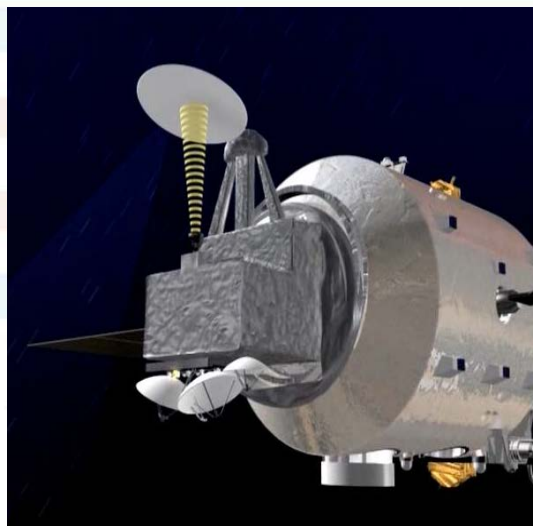
2003年

2005年

2008年

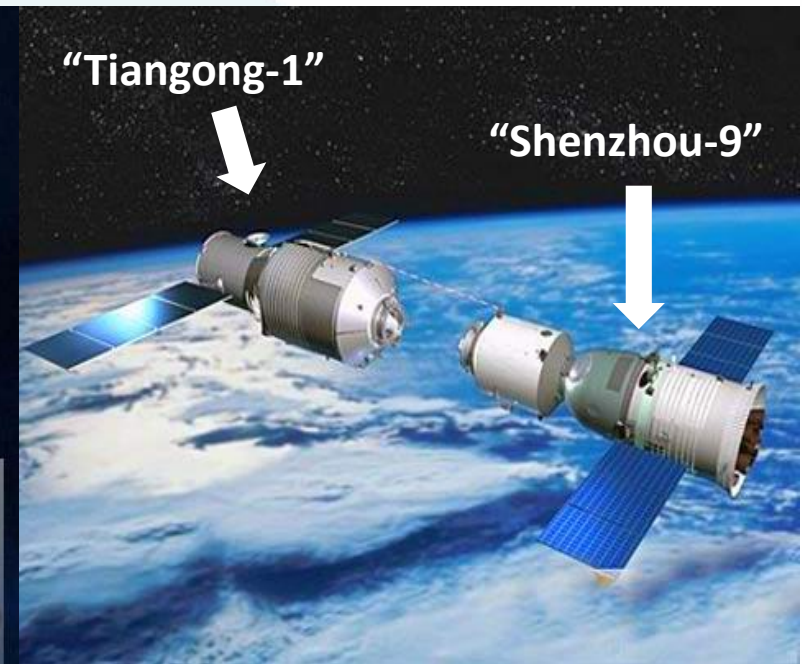
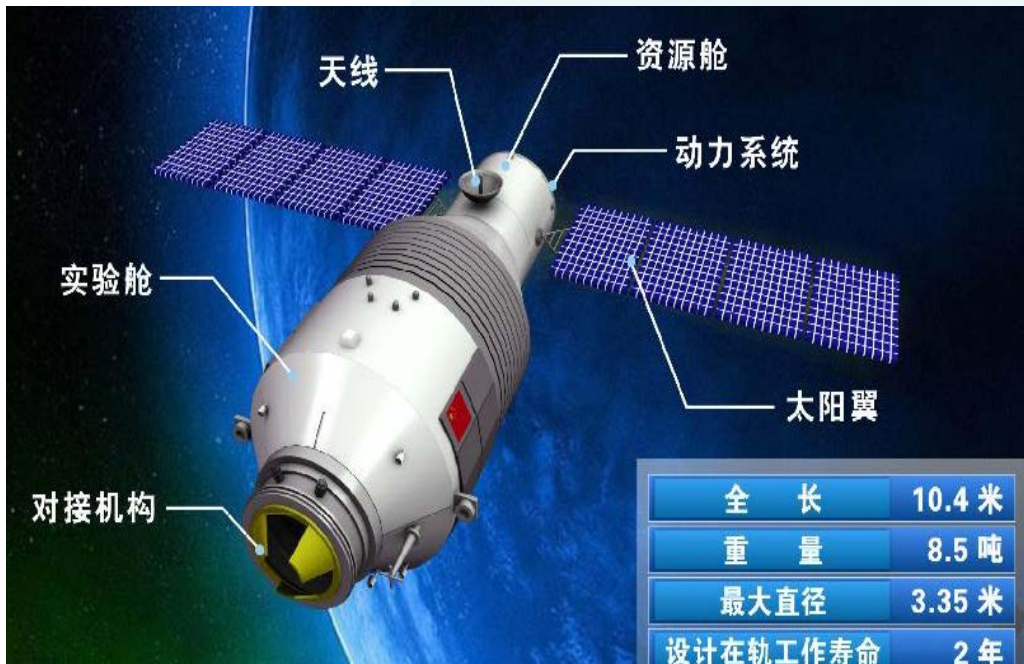
2010年

2011年

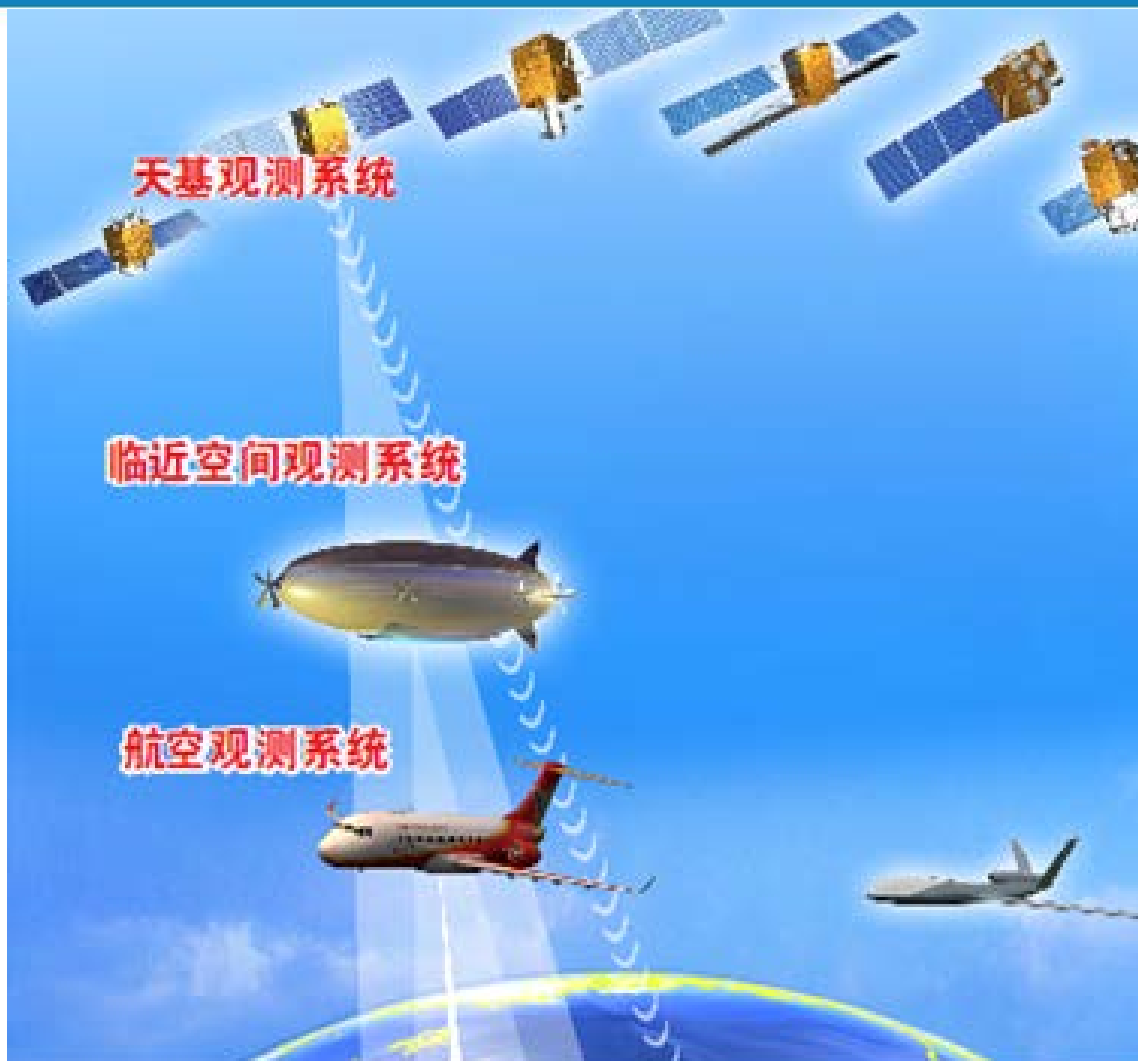


“Tiangong-1” Space Station

- On **29 Sep. 2011**, “Tiangong-1” space station started 2-year mission.
- On **18 Jun. 2012**, “Shenzhou-9” spacecraft successfully docked with “Tiangong-1” space station.



A High-resolution Earth Observing System



- **Satellite**, **stratospheric airship**, and **airborne observation systems**.
- **Ground service network: data center, and application facilities.**
- **Space- aerial -in situ observation systems**


From: <http://www.cnsa.gov.cn/n1081/n7499/n108303/index.html>




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Huadong Guo
Ji Wu
Editors

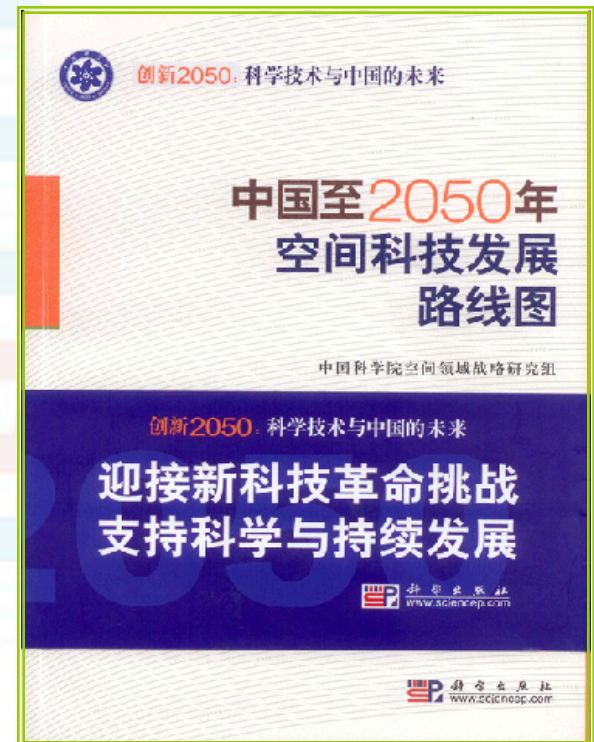
Space Science & Technology in China: A Roadmap to 2050

 Science Press
Beijing

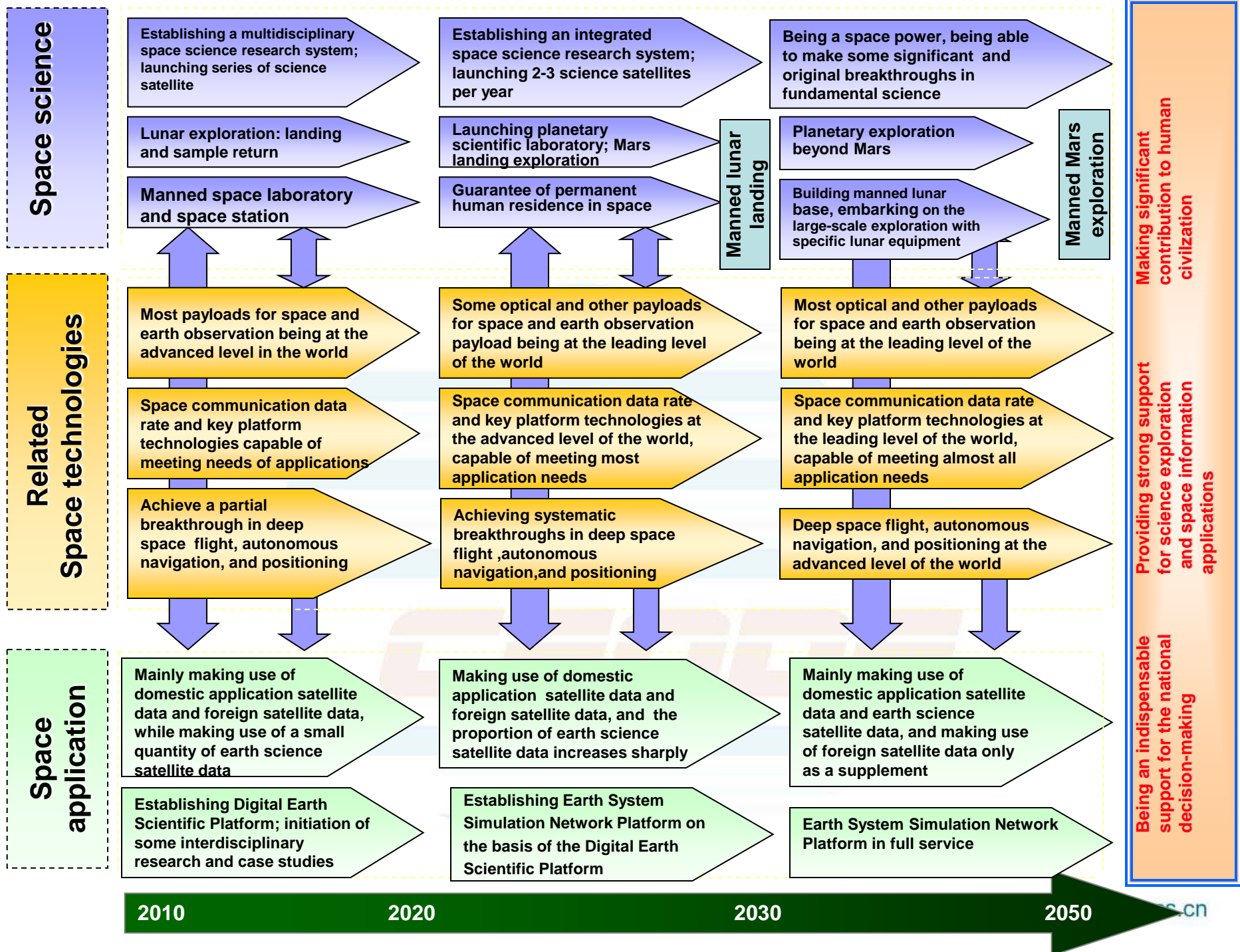
 Springer



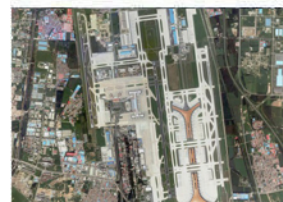
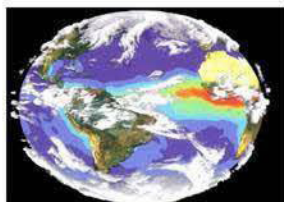
Book on Space S/T in China: A Roadmap to 2050



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Thanks !



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