The Space Earth Observation System of China

Center of Earth Observation System Engineering
China National Space Administration
● Space Earth Observation Technology
● Space Earth Observation Applications
● Earth Observation International Exchanges and Cooperation
● Future Earth Observation plans
● New Generation
In recent years, China has successfully launched more than 50 of the earth observation satellite, initially forming a brief view of space borne earth observation system.
Chinese Satellites and Spacecrafts

Meteorology series (FY)  Oceanic series

Resource series  Environment series
<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meteorological Satellite</td>
<td></td>
</tr>
<tr>
<td>Polar Orbit FY-1 A, B, C, D</td>
<td>4</td>
</tr>
<tr>
<td>Geo-stationary FY-2A, 2B, 2C</td>
<td>3</td>
</tr>
<tr>
<td>Marine Satellite HY-1, HY-2</td>
<td>2</td>
</tr>
<tr>
<td>Resource Satellite (CBERS, ZY, Beijing, Tsinghua)</td>
<td>7</td>
</tr>
<tr>
<td>Environmental and Disaster Monitoring Satellite H</td>
<td></td>
</tr>
<tr>
<td>HJ-1A, 1B</td>
<td>2</td>
</tr>
<tr>
<td>Communication Satellite</td>
<td>7</td>
</tr>
<tr>
<td>Navigation Satellite Beidou -1</td>
<td>8</td>
</tr>
<tr>
<td>Return Land Satellites</td>
<td>17</td>
</tr>
<tr>
<td>Scientific experiment Satellites</td>
<td>15</td>
</tr>
<tr>
<td>Spacecraft SZ –1, 2, 3, 4, 5, 6, 7</td>
<td>7</td>
</tr>
</tbody>
</table>
HY-1A Satellite

HY-1A Satellite was launched on May 15, 2002.

- China Marine Satellites Programme
- Ocean Color Environmental Satellite Series (HY-1) Monitoring of red tide, oil spill, fisheries, sea ice and sea surface temperature.

HY-1A is the first China marine exploration satellite, with the payloads of 10-band COCTS and 4-band CCD imaging device.
HY–2

HY–2 is an environment satellite for ocean applications. Monitor marine dynamic environment.

- Three sensors:
  - Microwave radiometer
  - Scatterometer
  - Radar altimeter
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.
The first stage: 3 satellites
2 optical satellites + 1 SAR satellites
HJ-1-A/B, HJ-1-C

The second stage: 8 satellites
4 optical satellites + 4 SAR satellites
Navigation Satellite: Compass (Beidou)

- **Accuracy**
  - Positioning 10 meters, velocity - 0.2 meter per second
  - Timing accuracy - 50 nanoseconds.
- **System: include at least 30 satellites**
  - five geostationary Earth orbit (GEO)
  - 30 medium Earth orbit (MEO) satellites
Shenzhou Spacecrafts

- Unmanned-SZ1, SZ2, SZ3, SZ4
- Manned-SZ5, SZ6, SZ7, …

SZ-5 in the Space
Space Earth Observation Applications

- Agriculture
- Land Use Investigation
- Forestry
- Ocean
- Disaster Management
- City Application
- Ecology and Environment
China widely applies space technologies in such areas as meteorology, ocean, disaster prevention and mitigation, environment monitoring and navigation, which have been playing an important role in national economic construction, scientific and technical progress and improving people’s life.
Climate observation

China is one of the nations with both polar-orbit and geostationary orbit (GEO) meteorological satellites in the world. China’s in-orbit meteorological satellites have been included into the operational meteorological satellites by the World Meteorological Organization (WMO) and are providing both domestic and international services.
(1) Weather forecast

Rainstorm monitoring image taken by meteorological Satellite (09:48 BT, May, 2010)

(2) Weather monitoring Outside China

Typhoon monitoring image acquired by FY-3A satellite (Sept. 18, 2010)
The HY-1B satellite independently developed by China operates stably in orbit and provides services for ocean applications:
(1) Sea ice monitoring
(2) Sea surface temperature monitoring
(3) Green tide monitoring
(4) Oil spill pollution monitoring
(5) Water color environment monitoring
Dalian New Port oil spill remote sensing monitoring analysis map (July 20-22, 2010)

Sea surface temperature remote Sensing thematic image from HY-1B satellite (Oct. 1-31, 2010)
Environment protection

Integrating the satellite remote sensing technology into the environment management system including environment monitoring, environment enforcement, environment emergency, ecological protection and nuclear safety regulation, China has established an environment remote sensing operational technical system which is mainly based on the data from HJ-1A/IB satellites and assisted by other satellite and airborne data, and initially formed an operational application system including water environment, air environment and ecological environment.
 Nationwide remote sensing monitoring for straw burning
Disaster prevention and mitigation

HJ-IA and HJ-1B are China's first small satellite constellation specially developed and launched for disaster and environment monitoring. Since they were launched on Sept. 6, 2008, HJ-1A/1B have been integrated into China's disaster mitigation and relief operational system and played an increasingly important role in domestic and international disaster mitigation.
Evaluation image for the damaged and Collapsed houses in Gyegu Town, Yushu County, Qinghai Province

Russian fire monitoring image from FY-3A/VIRR

FY-3A/VIRR俄罗斯火情监测图像
2010年8月7日 08:15（世界时）
China positively participates in the related space activities organized by the United Nations and other relevant international organizations; provides resources to help mitigate the effects of disasters on human life and property as a member of the International Charter on Space and Major Disasters (CHARTER); develops bilateral space cooperation with many national space agencies from countries including Russia, Ukraine, France, the UK, and Brazil and regional space agency such as European Space Agency (ESA); and supports international commercial space activities.
On Jan. 13, a major earthquake of magnitude 7.3 struck Haiti. NDRCC made an emergency observation plan for HJ-1A/1B satellites to timely acquire the data on the affected area for rapid disaster evaluation, and provided 8 scenes of satellite data and 2 issues of products to the international organizations and agencies including CHARTER. On the same day, at the 2010 Annual Conference of Asia Disaster Reduction Center, UN-SPIDER reported the services provided by the HJ-1A/1B satellites to the participants, fully reflecting the application capability of HJ-1A/1B and highly praised by the conference.
On Feb. 27, a major earthquake of magnitude 8.8 struck Chile. NDRCC made an emergency observation plan for HJ-IA/IB satellites to timely acquire the data on the affected area, and provided 4 scenes of satellite data and I issue of product to the international organizations and agencies including CHARTER.
As an Authorized User (AU) and Project Manager (PM), NDRCC activated the CHARTER for 5 times for Yushu earthquake in Qinghai province on April 14, floods in South China in June and July, Wenchuan debris flow in Sichuan Province on August 14 and Gongshan debris flow in Yunnan Province on August 18. Based on the acquired data, NDRCC conducted disaster monitoring and evaluation and provided important support to disaster emergency rescue and evaluation decision-making.
On April 15, 2010, during Chinese President Hu Jintao's visit to Brazil, China and Brazil signed the Memorandum of Understanding for CBERS Image Data Distribution Policy between the China Center for Resources Satellite Data and Application and Brazilian National Institute of Space Research, providing policy support to the international cooperation. In Nov. 2010 at the 2010 GEO Beijing Ministerial Summit, China announced to continue to provide remote sensing satellite data to Africa for free, and later signed an agreement on promoting CBERS-3 data reception and distribution in South Africa with the South African National Space Agency (SANSA).
Jointly developed by the Chinese Ministry of Science and Technology (MOST) and ESA, Dragon Program is an important China-ESA cooperation program in the field of remote sensing applications. The 2010 Dragon 2 Program Symposium took place from 17 to 21 May in Yangshuo County, Guilin City, Guangxi Zhuang Autonomous Region, China. The symposium discussed the results achieved since the kick-off of the Dragon 2 Program two years ago and made planning for further cooperation.
The 6th China-UK Workshop on Space Science and Technology was held from 27 to 28 May in Wuhan, Hubei Province, China. Topics on lunar and deep space exploration, payload technologies, space science and experiments were discussed and multiple cooperation agreements were signed based on the cooperation platform of China-UK Joint Laboratory of Space Science and Technology.
On June 4-21, the Training Courses on GNSS and Its Applications, co-sponsored by the Chinese Ministry of Industry and Information Technology and the Asia-Pacific Space Cooperation Organization (APSCO), organized by Peking University, was held in Beijing. 18 participants from the APSCO member states including Bangladesh, Iran, Mongolia, Pakistan, Peru, Thailand and China participated in the 18-day training courses.
On June 17, the Chinese Government and the United Nations signed the host country agreement on establishment of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) Beijing Office in Vienna. On Nov. 10, the China National Committee for Disaster Reduction (NCDR), the Chinese Ministry of Civil Affairs, the Chinese Ministry of Foreign Affairs, China National Space Administration (CNSA) and UNOOSA jointly held the opening ceremony of UN-SPIDER Beijing Office in Beijing. UN-SPIDER Beijing Office. UNOOSA's first international agency in China, is an important cooperation result by China and UNOOSA in disaster prevention and reduction by use of space technology. The establishment of the office will help all countries over the world improve their disaster management capability by use of space technology and mitigate the effects of natural disasters on mankind.
A serious flood disaster hit Pakistan in late July, 2010. NDRCC immediately made an emergency observation plan for HJ1A/1B satellite to timely acquire the data on the affected area for rapid disaster evaluation, and provided HJ satellite data and products to the relevant organizations.
The 1st Asia/Oceania Meteorological Satellite Users' Conference was held on Nov. 1 in Beijing, China. The conference aimed to promote exchanges and cooperation on meteorological satellite remote sensing applications for users in Asia and Oceania, advance collaborative development of meteorological satellite applications in various countries, improve applications of satellite remote sensing in climate forecast/prediction and disaster prevention and mitigation, and expand more extensive applications to benefit society in the fields such as disaster, health care, energy, water resource, weather, ecosystem, agriculture and biological diversity.
On Nov. 3-5, China held the Seventh Plenary Session of the Group on Earth Observations (GEO-VII) & Beijing Ministerial Summit. The plenary session accepted 5 new member states including Gabon and Serbia, 2 new member organizations and 1 new observer. The ministerial summit adopted the Beijing Declaration, which called on member states and member organizations to take positive actions to make substantial contributions to the construction of the Global Earth Observation System of Systems (GEOSS) and the implementation of various tasks of GEO.
China Center for Resources Satellite Data and Application (CRESDA) implements the unified on-duty plan and arrangement of the secretariat according to the CHARTER and performs its routine duty as an Emergency on-Call Officer (ECO). In 2010, CRESDA was on duty for 42 days in total and received 5 disaster requests.

<table>
<thead>
<tr>
<th>Date</th>
<th>Disaster</th>
<th>Affected area</th>
<th>Satellite arrangement</th>
<th>Time upon receiving request</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-01-18</td>
<td>flood</td>
<td>Gaza</td>
<td>ESA, CSA, JAXA</td>
<td>23:56</td>
</tr>
<tr>
<td>2010-05-31</td>
<td>flood</td>
<td>Guatemala</td>
<td>CNES, CSA, JAXA, DMCii, USGS</td>
<td>00:40</td>
</tr>
<tr>
<td>2010-05-31</td>
<td>Volcanic eruption and flood</td>
<td>The US Indiana</td>
<td>Left for the next ECO</td>
<td>18:14</td>
</tr>
<tr>
<td>2010-08-02</td>
<td>flood</td>
<td>Pakistan</td>
<td>CNES, ESA, CSA, JAXA, USGS, DMCii</td>
<td>03:37</td>
</tr>
<tr>
<td>2010-12-03</td>
<td>Forest fire</td>
<td>Israel</td>
<td>CNES, JAXA, DMCii</td>
<td>23:04</td>
</tr>
</tbody>
</table>
Future EO plans

• Compendium of Medium and Long-Term National Science and Technology development Programs

• National Spatial Science development Programs of No.11&12 five-year planning
Main EO projects in future

- It is an important year for satellite launching in China in 2011. More than 20 satellites, such as TG – 1, SZ – 8, BeiDou series satellites will be launched by 2011’s end.
And also More than 20 satellites will be launched in the coming years, including four series of satellites.

- FY-4: Meteorology satellite
- HJ-1C: Environment satellite
- CBERS-03/04: Resource satellite
- Ziyuan–3: Resource satellite
The second geostationary meteorological satellite.

- Design life: 5 years;
- 12 channels of visible and infrared bands,
- Spatial resolution: 1 km for visible band, 4 km for infrared band.
- Will be approval by the government soon.
HJ – 1C will be launched in 2012.

<table>
<thead>
<tr>
<th>Parameters of HJ – 1C</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbot hight</td>
<td>~500km</td>
</tr>
<tr>
<td>weight</td>
<td>~690kg</td>
</tr>
<tr>
<td>size</td>
<td>1200mm×1200mm×3000mm</td>
</tr>
<tr>
<td>band:</td>
<td>S band</td>
</tr>
<tr>
<td>Ground resolution:</td>
<td>5m (single), 20m (4 view)</td>
</tr>
<tr>
<td>Band width:</td>
<td>40km (strip), 100km (scan)</td>
</tr>
<tr>
<td>Radiation resolution:</td>
<td>3dB</td>
</tr>
<tr>
<td>polarization</td>
<td>VV</td>
</tr>
<tr>
<td>Incident angle:</td>
<td>25~47°</td>
</tr>
<tr>
<td>life:</td>
<td>3 years</td>
</tr>
</tbody>
</table>
- Life: 3 years;
- Power of end of life is 2300W;
- CCD: resolution 5m, 10m and 20m;
- Infrared: resolution 40/80m;
- WFI: resolution 73m;
ZIYUAN - 3

ZIYUAN – 3 (high-resolution stereo survey satellite):

To provide data for surveying and updating large-scale relief maps,

- Using ZIYUAN – 2 platform;
- Life: 3 years;
- Resolution: 5m stereo, 2m orthophotomap, 10m multi spectrum data;
• SZ–8 is the newest Shenzhou spacecraft series
• SZ–8 is unmanned spacecraft and will join with TG –1 automatically
TG–1

- TG–1 is used to join with SZ-8, SZ-9, SZ-10 spacecraft and establish the first Space Lab and Space Station of China.
In 2020, all of the **BeiDou (COMPASS) Navigation** satellites will be launched and can provide international position service.
New Generation EO system

New-generation advanced Earth observation system Currently China is building a new-generation advanced Earth observation system focusing on developing Earth observation platforms based on high-resolution satellite, stratospheric airship and airborne remote sensing, establishing data center and ground operation system, thus resulting in all-weather and all-time Earth observation data acquiring and application capability. It will provide spatial data and information services for social and economic development areas such as disaster prevention and mitigation, environment protection and climate change, and participate in the global environment protection to jointly response to the major natural disasters.
Thanks!