Fengyun Meteorological Satellite and application service

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Satellite Status

GEO Programs
- FY-2D/E/F/G(op.)
- FY-4A(R&D), new generation!
- FY-2H(op.)

LEO Programs
- FY-3A/B(R&D)
- FY-3C(op.), AM
- FY-3D(op.), PM, Latest one!

Others (cooperative missions)
- TANSAT(R&D), CO2 & aerosol led by MOST
- GF-4 (R&D), High Spatial Res. Imaging In GEO led by CNSA
FengYun Programs: 8 in orbit, 6 in operation, 2 in orbit testing

Joint programs: Tansat, GF-4
1. FY-4A
   • The first GEO. meteorological satellite of new generation
   • Launched on Dec.11, 2016

2. FY-2H
   • The last one of FY-2 series
   • Launched on June 5, 2018
   • to support IOC and serve for the belt&road countries

3. FY-3D
   • A new operational afternoon orbit LEO. satellite, will co-work with FY-3C in morning orbit.
   • Launched on Nov. 15, 2017.

4. TANSAT
   • A joint R&D satellite program initiated by MOST.
   • Launched successfully on Dec.22, 2016

5. GF-4
   • The 1th High res. satellite in geostationary orbit. (The project was led by CNSA. CMA is responsible for data reception, transmission and preprocessing of MET mode.)
   • Launched in Dec. 29, 2015
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AGRI:</strong> Advanced Geosynchronous Radiation Imager</td>
<td>14-channel Earth images</td>
</tr>
<tr>
<td><strong>GIIRS:</strong> Geostationary Interferometric InfraRed Sounder</td>
<td>Clear-sky atmospheric temperature and humidity profiles</td>
</tr>
<tr>
<td><strong>LMI:</strong> Lightning Mapping Imager</td>
<td>Lightning distribution map in China area</td>
</tr>
<tr>
<td><strong>SEP:</strong> Space Environment Package</td>
<td>Space electric and magnetic environment information</td>
</tr>
</tbody>
</table>
AGRI’s Main Usage:
to get high temporal and spatial resolution images of Earth surface and atmosphere. Spatial resolution vary from 0.5Km to 4KM, and temporal resolution is 15m for full disc scanning and 1minute for regional scanning.

Advanced Geosynchronous Radiation Imager (AGRI)

AGRI has 14 channels with a spectral range of between 0.45μm and 13.8μm. Technically featuring a precisely-designed two-mirror structure, it is capable of making accurate and flexible sensing in two dimensions, and minute-level fast sector scanning. The onboard black body is available for IR calibration at very short time intervals.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channel</td>
<td>14, including 6 visible/near infrared bands, 2 mid-wave infrared bands, 2 water-vapor bands and 4 long-wave infrared bands</td>
</tr>
<tr>
<td>Spatial resolution</td>
<td>0.5-1 km (VIS/near IR), 2-4 km (IR)</td>
</tr>
<tr>
<td>Time for full-disc scanning</td>
<td>15 min</td>
</tr>
<tr>
<td>Time for sector scanning</td>
<td>1 min (1000km×1000km)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>S/N&gt;3 @ 1% (reflection bands)</td>
</tr>
<tr>
<td></td>
<td>NEΔT: 0.2K @ 300K (IR bands)</td>
</tr>
</tbody>
</table>
# GIIRS: Geo. Interferometric Infrared Sounder

<table>
<thead>
<tr>
<th>Working bands</th>
<th>Range</th>
<th>Resolution</th>
<th>Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>LWIR</td>
<td>700-1130 cm(^{-1})</td>
<td>0.8</td>
<td>538</td>
</tr>
<tr>
<td>S/MIR: 1650-2250 cm(^{-1})</td>
<td>1.6</td>
<td></td>
<td>375</td>
</tr>
<tr>
<td>VIS</td>
<td>0.55-0.75 μm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Spatial Resolution     |                    |            |          |
| LWIR/MWIR              | 16 Km              |            |          |
| VIS                    | 2 Km               |            |          |

| Operational Mode       |                    |            |          |
| China area             | 5000 x 5000 Km\(^2\) |            |          |
| Mesoscale area         | 1000 x 1000 Km\(^2\) |            |          |

| Temporal Resolution    |                    |            |          |
| China area             | <1 hr               |            |          |
| Mesoscale area         | <\(\frac{1}{2}\) hr |            |          |

| Radiation Calibration accuracy | 1.5 K (3\(\sigma\)) |
| Spectral Calibration accuracy | 10 ppm (3\(\sigma\)) |
LMI: lightning Mapping Imager

Acquire lightning distribution maps over China region

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial resolution</td>
<td>About 2.4 km at 560 m</td>
</tr>
<tr>
<td>Wave-length at center</td>
<td>777 Å</td>
</tr>
<tr>
<td>Band-width</td>
<td>1 mm</td>
</tr>
<tr>
<td>Detection efficiency</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Polarization ratio</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Dynamic range</td>
<td>&gt;100</td>
</tr>
<tr>
<td>DNR</td>
<td>&gt;5</td>
</tr>
<tr>
<td>Frequency of scans</td>
<td>2 km (500 frames per sec.)</td>
</tr>
<tr>
<td>Quantization bits</td>
<td>12</td>
</tr>
<tr>
<td>Measurement error</td>
<td>10%</td>
</tr>
</tbody>
</table>
1. FY-4A lightning frequency map: strong convective cloud clusters often accompany with obvious lightnings.

2. FY-4A high spatial resolution imager: finer structure and texture of strong convective cloud cluster; and clearer small scale cumulus line.

3. Cloud free atmospheric profile acquired from GIIRS can be used for nowcast.
# FY-4A Baseline Products

<table>
<thead>
<tr>
<th>FY-4A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cloud</strong></td>
</tr>
<tr>
<td>Cloud Mask</td>
</tr>
<tr>
<td>Cloud Top Temperature</td>
</tr>
<tr>
<td>Cloud Top Height</td>
</tr>
<tr>
<td>Cloud Top Pressure</td>
</tr>
<tr>
<td>Cloud Type</td>
</tr>
<tr>
<td>Cloud Phase</td>
</tr>
<tr>
<td>Daytime Cloud optical and microphysical properties</td>
</tr>
<tr>
<td>Nighttime cloud optical and microphysical properties</td>
</tr>
<tr>
<td><strong>Atmosphere</strong></td>
</tr>
<tr>
<td>Quantitative Precipitation Estimate</td>
</tr>
<tr>
<td>Layer Precipitable Water</td>
</tr>
<tr>
<td>Atmosphere Motion Vector</td>
</tr>
<tr>
<td>Atmospheric Temperature Profile</td>
</tr>
<tr>
<td>Atmospheric Humidity Profile</td>
</tr>
<tr>
<td>Cloudy Vertical Temperature Profile</td>
</tr>
<tr>
<td>Cloudy Vertical Moisture Profile</td>
</tr>
<tr>
<td>Aerosol Detection</td>
</tr>
<tr>
<td>Atmosphere Instability Index</td>
</tr>
<tr>
<td>Convective Initiation</td>
</tr>
<tr>
<td>Tropopause Folding Turbulence Prediction</td>
</tr>
<tr>
<td>Total Ozone Amount</td>
</tr>
<tr>
<td>Ozone Profile</td>
</tr>
<tr>
<td><strong>Radiation</strong></td>
</tr>
<tr>
<td>Outgoing Long wave Radiation</td>
</tr>
<tr>
<td>Surface Solar Irradiance</td>
</tr>
<tr>
<td>Downward Longwave Radiation</td>
</tr>
<tr>
<td>Upward Longwave Radiation</td>
</tr>
<tr>
<td>Reflected Shortwave Radiation</td>
</tr>
<tr>
<td><strong>Surface</strong></td>
</tr>
<tr>
<td>Sea Surface Temperature (Skin)</td>
</tr>
<tr>
<td>Land Surface Temperature</td>
</tr>
<tr>
<td>Snow Cover</td>
</tr>
<tr>
<td>Land Surface Albedo</td>
</tr>
<tr>
<td>Land Surface Emissivity</td>
</tr>
<tr>
<td>Evapotranspiration products</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
</tr>
<tr>
<td>Dust/Smoke Detection</td>
</tr>
<tr>
<td>Fire/Hot Spot Characterization</td>
</tr>
<tr>
<td>Fog Detection</td>
</tr>
<tr>
<td><strong>Lightning</strong></td>
</tr>
<tr>
<td>One Minute Lightning Quantitative Product</td>
</tr>
<tr>
<td>(including flash group event)</td>
</tr>
<tr>
<td>Lightning Jump Identification Product</td>
</tr>
<tr>
<td>Flash Daily Density</td>
</tr>
<tr>
<td><strong>Space</strong></td>
</tr>
<tr>
<td>High energy particle distribution</td>
</tr>
<tr>
<td>Magnetic Field Intensity</td>
</tr>
<tr>
<td>Space Environment Effect</td>
</tr>
</tbody>
</table>
Examples of FY-4 products

- SST
- Fire/Hot Spot
- AOD
- Snow Cover
- Land Surface Emissivity
- LST
北京时：2018-05-29 08:00:00
北京时：2018-05-25 09:00:00
北京时：2018-05-24 09:00:00
Caused by the strong south wind, the sand storm happened in north-western Indian and eastern Pakistan. The sand storm spread northward then eastward when it reached the Himalayas.
FY4A Dust-IDDII

Without Dust-IDDII Assimilation

With Dust-IDDII Assimilation

(NIU. Et al)
positive effect on rainfall area and intensity
FY-2H: To support IOC and serve the Belt & Road countries

- Launched on June 5, 2018
- positioned at 79° E and to be operational by September, 2018

Covering the central Africa in the west and Oceania in the east, FY2-H provides exclusive services for countries along the Belt and Road.
**FengYun Programs:** 8 in orbit, 6 in operation, 2 in orbit testing

**Joint programs:** Tansat, GF-4
## FY-3: Comprehensive Observation Capability

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Measurement</th>
<th>FY-3A/B/C Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Atmosphere</strong></td>
<td>Cloud/Fog Properties</td>
<td>MERSI VIRR IRAS MWRI MWHS</td>
</tr>
<tr>
<td></td>
<td>Total Water Vapor</td>
<td>VIRR MERSI MWRI</td>
</tr>
<tr>
<td></td>
<td>Precipitation</td>
<td>MWHS MWRI</td>
</tr>
<tr>
<td></td>
<td>Aerosol Properties</td>
<td>MERSI VIRR TOU</td>
</tr>
<tr>
<td></td>
<td>Atmospheric Temperature and Humidity</td>
<td>IRAS MWTS MWHS GNOS</td>
</tr>
<tr>
<td></td>
<td>Total Ozone and Ozone Profile</td>
<td>TOU SBUS IRAS</td>
</tr>
<tr>
<td></td>
<td>Land Cover</td>
<td>VIRR MERSI</td>
</tr>
<tr>
<td></td>
<td>Surface Temperature</td>
<td>VIRR</td>
</tr>
<tr>
<td></td>
<td>Vegetation Dynamics</td>
<td>VIRR MERSI</td>
</tr>
<tr>
<td></td>
<td>Fire and Flood Monitoring</td>
<td>VIRR MERSI</td>
</tr>
<tr>
<td></td>
<td>Surface Wetness</td>
<td>MWRI</td>
</tr>
<tr>
<td><strong>Ocean</strong></td>
<td>Sea Surface Temperature</td>
<td>VIRR MWRI</td>
</tr>
<tr>
<td></td>
<td>Sea Surface color</td>
<td>MERSI</td>
</tr>
<tr>
<td></td>
<td>Sea Surface Wind Speed</td>
<td>MWRI</td>
</tr>
<tr>
<td><strong>Cryosphere</strong></td>
<td>Sea Ice</td>
<td>MERSI VIRR MWRI</td>
</tr>
<tr>
<td></td>
<td>Snow Cover</td>
<td>VIRR MWHS MERSI MWRI</td>
</tr>
<tr>
<td><strong>Radiation Budget</strong></td>
<td>Earth’s Radiation and Solar Irradiance</td>
<td>ERM SIM</td>
</tr>
<tr>
<td><strong>Space Environment</strong></td>
<td>High Energy Particles</td>
<td>SEM GNOS</td>
</tr>
<tr>
<td></td>
<td>Radiation Dose</td>
<td></td>
</tr>
</tbody>
</table>
Global coverage

Cover globally 2 times a day (1 satellite)
Global data latency within 2 hours (80%) -> 1 hour
deployed in afternoon orbit, 10 instruments on board the satellite:

- **5 Successive instruments:**
  - MWTS-II: Microwave Temperature sounder
  - MWHS-II: Microwave Humidity sounder
  - MWRI: Microwave Radiation Imager
  - GNOS: Microwave Navigation Occultation Sounder
  - SEM: Space Environment Monitor

- **2 Improved instruments:**
  - MERSI-II: Improved from MERSI
  - HIRAS: Upgraded from filter-type spectrometer

- **3 New Instruments:**
  - GAS: Greenhouse gases Absorption Spectrometer
  - WAI: Wide-angle Aurora Imager
  - IPM: Ionospheric Photometer

**FY-3D:** Launched on 15, Nov.
<table>
<thead>
<tr>
<th>Primary Usage</th>
<th>Band</th>
<th>Band Center (um)</th>
<th>Bandwidth (nm)</th>
<th>Spatial Resolution (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land/Cloud/Aerosols Boundaries</td>
<td>1</td>
<td>0.470</td>
<td>50</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.550</td>
<td>50</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.650</td>
<td>50</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.865</td>
<td>50</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1.24/1.03</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>1.64</td>
<td>50</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>2.13</td>
<td>50</td>
<td>1000</td>
</tr>
<tr>
<td>Ocean</td>
<td>8</td>
<td>0.412</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td>Color/Phytoplankton/Biogeochemistry</td>
<td>9</td>
<td>0.443</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>0.490</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>0.555</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>0.670</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>0.709</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>0.746</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>0.865</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td>Water Vapor</td>
<td>16</td>
<td>0.905</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>0.936</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>0.940</td>
<td>50</td>
<td>1000</td>
</tr>
<tr>
<td>Cirrus Cloud</td>
<td>19</td>
<td>1.38</td>
<td>20/30</td>
<td>1000</td>
</tr>
<tr>
<td>Surface/Cloud</td>
<td>20</td>
<td>3.8</td>
<td>180</td>
<td>1000</td>
</tr>
<tr>
<td>Temperature</td>
<td>21</td>
<td>4.050</td>
<td>155</td>
<td>1000</td>
</tr>
<tr>
<td>Water vapor</td>
<td>22</td>
<td>7.2</td>
<td>500</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>8.550</td>
<td>300</td>
<td>1000</td>
</tr>
<tr>
<td>Surface/Cloud</td>
<td>24</td>
<td>10.8</td>
<td>1000</td>
<td>250</td>
</tr>
<tr>
<td>Temperature</td>
<td>25</td>
<td>12.0</td>
<td>1000</td>
<td>250</td>
</tr>
</tbody>
</table>
Good consistency in global distribution and AOD of pollution sources.
Snow depth/SEW

MWRI Sea ice
✓ In Orbit testing began on December 12\textsuperscript{th}, 2017;
✓ the testing has been finished. The results show that the satellite platform and main payloads functions well, and meets the requirements;
ECMWF has analysed FY-3A/B data quality through a careful assessment, including the first guess departures, comparisons with corresponding ATOVS instruments, and a comprehensive series of observing system experiments (OSEs).

….FY-3 meteorological satellite is set to become an increasingly important component of the global satellite system, supporting NWP centers worldwide,.....the date quality ......is now comparable to that from equivalent US and European meteorological satellites.

<table>
<thead>
<tr>
<th></th>
<th>FY-3B MWH</th>
<th>FY-3C MWTS2</th>
<th>FY-3C MWHS 2</th>
<th>FY-3C MWRI</th>
<th>FY-3C IRAS</th>
<th>FY-3C GNOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECMWF</td>
<td>Op Da</td>
<td>Can be Op Da</td>
<td>Op Da</td>
<td>To be Op Da</td>
<td>Monitor ing</td>
<td>Op Da</td>
</tr>
<tr>
<td>UKMO</td>
<td>Op Da</td>
<td>Can be Op Da</td>
<td>Op Da</td>
<td>To be Op Da</td>
<td>Evaluation</td>
<td></td>
</tr>
<tr>
<td>CMA NWPC</td>
<td>Evaluation</td>
<td>Can be Op Da</td>
<td>Op Da</td>
<td>To be Op Da</td>
<td>Op Da</td>
<td></td>
</tr>
</tbody>
</table>

![Better](image1)

![Worse](image2)
Satellite in orbit

FengYun Programs: 8 in orbit, 6 in operation, 2 in orbit testing

Joint programs: Tansat, GF-4
TANSAT A joint mission between CMA and CAS (Chinese Academy of SCIENCES), and financed by MOST.
Mission objective: to monitor global CO2 concentration in atmosphere.

TANSAT satellite was successfully launched in Dec. 22, 2016.
1) ACGS (Atmospheric CO2 Grating Spectrometer) is mainly used for CO2 monitoring. It has three spectral bands: the oxygen absorbing band; weak and strong carbon dioxide absorbing band.

**Instrument Specification: ACGS**

<table>
<thead>
<tr>
<th></th>
<th>O2A</th>
<th>CO2 weak</th>
<th>CO2 strong</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral Range</td>
<td>758 – 776 nm</td>
<td>1594 – 1624 nm</td>
<td>2042 – 2082 nm</td>
</tr>
<tr>
<td>Spectral Resolution</td>
<td>0.033 – 0.044 nm</td>
<td>0.12 – 0.142 nm</td>
<td>0.16 – 0.182 nm</td>
</tr>
<tr>
<td>SNR</td>
<td>360</td>
<td>250</td>
<td>180</td>
</tr>
<tr>
<td>Spatial Resolution</td>
<td>2 km x 1 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swath</td>
<td>20 km</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2) CAPI (Cloud and Aerosol Polarization Instrument) is a 5-channel UV/ VIS/ NIR/ SWIR radiometer with three polarizations in two channels.
**Satellite Working Mode**

- TanSat has three observation modes: nadir, sunglint and target.
- Tansat also use solar and lunar viewings for spectral and radiometric calibration.
Demonstration of observing process
The first spectra of TanSat
TanSat: The irradiance of nine cross-track positions show good consistency.
Tansat data and products include:

- **Level 1A** --- Digital number
- **Level 1B** --- calibrated and geolocated data
- **Level 2** --- retrieved products, such as XCO2, surface pressure, AOD, etc.
- **Level 3** --- global maps of XCO2.

Tansat products will be open-access and free of charge.
Gaofen-4 (GF-4)

- Launched on 29 December 2015, Location at 105.6°E
- GF-4 is China’s first high resolution geostationary satellite. Its spatial resolution is 50m at visible and near infrared band, and 400m at mid-infrared band. Its temporal resolution can reach several seconds.
- Useful for the monitoring of rapid growing meso- or small scale convective system.
Our studies show that to capture the evolution of a rapid growing meco-or small scale convective system, the observation frequency should be less than 1 minute.
By 2021, new generation Geo satellites will form an operational pattern of “two satellites in operation, and one in orbit backup”. Fengyun LEO satellites will form a constellation and cover all the earth surface more than 6 times a day.
## Sensor Suite Table

<table>
<thead>
<tr>
<th>NO.</th>
<th>Sensor Suite</th>
<th>Sensor Siute</th>
<th>FY-3E (05) EM Satellite</th>
<th>FY-3F (06) AM Satellite</th>
<th>FY-3G (07) PM Satellite</th>
<th>FY-3R (08) Rainfall Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scheduled Launch Date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Optical Imagers</td>
<td>MERSI</td>
<td>√ (III-Low Light)</td>
<td>√ (III)</td>
<td>√ (III)</td>
<td>√ (III-Simplified)</td>
</tr>
<tr>
<td>2</td>
<td>Passive Microwave Sensors</td>
<td>MWTS</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MWHS</td>
<td>√</td>
<td>√</td>
<td>√</td>
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<tr>
<td></td>
<td></td>
<td>MWRI</td>
<td>√</td>
<td>√</td>
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<tr>
<td>3</td>
<td>Occultation Sounder</td>
<td>GNOS</td>
<td>√</td>
<td>√</td>
<td>√</td>
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<tr>
<td>4</td>
<td>Active Microwave Sensors</td>
<td>WindRAD</td>
<td>√</td>
<td>√</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Rainfall RAD</td>
<td></td>
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<tr>
<td>5</td>
<td>Hyperspectral Sounding Sensors</td>
<td>HIRAS</td>
<td>√</td>
<td>√</td>
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<tr>
<td></td>
<td></td>
<td>GAS (Greenhouse Gases Absorption Spectrometer)</td>
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<td></td>
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<td>OMS (Ozone Mapping Spectrometer)</td>
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<td>6</td>
<td>Radiance Observation Sensor Suite</td>
<td>ERM</td>
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<td></td>
<td></td>
<td>SiM</td>
<td>√</td>
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<tr>
<td></td>
<td></td>
<td>SSIM (Solar Spectral Irradiation Monitor)</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>7</td>
<td>Space Weather Sensor Suite</td>
<td>SEM</td>
<td>√</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Wide Angle Aurora Imager</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Ionosphere photometer</td>
<td>√(Multi-angle)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Solar X-EUV Imager</td>
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<td></td>
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<td>------------------------------------------------</td>
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<tr>
<td>AGRI (Advanced Geo. Radiation Imager)</td>
<td>✓</td>
<td>✓</td>
<td></td>
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<tr>
<td>GIIRS (Geo. Interferometric Infrared Sounder)</td>
<td>✓</td>
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<tr>
<td>LMI (Lightning Mapping Imager)</td>
<td></td>
<td>✓</td>
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<tr>
<td>RSI (Rapid Scan Imager)</td>
<td>✓</td>
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<tr>
<td>SWOP (Space Weather Observation Package)</td>
<td>✓</td>
<td>✓</td>
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</tr>
</tbody>
</table>
Data Service

Integrated Space/Ground Based Data Service System

❖ Real time Data:
  ▪ DB station
  ▪ CMACast station

❖ Non Real Time
  ▪ Website
  ▪ Manual Service

Data Service
http://satellite.nsmc.org.cn

- All 10PB archived data (real time)
- Satellites’ information
- Satellite images browse
- Documents and tools

User:  freely register,

❖ Normal:    500MB/day
❖ Junior:     3GB/day
❖ Senior:     10GB/day
ECMWF has analysed FY-3A/B data quality through a careful assessment, including the first guess departures, comparisons with corresponding ATOVS instruments, and a comprehensive series of observing system experiments (OSEs).

….FY-3 meteorological satellite is set to become an increasingly important component of the global satellite system, supporting NWP centers worldwide,…..the date quality ……is now comparable to that from equivalent US and European meteorological satellites. 
Satellite observation plays an irreplaceable role in TC monitoring and forecasting. Using satellite data and products, the TC intensity, path, and rainfall area can be estimated.
The optical and microphysical cloud products derived from FY-4 can be used to monitor strong convection systems.

Products that may be used for strong convection monitoring

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRI</td>
<td>Cloud type</td>
</tr>
<tr>
<td></td>
<td>Cloud phase</td>
</tr>
<tr>
<td></td>
<td>Cloud pressure/height/temperature</td>
</tr>
<tr>
<td></td>
<td>Atmospheric motion vector</td>
</tr>
<tr>
<td></td>
<td>Convective initiation</td>
</tr>
<tr>
<td></td>
<td>Tropopause folding</td>
</tr>
<tr>
<td>GIIRS</td>
<td>Temperature profile</td>
</tr>
<tr>
<td></td>
<td>Water vapor profile</td>
</tr>
<tr>
<td></td>
<td>Instability index (K/SI/TT/CAPE)</td>
</tr>
</tbody>
</table>
FY-4 Convective Initiation and Mature Convection detection

1. Convective targets Identification
2. Multi Targets Track
3. Cooling Rate of Cloud Top temperature
Because of effective measures taken for the overall management and protection of Taihu Lake environment since year of 2007, blue algae pollution is decreasing significantly in size.
Application in global environmental monitoring

Monitoring Antarctic Ozone hole by FY-3A/B/C

The trend of the minimal area of Sea Ice Coverage
Fire monitoring
Drought Monitoring

Italia

Australia
Global vegetation

FY3C MERSI 5KM 10 days NDVI 20140710(UTC)
SATs: New Observation Capability

Application tools

Weather monitoring and analysis
---Geostationary Satellite data (FY-2/FY-4)
Satellite Weather Application Platform -SWAP

Natural disaster and environment monitoring and analysis
---polar orbiting Satellite data
Satellite Monitoring Application Remote sensing Toolkit -SMART

Users: New Applications
Flowchart of 3D-ADVP

- Conventional observation
- Remote sensing images
- Sat. retrieved data
- NWP data
- Other data

Data fusion

Efficient massive data organization scheme
The global scale range of atmospheric data lie in three-dimensional spherical space around the earth. We developed a direct visual technology to support fast 3D browse view on multiple parameters such as cloud, temperature and so on from any angle and cutting profile.
Thank you for your attention
Slides for backup
China provides timely and efficient observation of extreme weather, climate and environmental events regionally and globally by operating both geostationary and polar-orbiting meteorological satellites. China Meteorological Administration (CMA) introduced the Emergency Support Mechanism of FENGYUN (FY) Satellite (FY ESM) in 2018, open to international users who made a request once visited by such extreme events as typhoon, heavy rain, severe convection, forest or grassland fire and sand and dust storm. In this case, the on-duty FY satellite is activated to initiate highly frequent observation of a given area at an interval of up to 5 minutes, processing and generating images and quantitative products, which are provided through such channels as CMACast, Internet and direct satellite broadcasting, to inform the processes of disaster preparedness, mitigation and relief in a timely fashion.
• **Geostationary meteorological satellites**  
As of August 2018, the on-orbit geostationary FY series are operating from 4E to 173W, the data from which are used for severe weather monitoring and forecasting.

<table>
<thead>
<tr>
<th>Position</th>
<th>Sat</th>
<th>Operating mode</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>79°E</td>
<td>FY-2H</td>
<td>Normal observation (hourly, 28 full-disc images/day)</td>
<td>Data available</td>
</tr>
<tr>
<td>86.5°E</td>
<td>FY-2E</td>
<td>Bi-sat observation (half-hourly, 28 full-disc images/day)</td>
<td>Data available</td>
</tr>
<tr>
<td>99.5°E</td>
<td>FY-2G</td>
<td>Bi-sat observation (hourly, 28 full-disc images/day)</td>
<td>Data available</td>
</tr>
<tr>
<td>104.7°E</td>
<td>FY-4A</td>
<td>Normal observation (40 full-disc images/day, 165 images of China and its surrounding areas)</td>
<td>Data available</td>
</tr>
<tr>
<td>112°E</td>
<td>FY-2F</td>
<td>Area scanning</td>
<td>Emergency observation services and data available</td>
</tr>
</tbody>
</table>
- **Polar-orbiting meteorological satellites**

  As of August 2018, the FY polar-orbiting meteorological satellites operating on-orbit include FY-3B, FY-3C and FY-3D, which are open to regional users for a requested data support to disaster monitoring and analyses.

<table>
<thead>
<tr>
<th>Position</th>
<th>Sat</th>
<th>Operating mode</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIRR</td>
<td>FY-3B, FY-3C</td>
<td>1km</td>
<td>L1, L2</td>
</tr>
<tr>
<td>MERSI</td>
<td>FY-3B, FY-3D</td>
<td>250m, 500m, 1km</td>
<td>L1, L2</td>
</tr>
</tbody>
</table>
User Registration

User application

- The eligibility of a user is open to Members of World Meteorological Organization (WMO). A Permanent Representative with WMO presents a written application to the Permanent Representative of China with WMO and designates a focal point as an authorized user contact. CMA opens an authorized account for an applicant for activation of FY ESM.

User change

- In case that it is deemed necessary to change the focal point of an authorized user, the Permanent Representative of this user with WMO presents a written application to the Permanent Representative of China with WMO.
**Conditions for a Request**

An international user may request CMA to activate FY ESM before, during and after an extreme event such as typhoon, heavy rain, severe convection, forest or grassland fire and sand and dust storm, etc., with one of the following references provided:

- **Typhoon**: The central wind force exceeds 28m/s and the impact is expected to be felt within 24 hours;
- **Heavy rain and severe convection**: It is expected that the rainfall will exceed 200mm within 24 hours;
- **Fire**: A forest/grassland fire breaks out, posing a grave threat;
- **Flood**: A widespread flood looms large;
- **Other extreme events predicted to pose a grave threat.**
Response priority

When receiving a request for emergency support, which conflicts with other emergency requests, CMA will prioritize such requests subject to the performance of the watch satellite and the development of the said event, the order of which is generally as follows: · An event of higher impact is given a higher priority; · An event of more recent occurrence is given a higher priority
Lead Time for Emergency Response and Support

An international user shall make a request preferably 24 hours in advance when it needs to activate the FY geostationary meteorological satellite for intensive observation of a given area to, with the maximum duration of intensive observation being no more than 48 hours. Any extension needs to be re-requested. If and when an international user needs data observed by FY polar-orbiting meteorological satellites, each requested duration shall not exceed 7 days. Any extension needs to be re-requested.
1. The focal point of an authorized user logs in to the service website (http://fy4.nsmc.org.cn/service/en/emergency/index.html) to submit, as required, the requested temporal and spatial ranges for emergency support;

2. When receiving the request, CMA will determine whether to initiate the emergency mechanism. If yes, an email notification will be sent to inform the focal point of the exact start and end times, locations and methods of data acquisition. If the initiation fails for any reason, an email notification will be sent.

3. The emergency-oriented observation is started and completed to generate appropriate data and products, which are provided to the user through the Internet, satellite broadcasting, etc.