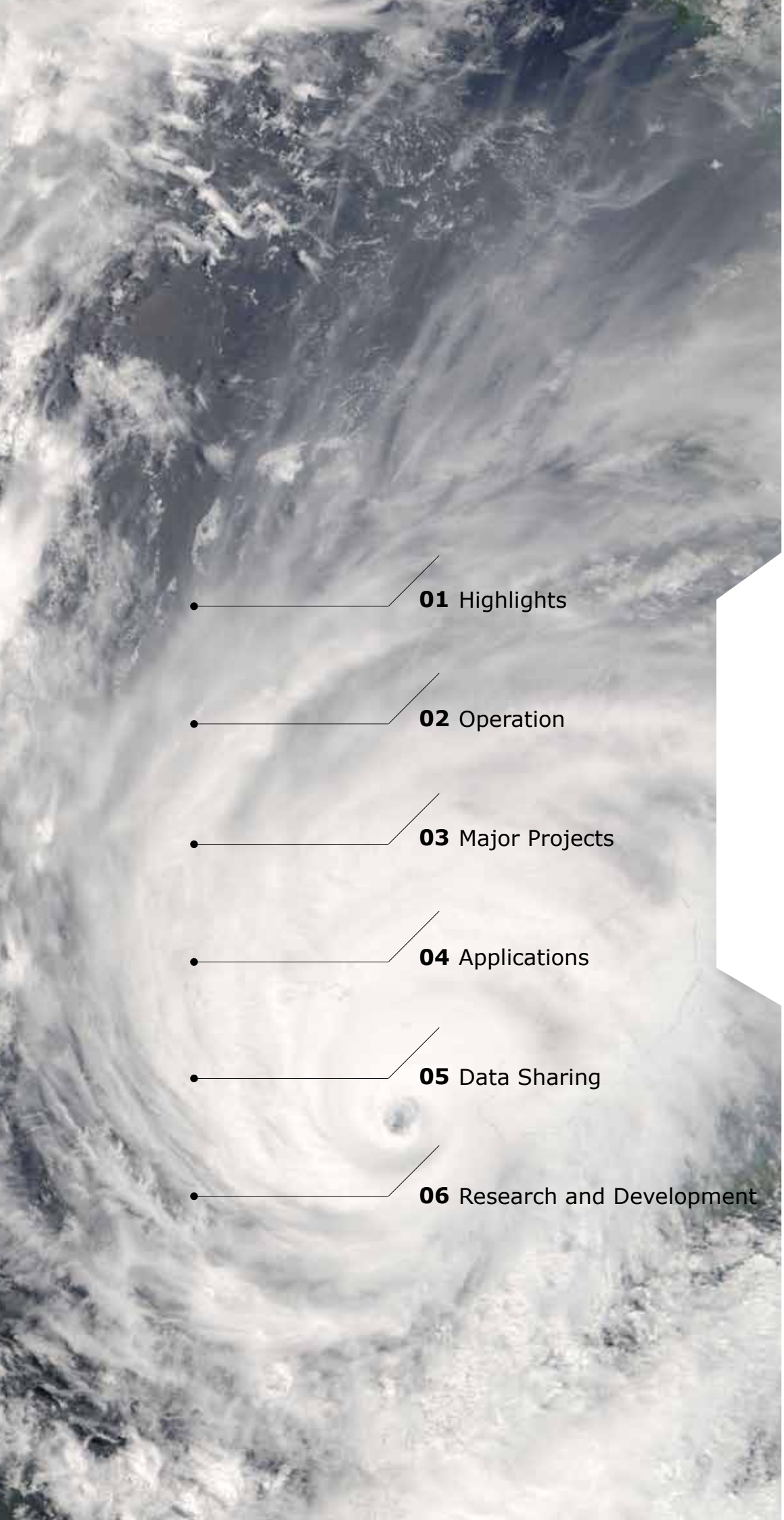
National Satellite Meteorological Center
(National Center for Space Weather), CMA

# 風雲

# 2015 VOL.4
# FENGYUN Bulletin

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

# Contents



# 01 Highlights

*Fig. 1. A forum on the development of space weather forecast*

## 1. National Observatory for Space Weather

To integrate the needed resources, optimize the current structures of space weather forecast, and to enhance the capabilities of space weather forecast serving the national economy, National Observatory for Space Weather (NOSW) was, with the approval of China Meteorological Administration (CMA), created on November 27, 2015 at the facilities of the National Space Weather Monitoring and Warning Center.

The newly established NOSW is mandated to prepare and release space weather forecasts, services and products at the national level. It facilitates the sharing and exchange of the space-born or ground-born observations or forecast products, and the assessment of possible impacts of space weather hazards on the human society as well as on the national security, providing tailored emergency support services to decision-makers and professional users.

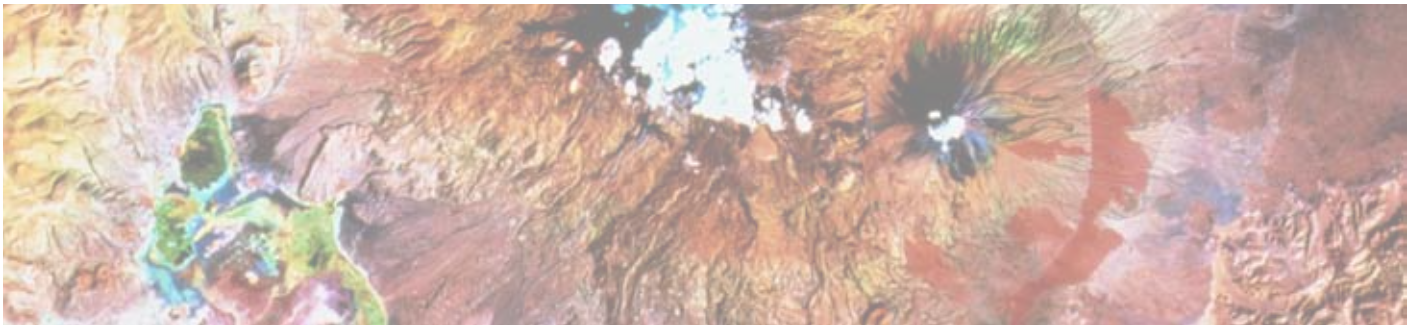


*Fig. 2. A ceremony in honor of the establishment of the new center.*

## 2. Center of Remote Sensing Application and Service

Approved by CMA, Center of Remote Sensing Application and Service was established on December 2, 2015, in a bid to boost the social and economic benefits derived from FY satellites, enhancing the support to meteorological satellites based remote sensing activities and providing an enhanced data service to users both at home and abroad.

The new center is designed to prepare and provide remote sensing application products and services at the national level to users both at home and abroad and to the public as well, facilitating the reconstruction and sharing of satellite remote sensing data, enhancing the technological support to remote sensing applications, and providing remote sensing services to both decision makers and the public. Meanwhile, the center will conduct weather, climate, environment and disaster related remote sensing activities, and create satellite data and application platforms.

## 3. Meteorological Satellite Users Office

Upon the approval of CMA, a special users unit, or the Meteorological Satellite Users Office, was established on October 9, 2015 to supervise the quality of meteorological satellites and associated payloads.

The Office is mandated to take care of the quality control issues concerning meteorological satellites and associated payloads.


*Fig. 3. A users unit was established to deal with the quality control issues of meteorological satellites and payloads.*

## 2. International visits

| NO | Date | Substance |
|---|---|---|
| 1 | October 4-10 | Liu. J and Xian D. attended a meeting held in Canada to facilitate the exchange of satellite data between North America, Europe and Asia-Pacific |
| 2 | October 6-10 | Zhang J. S. was present at a seminar and a space forum sponsored by the CGMS socio-economic benefits working group in France |
| 3 | October 10-15 | Wu X.J. attended a World Meteorological Organization RA-II Disaster Risk Reduction Symposium convened in Indonesia |
| 4 | October 14- 23 | Chen Z.H. and Chiu H. J. participated in a meeting held in Belgium to discuss international cooperation on FY-3 solar radiation observations |
| 5 | October 10 | 15 members of the 45th multi-national study tour visited the National Satellite Meteorological Center (NSMC) |
| 6 | October 21 | 45 participants from different countries who were attending the third round course of climate change and green low-carbon development visited the NSMC |
| 7 | October 25-31 | Zheng W. presented a CMACast/MICAPS system maintenance training at Malaysian Meteorological Service in Malaysia |
| 8 | October 26 | 6 participants who attended the 9th China-Russia meteorological cooperation JWG meeting visited the NSMC |
| 9 | October 27-November 5 | Zhang P., a deputy NSMC director, and Lu Q. F. attended the 20th International TOVS Conference held in the United States |
| 10 | November 1-7 | Wei C. Y. a deputy NSMC director, Zhang J.S., Fan J. L. and Liu N. Q. participated in the 29th CEOS Plenary held in Japan |
| 11 | November 1-29 | Nie J. and Yin H. G. were present at the 2015 World Radio Conference held in the Switzerland |
| 12 | November 2-7 | Xu Z. attended a EUMETSAT forum on long series scientific data archival and management held in Germany |
| 13 | November 8-14 | Wei C. Y. a deputy NSMC director, Zhang J. S., Guo Q. and Fang X. participated in the 6th Asia-Oceania Meteorological Satellite Users Conference held in Japan |
| 14 | November 8-12 | Zhang X. H. attended a maritime satellite user working group meeting held in Australia |
| 15 | November 9-15 | Zhao D.T., a deputy NSMC director, and Zhang X. Y. attended the 12th GEOSS Plenary and the 4th Ministerial Meeting held in Mexico |
| 16 | November 15-19 | Liu R. X. participated in the First International Meteorological Satellite Congress sponsored by the KMA in South Korea |
| 17 | January 15-29 | Fan J. L. attended a global agriculture monitoring innovation projects meeting held in Belgium |
| 18 | January 16-22 | Lu F. participated in the 10th satellite expert group meeting and a WIGOS seminar held in the Switzerland |
| 19 | January 17-22 | Zhang P., a deputy NSMC director, participated in a WIGOS 2040 space meeting held in the Switzerland |
| 20 | December 13-20 | Huang C. attended the 2015 American Geophysical Union Fall Meeting held in the United States |

# 02 Operation

## 1. Geostationary

### 1.1 FY-2E

Date Event

October13: Moon shadow management conducted during 0846-1259 (UTC). Cloud image reception operations suspended at 0830, 0900, 0930, 1030, 1130, and 1230.

October18: Fall earth shadow management ended.

December22-23: South-north orbit maintenance conducted during 0200 of December 22 - 0900 of December 23. The orbital inclination was realigned from 2.95 degree to 1.21 degree.

### 1.2 FY-2F

Date Event

October 2-5: A special regional observation was initiated at 0342 of October 2 (UTC) with a 6-minute interval to monitor Typhoon Dujuan, covering an area of 10-30ºN. The observation ended at 0730 of October 5 (UTC). The operation collected 549 regional images.

October 13: Moon shadow management conducted during 0630-0730 (UTC). Cloud image reception suspended at 0630, 0730, 1030, and 1130.

October 30: Attitude and east-west orbit maintenance was made during 0730-0830 (UTC). Cloud image reception suspended at 0730.

October 22: Fall earth shadow management ended.

December 21: East-west orbit maintenance was made during 0730-0830 (UTC). Cloud image reception suspended at 0800.

### 1.3 FY-2G

Date Event

October 9: East-west orbit maintenance was made during 0730-0830 (UTC). Cloud image reception suspended at 0800.

October 13: Moon shadow management conducted during 0657-0818 (UTC), and during 1111-1226 (UTC). Cloud image reception suspended at 0700, 0800, 1100, and 1200.

October 13-15: A daily solar transit management was made during 0458-0501 (UTC). Cloud image reception suspended at 0500.

October26: Fall earth shadow management ended.

November 24: Attitude and east-west orbit maintenance was made during 0730-0830 (UTC). Cloud image reception suspended at 0800 (UTC).

December 1-4: Operation was suspended at 1900 of December 1 (UTC) due to the failure of scanning radiometer calibration mirror. Operation was resumed at 0535 of December 4 (UTC). The period secured the reception of 72 cloud images.

## 1.4 FY-2 operation statistics

*FY-2 operation statistics*

| Mon | SATELLITE VISSR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FY2E | | | FY2F | | | FY2G | | |
| | Plan | Real | Success rate | Plan | Real | Success rate | Plan | Real | Success rate |
| Oct | 828 | 827 | 99.88% | 1275 | 1274 | 99.92% | 755 | 752 | 99.60% |
| Nov | 840 | 839 | 99.88% | 840 | 838 | 99.76% | 839 | 838 | 99.88% |
| Dec | 812 | 812 | 100% | 866 | 866 | 100% | 796 | 794 | 99.75% |

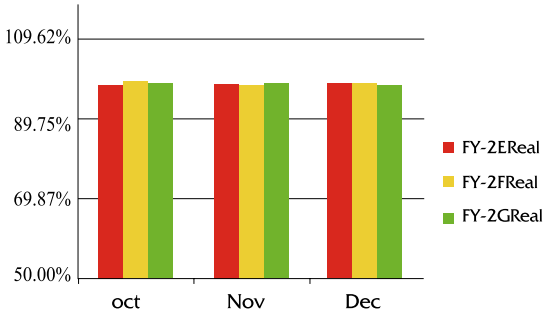



*Fig.4 FY-2 operation statistics*

# 2. Polar-orbiting

## 2.1 FY-3B

*FY-3B operation statistics*

| | Oct | | | Nov | | | Dec | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plan | Real | Success rate | Plan | Real | Success rate | Plan | Real | Success rate |
| HRPT | 423 | 418 | 98.82% | 411 | 410 | 99.77% | 423 | 422 | 99.76% |
| MPT | 423 | 421 | 99.53% | 411 | 410 | 99.77% | 423 | 422 | 99.76% |
| DPT | 422 | 416 | 98.58% | 410 | 407 | 99.27% | 422 | 421 | 99.76% |

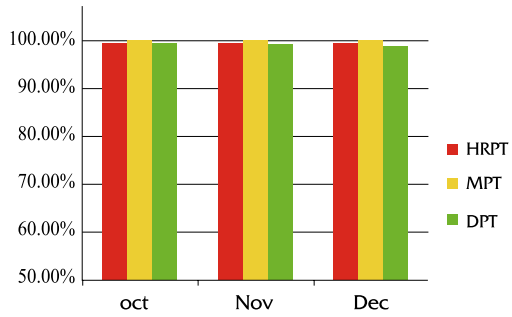



*Fig.5 FY-3B operation statistics*

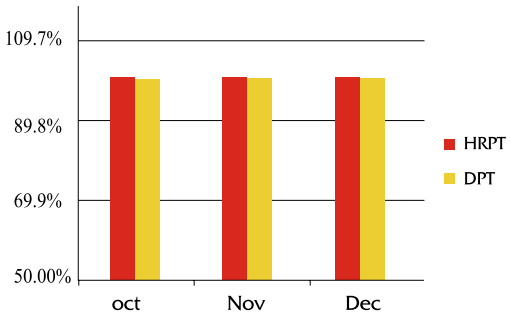



*Fig.6 FY-3C operation statistics*

## 2.2 FY-3C

*FY-3C operation statistics*

| | Oct | | | Nov | | | Dec | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plan | Real | Success rate | Plan | Real | Success rate | Plan | Real | Success rate |
| HRPT | 425 | 418 | 98.35% | 409 | 408 | 99.76% | 424 | 424 | 100% |
| DPT | 424 | 415 | 97.88% | 408 | 402 | 98.53% | 423 | 419 | 99.05% |

# 03 Major Projects


*Fig. 7. A FY-4 prototype design review meeting*

## 1. FY-4 prototype design endorsed

A FY-4 prototype design review meeting, sponsored by China Aerospace Science and Industry Corp. No. 8 Institute, was held on November 30, 2015 in Shanghai. The participants reviewed a range of documents, including a FY-4 prototype design report, an analysis report on the prototype's reliability, safety, and design, and a risk identification and evaluation analysis report. After a thorough review and discussion, the participants unanimously agreed to endorse the design.

The prototype development is a stage supposed to complete the product design, production and dual-mode tests, including power performance tests, mechanical and thermal tests, docking the satellite with the rocket, ground control system and ground application system, payload calibration, and refitting the physical satellite to be launched before its delivery to users. It has to test a range of other parts of the launch, including satellite launch pad, satellite launch and in-orbit tests.

## 2. Second Space Weather Standardization Committee session

The Chinese National Standardization Committee approved on January 27, 2015 to establish the second session of the National Technical Commitee 347 on Satellite Meteorology and Space Weather Monitoring of Standardization Administration of China(SAC/TC347).

SAC/TC 347 was created on April 2008, responsible for the standardization of meteorological satellites operation and associated data monitoring, transmission and exchange. It also takes care of space weather related monitoring, forecasting, early warning activities, among others.

China has since 2008 released and enforced 5 national standards and 38 industrial standards in the area. In addition, 24 more industrial standards are on the list to be revised as a meteorological standard. The enforced standards have found effective applications in meteorological operations, enhanced the operation and service capabilities of satellite meteorology and space weather, and met the needs of national economic development and disaster prevention/mitigation.

In 2015 alone, 5 industrial standards have been released in the area of meteorology. They are the QX/T 266-2015 concerning the field radiometric calibration of meteorological satellite remote sensors, the QX/T 267-2015 on satellite remote sensing fog products preparation, the QX/T 294-2015 for solar radio traffic observation, the QX/T 295-2015 on verifying the results of short-term space weather forecasts, and the QX/T 296-2015 for the operation flows of FY ground application systems.

# 04 Applications

## 1.Northern China hit by severe haze in fourth quarter

Having entered the winter season, the northern part of China was geared up to provide heating for its residents. As a result, some part of northern China reported biomass burning that increased the emission of particulate matters. Meanwhile, this part of China enjoyed a relatively stable atmospheric condition with an increased relative humidity, which hampered the diffusion of contaminants. The combined effects encouraged the repeated incidences of hazy weather in northern China. Chinese meteorological satellites spotted 17 incidences of hazy weather in October, 11 in November and 7 in December. Hazy weather mainly prevailed over the northern and northeastern part of China, affecting the Huang-Huai Basin as well. Some severe hazy weather processes were reported, including the one that occurred in early November across the northeastern and northern part of China. Beijing reported two red labeled heavy pollution processes during December 8-10 and December 19-22.

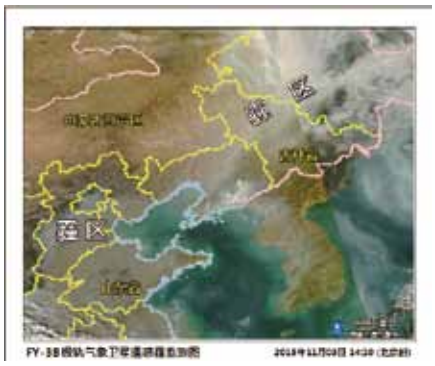


*Fig. 8. An image stemmed from FY-3B at 1410 of November (Beijing Time)*

An image (Fig. 8) derived from FY-3B at 1410 of November 3 showed that in the cloudless areas or the areas with few clouds, Heilongjiang Province stood out with severe haze. Both Liaoning and Jilin reported moderate haze, with severe haze in some localities. A range of plains from Beijing to Shijiazhuang had moderate haze. The eastern part of Tianjin and Hebei, the northern part of Henan and Shandong registered mild haze.

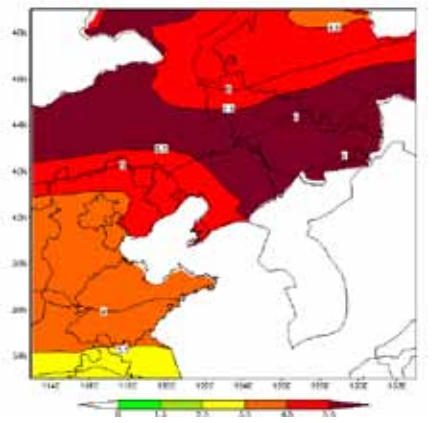


*Fig. 9. Absorbing aerosols index (AAI) collected by FY-3B/TOU in the afternoon of November 3, 2015.*

The absorbing aerosols index (AAI) (Fig. 9) collected by FY-3B/TOU, a polar-orbiting meteorological satellite, showed that the above-mentioned areas had an AAI higher than 4.0, with the one having severe haze exceeding 6.0.

An image (Fig. 10) stemmed from FY-3B at 1400 of December 20 showed that in the cloudless areas or the areas with few clouds, an array of areas have witnessed moderate or severe haze, including Beijing, the central and southern part of Hebei, most part of Henan, western Shandong, most part of Hubei, Shanxi and Shaanxi. In the above-mentioned areas, the AAI collected by FY-3B/TOU sat between 3.5 and 4.5, suggesting an obvious aerosol impact on the areas.

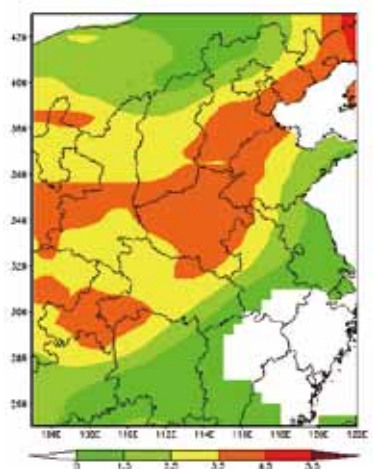


*Fig. 10. An image derived from FY-3B at 1400 of December 20, 2015 (Beijing Time)*

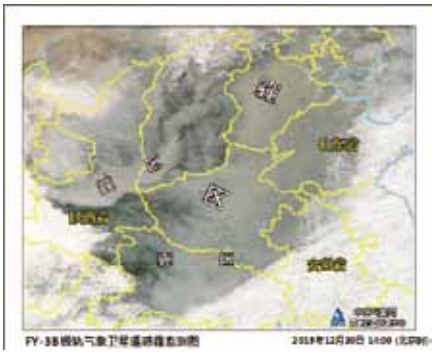


*Fig. 11. AAI collected by FY-3B/TOU in the afternoon of December 20, 2015.*

## 2. Earth magnetic storms in October

A significant earth magnetic storm hit China during October7-9 of 2015 (Beijing Time). As a result, most part of the country reported ionospheric disturbances, with southern China having ionospheric storms. Some localities, including Nanning and Xiamen, registered a significantly descended critical frequency in the ionosphere. Some local shortwave communications were affected because of the earth magnetic storm. Meanwhile, in some localities, pigeons training and homing were affected to some degrees.

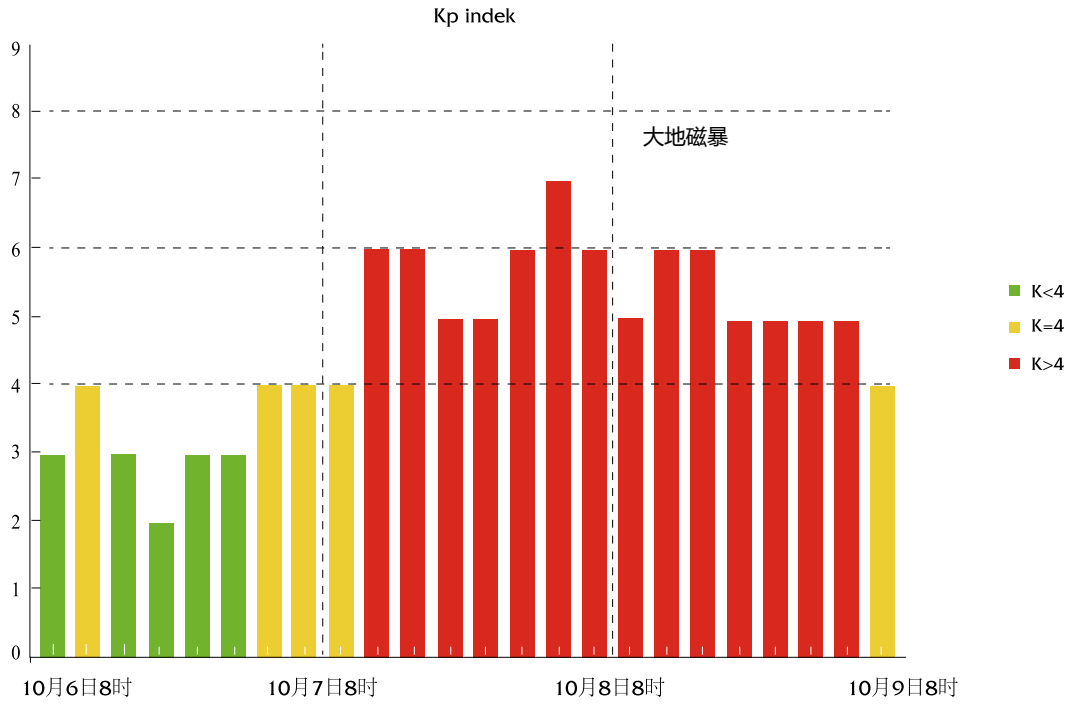



*Fig. 12. Earth magnetic storms*

# 05 Data Sharing

NSMC provided 9,139,326 files in a data volume of 245,423.28GB during the fourth quarter of 2015 (October-December). Of them:

Online orders reached 10,561 in number (2,824,623 files in a data volume of 121,216.00GB);

FY files accounted for 2,578,164 in number, in a data volume of 76,227.29GB, (FY-1: 1 file in 0.09GB; FY-2: 719,975 files in 24,142.87GB; and FY-3: 1,858,188 files in 52,084.33GB);

Some 6,314,703 FTP files were downloaded in a data volume of 124,207.28GB. Wherein, EUMETCast files reached 180,653 in number, with a data volume of 878.54GB.

## 1.User behavior statistics

*Tab.4 User behavior statistics*

| | Oct | Nov | Dec | Total |
|---|---|---|---|---|
| No. of registered users | 110 | 98 | 106 | 314 |
| No. of visit | 1901 | 2136 | 2689 | 6726 |
| No. of order | 2919 | 3396 | 4246 | 10561 |
| Files ordered | 507955 | 655921 | 1660747 | 2824623 |

## 2 Online data order

*Online orders in the first quarter of 2015 by number of files*

| Online orders in the first quarter of 2015 by number of files | | | | |
|---|---|---|---|---|
| Spacecraft | Oct | Nov | Dec | Total |
| FY-3C | 156564 | 33779 | 1134092 | 1324435 |
| FY-2E | 42952 | 41391 | 213496 | 297839 |
| FY-3A | 229214 | 53972 | 7216 | 290402 |
| FY-3B | 95578 | 50971 | 96802 | 243351 |
| FY-2D | 72285 | 66393 | 73199 | 211877 |
| MSG-2 | 0 | 112693 | 4 | 112697 |
| FY-2F | 15086 | 14323 | 60316 | 89725 |
| FY-2G | 10866 | 15774 | 42955 | 69595 |

*Online orders in the first quarter of 2015 by number of files*

| Online orders in the first quarter of 2015 by number of files | | | | |
|---|---|---|---|---|
| Spacecraft | Oct | Nov | Dec | Total |
| FY-2C | 9151 | 17147 | 24641 | 50939 |
| MSG-3 | 4 | 42216 | 2 | 42222 |
| MTSAT-2 | 12510 | 20715 | 662 | 33887 |
| COMM | 4010 | 24743 | 558 | 29311 |
| MTSAT-1R | 100 | 12387 | 1121 | 13608 |
| TERRA | 3776 | 748 | 3260 | 7784 |
| AQUA | 3686 | 344 | 2300 | 6330 |
| NOAA-18 | 102 | 323 | 101 | 526 |
| GOES-9 | 0 | 24 | 22 | 46 |
| NOAA-17 | 27 | 0 | 0 | 27 |
| NOAA-15 | 4 | 0 | 0 | 4 |
| NOAA-16 | 5 | 12 | 0 | 17 |
| FY-1D | 1 | 0 | 0 | 1 |
| Total | 655921 | 507955 | 1660747 | 2824623 |

*Online orders in the fourth quarter of 2015 by data volume*

| Online orders in the first quarter of 2015 by number of files | | | | |
|---|---|---|---|---|
| Spacecraft | Oct | Nov | Dec | Total |
| FY-3A | 21938.13 | 12067.58 | 1043.98 | 35049.69 |
| MSG-2 | 0 | 19201.37 | 1.13 | 19202.5 |
| FY-2D | 9202.26 | 832.98 | 1733.05 | 11768.29 |
| MTSAT-2 | 3525.3 | 5826.95 | 124.64 | 9476.89 |
| FY-3B | 1313.21 | 5165.95 | 2154.44 | 8633.6 |
| FY-3C | 3000.03 | 2509.67 | 2891.34 | 8401.04 |
| MSG-3 | 1.13 | 7511.9 | 0.56 | 7513.59 |
| FY-2E | 2236.87 | 2520.24 | 2437.79 | 7194.9 |
| MTSAT-1R | 0.02 | 3468.37 | 315.98 | 3784.37 |
| TERRA | 1295.93 | 316.22 | 1163.05 | 2775.2 |
| FY-2F | 458.81 | 549.31 | 1123.09 | 2131.21 |
| AQUA | 1289.14 | 145.5 | 684.4 | 2119.04 |
| FY-2G | 434.96 | 420.84 | 789.47 | 1645.27 |
| FY-2C | 673.67 | 626.75 | 102.78 | 1403.2 |
| COMM | 0.84 | 69.42 | 2.72 | 72.98 |
| NOAA-18 | 9.51 | 10.41 | 10.72 | 30.64 |
| GOES-9 | 0 | 9.26 | 0.32 | 9.58 |
| NOAA-17 | 2.47 | 0 | 0 | 2.47 |
| NOAA-16 | 0.1 | 1.34 | 0 | 1.44 |
| FY-1D | 0.09 | 0 | 0 | 0.09 |
| NOAA-15 | 0.01 | 0 | 0 | 0.01 |
| Total | 45382.48 | 61254.06 | 14579.46 | 121216.00 |

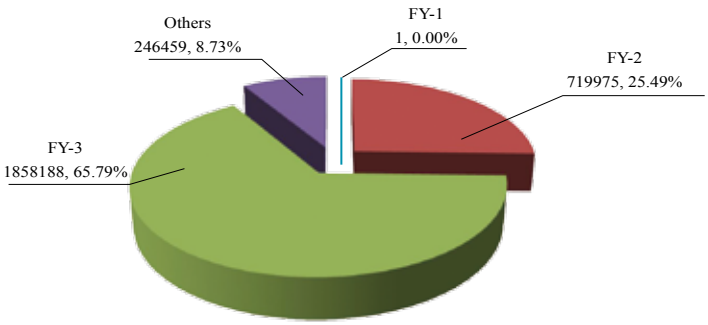
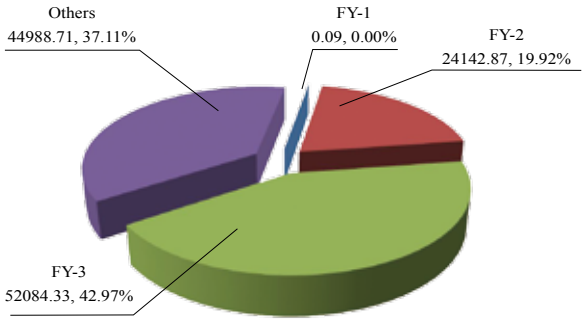



Fig. 13. Online FY data files ordered in the fourth quarter of 2015.




Fi5. 14. Data volume of online FY files ordered in the fourth quarter of 2015.

# 06 Research and Development

## 1. Increasingly enhanced quality of FY cloud-derived wind products

FY-2 cloud-derived wind is a major quantitative product provided by FY satellite data applications. It is also one of the quantitative products to be further enhanced under a meteorological satellite modernization plan.

To enhance the quality of cloud-derived wind products, a task force, led by Xu J. M., a Chinese Academy of Engineering academician, solicited users' evaluation and comments of the quality of cloud-derived wind products, and worked out a range of solutions to enhance the quality of products. The task force established a strict quality control procedure for cloud data input, and employed a noise removal algorithm based on middle-level value filtering to eliminate the interference of noise data. Efforts have also been made to correct forecast errors, and develop a dedicated solution to handle abnormal images, ensuring the stability of products quality. Scientists also introduced a blackbody calibration method (CIBLE) to raise the accuracy of calibration. Meanwhile, they enhanced the accuracy of cloud wind inversion, using a re-tracking algorithm to re-track the areas with a correlation coefficient larger than 0.8, so as to obtain a more accurate wind speed. Scientists also applied in the inversion process a greatest contribution pixel method to determine the height of wind vector, enhancing the tracking density. When a tracking area is completely covered by clouds, they employed a steadily amplified search approach to spot a ground point with clear air in the region, and obtain a brightness temperature that can be a proxy to the cloud-covered region, enhancing the accuracy of wind vector height of the products. The above-mentioned enhancements have been put into operation one after another, and consequentially quadrupled the number of wind vectors in the products, from 5,000 to 25,000 or so, with a significantly enhanced accuracy that has passed international peers' review. According to the real-time monitoring results released by the ECMWF portal, the deviation of FY-2E full infrared wind sample has declined from -3m/s to -1m/s, and the standard deviation from 7m/s to 5.7m/s. The enhanced quality has reached an internationally advanced level.

In a report released by ECMWF in 2015 on the quality of cloud-derived wind products, it is stated that long-term monitoring statistics demonstrated that FY-2E has in recent years increasingly enhanced the quality of its cloud-derived wind products, enjoying a fine development trend. The current analysis shows that FY-2E's cloud-derived wind products have a quality in parallel to that of other geostationary satellites. The assimilation of Meteosat-7 and FY-2E cloud-derived wind products would have a neutral-to-positive impact on models.

## 2. Comparisons of emissivity observations from satellites and the ground at the CRCS Dunhuang Gobi site

Two sets of field measured high spectral emissivity spectra were taken from the CRCS Dunhuang site, with one representing daytime and the other representing nighttime. Comparison of them shows that the daytime emissivity is smaller than nighttime from 7.5 to 14 μm, a strong field evidence to support emissivity diurnal variations, which have been reported from previous studies using satellite observations. The diurnal variations are believed to be related to the soil moisture content; warmer surface skin temperature causes more evaporation of soil moisture than adsorption; and less soil moisture leads to lower emissivity values. These emissivities are used as reference to evaluate three different emissivity products from the same site: the Atmospheric InfraRed Sounder (AIRS) operational emissivity products, the Moderate Resolution Imaging Spectroradiometer (MODIS) operational emissivity products, and the University of Wisconsin - Madison High Spectral Resolution IR emissivity (UWIREMIS) database. The results show that the AIRS emissivity has a worse agreement with the field measurements compared to MODIS and the UWIREMIS despite of the fact that AIRS is a hyperspectral InfraRed (IR) sounder. The AIRS V6 demonstrates a major improvement over the V5; the temporal variations are much more stable and reasonable than the V5. However, the AIRS V6 still has difficult to capture emissivity diurnal variation well. The relative poor quality of AIRS emissivity is likely cause by cloud contamination due to the large AIRS footprint. The broadband imager, MODIS, has the advantage of high spatial resolution and VIS/NIR channels to help cloud mask. The MODIS emissivity retrieval therefore is less affected by cloud contamination compared with AIRS. The results show that the V4.1 MODIS emissivity has a better agreement with the field measurement than the UWIREMIS, but not the V5. The temporal analysis of MODIS V4.1 emissivity reveals reasonable seasonal variations; emissivities from the warmer season are smaller than cold season, which is also possibly related to soil moisture content. The UWIREMIS has an agreement with the field measurements not as good as the MODIS V4.1. However, the advantage of the UWIREMIS over the operational MODIS emissivity products is the high spectrum, which makes it much easier for application.

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