

• Meeting Summary •

The First Fengyun Satellite International User Conference

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1. Introduction

The First Fengyun Satellite International User Conference, sponsored by the China Meteorological Administration (CMA) and China National Space Administration (CNSA), took place during 15–17 November 2019 in Haikou, Hainan Province, China. The purpose of this initial conference was to develop a comprehensive mechanism for Fengyun satellite international users to exchange their applications, discuss an integrated approach to promote global applications of FY satellite data, and to better serve countries and users along the “Belt and Road”. Experts from over 30 countries, the World Meteorological Organization (WMO), the Asia-Pacific Space Cooperation Organization (APSCO), the National Oceanic and Atmospheric Administration (NOAA), the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), and the Sixth International Strategic Consultative Committee on Chinese Meteorological Satellite Programmes (ISCC), attended this conference (Fig. 1).



Fig. 1. Opening ceremony of the First Fengyun Satellite International User Conference (Photo taken by Jingtian LU).

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The conference included one plenary session and three thematic sessions. In the plenary session, invited speakers from the CMA, CNSA, WMO, NOAA, EUMETSAT, and APSCO presented separate overviews of the Chinese Fengyun meteorological satellite program, the European meteorological satellite program, the United States meteorological satellite program, and the Chinese Gaofen satellite program, as well as APSCO activity in Asia and Pacific regions. In the three thematic sessions, Chinese and foreign representatives and experts entered into intensive discussions in areas that included global data sharing, application and services of FY satellites, international application needs, and global weather and forecasting applications, as well as global ecological environmental monitoring and applications. One sub-session discussed studies on big data and deep learning technology in relationship to their use in Fengyun satellite image generation and aerosol algorithm output. In addition, a Fengyun satellite international service delivery exhibition was held. As part of that exhibition users were shown how to access FY data and products via the FY-3 and FY-4 satellite direct broadcasting systems, the CMACast data broadcasting system, the Satellite Weather Application Platform (SWAP), and the Meteorological Information Combined Analysis and Process System (MICAPS).

2. Status and development of Fengyun satellites

Fengyun meteorological satellites are developed by the CMA and CNSA. Seventeen Fengyun meteorological satellites have been successfully launched since 1988 and seven are in orbit operating at this time (2019), including four geostationary-orbit satellites and three polar-orbit satellites (Dong et al., 2009; Yang et al., 2018; Zhang et al., 2019). The four geostationary-orbit Fengyun satellites are providing both full-disk earth observations and rapid-scan imagery. Their orbital positions are 79°E (FY-2H), 99.5°E (FY-2G), 105°E (FY-4A) and 112°E (FY-2F). FY-4A (105°E) is the first of the new generation geostationary Fengyun satellites. FY-4A carries four new instruments: the Advanced Geosynchronous Radiation Imager (AGRI), the Geosynchronous Interferometric Infrared Sounder (GIIRS), a Lightning Mapping Imager (LMI), and a Space Environment Package (SEP) (Yang et al., 2017). AGRI is capable of taking 40 full-disk cloud images and 165 Asia-region cloud images in a 24-h period. GIIRS is the first hyperspectral infrared sounder in geostationary orbit and it is designed to provide data for determining high vertical resolution temperature and humidity information; such observational data are very useful for improving numerical weather prediction models and nowcasting of severe weather. LMI provides 10-km-resolution lightning data over the Asia area or western Australia; it is designed to detect lightning flashes every two milliseconds, and those data are then used to generate a variety of lightning products every minute. SEP performs continuous space environment observations. FY-3D is the newest polar-orbit Fengyun satellite, with 10 instruments on board. The Medium Resolution Spectral Imager (MERSI-II) takes global observations at a 250-m spatial resolution. Several passive microwave instruments probe the atmosphere to provide information on humidity and temperature. The Wide-field Aurora Imager (WAI), Ionospheric Photometer (IPM), and other space-weather-related instruments detect different kinds of parameters of space from multi-spectral bands. FY-2H is the last one of the FY-2 series geostationary-orbit Fengyun satellites. Based on requirements from WMO and the observational needs for Indian Ocean Data Coverage (IODC), China decided to move the sub-satellite point of FY-2H from 86.5°E to 79°E from June 2018. This shift in FY-2H's subpoint allows for China's Fengyun geostationary satellite system to provide broader coverage with near continuous satellite observations for regions of China and countries and regions along the "Belt and Road".

Fengyun satellites have been adopted by the WMO for operational meteorological services and China has also become a member of the International Charter Space and Major Disasters (CHARTER) for international disaster prevention and mitigation. In the opening ceremony, Dr. Wenjian ZHANG, the Assistant Secretary-General of WMO, said that Fengyun meteorological satellites are playing an important role in WMO's Integrated Global Observing System (WIGOS) and that the development of the Fengyun satellites is highly consistent with the WMO's vision for the future space-based component of WIGOS. Dr ZHANG also stated that he hoped all countries would take full advantage of the application value of the Fengyun satellites to promote their own weather services and to help bring about positive socioeconomic gains. At present, the Fengyun satellite program benefits more than 100 countries and 2700 users with a space-ground integrated data sharing system.

3. International applications and requirements

Fengyun satellite data are widely used around the world. The Fengyun Satellite Data Center website (<http://data.nsmc.org.cn>) is well known by international users who are actively performing earth remote-sensing research; users from 105 countries are registered on this website (Xian et al., 2016). An international survey carried out by NSMC at the end of 2019 showed that most Belt & Road countries are interested in the Fengyun satellite applications, but need to become more familiar with the instrument capabilities of the Fengyun satellites and their corresponding data formats. There is also a need for familiarization in terms of the use of various tools to improve utilization across the region. To further address the needs, prior to the conference, the NSMC released a web version of SWAP (<http://rsapp.nsmc.org.cn/geofy/en>)

to attendees in order to collect their requirements.

Fourteen oral reports from different countries and regions were presented at the conference. Those presentations addressed satellite acquisition, including Fengyun satellite acquisition; independently developed satellite applications or applications via the SWAP platform; and their requirements to the Fengyun satellite. Somkuan TONJAN from the Thai Meteorological Department (TMD) showed their application of Fengyun satellite data in Thailand. He stated that Fengyun satellite data are very useful for Thailand because a coordinate position matches Thailand precisely, allowing TMD to use the products to monitor, via their Early Warning System, phenomena such as tropical storm tracks and areas of heavy rain. S. JAVZMAA from Environment and Monitoring of Mongolia (NAMEM) presented their utilization of Fengyun satellite data and products. NAMEM uses FY-4A satellite products to diagnose synoptic-scale weather patterns, track the growth of individual convective storms, differentiate high from low clouds, ice clouds from liquid clouds, and distinguish between low clouds, snow, dust, land and water surfaces.

4. Global weather monitoring and forecasting applications

Presentations on global weather monitoring and forecasting applications showed how Fengyun satellite data are being received and used in weather forecasting and nowcasting. FY-3D HIRAS, GNOS, MWTS-2 and MWRI data have been assimilated in the GRAPES-4DVar system (Global four-dimensional variational analysis system) to improve NWP.

A scene-dependent 1DVar (SD1dvar) algorithm has been tested for both microwave sounding instruments and hyperspectral infrared instruments onboard FY-3D. Results show that the SD1dvar algorithm, when using these FY-3D data, is able to retrieve reasonable thermal structures for tropical cyclones (Hou et al., 2019; Weng et al., 2020).

New-generation geostationary satellite imager data are being used in nowcasting-related activities, including convective initiation, thunderstorm top features and storm properties, mesoscale convective systems, and storm classification (Li et al., 2018). A convective storm occurrence prediction model has been developed using the Machine Learning technique, based on combined high-spatiotemporal-resolution GEO imager and short-range NWP data.

5. Global ecological and environmental monitoring applications

Applications of Fengyun satellite data in the field of global ecological and environmental monitoring were also presented. An integrated wildfire detection method using multi-meteorological satellite data (FY-2, FY-3 and FY-4) is being operated by the NSMC. The real-time wildfire results from FY-4A can also be found on the webpage of the SWAP platform. The product is very timely, and in cases with rapid scan can be updated every 5 min. A validation study of AOD (aerosol optical depth) from FY-3C MRESI-I showed that the result is similar to MODIS. Validation of FY-3D MERSI-II is underway with high expectations due to new surface reflectance bands on MERSI-II.

6. Summary

This conference was the first in a planned series of international Fengyun meteorological satellite conferences to address applications and the broad user community. A diverse variety of topics addressed weather, environment, and climate applications with Fengyun meteorological satellite data, as well as in the fields of data verification, deep learning and artificial intelligence. The CMA plans to host Fengyun meteorological satellite international user conferences every two years. These conferences will play an important role in the Fengyun meteorological satellite system in designing services for supporting the Belt and Road initiative.

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