HY-2A Satellite User's Guide

National Satellite Ocean Application Service

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Contents

1 Introduction to HY-2 Satellite

The HY-2 satellite, launched on 16 August 2011, is China's first ocean dynamic environment satellite with all weather and 24-hour capabilities for observing ocean dynamic environment parameters such as sea surface wind field, sea surface height, significant wave height and sea surface temperature etc. This satellite integrates the active and passive microwave remote sensors, high accurate orbit tracking and determination system.

HY-2 satellite is equipped with radar altimeter, microwave scatterometer, scanning microwave radiometer and calibration microwave radiometer as well as DORIS, dual-band GPS and laser range reflector. The radar altimeter is used for measuring the sea surface height, significant wave height and wind speed etc; the microwave scatterometer is mainly used for observing the global sea surface wind field; the scanning microwave radiometer is mainly used for observing global sea surface temperature, sea surface wind field, water vapor content in the atmosphere, cloud moisture, sea ice and rainfall amount etc; and the calibration microwave radiometer measures atmospheric water vapor necessary for altimeter measurement calibration. The technical specifications are summarized as follows:

Table 1-1 Radar altimeter technical specifications

Working frequency	13.58GHz, 5.25GHz
Pulse limited footprint	≤ 2 km
Height measuring accuracy	≤ 4 cm (ocean sub-satellite point)
Effective wave height measuring range	0.5∼20 m
Effective wave height measuring accuracy	0.5 m

Table 1-2 Microwave scatterometer technical specifications

Working frequency		13.256 GHz
Polarization mode		HH, VV
Ground footprint		≤ 50 km
Swath	H- polarization	> 1350 km
	V- polarization	>1700 km
Wind speed range		2∼24 m/s
Wind speed accuracy		2 m/s
Wind direction accuracy		20 °

Table 1-3 Scanning microwave radiometer technical specifications

Working frequency (GHz)	6.6	10.7	18.7	23.8	37.0
Polarization mode	VH	VH	VH	V	VH
Scanning swath (km)	>1600				
Ground footprint (km)	100	70	40	35	25
Sensibility(K)	>0.5				>0.8
Accuracy of calibration (K)	1.0 (180～320)				
Dynamic range (K)	3～350				

Table 1-4 Calibration microwave radiometer technical indexes

Working frequency (GHz)	18.7	23.8	37.0
Polarization mode	linear polarization		
Sensibility(K)	0.4	0.4	0.4
Accuracy of calibration (K)	1.0 (180～320)		
Dynamic range (K)	3～300		

Table 1-5 HY-2 satellite orbit parameters

Orbit	Sun synchronous
Inclination	99.34 degrees
Descending local time	6:00 am
Repeat cycle	Phase I mission：104.46 min., Phase II：104.50 min.
Designed life	3 years
Satellite dimension	8.56 m×4.55 m×3.185 m
Mass	≤1575 kg
Output power	1550 W

2 HY-2 satellite data reception and processing

2.1 HY-2 satellite data reception

The HY-2 satellite data are received by three ground stations located in China including Beijing, Sanya and Mudanjiang Station. HY-2 satellite observes global oceans in one day. Data within ground views of the three stations are received in real time and data over the other parts of the global oceans are dumped from onboard memory.
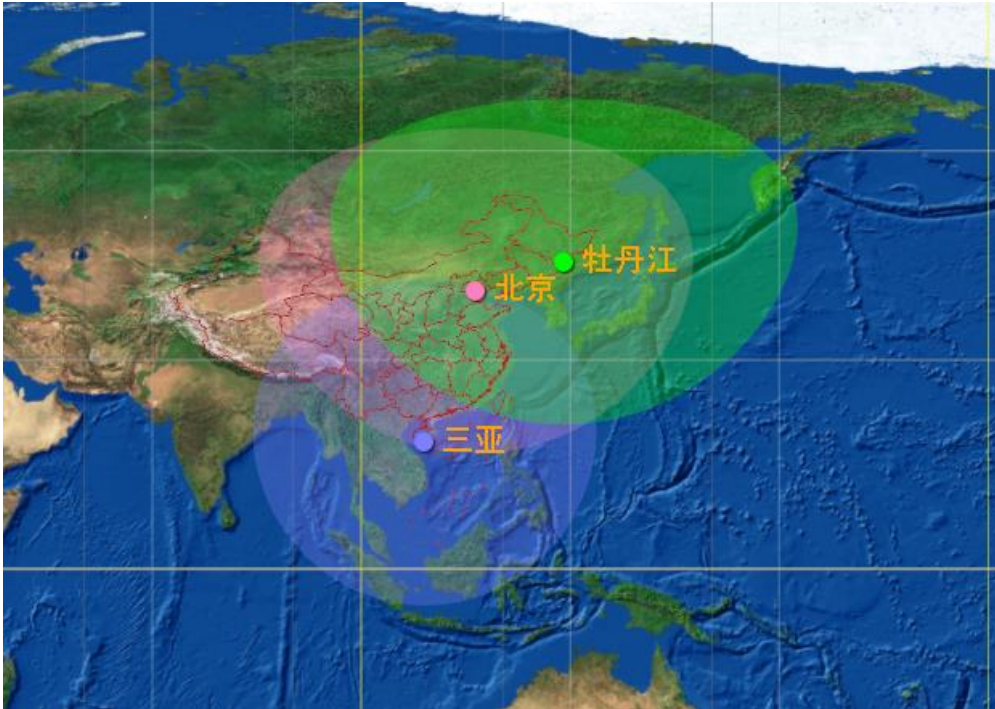
Fig. 2-1 HY-2 satellite ground stations reception coverage

2.2 HY-2 satellite data processing system

The data processing system for HY-2 satellite includes Operation and Control Subsystem, Data Preprocessing Subsystem, Precise Orbit Determination Subsystem, Data Processing Subsystem, Product Archive and Distribution Subsystem, Operational data Applications Subsystem, and Calibration and Validation Subsystem. The data processing system performs routine operations for data processing, products archiving and distribution, and is the key component for HY-2 satellite operational mission of global oceanic dynamic environment observations. The data processing system has the following characteristics:

1) Runs 24 hours a day, 7 days a week.

2) Performs stable and reliable receiving, processing, and distributing operations for radar altimeter, microwave scatterometer, scanning microwave radiometer and calibration microwave radiometer, as well as DORIS, dual-band GPS and laser ranging data.

3) Exceeds 300 TB of online data storage for ground system.

4) Supports 5000 users simultaneously accessing the data service website.

Level 2 and Level 3 products are provided to users, which are generated from the raw data of HY-2 satellite after multiple station combination, precise orbit preprocessing, medium precision orbit ephemeris (MOE), precise orbit ephemeris (POE) processing steps.
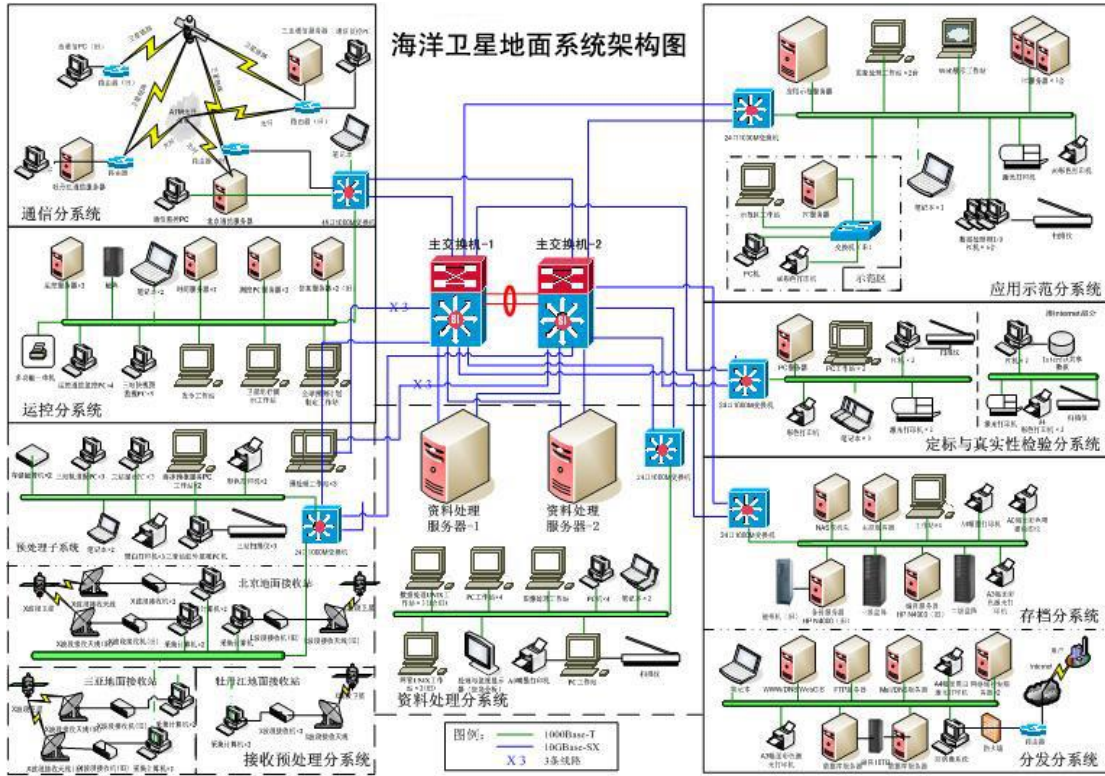
Fig.2-2 HY-2 satellite ground system framework

2.3 HY-2 satellite data products

The HY-2 satellite data products include microwave scatterometer products, radar altimeter products and scanning microwave radiometer products.

Microwave scatterometer product: sea surface wind.

Radar altimeter products: sea surface height and significant wave heights.

Scanning microwave radiometer products: sea surface temperature and atmospheric water vapor content.

Table 2-1 HY-2 satellite data products

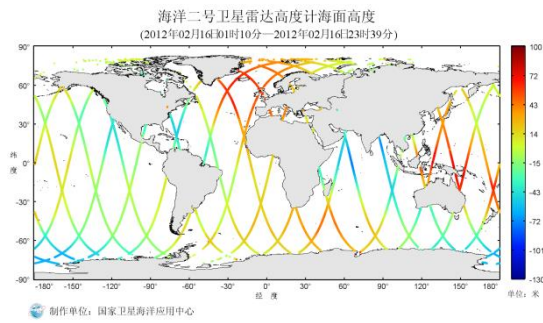| Satellite payload	Data product	Accuracy
Microwave scatterometer	Sea surface wind	2m/s, 20 deg.
Radar altimeter	Sea surface height	5 cm
	Significant wave height	0.4 m
Scanning microwave radiometer	Sea surface temperature	1.0 K
	Water vapor content	10 %

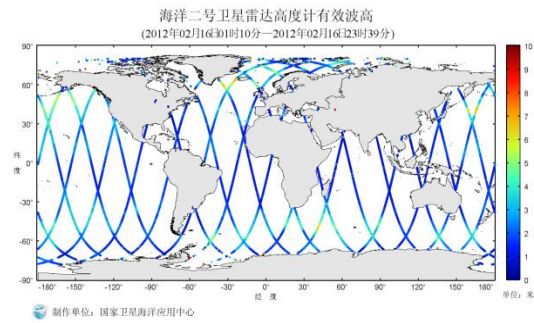**Fig.2-3 Sea surface height of HY-2 radar altimeter**   **Fig.2-4 Significant wave height of HY-2 altimeter**
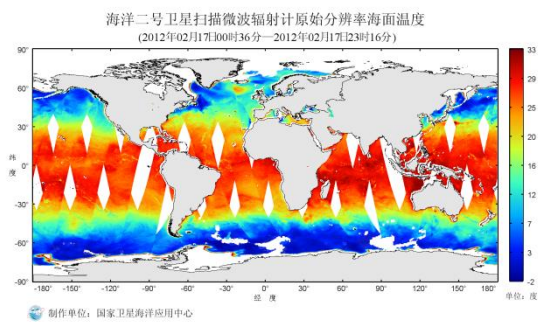

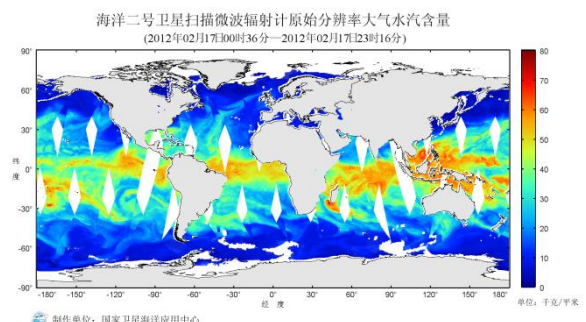**Fig.2-5 Sea surface temperature of HY-2 radiometer**   **Fig.2-6 Water vapor content of HY-2 radiometer**
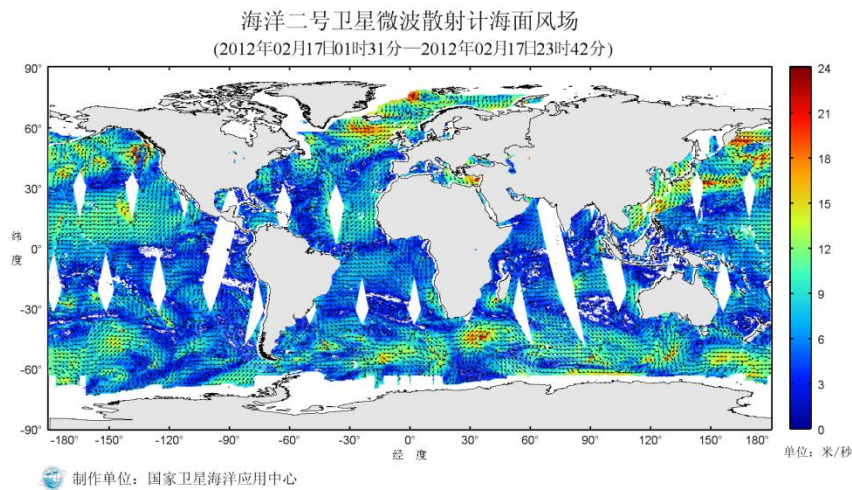

Fig.2-7 Sea surface winds of HY-2 scatterometer

3 HY-2 satellite operation management

1) HY-2 satellite makes global observations in all weather conditions;

2) Composes HY-2 satellite data link activation plans. When HY-2 satellite is within views of three stations, the data link is enabled based on activation plans and global data are down-linked.

3) After data are down-linked to ground stations, raw data are transferred to the Data Processing Center of National Satellite Ocean Application Service (NSOAS). The data processing system performs data preprocessing and processing, and generated corresponding data products.

4) The data products are transferred to data distribution sub-system, and provided to end users upon request.

4   HY-2 satellite data product distribution service

4.1   Near real time data distribution

Upon end user request, the HY-2 satellite near real time data (Level 2 and some Level 0 and Level 1 data) are distributed on the website and provided to end users.

4.2   Delayed data distribution

Upon end user request, the HY-2 data that need longer processing time (Level 3 and some Level 1 and Level 2 data) are distributed on the distribution website and provided end users.

The HY-2 satellite data are distributed via FTP at ftp://114.255.97.103. The data release policy and application procedure can be found on the website of NSOAS (http://www.nsoas.gov.cn), or can be reached via telephone at (86)10-62105715.

5   HY-2 satellite data applications

5.1   Ocean surface wind prediction

Sea surface winds obtained by HY-2 microwave scatterometer are added into China's marine wind prediction model system, and thus provide better initial conditions and improve prediction skills. The use of HY-2 scatterometer wind observations in marine prediction marks a new era in marine environmental prediction without using other sources of wind observations. The application of HY-2 scatterometer winds in numerical models improves China's marine environmental prediction abilities and thus meets the needs of national economics and security.

5.2   Sea level rise decision support

The long time-series of HY-2 satellite altimeter measurements of sea surface height, combined with data from China's coastal and polar stations, are used to establish sea level rise decision support system to support sea level rise hazards and prevention.

5.3 Ocean waves prediction and assimilation

The significant wave height and sea surface wind derived from HY-2 satellite are assimilated into China's numerical wave model to improve marine environmental prediction skills.

5.4 Data assimilation in ocean model

The sea surface temperature and height data of HY-2 satellite are assimilated into 3-D ocean numerical model to improve ocean model prediction accuracy and skills.

5.5 Storm surge monitoring

The sea surface height and winds data of HY-2 satellite as well as data from coastal stations and buoys are used for the storm surge hazards prevention decision support system. The use of these data improves China's ability in storm surge hazard prevention and decision making.

5.6 Sea ice monitoring and forecasting

The brightness temperature of HY-2 microwave radiometer, together with sea ice observations from other satellites and in situ observations, is used to monitor and predict sea ice hazards, and to improve sea ice hazard prevention and decision making.

5.7 Oceanic gravity field

The variations of sea surface dynamic height observed by the HY-2 satellite and ship measurements are used to compute and monitor oceanic gravity field.

5.8 Air-sea interaction

The HY-2 satellite measurements of sea surface temperature and winds and in situ measurements of sea surface fluxes are used to study air-sea interaction. The HY-2 satellite data is used to quantify air-sea interaction and monitor its variations, and thus provide observations to study climate change and global warming.

5.9 Oceanic fishery

The combined use of measurements of sea surface temperature, winds and waves from HY-2 satellite and ocean color from HY-1 satellite is important in the open ocean fishery application system. Measurements of HY-2 radar altimeter and scanning microwave radiometer may identify oceanic fronts and mesoscale eddies, and detect the ocean fishing ground. The radar altimeter, microwave scatterometer and microwave radiometer are useful for improving the weather forecasting accuracy for ocean fishing.