

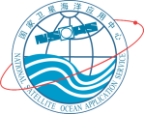
国家卫星海洋应用中心

The application of satellite remote sensing techniques in NSOAS (a review)

National Satellite Ocean Application Service
(NSOAS)

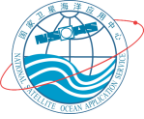
June 5, 2017

<http://www.nsoas.org.cn>



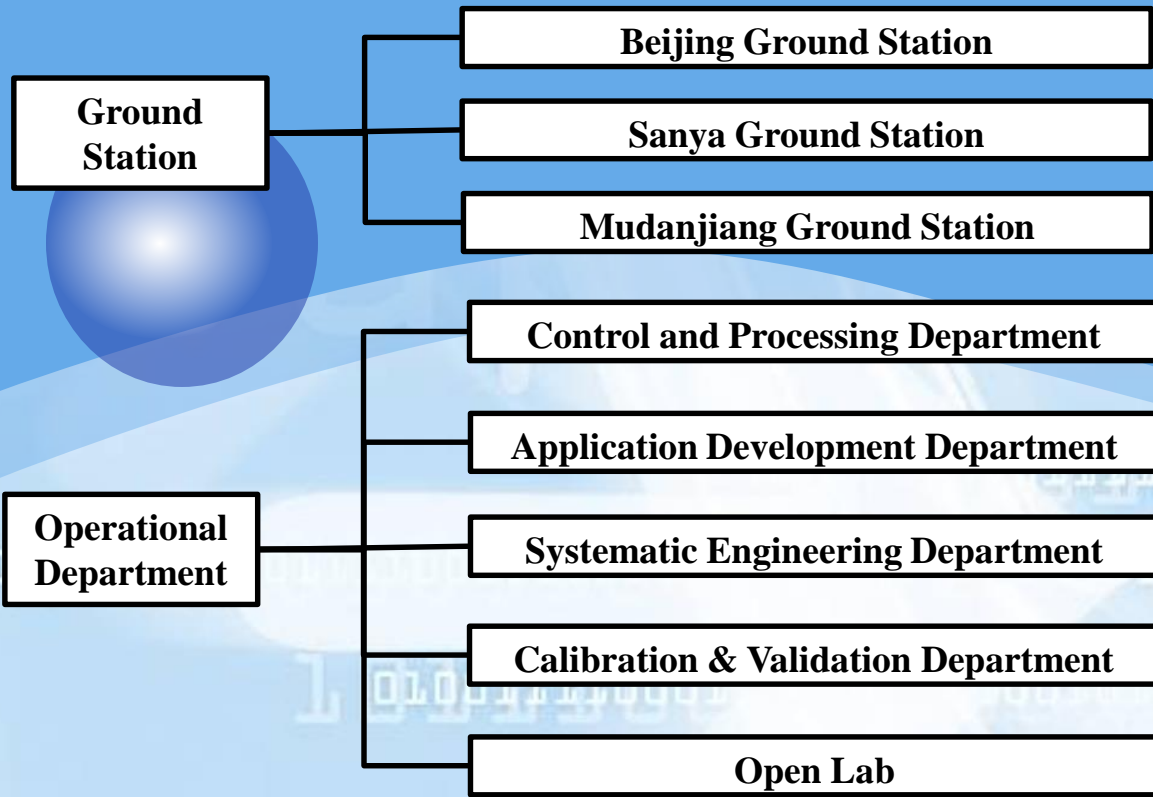
Outline

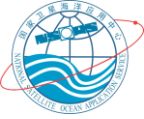
- 1 ● **Brief introduction of NSOAS**
- 2 ● **China ocean satellite plan & status**
- 3 ● **The application of satellite remote sensing techniques in NSOAS**



History of NSOAS

- **National Satellite Ocean Application service (NSOAS)** is a public-interested institutional organization, which belongs to **State Oceanic Administration (SOA)**.
- NSOAS was established in 1996, and officially founded in 2000. The predecessor of NSOAS was ocean satellite integrative system design department of SOA.

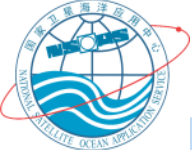




Main Responsibilities of NSOAS

- to make plan for China's ocean satellite and construct satellite ground station and ocean application system
- to collect, process, calibrate and validate China's ocean satellite data
- to archive and distribute satellite data for public use
- to undertake marine remote sensing international academic exchange and cooperation
- ...





Chinese Oceanic Satellite Series

1

HY-1 Series Satellites

- Ocean Color and Temperature Scanner
- Coastal Zone Imager



HY-1 series satellites are mainly used in the development and utilization of marine resources, marine disaster monitoring, marine environmental protection, global climate change research, etc.

2

HY-2 Series Satellites

- Microwave Scatterometer
- Radar Altimeter
- Microwave Radiometer



HY-2 series satellites are used to obtain the measurement of ocean dynamic and environmental parameters, as well as for the prevention and relief of ocean disaster.

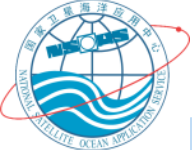
3

HY-3 Series Satellites

- Synthetic Aperture Radar

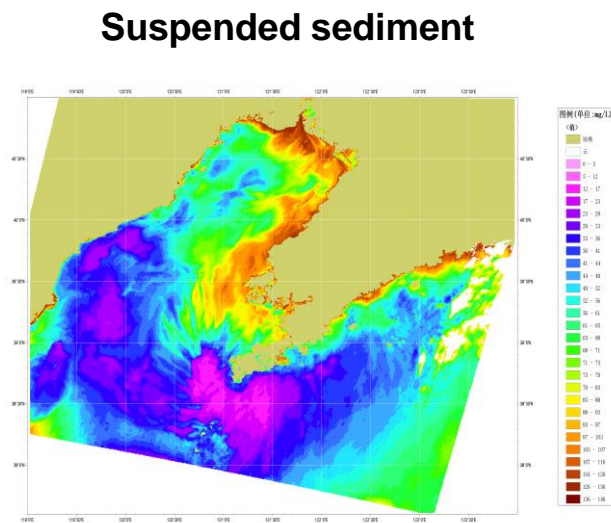
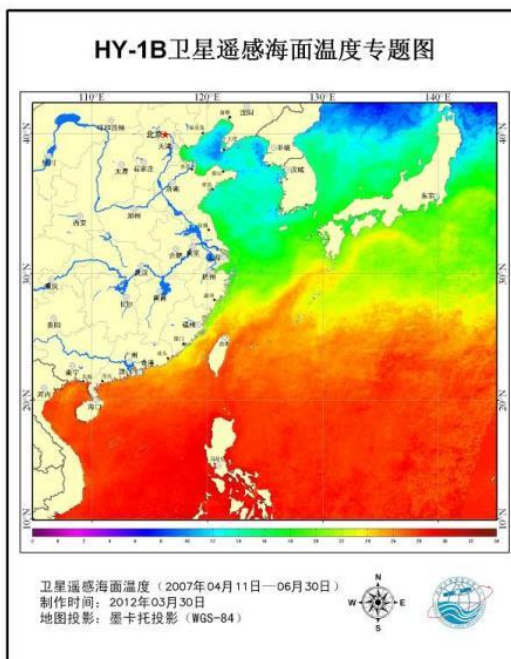
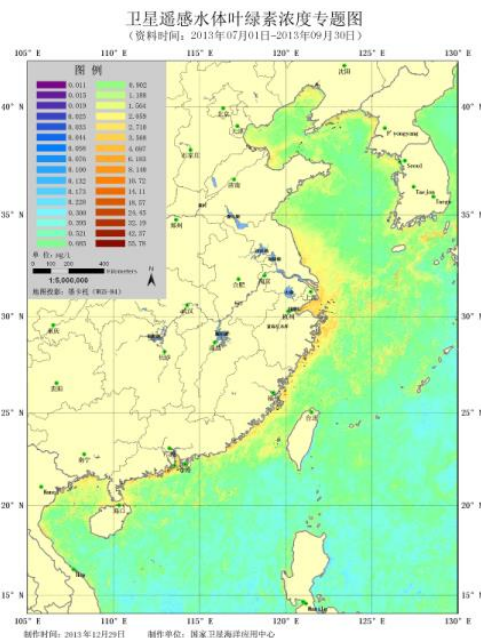


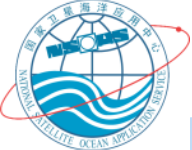
HY-3 series satellites are used to monitor the marine environment, islands and reefs, ships and oil spill.



China ocean satellite plan & status

- ◆ China has successfully launched HY-1A and HY-1B ocean color satellites. The HY-1A satellite is an experimental satellite. HY-1B satellite was developed on the basis of the HY-1A satellite.
- ◆ As the first satellite in the HY-1 series, HY-1A ocean satellite with a design lifetime of two years, was launched in May 2002, and expired in March 2004; China's second ocean satellite HY-1B with a design lifetime of three years was launched in April 2007, and stopped working in February 2016.
- ◆ The products mainly include: suspended material, soluble organic matter; chlorophyll concentration; sea surface temperature.

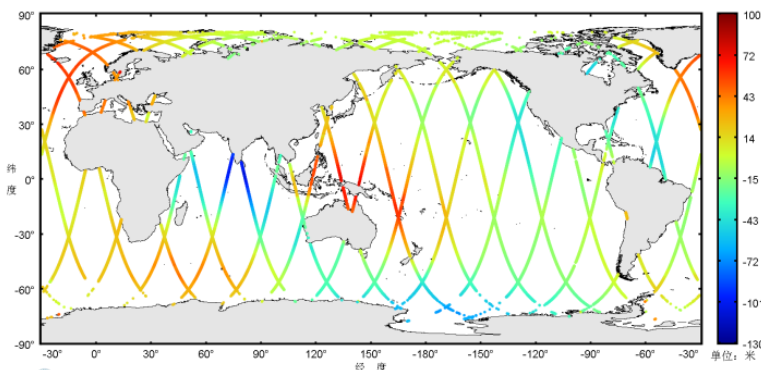




China ocean satellite plan & status

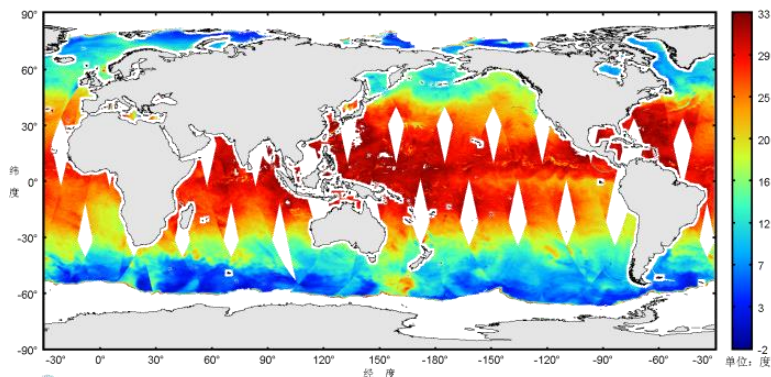
- ◆ **As the first satellite in the HY-2 series, HY-2A ocean dynamic satellite was launched in August, 2011 and delivered to the SOA in March 2012 for formal operation.**
- ◆ **The products mainly include: sea surface height, significant wave height, sea surface wind, sea surface temperature.**

海洋二号卫星雷达高度计海面高度
(2016年08月26日23时21分—2016年08月27日23时44分)



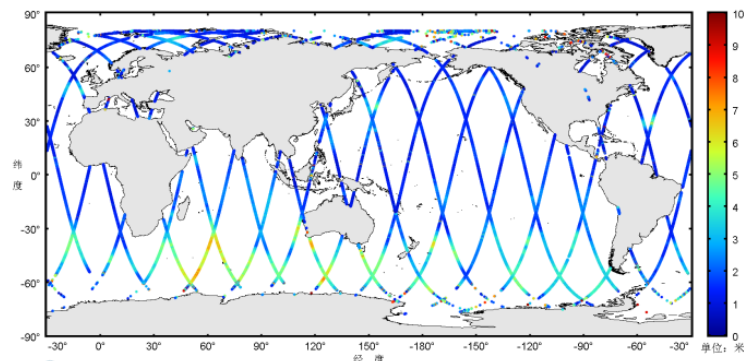
制作单位: 国家卫星海洋应用中心

海洋二号卫星扫描微波辐射计原始分辨率海面温度
(2016年08月28日00时05分—2016年08月28日22时41分)



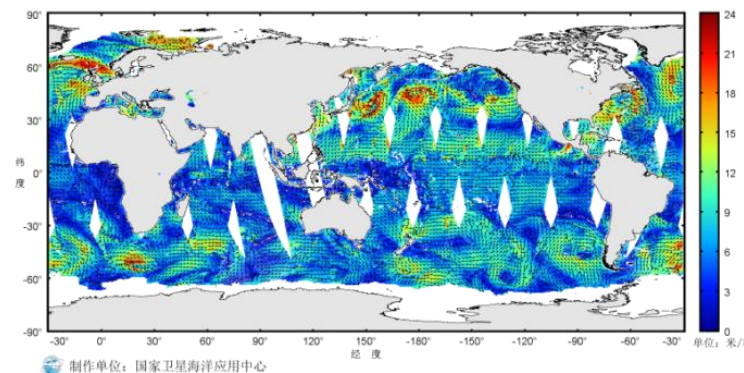
制作单位: 国家卫星海洋应用中心

海洋二号卫星雷达高度计有效波高
(2016年08月26日23时21分—2016年08月27日23时44分)

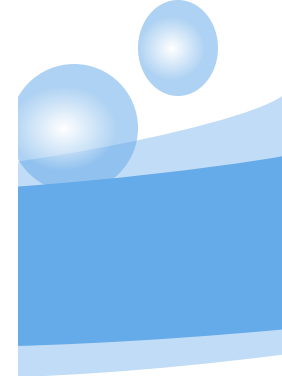
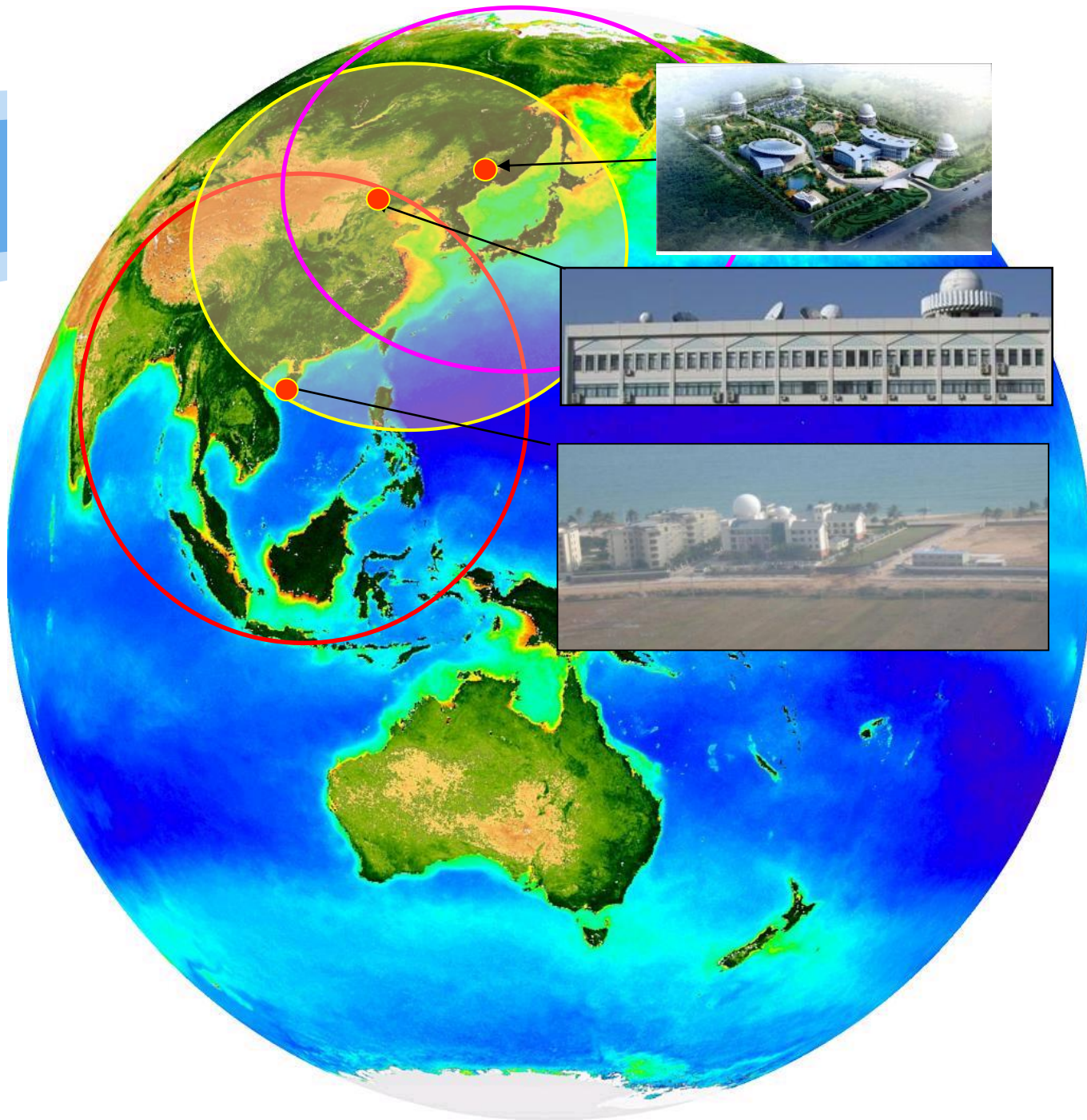
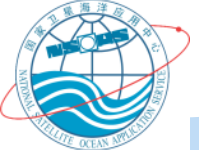


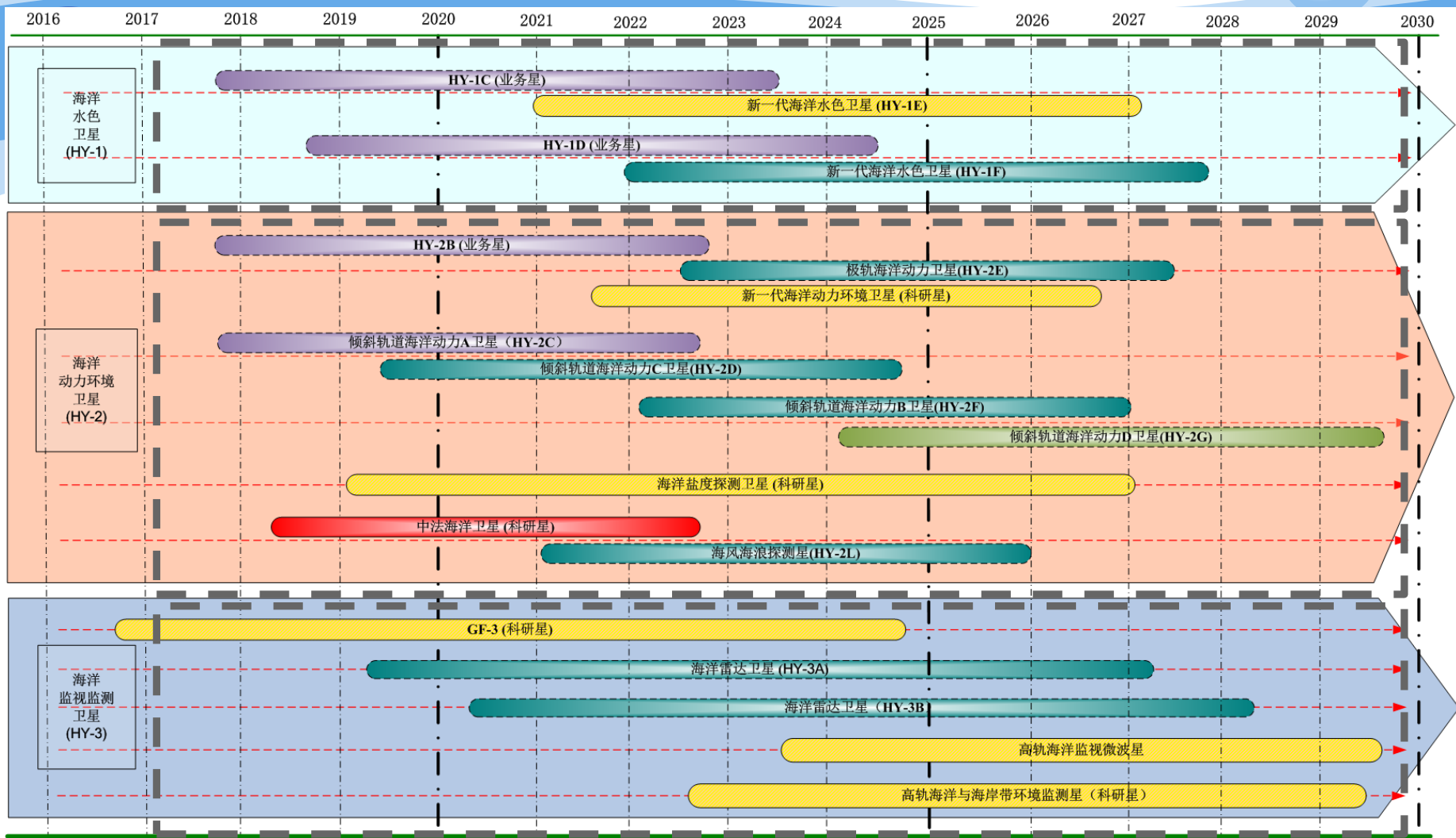
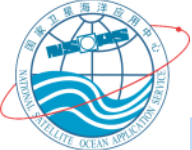
制作单位: 国家卫星海洋应用中心

海洋二号卫星微波散射计海面风场
(2012年12月22日00时12分—2012年12月22日08分)

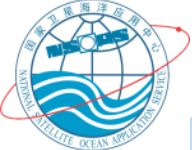


制作单位: 国家卫星海洋应用中心





图例: █ “十三五”业务星 █ “十二五”业务星 █ “十四五”业务星 █ 科研星 █ 联合研发卫星



HY-1 Series Satellite plan (HY-1C、HY-1D)

The successors of HY-1B satellite.

- **Products:**

Chlorophyll Concentration, Suspended Material, Soluble Organic Matter, Sea Surface Temperature...

- **Orbit:**

sun-synchronous orbit

- **Accuracy and Resolution:**

sea surface temperature(1K, 1.1km);

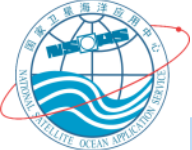
- **Sensors:**

- Chinese Ocean Color and Temperature Scanner (swath ≥ 2900 km; **10 bands**)

- Coastal Zone Imager(**4-band**)

- Two ultraviolet bands are added on the basis of the HY-1B satellite.

- HY-1C&HY-1D are expected to be launched in 2018.



HY-1 Series Satellite plan (HY-1E、HY-1F)

New generation ocean color satellite

■ Products:

Chlorophyll Concentration, Suspended Material, Soluble Organic Matter, Sea Surface Temperature...

■ Orbit:

sun-synchronous orbit

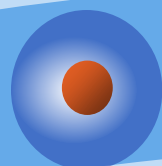
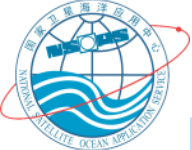
■ Accuracy and Resolution:

Sea Surface Temperature(1K, 500m);

■ Sensors:

- New Generation Ocean Color and Temperature Scanner(swath $\geq 3000\text{km}$; 18 bands)
- Programmable Medium Resolution Spectrometer
- Data Collection System
- Coastal Zone Imager

■ The experimental version will be launched in 2020, and the operational version will be launched in 2021.



HY-2 Series Satellite plan(HY-2B、HY-2C)

The successors of HY-2A satellite

Products:

Sea Surface wind, Sea Surface Temperature, Sea Surface Height, Significant Wave Height, etc.

Orbit:

HY-2B: sun-synchronous orbit; HY-2C: Inclined orbit

Accuracy:

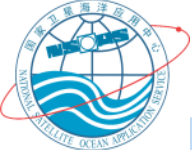
sea surface wind(2m/s, 20deg); sea surface temperature(1K, HY-2B);
Sea surface height(5cm); significant wave height(0.5m or 10%)

Sensors:

- Radar Altimeter
- Microwave Scatterometer
- Microwave Radiometer

HY-2B will be launched in 2018, and HY-2C is scheduled to be launched in 2019.

HY-2D, HY-2E and HY-2F satellites



HY-2 Series Satellite plan(China France Ocean Satellite, CFOSAT)

A joint mission of China and France space agencies with the goal to monitor the ocean surface winds and waves on a global scale and to provide information on related ocean and atmospheric science and applications.

- **Products:**

Swell Wave Length and Direction, Sea Surface Wind

- **Orbit and resolution:**

sun-synchronous orbit; designed lifetime: 3 years

spatial resolution(SCAT) : **50**km ;

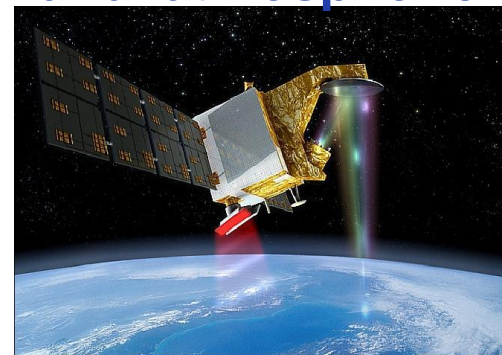
swath width: 70 km (SWIM); 1000Km(SCAT)

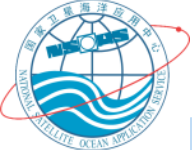
- **Sensors:**

- Surface Waves Investigation and Monitoring Radar(SWIM)
- Microwave scatterometer(SCAT)

- CFOSAT will provide a global coverage within 3 days for wind fields (SCAT) and almost global for waves within 13 days (SWIM).

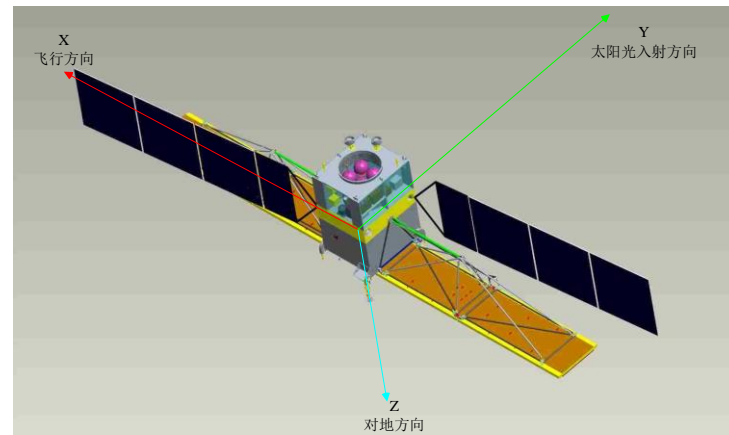
- **scheduled to be launched in 2018**

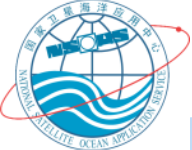




HY-3 Series Satellite plan(HY-3A、HY-3B)

- ◆ Constellation of Earth Observation Satellite for monitoring environmental disaster, ship and oil platform, ocean wave , sea surface wave and Internal Wave, etc.
- ◆ ensure service continuity of Chinese GF-3 satellites, which have been operating since 2016.
- **Orbit and resolution:**
sun-synchronous polar orbit; designed lifetime: 3 years
- **Sensors:**
 - **Polarimetric SAR(C band)**
 - **Automatic Identification System(AIS)**
- **scheduled to be launched in 2019.**





The applications of satellite remote sensing techniques in NSOAS focus on the following aspects:



The Application in Polar navigation Safety



The Application in Ocean Forecast



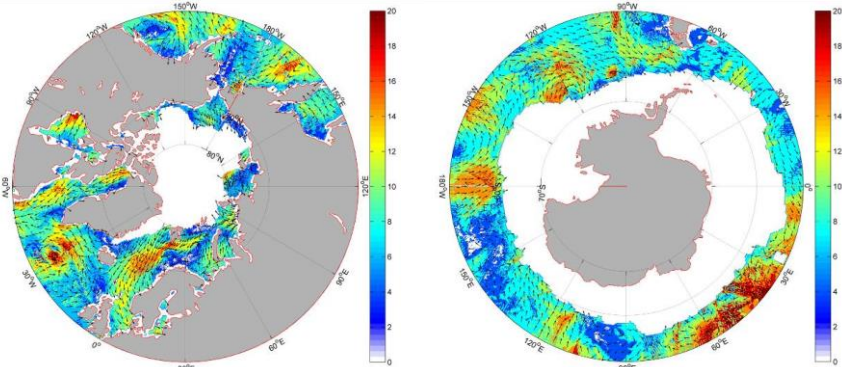
The Application in Ocean Disaster monitoring



The Application in Oceanic Fishery

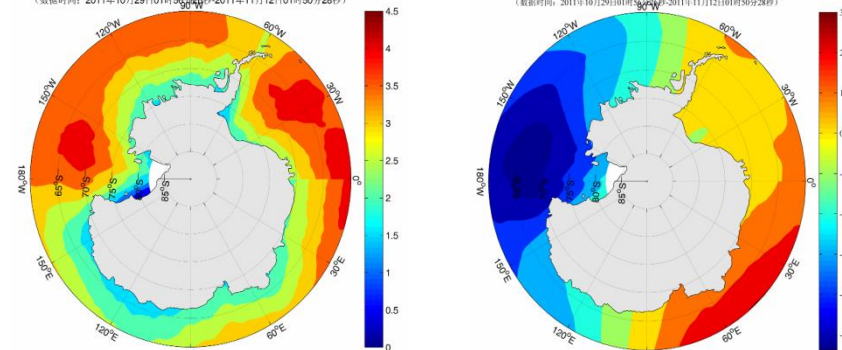


The Application in Polar navigation Safety

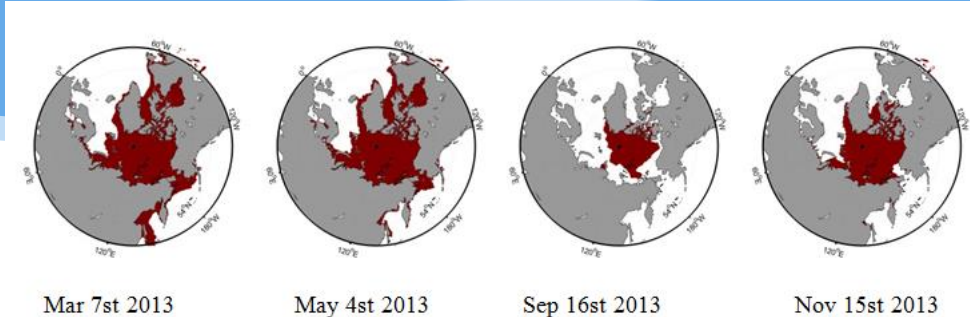


HY-2A 卫星雷达高度计-有效波高 (单位: 米)
(数据时间: 2011年10月29日10时56分至2011年11月12日10时50分28秒)

HY-2A 卫星雷达高度计-周期波高 (单位: 米)
(数据时间: 2011年10月29日10时56分至2011年11月12日10时50分28秒)

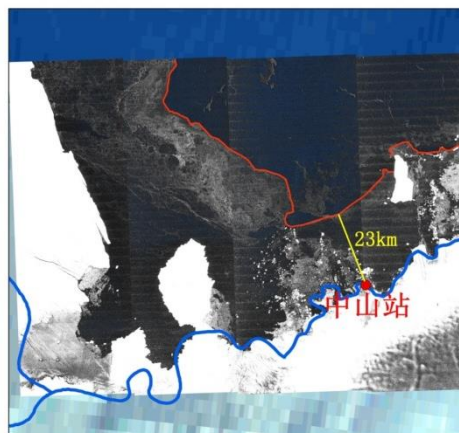


Ocean dynamical parameters

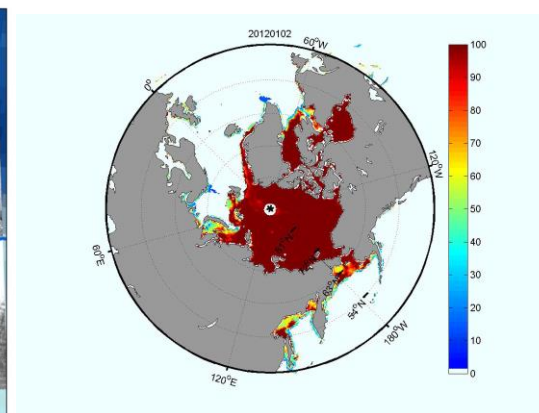


Sea ice extent

普里兹湾遥感影像图

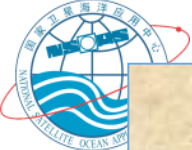


卫星: COSMO-Skymed 1 探测日期: 2009年11月30日 制作人: 朱海天
传感器: SAR 探测时间: 01:19:36 (UTC) 审核: 邹斌



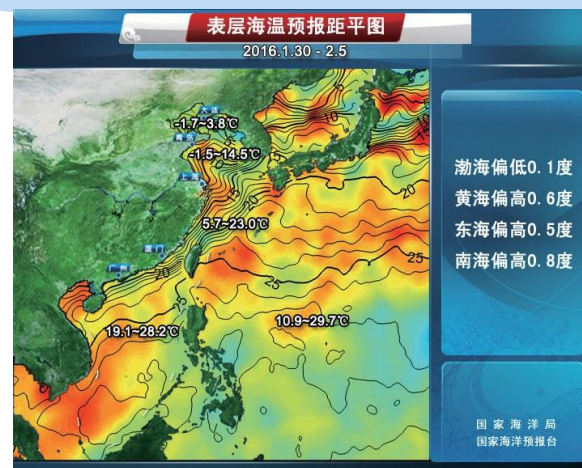
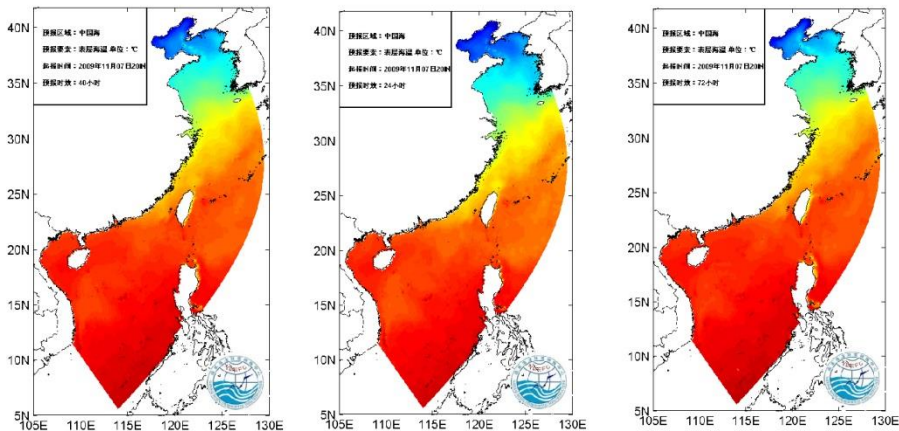
Sea ice concentration

- Based on HY-2 satellite data, wind speed and wave height information can be retrieved around the polar regions.
- Satellite Remote sensing data can provide significant support when China's Antarctic expedition ship sails through westerlies
- The 2009 Antarctic scientific expedition ship was blocked during the journey. Satellite data played an important role for icebreaker to safely sail through the ice regions.



The Application in Ocean Forecast

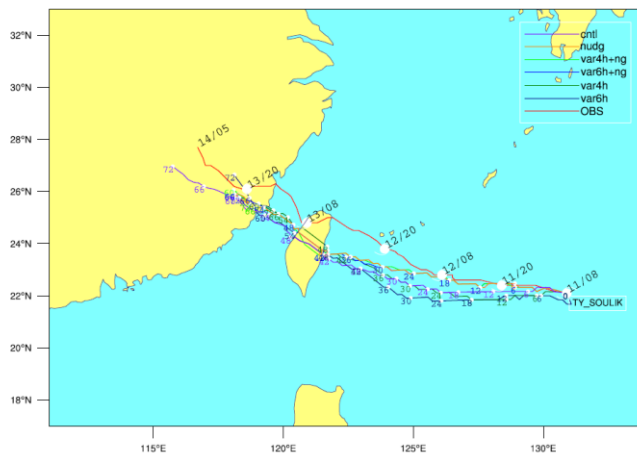
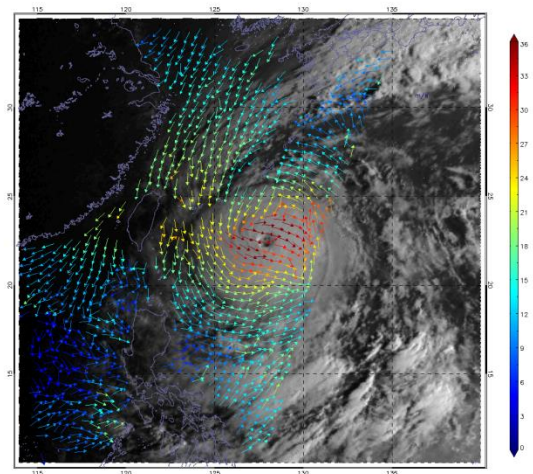
- The sea surface temperature product in the Northwest Pacific ocean captured by HY-2 satellite has been used in numerical model for sea surface temperature prediction, and provides the important observation data for CCTV13 ocean environment broadcast.



- HY-2 satellite data has been proved to be potential for application in typhoon monitoring.
- Using HY-2 data can improve the typhoon path forecasting performance.

Tropical Cyclone 72h Forecast Tracks comparison

Initial Time : 20130711 08:00 BeiJing Time



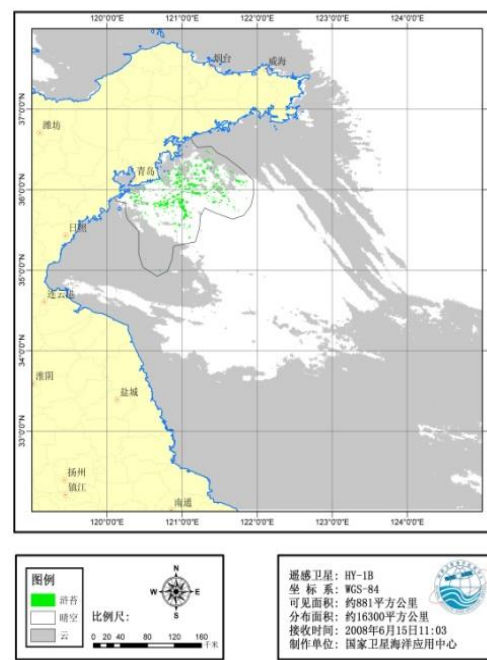
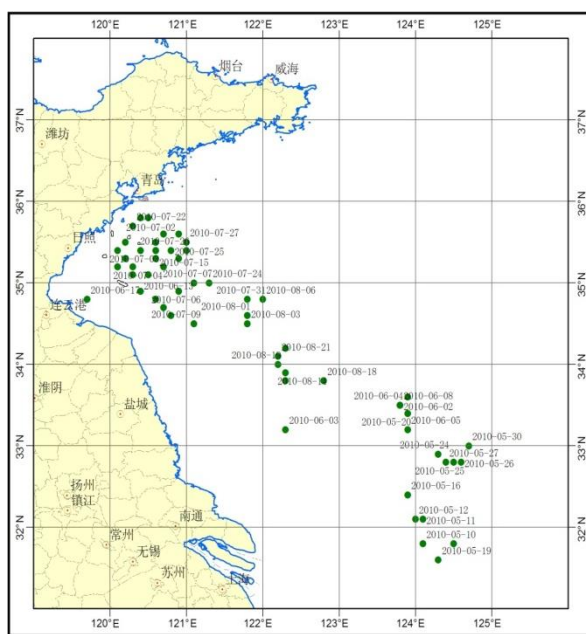
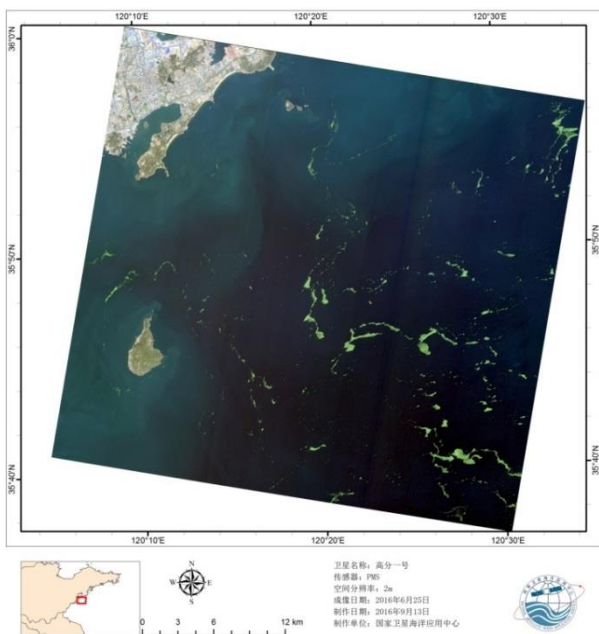
(provided by NMEFC)

The Application in Ocean Disaster monitoring

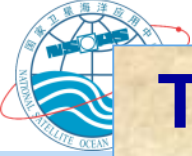


Shandong province suffered a severe green algae invasion in recent years. Although the green algae is not poisonous, it can ravage the ecosystem and have an effect on tourism in affected areas.

黄海绿潮遥感影像专题图

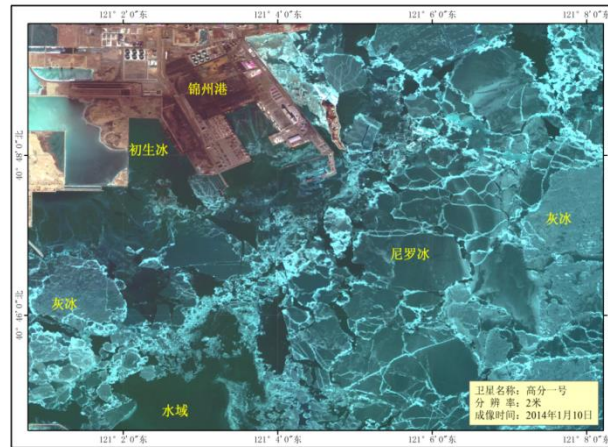
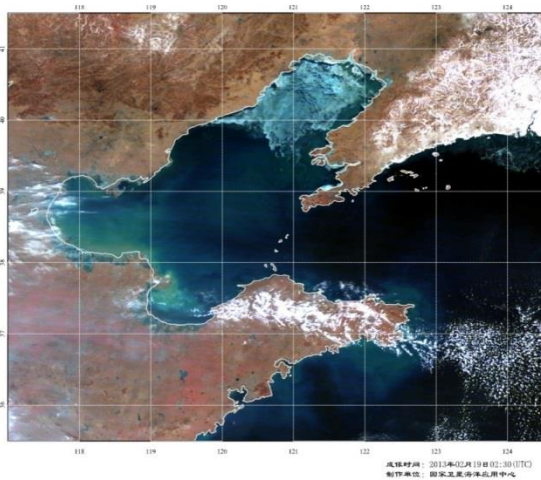


green algae monitoring based on satellite data



The Application in Ocean Disaster monitoring

Sea ice monitoring based on satellite data in the Bohai Sea



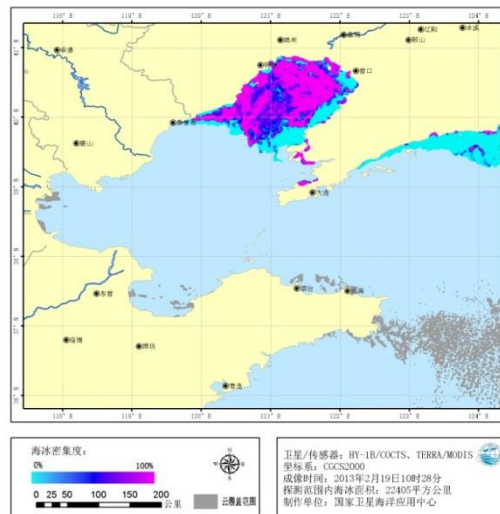
光学卫星遥感渤海及黄海海冰密集度专题图



Oil and gas exploration and production and other maritime activities are rapidly increasing in the Bohai Sea.

Since sea ice occurs every winter in this region, it poses serious threats to these activities.

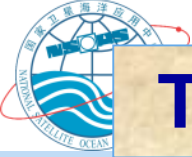
During the 2009–2010 winter, the Bohai Sea experienced its most severe sea ice event, which caused significant economic losses, affected marine transportation and fishery.



Sea ice product in the Bohai Sea based on satellite data



Sea ice prediction in the Bohai Sea based on numerical model

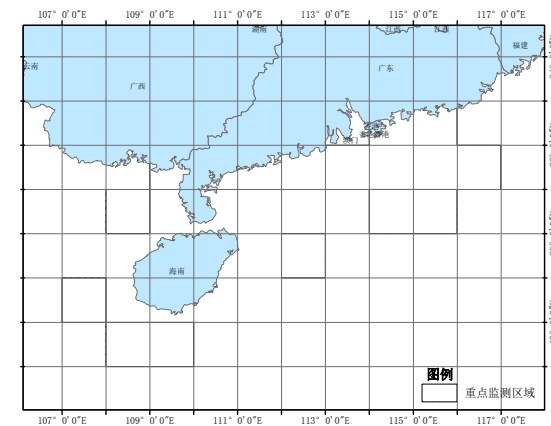
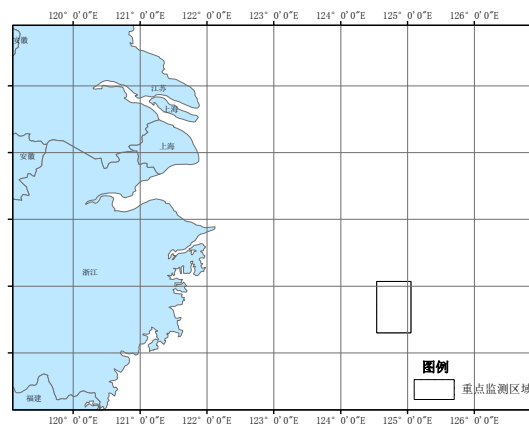
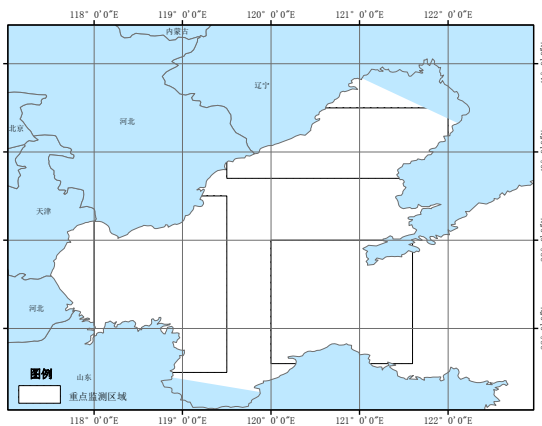
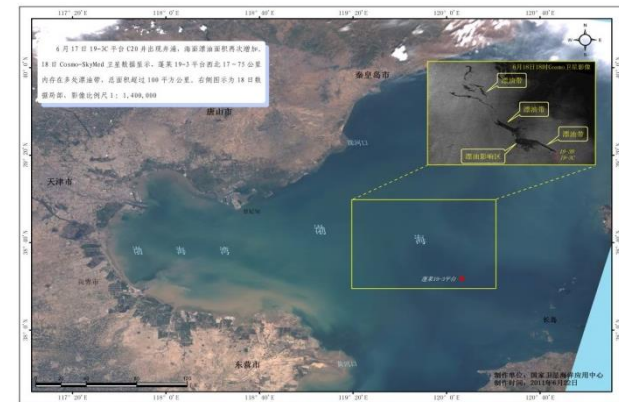


The Application in Ocean Disaster monitoring

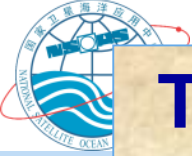
In recent years, With growing offshore oil exploration, transportation, various types of oil spill accidents occur frequently.

- ◆ Australia oil platform leakage in 2009
- ◆ Platform explosion in the Gulf of Mexico in 2010
- ◆ Oil spill accidents in Chinese BoHai sea in 2011

蓬莱19-3平台事件6月18日遥感监测分析图



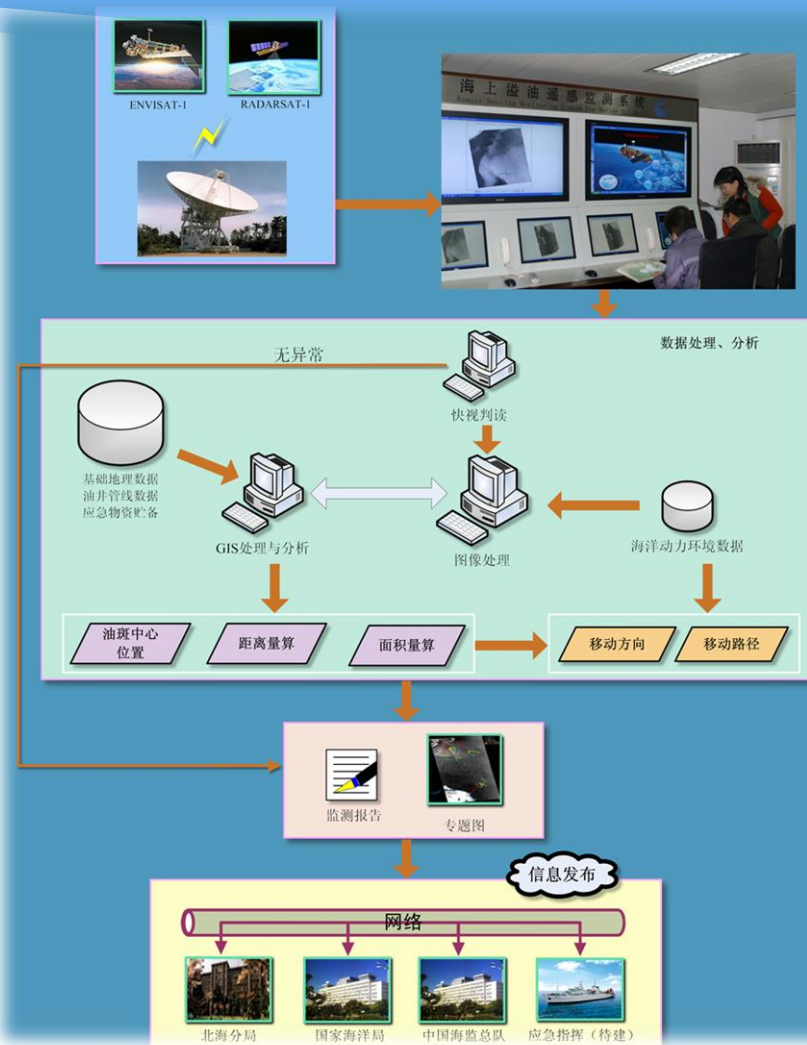
The area for oil spill operational monitoring based on satellite data

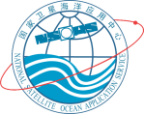


The Application in Ocean Disaster monitoring

Oil spill monitoring based on satellite data

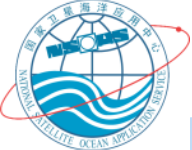
- Based on satellite SAR and GIS technology
- SAR image processing
- Oil Spill Information Extraction
 - Dark spot detection
 - Feature extraction
 - Dark spot classification
- Oil spills are assigned confidence levels
 - Low
 - Medium
 - High
- Oil spill information release





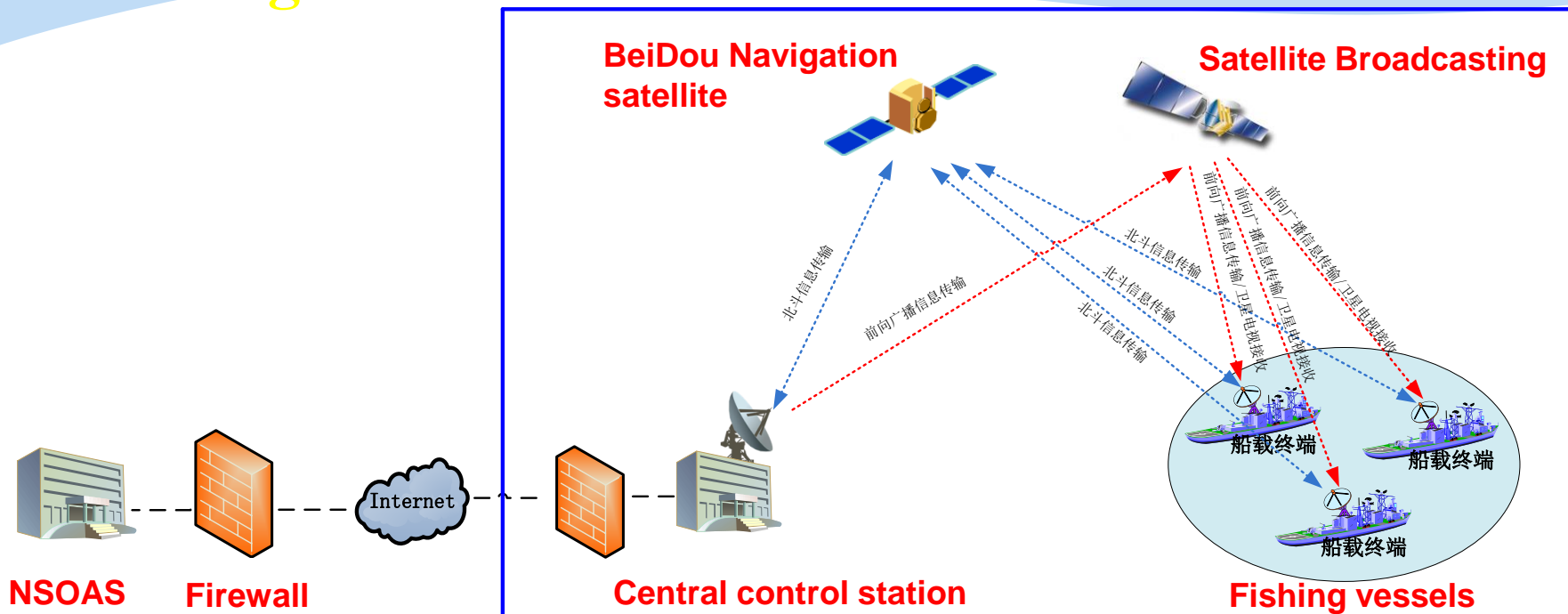
The Application in Oceanic Fishery

- **The sea covers two thirds of the earth's surface. To a large extent, man is dependent on it for food species.**
- **Variations in environmental conditions affect the distribution, abundance and availability of fishery resources.**
- **Fortunately, some conditions and processes affecting fish populations may often be deduced using remote sensing techniques, e.g., concentration of dissolved and suspended matter, sea surface temperature, location of frontal boundaries, regions of upwelling, currents.**
- **Remote sensing techniques can help fishermen to exploit fishery resources more effectively, to minimize costs and optimize the scheduling of their operations.**



The Application in Oceanic Fishery

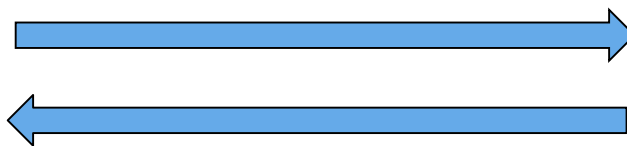
The information transmission between NSOAS and fishing vessels



Environmental parameters and fishery forecasting results

NSOAS

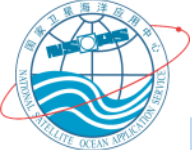
Satellite Broadcasting



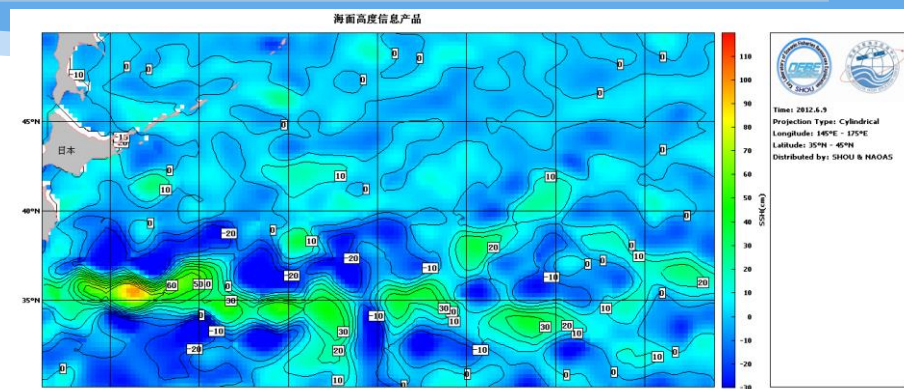
Fishing Vessels

BeiDou Navigation Satellite

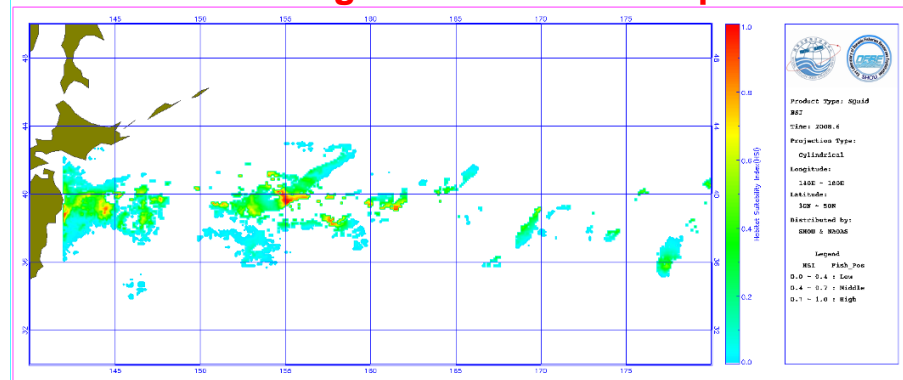
Fish catch data and the position of fishing vessels



The Application in Oceanic Fishery

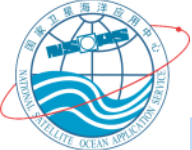


Sea surface height in the northwest pacific ocean



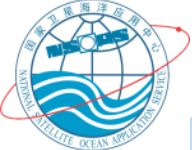
Fishery information of squid in the northwest pacific ocean

- The data from remote sensing satellite, broadcasting satellite and Beidou Satellite are firstly used simultaneously for fishery service.
- Shipboard visualized analysis software was developed for ocean environment and fishery forecast information display.



Summary

- ◆ **China are developing 3 series ocean satellite and considerable progress will be achieved in China's ocean satellite missions in the future.**
- ◆ **Chinese ocean satellites have been successively used in marine environment monitoring, marine resources development, Ocean disaster prevention and mitigation, etc.**
- ◆ **The application potentiality of China's ocean satellite will be further extended as more and more China's ocean satellites are in operation.**



Thanks for your attention!

Welcome to NSOAS !