Introduction of Operational Marine Environmental Disaster Monitoring using Remote Sensing Data

Bin Zou
zoubin@mail.nsoas.org.cn
Hyderabad, India, 2016-3-8

National Satellite Ocean Application Service, China
1. Who is NSOAS
2. The operational system
   --- oil spill
   --- sea ice, green tide
   --- typhoon
   --- Emergency monitoring Team
3. International cooperation
4. Summary
1. Who is NSOAS

The National Satellite Ocean Application Service (NSOAS) was founded on Nov. 19th, 1998. It is a scientific research and operational service department under the State Oceanic Administration of China.

The main functions of NSOAS include:

- To make strategy and development program for Chinese oceanic satellites.
- To build up ground segment for Chinese oceanic satellites.
- To fulfill scientific researches on oceanic satellite technology.
- To be responsible for receiving, processing, distributing and application of oceanic satellite data.
- To carry out satellite marine monitoring system.
One Processing Center and three Station
China Ocean Satellite Plan & Status

- **HY-1A 2002.5.15 (Stop work)**
- **HY-1B 2007.4.11 (Stop work in Feb. 2016)**
- **HY-2A 2011.8.16 launch**
  - For Ocean dynamic environment parameters (Wind, SSH, SST)
  - Sensor are ALT, SCA, MR, GPS, DORIS
- **HY-1C/1D (will be approved)**
  - For Ocean color, SST, Coast zone
  - Sensor are COCTS (Chinese ocean color and temperature scanner), CZI (Coast zone imager)
- **HY-3**
  - For pollution hazard, sea ice, ship, coast zone
  - Sensor are SAR, …
chlorophyll

SST

Water quality

Green algae bloom

Sea ice

Fishery environment

suspended sediment

Estuary and coastal zone

Red tide
2. The operational system

Remote sensing system for marine disaster monitoring

Providing useful data products and information derived from satellite sensors on a continued basis for its use in routine monitoring applications related to marine environmental disaster, like sea ice, oil spill, red tide and typhoon for local and state governments, commercial entities, academic institutes, non-governmental agencies and public at large for early warning and emergency response.
Beijing
Sanya
Mudanjiang

Data Transfer
Data Processing
Information Analysis
Information release
Orbit Plan

Other Satellites

Data Receiving

Orbit Plan

FAX, Email
Website, · · ·

SOA
Local government
Marine surveillance Team
Public

Emergency Response

Oil spill
Green Tide
Sea ice
Emergency Response
Typhoon
## Satellites

<table>
<thead>
<tr>
<th>Type</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil spill</td>
<td>ENVISAT-ASAR, RADARSAT-2, TerraSAR-X, COSMO-1/2/3/4, HJ-1A/B, Terra-MODIS, Aqua-MODIS</td>
</tr>
<tr>
<td>Sea ice</td>
<td>HY-1B/COCTS, Terra/MODIS, Aqua/MODIS, RADARSAT-2, COSMO-1/2/3/4, HJ-1A/B</td>
</tr>
<tr>
<td>Algae bloom</td>
<td>HY-1B/COCTS, Terra/MODIS 和 Aqua/MODIS, FY3/MERSI, HJ-1A/CCD, HJ-1B/CCD, RADARSAT-2, COSMO-1/2/3/4</td>
</tr>
<tr>
<td>Typhoon</td>
<td>HY2-SCAT</td>
</tr>
</tbody>
</table>
2.1 Oil Spill Monitoring in Action

- NSOAS carries out operational monitoring of oil spill by remote sensing since 2007, Under RS and GIS support, NSOAS uses SAR data, in combination with other data to monitor marine oil spill, focusing on the Bohai Sea, South China Sea, East China Sea.
- NSOAS has processed over 3000 ENVISAT data, and 600 COSMO, Radarsat-2 data, 500 Monitoring Reports published. Particularly in the July 25, 2007, NSOAS firstly monitors the one oil pipeline oil spill incidents, severing for China Marine surveillance.
- Take part in many oil spill Emergency response actions.
- Intentional oil spill
- Improve the efficiency of decision making and cleaning.
Oil Spill Operation Monitoring Zones

Bohai Sea (from 2007)

East China Sea (from 2009)

South China Sea (from 2008)
Operation steps

Analyse the interest of several data sources (SAR, colour, SST, currents, oceanographic model forecasts) as an auxiliary data set for improved detection and environmental conditions for first guess of the spill drift.

In case of an oil-spill detection, an analytical report is sent to run the oil-spill model for 3-day forecast based on the detection data. The SAR image analysis results together with the model forecasts will be available to the end-user through a dedicated web site.
Monitoring reports

- **Service description**
  - Geo-location, date
  - Parameters: area, size, orientation, complexity, contrast
  - Reliability
  - Potential Source (Ship, platform, ...)
  - Metocean environmental conditions

- **Early warning system:**
  - Semi-automatic detection scheme
  - Validation by trained operators

- **Required evolution**
  - Ancillary information to reduce FAR (ambiguous slicks)
  - Coupling with AIS
Oil spill response system
Potential Leak point
Joint Action to deal with oil spill in effect

31, Mar., 2009 Bohai oil spill
Dalian Oil Spill, 2010

A fisherman displays cultured sea snails polluted by the oil pipeline explosion on July 16 in Dalian, a port city in Northeast China’s Liaoning province, in this file photo taken on July 20. Provided to China Daily

China Daily, Sep.16, 2010
Dalian Xingang oil pipeline explosion in July, 2010
Dalian Xingang oil pipeline explosion 17-20 July, 2010
Dalian Xingang oil pipeline explosion 20-22 July, 2010

图 例
△ 爆炸位置

7月22日16时RADARSAT-2
7月21日国产卫星
7月20日18时COSMO-SkyMed
7月20日06时RADARSAT-2

海面漂油分布7月20日至22日
Penglai 19-3 oil spill accident brought great damage to marine ecological environment, satellite data help the decision making and law enforcement.

Jun.6, ENVISAT/ASAR image shows large oil spill near to the platform, oil spill area is extended to 27km2
Penglai 19-3 platform accident in 2011
2.2 Sea Ice Monitoring

- carries out operational monitoring of Bohai sea ice by remote sensing since 2001
- uses HY-1, NOAA, MODIS data, in combination with other data to monitor sea ice on Bohai.
- Dec. 1st - Mar. 31st
HY-1/CCD and EOS-modis Sea Ice image
Bohai Sea ice

Provide initial parameter for sea ice forecast
渤海和黄海海冰近三年分布面积统计分析
2.2 Green Algae monitoring

Is it greensward?

No. It is green tide.
Qingdao Green Algae Bloom Remote Sensing Monitoring
31th May, 2008 HY-1B image
15th, June, 2008 green algae
绿潮监测
Half Day Change
青岛近海浒苔遥感监测释图 (SAR)

2nd July, 2008

统计数据
- 遥感监测面积：1200平方公里
- 浒苔面积：33.13平方公里
- 浒苔覆盖率：2.76%
- 警戒区面积：49.48平方公里

图例
- 陆地
- 浒苔
- 浒苔

遥感卫星：COSMO-1
传感器：SAR
分辨率：30米
坐标系：WGS-84
成像时间：05:26
成像日期：2008年07月02日
7月21日北京一号
青岛近海绵苔分布
2.3 Typhoon monitoring

- The microwave scatterometer and altimeter on HY-2A successfully monitored all typhoons from 2012 to 2014
- In the life cycle of each typhoon, it has been observed once at least
- 79 typhoons have been monitored from 2012 to 2014
- HY-2A satellite provides accurate data sources for scientific research, typhoon analysis and typhoon forecasting
The wind field and significant wave height of typhoon “Vicente” observed by HY-2A in July 23, 2012
Typhoon Bolaven observed by HY-2A/SCAT

Background is the cloud chart provided by FY2E stationary satellite visible channel

2012-8-26-21:42:52,
Typhoon Bolaven 2012 observed by HY-2A/SCAT

2012-8-26-21:42:52,

Background is the cloud chart provided by FY2E stationary satellite visible channel
Typhoon Saola, 29 July-3 Aug. 2012
Typhoon Du Surui, 26-30 June, 2012
Typhoon Haikui, 03-08 Aug., 2012
Typhoon(tsunami) monitoring

stormy tide by Hurricane Sandy

(Lilibridge, Lin et al., 2013. Oceanography)
2.5 Keep an eye on Emergency event

- Established a remote sensing emergency response team.
- Keep an eye on emergency event
- Collecting remote sensing data
- Analysis of the satellite data
- Information release
- Improve the efficiency of decision making and cleaning.

- MH370, Russia ship in Antarctica, large oil spill by routine monitoring, ship accident, pollution, request by the local government or other unit.
China Ocean Satellite Plan & Status

– HY-1A 2002.5.15 (Stop work)
– HY-1B 2007.4.11 (operational)
– HY-1C/1D (will be approved)
  • For Ocean color, SST, Coast zone
  • Sensor are COCTS (Chinese ocean color and temperature scanner), CZI (Coast zone imager)
– HY-2 2011.8.16 launch
  • For Ocean dynamic environment parameters (Wind, SSH, SST)
  • Sensor are ALT, SCA, MR, GPS, DORIS

– HY-3 (Sensor are SAR, …)
  • For pollution hazard, sea ice, ship, coast zone

To 2020, 6-8 Ocean Satellite will be available
3. International cooperation

- **To 2020, 6-8 Chinese Ocean Satellite will be available**
- Data is FREE.
- Non near-realtime download
  - Download data application form from [http://www.nsoas.org.cn](http://www.nsoas.org.cn)
  - Fill in Application form
  - Submit to the website
  - Download data
- Operational obtaining data contact NSOAS
- Data receiving station oversea??
- Looking forward internation cooperation
summary

• Marine Disaster monitoring and reduction cannot afford ignoring high resolution and observation capacity of Satellite series

• Significant progress:
  – Mature processing techniques and products
  – Beginning of a decade with over 8 satellites (ocean color/microwave/SAR,) simultaneously

• Successful demonstration of operational satellite-derived marine environmental disaster monitoring system
  – Oil spill
  – Typhone
  – Sea ice
  – Green tide/red tide

⇒ Continue to develop operational use of satellite data
Thanks!
zoubin@mail.nsoas.org.cn