Applications of Marine Observation Data and Numerical Models in North China Sea

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2017/6/2, Brussels, Belgium
Observation network

- Volunteer ships
- HF radar
- Sea-bed bases
- Monitoring vehicles
- Buoys
- Satellites
- Ocean stations
- Unmanned aircrafts

North China Sea Marine Forecasting Center
Numerical forecast system

<table>
<thead>
<tr>
<th>Forecast item</th>
<th>Wind velocity</th>
<th>Wind direction</th>
<th>Tide level</th>
<th>Tidal current velocity</th>
<th>Tidal current direction</th>
<th>Current velocity</th>
<th>Current direction</th>
<th>Significant wave height</th>
<th>Sea surface temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-h error</td>
<td>&lt; 20%</td>
<td>&lt; 20°</td>
<td>&lt; 30 cm</td>
<td>&lt; 30%</td>
<td>&lt; 30°</td>
<td>&lt; 25%</td>
<td>&lt; 30°</td>
<td>&lt; 30%</td>
<td>&lt; 0.8°C</td>
</tr>
</tbody>
</table>
Application cases

- Green tide prevention in Yellow Sea
- Storm surge risk assessment for Shouguang
- Emergency response
- Sea ice response in Bohai Sea
Case 1

Green Tide in Yellow Sea
Green tide in Yellow Sea

- mostly caused by enteromorpha proliferation.
- flow on the sea surface and grow fast during summer.
- float from south Yellow Sea to southern Shandong coast
- affect the natural view of ocean and breaks the ecological condition.
Green tide distribution 2016/6/25
Green tide near Qingdao
Green tide monitoring

- Satellite
  - optical satellite
  - SAR
- Aircraft
  - SAR
  - spectrometer
  - photograph
- ship
- coastal surveillance
- Real-time video
Case 2

Storm Surge Risk Assessment
Shouguang, Shandong, China
Extratropical storm surge in Shouguang, Shandong, China

- 2010/9/21
- 2013/10/12
- 2015/10/18
Data type and acquisition

Data “in ocean”
• Long-term tide, wave, wind

Data “on land”
• Land-use
• Digital Line Graphic (DLG)
• Urban Cadastral

Problems: data acquired from different departments

• Data “in ocean”: State Oceanic Administration
• Data “on land”: Department of Land and Resources
Data

Land altitude (1:50,000)

Land use (1:5,000)
Storm surge risk assessment

Data

Numerical model

Outcome

- Risk levels and areas
- Evacuation routes
Risk assessment and response

Warning water level gauge

Evacuation routes

Warning water level gauge

Emergency supplies
Case 3
Marine Emergency Response
Oil spill monitoring and forecast

Forecast model
- 2-D Trajectory prediction model
- 2-D trajectory and fate prediction model
- 3-D trajectory and fate prediction model

Source tracing model
- 2-D source tracing model
- 2-D source tracing probability model

SAR images
Search and rescue
Case 4

Sea Ice Monitoring and Forecast in Bohai Sea
Sea ice in Bohai Sea

- 5 ranks:
  1. light
  2. less light
  3. normal
  4. less serious
  5. serious
## Sea Ice Monitoring

### Approaches
- Shoreline survey
- Aircraft
- Ships, buoys and oil platform
- Vehicle-based radar
- Satellite
- Field survey

### Parameters
- Area
- Intensity
- Ice type
- Ice shape
- Drifting velocity and direction
- Ice thickness
- Outline
Monitoring Approaches 1: Shoreline survey
Monitoring Approach 2: Aircraft

鲅鱼圈冰情

锦州9-3油田冰情
Monitoring Approach 3: Ships, buoys and oil platform
Monitoring Approach 4: Vehicle-based radar
Monitoring Approach 5: Satellite

Satellite image with geographic coordinates and metadata.
WEBGIS platform
Monitoring Approach 6: Mechanical field survey
Sea ice forecast

• Statistic forecast
  – 3 days
  – 10-15 days
  – Monthly
  – Yearly

• Numerical forecast
  – FVCOM
  – CIOM
Problems

• Ice thickness monitoring is inaccurate
• Numerical model accuracy still needs to be improved
• 10-15 days forecast is less accurate than short & long-term forecast
Future cooperation

• Similarities of Bohai and Baltic Sea
  – Enclosed seas
  – Shallow seas, mean water level less than 60 m
  – Weak water exchange with outer sea
  – Sea ice in winter

• Looking forward to more cooperation
  – Workshops, technique exchange, etc.
Thank you very much for your listening!

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