Development and application of comprehensive decision-support system for marine oil spill

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1、 Background

- More than 100 countries have entered the productive offshore oil drilling, the oil tanker transportation volume has exceeded 2 billion tons every year in the world. According to the statistics, about 10 million tons of oil flows into the sea every year due to human activities, of which 2.2 million tons are caused by oil blowout accidents in offshore wells and oil tanker accidents.
- With the development of marine economic, oil spill accidents have increased significantly. In fact, We've experienced several major oil spills in the Bohai Sea, such as oil storage-base explosion in Dalian in 2010, oil released from the bottom of the 19-3 platform in 2011, the “Symphony” oil wheel release in 2021, etc. However, to deal with these accidents, we have accumulated mature experience.

1、 Background-“One map” for emergency response of oil spill

- Integrate the real-time **monitoring**, environmental **forecasting**, the **drifting** of oil spill, and the distribution of **disposal resources**, to give the analysis on development of oil pollution, and the disposal plan or strategies. That will help managers make their decisions quickly.

Monitoring

Forecasting (Forward & backward)

Emergency response

Contents

2、Monitoring of marine oil spill

To monitor marine oil spill,

we established a 3D monitoring network, including satellites,

aviation,

ships,

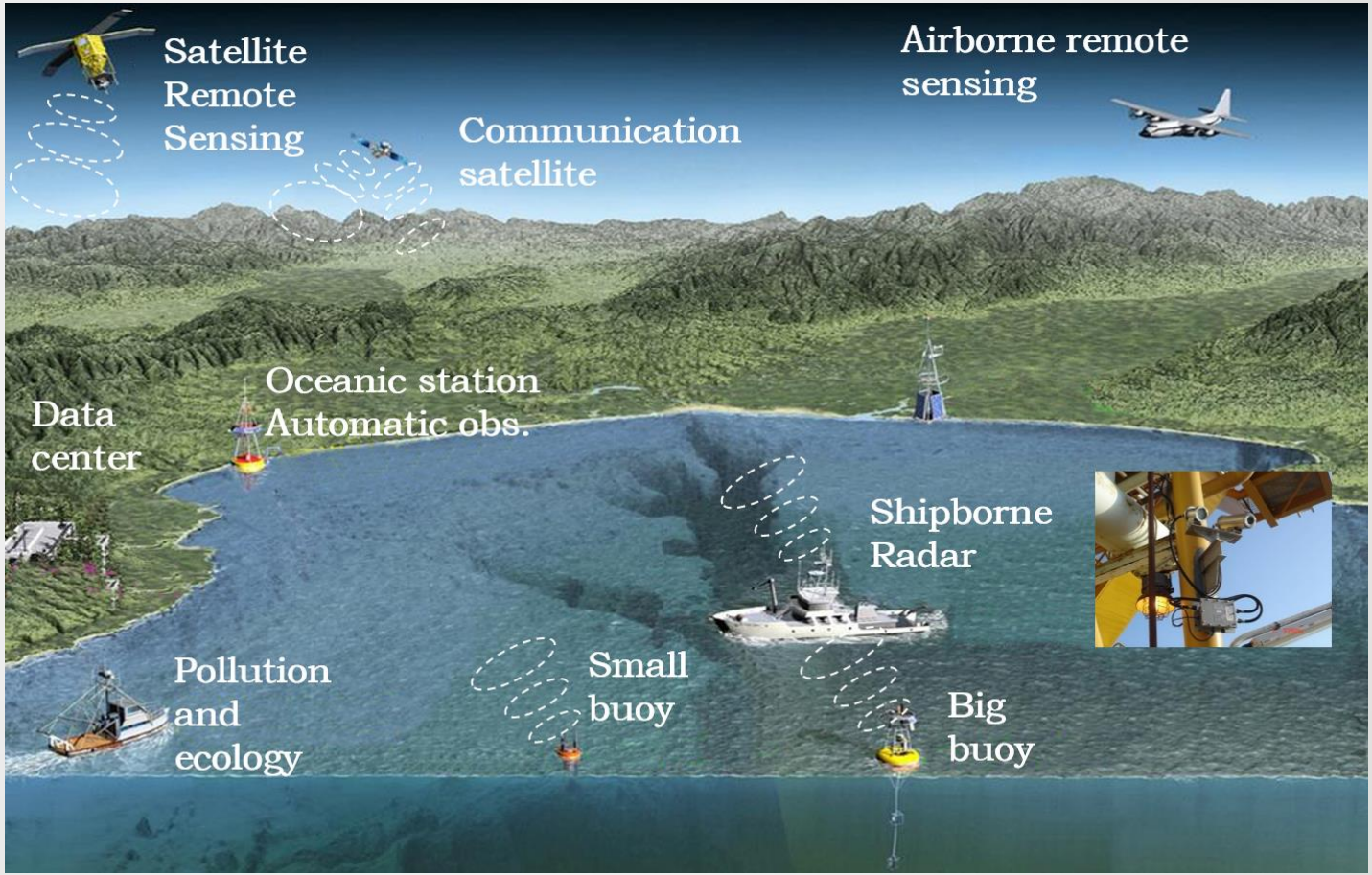
offshore platforms,

buoys,

seabed based stations

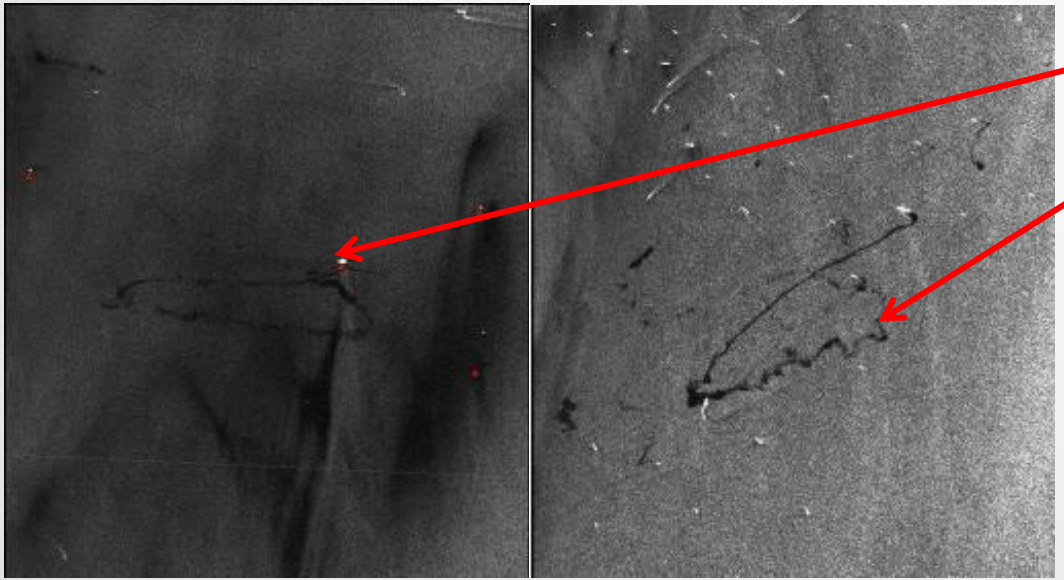
and

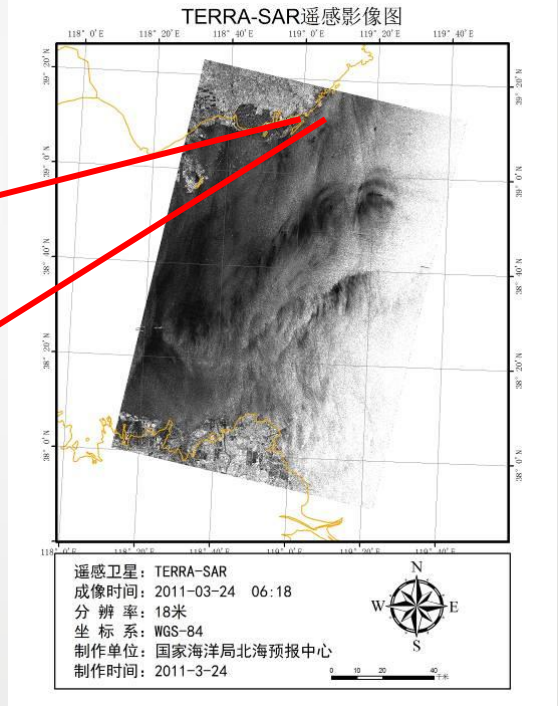
shore-based stations.



2、Monitoring of marine oil spill

- The operational monitoring is based on the satellite, our center try to get all available satellite images over the Bohai Sea , including RADARSAT，COSMO，TerraSAR，GF, etc..
- Analyze almost 500 satellite images each year, and each image takes less than half an hour to process.





2、Monitoring of marine oil spill

- One oil spill case happened in Indonesia on July 12, 2019 monitoring software, and the distribution of oils from 20th as following.
- We sent our results to our cooperative partner (ITB), ar consistent with the actual location.

Q:Where and when did you find the oil on the coast?

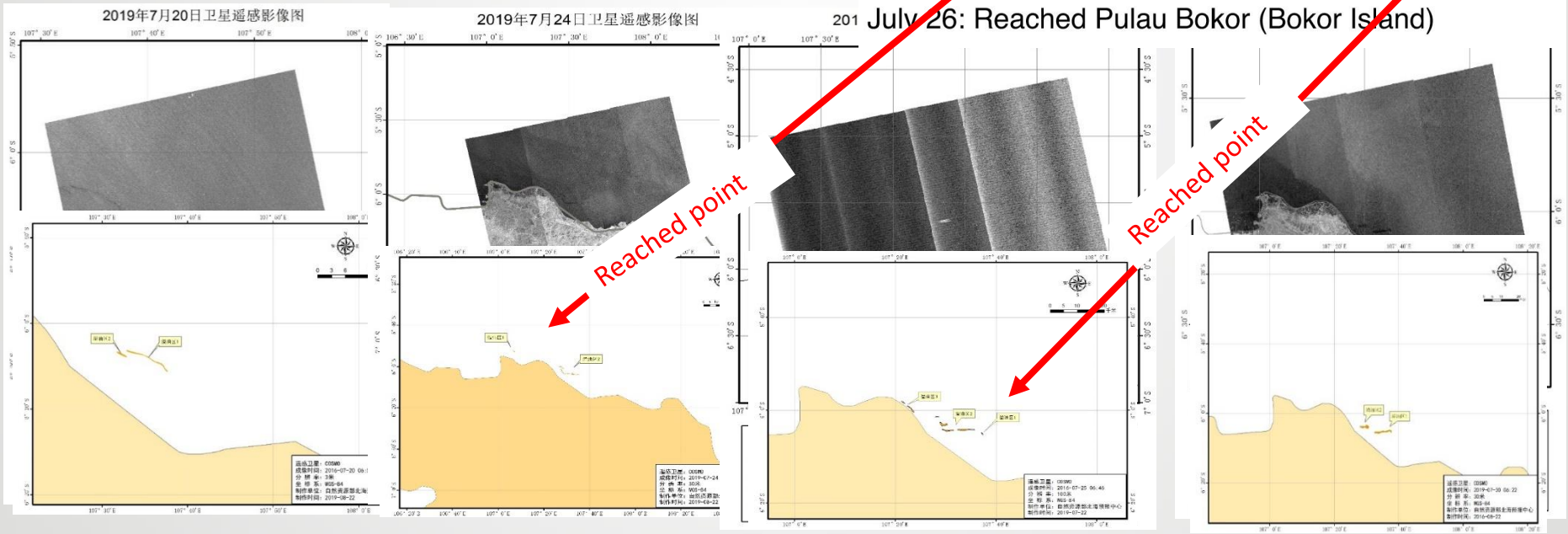
A: July 18: coastal impact started to occur (2 km from west of the platform)

July 18: from satellite report advected up to 17 km.

July 23: Reached conservation area of Pulau Rambut (Rambut Island)

July 24: Reached Pulau Untung Jawa (Untung Jawa Island)

July 26: Reached Pulau Bokor (Bokor Island)



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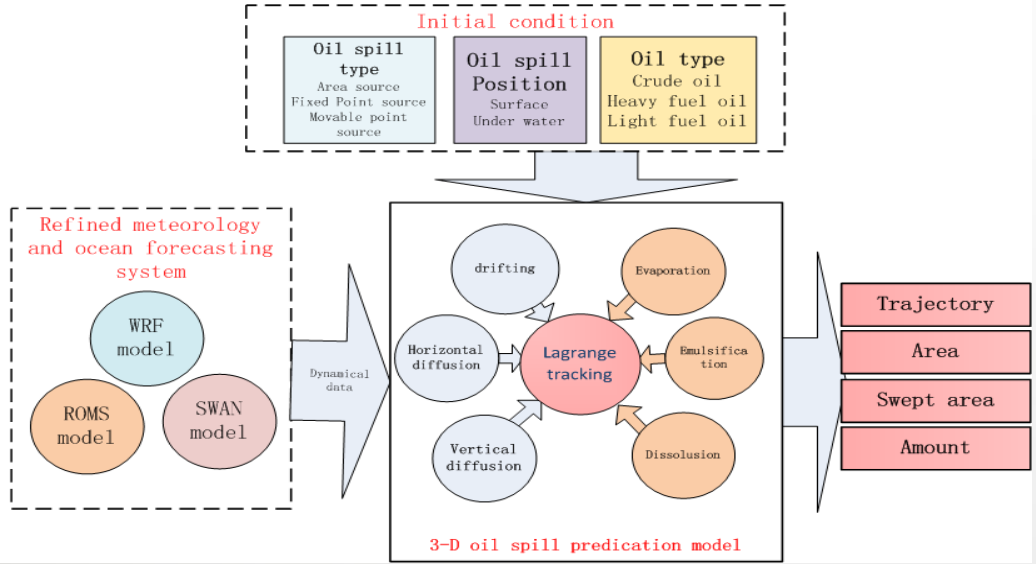
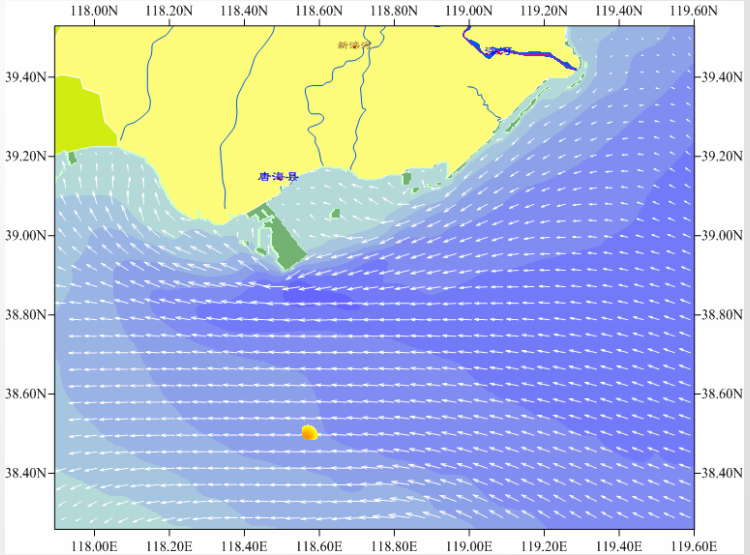
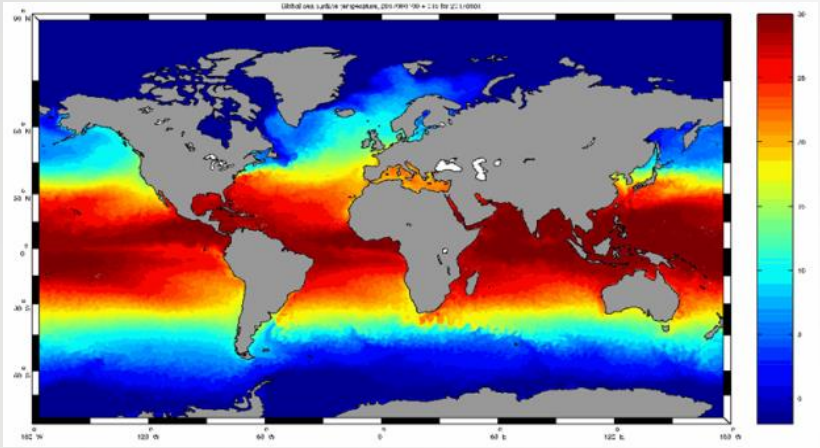
3、Prediction model of marine oil spill

- We established a 3D prediction model to simulate the behavior and fate of spilled oil in the water, including oil spreading, evaporation on the surface, as well as its dissolution and sedimentation in the water.
- The model is driven by oceanic environment operation forecasting system run by our center, which is composed of WRF, ROMS, FVCOM and SWAN models.
- The input of the model is informations about oil, such as its type, amount, position and so on. The outputs are its trajectory, swept area, effect region, and residual oil amount.

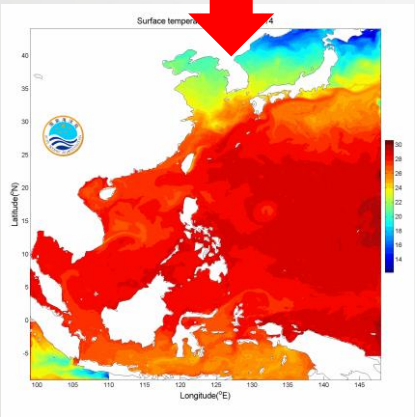


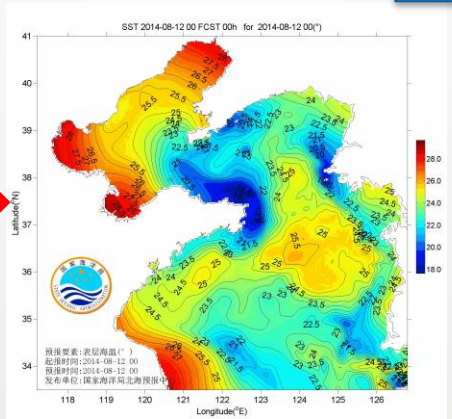


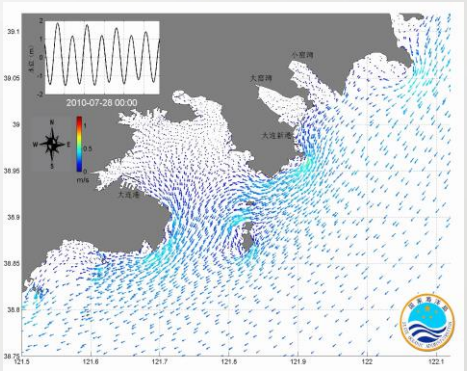
3、Prediction model of marine oil spill



multi-nested oceanic forecasting models
Global to local area

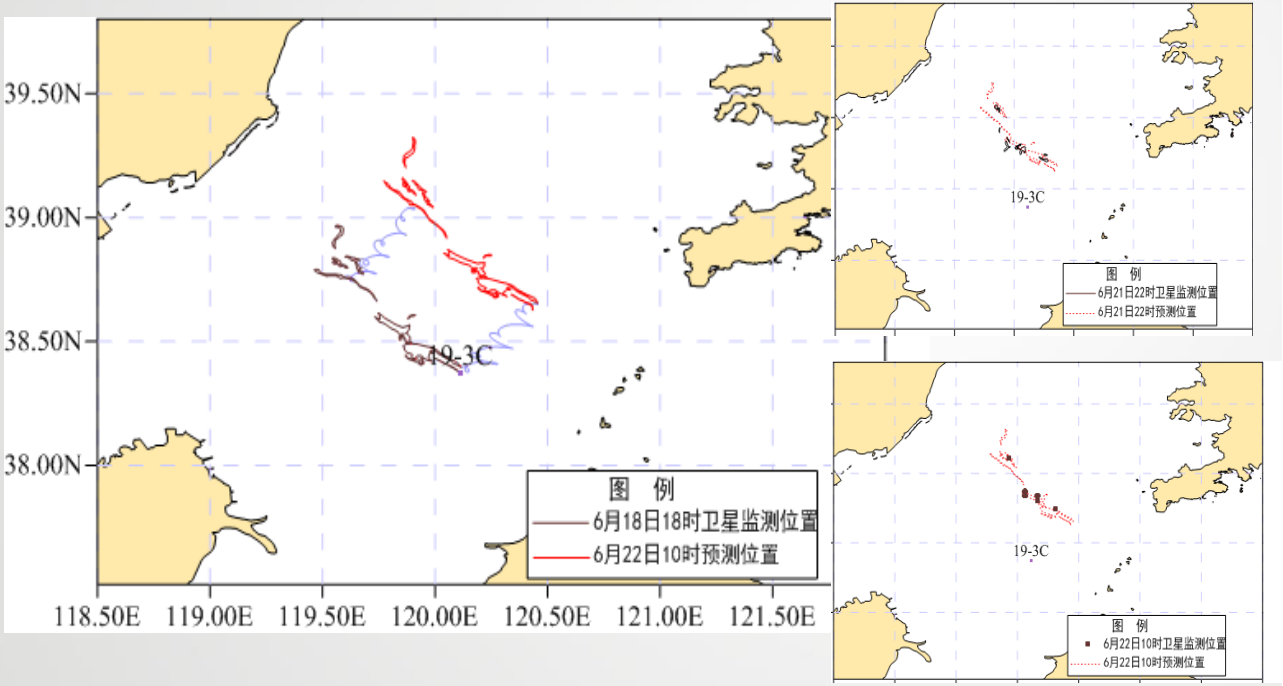


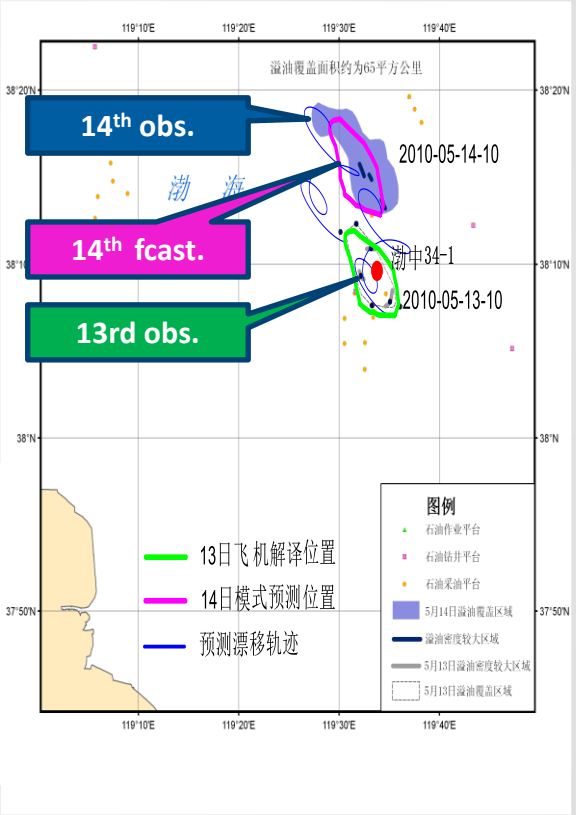




3、Prediction model of marine oil spill

- The oil spill prediction model has been validated through many practical cases.





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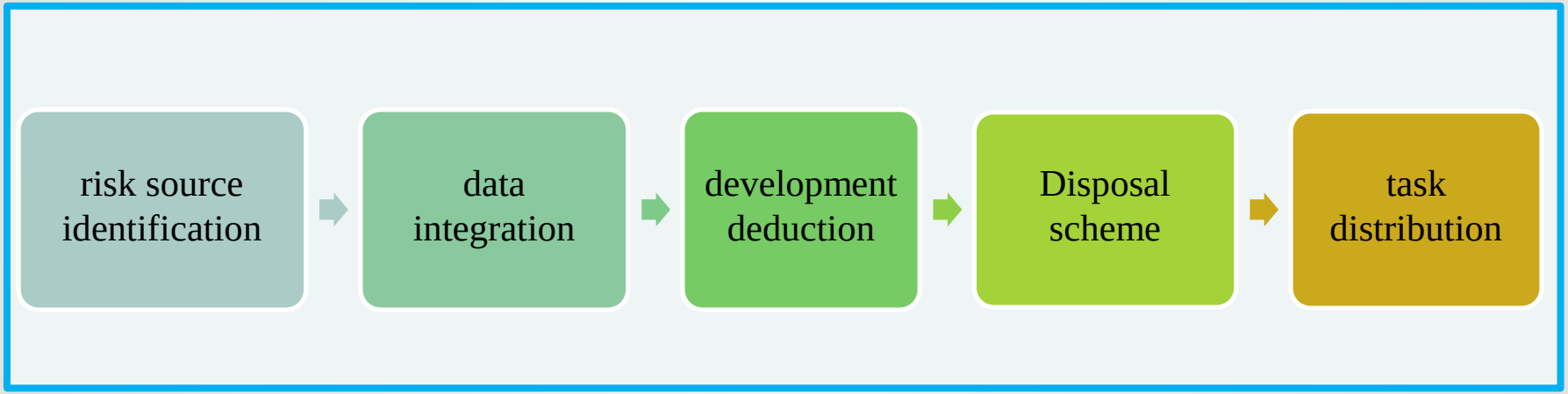
4、Decision-support system

❖ **Learn from the idea of decision-making in battlefield, to address many problems in the process of emergency response, like information discrete, insufficient situation analysis, subjective decision-making and inefficient response.**

- **Integrate multi-source monitoring data**
- **Breakthrough key technology, like big data platform, situation deduction, intelligent decision scheme, distribution for multi-cooperative tasks,**
- **Develop an "intelligent-interactive-integrated" offshore decision support system for emergency response,**
- **Realize operational application.**

4、Decision support system

- The design idea of our system is to face decision makers and decision-making process, that covers the whole process of emergency response.

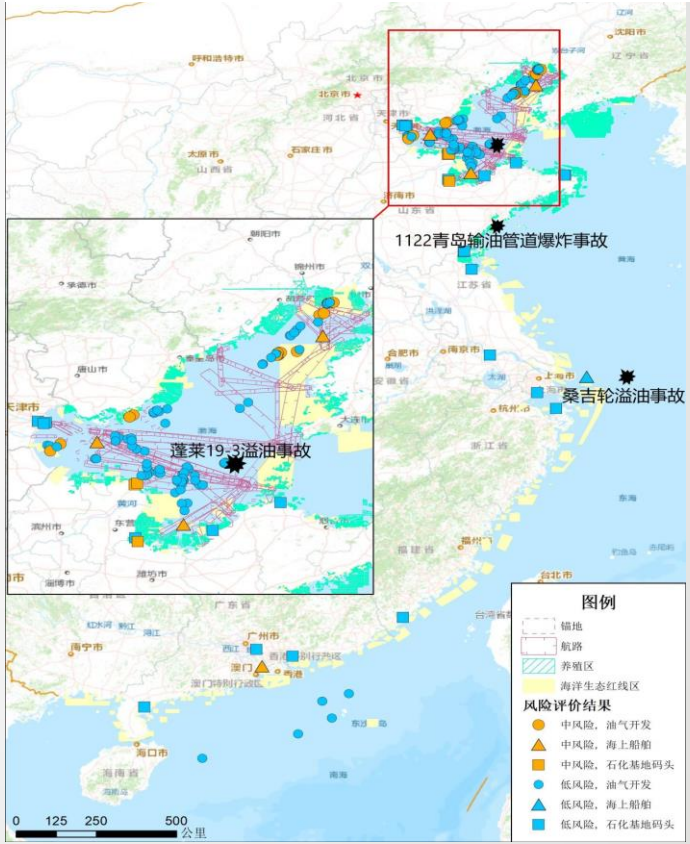


4、Decision support system

risk source identification

- Investigation and identification of offshore oil spill hazards and sensitive areas,
- Develop a set of oil spill risk assessment method to give the risk level before and after accidents occur,
- Based on that, according to the development trend of oil spill, the identification of emergency risk and corresponding disposal measures in the whole process of oil spill emergency disposal can be carried out.

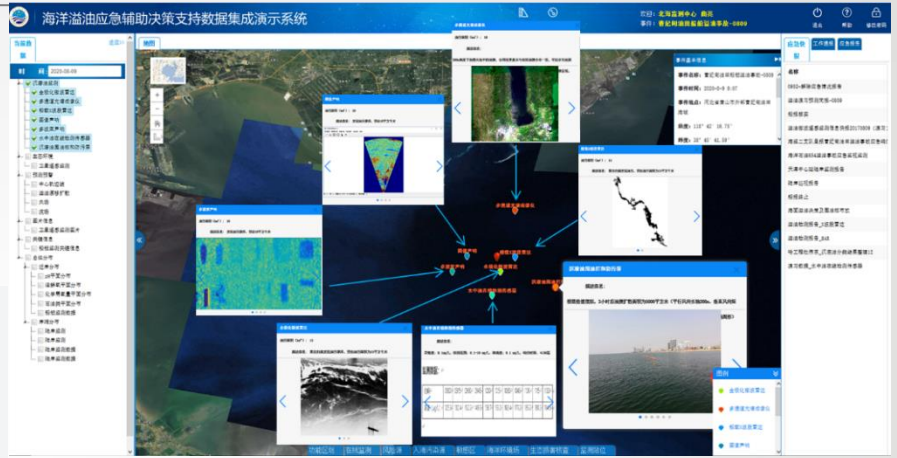
Risk distribution of offshore oil spill in China

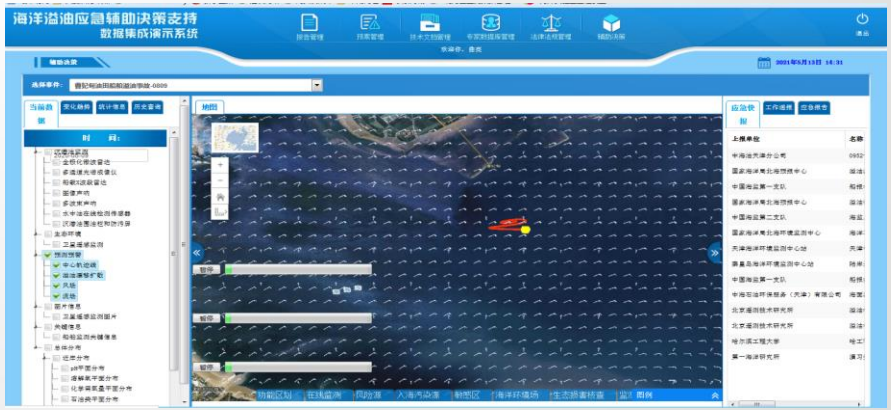


4、Decision support system

data integration

- Based on ‘big data’ technology,
- Integrate the conventional and new emergency monitoring means,
- realize data real-time transmission, receiving and processing,
- realize the automatic analysis of all kinds of data fusion,
- and provide standardized data products and services.

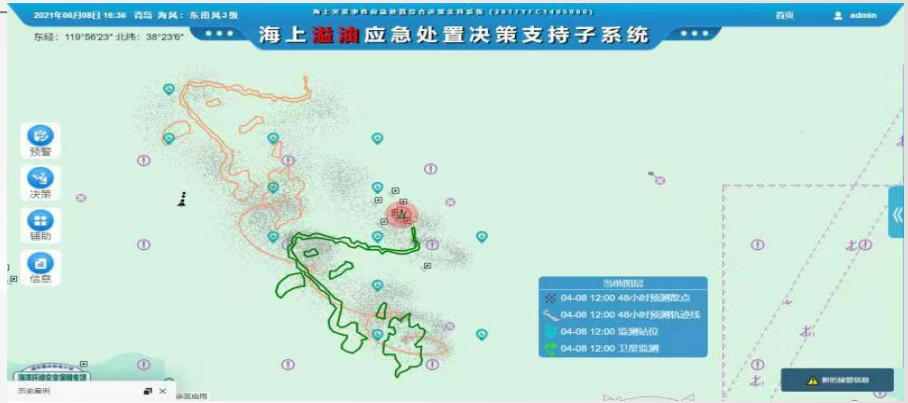


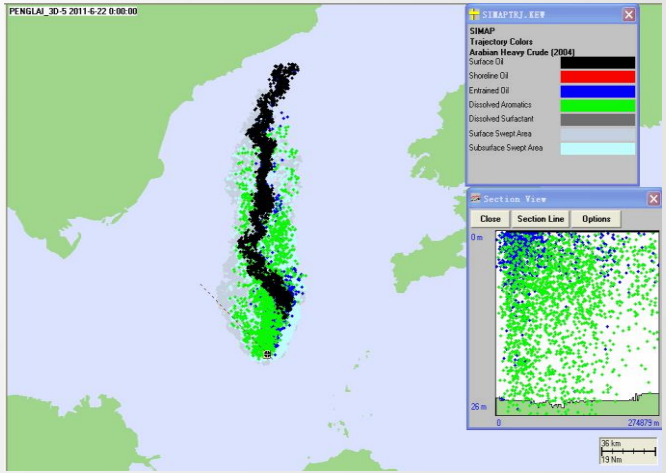


4、Decision support system

development deduction

- Integrate 3-dimensional offshore oil spill drift diffusion model and submerged oil drift prediction model,
- Provide the prediction of sea surface oil film distribution and coastal oil pollution.





4、Decision support system

Disposal scheme

- Based on the responsibilities of offshore oil spill emergency response business and various emergency plans,
- Establish knowledge base,
- Take into account the accident information, emergency monitoring, prediction, disposal resources allocation,
- Give disposal plan.

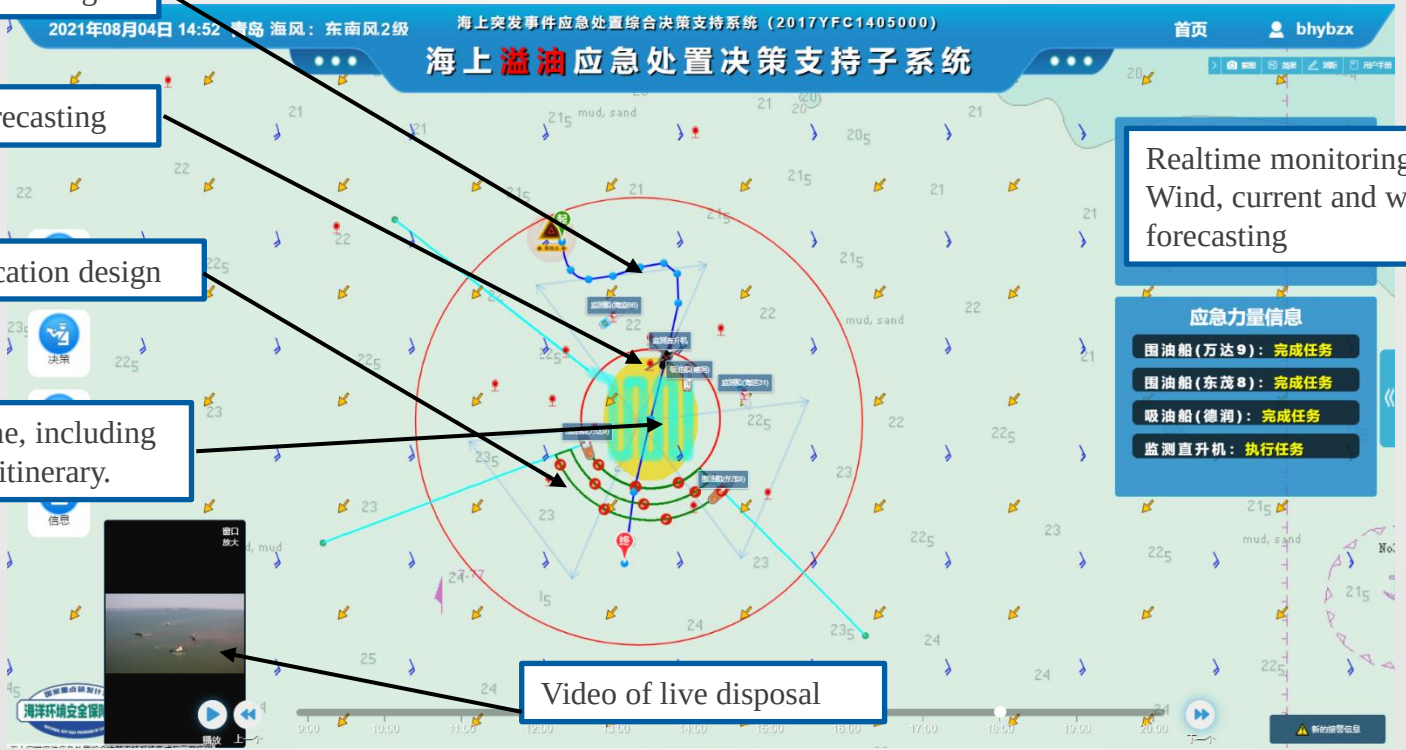
4、Decision support system

Trajectory forecasting

Swept area forecasting

Monitoring location design

Clean up scheme, including equipment and itinerary.



Realtime monitoring
Wind, current and wave forecasting

Video of live disposal

Thank you!