Emergency response and Disaster risk management based on Remote sensing and Multi-source data fusion

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Ministry of Transport of the People's Republic of China

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Content

Transport infrastructure in China

By the end of 2018

- Total length of highway network: 4.84 million kilometers
  - expressway: 142,600 kilometers
  - rural road: 4.03 million kilometers
- railways: 131,000 kilometers
- inland waterways: 127,100 kilometers
- berths: 23,919

Transportation Emergency Response

Transportation Emergency Events（in 2018）

Maritime Search and Rescue

- 2063 rescue operations
  - rescued 15046 people

Highway Traffic Security

- 7 major transport accidents
  - 95 deaths

Waterway Traffic Safety

- 129 ship accidents
  - 190 people dead or missing

Construction Safety

- 44 fatalities and disappearances
  - 5 major accidents

Highway damage caused by Natural disasters

in July 2019

- 777.65 kilometers of subgrade damage
- 1427.48 kilometers of pavement damage
- 101 bridges damaged
- 5 tunnels damaged
- 2196 collapses
- 119 highways interrupted

total loss exceeds 3.9 billion yuan.

Highway damage caused by Natural disasters

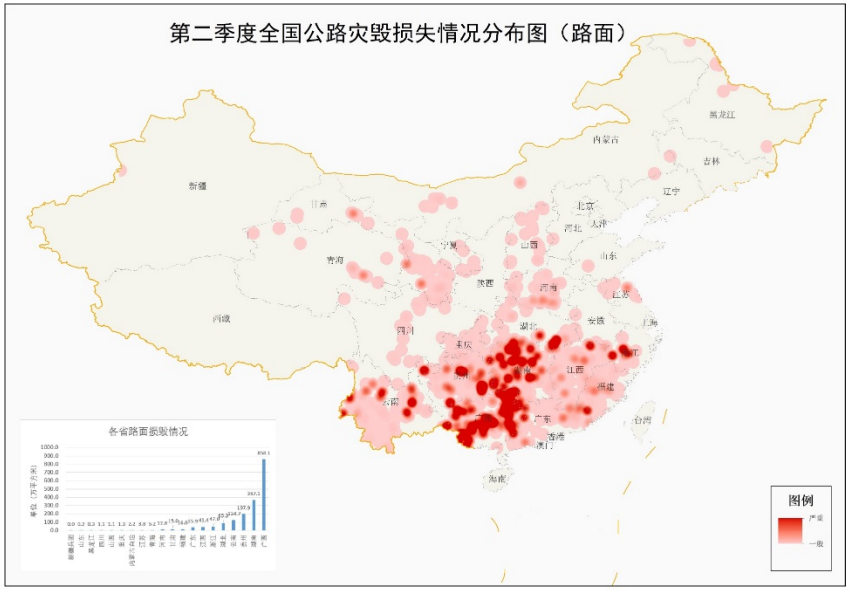


Fig1. Spatial distribution of disaster damage of national highway in the second quarter (pavement)

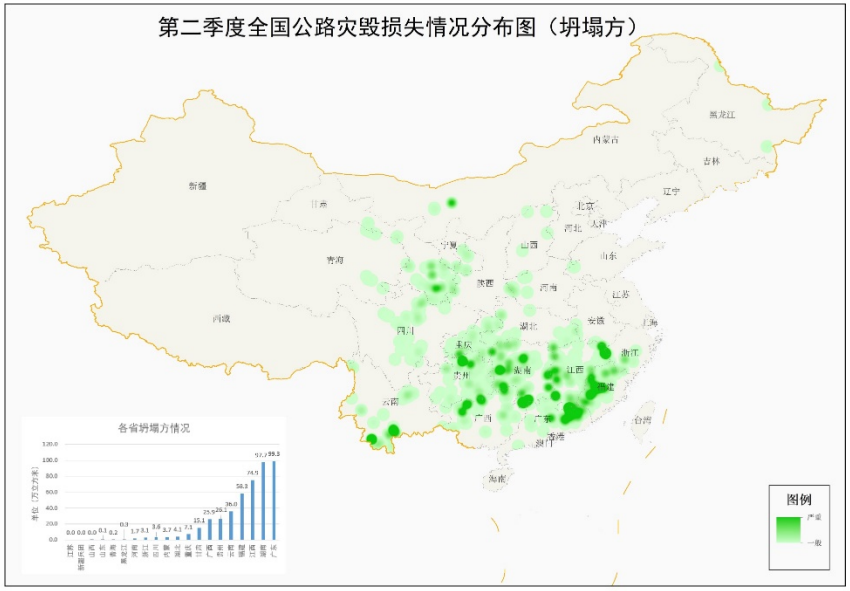
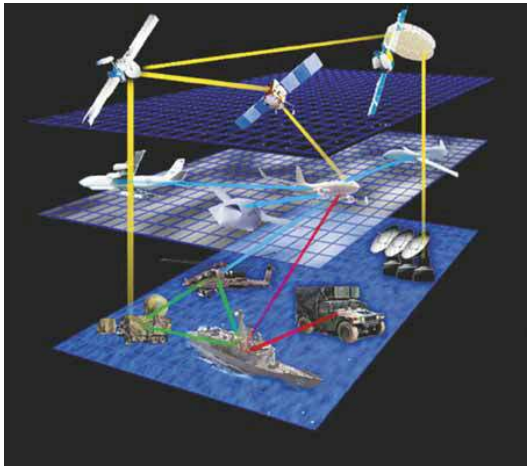


Fig2. Spatial distribution of disaster damage of national highway in the second quarter (Collapse)

Requirements for Efficient Disaster Assessment & Rapid Response

- Localize and identify potential disaster risks.
- Rapid assessment for emergency response.
- Quantitative analysis supporting post-disaster reconstruction.



Content

Applications

1. Pre-Disaster Risk Assessment

- Deformation monitoring
- Sea ice monitoring

2. Disaster Information Management

- Disaster and highway damage information acquisition system
- Assessment of reported disaster information
- Dispatch and emergency command system

3. Emergency Response and Risk Deduction

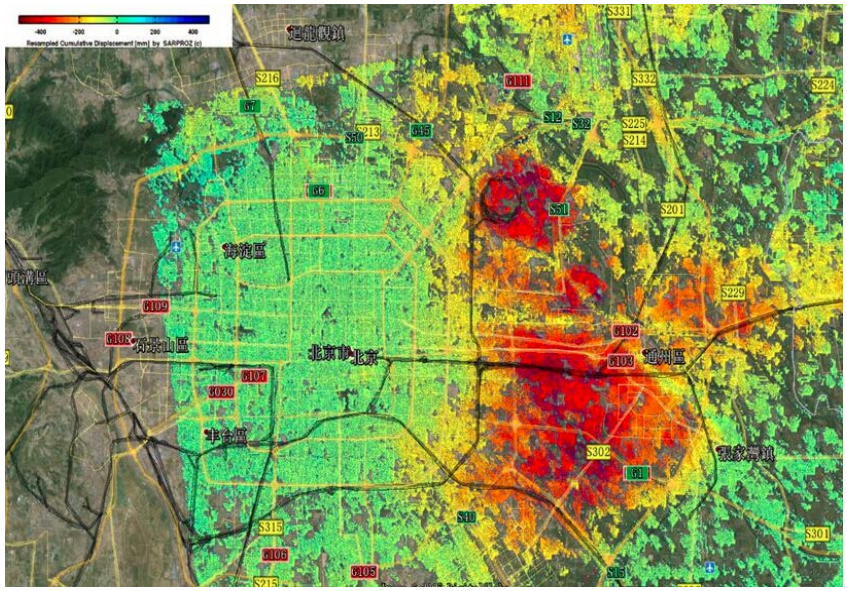
- Emergency response after earthquakes and landslides
- Maritime search and rescue
- Oil spill monitoring

Pre-Disaster Risk Assessment

Pre-Disaster Risk Assessment

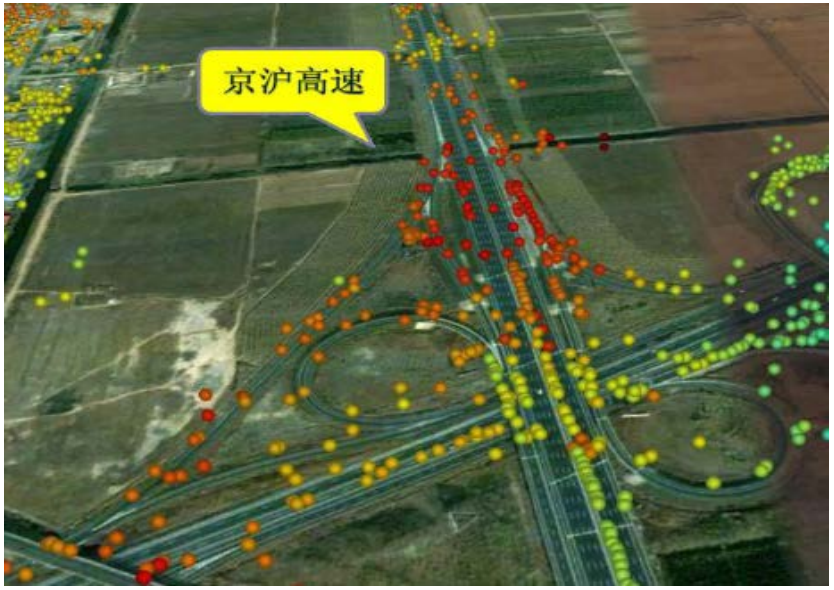
Deformation monitoring of transport infrastructure

- subgrade of highways
- bridges and slopes along the roads



Subsidence Monitoring of Beijing

（Red dots represent severe deformation）



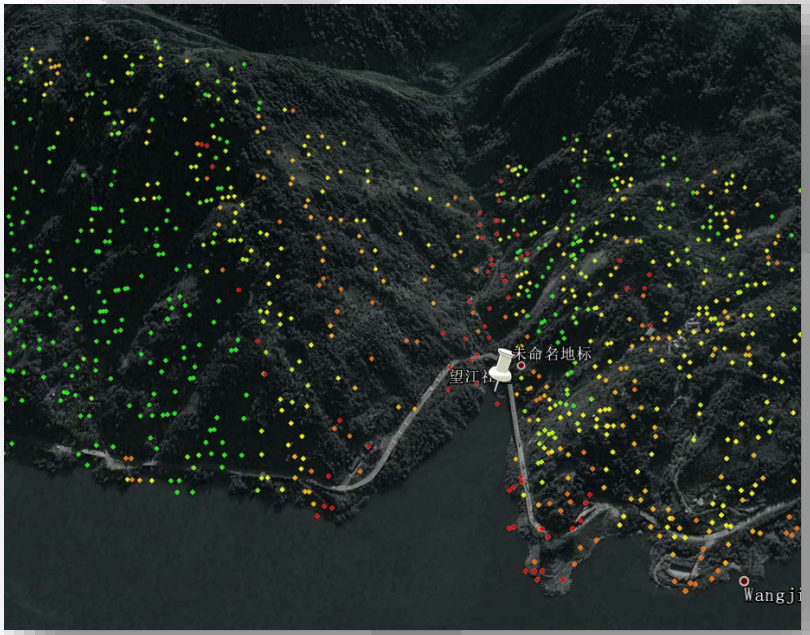
Deformation Monitoring of Bridges along Beijing-Shanghai Expressway

(Red dots represent severe deformation and high risk)

Pre-Disaster Risk Assessment

Deformation monitoring of transport infrastructure

- bridge
- and surrounding slope

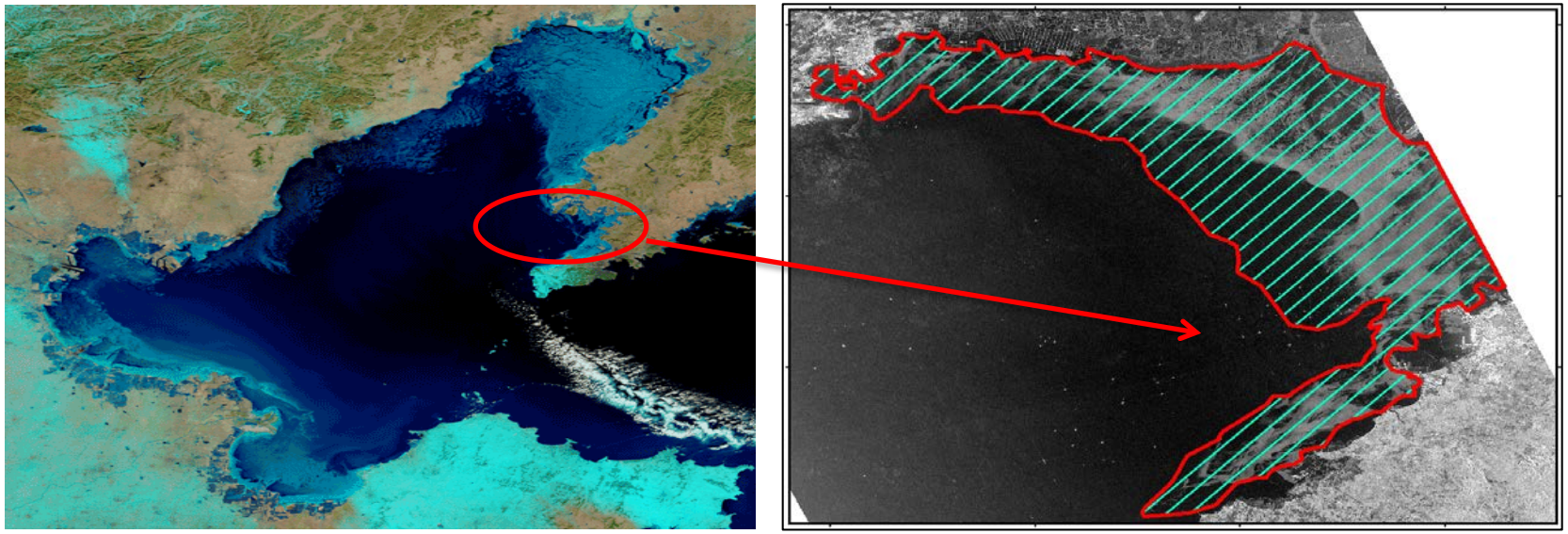


（Red dots represent severe deformation）

Pre-Disaster Risk Assessment

Sea Ice Monitoring with MODIS & SAR data

- release maritime warning
- to ensure the navigation security
- avoid the occurrence of sudden accidents at sea



MODIS data capatured on January 25, 2016

SAR image captured on 11 January 2019

Sea ice monitoring of Bohai Bay, China

Disaster Information Management

Disaster and highway damage information acquisition

Disaster and highway damage information

- collected by maintenance crews **nationwide**,
- **in time** (within one week after disaster happened),
- to support financing arrangements for post-disaster reconstruction

APP **+** **Web-GIS system**

More than 500 highway disaster sites on average are reported everyday.

Assessment of reported disaster information

- accurate location
- type of disaster
- degree of road damage

Fig1. Details comparison of water-damaged road section of G317 in Keku Township, Wenchuan County, Sichuan Province.

Dispatch and Emergency Command System

Dispatch and Emergency Command

Dynamic monitoring

Emergency warning

Dispatch coordination linkage

Emergency disposal command

Safety production supervision

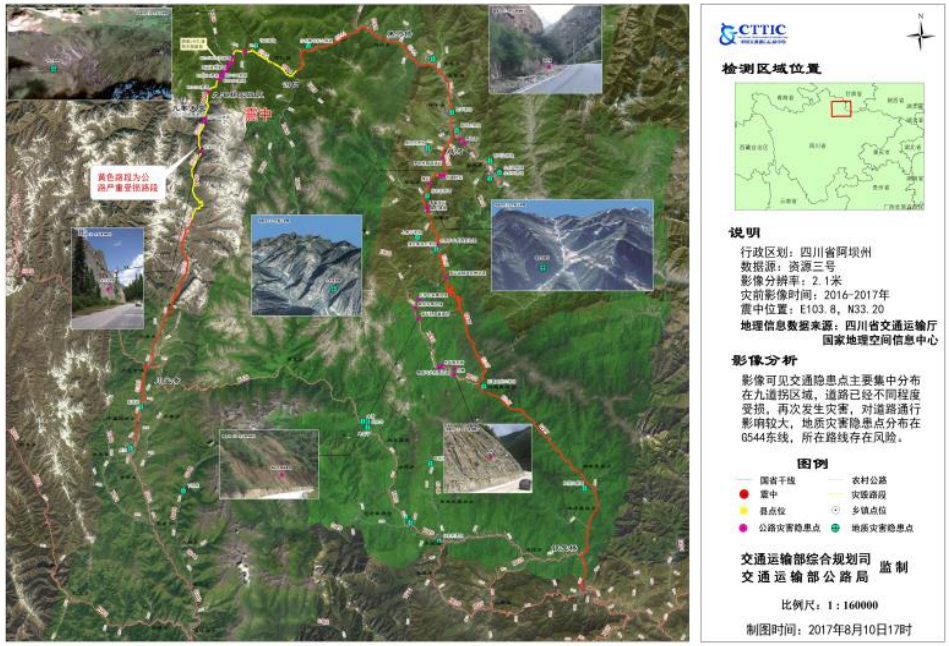
Emergency Response and Risk Deduction

Emergency Response after Earthquake

Jiuzhaigou earthquake:

- result in Road damage and interruption, building collapse
- We use remotely sensed images before and after disaster happened
- localize and evaluate the road damage area

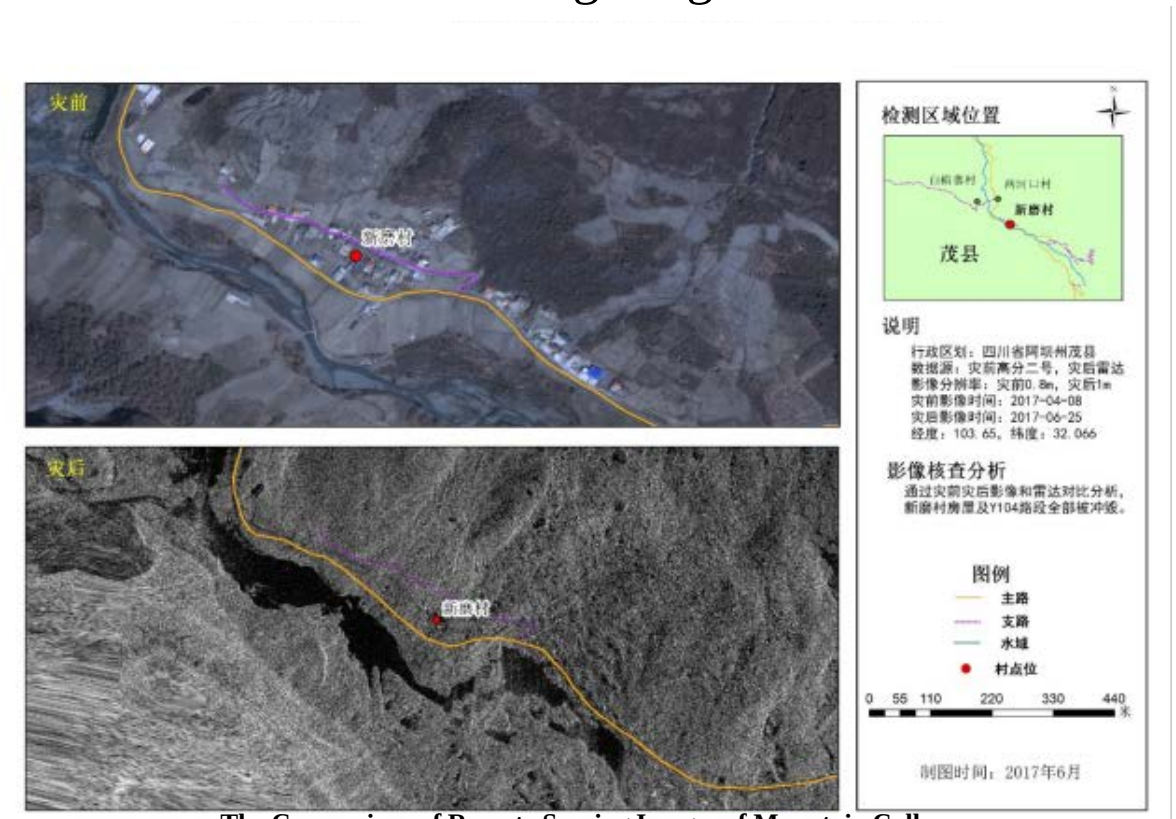
The Distribution of Potential Points of Traffic Disasters after Jiuzhaigou M7 Earthquake in Sichuan Province



Emergency Response after landslide

Maoxian Landslide

- road damage caused by mountain collapse
- before: optical satellite image after: SAR+optical image
- localize and evaluate the damage degree



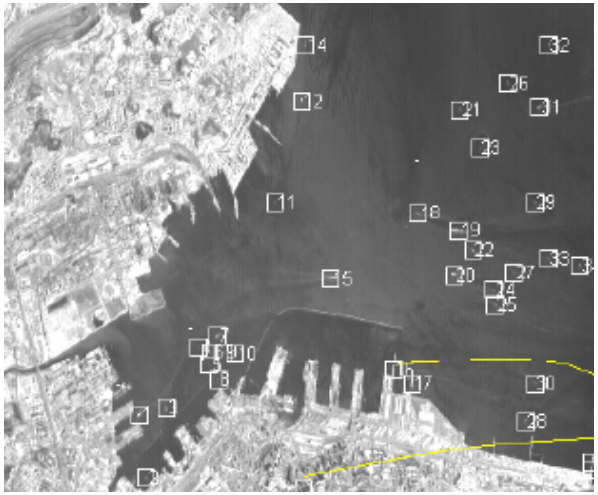
The Comparison of Remote Sensing Images of Mountain Collapse Area(Y104) before and after Disaster in Xinmo Country Section.

Maritime Search and Rescue

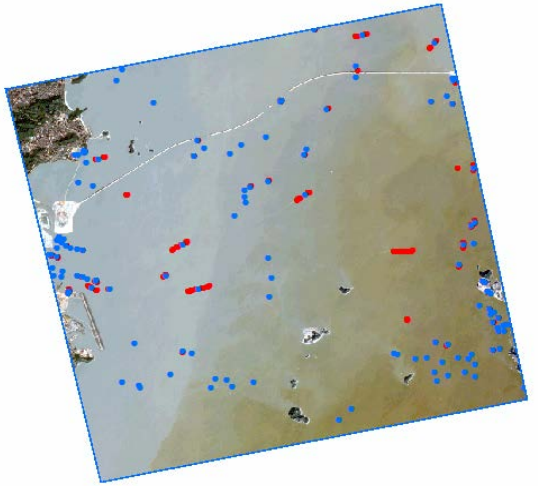
Maritime search and rescue synthetically uses multi-source data:

- Optical satellite image
- SAR image
- AIS data (Automatic Identification System)

Ship detection with optical image



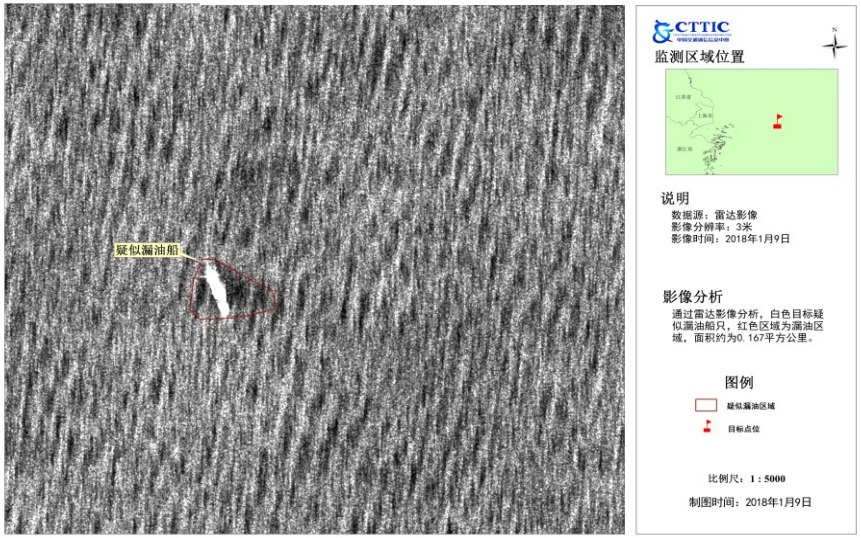
Ship detection with SAR image



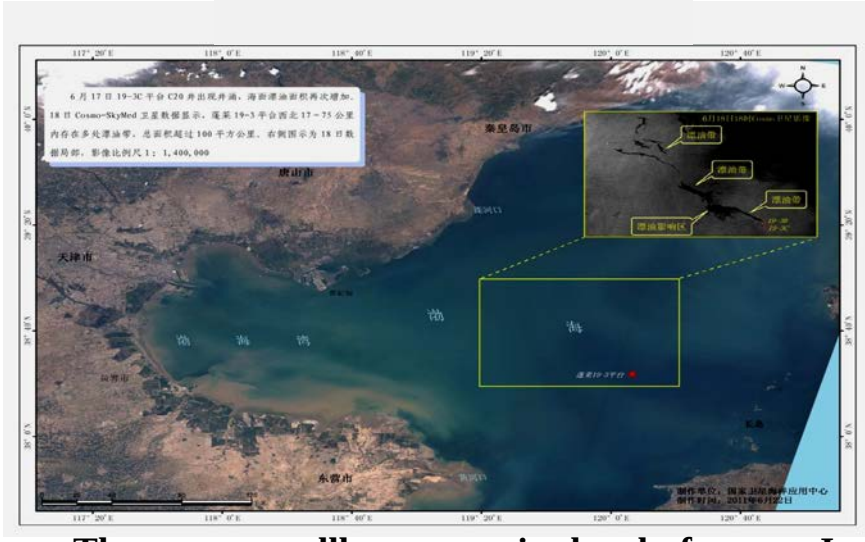
Extraction results of remote sensing superimposed with AIS (blue for remote sensing monitoring, and red for AIS monitoring)

Oil spill monitoring

- Localize the crash area.
- Get information： film thickness and extent of spilled oil.
- Support following search, rescue and oil spill disposal.



Remote sensing of oil spill accident in the East China Sea collision



There was a wellbore surge in the platform on June 17th,the display position was 17-75 kilometers northwest of the platform on the 18th, with a total area of more than 100 square kilometers.

Content

Limitation

Resolution Spatial resolution, temporal resolution.

Cooperation Cooperative observation by different earth observation missions.

Content

Conclusion

I. Importance. Remote sensing technology has played an important role in transportation emergency response and risk management;

II. Trend. Single-source remote sensing has limitations and should be combined with other data analysis mothods;

III. Suggestion. More technical cooperation and communications on emergency response topics.


Thank you!