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

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I. Requirements

II. Applications

III. Limitations

IV. Conclusion
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 Events (in 2018)

### Maritime Search and Rescue
- 2063 rescue operations
- rescued 15046 people

### Waterway Traffic Safety
- 129 ship accidents
- 190 people dead or missing

### Highway Traffic Security
- 7 major transport accidents
- 95 deaths

### 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.
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 captured 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

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

Fig 1. Details comparison of water-damaged road section of G317 in Keku Township, Wenchuan County, Sichuan Province.
Dynamic monitoring
Emergency warning
Dispatch coordination linkage
Emergency disposal command
Safety production supervision
Emergency Response and Risk Deduction
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
Maoxian Landslide

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

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.

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

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Limitation

Resolution

Spatial resolution, temporal resolution.

Cooperation

Cooperative observation by different earth observation missions.
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 methods;

III. Suggestion. More technical cooperation and communications on emergency response topics.
4.3 国内外的交通遥感合作

国内方面,我中心已经与军方、科研院所、高校及大型的卫星遥感企业建立了长期的合作关系,进一步推动遥感技术在交通领域的应用。

中国交通通信信息中心联合航天有关卫星和传感器研制单位,以及中科院遥感所等科研单位,开展了p波段雷达在交通行业的应用及算法研究。主要围绕亚地表冻土层分布,林下道路识别,边坡土壤湿度反演,河道泥沙淤积等方面。

Thank you!