



Center for Earth Observation and Digital Earth  
Chinese Academy of Sciences

# Earth Observation for Natural Disaster Mitigation and Data Sharing

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# Outline



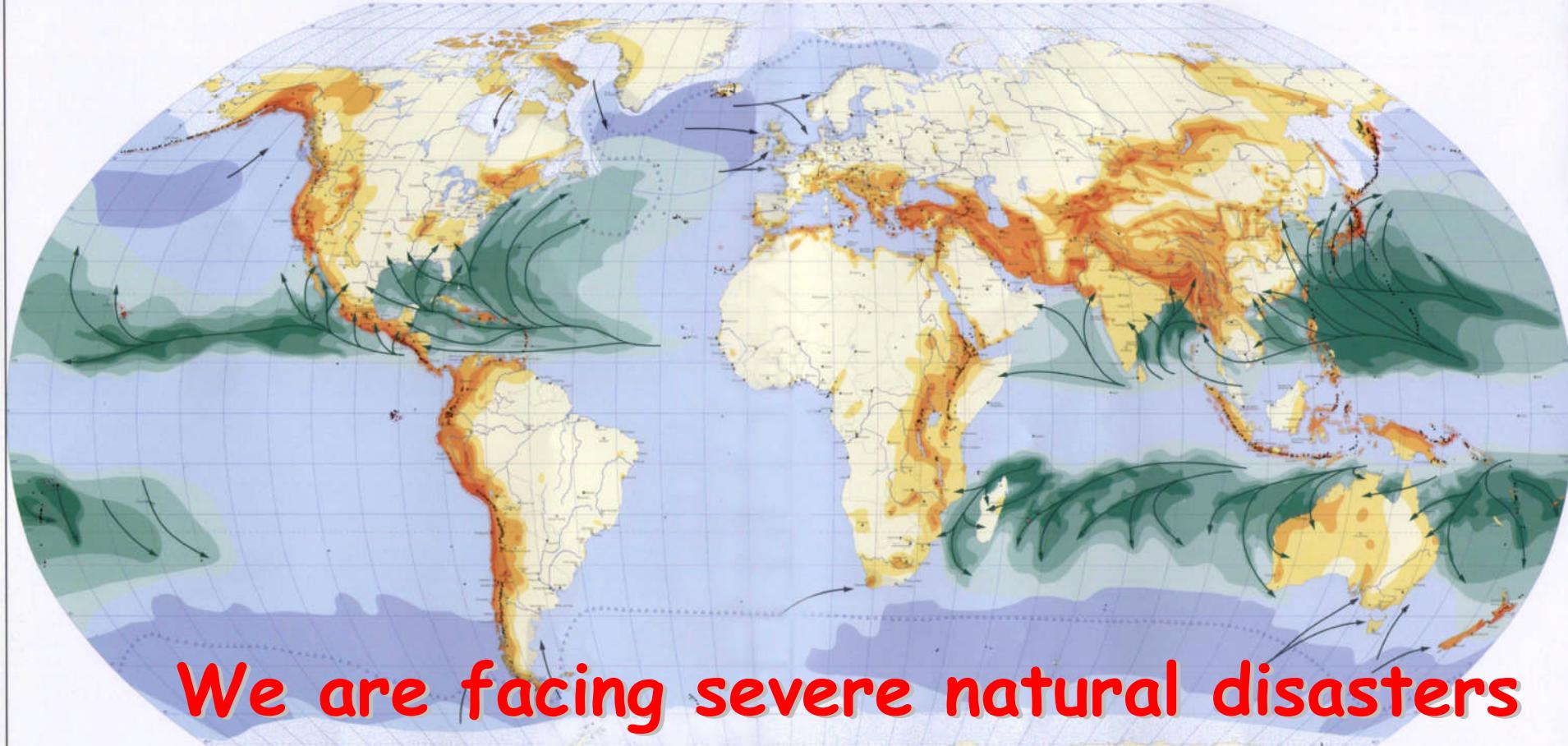
- 1. Introduction**
- 2. Earth Observing Satellites**
- 3. Disaster Monitoring and Assessment**
- 4. Earth Observation Data Sharing**
- 5. Concluding Remarks**

# 1、Introduction



世界自然灾害分布图

Münchener Rück  
Munich Re



# 1. Introduction

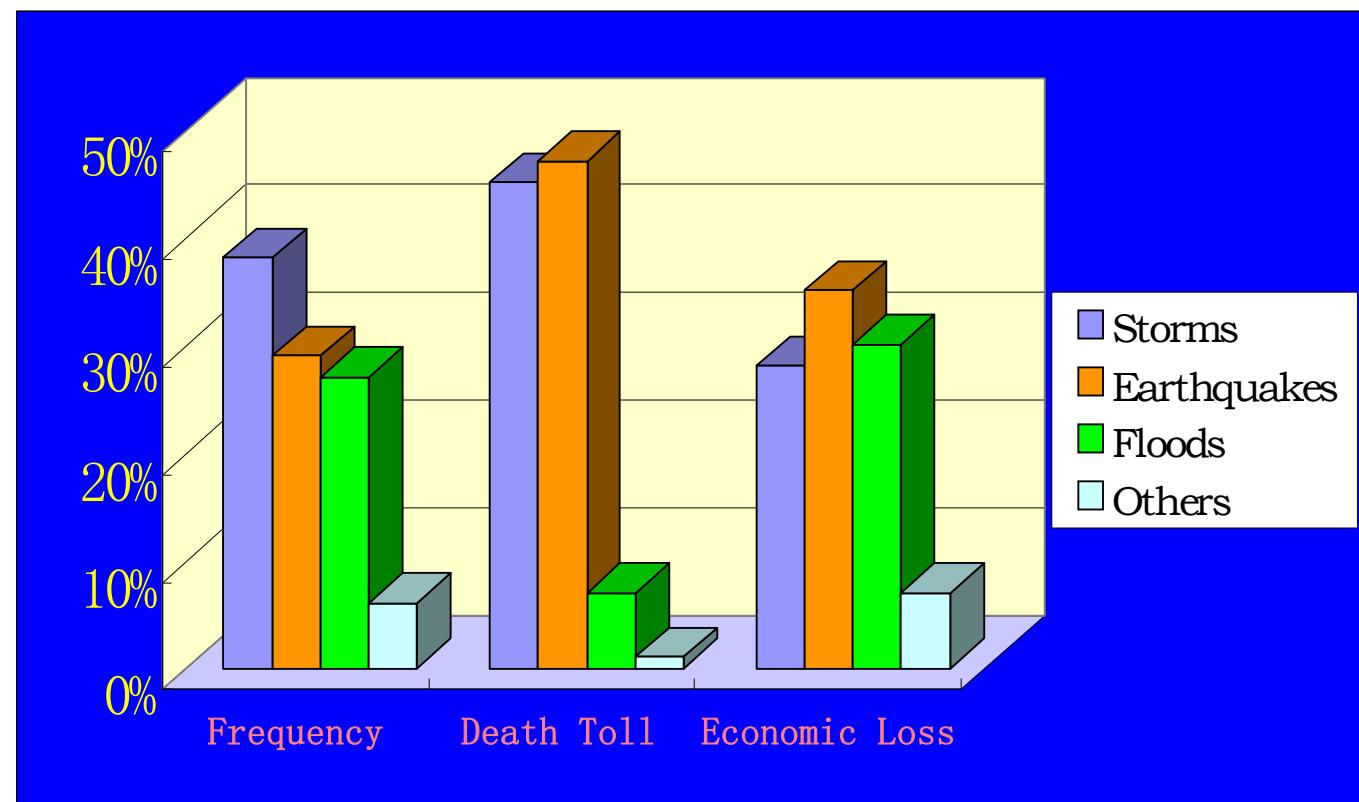


From 1950 to 1999 (Murchener Ruck Munich Re Group, 1999), all kinds of sudden natural disasters (excluding drought) have resulted in:

- **A death toll of up to 1,400,000**
- **Economic losses up to US\$ 960 billion**

☆ The Categories of major sudden disasters:

- ❖ Storms (including tsunamis, typhoons, storm tides, etc.)
- ❖ Earthquakes
- ❖ Floods
- ❖ Others (volcanoes, geological disasters, biological disasters, fires, etc.)



# 1. Introduction



**In 2008, all kinds of sudden natural disasters have happened up to 321 in the world, and results in: A death toll of up to 2,350,00**



**Typhoon**



**Flood**



**Drought**

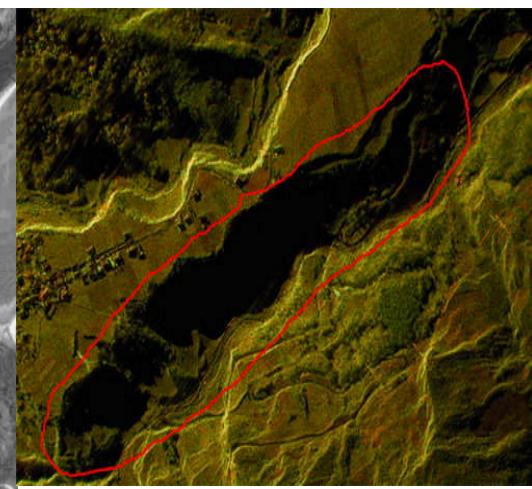


**Ice and Snow Disaster**

# 1. Introduction



The number of natural disaster in 2008 is less than ones before, but the death toll and economic losses are more than the average ones from 2000 to 2007, and most of them were focused in Asia, for example Nargis severe tropical storm; Wenchuan earthquake.



The optical and airborne SAR Image of Maoxiangping area alongside national highway (G213)pre- and post-earthquake, there was surface subsidence in red frame(CEODE )

Satellite Image of Nargis severe tropical storm,  
Apr. 15 and May. 5 ( NASA )

[www.ceode.ac.cn](http://www.ceode.ac.cn)

## 2. Earth Observing Satellites



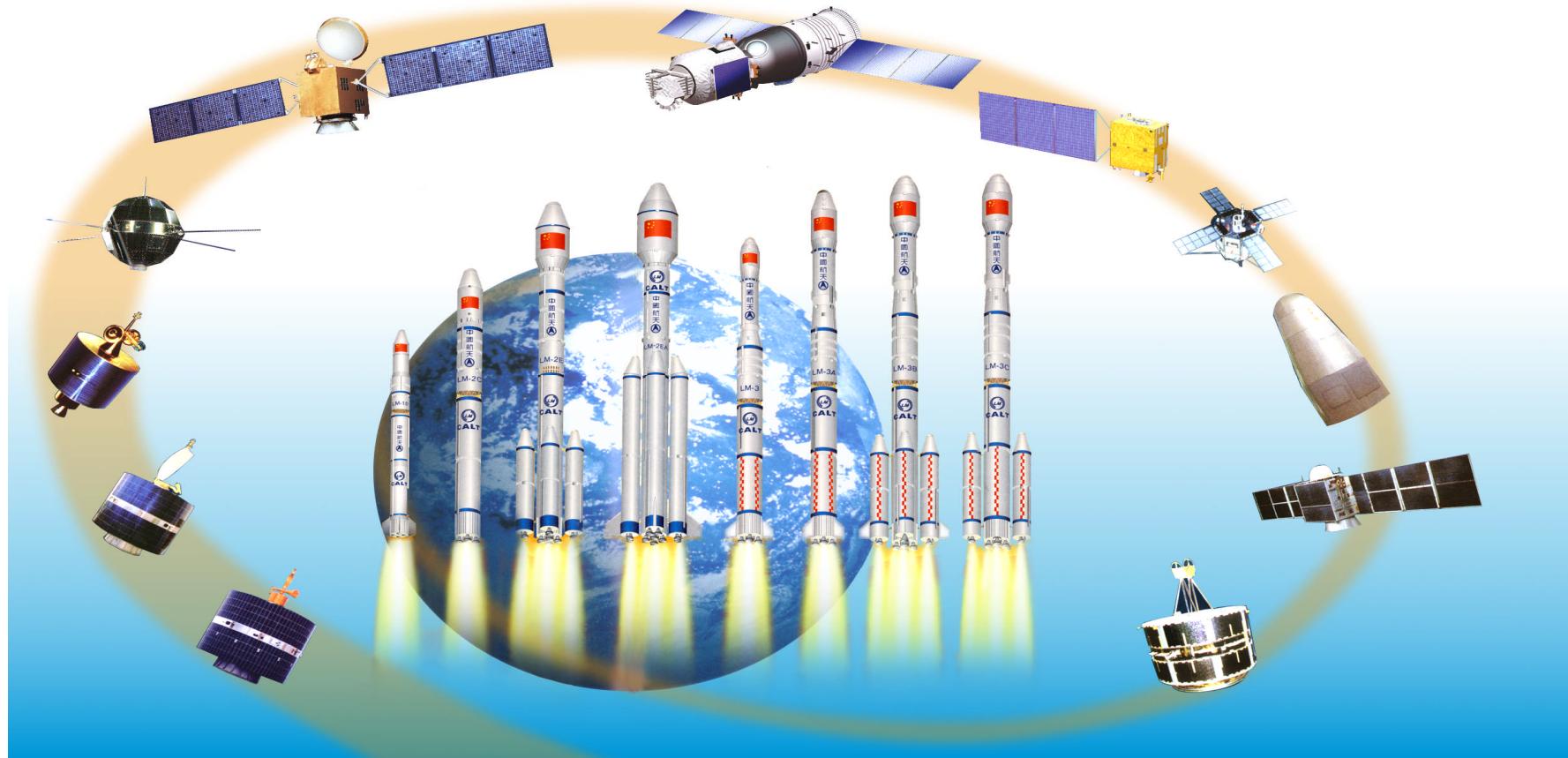
# Satellite Development and Application

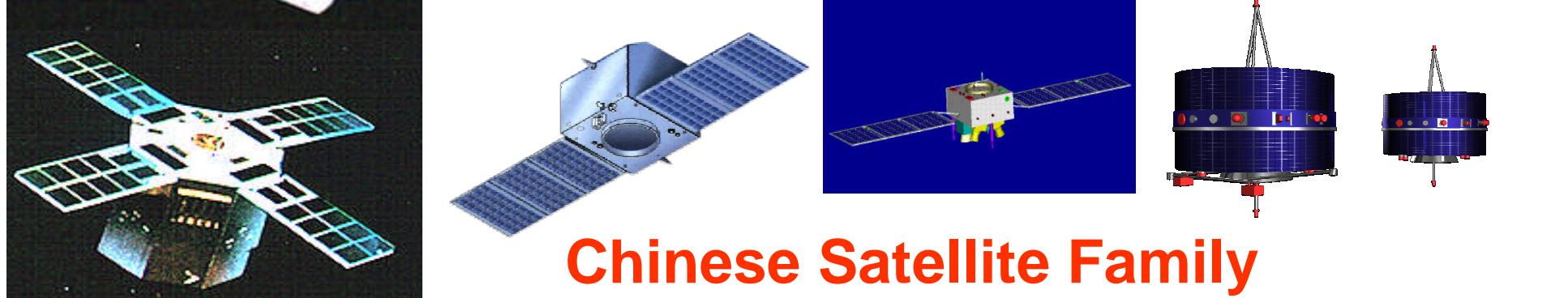
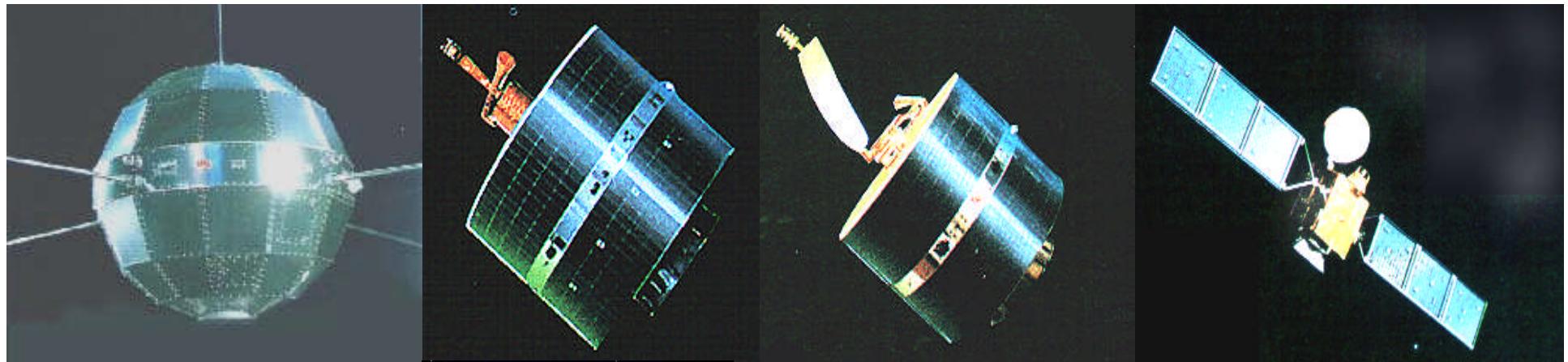
## — 5 capacities of Chinese Space Program



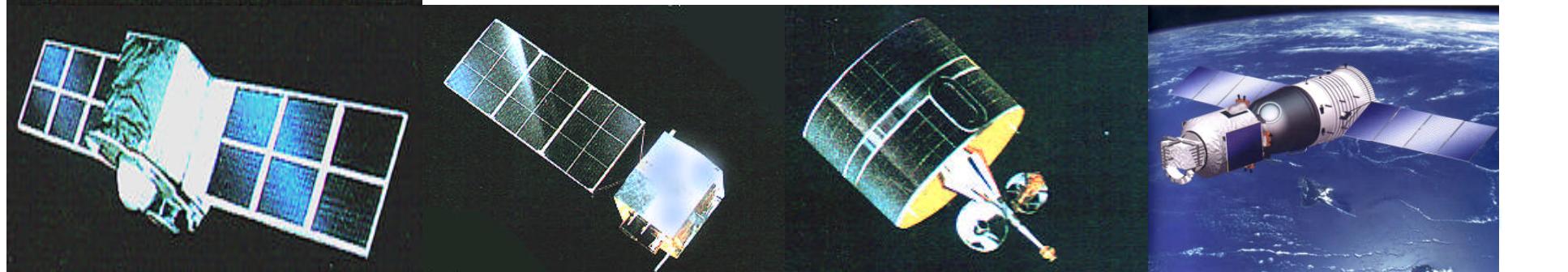
# Entering into the Space

## —One of the 5 capacities of Chinese Space Program





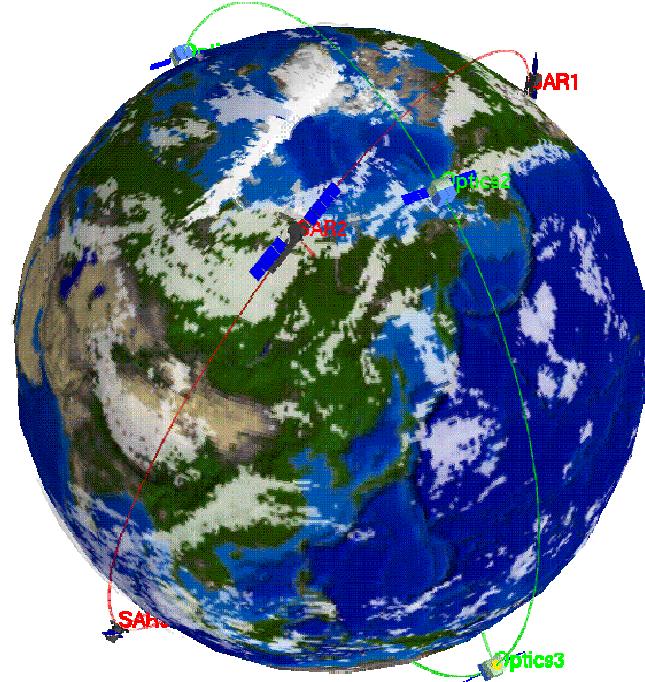
## Chinese Satellite Family



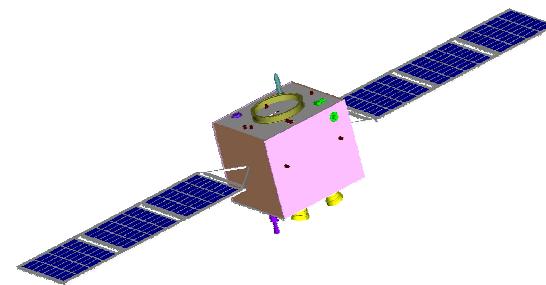
# Chinese Satellites and Spacecrafts

<input type="checkbox"/> Meteorological Satellite	
Polar Orbit FY-1 A, B, C, D	4
Geo-stationary FY-2A, 2B, 2C	3
<input type="checkbox"/> Marine Satellite HY-1	1
<input type="checkbox"/> Resource Satellite (CBERS, ZY, Beijing, Yaogan, Tsinghua)	7
<input type="checkbox"/> Environmental and Disaster Monitoring Satellite	2
<input type="checkbox"/> Communication Satellite	7
<input type="checkbox"/> Navigation Satellite Beidou -1	3
<input type="checkbox"/> Return Land Satellites	17
<input type="checkbox"/> Scientific experiment Satellites	15
<input type="checkbox"/> Spacecraft SZ -1, 2, 3, 4, 5, 6, 7	7

# HJ-1A,HJ-1B(optical) and HJ-1C(SAR)



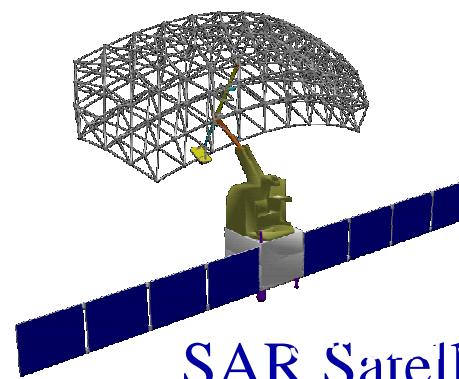
Disaster, Environment Monitoring  
and Forecast Small Satellite  
Constellation in orbit



Optical  
Satellite  
Configuration

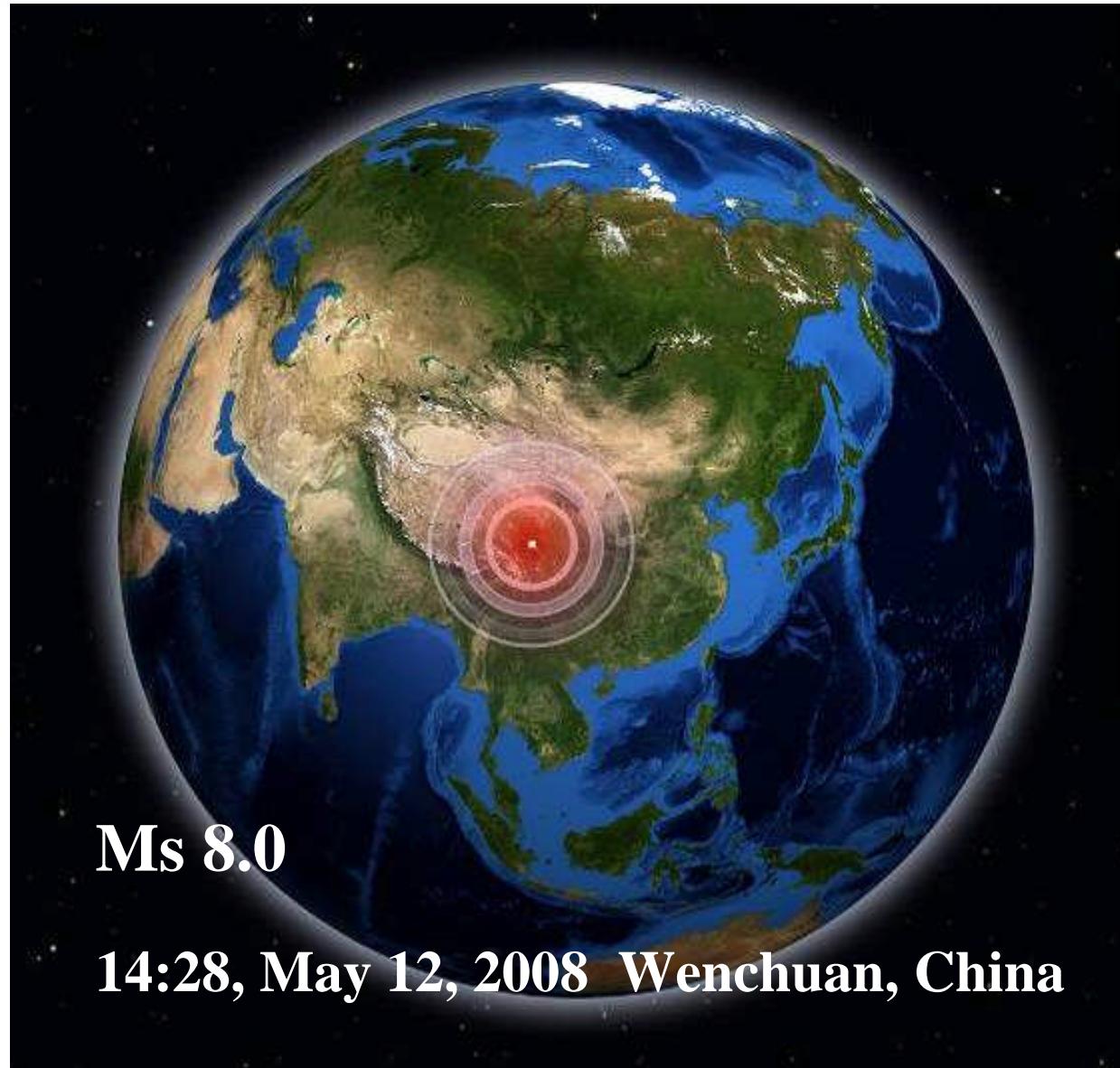


Two optical satellites  
were launched on  
Sept. 6, 2008



SAR Satellite Configuration

### 3. Disaster Monitoring: Wenchuan Earthquake





*Miyun ground station*



*Kashi ground station*



*Sanya ground station*

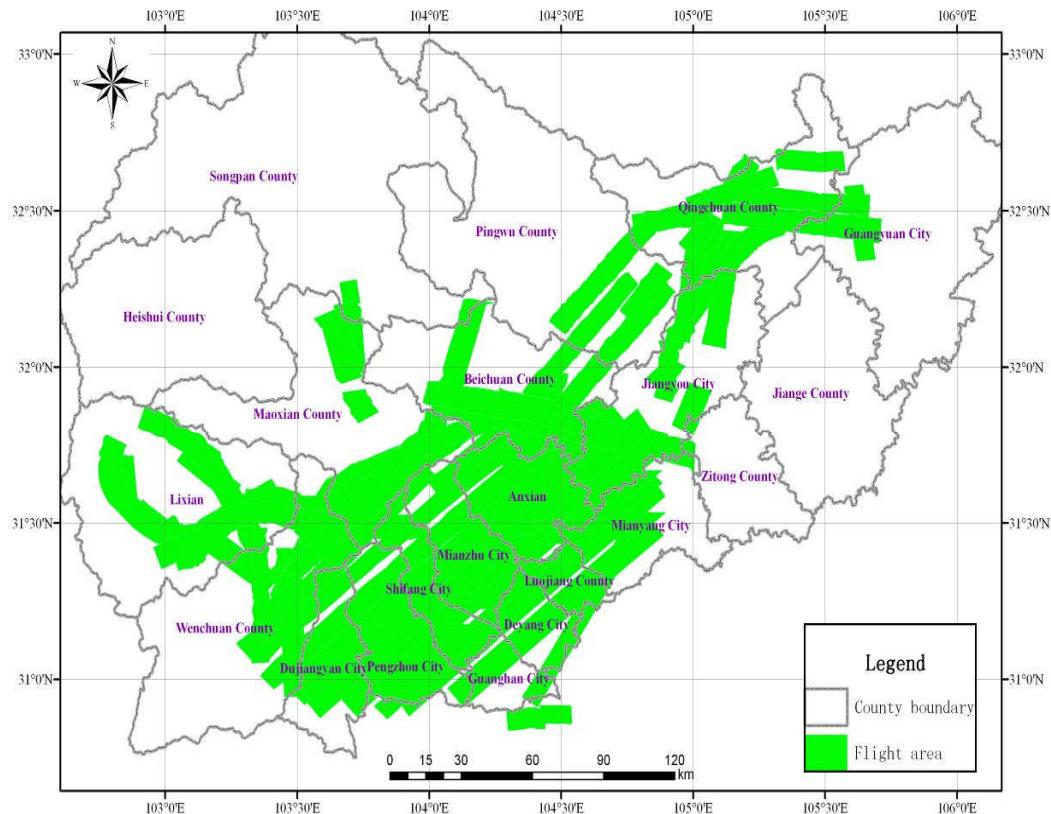


*Data coverage of the three ground receiving stations*

### 3. Disaster Monitoring: Wenchuan Earthquake



**Airborne Remote Sensing data acquired Post-quake during from May 14 – Jun. 5**



**Airborne optical remote sensing covered above 20000 km<sup>2</sup> and data amounted 5.3 TB.**

**SAR remote sensing covered above 40000 km<sup>2</sup> and data amounted 18.5 TB.**

**CEODE sent two Remote Sensing aircrafts to the earthquake affected areas, one with optical sensor, and another with one SAR**

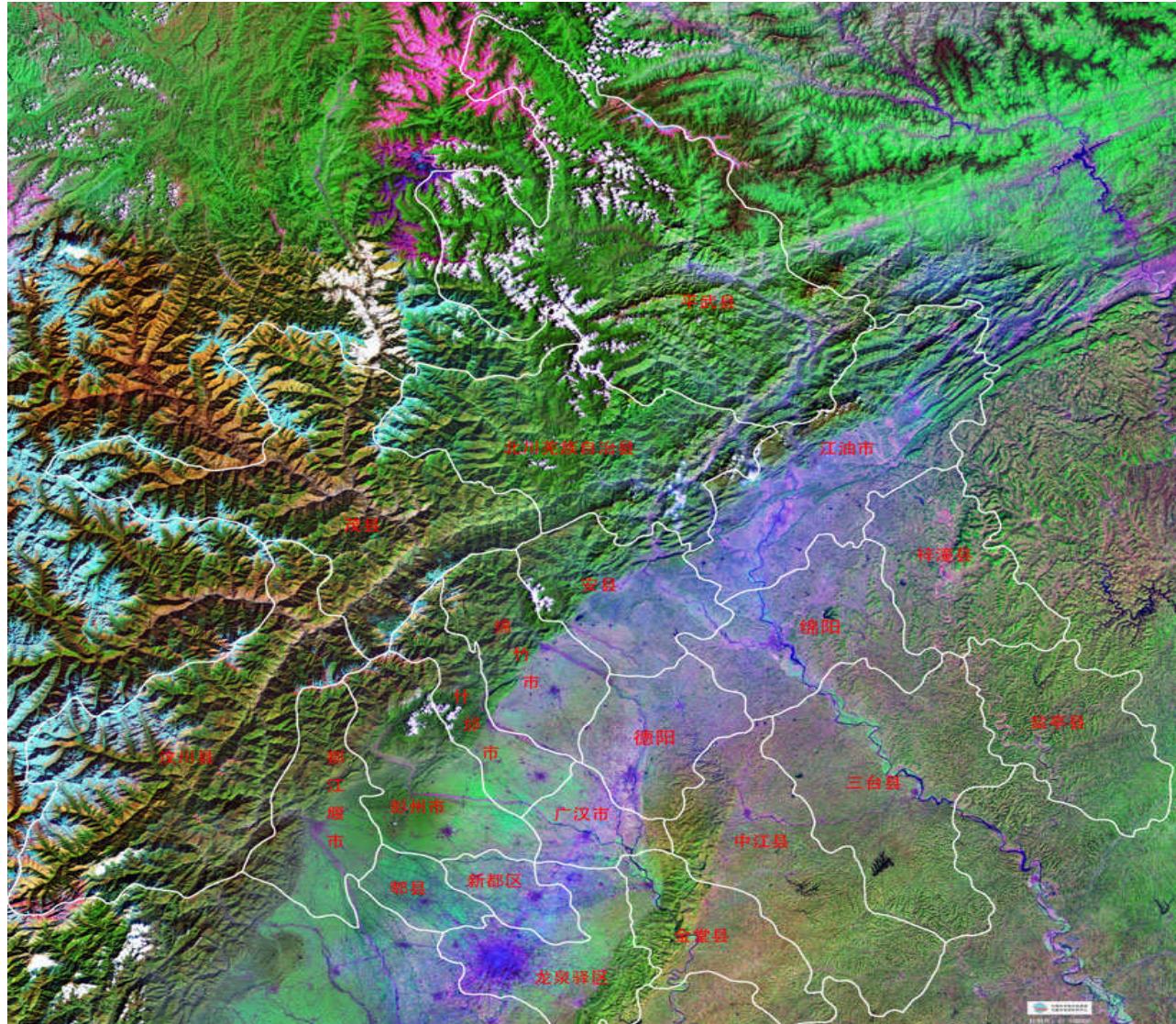
Beichuan  
County  
before  
Earthquake



Beichuan  
County  
after  
Earthquake



### 3. Disaster Monitoring: Wenchuan Earthquake



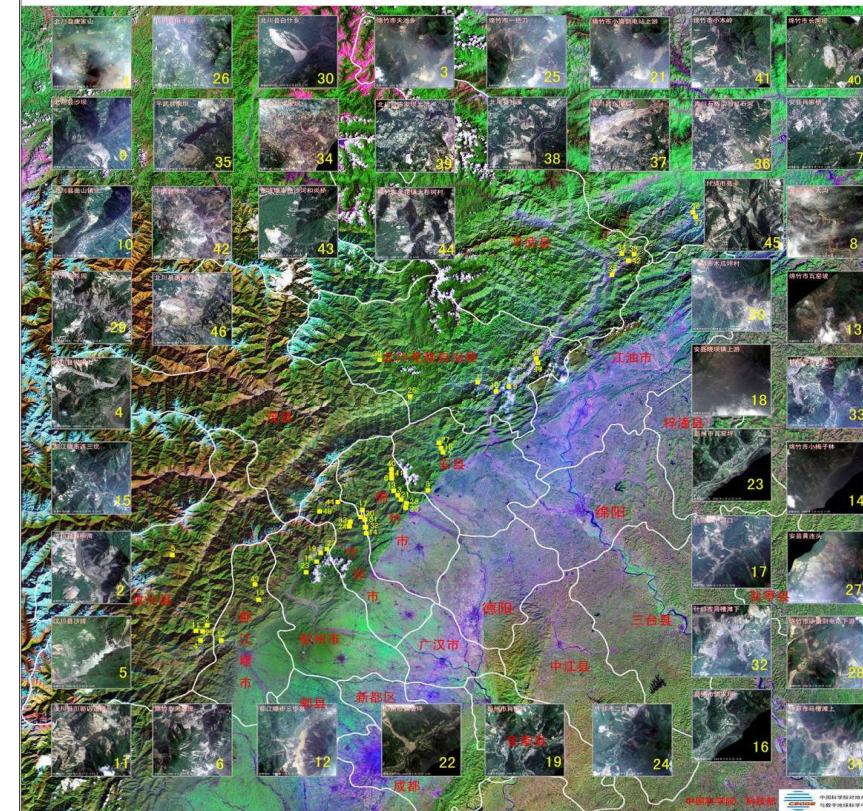
Landsat Image

### 3. Disaster Monitoring: Wenchuan Earthquake



#### Barrier Lakes

Remote sensing images detected 46 Barrier lakes in the earthquake hit area, and the Tangjiashan barrier lake was the famous one among them.



Monitoring results of water level and volume of the Tangjiashan barrier lake

Date	5-16	5-19	5-23	5-24	5-25
Level (m)	688.0	710.0	720.0	722.5	724.0
Volume(m <sup>3</sup> )	2387	7681	11826	13103	13870

# Quake Lake Monitoring (CBERS02B-HR)

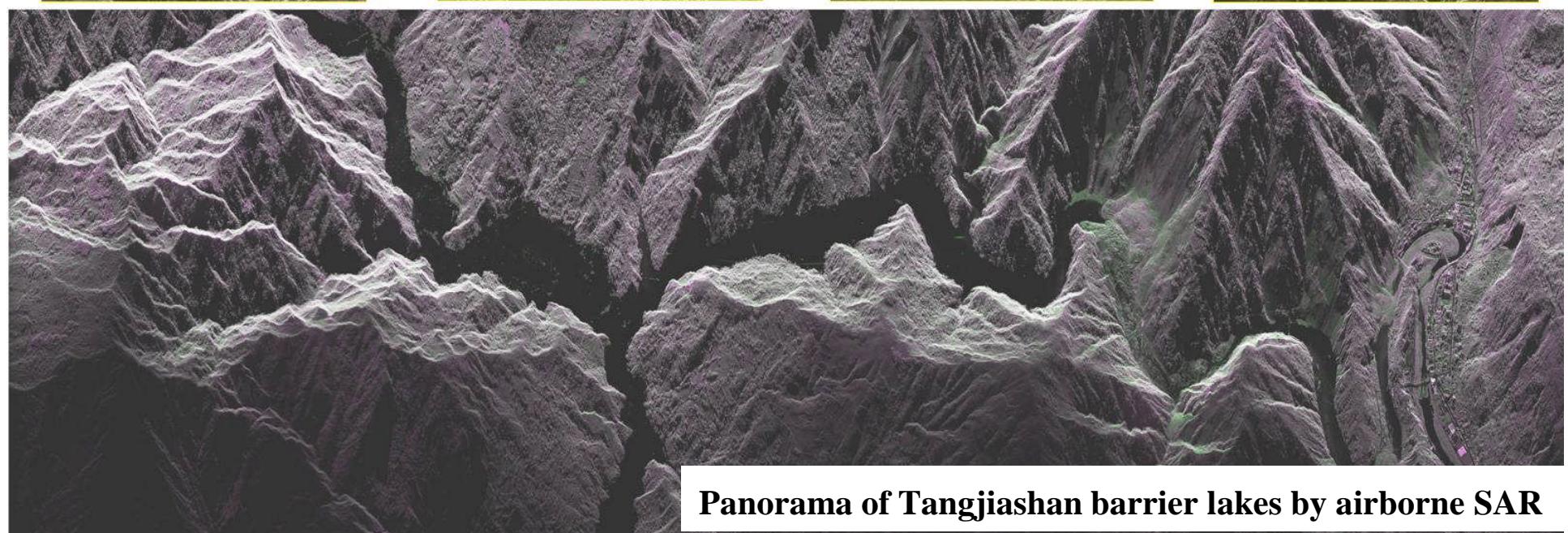
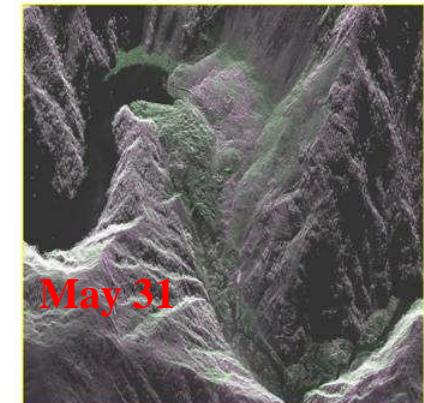
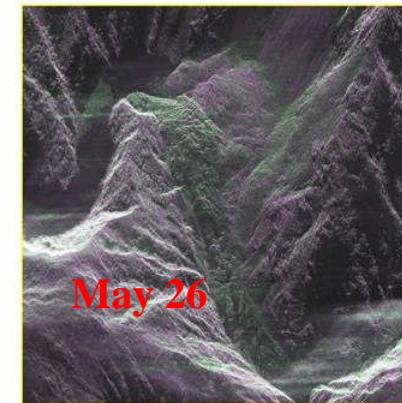
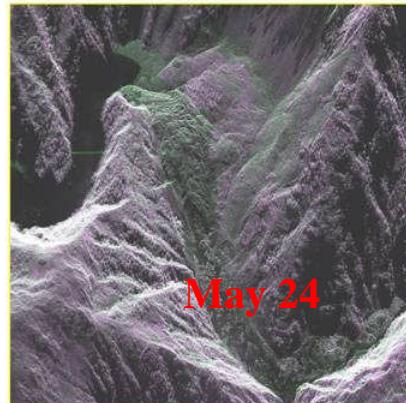


### 3. Disaster Monitoring: Wenchuan Earthquake



#### Barrier Lakes

A serial SAR images of Tangjiashan barrier lake

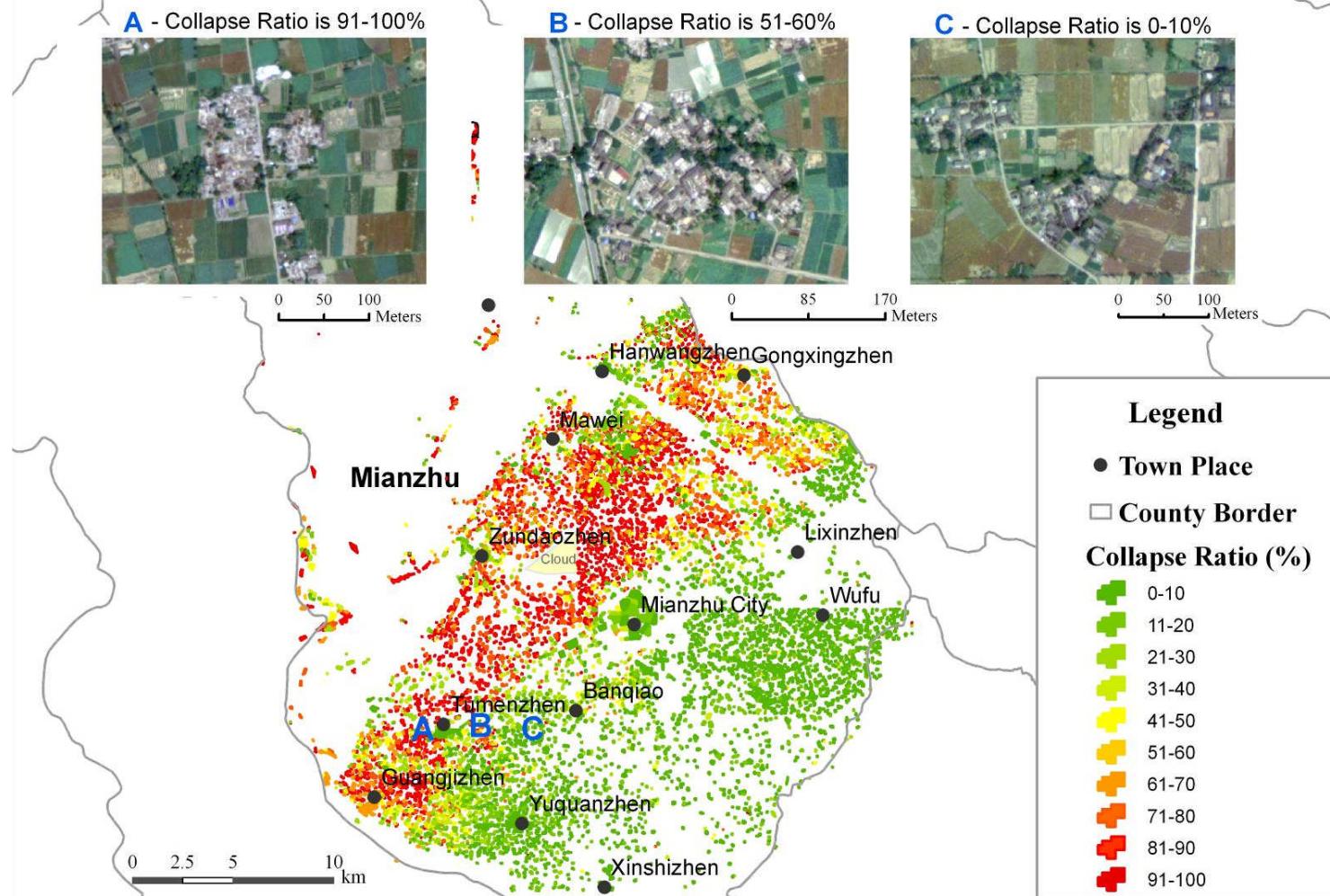


Panorama of Tangjiashan barrier lakes by airborne SAR

### 3. Disaster Monitoring: Wenchuan Earthquake



#### Collapsed Buildings and Houses

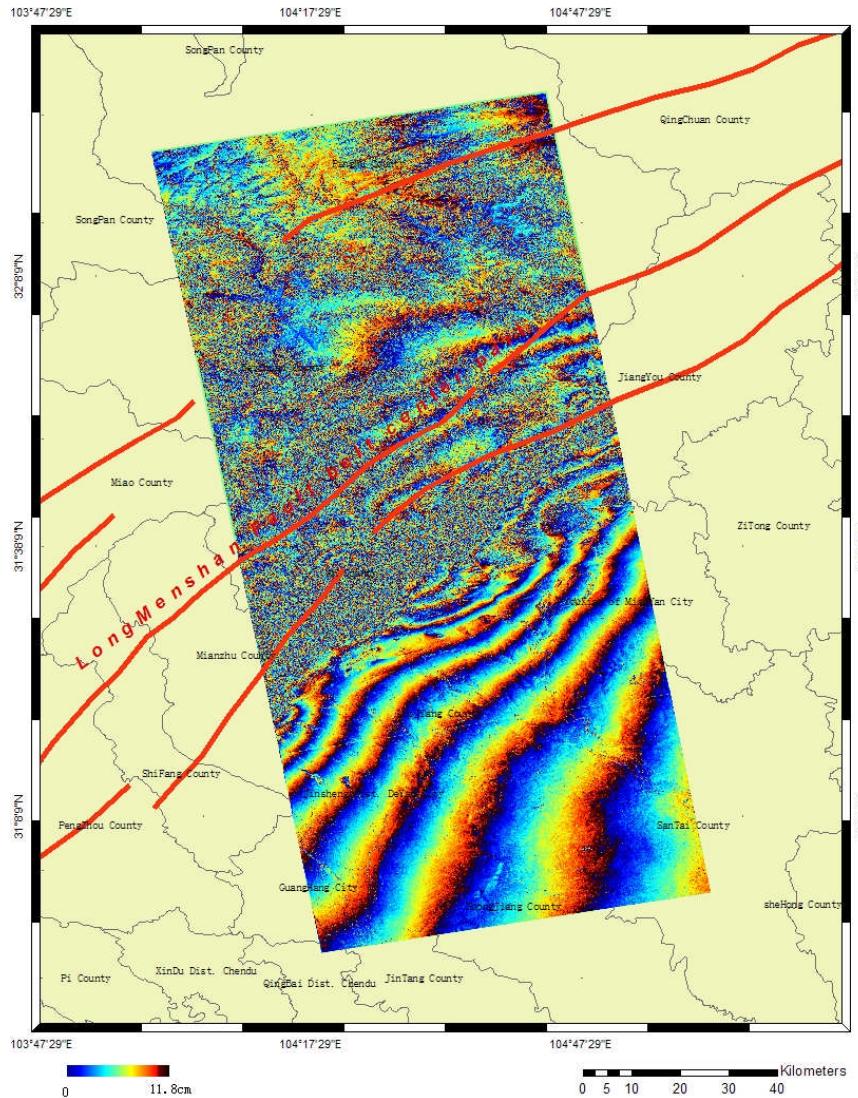


House collapse ratio in the Mianzhu City interpreted from the aerial images.

### 3. Disaster Monitoring: Wenchuan Earthquake



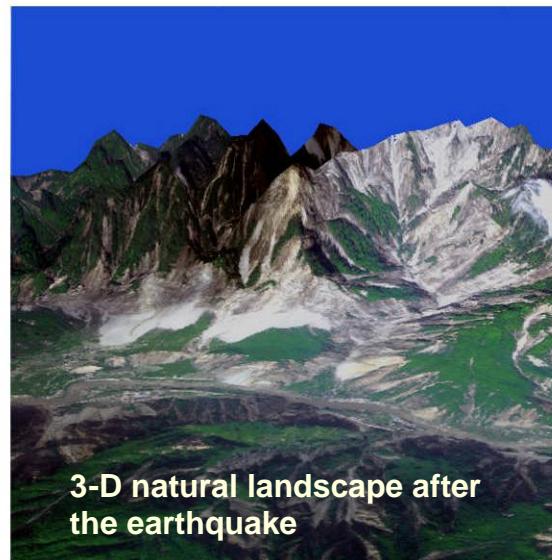
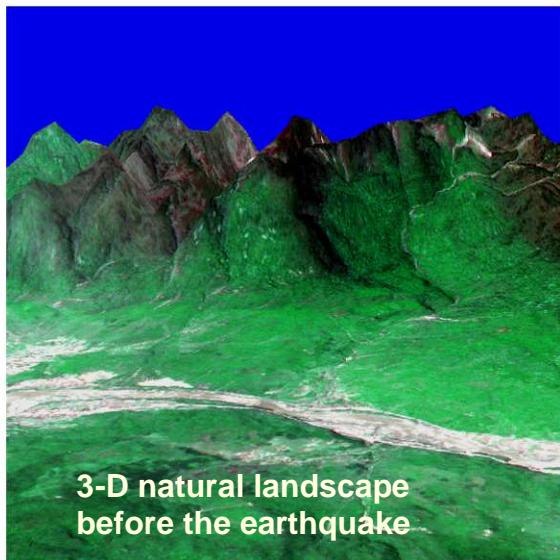
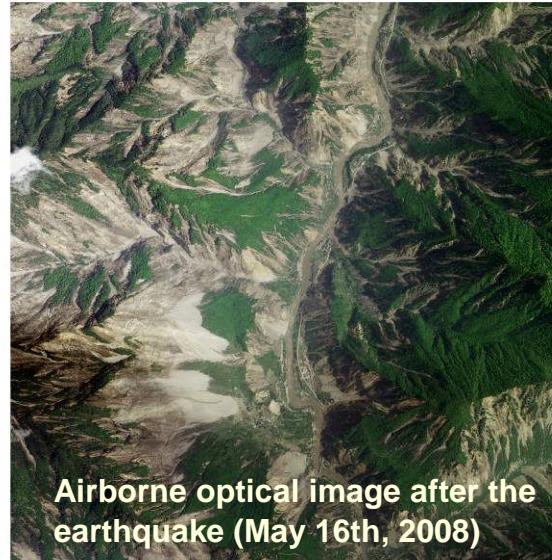
#### Geological Disaster



Interferogram of SAR images were obtained on 17-Feb-2008 and 19-May-2008. Together with the information of fault distribution from ground survey, it shows that most of the area have subsidence, the scale is about centimeters to meters and there are two deformation centers within Beichuan County and Mianzhu county, the LOS deformation was beyond 1 meter.

Since the rock area is stable of the south plain area, the fringes are relatively continuous, but the mountain area is located at the north of the fault, the fringes are fractal since the extrusion of the Tibetan Plateau.

### 3. Disaster Monitoring: Wenchuan Earthquake



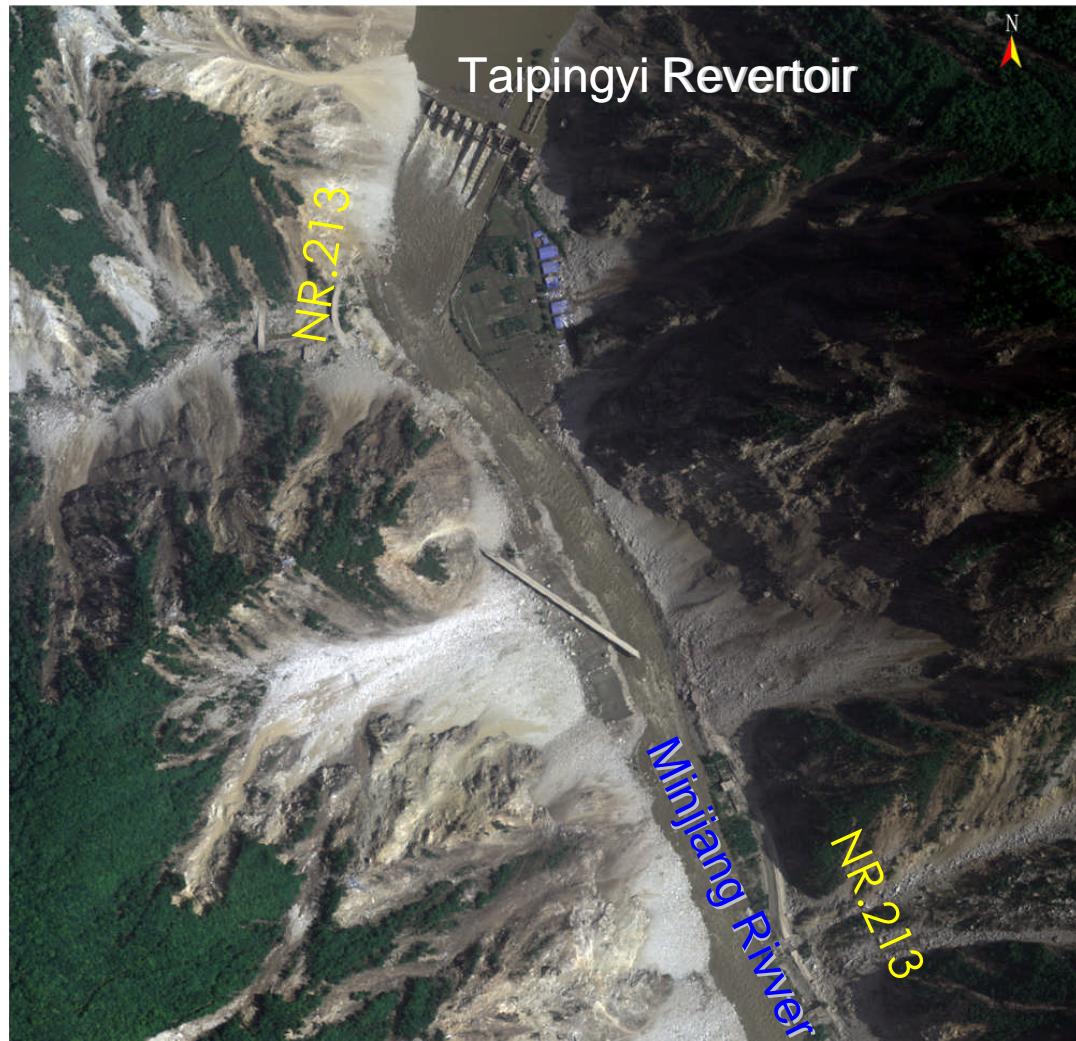
**Destroyed Farmlands  
and Forests**

Comparing SPOT-5  
image on May 9, 2007  
and the image of the  
same region on May 16,  
2008, it is obvious that  
the earthquake has  
**destroyed surface  
vegetations.**

### 3. Disaster Monitoring: Wenchuan Earthquake



#### Damaged Roads



#### Airborne Image of Taipingyi Reservoir

A highway bridge across Minjiang River of National Road 213 near Taipingyi Reservoir, labeled as A, was collapsed. Also we can see debris flows besides both bank of Minjiang River blocked the National Highway 213.



### 3. Disaster Monitoring: Wenchuan Earthquake



#### Lives Rescue

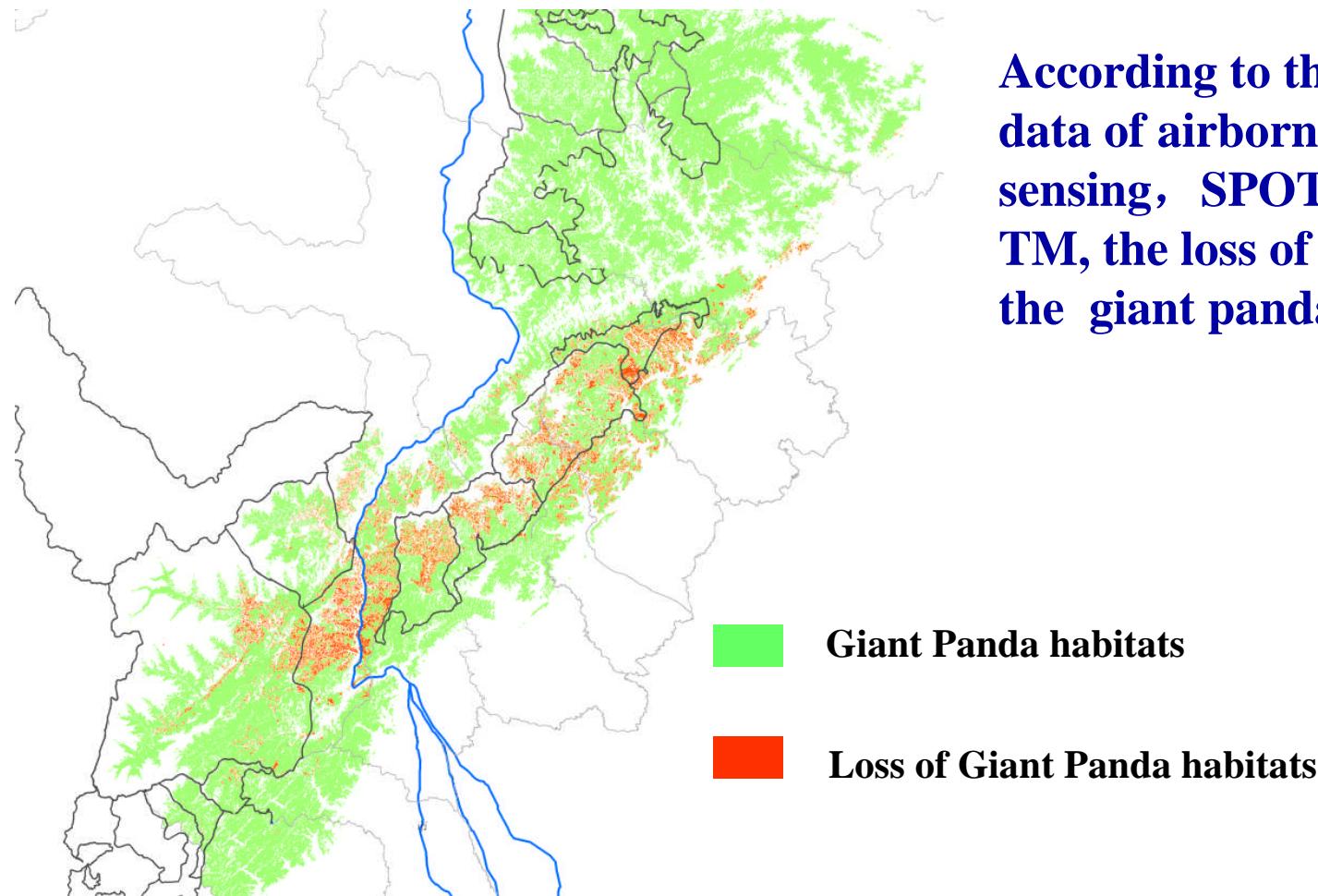
A sign of “SOS700” on the top of a building near Caopoxiang of Wenchuan county was found in the airborne remote image on May 16, 2008. Immediately the “island” after the earthquake was rescued according to traffic information shown in the image.



### 3. Disaster Monitoring: Wenchuan Earthquake



#### Giant Panda Habitat in Earthquake



According to the analysis of data of airborne remote sensing, SPOT 5 and Landsat TM, the loss of living areas of the giant panda are assessed.

### 3. Disaster Monitoring: Wenchuan Earthquake



#### Contents

- **Remote Sensing Data**
- **Geological Disaster**
- **Barrier Lakes**
- **Collapsed Buildings and Houses**
- **Damaged Roads**
- **Destroyed Farmlands and Forests**
- **Demolished Infrastructure**
- **Civilization Continuation**

*Atlas of Remote Sensing for Wenchuan Earthquake Disaster* [www.ceode.ac.cn](http://www.ceode.ac.cn)

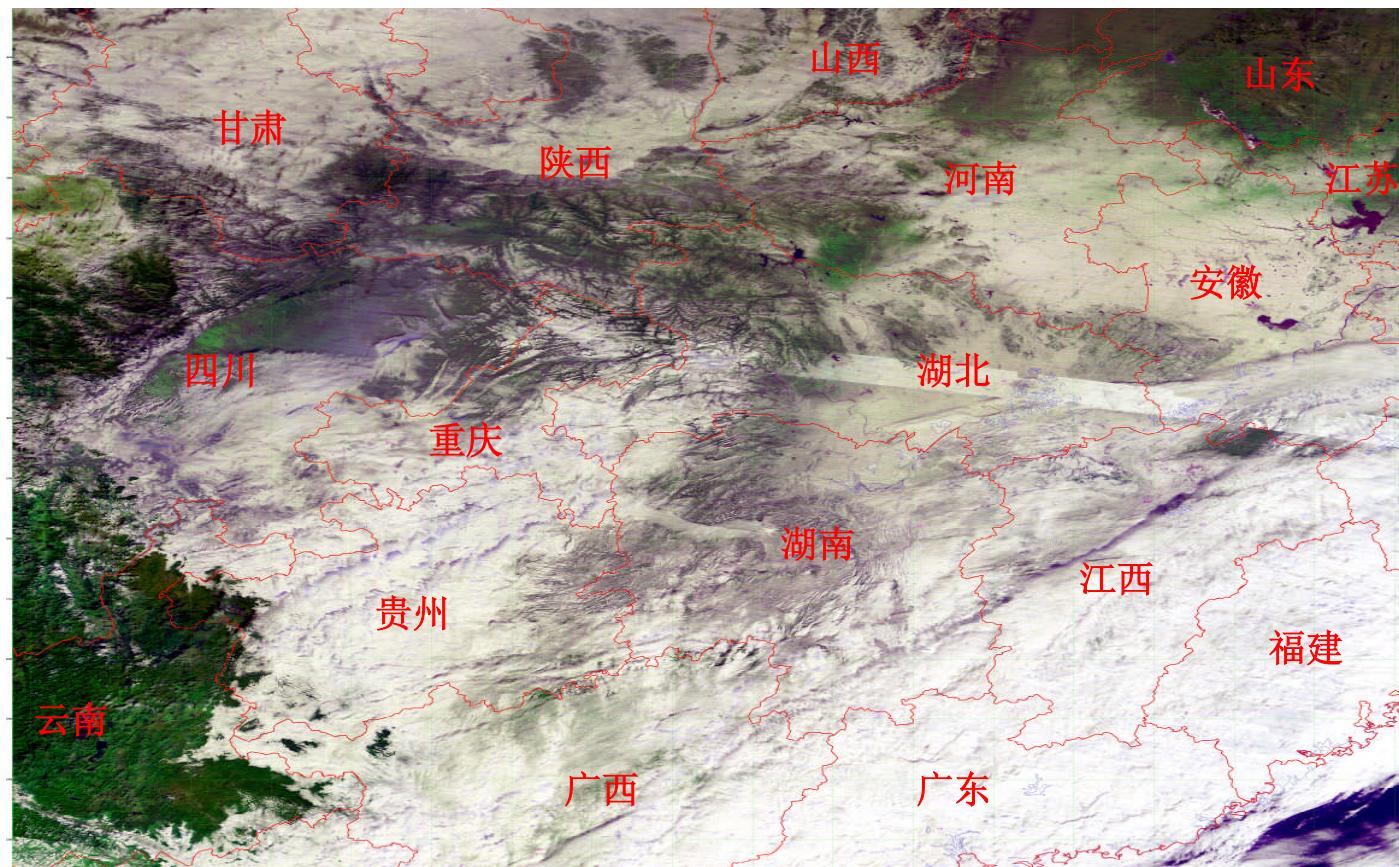


***The Atlas had been presented to Premier Wen Jiabao  
by Lu Yongxiang, President of CAS***

### 3. Disaster Monitoring: Ice and Snow



The Remote Sensing Image of Snow Distribution in Southern China, 2008



**Ice and Snow**



**Cloud**



**Vegetation**



**Plain**

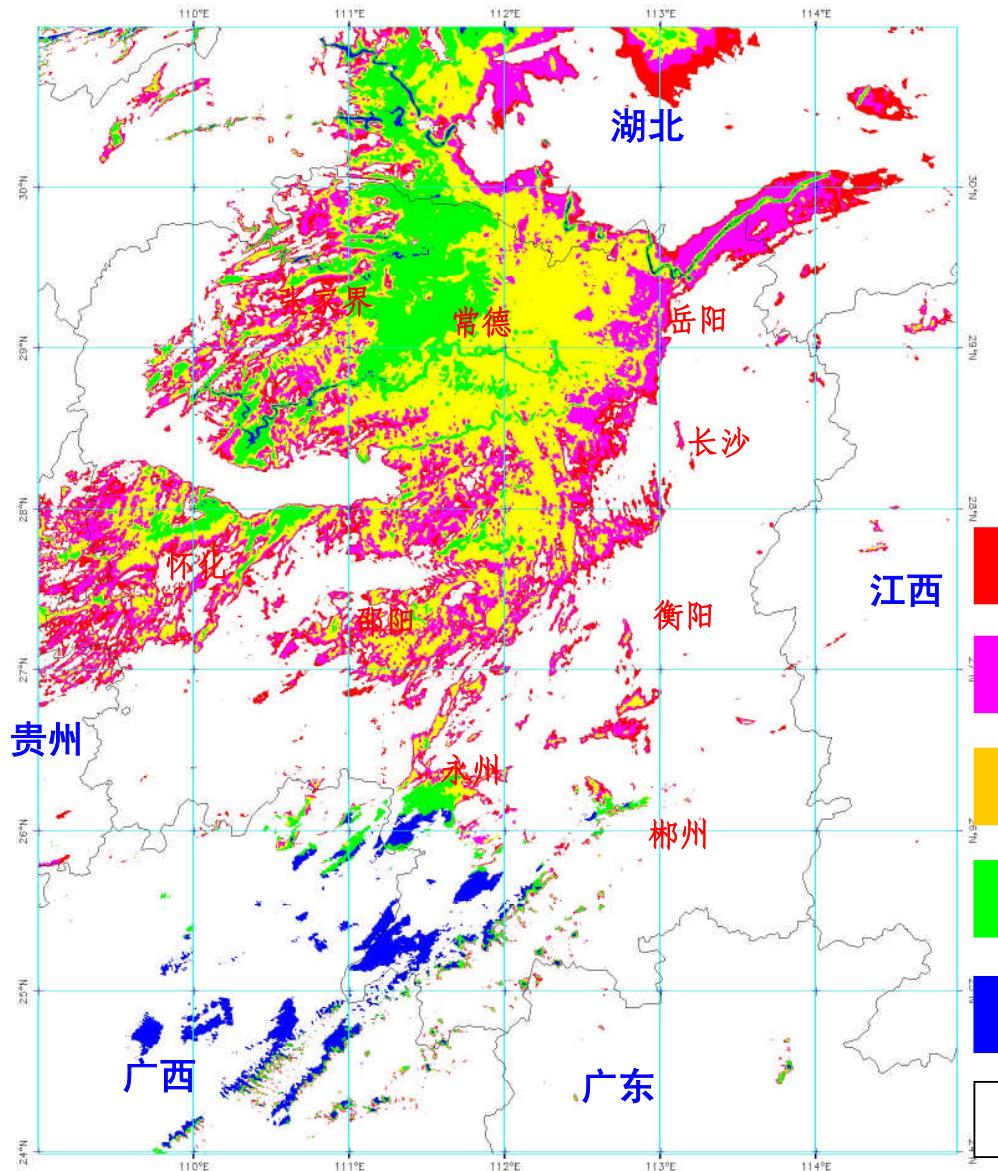


**Lake**



**Ocean**

### 3. Disaster Monitoring: Ice and Snow



The result of remote sensing monitoring on Ice and Snow disaster in Hunan Province.

Severe snow cover at low temperature

Severe and moderate snow cover at low temperature

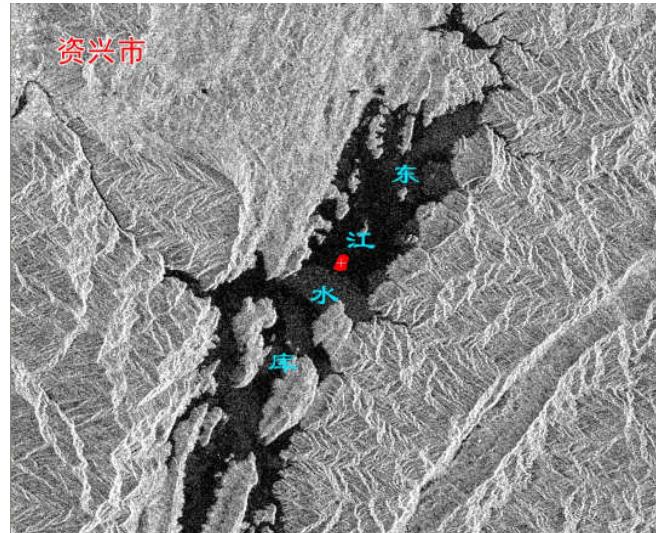
Thick snow cover at low temperature

Moderate snow cover at low temperature

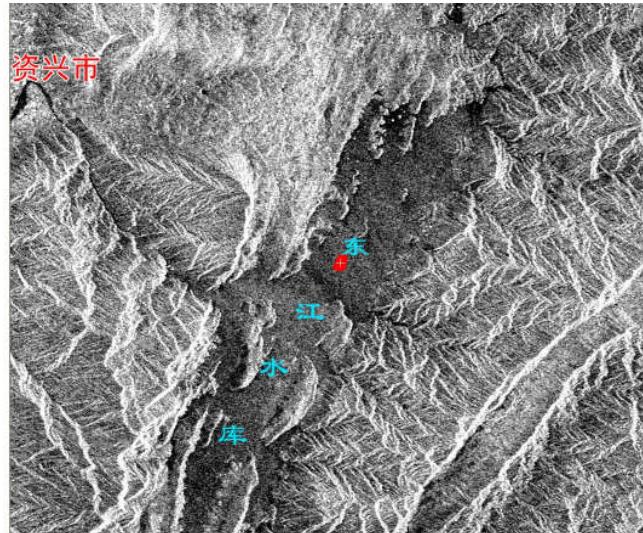
Snow cover at low temperature

Clouds cover

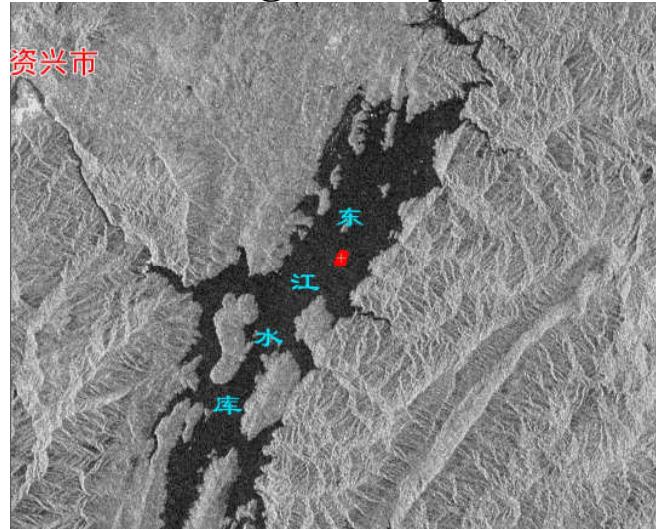
### 3. Ice and Snow Disaster



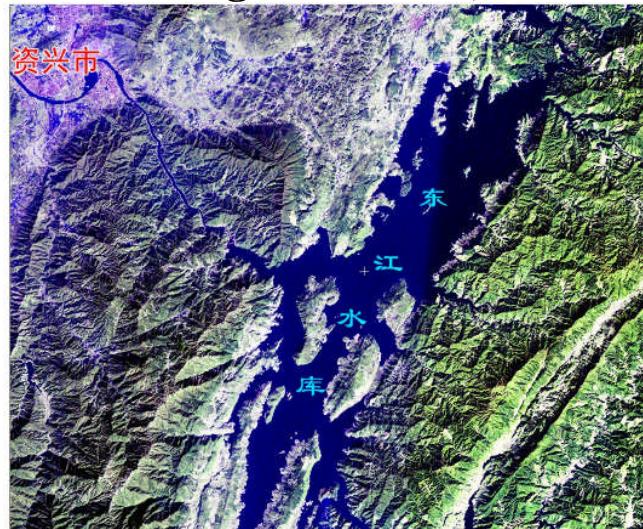
SAR image on Sep. 8, 2005



SAR image on Feb. 6, 2008



SAR image on Feb. 12, 2008



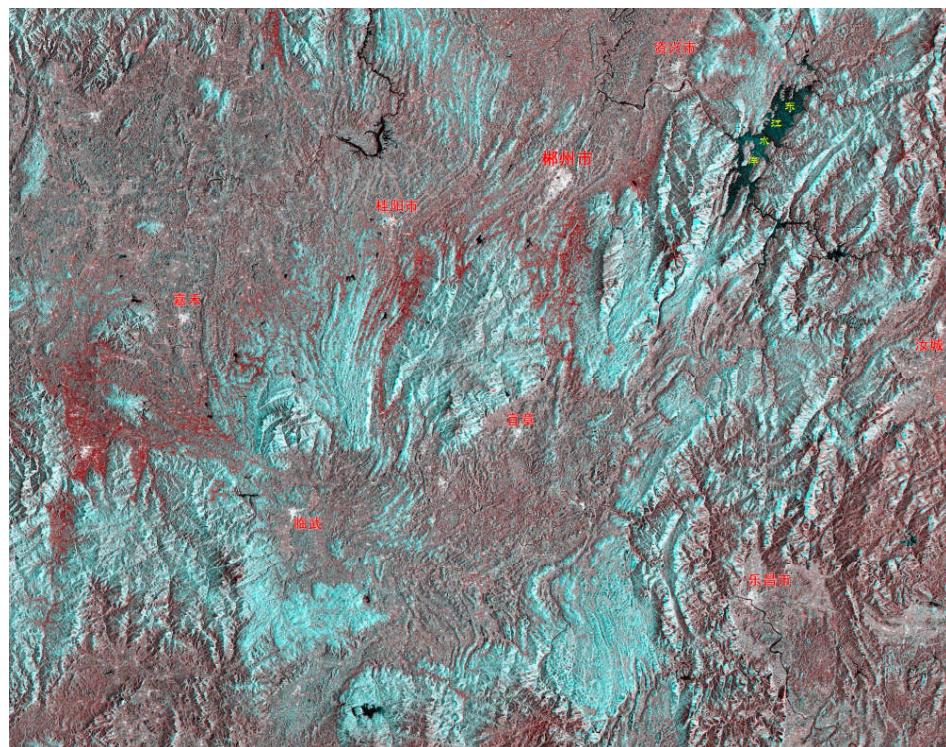
TM image in 2000

Comparing multi-temporal images of snow on the water surface in Dongjiang Reservoir, we found **the SAR image is useful to detect snow** because its backscattering coefficient is obviously different when water surface is froze or covered by snow.

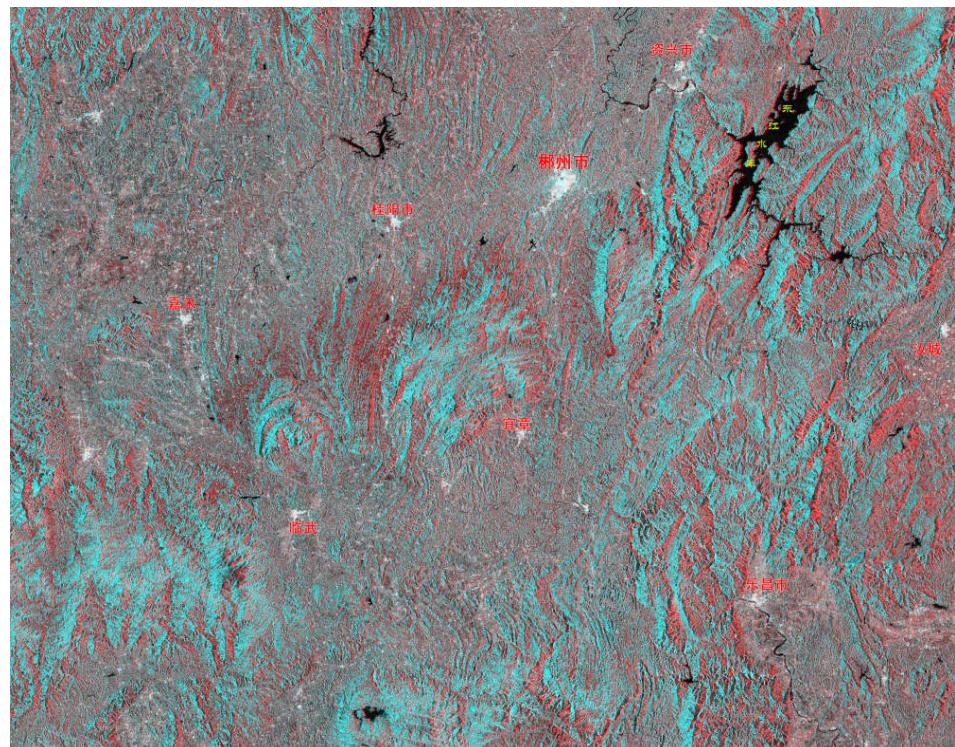
### 3. Ice and Snow Disaster



Analysis of snow distribution by comparing SAR images acquired on Feb. 6, and Feb. 12, 2008 with Sep. 4, 2005 respectively, and **the blue area** presents snow cover.



**Snow distribution of bingzhou in Hunan Province on Feb. 6, 2008**



**Snow distribution of bingzhou in Hunan Province on Feb. 12, 2008**

### 3. Disaster Monitoring: Drought

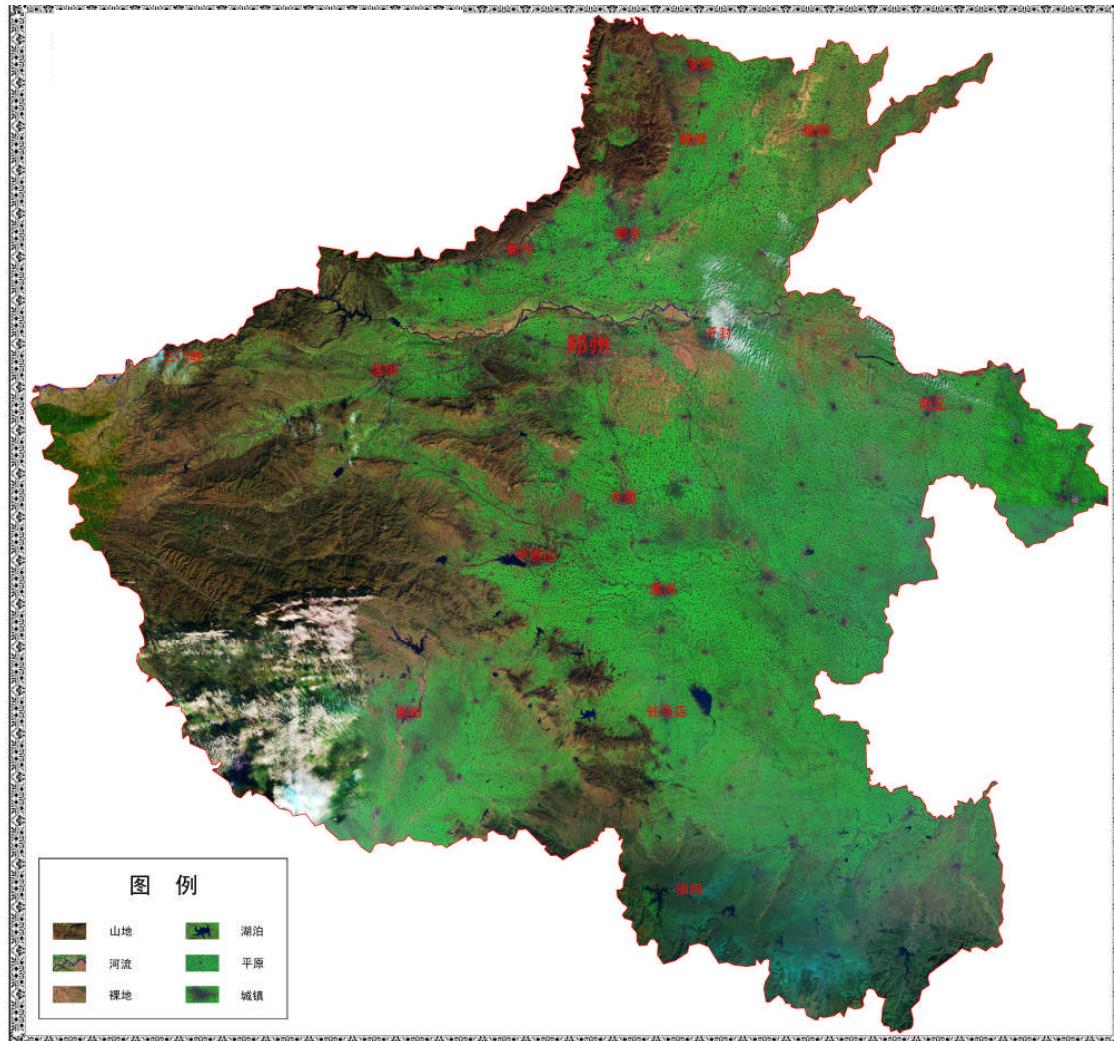


The severe drought happened in Feb. 2009, which is **the most serious one in China during recently 50 years**, especially in Henan province. The national headquarters on inspection of flood control and drought relief started the **grade I** of emergency drought relief, and CEODE set up **the Emergency-Group for Remote Sensing Monitoring of drought relief** immediately.



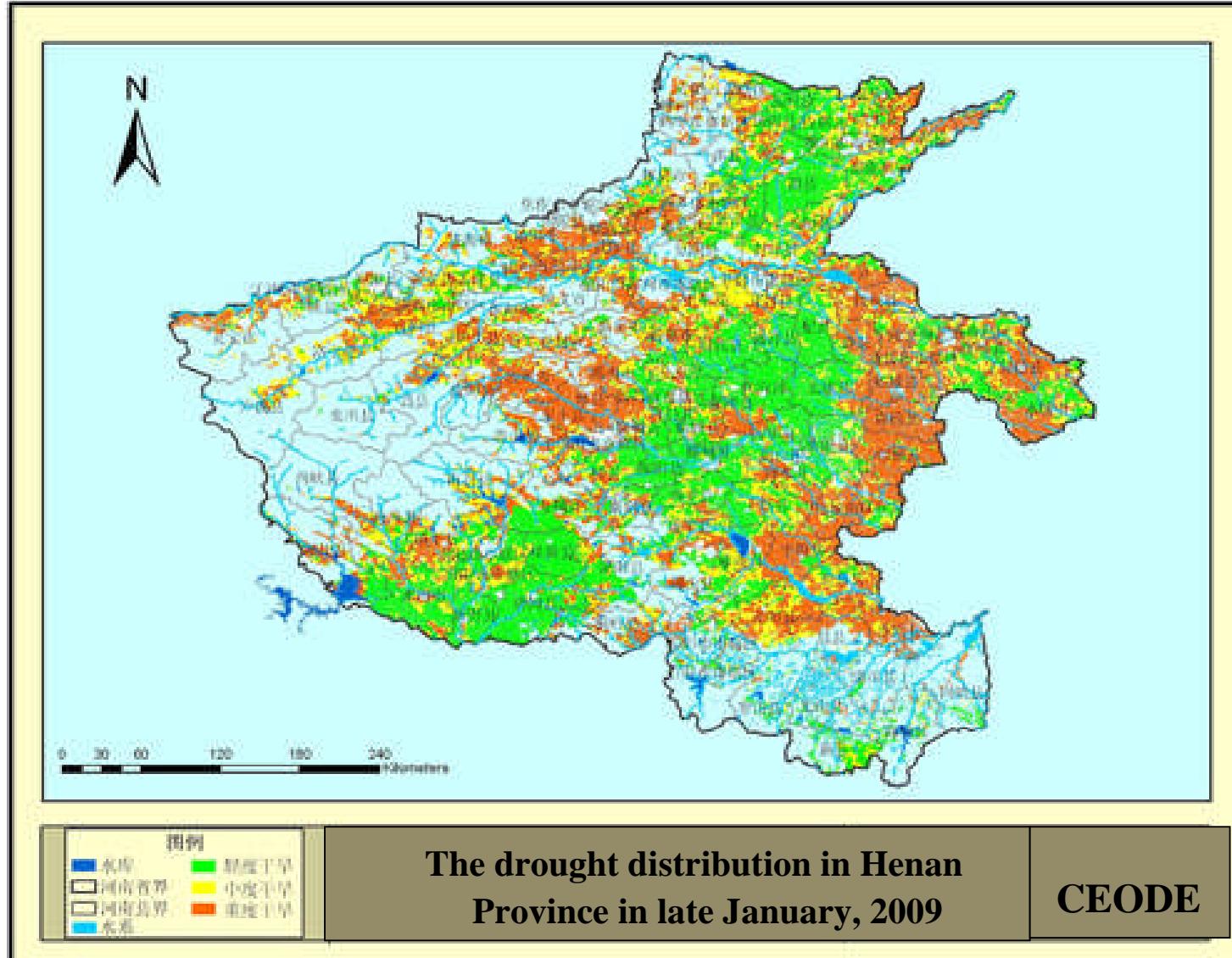
### 3. Disaster Monitoring: Drought

The Satellite image of Henan Province



This true color synthesis image was mosaicked by 15 scenes of Landsat 5 TM data which were imaged from Jan. 9 to Jan. 23 2009.

### 3. Disaster Monitoring: Drought



The group compared and analyzed the leaf area index extracted from multi-temporal remote sensing images, and got the drought distribution chart in Henan province in late Jan, 2009.

### 3. Disaster Monitoring: Drought



The IRS-P6 image on Jan. 6, 2007



The Landsat5 image in Jan, 2009  
**Luhui reservoir**



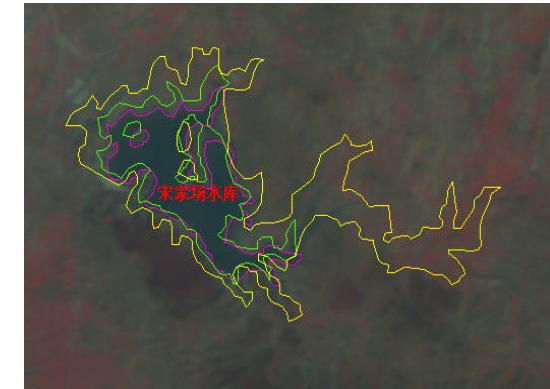
The dynamic change of water area



The IRS-P6 image on Jan. 6, 2007



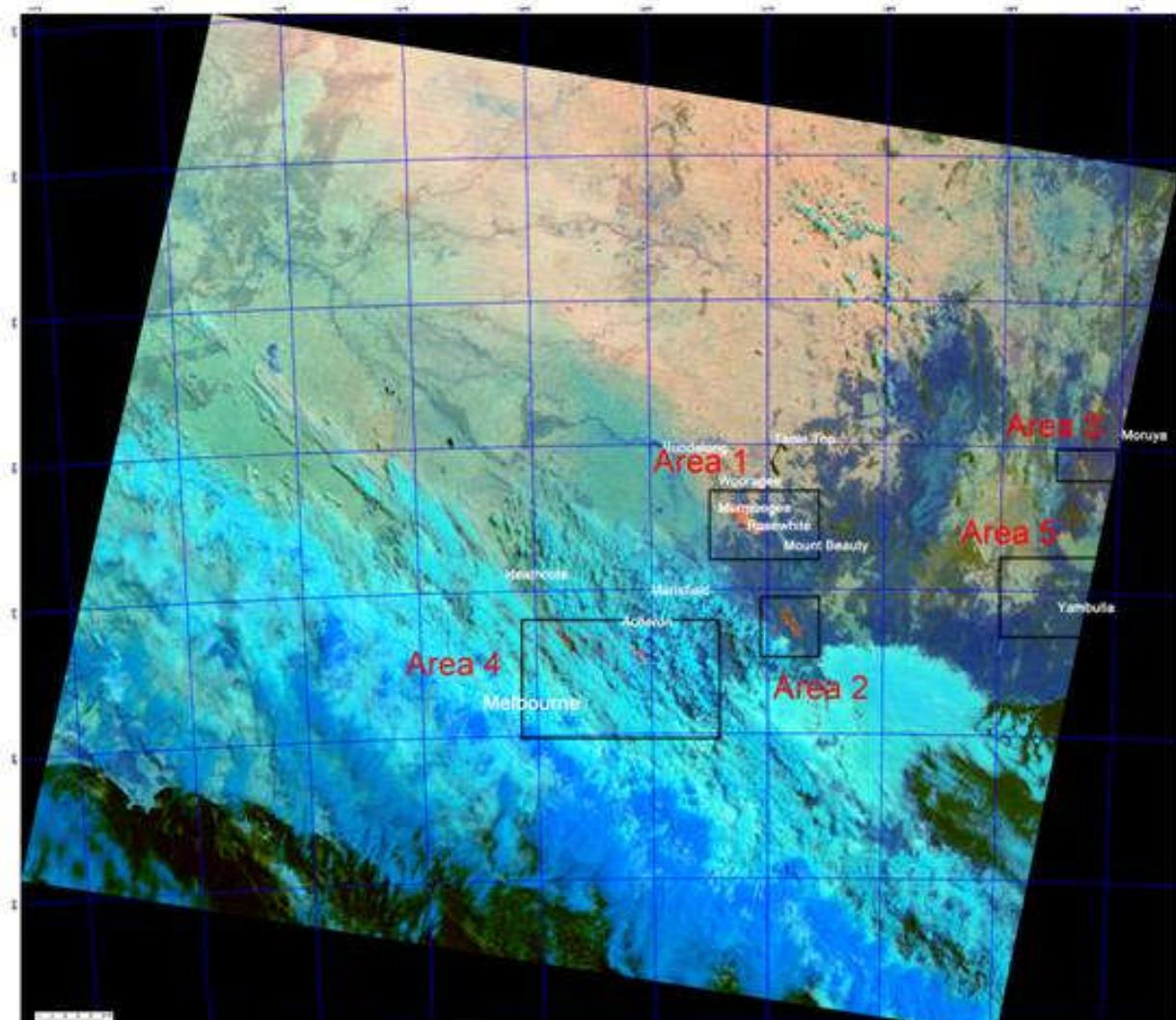
The Landsat5 image in Jan, 2009  
**Songjiayang reservoir**



The dynamic change of water area

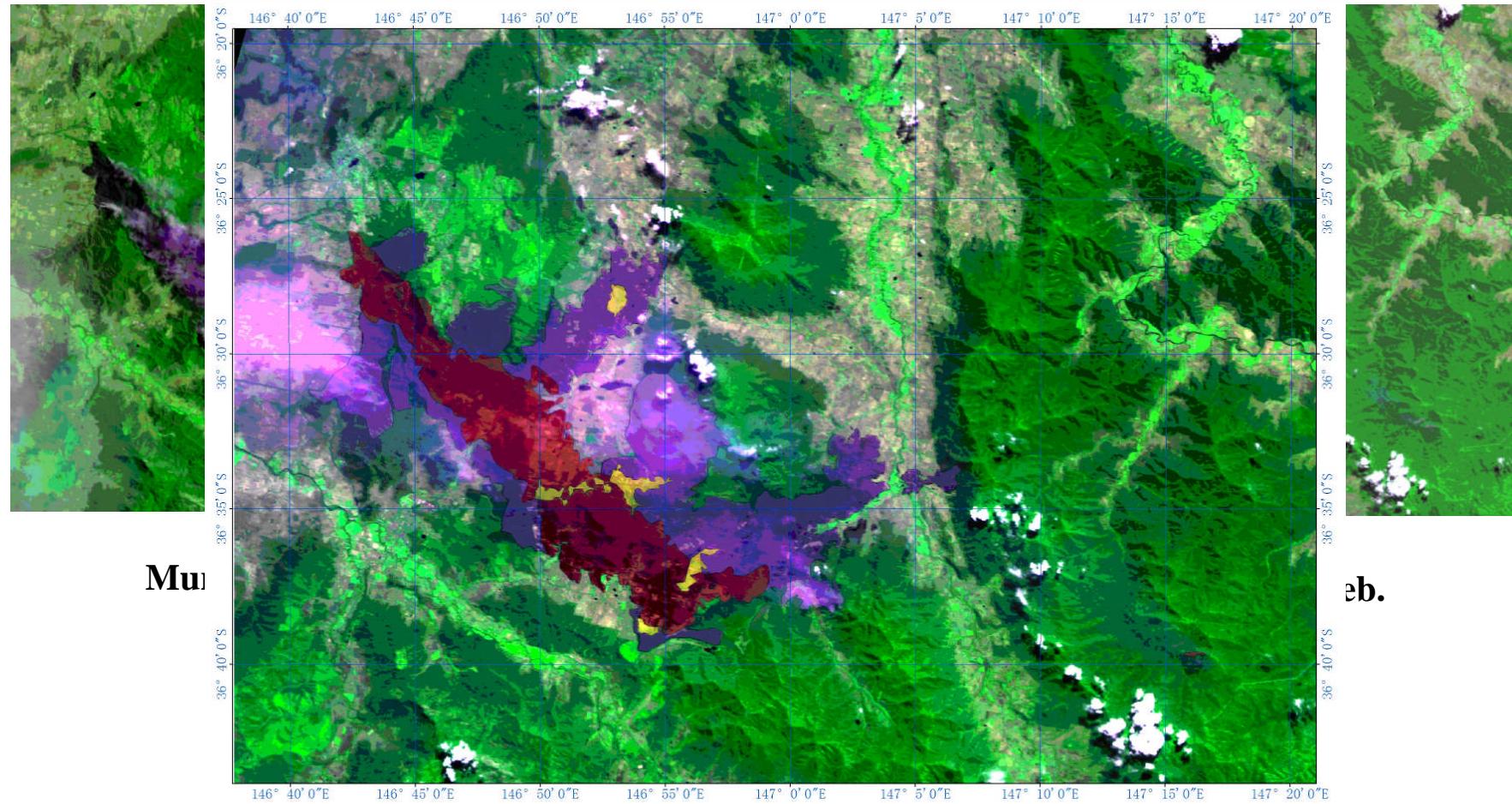
In dynamic change chart of water area, **the yellow line** means the water area on Jan. 6, 2007, **the green line** means one on Jan. 10, 2009, and **the red line** means one on Feb. 4, 2009. So we can see that the water area was shrinking from Jan 2007 to Feb 2009.

### 3. Disaster Monitoring: Bushfire, Australia



The spatial distribution of five fire area in Victoria Province, Australia in 2009

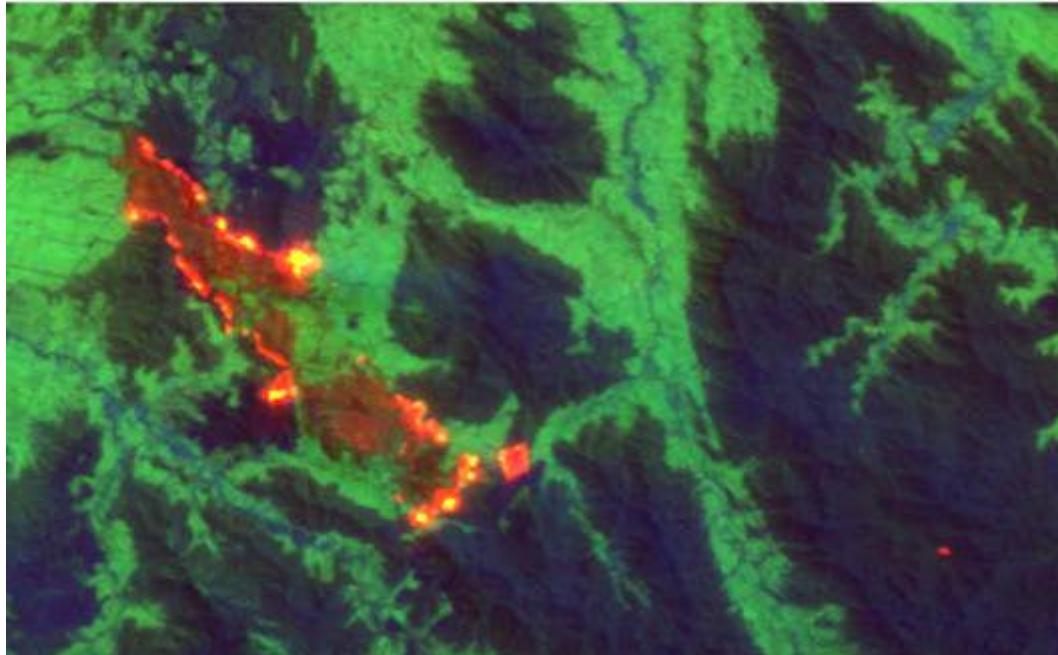
### 3. Disaster Monitoring: Bushfire, Australia



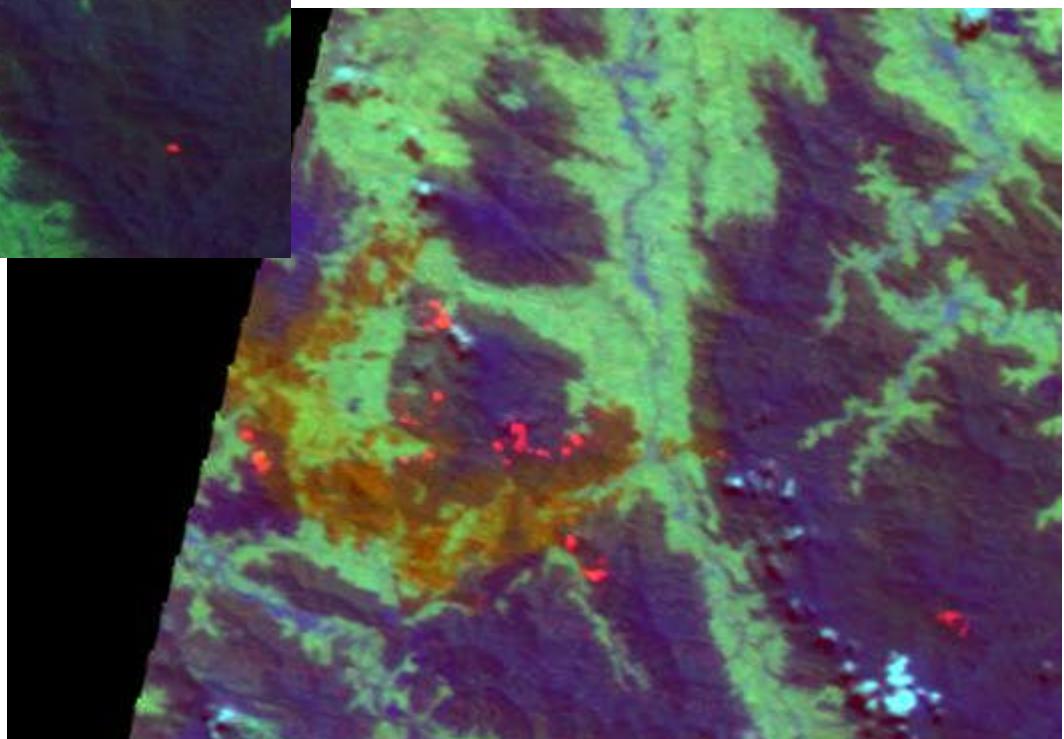
The analysis chart of Murmungee fire scene from Feb. 8 to Feb. 11

**The dark red map spot means fire area on Feb. 8, the purple map spot means new fire area from Feb. 8 to Feb. 11, and the yellow map spot means unfired area like isolated island.**

### 3. Disaster Monitoring: Bushfire, Australia



The thermal infrared image of murmungee (Feb. 8, 2009). The area of fire extended like moniliforme at the edge of fire scene , and the disaster situation became serious.

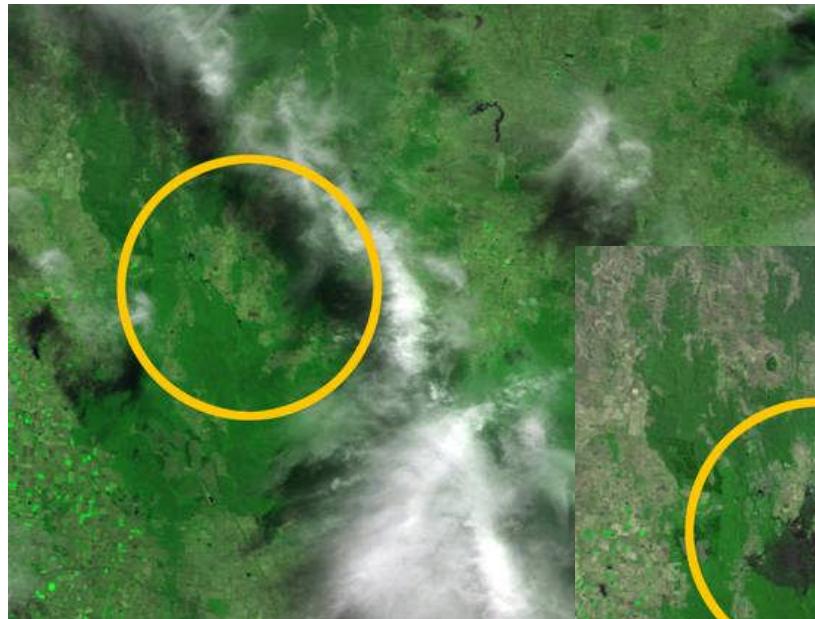


The thermal infrared image of murmungee (Feb. 11, 2009). the fire situation in east was still serious.

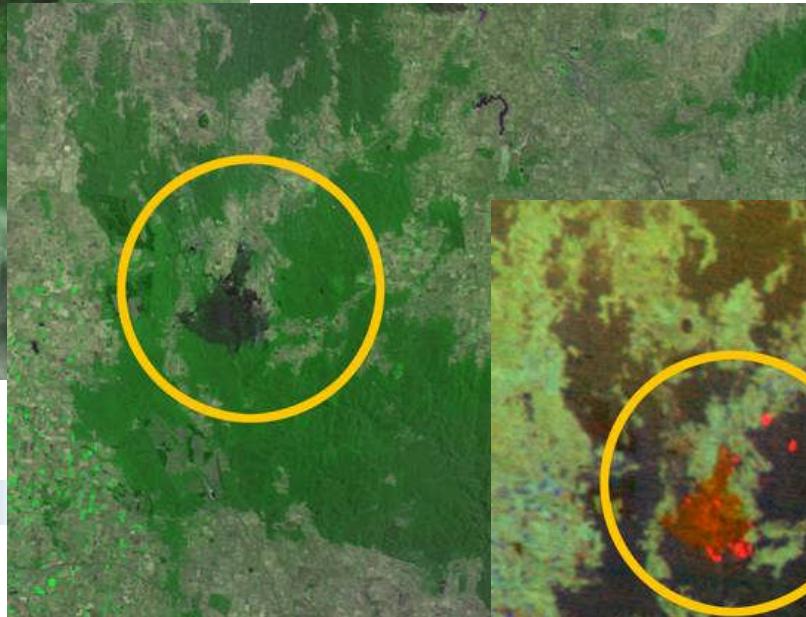
### 3. Disaster Monitoring: Bushfire, Australia



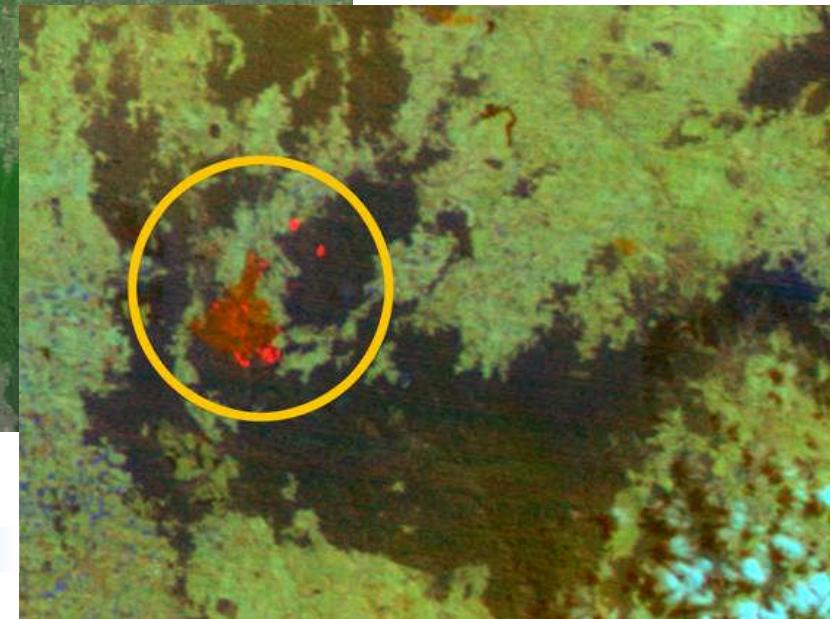
Remote Sensing Monitoring on the Formation of Ballarat Fire Scene



The multi-spectral image of Ballarat Fire Scene on Feb. 23, 2009



The multi-spectral image of Ballarat Fire Scene on Feb. 24, 2009

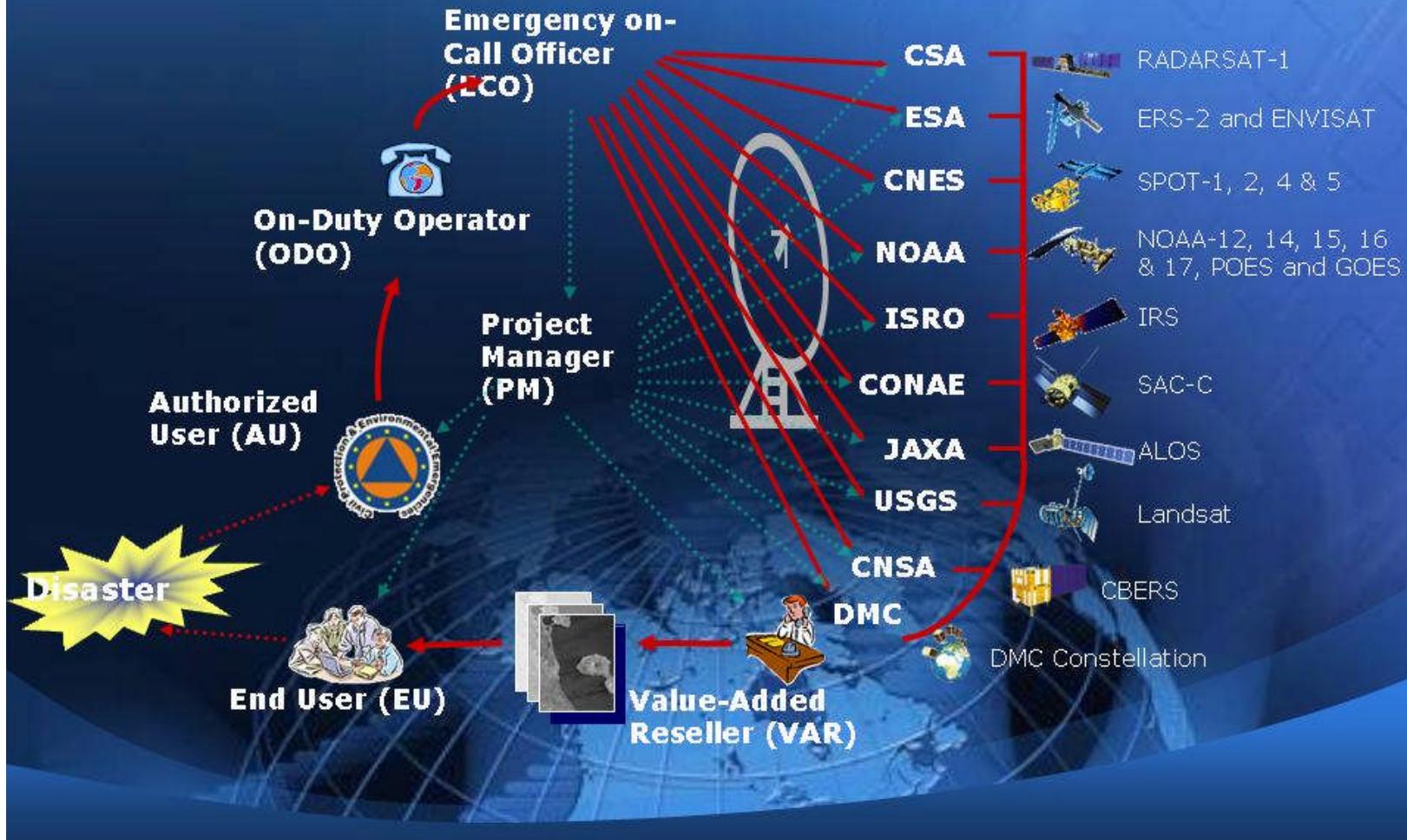


The infrared image of Ballarat Fire Scene on Feb. 24, 2009

# 4. Earth Observation Data Sharing



## International Charter



## 4. Earth Observation Data Sharing



**Satellite data Acquired Post-quake from May 12 – 31**

**According to International Charter on Space and Major Disasters, CEODE received international spaceborne remote sensing data for the disaster area, including:**

**ASTER, 84 scenes, TM 8 scenes, IKONOS 6 scenes,**

**WORLDVIEW 29 scenes from U.S.A**

**ALOS 83 scenes from Japan**

**Terra SAR-X 9 scenes from Germany**

**EROS-B 7 scenes from Israel**

**COSMOS 9 scenes from Italy**

中国空间信息网(SIG)技术示范验证平台

汶川地震 国际对地观测数据支援服务网格

平台信息

卫星类型：全部 摄像器：全部 级别信息：

输出格式：全部 产品级别：全部

数据来源：全部

地理位置

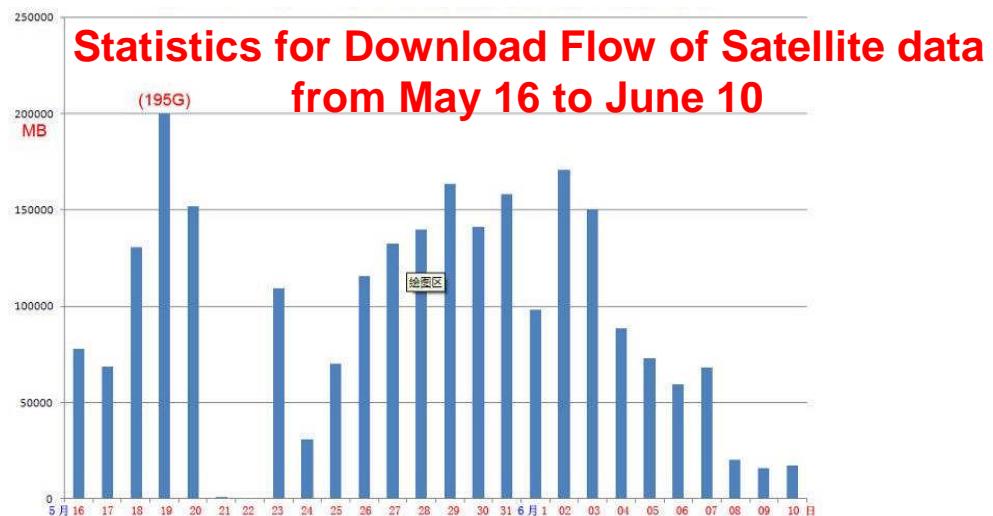
汉川区域  北边界纬度  60.05  东边界经度  140.70   
 甘南区域  西边界经度  73.61  南边界纬度  15.08   
 汉中区域

数据获取时间

开始时间：2008年05月12日00时00分00秒

结束时间：2008年05月23日11时04分22秒

提交  清空



By the time of May 20, the access amount of the data sharing Website was over 50,230 times, and the highest access amount was over 100 times per minute.

Free download sharing data was over 2.7TB, and free copy data was over 3.6G [www.ceode.ac.cn](http://www.ceode.ac.cn)

## 4. Earth Observation Data Sharing



### Wenchuan Earthquake



A data sharing mechanism was formed by the Ministry of Science and Technology and Chinese Academy of Sciences

Meetings attended by representatives from 13 ministries such as MOST, MLR, MWR etc. were held regularly at the CEODE for disaster's situation analysis and data sharing. [www.ceode.ac.cn](http://www.ceode.ac.cn)

# 4. Earth Observation Data Sharing



## Drought, Northern China

中国科学院对地观测与数字地球科学中心

### 旱情遥感监测与数据共享平台

河南省2009年1月下旬农田旱情分布图

河南省主要大型水库分布图

旱情监测工作动态

- 胡锦涛温家宝李克强对当前抗旱工作作出重要指示
- 在历史罕见大旱考验面前——中央有关部门迎战旱魔纪实
- 国家发展改革委部署农业抗旱夺丰收工作
- 水利部称将调黄河长江水灌溉旱田
- 中国农业部部长孙政才分析旱情特点

数据共享平台

- 灾区最新TM数据
- ...
- ...

旱情监测工作简报

- 河南省旱情遥感监测信息
- 河南省水库遥感监测报告
- ...

陆浑水库在前后两期卫星影像对比

2007.01.06 IRS-P6监测影像

2009.01 Landsat5监测影像

中国科学院对地观测与数字地球科学中心 建设遥感技术与数据平台

Center for Earth Observation and Digital Earth  
Chinese Academy of Sciences

2009年2月9日

English ARP 内网 邮件 检索 搜索

· 中心概况 · 科研队伍 · 科研进展 · 国际合作 · 创新文化 · 研究生教育  
· 前沿扫描 · 规划战略 · 学术交流 · 科普天地 · 用户服务 · 图像展示

通知通告 用户信息

· TerraSAR卫星数据专辑 (2008-09-17)  
· 对地观测中心正式分发ALOS卫星数据 (2008-09-17)  
· SPOT卫星数据分发通知 (2008-09-17)

对地观测中心积极开展北方旱情遥感应急监测与数据共享工作

由降水异常偏少和平均气温较常年同期偏高导致的气象干旱已波及中国12个省份，抗旱救灾工作已成为目前紧迫的国家需求。为充分发挥空间遥感技术在旱灾监测中的作用，更快、更好地为全国抗旱救灾工作服务，中国科学院对地观测与数字地球科学中心充分利用自身科技优势，启动灾情遥感监测工作。2月6日上午，对地观测中心紧急成立了以郭华东主任为组长、30余名科技人员组成的工作组，开展旱情遥感监测与数据共享工作。...

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特别专题

旱情遥感监测与数据共享平台

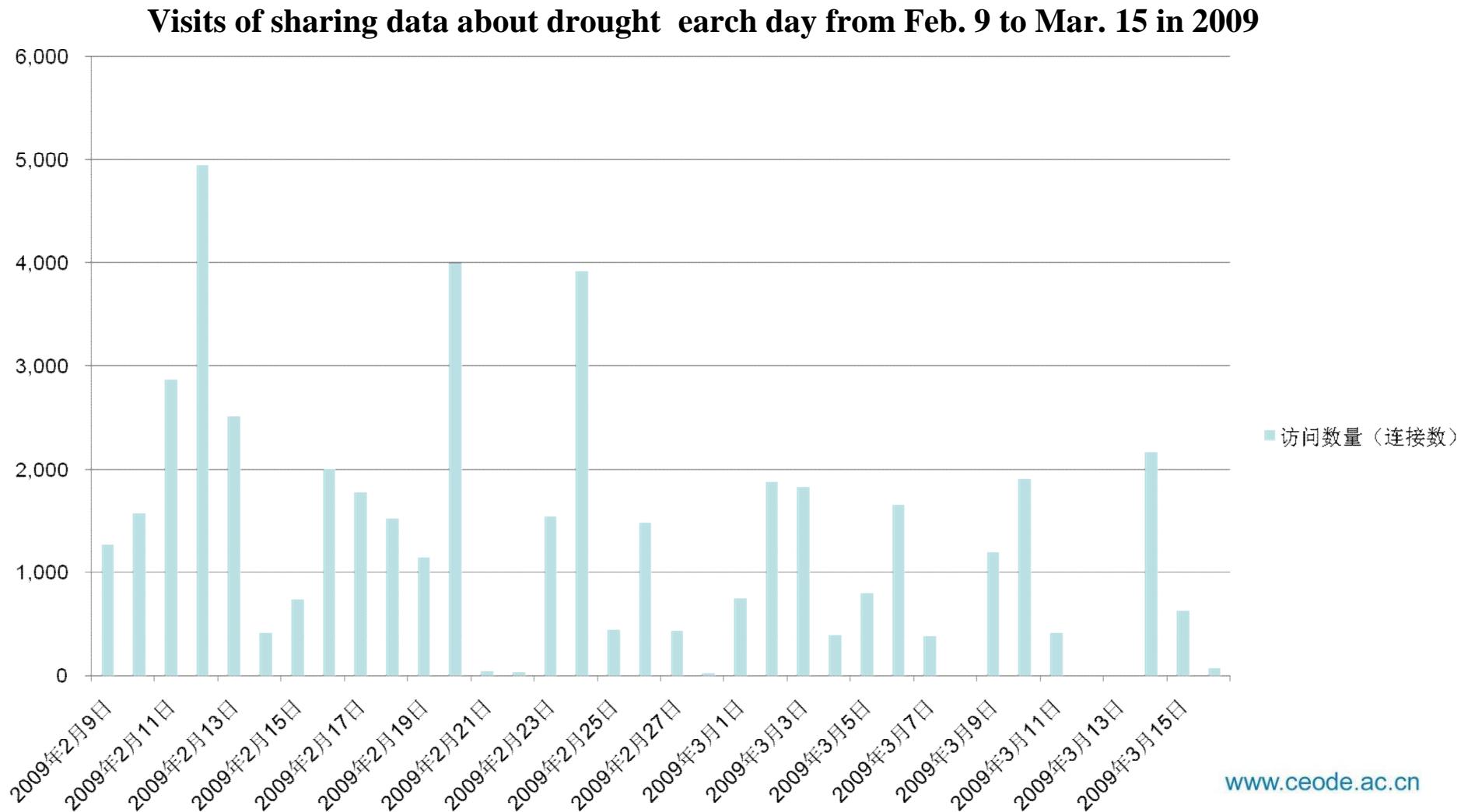
Website for data sharing

[www.ceode.ac.cn](http://www.ceode.ac.cn)

## 4. Earth Observation Data Sharing



### Drought, Northern China

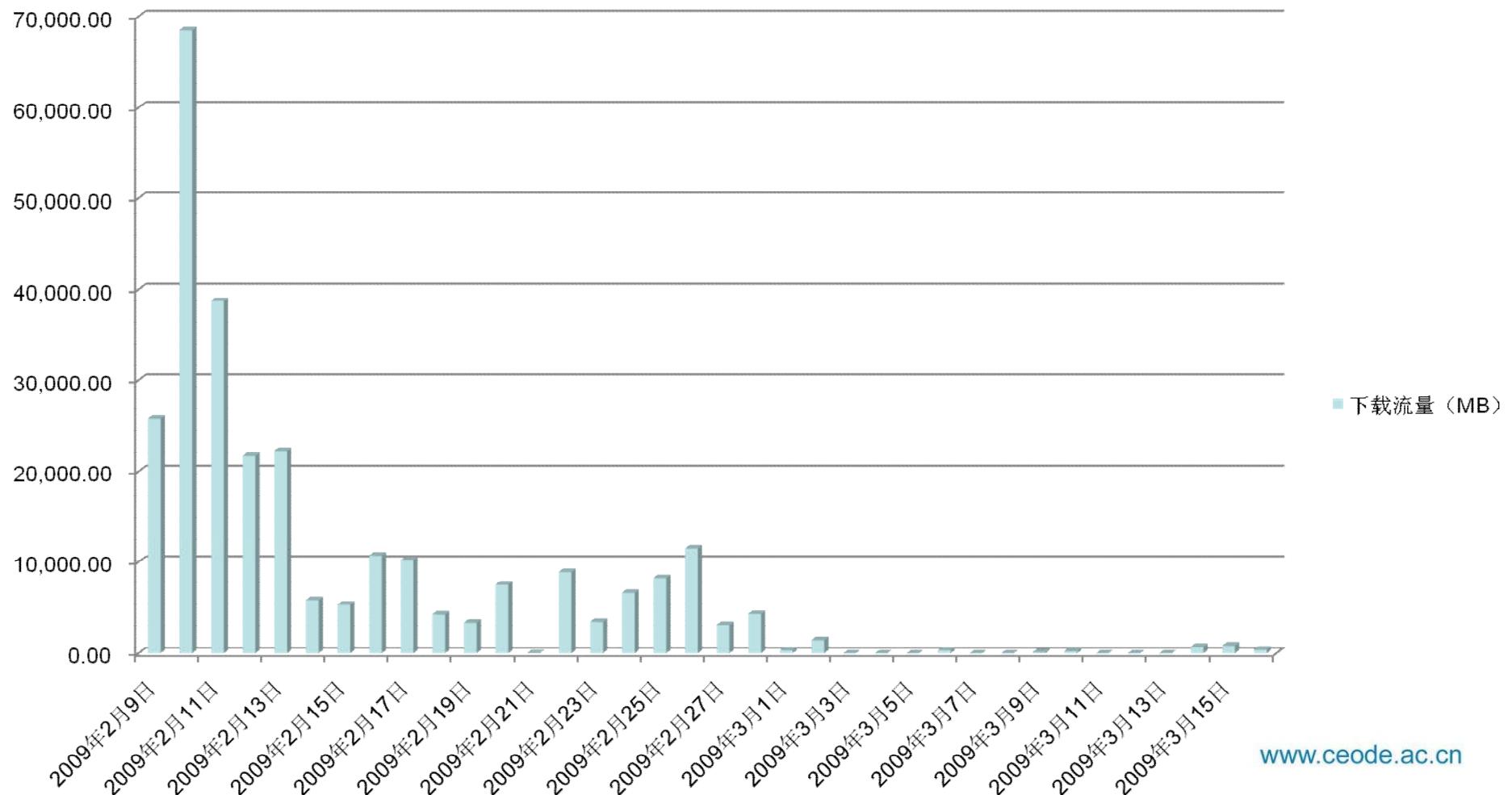


## 4. Earth Observation Data Sharing



### Drought, Northern China

Download flow of sharing data about drought each day from Feb. 9 to Mar. 15 in 2009



## 5. Concluding Remarks



- An emergency disaster monitoring system with advanced, operational, fast and reliable technical ability should be further established.
- Earth observation technology is a powerful tool for natural disaster mitigation. Decision makers should pay attention to this high-tech.
- Should effectively coordinate key space infrastructures to achieve a high degree of data sharing among different agencies.

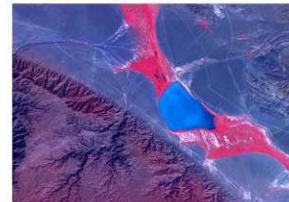
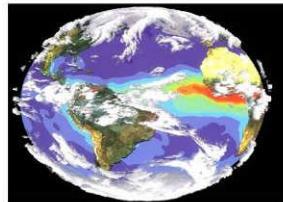
- Some natural events, regarded as disasters by human beings, were merely natural phenomena in the Earth's long-term evolutionary process. We must wage our struggles with natural disasters in accordance with the idea that mankind should coexist harmoniously with nature.



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