

RESEARCH ON CHINESE NATURAL DISASTER REDUCTION SYSTEM OF SYSTEMS (CNDRSS)

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Nov.7th, 2012 Beijing, China



OUTLINE



1 Why build CNDRSS?



2 How to build CNDRSS?

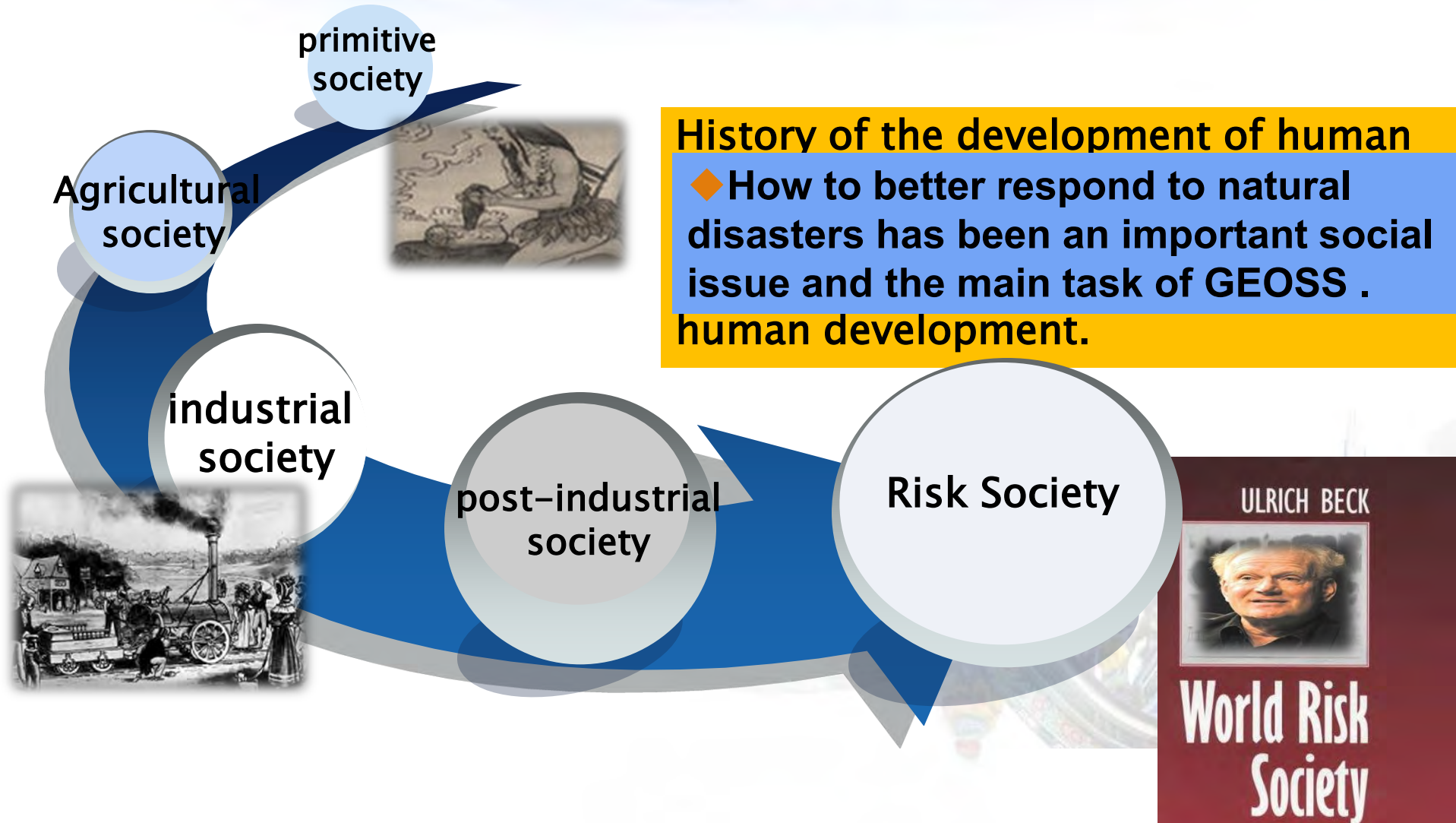


3 Case analysis



4 CNDRSS program plan.

1.1 The Relationship Between Natural Disasters and Human Beings




1.1 The Relationship Between Natural Disasters and Human Beings - **Disaster trends**

- Global change leads to higher frequency of natural disasters.

- Active tectonic plates movements cause the increasing frequency and intensity of solid earth disasters.

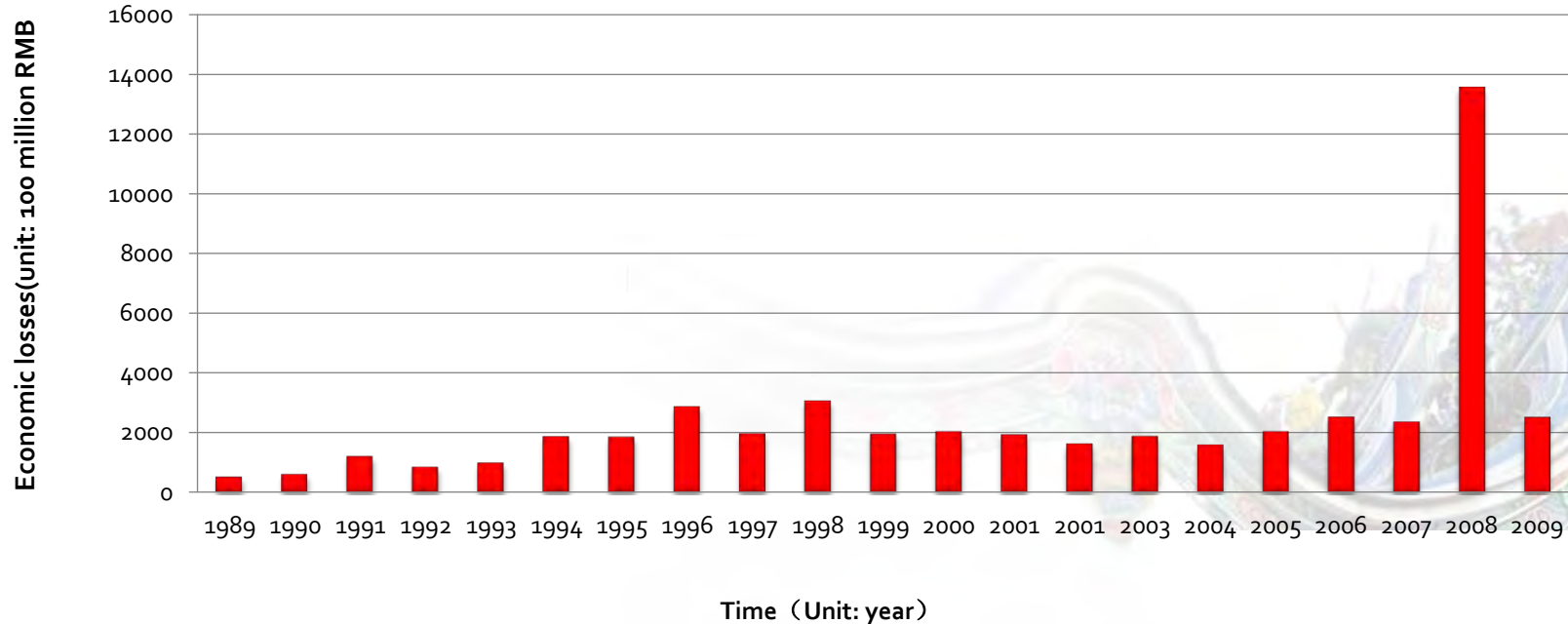
- Tremendous pressure on the global ecological environment, caused by economic globalization, which is beyond its carrying capacity, has also led to frequent disasters.



1.2 The Characteristics of Chinese Natural Disasters - Heavy Losses

During 1990 and 2008, natural disasters in China annually caused that about 300 million people were affected and that the direct economic loss was more than 200 billion RMB. In 2008, as a result of great snow disaster in the South and earthquake in Wenchuan, the direct economic loss was over 1200 billion RMB.

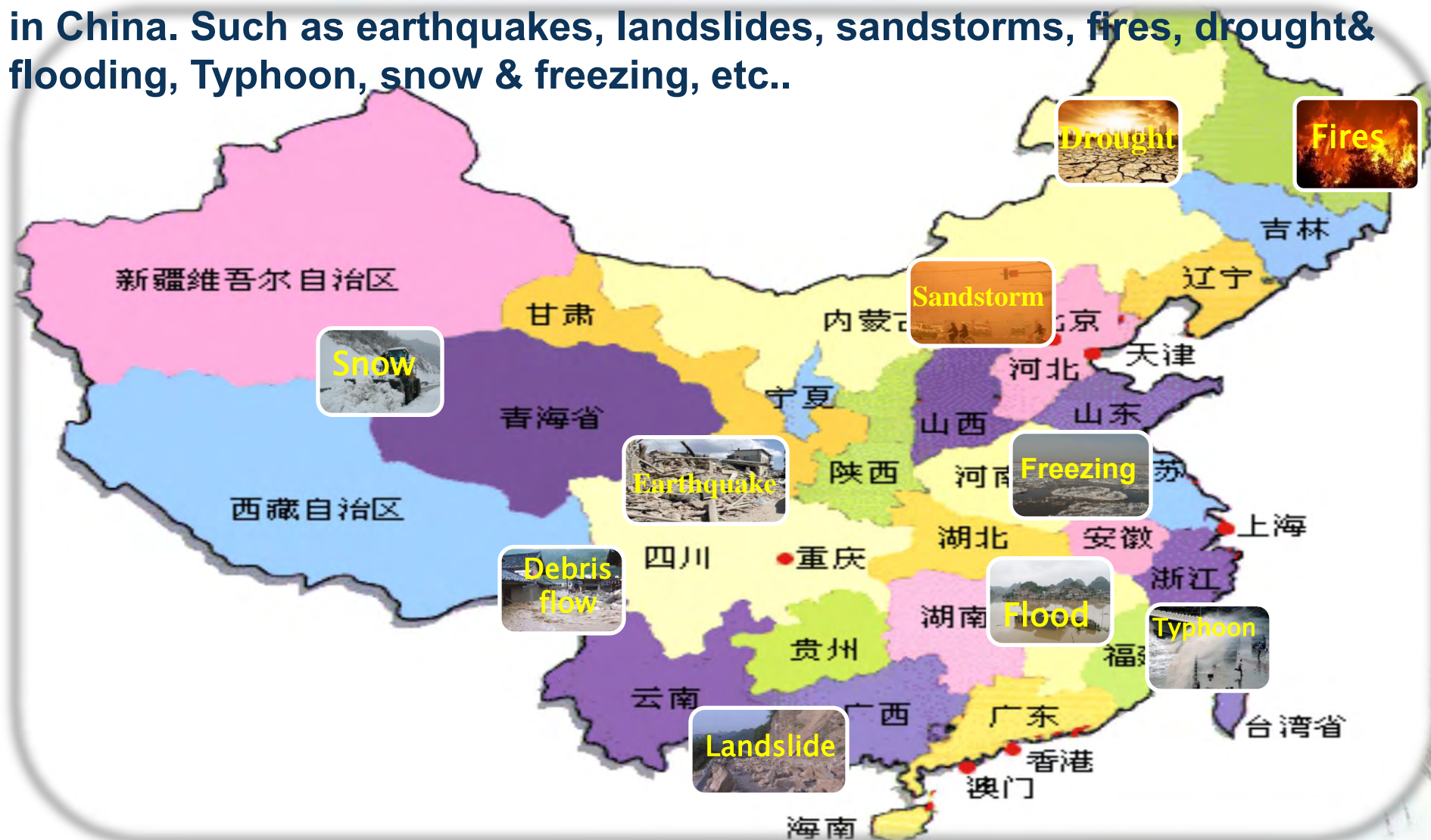
China's direct economic losses of natural disasters in recent years



Data source: National Ministry of Civil Affairs

1.2 The Characteristics of Chinese Natural Disasters - Disasters diversity

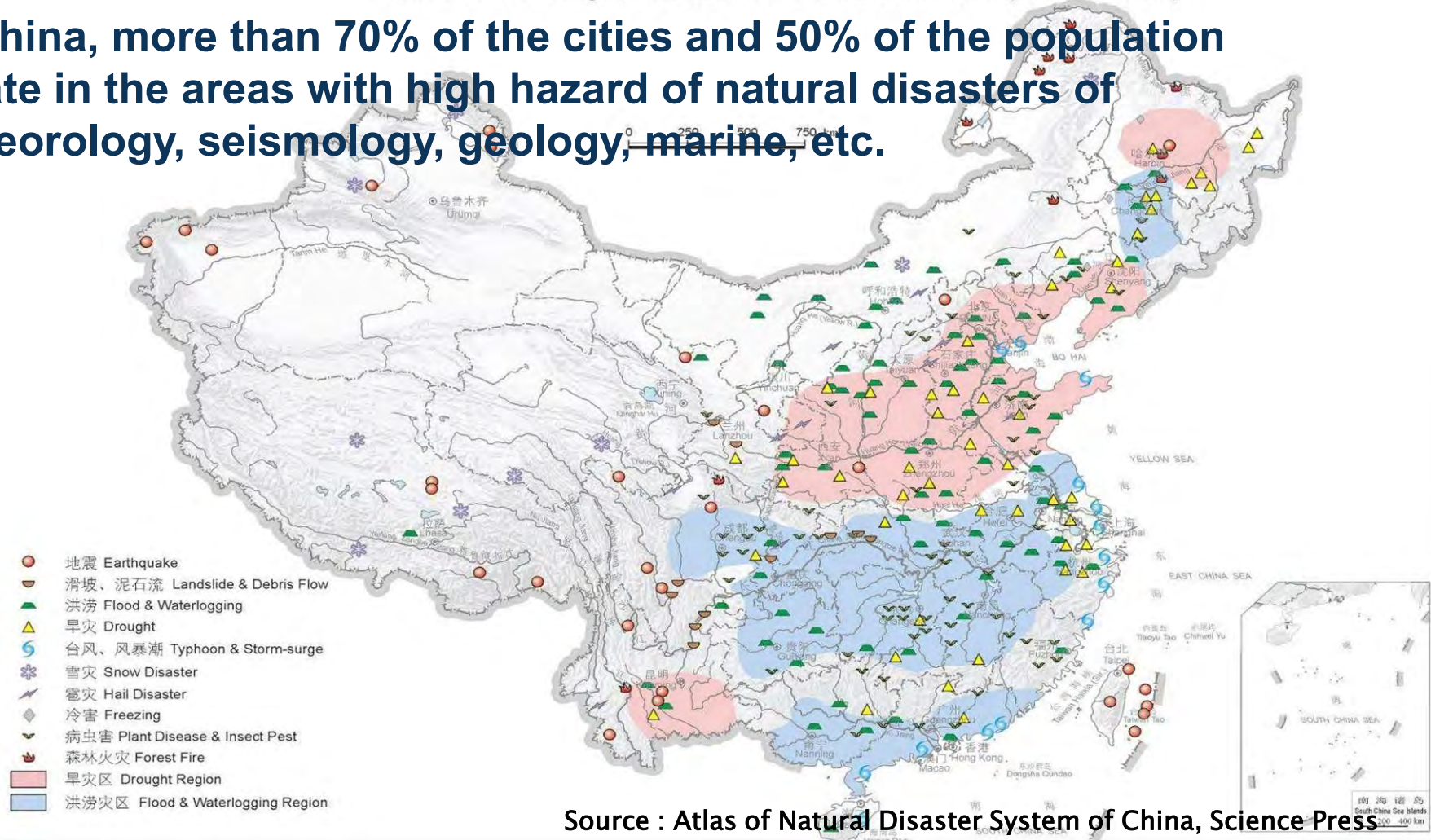
Except volcanic eruptions, all kinds of natural disasters have occurred in China. Such as earthquakes, landslides, sandstorms, fires, drought & flooding, Typhoon, snow & freezing, etc..



1.2 The Characteristics of Chinese Natural Disasters - **Wide geographic distribution**

Location of Major Natural Disasters in China (1900~2000)

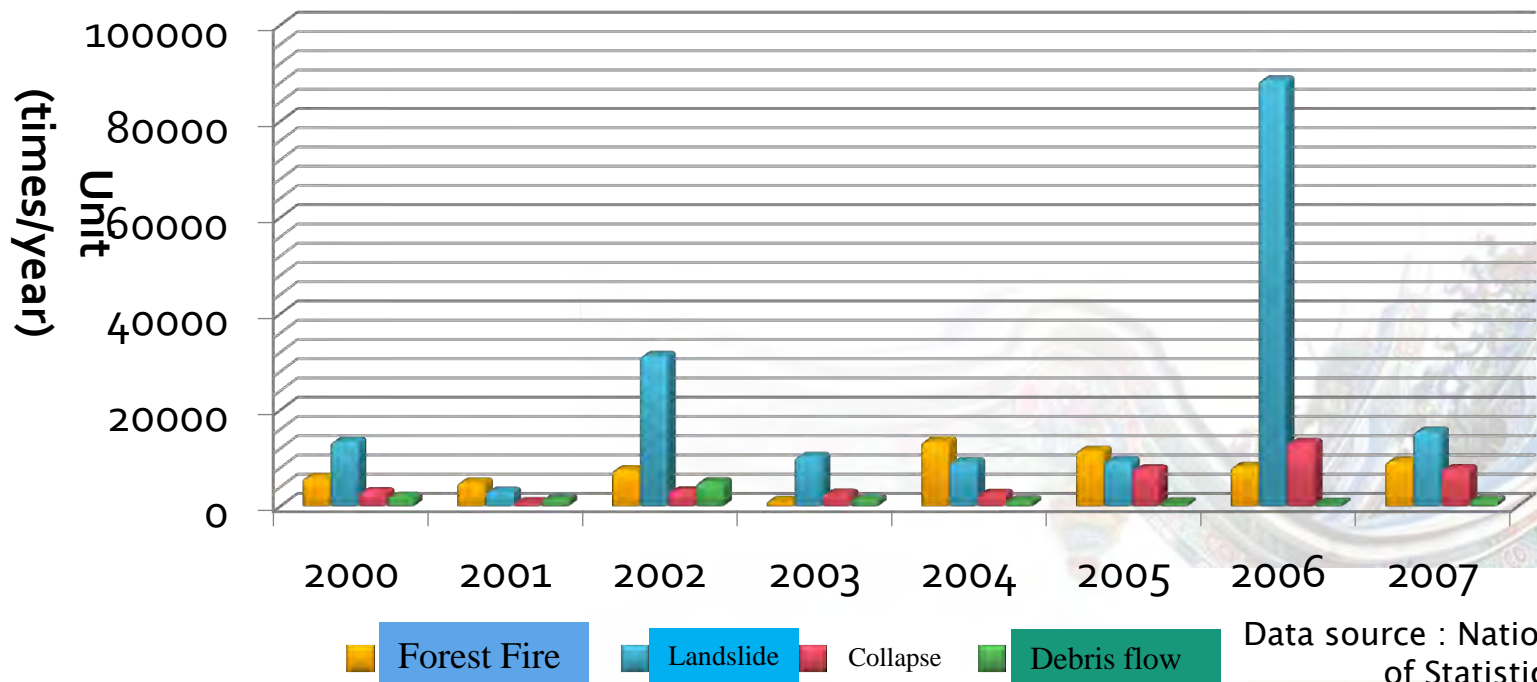
In China, more than 70% of the cities and 50% of the population locate in the areas with high hazard of natural disasters of meteorology, seismology, geology, ~~marine~~, etc.



1.2 The Characteristics of Chinese Natural Disasters - High Frequency

Due to the influence of monsoon, meteorological disasters occur frequently in China. In addition, China is also the country with most mainland earthquake. Especially, in 2006, landslides occurred over 80,000 times in China.

The frequency of several natural disasters in China
from 2000-2007



1.3 The Current Situation of Chinese Disaster Reduction - The available operational systems

The 12 Twelve Integrated Observation Systems

Comprehensive Information on Disaster & Obs.System

Integrated agricultural observing system

Integrated hydrological monitoring system

Integrated land observing system

Integrated observing system in cities/townships

Integrated meteorological monitoring systems

Seismological & Geophysical monitoring system

Integrated environment monitoring system

Integrated forest & Ecological monitoring system

Basic ocean monitoring system

Integrated surveying and mapping information platform

Scientific research-oriented monitoring system

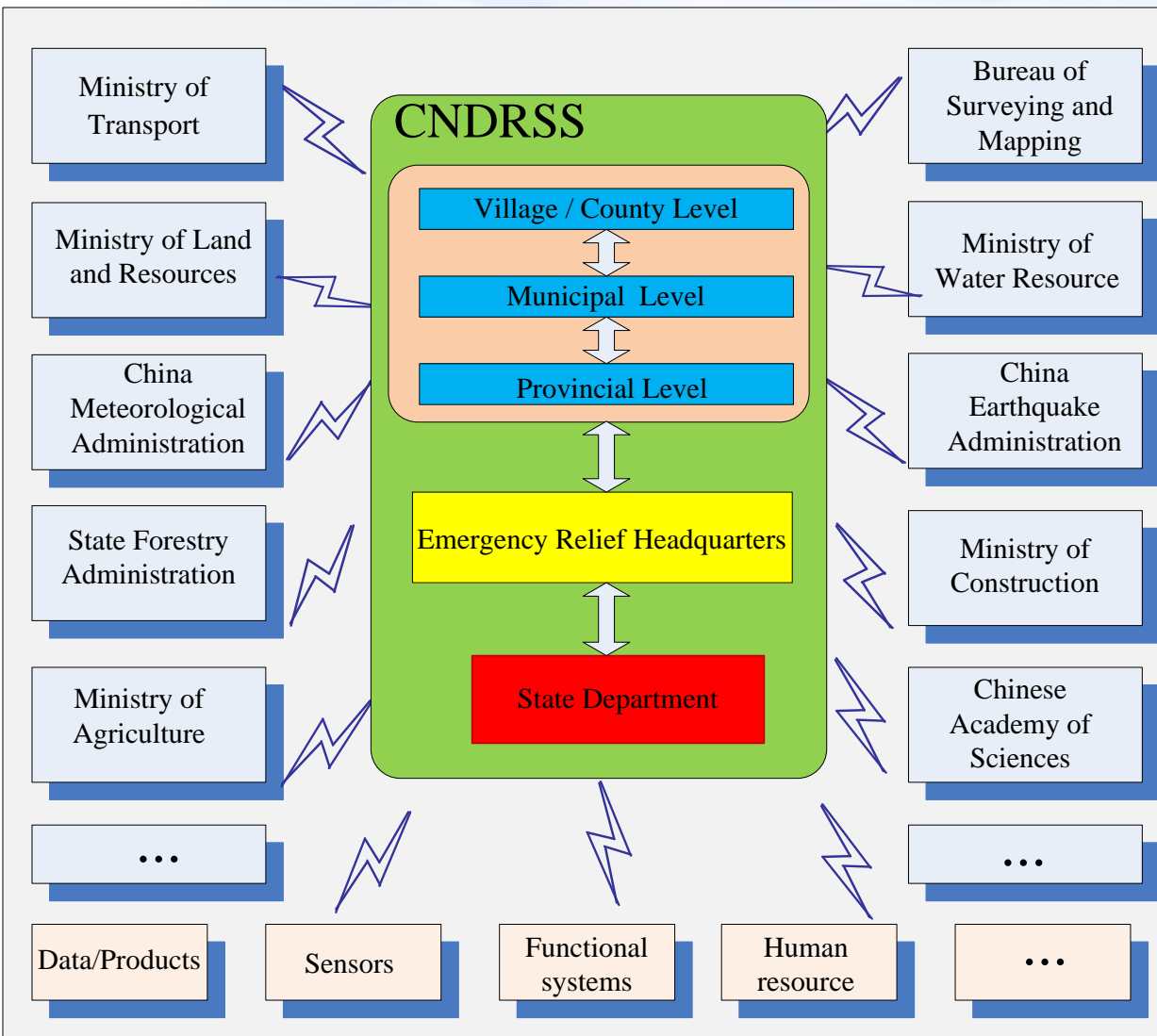


1.3 The Current Situation of Chinese Disaster Reduction - The Existing problems

- Sensors, data and information cannot be shared and integrated sufficiently
- **"Rich** of data, barren of information, lack of **knowledge"**
- Collaboration among different ministries/institutions is insufficient.
- Stable and efficient channel for disaster information transmission among stricken areas, related ministries and headquarters cannot be guaranteed.

We need to integrate multiple disaster related systems among different ministries/institutions by federated databases and interoperability and to use the sensor web to integrate airborne, space borne and in-situ observations through a web service.

1.4 Integration of Multiple Systems is the Resolution - **The Task of CNDRSS**



- Sensor web available for real-time or near real-time use.
- Full and open exchange of data, service and other resources;
- Effective mechanism and platform for the collaboration of various ministries;
- Timely and rapid delivery of disaster data and information;

2 How to build CNDRSS?

2.1

The design of CNDRSS

2.2

The architecture of CNDRSS

2.3

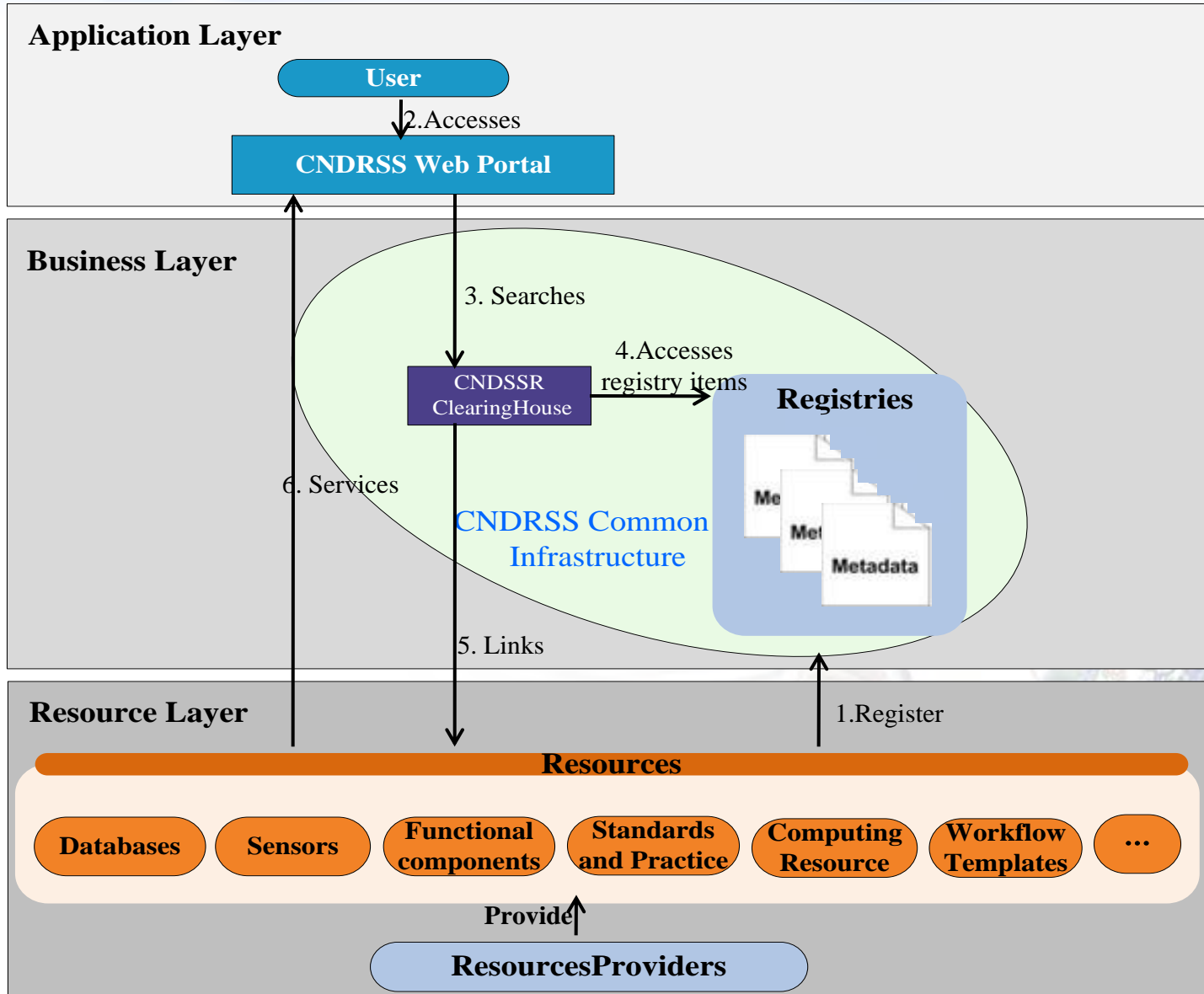
The key Technologies of CNDRSS

2.1 The Design Consideration of CNDRSS - Integration among different ministries through federal database and interoperability

- ✓ Geographic Distribution
- ✓ Interoperability
- ✓ Independence
- ✓ Flexibility



2.2 The Architecture of CNDRSS



Chinese Meteorological Satellite: FY Series

Polar Orbits

Geostationary Orbits

First Generation

FY
|
1A
1B
1C
1D



FY
|
2A
2B
2C
2D
2E

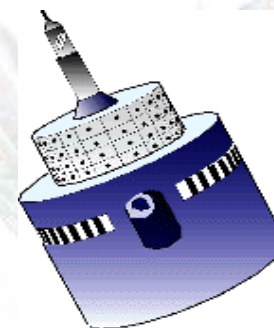


Second Generation

FY
|
3A
3B
3C
↓
3H

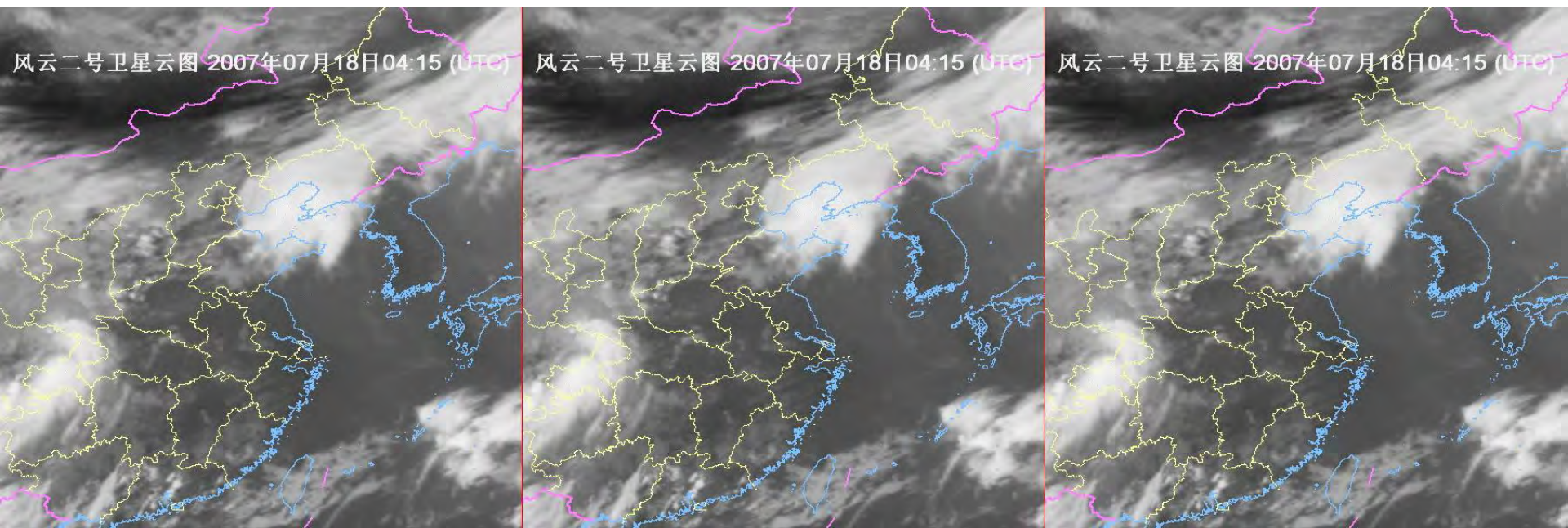


FY
|
4



FY-3A launched on May 27, 2008

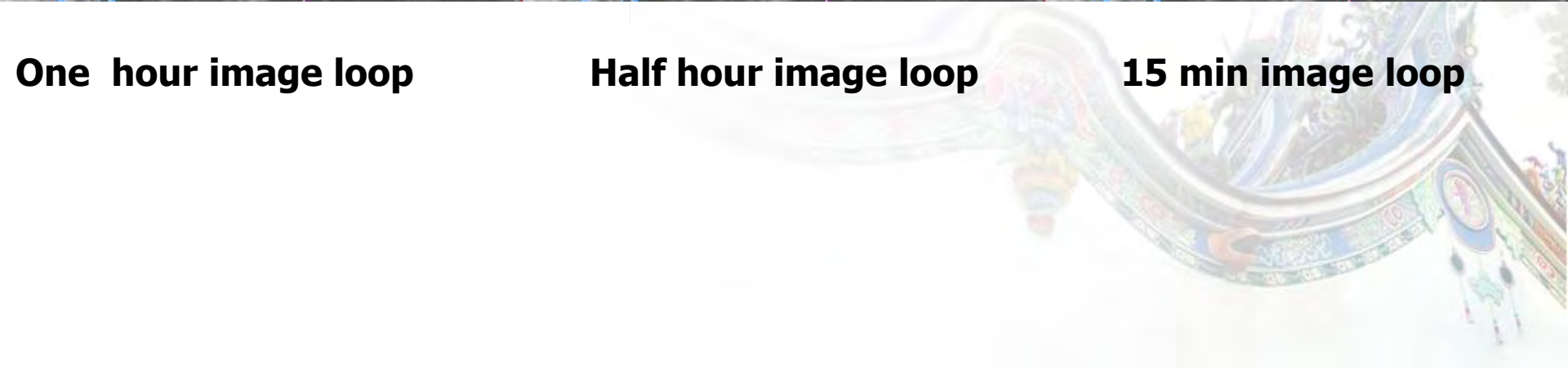
Two FY-2s observe to acquire images every 15 minutes



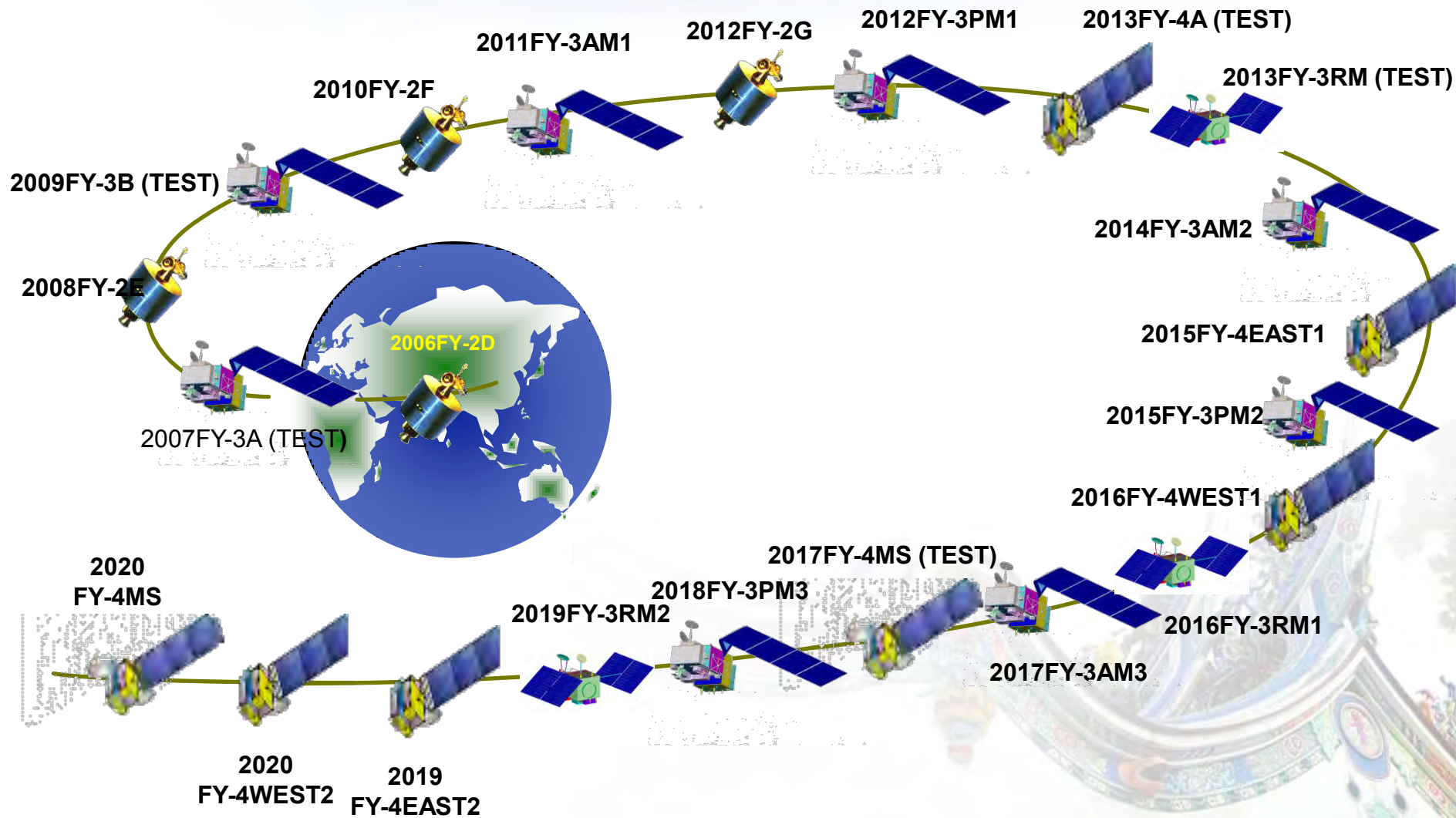
One hour image loop

Half hour image loop

15 min image loop



The route for future development of FY series

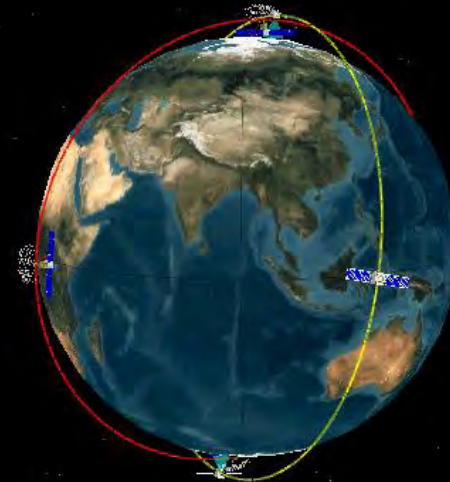


Environmental & Disaster Monitoring Satellite Constellation

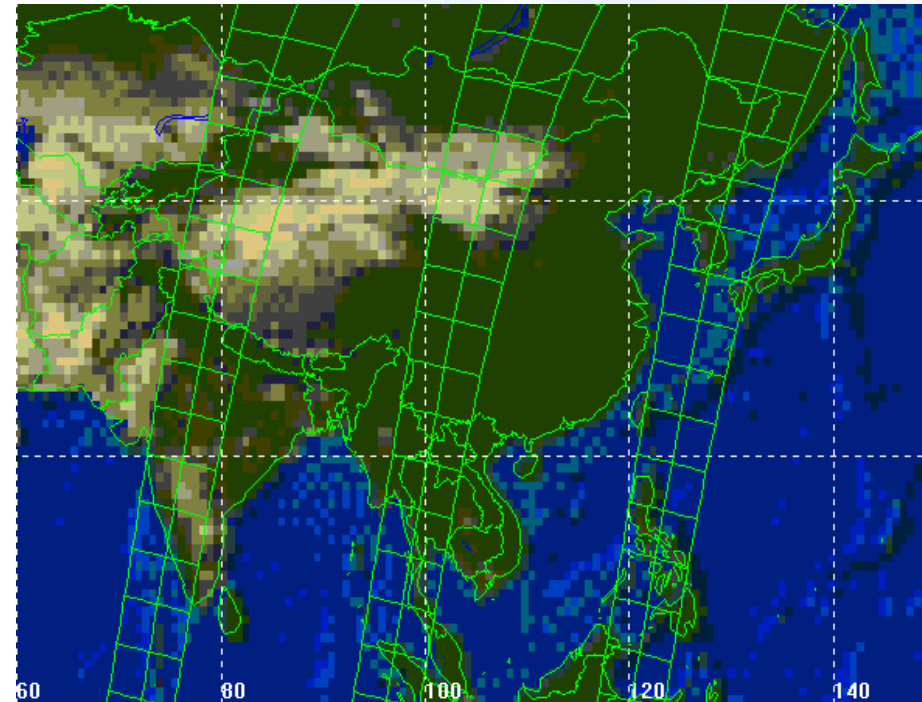


The "2+1" project includes three satellites and ground system, 2 optical and 1 SAR

And it is expected to expand to "4+4" project. The second stage is proposed to be constructed through international cooperation

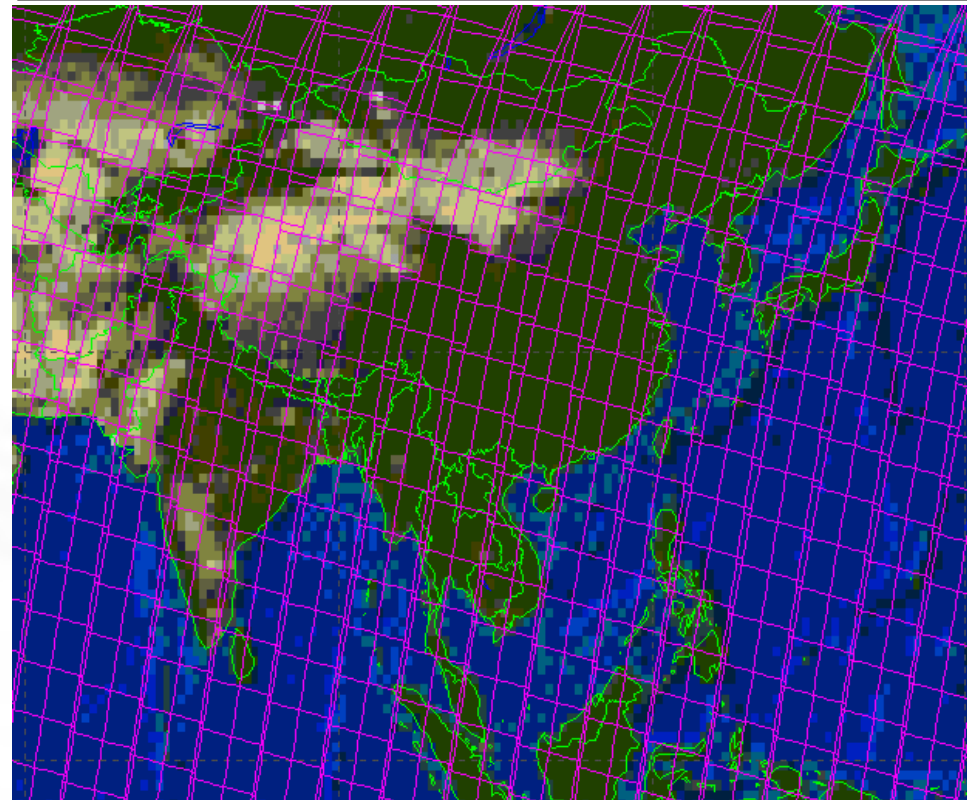


Environmental & Disaster Monitoring Satellite Constellation



24 hours coverage by 4 optical satellites

24 hours coverage by 1 optical satellite



High Resolution EOS of China

(Up to 2020)

High spatial Resolution;

Up to 0.3m for optical and SAR Satellites;

High spectral Resolution:

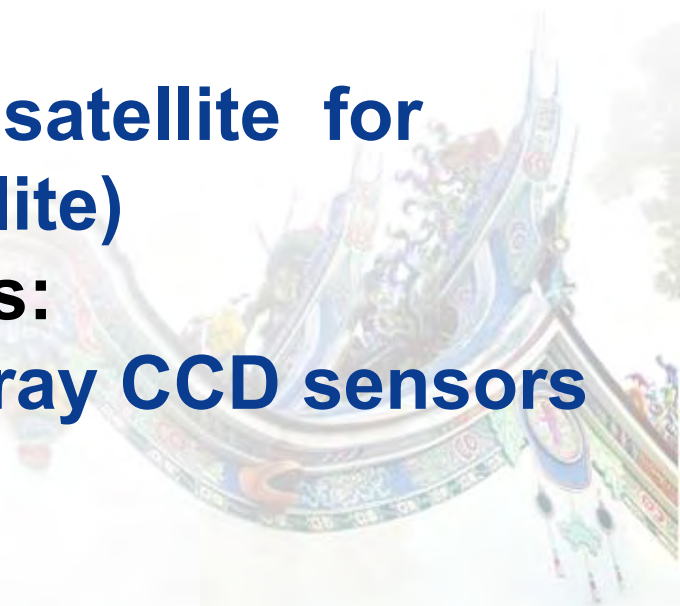
Up to few nm in high spectral RS;

High temporal Resolution:

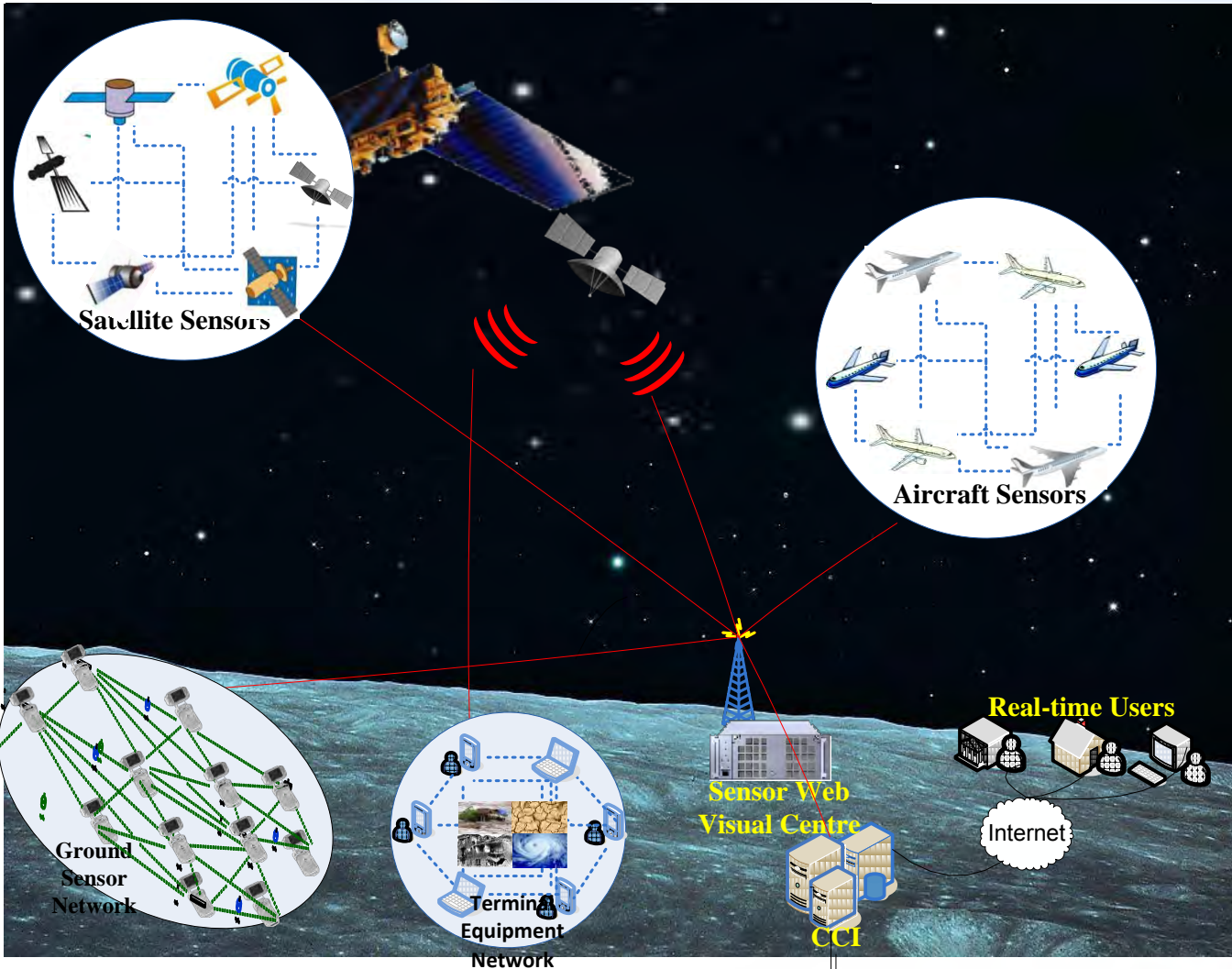
Up to 20m in Geo- stationary satellite for interested area (Staring satellite)

High Resolution Mapping Satellites:

Up to 0.6/2.4m three linear array CCD sensors



2.3 The Key Technologies - Use of Sensor Web to integrate ground-air-spaceborne sensors



- Satellite Sensors;
- Aircraft sensors;
- In-situ sensors;
- Terminate equipments;

Sensor Network Applied in Disaster Management

Identify NIFC-tracked
Wildfire Incidents

1

Large Incidents - August 21, 2003

Roberts Fire

Science Goal Monitor



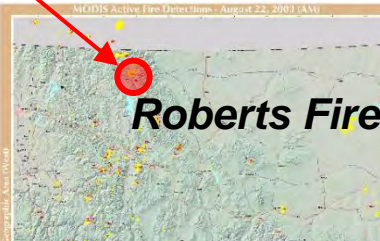
Fire location confirmed
and selected for imaging

3

SGM adds target to EO-1
ground & on-orbit planning
& scheduling systems and
tasks EO-1

2

Correlate latest fire
location information
with MODIS imagery



Roberts Fire

**Active Fires
Detection Map**

**UMD Natural Hazards
Investigation Team**

6

**Roberts Fire
USFS Burned Area Emergency Response
(BAER) team**

**Aqua or Terra
MODIS data**

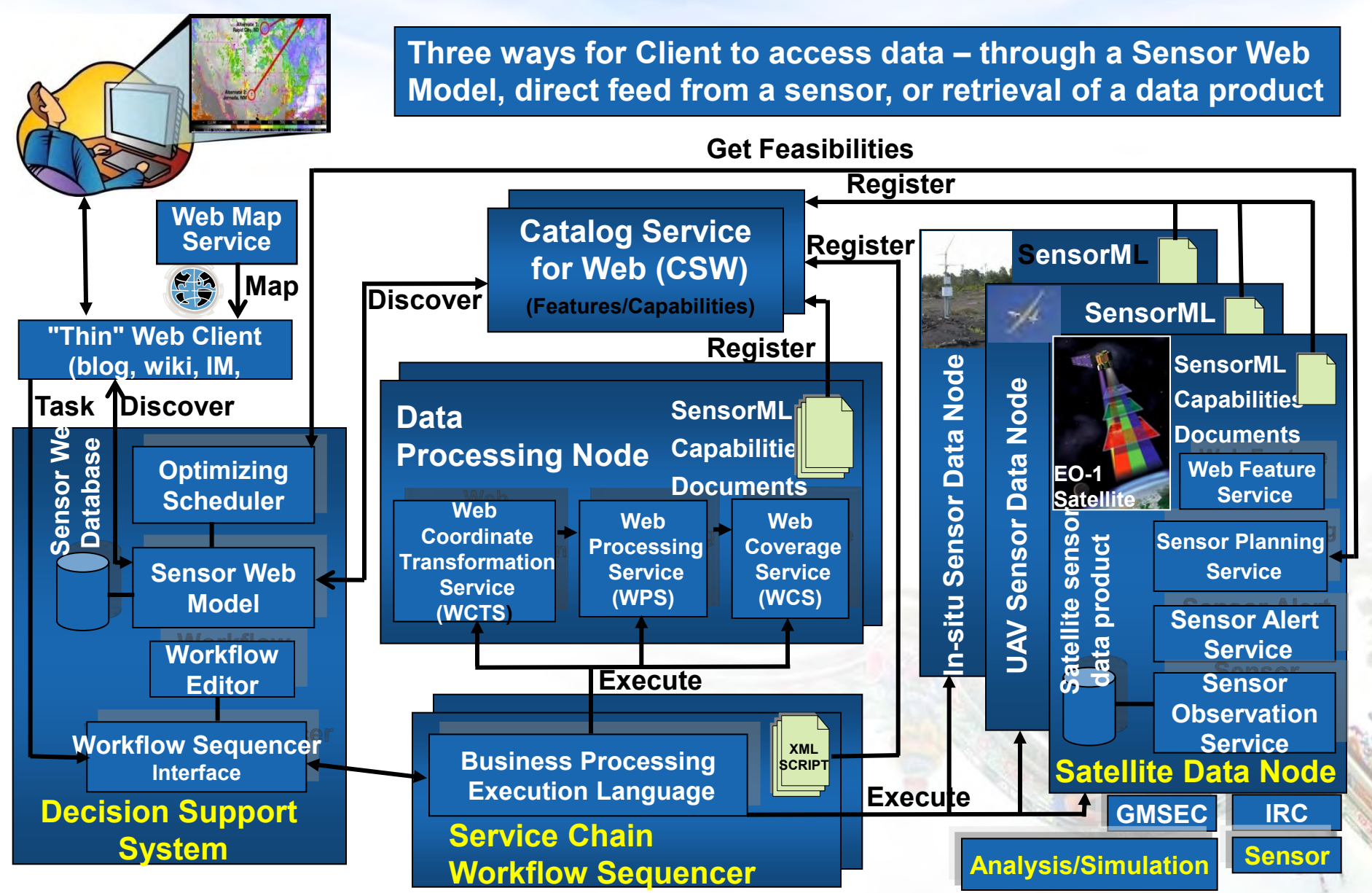
EROS Data Center

4

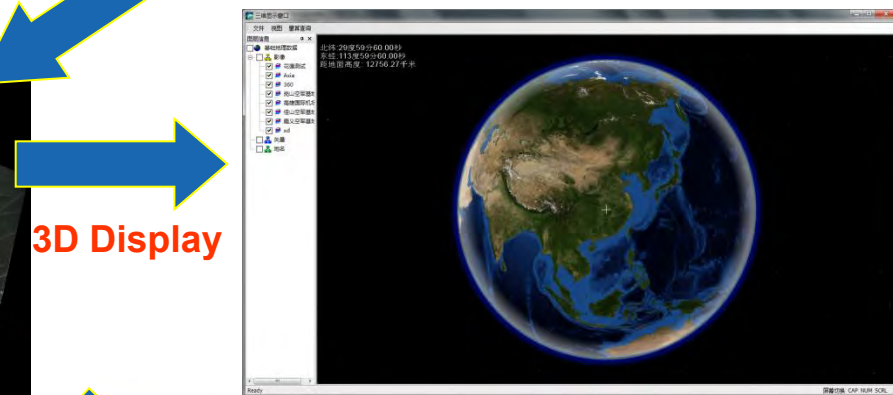
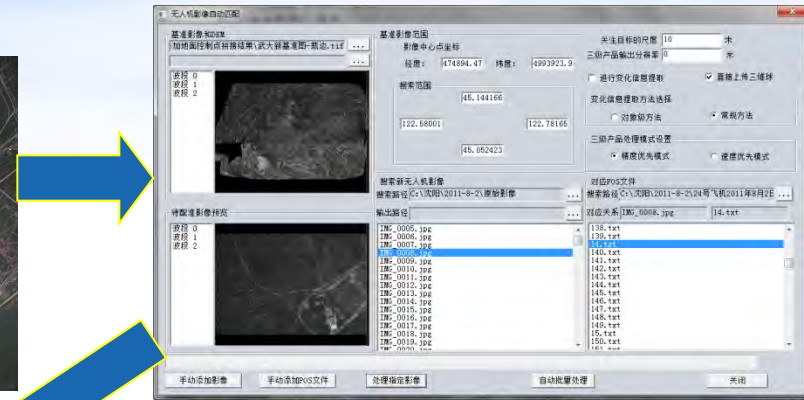
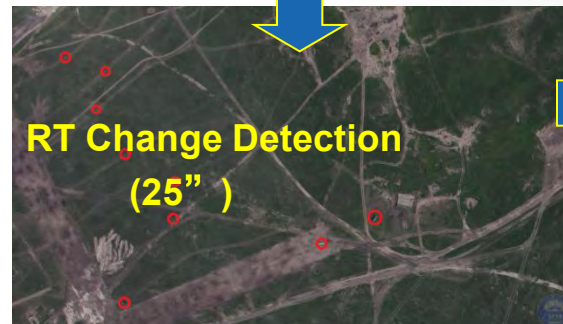
5

L1 Data

Reference Architecture for an Inter-Operable Sensor Web



Real Time Change Detection with UAV Data



Results sending to Enduser



UAV take off

RT Change Detection
(25")

3D Display

Real Time Data transmission

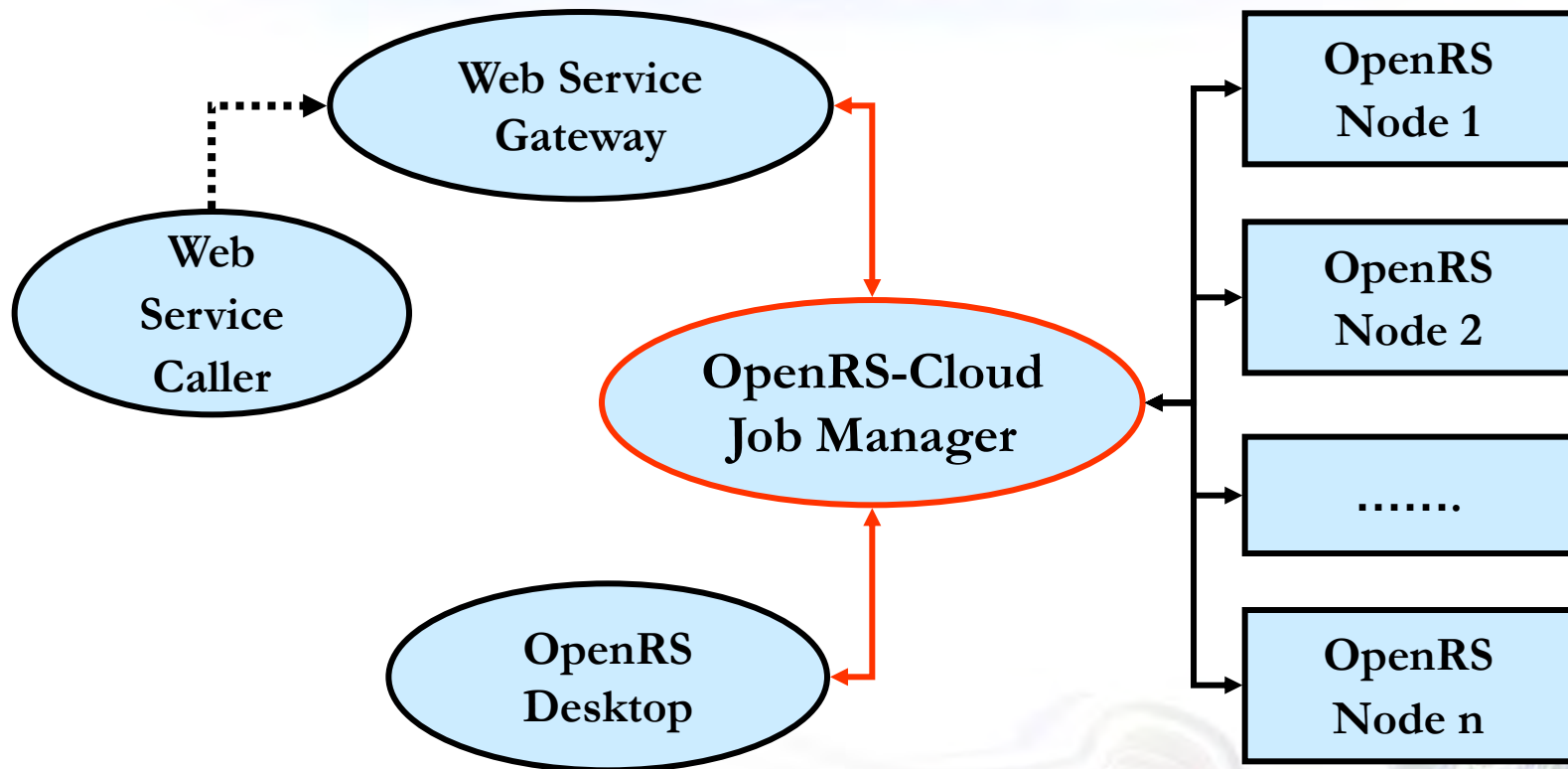
RT Matching for
Ortho-photo
(10")

OpenRS Cloud —— An Open Software Platform for Remote Sensed Data Processing



Engine of Data Processing & Information Extraction

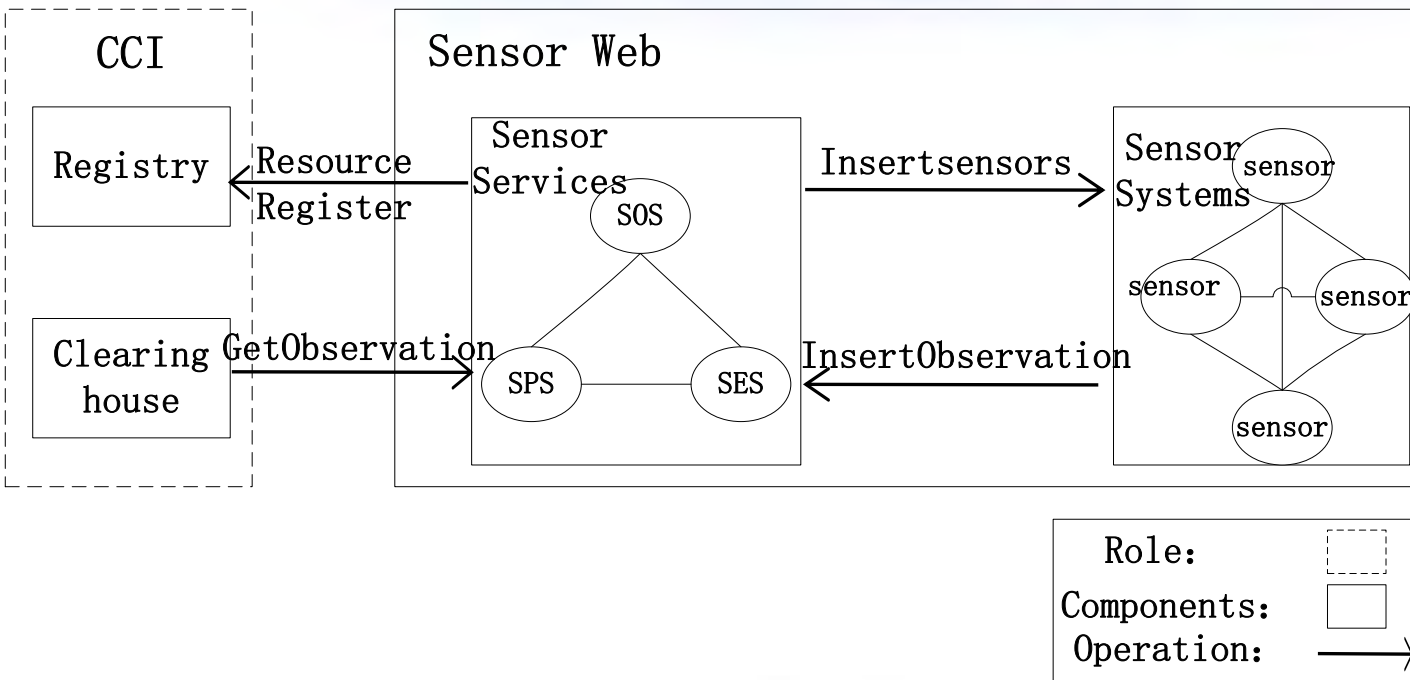
Integration of DP,DPP,WPS



Algorithm: Compiled once, Run on desktop, cluster and for WPS

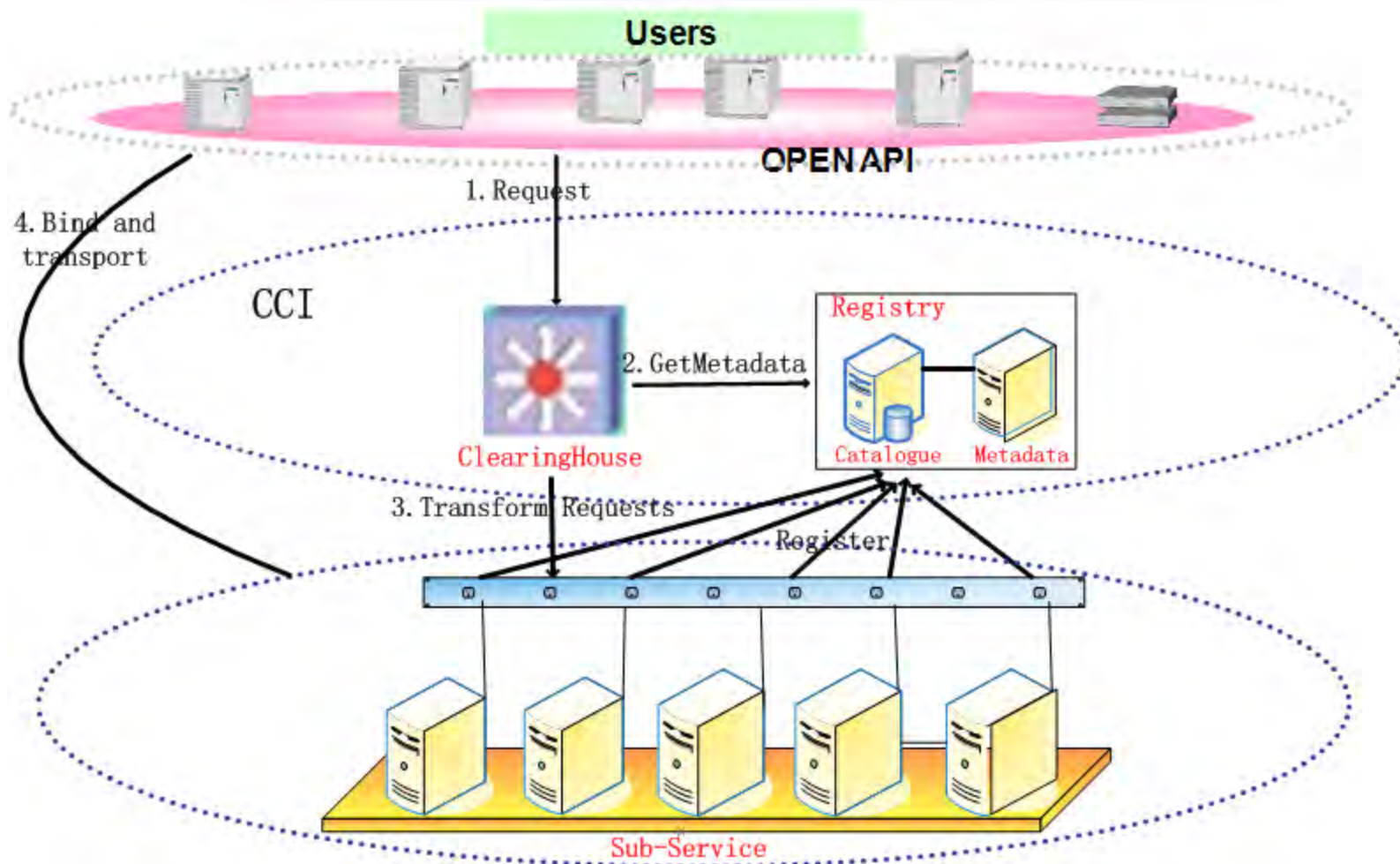
Platform: Providing UI, Paralleled Environment, WPS Wrapper

2.3 The Key Technologies – The Sensor Web in CNDRSS

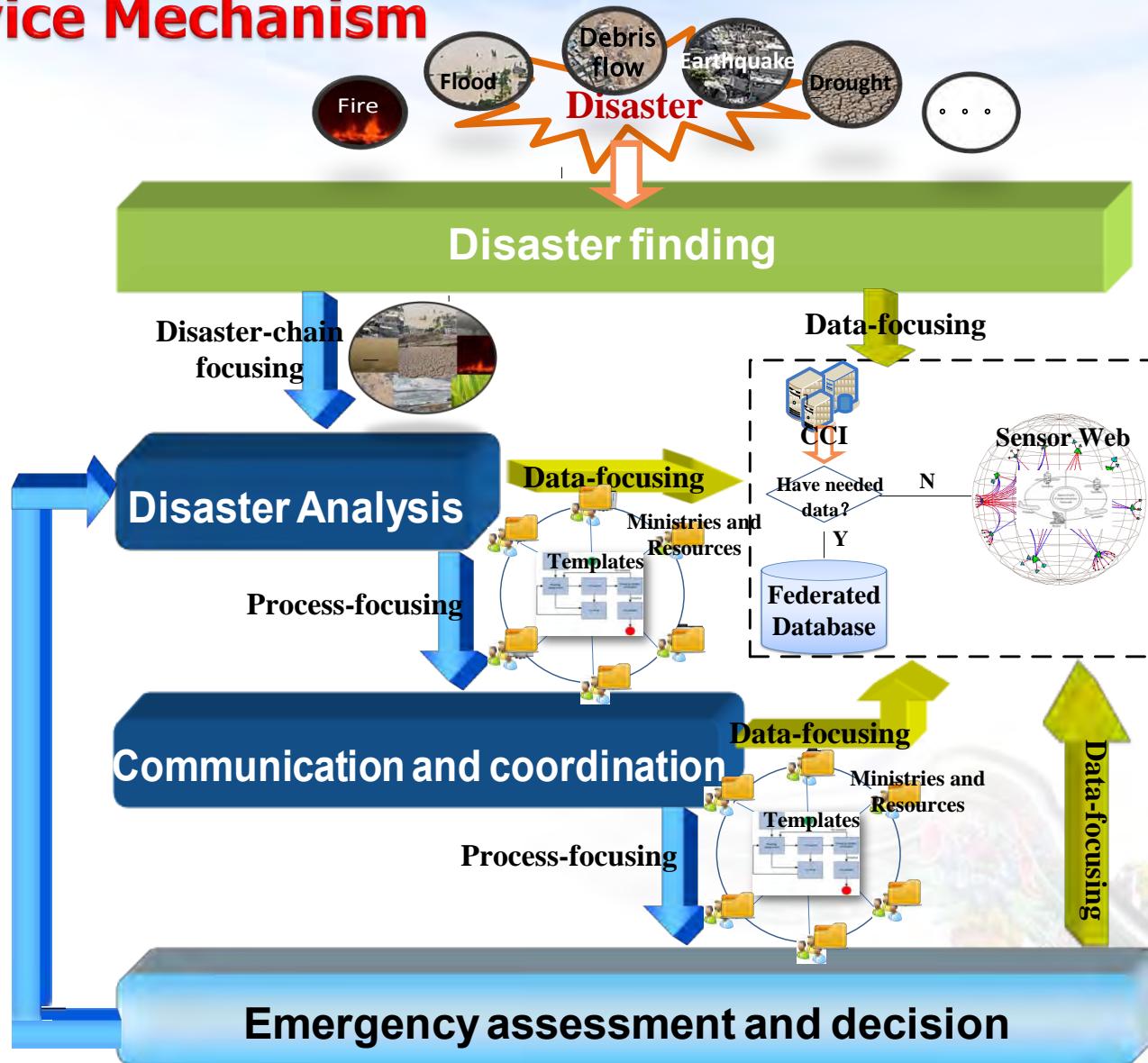


● According to the requests of the users, corresponding sensor observation services can be registered in the Registry centre of CCI, scheduled by the data and sensor planning service and discovered by the Clearinghouse of CCI for real-time or near real-time use.

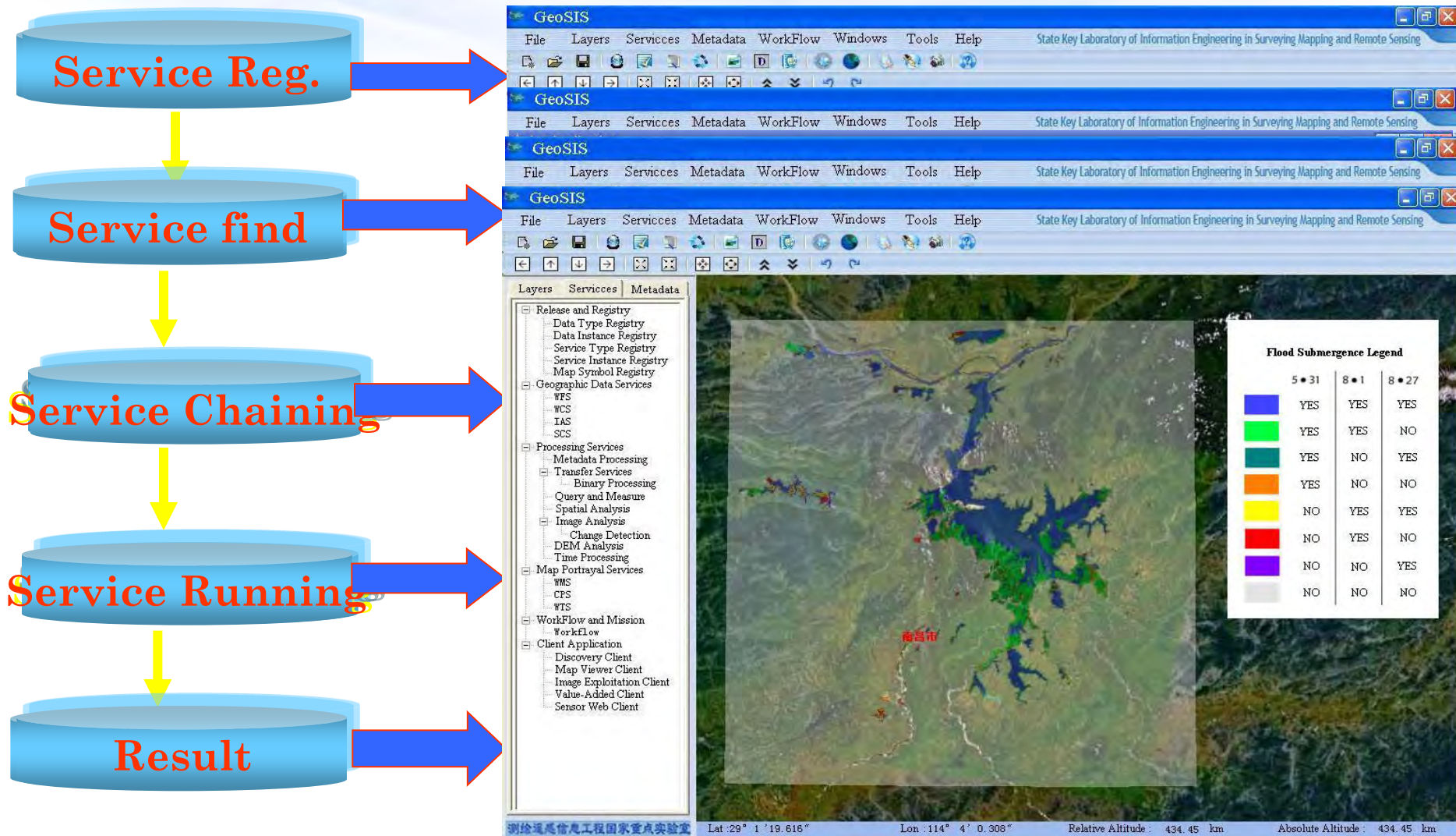
2.3 The Key Technologies - Use of Federated Database



2.4 The Key Technologies - Event-driven Focusing-service Mechanism



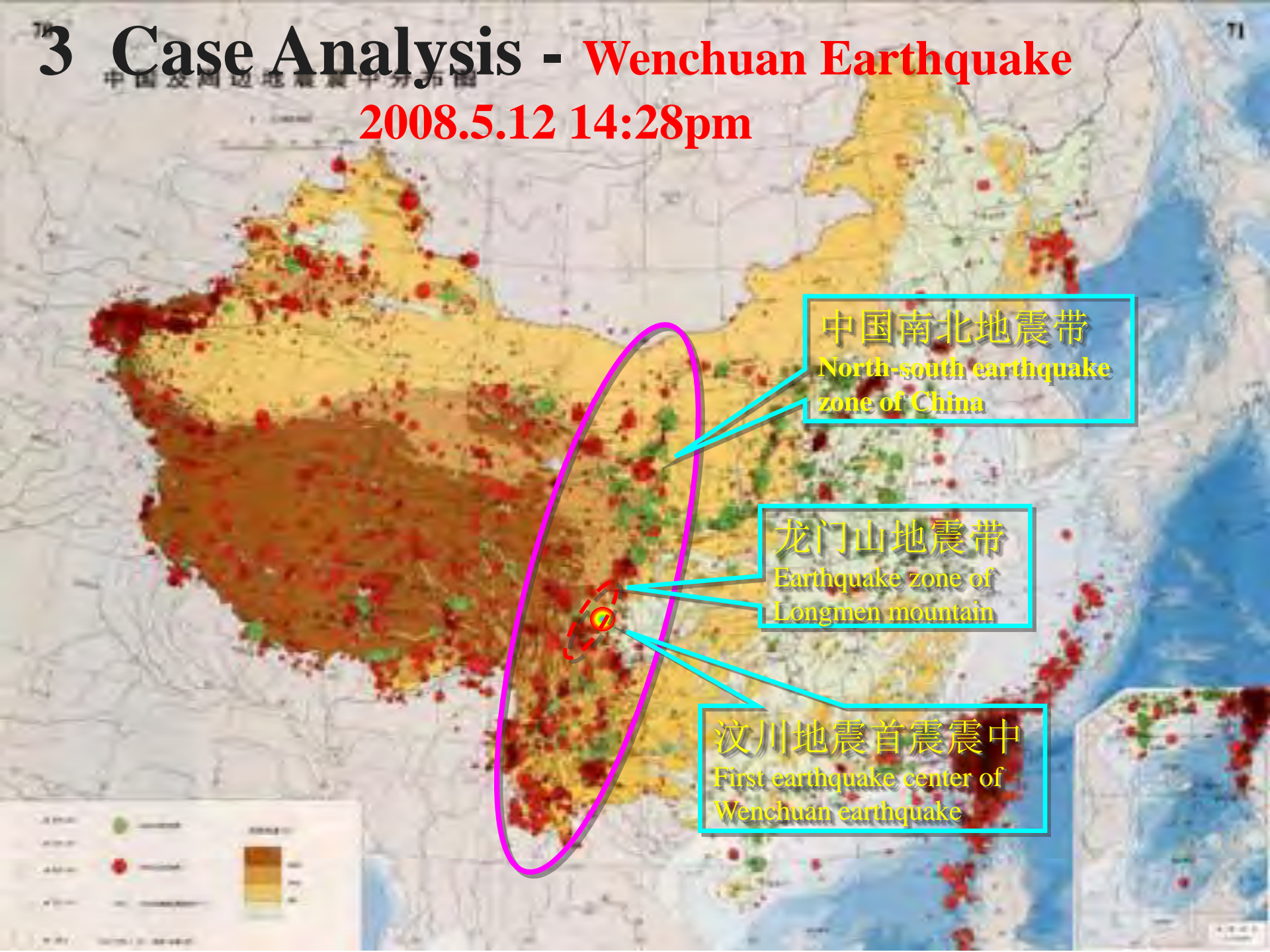
Geospatial information Service Web



Visualizing geoprocessing result in GeoGlobe

3 Case Analysis - Wenchuan Earthquake

2008.5.12 14:28pm



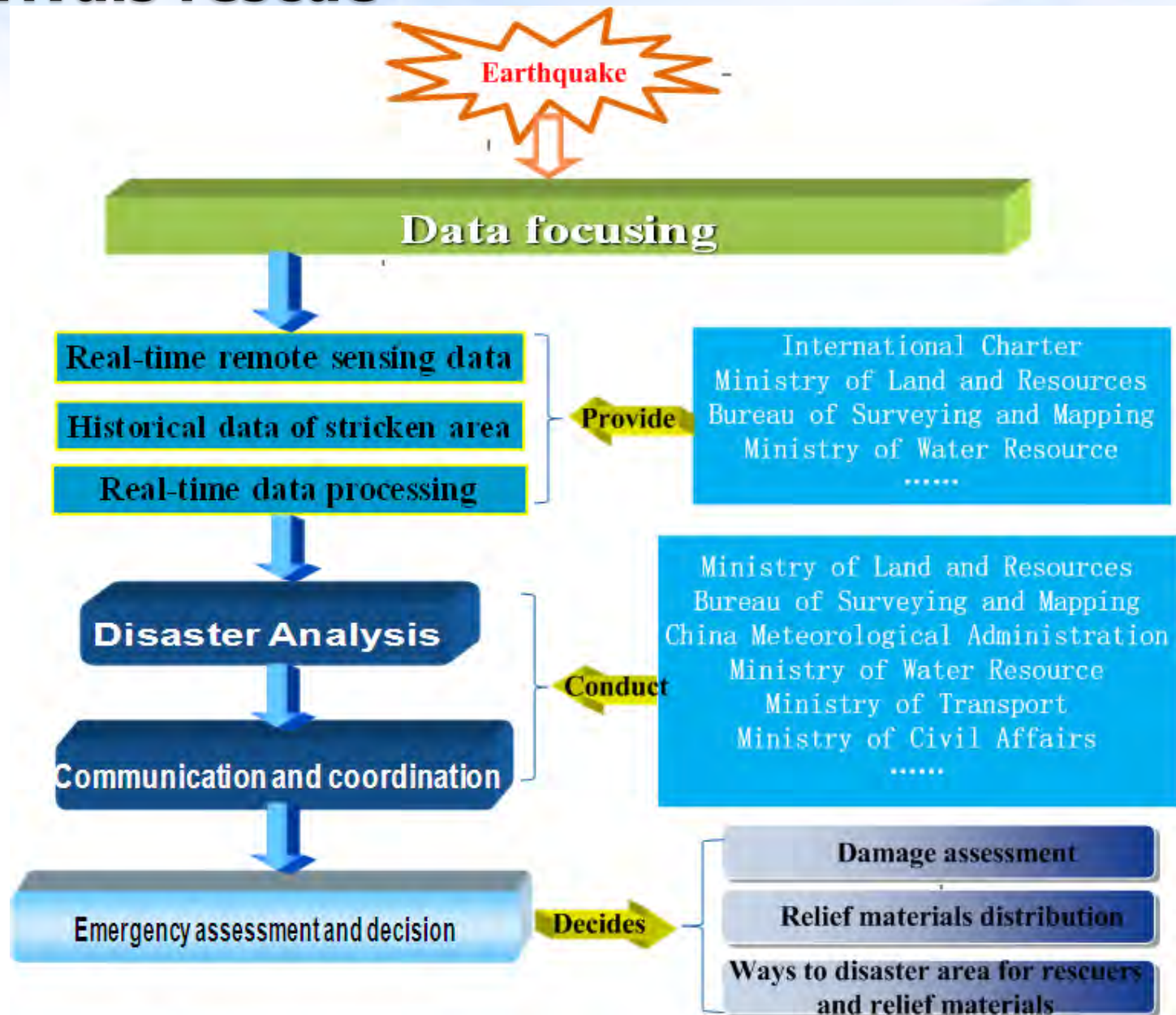
3 Case Analysis - Disaster Relief

- ✓ Step 1: Survivals rescue
- ✓ Step 2: Secondary disaster monitoring and prevention
- ✓ Step 3: Post-disaster reconstruction

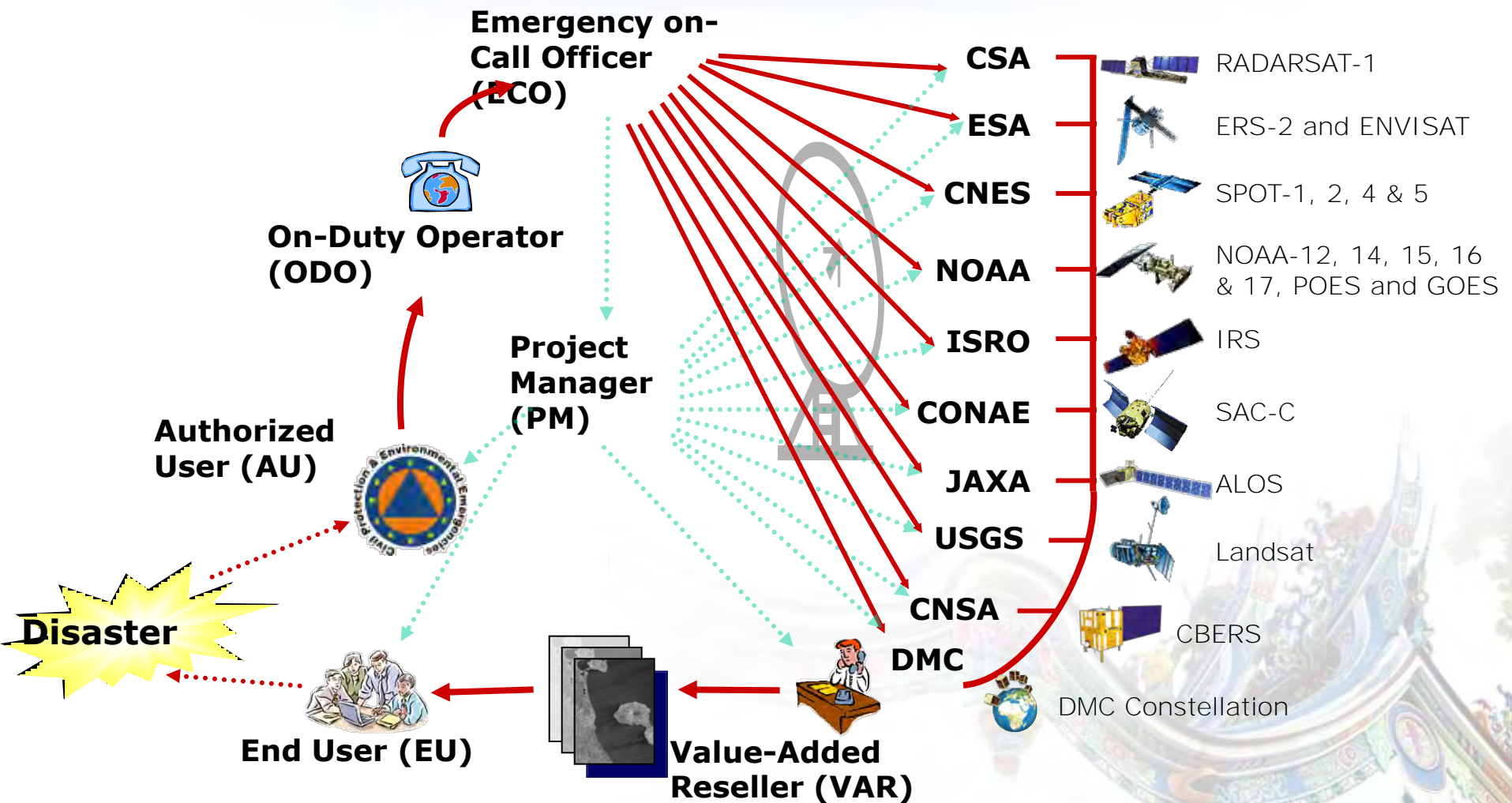
During these processes, massive high resolution data and historical data, of disaster area, were needed and many ministries/institutions were involved:

➤ **Effective mechanism and platform were supposed to be available, where data and information could be fully shared among different ministries/institutions and comprehensive analysis and evaluation from multi-perspective could be conducted by different ministries.**

3.1 Survivals rescue



International Charter



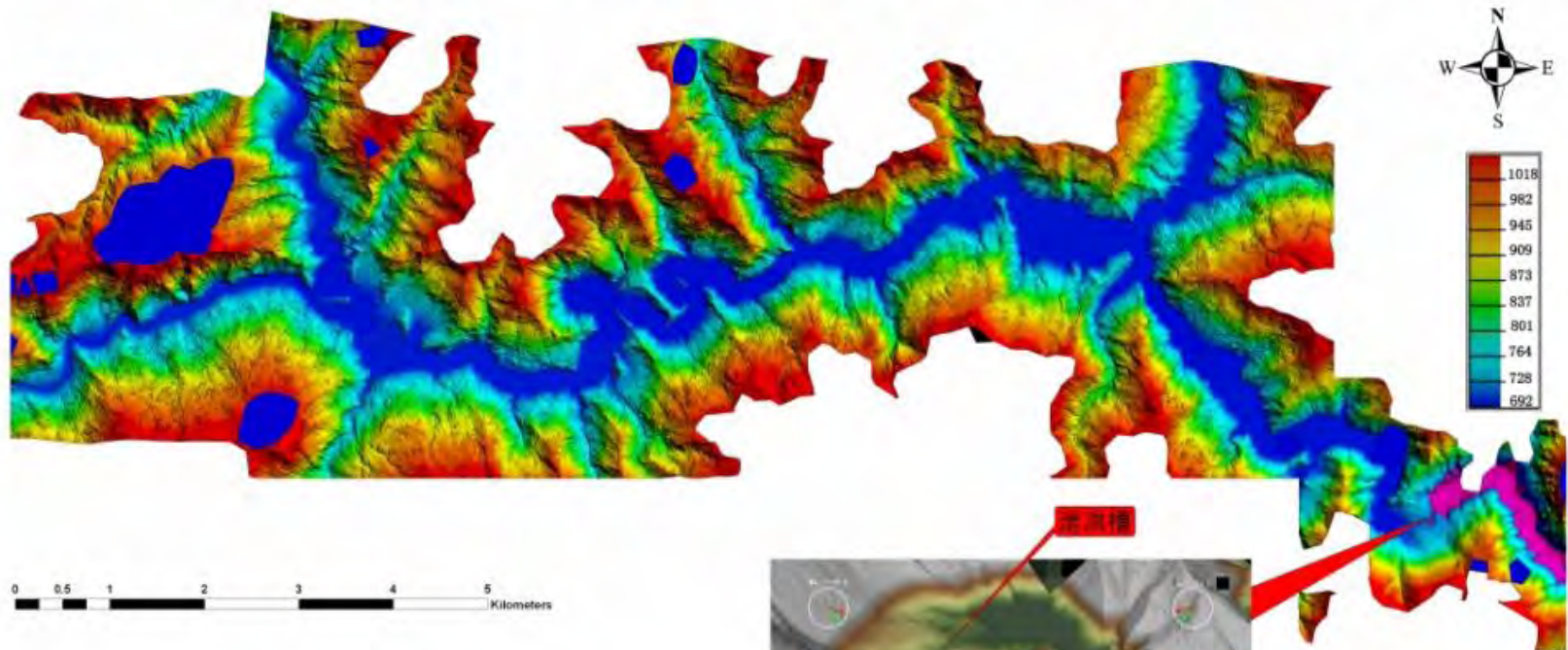
3.2 Secondary disaster monitoring

Tangjiashan Quake Lake before and after earthquake



3.2 Secondary disaster monitoring

汶川地震唐家山堰塞湖三维晕渲地形图 (DEM)



ALS50 II 机载激光雷达

采样间隔: $2\text{m} \times 2\text{m}$

航飞时间: 2008年5月31日

国家测绘局、武汉大学、武大吉奥飞行制作

Tangjiashan Quike Lake

DEM: 2x2m Image: 0.35m



3.2 Secondary disaster monitoring



3D Visualization and measurement for Decision Making by various ministries, like Ministry of Water Resources, Ministry of Transport, Ministry of Civil Affairs, etc.

Tangjiashan Quike Lake

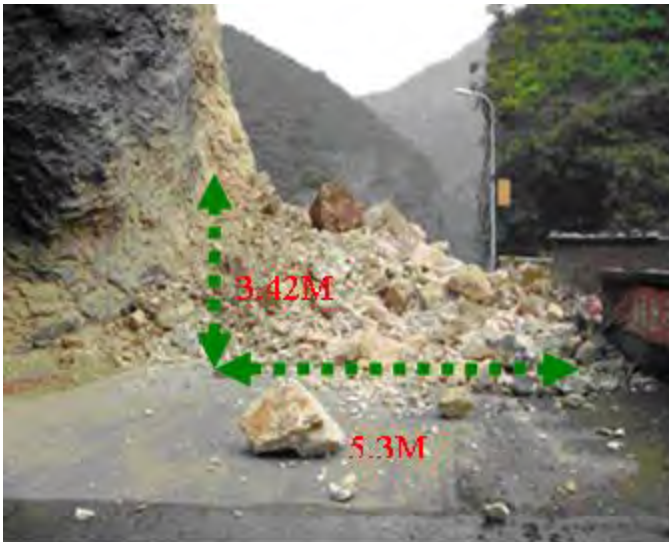
DEM: 2x2m

Image: < 0.5m

LD2000 MMS for Wenchuang Earthquake Investigation

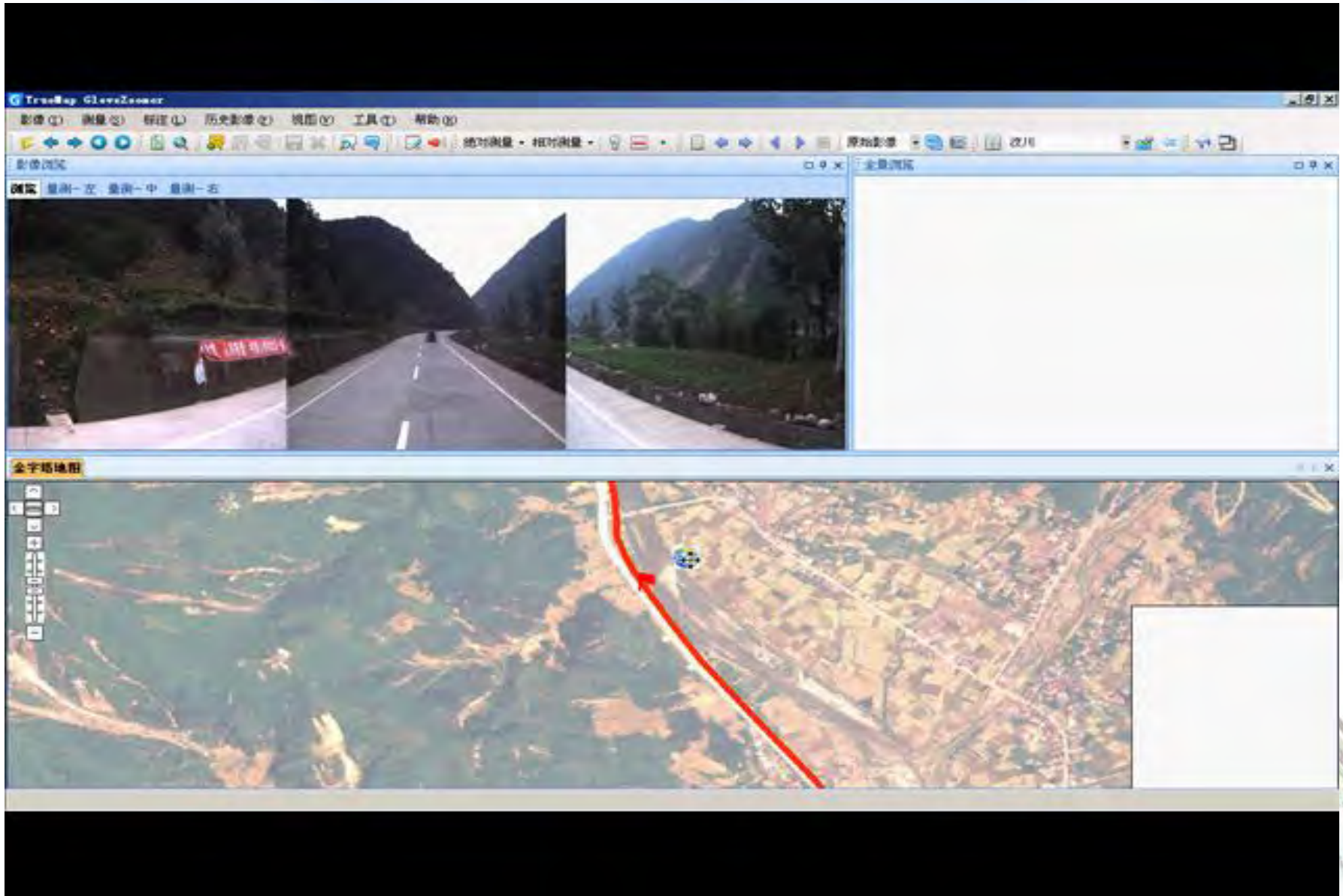
Task 1: Capture street
images in

Disaster area
Task 2: Setup 3D database
for Disaster Management



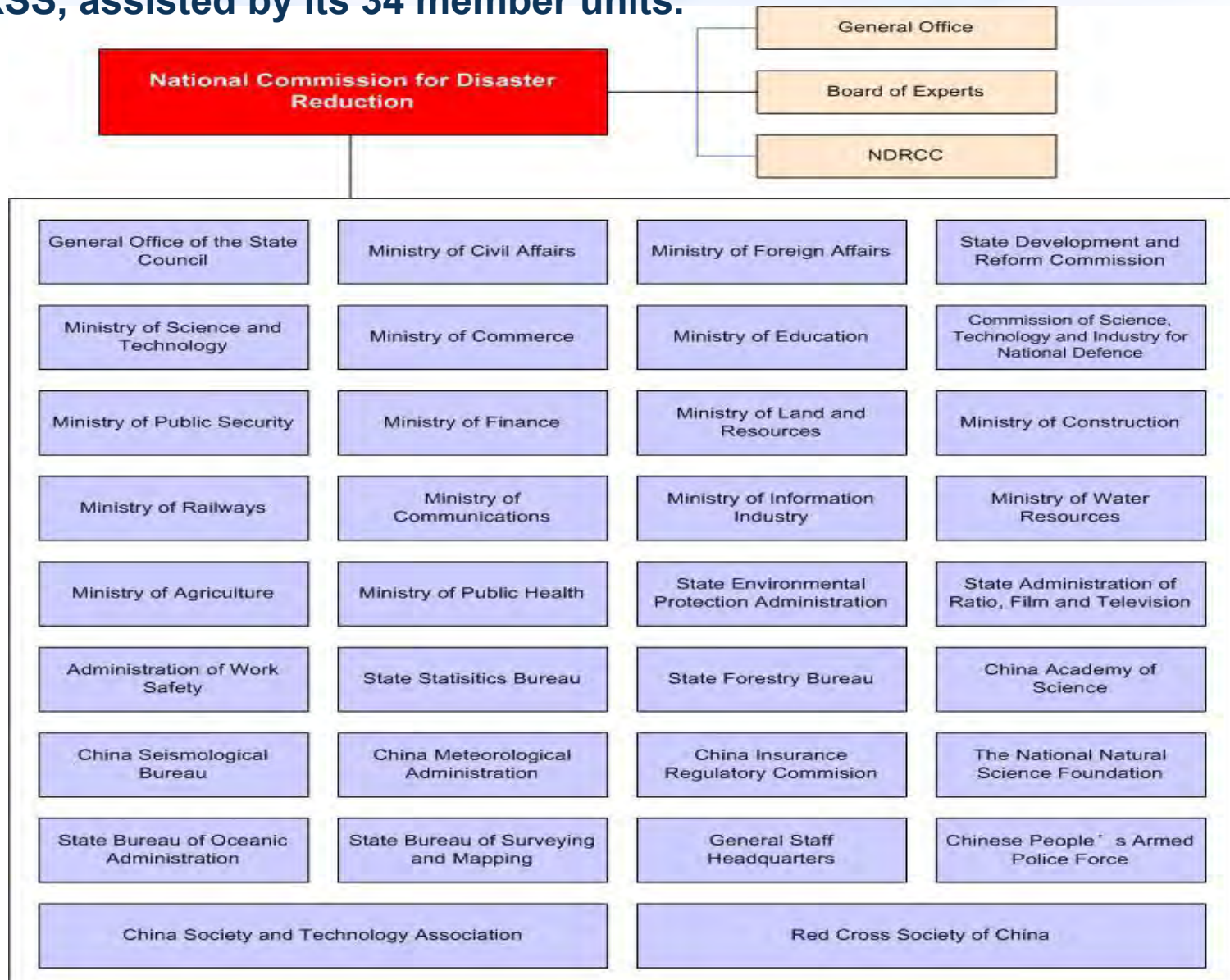
17 towns
in 2
weeks

3D GIS of the Earthquake Area Based on Digital Measurable Images



4 CNDRSS Program Plan

National Commission for Disaster Reduction is in charge of the construction of NDRSS, assisted by its 34 member units.



4 The Road Map of CNDRSS

Step one(2011-2015)


- To cover 10 provinces, 12 ministries and 300,000 disaster messengers
- To invest 1.5 billion RMB



Step two(2015-2020)

- To cover all provinces and all relevant ministries in China and 400,000 disaster messengers
- To invest 2 billion RMB

5. Final Remarks

- **China has in recent 30 years made big progress in earth observation and geospatial science.**
 - **China needs to strengthen the spatial Data infrastructure construction.**
 - **China needs to construct the rapid response system and mechanism in the national level (CNDRSS) and to strengthen the international cooperation in spatial information science and technology.**
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Thank You

