



四川省应急测绘保障体系与应用

Sichuan Emergency Surveying and Mapping
Services System and Practice for Disasters

Quanhong Zheng (郑全红)

Sichuan Geomatics Center , Ministry of Natural Resources

(自然资源部应急测绘技术创新中心)

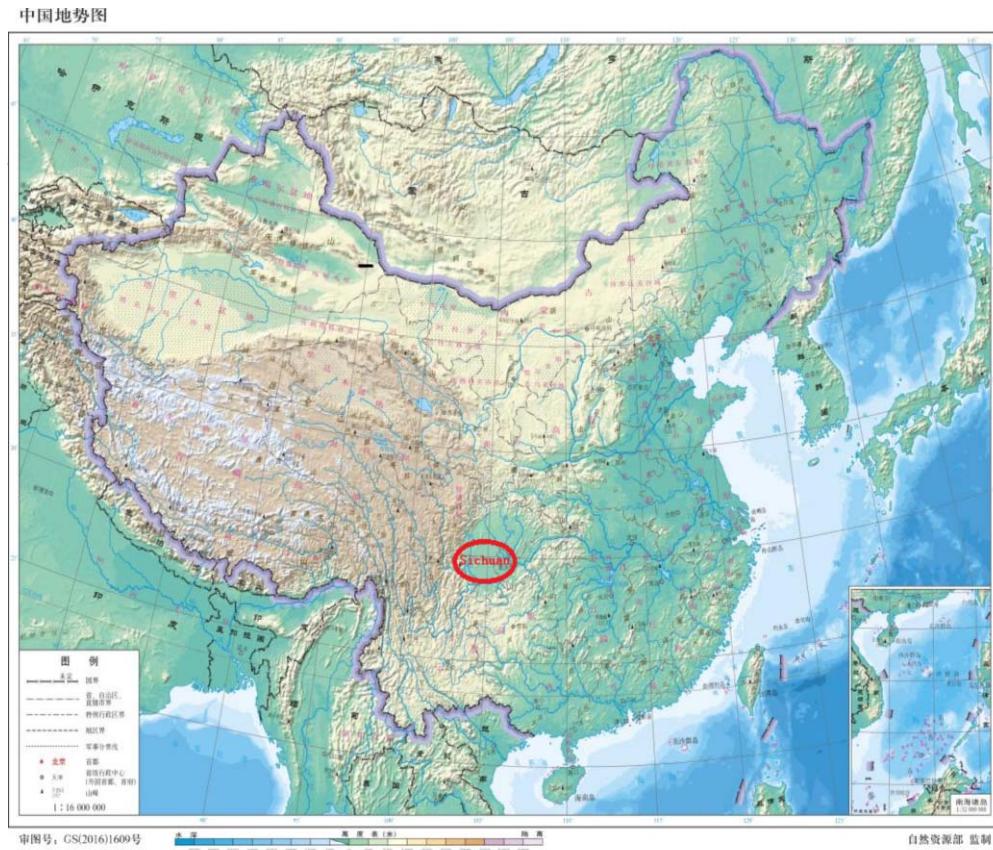
Contents (内容)

- 1. Background Introduction (背景介绍)**
- 2. Emergency Services System (应急保障体系)**
- 3. Practical case (实际案例)**
- 4. Conclusions (结束语)**

1. 1 Topography of Sichuan (四川地形地貌)

Sichuan province is located in the southwest of China which is in the transitional zone between Qinghai-Tibet plateau and the middle and Yangtze River plain with an area of 486,000 square kilometers and a population of more than 90 million.

The topography of Sichuan is complex and varies from east to west. The eastern region are basin and hills where elevations are between 500-2000 meters while the western region are plateaus and mountains where elevations are over 4000 meters.



图片来源：自然资源部官网

四川省位于中国西部，地处青藏高原和长江中下游平原的过渡地带，面积48.6万平方公里，人口9000多万。四川的地形复杂多样，西高东低的特点明显。东部地区是盆地和丘陵，海拔在500 - 2000米之间，而西部地区是高原和山区，海拔超过4000米。

1.2 Severe Disaster Situation in Sichuan (四川抗灾形势严峻)

There are three major earthquake fault zones in Sichuan province which are in a shape of Y. (四川有三大地震断裂带，呈Y字形分布)

Due to its complex topography, Sichuan is deeply suffered from geological disasters such as earthquake, debris flow, slides and etc.

由于复杂的地形地貌，四川深受地震、泥石流，滑坡等多种地质灾害的影响

1.2 Severe Disaster Situation in Sichuan (四川抗灾形势严峻)



In 2008, a mega earthquake happened in Wenchuan county , Sichuan Province, which caused 68,712 people dead and 17,921 people missing. Furthermore, the earthquake triggered tens of thousands of landslides as a consequence of strong rain weather.

2008年四川汶川发生了一次特大地震，造成68,712人死亡，17921人失踪。由于强降雨天气，地震在大面积范围内引发了数以万计的山体滑坡。

1.3 Reflections in Wenchuan earthquake relief (汶川抗震救灾带来的思考)

How geospatial information and services play its important role in fast、orderly and effective disaster response? (如何在灾害应急响应中快速、有序、高效地发挥地理信息应急保障服务的重要作用？)



Contents (内容)

1. Background Introduction (背景介绍)
2. Emergency Services System (应急保障体系)
3. Practical case (实际案例)
4. Conclusions (结束语)

2. UN-GGIM Strategic Framework (UN-GGIM战略框架)

UN-GGIM WG-Disasters developed a Strategic Framework on Geospatial Information and Services for Disasters. Five priorities for action are listed to implement the strategic framework, which are Governance and Policies, Awareness Raising and Capacity Building, Data Management, Common Infrastructure and Resource Mobilization. (UNGGIM地理信息应急保障工作组起草了一份战略框架，并列出五项优先行动计划来推动实施)



- **Priority 1:** Governance and Policies;
- **Priority 2:** Awareness Raising and Capacity Building;
- **Priority 3:** Data Management;
- **Priority 4:** Common Infrastructure and Services; and
- **Priority 5:** Resource Mobilization.



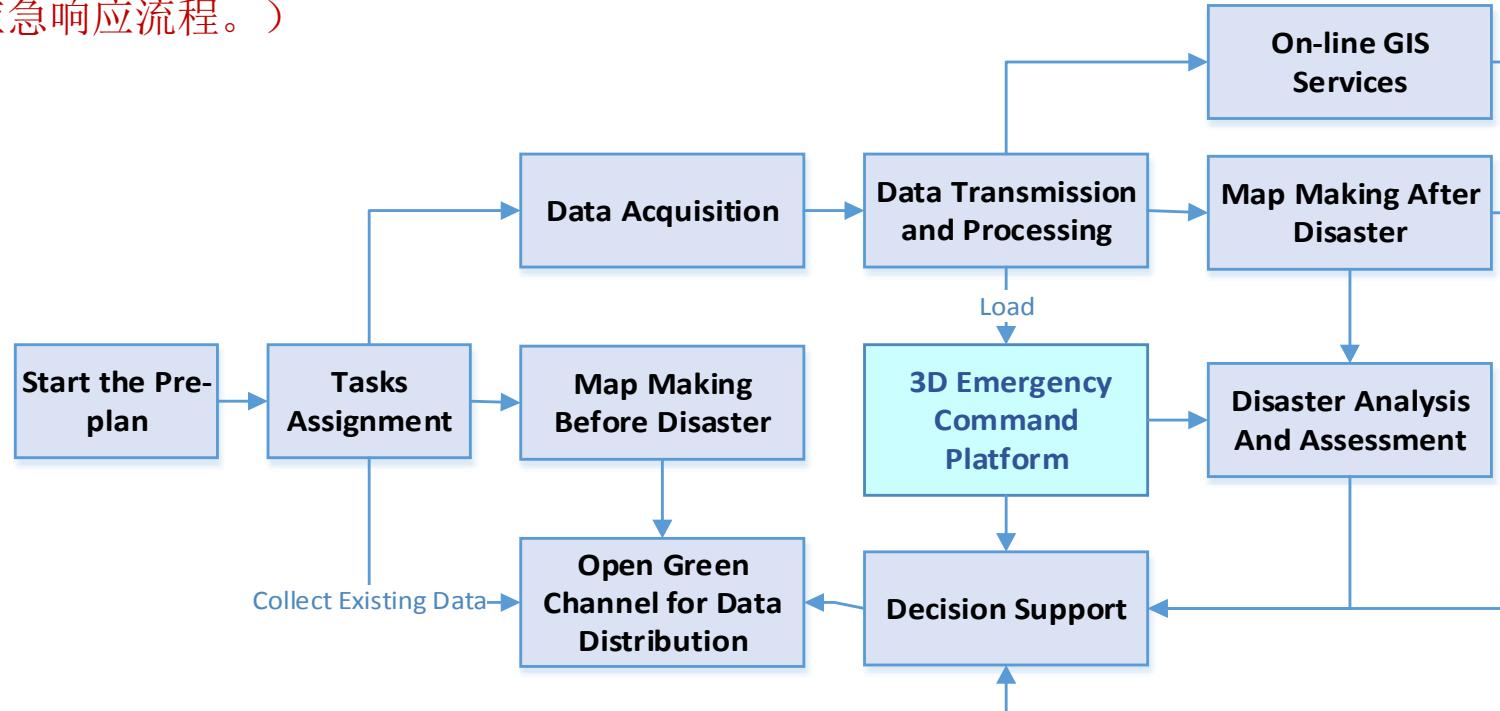
2. Emergency Services System (应急测绘保障体系)

This presentation will explain Sichuan provincial emergency surveying and mapping services system for disasters in align with the UN-GGIM strategic framework from aspects of mechanism construction, capacity building, equipment construction and team building .(报告主要从机制建设、能力建设、装备建设以及队伍建设讲述四川省应急测绘保障体系)

1. Mechanism Construction (机制建设)
2. Capacity Building (能力建设)
3. Equipment Construction (装备建设)
4. Team Building (队伍建设)

2.1.1 Emergency Response Pre-Plan (应急响应预案)

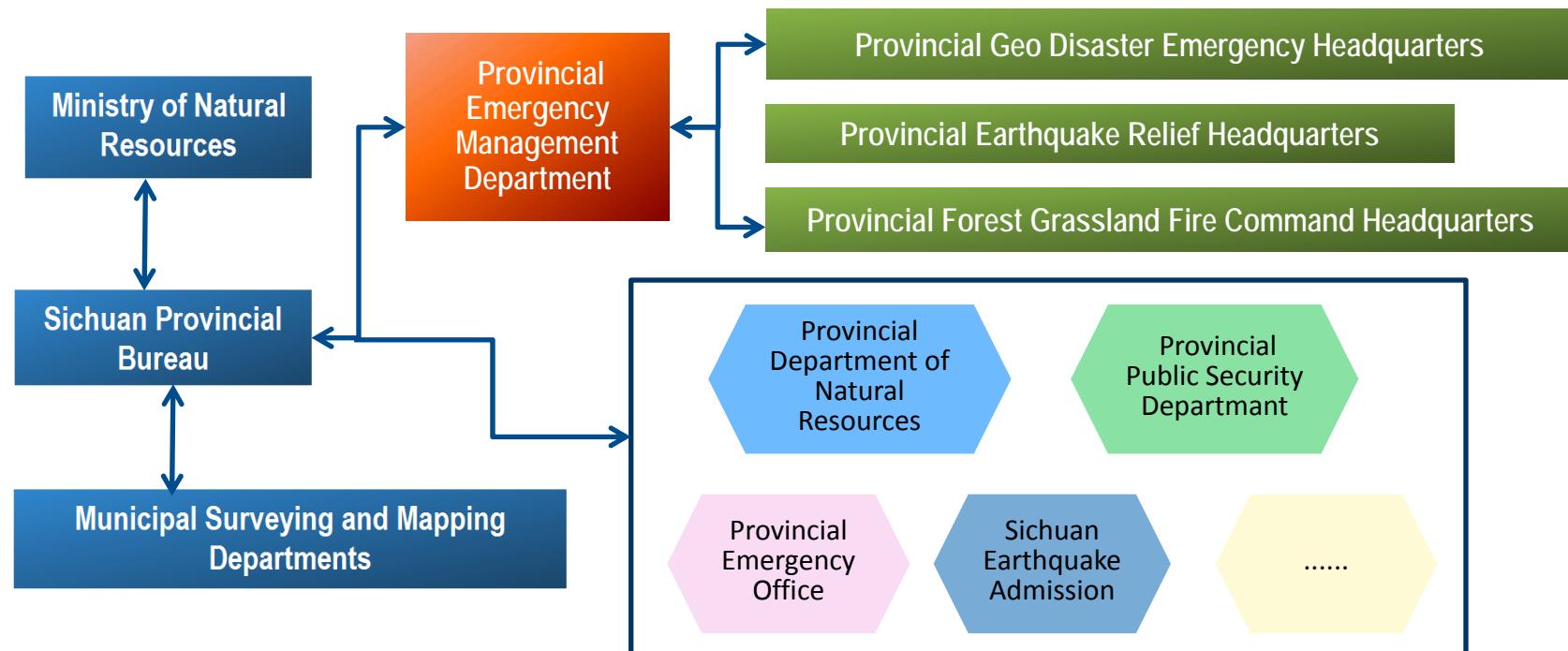
Sichuan Bureau of Surveying, Mapping and Goinformation firstly released a provincial emergency response pre-plan in 2008. The emergency plan has covered the contents of emergency organization, response procedures, coordinated response with national, provincial and municipal authorities, daily emergency drills, and etc. (四川测绘地理信息局于2008年制定了应急测绘预案。预案规定了参与应急响应的机构、各自的职责以及针对不同级别的应急响应流程。)



应急响应流程 : Emergency Response Procedure

2.1.2 Coordinated Emergency Response Mechanism (应急联动响应机制)

Sichuan Bureau has fully integrated into provincial government emergency system. From vertical direction, it is interconnected with Ministry of Natural Resources and local mapping agencies, From horizontal direction, it is interconnected with several emergency command departments under Sichuan Emergency Management Department and other related provincial departments. (四川局全面融入四川省应急保障体系，实现了国家、省到地市州级测绘部门的纵向互联，并与四川省应急管理委员会下多个应急指挥部门及相关厅局的实现横向互联。)



2. Emergency Services System (应急测绘保障体系)

1. Mechanism Construction (机制建设)
2. Capacity Building (能力建设)
3. Equipment Construction (装备建设)
4. Team Building (队伍建设)

2.2 Capacity Building (能力建设)

Capacity building mainly including following contents:

(能力建设主要包括：)

- (1) Emergency data acquisition (应急数据获取能力)**
- (2) Emergency data management (应急数据管理能力)**
- (2) Emergency command and dispatch (应急指挥调度能力)**
- (3) Technology research and development (应急技术研发能力)**

2.2.1 Emergency data acquisition (应急数据获取)

(1) Emergency Safeguard Center for Surveying and Mapping (应急测绘保障中心)

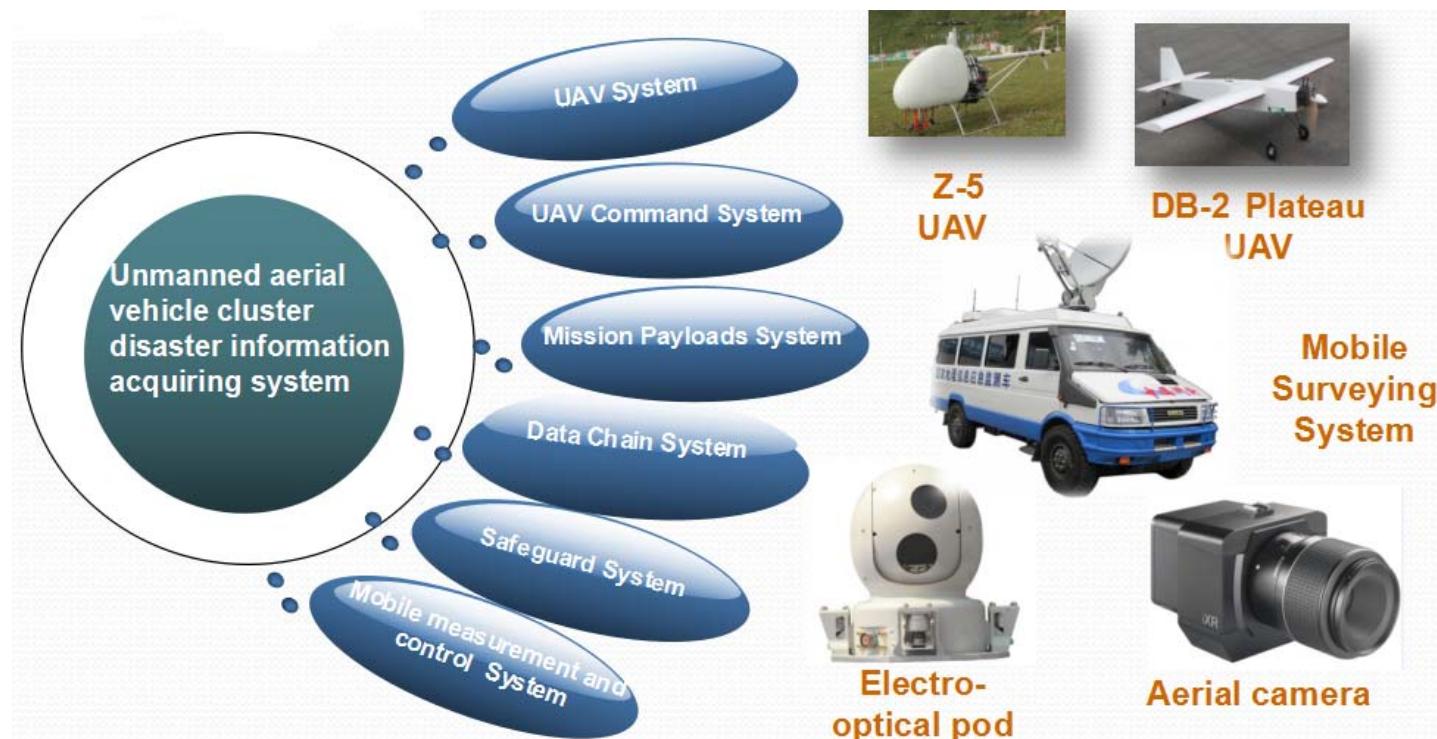
The center mainly responsible for on-site surveying and mapping tasks of the disaster area, including data acquisition , processing and etc. (测绘应急保障中心主要承担灾害和突发事件的现场测绘保障任务)



2.2.1 Emergency data acquisition (应急数据获取)

(2) UAV Cluster Disaster Information Acquiring System (无人机集群灾情信息获取系统)

Making use of multi-UAV cooperative technology, the system integrated UAV Platform with multiple earth observation hardware and software, realizing fast、efficient and accurate geospatial information acquisition under complex condition, especially in extremely cold and high altitude area (系统实现了复杂条件下，特别是极寒高海拔地区地理信息的快速、有效、准确获取)



2.2 Capacity Building (能力建设)

Capacity building mainly including following contents:

(能力建设主要包括：)

- (1) Emergency data acquisition** (应急数据获取能力)
- (2) Emergency data management** (应急数据管理能力)
- (3) Emergency command and dispatch** (应急指挥调度能力)
- (4) Technology research and development** (应急技术研发能力)

2.2.2 Emergency data management (应急数据管理)

(1) Geographic Information Public Service Platform (地理信息公共服务平台)

The provincial geospatial information resources has been greatly enriched during the 12th Five-Year period . Sichuan Geographic Informaton Public Service Platform was created offering authoritative, standard and unified on-line geoinformation services for public.(“十二五”期间极大地丰富了四川省地理空间信息资源,建成了四川地理信息公共服务平台,为公提供权威,标准和统一的在线服务)

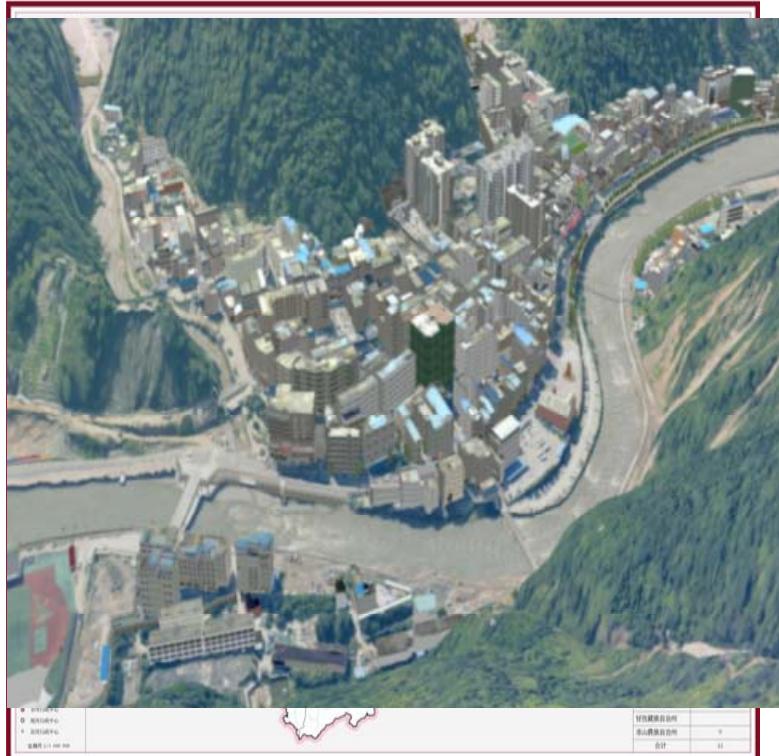


2.2.2 Emergency data management (应急数据管理)

(2) High resolution geodatabase for disaster prevention and control (高精度地灾防治数据库)

According to the needs of geo-disaster prevention and control, Sichuan Bureau firstly built a 1:2000 large scale and high resolution geodatabase. This geodatabase is essential for disaster situation analysis , assessment, and decision making (根据地质灾害防治实际需求, 川局在重大地质灾害隐患区域率先建立了**1:2000**省级地质灾害防治高精度数据库, 这对灾情分析、评估和决策至关重要)

四川省受地质灾害严重威胁的重要场镇(第一批)分布图



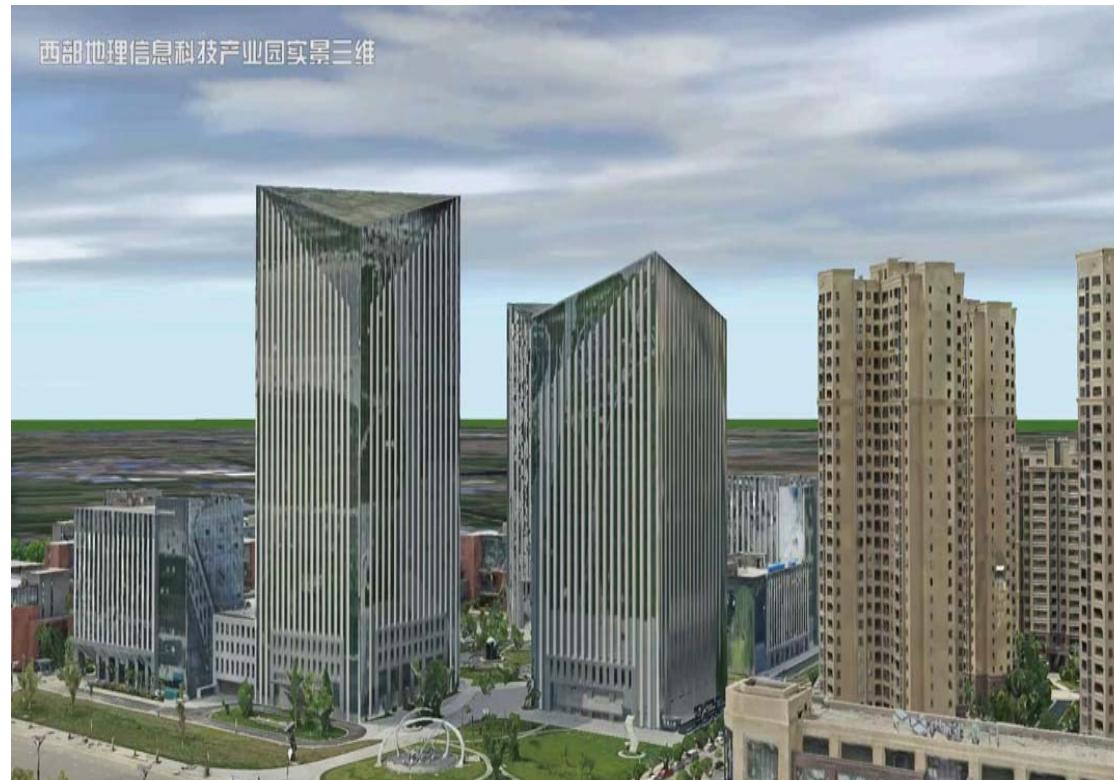
四川省重大地质灾害隐患点(第一批)分布图



2.2.2 Emergency data management (应急数据管理)

(3) Geospatial Big Data Center (地理空间大数据中心)

Sichuan Geospatial Big Data Center is under construction. Its Cloud infrastructure and database management system will offer even powerful support for data storing, processing ,computing and analysis. (四川地理空间大数据中心正在建设中。 云基础架构和数据库管理系统将为数据存储， 处理， 计算和分析提供强大的支持。)



2.2 Capacity Building (能力建设)

Capacity building mainly including following contents:

(能力建设主要包括：)

- (1) Emergency data acquisition** (应急数据获取能力)
- (2) Emergency data management** (应急数据管理能力)
- (3) Emergency command and dispatch** (应急指挥调度能力)
- (4) Technology research and development** (应急技术研发能力)

2.2.3 Emergency command and dispatch (应急指挥调度)

(1) Emergency Command Center for Surveying and Mapping (应急测绘指挥中心)

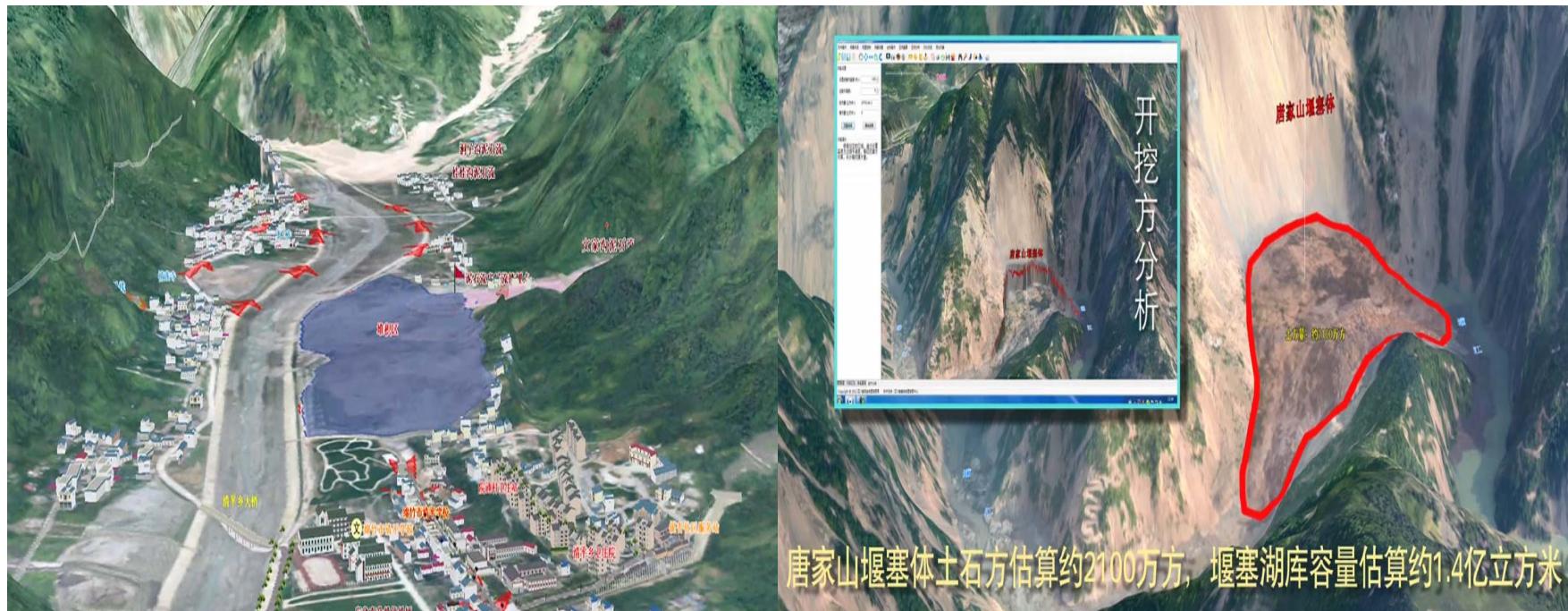
The center was established in 2012. It is equipped with a 3D projection system, a conference system and a 3D platform. The on-site disaster information can be transmitted to the command center and further to national、provincial and other related emergency command departments through satellite or private network.(该中心成立于2012年。它配备了3D投影系统,会议系统和3D平台。现场灾害信息可以通过卫星或专用网络传输到指挥中心, 进一步传输到国家, 省和其他相关的应急指挥部门。)



2.2.3 Emergency command and dispatch (应急指挥调度)

(2) Emergency Surveying and Mapping Command Platform (应急测绘指挥平台)

The 3D platform has integrated with large-scale, high resolution geospatial information data of the whole province. With some powerful spatial analysis tools, it is possible to conduct disaster analysis, disaster assessment, emergency command and reconstruction planning etc for decision maker. (该平台集成了全省大规模，高分辨率的地理空间信息数据，具有分析，评估，规划等功能，支持决策和指挥。)



2.2 Capacity Building (能力建设)

Capacity building mainly including following contents:

(能力建设主要包括：)

- (1) Emergency data acquisition** (应急数据获取能力)
- (2) Emergency data management** (应急数据管理能力)
- (3) Emergency command and dispatch** (应急指挥调度能力)
- (4) Technology research and development** (应急技术研发能力)

2.2.4 Technology Research and Development (技术研发能力)

Technology Innovation Center of Emergency Surveying and Mapping, MNR
(自然资源部应急测绘技术创新中心)

Co organized by:: (共建单位)

Sichuan Bureau of Surveying ,Mapping and Geoinformation (四川测绘地理信息局)

Southwest Jiaotong University (西南交通大学)

Institue of Moutain Hazards and Envirment, CAS (中科院成都山地灾害与环境研究所)

Three mJOR research directions: (三大研究方向)

1. Emergency Surveying & Mapping (应急测绘)
2. Geo Disaster Monitoring and Warning (地质灾害监测与预警)
3. Geospatial information services for disaster. (应急信息服务)



2.2.4 Technology Research and Development (技术研发能力)

The innovation center has jointly conducted scientific research, academic exchange and disaster response work. It has played an important role in many geological disaster response events (工程中心联合开展了科技研究，学术交流和灾害应对等工作，在多次应急响应中发挥了科技支撑作用。)



2. Emergency Services System (应急测绘保障体系)

1. Mechanism Construction (机制建设)
2. Capacity Building (能力建设)
3. Equipment Construction (装备建设)
4. Team Building (队伍建设)

2.3 Equipment Construction (装备建设)

While upgrading the emergency mapping capabilities, Sichuan Bureau have accumulated various of technical equipments covering data acquisition, processing, storage, management and output. (在提升应急测绘保障能力的同时，积累了涵盖数据采集，处理，存储，管理和输出的各种技术装备。)

2.3 Equipment Construction (装备建设)

Data acquisition equipment (数据获取装备)



GPS



RTK



Measuring robot



Ground radar



Geological radar



Total Station



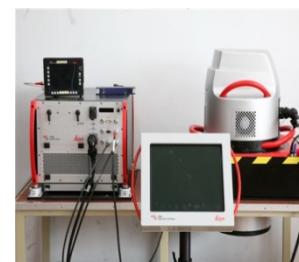
Detector



Level



Tilt aerial camera



Digital aerial camera



Mobile measuring vehicle

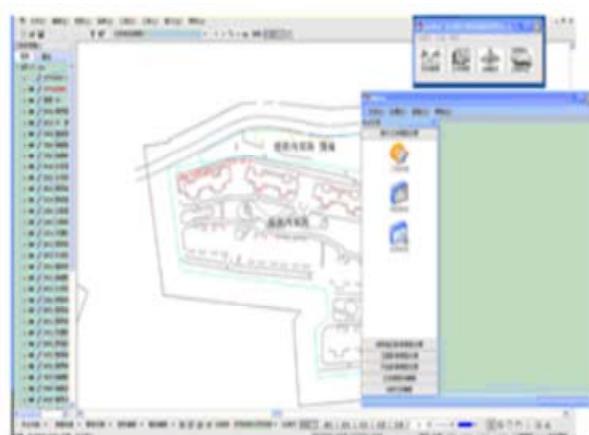


2.3 Equipment Construction (装备建设)

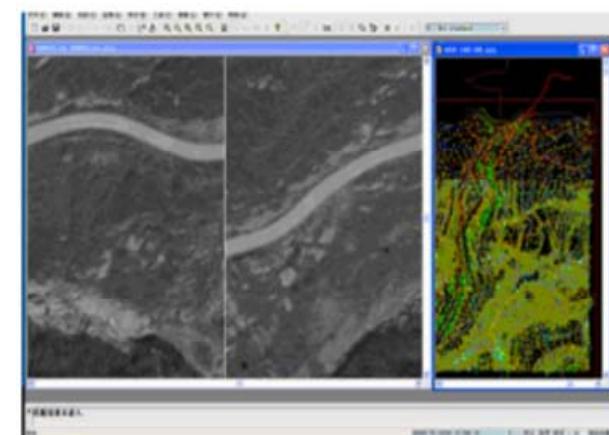
Data collecting and processing system (数据采集与处理系统)



Pixelgrid



Geoway



VirtuoZo



Digital photogrammetry system

StreetFactory

SAR Mapping Station

OneDataPro Editor

.....

2.3 Equipment Construction (装备建设)

Data storage and management system, output device (数据存储，管理与输出设备)



Storage and computing integrated machine



Disk array



Printing and scanning integrated machine



Color printing machine



Quick printer



Direct plate making machine

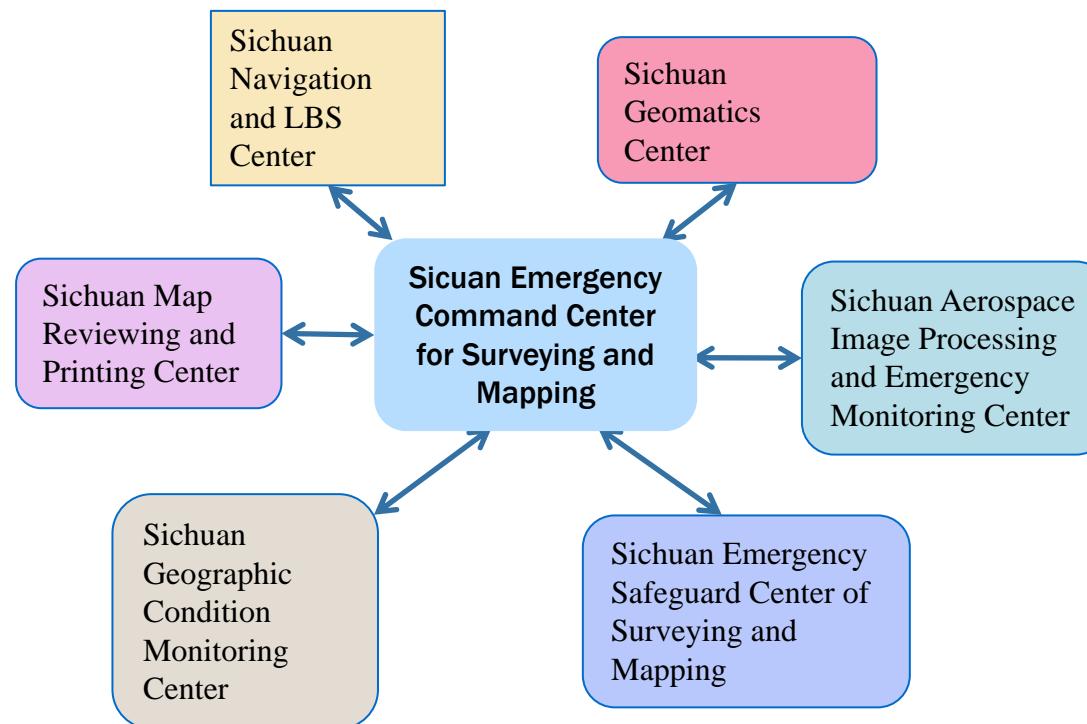
2. Emergency Services System (应急测绘保障体系)

1. Mechanism Construction (机制建设)
2. Capacity Building (能力建设)
3. Equipment Construction (装备建设)
4. Team Building (队伍建设)

2.4 Team Building (应急队伍建设)



Sichuan Bureau has established six professional emergency teams covering navigation and LBS, database construction, aerospace image processing, emergency safeguard, disaster monitoring, map making and printing etc. (四川局组建了六支专业应急测绘保障队伍，涵盖导航与位置服务，数据管理，航空航天影像处理，应急保障，灾情监测，制图与打印等方面。)



2.4 Team Building (应急队伍建设)

In addition, Sichuan Bureau has signed strategic cooperation agreements with other surveying and mapping organizations, universities, research institutes, enterprises and institutions to integrate the advantages of all parties developing the supportive force for emergency surveying and mapping.



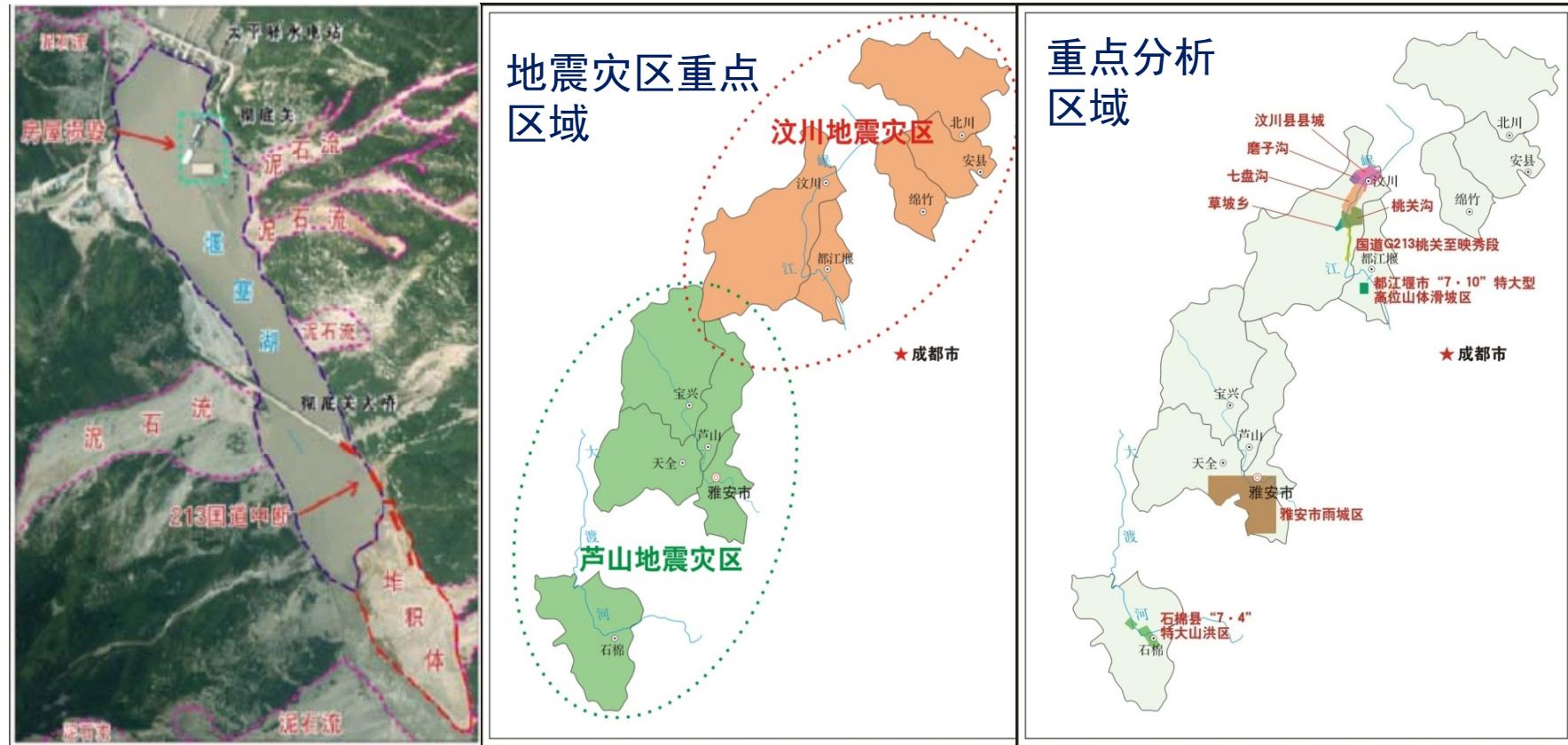
(此外四川局还与省内其他测绘单位、高校、科研院所、企事业单位签订了战略合作协议，整合各方优势，发展四川应急测绘辅助力量)

Contents (内容)

1. Background Introduction (背景介绍)
2. Emergency Services System (应急保障体系)
3. Practical case (实际案例)
4. Conclusions (结束语)

3. Practice Case (实际案例)

The emergency services system has been applied and improved in many emergency response events, such as “4.20” Lushan 7 magnitude earthquake, “6.18” flood, “11.12” Kangding earthquake, “6.24” Maoxian high mountain collapse and “8.8” Jiuzhaigou earthquake etc. 四川省应急测绘保障体系在很多重要地质灾害应急中发挥了重要作用。



3. Practicle Case (实际案例)

At 5:45 on June 24,2017, a high mountain collapse occurred in Maoxian, Sichuan province, causing more than 40 households and more than 100 people buried. The Songjianggou River, was blocked by 2 km. (6月24日5时45分，四川阿坝州茂县叠溪镇新磨村发生高位山体垮塌，造成40余户农房、100余人被掩埋，岷江支流松坪沟河道堵塞2公里)



3. Practicle Case (实际案例)

9:30 Sichuan bureau started the emergency pre-plan and initiated first-level
AM emergency response (启动应急预案1级响应)



3. Practice Case (实际案例)

10:00 AM UAV squad headed out to core disaster area. Meanwhile the professional map making and printing team started to make thematic map and pre-disaster image map . (无人机分队紧急集结完毕 , 立即奔赴核心灾区,后方开始制作应急专题图和灾前影像图)



3. Practice Case (实际案例)

11:00 AM Sichuan surveying and mapping emergency command platform was deployed in provincial government emergency command center and started to offer geo-information support. (省测绘应急指挥平台部署至省政府应急指挥中心)



(图片来源 : 中国网.锦绣天府)

3. Practice Case (实际案例)

11:20 AM Maoxian geo-disaster thematic map and pre-disaster satellite image map have been finished and sent to provincial government and former national bureau. (茂县地质灾害图和灾前卫星影像地图紧急送往省政府应急指挥中心和前国家测绘地理信息局)



3. Practicle Case (实际案例)

5:35 PM Multiple UAVs started to obtain post-disaster high resolution image collaborately (多架无人机协同获取灾后高分影像)



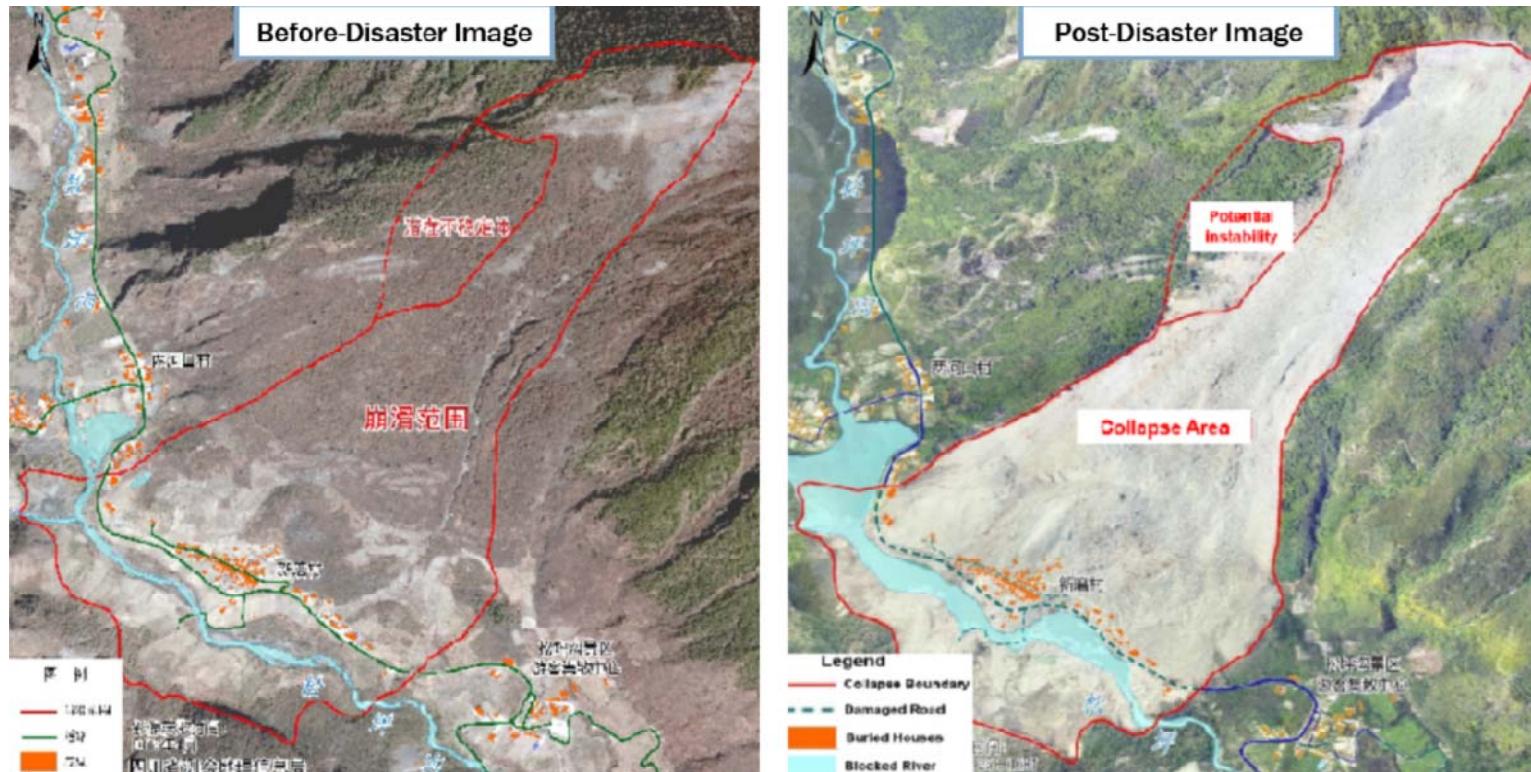
3. Practice Case (实际案例)

8:35 PM The fist batch of Post-disaster images were sent to provincial government emergency command center. (首批灾后高分影像资料送往省政府应急指挥中心)



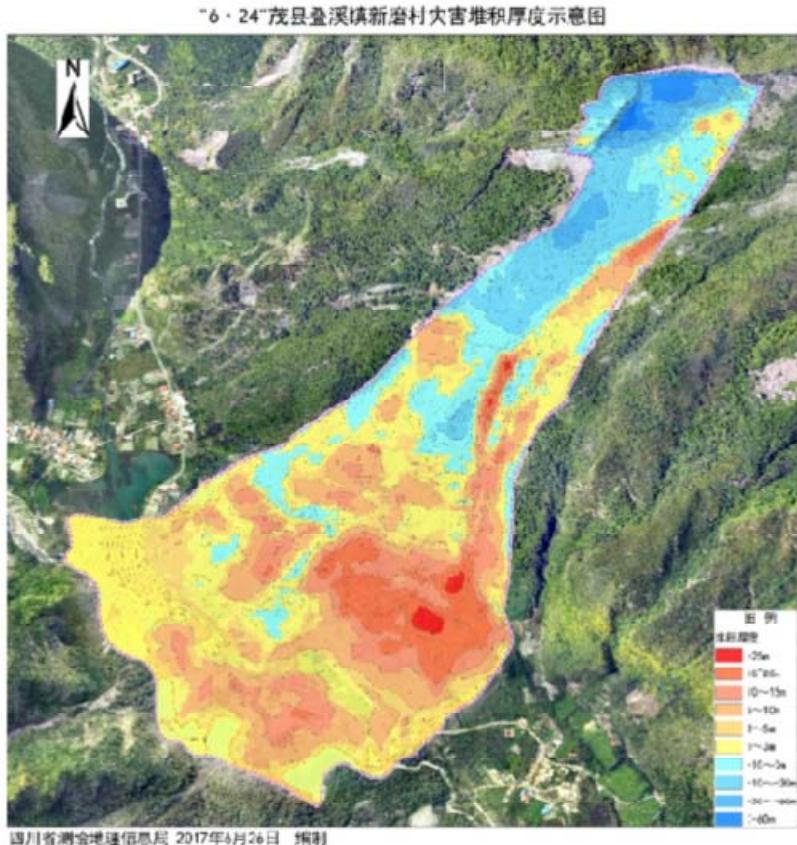
3. Practice Case (实际案例)

Experts of Engineering Technology Research Center studied and analyzed the situation of disaster area by comparing pre and post disaster images. (省局会同中科院山地所的专家，根据6月25日16时获取的影像数据，对比灾前影像，对灾害及周边区域进行了对比分析。)



3. Practicle Case (实际案例)

Experts conducted research on the potential instability of the collapsed bodies, made recommendations, and prepared a disaster assessment report. (专家们对崩塌体潜在的不稳定性进行会商研究、提出建议，并编写灾情评估报告)



3. Practicle Case (实际案例)

Maoxian high mountain collapse response is just a typical application case of the Strategic Framework. From this case , we can see how the Strategic Framework make its function in terms of mechanism, capacity, equipment and team. (茂县山体崩塌应急响应只是应急测绘保障系统的典型应用案例。从这个案例中，我们可以看到战略框架如何在机制，能力，设备和团队方面发挥作用。)



Contents (内容)

1. Background Introduction (背景介绍)
2. Emergency Services System (应急保障体系)
3. Practical case (实际案例)
4. Conclusions (结束语)

4. Conclusions (结束语)

Sichuan provincial emergency services system on geospatial information and services for disasters is aiming to establish a emergency support system with characteristics of “sky-earth-ground” integrated, flexible and connectived” (四川省应急测绘保障体系旨在实现“天-空-地一体化，机动灵活，互联互通）



4. Conclusion (结束语)

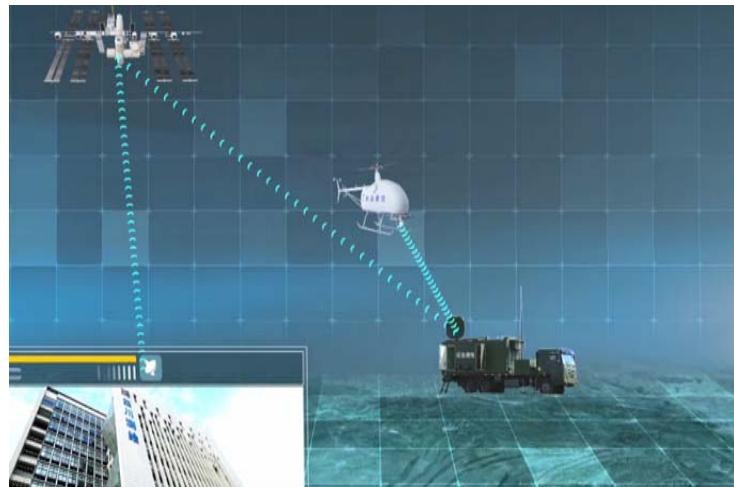
All-weather emergency monitoring
(全天候应急监测)



Automated fast mapping
(自动快速出图)



Real-time information transmission
(实时信息传输)



Efficient command decision
(高效指挥决策)



4. Conclusions (结束语)

Challenges we are facing: (面临的挑战)

1. “**Where are these disasters ?**” Most potential geological disasters are in high location and covered by trees. It is difficult to identify or find in advance by traditional manual investigation methods. (挑战1：不知道灾害在哪里。大多数地质灾害都在高位且被植被覆盖。传统的人工调查方法很难预先识别。)
2. “**When will they happen?**” Large quantities of potential geological disasters are widely distributed, it is hard to monitor (挑战2：不知道灾害什么时候发生。地质灾害点多面广,难以监测)
3. Intelligent technology for disarster assessment and **reliable warning** need to be improved.(智能化灾情评估和可靠预警技术有待提高)

4. Conclusions (结束语)

Key technology of Pe-disaster prevention should be taken into account.

- ◆ Establish a multi-source observation system based on spaceborne, aerospace and ground platforms. (建立“天-空-地”一体化多源观测系统)
- ◆ Conduct key technology research on early recognition and monitoring of potential geological disasters using InSAR, Lidar, Satellite and UAV remote sensing technology.
(综合利用InSAR, 激光雷达, 卫星和无人机遥感技术, 开展地质灾害早期识别和监测关键技术研究)
- ◆ Conduct key technology research on secondary disaster assessment and early warning.
(开展次生灾害预警关键技术研究)

4. Conclusions (结束语)

Disaster prevention and mitigation is an eternal topic for mankind. We welcome common cooperation from all over the world working on disaster risk deduction. (防灾减灾是人类永恒的话题。 我们希望和世界各地同行共同合作，致力于减少灾害风险)。



4. Conclusions (结束语)

Last but not least, Sichuan is a beautiful place which has rich tourist resources and 5 are listed in the UNESCO world heritage list.



Thank you for your kind attention

谢谢聆听！