UN GEONOW 2024
首届联合国地信周

地理信息应用于中国地质灾害防治进展与思考

Progress and Initiative of Geospatial information for Geo-hazards Prevention in China

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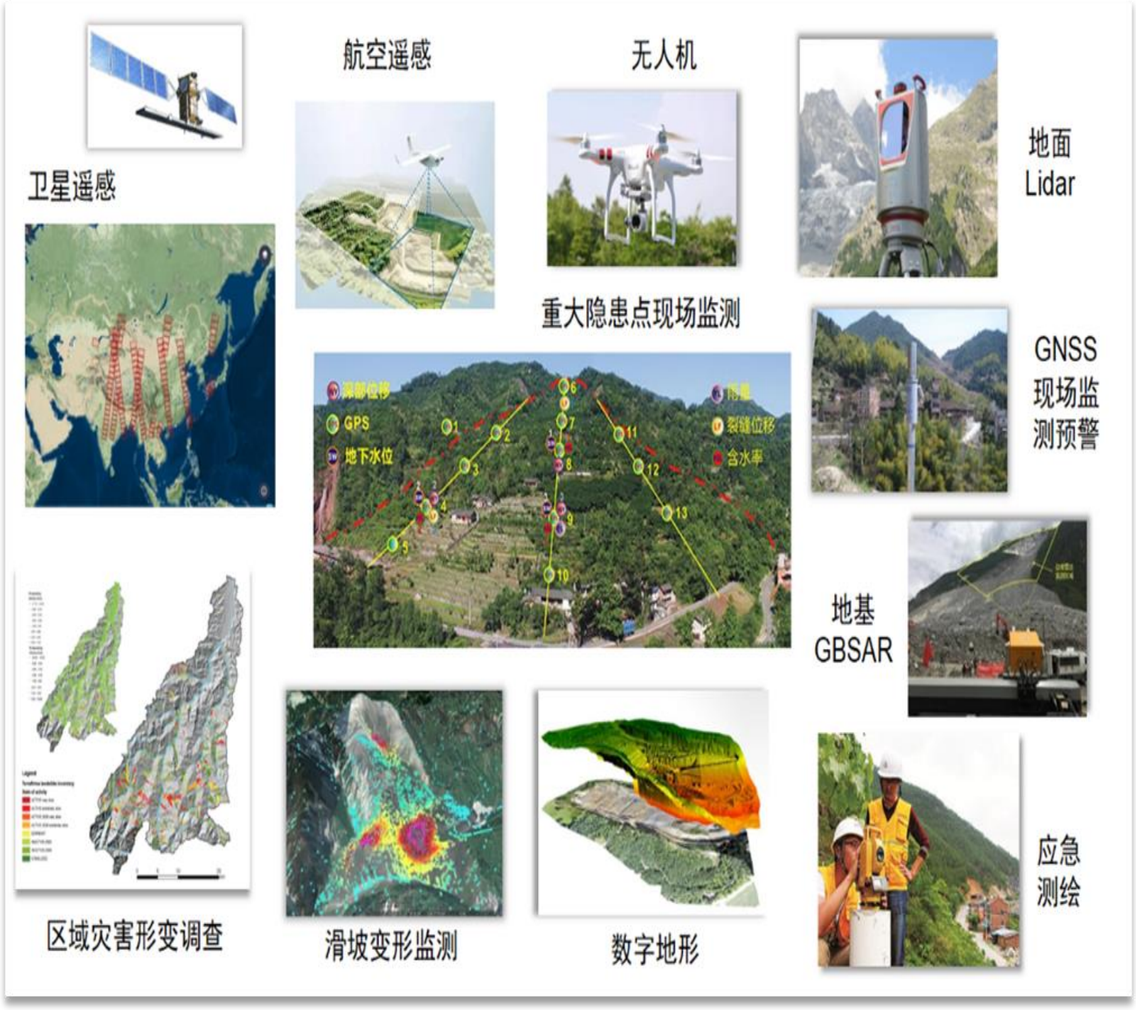
前言 Forward



- ◆ “地理空间智慧造福世界”，支撑地理空间信息发展的“空天地深”多类型、多平台的感知体系和“感-传-智-用”等关键环节的科技创新是防灾减灾科技进步的关键动力。
- ☐ "Geospatial ideas benefiting our world", and the scientific and technological innovation of the "air, space, ground, and underground" multi-type and multi-platform perception system and the key steps of "sensing-transmission-AI--App" that support the development of geospatial information are the key driving forces for the scientific and technological progress of risk mitigation.
- ◆ RS、GNSS、GIS和AI等技术快速发展和应用场景的不断拓展，有力提升了地质灾害隐患识别，调查评价，监测预警的精准性，时效性，为构建具有特色的地质灾害防治体系提供了关键支撑。
- ☐ The rapid development of RS, GNSS, GIS and AI modeling technologies and the continuous expansion of application scenarios have effectively improved the accuracy and timeliness of geohazard identification, investigation and risk mapping, monitoring and early warning，which provided key for the construction of geohazards prevention technology system with Chinese characteristics.
- ◆ 地理信息智慧为实现“数据、工具、应用人人可享”，在气候变化背景下减轻灾害风险提供了多样化解决方案。
- ☐ Geospatial ideas provides diversified solutions for the dream of Data, tools and APPs for everyone to risk mitigation in the context of climate change.

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一、基本情况 Introduction

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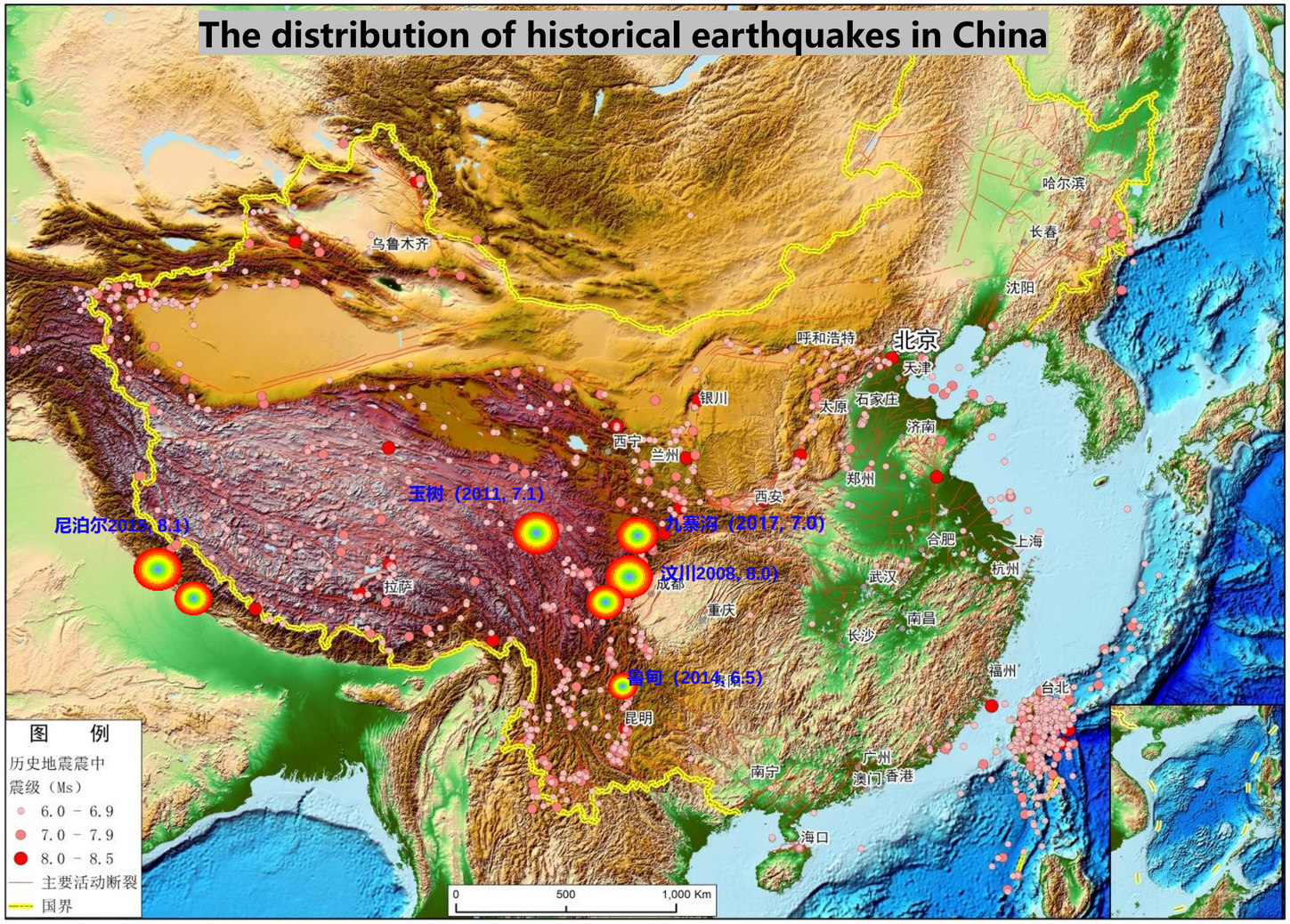
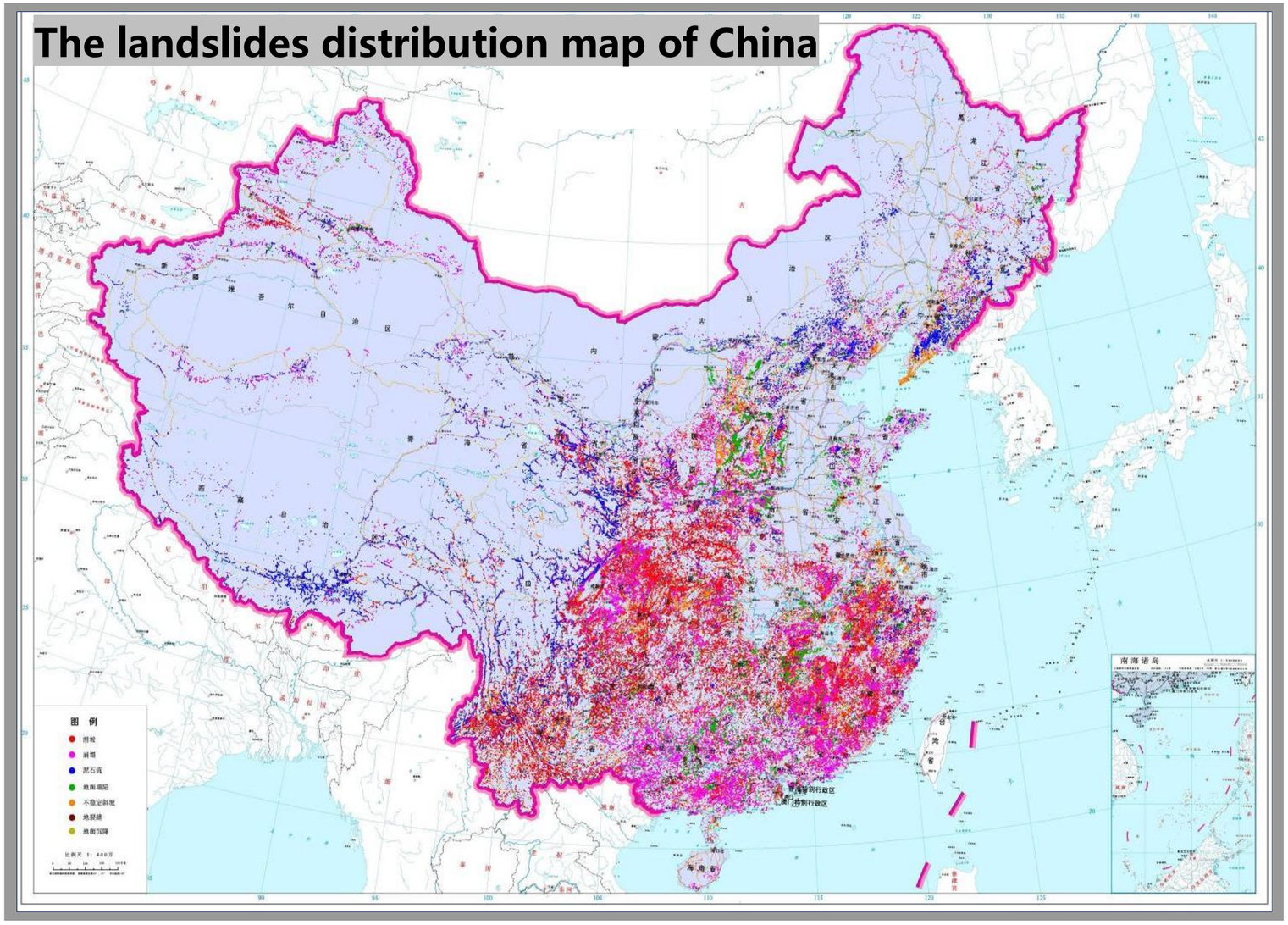
1.1中国地质灾害基本特征 The current condition of landslides in China



- ◆ 1.1.1 我国地形地貌、地质条件、气候类型复杂多样，构造与地震活动强烈，加上气候变化和人类工程活动影响，地质灾害易发、多发、频发，是世界上地质灾害最严重的国家之一。
- ☐ Due to the topography, geological conditions, and climate types are complex and diverse, with strong tectonic and seismic activities, coupled with the influence of climate change and human engineering activities, geo-hazard are prone to occur, frequent， China is one of the most susceptible countries to landslides worldwide.
- ◆ 降雨（80%）、人类工程活动和地震、构造运动等地质灾害的主要诱发因素。
- ☐ Intensive precipitation, improper humen activities, seismic activities/fault movements are the major triggering factors of landslides in China.

基本情况 Introduction

1.1.2 地质灾害**隐患点**多面广、危害大、风险高，且受气候变化和人类工程活动影响，地质灾害风险动态变化快，防范难度大。High risk and dynamic change



◆截至2023年底，全国共登记在册地质灾害隐患点274613处，潜在威胁1194万人和6572亿元财产安全，我国地质灾害类型以崩塌、滑坡、泥石流为主，三者占地质灾害总数的96. 8%。

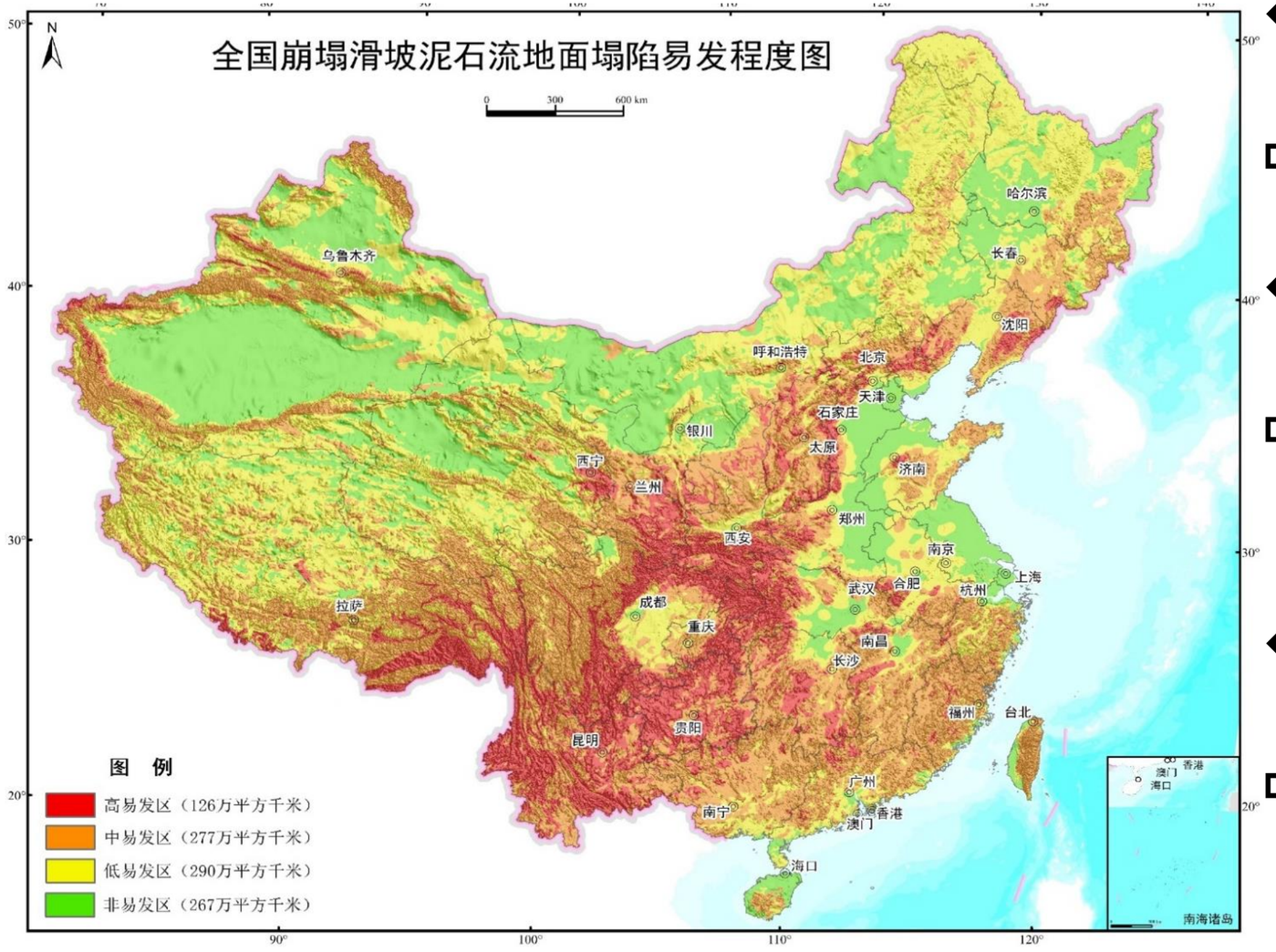
□ By the end of 2023, approximate 275 thousand of landslides have been identified and recorded, which threat 11.94 million of people.

◆ 受调查手段和精度制约，尚有大量地质灾害隐患点没有被发现，且气候变化引起的极端强降雨，地震诱发地质灾害风险难以有效判定，大量高风险区域没有得到有效管控。

□ Due to the limitation of landslide survey methods and precision requirement , a large number of landslides still not inventoried The risk assessment is insufficient, and a large number of high-risk slopes and valleys have not been under control.

基本情况 Introduction

1.1.3 地质灾害易发区面积大，占国土面积72%，发生时间主要集中在讯期占94%，以崩塌滑坡泥石流灾害，为主具有突发性、隐蔽性、破坏性和动态变化强的特征。Major in raining season



- ◆ **地质灾害易发区面积：总面积693万平方千米，占全国面积的72%。，其中高易发区面积128万平方千米，中易发区面积约277万平方公米。**
- ☐ Area prone to geohazards: The total area is 6.93 million km^2, accounting for 72% of the national area. the high-prone area is 1.28 million km^2, the medium-prone area is about 2.77 million km^2
- ◆ **空间分布情况：主要分布在川东渝南山地、鄂西湘西山地、青藏高原东缘、云贵高原、秦巴山地、黄土高原等高山峡谷地区**
- ☐ Spatial distribution: It is mainly distributed in the mountains and valleys of eastern Sichuan and southern Chongqing, western Hubei and western Hunan mountains, the eastern edge of the Qinghai-Tibet Plateau, the Yunnan-Guizhou Plateau, the Qinba Mountains, the Loess Plateau and other alpine valleys
- ◆ **时间分布情况：发生季节性特征十分明显，地质灾害主要集中在每年汛期（5月-9月），占总数的94.07%，主汛期（6月-8月），占总数的81.5%。**
- ☐ Temporal distribution: The seasonal characteristics are very obvious, the geological disasters are mainly concentrated in the flood season (May to September), accounting for 94.07% of the total of the year, and the main flood season (June to August), the number of occurrences accounts for 81.5% of the total of the year.

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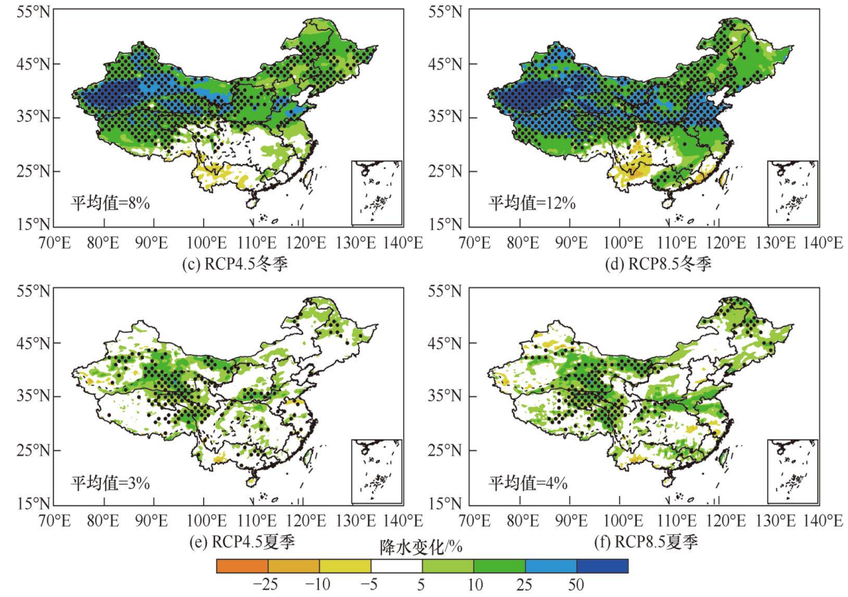
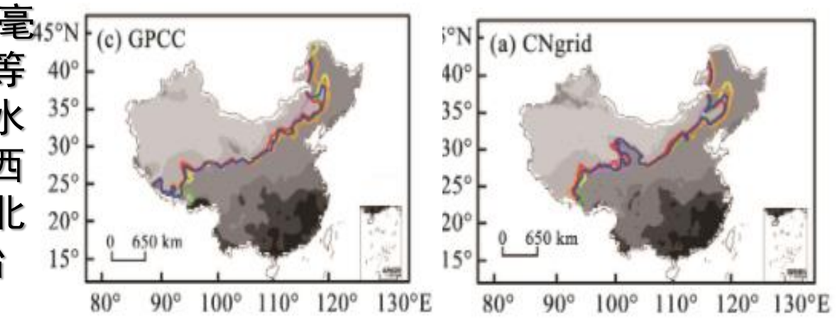
1.2 气候变化引起的降雨量增多，升温、海平面上升和极端气候事件趋多，导致地质灾害风险呈快速变化。climate change induced geohazard Risk change rapidly

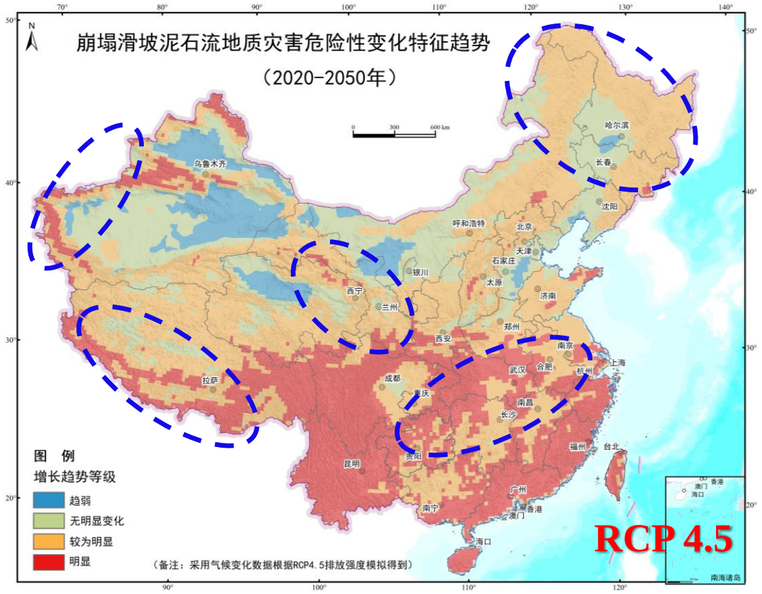
- 全国降水总量增加，改变地质环境条件，导致地质灾害中、低易发区和非重点防治区的地质灾害易发性增强，全国地质灾害高、中易发区面积增大。
- 极端强降雨趋频、趋强，可能导致区域性、群发性、突发性特大型地质灾害发生概率进一步升高。

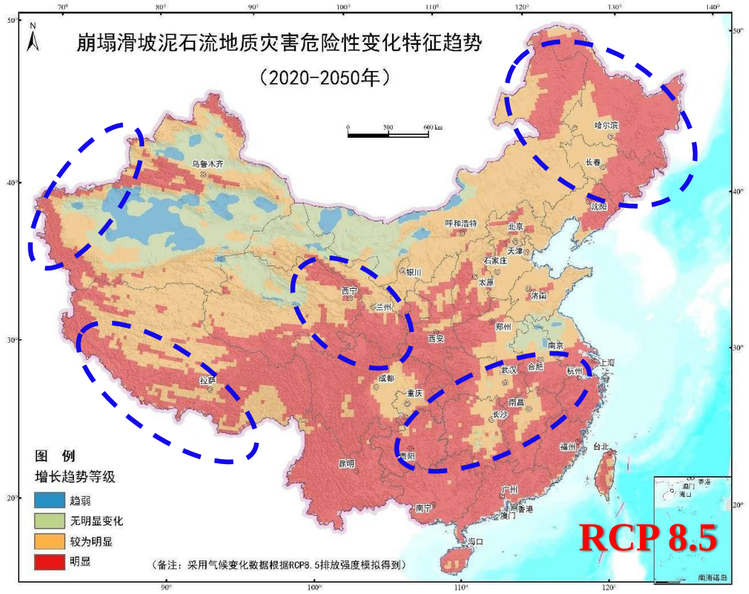
本世纪中期降水变化



400毫米等降水线西移北抬

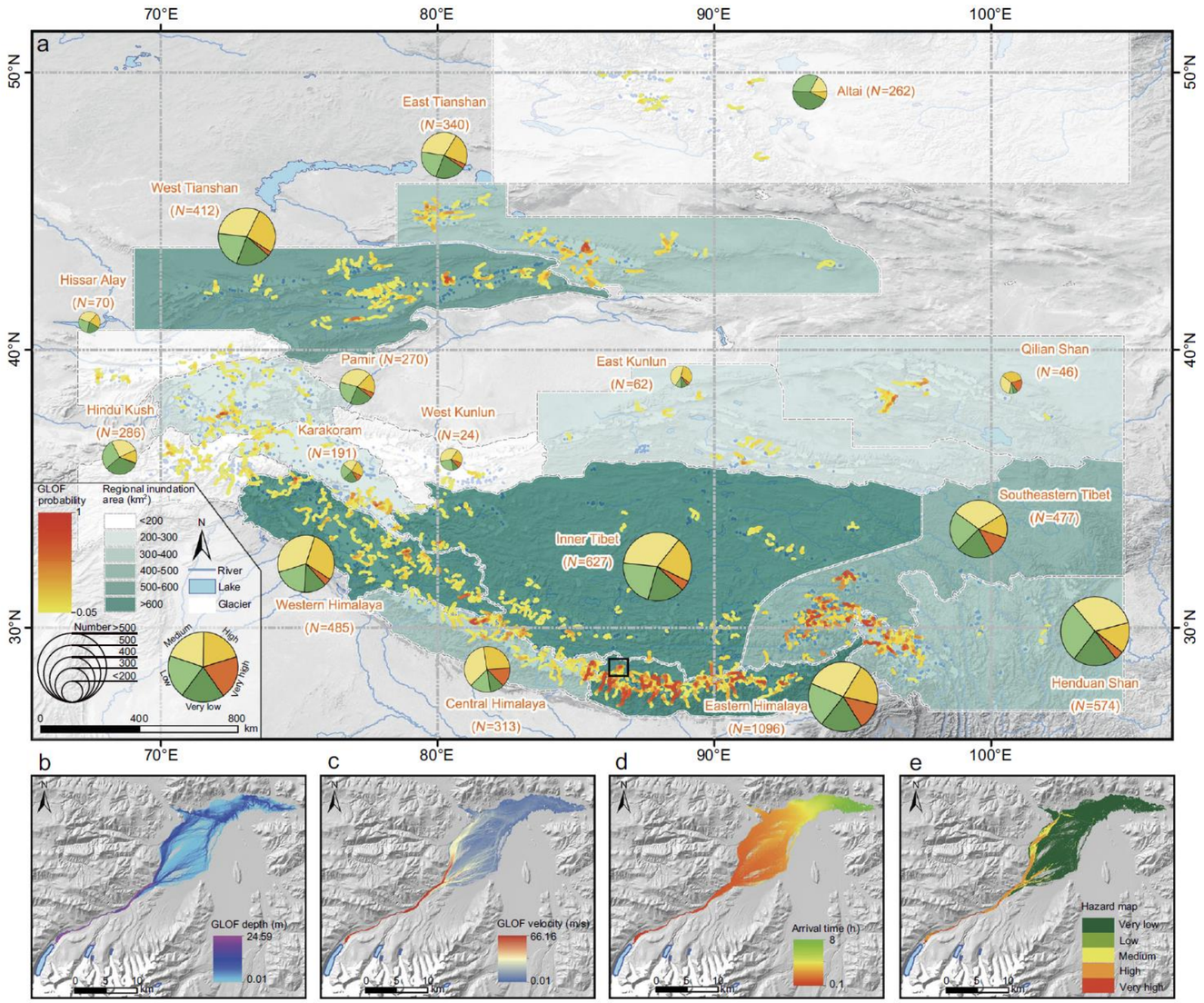






- **The increase of the total precipitation has changed the geological environment conditions, resulting in the enhancement of the susceptibility of geohazards in the medium and low geohazards prone areas and non-key pareas, and the increase in the area of high and medium geohazards prone areas in the country.**
- **Extremely heavy rainfall tends to be more frequent and stronger, which may lead to a further increase in the probability of regional, massive, and sudden mega-geological disasters**

基本情况 Introduction



GLOFs susceptibility and simulation in the Third Pole

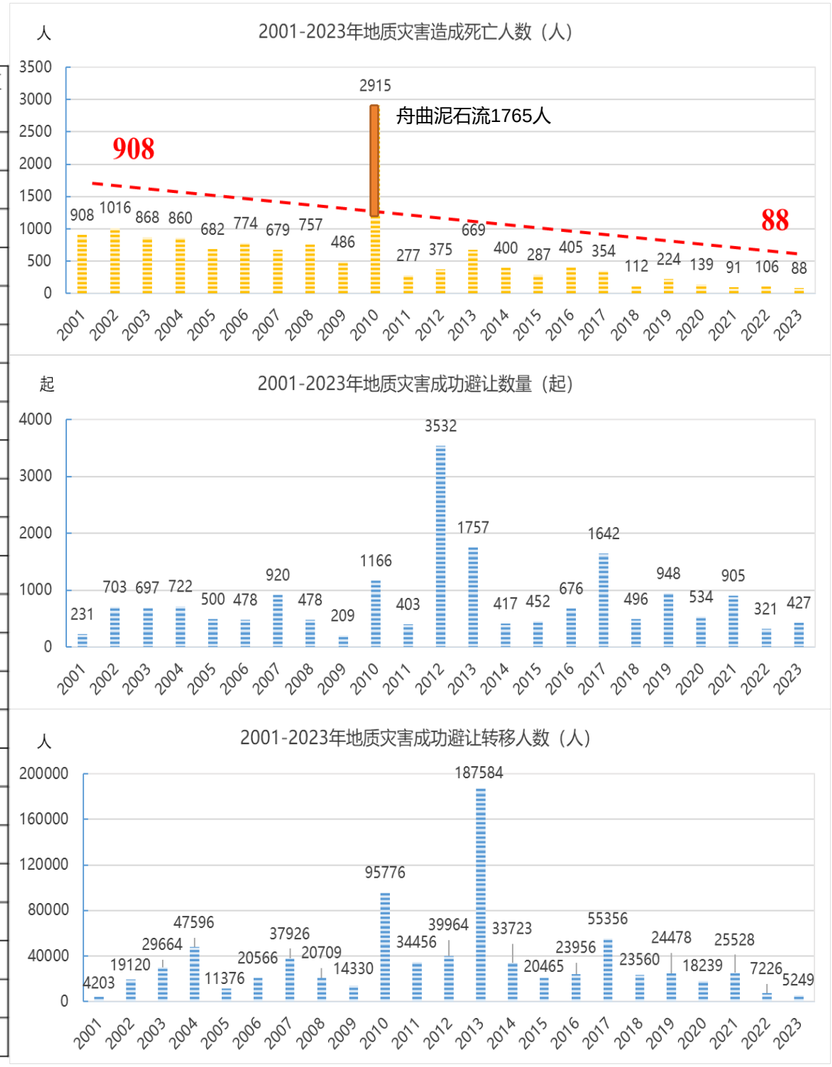
- ◆ 升温导致青藏高原冰崩、岩崩、冰川跃动和冰湖溃决发生频率和强度呈显著上升趋势；
- ◆ The frequency and intensity of ice avalanches, rock avalanches, glacier upsurges and glacial lake outbursts on the Tibetan Plateau increased significantly.
- ◆ 岩体崩滑形成碎屑流堵江与洪水溃决等重大链式灾害和级联风险增加
- ◆ The risk of major chain disasters and cascade disasters such as the formation of debris flow and flood outburst by rock mass collapse increases
- ◆ 冻土面积萎缩，热融湖塘增多，地面沉陷和斜坡地段热溶滑塌风险加剧。
- ◻ The area of permafrost has shrunk, the number of hot-thaw lakes and ponds has increased, and the risk of land subsidence and thermal melt landslide in slope areas has intensified.

基本情况 Introduction

1.3 在各地区、各部门的共同努力下，地质灾害防治成效显著，年因灾死亡人数明显下降，成功避险成效明显，地质灾害综合治理和避险搬迁取得重要进展。Major Progress

2001-2023年地质灾害灾情及成功避让

年份（年）	死亡人数（人）	成功避让灾害数量（起）	成功避让转移人数（人）
2001	908	231	4203
2002	1016	703	19120
2003	868	697	29664
2004	860	722	47596
2005	682	500	11376
2006	774	478	20566
2007	679	920	37926
2008	757	478	20709
2009	486	209	14330
2010	2915	1166	95776
2011	277	403	34456
2012	375	3532	39964
2013	669	1757	187584
2014	400	417	33723
2015	287	452	20465
2016	405	676	23956
2017	354	1642	55356
2018	112	496	23560
2019	224	948	24478
2020	139	534	18239
2021	91	905	25528
2022	106	321	7226
2023	88	427	5249
合计	13472	18614	801050



- ◆ 地质灾害造成的死亡失踪人数由“十二五”的2008人降低到“十三五”（2016-2020年）的1234人，降低39%；2021-2023年共274人。
- ☐ The number of deaths and missing persons caused by geohazards decreased from 2,008 during the 12th 5-year-plan period to 1,234 during the 13th 5-year-plan period (2016-2020) , with a reduction rate of 39%. A total deaths is 274 in 2021-2023
- ☐ “十三五”因灾直接经济损失160亿元，较“十二五”期间减少41%。“十三五”全国共实现地质灾害成功避险4296起，涉及可能伤亡人员14.6万人，避免直接经济损失达50亿元
- ☐ The direct economic loss due to geohazard during the 13th 5-year-plan period amounted to 16 billion yuan, a decrease of 41% compared to the 12th 5-year-plan period.

基本情况 Introduction

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1.3.2 地质灾害综合防治体系建设和基于地理空间信息的防治技术支撑体系更加完善，基本建成了世界规模最大的地质监测预警体系和实施了最大规模的搬迁避让和工程治理。Progress and achievement

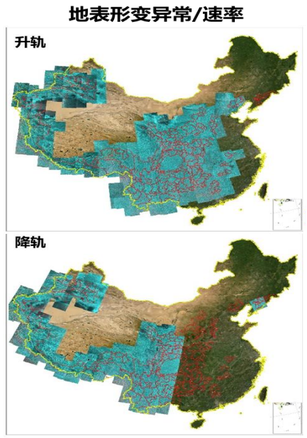
调查评价。完成2117县1:5万地质灾害风险调查，713个县隐患识别，2137个重点集镇1:1万精细调查，4万余处隐患勘查。

监测预警。26.7万群测群防员队伍；开展1.8万余处简易监测、5千余处专业监测、6.5万余处普适型监测；实现1个国家级、30个省（区、市）、300多个市（地、州）、1800多个县（市、区）四级气象预警。

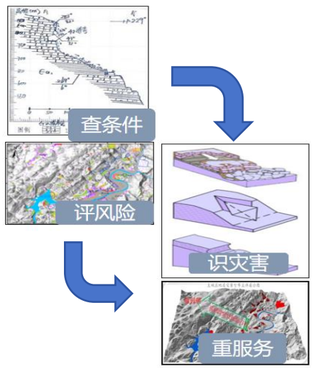
综合治理。完成186万人搬迁避让，29825处工程治理，有效保护340余万人生命安全。通过搬迁避让、排危除险与工程治理，核销隐患点7.2万万处，受灾害威胁人口由1891万人降至1194万人。

能力建设：发布国家标准3项、行业标准10项、团体标准90余项，30个省份建立了地质灾害信息平台并正常运行。

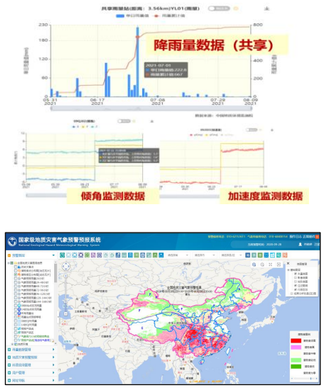
InSAR based ground deformation monitoring



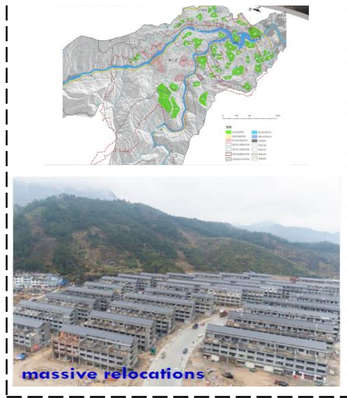
Triggering condition & risk mapping



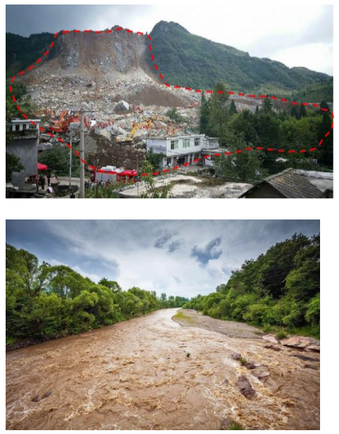
Monitoring & Meteorological warning



Spatial planning
Land use regulation
Relocation



Emergency response



Database
Information system
Information service

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应用研究进展 Progress of Application

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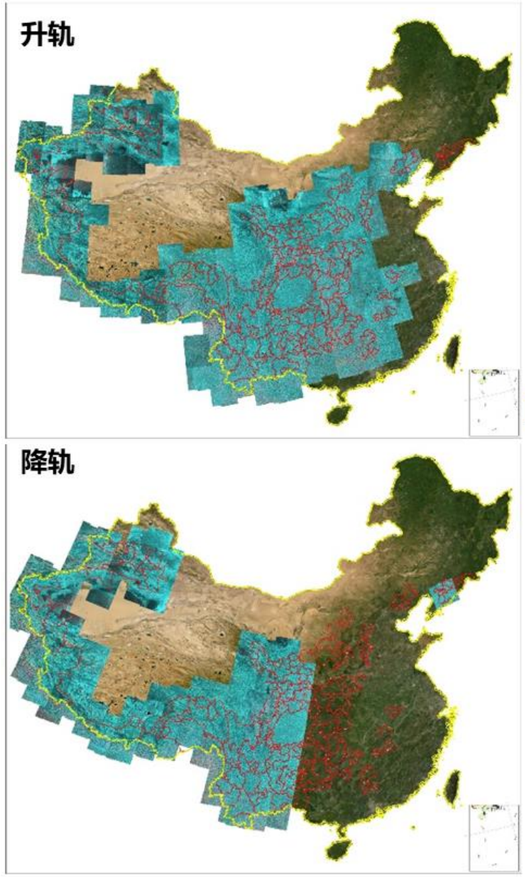
2.1 调查评价体系 Landslide survey and risk assessment

2.1.1 综合遥感识别 Integrated geohazards identification by InSAR +AI

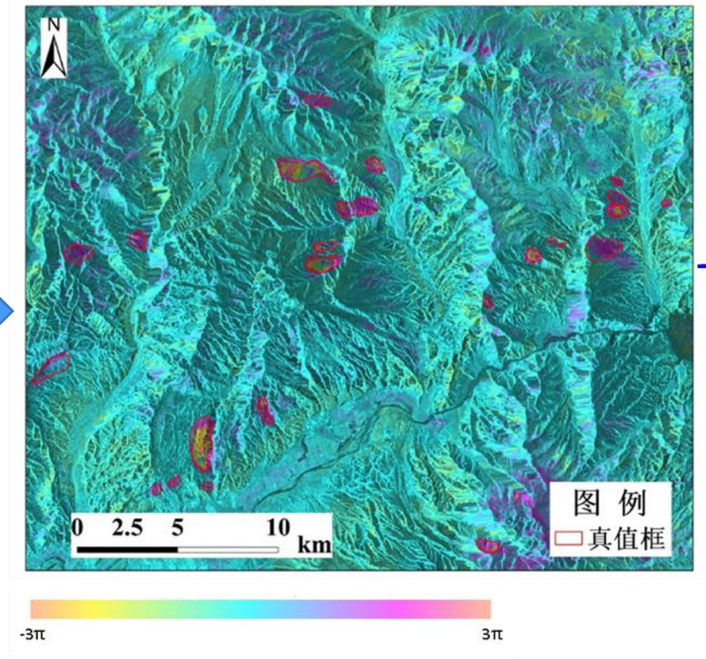
ground deformation monitoring

地表形变异常/速率



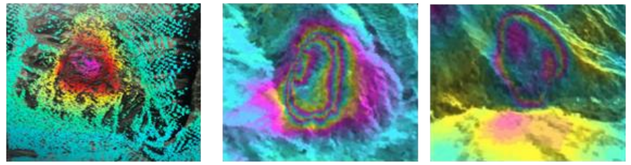
ground deformation detection

形变聚集区提取

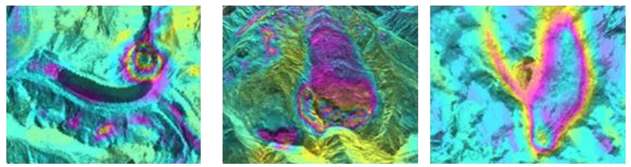


面向对象：交互解译、面向特征：智能提取

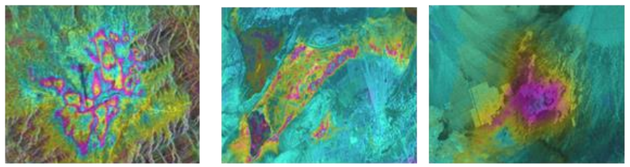
地质灾害隐患分类_形变模式 **Catgories of landslide**



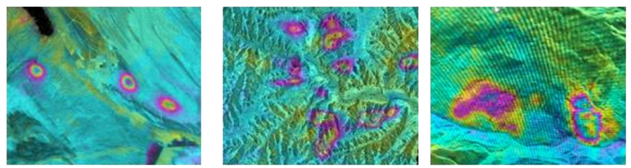
滑坡崩塌类 **landslides**



土石流冰川类 **debris flow glaciers**



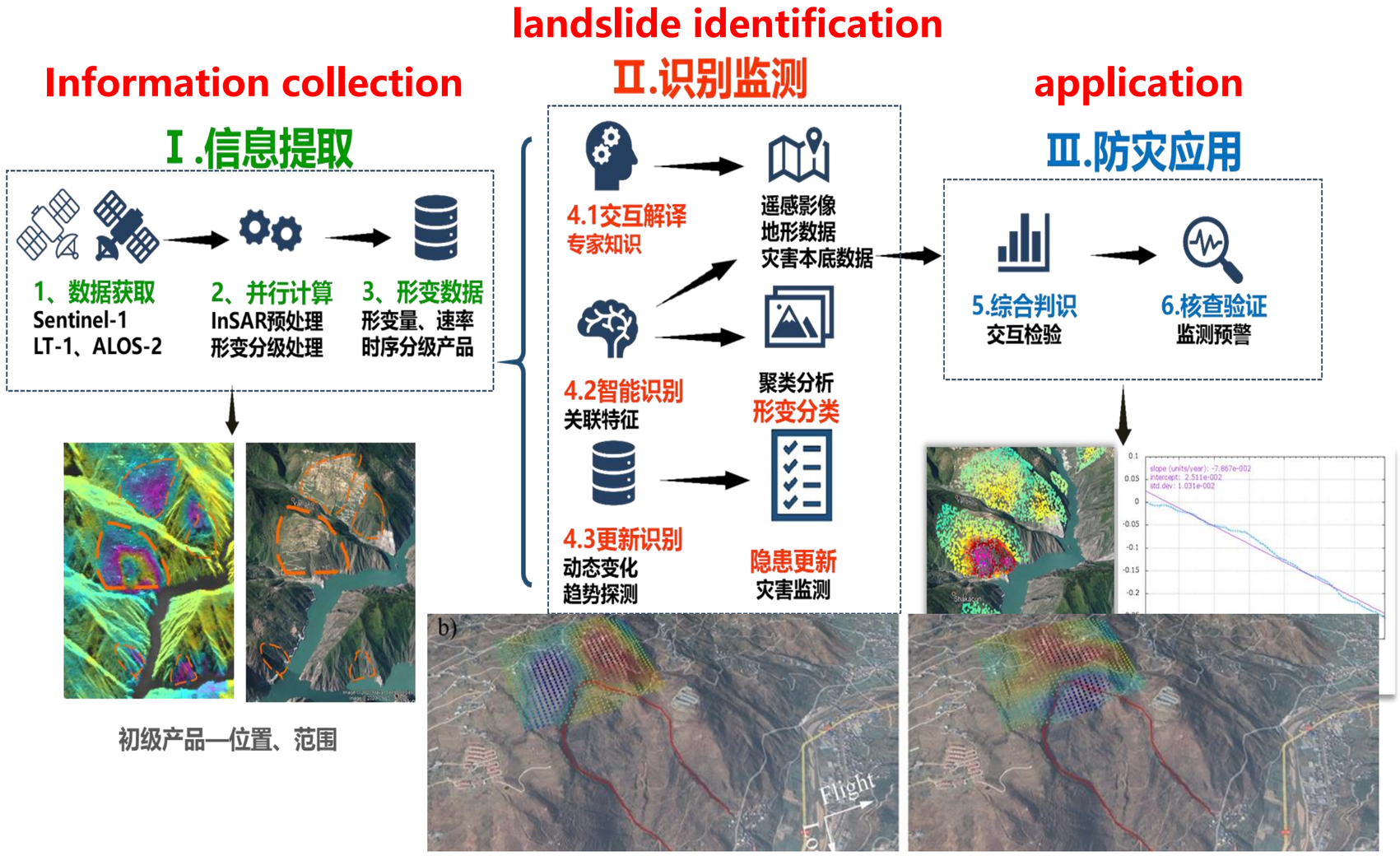
区域沉降类 **regional settlement**



地面沉陷类 **subsidence**

应用研究进展 progress of Application

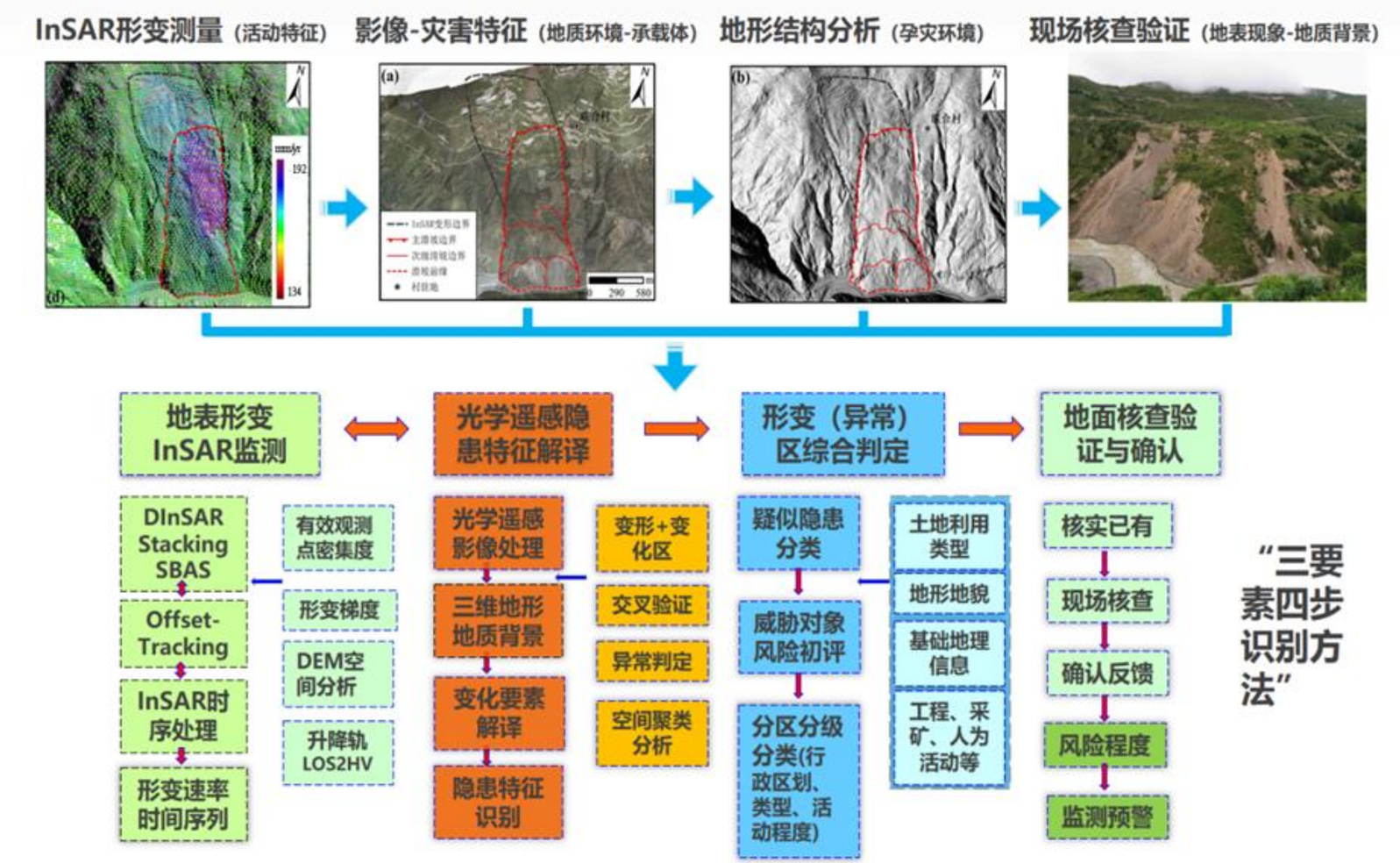
综合遥感识别系列软件平台 A comprehensive RS Identification System for geohazard.



- ◆ 广域InSAR处理技术与并行系统改造
- ☐ Wide-area InSAR processing technology and parallel system transformation;
- ☐ 地质灾害隐患三维综合遥感判识系统
- ☐ Three-dimensional Comprehensive Remote Sensing Identification System for geohazards
- ☐ 疑似隐患野外核查系统
- ☐ Field Verification System for Suspected site prone to geohazards

应用研究进展 progress of Application

2.1.1 形成了综合遥感识别的技术规程 Technical specifications for landslide identification



- ◆ 基于InSAR等综合遥感隐患识别技术规程
- ☐ Comprehensive remote sensing identification technology specifications;
- ◆ 遥感数据信息化技术规程
- ☐ RS Information technology specifications;
- ◆ 野外核查验证技术规程
- ☐ Field verification technical specification.

应用研究进展 progress of Application

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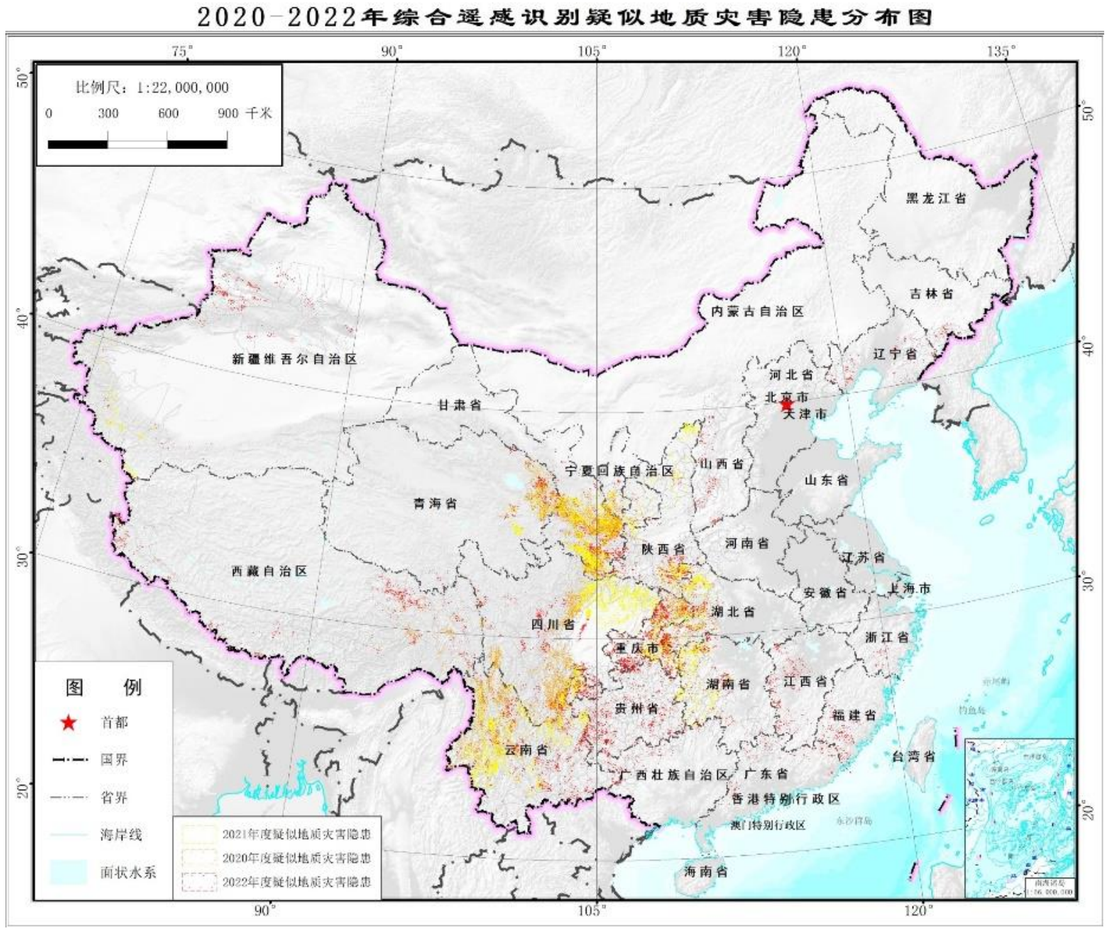
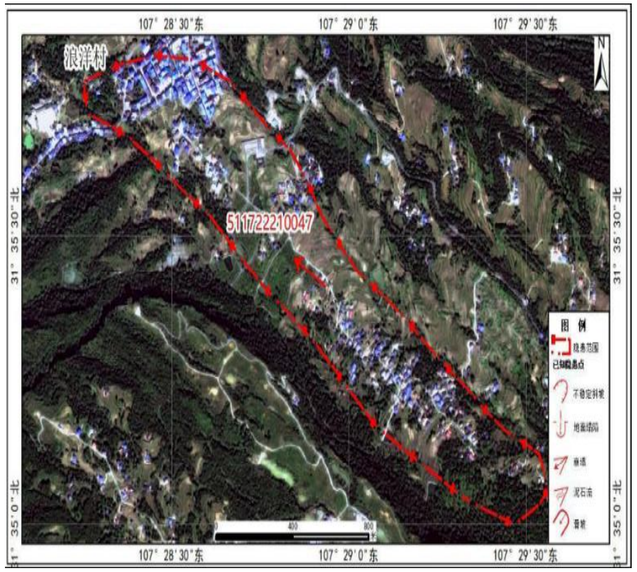
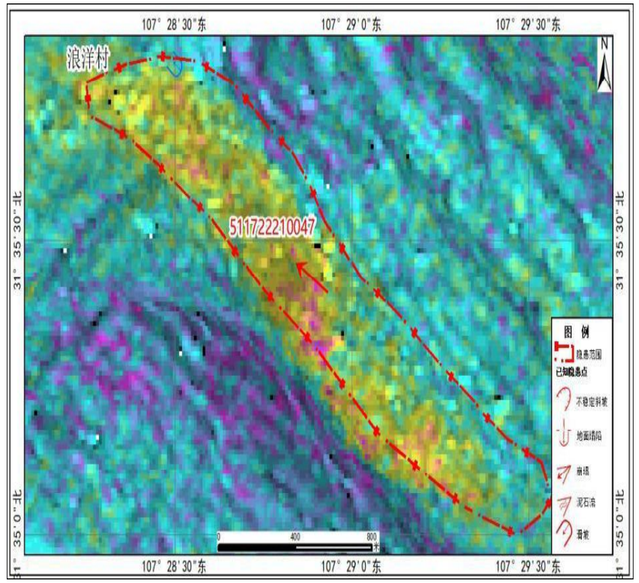
2.1.1 综合遥感识别 Integrated geohazards identification by RS（InSAR） +AI

The distribution map of landslide detection based on RS technologies



- 经自然资源部下发的地质灾害综合遥感识别疑似隐患点15327处，经核查确认为隐患点6280处，正确识别率约41%
- The Ministry of Natural Resources issued a list of 15,327 suspected sites prone to occurrence identified by comprehensive remote sensing technology , and 6,280 sites were verified and confirmed, the Correctness rate 41%





应用研究进展 progress of Application

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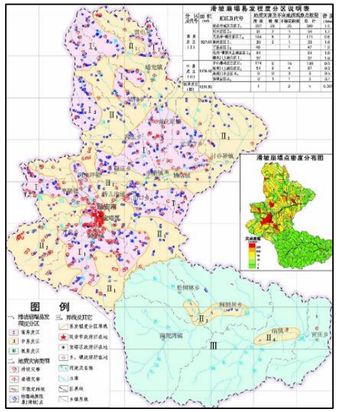
2.1.2 地质灾害野外调查与风险评价 Geohazards field survey and risk mapping

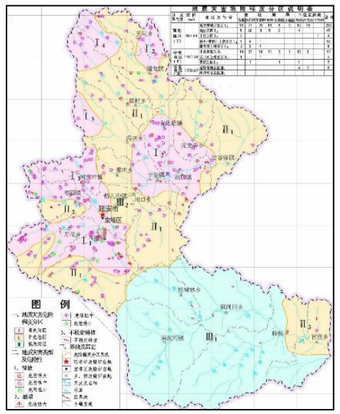
◆ 涵盖易发、危险性、风险以及风险管理等一系列调查评价与服务成果

□ Generation of a series of geohazards risk maps/diagrams formanagement, spatial plannng, etc.

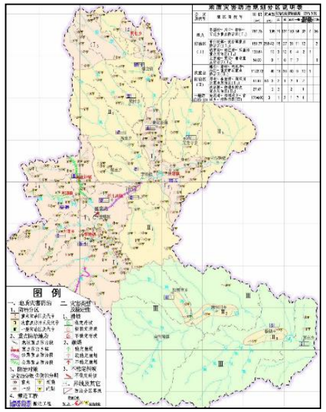
Susceptibility



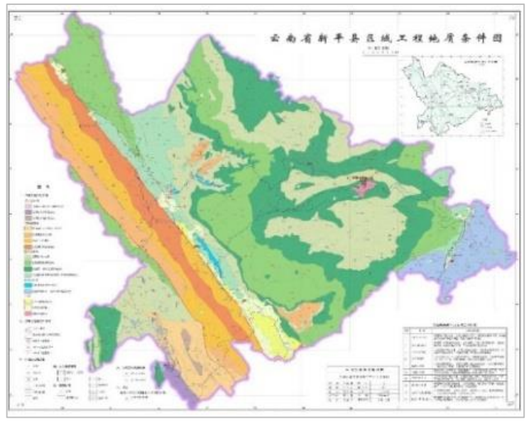
Hazard



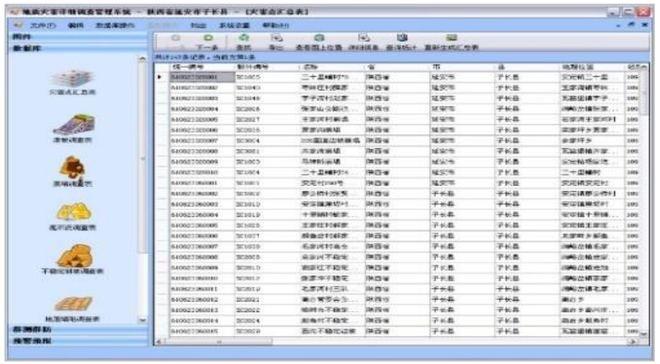
Risk



Engineering geology map



Risk control map



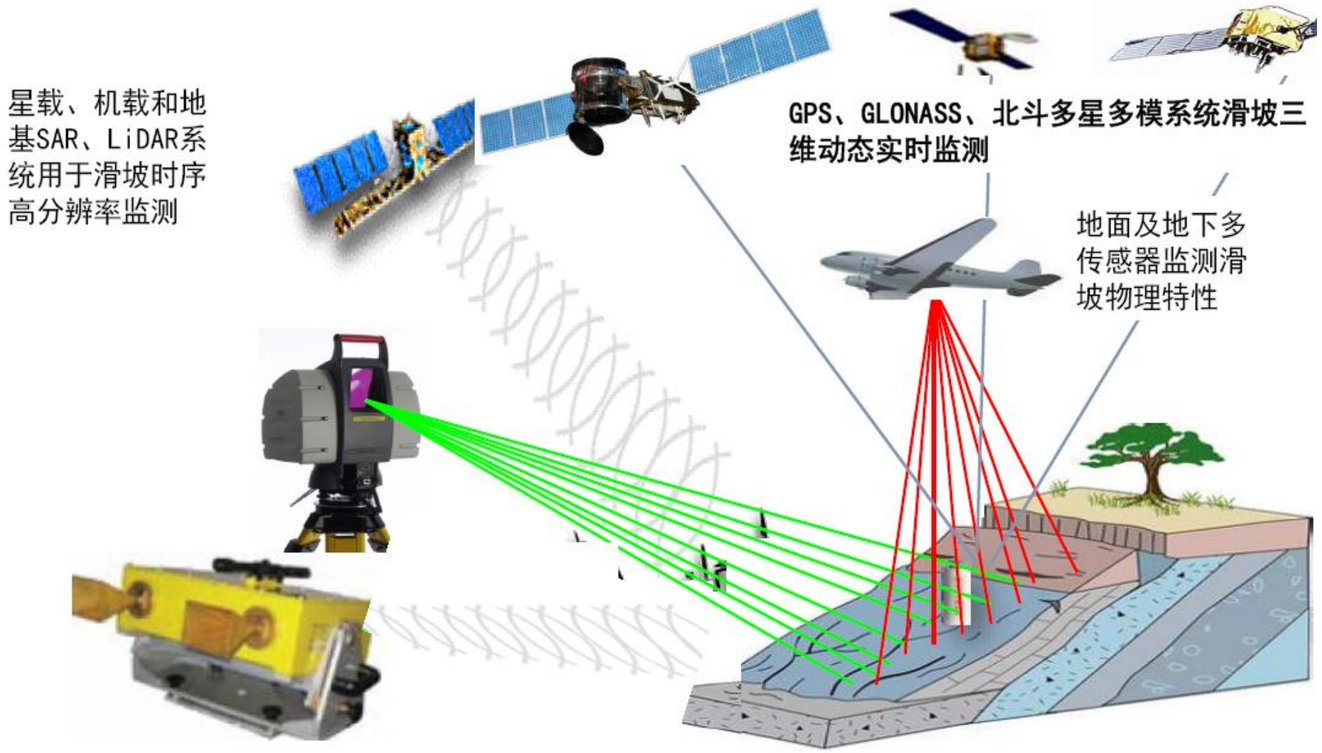
National geohazards database

National geohazards information system

◆ 完成2117县1:5万地质灾害风险调查，713个县隐患识别，2137个重点集镇1:1万精细调查，4万*余处隐患勘查。*

2.1.2 地质灾害野外调查与风险评价 Geohazards field survey and risk mapping

- 建立了空-天-地一体化调查技术体系
- Establishment of a comprehensive system of geohazard survey technologies



space-based

天

大范围
InSAR
光学遥感

deformation location
识别正在变形点
变形部位
变形程度

air-based

空

高分辨率
无人机航拍
机载LiDAR
机载红外

deformation features
识别已变形隐患点
滑坡边界
微地貌
影响范围
承灾体

ground-based

地

全方位
地面核查
三维激光扫描
剖面测量
钻探物探坑槽探
实验测试

deformation details
隐患点精细刻画
变形特征
三维结构
潜在滑面
岩土体参数

应用研究进展 progress of Application

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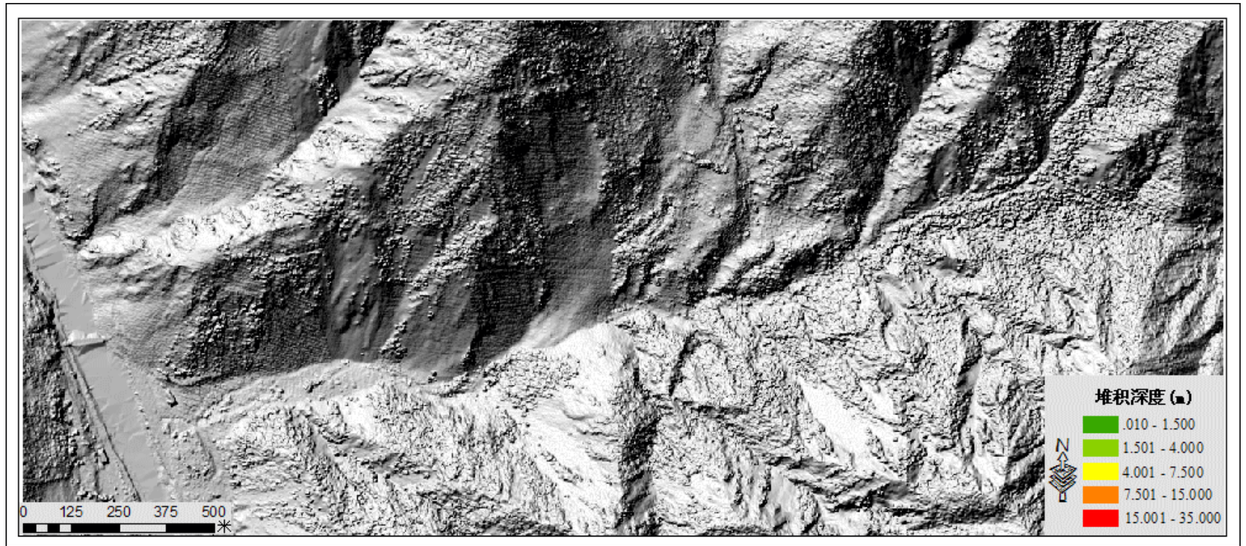
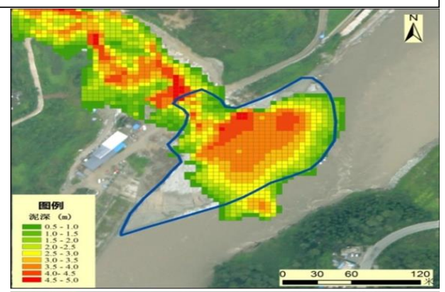
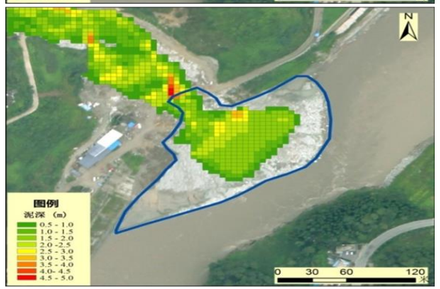
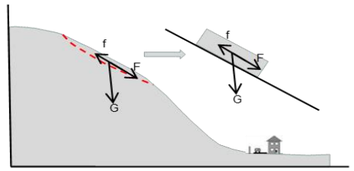
2.1.2 地质灾害野外调查与风险评价 Geohazards field survey and risk mapping



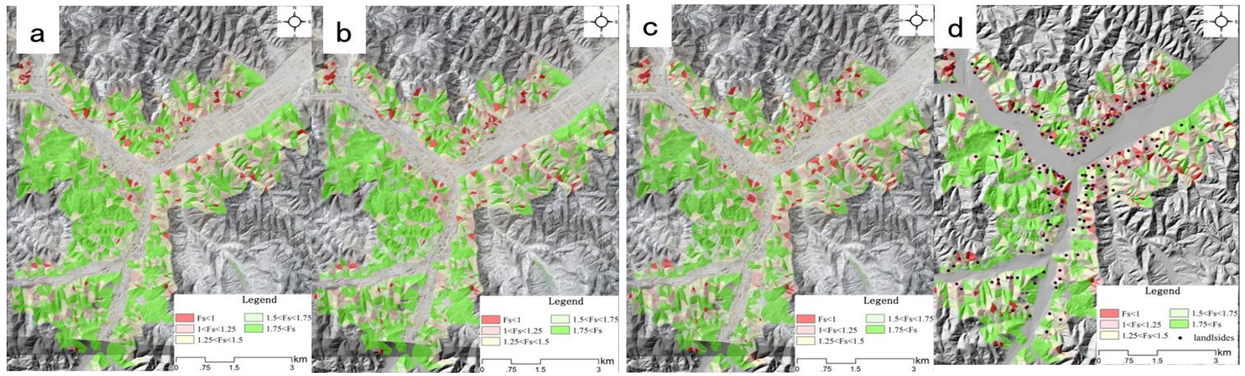






a：10年一遇有效降雨强度
b：20年一遇有效降雨强度
c：50年一遇有效降雨强度
d：100年一遇有效降雨强度

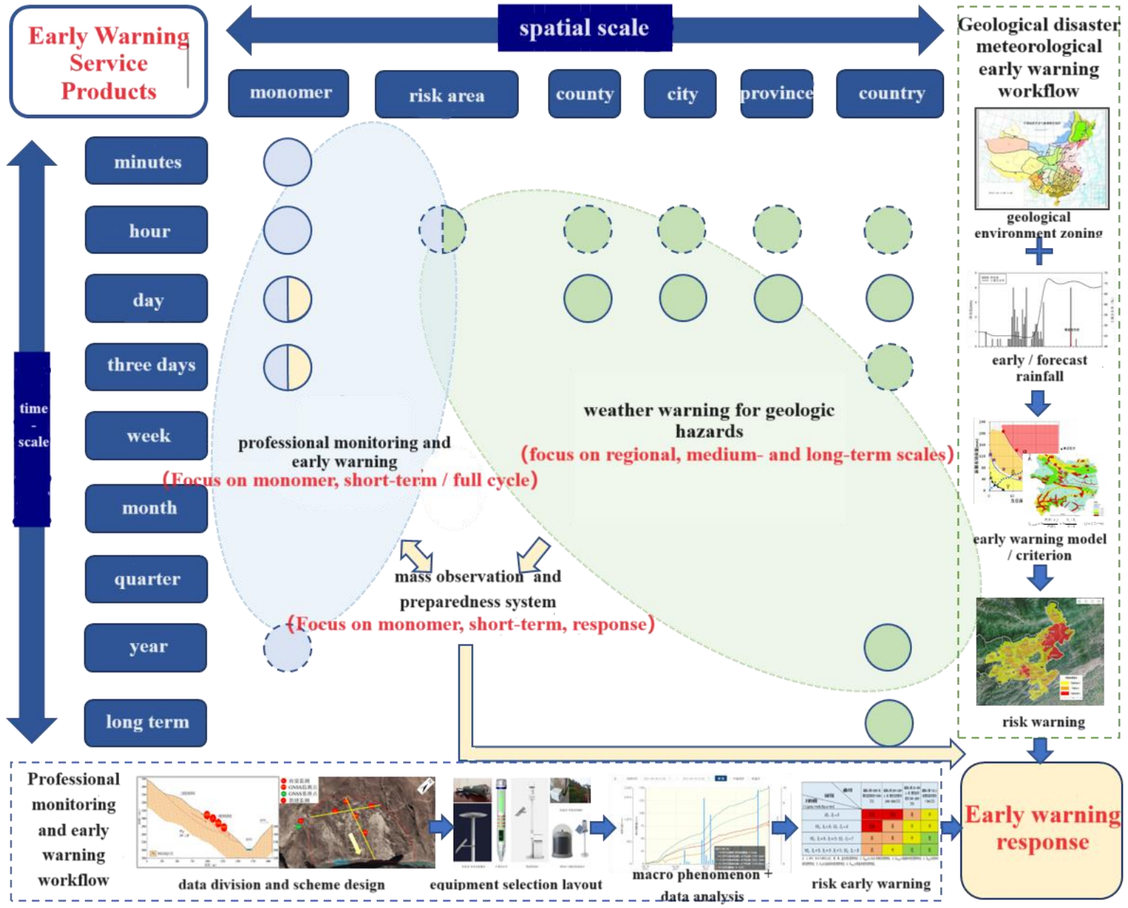
Fs	100年一遇	50年一遇	20年一遇	10年一遇
<1	6.2%	4.6%	3.4%	2.8%
1-1.25	16.5%	14.6%	1.2%	10.0%
1.25-1.5	21.5%	21.2%	19.6%	18.1%
1.5-1.75	18.3%	17.2%	18.0%	17.4%
>1.75	37.4%	42.4%	46.9%	51.6%



- 合作研发地质灾害风险评估的模型和软件工具，形成适用于不同地区、精度的地质灾害风险评估软件工具系列，支撑开展了不同降雨等情景条件下的泥石流、滑坡危险性评价和风险评价。
- Through cooperation with ITC, Germany BGR, Austria AIT and Italy ISPRA, we continue to develop models and software tools for geohazards risk assessment for different regions， accuracy， rainfall and other scenario conditions, and form a series of hazard and risk assessment products

应用研究进展 progress of Application

2.2 监测预警体系 geohazard monitoring and early warning network



Geohazard Monitoring and Early Warning System Operation Process and Service Products

初步形成了“群测群防”、“地灾气象预警”与“专业监测预警” 相结合的监测预警体系

“public observation and preparedness” + “weather warning for geohazard” + “professional monitoring and early warning” , has been initially formed.

- ◆ 地灾气象预警侧重区域、中长期尺度的预警，
- ◆ 专业监测预警侧重单体隐患、临灾阶段的预警，
- ◆ 同时这两类“技防”工作在现场确认、避险转移阶段都依托“群测群防”来组织实施

- ☐ weather warning for geohazard focus on regional, medium- and long-term scales
- ☐ professional monitoring and early warning focus on individual hazards, critical phases
- ☐ The above two "technical prevention" work rely on " public observation and preparedness " to organize and implement during the on-site confirmation and risk avoidance transfer stages

应用研究进展 progress of Application

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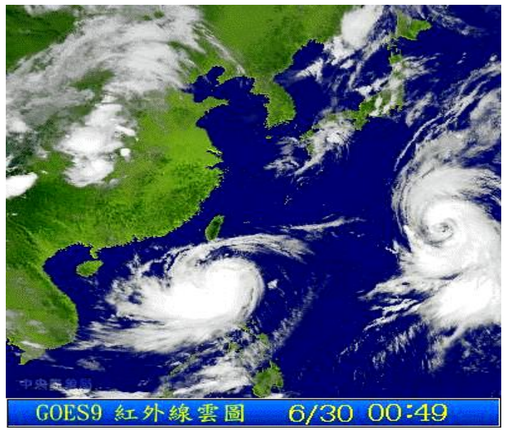
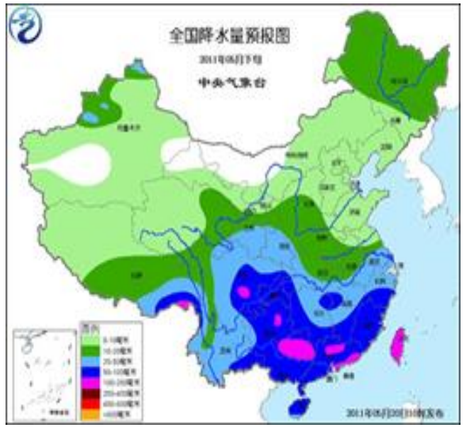
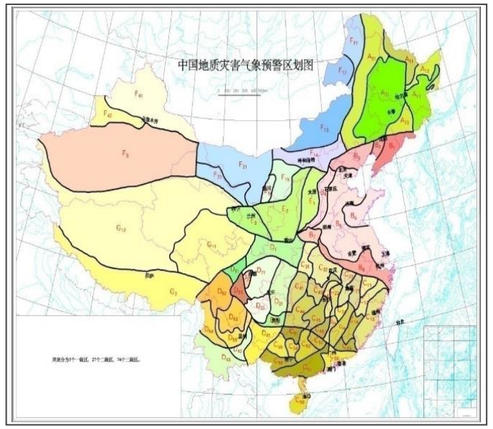
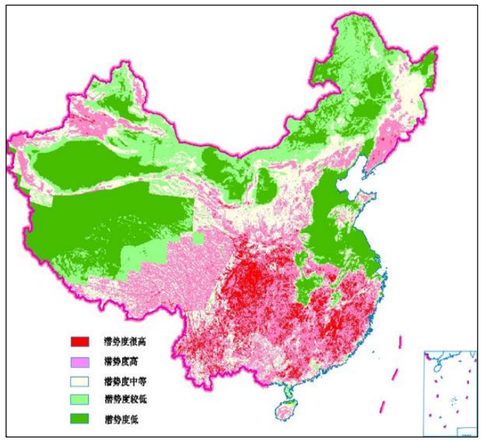
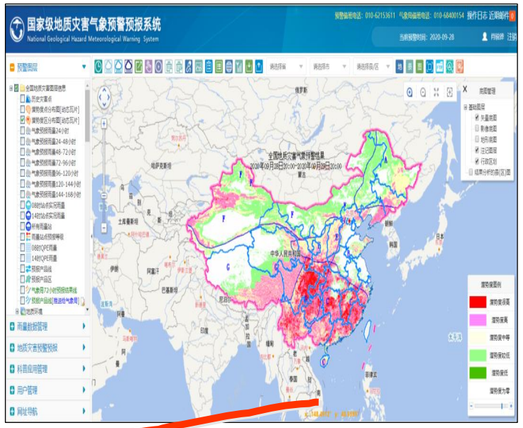
2.2.1 与中国气象局合作，充分利用GIS技术，形成黄、橙、红色区域地质灾害气象预警机制并在汛期发布地质灾害气象预警信息。With the help of China Meteorological Administration, we apply GIS technology to form a meteorological early warning mechanism for geoharazd in yellow, orange and red regions, and release early warning information during the raining season.

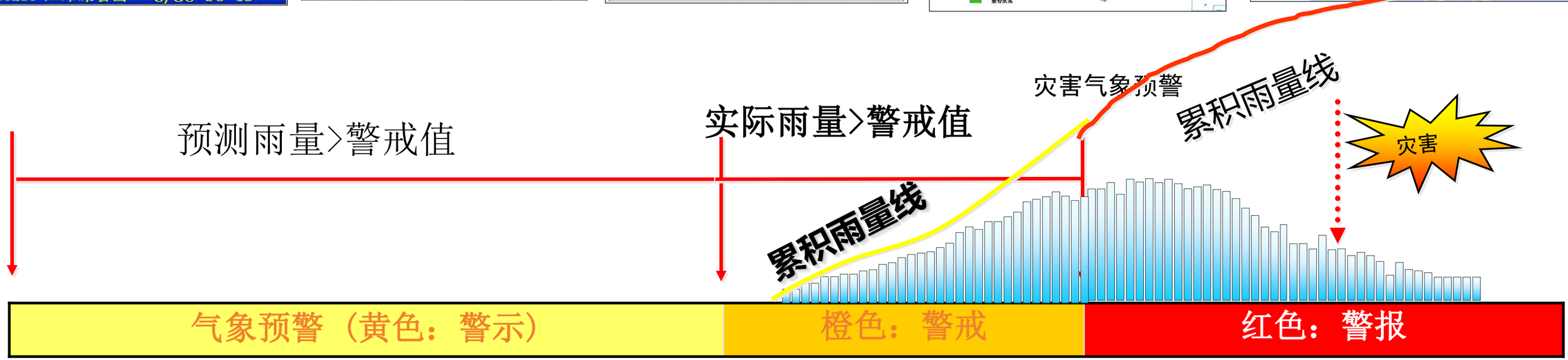












应用研究进展 progress of Application

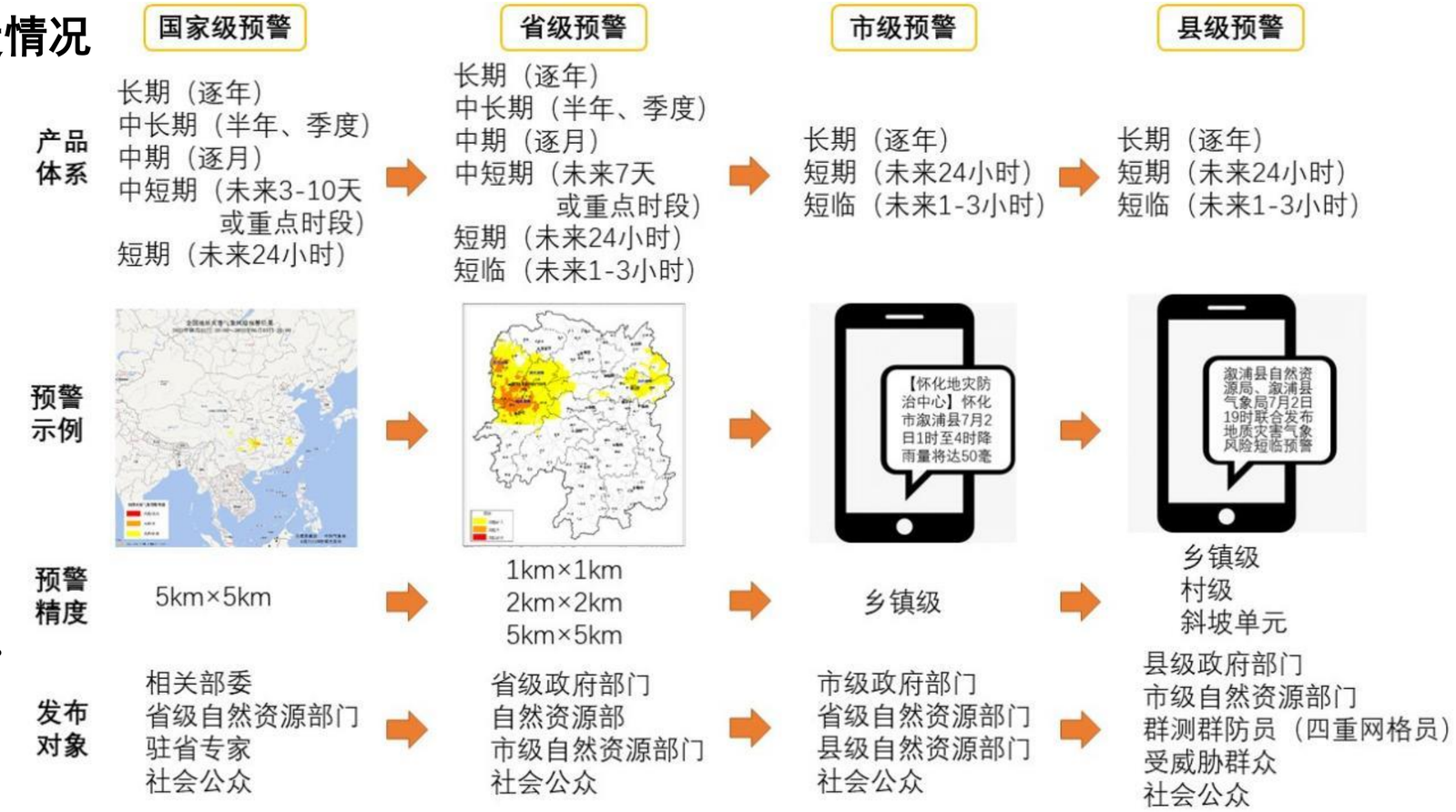
2. 2. 1全国地质灾害气象预警信息平台建设情况

◆ **30个省（区、市）、300个市（地、州）、1600个县（市、区）建设了地质灾害气象风险预警信息平台。**

□ **30 provinces (autonomous regions and municipalities), 300 cities (prefectures and prefectures) and 1,600 counties (cities and districts) have built geohazard meteorological risk early warning platforms.**

□ **2023年发布了422期国家级地质灾害气象风险预警信息。**

□ In 2023, 422 issues of national geohazards meteorological risk early warning information were released.



国家-省-市-县四级预警体系

The ￥4 Level meteorological risk early warning

2.2.2 全国地质灾害群测群防体系 public observation and preparedness

- ◆ 每一处地质灾害隐患点配备一名专职监测员，开展隐患点监测、预警、预报、预防工作。
  Each geohazard site is appointed a full-time monitor to carry out monitoring, early warning, forecasting and prevention of hidden danger points.
- ◆ 2023年底，全国共有26.7万名群测群防员在汛期参与地质灾害防治工作。
- ☐ By the end of 2023, a total of 267,000 persons participated in the prevention and control of geological disasters during the raining season.
- ◆ 严格选拔考核，每名群测群防员发放600-3600元的补助费用每年。
- ◆ Strict selection and assessment, each person appointed will be issued a subsidy of 600-3600 yuan per year

应用研究进展 progress of Application

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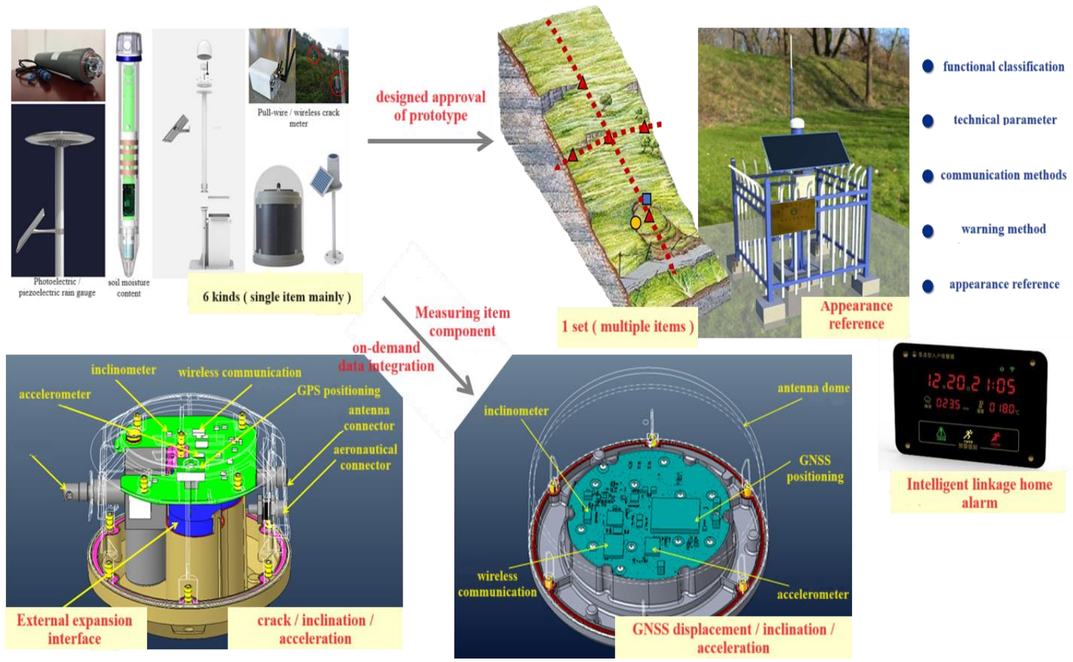
2.2.3 普适型地质灾害监测装备研发与试验
Landslide automatic monitoring and warning based equipment.

1 set of equipment + 1 system + 5 standards, the monitoring network has covered 66,000 hidden dangers (308,000 sets of monitoring instruments)。

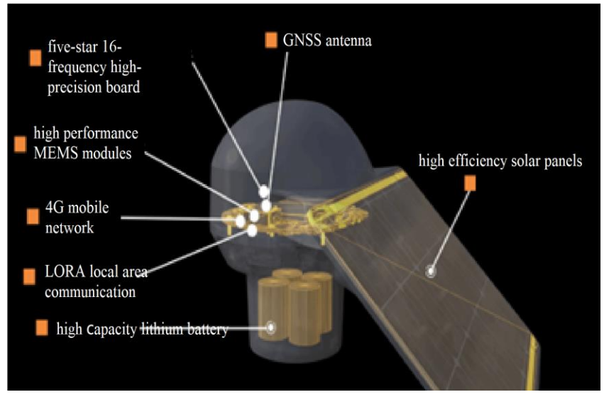
- **Finalization and development of the first generation of monitoring technology and equipment**
- **A real-time interconnected monitoring and early warning system built**
- **“1+4” monitoring and early warning technical standard system**



应用研究进展 progress of Application

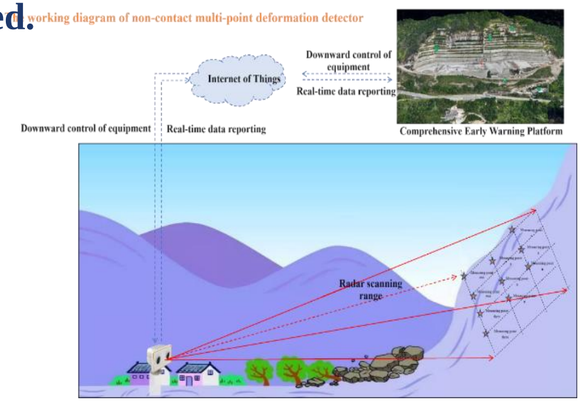
2.2.3 普适型地质灾害监测装备研发与试验—传感器
Landslide automatic monitoring and warning based equipment-sensor.

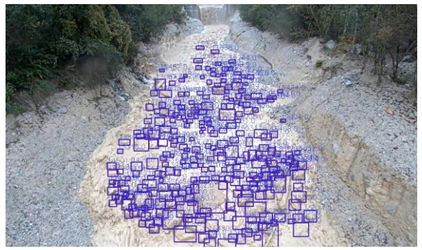
- Generation I monitoring equipment represented by GNSS innovated, with high integration, low power consumption and intelligent frequency conversion.
- The "MEMS +" multi-sensor fusion increasing the reliability of monitoring in complex mountainous areas.
- The "video +" mode realizing intelligent identification and automatic inspection of multi-source monitoring data.
- The hardware design of collapse landslide feature recognition and deformation monitoring equipment based on machine vision completed.
- The universal multi-point/planar deformation radar prototype and laboratory test completed, and the field pilot test carried out.



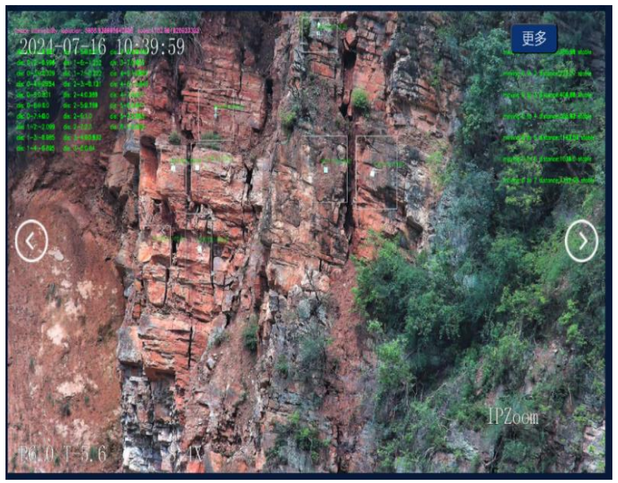
The new generation of universal GNSS

- Hardware finalization of " Radar-video integrated " debris flow monitoring equipment , lateral installation, multi-parameter intelligent early warning completed.





"radar-video integrated " debris flow monitoring



Unmarked feature recognition and target deformation monitoring of perilous rock collapse

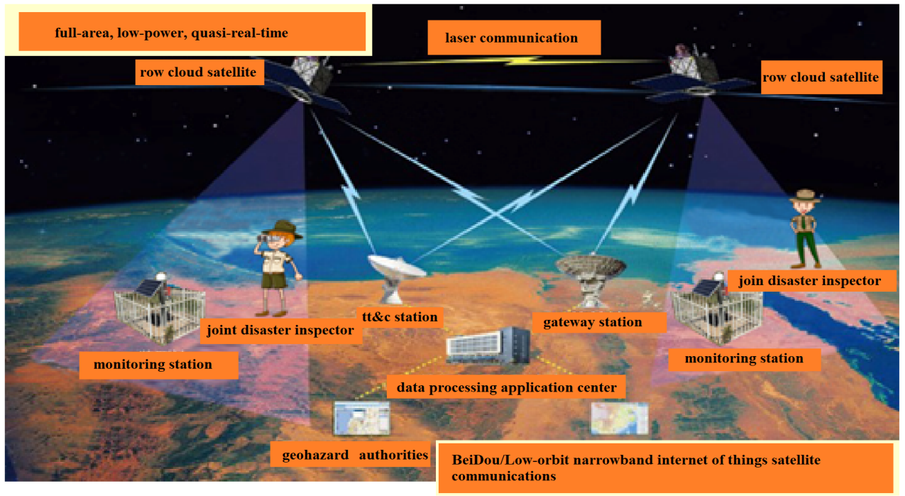
应用研究进展 progress of Application

2.2.3 普适型地质灾害监测装备研发与试验—数据传输
Landslide automatic monitoring and warning based equipment-data transition.

- **Satellite communication / near-Earth networking** has become one of the key technologies for successful early warning under extreme conditions.

High-orbit broadband	Low-orbit wide / narrow-band	BeiDou satellite short message	5GNTN	LoRa/MESH/α

- Explore blockchain technology to build ' **trusted data flow** '
- Optimize the ' 1 + 30 ' provincial data transmission **security architecture**
- The targeted release of early warning information, **closed-loop feedback**, and **call should be called**.



应用研究进展 progress of Application

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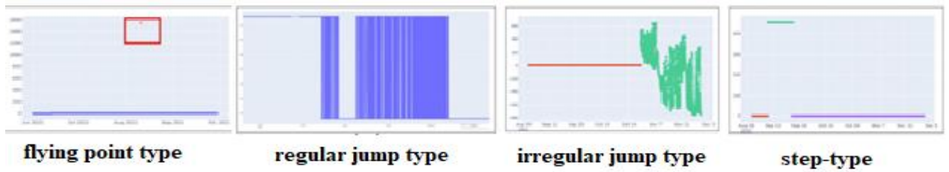
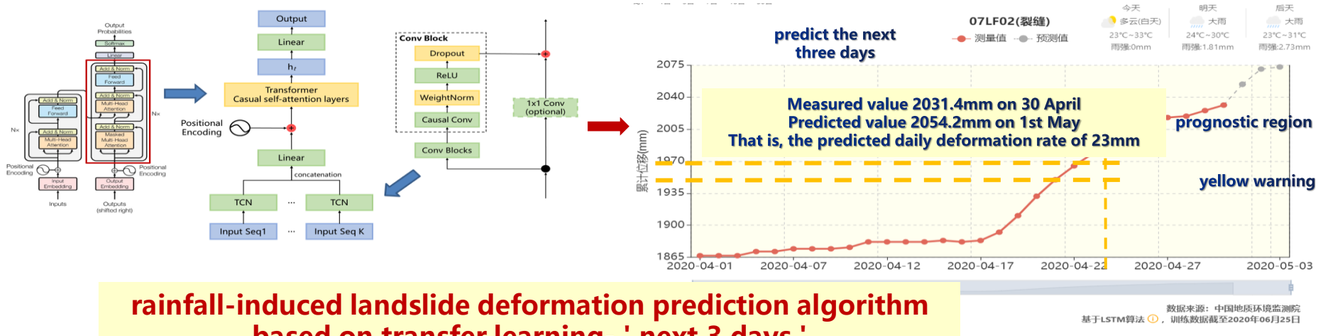
2.3.3 普适型地质灾害监测装备研发与试验—数据分析
Landslide automatic monitoring and warning based equipment-data analysis.

Intelligence： big data analysis and intelligent risk early warning

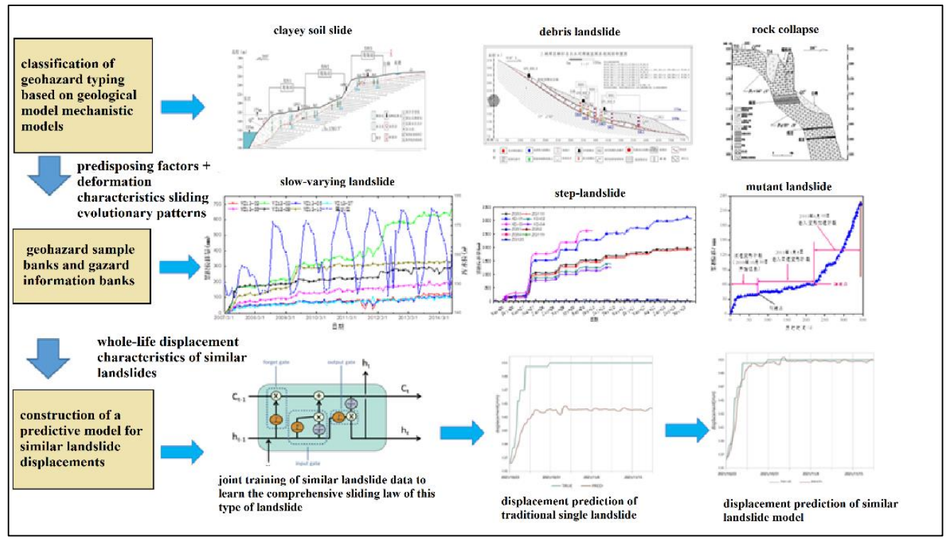
- Establish evaluation standards and comprehensive analysis platforms such as data quality to reduce false alarms in multiple dimensions.
- The partition classification sample library has been constructed, and the similar landslide migration method has been used to optimize the new slope warning model.
- Risk early warning model based on “geological model” + “data driven” proposed.



Intelligent data cleaning



rainfall-induced landslide deformation prediction algorithm based on transfer learning- ' next 3 days '

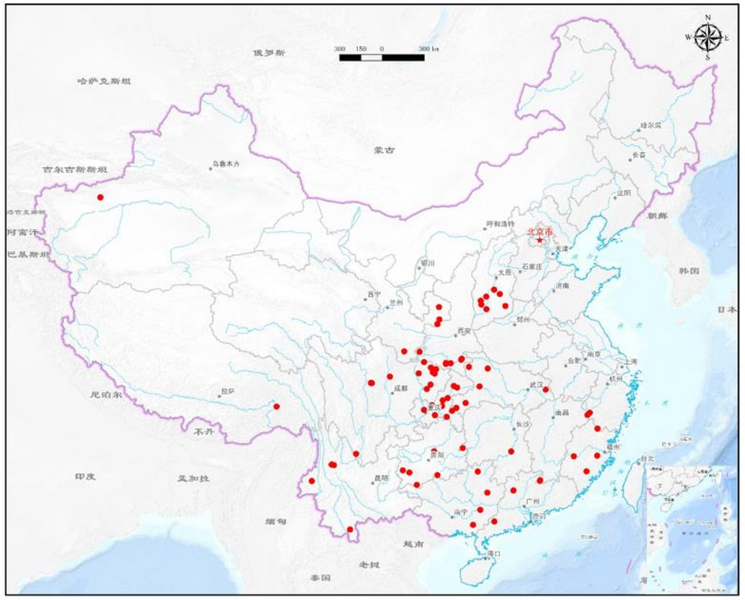


Risk early warning model based on “geological model” + “data driven”

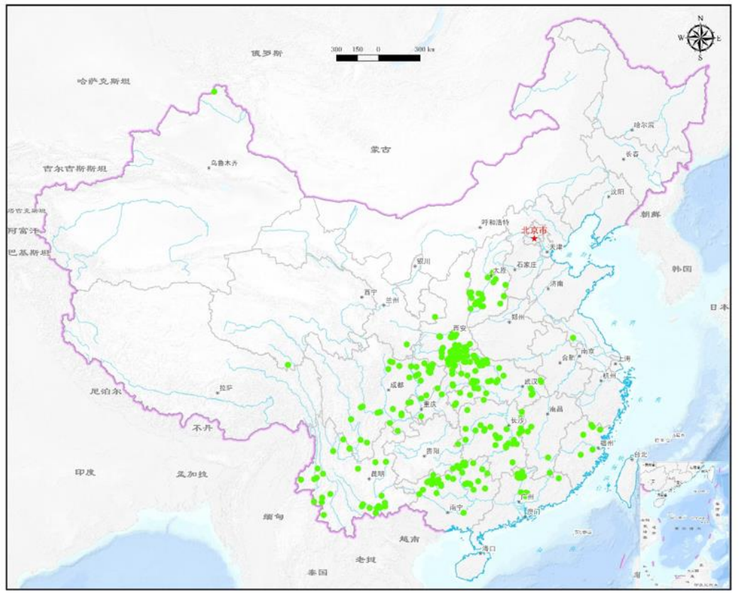
应用研究进展 progress of Application

2.3 普适型地质灾害监测装备研发与试验—应用成效
Landslide automatic monitoring and warning based equipment-Application.

- 640 successful early warning forecasts, effectively safeguarding the lives of 2,869 people (up to August 2024)
- Successfully forecast 131 disaster situations involving potential casualties of 2,869 people.
- 509 effective warnings of dangerous situations, nearly 10,000 people moved in time, potential economic losses of nearly 1.4 billion yuan.



131 successful geohazard forecasts

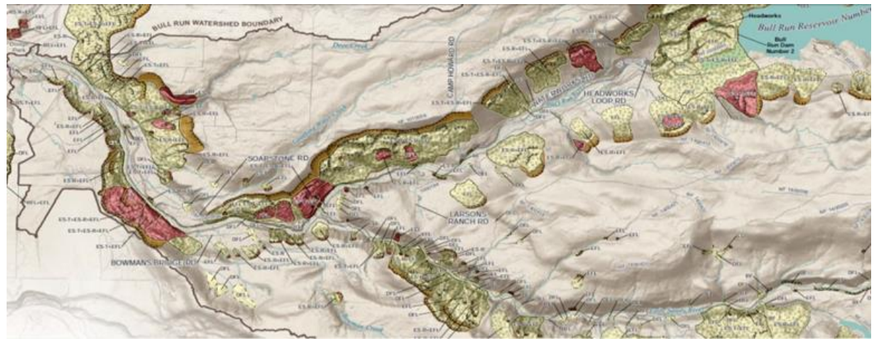


509 effective warnings of danger

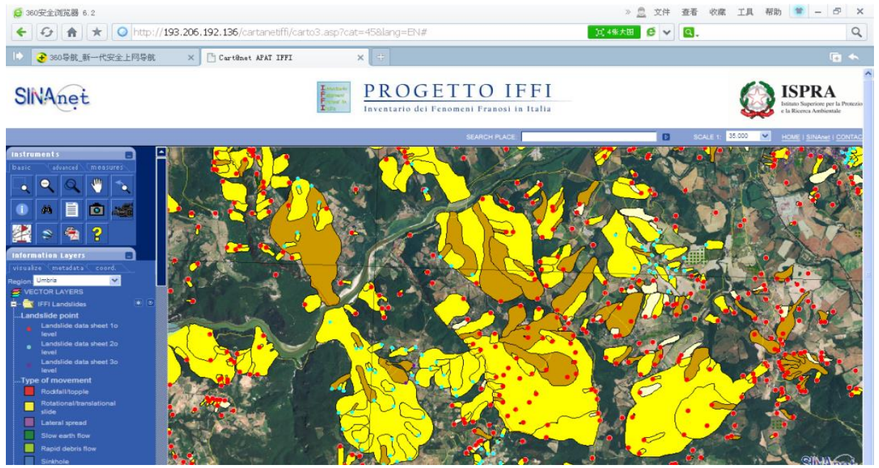
内容 Contents

存在的问题与挑战 Problem and challenges

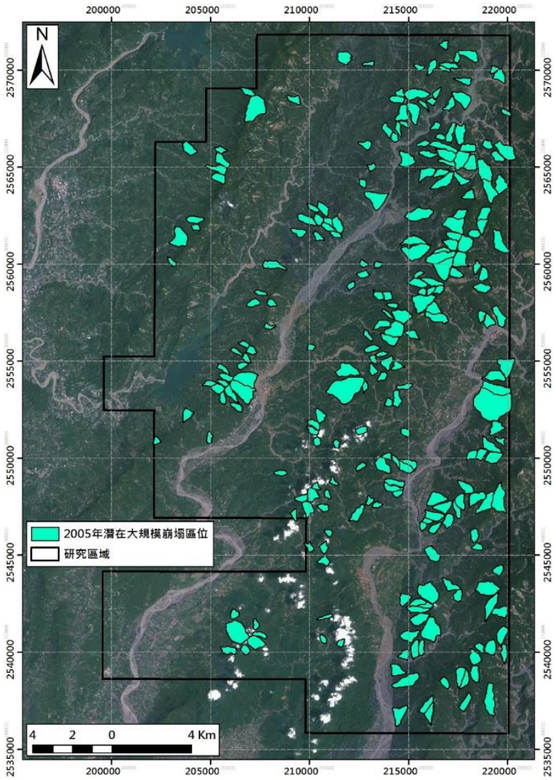
3.1调查评价的精度、深度不足和质量参差不齐。 The precision of landslide survey and risk assessment is insufficient, and is difficult to support risk identification, scientific monitoring and early warning, and the application of prevention and control measurements.



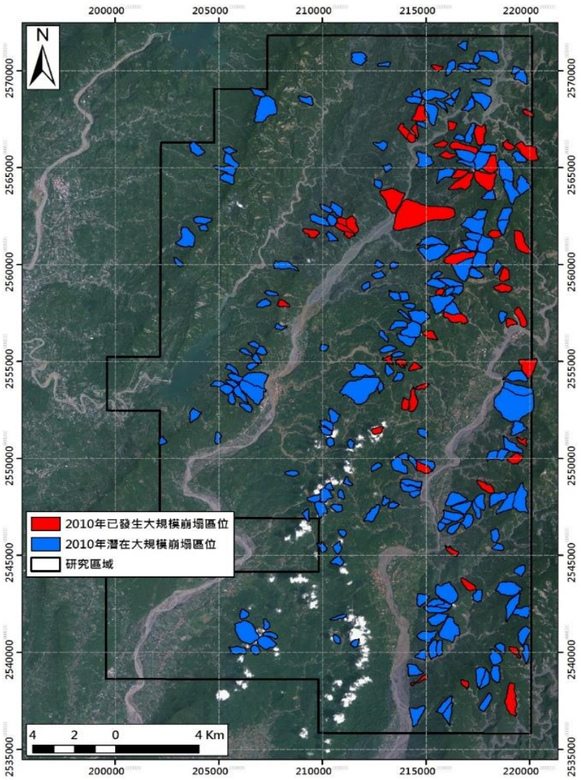
美国Oregon州基于LiDAR的滑坡图（1:1万）



意大利（30万km2）国家滑坡数据库，499511个



调查识别圈定的滑坡隐患分布图
landslide(based on survey)inventory map



实际发生滑坡与隐患图对比
landslide (actually occurred) inventory map

存在的问题与挑战 Problem and challenges

3.2 地质灾害监测预警的精准性、时效性、专业水平亟待提高。The precision, timeliness, and professional level of landslide monitoring and early warning urgently need to be improved.

茂县新磨村滑坡

贵州纳雍滑坡

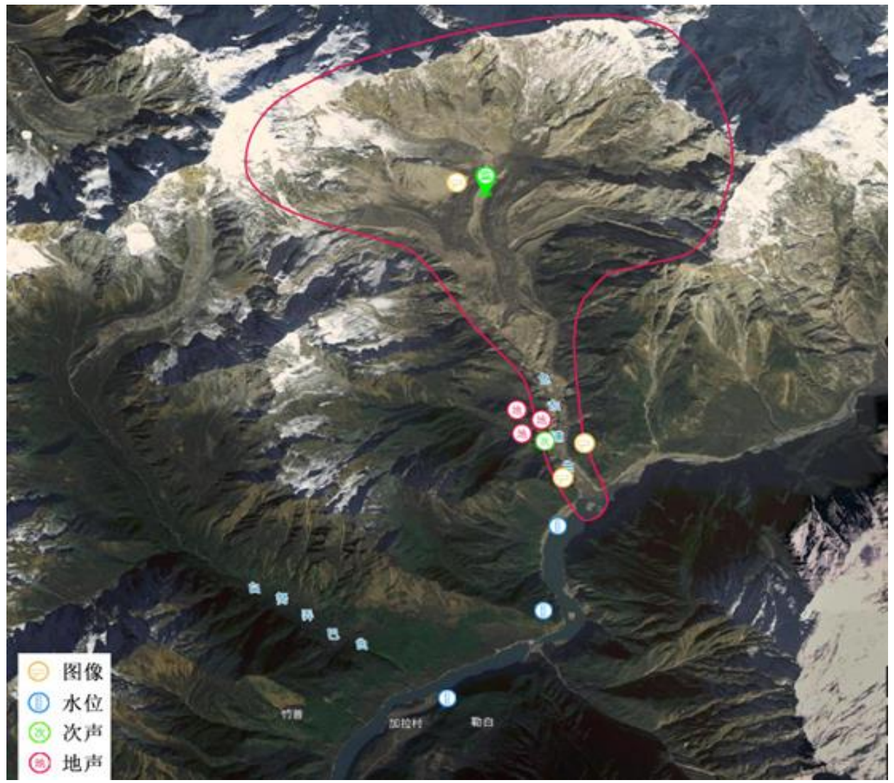
甘肃周曲泥石流

色东普沟崩塌碎屑流

- ◆ 以“人防”为主的监测预警体系难以满足新技术应用不足，专业化程度不高，以“人防”为主的监测预警体系难以满足具有高位、远程、隐蔽性等特征的复杂地质灾害防御需求。
- ◻ The monitoring and warning approach based on community/public is outdated, with insufficient application of new technologies, a low level of specialization, and high uncertainty. The system is insufficient to match the requirements of complex landslide characterized by high altitudes, long distances, and concealment.
- ◆ “技防”的普适型或专业监测预警体系覆盖不足，预警精准性，信息化、规范化和科技支撑能力不足。
- ◻ The professional monitoring and warning system lacks sufficient coverage, precision in early warning, as well as adequate capabilities in informatization, standardization, and scientific and technological support.

存在的问题与挑战 Problem and challenges

3.3 监测预警仪器设备的标准化程度低，稳定性不足，运行维护成本高，监测预警预报精准性有待提高。The standardization of monitoring/early warning instruments and equipment is low, with insufficient stability and high cost for operation and maintenance，The accuracy of early warning needs to be improved.



雅鲁藏布江色东普流域冰（岩）崩碎屑流监测规划
comprehensive monitoring program for debris flow triggered by ice/glacier movements

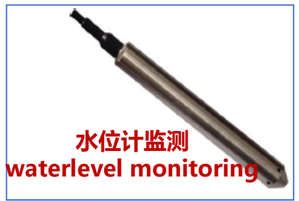
雨量和GNSS
rainfall gauge

声光报警
Acoustic and optical alarm

裂缝位移
crack deformation monitoring

GNSS

含水率监测
moisture monitoring

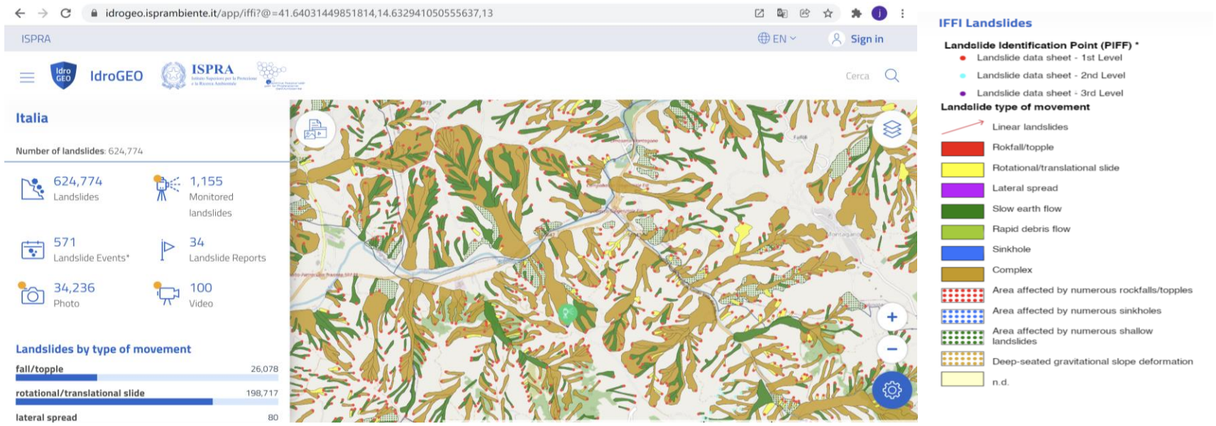


水位计监测
waterlevel monitoring

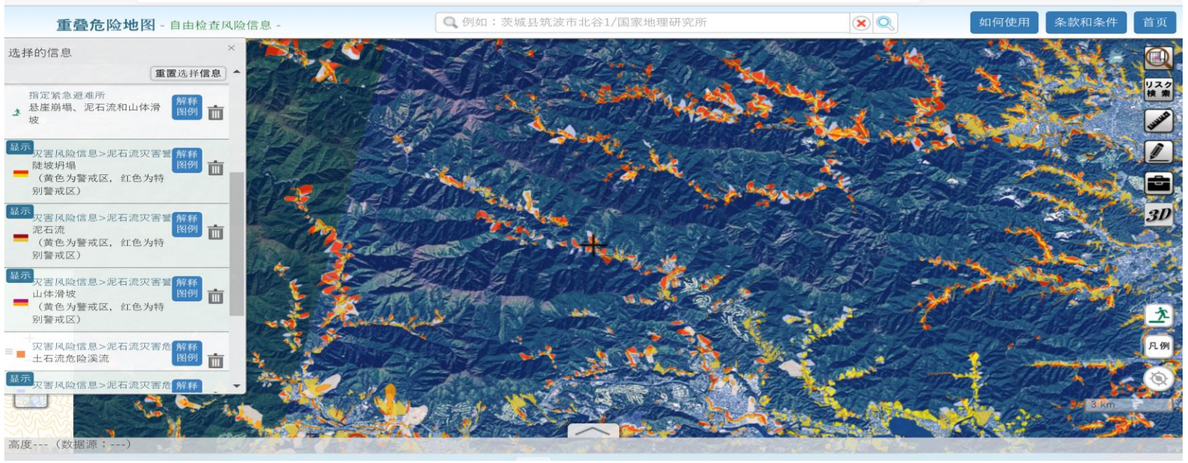
Develop stable, economically reliable, and practical instruments and equipment to enhance technical defense capabilities.

存在的问题与挑战 Problem and challenges

3.4 地质灾害风险数据信息共享、动态更新机制方面还存在诸多制约。The construction of landslide information system, the sharing of data and information, and dynamic update mechanism still face many challenges.



意大利地质灾害编录与风险系统



日本国土交通省灾害风险图

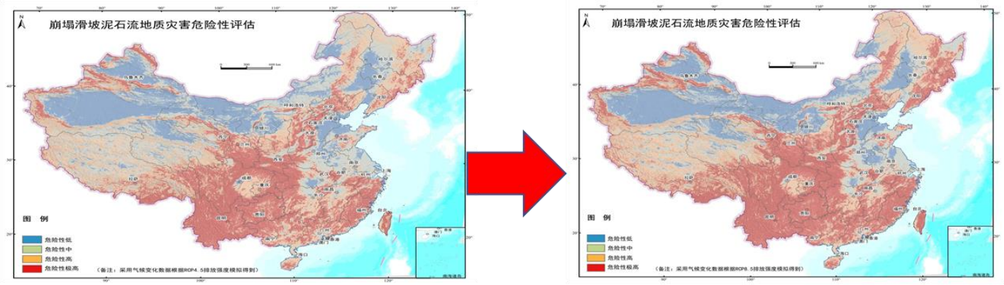
- 数据精度低 geohazard survey and risk evaluation - low accuracy
- 数据的时效性不足，The dynamic updates of database lack timeliness
- 获取多源数据不充分，The capability of acquiring multi-source data is insufficient
- 监测预警精度不足，A lack of precision in monitoring and early warning
- 动态实时气象预警信息更新 The ability for near-real-time updates (near-real-time meteorological warning forecasts) is insufficient.

内容 Contents

下一步工作建议　Initiative

4.1 坚持问题、目标导向，结合防治管理需求，深入开展气候变化相关的基础性、系统性研究。 Adhere to the problem-oriented and goal-oriented, combined with the needs of prevention and management, and carry out in-depth basic and systematic research related to climate change

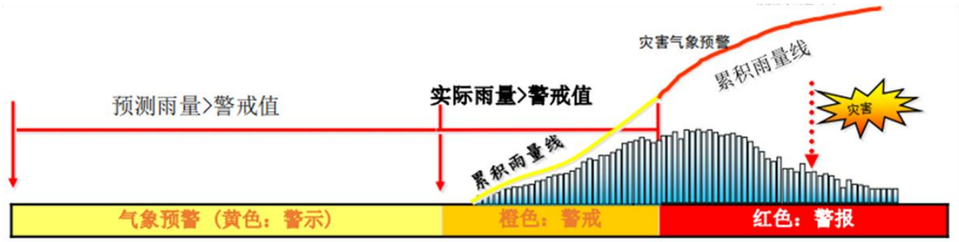
气候变化下我国地质灾害风险时空演化研究



针对不同碳排放强度下的地质灾害风险区时空变化

趋势预测

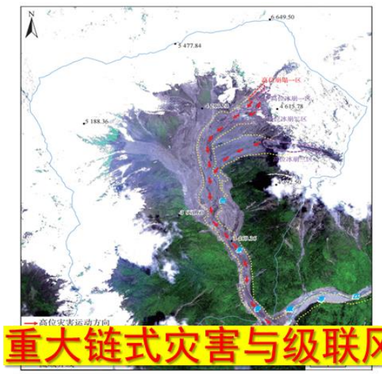
气候变化背景下地质灾害风险预警模型研究



温度频变骤变和降雨趋强趋长条件下预警研究

预警预报

气候变化影响地区典型地质灾害机理模式研究



重大链式灾害与级联风险

机理模式

风险管理

下一步工作建议　Initiative

4.2 夯实重大基础工作及其保障体系，提升地质灾害调查评价精度、监测预警能力、避险搬迁和综合治理力度，提升基层防灾减灾科技水平。Improve the accuracy of geohazardinvestigation and evaluation, monitoring and early warning capabilities, risk mitigating and relocation, as well as improve the scientific and technological level of geohazard prevention and mitigation

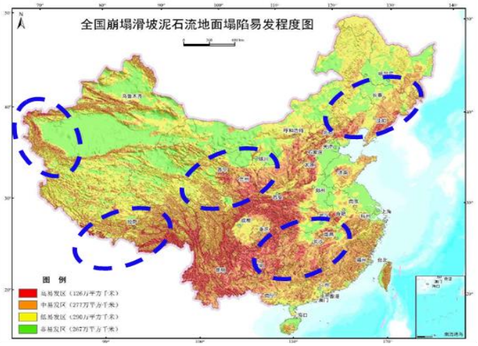
进一步提升地质灾害调查评价工作精度

1:5万调查区

1:1万调查区

重点勘查区

InSAR观测区



（1）高、中易发区（1:5万及以上精度）地质灾害风险调查全覆盖。

（2）加强西北、西南等气候变化影响显著区调查评价。

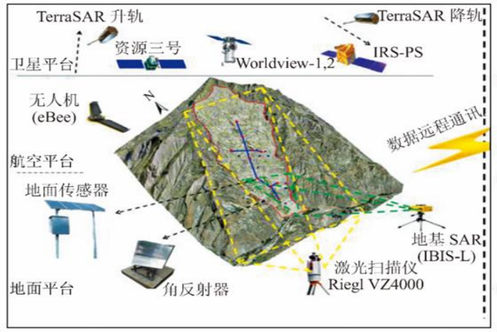
推进地质灾害监测预警网络体系建设

多尺度

分区域

多工况

多时态

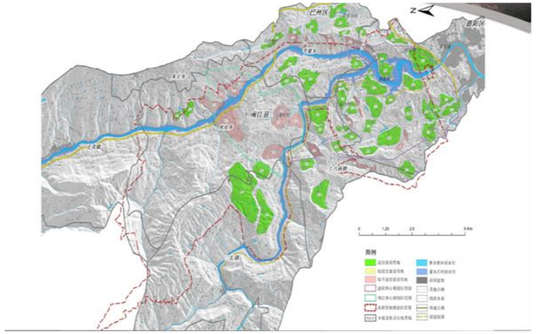


进一步加大搬迁避让和工程治理力度

- 加大搬迁避让与城镇化安置；
- 加强工程治理，提升防护标准；
- 加大生态化治理，提升风险防御能力。

进一步加大资金筹措和工作统筹协调力度

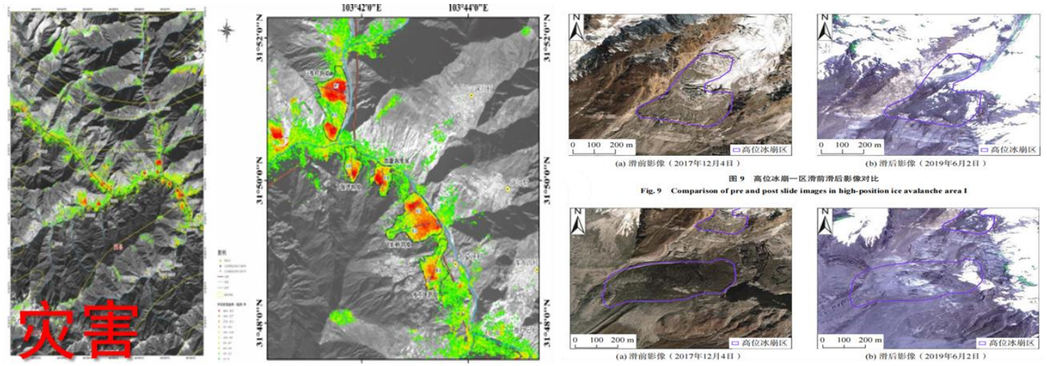
- 建立地质灾害保险分担机制；
- 推进多部门协同，落实防治主体责任，强化空间管控；
- 强化政策衔接，统筹防灾资源。



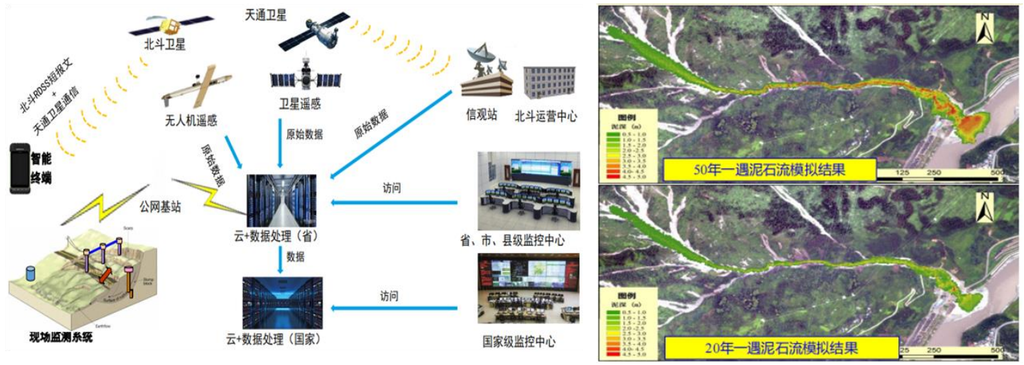
下一步工作建议　Initiative

4.3 加大科技创新，着力破解防灾减灾关键技术问题，形成“实用、管用、好用”的技术支撑体系，引领地质灾害防治。Increase scientific and technological innovation, focus on solving key technical problems in disaster prevention and mitigation, form a "practical, effective, and easy-to-use" technical support system, and leading the prevention and control of nature disasters.

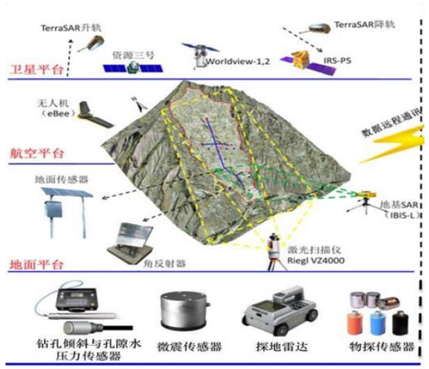
1. 提升地质灾害隐患综合遥感识别技术



2. 加强地质灾害信息化与风险动态精准评价



3. 加强地质灾害风险预警技术方法体系建设



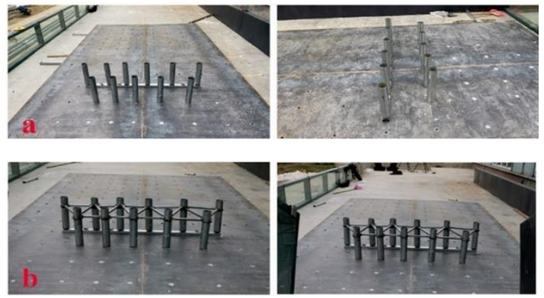
全国地质灾害监测预警中心

感传知用　时空精准　可靠稳定

重点地区　重大灾害　重点时段

重大设施　重大活动　极端天气

4. 提升防灾减灾设计理论与工程技术材料装备水平

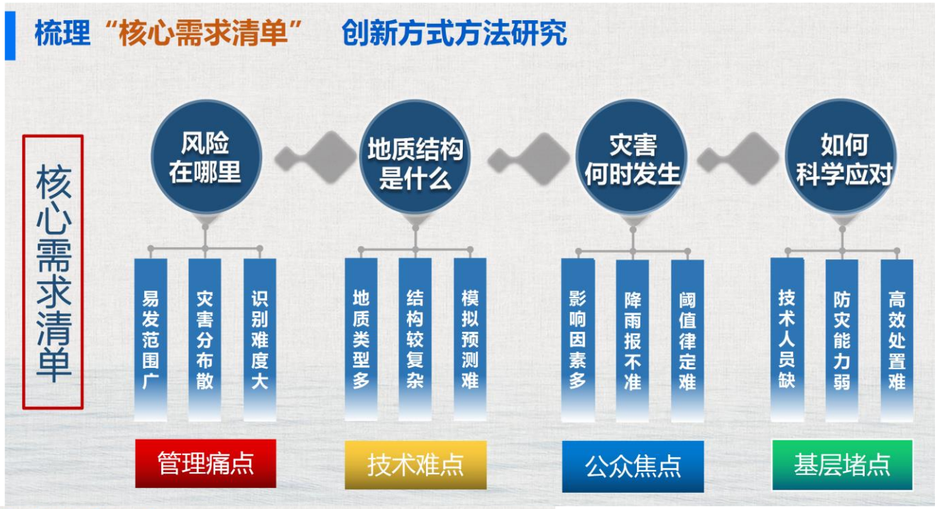


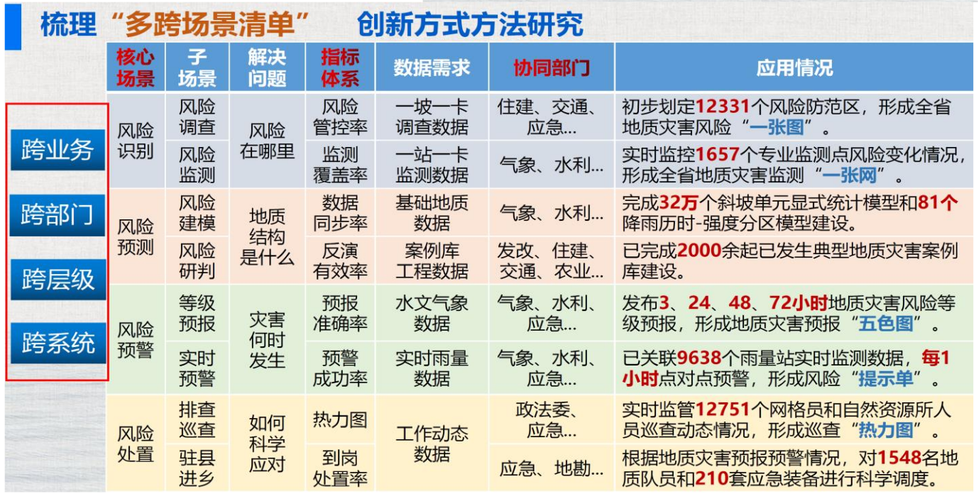
治理新理论、新方法、新技术、新材料、新装备。

下一步工作建议　Initiative

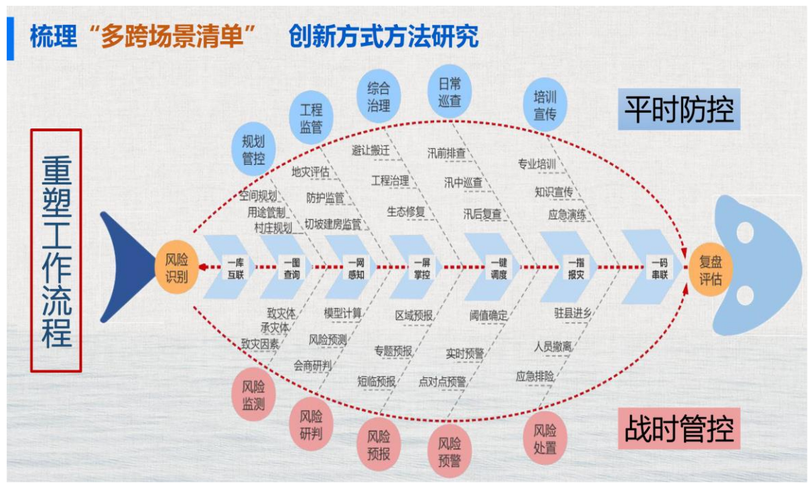
4.4 谋划建设国家地质灾害监测预警与风险管理中心和综合信息服务平台，建立需求清单、场景清单和管理流程清单，提升高质量、全方位智慧服务能力。**To build a national geohazards monitoring, early warning and risk management center and a comprehensive information service platform**

- ◆ **提供政府管理、技术业务、公众防灾教育、重大工程和巨灾保险服务**
- ☐ Provide government management, technical business, public disaster prevention education, major engineering and catastrophe insurance services





核心场景	子场景	解决问题	指标体系	数据需求	协同部门	应用情况
风险识别	风险调查	风险在哪里	风险管控率	一坡一卡调查数据	住建、交通、应急...	初步划定12331个风险防范区，形成全省地质灾害风险“一张图”。
	风险监测		监测覆盖率	一站一卡监测数据	气象、水利...	实时监控1657个专业监测点风险变化情况，形成全省地质灾害监测“一张网”。
风险预测	风险建模	地质结构是什么	数据同步率	基础地质数据	气象、水利...	完成32万个斜坡单元显式统计模型和81个降雨历时-强度分区模型建设。
	风险研判		反演有效率	案例库工程数据	发改、住建、交通、农业...	已完成2000余起已发生典型地质灾害案例库建设。
风险预警	等级预报	灾害何时发生	预报准确率	水文气象数据	气象、水利、应急...	发布3、24、48、72小时地质灾害风险等级预报，形成地质灾害预报“五色图”。
	实时预警		预警成功率	实时雨量数据	气象、水利、应急...	已关联9638个雨量站实时监测数据，每1小时点对点预警，形成风险“提示单”。
风险处置	排查巡查	如何科学应对	热力图	工作动态数据	政法委、应急...	实时监管12751个网格员和自然资源所人员巡查动态情况，形成巡查“热力图”。
	驻县进乡		到岗处置率		应急、地勘...	根据地质灾害预报预警情况，对1548名地质队员和210套应急装备进行科学调度。

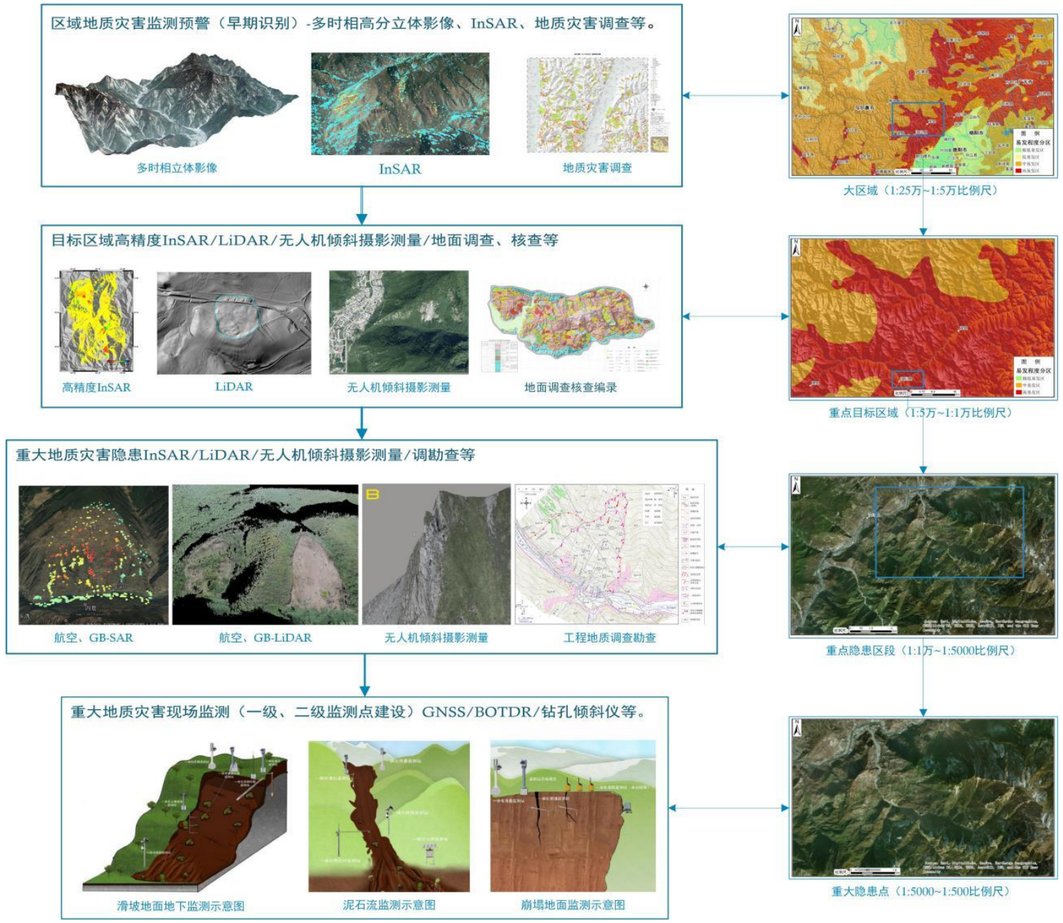


- ◆ **突出用户思维，完善需求、问题、目标（成果）导向的全流程信息化解决方案，强化空间数据、专业模型算法、应用场景的工具研发和应用。**
- ☐ Highlight user thinking, improve the demand, problem, goal (outcome) oriented whole-process information solutions, and strengthen the development and application of tools for spatial data, professional model algorithms, and application scenarios.

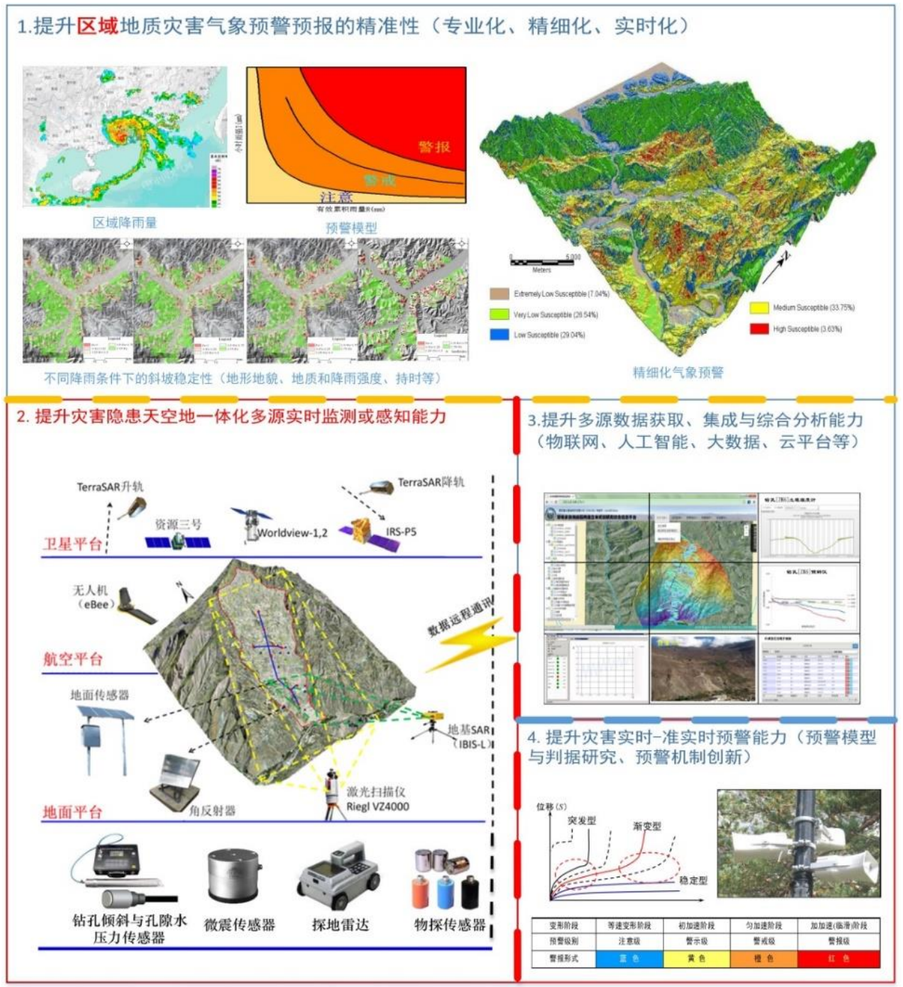
Geospatial ideas benefiting our world，is the key for climate change adaption and risk mitigation (5W1H)

UN GEONOW 2024 首届联合国地信周

◆ **Where/What/who/why？** 提高自然灾害风险识别和探测精准性，关键在地理空间信息的高效获取、多源数据融合处理和基于人工智能的目标识别和科学经济的应用。



◆ **When/why？** 提高预警的精准性、时效性和有效性。关键在于传感器、多源数据处理能力、预警模型的科学性、可靠性和成本可负担性。



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Geospatial Data ,Tools,Apps for Everyone

THANK YOU