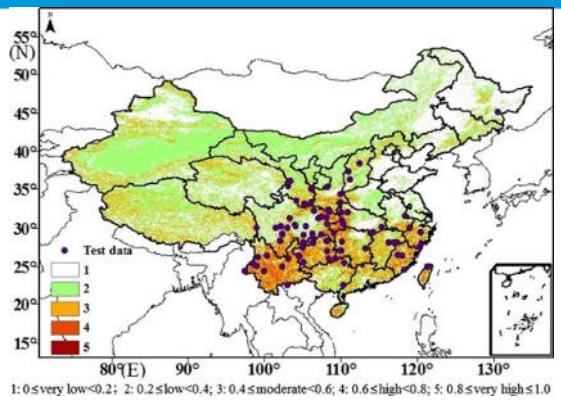


Potential Chinese Landslide Pilot Region:

South-western China

Zeng-Guang Zhou

zgzhou@aoe.ac.cn

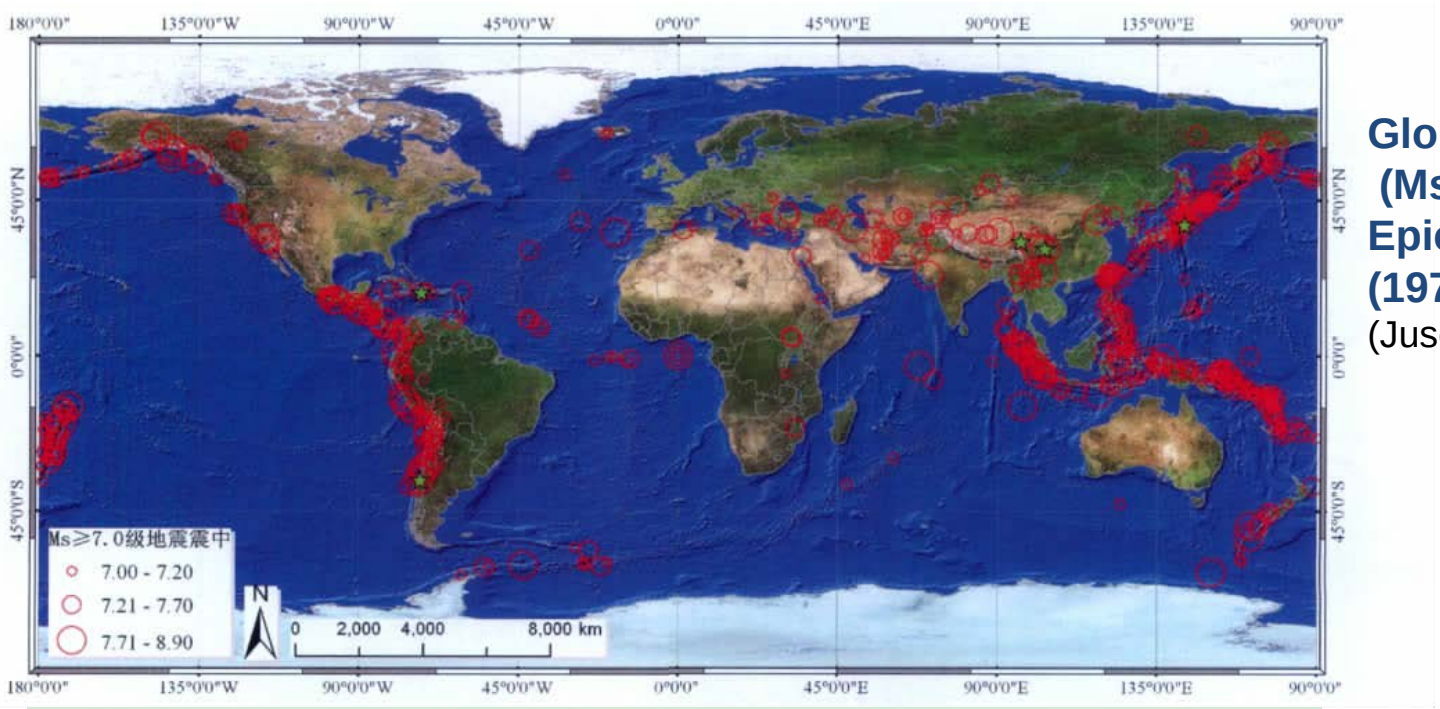
Key Laboratory of Quantitative Remote Sensing Information Technology, Academy of Opto-Electronics (AOE), Chinese Academy of Sciences (CAS)

CVO, Vancouver, USA, 6-8 September, 2016

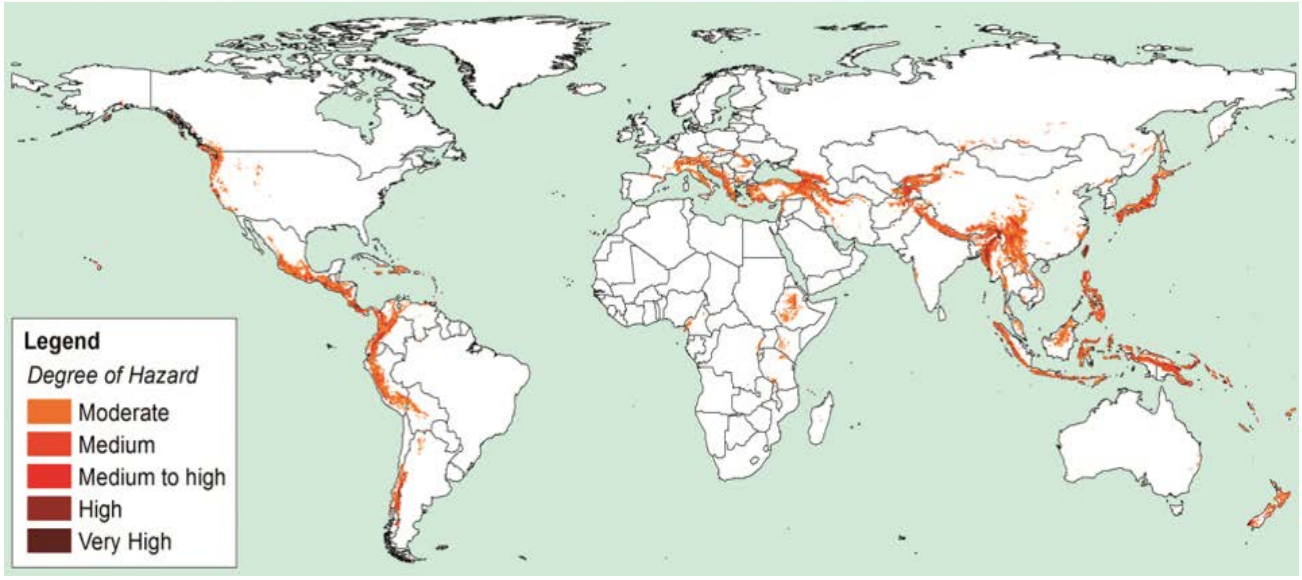
Outline

- 1 Landslide Hazards in China
- 2 Potential Chinese Landslide Pilot Region
- 3 Related Research Project

1. Landslide Hazards in China

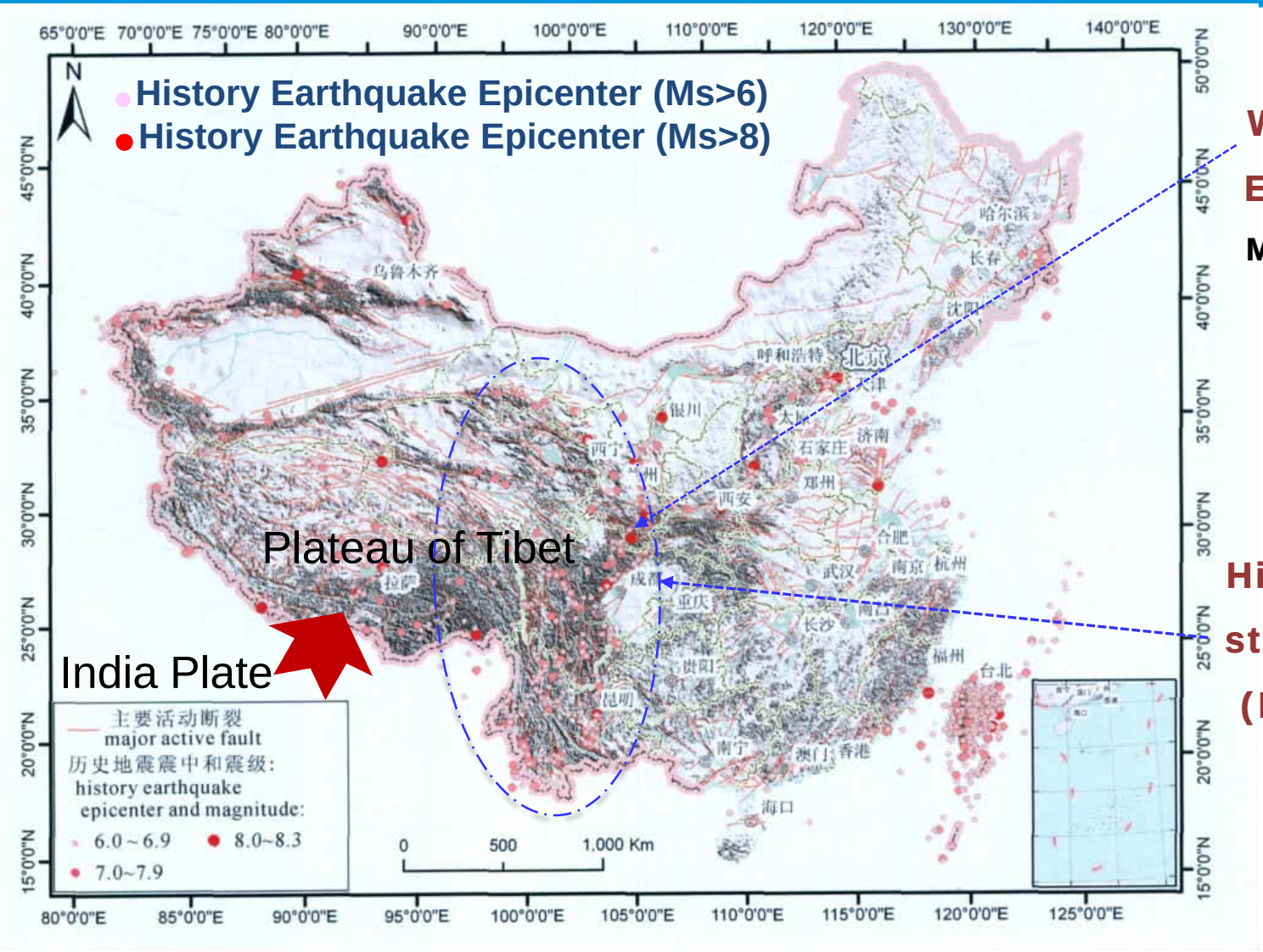


Global Strong Earthquake (Ms≥7.0) Epicenter Distribution (1970 ～ 2011)
(Jusong Shi et al., 2012)



Global Landslide Hazards Distribution
(Nadim et al., 2006)

1. Landslide Hazards in China



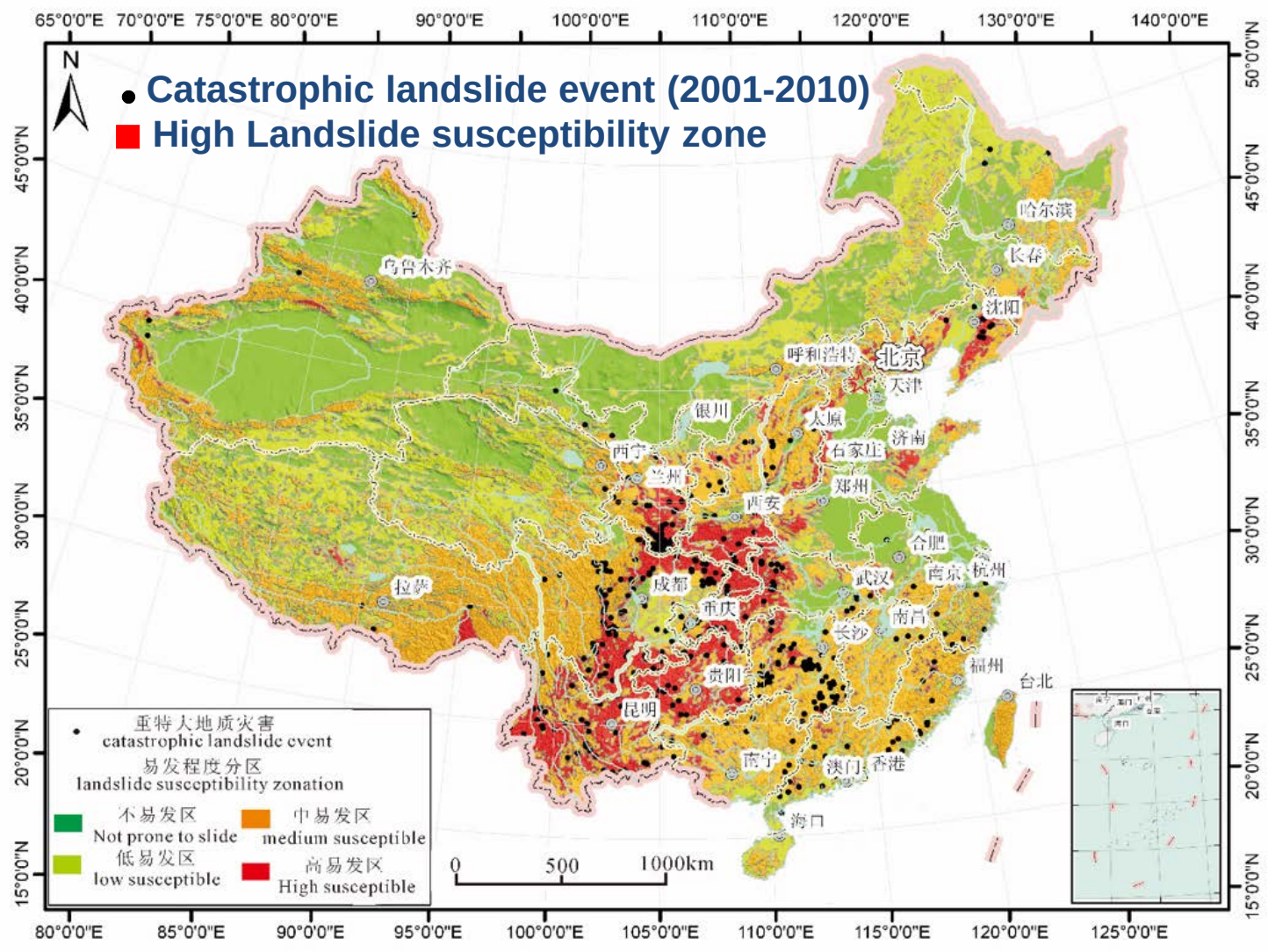
Wenchuan Ms8.0 Earthquake

May 12, 2008

High incidence of strong earthquakes (Ms>6)

Major active faults and history earthquake epicenter map of China
(Jusong Shi et al., 2012)

1. Landslide Hazards in China



Threating

- 280,000 potential landslide hazards*
- 10 million people
- 200 billion property

Damaging

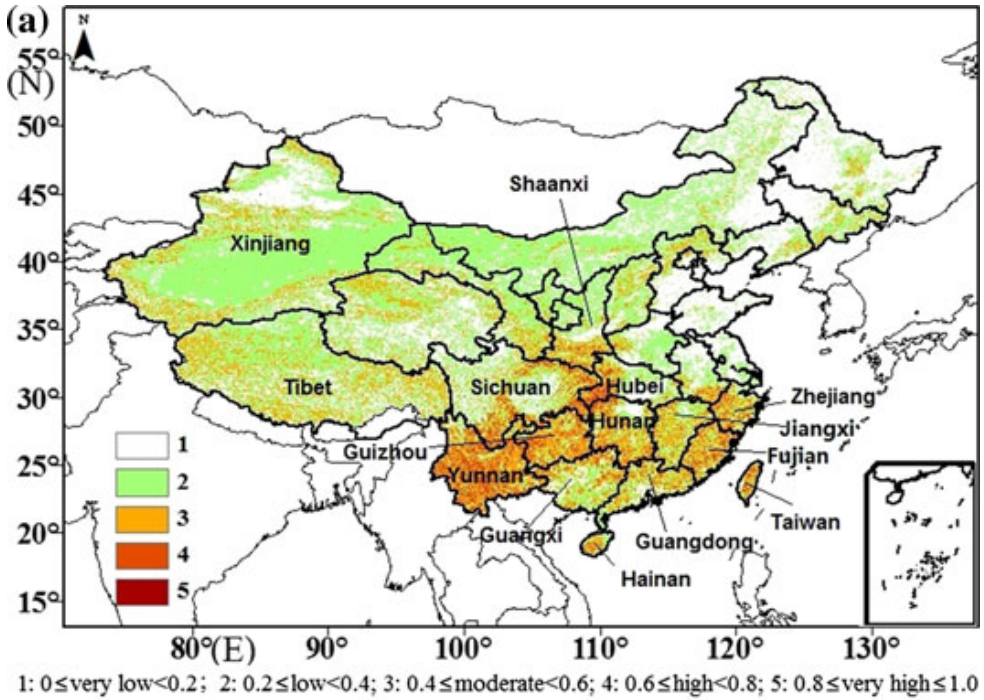
- People's property
- Infrastructure
- Eco-environment

in mountain areas

(*China Geological Survey)

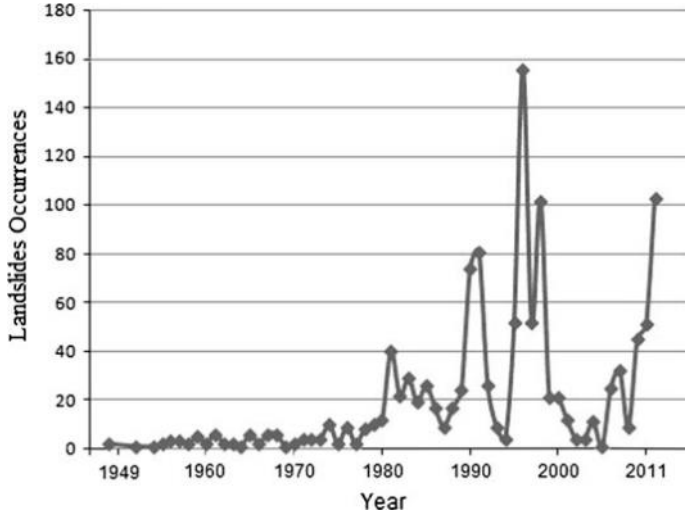
Landslide susceptibility map and catastrophic landslide events during 2001-2010 in China (Jusong Shi et al., 2012)

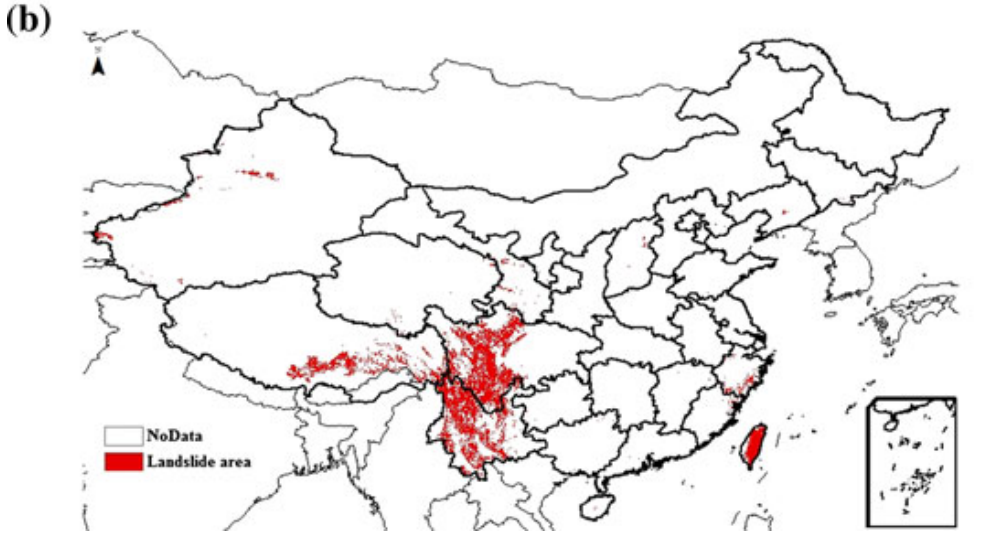
1. Landslide Hazards in China



Chinese landslide susceptibility map derived from surface multi-geospatial data

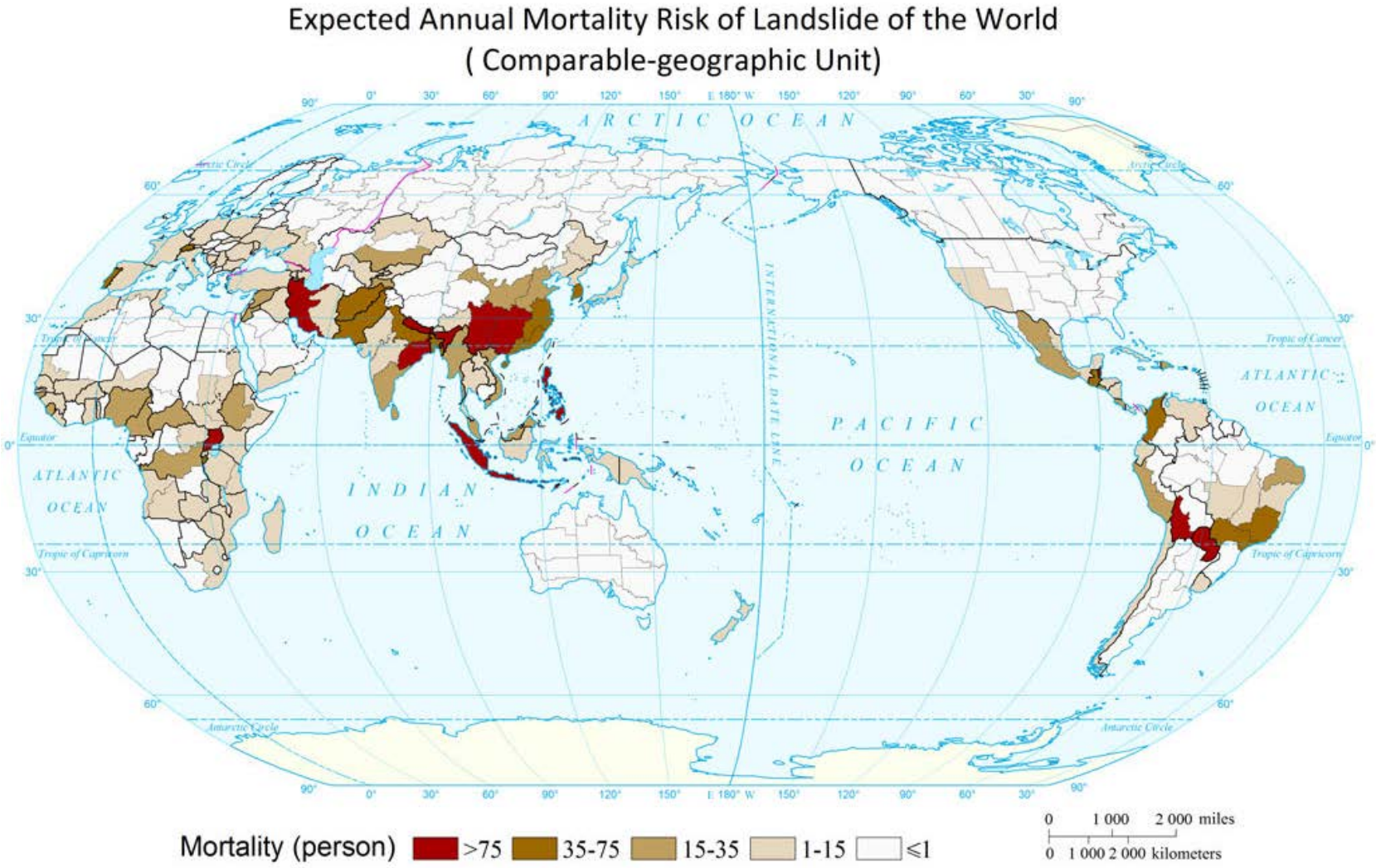
The number of landslide events over 60 years





China's Landslide Hazards hotspot map based on NGI's work in 2005
(Nadim et al. 2006)

1. Landslide Hazards in China



China (southwestern area) has highest landslide mortality risk !

(Mapping Landslide Risk of the World, Wentao Yang et al., 2015)

Outline

- 1 Landslide Hazards in China
- 2 Potential Chinese Landslide Pilot Region
- 3 Related Research Project

2. Potential Chinese Landslide Pilot Region

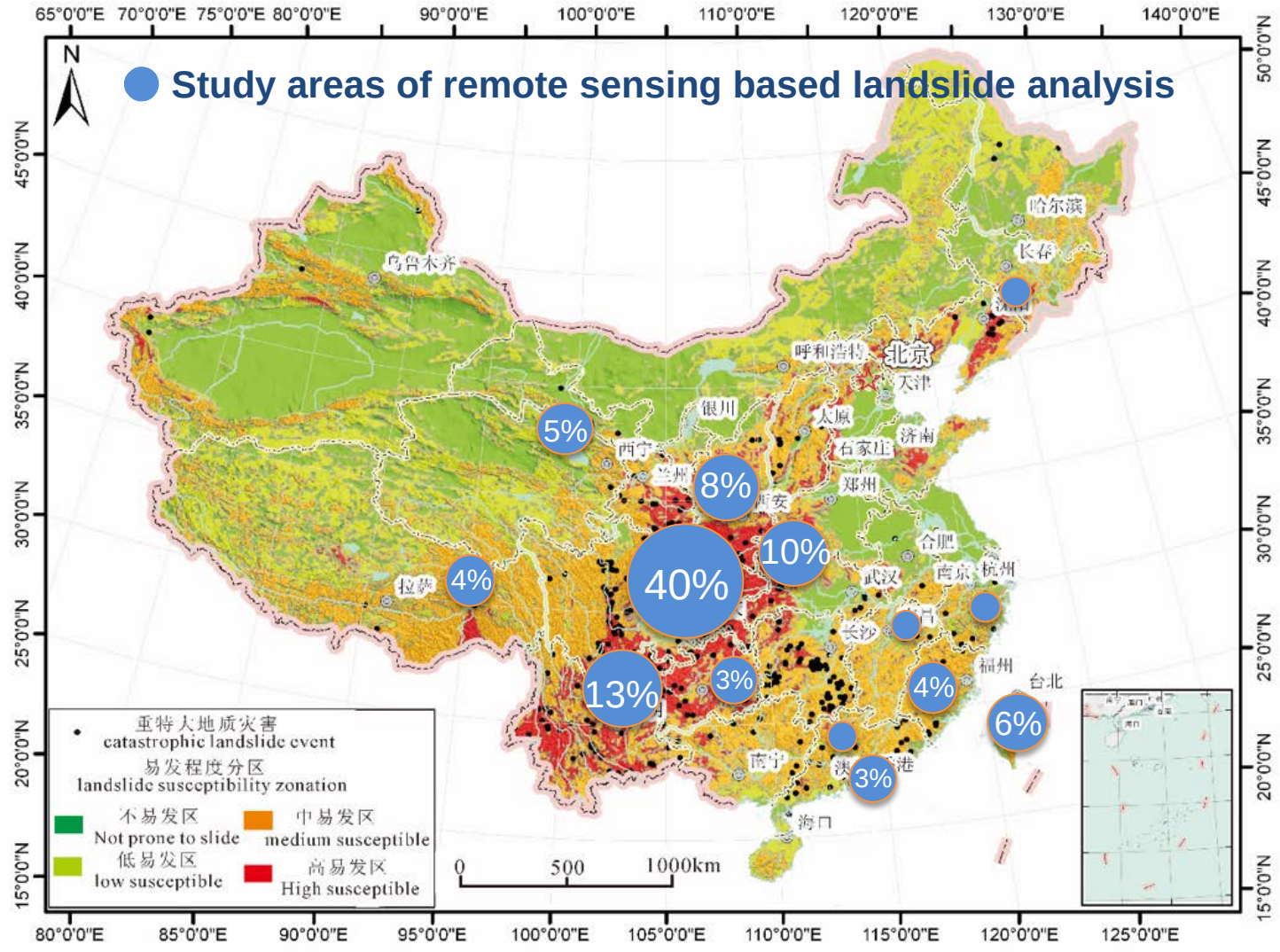
2.1 Pilot Region: SW China

2.2 Landslides after Wenchuan Ms8.0 Earthquake

2.3 Pilot Objectives & Outputs

2. Potential Chinese Landslide Pilot Region

2.1 Pilot Region: SW China

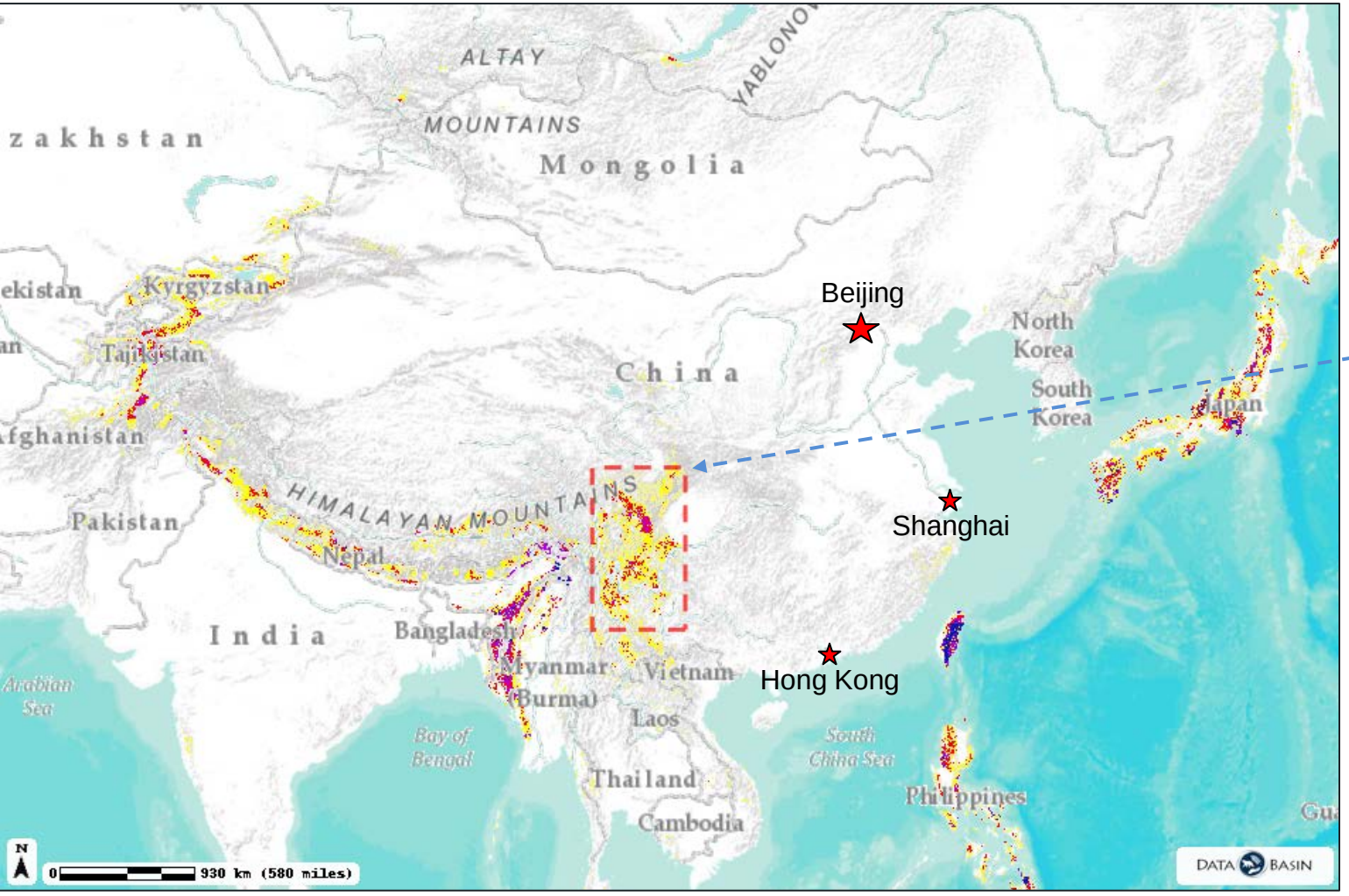


About ¾ studies focusing on SW China

(from investigation of 100+ studies of remote sensing based landslide analysis in China)

2. Potential Chinese Landslide Pilot Region

2.1 Pilot Region: SW China



Legend

Global Landslide Hazards Distribution

- 1-6
- 7
- 8
- 9
- 10

Pilot Region: SW China

Active earthquake & Landslide-prone region

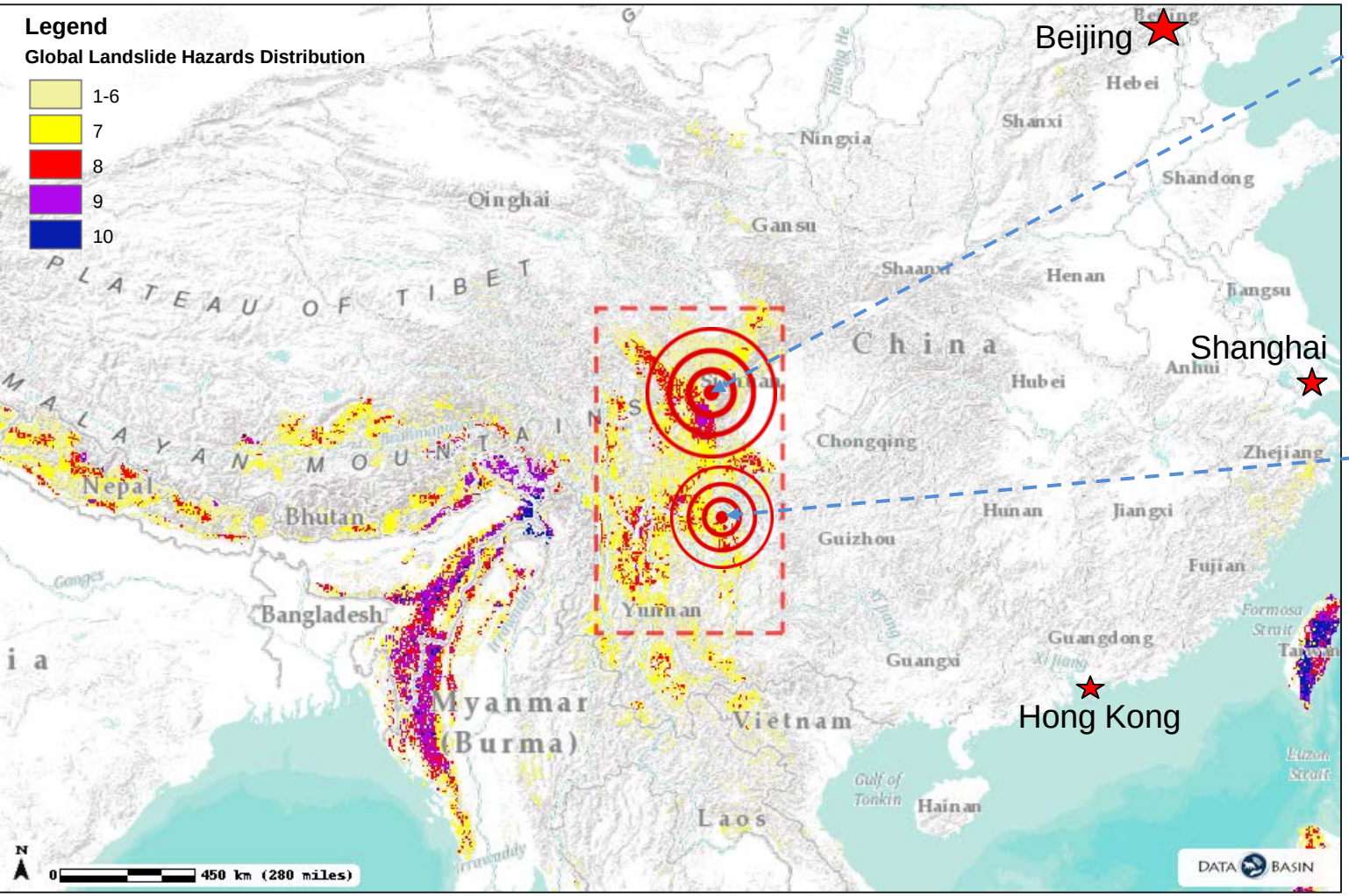
Global Landslide Hazards Distribution

https://databasin.org/datasets/b5c842f4b248464593a7673f5ad7f10f

Credits: Center for Hazards and Risk Research (CHRR); Center for International Earth Science Information Network (CIESIN), Columbia University; Norwegian Geotechnical Institute (NGI)

2. Potential Chinese Landslide Pilot Region

2.1 Pilot Region: SW China



Wenchuan Ms8.0 Earthquake

May 12, 2008

≈ 48,000 landslides*

≈ 70,000 fatalities
(20,000 by landslides)

Ludian Ms6.5 Earthquake

August 3, 2014

1,000+ big landslides

617 fatalities by earthquake

Thousands killed in landslides

Global Landslide Hazards Distribution

https://databasin.org/datasets/b5c842f4b248464593a7673f5ad7f10f

(*Runqiu Huang et al., 2011)

Credits: Center for Hazards and Risk Research (CHRR); Center for International Earth Science Information Network (CIESIN), Columbia University; Norwegian Geotechnical Institute (NGI)

2. Potential Chinese Landslide Pilot Region

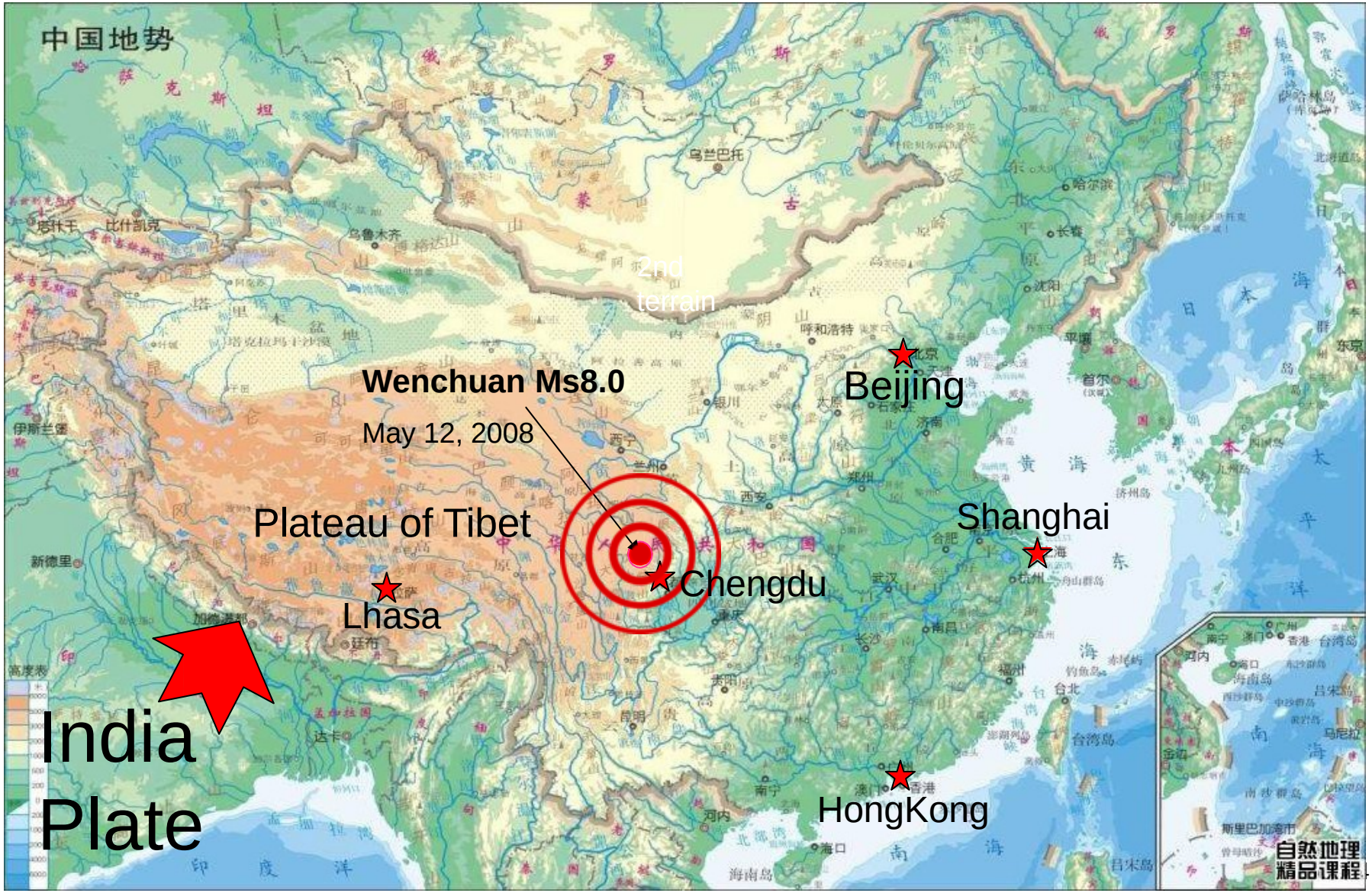
2.1 Pilot Region: SW China

2.2 Landslides after Wenchuan Ms8.0 Earthquake

2.3 Pilot Objectives & Outputs

2. Potential Chinese Landslide Pilot Region

2.2 Landslides after Wenchuan Ms8.0 Earthquake



2. Potential Chinese Landslide Pilot Region

2.2 Landslides after Wenchuan Ms8.0 Earthquake

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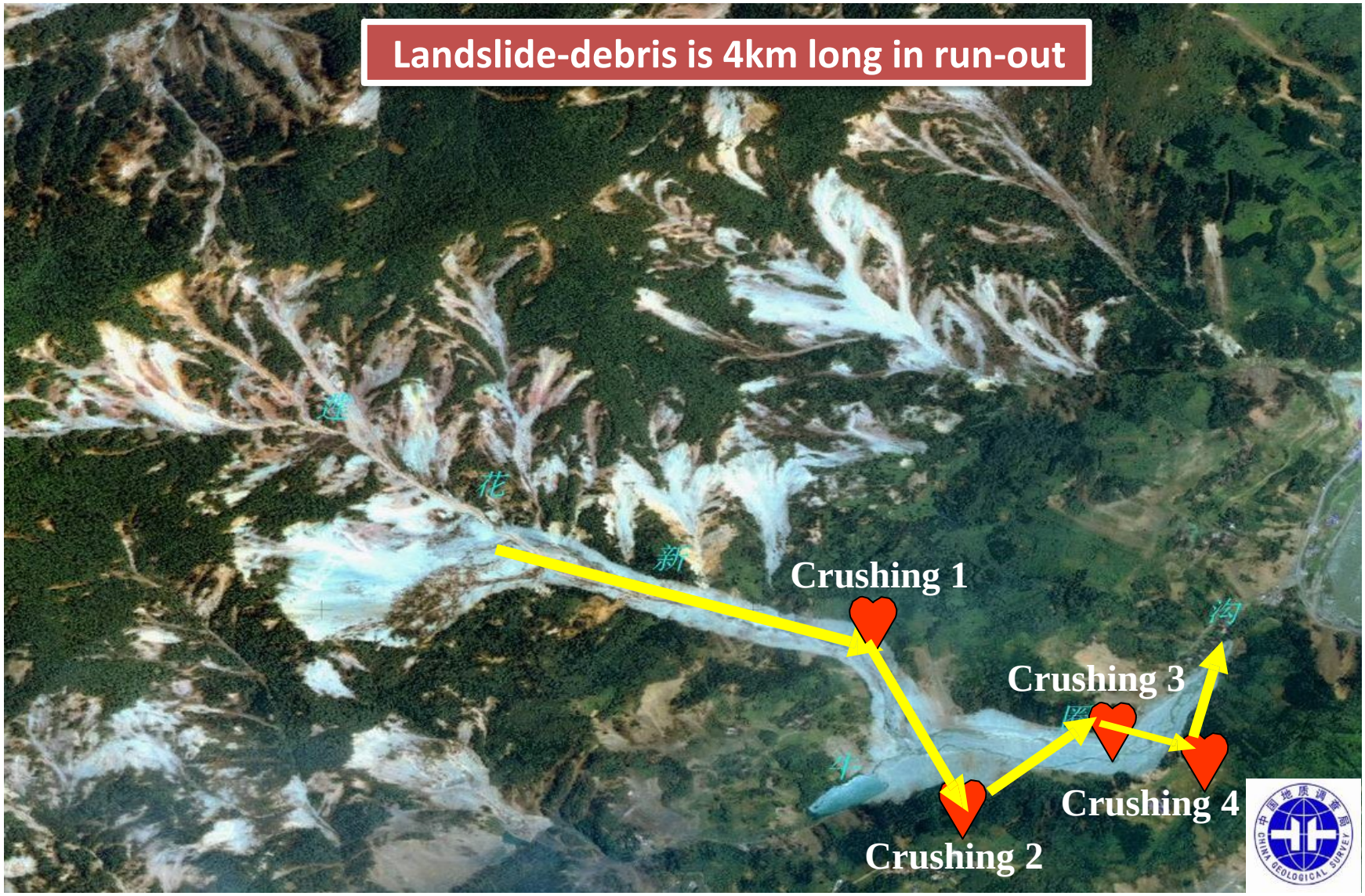
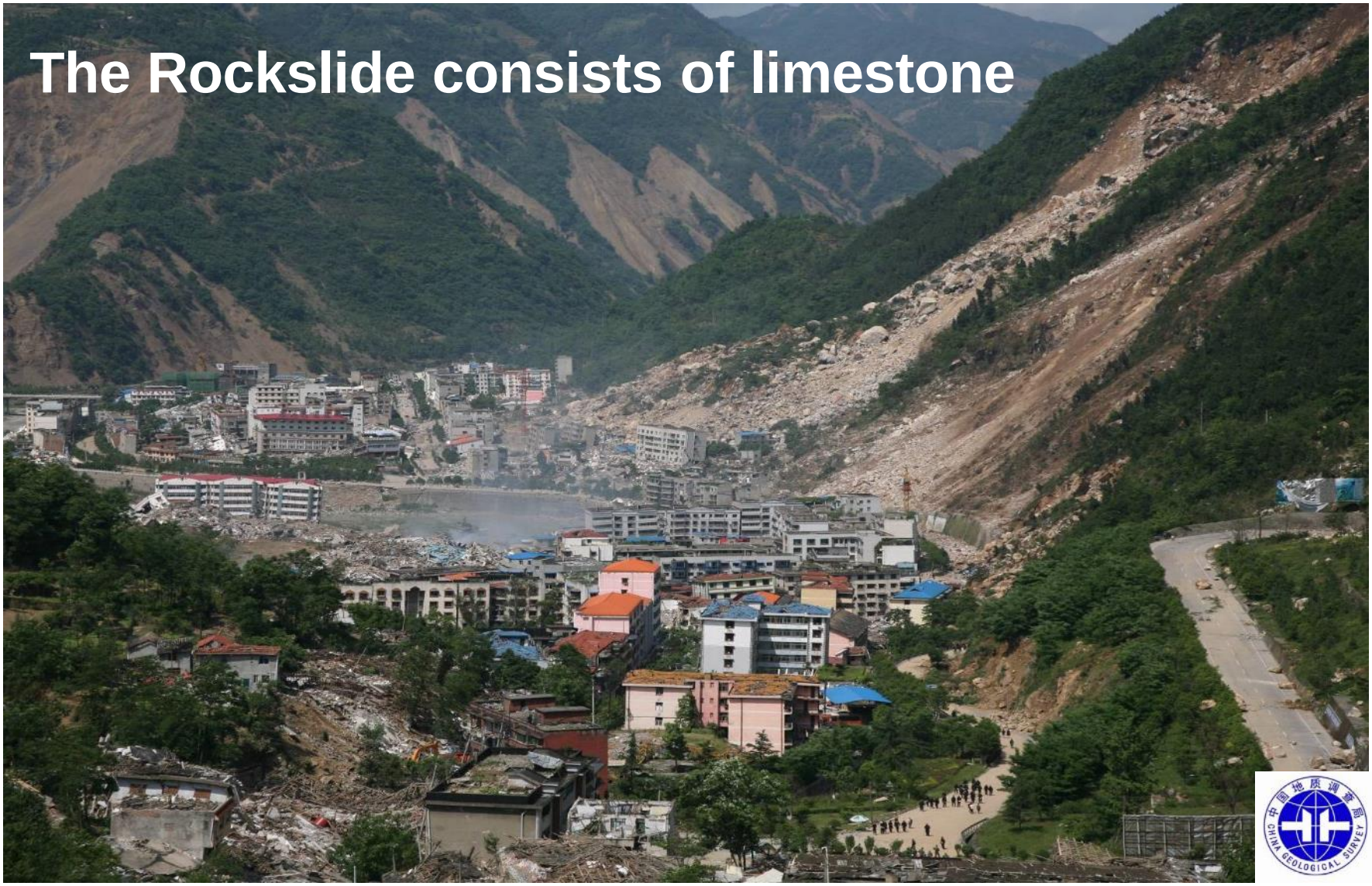


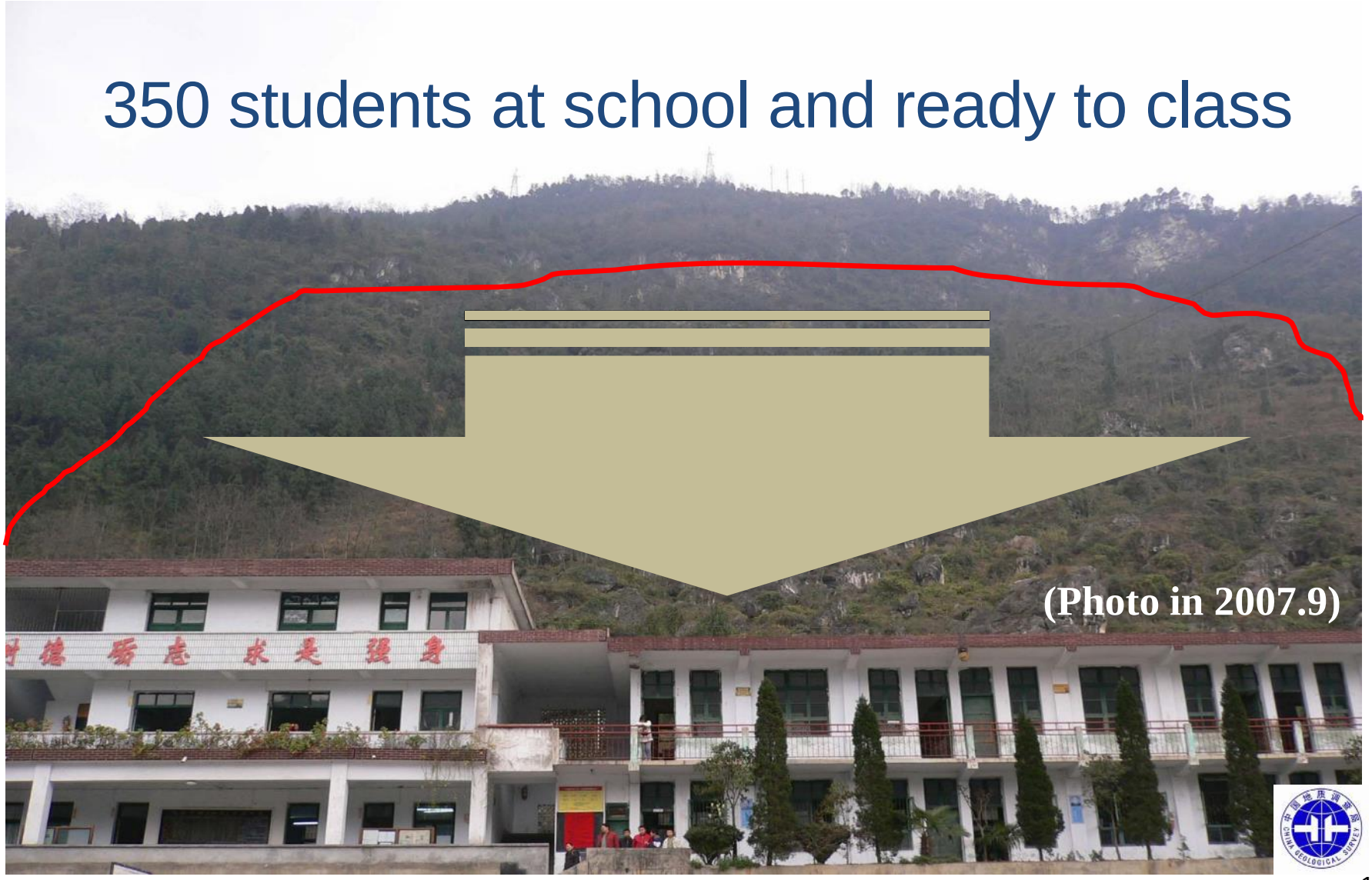
2. Potential Chinese Landslide Pilot Region

2.2 Landslides after Wenchuan Ms8.0 Earthquake



2.2 Landslides after Wenchuan Ms8.0 Earthquake

350 students at school and ready to class



2. Potential Chinese Landslide Pilot Region

2.2 Landslides after Wenchuan Ms8.0 Earthquake

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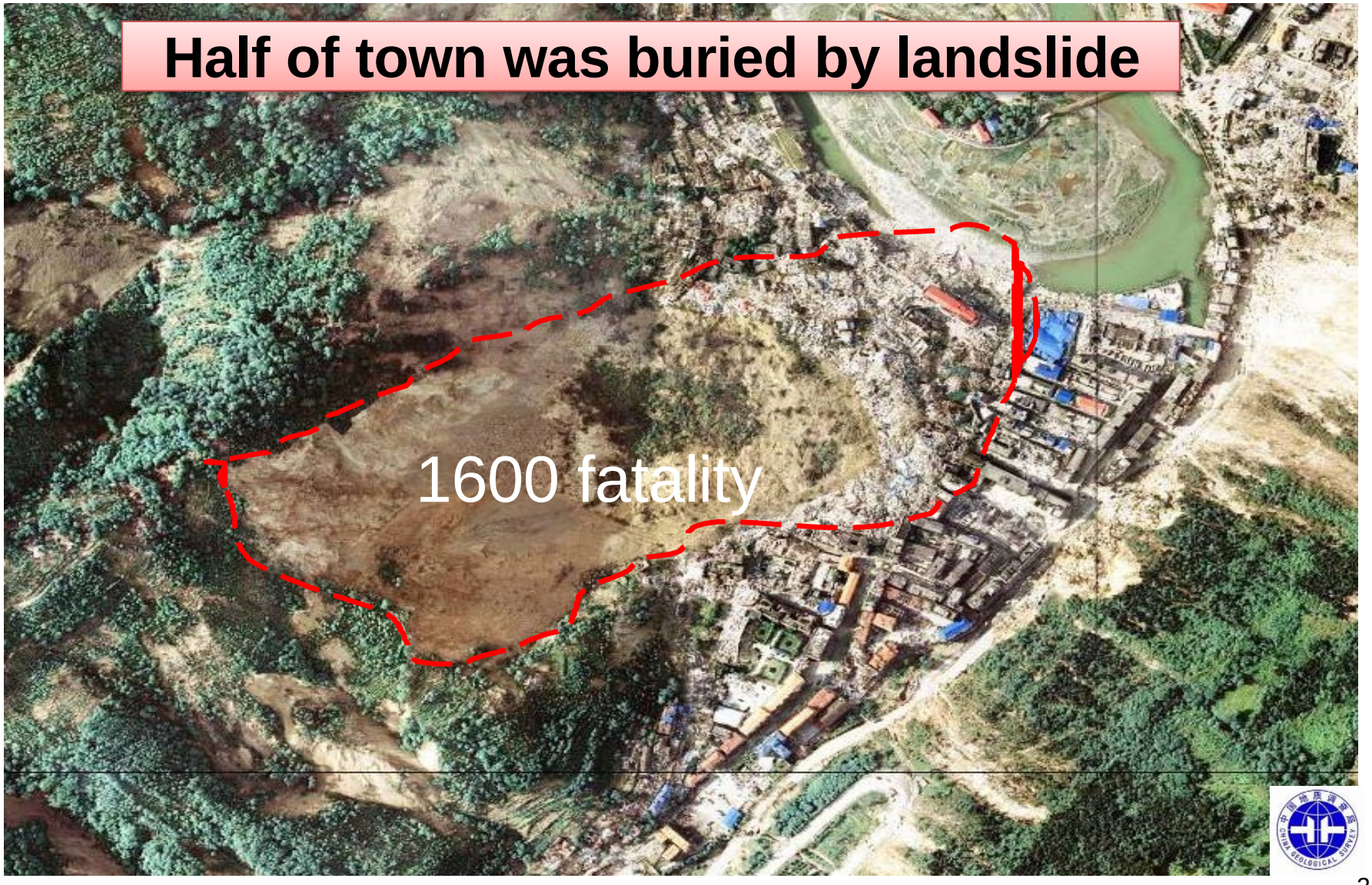


2. Potential Chinese Landslide Pilot Region

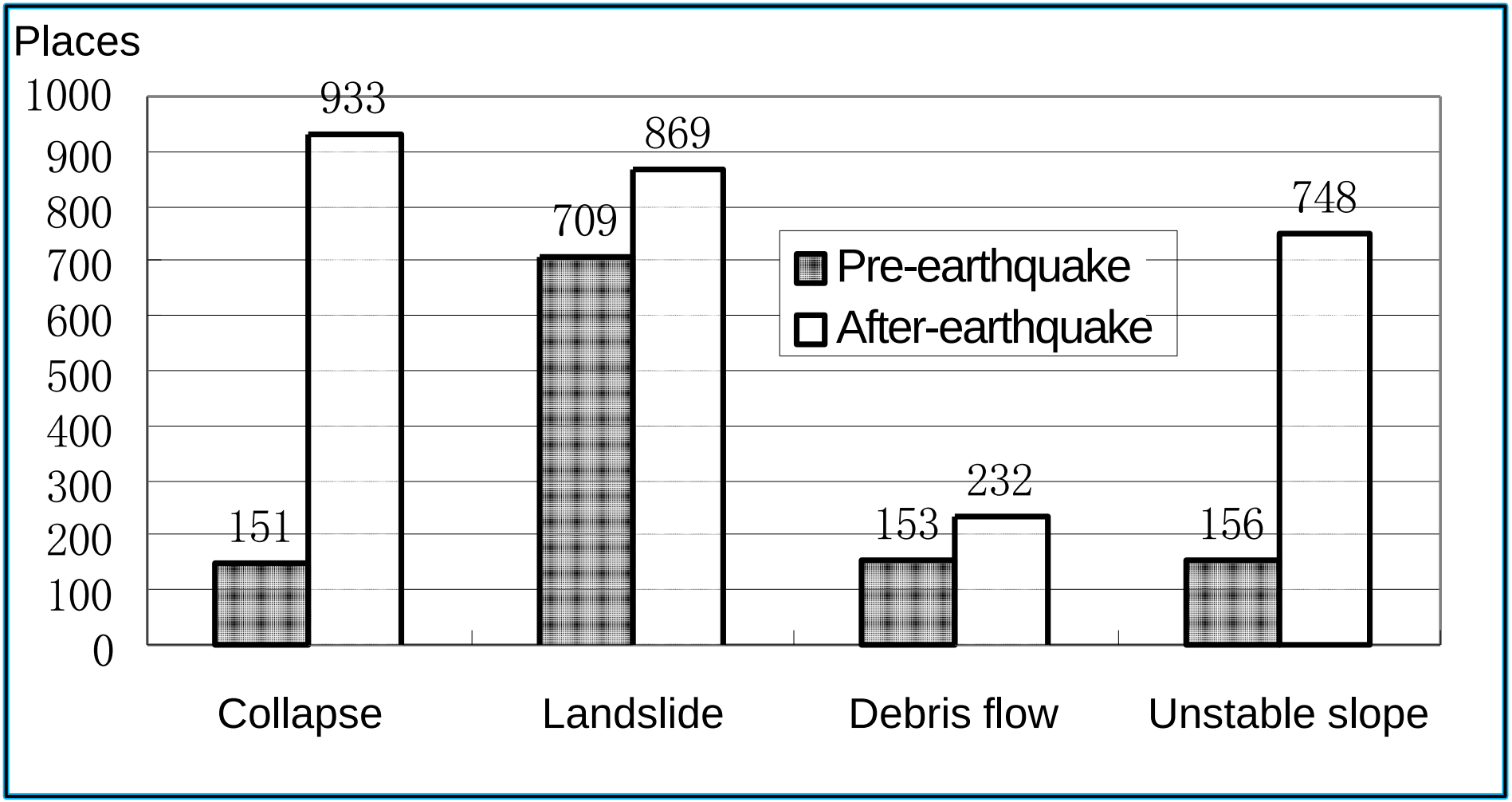
2.2 Landslides after Wenchuan Ms8.0 Earthquake

Landslide Name	Landslide Place	Volume (million m^3)	Deaths
城西滑坡	北川县老城王家岩	4.80	1600
都—汶路滑坡	都江堰—九寨沟旅游公路	100	1000
樱桃沟滑坡	北川县陈家坝乡茶园梁村	1.88	906
北川新中滑坡	北川县新县城中学新区	2.40	500
陈家坝滑坡	北川县陈家坝场镇	12	400
东河口滑坡	青川县红光乡东河口村	10	260
太洪村滑坡	北川县陈家坝乡太洪村	2	150
红村电站滑坡	石邡县石亭江红村电站	1	150
红岩村滑坡	北川县陈家坝乡红岩村	4.8	141
黎明村滑坡	都江堰市黎明村（213线）	0.2	120
罐滩滑坡	安县睢水镇罐滩	1.44	100
小龙潭崩塌	彭州市银厂沟景区	0.05	100
大龙潭沟口崩塌	彭州市银厂沟景区	0.1	100
谢家店滑坡	彭州市九峰村7社	4	100

Deaths due to earthquake landslides (>100)

2. Potential Chinese Landslide Pilot Region

2.2 Landslides after Wenchuan Ms8.0 Earthquake



Potential hazards in the counties of extreme severe hazards before/after earthquake

2. Potential Chinese Landslide Pilot Region

2.1 Pilot Region: SW China

2.2 Landslides after Wenchuan Ms8.0 Earthquake

2.3 Pilot Objectives & Outputs

2.3 Pilot Objectives & Outputs

- **Objectives**
  - **Objective A:**

    Develop effective methodologies for merging multi-source optical satellite imagery to better detect regional landslides in case of earthquake.

  - **Objective B:**

    For selected case studies areas (e.g., Wenchuan or Ludian) in SW China, monitor landslides hotspots using multi-source optical satellite EO on a quarterly to monthly basis.

2.3 Pilot Objectives & Outputs

- **Outputs**
  - **Output A:**

    Report on effective methodologies for multi-temporal landslide detection using multi-source optical satellite images.

  - **Output B:**

    Multi-temporal landslide inventory produced using multi-source optical satellite images for selected case studies areas (e.g., Wenchuan or Ludian) in SW China.

Outline

- 1 Landslide Hazards in China
- 2 Potential Chinese Landslide Pilot Region
- 3 Related Research Project

3. Related Research Project

Change Detection in Big Data of Satellite Image Time Series

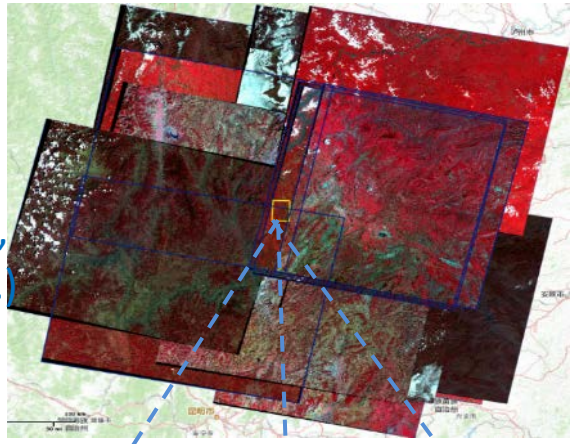
(funded by Chinese Academy of Sciences for 2016-2018.)

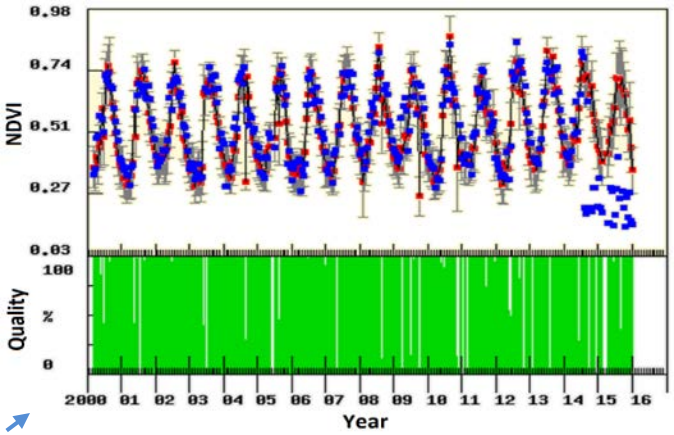
Goal:

A. **Develop methods for change detection using multi-source satellite image time series.**

B. **Demonstrate how the method can support multi-temporal landslide detection.**

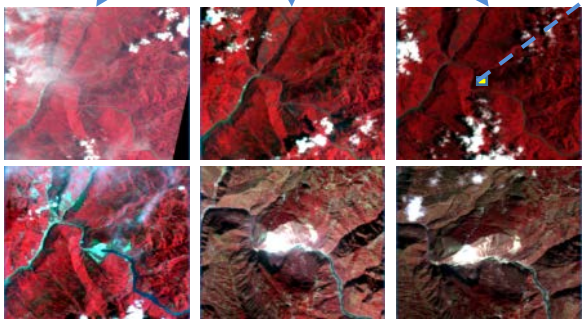
Multi-source optical images (Landsat, Spot, HJ, **GF**, ZY, etc.)

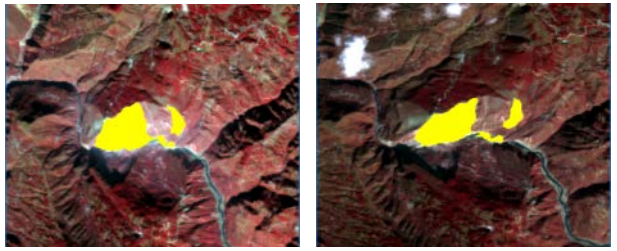




Time series change detection

High-freq images time series





Multi-temporal landslide detection

3. Related Research Project

Change Detection in Big Data of Satellite Image Time Series

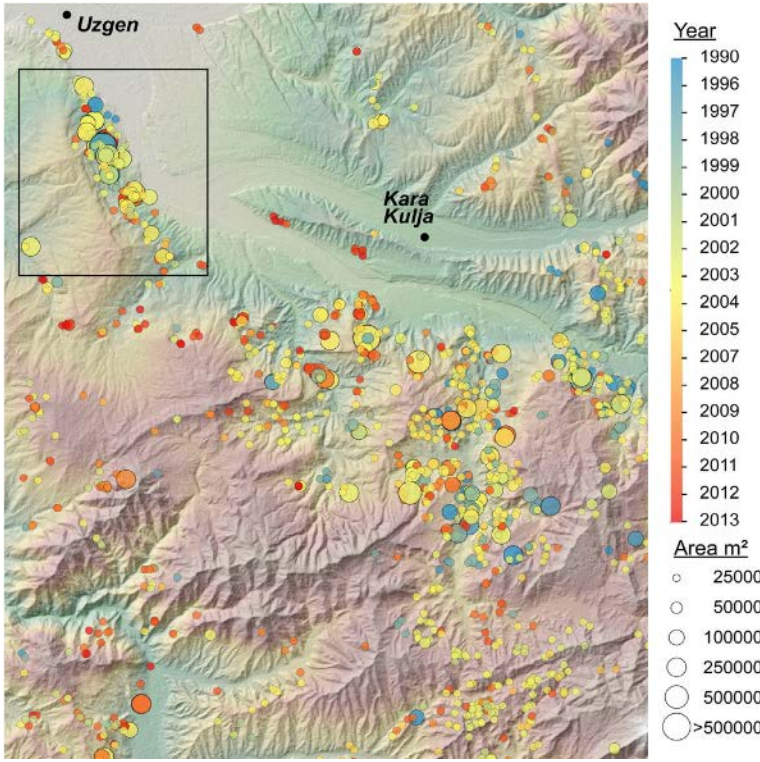
(funded by Chinese Academy of Sciences for 2016-2018.)

Expected highlights:

A. **Merging multi-source optical satellite images time series.**

B. **Detecting changes in image time series on a monthly basis.**

C. **Detecting regional landslides over space and time after an earthquake.**



Yearly multi-temporal landslide inventory in Kyrgyzstan
(Robert Behling, et al., 2016)

Potential Chinese Landslide Pilot Region: SW China

Thanks