CEOS Working Group on Disaster Meeting #5

How will China's ArcSer system support landslide monitoring?

Ziyang Li

zyli@aoe.ac.cn

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

8 March, 2016 DLR, Bonn, Germany

Outline

- 1 An overview of the ArcSer system
- 2 How to improve the ArcSer – a prospect
- 3 Supporting projects

2. An overview of the ArcSer system

Overview

ArcSer was introduced in detail at the CEOS WGDisaters Meeting #4 held in Frascati Italy in 2015, by Prof. Chuanrong Li , AOE of CAS.

- **What is ArcSer?**
  - Aerospace Application Coordination System for Emergency Response and Data Sharing
- **What is it for?**
  - An universal mechanism and system to coordinate the spatial resources to implement disaster reduction
- **Who operates it?**
  - AOE, as EO sharing service center for emergency response, is responsible for ArcSer's operation.
  - AOE plays a key role in EO technology for disaster reduction in China.

2. An overview of the ArcSer system

Framework & Workflow

Ministry of Science and Technology of China

Emergency Management Office of the State Council

National Committee for Disaster Reduction of China

Other Related Departments

Spatial Data acquisition and Application Coordination System for Emergency Response

Spatial Data Sharing Service Center for Emergency Response

Integrated Space Remote Sensing Data Acquisition System

Integrated Aerial Remote Sensing Data Acquisition System

Severe Disaster
especially earthquake

- Coordinate civil aerospace resources to acquire remote sensing data for disaster area
- Acquire aerospace remote sensing data and collects the data together
- Distribute the data to disaster reduction application agencies a.s.a.p.

2. An overview of the ArcSer system

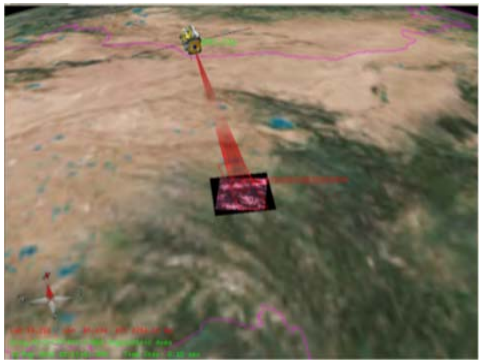
Characteristics

1. Unified
- Unified coordination mechanism of EO data sharing for emergency response.
- Adopt universal standards for aerospace data acquisition and exchange.

2. Extensive and Timely
- Capable to coordinate and dispatch all civil satellite and aerial resources.
- Plan space and aerial tasks uniformly based on EO data requirements.

3. Consultation supportive
- Disaster experts, space technology engineers, government officers, end users etc., can consult together on how to acquire EO data.

4. Visual
- Display tasks implementing state, disaster information, related base data, and EO data of disaster area.

Outline

- 1 An overview of the ArcSer system
- 2 How to improve the ArcSer – a prospect
- 3 Supporting projects

2. How to improve the ArcSer – a prospect

2.1 Two cases of landslides needed to monitor

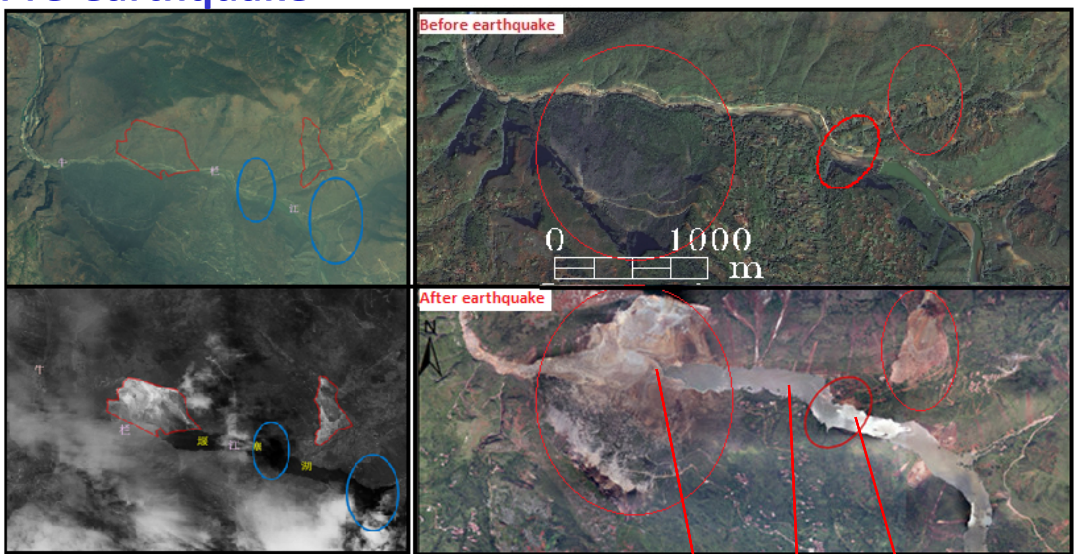
2.2 Current situation of the ArcSer for landslide monitoring

2.3 Ways to improve the ArcSer to support landslide monitoring

2.1 Two cases of landslides needed to monitor

Case 1: Seismic-triggered landslides

Pre-earthquake



Post-earthquake

Landslide barrier

barrier lake

- **Location**
  - Riverside in Ludian, Yunnan, China
- **Time**
  - 2014-08-03, after 16:30
- **Trigger factor**
  - Ms 6.5 Earthquake in Ludian
- **Landslide & barrier dam**
  - Landslide size: > 1km * 1km
  - Height of barrier: ~120 m
- **Barrier lake size**
  - Rising of water level: 58 m
  - Water storage: > 50 million m^3
- **At risk**
  - 40,000 people in 10+ towns
  - 30 ㎞² cropland

inundated power station

2.1 Two cases of landslides needed to monitor

Case 2: Human-activity-triggered landslide

Pre-slide   Post-slide

- **Location**
  - Urban area in Shenzhen, China
- **Time:** 2015-12-20 11:40
- **Trigger factor**
  - Excessive stacking of waste soil
- **Slide size**
  - Depth: tens of meters
  - Area: ≈ 0.3-0.5km * 1.2km, 380,000 ㎡
  - Volume: 4,000,000 m^3
- **Losses**
  - 33 buildings buried/damaged
  - 69 dead, 8 missing

sweeping like
sea waves

2. How to improve the ArcSer – a prospect

2.1 Two cases of landslides needed to monitor

2.2 Current situation of the ArcSer for landslide monitoring

2.3 Ways to improve the ArcSer to support landslide monitoring

2. How to improve the ArcSer – a prospect

2.2 Current situation of the ArcSer for landslide monitoring

- **Lack of feedback from users**
  - **ArcSer distributed all available EO data to users but got few feedback**
  - **ArcSer did not know much about user's data and service requirements**
- **Lack of aerial remote sensing data**
  - **ArcSer mainly coordinated and dispatched satellite resources**
  - **ArcSer has a mechanism to coordinate aerial resources, but they are scarce and difficult to get in time when great natural catastrophe occurred.**
- **Lack of hazard information product**
  - **ArcSer is mainly engaged in acquiring, managing and distributing EO data to users for emergency response.**
  - **ArcSer now provides no hazard information product derived from EO data.**

2. How to improve the ArcSer – a prospect

2.1 Two cases of landslides needed to monitor

2.2 Current situation of the ArcSer for landslide monitoring

2.3 Ways to improve the ArcSer to support landslide monitoring

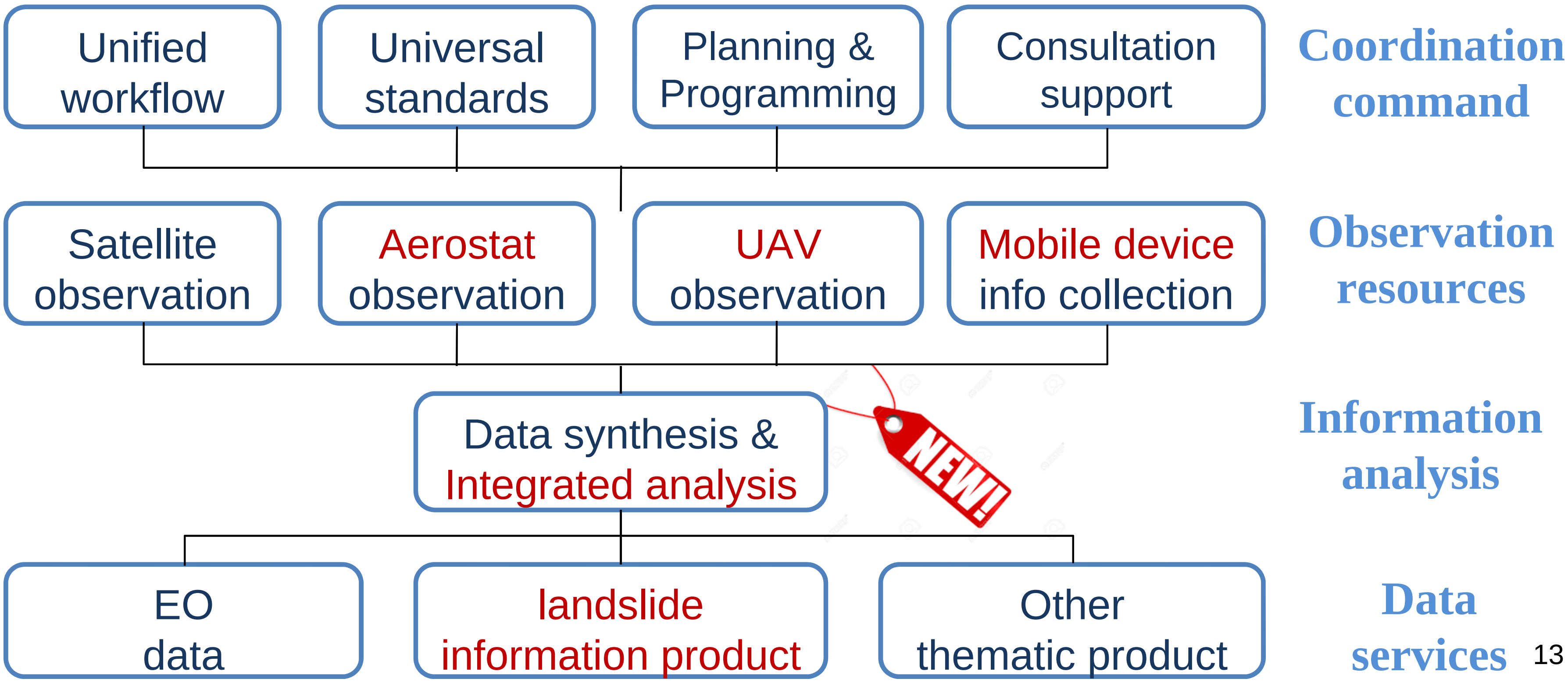
2. How to improve the ArcSer – a prospect

2.3 Ways to improve the ArcSer to support landslide monitoring

I. Find **ArcSer's end-users** & potential **participants** of Landslide Pilot

II. Integrate **aerial** remote sensing resources

III. Produce hazard / **landslide information product**



2. How to improve the ArcSer – a prospect

I. Find ArcSer's end-users & potential participants of Landslide Pilot

ArcSer's command and control center

Academy of Opto-Electronics (AOE), Chinese Academy of Sciences (CAS)

- Institute of Mountain Hazards and Environment (IMDE), CAS
- Institute of Water Resources and Hydropower Research
- National Disaster Reduction Center of China (NDRCC)
- China Eartqhuake Networks Center
- Institute of Crustal Dynamics (ICD), China Earthquake Administration (CEA)
- …

Landslide Pilot Survey Questionnaire:

Questions for CEOS Landslide Pilot Survey

1. What is your area(s) of expertise or operational authority or responsibility (e.g. research focus or, disaster response and recovery)?
2. In what geographic region(s) do you primarily work or have responsibility (e.g. Global, national, and regional)?
3. The proposed Pilot Objectives are listed below. Please rate your interest in each (1 – Very important/relevant to your work, 2- Moderately important/relevant, 3 – Neutral, 4 – Not important/relevant). You can include all 1s or 4s depending on the importance.

__Objective A:__
Establish effective practices for merging different Earth Observation data (e.g. optical and radar) to better manage landslide detection, mapping, and monitoring.

__Objective B:__

We distributed the questionnaire to our Chinese partners, received 8 responses from 5 institutions, and found 10 potential participants of the Landslide Pilot.

2. How to improve the ArcSer – a prospect

I. Find ArcSer's end-users & potential participants of Landslide Pilot

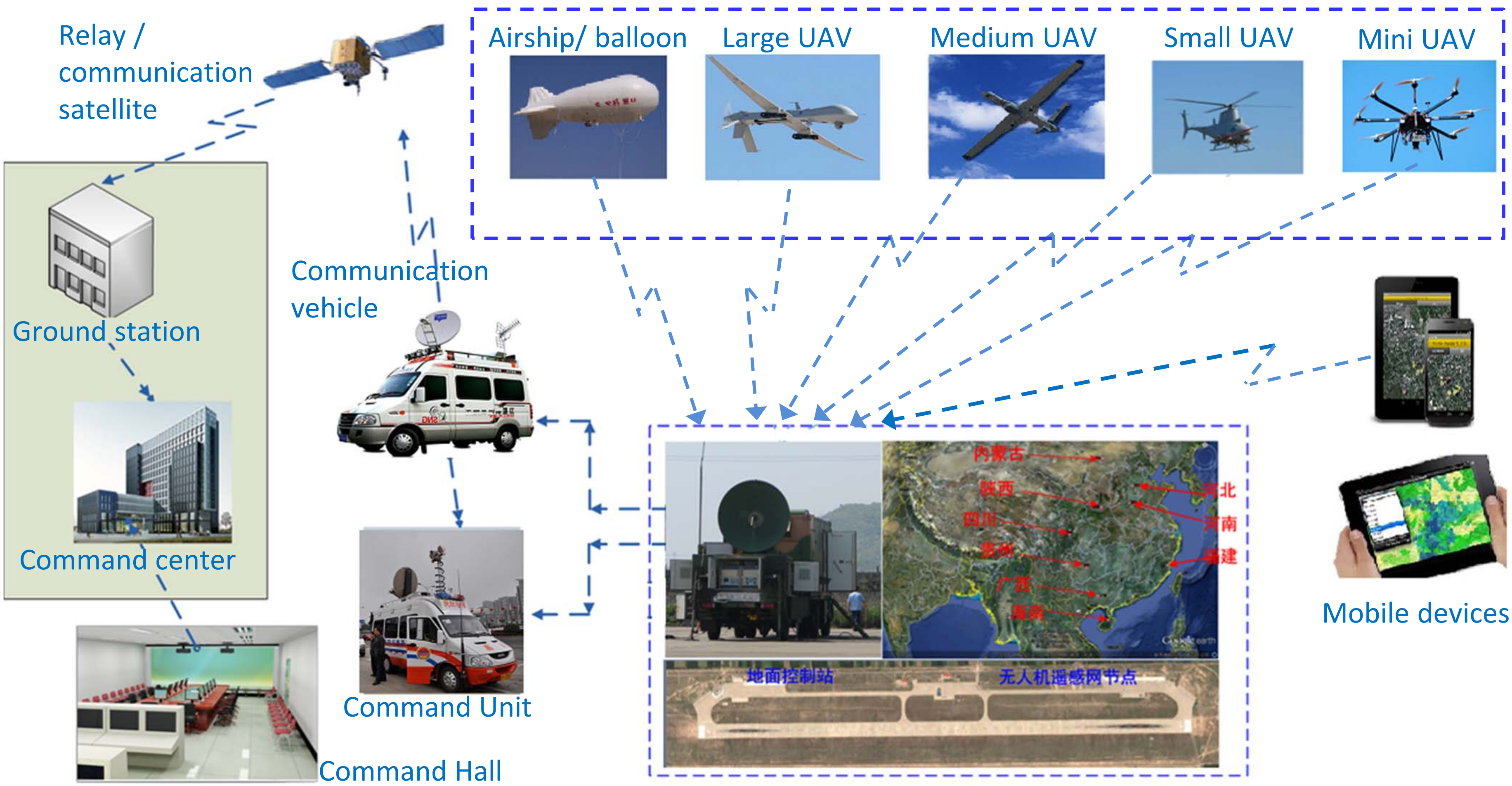
- **Number**
  - 10 people
- **Roles**
  - Researcher
  - Disaster Response Coordinator
  - User
- **Research**
  - Image analysis for landslide detection
  - Seismic landslides risk assessment
  - Hydro-meteorological related hazards
  - …
- **Disaster response**
  - EO data coordination and sharing
  - Earthquake disaster emergency and relieve
  - Post-disaster impact assessment
  - …

- **Research area foci:**
  - China
  - Southwest China
  - South Asia
- **EO data requirements**
  - High-res optical images for landslide mapping and risk assessment
  - Optical and radar images for landslide process understanding
  - InSAR data for landslide monitoring
  - Images of staring camera in stationary orbit
  - …

2. How to improve the ArcSer – a prospect

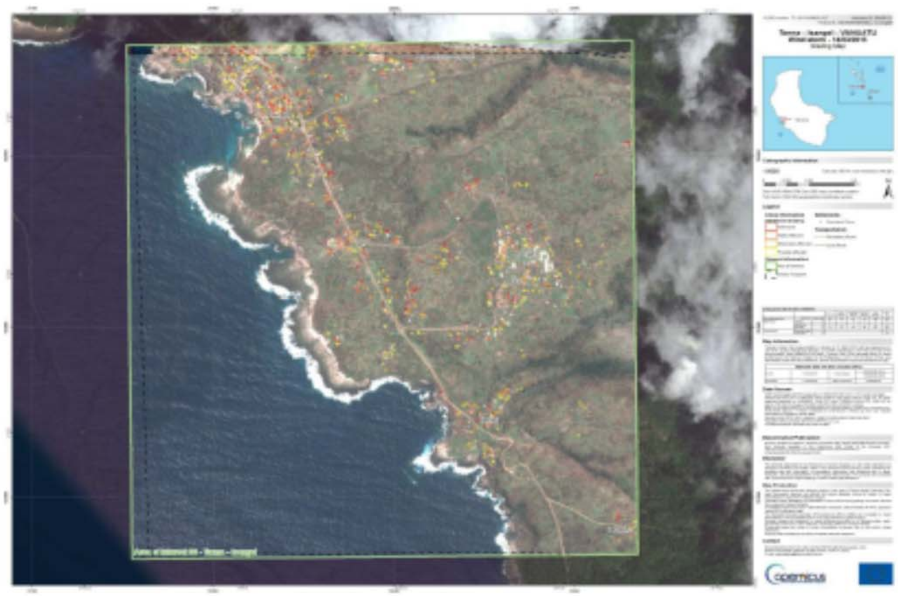
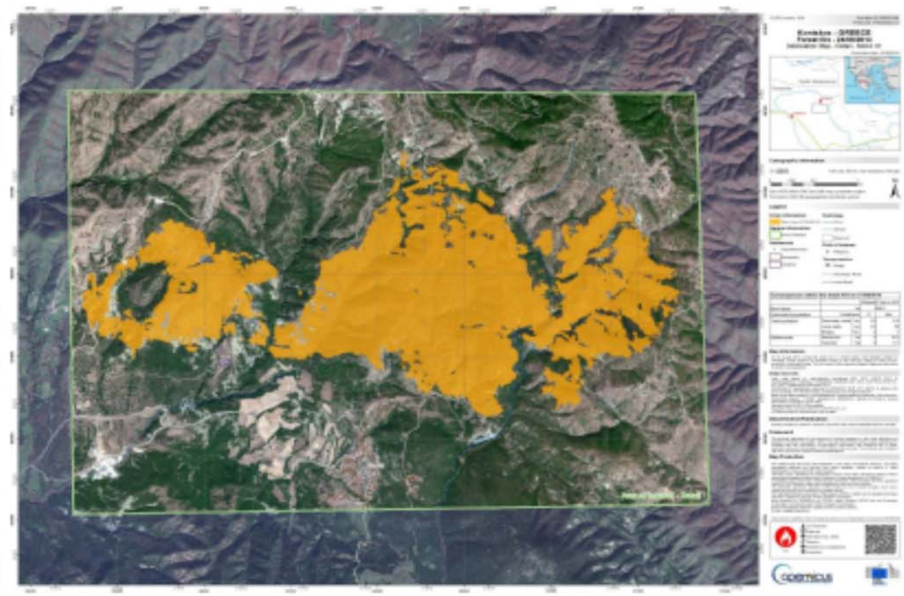
II. Integrate aerial remote sensing resources

- **Aerial remote sensing resources, especially from aerostat and UAV platform, will provide technology support for optimizing aerial resources to further improve the emergency response (and landslide monitoring) capabilities.**



III. Produce hazard / landslide information product

- Like the Copernicus Emergency Management Service (EMS) Rapid Mapping service, the hazard maps can be produced by visual-interpretation of EO data.
- By developing and integrating some landslide monitoring algorithms, landslide information (e.g., delineation, dynamic changes, forecast) products can be automatically produced and distributed to users.

Hazard maps of the Copernicus EMS Rapid Mapping service

Outline

- 1 An overview of the ArcSer system
- 2 How to improve the ArcSer – a prospect
- 3 Supporting projects

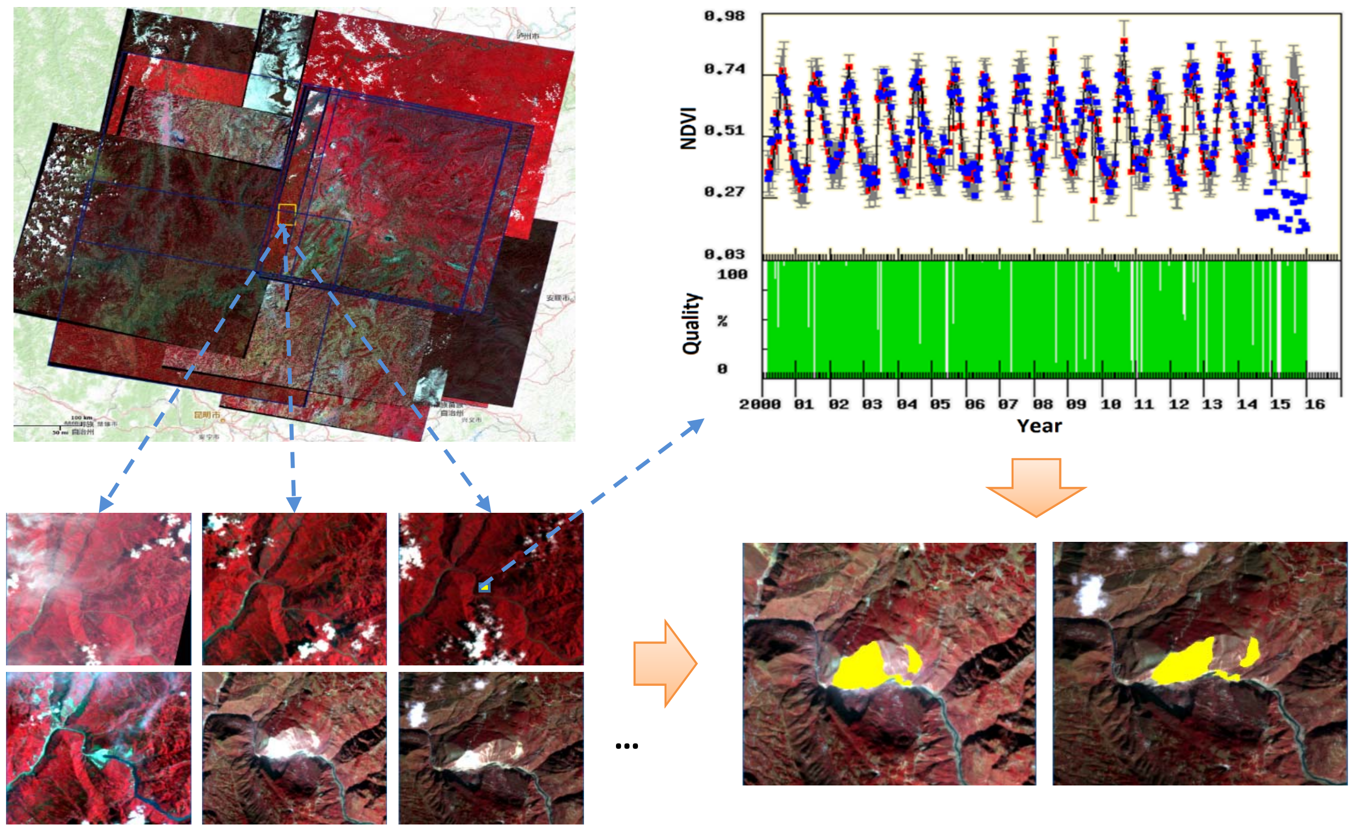
3. Supporting projects

- **Present**
  - **We have obtained funding from AOE since 2016: a Startup Project for research on landslide monitoring using remote sensing big data.**

Now developing algorithm for monitoring spatial-temporal dynamics of landslides using multi-source remote sensing image time series.

Multi-source images

Time series analysis



High-freq images time series

Landslide dynamic monitoring

3. Supporting projects

- **Future**
  - **We are now applying for a Natural Science Fund Project from China NSFC (Natural Sciences Foundation Committee) for research on landslide monitoring using multi-source satellite image time series.**
  - **We are also applying for a Major Special Project on Earth Observation from China's MOST (Ministry of Science and Technology) for Integrated ground-air-space based remote sensing technology and systems for cooperative emergency monitoring.**
  - **We will get continuous funding to engage in improving the ArcSer system to support landslide monitoring and contributing to the CEOS Landslide Piot.**

Thank you !

Lucky dolls of Chinese New Year