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2017年“龙计划”四期学术研讨会

Research on Potential Landslides Identification Using SBAS Technology——A Case Study of Minjiang River Basin

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DRAGON 4 ID. 32365 PROJECT

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Sub-project and theme:

Id. 32365_3

Spatio-temporal landslide identification and activity assessment for hazard and risk investigations in Longnan region, Northwest China.

O1: The creation and updating of multi-temporal landslide inventory maps which also describe the landslide' state of activity;

O2: The acquisition of ground-based landslide monitoring data for a validation of remote sensing-based maps.

O3: The application of local and regional landslide simulation models to predict future landslide scenarios;

O4: The qualitative and quantitative assessment of landslide hazards and risks.

Landslides in Wenchuan earthquake area (LongMen Mountain in Sichuan province) + Longnan area in South-East of Gansu province



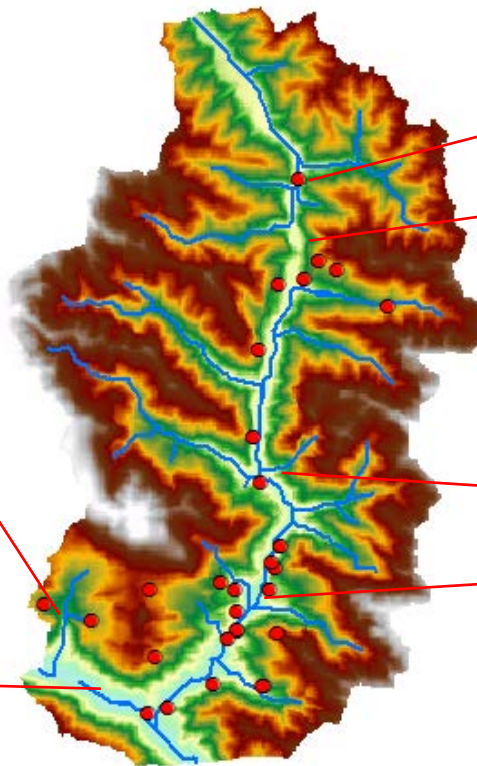
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Data: GTO, NOAA, U.S. Navy, NGA, GEBCO



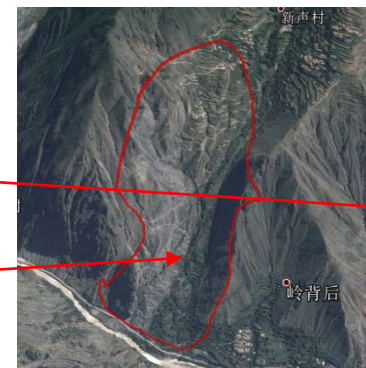
← Suertou landslide
reason why choose the study area?
Huma landslide →



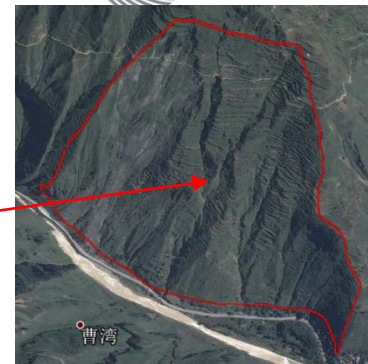
Xieliupo landslide



Lubanyan landslide →



Shiyuzi landslide



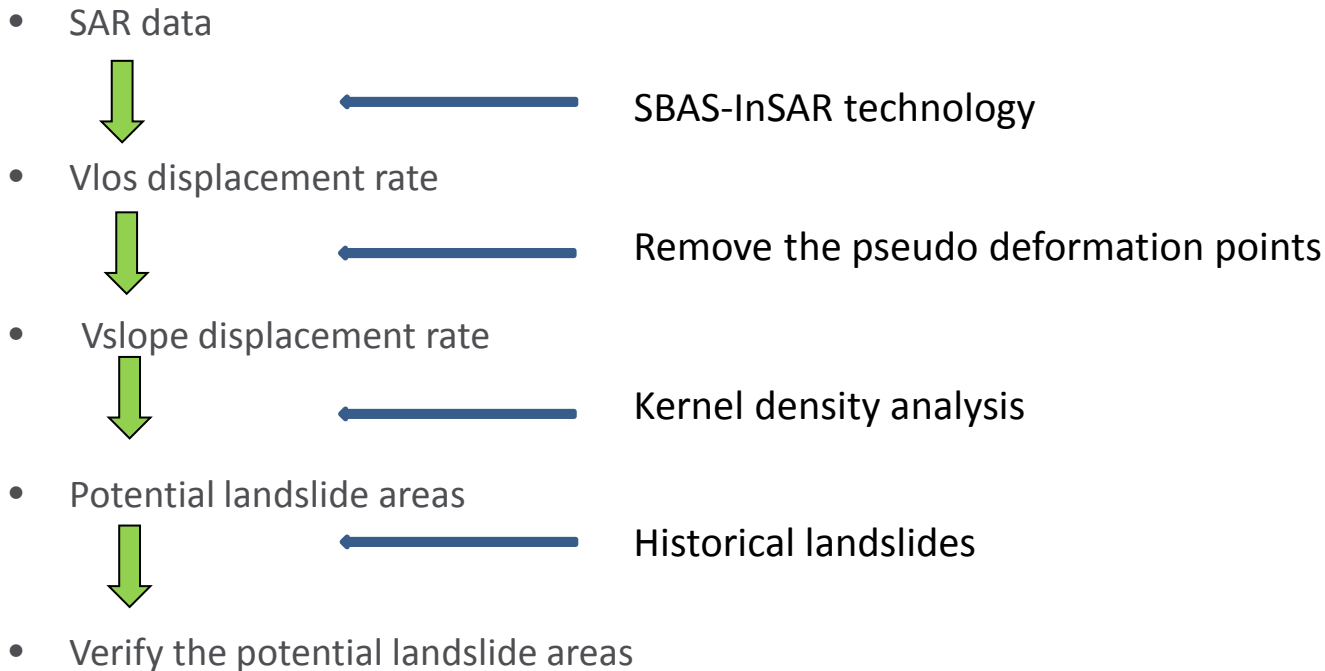
Qinyu landslide



Research progress in SBAS-InSAR

- [Berardino et al.\(2002\)](#) proposed the method of Small Baseline Subset (SBAS) algorithm. which overcomes the problem of the spatial decorrelation and solves the problem that PS-INSAR requires too much data.
- [Lauknes T R et al.\(2007\)](#) utilized SBAS technology to quickly identify landslides in Norway through timing INSAR data;
- [Ardizzone F et al. \(2012\)](#) detected the landslides of the Umbria landslide in central Italy using SBAS-DInSAR .
- [Bonan M & Calò F \(2012\)](#) used the SBAS technique to get the surface deformation at the regional and local scales, using the ERS-1/2 and ENVISAT SAR images , and the results were compared with the existing results.
- In China, [Sun Q](#) and [Zhang Y et al.\(2015\)](#) have demonstrated the feasibility of SBAS-InSAR in landslide monitoring.

Workflow for potential landslide identification



Method

1.Remove the pseudo landslide deformation points

(1)Displacement rate

$$V_{slope} = \frac{V_{Los}}{C} \quad (1)$$

$$C = \cos \beta \quad (2)$$

$$\cos \beta = (-\sin \alpha \cos \varphi)(-\sin \theta \cos \alpha_s) + (-\cos \alpha \cos \varphi)(\sin \theta \sin \alpha_s) + \sin \varphi \cos \theta \quad (3)$$

β : The angle of radar Line of Sight and the steepest slope;

α : Aspect;

φ : Slope;

θ : Incident angle;

α_s : The angle between the azimuth and the north.

Meanwhile, V_{slope} Value turn positive ($V_{slope} > 0$), they are discarded. Because a positive V_{slope} represent uphill movement. ([Herrera et al., 2012](#)).

Method

(2) Occurring landslide conditions

- slope: 5° for the threshold ([Bianchini et al., 2013](#)), remove the flat area in the deformation point.
- discreteness: landslide deformation points have the characteristics of massive movement, many scholars suggested that each landslide need 2-4 deformation points of the use of C-band landslide monitoring ([Meisina et al., 2008](#); [Notti et al., 2010](#); [Herrera et al., 2013](#); [Bianchini et al., 2012](#)).

2. Landslide deformation points reliability verification

$$\text{precision} = \sqrt{\frac{1-\gamma^2}{2\lambda^2}} * \frac{\lambda}{4\pi} \quad (4)$$

λ : wavelength;

γ : Coherence coefficient.

Method

3. Kernel density analysis

$$f(x) = \frac{1}{nh} \sum_{i=1}^n K\left(\frac{x - x_i}{h}\right) \quad (5)$$

n : Numbers of landslide deformation points;

x : Deformation rate;

$f(x)$:Probability density function of the relation between the degree of occurrence and the deformation rate of deformation points;

h : The size of window, which determines the scope of the kernel function;

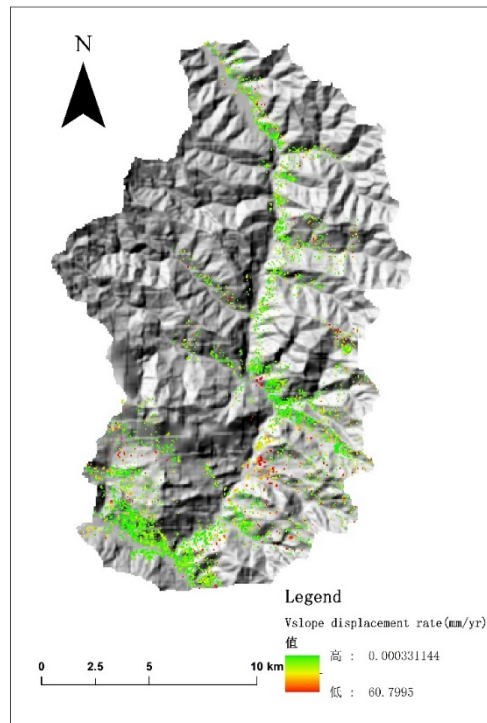
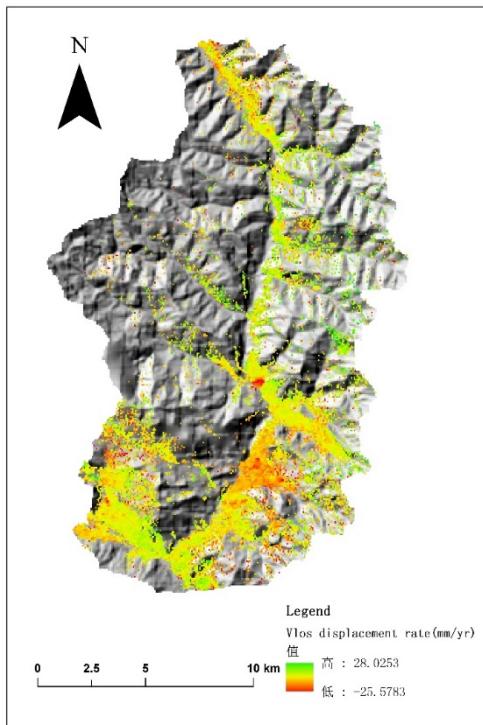
$K()$: Kernel function.

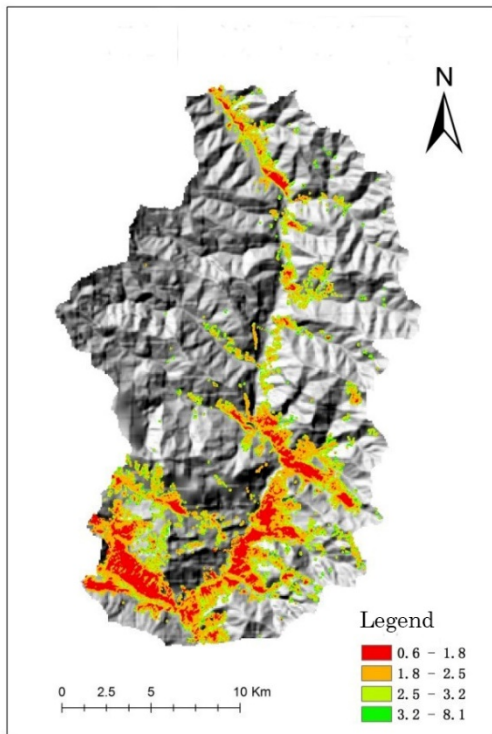
22 scenes

ENVISAT ASAR

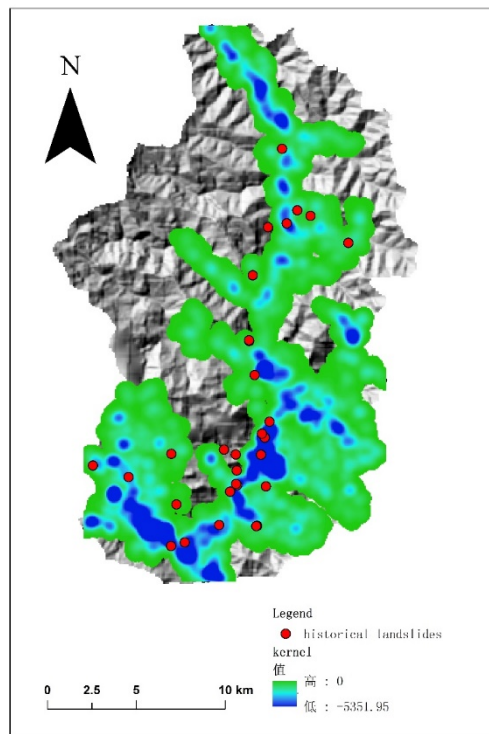
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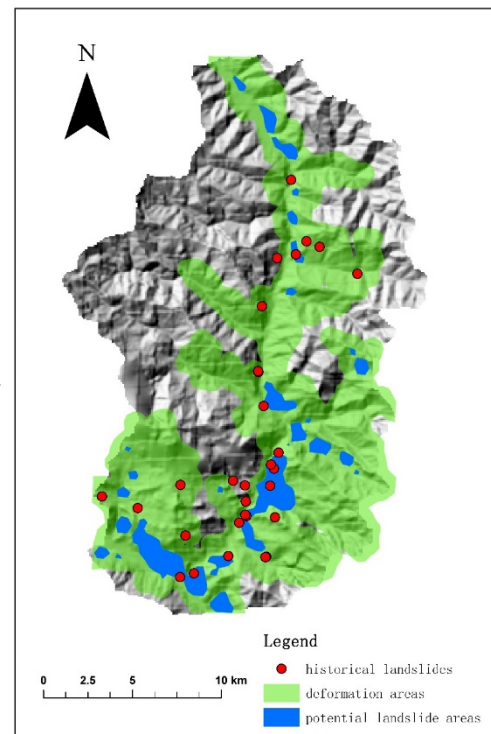




Kernel Density Analysis



Results



Results

- The landslide deformation points are mainly distributed on the right bank of the river, which is related to the low sensitivity of the ENVISAT data whose orbit is descending direction.
- The potential landslide areas extracted using the spatial analysis method in ArcGIS software are mainly distributed along the river. The main reason is the influence of the river erosion on the slope foot so that landslides distributed along the river.

Results

- among 30 historical landslides, 16 points lie in the deformation area, and 11 points lie in the potential landslide areas, only 3 points are outside of the deformation area.
- The results show that the landslide deformation points can better reflect the spatial distribution of historical landslides. Therefore, in the absence of historical landslide inventories, Potential landslides detection by using deformation points provides effective assistance for regional disaster prevention and investigation work.

Future Activities

- Field survey and validation activity
 - ◆ During the field validation activity, it is possible to check the reliability of the radar interpretation for almost all the cases identified.



Future Activities

➤ Using X-band mission COSMO-SkyMed for mutually complement and verification.

- ◆ With acquisition parameters more suitable for landslide investigations
- ◆ Higher spatial and temporal resolution
- ◆ providing acquisitions with a shorter revisiting time.

Thank you for your attention !