Committee on Earth Observation Satellites

CEOS Landslide Pilot in Chinese Region: A Recent Progress

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Virtual

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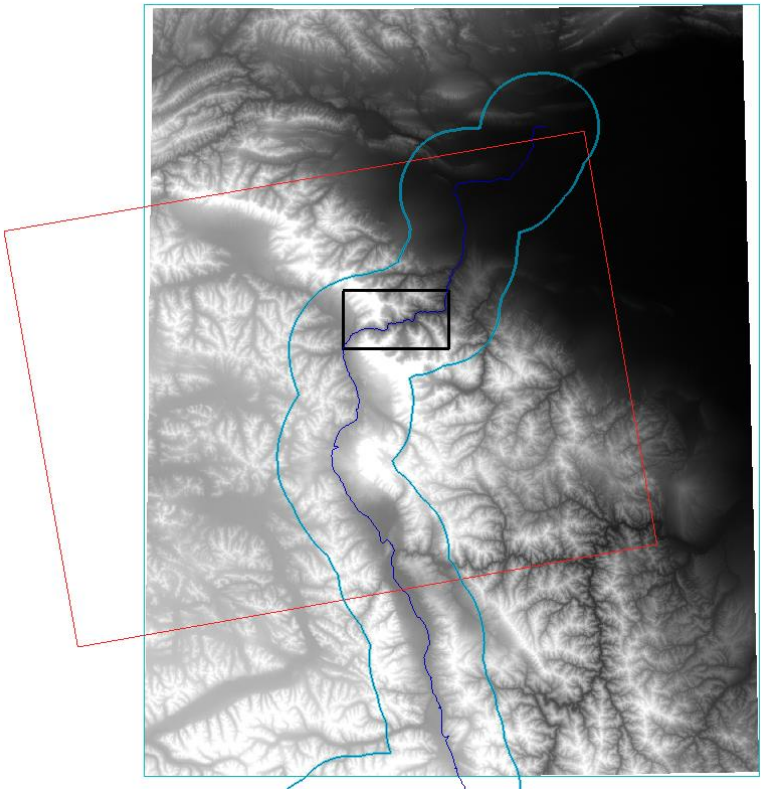
Overview

- **SAR images used for landslide detection**
- Comparison of PS-InSAR and SBAS-InSAR method for landslide detection
- Application of SBAS-InSAR method in landslide detection
- Landslide detection by classification of deformation time series

SAR images used for landslide detection

- Data used

SAR images：Sentinel-1A IW mode, SLC(single-look complex) format.



Background image: DEM data
Red box: coverage of S1A image
Blue curves: buffer area of the study region
Black box: Region of Interest(ROI), used for InSAR processing
Lat: 74°58’ E-75°30’E
Lon: 38°40’N-38°53’N

Acquisition dates of S1A SAR images used for InSAR processing
(30 scenes in total)

Year	Date
2015	0405, 0523, 0710, 0827, 1002, 1119
2016	0106, 0223, 0411, 0529, 0716, 0902, 1020, 1207
2017	0124, 0313, 0430, 0605, 0723, 0909, 1027, 1214
2018	0131, 0320, 0507, 0624, 0811, 0928, 1103, 1209

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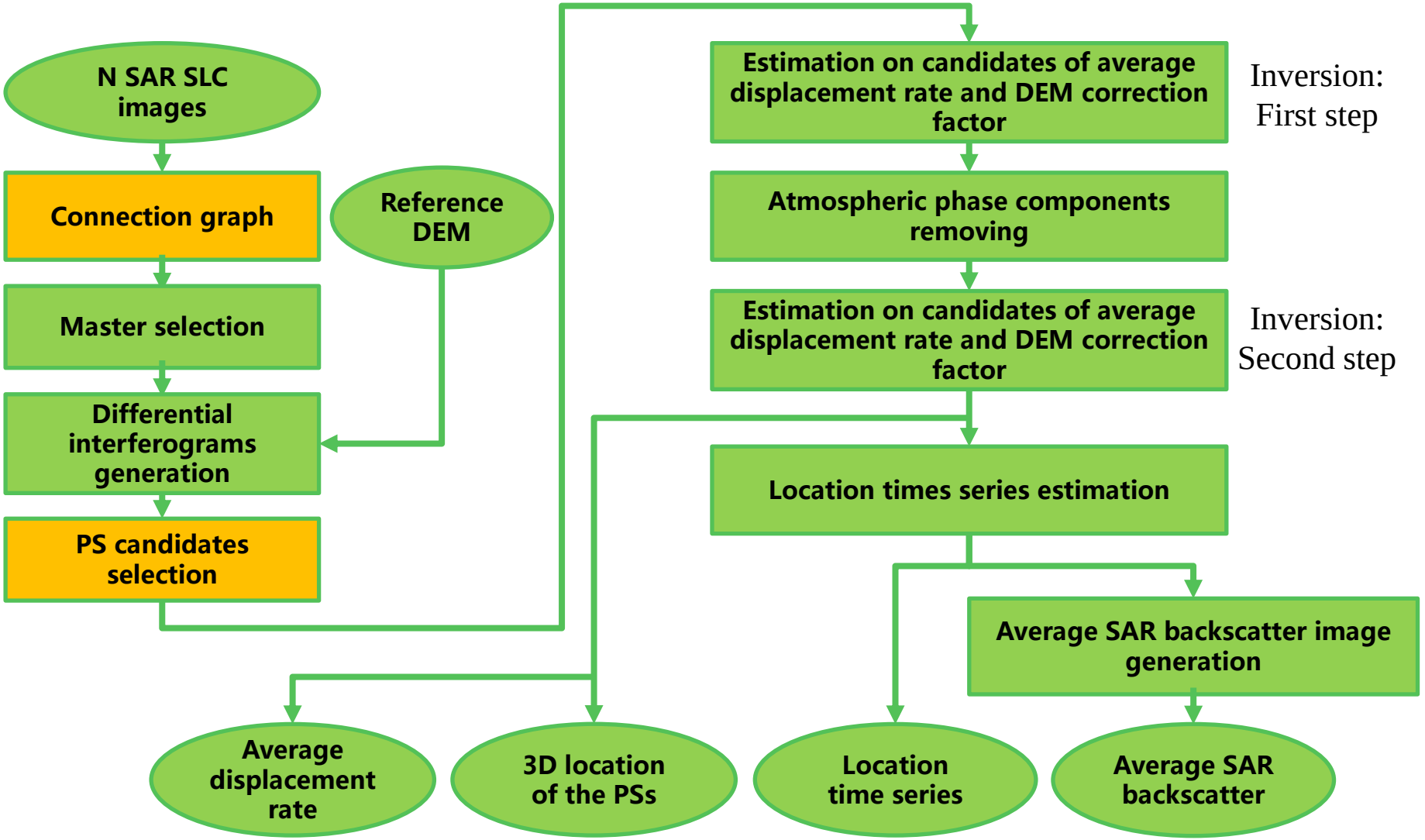
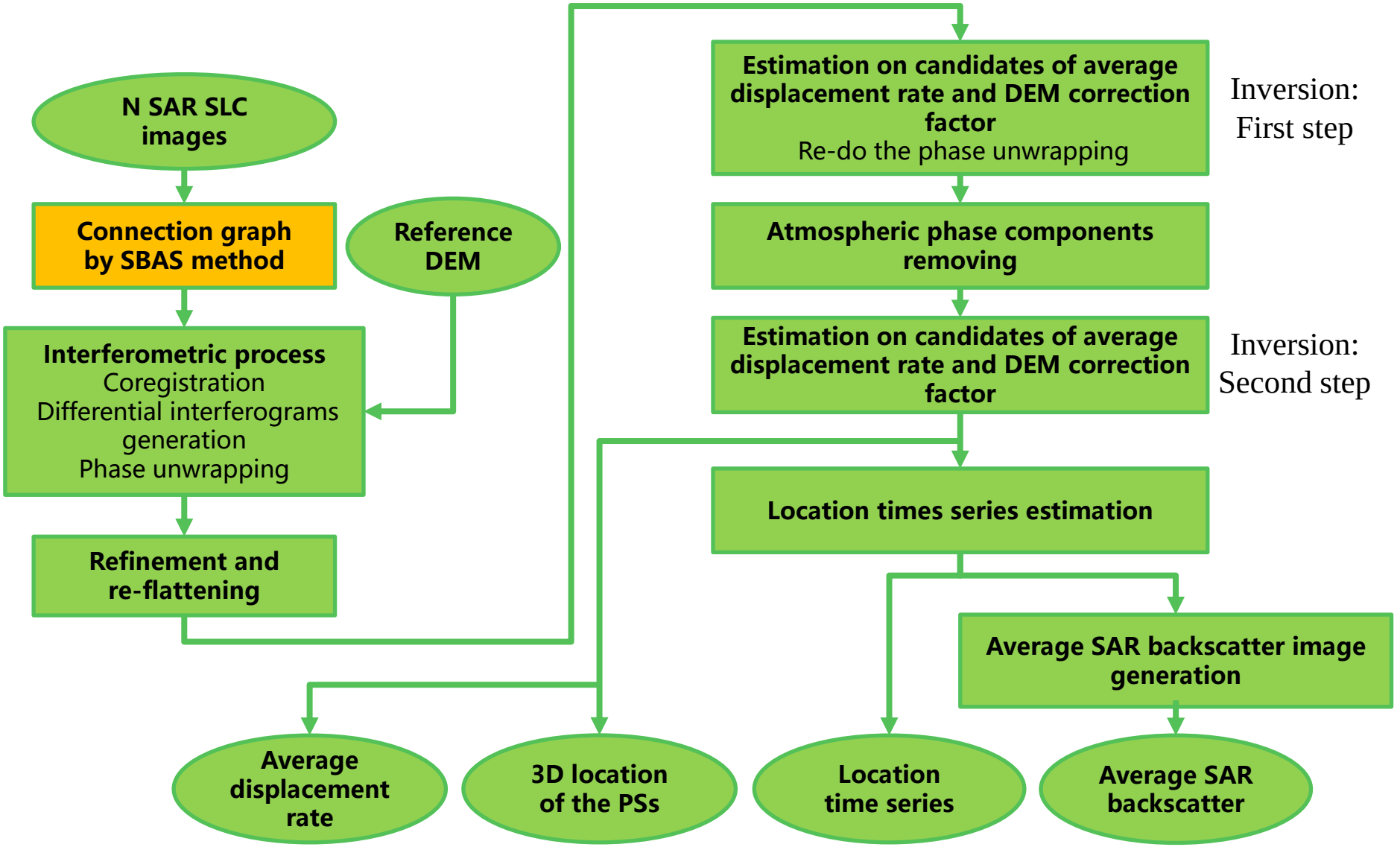
Comparison of PS-InSAR and SBAS-InSAR method

- PS-InSAR processing flow chart (PS: Permanent Scatterers)



Comparison of PS-InSAR and SBAS-InSAR method

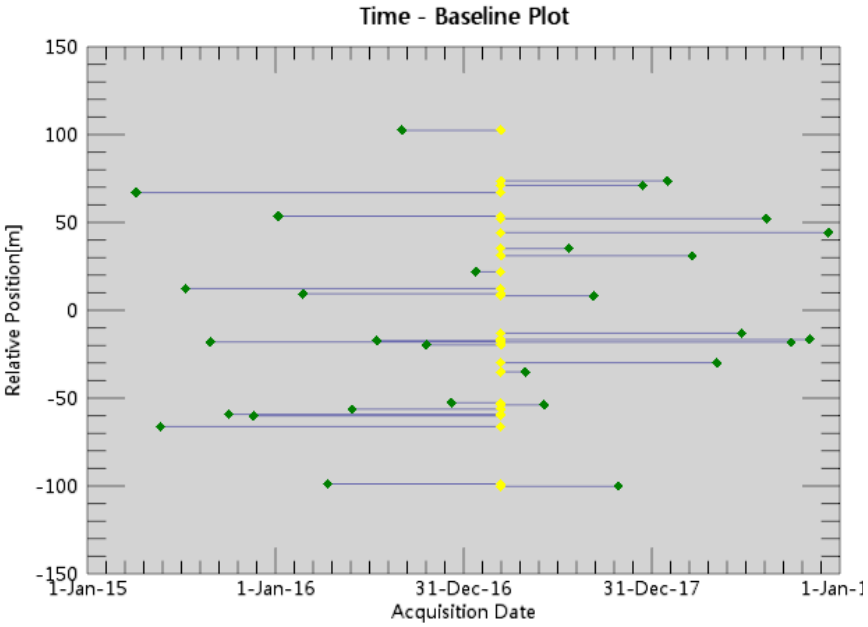
- SBAS-InSAR processing flow chart (SBAS: Small Baseline)



Comparison of PS-InSAR and SBAS-InSAR method

- Connection graphs: PS-InSAR *vs*. SBAS-InSAR

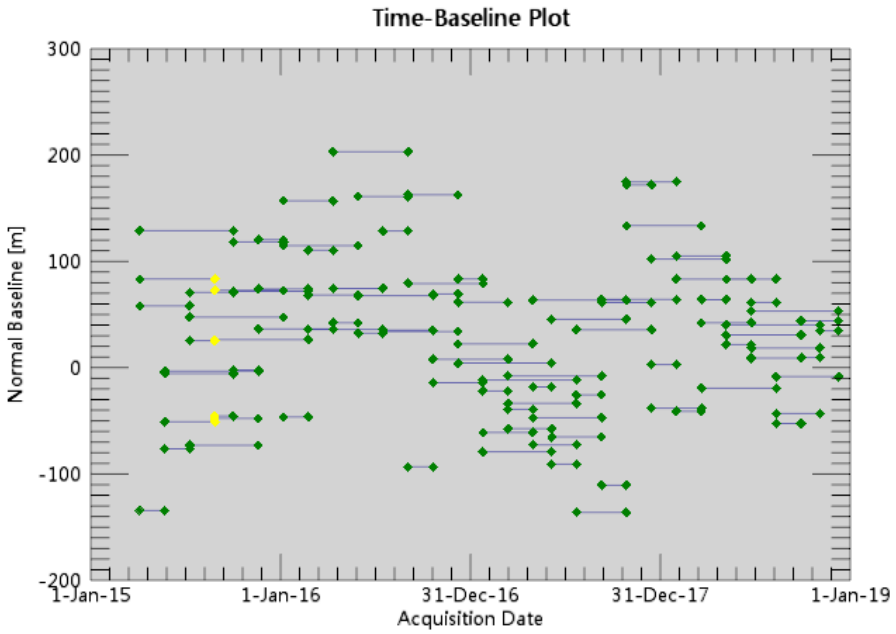
① PS-InSAR (30 scenes used)



Master image: 2017.03.13

InSAR image pairs: 29

② SBAS-InSAR (30 scenes used)

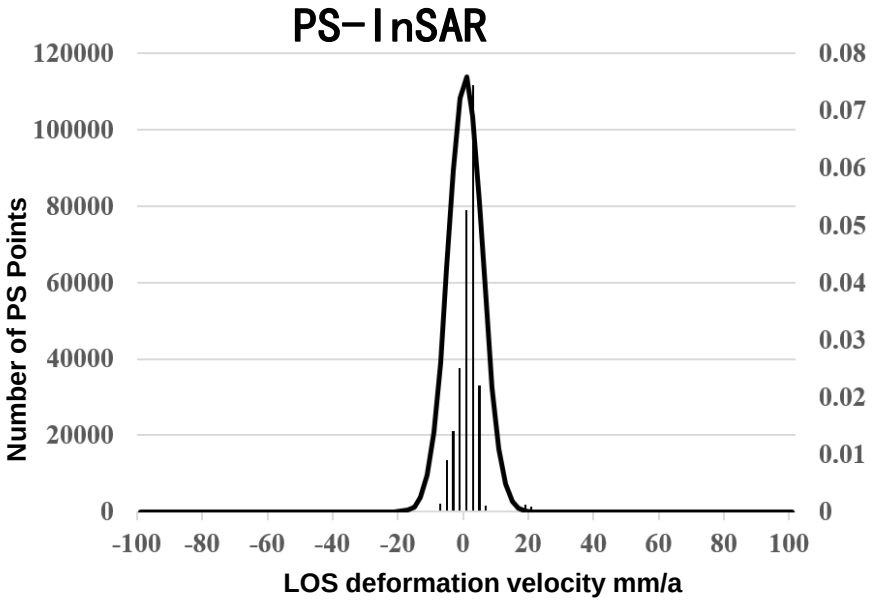


Super master image: 2015.08.27

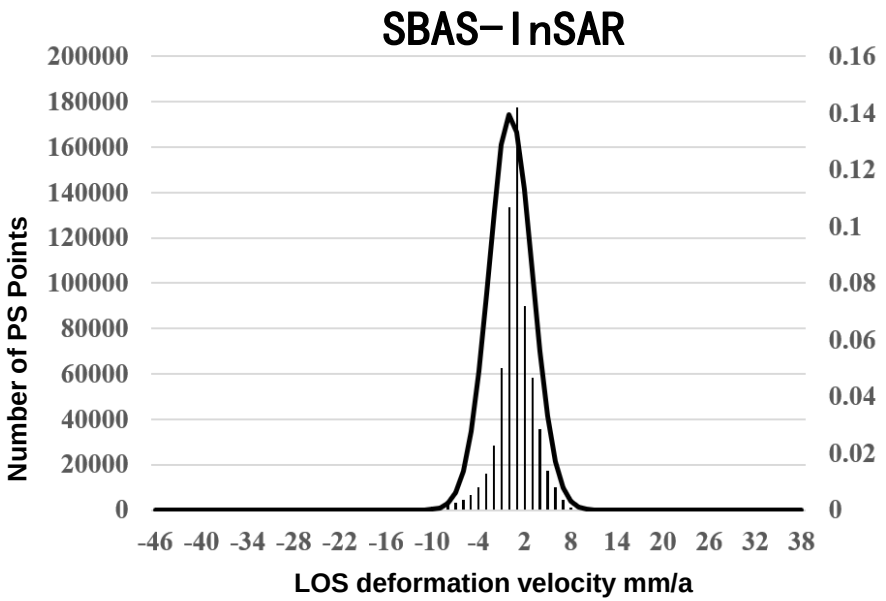
InSAR image pairs: 94

Comparison of PS-InSAR and SBAS-InSAR method

- LOS of PS points: PS-InSAR *vs*. SBAS-InSAR



(a) The number of PS points at different LOS deformation velocity by PS-inSAR method



(b) The number of PS points at different LOS deformation velocity by SBAS-inSAR method

PS Point in total: 305853;

Line-of-sight Deformation: -98 mm/a ~98 mm/a;

The LOS deformation velocities follow an approximately normal distribution curve

- Mean: -0.32 mm/a;
- Standard Deviation: 5.25 mm/a

PS Point in total: 670757;

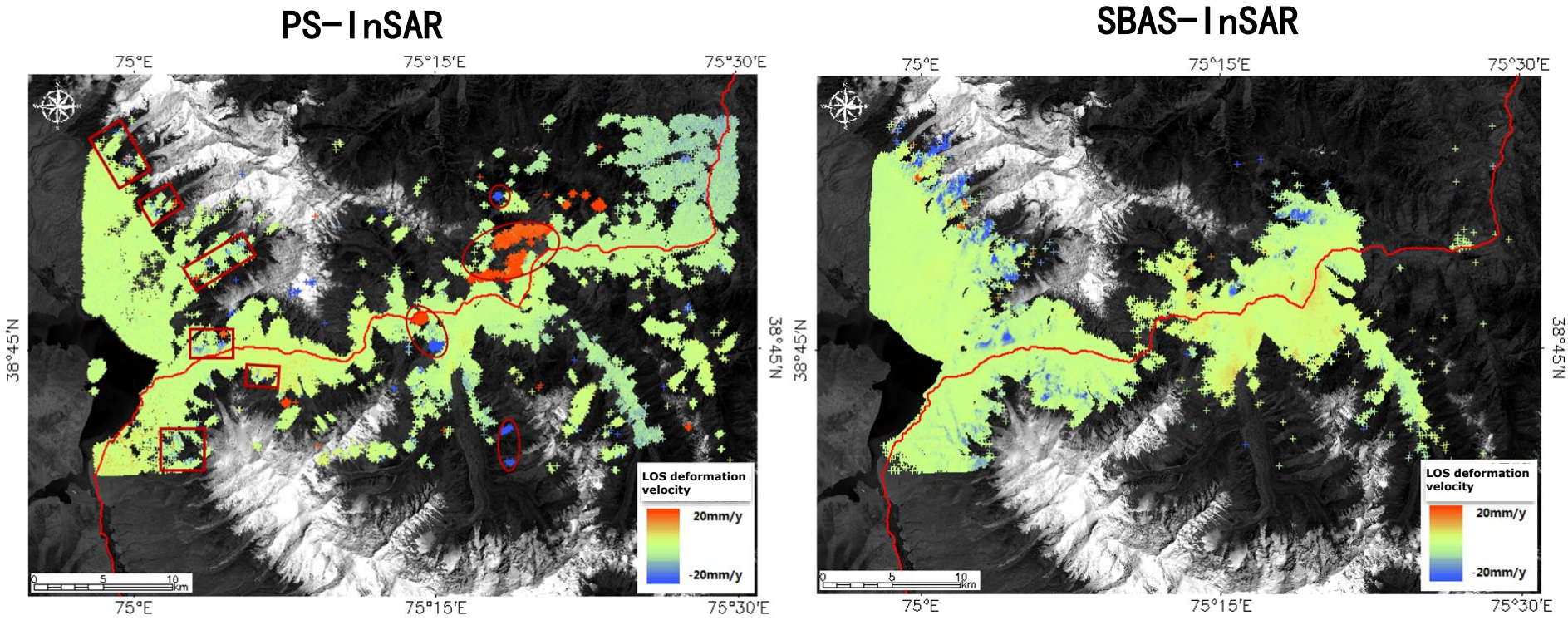
Line-of-sight Deformation: -46 mm/a~38 mm/a;

The LOS deformation velocities follow an approximately normal distribution curve

- Mean: -0.15 mm/a;
- Standard Deviation: 2.86mm/a

Landslide disaster detection by SAR image

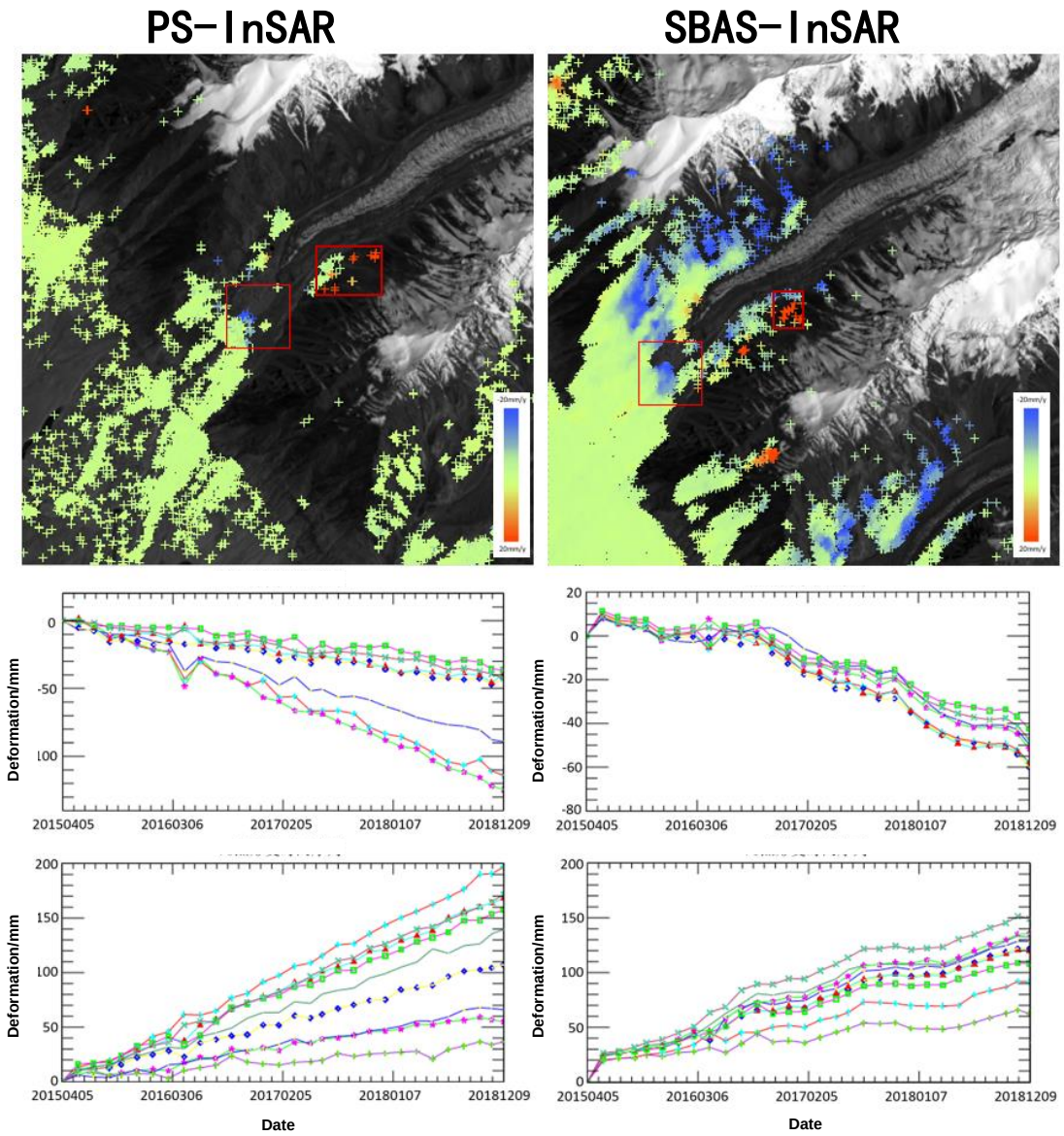
- PS points mapping: PS-InSAR *vs*. SBAS-InSAR



- Similarly mapping of PS points by PS-InSAR and SBAS-InSAR methods are obtained.
- **Red Rectangle:** PS points with high LOS deformation velocities can be attributed to the deformation by geological disasters.
- **Elliptical Circle:** The PS points with extremely high LOS deformation velocities by PS-InSAR method are mal-points induced by improper separation of atmospheric phase or DEM residual phase.

Comparison of PS-InSAR and SBAS-InSAR method

- Time series of deformation: PS-InSAR *vs*. SBAS-InSAR



- The deformation trend by the two methods are similar;
- More PS Points obtained by SBAS-InSAR method;
- Deformation detected by PS-InSAR method is higher than that by SBAS-InSAR method in the same region.

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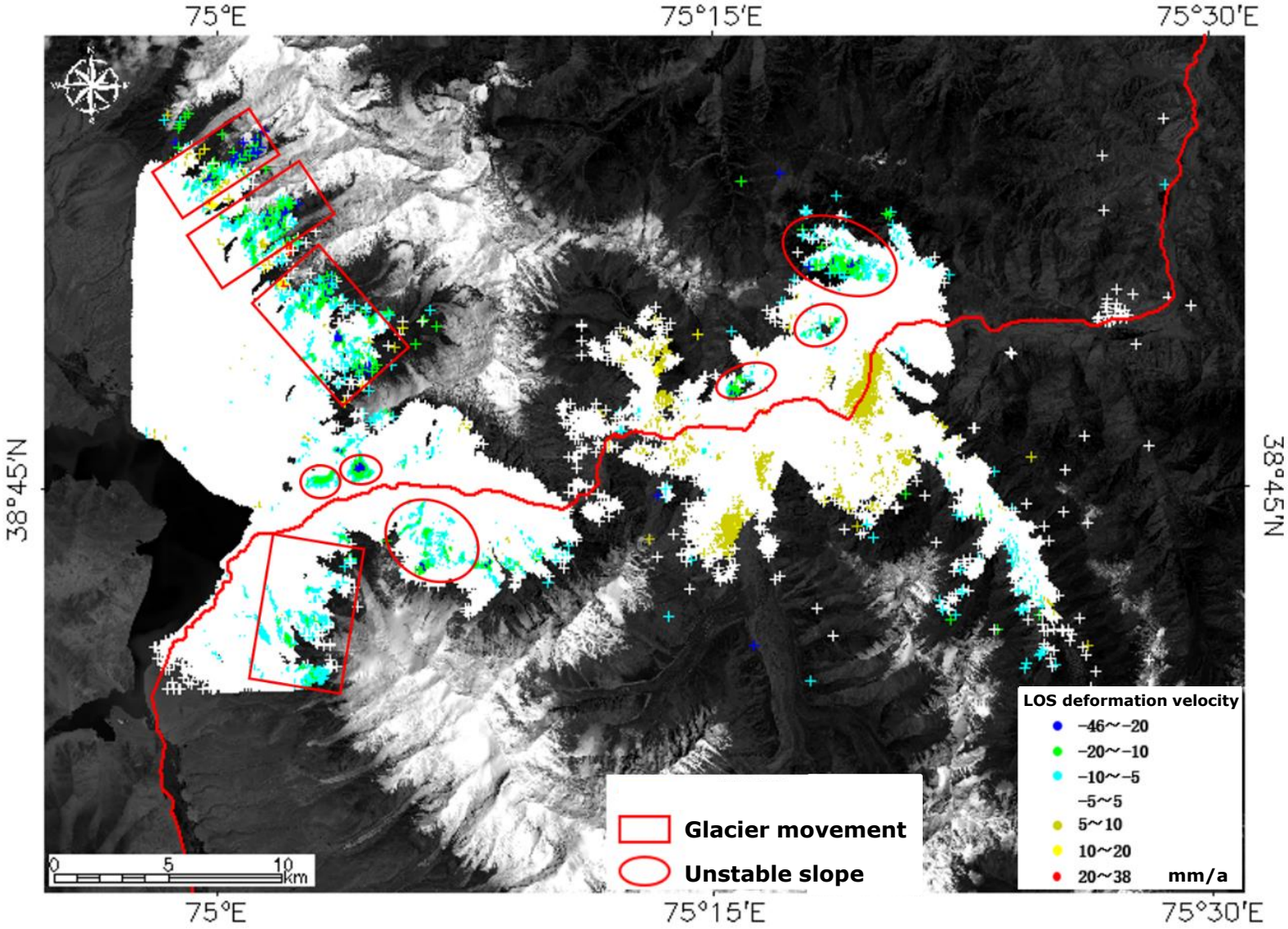
- Landslide detection by classification of deformation time series

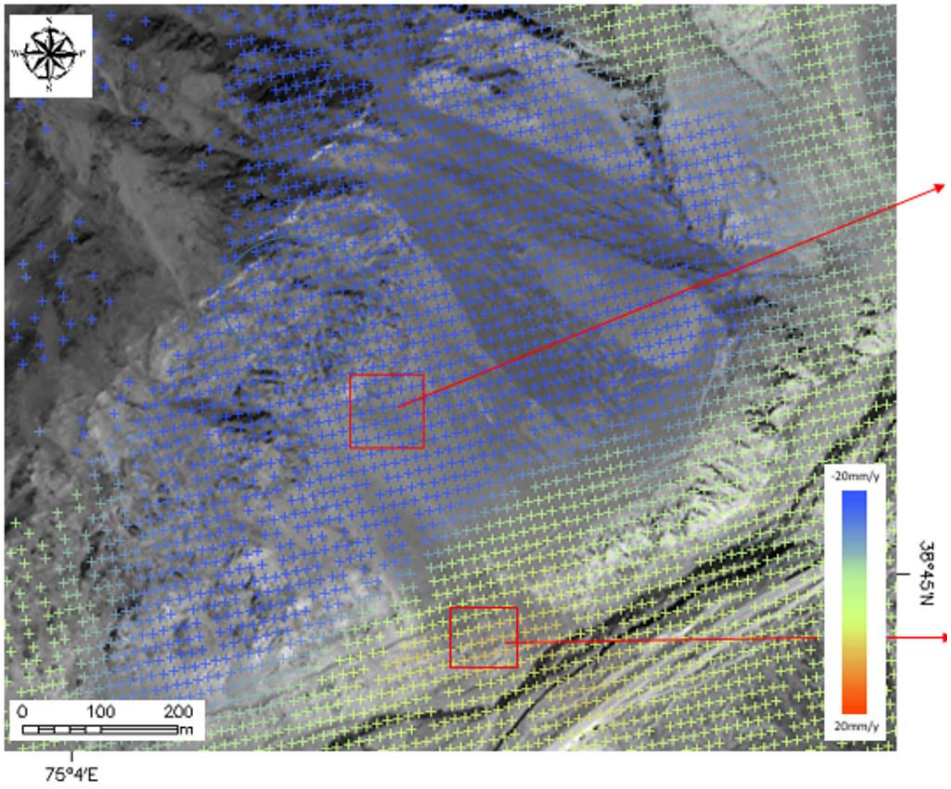
Application of SBAS-InSAR method in landslide detection

- PS points mapping: SBAS-InSAR

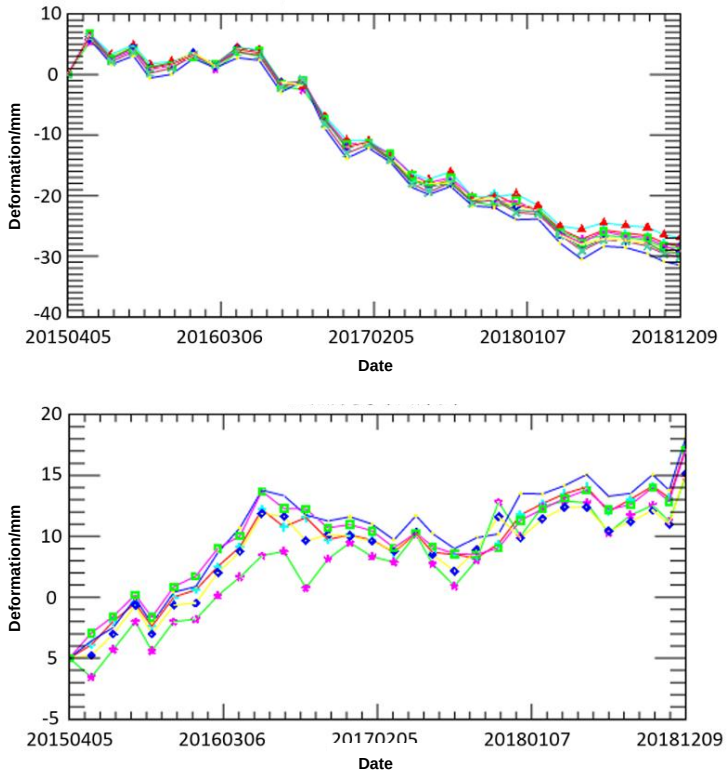


Application of SBAS-InSAR method in landslide detection

- Detection of unstable slope



The mapping of PS points by SBAS-InSAR method for unstable slope



Surface deformation time series

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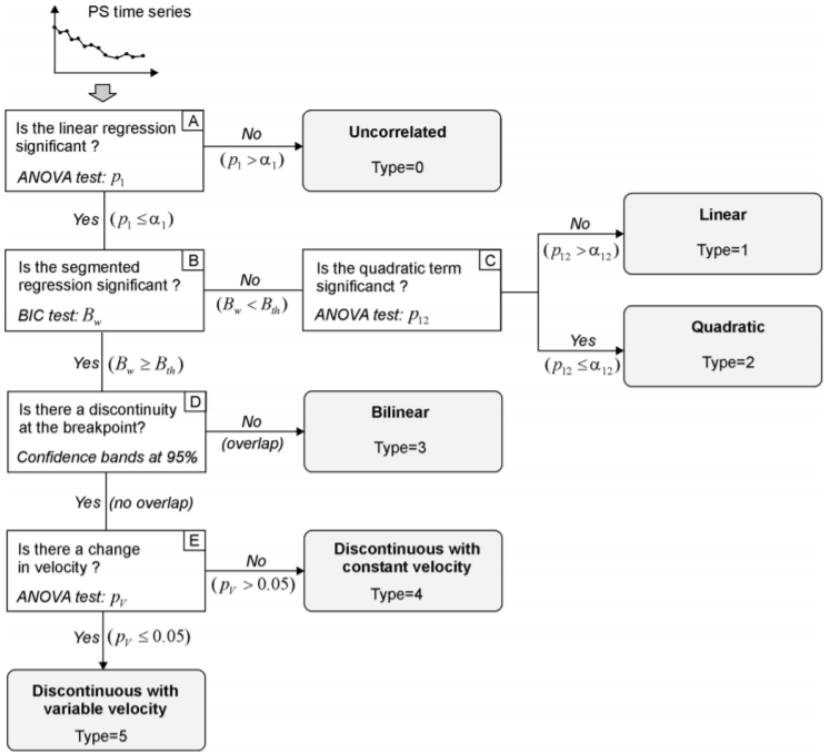
- **Landslide detection by classification of deformation time series**

Landslide detection by classification of deformation time series

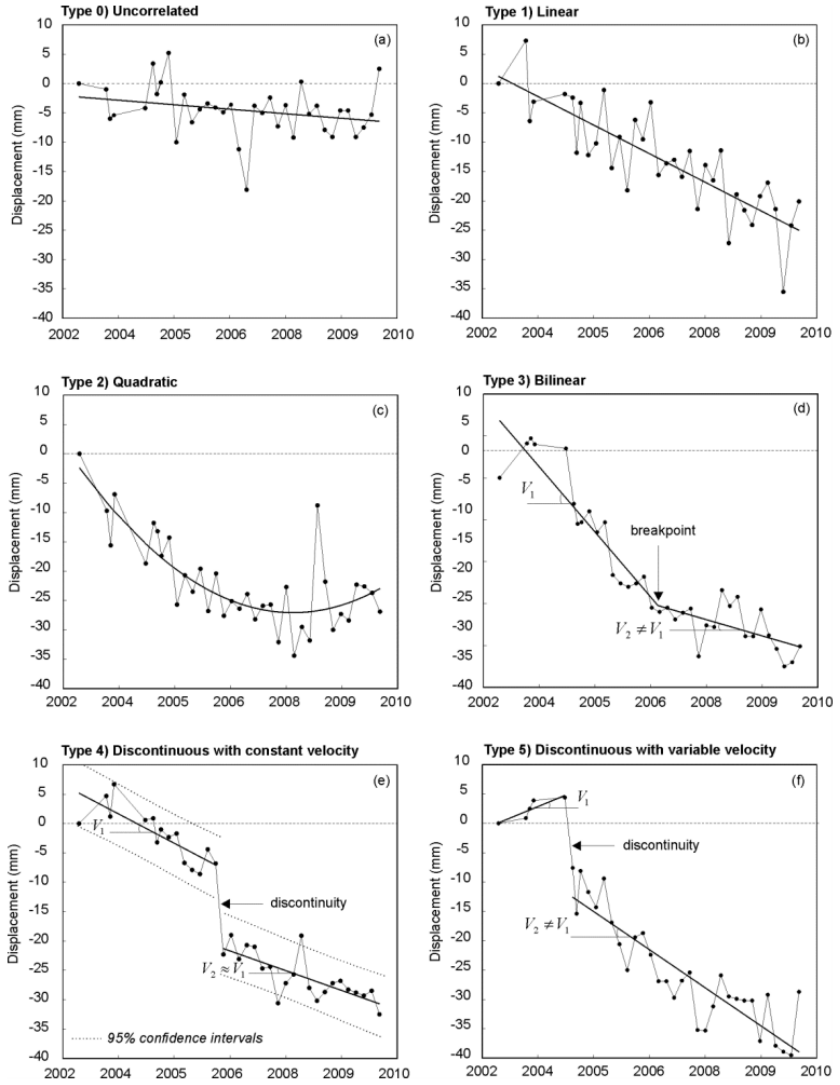
- Classification of deformation time series

  - **PS-Time** (Berti, M., et al. 2013):

Type0：Uncorrelated — **Stable**
Type1：Linear — **Linear unaffected region**
Type2：Quadratic — **Progressive displacement**
Type3：Bilinear — **Abrupt displacement**
Type4：Discontinues with constant velocity — **Temporary affected targets**
Type5：Discontinues with variable velocity — **Permanent affected targets**



Workflow of PS-Time

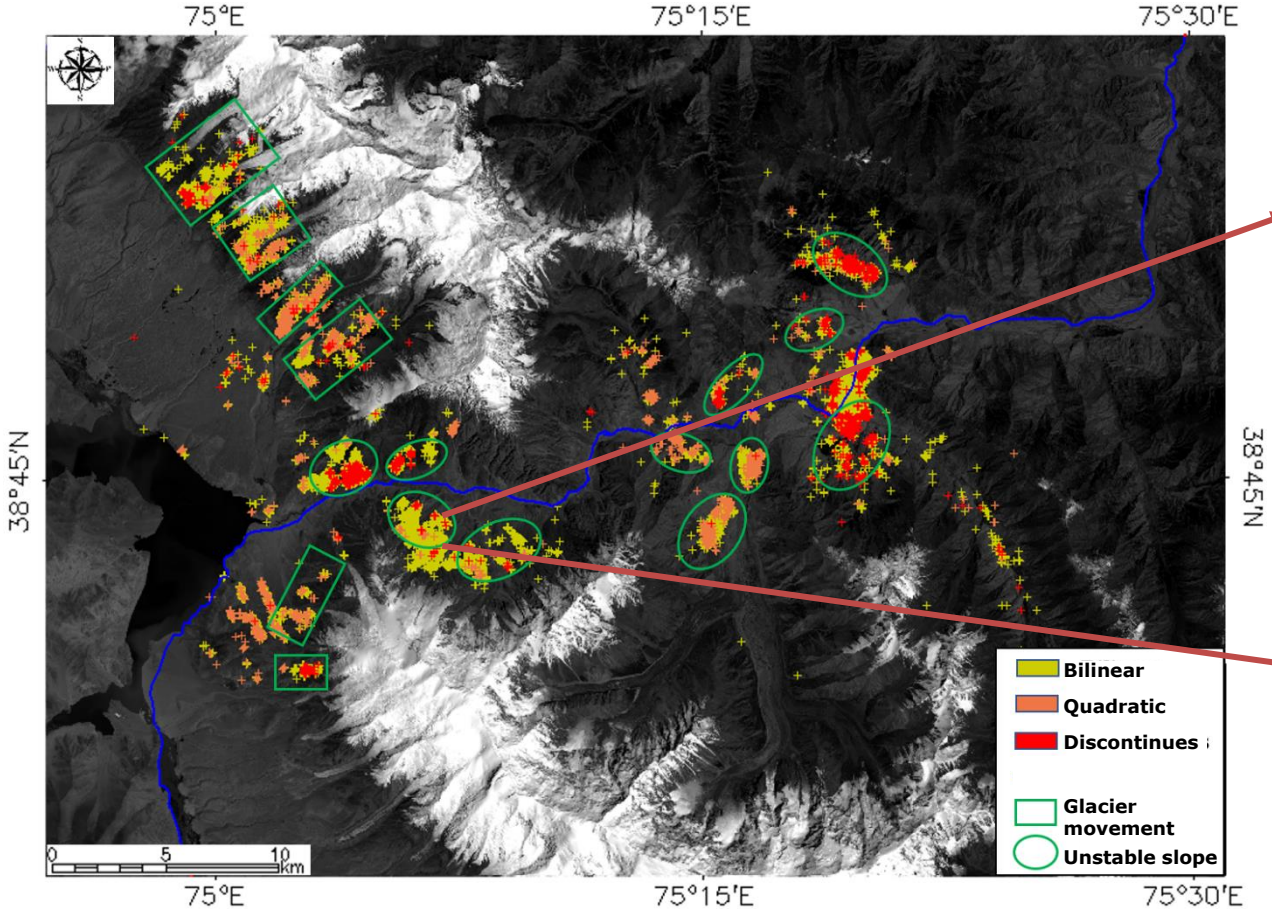


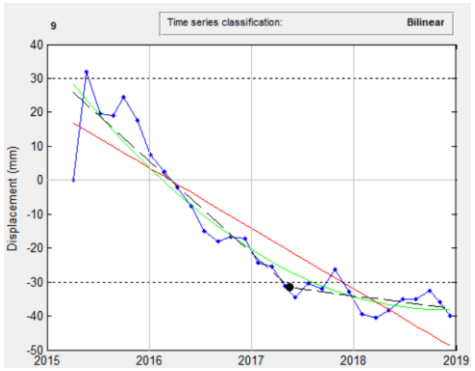
Typical ground displacement trends identified by inspection of Permanent Scatterers time series

Landslide detection by classification of deformation time series

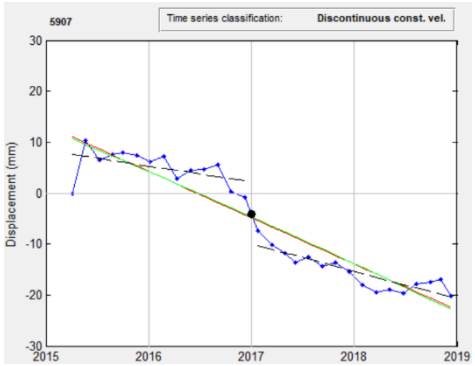
- Potential disaster site identification

Scheme: (1) Displacement of the PS point is bilinear/quadratic/discontinues;
(2) Average deformation is higher than 5mm/a or lower than-5mm/a.





Bilinear



Discontinues

Potential Disaster sites detected by PS-time

Thank you！

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