

Three-Dimensional Surface Displacement of Jiaju Landslide Based on Surface-Parallel Flow Assumption

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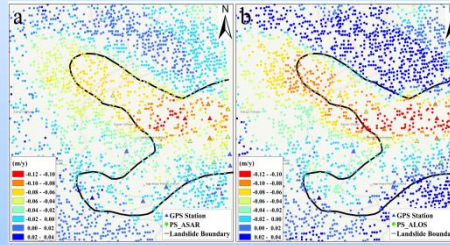
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Abstract

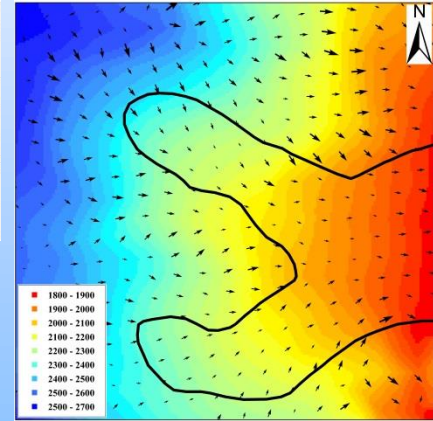
One-dimensional InSAR LOS measurement has limited its application to retrieve 3-D surface displacements. We reconstruct the three-dimensional deformation field with surface-parallel flow assumption based on the knowledge of DEM information. The iteration method by correcting characteristic value with maximum likelihood estimation is used to iteratively process the function model to get the accurate random model.

Objective

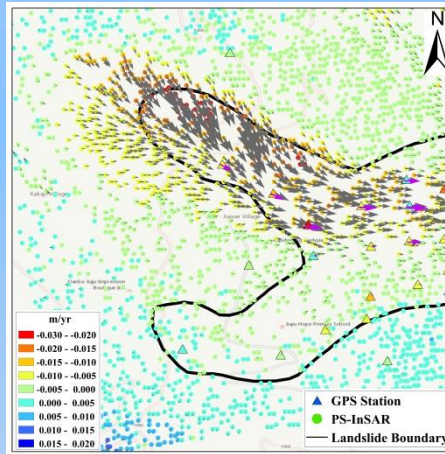
9 ENVISAT SAR images and 19 ALOS SAR images were collected to retrieve 3-D deformation field of Jiaju landslide, locating on the right bank of the Da Jinchuan River, which is one of active large tractive landslides.



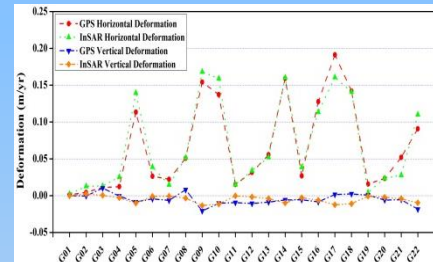
Annual deformation rate of Jiaju was calculated from Envisat (a) and ALOS dataset (b), the two results keep well consistent even though with difference due to different incidence angle and heading angle. The GPS results are projected on LOS direction which are displayed as colorful triangles.



The DEM and slope information of Jiaju landslide. Arrow shows the direction and magnitude of slope.



3D deformation field of Jiaju landslide. Grey arrows show the horizontal deformation rate field, and colorful points show the deformation rate in vertical direction. Pink arrows display the direction and magnitude of the horizontal deformation on the GPS stations, and the color show the vertical deformation.



The InSAR and GPS measurements agree both in the trend and the value, and it accurately reflects the deformation characteristic of Jiaju landslide.

GPS & InSAR	Horizontal	Vertical
Standard Deviation	0.0140m	0.0070m

The standard deviation between GPS and InSAR is 0.0140m and 0.0070m in horizontal and vertical direction.

Results

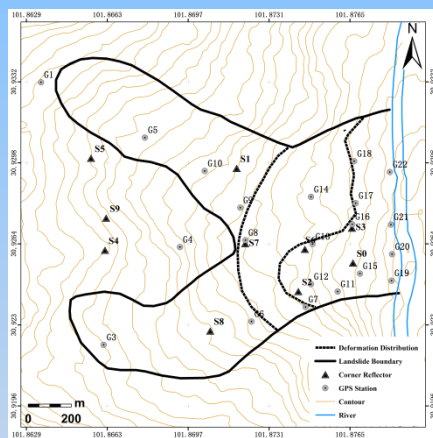
Horizontal displacement of Jiaju landslide appears to move along the landslide direction in the east-west direction, the northern part of the landslide shows obvious horizontal deformation, and the deformation rate exceeds -10cm/y. Vertical deformation rate of the north part is large which exceeding -2cm/y, while the south part is -0.5cm/y.

Conclusion

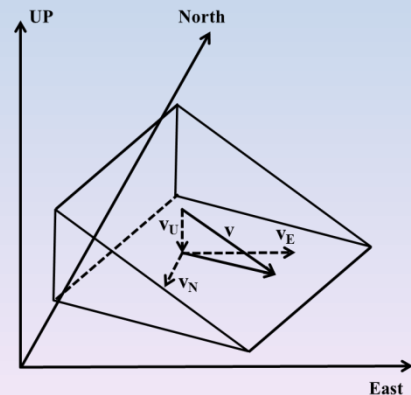
Based on the knowledge of DEM slope information, 3D deformation field is reconstructed under surface-parallel flow assumption. And the iteration method by correcting characteristic value with maximum likelihood estimation is used to obtain the optimal value of the parameters with different measurements.

Major Reference

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- Gourmelen, N., Kim, S.W., Shepherd, A., Park, J.W., Sundal, A.V., Björnsson, H., Pålsson, F., 2011. Ice velocity determined using conventional and multiple-aperture InSAR. *Earth Planet. Sci. Lett.* 307 (1-2), 156-160.
- Mohr, J.J., Reeh, N., Madsen, S.N., 1998. Three-dimensional glacial flow and surface elevation measured with radar interferometry. *Nature* 391, 273-276.



Geological Map of Jiaju Landslide. Position of GPS stations (circle) and Corner Reflectors (triangle) are displayed on this map.



Model of surface-parallel flow assumption. The slope information of the surface is usually calculated by the DEM data.