

# Activity Tracking and Evaluation of Large-scale Collapse Zones using Synthetic Aperture Radar Differential Interferenc

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# Introduction

- This study used synthetic aperture radar interference technology (InSAR) to monitor the activities of large-scale collapse zones in southern Taiwan (Tainan City, Kaohsiung City, Pingdong County).
- DInSAR analysis shows that the vertical displacement of the surface is  $\pm 60\text{mm}$ , which is within the range of elevation tolerance error, so it is not possible to use the satellite tracking station to compare the trace displacement in large collapse areas.
- PsInSAR results show that if there is PS point in a large-scale collapse zone, the PS point may be used as index of stabilization, and once the PS point suddenly disappears, it is highly likely that the area will change, and special care should be taken.

# Study Area & Materials

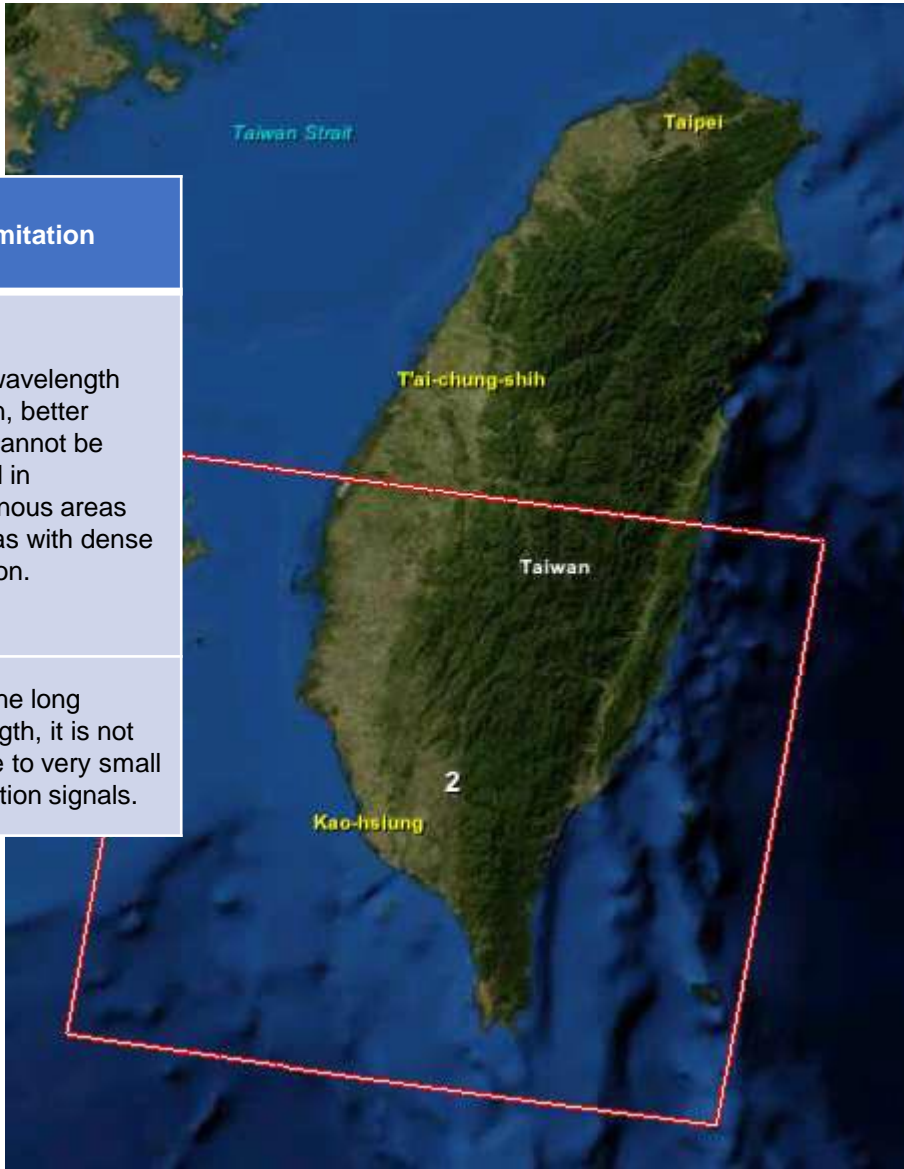
InSAR Satellite image information (WRA · 2017)

Band	Wavelength (cm)	Satellite	Year of service	Revisit period (Day)	Spatial Baseline	Image shooting frame	Advantage	Limitation
X	3.2	TerraSAR-X	2007-	11	Medium	Small	Suitable for deformation measurement in metropolitan areas	Due to wavelength limitation, better results cannot be obtained in mountainous areas and areas with dense vegetation.
C	5.6	ERS-1/2	1991-2000/ 1995-2011	35	Short	Medium	Suitable for deformation measurement in general areas	
		EnviSAT	2002-2012		Short	Medium		
		Sentinel-1A/B	2014- /2016-	12	Short	Large		
L	23.5	DAICHI (ALOS)	2006-2011	46	Long	Medium	Suitable for deformation measurement in areas with more plants	Due to the long wavelength, it is not sensitive to very small deformation signals.

Sentinel-1 SAR System specifications

Deployment time	2014/04/03
Orbits	12-day repeat cycle and 175 orbits per cycle
Centre frequency	BAND-C 、5.405 GHz (corresponding to a wavelength of ~5.5465763cm cm)
Incidence angle range	20°- 46°
Polarisation	single polarisation (HH or VV) and dual polarisation (HH+HV or VV+VH)
Interferometric Wide Swath	250 km swath at 5 m by 20 m spatial resolution

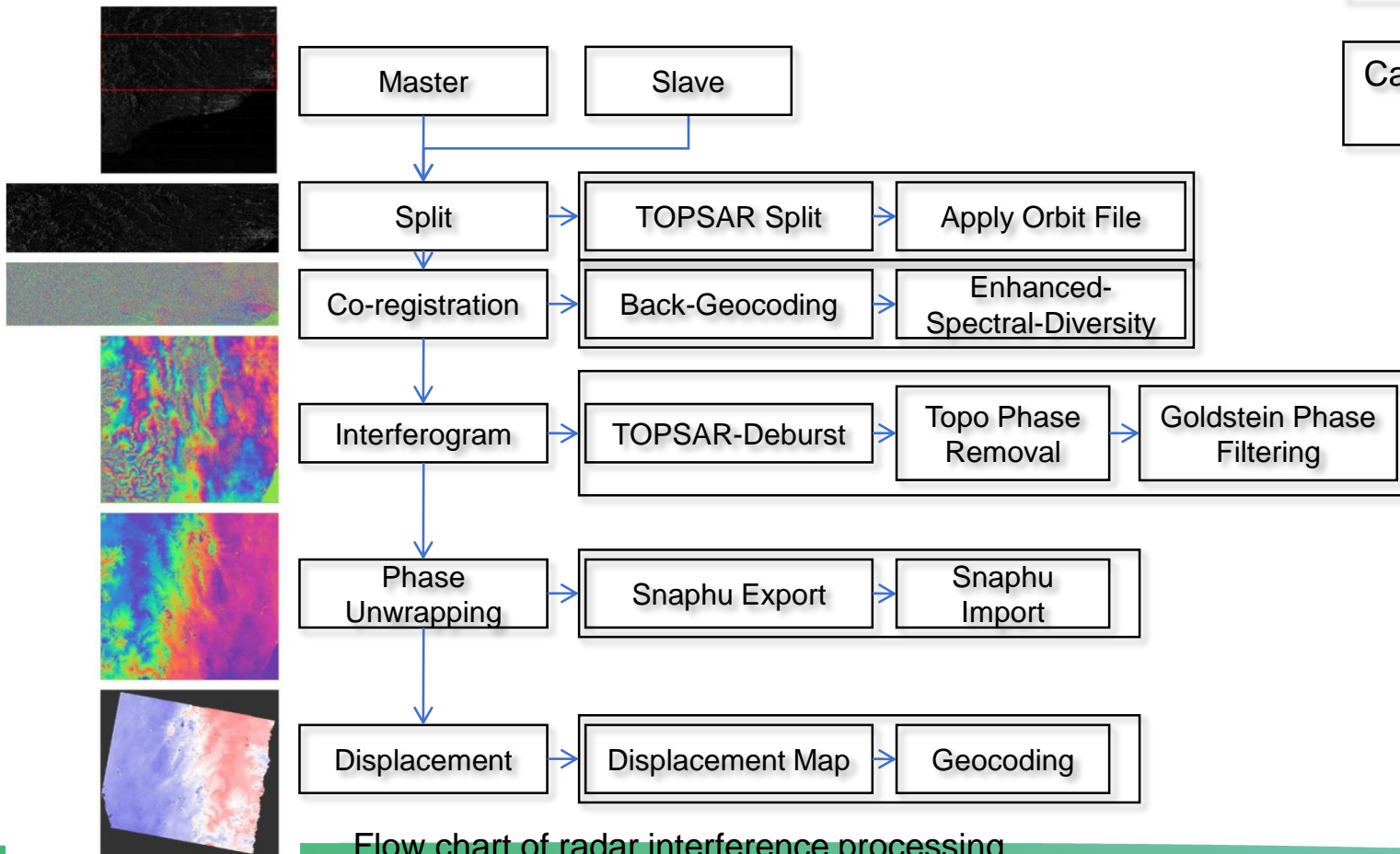
(source : <https://sentinel.esa.int/web/sentinel/missions/sentinel-1>)



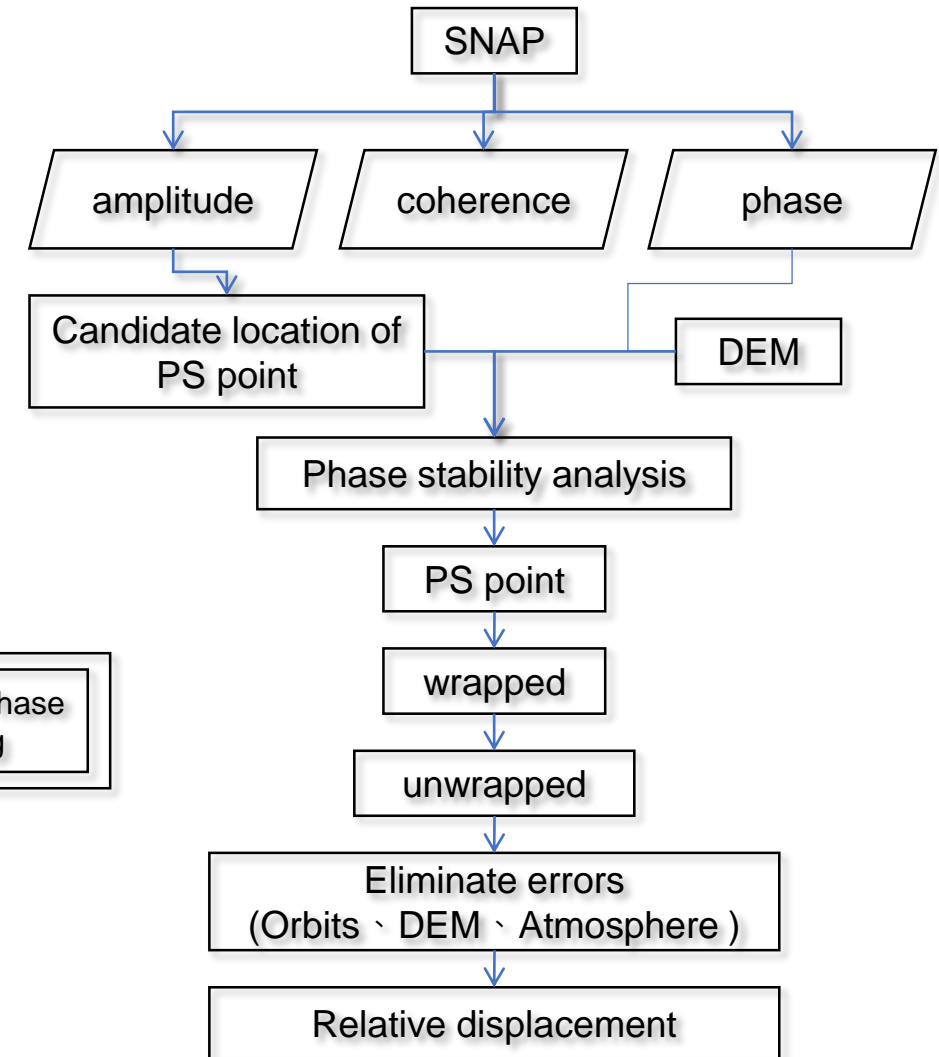
# Flow chart

## ■ Interferometric Synthetic Aperture Radar ( InSAR )

DInSAR (Differential Interferometric Synthetic Aperture Radar) · The way to repeat tracks, Obtain SAR images of the same area at different times for differential conversion, can get the amount of surface change between the two images.



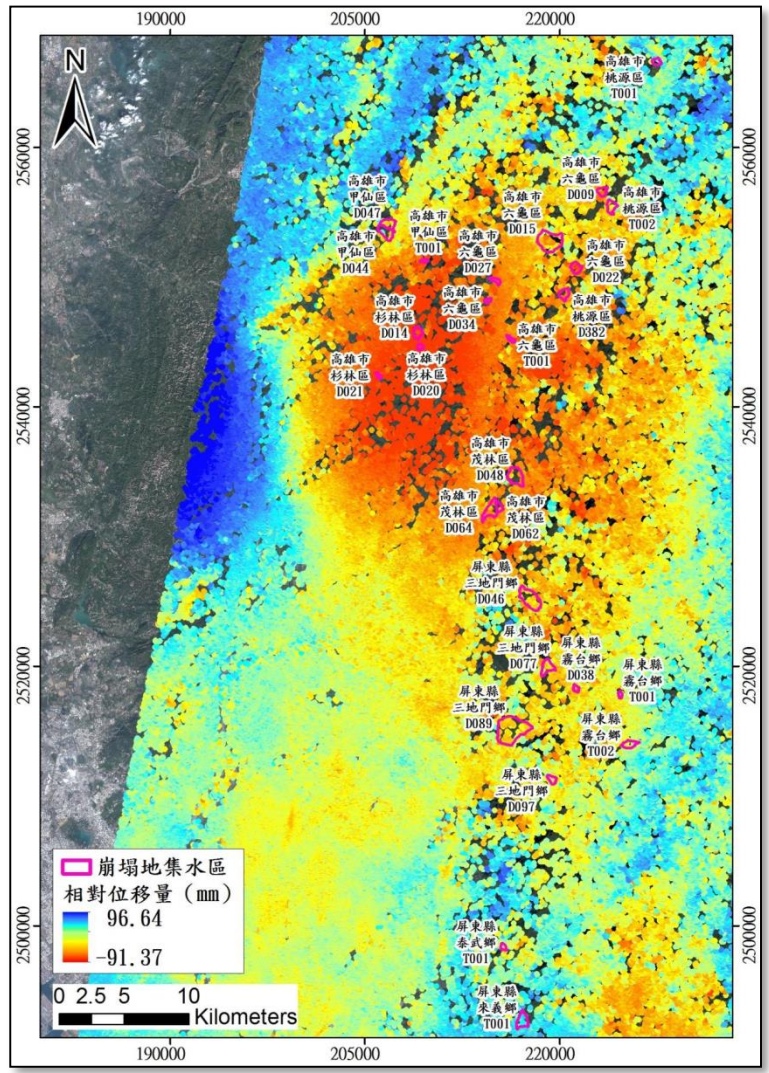
Flow chart of radar interference processing



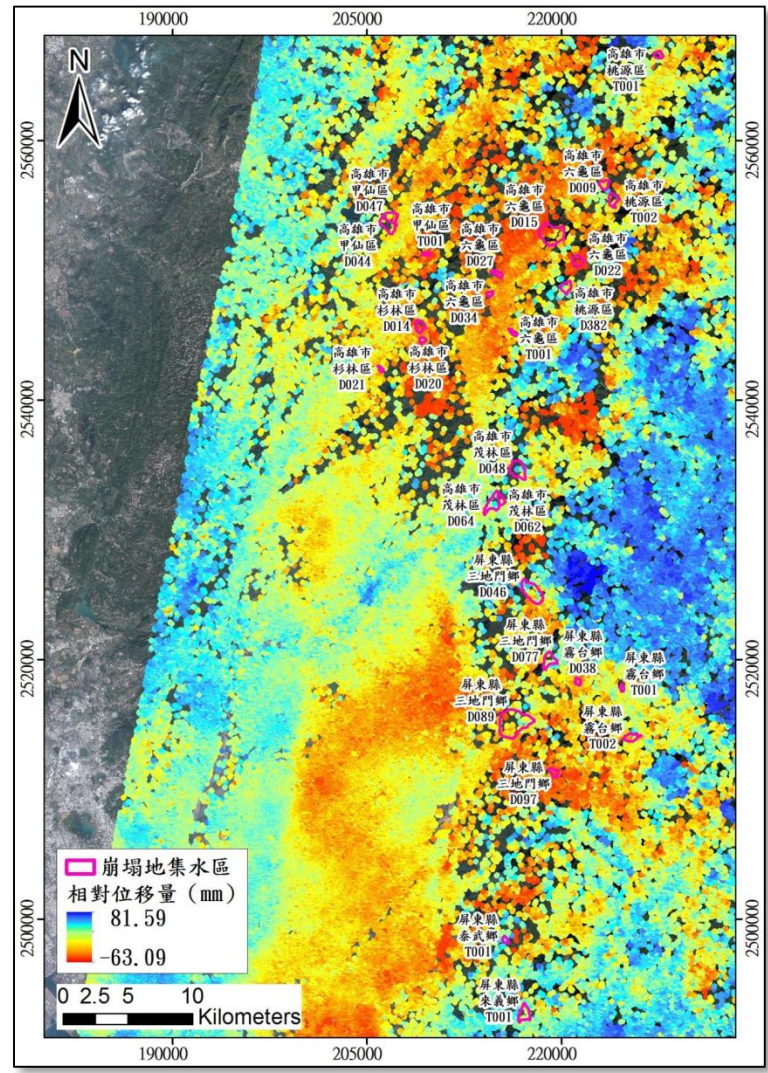
Flow chart of PSI Analysis



# Results and Discussions



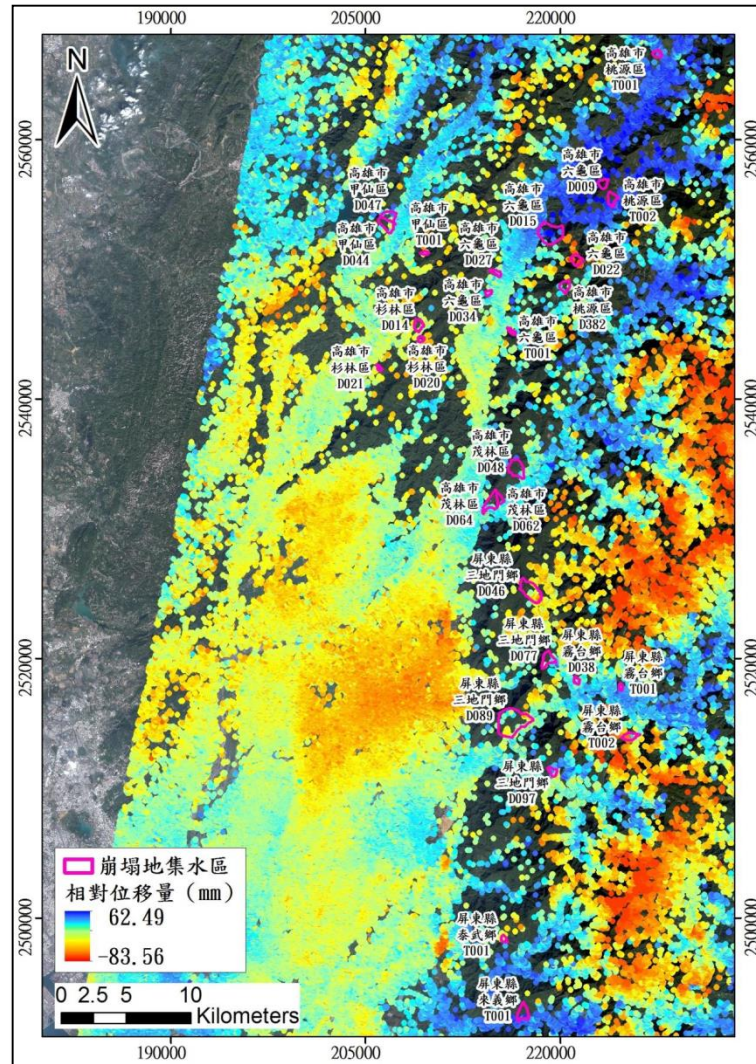
Large-scale collapse zones PSI Analysis results in southern Taiwan  
(2015/6~2016/6)



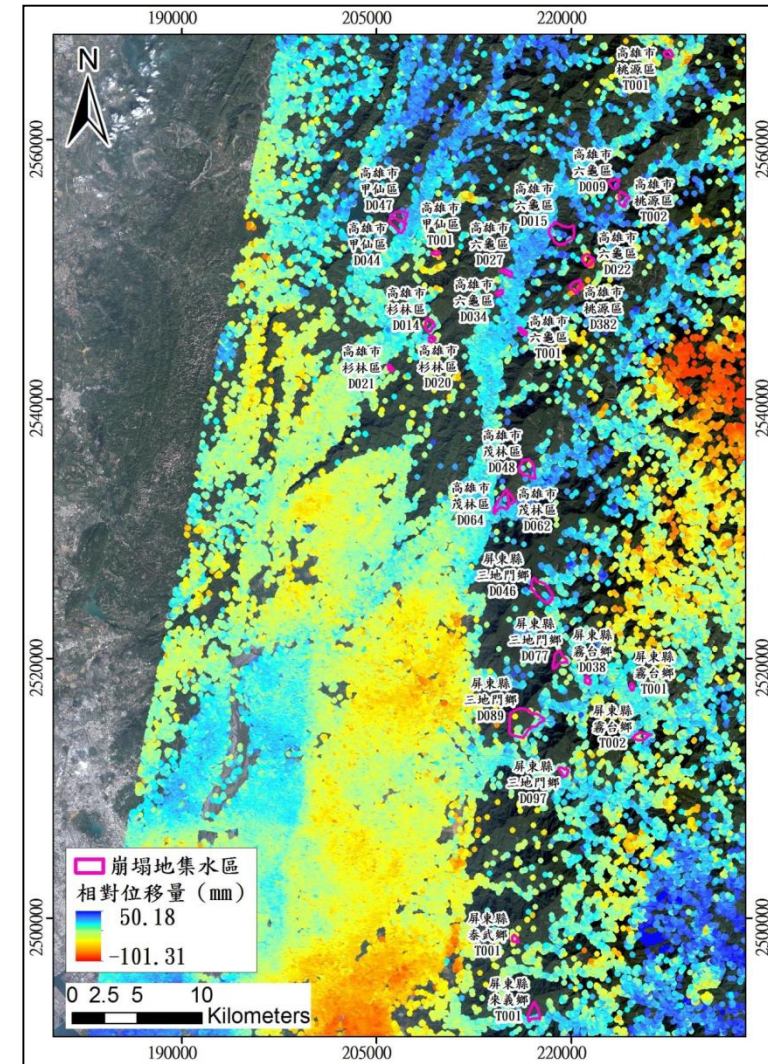
Large-scale collapse zones PSI Analysis results in southern Taiwan  
(2016/6~2017/6)



## Results and Discussions



Large-scale collapse zones PSI Analysis results in southern Taiwan  
(2017/6~2018/6)



Large-scale collapse zones PSI Analysis results in southern Taiwan  
(2018/6~2019/6)



# Conclusion

- Because the screening of PS points requires a certain degree of phase stability, the analysis results in the Large-scale collapse zones PSI Analysis results in southern Taiwan, if there are no PS points, it means that it is impossible to determine whether there is a displacement. The planned Sentinel-1A uses the C-band, which cannot penetrate the densely planted areas.
- In addition, due to seasonal changes in agricultural areas, it is difficult to generate PS points. For bare areas with high soil erosion, it is not possible to become PS points due to surface changes.
- According to the results of Large-scale collapse zones PSI Analysis results in southern Taiwan, it is found that the potential areas for large-scale collapse are covered by plants and most of them have no PS points, so it is impossible to determine the possibility of their displacement. In other words, good vegetation cover also means that the soil and sand content is high, so it may be a potential location for large-scale collapse.
- If the slope foot of the large-scale collapse potential site is a concave bank or bare area, and there are PS points, it means that this area may be a rock disk that can provide a certain degree of phase stability, and a certain slope can be provided for the large-scale collapse potential site stable. In the future, when PSI continues to analyze, the PS point suddenly disappears, indicating that the area may change, so special care is required.





Thank you for your attention.