Upgrade long-term monitoring of Passo della Morte Landslide

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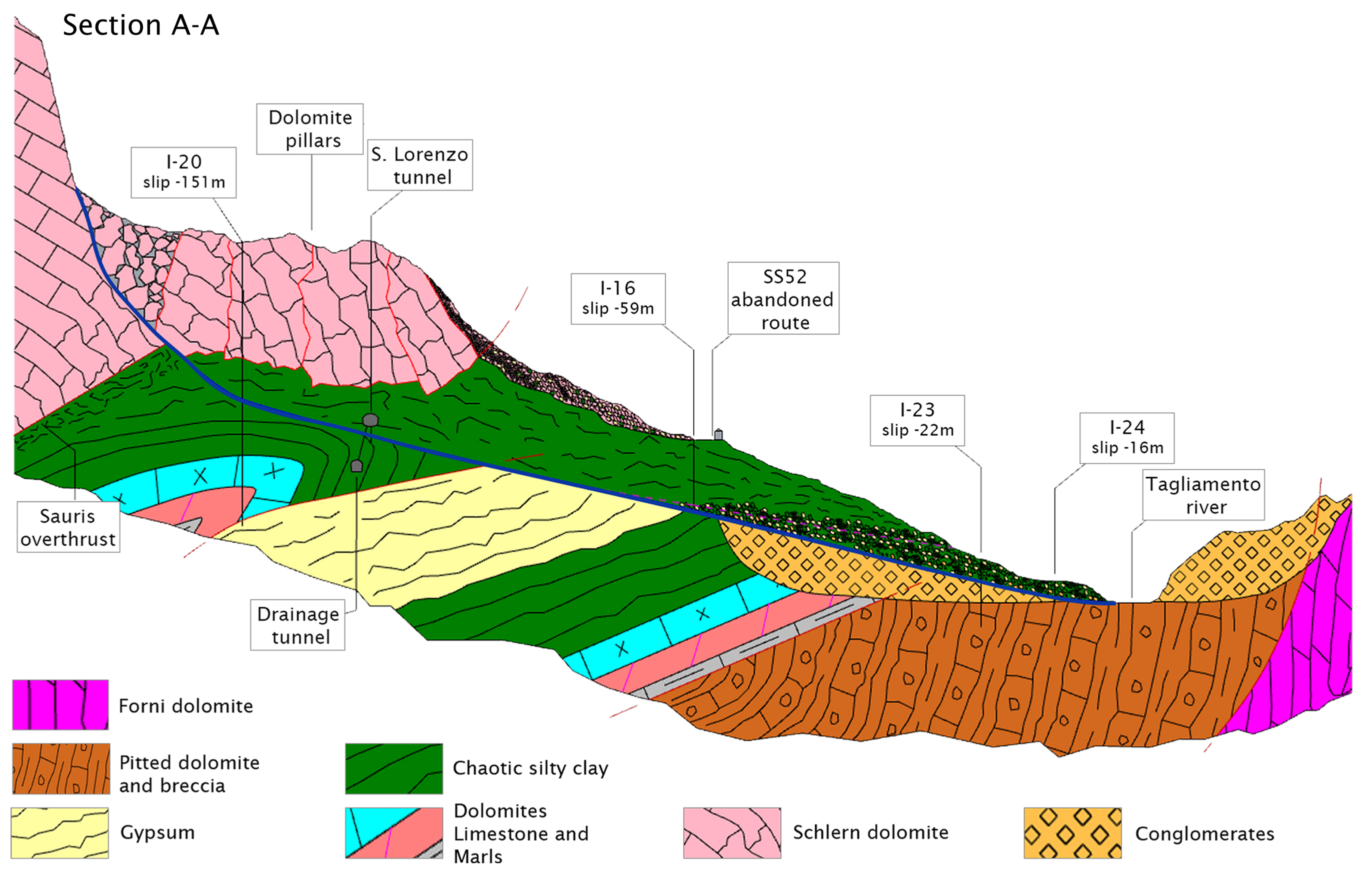
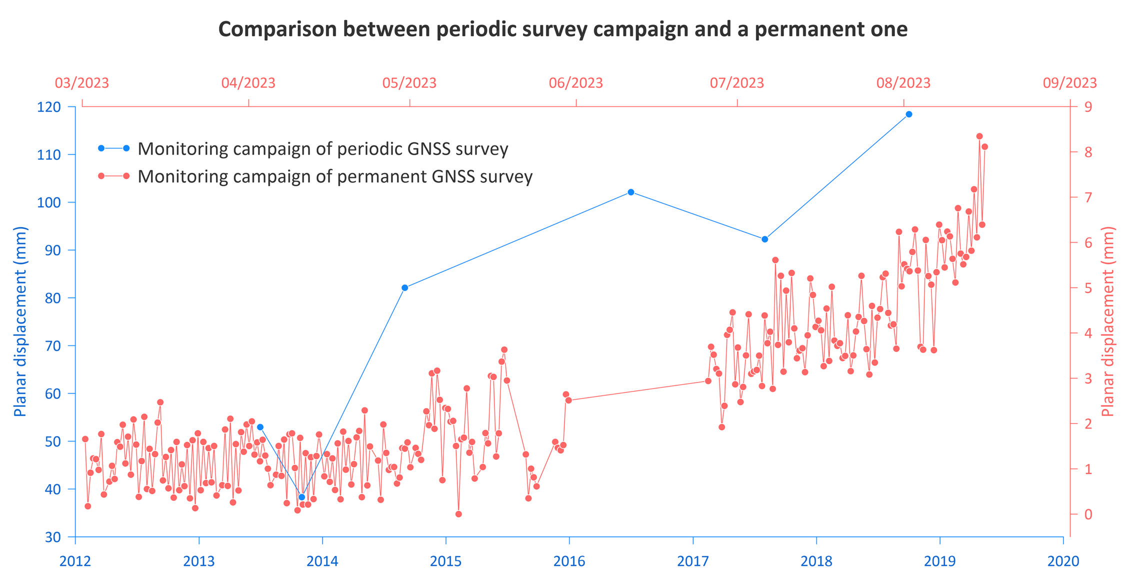
INTRODUCTION

This study focuses on detecting and monitoring a large, slow-moving landslide in the Passo della Morte area of the Italian Alps. It emphasizes the complexity of landslide detection, which involves analyzing geological factors, geomorphological evidence, and long-term monitoring. The study highlights the importance of collecting and analyzing datasets to identify correlations and potential triggers, with near-real-time monitoring offering detailed data and quick notifications for improved mitigation strategies.

To validate the hypothesis of block-type movement and determine absolute displacements, a new permanent GNSS monitoring system was installed, complementing the existing periodic network. The continuous network enables tracking of seasonal movement trends and their correlation with rainfall, estimation of trigger thresholds, and the potential configuration of an early warning system.



SYSTEM UPGRADE



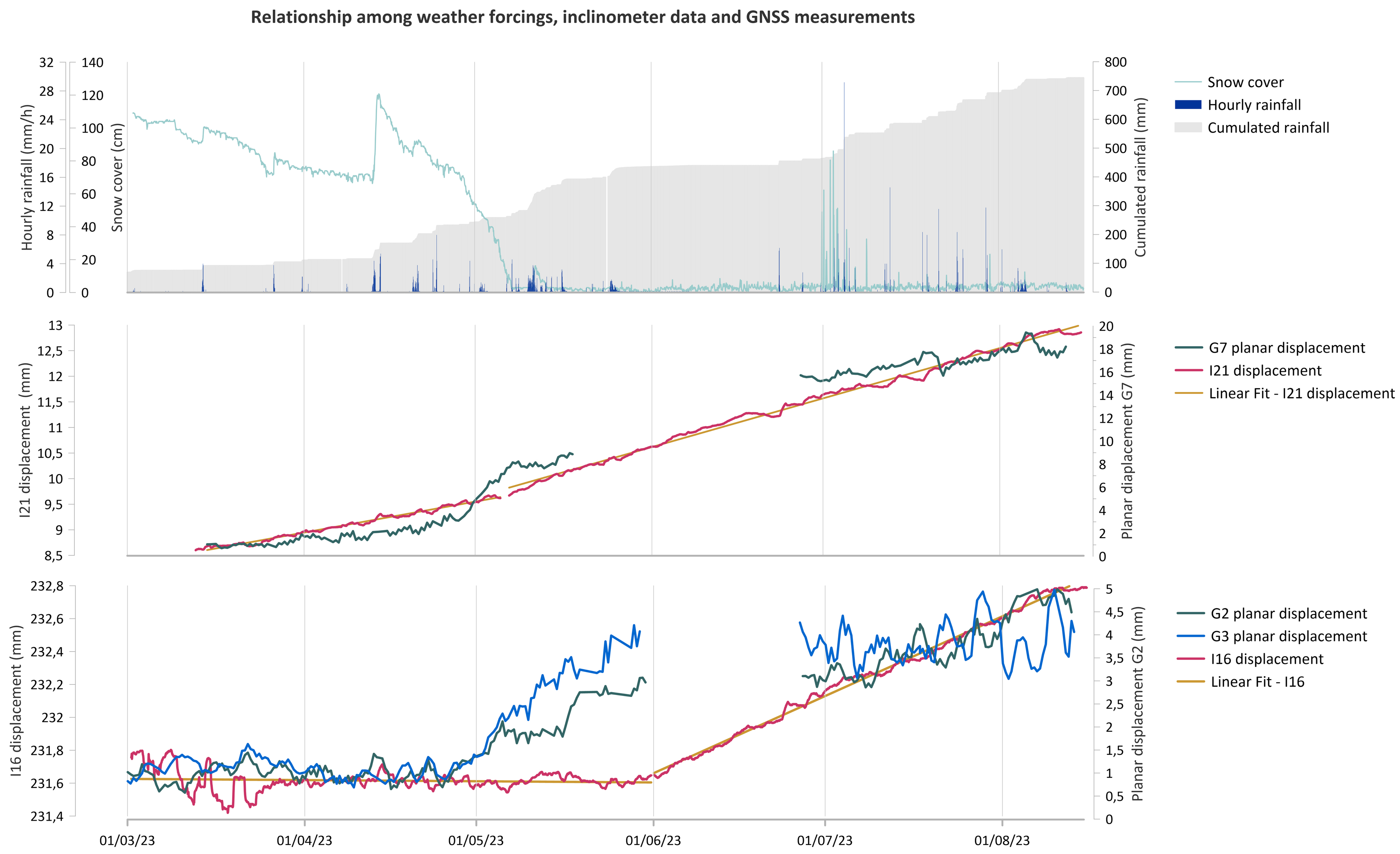
This research utilizes data collected from the stationary inclinometers and 12-hour data from permanent GNSS. The GNSS survey employed is the static differential approach, renowned for its exceptional precision, yielding errors within the millimetre range. On-site, dual-frequency receivers maintain continuous communication with the central master receiver (referred to as GNSS-MU in the figure) for transmitting error corrections. The devices communicate via a radio link, with mutual distances spanning less than 1 kilometre. The network provides daily RINEX data, which is post-processed using precise ephemeris with the support of LEICA commercial software (see Table 1 for instrument specifications).

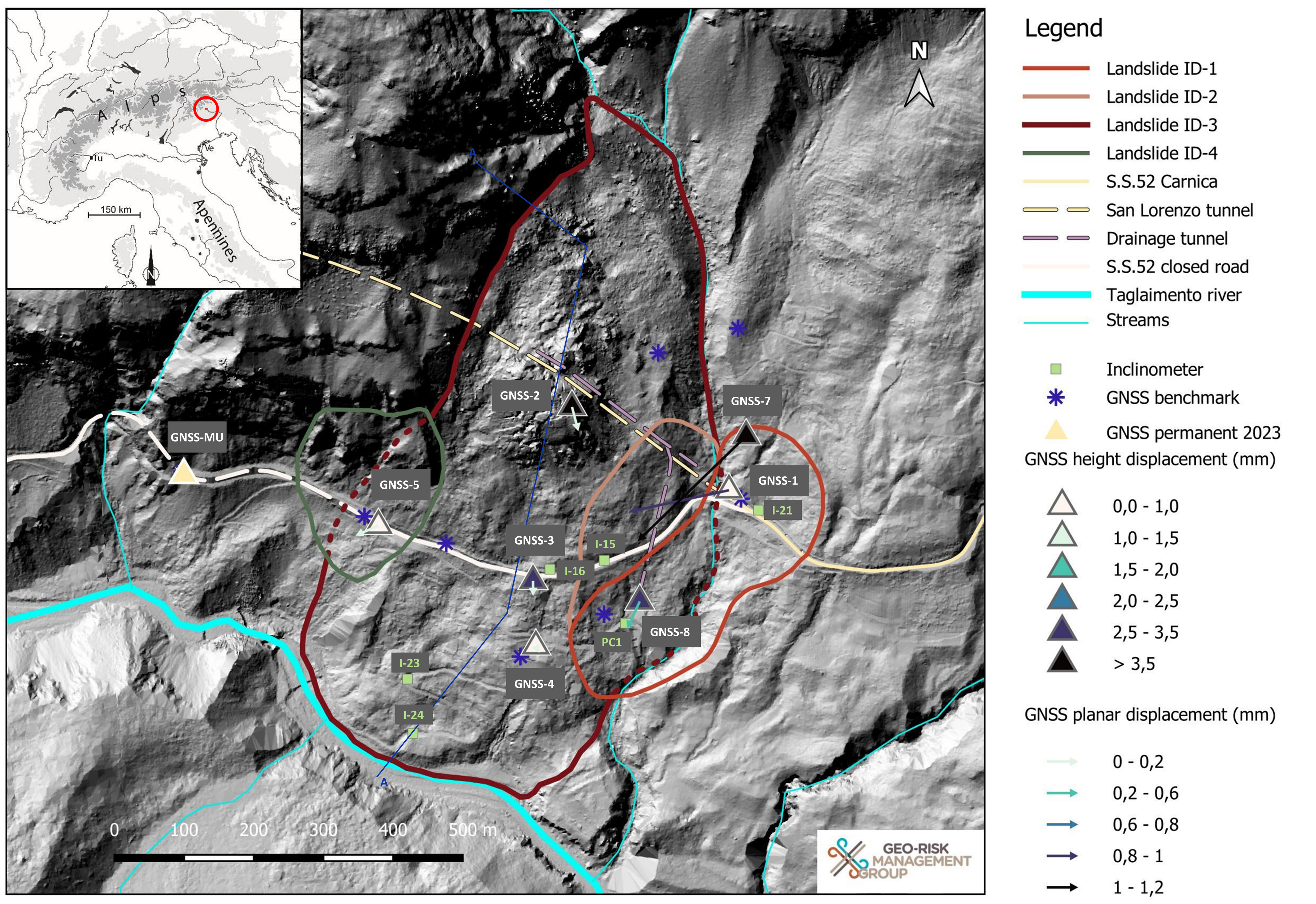
GNSS Receiver	Satellite System	Receivers Channels (number)	Frequencies Tracked	Antenna Cut-Off Angle (deg)
Leica GR30	GPS - GLO	555	L1 – L2 – L5	15°

Table 1: Characteristics of the new GNSS system.

PRELIMINARY RESULTS

The behaviour of ID1-2 and ID3 landslides varies due to differences in their volume and geological characteristics. However, despite these distinctions, the GNSS surface measurements reveal a similar pattern, not so much in terms of magnitude but in terms of timing. Specifically, the displacements precede the initiation of the overall movement by a few days in the case of the ID1-2 landslide and approximately one month in the case of the ID3 landslide. It is also noteworthy that once the inclinometer is triggered, the the angular coefficient of the two curves becomes consistent again.





CONCLUSION

Long-term monitoring is crucial in creating a temporal database and implementing effective mitigation measures. Analyzing datasets makes it possible to identify potential correlations among the monitored parameters, which may also include the potential triggering factors. Near-real-time monitoring enhances the level of detail by offering high-quality data and immediate notifications of landslide activity. This facilitates a better understanding of active landslide dynamics and the development of more efficient mitigation strategies.

This GNSS system will be critical in the coming years because it will enable tracking seasonal movement trends and their correlation with rainfall; it will facilitate the estimation of trigger thresholds and assess the feasibility of configuring the network with an early warning system.

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