EJEC REPORT

Observation case study of landslide caused by the 2024 Noto Peninsula earthquake

Eight-Japan Engineering Consultants Inc.

〇Yuki Ushirone, Masahiko Ishiwata, Yasumasa Fujiwara

Introduction

In Japan, a number of landslides occurred due to the Noto Peninsula earthquake on January 1, 2024.
In this presentation, we will introduce a case survey of one of the landslides due to the Noto Peninsula earthquake, in which we conducted a field survey ,Laser profiler investigation and installed GNSS observation equipment to observe the landslide.
Investigations and observations of this landslide are still underway. This presentation presents the results of the survey at this time.

◆ outline

1．Outline of landslide area

2．Field survey

3．Laser profiler investigation

4．GNSS Observation

5．Conclusion

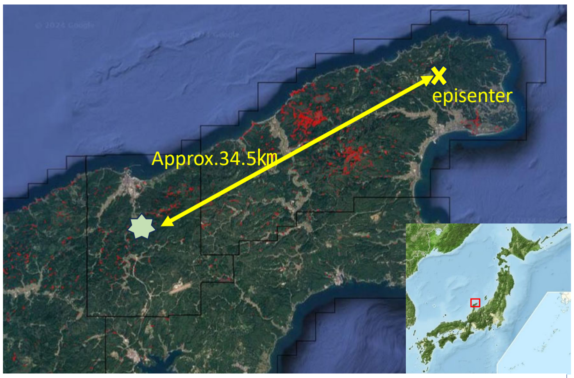


Fig Location map

(Adapted from *https://ja.wikipedia.org/wiki/%E6%97%A5%E6%9C%AC%E5%88%97%E5%B3%B6, https://gbank.gsj.jp/geonavi/geonavi.php#15,37.35129,136.91*)

1． Outline of the landslide area

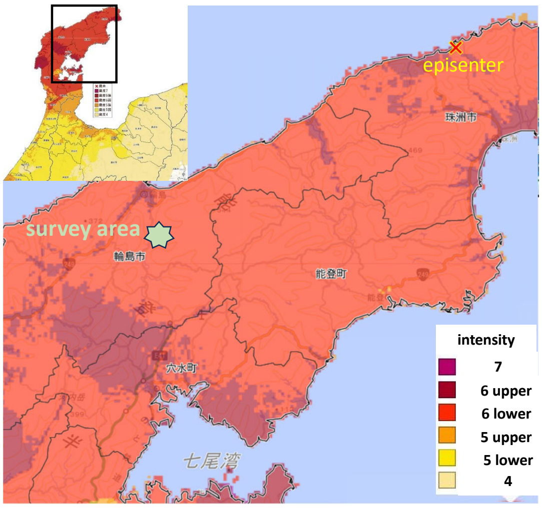


Fig. Estimated seismic intensity distribution map by JMA

Adapted from *https://www.jma.go.jp/bosai/map.html#11/37.341/137.03/&contents=estimated_intensity_map*

The earthquake Overview

Date and time :2024/1/1 16:10

Depth of epicenter ：16km

Magnitude ：M7.6

maximum intensity ： 7

Excerpt from Earthquake Research Committee, Headquarters for Earthquake Research Promotion

The survey area is in the seismic intensity of 6 or higher.

Fig. Earthquake-induced coastal uplift in the area around the epicenter (*Taken October 29,2024*)

3

1． Outline of the landslide area

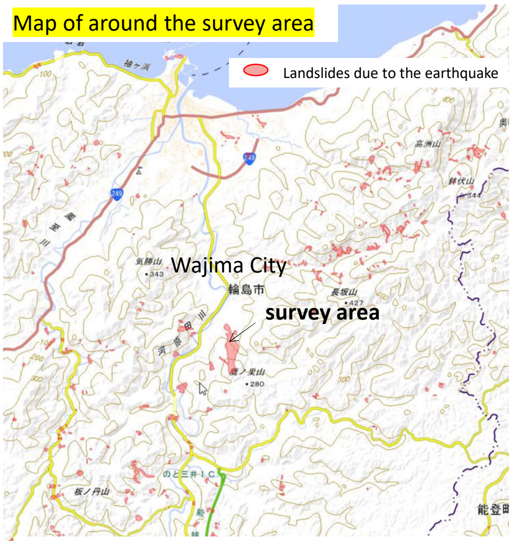


Fig Location map

Adapt from *https://gbank.gsj.jp/geonavi/geonavi.php#15,37.35129,136.91484*

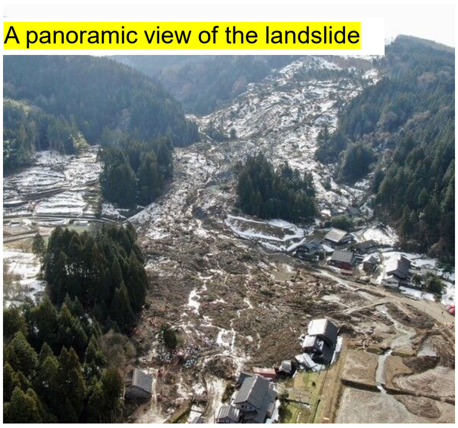


Fig. panoramic view of the landslide

Adapt from https://www.hokkoku.co.jp/articles/-/1305109

4

1． Outline of the landslide area

Distribution of geological features and pre-existing landslide topographys

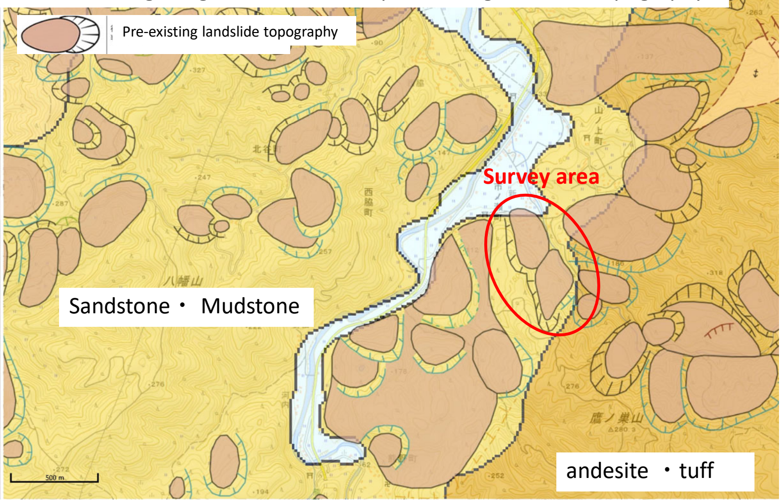
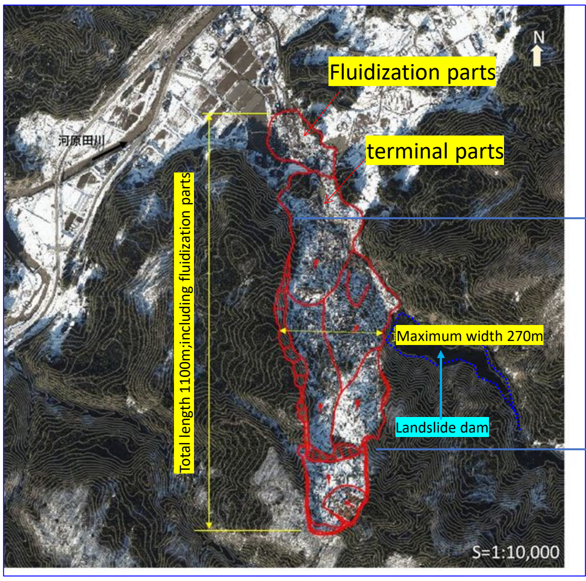


Fig. Geologic map and pre-existing landslide topographic distribution map
Adapt from *https://gbank.gsj.jp/geonavi/geonavi.php#15,37.35129,136.91484*

- The study area consists of Paleogene andesite l ava and mudstone/sandstone. Sandstone and mudstone unconformably overlie andesite lava.
- There are many pre-existing landslide topograp hys around the study area.

Fig. Geologic boundary identified in survey borings

2. Field survey

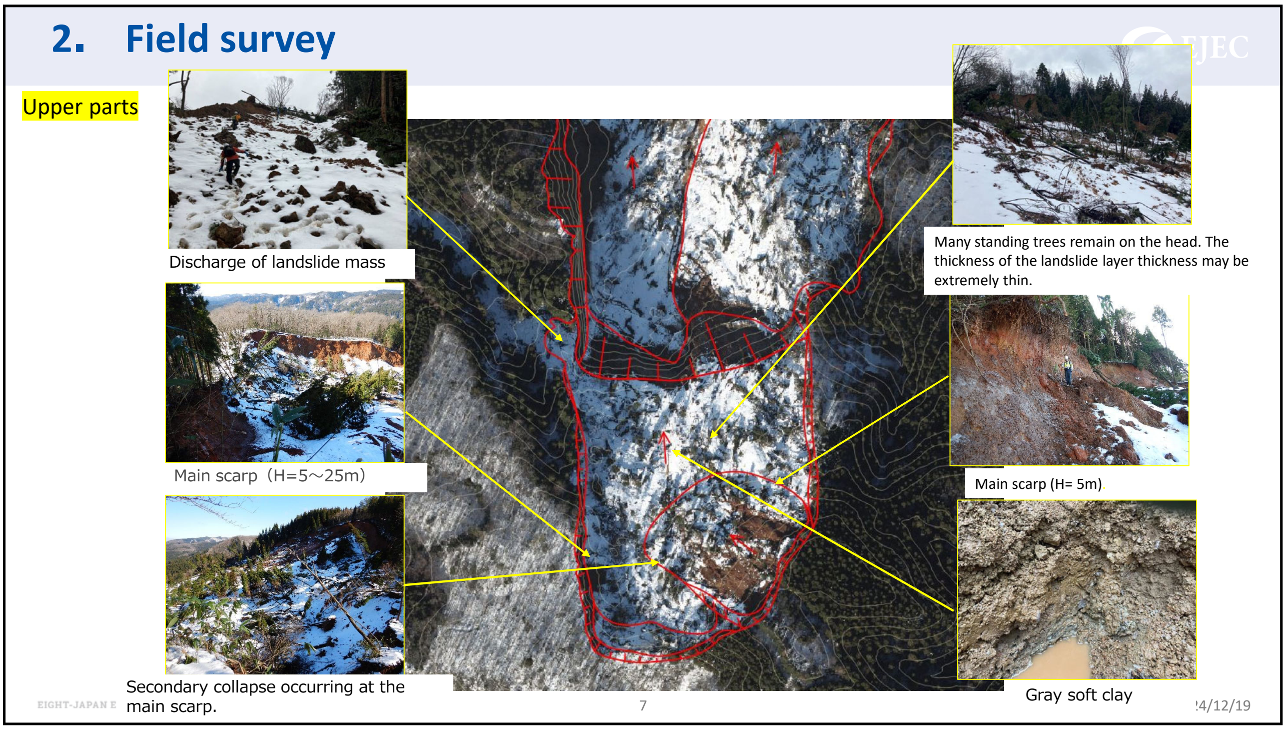


Terminal and Fluidization parts

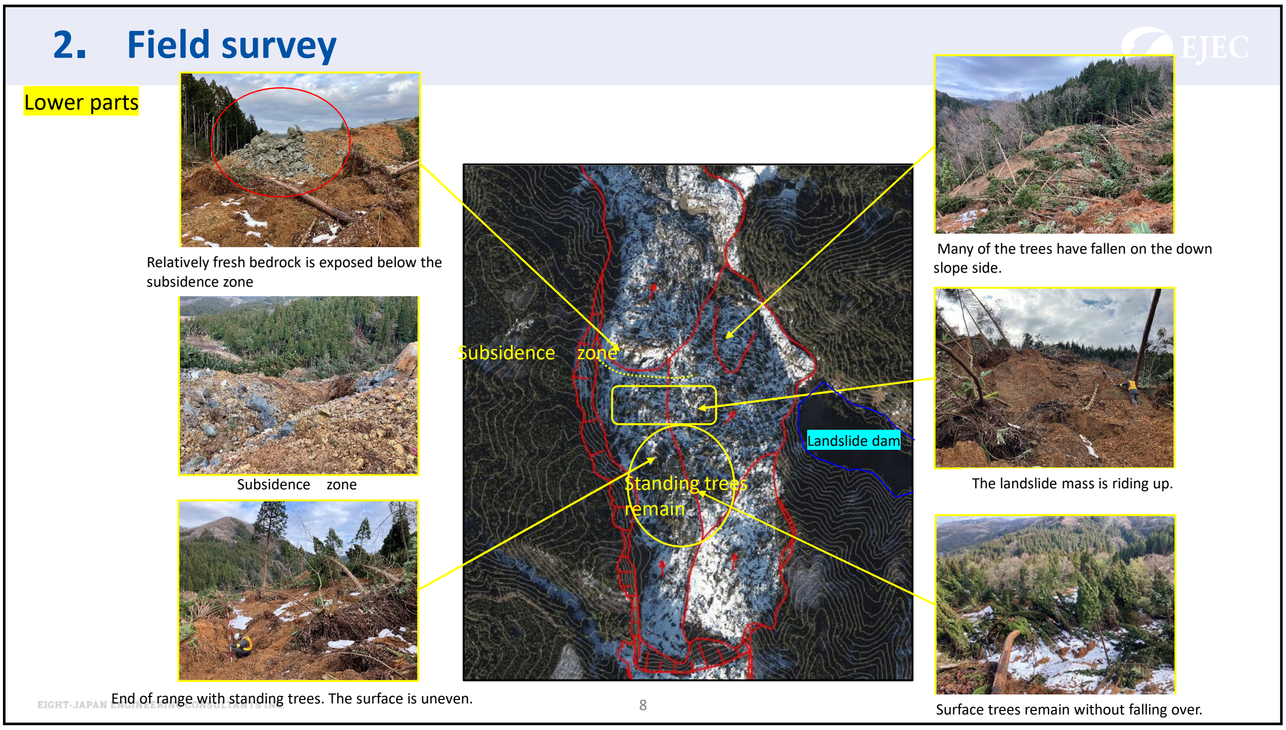
Lower parts

Minor scarp

upper parts


2. Field survey
EJEC
Upper parts
Discharge of landslide mass
Main scarp（H=5～25m)
Secondary collapse occurring at the main scarp.
Many standing trees remain on the head. The thickness of the landslide layer thickness may be extremely thin.
Main scarp (H= 5m)
Gray soft clay
7
'4/12/19

7


2. Field survey
EJEC
Lower parts
Relatively fresh bedrock is exposed below the subsidence zone
Subsidence zone
End of range with standing trees. The surface is uneven.
Subsidence zone
Landslide dam
Standing trees remain
Many of the trees have fallen on the down slope side.
The landslide mass is riding up.
Surface trees remain without falling over.
8

8

3． Laser profiler investigation

EJEC

（1）Comparison of topographic maps before and after the earthquake

Before the earthquake,2021

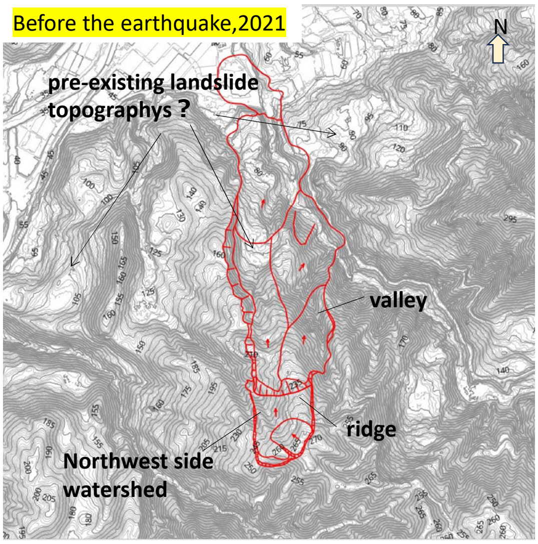


Fig. Pre-earthquake topographic map created by 2021 LP data

After the earthquake(2024/1/11)

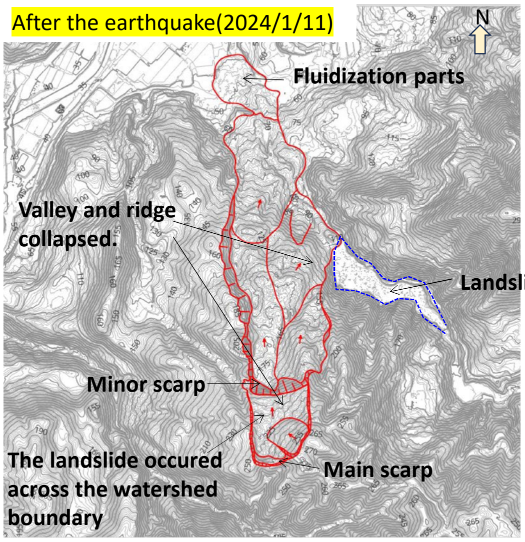


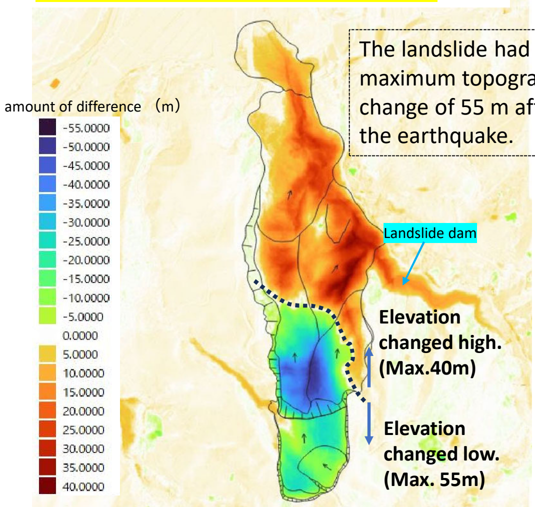
Fig. Post-earthquake topographic map created with LP data for January 11, 2025

3． Laser profiler investigation

EJEC

（2）Differential analysis using LP data before and after the earthquake

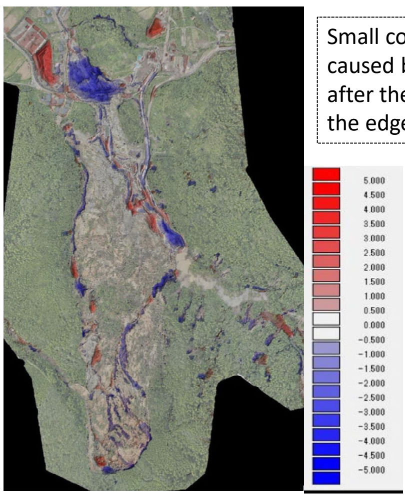
Topographic change after the earthquake



The landslide had a maximum topographic change of 55 m after the earthquake.

Fig. Differential analysis using LP data before and after the earthquake①
（LP in 2021）－（LP in April 2024）

Topographic change of heavy rainfall in September 2024



Small collapses occurred caused by heavy rainfall after the earthquake at the edges of the landslide.

Fig. Differential analysis using LP data before and after the earthquake②
（LP in April 2024） － （LP in October 2024）

4． GNSS Observation

EJEC

◆**Purpose of the observation**

- To prevent secondary damage
- To study the mechanism of landslide occurrence
- and the design of landslide control works

※ Landslide dam monitoring is conducted separately.

◆ **Selection of Observation Instruments**

- The scale of the landslide is large.
- The landslide masses are soft and easily dismantled and fluidized
- The height of the scrap is high. （H＝5～25m）

→Installation of invar wire extensometer is difficult.

Adopted GNSS observation at multiple points

※Satellite positioning systems are systems that use satellites to measure current location on the ground.

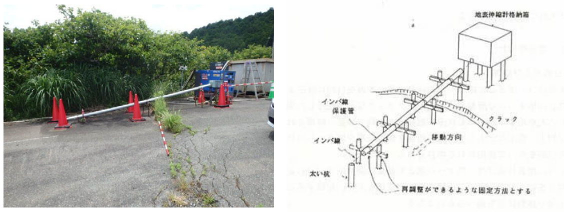


Fig. Example of installation of an extensometer

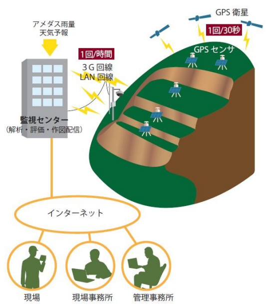


Fig. Image of GNSS observation system

Adapt from https://www.k-mil.net/construction_methods/detail/1858

4． GNSS Observation

EJEC

◆ **Selection of installation location; 4 locations**

- A safe place at aftershocks
- Representative points of each block
- Points where downstream impacts are significant in the event of large-scale sediment transport.

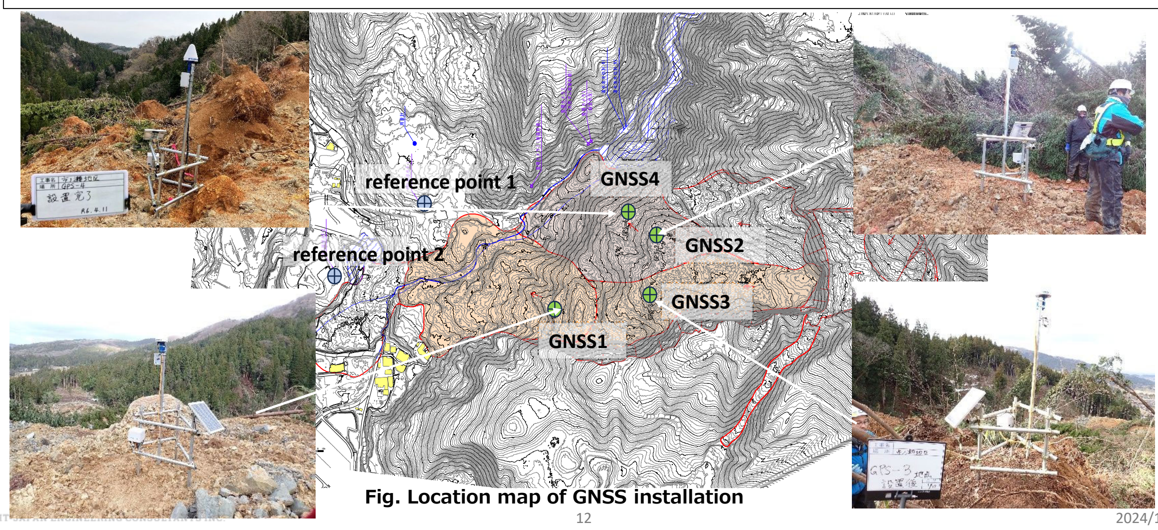


Fig. Location map of GNSS installation

4． GNSS Observation

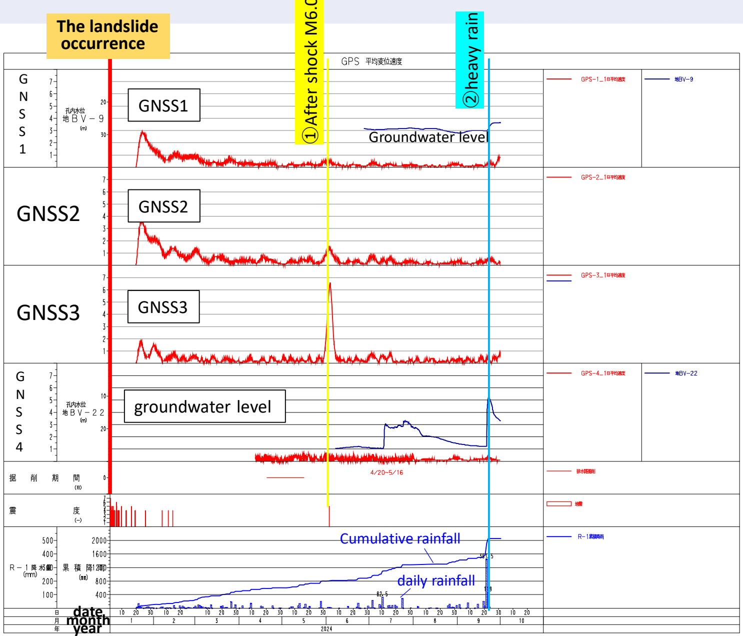


Fig. Displacement rate per day based on GNSS

- All GNSS show a decreasing trend in daily displacement velocity.
- Short-term increase in displacement velocity is confirmed at the June 3 M6.0 aftershock （①）
（The increase in displacement due to aftershocks was greatest for GNSS3.）
- No significant displacement was observed at the heavy rainfall after the earthquake （②） .

13

4． GNSS Observation

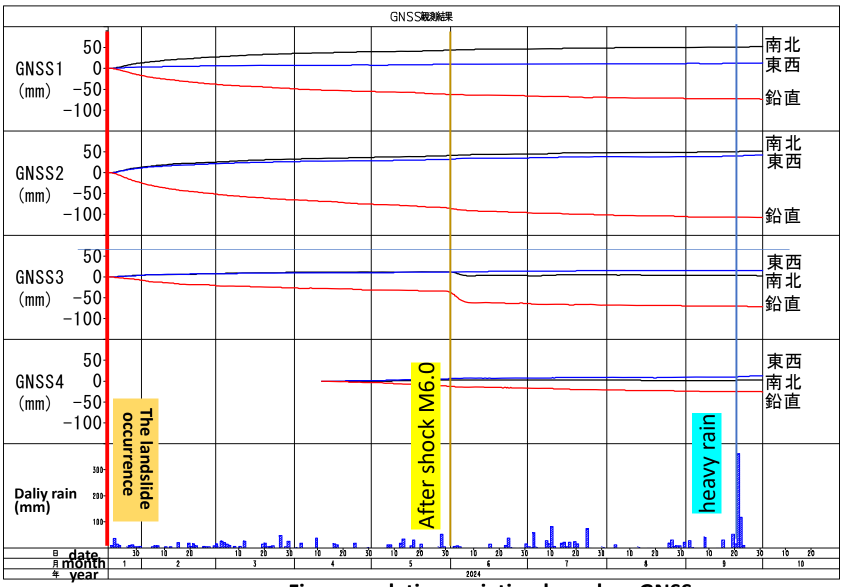


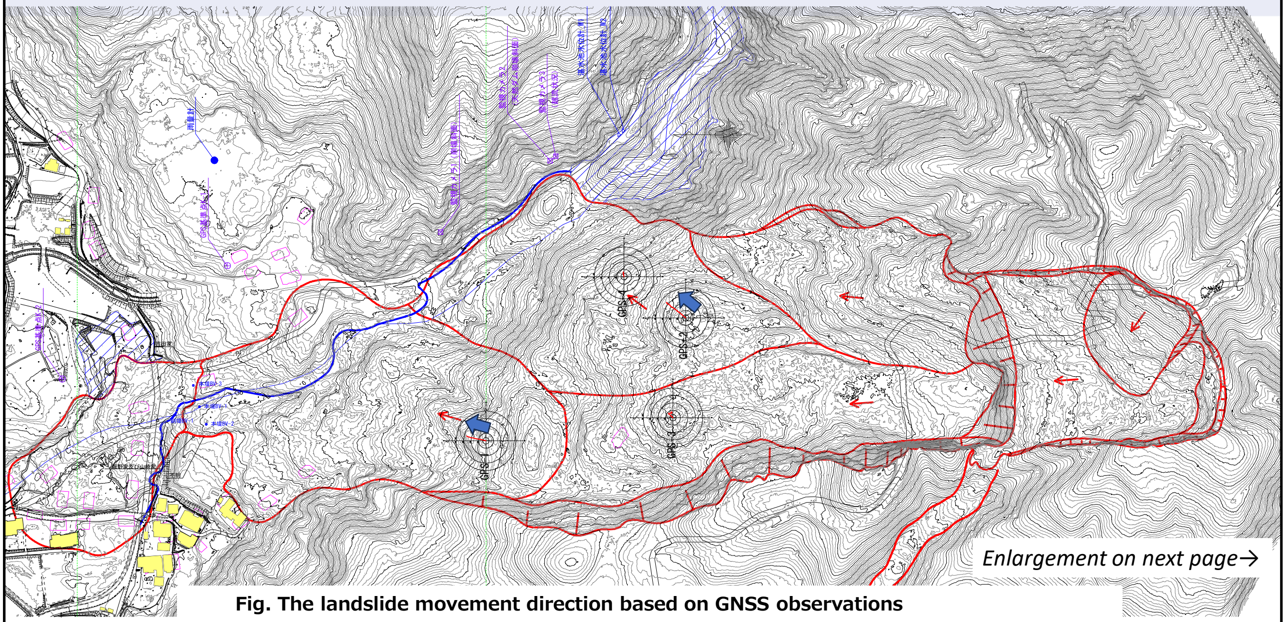
Fig. cumulative variation based on GNSS

- Cumulative variation is dominated by the vertical component.
- Vertical displacements of Approx.100 mm were observed with GNSS2.
（Approx. 70 mm in GNSS1 and GNSS3.）
- GNSS4 has a short observation period and the vertical subsidence is about 24 mm.

legend	
black line	south and north
blue line	East and West
red line	vertical

14

4． GNSS Observation

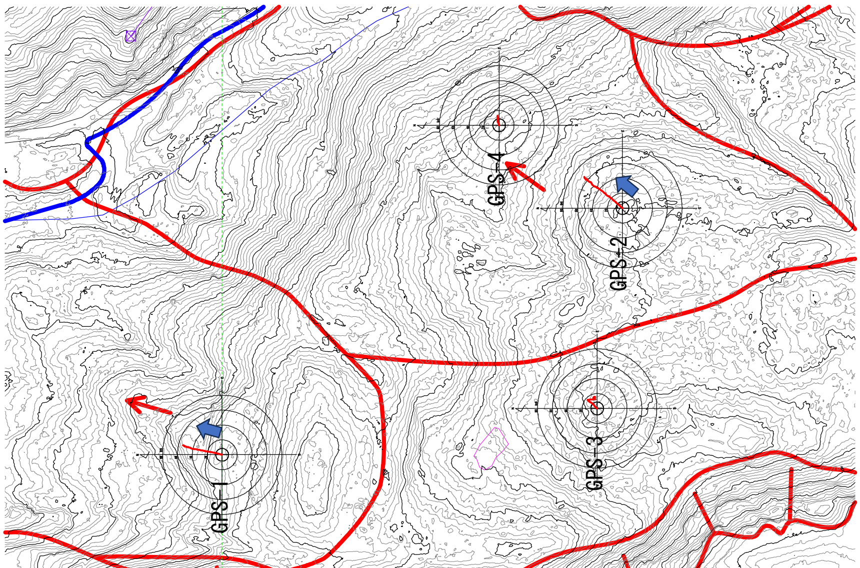


Enlargement on next page→

Fig. The landslide movement direction based on GNSS observations

15

4． GNSS Observation



The landslides generally tend toward steeper slopes.

Fig. The landslide movement direction based on GNSS observations

16

5. Conclusion

EJEC

- **GNSS installation is effective for large landslides where it is difficult to install an invar-wire extensometer in an emergency.**
- **The landslide shows a decreasing trend in displacement velocity after the earthquake.**
- **After the main quake, there was an aftershock of M6.0 and the heavy rain , but no significant landslide movement was observed.**
- **In the future, we plan to evaluate the stability and design countermeasures of the landslide by synthesizing the results of the borehole investigation and the displacement observations of the landslide in the ground.**

EIGHT-JAPAN ENGINEERING CONSULTANTS INC. 17 2024/12/19

17

EJEC

Thank you for your attention

EIGHT-JAPAN ENGINEERII

EIGHT-JAPAN ENGINEERING CONSULTANTS INC.

2024/12/19

18