

Landslides (2018) 15:2521–2524
 DOI 10.1007/s10346-018-1092-z
 Received: 28 September 2018
 Accepted: 12 October 2018
 Published online: 31 October 2018
 © The Author(s) 2018

Hiromitsu Yamagishi · Fumiaki Yamazaki

Landslides by the 2018 Hokkaido Iburi-Tobu Earthquake on September 6

Abstract In the early morning of September 6th, 2018, an intense earthquake struck Hokkaido Iburi-Tobu area. By this earthquake, many landslides occurred and claimed 36 lives. The landslide numbers reached 6,000 and mostly they are shallow landslides moving down of the air-fall pumice layer from Tarumai volcano which erupted ca. 9,000 years ago. However, southeast of the area, deep-seated landslides of dip-slipping type are also found.

Keywords Intensive earthquake · Landslides · Hokkaido · Japan

Introduction

On September 6, at 03:08 AM, Japan time, an intense earthquake struck the Iburi-Tobu area of Hokkaido, Japan. Its JMA magnitude of 6.7 was registered with its epicenter located at 42.72° North, and 142.0° East. The maximum intensity of 7 was registered at Atsuma Town (Fig. 1). The affected area has been hit by a series of aftershocks, and they are still continuing (Fig. 2: National Institute of Earth Science and Disaster Prevention, NIED). This earthquake reportedly killed 41 persons, including 36 dead by landslides as mentioned herein.

Climate condition of the day The earthquake occurred just 1 day after powerful typhoon Jebi (No. 21 in Japan) left torrential rains in the region. The Meteorological Agency of Japan reported that the precipitation had accumulated within the last 3 days from September 3 to 5 reached almost 100 mm.

Geology The huge tremor triggered landslides over about 20 km × 20 km area behind Atsuma Town, wiping out homes at the foot of the slopes there. This area is composed of Neogene sedimentary rocks as its basement, and covered mostly up with air-fall lapilli-sized pumice layers (1.5 m thick; Ta-d: ca. 9000 years ago) from Tarumai Volcano to the east. Surface soil layers covering low to middle mountain ranges are inter-bedded with the pumice and ash. Total thickness of the surface geology is about 4–5 m in and around the epicentral area.

Landslide distribution and characteristics

The Geographical Survey Institute, Japan (GSI, hereafter), quickly took aerial photographs (ortho-photographs) for the whole area affected by the earthquake, and has not only been providing them to many public offices relevant to the disaster but also posted them up on the Web together with analyzed satellite images for the public. Also, many aerial surveying companies have taken aerial photographs such as Fig. 3 and posted them up on the Web.

Given many high-resolution ortho-photographs from GSI, Mr. Kouichi Kita of Hokkaido Government has extracted

landslide scarps and debris deposits during the photo interpretation using GIS as shown in Fig. 4. He recognized more than 6000 landslide scarps and 1000 associated debris deposits. The reason why the number of the landslide scarps was much larger than that of the debris deposits is that some debris flowing from different sources must have been mixed up into a single larger mass.

Most landslides are shallow, several meters deep-seated (“hokai” in Japanese), and are mostly classified as planar types (left of Fig. 5) and spoon types (right of Fig. 5), both of which are the same as the rainfall-induced landslides (Yamagishi and Moncada 2017). Some deep-seated landslides of dip-slipping type are also found in the southeast part of the mountains.

Most landslides slid down over the air-fall pumice and ash layers. We visited one landslide at Tomisato to fly a drone for extracting its 3D image by using SFM (structure from motion) (Fig. 6). We have extracted three-dimensional coordinates of surface points making up the terrain as shown in Fig. 6. The landslide masses were detached from both valley walls as well as the head of the valley. The detached debris mass was a mixture of pumice/ash materials and uprooted pine trees, and its surface spreading over the depositional area was rugged and hummocky along its margin. The debris mass that has stopped and spread over rice fields can be divided into the lower and upper parts. The lower part includes many uprooted trees, while most of the upper part is composed of fine sand indicating that the mass flowed like a viscous slurry. The volume of this debris mass is estimated from SFM to be about 65,000 m³.

Conclusion

This earthquake is very similar to the October 23, 2004, Chuetsu Earthquake ($M = 6.8$), in that it triggered many landslides given the maximum intensity of 7 on the JMA Intensity scale and the JMA magnitude of 6.7 (Yamagishi and Iwahashi 2007). The number of landslides triggered by this earthquake was about 6000 while it was 3370 in the Chuetsu Earthquake according to Niigata Prefecture, though the focal depth of the Hokkaido Iburi-Tobu Earthquake was 37 km, about 4 times as deep than that (10 km) of the Chuetsu Earthquake. It may be a little premature to say the following, but this may be attributed to the volcanic-product-rich surface geology covering Neogene hard rocks of the affected area while the area struck by the Chuetsu was dominated by sedimentary rocks. We are currently planning to scan the terrain using a 2-km-long-range terrestrial LiDAR and then to run debris mass flow simulations in the near future.

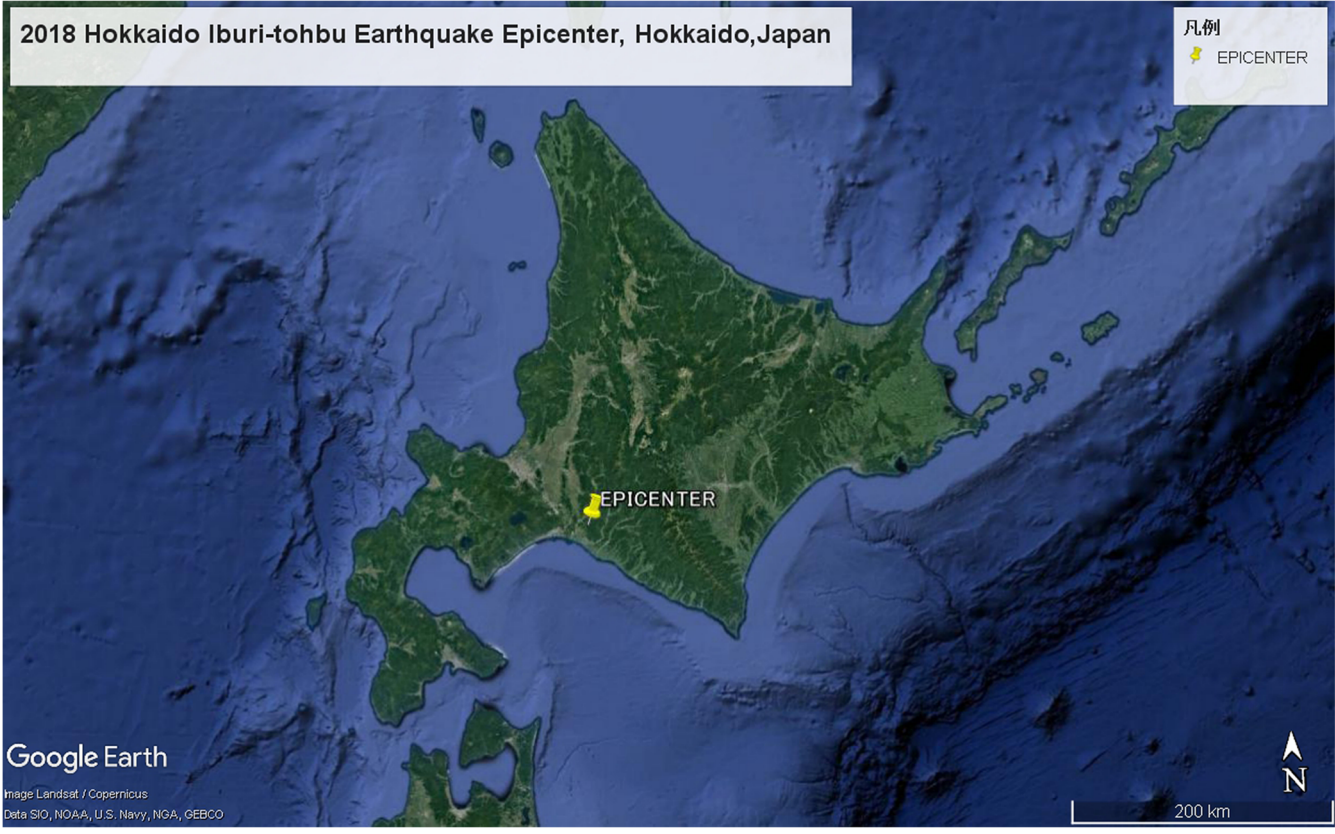


Fig. 1 The Iburitohbu area of Hokkaido, Japan

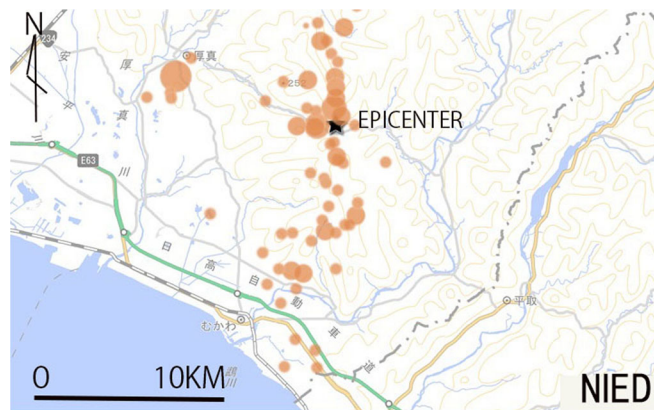


Fig. 2 The affected area was hit by a series of aftershocks, and they are still continuing



Fig. 3 Aerial photograph of the area (taken by Asia Air Survey and Aero Asahi Corporation)

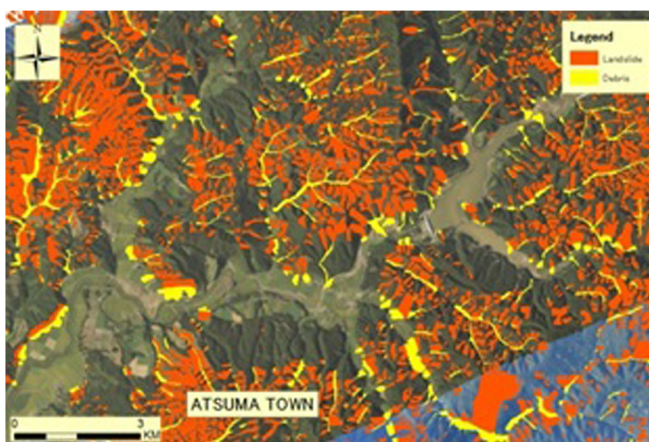


Fig. 4 Photo interpretation of the area using GIS (interpreted by Mr. Kouichi Kita)



Fig. 5 Most landslides are shallow, several meters deep-seated, and are mostly classified as planar types (left) and spoon types (right)

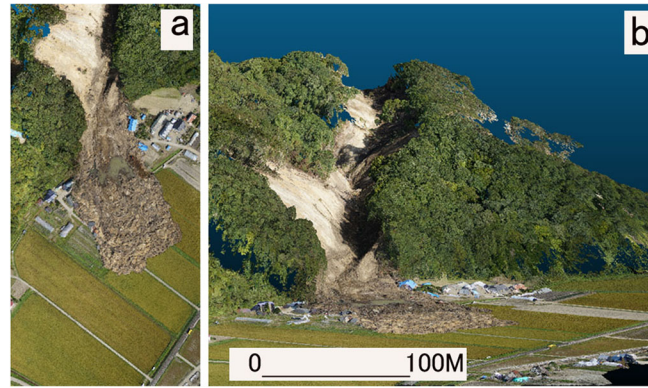


Fig. 6 Extracted its 3D image by using SFM (structure from motion) and extracted three-dimensional coordinates of surface points making up the terrain a) is vertical view image, and b) is oblique view

Acknowledgements

We are grateful to the reviewer for useful comments and suggestions.

Open Access This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

References

Yamagishi H, Iwahashi J (2007) Comparison between the two triggered landslides in Mid-Niigata, Japan—by July 13 heavy rainfall and October 23 intensive earthquakes in 2004. *Landslides* 4:389–397

Yamagishi H, Moncada R (2017) TXT-tool 1.081-3.1 landslide recognition and mapping using aerial photographs and Google Earth, *Landslide dynamics: ISDR-ICL landslide interactive teaching tools, vol 1: fundamentals, mapping and monitoring* 67–82

H. Yamagishi (✉)

Hokkaido Research Center of Geology (HRCG),
Sapporo, Japan
Email: hiromitsuyamagishi88@gmail.com

F. Yamazaki

PENTAX TI ASAHI Co. Ltd,
Otaru, Japan