

Landslide disasters induced by the 2011 off the Pacific Coast of Tohoku Earthquake

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1. Introduction

The largest scale earthquake with the epicenter approximately 130 km southeast of the Oshika Peninsula of Miyagi Prefecture, the fault rupture length about 500 km and a magnitude 9.0 (M_w) caused extreme catastrophic disasters in East Japan in March 2011. The damages by a wide-spread seismic vibration with over 6 of the Japanese seismic scale and a Tsunami from Hokkaido to Chiba Prefecture caused about 26,000 people killed and missing as of 11 May 2011. Long-term stop of lifelines have had great interruption to searching missing persons, rehabilitation and reconstruction activities and daily life of evacuating people.

The difficulty in disaster management of this earthquake is that various remedial works must be operated at the same time as planning reconstruction of the devastation areas along the Pacific coast suffered from Tsunami.

At the first stage, there were several information of landslide disasters in contrast to large earthquake. Gradually, we have found that the damages are widely distributed over the whole East Japan, and there are several areas of concentrated occurrences in southern part of Fukushima Prefecture, hilly residential areas of Miyagi and Fukushima Prefecture, island areas of Matsushima coast.

We briefly introduce the situation of landslide disasters in Northeast Japan.

2. Distribution of landslide disasters

We give an outline of distribution of landslide disasters in Tōhoku region by the investigation team of the Tōhoku branch of the Japan Landslide Society. Some of them can be referred on the Japan Landslide Society's Home Page, the information site of the Great East Japan Earthquake (Fig 1). The distribution of landslides we have already known until late May are as given below.

1) From reading aerial photography taken by Geographical Survey Institute of Japan (taken on March 2011) from southern part of Aomori to Fukushima coast (Abe, • Higaki, 2011; Sato • Higaki, 2011), slope failures over 20m length and width seems to be little.

Especially in the mountain areas of Sanriku coast many landslides have not occurred though the extensive damages by Tsunami.

2) In the residential areas which have been developed on the hills composed of the Pliocene to Pleistocene sediments, slopes of earth-fill have been deformed by many cracks, steps, slides, and thus many houses were destroyed in Sendai city with 788 square kilometers in area (Fig 2). Many of them occurred by the main shock on 11th March. After that, many after-shocks have made further deformation. Such slope deformation also appeared in southern part of Miyagi and Fukushima Prefecture, so large number of residents have been evacuating.

3) On Matsushima coast area of Miyagi facing Pacific Ocean of the Neogene volcanic deposits with mudstone/sandstone, many slope collapses occurred in the islands (Fig 3).

From interview and fieldworks, many of them occurred during the main shock and soon Tsunami attacked the residential area.

4) In the southern part of Fukushima Prefecture that had affected by both strong main shock of 6 in Japanese seismic scale and many after-shocks, many landslides occurred near Shirakawa and Iwaki city. Some landslides occurred in relation to Pleistocene volcanic ash and welded tuff layer in hilly area in the eastern areas of Oou Mountains.

5) On the south eastern areas on Iwaki city happened magnitude 7.1 inland earthquake on 11th April , land surface deformation appeared along the Idosawa fault (Shionohira fault) and Yunodake fault during this earthquake. Many rock slides and deep-seated landslides occurred in the surroundings of faults to coast areas of the Pacific Ocean (Fig 4).

In this area, landslide disasters happened on the slopes consisting of the Neogene and Paleogene strata and the crystalline schist area. Since them some of slopes have been still unstable due to after shocks and rainfall, so it is urgent to distinct movement rate and risk of them.

3. Conclusion

Many different types of mass movement (landslides) have been caused by the 2011 off the Pacific Coast of Tohoku Earthquake and the after-shocks of it in wide areas in the Eastern Japan. Concentrated distribution of them is 1) residential areas of earth-fill in the hilly terrain of Sendai city, 2)the slopes of volcanic deposits in the inland area of southern Fukushima, 3)Hilly coastal areas of Neogene soft rocks around Matsushima Bay, 4) Surrounding areas of the displaced faults during the large after-shock in Iwaki city of sandstone/madstone and schist.

Further investigation is urgently needed to distinct other risky landslides by the earthquake.

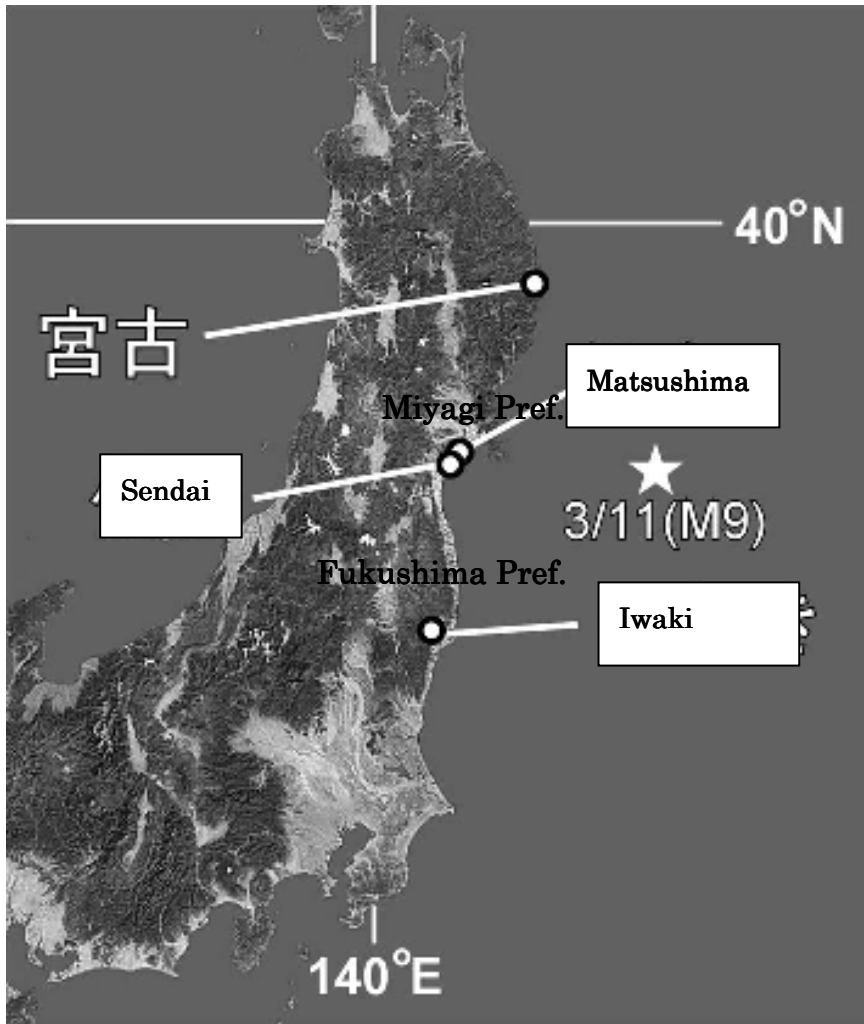


Fig.1 Location of the epicenter
(Base image: Landsat)



Fig.2 Houses destroyed by a
landslide in Sendai



Fig.3 A slope failue in Sabusawa Island (Tsunami from left side also destroyed the houses



Fig.4 A deep-seated slide blocked a highway in Iwaki