Outline and Future Strategies of SABO Works in Japan

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Technical Conference on Sediment Disaster Risk Management, Japan-Austria

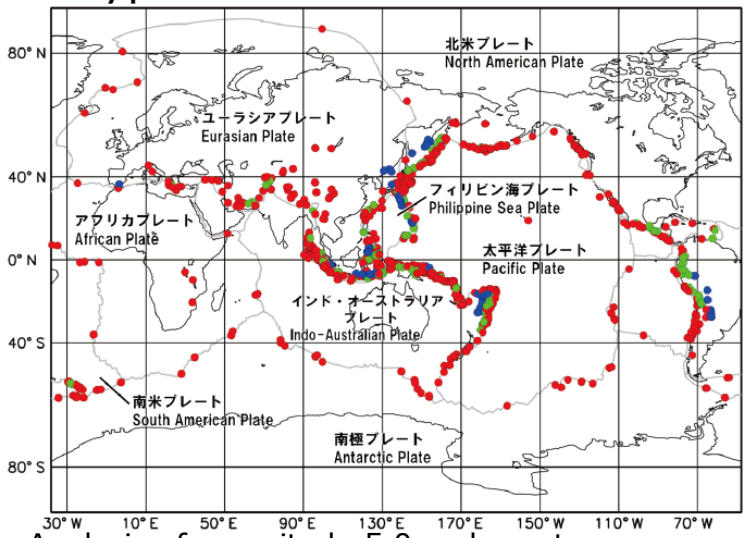
1. Sediment disaster situations in Japan

2. Summary of sediment disaster management

3. Future Perspectives and Strategies

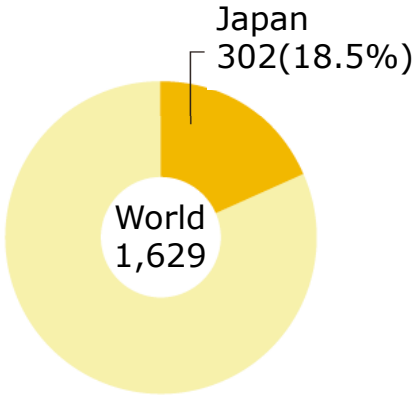
Natural conditions

World Geographical Distribution of Hypocenters and Plates



Analysis of magnitude 5.0 and greater earthquake's epicenters from 2004 to 2013

Number of earthquakes with magnitude of 6.0 or greater (2004-2013)

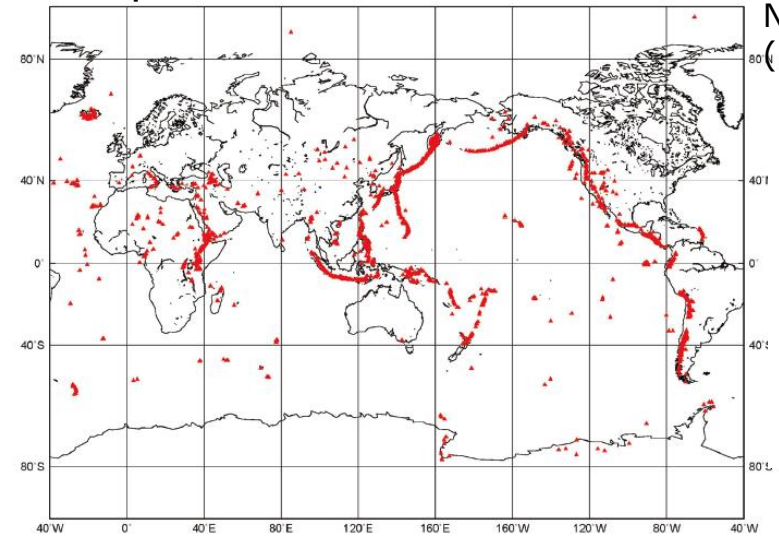


Because of natural conditions, e.g.

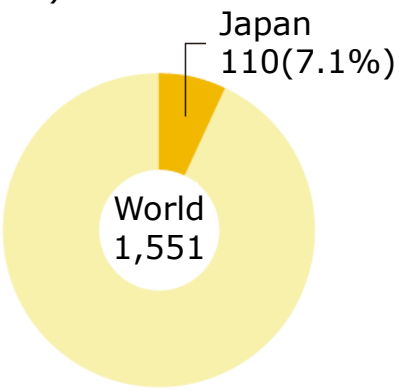
1. 4 converging tectonic plates
2. Active volcanos
3. Earthquakes
4. Fragile geology
5. Mountainous topography

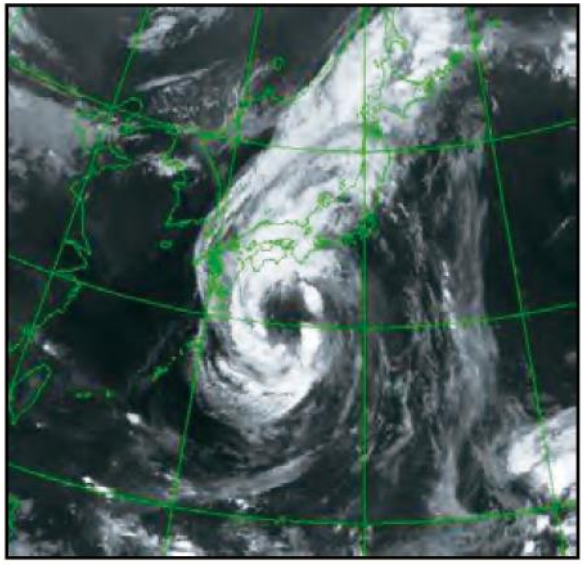
Japan is very susceptible to sediment disasters.

Principal Volcanoes in the World



Number of active volcanoes (2014)

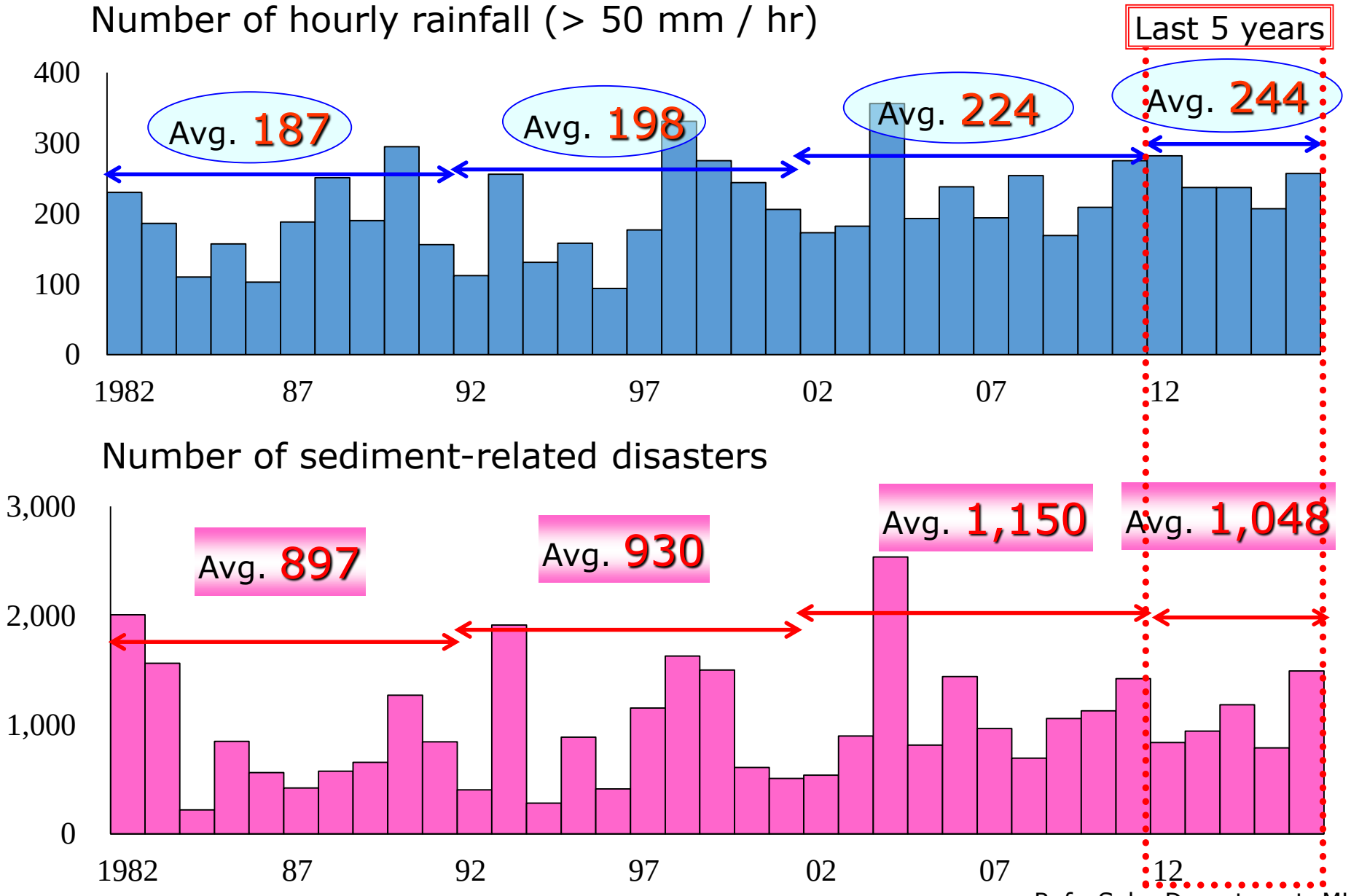




Typhoon Talas, 2011

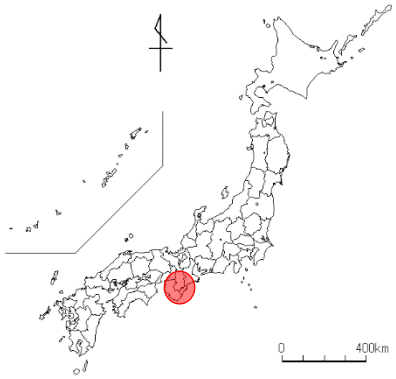
Ref.: White Paper on Disaster Management

Number of heavy rain and sediment-related disasters are increasing

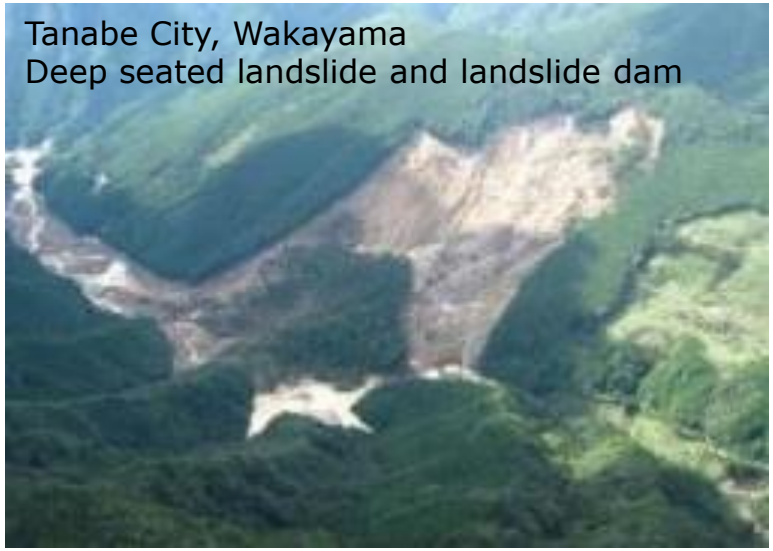


Ref.: Sabo Department, MLIT

Sediment-related disaster in 2011

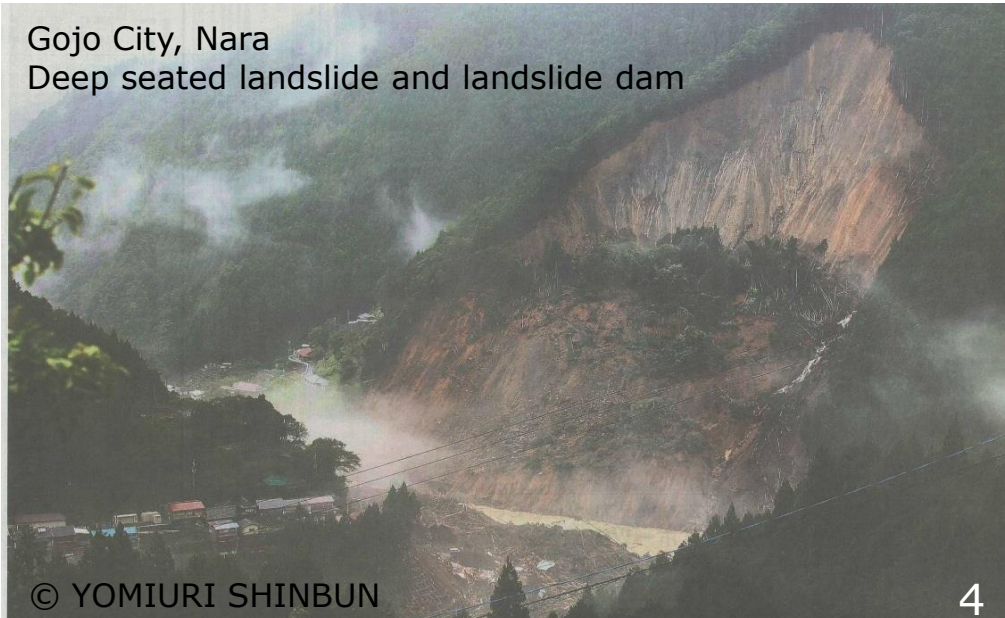


62 casualties, September 2011, Typhoon Talas
Kii peninsula, Nara and Wakayama

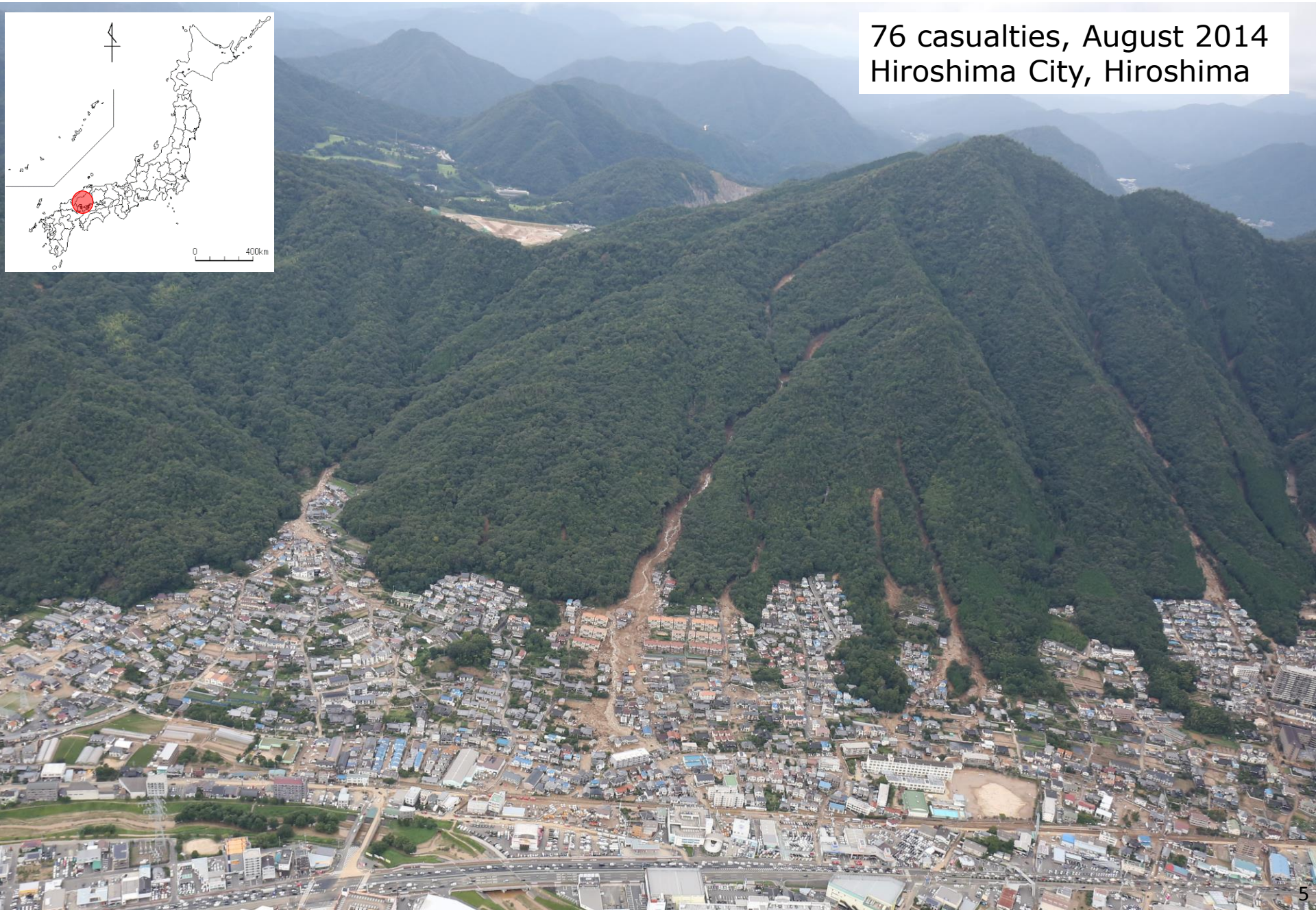

Tanabe City, Wakayama
Deep seated landslide and landslide dam


Totsukawa Village, Nara
Deep seated landslide and landslide dam


Nachikatsuura Town, Wakayama
Debris flows


Gojo City, Nara
Deep seated landslide and landslide dam

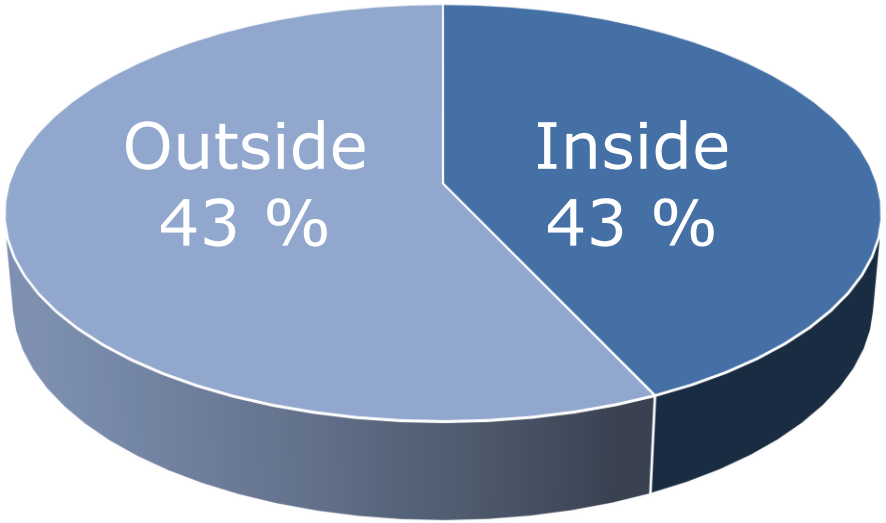
Sediment-related disaster in 2014



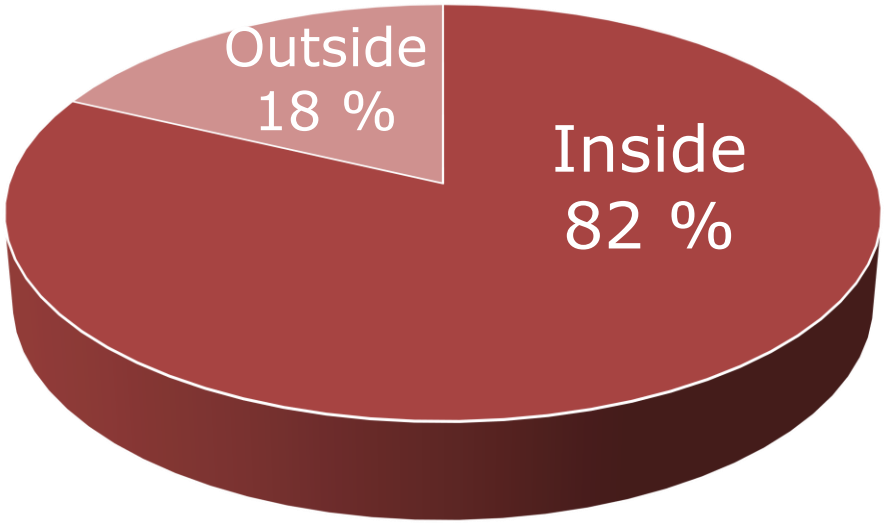
76 casualties, August 2014
Hiroshima City, Hiroshima

More people are killed inside a building in the case of sediment-related disasters

Disasters caused by heavy rain
(Flooding, Plunge to a canal, etc.
including sediment-related disasters)



Sediment-related disasters



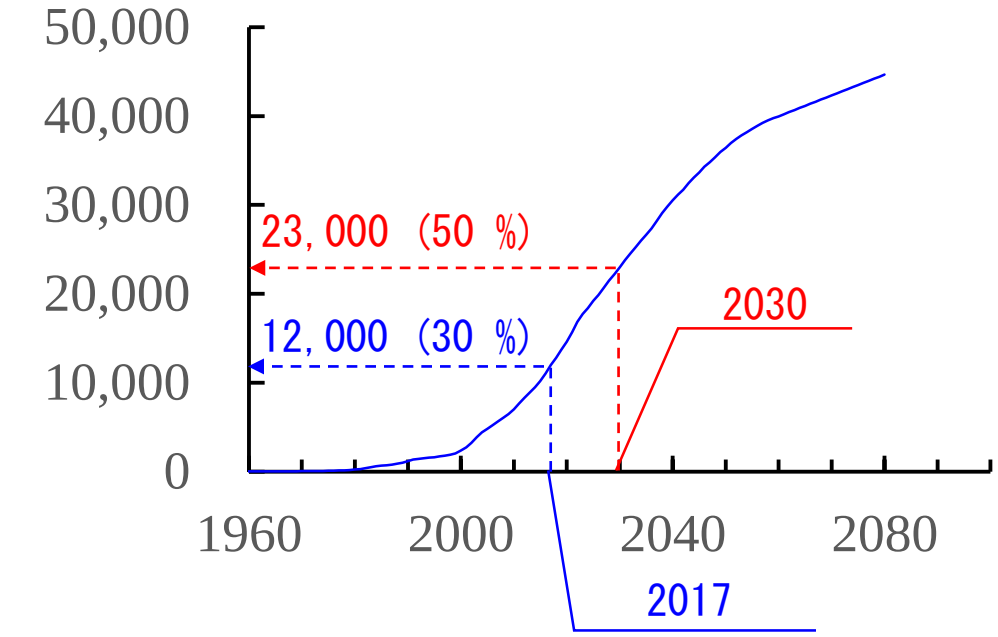
Ushiyama and Yokomaku(2013):
Location characteristics of victims caused by recent heavy rainfall disasters

Increase in the number aging check dams

- The number of check dams has grown to about 42,000 in 2017.
- The number of check dam over 50 years old is about 12,000 in 2017.
- It is estimated that the number is going to be about 23,000 in 2030.

Cumulative number of check dam over 50 years old

[number of check dam]



Example

Erosion of the crown of check dam

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Recent SABO construction technologies

Open check dam

Encouraging the open check dam to effectively trap debris and driftwood

Unmanned construction technologies

- Used for dangerous sites
- Excavator, bulldozer, and dump truck were controlled from an operator's room over 1 km away from construction site

Construction using "Sabo soil cement"

Encouraging the use of surplus soil to make concrete;
Leads to reduction of soil emission and construction cost

Life Extension Plan for Sabo facilities

Life Extension Plan

Plan to prolong the function of SABO facilities thorough maintenance activities in an early stage of deficiencies

Contents of Life Extension Plan for Sabo facilities

- ○Preparation of daily operation and maintenance plan
- ○Soundness assessment based on inspection results
- ○Preparation of priority ranking for maintenance activities (repair, reconstruction, etc.) and annual plan
- ○Observation technique (survey, observation)
- ○Detail of countermeasure (repair, reconstruction, etc.) etc.

Life extension plan for government-owned facilities has been developed until March 2017.

Life extension plan for municipality-owned facilities will be developed until March 2021.

Sediment Disaster Prevention Act (2000)

Creation of Guidelines for Sediment Disaster Risk Management [MLIT]

- Basic principles of sediment disaster risk management
- Guidelines for basic investigation of risk assessment
- Guidelines for designation of Sediment Disaster Hazard Areas, etc.

Basic Investigation [Prefectures]

Investigation of the topography, geology, and land-use in sediment disaster prone areas

Designation of Sediment Disaster Hazard Areas [Prefectures]
(Areas at risk of sediment disaster)

Yellow Zone

- Development of information transmission and warning/evacuation systems [Municipalities]
- 480,000 is set as Yellow Zone by March 2017

(NOTE:Total number is estimated as 660,000)

Designation of Sediment Disaster Special Hazard Areas [Prefectures]
(Areas where normal buildings would be completely destroyed by a sediment disaster)

Red Zone

- Land use regulations
  Targets: Sales of building lots and houses, as well as development projects concerning facilities for special needs populations
- Building codes
- Recommendation of building relocation
- 330,000 is set as Red Zone by March 2017

Enactment and amendments of Sediment Disaster Prevention Act

Hiroshima debris flow disaster in 29th Jun 1999

May 2000 Enactment of Sediment Disaster Prevention Act

- Announcement of the design of sediment disaster warning area based on the basic investigation
- Establishment of warning and evacuation system in the sediment-related warning area
- Land use and house building regulation in the sediment disaster warning area

May 2005 Partial amendment

- Requirement of distribution of sediment-related disaster hazard map

Nov. 2010 Partial amendment

- Operation of emergency investigation when a large-scale sediment-related disaster is about to happen

Nov. 2014 Partial amendment

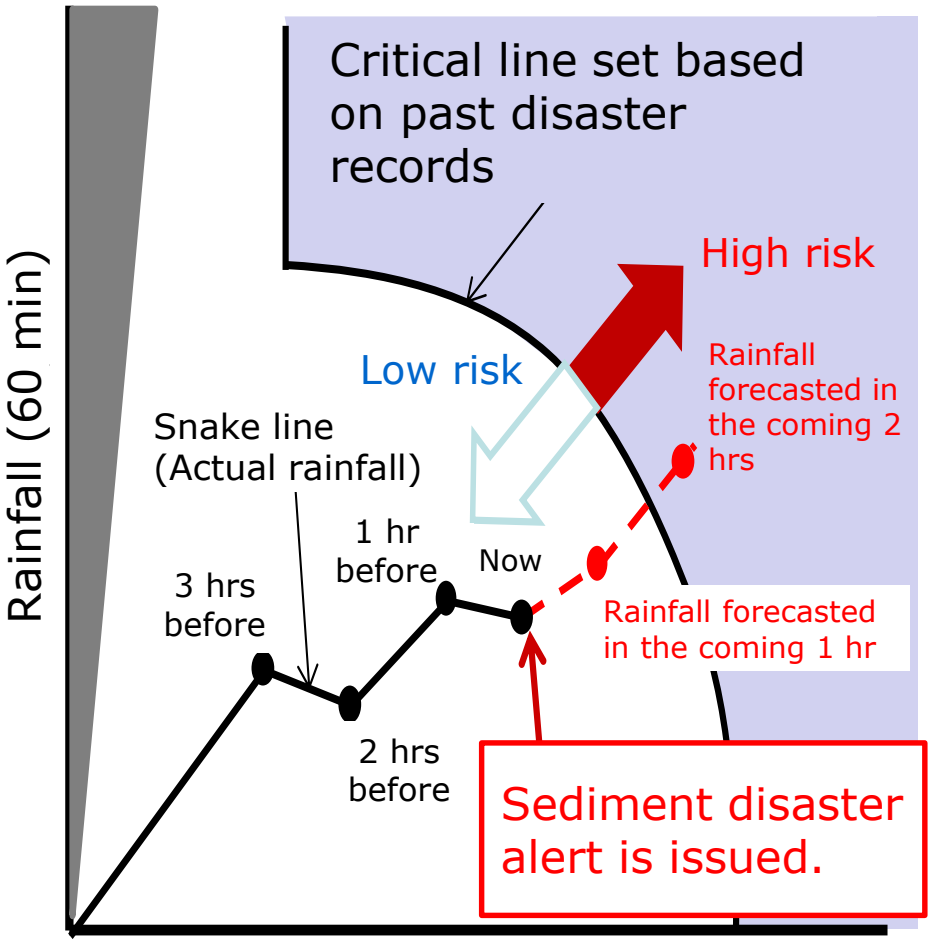
- Requirement of the publication of the basic investigation result
- Requirement of the announcement of sediment-related disaster alert for municipality and residents

May. 2017 Partial amendment is decided by the cabinet

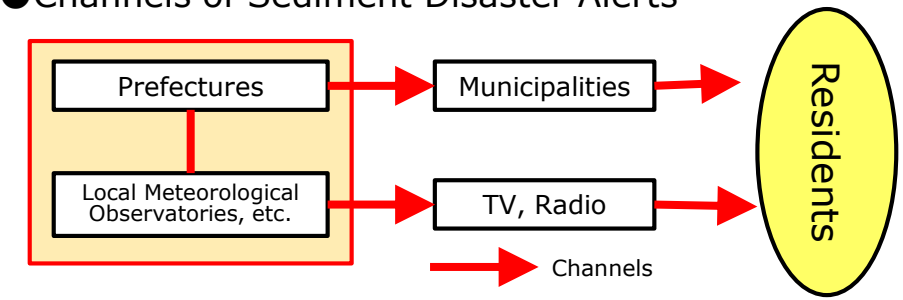
- Requirement to operate evacuation drill and to prepare evacuation scheme at facilities used by people who needs assist (ex. Elders who need care, the physically challenged, students under 18)

Sediment disaster alert

Purpose: To assist mayors in determining whether to issue evacuation recommendations/orders, and to provide residents with useful information for evacuation, during times of elevated danger due to rainfall.



● Channels of Sediment Disaster Alerts

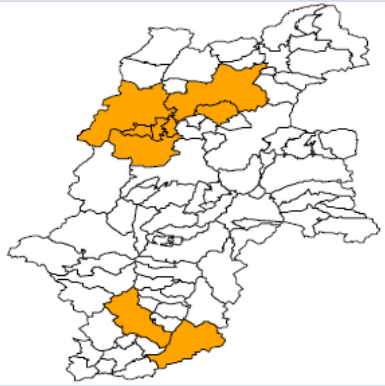


● Number of Alert in 2016

Total number of municipalities: about 1,800

Summary:
Because of heavy rainfall, sediment-related disaster risk is quite high in warning areas.

Recommendation:
Residents lived in an area prone to sediment-related disaster such as an area near a river or cliff should evacuate as soon as possible if necessary and be careful to heed information such as "evacuation advisement" announced by local government.



Example of sediment disaster alert

Evacuation table

Rainfall and soil water index reach warning level

⇩

Announcement of sediment disaster alert

[Prefecture/Meteorological office]

⇩

Evacuation recommendation/order

[Municipality]

⇩

Evacuation from yellow zones to public shelters

⇩

Cancellation of SDA and confirmation of safety

[Prefecture/Meteorological office]

[Municipality]

⇩

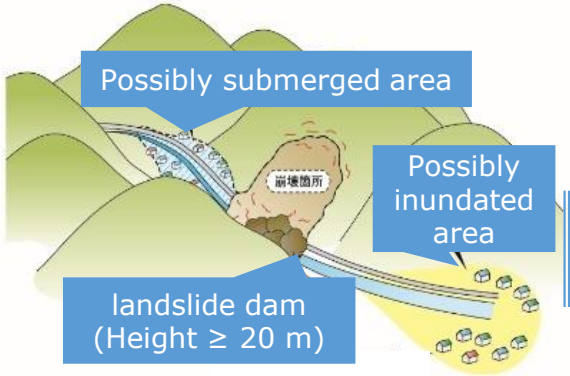
Cancellation of evacuation recommendation/order

[Municipality]

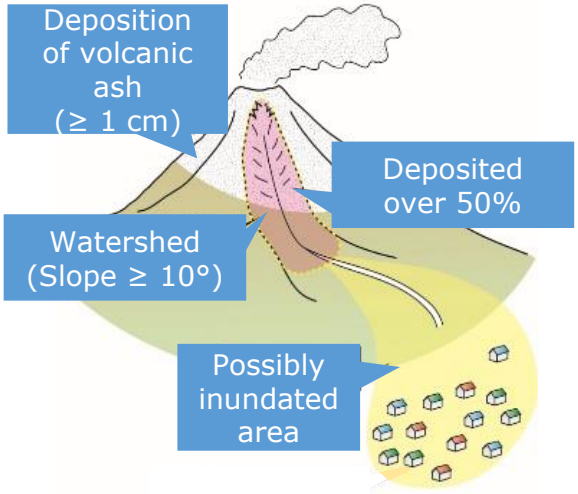
SDA: Sediment Disaster Alert

Emergency investigation when large scale sediment-related disasters are about to happen

Debris flow and impoundment due to landslide dam



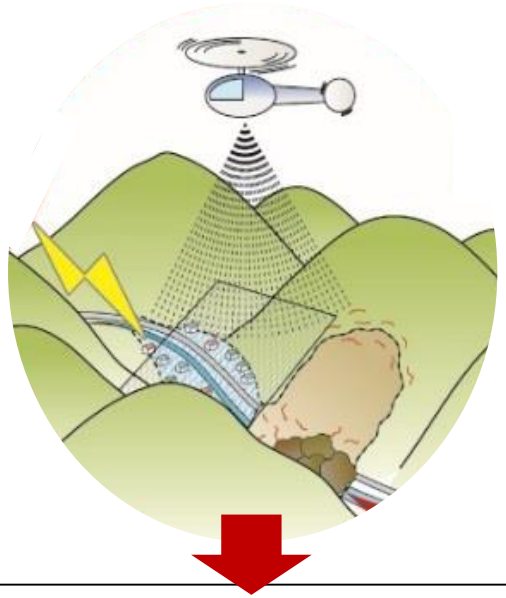
Debris flow following deposition of volcanic ash on steep slope



Operation of emergency investigation

In the case of landslide dam

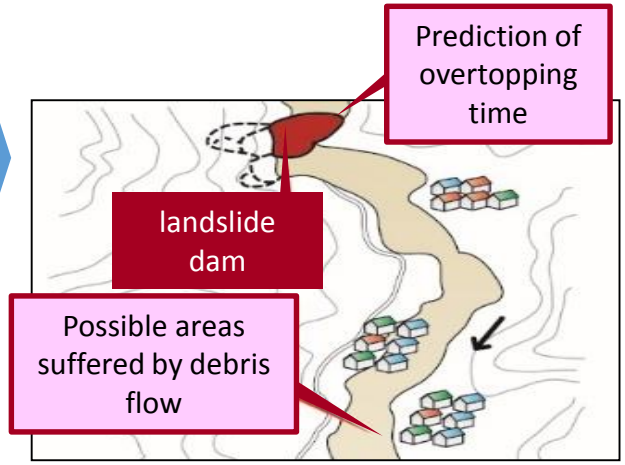
Automatic observation of water level	Investigation by experts of NILIM etc.



Simulation of overtopping and failure of landslide dam
Simulation of inundation

Announcement of emergency information

Possible areas and timing are announced

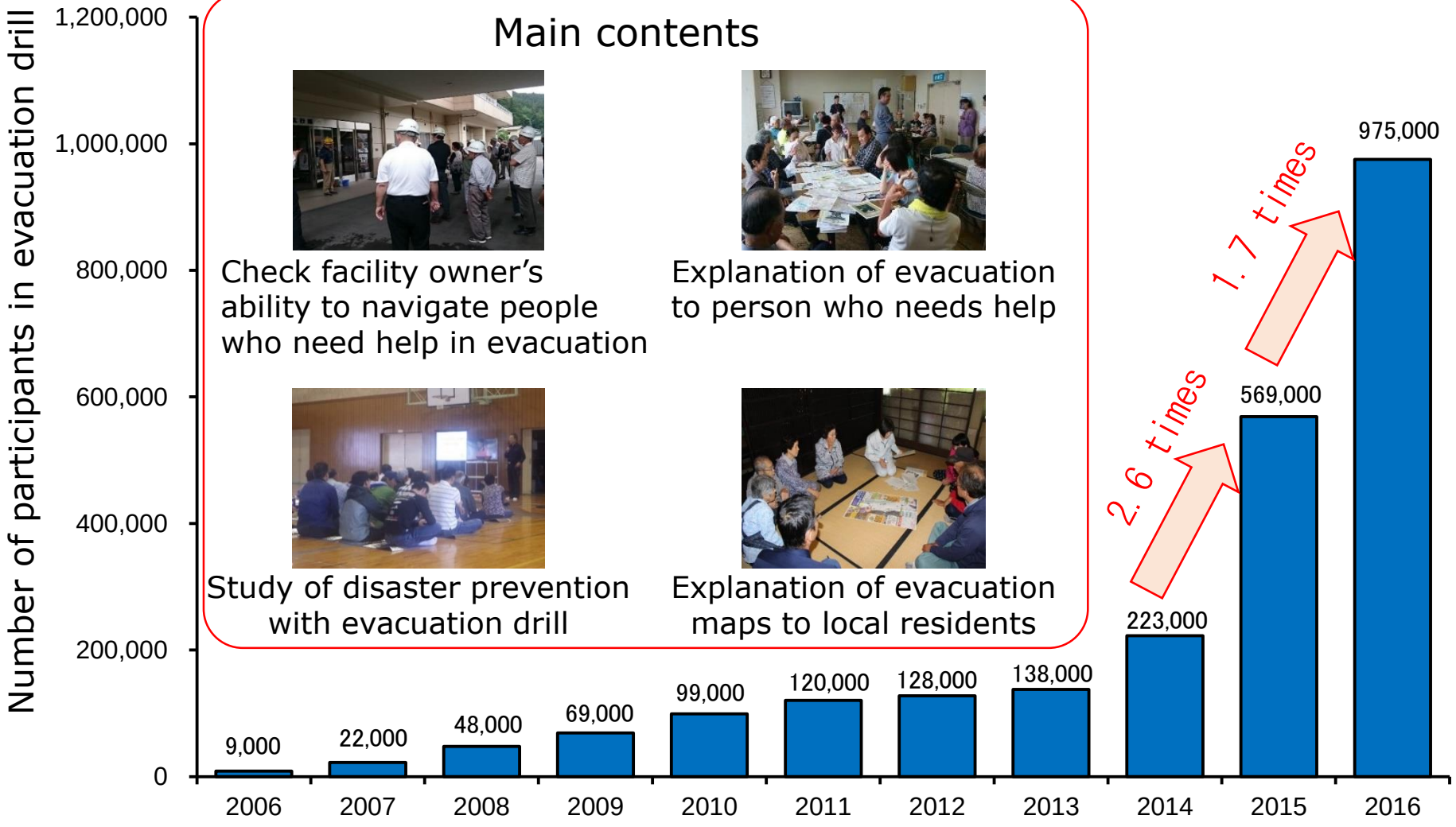


Evacuation advised / ordered by mayor of municipality

Evacuation of residents

Sediment-related disaster evacuation drill

To enhance the warning and evacuation system and disaster preparedness, evacuation drill is conducted in municipalities of all over Japan. Number of participants reaches a record high of about 975,000 in 2016.



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Progress of Installation of Sabo facilities in dangerous locations for sediment-related disasters

Sabo facilities (check dams, landslide control facilities, slope failure prevention facilities) have been installed in about 50,000 dangerous locations for sediment-related disasters.

We have installed Sabo facilities about 4,000 in 2016.

We strongly install SABO facilities on the upstream of shelters, disaster prevention centers, facilities used by person who need help and important roads for evacuation.

<Installation of check dam to capture debris flow>

<Installation of facility to control landslide movement>

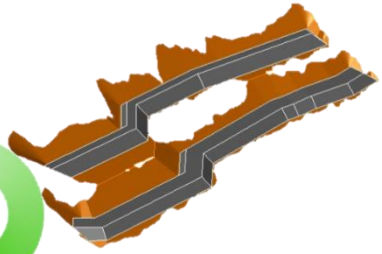
<Installation of retaining wall to prevent slope failure>

Progress of i-Construction

○Construction control using UAV and ICT(Information and communication technology) construction equipment

1. 3D land surveying using UAV

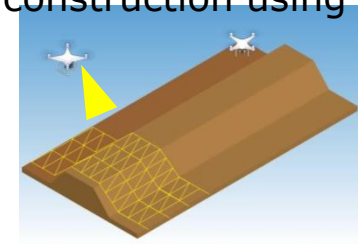
2. 3D model of design



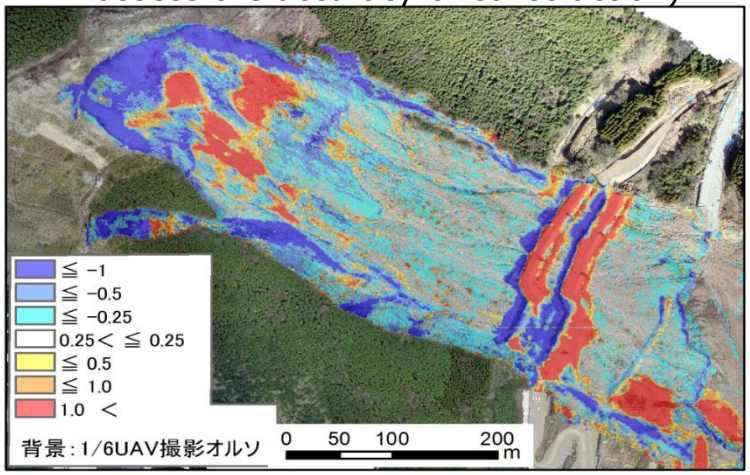
3. Construction with 3D data

Introduce Machine Guidance* and Machine Control

4. Assessment of accuracy of construction using UAV



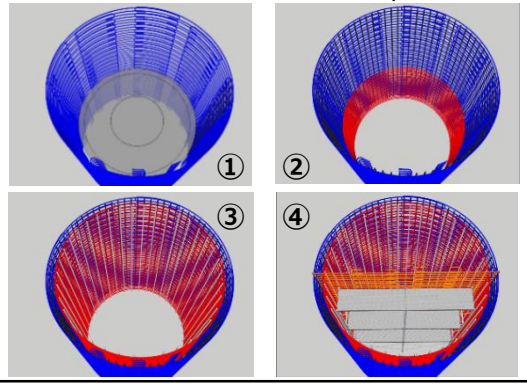
Elevation change due to the construction (used to confirm movement of slope and assess the accuracy of construction)

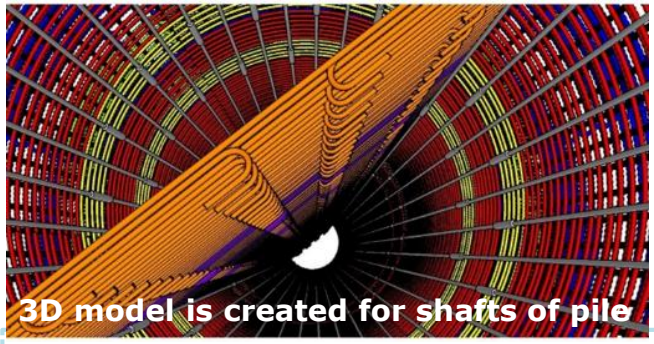


* A technique to provide information to operators through visual displays installed on machines about the heavy machine's position obtained using TS and GNSS and the difference between actual condition and 3D design of construction.

○Construction control using 3D data

3D data is created to design facilities (ex. Shafts of pile). By Checking the ideal construction process through animation, mistakes in the process are prevented and the construction period is shortened. Moreover, the data are used for maintenance.





Construction at Yui district No.SC7(2014)

○Application of UAV to facility inspection

Using UAV, time and labor for inspection of Sabo facility are substantially saved.

Recent topics for study

①Monitoring of sediment dynamics in mountainous watershed using hydrological and sediment transport observation

②Detection of possible slope failure using InSAR and Estimation of possible area suffered from high-volume sediment transport

③Development of rainfall index for improvement of the accuracy of rainfall-induced sediment-related disaster prediction

④Development of early warning system and identification of early-stage of sediment-related disaster using SNS (ex. Twitter)

⑤Study on deep-seated landslide(1. Prediction of possible site, magnitude of, types of suffering, 2. Estimation of possible suffered area, 3. Establishment of countermeasure)

⑥1-dimensional calculation of bed deformation considering transition from debris flow to bed material load

Sabo volunteer, education of disaster prevention

Inspection of Sabo facility by Sabo volunteers

Education of disaster prevention for elementary students using experimental flume

Tree-planting event joined by residents

Example of text book for Sabo works

Tour event to Sabo facilities

To obtain the safety against sediment-related disasters