A Programme of
the ICL for ISDR

Rain & Earthquake-induced Rapid Landslide Disasters

Landslide Dynamics to Assess the Initiation and the Motion

Invitation to the World Landslide Forum 5 in Kyoto, 2020

10:40-11:20 on 17 July 2017

Venue: Institute of Diplomacy and International Affairs
Taipei City

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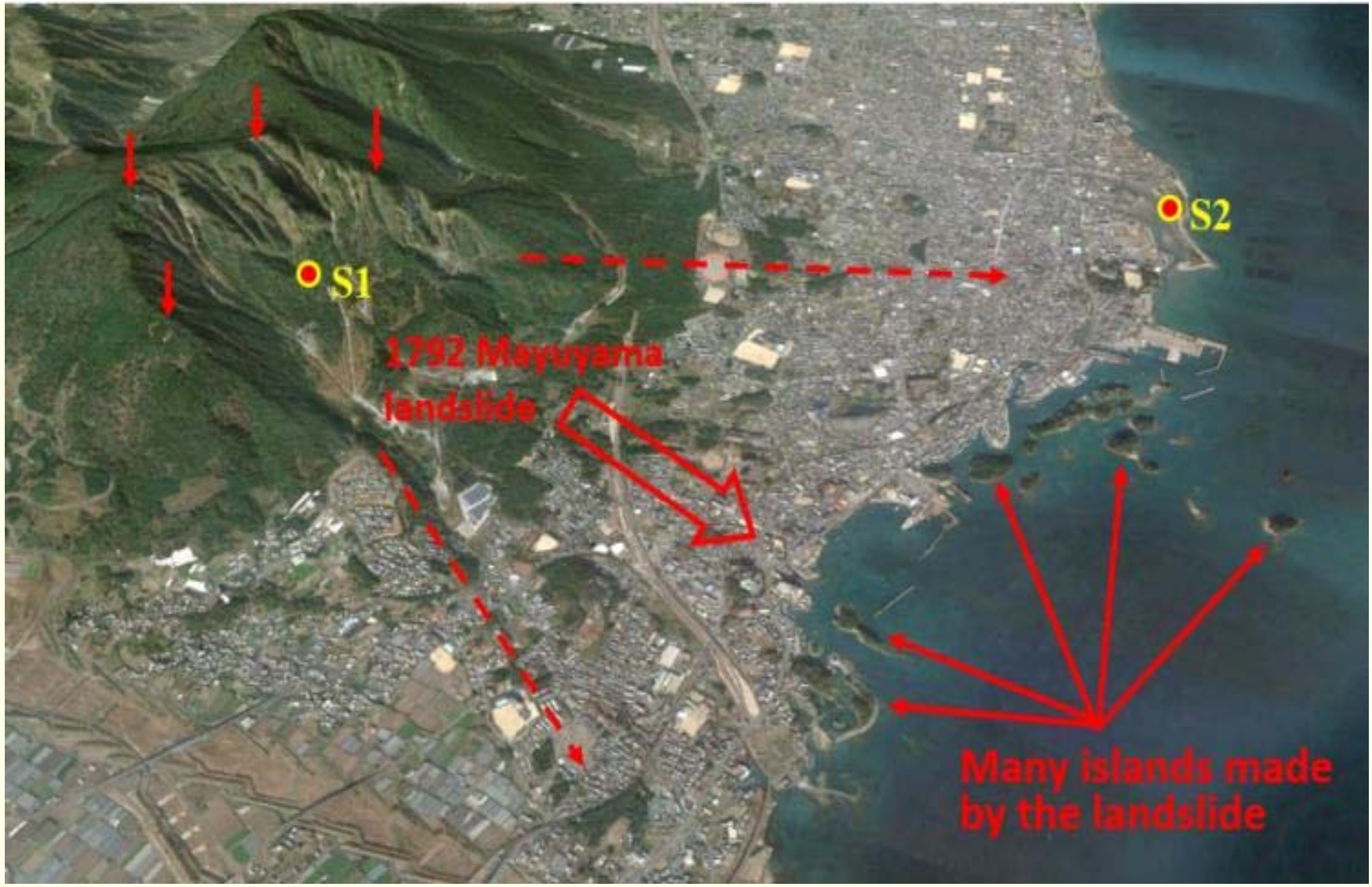
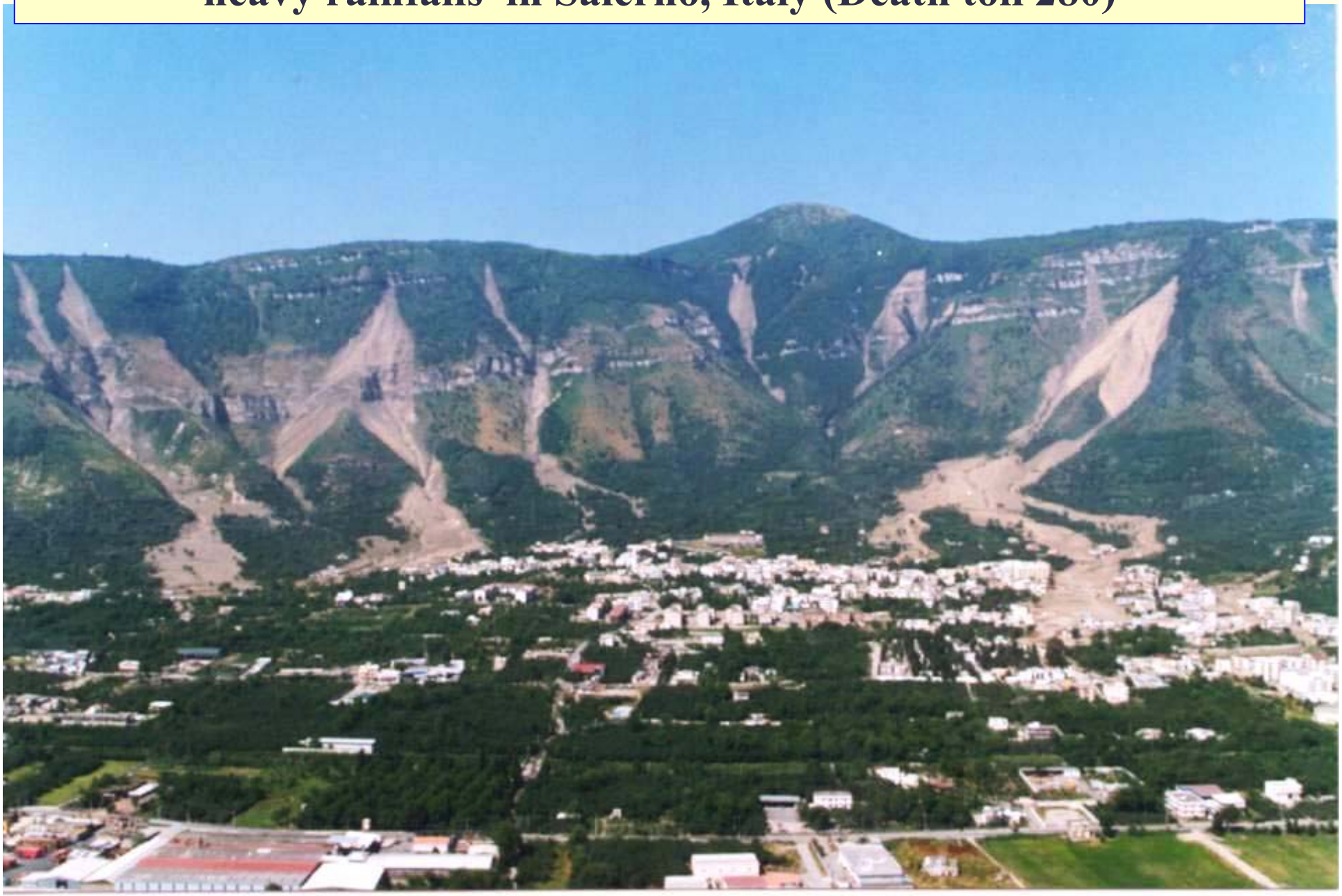
Contents



The 1792 largest landslide disaster in Japan killing 15,153 persons. 400m deep landslide was triggered by an earthquake of M=6.4±0.2. The lanslide mass entered into the sea and caused a large-scale tsunami which killed around 5,000 people in the opposit bank.

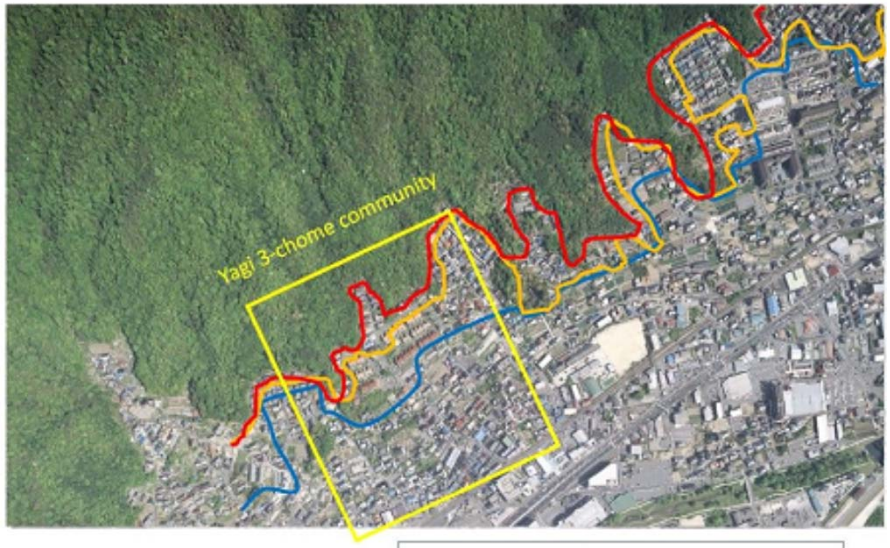
Leyte Landslide, Philippines on 17 February 2006
A small earthquake (Ms 2.6) after heavy rainfalls triggered this rapid landslide destroying a village (Death toll: 1,144)

May 1998 shallow landslides – debris flow disasters triggered by heavy rainfalls in Salerno, Italy (Death toll 280)



2014 Hiroshima shallow landslides-debris flow disaster triggered by extreme rainfalls. It killed 74 persons. Red points in the left bottom were destroyed houses.
If the urban area stays in the line of 1948, disaster was much smaller.

Comparison of air photos of the most devastated area; the Yagi 3-chome community before (left) and after (right) the disaster. Red filled circles in the left photo show the severely or completely damaged houses. (Photo before : Google Earth, Photo after : Geo-Spatial Authority of Japan)

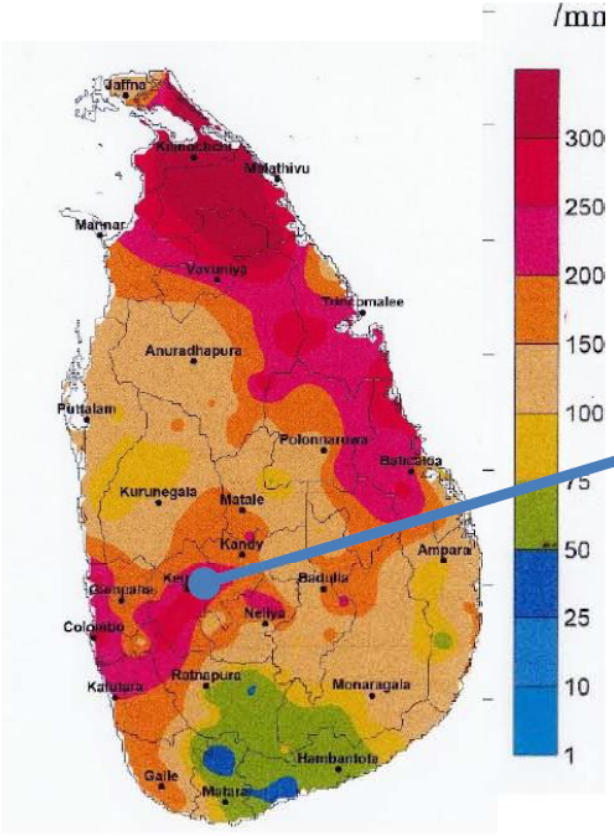


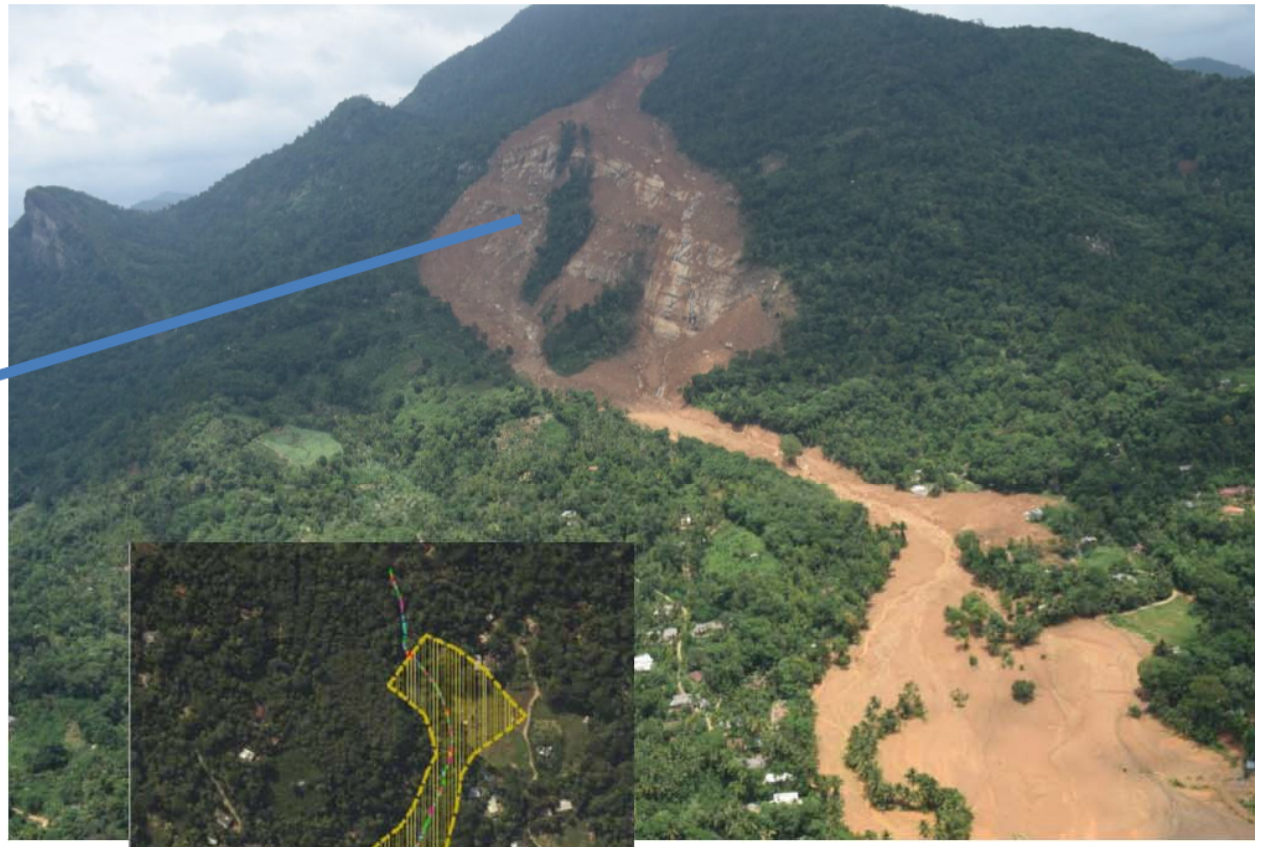
Border of residences expanded to hillside and toward the exits of torrents year by year.

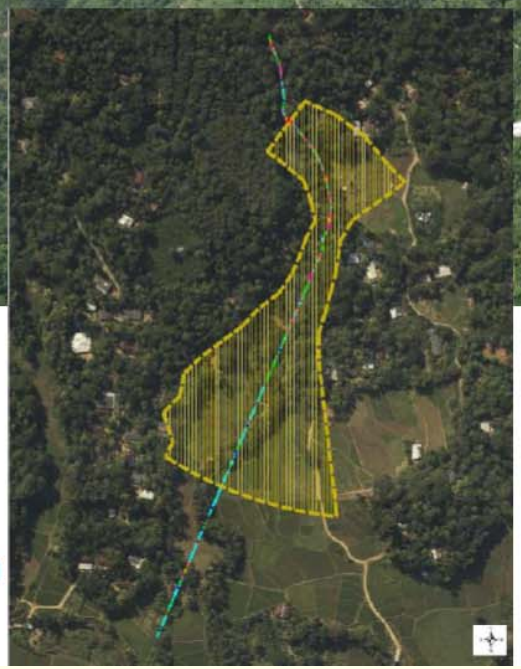
Mountain-side limit of residential house distribution
1948年
1969年
2009年

July 2015 landslide-debris flow disasters triggered by local heavy rains. Many shallow landslides occurred and 20 persons were killed in Ha Long City, Vietnam. 8 persons were killed in the site below.

Landslide in Kegalle District- May 2016







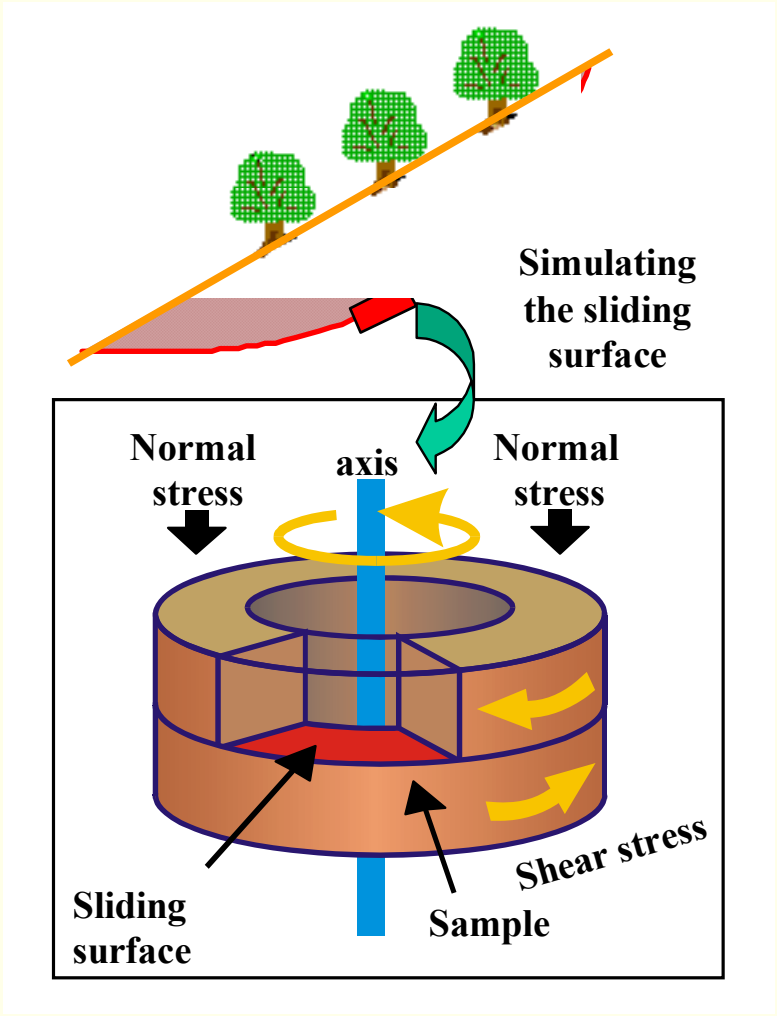
- Landslide, Aranayaka ,Kegalle District
- Occurred in May 2016
- No of houses destroyed - 75
- No of deaths reported – 125
- Length of debris Flow – more than 2 km

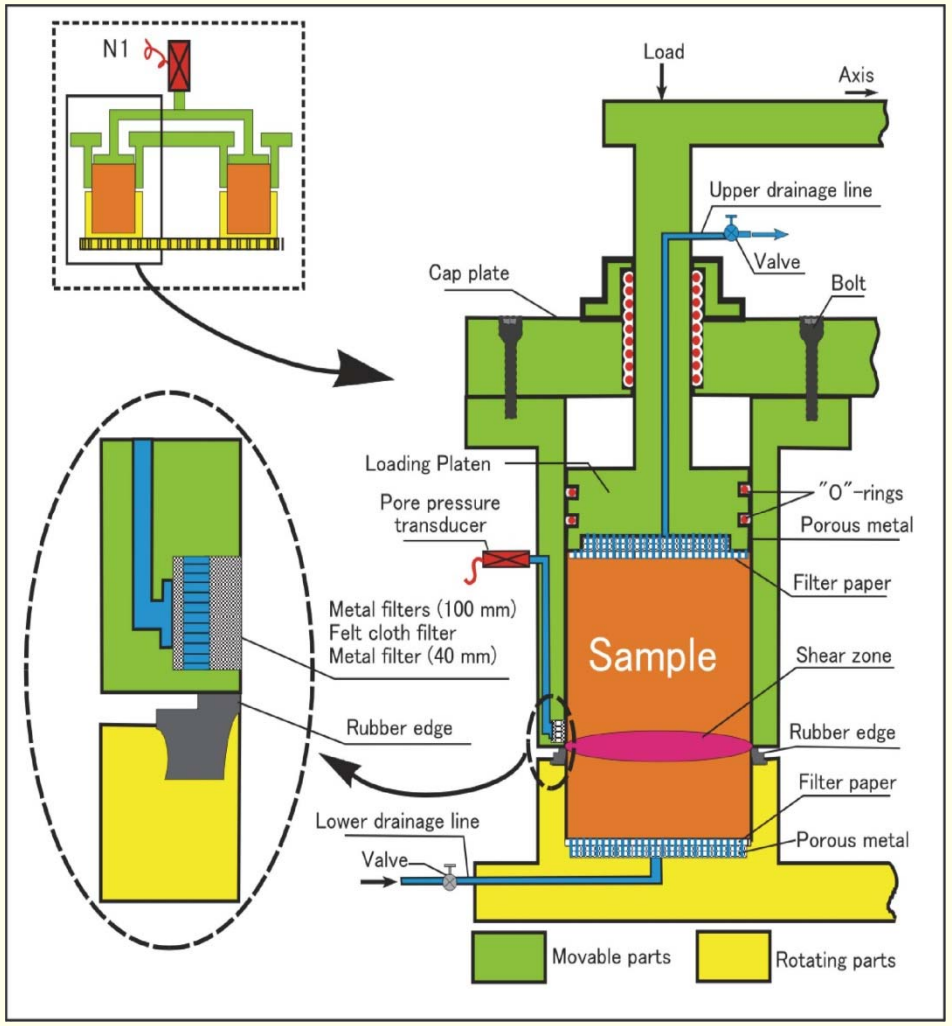
Areal view before the landslide

2. Development of Landslide Dynamics to Assess the Initiation and Motion of Rapid Landslides

2.2 Development of Landslide Ring-shear simulator (Undrained loading ring shear apparatus)

- A new apparatus was developed to reproduce the landslide initiation and the post-failure motion within an apparatus.
- The apparatus could measure the pore water pressure mobilized on the sliding surface.
- Then, it could measure the frictional resistance at the initiation and post-failure strength reduction to a steady state during rapid motion.
- This enabled to develop an integrated landslide simulation code LS-RAPID





Dynamic Loading undrained ring shear test for Landslide Dynamic s:

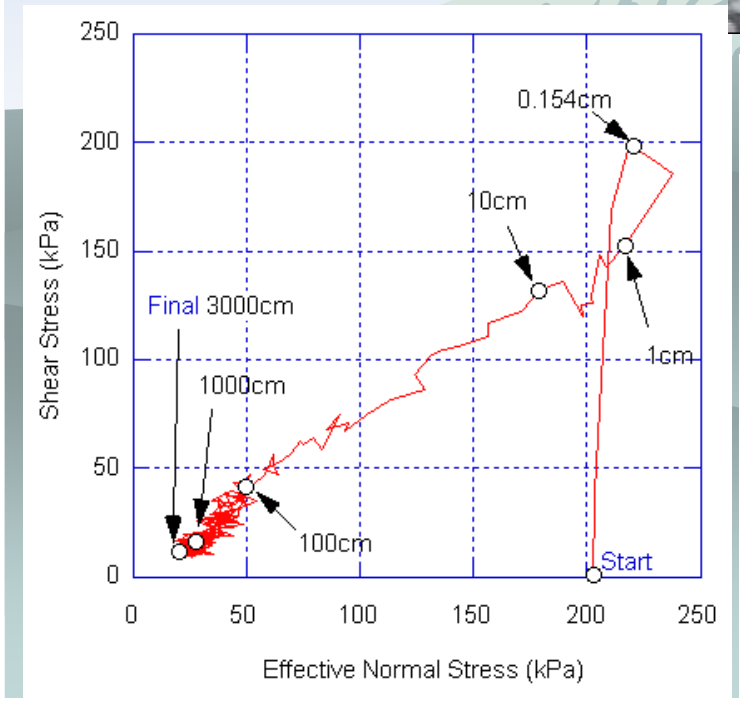
Geotechnical simulation of the sliding surface formation and post-failure motion within laboratory

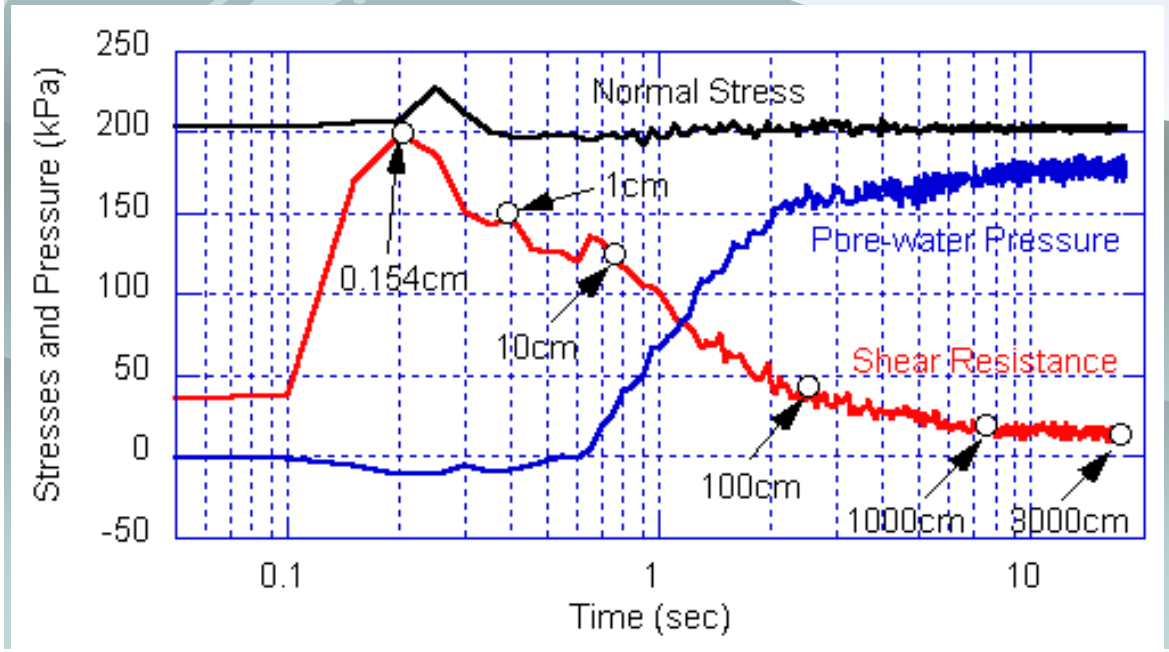
(IPL M101-APERITIF)

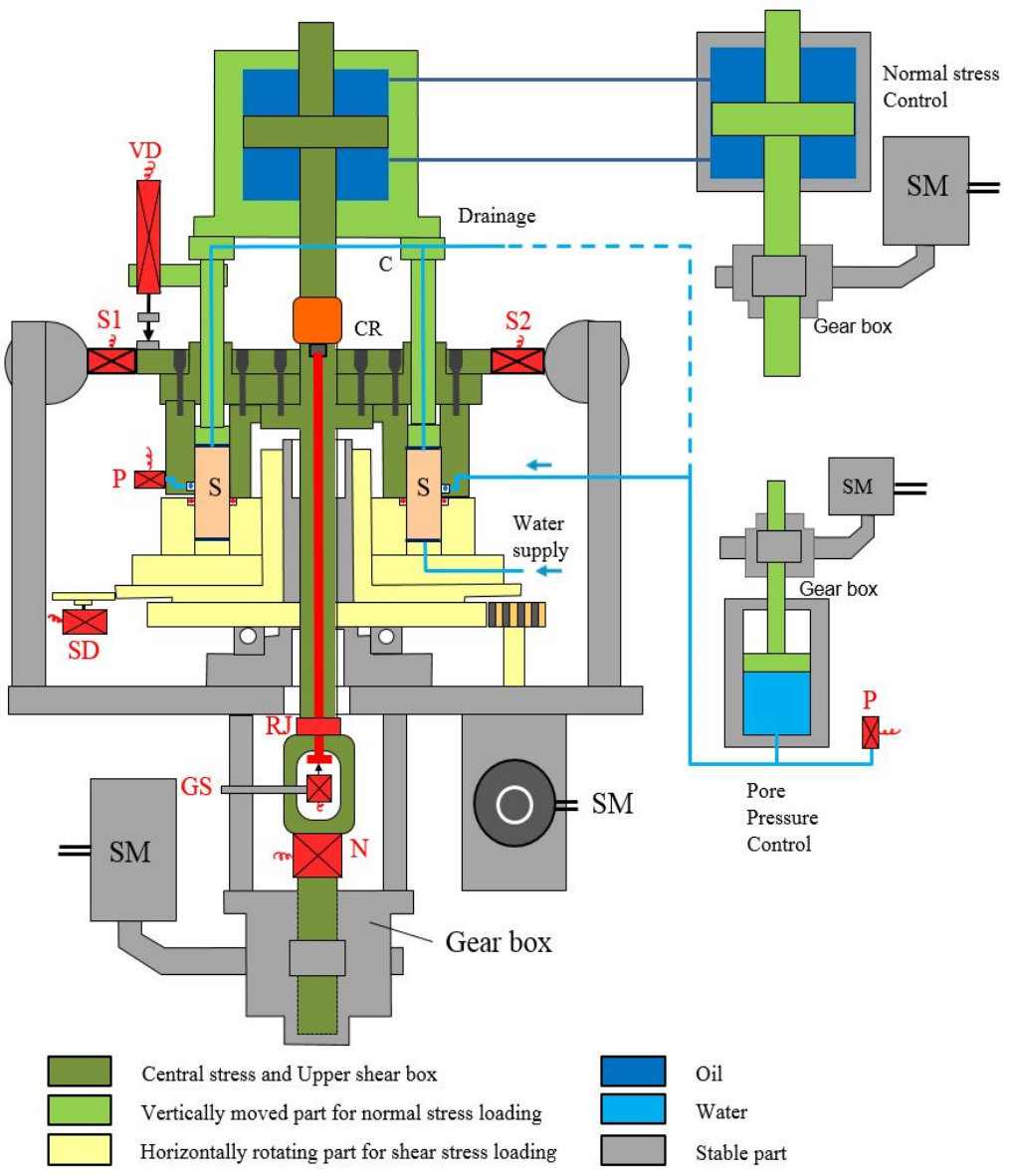
Sliding Surface Liquefaction

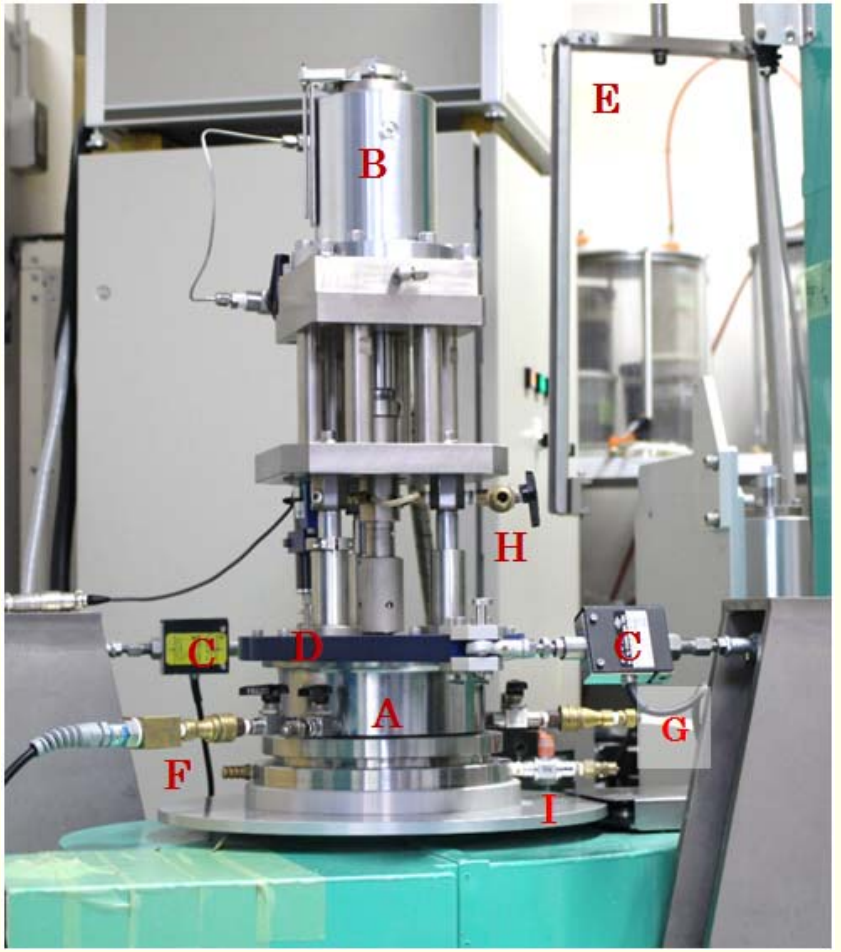
by Volume reduction due to grain crushing in the shear zone.

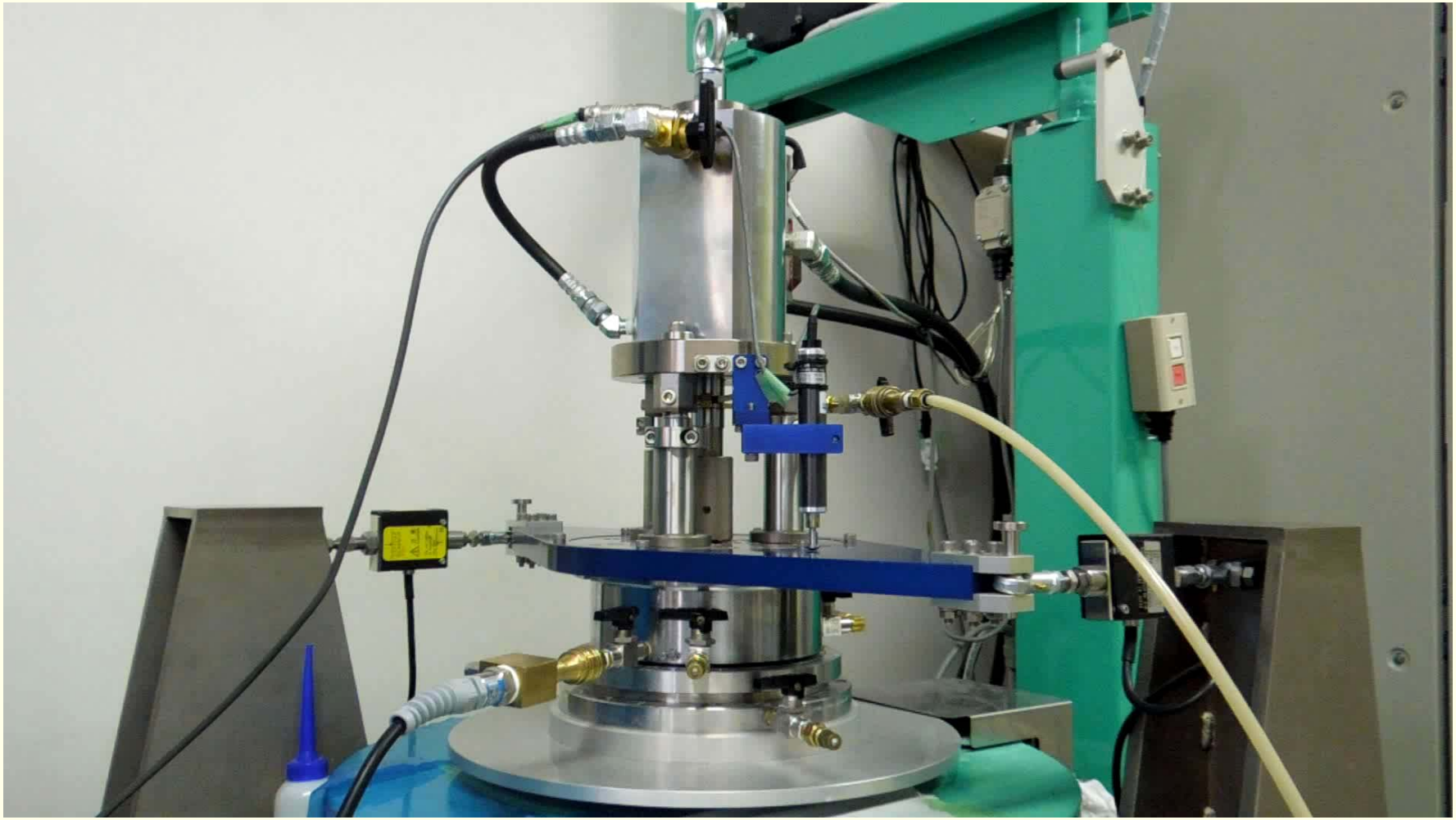
Key Mechanism for rapid landslide motion






Normal stress
Control
SM
VD
Drainage
C
S1
CR
S2
Gear box
P
S
S
SM
Water
supply
Gear box
SD
P
RJ
GS
SM
SM
N
Pore
Pressure
Control
Gear box
Central stress and Upper shear box
Vertically moved part for normal stress loading
Horizontally rotating part for shear stress loading
Oil
Water
Stable part


E
B
H
C
D
C
A
G
F
I



2. Development of Landslide Dynamics to Assess the Initiation and Motion of Rapid Landslides

2.3 Development of Integrated Landslide Simulation Model (LS-RAPID) and Landslide-Induced Tsunami Simulation Model (LS-TSUNAMI)

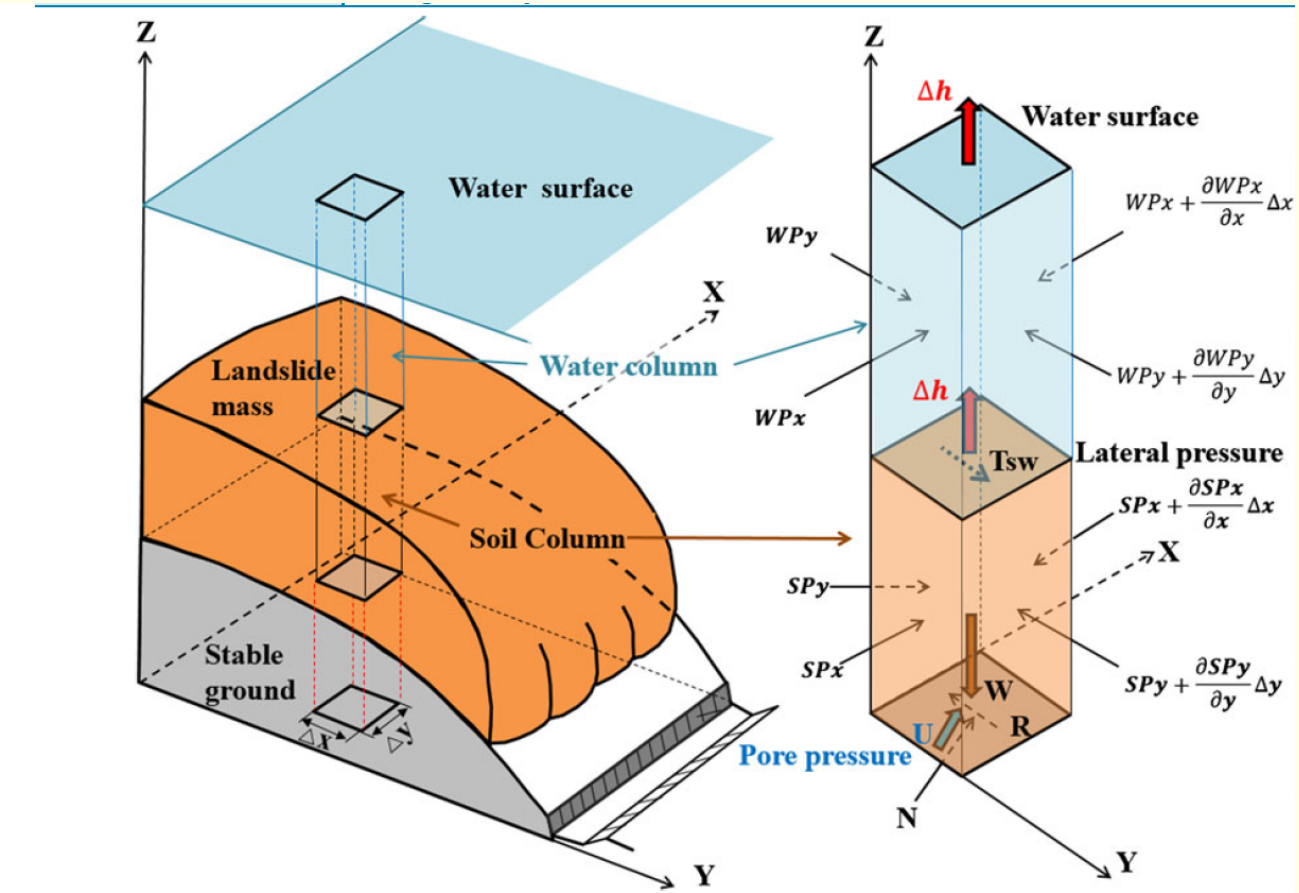
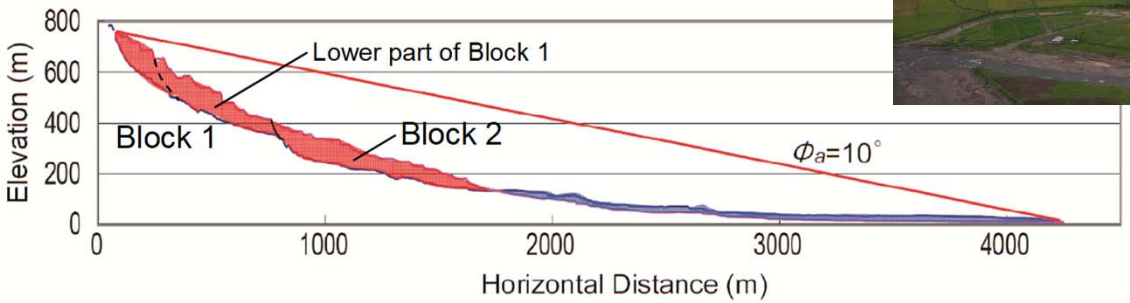


Fig. 1 Basic principle of the landslide-induced tsunami simulation model

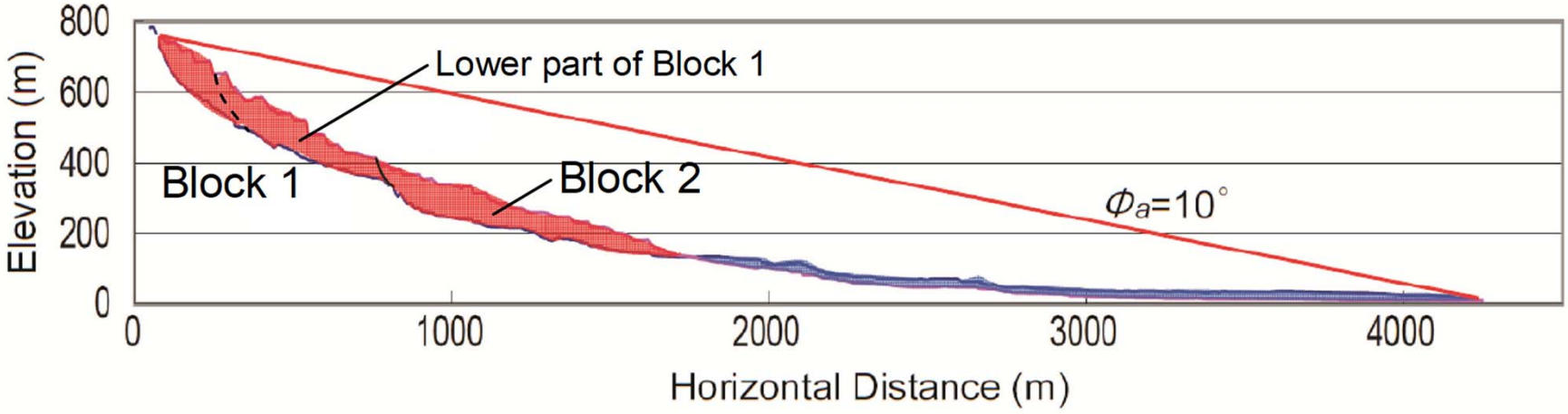
2006 Leyte Landslide in Phillipines (induced by Rain + Earthquake)

A

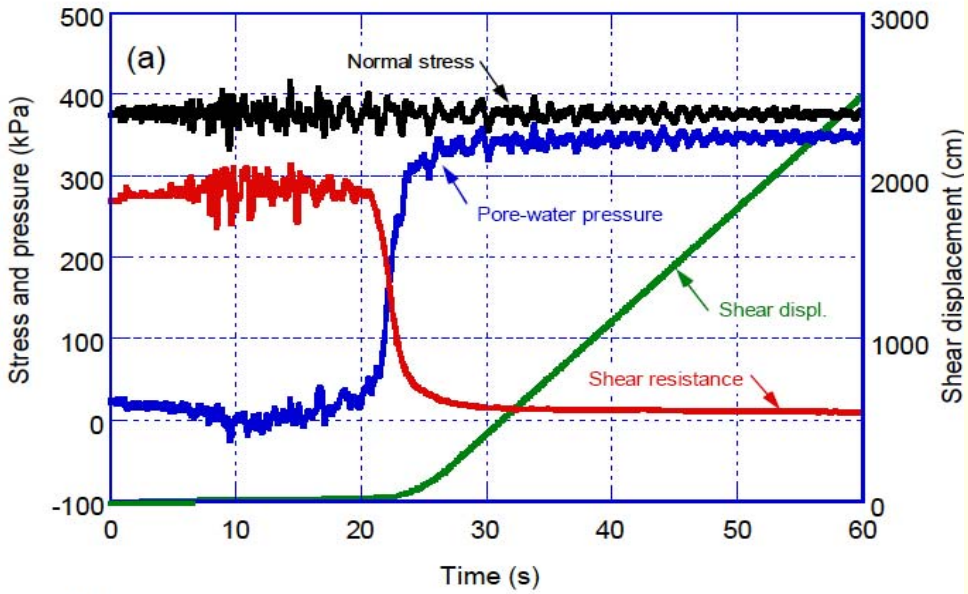


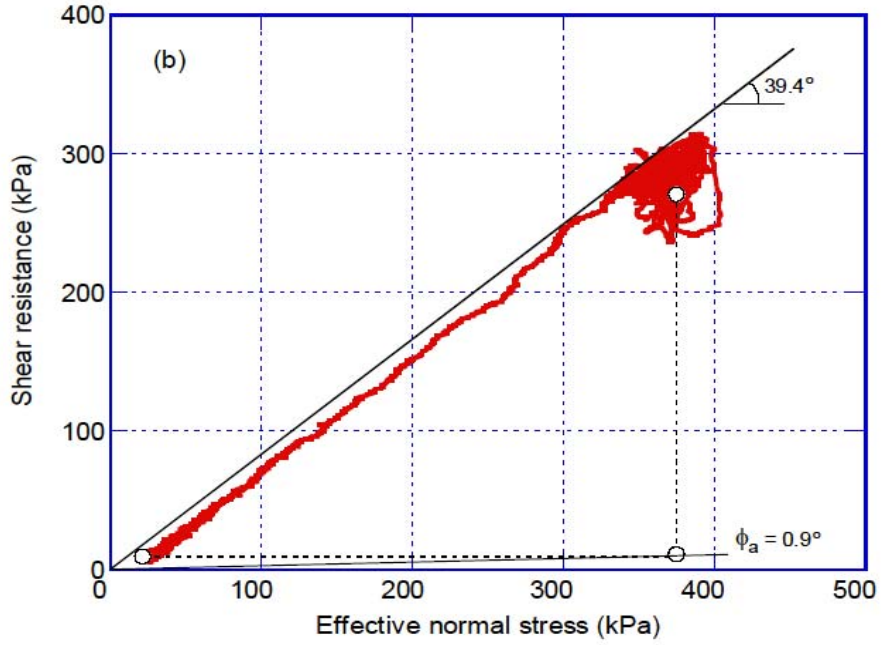
B

A


800
600
400
200
0
Elevation (m)
Lower part of Block 1
Block 1
Block 2
ϕ_a=10°
0
1000
2000
3000
4000
Horizontal Distance (m)

B





Test Procedure and Result

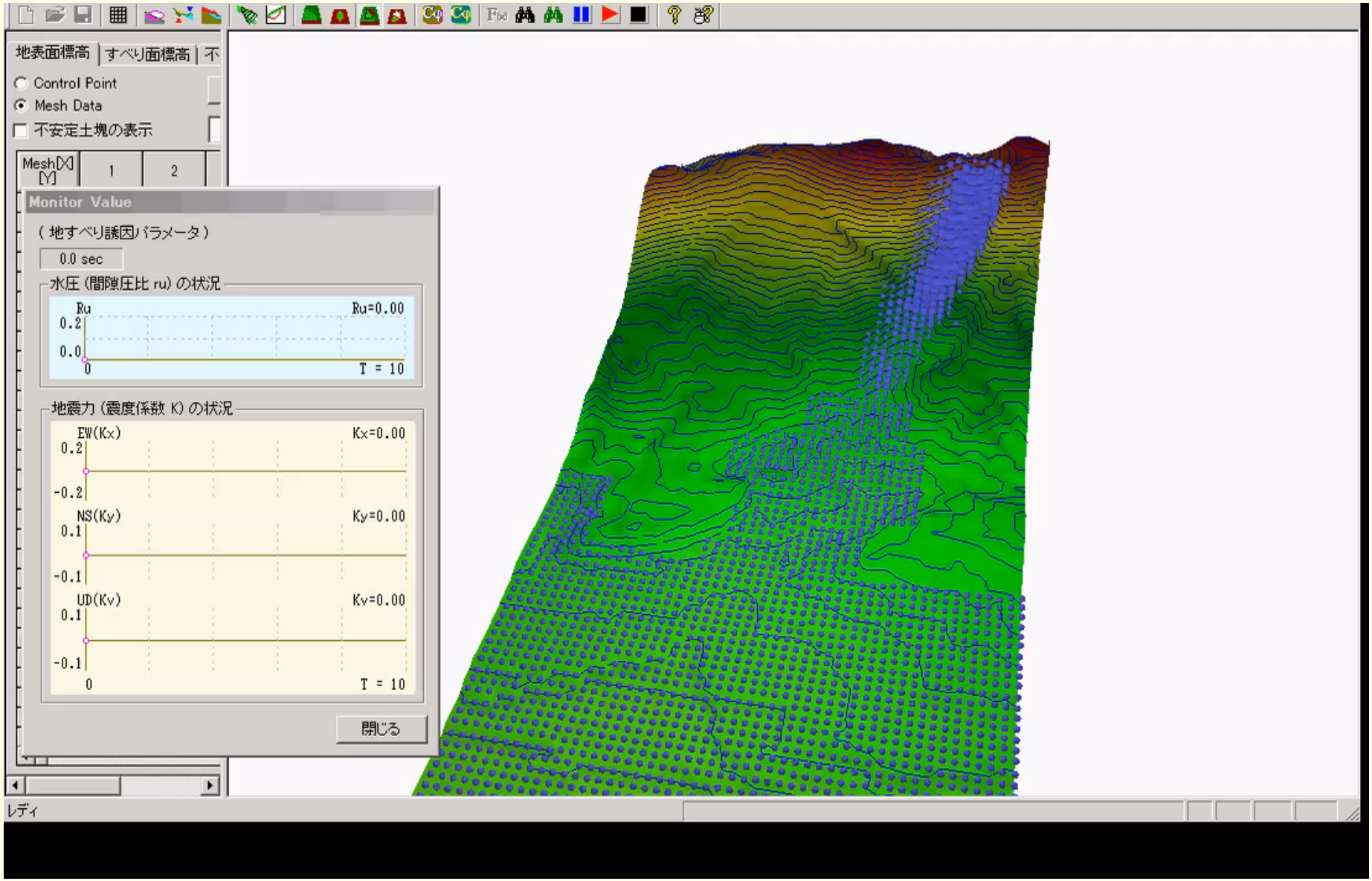
1. Volcanoclastic debris taken from the bottom of flow mound was tested.

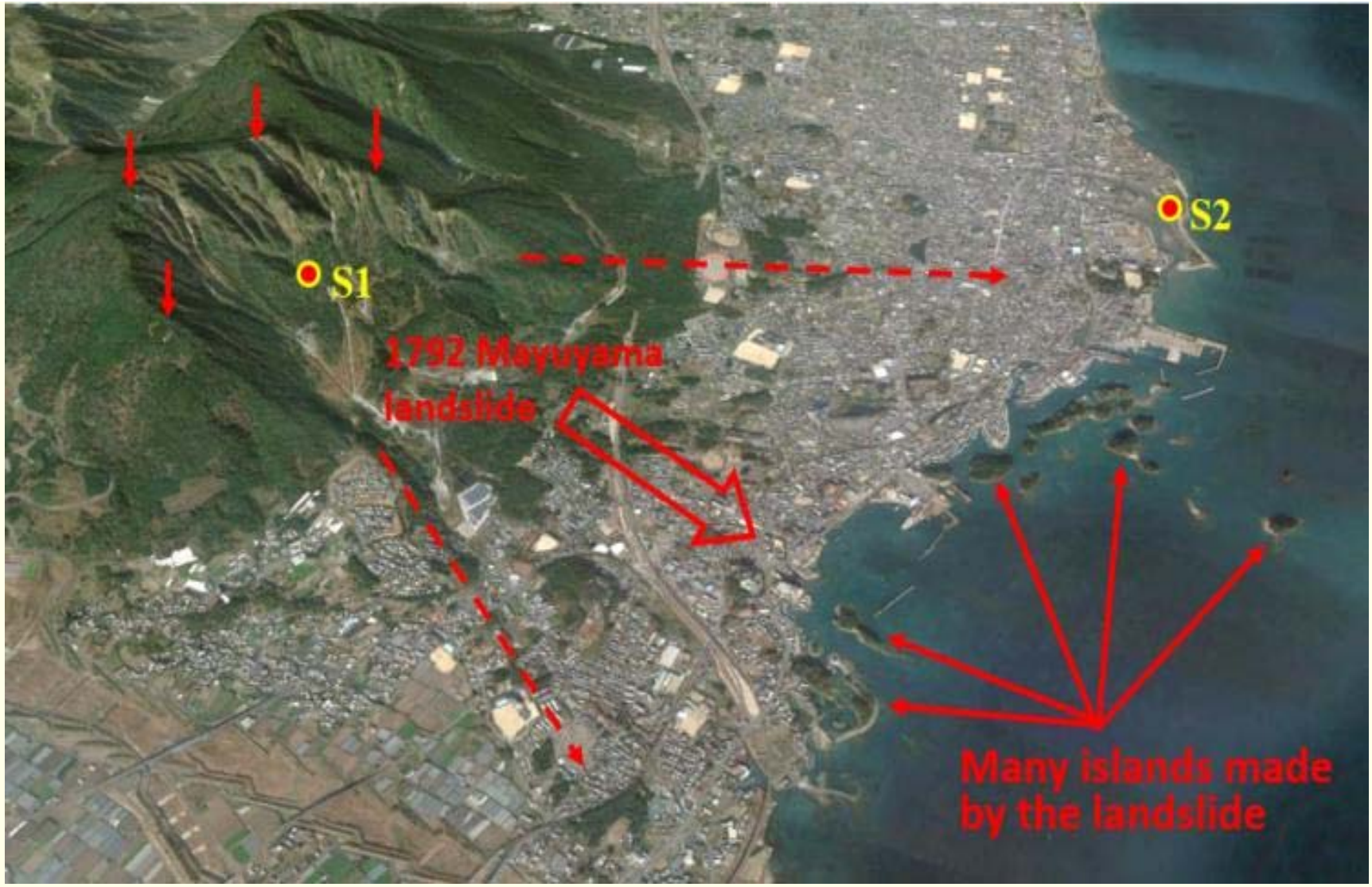
2. 35m deep landslide was simulated because of limited capacity of apparatus.

3. Ground water rise was simulated by increase of pore pressure.

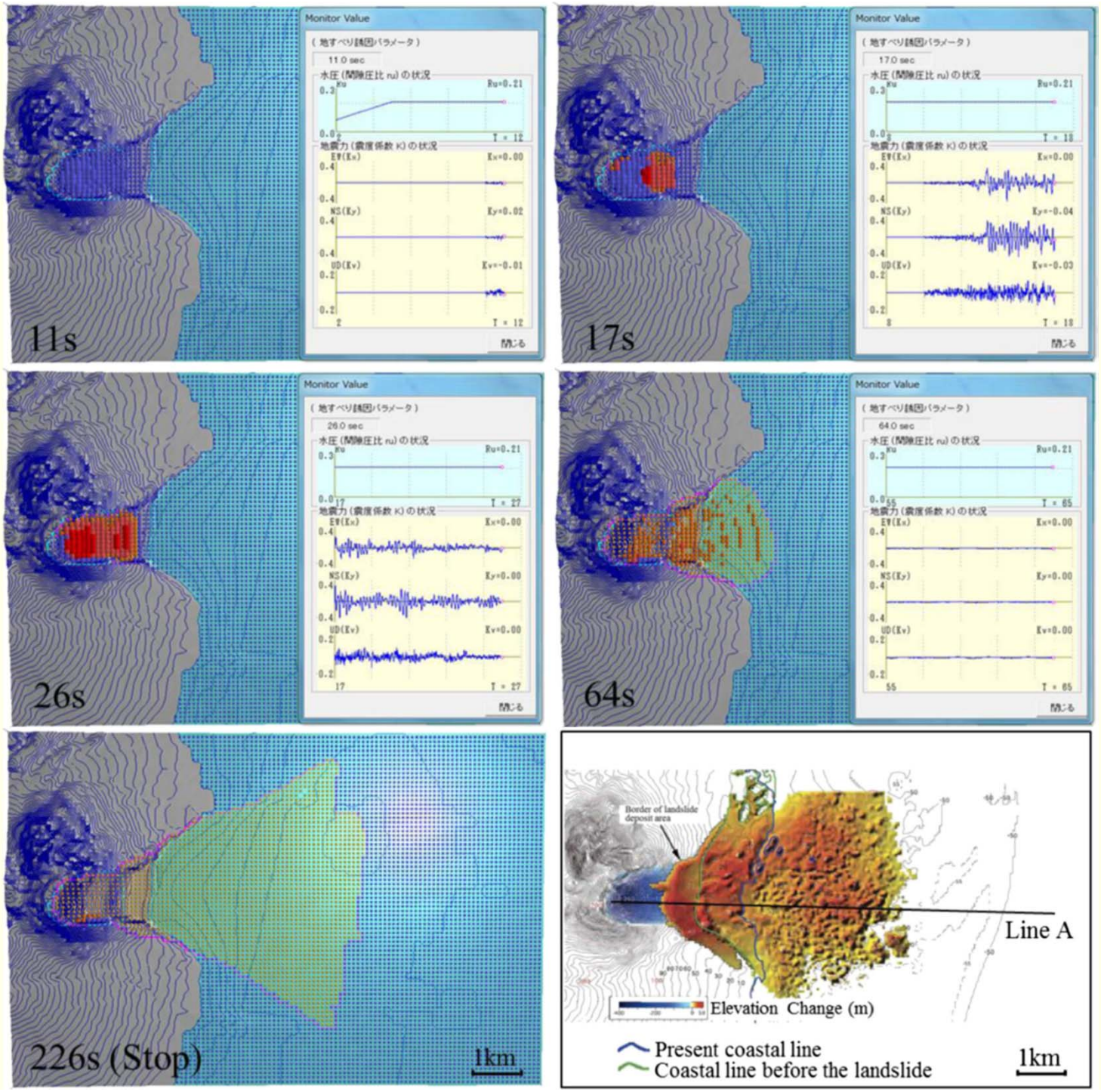
4. At the further 5 m rise should cause failure , 60 gal seismic wave using the nearby real earthquake record was loaded.

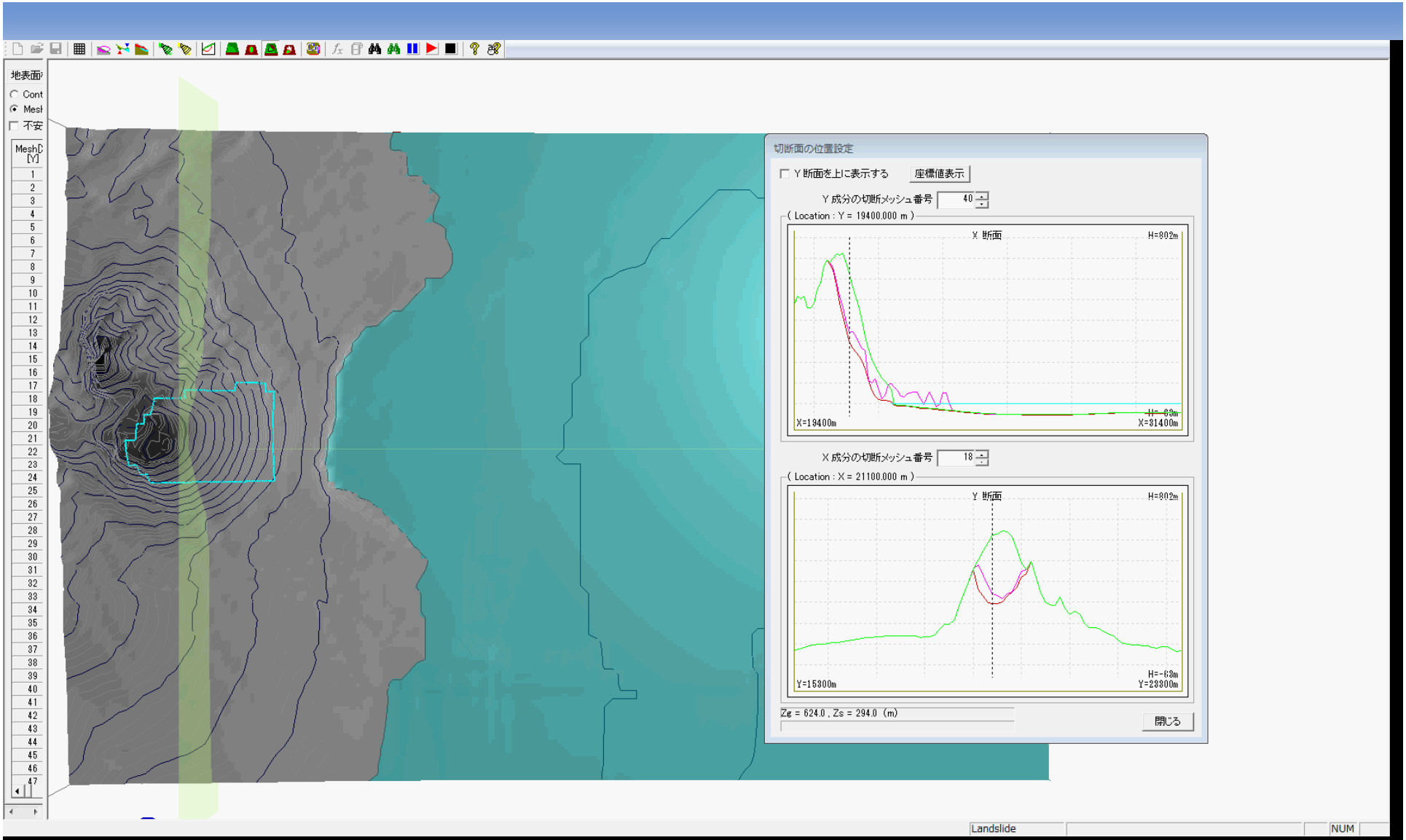
5. Rapid landslide was confirmed to occur. The mobilized apparent friction angle was 0.9˚.


地表面標高
すべり面標高
不
Control Point
Mesh Data
不安定土塊の表示
Mesh[X][Y]
1
2
Monitor Value
(地すべり誘因パラメータ)
0.0 sec
水圧 (間隙圧比 ru) の状況
Ru
Ru=0.00
0.2
0.0
0
T = 10
地震力 (震度係数 K) の状況
EW(Kx)
Kx=0.00
0.2
-0.2
NS(Ky)
Ky=0.00
0.1
-0.1
UD(Kv)
Kv=0.00
0.1
-0.1
0
T = 10
閉じる
レディ

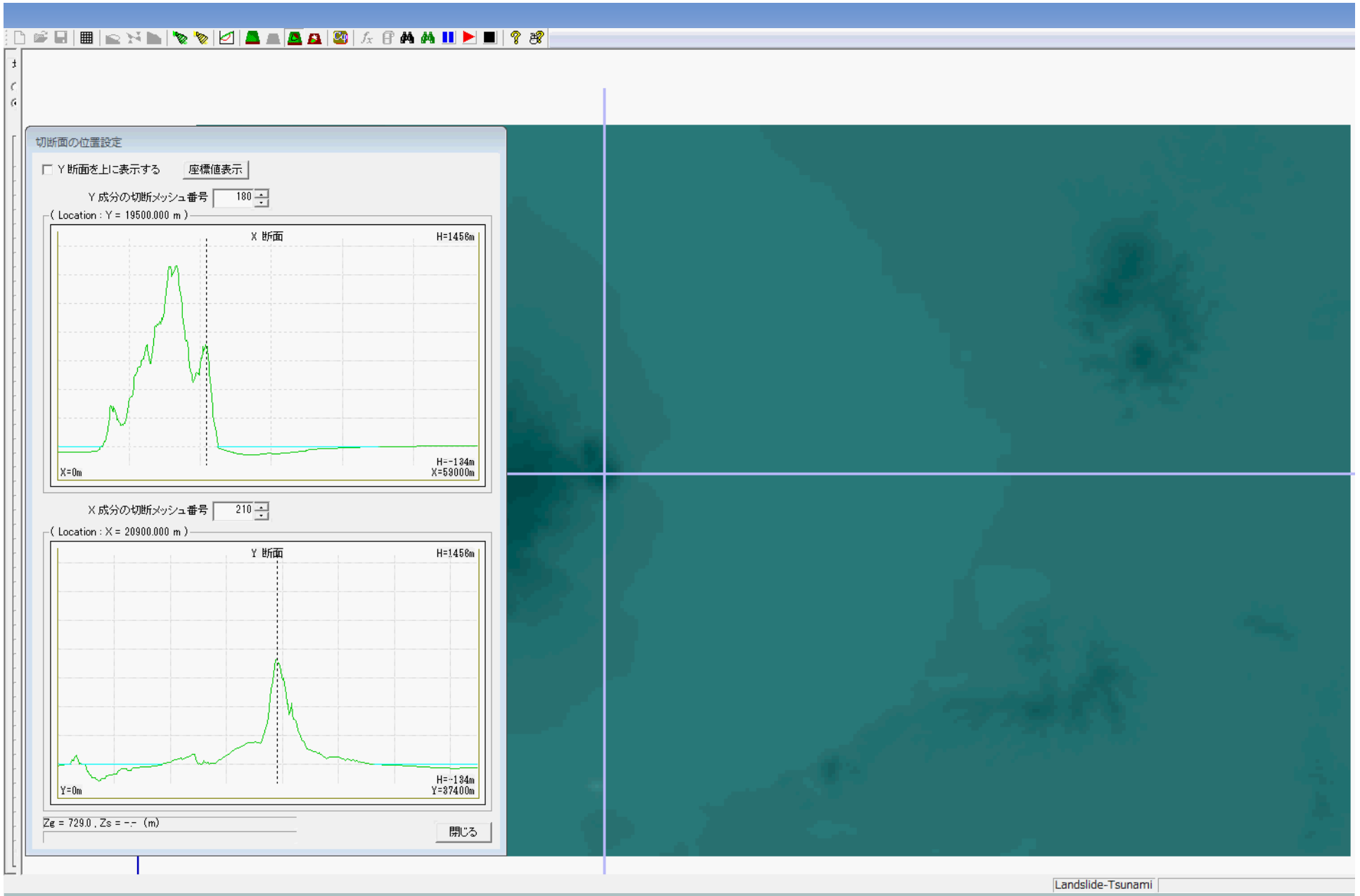


The 1792 largest landslide disaster in Japan killing 15,153 persons. 400m deep landslide was triggered by an earthquake of M=6.4±0.2. The lanslide mass entered into the sea and caused a large-scale tsunami which killed around 5,000 people in the opposit bank.


11s
17s
26s
64s
226s (Stop)
1km
Monitor Value
Border of landslide deposit area
Line A
Elevation Change (m)
Present coastal line
Coastal line before the landslide
1km

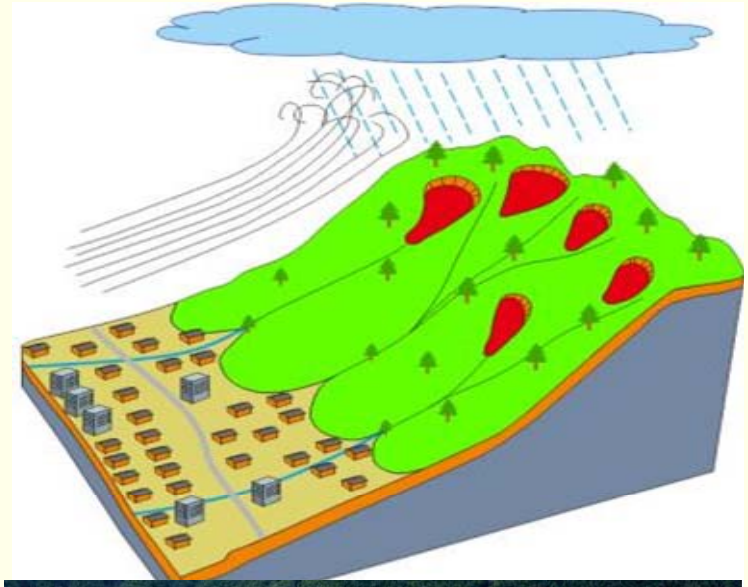


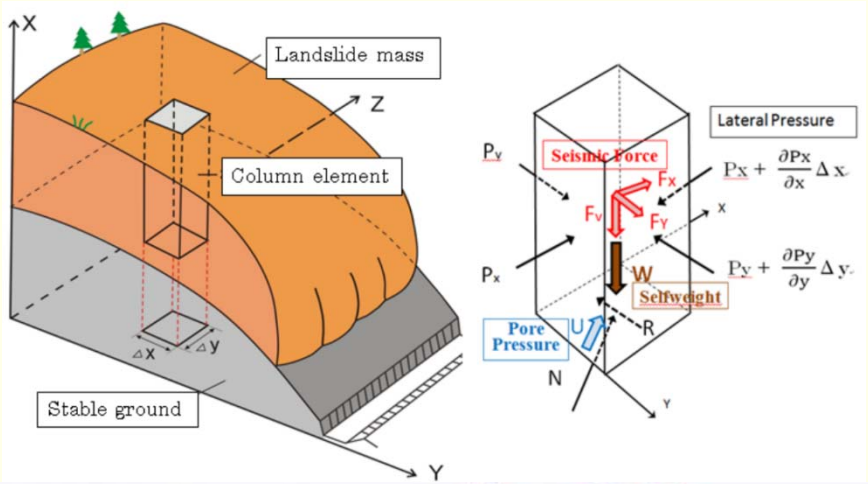
Simulation of 1792 Unzen-Mayuyama Megaslide by LS-RAPID model with cross sections



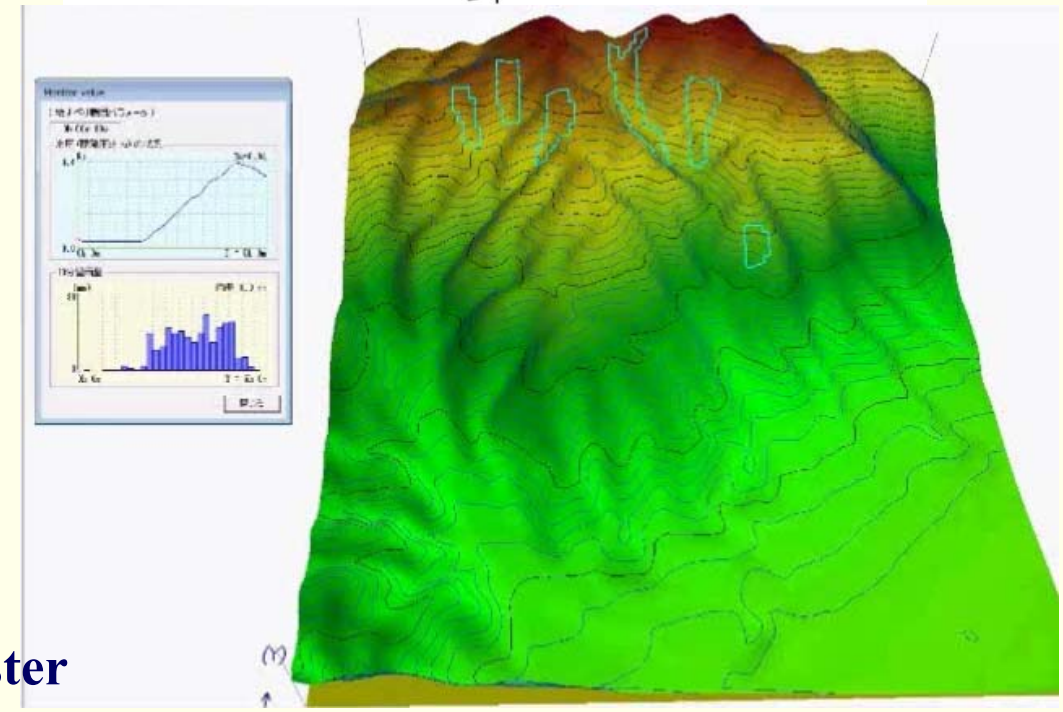
Simulation of 1792 Unzen-Mayuyama Megaslide-induced Tsunami by LS-TSUNAMI Model with cross sections

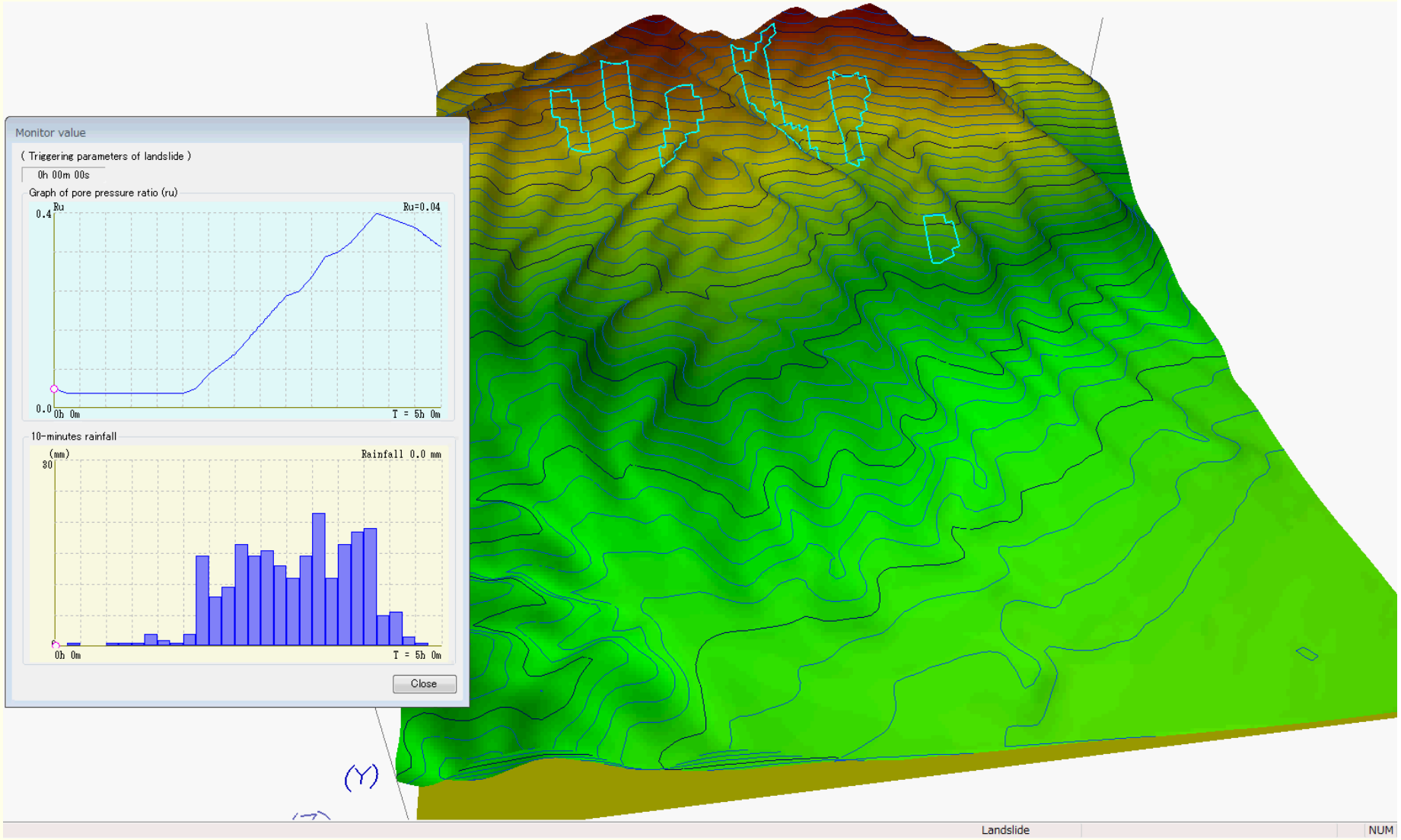
A method to assess landslide motion for vulnerability and Exposure for landslide risks: LS-RAPID simulation (Sassa et al. 2014) based on the landslide dynamics parameters of soils taken from the site

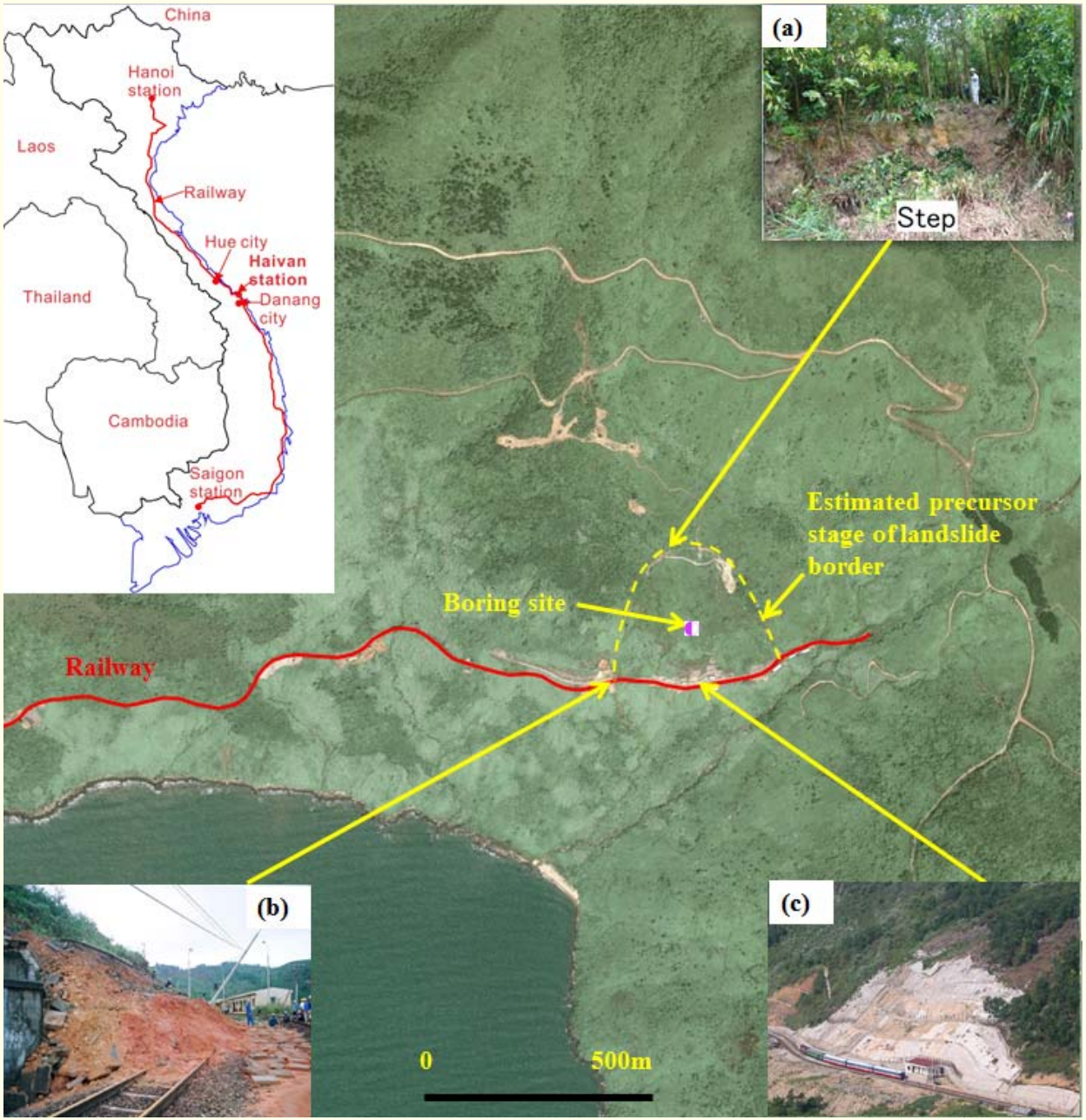


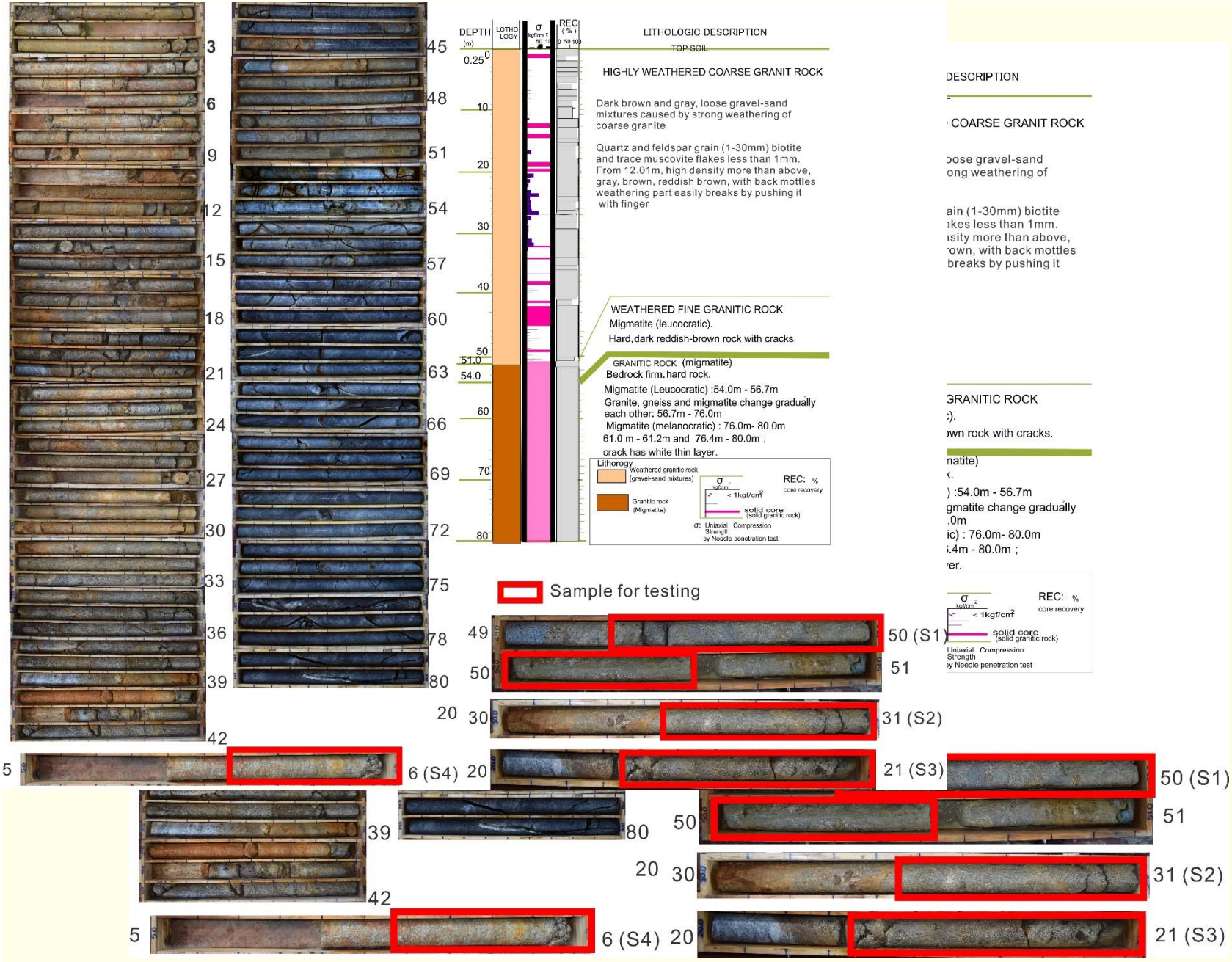


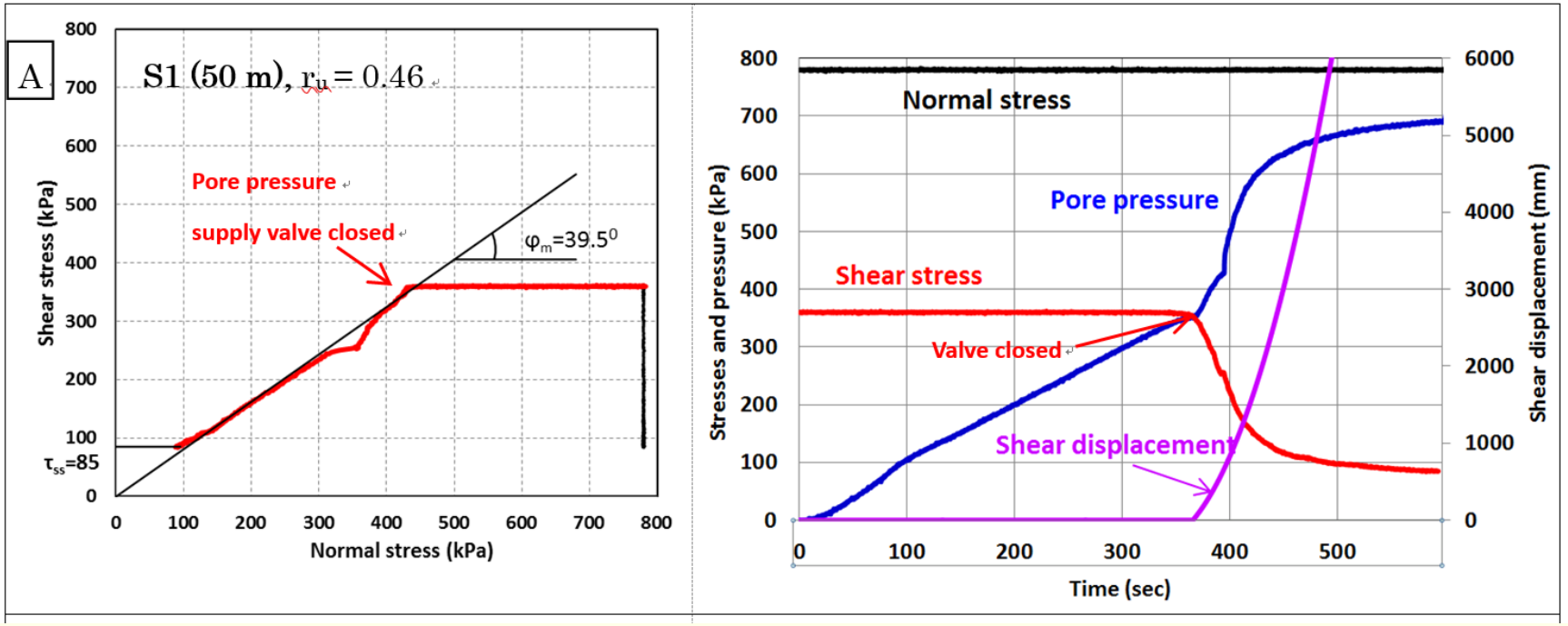
2014.8 Hiroshima Landslide Disaster

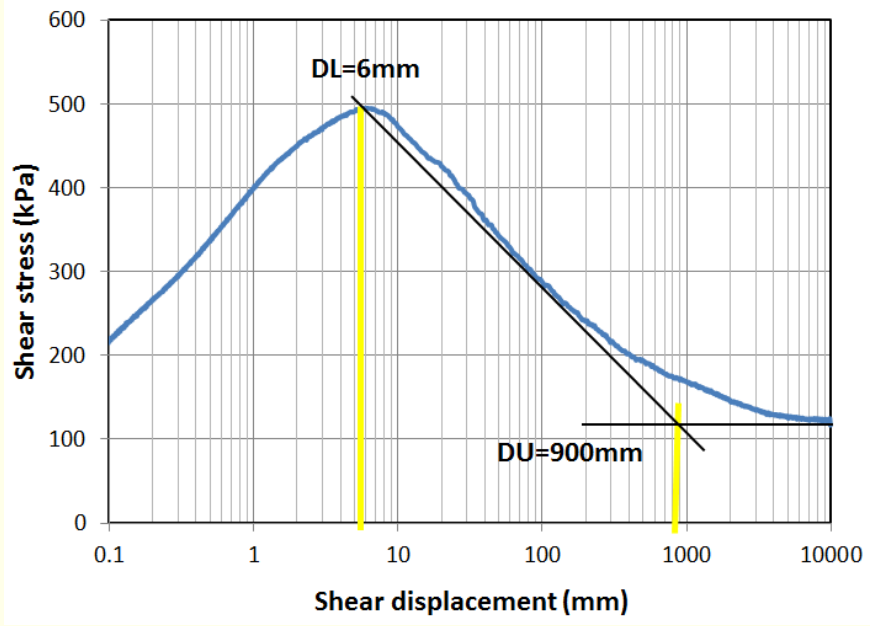


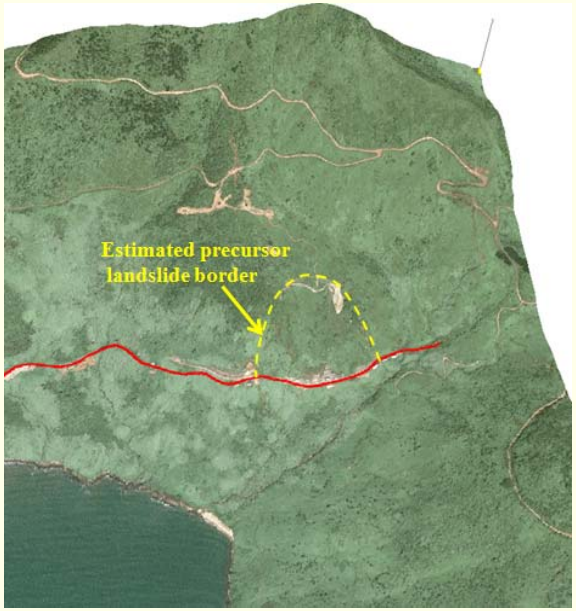

Monitor value
(Triggering parameters of landslide)
0h 00m 00s
Graph of pore pressure ratio (ru)
Ru
Ru=0.04
0.4
0.0
0h 0m
T = 5h 0m
10-minutes rainfall
(mm)
Rainfall 0.0 mm
80
0h 0m
T = 5h 0m
Close
Landslide
NUM

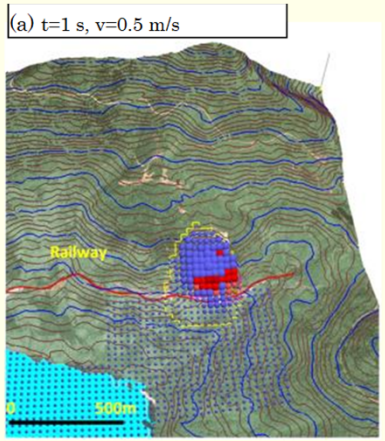

China
Hanoi station
Laos
Railway
Hue city
Haivan station
Danang city
Thailand
Cambodia
Saigon station
(a)
Step
Estimated precursor stage of landslide border
Boring site
Railway
(b)
(c)
0
500m

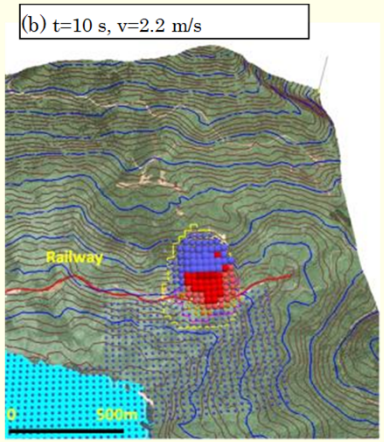

DEPTH (m)
LOTHO -LOGY
σ kgf/cm²
REC (%)
LITHOLOGIC DESCRIPTION
TOP SOIL
HIGHLY WEATHERED COARSE GRANIT ROCK
Dark brown and gray, loose gravel-sand mixtures caused by strong weathering of coarse granite
Quartz and feldspar grain (1-30mm) biotite and trace muscovite flakes less than 1mm. From 12.01m, high density more than above, gray, brown, reddish brown, with back mottles weathering part easily breaks by pushing it with finger
WEATHERED FINE GRANITIC ROCK
Migmatite (leucocratic).
Hard, dark reddish-brown rock with cracks.
GRANITIC ROCK (migmatite)
Bedrock firm. hard rock.
Migmatite (Leucocratic) :54.0m - 56.7m
Granite, gneiss and migmatite change gradually each other: 56.7m - 76.0m
Migmatite (melanocratic) : 76.0m- 80.0m
61.0 m - 61.2m and 76.4m - 80.0m ;
crack has white thin layer.
Lithorogy
Weathered granitic rock (gravel-sand mixtures)
Granitic rock (Migmatite)
REC: % core recovery
< 1kgf/cm²
solid core (solid granitic rock)
σ: Uniaxial Compression Strength by Needle penetration test
Sample for testing
50 (S1)
51
31 (S2)
6 (S4)
21 (S3)

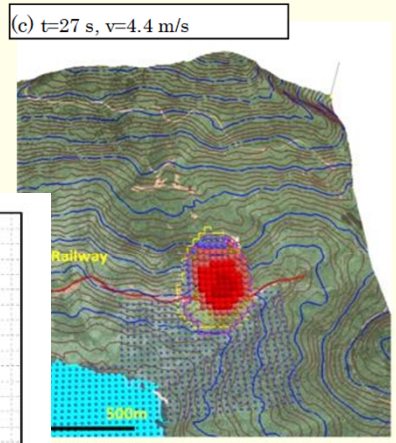

A
S1 (50 m), r_u = 0.46
Pore pressure
supply valve closed
φ_m=39.5^0
τ_{ss}=85
Shear stress (kPa)
Normal stress (kPa)
Normal stress
Pore pressure
Shear stress
Valve closed
Shear displacement
Stresses and pressure (kPa)
Shear displacement (mm)
Time (sec)

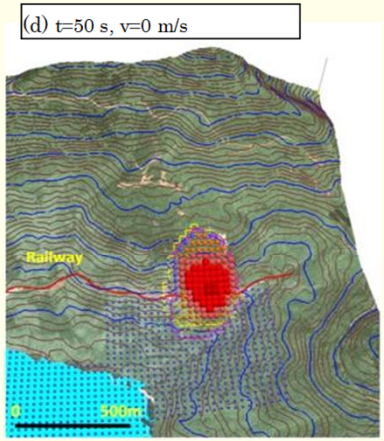

DL=6mm
DU=900mm
Shear stress (kPa)
Shear displacement (mm)

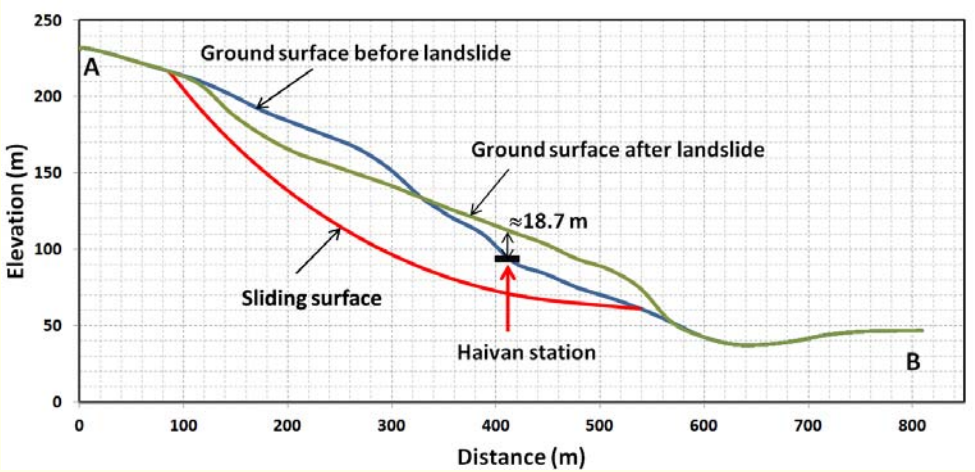

Estimated precursor
landslide border

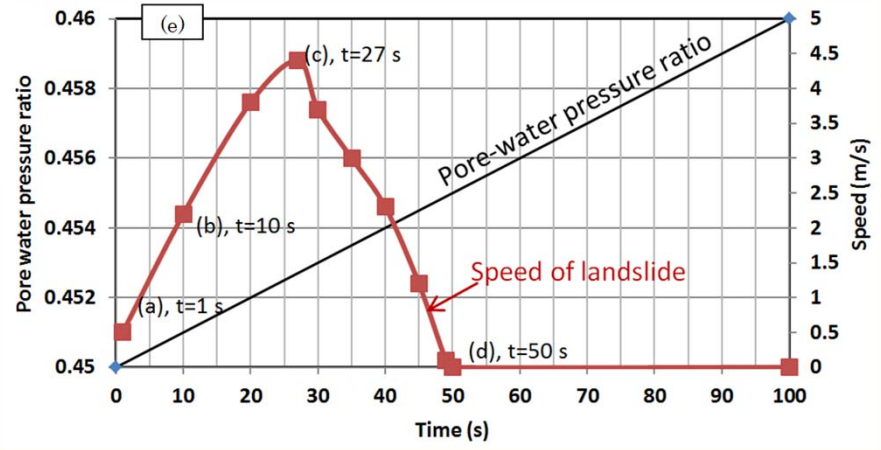

(a) t=1 s, v=0.5 m/s
Railway
0
500m


(b) t=10 s, v=2.2 m/s
Railway
0
500m

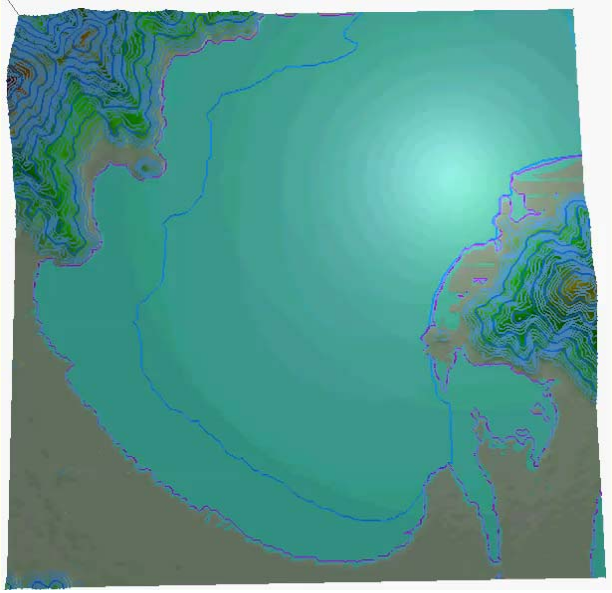

(c) t=27 s, v=4.4 m/s
Railway
500m


(d) t=50 s, v=0 m/s
Railway
0
500m

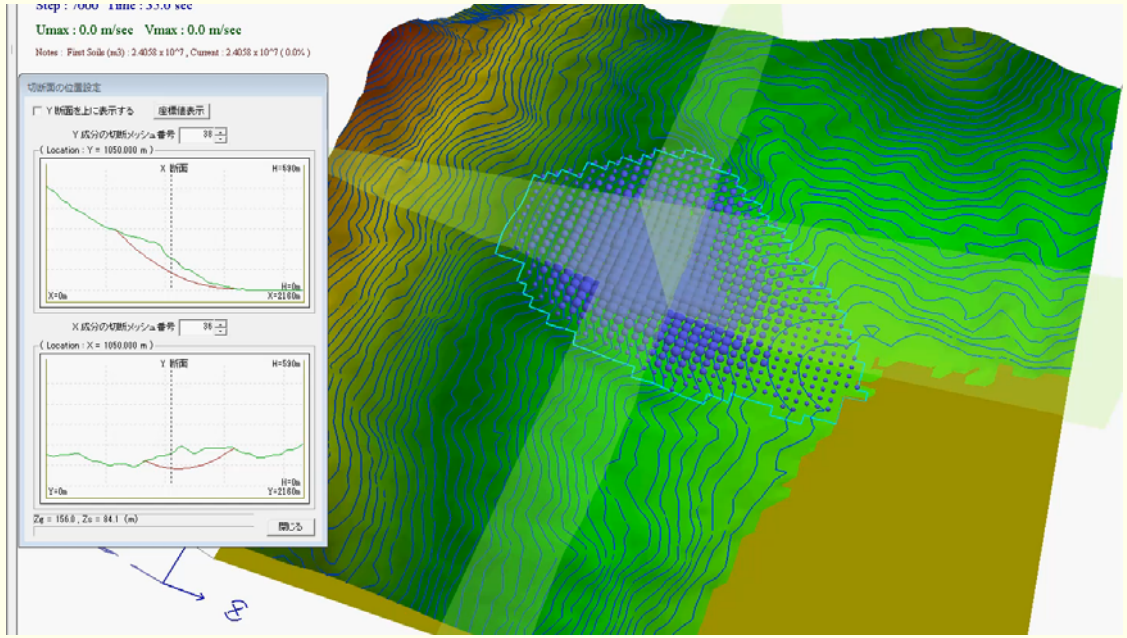

A
Ground surface before landslide
Ground surface after landslide
≈18.7 m
Sliding surface
Haivan station
B
Elevation (m)
Distance (m)
250
200
150
100
50
0
0
100
200
300
400
500
600
700
800


(e)
(a), t=1 s
(b), t=10 s
(c), t=27 s
(d), t=50 s
Pore-water pressure ratio
Speed of landslide
Pore water pressure ratio
Speed (m/s)
Time (s)
0.46
0.458
0.456
0.454
0.452
0.45
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
10
20
30
40
50
60
70
80
90
100

Application of Testing and Simulation to Haivan station landslide in Vietnam



The method to assess exposure to landslides and landslide-induced tsunamis is being applied to Vietnam and other areas through ICL-network (34 countries and 62 ogranizatons). The technologies will be transferred through the planned ISDR-ICL Landslide interactive teaching tools and full color books published in the World Landslide Forum in 2017(Ljubljana, Slovenia), 2020 (Niigata, Japan) and 2023 (USA under examination) during the Sendai Partnerships.



Testing of Haivan samples (Left-top), simulation by LS-RAPID (right) and LS-Tsunami (Left-bottom)

3. Establishment of a new International Consortium on Landslides (ICL) in 2002

Invitation to the Fifth World Landslide Forum on 2-6 November 2020 in Kyoto, Japan

An international Consortium on Landslides (ICL) was established during the UNESCO-Kyoto University Joint Symposium in 2002. Participants are from UNESCO (ADG:AS-Nagy), UNISDR (Pedro Basabe), WMO (DSG:Michel Jarraud), MOFA & MEXT, KU(Kaoru Takara), Japan and others.

ICL members from South East Asia

Indonesia

- **University of Gadjah Mada**
- **Research Center for Geotechnology, Indonesian Institute of Sciences**
- **Parahyangan Catholic University**

Taiwan, China

- **National Taiwan University, Department of Civil Engineering**
- **Landslide group in National Central University from Graduate Institute of Applied Geology, Department of Civil Engineering, Center for Environmental Studies**

Vietnam

- **Institute of Transport Science and Technology**
- **Vietnam Institute of Geosciences and Mineral Resources (VIGMR)**

Thailand

- **Ministry of Agriculture and Cooperatives, Land Development Department**
- **Asian Disaster Preparedness Center(ADPC)**

Sri Lanka (Nearest country to South East Asia)

- **National Building Research Organization**
- **Central Engineering Consultancy Bureau (CECB)**

(60 organizations in the World)

The Fifth World Landslide Forum

Date: 2-6 November 2020

Venue: Kyoto International Conference Center, Kyoto, Japan

Organizers:

International Consortium on Landslides (ICL)Global Promotion Committee of International Programme on Landslides (IPL-GPC), including:

- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- World Meteorological Organization (WMO)
- Food and Agriculture Organization (FAO)
- United Nations Office for Disaster Risk Reduction (UNISDR)
- United Nations University (UNU)
- International Council for Science (ICSU)
- World Federation of Engineering Organizations (WFEO)
- International Union of Geological Sciences (IUGS)
- International Union of Geodesy and Geophysics (IUGG)

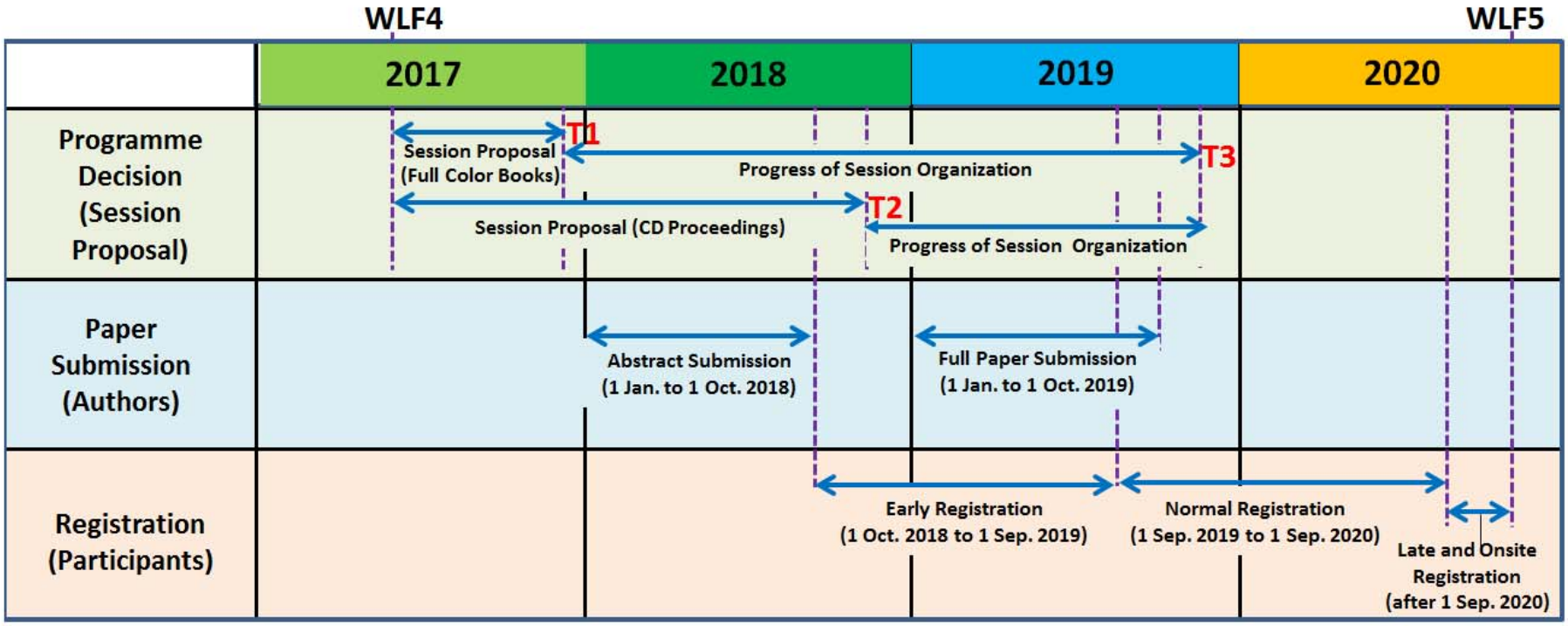
Science Council of Japan (SCJ) (process under way)

Kyoto University (KU)

Japan Landslide Society (JLS)

Japanese Geotechnical Society (JGS)

Japan Society for Natural Disaster Science (JSNDS)



T1: Decision of Session (Full Color Books), 29 Nov. – 1 Dec. 2017 **T2:** Decision of Session (CD Proceedings) on 5 Nov. 2018

T3: Final Programme Decision in Nov. 2019

1. **A thematic issue "ISDR-ICL Sendai Partnerships 2015-2025" of Journal *Landslides* (published in October 2020 and free access for one month**
2. **A series of full color books for some major themes of WLF5 published by Springer.**

   Call for session proposals until 1 November 2017.
3. **Proposal of a variety of sessions, symposia, workshops, round table discussions are called until 1 November 2018. Their proceedings will be edited by the proposing organizations and groups and published in CD proceedings of WLF5.**

Kyoto International Conference Center

Entrance of Building

Opening Plenary Session

Closing Plenary Session RD

Kiyomizudera during fall illuminations

Bamboo Groves in Sagano, K

Kinkaku-ji Temple

Bentendo Hall, Daigoji Temple,

Wishing to meet many of you to the Fifth World Landslide Fouum in Kyoto Japan 2-6 November 2020

from the top of Usoy landslide dam, Tajikustan