

Heavy Rain and Landslide Disaster of July 2018 in Western Japan



Tomohiro NISHIMURA (Kokusai Kogyo Co., LTD)

A member of

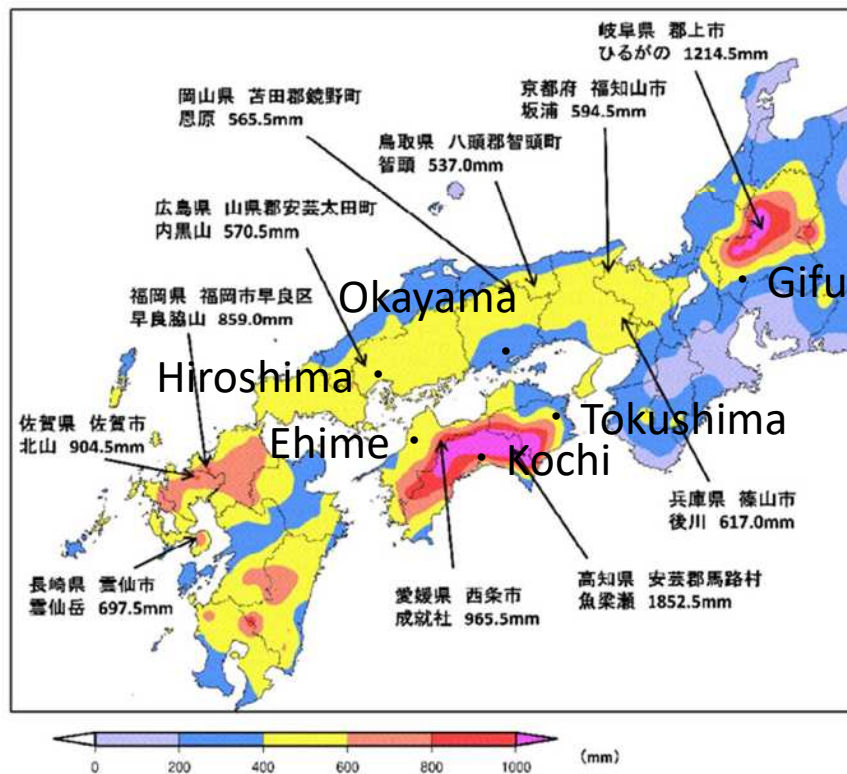
**Working Group on Geology Related to Disasters
in Japan Society of Engineering Geology (JSEG)**



Today's topics

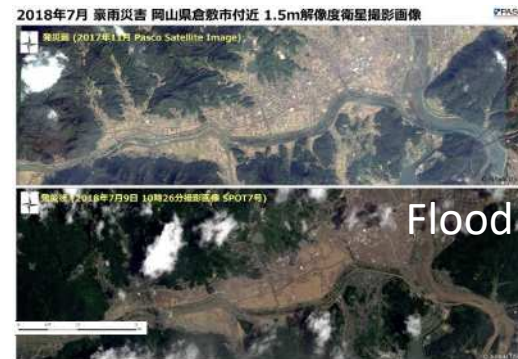
1. Overview of Heavy Rains of July 2018
2. About the Disaster Research Team of JSEG
3. Our Base Technology
4. Debris flow disasters in Hiroshima Prefecture
5. Flooding in Okayama Prefecture
6. Landslide disasters in Ehime prefecture
7. Return of our Survey Results to Society
8. Efforts to Standardize Research Methods at JSEG

1. Overview of Heavy Rain of July 2018 in Western Japan

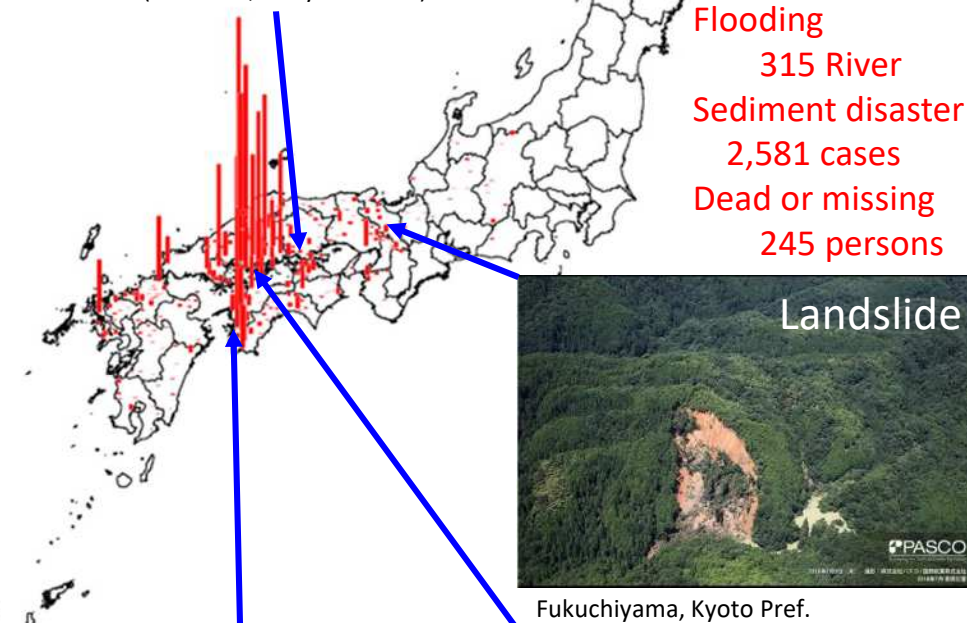


Period precipitation distribution map (from 0:00, 28/Jun to 24:00, 8/Jul : JMA)

- Total rainfall exceeded 500 mm over a wide area in western Japan
- Especially in Gifu, Kochi and Tokushima prefectures, the total rainfall exceeded 1000mm
- In Okayama, Hiroshima and Ehime prefectures where the damage was concentrated, the total rainfall was 400-600 mm



Oda River (Kurashiki, Okayama Pref.)



Flooding
 315 River
Sediment disaster
 2,581 cases
Dead or missing
 245 persons



Fukuchiyama, Kyoto Pref.



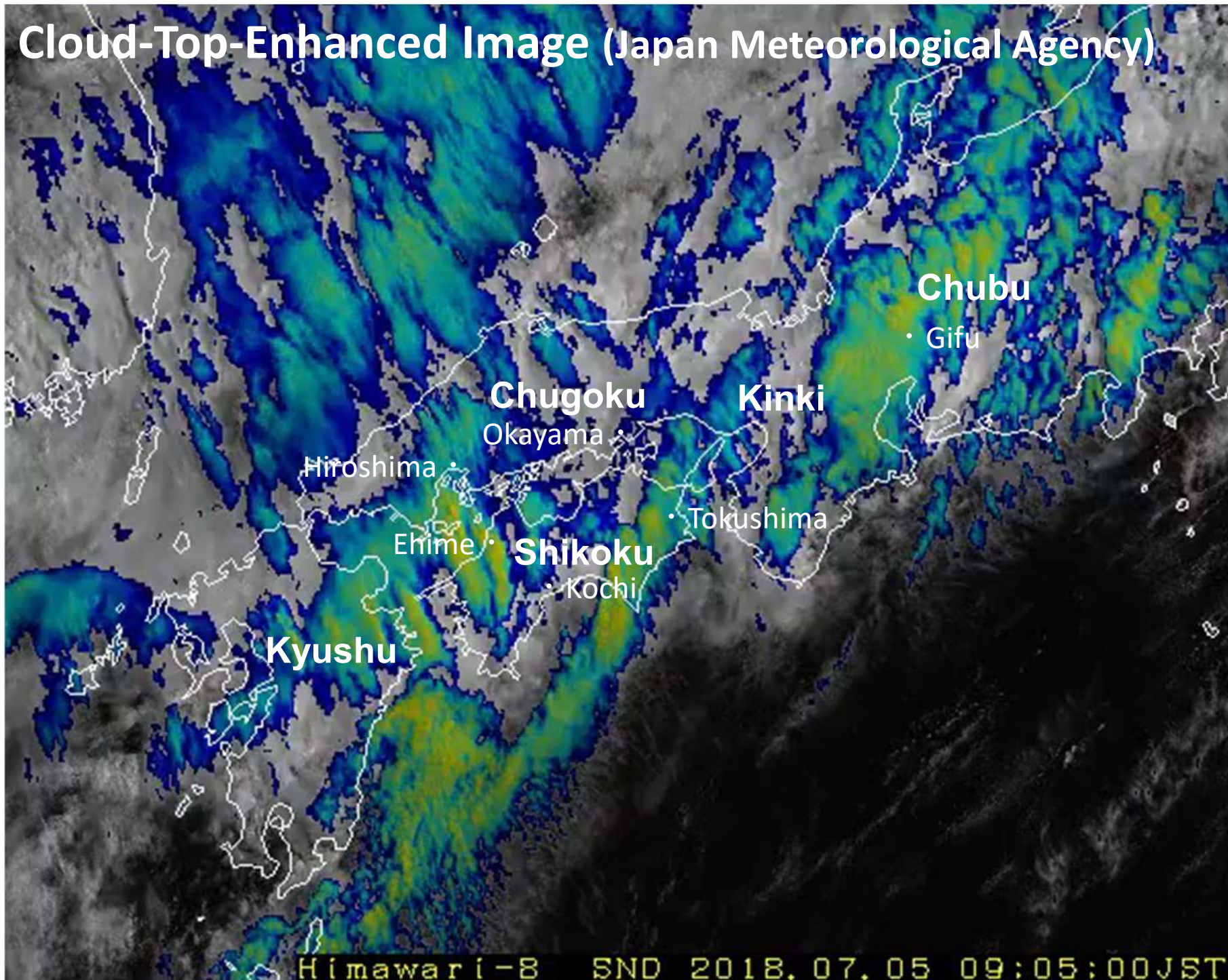
Uwajima, Ehime Pref.



Kure, Hiroshima Pref.

Distribution map of sediment disasters by municipality

Cloud-Top-Enhanced Image (Japan Meteorological Agency)



2. About the Disaster Research Team of JSEG



Japan Society of Engineering Geology (JSEG)

Disaster Research Team

Team Leader

Prof. Shigeyuki SUZUKI (Okayama Univ.)

Deputy Team leader

Dr. Hideki INAGAKI (Kankyo Chishitsu Co., LTD.)

Secretary-General

Mr. Tomohiro NISHIMURA (Kokusai Kogyo Co., LTD.)

Team Member

73 experts

(Mainly consists of University Researchers and
Geological Survey / Spatial Information Consultants)



Conducted surveys in many fields

- > Detailed records of disaster
- > Cause of disaster
- > Recovery after disaster
- > Damage situation of countermeasures
- > Evacuation behavior

29 survey results in one report



Report of the Research Mission on the Heavy Rain Disasters of July 2018

29 survey results in a report



I . Preface

- I -2. List of members of the Research Mission on the Heavy Rain Disasters of July 2018
- I -3. Members of the research mission and their backgrounds

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- III-3-6. The damage situation along the Hiji River, Ozu City, Ehime Prefecture
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III-4. Kinki Region

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VI . Proposals and Issues for Disaster Mitigation

- VI-1. Proposals and problems concerning reduction of torrential disaster damage from the standpoint of engineering geology

VII . Conclusions

3. Our Base Technology : Geospatial Information + Field Work



Sensing altitude

Satellite Imaging

Sensing altitude: 600-700km

Satellite imaging

Satellite image (optical sensor) Satellite image (synthetic aperture radar)



Aerial Imaging

Sensing altitude: 300-3,000m

Aerial imaging

3-D measurements using laser scanner High resolution aerial digital camera image



Drone

Sensing altitude: 50-800m

Drone (UAV*)

Orthophoto image Survey of disaster area

*Unmanned Aerial Vehicle

Ground laser scanner **MMS***

Sensing altitude: 0m

Terrestrial laser scanning of cultural heritage assets Acquiring spatial data via MMS

*Mobile Measurement System

Ship/Marine Radar

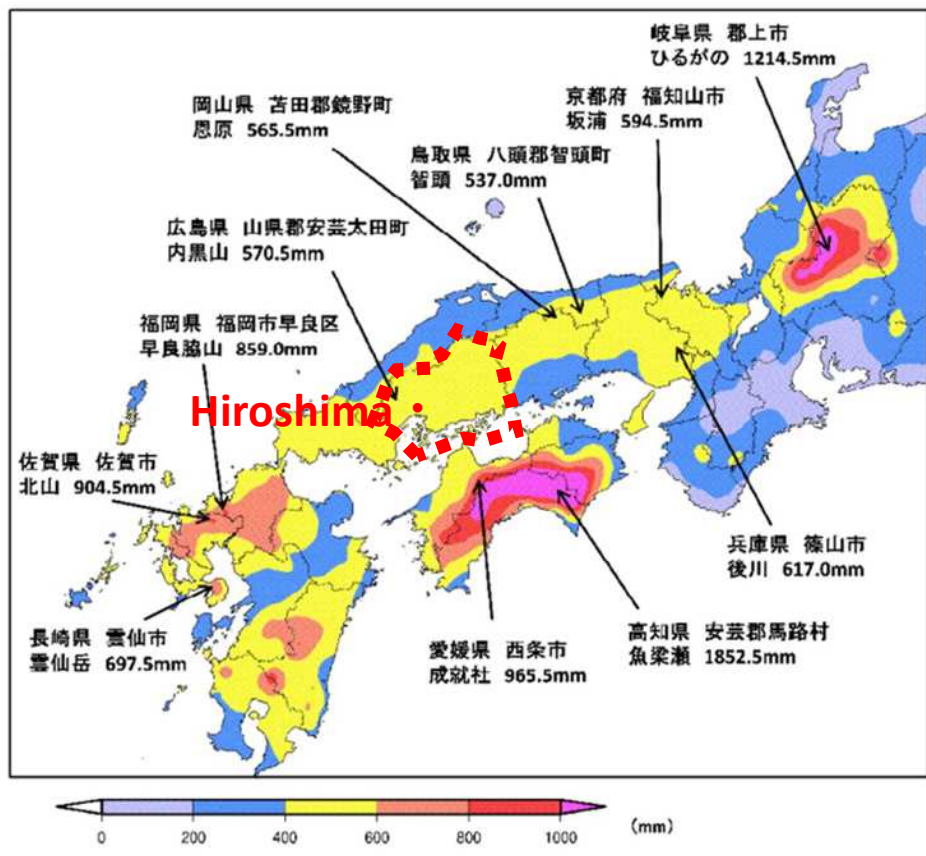
Sensing altitude: 0-200m

Ship/marine radar

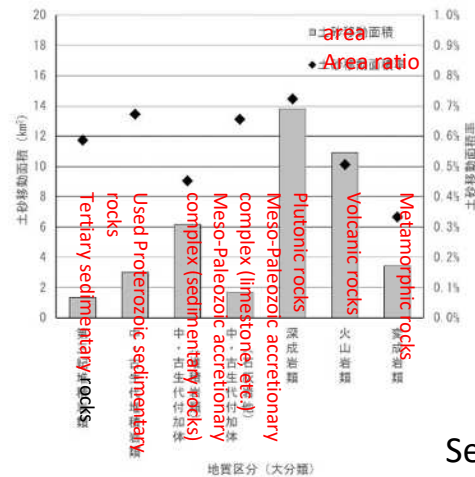
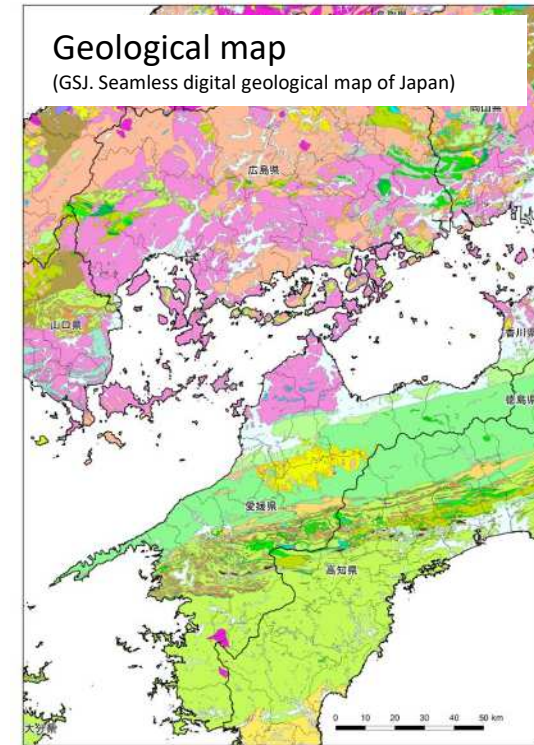
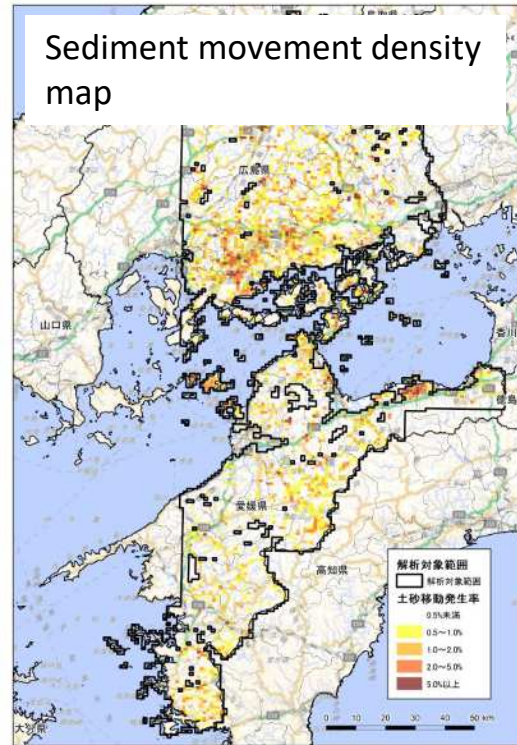
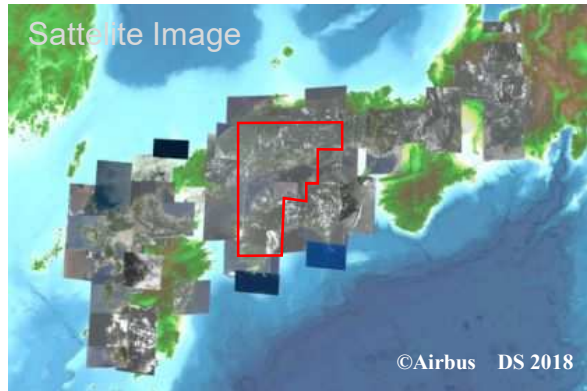
Mapping seafloor terrain using narrow multi-beam sonar Marine radar analysis of surface current flows



4. Debris flow disasters in Hiroshima Pref. Kurose-cho, Higashi- Hiroshima



Estimation of Wide Area Distribution of Sediment Disaster Using Optical Satellite Images

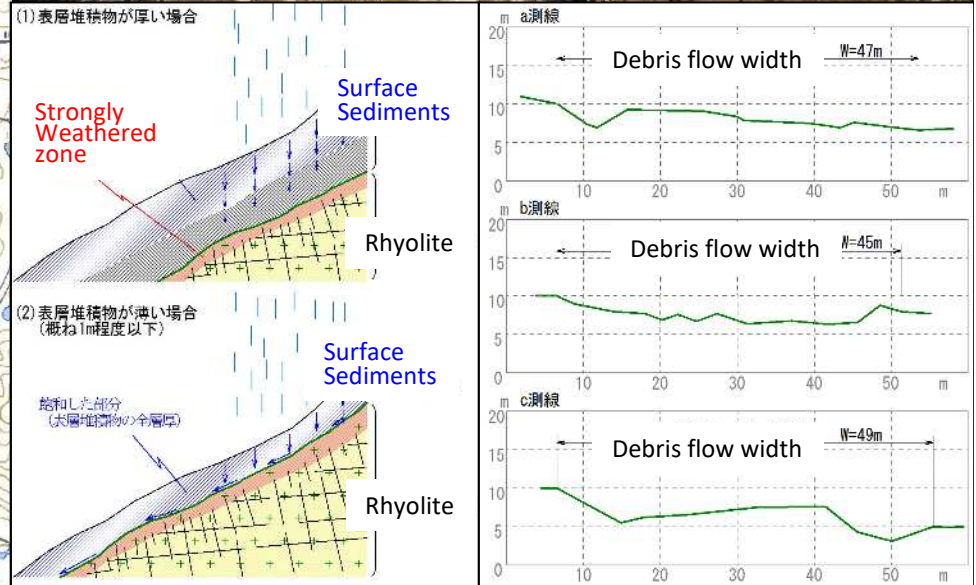
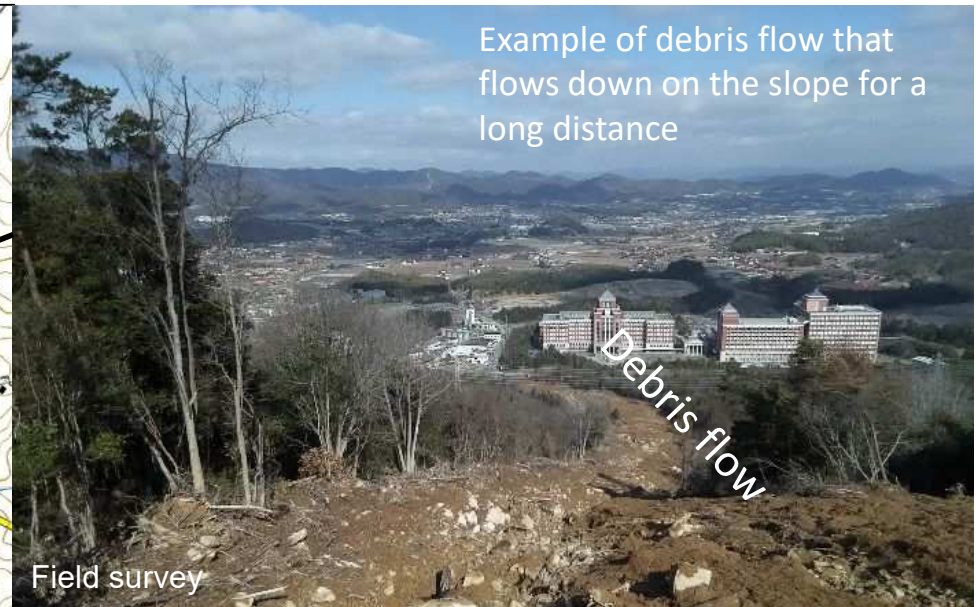
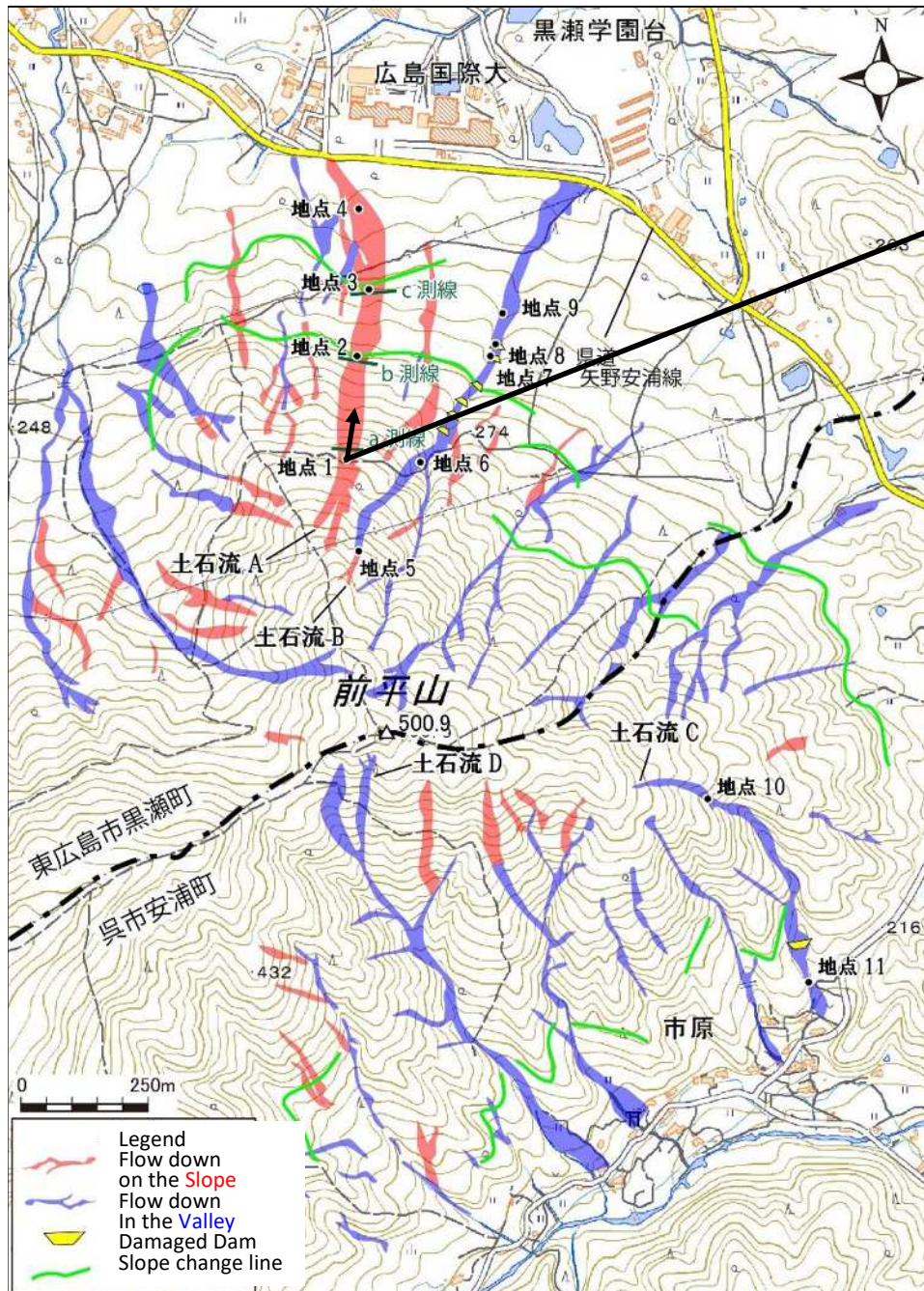


The amount of sediment movement by geology was investigated by overlaying the sediment movement density map and the geological map.

>> Most frequently occurring in plutonic rock (granite) areas

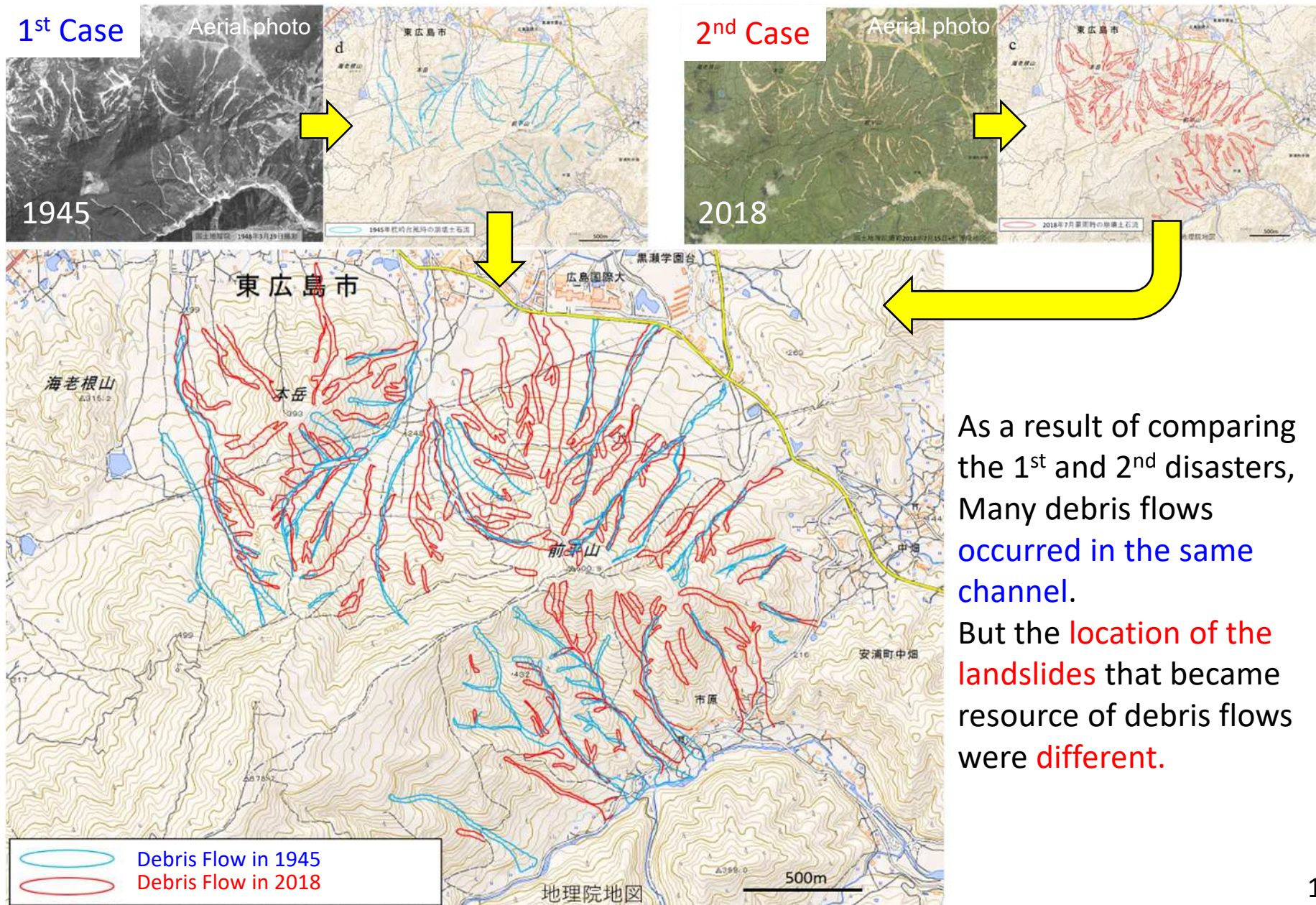
Sediment transfer rate by geology

Specific characteristics and disaster situation of debris flow

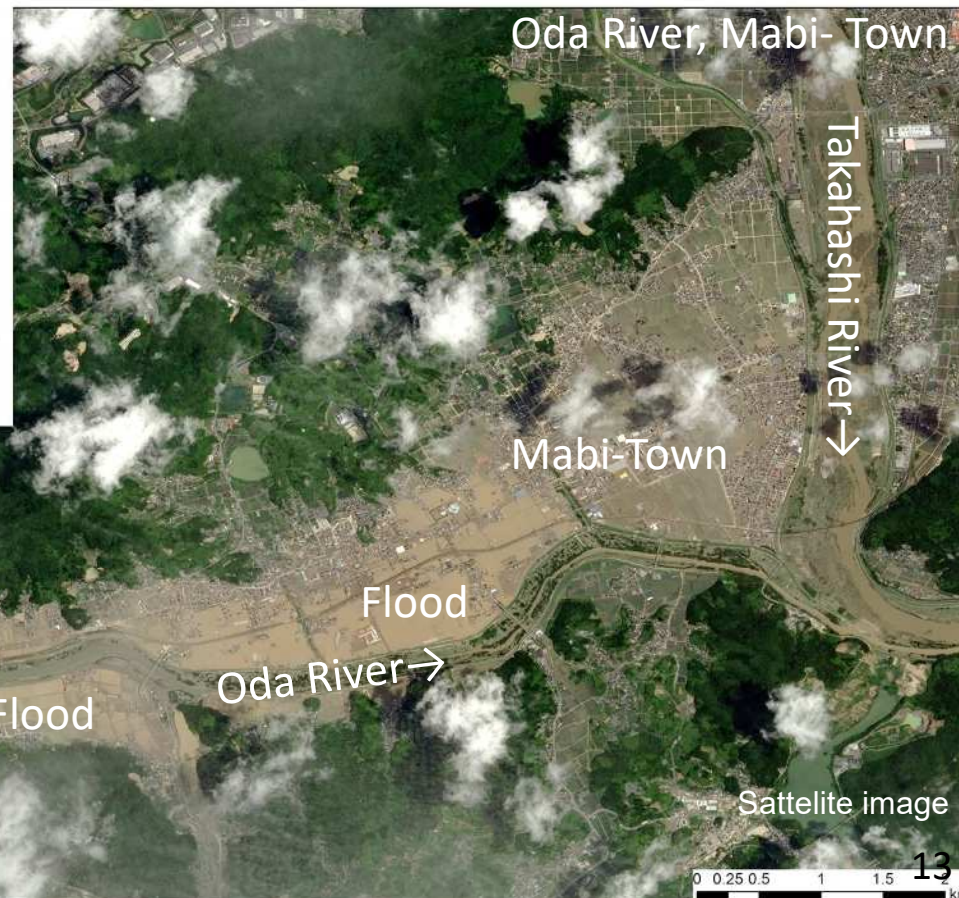
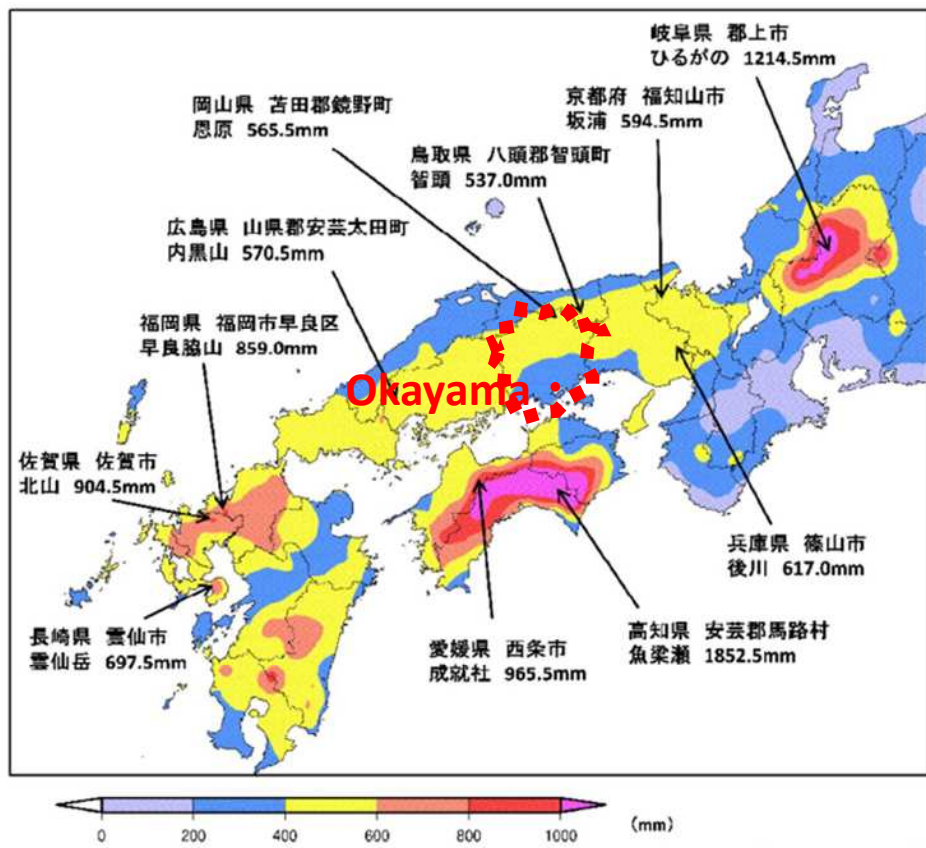


In the area where **Rhyolite** is distributed, it was observed that the shallow landslides that occurred on the hillside **flows down on the slope for a long distance** instead of valley

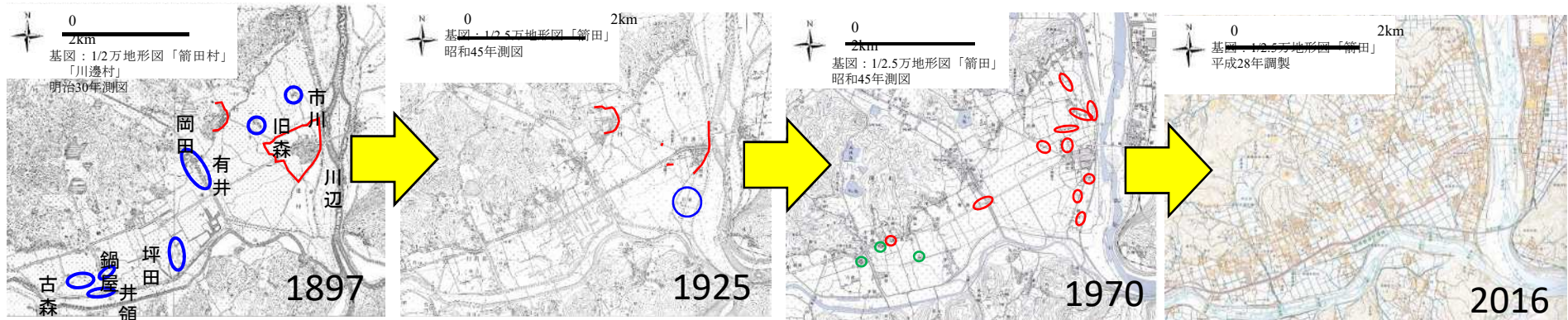
Comparative study of debris flows that occurred twice in the past in the same area



5. Flooding in Okayama Pref.

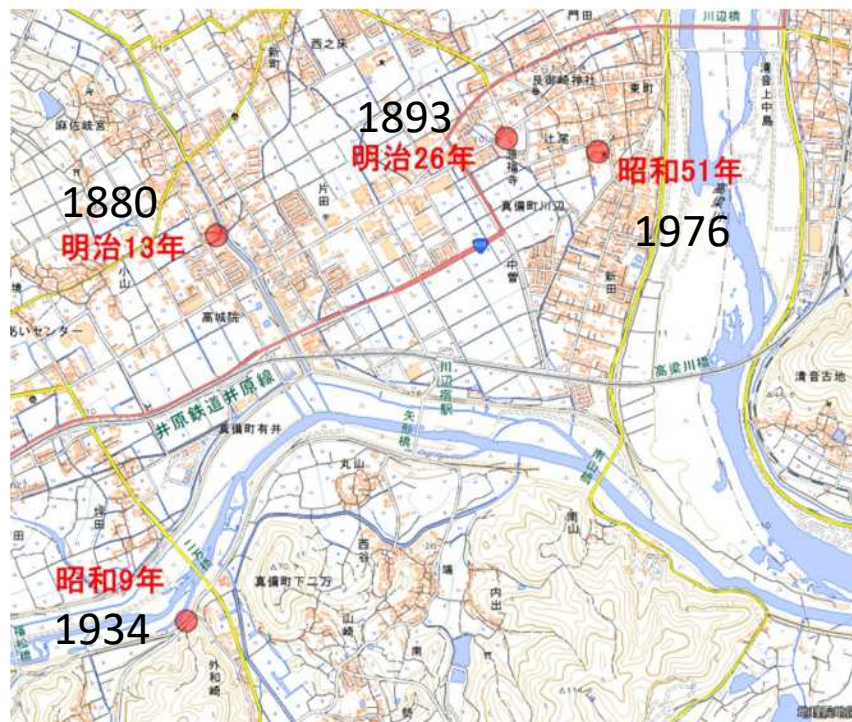


Changes in land use for 120 years and Monument showing flood damages in Mabi-town



Changes in land use

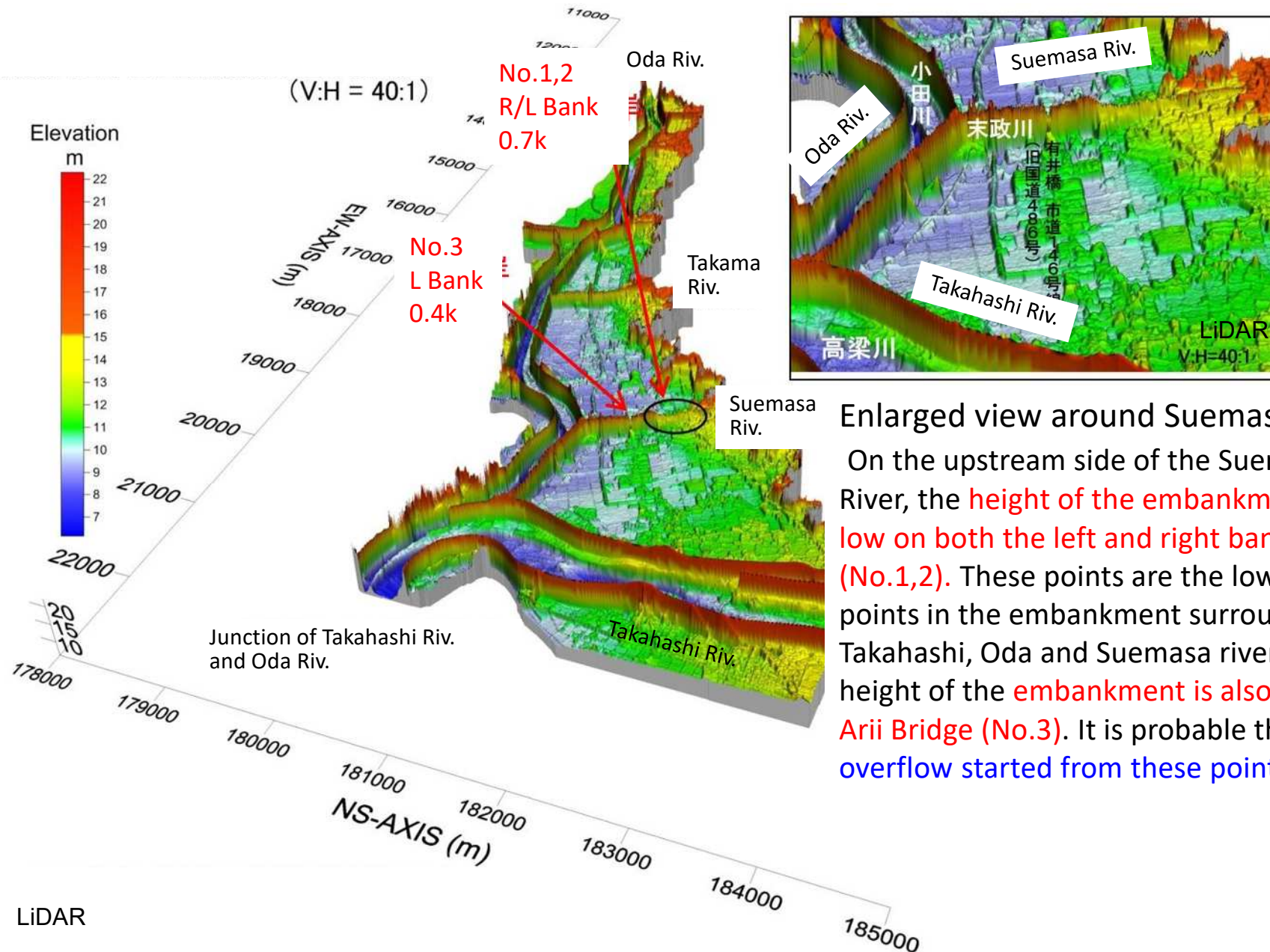
In recent years, wetlands and rice fields have rapidly become urbanized



Monuments showing flood damages

Bird view around the junction of Takahashi River and Oda River

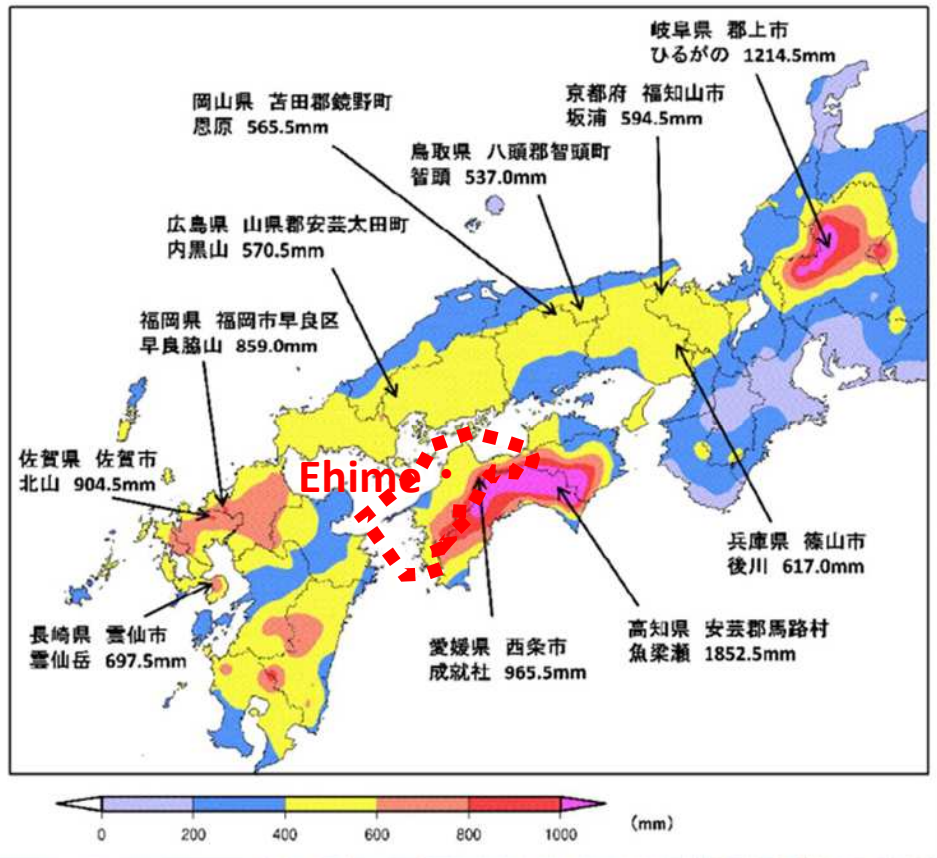
Base data: 5m mesh DEM from LiDAR provided by Geospatial Information Authority of Japan



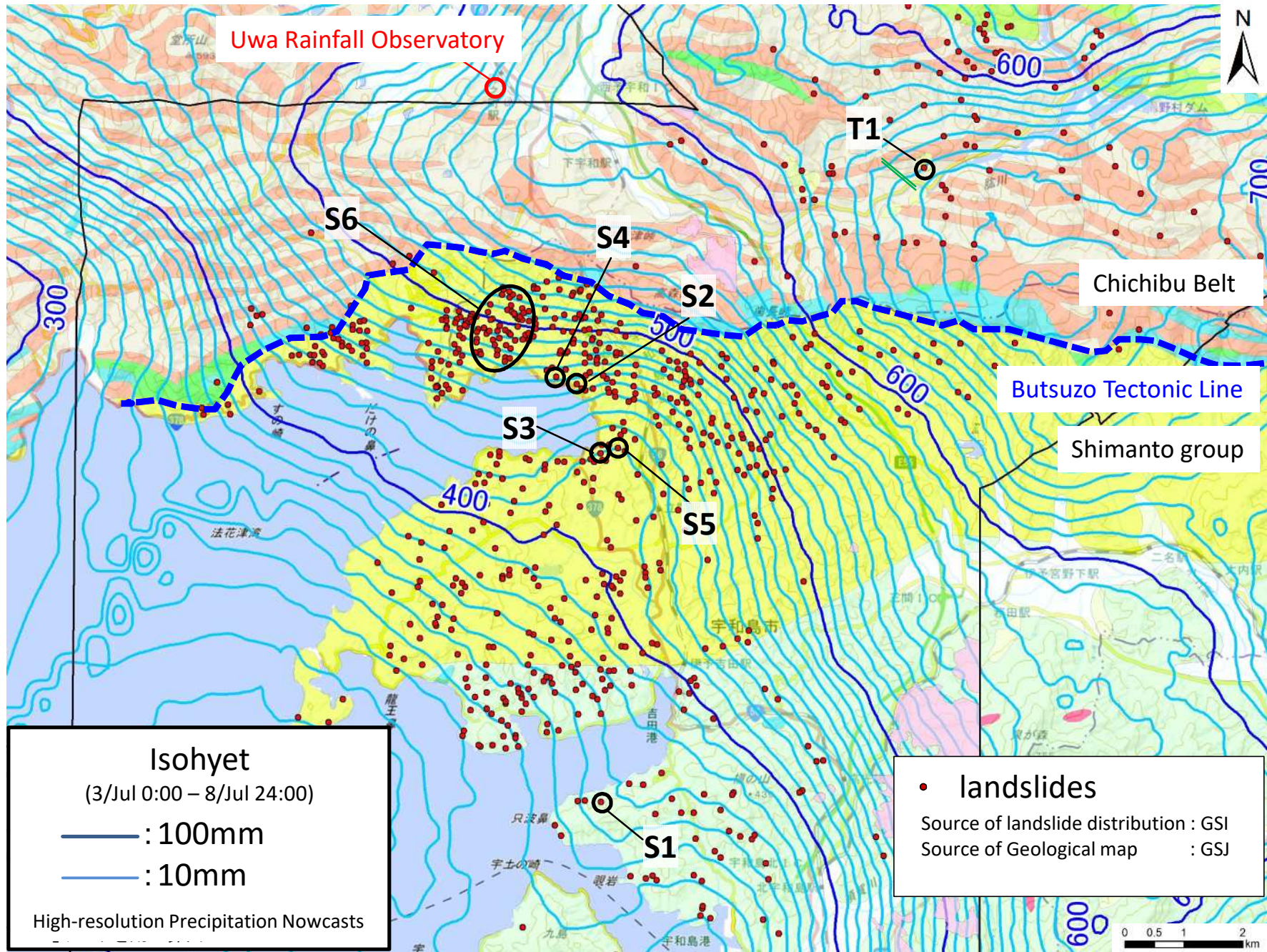
Enlarged view around Suemasa River

On the upstream side of the Suemasa River, the **height of the embankment was low on both the left and right banks (No.1,2)**. These points are the lowest points in the embankment surrounding Takahashi, Oda and Suemasa rivers. The height of the **embankment is also low near Arii Bridge (No.3)**. It is probable that the **overflow started from these points**.

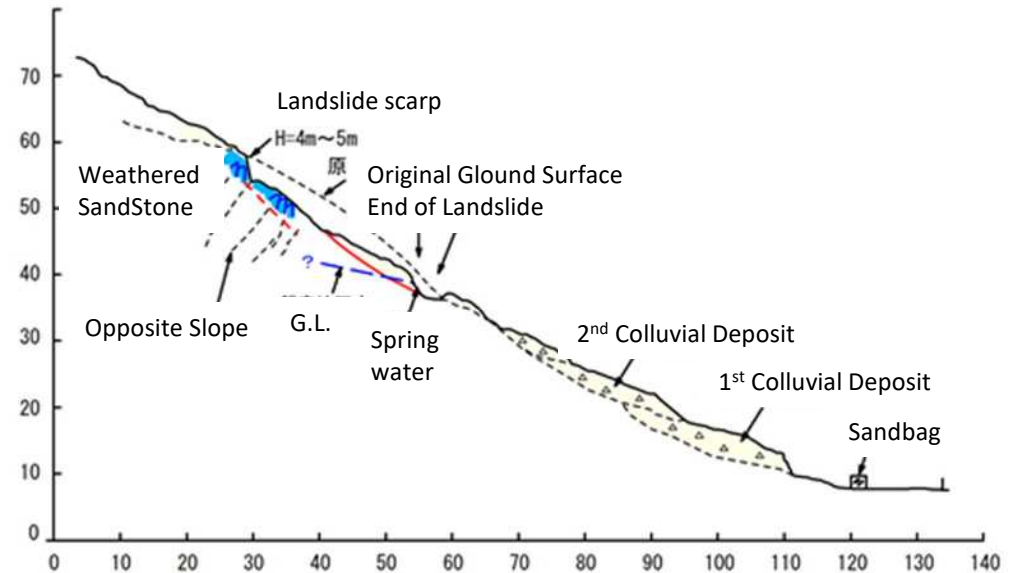
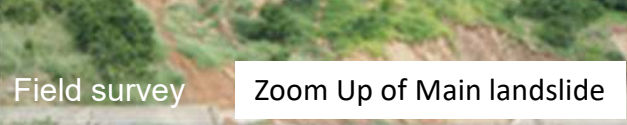
6. Landslide disasters in Ehime Pref.



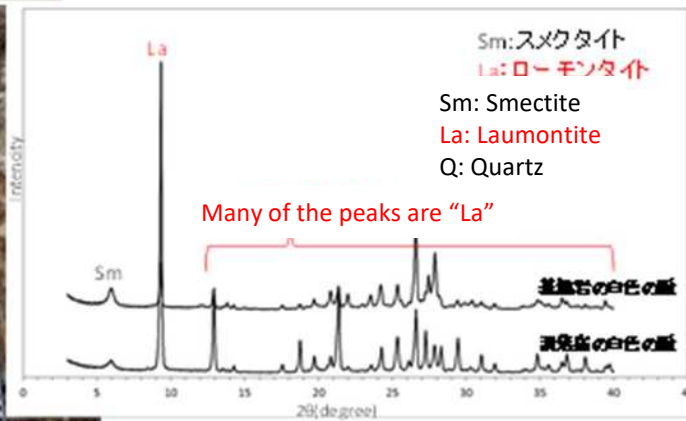
Relationship between distribution of landslides and rainfall



The influence of Laumontite on Landslides



Cross-section of Landslide



Analysis by X-ray diffraction method

Observation of Landslide scarp and colluvial deposit revealed **many white veins in the rocks**. As a result of analysis by X-ray diffraction method these veins, it was found that a lot of **Laumontite** was contained. It is known that the volume change of Laumontite occurs due to dry and wet conditions

7. Return of Our Survey Results to Society



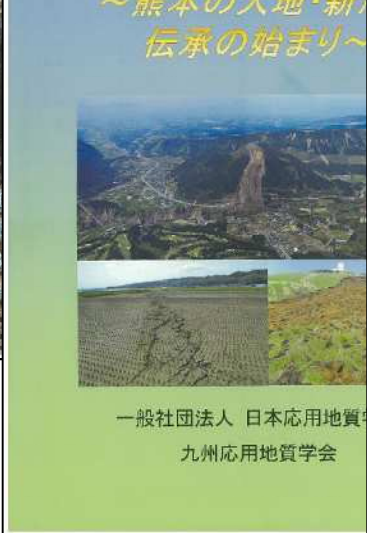


2014 Hiroshima Debris flow Disasters

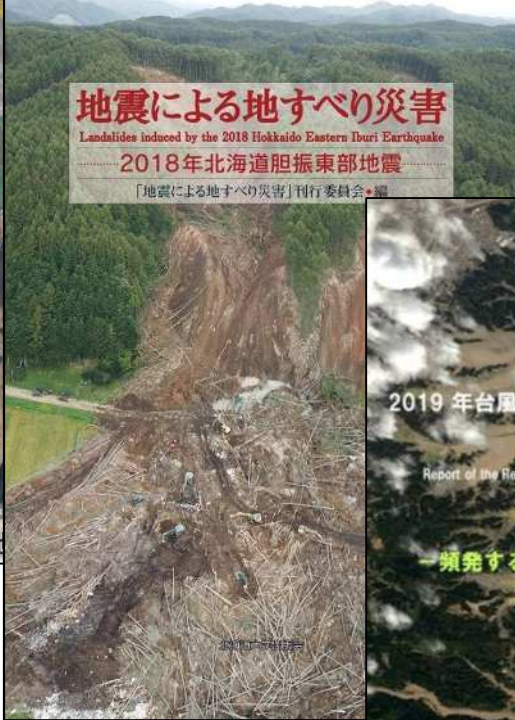
土地の成り立ち
土砂災害から身



2016 Kumamoto-Oita Earthquake Disaster



2017 Northern Kyushu Heavy Rain Disaster



2018 Hokkaido Eastern Iburi Earthquake Disaster



2019 Typhoon No. 19 disaster

8. Efforts to Standardize Research Methods at JSEG

Using the Latest Sensing Technology

Utilizing Accumulated Technologies and Materials



山地	崖線(龍洞渓を含む)	
斜面 (集団移動地形)	沖積堆	
丘陵		
	自然堤防	
	後背低地	
蛇行原	後背湿地	
	流路跡地	
低地		
	谷底堆積低地	



VI-1. 応用地質学から見た豪雨災害減災の提案と課題

Proposals and problems concerning reduction of torrential disaster damage from the standpoint of engineering geology

稲垣 秀輝 (環境地質)

Hideki Inagaki

1. はじめに

近年豪雨災害の頻度が増加し、その規模が大きくなっているようである。今回発生した西日本豪雨は、その広域的な被災状況が注目を浴びた。この機会に、最近20年以降に発生した豪雨災害を概観し、被災に大きく影響する住居の避難行動とその対応の仕方について応用地質学的な観点からまとめた。著者は1998年以降に発生した22の豪雨による災害の調査を実施した(表-1)。その際に現場の住居や被災者から聞き取り調査した内容と日本応用地質学会で実施した災害調査報告会や市民フォーラムの際の参加者へのアンケート調査内容を加えて、豪雨災害の被災・防災アウトプットのあり方を整理して、(稲垣、2018)を出版した。

1998年8月の北関東・南東北豪雨災害では、27日早朝に福島県の社会福祉施設太陽の園構内の救護施設「からまつ荘」において、裏山の表面崩壊で崩れた土砂が流動化して施設内に流れ込んだため、就寝中の5名が亡くなった。また、近くの住宅の裏山が崩れ、1階建ての住居で寝ていた住民2名が死亡した。災害時などの避難のあり方などについては2005年の「避難勧告等の判断・伝達マニュアル作成ガイドライン」¹⁾に災害弱者や通所避難の考え方が明示されたようであるが、1998年当時では、災害弱者施設での豪雨災害に対する防災対策や建物内の重症避難の重要性は一般化していないようである²⁾。

2012年7月の九州北部豪雨災害では、避難勧告が示されたにもかかわらず、40名に達する死者・行方不明者が発生したことは、深夜の悪化を懸念する豪雨で火山灰降面が広い範囲で崩壊し、尾根を超えるような土砂流出が影響したと考えられる。2012年7月九州北部豪雨と同様に火山地域での豪雨による土砂災害の特殊性を示した災害である。現地調査時に大島町長と情報交換するともに、火山地域に住む住民に対して地元説明会を開催し(写真-6)、意見交換を行った。多くの住民には火山地域特有の地盤災害を理解していただき、継続して被災に向けて住民サイドと専門家との現地見学会の開催などを行った。これらのアウトリーチ活動は今後の被災に効果的である。

2. 既往現地調査結果

2.1 1998年-2009年の豪雨土砂災害

1998年から2009年までの間に北関東・南東北豪雨災害、台風7号岐阜県豪雨災害、水俣豪雨災害、中国・九州北部豪雨災害、台風9号佐賀豪雨災害が発生した。

表-1 現地調査した豪雨災害

年次	豪雨災害	調査内容
1998.8	平成10年北関東・南東北豪雨災害	被災地調査
2000.7	平成12年西日本豪雨災害	被災地調査
2001.7	平成13年西日本豪雨災害	被災地調査
2001.8	平成13年西日本豪雨災害	被災地調査
2001.9	平成13年西日本豪雨災害	被災地調査
2001.10	平成13年西日本豪雨災害	被災地調査
2002.7	平成14年九州北部豪雨災害	被災地調査
2003.8	平成15年九州北部豪雨災害	被災地調査
2003.9	平成15年九州北部豪雨災害	被災地調査
2003.10	平成15年九州北部豪雨災害	被災地調査
2004.7	平成16年西日本豪雨災害	被災地調査
2004.8	平成16年西日本豪雨災害	被災地調査
2004.9	平成16年西日本豪雨災害	被災地調査
2004.10	平成16年西日本豪雨災害	被災地調査
2005.7	平成17年西日本豪雨災害	被災地調査
2005.8	平成17年西日本豪雨災害	被災地調査
2005.9	平成17年西日本豪雨災害	被災地調査
2005.10	平成17年西日本豪雨災害	被災地調査
2007.7	平成19年西日本豪雨災害	被災地調査
2007.8	平成19年西日本豪雨災害	被災地調査
2007.9	平成19年西日本豪雨災害	被災地調査
2007.10	平成19年西日本豪雨災害	被災地調査

図-1 現地調査した豪雨災害

図-2 北政地区の崖崩壊 詳細して花寄川

図-3 十津川豪雨災害での川の道と山の道

写真-6 現地で行った災害調査報告会 住民説明会

2014年7月の南日本豪雨災害では、近くに過ぎの土石流が壊れた瓦石に倒れた土石流災害の被害調査があったが、7月の土石流によって1名が亡くなった。

また、2014年8月広島豪雨災害では、多くの斜面崩壊と土石流が発生し、74名の方が亡くなった。図-4には、阿蘇の集落での土石流被災状況を示した。

土石流②の末端で家屋が被災した住民の話では、早朝の当時、道路が流水であふれ溢れ、2階に避難していたが、土石流が家裏に達したと同時に停止した(写真-7)。それは幸運であったが、ちょうど2階にあった梯子を使って隣接する少し高台の家へ避難できた。その後、③の土石流が発生して家出ではなく住居を壊した。

なお、神積内でのc,dの被災は大きく、ここでは、少なくとも2層の古期土砂堆積物が露出して、これは、過去に多くの土石流が神積内でも発生したことを示すと同時に、神積内が土石流が谷を覆って作り出した危険な土地であることを示している。しかし、現地調査をしてもこのことを知る住民は少なかった。

2013年10月の伊豆大島豪雨災害では、連続雨量82mm、時間雨量122.5mmの降雨が深夜にあり、多くの気象情報が発信されていたが、深夜であるこ

Recommendations based on Lessons Learned from Disasters



Detailed Field Survey



Interview with Resident



Japan Society of Engineering Geology (JSEG)

Thank you for your attention

