International Forum
"Japanese contribution to Landslide Disaster Risk Reduction"

Sendai Partnership 2015-2025 for Global Promotion of Understanding and Reducing Landslide Disaster Risk
Science and Technology Research Partnership for Sustainable Development (SATREPS)

24 November 2016, Tokyo, Japan

Organized by
International Consortium on Landslides (ICL) and
Japan Landslide Society (JLS)

Supported by
Japan Science and Technology Agency (JST) and
United Nations Educational, Scientific and Cultural Organization (UNESCO)

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Programme

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Date: 9:00-18:00 on 24 Nov 2016
Venue: 22nd at TKP Tokyo Otemachi Conference Center in the KDD building in Tokyo, Japan (http://www.kashikaigishitsu.net/facilitys/cc-tokyo-otemachi/access/)

Aim of the Conference:

The International Consortium on Landslides (ICL) proposed the “Sendai Partnerships 2015–2025 for global promotion of understanding and reducing landslide disaster risk” in contribution to the Third UN World Conference on Disaster Risk Reduction. The proposal goes into effect by the signature of ICL, Special Representative of Secretary General of the United Nations, UNESCO, Cabinet office and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of the Government of Japan and other 17 organizations in Japan and overseas. This partnership was significantly gained from the implementation of JICA and JST Joint funded SATREPS projects.
At this conference, we will introduce the results of SATREPS project in Croatia (2009-2014) and in Vietnam (2011-2017) , and other SATREPS and JICA projects in Malarysia, Butan and Honduras. Then, we will examine further Japan’s international contribution for the landslide disaster reduction as a part of Sendai Partnerships 2015-2025.
ICL and UNESCO, UNISDR, and other ICL supporting organization will organize the Fifth World Landslide Forum (WLF5) in Kyoto, Japan. This conference is the mid-term milestone of

the Sendai Partnerships 2015-2025 and the first five year milestone of the Sendai Framework for Disaster Risk Reduction 2015-2030. Participants will examine road map of the Sendai partnerships 2015-2025 to WLF5 2020.

Programme of Tokyo Forum

9:00- 9:20	**Opening session** Collaboration Between UNESCO and ICL by Mr. Qunli Han, Director of the Division of Ecological and Earth Sciences of UNESCO Objective of the Forum by Prof. Kyoji Sassa, Executive Director of ICL
JST - JICA International Scientific and Technical Cooperation SATREPS Projects	
9:20-9:40	- Greeting from SATREPS + Prof. Kaoru Takara, Research Supervisor, Disaster Prevention and Mitigation, JST + Mr. Masahiro Ueki, Director, Disaster Risk Reduction Team 1, JICA - Greetings from Mr. Dražen Hrastić, Ambassador of the Republic of Croatia - Greetings from Mr. Bui Viet Khoi, Counsellor, Embassy of S.R. of Vietnam
	1. Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam
9:40-10:00	Achievements of Vietnam-Japan SATREPS Project (2011.11-2017.3) *Prof. Kyoji Sassa (Project Leader, ICL)*
10:00-10:15	Impact of the Project to the Vietnam Society and Output of Mapping Group *Dr. Dinh Van Tien (Project Manager, Vietnam Institute of Transport Science and Technology)*
10:15-10:30	Output of Monitoring Group *Dr. Hirotaka Ochiai, Dr. Shiho Asano*
	2. Risk identification and land-use planning for disaster mitigation of landslides and floods in Croatia
10:30-10:45	Output of Croatia Project *Prof. Hideaki Marui*
10:45-11:00	Report from Croatia Landslide Group *Prof. Zeljko Arbanas (Rijeka University)*
11:00-11:15	Report from Hazard Mapping Group *Prof. Snjezana Mihalic-Arbanas (Zagreb University)*

	3. Research on Disaster Reduction by Landslides and Floods in Malaysia
11:15-11:30	Outline of the Project *Prof. Hiroshi Fukuoka*
	4. Study on GLOFs (Glacial Lake Outburst Floods) in the Bhutan Himalayas
11:30-11:45	Outline of the Project *Prof. Dasuke Higakii*
Another International Landslide Projects	
	5. Research on Landslide Hazard Map in Honduras
11:45-12:00	Report on Hazard Map Training. *Dr. Kiyoharu Hirotao*
	6. UNESCO ENHANS project in Peru, Ecuador and Chile (GIS landslide mapping)
12:00-12:15	Report on training of the hazard mapping *Prof Hiromitsu Yamagishi*
Comment on Future Activities on SATREPS and Landslide Activities	
12:15-12:30	*Giuseppe Arduino* *Division of Water Sciences, International Hydrological Programme (IHP), UNESCO*
12:30-14:00	Working Lunch (UNESCO and other Invited foreign Researchers and officers from Croatia and Vietnam Embassy) in Room 22 C (next door)
Round Table Meeting on Sendai Partnerships	
14:00-14:20	- Greeting from Ministry of Land, Infrastructure, Transport and Tourism of Japan *(Mr. Shinichi Kusano)* - Greeting from Ministry of Education, Culture, Sports, Science and Technology *(Mr. Yamato Tanaka)* - Greeting from Vietnam Institute of GeoSciences and Mineral Resources *(Mr. Le Quoc Hung)*
Introduction of Internationally Acknowledged Techniques and Practices (Private Sectors and Researchers)	
14:20-14:35	World Landslide Forum 4 and Introduction of 8 Japanese Landslide Techniques *Prof. Kyoji Sassa*
14:35–15:35	Private companies working on landslide (technical)
15:35-15:50	Break

15:50-17:40	Panel discussion (Japanese contribution on landslide DRR) Chairs: Prof. Kaoru Takara, Mr. Qunli Han, Prof. Yamagishi
	1. Activities of ICL for implementation of Sendai partnership, increasing signatures; Landslide Dynamics：ISDR-ICL Interactive Teaching Tools; ICL World Reports on Landslides *Prof. Kyoji Sassa* 2. UNESCO’s activities to implement Sendai Parnership *Mr. Qunli Han/Mr. Giuseppe Arduino* 3. Proposal for new joint research between Japan and Viet Nam *Dr. Hung Le Quoc (VIGMR)* 4. Planning on the 5^{th} world landslide forum in Japan in 2020 5. World Bosai Forum in Sendai 2017 by Prof. Ono 6. Prof. Snjezana Mihalic-Arbanas（ICL Adria Balkan Network Coordinator） 7. Free discussion time
17:40-18:00	**Closing：Toward further development of the Japanese contribution to Landslide Disaster Risk Reduction** **Prof. Kaoru Takara, Mr. Qunli Han and Prof. Hiromitsu Yamagishi**

Contact on the Tokyo Forum

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ICL WEB: http://icl.iplhq.org/category/home-icl/

IPL WEB: http://iplhq.org/

国際フォーラム「地すべり災害リスク軽減への日本の貢献」

地すべり災害の理解と軽減のための仙台パートナーシップ 2015-2025 と 地球規模課題対応国際科学技術協力 SATREPS）プログラム

主催：国際斜面災害研究機構、日本地すべり学会
後援：科学技術振興機構、ユネスコ
日時：平成 28 年 11 月 24 日 9:00-18:00
場所：TKP 東京大手町コンファレンスセンター（ＫＤＤＩ大手町ビル 22 階）
目的:ICL グループでは、第 3 回国連防災世界会議への自発的貢献として「地すべり災害リスクの理解と軽減を推進するための仙台パートナーシップ 2015-2025」を提案し、採択された。ICL, ユネスコ、国際防災戦略事務局、内閣府、文部科学省ほか国内外の 17 機関の署名を得て、発効している。このパートナーシップの成立は、地すべりに関する SATREPS プログラムの実施によるところが大きい。今回の会議では、過去の SATREPS プロジェクト、今後のプロジェクト、JICA-JST その他の fund を得た国際地すべり協力プログラム、今後の日本の地すべり災害危険度軽減分野での国際貢献・推進方策を検討する。特に 2020 年 9 月に、新潟市において第5回斜面防災世界フォーラム（WLF5）を実施することが決まっている。
国内外の研究者・アドバイザーとともに仙台パートナーシップの中間年（2020 年）と同年に開催する第5回斜面防災世界フォーラム（WLF5）にむけて、日本において発達してきた地すべり災害予測・軽減技術に基づいて、地すべり災害軽減分野での日本の国際貢献と日本の研究者・研究機関・民間企業と個人の世界展開の推進策についての枠組みを検討する。

プログラム

国際フォーラム「地すべり災害リスク軽減への日本の貢献」	
オープニング・セッション	
9:00- 9:20	国際フォーラム来賓挨拶　UNESCO と ICL の協力 ユネスコ生態学・地球科学部長　Qunli Han 国際フォーラム開会・趣旨説明　仙台パートナーシップと SATREPS プロジェクト 国際斜面災害研究機構理事長・佐々恭二
JST-JICA　地球規模課題対応国際科学技術協力 SATREPS プロジェクト　(スクール形式)	
9:20-9:40	- SATREPS 挨拶 ＋JST　SATREPS 防災領域座長・寶　馨（京都大学防災研究所長） ＋JICA 地球環境部防災第一課長　植木雅浩 - 駐日クロアチア共和国大使館　大使 Dražen Hrastić - 駐日ベトナム社会主義共和国大使館　参事官（科学技術担当）Bui Viet Khoi
1	ベトナムにおける幹線交通網沿いの斜面災害危険度評価技術の開発
9:40-10:00	佐々恭二（プロジェクトリーダー：ICL）：ベトナムプロジェクト 2011.11-2017.3 の成果
10:00-10:15	Dinh van Tien （プロジェクト・マネージャー・地形班リーダー、ベトナム交通科学研究所）： ベトナム側からみたプロジェクトの成果と地形班の成果
10:15-10:30	落合博貴・浅野志穂（計測班リーダー/副リーダー・森林総合研究所）：計測班の成果
2	クロアチア土砂・洪水災害軽減基本計画構築

10:30-10:45	丸井英明(プロジェクトリーダー:新潟大学):クロアチアプロジェクト 2009.3-2014.3 の成果
10:45-11:00	Zeljko Arbanas (地すべりグループリーダー・リエカ大学):地すべり班の成果
11:00-11:15	Snjezana Mihalic-Arbanas(災害危険地図リーダー・ザグレブ大学):災害危険地図班の成果
3	マレーシアにおける地すべり災害および水害による被災低減に関する研究
11:15-11:30	福岡浩(地すべり班:新潟大学):マレーシアプロジェクトにおける地すべり研究
4	ブータンヒマラヤにおける氷河湖決壊洪水(GLOF)に関する研究
11:30-11:45	桧垣大介(不安定斜面班:弘前大学):SATREPS ブータンプロジェクトにおける地すべり研究
その他の国際地すべりプロジェクト	
5	JSPS-JICA ホンジュラス・テグシガルにおける地すべりハザードマップの研究
11:45-12:00	廣田清治(国斜面災害研究機構) :ホンジュラスプロジェクトにおける地すべりハザードマップ指導
6	UNESCO –ENHANS ペルー、エクアドル、チリ—での GIS 地すべりマッピング研修プロジェクト
12:00-12:15	山岸宏光(シン技術コンサルタント):ユネスコプロジェクトによる地すべりマッピング研修
地すべり国際貢献と SATREPS 発展に向けてコメント	
12:15-12:30	Giuseppe Arduino (ユネスコ水科学部生態水文学・水質・水教育課長)
12:30-14:00	昼 食 (レストラン) 海外からの講演者と日本のアドバイザーによる Working Lunch (会議室22C)
地すべり災害リスクの理解と軽減を地球規模で推進するための ISDR-ICL 仙台パートナーシップの推進 2015-2025 (円卓会議形式)	
挨拶 14:00-14:20	国土交通省砂防計画課砂防計画調整官・草野 愼一 文部科学省研究開発局地震・防災研究課防災科学技術推進室長補佐・田中大和 ベトナム天然資源環境省・地質科学鉱物資源研究所(VIGMR)副所長・Hung Le Quoc
日本の地すべり技術の世界展開を推進するための新技術・国際貢献可能な確立された技術・事例紹介—地すべり関連企業・研究者	
14:20-14:35	佐々恭二:第 4 回斜面防災世界フォーラム (2017 年 5 月 29 日~6月 2 日 スロベニア国リュブリアナ市)開催とその Proceeding への日本の地すべり技術紹介 8 社の紹介
	進行役:桧垣大介・新井場公徳
14:35-15:35	(株)マルイ:リングせん断試験機(圓井健敏:代表取締役 、碇祐次)
	奥山ボーリング(株)(林 一成)
	国土防災技術(株) (榎田充哉:取締役・技術本部長):
	五大開発(株)(瀧本圭介、関家史郎):地すべりシミュレーション/地すべり観測システム
	(株)オサシ・テクノス(古島広明部長、田中龍一主任、中平博文課長)
	応用地質株式会社(宮崎良)
	国際航業株式会社塚本哲 (塚本哲・海外本部防災水資源部)
	プロテックエンジニアリング(相澤純一郎):土砂崩れ対応製品の紹介
	その他の日本の技術紹介
	道畑亮一(砂防・地すべり技術センター・斜面保全部課長代理)、比留間雅紀
	斉藤健一(株)シン技術コンサルタント):地すべり・崩壊の新しい写真測量技術
	宇津木 慎司(安藤・間組);3次元地質情報図を利活用した地すべり施工現場への適用
	高山陶子(アジア航測(株))「LIDER 等の DEM 利活用技術」
15:35-15:50	休憩

15:50- 17:40	パネル討論「地すべり災害軽減への日本の貢献」 司会:寶 馨、Qunli Han、山岸宏光
	1. 佐々恭二:仙台パートナーシップ 2015-2025 の推進に向けた ICL の取り組み ● 第4回斜面防災世界フォーラムにおける仙台パートナーシップ(SP)の推進のためのハイレベルパネル討論と強化のための追加署名 ● 地すべり技術の世界標準化と普及に向けた地すべり教材(Landslide Dynamics:ISDR-ICL Interactive Teaching Tools) (テキスト+PPT+PDF)の作成 ● 世界地すべりレポート(WEB: ICL World Reports on Landslides)の構築 2. Qunli Han/Giuseppe Arduino:仙台パートナーシップ 2015-2025 の推進に向けたユネスコの取り組み 3. 仙台パートナーシップの一環としての豪雨時表層すべりの災害軽減に向けた日越共同研究の提案 Hung Le Quoc (VIGMR): ベトナムの地すべりと日越共同研究プロジェクトの提案 4. 第 5 回斜面防災世界フォーラム (2020 年 11 月、京都市)の組織:12年ぶりの日本開催、仙台パートナーシップ 2015-2025 中間年、仙台防災枠組 2015-2030 のレビュー年における日本のプレゼンスの増大に向けた取り組み (会議組織に参画する機関と個人のネットワークの構築) 5. 小野裕一(東北大学災害科学国際研究所・所長補佐)」仙台市における隔年開催の世界防災フォーラムの準備について 6. Snjezana Mihalic-Arbanas(ICL Adria Balkan Network Coordinator): クロアチプロジェクトと外務省主催の「防災分野(斜面災害)における南東欧地域の協力促進に向けたワークショップ」(2010 年 12 月 14-17 日、於:外務省三田共用会議所)を受けて、設立された ICL のアドリア・バルカンネットワーク(スロベニア3機関、クロアチア2機関、セルビア1機関、アルバニア1機関、ボスニア・ヘルツェゴビナ1機関の8機関が加盟)について 7. 会議は円卓会議方式です。討論では、時間の範囲で自由に話してください。 ICL 会議、クロアチア、ベトナム SATREPS プロジェクト研究に参加して(飯塚昌、木村直子、藤田久美子、永井修、Pham Tien、Hendy Setiawan、Nguyen Duc Ha)、参加者からのその他のコメント、「地すべり災害軽減への日本の貢献」、「第 5 回斜面防災世界フォーラム」組織への協力表明など
17:40- 18:00	「地すべり災害軽減への日本の貢献」の増大に向けて 寶 馨、Qunli Han、山岸宏光

Contents

Voluntary commitment to the World Conference on Disaster Risk Reduction
Sendai, Japan, 2015

ISDR-ICL SENDAI PARTNERSHIPS 2015-2025 FOR GLOBAL PROMOTION OF UNDERSTANDING AND REDUCING LANDSLIDE DISASTER RISK

***Tools for Implementing and Monitoring** the Post-2015 Framework for Disaster Risk Reduction and the Sustainable Development Goals*

At the 2nd United Nations World Conference on Disaster Reduction, which was held in Kobe, Japan, on 18-22 January 2005, the International Consortium on Landslides (ICL) co-organized a session which resulted in a global partnership and platform taking a holistic approach to research and learning on 'Integrated Earth system risk analysis and sustainable disaster management'. This partnership was forged through a "Letter of Intent", that was signed by UNESCO, UNISDR, WMO, FAO, UNU, ICSU, and WFEO. It further led to the adoption and implementation of the 2006 Tokyo Action Plan, thus creating a global partnership on Landslides, i.e., the current International Programme on Landslides (IPL) of ICL.

At the 3rd World Conference on Disaster Risk Reduction (WCDRR), which was convened by the United Nations and hosted by Japan in Sendai from 14 to 18 March 2015, the ICL and its IPL contributed further to the UN International Strategy for Disaster Reduction (ISDR) and co-organized the Working Session "Underlying Risk Factors" together with UNESCO, the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and other pertinent organizations.

At the Working Session, the causes that create risk and their cumulative effects, as well as the relevant achievements of the Hyogo Framework for Action 2005-2015, were reviewed. Steps to address the principal drivers of vulnerability and exposure and to support hazard and risk assessment were suggested. In addition, the participating scientific and academic institutions and governmental and non-governmental organizations proposed that the ***Sendai Partnerships 2015-2025 for Global Promotion of Understanding and Reducing Landslide Disaster Risk*** be established. This sound global platform will be mobilized in the coming decade to pursue prevention, to provide practical solutions, education, communication, and public outreach to reduce landslide disaster risk. These Partnerships will engage all significant stakeholders concerned with the challenge of understanding and reducing disaster risk, including relevant international, national, local, governmental, and non-governmental institutions, programmes and initiatives. The Partnerships will focus on delivering tangible and practical results that are directly related to the implementation of the goals and targets of the post-2015 Framework for Disaster Risk Reduction.

The ***Sendai Partnerships 2015-2025 for Global Promotion of Understanding and Reducing Landslide Disaster Risk*** are hereby established. They represent **Tools for Implementing and Monitoring** the Post-2015 Framework for Disaster Risk Reduction and the Sustainable Development Goals.

Partners in the "Partnerships" adopt the following Resolution:

We acknowledge that:

- ✓ Landslide disasters are caused by exposure to hazardous motions of soil and rock that threaten vulnerable human settlements in mountains, cities, coasts, and islands.

- ✓ Climate change will intensify the risk of landslides in some landslide prone areas through an increase in the frequency and/or magnitude of heavy rainfall, and shifts in the location and periodicity of heavy rainfall.
- ✓ Developments in mountains and coastal areas, including construction of roads and railways and expansion of urban areas due to population shifts, increase exposure to hazards of landslides.
- ✓ Although they are not frequent, strong earthquakes have potential to trigger rapid and long runout landslides and liquefaction. Earthquake-induced coastal or submarine large-scale landslides or megaslides (with depths on the order of hundreds of meters to one thousand meters) in the ocean floor can trigger large tsunami waves. These hazardous motions of soil and water impacting on exposed and vulnerable population can result into very damaging effects.
- ✓ The combined effects of triggering factors, including rainfall, earthquakes, and volcanic eruptions, can lead to greater impacts through disastrous landslides such as lahars, debris flows, rock falls, and megaslides.
- ✓ Understanding landslide disaster risk requires a multi-hazard approach and a focus on social and institutional vulnerability. The study of social and institutional as well as physical vulnerability is needed to assess the extent and magnitude of landslide disasters and to guide formulation of effective policy responses.
- ✓ Human intervention can make a greater impact on exposure and vulnerability through, among other factors, land use and urban planning, building codes, risk assessments, early warning systems, legal and policy development, integrated research, insurance, and, above all, substantive educational and awareness-raising efforts by relevant stakeholders.
- ✓ The understanding of landslide disaster risk, including risk identification, vulnerability assessment, time prediction, and disaster assessment, using the most up-to-date and advanced knowledge, is a challenging task. The effectiveness of landslide disaster risk reduction measures depends on scientific and technological developments for understanding disaster risk (natural hazards or events and social vulnerability), political "buy-in", and on increased public awareness and education.
- ✓ At a higher level, social and financial investment is vital for understanding and reducing landslide disaster risk, in particular social and institutional vulnerability through coordination of policies, planning, research, capacity development, and the production of publications and tools that are accessible, available free of charge and are easy to use for everyone in both developing and developed countries.

We agree on the following initial fields of cooperation in research and capacity building, coupled with social and financial investment:

- ✓ Development of people-centered early warning technology for landslides with increased precision and reliable prediction both in time and location, especially in a changing climate context.
- ✓ Development of hazard and vulnerability mapping, vulnerability and risk assessment with increased precision, and reliability as part of multi-hazard risk identification and management.
- ✓ Development of improved technologies for monitoring, testing, analyzing, simulating, and effective early warning for landslides.
- ✓ Development of international teaching tools that are always updated and may be used free of charge by national and local leaders and practitioners, in developed and developing countries through the Sendai Partnerships 2015-2025.
- ✓ Open communication with society through integrated research, capacity building, knowledge transfer, awareness-raising, training, and educational activities to enable societies to develop effective policies and strategies for reducing landslide disaster risk, to strengthen their capacities for preventing hazards to develop into major disasters,

and to enhance the effectiveness and efficiency of relief programs.

- ✓ Development of new initiatives to study research frontiers in understanding landslide disaster risk, such as the effect of climate change on large-scale landslides and debris flows, the effective prediction of localized rainfall to provide earlier warning and evacuation especially in developing countries, the mechanism and dynamics of submarine landslides during earthquakes that may cause or enhance tsunamis, and geotechnical studies of catastrophic megaslides for prediction and hazard assessment.

We further agree to advocate that activities should be balanced at regional, national, and community levels in order to empower and engage more professionals, practitioners and decision-makers in formulating policies and establishing programmes for the benefit of disaster risk reduction efforts.

We further agree that progress made in the contribution of the ***Sendai Partnerships 2015-2025 for Global Promotion of Understanding and Reducing Landslide Disaster Risk*** toward the implementation of the Post-2015 Framework for Disaster Risk Reduction will be reported and emerging challenges will be discussed every two years at the Global Platform for Disaster Risk Reduction in Geneva.

A Call for joining the Partnerships

Competent global, regional, national, and local institutions participating in the 3rd WCDRR and in the implementation of the Post-2015 Framework for Disaster Risk Reduction are invited to support this initiative by joining and signing these Partnerships through participation in clearly defined projects related to the issues and objectives of these Partnerships. The potential partners are requested to be in contact with the secretariat of the host organization.

Host Organization and Secretariat

The International Consortium on Landslides (ICL) hosts the Sendai Partnerships 2015-2025 as a voluntary commitment to the United Nations World Conference on Disaster Risk Reduction, Sendai, Japan. The ICL Secretariat in Kyoto, Japan, serves as the Secretariat of the Sendai Partnerships.

Signatories:

Mr. Kyoji Sassa
Executive Director
International Consortium on Landslides
Host organization of the Partnerships

16/03/15

Date

Ms. Margareta Wahlström
Special Representative of the UN Secretary-General for Disaster Risk Reduction
Chief of UNISDR

16 March 2015 in Sendai

Date

Mr. Qunli Han
Director
Division of Ecological and Earth Sciences
United Nations Educational, Scientific and Cultural Organization

16 March 2015
Date

Mr. Dominique Burgeon
Resilience Coordinator, Director
Emergency and Rehabilitation Division
Food and Agriculture Organization of the United Nations

16 March 2015
Date

Mr. Kazuhiko Takeuchi
Senior Vice-Rector
United Nations University

16 March 2015
Date

Mr. Petteri Taalas
Secretary-General
World Meteorological Organization

15.4.16
Date

Mr. Gordon McBean
President
International Council for Science

16/03/2015
Date

Mr. Toshimitsu Komatsu
Vice President
World Federation of Engineering Organizations

March 16, 2015
Date

Mr. Roland Oberhänsli
President
International Union of Geological Sciences

16/03/2015
Date

Mr. Alik Ismail-Zadeh
Secretary-General
International Union of Geodesy and Geophysics

16 MARCH 2015, SENDAI, JAPAN
Date

Mr. Kaoru Saito
Director
Disaster Preparedness and
International Cooperation Division
Disaster Management Bureau
Cabinet Office, Government of Japan

16/03/2015
Date

Mr. Hideaki Maruyama
Director
Office for Disaster Reduction Research
Minstry of Education, Culture, Sports,
Science and Technology, Japan

16. 03. 2015.
Date

Mr. Takashi Onishi
President
Science Council of Japan

March 16, 2015
Date

Ms.Kayo Inaba
Executive Vice President for Gender
Equality, International Affairs, and
Public Relations
Kyoto University

16. 03. 15
Date

Mr. Prefetto Franco Gabrielli
Head
National Civil Protection Department
Italian Presidency of the Council of
Ministers
Government of Italy

16. 03. 2015
Date

Mr. Jadran Perinic
Director General
National Protection and Rescue Directorate
Republic of Croatia

16.03.2015.
Date

Mr. Walter Ammann
President/CEO
Global Risk Forum GRF Davos

16 March 2015
Date

ANNEX to the ISDR-ICL SENDAI PARTNERSHIPS 2015-2025

ICL member organizations (as of 10 November 2016)

1. Albanian Geological Survey, ALBANIA
2. The Geotechnical Society of Bosnia and Herzegovina, BOSNIA AND HERZEGOVINA
3. Geological Survey of Canada, CANADA
4. China Geological Survey, CHINA P.R.
5. Institute of Cold Regions Science and Engineering, Northeast Forestry University, CHINA P.R.
6. Institute of Mountain Hazards and Environment, Chinese Academy of Sciences, CHINA P.R.
7. Bureau of Land and Resources of Xi'an, China P.R.
8. Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, CHINA P.R.
9. Tongji University, College of Surveying and Geo-Informatics, CHINA P.R.
10. Universidad Nacional de Colombia, Colombia
11. Croatian Landslide Group from University of Rijeka and University of Zagreb, CROATIA
12. City of Zagreb, Emergency Management Office, CROATIA
13. Charles University, Faculty of Science, CZECH REPUBLIC
14. Institute of Rock Structure and Mechanics, Czech Academy of Sciences, Department of Engineering Geology, CZECH REPUBLIC
15. Joint Research Centre (JRC), EUROPEAN COMMISSION
16. Cairo University, EGYPT
17. Technische Universitat Darmstadt, Institute and Laboratory of Geotechnics, GERMANY
18. Department of Geology of National Environmental Agency of Georgia, GEORGIA
19. Universidad Politécnica de Ingeniería, UPI, HONDURAS
20. Instituto Hondureño de Ciencias de la Tierra, IHCIT /Universidad Nacional Autónoma de Honduras UNAH, HONDURAS
21. National Institute of Disaster Management, New Delhi, INDIA
22. Amrita Vishwa Vidyapeetham, Amrita University, Tamilnadu, INDIA
23. Gadjah Mada University, INDONESIA
24. Parahyangan Catholic University, INDONESIA
25. Research Center for Geotechnology-Indonesian Institute of Sciences, INDONESIA
26. Building & Housing Research Center, IRAN
27. Soil Conservation and Watershed Management Research Institute, IRAN
28. University of Firenze, Earth Sciences Department, ITALY
29. ISPRA-Italian Institute form Environmental Protection and Research, ITALY
30. University of Calabria, Laboratory of Environmental Cartography and Hydraulic and Geological Modeling, ITALY

31. Istituto di Ricerca per la Protezione Idrogeologica (IRPI), of the Italian National Research Council (CNR), ITALY
32. Kyoto University, Disaster Prevention Research Institute, JAPAN
33. University of Tokyo, Geotechnical Engineering Group, JAPAN
34. Niigata University, Research Institute for Natural Hazards and Disaster Recovery, JAPAN
35. Forestry and Forest Product Research Institute, JAPAN
36. Japan Landslide Society, JAPAN
37. Korea Institute of Geoscience and Mineral Resources (KIGAM), REPUBLIC OF KOREA
38. Korea Forest Research Institute, REPUBLIC OF KOREA
39. Korea Infrastructure Safety & Technology Corporation, REPUBLIC OF KOREA
40. Korea Institute of Construction Technology, REPUBLIC OF KOREA
41. Korean Society of Forest Engineering, REPUBLIC OF KOREA
42. Slope Engineering Branch, Public Works Department of Malaysia, MALAYSIA
43. Institute of Geography, UNAM, MEXICO
44. International Centre for Integrated Mountain Development (ICIMOD), NEPAL
45. Department of Geology, University of Nigeria, Nsukka, NIGERIA
46. Norwegian Geotechnical Institute (NGI), Oslo, NORWAY
47. Grudec Ayar, PERU
48. Department of Engineering and Ecological Geology, Moscow State University, RUSSIA
49. JSC "Hydroproject Institute", RUSSIA
50. University of Belgrade, Faculty of Mining and Geology, SERBIA
51. Comenius University, Faculty of Natural Sciences, Department of Engineering Geology, SLOVAKIA
52. University of Ljubljana, Faculty of Civil and Geodetic Engineering (ULFGG), SLOVENIA
53. Geological Survey of Slovenia, SLOVENIA
54. University of Ljubljana, Faculty of Natural Sciences and Engineering (UL NTF) , SLOVENIA
55. Central Engineering Consultancy Bureau (CECB), SRI LANKA
56. National Building Research Organization, SRI LANKA
57. Landslide group in National Central University from Graduate Institute of Applied Geology, Department of Civil Engineering, Center for Environmental Studies, CHINESE TAIPEI
58. National Taiwan University, Department of Civil Engineering, CHINESE TAIPEI
59. Ministry of Agriculture and Cooperatives, Land Development Department, THAILAND
60. Asian Disaster Preparedness Center, THAILAND
61. Institute of Telecommunication and Global Information Space, UKRAINE
62. California State University, Fullerton, USA & Tribhuvan University, Institute of Engineering, Nepal, USA/NEPAL

63. Institute of Transport Science and Technology, Ministry of Transport, VIET NAM
64. Vietnam Institute of Geosciences and Mineral Resources, Ministry of Natural Resources and Environment, VIET NAM

地すべり災害リスクの理解と軽減を地球規模で推進するための
国際防災戦略(ISDR) – 国際斜面災害研究機構(ICL) 仙台パートナーシップ 2015 - 2025

ポスト 2015 年防災枠組みと持続可能な開発目標の実施と進行管理のためのツール

2005 年 1 月 18 日～22 日にかけて神戸市で開催された第 2 回国連防災世界会議において国際斜面災害研究機構（ICL）はセッションを共催し、「統合地球システムの危険度解析と持続可能な災害管理」の研究と学習への総括的アプローチを行うための地球規模のパートナーシップとプラットフォームを構築した。このパートナーシップは、国連教育科学文化機関(UNESCO)、国連国際防災戦略事務局(UN-ISDR)、世界気象機関(WMO)、国連食糧農業機関(FAO)、国連大学(UNU)、国際科学会議(ICSU)、世界工学団体連盟(WFEO)らと同意書を交換することにより成立した。これはさらに 2006 年に「東京行動計画」を採択、実施することを通じて地すべりに関する地球規模のパートナーシップを構築することにつながった。これがすなわち、ICL が現在実施している国際斜面災害研究計画(IPL)である。

国連が主催し日本政府がホストして 2015 年 3 月 14 日から 18 日まで仙台で開催された第 3 回国連防災世界会議において、ICL と、そのプログラムである IPL は、ワーキングセッション「潜在的なリスク要因」をユネスコ、国土交通省、および他の該当する機関と共催し、さらに国際防災戦略に貢献した。

このワーキングセッションにおいては、兵庫行動枠組み 2005-2015 に関連する成果についてレビューを行うとともに、災害リスクの原因とそこから派生する様々な影響について検討を行った。脆弱性と危険への露出をもたらす主な要因を概観し、災害を引き起こす自然現象とその危険度評価を推進するための道程を提案した。また、ここに参加した科学・学術機関、政府・非政府機関らが、
「地すべり災害の理解と軽減を地球規模で推進するための国際防災戦略(ISDR) – 国際斜面災害研究機構(ICL) 仙台パートナーシップ 2015 - 2025」
を設立すべきという提案を行った。ここで提案されたしっかりとした地球規模のプラットフォーム(仙台パートナーシップ)は、来る 10 年間にわたり、災害予防を追求し、地すべり防災のための実務的な解決策を提供するとともに、防災教育・情報提供・公共へのアウトリーチに活用されることとなる。このパートナーシップは、災害リスクの理解と軽減に関心を持つすべての主要な関係者、すなわち、国際・各国・地方の政府機関及び非政府機関、各種プログラム・イニシアチブ、の参画を求めるものとなるであろう。このパートナーシップはポスト 2015 年防災枠組みの目的と目標の実施に直接寄与するような確実かつ実務的な成果をもたらすことに焦点を当てる。

「地すべり災害リスクの理解と軽減を地球規模で推進するための仙台パートナーシップ 2015 – 2025」
を、ここに設立する。このパートナーシップは、ポスト 2015 年防災枠組みと持続可能な開発目標の実施と進行管理のためのツールとならんとするものである。

パートナーシップに参加する各パートナーは以下の決議を採択する。

我々は下記の各項目を認識している：

- ✓ 地すべり災害は、山地、都市域、沿岸域、島嶼部に存在する脆弱な居住地が、土と水の危険な変動にさらされることにより引き起こされる。
- ✓ 気候変動は、地すべりが発生しうる地域において、豪雨の頻度あるいは／及び規模の増大、発生場所、期間の変動によって、地すべりの危険性を増大させる。
- ✓ 山地と沿岸域における開発、それは道路や鉄道の建設によってもたらされるものもあり、そして、人口移動に伴う都市域の拡大は、地すべりへの露出を増大させている。
- ✓ 頻繁ではないものの、大地震は危険な高速長距離運動地すべりや液状化を引き起こすことがある。地震が誘発する沿岸域や海面下の大規模地すべり、そして海底巨大地すべり（数百ｍから千ｍの深さのあるもの）は巨大な津波を引き起こす可能性がある。このような危険な土塊や水塊の衝撃が、脆弱な人々を直撃した場合には、大変壊滅的な被害をもたらしかねない。
- ✓ 降雨、地震および火山噴火等の複数の誘因が同時に作用する場合には、ラハール（火山泥流）、土石流、落石、巨大地すべりなどの壊滅的地すべりが発生し、より大規模な衝撃を与えかねない。
- ✓ 地すべり災害の理解のためには、複合災害の観点と社会的・制度的な脆弱性に注目することが必要である。地すべり災害の規模を事前にアセスし、効果的な対応策を立案するには、社会的・制度的そして物理的な脆弱性についての研究が必要となる。
- ✓ 土地利用、都市計画、建築基準、リスクアセスメント、早期警戒システム、防災法制度や政策の立案、統合的研究、保険、そして何より実際的な教育と関係機関による意識向上の努力などの人間の諸活動により、危険な自然現象にさらされる可能性や脆弱性を大きく変化させることができる。
- ✓ 最新かつ先進的な知識を用いて、リスクの洗い出し、脆弱性の評価、発災時期の予測や被害の評価を含む災害危険度を理解することは、挑戦的な課題である。災害対策の有効性は災害リスク（危険な自然現象あるいは出来事と社会的脆弱性）の理解のための科学技術開発、政治的な関与、そして市民の防災意識と知識に依存する。
- ✓ 災害リスクの理解と軽減、特に社会的・制度的脆弱性を軽減するためには、高いレベルの社会的投資、財政投資が不可欠であり、政策・計画・研究・能力開発、そして途上国、先進国の誰もが無料でかつ容易に利用することができる出版物とツールの作成を統合的に組み合わせて実施することが必要である。

我々は以下の社会的・財政的投資を伴う研究と能力開発に関する初期の協力分野について合意した。

- ✓ 地すべりに関して発災時期、発災場所の両面でより高い精度と信頼性を持った、人間を中心においた早期警報技術を、気候変動下にあることに特に留意しつつ開発すること。
- ✓ 複数種の災害の特定と災害対策の一環として、より高い精度と信頼性をもつ、危険な自然現象の及ぶ範囲と脆弱性を示す地図の作成および脆弱性・危険度評価技術を開発すること。
- ✓ 災害の監視・試験・解析・シミュレーション及び有効な早期警戒のためのより良い技術の開発。
- ✓ 仙台パートナーシップ 2015-2025 の活動として、途上国、先進国における国や地方の指導者、実務家が無料で利用でき、かつ常に更新される国際的教材を開発すること。
- ✓ 地すべりのリスクを軽減するため有効な政策と戦略の開発を可能とし、危険な自然現象が大災害に直結することを防ぐ能力を強化し、災害復旧プログラムを拡大することを可能とするため、統合的研究、能力開発、知識の伝達、意識向上、訓練と教育活動を通じて、社会に対し開かれた対話を行

うこと。

- ✓ 地すべり災害危険度の理解のために、たとえば気候変動が大規模地すべり・土石流に与える影響、特に途上国における早期警戒と避難を実現するための局地的豪雨に対する有効な予知の方法、津波を引き起こしたり巨大化させたりする地震時海底地すべりの発生機構と動力学、 壊滅的災害を引き起こす巨大地すべりの予知と災害予測のための地盤工学的研究、といった先端的研究を推進するための新たなイニシアチブを開発すること。

我々はさらに、これらの活動を地域レベル、国家レベル、コミュニティレベルでバランス良く実施し、より多くの専門家、実務家、意思決定権者のそれぞれにとって有益な政策の決定、プログラムの創設を推進することを提唱することに合意した。

我々はさらに、2 年毎にジュネーブで開催される防災グローバルプラットフォームにおいて、「**地すべり災害の理解と軽減を地球規模で推進するための仙台パートナーシップ 2015 – 2025**」によるポスト 2015 防災枠組みへの貢献の進捗状況が報告され、今後現れるであろう種々の課題が議論されることについて合意した。

本パートナーシップへの参加の呼びかけ

第 3 回 WCDRR に参加し、ポスト 2015 防災枠組みの実施に寄与する地球規模、地域規模、国家、地方レベルの能力のある諸機関は、本パートナーシップに参加・署名し、本パートナーシップに明瞭に定義された課題と目的に関連したプロジェクトへ参加し、このイニシアチブを支持することに招待されている。潜在的パートナーは、本パートナーシップのホスト機関にコンタクトされたい。

ホスト機関と事務局

国際斜面災害研究機構（ICL)が、国連世界防災会議（仙台、日本）に対する自発的貢献である仙台パートナーシップ 2015-2025 のホスト機関である。日本の京都に置かれている ICL 事務局が仙台パートナーシップの事務局を務める

署名:

Kyoji Sassa

佐々恭二
理事長
国際斜面災害研究機構
仙台パートナーシップ主催機関

16/03/15
日付

Margareta Wahlström

Ms. Margareta Wahlström
国連事務総長特別代表（防災担当）
国連国際防災戦略事務局

16 March 2015 in Sendai
日付

Mr. Qunli Han
部長
生態学地球科学部
国連教育科学文化機関

16 March 2015
日付

Mr. Dominique Burgeon
緊急・復興支援部長
国連食糧農業機関

16 March 2015
日付

武内和彦
上級副学長
国際連合大学

16 March 2015
日付

Mr. Petteri Taalas
事務局長
世界気象機関

15.4.16
日付

Mr. Gordon McBean
会長
国際科学会議
16/03/2015
日付

Yoshimitsu Komatsu
小松利光
副会長
世界工学団体連盟
March 16, 2015
日付

Mr. Roland Oberhänsli
会長
国際地質科学連合

16/03/2015
日付

A.Ismail-Zadeh
Mr. Alik Ismail-Zadeh
事務局長
国際測地学地球物理学連合

16 MARCH 2015, SENDAI, JAPAN
日付

齊藤　馨
内閣府政策統括官（防災担当）付参事官
（普及啓発・連携担当）

16/03/2015
日付

丸山秀明
室長
防災科学技術推進室
文部科学省

16.03.2015.
日付

大西　隆
会長
日本学術会議

March 16, 2015
日付

稲葉カヨ
副学長
男女共同参画・国際・広報担当
京都大学

16.03.15
日付

Mr. Prefetto Franco Gabrielli
イタリア国家市民保護局長

16.03.2015
日付

Mr. Jadran Perini
クロアチア国家保護救済局長

16.03.2015.
日付

Mr. Walter Ammann
創設者
グローバル・リスク・フォーラム（GRF）ダボス
16 March 2015
日付

ISDR-ICL 仙台パートナーシップ 2015-2025　アネックス

	国　名	機　　　関　　　名

1	アルバニア	アルバニア地質調査所 Albanian Geological Survey
2	ボスニアヘルツェゴビナ	ボスニアヘルツェゴビナ地盤工学会 The Geotechnical Society of Bosnia and Herzegovina
3	カナダ	カナダ地質調査所 Geological Survey of Canada
4	中国	中国地質調査所 China Geological Survey
5	中国	中国東北林業大学 Northeast Forestry University
6	中国	中国科学院山地災害環境研究所 Institute of Mountain Hazards and Environment, Chinese Academy of Sciences
7	中国	中国西安市国土資源局 Bureau of Land and Resources of Xi'an
8	中国	中国科学院南京地理湖沼学研究所 Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences
9	中国	同済大学調査・地球情報カレッジ Tongji University
10	コロンビア	コロンビア国立大学 Universidad Nacional de Colombia
11	クロアチア	クロアチア地すべりグループ：リエカ大学・ザグレブ大学 Croatian Landslide Group from Faculty of Civil Engineering University of Rijeka and Faculty of Mining, Geology and Petroleum University of Zagreb
12	クロアチア	クロアチア国ザグレブ市緊急事態管理局 City of Zagreb, Emergency management office
13	チェコ	チェコ国チャールズ大学理学部 Charles University, Faculty of Science
14	チェコ	チェコ科学院岩盤構造研究所 Institute of Rock Structure and Mechanics Academy of Sciences of the Czech Republic
15	欧州委員会	欧州委員会共同研究センター Joint Research Centre (JRC), European Commission
16	エジプト	エジプト国、カイロ大学 Cairo University
17	ドイツ	独ダルムシュタット工科大学・地盤工学研究センター Technische Universitat Darmstadt, Institute and Laboratory of Geotechnics
18	グルジア	グルジア環境庁地質局 Department of Geology of National Environmental Agency of Georgia

19	ホンジュラス	ホンジュラス工科大学 Universidad Politécnica de Ingeniería, UPI
20	ホンジュラス	ホンジュラス国立自治大学地球科学研究所 Instituto Hondureño de Ciencias de la Tierra, IHCIT /Universidad Nacional Autónoma de Honduras UNAH, HONDURAS
21	インド	インド国立災害管理研究所 National Institute of Disaster Management, New Delhi
22	インド	アムリタ大学 Amrita University, Tamilnadu
23	インドネシア	インドネシア国ガジャマダ大学 Gadjah Mada University
24	インドネシア	インドネシア国パラヒャガンカトリック大学 Parahyangan Catholic University
25	インドネシア	インドネシア科学院地盤工学研究センター Research Center for Geotechnology-Indonesian Institute of Sciences
26	イラン	イラン建築住宅研究センター Building & Housing Research Center
27	イラン	イラン土壌保全・流域管理研究所 Soil Conservation and Watershed Management Research Institute
28	イタリア	イタリア国フローレンス大学応用地質学科 University of Firenze, Earth Sciences Department
29	イタリア	イタリア環境保護研究所 ISPRA-Italian Institute for Environmental Protection and Research
30	イタリア	イタリア国カラブリア大学 UNIVERSITY OF CALABRIA, DIMES (Dipartimento di Ingegneria Informatica, Modellistica, Elettronica e Sistemistica) , CAMILAB (Laboratory of Environmental Cartography and Hydraulic and Geological Modeling)
31	イタリア	イタリア科学院水文地質保全研究所 Istituto di Ricerca per la Protezione Idrogeologica (IRPI),of the Italian National Research Council (CNR)
32	日本	京都大学防災研究所 Kyoto University, Disaster Prevention Research Institute
33	日本	東京大学(生産技術研究所，地盤工学研究グループ) University of Tokyo, Institute of Industrial Science and Geotechnical Research Group
34	日本	新潟大学災害復興科学研究所 Niigata University, Research Institute for Natural Hazards and Disaster Recovery
35	日本	森林総合研究所

		Forestry and Forest Product Research Institute
36	日本	日本地すべり学会 Japan Landslide Society
37	韓国	韓国地質科学及び資源研究所 Korea Institute of Geoscience and Mineral Resources (KIGAM)
38	韓国	韓国森林工学学会 Korean Society of Forest Engineering
39	韓国	韓国森林研究所 Korea Forest Research Institute
40	韓国	韓国社会基盤安全技術公団 Korea Infrastructure Safety & Technology Corporation
41	韓国	韓国建設技術研究所 Korea Institute of Construction Technology
42	マレーシア	マレーシア公共事業省斜面部 Slope Engineering Branch, Public Works Department of Malaysia
43	メキシコ	メキシコ国立自治大学地理学研究所 Institute of Geography, UNAM
44	ネパール	ネパール国際山地統合開発センター International Centre for Integrated Mountain Development (ICIMOD)
45	ナイジェリア	ナイジェリア大学理学部地質学科 Department of Geology, Faculty of Science, University of Nigeria,
46	ノルウェー	ノルウェー地盤工学研究所 Norwegian Geotechnical Institute (NGI)
47	ペルー	ペルー国クスコ市環境・斜面保全ＮＰＯ Grudec Ayar
48	ロシア	ロシア国モスクワ大学地質学部 Department of Engineering and Ecological Geology, Geological Faculty, Moscow State University
49	ロシア	ロシア水関連プロジェクト研究所 JSC "Hydroproject Institute"
50	セルビア	セルビア国ベオグラード大学鉱山地質学部 University of Belgrade, Faculty of Mining and Geology
51	スロバキア	スロバキア国コメニウス大学理学部 Comenius University, Faculty of Natural Sciences, Department of Engineering Geology
52	スロベニア	スロベニア国リュブリアナ大学土木及び測地工学部 University of Ljubljana, Faculty of Civil and Geodetic Engineering (ULFGG)
53	スロベニア	スロベニア地質調査所

		Geological Survey of Slovenia
54	スロベニア	スロベニア国リュブリアナ大学自然科学及び工学部 University of Ljubljana, Faculty of Natural Sciences and Engineering (UL NTF) , SLOVENIA
55	スリランカ	スリランカ中央行程勘察局 Central Engineering Consultancy Bureau (CECB)
56	スリランカ	スリランカ国立建築研究機構 National Building Research Organization
57	台湾，中国	国立台湾大学 National Taiwan University, Department of Civil Engineering
58	台湾，中国	国立中央大学 Landslide group in National Central University from Graduate Institute of Applied Geology, Department of Civil Engineering, Center for Environmental Studies
59	タイ	タイ国農業協同省・土地開発局 Ministry of Agriculture and Cooperatives, Land Development Department
60	タイ	タイ国アジア災害予防センター Asian Disaster Preparedness Center(ADPC)
61	ウクライナ	ウクライナ通信・地球規模情報研究所 Institute of Telecommunication and Global Information Space
62	USA、ネパール	米国カリフォルニア州立大学フラートン校、ネパール国トリバン大学工学研究所 California State University, Fullerton, USA & Tribhuvan University, Institute of Engineering
63	ベトナム	ベトナム交通科学技術研究所 Institute of Transport Science and Technology
64	ベトナム	ベトナム天然資源環境省地球科学鉱物資源研究所 Vietnam Institute of Geosciences and Mineral Resources, Ministry of Natural Resources and Environment

仙台パートナーシップ 2015-2025 調印式写真（2015.3.16 仙台市）

ISDR-ICL SENDAI PARTNERSHIPS 2015-2025

for global promotion of understanding and reducing landslide disaster risk

12:00-13:30 on 16 March 2015, JUNSEN, Sendai, Japan

Front (left to right): Sorrenti Ambra (for Franco Gabrielli, Italian Civil Protection), Irasema Alcantara-Ayala (for Gordon Mcbean, ICSU), Srikantha Herath (for Kazuhiko Takeuchi, UNU), Roland Oberhansli (IUGS), Kaoru Saito (Cabinet Office, Japan), Giuseppe Arduino (for Qunli Han, UNESCO), Kyoji Sassa (ICL), Margareta Wahlström (UNISDR), Dominique Burgeon (FAO), Robert Mikac (for Croatia Civil Protection), Takashi Onishi (Science Council of Japan), Alik Ismail-Zedeh (IUGG), Kaoru Takara (for Kayo Inaba, Kyoto University).

Back (left to right): Hiroshi Fukuoka (ICL), Nicola Casagli (ICL), Yuki Matsuoka (UNISDR), Alexandros Makarigakis (UNESCO), Toshimitsu Komatsu (WFEO), Satoru Nishikawa (Water Agency, Japan), Badaoui Rouhban (IPL-ICL), Paolo Canuti (ICL), Yueping Yin (ICL), Matjaz Mikos (ICL)

Left Bottom: Qunli Han (UNESCO) and Franco Gabrielli (Italian Civil Protection)

Left-top: Speech by Ms Margareta Wahlström celebrating the launch of the ISDR-ICL Sendai Partnerships 2015-2025.

Right-top: Originally designed sake cup for the cerebration of the Sendai Partnerships. Sake cup is a Japanese sumac lacquerware. ICL logo and the edge are pure Gold. ICL logo was designed by K. Sassa at the ICL foundation. I: Cultural heritage/building at landslide risk, C: Advancing Consortium (C is inclined during motion), L: Retaining wall for landslide disaster risk reduction

Bottom: Thanks for all partners by Mr. Kyoji Sassa and Toast for the success of the the ISDR-ICL Sendai Partnerships 2015

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

A Programme of the ICL for ISDR

International Forum "Japanese contribution to Landslide Disaster Risk Reduction"

Sendai partnership 2015-2025 for global promotion of understanding and reducing landslide disaster risk
Science and Technology Research Partnership for Sustainable Development (SATREPS)

Organized by ICL and the Japan Landslide Society
Supported by the Japan Science and Technology Agency (JST) and UNESCO

Kyoji SASSA
Executive Director of ICL

Aim of the Conference

- The International Consortium on Landslides (ICL) proposed the "Sendai Partnerships 2015–2025 for global promotion of understanding and reducing landslide disaster risk" in contribution to the Third UN World Conference on Disaster Risk Reduction. The proposal goes into effect by the signature of ICL, Special Representative of Secretary General of the United Nations, UNESCO, other 17 organizations in Japan and overseas. This partnership was significantly gained from the implementation of JICA and JST Joint funded SATREPS projects.
- We will introduce the results of SATREPS project in Croatia (2009-2014) and in Vietnam (2011-2017) , and other SATREPS and JICA projects in Malaysia, Butan and Honduras. Then, we will examine further Japan's international contribution for the landslide disaster reduction as a part of Sendai Partnerships 2015-2025.
- ICL and UNESCO, UNISDR, and others will organize the Fifth World Landsldie Forum (WLF5) in Niigata, Japan. This conference is the mid-term milestone of the Sendai Partnerships 2015-2025 and the first five year milestone of the Sendai Framework for Disaster Risk Reduction 2015-2030. Participants will examine road map of the Sendai partnerships 2015-2025 to WLF5 2020.

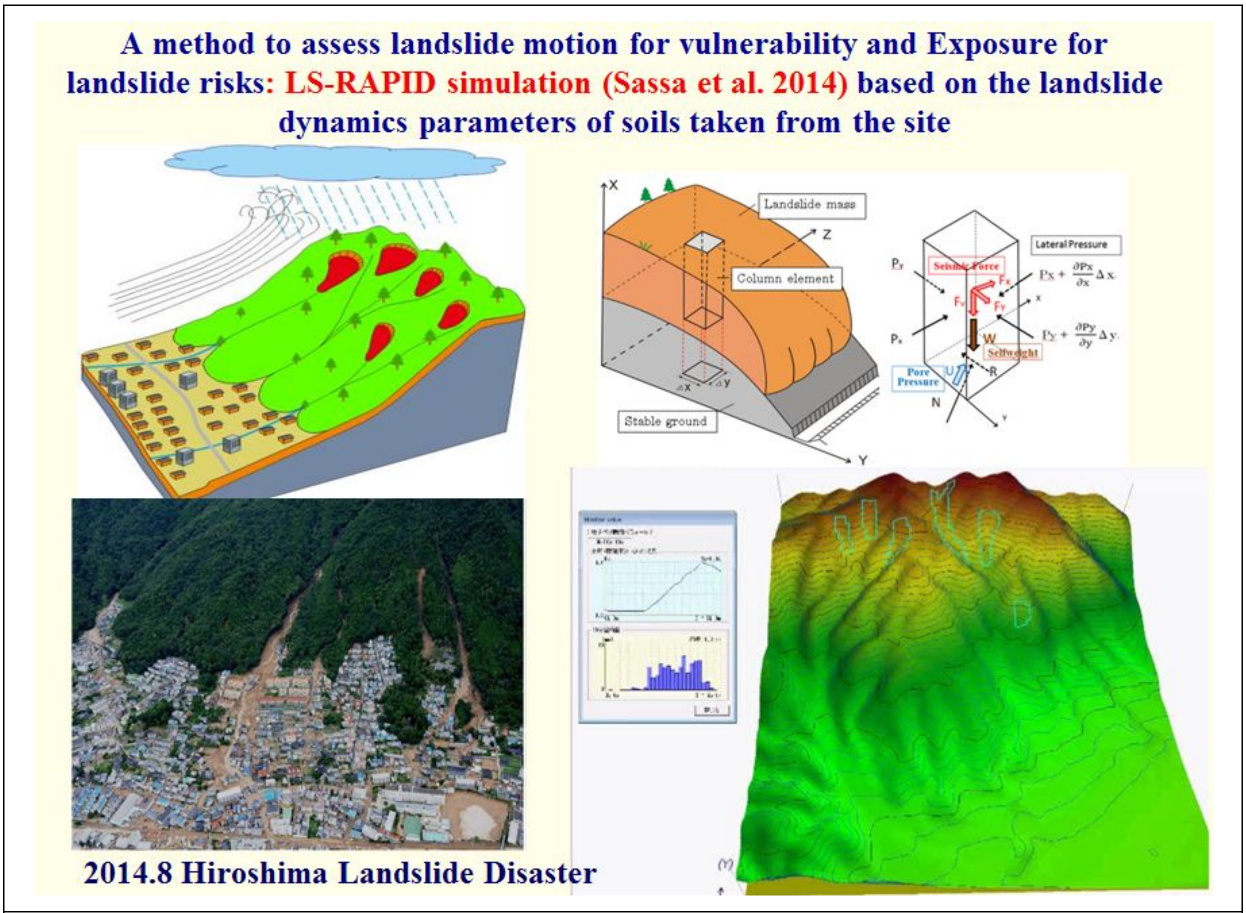
An international Consortium on Landslides (ICL) was established during the UNESCO-Kyoto University Joint Symposium in 2002.
Participants are from UNESCO (ADG:AS-Nagy), UNISDR (Pedro Basabe), WMO (DSG:Michel Jarraud), MOFA & MEXT, KU(Kaoru Takara), Japan and others.

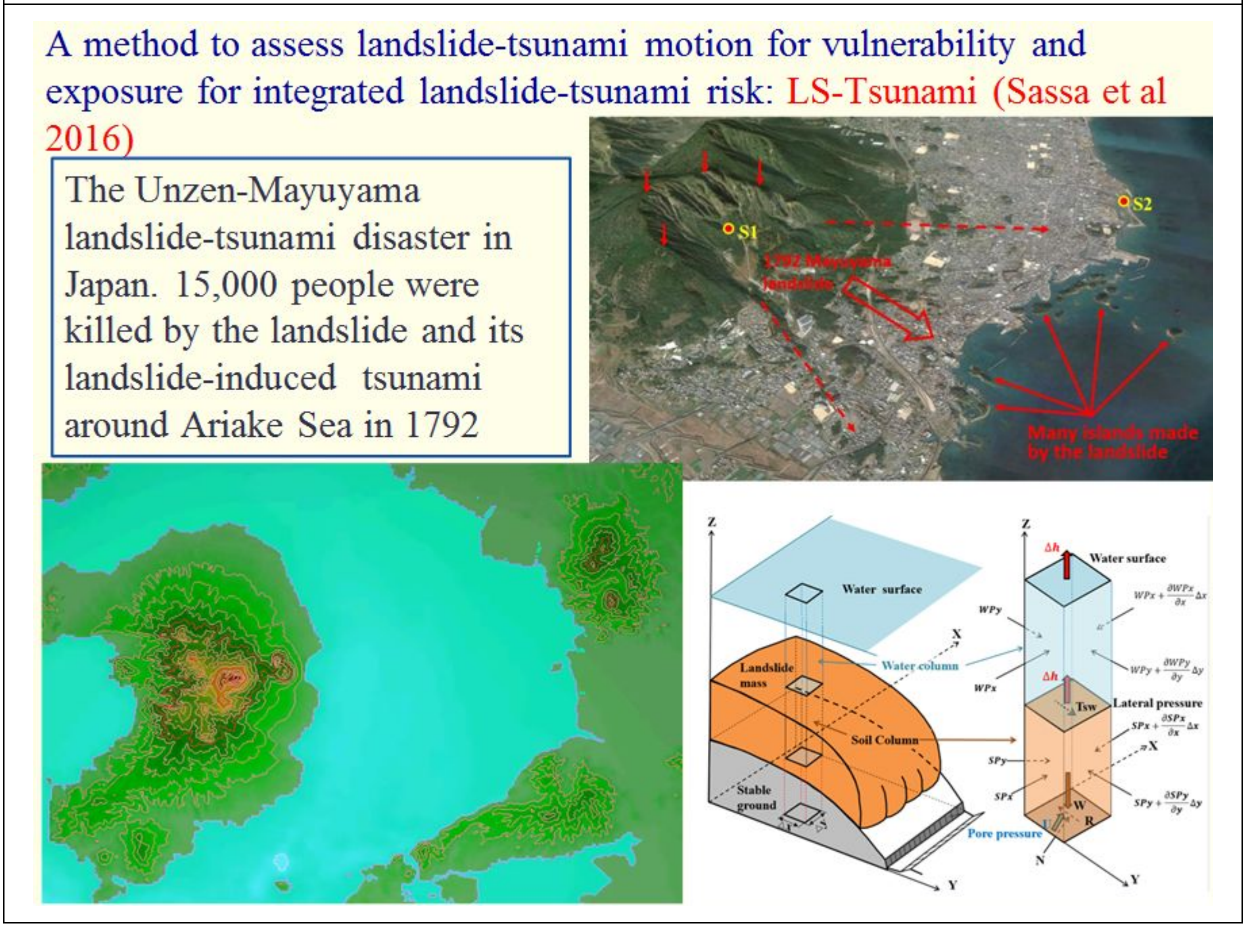
High-Level Panel Discussion:
Initiative to create a safer geoenvironment toward WCDR2015 and forward

High-level panel was chaired by Hans van Ginkel (Fomer Rector of UNU).
UNESCO (Director-General Irina Bokova), UNISDR, WMO, ICSU/IRDR, China Geological Survey, ICL together from floor discussed.
The 2014 Beijing Declaration "Landslide Risk Mitigation : Toward a Safer Geoenvironment" was adopted on 6 June 2014 following this panel discussion, which was the preparation for the ISDR-ICL Sendai Partnerships 2015-2025 to be adopted in Sendai 2015. 531 people, 211 national and international organizations from 40 countries and 5 organizations of United Nations System participated WLF3.

ISDR-ICL Sendai Partnerships 2015-2025 for global promotion of understing and reducing landslide disaster risk

The partnerships was proposed by ICL and adopted in a session of "Underlying risk factors" of 3rd WCDRR in AM on 16 March 2015. It was agreed and signed by leaders of 16 UN, International and national organizations in PM on 16 March 2015 in Sendai, Japan. Signatories are ICL Exective Director, Ms. Margareta Wahlström (SRSG), and leaders of UNESCO, FAO, UNU, ICSU, WFEO, IUGS, IUGG, KU, SCJ, GRF and Japanese (Cabinet office and MEXT), Italian and Croatian Governments.


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
Landslide mass
Column element
Stable ground
Lateral Pressure
Seismic Force
Selfweight
Pore Pressure
2014.8 Hiroshima Landslide Disaster

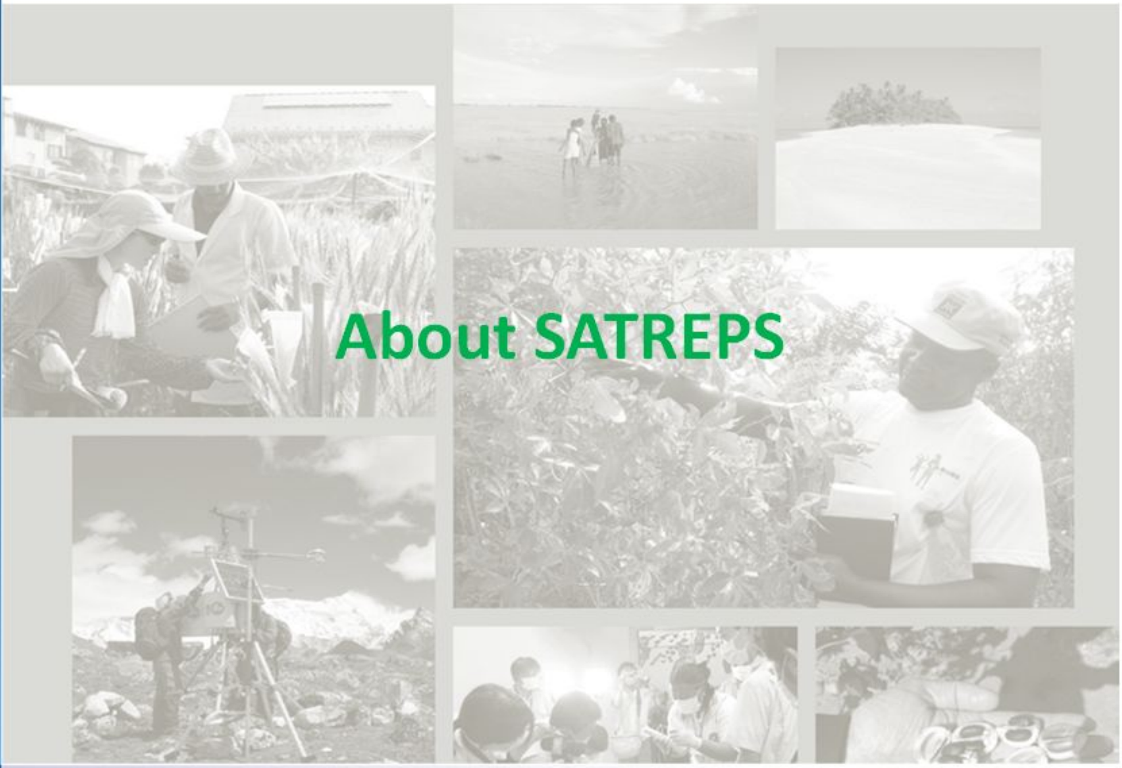

A method to assess landslide-tsunami motion for vulnerability and exposure for integrated landslide-tsunami risk: LS-Tsunami (Sassa et al 2016)
The Unzen-Mayuyama landslide-tsunami disaster in Japan. 15,000 people were killed by the landslide and its landslide-induced tsunami around Ariake Sea in 1792
S1
S2
1792 Mayuyama landslide
Many islands made by the landslide
Water surface
Landslide mass
Water column
Soil Column
Stable ground
Lateral pressure
Pore pressure

Science and Technology Research Partnership for Sustainable Development (SATREPS)

Kaoru Takara
SATREPS Research Supervisor
Japan Science and Technology Agency
November 24, 2016

JST 科学技術振興機構

Japan Science and Technology Agency



Japan Science and Technology Agency 2

Nowadays,
Joint Research efforts with Japan in Science and Technology are gathering much attention among developing countries.

Research focuses on 'GLOBAL ISSUES' that cannot be resolved by a single country or region.

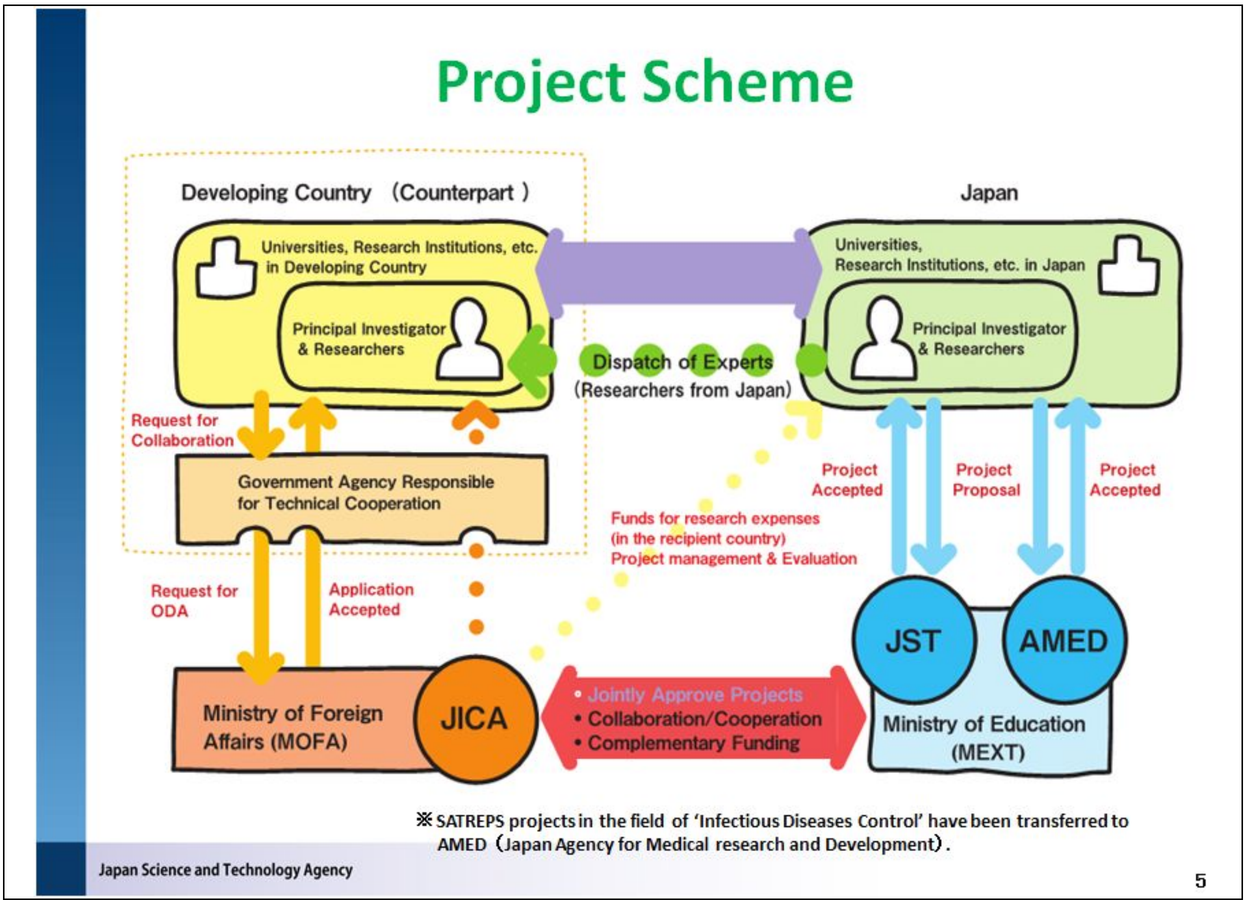
Japan Science and Technology Agency 3

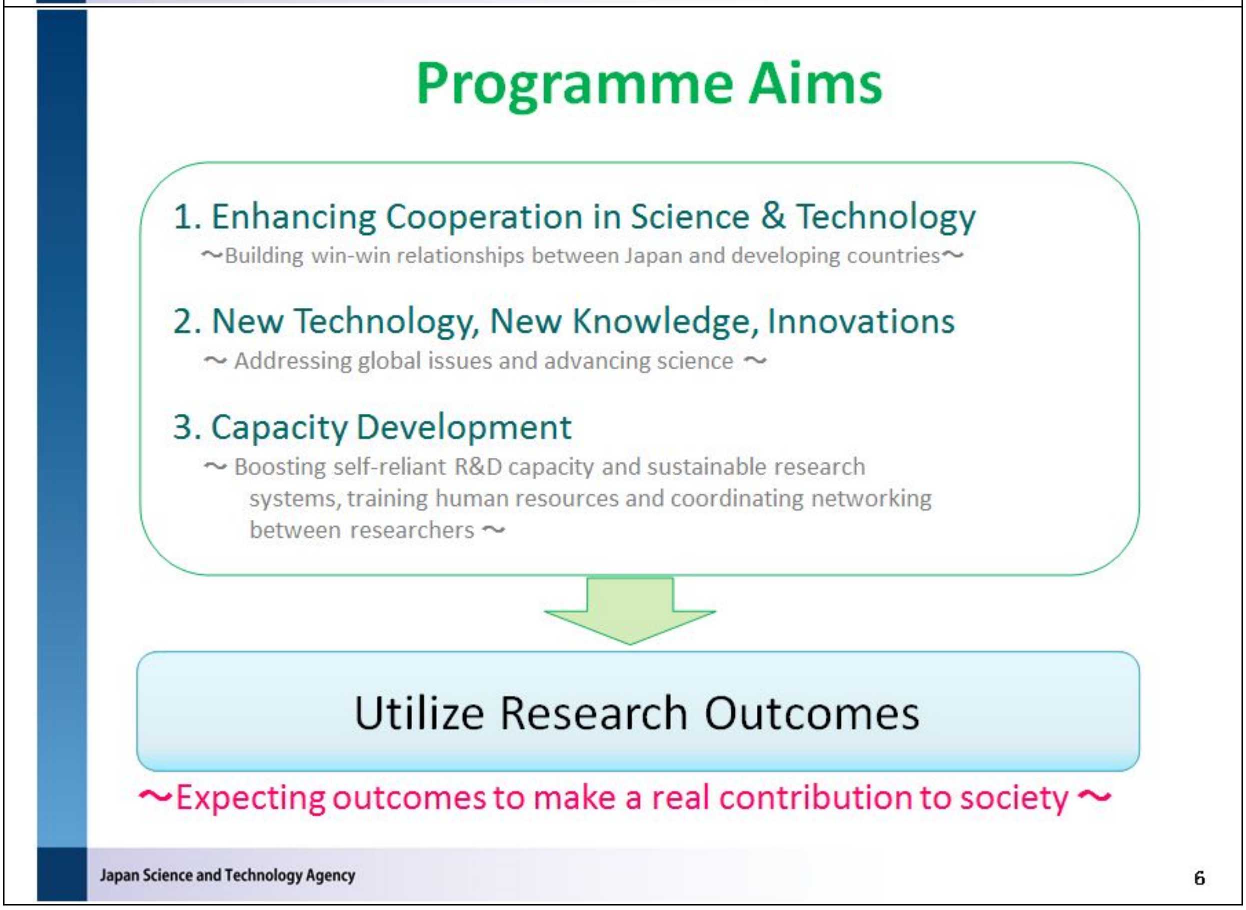
JST jica

Science & Technology × Official Development Assistance（ODA）

Science and Technology Promoting science and technology, encouraging innovation	×	International Cooperation ODA, development assistance
Meeting Global Needs Resolving global issues and contributing to the science and technology community	×	Meeting Local Needs Capacity development to address issues emerging as local needs in developing countries
Japan's Capabilities ·World-leading technology, proven research capacity ·Soft power	×	Developing Countries' Capabilities ·Direct experience, knowledge, and data needed for research on global issues ·Potential to contribute to the global economy through new markets and industries

Japan Science and Technology Agency 4


Project Scheme
Developing Country (Counterpart)
Japan
Universities, Research Institutions, etc. in Developing Country
Principal Investigator & Researchers
Dispatch of Experts
(Researchers from Japan)
Universities, Research Institutions, etc. in Japan
Principal Investigator & Researchers
Request for Collaboration
Government Agency Responsible for Technical Cooperation
Project Accepted
Project Proposal
Project Accepted
Funds for research expenses
(in the recipient country)
Project management & Evaluation
Request for ODA
Application Accepted
JST
AMED
Ministry of Foreign Affairs (MOFA)
JICA
• Jointly Approve Projects
• Collaboration/Cooperation
• Complementary Funding
Ministry of Education (MEXT)
※SATREPS projects in the field of 'Infectious Diseases Control' have been transferred to AMED (Japan Agency for Medical research and Development).
Japan Science and Technology Agency
5


Programme Aims
1. Enhancing Cooperation in Science & Technology
~Building win-win relationships between Japan and developing countries~
2. New Technology, New Knowledge, Innovations
~ Addressing global issues and advancing science ~
3. Capacity Development
~ Boosting self-reliant R&D capacity and sustainable research systems, training human resources and coordinating networking between researchers ~
Utilize Research Outcomes
~Expecting outcomes to make a real contribution to society~
Japan Science and Technology Agency
6

Point

<u>Duration of Research</u> 3 - 5 years (After provisional period*)

<u>Project Budget</u>

Approx. 1,000,000 USD*/year for one project

(*1USD=100JPY)

JST/AMED Approx. 360,000USD (36million yen)

JICA Approx. 600,000USD (60million yen)

* The provisional period is the period before the R/D and MOU are signed and the project officially starts.

Japan Science and Technology Agency

Research Fields & Areas

■Environment and Energy

<u>・Global-scale Environmental Issues</u>

Climate change mitigation & adaptation, Safe water supply, Biodiversity conservation..

<u>・Low-carbon Society/energy</u>

Biomass energy, Energy efficiency, Renewable energy..

■Bioresource

Breeding and cultivation technology, Bioresource management..

■Disaster Prevention and Mitigation

Natural disaster mechanisms (Earthquakes, Volcanic..), Disaster mitigation..

■Infectious Diseases Control

Diagnostic tool, Vaccines, Therapeutic products development
(Avian influenza, HIV/AIDS, Dengue fever..)

※ 'Infectious Diseases Control' has been transferred to AMED.
(AMED: Japan Agency for Medical research and Development)

Japan Science and Technology Agency 8

Counterpart Research Countries

115 projects in 46 countries around the world
(since 2008)

Area	Number of eligible countries	Number of projects
Asia	14 countries	60 projects
Africa	17 countries	30 projects
Latin America/Others	15 countries	25 projects

Projects funded by SATREPS in Disaster Prevention and Mitigation

11 on-going projects

- Vietnam (2011-) landslide
- Turkey (2012-) EQ and tsunami
- Bangladesh (2013-) flood, high tide
- Indonesia (2013-) volcano
- Myanmar (2014-) resilient system
- Colombia (2014-) EQ, tsunami, volcano
- Bangladesh (2015-) EQ, city planning
- Nepal (2015-) EQ
- Mexico (2015-) EQ, tsunami
- The Philippines (2016-) Extreme weather
- Bhutan (2016-) EQ, buildings

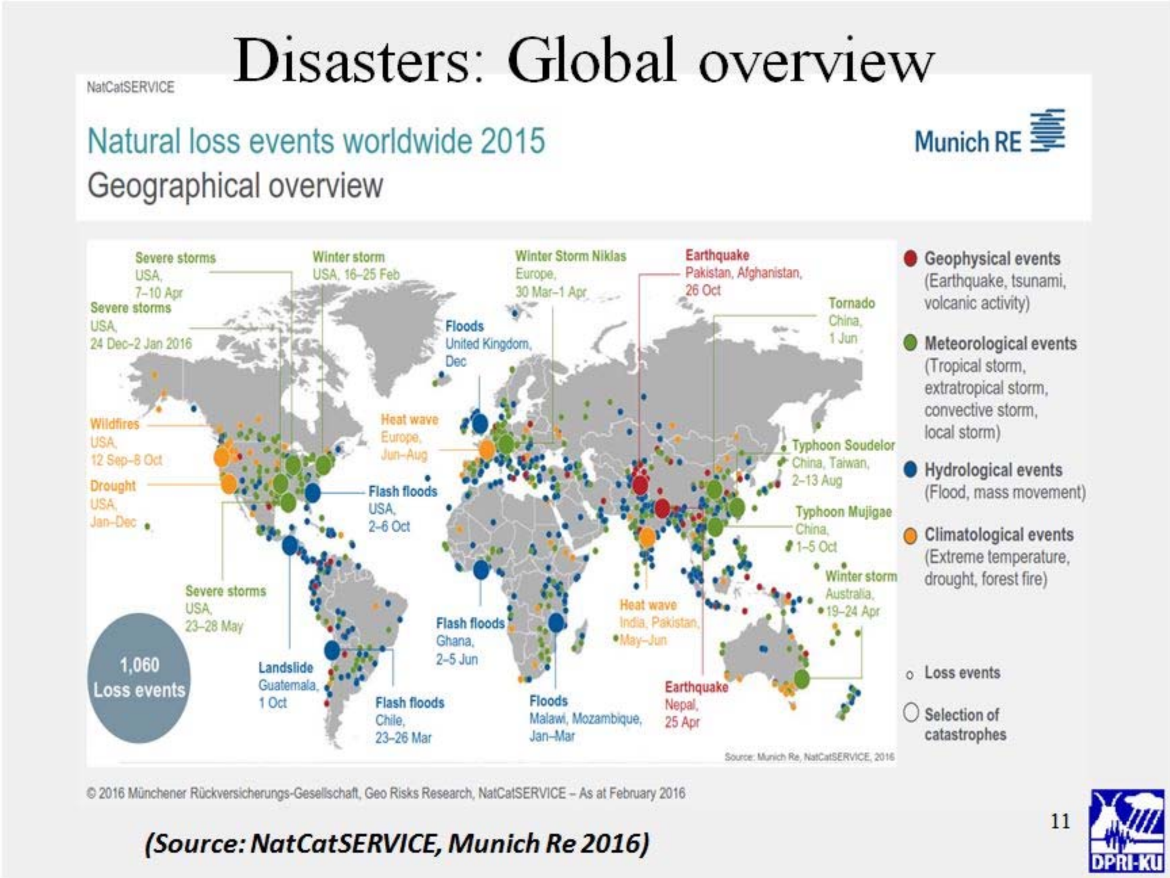
10 projects completed

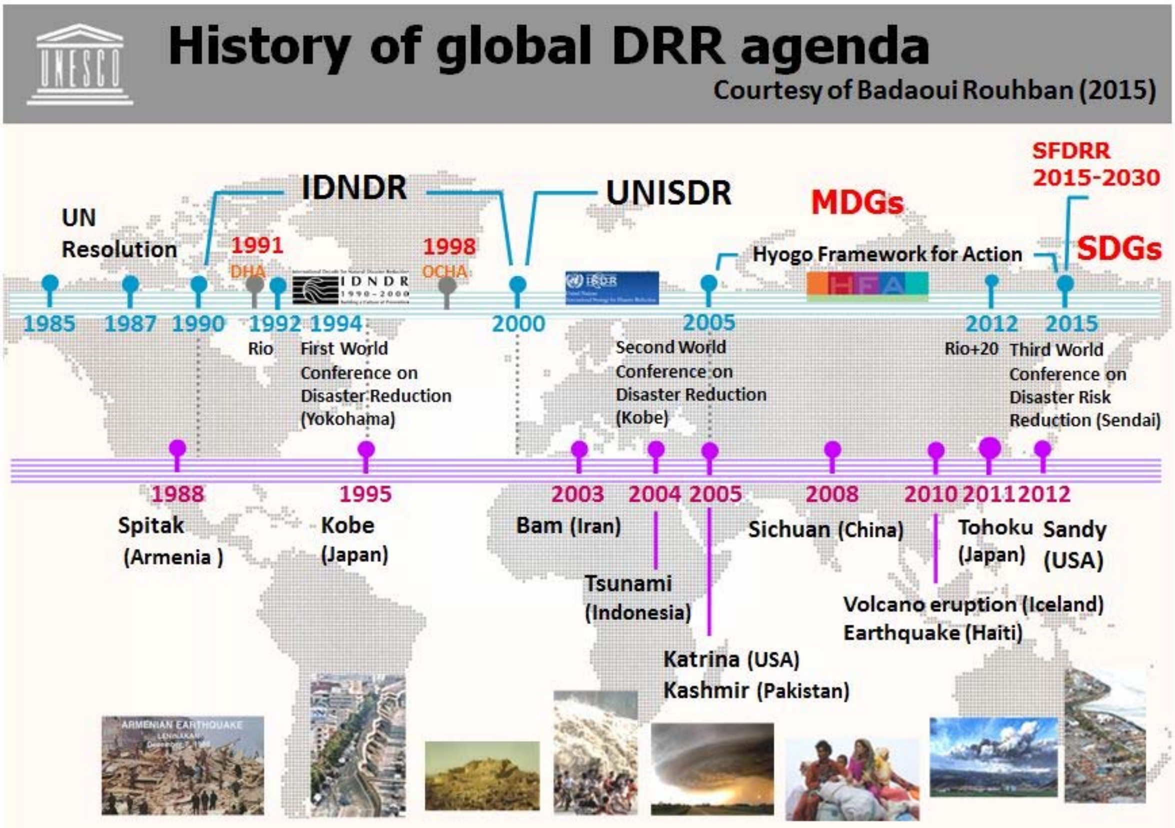
- Indonesia (2008-2012) EQ, volcano
- Bhutan (2008-2013) GLOF
- Croatia (2008-2013) landslide
- The Philippines (2009-2014) EQ, volcano
- South Africa (2009-2014) EQ
- India (2009-2014) Extreme weather info.
- Peru (2009-2014) EQ, tsunami
- Cameroon (2010-2015) CO_2 lakes
- Malaysia (2010-2015) landslide, flood
- Chile (2011-2016) EQ, tsunami

SATREPS For the Earth, For the Next Generation

Japan Science and Technology Agency

10


Disasters: Global overview
NatCatSERVICE
Natural loss events worldwide 2015
Geographical overview
Munich RE
Severe storms USA, 7–10 Apr
Severe storms USA, 24 Dec–2 Jan 2016
Winter storm USA, 16–25 Feb
Winter Storm Niklas Europe, 30 Mar–1 Apr
Earthquake Pakistan, Afghanistan, 26 Oct
Tornado China, 1 Jun
Floods United Kingdom, Dec
Wildfires USA, 12 Sep–8 Oct
Heat wave Europe, Jun–Aug
Drought USA, Jan–Dec
Flash floods USA, 2–6 Oct
Typhoon Soudelor China, Taiwan, 2–13 Aug
Typhoon Mujigae China, 1–5 Oct
Winter storm Australia, 19–24 Apr
Severe storms USA, 23–28 May
Heat wave India, Pakistan, May–Jun
Flash floods Ghana, 2–5 Jun
1,060 Loss events
Landslide Guatemala, 1 Oct
Flash floods Chile, 23–26 Mar
Floods Malawi, Mozambique, Jan–Mar
Earthquake Nepal, 25 Apr
Geophysical events (Earthquake, tsunami, volcanic activity)
Meteorological events (Tropical storm, extratropical storm, convective storm, local storm)
Hydrological events (Flood, mass movement)
Climatological events (Extreme temperature, drought, forest fire)
Loss events
Selection of catastrophes
Source: Munich Re, NatCatSERVICE, 2016
© 2016 Münchener Rückversicherungs-Gesellschaft, Geo Risks Research, NatCatSERVICE – As at February 2016
11
(Source: NatCatSERVICE, Munich Re 2016)
DPRI-KU


History of global DRR agenda
Courtesy of Badaoui Rouhban (2015)
UN Resolution
IDNDR
UNISDR
MDGs
SFDRR 2015-2030
SDGs
1991 DHA
1998 OCHA
Hyogo Framework for Action
1985
1987
1990
1992
1994
2000
2005
2012
2015
Rio
First World Conference on Disaster Reduction (Yokohama)
Second World Conference on Disaster Reduction (Kobe)
Rio+20
Third World Conference on Disaster Risk Reduction (Sendai)
1988
1995
2003
2004
2005
2008
2010
2011
2012
Spitak (Armenia)
Kobe (Japan)
Bam (Iran)
Tsunami (Indonesia)
Katrina (USA)
Kashmir (Pakistan)
Sichuan (China)
Volcano eruption (Iceland)
Earthquake (Haiti)
Tohoku (Japan)
Sandy (USA)
ARMENIAN EARTHQUAKE

Top 10 Global risks for 2016

In terms of Likelihood	In terms of Impact
1. Large-scale involuntary migration	**1. Failure of climate-change mitigation and adaptation**
2. Extreme weather events	2. Weapons of mass destruction
3. Failure of climate-change mitigation and adaptation	**3. Water crisis**
4. Interstate conflict	4. Large scale involuntary migration
5. Major Natural catastrophes	5. Severe energy price shock
6. Failure of national governance	**6. Biodiversity loss and ecosystem collapse**
7. Unemployment or underemployment	7. Fiscal crises
8. Data fraud or theft	**8. Spread of infectious diseases**
9. **Water crisis**	9. Asset bubble
10. Illicit trade	10. Profound social instability

(Source: World Economic Forum)

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DPRI-KU

Recent Agenda

- Education for Sustainable Development (ESD)
- SFDRR2015-2030
- Sustainable Development Goals (SDGs)
- Paris Agreement at COP21

DPRI-KU

Dear Prof. Kyoji Sassa, Executive Director of International Consortium on Landslides
Dear H.E. Mr. Dražen Hrastić, Ambassador of the Republic of Croatia

Distinguished Guests,

On behalf of the Vietnam Embassy in Japan, it is a great honor for me to participate in the International Forum on “Japanese contribution to Landslide Disaster Risk Reduction” organized by the International Consortium on Landslides (ICL) and the Japan Landslide Society (JLS), held in Tokyo for the first time.

I would like to take advantage of this great opportunity to extend my deep appreciation to the International Consortium on Landslides (ICL) for its excellent initiative on the Sendai Partnerships 2015–2025 for global promotion of understanding and reducing landslide disaster risk”.

I would like also to express my special thanks to the Japan Science and Technology Agency (JST) and Japan International Cooperation Agency (JICA) for supporting this activity under SATREPS projects.

At the conference today, the researchers from Japan, Vietnam and Croatia will review their results in the previous SATREPS and JICA Projects on landslide disaster reduction and discuss the possibilities for further collaborative research.

Vietnam, as many other countries, is facing up to the climate change and many natural disaters, including floods and landslides.

It is of my satisfaction to note that your research projects turned out to be very fruitful and productive. It is also pleased to see that the researchers of three countries today have a chance to discuss in details for new joint research projects, leading them to a new stage of further cooperation.

I would like to conglatulate all of you on the excellent results in the past and I do strongly believe in the continuity of your collaborative research and your contribution for the landslide disaster reduction in the future.

I wish the International Symposium on “Japanese contribution to Landslide Disaster Risk Reduction” a great success.

Thank you very much for your kind attention.

Mr. Bui Viet Khoi,
Counsellor, Head of Science and Technology Section
Embassy of the S.R. of Vietnam in Japan

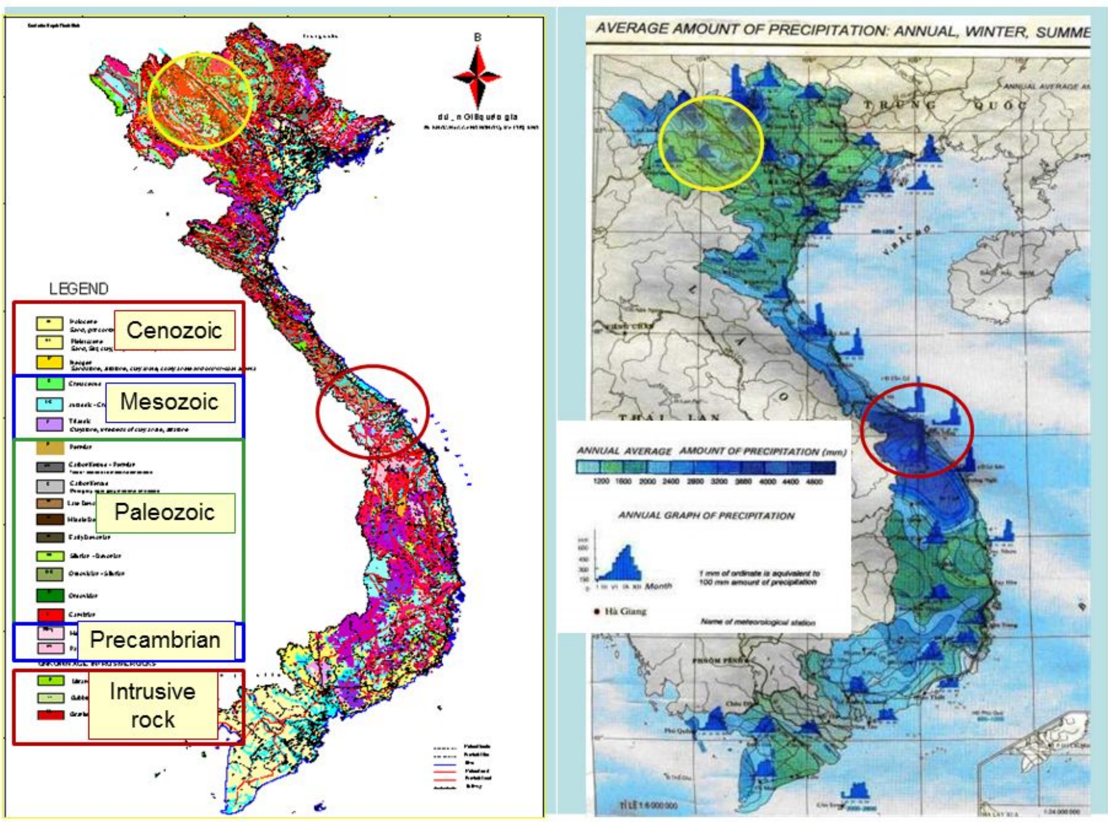
JICA-JST Joint Project in Vietnam

Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam

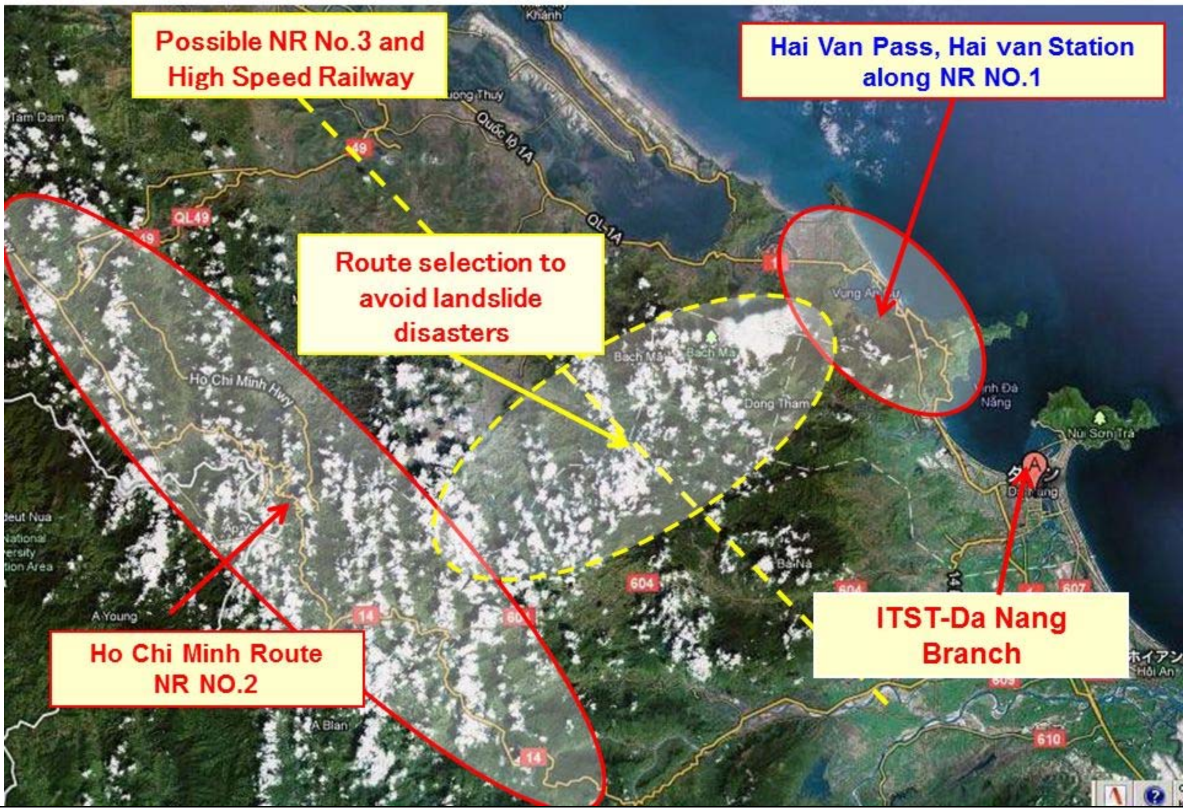
WG 1
Objectives and Achievements

Kyoji Sassa, Project Leader
Executive Director of ICL
Nguyen Xuan Khang, Project Director
Director of ITST

Geology and Rain fall in Vietnam

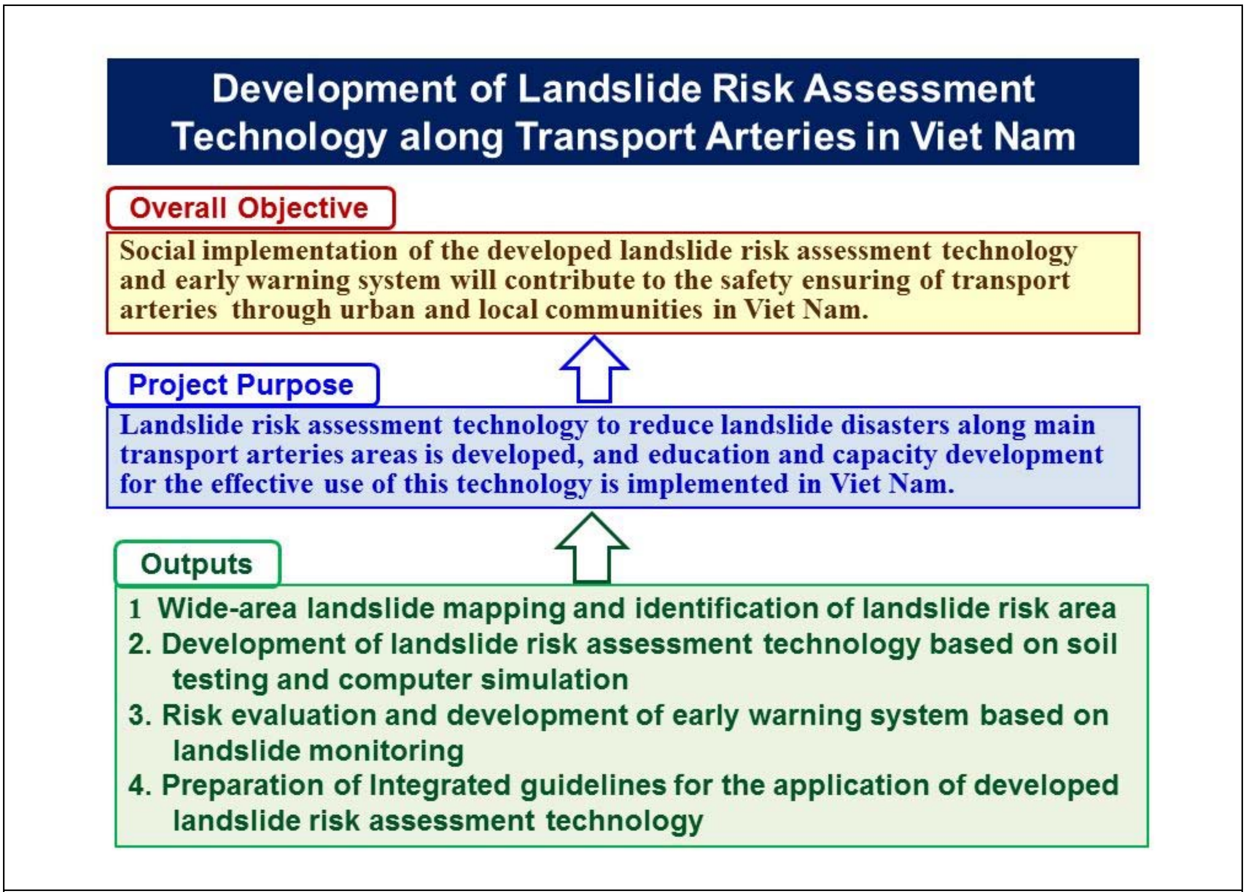


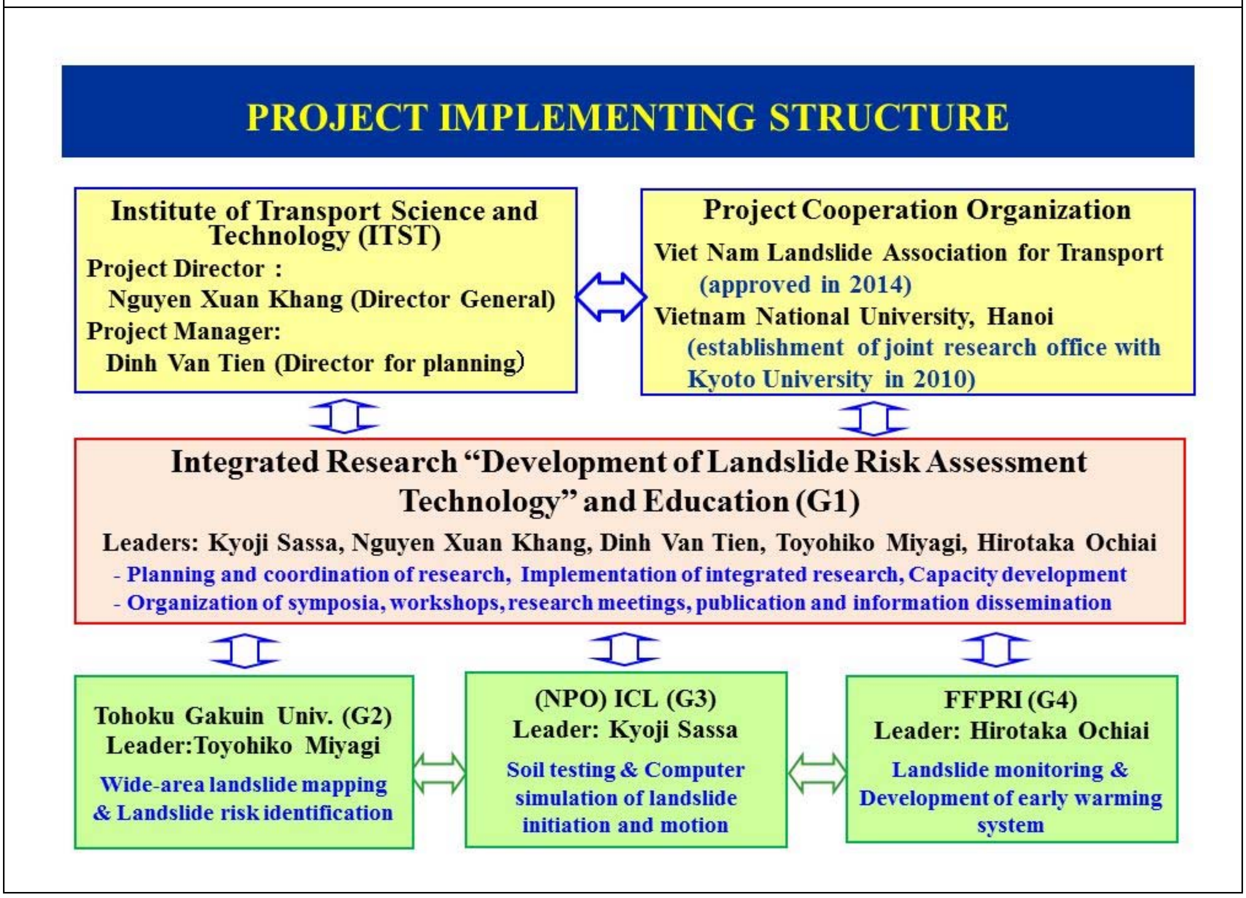
The Investigation Sites in Da Nang (MM and RD in 2011)



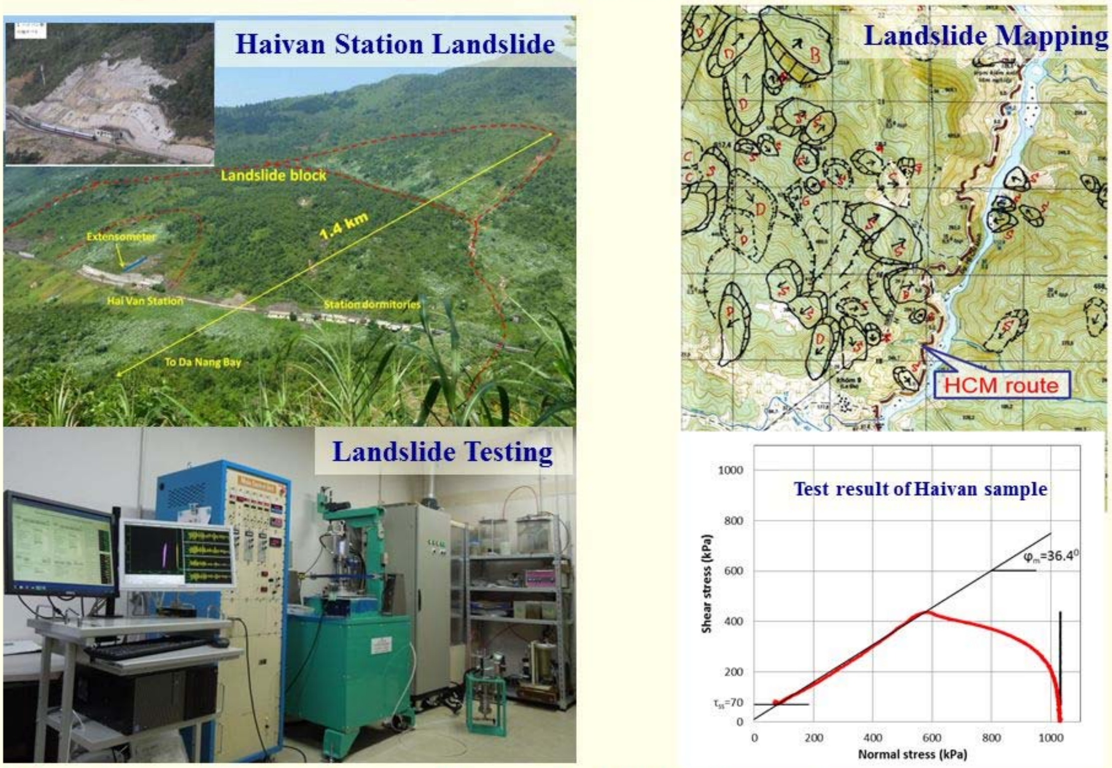
Objectives of SATREPS Joint research

- Mountainous areas of Greater Mekong Sub-region are subject to frequent slope disasters caused by a combination of weak ground, steep slopes, and tropical monsoon.
- Safety ensuring of transport arteries connecting north and south is the most important issue for national development in Vietnam.
- Establishment of an effective landslide risk assessment technology suitable for Vietnam is the key issue for disaster reduction.
- Technologies of landslide mapping, landslide risk identification, soil testing and computer simulation, landslide monitoring and early warning are jointly developed and transferred to Vietnam.
- An extensive human resources with an advanced landslide risk assessment technology are developed through capacity development in Vietnam and in Japan.
- Network for landslide risk reduction is established in Vietnam, Japan and other mountainous countries.


Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam
Overall Objective
Social implementation of the developed landslide risk assessment technology and early warning system will contribute to the safety ensuring of transport arteries through urban and local communities in Viet Nam.
Project Purpose
Landslide risk assessment technology to reduce landslide disasters along main transport arteries areas is developed, and education and capacity development for the effective use of this technology is implemented in Viet Nam.
Outputs
1 Wide-area landslide mapping and identification of landslide risk area
2. Development of landslide risk assessment technology based on soil testing and computer simulation
3. Risk evaluation and development of early warning system based on landslide monitoring
4. Preparation of Integrated guidelines for the application of developed landslide risk assessment technology

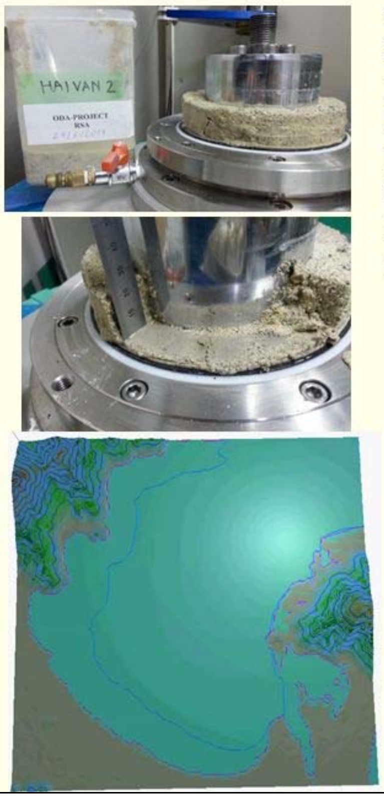

PROJECT IMPLEMENTING STRUCTURE
Institute of Transport Science and Technology (ITST)
Project Director :
Nguyen Xuan Khang (Director General)
Project Manager:
Dinh Van Tien (Director for planning)
Project Cooperation Organization
Viet Nam Landslide Association for Transport
(approved in 2014)
Vietnam National University, Hanoi
(establishment of joint research office with Kyoto University in 2010)
Integrated Research "Development of Landslide Risk Assessment Technology" and Education (G1)
Leaders: Kyoji Sassa, Nguyen Xuan Khang, Dinh Van Tien, Toyohiko Miyagi, Hirotaka Ochiai
- Planning and coordination of research, Implementation of integrated research, Capacity development
- Organization of symposia, workshops, research meetings, publication and information dissemination
Tohoku Gakuin Univ. (G2)
Leader:Toyohiko Miyagi
Wide-area landslide mapping & Landslide risk identification
(NPO) ICL (G3)
Leader: Kyoji Sassa
Soil testing & Computer simulation of landslide initiation and motion
FFPRI (G4)
Leader: Hirotaka Ochiai
Landslide monitoring & Development of early warming system

Application to Developing Countries (Case for Vietnam)

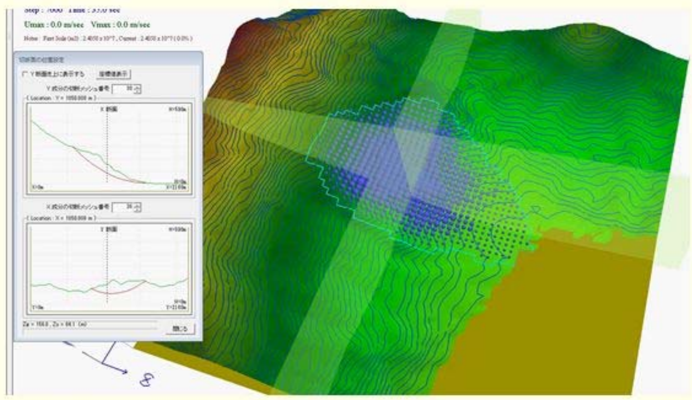


A dynamic loading undrained ring shear apparatus to meaure landslide dynamics parameters

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)

Review of Activities (WG3)

WG3 has successful developed the world first high-stress (up to 3 MPa) undrained dyanamic-laoding ring-shear apparatus (ICL-2) to simulate large-scale landslides (100-200 m in depth) using the budget provided by the Japan Science and Technology Agency (JST) which was reported in Landslides Vol.11, No.5.

- **A practical version of ICL-2 has been developed to donate it to Vietnam together with technological transfer. The practical and sustainable version of ICL-2 used in Vietnam needs many of technological development, to change the laoding system for easy handling, to change the rubber edge system to keep undrained condistion for easy maintenounce, and the many of safety systems to avoid damages of apparatus by mis-handling.**
- **After ICL-2 donated version has been completed, it has been tested by Vietnamease long term and short term trainees for around two years. All trouble sources are solved, and all trainees had confident to use ICL-2. The trainees has developed video manuals in addition to the written manuals for teaching engineers who have not visited Japan. The video manual made by ITST is included in Landslide Dynamcis:ISDR-ICL Landslide Interactive Teaching Tools.**
- **ICL2 was applied by Lam Huu Quang and other Vietnamese engineers to test the samples taken from drilling in the Hai van Station and succeeded to test those samples. This is the world first successful application of the undrained dynamic-loading ring-shear apparatus to test samples taken from the potential sliding surface found from the drilled cores in the precursor stage of Landslides.**
- **WG3 main objectives has been completed within the project period.**

Review of Activities (WG3)

WG3 has published or submitted five papers to Landslides (2015 Impact Factor is 3.049) as below.

1.Sassa K, Dang K, He B, Takara K, Inoue K, Nagai O (2014) A new high-stress undrained ring-shear apparatus and its application to the 1792 Unzen–Mayuyama megaslide in Japan. Landslides 11 (5):827-842.

2.Sassa K, Dang K, Yanagisawa H, He B (2016) A new landslide-induced tsunami simulation model and its application to the 1792 Unzen-Mayuyama landslide-and-tsunami disaster. Landslides (published online first. DOI 10.1007/s10346-016-0691-9).

3.Dang K, Sassa K, Fukuoka H, Sakai N, Sato Y, Takara K, Lam H Q, Doan H L, Pham V T, Nguyen D H (2016) Mechanism of two rapid and long runout landslides in the 16 April 2016 Kumamoto earthquake using a ring-shear apparatus and computer simulation (LS-RAPID), Landslides (published online first. DOI: 10.1007/s10346-016-0748-9).

4.Lam H Q, Doan H L, Sassa K, Takara K, Dang K, Abe S, Asano S (2016) Risk Assessment of a Precursor Stage of Landslide Threatening the Haivan Railway Station in Vietnam (Submitted to Landslides).

5.Doan H L, Lam H Q, Sassa K, Takara K, Dang D, Nguyen K T ,Pham V T (2016) The 28 July 2015 rapid landslide at Ha Long city, Quang Ninh, Vietnam (Submitted to Landslides).

Review of Activities (WG1-Guidelines)

Based on the technological transfer from Japan to Vietnam, Vietnamese researchers have made the guidelines in the following 5 parts – 33 guidelines (GL). The guidelines will be submitted to the Ministry of Trasport (MOT) to be approved as the guidelines of MOT.

- **Part 1. Mapping and Site Prediction.**
  This includes 8 GLs (No.1-No.8), covers on Landslide classification, Field Work for Landslide Engineers, Geotechnical , topo survey, inventory, occurred landslide risk evaluation Hazard, susceptibility mapping.
- **Part 2. Material Tests**
  This includes 8 GLS (No.9-No.16), covers the ring shear testing apparatus, 5 types of test, direct shear test and portable direct shear test.
- **Part 3. Monitoring**
  This includes 9 GLs (No.17-No.25) covers on parameters for Landslide Monitoring Systems for conventional landslide (slow and middle velocity)and high velocity landslide (Debris flow)
- **Part 4. Landslide experiment**
  This includes 5 GLs (No.26-No.30), covers on Introduction, relationship between Landslide Motion and Cumulative rainfall, Pore water Pressure Distribution, Volumetric Strain, Velocity
- **Part 5. Software and simulation**
  This includes 3 GLs (No.31-No.33) which support for landslide study and mapping

Review of Activities (WG1-Teaching Tools)

The United Nations World Conference on Disaster Risk Reduction (WCDRR) was organized in Sendai, Japan from 14-18 March 2015. **The Sendai Partnerships 2015-2025 for Global Promotion of Understanding and Reducing Landslide Disaster Risk** was proposed by ICL and agreed and signed by 17 international and national organizations (UNISDR,UNESCO, WMO, FAO, UNU, ICSU, WFEO, Gov of Japan, Italy, Croatia et al.). One of the proposed activities in this partnerships is to develop an integrated teaching tools on landslides, **Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools (LITT)** . It contains 102 text tools, 1,700 pages in two volumes. Within 102 tools, 18 tools come from this SATREPS projects in Vietnam and in Croatia. The video manual for the undrained dynamic-loading ring-shear apparatus (ICL-2) and its testing was produced by Lam Huu Quang et al., ITST

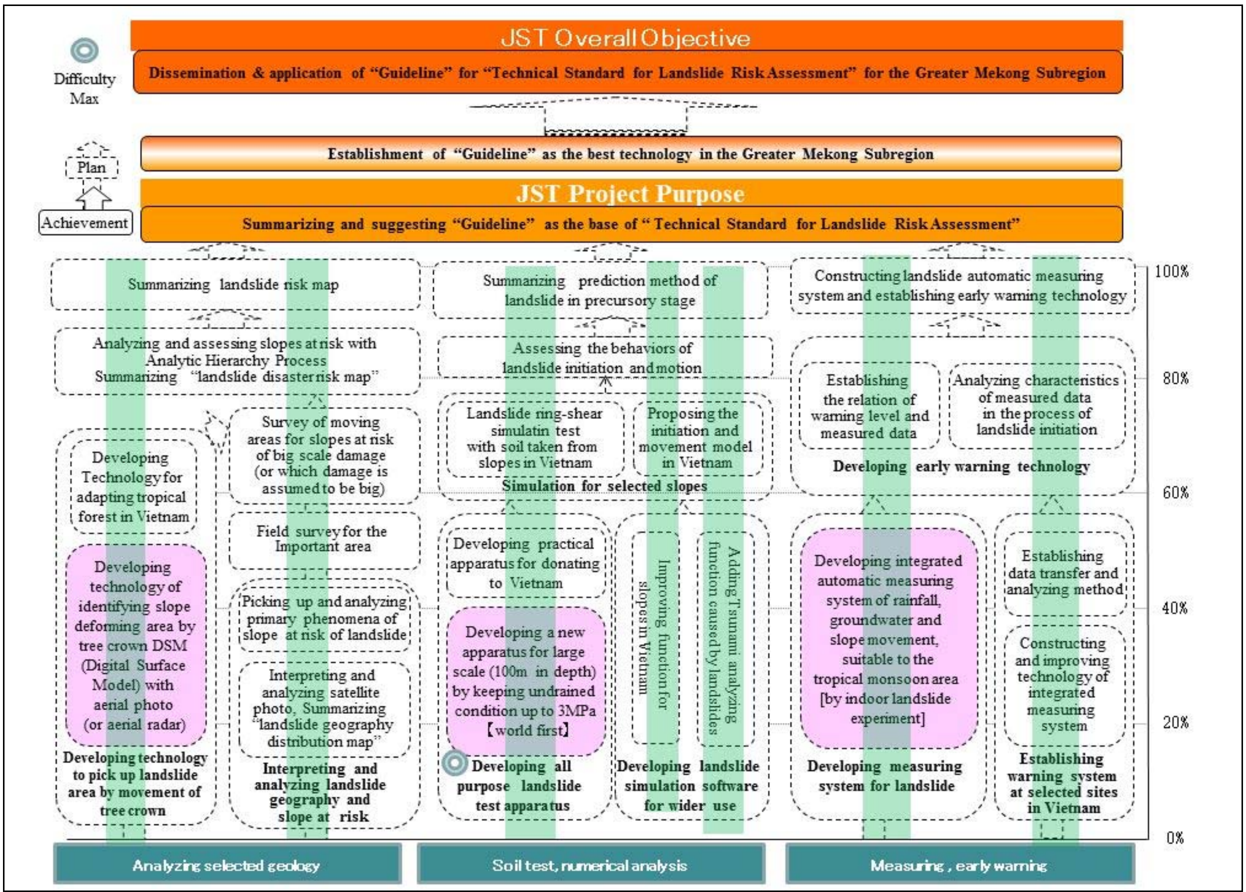
LITT includes PPT tools for lesson and PDF tools of papers/reports and manuals as well as text tools. This LITT is always updated in WEB by the interactive response between users and authors. A new updated version will be periodically published. The publication of LITT aims to provide the successful and effective technologies and experiences from many countries to the world and to create the latest landslide risk reduction technologies for the UN sustainable development goals and the Sendai Framework for Disaster Risk Reduction 2015-2030.

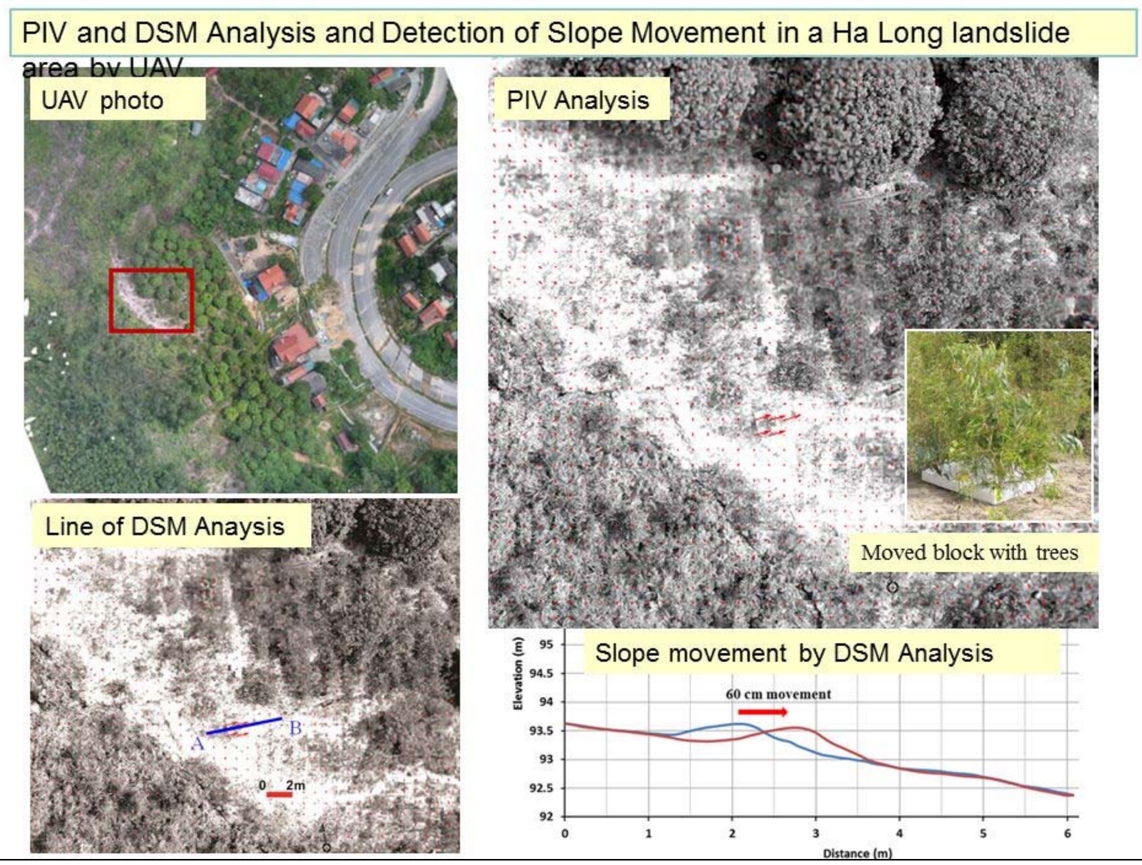
Review of Activities (WG1:Capacity Development)

Name	ITST/ VNU	University	Doctor/ Mater	Period
Khang Dang Quang	VNU	Kyoto Univ.	Doctor	10/1/2012-9/30/2015
Le Hong Luong	ITST	Tohoku G. U.	Doctor	4/1/2013-3/31/2016
Pham Van Tien	ITST	Kyoto Univ.	Master	4/1/2013-3/31/2015
		Kyoto Univ. (KU Scholarship)	Doctor	4/1/2015 3/31/2018
Doan Huy Loi	ITST	Kyoto Univ.	Master	4/1/2013-3/31/2015
Do Ngoc Ha	ITST	Shimane Univ.	Master	10/1/2012-9/30/2014
Pham Thi Chien	ITST	Shimane Univ.	Master	10/1/2013-9/30/2015
Vu The Truong	ITST	Shizuoka Univ.	Master	10/1/2013-9/30/2015

Review of Activities (WG1-Capacity Development in Japan-Continued)

Name	ITST/ VNU	University	Doctor/ Mater	Period
Short term training engineers (studying for Ph.D)				
Dinh Van Tien	ITST	Tohoku G. U.	Thesis Doctor	2016.9.15
Lam Huu Quang	ITST	Kyoto Univ.	For Thesis Doctor	Expected to complete in 2017.
Do Ngoc Ha	ITST	Kyoto Univ.	For Thesis Doctor	Studying
Ngo Doan Dung	ITST	Tohoku G. U.	For Thesis Doctor	Studying
Doan Huy Loi	ITST	Kyoto Univ.	For Course/ Thesis Doctor	Studying

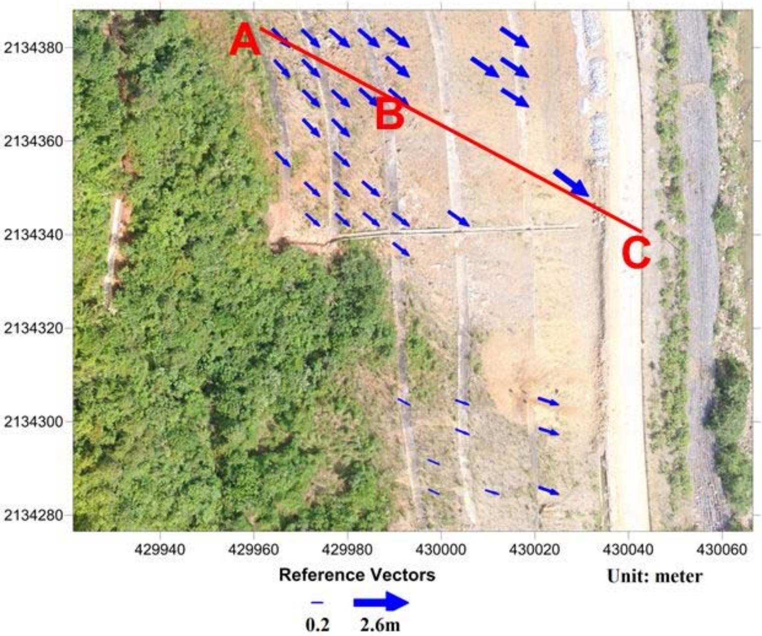

JST Overall Objective
Dissemination & application of "Guideline" for "Technical Standard for Landslide Risk Assessment" for the Greater Mekong Subregion
Establishment of "Guideline" as the best technology in the Greater Mekong Subregion
JST Project Purpose
Summarizing and suggesting "Guideline" as the base of "Technical Standard for Landslide Risk Assessment"
Summarizing landslide risk map
Analyzing and assessing slopes at risk with Analytic Hierarchy Process Summarizing "landslide disaster risk map"
Developing Technology for adapting tropical forest in Vietnam
Developing technology of identifying slope deforming area by tree crown DSM (Digital Surface Model) with aerial photo (or aerial radar)
Developing technology to pick up landslide area by movement of tree crown
Survey of moving areas for slopes at risk of big scale damage (or which damage is assumed to be big)
Field survey for the Important area
Picking up and analyzing primary phenomena of slope at risk of landslide
Interpreting and analyzing satellite photo, Summarizing "landslide geography distribution map"
Interpreting and analyzing landslide geography and slope at risk
Summarizing prediction method of landslide in precursory stage
Assessing the behaviors of landslide initiation and motion
Landslide ring-shear simulatin test with soil taken from slopes in Vietnam
Proposing the initiation and movement model in Vietnam
Simulation for selected slopes
Developing practical apparatus for donating to Vietnam
Developing a new apparatus for large scale (100m in depth) by keeping undrained condition up to 3MPa 【world first】
Developing all purpose landslide test apparatus
Improving function for slopes in Vietnam
Adding Tsunami analyzing function caused by landslides
Developing landslide simulation software for wider use
Constructing landslide automatic measuring system and establishing early warning technology
Establishing the relation of warning level and measured data
Analyzing characteristics of measured data in the process of landslide initiation
Developing early warning technology
Developing integrated automatic measuring system of rainfall, groundwater and slope movement, suitable to the tropical monsoon area [by indoor landslide experiment]
Developing measuring system for landslide
Establishing data transfer and analyzing method
Constructing and improving technology of integrated measuring system
Establishing warning system at selected sites in Vietnam
100%
80%
60%
40%
20%
0%
Analyzing selected geology
Soil test, numerical analysis
Measuring, early warning


PIV and DSM Analysis and Detection of Slope Movement in a Ha Long landslide area by UAV
UAV photo
PIV Analysis
Moved block with trees
Line of DSM Anaysis
A
B
0 2m
Slope movement by DSM Analysis
60 cm movement
Elevation (m)
Distance (m)

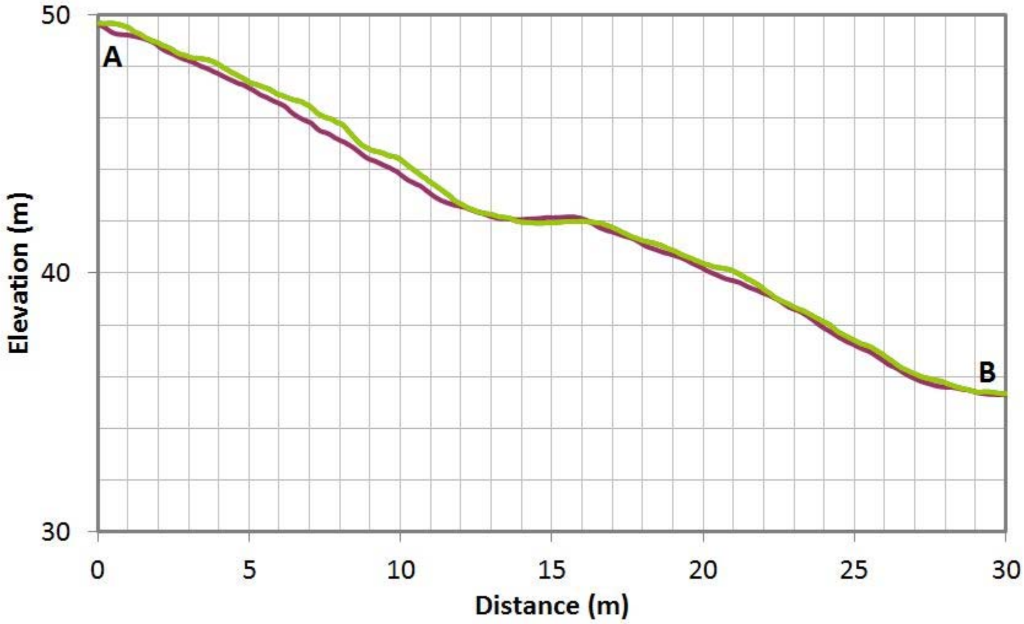
Movement in the topsoil (thickness: 30-40 cm)

Making the gabion box in October

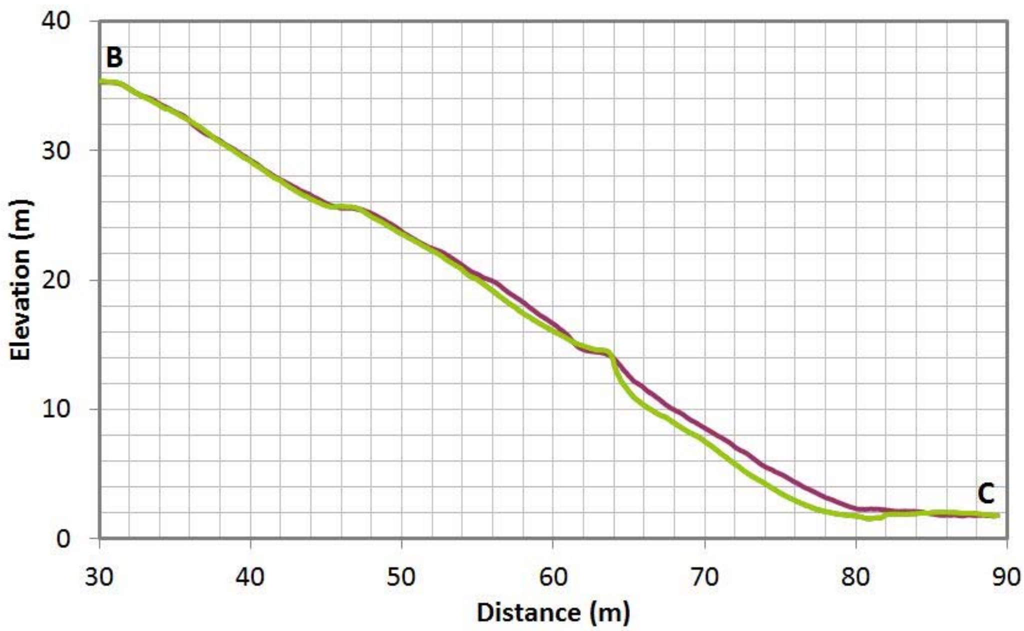
Crack



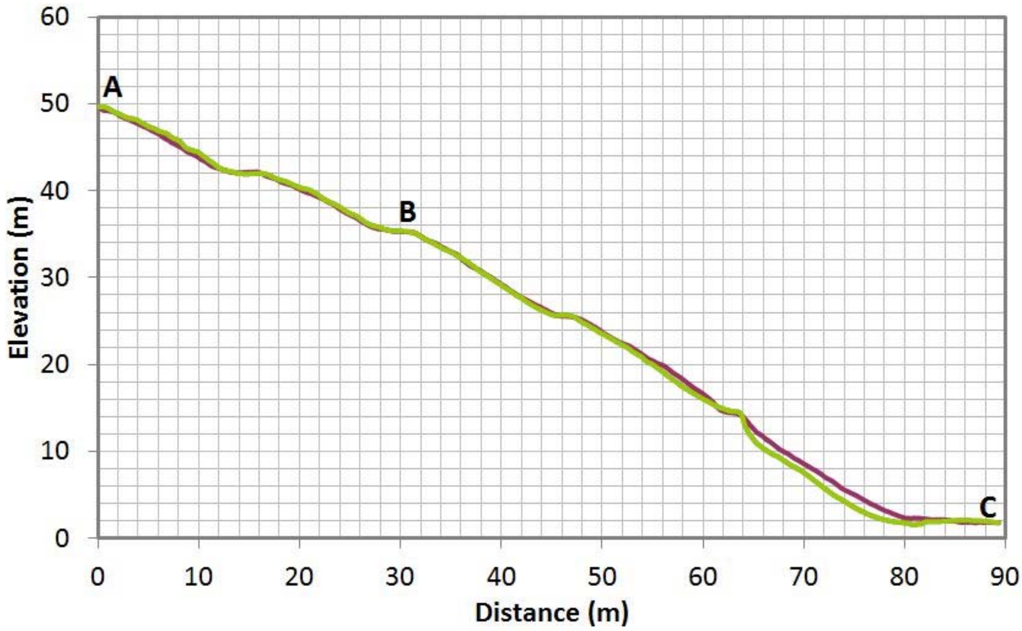
PIV result



AB cross section



BC cross section



ABC cross section

JICA-JST Joint Project in Vietnam

Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam

Impact of project to Vietnam Society and out put of mapping group

Dinh Van Tien, Project Manager
WG2 Leader of ITST
Toyohiko Miyagi, WG2 Leader
Professor of Tohokugakuin University

Vietnam- Japan SATREPS Project "Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam"

Overview of Four components and achievements

WG1 integrated research, education, development of human resources, announcement and information spread; (2)

1	Technical integrating guidelines
2	3 Doctors ,5 Masters, 4 doctor candidates

WG2 wide-area landslide mapping and identification of landslide risk area; (6)

3	LS distribution map of HCM road
4	LS risk asecement map of HCM road
5	LS suceptibility map of HCM road
6	Landslide Identify by air photo, From airplane or UAV
7	Field investigation and the inspection sheet making
8	Recognition of pre landslide through analysis mode of DSM

WG3 deve... ...sed on soil testing and computer simulation;(4) and

9	Develop researching and simulation technology
10	The developed ring shear apparatus
11	Shifting mechanism at Hai Van
12	Adding the function simulating tsunami

WG4 Risk ... n based on landslide monitoring.(4)

13	Selection Hai Van and Three boreholes
14	An integration monitoring system , early waning
15	Installation of data transmission system and display system
16	Landslide chutes and ecording systems

International Consortium on Landslides (ICL) and Institute of Transport Science and Technology (ITST) - MOT- Vietnam

Vietnam- Japan SATREPS Project "Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam"

Short-term objectives.

to develop the landslide risk assessment technology to reduce disasters caused by landslides on transport arteries throughout the joint research based on experimental technology from Japan and human resources development to effectively technology implementation in Vietnam.

WGs	No	Project achivement		Plan	Short-term objectives.
WG1	1	Technical integrating guidelines	→	Developing	ITST standard
	2	3 Doctors ,5 Masters, 4 doctor cadedates	→	fee for maintenance	Geo. and LS disaster prevention Div.
WG2	3	LS distribution map of HCM road	→	combination 3,4,5. Expansion	LS mitigation Map for main roads
	4	LS risk asecement map of HCM road	→	as above	as above
	5	LS suceptibility map of HCM road	→	as above	as above
	6	Landslide Identify by air photo, From airplane or UAV	→	continue study by MOT	upgrade survey standard
	7	Field investigation and the inspection sheet making	→	as above	as above
	8	Recognition of pre landslide through analysis mode of DSM	→	as above	new standard for LS recognition
WG3	9	Develop researching and simulation technology	→	mainternace for further study	new standard for LS testing
	10	The developed ring shear apparatus	→	application for other LSs	Testing and shearing service
	11	Shifting mechanism at Hai Van	→	LS hazard map	Application other after Haivan
	12	Adding the function simulating tsunami	→	as above	as above
WG4	13	Selection Hai Van and Three boreholes	→	Propose new active Landslides	Application study case
	14	An integration monitoring system , early waning	→	mainternace for further study	Monitoring study site
	15	Installation of data transmission system and display system	→	mainternace for further study	Application monitoring Veiw
	16	Lanslide chutes and ecording systems	→	continue study by MOT	Experiment for early warning

International Consortium on Landslides (ICL) and Institute of Transport Science and Technology (ITST) - MOT- Vietnam

Vietnam- Japan SATREPS Project "Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam"

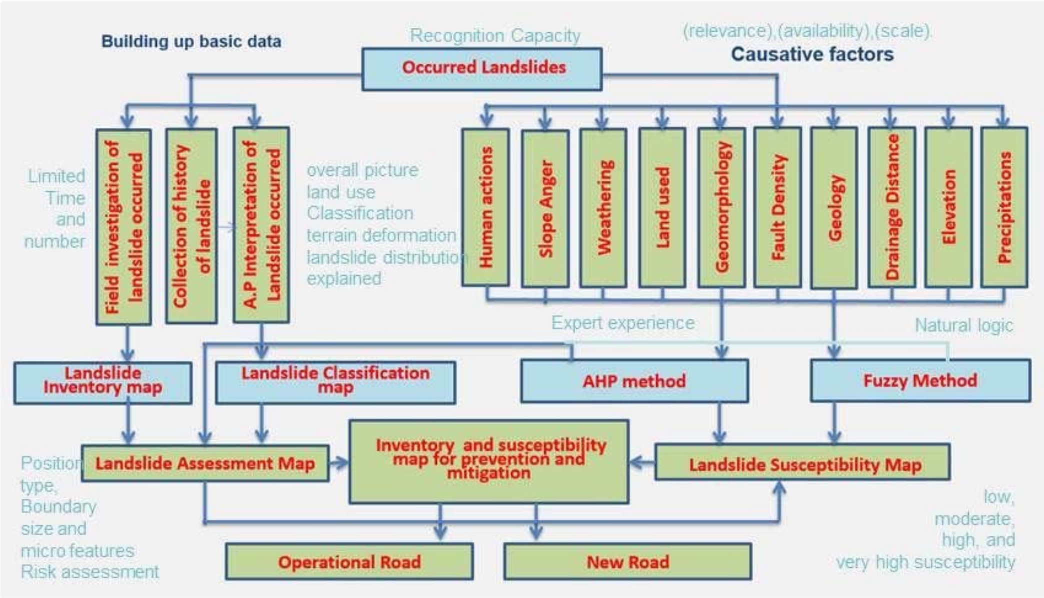
Long-term objectives.

to socialize developed landslide risk assessment technology and early warning system to not only ensures transport arteries operation but also mountainous resident areas in Vietnam.

WGs	No	Project achivement		Plan	Long-term objectives.
WG1	1	Technical integrating guidelines	→	Developing	National Standard
	2	3 Doctors ,5 Masters, 4 doctor cadedates	→	New Standards for countermeasure	MOT LS countermeasure
WG2	3	LS distribution map of HCM road	→	expantion for other areas	national LS mitigation map, disemitation
	4	LS risk asecement map of HCM road	→	as above	as above
	5	LS suceptibility map of HCM road	→	as above	as above
	6	Landslide Identify by air photo, From airplane or UAV	→	upgrading	National Standard
	7	Field investigation and the inspection sheet making	→	as above	as above
	8	Recognition of pre landslide through analysis mode of DSM	→	as above	as above
WG3	9	Develop researching and simulation technology	→	up grade standard	Important LS case for mitigation
	10	The developed ring shear apparatus	→	application for other LSs	as above
	11	Shifting mechanism at Hai Van	→	expantion for other LSs	LS Hazard map
	12	Adding the function simulating tsunami	→	expantion for other LSs	as above
WG4	13	Selection Hai Van and Three boreholes	→	expantion for other LSs	selection of high-value targets
	14	An integration monitoring system , early waning	→	as above	as above
	15	Installation of data transmission system and display system	→	as above	as above
	16	Lanslide chutes and ecording systems	→	developing	National Standard for LS early waning

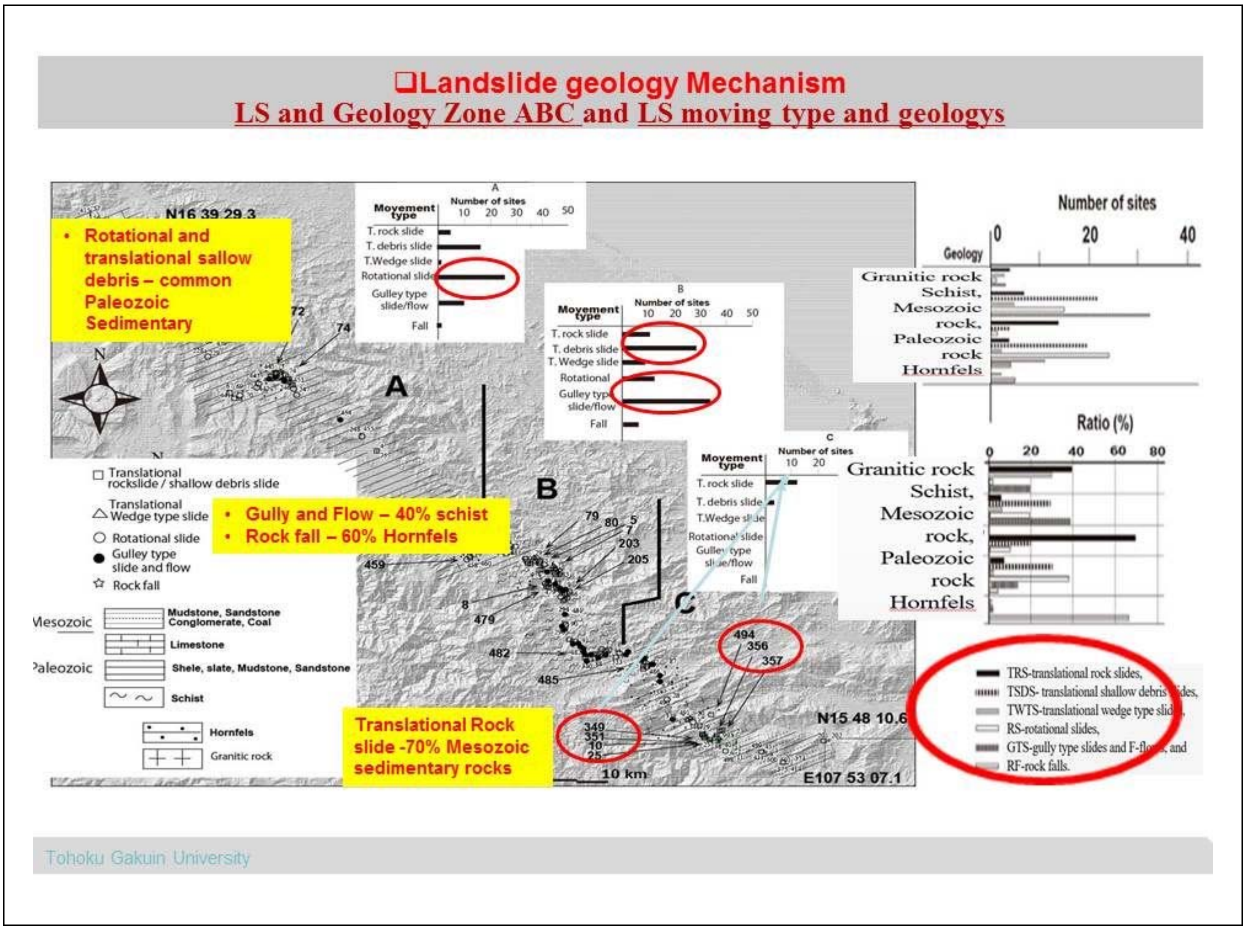
International Consortium on Landslides (ICL) and Institute of Transport Science and Technology (ITST) - MOT- Vietnam

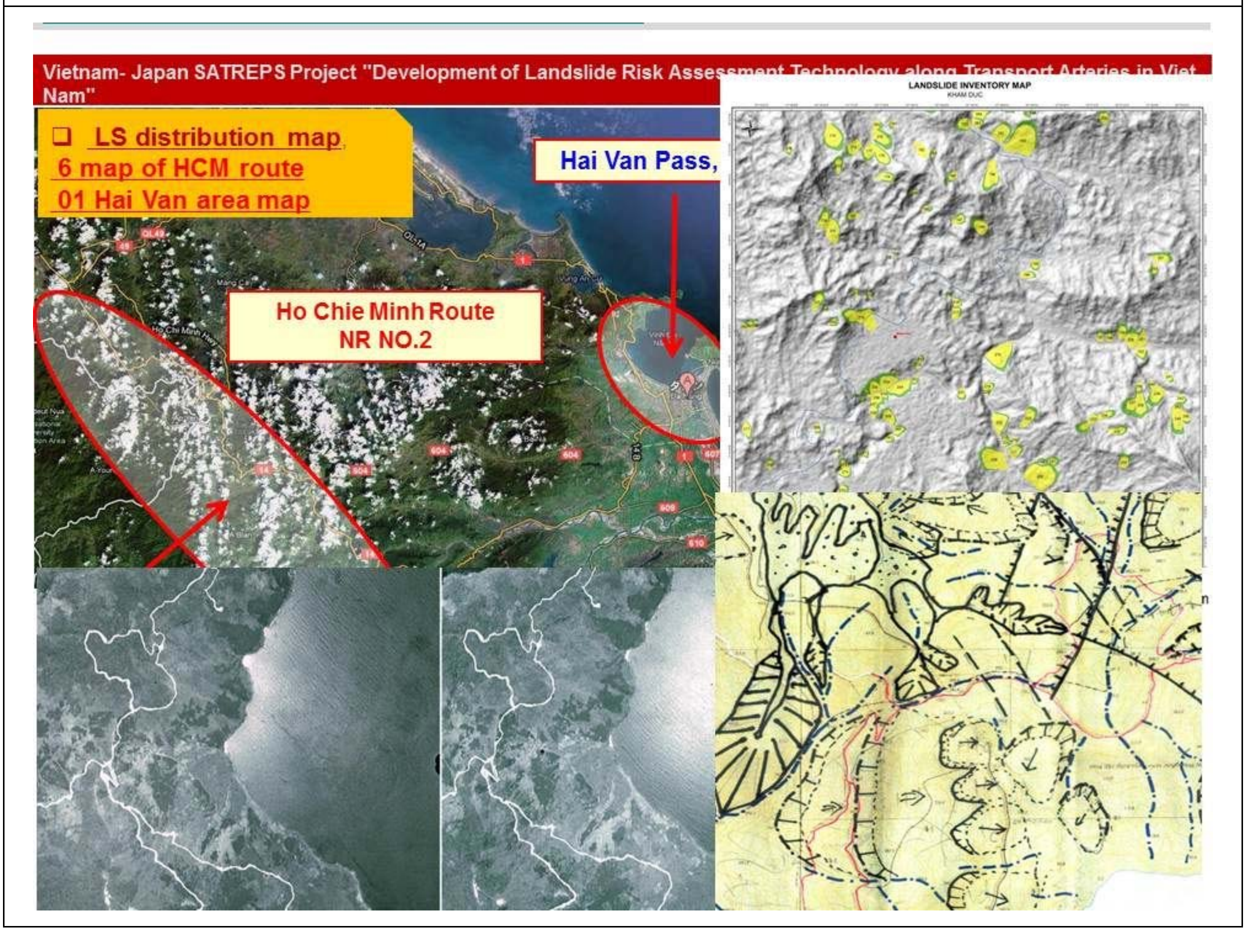
❑ Discussions on the Flow chart Research -The 4th volume of World Landslide Forum 3 (WLF3) -2-6 June 2014, Beijing:



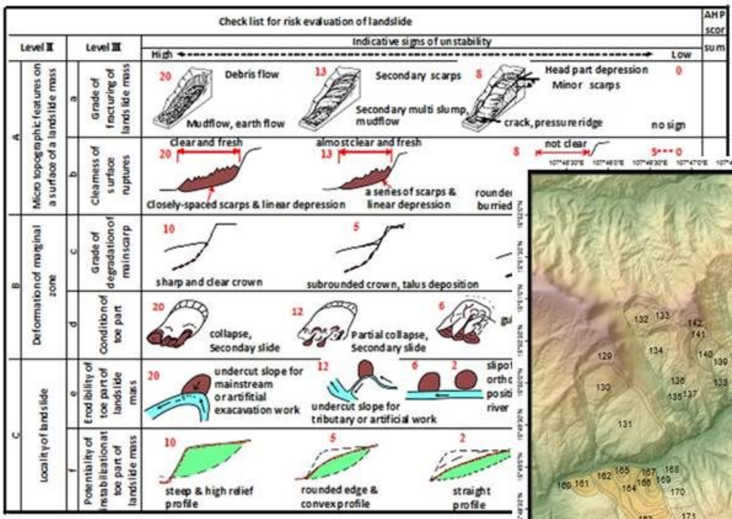
❑ Landslide classification in consideration of fuzzy nature

Movement type	Rock	Debris	Earth
Fall	1. Rock fall	2. Debris fall	3. Earth fall
Topple	4. Rock topple	5. Debris topple	6. Earth topple
Rotational sliding	7. Rock slump	8. Debris slump	9. Earth slump
Translational sliding	10. Rock slide	11. Debris slide	12. Earth slide
Lateral spreading	13. Rock spread	-	14. Earth spread
Flow	15. Rock creep	16. Talus flow	21. Dry sand flow
		17. Debris flow	22. Wet sand flow
		18. Debris avalanche	23. Quick clay flow
		19. Solifuction	24. Earth flow
		20. Soil creep	25. Rapid earth flow
			26. Loess flow
Complex	27. Rock slide-debris avalanche	28. Cambering, valley bulging	29. Earth slump - earth flow

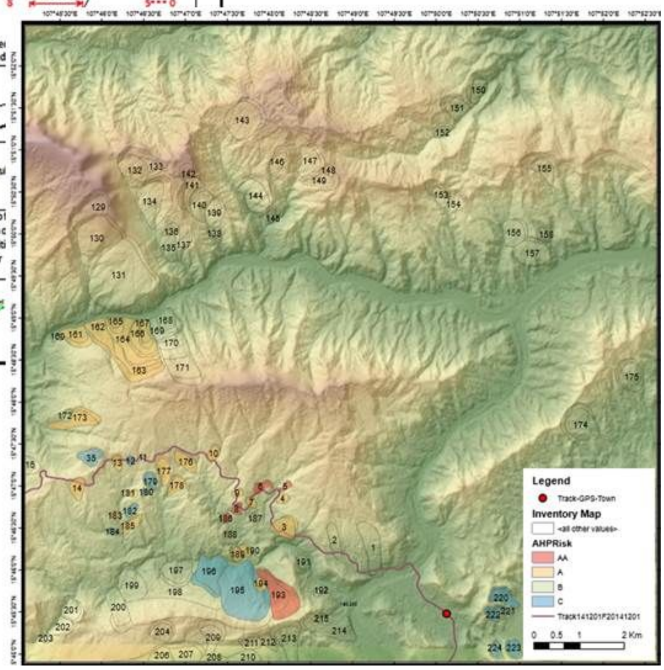

❑Landslide geology Mechanism
LS and Geology Zone ABC and LS moving type and geologys
N16 39 29.3
• Rotational and translational sallow debris – common Paleozoic Sedimentary
• Gully and Flow – 40% schist
• Rock fall – 60% Hornfels
Translational Rock slide -70% Mesozoic sedimentary rocks
A
B
C
Movement type
Number of sites
T. rock slide
T. debris slide
T.Wedge slide
Rotational slide
Gulley type slide/flow
Fall
Translational rockslide / shallow debris slide
Translational Wedge type slide
Rotational slide
Gulley type slide and flow
Rock fall
Mesozoic
Mudstone, Sandstone Conglomerate, Coal
Limestone
Paleozoic
Shele, slate, Mudstone, Sandstone
Schist
Hornfels
Granitic rock
N15 48 10.6
E107 53 07.1
10 km
Number of sites
Geology
Granitic rock
Schist,
Mesozoic rock,
Paleozoic rock
Hornfels
Ratio (%)
TRS-translational rock slides,
TSDS- translational shallow debris slides,
TWTS-translational wedge type slides,
RS-rotational slides,
GTS-gully type slides and F-flows, and
RF-rock falls.
Tohoku Gakuin University


Vietnam- Japan SATREPS Project "Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam"
❑ LS distribution map,
6 map of HCM route
01 Hai Van area map
Hai Van Pass,
Ho Chie Minh Route NR NO.2
LANDSLIDE INVENTORY MAP

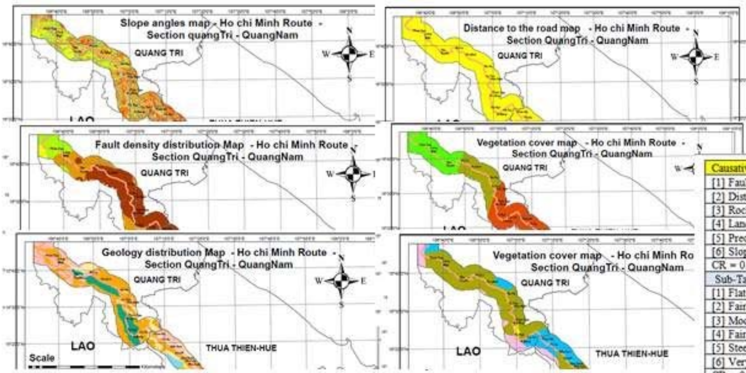
6 Landslide Risk assessment map uising AHP evaluation

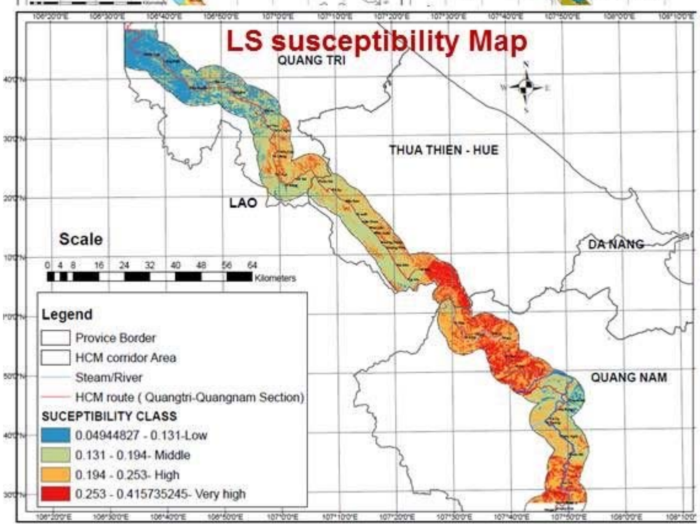


Typical landslide Risk assessment map along HCM road



Landslide micro features (mophomology) and geology is considered using AHP for Risk assessment map

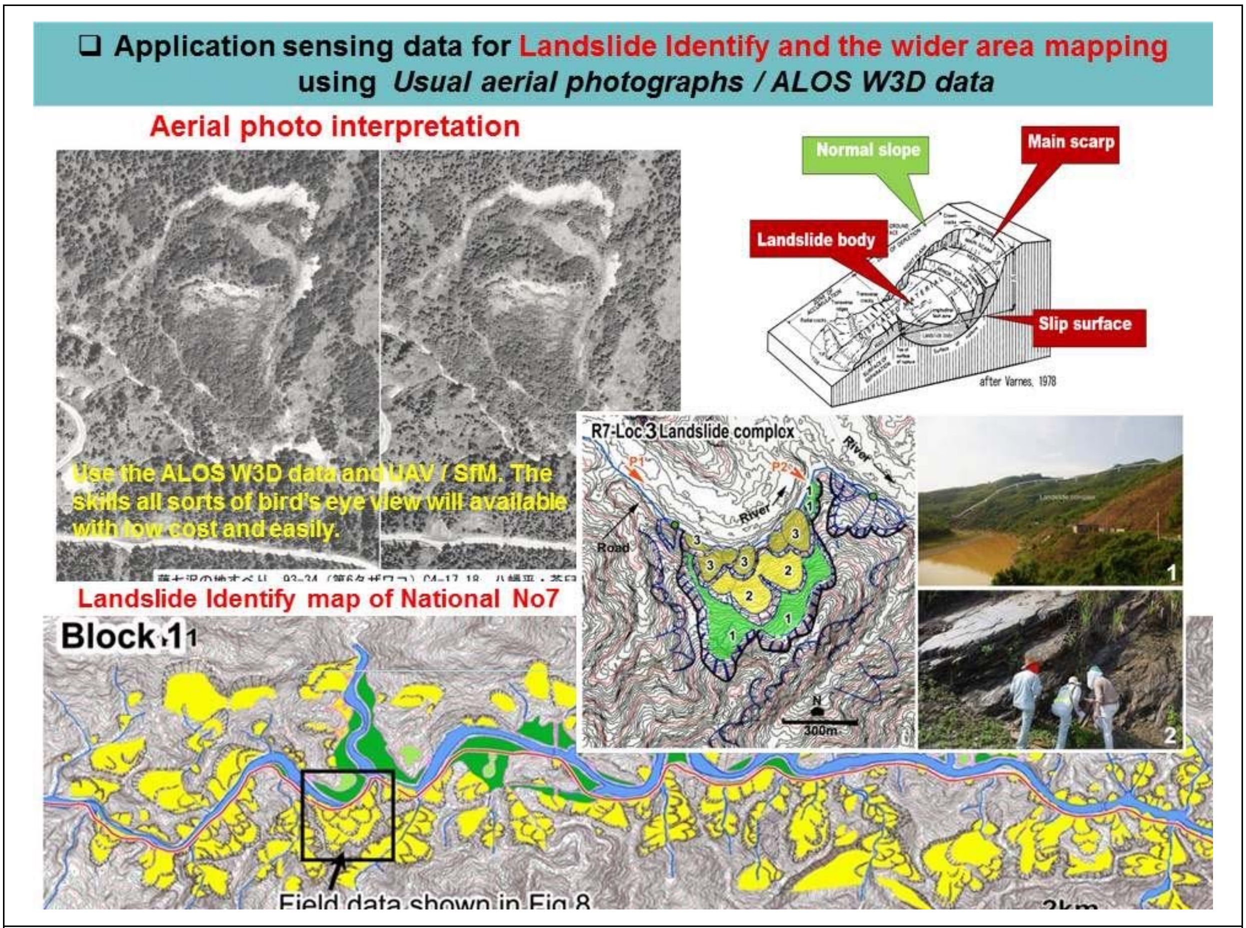


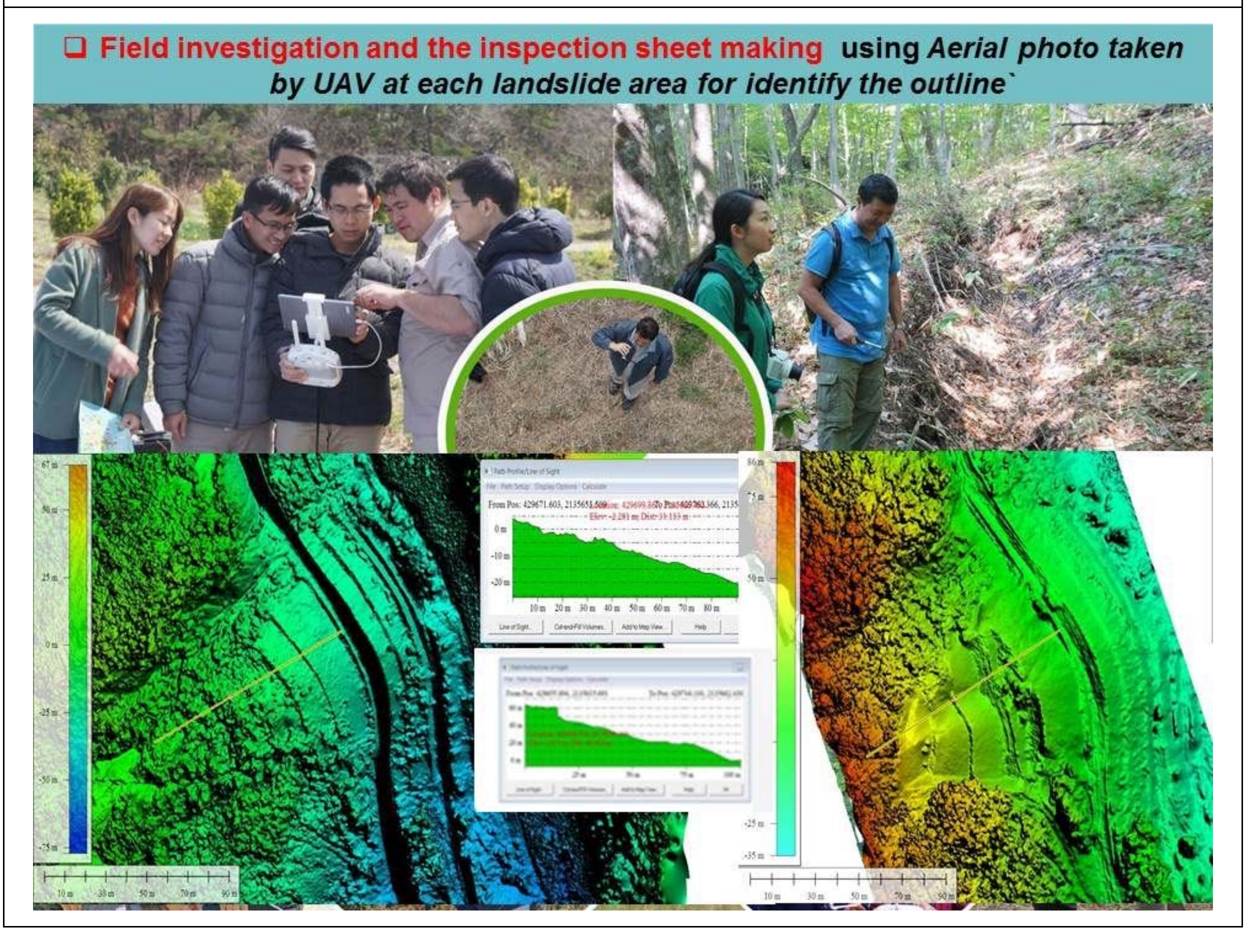


LS susceptibility Map

- slope angle, land use, rock type, total annual average precipitation, fault density, and distance to the road. - AHP

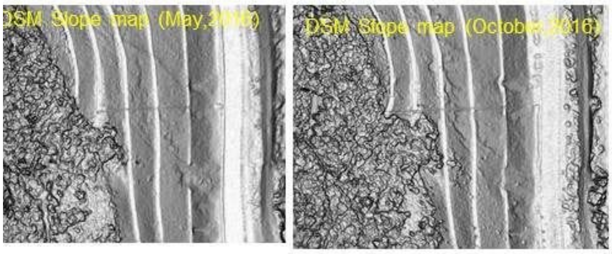
Causative Factor	[1]	[2]	[3]	[4]	[5]	[6]	[7]	Eigenvectors
[1] Fault density	1							0.0287
[2] Distance to the road	2	1						.040
[3] Rock type	5	3	1					00.0752
[4] Land use	7	5	3	1				0.1292
[5] Precipitation	8	7	4	3	1			0.2875
[6] Slope angle	9	9	5	4	2	1		0.4395
CR = 0.0578								
Sub-Table1-Slope angle								
[1] Flat-gentle slope (> 3°)	1							0.0287
[2] Fair slope (3–8°)	2	1						0.040
[3] Moderate slope (8–15°)	5	3	1					0.0752
[4] Fairly moderate slope (15–30°)	7	5	3	1				0.1292
[5] Steep slope (30–45°)	8	7	4	3	1			0.2875
[6] Very steep slope (>45°)	9	9	5	4	2	1		0.4395
CR = 0.0578								
Table 5-Land use								
[1] Special use forest land.	1							0.3192
[2] Agricultural land	2	1						0.0888
[3] Production forest land	3	2	1					0.1759
[4] Protection forest land	5	4	3	1				0.2731
[5] Special and defense forest	9	7	6	5	1			0.4303
CR = 0.0488								
Sub-Table 3-Rock type								
[1] Limestone	1							0.0238
[2] Igneous rocks	3	1						0.0452
[3] Mesozoic sedimentary rock	3	1	1					0.0452
[4] Sedimentary with coal and limestone rock.	5	3	3	1				0.0955
[5] Metamorphic+sedimentary rocks	7	5	5	3	1			0.1962
[6] Metamorphic rocks	7	5	5	3	1	1		0.1962
[7] Quaternary sediment rock	9	7	7	5	3	3	1	0.3979
CR =0.0474								
Sub- Table 4-Total annual average precipitation								
[1] <2300 mm/year	1							0.0333
[2] 2300–2600 mm/year	3	1						0.0633
[3] 2600–2900 mm/ year	5	3	1					0.129
[4] 2900–3200 mm/ year	7	5	3	1				0.2615
[5] >3200 mm/ year	9	7	5	3	1			0.5128
CR =0.0593								
Sub-Table 2-Fault density								
[1] <=150 m/km^2	1							0.0438
[2] 150–300 m/km^2	4	1						0.0885
[3] 300–4500 m/km^2	7	4	1					0.2431
[4] >=450 m/km^2	9	6	3	1				0.6246
CR =0.060								
Sub-Table 6-Distance to the road								
[3] >=100 m	1							0.1095
[2] 50–100 m	3	1						0.309
[1] <= 50 m	5	3	1					0.8516
CR =0.0018								

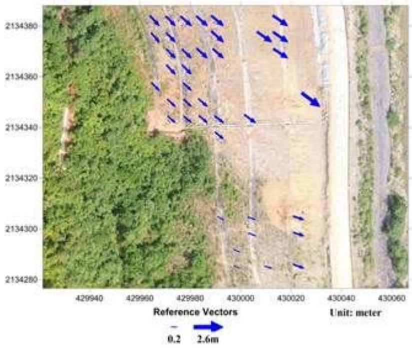

❑ Application sensing data for Landslide Identify and the wider area mapping using Usual aerial photographs / ALOS W3D data
Aerial photo interpretation
Normal slope
Main scarp
Landslide body
Slip surface
after Varnes, 1978
Use the ALOS W3D data and UAV / SfM. The skills all sorts of bird's eye view will available with low cost and easily.
R7-Loc 3 Landslide complex
River
Road
300m
Landslide Identify map of National No7
Block 11
Field data shown in Fig.8


❑ Field investigation and the inspection sheet making using Aerial photo taken by UAV at each landslide area for identify the outline`

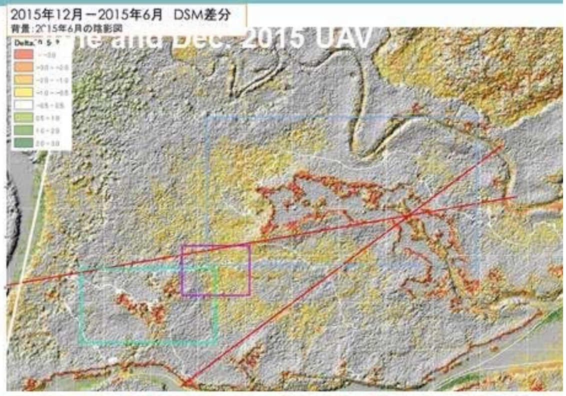
❑ Recognition of pre-landslide by DSM comparing

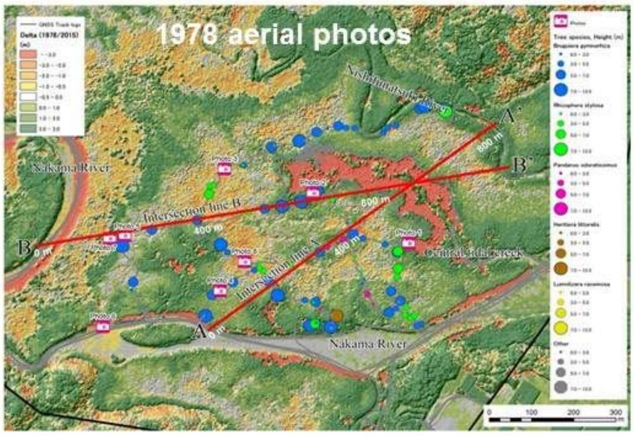
Landslide on national highway No7,Vietnam



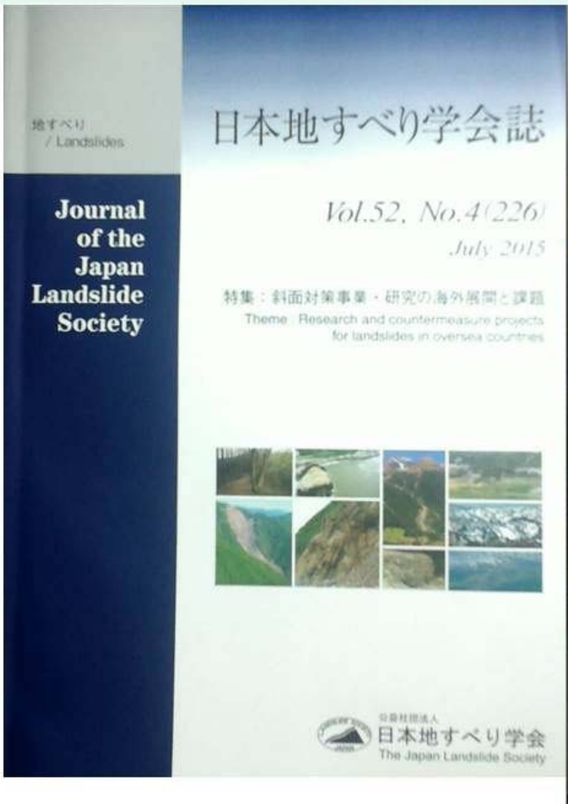


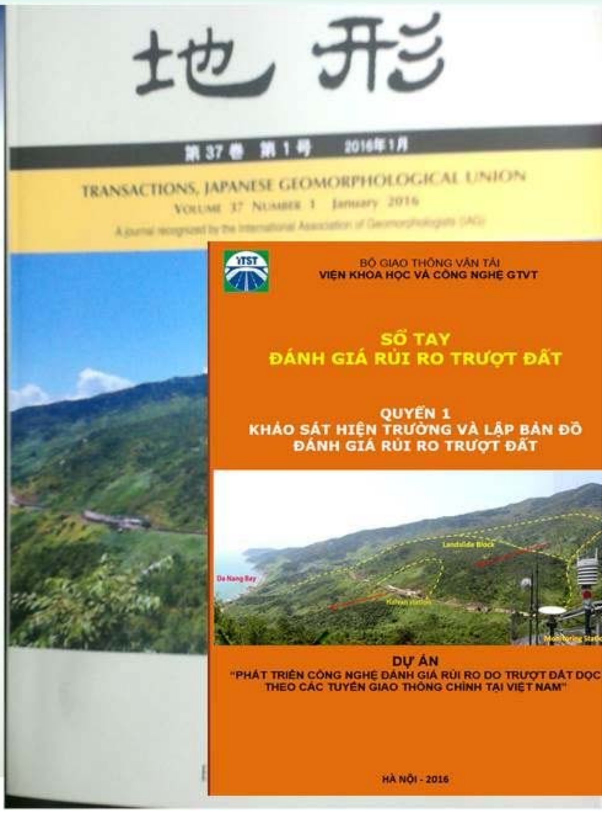
Result compare 2 DSMs by PIV





❑ Book1 includes **8 guidelines** is under development., **10 papers** were published ❑






Vietnam-Japan SATREPS Project "Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam"
Institute of Transport Science and Technology (ITST) and International Consortium on Landslides (ICL)
ITST
ICL
ISO 9001 : 2008
THANKS FOR YOUR ATTENTION !
International Consortium on Landslides (ICL) and Institute of Transport Science and Technology (ITST) - MOT- Vietnam

Japan-Vietnam SATREPS Final Workshop

Monitoring system in Hai Van and landslide flume construction in ITST, Vietnam

Hirotaka Ochiai, Shiho Asano (Forestry and Forest Products Research Institute),
Huynh Dang Vinh, Do Ngoc Ha (Institute of Transport Science and Technology)

Purpose of Landslide monitoring and flume test

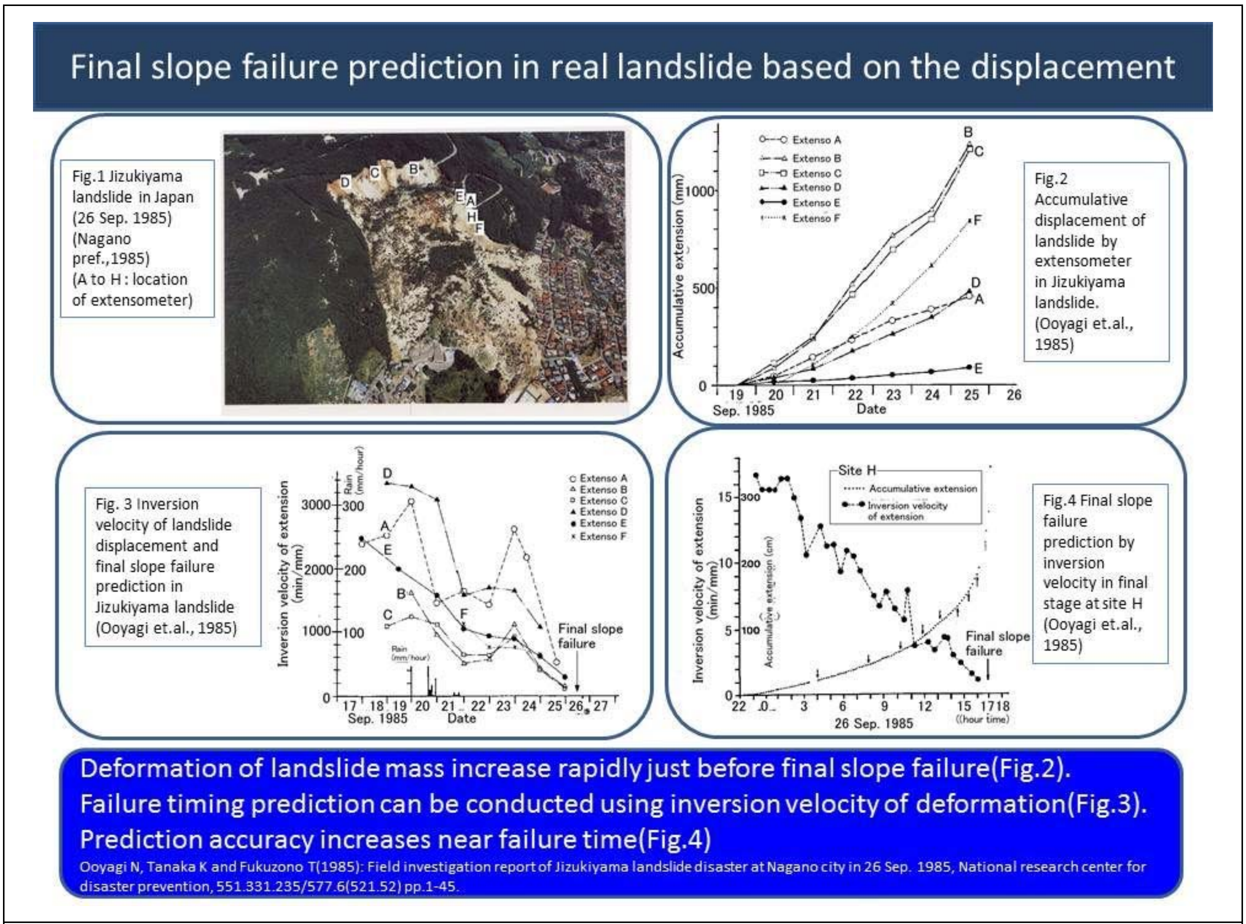
When landslide prone slopes are estimated by the mapping or actual slope deformation, we need to consider about risk level of collapse.

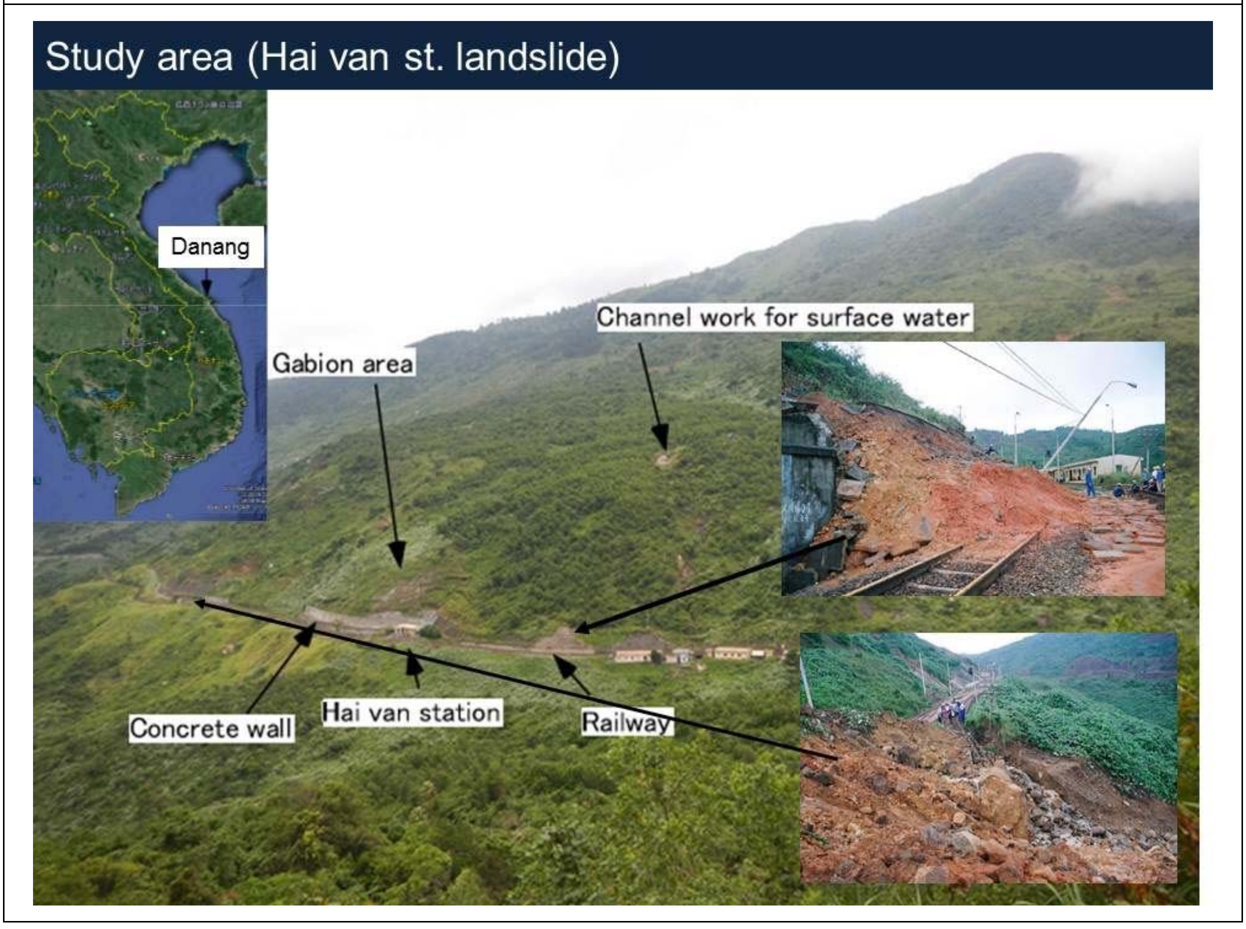
Specific landslide risk level and estimation of collapse time for the early warning from disaster is able to be considered based on the actual landslide phenomenon. Landslide monitoring is very important for the risk level estimation,.

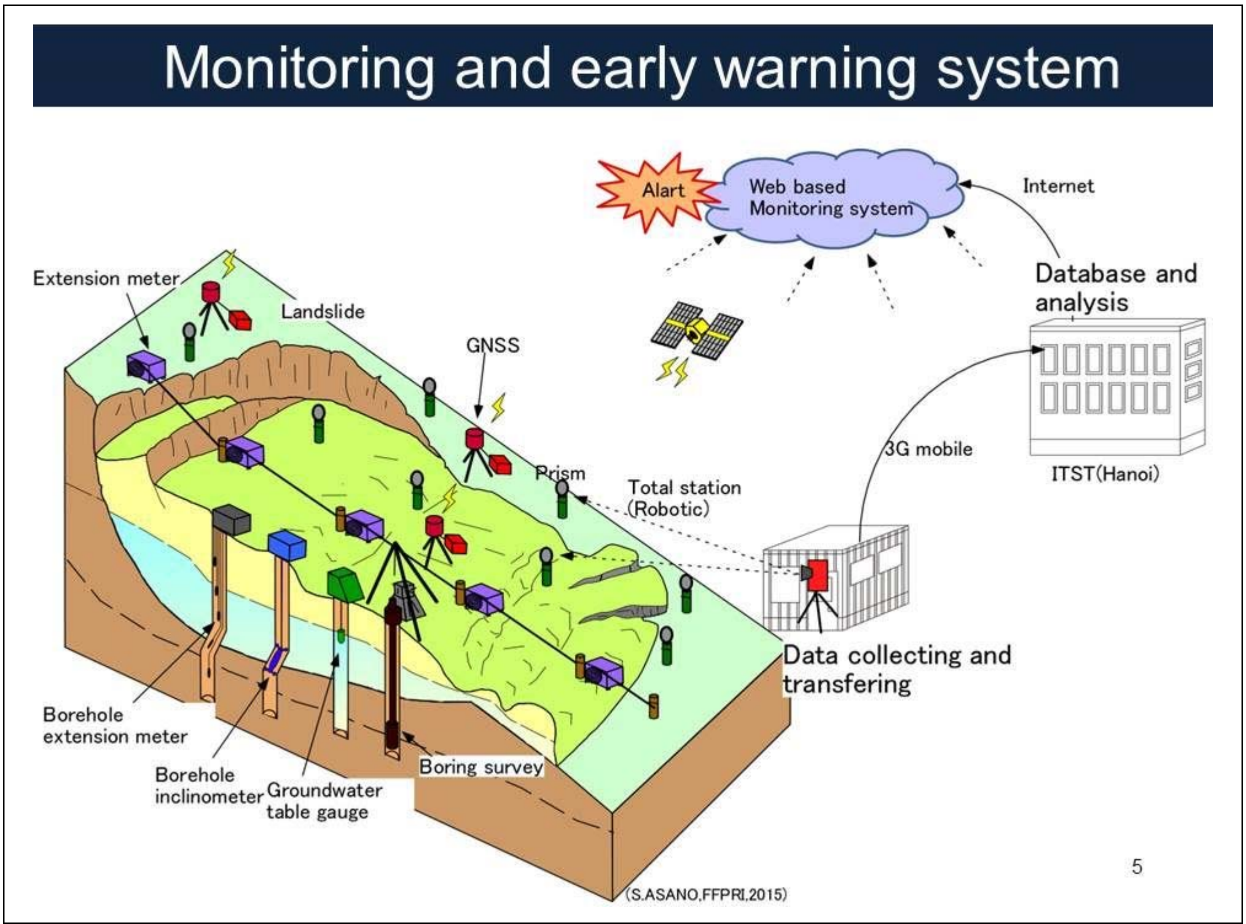
Web based the landslide monitoring system is developed and installed on the landslide prone slopes.

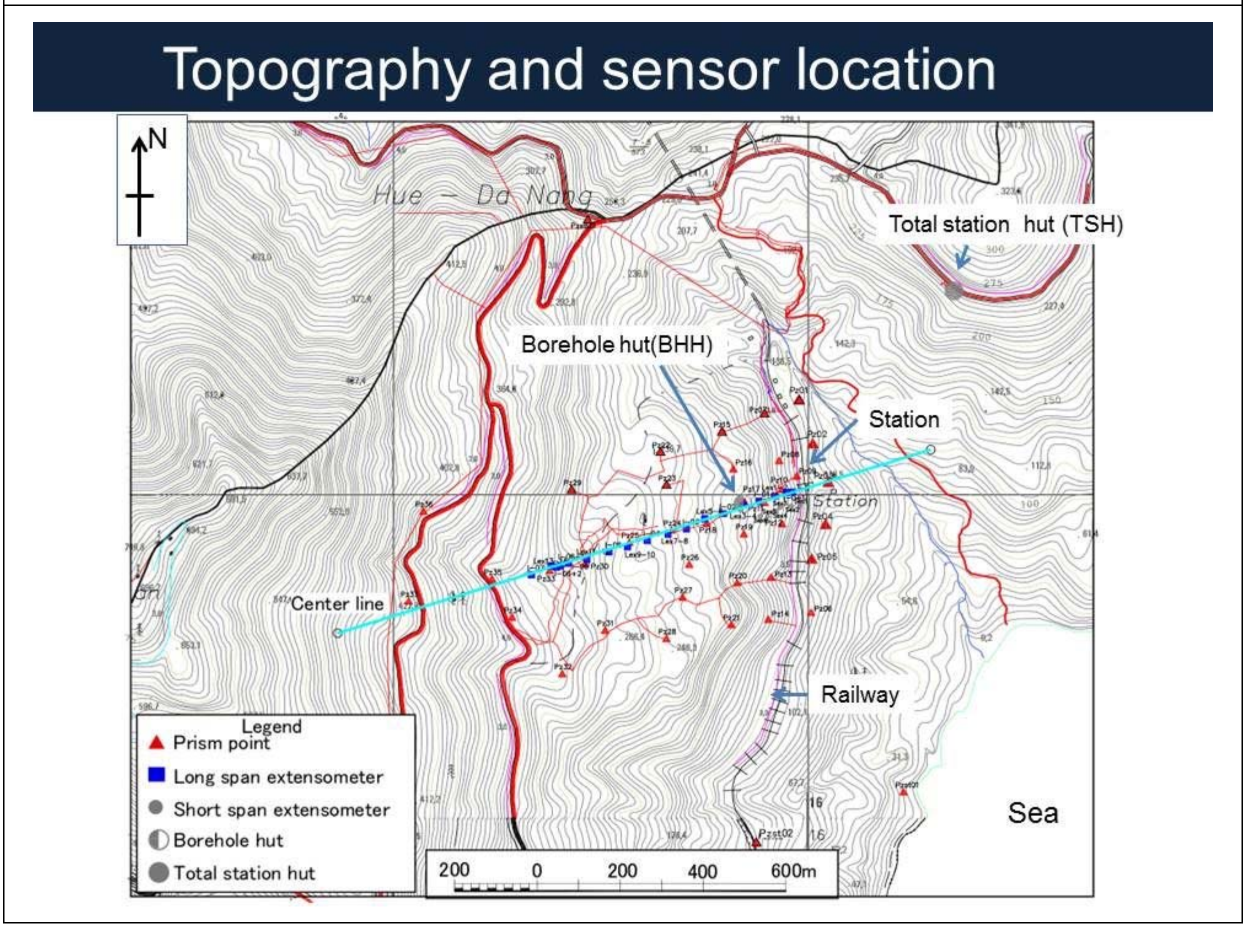
This system is consisted by many sensors that utilized various kind of technology and presented the real time monitoring data on web.
It could be useful for clarification of landslide mechanism for the early warning.
It will be the prototype model of landslide monitoring in Vietnam in a future.

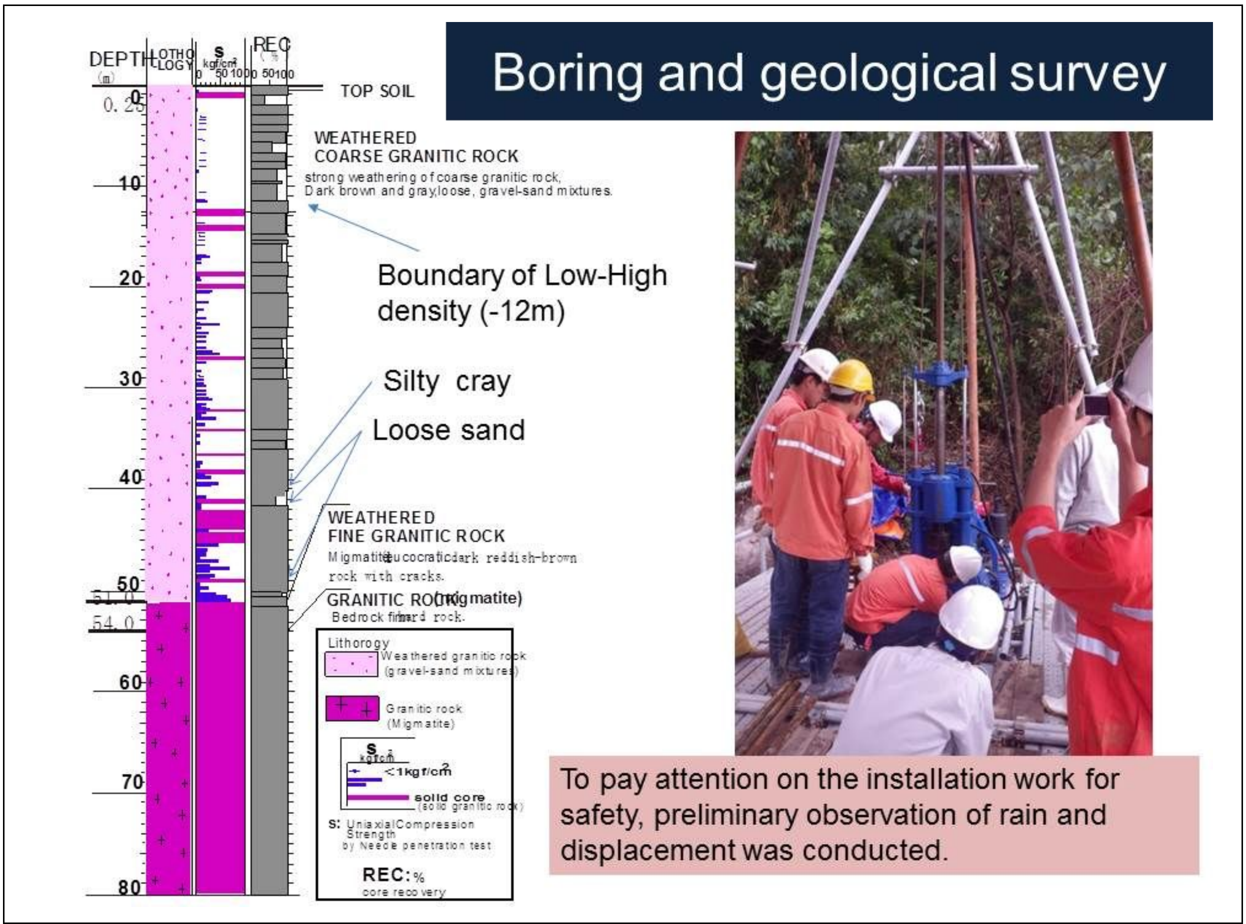
Relationship between landslide displacement and initiation is different on each landslide is necessary for forecasting and early warning.
The landslide flume equipment by rainfall simulator is installed in ITST and landslide examination is started for early warning.

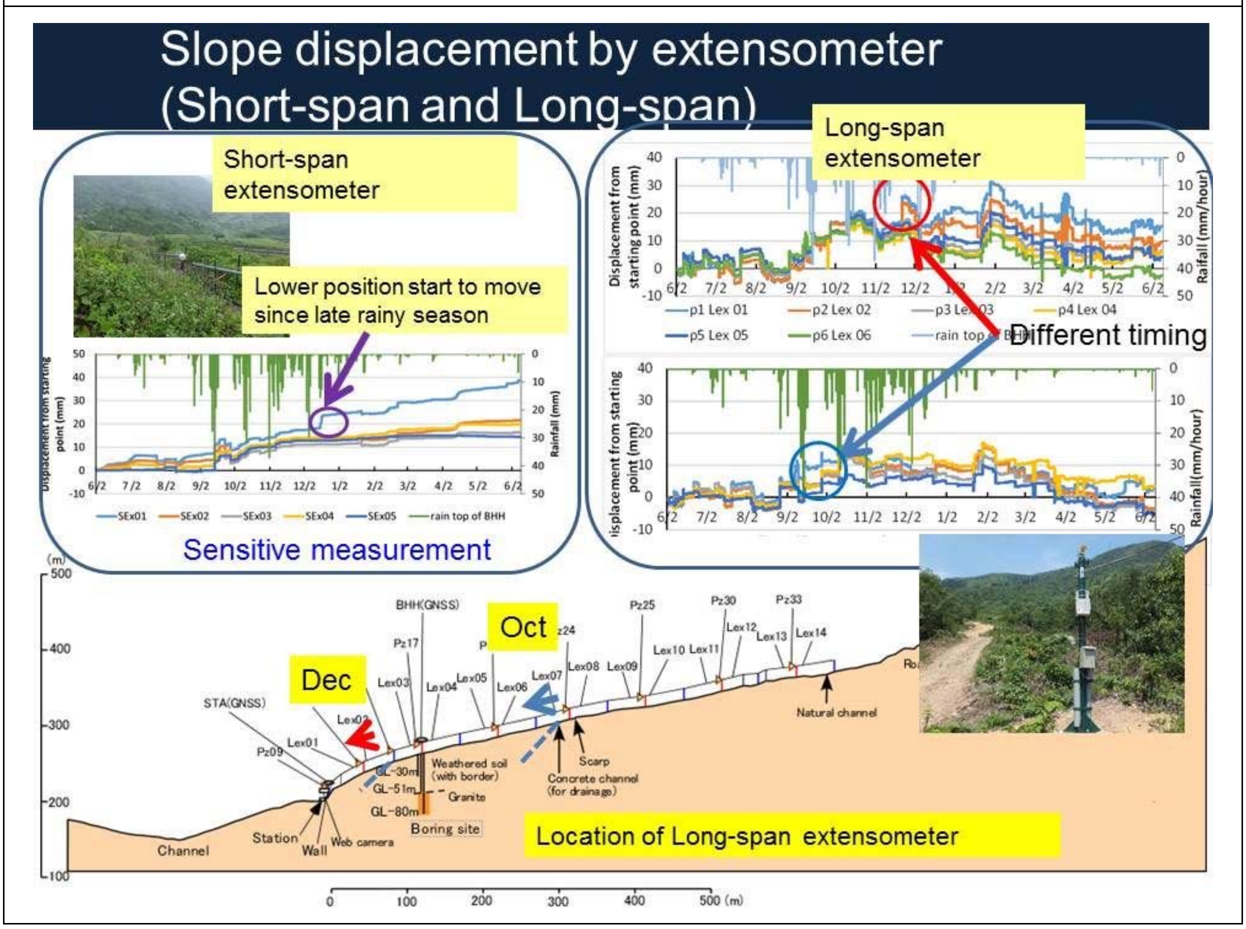

Final slope failure prediction in real landslide based on the displacement
Fig.1 Jizukiyama landslide in Japan (26 Sep. 1985) (Nagano pref.,1985) (A to H : location of extensometer)
Fig.2 Accumulative displacement of landslide by extensometer in Jizukiyama landslide. (Ooyagi et.al., 1985)
Accumulative extension (mm)
Extenso A
Extenso B
Extenso C
Extenso D
Extenso E
Extenso F
Sep. 1985
Date
Fig. 3 Inversion velocity of landslide displacement and final slope failure prediction in Jizukiyama landslide (Ooyagi et.al., 1985)
Inversion velocity of extension (min/mm)
Rain (mm/hour)
Final slope failure
Fig.4 Final slope failure prediction by inversion velocity in final stage at site H (Ooyagi et.al., 1985)
Site H
Accumulative extension
Inversion velocity of extension
Accumulative extension (cm)
26 Sep. 1985
(hour time)
Deformation of landslide mass increase rapidly just before final slope failure(Fig.2).
Failure timing prediction can be conducted using inversion velocity of deformation(Fig.3).
Prediction accuracy increases near failure time(Fig.4)
Ooyagi N, Tanaka K and Fukuzono T(1985): Field investigation report of Jizukiyama landslide disaster at Nagano city in 26 Sep. 1985, National research center for disaster prevention, 551.331.235/577.6(521.52) pp.1-45.

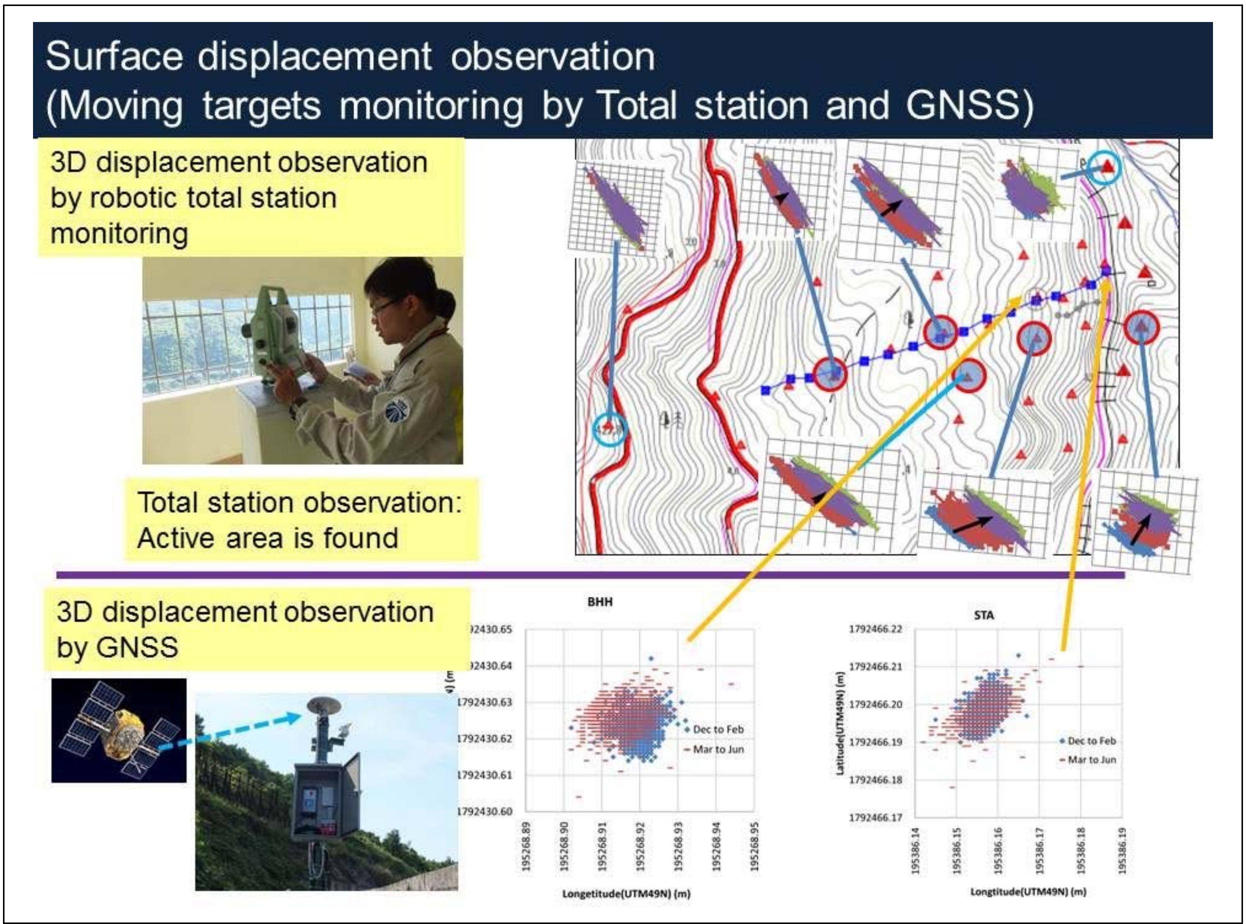

Study area (Hai van st. landslide)
Danang
Gabion area
Channel work for surface water
Concrete wall
Hai van station
Railway

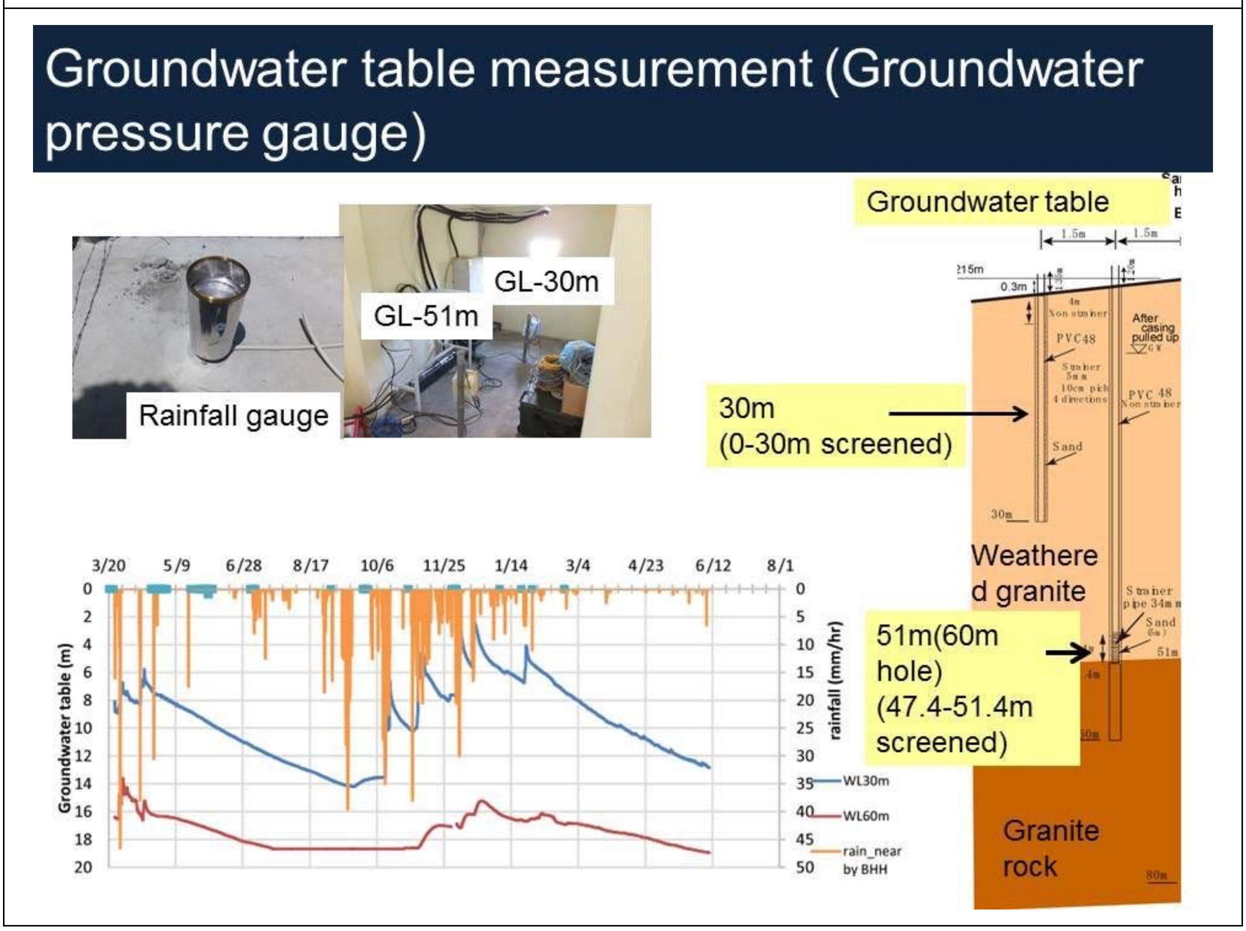

Monitoring and early warning system
Alart
Web based
Monitoring system
Internet
Database and
analysis
Extension meter
Landslide
GNSS
Prism
Total station
(Robotic)
3G mobile
ITST(Hanoi)
Data collecting and
transfering
Borehole
extension meter
Borehole
inclinometer
Groundwater
table gauge
Boring survey
5
(S.ASANO,FFPRI,2015)

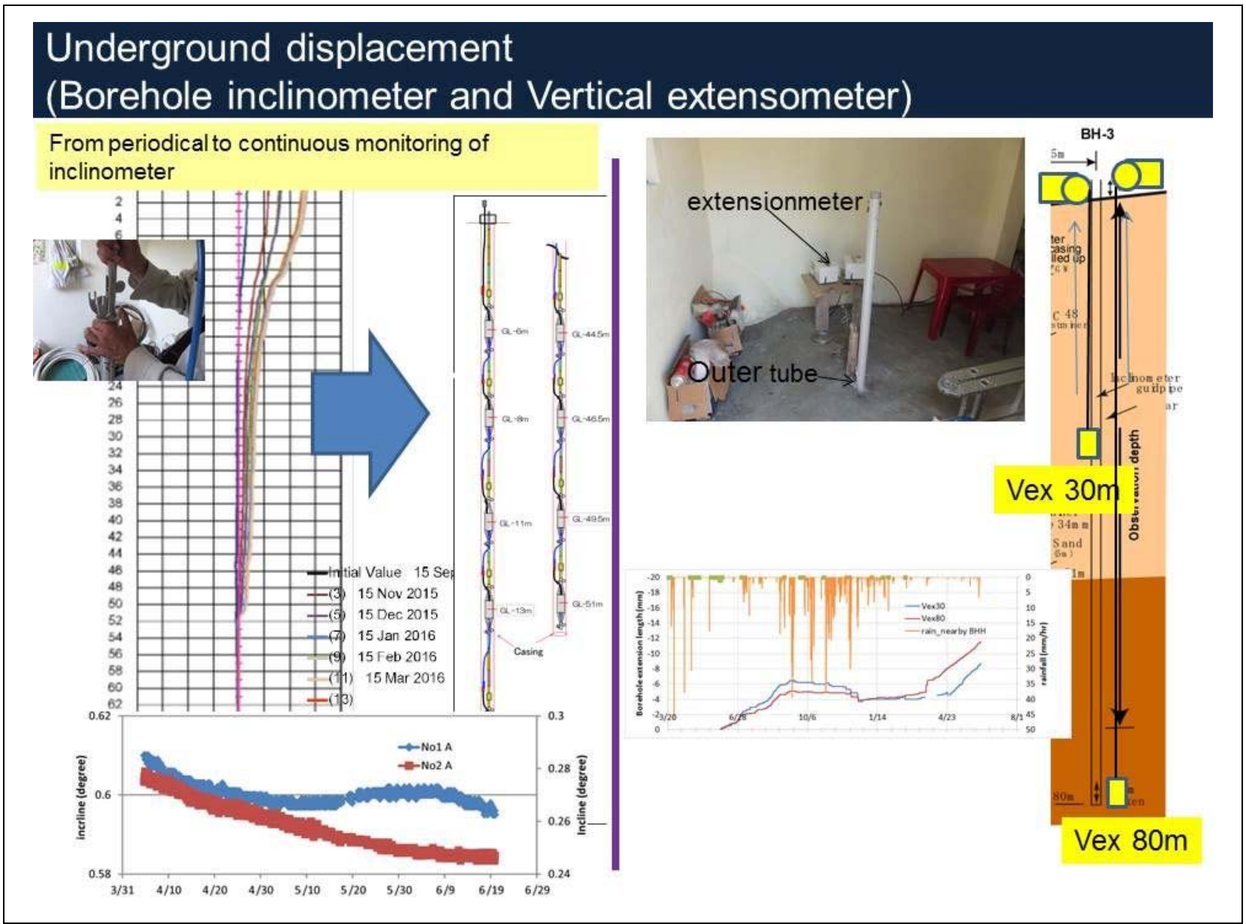

Topography and sensor location
N
Hue – Da Nang
Total station hut (TSH)
Borehole hut(BHH)
Station
Center line
Railway
Sea
Legend
Prism point
Long span extensometer
Short span extensometer
Borehole hut
Total station hut
200 0 200 400 600m

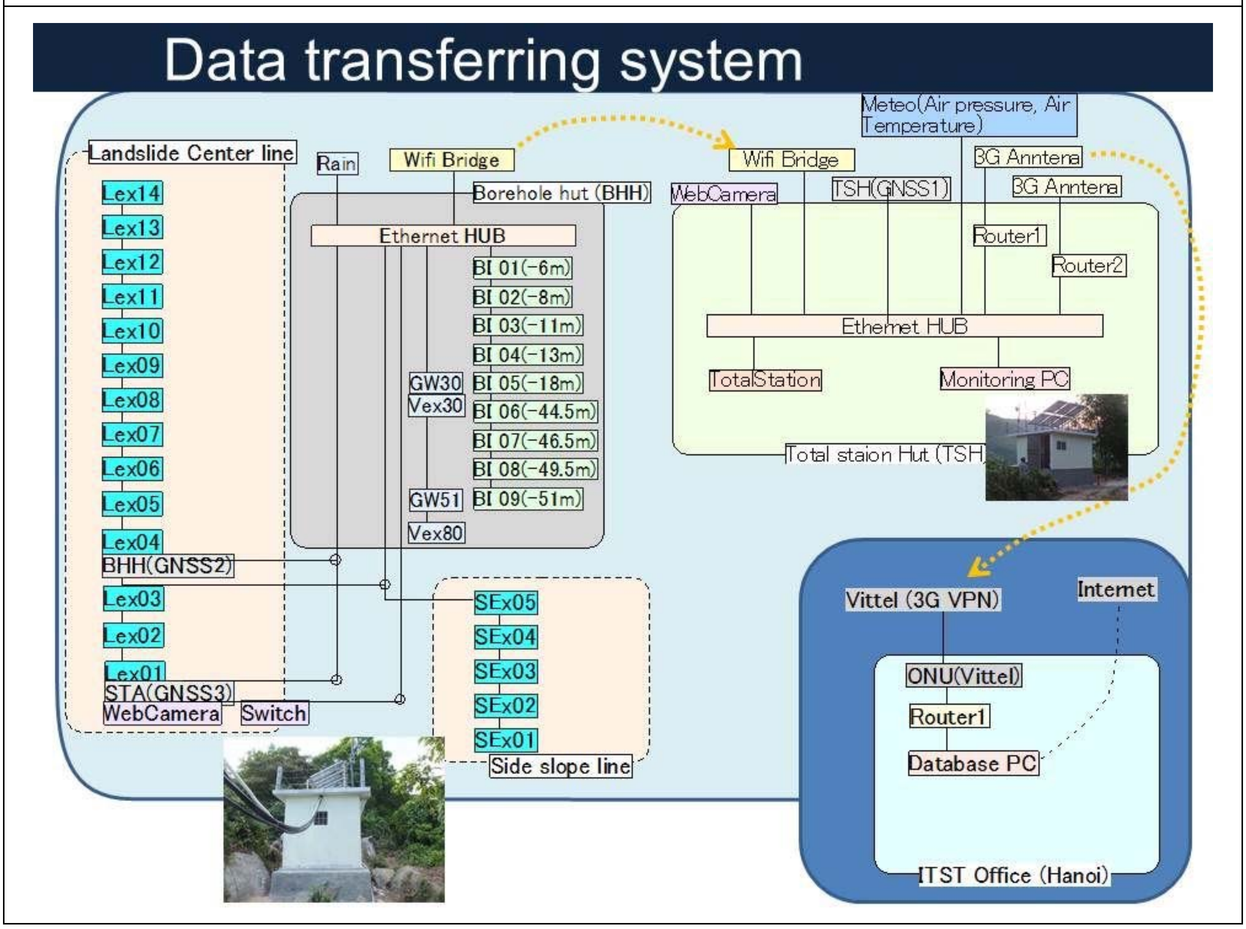

Boring and geological survey
DEPTH
LITHOLOGY
REC
TOP SOIL
WEATHERED
COARSE GRANITIC ROCK
strong weathering of coarse granitic rock,
Dark brown and gray,loose, gravel-sand mixtures.
Boundary of Low-High
density (-12m)
Silty cray
Loose sand
WEATHERED
FINE GRANITIC ROCK
GRANITIC ROCK
Lithorogy
Weathered granitic rock
(gravel-sand mixtures)
Granitic rock
(Migmatite)
solid core
S: Uniaxial Compression Strength
by Needle penetration test
REC: %
core recovery
To pay attention on the installation work for safety, preliminary observation of rain and displacement was conducted.


Slope displacement by extensometer
(Short-span and Long-span)
Short-span
extensometer
Lower position start to move
since late rainy season
Sensitive measurement
Long-span
extensometer
Different timing
Displacement from starting point (mm)
Raifall (mm/hour)
Rainfall(mm/hour)
p1 Lex 01
p2 Lex 02
p4 Lex 04
p5 Lex 05
p6 Lex 06
SEx01
SEx02
SEx03
SEx04
SEx05
rain top of BHH
Oct
Dec
BHH(GNSS)
STA(GNSS)
Natural channel
Weathered soil
(with border)
Granite
Scarp
Concrete channel
(for drainage)
Boring site
Station
Wall
Web camera
Channel
Location of Long-span extensometer


Surface displacement observation
(Moving targets monitoring by Total station and GNSS)
3D displacement observation by robotic total station monitoring
Total station observation: Active area is found
3D displacement observation by GNSS
BHH
Dec to Feb
Mar to Jun
Longetitude(UTM49N) (m)
STA
Latitude(UTM49N) (m)
Longtitude(UTM49N) (m)

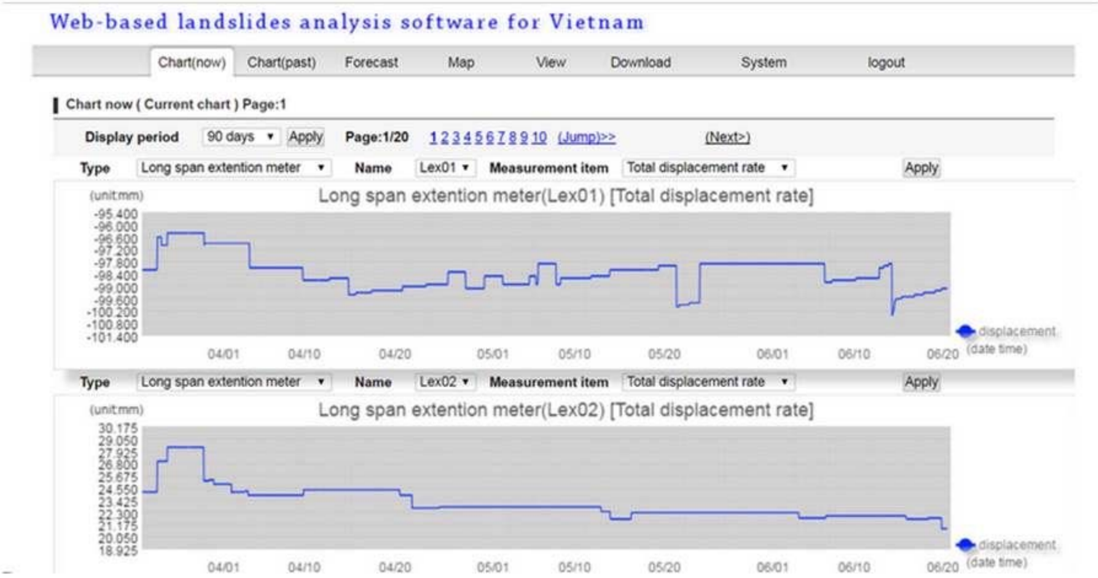

Groundwater table measurement (Groundwater pressure gauge)
Rainfall gauge
GL-51m
GL-30m
Groundwater table
30m
(0-30m screened)
51m(60m hole)
(47.4-51.4m screened)
Weathered granite
Granite rock
Groundwater table (m)
rainfall (mm/hr)
WL30m
WL60m
rain_near by BHH
3/20
5/9
6/28
8/17
10/6
11/25
1/14
3/4
4/23
6/12
8/1


Underground displacement
(Borehole inclinometer and Vertical extensometer)
From periodical to continuous monitoring of inclinometer
Initial Value 15 Sep
(3) 15 Nov 2015
(5) 15 Dec 2015
(7) 15 Jan 2016
(9) 15 Feb 2016
(11) 15 Mar 2016
(13)
No1 A
No2 A
Incline (degree)
Casing
extensionmeter
Outer tube
BH-3
Vex 30m
Vex 80m
Observation depth
Vex30
Vex80
rain_nearby BHH

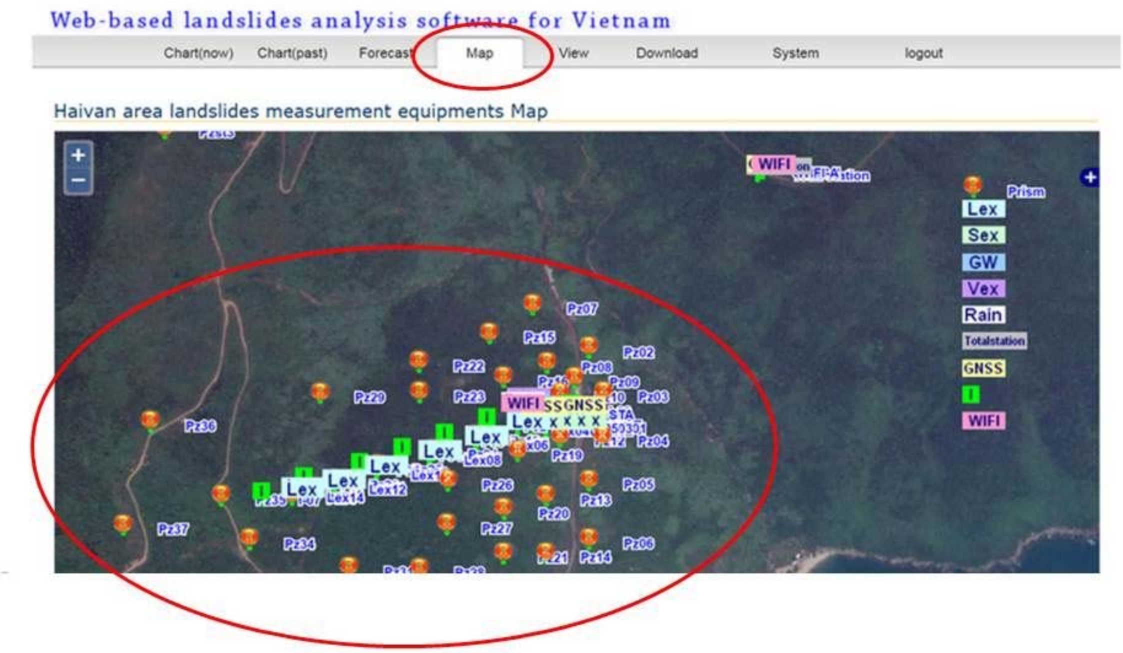

Data transferring system
Landslide Center line
Lex14
Lex13
Lex12
Lex11
Lex10
Lex09
Lex08
Lex07
Lex06
Lex05
Lex04
BHH(GNSS2)
Lex03
Lex02
Lex01
STA(GNSS3)
WebCamera
Switch
Rain
Wifi Bridge
Borehole hut (BHH)
Ethernet HUB
BI 01(-6m)
BI 02(-8m)
BI 03(-11m)
BI 04(-13m)
BI 05(-18m)
BI 06(-44.5m)
BI 07(-46.5m)
BI 08(-49.5m)
BI 09(-51m)
GW30
Vex30
GW51
Vex80
SEx05
SEx04
SEx03
SEx02
SEx01
Side slope line
Meteo(Air pressure, Air Temperature)
Wifi Bridge
3G Anntena
WebCamera
TSH(GNSS1)
3G Anntena
Router1
Router2
Ethernet HUB
TotalStation
Monitoring PC
Total staion Hut (TSH)
Vittel (3G VPN)
Internet
ONU(Vittel)
Router1
Database PC
ITST Office (Hanoi)

Web observation

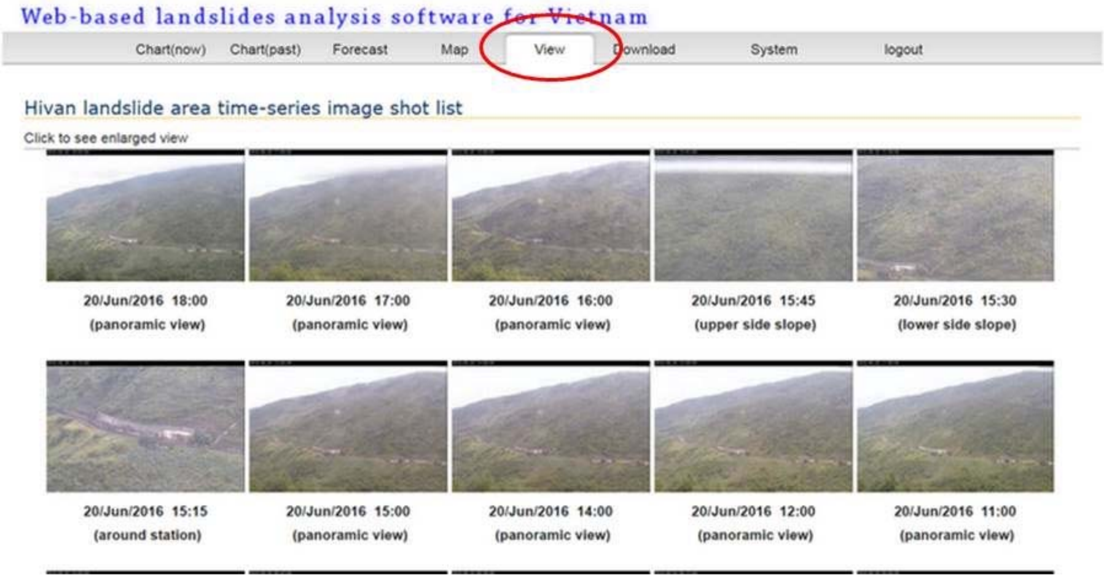
・All data can be seen and downloaded on the web-site.
・The web site needs to be accessed by the parties concerned of Hai van landslide monitoring.
・Access level (ex. High or low) of web site will be set in order to use effectivly.



"Map"



"View"



Construction of landslide experimental facilities

In 2013, landslide experimental facility was designed and the building was made. In 2014, the data logging system and sensors are donated. The landslide flume was designed based on the soil properties of the weathered granite of Hai Van area. In 2015, the landslide flume with rainfall simulator was constructed and first landslide experiment in Vietnam was conducted in ITST in November 2015.
Vietnamese researchers participate in developing these facilitie, are encouraged for human resources development. They are expected to be key persons after the project finished.

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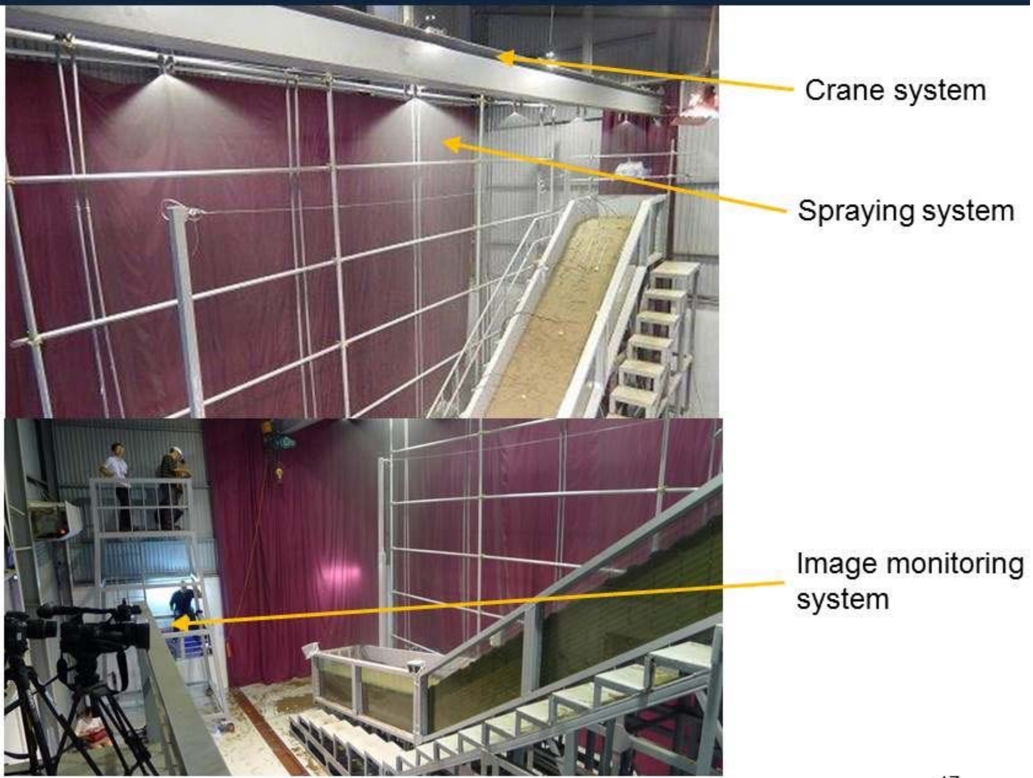
Landslide flume

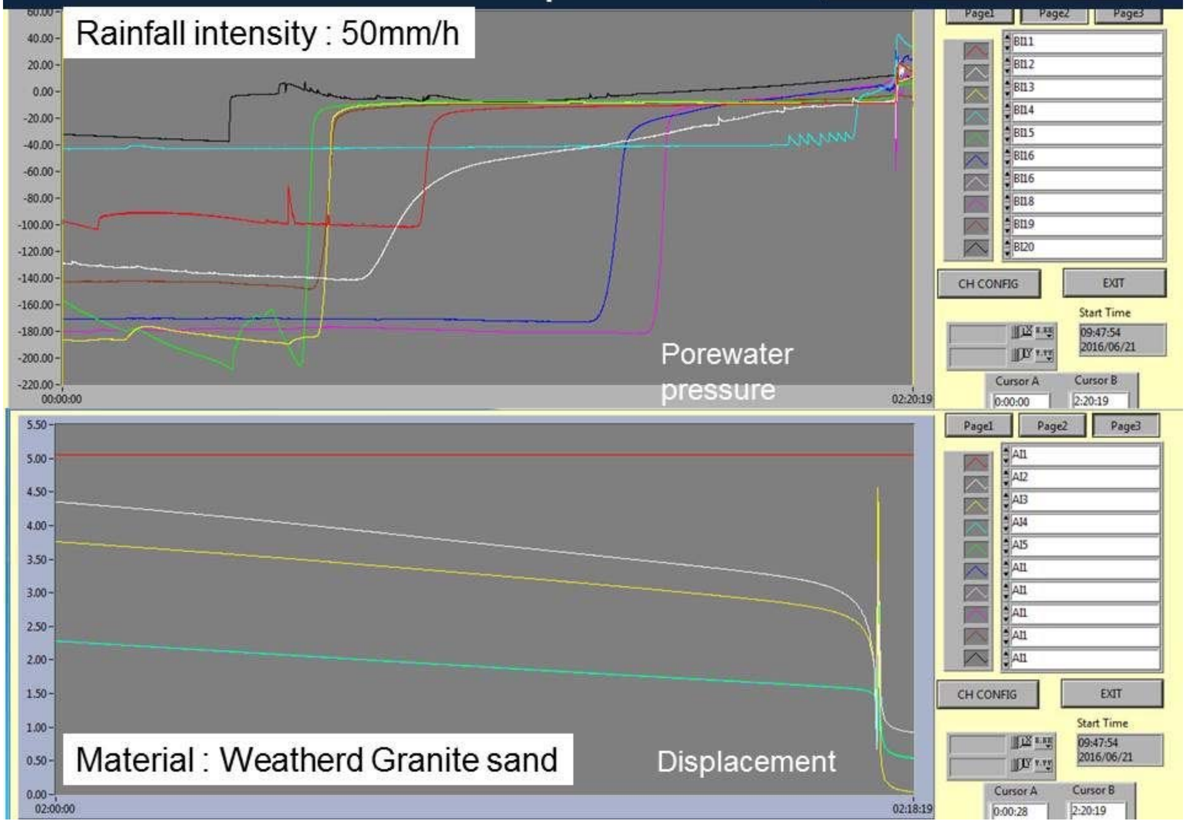


Landslide experiment started in ITST from November 2015.

17

Result of landslide experiment

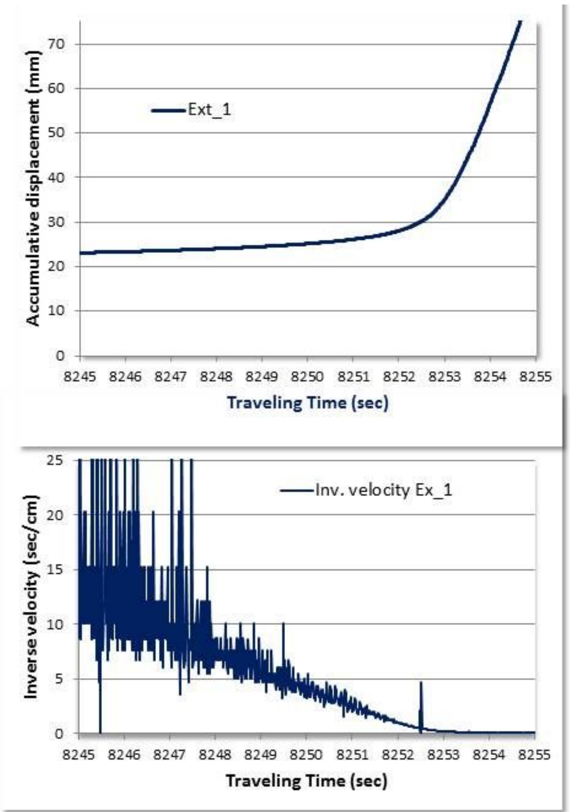
Date : June 21, 2016



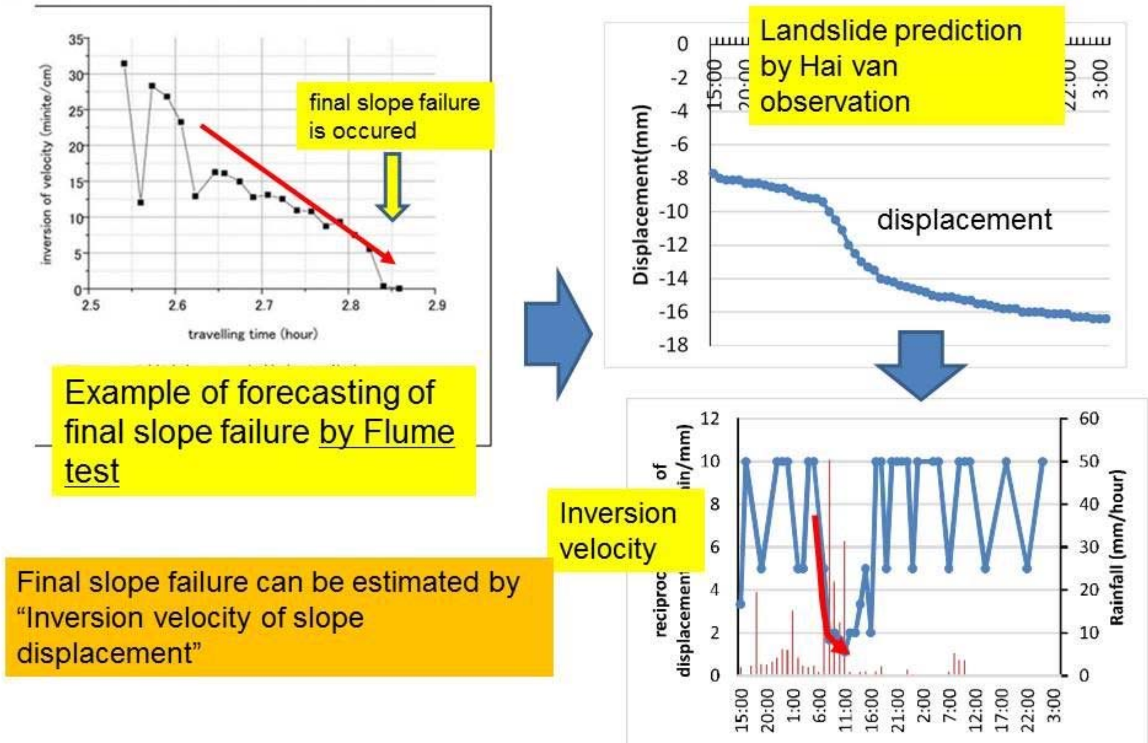
Landslide occurrence on the flume

19

Results of inverse velocity from the displacement of the 4th experiment in Jul. 21, 2016



Trial test of forecasting with observed data in Hai van



Conclusion

Landslide monitoring system was developed and installed in Hai van slopes.

It provides the newest information of landslide activity and risks for early warning.

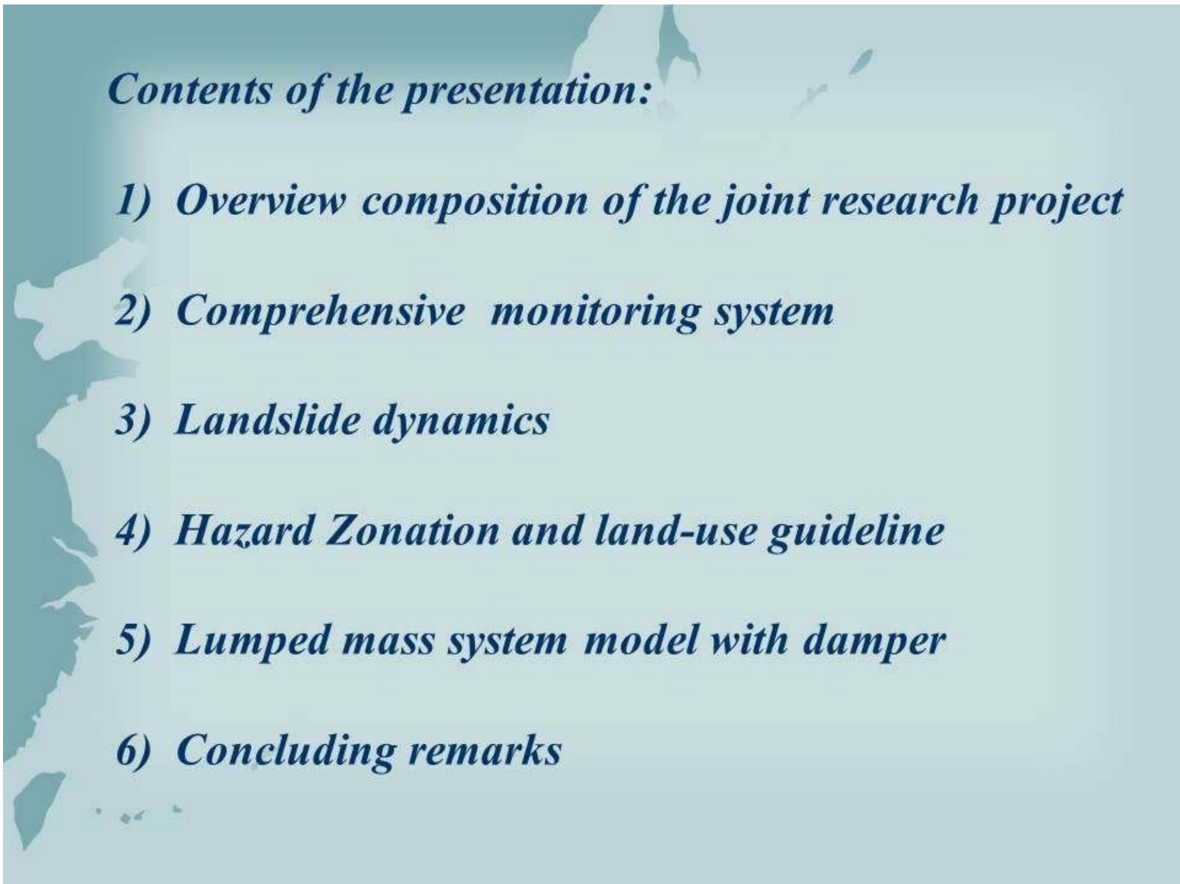
Landslide flume experiment was started. It provides the important information about the relationship between landslide activity and landslide risks based on the landslide mechanism.

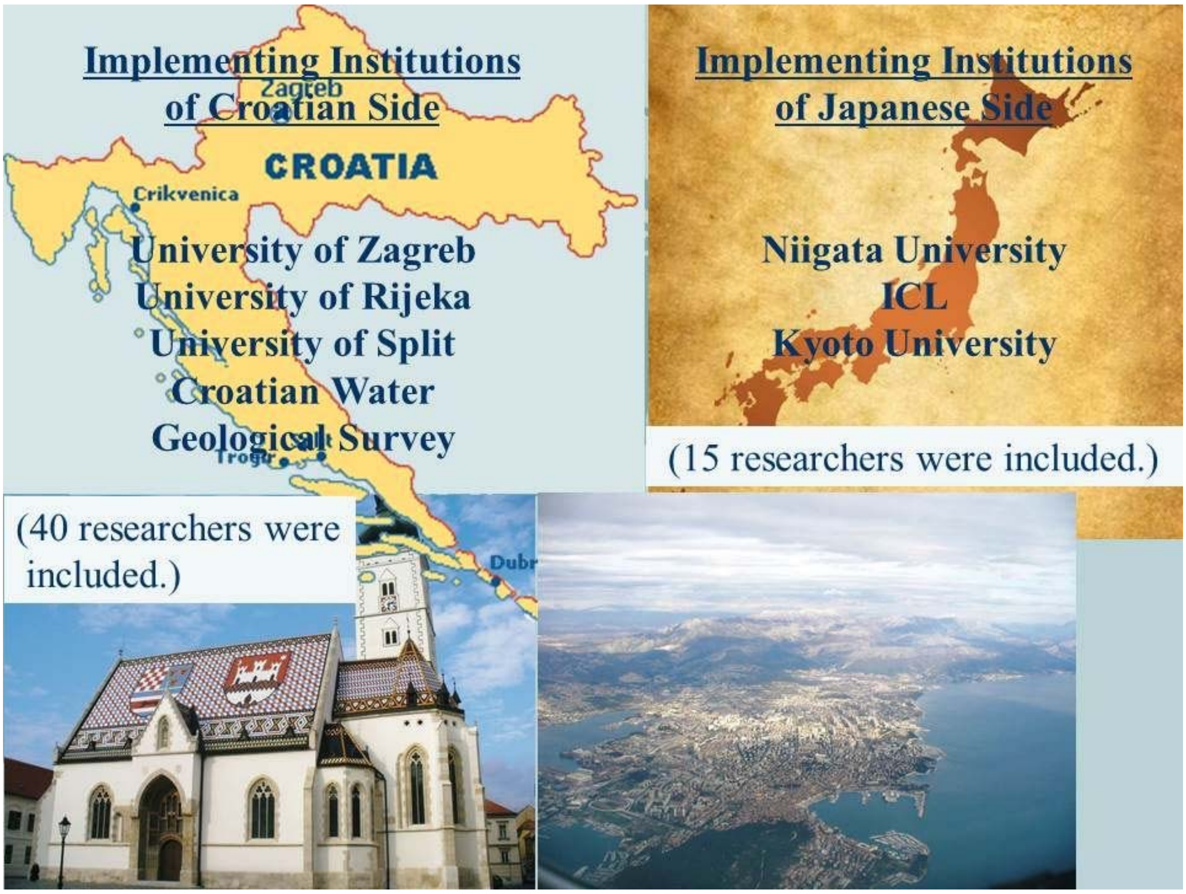
These system will contribute to reduce the large-scale landslide disaster triggered by heavy rain.

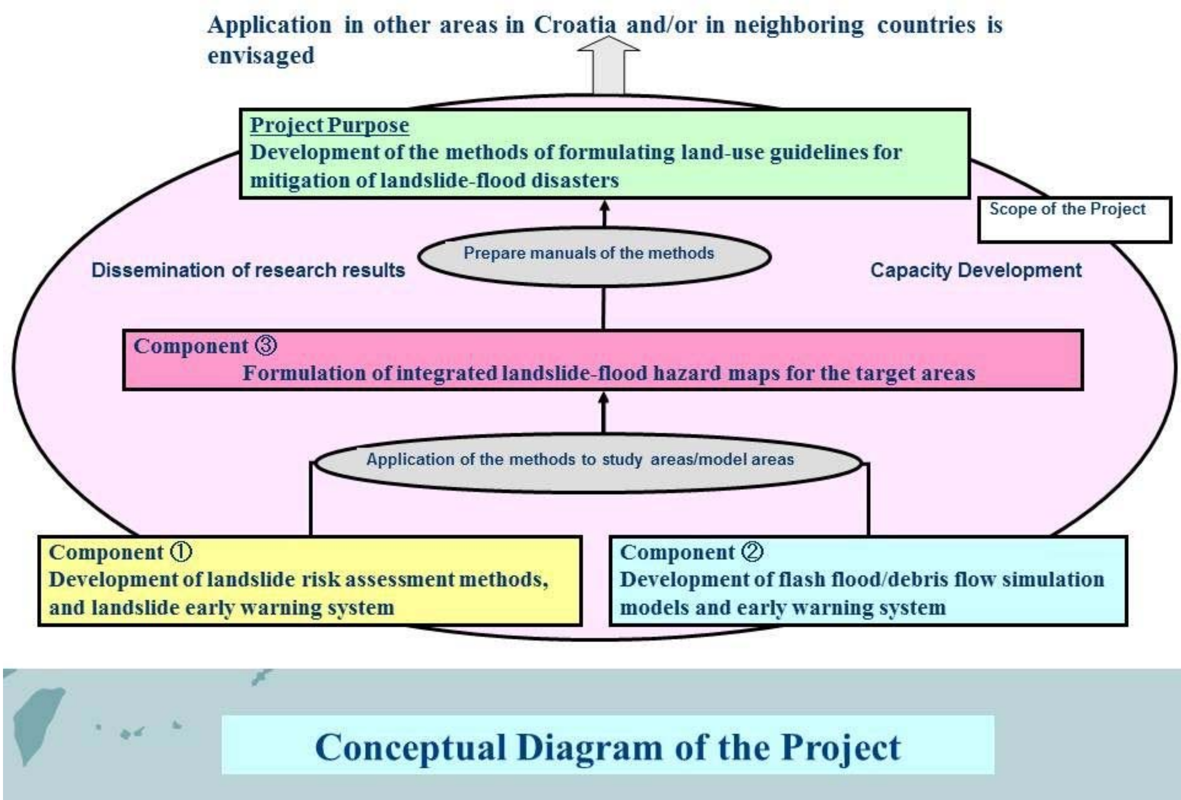
This system is specialized for the specific landslide.
When the landslide risk estimation for the wide transportation system would be needed, another type of the warning system should be consider (ex. rainfall and soil water forecasting).

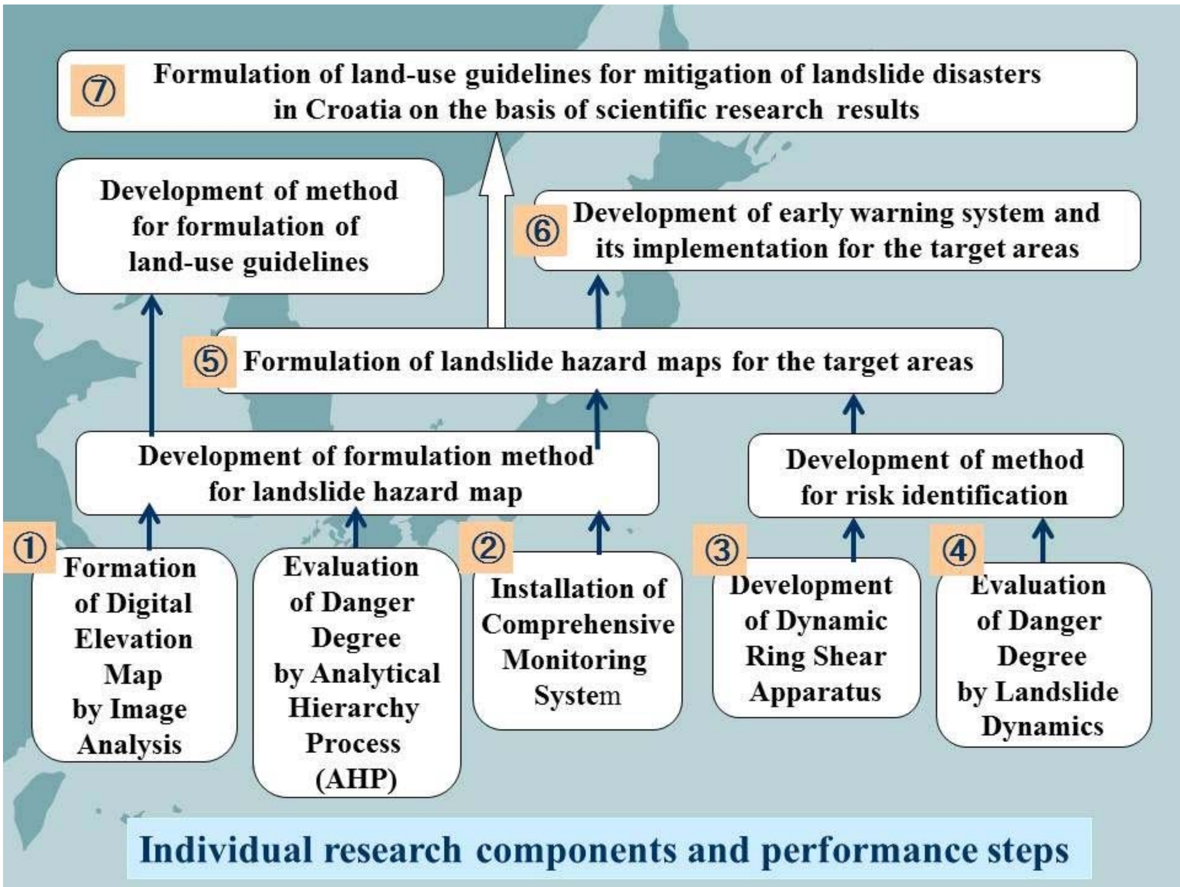

Channel work for surface water
Gabion area
Thank you very much!
Concrete wall
Hai van station
Railway


November 24, 2016 TKP/Tokyo
International Forum
"JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION"
Organized by ICL, Japan Landslide Society
"INSTRUCTION AND ESSENTIAL OUTPUTS OF THE CROATIAN-JAPANESE RESEARCH PROJECT ON LANDSLIDES"
Hideaki MARUI, Niigata University

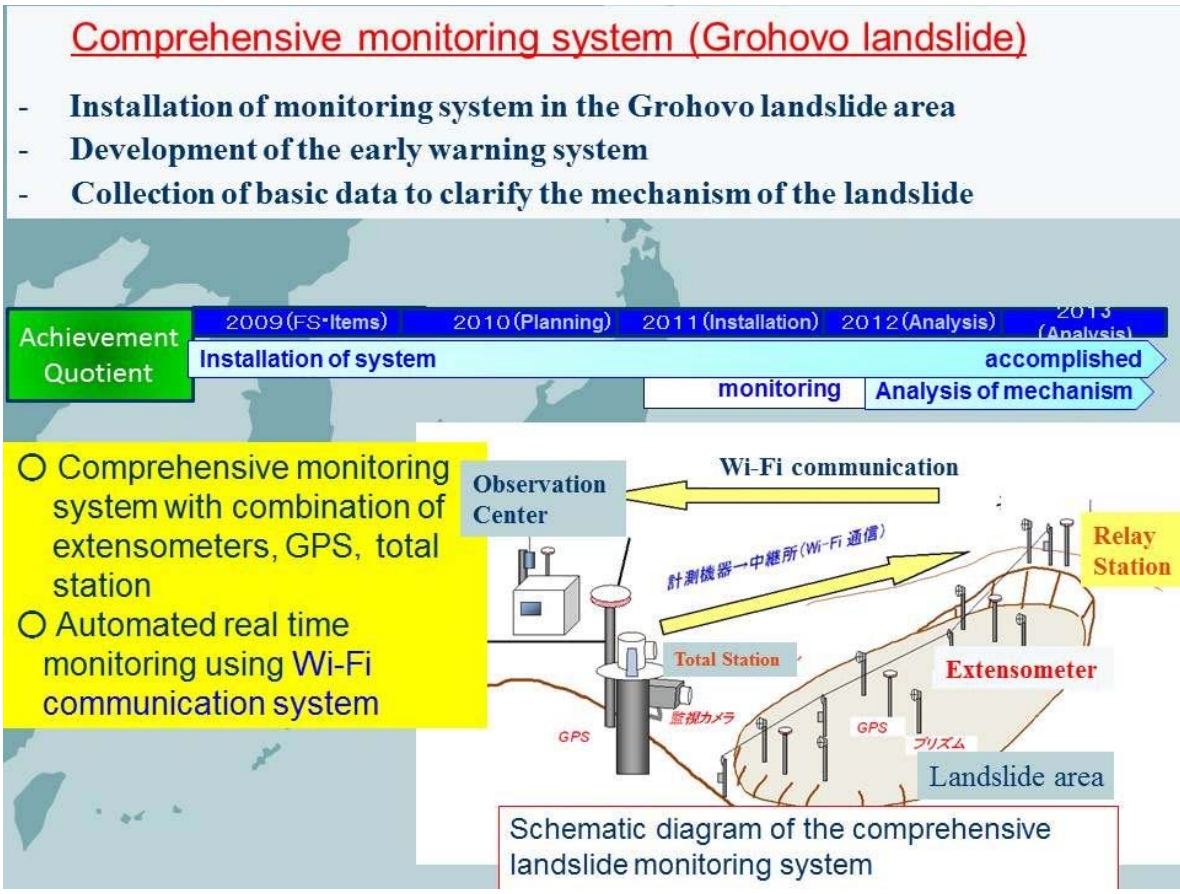

Contents of the presentation:
1) Overview composition of the joint research project
2) Comprehensive monitoring system
3) Landslide dynamics
4) Hazard Zonation and land-use guideline
5) Lumped mass system model with damper
6) Concluding remarks


Implementing Institutions of Croatian Side
Zagreb
CROATIA
Crikvenica
University of Zagreb
University of Rijeka
University of Split
Croatian Water
Geological Survey
(40 researchers were included.)
Dubr
Implementing Institutions of Japanese Side
Niigata University
ICL
Kyoto University
(15 researchers were included.)

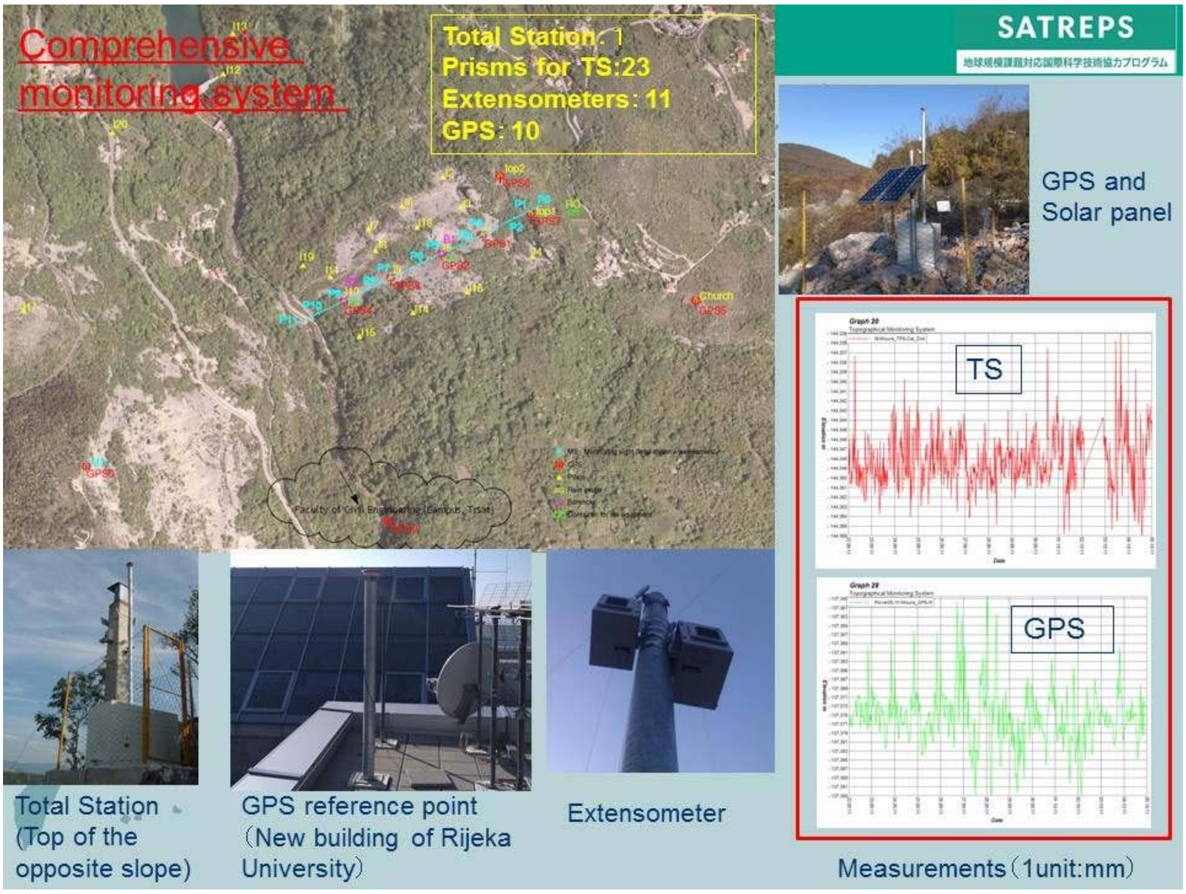

Application in other areas in Croatia and/or in neighboring countries is envisaged
Project Purpose
Development of the methods of formulating land-use guidelines for mitigation of landslide-flood disasters
Scope of the Project
Prepare manuals of the methods
Dissemination of research results
Capacity Development
Component ③
Formulation of integrated landslide-flood hazard maps for the target areas
Application of the methods to study areas/model areas
Component ①
Development of landslide risk assessment methods, and landslide early warning system
Component ②
Development of flash flood/debris flow simulation models and early warning system
Conceptual Diagram of the Project

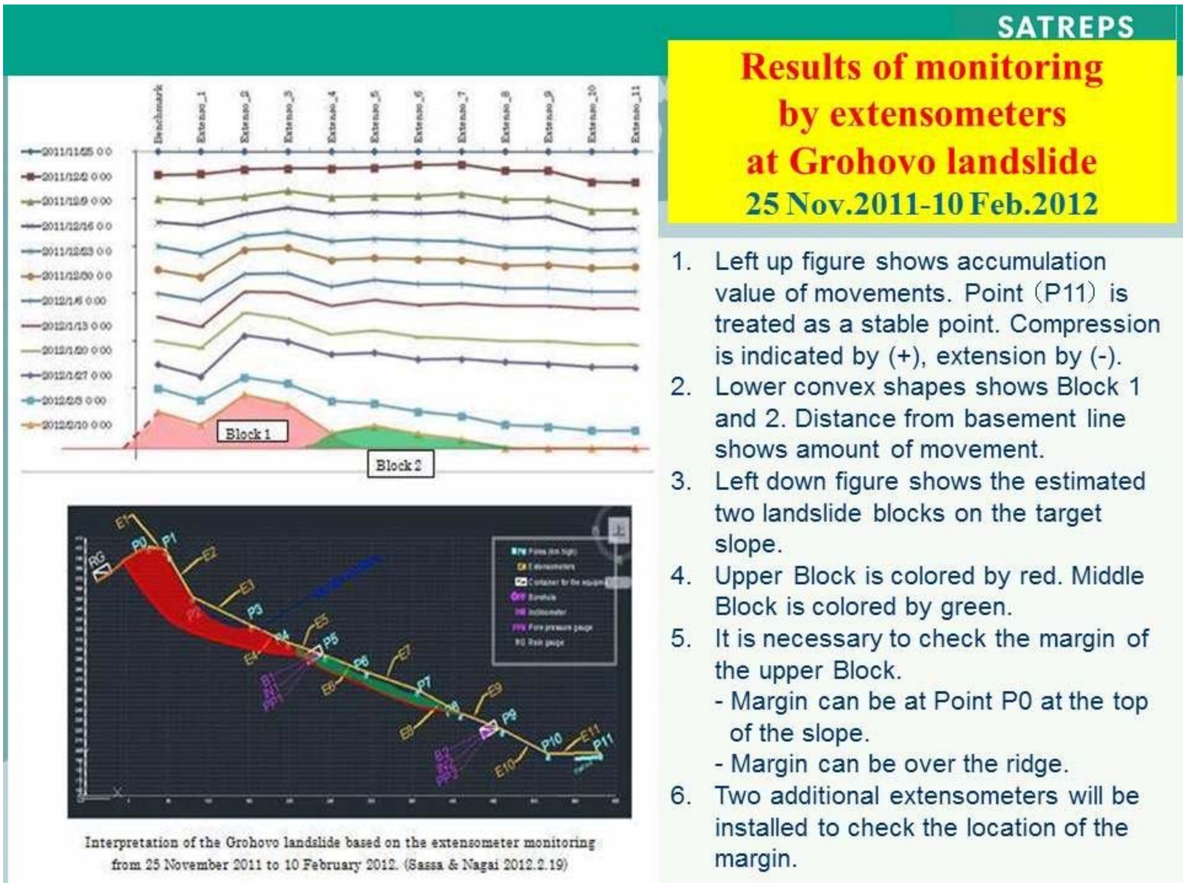


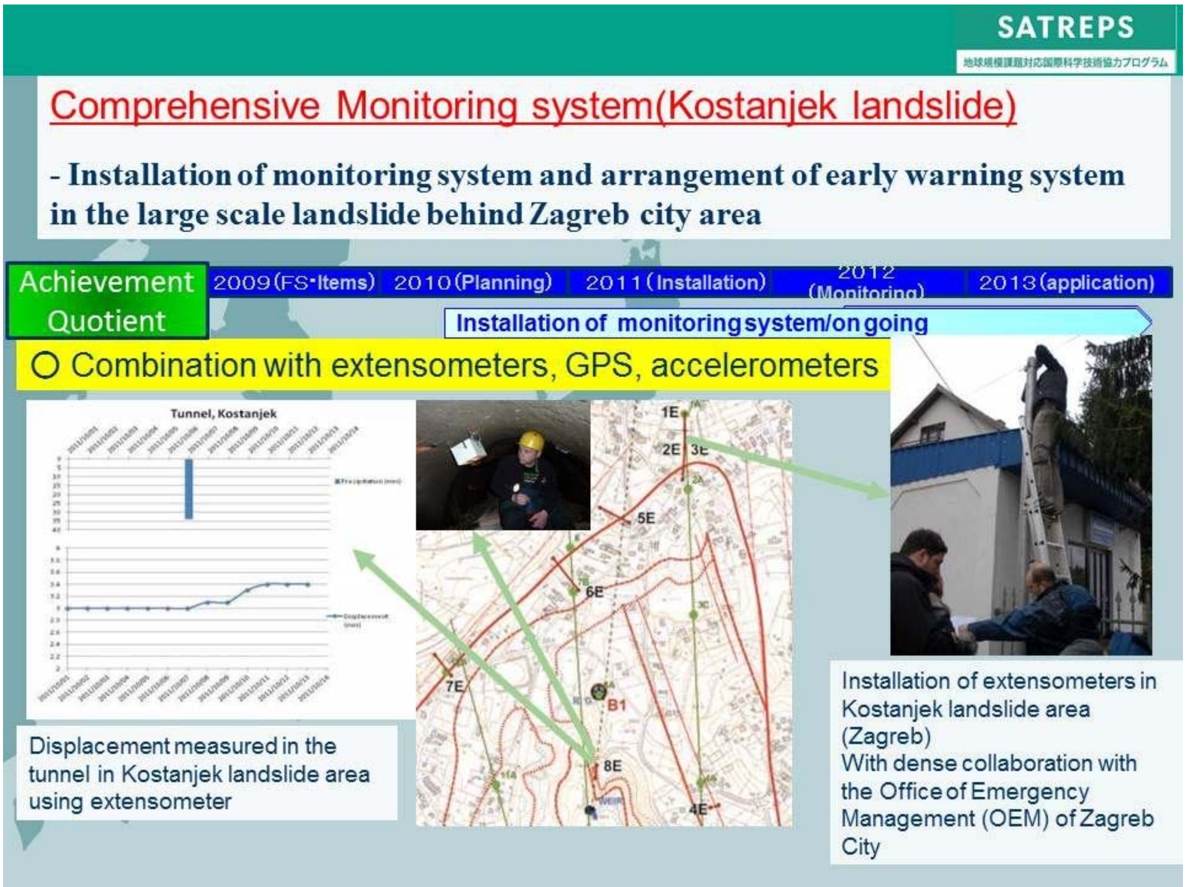
⑦ Formulation of land-use guidelines for mitigation of landslide disasters in Croatia on the basis of scientific research results
Development of method for formulation of land-use guidelines
⑥ Development of early warning system and its implementation for the target areas
⑤ Formulation of landslide hazard maps for the target areas
Development of formulation method for landslide hazard map
Development of method for risk identification
① Formation of Digital Elevation Map by Image Analysis
Evaluation of Danger Degree by Analytical Hierarchy Process (AHP)
② Installation of Comprehensive Monitoring System
③ Development of Dynamic Ring Shear Apparatus
④ Evaluation of Danger Degree by Landslide Dynamics
Individual research components and performance steps

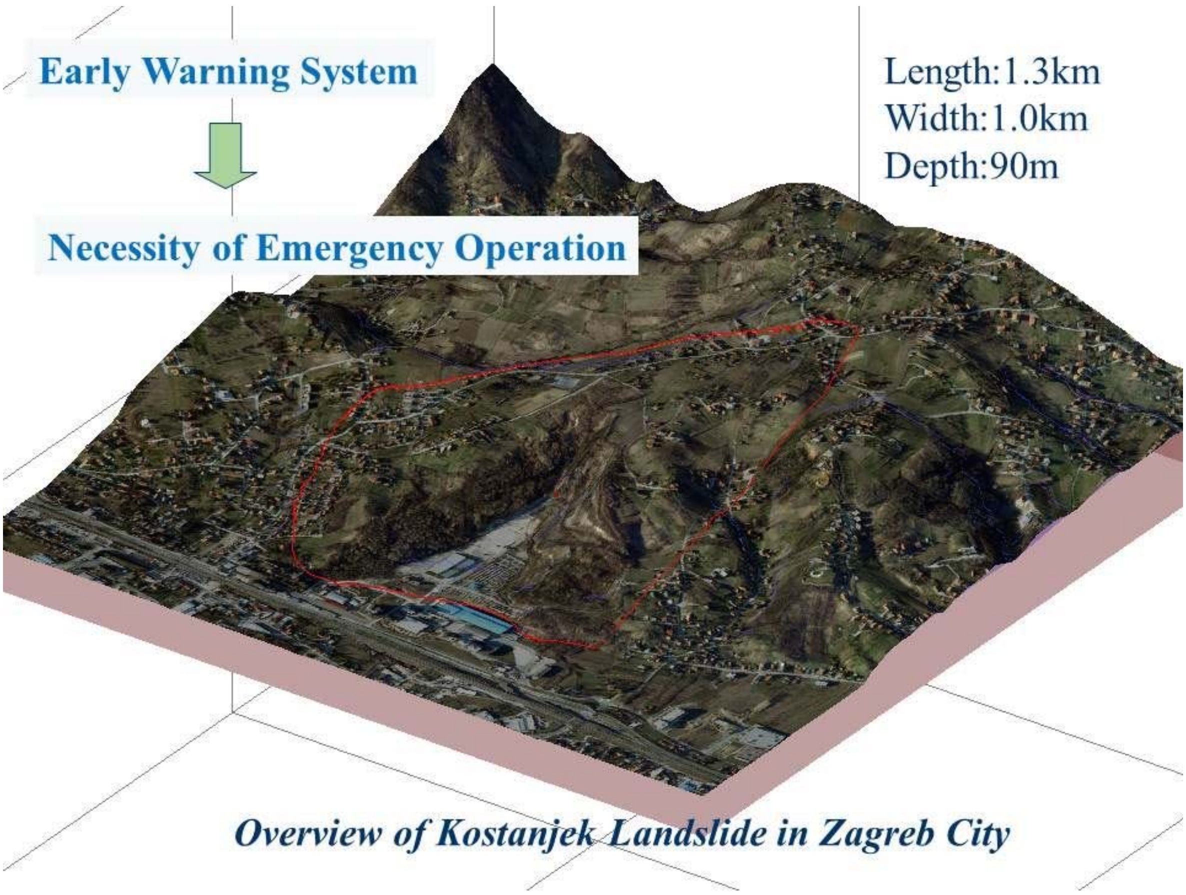


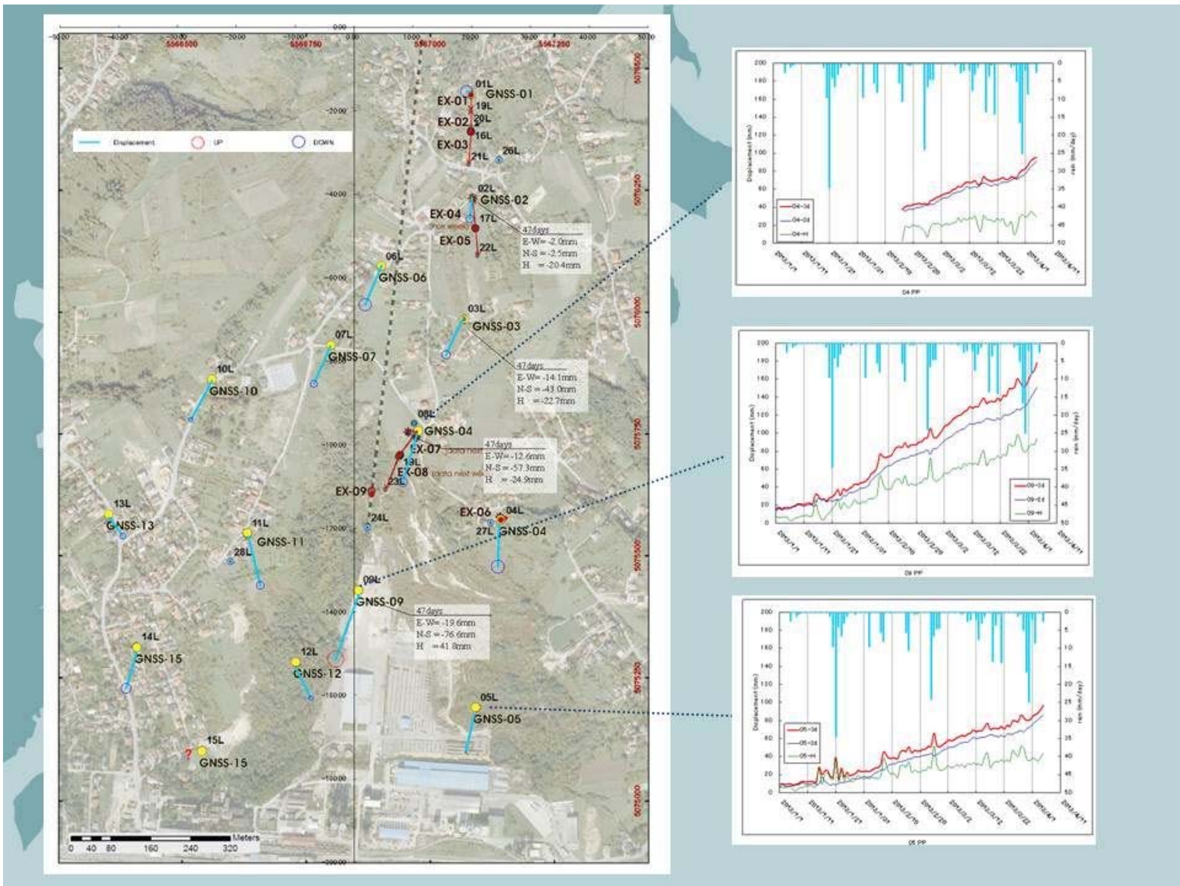
Comprehensive monitoring system (Grohovo landslide)
- Installation of monitoring system in the Grohovo landslide area
- Development of the early warning system
- Collection of basic data to clarify the mechanism of the landslide
Achievement Quotient
2009(FS-Items)
2010(Planning)
2011(Installation)
2012(Analysis)
2013 (Analysis)
Installation of system
accomplished
monitoring
Analysis of mechanism
○ Comprehensive monitoring system with combination of extensometers, GPS, total station
○ Automated real time monitoring using Wi-Fi communication system
Observation Center
Wi-Fi communication
計測機器→中継所(Wi-Fi 通信)
Relay Station
Total Station
Extensometer
監視カメラ
GPS
GPS
プリズム
Landslide area
Schematic diagram of the comprehensive landslide monitoring system

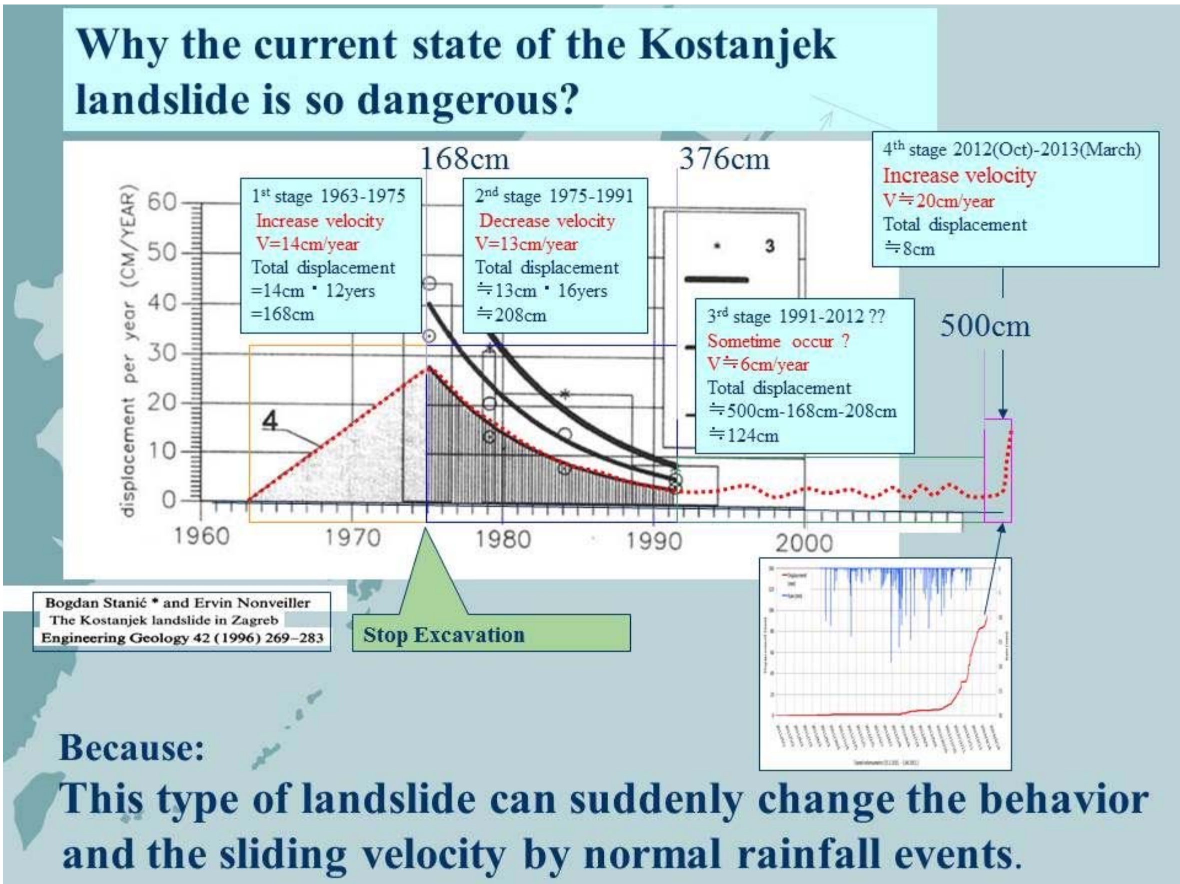

SATREPS
Comprehensive monitoring system
Total Station: 1
Prisms for TS:23
Extensometers: 11
GPS: 10
GPS and Solar panel
TS
GPS
Total Station (Top of the opposite slope)
GPS reference point (New building of Rijeka University)
Extensometer
Measurements (1unit:mm)


SATREPS
Results of monitoring by extensometers at Grohovo landslide
25 Nov.2011-10 Feb.2012
Block 1
Block 2
1. Left up figure shows accumulation value of movements. Point (P11) is treated as a stable point. Compression is indicated by (+), extension by (-).
2. Lower convex shapes shows Block 1 and 2. Distance from basement line shows amount of movement.
3. Left down figure shows the estimated two landslide blocks on the target slope.
4. Upper Block is colored by red. Middle Block is colored by green.
5. It is necessary to check the margin of the upper Block.
- Margin can be at Point P0 at the top of the slope.
- Margin can be over the ridge.
6. Two additional extensometers will be installed to check the location of the margin.
Interpretation of the Grohovo landslide based on the extensometer monitoring from 25 November 2011 to 10 February 2012. (Sassa & Nagai 2012.2.19)

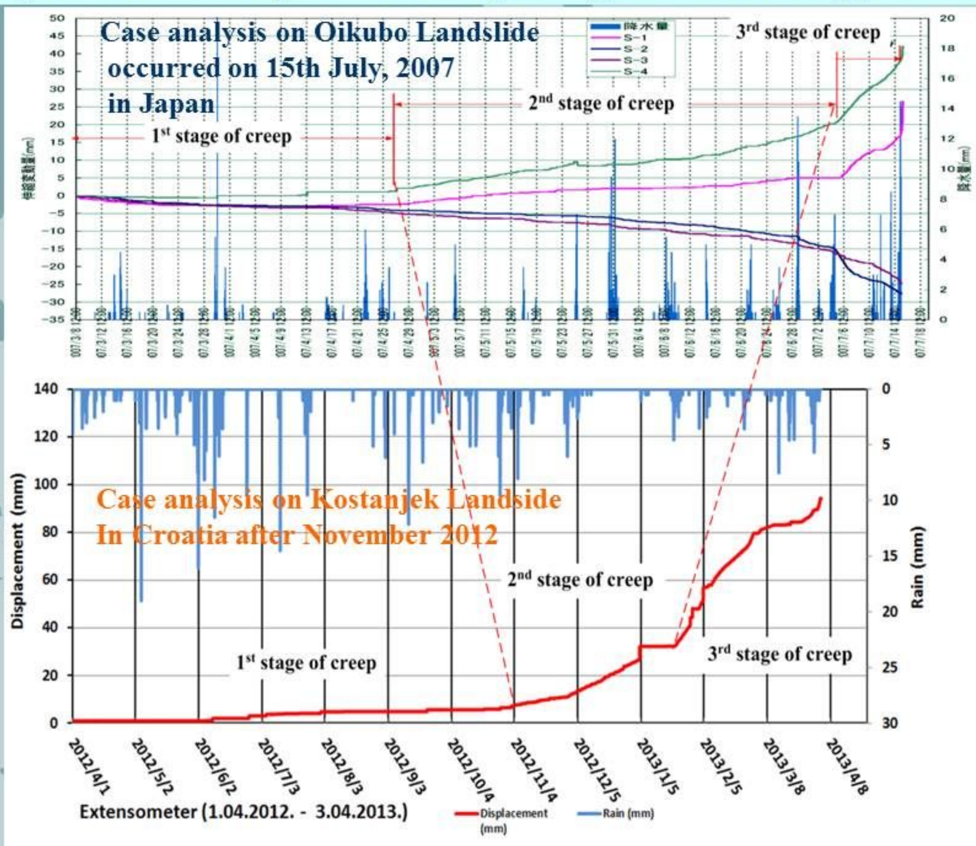

SATREPS
地球規模課題対応国際科学技術協力プログラム
Comprehensive Monitoring system(Kostanjek landslide)
- Installation of monitoring system and arrangement of early warning system in the large scale landslide behind Zagreb city area
Achievement Quotient
2009(FS・Items)
2010(Planning)
2011(Installation)
2012 (Monitoring)
2013(application)
Installation of monitoring system/on going
○ Combination with extensometers, GPS, accelerometers
Tunnel, Kostanjek
Displacement measured in the tunnel in Kostanjek landslide area using extensometer
Installation of extensometers in Kostanjek landslide area (Zagreb)
With dense collaboration with the Office of Emergency Management (OEM) of Zagreb City


Early Warning System
Necessity of Emergency Operation
Length:1.3km
Width:1.0km
Depth:90m
Overview of Kostanjek Landslide in Zagreb City


EX-01
EX-02
EX-03
EX-04
EX-05
EX-06
EX-07
EX-08
EX-09
GNSS-01
GNSS-02
GNSS-03
GNSS-04
GNSS-05
GNSS-06
GNSS-07
GNSS-09
GNSS-10
GNSS-11
GNSS-12
GNSS-13
GNSS-15
47days
E-W= -2.0mm
N-S = -2.5mm
H = -20.4mm
47days
E-W= -14.1mm
N-S = -43.0mm
H = -22.7mm
47days
E-W= -12.6mm
N-S = -57.3mm
H = -24.9mm
47days
E-W= -19.6mm
N-S = -76.6mm
H = -41.8mm
Meters
0 40 80 160 240 320


Why the current state of the Kostanjek landslide is so dangerous?
168cm
376cm
500cm
1st stage 1963-1975
Increase velocity
V=14cm/year
Total displacement
=14cm・12yers
=168cm
2nd stage 1975-1991
Decrease velocity
V=13cm/year
Total displacement
≒13cm・16yers
≒208cm
3rd stage 1991-2012 ??
Sometime occur ?
V≒6cm/year
Total displacement
≒500cm-168cm-208cm
≒124cm
4th stage 2012(Oct)-2013(March)
Increase velocity
V≒20cm/year
Total displacement
≒8cm
displacement per year (CM/YEAR)
1960
1970
1980
1990
2000
Bogdan Stanić * and Ervin Nonveiller
The Kostanjek landslide in Zagreb
Engineering Geology 42 (1996) 269–283
Stop Excavation
Because:
This type of landslide can suddenly change the behavior and the sliding velocity by normal rainfall events.

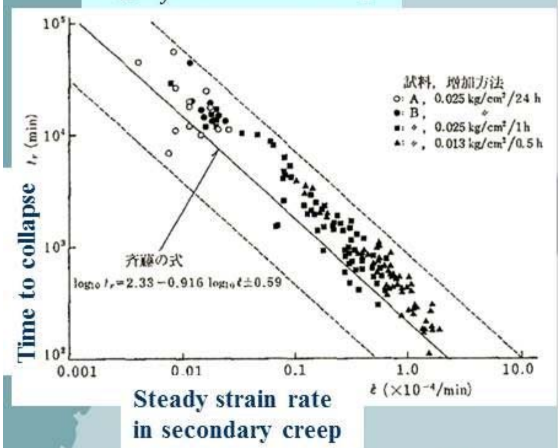
4 days after the velocity reached 1mm per day, the landslide slipped down.



Is the current situation of the Kostanjek landslide so critical?

SAITO and UEZAWA method for time prediction of slipping down of landslide.

$$\log t_f = \text{const} - \log \dot{\varepsilon}$$



Steady strain rate of 2mm/day → the landslide will slip down approximately in two months.

The time to collapse by SAITO and UEZAWA method

The time to the collapse time of setting the Length of an extensometer to Tenm

Steady strain Velocity	The inside of time : ( ) is a trusted width.	
	hour	day
1mm/day	2,766 (716~10,837)	116.1 (29.8~451.5)
2mm/day	1,476 (380~5,743)	61.5 (15.8~239.3)
5mm/day	638 (164~2.481)	26.6 (6.8~103.5)
10mm/day	338 (87~1,315)	14.1 (3.6~54.8)
20mm/day	179 (46~697)	7.5 (1.9~29.0)
1mm/hour	151.5 (39~589.7)	6.3 (1.6~24.6)
2mm/hour	80.3 (20.6~312.5)	3.3 (0.9~13.0)
4mm/hour	42.6 (10.9~165.6)	1.8 (0.5~6.9)
10mm/hour	18.4 (4.7~71.6)	0.8 (0.2~3.0)

Quotation: The Public Works Research Institute, the Ministry of Construction, a landslide Observe standard investigation report, No.3184, 1993

Prediction of a collapse time is possible independent from clay types.

Example of evacuation criteria

ITEM	RESPONSE CLASSIFICATION		
	CAUTION	WARNING	EVACUATION
AMOUNT OF MOVEMENT (CRITERIA)	• >1mm/day	>10mm/day	• >2mm/hour (2 hours continuous) • >4mm/hour
BASIC RESPONSE POLICY	• begin providing information • begin operating continuous monitoring system	• enhance monitoring • prepare for evacuation	• begin evacuation
PRINCIPAL MATTERS TO BE UNDERTAKEN	• provision of information to relevant organization/s • site patrol • check of monitoring equipment • re-installation and additional installation of monitoring equipment • investigation into information transmission methods • provision of information to residents and implementing body/ies related to roads, railways, etc. • confirmation of evacuation warning system	- continuity, enhancement of system- • continuous monitoring system (24hours) • confirmation of moving block/s; and reexamination of the possibility of moving block/s expanding and the dangerous areas of the landslide • preparation for evacuation and confirmation of evacuation routes	- continuous monitoring • establishment of disaster control headquarters • decision and recommendation of evacuation • assignment of evacuation instructor • establishment of evacuation site

(Citation: Prevention measures for secondary disasters - For use in advisor system, National Association of Disaster Prevention, 1994)

Examples of places to which the evacuation criteria applied in districts applicable to the advisor system

- Amount of Movement: >2mm/hour:

Iwaki City Landslide in Fukushima Prefecture, Tachibana Landslide in Yame-gun, Fukuoka Prefecture, Onomichi City Landslide in Hiroshima Prefecture, Hamada City Landslide in Shimane Prefecture, Rokugo-cho Landslide in Nishi-Yatsusiro-gun, Yamanashi Prefecture, Kita-Ibaraki Landslide in Ibaraki Prefecture

Notes

As the behavior of landslides changes as mass movement progresses, movement characteristics unique to the area the landslide is generated are exhibited. Therefore, it is risky to generalize all landslides in the same way, and as a general principle they should be considered on a case by case basis.

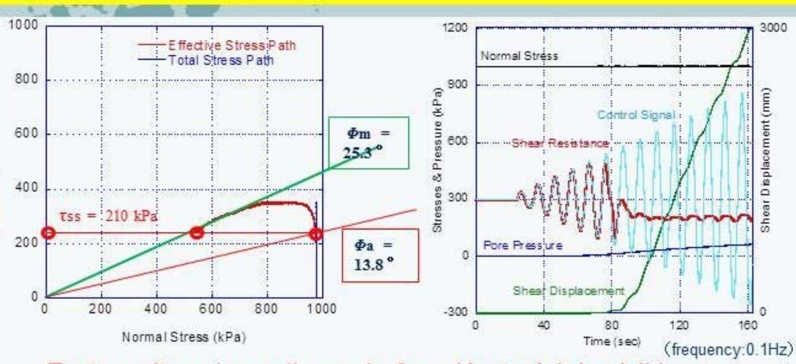
SATREPS

Development of dynamic-loading ring shear apparatus

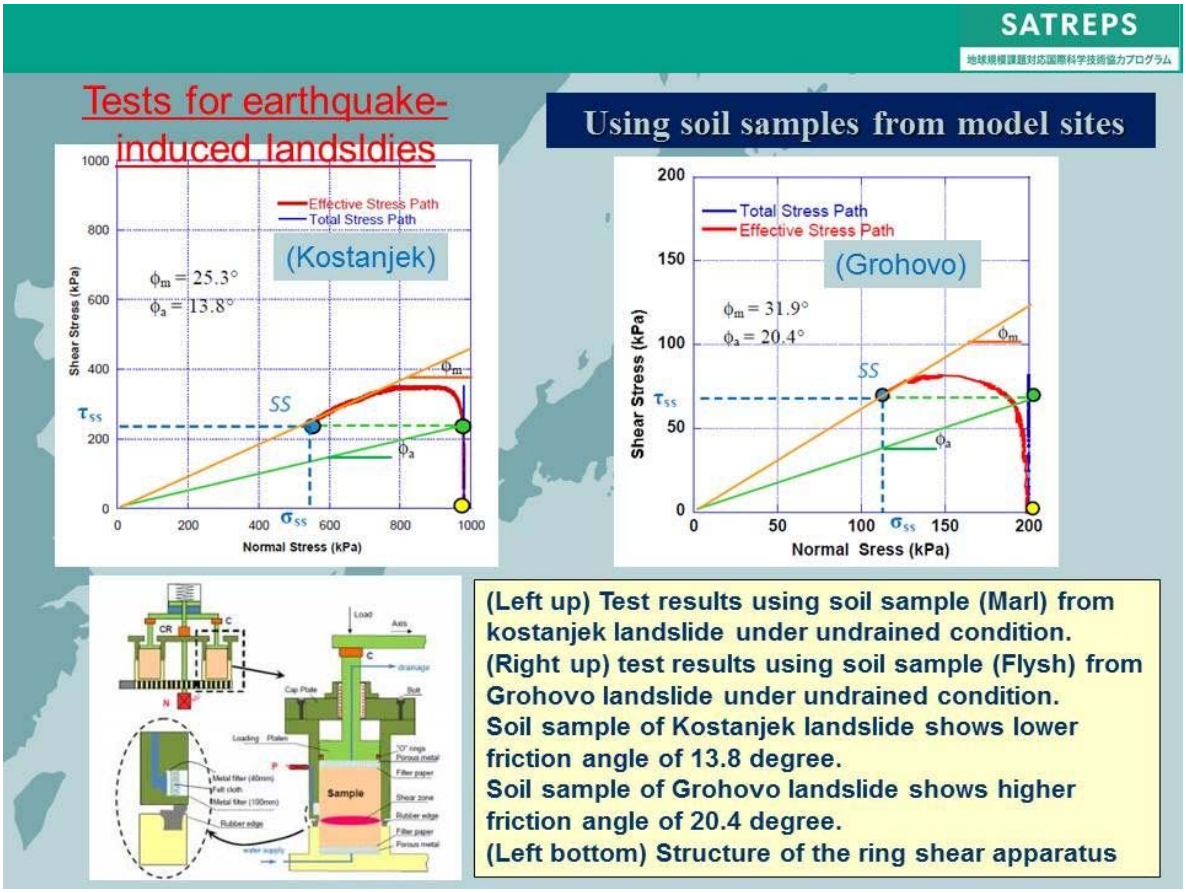
- Clarification of landslide mechanism
- Estimation of velocity and travel distance of sliding mass

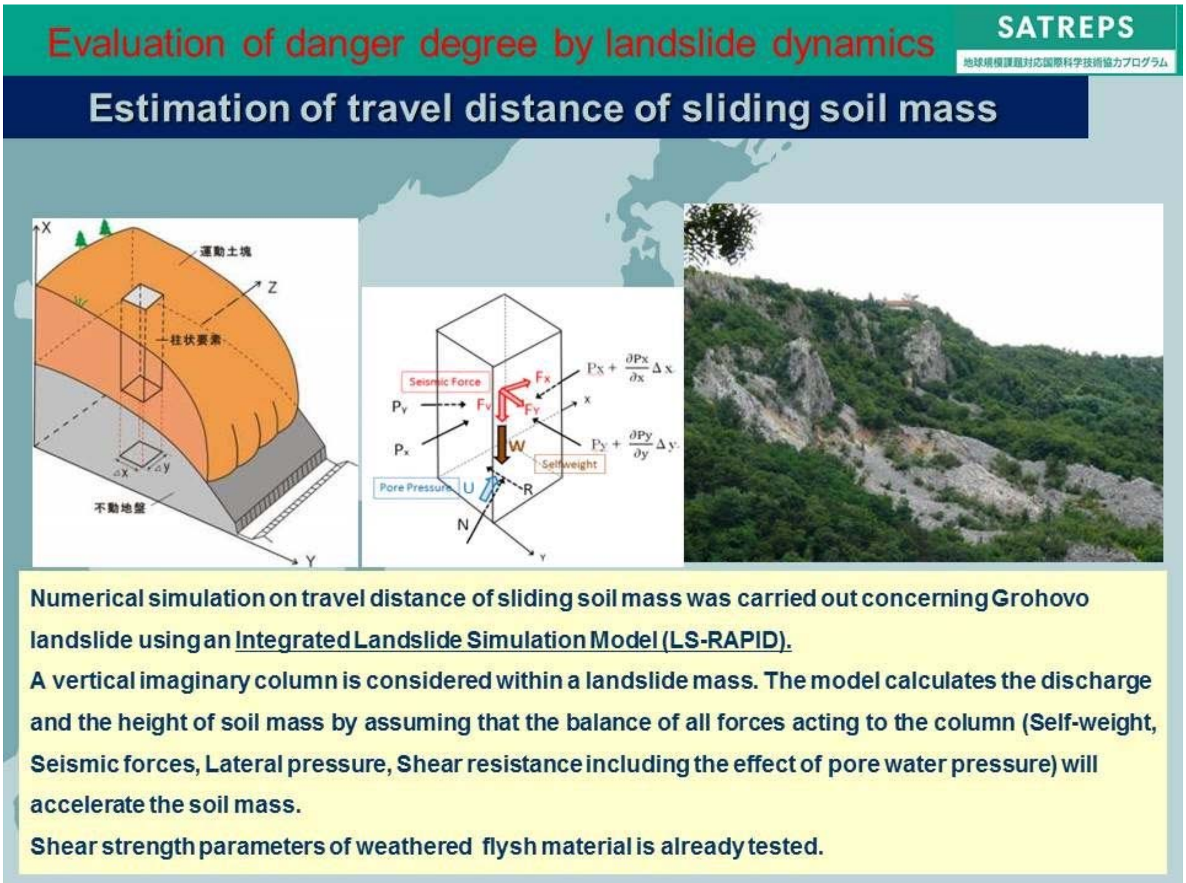
Achievement Quotient	2009(FS)	2010(Design)	2011(Completio	2012(Purchase)	2013(Testing)
	Completion				

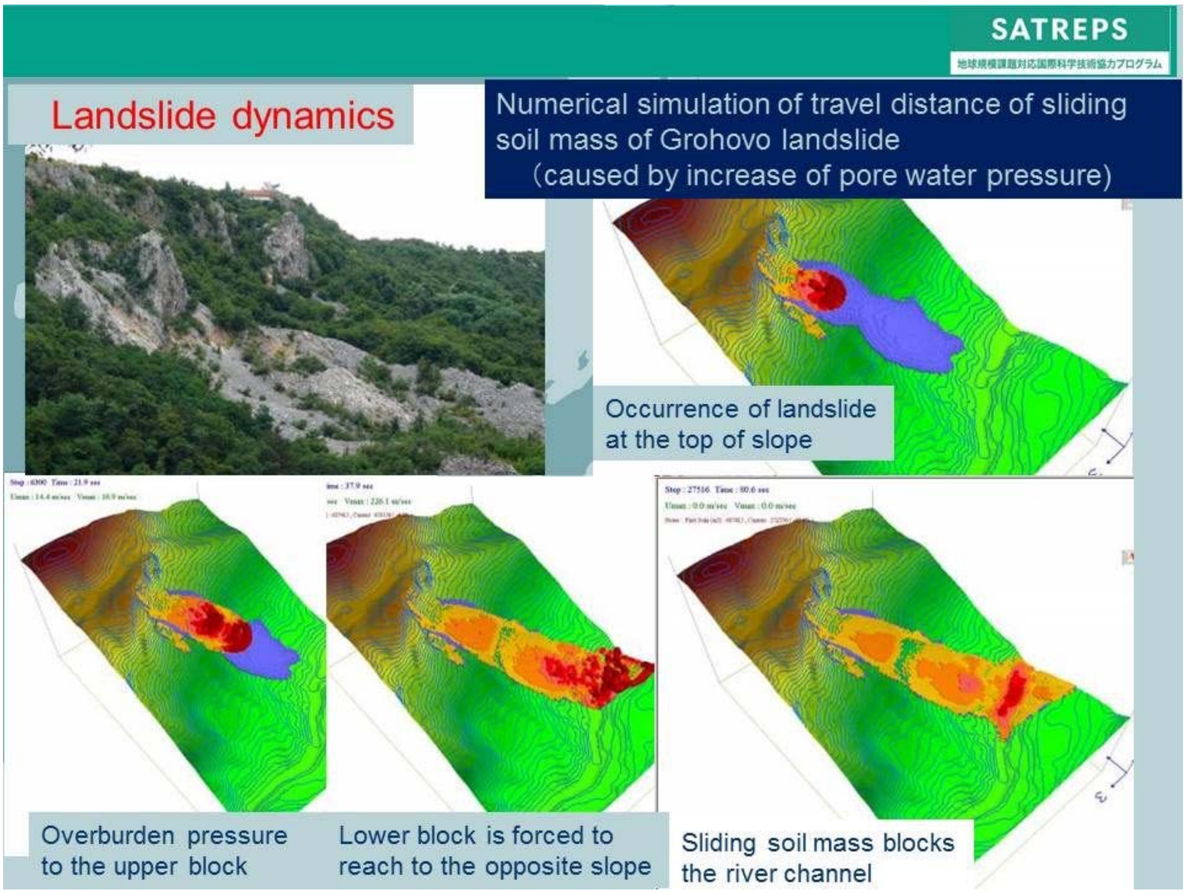
○Measurement of shear strength of soil and pore water pressure
○Volume of soil specimen ca.300 cm^3 (ID= 100 mm, OD= 140 mm)
○Loading corresponding to seismic wave form

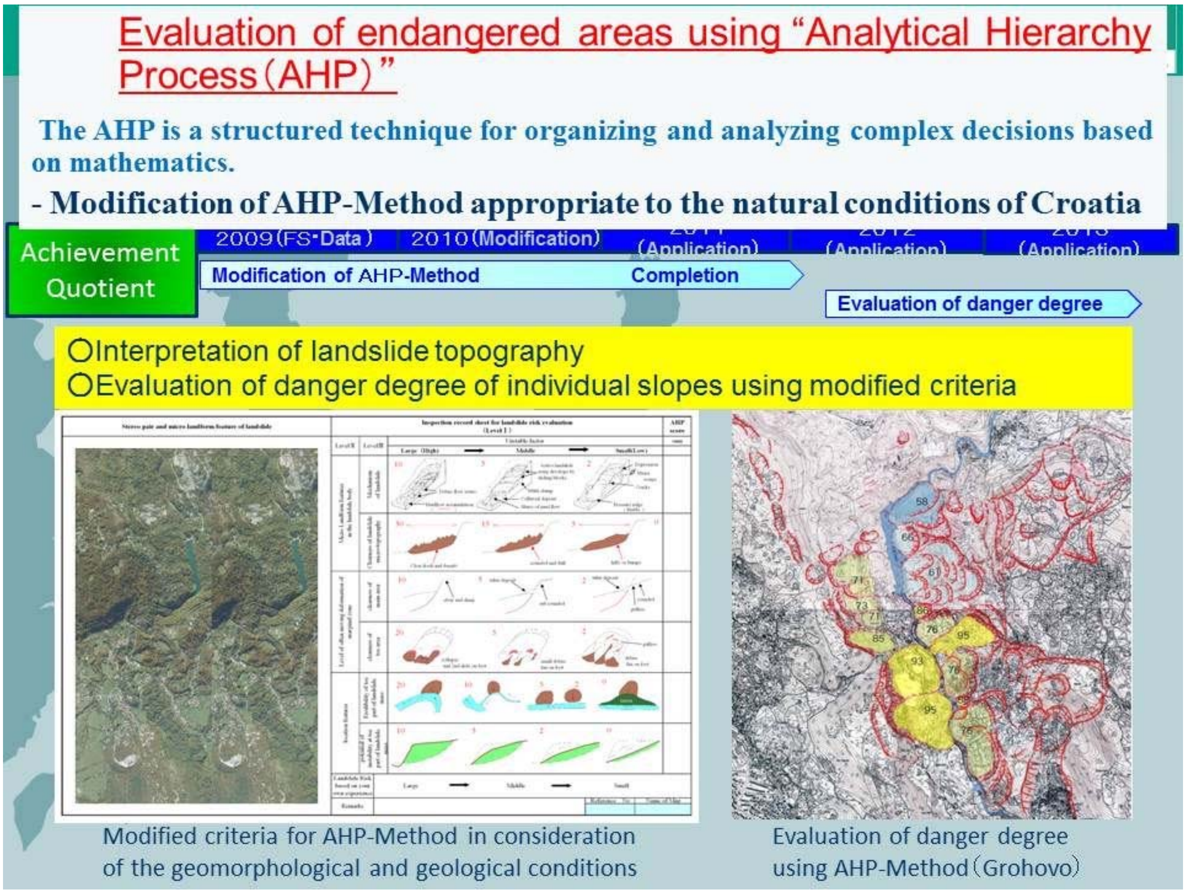


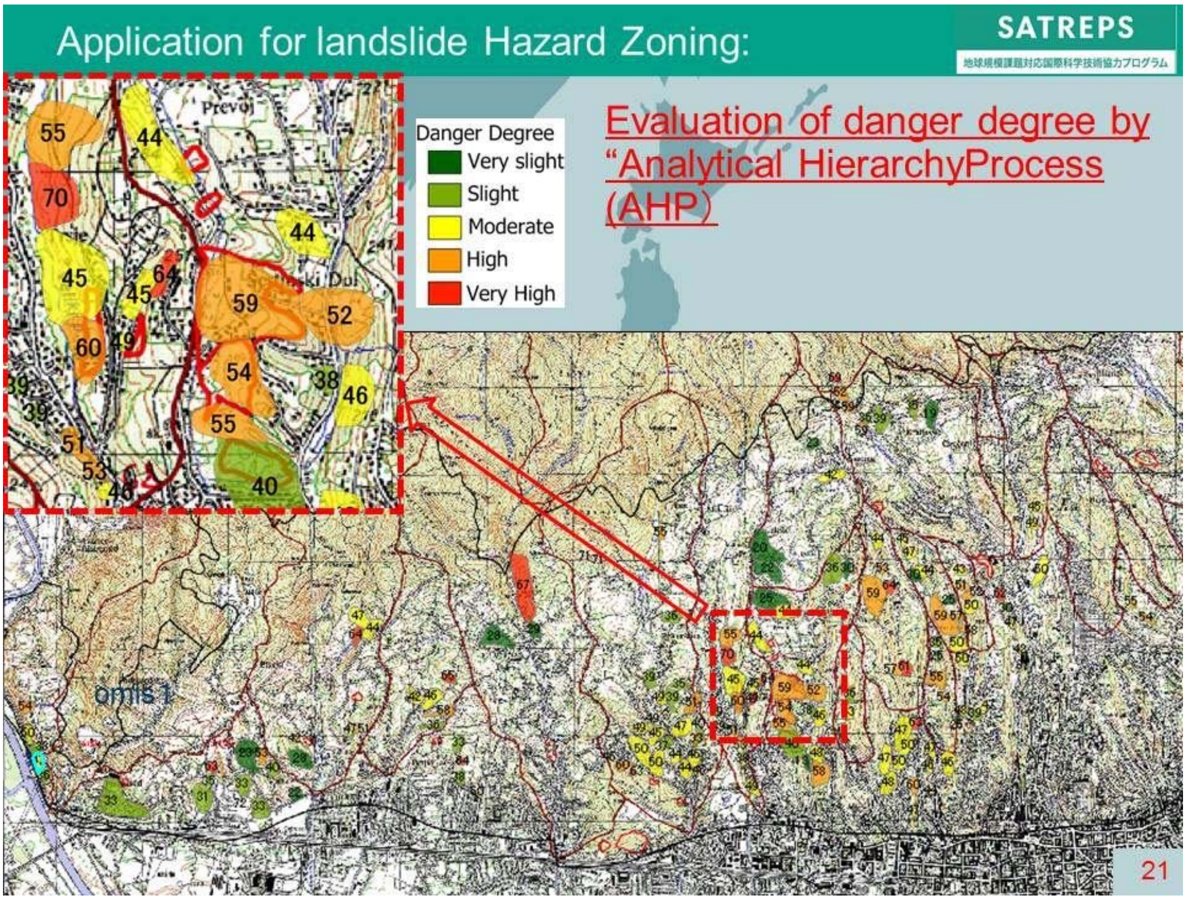
Test results using soil sample from Kostanjek landslide area

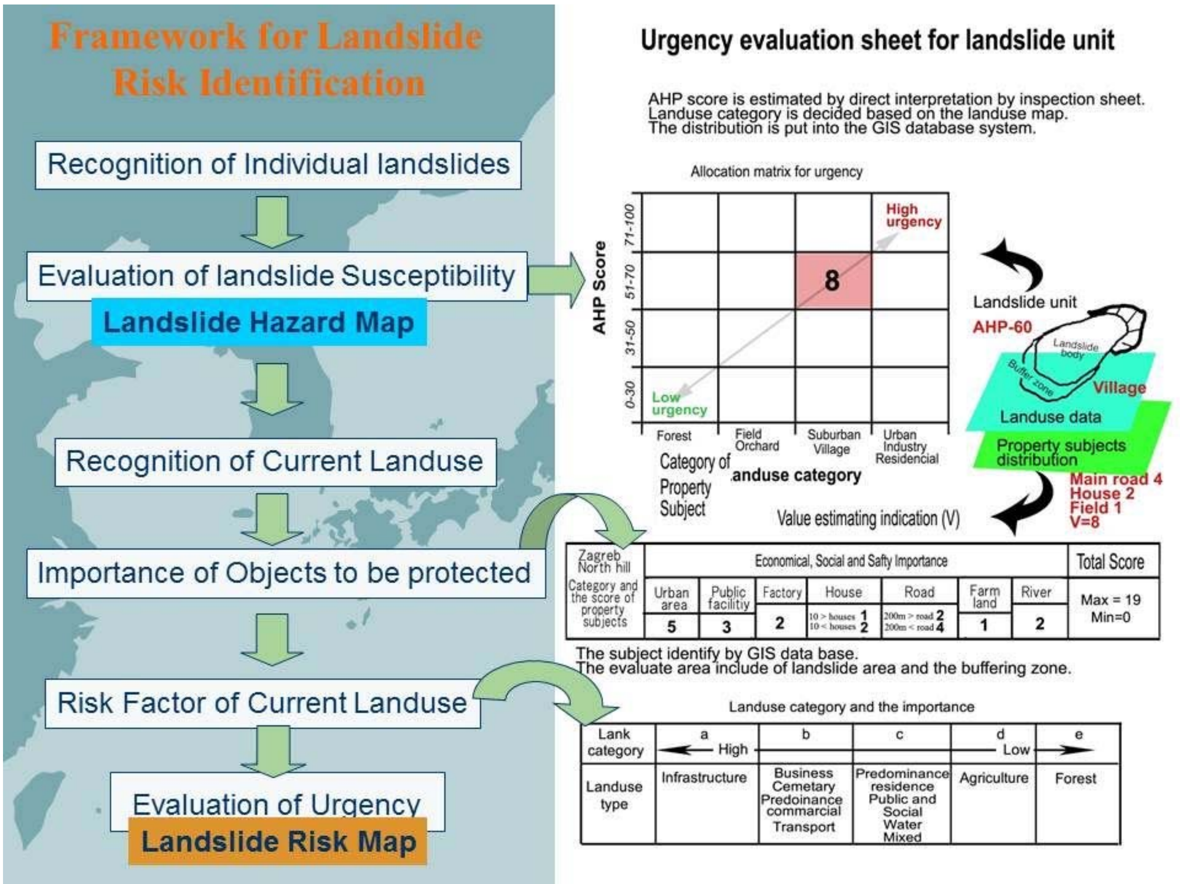

SATREPS
地球規模課題対応国際科学技術協力プログラム
Tests for earthquake-induced landsldies
Using soil samples from model sites
Effective Stress Path
Total Stress Path
(Kostanjek)
$\phi_m = 25.3°$
$\phi_a = 13.8°$
Shear Stress (kPa)
Normal Stress (kPa)
τ_{ss}
σ_{ss}
SS
Total Stress Path
Effective Stress Path
(Grohovo)
$\phi_m = 31.9°$
$\phi_a = 20.4°$
Shear Stress (kPa)
Normal Sress (kPa)
Sample
(Left up) Test results using soil sample (Marl) from kostanjek landslide under undrained condition.
(Right up) test results using soil sample (Flysh) from Grohovo landslide under undrained condition.
Soil sample of Kostanjek landslide shows lower friction angle of 13.8 degree.
Soil sample of Grohovo landslide shows higher friction angle of 20.4 degree.
(Left bottom) Structure of the ring shear apparatus


Evaluation of danger degree by landslide dynamics
SATREPS
地球規模課題対応国際科学技術協力プログラム
Estimation of travel distance of sliding soil mass
運動土塊
柱状要素
不動地盤
Seismic Force
Pore Pressure
Selfweight
Numerical simulation on travel distance of sliding soil mass was carried out concerning Grohovo landslide using an Integrated Landslide Simulation Model (LS-RAPID).
A vertical imaginary column is considered within a landslide mass. The model calculates the discharge and the height of soil mass by assuming that the balance of all forces acting to the column (Self-weight, Seismic forces, Lateral pressure, Shear resistance including the effect of pore water pressure) will accelerate the soil mass.
Shear strength parameters of weathered flysh material is already tested.

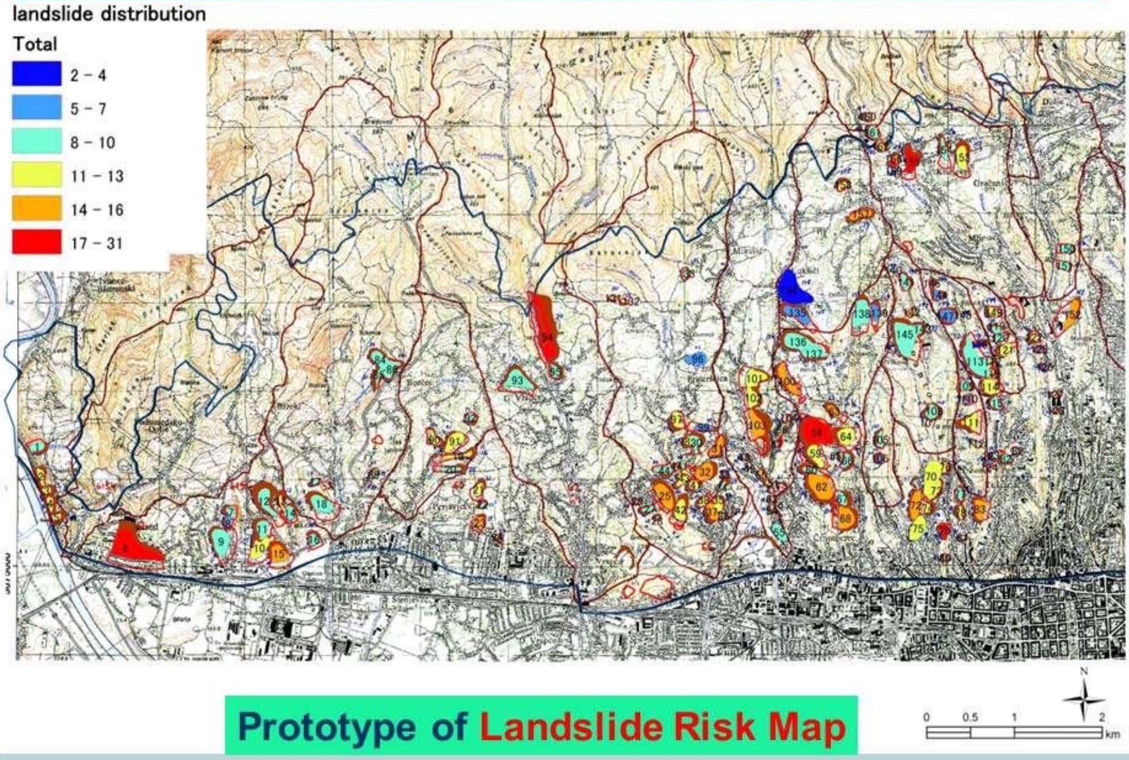

SATREPS
地球規模課題対応国際科学技術協力プログラム
Landslide dynamics
Numerical simulation of travel distance of sliding soil mass of Grohovo landslide
(caused by increase of pore water pressure)
Occurrence of landslide at the top of slope
Overburden pressure to the upper block
Lower block is forced to reach to the opposite slope
Sliding soil mass blocks the river channel


Evaluation of endangered areas using "Analytical Hierarchy Process (AHP)"
The AHP is a structured technique for organizing and analyzing complex decisions based on mathematics.
- Modification of AHP-Method appropriate to the natural conditions of Croatia
Achievement Quotient
2009 (FS·Data)
2010 (Modification)
(Application)
(Application)
(Application)
Modification of AHP-Method
Completion
Evaluation of danger degree
○Interpretation of landslide topography
○Evaluation of danger degree of individual slopes using modified criteria
Modified criteria for AHP-Method in consideration of the geomorphological and geological conditions
Evaluation of danger degree using AHP-Method (Grohovo)


Application for landslide Hazard Zoning:
SATREPS
地球規模課題対応国際科学技術協力プログラム
Evaluation of danger degree by "Analytical HierarchyProcess (AHP)
Danger Degree
Very slight
Slight
Moderate
High
Very High
21


Framework for Landslide Risk Identification
Recognition of Individual landslides
Evaluation of landslide Susceptibility
Landslide Hazard Map
Recognition of Current Landuse
Importance of Objects to be protected
Risk Factor of Current Landuse
Evaluation of Urgency
Landslide Risk Map
Urgency evaluation sheet for landslide unit
AHP score is estimated by direct interpretation by inspection sheet.
Landuse category is decided based on the landuse map.
The distribution is put into the GIS database system.
Allocation matrix for urgency
AHP Score
0-30
31-50
51-70
71-100
High urgency
Low urgency
8
Forest
Field Orchard
Suburban Village
Urban Industry Residencial
Category of Property Subject
Landuse category
Value estimating indication (V)
Landslide unit
AHP-60
Village
Landuse data
Property subjects distribution
Main road 4
House 2
Field 1
V=8
Zagreb North hill
Category and the score of property subjects
Economical, Social and Safty Importance
Urban area 5
Public facilitiy 3
Factory 2
House 10 > houses 1 10 < houses 2
Road 200m > road 2 200m < road 4
Farm land 1
River 2
Total Score
Max = 19
Min=0
The subject identify by GIS data base.
The evaluate area include of landslide area and the buffering zone.
Landuse category and the importance
Lank category
a High
b
c
d Low
e
Landuse type
Infrastructure
Business Cemetary Predoinance commarcial Transport
Predominance residence Public and Social Water Mixed
Agriculture
Forest

Evaluation of Urgency for Land-use Management



Prototype of Landslide Risk Map

SATREPS

SATREPS

Science and Technology Research Partnership
for Sustainable Development

Output of the Joint Project on

Risk Identification and Land-use Planning for Disaster Mitigation of Landslides and Floods in Croatia

Manual for Hazard Mapping and Formulation of Landuse Guideline

WG3 Leader of Japanese Research Team: Prof. Hideaki Marui

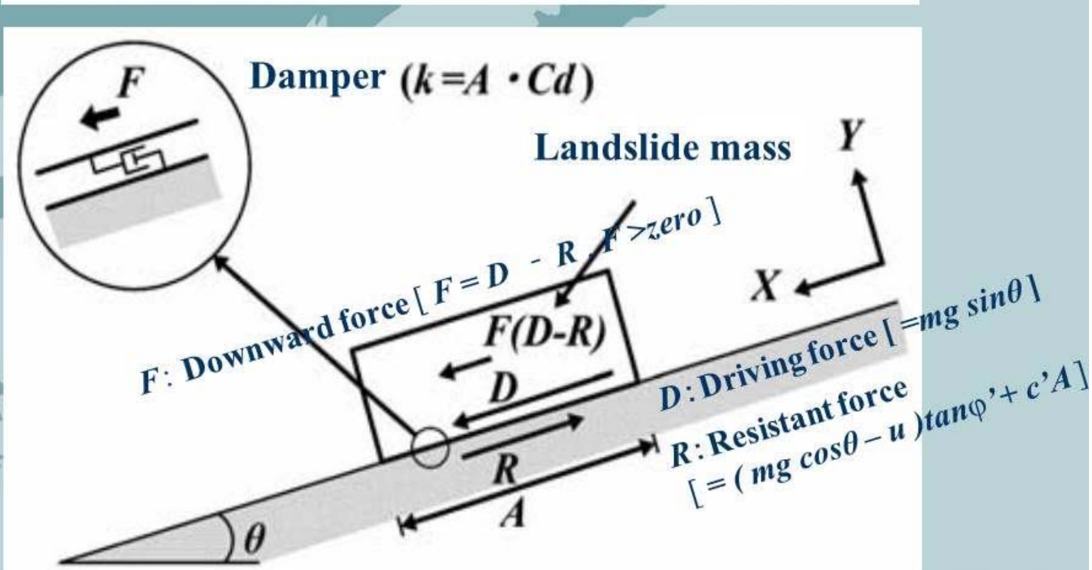
Contents of manual for Hazard Mapping and Land-use guideline:

*Definition and terminology.
*Description of the types and levels of landslide zoning.
*Definition of levels of mapping and suggested scales.
*Guidance on formation process of hazard map and risk map.

A Certain Modifications should be necessary.

Development of new model to explain landslide movement

Lumped mass system model with damper



Fs: Safety factor, Fs=R/D. If Fs>1 then R>D (Stable). F=0 (F can not be negative)
If Fs<1 then R<D (Unstable). F>0

Kinematic diagram of landslide mass

Equation of motion:

$$m\alpha = F - kv \qquad [1]$$

Where,

m *: Mass of the landslide body*
α *: Moving acceleration of the landslide*
F *: Downward force [* ***F = D - R*** *,* ***F >zero*** *]*
k *: Coefficient of dashpot [* ***k = ACd*** *]*
Cd *: Coefficient of damper*
v *: Moving velocity of the landslide*
D *: Driving force [* ***=mg sinθ*** *]*
R *: Resistant force [* ***= (mg cosθ – u)tanφ’+ c’A*** *]*
g *: Gravitational acceleration*
θ *: Gradient of the slope*
u *: pore water pressure*
c’ *: Cohesion of the slip surface*
φ’ *: Internal friction angle of the slip surface*
A *: Area of the slip surface*
In case of a cross section, 'A' means the length of the slip surface

Dividing equation [1] by m, leads to the following formula:

$$dv/dt = F/m - (k/m) \cdot v \qquad [2]$$

Where,

t *: Time*

dv/dt *: Moving acceleration of the landslide[=**α**]*

Using the method of separation of valuables in Equation [2], and integrating both sides of the equation with respect to time, the landslide velocity is indicated by the following equation:

$$v = (F/k)\,(1 - e^{(-k/m)\cdot t}) \qquad [3]$$

*Where, **k=A · Cd**. Therefore Equation [3] is as follows:*

$$v = (F/A \cdot Cd)\,(1 - e^{(-A \cdot Cd/m)\cdot t}) \qquad [4]$$

$$v = (F/A \cdot Cd)\,(1 - e^{(-A \cdot Cd/m)\cdot t}) \qquad [4]$$

Moreover, in a very short time ($t<10^{-5}$ second), the term $e^{(-A \cdot Cd/m)\cdot t}$ will convergr to 'zero'.

Hence, the velocity of landslide is given approximately as follows:

$$v = F/A \cdot Cd \qquad [5]$$

*Equation [5]means that when **A · Cd** is constant, the velocity of landslide increases or decreases directly in propotion to the downward force.*

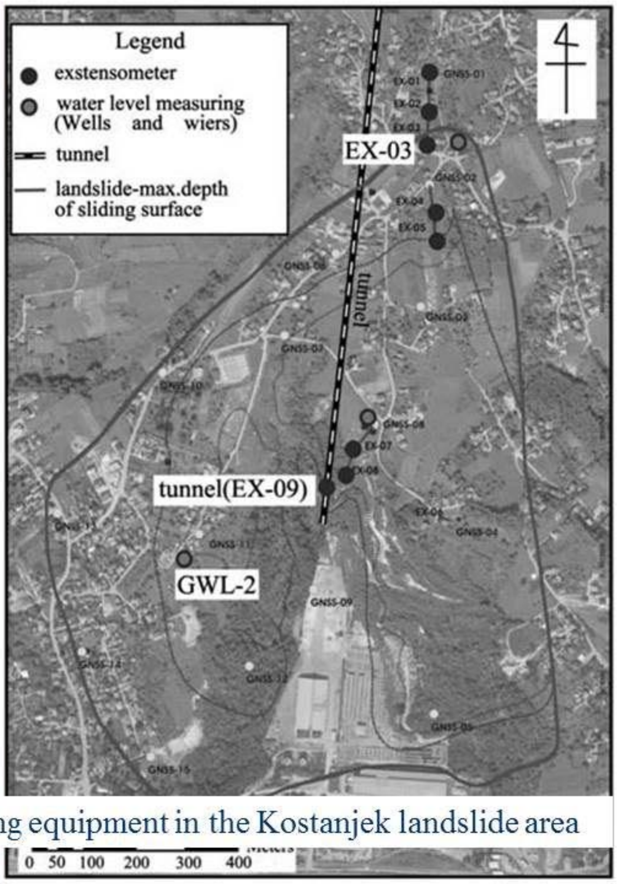
Application of damper model for the Ksotanjek landsldie

Kostanjek landslide is a large scale, deep-seated landslide.

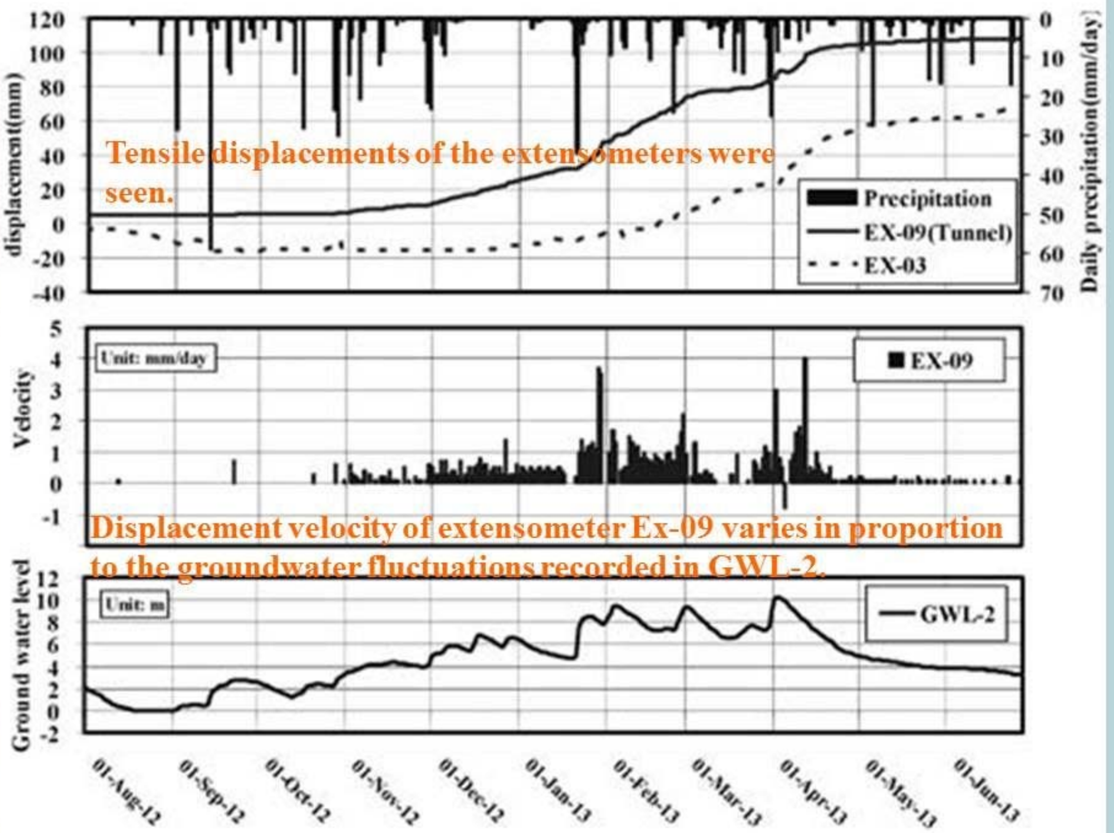
Maximum length: 1,300 m
Average length: 1,100 m
Depth: 70 – 90 m
Inclination of slip surface: 5 °

On the landslide and in its surrounding areas there are many factories and houses.

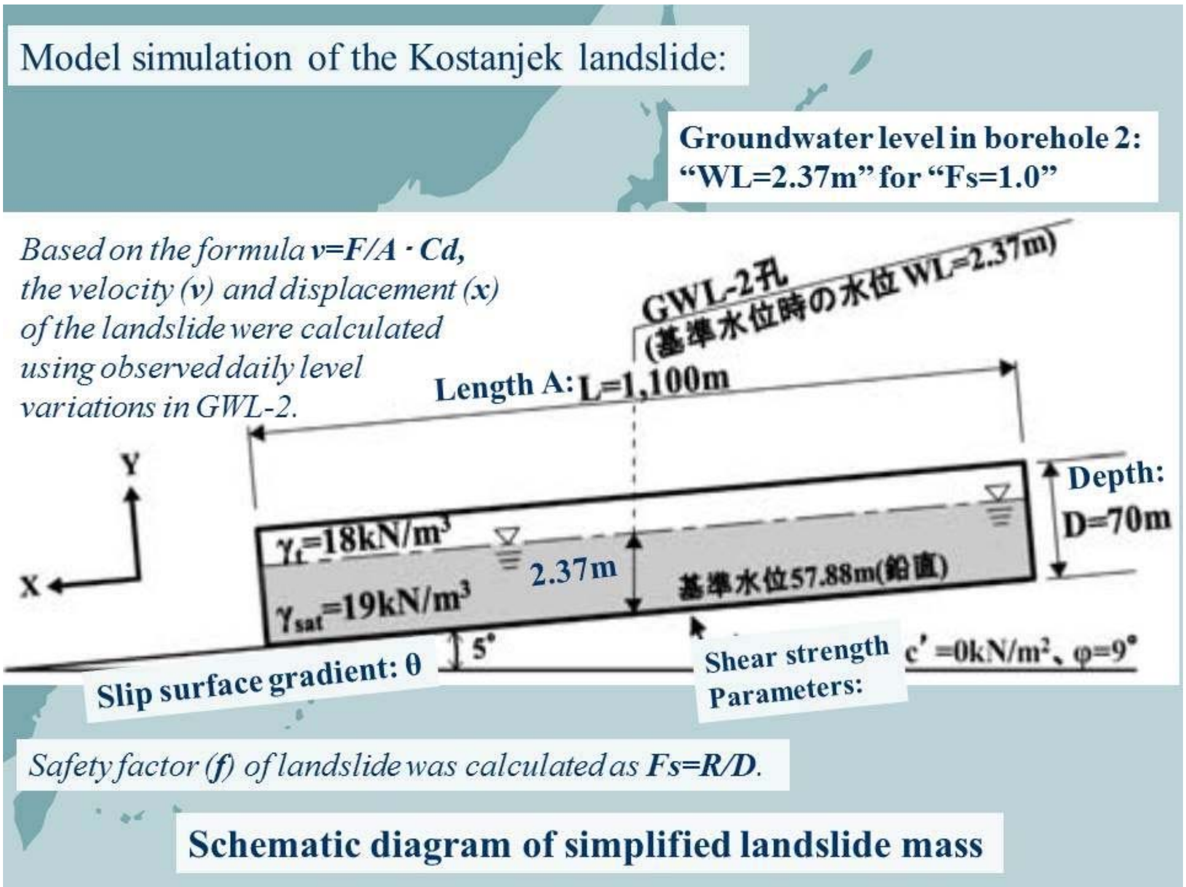
Extensometer(EX-09) is installed in the Tunnel to the slip boundary portion.



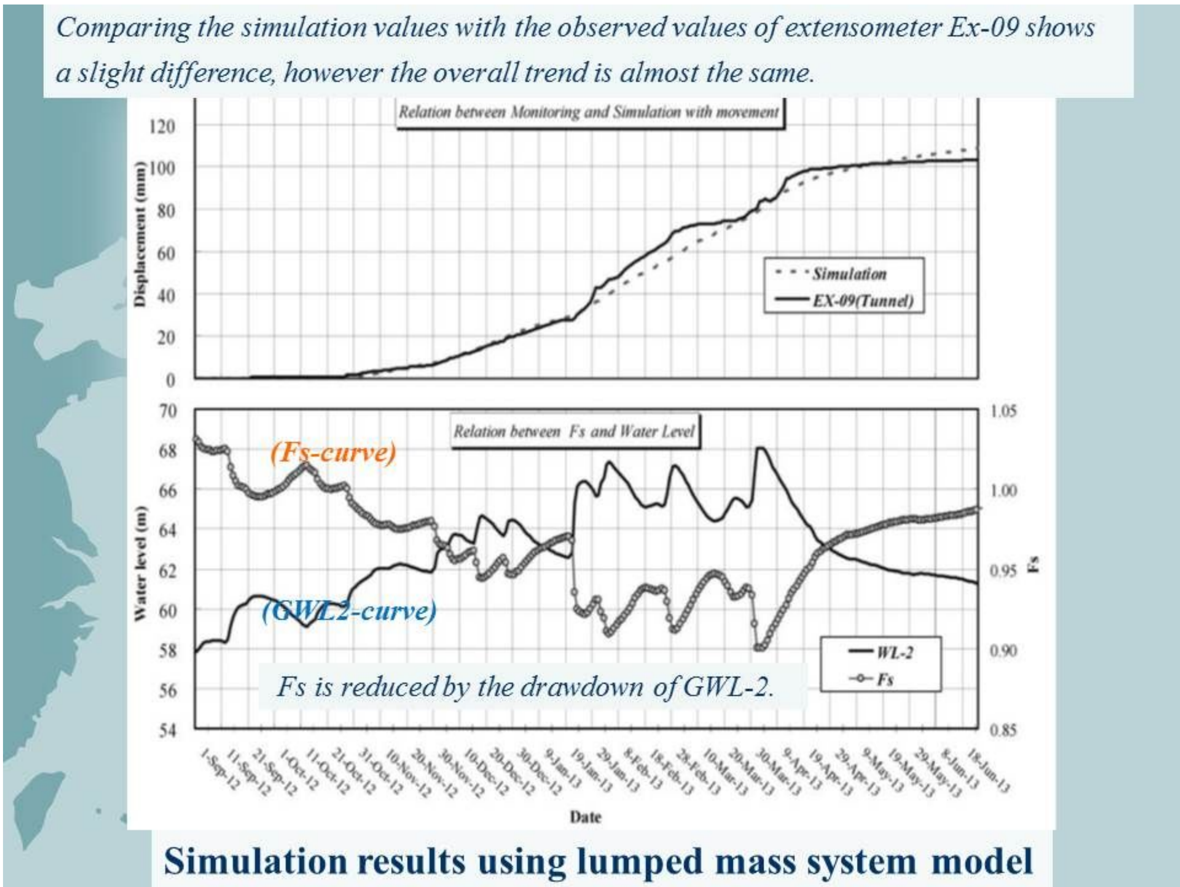
Location map of monitoring equipment in the Kostanjek landslide area



Relation among monitoring data at Kostanjek landslide



Schematic diagram of simplified landslide mass



Simulation results using lumped mass system model

Concluding remarks:

- # The most important initial stage is fundamental study to grasp actual behavior of landslide, to know charactersitics of landslide and to clarify mechanism of landslide.
- # Only based on such fundamental study results, planning and design of effective and useful mitigation measure can be feasible.
- # On the basis of such idea, comprehensive monitoring systems were installed in two representative target landslide areas.
- # Abundant interesting and important data on characteristics and mechanism of landslides have been provided by such monitoring system.
- # It enables to dvelop some new model to explain landslide movement in relation with triggering factors.
- # In the final stage, practical method of hazard zonation and further land-use guidelines were formulated and also early warning system were arranged in the target areas for mitigation of landsldie disasters.
- # Additional follow up researches and analyses are on going based on the instruction and outputs of the joint research project.

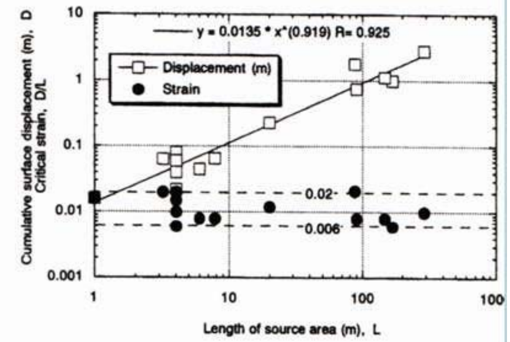
SATREPS

What is the mechanism of the latest rapid movement after slow movement of the range of about 5m in 50 years ?

Moriwaki (2001) showed the "Relationship between critical surface displacement, critical strain and length of the landslide (source area).
The amount of critical strain for slipping down to landslide length should be 0.6% to 2%.

For the case of the Kostanjeck landslide:
Length : about 1300m
Critical surface displacement:
0.6～2% ×1300m =7.8～26m

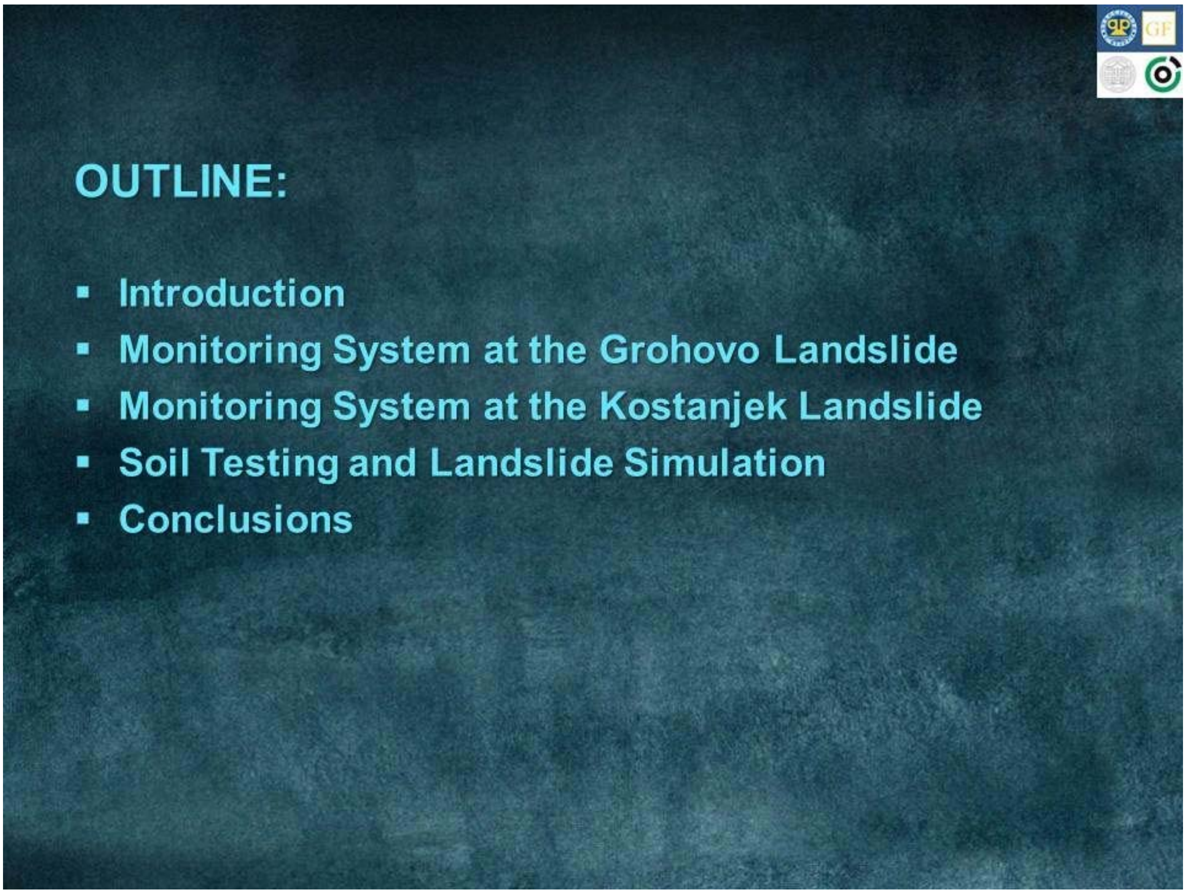
The previous total displacement of 5m is close to the lower limit of the critical surface displacement of 7.8m for slipping-down.
For this reason, it is estimated that current moving velocity is high.

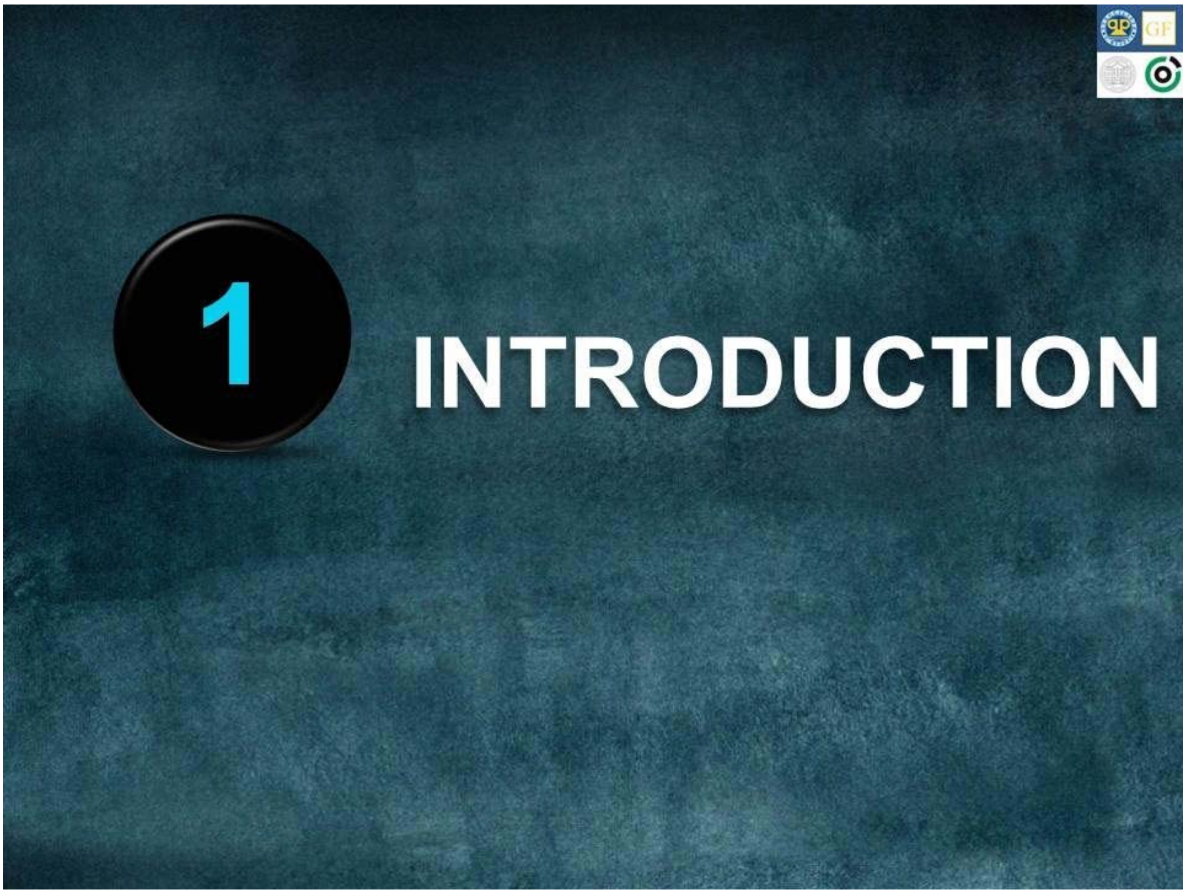


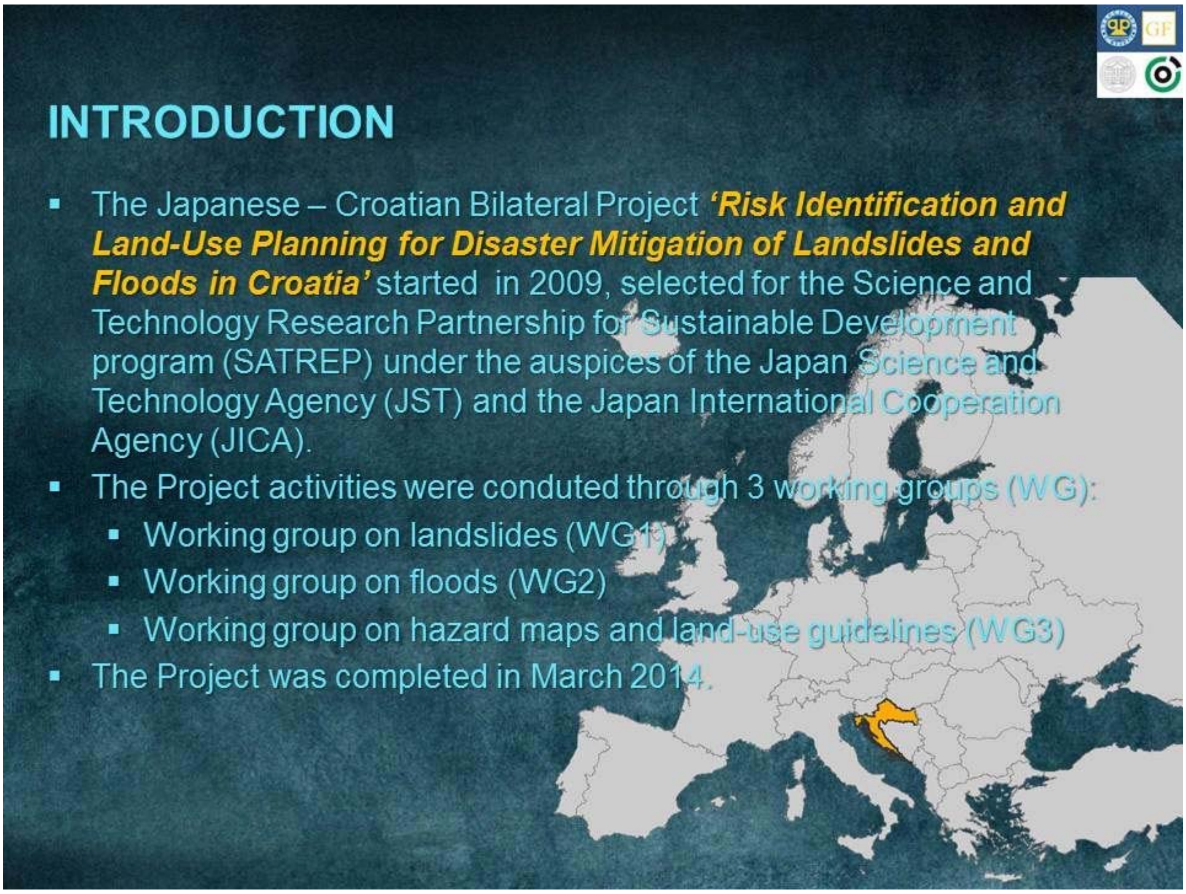
図ー6　崩壊斜面長に対する限界移動量，限界ヒズミの関

Fig. 6 Relationship between critical surface displacemen critical strain and length of source area


International Forum
"Japanese contribution to Landslide Disaster Risk Reduction", Tokyo, 24 November 2016
University of Rijeka
Faculty of Civil Engineering
University of Zagreb
FACULTY OF MINING, GEOLOGY AND PETROLEUM ENGINEERING
Željko ARBANAS
Snježana MIHALIĆ ARBANAS
Japanese-Croatian Bilateral SATREPS Project 2009-2014
RISK IDENTIFICATION AND LAND-USE PLANNING FOR DISASTER MITIGATION OF LANDSLIDES AND FLOODS IN CROATIA
Activities of WG on Landslides
Croatian Landslide Group
IPL World Centre of Excellence


OUTLINE:
Introduction
Monitoring System at the Grohovo Landslide
Monitoring System at the Kostanjek Landslide
Soil Testing and Landslide Simulation
Conclusions


1
INTRODUCTION

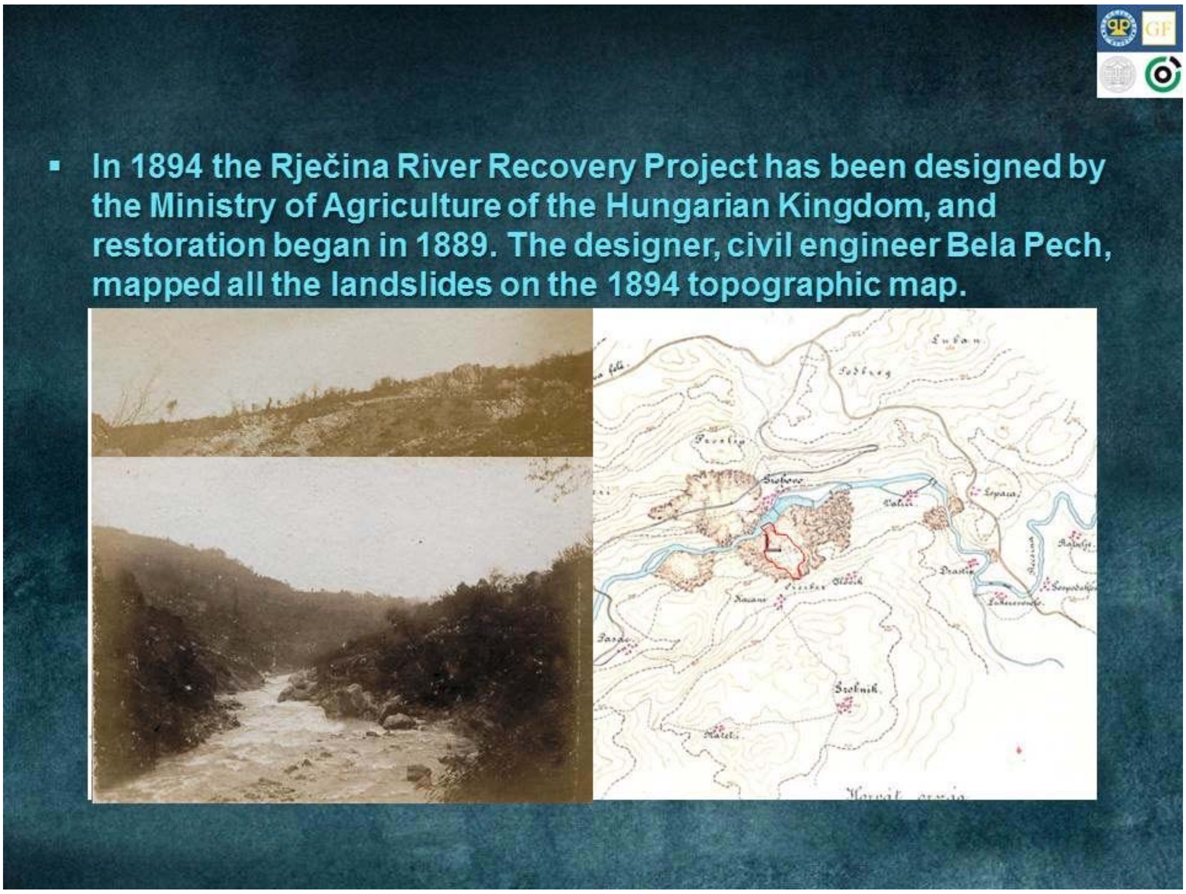

INTRODUCTION
The Japanese – Croatian Bilateral Project ‘Risk Identification and Land-Use Planning for Disaster Mitigation of Landslides and Floods in Croatia’ started in 2009, selected for the Science and Technology Research Partnership for Sustainable Development program (SATREP) under the auspices of the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA).
The Project activities were conduted through 3 working groups (WG):
Working group on landslides (WG1)
Working group on floods (WG2)
Working group on hazard maps and land-use guidelines (WG3)
The Project was completed in March 2014.

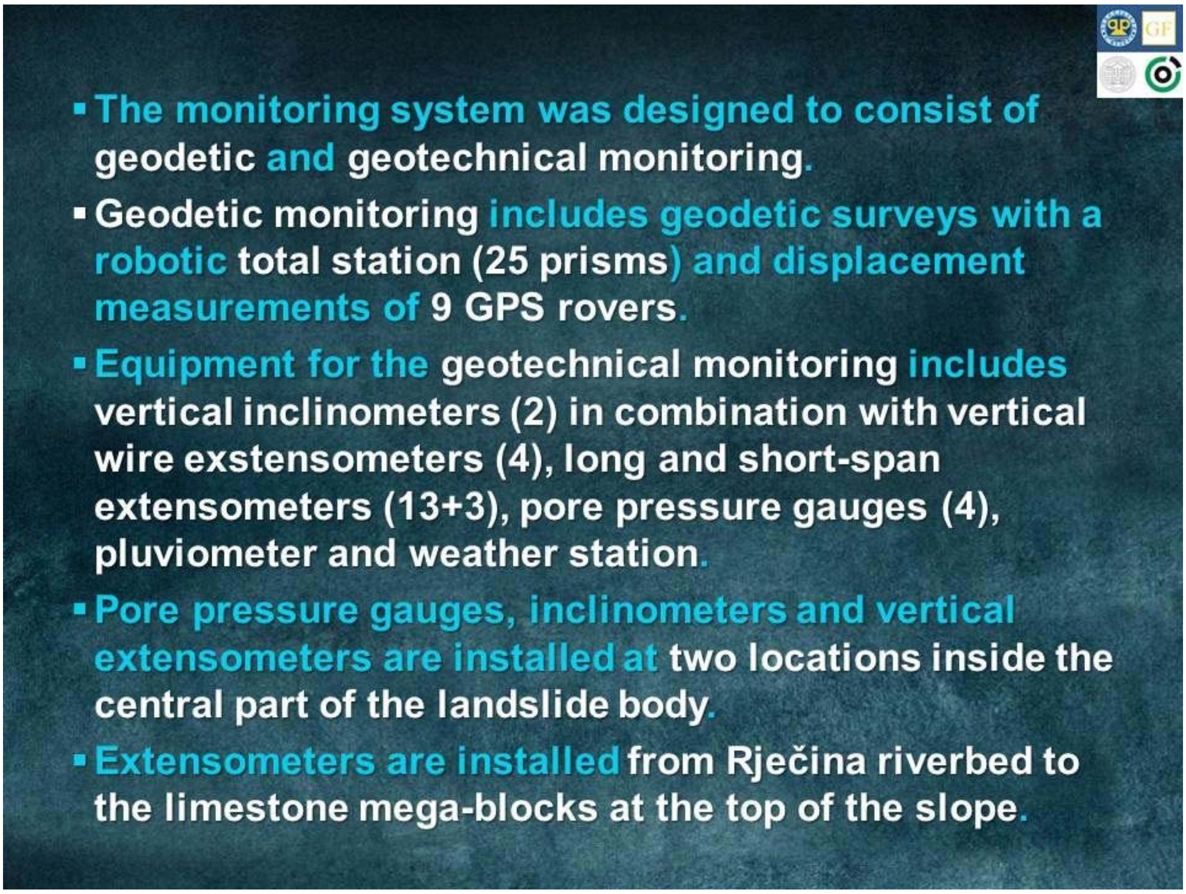

The Project activities of Working Group on Landslides (WG1)
▪ Activities: comprehensive real time monitoring of landslides, laboratory soil testing, numerical modeling of static and dynamic landslide behavior, early warning system
▪ Study areas: the Grohovo Landslide in Primorsko-Goranska County and the Kostanjek Landslide in the City of Zagreb.

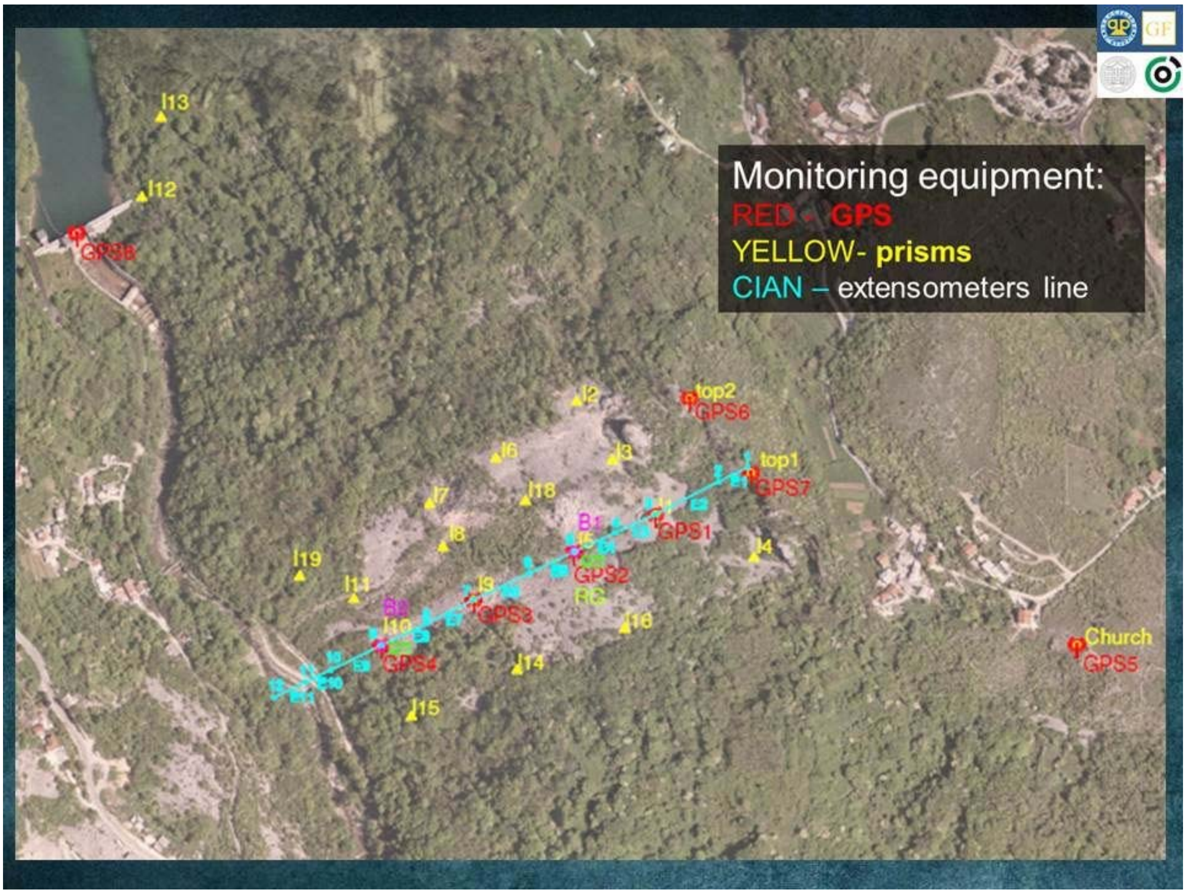

2
GROHOVO
LANDSLIDE
MONITORING
SYSTEM

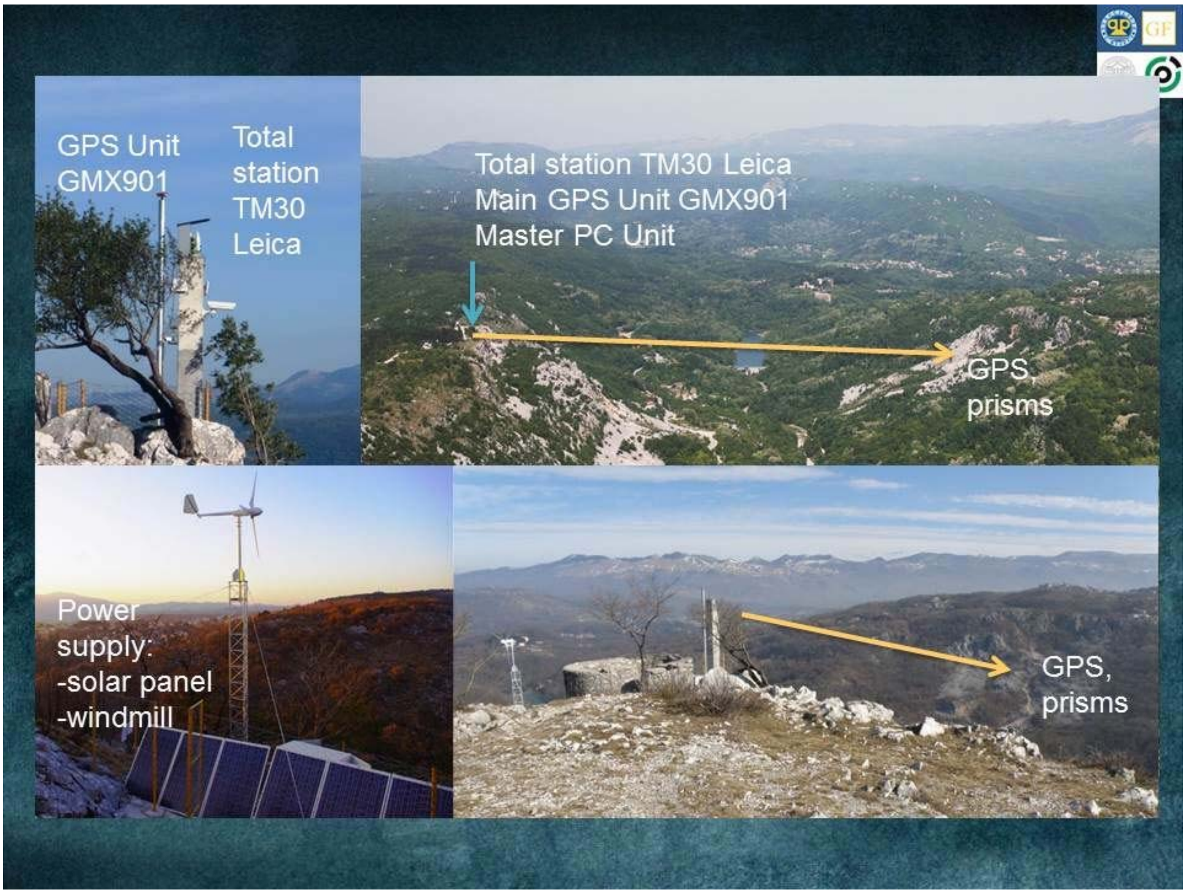
- The Grohovo Landslide was last time reactivated in December 1996, after long time dormant period and about 1.0×10^6 m^3 were moved down the slope and buried the Rječina riverbed forming a landslide dam.

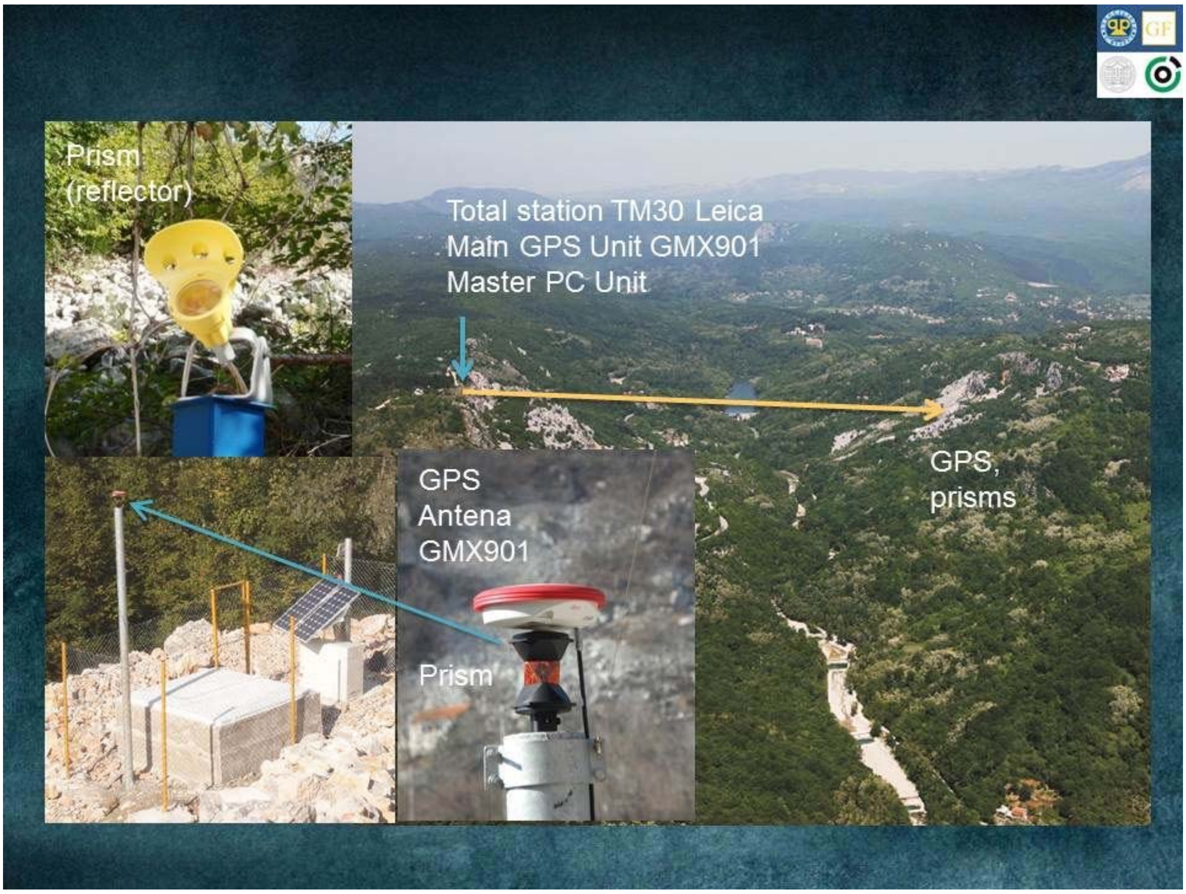
- The Grohovo Landslide is the part of the old dormant landslide activated in 1893 of about 6.5 Mm^3. There are signs of many old landslides in this part of the Rječina River Valley.

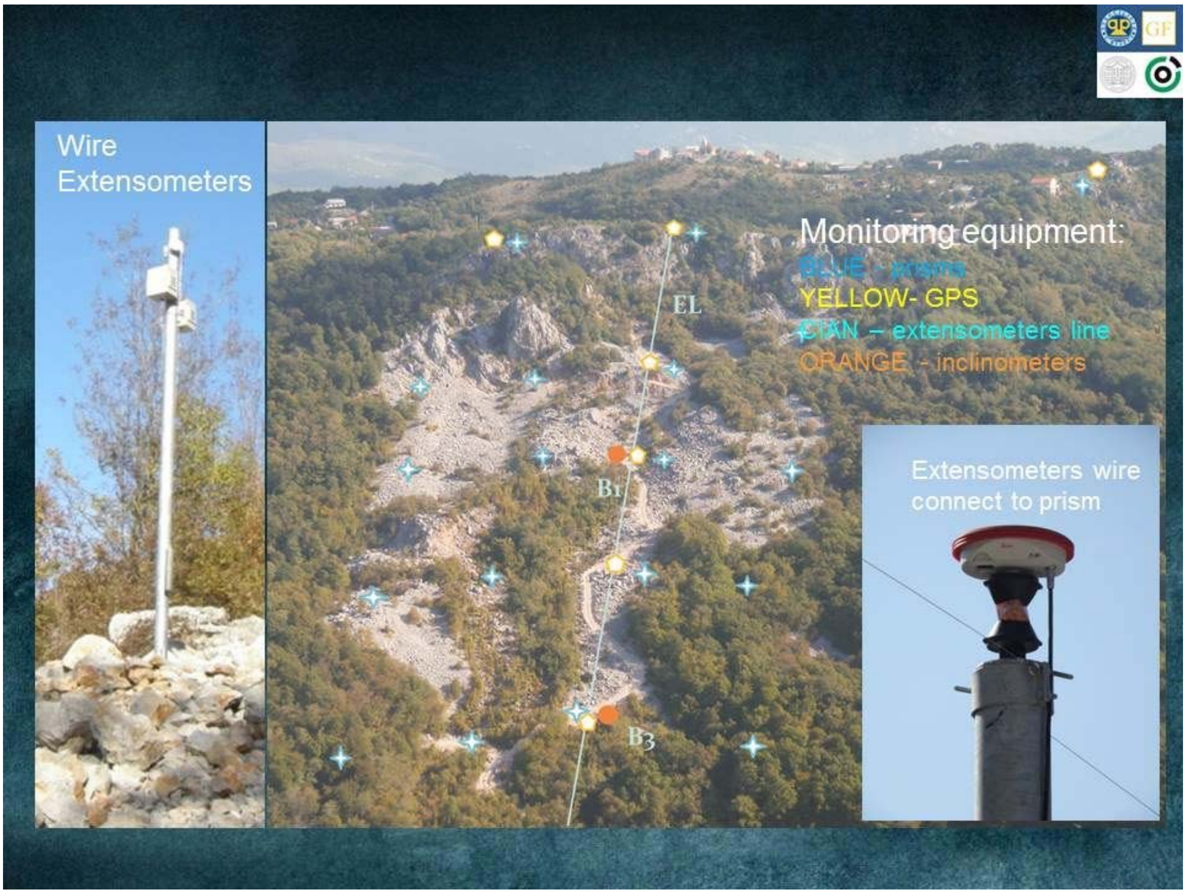

In 1894 the Rječina River Recovery Project has been designed by the Ministry of Agriculture of the Hungarian Kingdom, and restoration began in 1889. The designer, civil engineer Bela Pech, mapped all the landslides on the 1894 topographic map.

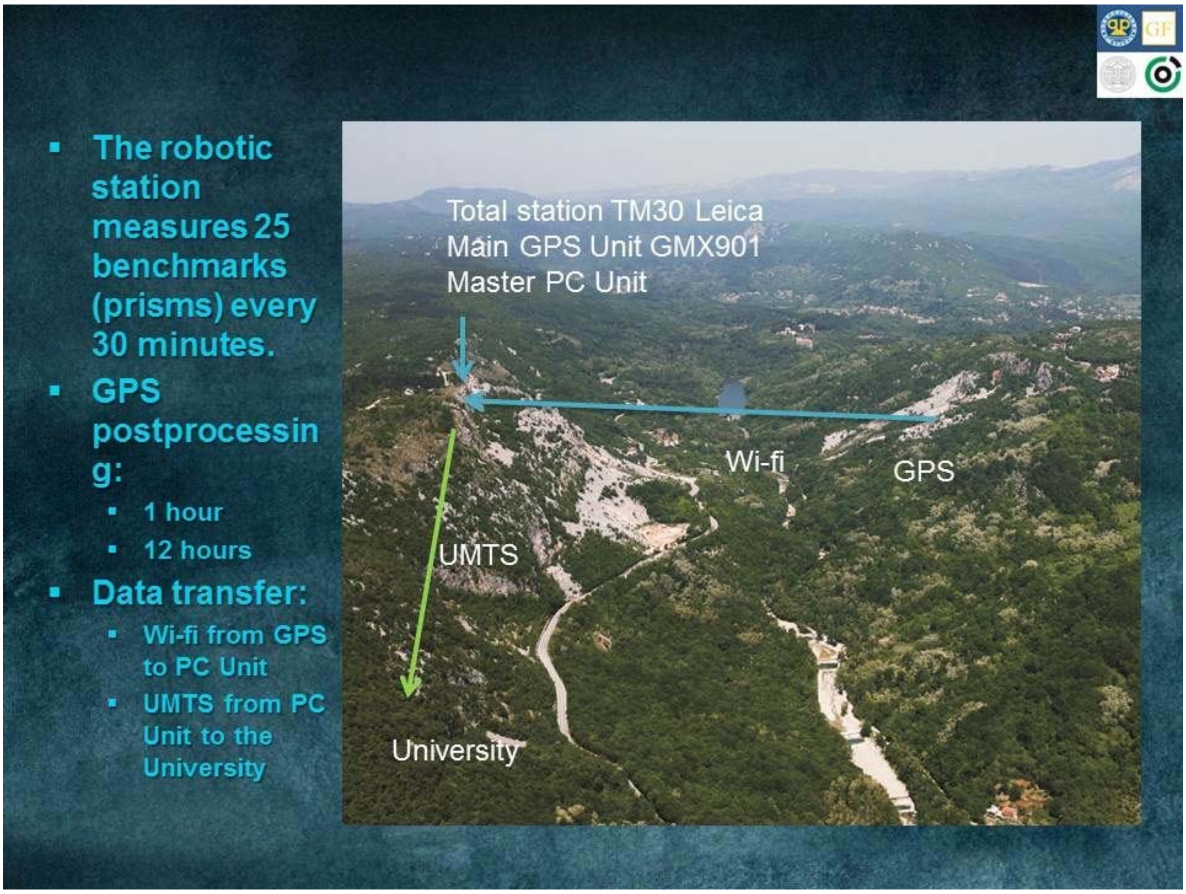

The monitoring system was designed to consist of geodetic and geotechnical monitoring.
Geodetic monitoring includes geodetic surveys with a robotic total station (25 prisms) and displacement measurements of 9 GPS rovers.
Equipment for the geotechnical monitoring includes vertical inclinometers (2) in combination with vertical wire exstensometers (4), long and short-span extensometers (13+3), pore pressure gauges (4), pluviometer and weather station.
Pore pressure gauges, inclinometers and vertical extensometers are installed at two locations inside the central part of the landslide body.
Extensometers are installed from Rječina riverbed to the limestone mega-blocks at the top of the slope.

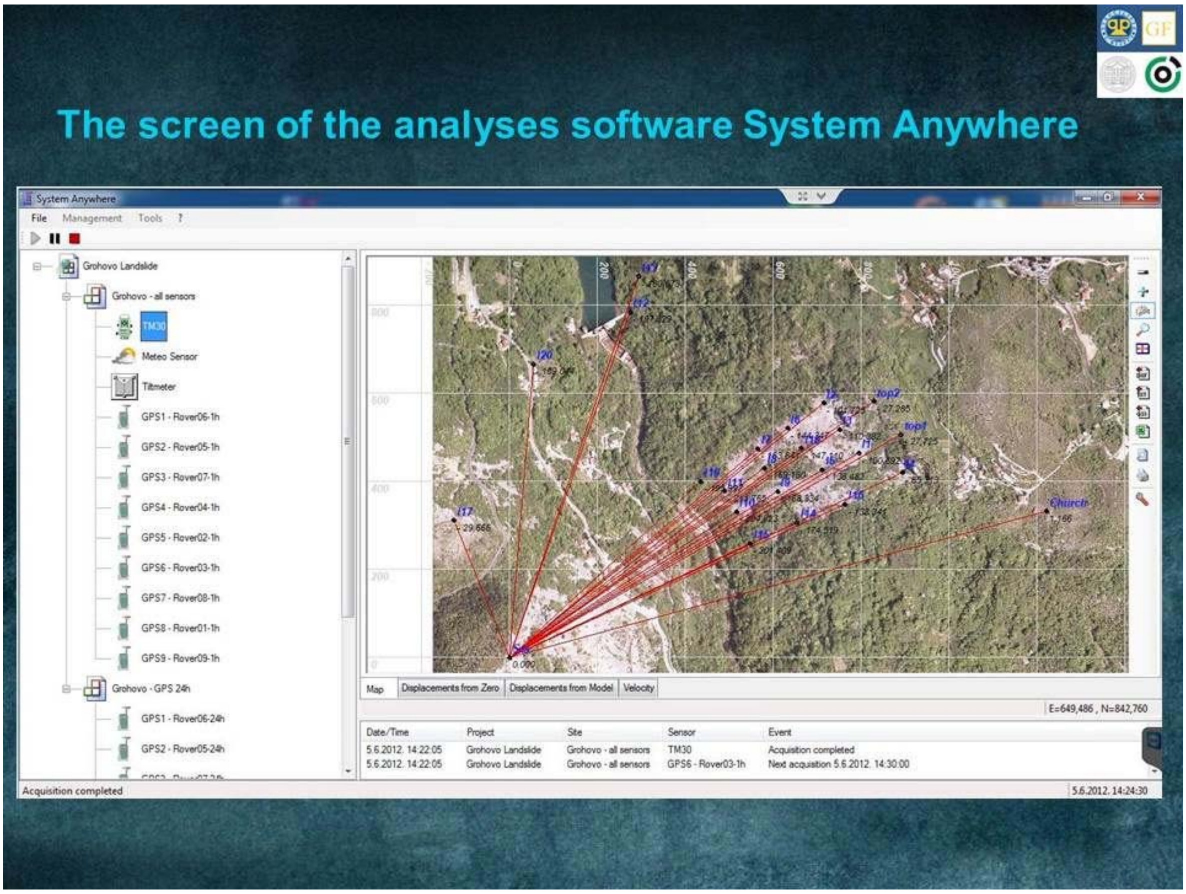

Monitoring equipment:
RED – GPS
YELLOW- prisms
CIAN – extensometers line
I13
I12
GPS8
I2
top2
GPS6
I6
I3
top1
GPS7
I7
I18
B1
GPS1
I8
I5
I4
I19
GPS2
I11
I9
RG
B2
I10
GPS3
I16
GPS4
I14
Church
GPS5
I15

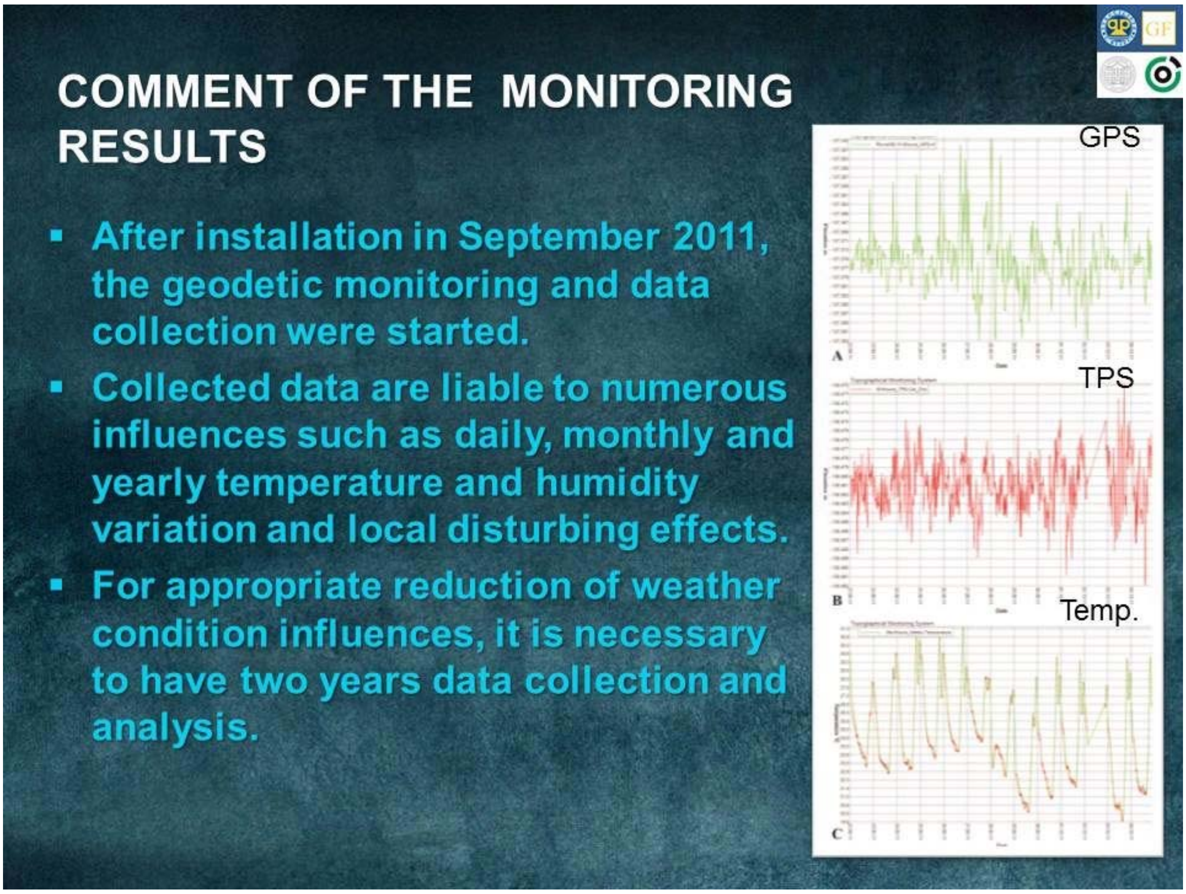

GPS Unit
GMX901
Total
station
TM30
Leica
Total station TM30 Leica
Main GPS Unit GMX901
Master PC Unit
GPS,
prisms
Power
supply:
-solar panel
-windmill
GPS,
prisms

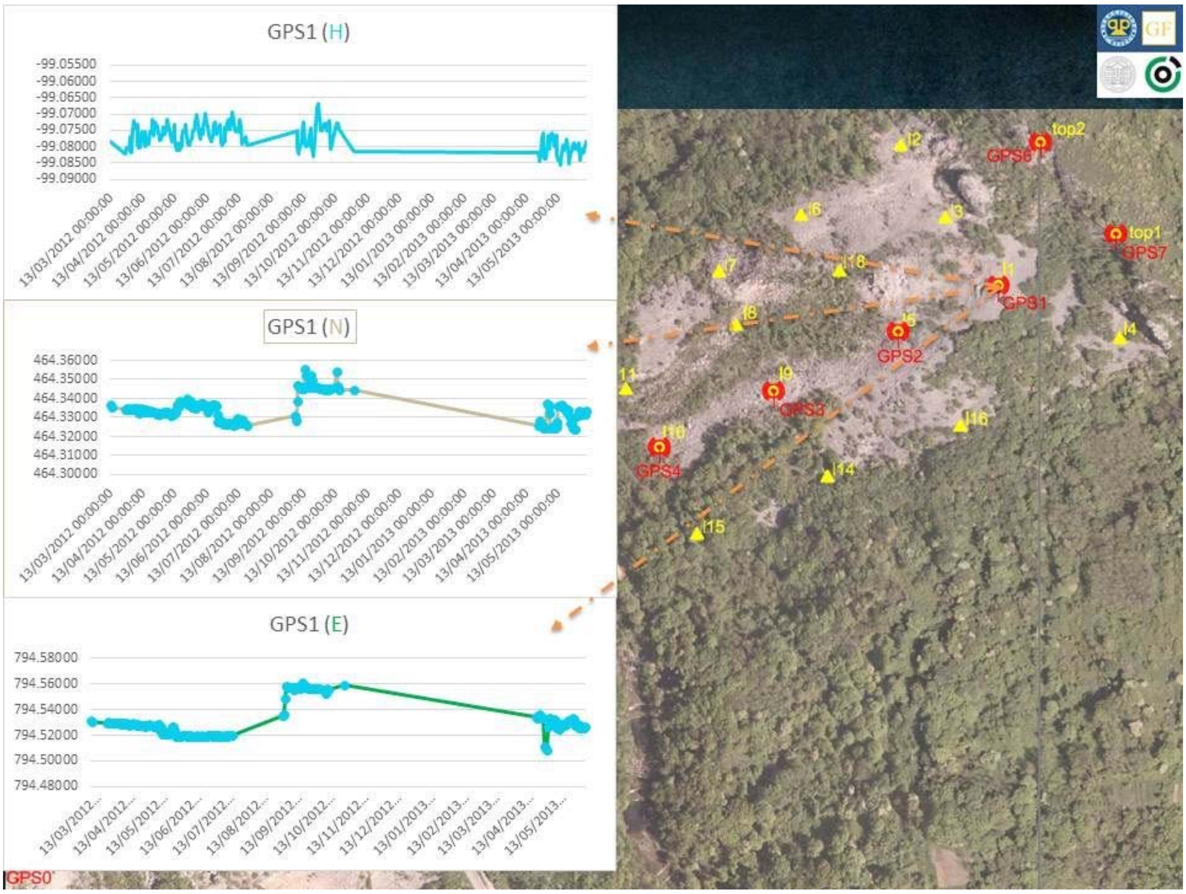

Prism (reflector)
Total station TM30 Leica
Main GPS Unit GMX901
Master PC Unit
GPS, prisms
GPS Antena GMX901
Prism

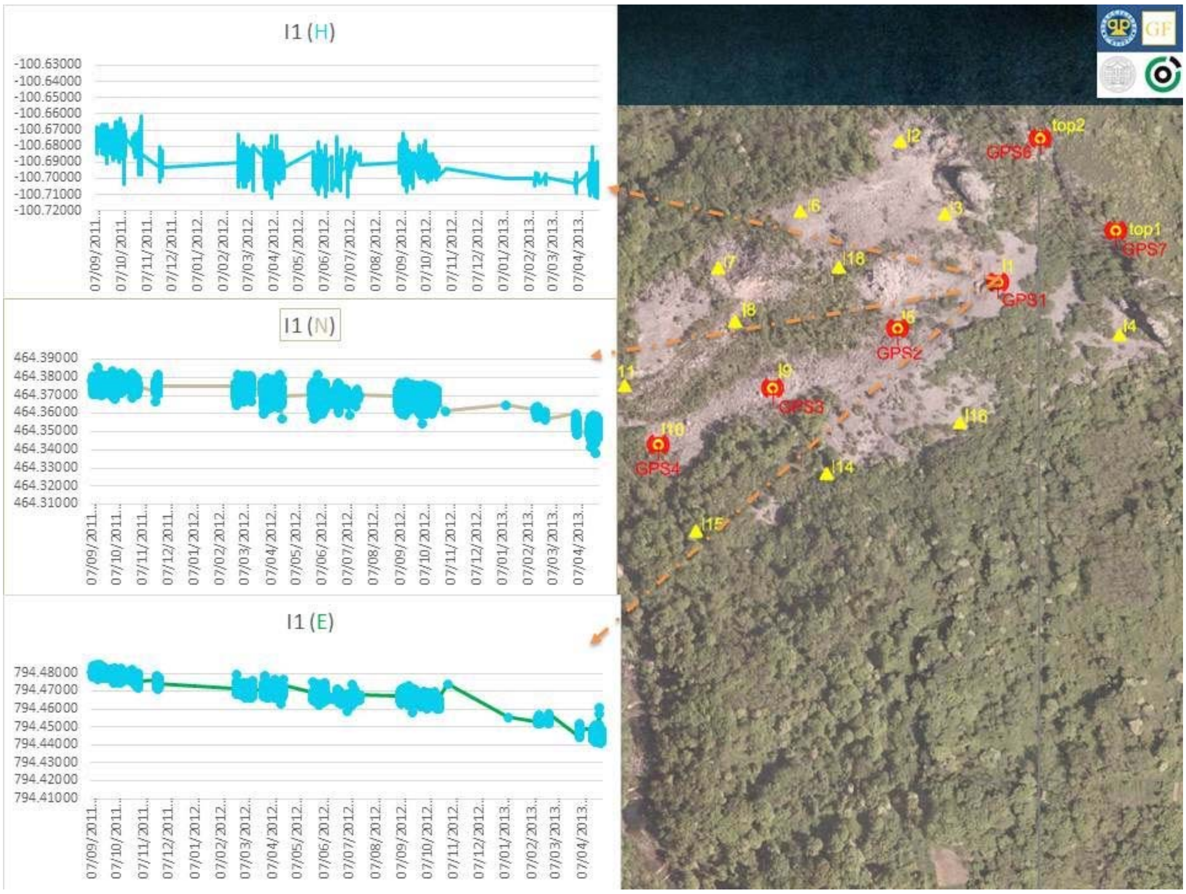

Wire Extensometers
Monitoring equipment:
BLUE - prisms
YELLOW- GPS
CIAN – extensometers line
ORANGE - inclinometers
EL
B1
B3
Extensometers wire connect to prism

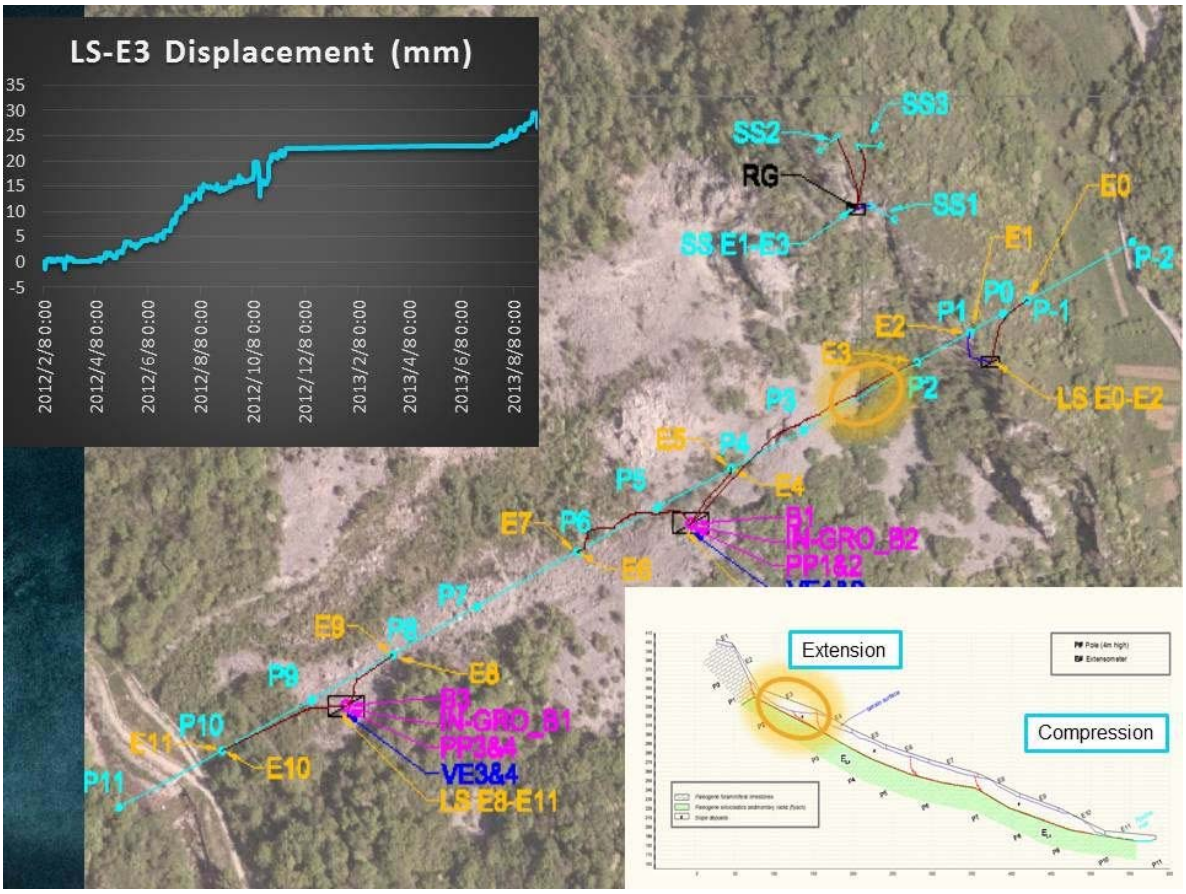

The robotic station measures 25 benchmarks (prisms) every 30 minutes.
GPS postprocessing:
1 hour
12 hours
Data transfer:
Wi-fi from GPS to PC Unit
UMTS from PC Unit to the University
Total station TM30 Leica
Main GPS Unit GMX901
Master PC Unit
Wi-fi
GPS
UMTS
University

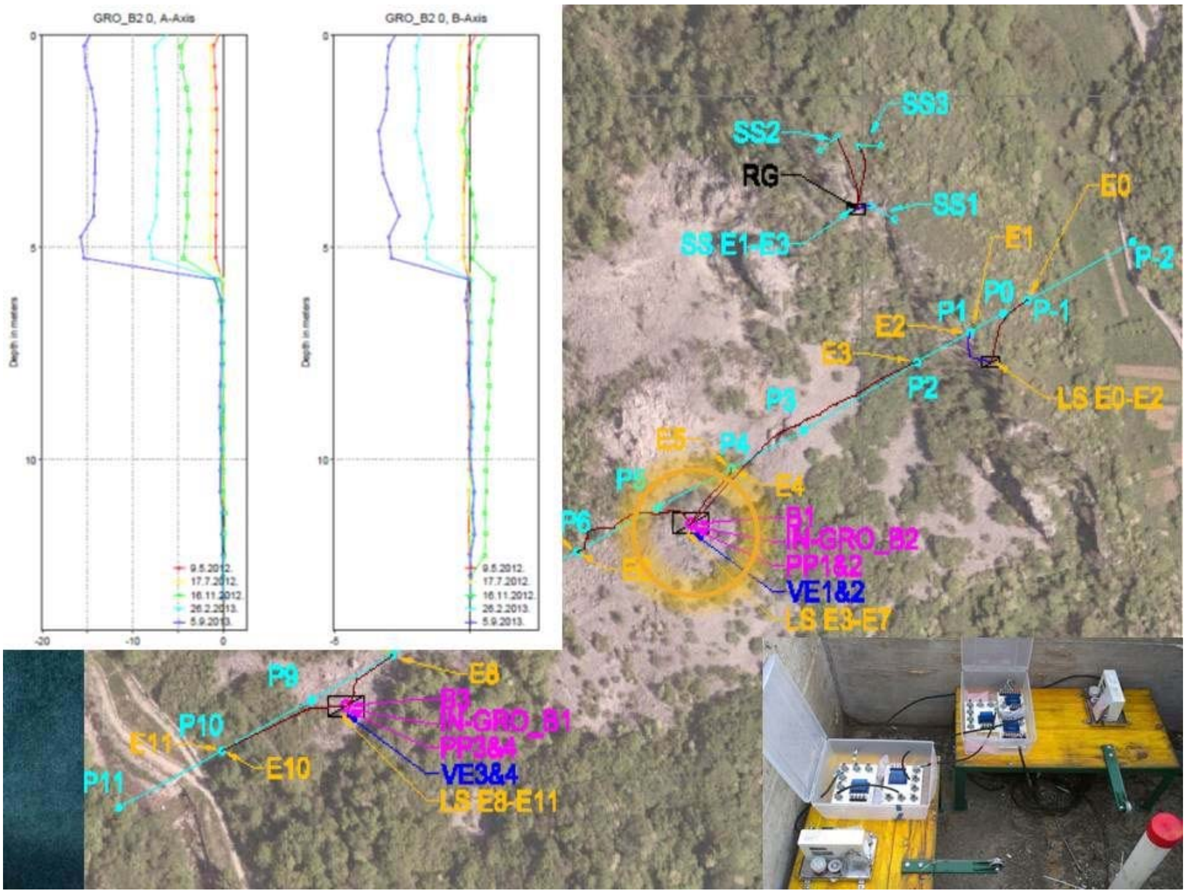

The screen of the analyses software System Anywhere
System Anywhere
File Management Tools ?
Grohovo Landslide
Grohovo - all sensors
TM30
Meteo Sensor
Tiltmeter
GPS1 - Rover06-1h
GPS2 - Rover05-1h
GPS3 - Rover07-1h
GPS4 - Rover04-1h
GPS5 - Rover02-1h
GPS6 - Rover03-1h
GPS7 - Rover08-1h
GPS8 - Rover01-1h
GPS9 - Rover09-1h
Grohovo - GPS 24h
GPS1 - Rover06-24h
GPS2 - Rover05-24h
Map
Displacements from Zero
Displacements from Model
Velocity
E=649,486 , N=842,760
Date/Time
Project
Site
Sensor
Event
5.6.2012. 14:22:05
Grohovo Landslide
Grohovo - all sensors
TM30
Acquisition completed
5.6.2012. 14:22:05
Grohovo Landslide
Grohovo - all sensors
GPS6 - Rover03-1h
Next acquisition 5.6.2012. 14:30:00
Acquisition completed
5.6.2012. 14:24:30


COMMENT OF THE MONITORING RESULTS
After installation in September 2011, the geodetic monitoring and data collection were started.
Collected data are liable to numerous influences such as daily, monthly and yearly temperature and humidity variation and local disturbing effects.
For appropriate reduction of weather condition influences, it is necessary to have two years data collection and analysis.
GPS
TPS
Temp.
A
B
C


GPS1 (H)
-99.05500
-99.06000
-99.06500
-99.07000
-99.07500
-99.08000
-99.08500
-99.09000
GPS1 (N)
464.36000
464.35000
464.34000
464.33000
464.32000
464.31000
464.30000
GPS1 (E)
794.58000
794.56000
794.54000
794.52000
794.50000
794.48000
13/03/2012 00:00:00
13/04/2012 00:00:00
13/05/2012 00:00:00
13/06/2012 00:00:00
13/07/2012 00:00:00
13/08/2012 00:00:00
13/09/2012 00:00:00
13/10/2012 00:00:00
13/11/2012 00:00:00
13/12/2012 00:00:00
13/01/2013 00:00:00
13/02/2013 00:00:00
13/03/2013 00:00:00
13/04/2013 00:00:00
13/05/2013 00:00:00
top2
GPS6
top1
GPS7
GPS1
GPS2
GPS3
GPS4
GPS0


I1 (H)
I1 (N)
I1 (E)
top2
GPS6
top1
GPS7
GPS1
GPS2
GPS3
GPS4
I2
I3
I4
I6
I7
I8
I9
I10
I11
I14
I15
I16
I18


LS-E3 Displacement (mm)
SS3
SS2
RG
SS1
SS E1-E3
E0
E1
P-2
P0
P-1
P1
E2
E3
P2
LS E0-E2
P3
E5
P4
E4
P5
E7
P6
B1
IN-GRO_B2
PP1&2
E6
P7
E9
P8
E8
P9
B3
IN-GRO_B1
PP3&4
E11
P10
E10
VE3&4
LS E8-E11
P11
Extension
Compression



- The weakest link in the Grohovo landslide monitoring system is power supply: solar panels and windmill cannot produce enough electric energy to ensure system running during winter season (November to early March).
- Establishment of an early warning system and defining of alarm thresholds is based on existing cognition of the Grohovo landslide behavior so as from collected consequent comprehensive monitoring data.

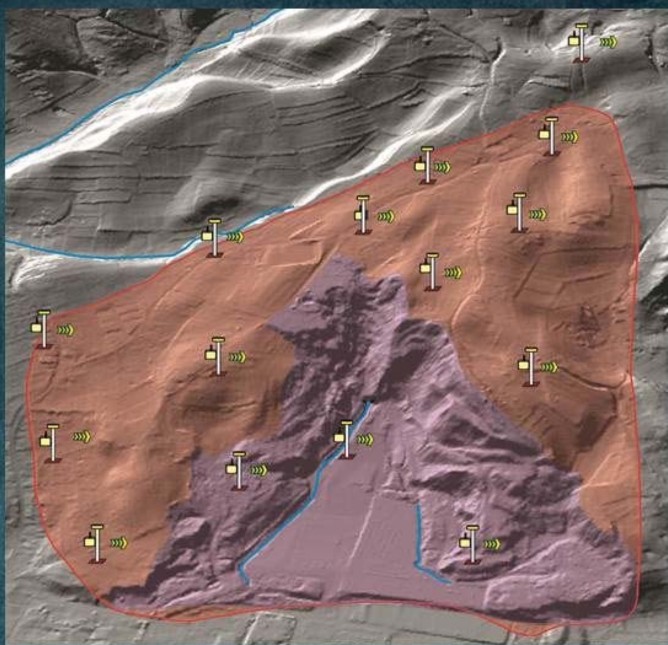

3
KOSTANJEK
LANDSLIDE
MONITORING
SYSTEM

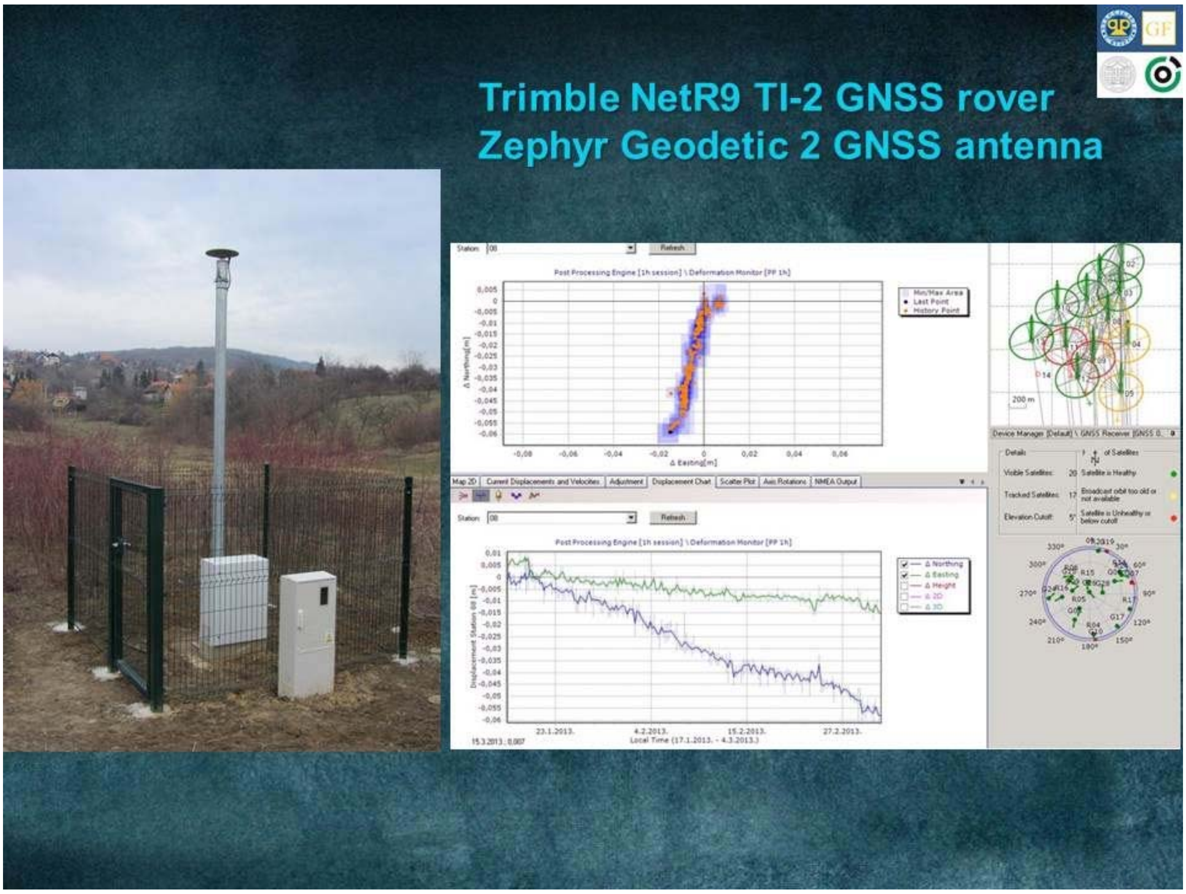

The Kostanjek landslide is the largest landslide in the Republic of Croatia, located in the western residential area of the City of Zagreb.
Landslide was activated in 1963 and main cause of sliding was excavation of marl at the foot of slope.
Area of landslide is 1.2 km2 and estimated sliding mass of 32x106 m3

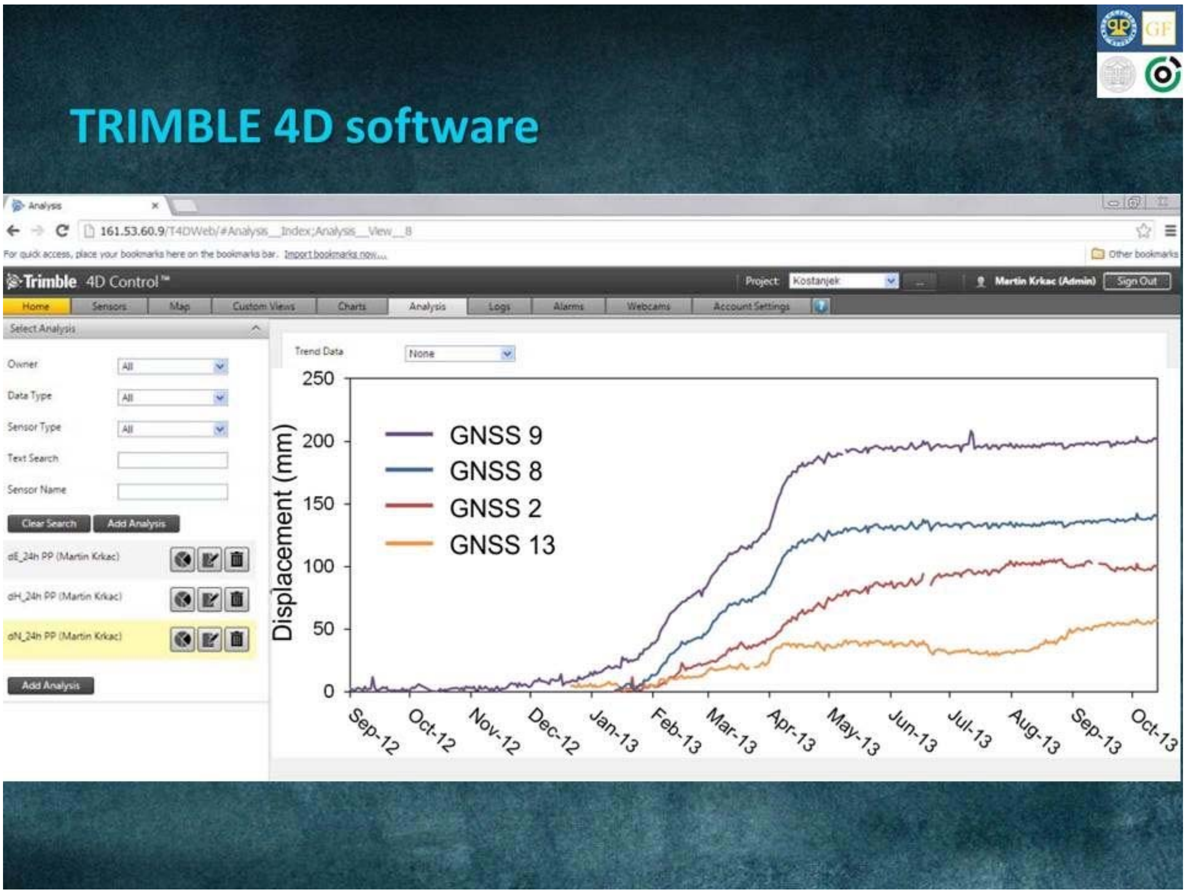
- The monitoring system was designed to consist of geodetic and geotechnical monitoring.
- Geodetic monitoring includes geodetic surveys OF displacement measurements using 15 GNSS rovers.
- Equipment for the geotechnical monitoring includes vertical inclinometer (1) in combination with vertical wire exstensometers (4), long and short-span extensometers (9), pore pressure gauges (3), 5 water level gauges, 2 mini divers and pluviometer.
- Pore pressure gauges, inclinometers and vertical extensometers are installed at location inside the central part of the landslide body.
- Seismic activity (geophysical monitoring) of the landslide is measured with 7 accelerometers .

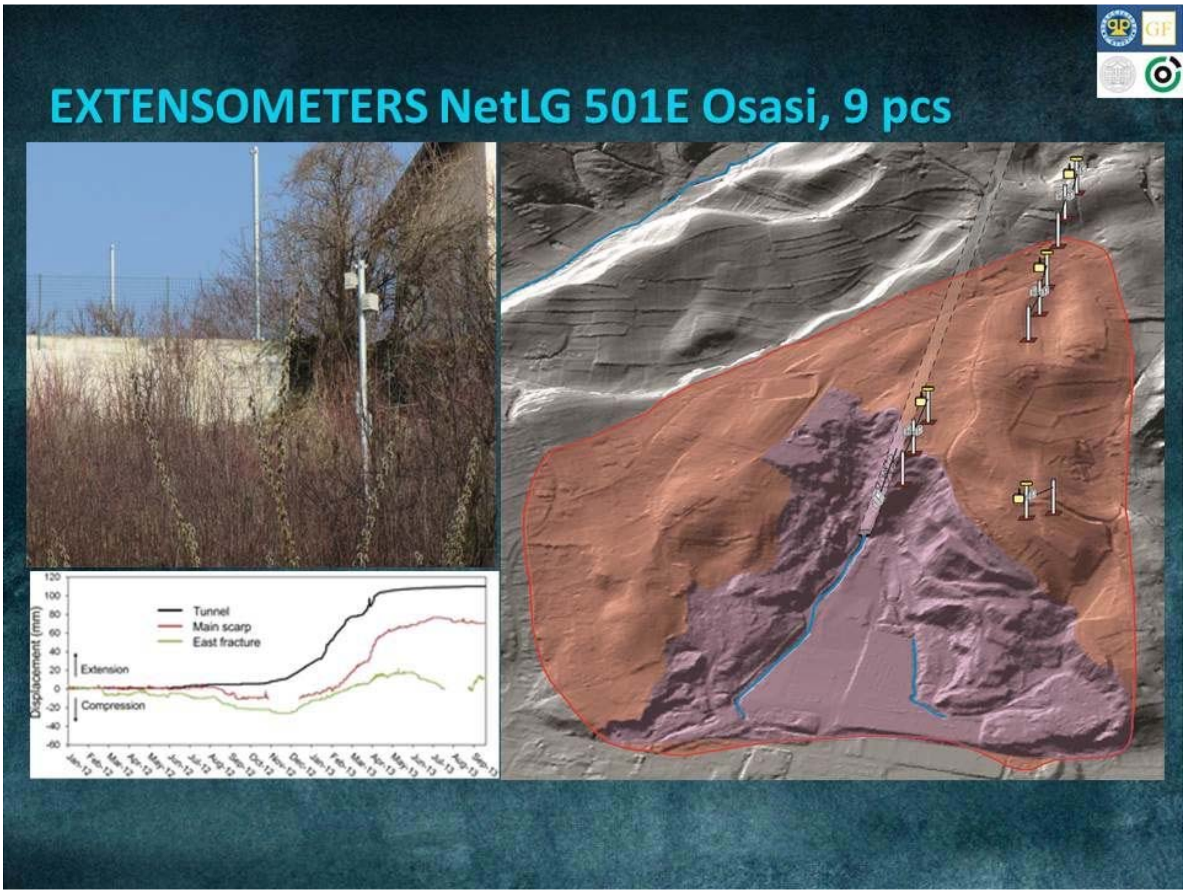
GNSS units

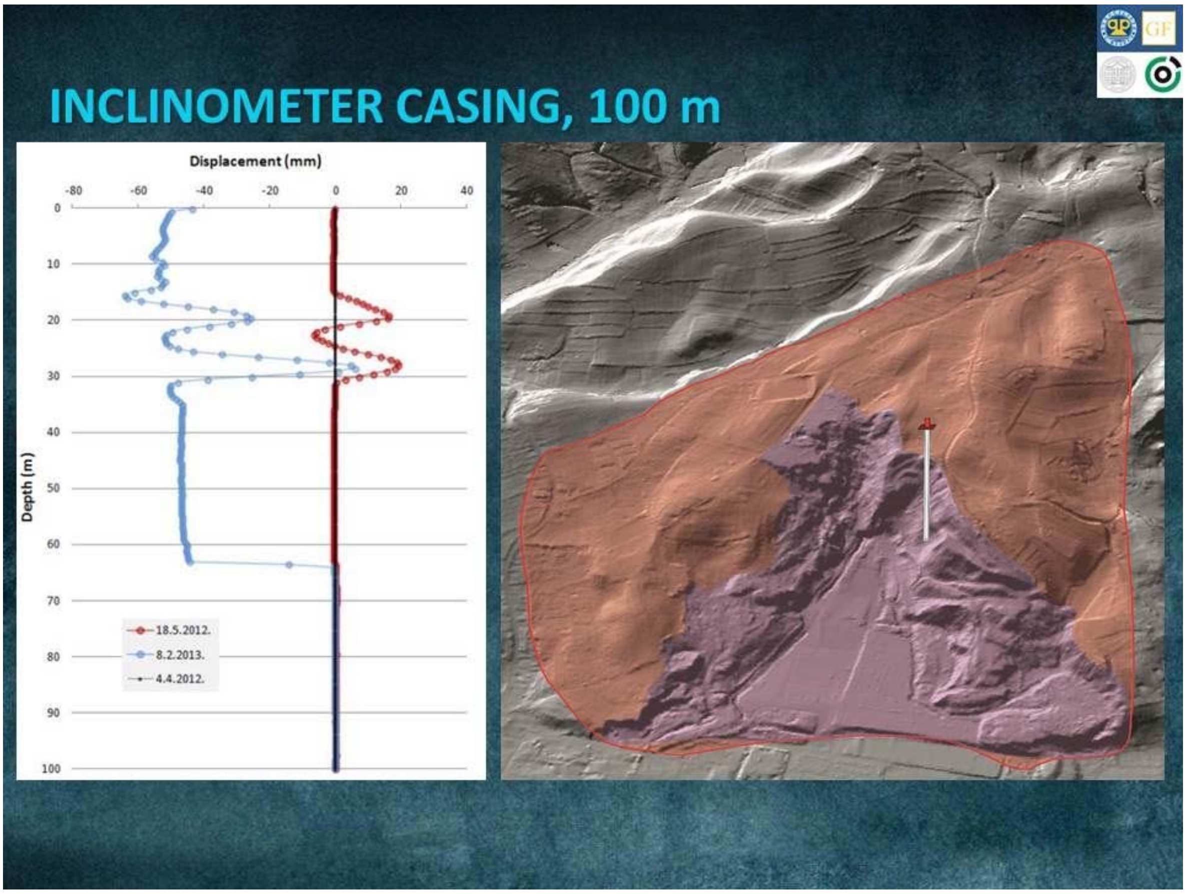
15 double frequency Trimble NetR9 TI-2 GNSS rovers with Zephyr Geodetic 2 GNSS antenna

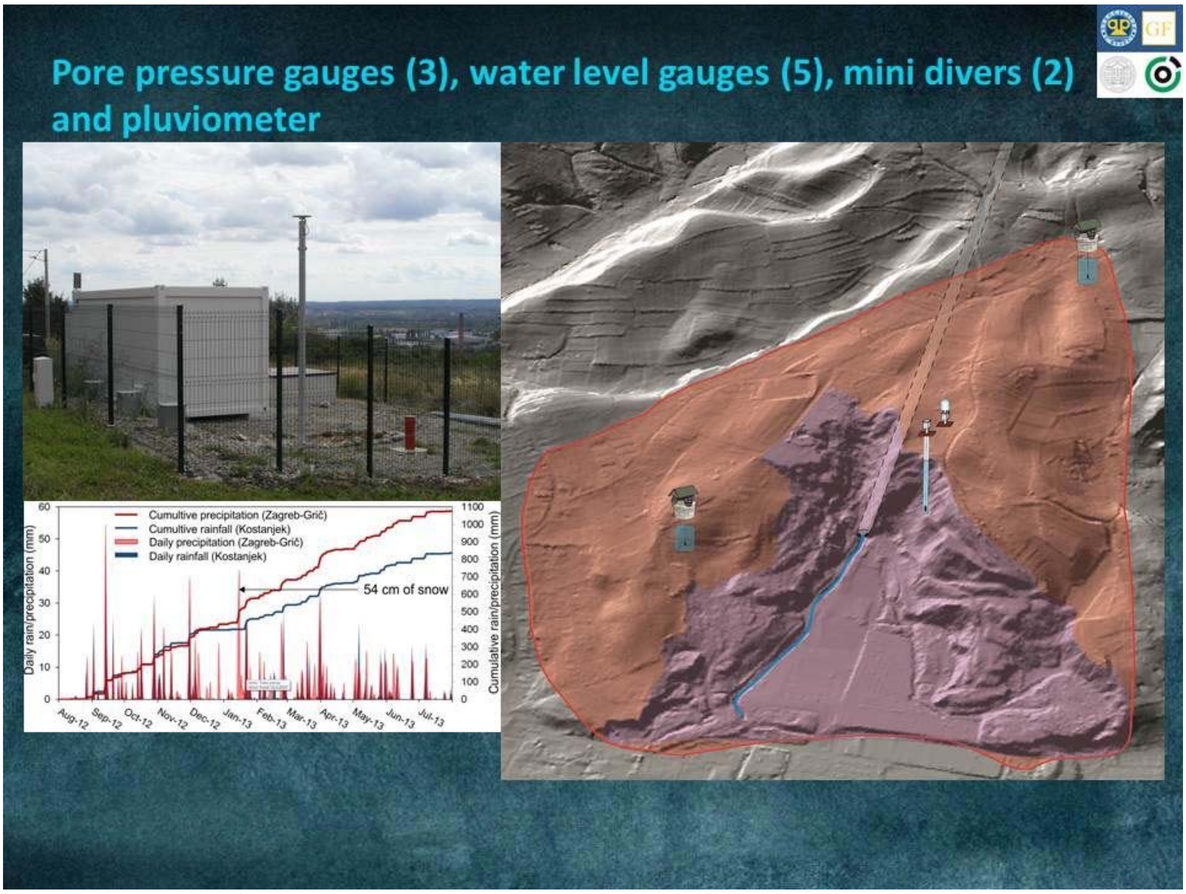


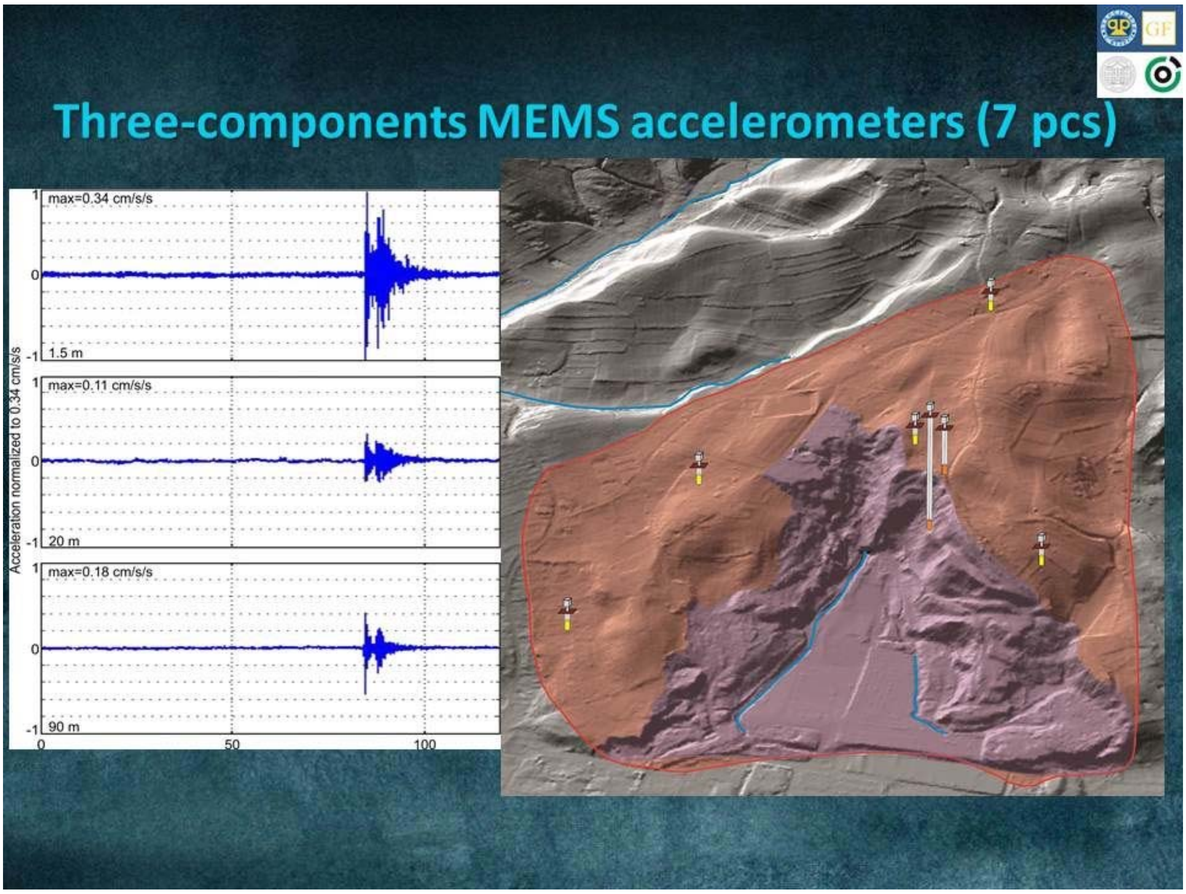

Trimble NetR9 TI-2 GNSS rover
Zephyr Geodetic 2 GNSS antenna

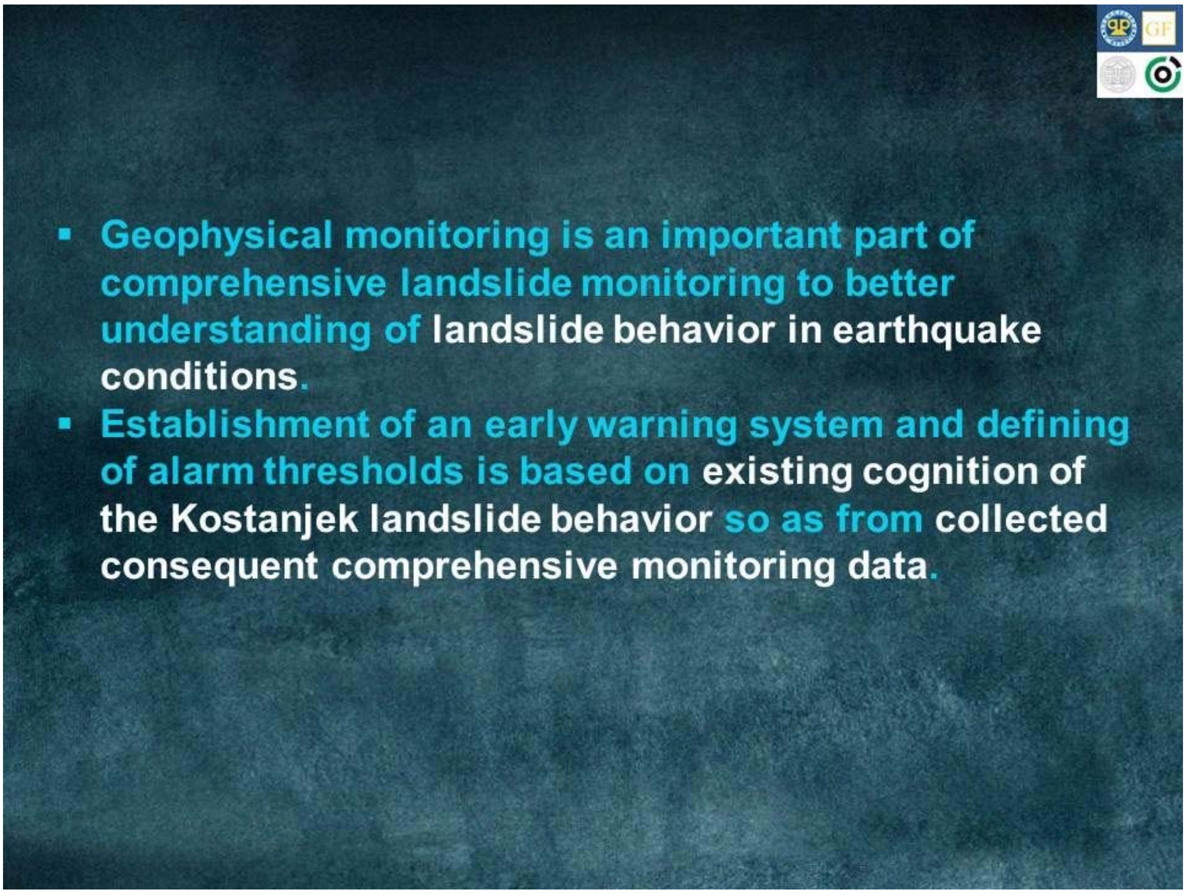

TRIMBLE 4D software
Trimble 4D Control™
Home
Sensors
Map
Custom Views
Charts
Analysis
Logs
Alarms
Webcams
Account Settings
Select Analysis
Owner
Data Type
Sensor Type
Text Search
Sensor Name
Clear Search
Add Analysis
Trend Data
None
GNSS 9
GNSS 8
GNSS 2
GNSS 13
Displacement (mm)
250
200
150
100
50
0
Sep-12
Oct-12
Nov-12
Dec-12
Jan-13
Feb-13
Mar-13
Apr-13
May-13
Jun-13
Jul-13
Aug-13
Sep-13
Oct-13


EXTENSOMETERS NetLG 501E Osasi, 9 pcs
Tunnel
Main scarp
East fracture
Displacement (mm)
Extension
Compression


INCLINOMETER CASING, 100 m
Displacement (mm)
Depth (m)
18.5.2012.
8.2.2013.
4.4.2012.

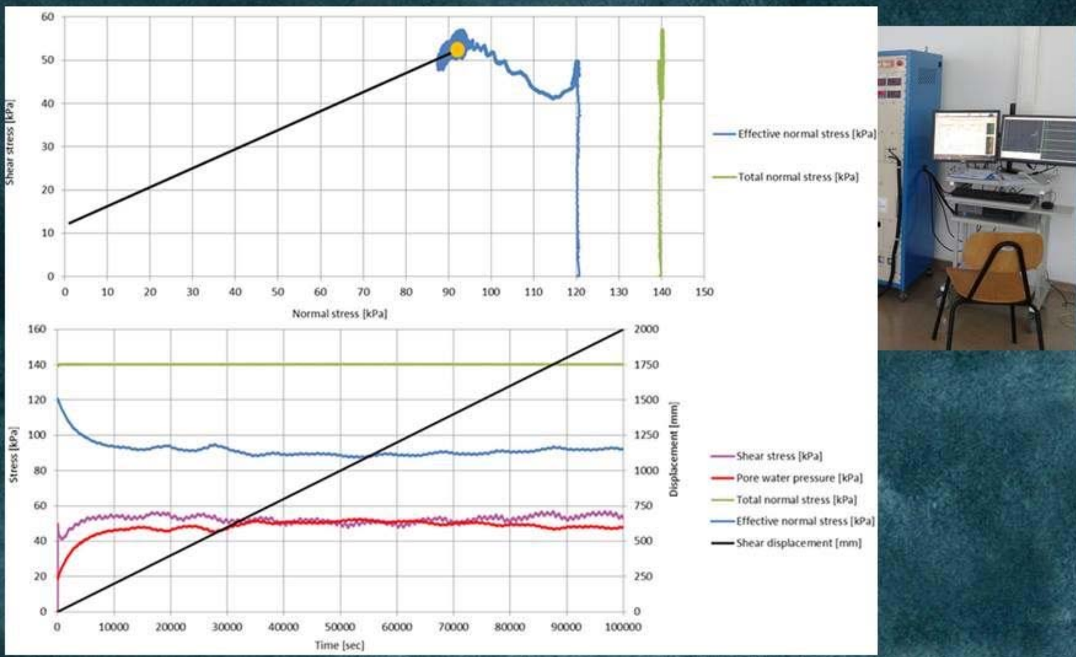

Pore pressure gauges (3), water level gauges (5), mini divers (2) and pluviometer
Cumultive precipitation (Zagreb-Grič)
Cumultive rainfall (Kostanjek)
Daily precipitation (Zagreb-Grič)
Daily rainfall (Kostanjek)
54 cm of snow
Daily rain/precipitation (mm)
Cumulative rain/precipitation (mm)
Aug-12 Sep-12 Oct-12 Nov-12 Dec-12 Jan-13 Feb-13 Mar-13 Apr-13 May-13 Jun-13 Jul-13


Three-components MEMS accelerometers (7 pcs)
max=0.34 cm/s/s
1.5 m
max=0.11 cm/s/s
20 m
max=0.18 cm/s/s
90 m
Acceleration normalized to 0.34 cm/s/s
0
50
100


▪ Geophysical monitoring is an important part of comprehensive landslide monitoring to better understanding of landslide behavior in earthquake conditions.
▪ Establishment of an early warning system and defining of alarm thresholds is based on existing cognition of the Kostanjek landslide behavior so as from collected consequent comprehensive monitoring data.

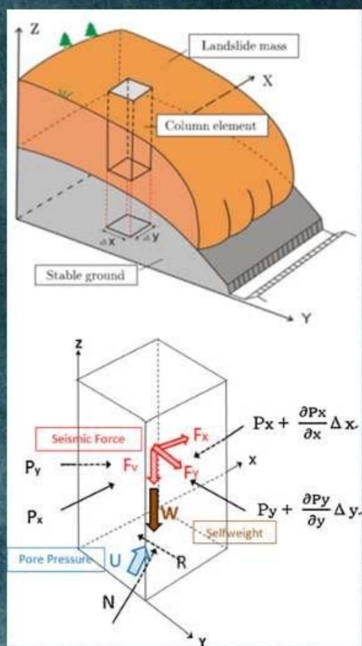

4
SOIL
TESTING
LANDSLIDE
SIMULATION

SOIL TESTING



LANDSLIDE SIMULATION

- The LS-Rapid software is the landslide simulation model developed by Professor Sassa possible to integrate the whole process of stable state, failure, post-failure strength reduction, motion and deposit of sliding mass.



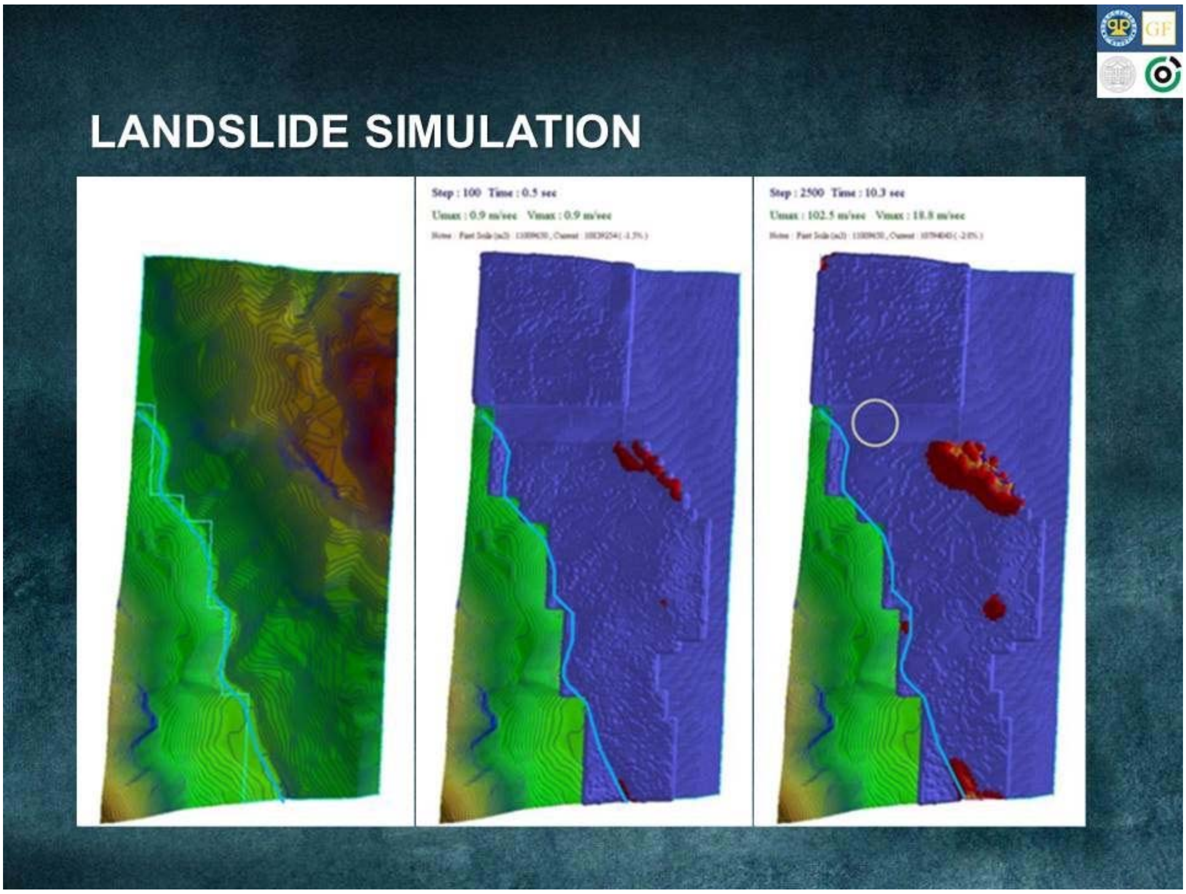
LANDSLIDE SIMULATION

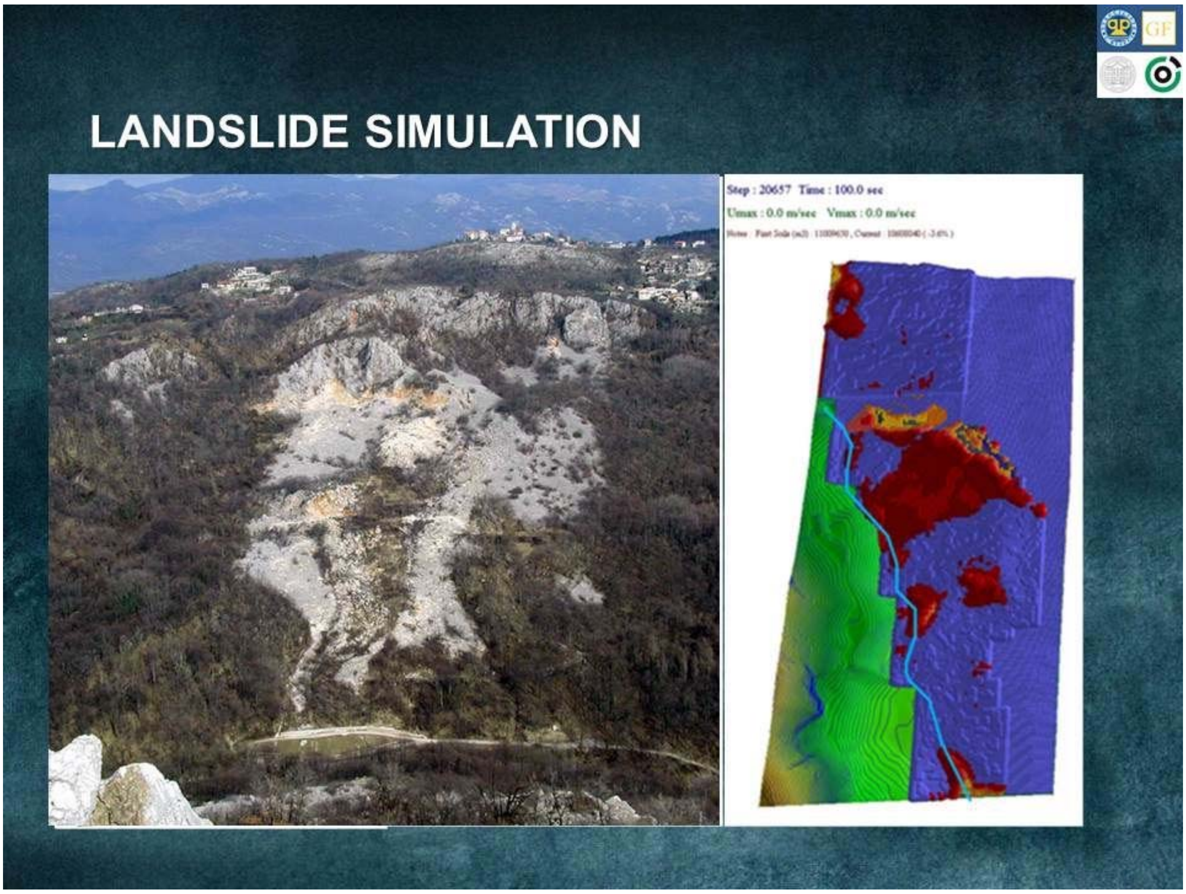
- The topography of the Rječina River Valley was determined using original DEM data. The limestone rock mass is situated at the top of the slopes, while the siliciclastic rocks and flysch are situated on the lower slopes and the bottom of the valley. Depth of the sliding mass varies from 3 to 10 m over the flysch bedrock and from 0.0 to 0.5 m over the limestone rock mass.
- In the simulation, the friction angle and cohesion are reduced from their peak values to the normal motion time values within the source area in the determined distribution of the unstable mass.
- The strength reduction started in the moment when the travel length became equal to shear displacement at the start of strength reduction (DL, mm).

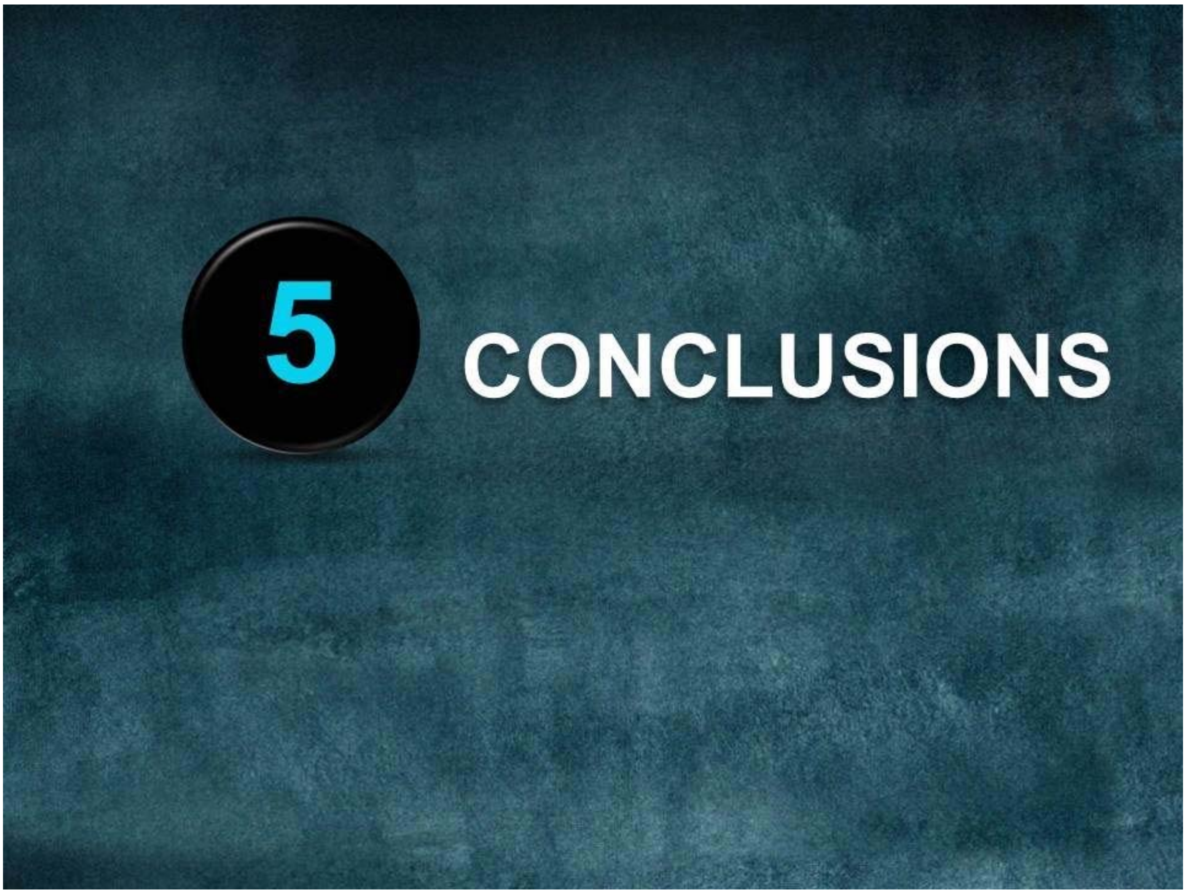
LANDSLIDE SIMULATION

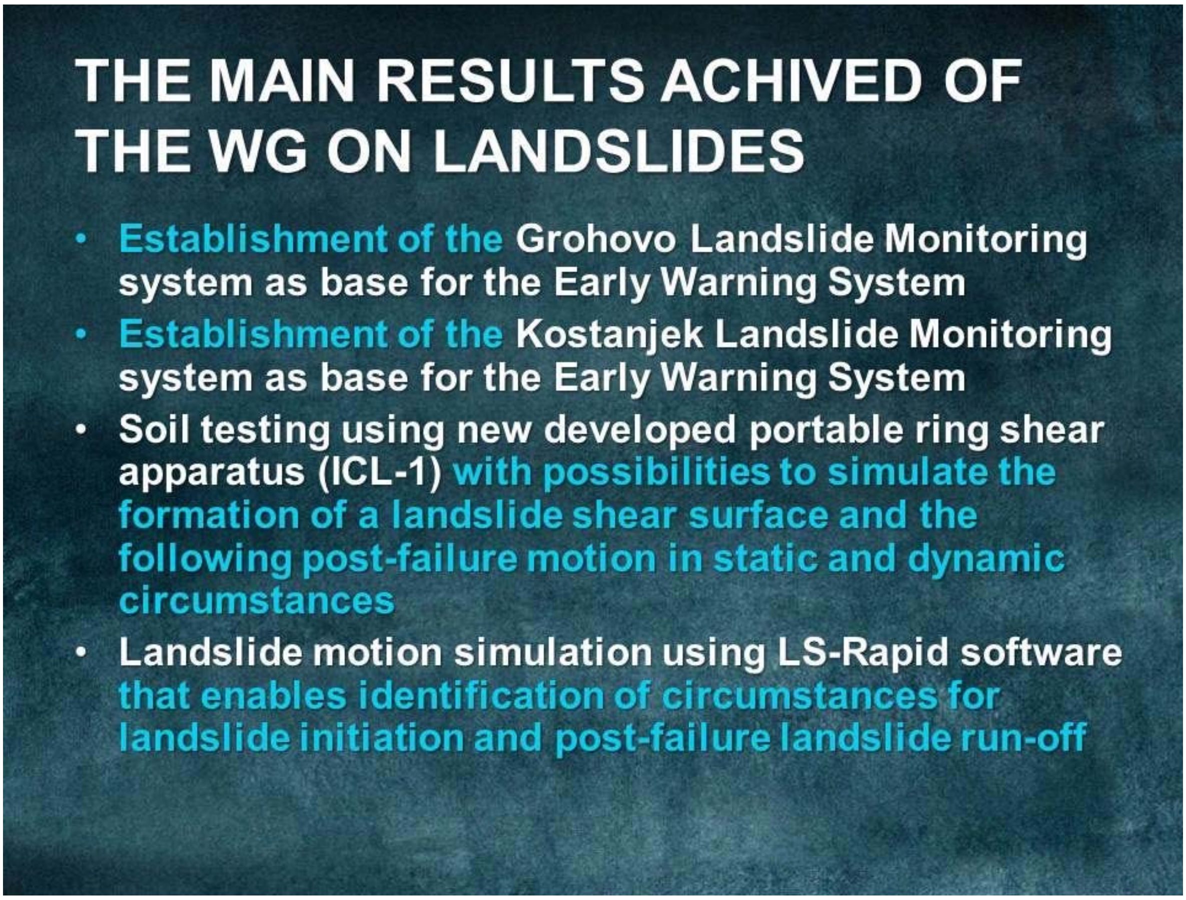
- The ground water level rising in the model was expressed by excess of the pore pressure ratio until the value of r_u=0.60, which is correspondent to the ground water level equal to terrain surface.
- The time period of ground water level rising in the model was set up as 60 seconds and one second in the model was correspondent to one day real time period.
- The most important simulation parameters are the steady state shear resistance (τ_{ss}), the lateral pressure ratio (k) and the critical shear displacements (DL, DU).

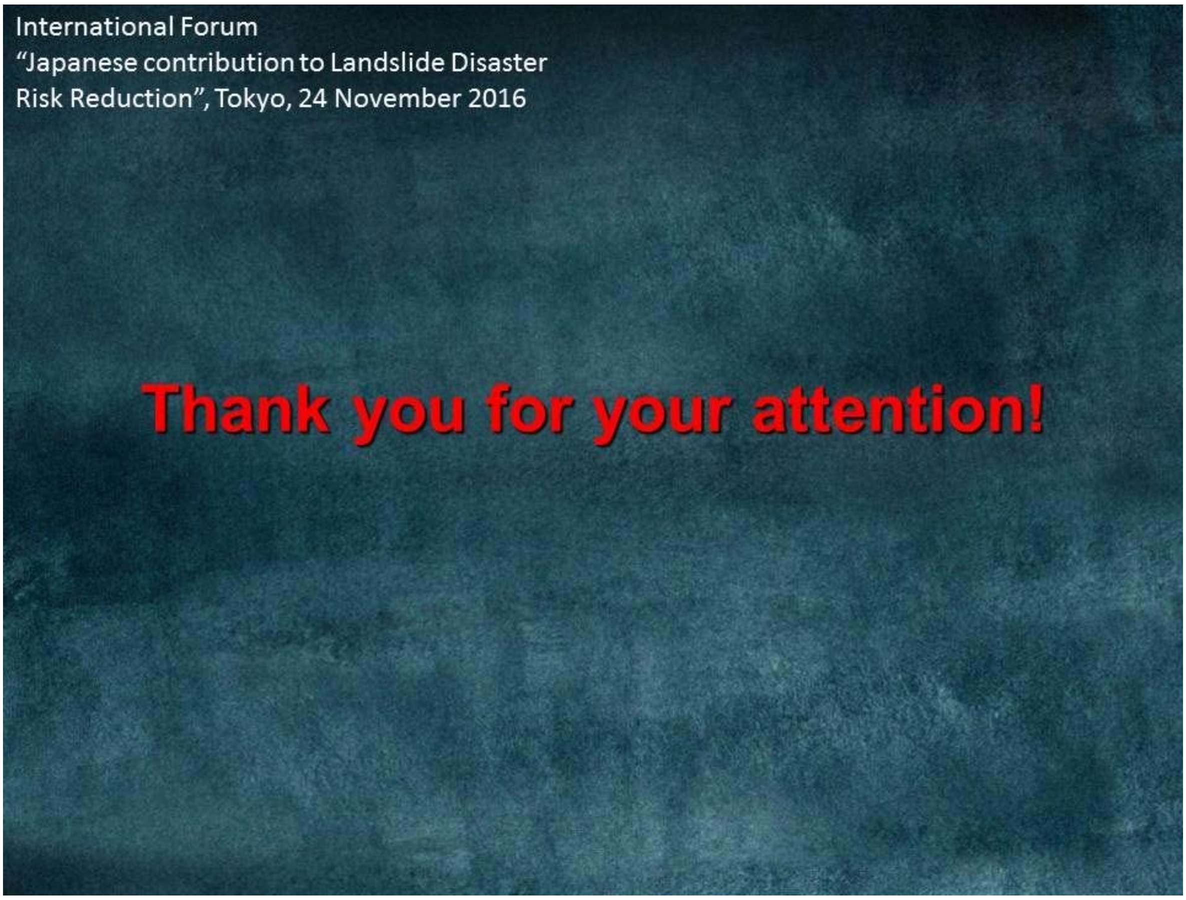
Soil parameters	Value	Source
Total unit weight of the mass (γ_t)	20 kN/m^3	Benac et al., 2005
Steady state shear resistance in the source area (τ_{ss})	65 kPa	Test data Oštrić et al., 2012
Lateral Pressure ratio ($k=\sigma_h/\sigma_v$)	0.7	Estimation from the test data
Friction angle inside landslide mass (ϕ_i)	33°	Benac et al., 2005
Friction angle during motion (ϕ_m)	26°	Test data Oštrić et al., 2012
Peak friction angle at sliding surface (ϕ_p)	34°	Benac et al., 2005
Peak cohesion at slip surface (c_p)	7.5 kPa	Benac et al., 2005
Shear displacement at the start of strength reduction (*DL*)	30 mm	Test data Oštrić et al., 2012
Shear displacement at the end of strength reduction (*DU*)	1000 mm	Test data Oštrić et al., 2012
Pore pressure generation rate (B_{ss})	0.7	Estimation
Cohesion inside mass (c_i)	0.0 kPa	Benac et al., 2005
Cohesion at sliding surface during motion (c_m)	0.0 kPa	Benac et al., 2005
Excess pore pressure (r_u)	0.0 – 0.6	Assumption


LANDSLIDE SIMULATION
Step : 100 Time : 0.5 sec
Umax : 0.9 m/sec Vmax : 0.9 m/sec
Step : 2500 Time : 10.3 sec
Umax : 102.5 m/sec Vmax : 18.8 m/sec


LANDSLIDE SIMULATION
Step : 20657 Time : 100.0 sec
Umax : 0.0 m/sec Vmax : 0.0 m/sec


5
CONCLUSIONS


THE MAIN RESULTS ACHIVED OF THE WG ON LANDSLIDES
• Establishment of the Grohovo Landslide Monitoring system as base for the Early Warning System
• Establishment of the Kostanjek Landslide Monitoring system as base for the Early Warning System
• Soil testing using new developed portable ring shear apparatus (ICL-1) with possibilities to simulate the formation of a landslide shear surface and the following post-failure motion in static and dynamic circumstances
• Landslide motion simulation using LS-Rapid software that enables identification of circumstances for landslide initiation and post-failure landslide run-off


International Forum
"Japanese contribution to Landslide Disaster
Risk Reduction", Tokyo, 24 November 2016
Thank you for your attention!

JAPANESE - CROATIAN SATREPS FY2008 PROJECT 2009-2014 'HAZARD MAPS AND LAND-USE GUIDELINES' (WORKING GROUP 3)

SNJEŽANA MIHALIĆ ARBANAS
UNIVERSITY OF ZAGREB, FACULTY OF MINING, GEOLOGY AND PETROLEUM ENGINEERING (UNIZG-RGNF)
CROATIAN LEADER OF WORKING GROUP 3
ŽELJKO ARBANAS
UNIVERSITY OF RIJEKA, FACULTY OF CIVIL ENGINEERING (UNIRI-GF)

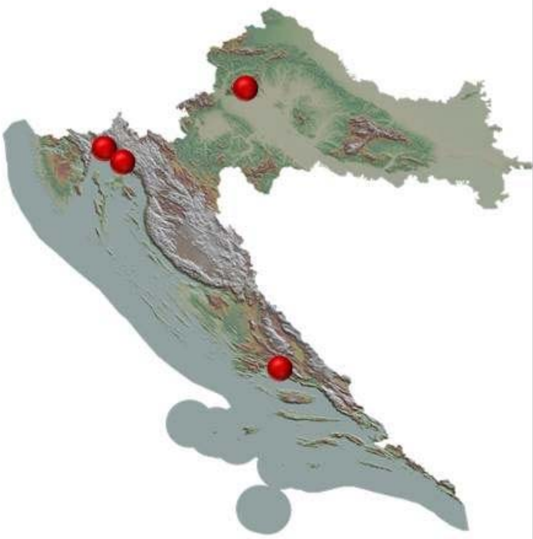
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

THE JAPANESE-CROATIAN SATREPS FY2008 PROJECT: GENERAL INFORMATION

PROJECT TITLE:
Risk Identification and Land Use Planning for Disaster Mitigation of Landslides and Floods in Croatia

SPECIFIC OBJECTIVES:
2009-2014

PILOT AREAS:
The City of Zagreb
Primorsko-Goranska County
Splitsko-Dalmatinska County

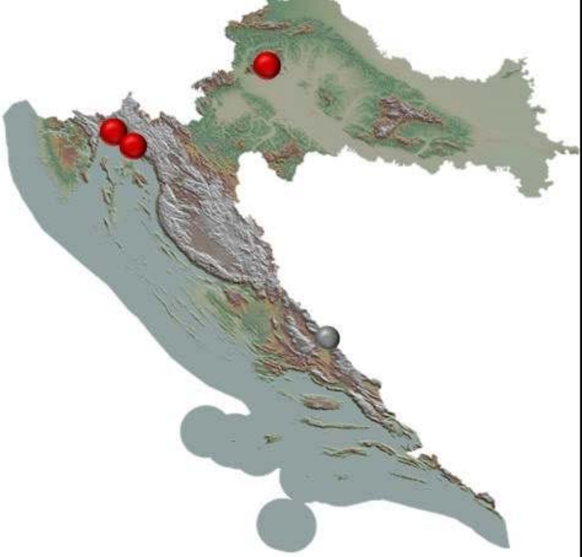


INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

THE JAPANESE-CROATIAN SATREPS FY2008 PROJECT: WORKING GROUP 3

WG3 TITLE:
Hazard maps and land-use guidelines

SPECIFIC OBJECTIVES:
- Identification and mapping of landslides
- Landslide susceptibility and hazard zonation



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'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

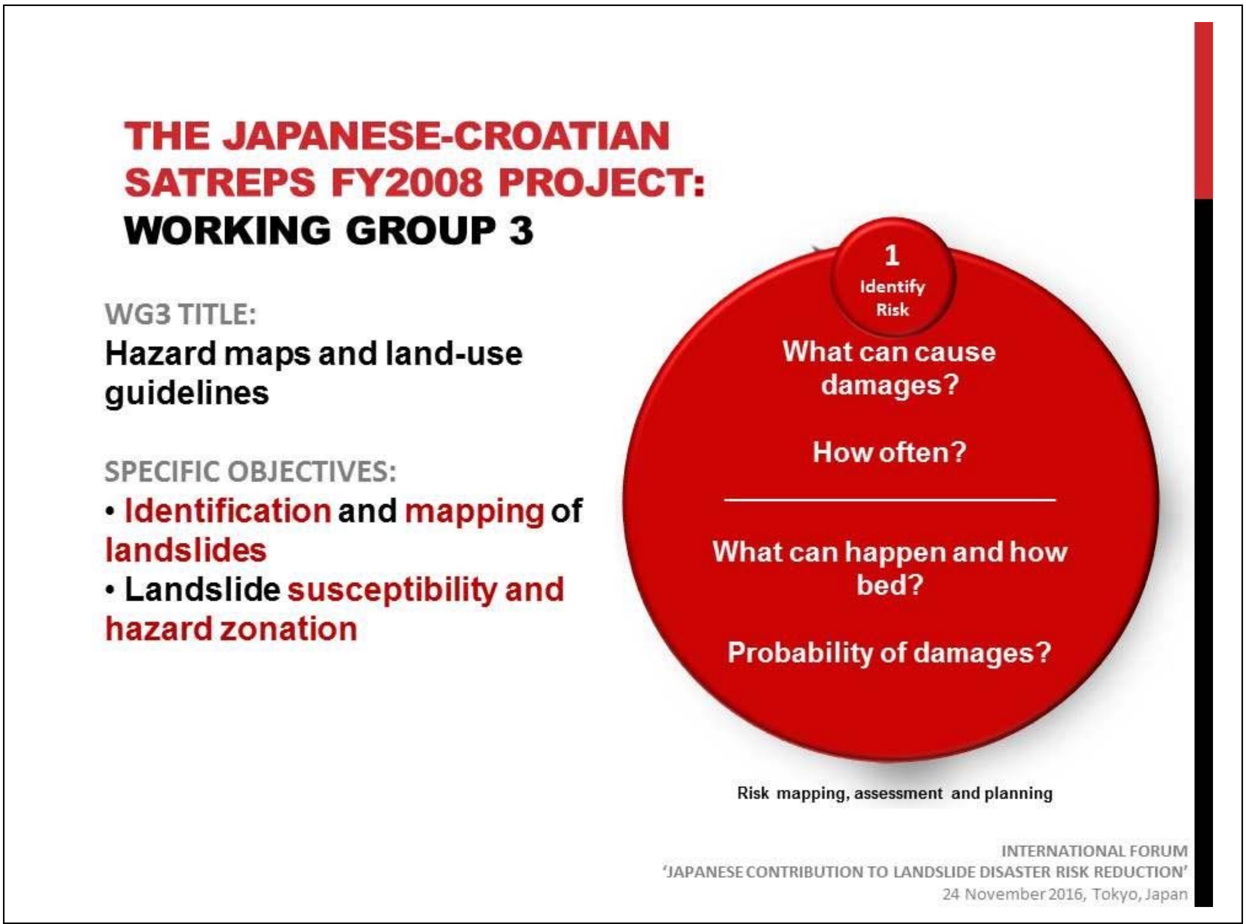
THE JAPANESE-CROATIAN SATREPS FY2008 PROJECT: WORKING GROUP 3

WG3 TITLE:
Hazard maps and land-use guidelines

SPECIFIC OBJECTIVES:
- Identification and mapping of landslides
- Landslide susceptibility and hazard zonation

Risk mapping, assessment and planning

INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan


THE JAPANESE-CROATIAN
SATREPS FY2008 PROJECT:
WORKING GROUP 3
WG3 TITLE:
Hazard maps and land-use guidelines
SPECIFIC OBJECTIVES:
• Identification and mapping of landslides
• Landslide susceptibility and hazard zonation
1
Identify
Risk
What can cause damages?
How often?
What can happen and how bed?
Probability of damages?
Risk mapping, assessment and planning
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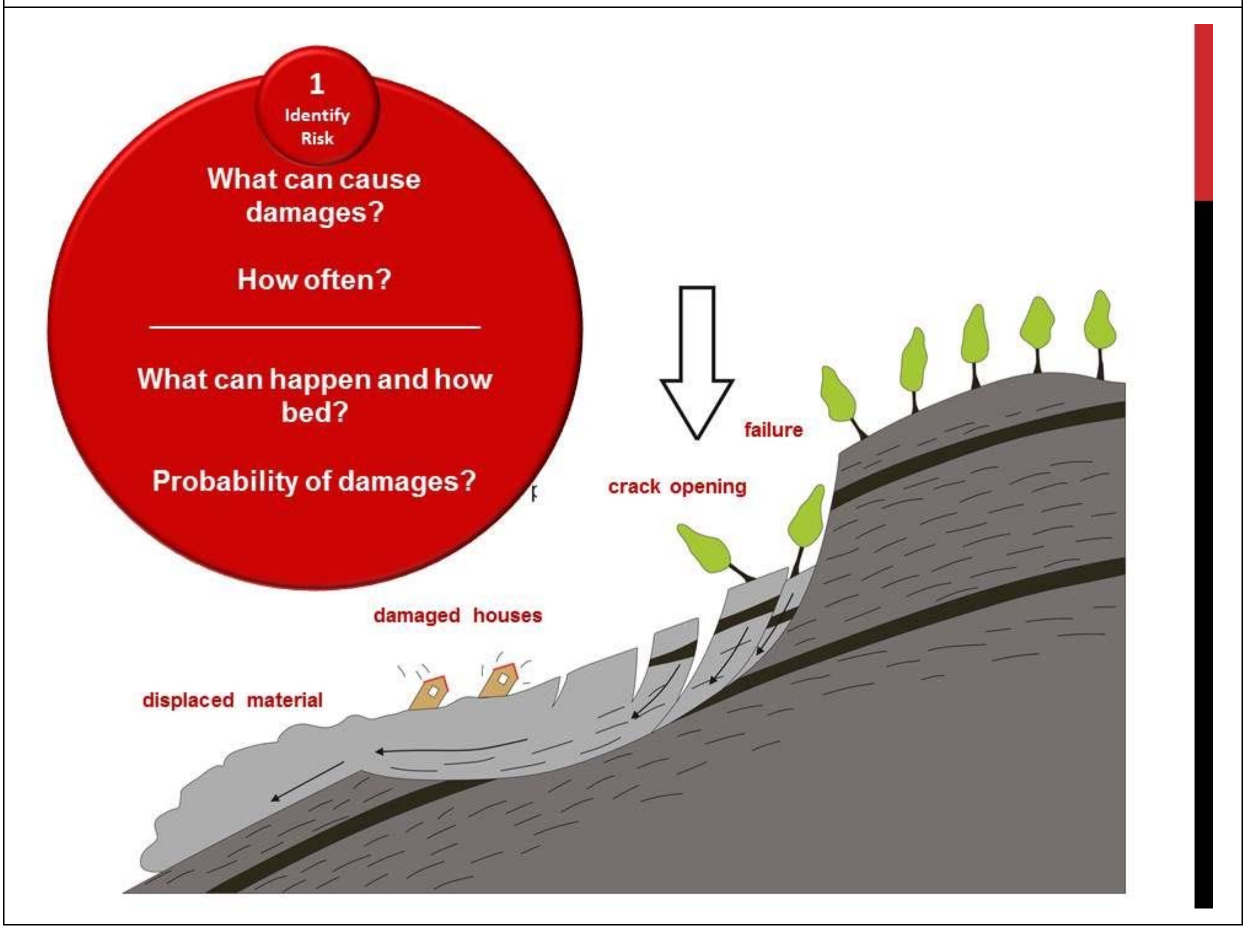
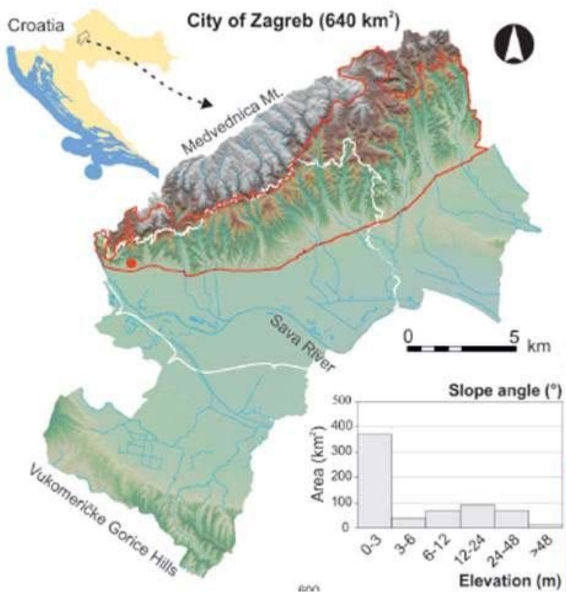

1
Identify
Risk
What can cause damages?
How often?
What can happen and how bed?
Probability of damages?
failure
crack opening
damaged houses
displaced material

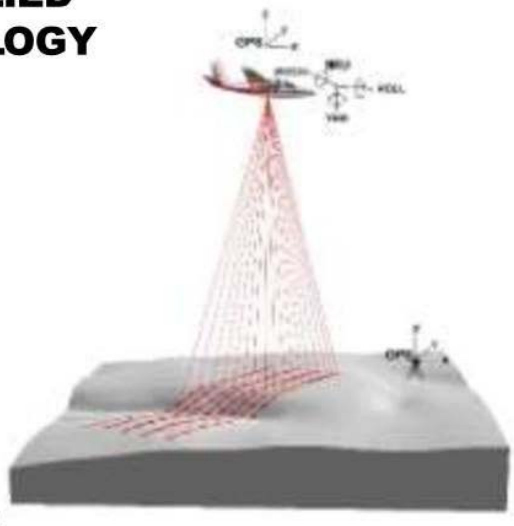
APPLICATION OF INNOVATIVE TECHNOLOGIES (2009-2014): CITY OF ZAGREB

IDENTIFICATION AND MAPPING OF LANDSLIDES

INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

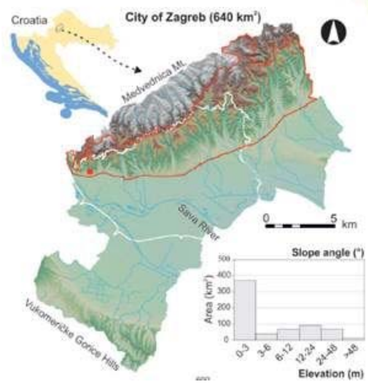
CITY OF ZAGREB: PILOT AREA AND APPLIED INNOVATIVE TECHNOLOGY





Airborne Laser Scanning (ASL)

CITY OF ZAGREB:
PILOT AREA AND APPLIED INNOVATIVE TECHNOLOGY



DTM derived from ASL data

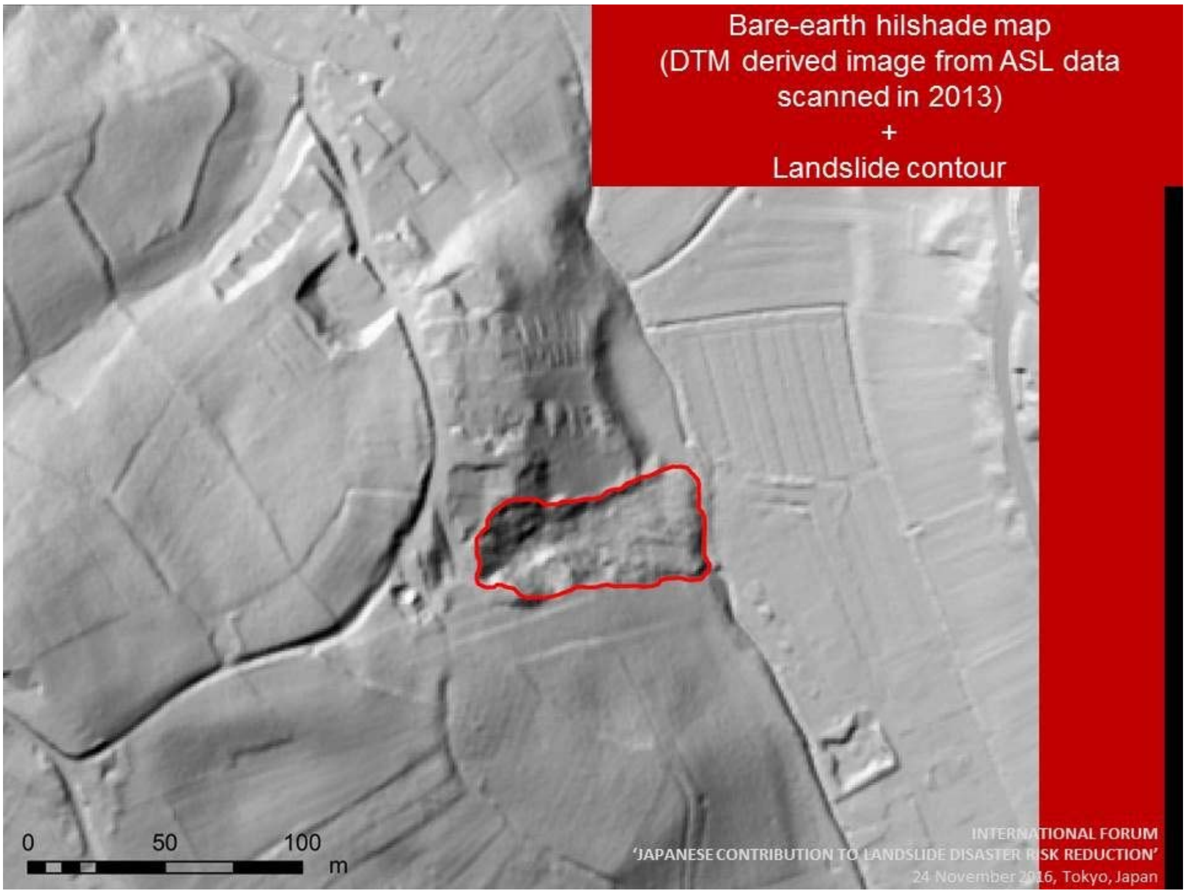
Landslides in the City of Zagreb activated in 2013 and 2014

INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan


CITY OF ZAGREB:
PILOT AREA AND LANDSLIDE EVENTS IN 2013 AND 2014
Landslide inventory preparation from reported landslides (in cooperation with EMO office and DUZS) and field checking
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

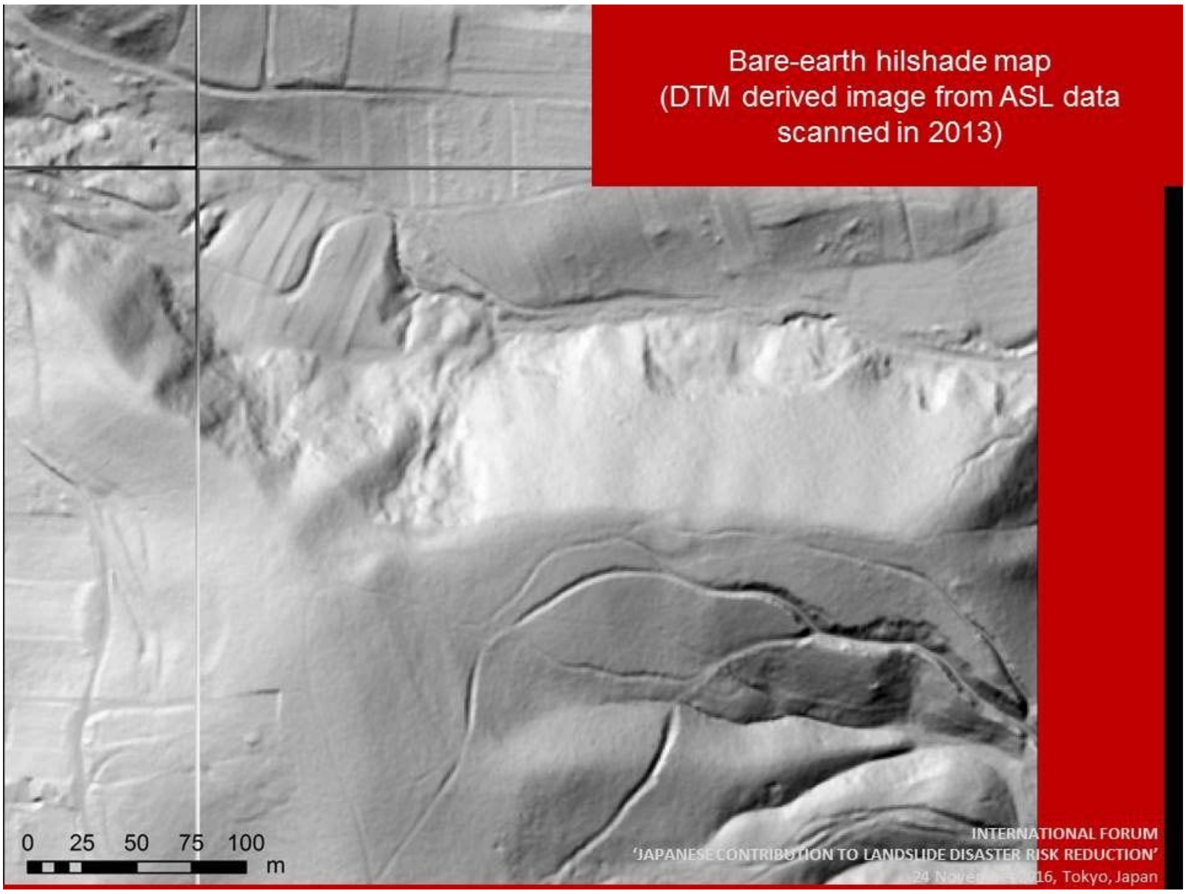

Orthophoto map 1:5,000
(City of Zagreb)
0
50
100
m
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

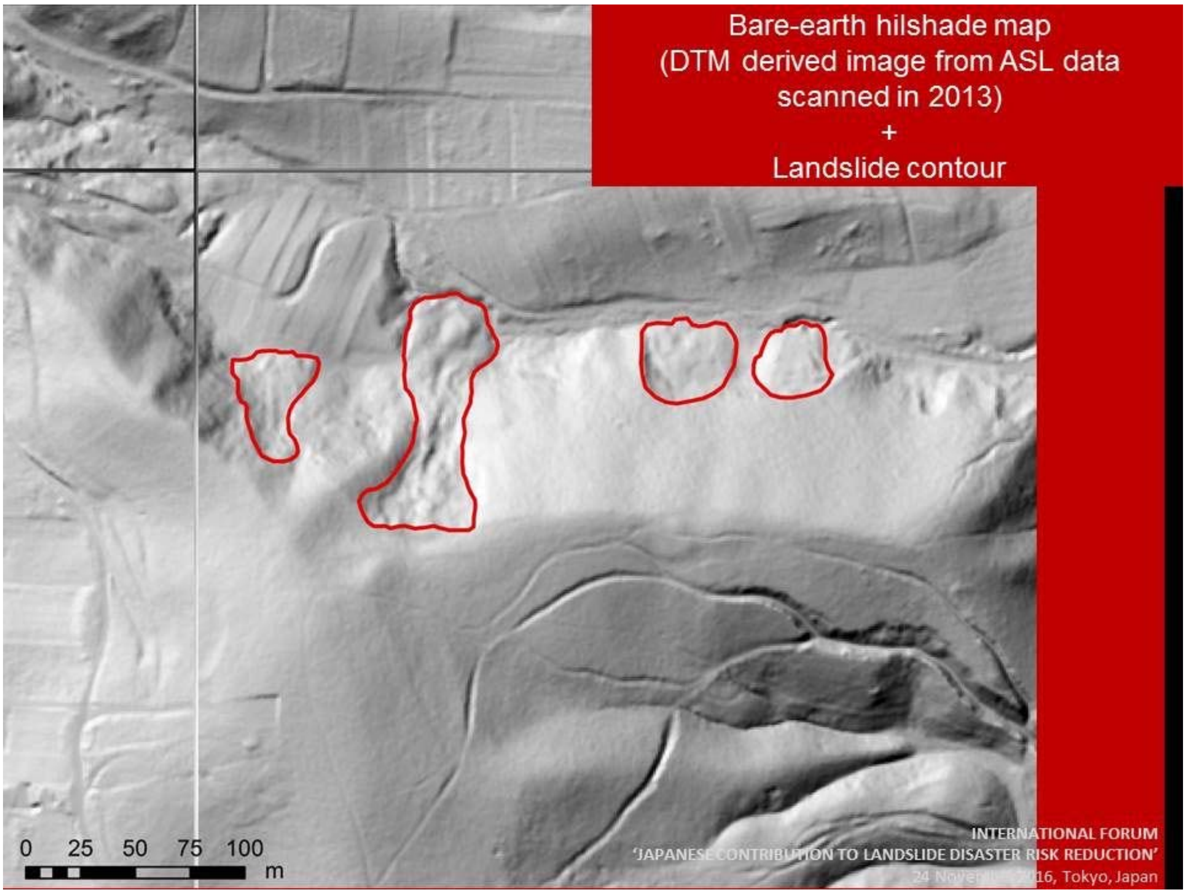

Bare-earth hilshade map
(DTM derived image from ASL data
scanned in 2013)
0
50
100
m
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

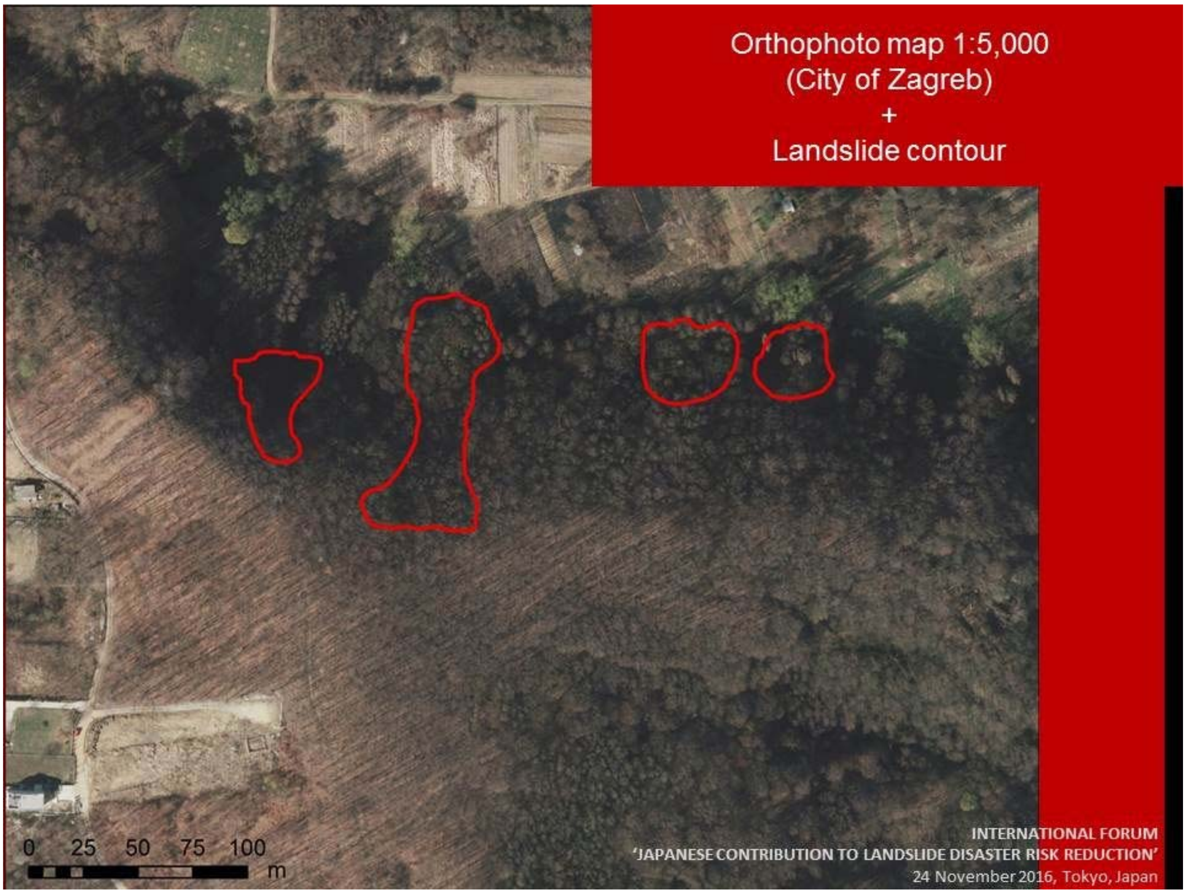

Bare-earth hilshade map
(DTM derived image from ASL data
scanned in 2013)
+
Landslide contour
0
50
100
m
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

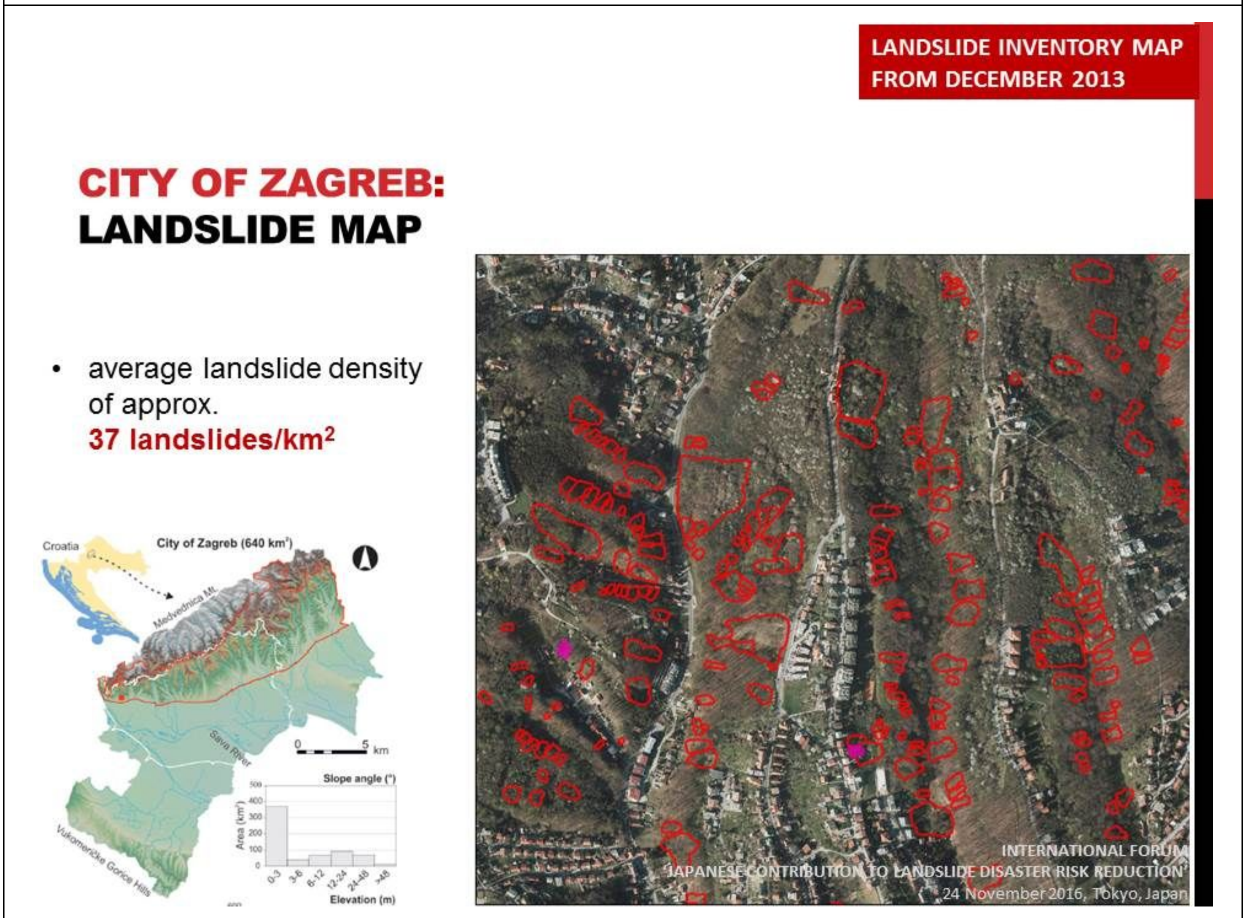

Orthophoto map 1:5,000
(City of Zagreb)
+
Landslide contour
0
50
100
m
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

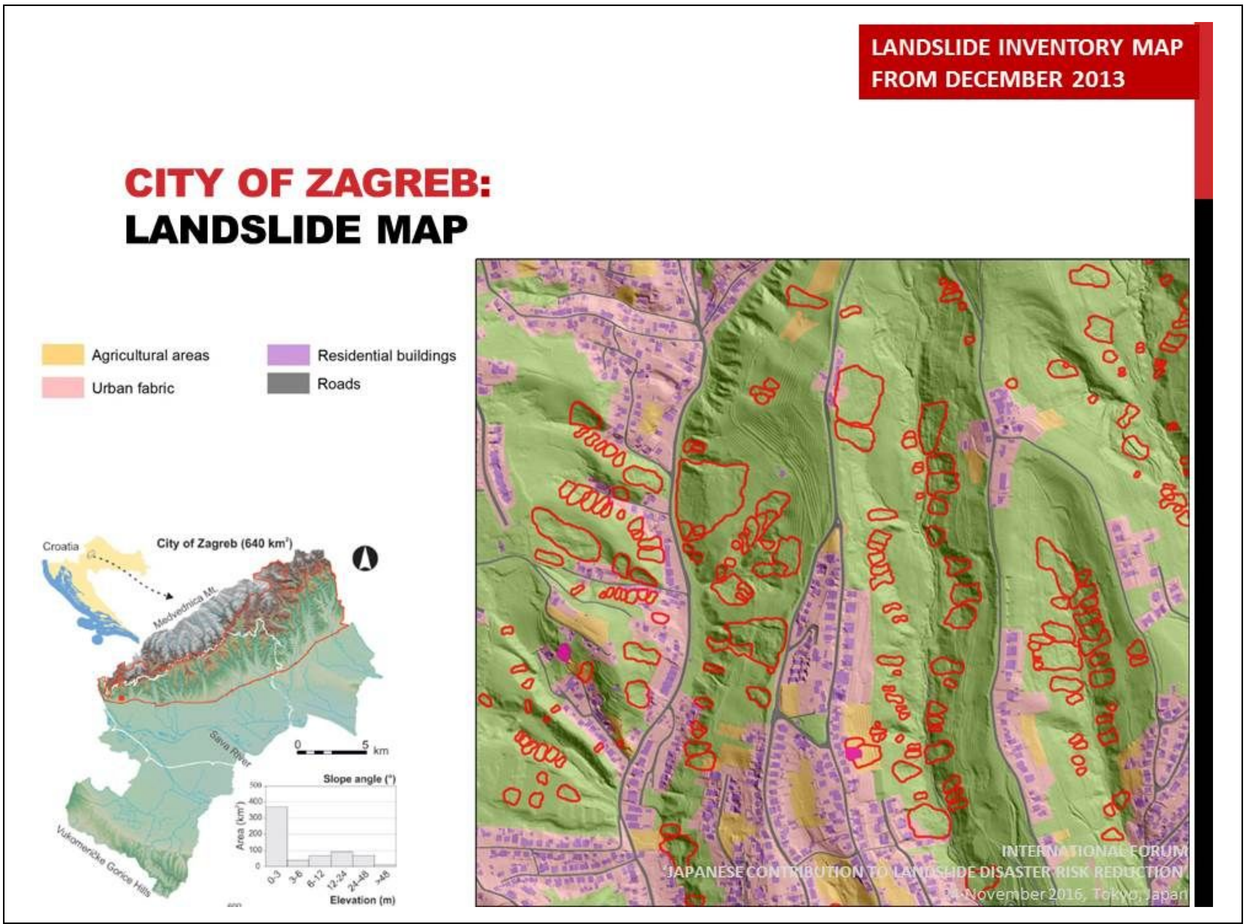

Orthophoto map 1:5,000
(City of Zagreb)
0 25 50 75 100
m
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

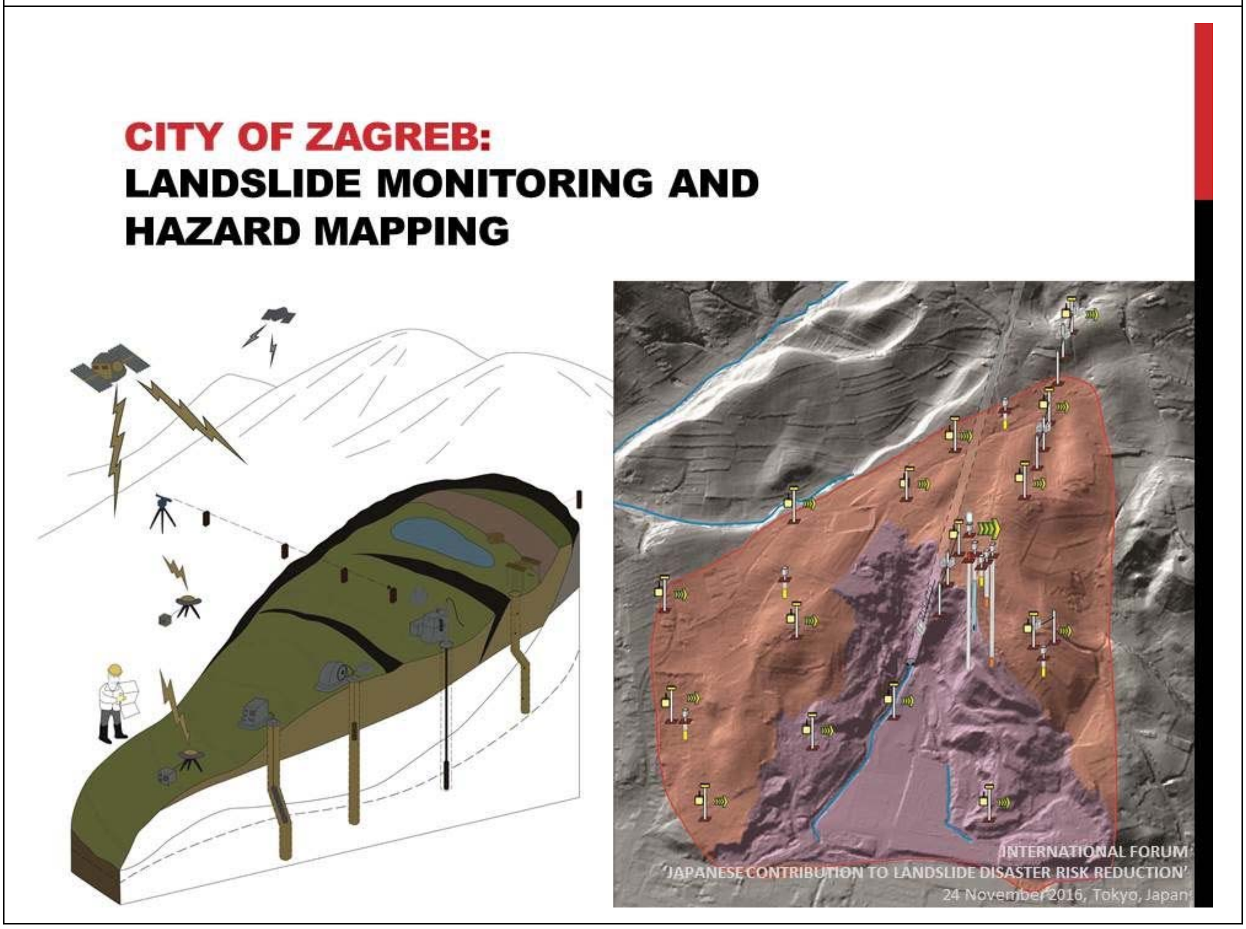

Bare-earth hilshade map
(DTM derived image from ASL data
scanned in 2013)
0 25 50 75 100
m
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan


Bare-earth hilshade map
(DTM derived image from ASL data
scanned in 2013)
+
Landslide contour
0 25 50 75 100
m
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

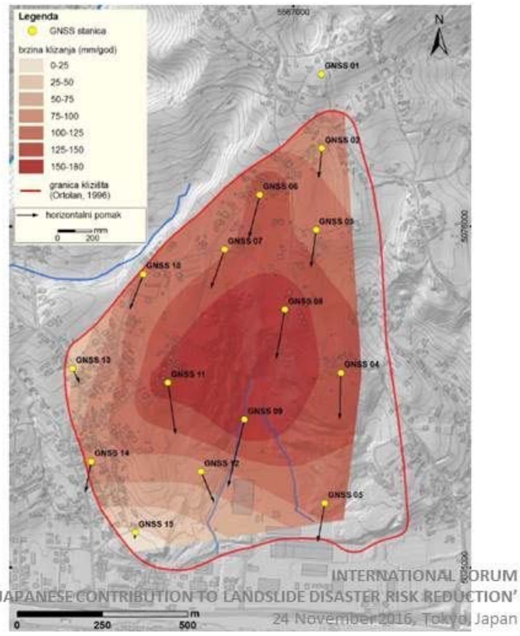

Orthophoto map 1:5,000
(City of Zagreb)
+
Landslide contour
0 25 50 75 100
m
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan


LANDSLIDE INVENTORY MAP
FROM DECEMBER 2013
CITY OF ZAGREB:
LANDSLIDE MAP
• average landslide density of approx. 37 landslides/km²
Croatia
City of Zagreb (640 km²)
Medvednica Mt.
Sava River
Vukomeričke Gorice Hills
Slope angle (°)
Area (km²)
Elevation (m)
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

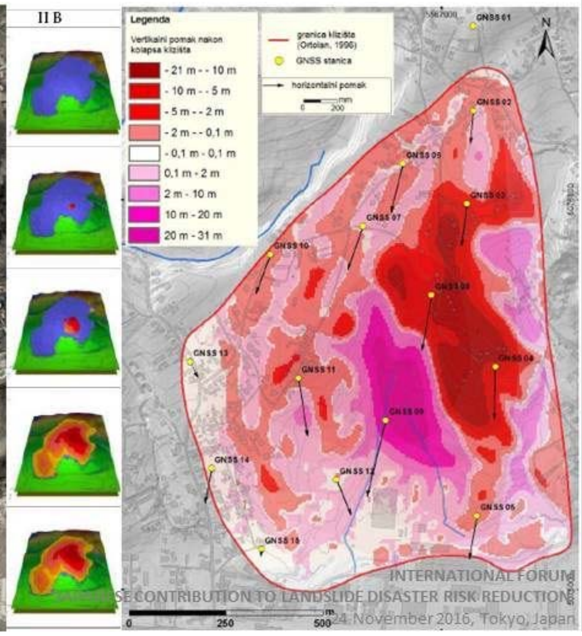

LANDSLIDE INVENTORY MAP
FROM DECEMBER 2013
CITY OF ZAGREB:
LANDSLIDE MAP
Agricultural areas
Urban fabric
Residential buildings
Roads
Croatia
City of Zagreb (640 km²)
Medvednica Mt.
Sava River
Vukomeričke Gorice Hills
Slope angle (°)
Area (km²)
Elevation (m)
INTERNATIONAL FORUM
JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION
24 November 2016, Tokyo, Japan


CITY OF ZAGREB:
LANDSLIDE MONITORING AND
HAZARD MAPPING
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

CITY OF ZAGREB:
LANDSLIDE MONITORING AND HAZARD MAPPING



CITY OF ZAGREB:
LANDSLIDE MONITORING AND HAZARD MAPPING

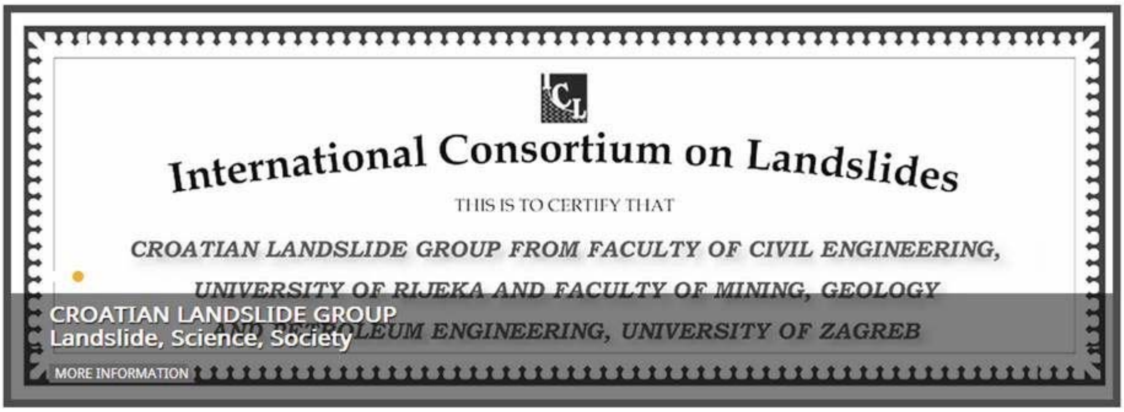


DISSEMINATION AND VISIBILITY OF PROJECT RESULTS / SUSTAINIBILITY

- INTERNATIONAL CONFERENCES
- INTERNATIONAL ORGANIZATIONS
- CROATIAN LANDSLIDE PORTAL (WWW.KLIZISTA-HR.COM)

INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

THE JAPANESE-CROATIAN SATREPS FY2008 PROJECT:
DISSEMINATION AND VISIBILITY OF PROJECT RESULTS / SUSTAINIBILITY



- Croatian landslide scientists become member of the International Consortium on Landslides

INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

THE JAPANESE-CROATIAN SATREPS FY2008 PROJECT:

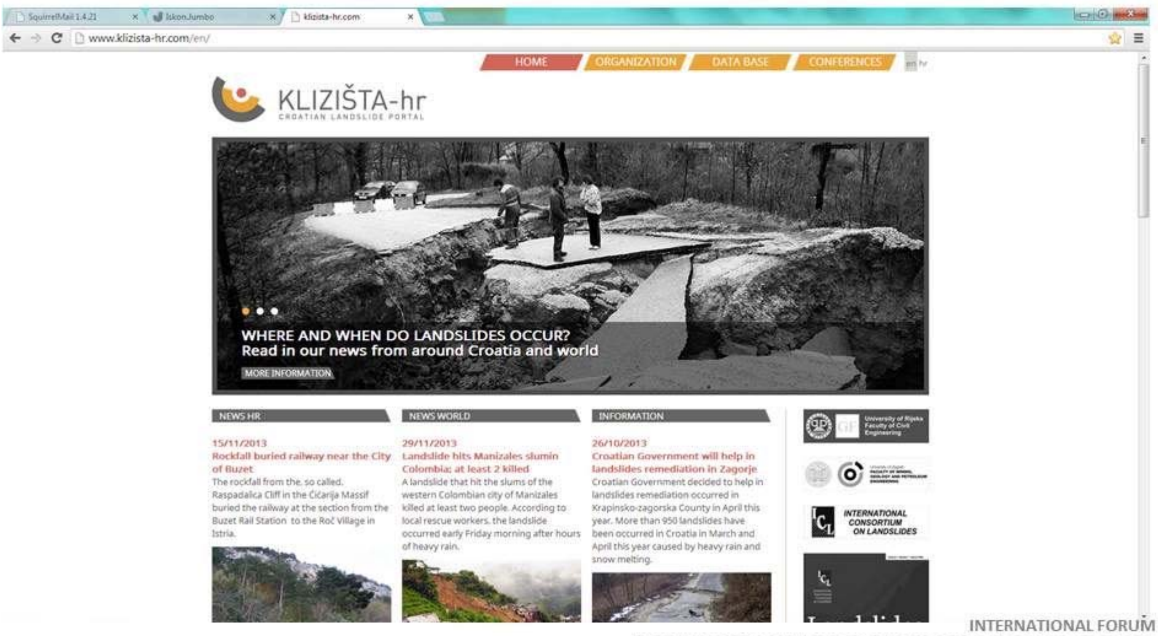
DISSEMINATION AND VISIBILITY OF PROJECT RESULTS / SUSTAINIBILITY

Organization of international conferences on landslides:

- 1st Regional Symposium on Landslides in Adriatic-Balkan Region, Zagreb, 2013
- 2nd Regional Symposium on Landslides in Adriatic-Balkan, Belgrade, 2015
- **4th World Landslide Forum, Ljubljana, 2017**
- **3rd Regional Symposium on Landslides in Adriatic-Balkan, Ljubljana, 2015**

CROATIAN LANDSLIDE PORTAL

WWW.KLIZISTA-HR.COM



INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan

COOPERATION WITH LOCAL/REGIONAL AND NATIONAL AUTHORITIES

NATIONAL, COUNTY, CITY AND MUNICIPAL LEVEL

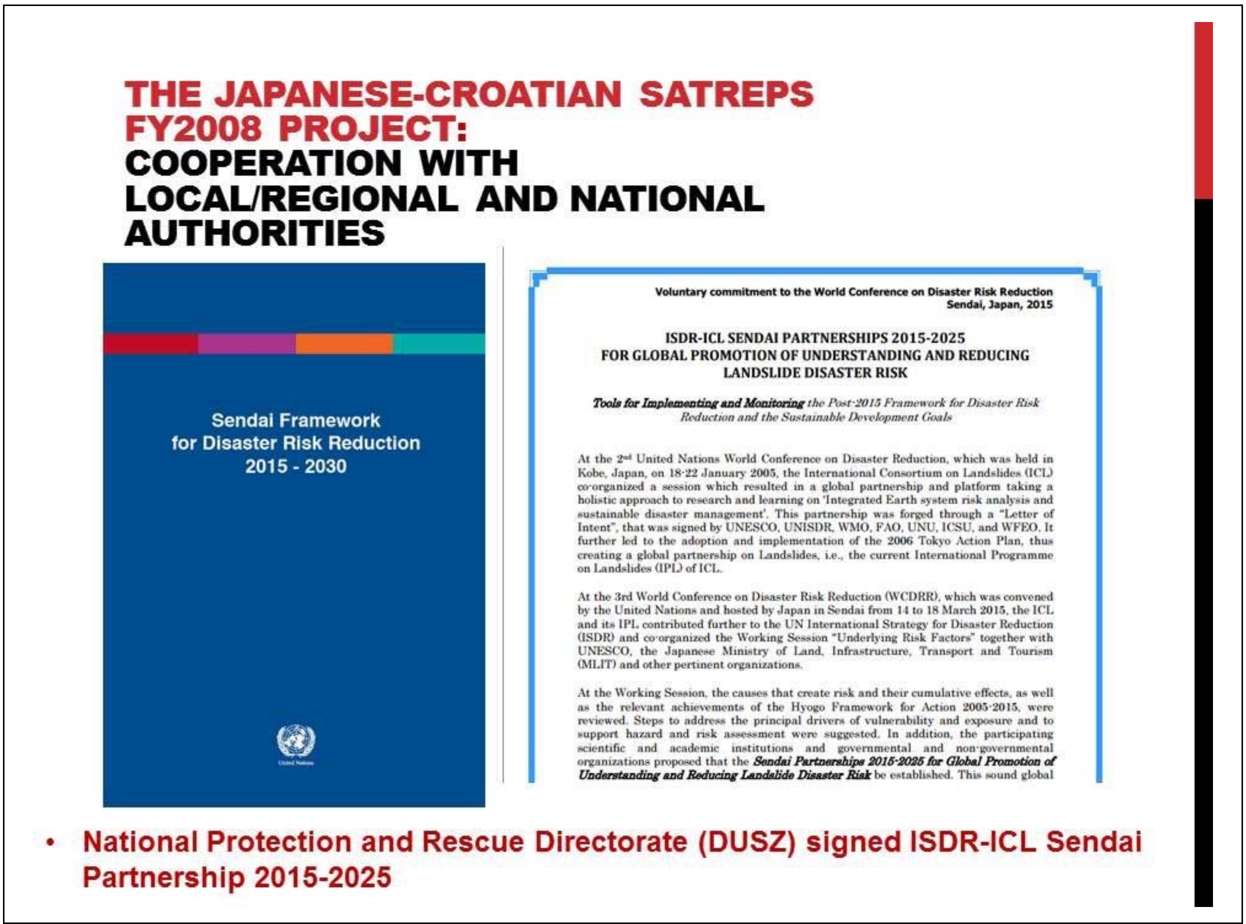
THE JAPANESE-CROATIAN SATREPS FY2008 PROJECT:

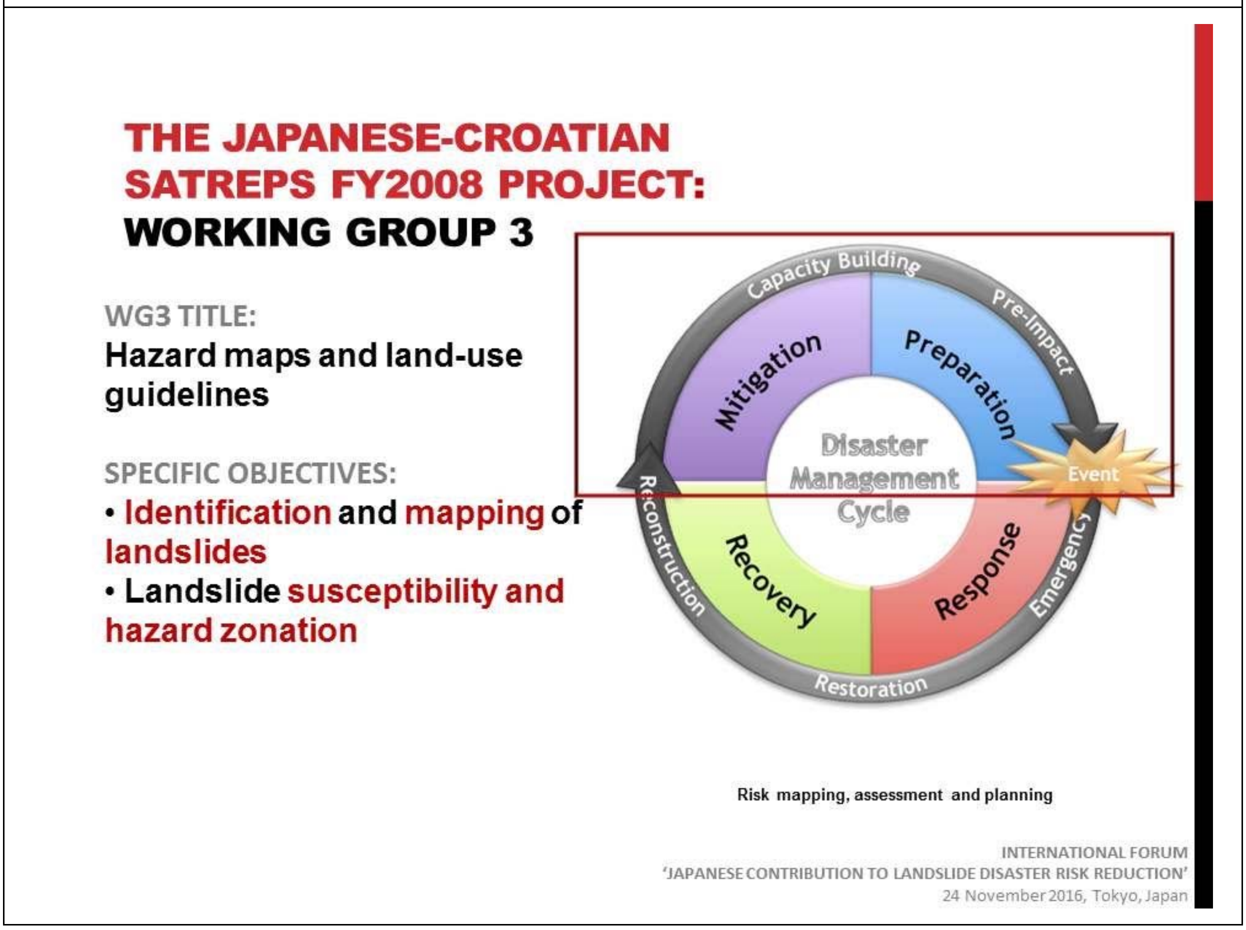
COOPERATION WITH LOCAL/REGIONAL AND NATIONAL AUTHORITIES

- **City of Zagreb (County)**
  - OEM - City Office of Emergency Management
  - City Office for The Strategic Planning and Development Of The City
  - City Office for Physical Planning, Construction of the City, Utility Services and Transport

- **Primorsko-Goranska County**
- **City of Rijeka**
- **Municipality of Čavle, Primorsko-Goranska County**
- **DUZS (National Protection and Rescue Directorate)**

INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan


THE JAPANESE-CROATIAN SATREPS FY2008 PROJECT:
COOPERATION WITH LOCAL/REGIONAL AND NATIONAL AUTHORITIES
Sendai Framework for Disaster Risk Reduction 2015 - 2030
Voluntary commitment to the World Conference on Disaster Risk Reduction Sendai, Japan, 2015
ISDR-ICL SENDAI PARTNERSHIPS 2015-2025 FOR GLOBAL PROMOTION OF UNDERSTANDING AND REDUCING LANDSLIDE DISASTER RISK
Tools for Implementing and Monitoring the Post-2015 Framework for Disaster Risk Reduction and the Sustainable Development Goals
At the 2nd United Nations World Conference on Disaster Reduction, which was held in Kobe, Japan, on 18-22 January 2005, the International Consortium on Landslides (ICL) co-organized a session which resulted in a global partnership and platform taking a holistic approach to research and learning on 'Integrated Earth system risk analysis and sustainable disaster management'. This partnership was forged through a "Letter of Intent", that was signed by UNESCO, UNISDR, WMO, FAO, UNU, ICSU, and WFEO. It further led to the adoption and implementation of the 2006 Tokyo Action Plan, thus creating a global partnership on Landslides, i.e., the current International Programme on Landslides (IPL) of ICL.
At the 3rd World Conference on Disaster Risk Reduction (WCDRR), which was convened by the United Nations and hosted by Japan in Sendai from 14 to 18 March 2015, the ICL and its IPL contributed further to the UN International Strategy for Disaster Reduction (ISDR) and co-organized the Working Session "Underlying Risk Factors" together with UNESCO, the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and other pertinent organizations.
At the Working Session, the causes that create risk and their cumulative effects, as well as the relevant achievements of the Hyogo Framework for Action 2005-2015, were reviewed. Steps to address the principal drivers of vulnerability and exposure and to support hazard and risk assessment were suggested. In addition, the participating scientific and academic institutions and governmental and non-governmental organizations proposed that the Sendai Partnerships 2015-2025 for Global Promotion of Understanding and Reducing Landslide Disaster Risk be established. This sound global
• National Protection and Rescue Directorate (DUSZ) signed ISDR-ICL Sendai Partnership 2015-2025


THE JAPANESE-CROATIAN SATREPS FY2008 PROJECT:
WORKING GROUP 3
WG3 TITLE:
Hazard maps and land-use guidelines
SPECIFIC OBJECTIVES:
• Identification and mapping of landslides
• Landslide susceptibility and hazard zonation
Capacity Building
Pre-Impact
Mitigation
Preparation
Disaster Management Cycle
Event
Reconstruction
Recovery
Response
Emergency
Restoration
Risk mapping, assessment and planning
INTERNATIONAL FORUM
'JAPANESE CONTRIBUTION TO LANDSLIDE DISASTER RISK REDUCTION'
24 November 2016, Tokyo, Japan


IZLOŽBA FOTOGRAFIJA
PHOTO EXHIBITION
Ova izložba nastala je kao popratni događaj 1. regionalnog simpozija o klizištima u Jadransko-balkanskoj regiji koji je održan u Zagrebu od 6. do 9. ožujka 2013. godine pod pokroviteljstvom Međunarodnog konzorcija za klizišta (ICL) i regionalne ICL Jadransko-balkanske istraživačke mreže za klizišta (ICL ABN).
zgFORUM
ŽIVJETI S KLIZIŠTIMA /
LIVING WITH LANDSLIDES
ZGFORUM, GAJEVA 27
8—15. OŽUJAK 2013.
8—15 MARCH 2013
www.klizista-hr.com
STALNA IZLOŽBA
Thank you very much for your attention!
SNJEŽANA MIHALIĆ ARBANAS
ŽELJKO ARBANAS
WWW.KLIZISTA-HR.COM

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

SATREPS Project for "Research and Development for Reducing Geo-Hazard Damage in Malaysia Caused by Landslide and Flood"

2011 – 2016 (5 years)

Research Team

USM Universiti Sains Malaysia; Universiti Tenaga Nasional; Multimedia University; CEReS Center for Environmental Remote Sensing, Chiba University; 東京大学 The University of Tokyo; ICHARM; PWRI; NIED 独立行政法人 防災科学技術研究所 National Research Institute for Earth Science and Disaster Prevention

Supported by

JST; JICA; Ministry of Higher Education

Background

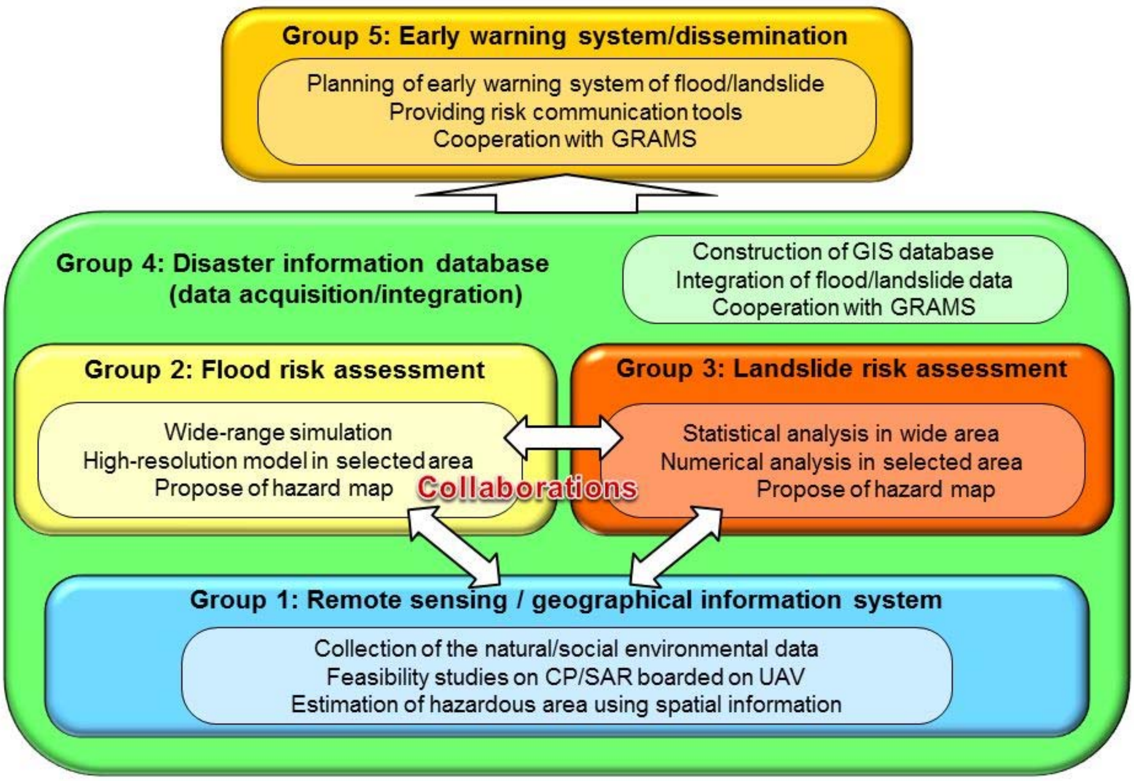
- Concern for economical damage by landslide and flood in accordance with the climate change as well as recent population increase and urbanization

<Project Purpose>

Proposal of a trial disaster risk management system with an integrated data system landslide and flood

- Construction of the system for reducing geo-hazard
- Human resources development with sufficient skills and experiences
- Establishment of cooperation framework centering governmental agencies

Implementation Framework



Organizations concerned

Research team in Malaysia

- Universiti Sains Malaysia (USM)
- Multimedia University (MMU)
- Universiti Tenaga Nasional (UNITEN)

Research team in Japan

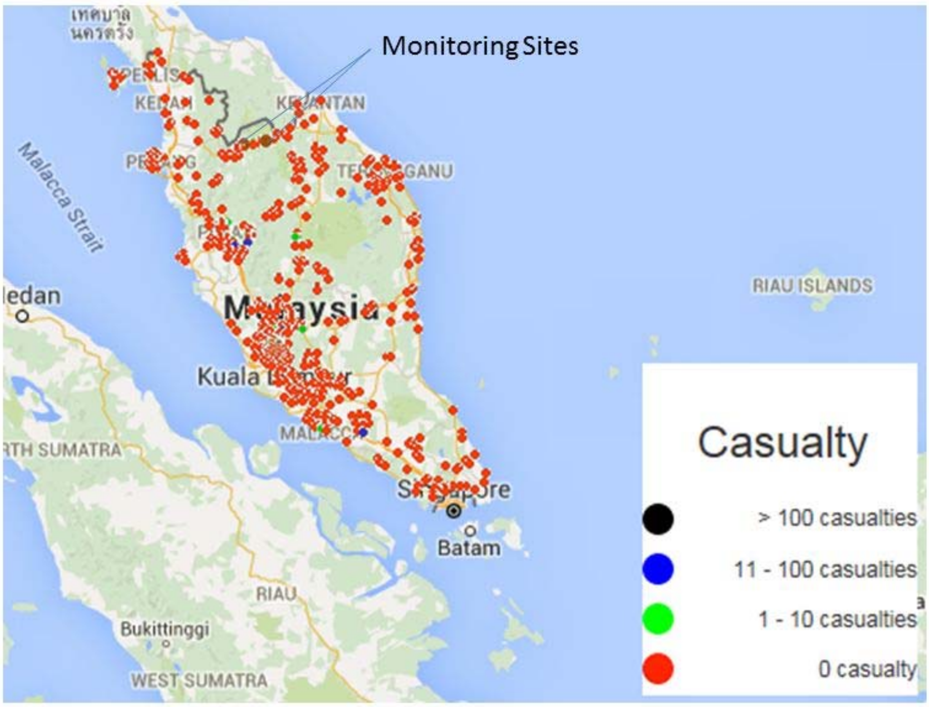
- The University of Tokyo (UT)
- Center for Environmental Remote Sensing, Chiba University (CEReS)
- National Institute of Earth Science and Disaster Prevention (NIED)
- International Centre for Water Hazard and Risk Management (ICHARM)
- Experts from Vision Tech Inc.(VTI), Kyoto University (Niigata University), Ibaraki University, and Kyushu University

Ministries concerned in Malaysia

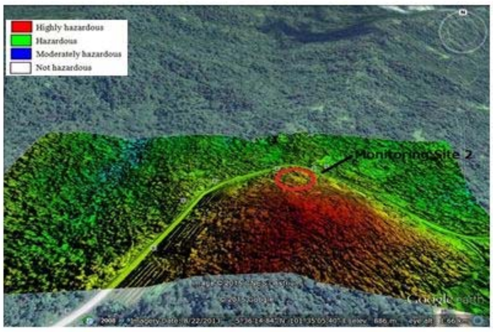
- Economic Planning Unit (EPU)
- Ministry of Higher Education (MOHE)
- Ministry of Science, Technology and Innovation (MOSTI)
- National Security Council (NSC)
- Public Work Department (PWD)
- Department of Irrigation and Drainage (DID)
- Malaysia Remote Sensing Agency (MRSA)
- Malaysia Meteorological Department (MMD)

East-West Highway Cut Off after Landslides Occurred at 23rd. December, 2014 night(7)

Monitoring Sites and Landslides Occurred Sites



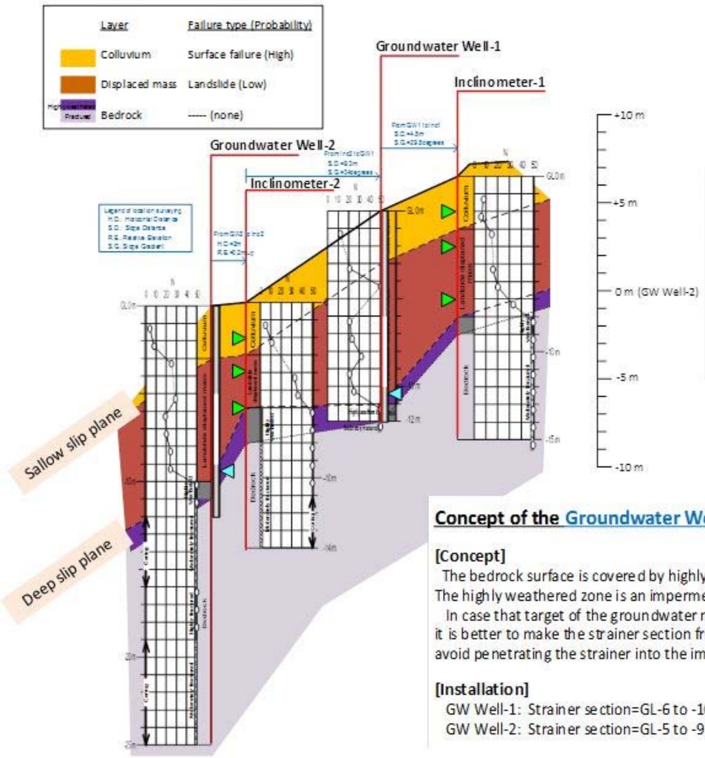
Real Time Slope Monitoring Site (70.52KM East-West Highway)



Monitoring Site in N05°, 36.042', E101°, 35.546'

10

Cross section of Monitoring Site (geological situation)



Concept of the Inclinometer Deployment

[Concept]

- 1st depth: 1 m above the bottom of surface layer (colluvium)
- 2nd depth: 1 m below the bottom of surface layer (colluvium)
- 3rd depth: 1 m above the surface of bedrock

[Installation]

Inclinometer-1: 1st depth=1.8 m, 2nd depth=3.8 m, 3rd depth=6.8 m
Inclinometer-2: 1st depth=1.8 m, 2nd depth=3.8 m, 3rd depth=5.8 m

Concept of the Groundwater Well

[Concept]

The bedrock surface is covered by highly weathered with 1 to 2 m thickness. The highly weathered zone is an impermeable layer.
In case that target of the groundwater monitoring is the displaced mass layer, it is better to make the strainer section from 1 m above the bedrock surface to avoid penetrating the strainer into the impermeable layer (highly weathered zone).

[Installation]

GW Well-1: Strainer section=GL-6 to -10 m, Water level sensor=GL-10.5 m
GW Well-2: Strainer section=GL-5 to -9 m, Water level sensor=GL-9.5 m

11

Joint studies on landslide mechanism

Real-scale landslide flume test at NIED

(National Institute for Earth Science and Disaster Resilience)

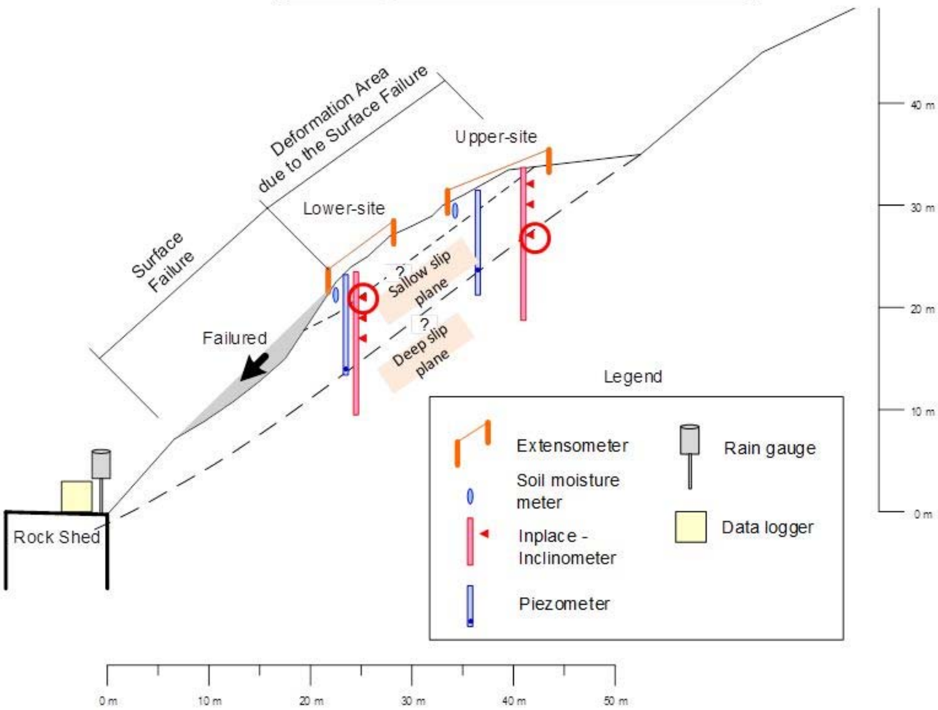
Real-scale landslide flume test at NIED

(National Institute for Earth Science and Disaster Resilience)

Exercise to conduct constant-volume direct shear test in the campus

Cross section of Monitoring Site

(Arrangement of instruments)



16

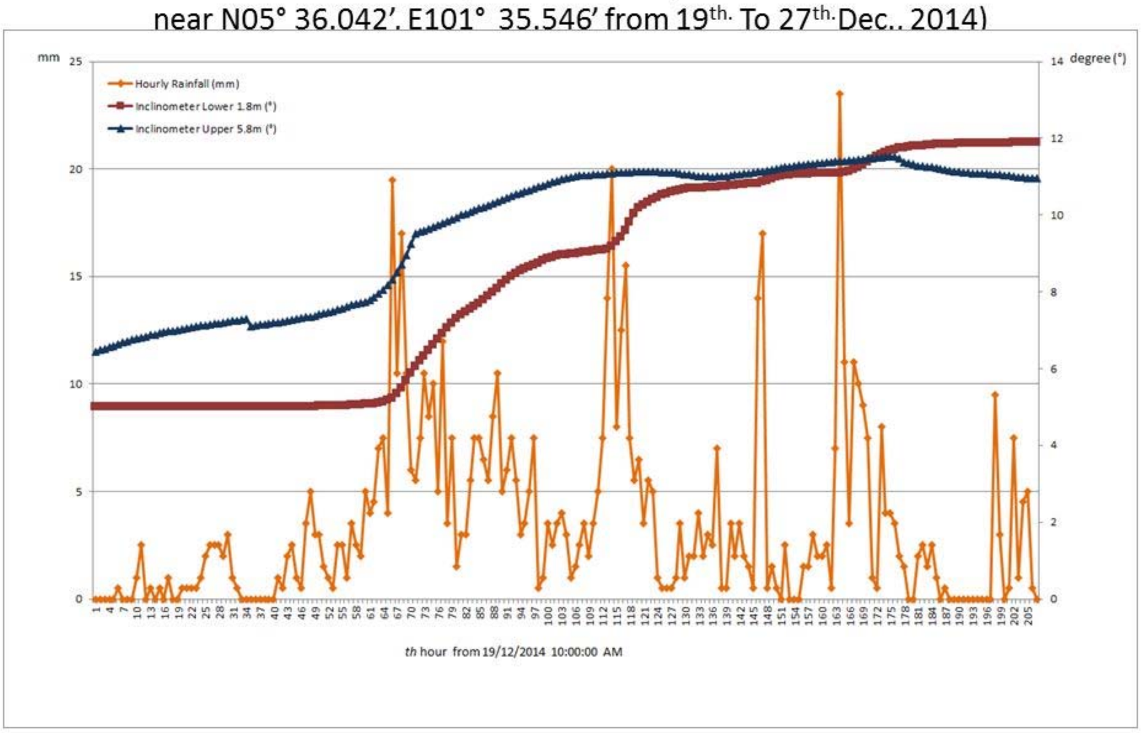
Photos from The Site

Photo taken on 24/11/2015

Photo taken on 27/06/2016

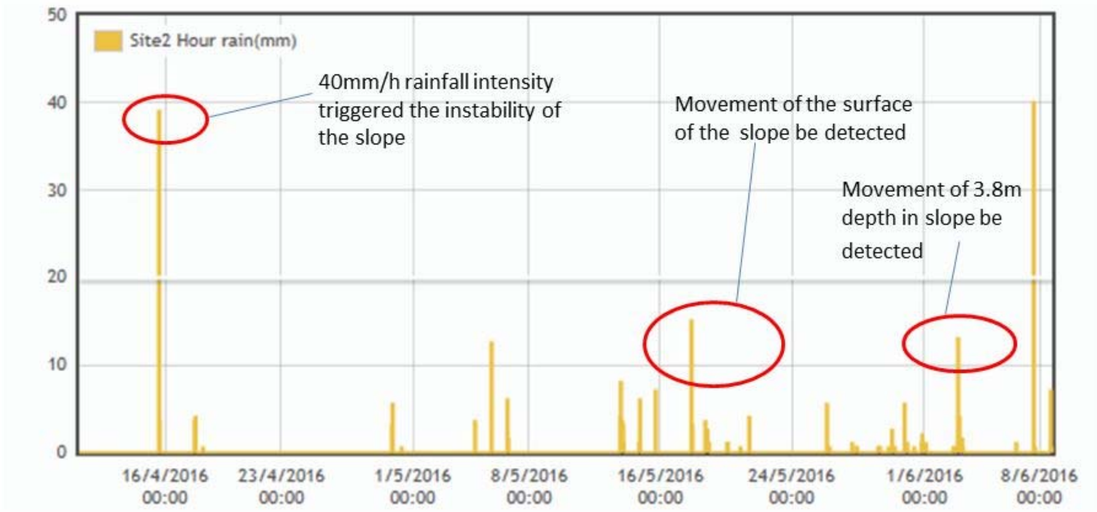
Rainfall(890mm in 9days) and Slope Movement Data (Y-Direction)

near N05° 36.042', E101° 35.546' from 19th. To 27th. Dec., 2014)

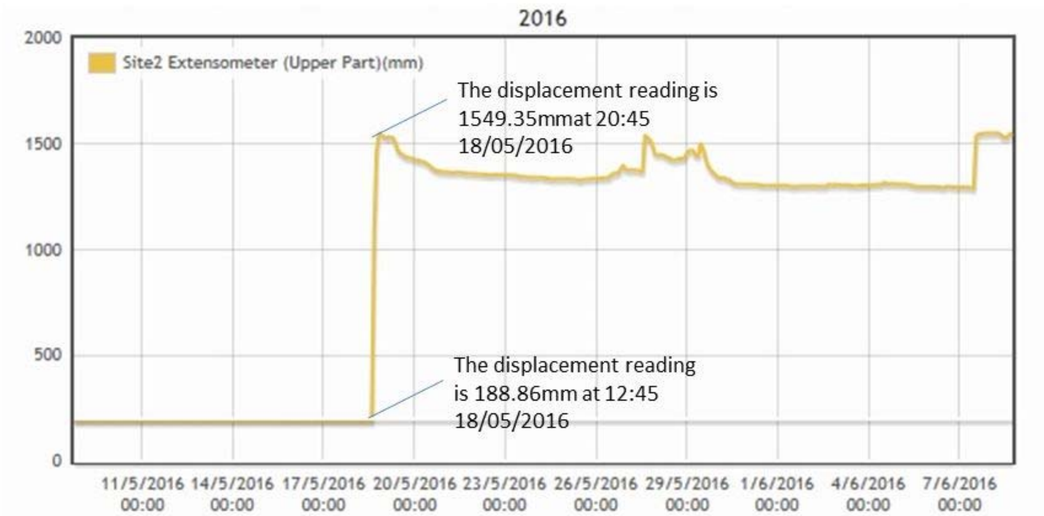


Moreover, in May 2016

The devices in the monitoring site showed the movement of the slope after heavy and continuous rainfall as below:



Movement of the Surface of the Slope detected by Extensometer



Early Warning System

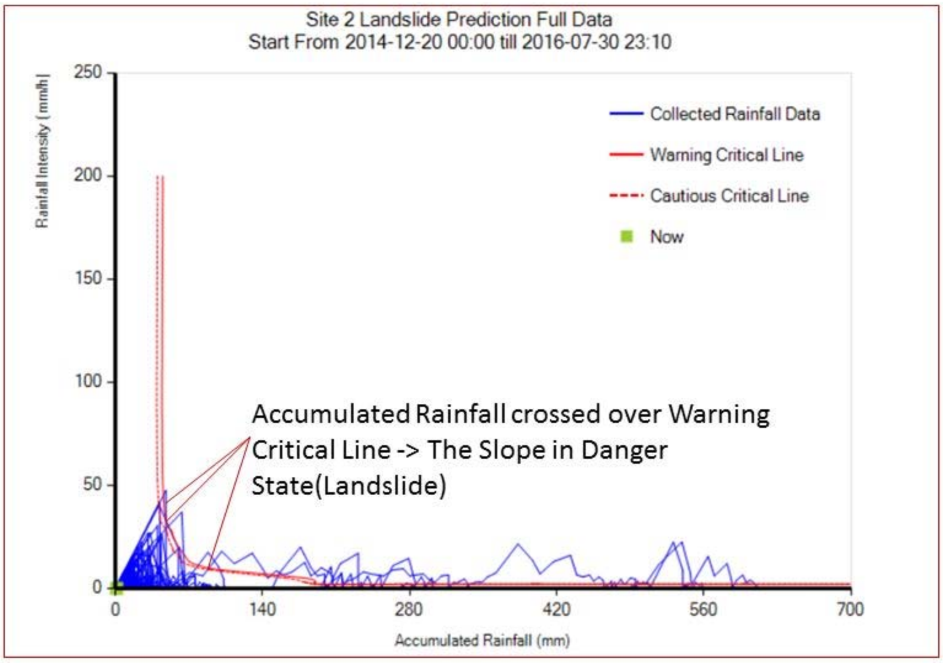
By

1 collecting the real time monitoring data from the sites

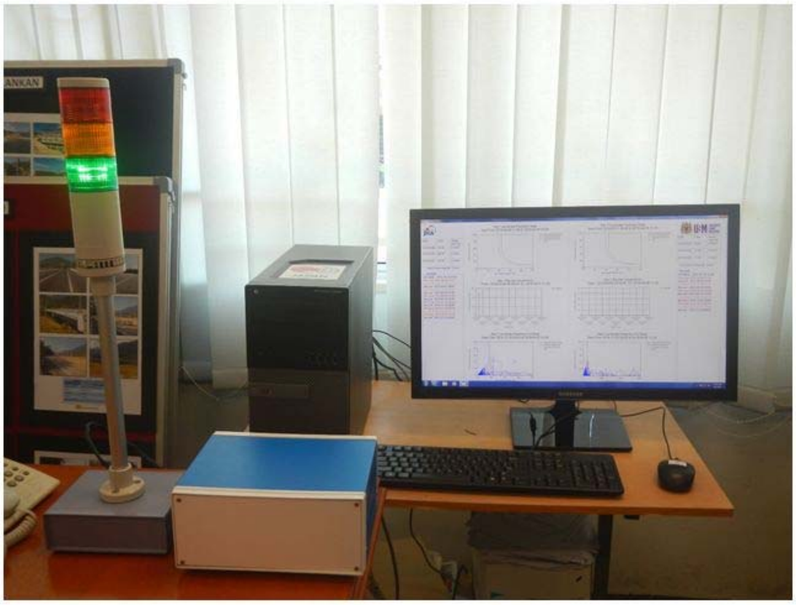
2 analyzing the rainfall intensity data

we establish the real time slope failure prediction system for the monitoring sites as next slide

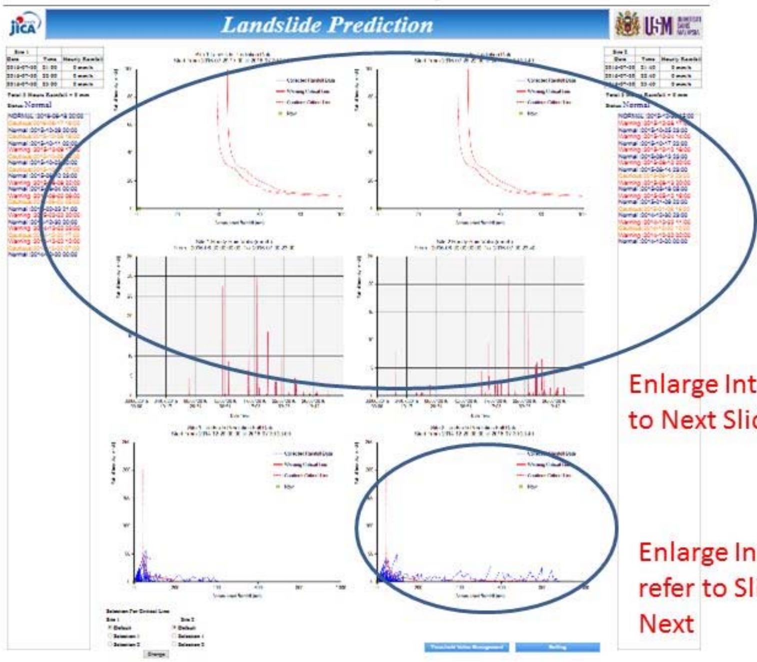
Landslide Prediction



Real Time Landslide Prediction and Early Warning System



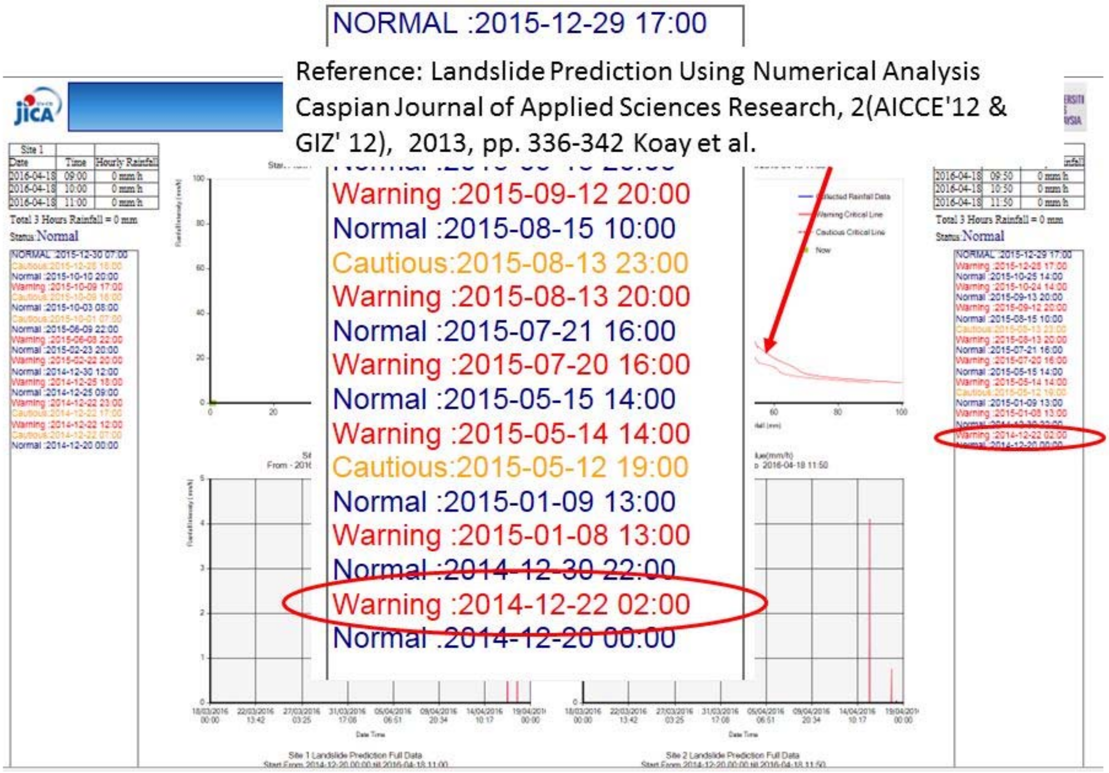
Real Time Landslide Prediction on Monitoring Sites



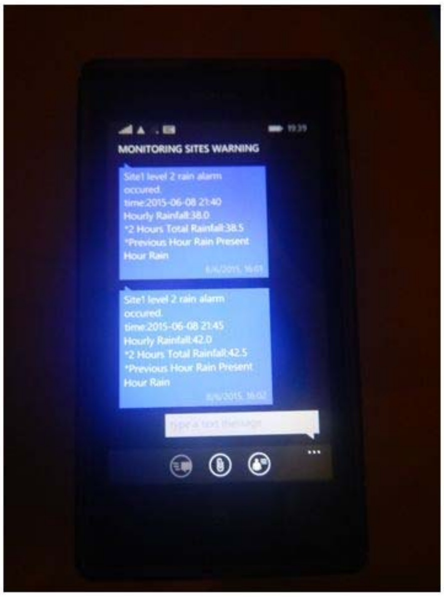
Enlarge Interface refer to Next Slide

Enlarge Interface refer to Slide after Next

Real Time Landslide Prediction on



Early Warning Information Dissemination



Short Mail(Mobile Phone) Received from Alert System

Site1 rain alarm level 2

admin.isensor@cs.usm.my [admin.isensor@cs.usm.my]

Sent: Monday, June 08, 2015 10:00 PM

To: spkoay@cs.usm.my

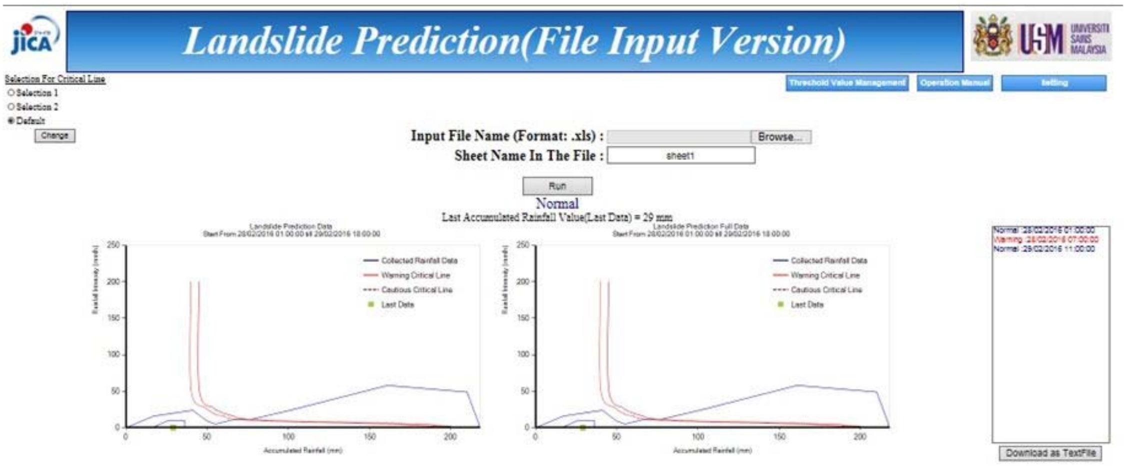
```
Site1 level 2 rain alarm occured.
time:2015-06-08 21:45
Hourly Rainfall:42.0
*2 Hours Total Rainfall:42.5
*Previous Hour Rain Present Hour Rain

--
This message has been scanned for viruses and
dangerous content by MailScanner, and is
believed to be clean.
```

Alert message (Email) sent by slope monitoring server after rainfall data exceeding threshold level

Landslide Prediction

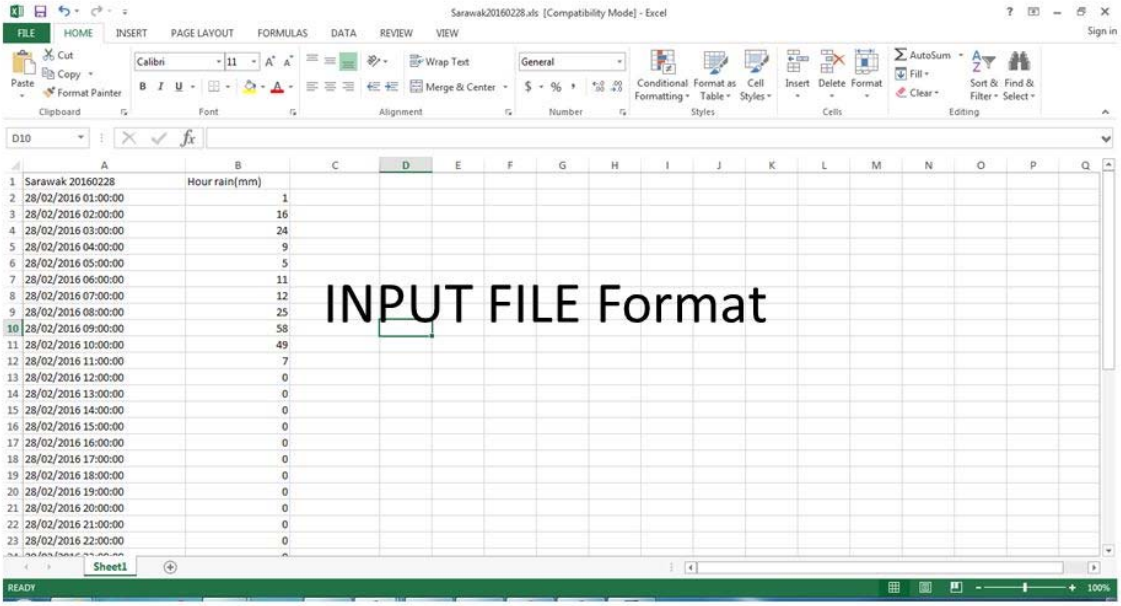
(Analysis Purpose)



http://e-participatory.cs.usm.my/LandslideInputVersionCA/

Collected Rainfall Intensity Data in Km 18 of Jalan Tebedu, Sarawak

(Landslides Occurred at 9:23a.m., 27th. Feb, 2016)



	A	B
1	Sarawak 20160228	Hour rain(mm)
2	28/02/2016 01:00:00	1
3	28/02/2016 02:00:00	16
4	28/02/2016 03:00:00	24
5	28/02/2016 04:00:00	9
6	28/02/2016 05:00:00	5
7	28/02/2016 06:00:00	11
8	28/02/2016 07:00:00	12
9	28/02/2016 08:00:00	25
10	28/02/2016 09:00:00	58
11	28/02/2016 10:00:00	49
12	28/02/2016 11:00:00	7
13	28/02/2016 12:00:00	0
14	28/02/2016 13:00:00	0
15	28/02/2016 14:00:00	0
16	28/02/2016 15:00:00	0
17	28/02/2016 16:00:00	0
18	28/02/2016 17:00:00	0
19	28/02/2016 18:00:00	0
20	28/02/2016 19:00:00	0
21	28/02/2016 20:00:00	0
22	28/02/2016 21:00:00	0
23	28/02/2016 22:00:00	0

Information Dissemination by IT Technology

Early warning system is NOT enough for lessen casualty.

Public awareness(preparedness) on natural hazard is very important for disaster prevention.

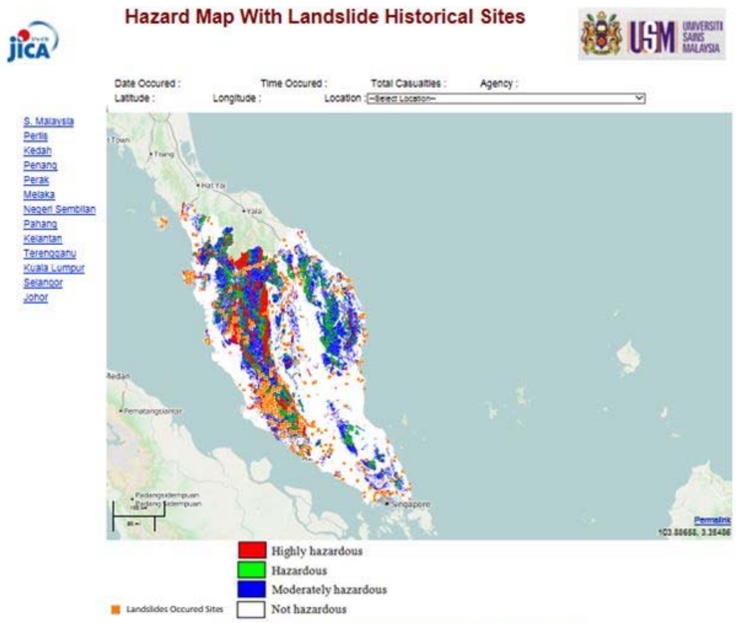
So, the below information should be disseminated:

a) Hazard map

b) Information on landslides historical occurrence venue

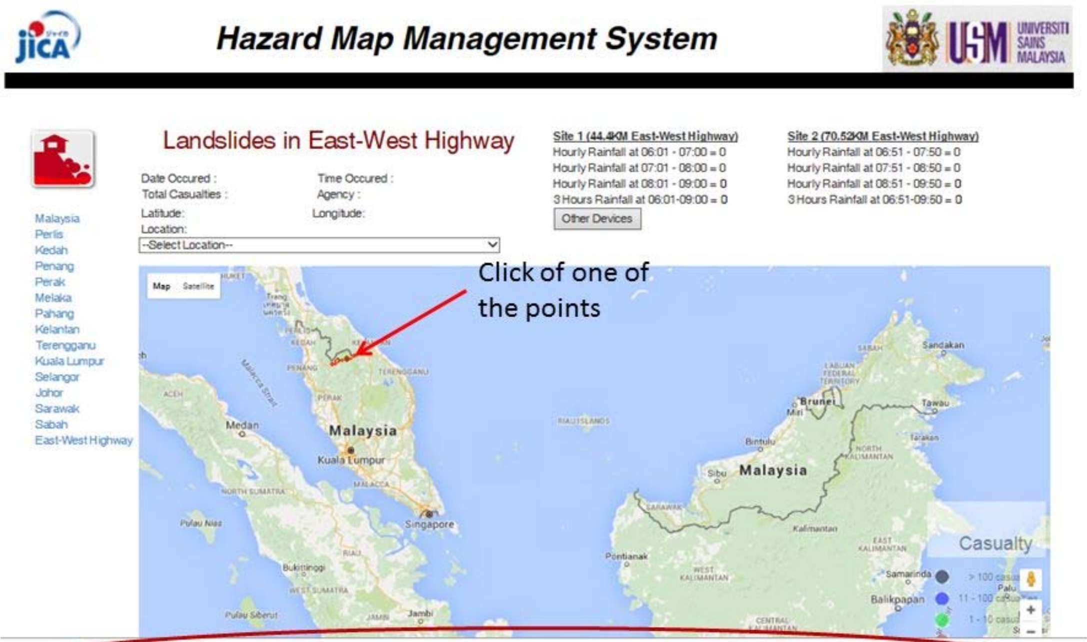
c) Evacuation map for preparedness escaping to shelter if the slope failure occurs

Hazard Map



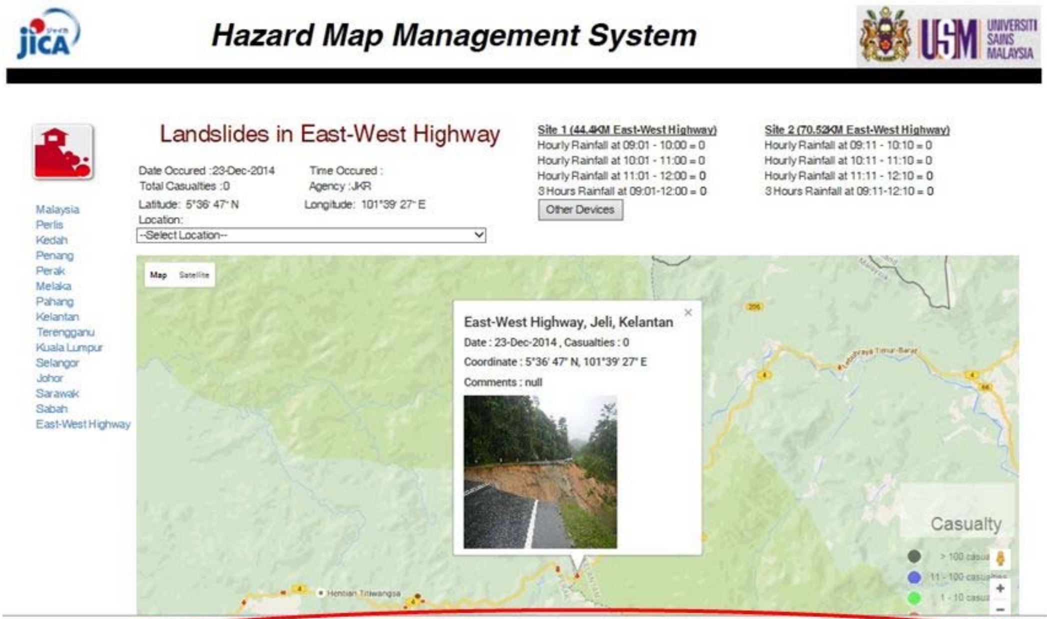
http://e-participatory.cs.usm.my/historicalmap/MemberPages/historical.aspx

Landslides Historical Data



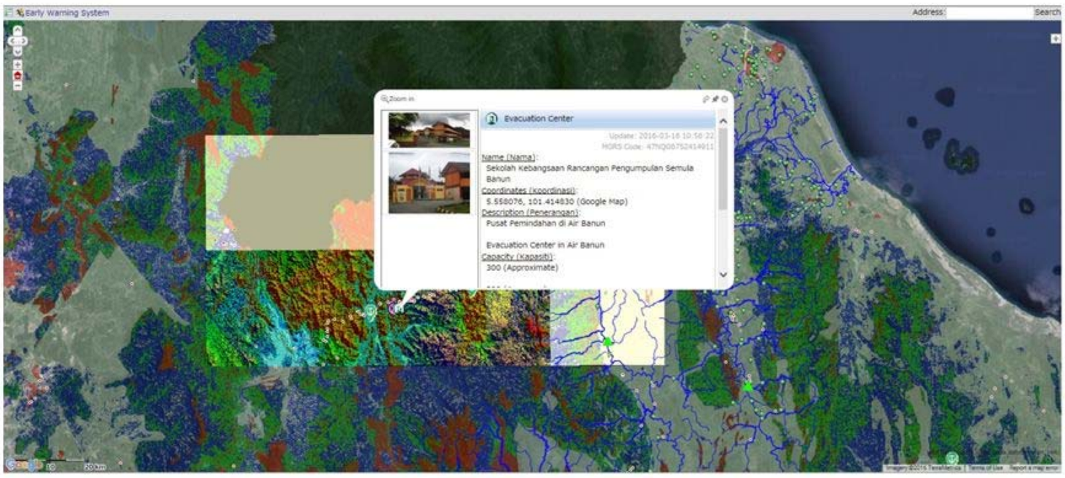
http://e-participatory.cs.usm.my/hazardmap/map/Show.aspx?country=Highway

The details(photo) of landslides occurrence will be shown

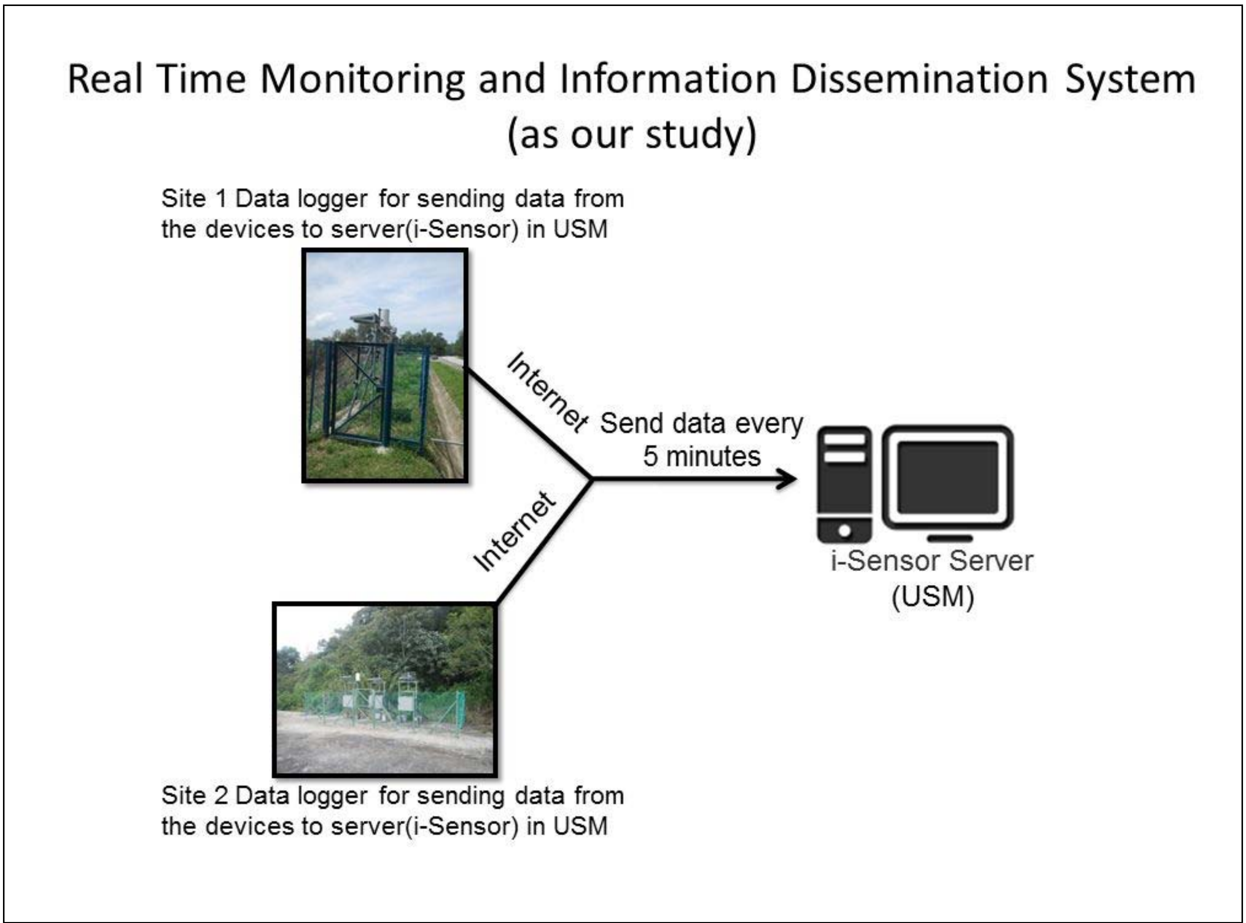


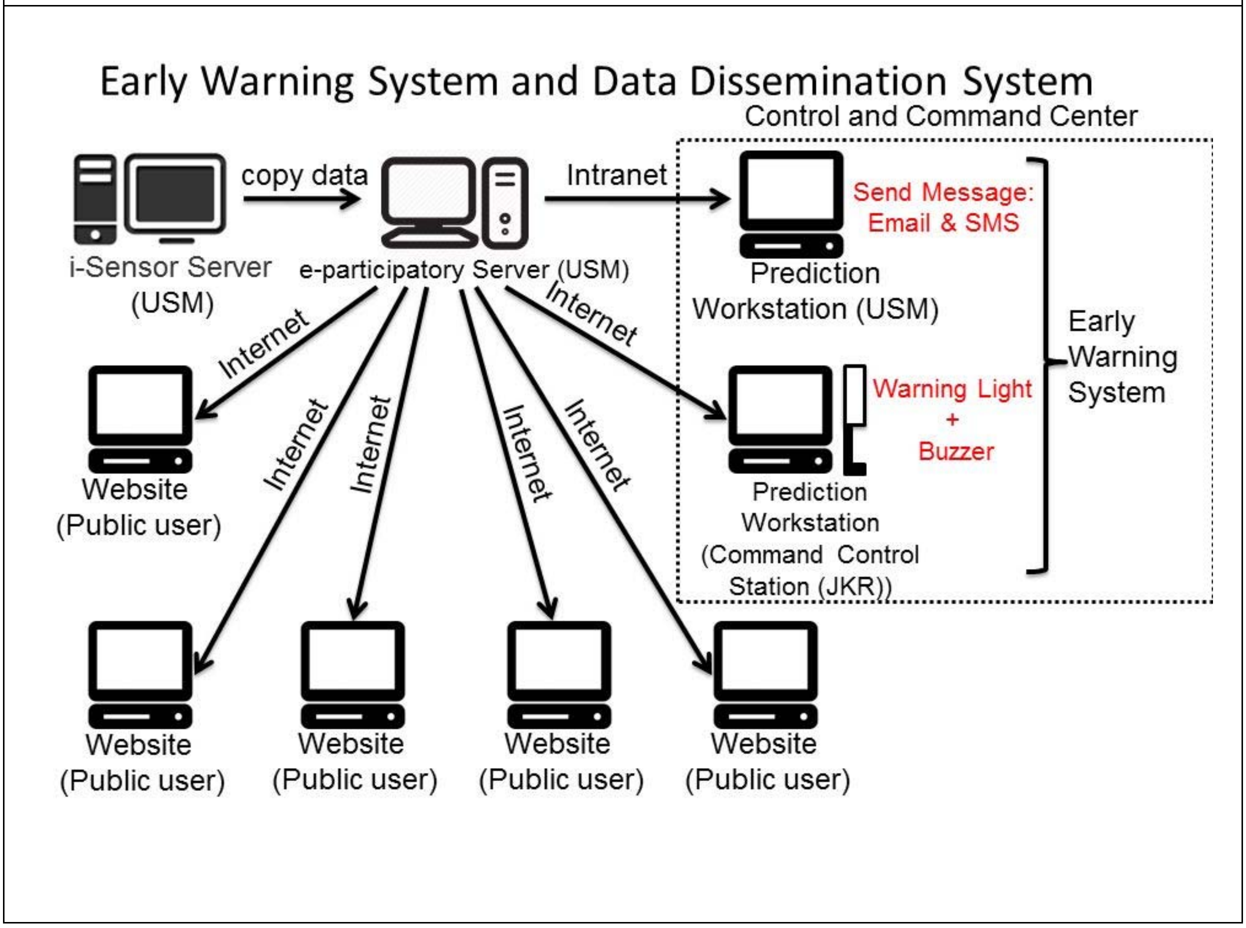
http://e-participatory.cs.usm.my/hazardmap/map/Show.aspx?country=Highway

Information on Evacuation Center

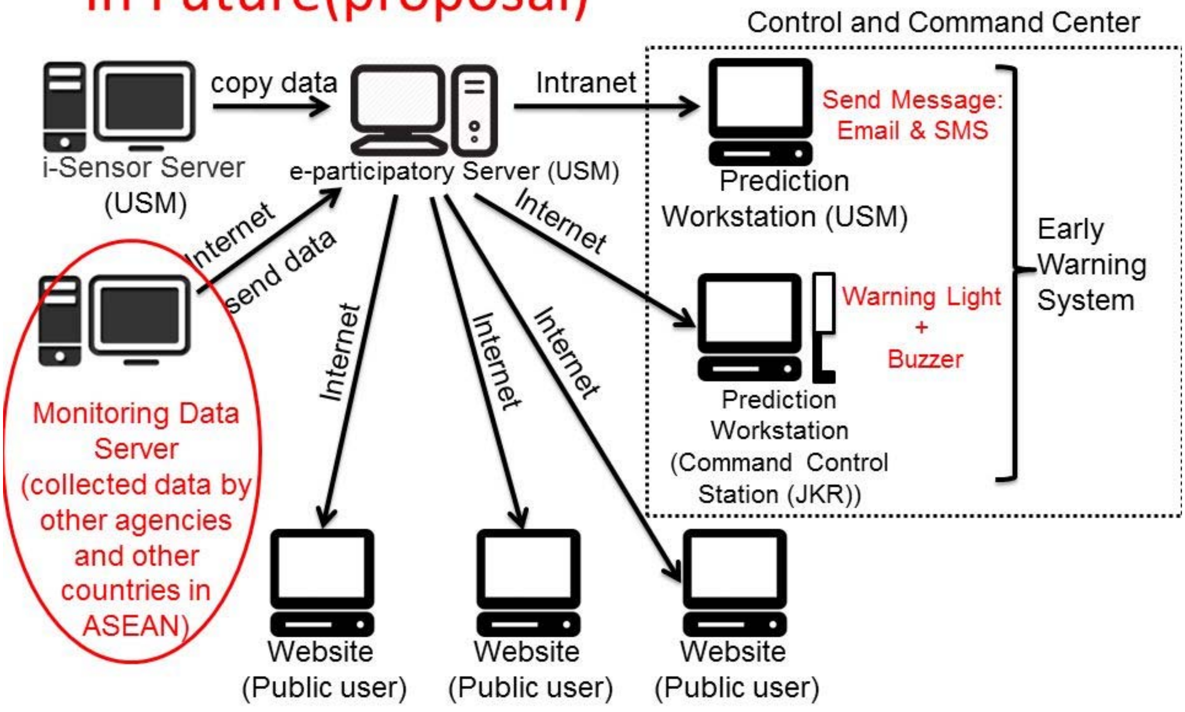


http://jmgeohazard.cs.usm.my/map/map/eMapEmbed.jsp?cid=1&gid=0&mid=26


Real Time Monitoring and Information Dissemination System
(as our study)
Site 1 Data logger for sending data from the devices to server(i-Sensor) in USM
Internet
Send data every 5 minutes
Internet
i-Sensor Server (USM)
Site 2 Data logger for sending data from the devices to server(i-Sensor) in USM


Early Warning System and Data Dissemination System
Control and Command Center
copy data
Intranet
i-Sensor Server (USM)
e-participatory Server (USM)
Send Message: Email & SMS
Prediction Workstation (USM)
Internet
Internet
Internet
Internet
Internet
Internet
Warning Light + Buzzer
Prediction Workstation (Command Control Station (JKR))
Early Warning System
Website (Public user)
Website (Public user)
Website (Public user)
Website (Public user)
Website (Public user)

In Future(proposal)



3. Public Awareness Education

The smart public will not be panic to confront the natural hazard with well preparedness.

In Malaysia, one of the developing countries, as there are only a few community center facilities, it is hard to organize public disaster awareness talk to public (adults).

The education attainment rate for adults who are 25years and above is not high(year 2009), in Malaysia and other South East Asia countries, except Singapore.

(* Source: ASEAN State of Education Report 2013)

Education attainment of the population aged 25 years and above (%) in South East Asia Countries (ASEAN)

Education Attainment of the Population aged 25 years and older (%) in South East Asia Countries(ASEAN)

2009

Country Name	Primary	Lower Secondary	Upper Secondary	Tertiary Education
Brunei	98	75(secondary)	75(secondary)	11
Cambodia	20.1	9.2	4.2	-
Indonesia	30.58	14.45	20.34	7.5
Laos	68.4	75	-	3
Malaysia	23.7	17.5	31.2	18.3
Myanmar	83.94	39.57(secondary)	39.57(secondary)	-
Philippines	89.4	59.9(secondary)	59.9(secondary)	28.1
Singapore	96.8	95.2	74.6	63.6
Thailand	89.7	72.7(secondary)	72.7(secondary)	45.8
Vietnam	98.5	84.96(secondary)	84.96(secondary)	51.73

* Source: ASEAN State of Education Report 2013

*- means not available

**secondary means the survey does not separate lower or upper secondary

Public Awareness Education in Schools

Moreover, most of the adults are busy in their works daily.

These are the reasons why

we choose to educate school students, in schools, to bring public awareness to family by bottom-up, information dissemination among family members.

Natural Hazard Education

Conducted natural hazard education in primary schools

1) 7th. April, 2015 in Sekolah Kebangsaan RPS Banun, Address: 48km, East-west Highway from Gerik.
Most of the students are aborigines Jahai, Negrito tribe (rural area).

2) 12th. October, 2015 in Sekolah Jenis Kebangsaan Perempuan China, Address: 2-D, Jalan Gottlieb, Penang
Most of the students are Malaysian Chinese (urban area).

3) 2nd. November, 2015 in Sekolah Kebangsaan Minden Height
Address: Minden Heights, 11700 Gelugor, Pulau Pinang
Most of the students are Malay (urban area)

Photos of Natural Hazard Education in Primary Schools

In Public Awareness Education

- 1. Conducting questionnaire(before and after education) to understand how details the students know about landslides
- 2. Educating School Children and indirectly to the Community(adults) by showing video and explaining the mechanism of slope failure
- 3. Providing Hazard Map Information

Hands-on education on weather station

⇨ **Hands-on education will give students better picture on the weather, and attract their attention on natural hazard**

Handover ceremony in March 2016 at Ministry of Higher Education, Kuala Lumpur

4. Conclusion

1) IT Technology plays very important roles in
   a) Analyzing slope condition and prediction the slope failure
   b) Information dissemination(such as slope condition, hazard map, evacuation map and landslides historical map) to the public

2) Public Awareness:
   a) Natural hazard education should be conducted in schools, especially in the areas near to lakeside, riverside and hilly area
   b) In developing countries, educating school children can bring public awareness to family while doing communication among family members

THANK YOU for Your Attention

JST/JICA SATREPS Study on Glacial Lake Outburst Floods in the Bhutan Himalayas

ブータンヒマラヤにおける氷河湖決壊洪水に関する研究

2009～2011

Leader：K. Nishimura（Nagoya University)

（C/P in Bhutan：Department of Geology and Mines Royal Gov. of Bhutan）

Presenter: D. Higaki (Hirosaki University)

Yamada（1998)

Background

- Glacial lake outburst floods (GLOFs) as natural hazards in the Himalayan countries

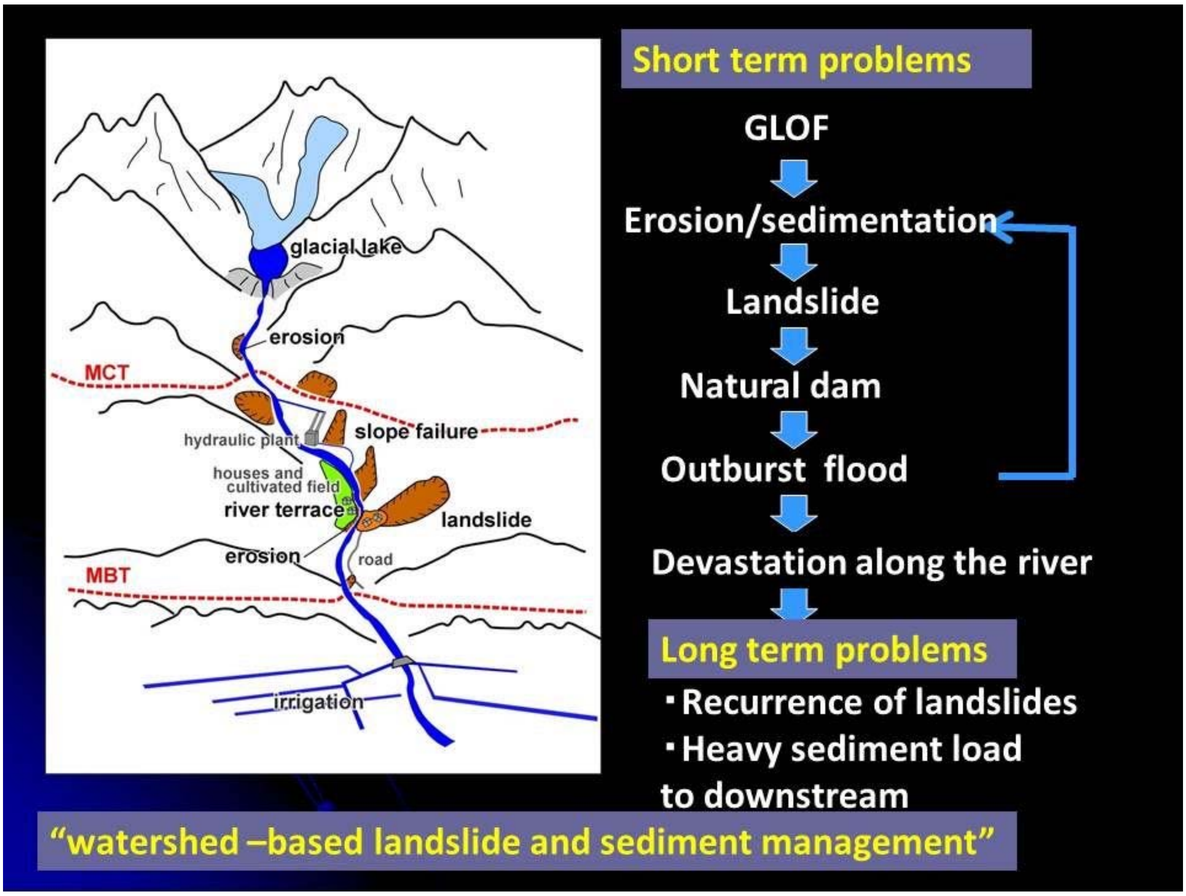


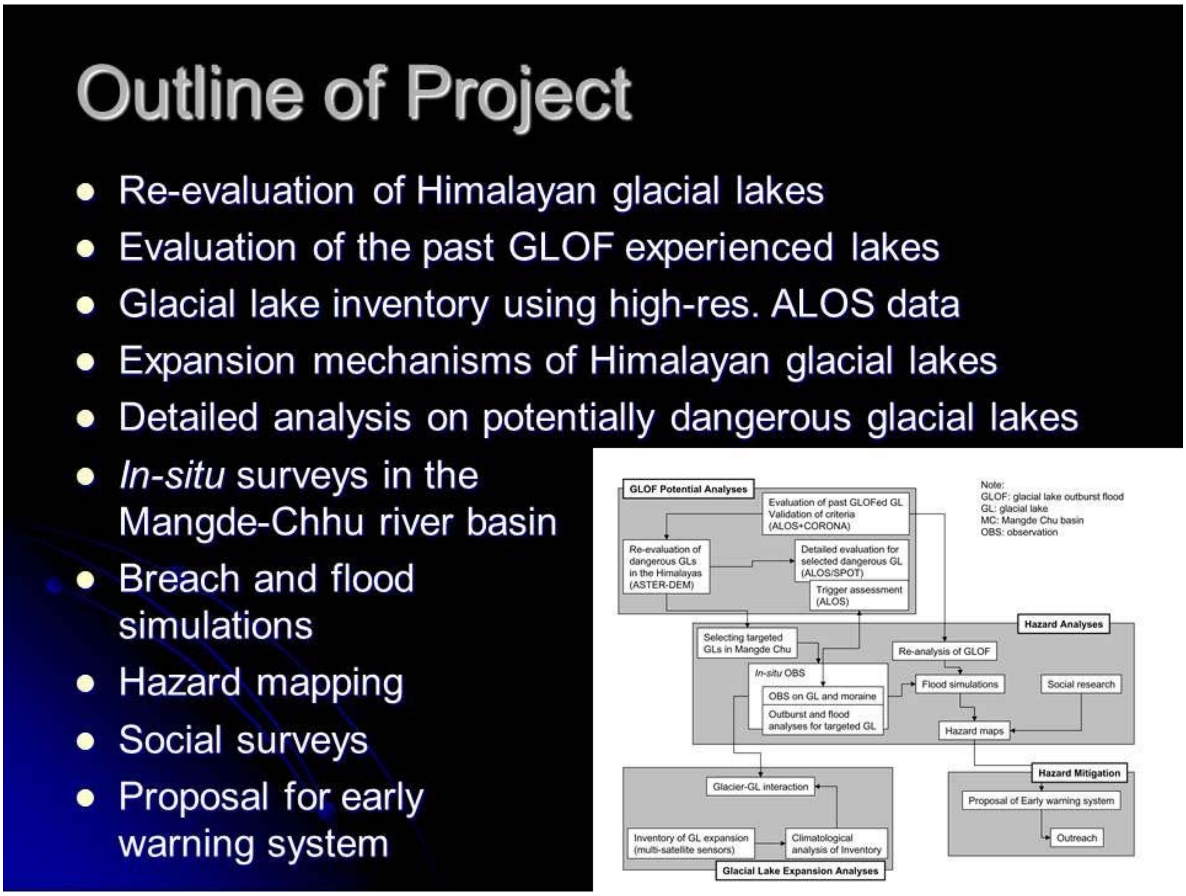

Photos courtesy of Dr. Yamada & WECS, Nepal

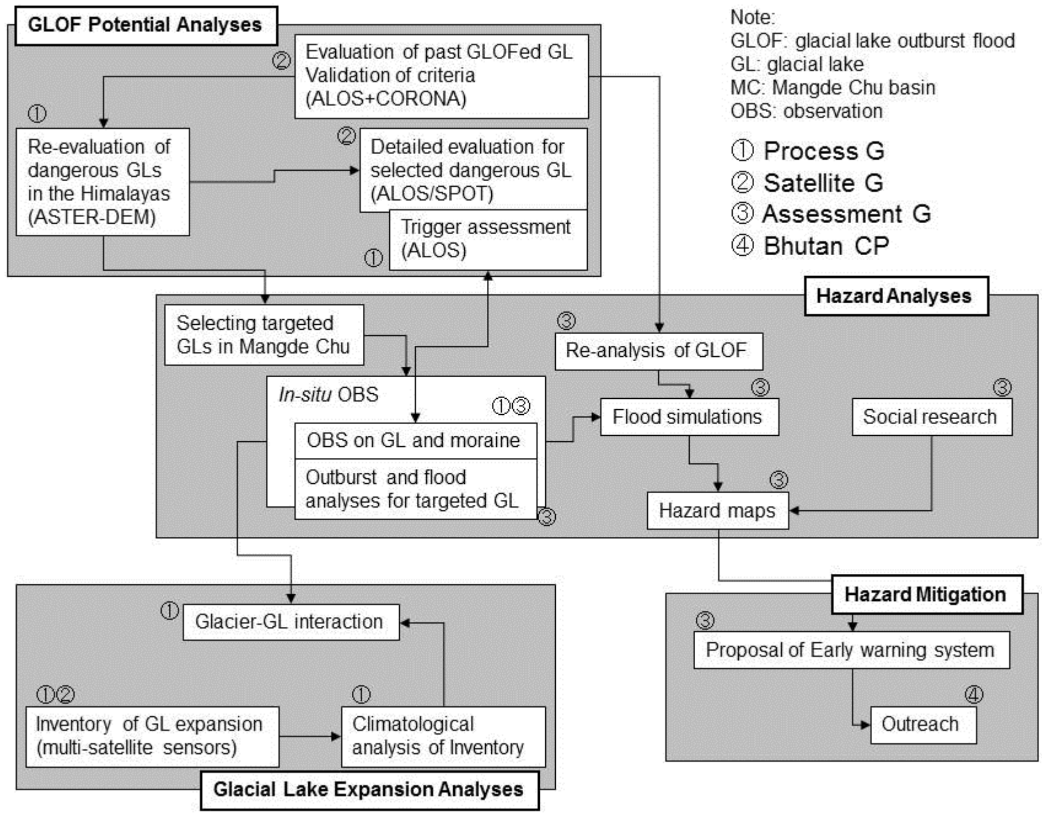
The Dig Tsho GLOF in 1985 triggered by the fall of i
mass (photo by Umemura, J. in 2003)

CASE – BHOTE/DUDH KOSI –

Landslides triggered by the stream erosion of GLOF in 1985 (Khumbu, Nepal, WECS, 1987)
Erosion and sedimentation are the GLOF associated hazards.


glacial lake
erosion
MCT
hydraulic plant
slope failure
houses and
cultivated field
river terrace
landslide
erosion
road
MBT
irrigation
Short term problems
GLOF
Erosion/sedimentation
Landslide
Natural dam
Outburst flood
Devastation along the river
Long term problems
・Recurrence of landslides
・Heavy sediment load
to downstream
“watershed –based landslide and sediment management”

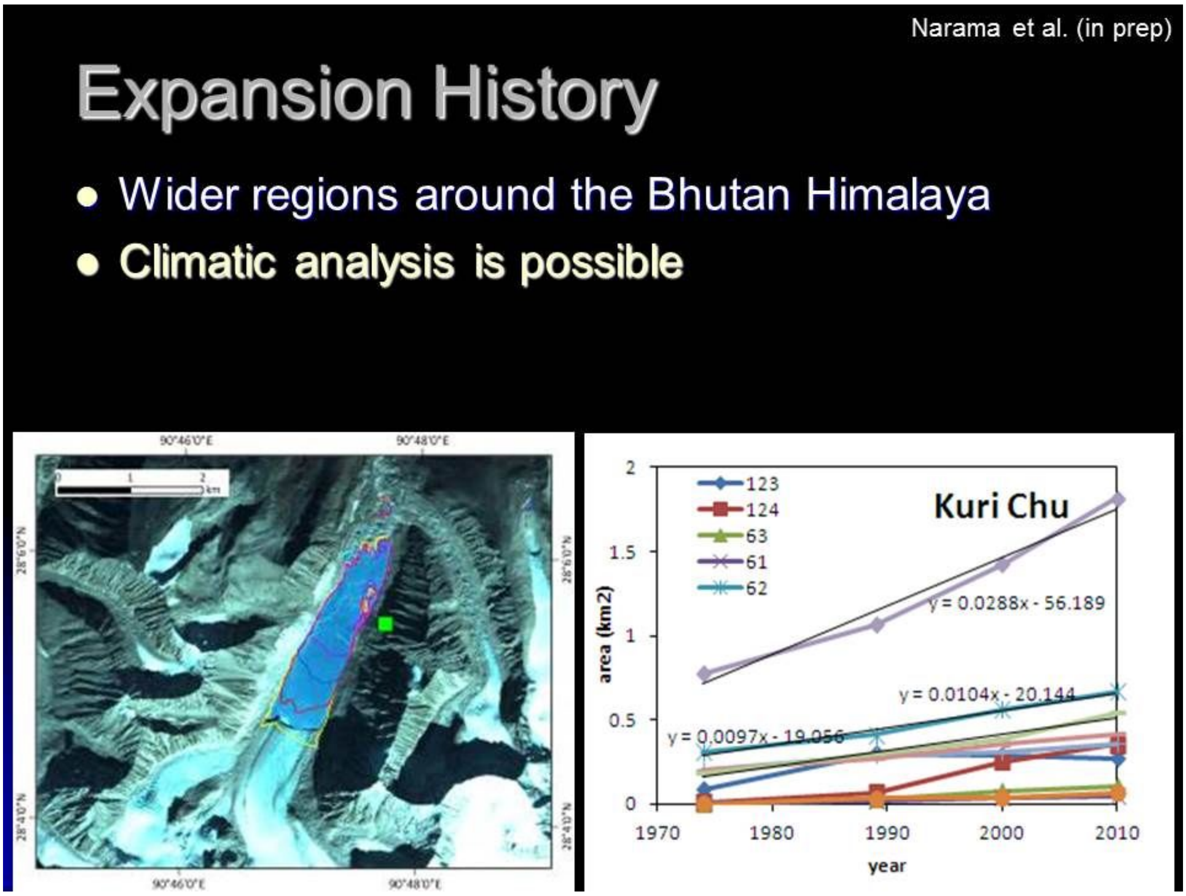

Outline of Project
Re-evaluation of Himalayan glacial lakes
Evaluation of the past GLOF experienced lakes
Glacial lake inventory using high-res. ALOS data
Expansion mechanisms of Himalayan glacial lakes
Detailed analysis on potentially dangerous glacial lakes
In-situ surveys in the Mangde-Chhu river basin
Breach and flood simulations
Hazard mapping
Social surveys
Proposal for early warning system
GLOF Potential Analyses
Evaluation of past GLOFed GL Validation of criteria (ALOS+CORONA)
Re-evaluation of dangerous GLs in the Himalayas (ASTER-DEM)
Detailed evaluation for selected dangerous GL (ALOS/SPOT)
Trigger assessment (ALOS)
Note:
GLOF: glacial lake outburst flood
GL: glacial lake
MC: Mangde Chu basin
OBS: observation
Hazard Analyses
Selecting targeted GLs in Mangde Chu
Re-analysis of GLOF
In-situ OBS
OBS on GL and moraine
Outburst and flood analyses for targeted GL
Flood simulations
Social research
Hazard maps
Hazard Mitigation
Proposal of Early warning system
Outreach
Glacier-GL interaction
Inventory of GL expansion (multi-satellite sensors)
Climatological analysis of Inventory
Glacial Lake Expansion Analyses

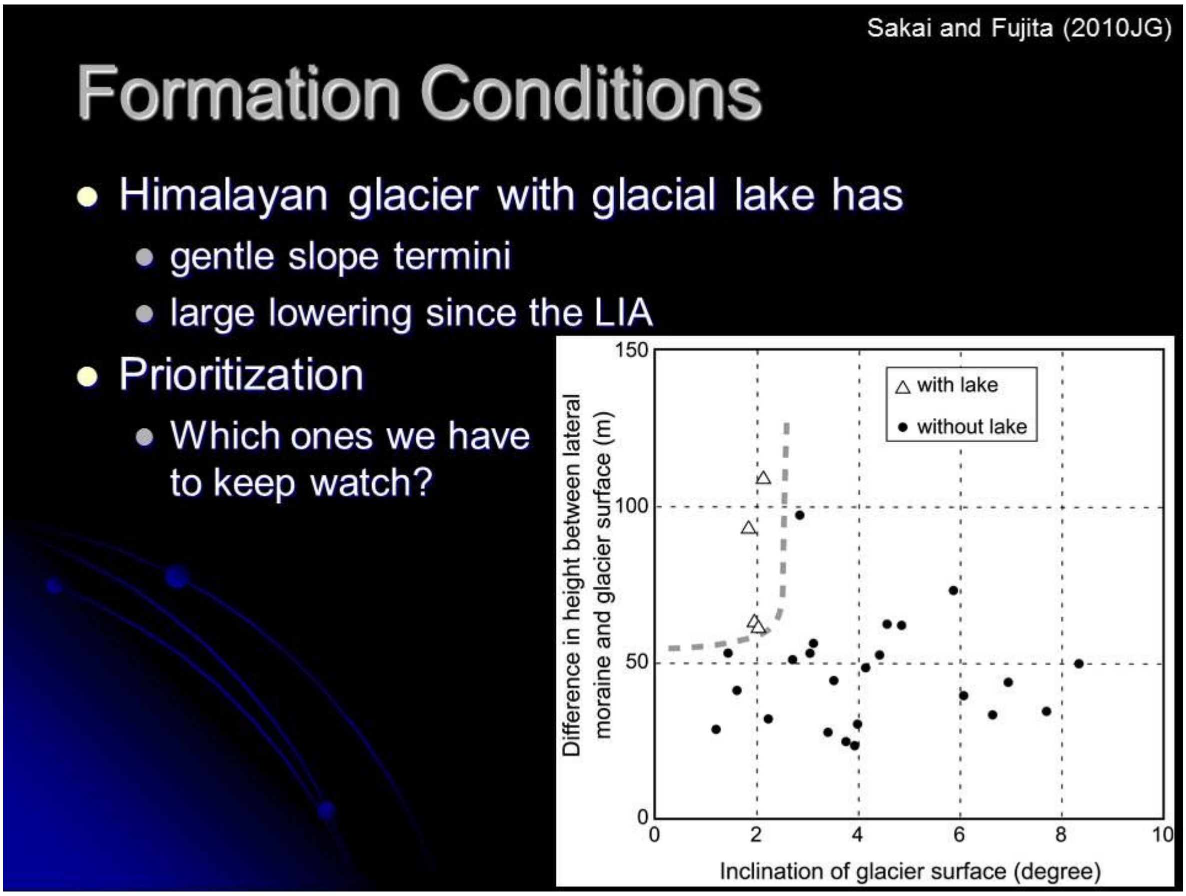


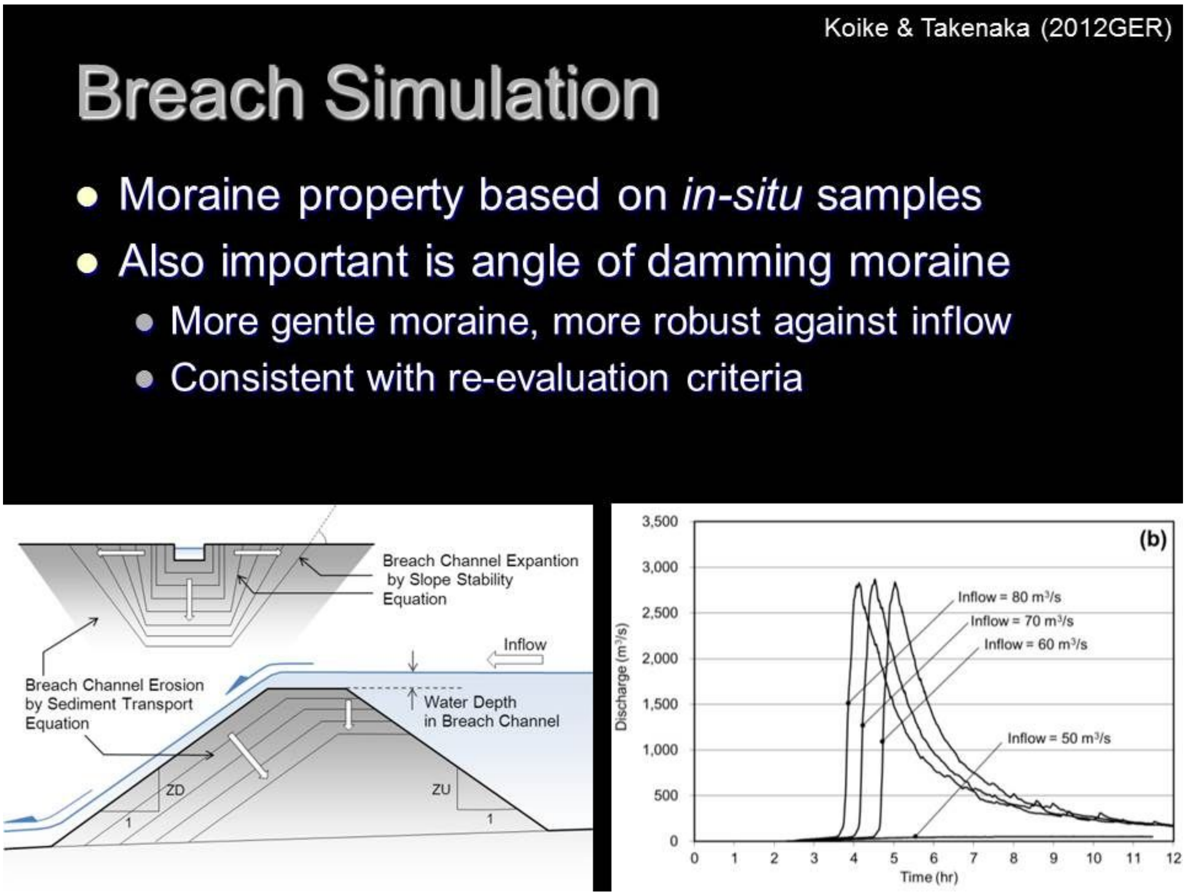
Structure of Project

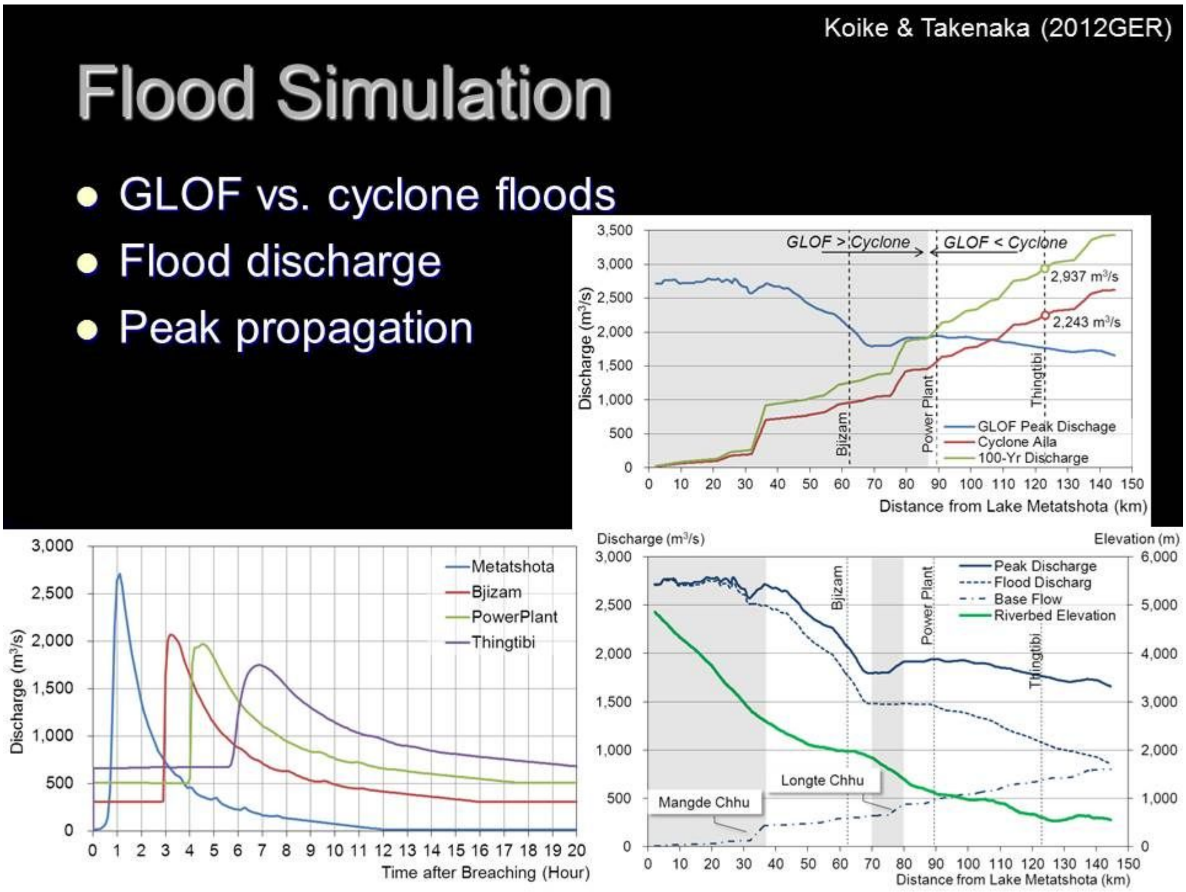
- Process Group
  - Expansion mechanisms and *In-situ* surveys
  - Nagoya University and 7 institutions
- Satellite Group
  - Glacial lake inventory
  - JAXA and 4 institutions
- Assessment Group
  - Flood simulations and hazard mapping
  - Earth System Science Co Ltd and 5 institutions
- Counterparts in Bhutan
  - 9 researchers from Department of Geology and Mines


Ukita et al. (2011AG)
New Inventory
• Based on ALOS mosaic images with high-res digital terrain model
N
30 15 0 30 60 90 km
1:1,500,000


Narama et al. (in prep)
Expansion History
• Wider regions around the Bhutan Himalaya
• Climatic analysis is possible
90°46'0"E
90°48'0"E
28°6'0"N
28°4'0"N
Kuri Chu
123
124
63
61
62
y = 0.0288x - 56.189
y = 0.0104x - 20.144
y = 0.0097x - 19.056
area (km2)
year
1970 1980 1990 2000 2010
0 0.5 1 1.5 2


Sakai and Fujita (2010JG)
Formation Conditions
Himalayan glacier with glacial lake has
gentle slope termini
large lowering since the LIA
Prioritization
Which ones we have to keep watch?
with lake
without lake
Difference in height between lateral moraine and glacier surface (m)
Inclination of glacier surface (degree)
0
50
100
150
0
2
4
6
8
10

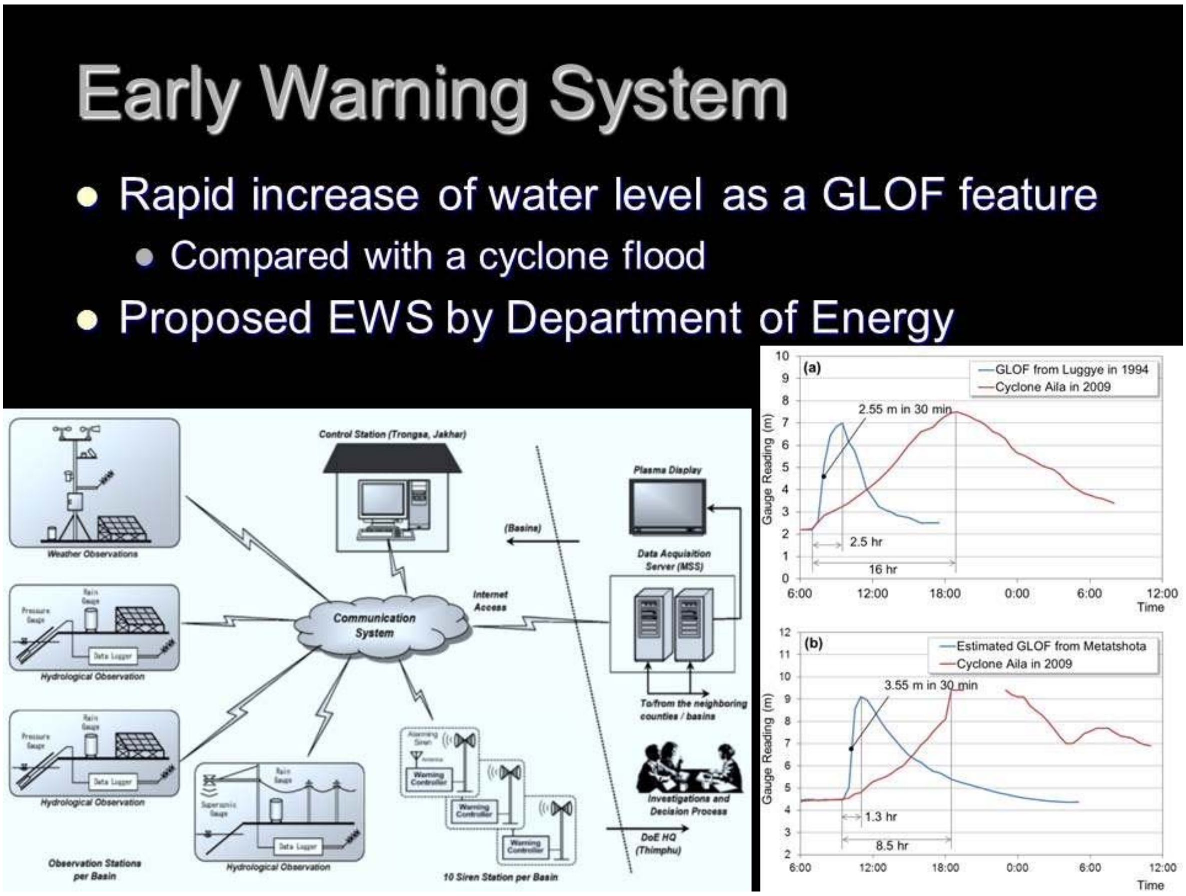

Koike & Takenaka (2012GER)
Breach Simulation
Moraine property based on *in-situ* samples
Also important is angle of damming moraine
More gentle moraine, more robust against inflow
Consistent with re-evaluation criteria
Breach Channel Expantion by Slope Stability Equation
Breach Channel Erosion by Sediment Transport Equation
Inflow
Water Depth in Breach Channel
ZD
ZU
1
1
(b)
Inflow = 80 m³/s
Inflow = 70 m³/s
Inflow = 60 m³/s
Inflow = 50 m³/s
Discharge (m³/s)
Time (hr)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
0
1
2
3
4
5
6
7
8
9
10
11
12

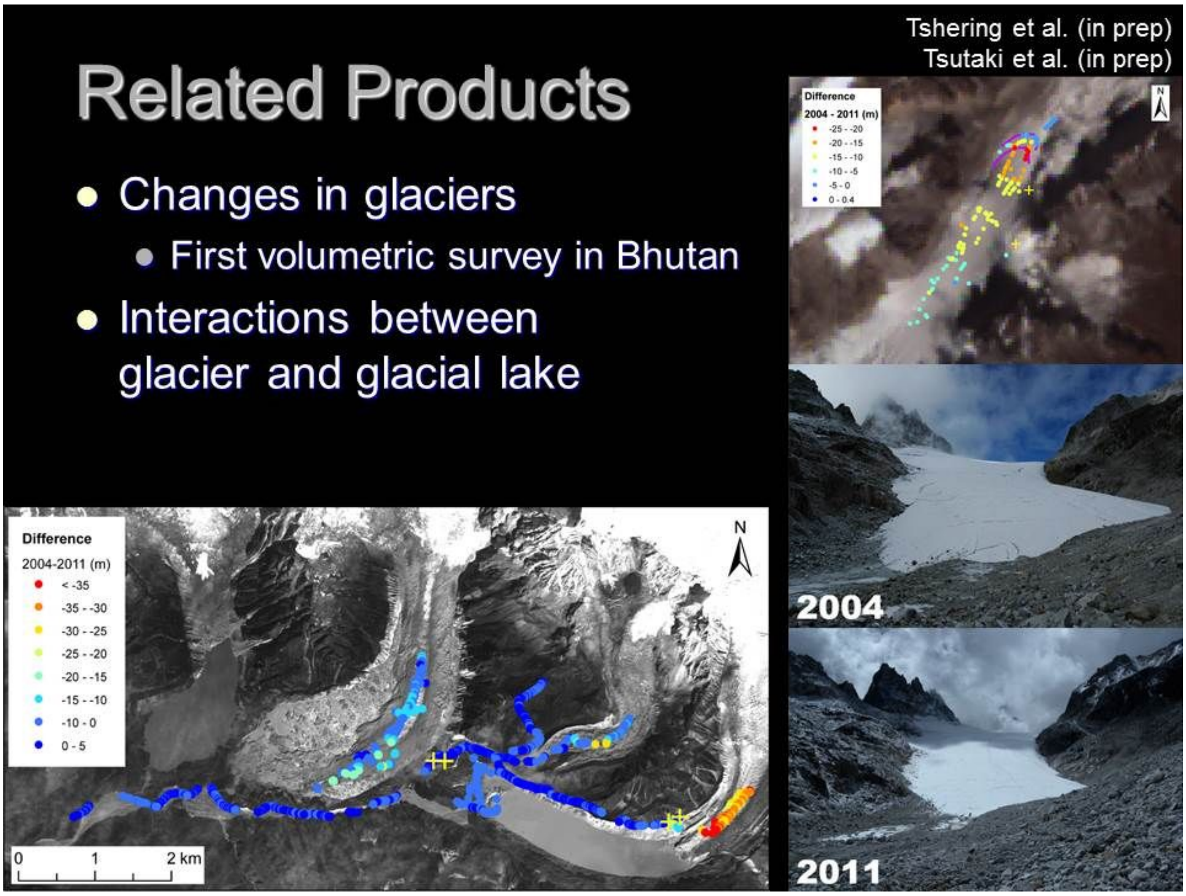

Koike & Takenaka (2012GER)
Flood Simulation
GLOF vs. cyclone floods
Flood discharge
Peak propagation
GLOF > Cyclone
GLOF < Cyclone
2,937 m³/s
2,243 m³/s
Discharge (m³/s)
Bjizam
Power Plant
Thingtibi
GLOF Peak Dischage
Cyclone Aila
100-Yr Discharge
Distance from Lake Metatshota (km)
Metatshota
Bjizam
PowerPlant
Thingtibi
Discharge (m³/s)
Time after Breaching (Hour)
Elevation (m)
Peak Discharge
Flood Discharg
Base Flow
Riverbed Elevation
Mangde Chhu
Longte Chhu
Distance from Lake Metatshota (km)

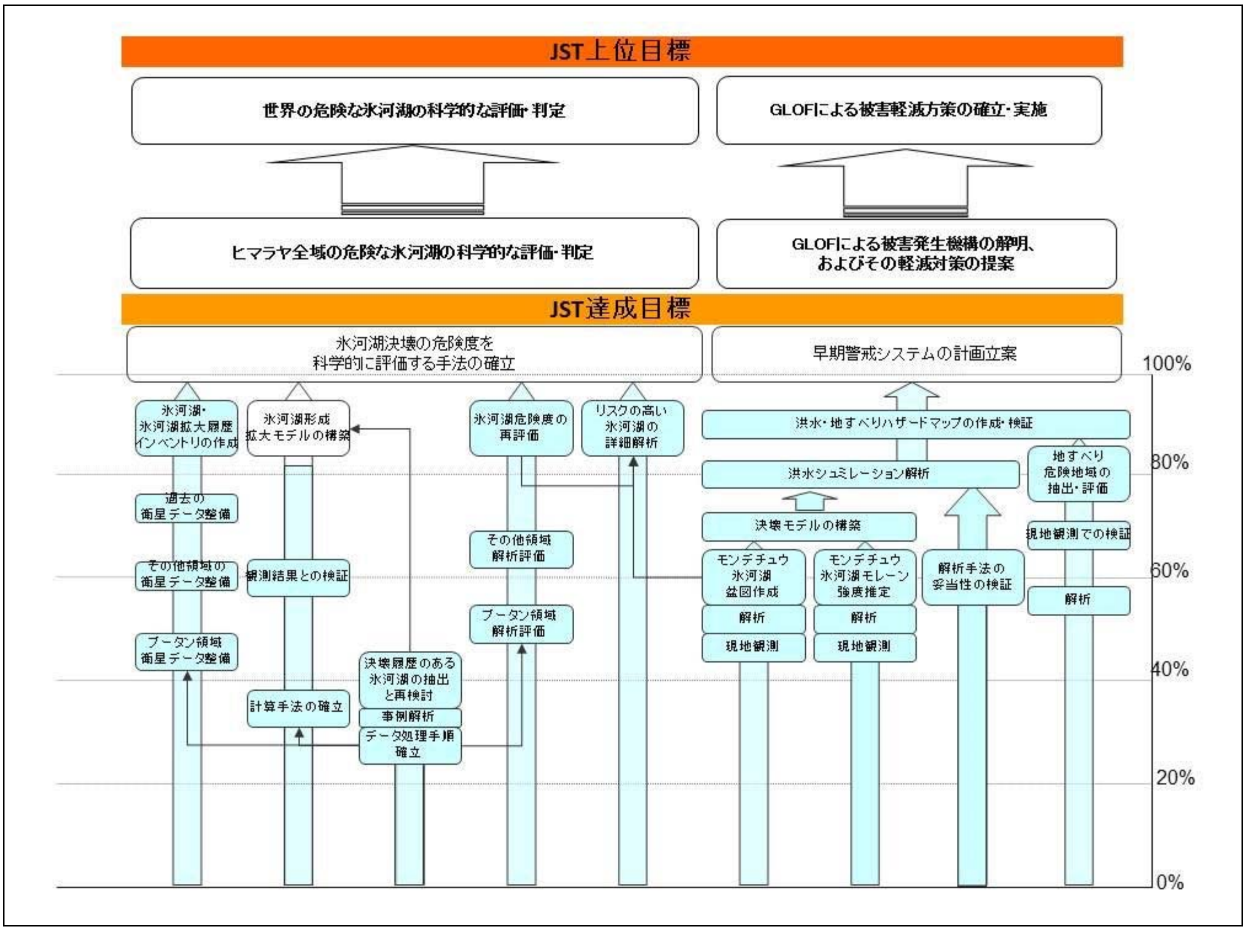

Koike & Takenaka (2012GER)
Takenaka et al. (2012GER)
Hazard Mapping
Detailed 3D simulation around targets requiring protection
Also important are social surveys
Prim. School
Check Post Office
Takabi
Khamzar
Mangde Bridge
Thingtibi
MAX DEPTH


Gentle slopes with houses and paddy fields (Kungarapten, Bhutan)
Deep-seated landslides may occur due to stream erosion by GLOF


Higaki & Sato (2012GER)
Landslide Inventory
• Potential hazards induced by GLOFs or floods
Aug 2009
Mar 2011
1: Rock creep 2: Landslide 3: Scarp 4. Terrace
Legend
Mangde-chhu
Primary School
Bjizam Bridge
Highway
To Wangdue
To Trongsa
500 M
© JAXA


Early Warning System
Rapid increase of water level as a GLOF feature
Compared with a cyclone flood
Proposed EWS by Department of Energy
Control Station (Trongsa, Jakhar)
Communication System
Internet Access
Plasma Display
Data Acquisition Server (MSS)
(Basins)
Weather Observations
Hydrological Observation
Hydrological Observation
Hydrological Observation
Observation Stations per Basin
10 Siren Station per Basin
To/from the neighboring counties / basins
Investigations and Decision Process
DoE HQ (Thimphu)
(a)
GLOF from Luggye in 1994
Cyclone Aila in 2009
2.55 m in 30 min
2.5 hr
16 hr
Gauge Reading (m)
Time
(b)
Estimated GLOF from Metatshota
Cyclone Aila in 2009
3.55 m in 30 min
1.3 hr
8.5 hr
Gauge Reading (m)
Time


Tshering et al. (in prep)
Tsutaki et al. (in prep)
Related Products
Changes in glaciers
First volumetric survey in Bhutan
Interactions between glacier and glacial lake
Difference
2004 - 2011 (m)
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
0 - 0.4
N
Difference
2004-2011 (m)
< -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - 0
0 - 5
0
1
2 km
N
2004
2011


JST上位目標
世界の危険な氷河湖の科学的な評価・判定
GLOFによる被害軽減方策の確立・実施
ヒマラヤ全域の危険な氷河湖の科学的な評価・判定
GLOFによる被害発生機構の解明、
およびその軽減対策の提案
JST達成目標
氷河湖決壊の危険度を
科学的に評価する手法の確立
早期警戒システムの計画立案
100%
80%
60%
40%
20%
0%
氷河湖・
氷河湖拡大履歴
インベントリの作成
過去の
衛星データ整備
その他領域の
衛星データ整備
ブータン領域
衛星データ整備
氷河湖形成
拡大モデルの構築
観測結果との検証
計算手法の確立
決壊履歴のある
氷河湖の抽出
と再検討
事例解析
データ処理手順
確立
氷河湖危険度の
再評価
その他領域
解析評価
ブータン領域
解析評価
リスクの高い
氷河湖の
詳細解析
洪水・地すべりハザードマップの作成・検証
洪水シュミレーション解析
決壊モデルの構築
モンデチュウ
氷河湖
盆図作成
解析
現地観測
モンデチュウ
氷河湖モレーン
強度推定
解析
現地観測
解析手法の
妥当性の検証
地すべり
危険地域の
抽出・評価
現地観測での検証
解析

5. Research on Landslide Hazard Map in Honduras

Report on Hazard Map Training

Kiyoharu Hirota

International Consortium on Landslides

特定非営利活動法人

国際斜面災害研究機構

International Consortium on Landslides

TKP Tokyo Otemachi Conference Center in the KDD building in Tokyo, 24 Nov. 2016

International Forum "Japanese contribution to Landslide Disaster Risk Reduction"

Contents

*: Japan International Cooperation Agency

1. Introduction

This presentation shows a part of the JICA project "Assistance for Strengthening and Capacity Building of professional Techniques for the Control and Mitigation of Landslides in the Tegucigalpa Metroplolitan Area" with continuous projects.

Under this project, I (we) show how to make the hazard map with counterparts in two areas *El Edén* and *Nueva Santa Rosa* of Tegucigalpa.

2. Previous studies of JICA project

2000-2002 : The study on flood control and landslide prevension in Tegucigalpa metropolitan area of the republic of Honduras (JICA).

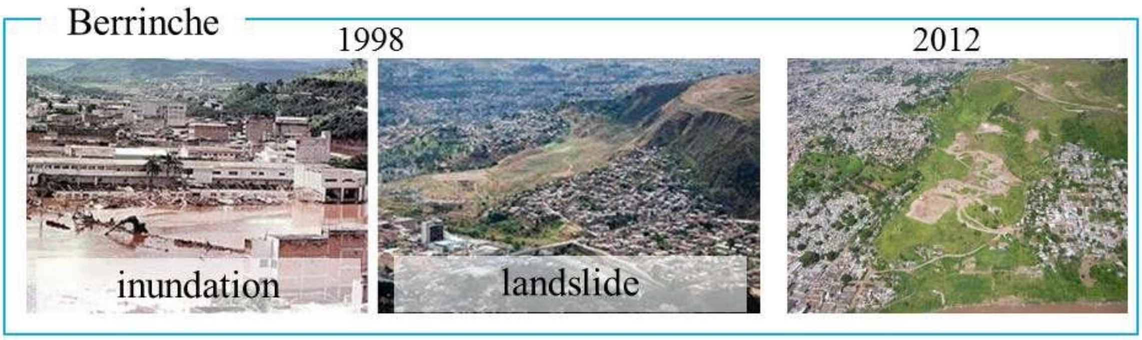
2011-2013 : Project on landslide prevention in Tegucigalpa metropolita area (ODA)

2011-2013 : Hazard geology focusing on the landslides in Tegucigalpa (JICA-JSPS)

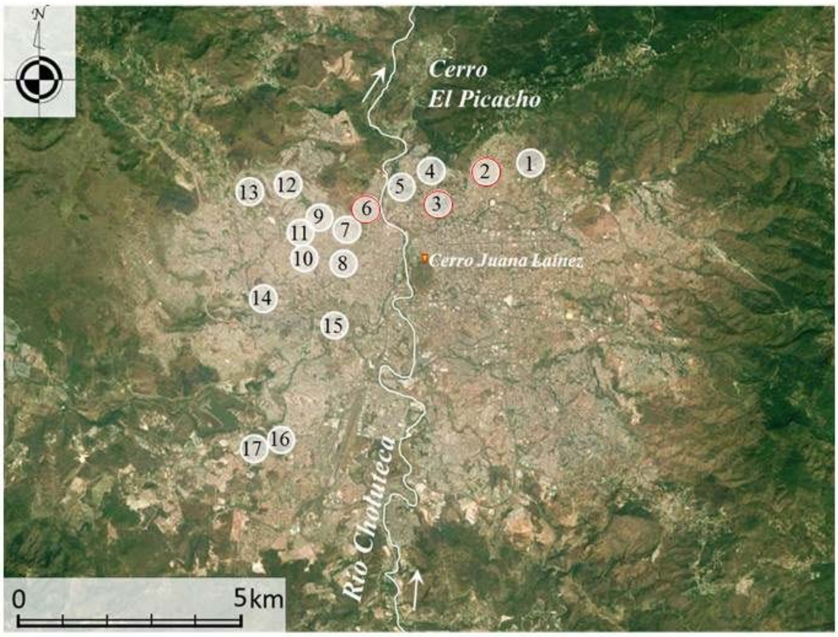
2011-2013 : Technical support for landslide studies at Honduran universities (JICA-SV)

Hurricane Mitch 1998

(from october 22 to november 5, 1998)



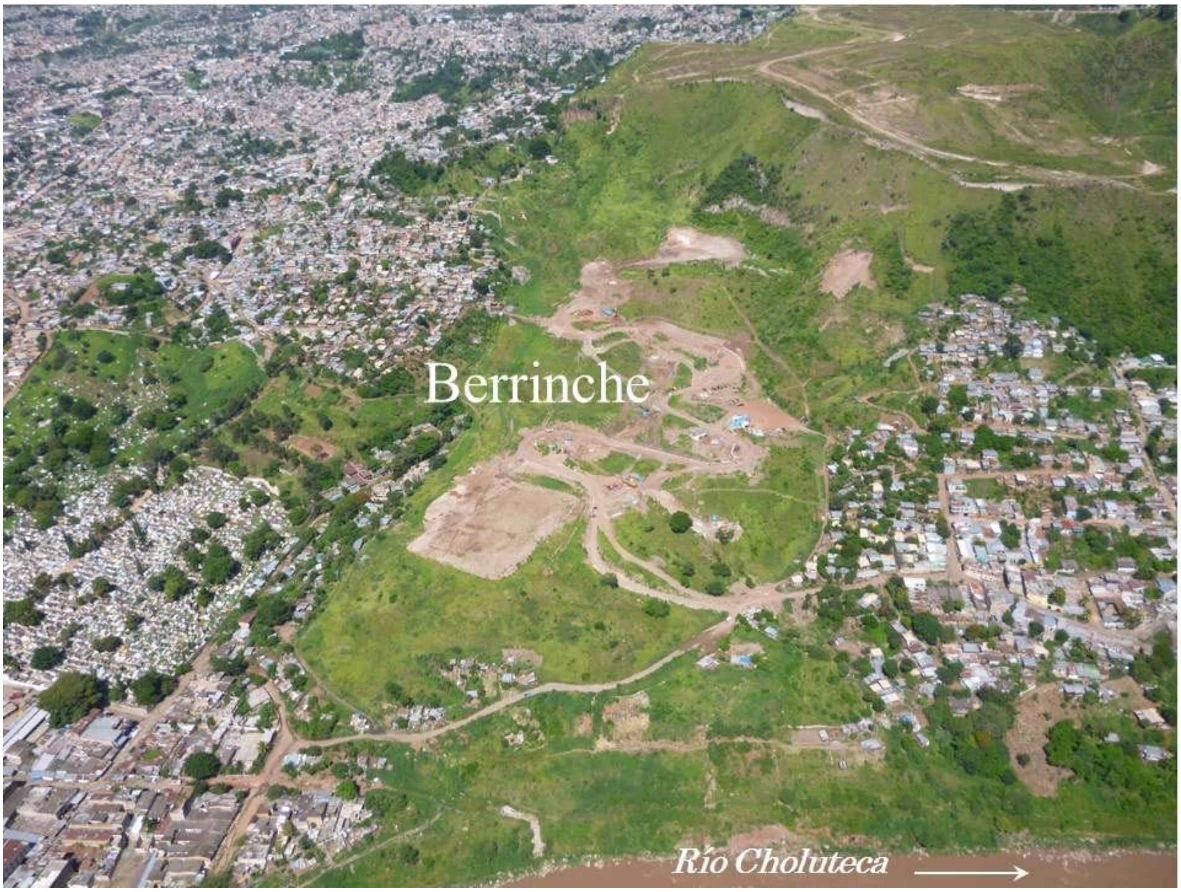
17 Landslides caused by Hurricane Mitch in Tegucigalpa



1.Canaán, 2.Reparto, 3.Bambú, 4.Bosque, 5.Buena Vista, 6.Berrinche, 7.Campo Cielo, 8.San Martín, 9.Flor 1, 10.Zapote Centro, 11.Zapote Norte, 12.Villa Unión, 13.Brasilia, 14.Centroamérica, 15.Nueva Esperanza, 16.Las Torres Este, 17.Las Torres Oeste

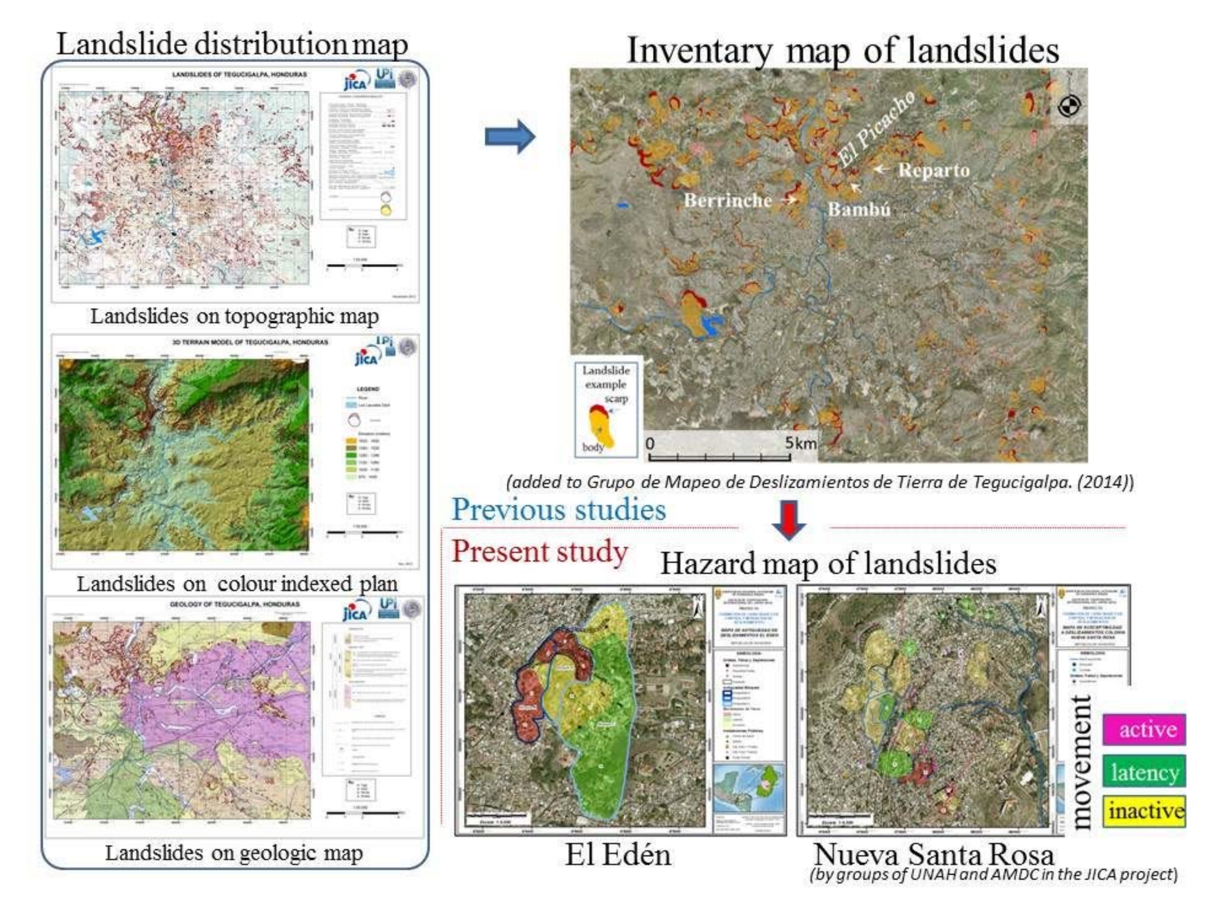
(*The Google Earth image is used as the base map*)


Countermeasures against Landslides
Drainage with gabions
Embankment
JAPON-AMDC
Bambú
Drainage well
Berrinche
Drainage well
Reparto


Berrinche
Río Choluteca


El Picacho
Reparto
Bambú
2012


El Picacho
Bambú
Reparto
2012



3. Landslide Hazard Mapping

2015-2016： Assistance for Strengthening and Capacity Building of Professional Techniques for the Control and Mitigation of Landslide in Tegucigalpa Metropolitan Area (JICA).

Stuffs

JICA Experts: Drs. H. Yamagishi, H. Yagi, G. Sato, and K. Hirota

Companies: Kokusai Kogyou Co., Ltd., OYO International Corporation

Counterparts

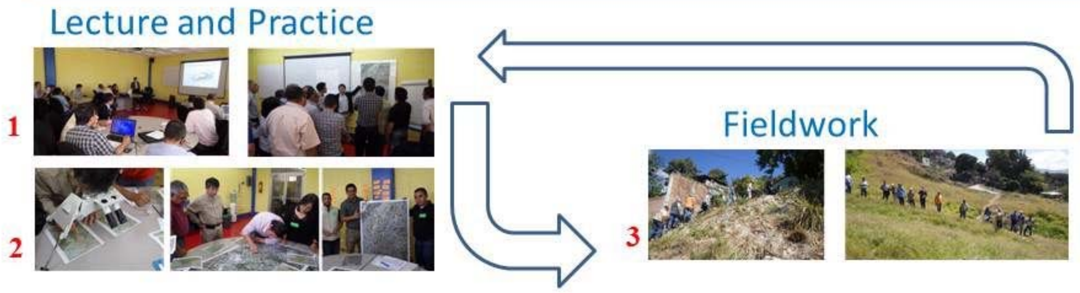
- Alcaldia Municipal del Distrito Central (Municipal Office of the Central District)

- Universidad Nacional Autónoma de Honduras (National Autonomous University of Honduras)

3.1 Educational program

Educational three activities as followings;

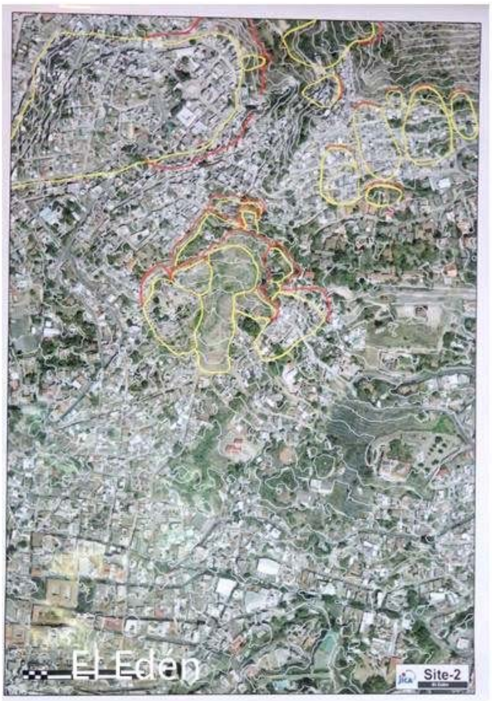
1. The lecture to learn geology and geomorphology.
2. The practice to read aerial photography and map.
3. Fieldwork to confirm landslides after practice.

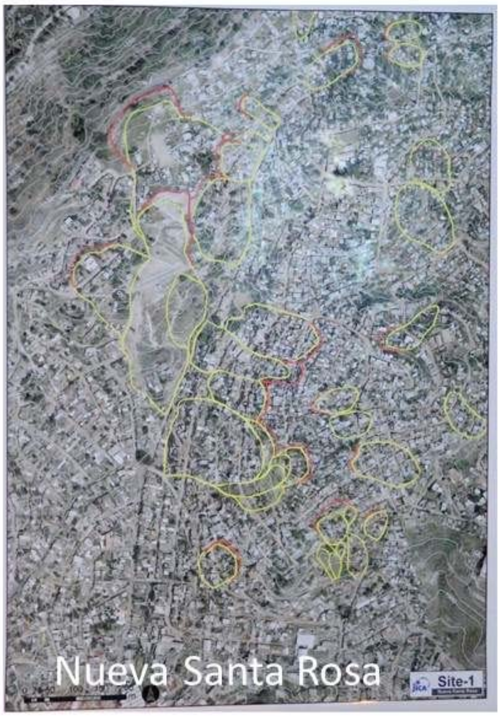


Educational process of the project seminar (JICA)

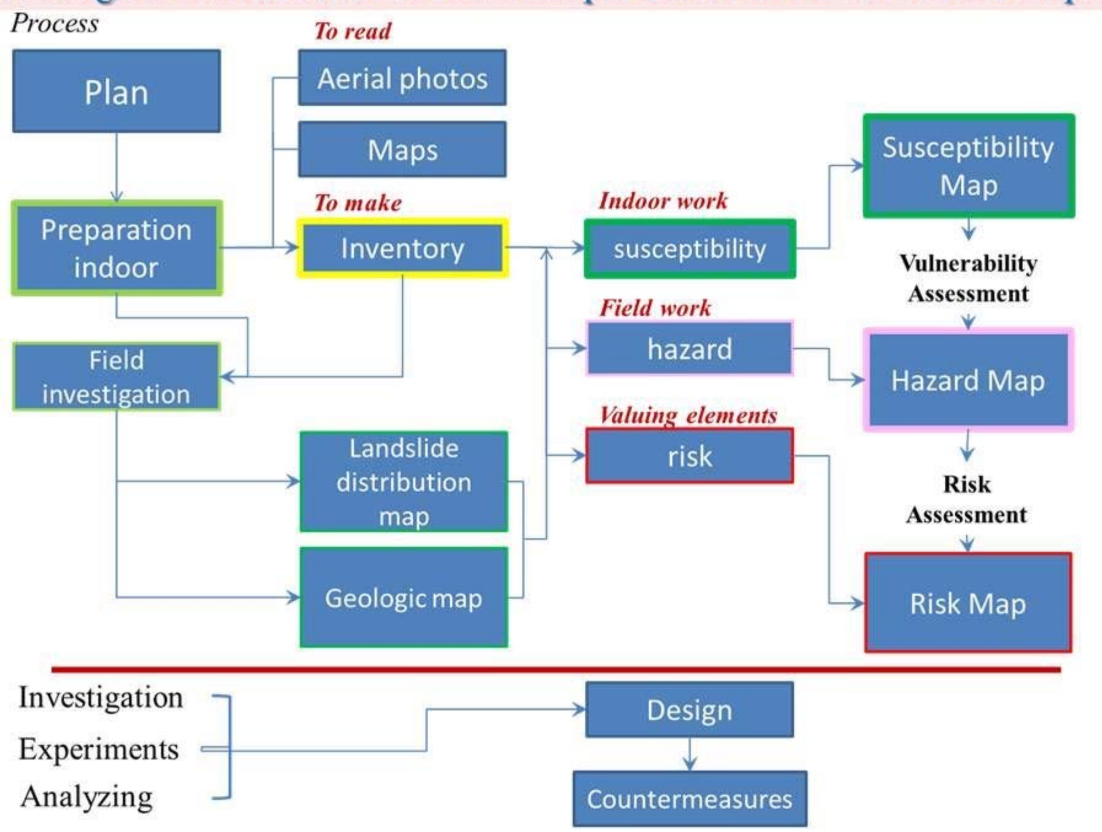
3.2 Sites Selection for activity

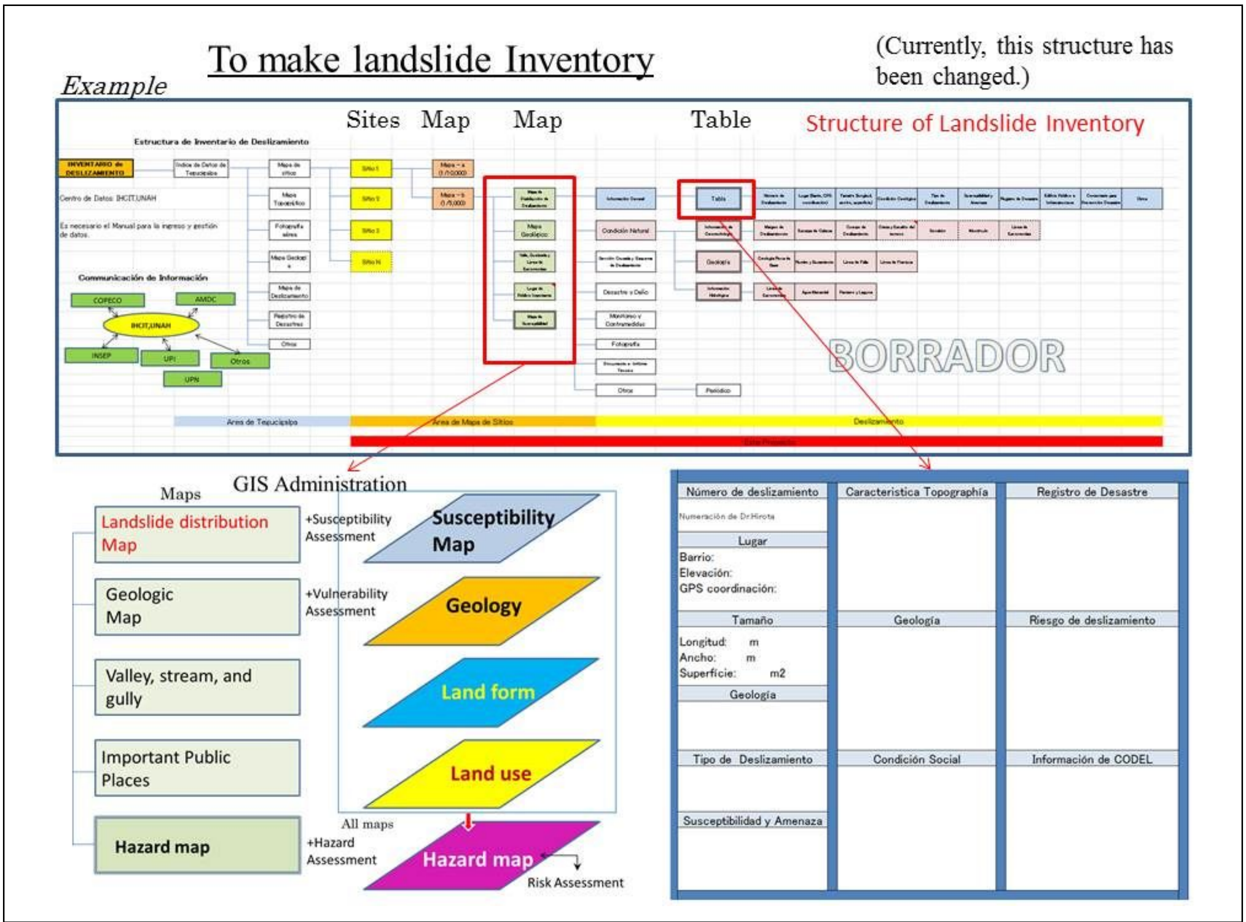
Two examples of landslide destribution map

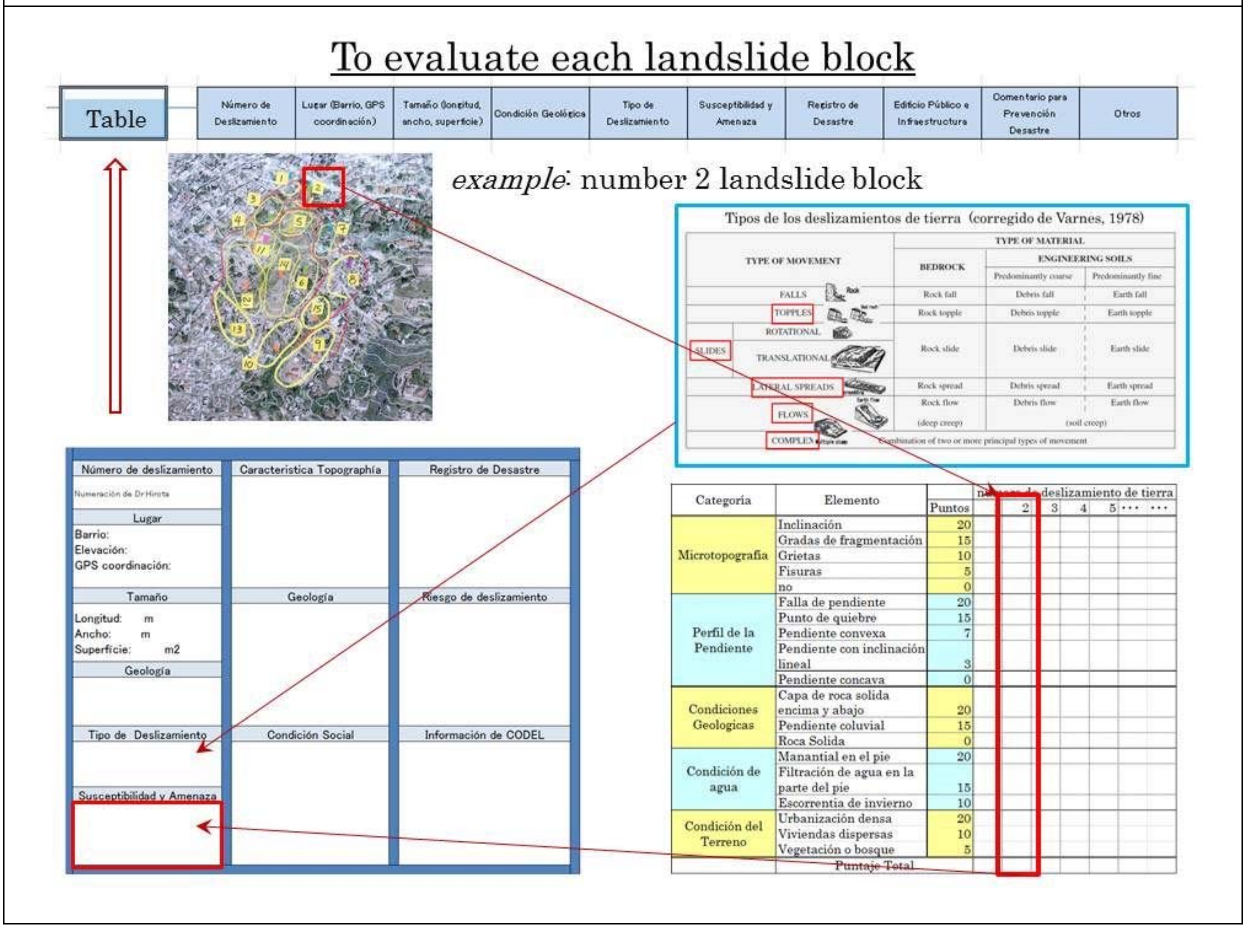




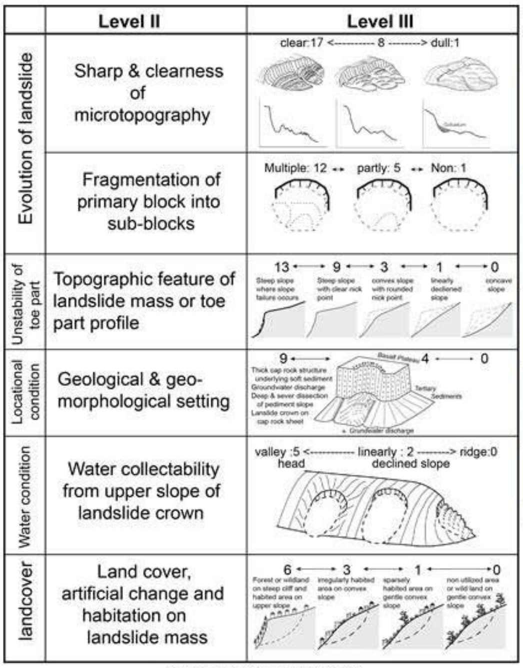
Flow diagram indicates the educational process to make the hazard map.




To make landslide Inventory
(Currently, this structure has been changed.)
Example
Sites
Map
Map
Table
Structure of Landslide Inventory
Estructura de Inventario de Deslizamiento
Comunicación de Información
BORRADOR
Maps
GIS Administration
Landslide distribution Map
Geologic Map
Valley, stream, and gully
Important Public Places
Hazard map
+Susceptibility Assessment
+Vulnerability Assessment
All maps
+Hazard Assessment
Susceptibility Map
Geology
Land form
Land use
Hazard map
Risk Assessment
Número de deslizamiento
Característica Topographía
Registro de Desastre
Lugar
Barrio:
Elevación:
GPS coordinación:
Tamaño
Geología
Riesgo de deslizamiento
Longitud: m
Ancho: m
Superficie: m2
Geología
Tipo de Deslizamiento
Condición Social
Información de CODEL
Susceptibilidad y Amenaza


To evaluate each landslide block
Table
Número de Deslizamiento
Lugar (Barrio, GPS coordinación)
Tamaño (longitud, ancho, superficie)
Condición Geológica
Tipo de Deslizamiento
Susceptibilidad y Amenaza
Registro de Desastre
Edificio Público e Infraestructura
Comentario para Prevención Desastre
Otros
example: number 2 landslide block
Tipos de los deslizamientos de tierra (corregido de Varnes, 1978)
TYPE OF MOVEMENT
TYPE OF MATERIAL
BEDROCK
ENGINEERING SOILS
FALLS
TOPPLES
SLIDES
ROTATIONAL
TRANSLATIONAL
LATERAL SPREADS
FLOWS
COMPLEX
Número de deslizamiento
Característica Topographía
Registro de Desastre
Lugar
Barrio:
Elevación:
GPS coordinación:
Tamaño
Geología
Riesgo de deslizamiento
Longitud: m
Ancho: m
Superficie: m2
Geología
Tipo de Deslizamiento
Condición Social
Información de CODEL
Susceptibilidad y Amenaza
Categoría
Elemento
Puntos
número de deslizamiento de tierra
Microtopografía
Inclinación 20
Gradas de fragmentación 15
Grietas 10
Fisuras 5
no 0
Perfil de la Pendiente
Falla de pendiente 20
Punto de quiebre 15
Pendiente convexa 7
Pendiente con inclinación lineal 3
Pendiente concava 0
Condiciones Geologicas
Capa de roca solida encima y abajo 20
Pendiente coluvial 15
Roca Solida 0
Condición de agua
Manantial en el pie 20
Filtración de agua en la parte del pie 15
Escorrentia de invierno 10
Condición del Terreno
Urbanización densa 20
Viviendas dispersas 10
Vegetación o bosque 5
Puntaje Total

Analytic Hierarchy Process: AHP



Numeral is a weight for each criteria.

Schematic illustration of weighting system for landslides locating on hilly slope

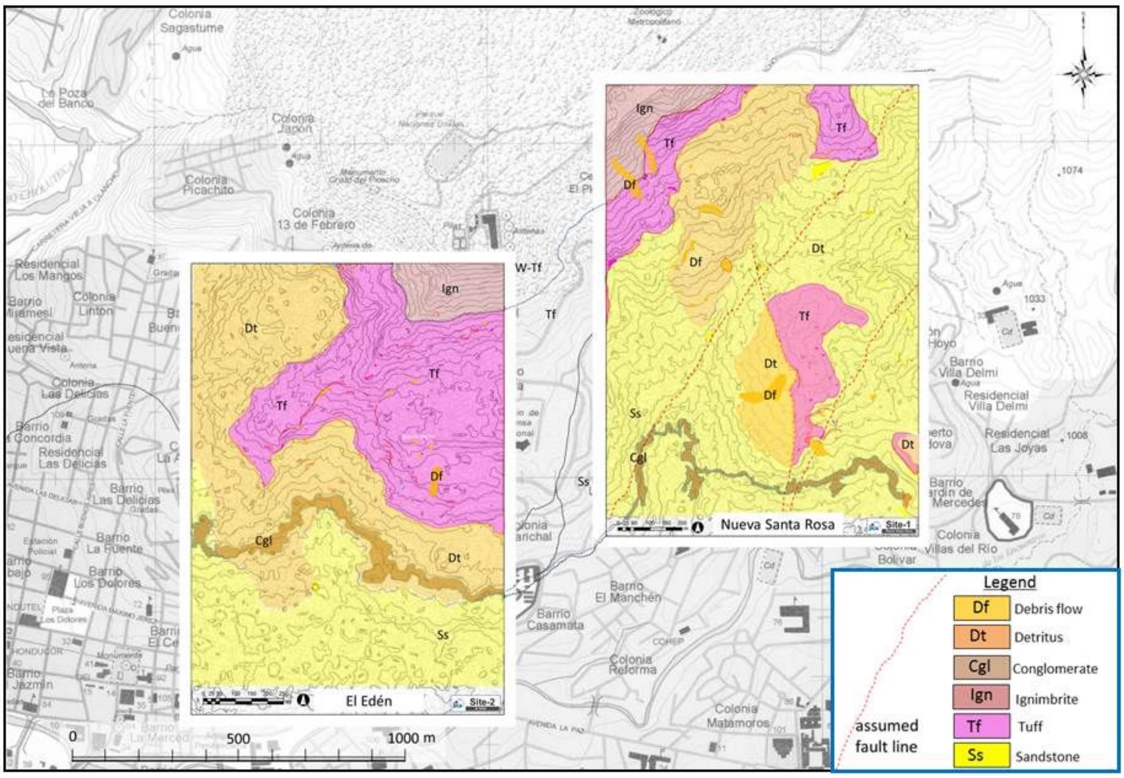
Por Dr. Yagi

Lately, we do the inventory of the landslide with the system to have criterion weight.

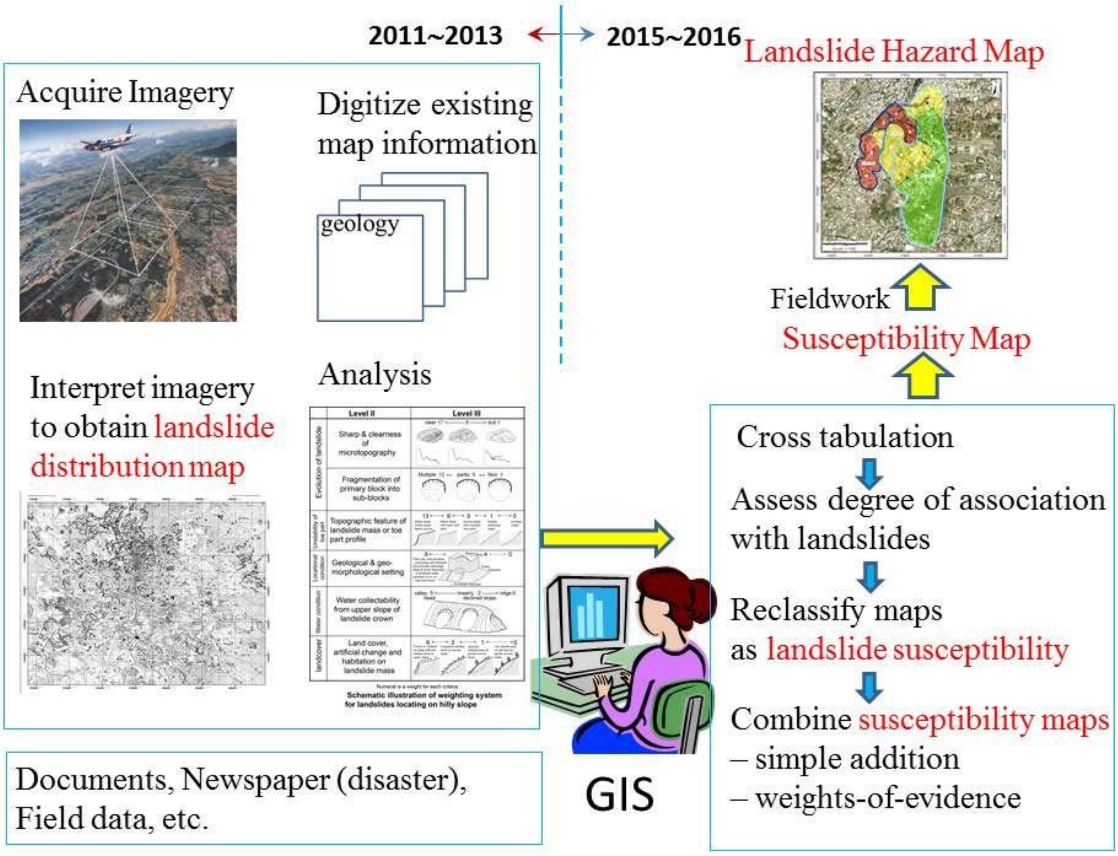
Categoría	Elemento	Puntos	numero de deslizamiento de tierra 1	2	3	4	5 ・・・	・・・
Microtopografía	Inclinación	20						
	Gradas de fragmentación	15						
	Grietas	10						
	Fisuras	5						
	no	0						
Perfil de la Pendiente	Falla de pendiente	20						
	Punto de quiebre	15						
	Pendiente convexa	7						
	Pendiente con inclinación lineal	3						
	Pendiente concava	0						
Condiciones Geologicas	Capa de roca solida encima y abajo	20						
	Pendiente coluvial	15						
	Roca Solida	0						
Condición de agua	Manantial en el pie	20						
	Filtración de agua en la parte del pie	15						
	Escorrentia de invierno	10						
Condición del Terreno	Urbanización densa	20						
	Viviendas dispersas	10						
	Vegetación o bosque	5						
	Puntaje Total							

Twenty points for each Category at most, even if the total score number of the elements passes more than twenty.
And a hundred points totally at most.

Geologic map of two sites in the project



Discussion and putting together our thoughts with GIS after field investigation for landslide

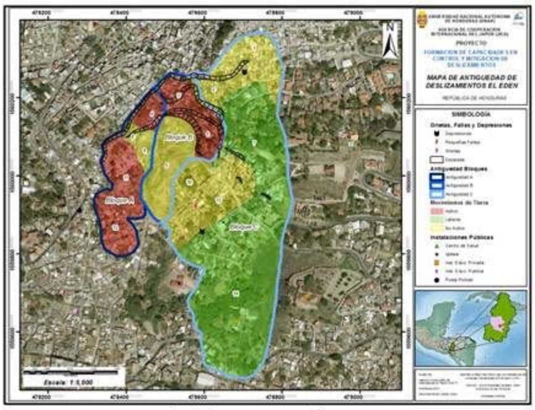


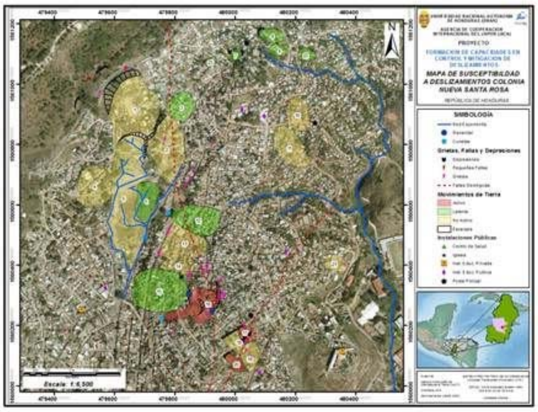
3.3 results

biggining → fulfillment

Susceptibility map → Hazard map

El Edén | Nueva Santa Rosa





Hazard maps (el Edén y Nueva Santa Rosa)

Land movement: active / latent / no active

By tow examples of UNAH and AMDC

3.4 conclusion

1. Results of the previous project for landslide education are sustained, because it has been concentrated to work at the same time during 2011 to 2013.

2. There were several people in the counterparts who use GIS skillfully.

3. Educational methods that circulate lectures, exercises and fieldworks are basic, but it was possible to go to the site finely in a short time, and to be able to discuss with the result of investigation worked well.

Landslide Mapping Education Programs in Latin America-CEPEIGE (ECUADOR) and UNESCO ENHANS PROJECT(PERU)

Hiromitsu Yamagishi (Shin Engineering Consultant ,Japan, UNESCO EXPERT)

Rigoberto Moncada Lopez (UNITEC, Honduras, UNESCO EXPERT)

ICL SATREPS

Tokyo KTP Conference Center

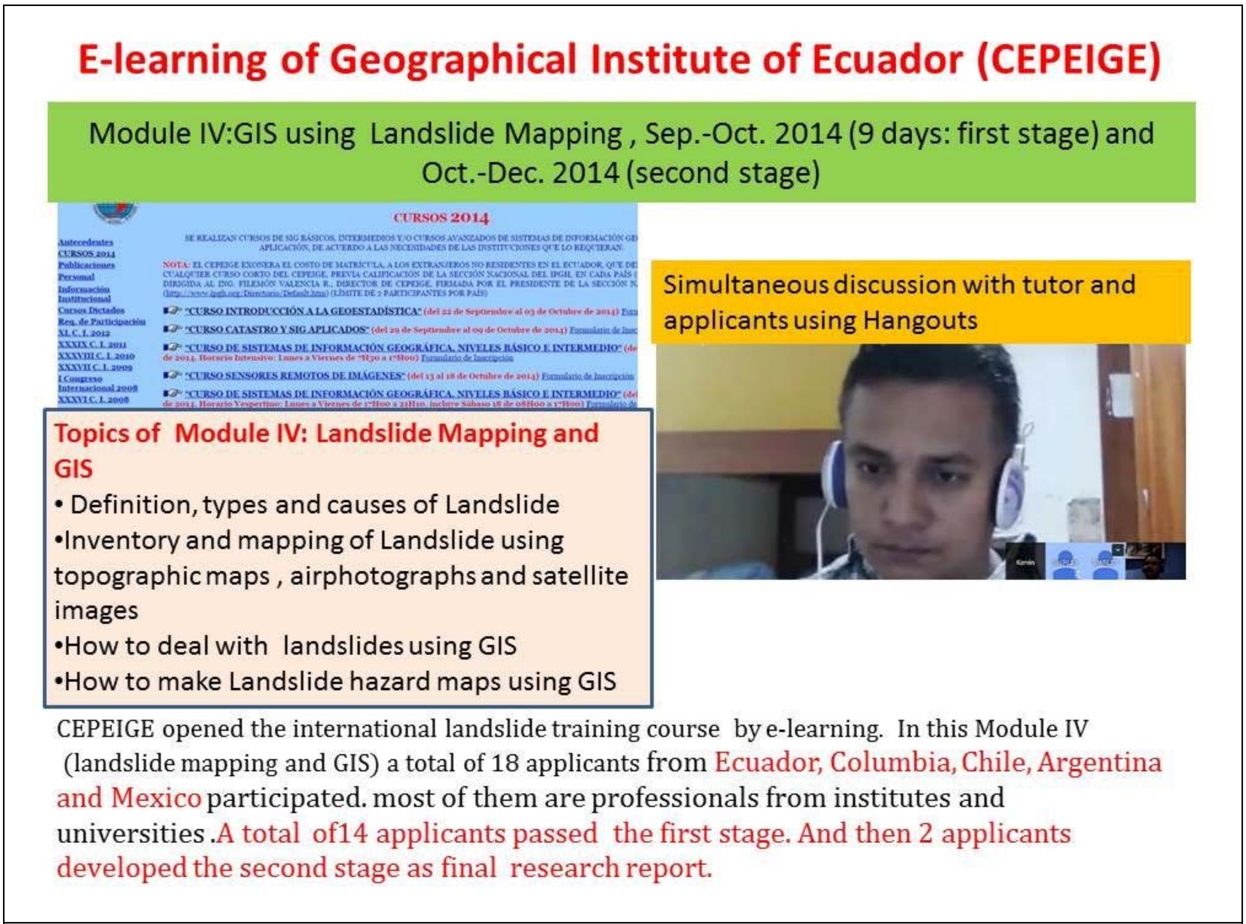
2016 Nov 24, Tokyo

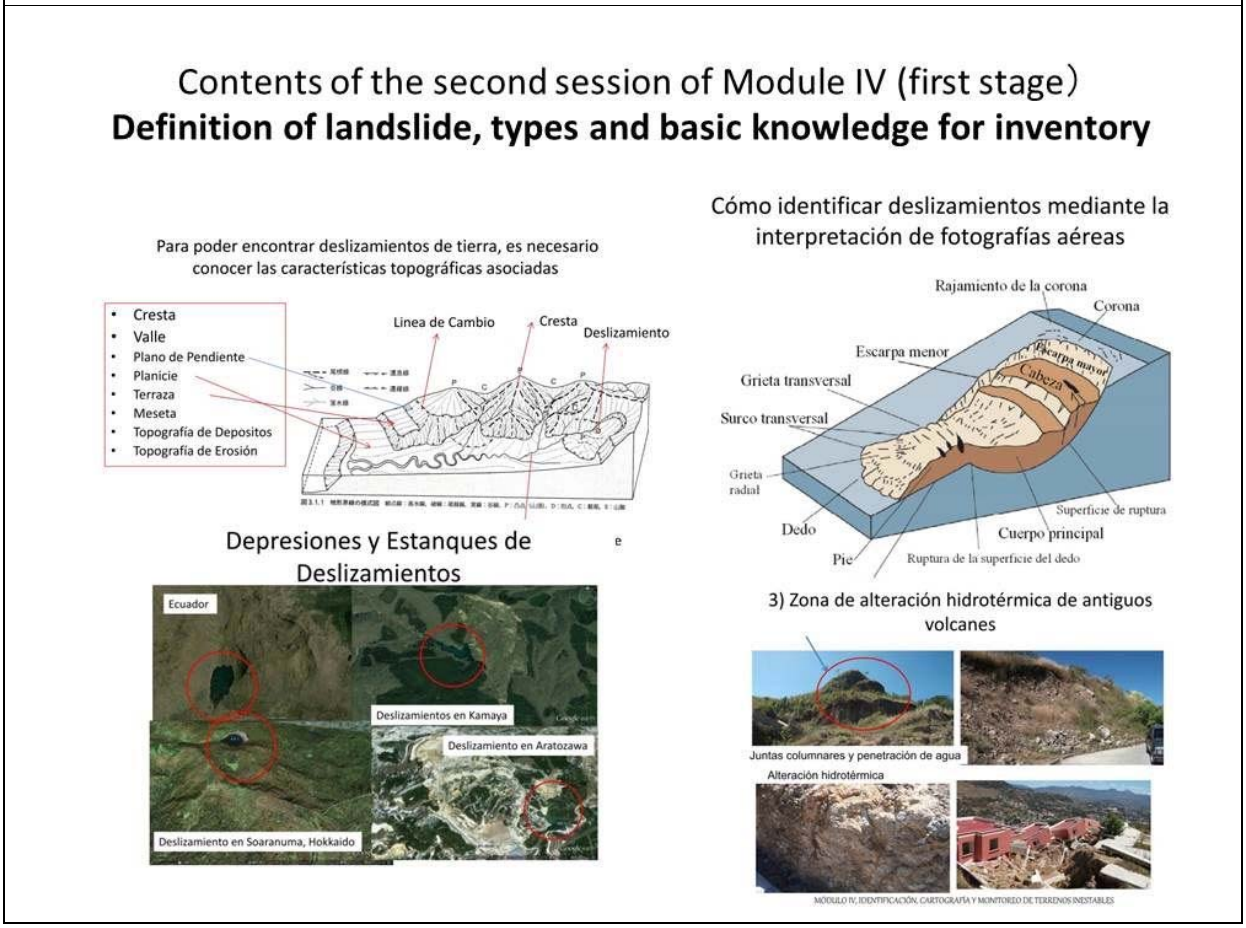
CEPEIGE(ECUADOR)

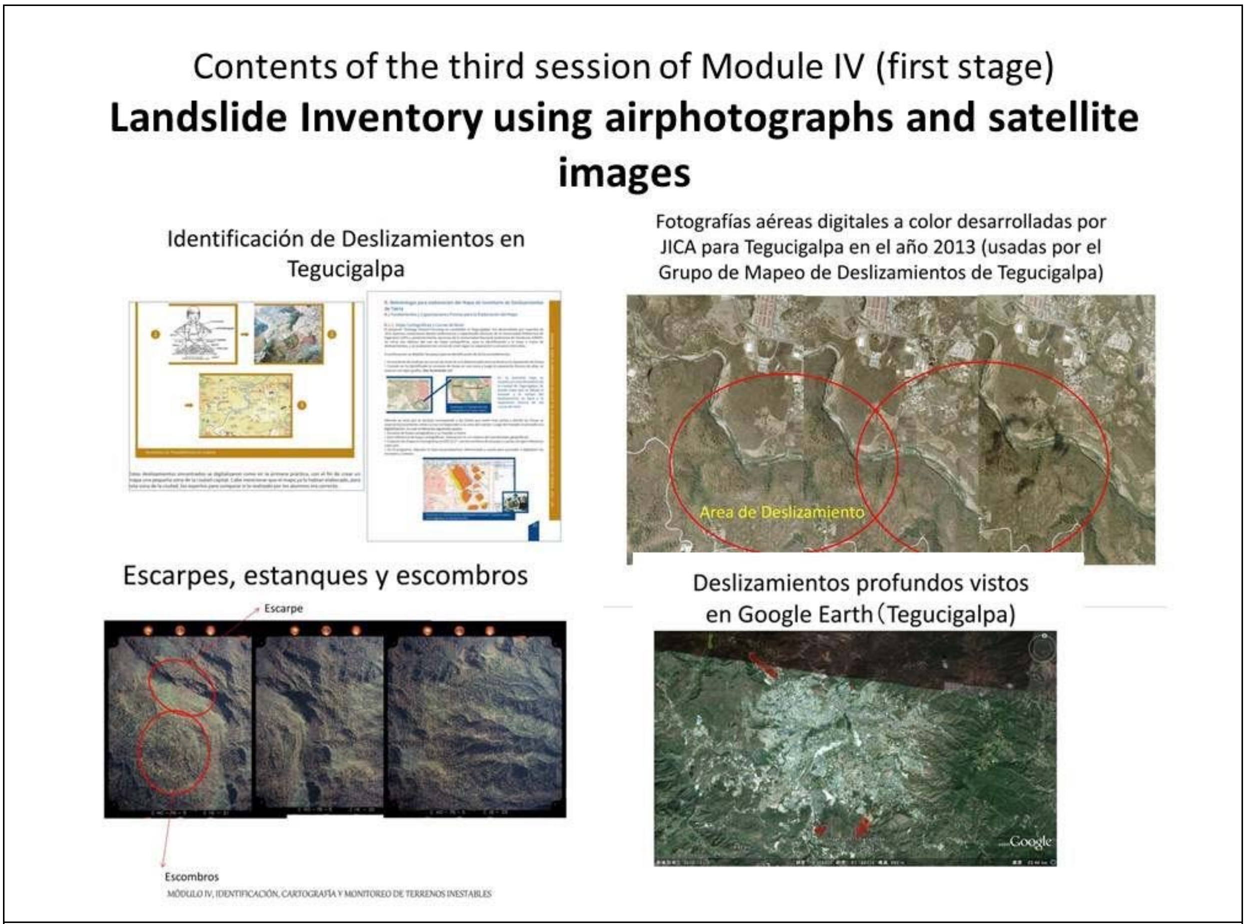
E-LEARNING PROGRAM

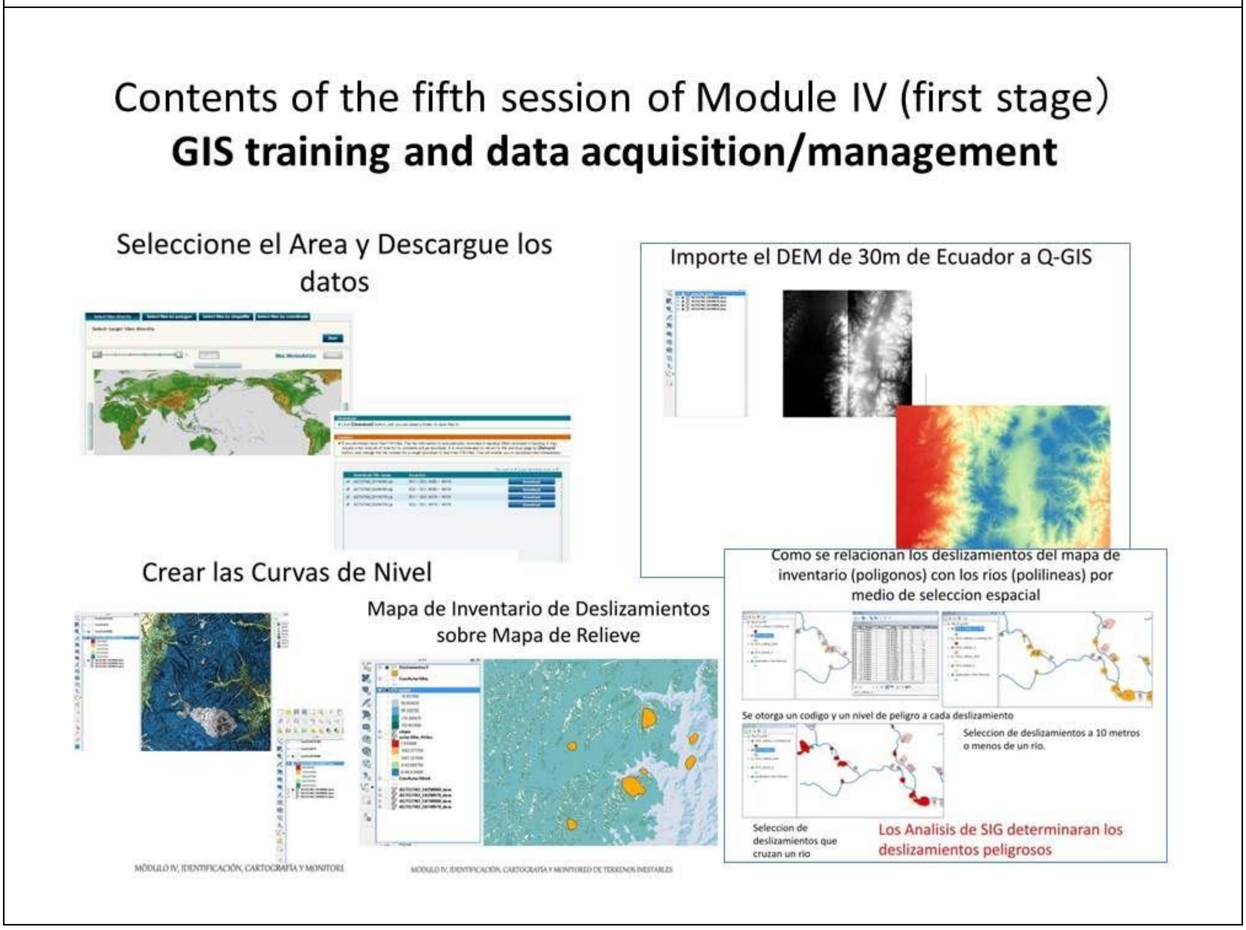
(LANDSLIDE COURSE; MODULE_IV)

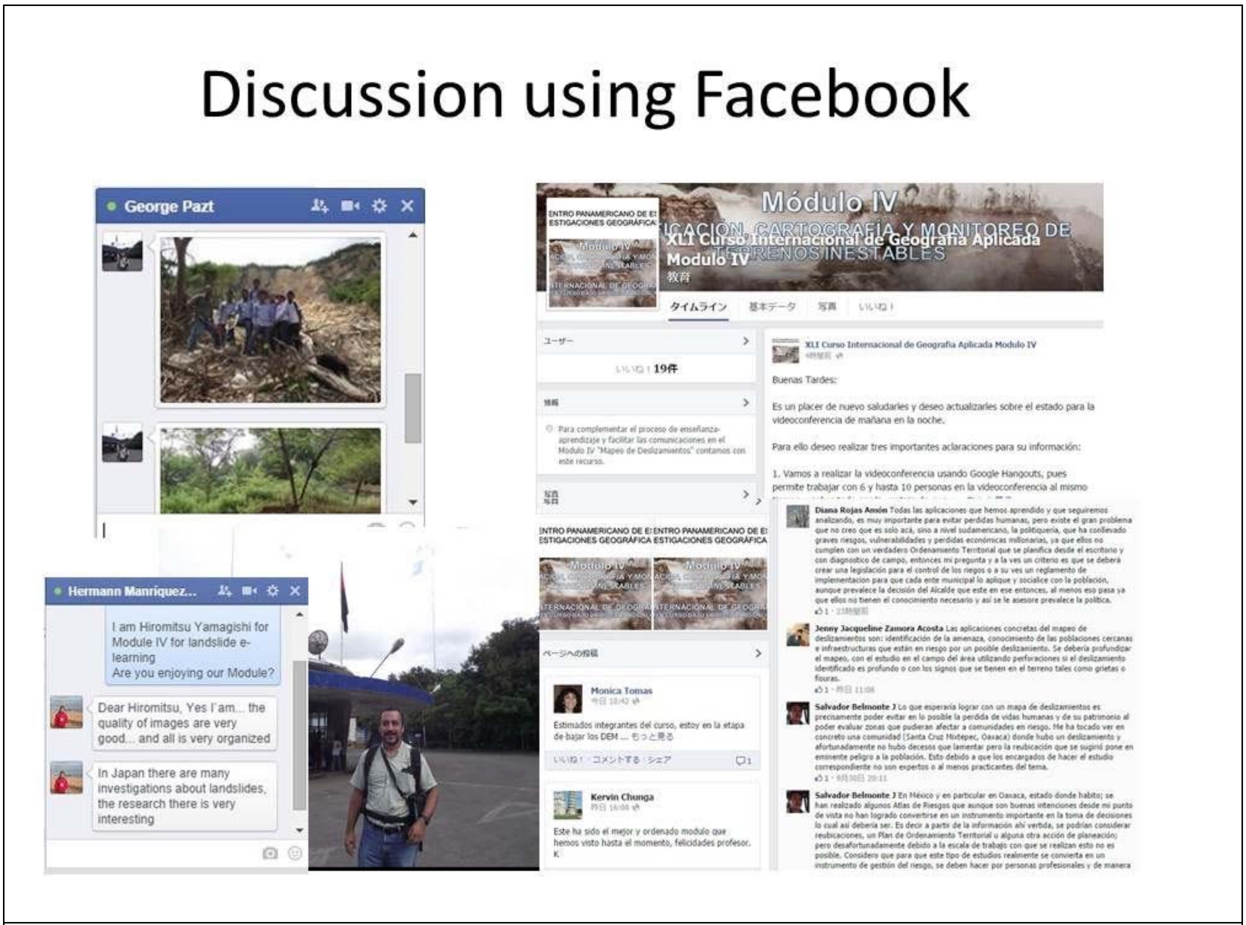
(GIS USING LANDSLIDE MAPPING PROGRAM) IN 2014


E-learning of Geographical Institute of Ecuador (CEPEIGE)
Module IV:GIS using Landslide Mapping , Sep.-Oct. 2014 (9 days: first stage) and Oct.-Dec. 2014 (second stage)
CURSOS 2014
Simultaneous discussion with tutor and applicants using Hangouts
Topics of Module IV: Landslide Mapping and GIS
• Definition, types and causes of Landslide
•Inventory and mapping of Landslide using topographic maps , airphotographs and satellite images
•How to deal with landslides using GIS
•How to make Landslide hazard maps using GIS
CEPEIGE opened the international landslide training course by e-learning. In this Module IV (landslide mapping and GIS) a total of 18 applicants from Ecuador, Columbia, Chile, Argentina and Mexico participated. most of them are professionals from institutes and universities .A total of14 applicants passed the first stage. And then 2 applicants developed the second stage as final research report.


Contents of the second session of Module IV (first stage)
Definition of landslide, types and basic knowledge for inventory
Para poder encontrar deslizamientos de tierra, es necesario conocer las características topográficas asociadas
Cresta
Valle
Plano de Pendiente
Planicie
Terraza
Meseta
Topografía de Depositos
Topografía de Erosión
Linea de Cambio
Cresta
Deslizamiento
Cómo identificar deslizamientos mediante la interpretación de fotografías aéreas
Rajamiento de la corona
Corona
Escarpa menor
Escarpa mayor
Cabeza
Grieta transversal
Surco transversal
Grieta radial
Dedo
Pie
Ruptura de la superficie del dedo
Cuerpo principal
Superficie de ruptura
Depresiones y Estanques de Deslizamientos
Ecuador
Deslizamientos en Kamaya
Deslizamiento en Aratozawa
Deslizamiento en Soaranuma, Hokkaido
3) Zona de alteración hidrotérmica de antiguos volcanes
Juntas columnares y penetración de agua
Alteración hidrotérmica
MODULO IV, IDENTIFICACIÓN, CARTOGRAFÍA Y MONITOREO DE TERRENOS INESTABLES


Contents of the third session of Module IV (first stage)
Landslide Inventory using airphotographs and satellite images
Identificación de Deslizamientos en Tegucigalpa
Fotografías aéreas digitales a color desarrolladas por JICA para Tegucigalpa en el año 2013 (usadas por el Grupo de Mapeo de Deslizamientos de Tegucigalpa)
Area de Deslizamiento
Escarpes, estanques y escombros
Escarpe
Escombros
Deslizamientos profundos vistos en Google Earth (Tegucigalpa)
Google
MÓDULO IV, IDENTIFICACIÓN, CARTOGRAFÍA Y MONITOREO DE TERRENOS INESTABLES


Contents of the fifth session of Module IV (first stage)
GIS training and data acquisition/management
Seleccione el Area y Descargue los datos
Importe el DEM de 30m de Ecuador a Q-GIS
Crear las Curvas de Nivel
Mapa de Inventario de Deslizamientos sobre Mapa de Relieve
Como se relacionan los deslizamientos del mapa de inventario (poligonos) con los rios (polilineas) por medio de seleccion espacial
Se otorga un codigo y un nivel de peligro a cada deslizamiento
Seleccion de deslizamientos a 10 metros o menos de un rio.
Seleccion de deslizamientos que cruzan un rio
Los Analisis de SIG determinaran los deslizamientos peligrosos
MÓDULO IV, IDENTIFICACIÓN, CARTOGRAFÍA Y MONITOREO
MÓDULO IV, IDENTIFICACIÓN, CARTOGRAFÍA Y MONITOREO DE TERRENOS INESTABLES

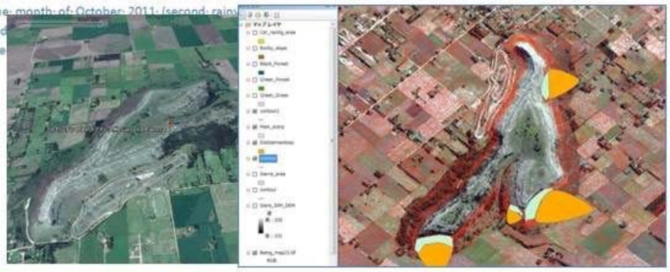

Discussion using Facebook
George Pazt
Módulo IV
XLI Curso Internacional de Geografía Aplicada
Modulo IV
Hermann Manriquez...
I am Hiromitsu Yamagishi for Module IV for landslide e-learning
Are you enjoying our Module?
Dear Hiromitsu, Yes I'am... the quality of images are very good... and all is very organized
In Japan there are many investigations about landslides, the research there is very interesting


Direct Discussion with students
By Skype (participants are mostly
Professors and geologists in institutes
Tutor: Rigoberto Moncada Lopez
Contents of the fourth session of Module IV (first stage)
Video conference

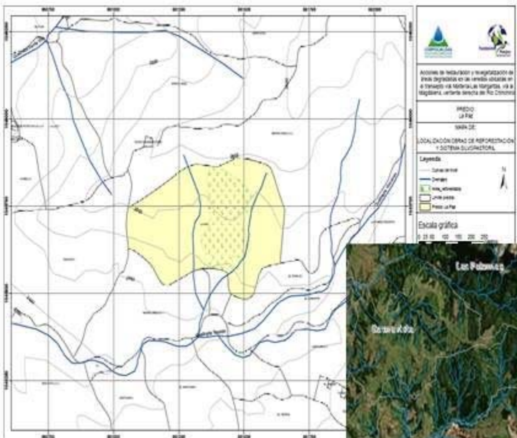
Second stage (Research Reports)

1. **Topics : landslide mapping and GIS**
2. **Initially 4 people applied, but only two people completed the report**
3. **One was an engineering geologist from Colombia and the other was a geographer from Argentina.**

Report by Juan Pablo Zuluaga on Rio CHINCHINA Area, Columbia

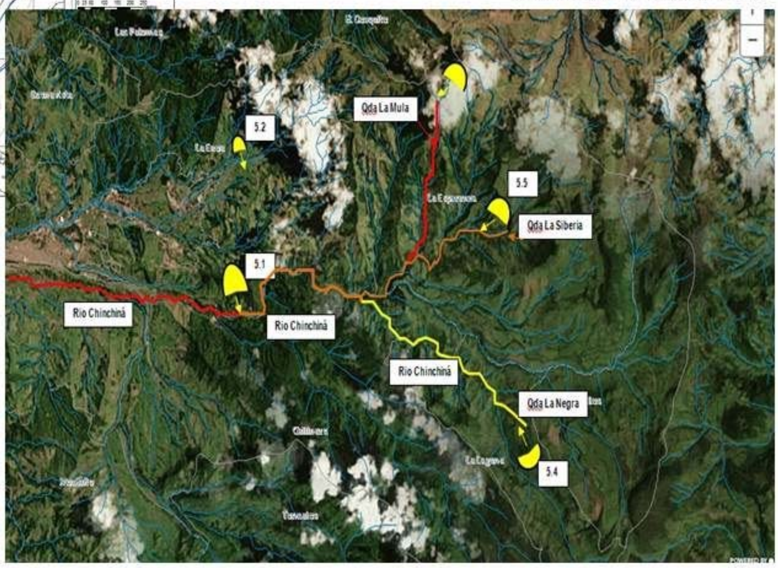


Description on Sierra La Barrosa submitted by Mónica Tomás From Argentina

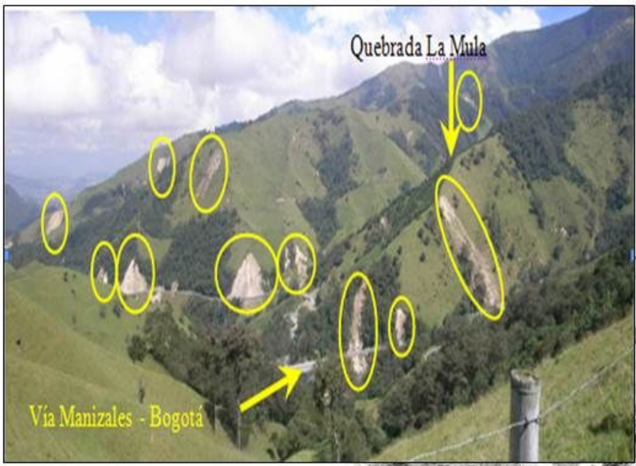


Report by Juan Pablo Zuluaga on Rio CHINCHINA Area, Columbia

Juan Pablo Zuluaga (2014)



- Landslide Inventory using topographic maps and satellite images.

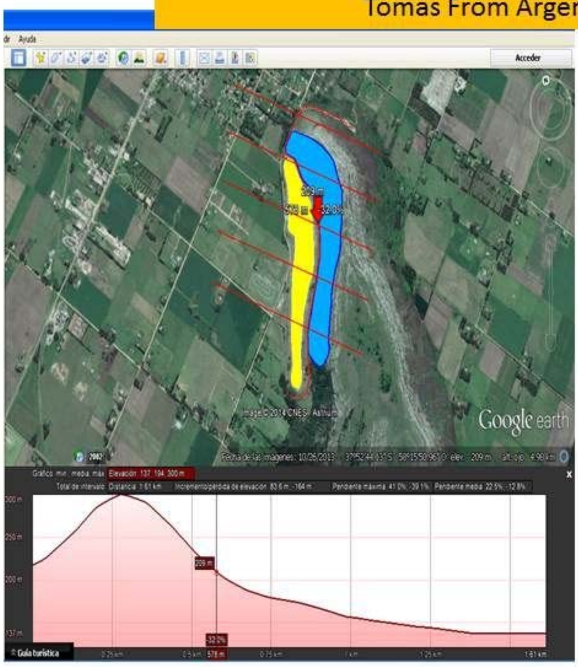


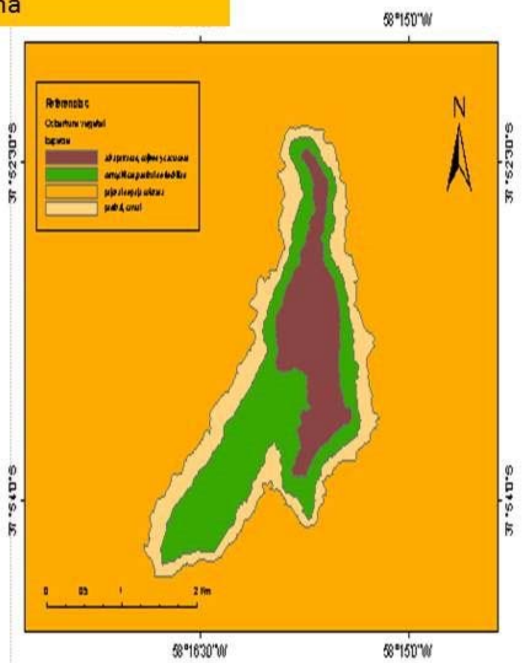
Report by Juan Pablo Zuluaga on Rio CHINCHINA Area, Columbia

Juan Pablo Zuluaga (2014)

- Use of aerial photographs for inventory near Bogotá, Colombia.

Description on Sierra La Barrosa submitted by Mónica Tomás From Argentina





- Landslide analysis using satellite images from Google Earth and DEM.

Mónica Tomás (2014)

UNESCO ENHANS PROJECT WORKSHOP

- ENHANS "Extreme Natural Hazards and Societal Implications" of the UNESCO. An intensive training program incudes volcanic hazard, seismic hazard, flooding hazard and landslide hazard training:
- We are responsible to landslide hazard training program. Our first workshop was executed on November of 2015, in Lima, Peru.

The objective of this landslide and related disaster project is to train key representatives and technicians who should then replicate landslide mapping and hazard assessment methodologies in their respective countries (Chile, Ecuador and Peru). This project is on going: next year we are doing in Ecuador and Chile, as well as Peru.

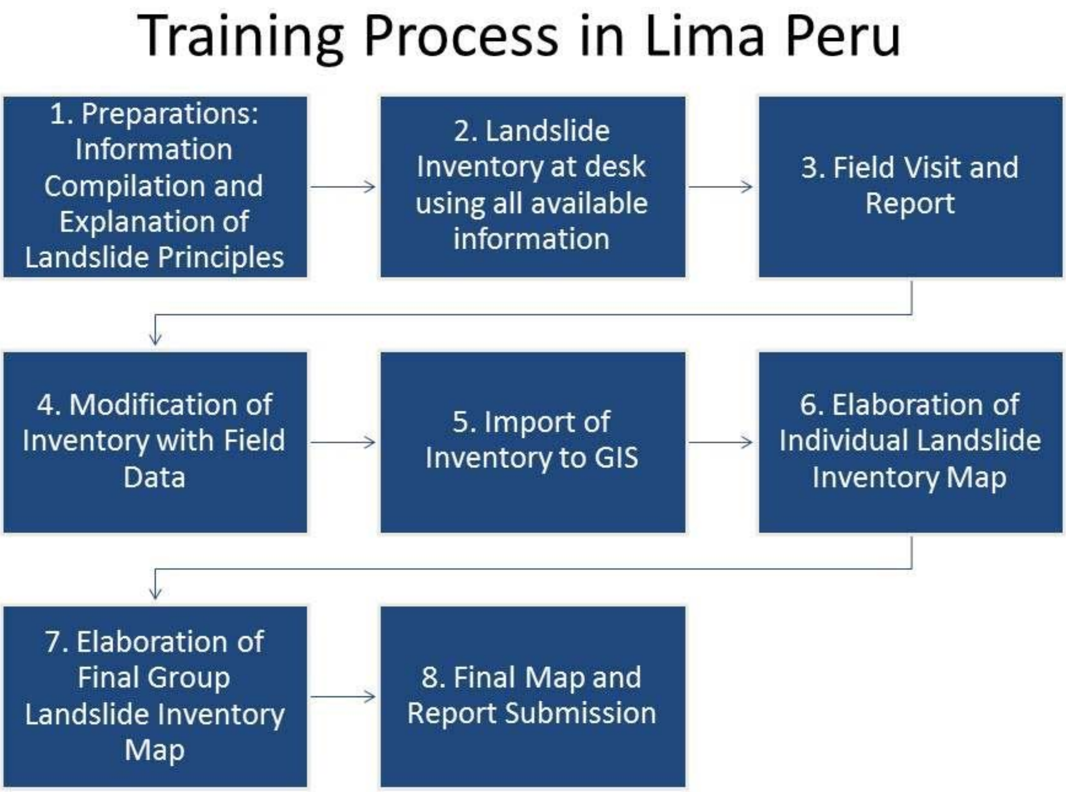
Preparation Events for ENHANS Project in Chile, Ecuador and Peru

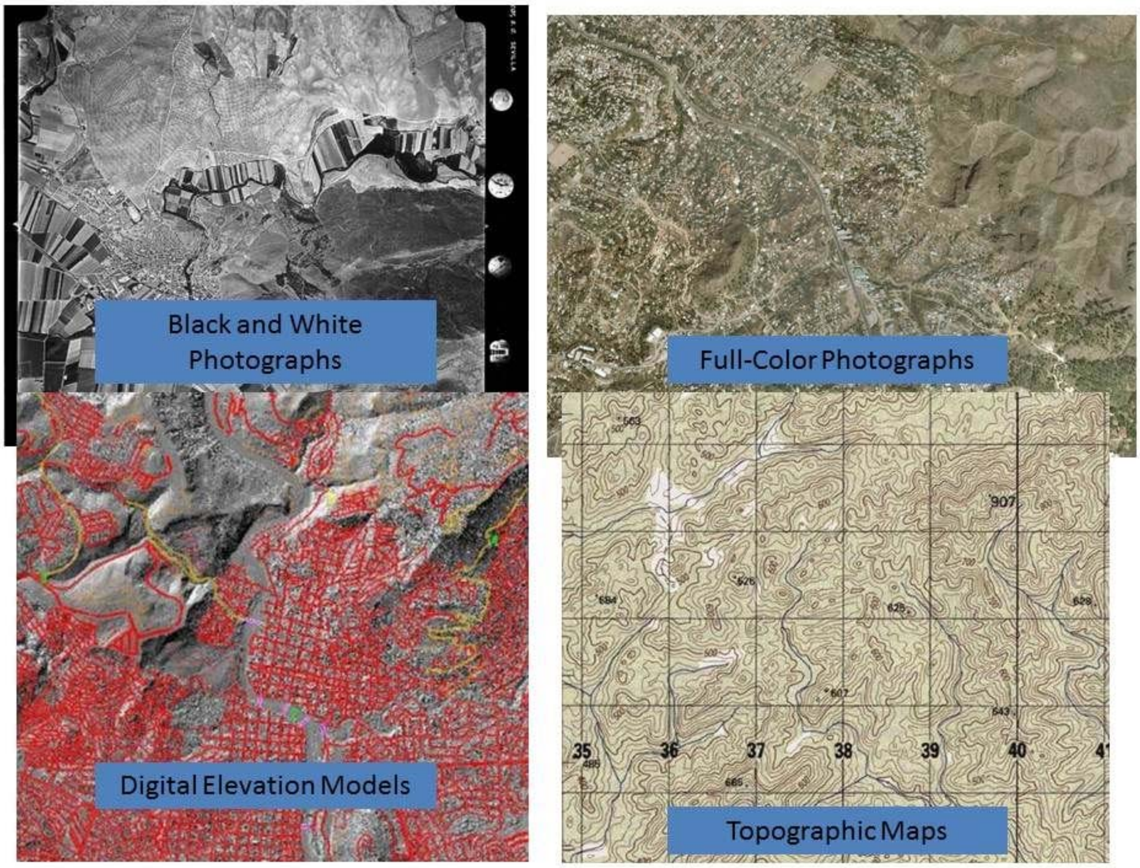
Quito Meeting, 2015, April

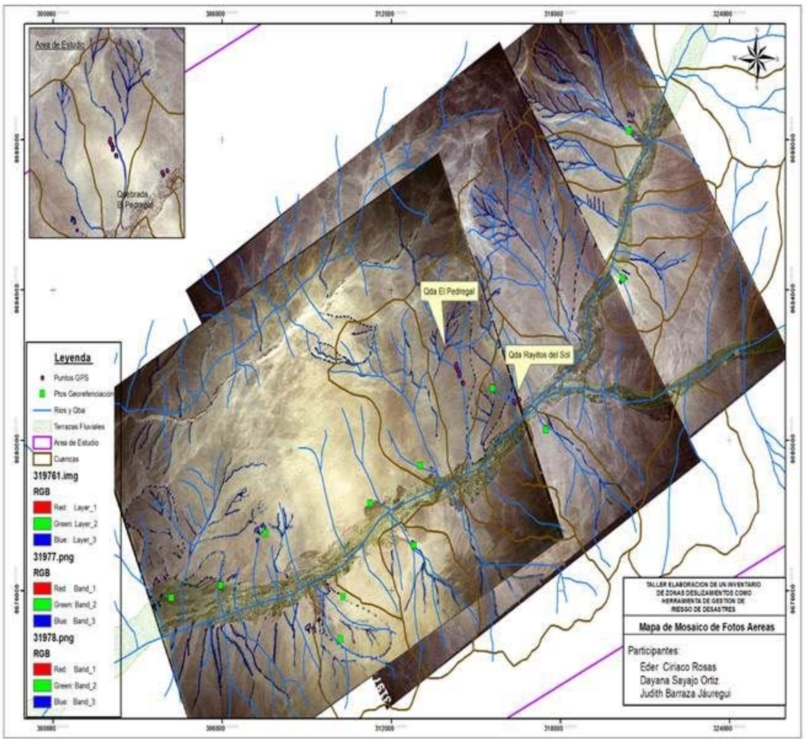
Santiago Meeting, 2015, April

Lima Meeting, 2015, September

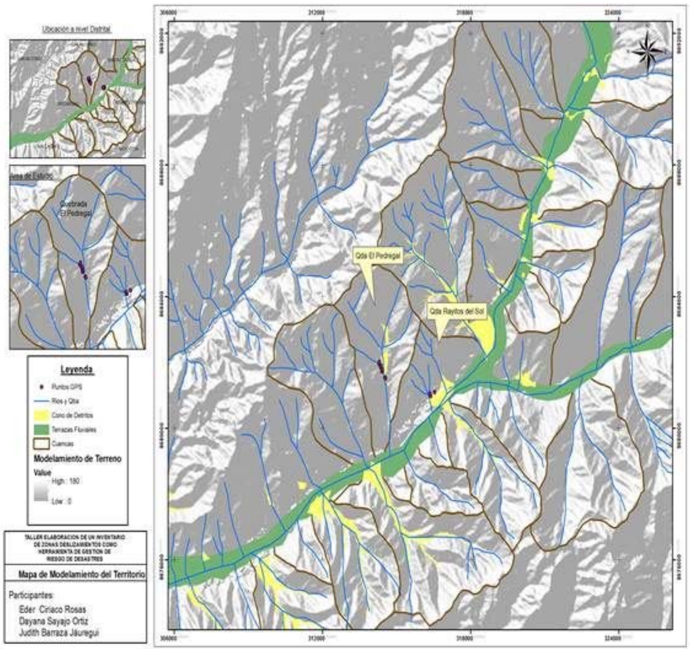
Opening Ceremony and Training Activities for the workshop in Lima, Peru, 2015, Sep. (Opening ceremony, training of stereoscopy and GIS applications)



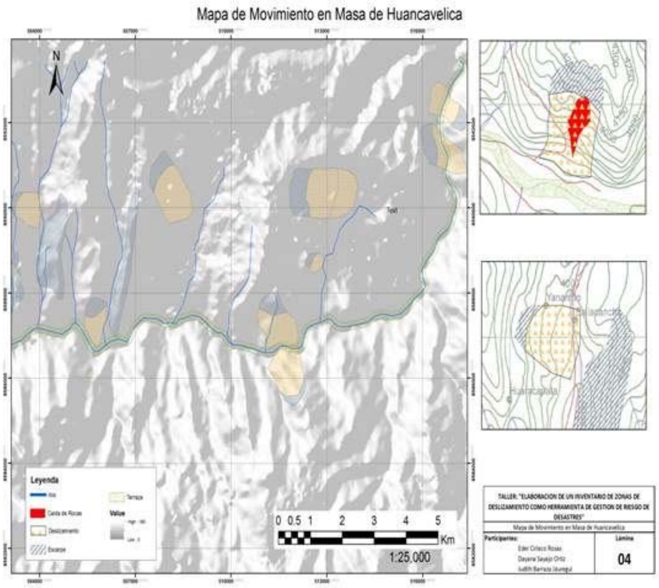




- Landslide inventory map of Chosica with aerial photographs (1961-1962) (also developed by participants)



- Landslide inventory map of site in Huancavelica using DEM analysis (also developed by participants).



- Use of DEM and topographic maps for landslide identification in Huancavelica (also developed by participants).

Map of Field Visit Debris flows in Chosica (east of Lima)

- Field visit Activities in Chosica

Conclusions

- Training activities in the methodology were able to successfully teach participants how to use available information for the development of landslide inventory maps both in a virtual (Ecuador-CEPEIGE) or classroom (Peru-ENHANS/UNESCO) environment.
- Participant profile is essential for effectiveness of training. Higher comprehension of GIS, landslide and geology topics are greatly recommended.
- An essential component of this methodology is field visit also, to confirm in situ the existence of landslides.
- This methodology is practical and low-cost for different scales, both for regional and local landslide mapping.
- However, how these educations are carried out smoothy, depends on how many data are available, such as air photos and digital data such as DEM etc. There are very few data in Latin American countries excepting for 30m DEM from JAXA(Alos3 etc) free in charge.


ICL
4th WLF 2017
4th World Landslide Forum
LJUBLJANA SLOVENIA EU
UNESCO・ICL・ICSU・WFEO・UNU・WMO・UNISDR・FAO
IPL
A Programme of the ICL for ISDR
ISDR
国際斜面災害研究機構(ICL)
第四回斜面防災世界フォーラム
2017 年 5 月 29 日～6 月 2 日
http://www.wlf4.org/
開催地：アドリア海の国
スロベニア、リュブリアナ市
地すべり巡検：スロベニア、
クロアチア、ボスニア・ヘルツェゴビナ、イタリア・ドロマイト地方
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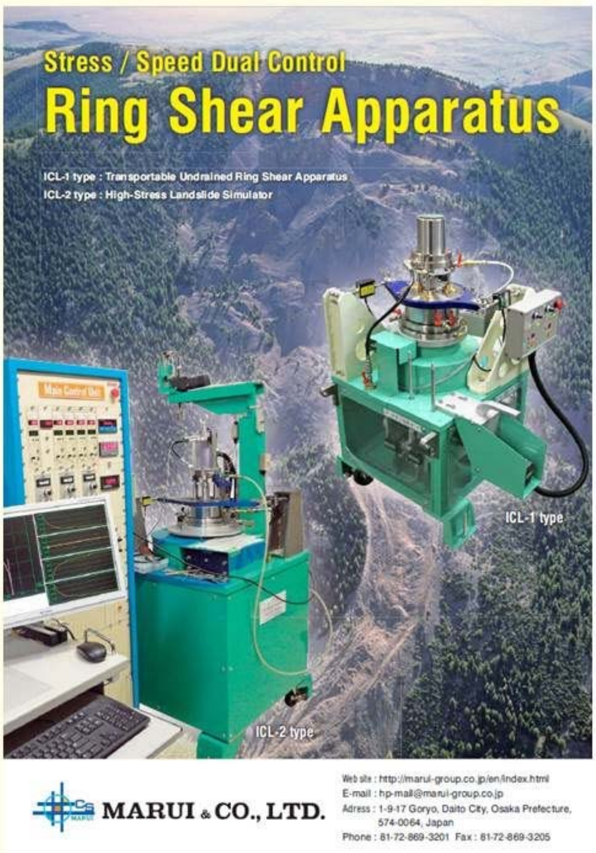
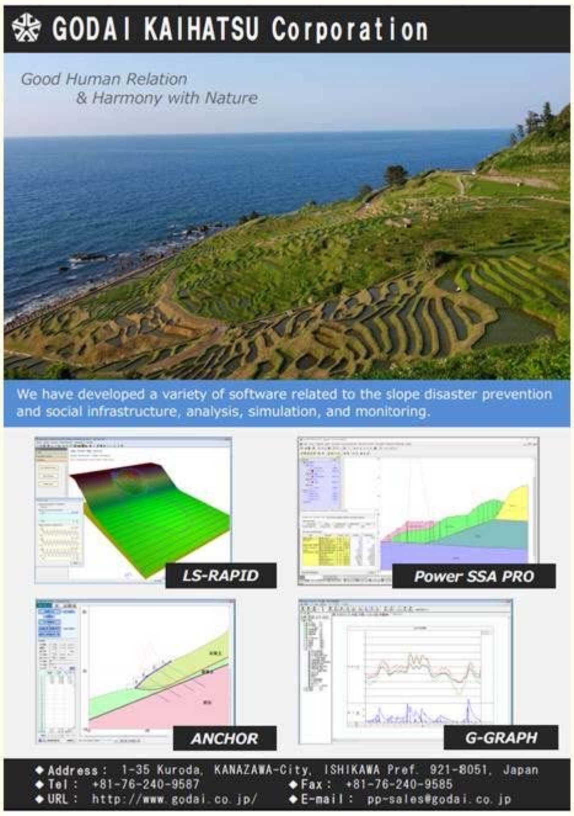

Stress / Speed Dual Control
Ring Shear Apparatus
ICL-1 type : Transportable Undrained Ring Shear Apparatus
ICL-2 type : High-Stress Landslide Simulator
Main Control Unit
ICL-1 type
ICL-2 type
MARUI & CO., LTD.
Web site : http://marui-group.co.jp/en/index.html
E-mail : hp-mail@marui-group.co.jp
Adress : 1-9-17 Goryo, Daito City, Osaka Prefecture, 574-0064, Japan
Phone : 81-72-869-3201 Fax : 81-72-869-3205


"We keep clean nature for the future"
Buisiness Outline
Planning
Survey
Research Design
Landslide Research
General Research
Numerical Analysis
Soil Test
Environmental Research
Hot Spring Exploration
River・Erosion Control・Forestry Conservation
Miscellaneous Research
Operation
Landslide Countermeasure Works
Slope Works
Water Well Drilling Works
Large-Diameter Boring Works
Grouting Works
Foundation Improvement Works
Anchoring Works
Servicing
Geoengineering Consultants
OKUYAMA BORING CO.,LTD.
URL : http://www.okuyama.co.jp/
Addres : 10-39 Shinmei-cho Yokote-City AKITA Pref 013-0046 JAPAN
E-mail : info@okuyama.co.jp
Tel : +81-182-32-3475 Fax : +81-182-33-1447


GODAI KAIHATSU Corporation
Good Human Relation
& Harmony with Nature
We have developed a variety of software related to the slope disaster prevention and social infrastructure, analysis, simulation, and monitoring.
LS-RAPID
Power SSA PRO
ANCHOR
G-GRAPH
◆Address : 1-35 Kuroda, KANAZAWA-City, ISHIKAWA Pref. 921-8051, Japan
◆Tel : +81-76-240-9587 ◆Fax : +81-76-240-9585
◆URL : http://www.godai.co.jp/ ◆E-mail : pp-sales@godai.co.jp


With the people exposed to natural disasters in mind.
Technology connecting us to the world.
Field surveys and various types of research on natural disaster.
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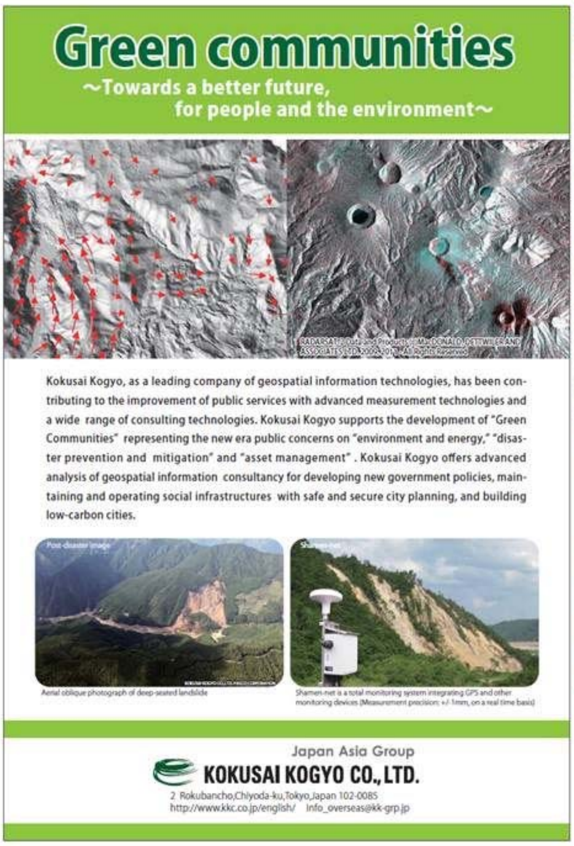
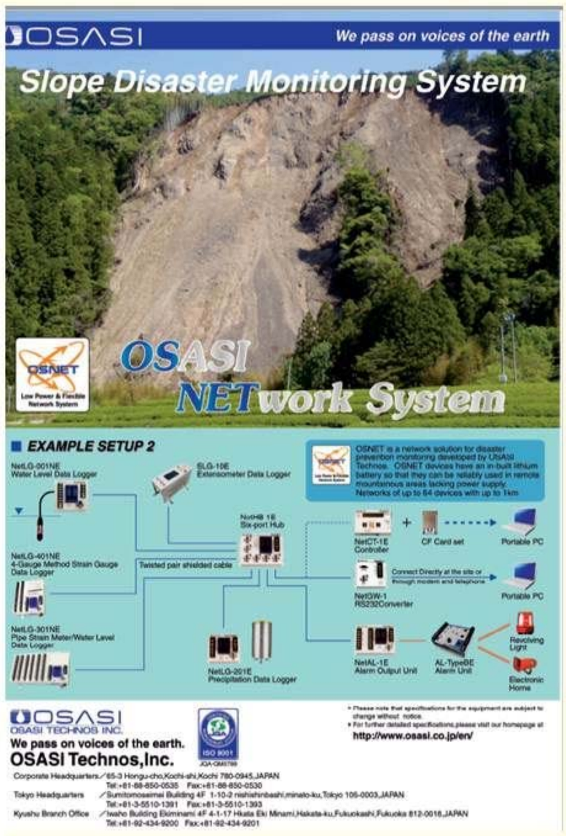
362 Landslide Survey
Operation Performance Data of 2015
1,105
500 Consulting and Design
243 Construction Works
Provide construction management services for slope protection and landslide prevention.
Selected and designed for the landslide prevention works.
JAPAN CONSERVATION ENGINEERS & CO.,LTD.
3-18-5, Toranomon, Minato, Tokyo,Japan 105-0001
Tel:+81.3.3436.3673 URL http://www.jce.co.jp/


Green communities
~Towards a better future,
for people and the environment~
Kokusai Kogyo, as a leading company of geospatial information technologies, has been contributing to the improvement of public services with advanced measurement technologies and a wide range of consulting technologies. Kokusai Kogyo supports the development of "Green Communities" representing the new era public concerns on "environment and energy," "disaster prevention and mitigation" and "asset management". Kokusai Kogyo offers advanced analysis of geospatial information consultancy for developing new government policies, maintaining and operating social infrastructures with safe and secure city planning, and building low-carbon cities.
Aerial oblique photograph of deep-seated landslide
Japan Asia Group
KOKUSAI KOGYO CO., LTD.
2 Rokubancho,Chiyoda-ku,Tokyo,Japan 102-0085
http://www.kkc.co.jp/english/ Info_overseas@kk-grp.jp


OSASI
We pass on voices of the earth
Slope Disaster Monitoring System
OSASI NETwork System
EXAMPLE SETUP 2
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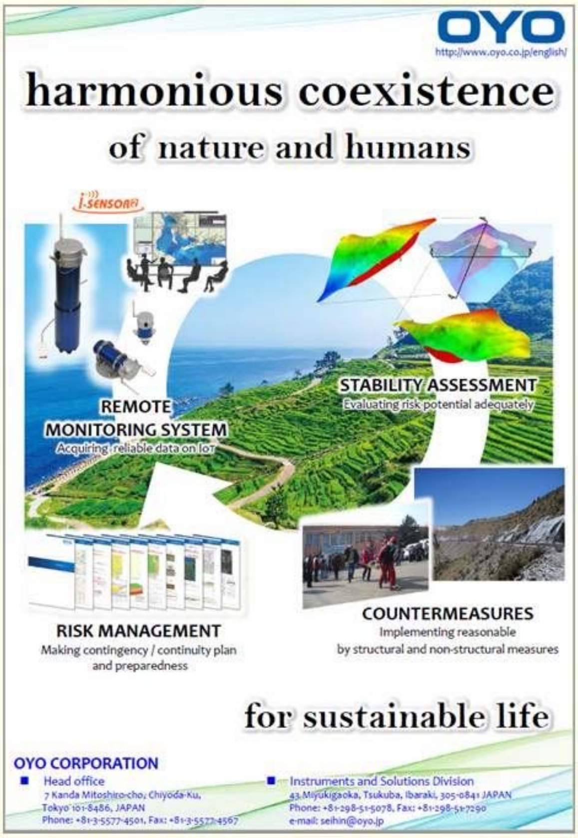
We pass on voices of the earth.
OSASI Technos,Inc.
http://www.osasi.co.jp/en/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Acquiring reliable data on IoT
STABILITY ASSESSMENT
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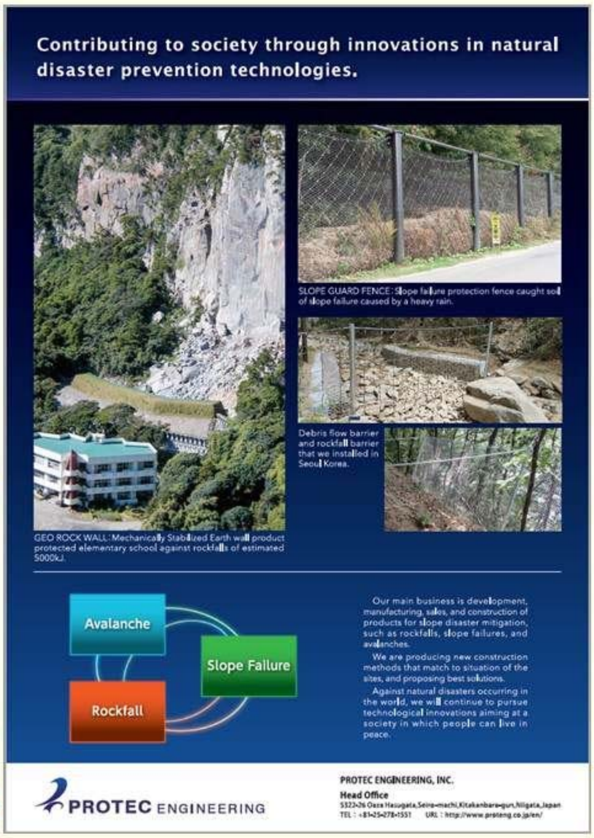
Instruments and Solutions Division
43 Miyukigaoka, Tsukuba, Ibaraki, 305-0841 JAPAN
Phone: +81-298-51-5078, Fax: +81-298-51-7290
e-mail: seihin@oyo.jp


Contributing to society through innovations in natural disaster prevention technologies.
SLOPE GUARD FENCE : Slope failure protection fence caught soil of slope failure caused by a heavy rain.
Debris flow barrier and rockfall barrier that we installed in Seoul Korea.
GEO ROCK WALL : Mechanically Stabilized Earth wall product protected elementary school against rockfalls of estimated 5000kJ.
Avalanche
Slope Failure
Rockfall
Our main business is development, manufacturing, sales, and construction of products for slope disaster mitigation, such as rockfalls, slope failures, and avalanches.
We are producing new construction methods that match to situation of the sites, and proposing best solutions.
Against natural disasters occurring in the world, we will continue to pursue technological innovations aiming at a society in which people can live in peace.
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TEL : +81-25-278-1551 URL : http://www.proteng.co.jp/en/


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Enviroment、Concrete
Ground & Disaster prevention
Established 1971
Captal ¥43,200,000
Head office &Factories Daito City Osaka
Branch offices Tokyo, Nagoya,
Fukuoka

Certification

1） JCSS 0128（Conforming ISO17025）
＜ Force-proving Instruments & Uniaxial Testing machines ＞

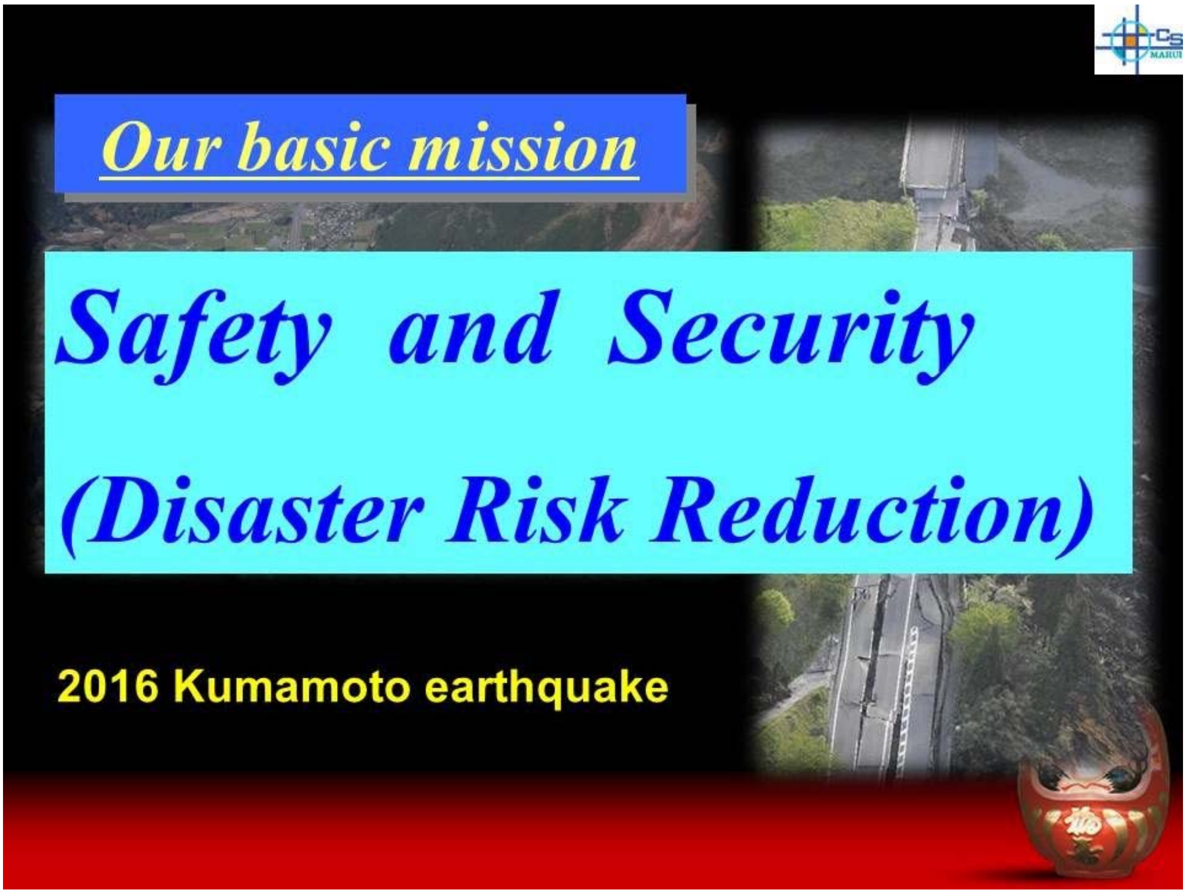
2） ISO9001：2008
（Factory & Branches）

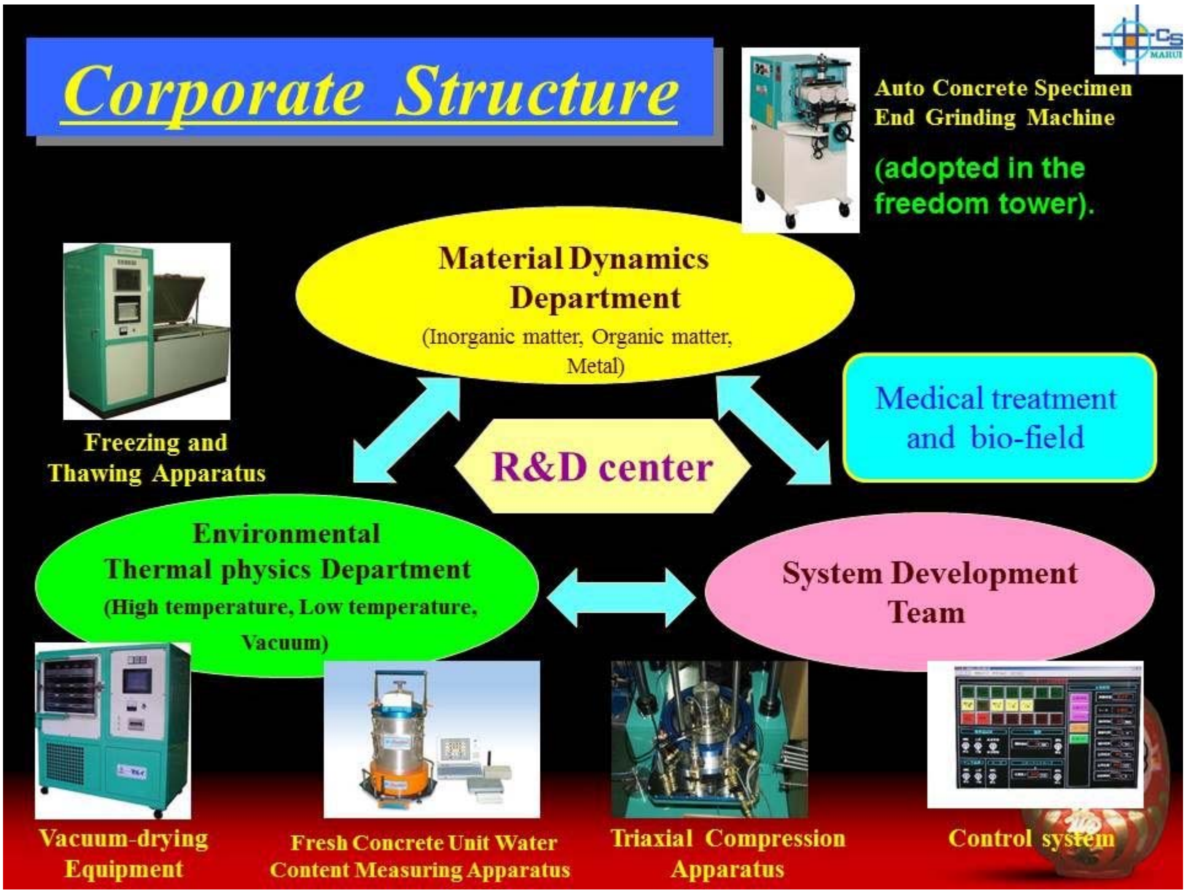
Company motto

「運・根・鈍」

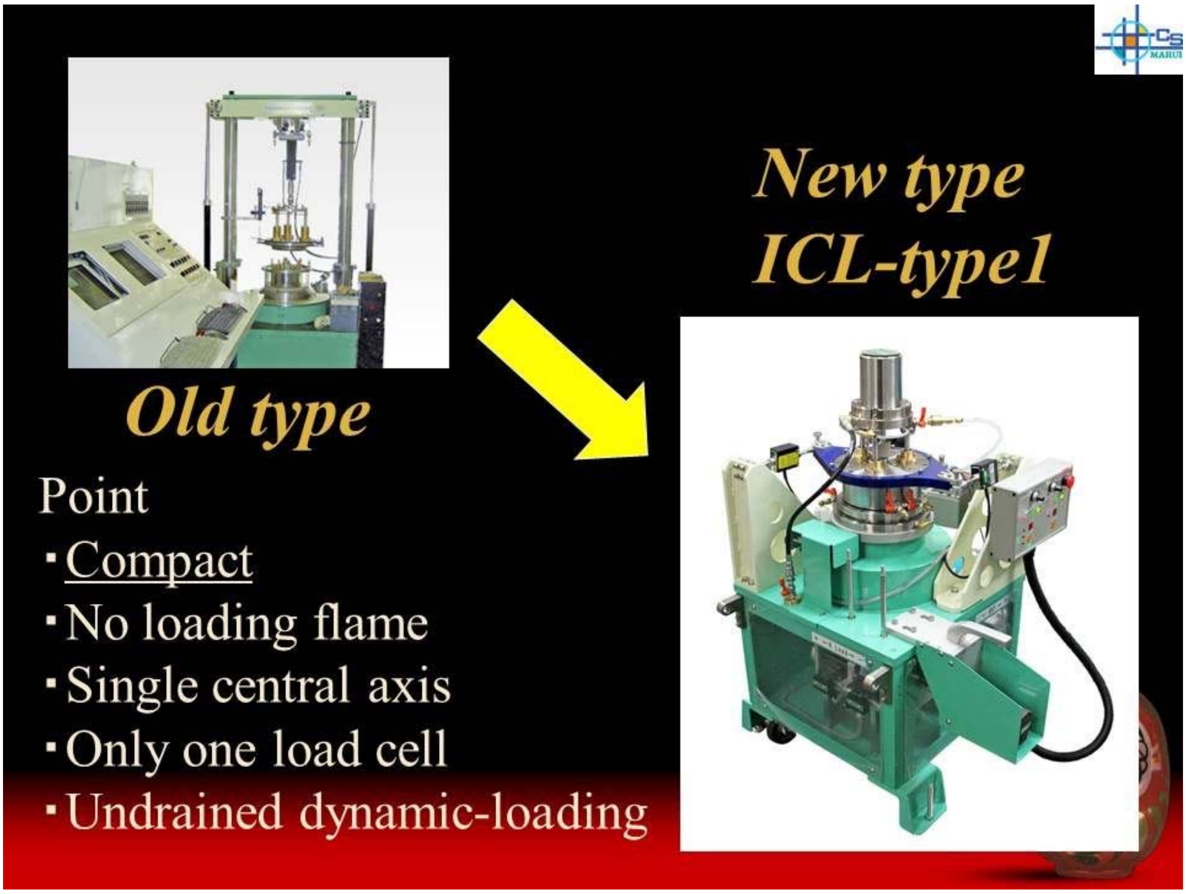
UN KON DON

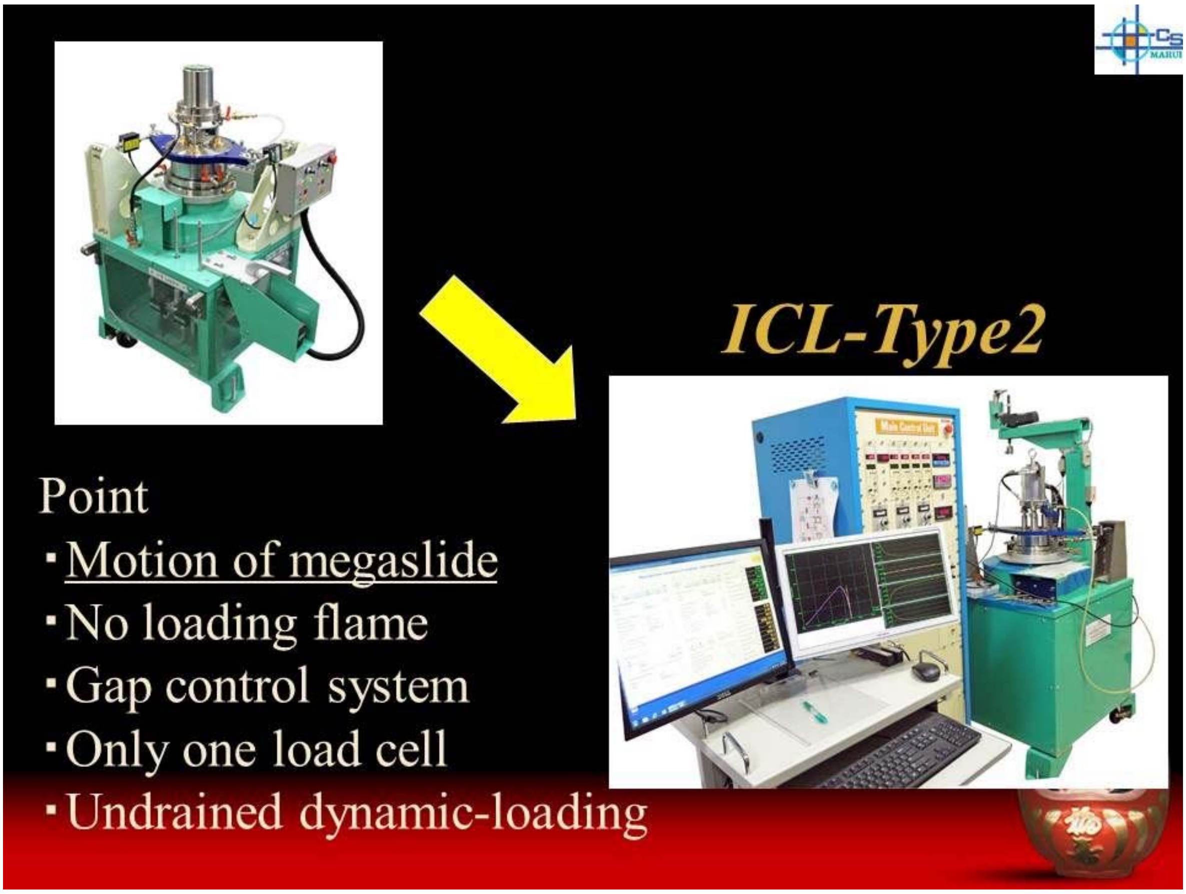
「Luck, Perseverance and *Simple honesty」*

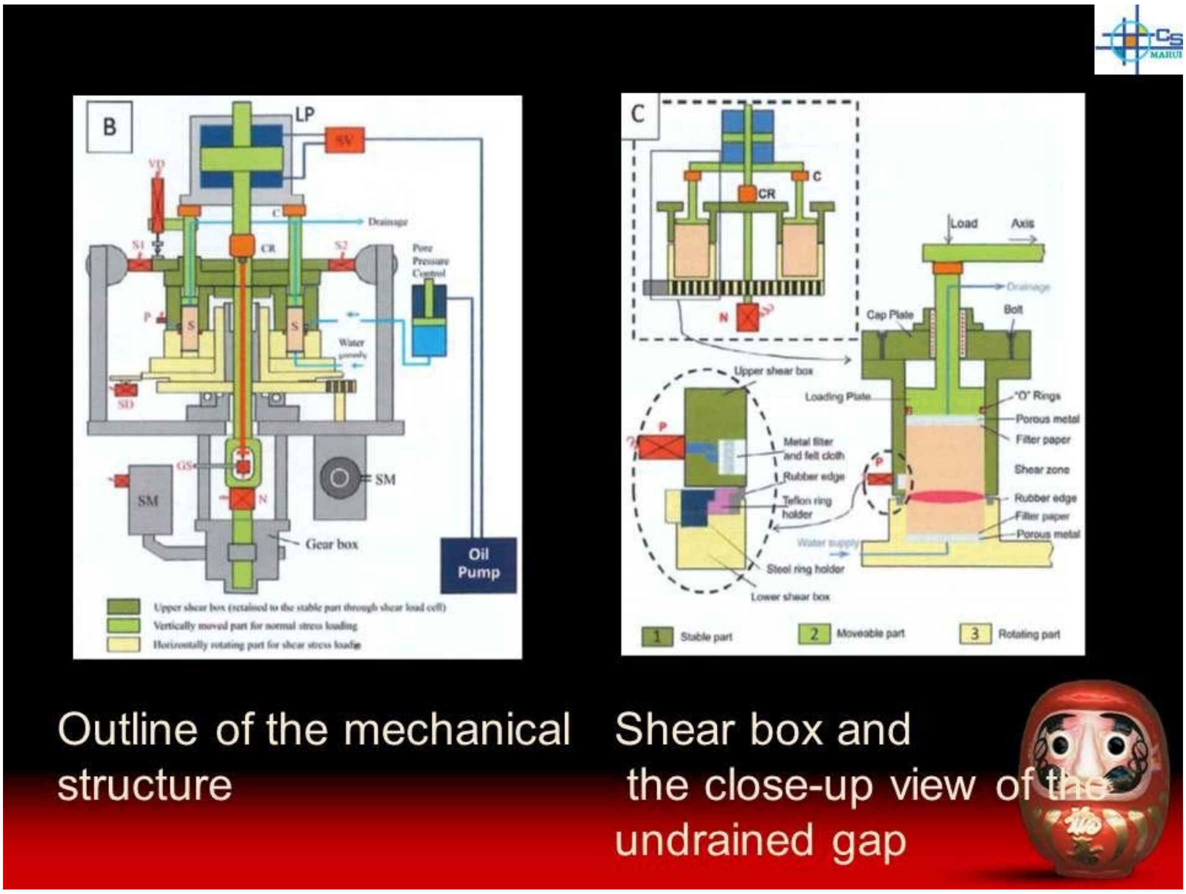

Our basic mission
Safety and Security
(Disaster Risk Reduction)
2016 Kumamoto earthquake

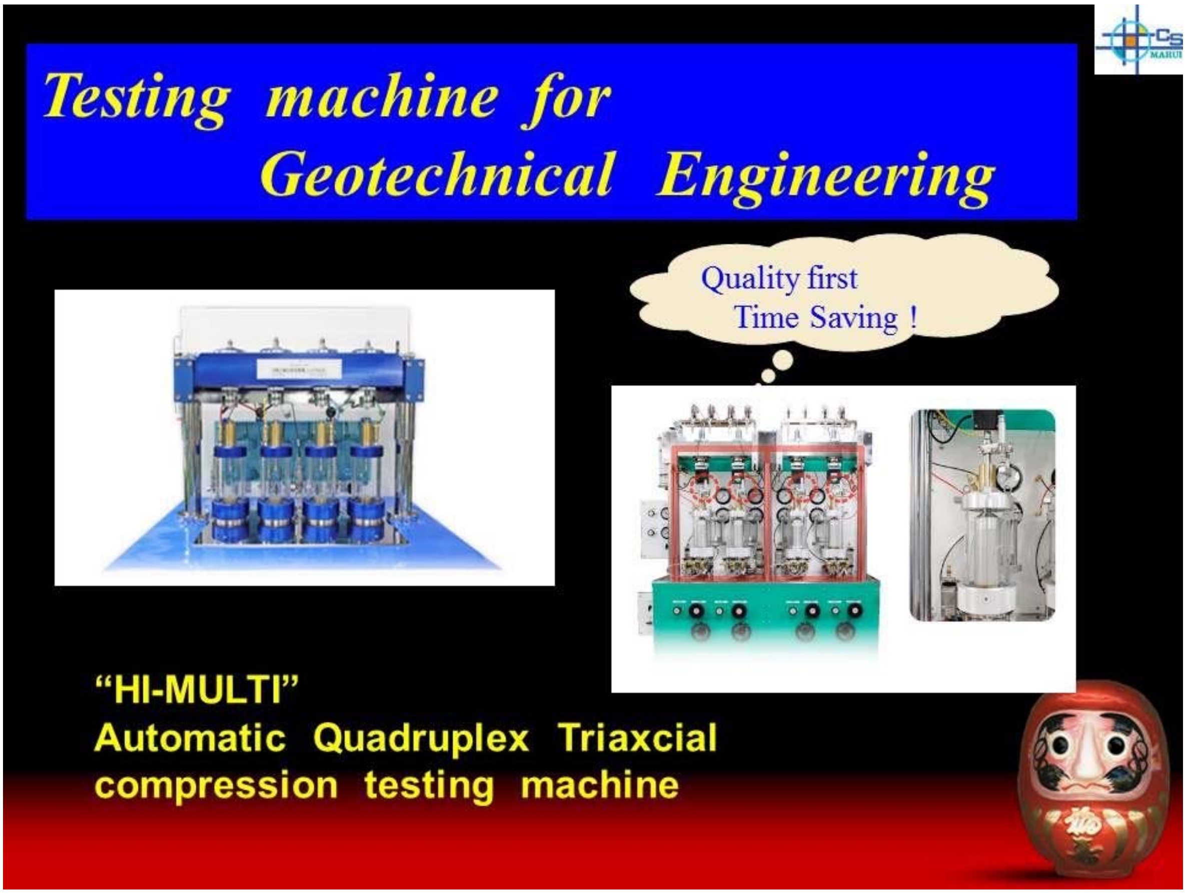

Corporate Structure
Auto Concrete Specimen End Grinding Machine
(adopted in the freedom tower).
Material Dynamics Department
(Inorganic matter, Organic matter, Metal)
Freezing and Thawing Apparatus
R&D center
Medical treatment and bio-field
Environmental Thermal physics Department
(High temperature, Low temperature, Vacuum)
System Development Team
Vacuum-drying Equipment
Fresh Concrete Unit Water Content Measuring Apparatus
Triaxial Compression Apparatus
Control system


Ring shear Apparatus for
Geotechnical engineering & Disaster prevention
ICL-Type1
ICL-Type2
(High-stress dynamic-loading undrained)


Old type
New type
ICL-type1
Point
・Compact
・No loading flame
・Single central axis
・Only one load cell
・Undrained dynamic-loading


ICL-Type2
Main Control Unit
Point
・Motion of megaslide
・No loading flame
・Gap control system
・Only one load cell
・Undrained dynamic-loading

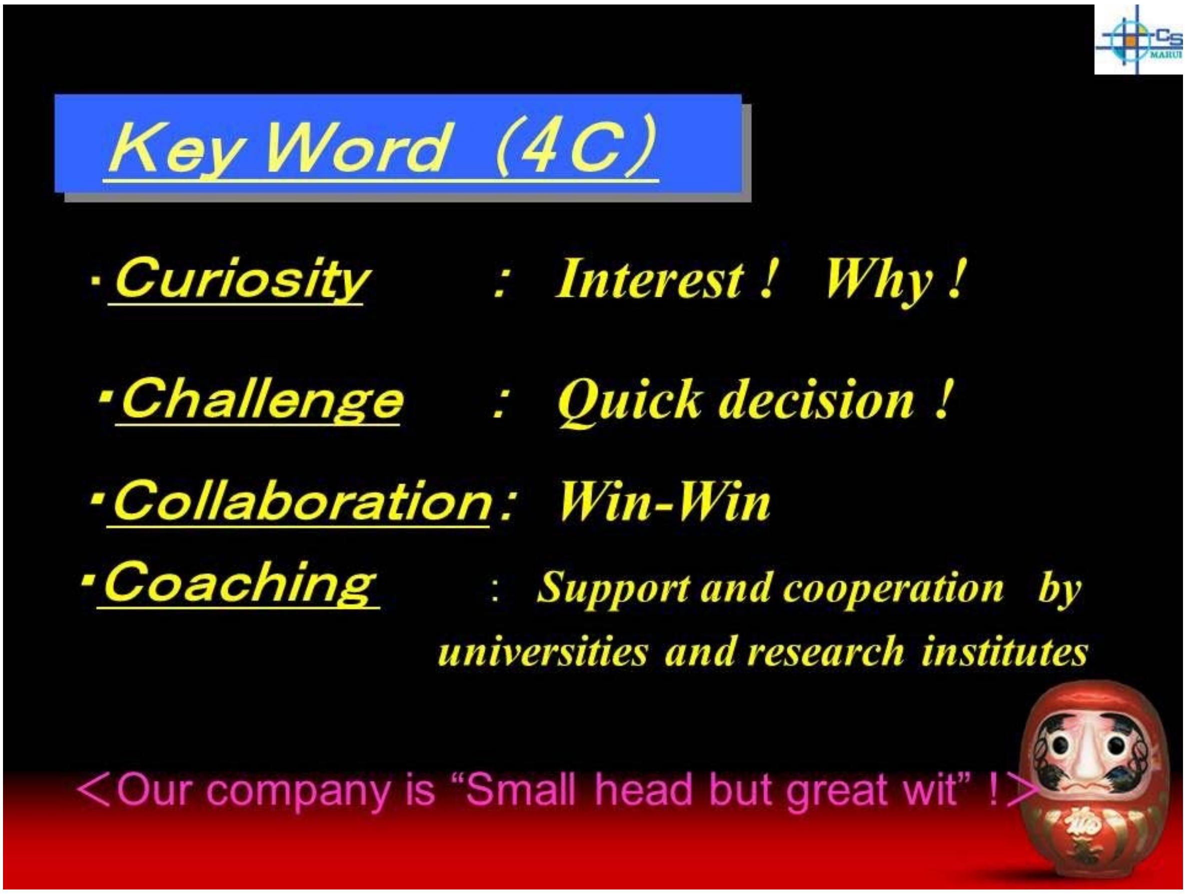

B
LP
SV
CR
Drainage
Pore Pressure Control
Water supply
SM
Gear box
Oil Pump
C
CR
Load
Axis
Cap Plate
Bolt
Upper shear box
Loading Plate
"O" Rings
Porous metal
Filter paper
Shear zone
Rubber edge
Metal filter and felt cloth
Teflon ring holder
Steel ring holder
Lower shear box
Stable part
Moveable part
Rotating part
Outline of the mechanical structure
Shear box and the close-up view of the undrained gap


Testing machine for
Geotechnical Engineering
Quality first
Time Saving !
"HI-MULTI"
Automatic Quadruplex Triaxcial
compression testing machine


Testing machine for
Geotechnical Engineering
Quality first
Time Saving !
Cyclic Direct Shear Apparatus
Direct Shear Apparatus
of the Japanese Geotechnical
Society type


Our company's World wide trading
Republika
Hrvatska
Spain
UAE・Dubai
China
USA・1World
Trade Center
Saudi Arabia
Kenya
Việt Nam
Australia


" The best companies
don't create customers.
They create fans."
Peter F. Drucker


Key Word (4C)
・Curiosity : Interest ! Why !
・Challenge : Quick decision !
・Collaboration : Win-Win
・Coaching : Support and cooperation by universities and research institutes
＜Our company is "Small head but great wit" !＞


Thank you for your attention !
Let's collaborate and develop new technology together

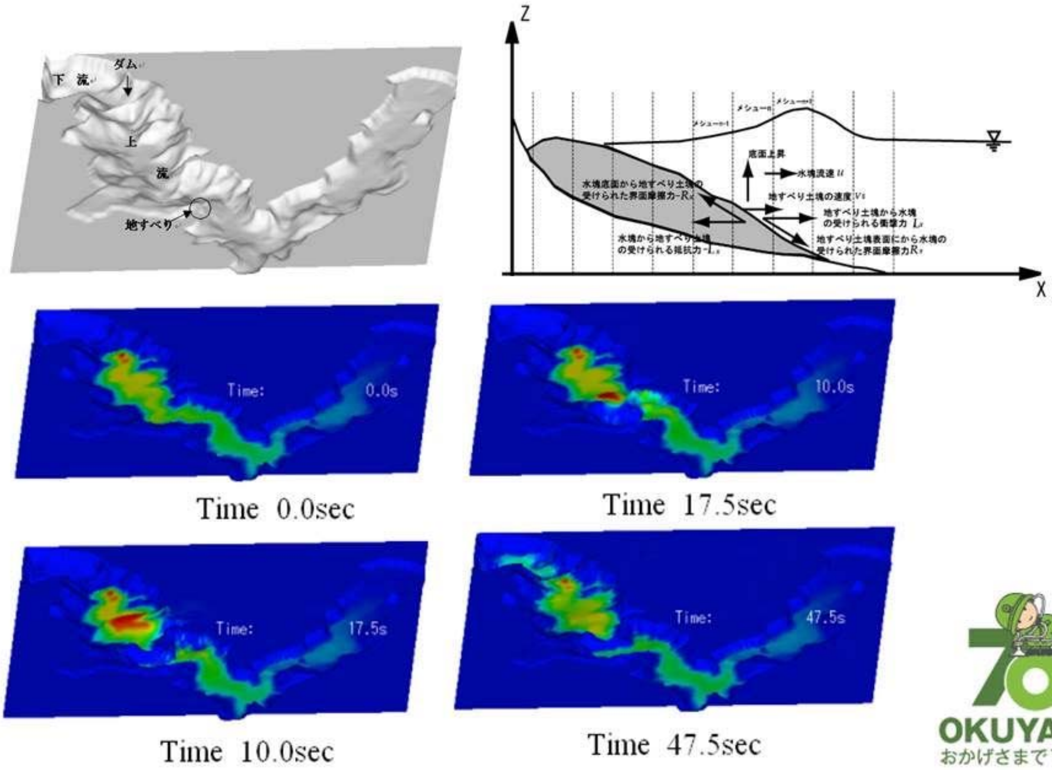

Osaka prefecture will run for the host city
of the World Exposition 2025 !
Welcome to OSAKA !

OKUYAMA BORING CO.,LTD.
70th ANNIVERSARY

- 1990~ Nepal, Indonesia
  (Technical cooperation project ; JICA)
- 2011 Malawi
  (Groundwater Development project)
- 2012 Vietnam
  (Study on slope stabilization method project)

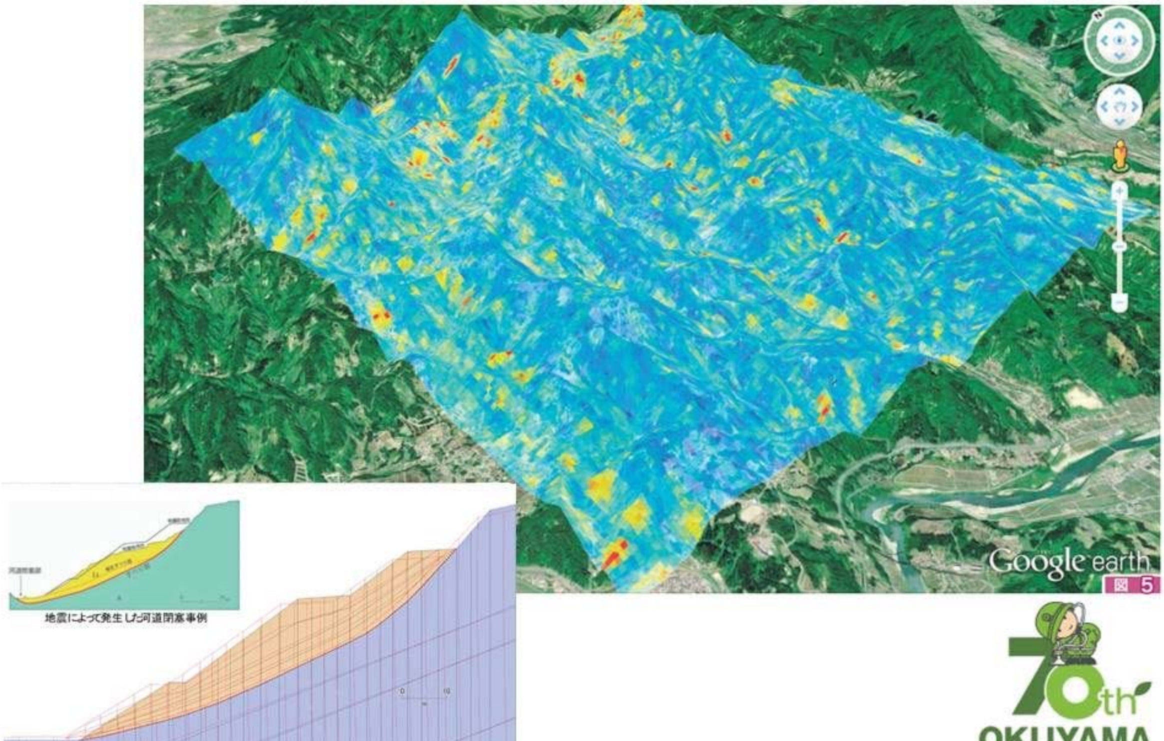
OKUYAMA
おかげさまで70周年

3D Coupling Numerical Simulation of Landslide and Surge



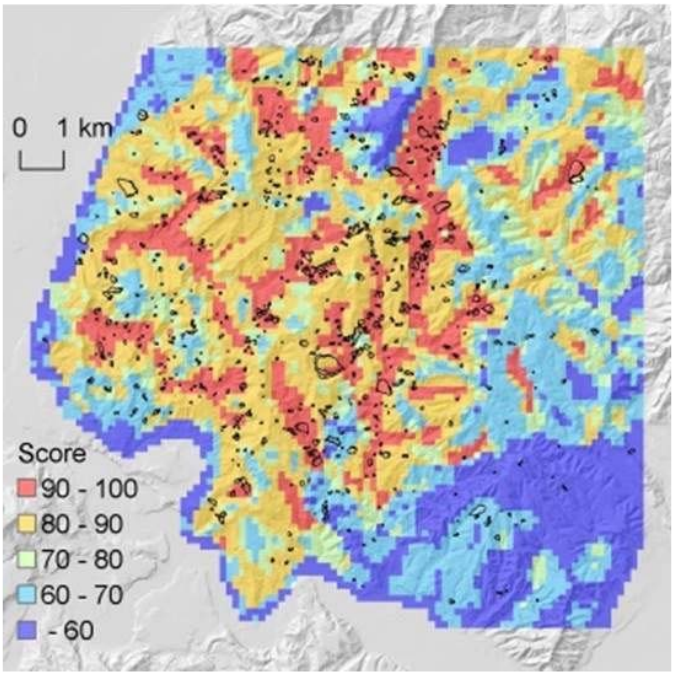
OKUYAMA
おかげさまで70周年

Seismic slope stability analysis



OKUYAMA
おかげさまで70周年

Susceptibility mapping for earthquake-induced landslides



OKUYAMA
おかげさまで70周年

Elasto-viscoplastic analysis for landslide deformation

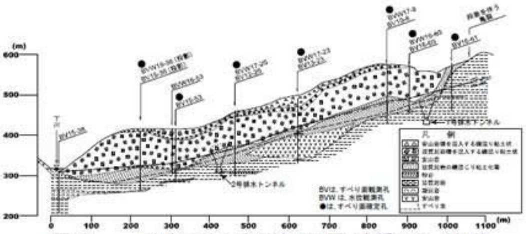


図-2　地すべり A-5 測線断面図（高橋ほか，2016）

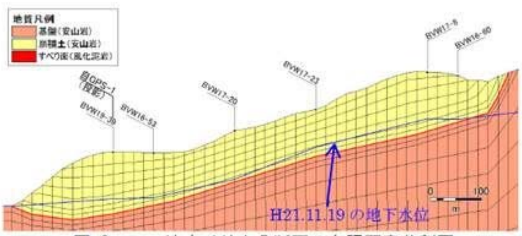


図-3　地すべり A-5 断面の有限要素分割図

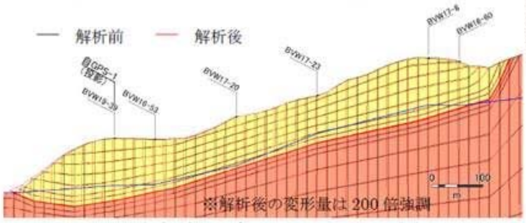


図-6　解析結果（変形図，H22.11.18 時点）

表-1　解析に用いた材料パラメータ

	変形係数 E(kN/m²)	ポアソン比 ν	粘着力 C(kN/m²)	内部摩擦角 φ(°)	ダイレイタンシー角 ψ(°)	単位体積重量 γ(kN/m³)	粘塑性材料パラメータ α	粘塑性材料パラメータ n
崩積土（安山岩）	500,000	0.30	500	25.0	0	20	−	−
基盤（安山岩）	2,000,000	0.25	2,000	35.0	0	20	−	−
すべり面（風化泥岩）	50,000	0.45	56	18.0	0	20	0.1	0.1

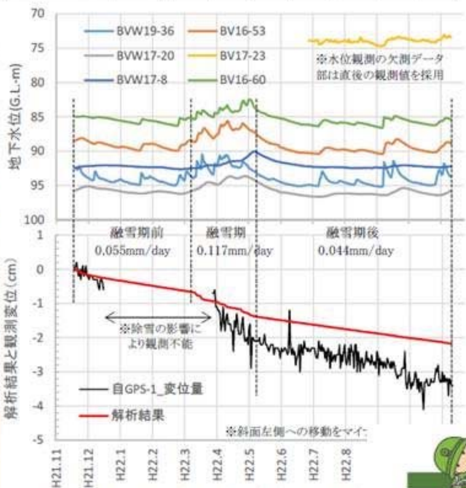


図-4（上段）　観測地下水位（入力地
図-5（下段）　自 GPS-1（投影）位置
観測変位と解析結果の時刻歴比

OKUYAMA
おかげさまで70周年


New simple drilling system for water drainage boring
Before...
実用新案登録: 第3186011号
70th
OKUYAMA
おかげさまで70周年

Japan Bosai Platform

JAPAN CONSERVATION ENGINEERS & CO.,LTD.

How about JCE

JAPAN CONSERVATION ENGINEERS & CO.,LTD.

3-18-5, Toranomon, Minato, Tokyo,Japan 105-0001

Tel:+81.3.3436.3673 URL http://www.jce.co.jp/

1

Japan Bosai Platform

JAPAN CONSERVATION ENGINEERS & CO.,LTD.

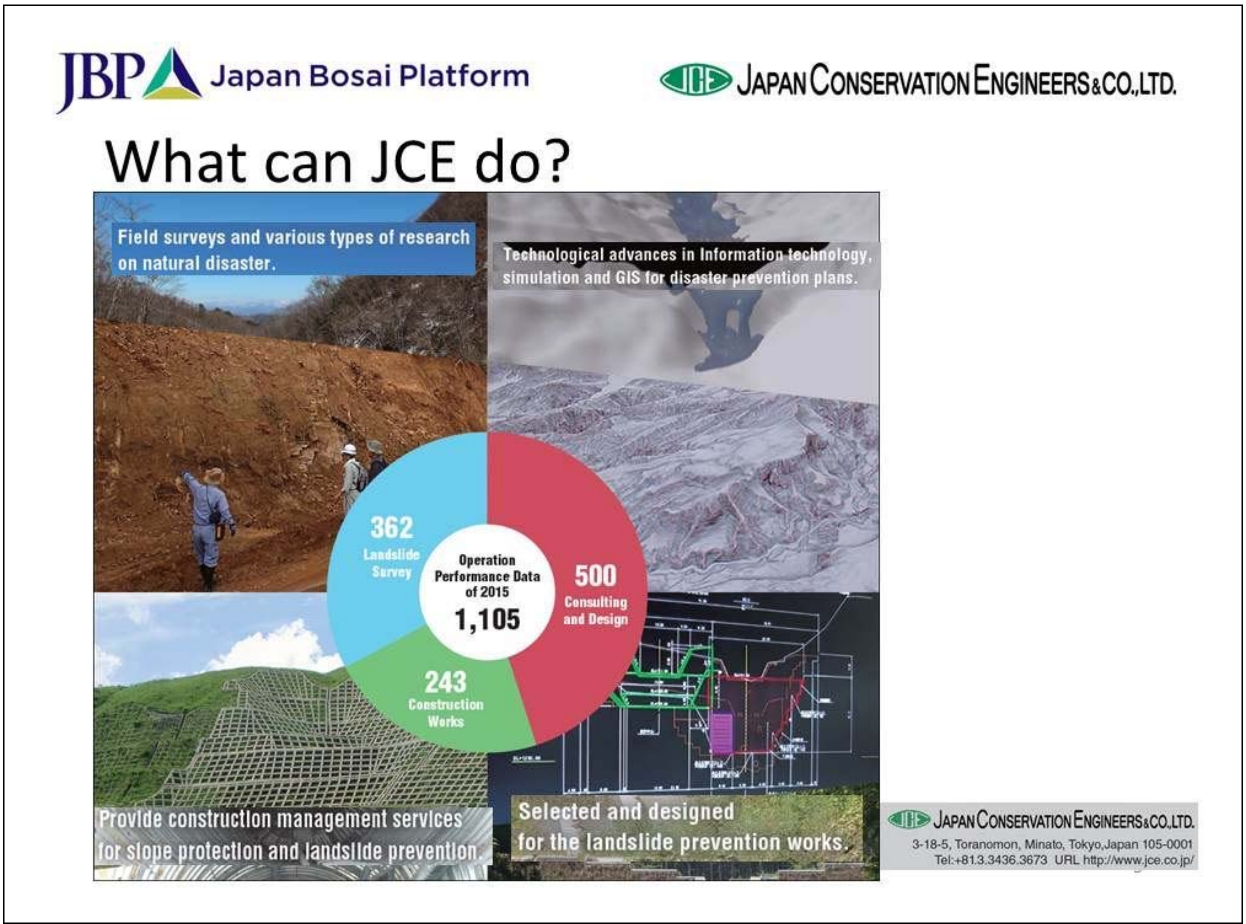
Information of JCE

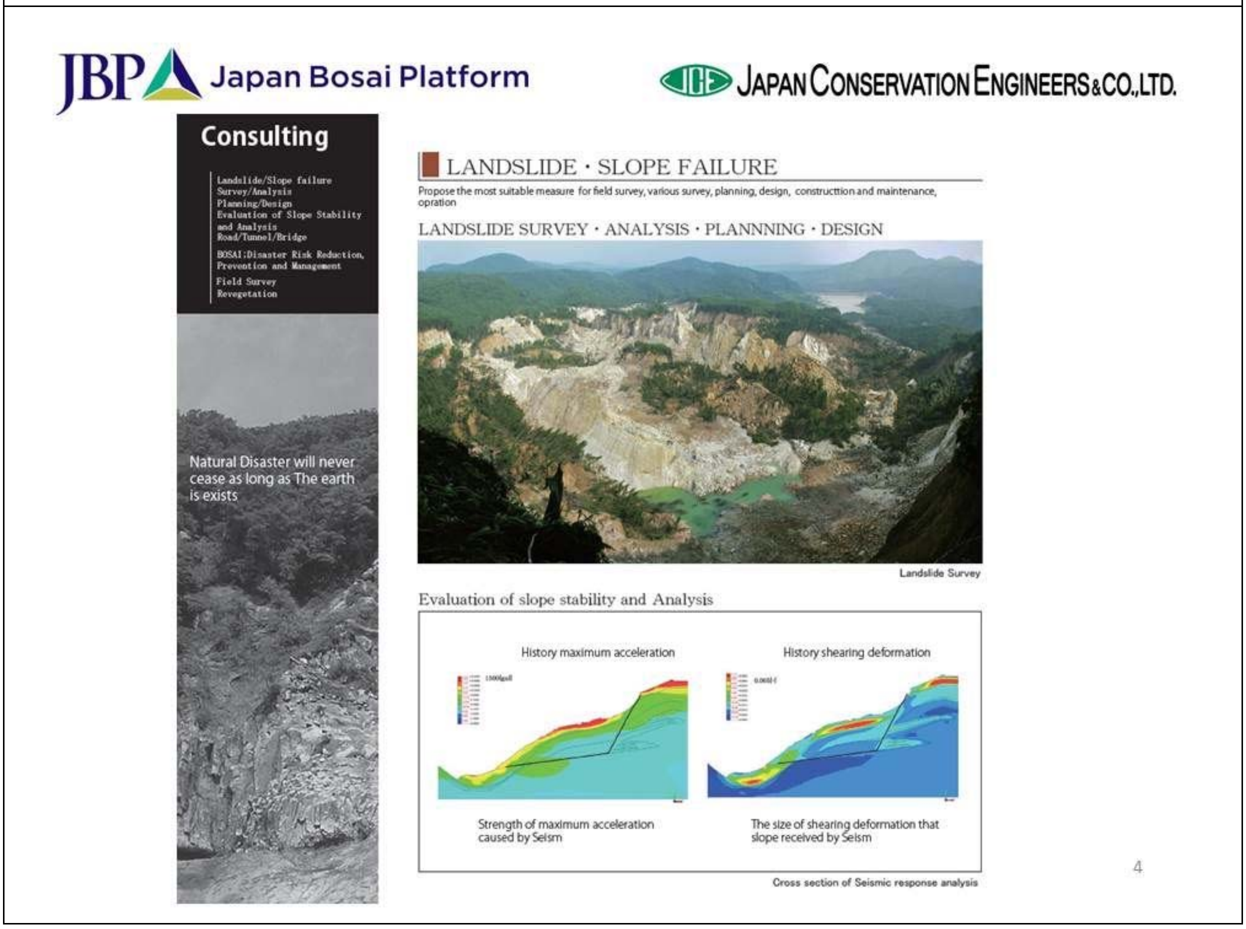
PROFILE

Name	Japan Conservation Engineers & Co., Ltd.
President	YANAI Katsuyuki
Headquarters	[Administrative Department] 3-18-5 Toranomon, Minato-ku, Tokyo 105-0001, JAPAN [Technical Department] 11-12-2 Kitaurawa, Urawa-ku, Saitama 330-0074, JAPAN
Homepage	http://www.jce.co.jp/
Tel. / Fax. Numbers	[Administrative Department] +81 3 3436 3673 / +81 3 3432 3787 [Technical Department] +81 48 833 0422 / +81 48 833 0424
Capital	342 million Yen
Net Sales	8,339million (fiscal year ended September 30, 2011)
Employees	361(as of April 1, 2012)
Established	May, 1966
Management system	ISO9001:2008 (Quality management standard)

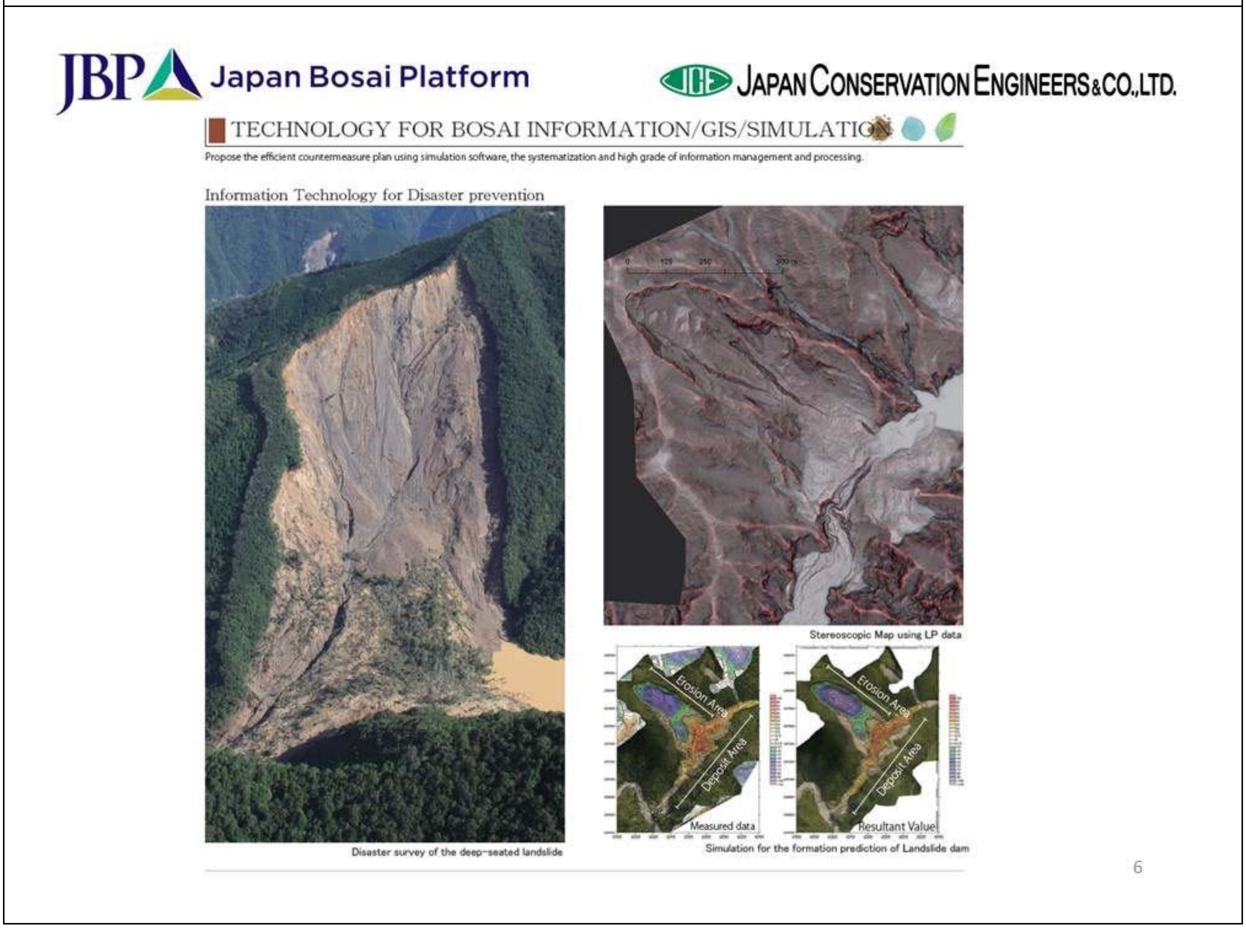
ISO9001 CERTIFIED

2


JBP Japan Bosai Platform
JAPAN CONSERVATION ENGINEERS&CO.,LTD.
What can JCE do?
Field surveys and various types of research on natural disaster.
Technological advances in Information technology, simulation and GIS for disaster prevention plans.
362 Landslide Survey
Operation Performance Data of 2015
1,105
500 Consulting and Design
243 Construction Works
Provide construction management services for slope protection and landslide prevention.
Selected and designed for the landslide prevention works.
JAPAN CONSERVATION ENGINEERS&CO.,LTD.
3-18-5, Toranomon, Minato, Tokyo,Japan 105-0001
Tel:+81.3.3436.3673 URL http://www.jce.co.jp/


JBP Japan Bosai Platform
JAPAN CONSERVATION ENGINEERS&CO.,LTD.
Consulting
Landslide/Slope failure
Survey/Analysis
Planning/Design
Evaluation of Slope Stability and Analysis
Road/Tunnel/Bridge
BOSAI:Disaster Risk Reduction, Prevention and Management
Field Survey
Revegetation
Natural Disaster will never cease as long as The earth is exists
LANDSLIDE・SLOPE FAILURE
Propose the most suitable measure for field survey, various survey, planning, design, construction and maintenance, opration
LANDSLIDE SURVEY・ANALYSIS・PLANNNING・DESIGN
Landslide Survey
Evaluation of slope stability and Analysis
History maximum acceleration
History shearing deformation
Strength of maximum acceleration caused by Seism
The size of shearing deformation that slope received by Seism
Cross section of Seismic response analysis
4

JBP Japan Bosai Platform
JAPAN CONSERVATION ENGINEERS & CO.,LTD.
Consulting
Geology/Soil/Ground
Geological Survey/Analysis
Physical Logging/Exploration
Ground survey/Analysis/
Countermeasure Design
Radioactive ray contamination and
Soil contamination investigation
Information for Disaster
prevention/GIS/Simulation
Geo-processing technology
Monitoring system for Natural
disaster
We have confidence to
be the best counsellor.
GEOLOGY/SOIL/GROUND
To accurately grasp characteristics of geology, soil and ground, by utilizing new technology of physical lexploration and accumulated past experiences of fifty years.
Geological Survey/Analysis
Boring survey
Physical Logging/Exploration
Visualized by ultrasound the hole wall surface
Example of Borehole Televiewer
Sheave signal
Winch
Laptop computer
Temperature logging probe
Measure the temperature of borehole due to detect to groundwater flow stratum of the ground.
High resolution temperature logging
5



JBP Japan Bosai Platform
JAPAN CONSERVATION ENGINEERS & CO.,LTD.
TECHNOLOGY FOR BOSAI INFORMATION/GIS/SIMULATION
Propose the efficient countermeasure plan using simulation software, the systematization and high grade of information management and processing.
Information Technology for Disaster prevention
Disaster survey of the deep-seated landslide
Stereoscopic Map using LP data
Erosion Area
Deposit Area
Measured data
Resultant Value
Simulation for the formation prediction of Landslide dam
6

JBP Japan Bosai Platform

JAPAN CONSERVATION ENGINEERS & CO.,LTD.

Consulting

Afforestation/Forest Road/
Forest Management
Forest Development
Rural Development
Steeo slope・Avalanch
Environment
Maintenance and control
River works/Erosion control
Seacoast prevention/Harbor
Forest for damage seacoast
prevention

AFFORESTATION/FOREST ROAD/FOREST MANAGEMENT/ RURAL DEVELOPMENT/STEEP SLOPE・AVALANCH/ ENVIRONMENT

Carry out the land conservation effectively through the natural hazard risk areas survey using GIS and consulting forest conservation plan based on characteristic forest and basin.

Survey and Design for afforestation

Living environmental preservation forest

Forest road restoration

Construction works for forest road restoration

7

JBP Japan Bosai Platform

JAPAN CONSERVATION ENGINEERS & CO.,LTD.

Construction Works

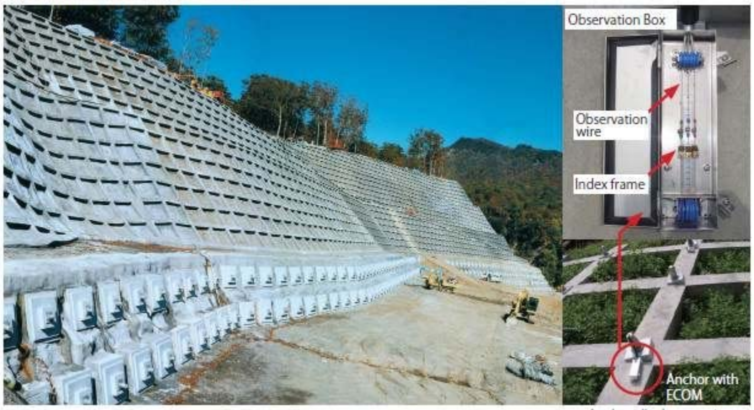
Landslide prevention construction
Anchor works・Crib works
Pile works・Drainage well work
Tunnel works

Slope protection works
Crib works・Falling rock
preventive countermeasure
Reinforced soil works
Greening works

LANDSLIDE PREVENTION CONSTRUCTION

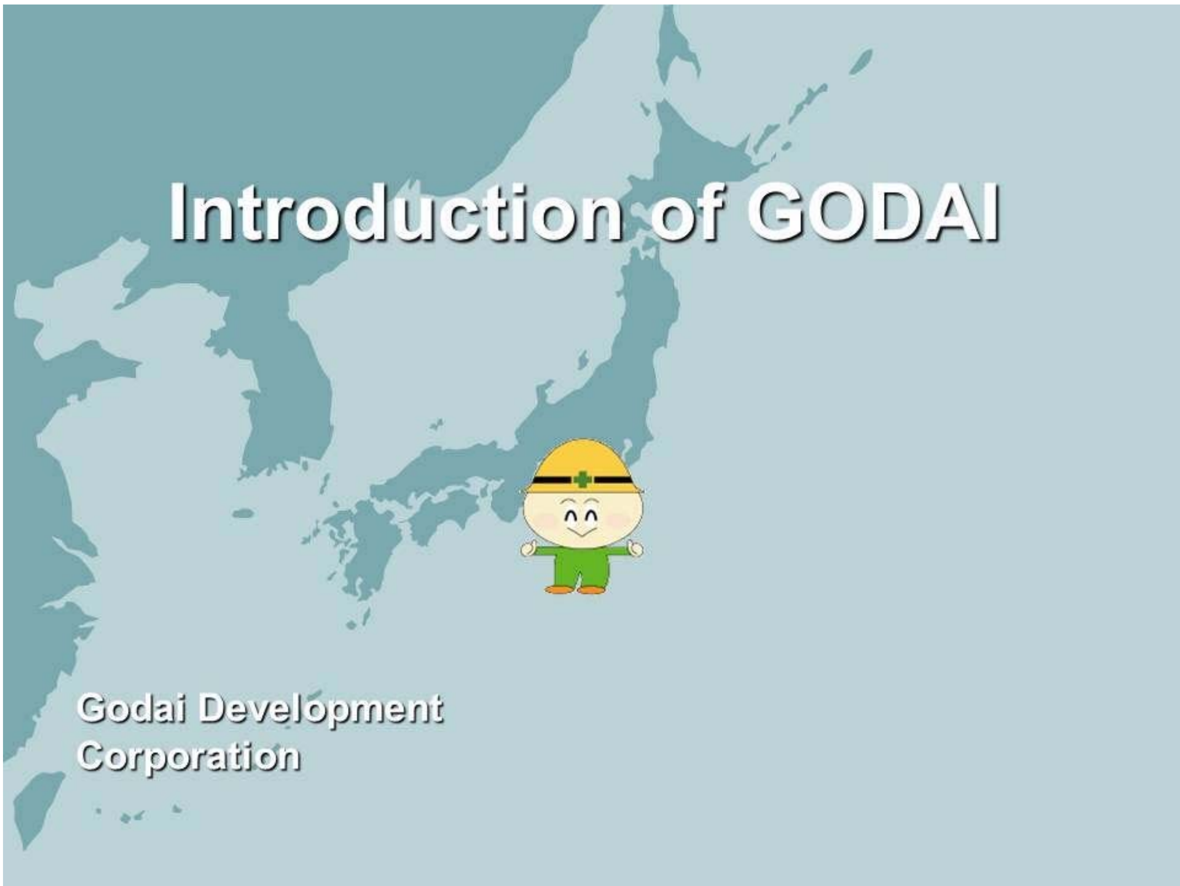
Conduct to the quality and safety controls with reliable techniques

Anchor Works/Crib Works



Anchor displacement gage

8



Profile of Godai Development Corporation

■ Head Office ■	1-35,Kuroda,Kanazawa-city,Ishikawa 921-8051 JAPAN
■ Shizuoka Office ■	56 Yanagimachi,Kakegawa-city,Shizuoka 436-0052 JAPAN
■ Sendai Office ■	♯512,Aoba Heights No.2,117,Sanbyakunin-machi,Wakabayashi-ku,Sendai-city,Miyagi 984-0057 JAPAN
CEO	Tohru Ishikawa, Kaneo Oda
Establishment	8.March.1965
Capital stock	55 million Yen
Number of employees	6 3
Business Line	**Civil Engineering Consulting**
	Survey: ground, aviation, rivers, lakes, coasts ,etc ,registers
	Research and Analysis: landslides, geological research, soil research, EIA(environmental impact assessment),FEM,etc
	Civil Design: roads, bridges, tunnels, urban planning, tap water and sewage, airports, ports, development,construction management, parks, railways
	Planning and management Of Natural disaster: slope disaster (landslides, steep slopes), rivers and erosion control
	IT Consulting: software development and selling, contract-based software development, network building, database building including Geographic Information System, "ISABOU NET"

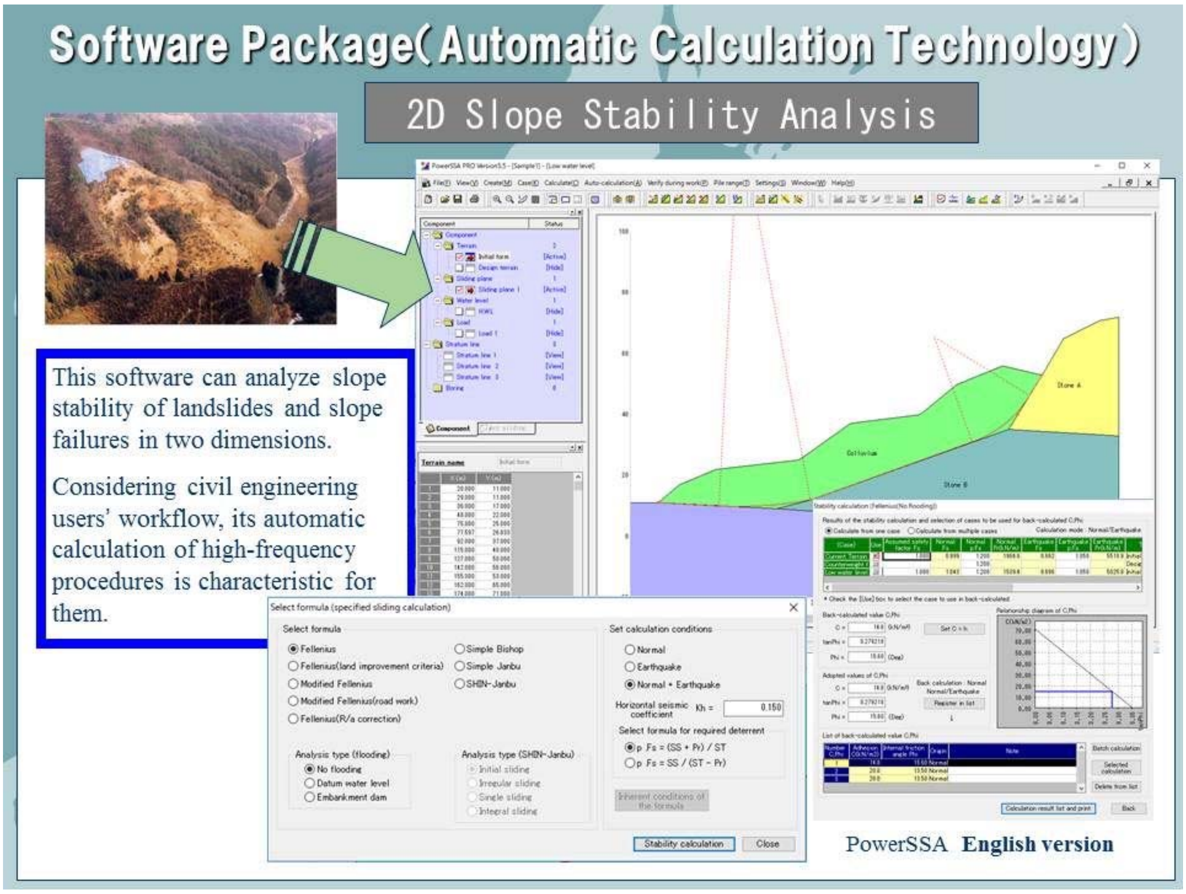
Civil Engineering(Design, Field work management)

Research & Analysis	landslides, river, ground water, soil and miscellaneous observations
Civil Design	slope disaster, roads, brides, tunnels, urban planning, parks, railways, tap water and sewage, rivers and erosion control, development, construction management, sports facilities, snow melting system, common utility ducts, construction management
Survey	control point survey,GPS(Global Positioning System), leveling, topographical survey, route survey, river surveying, land surveying and register of river, erosion control, public facilities

System Engineering(software for slope disaster measures)

Products	
Research and Analysis	
Plotting System of Landslide Survey	GGRAPH
Plotting System of Groundwater Prospecting	EGLOG
3 D Ground Modeling System	MakeJiban
An integrated model simulating the initiation and motion of earthquake & rain induced rapid landslides	LS-RAPID
3 D Slope Stability Analysis	SSA_3D
	Option 1:Anchor Works
	Option 2:Reinforcing Steel Bar
	Option 3:Plane Figure Converting
	Option 4:Cutting and embankment
	Option 4:Dam with Filling Water
2D Slope Stability Analysis	PowerSSA (Standard edition)
〃	PowerSSA PRO (Professional edition)
	Option
	Landslides near Filling Water Area
FEM for Soil Analysis	Dodomemaru
	Optimizing Parameter Option
FEM for Analysis of Groundwater Seepage and Slope Stability Analysis	SAUSE(※)
	※developed by Nita Corporation.,Ltd.
	Inundation edition
	River Water edition
	Inundation and River Water edition

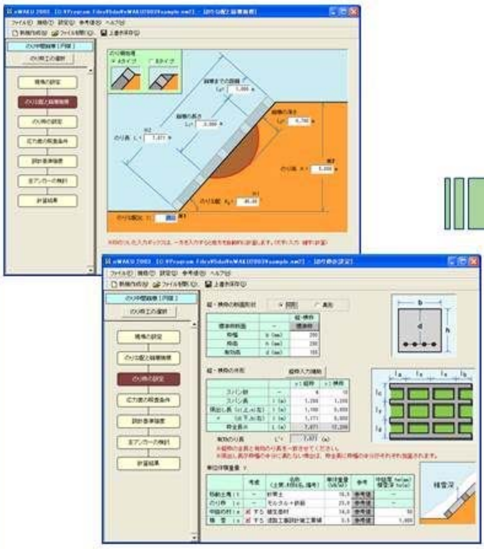
Products	
Anchor Works Design Calculation	ANCHOR
Design Calculation of Piles for Landslides	Landslide Prevention Pile
Design Calculation of Reinforcing Piles for Landslides	Landslide Reinforcing Prevention Pile
Design Calculation for Soil Nails	Reinforced Cutting
Frame Design Calculation	nWAKU
Design Calculation for Rock-fall Protection	Rock-fall
	Cross Section Converting Option
Retaining Wall Design Calculation	The Most Suitable Retaining Wall
Design Calculation for MSE	MSE (Mechanically Stabilized Earth)
Designing Support System for Greening	Greening Expert
Drainage Wells Design Calculation	Well
Design Calculation for Wire Cylinder Works	Wire Mat Woks
Drawing System of Tension Control Chart	Tension Control for Anchor Works
Construction Quality Assessment System	Construction Quality Assessment for Contractor
Civil Engineering CAD	CRAFT5 Standard edition
〃	CRAFT5 Frame Drawing Extension
Frame Structure Drawing	"WAKU Tarou"
Drawing Mistakes Prevention	"Miss Bousi"


Software Package(Automatic Calculation Technology)
2D Slope Stability Analysis
This software can analyze slope stability of landslides and slope failures in two dimensions.
Considering civil engineering users' workflow, its automatic calculation of high-frequency procedures is characteristic for them.
Select formula (specified sliding calculation)
Fellenius
Simple Bishop
Simple Janbu
Modified Fellenius
Normal
Earthquake
Normal + Earthquake
Stability calculation
Close
PowerSSA English version


Software Package(3D Expression Technology)
3D Slope Stability Analysis
This software can analyze slope stability of landslides and slope failures in two dimensions.
It can create three dimensional data automatically from cross section using spline surface.

Software Package(Structure Calculation Technology)

Design Calculation System for Landslides and Slope Failure Measures

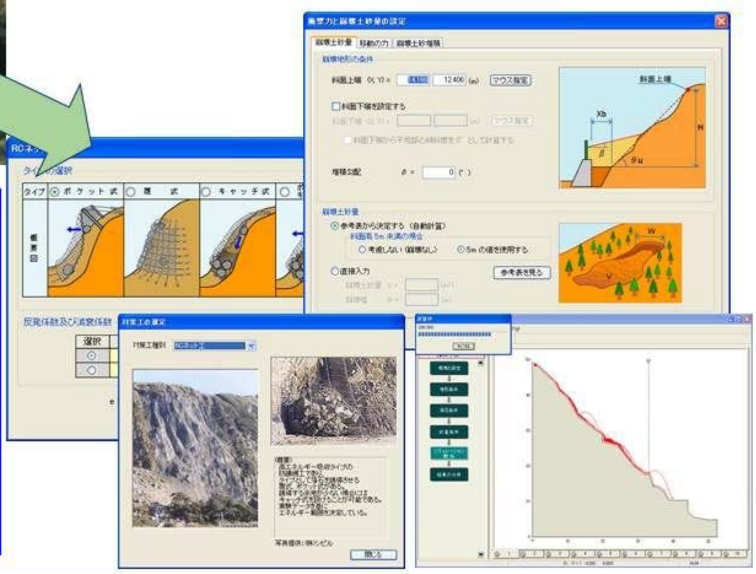


Design Calculation System of Anchor Works, Piles, Reinforcing Steel Bar, etc.

It enables users to make structure calculation and construction estimation at the same time. Users can decide the most suitable and most efficient method at one trial procedure.

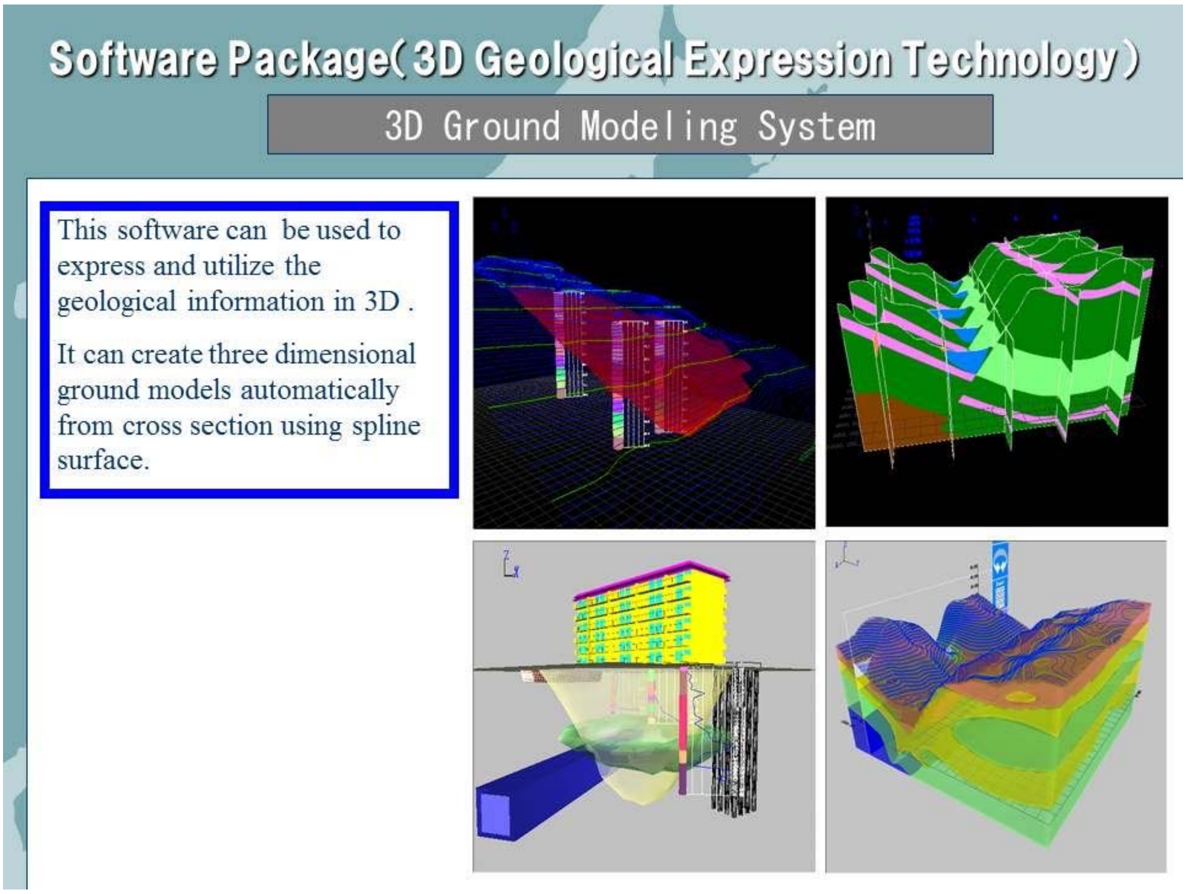
Software Package(Simulation Technology)

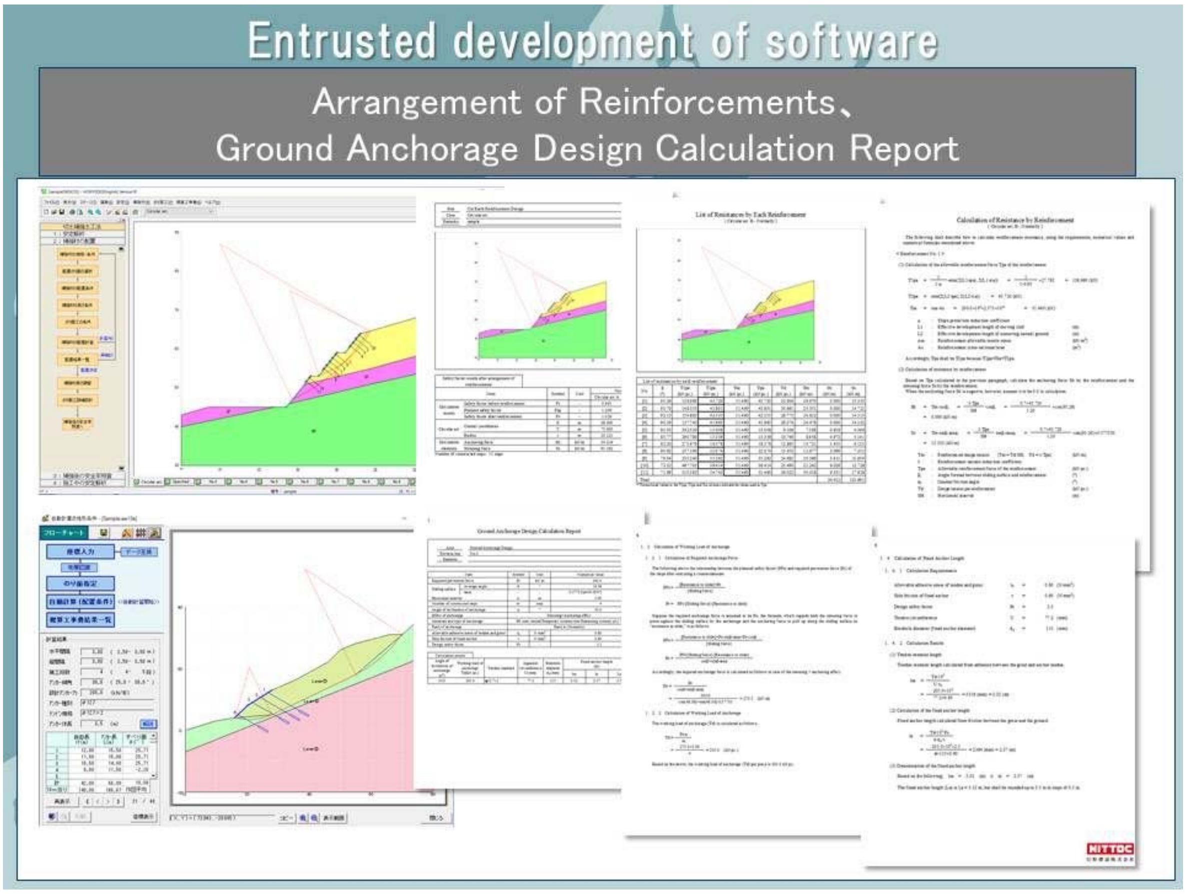
Design Calculation System for Rock-fall Protection

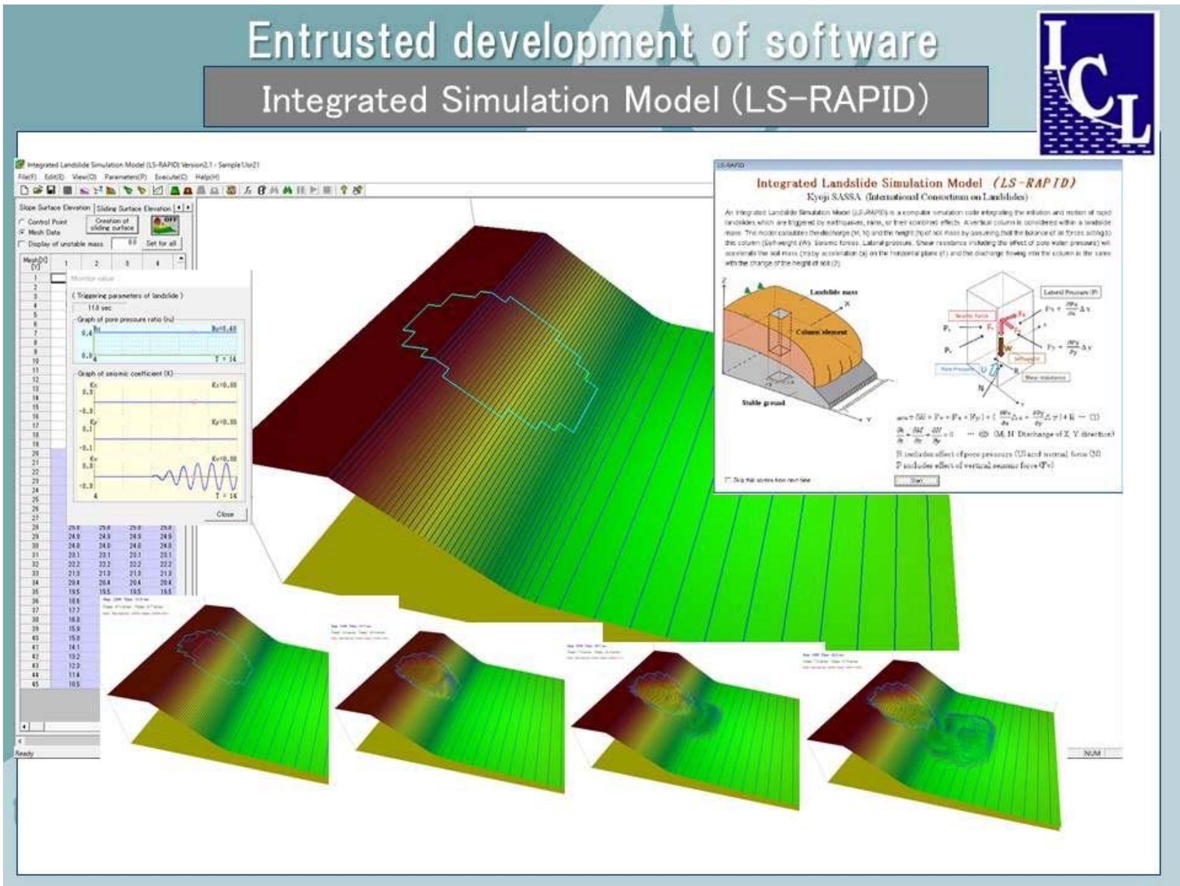


Design Calculation System for Rock-fall Protection

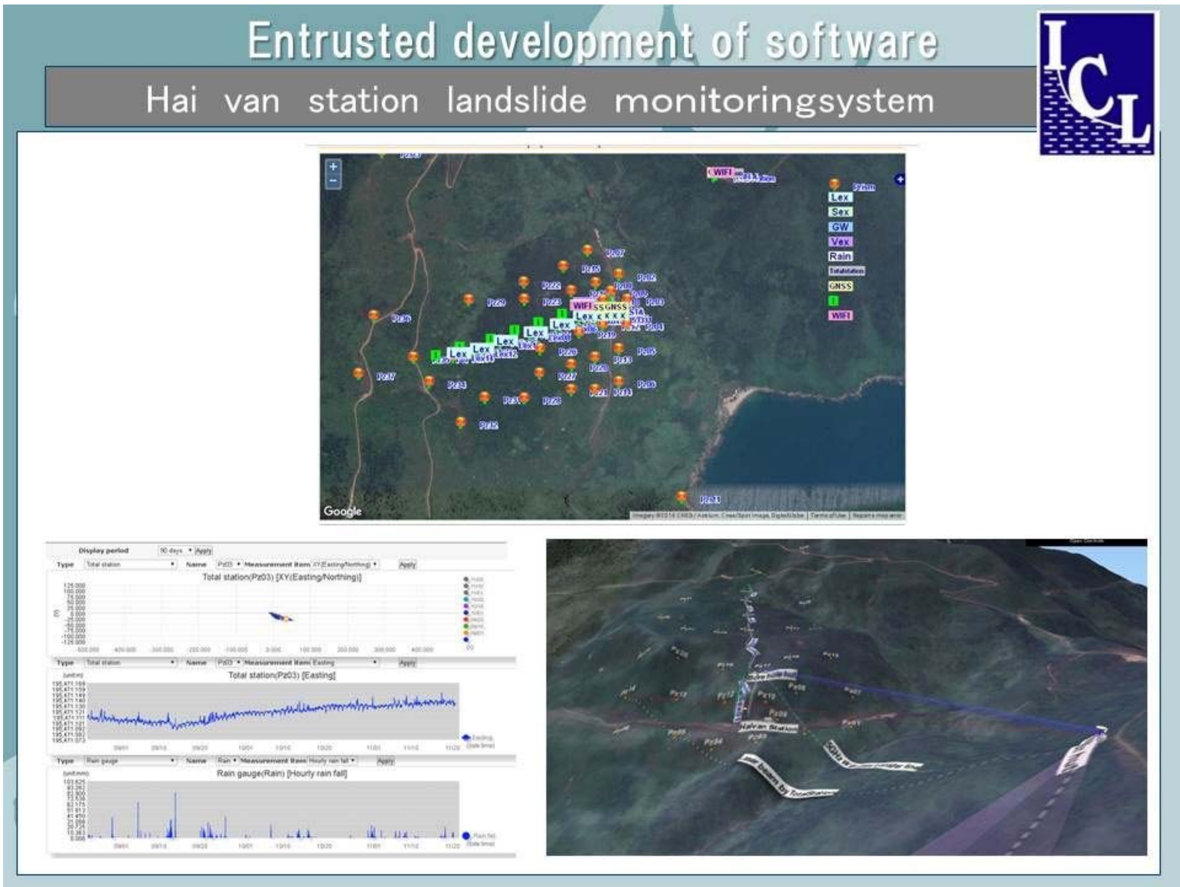
All planning works such as rock-fall simulation, structure calculation, construction estimation, comparison of construction method, are possible in one software.

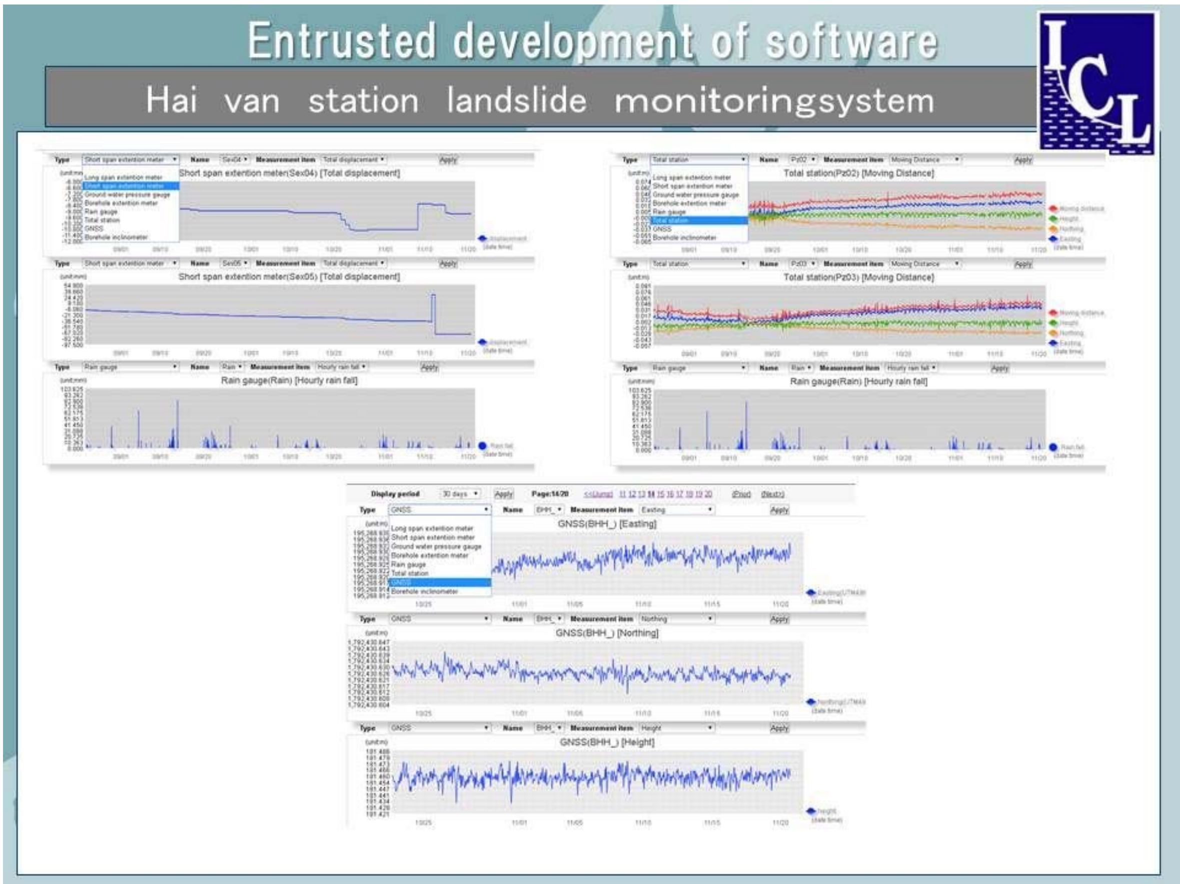

Software Package(3D Geological Expression Technology)
3D Ground Modeling System
This software can be used to express and utilize the geological information in 3D .
It can create three dimensional ground models automatically from cross section using spline surface.


Entrusted development of software
Arrangement of Reinforcements、
Ground Anchorage Design Calculation Report
List of Resistances by Each Reinforcement
Calculation of Resistance by Reinforcement
Ground Anchorage Design Calculation Report
NITTOC


Entrusted development of software
Integrated Simulation Model (LS-RAPID)
ICL
Integrated Landslide Simulation Model (LS-RAPID)
Kyoji SASSA (International Consortium on Landslides)


Entrusted development of software
Hai van station landslide monitoringsystem
ICL
Hai van station landslide monitoring system
JST-JICA SATREPS Project
Development of landslide risk assessment technology along transportation arteries in Viet nam
About
Chart(now)
Chart(past)
Forecast
Map
View
Download
System
logout
About this system
General information
This landslide monitoring system was developed for the reduction of the landslide disaster on focused slope. It is the prototype of the monitoring of actual slope displacement and water condition on specific landslide-prone slope.
Target area
Monitored landslide-prone slope is located at middle part of Hai Van Mountain near Danang city. It is near the railway and Hai Van station. Small landslides was occurred in past and slope deformations could be found still now in this slope.
Photo target area
Haivan land slides area Location
Bore hole hut
Total Station hut
Developing member
International Consortium on Landslide (ICL, Japan)
National Research and Development Agency, Forestry and Forest Products Research Institute (FFPRI, Japan)
Ministry of Transportation, Institute of Transport Science and Technology (ITST, Vietnam)
GODAI KAIHATSU Corporation(Japan)
Developing supporters
OSASI Technos Inc. (Japan)
Oyo Corporation (Japan)
Vietnam-Japan Engineering Consultant Co., Ltd. (VJEC, Vietnam)
Okuyama Boring Co.,Ltd.
OKUYAMA BORING Co., Ltd (Japan)


Entrusted development of software
Hai van station landslide monitoringsystem
Total station(Pz03) [XY(Easting/Northing)]
Total station(Pz03) [Easting]
Rain gauge(Rain) [Hourly rain fall]

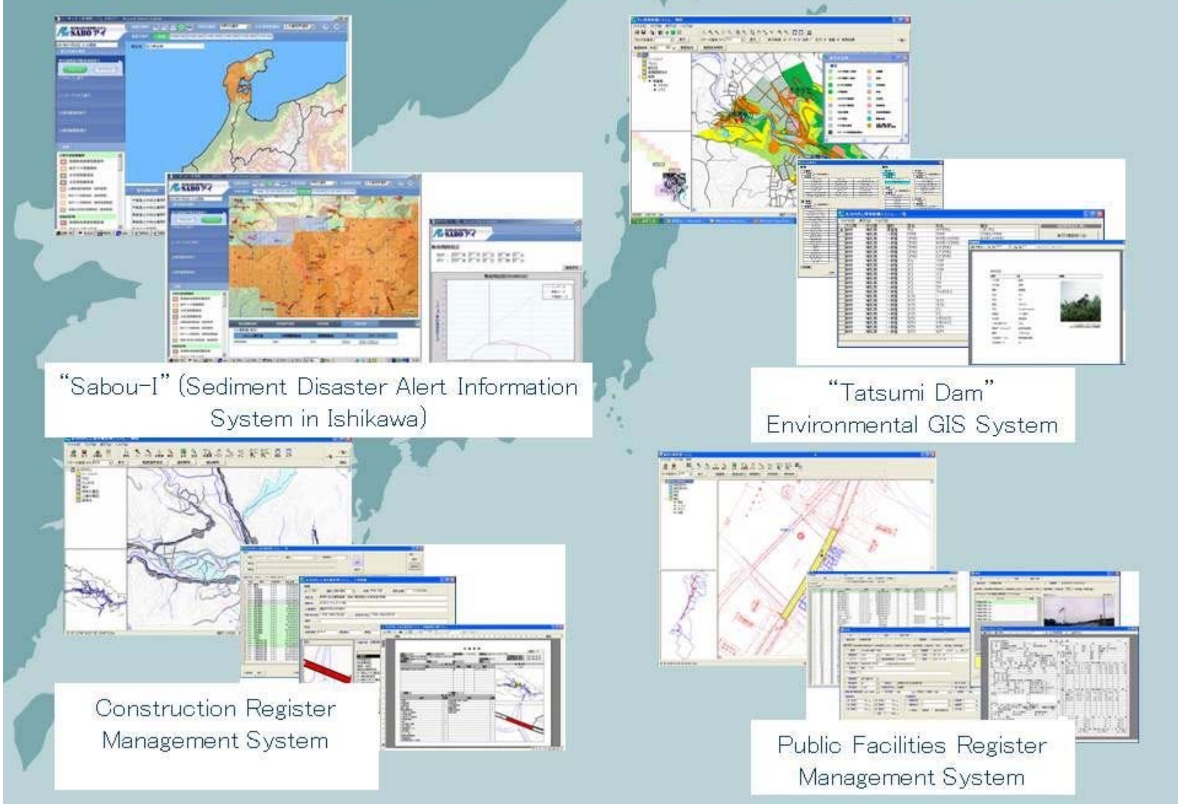

Entrusted development of software
Hai van station landslide monitoringsystem
Short span extention meter(Sex04) [Total displacement]
Short span extention meter(Sex05) [Total displacement]
Rain gauge(Rain) [Hourly rain fall]
Total station(Pz02) [Moving Distance]
Total station(Pz03) [Moving Distance]
Rain gauge(Rain) [Hourly rain fall]
GNSS(BHH_) [Easting]
GNSS(BHH_) [Northing]
GNSS(BHH_) [Height]

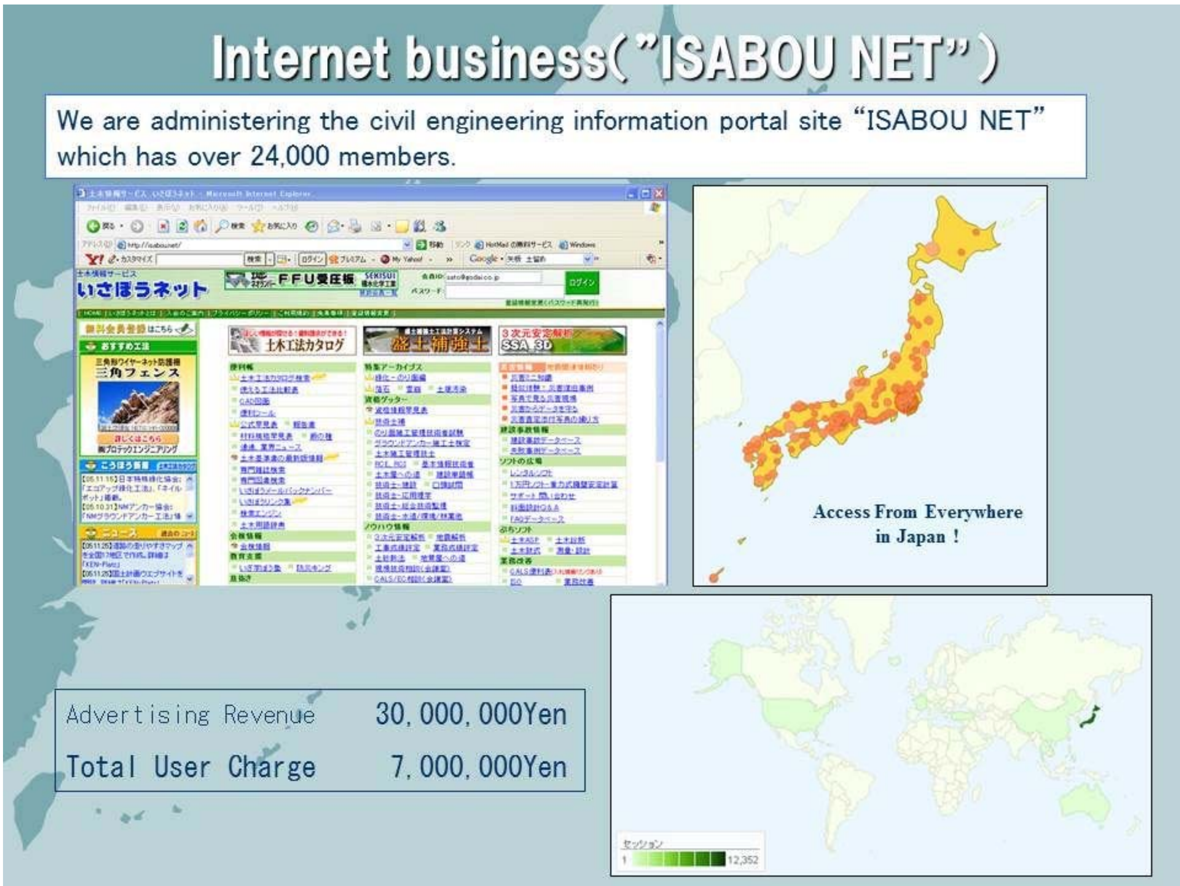
System Technology (Database System for Government Office)

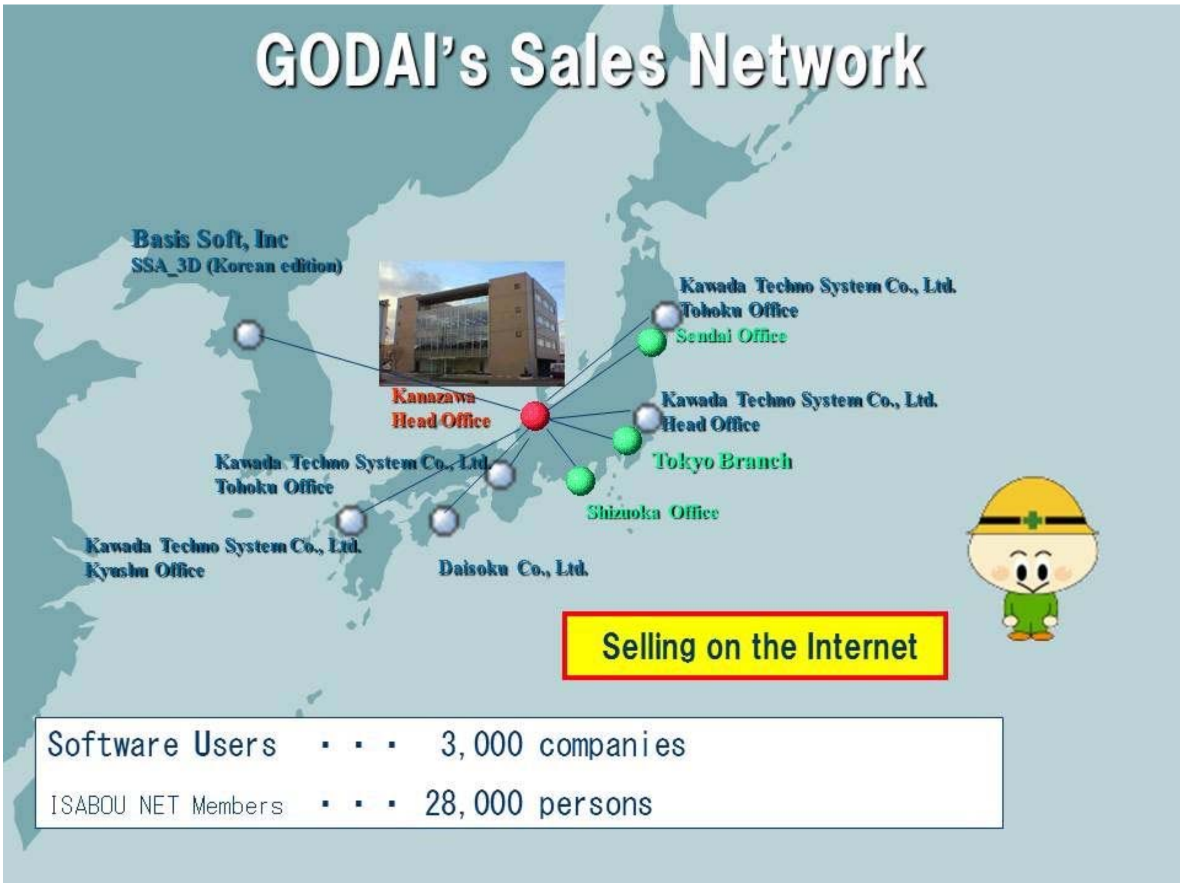
No.2

System Name	Outline	Foundation Act	Customer	Notes
Data Management System of Water Quality and Quantity	management of periodic hydrological data		Tastumi Dam Construction Office	
Telemetering Facilities Control System	management of telemetering facilities register		Kanazawa-city,River Dept.	
River Control Information System	database of river status research		Kanazawa-city,River Dept.	GIS
Rainwater Drainpipe Management System	management of register in rainwater drainage consultation		Kanazawa-city,River Dept.	
Disaster Assessment System	management of disaster assessment sheets	Act on National Treasury's Sharing of Expenses for Project to Recover Public Civil Engineering Works Damaged by Disaster	Kanazawa-city,River Dept.,Civil Engineering Dept.	
Erosion Control Points Management System	management of erosion control points register	Erosion Control Law	Ishikawa,Erosion Control Dept.,local cities and towns	
Cemetery Management System	cemetery guide and management		Kanazawa-city,Health and Hygiene Dept.	
Book Management System	management of reports information		Kitakawachi Dam Construction Office	
Document Management System			Railway Transit Elevated Bridge Office, Komatsu Station	
Drawing Management System	management of construction drawings		Kanazawa Ports and Harbor Bureau	
Construction Records Management System	management of construction records		Railway Transit Elevated Bridge Office, Komatsu Station	
Shoreline Data Management System	management of periodical shoreline data		Ishikawa,Hakui Civil Engineering Office	

System Technology (GIS System for Government Office)




Internet business("ISABOU NET")
We are administering the civil engineering information portal site "ISABOU NET" which has over 24,000 members.
いさぼうネット
Access From Everywhere in Japan !
Advertising Revenue 30,000,000Yen
Total User Charge 7,000,000Yen
12,352


GODAI's Sales Network
Basis Soft, Inc
SSA_3D (Korean edition)
Kawada Techno System Co., Ltd.
Tohoku Office
Sendai Office
Kanazawa
Head Office
Kawada Techno System Co., Ltd.
Head Office
Tokyo Branch
Kawada Techno System Co., Ltd.
Tohoku Office
Shizuoka Office
Kawada Techno System Co., Ltd.
Kyushu Office
Daisoku Co., Ltd.
Selling on the Internet
Software Users ・・・ 3,000 companies
ISABOU NET Members ・・・ 28,000 persons

OSASI

OSASI TECHNOS INC.

Our Business

Our company is a maker of measurement instruments for natural disaster prevention.

Vision

"We contribute to the Safety of Society with Reliable Information."

Natural Disaster

- Landslide
- Debris Flow
- Slope Failure
- Natural Dam

Exploration

- Landslide
- Hydrologic studies
- Survey of water quality
- Weather observation

Maintenance

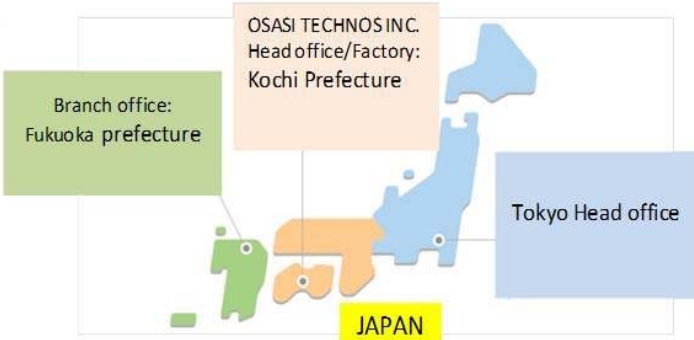
- Slope Monitoring
- Flood Disaster
- River water level observation
- Agricultural water management

Company Information

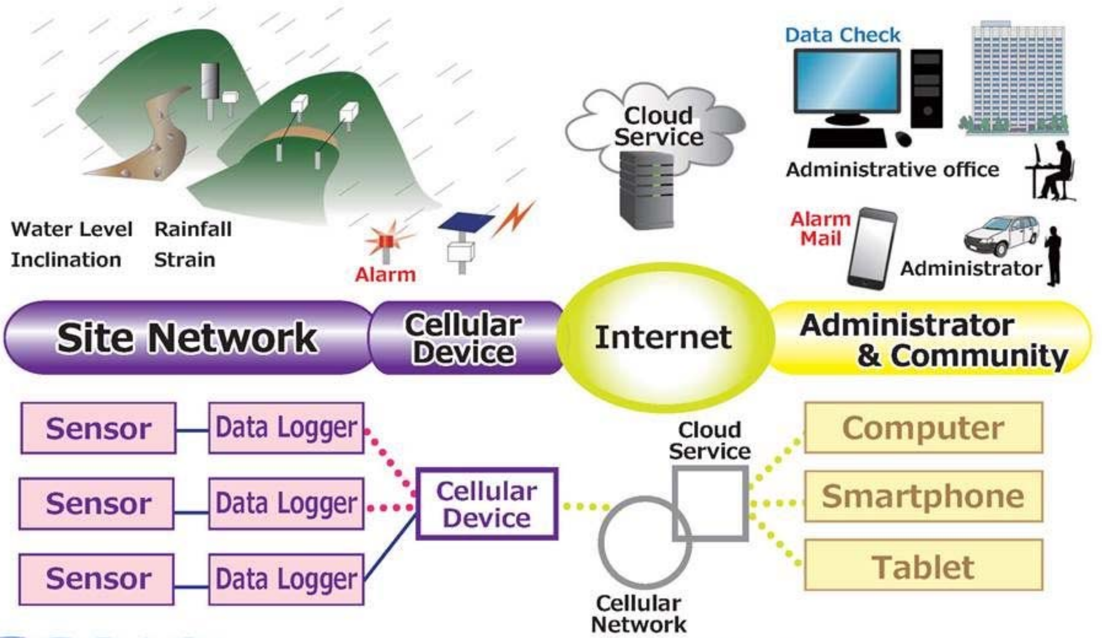
OSASI TECHNOS INC.

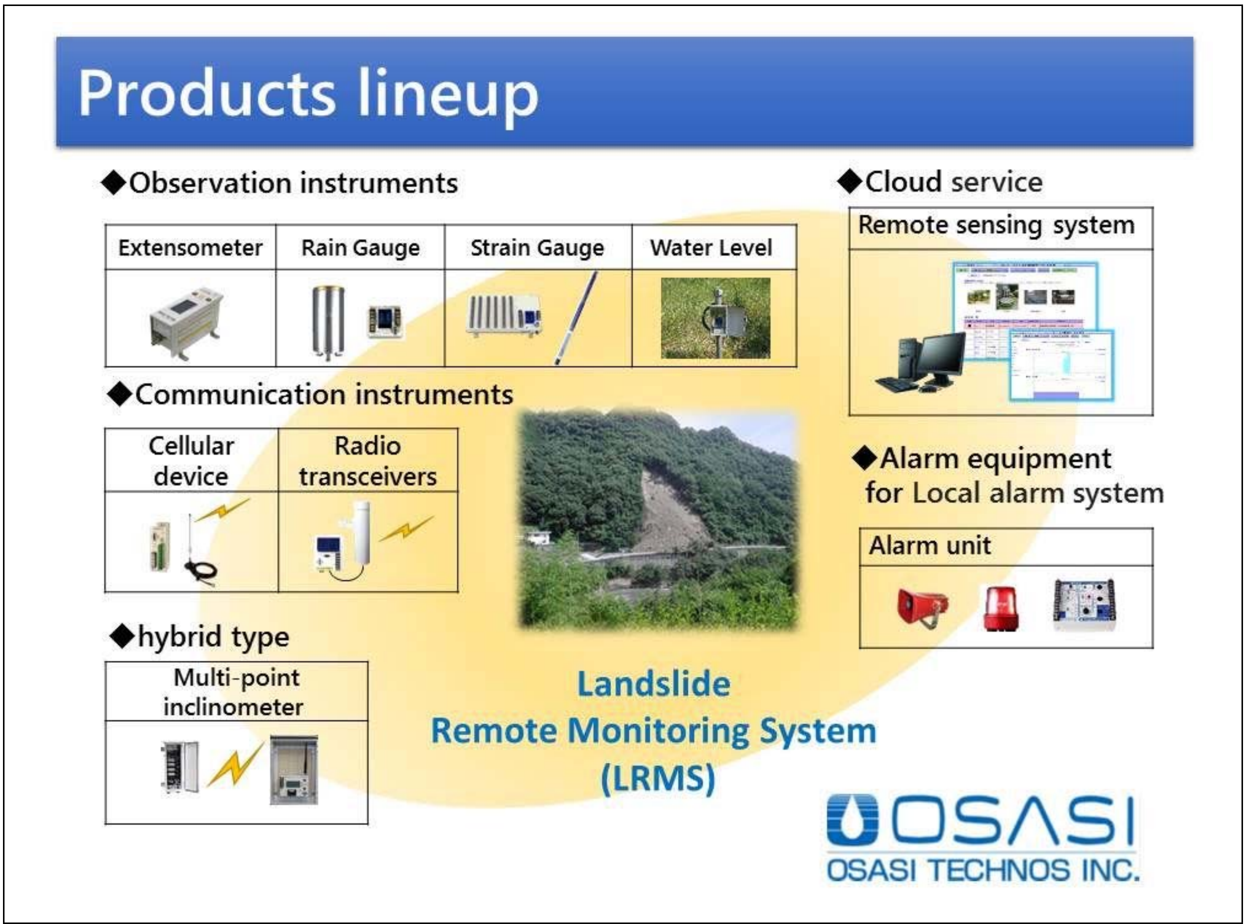
- Established in 10 Jun 1972
- Head office & Factory : Kochi prefecture, Japan
- Tokyo Head office, 1 Branch office : Fukuoka prefecture
- Number of staff : 64

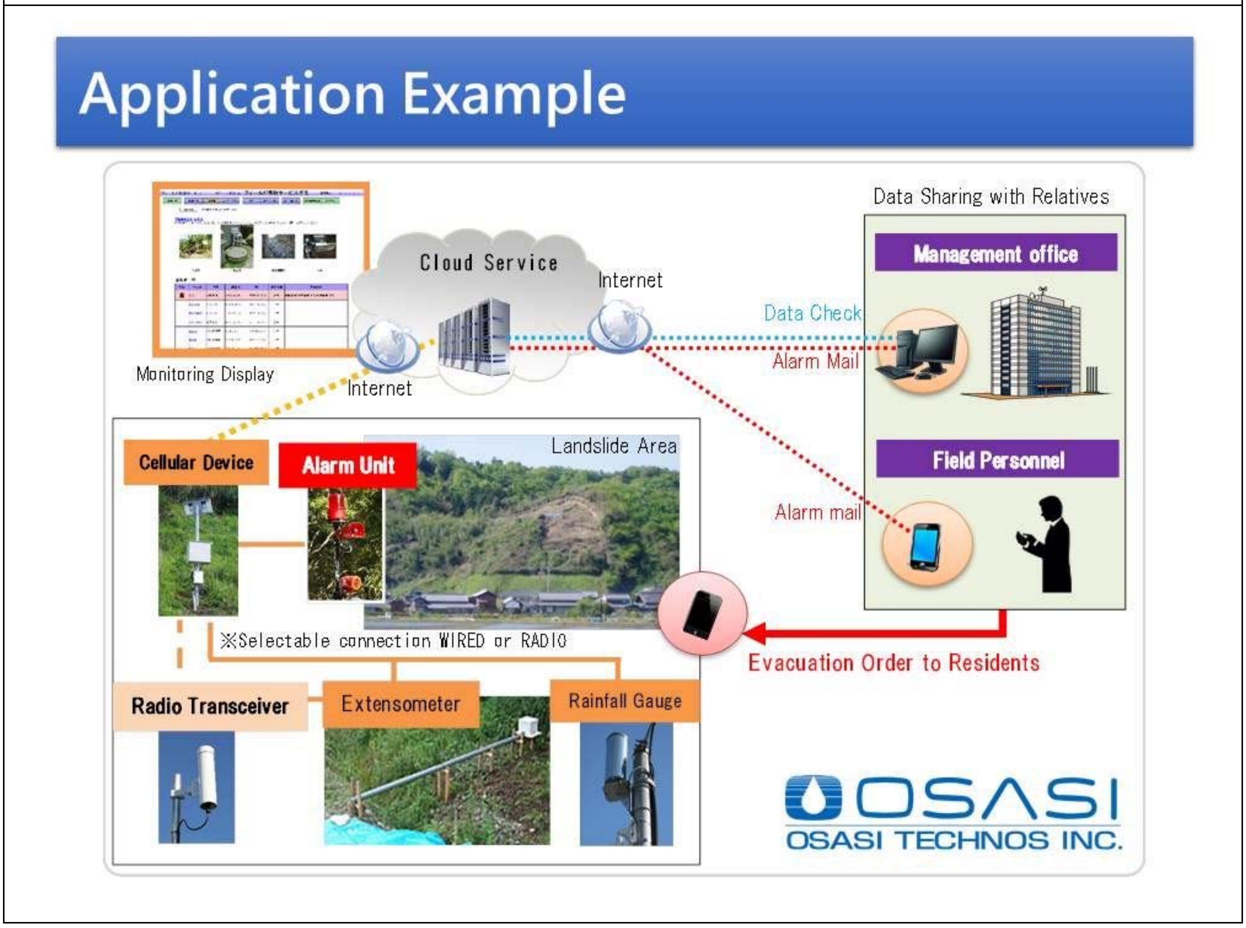
Head office in Kochi prefecture, JAPAN

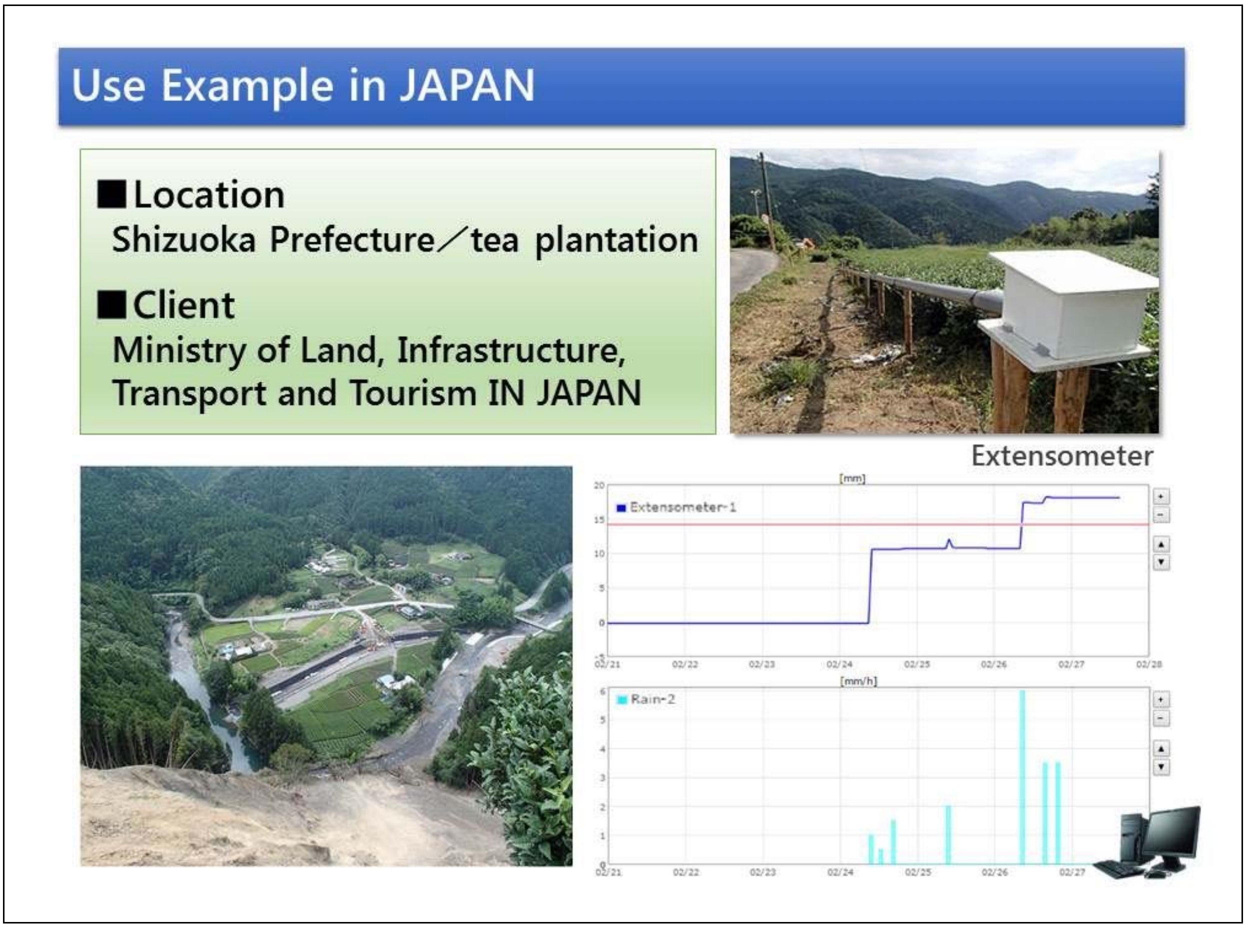


Monitoring System




Products lineup
◆Observation instruments
Extensometer
Rain Gauge
Strain Gauge
Water Level
◆Communication instruments
Cellular device
Radio transceivers
◆hybrid type
Multi-point inclinometer
◆Cloud service
Remote sensing system
◆Alarm equipment for Local alarm system
Alarm unit
Landslide
Remote Monitoring System
(LRMS)
OSASI
OSASI TECHNOS INC.


Application Example
Cloud Service
Internet
Monitoring Display
Internet
Data Sharing with Relatives
Management office
Data Check
Alarm Mail
Field Personnel
Alarm mail
Landslide Area
Cellular Device
Alarm Unit
※Selectable connection WIRED or RADIO
Evacuation Order to Residents
Radio Transceiver
Extensometer
Rainfall Gauge
OSASI
OSASI TECHNOS INC.


Use Example in JAPAN
■Location
Shizuoka Prefecture／tea plantation
■Client
Ministry of Land, Infrastructure,
Transport and Tourism IN JAPAN
Extensometer
[mm]
Extensometer-1
[mm/h]
Rain-2

PROVIDING SAFETY AND ASSURANCE

OYO

Contact us

OYO Corporation

Instruments & Solutions Division

Address: 43 Miyukigaoka, Tsukuba, Ibaraki 305-0841, Japan

TEL: +81-2985-15078

FAX: +81-2985-17290

e-mail: seihin@oyo.jp

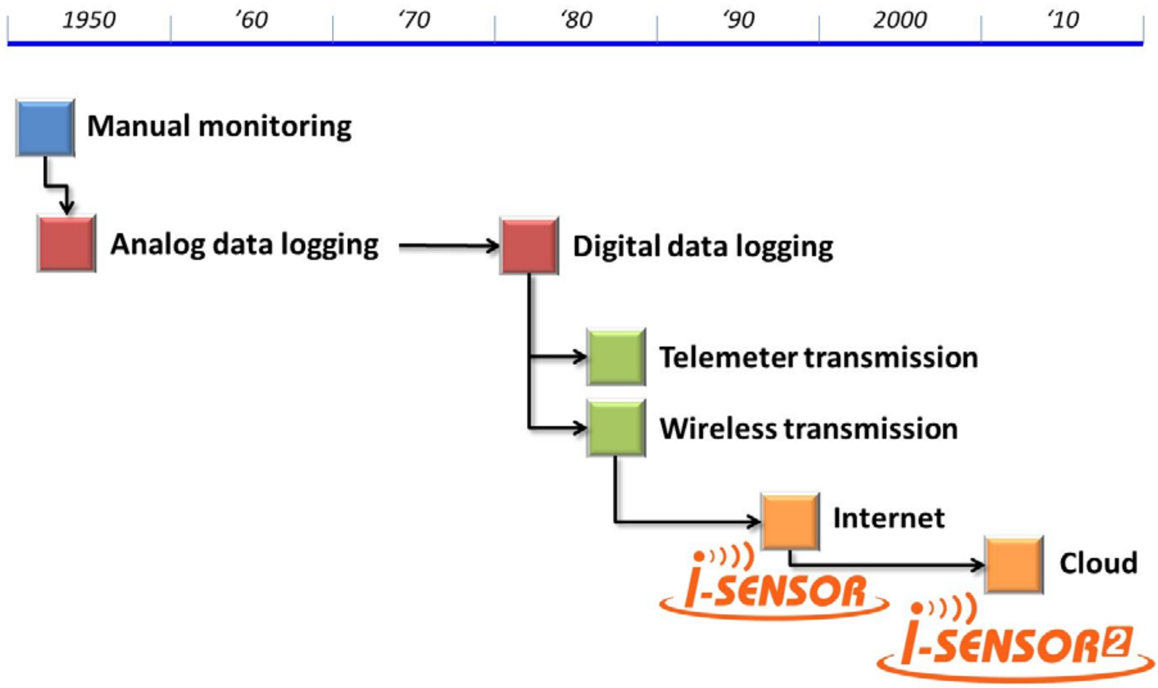
Website: www.oyo.co.jp/english/products

oyo corporation

CONTENTS

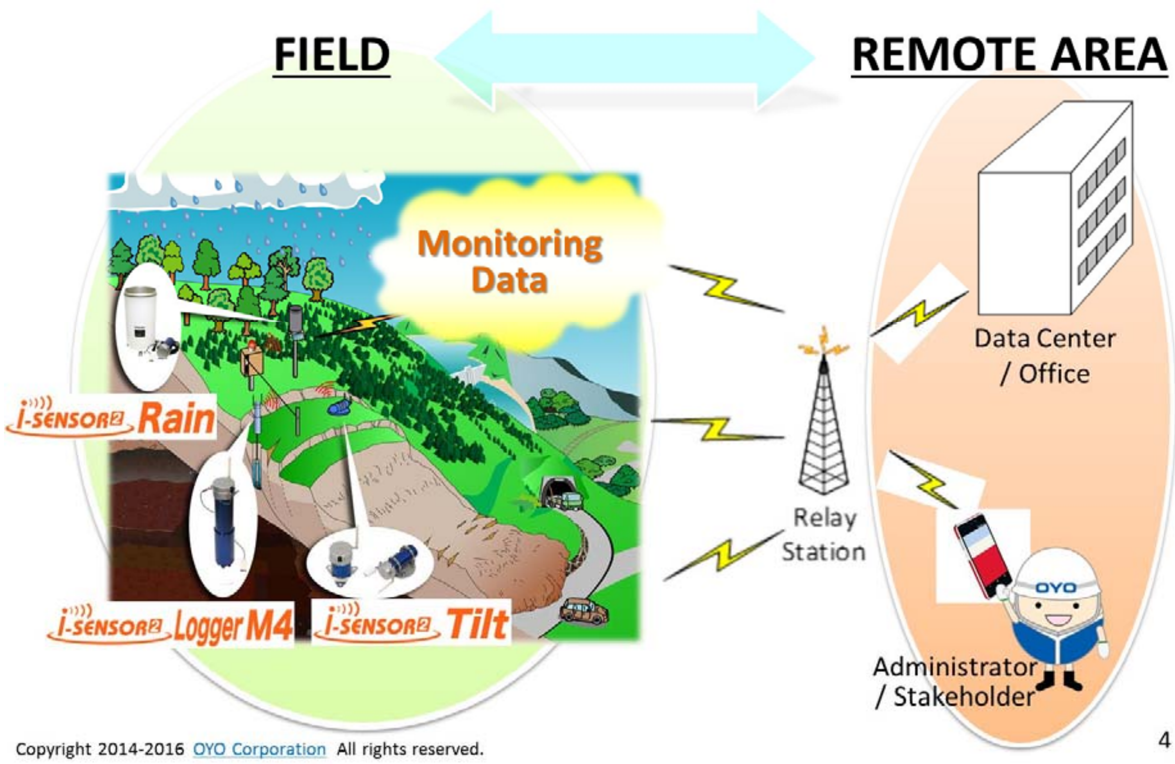
OYO oyo corporation

1. Monitoring Method Transition



3

2. Remote Monitoring System



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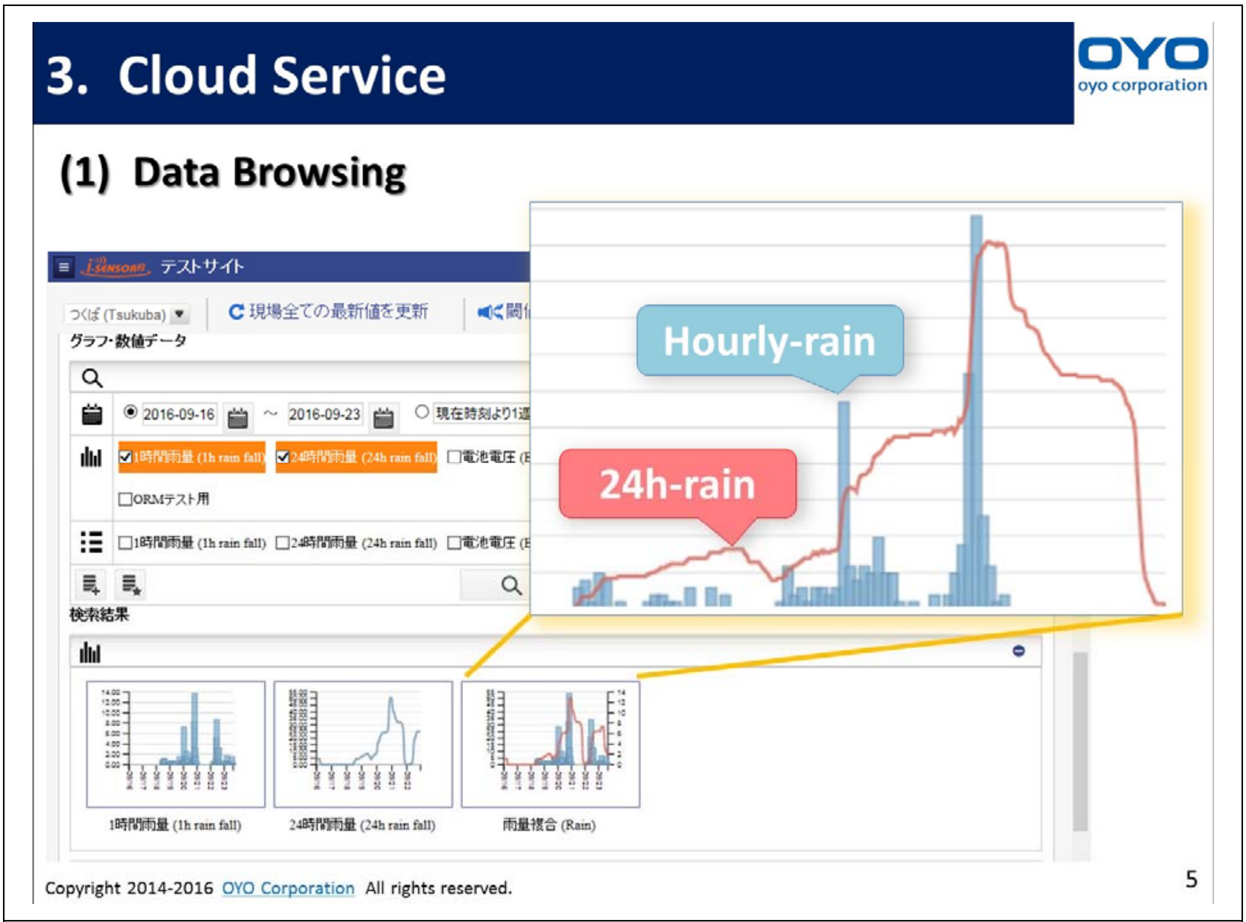
3. Cloud Service
OYO
oyo corporation
(1) Data Browsing
テストサイト
つくば (Tsukuba)
現場全ての最新値を更新
グラフ･数値データ
2016-09-16
2016-09-23
現在時刻より1週
1時間雨量 (1h rain fall)
24時間雨量 (24h rain fall)
電池電圧
ORMテスト用
検索結果
1時間雨量 (1h rain fall)
24時間雨量 (24h rain fall)
雨量複合 (Rain)
Hourly-rain
24h-rain
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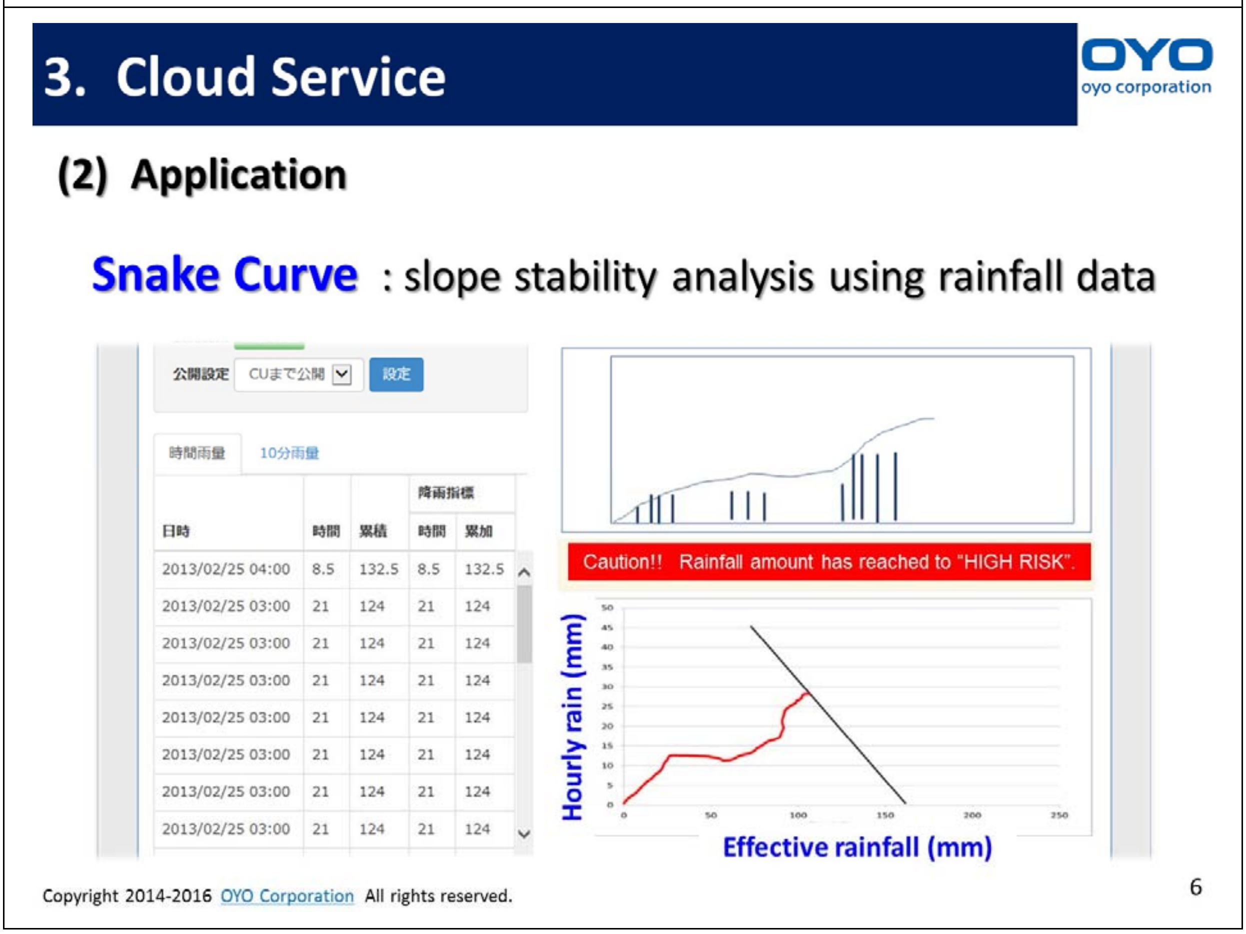
5


3. Cloud Service
OYO
oyo corporation
(2) Application
Snake Curve : slope stability analysis using rainfall data
公開設定
CUまで公開
設定
時間雨量
10分雨量
降雨指標
日時
時間
累積
時間
累加
2013/02/25 04:00 8.5 132.5 8.5 132.5
2013/02/25 03:00 21 124 21 124
2013/02/25 03:00 21 124 21 124
2013/02/25 03:00 21 124 21 124
2013/02/25 03:00 21 124 21 124
2013/02/25 03:00 21 124 21 124
2013/02/25 03:00 21 124 21 124
2013/02/25 03:00 21 124 21 124
Caution!! Rainfall amount has reached to "HIGH RISK".
Hourly rain (mm)
Effective rainfall (mm)
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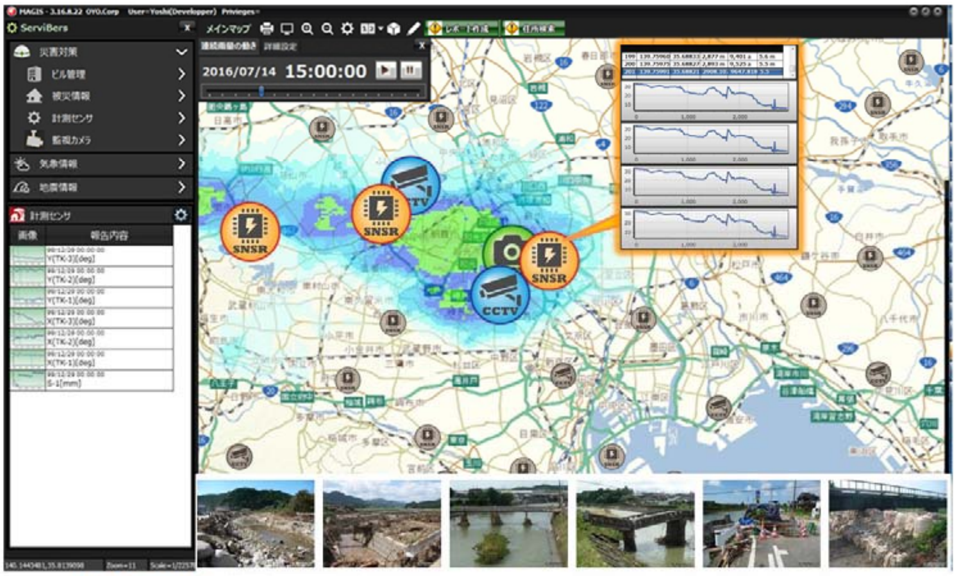
6

4. Expanded Feature

oyo corporation

Disaster Risk Management System

Combine the "REMOTE MONITORING" with GIS



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PROVIDING SAFETY AND ASSURANCE

Contact us

OYO Corporation
Instruments & Solutions Division

Address: 43 Miyukigaoka, Tsukuba, Ibaraki 305-0841, Japan
TEL: +81-2985-15078
FAX: +81-2985-17290
e-mail: seihin@oyo.jp
Website: www.oyo.co.jp/english/products

oyo corporation

PROTEC ENGINEERING
COMPANY PROFILE

安全の創造®
Creation of the Safety

PROTEC ENGINEERING

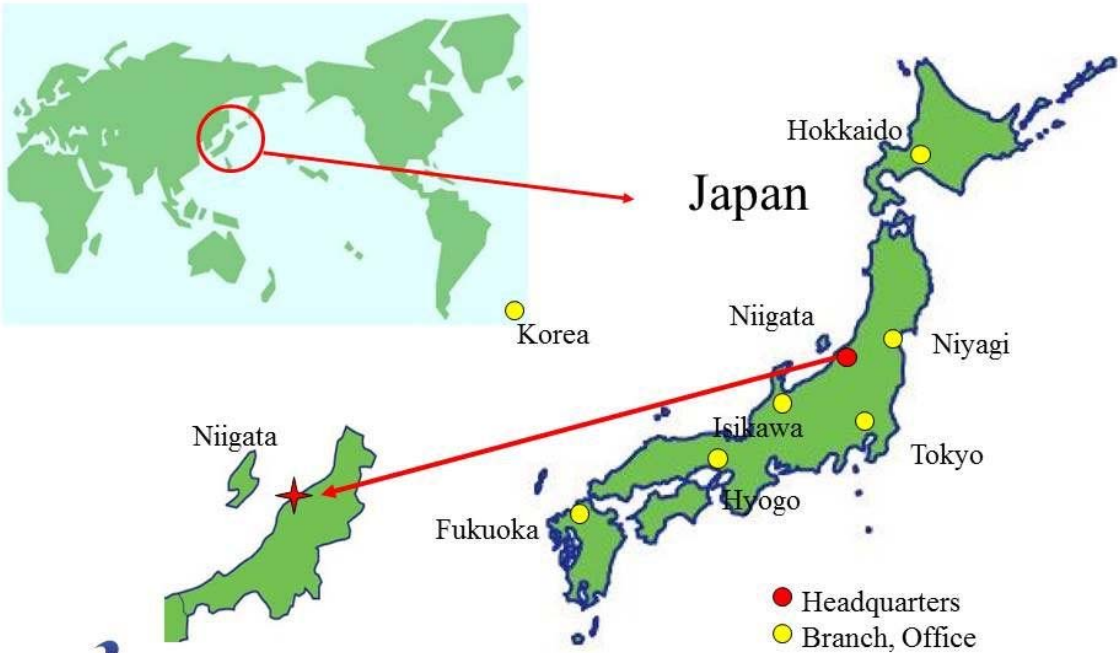
Nov,24,2016

Company's Business contents

- We have been developing effective and economical countermeasures for Rock-fall, Slope failure and Avalanche.
- Lately we started to deal in countermeasure for small size Debris flow.
- We develop, design, produce and install facilities by ourselves consistently.

PROTEC ENGINEERING

Location

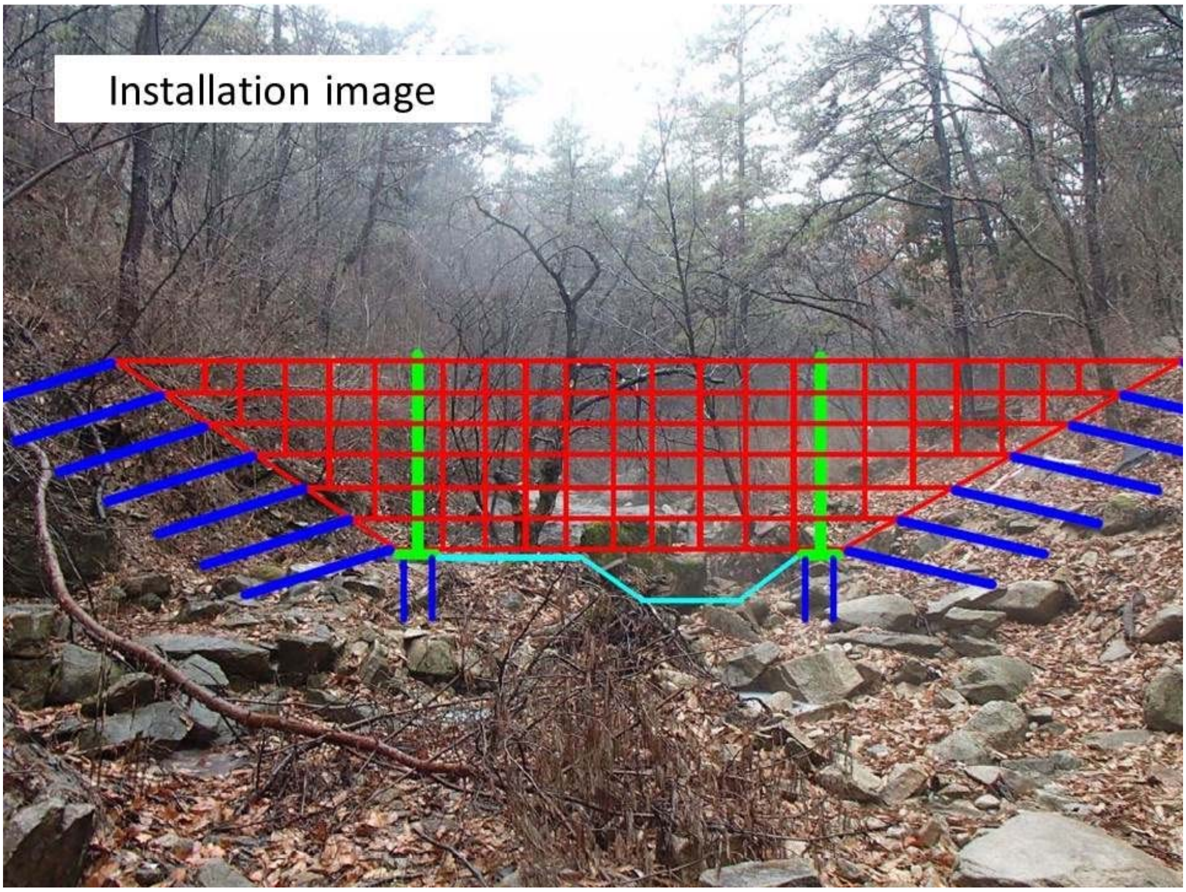


PROTEC ENGINEERING

Overseas Activity

We have an office at Seoul Korea.
Installing Rock-fall barriers and Debris flow barriers.

PROTEC ENGINEERING Debris flow barrier installed in Seoul city



Overseas Activity

We carried out JICA's project 2013〜Sep,2016 in Turkey.

Pilot survey for disseminating small and medium enterprises technologies for countermeasure against avalanche hazards.

Avalanche Prevention fence installed in Bolu Turkey

Activity of JICA's project in Turkey

We trained Turkey local constructor and carried out installation of avalanche prevention fence. Also we carried out a training program in Japan and workshops(3 times) in Turkey concerning countermeasure for avalanche for Turkey government people.

Products for Slope failure and Debris flow

PROTEC ENGINEERING

SLOPE GUARD FENCE

Fence for Slope Failure using Lotus Root Steel Tube

Pillar of the fence is made of newly developed lightweight Lotus Root Steel Tube, so pillar is relatively light but bending strength is very high.
This fence is planar structure, so it can be installed in a narrow construction area mainly on the narrow road side and at the back of local houses.

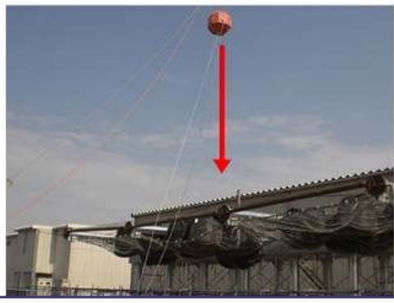
PROTEC ENGINEERING

Performance verification actual scale test

When we develop products, we confirm the performance by actual tests and analysis by computer simulation.

Energy can be absorbed in harmony with collapse of the entire steel pipe.
→Pillar doesn't break as strain doesn't concentrate on the outer steel pipe.

Load test for Sediment soil pressure



Load test for Impact force

U-GUARD

Structure for **small size debris flow** using Lotus Root Steel Tube

This is a newly developed debris flow barrier using Lotus Root Steel Tube. It is installed at the end of valley to protect roads and houses. Since it is a planar structure with piles structure, installation area is smaller than the general concrete dam, and it is possible to reduce the construction period and cost.

PROTEC ENGINEERING

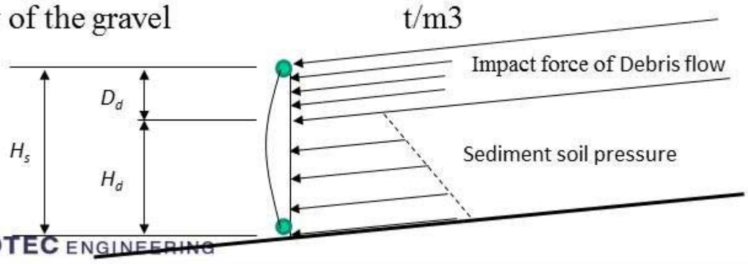
Design Condition

(1) Design load

・Impact force of debris flow ＋ Sediment soil pressure

(2) Consider following factors to design the facility

・Peak flow amount of debris flow	m3/s
・Unit volume weight of debris flow	KN/ m3
・Water depth of debris flow	m
・Flow speed of debris flow	m/s
・Fluid force of debris flow	KN/ m2
・Maximum gravel diameter	m
・Density of the gravel	t/m3



PROTEC ENGINEERING

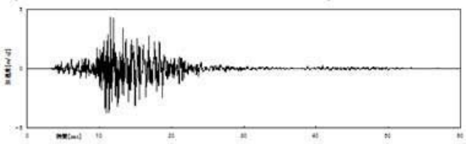

Thank you for your attention!
We will contribute to Reduce the damage of Slope disaster of the world.
Junichiro Aizawa
PROTEC ENGINEERING, INC.
Phone :+81-25-278-1551
E-mail: aizawa@proteng.co.jp
Website: http://www.proteng.co.jp/en/
PROTEC ENGINEERING

Evaluation of the landslide stability at the time of earthquake using numerical analysis

INPUT

■seismic data
・seismic motion data base containing generating landslide

・evaluation of active fault and subduction-zone earthquake

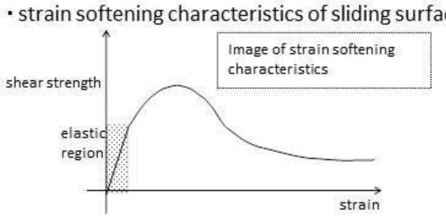


■geo-data
・geological distribution

・bedrock and soil strength

・dynamic deformation characteristic

・strain softening characteristics of sliding surface



■numerical analysis model construction
・model for evaluating of the landslide stability : FEM containing sliding surface element

・sliding surface element importable such soil characteristics information as strain softening

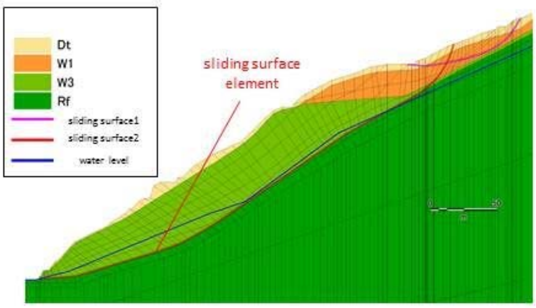
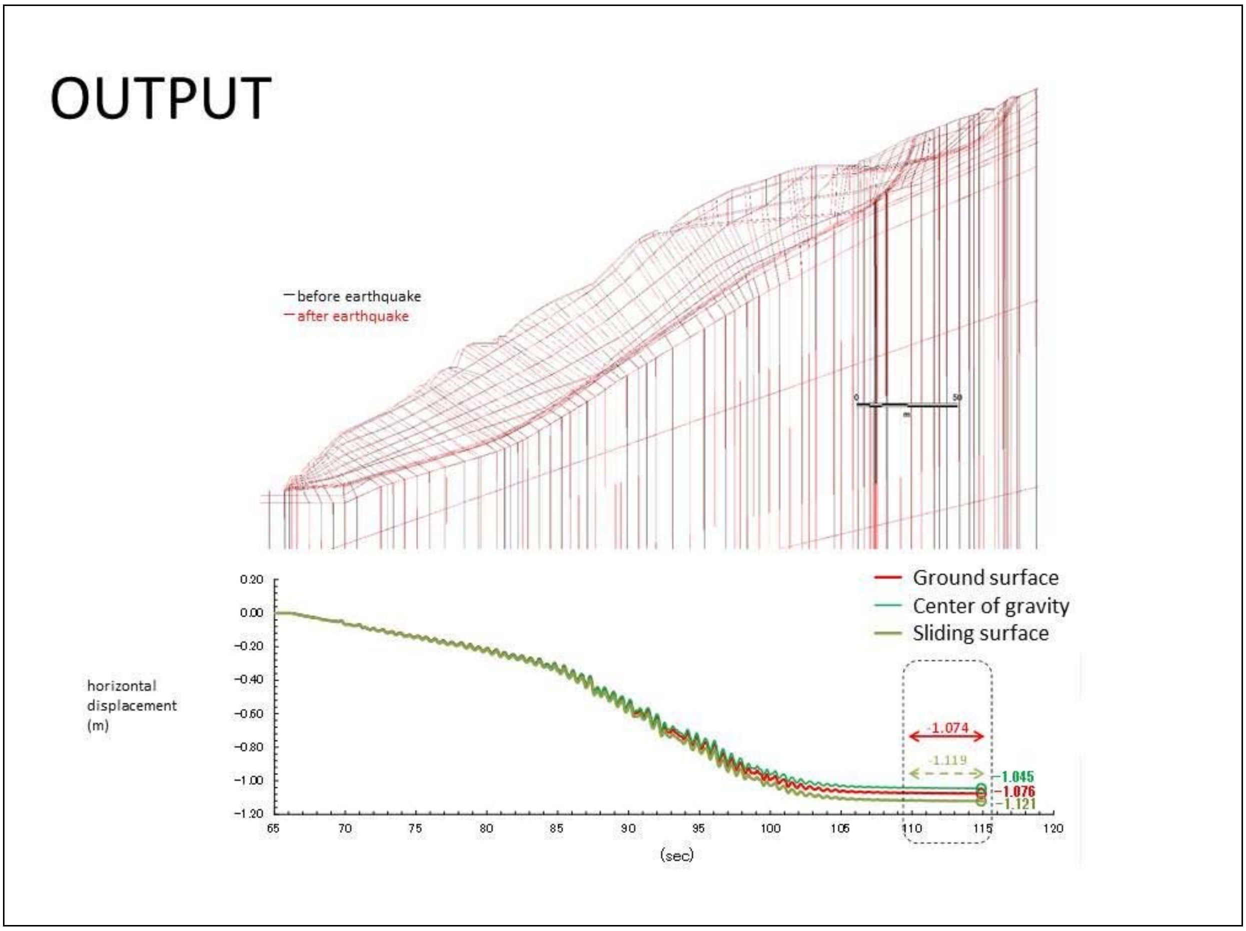
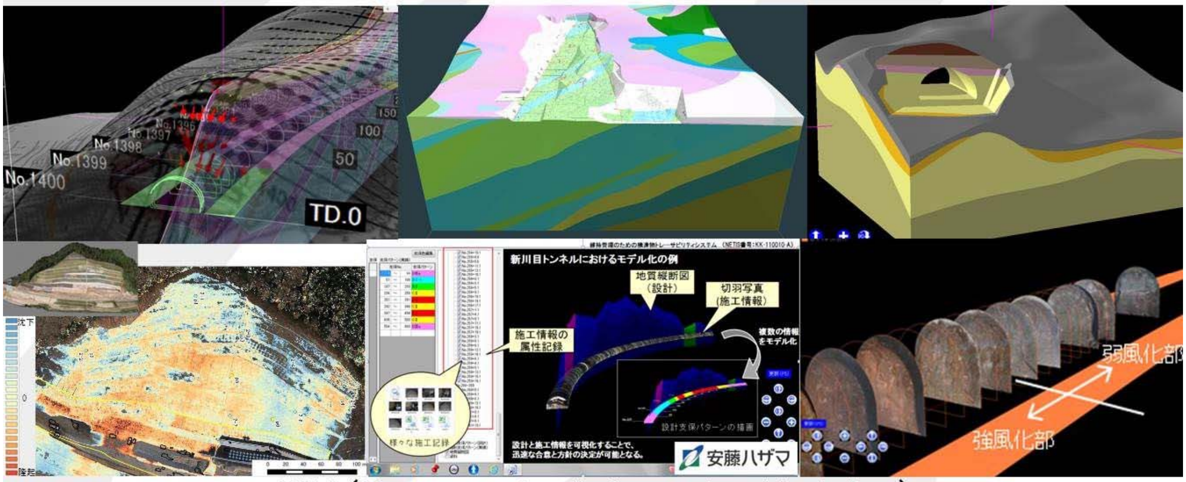


Image of FEM model containing sliding surface element


OUTPUT
before earthquake
after earthquake
Ground surface
Center of gravity
Sliding surface
horizontal displacement (m)
-1.074
-1.119
-1.045
-1.076
-1.121
(sec)

Construction of a geological information management system



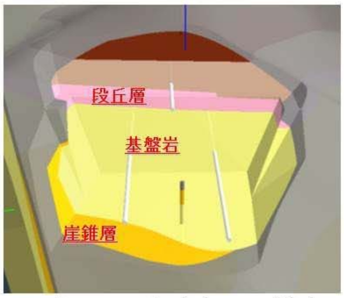
CIM (Construction Information Modeling)

HAZAMA ANDO Corporation
SHINJI UTSUKI

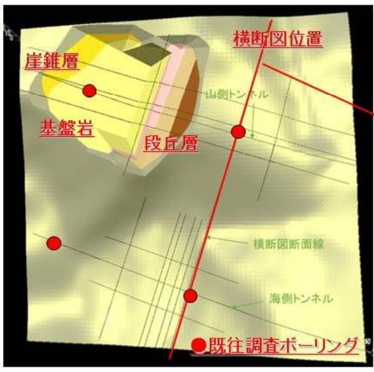
1

3D landslide figure using CIM method

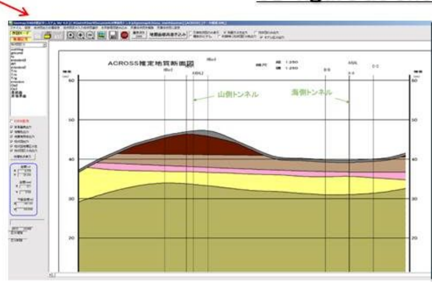
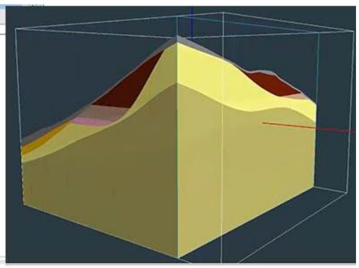
CIM is automatically figured from a few borehole informations.



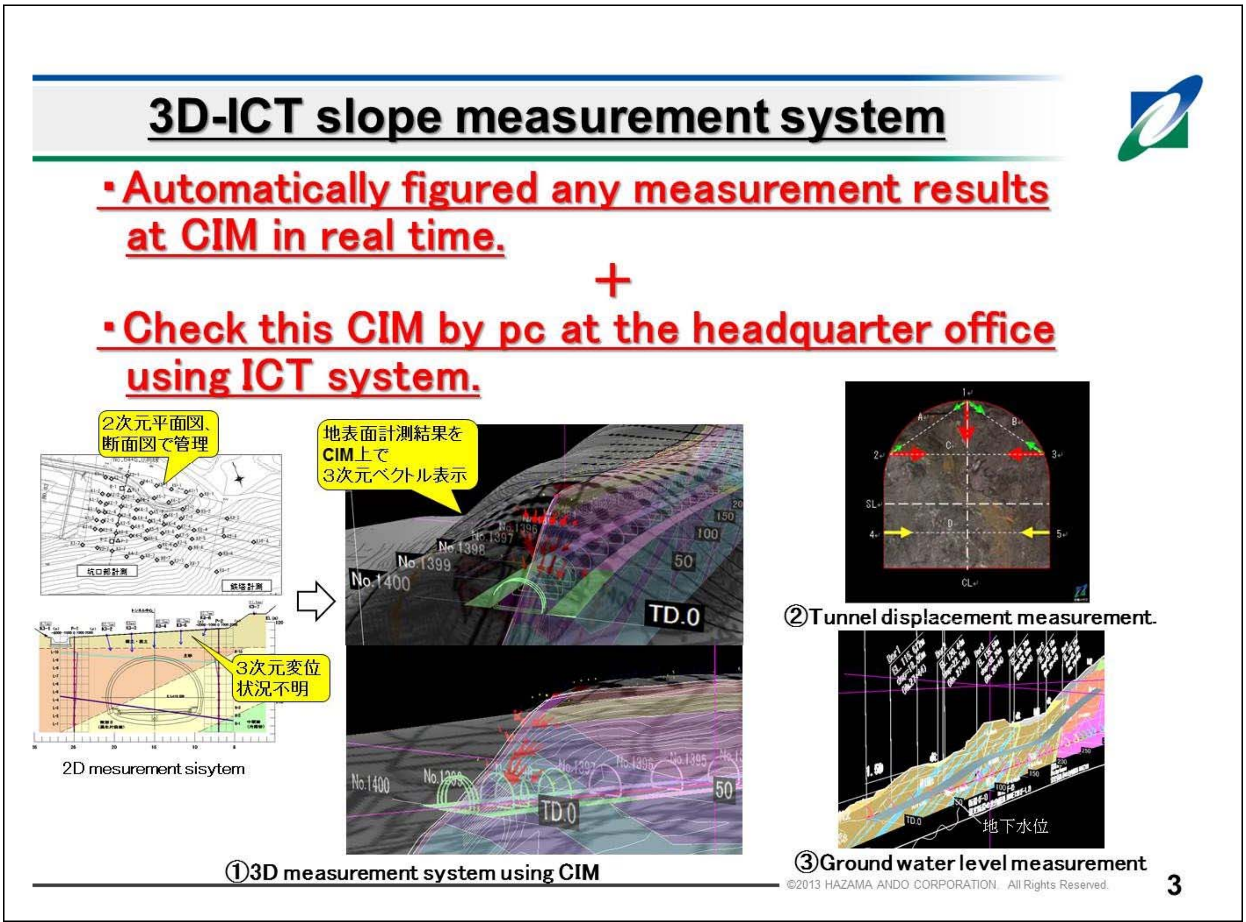
3D figure at excavated slope with landslide

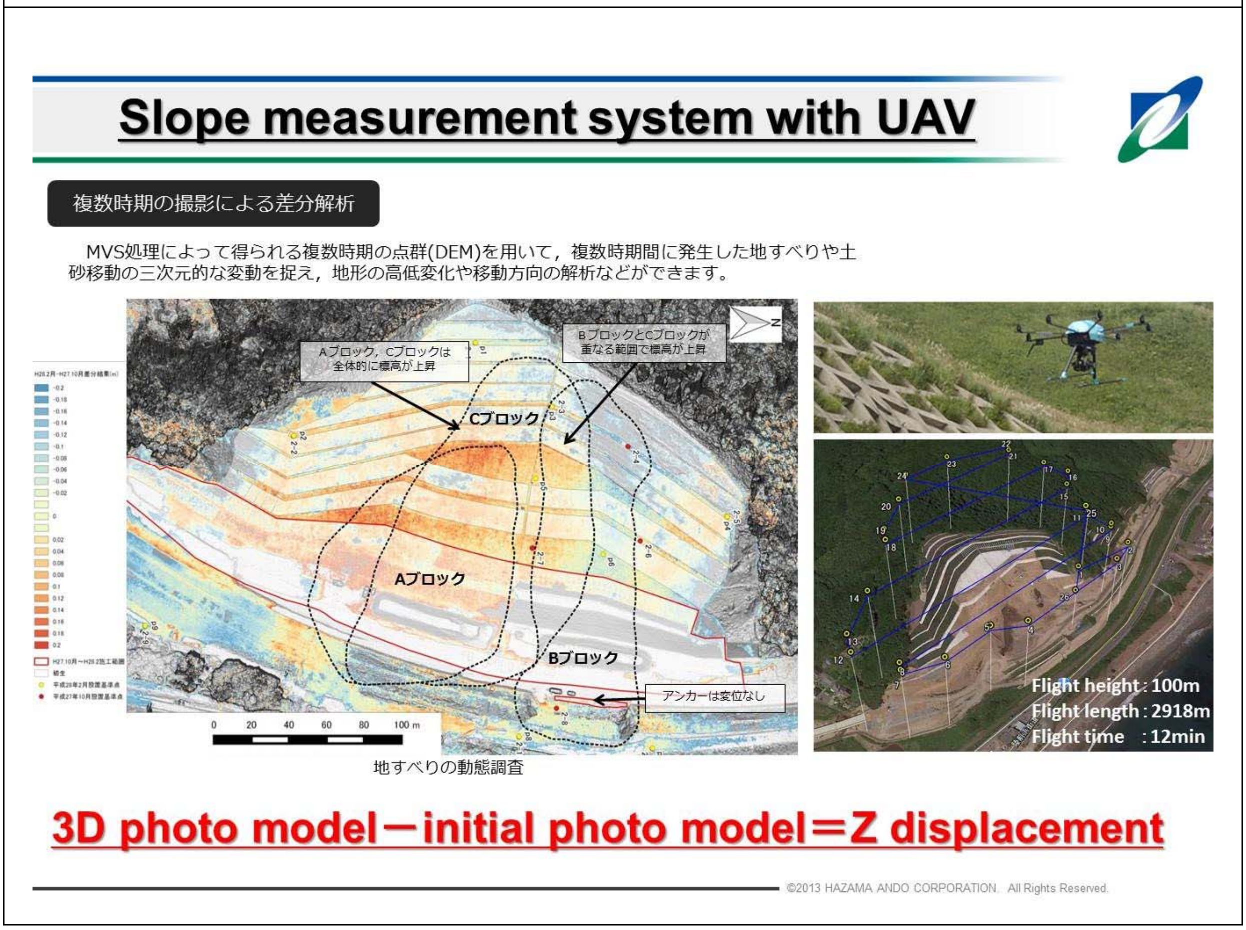


Plane figure with two tunnels .

Automatically figured sectional figures at any point


3D-ICT slope measurement system
・Automatically figured any measurement results at CIM in real time.
+
・Check this CIM by pc at the headquarter office using ICT system.
2次元平面図、断面図で管理
地表面計測結果をCIM上で3次元ベクトル表示
3次元変位状況不明
2D mesurement sisytem
No.1400
No.1399
No.1398
No.1397
No.1396
TD.0
50
100
150
①3D measurement system using CIM
②Tunnel displacement measurement
③Ground water level measurement
地下水位
©2013 HAZAMA ANDO CORPORATION. All Rights Reserved.
3


Slope measurement system with UAV
複数時期の撮影による差分解析
MVS処理によって得られる複数時期の点群(DEM)を用いて，複数時期間に発生した地すべりや土砂移動の三次元的な変動を捉え，地形の高低変化や移動方向の解析などができます。
Aブロック，Cブロックは全体的に標高が上昇
BブロックとCブロックが重なる範囲で標高が上昇
Cブロック
Aブロック
Bブロック
アンカーは変位なし
0 20 40 60 80 100 m
地すべりの動態調査
Flight height : 100m
Flight length : 2918m
Flight time : 12min
3D photo model－initial photo model＝Z displacement
©2013 HAZAMA ANDO CORPORATION. All Rights Reserved.

結論および今後の展開

現場のニーズに即した技術開発＋施工現場適用

- CIM･ICT･AI技術を活用した情報化施工実施
- 現場の「見える化」＋「見守り」管理

↓

- 現場で安価かつ容易に利活用実現

今後の展開

新技術を活用した地質評価の高度化、見せる化

- 調査･設計段階　地質に関わる課題摘出
- 施工段階　地質状況確認、最適な設計変更
- 維持管理段階　経時変化確認、最適な対策

↓

地質状況に応じた最適な建設事業の実現

5

トンネルCIM　開発の経緯～現場適用～今後の展開

CIM活用の利点

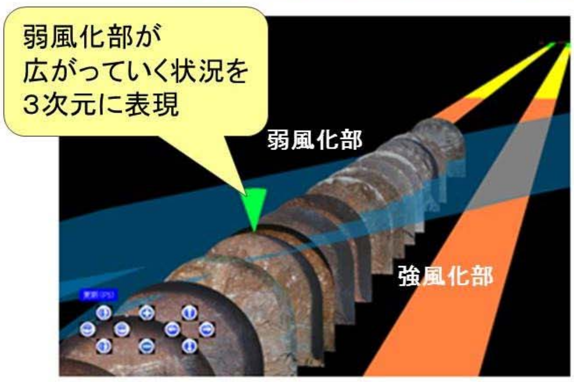
岩判定立会い

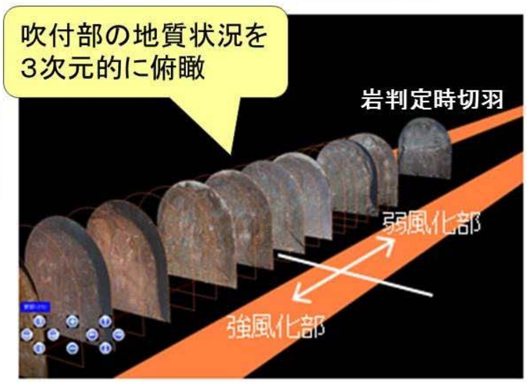
吹付部＝切羽手前の地質状況を3次元的に俯瞰

掘削の進捗に伴う地質状況の変化を「見える化」

↓

地質状況に応じた最適な支保設定に寄与





6

トンネルCIM　開発の経緯～現場適用～今後の展開

CIM活用の利点

竣工検査対応

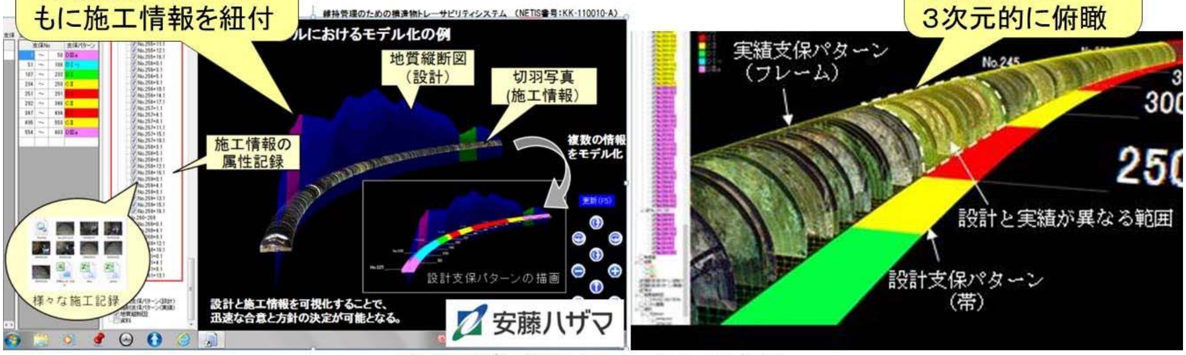
トンネル全線にわたる地質状況を俯瞰
設計変更箇所の地質状況を「見える化」

↓

竣工検査対応の高度化実現

CIM上に切羽写真を3次元配置するとともに施工情報を紐付

設計変更箇所の地質状況を3次元的に俯瞰



東北支店 新川目トンネルの実例

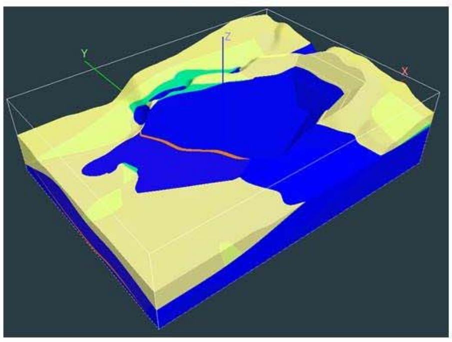
 7

ダム堤体材料原石採取における賦存量CIM管理システムの構築

調査・段階設計　必要骨材量算定、原石山設計
施　工　段　階　原石採取、骨材供給、賦存量管理

↓

・CIMを活用した情報化施工
3次元地質図による詳細検討
賦存量算出などの省力化、高精度化

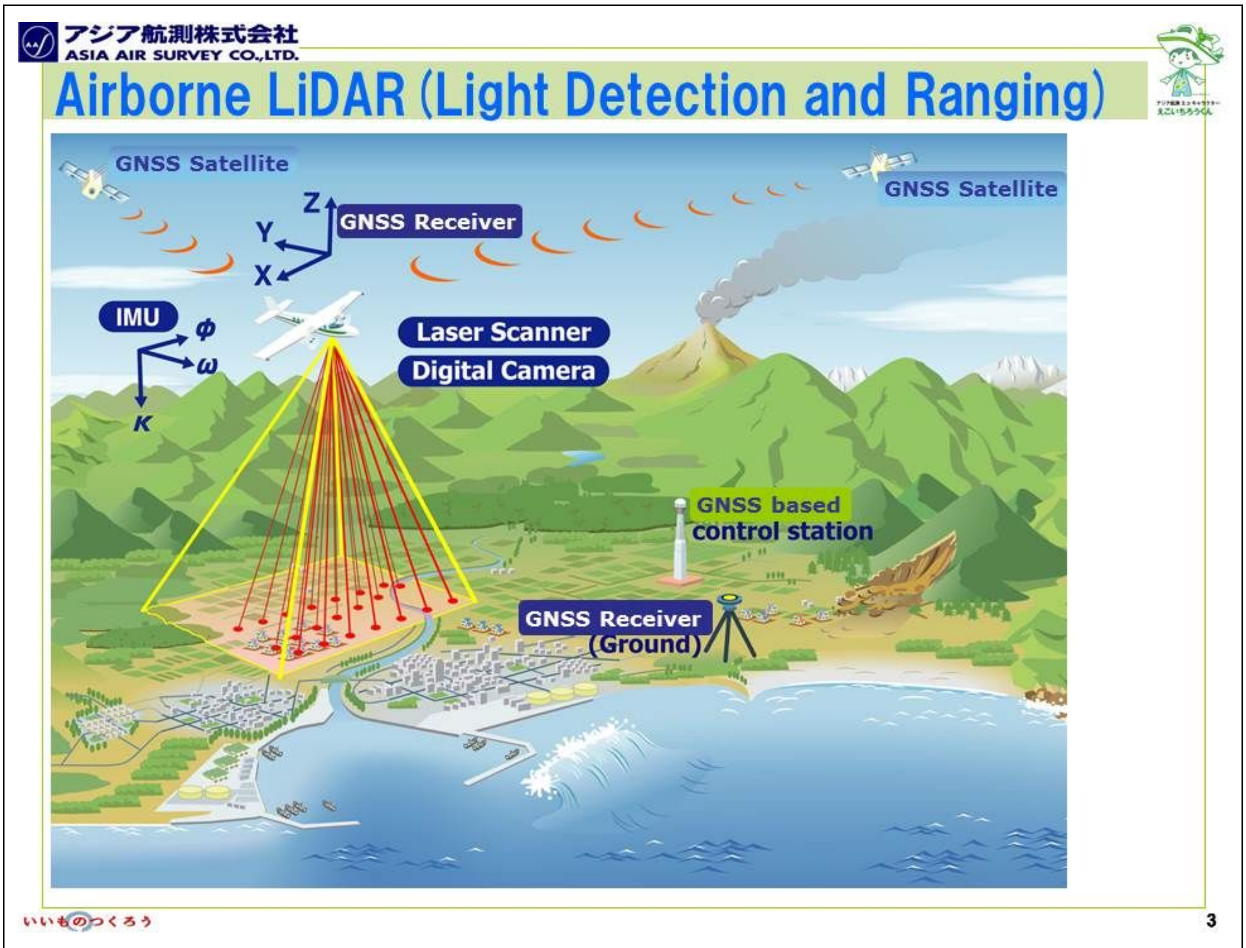


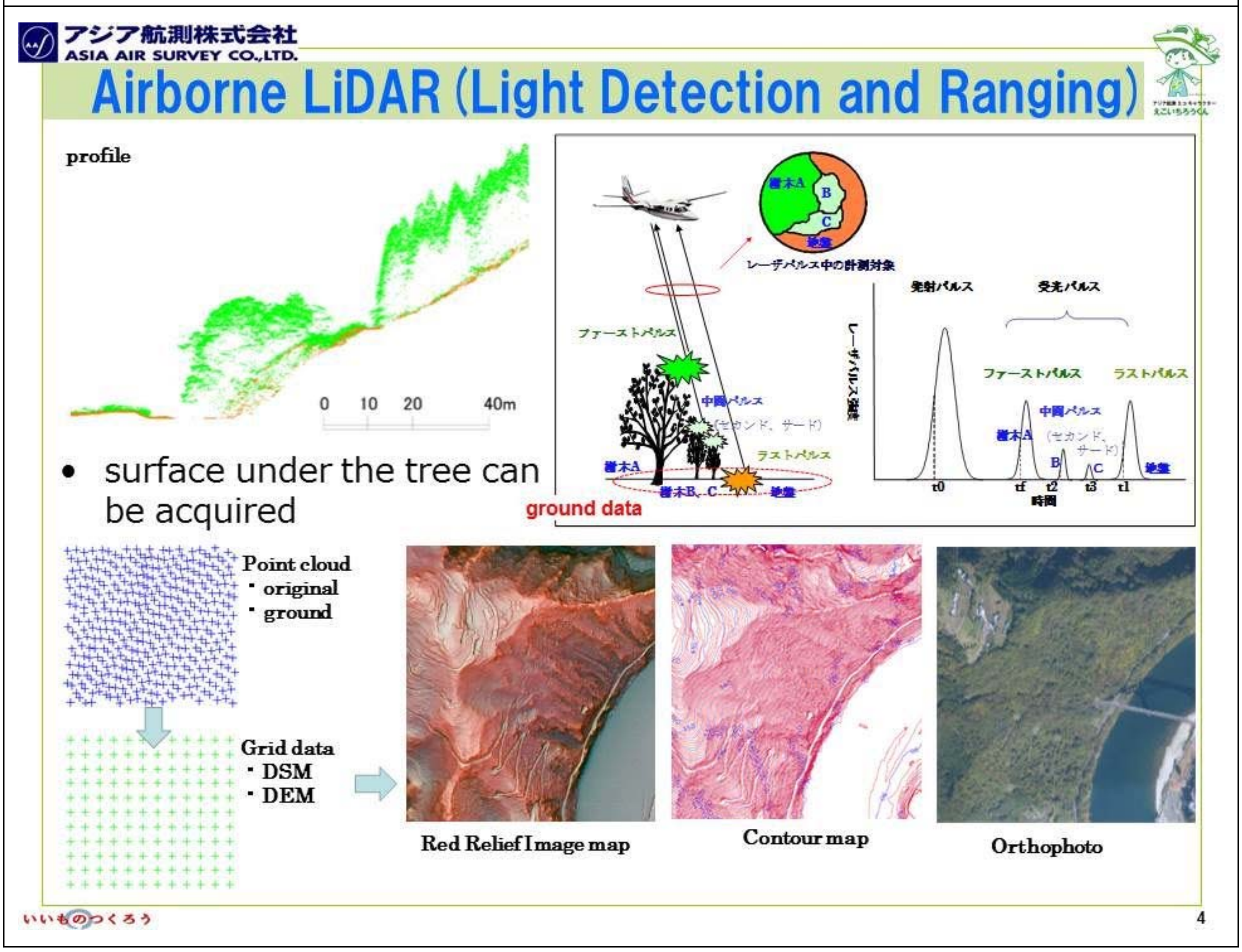
 8

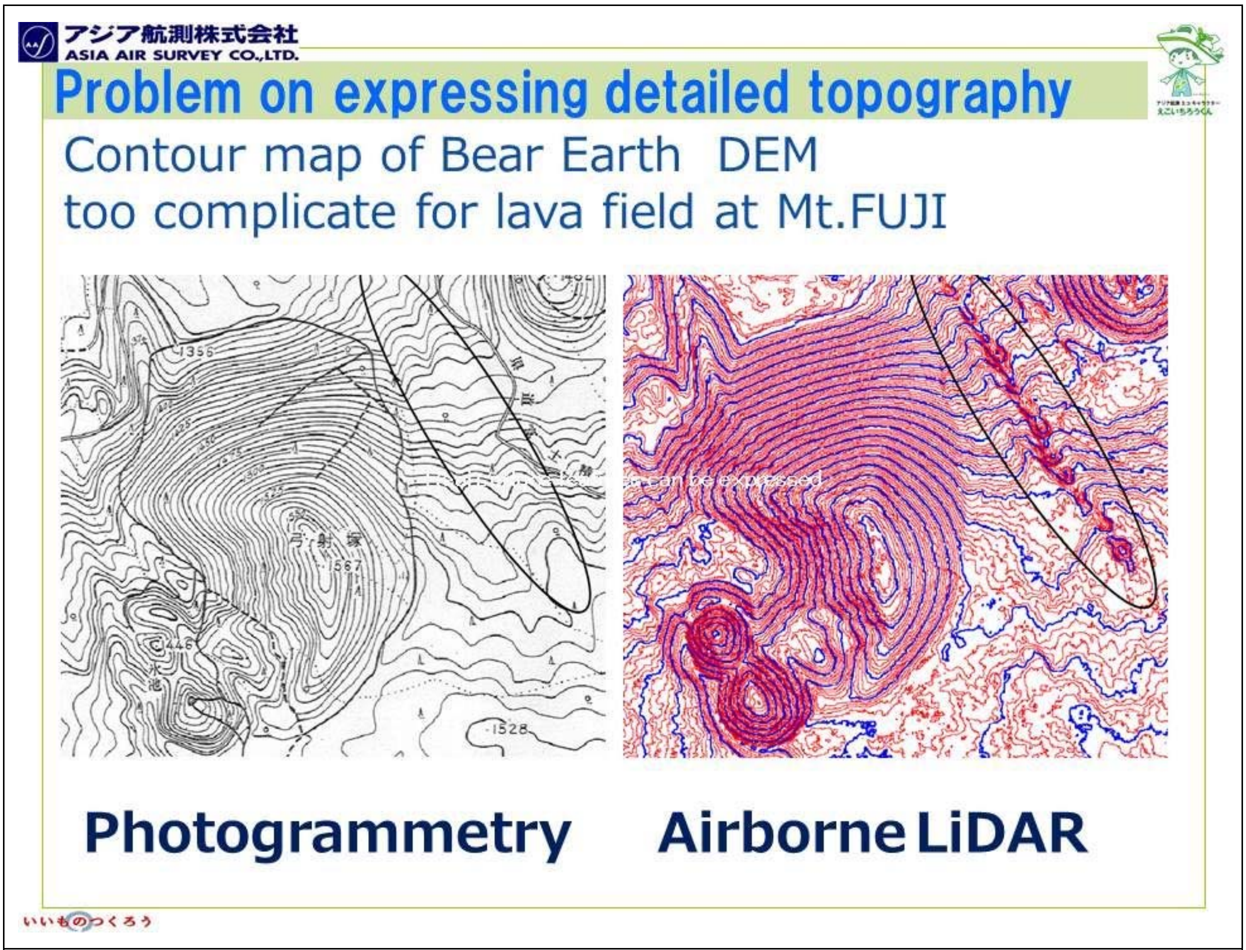
アジア航測株式会社
ASIA AIR SURVEY CO.,LTD.

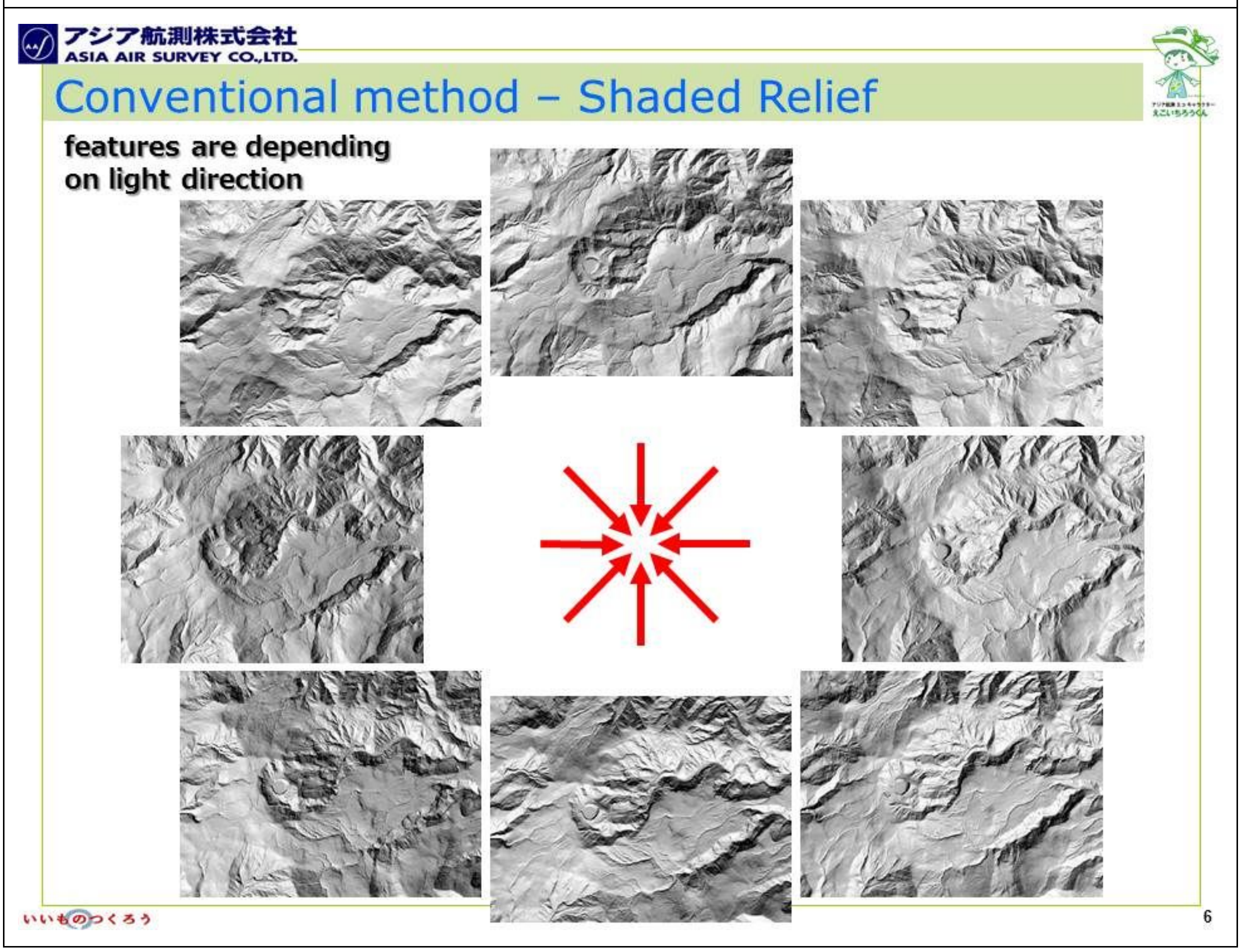
Providing solution using geospatial technology

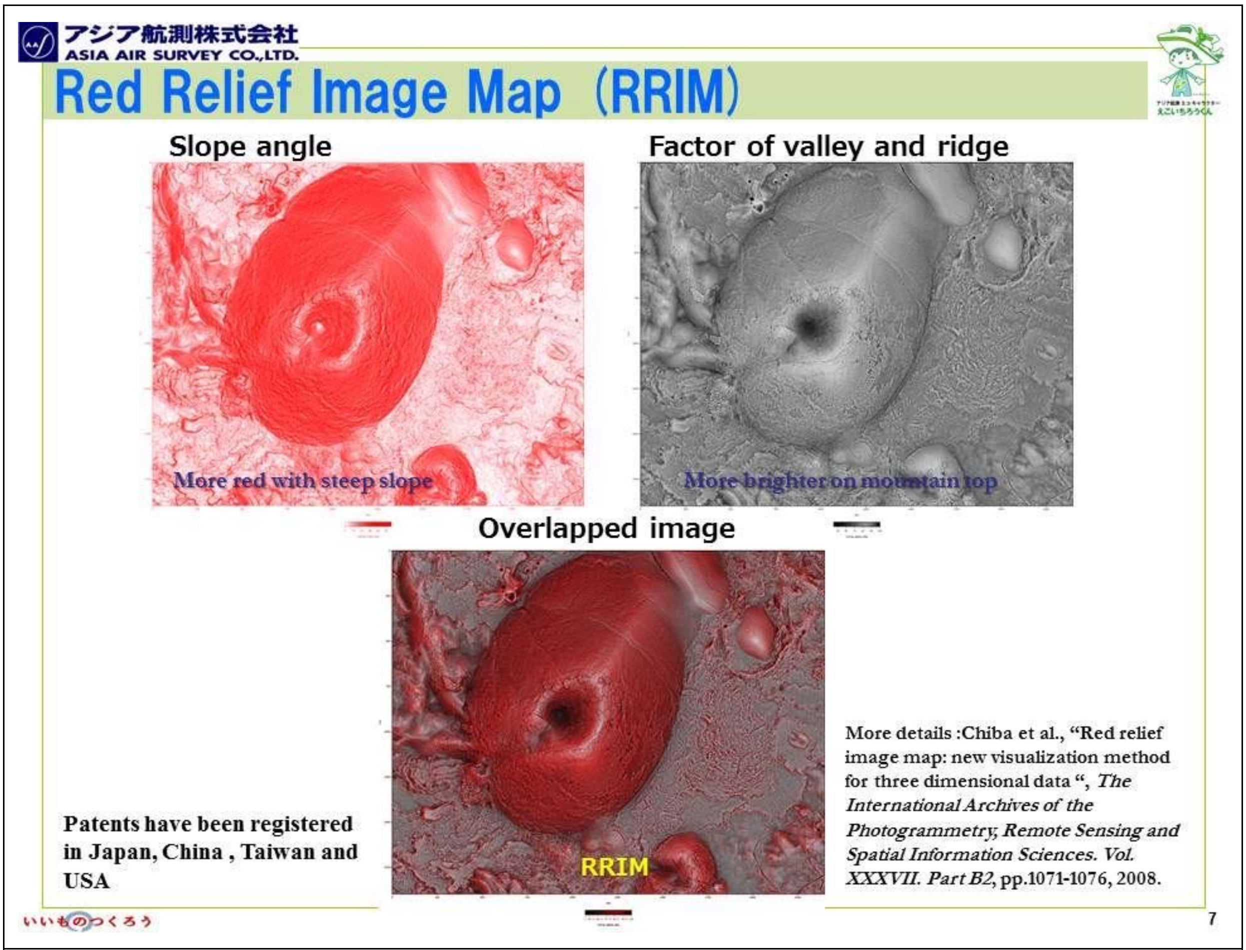
いいものつくろう 2


アジア航測株式会社
ASIA AIR SURVEY CO.,LTD.
Airborne LiDAR (Light Detection and Ranging)
GNSS Satellite
GNSS Satellite
GNSS Receiver
Z
Y
X
IMU
φ
ω
κ
Laser Scanner
Digital Camera
GNSS based
control station
GNSS Receiver
(Ground)
いいものつくろう
3

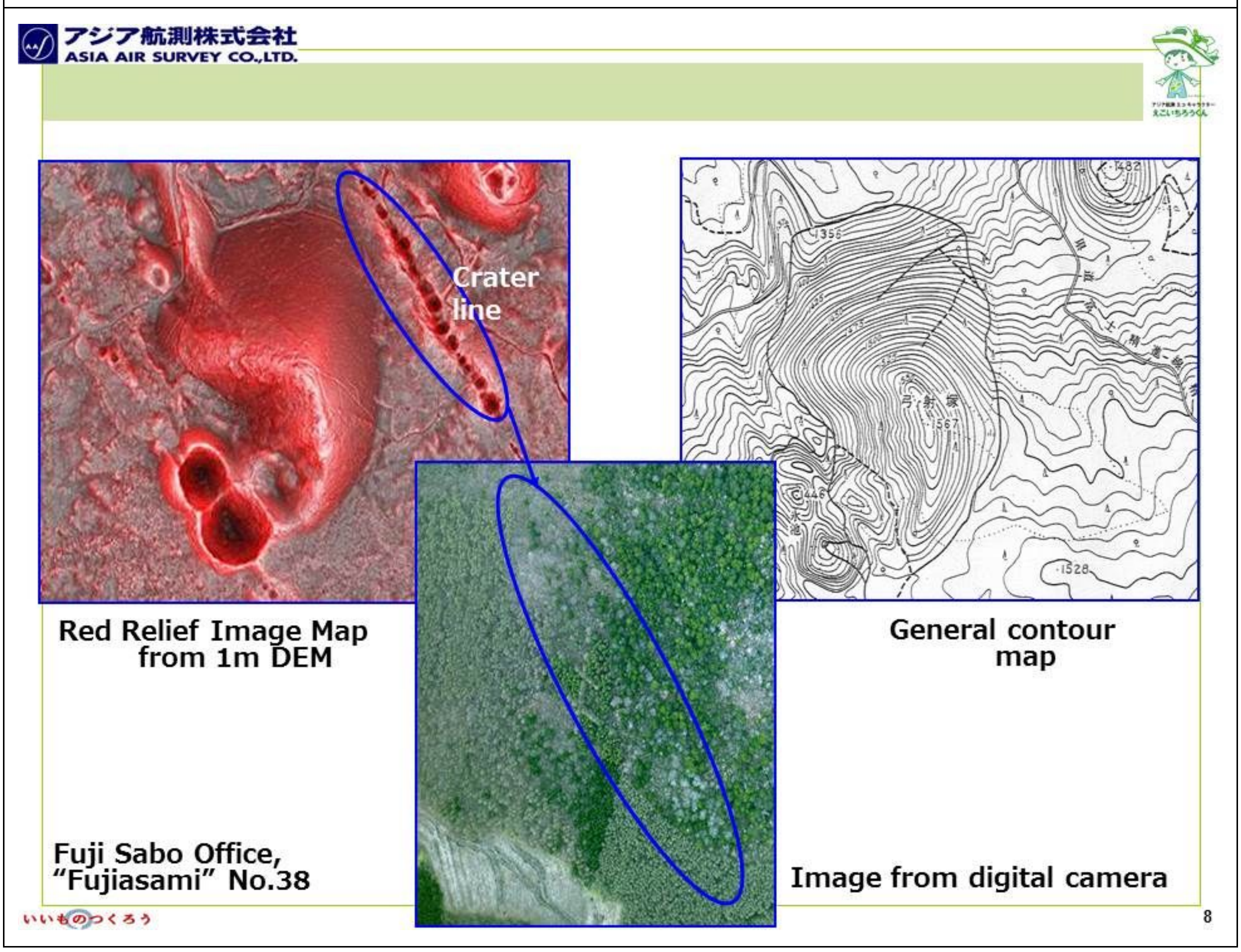

アジア航測株式会社
ASIA AIR SURVEY CO.,LTD.
Airborne LiDAR (Light Detection and Ranging)
profile
0 10 20 40m
• surface under the tree can be acquired
ground data
B
C
レーザパルス中の計測対象
ファーストパルス
中間パルス
(セカンド、サード)
ラストパルス
発射パルス
受光パルス
レーザパルス強度
ファーストパルス
ラストパルス
中間パルス
(セカンド、サード)
t0
tf
t2
t3
tl
時間
Point cloud
・original
・ground
Grid data
・DSM
・DEM
Red Relief Image map
Contour map
Orthophoto
いいものつくろう
4


アジア航測株式会社
ASIA AIR SURVEY CO.,LTD.
Problem on expressing detailed topography
Contour map of Bear Earth DEM
too complicate for lava field at Mt.FUJI
1356
1567
1446
1528
Photogrammetry
Airborne LiDAR
いいものつくろう

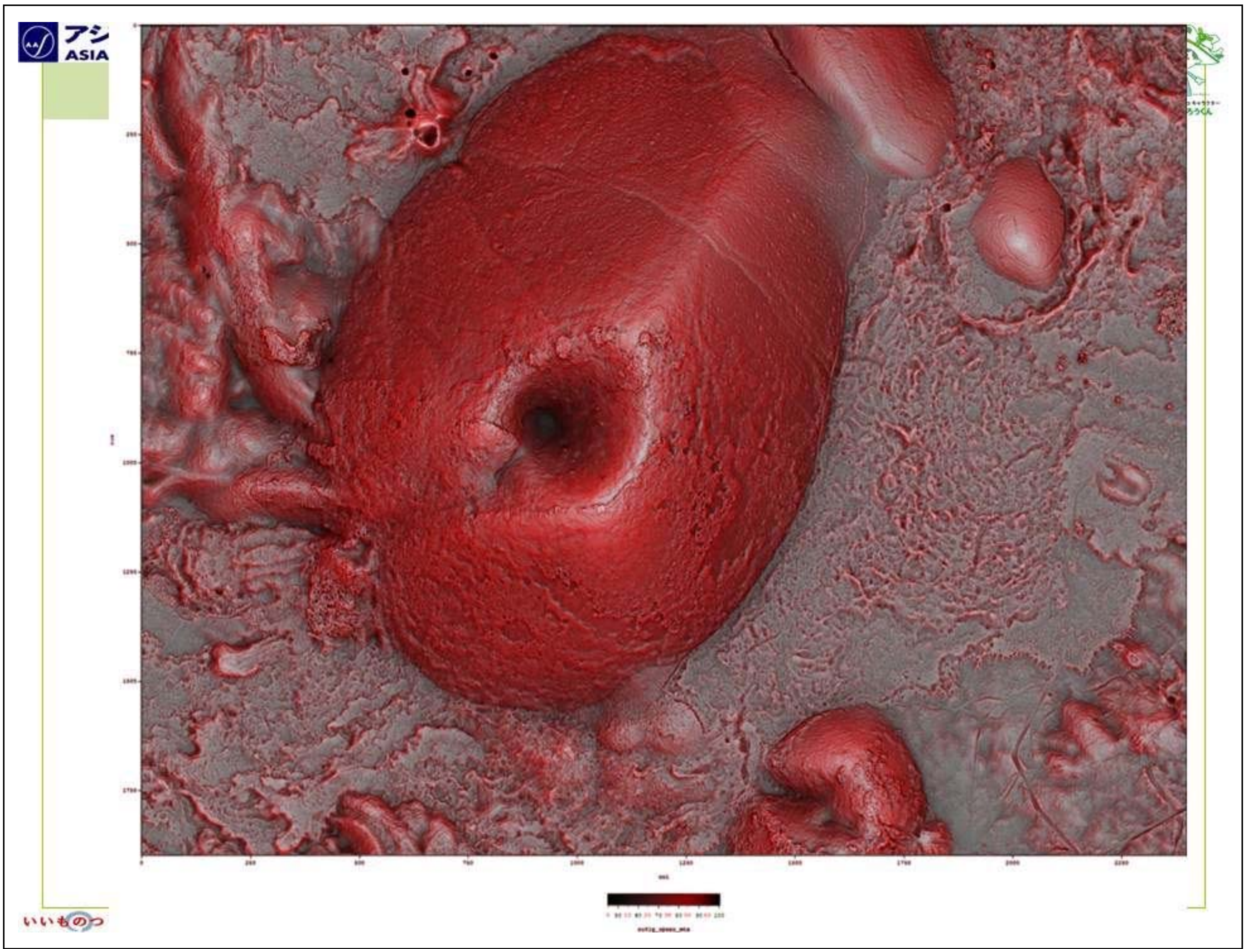

アジア航測株式会社
ASIA AIR SURVEY CO.,LTD.
Conventional method – Shaded Relief
features are depending
on light direction
いいものつくろう
6

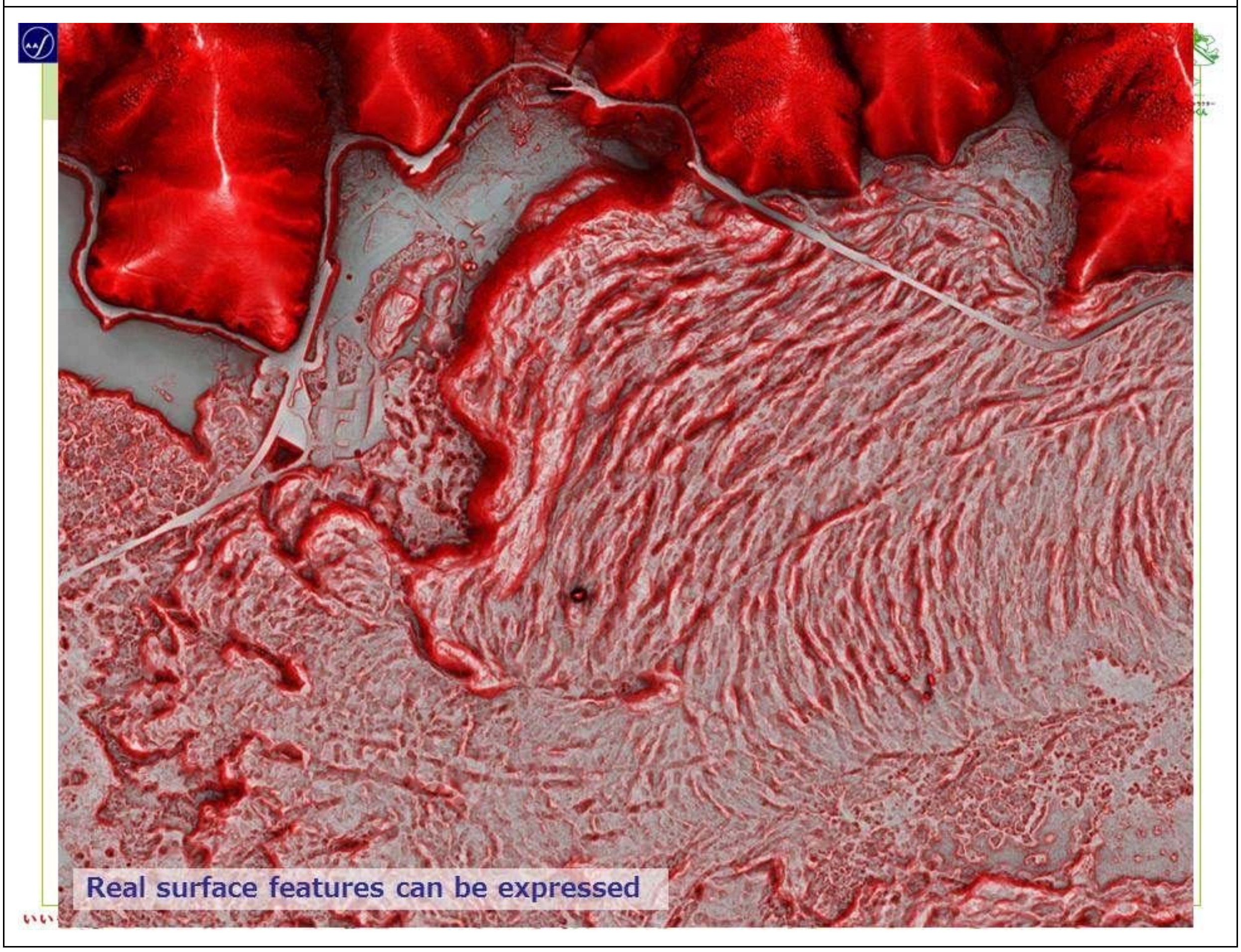


アジア航測株式会社
ASIA AIR SURVEY CO.,LTD.
Red Relief Image Map (RRIM)
Slope angle
More red with steep slope
Factor of valley and ridge
More brighter on mountain top
Overlapped image
RRIM
Patents have been registered in Japan, China , Taiwan and USA
More details :Chiba et al., "Red relief image map: new visualization method for three dimensional data ", The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B2, pp.1071-1076, 2008.
いいものつくろう
7



アジア航測株式会社
ASIA AIR SURVEY CO.,LTD.
Crater line
Red Relief Image Map from 1m DEM
General contour map
Fuji Sabo Office, "Fujiasami" No.38
Image from digital camera
いいものつくろう
8


ASIA


Real surface features can be expressed

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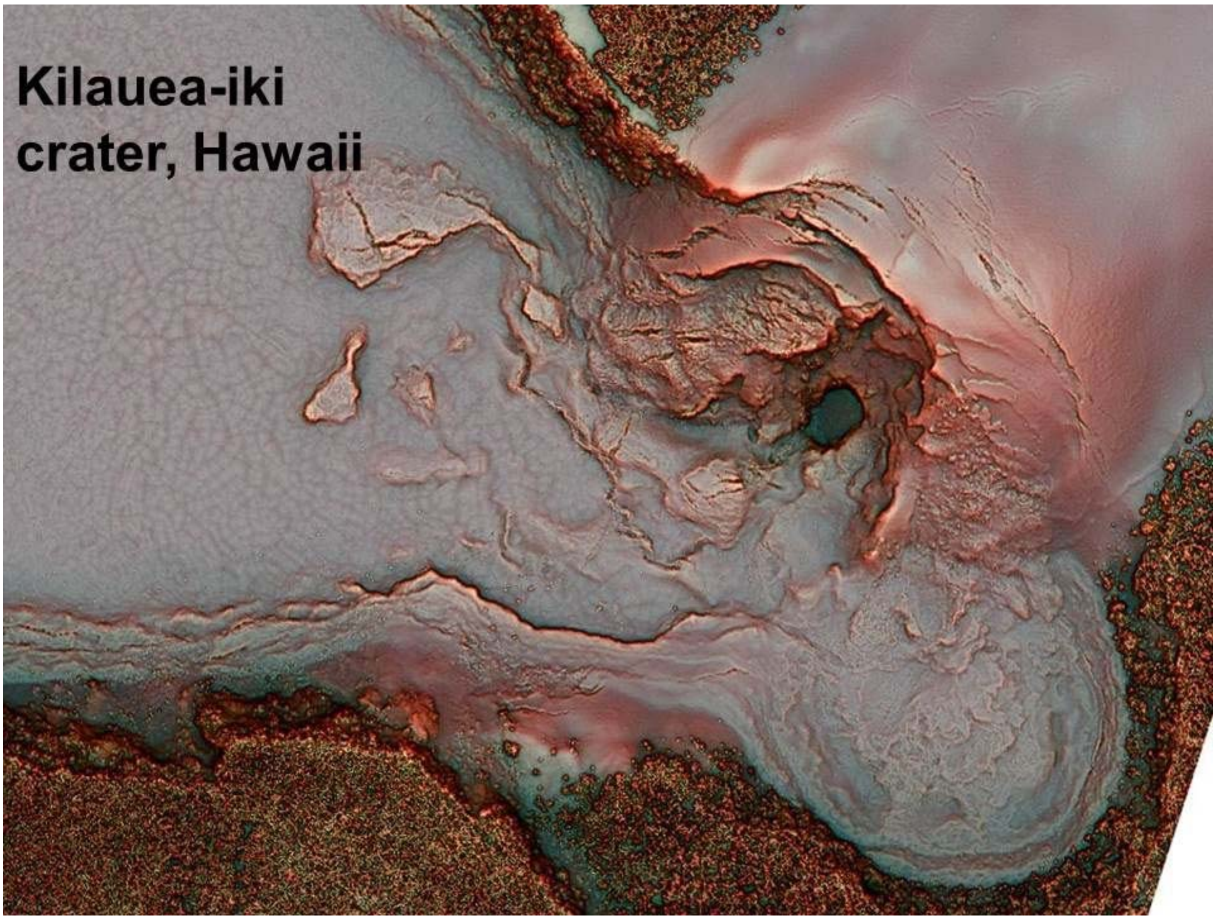
ASIA AIR SURVEY CO.,LTD.

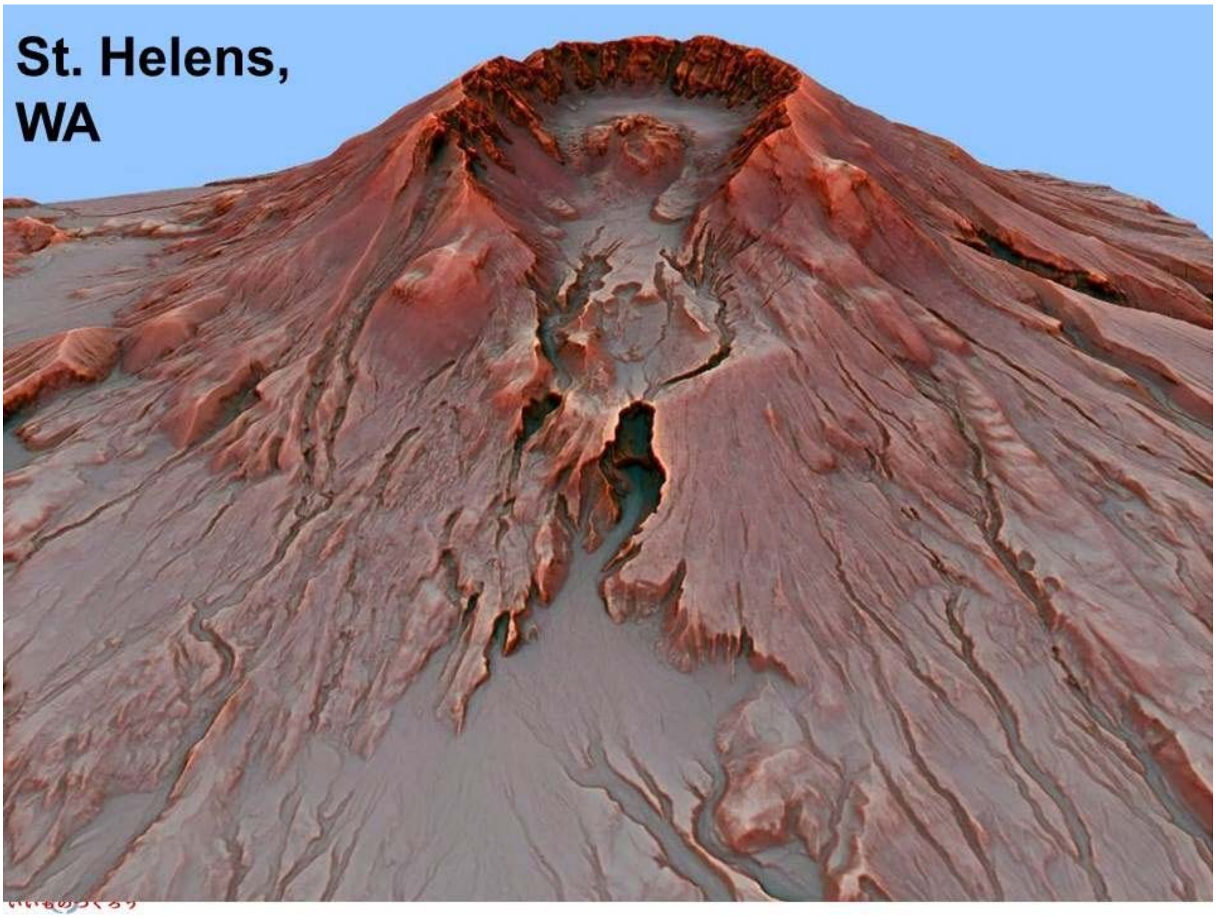
Application

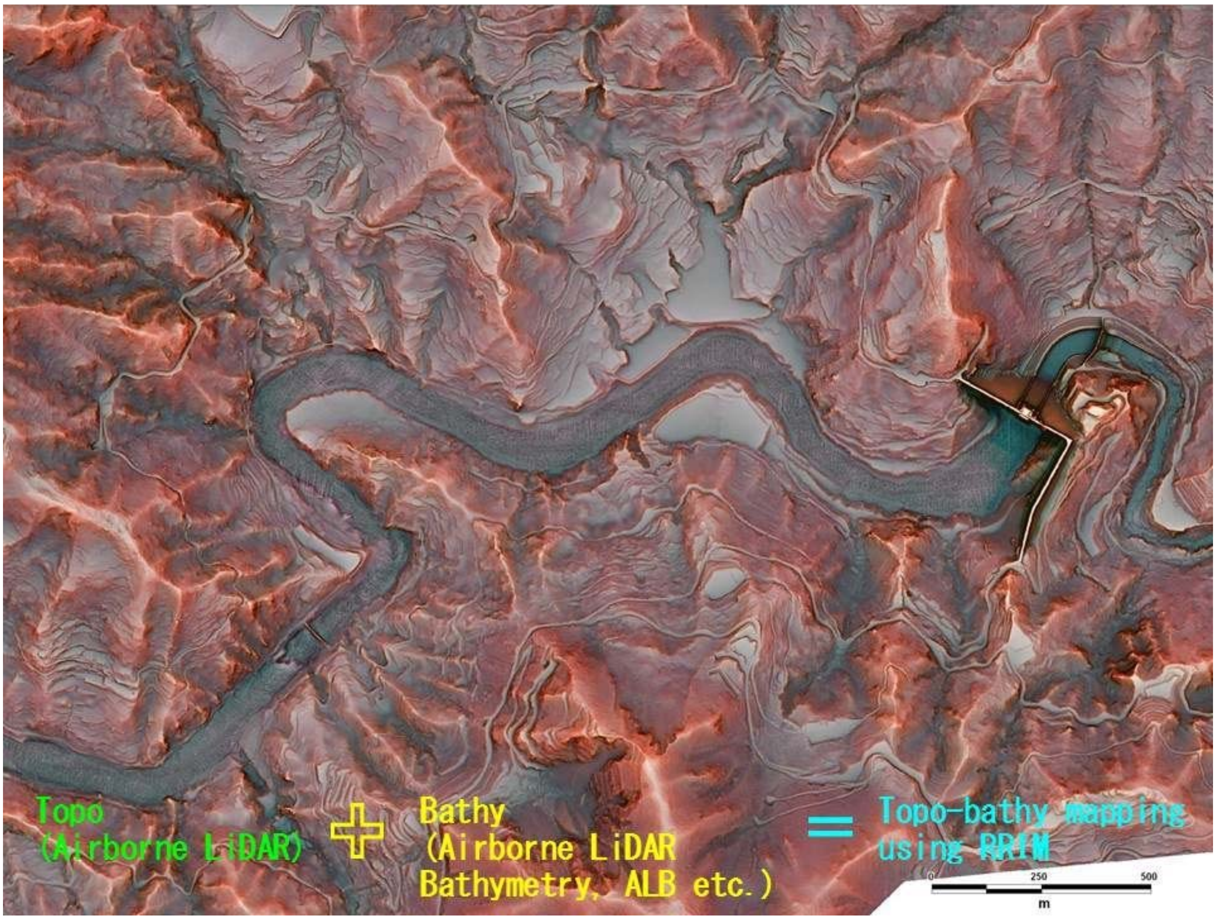
①Kilauea-iki crater, Hawaii
②St. Helens, WA
③Topo-bathy mapping using RRIM
④3D Model using photographs taken by UAV
etc.

11

いいものつくろう




St. Helens,
WA


Topo
(Airborne LiDAR)
Bathy
(Airborne LiDAR
Bathymetry, ALB etc.)
Topo-bathy mapping
using RRIM
250
500
m

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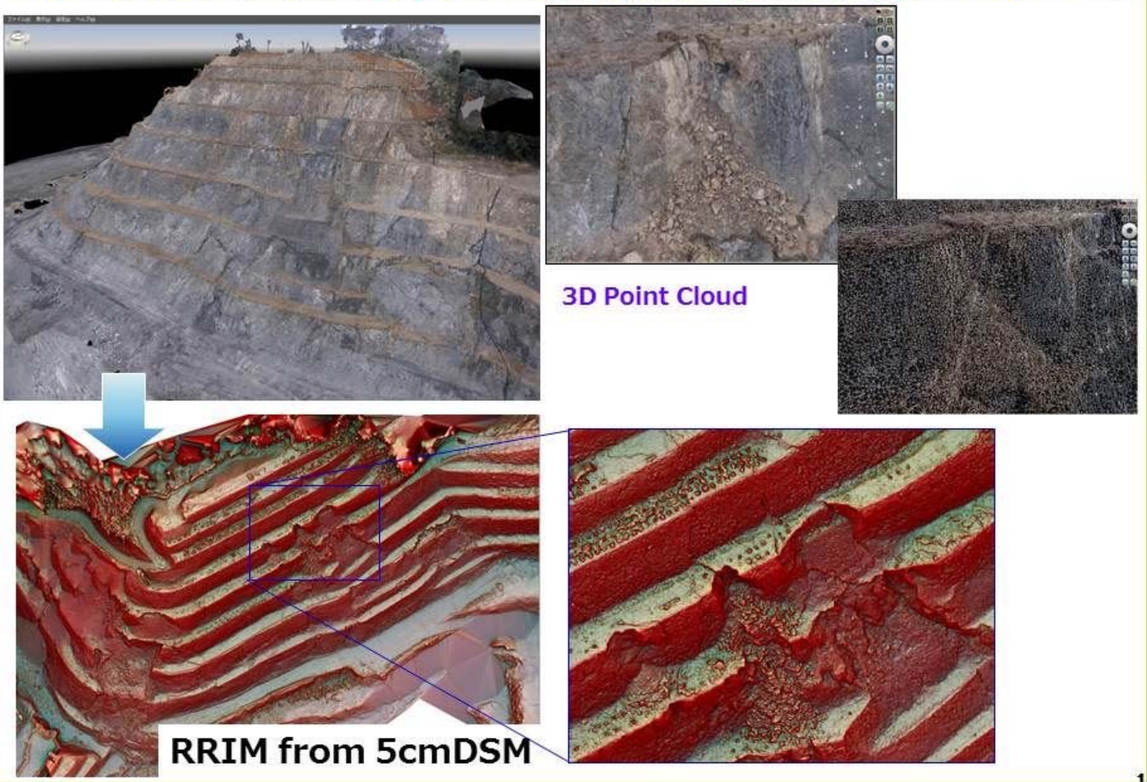
3D Model using photographs taken by UAV



いいものつくろう 15

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いいものつくろう 16


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3Dモデリングサービス
従来手法
デジタル航空カメラ
航空レーザ
デジタルステレオ図化機（図化名人）
建物：外形線（DM）に建物高付与
標高
建物外形
2.5D
細部表現困難
いわゆる「箱モデル」
新手法【マルチビューステレオ方式】
航空カメラ や 手持ちカメラ
オーバーラップ約80%の写真
ほぼ自動で作成
リアル3D
細部表現可能
写真画像
外部標定要素
カメラキャリブレーション
3Dモデルデータ作成
空中三角測量、モデリング
テクスチャ貼付
データ編集
穴埋め、間引き、平滑化 等
データ活用
3Dモデル
DSM,オルソ
特徴① プラットフォームを選ばない！
航空機／手持ちカメラ、DMC、オブリークカメラ
無人航空機／各種カメラ
地上／手持ちカメラ 等
特徴② リアル3D！
オーバーハングも表現可能
特徴③ 高速化を実現
災害時に威力を発揮。
2日後に撮影の写真で比較モデルを作成した例
いいものつくろう
17


アジア航測株式会社
ASIA AIR SURVEY CO.,LTD.
無人航空機（Unmanned Aerial Vehicle,UAV）
連続で斜め写真を旋回撮影
UAV
ラップした複数枚の画像
ビデオカメラ
赤外線カメラ
デジタルカメラ
レーザスキャナ
自動で三次元モデル化
災害後の状況早期確認
高所の構造物の変状等確認
高所の露岩、オーバーハング部の亀裂等確認
海岸沿いなど人が行けない箇所の状況確認
いいものつくろう

International Forum

“Japanese contribution to Landslide Disaster Risk Reduction”

Sendai partnership 2015-2025 for global promotion of understanding and reducing landslide disaster risk
Science and Technology Research Partnership for Sustainable Development (SATREPS)

A Programme of the ICL for ISDR

Organized by ICL and the Japan Landslide Society
Supported by the Japan Science and Technology Agency (JST) and UNESCO

Kyoji SASSA
Executive Director of ICL

Sendai Partnerships 2015-2025Road Map to 2020

2015				2016				2017				2018				2019				2020			
3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
WCDRR									GP WLF4								GP					WLF5	
仙台防災会議									世界フォーラム													世界フォーラム	
国際地すべりジャーナル（Landslides)の発展計画　From bimonthly to monthly journal																							
200 pages x 6 times/year								300 pages x 6 times/year								170 pages x 12 times/year							
地すべり教材の作成（Landslide Interactive Teaching Tools, テキスト、PPT, PDF)																							
1700 pages (97 tools)									2200 pages (130 tools)														
世界地すべりレポート（ICL World Report on Landslides)																							
Model establishment and 30 reports									300 reports and data sharing within reporters														
One Field Summer School/year										One field summer school+ Summer school/year													

斜面防災世界フォーラム(World Landslide Forum)

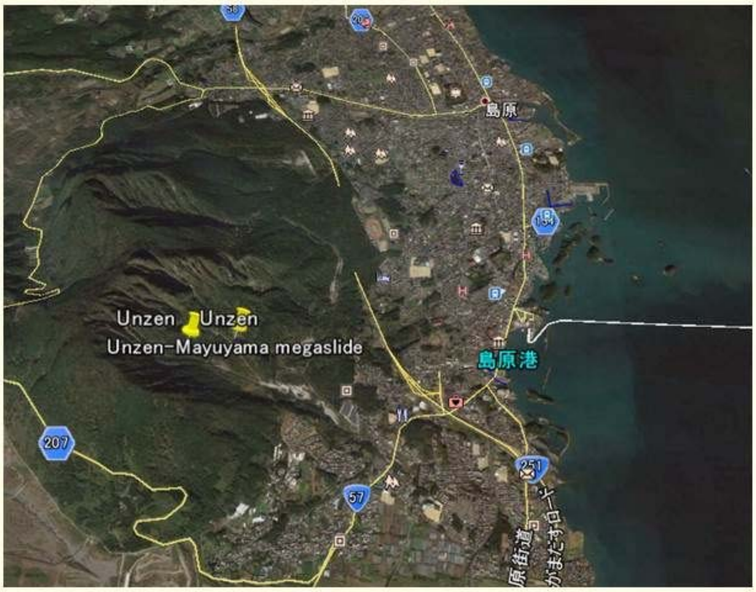
WLF1 2008, Tokyo, Full color Book１(Springe)+Mono-color book ２
WLF2, 2011, Rome, Full color Book ７(Springer)
WLF3, 2014, Beijing, Full color Book 3 (Springer)+Mono-color book 1
WLF4, 2017, Ljubljana, Full color Book 5 (Springer)
Vol.1 Sendai Partnerships is Open access book.
WLF5, 2-6 Nov. 2020, Kyoto, Japan (300 from Japan, 300 from abroad)
Full color Book 5 (Springer)＋Free Access thematic issue of Landslides + CD proceeding (open access in IPL web)

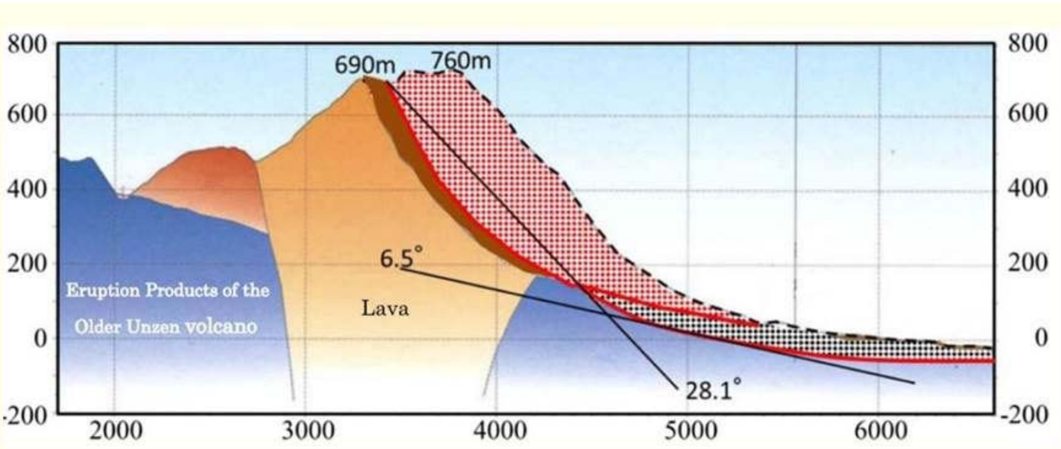
１. Full color books (Vol.1-Vol.5) published by Springer-Nature Full color
Paper submission is by end of 2019. Published by WLF5 in September
2. Free access Thematic issue "Sendai Partnerships 2015-2025" of *Landslides* will be published in October 2020 (free access from 10 October to 10 November 2020)
3. Open access proceedings by IPL Global Promotion Committee in IPL WEB
Paper submission is by the end of April 2020

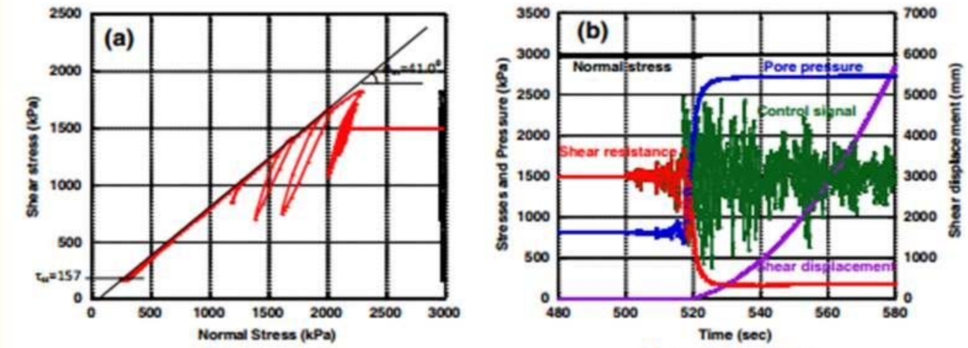
Please join the organizing committee and propose the session which are suitable for you (in Japan, China, Korea, private companies and policy makers etc)

Please access to ICL World Reports on Landslides in IPL WEB <**http://iplhq.org/ls-world-report-on-landslide/**>

An Example of Report (1792 Unzen Mayuyama Landslide)

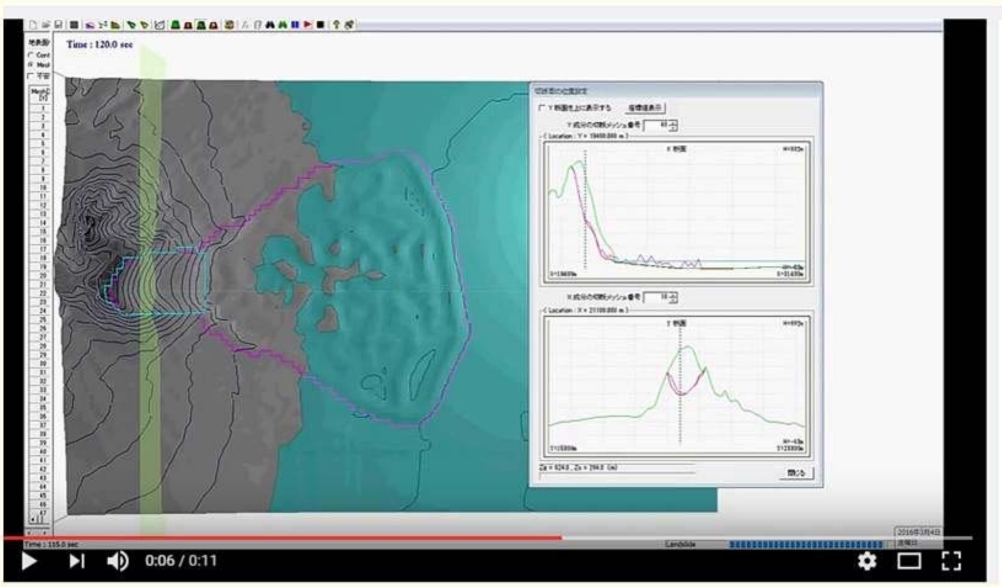




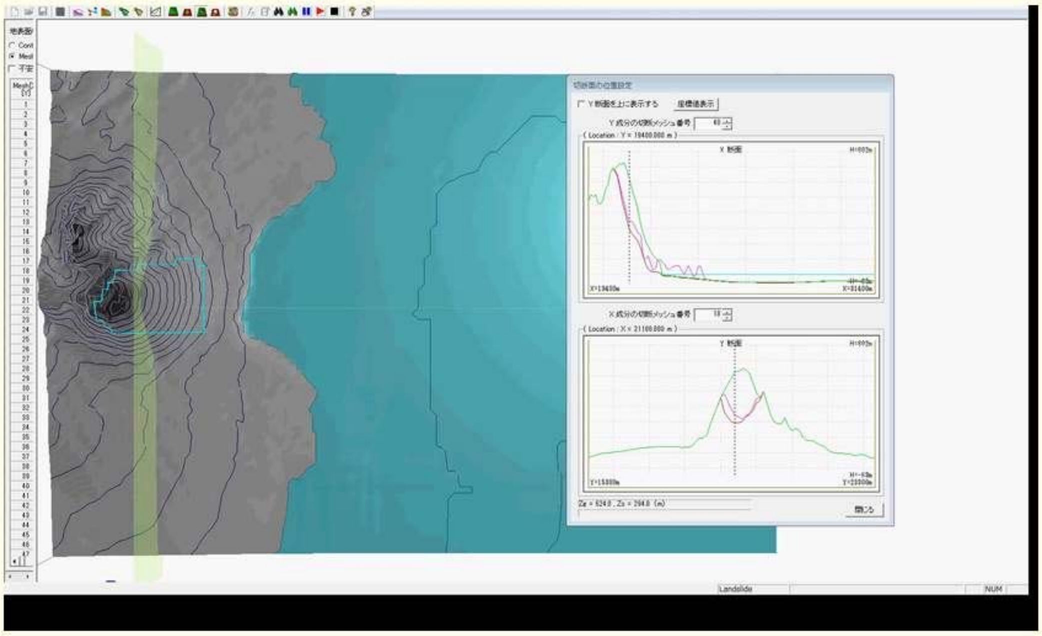


a) Stress path

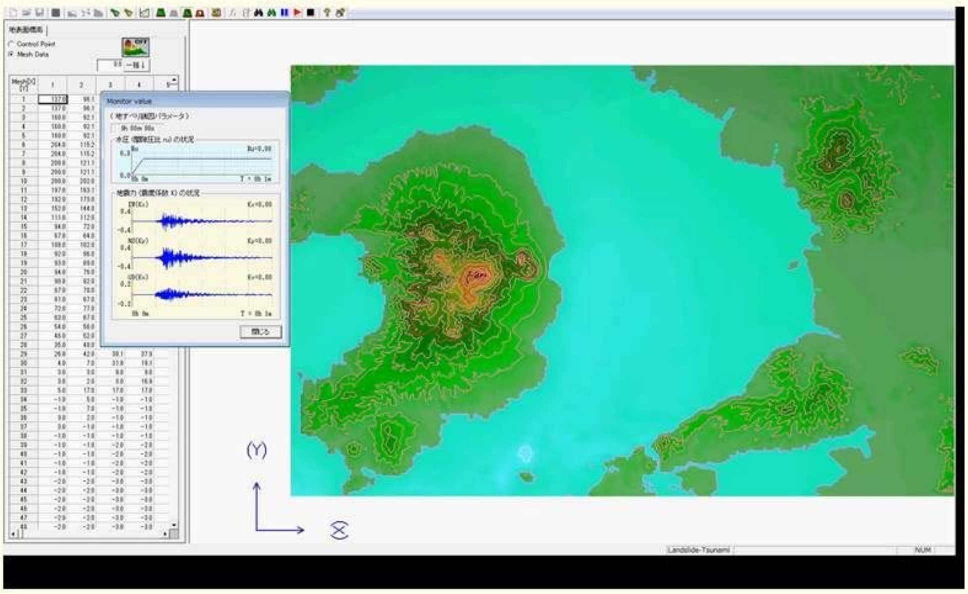
b) Time series data



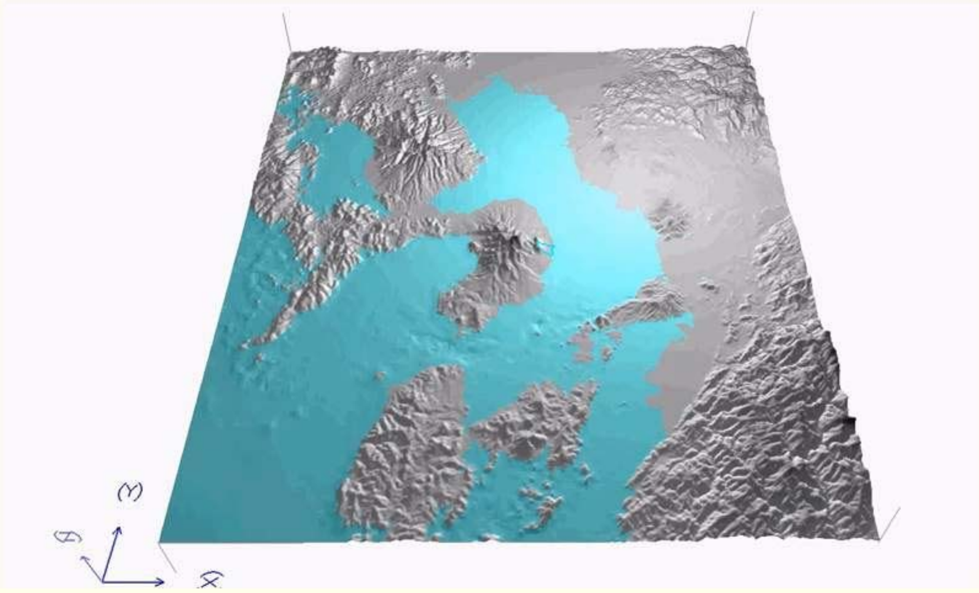
Unzen 3D Simulation Video(LS-RAPID)



3D Simulation video (LS-Tsunami)



3D Simulation Video (LS-Tsunami wide)



Aim of the Conference

- The International Consortium on Landslides (ICL) proposed the "Sendai Partnerships 2015–2025 for global promotion of understanding and reducing landslide disaster risk" in contribution to the Third UN World Conference on Disaster Risk Reduction. The proposal goes into effect by the signature of ICL, Special Representative of Secretary General of the United Nations, UNESCO, other 17 organizations in Japan and overseas. This partnership was significantly gained from the implementation of JICA and JST Joint funded SATREPS projects.
- We will introduce the results of SATREPS project in Croatia (2009-2014) and in Vietnam (2011-2017) , and other SATREPS and JICA projects in Malaysia, Butan and Honduras. Then, we will examine further Japan's international contribution for the landslide disaster reduction as a part of Sendai Partnerships 2015-2025.
- ICL and UNESCO, UNISDR, and others will organize the Fifth World Landsldie Forum (WLF5) in Niigata, Japan. This conference is the mid-term milestone of the Sendai Partnerships 2015-2025 and the first five year milestone of the Sendai Framework for Disaster Risk Reduction 2015-2030. Participants will examine road map of the Sendai partnerships 2015-2025 to WLF5 2020.

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.

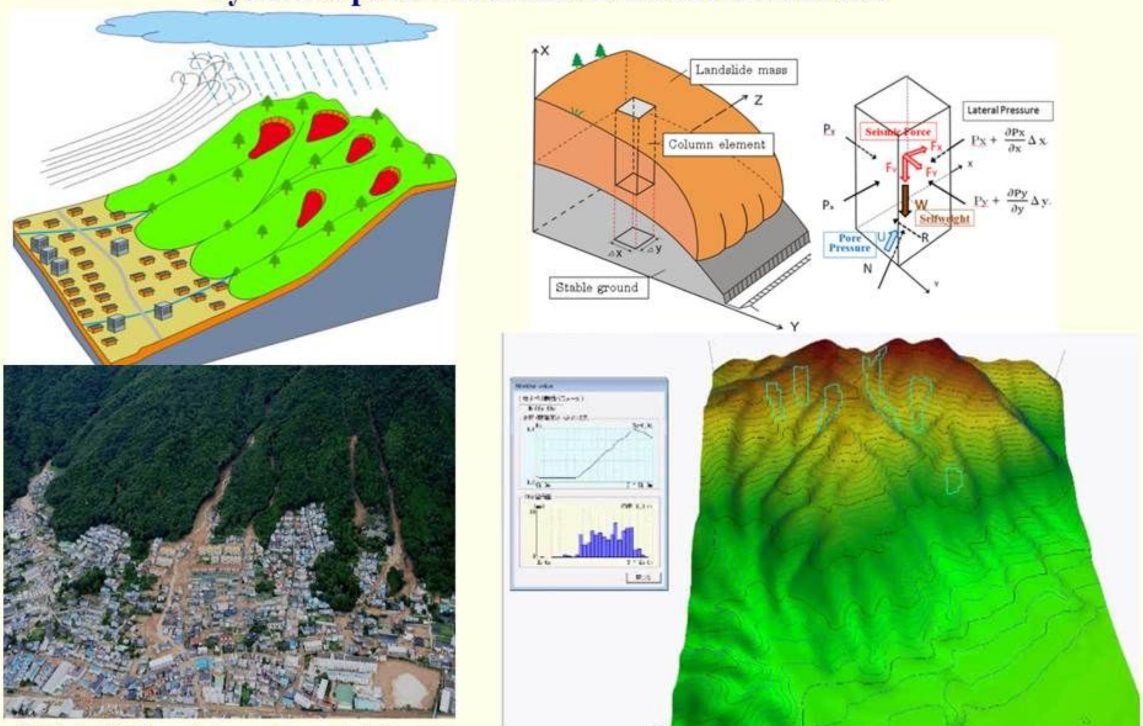
High-Level Panel Discussion:
Initiative to create a safer geoenvironment toward WCDR2015 and forward

High-level panel was chaired by Hans van Ginkel (Fomer Rector of UNU). UNESCO (Director-General Irina Bokova), UNISDR, WMO, ICSU/IRDR, China Geological Survey, ICL together from floor discussed.
The 2014 Beijing Declaration "Landslide Risk Mitigation : Toward a Safer Geoenvironment" was adopted on 6 June 2014 following this panel discussion, which was the preparation for the ISDR-ICL Sendai Partnerships 2015-2025 to be adopted in Sendai 2015. 531 people, 211 national and international organizations from 40 countries and 5 organizations of United Nations System participated WLF3.

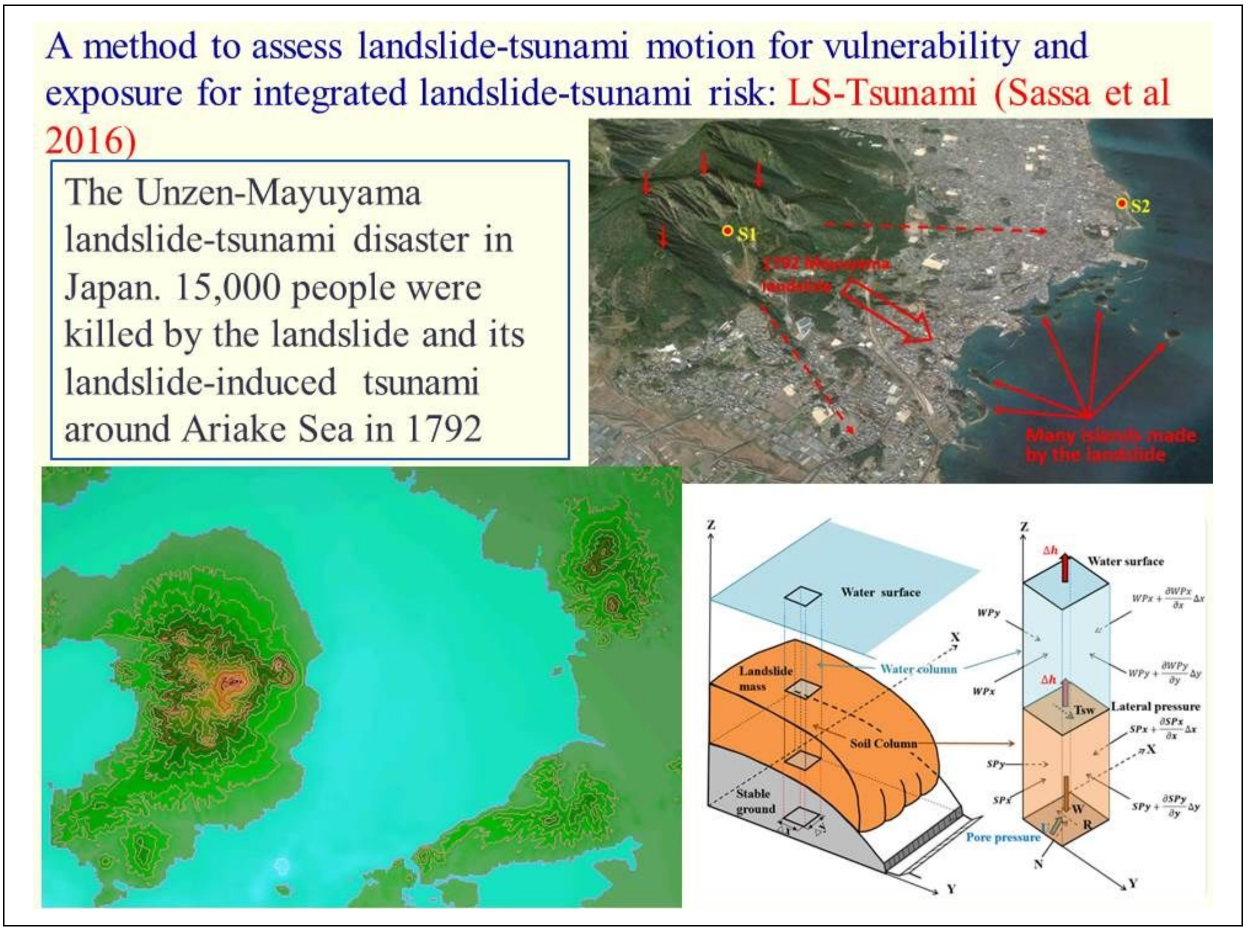
ISDR-ICL Sendai Partnerships 2015-2025 for global promotion of understing and reducing landslide disaster risk

The partnerships was proposed by ICL and adopted in a session of "Underlying risk factors" of 3rd WCDRR in AM on 16 March 2015. It was agreed and signed by leaders of 16 UN, International and national organizations in PM on 16 March 2015 in Sendai, Japan. Signatories are ICL Exective Director, Ms. Margareta Wahlström (SRSG), and leaders of UNESCO, FAO, UNU, ICSU, WFEO, IUGS, IUGG, KU, SCJ, GRF and Japanese (Cabinet office and MEXT), Italian and Croatian Governments.

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


A method to assess landslide-tsunami motion for vulnerability and exposure for integrated landslide-tsunami risk: LS-Tsunami (Sassa et al 2016)
The Unzen-Mayuyama landslide-tsunami disaster in Japan. 15,000 people were killed by the landslide and its landslide-induced tsunami around Ariake Sea in 1792
S1
S2
1792 Mayuyama landslide
Many islands made by the landslide
Z
Water surface
X
Landslide mass
Water column
Soil Column
Stable ground
Y
Δh
Tsw
Lateral pressure
Pore pressure
W
R
N

MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT (MONRE)

VIETNAM INSTITUTE OF GEOSCIENCES AND MINERAL RESOURCES (VIGMR)

Landslides in Vietnam and the needs to develop the landslide risk assessment technology

Dr. Eng. ***Le Quoc Hung***

INTERNATIONAL FORUM

Japan's Contribution to Landslide Disaster Risk Reduction

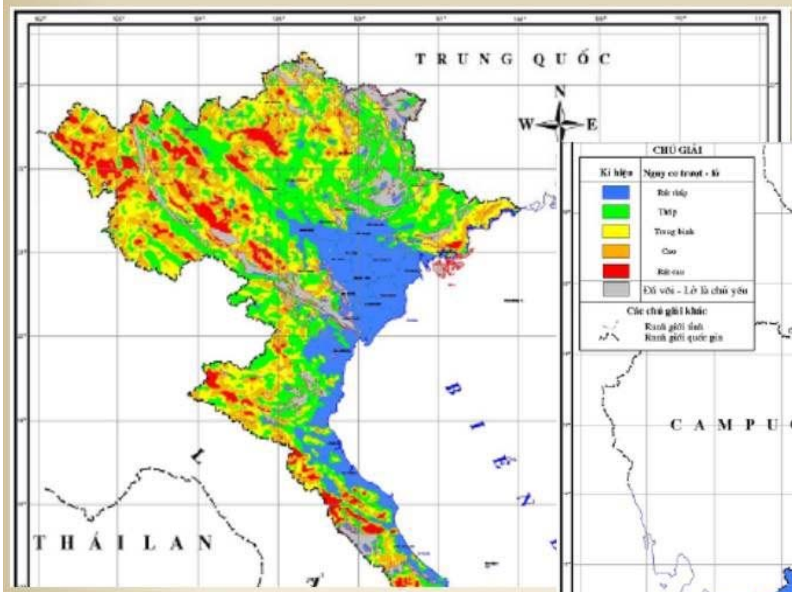
ISDR-ICL Sendai Partnerships 2015-2025 and SATREPS programme

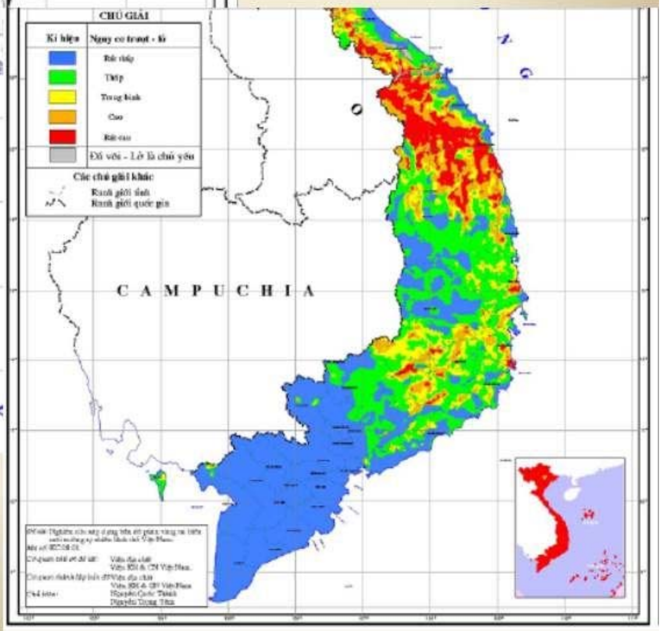
Tokyo, 23-24 November 2016

CONTENTS

1. Landslides in Vietnam
2. State-Funded Landslide Project (SFLP)
3. Needs of contribution from Japan

1. Landslide in Vietnam: *Prone areas*





Landslide susceptibility map in Vietnam - 1:1,000,000 scale
(Nguyen Trong Yem et al,. 2006)

1. Landslide in Vietnam: *Causes*

- **Vietnam = one of the countries affected by global climate change**
  - **Abnormal weather events ➔ extreme rainfall**
- **Mountainous regions in Vietnam:**
  - ✓ **Prone to geo-hazards**
  - ✓ **Potential of mineral resources, hydroelectricity, tourism etc.**
  - ✓ **Play an important roles in national socio-economic**
  - ✓ **Attract human resources**
- **Rapid development and urbanization in mountains**
  - **Human activities ➔ negative impacts *(deforestation, mining, slope-cuts for construction, etc.).***

➔ significantly promoting geohazard process

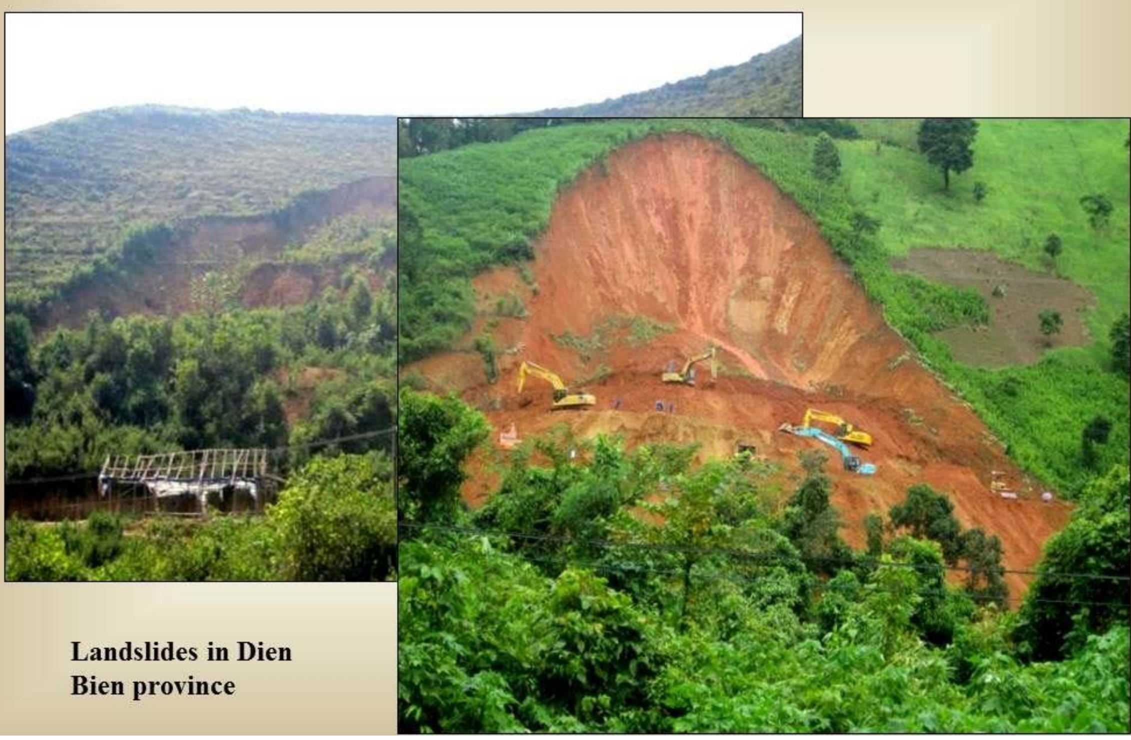
➔ triggering landslides in residential areas, road corridors, hydroelectricity's reservoir, mining areas…

➔ increasing loss of lives and damages to people, infrastructure and environment.


1. Landslide in Vietnam: Consequences
Tuyên Hóa – Quảng Bình
Minh Hóa – Quảng Bình
Minh Long-Quảng Ngãi
Minh Long – Quảng Ngãi
Minh Long –Quảng Ngãi
Minh Hóa – Quảng Bình


1. Landslide in Vietnam: Consequences
Landslides in Lao Cai province

1. Landslide in Vietnam: *Consequences*



Landslides in Dien Bien province

2. SFLP: *State-funded Landslide Project in Vietnam*

Full title:

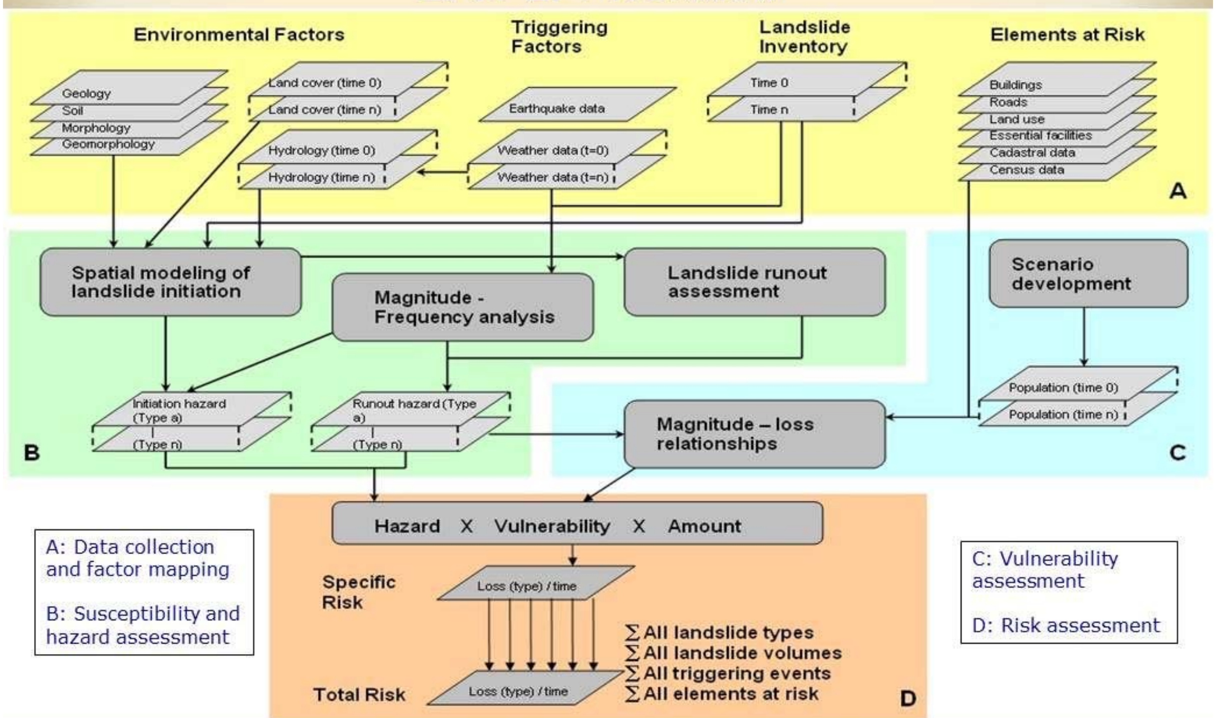
Investigation, assessment and warning zonation for landslides in the mountainous regions of Vietnam

- **Timed:**
  - **Phase I: 2012-2016**
  - **Phase II: 2017-2020**
- **Carried out by:**
  - **15 research institutions and all administrative divisions *under MONRE***
  - **Leading agency : *Vietnam Institute of Geosciences and Mineral Resources (VIGMR)***
  - **Pricipal manager: *Dr. Le Quoc Hung***
- **Implemented in *mountainous areas***
  - **75% area of the country mainland**
  - **37/63 provinces**

2. SFLP: *Goals*

- **Establishment of a standard national database on landslides and generation of landslide hazard maps at 1:50,000** for 37 mountainous provinces of Vietnam, and **at 1:10,000** for hot-spot areas;
- **Design of an Early Warning System for landslides, and implementing that in a number of test areas.**

2. SFLP: *Workflow*



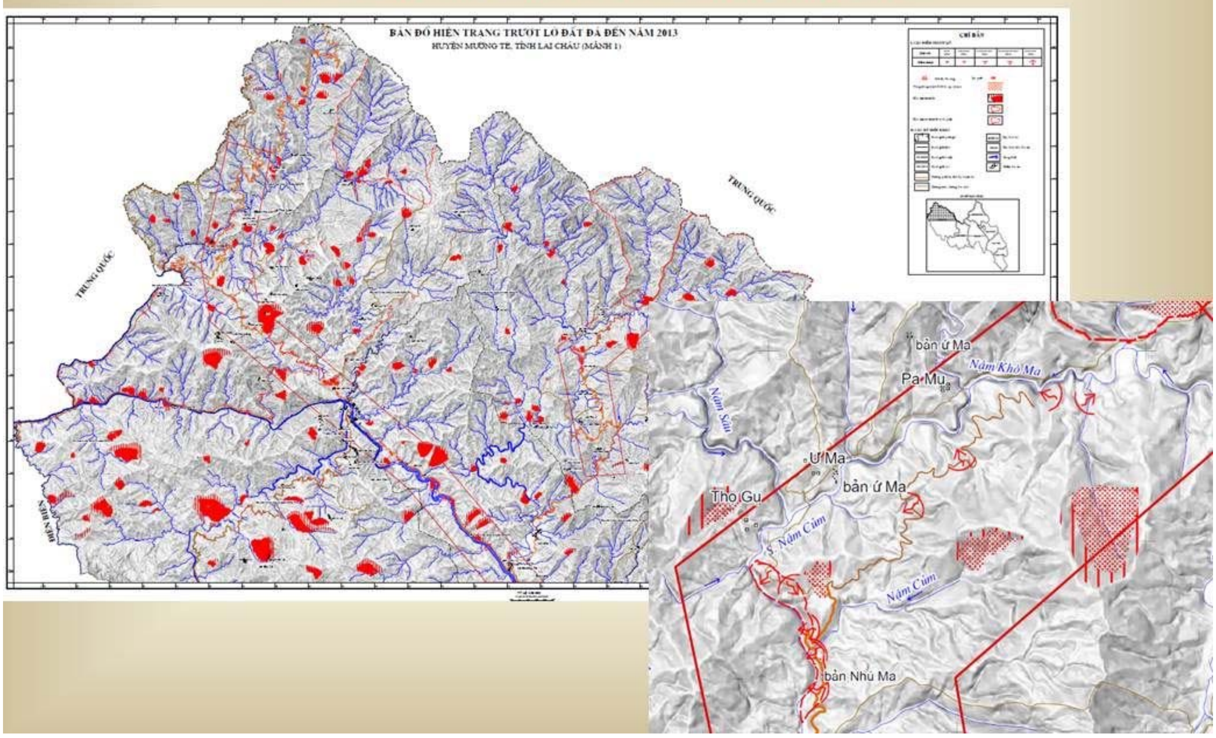
(adapted from Castellanos Abella, E.A., de Jong, S.M., Van Westen, C.J. and van Asch, W.J., 2008. Multi-scale landslide risk assessment in Cuba. ITC, University of Utrecht. ITC Dissertation 154, 272 p. ISBN: 978-90-6164-268- 8)

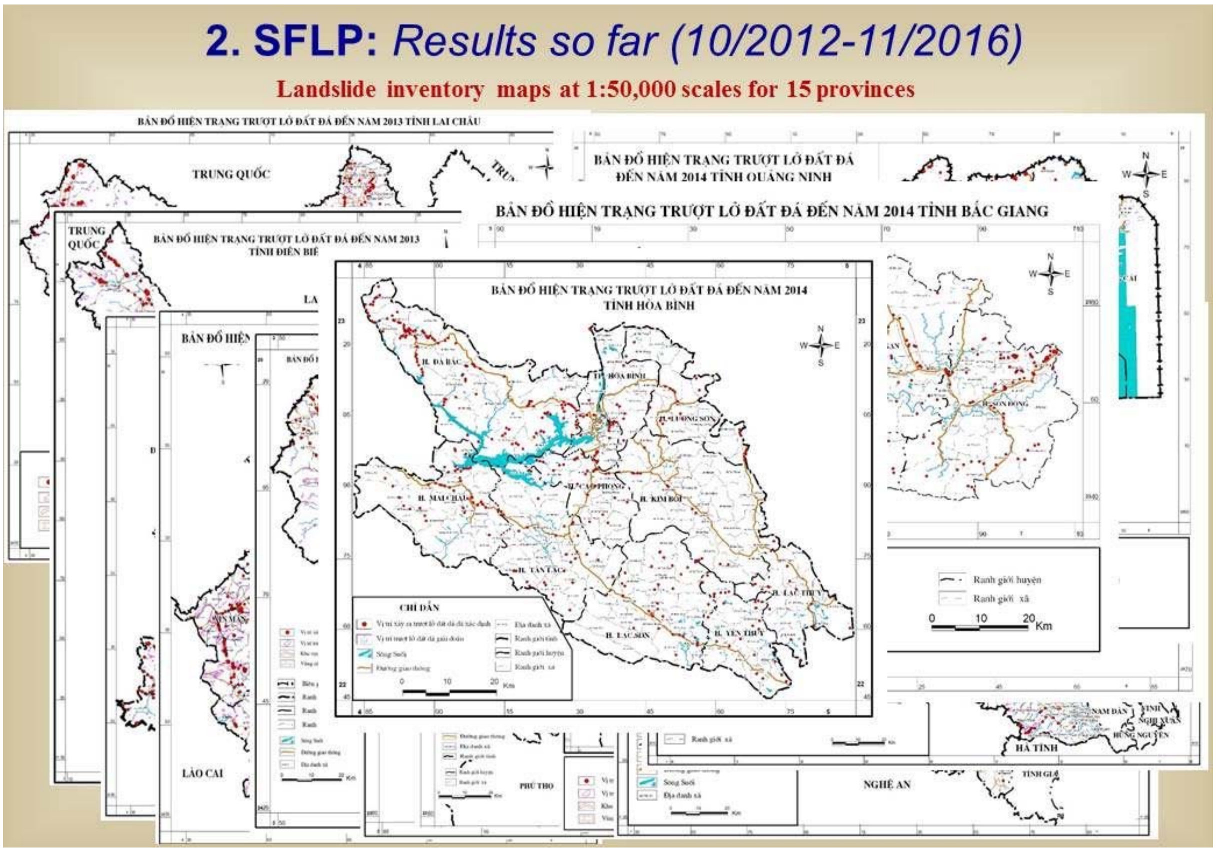
2. SFLP: *Deliverables*

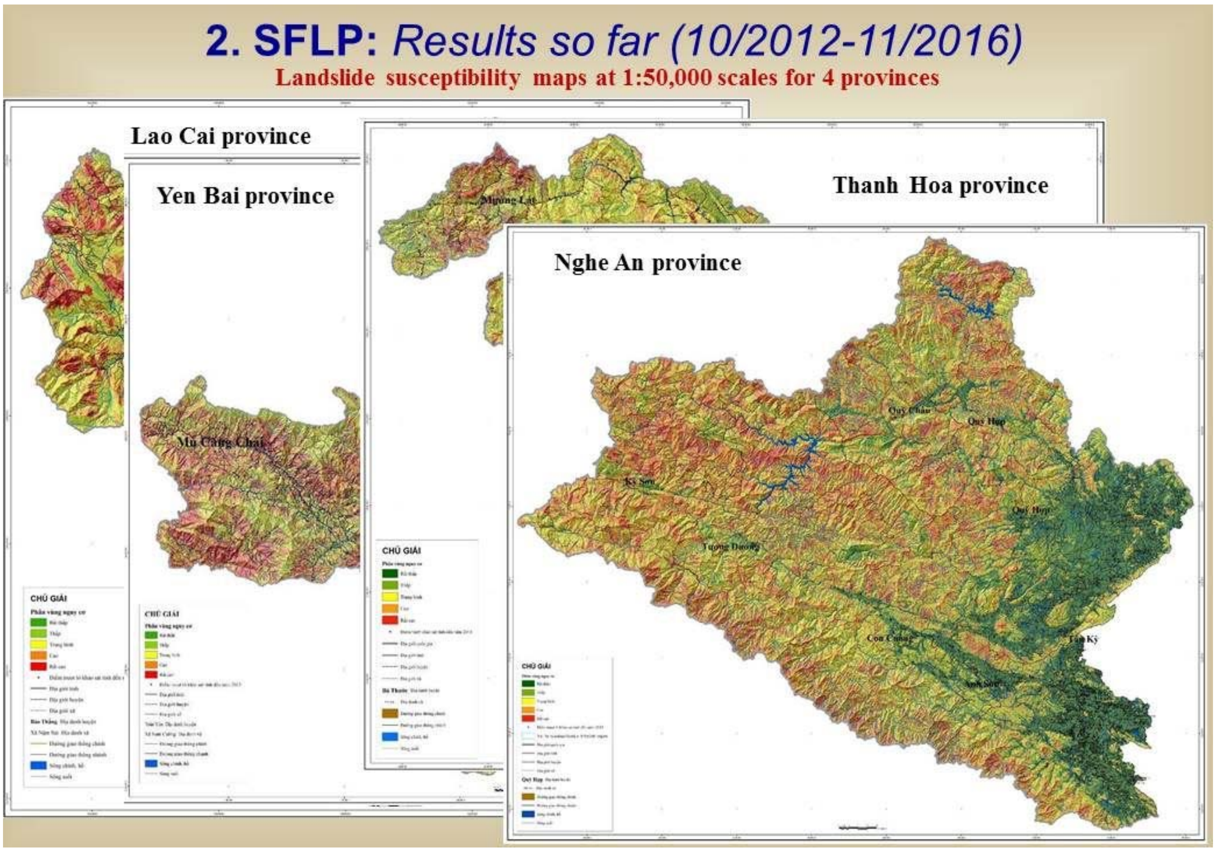
1. A national database and WebGIS on landslides and related factors;
2. Landslide warning zonation maps at 1:50,000 scales for 37 mountainous provinces, and at 1:10,000 scales for hotspot areas:
   - Landslide inventory maps
   - Landslide susceptibility maps
   - Landslide hazard maps
   - Landslide risk maps
3. A pilot network of landslide monitoring stations
4. Reports and guidelines to end-users for:
   - Using the result maps, WebGIS and database
   - Recommendation of landslide mitigation measures;
   - Dissemination and communication of landslide preparedness, prevention and mitigation;
   - Landslide monitoring and early warning for very high landslide hazard areas.

2. SFLP: *Results so far (10/2012-11/2016)*

Landslide inventory maps at 1:50,000 scales for 15 provinces



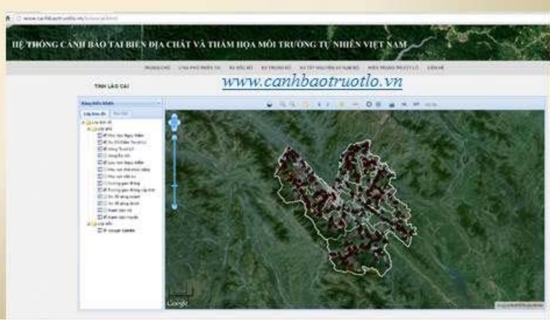

2. SFLP: Results so far (10/2012-11/2016)
Landslide inventory maps at 1:50,000 scales for 15 provinces
BẢN ĐỒ HIỆN TRẠNG TRƯỢT LỞ ĐẤT ĐÁ ĐẾN NĂM 2013 TỈNH LAI CHÂU
TRUNG QUỐC
BẢN ĐỒ HIỆN TRẠNG TRƯỢT LỞ ĐẤT ĐÁ ĐẾN NĂM 2014 TỈNH QUẢNG NINH
BẢN ĐỒ HIỆN TRẠNG TRƯỢT LỞ ĐẤT ĐÁ ĐẾN NĂM 2014 TỈNH BẮC GIANG
BẢN ĐỒ HIỆN TRẠNG TRƯỢT LỞ ĐẤT ĐÁ ĐẾN NĂM 2014 TỈNH HÒA BÌNH
CHỈ DẪN
Ranh giới huyện
Ranh giới xã
LÀO CAI
PHÚ THỌ
NGHỆ AN
HÀ TĨNH


2. SFLP: Results so far (10/2012-11/2016)
Landslide susceptibility maps at 1:50,000 scales for 4 provinces
Lao Cai province
Yen Bai province
Thanh Hoa province
Nghe An province

2. SFLP: *Results so far (10/2012-11/2016)*

Transfers of result maps to local authorities and involved organizations

a WebGIS on landslides in Vietnam



3. Need of contribution from Japan:
for the next tasks of SFLP

- **Rainfall & landslide correlations**
  - **Establishment of rainfall thresholds for different areas**
  - **Use of rainfall thresholds for**
    - **Temporal probability assessment**
    - **Development of an early warning system**
- **Landslide hazard assessment**
- **Landslide vulnerability and risk assessment**
- **Community-based landslide risk management**

3. Need of contribution from Japan:
for the current problems of landslides

- **Very pressing needs to develop:**
  - **Landslide risk assessment technology on swarm-landslides triggered by extreme rainfall events**
  - **Landslide risk reduction in the progress of climate change, urban development**
  - **Integrated technology of early warning and landuse change based on the reliable landslide hazard assessment**

3. Need of contribution from Japan:
for SATREPS projects

- **Past SATREPS project by ICL-ITST (2011-2016)**
  - **Assessed large-scale landslides along the transport arteries**
  - **Highly evaluated in Vietnam**
  - **Terminated on 6 November 2016**

3. Need of contribution from Japan:
for SATREPS projects

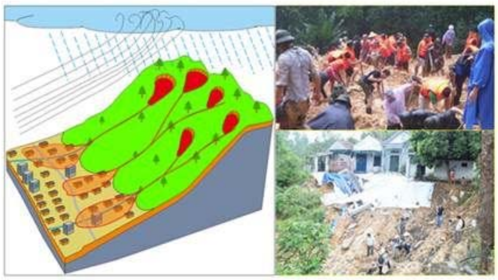
- **Planned SATREPS project by ICL-VIGMR (2017-2022)**
- **Asked Japan to support**
  - **Research and implementation of combined early warning and landuse change in vulnerable human settlements exposed to hazardous motion of debris**

3. Need of contribution from Japan:
for SATREPS projects

- **Planned SATREPS project by ICL-VIGMR (2017-2022)**
  - **Proposal submitted to the Embassy in October 2016**

PROJECT PROPOSAL FOR JAPAN'S TECHNICAL COOPERATION

RESEARCH AND IMPLEMENTATION OF COMBINED EARLY WARNING AND LANDUSE CHANGE IN VULNERABLE HUMAN SETTLEMENTS EXPOSED TO HAZARDOUS MOTION OF DEBRIS



Coordinating Agencies:
International Cooperation Department, Ministry of Natural Resources and Environment of Viet Nam (ICD-MONRE)
International Consortium on Landslides (ICL)

Vietnamese Immplementing Agencies:
Vietnam Institute of Geosciences and Mineral Resources (VIGMR-MONRE)
General Department of Land Administration (GDLA-MONRE)
National Hydro-Meteorological Service (NHMS-MONRE)
Department of Meteorology, Hydrology and Climate Change (DMHCC-MONRE)

Japanese Immplementing Agencies:
Research Institute for Natural Hazards and Disaster Recovery, Niigata University
International Consortium on Landslides (ICL)
Center for Earth Information Science and Technology of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

3. Need of contribution from Japan: *for SATREPS projects*

- **Planned SATREPS project by ICL-VIGMR (2017-2022)**
  - **Overall goals:**
    - Application of the developed combined technologies of early warning-evacuation
    - Landuse change to reduce landslide disaster risk is realized to contribute to the safety ensuring of vulnerable human settlements
  - **Purposes:**
    - Collaborative research based on the world most-advanced landslide risk assessment technology
    - Development of combined guidelines of early warning and landuse change to reduce landslide disaster risk in vulnerable human settlements

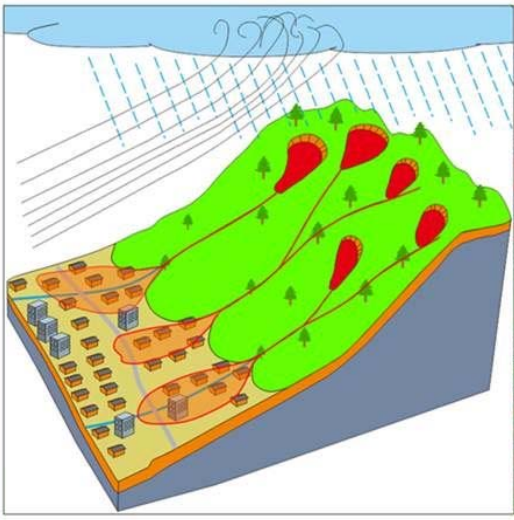
3. Need of contribution from Japan: *for SATREPS projects*

- **Planned SATREPS project by ICL-VIGMR (2017-2022)**
  - **Outputs:**
    - A new technology of localized hillslope heavy-rain forecasting is developed
    - The initiation mechanism of swarm-landslides in Vietnam is elucidated; and the hazard assessment technology of fluidized swarm-landslides in Vietnam is established
    - Guidelines of early-warning and land-use change are established and applied to the selected pilot site: Ha Long City

I wish all of participants to support our application of this planned project

PROJECT PROPOSAL FOR JAPAN'S TECHNICAL COOPERATION

RESEARCH AND IMPLEMENTATION OF COMBINED EARLY WARNING AND LANDUSE CHANGE IN VULNERABLE HUMAN SETTLEMENTS EXPOSED TO HAZARDOUS MOTION OF DEBRIS



Looking forwards to collaborating with you in the coming time!

Thanks for your attention !

Concept

The forum is a venue to spin knowledge from disasters and weave wisdom of disaster risk reduction into society

The forum would

1) Promote the implementation of the Sendai Framework for Disaster Risk Reduction
2) Explore Japanese experiences on disaster risk reduction and observe recovery process of the Tohoku Region
3) Welcome participants from disaster risk reduction experts as well as non-experts

Concept

4) Explore and develop business opportunities in disaster risk reduction
5) Focus on solution-oriented discussion on disaster risk reduction with concrete examples provided by multi-stakeholders
6) Thank assistance to Tohoku from all over the world after the 11 March 2011 East Japan Earthquake and Tsunami Disaster

Concept

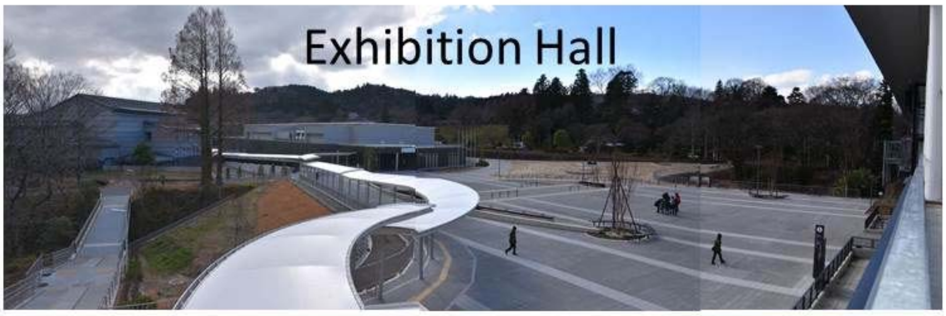
BOSAI

is a traditional Japanese term, indication a holistic approach to reduce human and economic losses from disasters which represents activities in all disaster phase, including prevention, recovery, response and mitigation

Date. November 25sat -27mon, 2017

Venue. Sendai International Center
(Sendai, Japan)

Venue. Sendai International Center
(Sendai, Japan)



Organizer:
Organizing Committee for the World Bosai Forum / IDRC 2017 in Sendai

Member of the committee (tbc.)

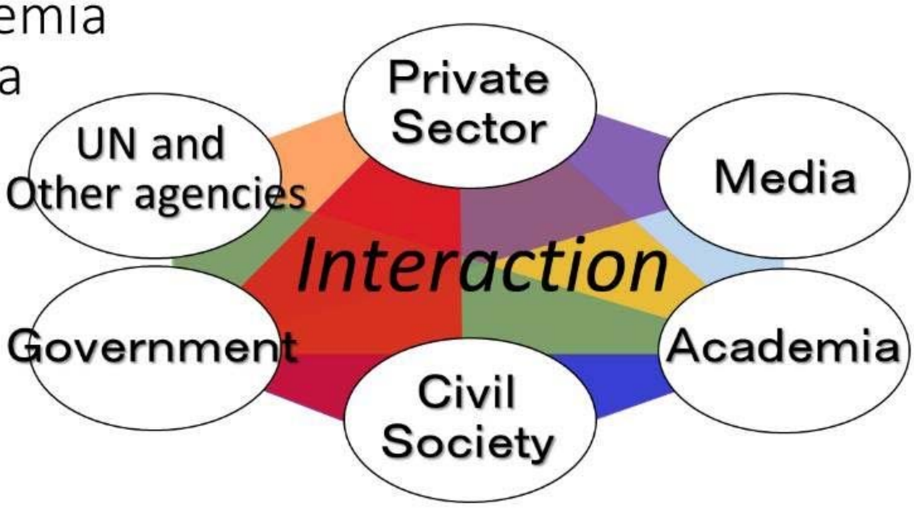
Tohoku University
International Research Institute of Disaster Science
Global Risk Forum GRF Davos
City of Sendai
Miyagi Prefecture
Kohoku Shimpo Publishing Co
Sendai Chamber of Commerce and Industry
Tohoku Economic Federation

Supporters (tbc.)

- Cabinet Office
- Ministry of Foreign Affairs
- Ministry of Land Infrastructure and Transportation and Tourism,
- Japan International Cooperation Agency JICA,
- Science Council of Japan
- Japan Bosai Platform
- World Bank
- UNDP
- National Research Institute for Earth Science and Disaster Resilience
- Miyagi Prefecture
- Tohoku Economic Federation
- Sendai Chamber of Commerce and Industry

Participants.

- UN and other agencies
- Private Sector
- Governments
- Civil Society
- Academia
- Media



How to attend

<u>Register Online (December/January)</u>

Participation fee: 300 USD / person

Program.

	25 Nov. (sat)			26 Nov. (sun)			27 Nov. (mon)	
AM	Opening		Exibition	Parallel Session	Parallel Session	Exibition	Plenary Session (2)	Exibition
	Plenary Session (1)			Plenary Session (3)	Parallel Session		Closing	
	Lunch Session			Lunch Session				
PM	Plenary Session (2)	Parallel Session		Plenary Session (4)	Parallel Session			
	Parallel Session	Parallel Session		Plenary Session (5)				
	Reception							

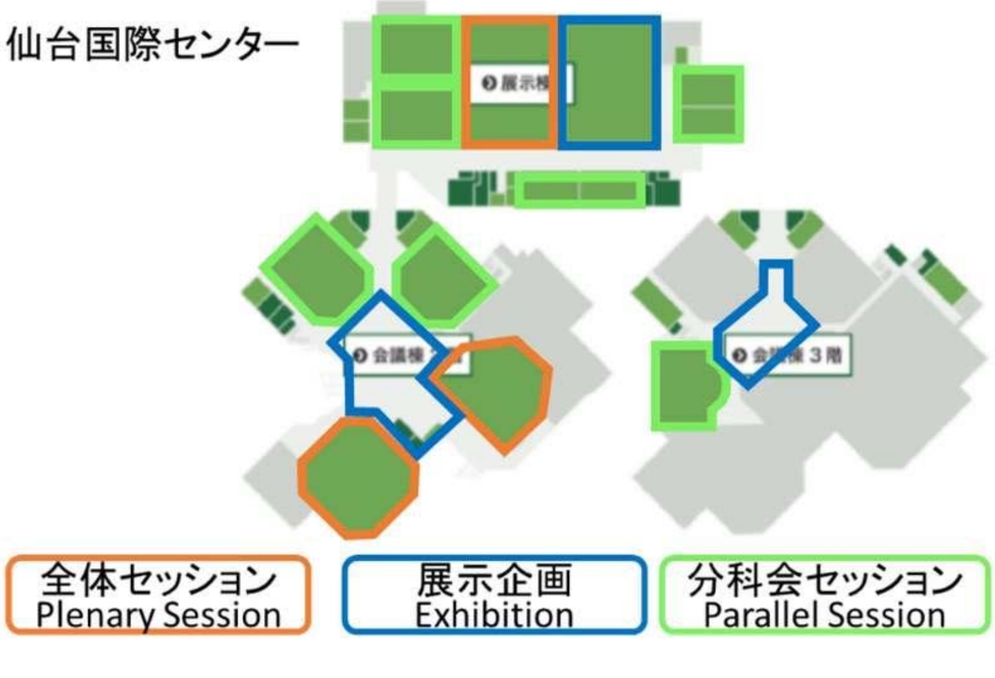
Program. Draft Idea of Session themes

- Solution-oriented discussion to facilitate implementation of Sendai Framework for Disaster Risk Reduction
- Sharing interactive Ideas and innovative and cutting-edge technologies
- Insight-building cross-cutting discussion across various sectors and scientific disciplines.

Program. Draft Idea of Sessions themes

- Role of local government / Good practices from Sendai city
- Role of media in DRR / Link between academia and media
- Outreach to the public / Events related to the World Tsunami Awareness day
- Success stories from the experience of mitigation, response, recovery and reconstruction from disaster

Program. Draft Idea of Sessions



Program. Draft Idea of the Business exhibition

- ◆ Attractive exhibition of innovative and cutting-edge technologies by leading companies for disaster risk reduction and a resilient society

from Japan Bosai Platform HP

from Fujitsu Journal

https://www.kurumaerabi.com/car_news/info/106869/

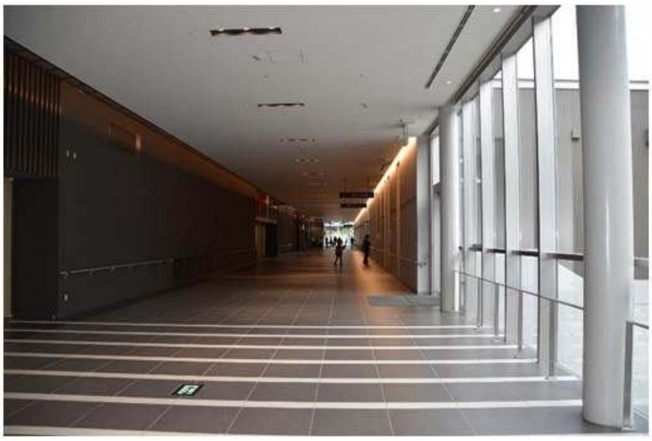
http://www.ists.co.jp/?author=3

http://www.sekisuijushi.co.jp/news/bousai_sendai_report/

From Pacific Consultants

Program. Draft Idea of the Panel exhibition

◆ Panel presented by multi-stakeholder



Program. Related events

- Excursion to affected areas
- Cultural Event

and more…

Schedule.

2016

Aug. Launch of the event

Dec. Establishment of the organizing committee
Homepage open

Apr. First Announcement
Confirm main speakers
Registration open

2017

Jul. Final announcement
Final call for speakers

Oct. Registration closed

2016 Aug. Launch of the event in Davos

List of Participants

No.	Name	氏名	Country	Organization	組織名
1	Qunli Han	Qunli Han	UNESCO	UNESCO Headquarters	UNESCO Headquarters
2	Giuseppe Arduino	Giuseppe Arduino	UNESCO	UNESCO Headquarters	UNESCO Headquarters
3	Dražen Hrastić	Dražen Hrastić	Croatia	Embassy of Croatia	クロアチア大使館
4	Bui Viet Khoi	Bui Viet Khoi	Vietnam	Embassy of Vietnam	Embassy of Vietnam
5	Zeljiko Arbanas	Zeljiko Arbanas	Croatia	University of Zagreb	Croatian Landslide Group
6	Snjezana Mihalic Arbanas	Snjezana Mihalic Arbanas	Croatia	University of Zagreb	Croatian Landslide Group
7	Dinh Van Tien	Dinh Van Tien	Vietnam	Institute of Transport Science and Technology	Institute of Transport Science and Technology
8	Le Quoc Hung	Le Quoc Hung	Vietnam	Vietnam Institute of Geosciences and Mineral Resources (VIGMR)	Vietnam Institute of Geosciences and Mineral Resources (VIGMR)
9	Kaoru Takara	寶馨	JST	Japan Science and Technology Agency, Kyoto University, DPRI,	科学技術振興機構　防災領域研究主幹、京都大学防災研究所
10	Osamu Kato	加藤修	JST	Japan Science and Technology Agency	科学技術振興機構
11	Katsuhiko Masuda	増田勝彦	JST	Japan Science and Technology Agency	科学技術振興機構
12	Atsuko Himeno	姫野敦子	JST	Japan Science and Technology Agency	科学技術振興機構
13	Masahiro Ueki	植木雅浩	JICA	Japan International Cooperation Agency	国際協力機構
14	Shinichi Kusano	草野愼一	MLIT	Ministry of Land, Infrastructure Transport and Tourism	国土交通省
15	Yamato Tanaka	田中大和	MEXT	Ministry of Education, Culture, Sports, Science and Technology (MEXT)	文部科学省
16	Kyoji Sassa	佐々恭二	ICL	ICL Headquarters	国際斜面災害研究機構
17	Kiyoharu Hirota	廣田清治	ICL	ICL Headquarters	国際斜面災害研究機構
18	Khang Dang	Khang Dang	ICL	ICL Headquarters	国際斜面災害研究機構
19	Mie Ueda	上田美恵	ICL	ICL Headquarters	国際斜面災害研究機構
20	Waka Kataoka	片岡稚	ICL	ICL Headquarters	国際斜面災害研究機構
21	Hendy Setiawan	Hendy Setiawan	Japan/ Indonesia	Kyoto University/ICL	京都大学博士課程
22	Pham Van Tien	Pham Tien	Japan/ Vietnam	Kyoto University/ICL	京都大学博士課程
23	Nguyen Duc Ha	Nguyen Duc Ha	Japan/ Vietnam	Kyoto University/ICL	京都大学博士課程
24	Hirotaka Ochiai	落合博貴	Japan	Japan Landslide Society/ Japan Forest Technology Association	日本地すべり学会、日本森林技術協会
25	Satoshi Tsuchiya	土屋　智	Japan	Japan Landslide Society/ Shizuoka University	日本地すべり学会、静岡大学

List of Participants

No.	Name	氏名	Country	Organization	組織名
26	Daisuke Higaki	檜垣大助	Japan	Japan Landslide Society/ Hirosaki University	日本地すべり学会、弘前大学
27	Kiminori Araiba	新井場公徳	Japan	Japan Landslide Society/ National Research Institute of Fire and Disaster	日本地すべり学会、消防研究所
28	Katsuo Sasahara	笹原克夫	Japan	Japan Landslide Society/ Kochi University	日本地すべり学会、高知大学
29	Osamu Nagai	永井　修	Japan	Japan Landslide Society	日本地すべり学会
30	Masaru Iizuka	飯塚昌	Japan (JICA)	Vietnam SATREPS Project Coordinator	ベトナム SATREPS プロジェクト JICA 調整員
31	Hiroshi Fukuoka	福岡浩	Japan	Niigata University	新潟大学災害・復興科学研究所
32	Hideaki Marui	丸井英明	Japan	Niigata University	新潟大学災害・復興科学研究所
33	Dabycharun Bhoopendra	Dabycharun Bhoopendra	Japan/ Mauritius	Niigata University	新潟大学修士課程
34	Yuichi Ono	小野裕一	Japan	Tohoku University	東北大学災害科学国際研究所
35	Toyohiko Miyagi	宮城豊彦	Japan	Tohoku University	東北学院大学
36	Kumiko Fujita	藤田久美子	Japan	Kyoto University	京都大学防災研究所
37	Naoko Kimura	木村直子	Japan	Kyoto University	京都大学博士後期課程
38	Shiho Asano	浅野志穂	Japan	Forestry and Forest Products Research Institute	森林総合研究所
39	Ryoichi Michihata	道畑亮一	Japan	SABO & LANDSLIDE TECHNICAL CENTER	砂防・地すべり技術センター
40	Masaki Hiruma	比留間雅紀	Japan	SABO & LANDSLIDE TECHNICAL CENTER	砂防・地すべり技術センター
41	Taketoshi Marui	圓井健敏	Japan	Marui & Co., Ltd.	㈱マルイ
42	Yuji Ikari	碇祐次	Japan	Marui & Co., Ltd.	㈱マルイ
43	Kazunori Hayashi	林 一成	Japan	OKUYAMA BORING Co., LTD.	奥山ボーリング
44	Keisuke Takimoto	瀧本圭介	Japan	GODAI KAIHATSU Corporation	五大開発
45	Shiro Sekiya	関家史郎	Japan	GODAI KAIHATSU Corporation	五大開発
46	Mitsuya Enokida	榎田充哉	Japan	JCE Co.,LTD.	国土防災技術株式会社
47	Satoru Tsukamoto	塚本哲	Japan	KOKUSAI KOGYO CO., LTD.	国際航業株式会社
48	Ryo Miyazaki	宮崎良	Japan	Oyo Corporation	応用地質株式会社
49	Hiroaki Kojima	古島広明	Japan	OSASI Technos Inc.	㈱オサシ・テクノス
50	Ryuichi Tanaka	田中龍一	Japan	OSASI Technos Inc.	㈱オサシ・テクノス
51	Hirofumi Nakahira	中平博文	Japan	OSASI Technos Inc.	㈱オサシ・テクノス
52	Hiromitsu Yamagishi	山岸宏光	Japan	Shin Engineering Consultant Co., Ltd.	㈱シン技術コンサル

List of Participants

No.	Name	氏名	Country	Organization	組織名
53	Kenichi Saito	斉藤健一	Japan	Shin Engineering Consultant Co., Ltd.	㈱シン技術コンサル
54	Junichiro Aizawa	相澤純一郎	Japan	Protec Engineering	プロテックエンジニアリング
55	Toko Takayama	高山陶子	Japan	Asia Air Survey Co., Ltd.	アジア航測株式会社
56	Shinji Utuki	宇津木慎司	Japan	HAZAMA ANDO CORPORATION	㈱安藤・間
57	Masao Yamada	山田正雄	Japan	Information Conservation Engineers Co., Ltd.	情報防災技術株式会社