JICA-JST Joint Project in Vietnam

Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam (2011-2016)

Project Outline and its Outcomes

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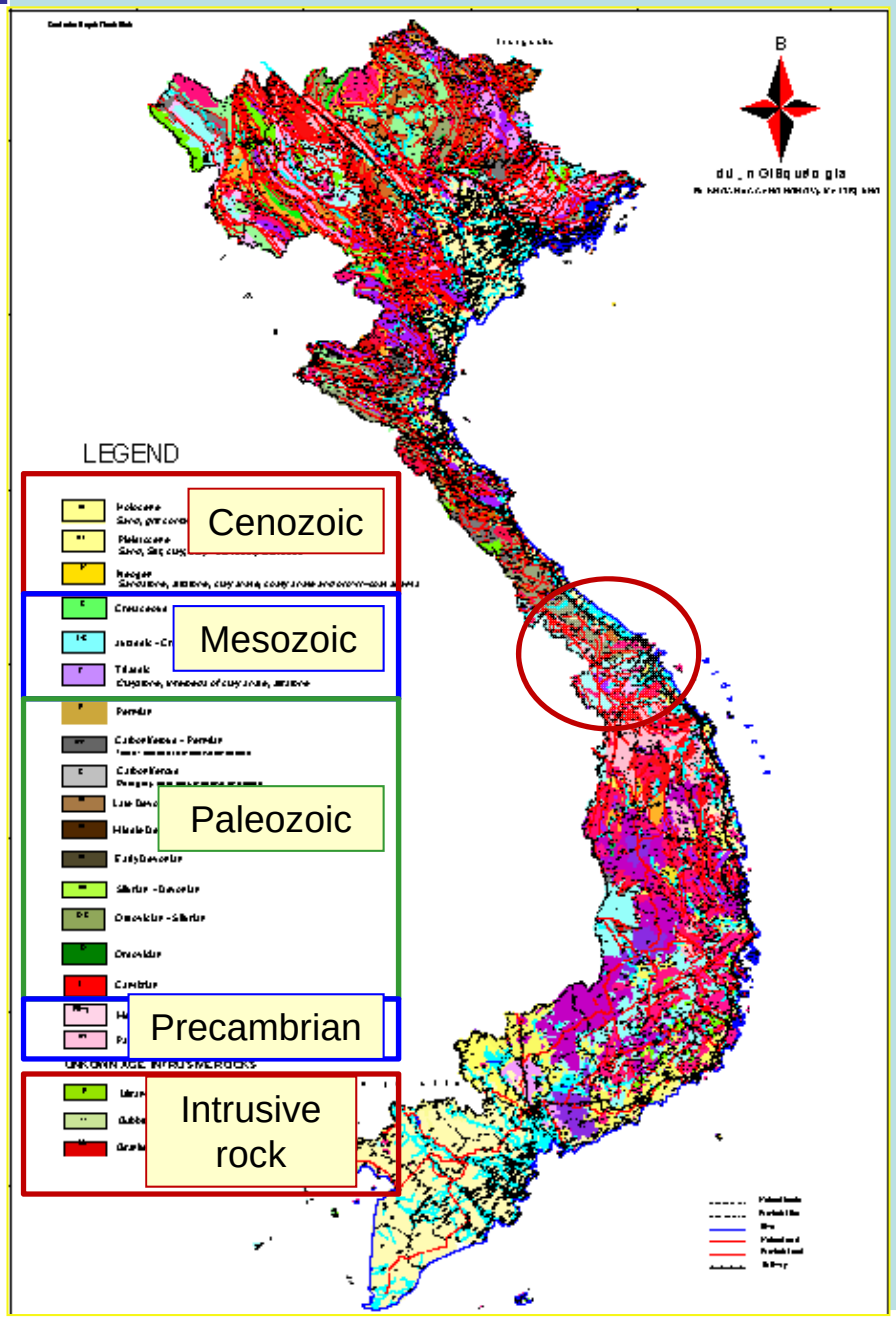
Presenter: Pham Van Tien (PhD Student)

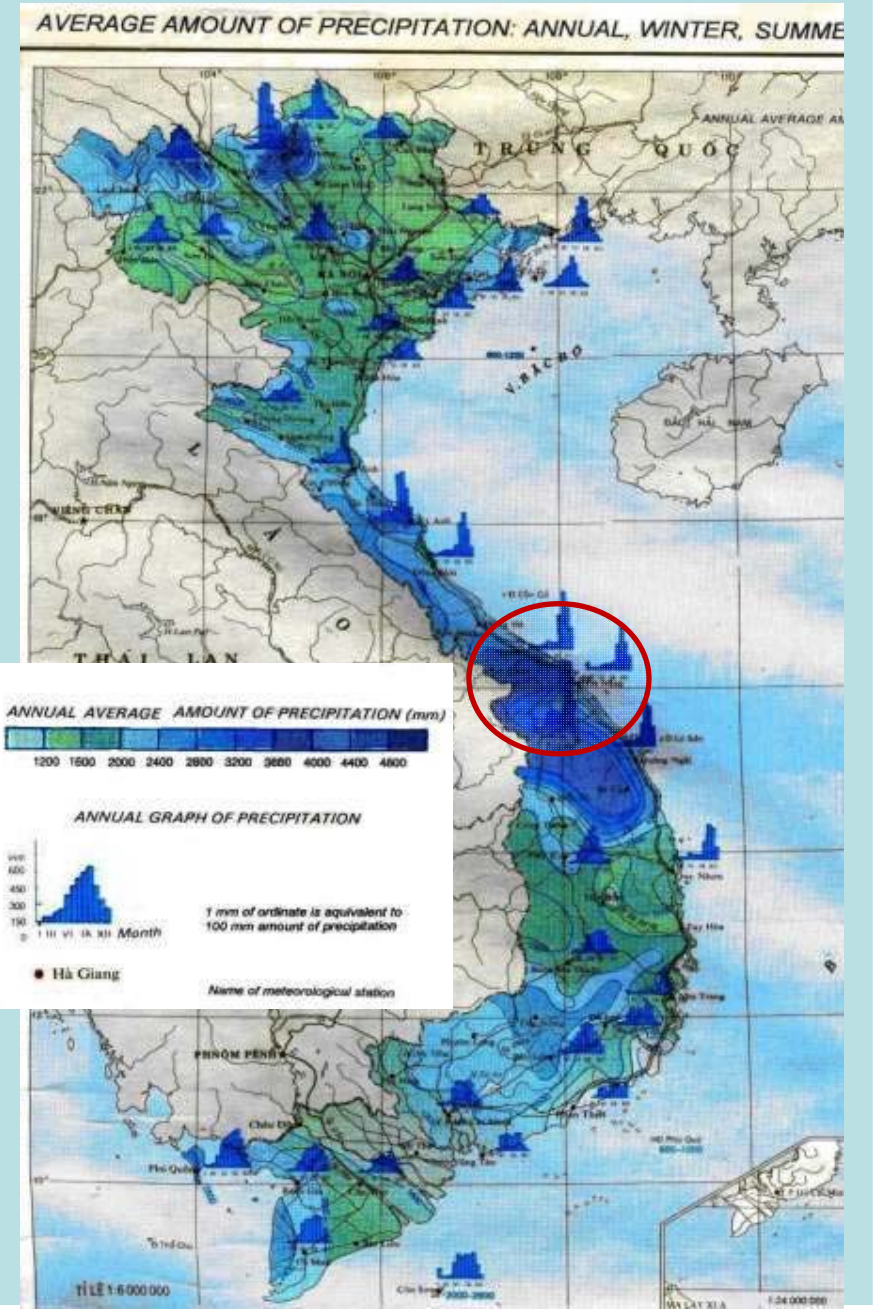
Kyoto, 23 March 2017

Outline

- Landslides in Vietnam
- The Vietnam SATREPS Project
- Project Outcomes
- The research at Kyoto University
- Conclusion

Geology and Rainfall in Vietnam





Landslides in Vietnam

- Vietnam is subject to frequent slope disasters caused by a combination of complex geology/topography and tropical monsoon.
- Landslide is one of the most serious natural disasters in Vietnam.

- Killed 30 people every year (Tam, 2007).
- Annual damage of nearly 100 million USD (Duc, 2009).

A joint cooperation project “Development of landslide risk assessment technology along transport arteries in Vietnam” funded by JICA/JST was implemented from 2011-2016

Aim of SATREPS Joint Research

- Safety ensuring of transport arteries connecting north and south is the most important issue for national development.
- 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 Japan and Vietnam.
- 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

As key issues to be overcome for National Development

Landslide risk assessment technology is established and human resources are developed the safety ensuring of transport arteries through urban and local communities in Viet Nam.

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 (WG1)

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. (WG2)

Leader:Toyohiko Miyagi

Wide-area landslide mapping & Landslide risk identification

(NPO) ICL (WG3)

Leader: Kyoji Sassa

Soil testing & Computer simulation of landslide initiation and motion

FFPRI (WG4)

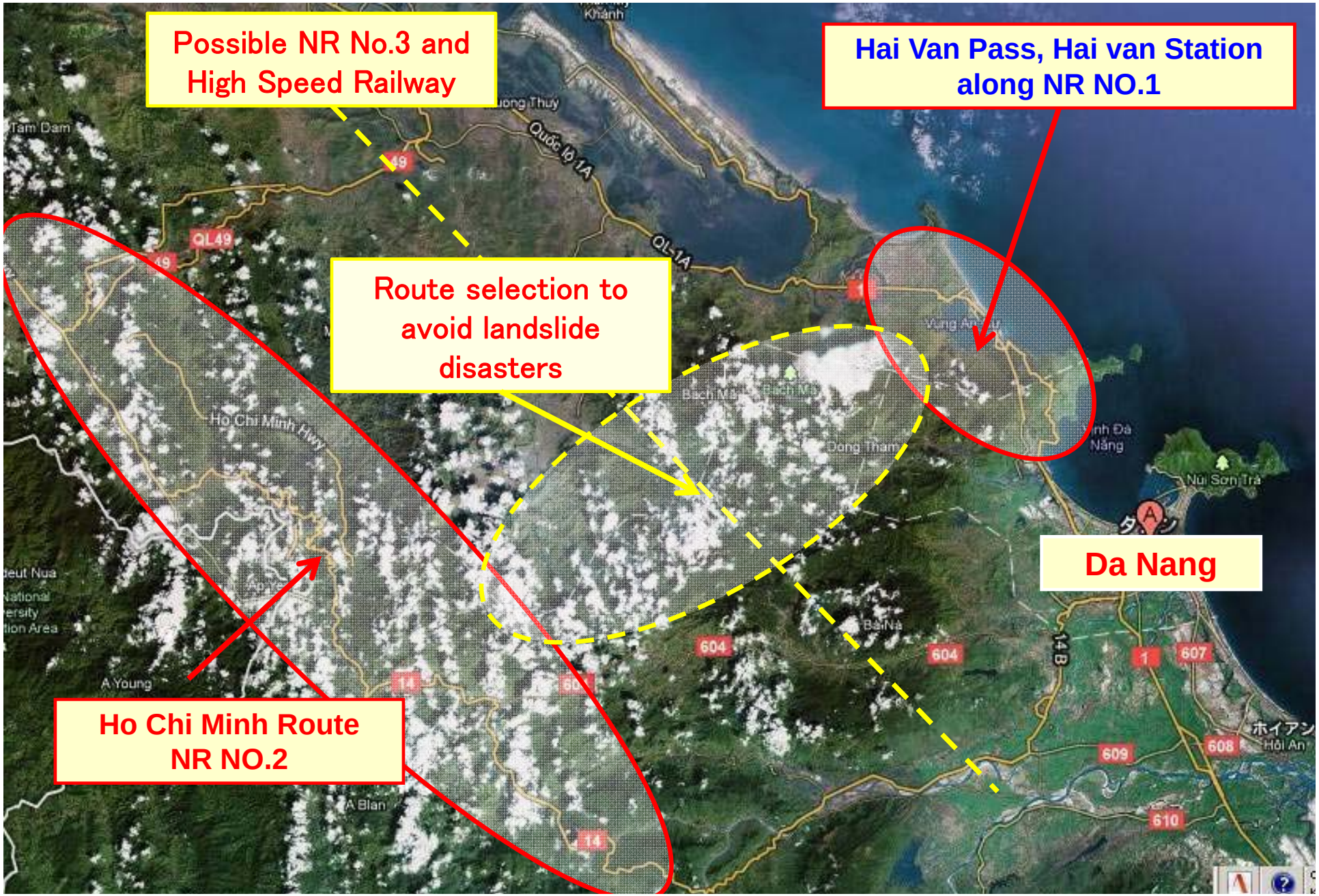
Leader: Hirotaka Ochiai

Landslide monitoring & Development of early warming system

Expected Results

- Preparation of **integrated guidelines** for the application of developed landslide risk assessment technology and **capacity development** by WG1 Joint Team of all groups
- Wide-area landslide mapping and identification of landslide risk area by WG2 Mapping Group
- Development of landslide risk assessment technology based on soil testing and computer simulation by WG3 Testing Group
- Risk evaluation and development of early warning system based on landslide monitoring by WG4 Monitoring Group

Location of the pilot area



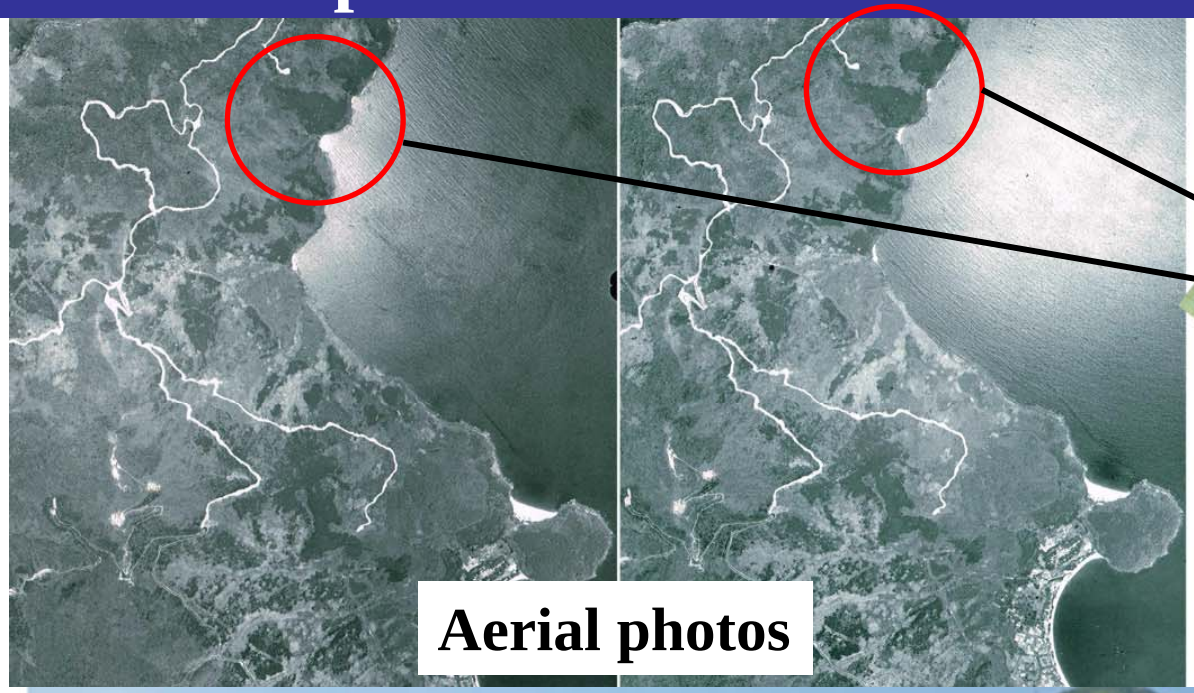
Main Outputs of WG1 Integrated Research and Education Group

- Many of ITST engineers as long-term and short–term trainees were educated in Japan (Doctor: 3 and Master: 4)
- 18 of 102 text tools in “Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools (LITT) ” containing 1,700 pages in 2 volumes comes from the SATREPS projects in Vietnam and in Croatia.
- 33 guidelines have been approving as the base of “ Technical Standard for Landslide Risk Assessment” in Vietnam.
- Technology transfer/Information disemination (workshops/media)
- Many journal papers and publications

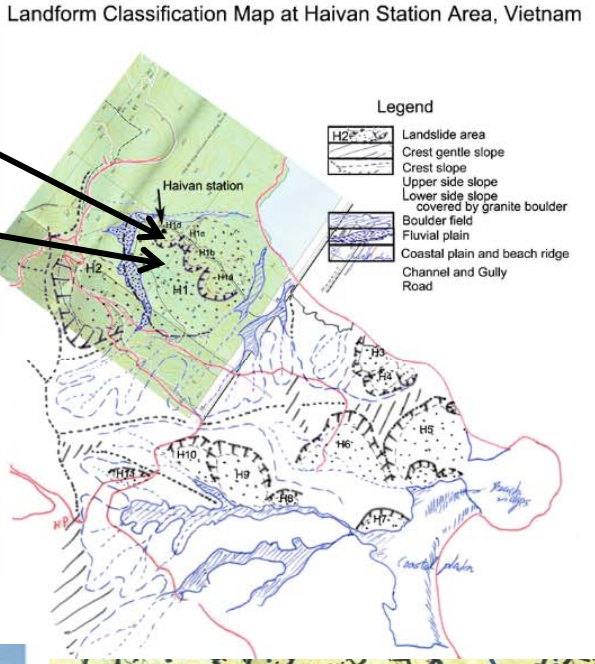
Main Outputs of WG2 Mapping Group

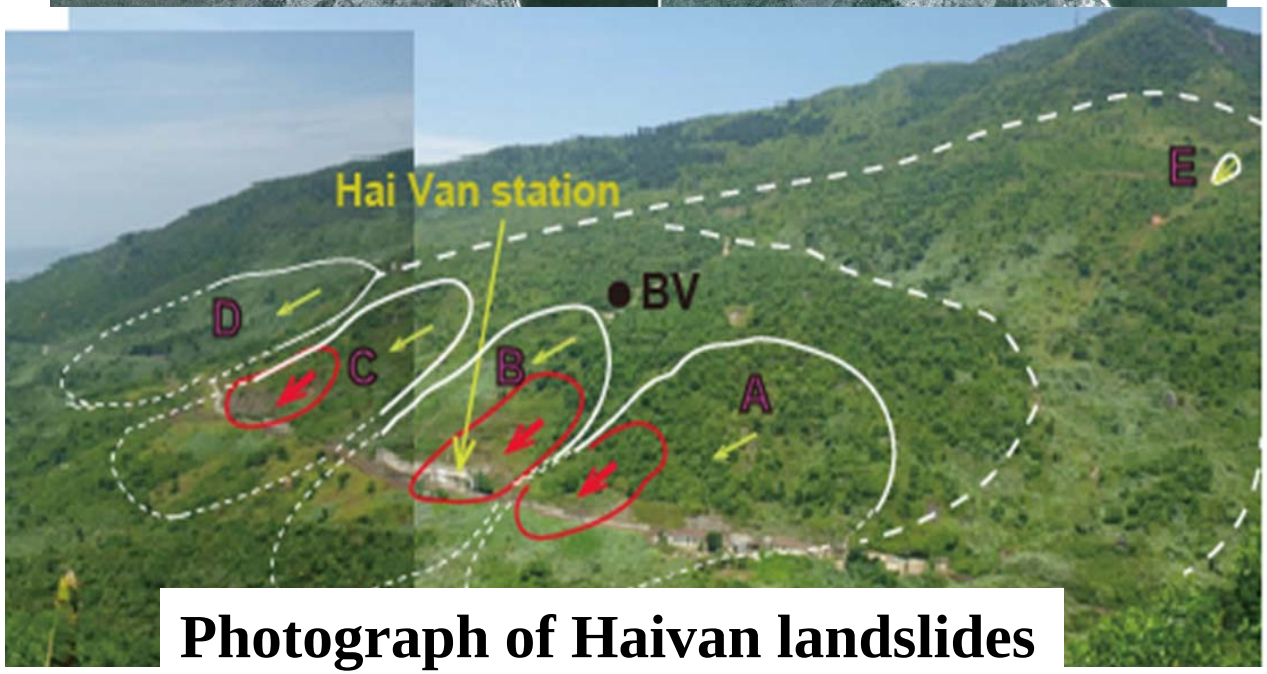
- Landslide susceptibility maps were created
- Landslide risk levels were evaluated and identified
- Technical methods for identifying slope deforming area and mapping landslide hazard were developed

Interpretation Haivan landslide by airphotos

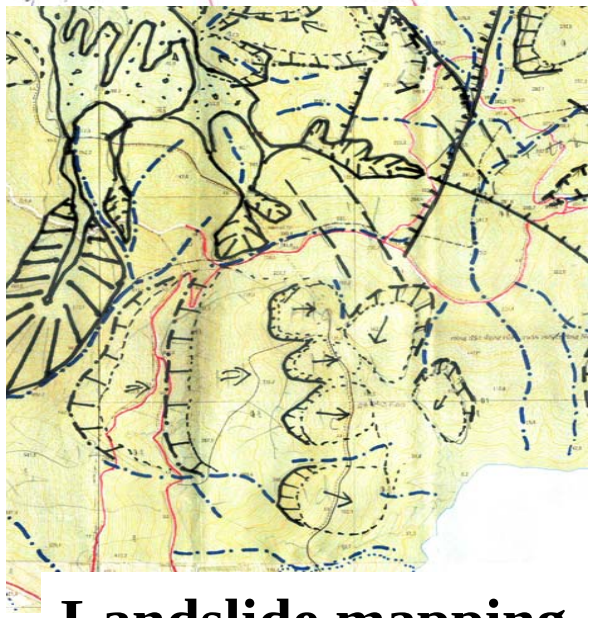


Aerial photos





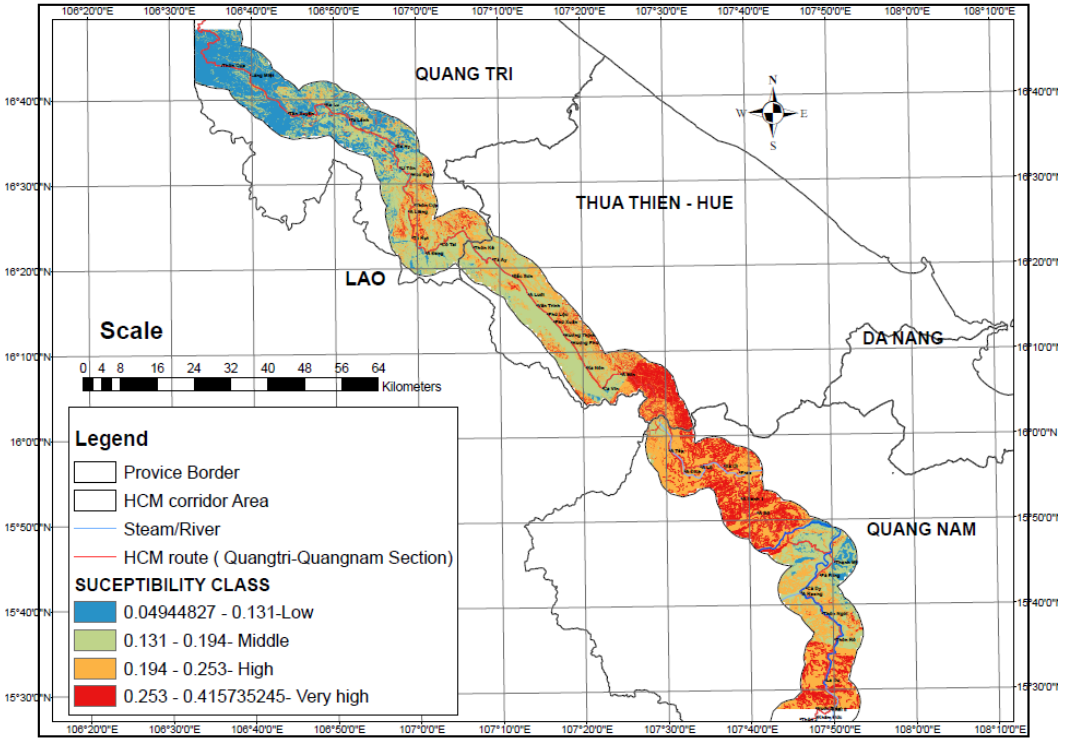
Photograph of Haivan landslides



Landslide mapping

Landslide susceptibility map of the study area, along HCM from Quang Tri to Kontum

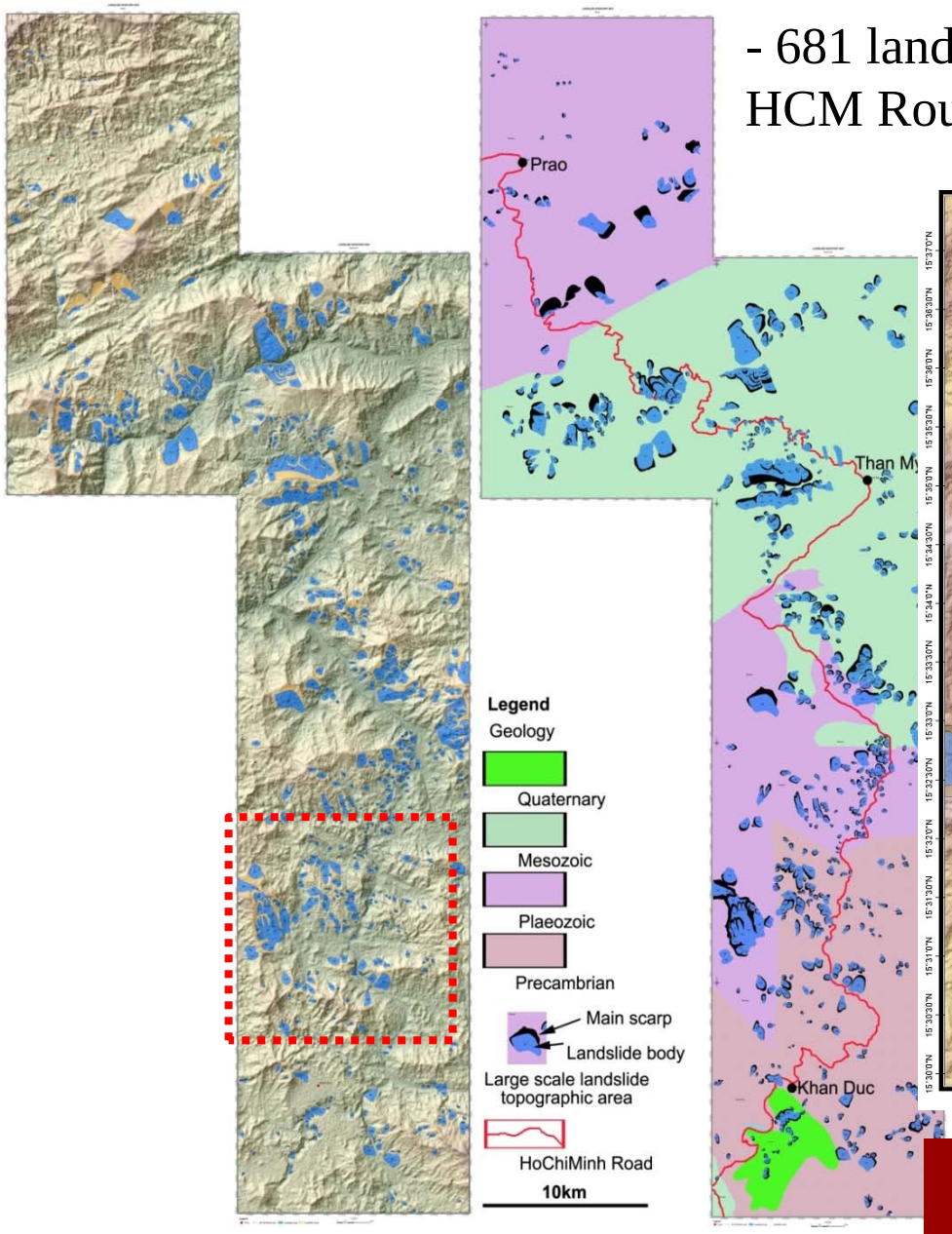
40.40% of the landslides were in the very high susceptibility areas; 42.22% of the landslides occurred in high susceptibility areas; 13.25% of the landslides occurred in middle susceptibility areas; only 4.14% of landslides occurred in low susceptibility areas. Specifically regarding high and very high susceptibility areas, 82.66% all landslides occurred there.

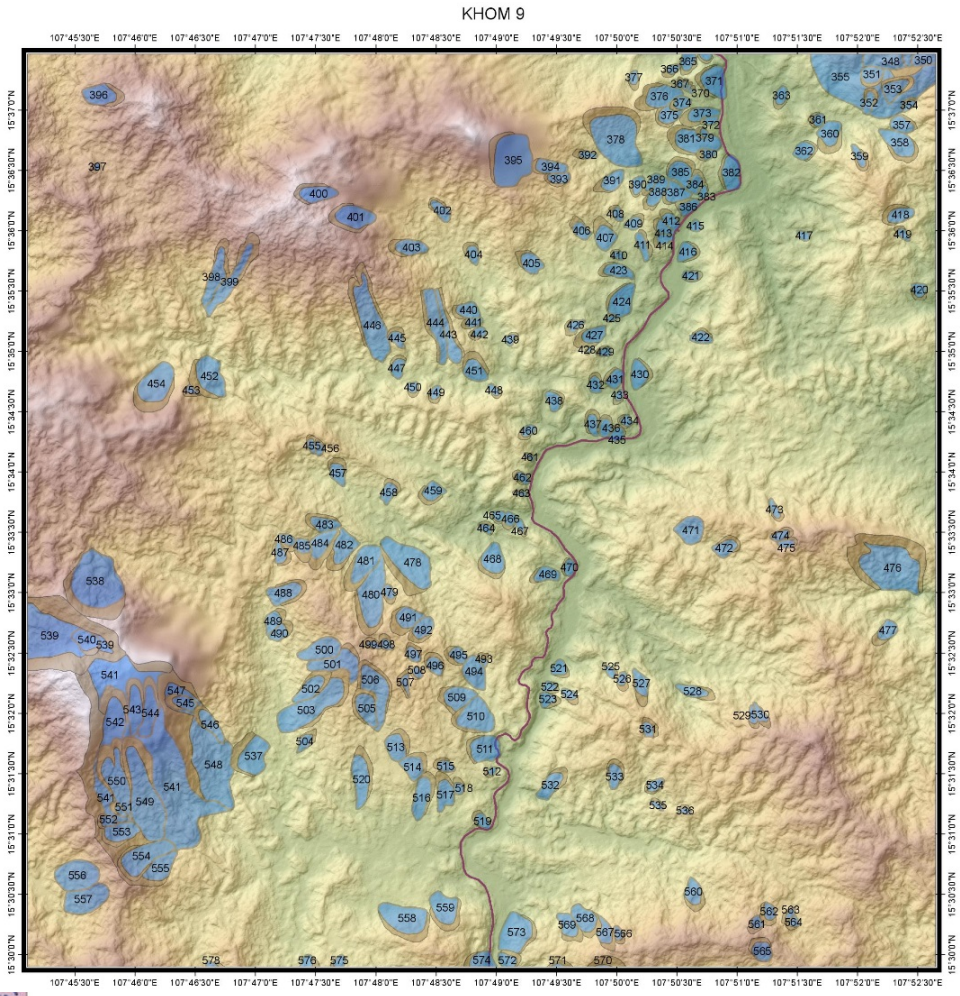


Causative Factor	[1]	[2]	[3]	[4]	[5]	[6]	[7]	Eigenvectors
[1] Fault density	1							0.0287
[2] Distance to the road	2	1						.040
[3] Rock type	5	3	1					00.0752
[4] Land use	7	5	3	1				0.1292
[5] Precipitation	8	7	4	3	1			0.2875
[6] Slope angle	9	9	5	4	2	1		0.4395
CR = 0.0578								
Sub-Table1-Slope 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								

Mapping of Large Scale Landslide Topographic Area

- 681 landslides were recognized along 100 km of HCM Route from Prao to Kham Duc





Landslide inventory map along HCM road

(Luong et al., 2016)