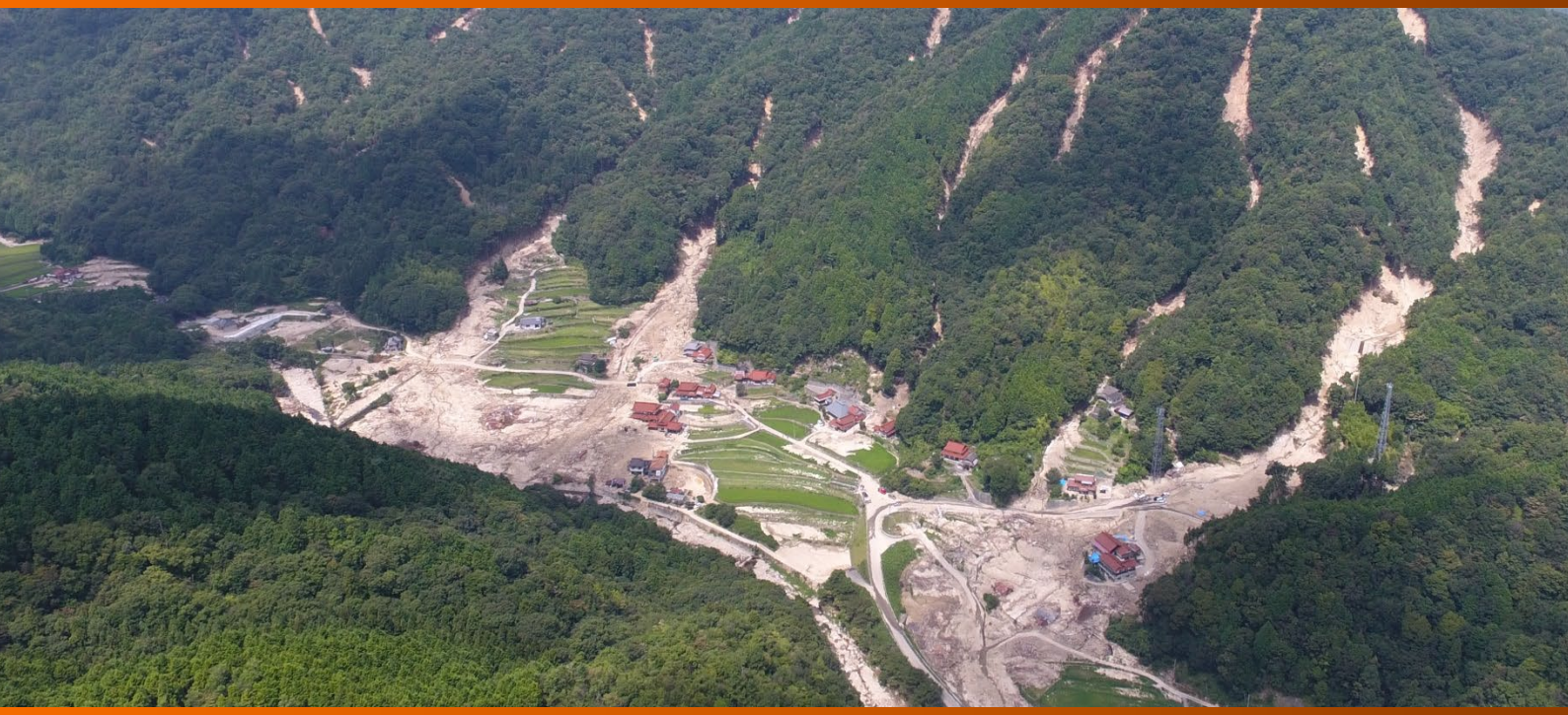
Progress in Landslide Research and Technology



Progress in Landslide Research and Technology,

Volume 1 Issue 1, 2022

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Book Series of the International Consortium on Landslides

Springer

Progress in Landslide Research and Technology

-Book Series of the International Consortium on Landslides for the Kyoto Landslide Commitment 2020-

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President of the International Union of Gedesy and Geophysics (IUGG)
Rafig Azzam, President of the International Association for the Engineering Geology and the Environment (IAEG)
Paolo Canuti, Past president of the International Consortium on Landslides (ICL), Italy.
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Badaoui Rouhban, Chair of the KLC2020 Launching Session and Moderator of ISDR-ICL Sendai Landslide Partnerships 2015-2025 Session of 3rd WCDRR in 2015

KLC2020 Official Promoters

Host organization

International Consortium on Landslides (ICL) / Nicola Casagli

Public sectors: KLC2020 Official Promoters-public

International Unions/Associations, Governmental organizations, Universities and Research institutes

- The International Union of Geological Sciences (IUGS) / John Ludden
- The International Union of Geodesy and Geophysics (IUGG) / Kathy Whaler
- The International Association for the Engineering Geology and the Environment /Rafig Azzam
- International Geosynthetics Society（IGS）/ John Kraus
- Geological Survey of Canada, Natural Resources Canada, Canada / Daniel Lebel
- Faculty of Civil and Geodetic Engineering, University of Ljubljana, Slovenia / Matjaž Mikoš
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- Department of Civil Engineering, National Taiwan University, Chinese Taipei /Shang-Hsien Hsien
- Institute of Rock Structure and Mechanics, the Czech Academy of Sciences / Josef Stemberk
- Institute of Cold Regions Science and Engineering, Northeast Forestry University, China / Wei Shan

Private sectors: KLC2020 Official Promoters-private

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Progress in Landslide Research and Technology
-Book Series of the International Consortium on Landslides-

Progress in Landslide Research and Technology is the Open Access book series of the International Consortium on Landslides (ICL). The series provides a common platform for the publication of recent progress in landslide research and technology for practical applications and the benefit for the society contributing to the Kyoto Landslide Commitment 2020, which is expected to continue up to 2030 and even beyond to globally promote the understanding and reduction of landslide disaster risk, as well as to address the 2030 Agenda Sustainable Development Goals. The contributions include the following seven categories:

1. Original articles (minimum 8 pages): Original articles reporting progress of landslide research and technology.
2. Review articles (minimum 8 pages): Review of landslide research and technology in a thematic area of landslides. A review article integrating a series of research and technology of the author or its group.
3. IPL/WCoE/Kyoto Commitment activities (minimum 8 pages): Progress or achievements of the projects of the International Programme on Landslides (IPL) and the World Centres of Excellence on Landslide Risk Reduction (WCoEs), and Kyoto Landslide Commitment.
4. Teaching tools with online extras (minimum 8 pages): User-friendly teaching tools with extras (i.e., photos, illustration, videos, guidelines & manuals) online to fill the gap between the available level of science and technologies and the practical use in the society.
5. Technical note & Case studies (minimum 4 pages): Technical note and case studies on landslides and landslide disaster risk reduction practice.
6. World Landslide Reports (2-4 pages): Landslide reports from landslide-prone developing countries and urbanizing areas of the developed countries from around the world. No processing charge, but limited to approximately 10 reports per issue.
7. Introduction of KLC2020 Official Promoters (1-3 pages): KLC2020 Official Promoters are eligible for this category. The introduction of the official promoters is published throughout the year.

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Call for Contribution
Progress in Landslide Research and Technology (Progress-LRT)
Book Series of the International Consortium on Landslides

Progress-LRT was founded by the Launching Declaration of the ICL Open Access Book Series "Progress in Landslide Research and Technology" for the Kyoto Landslide Commitment 2020 at the end of High-level panel discussion "Review of KLC2020 and the way forward" during the Fifth World Landslide Forum held at the National Kyoto Conference Center, Kyoto, Japan on 3 November 2021.

The series provides a common platform for the publication of recent progress in landslide research and technology for practical applications and the benefit for the society contributing to the Kyoto Landslide Commitment 2020, which is expected to continue up to 2030 and even beyond to globally promote the understanding and reduction of landslide disaster risk, as well as to address the 2030 Agenda Sustainable Development Goals.

Aim and scope	Original articles for practice and society
Online access and Print version	Open access for digital version. Print version is purchased from Springer Nature.
Publication fee	Book processing charge is 50 USD/page
Page number for each category	● Original articles (minimum 8 pages) ● Review articles (minimum 8 pages) ● IPL/WCoE/Kyoto Commitment activities (minimum 8 pages), ● Teaching tools with online extras (minimum 8 pages) ● Technical note & Case studies (minimum 4 pages) ● World Landslide Reports (2-4 pages) : No processing charge, but limited to approximately 10 reports per issue. ● Introduction of KLC2020 Official Promoters (1-3 pages)
Process from contribution to publication and the necessary standard weeks	1. Contribution 2. Decision of in-depth review or rejection (one week) 3. Payment of book processing charge by credit card 4. In-depth review (2 weeks) 5. Revision by the authors when needed (2 weeks) 6. Decision of acceptance or rejection (1 weeks). In the case of rejection, the book publication fee is refunded. 7. Online publication (around 4 weeks in Springer Nature) 8. Book publication (Spring issue or Autumn issue in the regular case)
Editorial Manager prepared by Springer Nature	Open Conference Service (OCS) or any equivalent system
Starting time of contribution	1 January 2022
Planned founding issue	June 2022

Template for the Text

Title of Contribution for Progress in Landslide Research and Technology book series (do not exceed 100 characters including spaces)

Firstname Firstsurname, Secondname Secondsurname and Thirdname Thirdsurname

Abstract

This is an example text template for the full paper submission to the Progress in Landslide Research and Technology book series. The book series publishes original articles for practice. Contributed articles align with one of five categories: Original articles, Review articles, Case studies, IPL/WCoE/Network activities and Teaching tools with online extras (i.e., PPT, Video). The Abstract should be concise and self-contained, clearly stating main conclusions of the paper. The length should be of minimum 150 words, and within 300 words. The style to be used, according to the Template Style List, is the Normal Style with justification. At the end of the abstract text a list of keywords (minimum: 3 maximum: 7) should be added as shown in this template. The paper size should be set to A4 size (210 mm × 297 mm). The minimum paper length is 8 pages for original articles, review articles, IPL/WCOE/Kyoto Landslide Commitment, Teaching tools, and 4 pages for Technical notes and Case studies. 2-4 pages for World Landslide Reports. Please submit both MS-Word and pdf files.

Keywords

keyword1, keyword2, keyword3…

Firstname Firstsurname ( )
University of the Moon, Centre for Disaster Studies, Address,
CityName and Zip Code,
Countrye-mail: first@moon.plt
Secondname Secondsurname
Peking University, Department of Sciences, Beijing 100082,
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Editor 1 et al. (eds), *Progress in Landslide Research and Technology, Volume 1 Issue 1, 2022*,
Progress in Landslide Research and Technology
DOI 10.1007/978-94-007-2162-3_36

General body of the manuscript

The main text of the paper should be formatted using Normal Style according to the Template Style List. The first paragraph of each Section should not have right indentation whilst following paragraphs should, as in the following.

Left indentation is of 5 mm (as per Template Style Normal). The Normal style of text is based on the Constantia font, available within Microsoft Word software in all recent releases, size 9. Line spacing is single. The page format must be strictly respected as per Template Page Format. In particular, two columns formatting with column width of 77 mm and column spacing of 6 mm should be used. Page margins are: Top 40 mm; bottom 40 mm; Internal side 25 mm; External side 25 mm.

Sections of the manuscript

How to start?

Copy the template file, TemplateWLF5-Fullpaper.docx, to the template directory. This directory can be found by selecting the Tools menu, Options and then the File Locations. When the Word program is started, open the File menu and choose New. Select Templates, On my computer, and then the template, ICL-book - Fullpaper.docx.

Please rename the document before you start writing your paper. The file name of the manuscript should include the abstract/paper ID . For instance, if the Abstract/Paper ID is 1234, file name is ICL-book- 1234.

Locations. When the Word program is started, open the File menu and choose New. Select Templates, On my computer, and then the template, Template ICL-book-Fullpaper.docx.

Please rename the document before you start writing your paper.

Section and sub-sections

Each manuscript section should be entitled according to the Template Style List using up to 3 levels of indentation: style Heading 1 for the main title of the

section, style Heading 2 for a possible sub-section and, if needed, style Heading 3 for a further sub-level. We recommend not use more than 3 levels on titles and sub- sections. The example up here shows the use of two levels of titles for section and sub-section heading.

The font to be used for all Headings is Calibri. Heading 1 has font size 11, typeface bold and colour blue with RGB=(0,102,153). Heading 2 has font size 10, typeface bold, black colour. Finally, Heading 3 has font size 10, typeface bold + italic, black colour. However, please choose the correct style in the Style List of the Template file so that formatting is automatically applied to avoid mistakes.

Figures and figure captions

Figures are allowed either in greyscale or in colour. It is possible to insert column-wide figures (half-page width) with maximum width of 77 mm and double-column-wide figures as well with a max allowed dimension of 160 mm. In any case, the max height is 230 mm. Figure should be directly attached within the document at the right place using preferentially the "insert -> image -> from file" option of Microsoft Word using a recommended resolution of ate least 400 dpi for greyscale images and of at least 300 dpi for colour images. TIFF format is recommended.

The following is an example of column-wide figure. The figure line (the line of text in which the figure has to be placed) should be formatted choosing the appropriate Style "Figure" from the Template Style List. This will ensure proper distancing between figure and surrounding text. However, authors are free to add one or two empty rows of normal text to adjust formatting and visual appearance.

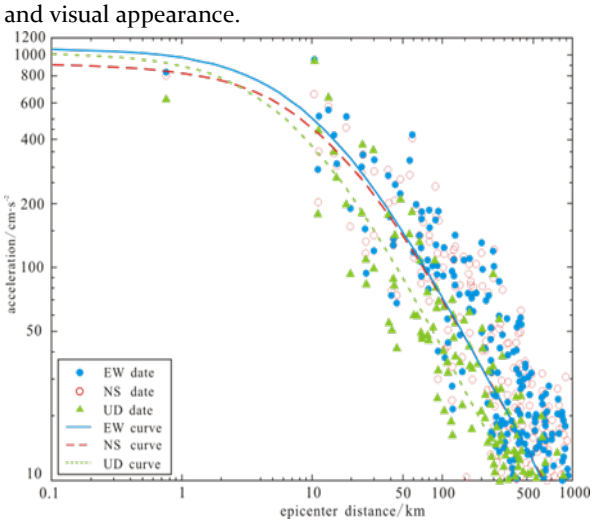


Fig. 1 Example of half page figure. Captions which are 2 or more rows long must be justified. Shorter caption must be column-centred. Please ensure to select the style "Figure Caption" and to place caption below figure. Figures should be cited in text using the short: "Fig.".

Title, authors, affiliations and other issues

Title and authors

The paper should start with the title section which has a special single-column formatting (see top of first page). Please make sure to maintain section separation to ensure proper column formatting of the document. In case you inadvertently delete the section break, insert a new one on top of the beginning of manuscript main body using Microsoft Word option "insert -> break -> section break -> continuous".

Author's names should precede paper title as in the example above. Please use style "Authors" for this part of paper, which uses the following formatting: font Calibri, font size 12, typeface bold, colour black, left indent 5 cm, vertical spacing after 3 pts. Each author has to be followed by a superscript number in parentheses corresponding to the author's affiliation (see also below). The title has to be formatted using the style "Title" reflecting the following format: font Calibri, font size 16, typeface bold, left indent 5 cm, justified, vertical spacing before 6 pts, after 12 pts, colour blue RGB=(0, 102, 153).

The title should follow, according to the ICL journal "Landslides" style, the author's names.

Finally, Affiliations conclude the first section of the paper, according to the style "Affiliation" in the Style List of paper Template. Each affiliation must be preceded by the relevant number between parentheses as in the example at the top of this file. Affiliation formatting is: font Calibri, font size 9, typeface bold, colour black, left indent 5 cm, vertical spacing after 3 pts. Each affiliation must be placed on a separate line, using the following order Department/Branch/Office, Institution/University, Address, Country. For the affiliation of the corresponding author also the following information must be included: email and/or telephone number.

Each author should also define a short or "running" title to be used in the right page heading (see example above in the page heading where the Template has the sentence "F. Author, S. Author, T. Author – Running title of contribution"). The running title should be limited to a maximum of 20 characters, blank spaces included. The page headings have a specific style "Page heading" to be used.

Math and formulas

All mathematical notations should be kept outside normal text paragraphs with the exception of single (or very simple combination of) symbols. An example of use of in-text symbols is this: β is defined as the slope angle in degrees. More complex expressions should be placed under the style "Equation" and inserted in the

manuscript as equation objects using the proper object -> Mathtype"). Please avoid copy-pasting of equations as images. If equation numbering is necessary, please use a right-sided numbering between squared parentheses as in the following example.

$$G = (\frac{e^2}{\sum r_i}).[\cos\alpha \cos\beta]^{-1.3} \quad [1]$$

All the units of measurement used in the paper should be in the SI system and every time a new symbol, group of symbols or specific operator is introduced, it should be explained and described along with its unit of measurement if appropriate

Tables

In the manuscript, tables have to be formatted according to the following example. It is possible to insert a single- or a double-column table (if needed) provided that the author insert the proper section breaks to ensure column formatting separation between sections.

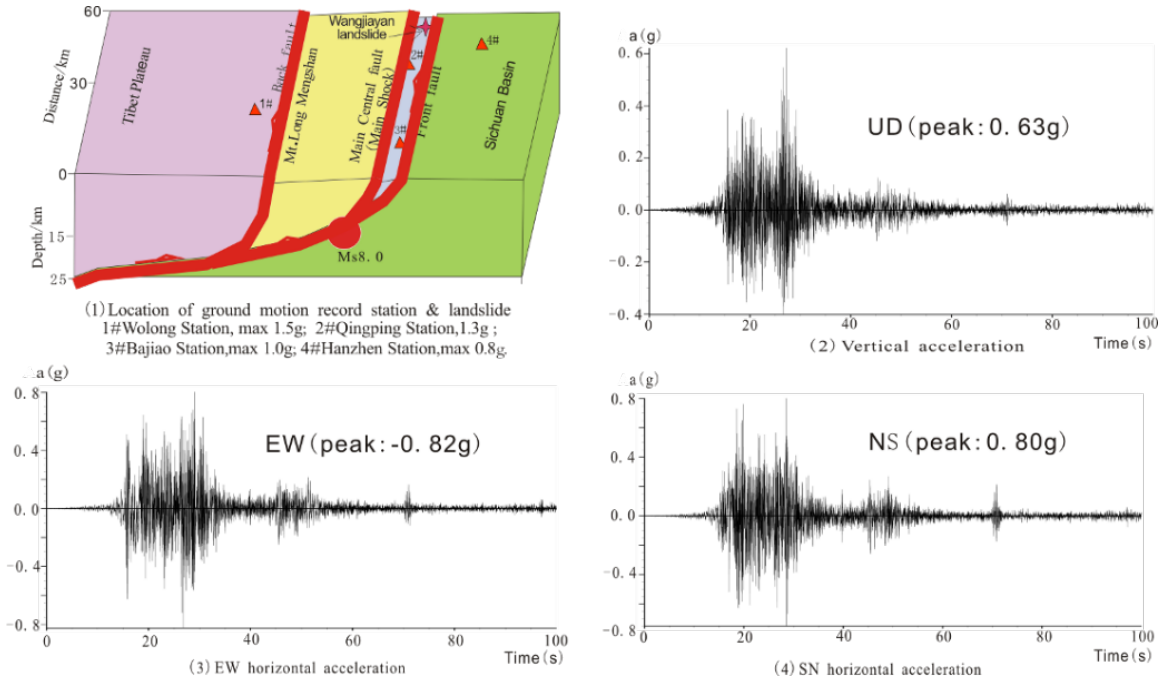
Microsoft Word commands (such as e.g. "insert -> Table format has to be copy-pasted from the example below, using font Calibri, font size 9, column heading colour white, text colour black.

Table caption must precede the table, and has to be formatted according to the style "Table caption". Maximum table width is 82 mm for single column tables and 170 mm for page-wide tables.

Table 1 Example of table. Colours, formatting and fonts are as per template (Calibri 9 pt). Please ensure left justification for alphanumeric text and right justification for numbers. Use same number of decimals with floating point numbers. Table should be cited in text using the short: "Tab.".

Col Head 1	Col Head 2	Col Head 3	Col Head 4
Text	34.90	17/11/2011	Descr 1
Text	12.98	01/06/1998	Descr 2
Text	3.64	31/02/1900	Descr 3

In particular, Table colour is as follows: heading row and grid: blue RGB=(0,102,153); normal text rows: light cyan RGB=(204,236,255).



(1) Location of ground motion record station & landslide
1#Wolong Station, max 1.5g; 2#Qingping Station,1.3g ;
3#Bajiao Station,max 1.0g; 4#Hanzhen Station,max 0.8g.

(2) Vertical acceleration

(3) EW horizontal acceleration

(4) SN horizontal acceleration

Fig. 2 Example of two-column figure. In case the caption of the figure is only one row, it must be centred.

It is possible to add page-wide sections (using the appropriate section breaks as explained and as exemplified below, to insert large figures. The maximum allowed width is 170 mm. Also, that max allowed height for both figures and tables is limited to 230 mm. Please remember that is this case you need to insert two section breaks (continuous): one just before the figure which starts single-column style, and the other one just after the figure caption, which tells the system to stop single column formatting and go back to double-column.

Please position your large figures in the best way, as to avoid large empty spaces on page.

In case this is not possible, add empty rows typing carriage-return characters until the visual appearance of the page is maintained, as in the following example.

As in the figure above, use row spacing also to ensure a proper distance between figure and text according to the overall dimension of your image and caption length.

We suggest that each paper will have at least one Introduction section laying out the state of the art and the motivations for the study to be reported, a Materials and Methods section, one of Results and one incorporating Discussion and relevant conclusions as derived from the research outcomes.

As in the figure above, use row spacing to ensure a proper distance between figure and text according to the overall dimension of your image and caption length. We suggest that each paper will have at least one Introduction section laying out the state of the art and the motivations for the study to be reported, a Materials and Methods section, one of Results and one incorporating Discussion and relevant conclusions as derived from the research outcomes.

The papers contribute to the Progress in Landslide Research and Technology book series should follow the rules depicted in this Template Guideline and, furthermore.

Acknowledgments

In the Acknowledgments section, appearing just before the References, the authors may credit others for their guidance or help. Also, funding sources may be stated. The Acknowledgments section does have a section heading at level 1, as in this example. Following this section the References section begins for which authors must use the style “Reference” (Font Calibri, font size 9, first row left indented 0.4 cm) and use reference citation rules as per the journal *Landslides*. Please follow the rules of the same journal also for citations within the textbody.

In the following section we present some example of formatting for references related to edited books, conference proceedings, periodic journal papers, scientific reports and web sites. References must be, firstly, in alphabetical order and then in date order, descending.

For any other formatting issue please refer to the editorial guidelines and style used by the ICL journal “Landslides”, edited by Springer.

References (in the alphabetical order)

Book_or_book_chapter__author_surname A A, Author_surname B B, Author C, (2009) Title of book. EditorSurname A (eds). Publisher and location. (ISBN _number_). 450p. Doi number.

CD-ROM_author_surname A A, Author_surname B B, Author C, (2009) Title of CD ROM. (CD-ROM), ASCE Press,Reston, Va.

Conf_paper_author_surname A A, Author_surname B B, Author C, (2009) Title of paper. Proceedings of 30th Canadian Symposium on Remote Sensing, 22-25 June 2009. Lethbridge AB., Canada. pp. 310-321.

Journal_paper_author_surname N P, Anotherone K, Thelastone P O (2009) Title of paper. Canadian Journal of Remote Sensing. 35(2): 244-253. Doi number.

Report_author_surname A A, Author_surname B B, Author C, (2009). Title of report. Publisher and location. (ISBN _number_). 50p.

Theses and dissertations _author_surname A A, Author_surname B B, Author C, (2009) Title of Theses and/or dissertations. MS thesis, DPRI Kyoto Univ., Kyoto,Japan.

Web_site_author_name_surname A A, Author_surname B B, Author C, (2009). Title of Page. URL: http://_ [Last accessed: full data

Official Promoters

The Kyoto Landslide Commitment 2020 (KLC2020)

Kyoto 2020 Commitment for Global Promotion of Understanding and Reducing Landslide Disaster Risk

-A Commitment to the Sendai Landslide Partnerships 2015-2025, the Sendai Framework for Disaster Risk Reduction 2015-2030, the 2030 Agenda Sustainable Development Goals, the New Urban Agenda and the Paris Climate Agreement-

KLC2020 Official promoters are public and private organizations who promote the Kyoto Landslide Commitment 2020 and provide financial support for the implementation of the KLC2020 activities including the Open Access Book Series "Progress in Landslide Research and Technology".

Host organization

International Consortium on Landslides (ICL) / Nicola Casagli

Public sectors: KLC2020 Official Promoters-public

International Unions/Associations, Governmental organizations, Universities and Research institutes

- The International Union of Geological Sciences (IUGS) / John Ludden
- The International Association for the Engineering Geology and the Environment /Rafig Azzam
- International Geosynthetics Society (IGS) / John Kraus
- Geological Survey of Canada, Natural Resources Canada, Canada / Daniel Lebel
- Faculty of Civil and Geodetic Engineering, University of Ljubljana, Slovenia / Matjaž Mikoš
- China University of Geosciences, Wuhan, China / Huiming Tang
- Department of Civil Engineering, National Taiwan University, Chinese Taipei /Shang-Hsien Hsien
- Institute of Rock Structure and Mechanics, the Czech Academy of Sciences / Josef Stemberk
- Institute of Cold Regions Science and Engineering, Northeast Forestry University/ Wei Shan

Private sectors: KLC2020 Official Promoters-private

Companies and corporation.

- Marui & Co. Ltd, Japan
- Nippon Koei Co., Ltd, Japan
- Ellegi srl, Italy
- IDS GeoRadar s.r.l., Italy
- Chuo Kaihatsu Corporation, Japan
- Godai Corporation, Japan
- Kiso-Jiban Consultants Co., Ltd, Japan
- Kokusai Kogyo Co., Ltd., Japan
- Osasi Technos, Inc., Japan

Geological Survey of Canada, Natural Resources Canada

Firstname Firstsurname, Secondname Secondsurname

GEOLOGICAL SURVEY OF CANADA – WHO WE ARE

The Geological Survey of Canada (GSC) is part of the Earth Sciences Sector of Natural Resources Canada. The GSC is Canada's oldest scientific agency and one of its first government organizations. It was founded in 1842 to help develop a viable Canadian mineral industry by establishing the general geological base on which the industry could plan detailed investigations. Throughout its long and colourful history, the GSC has played a leading role in exploring the nation.

Today, the GSC is Canada's national organization for geoscientific information and research. Its world-class expertise focuses on the sustainable development of Canada's mineral, energy and water resources; stewardship of Canada's environment; management of natural geological and related hazards; and technology innovation.

Fig.1 Paleotsunami investigations in order to understand regional earthquake cycles and submarine landslide hazards.

The GSC celebrated its 175th anniversary in 2017 which coincided with Canada's 150th anniversary of Confederation.

The GSC co-leads the Canada-Nunavut Geoscience Office and works with dozens of universities and research institutes, industry organizations, other federal departments, provinces, territories and municipalities in Canada and across the world. In particular, we work closely with other geological survey organizations in Canada through the unique Intergovernmental Geoscience Accord.

Firstname Firstsurname, Secondname Secondsurname
GSC-Pacific Division, 1500-605 Robson St., Vancouver, BC, V6B 5J3
e-mail:

Editor 1 et al. (eds), *Progress in Landslide Research and Technology, Volume 1 Issue 1, 2022*,
Progress in Landslide Research and Technology
DOI 10.1007/978-94-007-2162-3_36

Every year, we publish hundreds of maps, Open Files, peer-reviewed papers and other reports. Our scientists are recognized worldwide and sought after for their expert advice on locating mineral, energy and groundwater resources, reducing risk from natural hazards and reviewing environmental assessments.

STRATEGIC PRIORITIES

The GSC has attempted to plot a course through this changing, uncertain world.

First, we identify three core areas of persistent scientific endeavour, which reflect stable, long-term needs of society:

- **Geological knowledge for Canada's onshore and offshore lands**
- **Geoscience for sustainable development**
- **Geoscience for keeping Canada safe**

Next, we outline a new, fourth area of endeavour, Geoscience for society, which is the need to address the uncertainties of the changing world by expanding the reach and impact of geoscience knowledge in land-use decision making and in efforts to reduce the risk of disasters.

Finally, we recognize that our strength lies in a fifth area of endeavour, Our people, Our science, which we need to nurture to maintain a high-performing workforce capable of world-leading innovative geoscience for the benefit of Canada.

a) Geological knowledge for Canada's onshore and offshore lands

Fig.2 The GSC studies the sea floor of the Arctic to understand its geology and geohazards. Here a small craft surveys the bottom of Southwind Fjord (Baffin Island, N Nunavut).

Geoscientific knowledge is fundamental to managing our onshore and offshore lands and their abundant resources. With its 10 million km^2 of onshore land and an additional 7

million km^2 of ocean estate, Canada is a vast country and a core mission of the GSC is to map and understand the land and its resources. Our Geo-mapping for Energy and Minerals (GEM) program continues to advance our knowledge of the North and by 2020 will complete a first mapping of surface geology at a coarse scale.

In the offshore lands, our geoscience knowledge also serves to confirm the farthest extents of the Canadian territory. Our joint program with Global Affairs Canada and Fisheries and Oceans Canada to delineate the outer limits of the continental shelf in the Atlantic and Arctic Oceans will reach a critical milestone in 2019. The program will file its Arctic submission under the United Nations Convention on the Law of the Sea (UNCLOS).

b) Geoscience for sustainable development

Finding new resources remains a major challenge. Many near-surface deposits have been discovered in Canada, but significant mineral resources remain to be found in less accessible regions and at depths below the surface. Finding new resources requires systematic, intensive and innovative methods to assess the mineral potential in remote locations. It requires searching beneath overburden cover, imaging the 3-D structure of the earth and understanding the geological processes that lead to concentration of minerals in certain locations.

Fig.3 GSC geologists near the Heiberg Formation in northern Ellesmere Island (NU) as part of the Geo-mapping for Energy and Minerals program. This formation is the primary host of major gas accumulations in the Canadian High Arctic.

For the Energy sector, the greatest challenge is in the transition to a low-carbon economy. Although global fossil fuel use is likely to continue to grow over the foreseeable future, the trend will likely be at a decreasing rate. Canada has an abundant supply of conventional and unconventional (oil sands and shale) oil and gas, so development in frontier areas is likely to be slow. In addition, the government has placed a moratorium on exploration activity in the Arctic offshore lands.

c) **Geoscience for keeping Canada safe**

The GSC will continue to work on understanding how landscapes will change, how infrastructure will be affected and how resilience to climate change can be built into new infrastructure. Climate change will likely have a significant impact on the water cycle. GSC research will shed light on the risk to potable water supplies, hydroelectric power generation, and hazards from floods and drought.

Fig.4 The GSC conducts climate change studies, here documenting the effects of fast melting permafrost leading to extreme coastal erosion on Pelly Island, NT.

d) Geoscience for society

The scientific knowledge required to assess cumulative effects is broad. The complex interactions between land use, water management and waste management require an integrated approach at a landscape scale. The GSC is a national provider of information on both land (surficial and solid geology) and water, including the integration of surface water and groundwater into the complete water cycle.

The GSC recognizes that this area of endeavour involves inherent complexities and that our goals in this area will be to some degree aspirational. However, we will investigate new ways of planning our programs, undertaking our fieldwork, interacting with key stakeholders, and communicating our expert knowledge in ways that contribute positively to decision making about resource development.

Fig.5 The GSC conducts geohazard studies to reduce risks to people and infrastructure, here installing equipment to monitor landslide activity above a critical railway corridor in central BC.

e) Our people, Our science

As a science organization within the federal government, the GSC's mandate is to conduct world-class science to inform public decision making. The Canadian government has articulated and adopted the principle of evidence-based decision making and reaffirmed the need for government science to be objective and non-partisan.

To remain at the leading edge, our scientists need to work with a variety of partners. We need to reinforce the central role that the GSC plays in the Canadian geoscience community by building networks of collaboration, fully participating in national geoscience initiatives, and advocating for Canadian geoscience at the international level.

Fig.6 Among many celebratory activities for the GSC's 175th anniversary in 2017, the GSC held a Rock and Fossil Exhibit, at its site at the Bedford Institute of Oceanography (Dartmouth, NS), as part of a two-day open-house event, where more than 20,000 visitors participated.

Moving forward

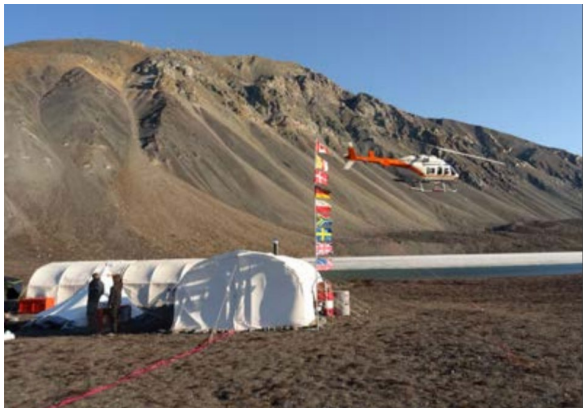


Fig. 7 Joint Canadian/German (GSC/BGR) field mapping camp on northern Ellesmere Island, looking west as the fog covered sea ice of Yelverton Inlet, 2017.

Some of the objectives and goals that the GSC has set represent familiar territory for a national geoscience organization, but many others will pull us out of our comfort zone. We will take the time to better understand the challenges of delivering objective, nonpartisan science to support evidence-based decision making in Canada at a time of great technological and social change.

We will not be able to do this alone, so we look forward to strengthening our ties to other federal departments, provinces and territories, universities, Indigenous organizations, the private sector and civil society as a whole.

We ask all our stakeholders to contact us, to challenge us and, most importantly, to join with us to assure the future of Canada through thoughtful, respectful dialogue about the land we live on, its resources and its future.

Exploring Canada

Through its history, the GSC has been responsible for mapping the land mass of Canada, which supported the integration of the western provinces and northern territories into the country that we have today. The limit of Canada's offshore territory is still being extended today though surveys conducted by the GSC and the Canadian Hydrographic Service.

In more recent years, the GSC helped find the first economic diamond deposit in the Northwest Territories, leading to the expansion of diamond mining in Canada.These are only a few of the key GSC achievements that have built our knowledge of Canada's lands and provided the building blocks of its natural resource economy.

Today, exploration of this vast land is still reaping its natural resource rewards. The search for natural resources is difficult, akin to looking for a needle in a haystack.

The GSC's GEM program is exploring vast tracts of Canada's North, a land mass roughly equivalent to the combined areas of Quebec, Ontario and Manitoba, to find the "haystacks" with resource potential. This information is shared with the provinces and territories, as well as the private sector, so that the search for the "needles" can continue. The information is also critical to inform land-use planning.

In November 2016, the Royal Canadian Geographical Society (RCGS) awarded its prestigious Gold Medal to the GSC in recognition of the Survey's outstanding contribution to the development of Canada on the occasion of it's 175th anniversary.

Faculty of Civil and Geodetic Engineering, University of Ljubljana

Matjaž Mikoš

Summary

In 2019, the Faculty of Civil and Geodetic Engineering of the University of Ljubljana (ULFGG) celebrated its centennial: The precursor of the faculty was the Technical Faculty established in 1919 as one of five founding faculties of UL.

ULFGG, covering technical disciplines of civil and geodetic engineering, as well as water science and technology, has been involved in landslide risk reduction activities at the national level in Slovenia (former Yugoslavia, until 1991) for decades (Fig. 1). In 2008, ULFGG became an ICL Full Member and has gradually developed its ICL engagement. ULFGG has been awarded the title of the World Centre of Excellence (WCoE) in Landslide Risk Reduction for 5 consecutive periods (2008–2011, 2011–2014, 2014–2017, 2017–2020, 2020-2023). Together with the Geological Survey of Slovenia, another ICL member in Slovenia, ULFGG hosted the 4th World Landslide Forum in Ljubljana, Slovenia, from May 29 to June 2, 2017. ULFGG strongly supports diverse activities of the International Consortium on Landslides, Kyoto, Japan, and thus contributes to the 2030 Agenda for Sustainable Development, as well as to the Sendai Framework for Disaster Risk Reduction 2015–2030 (SF DDR). ULFGG was a signatory of the Sendai Landslide Partnerships 2015 – 2030, and is a strong promoter of the Kyoto Landslide Commitment 2020, a SF DRR voluntary commitment by ICL.

In 2019, ULFGG hosted, together with the Slovenian Chamber of Engineers, the World Construction Forum 2019 (WCF 2019; www.wcf2019.org) in Ljubljana under the forum motto “Buildings and Infrastructure Resilience.” The Forum with one of the themes on Disaster Risk Management and Governance for Resilient Communities was co-organized by the World Federation of Engineering Organizations (WFEO) in support to the implementation of the 2030 Agenda for Sustainable Development. All lectures given at the WCF2019 are available for free on the forum web page, as a contribution to Open Science efforts.

In the field of capacity building, ULFGG offers several courses for graduate and postgraduate students in landslide mechanics and dynamics, landslide stabilization and landslide risk mitigation. In this paper, a short overview of the past activities of ULFGG as ICL Full Member is shown.

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World Centre of Excellence on Landslide Risk Reduction and IPL projects

WCoE activities

The title of World Centre of Excellence (WCoE) on Landslide Risk Reduction is given to a governmental or non-governmental entity, which contributes to the landslide disaster risk reduction at a regional and/or global level in a specific unique field of expertise, as well as helps promoting International Programme on Landslides (IPL) and landslide research intellectually, practically and financially (https://iplhq.org/category/iplhq/world-centre-of-excellence-wcoe/). ULFGG was granted the title of WCoE five consecutive times:

- WCoE 2008–2011 & 2011–2014: Mechanisms of landslides in over -consolidated clays and flysch.
- WCoE 2014–2017: Mechanisms of landslides and creep in over-consolidated clays and flysch.
- WCoE 2017–2020: Landslides in Weathered Flysch: from activation to deposition.
- WCoE 2020–2023: Landslides in Weathered Heterogenous Sedimentary Rock Masses such as Flysch.

The research efforts at ULFGG were focused on:

- Mechanisms of triggering such landslides (mud flows), estimation of debris-flow magnitudes triggered as shallow or deep-seated landslides (debris slides), and triggering of shallow rainfall-induced landslides using advanced statistical methods.
- Field and laboratory investigations of suction in over-consolidated clays and flysch, such as to improve the understanding of softening in stiff over-consolidated clays and marls, using soil matrix suction as an indicator for mudflow occurrence, and executing suction long-term monitoring of the Slano Blato landslide.
- Laboratory investigations of coarse debris-flow rheological parameters and soil-water characteristic curve of residual soil from a flysch rock mass.
- Mathematical modelling of debris flows (hazard assessment in deposition areas), using different numerical models and different digital terrain models.

The WCoE activities were financially supported by the Slovenian Research Agency through the Research Programme P2-0180 “Water Science and Technology, and Geotechnical Engineering: Tools and Methods for Process Analyses and Simulations, and Development of Technologies,” as well as by several national and international (bilateral) research projects.

ULFGG and the Geological Survey of Slovenia jointly organized 4th World Landslide Forum (WLF4; www.wlf4.org).

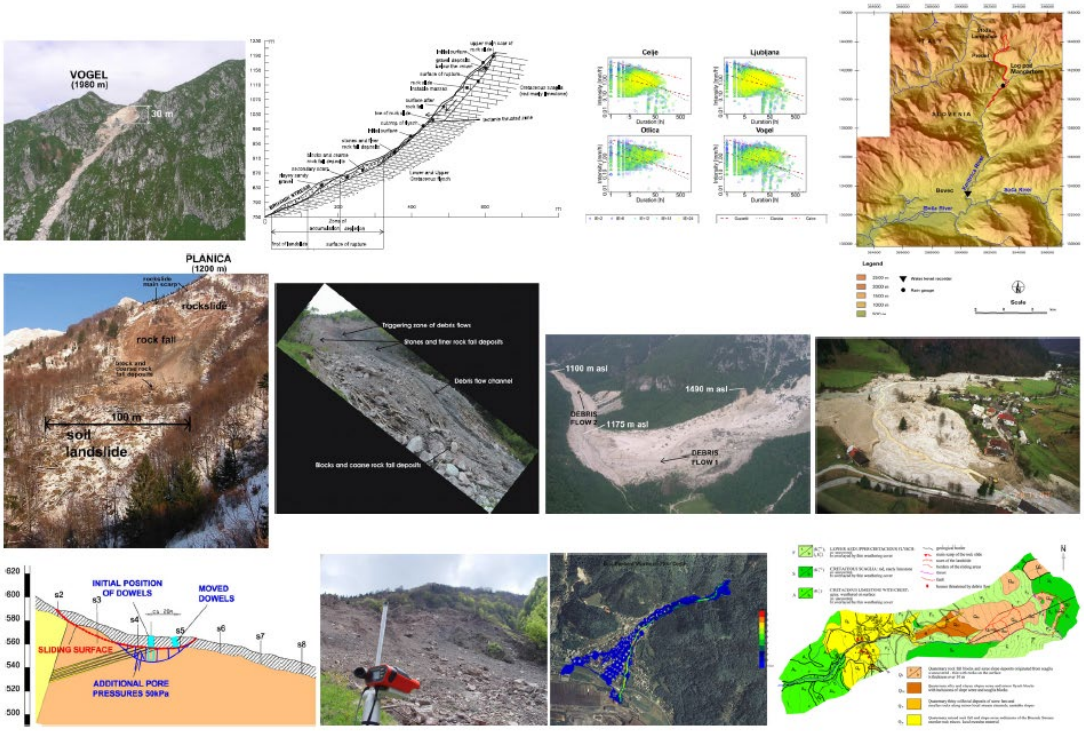

Fig. 1 A collage of landslides in Slovenia and their investigation performed by UL FGG

Fig. 2 At the WLF4 press conference in Ljubljana—from left to right: Qunli Han (UNESCO), Miloš Bavec (Geological Survey of Slovenia), Matjaž Mikoš (University of Ljubljana, ICL), Peter Bobrowsky (ICL) (from www.wlf4.org)

In Ljubljana between May 29 and June 2, 2017 (Fig. 2), followed by a three-day field study tour to see the variety of landslide forms in Slovenia and in its immediate NW surroundings. With over 600 participants from 49 countries and 5 international organizations, WLF4 was promoting the culture of living with natural hazards.

IPL projects

An important ICL activity is IPL projects (https://iplhq.org/category/iplhq/ipl-ongoing-projects/). The IPL Evaluation Committee examines the submitted proposals of ICL members by carefully reading the written proposals and by listening to their presentations at annual ICL conferences. The initially accepted proposals by the IPL Evaluation Committee are discussed and then approved at the annual Board of Representatives meeting of ICL members (Annual Assembly). Finally, the IPL projects are approved annually by the IPL Global Promotion Committee.

ULFGG has successfully submitted several proposals for IPL projects and has been so far actively involved in the following ones:

– IPL-151 Soil matrix suction in active landslides in flysch—the Slano Blato landslide case (2010–2012).

– IPL-225 Recognition of potentially hazardous torrential fans using geomorphometric methods and simulating fan formation (2017–2020).

– IPL-226 Studying landslide movements from source areas to the zone of deposition using a deterministic approach (2017–2020)—coordinated by the Geological Survey of Slovenia.

ICL thematic and regional networks

Following the ICL Strategic Plan 2012–2021, several thematic networks and regional networks have been established (for an overview, see http://icl.iplhq.org/category/icl/icl networks/).

Landslide Monitoring and Warning Thematic Network

In 2012, ULFGG proposed the ICL landslide monitoring and warning thematic network (abbr. LaMaWaTheN), and almost 10 ICL members joined the initiative. The general objective of the proposed network was to compare experiences in the field of landslide monitoring and installed early warning systems for active landslides in various regions of the world. A proposal for landslide monitoring techniques database was. The network was later coordinated by the Croatian Landslide Group from the Faculty of Civil Engineering, University of Rijeka, Croatia, and the Faculty of Mining, Geology and Petroleum,

University of Zagreb, Croatia. Lately, we contributed to the network activities by preparing practice guidelines on monitoring and warning technology for debris flows.

The idea of the network was partially taken over by the web database ICL World Report on Landslides (http://iplhq.org/ls-world-report-on-landslide/), created to be a platform to share landslide case studies among the global landslide community, with monitoring and warning systems being a part of the story.

ICL Adriatic-Balkan Network

Jointly with other ICL members from Croatia and Serbia, in 2013, ULFGG proposed to establish an ICL Adriatic-Balkan Regional Network (ICL ABN; https://www.klizista-hr.com/en/organization/about-us/icl-abn/). Various network activities were proposed, the most active being the organization of biennial regional symposia on landslide risk reduction in the Adriatic-Balkan Region (called ReSyLAB). ULFGG supported the 1st Symposium in Zagreb (Croatia) in 2013 (March 6–9), and the 2nd in Belgrade (Serbia) in 2015 (May 14–16), and jointly organized the 3rd in Ljubljana (Slovenia) in 2017 (October 11–13) together with the Geological Survey of Slovenia (also an ICL member).

In the last decade, ULFGG has signed bilateral research projects with the ICL members in the region: "Adriatic-Balkan Regional Network: Landslide Risk Mitigation for Society and Environment" (2012–13 with University of Belgrade, Serbia), "Study of landslides in flysch deposits: sliding mechanisms and geotechnical properties for landslide modelling and landslide mitigation SoLiFlyD" (2014–15 with University of Rijeka, Croatia), and "Laboratory investigations and numerical modelling of landslides in flysch deposits in Croatia and Slovenia" (2016–17 with the University of Rijeka, Croatia). This joint research has helped strengthen regional cooperation within the ICL ABN regional network.

Other ICL-related international activities

ULFGG served the ICL by taking different leading roles in the Consortium, i.e. ULFGG member served as Chair of IPL Evaluation Committee, twice as ICL Vice President, and was elected to Co-Chair of IPL Global Promotion Committee (https://iplhq.org/).

ULFGG has been strongly supporting the journal Landslides: Journal of the International Consortium on Landslides, published by Springer Nature (https://link.springer.com/journal/10346) since its launch in 2004. ULFGG works for the journal in the roles of reviewers and an associate editor, and regularly publishes its top research results in the journal, as well as disseminates information important for capacity building in landslide risk reduction in the journal.

ULFGG followed the development of the journal from its bibliometric perspective, and compared scientometric impacts of the journal with the other ICL publications (monographs, volumes from World Landslide Forums) in the field of landslide research.

ULFGG also contributed to the two-volume set of Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools (LITT), namely to Volume 1: Fundamentals, Mapping and Monitoring by practice guidelines on monitoring and warning technology for debris flows (https://www.springer.com/gp/book/9783319577739), and to Volume 2: Testing, Risk Management and Country Practices(https://www.springer.com/gp/book/9783319577760) by a state-of-the-art overview on landslide disaster risk reduction in Slovenia, a study on two-dimensional debris-flow modelling and topographic data, and by study on intensity-duration frequency curves for rainfall-induced shallow landslides and debris flows using copula functions.

UNESCO Chair on Water-related Disaster Risk Reduction

Experiences and knowledge accumulated in the past decades at the Chair on Hydrology and Hydraulic Engineering at ULFGG in the field of (applied) hydrology in experimental basins, landslide research, landslide risk reduction, and flood risk management, culminated in 2016 in the establishment of the UNESCO Chair on Water-related Disaster Risk Reduction (WRDRR Chair; www.unesco-floods.eu) at the University of Ljubljana. The UNESCO WRDRR Chair was positively evaluated in 2020 and prolonged for another 4 years (2020–2024). The Chair is associated to the university twinning and networking UNITWIN UNESCO – Kyoto University – ICL on "Landslide and Water-Related Disaster Risk Management".

ULFGG supports activities of the Slovenian National Committee for UNESCO Intergovernmental Hydrological Programme (www.ncihp.si) – focus of the activities is the development of the IHP-IX Programme (2022–2029).

Conclusions

ULFGG as one of World Centres of Excellence in Landslide Risk Reduction, hosts the UNESCO Chair on Water-related Disaster Risk Reduction. ULFGG strongly supports ISDR-ICL Sendai Partnerships 2015–2025 for global promotion of understanding and reducing landslide disaster risk, and its extension to 2030 and beyond: the Kyoto 2020 Commitment for Global Promotion of Understanding and Reducing Landslide Disaster Risk that that was signed in November 2020. ULFGG is proud to be its Official Promoter, and will specifically work for its Actions 2, 5, 6, 9 and 10.

This review contribution is intentionally written without giving references to described activities. For this purpose, listed websites and web search engines may be used.

The author wants to thank numerous colleagues from ULFGG and from the wide ICL community for a long-lasting excellent cooperation with a joint vision to reduce landslide disaster risk.

China University of Geosciences, Wuhan

Huiming Tang, Changdong Li, Qinwen Tan

Introduction

China University of Geosciences, Wuhan (CUG), founded in 1952, is a national key university affiliated with the Ministry of Education. It is also listed in the National "211 Project", the “985 Innovation Platform for Advantageous Disciplines” and the "Double First-class Plan". CUG, featuring geosciences, is a comprehensive university that also offers a variety of degree programs in science, engineering, literature, management, economics, law, education and arts. Its Geology and Geological Resources & Engineering have both been ranked as national number one disciplines.

CUG has two campuses in Wuhan. The main campus is the Nanwang Mountain Campus, located in the heart of the Wuhan East Lake National Innovation Demonstration Zone, which is popularly known as China Optics Valley. The Future City Campus is located in the east of Wuhan and is 27 km from the main campus. These two picturesque campuses cover a combined area of 1,474,353 m^2. They are ideal places to study, work, and enjoy life. CUG owns a 4A-Level tourist attraction—the Yifu Museum. CUG also boasts four field training centers: Zhoukoudian in Beijing, Beidaihe in Hebei Province, Zigui in Hubei Province, and Badong in Hubei Province.

CUG has established a complete education system. As of December 2020, 30,239 full-time students, including 18,080 undergraduate students, 9,302 master's students, 1,916 doctoral students, and 941 international students have enrolled in its subsidiary 23 schools and 86 research institutes. CUG currently has a faculty of 1,858 full-time teachers, among which there are 539 professors (11 of which are members of the Chinese Academy of Sciences) and 984 associate professors.

CUG is focused on fostering high-quality talent. Among its over 300,000 graduates, many have gone on to become scientific and technological elites, statesmen, business leaders and athletes. And they have made great contributions to the nation and society, represented by former Premier WEN Jiabao and 39 members of the Chinese Academy of Sciences and Chinese Academy of Engineering.

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CUG has strengthened exchanges and cooperation with international universities. It has signed friendly cooperation agreements with more than 100 universities from the United States, France, Australia, Russia and other countries. CUG has actively carried out academic, scientific and cultural exchanges with universities around the world. There are about 1,000 international students from more than 100 countries studying at CUG. It also sponsors more than 900 teachers and students to study abroad or conduct international exchanges, and invites more than 400 international experts to visit, lecture, and teach at CUG every year. In 2012, CUG initiated and co-established the International University Consortium in Earth Science (IUCES) with 11 other world-renowned universities. IUCES is committed to promoting the common development of geosciences education and scientific research through resource sharing, exchange and cooperation among its member institutions. In addition, CUG has partnered with Bryant University from USA, Alfred University from USA, and Veliko Turnovo University from Bulgaria in establishing three Confucius institutes on their campuses.

Strategic plan of building a world-renowned research university in earth sciences - a beautiful China and a habitable earth: towards 2030

Fig.1 Strategic plan of building a world-renowned research university in earth science

CUG reviewed and approved Strategic Plan of Building a World-Renowned Research University in Earth Sciences on December 25 of 2019.

Themed on “A Beautiful China & A Habitable Earth”, the Plan depicts the blueprint of the second goal of the

"three-steps strategic goals", which is to build a world-renowned research university in Earth Sciences by 2030 based on the attained goal of developing CUG into a "high-level university with first-class Earth Sciences and coordinated development of multi-disciplines".

According to the Plan, our education missions are: Remaining true to CUG's core value of "seeking harmonious development between man and nature", we are committed to cultivating innovative talents who have lofty morality, solid foundation, and profound expertise, and who pursue the unity of knowing and doing. We should provide personnel support, and endeavor to innovate, apply and spread knowledge in order to provide theories, technologies and approaches for the construction of a Beautiful China and a Habitable Earth. We should strive to optimize governance, reform culture, and fully invigorate the vitality of running a university. We should provide our service to the construction of an innovative country and to the promotion of a harmonious co-existence between man and nature. We should provide our service to the people and the governance of China. We should provide our service to the consolidation and development of the system of socialism with Chinese characteristics. We should provide our service to the reform and opening up and to the construction of the socialist modernization.

According to the Plan, our endeavoring goals are: By 2030, we will have built a world-renowned research university in Earth Sciences, whose main indexes will have reached or nearly reached the level of other world-class universities. To upgrade CUG into a world-class university, we will endeavor to make the discipline of Earth Sciences rank top in the world and forge boldly ahead in competition to improve the quality of other disciplines of CUG. We will assemble a contingent of teachers and researchers with international competitiveness and influences to build a university with Chinese characteristics and superiority. We will build a world-class university that will be fully engaged in international exchange and cooperation and that will achieve educational, academic, cultural, and administrative excellence.

Outstanding recent achievements

In recent years, CUG has achieved significant progress in the research fields of geohazards, water resource, geochemistry, paleontology, geodetic surveying and lunar exploration program, etc. To keep to the theme of KLC2020, recent achievements on geohazards researches of CUG are focused and introduced.

a. Approval of National Observation and Research Station for Geohazards in the Three Gorges Reservoir Area，Hubei

CUG was newly approved ***National Observation and Research Station for Geohazards in the Three Gorges Reservoir Area , Hubei***. This station, founded and administrated by Prof. Huiming Tang, is responsible to carry out field observations and scientific research on geohazards in condition of reservoir operation.

The central site of the station is located in Badong County of the Three Gorges Reservoir area (hereinafter abbreviated as the TGR area), and a larger monitoring network of multiple sites has been established, including the geohazard field test site for the Majiagou landslide, Zigui County, and systematic geophysical monitoring station for the whole TGR area, etc.

The Badong field site (also named *Badong in-situ large-scale experimental station*) is located in the Huangtupo landslide area, which has been recognized the largest reservoir landslide by volume in the TGR area. The field site consists of a tunnel complex and a series of monitoring systems (Fig. 2). The tunnel complex, built in the Huangtupo riverside sliding mass #1, consists of a main tunnel with a length of 908 m and a width of 5 m, five branch tunnels (5 m to 145 m long, 3.5 m wide), two test tunnels, and 35 observation windows. The test tunnels exposed the sliding zones of the landslide, facilitating their direct observation and the execution of scientific experiments, such as large-scale in-situ mechanical tests and deep deformation monitoring. The monitoring systems measure deformation as well as hydrologic, meteorological and hydro-chemical variables. The deformation system is composed of a slope surface displacement measurement unit and an underground displacement measurement unit. The slope surface displacement unit includes a number of GPS (Global Positioning System) and BDS (BeiDou Navigation Satellite System) measurement points, as well as an IBIS-FL (Interferometric Radar) monitoring system (Fig. 2). The underground displacement unit includes nine deep inclinometer boreholes, a number of crack meters installed on the ground and the walls of tunnels, and many hydrostatic level gauges that measure the settlement of the tunnels in the sliding mass. The hydrologic system includes a number of devices that allow for observation of the water level of the Yangtze River, the ground water level and water discharge of the tunnels (Fig. 2). A small meteorological station is located on the landslide and provides rainfall data. So far, multiple and massive data have been collected for the landslide area since the year 2012, when the field site was constructed; over 10,000 people with a variety of geology-related backgrounds from > 20 countries have visited this experimental station.

b. Approval of the Basic research on the prediction and forecasting of major landslides program supported by the Major Program of NSFC

CUG was approved the ***Basic research on the prediction and forecasting of major landslides*** program (2021-2025), supported by the Major Program of the National Natural Science Foundation of China. The program was designed for the prediction and forecasting

of major landslides, with the concentration on the core scientific problems of landslide evolution process and physical-mechanical mechanism. Three key scientific problems, including correlation mechanism for landslide initiation, physical-mechanical mechanism for landslide initiation, and prediction and forecasting theory based on landslide evolution were proposed.

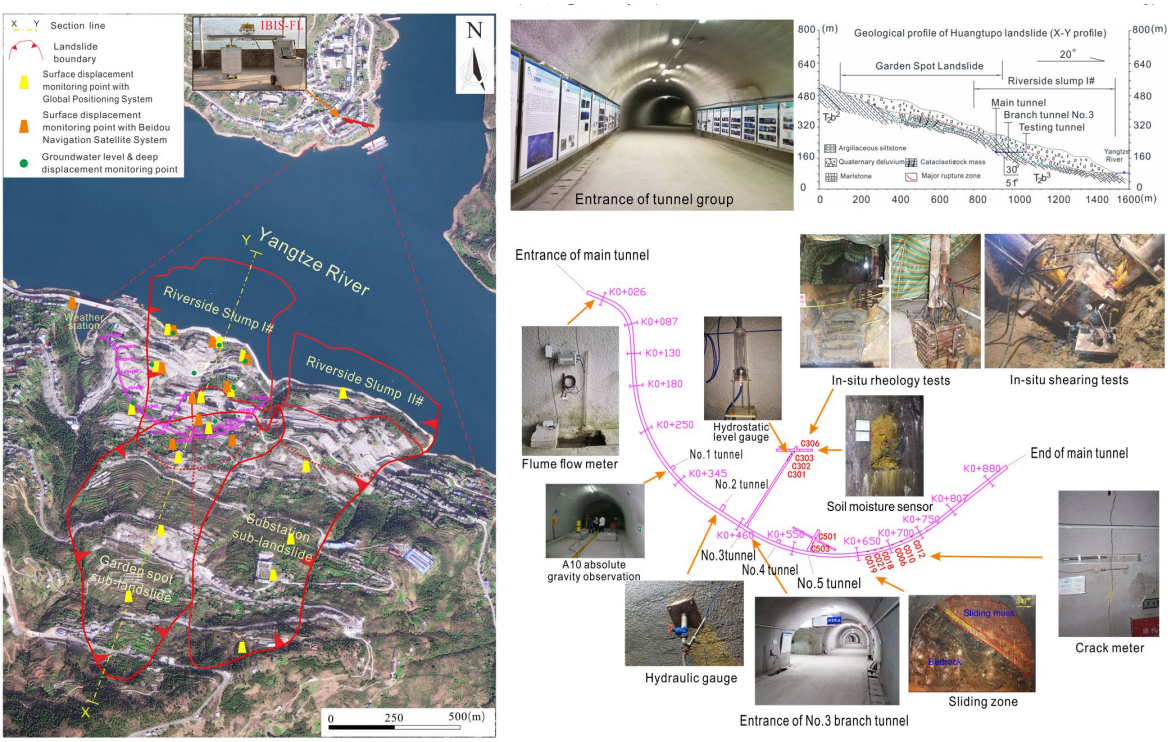

Fig. 2 Badong in-situ large-scale experimental station of the *National Observation and Research Station for Geohazards in the Three Gorges Reservoir Area, Hubei*

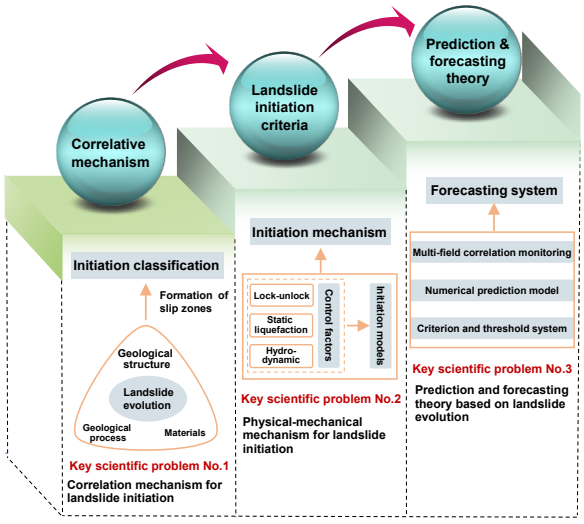

Fig. 3 Scientific thought for the implement of research

Five topics were set up to achieving those objectives. Topic 1 was proposing the initiation classification of major landslides based on large field test platform, with the adoption of field prototype test and other technical means. Topics 2-4 aimed to reveal the physical and mechanical mechanism of locked-segment dominated landslide, static liquefaction loess landslide and hydrodynamic pressure-driven landslide, and to establish the corresponding landslide initiation criteria, respectively. Topic 5 was responsible to established the prediction mode and real-time forecasting system. Ultimately, the landslide prediction and forecasting theory based on the evolution process and physical-mechanical mechanism would be put forward. The scientific thought for the implement of research is exhibited in Fig. 3.

The implementation of the research is respected to lay the geological, mechanical and physical foundation for the above three types of landslide prediction, and to substantially promote the research on landslide prediction.

Institute of Rock Structure and Mechanics, The Czech Academy of Sciences

Firstname Firstsurname, Secondname Secondsurname

Introduction

The Institute of Rock Structure and Mechanics (IRSM) of the Czech Academy of Sciences (CAS) is an academic institution specialising in the study of the structure and properties of rocks and the rock environment. The IRSM is one of the five institutes belonging to the Earth Sciences section of the CAS. As of 2007, the IRSM is a legally constituted public research institution. It is also involved in research into glass, ceramic materials for technical use, composite materials and biomaterials, their properties and application potential, and technological topics relating to the processing of inorganic as well as organic waste. Its research activities are spread across six scientific departments.

- Department of Geochemistry
- Department of Composites and Carbon Materials
- Department of Materials Structure and Properties
- Department of Neotectonics and Thermochronology
- Department of Engineering Geology
- Department of Seismotectonics

The main objectives of the research and educational activities of the IRSM include:

- Acquisition, processing and dissemination of scientific knowledge at conferences, their publishing in monographs and scientific journals
- Cooperation with universities and other scientific and professional institutions and private business companies through joint projects and cooperation agreements
- Teaching and tutoring young researchers at universities
- Management of doctoral and postdoctoral programs
- Contributing to furthering scientific knowledge and to the development of practical applications of research findings
- Involvement in international cooperation
- Management and operation of research infrastructures
- Organizing scientific meetings, conferences and seminars at the national and internationa level.
- Publishing of scientific journals: Acta Geodynamica et Geomaterialia, and in cooperation with the University of Chemistry and Technology, Prague, Ceramics-Silikáty

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Outstanding recent achievements

2015-2019

- The Global Database of Giant Landslides on Volcanic Islands summarizes statistics and knowledge of giant landslides on volcanic islands that are cubic kilometers in size. Landslides on volcanic islands – volcanic collapses – are among the largest on Earth and are fully comparable in size to the extra-terrestrial landslides observed on Mars. (Landslides 16, 2045–2052, 2019).

Fig.1 El Golfo: scarp of a giant landslide – collapse of a volcano. El Hierro, Spain

- Paleoseismic research in the Cheb basin has revealed repeated Quaternary movements at the Mariánské Lázně fault, accompanied by earthquakes that damaged Earth's surface. Dating has shown that even during the Holocene, there were at least two major earthquakes with M = 6.3 to 6.5, the most recent of which occurred around 1000 A.D. (Geomorphology 327, 472–488, 2019)

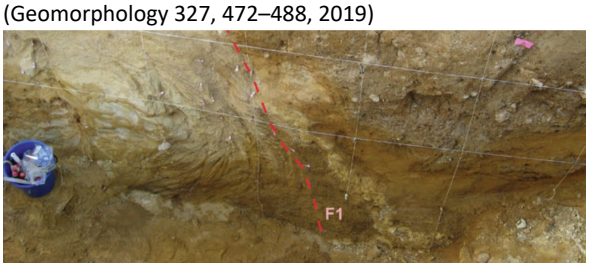


Fig.2 Photograph from the Kopanina paleoseismic trench in the Cheb basin with several types of tectonic deformation of late Quaternary sediments

- Development of advanced ceramic foams based on pyrolyzed polymer precursors. (Ceram. Int. 41, 6237, 2015; J. Eur. Ceram. Soc. 35, 2015).
- The influence of uranium mineralisation and spontaneous combustion processes on the physical and chemical properties of coal components was studied at the "Novátor" mine heap in Bečkov. Uranium minerals have caused local radioactive changes in organic compounds. Organic substances located in burned and burntout zones pose a potential risk to the environment, in particular to local river basins, soil and vegetation. (International Journal of Coal Geology 168, 162–178, 2016).
- In collaboration with the Pacific Nortwest National

Laboratory in the USA, we have provided an innovative explanation of the formation, thermal properties and subsequent interactions in the ‘‘cold-cap’’ – a layer of reacting melter feed that floats on the surface of molten glass during the vitrification of nuclear waste. (Ceramics International 45, 2019).

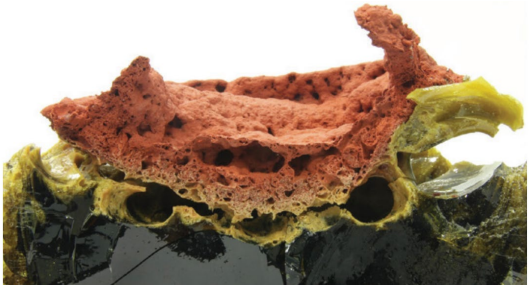
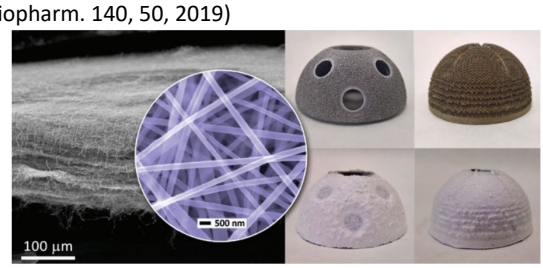


Fig.3 Cold cap – a reacting melter feed that float on the surface of molten glass

- The granting of a European patent for collagen-calcium phosphate nanolayers with the controlled release of antibiotics intended for orthopaedic implants applicable in cases of known inflammation or to prevent its formation. (European Patent Office EP3311854, Eur. J. Pharm. Biopharm. 140, 50, 2019)



Selected results in 2020

The Institute achieved a number of significant research results during the year via international research cooperation and cooperation with both domestic and foreign universities, other institutes of the Academy of Sciences of the Czech Republic and various industrial companies (TARPO, s.r.o., DEKONTA, a.s., etc.). Two examples are presented below:

1) The calculation of sediment volumes in a landslide dammed lake employing electrical resistance tomography and sonar profiles (sound navigation ranging) of the lake.

The calculation procedure is based on the use of an innovative geophysical resistance profiling application that records measurements from the lake surface in a series of profiles. Using this and other methods, i.e. sonar depth measurements, sediment contribution monitoring and conductivity measurements, it was possible to reconstruct the original relief of the bottom of the Mladotice lake immediately following the landslide and to calculate the volume of sediments and the sedimentation rate, thus allowing for the estimation of the future development of the lake. The most interesting result was that the sedimentation rate has decreased significantly over the last 20 years, suggesting that the lake may survive much longer than previously expected.

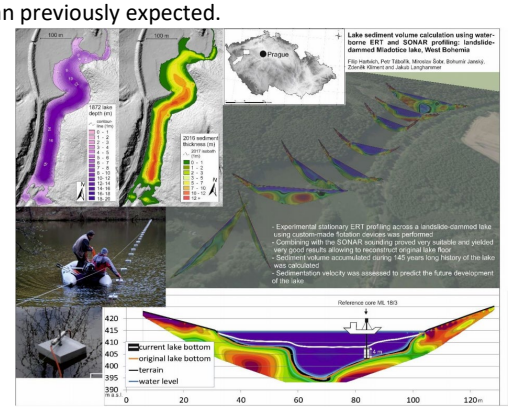


Fig.4 top left: depths of the lake in 1872; sediment layer thicknesses in 2016; bottom: current lake bottom and original lake bottom, terrain and water levels.

2) The hypogenetic versus the epigenetic origin of deep underwater caves applying the example of the Hranice abyss (Czech Republic)-the world’s deepest freshwater cave

A range of geophysical measurements were taken so as to determine the extent and form of the Hranice abyss. The geophysical results suggested that the depth of the abyss is up to ~ 1 km. Further, karst structures were identified, including a buried tower-like karst formation. The new geophysical results, interpreted in the context of the local tectonic development and the morphology of karst structures, indicate the epigenetic origin of the formation of the abyss despite the traditionally-accepted theory of its hypogenetic origin, which has implications in terms of the local and regional development of karsts in areas that feature deep karst systems.

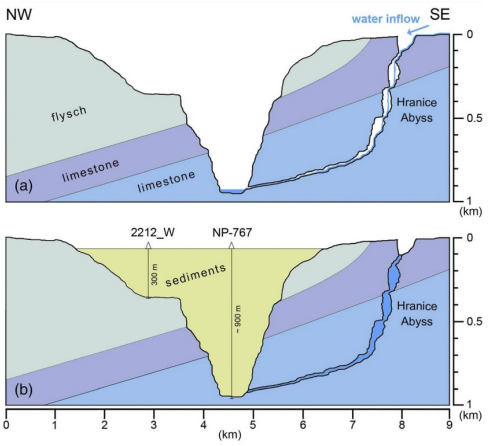


Fig.5 Conceptual geological section across the Hranice abyss and the Carpathian foredeep. Image (a) depicts the situation during the early Langhian (Neogene/Miocene) at which time the Carpathian foredeep was opened and the Hranice abyss was formed; image (b) shows the current situation.

Institute of Cold Regions Science and Engineering, Northeast Forestry University

Wei Shan, Ying Guo

Institute of Cold Regions Science and Engineering of Northeast Forestry University (ICRSE-NEFU) is committed to the environmental geology and engineering geology of high latitude permafrost region and deep seasonal frozen area under the background of climate change, and attaches importance to the combination of basic research and applied research. With undergraduate, master, doctor, postdoctoral professional training system and standards, ICRSE-NEFU initiated "Geological environment risk research plan for permafrost degraded areas in Northeast China (GERRP)". With the support of the Chinese government, "Field scientific observation and research station of the Ministry of Education - Geological environment system of permafrost area in Northeast China (FSSE-PFNEC)" was established. Its observation stations cover all kinds of permafrost areas in Northeast China. At the same time, in order to develop and transfer technologies related to environmental governance and infrastructure construction in permafrost regions, “Provincial Collaborative Innovation Centre, Environment and road construction & maintenance in permafrost area of Northeast China(PCIC-PFER)" was established. Over the years, ICRSE-NEFU have continuously established cooperation with academic institutions and organizations at home and abroad, held various academic exchanges and regularly held "Academic Seminar on Engineering Geology and Environmental Geology in the Permafrost Along the Sino-Russian-Mongolian Economic Corridor", edited and published research cases of geoenvironmental disasters in permafrost regions in Northeast China, and shared the research results of GERRP. At present, the research results of GERRP are gradually enriched, some of them have highly academic value, and have been put into engineering practice.

ICRSE-NEFU has gradually shown its unique research charm since it became an ICL member in 20032002. In 2012, ICRSE-NEFU established a landslide research network in cold regions (ICL-CRLN), and then Research Center of Cold Regions Landslide was build.

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Permafrost as one of the elements of the cryosphere, the change of thermodynamic stability of permafrost will directly affect the changes of hydrosphere, biosphere and lithosphere. Under the trend of global warming, the frequency and intensity of environmental and engineering geological disasters caused by permafrost degradation are getting higher and higher (Fig.1 and Fig.2). Taking the cold aera in the southern boundary of the permafrost zone in Northeast China as study area, disasters such as ground subsidence, slope icing, landslides and other disasters caused by permafrost melting were studied. At the same time, we found melting permafrost also leads to seasonally high concentrations of greenhouse gases, triggering wildfires that may further accelerate permafrost degradation and environmental changes of terrestrial ecosystems and roads.

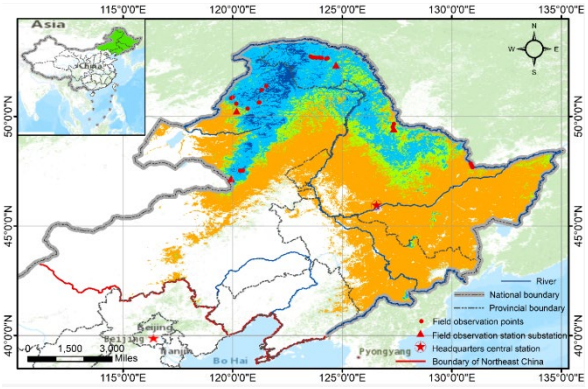

Fig.1 Permafrost distribution in NE of China(2014-2019)

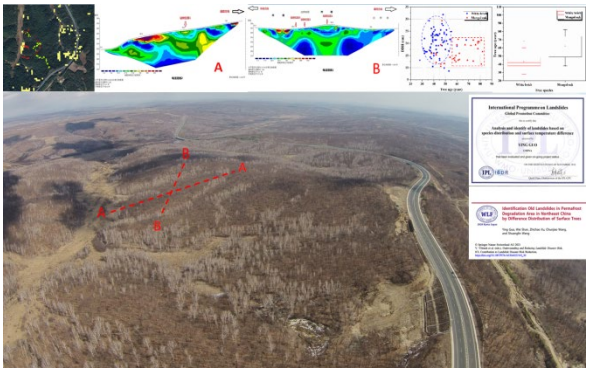

Fig.2 Different tree species and ages in the landslide area caused by permafrost degradation

Marui & Co. Ltd.

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Introduction

Marui & Co. Ltd. celebrates its 100th anniversary in 2020. Marui, as one of the leading manufacturers of testing apparatuses in Japan, has been constantly striving to further improve its service since its foundation in 1920, thus contributing to the sustainable development of our nation and society. Our main products cover a wide variety of destructive and non-destructive testing apparatuses in the fields of geotechnical engineering, concrete engineering (mortar, aggregates, etc.), and ceramic engineering (Fig. 1). Of special note is that Marui has been helping to manufacture ring-shear apparatuses (Fig. 2) for the past half-century based on the leading-edge ideas of Dr. Kyoji Sassa, Professor Emeritus at the Kyoto University. Marui has delivered a total of seven ring-shear apparatuses to the Disaster Prevention Research Institute, Kyoto University, and two to the International Consortium on Landslides. Also, the apparatuses have been exported to the United States of America, China, Croatia and Vietnam.

Since 2002, Marui has been a supporter of the International Consortium on Landslides (ICL) and has gradually been intensifying its contribution to the ICL worldwide efforts for landslide risk reduction and international promotion of landslide research. According to NASA, more frequent and intense rainfall events due to climate change have been causing frequent landslides particularly in mountains of Asian regions including Japan where waters can be stored in various ways. Summer monsoon rains as well as snow and glacier melt waters can destabilize steep mountainsides, triggering landslides, which are down-slope movements of rocks, soils, water, trees, etc. Marui, as an engineering supporter, commits deeply to various activities of research particularly on triggering mechanisms of landslides

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Marui & Co. Ltd. takes great pleasure in developing, manufacturing, and providing new products of high value sharing the delight of achievement with our customers, and thus contributing to the social development. The entire staff of Marui & Co. Ltd. is determined to devote ceaseless efforts to keep its organization optimized for its speedy and high-quality services, by the motto “Creativity and Revolution”, and strive hard to take a step further, as a leading manufacturer of testing apparatuses, to answer our customer's expectations for the 22nd century to come.

Marui continuously contributes to the 2030 Agenda for Sustainable Development, as well as to the Sendai Framework for Disaster Risk Reduction 2015–2030. In line with this, Marui signed KLC 2020 in 2019 and will strongly support its actions, especially KCL2020 actions 3, 4, 5, and 9

Fig.1 Products of testing apparatus such as non-destructive/model-testing for mesuring intensity, physical property, durability, etc. for concrete, soil, building material, etc.

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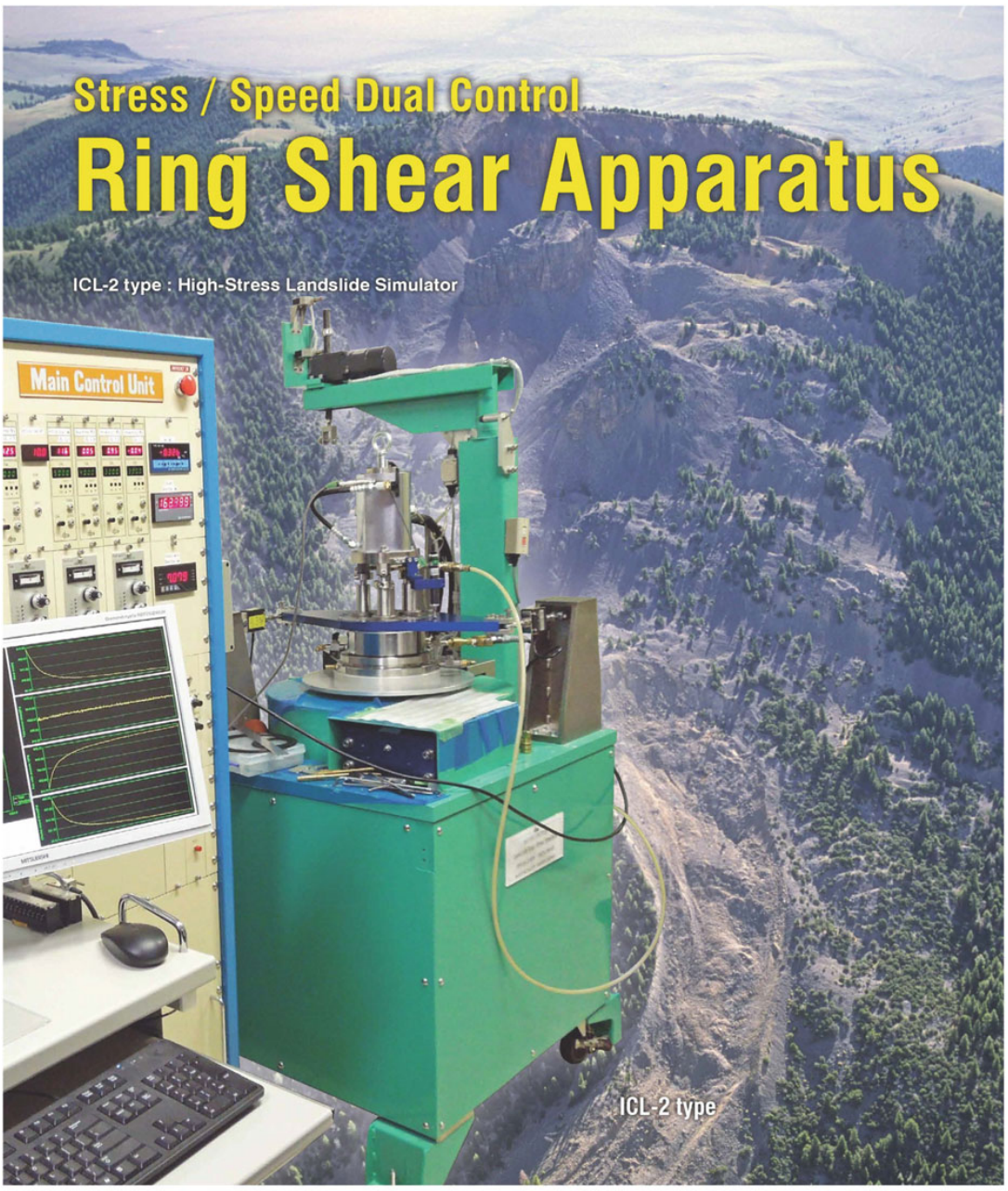

Fig. 2 High stress landslide simulator

Nippon Koei Co., Ltd., Geohazard Management Division

Hiroaki TAUCHI

Nippon Koei Co., Ltd., Geohazard Management Division

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For the supplemental information, please scan the QR code or visit this link: Nippon Koei Co., Ltd. - 7th Asia-Pacific Climate Change Adaptation Forum (asiapacificadapt.net)

Introduction

The Nippon Koei Group (NK) has been a leading international consultant in providing engineering consulting services to over 5500 multi-disciplinary infrastructure and development projects in 160 countries all over the world. The landslide prevention specialist team (at present called Geohazard Management Division) was established in 1966 to specifically provide countermeasures against sediment disasters. Over the last 50 years, we have significantly improved the capacity of countries to respond and reduce risk from debris flows, slope instabilities, landslides, avalanches and rock falls due to torrential rains, large-scale earthquakes, and volcanic eruptions that threaten a country's vital economic infrastructure lifelines, especially the road networks. At present, approximately 160 engineers provide engineering consulting services to protect communities from a variety of disasters (Fig1&2). During disasters, we provide experienced professional engineers to quickly make a risk assessment and promptly respond with a series of engineering design analyses, emergency and permanent measures based on our extensive experience and know-how. To maximize the effectiveness of infrastructures, we address efficient countermeasure plans, design and research in terms of cost reduction and cost-effectiveness using various numerical analyses such as finite element method (FEM) and discrete element method (DEM), etc.

In Japan, we have worked hard to restore and recover from sediment-related disasters caused by earthquakes and heavy rainfalls that have frequently occurred in recent years (the 2011 Great East Japan Earthquake, the Northern Kyushu Flood in 2017, etc.). We have received letters of appreciation for our efforts from the national and local governments.

Our major international projects include "The Project for Countermeasure Construction Against the Landslides on Sindhuli Road Section II, Nepal," "The project for the rehabilitation of Sindhuli road affected by the 2015 Gorkha Earthquake, Nepal," and "The project for landslide prevention for National Road 6 in Honduras"; all funded by the Japan International Cooperation Agency (JICA) grants-in-aid. Through these projects, we are contributing to the socioeconomic development of each country by improving vulnerable locations in road networks against sediment disasters, promoting traffic safety, and providing logistics assistance for road users. In particular, the 1st of the three NK's projects mentioned above won the "3rd JAPAN Construction International Award" from the Ministry of Land, Infrastructure, Transport and Tourism as the project that has realized "high-quality infrastructures" through its excellent know-how, technical capabilities, and project management capabilities.

NK is an ICL member and has been using its technology to reduce geohazard risk. Through various projects, NK is continuously contributing to the 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Reduction 2015–2030. Using our full capability with abundant experiences in Japan and Asia prone to natural disasters, we hope to contribute much more to a reduction of global sediment disasters including landslides. In line with this, NK has signed the KLC 2020, and will strongly support its actions, especially KCL2020 actions 1, 2, 3, 5, 6, and 8.

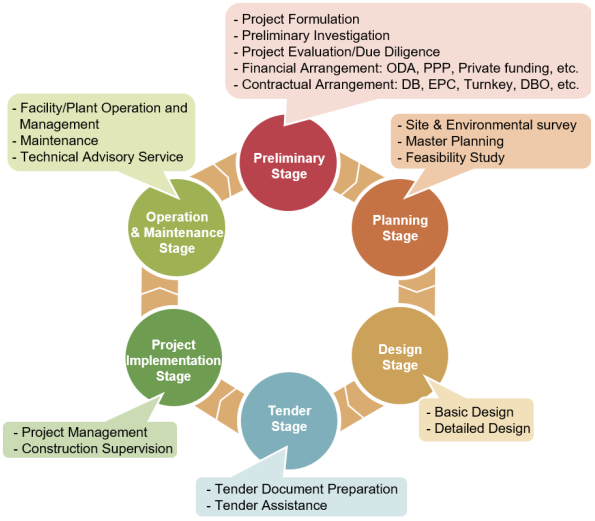

Fig. 1 Our service for Geohazard Management

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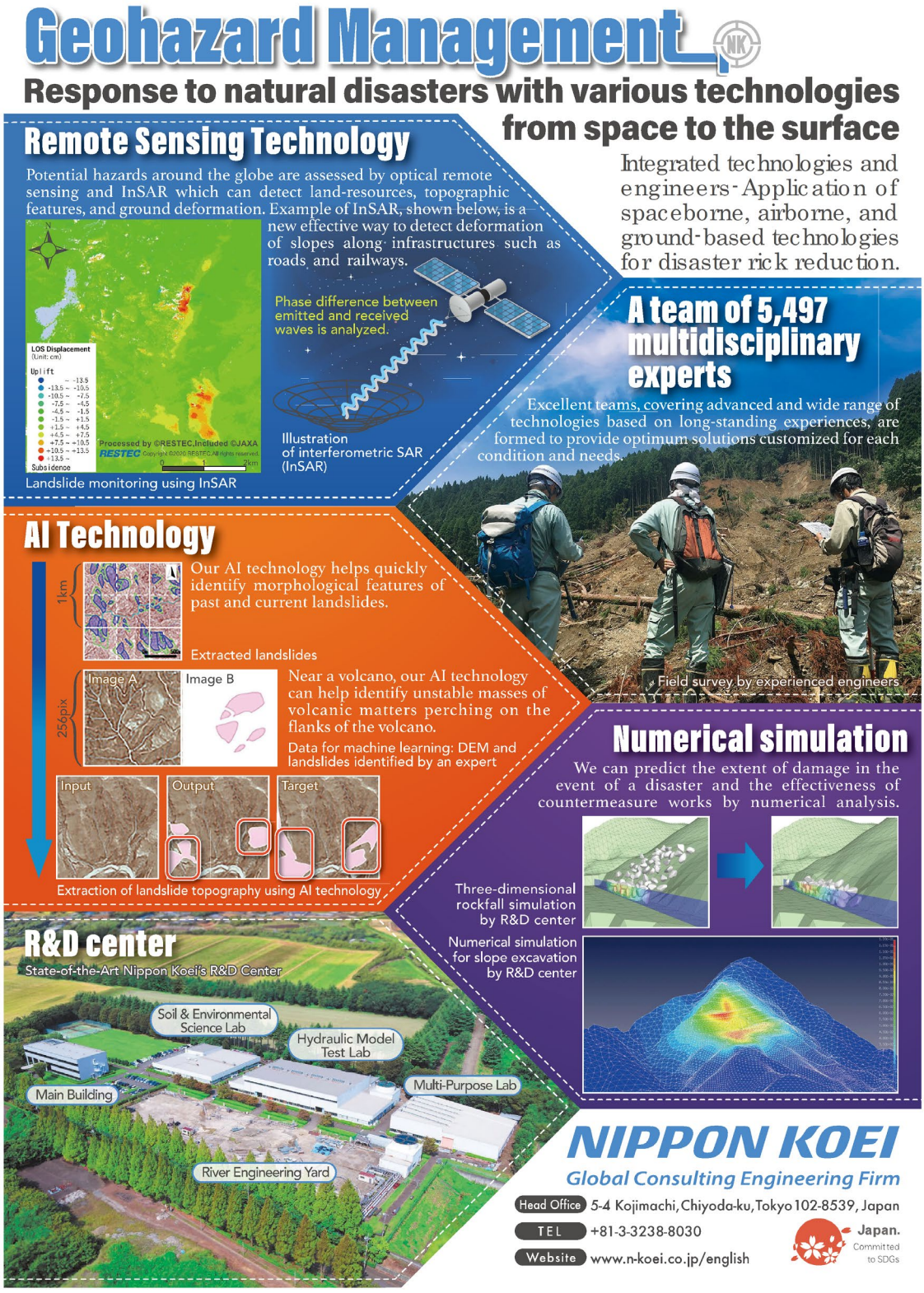

Fig2. Introduction of our survey analysis technology for geohazard

Godai Corporation

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Godai Corporation

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Introduction

Ever since its foundation in 1965, Godai Kaihatsu Co.Ltd. a civil engineering consulting firm, has long been providing a variety of software and measures particularly for natural disaster mitigation. With its rich expertise in both civil engineering and information technology (IT), the company has its primary goal to address real-world needs of disaster mitigation. All the staff of Godai Kaihatsu Co. Ltd. feels it more than happy that their cutting-edge technologies help mitigate natural disasters.

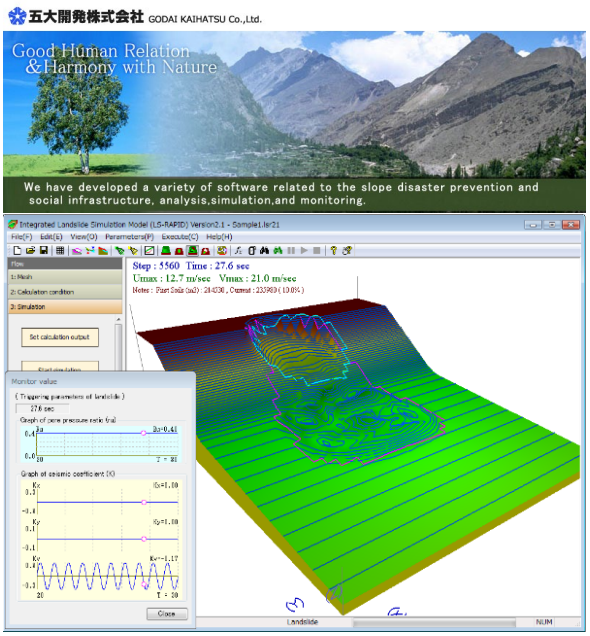

Fig1. Integrated model simulating of earthquake & rain induced rapid landslides (LS-RAPID)

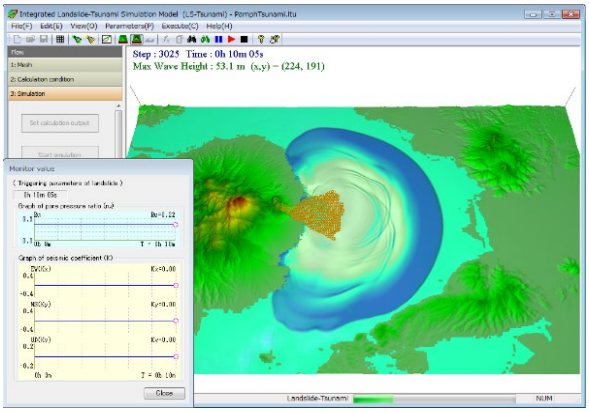

Fig 2. Tsunami model (LS-Tsunami)

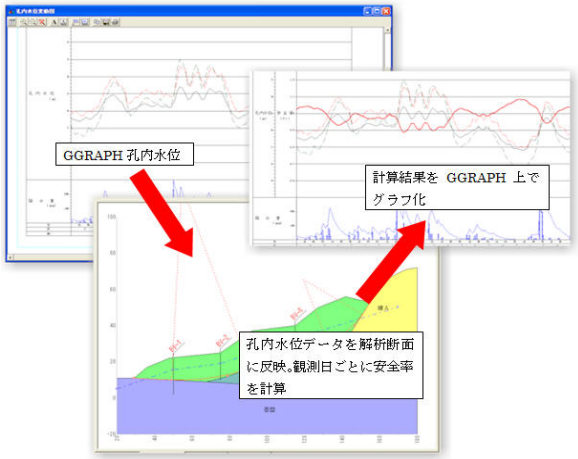

Fig.3 Power SSA PRO-Two-dimensional slope stability calculation of earthquake and rain induced landslide.

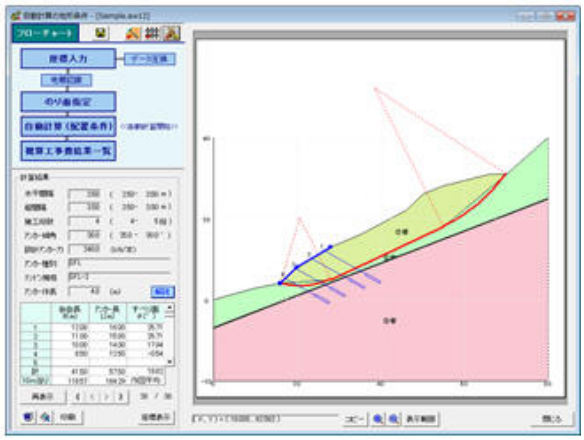

Fig 4. Anchor software- Slope stability analysis for ground anchor

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Chuo Kaihatsu Corporation

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Introduction

Chuo Kaihatsu Corporation (CKC) was founded in 1946, and has been aiming to become the “Only One” consultant for our customers. We engage in the hands-on work that will “Remain with the earth, Remain in people’s hearts, and Lead to a prosperous future”. We focus on road, river and dam engineering to flesh out industrial infrastructures specifically by means of geophysical/geotechnical/geological investigations, civil engineering surveys and project implementations. In recent years, we make significant efforts on earthquake disaster mitigation, sediment disaster prevention/mitigation and ICT information services. Many achievements of ours have already contributed to the mitigation of natural disasters such as landslides, earthquakes and slope failures in Japan, Asia and the Pacific Region. We aim to provide technological contributions so that a sustainable society will continue to develop in the future.

Fig1. Design for various structures

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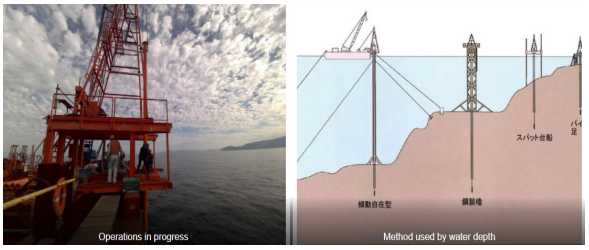

Fig 2. Deepwater drilling surveys

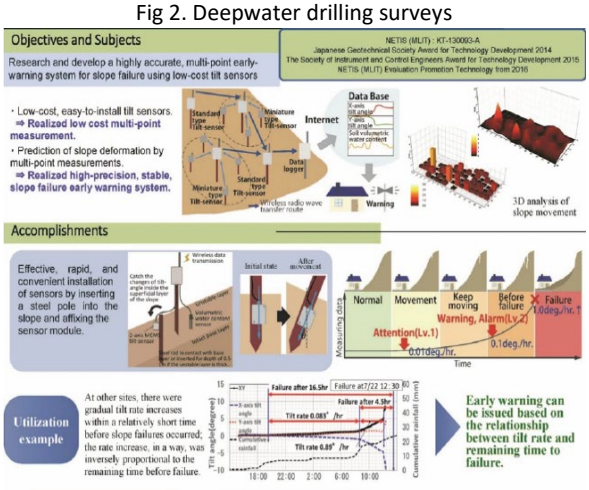

Fig.3 The early warning monitoring system of slope failure using multi-point tilt change and volumetric water content

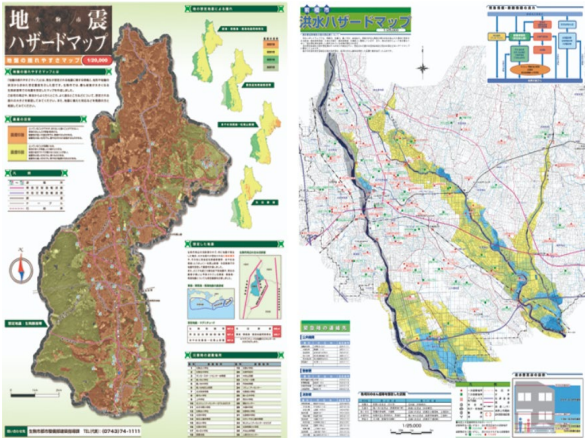

Fig 4. Making hazard map for sediment disaster, tsunami, flood, earthquake, liquefaction , etc…

Kokusai Kogyo Co. Ltd.

Firstname Firstsurname, Secondname Secondsurname

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Introduction

Kokusai Kogyo Co. Ltd. as a leading company of geospatial information technologies has long been providing public services with its comprehensive expertise to address real-world needs and cutting-edge measurement technologies. Kokusai Kogyo Co. Ltd. helps rebuild "Green Communities," which has been of our great concern in terms of "environment and energy," "disaster risk reduction" and "asset management". Kokusai Kogyo Co. Ltd. offers advanced and comprehensive analyses of geospatial information for developing new government policies, maintaining and operating social infrastructures safe and secure, and implementing low-carbon measures in cities. Influenced by the recent global climate change, extreme rainfall events have become more frequent worldwide and resultant hydro-meteorological hazards are creating more deaths and devastations particularly in many developing countries where effective advanced countermeasures are not readily available. Kokusai Kogyo Co. Ltd. is proud of its achievements in establishing resilient infrastructure systems and implementing effective monitoring/early warning systems in developing countries, which have long been helping reduce the risks from natural hazards.

Fig.1 Our Realtime Hazard Map reflects up-to-date information of soil natures and precipitations at landslide hazard sites, etc. that can constantly be changing, and evaluates area-wide hazard risk in real-time

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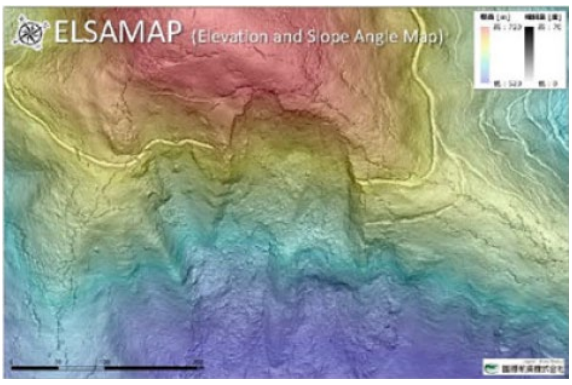

Fig 2. ELSAMAP is our cutting-edge 3D terrain visualization method allowing great geomorphological details to be visualized in one glance with gray-scaled slope inclinations and colored altitudes. ELSAMAP has been used to interpret micro-topographies, landslides and some other things.

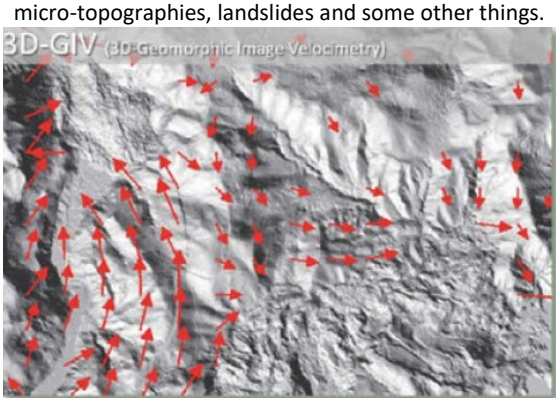

Fig.3 3D-GIV can help grasp the ground surface displacement caused by natural phenomena such as landslide by analyzing differences between digital geomorphic images obtained through ad hoc Airborne Laser Surveys

Fig 4. "Shamen-net" is a total monitoring system integrating GNSS and other monitoring device (Measurement precision: ±mm, on a real time basis)

OSASI Technos, Inc.

Firstname Firstsurname, Secondname Secondsurname

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Introduction

OSASI Technos, Inc. has been making its best efforts to develop its cutting-edge technologies for landslide early warning. Its unique compact and lightweight sensors making up the Landslide Early Warning System enable long-term monitoring of unstable landslide mass movements, precipitations, porewater pressure buildups, etc. in a remote mountainous area where commercial power is often unavailable. OSASI Technos, Inc. is also proud of its advanced technology to transfer observed data even in areas with poor telecom environments as proven in the successful implementations in South Asia. All staff members of OSASI Technos work together for mitigation of landslide disasters worldwide.

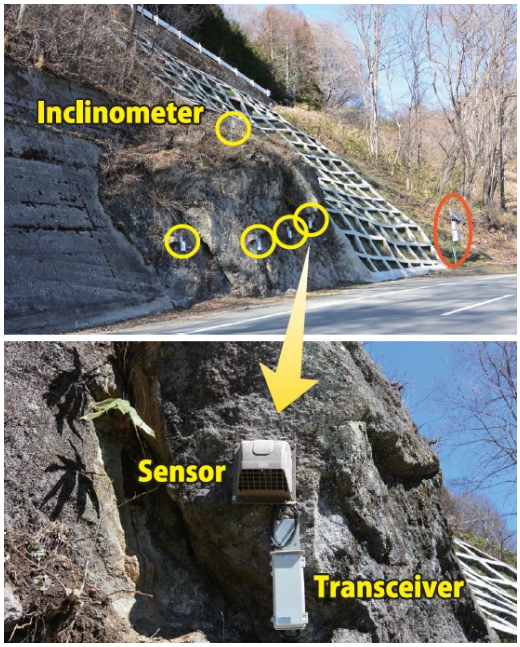

Fig1. Bedrock slope monitoring (maintenance control)

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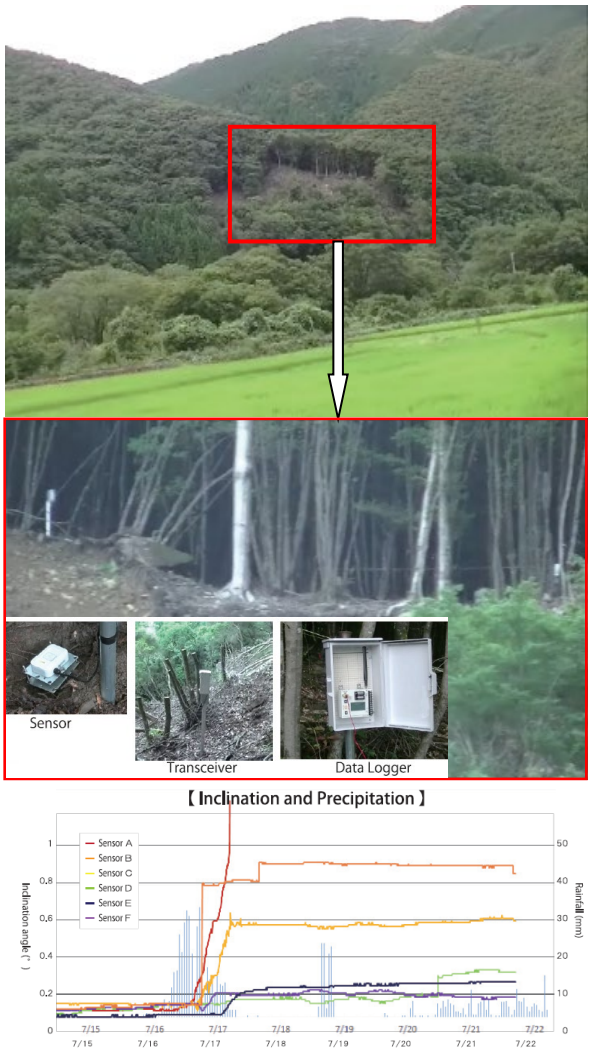

Fig 2. Measurement of the dynamic state of landslide using inclinometers with a wireless function

Fig3. Cut slope monitoring

Kiso-Jiban Consultants Co. Ltd.

Firstname Firstsurname, Secondname Secondsurname

Kiso-Jiban Consultants Co. Ltd.

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Introduction

Kiso-Jiban Consultants, established in 1953, is an engineering consulting firm especially well known in the field of geotechnical engineering. The areas of its comprehensive services are listed below

- Geological and Geotechnical Survey
- Geotechnical Analysis and Design
- Disaster Prevention and Management
- GIS (Geographic Information Systems)
- Soil and Rock Laboratory Tests
- Instrumentation and Monitoring
- Geophysical Exploration and Logging
- Distribution of Geosynthetics Products.

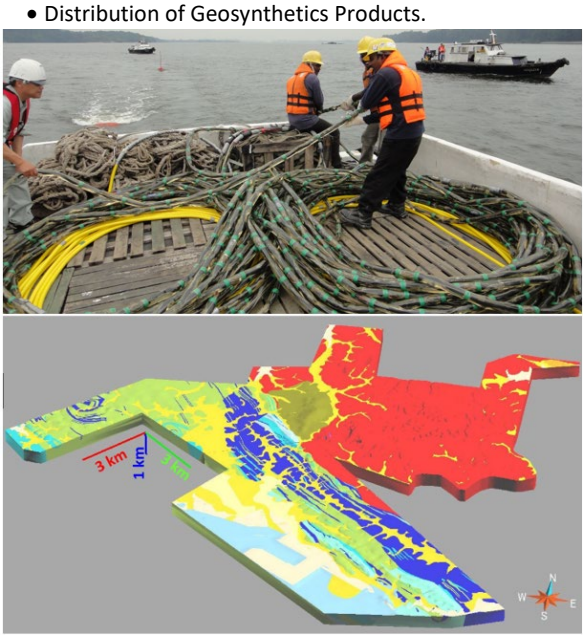

Fig.1 Nationwide geological survey and 3D-Geolofical model

Much-talked-about new service is the Kiso-SAR System allowing accurate estimation of both extent and rate of landslide movements based upon a comprehensive interpretation of InSAR results from geotechnical and landslide engineering viewpoints. With the Kiso-SAR system, the following pieces of important geotechnical information can be provided:

1) The extent of a deforming landslide mass (and the rate of its movement
2) Consolidation buildup in soft clay underlying a fill
3) Deformation buildups induced by slope cutting.

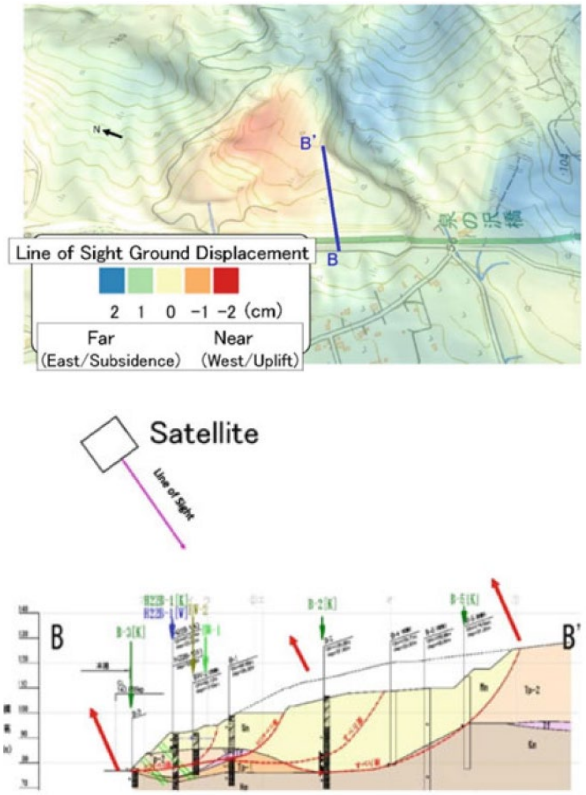

Fig.2 Ground deformation of landslide observed by Kiso-SAR system

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Ellegi Srl

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Introduction

Ellegi srl provides worldwide monitoring services and produces Ground Based synthetic aperture radar (GBInsAR) for remote measurement of displacements and deformations on natural hazards and manmade buildings using its own designed and patented LiSALab system.

Its activities started in 2003 as a spin off project to exploit commercially the Ground Based Linear Synthetic Aperture Radars technology developed by European Commission's Ispra Joint Research Centre and based on the results of more than 10 years of research. Since then, Ellegi has industrialized and developed the core technology of the LiSALab system and latest LiSAmobile system represents the 5th generation of development.

In 2003 it was the first commercial company in the world to provide GBInSAR measurements of natural hazards and structure.

Ellegi srl offers:

- Displacement fields measurement, control and monitoring of the deformation caused by natural hazards, like landslides, rockslides, sinkhole, volcanic deformation in every operative condition, including emergencies,
- Structural strain fields measurement, control, monitoring and diagnosis of the deformation affecting buildings, bridges, viaducts, dams.
- GBInSAR monitoring systems, installation, management and maintenance in order to provide information about natural hazards or anthropic activity, that can generate or cause slopes failures or buildings instabilities.

In all the above-mentioned activities Ellegi srl uses the GBInSAR LiSALab technology that represents a real "break-through".

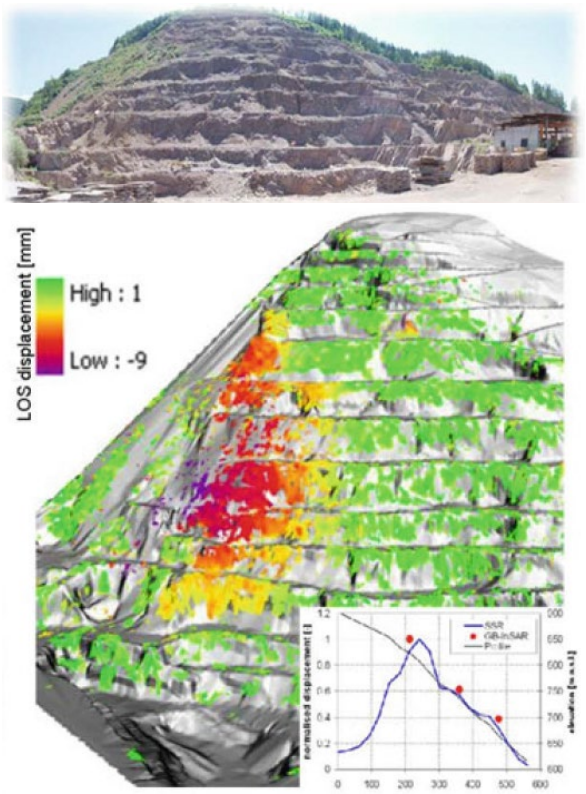

Fig.1 GBInSAR LiSALab technology quarry monitoring example and displacements' field comparison between the GBInSAR measurement and FEM model results

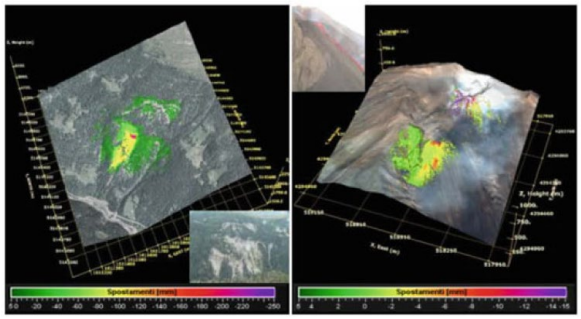

Fig.2 GBInSAR LiSALab technology result in monitoring a slope affected by a landslide (left) and a volcanic slope affected by deformation (right). Landslide or moving area mapping and boundaries identification is made easy by GBInSAR LiSALab technology

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Introduction

IDS GeoRadar, part of Hexagon, provides products and solutions, based on radar technology, for monitoring applications including landslides, rockfalls, complex structures, mining and civil engineering. The company is a leading provider of Ground Penetrating Radar (GPR) and Interferometric Radar solutions worldwide.

IDS GeoRadar is committed to delivering best-in-class performance solutions and to the pursuit of product excellence, through the creation of application-specific, innovative and cost-efficient systems for a wide range of applications:

- Utility mapping and detection
- Civil engineering
- Railway and road engineering
- Geology and environment management
- Archaelogy
- Forensics
- Landslide monitoring
- Mining safety

Natural hazard monitoring solution

The use of slope monitoring radar is now the standard practice for the active monitoring of slope in open pit mines and for safety critical landslide monitoring with the aim of providing alerts in the event of progressive movements which could potentially lead to slope failure and assessing worker safety. The unique IBIS-FM radar system accurately monitors multiple scales of displacements in real time, from early detection of slow movements to fast accelerations associated with slope collapse. The great operative range, up to 4500 m, allows to safely deploying the system in comfortably accessible areas, without exposing people and equipment to hazardous zones.

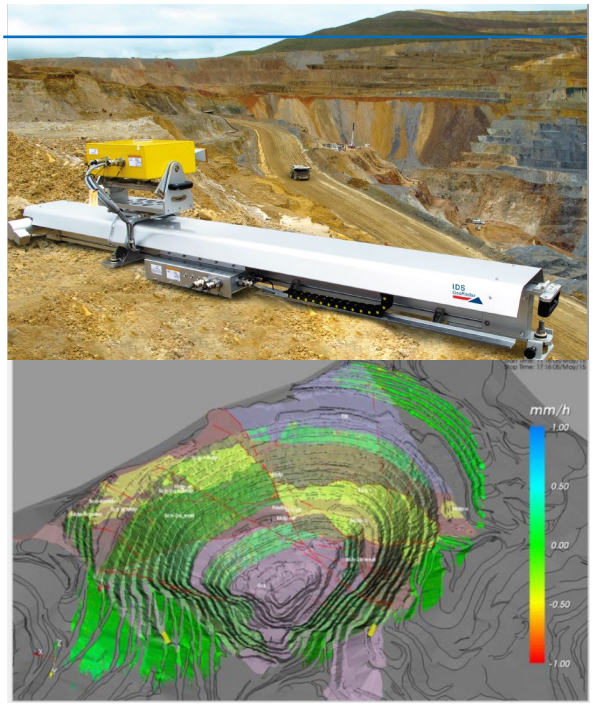

Fig.1 IDS GeoRadar: Innovative Interferometric Radar for Mining, Environmental and Civil Engineering

IDS GeoRadar cooperate with TRE ALTAMIRA, the worldwide leader in ground monitoring services using satellite InSAR offer a comprehensive solution – InSAR Service – to fulfill all mine stability needs, ranging from monitoring large-scale mining operations over hundreds of square kilometers, to specific movements at the pit scale. With the large spatial coverage of satellite data, mining engineers can identify unstable areas over wide areas, also with the ability to extend the analysis of deformation back in time. All mining assets can be monitored regularly and precisely for deformation.

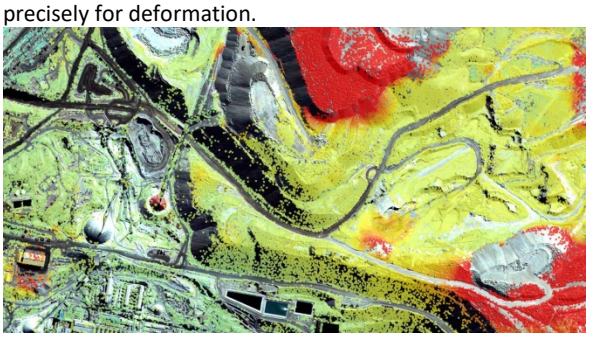

Fig.2 InSAR Service - Ground motion monitoring for mining operations

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