
Kyoji Sassa

Hiroshi Fukuoka

Fawu Wang

Gonghui Wang

(Editors)

Landslides

Risk Analysis and Sustainable Disaster Management

Kyoji Sassa
Hiroshi Fukuoka
Fawu Wang
Gonghui Wang
(Editors)

Landslides

Risk Analysis and Sustainable Disaster Management

Proceedings of the First General Assembly of the International Consortium on Landslides

With 417 Images

Editors

Sassa, Kyoji

President of the International Consortium on Landslides
Research Centre on Landslides, Disaster Prevention Research Institute,
Kyoto University, Uji, Kyoto 611-0011, Japan
Tel: +81-774-38-4110, Fax: +81-774-32-5597, E-mail: sassa@SCL.kyoto-u.ac.jp

Fukuoka, Hiroshi

Research Centre on Landslides, Disaster Prevention Research Institute,
Kyoto University, Uji, Kyoto 611-0011, Japan
Tel: +81-774-38-4111, Fax: +81-774-38-4300, E-mail: fukuoka@SCL.kyoto-u.ac.jp

Wang, Fawu

Research Centre on Landslides, Disaster Prevention Research Institute,
Kyoto University, Uji, Kyoto 611-0011, Japan
Tel: +81-774-38-4114, Fax: +81-774-38-4300, E-mail: wangfw@landslide.dpri.kyoto-u.ac.jp

Wang, Gonghui

Research Centre on Landslides, Disaster Prevention Research Institute,
Kyoto University, Uji, Kyoto 611-0011, Japan
Tel: +81-774-38-4114, Fax: +81-774-38-4300, E-mail: wanggh@landslide.dpri.kyoto-u.ac.jp

Library of Congress Control Number: 2005931122

ISBN-10 3-540-28664-0 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-28664-6 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitations, broadcasting, reproduction on microfilm or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media

springeronline.com

© Springer-Verlag Berlin Heidelberg 2005

Printed in Germany

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Cover design: Erich Kirchner, Heidelberg

Typesetting: Büro Stasch · Bayreuth (stasch@stasch.com)

Production: Almas Schimmel

Printing: Stürtz AG, Würzburg

Binding: Stürtz AG, Würzburg

Printed on acid-free paper 32/3141/as – 5 4 3 2 1 0

Preface

Population growth, increasing urbanization, and mountain and coastal development are magnifying the risk of various kinds of disasters. The imperatives of Earth system risk reduction will be even more pressing for sustainable development and environmental protection in the coming decades.

Landslides are various types of gravitational mass movements of the Earth's surface that pose the Earth-system risk; they are triggered by earthquakes, rainfall, volcanic eruptions and human activities. Landslides cause many deaths and injuries and great economic loss to society by destroying buildings, roads, life lines and other infrastructures; they also pose irrecoverable damage to our cultural and natural heritage. Landslides are multiple hazards, involving typhoons/hurricanes, earthquakes, and volcanic eruptions, and sometimes causing tsunamis. Landslide disaster reduction requires cooperation of a wide variety of natural, social, and cultural sciences.

The International Consortium on Landslides (ICL) was founded at the Kyoto Symposium in January 2002, through the adoption of the Statutes of the ICL and the 2002 Kyoto Declaration "Establishment of an International Consortium on Landslides", with participation from the Divisions of Earth Sciences, Water Sciences, and Cultural Heritage of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Meteorological Organization (WMO), the United Nations Secretariat for International Strategy for Disaster Reduction (UN/ISDR), the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Ministry of Foreign Affairs (MOFA) of the Government of Japan, and worldwide universities and institutes involved in landslide studies. The ICL has convened its Board of Representatives and Steering Committee meetings at UNESCO in Paris 2002, at the Food and Agriculture Organization of the United Nations (FAO) in Rome 2003, at the United Nations Building "Palace de Nation" in Geneva 2004, and at universities in Vancouver, Bratislava, and Cairo.

On 19 January 2005 in Kobe, Japan, the ICL organized the theme session "New International Initiatives for Research and Risk Mitigation of Floods (IFI) and Landslides (IPL)" at the United Nations World Conference on Disaster Reduction together with UNESCO, WMO, FAO, UNU (United Nations University), MEXT, Kyoto University, and others. In this session, the ICL proposed a "Letter of Intent" to United Nations organizations, as well as to the International Council for Science (ICSU) and the World Federation of Engineering Organizations (WFEO), in order to strengthen learning and research on "Earth System Risk Analysis and Sustainable Disaster Management" within the framework of the United Nations International Strategy for Disaster Risk Reduction (ISDR). These functions must be effective in order to create a sound basis of international cooperation in the field of Earth-system risk reduction, including landslides. This Letter of Intent was approved and signed by seven global stakeholders of UNESCO, WMO, FAO, UN/ISDR, UNU, ICSU, and WFEO by 30 June 2005. The electronically combined Letter of Intent is attached below.

Study and learning of landslide risk analysis and sustainable disaster management, including close cooperation with experts and organizations specializing in other types of disasters, must be our task in the coming decades. For the occasion of the ICL First General Assembly, to be held at the Keck Center of the National Academy of Sciences,

LETTER OF INTENT

"United Nations World Conference on Disaster Reduction (WCDR)", Kobe, Japan, 18-22 January 2005

This 'Letter of intent' aims to provide a platform for a holistic approach in research and learning on 'Integrated Earth system risk analysis and sustainable disaster management'.

Rationale

- Understanding that any discussion about global sustainable development without addressing the issue of Disaster Risk Reduction is incomplete;
- Acknowledging that risk-prevention policies including warning systems related to Natural Hazards must be improved or established;
- Underlining that disasters affect poor people and developing countries disproportionately;
- Stressing that after years of under-investment in preventive scientific, technical and communicational infrastructure activities it is time to change course and develop all activities needed to better understand natural hazards and to reduce the vulnerability notably of developing countries to natural hazards, and
- Acknowledging that a harmful deficiency in coordination and communication measurements related to Disaster Risk Reduction exists.

Proposal

Representatives of United Nations Organisations, as well as the Scientific (ICSU) and Engineering (WFEO) Communities propose to promote further joint global activities in disaster reduction and risk prevention through

Strengthening research and learning on 'Earth System Risk Analysis and Sustainable Disaster Management' within the framework of the 'United Nations International Strategy for Disaster Risk Reduction' (ISDR).

More specifically it is proposed,




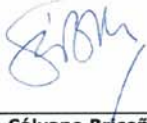



based on the existing structural framework of the ISDR and plan of action of the UN-WCDR, as well as other relevant networks and institutional and international expertise,

to establish specific, goal-oriented 'Memoranda of Understanding' (MoUs) between international stakeholders targeting Disaster Risk Reduction, for example focusing on landslide risk reduction, and other natural hazards.

Invitation

Global, regional and national competent institutions are invited to support this initiative by joining any of the specific MoUs following this letter through participation in clearly defined projects related to the issues and objectives of any of the MoUs.

Signatories:

			
Mr. Koichiro Matsuura Director-General United Nations Educational, Scientific and Cultural Organization	Mr. Michel Jarraud Secretary-General World Meteorological Organization	Mr. Jacques Diouf Director-General Food and Agriculture Organization of the United Nations	Mr. Sálvamo Briceño Director UN International Strategy for Disaster Risk Reduction
4 MAR 2005	22. 3. 2005	21. 31. 2005	19. 01. 05
Date	Date	Date	Date
			
Mr. Hans van Ginkel Rector United Nations University	Ms. Jane Lubchenco President International Council for Science	Ms Françoise Come Executive Director World Federation of Engineering Organizations	
19. 01. 05.	21. 04. 05	24/ 2/ 2005	
Date	Date	Date	

The International Consortium on Landslides (ICL) proposed the "Letter of Intent" at the thematic session 3.8 "New International Initiatives for Research and Risk Mitigation of Floods (IFI) and Landslides (IPL)" of the United Nations World Conference on Disaster Reduction held on 19 January 2005 in Kobe, Japan. This is the Letter of Intent, which was electronically combined based on the original Letters of Intent, formally approved and signed by all parties. All of the original Letters of Intent with signatures are deposited in the secretariat of the International Consortium on Landslides which is located in the Research Centre on Landslides of the Disaster Prevention Research Institute, Kyoto University.



International Consortium on Landslides

Secretariat : Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, Kyoto, Japan
Web: <http://ICL.dpri.kyoto-u.ac.jp>, E-mail: jimu@landslide.dpri.kyoto-u.ac.jp, Tel: +81-774-38-4110, Fax: +81-774-32-5597

Washington, D.C., we decided to organize a panel discussion on “Earth-system risk analysis and sustainable disaster management, especially in regard to landslides”. This volume, which includes the proceedings of papers submitted to the First General Assembly, is titled “Landslides – Risk Analysis and Sustainable Disaster Management –” to symbolize our target in the coming decades.

It is hoped that this volume will visualize the objectives and activities of the International Consortium on Landslides and result in intensified international cooperation in learning and research for landslide disaster reduction within global and regional entities involving in landslides. We request cooperation and support from scientists and engineers working on other disasters, and particularly from those organizations and entities that are willing to contribute to Earth-system risk reduction, including that of landslides.

Acknowledgments

I express my gratitude for the cooperation of the staff of the National Cooperative Geologic Mapping Program and the Landslide Hazard Program of the U.S. Geological Survey and the Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, for organization of the First General Assembly and for edition of this volume. Thanks also go to UNESCO, WMO, FAO, UN/ISDR, UNU, IUGS, and to the governments of Japan, U.S.A., Italy, Canada and Norway for their continued support of ICL activities. It is acknowledged that the organization of the First General Assembly of ICL and this publication are financially supported by the UNESCO fund supporting IPL/ICL activities, the Presidential leadership fund of Kyoto University, and the twenty-first century COE (Centre of Excellence) fund from the Ministry of Education, Culture, Sports, Science and Technology of the Government of Japan allocated to the Disaster Prevention Research Institute, Kyoto University.

Kyoto University, UNESCO and ICL launched the UNITWIN Cooperation Programme “Landslide Risk Mitigation for Society and the Environment” on 18 March 2003, then jointly constructed the UNITWIN Headquarter building as the activity-base on the Uji campus of Kyoto University. It is acknowledged that worldwide cooperation through the UNITWIN network and the facilities of the UNITWIN Headquarter were very helpful for the preparation of the General Assembly and editing this volume.



Kyoji Sassa

President, International Consortium on Landslides

*Director of the Research Centre on Landslides,
Disaster Prevention Research Institute,
Kyoto University, Japan*

Welcome Address

Today, many parts of the world, including the United States, are at significant risk from natural disasters. Escalating population and increased development on the coast, fault zones, mountainous areas, and flood plains mean that increasing numbers of people are at risk from hazards. Each year the importance of assessing, preparing for and mitigating the potential effects of natural hazards, including landslides, increases. For this reason, the U.S. Geological Survey (USGS) and the National Research Council (NRC) of the National Academy of Sciences are pleased to host this important General Assembly of the International Consortium on Landslides (ICL).

It is an honor that the first General Assembly of the ICL is meeting in the Washington, DC area – the center of the U.S. government with numerous Federal agency headquarters, including the USGS, NRC, Federal Emergency Management Agency, Federal Transportation Administration, and the National Oceanic Atmospheric Administration (NOAA). The city is also home to numerous international organizations such as the World Bank, the Organization of American States, the Inter American Bank, and others. We hope that you will have an opportunity to visit this very beautiful city and some of the organizations that would benefit from the work of ICL.

Landslides threaten lives and property in every state in the U.S. Fall and winter of 2004–2005, were especially active landslides seasons with numerous landslides caused by hurricanes in the east coast and heavy rainfall in the west coast, throughout the intermountain states of Utah and Colorado and the east coast states of Ohio, Pennsylvania and New York. Landslides in 2004–2005 caused many deaths and extensive property damage. Communities are still cleaning up after some of the most damaging events. Those members of ICL who will visit southern California will be able to see, first hand, two very heavily impacted areas.

The USGS currently has two important efforts to lessen the impact of natural hazards. The first is the “Initiative to Protect Communities and Resources from Natural Disasters.” The USGS is working toward implementing this initiative by 2007, which will focus on delivering USGS science to public officials and private industry to help them reduce the vulnerability of communities and the environment to hazards including: earthquakes, droughts, floods, landslides, and wildfires. Landslide hazards and debris-flow hazards following wildfires are important elements of this initiative. The second effort is the NOAA-USGS Debris Flow Warning System, which is a demonstration project which combines the expertise of the two agencies in precipitation forecasting, debris-flow prediction, and debris-flow hazard assessment in order to establish a debris-flow warning system for recently burned areas of southern California. This demonstration project, if successful and if funded, will be expanded to reach other parts of the U.S. which face similar hazards. More detailed explanations about these two important efforts by the USGS will be given during the General Assembly.

International meetings such as this one provide a unique opportunity for managers and researchers to share new research findings, knowledge, and experiences that can lead to better understanding of how to mitigate the devastating effects of natural

hazards. I look forward to learning from the presentations and discussions during the next few days and reading the proceedings of this First General Assembly of the International Consortium of Landslides.

Good luck and best wishes for a successful assembly,



A handwritten signature in blue ink, appearing to read "P. Patrick Leahy". The signature is fluid and cursive, with a long, sweeping tail on the final letter.

P. Patrick Leahy

*Honorary Chairman of the First General Assembly of the
International Consortium on Landslides*

Acting Director of the U.S. Geological Survey

Contents

Part I

International Consortium on Landslides 1

1 ICL History and Activities	3
1.1 July 13–17, 1997 International Symposium on Landslide Hazard Assessment, Xian, China	4
1.2 February 1998	5
1.3 November 30–December 1, 1998	6
1.4 September 20–24, 1999	6
1.5 November 26–December 3, 1999	7
1.6 March 14–20, 2000	7
1.7 January 15–19, 2001	7
1.8 January 21–25, 2002	10
1.9 November 19–21, 2002	11
1.10 March 13–18, 2003	12
1.11 May 20–21, 2003	13
1.12 Discussion with Springer-Verlag on the Publication of “Landslides”	13
1.13 October 28–November 1, 2003	14
1.14 January 21–24, 2004	15
1.15 May 3–4, 2004	15
1.16 September 3, 2004	16
1.17 September 12–25, 2004	16
1.18 October 19–22, 2004	17
1.19 January 15–19, 2005	17
1.20 May 15–16, 2005	18
1.21 “Letter of Intent”	18
Acknowledgments	20
References	21
List of Abbreviated Names (in Alphabetical Order)	21

Part II

International Programme on Landslides 23

2 Landslide Investigation in Machu Picchu World Heritage, Cusco, Peru (C101-1)	25
2.1 Background and History of Machu Picchu Project	25
2.2 Landslides in Machu Picchu	27
2.3 Possible Landslide Process in Machu Picchu	30
2.4 Monitoring of Extensometers in Machu Picchu	33
2.5 Further Landslide Investigation	34
2.6 Conclusions	37
Acknowledgments	38
References	38

3	Preliminary Remarks on Monitoring, Geomorphological Evolution and Slope Stability of Inca Citadel of Machu Picchu (C101-1)	39
3.1	Geological Setting	39
3.2	Structural Setting	40
3.3	Geomechanical Setting	41
3.4	Geomorphology and Slope Instability	41
3.5	GPS Monitoring Network	43
3.6	Realization of a Three-Dimensional Digital Terrain Model of the INCA Citadel	43
3.7	Monitoring with JRC GB-SAR	44
3.8	Interferometric Synthetic Aperture Radar (InSAR)	44
3.9	Conclusion	46
	References	47
4	Geomorphological Investigations at Machu Picchu, Peru (C101-1)	49
4.1	Introduction	49
4.2	Study Site	50
4.3	Methods	50
4.4	Results	51
4.5	Discussion	53
4.6	Conclusions	53
	Acknowledgments	54
	References	54
5	The Application of Ground Penetrating Radar (GPR) at Machu Picchu, Peru (C101-1)	55
5.1	Introduction	55
5.2	Setting	55
5.3	Background Theory	56
5.4	Methods and Results	57
5.5	Conclusions	58
	Acknowledgments	59
	References	59
6	Assessing the Capabilities of VHR Satellite Data for Debris Flow Mapping in the Machu Picchu Area (C101-1)	61
6.1	Introduction	61
6.2	Description of the Study Area	62
6.3	Methodology	63
6.4	Discussion of Results	65
6.5	Conclusions	69
	Acknowledgments	69
	References	70
7	Influence of Thermal Expansion on Slope Displacements (C101-2)	71
7.1	Introduction	71
7.2	Study Site	71
7.3	Results	73
	Acknowledgments	74
	References	74
8	Emergency Intervention for the Geo-Mechanical Conservation of the Niches of Bamiyan Buddhas (Northern Afghanistan) (C101-3)	75
8.1	Introduction	75
8.2	General Features of the Area	75

8.3	Long-Term Conservation Strategy for the Geo-Mechanical Preservation of the Site ..	76
8.4	Emergency Measures	77
8.5	Conclusion	78
	References	79
9	Landslide Risk Assessment and Disaster Management in the Imperial Resort Palace of Lishan, Xian, China (C101-4)	81
9.1	Introduction	81
9.2	Objects at Risk in Lishan	81
9.3	Potential Landslide Zoning	82
9.4	Depth of the Lishan Landslide	84
9.5	Travel Distance of the Landslide	85
9.6	Deformation Monitoring of the Lishan Landslide	85
9.7	The Results of Extensometer Monitoring	86
9.8	Landslide Risk Preparedness	88
9.9	Summary	88
	Acknowledgments	89
	References	89
10	Formation Conditions and Risk Evaluation of Debris Flow in Tianchi Lake Area of Changbai Mountains Natural Protection Area, China (C101-5)	91
10.1	Introduction	91
10.2	Formation Condition of Debris Flow	92
10.3	The Types and Distribution of Debris Flow in Study Area	93
10.4	Risk Degree Evaluation of Debris Flow	95
10.5	Conclusion	96
	References	97
11	Aerial Prediction of Earthquake and Rain Induced Rapid and Long-Traveling Flow Phenomena (APERITIF) (M101)	99
11.1	Introduction	99
11.2	Mapping of Micro Topography Using Airborne Laser Scanning	101
11.3	Full-Scale Landslide Flume Experiments and an Artificial Rainfall-Induced Landslide on a Natural Slope	102
11.4	Landslide Risk Evaluation and Hazard Zoning for Rapid and Long-Traveling Landslides in Urban Development Areas	104
11.5	Conclusions	108
	Acknowledgments	108
	References	108
12	Investigating Rock-Slope Failures in the Tien Shan: State-of-the-Art and Perspectives of International Cooperation (M111)	109
12.1	Introduction	109
12.2	Completed and Ongoing Activities	110
12.3	Aims and Goals of Further Studies	110
12.4	Conclusions	111
	References	111
13	Multi-Temporal and Quantitative Geomorphological Analysis on the Large Landslide of Craco Village (M118)	113
13.1	Introduction	113
13.2	Study Site	113
13.3	Methods	115
13.4	Results	115
	References	117

14 Tools for Rock Fall Risk Integrated Management in Sandstone Landscape of the Bohemian Switzerland National Park, Czech Republic (M121)	119
14.1 Introduction	119
14.2 Integration Issue	119
14.3 System Structure, Methods, Outputs	120
14.4 Discussion	123
14.5 Conclusions	124
Acknowledgments	126
References	126
15 The Mechanism of Liquefaction of Clayey Soils (M124)	127
15.1 Introduction	127
15.2 Tested Soils	127
15.3 Test Procedure	128
15.4 Results	128
15.5 Conclusions	130
Acknowledgment	131
References	131
16 On Early Detection and Warning against Rainfall-Induced Landslides (M129)	133
16.1 Introduction	133
16.2 Warning of Rainfall-Induced Landslide	134
16.3 Laboratory Tests on Effects of Moisture Increase on Shear Failure of Soil	135
16.4 Proposal of Slope Instability Detector for Personal Use	137
16.5 Conclusion	139
Acknowledgments	139
References	139
Part III	
Landslide Risk Analysis	141
17 Geological and Geomorphologic Relationship of the Sub-Active Landslides of Cusco Valley, Peru	143
17.1 Introduction	143
17.2 Study Site	143
17.3 Methods	144
17.4 Analysis	144
17.5 Conclusions	147
References	147
18 Measurement of Velocity Distribution Profile in Ring-Shear Apparatus with a Transparent Shear Box	149
18.1 Introduction	149
18.2 Ring Shear Apparatus with a Transparent Shear Box (DPRI Ver. 7)	150
18.3 Video Image Acquisition System and PIV Analysis System to Obtain Velocity Distribution Profile	152
18.4 Physical Properties of Samples and Ring Shear Test Condition	153
18.5 Velocity Distribution Profiles of Sand Grains	153
18.6 Conclusions	155
Acknowledgments	155
References	155
19 Seismic Behavior of Saturated Sandy Soils: Case Study for the May 2003 Tsukidate Landslide in Japan	157
19.1 Introduction	157

19.2 Tsukidate Landslide	157
19.3 Properties of the Sample	160
19.4 Ring-Shear Apparatus and Test Method	160
19.5 Test Results and Discussions	162
19.6 Summary and Conclusions	163
References	163
20 Chemical Weathering and the Occurrence of Large-Scale Landslides in the Hime River Basin, Central Japan	165
20.1 Introduction	165
20.2 Outline of Research Area	165
20.3 Samples and Analytical Method	166
20.4 Results of Chemical Analyzes	167
20.5 The Hieda-Yama Landslide Area (the Kanayama-Zawa Watershed)	168
20.6 Estimation of Chemical Weathering Rate	168
20.7 Connection between Chemical Weathering and Landslide Occurrence	169
20.8 Identification of the Buried Altered Zones	170
20.9 Summary	170
Acknowledgments	171
References	171
21 Mechanism of Landslide Causing the December 2002 Tsunami at Stromboli Volcano (Italy)	173
21.1 Introduction	173
21.2 Sciara del Fuoco Morphology and Instability Phenomena	173
21.3 The December 2002 Tsunamogenic Landslides	174
21.4 Lithological and Physical Properties of Volcanoclastic Material	176
21.5 Stress Loading Ring Shear Test Results	176
21.6 Discussion and Conclusions	179
Acknowledgments	180
References	180
22 Characteristics of the Recent Landslides in the Mid Niigata Region – Comparison between the Landslides by the Heavy Rainfall on 13 July 2004, and by the Intensive Earthquakes on 23 October 2004	181
22.1 Introduction	181
22.2 Landslide Distribution by Heavy Rainfall on 13 July 2004	182
22.3 Landslides Triggered by the Intensive Chuetsu Earthquake on 23 October 2004	182
22.4 Comparison between the Landslides by the Heavy Rainfalls and Those by Chuetsu Earthquake on 23 October 2004	184
22.5 Summary and Discussion	184
Acknowledgments	185
References	185
23 Slope Instability Conditions in the Archaeological Site of Tharros (Western Sardinia, Italy)	187
23.1 Geologic, Geomorphic and Climatic Characteristics of the Area	187
23.2 Historical and Archaeological Summary	189
23.3 The Murru Mannu Landslide (Tofet Area)	189
23.4 Rockfalls in the San Giovanni Di Sinis Necropolis	190
23.5 Mass Movements in the Capo San Marco Necropolis	192
23.6 The Complex Mass Movement of the Southern End of Capo San Marco	194
23.7 Conclusions	194
Acknowledgments	195
References	195

24	'ROM' Scale for Forecasting Erosion Induced Landslide Risk on Hilly Terrain	197
24.1	Introduction	197
24.2	Study Site	198
24.3	Methods	198
24.4	Results	200
24.5	Conclusions	201
	References	202
25	Geotechnical Field Observations of Landslides in Fine-Grained Permafrost Soils in the Mackenzie Valley, Canada	203
25.1	Introduction	203
25.2	Overview of Previous Research in the Region	203
25.3	Surficial Geology and Site Conditions	204
25.4	Geotechnical Field Observations	205
25.5	Data Interpretation	208
25.6	Meaning to Pipeline Design and Recommendations for Further Investigations	210
	References	211
26	Slope-Structure Stability Modeling for the Rock Hewn Church of Bet Aba Libanos in Lalibela (Ethiopia): Preliminary Results	213
26.1	Introduction	213
26.2	Geological Setting of the Area	215
26.3	Engineering Geology Investigation	216
26.4	Structural Setting and Kinematic Analysis	216
26.5	Slope-Structure Stability Modeling	217
26.6	Conclusion	218
	References	218
27	Clay Minerals Contributing to Creeping Displacement of Fracture Zone Landslides in Japan	219
27.1	Introduction	219
27.2	Experiments and Results	220
27.3	Conclusions	223
	References	223
28	Geotechnical Landslide Risk Analysis on Historical Monuments: Methodological Approach	225
28.1	Introduction	225
28.2	Framework of the General Methodology	226
28.3	General Methodology of Natural Risk Analysis	226
28.4	Geotechnical Risk Analysis	227
28.5	Uncertainty Analysis	228
28.6	Risk Analysis inside the Tomb of Ramsis I at the Valley of the Kings	228
28.7	Conclusions	230
28.8	Past Experiences	230
	References	230
29	Collection of Data on Historical Landslides in Nicaragua	231
29.1	Introduction	231
29.2	Study Site	231
29.3	Methodology	232
29.4	Results	232
	References	234

30	World Heritage “Monasteries of Mount Athos” at Rock Slide Risk, in Greece	235
30.1	Introduction	235
30.2	Study Case	235
30.3	Conclusions	239
	References	239
31	The Archaeological Site of Delphi, Greece: a Site Vulnerable to Earthquakes, Rockfalls and Landslides	241
31.1	Introduction	241
31.2	Geological and Tectonic Setting	242
31.3	Seismotectonic Activity of the Area	245
31.4	Stability Conditions of the Monuments	246
31.5	Geotechnical Modeling of the Limestone Cliffs	247
31.6	Rockfall Protection Measures	247
31.7	Conclusions	248
	References	249
32	The Landslide Sequence Induced by the 2002 Eruption at Stromboli Volcano	251
32.1	Introduction	251
32.2	Sciara del Fuoco Morphology	251
32.3	The Sciara del Fuoco Deposit	251
32.4	Investigations	253
32.5	The Sequence of Landslide Events Triggered by the December 2002 Eruption	254
32.6	Geometry of the Slid Masses	255
32.7	Mechanisms of Instability	256
	Acknowledgments	257
	References	257
33	Slope Phenomena in the Region of the Historical Monument “The Horseman of Madara” in NE Bulgaria	259
33.1	Introduction	259
33.2	Madara Reserve Area	259
33.3	Geological and Tectonic Preconditions for the Development of Slope Processes	260
33.4	Seismotectonic Conditions for Activation of Slope Processes	262
33.5	Mechanism of Slope Processes	263
33.6	Monitoring of Contemporary Movements in the Marginal Zone of the Plateau	264
33.7	Conclusions	266
	References	267
	Part IV	
	Sustainable Disaster Management	269
34	Landslide Hazard Mapping and Evaluation of the Comayagua Region, Honduras	271
34.1	Introduction	271
34.2	Geological Setting	271
34.3	Methods	273
34.4	Results	273
	References	274
35	Swift Action Taken by the Geographical Survey Institute to Analyze and Provide Landslide Information on the Mid Niigata Prefecture Earthquakes of 23 October 2004	275
35.1	Topographic Features of Damaged Areas	275
35.2	Addressing the Issues	276
35.3	Concluding Remarks	284
	References	284

36 Early Warning and Prevention of Geo-Hazards in China	285
36.1 Introduction	285
36.2 National Geo-Hazards Survey Program on the Basis of Counties in China ..	286
36.3 Geo-Hazard Risk Assessment and Zoning	287
36.4 Meteorological Early Warning of Landslide	288
36.5 Prevention and Control of Geological Hazards in Three Gorges Reservoir Area	289
36.6 Recommendation for National Geo-Hazard Mitigation Strategy	289
References	289
37 Landslide Hazard Zonation in Greece	291
37.1 Introduction	291
37.2 Geological Setting and Landslide Phenomena	291
37.3 Landslide Data Recording and Storage	293
37.4 Statistical Approach	294
37.5 Landslide Hazard Zonation	295
37.6 Conclusions	295
References	296
38 Landslides Risk Reduction and Monitoring for Urban Territories in Russia	297
38.1 Introduction	297
38.2 Monitoring Organization for Urban Territories	298
38.3 Results	303
References	303
39 Numerical Analysis on Slope Stability under Variations of Reservoir Water Level ..	305
39.1 Introduction	305
39.2 Calculating Theory	306
39.3 Numerical Calculation and Analysis	307
39.4 Case Study	309
39.5 Conclusions	310
Acknowledgment	311
References	311
40 Displacement Monitoring and Physical Exploration on the Shuping Landslide Reactivated by Impoundment of the Three Gorges Reservoir, China	313
40.1 Introduction	313
40.2 Features of the Shuping Landslide	313
40.3 Slope Deformation Characters of the Shuping Landslide	315
40.4 GPS Monitoring Results	316
40.5 Installation of Extensometer and the Monitoring Results	316
40.6 One Meter Depth Ground Temperature Measurement for Groundwater Veins	318
40.7 Summaries and Conclusive Remarks	319
Acknowledgments	319
References	319
41 Capacity Enhancement for Landslide Impact Mitigation in Central America	321
41.1 Introduction	321
41.2 Landslides and Regional Setting	321
41.3 Institutional Structure for Natural Disaster Prevention, Preparedness and Response	323
41.4 International Support	323
41.5 Norwegian-Supported Institutional Cooperation Programs	323
41.6 Norwegian-Supported Regional Training Program	324

41.7 Lessons Learned	325
Acknowledgment	326
References	326
42 Interpretation of the Mechanism of Motion and Suggestion of Remedial Measures Using GPS Continuous Monitoring Data	327
42.1 Introduction	327
42.2 Surface Monitoring Systems	329
42.3 Study Area	329
42.4 Regional Study	330
42.5 Complementary Study and Monitoring	331
42.6 Data Analysis and Interpretation of the Mechanism of Motion	333
42.7 Conclusions	334
42.8 Recommendations	334
References	335
43 On the Use of Ground-Based SAR Interferometry for Slope Failure Early Warning: the Cortenova Rock Slide (Italy)	337
43.1 Introduction	337
43.2 Study Site	337
43.3 Methods	339
43.4 Results	339
43.5 Conclusions	341
Acknowledgments	342
References	342
44 Preservation from Rockfall of the Engraved Wall in the Fugoppe Cave, Hokkaido, Japan	343
44.1 Introduction	343
44.2 Photographs for Image Processing	344
44.3 Geological Features	344
44.4 Identification of Rockfall-Prone Areas of the Walls	347
44.5 Concluding Remarks	349
Acknowledgment	349
References	349
45 Landslide Hazard and Mitigation Measures in the Area of Medieval Citadel of Sighisoara, Romania	351
45.1 Introduction	351
45.2 Morphological and Geological Conditions	352
45.3 Meteorological and Hydrological Data	352
45.4 Hydrogeological Conditions	352
45.5 Instability Phenomena	352
45.6 Geotechnical Works	353
45.7 Landslide Risk Assessment	354
45.8 Mitigation Measures	354
References	356
46 A Hazard Assessment of Settlements and Historical Places in the Upper Volga River Region, Russia	357
46.1 Introduction	357
46.2 Landslide Activity in the Studied Area	357
46.3 Other Geological Processes Developed in the Studied Area	359
46.4 Summary	360
References	360

Appendices	361
A.1 ICL Statutes and Structure	361
A1.1 International Consortium on Landslides – Statutes	361
A1.2 International Consortium on Landslides – Bylaws	363
A1.3 Officers of ICL for the First Term (2002–2005)	364
A1.4 Members and Supporting Organizations	365
A.2 IPL Projects	367
A2.1 Coordinating Projects	367
A2.2 Member Projects	368
A.3 ICL Documents	371
A3.1 The 1997 Xian Appeal	371
A3.2 The 1999 Tokyo Appeal	373
A3.3 The 1999 Memorandum of Understanding between UNESCO and Disaster Prevention Research Institute, Kyoto University	373
A3.4 The 2001 Tokyo Declaration	375
A3.5 The 2002 Kyoto Declaration	375
A3.6 2003 The Agreement of a UNITWIN Cooperation Programme between UNESCO, Kyoto University and ICL	375
A3.7 The 2005 Letter of Intent proposed by ICL and Approved by UNESCO, WMO, FAO, UN/ISDR, UNU, ICSU, and WFEO	375
Index	379

List of Contributors

Abdrakhmatov, Kanatbek E. · (Chapter 12)

Institute of Seismology, National Academy of Science, Asanbay 52/1, Bishkek, Kyrgyzstan

Abidin, Roslan Zainal · (Chapter 24)

Director, National Soil Erosion Research Centre, Universiti Teknologi MARA, Shah Alam, Malaysia

Corresponding author of Chapter 24:

Tel: +603-5544-2779, Fax: +603-5544-2783, E-mail: roslanza@salam.uitm.edu.my

Abu Hassan, Zulkifli · (Chapter 24)

Postgraduate Student, Faculty of Civil Engineering, Universiti Teknologi MARA, Shah Alam, Malaysia

Antonello, Giuseppe · (Chapter 43)

European Commission, Joint Research Center, Via E. Fermi 1, Ispra (VA), 21020, Italy

Araiba, Kiminori · (Chapter 40)

National Research Institute of Fire and Disaster/14-1, Nakahara 3 chome, Mitaka, Tokyo 181-8633, Japan

Astete, Fernando V. · (Chapters 2, 4)

Instituto Nacional de Cultura (INC), Calle San Bernardo s/n., Cusco, Peru

Ayalew, Lulseged · (Chapter 22)

Addis Ababa University, P.O. Box 29970, Addis Ababa, Ethiopia

Baldi, Paolo · (Chapter 32)

Dept. of Physics, University of Bologna, Italy

Benavente, Edwin · (Chapter 2)

Instituto Nacional de Cultura (INC), Calle San Bernardo s/n., Cusco, Peru

Best, Mel · (Chapter 5)

BEMEX Consulting, 5288 Cordova Bay Rd., British Columbia, Victoria, Canada

Bhandary, Netra P. · (Chapter 27)

Department of Civil and Environmental Engineering, Ehime University, 3 Bunkyo-cho, Matsuyama, Japan

Corresponding author of Chapter 27:

Tel: +81-89-927-8566, Fax: +81-89-927-8566, E-mail: netra@dpc.ehime-u.ac.jp

Bobrowsky, Peter · (Chapter 5)

NRCan, Geological Survey of Canada, 601 Booth Street, Ontario, Ottawa, Canada

Corresponding author of Chapter 5:

Tel: +1-613-947-0333, Fax: +1-613-992-0190, E-mail: pbobrows@nrcan.gc.ca

Boldini, Daniela · (Chapter 21)

Department of Structural and Geotechnical Engineering, University of Rome “La Sapienza”,
Via Monte d’Oro 28, 00186 Rome, Italy

Caillaux, Victor Carlotto · (Chapter 5)

INGEMMET, Instituto Geologico Minero y Metalurgico, Av. Canada, No 1470, San Borja, Lima, Peru

Canuti, Paolo · (Chapters 3, 23)

Department of Earth Sciences, University of Firenze, Via Giorgio La Pira 4, 50121 Firenze, Italy

Cao, Binglan · (Chapter 10)

Environmental Geological Disaster Research Institute, Jilin University, 6 Ximinzhu Street,
Changchun 130026, China

Corresponding author of Chapter 10:

Tel: +86-431-854-0912, Fax: +86-431-556-7570, E-mail: caobl@jlu.edu.cn

Carreño, Raúl · (Chapters 17, 34)

GRUDEC AYAR, Apartado Postal 638, Cusco, Peru

Corresponding author of Chapters 17, 34:

Tel: +51-84-974-1455, Fax: +51-84-26-2590, E-mail: raulcarreno@ayar.org.pe

Casagli, Nicola · (Chapters 3, 6, 23, 43)

Department of Earth Sciences, University of Firenze, Via Giorgio La Pira 4, 50121 Firenze, Italy

Cheibany, Ould Elemine · (Chapter 20)

Research Institute for Hazards in Snowy Areas, Niigata University, 2-8050 Ikarashi, Niigata, 950-2181, Japan

Chiocci, Francesco Latino · (Chapter 32)

Dept of Earth Sciences, University of Rome “La Sapienza”, Italy

Christaras, Basile · (Chapter 30)

School of Geology, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

Corresponding author of Chapter 30:

Tel: +30-2310-99-8506, Fax: +30-2310-99-8506, E-mail: christar@geo.auth.gr

Colombini, Vittorio · (Chapter 8)

Via Merulana 272, 00185 Rome, Italy

Coltelli, Mauro · (Chapter 32)

INGV, Catania, Italy

Coman, Mihai · (Chapter 45)

ISPIF SA, 35-37, Oltenitei St., Bucharest, Romania

Crippa, Carlo · (Chapter 8)

Trevi S.p.A, Divisione Rodio, Via Pandina 5, 26831 Casalmiocco, Lodi, Italy

Delmonaco, Giuseppe · (Chapters 3, 13, 26)

ENEA CR Casaccia, Via Anguillarese 301, 00060 S. Maria di Galeria, Rome, Italy

Corresponding author of Chapter 13:

Tel: +39-06-3048-4502, Fax: +39-06-3048-4029, E-mail: delmonaco@casaccia.enea.it

Devoli, Graziella · (Chapter 29)

International Centre for Geohazards, c/o Norwegian Geotechnical Institute, P.O. Box 3930, Ullevaal Stadion, 0806 Oslo, Norway
and Ph.D. Candidate at University of Oslo, Department of Geosciences, Norway
Corresponding author of Chapter 29:
Tel: +47-2202-3045, Fax: +47-2223-0448, E-mail: gde@geohazards.no

Dimitriou, Anastasios · (Chapter 30)

School of Geology, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

Dimopoulos, George · (Chapter 30)

School of Geology, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

Douma, Marten · (Chapter 5)

NRCan, Geological Survey of Canada, 601 Booth Street, Ontario, Ottawa, Canada

ElShayeb, Yasser · (Chapter 28)

Faculty of Engineering, Cairo University, Giza 12613, Egypt
Corresponding author of Chapter 28:
Tel: +20-10-604-4698, Fax: +20-2-571-0035, E-mail: yasser.elshayeb@tempus-egypt.com

Emamjomeh, Reza · (Chapter 42)

Soil Conservation and Watershed Management Research Institute, P.O. Box 13445-1136, Tehran, Iran

Falconi, Luca · (Chapter 13)

ENEA CR Casaccia, Via Anguillarese 301, 00060 Rome, Italy

Fanti, Riccardo · (Chapters 6, 23)

Department of Earth Sciences, University of Firenze, Via Giorgio La Pira 4, 50121 Firenze, Italy
Corresponding author of Chapters 6, 23:
Tel: +39-055-275-7523, Fax: +39-055-275-6296, E-mail: rfanti@steno.geo.unifi.it

Farina, Paolo · (Chapter 43)

Department of Earth Sciences, University of Firenze, Via Giorgio La Pira 4, 50121 Firenze, Italy
Corresponding author of Chapter 43:
Tel: +39-055-275-6221, Fax: +39-055-275-6296, E-mail: paolo.farina@geo.unifi.it

Ferretti, A. · (Chapter 3)

Tele-Rilevamento Europa, T.R.E., Via Vittoria Colonna 7, 20149 Milano, Italy

Fortuny-Guasch, Joaquim · (Chapter 43)

European Commission, Joint Research Center, Via E. Fermi 1, Ispra (VA), 21020, Italy

Frangov, Georgi · (Chapter 33)

Geological Institute, BAS, St. Acad. G. Bonchev Block 24, Sofia 1113, Bulgaria

Fukuoka, Hiroshi · (Chapters 2, 9, 11, 18, 19)

Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, Uji, Kyoto 611-0011, Japan
Corresponding author of Chapters 9, 18:
Tel: +81-774-38-4111, Fax: +81-774-38-4300, E-mail: fukuoka@SCL.kyoto-u.ac.jp

Furuya, Gen · (Chapter 20)

Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, Uji,
Kyoto 611-0011, Japan

Gallage, Chaminda · (Chapter 16)

Department of Civil Engineering, University of Tokyo, 7-3-1, Hongo, Bunkyo-Ku, Tokyo 113-8656,
Japan

Gao, Shihang · (Chapter 39)

Department of Civil Engineering, Xi'an Jiaotong University, Xi'an 710049, China

Gratchev, Ivan B. · (Chapters 15, 46)

Graduate School of Science, Kyoto University, Japan
and Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, Uji,
Kyoto 611-0011, Japan
Corresponding author of Chapters 15, 46:
Tel: +81-77-438-4107, Fax: +81-77-438-4300, E-mail: gratchev@landslide.dpri.kyoto-u.ac.jp

Guerri, Letizia · (Chapter 43)

Department of Earth Sciences, University of Firenze, Via Giorgio La Pira 4, 50121 Firenze, Italy

Hasegawa, Manabu · (Chapter 35)

Geographic Department, Geographical Survey Institute, Ministry of Land, Infrastructure and
Transport, 1 Kitasato, Tukuba, Ibaraki, Japan

Havenith, Hans-Balder · (Chapter 12)

SED-ETH, Swiss Seismological Service, Institute of Geophysics, Höggerberg, 8093 Zurich, Switzerland

Jezný, Michal · (Chapter 7)

Department of Engineering Geology, Faculty of Natural Sciences, Comenius University Bratislava,
84215 Bratislava, Mlynska dolina, Slovak Republic

Kalafatovich, Susana · (Chapter 34)

GRUDEC AYAR, Apartado Postal 638, Cusco, Peru

Kato, Koji · (Chapter 22)

Shin Engineering Consultant Co. Ltd., Sakaedori 2-8-30 Shiroishiku, Sapporo 003-0021, Japan

Kjekstad, Oddvar · (Chapter 41)

Norwegian Geotechnical Institute, NGI, Sognsveien 72, P.O. Box 3930, Ullevaal Stadion, 0801, Norway
Corresponding author of Chapter 41:
Tel: +47-2202-3002, Fax: +47-2223-0448, E-mail: oddvar.kjekstad@ngi.no

Klimesš, Jan · (Chapter 4)

Institute of Rock Structure and Mechanics, Academy of Sciences, V Holešovičkách 41, 18000 Praha 8,
Czech Republic

Kobayashi, Hideji · (Chapter 44)

Shin Engineering Consultants Co. Ltd., Sapporo 062-0931, Japan

Korup, Oliver · (Chapter 12)

Swiss Federal Research Institutes WSL/SLF, 7260 Davos, Switzerland

Koukis, G. · (Chapter 37)

Department of Geology, Section of Applied Geology and Geophysics, University of Patras,
26500 Patras, Greece

Leoni, Gabriele · (Chapter 13)

Consorzio Civita, Via del Corso 300, 00168 Rome, Italy

Leva, Davide · (Chapter 43)

LiSALab s.r.l., V. XX Settembre 34, Legnano (MI), 20025, Italy

Liao, Hongjian · (Chapter 39)

Department of Civil Engineering, Xi'an Jiaotong University, Xi'an 710049, China
Corresponding author of Chapter 39:
Tel: +86-29-8266-3228, Fax: +86-29-8323-7910, E-mail: hjliao@mail.xjtu.edu.cn

Lollino, G. · (Chapter 3)

CNR-IRPI Torino, Strada delle Cacce 73, 10135 Torino, Italy

Loupasakis, C. · (Chapter 37)

Institute of Geology and Mineral Exploration, Engineering Geology Department, Messogion Avenue 70,
11527 Athens, Greece

Mamaev, Yuri A. · (Chapter 46)

Institute of Environmental Geoscience of Russian Academy Science,
Ulansky Pereulok 13, Building 2, P.O. Box 145,
101000 Moscow, Russia

Mamani, Romulo Mucho · (Chapter 5)

INGEMMET, Instituto Geologico Minero y Metalurgico, Av. Canada, No 1470, San Borja, Lima, Peru

Margottini, Claudio · (Chapters 3, 8, 13, 26)

ENEA CR Casaccia, Via Anguillarese 301, 00060 S. Maria di Galeria, Rome, Italy
Corresponding author of Chapters 3, 8, 26:
Tel: +39-06-3048-4688, Fax: +39-06-3048-4029, E-mail: margottini@casaccia.enea.it

Marinos, Paul · (Chapters 30, 31)

National Technical University of Athens, School of Civil Engineering, Geotechnical Department,
9 Heron Polytechniou Str., 15780 Zografou, Athens, Greece
Corresponding author of Chapter 31:
Tel: +30-210-772-3430, Fax: +30-210-772-3770, E-mail: marinos@central.ntua.gr

Marsella, Maria · (Chapter 32)

Dept of Hydraulics, Transports and Roads, University of Rome "La Sapienza", Italy

Marui, Hideaki · (Chapter 20)

Research Institute for Hazards in Snowy Areas, Niigata University, 2-8050 Ikarashi, Niigata, 950-2181,
Japan

Marunteanu, Cristian · (Chapter 45)

Faculty of Geology and Geophysics, University of Bucharest, 6, Traian Vuia St., 020956 Bucharest,
Romania
Corresponding author of Chapter 45:
Tel: +40-1-3125-003/34, Fax: +40-1318-1557, E-mail: cristian@gg.unibuc.ro

Matova, Margarita · (Chapter 33)

Geological Institute, BAS, St. Acad. G. Bonchev Block 24, Sofia 1113, Bulgaria
Corresponding author of Chapter 33:
Tel: +359-2979-2212, Fax: +359-272-4638, E-mail: m_matova@geology.bas.bg

Mucho, R. · (Chapter 3)

INGEMMET, Instituto Geologico Minero y Metallurgico, Av. Canada 1470, San Borja, Lima 41, Peru

Nadim, Farrokh · (Chapter 41)

International Centre for Geohazards, ICG, c/o NGI, Sognsveien 72, P.O. Box 3930, Ullevaal Stadion, 0801, Norway

Nichol, Susan · (Chapter 25)

Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, Ontario, K1A 0E8, Canada

Nikolaou, N. · (Chapter 37)

Institute of Geology and Mineral Exploration, Engineering Geology Department, Messogion Avenue 70, 11527, Athens, Greece
Corresponding author of Chapter 37:
Tel: +30-210-779-6351, Fax: +30-210-778-2209, E-mail: nikolaou@igme.gr

Nocentini, Massimiliano · (Chapter 6)

Department of Earth Sciences, University of Firenze, Via Giorgio La Pira 4, 50121 Firenze, Italy

Ochiai, Hirotaka · (Chapter 11)

Forestry and Forest Products Research Institute, Tsukuba, Japan

Osipov, Victor I. · (Chapter 15)

Institute of Environmental Geoscience, Russian Academy of Sciences, Ulansky Pereulok 13, Building 2, P.O. Box 145, Moscow 101000, Russia

Oviedo, Martin Jhonathan · (Chapter 5)

INGEMMET, Instituto Geologico Minero y Metalurgico, Av. Canada, No 1470, San Borja, Lima, Peru

Pagáčová, Zuzana · (Chapter 7)

Department of Engineering Geology, Comenius University Bratislava, Faculty of Natural Sciences, 84215 Bratislava, Mlynska dolina, Slovak Republic

Paluš, Milan · (Chapter 14)

Institute of Computer Science, Academy of Sciences of the Czech Republic, Pod vodárenskou věží 2, 18207 Prague 8, Czech Republic

Pavlidis, Spyros · (Chapter 30)

School of Geology, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

Peng, Xuanming · (Chapter 40)

Yichang Institute of Geology and Mineral Resources, China Geological Survey, 37 Gangyao Road, Yichang 443003, China

Pinto, Walter Pari · (Chapter 5)

INGEMMET, Instituto Geologico Minero y Metalurgico, Av. Canada, No 1470, San Borja, Lima, Peru

Pompilio, Massimo · (Chapter 32)

INGV, Catania, Italy

Postoyev, G. P. · (Chapter 38)

Institute of Environmental Geosciences RAS, Ulansky Pereulok 13, Moscow 101000, Russia

Puglisi, Claudio · (Chapters 3, 13)

Consorzio Civita, Via del Corso 300, 00186 Rome, Italy

Righini, Gaia · (Chapter 6)

Department of Earth Sciences, University of Firenze, Via Giorgio La Pira 4, 50121 Firenze, Italy

Romagnoli, Claudia · (Chapter 32)

University of Bologna, Dept. of Earth and Environmental Sciences, Italy

Rondoyanni, Theodora · (Chapter 31)

School of Mining and Metallurgical Engineering, Dept. of Geological Sciences,
National Technical University of Athens, 9 Heroon Polytechniou Str., 15780 Zografou,
Athens, Greece

Sabatakakis, N. · (Chapter 37)

Department of Geology, Section of Applied Geology and Geophysics, University of Patras,
26500 Patras, Greece

Sagara, Wataru · (Chapter 20)

SABO Technical Center, 4-8-21 Kudan-minami, Chiyoda-ku, Tokyo, 102-0074, Japan

Sasaki, Ryo · (Chapter 18)

Former Master Course graduate student, Graduate School of Science, Kyoto University, Japan

Sassa, Kyoji · (Chapters 1, 2, 9, 11, 15, 18, 19, 21, 40)

President of the International Consortium on Landslides
Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, Uji,
Kyoto 611-0011, Japan
Corresponding author of Chapters 1, 2, 11:
Tel: +81-774-38-4110, Fax: +81-774-32-5597, E-mail: sassa@SCL.kyoto-u.ac.jp

Sato, Hiroshi P. · (Chapter 35)

Geography and Crustal Dynamics Research Center, Geographical Survey Institute,
Ministry of Land, Infrastructure and Transport,
1 Kitasato, Tukuba, Ibaraki, Japan

Shan, Wei · (Chapter 36)

College of Civil Engineering of Northeast Forestry University, Harbin 150040, China

Sheng, Qian · (Chapter 39)

Institute of Rock and Soil Mechanics, Chinese Academy of Sciences, Wuhan 430071, China

Shoaei, Gholamreza · (Chapter 42)

Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, Uji, Kyoto
611-0011, Japan
and Natural Disaster Research Institute of Iran (NDRII)

Shoaei, Zieaoddin · (Chapter 42)

Soil Conservation and Watershed Management Research Institute, P.O. Box 13445-1136, Tehran, Iran
Corresponding author of Chapter 42:
Tel: +98-21-4490-1415, Fax: +98-21-4490-5876, E-mail: shoaei58@yahoo.com

Spizzichino, Daniele · (Chapters 13, 26)

Consorzio Civita, Via del Corso 300, 00168 Rome, Italy

Strom, Alexander L. · (Chapter 12)

Institute of Geospheres Dynamics, Russian Academy of Sciences, Leninskiy Av., 38-1, Moscow, Russia
Corresponding author of Chapter 12:
Tel: +7-095-939-7980, Fax: +7-095-137-6511, E-mail: a.strom@g23.relcom.ru

Su, Xueqing · (Chapter 25)

Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, Ontario, K1A 0E8, Canada

Svalova, V. B. · (Chapter 38)

Institute of Environmental Geosciences RAS, Ulansky Pereulok 13, Moscow 101000, Russia
Corresponding author of Chapter 38:
Tel: +7-095-207-4726, Fax: +7-095-823-1886, E-mail: inter@geoenv.ru

Takata, Shuzo · (Chapter 27)

Fukken Civil Engineering Consultants, 2-10-11 Hikarimachi, Higashi-ku, Hiroshima, Japan

Takeuchi, Atsuo · (Chapter 40)

Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, Uji, Kyoto 611-0011, Japan

Tarchi, Dario · (Chapters 3, 43)

European Commission, Joint Research Centre, SERAC Unit, Via E. Fermi 1, TP 723, 21020 Ispra (VA), Italy

Tian, Yongjin · (Chapter 9)

Lishan Landslide Prevention and Control Office, Xian, China

Tommasi, Paolo · (Chapters 21, 32)

Institute for Geo-Engineering and Environmental Geology, National Research Council, c/o Faculty of Engineering, Via Eudossiana 18, 00184 Rome, Italy
Corresponding author of Chapter 32:
Tel: +39-064-458-5005, Fax: +39-064-458-5016, E-mail: paolo.tommasi@uniroma1.it

Tonoli, Gedeone · (Chapter 8)

Trevi S.p.A, Divisione Rodio, Via Pandina 5, 26831 Casalmiocco, Lodi, Italy

Towhata, Ikuo · (Chapter 16)

Department of Civil Engineering, University of Tokyo, 7-3-1, Hongo, Bunkyo-Ku, Tokyo 113-8656, Japan
Corresponding author of Chapter 16:
Tel: +81-35-841-6121, Fax: +81-35-841-8504, E-mail: towhata@geot.t.u-tokyo.ac.jp

Tsunesumi, Haruo · (Chapter 35)

Geographic Department, Geographical Survey Institute, Ministry of Land, Infrastructure and Transport, 1 Kitasato, Tukuba, Ibaraki, Japan
Corresponding author of Chapter 35:
Tel: +81-29-864-6920, Fax: +81-29-864-1804, E-mail: tsune@gsi.go.jp

Uchimura, Taro · (Chapter 16)

Department of Civil Engineering, University of Tokyo, 7-3-1, Hongo, Bunkyo-Ku, Tokyo 113-8656, Japan

Ugarte, David · (Chapter 2)

Instituto Nacional de Cultura (INC), Calle San Bernardo s/n., Cusco, Peru

Vankov, Dmitri A. · (Chapter 46)

Former doctoral student at Graduate School of Science, Kyoto University, Japan and Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, Uji, Kyoto 611-0011, Japan

Vařilová, Zuzana · (Chapter 14)

Bohemian Switzerland National Park Administration, Pra•ská 5, 40746 Krásná Lípa, Czech Republic

Verdel, Thierry · (Chapter 28)

LAEGO, École des Mines de Nancy, France

Vilímek, Vít · (Chapter 4)

Department of Physical Geography and Geoecology, Faculty of Science, Charles University, Albertov 6, 12843 Prague 2, Czech Republic

Corresponding author of Chapter 4:

Tel: +420-22-195-1361, Fax: +420-22-195-1367, E-mail: vilimek@natur.cuni.cz

Vlčko, Ján · (Chapters 7, 4)

Department of Engineering Geology, Faculty of Natural Sciences, Comenius University Bratislava, 84215 Bratislava, Mlynska dolina, Slovak Republic

Corresponding author of Chapter 7:

Tel: +421-26-029-6596, Fax: +421-26-029-6702, E-mail: vlcko@fns.uniba.sk

Wang, Baolin · (Chapter 25)

Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, Ontario, K1A 0E8, Canada

Corresponding author of Chapter 25:

Tel: +1-613-992-8323, Fax: +1-613-992-0190, E-mail: bwang@nrcan.gc.ca

Wang, Fawu · (Chapters 2, 9, 11, 21, 40)

Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, Uji, Kyoto 611-0011, Japan

Corresponding author of Chapters 21, 40:

Tel: +81-774-38-4114, Fax: +81-774-38-4300, E-mail: wangfw@landslide.dpri.kyoto-u.ac.jp

Wang, Gonghui · (Chapters 2, 9, 11, 18, 19, 40)

Research Centre on Landslides, Disaster Prevention Research Institute, Kyoto University, Uji, Kyoto 611-0011, Japan

Corresponding author of Chapter 19:

Tel: +81-774-38-4114, Fax: +81-774-38-4300, E-mail: wanggh@landslide.dpri.kyoto-u.ac.jp

Wang, Hui · (Chapter 10)

Environmental Geological Disaster Research Institute, Jilin University, 6 Ximinzhu Street, Changchun 130026, China

Wang, Yong · (Chapter 9)

Lishan Landslide Prevention and Control Office, Xian, China

Watanabe, Naoki · (Chapter 20)

Research Institute for Hazards in Snowy Areas, Niigata University, 2-8050 Ikarashi, Niigata, 950-2181, Japan

Corresponding author of Chapter 20:

Tel: +81-25-262-7058, Fax: +81-25-262-7050, E-mail: jibanken@cc.niigata-u.ac.jp

Yamagishi, Hiromitsu · (Chapters 22, 44)

Department of Environmental Science, Faculty of Science, Niigata University, Igarashi 2-no-cho 8050, Japan

Corresponding author of Chapter 22:

Tel: +81-25-262-6957, Fax: +81-25-262-6957, E-mail: hiroy@env.sc.niigata-u.ac.jp

Yasuda, Tadashi · (Chapter 44)

Public Consultants Co, Ltd., Sapporo 060-0005, Japan

Corresponding author of Chapter 44:

Tel: +81-11-222-2985, Fax: +81-11-222-2579, E-mail: tad_yasuda@public-con.co.jp

Yatabe, Ryuichi · (Chapter 27)

Department of Civil and Environmental Engineering, Ehime University, 3 Bunkyo-cho, Matsuyama, Japan

Ying, Jie · (Chapter 39)

Department of Civil Engineering, Xi'an Jiaotong University, Xi'an 710049, China

Yonekura, Naoshi · (Chapter 20)

Department of Public Works, Niigata Prefectural Government, 4-1 Shinko-cho, Niigata, 950-8570, Japan

Zhang, Lijun · (Chapter 36)

Northeast Institute of Geography and Agricultural Ecology, Chinese Academy of Sciences, Changchun, 130012, China

and Information Center of Ministry of Land and Resources, Beijing, 100812, China

Corresponding author of Chapter 36:

Tel: +86-10-6655-8719, Fax: +86-10-6655-8613, E-mail: ljzhang@infomail.mlr.gov.cn

Zhang, Yeming · (Chapter 40)

Yichang Institute of Geology and Mineral Resources, China Geological Survey, 37 Gangyao Road, Yichang 443003, China

Zheng, Xiaoyu · (Chapter 10)

Environmental Geological Disaster Research Institute, Jilin University, 6 Ximinzhu Street, Changchun 130026, China

Zvelebil, Jiří · (Chapters 4, 14)

Geo-tools, NGO, U Mlejnu 128, 25066 Zdiby, Czech Geological Survey, Klárov 3, 11821 Prague, Czech Republic

Corresponding author of Chapter 14:

Tel: +420-60-225-9921, Fax: +420-25-753-1376, E-mail: jiri.zvelebil@geo-tools.cz

Part I International Consortium on Landslides

Chapter 1 ICL History and Activities

ICL History and Activities

Kyoji Sassa, President of the International Consortium on Landslides

The International Consortium on Landslides (ICL), created during the Kyoto Symposium in January 2002, is an international non-governmental and non-profit scientific organization, which is supported by the United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Meteorological Organization (WMO), the Food and Agriculture Organization of the United Nations (FAO), the United Nations International Strategy for Disaster Risk Reduction (UN/ISDR), and intergovernmental programs such as the International Hydrological Programme of UNESCO, the International Union of Geological Sciences (IUGS), the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of the Government of Japan, U.S. Geological Survey, and other governmental bodies. ICL was registered as a legal body under the Japanese law for non-profit organizations in August 2002 in the Government of Kyoto Prefecture, Japan.

The objectives of the consortium are to:

1. promote landslide research for the benefit of society and the environment, and capacity building, including education, notably in developing countries;
2. integrate geosciences and technology within the appropriate cultural and social contexts in order to evaluate landslide risk in urban, rural and developing areas including cultural and natural heritage sites, as well as contribute to the protection of the natural environment and sites of high societal value;
3. combine and coordinate international expertise in landslide risk assessment and mitigation studies, thereby resulting in an effective international organization which will act as a partner in various international and national projects; and
4. promote a global, multidisciplinary program on landslides.

The central activity is the International Programme on Landslides (IPL). Other activities planned include international co-ordination, exchange of information and dissemination of research activities and capacity building through various meetings, dispatch of experts, landslide database, and publication of “Landslides”: Journal of the International Consortium on Landslides. The necessity of establishment of a new Research Centre on

Fig. 1.1.
Relationship of ICL, IPL, and RCL

