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## The Fourth World Landslide Forum, Ljubljana, 2017

**Abstract** The Fourth World Landslide Forum (WLF4) was held in Cankarjev dom—Cultural and Congress Centre in Ljubljana, Slovenia, from 30 May to 2 June 2017, with over 600 participants from 49 countries, 5 international organizations, and 4 United Nations organizations—scientists, engineers, researchers, students, experts, politicians, and other decision makers working in the area of landslide risk reduction. Well, over 100 of them were (post)graduate students. The WLF4 as a triennial event was a contribution of the International Consortium on Landslides (ICL) to the implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030. This article reports on the main WLF4 events and outcomes of the forum. Altogether, close to 400 peer-reviewed full papers, including keynote, invited, and other submitted papers, were published by Springer Nature in five volumes with a total of over 3600 pages. During the WLF4, 20 new World Centres of Excellence on Landslide Risk Reduction for 2017–2020, IPL Awards for Success, Varnes Medals, Best Paper Awards, and other means of recognitions were handed out to the recipients. The WLF4 participants have adopted the “2017 Ljubljana Declaration,” and drafted the “Kyoto 2020 Commitment,” in order to stress their strong and joint commitment for the ISDR-ICL Sendai Partnerships 2015–2025 on its way towards the Fifth World Landslide Forum to be held in November 2020 in Kyoto, Japan.

**Keywords** Fourth world landslide forum · International consortium on landslides · Landslide

### Introduction

#### Background

A World Landslide Forum is a triennial event, organized by the International Consortium on Landslides (Kyoto, Japan) and the International Programme on Landslides (IPL). The Fourth World Landslide Forum (WLF4) in Ljubljana 2017 followed three previous successful forums in Tokyo (WLF1, 2008; Sassa 2009), Rome (WLF2, 2011; Sassa et al. 2012), and Beijing (WLF3, 2014; Sassa et al. 2015).

The Third UN World Conference on Disaster Risk Reduction (3rd WCDRR) was organized in 14–18 March 2015 in Sendai City, Miyagi Prefecture, Japan. The Sendai Framework for Disaster Risk Reduction 2015–2030 was adopted by the United Nations Member States on 18 March 2015. International Consortium on Landslides (ICL) and ICL-supporting organizations proposed the ISDR-ICL Sendai Partnerships 2015–2025 for Global Promotion of Understanding and Reducing Landslide Disaster Risk in the morning session of 16 March 2015. It was accepted and signed on the same day by 16 United Nations, international and national stakeholders including the ICL, United Nations Office for Disaster Risk Reduction (UNISDR), United Nations Educational, Scientific and Cultural Organization (UNESCO), Food and Agriculture Organization of the United Nations (FAO), World Meteorological Organization (WMO), United Nations University (UNU), International Council for Science (ICSU), World Federation of

Engineering Organizations (WFEO), International Union of Geological Sciences (IUGS), International Union of Geodesy and Geophysics (IUGG), and other stakeholders (Sassa 2015). The Fourth World Landslide Forum is one of major activities of the ISDR-ICL Sendai Partnerships 2015–2025 as a voluntary contribution to the Sendai Framework for the Disaster Risk Reduction 2015–2030. The world forum aims at strengthening the cooperation of a wide network of stakeholders involved in landslide research and landslide risk reduction.

#### Organizers, organizing committee, and sponsors

The WLF4 was organized under the honorary patronage of the President of the Republic of Slovenia H.E. Borut Pahor.

*Organizers* International Consortium on Landslides (ICL), Global Promotion Committee of the International Programme on Landslides (IPL), University of Ljubljana (UL), and Geological Survey of Slovenia (GeoZS).

*Co-organizers* Ministry of Defence of the Republic of Slovenia (MORS), Ministry of the Environment and Spatial Planning of the Republic of Slovenia (MOP RS), Ministry of Infrastructure of the Republic of Slovenia (MI RS), Administration of the Republic of Slovenia for Civil Protection and Disaster Relief (URSZR), Slovenian Chamber of Engineers (IZS), International Association of Hydrogeologists Slovene Committee (SKIAH), Water Management Society of Slovenia (DVS), Geomorphological Association of Slovenia (GDS), Institute for Water of the Republic of Slovenia (IzVRS), Slovenian Geological Society (SGD), Slovenian Geotechnical Society (SloGeD), Slovenian National Committee for IHP (SNC IHP), Slovenian Association of Geodesy and Geophysics (SZGG).

*ICL supporters* United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Office for Disaster Risk Reduction (UNISDR), Food and Agriculture Organization of the United Nations (FAO), World Meteorological Organization (WMO), United Nations University (UNU), International Council for Science (ICSU), World Federation of Engineering Organizations (WFEO), International Union of Geological Sciences (IUGS), International Union for Geodesy and Geophysics (IUGG).

*Honorary chairpersons* Borut Pahor (President of the Republic of Slovenia), Irina Bokova (Director General of UNESCO), Robert Glasser (Special Representative of the United Nations Secretary-General for Disaster Risk Reduction), José Graziano Da Silva (Director-General of FAO), Petteri Talaas (Secretary-General of WMO), David Malone (Rector of UNU), Gordon McBean (President of ICSU), Toshimitsu Komatsu (Vice President of WFEO), Roland Oberhaensli (Past President of IUGS), Alik Ismail-Zadeh (Secretary-General of IUGG), Hisayoshi Kato (Director General for Disaster Management, Cabinet Office, Government of Japan), Kanji

Matsumuro (Director, Office for Disaster Reduction Research, Ministry of Education, Culture, Sports, Science and Technology, Government of Japan), Fabrizio Curcio (Head, National Civil Protection Department, Italian Presidency of the Council of Ministers, Government of Italy), Jadran Perinić (Director General, National Protection and Research Directorate, Republic of Croatia), Takashi Onishi (President of Science Council of Japan), Juichi Yamagiwa (President of Kyoto University), Ivan Svetlik (Rector of University of Ljubljana, Slovenia), Walter Ammann (President/CEO, Global Risk Forum Davos).

**Chairpersons** Matjaž Mikoš (Chairman, Slovenian National Platform for Disaster Risk Reduction), Yueping Yin (President, International Consortium on Landslides), Kyoji Sassa (Executive Director, International Consortium on Landslides).

**International scientific committee** It was composed of 126 members including the ICL members and internationally recognized scientist in the field of landslide research and landslide risk reduction.

**Local organizing committee** It was composed of 28 members including the ICL members in the Adriatic-Balkan Region, i.e., from Slovenia, Bosnia and Herzegovina, Croatia, and Italy.

**WLF4 silver sponsors** TRUMER Schutzbauten GmbH

**WLF4 bronze sponsors** Geobrugg AG, NHAZCA, Maccaferri, TRE ALTAMIRA

**WLF4 sponsor** Nikon CEE GmbH

## Report of the Fourth World Landslide Forum

### General information

The WLF4 motto was “Landslide Research and Risk Reduction for Advancing Culture of Living with Natural Hazards.”

Six hundred and eight participants, including VIPs, 19 exhibitors, 46 side event participants, and 22 accompanying persons and members of the local organizing committee, from 49 countries, 6 international organizations, and 5 UN organizations, attended the WLF4 that was held in Cankarjev dom—Cultural and Congress Centre in Ljubljana, Slovenia, on 29 May–2 June 2017. Further details on the WLF4 participants are given in Table 1.

The main themes of the WLF4 were

- The Sendai Partnerships 2015–2025 as a contribution of the ICL to the 2015–2030 Sendai framework for disaster risk reduction, stressing the society’s attitude to landslides,
- Advances in landslide science,
- Advances in landslide technology,
- Diversity of landslide forms,
- Landslides in different environments.

The international scientific committee reviewed almost 600 extended abstracts on the previous topics and accepted close to 400 full papers. They were published by Springer Nature publishing house in a set of five volumes with the title Advancing Culture of Living with

Landslides, totaling 3668 pages (see Table 2). The WLF4 Volume 1: ISDR-ICL Sendai Partnerships 2015–2025 deals with the activities of the ICL within the Sendai partnerships 2015–2025 and is an open access book.

### Forum plenary work

The opening ceremony in Cankarjev dom on 30 May 2017, started by Forum opening addresses, given by Yueping Yin, President of ICL; Qunli Han, UNESCO DG Representative; H.E. Keiji Fukuda, Ambassador of Japan to Slovenia; and Matjaž Mikoš, WLF4 Forum Chair.

After a short cultural program that accompanied the opening addresses, the following four invited WLF4 plenary lectures on understanding and reducing landslide risks were presented:

- “Rupestrian world heritage sites: Instability investigation and sustainable mitigation”—Claudio Margottini, Italy (coordinator of the very successful ICL thematic network of cultural heritage)
- “Rock fall occurrence and fragmentation”—Jordi Corominas, Spain (2016 Varnes Medal recipient)
- “Glacial lake outburst floods”—Vít Vilímek, Czech Republic (editor of the 2016 thematic issue in the journal *Landslides*)
- “Landslides and Society”—Irasema Alcántara-Ayala, Mexico (convener of the WLF4 Session 1–3 “Landslides and Society”)

In the afternoon of 30 May 2017, the WLF4 in its plenary session held a high-level panel discussion entitled “strengthening inter-governmental network and the International Programme on Landslides (IPL) for “ISDR-ICL Sendai Partnerships 2015–2025 for global promotion of understanding and reducing landslide disaster risk””. The high-level panel discussion was followed by the roundtable discussion on 31 May 2017, when the “2017 Ljubljana Declaration on Landslide Risk Reduction” was adopted by the WLF4 participants, as well as the outline of the concept of the “Kyoto 2020 Commitment for global promotion of understanding and reducing landslide disaster risk.” For details on these two important documents, see Sassa (2017b).

Videos and photos of much of the WLF4 plenary work, especially from the WLF4 opening day such as all Opening addresses, four WLF4 Plenary lectures, High-Level Panel Discussion including the Post-Forum Study Tour is freely available on the web (<https://www.wlf4.org/wlf4-week/>).

### Recognition of ICL and IPL activities in the period 2014–2017

On the WLF4 opening day on 30 May 2017, the ICL awarded several written recognitions for excellent achievements after the last World Landslide Forum in Beijing in 2014:

- The title of World Centre of Excellence on Landslide Risk Reduction for 2017–2020 (<http://iplhq.org/category/iplhq/world-centre-of-excellence-wcoe/>) to 20 new organizations (Table 3, Fig. 1).
- The Varnes Medal for professional excellence in landslide research (<http://iplhq.org/category/iplhq/award-and-honors/varnes-medal/>)
- Best Paper Award, given annually for the best paper published in *Landslides* journal (<http://iplhq.org/category/iplhq/award-and-honors/best-paper-award/>)

**Table 1** The list of total 608 registered WLF4 participants, including 22 accompanying persons (number in brackets), 19 exhibitors, and 46 side event participants

No.	Country	Participants	Percentage	No.	Country	Participants	Percentage
1.	Albania	2	0.33%	32.	Norway	6	0.99%
2.	Algeria	1	0.16%	33.	Poland	7	1.15%
3.	Argentina	2	0.33%	34.	Portugal	3	0.49%
4.	Australia	5 (2)	0.82%	35.	Romania	1	0.16%
5.	Austria	39	6.41%	36.	Russian Federation	9 (2)	1.48%
6.	Belgium	9	1.48%	37.	Saudi Arabia	2	0.33%
7.	Bosnia and Hercegovina	1	0.16%	38.	Serbia	6	0.99%
8.	Brazil	1	0.16%	39.	Slovakia	9	1.48%
9.	Bulgaria	3	0.49%	40.	Slovenia	103	16.49%
10.	Canada	8 (1)	1.32%	41.	Spain	16 (1)	2.63%
11.	People's Republic of China	42 (2)	6.91%	42.	Sri Lanka	2	0.33%
12.	Chinese Taipei	17 (1)	2.80%	43.	Switzerland	13	2.14%
13.	Colombia	3	0.49%	44.	Thailand	4	0.66%
14.	Croatia	13 (1)	2.14%	45.	Turkey	4	0.66%
15.	Czech Republic	15	2.47%	46.	Ukraine	4 (1)	0.66%
16.	France	7	1.15%	47.	UK	12	1.97%
17.	Germany	15	2.47%	48.	USA	7 (1)	1.15%
18.	Ghana	1	0.16%	49.	Vietnam	7	1.15%
19.	Hungary	1	0.16%		International organizations		
20.	India	12 (1)	1.97%		EuroGeoSurveys	1	0.16%
21.	Indonesia	7	1.15%		EU JRC	2	0.33%
22.	Italy	110 (2)	18.09%		ICL/IPL	2	0.33%
23.	Japan	35 (5)	5.76%		ICSU	1	0.16%
24.	Korea, Republic of	10	1.64%		IUGG	1	0.16%
25.	Kyrgyzstan	3	0.49%		IUGS	1	0.16%
26.	Lithuania	1	0.16%		UN organizations		
27.	Macedonia, Republic of	1	0.16%		FAO	2	0.33%
28.	Malaysia	1	0.16%		IRDR	1	0.16%
29.	Mexico	2	0.33%		UNESCO	3	0.49%
30.	Nepal	5 (1)	0.82%		UNU	1	0.16%
31.	New Zealand	6 (1)	0.99%		WMO	1	0.16%
					<i>Total</i>	<i>608</i>	<i>100.00%</i>

- Best IPL Project Award for the past 3 years (<http://iplhq.org/category/iplhq/award-and-honors/ipl-award-for-success/>)
- Best Reporter Award for the reports in the ICL World Report on Landslides database (<http://iplhq.org/ls-world-report-on-landslide/>)

The 2015 Varnes Medalist is late Professor Oldrich Hungr of Canada (Fig. 2). He, in his response, said “I am grateful to the International Consortium on Landslides for giving me the Varnes Medal. It is a rare honour. For me, it is personally very gratifying, because I have long admired David Varnes’ work and because I

believe that, the typological divisions needed for a classification provide a very important step towards understanding physical processes in landslides. Such understanding is essential, if we are to have any success in correctly analyzing landslides and designing appropriate mitigation measures.”

The 2016 Varnes Medalist is Jordi Corominas of Spain (Fig. 3). He, in his response, said “I want to thank Dr. Yueping Yin and the Board of Representatives of the International Consortium on Landslides for proposing my person and my work as recipient of the Varnes medal. I feel deeply moved and greatly honored for it. Particularly, when I look at the names of researchers that preceded me in this award. To see my name linked to the people from whom I learned and that have

**Table 2** The list of WLF4 books published by Springer Nature

No.	Volume title	Volume content	Editors	Associate Editors	Nr. of chapters	Nr. of pages	Reference
1.	Advancing Culture of Living with Landslides, Volume 1: ISDR-ICL Sendai Partnerships 2015–2025	Provides information about the ISDR-ICL Sendai Partnerships. Committed to the Sendai Framework for Disaster Risk Reduction 2015–2030. Leading papers from the Fourth World Landslides Forum.	Kyoji Sassa Matjaž Mikoš Yueping Yin	Mauri McSaveney Eileen McSaveney Khang Dang	51	XXVI+586 p.	Sassa et al. (2017)
2.	Advancing Culture of Living with Landslides, Volume 2: Advances in Landslide Science	Landslide field recognition and identification: remote sensing techniques, field techniques. Landslide investigation: field investigations, laboratory testing. Landslide modeling: landslide mechanics, simulation models. Landslide hazard risk assessment and prediction: landslide inventories and susceptibility, hazard mapping methods, damage potential.	Matjaž Mikoš Binod Tiwari Yueping Yin Kyoji Sassa	Mateja Jemer Aulfič Adrin Tohari Basanta Raj Adhikari Beena Almera Soježana Mihalič Arbanas	133	XXVII+1197 p.	Mikoš et al. (2017a)
3.	Advancing Culture of Living with Landslides, Volume 3: Advances in Landslide Technology	Landslide monitoring and warning: monitoring techniques and technologies, Early warning systems. Landslide disasters and relief: case studies, emergency measures, first aid, civil protection measures. Landslide mitigation, remediation and stabilization: landslide protection works, landslide stabilization and remediation measures, landslide non-structural measures.	Matjaž Mikoš Željko Arbanas Yueping Yin Kyoji Sassa	Veronica Tořani Janjo Logar Teuku Faisal Fathani Sabatino Cuomo	70	XXIV+621 p.	Mikoš et al. (2017b)
4.	Advancing Culture of Living with Landslides, Volume 4: Diversity of Landslide Forms	Global coverage of different landslide forms. Earthquake and rainfall-induced landslides. Rapid landslides, landslides in rocks, and complex landslides. Landslides and other natural hazards.	Matjaž Mikoš Nicola Casagli Yueping Yin Kyoji Sassa	Kazuo Konagai Giovanni Battista Crosta Hiroshi Fukuoka Peter Bobrowsky	79	XXI+707 p.	Mikoš et al. (2017c)
5.	Advancing Culture of Living with Landslides, Volume 5: Landslides in Different Environments	Landslide interactions with the built environment. Landslides in natural environment. Landslides and water. Landslides as environmental change proxies: looking at the past. Student papers.	Matjaž Mikoš Vit Vilimek Yueping Yin Kyoji Sassa	Mike G. Winter Patrick Wassmer Jan Klimeš Tomáš Pánek	63	XXI+557 p.	Mikoš et al. (2017d)

Volume 2 was published in the printed version as a set of two books (sold together) and in the electronic version as one e-book

**Table 3** The list of WCoEs for the period 2017–2020

No.	WCoE title	Leader	Country	Organizations
1.	Landslide Monitoring and Critical Infrastructure.	Peter Bobrowsky	Canada	Geological Survey of Canada
2.	Scientific research for mitigation, preparedness and risk assessment of Landslides.	Yueping Yin	China	China Geological Survey
3.	Formation mechanism research, disaster warning, and universal education of landslides in permafrost regions.	Wei Shan	China	Institute of Cold Regions Science and Engineering, Northeast Forestry University
4.	Landslide Risk Reduction in the Adriatic-Balkan Region through the Regional Cooperation, Croatian Landslides Group.	Snježana Mihalić Arbanas Željko Arbanas	Croatia	Croatian Landslide Group from University of Zagreb and University of Rijeka
5.	Landslide risk assessment and development guidelines for effective risk reduction—continuation.	Vit Vilimek	Czech Republic	Charles University, Faculty of Science & Institute of Rock Structure and Mechanics Czech Academy of Sciences
6.	Enhancement of the existing Real-time Landslide Monitoring and Early warning System in Western Ghats & Himalayas, India.	Maneasha V Ramesh	India	Amrita University
7.	Development of Community-based and Most Adaptive Technology for Landslide Risk Reduction.	Dwikorita Kamawati	Indonesia	University of Gadjah Mada
8.	ATLAS: Advanced Technologies for Landslides.	Nicola Casagli	Italy	Department of Earth Sciences, University of Firenze (DST-UNIFI)
9.	Methods and tools for landslide forecasting and risk mitigation and adaptation strategies.	Fausto Guzzetti	Italy	Istituto di Ricerca per la Protezione Idrogeologica (IRPI), of the Italian National Research Council (CNR)
10.	Landslide Hazards Mitigation Programs in the Korean Demilitarized Zone.	Sangjun Im	Korea	Korean Society of Forest Engineering
11.	Landslide Quantitative Risk Analysis Study for Malaysia.	Che Hassandi Abdullah	Malaysia	Slope Engineering Branch, Public Works Department of Malaysia
12.	Landslides Integrated Research for Disaster Risk Reduction.	Irasema Alcántara Ayala	Mexico	National Autonomous University of Mexico (UNAM)
13.	Characterizing past and planned activities: Klima 2050—Innovational methods for risk reduction associated to hydro-meteorologically induced landslides.	José Cepeda	Norway	Norwegian Geotechnical Institute (NGI)
14.	Central Asia rockslide inventory. Compilation and analysis.	Alexander Strom	Russia	JSC “Hydroproject Institute”
15.	Harmonization of Landslide Data and Local Communities Capacity Building for Landslide Risk Reduction.	Bijana Abolmasov	Serbia	University of Belgrade, Faculty of Mining and Geology
16.	Landslides in Weathered Flysch: from activation to deposition.	Ana Petkovšek	Slovenia	University of Ljubljana, Faculty of Civil and Geodetic Engineering (ULFGG)
17.	Landslide risk reduction in Slovenia.	Mateja Jemec Auflič	Slovenia	Geological Survey of Slovenia
18.	Model Policy Frameworks, Standards, and Guidelines on Landslide Disaster Risk Reduction.	A A Virajih Dias	Sri Lanka	Central Engineering Consultancy Bureau (CECB)
19.	Characterizing past and planned activities: NBRO is the national focal point for landslide disaster risk management.	Asiri Karunawardena	Sri Lanka	National Building Research Organization
20.	Implementation of National Slope Master Plan.	Oleksander Trofymchuk	Ukraine	The Institute of Telecommunication and Global Information Space (ITIGS) of the National Academy of Science of Ukraine (NASU)

For more details on the WCoE and their applications forms, see <http://iplhq.org/category/iplhq/world-centre-of-excellence-wcoe/>





**Fig. 1** Twenty organizations were awarded the title of World Centre of Excellence in Landslide Disaster Reduction 2017–2020 (source: [www.wlf4.org/wlf4-week](http://www.wlf4.org/wlf4-week), 2017)

been a reference for my work, is a true honor. I take this opportunity to state that this award really goes to a team. A team composed of colleagues and PhD students to whom I am deeply grateful for their ideas and hard work. I would also like to express my gratitude to my family, particularly to my wife. I want to thank her for her support and for her understanding when I have stolen the time that I should have shared with them. I feel myself fortunate. First, for choosing Geology as my profession. I did it to be in touch with nature, to observe it and to protect it. I was first attracted by environmental issues such as groundwater pollution, waste disposal and management of natural resources, which were hot topics in my country in the late 70s of last century. However, something unexpected happened. My eyes for the landslides were opened in 1982, when heavy rains struck the Pyrenees and thousands of slope failures occurred. I thought that these type of events should be prevented and that something had to be done. I can say without reservation that the

decision to work on landslides was one of the best decisions I could ever make. At this time, I had very limited knowledge on how to predict their location and occurrence. Despite this limitation, we began to prepare what we optimistically called landslide hazard and risk maps for the regional administration, which were heuristic and based on geomorphological reconnaissance. Soon the uncertainties and challenges appeared and our research was fueled by our ignorance. Looking back, I am impressed by the improvement of the knowledge on the landslide mechanisms, models and tools. In that respect, I realize how important has been working with colleagues particularly from Europe, through the EU-funded research projects and summer schools. This allowed sharing the knowledge, building fruitful networks between research institutes, and the exchange of students and of young researchers. As a result, strong synergies have been generated and the level of our students and professionals have significantly improved. Although research on landslides is not in



**Fig. 2** Varnes medalist late Professor Oldrich Hungr (left) receiving the Varnes medal for 2015 from Dr. Yueping Yin, the ICL President (right) (source: [www.wlf4.org/wlf4-week](http://www.wlf4.org/wlf4-week), 2017)



**Fig. 3** Varnes medalist Professor Jordi Corominas (left) receiving the Varnes medal for 2016 from Dr. Yueping Yin, the ICL President (right) (source: [www.wlf4.org/wlf4-week](http://www.wlf4.org/wlf4-week), 2017)

fashion anymore, I hope that this collaboration will continue the future and expand through other latitudes. Finally, I would like to thank the ICL and especially professor Sassa for making things happen. I remember when we met in Rio de Janeiro in 2004 before the launch of Landslides journal. He was requesting opinions for a new Journal. I asked him that academia needed a journal of high-quality and high-impact factor to encourage researchers to contribute with papers. Twelve years later, Landslides has an impact factor over 3.049 and is positioned as the first journal in the field of Geological Engineering. I am happy to have a forum like the Landslides journal and I congratulate him for such a success. Thank you very much indeed for your attention.”

The 2017 Varnes Medalist is Badaoui Rouhban of France (Fig. 4). He, in his response, said “I am deeply honoured by the distinction this award bestows upon me. Thank you all. I dedicate this medal to the community of the International Consortium of Landslides which itself deserves all distinctions. In my three decades of international career, it has been a particularly great honour and privilege for me to accompany, since its very birth in 2002, the ICL and its remarkable growth. I would also like to dedicate this award to a champion, the champion of champions, the founder and “father” of ICL, Professor Kyoji Sassa.”

#### Technical sessions including student session

On the three working days from 31 May to 2 June 2017, the WLF4 was conducted up to six parallel technical sessions; members of the WLF4 International Scientific Committee and the Local Organizing Committee chaired altogether 60 technical sessions. Each registered WLF4 participant was asked to present his/her accepted and published full paper orally in a technical session. Some of them selected rather to present their scientific results as a poster. Therefore, a separate poster exhibition was organized close to the exhibition area and at the lunch and coffee break area that attracted 36 posters. A WLF4 poster template was offered, and all 36 accepted posters together with its abstract were published as a pdf file in the WLF4 Local Proceedings with Programme (Mikoš and Bezak 2017; pp. 197–242). Furthermore, a stand-alone student session was organized as a separate technical session.

Student landslide researchers are the key of sustainable development of landslide science and community. The WLF4 was another

opportunity for them to develop international collaborative networks. Students were encouraged to present their landslide research in the form of a regular WLF4 Forum paper in the WLF Student Session. The first author had to be a (post)graduate student and the paper had to be presented orally by the student her/himself. Moreover, the number of each paper’s co-authors was limited to three (i.e., since the student is the first author, up to four authors were accepted). The 17 submitted and eligible students’ papers were reviewed as standard technical papers for WLF4 and additionally evaluated by a panel of eight university professors, being active in the field of landslide research, and lead by Professor Giovanni B. Crosta (Bicocca University, Milan, Italy). The following elements were considered while evaluating the student papers: organization and logic, clarity of text and figures, conclusions justified by the results, significance and originality, and selected diversity issues (gender, geographic location, and research topic).

The ICL President Mr. Yueping Yin presented the WLF4 Best Paper Award to the two selected WLF4 Best Student Paper Award recipients during the WLF4 Closing Plenary Session held on 2 June 2017:

- Mrs. T. Hemalatha from India (Amrita University, Kollam) for the paper “Adaptive Learning Techniques for Landslide Forecasting and the Validation in a Real World Deployment”, co-authored by Prof. Maneesha V. Ramesh and Dr. Venkat P Rangan—in the category of developing countries, and
- Mr. A. Schimmel from Austria (University of Applied Life Sciences—BOKU, Vienna) for the paper “Automatic detection of sediment-related disasters based on seismic and infrasound signals”, co-authored by Prof. Johannes Hübl—in the category of developed countries.

All student papers were published in the WLF4 book vol. 5 (Mikoš et al. 2017d).

#### WLF4 Landslide Photo Contest “Landslides and Mankind”

The WLF4 Landslide Photo Contest was a photographic event and was opened to all WLF4 registered participants. The objective of the photo contest was to inform and show the variety of landslide forms and their consequences and interaction with human activities, infrastructure, and landscape around the world.

Any photo showing the variety of landslide forms and their interaction with human activities, infrastructure, and landscape was invited for submission to the WLF4 Landslide Photo Contest.

Each photo was supported by a short explanation, describing the landslide on the photo and giving its location, causes/triggering factors, and consequences. Each WLF4 active participants could submit only one photo per category. The contest categories were as follows:

- Category 1. Landslides from above (aerial photos).
- Category 2. Impacts of Landslides on infrastructure of any art.
- Category 3. Landslides and Mankind (human causes, social impacts of landslides).

The four-member jury finally accepted all submitted photos that satisfied the WLF4 Photo Contest technical and ethical rules:



**Fig. 4** Varnes medalist Dr. Badaoui Rouhban (left) receiving the Varnes medal for 2017 from Dr. Yueping Yin, the ICL President (right) (source: [www.wlf4.org/wlf4-week](http://www.wlf4.org/wlf4-week), 2017)



16 photos in the category “Landslides from above,” 25 photos in the category “Impacts of Landslides on infrastructure of any art,” and 19 photos in the category “Landslides and Mankind.” All photos were presented in the WLF4 Local Proceedings (Mikoš and Bezak 2017; pp. 180–196) together with their short descriptions. All photos were printed in the format 70 × 50 cm and exhibited during the WLF4 in WLF4 Photo Exhibition. All registered participants had right to vote for one photo in each category. For the final selection of the best three exhibited photos in each category, the jury received 153 votes. The result was announced during the WLF4 Forum Closing Ceremony on 2 June 2017, and the authors of the best three photos in each category of the WLF4 Photo Contest received award from the WLF4 sponsor Nikon CEE GmbH, Vienna.

#### Category 1: Landslides from above (aerial photos)

In this photo category, the first two places went to two photos from Kyrgyzstan (Figs. 5 and 6), a country heavily affected by frequent landslide activities. Most of them occur as rotational and translational slides in weakly consolidated Quaternary and Tertiary sediments, whereas large events of more than 1 million m<sup>3</sup> frequently occur. Because of the limited living place in the Kyrgyz mountain ranges, landslides cause fatalities and severe economic losses every year. The awarded photos were taken by a quadcopter during a joint field campaign in October 2016 of the GFZ German Research Centre for Geosciences, the Kyrgyz Ministry of Emergency Situations, and the Central Asian Institute for Applied Geosciences. The authors studied geomorphological features of landslides of different types and ages, which were identified in advance by an automated approach using satellite time series imagery. The objective of combining ground-based measurements, satellite-, and UAV-based remote sensing is to establish a multi-scale landslide monitoring system for this region.

*First place—Sokutash Loess landslide 2016, Kyrgyzstan (UAV footage)—by Sigrid Roessner (GFZ German Research Centre Potsdam, Germany) – Fig. 5* The photo shows a rapid Loess landslide



**Fig. 5** First place—Sokutash Loess landslide 2016, Kyrgyzstan (UAV footage)—by Sigrid Roessner (GFZ German Research Centre Potsdam, Germany)



**Fig. 6** Second place—Landslide range in golden sunlight of Kyrgyz—by Robert Behling (GFZ German Research Centre Potsdam, Germany)

occurred on 27 April 2016 in two phases; a smaller failure of 0.1 km<sup>3</sup> and a larger failure of 1.6 km<sup>3</sup> displaced material. It killed a 14-year-old boy and destroyed several buildings. The length is approximately 1000 m and the width up to 350 m. The perspective view of the photo nicely shows fan-like shape of the landslide toe and that the landslide mass traveled up the slope as it was going around the bends in the valley, which are both strong indications of high travel velocities.

A video that captured this failure (<http://blogs.agu.org/landslideblog/2016/05/01/landslide-loess-kyrgyzstan/>) confirms this fluid-like behavior of the landslide mass.

*Second place—Landslide range in golden sunlight of Kyrgyz—by Robert Behling (GFZ German Research Centre Potsdam, Germany) – Fig. 6* The UAV photo shows an approx. 5 km long range of a northwestern facing slope of frequent Loess landslide occurrence. The main landslides occurred in 1994, whereas several reactivations occurred ever since. In 2016, the mass of a recent



**Fig. 7** Third place—Aerial view of the 3.6 km long Capriglio Landslide—by William Frodella (Earth Science Department, University of Florence, Italy)





**Fig. 8** First place — Rails dragged away by debris flow—by Martin Mergili (BOKU University, Vienna, Austria)

large failure stopped literally only a few meters away from the city of Komsomol (located right of the photo). The runout length of several landslides exceeds more than 1000 m and the width is a few hundred meters. The inclination of the slope is moderate with approx. 15 to 20° at the landslide source areas.

*Third place—Aerial view of the 3.6 km long Capriglio Landslide—by William Frodella (Earth Science Department, University of Florence, Italy) – Fig. 7* The Capriglio landslide (Northern Apennines, Emilia Romagna Region, Italy), activated on 6 April 2013. Two main adjacent enlarging bodies with a roto-translational kinematics constitute the landslide, triggered by prolonged rainfall and snowmelt. They activated in sequence and subsequently joined into a large earth flow, channelizing downstream of the Bardea Creek riverbed, for a total length of about 3600 m. In the crown area, the landslide completely destroyed a 450-m sector of provincial roadway S.P. 101, and its retrogression exposed to high risk the villages of Capriglio and Pianestolla, located in the upper



**Fig. 9** Second place—Impact of the Monte Beni rockslide on both the regional roadway SR 65 and the quarrying activity—by William Frodella (Department of Earth Sciences, University of Florence, Italy)



**Fig. 10** Third place—Disruption of a fast connection road in the Montescaglioso landslide—by Stefano Morelli (Department of Earth Sciences, University of Florence, Italy)

watershed area of the Bardea Creek. Furthermore, the fast moving landslide toe seriously threatened the Antria bridge, representing the “Massese” provincial roadway S.P. 665R transect over the Bardea Creek, the only strategic roadway left able to connect the above-mentioned villages. In the framework of the emergency management activities, aerial surveys were carried out on 5 May 2013, in order to map the area covered by the earth flow.

Category 2: Impacts of Landslides on infrastructure of any art

*First place—Rails dragged away by debris flow—by Martin Mergili (BOKU University, Vienna, Austria) – Fig. 8* A massive debris flow related to a localized heavy rainfall event has destroyed a former railway bridge near Tigre Dormido in the Mendoza Valley, Argentina, and dragged away the rails nearby. The photo was taken a few days after the event in February 2016.

*Second place—Impact of the Monte Beni rockslide on both the regional roadway SR 65 and the quarrying activity—by William Frodella (Department of Earth Sciences, University of Florence, Italy) – Fig. 9* Mt. Beni (1259 m a.s.l.) is located in the Municipality of Firenzuola, in the Province of Florence, close to the Regional Road n. 65, an important linear infrastructure connecting the regions of Tuscany and Emilia Romagna along the Apennine mountainous area. The eastern slope of Mt. Beni, where jointed basalts and ophiolitic breccias overlie Mesozoic limestones, had been the object of quarrying activity from the 1940s to the 1980s, when the quarry was closed for safety reasons due to evidence of occurring potentially catastrophic instability phenomena. Based on the risk scenarios, a barrier was designed, in order to protect the Regional Road from rockfalls; furthermore, a monitoring survey was implemented in order to stop the roadway traffic and to order the evacuation of the houses threatened by the landslide. On 28 December 2002, a rock topple–rockslide took place, involving a total volume of about 500,000 m<sup>3</sup>. Fortunately, no injured or fatalities occurred and minor structural damages were reported (Two quarrying excavators were destroyed.). The aerial picture,



**Fig. 11** First place—Autumn in the landslide—by Marco Mulas (Università di Modena e Reggio Emilia, Italy)

acquired on 13 April 2013, shows a remarkable example of impact of landslide on human activities.

*Third place—Disruption of a fast connection road in the Montescaglioso landslide—by Stefano Morelli (Department of Earth Sciences, University of Florence, Italy) – Fig. 10* On 3 December 2013, the SW facing slope of Montescaglioso village (Italy) was affected by a rapid roto-translational landslide (0.75 m/min) after some days of persistent rainfall. From the afternoon of 30 November to the late evening of 2 December, the cumulative rainfall was of about 155 mm, which is the 30% of the average annual quantity. Such concentrated precipitation, immediately before the event, further contributed to increase the soil saturation, which was induced by significant rainfall occurred during the month of October and November, producing a high critical state. The landslide began to move at 13:00 in a sector characterized by a shallow piezometric surface and known in the past for numerous water springs. The movement (lasted 20 only minutes) immediately involved a strategic fast connection road, progressively moved southeast, and then affected the northwestern part of the slope. The landslide has a total length of about 1200 m, a width of about 880 m, and covers an area of about 0.4 km<sup>2</sup>. This event resulted in a series of trenches (up to 2–3 m wide), scarps, and counterscarps, tens of meters in length and with height up to 8–10 m. In the upper sectors of the landslide, graben-type features were also present. The landslide movement determined the

complete alteration of the natural drainage of the surface water, the disruption of the whole road network, and the damage of some private buildings, of commercial and artisan activities.

Category 3: Landslides and Mankind (human causes, social impacts of landslides)

*First place—Autumn in the landslide—by Marco Mulas (Università di Modena e Reggio Emilia, Italy) – Fig. 11* The Corvara landslide is a complex phenomenon located in the Dolomites area (Bolzano Province, Italy). During fall 2014, the landslide experienced a re-activation with planimetric displacements up to 20 m in 45 days. This picture was taken at the crown of one source area, where the retrogression of the landslide involved in the movement a mountain hut.

*Second place—“Pirrere” quarries and unstable sea cliff in Cala Rossa bay (Favignana Island, Italy)—by Roberto Iannucci (“Sapienza” Università di Roma, Italy) – Fig. 12* In Favignana Island (Sicily, Italy), a mining activity was actuated since the Roman Age and until the last century, significantly changing the morphology of the eastern part of the island. In fact, this mining activity produced an extensive network of open air quarries, underground quarries and tunnels, locally named “Pirrere,” that are hosted into Pleistocene porous carbonate grainstones. Currently the landscape shows sea cliffs greatly modified by these abandoned quarries and affected by diffused gravity-induced instabilities. In Cala Rossa



**Fig. 12** Second place—“Pirrere” quarries and unstable sea cliff in Cala Rossa bay (Favignana Island, Italy)—by Roberto Iannucci (“Sapienza” Università di Roma, Italy)



**Fig. 13** Third place—Rock landslide in Gambatesa mine gallery, northern Italy—by Matteo Del Soldato (University of Florence, Italy)



bay, the landslide process is led by a lateral spreading phenomenon due to the presence of a Pliocene clay under the Pleistocene calcarenites: the horizontal deformations affecting the clayey materials induce cracks in the overlying stiff rock, favoring the detachment of single rock blocks by typical rock landslide mechanisms (i.e., planar sliding, wedge sliding, toppling, and falling).

*Third place—Rock landslide in Gambatesa mine gallery, northern Italy—by Matteo Del Soldato (University of Florence, Italy) – Fig. 13* The landslide is located into the fifth level, at 595 m above sea level, of the Gambatesa Mine in the hinterland of Genoa, western Liguria (northern Italy). In this mine was exploited the Manganese ore until 2011, found into the Jurassic Cherts of the Ligurian Ophiolitic Sequence since the end of the nineteenth century. The mine was originally set up as open pit, but subsequently, galleries were excavated realizing until 25 km of tunnels. They were divided in seven overlapping levels interconnected to each other by means of inclined galleries for the passage of air, material, or miners. The gallery landslide-involved in the mass movement, completely excavated into cherts, conducts to the bigger mining cavities in gallery of Europe, with approximate dimension of 220 m in length, 50 m in width, and 40 m in height. This was created exploiting the largest mineralized lens, so-called Lente Nord (north lense), intercepted by various levels, providing several thousand tons of manganese ore. The cause could be ascribed to the creation of several important empty spaces, also to connect the upper and lower levels very close together. An important fracture parallel to the left side of the gallery is visible with a prosecution involving the floor of the gallery. Another important separation is recognizable in the right side with a comparable displacement. These cracks allow supposing that along the rupture surfaces the available shear strength of the rock was probably overcoming due to the drastic excavation in adjacent tunnels.

#### Open sessions

During lunchtime on the three working days, open sessions were offered to the registered WLF4 participants:

- Resilience of communities exposed to landslide risk (COST Action Initiative “LandAWARE—Landslide early warning systems as tools for community resilience”). Organizer: Michele Calvello (University of Salerno, Italy) and Jan Klimeš (Czech Academy of Sciences, Czech Republic).
- Strengthening resilience of rural communities exposed to landslides and other natural hazards. Organizer: Muratbek Koshoev (Environment Resources Officer, FAO).
- Landslide risk management, an integrated approach in time. Organizer: Mitja Brilly (University of Ljubljana, Slovenia) and Roberto Ranzi (University of Brescia, Italy).

#### Side events

During the WLF4, a few side events were organized:

- The Italian Chapter AGI-IGS of the International Geosynthetics Society (IGS) run a 1-day workshop “Geosynthetics for slope stabilization” on 1 June 2017 for all interested experts and also

for the IGS members attending the WLF4. Organizers: Daniele Cazzuffi (IGS Past President, CESI SpA, Milano, Italy) and Sabatino Cuomo (University of Salerno, Italy).

- The Ministry of the Environment and Spatial Planning of the Republic of Slovenia run a 1-day workshop (in Slovenian language only) “Management of Large Natural Disasters in Slovenia,” offered to the administration staff of local communities in Slovenia in charge for remediation of natural disasters.
- A meeting of the Organizing Committee of WLF5 in Kyoto 2020. This important event is well under way; for details, please, see Sassa (2017a, c).

#### WLF4 post-forum study tour “Variety of Landslide Forms in Slovenia”

The WLF4 organizers have initially offered three post-forum study tours:

- A 3-day study tour “Variety of Landslide Forms in Slovenia”
- A 4-day study tour “Landslides and World Heritages in Croatia and Bosnia and Herzegovina”
- A 4-day study tour “Outstanding and highly hazardous landslides in the Dolomites—UNESCO World Heritage Site”

Due to the lack of interest (reaching the set minimum number of participants), only the first study tour with 34 participants (28 participants from abroad and 6 organizers from Slovenia, Italy, and Austria) was organized from 3 to 5 June 2017. On the first day of the field visit, 28 students of the 2nd Summer School on Natural disasters, organized by the University of Ljubljana ([www.let-group.com/summerschool.html](http://www.let-group.com/summerschool.html)), also joined the field visit.

The 3-day study tour brought the participants to the Western Slovenia, the Canal Valley in NE Italy, the Gailtal Valley in Austria, and the Upper Sava Valley in NW Slovenia. The post-forum study tour was entitled “Living with slope mass movements in Slovenia and its surroundings.” A special study tour guidebook was prepared for all participants (Jemec Auflič et al. 2017a). A shortened version of the guidebook was already published in the August 2017 issue of the journal *Landslides* under the section *ICL/IPL Activities* (Jemec Auflič et al. 2017b). The post-forum study tour to Croatia and Bosnia and Herzegovina was not carried out. However, the scientific details of the site are presented in a review paper by Mihalić Arbanas et al. (2017).

The participants expressed their highly positive impression about this study tour. Post-forum study tours can be evaluated as a very meaningful and important side event to the World Landslide Forums.

#### Conclusions

More information on the Fourth World Landslide Forum is still available on the WLF4 webpage [www.wlf4.org](http://www.wlf4.org), including extensive video reports of the event (<https://www.wlf4.org/wlf4-week/>). The organizers wish to thank the Slovenian Chamber of Engineers for the video coverage of the forum (<http://www.izs.si/e-izobrazevanja/strokovni-dogodki/4th-world-landslide-forum-4wlf/>) and the host of the event, the Cankarjev dom—Cultural and Congress Centre Ljubljana, who fulfilled our expectations while being selected as the WLF4 venue in Ljubljana.

All those interested in landslides risk reduction are invited to attend the 3rd Regional Symposium on Landslides in the Adriatic-



Balkan Region (3ReSyLAB, <http://www.geo-zs.si/ReSyLAB2017/>), taking place from 11 to 13 October 2017 in Ljubljana, Slovenia.

The WLF4, organized in Ljubljana in 2017, can be evaluated as a yet another milestone in the steady efforts of the International Consortium on Landslides (ICL) and its supporters in their joint world-wide efforts for a safer geoenvironment, supporting landslide research and landslide risk reduction for advancing culture of living with landslides and other natural hazards in order to support the Sendai Framework for Disaster Risk Reduction 2015–2030 and to achieve the United Nations Sustainable Development Goals 2030.

## References

- Jemec Auflič M, Jež J, Popit T, Košir A, Maček M, Logar J, Petkovšek A, Mikoš M, Calligaris C, Boccali C, Zini L, Reitner JM, Verbovšek T (2017a) The variety of landslide forms in Slovenia and its immediate NW surroundings. *Landslides* 14(4):1537–1546. <https://doi.org/10.1007/s10346-017-0848-1>
- Jemec Auflič M, Mikoš M, Verbovšek T (eds) (2017b) Living with slope mass movements in Slovenia and its surroundings: post forum study tour guide book, Saturday 3 June–Monday 5 June, 2017. Fakulteta za gradbeništvo in geodezijo Univerze v Ljubljani, Ljubljana. 51 p. [https://www.wlf4.org/wp-content/uploads/2017/06/Vodic-po-4thWLF\\_Post-Forum-Study-Tour.pdf](https://www.wlf4.org/wp-content/uploads/2017/06/Vodic-po-4thWLF_Post-Forum-Study-Tour.pdf). Accessed 25 Aug 2017
- Mihalić Arbanas S, Sečanj M, Bernat Gazibara S, Krkač M, Begić H, Džindo A, Zekan S, Arbanas Ž (2017) Landslides in the Dinarides and Pannonian Basin—from the largest historical and recent landslides in Croatia to catastrophic landslides caused by Cyclone Tamara (2014) in Bosnia and Herzegovina. *Landslides*. <https://doi.org/10.1007/s10346-017-0880-1>
- Mikoš M, Bezak N (eds) (2017) Landslide research and risk reduction for advancing culture of living with natural hazards: WLF4 local proceedings with programme. Fakulteta za gradbeništvo in geodezijo Univerze v Ljubljani, Ljubljana. 244 p., <https://www.wlf4.org/wp-content/uploads/2017/05/WLF4-Local-Proceedings-and-Programme-with-posters.pdf>. Accessed 25 Aug 2017
- Mikoš M, Vilimek V, Yin Y, Sassa K (eds) (2017a) Advancing culture of living with landslides, volume 5: landslides in different environments. Springer International Publishing AG, Switzerland, 557 p. <https://doi.org/10.1007/978-3-319-53483-1>
- Mikoš M, Arbanas Ž, Yin Y, Sassa K (eds) (2017b) Advancing culture of living with landslides, volume 3: advances in landslide technology. Springer International Publishing AG, Switzerland, 621 p. <https://doi.org/10.1007/978-3-319-53487-9>
- Mikoš M, Casagli N, Yin Y, Sassa K (eds) (2017c) Advancing culture of living with landslides, volume 4: diversity of landslide forms. Springer International Publishing AG, Switzerland, 707 p. <https://doi.org/10.1007/978-3-319-53485-5>
- Mikoš M, Tiwari B, Yin Y, Sassa K (eds) (2017d) Advancing culture of living with landslides, volume 2: advances in landslide science. Springer International Publishing AG, Switzerland, 1197 p. <https://doi.org/10.1007/978-3-319-53498-5>
- Sassa K (2009) Report of the 2008 first world landslide forum on 18–21 November 2008 at UNU, Tokyo. *Landslides* 6(3):167–179. <https://doi.org/10.1007/s10346-009-0161-8>
- Sassa K (2015) ISDR-ICL Sendai Partnerships 2015–2025 for global promotion of understanding and reducing landslide disaster risk. *Landslides* 12(4):631–640. <https://doi.org/10.1007/s10346-015-0586-1>
- Sassa K (2017a) The Fifth World Landslide Forum—implementing and monitoring the ISDR-ICL Sendai Partnerships 2015–2025. *Landslides* 14(3):1283–1288. <https://doi.org/10.1007/s10346-017-0828-5>
- Sassa K (2017b) The 2017 Ljubljana Declaration on landslide risk reduction and the Kyoto 2020 Commitment for global promotion of understanding and reducing landslide disaster risk. *Landslides* 14(4):1289–1296. <https://doi.org/10.1007/s10346-017-0857-0>
- Sassa K (2017c) Participants in the Fourth World Landslide Forum and call for ICL members, supporters, and associates. *Landslides*. <https://doi.org/10.1007/s10346-017-0858-z>
- Sassa K, Canuti P, Margottini C, Yin Y (2012) The Second World Landslide Forum, Rome, 2011 and the Third World Landslide Forum, Beijing, 2014. *Landslides* 9(2):285–297. <https://doi.org/10.1007/s10346-012-0328-6>
- Sassa K, Yin Y, Canuti P (2015) The Third World Landslide Forum, Beijing, 2014. *Landslides* 12:177–192. <https://doi.org/10.1007/s10346-015-0555-8>
- Sassa K, Mikoš M, Yin Y (eds) (2017) Advancing culture of living with landslides, volume 1: ISDR-ICL Sendai Partnerships 2015–2025. Springer International Publishing AG, Switzerland, 586 p. <https://doi.org/10.1007/978-3-319-59469-9>

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