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The ICL landslide monitoring and warning thematic network

Abstract The International Consortium on Landslides (ICL) was established in 2002 and soon became an important world player in the field of landslide risk mitigation; in 2012, it has more than 50 member organizations throughout the world. As a part of the activities to celebrate ICL's tenth anniversary, a strategic document for the second decade called the ICL Strategic Plan 2012–2021 with the motto "to create a safer geo-environment" was adopted in Kyoto in January 2012. An important part of this document was a clear dedication to broaden the scope and societal impact in a thematic, institutional, and geographic manner. Thus, thematic and regional networks for landslide risk reduction were recognized to be an important form of ICL activities in the decade to come. In this paper, one of the eight newly established thematic and regional ICL networks is presented: the ICL Landslide Monitoring and Warning Thematic Network, a joint effort of ten ICL member organizations and two ICL supporters from eight countries, five of them are active ICL World Centres of Excellence in Landslide Risk Reduction in the period 2011–2014. The general objective of this thematic network is to compare experiences in the field of landslide monitoring and existing/installed (early) warning systems for active landslides in different regions of the world.

Keywords ICL · Landslides · Mitigation · Monitoring · Rockfalls · Scientific cooperation · Warning systems

Introduction

At the start of this millennium, a program called the International Strategy for Disaster Reduction (http://www.unisdr.org) was launched. The parallel efforts of the United Nations and some other global organizations together with the International Consortium on Landslides (ICL; http://www.iclhq.org) led to the International Programme on Landslides (IPL; http://www.iplhq.org).

The IPL-ICL discussed the establishment of thematic and regional (consortia)/networks on landslides at the Secretarial meeting in Kyoto in January 2011, at the IPL-ICL Session of the Global Platform for Disaster Risk Reduction 2011 in Geneva in May 2011, and at the Secretarial meeting in Rome in October 2011 during the Second World Landslide Forum. After these discussions, finally during the Tenth session of the Board of Representatives of ICL in October 2011 in FAO, several thematic networks have been proposed, and they have also been structured; one of them was the ICL Landslide Monitoring and Warning Thematic Network (LaMaWa TheN).

The membership of this thematic network consists of ten ICL member organizations from eight countries, five of them are active ICL World Centres of Excellence in Landslide Risk Reduction in the period 2011–2014 and two ICL supporters (Table 1). The coordinating role was taken by the Faculty of Civil and Geodetic Engineering of the University of Ljubljana (Prof. Matjaž Mikoš), and the deputy coordination role will be executed by the Croatian Landslide Group (Prof. Željko Arbanas from the University of Rijeka) and by the Forestry and Forest Product Research Institute from Tsukuba, Japan (Prof. Hirotaka Ochiai).

Three members of this thematic network (i.e., UL FGG, GeoZS and the Croatian Landslide Group) are also members of the newly established regional ICL Adriatic-Balkan (ABC Network), where other aspects of a regional cooperation in this region will be discussed and developed.

Background justification and general objective

Numerous advanced and less advanced techniques for landslide monitoring are being applied more or less successfully in different regions of the world. The same is true for (early) warning systems that have been installed on active landslides. In most of the cases, the successful warning systems are dependent on the adequate modeling of the landslide process. There are numerous reports and research papers or case study reports available on the web, often written by the authors from only one country. The main aim for the newly established ICL thematic network is to try critically comparing different techniques and systems applied from the international point of view (possible transfer of technologies, pros, and cons). By attracting different ICL members that are very active in this field of expertise in different regions of the world, we may expect added value by preparing joint reports on the applicability, pros, and cons of different techniques and systems from one's own experiences critically discussed by other experts in the ICL community having experiences in the same field. Furthermore, new methods and technologies that are to be developed are important strategic goals of the ICL in the 2012–2021 decade and should be based on the existing best monitoring practices and best available technologies being known to the wide world community active in the field of landslide risk mitigation.

Description of the past thematic network member activities related to landslide monitoring and warning

All the active thematic network members (the core thematic network members are given in Table 1) have different and extensive experiences with landslide monitoring and warning systems as a part of mitigation of landslides and landslide risk reduction (Table 2). There are different laboratories and field installations available to be used for the planned network activities. All members together can support the network activities by a several dozens of senior scientists and young researchers. The financial means needed for the network to run are not only mainly covered by their own means but also partially covered by the running IPL projects or being constituent part of the WCoE activities for some of the network members. It follows a short overview of their past activities that gave them credit to be connected in this skilled network.

Furthermore, other ICL members are warmly invited to join the thematic network and discussions how to bring in their expertise in the field of landslide monitoring and warning. The further development of the LaMaWa Then according to the planned network activities will be discussed during the 11th Session of the Board of Representatives of ICL and the Seventh Session of the International Programme on Landslides Global Promotion Committee to be held in Paris in November 2012.

Table 1 The LaMaWa TheN members

No.	Network member (alphabetically)	Country	ICL member	WCoE	Contact persons
1	Charles University, Faculty of Science, Department of Physical Geography and Geoecology, Prague	Czech Republic	x	x	Prof. Vít Vilímek, Associate Professor, Department of Physical Geography and Geoecology, Faculty of Science, Charles University in Prague, Czech Republic, email: vilimek@natur.cuni.cz
2	Comenius University, Faculty of Natural Sciences, Department of Engineering Geology, Bratislava	Slovakia	x		Prof. Ján Vlčko, Associate Professor, Department of Engineering Geology, Faculty of Natural Sciences, Comenius University, Mlynská dolina G, 642 15 Bratislava, Slovak Republic, email: vlcko@fns.uniba.sk
3	Croatian Landslide Group from Faculty of Civil Engineering, University of Rijeka, Rijeka; Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, Zagreb	Croatia	x		Prof. Željko Arbanas, Associate Professor, Faculty of Civil Engineering, University of Rijeka, Radmile Matejčić 3, HR-51000 Rijeka, Croatia, email: zeljko.arbanas@gradri.hr Prof. Snježana Mihalić Arbanas, Associate Professor, Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, Pierottijeva 6, HR-10000 Zagreb, Croatia, email: smihalic@rgn.hr
4	Forestry and Forest Product Research Institute, Tsukuba	Japan	x		Prof. Hirotaka Ochiai, Professor, Forestry and Forest Product Research Institute, 1 Matsunosato, Tsukuba, Ibaraki, 305-8687 Japan, email: ochi@ffpri.affrc.go.jp
5	Gadjah Mada University, Faculty of Engineering, Department of Civil and Environmental Engineering, Yogyakarta	Indonesia	x	x	Dr. Teuku Faisal Fathani, Department of Civil and Environmental Engineering, Faculty of Engineering, Gadjah Mada University, Yogyakarta, Jl. Grafika no 2, 55281, Indonesia, email: tfathani@gmail.com
6	Geological Survey of Slovenia (GeoZS), Ljubljana, Slovenia	Slovenia	x		Dr. Marko Komac, Assistant Professor and Director, Geological Survey of Slovenia, Dimičeva ulica 15, Ljubljana, Slovenia, email: marko.komac@geo-zs.si
7	Geo-Tools, NGO, Zdiby	Czech Republic	ICL supporter		Dr. Jiří Zvelebil, NGO Geo-Tools, Zdiby, U Mlejnku 128, 250 66 Zdiby, Czech Republic, email: jiri.zvelebil@geotools.cz
8	Kokusai Kogyo Co., Ltd., Tokyo	Japan	ICL supporter		Dr. Yoshiko Abe, Urban Environment Division, Overseas Operations Department, Kokusai Kogyo Co., Ltd., 2 Rokubancho, Chiyoda-ku, Tokyo, 102-0083 Japan, email: yosh.abe@gmail.com
9	Public Works Department of Malaysia, Slope Engineering Branch, Kuala Lumpur	Malaysia	x		Dr. Che Hassandi Abdullah, Director, Public Works Department Headquarters, Slope Engineering Branch, 12th Floor, Jalan Sultan Salahuddin, 50582 Kuala Lumpur, Malaysia, email: Hassandi@jkr.gov.my
10	University of Florence, Department of Earth Sciences, Italy	Italy	x	x	Dr. Filippo Catani, Department of Earth Sciences, University of Florence, Via La Pira 4, I-50121 Firenze, Italy, email: filippo.catani@unifi.it, filippo.catani@gmail.com
11	University of Ljubljana, Faculty of Civil and Geodetic Engineering (UL FGG), Ljubljana	Slovenia	x	x	Prof. Matjaž Mikoš, Professor, Faculty of Civil and Geodetic Engineering University of Ljubljana, Jamova cesta 2, SI-1000 Ljubljana, Slovenia, email: matjaz.mikos@gmail.com
12	University of Niigata, Research Center for Natural Hazards and Disaster Recovery, Niigata	Japan	x	x	Prof. Hideaki Marui, Professor and Director, Research Institute for Natural Hazards and Disaster Recovery, University of Niigata, Ikarashi-Ninocjo, Nishi-ku, Niigata, 950-2181 Japan, email: maruihi@cc.niigata-u.ac.jp

Table 2 The LaMaWa TheN members' past activities related to landslide monitoring and warning

No.	Network member (alphabetically)	Country	Past activities related to landslide monitoring and warning
1	Charles University, Faculty of Science, Department of Physical Geography and Geoecology, Prague	Czech Republic	Field and laboratory experiences both in Czech Republic and abroad—from field projects in Peru and Ethiopia (Zvelebil et al. 2010). Rock deformations are continuously monitored and analyzed at Machu Picchu since 2002 (Vilímek et al. 2005, 2007). In Cordillera Blanca, a test area for evaluation of landslide hazard from moraines with respect to GLOFs (precipitation and infiltration are already monitored) is under preparation. Several landslide localities in Czech Republic are monitored by geodetic measurements; laser scanning has been used in recent times as well as dendrogeomorphology (Burda 2011).
2	Comenius University, Faculty of Natural Sciences, Department of Engineering Geology, Bratislava	Slovakia	Monitoring of unstable slopes along stability-sensitive landslide bodies along a new highway (Central and Eastern Slovakia) and along high-voltage poles of intra-European electric network
3	Croatian Landslide Group from Faculty of Civil Engineering, University of Rijeka, Rijeka; Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, Zagreb	Croatia	Field expertise in extensive monitoring of the complex Grohovo landslide in the Rječina river valley near the city of Rijeka (Benac et al. 2005, 2011; Arbanas et al. 2012) and the Kostanjek landslide in the urban area of the city of Zagreb (Mihalić and Arbanas 2012)
4	Forestry and Forest Product Research Institute, Tsukuba	Japan	Wealth of expertise in the field of research on earthquake- and rainfall-induced landslide mechanism (Sidle and Ochiai 2006; Okada et al. 2007, 2008)
5	Gadjah Mada University, Faculty of Engineering, Department of Civil and Environmental Engineering, Yogyakarta	Indonesia	Simple and low-cost equipped but effective landslide monitoring and (early) warning systems (Fathani and Karnawati 2007; Sassa et al. 2009; Liao et al. 2010)
6	Geological Survey of Slovenia (GeoZS), Ljubljana, Slovenia	Slovenia	Experiences with rainfall as triggering factor for shallow landsliding (Jemec and Komac 2012), GPS technique for 3D surface displacement measurements on active landslides (Komac et al. 2012), different remote sensing techniques such as PSInSAR and DInSAR for detection of landsliding (Oštir and Komac 2007) and PSInSAR and rainfall data for estimation of soil creep intensities (Žibret et al. 2012)
7	Geo-Tools, NGO, Zdiby	Czech Republic	Experiences with systematic rockfall security monitoring of rock slopes, nonlinear dynamics, and security of IT networks. New methods emerging from IT, cybernetics, and Complex Systems Science to engineering–geological practice were established by Geo-Tools in sandstone area in NW of Czech Republic (Pravcicka brana sandstone rock arch—partly in cooperation with Comenius University, Bratislava, Slovakia)
8	Kokusai Kogyo Co., Ltd., Tokyo	Japan	Cutting-edge surveying technologies as well as advanced technologies for processing and utilizing survey data
9	Public Works Department of Malaysia, Slope Engineering Branch, Kuala Lumpur	Malaysia	Extensive experiences in slope engineering in Malaysia and abroad: including slope failure investigations, repair works, landslide early warning system, slope cataloging, data digitalizing, promoting public awareness and also formulating specifications and guidelines for slopes
10	University of Florence, Department of Earth Sciences, Italy	Italy	Expertise in remote sensing techniques and landslide mitigation such as using SAR interferometry (Catani et al., 2005; Corsini et al. 2006) or ground-based radar interferometry for early warning systems (Casagli et al. 2010)
11	University of Ljubljana, Faculty of Civil and Geodetic Engineering (UL FGG), Ljubljana	Slovenia	Experiences with hydrometeorological, geodetical, and geotechnical monitoring of several active landslides in Slovenia as a part of their mitigation (Mikoš and Majes 2010), using different techniques such as terrestrial laser scanning (Mikoš et al. 2005) or soil matrix suction to understand mechanism of active landslides in flysch formations (Mikoš et al. 2009; Petkovšek et al. 2009, 2012)
12	University of Niigata, Research Center for Natural Hazards and Disaster Recovery, Niigata	Japan	Landslide monitoring of landslides in Japan and abroad (Ayalew et al. 2005)

Planned network activities and expected results

The objectives of the thematic network are to be achieved by:

1. Setting up of a dedicated web page (within IPL web pages) showing advanced landslide monitoring techniques and providing a short but comprehensive overview (with active links to web pages) of selected installed monitoring systems for active landslides in the world;
2. Preparing a series of review papers for the *Landslides* journal covering the themes of the network and being prepared jointly by the members of the network (strong international cooperation).

Thus, the activities of the network for the period 2012–2014 can be divided into three phase:

First phase:

1. Organization of the network, email/web discussions, preparing a final program, and finally building of a few working groups for selected topics in the fields of landslide monitoring and warning, such as remote sensing techniques, terrestrial landslide displacements monitoring, advanced warning systems for debris flows and rockfalls, easily managed but robust (early) warning systems, etc.
2. Cooperation with other active ICL thematic and/or regional networks where and when needed

Second phase:

1. Working out of a draft report for each topic, efforts to get more international experts in the specific field to work on the draft, preparation of the final report, and publication of the final report as a review paper (tactically as an original paper in the *Landslides* journal)
2. An initiation of an IPL Project in the field of monitoring and (early) warning systems (core members will be included into the project draft preparation)
3. Publishing short annual reports as the ICL/IPL activities in the *Landslides* journal

Third phase:

1. Publishing (final) joint results on the IPL-ICL web page and disseminating an overview of the best monitoring practices (BMP), best (early) warning practices (BWP), and best available technologies
2. Organizing of TN workshops and conferences as thematic ICL conferences or sessions during World Landslide Forums (e.g., WLF III in Beijing, 2–6 June 2014)
3. Taking a decision how to proceed in the future with the network (prolongation, reorientation, and new focuses)

Conclusions

The ICL activities in its second decade of existence were defined by the ICL Strategic Plan 2012–2021, adopted in Kyoto in January 2012. An important part of the implementation of this strategic plan was to establish new thematic and regional networks, eight of them were launched in 2012; the ICL LaMaWa TheN being one of them.

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