

SYLAB 2017

International Symposium on Landslides
Adriatic-Balkan Region, Ljubljana



Univerza v Ljubljani



11 - 13 October 2017
Ljubljana, Slovenia

SYMPOSIUM SPONZORS

Acknowledgments

The Organizing committee is deeply appreciative of the sponsorships generously provided by the following companies:



3Dsurvey



DEAR PARTICIPANTS OF THE 3RD RESYLAB 2017,

Regional Symposia on Landslides in the Adriatic-Balkan Region are important meetings of engineers, professionals and researchers in the region. The aim of reducing the risk of landslides is extremely important, and remains a both a decisive directive and challenge in the future. The 3rd ReSyLAB will take place this time in Ljubljana, the capital of Slovenia.

You will be visiting a Central European country where landslides threaten more than one-third of the Slovenian territory, which means some 20 percent of the population is vulnerable. Following the ISDR-ICL Sendai Partnerships 2015–2025 for the Global Promotion of Understanding and Reducing Landslide Disaster Risk and the 2017 Ljubljana Declaration on Landslide Risk Reduction, the symposium will explore possible ways of enhancing cooperation between the landslide science community and the diverse range of stakeholders both in the Adriatic-Balkan Region and around the world.

Over the next few days we hope you will enjoy the numerous opportunities for social and professional interaction with new experts and familiar colleagues and friends. Please take this symposium as an opportunity to visit the photo exhibition of selected images from the WLF4 Landslide Photo Contest and take advantage of our technical program. We will be hosting and presenting four invited lecturers over the course of the symposium. The symposium will be attended by over 60 geoprofessionals, including more than 20 students who are pursuing undergraduate studies in geology and civil engineering. The symposium organisers received 42 abstracts, out of which 38 papers have been accepted for oral presentation. Each paper includes one or more aspects of mapping, investigating, monitoring, analysing or mitigating landslides, as well as case studies on innovative analysis, mitigation techniques and solutions. The symposium will conclude with two interesting field study tours: "Landslides in the Vipava valley" and the "Potoška planina landslide".

Our wish is that this 3rd ReSyLAB meets and exceeds the high expectations of all participants in the larger effort to achieve two primary objectives: first, it should contribute to improving research and putting knowledge and experience into practice; and secondly, it should serve to enrich a general understanding of this country, together with its rich historical and cultural background, for all those who are coming to Slovenia for the first time.

Our sincere gratitude goes to all of the sponsors who made the organization of this symposium possible. We appreciate all of the help we have received from members of the International Scientific Committee, the Local Organizing Committee, and all of those individuals that expressed their support throughout the organization process.

We wish you a most fruitful and enjoyable 3rd ReSyLAB.

Mateja Jemec Auflič

Timotej Verbovšek

Matjaž Mikoš

Chairs of the Organizing Committee

3rd Regional Symposium on Landslides in the Adriatic-Balkan Region,
Ljubljana, Slovenia

CONTENTS

ORGANIZING COMMITTEE	6
GENERAL INFORMATION	8
SYMPOSIUM PROGRAMME	10
PROGRAMME SCHEDULE OF ORAL SESSIONS	12
ABSTRACTS	14
KEYNOTE LECTURES	14
1-MAPPING AND SPATIAL ANALYSES	21
2-HAZARD ZONING AND RISK	25
3-MONITORING TECHNIQUES AND WARNING SYSTEMS	27
4-LANDSLIDE MECHANICS AND SIMULATION MODELS	36
5-GENERAL CASE STUDIES	42
6-REMEDIAL MEASURES AND EFFECTS	49
7-SOCIAL, POLITICAL AND ECONOMIC IMPACT	50
FIELD STUDY TOUR, 1. LANDSLIDES IN VIPAVA VALLEY	58
FIELD STUDY TOUR, 2. POTOŠKA PLANINA LANDSLIDE	60
NOTES	62

ORGANIZING COMMITTEE

ORGANIZERS

ICL ADRIATIC-BALKAN NETWORK
GEOLOGICAL SURVEY OF SLOVENIA
UNIVERSITY OF LJUBLJANA, FACULTY OF CIVIL AND GEODETIC ENGINEERING
UNIVERSITY OF LJUBLJANA, FACULTY OF NATURAL SCIENCES AND ENGINEERING



Univerza v Ljubljani



UNDER HONORARY PATRONAGE OF

MINISTRY OF EDUCATION, SCIENCE AND SPORT, SLOVENIA

CHAIRPERSONS

MATEJA JEMEC AUFLIČ
MATJAŽ MIKOŠ
TIMOTEJ VERBOVŠEK

INTERNATIONAL SCIENTIFIC COMMITTEE

SNJEŽANA MIHALIĆ ARBANAS
Faculty of Mining, Geology and Petroleum
Engineering, University of Zagreb, Croatia
Coordinator of ICL ABN Network
ŽELJKO ARBANAS
Faculty of Civil Engineering, University of Rijeka
Croatia
Co-Coordinator of ICL ABN Network
BILJANA ABOLMASOV
Faculty of Mining and Geology, University of Belgrade,
Serbia
Co-Coordinator of ICL ABN Network
KIRIL ANGUELOV
University of Mining and Geology "St. Ivan Rilski"
Sophia, Bulgaria
MILOŠ BAVEC
Geological Survey of Slovenia, Slovenia

GORDANA HADZI NIKOVIĆ
Faculty of Mining and Geology, University of
Belgrade, Serbia
ADNAN IBRAHIMOVIĆ
The Faculty of Mining, Geology and Civil Engineering,
University of Tuzla, Bosnia and Herzegovina
VEDRAN JAGODNIK
Faculty of Civil Engineering, University of Rijeka,
Croatia
MATEJA JEMEC AUFLIČ
Geological Survey of Slovenia, Slovenia
JERNEJ JEŽ
Geological Survey of Slovenia, Slovenia
MILORAD JOVANOVSki
Faculty of Civil Engineering, Ss. Cyril and Methodius
University Skopje, Republic of Macedonia

PAVLE KALINIĆ

City of Zagreb, OEM- City Office of Emergency
Management, Croatia

MARKO KOMAC

Faculty of Civil and Geodetic Engineering, University
of Ljubljana, Slovenia

MARTIN KRKAČ

Faculty of Mining, Geology and Petroleum Engineering,
University of Zagreb, Croatia

HASAN KULICI

Albanian Geological Survey, Albania

JANKO LOGAR

Faculty of Civil and Geodetic Engineering, University
of Ljubljana, Slovenia

MATEJ MAČEK

Faculty of Civil and Geodetic Engineering, University
of Ljubljana, Slovenia

KENAN MANDŽIĆ

The Faculty of Mining, Geology and Civil Engineering,
University of Tuzla, Bosnia and Herzegovina

MILOŠ MARJANOVIĆ

Faculty of Mining and Geology, University of Belgrade,
Serbia

MATJAŽ MIKOŠ

Faculty of Civil and Geodetic Engineering, University
of Ljubljana, Slovenia

MIRALEM MULAĆ

City Office of Emergency Management, Bosnia and
Herzegovina

IGOR PEŠEVSKI

Faculty of Civil Engineering, Ss. Cyril and Methodius
University Skopje, Republic of Macedonia

TINA PETERNEL

Geological Survey of Slovenia, Slovenia

ANA PETKOVŠEK

Faculty of Civil and Geodetic Engineering, University
of Ljubljana, Slovenia

TOMISLAV POPIT

Faculty of Natural Sciences and Engineering, University
of Ljubljana, Slovenia

BOŠTJAN PULKO

Faculty of Civil and Geodetic Engineering, University
of Ljubljana Slovenia

ZORAN RADIĆ

Faculty of Civil Engineering, University of Belgrade,
Serbia

MILEVA SAMARDŽIĆ-PETROVIĆ

Faculty of Mining and Geology, University of Belgrade,
Serbia

KYOJI SASSA

Executive Director, International Consortium on
Landslides, Japan

MARTINA VIVODA PRODAN

Faculty of Civil Engineering, University of Rijeka,
Croatia

TIMOTEJ VERBOVŠEK

Faculty of Natural Sciences and Engineering, University
of Ljubljana Slovenia

MARJANA ZAJC

Geological Survey of Slovenia, Slovenia

SABID ZEKAN

The Faculty of Mining, Geology and Civil Engineering,
University of Tuzla, Bosnia and Herzegovina

LOCAL ORGANIZING COMMITTEE

MILOŠ BAVEC

Geological Survey of Slovenia, Slovenia

MATJAŽ MIKOŠ

Faculty of Civil and Geodetic Engineering, University
of Ljubljana, Slovenia

MATEJA JEMEC AUFLIČ

Geological Survey of Slovenia, Slovenia

JERNEJ JEŽ

Geological Survey of Slovenia, Slovenia

TINA PETERNEL

Geological Survey of Slovenia, Slovenia

TIMOTEJ VERBOVŠEK

Faculty of Natural Sciences and Engineering, University
of Ljubljana, Slovenia

TOMISLAV POPIT

Faculty of Natural Sciences and Engineering, University
of Ljubljana, Slovenia

GENERAL INFORMATION

SYMPOSIUM VENUE, 11 October 2017

UNIVERSITY OF LJUBLJANA
KONGRESNI TRG 12
SI-1000 LJUBLJANA
SLOVENIA

REGISTRATION DESK

The Registration Desk of the first day of the 3rd ReSyLAB will be located in the Hall of Zbornična dvorana in the first floor of University of Ljubljana (entrance from Vegova street).

SYMPOSIUM VENUE, 12 October 2017

UNIVERSITY OF LJUBLJANA
FACULTY OF CIVIL AND GEODETIC ENGINEERING
JAMOVA CESTA 2
SI-1000 LJUBLJANA
SLOVENIA

REGISTRATION DESK

The Registration Desk of the second day of the 3rd ReSyLAB will be located in the 2nd floor of Faculty of Civil and Geodetic Engineering.

OFFICIAL LANGUAGE

The official language of the 3rd Regional symposium on Landslides in the Adriatic-Balkan Region is English.

PHOTO EXHIBITION

Please take this symposium as an opportunity to visit the photo exhibition of the selected photos from the WLF4 Landslide Photo Contest on the ground floor at the Faculty of Civil and Geodetic Engineering.

COFFEE BREAK AND LUNCH

During session breaks, refreshments will be served free of charge to participants wearing symposium identification badges. Lunches are included in the registration fee and will be served during lunch time.

INFORMATION FOR SPEAKERS

ORAL PRESENTATIONS

All accepted abstracts and full papers will be presented orally. Authors should bring their presentations (in PowerPoint or PDF format) on a USB stick or CD/DVD-ROM, and must upload them to the computer in the section room 30 minutes before the actual time of the session. Symposium staff will assist authors with the loading of the presentation and will transfer the presentation files to the computers in the presentation rooms.

Each presentation should be 12 minutes speech followed by 3 minutes of discussion.

FIELD STUDY TOUR

Requirements for participants: there will be approximately two hours of walking at the both field study tours. Weather-appropriate clothing and sturdy footwear is required. Travel cost and a lunch box are covered by the organizers and symposium sponsors.

REGISTRATION FEE

Symposium fee for all participants is 120 EUR, except for students for whom it is 60 EUR. The registration fee includes: symposium material, admission to all scientific sessions, book of abstracts, Proceedings of the 3rd ReSyLAB, refreshments during coffee breaks and lunches, social event and a field study tours (optional).

Due to delays the Proceedings of the 3rd ReSyLAB will be published soon after the symposium.

SIDE EVENT

ROUND TABLE DISCUSSION

TITLE: ENHANCING COOPERATION BETWEEN THE LANDSLIDE SCIENCE COMMUNITY AND END USERS

DATE: Wednesday, 11 October 2017, 13:30–15:00

VENUE: Zbornična dvorana, University of Ljubljana, Kongresni trg 12, 1000 Ljubljana

ORGANIZERS

Adriatic-Balkan Network of the International Consortium on Landslides (ICL ABN)

INTRODUCTORY LECTURE

International and regional cooperation on reducing landslide risk in Italy
VERONICA TOFANI, Department of Earth Sciences, University of Firenze, Italy

MODERATOR

MATJAŽ MIKOŠ, Chair of the UNESCO Chair on Water-related Disaster Risk Reduction, Faculty of Civil and Geodetic Engineering, University of Ljubljana, Slovenia

Invited panelists include landslide scientists from academic and research institutions and civil protection administration authorities from Bosnia in Hercegovina, Croatia, Serbia and Slovenia. Following the ISDR-ICL Sendai Partnerships 2015-2025 for Global Promotion of Understanding and Reducing Landslide Disaster Risk and the 2017 Ljubljana Declaration on Landslide Risk Reduction the Round Table Discussion will explore possible ways of enhancing cooperation between the landslide science community and end users from administrative bodies in BIH, Croatia, Serbia and Slovenia.

The round table discussion will cover the following topics:

- (1) Disaster risk factors and scenarios, including emerging disaster risks, in the medium and long term;
- (2) Enhance research for local, regional, national applications;
- (3) Support actions by local communities and authorities; and
- (4) Support decision-making with interaction between policy makers and the scientific community.

The aim of the Round Table Discussion is to debate, with a wider audience, the priorities for future practical applications derived from the scientific results gained in the framework of landslide research in those member-countries that belong to the ICL Adriatic-Balkan Network: Albania, Bosnia and Herzegovina, Croatia, Slovenia and Serbia. The discussion among governmental representatives and scientists will be conducted with a view to finding answers to questions related to current and applicable use of geoenvironmental data and information in systems dealing with land-use planning, civil and environmental protection, and to the development of related necessary legislative documentation (e.g., guidelines, laws).

SOCIAL EVENT

DATE: Wednesday, 11 October 2017, 18:00

Welcome reception in the Ljubljana City Hall (Mestna hiša).

Participants will also have the opportunity to attend a short guided tour in Ljubljana city centre focusing on natural stone in cultural buildings and monuments.

4-Landslide Mechanics and Simulation Models

ROCKFALL MONITORING AND SIMULATION ON A ROCK SLOPE NEAR LJIG IN SERBIA

MILOŠ MARJANOVIĆ⁽¹⁾, BILJANA ABOLMASOV⁽¹⁾, MARKO PEJIĆ⁽²⁾, SNEŽANA BOGDANOVIĆ⁽¹⁾,
MILEVA SAMARDŽIĆ-PETROVIĆ⁽¹⁾

(1) FACULTY OF MINING AND GEOLOGY, UNIVERSITY OF BELGRADE, SERBIA (*biljana.abolmasov@rgf.bg.ac.rs*)

(2) FACULTY OF CIVIL ENGINEERING, UNIVERSITY OF BELGRADE, SERBIA

This paper addresses a rock slope on the M-22 road, which is one of the corridors with the highest frequency and heaviest traffic load among all of 1-b category roads in Serbia. Therefore, stability along its slopes is vital. One of its critical points is a medium-sized rock slope located near the town of Ljig. This rock slope is composed of a flysch complex, dominated by brittle and compact sandstone banks (2-3 m thick), interlayered by less-competent, ductile series of marly-shales (several cm thick). Rockfalls on this slope mainly consume larger sandstone blocks severed by three main sets of discontinuity plains, as well as weathered, crumbly crust atop the uppermost sandstone layers. These source areas were precisely identified through 4-year long slope monitoring, based on Terrestrial Laser Scanning technique. However, the runouts and accumulation zone was never precisely determined, because the Public Enterprise Roads of Serbia, which maintains the road infrastructure, reacts quickly after the fall takes place and swipes off all the shatter, so the runout evidence was never recorded in those 4-years.

The research concept included typical back-analysis. Firstly, the source areas were analyzed by comparing point clouds of the first and the latest TLS scanning epoch. Four main source areas were identified and adopted for the model. Secondly, potential rockfall block size and shape were adopted based on the measurements over the first epoch point cloud. Subsequently, some mechanical and physical properties of the rock were determined. These three steps included known and documented facts of the present rock slope. The last step was to simulate the most likely trajectories to obtain runout distances and possible threats to the road asset, based on known source areas and material properties.

The results show that the source area No. 4 is potentially the most critical, because its trajectories' runouts can reach the road infrastructure. This was somewhat expected, given that this source area is positioned on the upper part of the slope, with small horizontal distance to the road. Simultaneously, kinetic energy, componential velocities and forces were also calculated. These showed that rockfalls could be easily controlled as none of the trajectories resulted in energies or forces that would be overwhelming for some standard structural remediation measures (mash, barriers, embankments, etc.). Rock bouncing and fragmentation effects did not show significant influence, because of the relatively short slope, moderate steepness angles of the rock face, and soft weathered material accumulated along the slope's foot that absorbs the impact energy.