World Centre of Excellence (WCoE-2017-2020)  
Progress Report Form 2018  
1 January 2018 to 31 December 2018

1. Short Title of WCoE: Center for Applied Landslide Research (CALaR)

2. Name of Institution (Name of leader and email)

   Croatian Landslide Group

   **Snježana Mihalić Arbanas**
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   **Željko Arbanas**
   Full Professor, University of Rijeka, Faculty of Civil Engineering, Department of Hydrotechnics and Geotechnics, Rijeka, Croatia
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3. List of core members

   **Assist. Prof. Martin Krkač**, University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Zagreb, Croatia

   **Assist. Prof. Vedran Jagodnik**, University of Rijeka, Faculty of Civil Engineering, Rijeka, Croatia

   Other members:

   **Sanja Bernat Gazibara, PhD student; Marin Sečanj, PhD student**
   University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Zagreb, Croatia

   **Assist. Prof. Sanja Dugonjić Jovančević; Assist. Prof. Martina Vivoda Prodan; Dr Petra**
4. Progress report of activities up to 31 December 2018 (up to 30 lines)

(i) The results of the interdisciplinary scientific joint research of CLG’s scientists, for the period of two years (2017-2018), are published in: 1 PhD dissertation (“Identification and classification of landslides and erosion phenomena using the visual interpretation of the Vinodol Valley digital elevation model”, Đomlija, P.), 6 papers in international journals (3 paper in the Landslides journal) and 26 papers at the international conferences (15 papers at the WLF4, 6 papers at the 2nd ReSyLAB, 2 papers at the 3rd ReSyLAB, 3 papers are from other international scientific conferences) and in the ISDR-ICL Landslide Interactive Teaching Tools (6 chapters). Besides scientific publications, there are 14 Master Thesis and 21 Undergraduate Thesis supervised by CLG’s scientists.

(ii) The regional scientific and high-education projects and cooperation are the following:

- One bilateral Croatian-Slovenian scientific projects (2016-2017 “Laboratory testing and numerical modelling of landslides in flysch deposits of Croatia and Slovenia”, Project Leader Arbanas, Ž.); one Croatian scientific HRZZ projects (2018-2021“Physical modelling of landslide remediation constructions behaviour under static and seismic actions, ModLandRemSS”, Leader Arbanas, Ž.); two ICL IPL projects (2017-2021 IPL-219 “Rockfall hazard identification and rockfall protection in the coastal zone of Croatia”, Project Leader Arbanas, Ž.; 2017-2019 IPL-220“Kostanjek landslide monitoring project (Zagreb, Croatia)”, Project Leader Krkač, M.); two research projects supported by the University of Rijeka (2019-2021 “Development of the landslide monitoring and early warning system for landslide hazard mitigation purposes”, Project Leader Arbanas, Ž.; 2019-2021 “Laboratory research of static and cyclic soil behavior at landslide activation”, Project Leader Jagodnik, V.; 2018-2019 “Analysis of the rock mass and instability phenomena along the karst-flysch contacts”, Project Leader Dugonjić Jovančević, S.); research projects supported by the University of Zagreb (2015-2019 “Analysis and identification of the Kostanjek landslide hazard based on monitoring data”, Project Leader Mihalić Arbanas, Ž.); One European DG ECHO project (2015-2017 “Resilient European Communities Against Local Landslides, RECALL”, Project Members);

- Mobility of lecturers and (under)graduate students to Slovenia (Vipava Valley, Field trip for Graduate study students) and to Bosnia & Herzegovina (Gračanica Municipality, Field trip for Graduate study students; Vogošća Municipality, Field trip for Graduate study students); mobility of professors to Italy (2017 Arbanas, Ž., Member of PhD Evaluation Committee at the University of Salerno); mobility of PhD students to Italy (2017 Peranić, J., PhD research/laboratory testing at the University of Salerno; 2018 Sečanj, M., PhD course LARAM
School in Salerno), to Slovenia (2017 Peranić, J., PhD research/laboratory testing at the University of Ljubljana)

- **Coordination of regional ICL Adriatic-Balkan network** (Coordinatos and co-coordinators of the ICL ABN, Mihalić Arbanas, S., Arbanas, Ž.);

- **Organization of regional symposia** (3rd ReSyLAB, Ljubljana, Slovenia, 2017; 4th ReSyLAB, Sarajevo, BIH, 2019) and **WLF 5** (Kyoto, 2020).

(iii) Continuous cooperation with Croatian **national, regional and local governments** in the framework of:

- **Performing official landslide risk assessment for Republic of Croatia** in joint cooperation with *Ministry of Civil Engineering and Spatial Planning of the RH (MGIPU)* and *Croatian Platform for Risk Reduction*, published in the study “Landslide risk assessment in the Republic of Croatia”,

- **Design of remedial measures and measures in urgent situations of high landslide risk** (*Croatian Roads; County of Istria; Šibensko-Kninska County; City of Omiš),

- **Consultative support** to authorities related to geotechnical investigation of landslides (*Sisačko-Moslavačka County; City of Zagreb; Petrinja City; Hrvatska Kostajnica City; Dvor Municipality),

- **Consultative support** to the national government, *Ministry of Civil Engineering and Spatial Planning of the RH (MGIPU)*, **related to landslide disaster response and recovery** from the MORLE in March 2018,

- **Presentation of application of scientific results in praxis to stakeholders** (e.g., presentation of landslide inventories, landslide hazard and risk zonation, landslide monitoring, prediction and early warning, landslide modeling for specific purposes) (*Croatian National Protection and Rescue Directorate, DUZS; Croatian Water; Vukovar-Srijem County; Sisačko-Moslavačka County; Petrinja City),

- Involvement in **joint activities related to ICL Sendai Partnership** (*Croatian National Protection and Rescue Directorate, DUZS; City of Zagreb*).

(iv) **Communication and dissemination** of scientific results to the:

- **Lectures about application of scientific results in civil protection and risk mitigation** to the *wider professional community and governmental authorities* (Oral presentation “Recent experiences in rockfall hazard and risk assessment”, Arbanas, Ž.; Oral presentation “Landslide hazard and risk analysis: international and Croatian experience in last 20 years”, Mihalić Arbanas, S.; Poster presentation “Landslide inventory mapping based on LiDAR data”, Bernat
Gazibara, S.; Poster presentation “Monitoring and prediction of landslide movement”, Krkač, M.)

- Lecture about scientific results to the Croatian Academy of Science and Arts (Oral presentation “Using the remote sensing techniques in rockfall susceptibility assessment”, Sečanj, M.)

- Lecture about application of scientific results in urban planning to the students community from geographic and architecture faculties (Oral presentation “Landslides in urban area of the City of Zagreb”, Bernat Gazibara, S.)

5. Plan of future activities (up to 30 lines)

(i) Publication of results of scientific research during 2019 in the form of: 2 PhD dissertation (“Importance of geotechnical cross-section unsaturated zone for landslide occurrence in flysch deposits”, Peranić, J.; “Methodology for landslide mapping using high resolution digital elevation model in the Podsljeme area (City of Zagreb)”, Bernat Gazibara, S.), 13 papers in international journals (30% papers in the Landslides journal) and 6 papers at the international conferences (4 papers at the 4th ReSyLAB, 2 papers at other international scientific conferences). Besides scientific publications, there are 3 Master Thesis and 7 Undergraduate Thesis supervised by CLG’s scientists

(ii) Implementation of regional scientific and high-education projects and cooperation are the following:

- Croatian scientific HRZZ projects (2018-2021 “Physical modelling of landslide remediation constructions behaviour under static and seismic actions, ModLandRemSS”, Leader Arbanas, Ž.); two ICL IPL projects (2017-2021 IPL-219 “Rockfall hazard identification and rockfall protection in the coastal zone of Croatia”, Project Leader Arbanas, Ž.; 2017-2019 IPL-220 “Kostanjek landslide monitoring project (Zagreb, Croatia)”, Project Leader Krkač, M.); two research projects supported by the University of Rijeka (2019-2021 “Development of the landslide monitoring and early warning system for landslide hazard mitigation purposes”, Project Leader Arbanas, Ž.; 2019-2021 “Laboratory research of static and cyclic soil behavior at landslide activation”, Project Leader Jagodnik, V.; 2018-2019 “Analysis of the rock mass and instability phenomena along the karst-flysch contacts”, Project Leader Dugonjić Jovančević, S.); research projects supported by the University of Zagreb (2015-2019 “Analysis and identification of the Kostanjek landslide hazard based on monitoring data”, Project Leader Mihalić Arbanas, Ž.)

- Mobility of professors to Italy (2019 Mihalić Arbanas, S., Member of PhD Evaluation Committee at the University of Florence); mobility of experienced researchers to Italy (2019 Vivoda Prodan, M. and Dugonjić Jovančević, S., research/laboratory testing at the University of
Salerno); **mobility of PhD students to Switzerland** (2019 Pajalić, S., PhD course LARAM School in Laussane)

- **Coordination of regional ICL Adriatic-Balkan network** (Coordinatos and co-coordinators of the ICL ABN, Mihalić Arbanas, S., Arbanas, Ž.);

- **Organization of regional symposia** (4th ReSyLAB, Sarajevo, BIH, 2019) and WLF 5 (Kyoto, 2020).

(iii) Continuous cooperation with Croatian **national, regional and local governments** in the framework of:

- **Continuous cooperation on landslide risk assessment of Republic of Croatia (development of strategy)** in joint cooperation with Ministry of Civil Engineering and Spatial Planning of the RH (MGIPU) and Croatian Platform for Risk Reduction; **Consultative support to regional and local government related to geotechnical investigation of landslides and remedial measures**; Consultative support to national, regional and local government related to measures in urgent situations of high landslide risk and landslide disaster response and recovery from the MORLE.

- **Presentation of application of scientific results in praxis** (e.g., landslide inventories, landslide hazard and risk zonation, landslide monitoring, prediction and early warning),

- **Involvement in joint activities related to ICL Sendai Partnership.**

(iv) **Communication and dissemination** of scientific results to the:

- **Lecture about scientific results of the CLG** to the Department of Earth Sciences of the University of Firenze (Oral presentation “Applied Landslide Research in the area of Dinarides and Pannonian Basin in Croatia”, Mihalić Arbanas, S. & Arbanas, Ž.)

- **Lecture about scientific results related to landslide inventory mapping** to the wider public of Science festival 2019 (Oral presentation “From airborne laser scanning to geomorphological mapping – research in color”, Đomlija, P.)

6. Publication (in Landslides, proceedings, meeting reports, or WEB)

**Papers in scientific journals**


Papers in proceedings of the World Landslide Forum


of the Kostanjek Landslide Movements Based on Monitoring Results Using Random Forests Technique.  


**Papers in proceedings of the Regional Symposium on Landslides in the Adriatic-Balkan Region**


Papers in proceedings of international scientific conferences


**Chapter in ICL Teaching Tools**


**PhD Thesis**

MS Thesis


5. DINKO KLARIĆ (2018): Risk Analyses in the Wider Area of the Grohovo Landslide. MS Thesis. Rijeka, Faculty of Civil Engineering of the University of Rijeka. (Supervisor Dugonjić Jovančević, S.)

6. KRISTINA PLAZIBAT (2018): Instability Analysis in the Rječina River Valley. MS Thesis. Rijeka, Faculty of Civil Engineering of the University of Rijeka. (Supervisor Dugonjić Jovančević, S.)


9. PAVIĆ, I. (2018): Remediation of the landslide at the Local Road LC50059 Lazi-Štefanići in Istria. MS Thesis. Zagreb, Faculty of Civil Engineering of the University of Rijeka. 81p. (Supervisor: Arbanas, Ž.)


BS Thesis

1. AHMIČIĆ, S. (2018): Types of the rock mass failure. BS Thesis. Faculty of Civil Engineering of the University of Rijeka. (Supervisor Dugonjić Jovančević, S.)

2. BIŠIĆ, E. (2018): Effect of discontinuity characteristics on the rock mass stability – case study of the City of

4. BUDIMIR, I. (2017) Design of sheet-pile wall according to Eurocode 7. **BS Thesis.** Faculty of Civil Engineering, University of Rijeka, Rijeka, Croatia. In Croatian (Supervisor: Jagodnik, V.)

5. ĆIĆA, S. (2017) Stiffness parameters of Rijeka clay. **BS Thesis.** Faculty of Civil Engineering, University of Rijeka, Rijeka, Croatia. In Croatian (Supervisor: Jagodnik, V.)


7. GAŠPARIĆ, L. (2018) Influence of pH value on the shear strength of soil. **BS Thesis.** Faculty of Civil Engineering, University of Rijeka, Rijeka, Croatia. In Croatian (Supervisor: Jagodnik, V.)


11. MARETIĆ, A. (2018) Unconsolidated undrained shear strength of laboratory prepared samples. **BS Thesis.** Faculty of Civil Engineering, University of Rijeka, Rijeka, Croatia. In Croatian (Supervisor: Jagodnik, V.)


17. ROJNIĆ, N. (2018): Toppling failures in rock masses. **BS Thesis.** Zagreb, Faculty of Civil Engineering of the University of Rijeka. (Supervisor: Arbanas, Ž.)


Note:
Please fill and submit this form by **30 March 2019** to ICL Network <icl-network@iclhq.org>

Less than 2 printed pages.

Activities are recommended to submit to the ICL-IPL activities of Landslides: Journal of International Consortium on Landslides.