Date of Submission	26 October 2020

IPL Project (IPL - 266) Annual Report Form 2020

1 January 2019 to 31 December 2019

1. Project Number (approved year) and Title,

   IPL – 266 (approved year: 2017)

   Title: Studying landslide movements from source areas to zone of deposition using a deterministic approach

   Main Project Fields: (1) Technology Development: B. Hazard Mapping, Vulnerability and Risk Assessment

2. Name of Project leader

   Mateja Jemec Auflič PhD

   Affiliation: Geological information Centre, Geological Survey of Slovenia

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   Core members of the Project: Names/Affiliations: (4 individuals maximum)

   Tina Peternel, PhD (GeoZS), Jernej Jež, PhD (GeoZS), Mitja Janža, PhD (GeoZS), Prof. dr. Matjaž Mikoš (UL FGG)

3. Objectives: (5 lines maximum)

   The main objective of this project is an interdisciplinary approach aimed at developing a methodology for risk assessment of landslides and debris flows, which will include landslide origin (source areas) modelling, assessment of deposition volume, determination of rheological characteristics of the material, and modeling of the runout distance and the zone of deposition.

4. Study Area: (2 lines maximum)

   Studying landslide movements from their source areas to the zone of deposition is performed in two selected pilot areas: at the Stože landslide and at the Potoška planina landslide.

5. Project Duration (1 line maximum)

   3 years (May 1, 2017 – April 30, 2020).

6. Report

1) Progress in the project: (30 lines maximum)

Project “Studying landslide movements from source areas to zone of deposition using a deterministic approach” was approved in November, 2017. Considering that the Potoška planina landslide lies above the village Koroška Bela, which occupies an area of 1.02 km^2 and is densely populated (with more than 2,200 inhabitants), the landslide could represent a huge hazard to inhabitants and public infrastructure (i.e., a major railway, local road and steel factory). The geological and tectonic setting of the wider Potoška planina area is fairly complex and consequently is very prone to different types of slope mass movements. In the third year of present IPL project the near real time GNSS system has been established for monitoring landslide surface displacements. Seven low-cost GNSS units were installed to supplement the existing instrumentation with the monitoring of surface movements. The GNSS hardware and data processing employed in this study have been developed in the framework of the Geodetic Integrated Monitoring System (GIMS) project (https://www.gims-project.eu/). The GNSS component of the GIMS unit brings several innovations to the recent remote sensing landslide monitoring techniques. The station hardware is among the first types of low-cost dual-frequency GNSS equipment successfully deployed and used operatively to monitor an active landslide, while the processing software has been developed as an open-source application capable of matching the performance of the state-of-the-art Bernese software. The performance of the GNSS monitoring system was evaluated through a comparison with geodetic measurements. As geodetic measurements were not carried out at the exact locations of the GNSS units, the measurements recorded at the geodetic point (i) located within the area of equivalent kinematic characteristics and (ii) closest to the individual GNSS unit, were considered. It should be noted that the GNSS displacements are relative with respect to unit 7 (reference station), which is assumed to be stable. The detailed inspection of the displacement rates shows the complex nature of the landslide surface kinematics at this location. During dry periods, the area recorded a continuous displacement rate of 0.48 mm/day, which is four times faster compared to the constant displacement rate during the dry period recorded at the head of the landslide. The highest displacement rate observed at the site occurred during rain event 1 between 16 November 2019 and 26 November 2019, when it reached 17.69 mm/day.

2) Planned future activities or Statement of completion of the Project (15 lines maximum)

In the last year of the ongoing IPL project we will define boundary conditions and the parameters and variables for setting-up 3D hydrogeological models of the study areas, which will be based on observed meteorological, hydrogeological, and vegetation data (precipitation intensity, temperature, discharge measurements of springs and surface streams, infiltration capacity and water saturation of soil, groundwater table, and vegetation cover properties). The developed

models will allow for spatially distributed and transient modelling of the hydrological cycle processes induced by meteorological conditions, particularly the precipitation amount and intensity. The results of hydrological modelling will be introduced into the geomechanical model to forecast critical precipitation conditions for landslide triggering.

3) Beneficiaries of Project for Science, Education and/or Society (15 lines maximum)

The results concerning the volume and deposition modelling presented in the form of thematic maps will provide an effective tool for the work of Civil Protection when dealing with landslides, improving the existing or creating a new Early Warning System (EWS) and creating risk assessments of unpredicted natural disasters. They could also be used in spatial planning and proper placement of infrastructures in relation to potential risks due to landslides and debris flows.

4) Results: (15 line maximum, e.g. publications)

ŠEGINA, Ela, PETERNEL, Tina, URBANČIČ, Tilen, REALINI, Eugenio, ZUPAN, Matija, JEŽ, Jernej, CALDERA, Stefano, GATTI, Andrea, TAGLIAFERRO, Giulio, CONSOLI, Angelo, REYES GONZÁLEZ, Joaquín, JEMEC AUFLIČ, Mateja. Monitoring surface displacement of a deep-seated landslide by a low-cost and near real-time GNSS system. *Remote sensing*, ISSN 2072-4292, 2020, vol. 12, no. 20, str. 1-26, doi: 10.3390/rs12203375.

BEZAK, Nejc, JEMEC AUFLIČ, Mateja, MIKOŠ, Matjaž. Application of hydrological modelling for temporal prediction of rainfall-induced shallow landslides. *Landslides : Journal of the international consortium on landslides*, ISSN 1612-510X. [Print ed.], jul. 2019, letn. 16, št. 7, str. 1273-1283, ilustr. https://link.springer.com/article/10.1007/s10346-019-01169-9, doi: 10.1007/s10346-019-01169-9.

Note:

1) If you will change items 1)-6) from the proposal, please write the revised content in Red.
2) Please fill and submit this form by 30 March 2020 to ICL Network <icl-network@iclhq.org>