| Date of Submission | 28 August 2017 |
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## IPL Project Proposal Form 2017

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title: Studying landslide movements from source areas to zone of deposition using a deterministic approach
2. Main Project Fields: (1) Technology Development: B. Hazard Mapping, Vulnerability and Risk Assessment
3. Name of Project leader: dr. Mateja Jemec Auflič

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   Core members of the Project: Tina Peternel, PhD (GeoZS), Jernej Jež, PhD (GeoZS), Mitja Janža, PhD (GeoZS), Prof. dr. Matjaž Mikoš (UL FGG)
4. Objectives: 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.
5. Background Justification: This research project is focused on landslides investigations and conditions required for mobilization into debris flow. The landslide and debris flow origin (source areas) was determined by previous studies using spatiotemporal factors while rainfall, velocity, volume of deposit, sliding/flow path, and deposition area are more difficult to predict and manage and were not yet considered in studying the dynamics of the landslide. Therefore, in order to determine movement and hazard assessment regarding potential mobilization of the landslide mass into a rapid debris flow, the following key parameters will be studied: geological structure, slope inclination (relief), geomechanical characteristics of the soil, catchment area of surface water and groundwater, and rainfall threshold above which landslide failure is initiated.
6. Study Area: Studying landslide movements from their source areas to the zone of deposition will be performed in two selected pilot areas: at the Stože landslide and at the Potoška planina landslide.
7. Project Duration: 3 years (May 1, 2017 – April 30, 2020).
8. Resources necessary for the Project and their mobilization: The total project budget is 300.000 EUR, approved in 2017 by Slovenian Research Agency, covering materials and personnel costs for 57.15 man-months (principal researchers from GeoZS, research collaboration with UL FGG).
9. Project Description: The proposed research project is aimed at studying landslide movements from their source areas to the zone of deposition using a deterministic approach. Shallow landslides, soil slips and low speed movements may cause failure of structures but are not usually dangerous for humans. While a highspeed, long-runout and wide-spreading landslides may cause a greater disaster

since they occur more suddenly, without showing any prior signs of cracks. Therefore only a small possibility exists for a timely evacuation. Thus the significance of landslide dynamics from their origin to the deposition areas is becoming crucial to reduce human loss from landslides and assess landslide hazard. In doing so, the following questions are pursued: where can landslides occur (place of origin), when (rheological properties of material, rainfall), how extensive can they be (magnitude), and where can landslides act (place of action)? Therefore, in order to determine movement and hazard assessment regarding potential mobilization of the landslide mass into a rapid debris flow, the following key parameters will be studied: geological structure, slope inclination (relief), geomechanical characteristics of the soil, catchment area of surface water and groundwater, and rainfall threshold above which landslide failure is initiated. The existing landslide susceptibility map will be upgraded for the wider catchment of Potoška planina and Stože landslides in a detailed scale which will be directly applicable in spatial planning, planning of prevention measures, and mitigation measures. Developed hydrogeological models for both study cases will enable spatially distributed and transient modelling of processes of the hydrological cycle. At the same time integration into slope stability model will significantly improve the accuracy of landslide prediction models. The results of modeling and the rheological characteristics of the sampled soils will enable the prediction of the landslide source area, its spreading and possible mobilization into debris flow and 3D visualisation of potential landslide areas at different scales. These objectives will be achieved through extensive fieldwork in order to capture the data needed to improve the reliability of the modeling results.

10. Work Plan/Expected Results: The structure of the proposed IPL project consists of 5 Work Packages: (1) Geological, geomorphological, geophysical, geotechnical and hydrogeological investigations in pilot areas; (2) Rheological investigations of materials in pilot areas; (3) Analytical and model-based prediction of landslide movements; (4) 3D maps of landslide hazards; (5) Project management and reports. A detailed plan for the implementation of individual Work Packages of the project and the timetable for the 3 years is shown in Table 1.

| TIME SCALE | | YEAR 1 | YEAR 2 | YEAR 3 |
|---|---|---|---|---|
| **WP1** | **Geological, geophysical, geotechnical and hydrogeological investigations in pilot areas** | | | |
| 1.1 | Geological mapping of the Stože landslide and the wider Koroška Bela catchment | * * * * * * * * | | |
| 1.2 | Shallow excavation and boreholes | * * * * * | | |
| 1.3 | Lithological and geomechanical characteristics of material | * * * | | |
| 1.4 | Geophysical measurements | * * * * * | | |
| 1.5 | Hydrogeological measurementse (infiltration, groundwater table) | * * * * | | |
| **WP2** | **Rheological investigations of materials in pilot areas** | | | |
| 2.1 | Rheological characteristics of the material | * * * * * | | |
| **WP3** | **Analytical and model-based prediction of landslide movements** | | | |
| 3.1 | Geological maps of Stože landslide and wider Koroška Bela catchment | * * * * * | | |
| 3.2 | Landslide source area identification using Lidar-derived DEMs | | * * * * * | |
| 3.3 | Hydrological modelling | | * * * * * | |
| 3.4 | Modelling of landslide initiation, movement and spreading (LS-RAPID) | | * * * * * * * | |
| 3.5 | Modelling landslide volume (Flo-2D ) | | | * * * * * * |
| **WP4** | **3D maps of landslide hazards** | | | |
| 4.1 | Conceptual model for hazard maps | | | * * * |
| 4.2 | 3D landslide hazard maps in different scales | | | * * * |
| **WP5** | **Reports** | | | |
| 5.1 | Intermediate annual reports | * * | * * | |
| 5.2 | Final report | | | * * * |

Table 1: Grant chart of the project

11. Deliverables/Time Frame: WP1 is the most comprehensive, consisting of geological, geomorphological, geophysical, geotechnical and hydrogeological research done on the field of pilot areas. The field work described in WP1 will mostly take in the first year of the project, and to a lesser extent in the last year when field verification of the developed models will be performed. The gained field data and samples will be used for input data for further research, as outlined in WP 2. Analytical and model-based prediction of landslide movements from the origin point to the deposit areas, using a deterministic approach, will start in the second year of the project once data from the field works and laboratory will be available. In WP 4 the results of modelling of landslide movements from the origin point to the deposit areas, will be shown as 3D maps. This will serve as the basis for spatial planning and hazard assessment for the Stože landslide (Log pod Mangartom) and the Koroška Bela catchment (Potoška planina). The activities outlined in WP 5 will take place during the whole time of the project.
12. Project Beneficiaries: 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.
13. References (Optional):


- Jež, J., Mikoš, M., Trajanova, M., Kumelj, Š., Budkovič, T., Bavec, M. (2008) Koroška Bela alluvial fan - the result of the catastrophic slope events (Karavanke Mountains, NW Slovenia. Geologija 51 (2): 219–227
- Peternel, T., Kumelj, Š., Oštir, K., Komac, M. (2017) Monitoring the Potoška planina landslide (NW Slovenia) using UAV photogrammetry and tachymetric measurements. Landslides, 14/1, 395-406
- Mikoš, M., Fazarinc, R., Majes, B. (2007) Delineation of risk area in Log pod Mangartom due to debris flow from the Stože landslide. Acta geographica Slovenica 47(2): 171–198
- Sassa, K., Nagai, O., Solidum, R., Yamazaki, Y., Ohta, H. (2010) An integrated model simulating the initiation and motion of earthquake and rain induced rapid landslides and its application to the 2006 Leyte landslide. Landslides 7:219-236


Note: Please fill and submit this form by 1 September 2017 to ICL secretariat <secretariat@iclhq.org> and ICL network <ICL-network@iclhq.org>