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List of IPL Project Proposal

Date of Submission	04 November 2015

IPL Project Proposal Form 2016

(MAXIMUM: 3 PAGES IN LENGTH)

1. **Project Title:** Landslide inventory and Susceptibility map in Durres and Kavaja region

2. **Main Project Fields**

Select the suitable topics. If no suitable one, you may add new field.

(1) Technology Development

A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

(2) Targeted Landslides: Mechanisms and Impacts

A. Catastrophic Landslides, B. Landslides Threatening Heritage Sites

(3) Capacity Building

A. Enhancing Human and Institutional Capacities

B. Collating and Disseminating Information/ Knowledge

(4) Mitigation, Preparedness and Recovery

A. Preparedness, B. Mitigation, C. Recovery

3. **Name of Project leader** Prof. Hasan Kulici

Affiliation: (office and position) Director of Engineering Geological department in Albanian Geological Survey (AGS)

Contact: (postal address, fax, phone, email) Rruga e Kavaje Nr 153. Tirane, Albania, 0672053196, hkulici@yahoo.com

Core members of the Project

Olgert Jaupaj Chief of GIS section in Geoinformation department in AGS

Mentor Lamaj Chief of engineering geological section in AGS

Names/Affiliations: (4 individuals maximum)

4. Objectives: The final goal of this project is to create landslide inventory in GIS and to produce a Landslide Susceptibility Map in order to prevent or minimize the loss of life and damage of property and livelihoods caused by landslides. Landslide susceptibility map can be used as supporting information for Local administrators and local inhabitants for a better landuse planning.

5. Background Justification: Albania Geological Survey is the only institution in Albania which is dealing with landslides. For the moment we are only making reports for landslides for Civil Emergency when a landslide occurs in urban area.

6. Study Area: The study is will be in Durres and Kavaja region which have a high frequency of landslides occurrences. The study region includes a high density of local inhabitants and infrastructures

will be concentrated in the future (2 lines maximum; where will the project be conducted/applied?)

7. Project Duration: (1 line maximum) 2 years
8. Resources necessary for the Project and their mobilization

   Personnel, Facilities, and Budgets

   For this project all the department of engineering geological and geophysics will be in our help, also we will have a close cooperation with the faculty of Geology in Albania. We will need: 3 GPS for gathering the coordinates of Landslide crown, 3 photograph camera, 2 laptops for mapping and analysis in ArcGis, 1 HDD to collect all the information from field surveys and a drone.

   The Budget for this project will be approximately 30.000 euro
9. Project Description:
   a. Literature review: Collection of all bibliographic materials and historic information for this area. Collection literature from international scientific and technical journal articles concerning landslides classification system,
   b. Interpretation of landslides occurrences from aerial photographs, Google earth according with field verification
   c. Field surveys for looking new landslides, evaluate the landslide evolution, present state and activity, to confirm the aerial photographic interpretations
   d. Inventory map compilation: Each landslide identified through orthophotos or in the field will be mapped as closed polygon in Arc_GIS
   e. Create a Gis Database for each landslide.
   f. Select landslide causative factors on the basis of previous fieldwork survey and landslide inventory analysis for landslide susceptibility ma preparation
   g. To evaluate the role of landslide causative factors in the study area and prepare input factor
   h. Apply bivariate method for deriving landslide susceptibility map of the study areas.
   i. Based on the final map of the study areas, recommendation for landslide hazard prevention measures will be given in order to help the local community to be prepared and to respond adequately to disasters

10. Work Plan/Expected Results: (20 lines maximum; work phases and milestones)

This project aimed to create database for landslide inventory and to generate a Landslide susceptibility map for Durres and Kavaja. The construction of landslide susceptibility maps represents a significant step towards landslide mitigation in these areas. The Landslide susceptibility map will help the local government for the prediction of the risks. The local government will be in position to propose a land-use planning using this map in order to reduce the landslides risk

11. Deliverables/Time Frame: (10 lines maximum; what and when will you produce?)

	1-3	3-6	6-12	12-14	14-16	16-18	18-21	21-24
Literature review								
Data Acquisition								
Field mapping and investigation process								
Landslide database generation in GIS								
Developing landslide inventory map								
Generation of Landslide Susceptibility map								
Data verification finalization of results								
Final Report								

12. Project Beneficiaries: (5 lines maximum; who directly benefits from the work?

   a. Albanian Geological Survey
   b. Ministry of industries
   c. Albanian Civil Emergency
   d. Local Government

13. References (Optional): (6 lines maximum; i.e. relevant publications)

a. **Group authors, (2008).** *Geology of Albania***,** Albanian Geological Survey

b. **NGUYEN THANH LONG, (2008).** *Landslide susceptibility mapping of the mountainous area in a Luoi district, Thua Thien Hue province, Vietnam,* doctoral thesis, University of Vrije Brussel

c. **Rebekah Gereldene Singh, (2009).** *Landslide classification, characterization and susceptibility modeling in*

d. *Kwazulunatal,* degree of Master of Science, University of the Witwatersrand

e. **Pank JAISWAL (2011),** *Landslide risk quantification along transportation corridors based on historical information,* doctoral thesis, University of Twente

f. **C.J. Van Westen** *Geo-Information tools for Landslide Risk Assessment. An overview of recent developments*

g. **C.J. van WESTEN T.W.J. VAN ASCH R. SOETERS, (2005).** *Landslide hazard and risk zonation —why is it still so difficult?*

h. **Paola Reichenbach, Mirco Galli, Mauro Cardinale, Fauste Guzzeti,Francesca Ardizzone,** *Geomorphological mapping to assess landslide risk: Concepts, methods and applications in Umbria region of central Italy*

Note: Please fill and submit this form by 15 November 2015 to ICL network <ICL-network@iclhq.org>

Date of Submission	11 August 2015

IPL Project Proposal Form 2016

1. **Project Title:**
   RIPLEY LANDSLIDE MONITORING PROJECT (ASHCROFT, BC, CANADA)
2. **Main Project Fields**
   Technology Development - Monitoring and Early Warning
3. **Name of Project leader: Dr. Peter Bobrowsky**

Affiliation: Senior Scientist, Geological Survey of Canada

Contact: 9860 West Saanich Road, PO Box 6000, Sidney, BC, Canada, V8L4BA

Core members of the Project: GSC, University of Alberta, Canadian National Railway, Canadian Pacific Railway

Names/Affiliations:

David Huntley (GSC), Michael Hendry (U of A), Chris Bunce (CP), Tom Edwards (CN)

4. **Objectives: The aim of this project is two-fold. First to identify the nature and mechanism of movement on this small but active landslide which poses an ongoing threat to the safety and integrity of the rail infrastructure at the site. Second, this project will involve the application, testing and comparison of results from multiple methods of monitoring; including traditional and innovative technologies.**
5. **Background Justification: As Canada's economy continues to grow, there will be an increasing demand for safe and secure transportation of natural resources, agricultural products, manufactured goods, people and other cargo using the national network of railways. In the Cordillera of southern British Columbia, landslides are costly geological hazards that have challenged the major rail companies since the late 19th Century. Today and in the near future, pronounced economic and environmental repercussions are anticipated if railways are severed and infrastructure damaged by landslide activity in mountainous western Canada. In southern BC, both Canadian Pacific (CPR) and Canadian National (CNR) railways run along the lower valley slopes of Thompson and Fraser rivers. Up to 80 trains per day, with lengths up to 4 km, run through these valleys. Landslides in this transportation corridor have the potential to stop the flow of exports and imports to, and from the Port of Vancouver, resulting in economic losses that grow exponentially with the duration of the interruption of services. One very susceptible area occurs at the Ripley Landslide where both CN and CPR tracks run side-by-side and are being impacted by this slow moving landslide. Understanding the nature and mechanism of movement at this site is critical to properly mitigate the slope from further movement. The resultant knowledge will be readily applied elsewhere to similar sites across Canada.**

6. **<u>Study Area</u>: The landslide is located along the Thompson River, some 10 km south of the village of Ashcroft, British Columbia, Canada.**
7. **<u>Project Duration</u>: 5 years (2013-2018)**
8. **<u>Resources necessary for the Project and their mobilization:</u>**
   The project requires geological and engineering technical expertise at multiple levels. Experts in the rail industry are involved (engineers), as are several geotechnical engineers (Professors and graduate students) from the University of Alberta; geological and remote sensing expertise is being provided by Natural Resources Canada. Facilities from each of these institutes and organizations are at the disposal of the project. Funding is being provided through Transport Canada and the Geological Survey of Canada, as well as directly from industry and research grants to the university personnel. Approximately $250,000 per year has been spent during the first two years of the activity.
9. **<u>Project Description</u>: As Canada's economy grows, an increasing volume of imports and exports is expected to be transported by rail across the country. Vital infrastructure and operations are at risk from landslides in the section of the Canadian National (CN) and Canadian Pacific (CP) railway corridor that runs through the Thompson River valley between Ashcroft and Spence's Bridge in southern British Columbia. A suite of methods are being applied, tested and compared at the site including fiber optic measurements, terrain mapping, permanent global positioning stations, corner reflectors for radar satellite imagery (interferometry), lidar, geophysical surveys, piezometers, inclinometers, ShapeAccelArray, borehole/drilling, weather stations, moisture probes, etc. Additional techniques are being applied annually to the site for long term monitoring goals.**
10. **<u>Work Plan/Expected Results</u>: Project team participates monthly in teleconference call to review and discuss progress and plans for the project. Project team meets annually in the fall for a workshop to review annual progress with stake holders and interested parties. Fieldwork in ongoing annually with multiple visits to the site by all participants. Collaborators plan cost effective deployment of equipment. Data are collected remotely and routinely as necessary from the site. Presentations are given at national and international venues. A number of publications have already resulted and will continue to be produced during the history of the project.**
11. **<u>Deliverables/Time Frame</u>: Several publications have already been produced. Expectation is to continue publishing papers annually as well as present progress and results at meetings across the globe annually. Project is expected to run 5 years (3 years remaining).**
12. **<u>Project Beneficiaries</u>: Primarily the rail industry, secondary professional practitioners who will apply methods elsewhere across Canada and abroad, finally the general public given enhanced security and safety involving rail transport and general landslide**

monitoring and mitigation practices.

13. <u>References</u>:

Bobrowsky, P. et al. (2014) Multi-parameter monitoring of a slow-moving landslide: Ripley Landslide, British Columbia, Canada. *In* Proceedings Volume, *International Association of Engineering Geologists*, 5 p., Turin, Italy

Huntley, D. and Bobrowsky, P. (2014) Surficial geology and monitoring of the Ripley Slide, near Ashcroft, British Columbia, Canada; *Geological Survey of Canada*, Open File 7531.

Huntley, D., et al. (2014) Fiber optic strain monitoring and evaluation of a slow-moving landslide near Ashcroft, British Columbia, Canada; Proceedings Volume, 3rd *World Landslide Forum 3*, 6 p. Beijing, China

Macciotta, R., et al. (2014) Monitoring of the Ripley Slide in the Thompson River Valley, B.C. Proceedings Volume, *Geohazards 6 Symposium*, Kingston, Ontario, Canada

Note: Please fill and submit this form by 15 November 2015 to ICL network <ICL-network@iclhq.org>

Date of Submission	

IPL Project Proposal Form 2016

(MAXIMUM: 3 PAGES IN LENGTH)

1. **Project Title:**

   Analysis and identify of landslides based on species distribution and surface temperature difference

2. Main Project Fields

   (1) Technology Development

   ✓A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

   (2) Targeted Landslides: Mechanisms and Impacts

   A. Catastrophic Landslides, B. Landslides Threatening Heritage Sites

   (3) Capacity Building

   A. Enhancing Human and Institutional Capacities

   B. Collating and Disseminating Information/ Knowledge

   (4) Mitigation, Preparedness and Recovery

   A. Preparedness, B. Mitigation, C. Recovery

3. **Name of Project leader**

Ying Guo

Affiliation:

Institute of Cold Regions Science and Engineering,Northeast Forestry University,China.

Contact:

No.26 Hexing Road, Harbin, China.150040.

Institute of Cold Regions Science and Engineering, Northeast Forestry University,China.

Tel.86-451-82191590; E-mail:samesongs@163.com

Core members of the Project

Zhaoguang Hu

Chunjiao Wang

Chengcheng Zhang

Hua Jiang

(All of above belongs to Institute of Cold Regions Science and Engineering, Northeast Forestry University,China.)

4. **Objectives:** (5 lines maximum; what you expect to accomplish?)

   In Northeast high latitude permafrost zone of China, forest is extensive distribution, landslides distribution will associate with tree species distribution. Using radar data and small UAV images, combining with manual investigation, finally to obtain landslides distribution in whole forest area.

5. **Background Justification:** (10 lines maximum)

   In Northeast high latitude permafrost zone of China, forest is extensive distribution, during the past 50 years, there occur frequently landslides affected by global climate change and human engineering activities. This landslide is slowly in its beginning and processing, and affected by extensive forest, it is very difficult in this area to conduct landslides survey in large scale. In cold regions, landslides often associate with permafrost melting process and surface hydrological conditions, the differences in surface soil temperature and soil moisture will result in the difference of tree species. So in this study, using of radar data and small UAV images, combining with manual investigation, finally to obtain landslides distribution in whole forest area.

6. **Study Area:** (2 lines maximum; where will the project be conducted/applied?)

   Hinggan forest Mountains located in Northeast of China.

7. **Project Duration**: (1 line maximum)

   2016.04——2020.04

8. **Resources necessary** for the Project and their mobilization

   Personnel, Facilities, and Budgets

   Satellite data, small UAV, ground penetrating radar, High-density electrical equipment, GPS

9. **Project Description:** (30 lines maximum)

   During the study of IPL-167 project, in K175-K183 sections of Beian-Heihe Highway, we found species differences and water content different between on-landslide body and outside-landslide body, similar situation in other area is also found by UAV survey. In this project, using L-band and InSAR data to analyze surface deformation, using LANDSAT8 data to analyze near surface temperature, using Modes data to analyze surface water distribution, combining with ground-penetrating radar, high-density electrical measurement, GPS measurement, PANDA2C measurement to obey landslide maps in this area and single landslide prediction.

10. **Work Plan/Expected Results:** (20 lines maximum; work phases and milestones)

    Through this project, landslides distribution maps in forest mountain will be got, and will get the method to judge the landslide distribution in similar regions.

11. **Deliverables/Time Frame:** (10 lines maximum; what and when will you produce?)

    2016.04--2017.04

    detailed investigation in study area, analysis validation, improving research methods

    2017.04--2018.04

    conducting survey within 5km wide crossing Beian-Heihe Highway domain, selecting 10 representative landslide.

    2018.04--2019.04

    combining analysis data and ground measurements, collating and analyzing data, published research papers.

    2019.04--2010.04

    forming research methods and reporting to related to agency.

12. **Project Beneficiaries:** (5 lines maximum; who directly benefits from the work?)

The Methods and Results of this project could provide reference for forest use planning, railway line construction, highway construction, so has important environmental, economic, and engineering efficiency and important practical value.

13. **References** (Optional): (6 lines maximum; i.e. relevant publications)

HE R,JIN H,CHANG X,LV L,YU S,YANG S,WANG S,SUN G.2009.Degradation of Permafrost in the Northern Part of Northeastern China :Present State and Causal Analysis, Journal of Glaciology and Geocryology-Volume 5,829-834.ISSN：1000-0240

JIN H，LI SH，WANG SH，ZHAO L.2000.Impacts of Climatic Change on Permafrost and Cold Regions Environments in China, Acta Geogeraphica Sinica-Volume 2,161-174.ISSN：0375-5444

WEI ZH, JIN H, ZHANG J, YU SH, HAN X, JI Y, HE R, CH X.2011.Change Prediction of Permafrost in Northeast China in the Context of Climate Change, Scientia Sinica(Terrae)-Volume 1,74-84.ISSN:1674-7240

Note: Please fill and submit this form by 15 November 2015 to ICL network <ICL-network@iclhq.org>

Date of Submission	2 November 2015

IPL Project Proposal 2016

(MAXIMUM: 3 PAGES IN LENGTH)

1. **Project Title: A Study on Socio-economic and Environmental Impacts of Landslides**
2. **Main Project Fields: Landslide Impacts**

Select the suitable topics. If no suitable one, you may add new field.

(1) Technology Development

A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

(2) **Targeted Landslides**: Mechanisms and **Impacts**

A. Catastrophic Landslides, B. Landslides Threatening Heritage Sites

(3) Capacity Building

A. Enhancing Human and Institutional Capacities

B. Collating and Disseminating Information/ Knowledge

(4) Mitigation, Preparedness and Recovery

A. Preparedness, B. Mitigation, C. Recovery

3. **Name of Project leader: Dr. Surya Parkash**

Affiliation: (office and position): **Head, Knowledge Management & Communication Division, National Institute of Disaster Management, Ministry of Home Affairs, Govt. of India**

Contact: (postal address, fax, phone, email): **5-B, I.P. Estate, Ring Road, New Delhi-110 002, India Fax:+91-11-23702446 Phone:+91-11-23724310 Email: surya.nidm@nic.in, suryanidm@gmail.com**

Core members of the Project

Names/Affiliations: (4 individuals maximum)

4. **Objectives:** (5 lines maximum; what you expect to accomplish?)

- Systematic compilation of socio-economic and environmental impacts data from the archival records of the different affected states in India
- Statistical analysis of landslide impacts (state-wise distribution)
- Identify and assess the significant factors affecting degree of landslide impacts
- Formulation of contextual and rational strategies for reducing landslide impacts and risks
- Suggest action plan for different stakeholders for prevention, mitigation and preparedness against landslides

5. **Background Justification:** (10 lines maximum)

Landslides have been frequently affecting the hilly terrains in India. But there are no credible systematic structured scientific or socio-economic and environmental data bases on landslides available from the affected states. It has been often very difficult to decipher and differentiate between the degree of incidences and impacts of landslides among the various states, due to lack of adequate and reliable data. Although some records are made in the revenue departments or by the concerned field agencies, after a landslide event occurs and causes damages / losses of human lives, livestock, crops, land, buildings, roads, and other infrastructures / properties. Sometimes, the significant landslide events are reported in the media like newspapers, TV and related websites. All such landslides records or information are sparsely distributed across different stakeholders but no systematic efforts have been made to organize this data / information systematically for assessing the cumulative impacts of landslides in any particular district or state. However, this information is very important in planning and decision making for investments in avoidance, prevention, mitigation and preparedness against landslide risks. Hence, the present study proposes to initiate such an attempt to compile data base on landslide incidences and impacts in different states of India.

6. **Study Area:** The study will be done in all the states affected by landslides in India.
7. **Project Duration:** 1 year (2016)
8. **Resources necessary for the Project and their mobilization**

   The resources for the implementation of project would include communication facilities like computers, internet, email, fax, phone and postal services for correspondence with concerned authorities, officials, organizations / departments / ministries to get available / existing data on landslides from the archival records and their consequences either directly or through meetings and workshops. A statistical software will be used for data analysis and interpretation. Finally the results will be published and disseminated along with recommendations and outcome of the study among the concerned stakeholders for promoting their capacity to reduce landslide risks and impacts in the affected areas. The overall budget will include expenses on the facilities, services and meetings / workshops for this work.
9. **Project Description:** Landslides have adversely affected the lives, livelihood, living places, livestock and life-styles of the people in the hilly terrains in India. But there have not been any systematic efforts to compile database on the impacts of landslides so that a rational and contextual approach could be adopted with due considerations of the socio-economic and environmental aspects. Hence, it is proposed to systematically compile the available / existing data on landslide impacts from the archival records in different states of India.

10. **Work Plan/Expected Results:** (20 lines maximum; work phases and milestones)

    The work plan will include the following phases of activities

    a. Communication, Data Collection and Compilation – 3 to 4 months
    b. Re-organization of available data into a systematic structured database – 1 month
    c. Analysis of landslide database and assessment of the degree of landslide problems – 2 months
    d. Plotting and Visualization through graphs and maps for understanding the distribution and trends of landslide incidences and impacts – 1 month
    e. Identification and assessment of underlying risk factors for landslides – 1 month
    f. Formulation of strategies for reducing landslide risks based on the above studies – 1 month
    g. Suggestions / guidelines for implementation and sustenance – 1 month

h. Final Report Preparation and Publication – 2months

11. **Deliverables/Time Frame:** (10 lines maximum; what and when will you produce?)

The study will deliver credible systematic structured socio-economic data base on landslide incidences and impacts in different parts of India. It can also help in identifying the most important landslide events for the purpose of documentation of disasters.

12. **Project Beneficiaries:** (5 lines maximum; who directly benefits from the work?)

The major project beneficiaries will be the department of disaster management in the states and in the central government who can rely on this data and formulate their plans, policies and decisions based on the distribution of landslide incidences and impacts in their administrative territories. It will also help the scientists, engineers, environmentalists, economists and sociologists in understanding the landslide situations in these areas.

13. **References** (Optional): (6 lines maximum; i.e. relevant publications)

Parkash Surya and Nair S.S. (2008), *"National Disaster Statistical System – An Initiative for Disaster Information Management with particular reference to Landslides",* Proceedings of Central Building Research Institute (CBRI) Diamond Jubilee Conference on Landslide Management – Present Scenario & Future Direction, 10-12 February 2008, pp.55-64

Parkash Surya*: "Some Socio-Economically Significant Landslides in Uttarakhand Himalaya: Events, Consequences and Lessons Learnt"*, Chapter 12 published in Mountain Hazards and Disaster Risk Reduction (eds.: Rajib Shaw and Hari Krishna Nibanupudi), Series on Disaster Risk Reduction – Methods, Approaches and Practices, published by Springer Japan, 2015, ISBN 978-4-431-55241-3, ISBN 978-4-431-55242-0(eBook), pp.211-232

Parkash Surya: *"Historical Records of Socio-economically Significant Landslides in India",* Journal of South Asia Disaster Studies, published by SDMC – Delhi, Vol.4, No.2, December 2011, pp.177-204, ISSN 0974-6463

Note: Please fill and submit this form by 15 November 2015 to ICL network <ICL-network@iclhq.org>

2015 October 27th	

IPL Project Proposal Form 2015

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title: *INTEGRATED SYSTEMS FOR LANDSLIDES MONITORING, EARLY WARNING AND RISK MITIGATION ALONG MOTORWAYS*
2. Main Project Fields

Select the suitable topics. If no suitable one, you may add new field.

(1) Technology Development

A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

(3) Capacity Building

B. Collating and Disseminating Information/ Knowledge

(4) Mitigation, Preparedness and Recovery

A. Preparedness, B. Mitigation,

3. Name of Project leader

Prof. Eng. Pasquale VERSACE

Affiliation: (Director of Laboratory of Environmental Cartography and Hydraulic and Geological Modeling – CAMILab, DIMES, University of Calabria; Consorzio Interuniversitario per l'Idrologia CINID (Interuniversity Consortium for Hydrology) - POTENZA).

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Core members of the Project

Names/Affiliations: (4 individuals maximum)

- Ing. Giovanna Capparelli / CAMIlab, DIMES, University of Calabria
- Prof. Giuseppe Di Massa / Department of Computer Engineering, Modeling, Electronics and Systems Science (DIMES), University of Calabria
- Ing. Fabrizio Paoletti /Autostrade Tech S.p.A - Via Bergamini, n. 50 00159 ROMA
- Prof. Antonino Cancelliere Department of Civil and Environmental Engineering (DICA), University of Catania, Viale Andrea Doria 6 - 95125 - Catania

4. Objectives: the project aims to develop an integrated early warning system (EWS) in order to mitigate the landslide risks along motorways and other transport infrastructures. The final goal is to timely identify the potentially dangerous landslides for define information delivery and activate the necessary safeguard measures.
5. Background Justification: Landslides represent a widespread natural hazard that often cannot be solved with structural works because their costs would be unsustainable. The planning of non-structural measures is very often the only solution. Advanced early warning systems, linked to the proper contingency plans, can save lives and prevent the risk. In particular, along the major transport infrastructures the landslides problem is extremely complex and requires the development of specific

solutions.

6. Study Area: three highway stretches, located in the south of Italy.
7. Project Duration: (8 years): 3 years for research development and 5 years for experimental application of devices and models designed.
8. Resources necessary for the Project and their mobilization

   The project involves about 70 people and around 13000 man-days. This research is funded by the Italian Ministry of Education, University and Research (MIUR), PON Project No. 01_01503 in the framework of the National Operational Programme for "Research and Competitiveness" 2007-2013. The total budget is almost 10 million euros.
9. Project Description: (30 lines maximum)

   The project develops original components of the EWS (risk scenarios, monitoring sensors, networks, models, data acquisition and processing centers, traffic control centers) and provides its integration.

   (1) Through the inventory and characterization of landslide types in the test sites, a proper procedure for risk scenarios identification is defined, which includes the types and guidelines for on-site testing and the presentation of results, such as the risk maps.

   (2) Landslides can be observed through appropriate monitoring systems: the “punctual system”, made up by a network of sensors that measure the local displacements, and the “areal system” to remotely measure the displacements in large areas. In particular, as punctual systems, in addition to the classical schemes of in situ geotechnical control, a network of acceleration sensors by MEMS technology and an original system designed for the measurement of position and inclination have been developed. Among the areal sensors: a system based on interferometric techniques of image analysis which use a synthetic aperture radar on a rail, operating at 17 GHz; two new radar sensors in X-band and in L-band, and the relative on-board electronics. A wireless network system, with smart sensors, acquires and transmits data.

   (3) Simulation models which include the analysis of triggering condition and propagation phase. In particular, the models are represented by: (A) a physically based model, developed in a GIS environment, which provides the soil water circulation, the water and energy balance at the catchment spatial scale and the probabilistic slope stability conditions; (B) a punctual complete model that analyzes the hydrological processes at slope-scale and the soil deformations induced by soil water pressure, both in saturated and unsaturated conditions; (C) for phenomena such mud-flows, based on to Macroscopic Cellular Automata, a model provides the landslide propagation and the affected area.

   (4) The setting up of the center of data acquisition and processing and of the center of traffic control is the core of the integrated system. The former, newly designed, acquires and processes data ranging in intensity, dimensions, characteristics and information content. The latter integrates the informations regarding monitoring and early warning of hydrological risk with the ITS (Intelligent Transport System) and other aspects of management of infrastructure.
10. Work Plan/Expected Results: (20 lines maximum; work phases and milestones)

    The project includes a research step, in which all the components of the system are developed and a test step, in areas where the integrated system is experimentally validated. The project is organized in "development goals" (DG), which comprise: a) definition of procedures aimed at identification of event and risk scenarios (DG1); b) development of sensors able to monitor the stability condition of single points of a slope or large areas (DG2 and DG3); c) development of mathematical models suitable for simulation of triggering and propagation of landslides induced by rainfall (DG4); d) realization of a data transmission system, able to collect and transmit the recorded data from sensors (DG5); e) development of a center of data acquisition and processing , aimed at acquisition, validation and storage of data, and able to provide information in real time (DG6); f) realization of a control center, from which alerts are sent to Authorities (DG7); g) definition of guidelines for organization and management of contingency phases (DG8). The integrated system is applied in three motorway areas (DG9).

11. Deliverables/Time Frame: (10 lines maximum; what and when will you produce?)

The project is started in October 2011 and it will be ended in October 2019. As of today, all the development activities of the research have been completed and the implementation phases of testing have been started to allow the validation of all realized devices and models. Updating of research products will be ongoing until the end of the whole project, on the basis on results of the site tests. The test step is started in October 2012, with preliminary activities concerning the scenario analysis along the selected motorway areas and choice of landslides to be monitored. The laboratory applications of research products are started in October 2013. The end of the project is scheduled for October 2019.

12. Project Beneficiaries: (5 lines maximum; who directly benefits from the work?)

The research will promote innovation in the field of environmental monitoring and of mathematical modeling of landslides, improvement of services to support mobility, the enhancement of skills of involved research groups, who will improve their level of excellence in the scientific community. The main beneficiaries will be the managers of motorways and national roads; the managers of the railways; the national civil protection; the manufacturers of the various components of the integrated system.

13. References (Optional): (6 lines maximum; i.e. relevant publications)

- Formetta G., Capparelli G.& Versace P., "Modelling rainfall induced shallow landslides in the Landslide Early Warning Integrated System project". Proceedings Books of the XVI European Conference on Soil Mechanics and Geotechnical Engineering (ECSMGE 2015).
- Costanzo S. et al. "Multiband software defined radar for soil discontinuities detection", Journal of Electrical and Computer Engineering, 2013.
- Avolio M. V. et al. "SCIDDICA-SS3: a new version of cellular automata model for simulating fast moving landslides", The Journal of Supercomputing, 2013, Vol.65, Issue 2, pp 682-696.
- Laganà R. et al. "Modeling and Processing L-Band Ground Based Radar Data for Landslides Early Warning", Journal of Electrical and Computer Eng. 2013
- Muto F. et al. "Multidisciplinary approach to evaluate landslide susceptibility along highway in northern Calabria, Italy", Geophysical Research Abstracts, EGU2014
- Capparelli G. et al. "Landslides risk mitigation along lifelines", Geophysical Research Abstracts,

Date of Submission	November 15, 2015

IPL Project Proposal Form 2016

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title: Towards Improved Landslide Mapping and Forecasting

2. Main Project Fields

Select the suitable topics. If no suitable one, you may add new field.

(1) Technology Development

A. Monitoring and Early Warning

(3) Capacity Building

B. Collating and Disseminating Information/ Knowledge

(4) Mitigation, Preparedness and Recovery

A. Preparedness, B. Mitigation

3. **Name of Project leader:** Fausto Guzzetti

Affiliation: CNR-IRPI, Director

Contact: CNR-IRPI, Via Madonna Alta 126, 06128, Perugia, Italy; tel: +390755014402, fax: +390755014420, mail: fausto.guzzetti@irpi.cnr.it

Core members of the Project

Names/Affiliations:

Nicola Casagli (Earth Science Department, University of Florence, Italy)

Mario Parise (CNR-IRPI, Bari, Italy)

Pasquale Versace (Laboratory of Environmental Cartography and Hydraulic and Geological Modeling, University of Calabria, Italy)

Giovanna Capparelli / CAMIlab, DIMES, University of Calabria

4. Objectives:

We propose an ICL project initiative (i) to review past and existing operational landslide forecasting and warning systems, (ii) to propose recommendations for the design, the implementation, and the validation of operational landslide forecasting and warning systems, (iii) to identify the best procedure for decision making when information from different source are available. We propose to limit the project to the evaluation of systems aimed at predicting rainfall induced landslides and their consequences.

5. Background Justification:

Landslides are present in all continents, and play an important role in the evolution of landscapes. They also represent a serious hazard in many areas of the world. In many regions, there is mounting interest towards the operational forecasting of landslides, and chiefly of rainfall induced landslides. A limited number of regional / national-scale forecasting and/or warning systems has been, or are, operational. The systems use different methods and tools (local and areal monitoring system, simulation models, rainfall nowcasting) to prepare the forecasts and to issues the warnings, and cover areas of very different extent, from single sites to entire nations. The systems also differ for the frequency of the forecasts (daily to hourly) and their operation history, with only a limited number of systems that have been operational for several years. The aims of the systems also vary, with some of the system designed for civil protection purposes and other systems to provide information or advice to private business. The differences make it difficult to compare the systems and to relate and evaluate their performances.

6. Study Area:

Two different levels. At very large scale, data collection all over the world. At the local scale, three monitored areas in Italy (Calabria, Umbria, Toscana).

7. Project Duration:

3 years.

8. Resources necessary for the Project and their mobilization
Personnel, Facilities, and Budgets

The project involves about 15 people, and internal resources from the involved institutions (CNR, University of Florence, and University of Calabria). The project also involves instrumentation for field survey and experimental and representative sites.

9. Project Description:

Designing an operational landslide forecasting and/or warning system is a challenging task that requires interdisciplinary skills and expertise. A typical forecasting system has many components, including landslide and meteorological data, forecasting models and tools to define their uncertainties, adequate SW and HW, and criteria and tools for validation of the forecasts and to deliver the warnings. It is critical that all components are robust, because a chain has the strength of its weakest element, and that the single components and the entire system relay on sound science, to be credible to the users.
For the Italian National Department for Civil Protection, the Institute of Research for the Hydrological Protection of the National Research Council of Italy (CNR IRPI) has designed and operates since 2010 a national system to forecast the possible occurrence of rainfall-induced landslides in Italy. The Department of Earth Sciences at the University of Florence, and the Laboratory of Environmental Cartography and Hydraulic and Geological Modeling at the University of Calabria, both long-term members of ICL, have consolidated experience in the design and the implementation of operational landslide forecast / warning systems, and are directly involved in this project proposal. Further, the proposal is open to all ICL partners, and intends to build on the specific expertise of many of the ICL partners as well as on the lessons learned from other landslide experts.

10. Work Plan/Expected Results:

The first phase of the project will consist of reviewing past and existing operational landslide forecasting and warning systems, highlighting their distribution in the different countries/continents, their level of accuracy during past events, the effective adoption of the systems by local authorities and the forensic aspects during the operation phase. This phase will allow to have a clear framework of the world situation on the topic, and will be mandatory for the implementation of the second phase. During this latter, recommendations for the design, the implementation, and the validation of operational landslide forecasting and warning systems will be proposed, based upon the outcomes derived from the first phase. The application of these recommendations will be applied during the running of the Italian experimental sites. In particular, the project will be limited to the evaluation of systems aimed at predicting rainfall induced landslides and their consequences.

11. Deliverables/Time Frame:

At the end of the first year, a first report depicting the past and existing operational landslide forecasting and warning systems for which documentation has been found will be prepared. The report will represent the basis on which to build the second year work, essentially consisting in critical evaluation of the warning systems, aimed at highlighting their positive elements, and their drawbacks as well. Further, a classification of different kind of warning system will be developed. Eventually, at the end of the third year issuing guidelines for the development of early warning systems for the prediction of rainfall-induced landslides at different operational scales will represent the main final outcome of the project.

12. Project Beneficiaries:

The project is addressed to all those governmental and administrative bodies in charge of the land management and dealing with civil protection issues. These could use the project outcomes, in direct co-operation with scientific bodies, to design, implement, and validate landslide early warning systems, personalized in function of the main physical and meteorological characters of their own areas of study/interest.

13. References:

Brunetti M.T., Peruccacci S., Rossi M., Luciani S., Valigi D. & Guzzetti F. (2010) - Rainfall thresholds for the possible occurrence of landslides in Italy. Nat. Hazards Earth Syst. Sci., 10, 447–458.

Brunetti, M.T., Peruccacci, S. et al. (2015) - Catalogue of Rainfall Events with Shallow Landslides and New Rainfall Thresholds in Italy. In: Engineering Geology for Society and Territory, 2, 1575–1579. Springer International Publishing. DOI:10.1007/978-3-319-09057-3_280.

Rossi M., Peruccacci S., Brunetti M.T et al. (2012) - SANF: National warning system for rainfall induced landslides in Italy. Proc. 11th Int. Symp. Landslides, Banff (Canada), 3-8 June 2012, 2, 1895-1899.

Date of Submission	14 November 2015

IPL Project Proposal Form 2016

1. **Project Title:** Evaluation On Social Research Approach In Determining “Acceptable Risk” And “Tolerable Risk” In Landslide Risk Areas In Malaysia

2. **Main Project Fields:** Capacity Building - Collating and Disseminating Information/ Knowledge

3. **Name of Project leader:** Ir. Dr. Che Hassandi Bin Abdullah

   Affiliation: Director of Slope Engineering Branch, Public Works Department, Malaysia

   Contact: Cawangan Kejuruteraan Cerun, Tingkat 12, Blok F, Jalan Sultan Salahuddin, 50582, Kuala Lumpur.

   No Tel:*603-2610 8888, No Fax:+603-2692 7010, email: slopes@jkr.gov.my

   Core members of the Project; Names/Affiliations: Ir. Hj. Zainal Arsad Bin Md Amin, Sakinah Binti Dahrawi Edrus, Wardatun Ahmar Binti Abdul Manan

4. **Objectives:** The main objective of the project is to enable slope designers and urban planners to come up with better decision making on hillside developments and policies. Thus, the study will extract and analyze historical landslide data in Malaysia and plot cumulative frequency (F) versus number of deaths (N) to propose “acceptable risk” and “tolerable risk” for suggested area. Besides that, this study will demonstrate the applicability of the developed F-N curves and the associated “acceptable risk” and “tolerable risk” criteria for assessing the risk level of a newly proposed development. Other than that, to ascertain the willing to pay (WTP) of stakeholders to mitigate landslide risks through various instruments such as landslide insurance and levies imposed towards slope management. This study also will investigate and to assess the public perception, expectation and tolerability of landslide risk areas in Malaysia and for enhancing the government understanding of public attitude towards landslide risk and facilitating landslide risk management and policy decision making.

5. **Background Justification:** Societal risk is often given the highest priority in risk assessment because human life should be regarded as invaluable. The societal risk can be evaluated by plotting cumulative frequency (F) versus number of deaths (N) in a log-log scale, known as F-N curve. The “acceptable” and “tolerable” risk criteria are normally defined in the F-N curve. Similar F-N curves can be plotted to assess economic and environmental losses. Successful development of the F-N curves with well-defined “acceptable” and “tolerable” risk criteria could be a huge stride towards a more established landslide risk assessment and management practice in Malaysia. It can be used to guide the design and approval of proposed development, and to prioritize treatment and monitoring efforts for existing development that is susceptible to landslide.

6. **Study Area:** This study will be conducted at three (3) locations which are at Cameron Highlands in Pahang, Kundasang in Sabah and in Kuala Lumpur.

7. **Project Duration:** Eight (9) months starting January 2016.

8. **Resources necessary for the Project and their mobilization Personnel, Facilities, and Budgets:** A multi-discipline project team that comprises of geotechnical engineers, economist, sociologist and statistician will be assembled to implement this study. Other facilities such classified and restricted information include airborne data, land survey, geographical information, topography maps and landslide inventory maps are necessary in this study.

9. **Project Description:** Previous study was carried out in Klang Valley and the data achieved is format and rough indication of what to be expected from the public. However, to enhance the results to be applicable for better understanding of acceptable and tolerable risk, further study of landslide prone areas should be studied. The areas suggested for further study are at Cameron Highlands in Pahang, Kundasang in Sabah and Kuala Lumpur. The project shall have two approaches: Technical and Social Research Approaches. The technical approach will present historical landslide data that can determine frequency and severity of landslide incidents. While, social research approach is implementing survey questionnaires and interviews among residents to collect information about public's perception on landslide "acceptable risk" and "tolerable risk" criteria.

10. **Work Plan/Expected Results:** To meet the objective of the study, appropriate scope of works shall be carried out. Mainly, literature review will be established indicating the state of the art of this study and information on similar studies done locally and abroad. A desk study of available must be recorded concurrently with the compilation of historical landslide data, evaluate, filter and summarize the data. The scope of the study shall focus on suggested areas, with particular focus on landslide-prone areas. Flatter, lowland areas in the area will also be studied. The project will develop a feasible analyze historical landslide data to determine frequency and severity of each landslide incident. Then, plotting of cumulative frequency (F) versus number of deaths (N), F-N curves will be carried out. Besides that, survey questionnaires will be given out to collect information about public's perception on landslide "acceptable risk" and "tolerable risk" criteria. Furthermore, interviews and surveys will be conducted among residents. Afterward, F-N charts will be developed with "acceptable risk" and "tolerable risk" criteria while the risk criteria are determined by evaluating the existing landslide risk level in the region, and the survey data collected from the respondents. Based on the estimate results, the impacts of structural and non-structural landslide mitigation measures on policies can be determined. Lastly, database from the study will be organized which will include explanation of the model selection, survey results and analysis, parameter, relationship and determinant identification, existing levels of F-N relationships at the selected study areas and also framework and simulation of model application in specific policy domains.

11. **Deliverables/Time Frame:** the study shall be completed within eight (9) months starting January 2016.

12. **Project Beneficiaries:** This study will be of benefits to slope designers, planners, local governments and legislators to come up with better decision making on hillside developments and policies.

Date of Submission	November 5, 2015

IPL Project Proposal Form 2016

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title: **Landslide disaster risk communication in mountain areas**
2. Main Project Fields

Select the suitable topics. If no suitable one, you may add new field.

(1) Technology Development

A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

(2) Targeted Landslides: Mechanisms and Impacts

A. Catastrophic Landslides, B. Landslides Threatening Heritage Sites

(3) Capacity Building

A. Enhancing Human and Institutional Capacities

B. Collating and Disseminating Information/ Knowledge

(4) Mitigation, **Preparedness** and Recovery

A. Preparedness, B. Mitigation, C. Recovery

3. Name of Project leader: **Irasema Alcántara-Ayala**

Affiliation: **Institute of Geography, National Autonomous University of Mexico (UNAM), Full Professor**

Contact: **Circuito Exterior, Ciudad Universitaria, 04510, México City, +5255 5623022 ext. 45466**

Core members of the Project

Names/Affiliations:

Ana Rosa Moreno, Faculty of Medicine, National Autonomous University of Mexico (UNAM) (expert on risk communication)

Ricardo Garnica-Peña, Institute of Geography, National Autonomous University of Mexico (UNAM)

4. Objectives: (5 lines maximum; what you expect to accomplish?)

- Developing a landslide risk communication strategy that can be applied at local level.
- Helping to induce landslide capacity building in the municipality of Teziutlán by incorporating landslide risk awareness and preparedness.
- Merging the efforts and capabilities of Civil Protection authorities and the community to implement a successful strategy of landslide risk communication.

5. Background Justification: (10 lines maximum)

The municipality of Teziutlán has been historically affected by landsliding. However, in spite of the scientific research developed to understand landslide's dynamics, no systematic efforts have been carried out to establish a landslide risk communication strategy that can be useful to improve landslide awareness and preparedness. Therefore, the spatial analysis of landslide occurrence and landslide risk perception of population can be used as a base for the design and implementation of a solid strategy to communicate risk concerning landslide disaster risk.

6. Study Area: **The project will be conducted in the municipality of Teziutlán, Puebla**
7. Project Duration: **2 years**
8. Resources necessary for the Project and their mobilization

   Core members of the project and students will be involved. Facilities and resources of the Institute of Geography will be available. Resources involved vehicles for transport, computer facilities, in addition to a budget of US$5000.00 for community based workshops and development of materials (already available).
9. Project Description: (30 lines maximum)

   Landslide disaster risk is a major issue in mountain areas of Mexico. As such, reducing levels of vulnerability through community awareness and preparedness can be regarded as one of the most significant means to reduce disasters. Information and knowledge therefore should be not only transferred to people, but to communicate in a way that can be useful and used. Risk communication therefore cannot be regarded as a simple task, but a challenge. Under such framework, the perception of risk is an important element contributing to develop and implement a risk communication plan to protect vulnerable people exposed to landslides. Therefore, this project aims at developing a landslide disaster risk communication strategy based on a risk perception analysis that is being carried out at the moment. Results derived from such analysis will allow delineating specific actions to build a solid risk communication strategy. For the latter to be successful it is necessary to consider the participation of different actors. Of particular interest will be the participation of local authorities and population given that there is a lack of interaction among them. The mixture of ways to get knowledge is of great importance for reducing vulnerability. Actions not only to avoid impacts, but to manage risk can be inspired by a solid risk communication strategy as it is an essential approach to strengthen disaster reduction capacity building. The landslide communication strategy therefore will have to be build not only by introducing scientific knowledge in terms of landslide's dynamic, but based on perception of people and on ideas and needs to be identified as authorities and community interact.
10. Work Plan/Expected Results:

    Work plan:

    Based on results derived from a landslide risk perception survey applied in the municipality of Teziutlán, Puebla, specific actions for risk communication will be defined.

    The main idea is to work in collaboration with the Director of Civil Protection of the town and key actors of the community, including people who have work in mass media in recent years and have been involved with previous landslide episodes.

    Risk communication strategies will be defined in terms of age groups, gender, and degree of exposure to landslides, in addition to other factors resulting from the risk perception analysis.

    Feedback from the population in terms of the best practice for landslide risk communication also is considered as a very significant input; therefore, community workshops will be organized.

    Once the strategies of risk communication are defined, there will be put in practice and an evaluation of impact will be undertaken.

Expected results:

- Capacity building in terms of community awareness and preparedness.
- Involvement of authorities and communities in activities

11. Deliverables/Time Frame: (10 lines maximum; what and when will you produce?)
    - Definition of a risk communication strategy that can be used and implemented by local authorities in Teziutlán in the short term, and can be extended to the region on medium and long term basis. The activities for the short term will be developed during 2016, while those for the medium and long term will be carried out in 2016 and 2017.
    - Preparation of materials (to be defined according to the risk perception strategy and the input from local actors) to be used for implementing the landslide risk communication strategy at local level. This also will be undertaken within the two years framework. These will be parallel activities.
    - Preparation of a couple of manuscripts to be submitted for publication in journals (at the end of the project).
12. Project Beneficiaries: **The authorities of Civil Protection of the municipality and the inhabitants of municipality and the region.**
13. References (Optional): (6 lines maximum; i.e. relevant publications)

- Fischhoff, B. (1995). Risk perception and communication unplugged: Twenty years of process. Risk Analysis, 15(2), 137-145.
- Landeros-Mugica, K., Urbina-Soria, J., Alcántara-Ayala, I. (on line) The good, the bad and the ugly: on the interactions among experience, exposure and commitment with reference to landslide risk perception in México, Natural Hazards, DOI 10.1007/s11069-015-2037-7.
- Slovic, P. (Ed.). (2000). The perception of risk. London: Routledge.

Note: Please fill and submit this form by 15 November 2015 to ICL network <ICL-network@iclhq.org>

Date of Submission	5th November 2015

IPL Project Proposal Form 2016

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title: Landslides and Related Sediment Disaster Project Covering the Entire South-East Nigeria, West Africa
2. Main Project Fields

Select the suitable topics. If no suitable one, you may add new field.

(1) Technology Development

A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

(2) Targeted Landslides: Mechanisms and Impacts

A. Catastrophic Landslides, B. Landslides Threatening Heritage Sites

(3) Capacity Building

A. Enhancing Human and Institutional Capacities

B. Collating and Disseminating Information/ Knowledge

(4) Mitigation, Preparedness and Recovery

A. Preparedness, B. Mitigation, C. Recovery

3. Name of Project leader: **IGWE** Ogbonnaya

Affiliation: Department of Geology, University of Nigeria, Nsukka

Contact: ogbonnaya.igwe@unn.edu.ng;igwejames@hotmail.com

Core members of the Project: **Fawu** Wang[1], **Fukuoka** Hiroshi[2], **Nnebedum** Okechukwu[3], **Ikenna** Okonkwo[3], **Oha** Ifeanyi[3], **Onwuka** Solomon[3].

Names/ 1. Shimane University, Japan 2. Niigata University, Japan 3. University of Nigeria, Nsukka

4. Objectives: To understand the distribution, severity and frequency of landslides and related geo-hazards in the whole of South-East Nigeria; and relate these variable parameters to their different mechanisms. Finally, we will produce a susceptibility map as a guide to developmental strategies in the region.
5. Background Justification: The aim of the present study is to understand the distribution, severity, frequency and the different mechanisms of landslides and related geo-hazards in the whole of the south-east Nigeria. Previous studies have focused on only the mechanisms of mass movements in areas with well-known cases of instability, without adequate attention to their distribution, severity and frequency in the entire region underlain by erosion-prone lithologies. This new study have shown that there are other places within the region where similar sediment disaster have destroyed lives, resources and displace thousands, and are about displacing more from their homes. Understanding the different mechanisms controlling the development of huge gullies in the area o interest, and relating them to their distribution, severity and frequency will aid the production of reliable susceptibility maps important in prevention and mitigation strategies.

6. Study Area: South-East Nigeria, West Africa
7. Project Duration: 3 years
8. Resources necessary for the Project and their mobilization

   Personnel, Facilities, and Budgets: A team of local and international experts, field mapping apparatuses, laboratory devices, GPS, GIS networks, USD 40, 000. Some of the funds will come from University Research Grants, contributions from National Governments, and from Private Companies. Collaboration with Shimane and Niigata Universities is very necessary for a successful work.

Project Description: It was found that the occurrence of landslides and related sediment disaster have a close relationship with bedrock geology, slope gradient, vegetation cover and macro and micro landforms. We will attempt to classify the failure modes into complex movements, translational slides and rotational slides, and indicate which are predominant. We will also carry out the analysis of the hydrological response of the regoliths and colluvial slopes during the rainstorm and attempt to relate the failures to the possible development of a perched water table in the thin surface layer of colluvium of sedimentary, igneous or metamorphic origin due to infiltration during the heavy rain. Disturbed and undisturbed samples will be subject to laboratory analysis to isolate their engineering characteristics. An integrated approach incorporating standard penetration test and DEM-based analysis was adopted in the research. Representative samples from different geological units were collected and a total of six SPT boreholes were drilled on the sedimentary basin. Extensive site investigations were conducted including field reconnaissance and detailed mapping, geophysical exploration, and laboratory experiments following ASTM standards. The main target was to evaluate geologic and hydrologic conditions related to the occurrence of different types of landslides. Primary attention was devoted to the study of landslide slopes, water table, thickness of landslide body, slip surfaces and seepage flow which was consistent with (Shoaei and Sidle 2009; Fan and Hsiao 2012). To achieve the aim, available spatial data (geologic, topographic maps and DEM) for the considered areas were assembled. Visual interpretation of stereoscopic aerial photography, field surveys and STRM based on high resolution digital elevation models aided the production of 3D topographic maps. Landslides, geology and hydrogeology in the zones underlain by granite, gneiss, schist and sedimentary rocks were mapped and the potential factors causing their occurrence documented.

9. Work Plan/Expected Results: The methodology employed for this research were carried out systematically in three phases, which includes: (i) Site investigations carried out in the field, (ii) Geotechnical analysis carried out in the laboratory, and (iii) Statistical data gathered from agencies, and also from previous literatures. Also, the results from some geotechnical parameters were applied to a numerical model the Geostudio 2012, to simulate the morphology and mechanism of the landslide on one hand, and to generate a factor of safety value on the other hand, which helped me produce a landslide susceptibility map. The Site investigation involved three stages: the preliminary studies, the reconnaissance and detailed mapping. Pervious works carried out on the area by several authors and researchers on a regional and local scale were consulted with the aim of getting vital information of the study area before going to the field. Topographic, geologic and geographical maps were carefully

studied in order to have a better understanding of the terrain. A base map on a scale of 1: 50,000 was prepared for the field work. Detailed field work will commence in February 2015, which will include the hydrogeology of the area, which included ground water levels, as observed in nearby wells, stream courses, gullies, and the discharge of ground water at the slope; determination of the landslide properties, which included the studies of the slope angles, depth of sliding surface, run-out distance(length of landslide), thickness of the sliding mass, as well as the date the landslide occurred as reported by local residents; the geographical location of all the sampling points was established, using a GPS; geologic descriptions were recorded in geologic field note books, and the descriptions included; the lithologic compositions, the bedding surfaces, faults and joint systems, dip amounts, as well as dip and strike directions with the help of a compass clinometers; disturbed and undisturbed samples of residual soils were collected for further analysis, using a hand auger; the vegetation type was also determined, and it included studies of the tree types, the density of coverage, as well as the cultivation practices; photographs of important geologic and geographical features were taken, as well as photographs of the landslide for reference purposes. To understand the mechanisms controlling the development of translational and rotational slides, and the mobility of the slides it is important to reproduce the pre- and post-failure behavior of the sliding masses. Representative residual soil properties were investigated by subjecting them to several geotechnical analyses including consistency, moisture content, specific gravity, triaxial and ring shear tests. The behaviors of the specimens from different sites were investigated under varying B_D (saturation) levels. Details of sample preparation, consolidation and shearing procedure are in Sassa et al. (2004), Igwe et al. (2013) and Igwe and Fukuoka (2014).

10. Deliverables/Time Frame: This is the first time such project will be carried out in Nigeria. For this reason, we intend to understand the different mechanisms controlling the development of huge gullies in the area of interest, and relate them to their distribution, severity and frequency, which will aid the production of reliable susceptibility maps important in prevention and mitigation strategies.
11. Project Beneficiaries: This work is the first such project in Nigeria, so it will benefit the country and Africa. The universities in the region of study will also benefit as it will increase the capacity of staff and students to deal with landslides and related sediment disaster.

Date of Submission	November 15, 2015

IPL Project Proposal Form 2016

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title: **Massive landsliding in Serbia following Cyclone Tamara in May 2014**
2. Main Project Fields

Select the suitable topics. If no suitable one, you may add new field.

(1) Technology Development

A. Monitoring and Early Warning, B. **Hazard Mapping, Vulnerability and Risk Assessment**

(2) Targeted Landslides: Mechanisms and Impacts

A. **Catastrophic Landslides**, B. Landslides Threatening Heritage Sites

(3) Capacity Building

A. Enhancing Human and Institutional Capacities

B. Collating and Disseminating Information/ Knowledge

(4) Mitigation, Preparedness and Recovery

A. Preparedness, B. Mitigation, C. Recovery

3. Name of Project leader **Biljana Abolmasov, PhD**

Affiliation: **Associate Professor, University of Belgrade, Faculty of Mining and Geology**

Contact: **Serbia, 11000 Belgrade, Djusina 7, tel +381 11 3219 225, biljana.abolmasov@rgf.bg.ac.rs**

Core members of the Project

Names/Affiliations: (4 individuals maximum)

Miloš Marjanović, PhD, Assistant Professor, University of Belgrade, Faculty of Mining and Geology

Uroš Djurić, PhD student, researcher, University of Belgrade, Faculty of Civil engineering

Jelka Krušić, PhD student, researcher, University of Belgrade, Faculty of Mining and Geology

Katarina Andrejev, PhD student, researcher, University of Belgrade, Faculty of Mining and Geology

4. Objectives: (5 lines maximum; what you expect to accomplish?)

The project attempts to accomplish that the May 2014 extreme landsliding event was preconditioned by soil saturation, caused by a high precipitation yield, within several weeks to the event. All relevant data, including historic/current rainfall, landslide records, aftermath reports, and environmental features datasets, have to be analyzed for characterizing the extreme nature of the event and identifying key environmental controls of landslide occurrences.

5. Background Justification: (10 lines maximum)

The Cyclone "Tamara" swept through Serbia, Croatia and Bosnia and Herzegovina, causing severe damage and dozens of casualties during mid May 2014. It is considered as the 100-year rainfall event that triggered extreme landsliding throughout Serbia and Bosnia and Herzegovina, while no significant landslide occurrences were reported in Croatia (only floods). The damages were not uniform in character along affected municipalities due to their different origin, i.e. landslides, floods or erosion, and intensity of the event. As a result, 1.6 million persons (one fifth of the population) were directly or indirectly affected in Serbia. The floods and landslides caused 51 casualties and around 32000 people were evacuated. The Serbian Recovery Needs Assessment (RNA) revealed that the total effects of the disaster in the 24 affected municipalities amounts to EUR 1.525 billion (equal to 3% of the Serbian Gross Domestic Product).

6. Study Area: (2 lines maximum; where will the project be conducted/applied?)

   The study area is Western and Central part of the Republic of Serbia - territory affected by Cyclone Tamara during May 2014.

7. Project Duration: 3 years

8. Resources necessary for the Project and their mobilization

   Personnel, Facilities, and Budgets

   The Project will be organized by University of Belgrade, Faculty of Mining and Geology and Faculty of Civil Engineering. University and staff will provide all necessary documentation for Project finalization. Additional software will be necessary for numerical modeling of landslides (debris flow). The total budget requirement is US 40000.

9. Project Description: (30 lines maximum)

   Landslides are amongst the most dangerous natural threats to human lives and property, especially in times of dramatic climate change effects on one hand, and urban sprawl and land consumption on the other. Heavy precipitation peaked on May 14-16, locally exceeding monthly rates 3-4 times in just 3 days (RHMSS - Republic Hydro-Meteorological Survey of Serbia 2014). In Western and Central Serbia for instance, daily precipitation on May 15 exceeded the expected average of the entire month (Fig 6). Several rain gauges in Belgrade, Valjevo and Loznica, registered the highest daily precipitation ever recorded (over 100mm/day), since the beginning of recording in Serbia (1888). The rainfall event was synchronized throughout the region and concentrated on the Sava River catchment and partly the Velika Morava River system. The first flow-like landslides occurred on May 15, and the hotspots were located in the areas Western Serbia. Early estimates on the number of activated landslides were in the order of hundreds, but the final number was estimated to over 2000. In this respect, it was essential to produce unified large-scale inventories of May 2014 event and use them for the state-of-the-art hazard analysis. Thus, the project aims to summarizing and analyzing collected landslide information from the May 2014 sequence. Following these idea objectives of the proposed project include: (1) collecting all available (existing) and acquiring landslides data, (2) analyzing the trigger/landslide relation in affordable time span (past 15 years) and May 2014 event, (3) relating the landslide mechanisms and magnitudes versus the trigger and its aftermath, (4) locating spatial patterns and relationships between landslides and geological and environmental controls, (5) proposing an overview susceptibility map of the event and (6) numerical modeling on the site specific location/landslide mechanism.

10. Work Plan/Expected Results: (20 lines maximum; work phases and milestones)

Phase 1: Collecting, review and harmonization of landslides data

Phase 2: Analysis of trigger/landslide data

Phase 3: Analysis of landslides vs. geological/environmental controls

Phase 4: Proposing landslide susceptibility map

Phase 5: Numerical modeling on site specific locations/landslide mechanism

Phase 6: Compilation and analysis of all results

11. Deliverables/Time Frame: (10 lines maximum; what and when will you produce?)

Report 1. Compilation of results of Phase 1 and Phase 2 (end of 1st year)

Report 2. Compilation of results Phase 3 (end of month 18th)

Report 3. Proposing landslide susceptibility map Phase 4 (end of month 24th)

Report 4. Numerical modeling on site specific locations/landslide mechanism Phase 5 (end of month 30th)

Report 6. Final report (end of 3rd year)

12. Project Beneficiaries: (5 lines maximum; who directly benefits from the work?)

(1) Direct beneficiaries will be local community – municipalities affected by landslide occurrences during May 2014 event

(2) Local and regional authorities – housing sector, infrastructure authorities, Civil protection units and land/use sectors within affected area

13. References (Optional): (6 lines maximum; i.e. relevant publications)

Note: Please fill and submit this form by 15 November 2015 to ICL network <ICL-network@iclhq.org>

Date of Submission	11 November 2015

IPL Project Proposal Form 2016

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title: (2 lines maximum) : Development of Wireless Sensor Network for Monitoring and Earlier Warning of Shallow and Deep Landslides (WISE-LAND)

2. Main Project Fields
   Select the suitable topics. If no suitable one, you may add new field.
   (1) Technology Development
   A. Monitoring and Early Warning, ~~B. Hazard Mapping, Vulnerability and Risk Assessment~~
   (2) Targeted Landslides: Mechanisms and Impacts
   A. Catastrophic Landslides, ~~B. Landslides Threatening Heritage Sites~~
   (3) Capacity Building
   ~~A. Enhancing Human and Institutional Capacities~~
   B. Collating and Disseminating Information/ Knowledge
   (4) Mitigation, Preparedness and Recovery
   A. Preparedness, ~~B. Mitigation, C. Recovery~~

3. Name of Project leader : Dr. AdrinTohari
   Affiliation: Research Center for Geotechnology, Indonesian Instititute of Sciences/ Senior Researcher
   Contact: Jl. Sangkuriang, Bandung 40135, Phone. ++62-22-2503654, Fax. +62-22-2504593, email : adrin@geotek.lipi.go.id.

   Core members of the Project:
   (1) Arifan Jaya Syahbana, M.Eng/ Research Center for Geotechnology, Indonesian Institute of Sciences
   (2) Suryadi/ Research Center for Physics, Indonesian Institute of Sciences
   (3) Mohamad Imam Afandi/ Research Center for Physics, Indonesian Institute of Sciences

4. Objectives: the main objective of this project is to develop a low-cost wireless sensor network applicable for monitoring of shallow and deep landslides in order to establish an effective landslide earlier warning system. This objective will be achieved by developing a prototype of a wireless sensor module for many types of sensor and gateway and by conducting a field test to evaluate and improve the developed wireless sensor module network.

5. Background Justification:

   Landsliding is not uncommon occurrence during a period of heavy rainfall in tropical countries including Indonesia. The occurrences of landslide have claimed hundreds of lives and significant economic losses in hilly region in Indonesia. In order to reduce landslide riks, various efforts, such as landslide hazard mapping, slope stabilization and development of monitoring system, have been made by various government agencies in Indonesia, such as National Disaster Management Agency, Ministry of Energy and Mineral Resources, Ministry of Transportation, etc. Currently, landslide monitoring system is mainly based on a traditional monitoring system, in which all sensors will directly communicate to receiver transmitter unit. This conventional system will hinder an effective earlier warning due to its limittation in coverage areas and its application merely for one type of landslides. In constrast, wireless sensor network will have a capability of monitoring landslide hazard in a larger areas with different types of landslide hazard. Thus, this monitoring system will provide an effective earlier warning on landslide hazard.

6. Study Area: the project will be conducted in highly landslide prone residential areas in Bandung and Sukabumi District, West Java. The selection of study areas will be based on the landslide susceptibility assessment.

7. Project Duration: 4 years. Two years for research and development of sensor network, and two year for implementation of wireless sensor networks. The project has been started in 2015.

8. Resources necessary for the Project and their mobilization

   The project will involve 4 researchers, 3 technicians and 2 undergraduate students. The research and development will be conducted at Laboratory of Physical Instrumentation and Opto-electronics. Laboratory testing will conducted at Laboratory of Geotechnical Engineering. Meanwhile, field experiments will be performed at some landslide prone sites around Bandung District in cooperation with the regional disaster management agencies and local residences. The project will be funded by Indonesian Institute of Sciences under Competitive Research Grant scheme FY 2015-2018. The total budget is about USD 250.000.

9. Project Description: (30 lines maximum)

   The proposed project will involve research, development and implementation of wireless sensor network. To achieve this purpose, the research and development stage will focus on producing a low-cost wireless sensor module, displacement-inclination sensor, gateway and data acqusition software. The wireless sensor modules will be developed to have a long distance communication and facilitated with 4 channels of analog input and 2 channels of digital input. So, it can be connected to a raingage, two soil moisture sensors, and wire extensometers. The sensor modules will be also equiped with built-in two axial tiltmeters. The gateway will be developed to receive and transmit data to server. The communication between sensor modules and gateway will use Xbee pro modules. Meanwhile

GPRS module will be used for communication between gateway and server. The development stage will also involve field testing to evaluate and improve the key parameters of warning system, such as accuracy, real-time transmission and low power consumption.

The implementation stage is the core of the project. This stage will consist of installation of the sensor module network and gateway in the selected sites, and establishment of data acquisition center to colllect, process and disseminate monitoring data to local disaster management. The installation of sensor network will be conducted after completion of landslide risk assessment at the study sites.

10. Work Plan/Expected Results:

The project will be aimed to produce an effective and low-cost wireless sensor network for landslide monitoring (so called WISE-LAND). For this purpose, the project will be based on three work phase :

WP – 1 (Development of proto type of low-cost wireless sensor network). The acitivities in this first work phase consists of two tasks (1) developmenet of wireless sensor module and gateway and (2) data acqusition software for different types of sensors.

WP – 2 (Validation of prototype of wireless sensor network). The activities of the second work phase consist of field testing of protype of wireless sensor network in order to verify its capability to measure the various time of soil parameters, such as water content, pore-water pressures, displacement in different landslide types and slope conditions.

WP – 3 (Implementation of wireless sensor network). This work phase will deal with the application of wireless sensor network at selected sites.

11. Deliverables/Time Frame:

No.	Deliverables	Time
1.	Proto-type of wireless sensor network	2015
2.	Tested and improved wireless sensor netwok	2016 - 2017
3.	Implemented wireless sensor network	2018

12. Project Beneficiaries:

The project will promote some innovations of physical electronic based instrumentation for landslide monitoring system and enhancement of scientific knowledge. The main beneficiaries of this project would be the, local residences, the local and national disaster management agencies in landslide prone hilly region and participating researchers and institution.

13. References (Optional): (6 lines maximum; i.e. relevant publications)