Date of Submission	29 March 2017

IPL Project (IPL - 206)

Annual Report Form 2017

1 January 2016 to 31 December 2016

1. Project Number (approved year) and Title

   Number: IPL-206 (2015)

   Title: **Towards Improved Landslide Mapping and Forecasting**

2. Main Project Fields
   (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

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   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 (Laboratory of Environmental Cartography and Hydraulic and Geological Modeling, DIMES, University of Calabria)

4. Objectives:

   This ICL project has the following goals: (i) to review past and existing operational landslide forecasting and warning systems, and (ii) to propose recommendations for the design, the implementation, and the validation of operational landslide forecasting and warning systems. The project evaluates only the systems aimed at predicting rainfall induced landslides and their consequences.

5. Study Area: Data collection all over the world.

6. Project Duration: 3 years

7. Report

1) **Progress in the project**

   The project started from the work done by the Institute of Research for the Hydrological Protection of the National Research Council of Italy (CNR IRPI) for the Italian National Department for Civil Protection, consisting in the design and operational activities, since 2010, of a national system to forecast the possible occurrence of rainfall-induced landslides in Italy. Further, the other partners of the project (Department of Earth Sciences at the University of Florence, and Laboratory of Environmental Cartography and Hydraulic and Geological Modeling at the University of Calabria), have also consolidated experience in the design and the implementation of operational landslide forecast / warning systems. During the first phase of the project we started to review the past and existing operational landslide forecasting and warning systems available in the literature. In detail, our scrutiny of the data highlighted their distribution in the different countries/continents, their level of accuracy during past events, and whether the systems were effectively adopted (or not) by the local authorities. This phase was relevant to have a clear framework of the world situation on the topic, and was considered to be mandatory for the implementation of the second phase. Aimed at involving other ICL partners as well, in the course of the first year we contacted all the ICL partners, asking for information about the existence and the operational activity of landslide forecast / warning systems. This phase of the project had as main goal to reach an updated knowledge about the specific expertise of the ICL partners on the issue of interest for the project, and to evaluate the lessons learned from landslide experts in other countries. We received responses from 23 ICL partners, whilst with others there was a direct contact during the meeting held at the UNESCO facilities in Paris (November 2016). Integrating the outcomes deriving from these replies

with the data from our scrutiny of the material available in the literature, we are at present preparing a report, where the general framework about the definition of landslide forecast/warning systems, and their operational activities will be presented and discussed.

2) Planned future activities or Statement of completion of the Project

During the second phase of the project, 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. It has to be pointed out that the project will be limited to the evaluation of systems aimed at predicting rainfall induced landslides and their consequences. Preparation is in progress of a report depicting the past and existing operational landslide forecasting and warning systems for which documentation has been found, based upon a detailed scrutiny of the available scientific literature, integrated by the replies received from ICL partners, in response to the request of information sent during the first year of the project. The report will represent the basis to build the rest of the work, essentially consisting in a critical evaluation of the warning systems, aimed at highlighting their positive elements, and their drawbacks, if any. 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.

3) Beneficiaries of Project for Science, Education and/or Society

The project is addressed to governmental administrations, agencies and offices in charge of, or interest in land management, or dealing with civil protection issues. We expect that the governmental administrations will use the project outcomes, in direct co-operation with scientific and academic institutes, to design, implement, and validate landslide early warning systems, tailored to the main physical and meteorological characteristics of their own areas of study or interest.

4) Results

Vessia G., Pisano L., Vennari C., Rossi M. & Parise M., 2016, *Mimic expert judgement through automated procedure for selecting rainfall events responsible for shallow landslide: A statistical approach to validation*. Computers & Geosciences, 86, 146-153.

Rossi M., Luciani S, Valigi D, Kirschbaum Bach D., Brunetti M.T., Peruccacci S., Guzzetti F., 2017. Statistical approaches for the definition of landslide rainfall thresholds and their uncertainty using rain gauge and satellite data. Geomorphology 285, 16-27.

Martinotti, M. E., Pisano, L., Marchesini, I., Rossi, M., Peruccacci, S., Brunetti, M. T., Melillo, M., Amoruso, G., Loiacono, P., Vennari, C., Vessia, G., Trabace, M., Parise, M., and Guzzetti, F., 2017. *Landslides, floods and sinkholes in a karst environment: the 1–6 September 2014 Gargano event, southern Italy*. Natural Hazards and Earth System Sciences, 17, 467-480.

Peruccacci S., Brunetti M.T., Gariano S.L., Melillo M., Rossi M., Guzzetti F., 2017. *Rainfall thresholds for possible landslide occurrence in Italy*. Geomorphology (accepted for publication).

Rosi A., Peternel T. Jemec-Auflic M., Komac M., Segoni S., Casagli N. *Rainfall thresholds for rainfall-induced landslides in Slovenia.* Landslides, 13(6), 1571-1577.

Formetta G., Capparelli G., Versace P., 2016. *Evaluating performance of simplified physically based models for shallow landslide susceptibility*. Hydrology and Earth System Sciences, 20(11), 4585-4603.