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State-of-the-art and challenges of landslide susceptibility modelling at regional to continental scales

M. Van Den Eeckhaut[1], J. Poesen[2], A. Günther[3], J.P. Malet[4], P. Reichenbach[5], J., F. Guzzetti[5], J. Hervás[1]

[1] Joint Research Centre (JRC), European Commission, Ispra, Italy
[2] KU Leuven, Department of Earth and Environmental Sciences, Heverlee, Belgium
[3] Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany
[4] School and Observatory of Earth Sciences (CNRS) & University of Strasbourg (EOST), Strasbourg, France
[5] National Research Council, Research Institute for Hydrogeological Protection (CNR-IRPI), Perugia, Italy

Growing awareness of regional, national and international organizations has resulted in several initiatives fostering to identify, assess and mitigate the risks posed by landslides using scientific knowledge and innovation. Here, we present an overview of landslide susceptibility modelling at scales ranging from regions to continents, based on case-studies from Belgium and Europe. We mainly focus on the type of models, their validation and their use for regional and European policy making.

Regional-scale landslide susceptibility assessments nowadays mainly comprise statistical modelling. Hilly areas of Flanders (northern Belgium) are affected by more than 330 landslides of various types. In these areas, we evaluated different statistical models among which stepwise logistic regression and discriminant analysis. Susceptibility maps produced from the logistic regression models, which can be freely consulted on the internet and which are currently used by the Flemish Government as an additional input map for land use planning and management purposes, have already proven their value.

After presenting a short overview of national-scale landslide susceptibility assessments in Europe, we move to the continental scale, and present the ongoing activities of the JRC Landslide Expert Group in the context of EU's Soil Thematic Strategy for Soil Protection. This Strategy considers landslides as one of the eight main soil threats in Europe for which it is necessary to identify risk areas, i.e. areas where landslides are likely to occur in the future and where risk reduction measures have to be taken. Because of the wide variety of climate and physiographic regions in Europe, the continent was divided in seven climato-physiographic regions, and for each region a specific model was produced. Both semi-quantitative (Spatial Multicriteria Evaluation) and quantitative (logistic regression) methods are evaluated using available Pan-European thematic maps of slope gradient, lithology and land cover as independent variables. Model calibration and evaluation are possible, because more than 110,000 landslide locations were made available by national and regional authorities from 18 European countries. Combination of the susceptibility maps obtained for each climato-physiographic region results in a European-wide landslide susceptibility map that performs significantly better than previous attempts of continental-scale landslide zoning.

Finally, we conclude with some major challenges for future landslide susceptibility modelling at various spatial scales.