

# Expert opinion on doctoral dissertation

**Name of candidate:** MSc Miloš Marjanović

**Title:** Advanced Methods for Landslide assessment using GIS

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## **A. Topicality chosen theme**

The theme is always very topical at home and abroad in connection with many research and application implications. The increasing human pressure on the nature attracts more attention to the damage caused by landslides in many regions what forms key safety problems and other land use problems.

## **Conclusion on A**

Candidate has managed the topic very well both from the theoretical side, ie. the analysis of literary sources of knowledge, existing methodologies and evaluation of the reliability of their results, and their transfer into practical terms in the three test areas on the territory of Serbia, Croatia and the Czech Republic. The terminology of slope instability, classification of slope movements, traditional and remotely sensed data source, the modelling of landslide phenomenon have been also questioned in details. There is a remarkable literary overview of both its volume and its assessment. Especially valuable is the analysis of inventory, evaluation and modelling methods of landslides and of the display of their risks in the field using modern GIT. Author has tested wide range of methods for the indication of the landslide risk in the test areas where he had a good and reliable database of landslides. The results of modelling methods of the landslide risk were by then verified using the existing evidence of landslides.

## **B. Objectives of the work**

*(Evaluation of the PhD thesis goals and evaluation the level, how the candidate has met the objectives set in the thesis)*

1. Testing the suitability of low-cost and publicly available data and technologies for territory assessment from the aspect of the landslides susceptibility with regard to the list of available methods for the phenomenon modelling.
2. Verification of selected landslide risk indication (modelling) methods in the test areas and evaluation of their properties.

## **Conclusion on B**

Although the author declared total 6 main goals, but those may be divided well into two categories as mentioned above.

Ad1) The objective was met adequately, the author conducted a thorough analysis of the current situation in the problem, examined existing methods of the landslide risk modelling, discussed at some length the availability of the necessary data (though eventually his work was also based on data publicly unavailable) and without assess on the appropriateness of publicly available technologies (GI and statistical ones), he has used them properly.

Ad2) The objective was accomplished enough. Author applied the theoretical and methodological knowledge, acquired as the results of his previous work in the test areas as well as unpublished results of other studies, that all helped to build high-quality models of landslide risk for the areas on NW slopes of Fruška Gora Mts., Starča Basin and vicinity of the Halenkovice village in NE Chříby Mts.

### **C. The selected processing methods and work course**

*(Commentary on selected methods and problem solving procedures)*

The data processing methods selected by the candidate are adequate to the appropriate solution of the problems with regard to the current GIS technology and statistical data processing, they are suitable for the given purposes and fit the thesis tasks.

### **Conclusion on C**

Author applied his deep theoretical knowledge of the landslide risk modelling methodology and currently his own practical skills gained during geological mapping in the field on the one hand, on the other hand he has creatively applied them to address the challenges of PhD thesis and research tasks in the test areas. He has improved the proven existing GIS based landslide risk assessment methods using an addition of yet little used statistical data evaluation methods as well as the data significance assessment procedures for work in the test areas.

### **D. Evaluation of the results achieved by the candidate**

*(Comments on the results of the PhD thesis, stating the specific contribution of the student)*

Author compiled a thorough overview of the current state of the problem of the landslide risk modelling, analyzed the advantages and disadvantages of the known methods, developed their specific application for the usage in the test areas, enriched them by taking into account the statistical significance of the various factors influencing the risk of landslides, completed the very rich mapping documentation for the each test area, assessed effectiveness of procedures and evaluated their pros and cons. On examples of 3 test areas, he documented and compared the results of the models, but also he hit critically a number of methodological and substantive features of the used procedures. It should be noted, however, that in the end the testing of a wide range of publicly available data and methods was avoided and the author was forced to rely on data available in areas of interest (particularly in Serbia and Croatia) publically not accessible.

### **Conclusion on D**

The PhD thesis documents the author's profound theoretical knowledge, broad experience gained in experimenting with various statistical and modelling techniques, also using GIS tools in a number of software packages. Practical demonstrations of selected and by the author improved procedures of the data processing to assess the landslides risk in the areas of interests have a perspective impact on the further studies and effectively motivate for the further research. Differentiated reserves still remain in the uncertainty in achieving reliability and accuracy of the results of each method. A further improvement in relation to the scientific and technical progress can be expected in the future.

### **E. Significance for practice or for the development of science branch**

*(Statement about the importance for practice or for the development of science branch)*

The results are inspiring for the further development of the landslide risk modelling in the territory, because of they bring both a comprehensive overview of the current state of the problem and provide a completely new methodological and practical knowledge. The regional empirical results obtained in the test areas are important for the further experimentation in them using more improved methods in the future, not to forget the support of decision making in the land management, which did not address this work so far. These represent the main values added by the PhD thesis.

## **Conclusion on E**

Author has assembled a broad theoretical and methodological overview of the current state of the problem of the landslide risk modelling, presented his own improvement of existing procedures, and he has documented practical experience in the test areas. The demonstrated procedures based on combining the available methodologies and his own creative ingenuity push forward the effectiveness of validated methods and improve their applicability elsewhere in the world, at least in areas with similar geographic parameters.

## **F. Publication activity of the candidate**

*(Statement about publication activity of the candidate)*

The publishing activity of the candidate is extensive. Practically the entire publishing activity is purposefully related to the topic of the PhD thesis. The papers published in the prestigious journals and at the conferences can be considered sufficient and of a high quality.

## **Conclusion on F**

The candidate has proved his capability of an independent innovation of a creative scientific work without any doubt, but also his ability to process methodically his work results and to formulate them into a coherent scientific work.

## **G. Formal design of the PhD thesis and its language quality**

*(Statement about the structure of the PhD thesis, its formal design and language quality)*

The PhD thesis has a fair layout and it is clearly structured into nine main chapters, it is written in a readable technical English language of an excellent quality. It is equipped with a number of black and white and colour illustrations that suit its own text. The good impression is reduced drastically by the size of work, which is achieved 134 1.0 spaced pages of text (not counting attachments), which is (with attachments) total nearly 300 standardized pages. In terms of understanding this PhD thesis as a thematic monograph, it would not be certainly a problem, but the author should be able to submit the key passages of his work in a concentrated form. In my opinion, the work will also benefit by the saving duplex printing. Some clumsy formulation raise questions that the author should respond (see section H). Many considerable reserves are in the cartographic documentation, where is the vast number of formal defects (bad choice of colours in maps, abundant absence of scales - see section H). In some cases, there is no clear clarification of terms (such as "dormant landslides").

## **Conclusion on G**

Some (marked \*) terminology and other comments (see section H) are to be explained by the candidate in the course of the defence. The author has to pay more attention to the cartographic documentation of his text in the future, especially when presented work deserves the publication as a whole.

## **H. Observations on the dissertation**

*(Specific comments on the PhD thesis)*

Page-paragraph-line:

2-Fig.2: small not readable map elements

8-Tab.1: "soil" is a wrong expression – better "weathering products"

\*10-4- and 11-1- : "landslide hazard" = realised risk; Landslide risk = potential vulnerability

13-Tab.2: better is usage of R,G,B (capital letters)

\*15-1-1: geological radar can be also mentioned

17-4-1: no one modul is mentioned

\*17-6-5: mechanistic approach to GIS feeding with unlimited individual (analytic) data represents a wrong procedure if relations between data layers in the territory (not statistically) are not being studied

22-2-6 from bottom: do not forget the “dendrogeomorphology”

\*29-Tab.3: what was the factor ranking procedure?

\*51-Fig.18: what does mean “slope 0.5” on the axis X and “area” on axis Y?

58-3-1/2: map scales 1:5000 – 1:50 000 do not represent the “regional scale” (1:1M is OK)

59-Fig.21: numerical or graphical scale absents (map grid is not enough), the legend is not ordered in a right way (it must start from youngest materials)

64-Fig.23: wrong colours used in the figures, esp. a, c

\*71-Tab.8: what does mean the mean aspect 173.26 if the test area is located on the NW slopes of Fruška Gora?

77-3-11: what does mean “slopes higher than 20°”?

84-2-8: what is the definition of “dormant landslides” in the course of data processing?

\*84-Fig.38: what is the difference between “active landslides” and “actual landslides” in reality?

\*92: Starča basin – why?

93-Fig.46: wrong colour selection (opposite colours), the legend set up in the opposite way

94/95: scales are missing, Fig.48d – opposite colours selection

\*96/97/109: Tab.7+8/list on p. 96: why different terrain features applied?

98-Fig.49: scale absent

\*98-1-1: what method was applied for landslide mapping?

99-Fig.50: scales absent

101-1-2/3: Halenkovice study area is not located between the Bohemian Massive and Carpathians, but it is directly in the Carpathians (Chřiby Mts.)

101-1-4: there is no relation to the Carpathian Foredeep

\*106-Fig.53: what do represent two blue patches in upper centre of the map?

107-Fig.54: scale is missing

111-Fig.55c: wrong colour selection, missing scale

112-Fig.56: missing scale, f – legend is not completed

113-Fig.57: missing scale

\*Was the landslide typology studied and compared with modelling results?

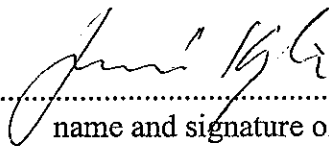
### **Final evaluation statement**

*(Overall assessment of the PhD thesis and unambiguous statement whether its opponent does recommend or not recommend it for the defence)*

The work considers sufficient quality in both theoretical (methodological innovation, new evidence) and the practical (use real territories of the available data) sense. In my opinion, this PhD thesis meets the requirements for the doctoral dissertation and **I recommend** it for defence.

Brno, May 31, 2013

Doc. RNDr. Jaromír Kolejka, CSc.

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name and signature of the opponent