

Review of the manuscript '**COMPREHENSIVE LANDSLIDE SUSCEPTIBILITY MAP OF CENTRAL ASIA**' by *Rosi et al.* submitted to *Natural Hazards and Earth System Sciences*.

Recommendation: **ACCEPT**

Focus of the paper: landslide susceptibility mapping aimed at land use-planning and risk reduction strategies in the Central Asia region which is prone to landslides due to high tectonic activities.

Relevance: The presented study is the original primary research within scope of the journal. The manuscript meets general criteria of the significance in Earth science and geologic risk assessment. The study has been conducted in accordance to the technical standards in spatial analysis, mapping and numerical assessment. It is relevant to the journal topic as corresponding to the major domain and research disciplines: Geography, Earth sciences, Hazard risk assessment, and Landslide mapping.

Abstract is well written and clearly describes the undertaken study. It describes the major problems of Central Asian region related to tectonics and seismicity which results in high risk of landslides. Methods used in this study are mentioned, results reported briefly and concisely. Abstract is well done.

Structure: The article is well organized with structured sections. The structure of the manuscript conforms to the journal standards and discipline norm. It has the following standard sections: 1. *Introduction*; 2. *Study area*; 2.1 *Landslide types in Central Asia*; 2.2 *Large Rockslides and natural dams*; 2.3. *Landslide in soft rocks and loose deposits*; 3 *Materials and Methods*; 3.1 *Landslide databases*; 3.2 *Random Forest (RF) model*; 3.3. *Selection of independent variables*; 3.4. *Model optimization*; 3.5. *Model training*; 3.6. *Model validation*; 3.7. *Landslide susceptibility and elements at risk*; 4. *Results*; 4.1 *Susceptibility map*; 4.2 *The Fergana valley mountainous rim*; 4.3 *Trained model performances and conditioning factors relevance*; 5. *Discussion*; 6. *Conclusions*. Some sections are divided into the minor subsections and paragraphs for a better structure. The numeration of the sections is correct and consecutive.

Logic: The clarity of the text logic and organization of the paper is sufficient. It demonstrates the consistent interpretation of the results with detailed explanations and comments. A comparison of the results with those in previous studies regarding landslide risk assessment is presented.

Introduction presents a background, defines research goals and provides a clear statement of research problem on landslide disasters in Central Asia. *Rosi et al.* reported economic losses and damages caused by landslides and presented the observed landslide hazard statistics summarised in a table. It is clear from this table that the most affected region is Tajikistan. The authors then compared the effects from landslide and discussed briefly the outcomes for other countries in Central Asian region. Existing studies on regional studies on landslide hazard are mentioned as well as initiatives on landslide inventories. *Rosi et al.* then overviewed the existing methods of landslide risk assessment and approaches to susceptibility mapping, among which methods of machine learning. They then introduced the approach use din their study – Random Forest algorithm, and mentioned its advantages. The Introduction well describes the research. Introduction and background show context of the article. Literature is well referenced and relevant.

Study area: is described with sufficient details in section 2. Maps depicting the target region are inserted. *Rosi et al.* described landslide types in Central Asia with sufficient details in subsection 2.1. Rockslides existing in the region with Palaeozoic magmatic and metamorphic crystalline bedrock are described with examples presented in photos. Study area section is well done.

Research questions and goals are well identified: presenting maps of landslide susceptibility in

Central Asian region using methods of machine learning. Objectives are relevant and meaningful with regard to natural risk assessment in the geologically unstable region prone to earthquakes and landslides. It is stated how the research fills an identified knowledge gap by presenting new advanced methods for modelling landslide risks.

Literature regarding the relevant topics is reviewed, formatted according to the journal rules and appropriately referenced. Major sources include published papers on natural risk assessment, with a special focus on landslide and avalanches, analysis of risks in seismically active regions; papers on applied statistics and issues of disaster risk management and climate-related issues. The authors also reviewed papers on regional studies with regard to Central Asian region.

Research gaps and weakness in former works are described; the existing gaps are identified. The contribution of this work filling this gap is explained. It concerns providing novel methods applied to landslide risk evaluation and modelling.

Motivation is explained: this study contributes to fill in the gaps in the existing similar research through presenting a unique accurate map created with a higher resolution compared to existing works, aimed at landslide susceptibility assessment of Central Asia. Given the size and heterogeneity of the study area, *Rosi et al.* used many input variables including landslide inventory which ensured the accuracy of modelling. The authors also considered the elements at risk and communication routes when assessing the risks.

English language: acceptable. Clear, unambiguous, professional English language used throughout.

Data used in this study are described and summarised with a comprehensive details in subsection 2.1. Landslide databases (pp. 8-9). The research presents novel data and results regarding landslide inventory and data derived from reliable repositories. Data are explained, sources are mentioned. The key parameters used for modelling are listed in subsection 3.3. Selection of independent variables (pp. 10-11).

Methods: Methods described with sufficient detail and information to replicate. *Rosi et al.* identified many key parameters of landslide susceptibility such as soil type, lithology, elevation, the distance from roads, rainfalls and slope curvature, among others. This supports the accuracy of the assessment and modelling. Modifications of the existing methods are mentioned briefly. The workflow is well structured and clearly described with sufficient information to reproduce the approach. The authors used advanced methods of modelling using machine learning algorithms of Random Forest (RF), and LSM. The models were defined and optimised, trained, executed and validated (true/false).

Results are reported: *Rosi et al.* assessed the data by modelling approach and presented the results. The results include the obtained Landslide susceptibility map of Central Asia (Figure 9); Detail of the landslide susceptibility map with the overlapping landslide polygons (Figure 10); Landslide susceptibility class intervals summarised in Table 2; Details of the landslide susceptibility map (Figure 11); Landslide susceptibility map obtained for Fergana (Figure 12) and Frequency histogram of susceptibility classes (Figure 13). The results are well presented, convincing and argued. The Results are presented with clarity and include description, graphical illustrations, tables, and descriptions. The results are relevant to the initial research goals and objectives and highlights major achievements of this study.

Discussion interpreted the major outcomes of this study. The advantages of the obtained results are described and compared with other studies. The Discussion described the issues of methodology and results.

Conclusion Conclusions are well stated, linked to original research question, limited to supporting results and summarized the study with interpretation of facts. The conclusions are appropriately stated and connected to the original questions.

Actuality, novelty and importance of the research is clear. It consists in technical approach of landslide susceptibility and risk assessment and evaluating the over the Central Asian region using multi-source geospatial datasets and advanced methods of modelling (RF model and LSM model).

Academic contribution: Rigorous investigation performed to a high technical and professional standard. The paper increases the knowledge in landslide risk assessment in Central Asian region. The paper combines technical approaches, cartographic work and machine learning algorithms which presents a multi-disciplinary study well deserved to be published in *NHESS*.

Figures The authors presented 18 figures which are of acceptable quality, easy to read, relevant and suitable. Figures are labelled and appropriately described. They illustrate the results of the undertaken study.

Recommendation: This manuscript can be **ACCEPTED** based on the detailed report above.

With kind regards,

- Polina Lemenkova.

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