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Geospatial methods and techniques for evaluating the risk phenomena of hydrological surplus and geomorphological dynamics - Applications in the Sitna river basin

THESIS SUMMARY

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The study of hydro-geomorphological risks, especially in the context of climate change, has undergone a series of paradigm shifts in the last two decades, particularly by embracing the concepts of flood risk management and flood risk governance. This more integrated approach to extreme hydro-geomorphological phenomena is mainly due to the economic damage caused, in the context of the contemporary level of socio-economic development as well as the impact of natural phenomena on society, with floods being responsible for damages worth up to 250 billion dollars between 2005 and 2020, according to recent studies.

Studying dam failures as hydrological risk phenomena are carried out in the context of the very high probability that these structures will fail, an approach that provides concrete examples from which solutions or approaches can be extrapolated for similar future scenarios. The same can be stated regarding landslides, which are extremely distructive by nature and of great interest to be evaluated with the purpose of being mitigated.

This endeavor has therefore aimed to identify and apply effective methodologies for assessing the vulnerability to geomorphological (landslides) and hydrological (dam failures) risks, as well as using the results to highlight areas with potential exposure to these hazards in the Sitna River basin.

Specifically, the formulated goals include the following objectives: a) the identification and mapping of areas vulnerable to landslides using computerized methodologies that take into account a series of determining variables and b) the development of flood hazard maps in accordance with the results generated by the simulation of the dam failure phenomenon, in order to identify results of interest for decision-making authorities, in case such scenarios become iminent.

To fulfill the aforementioned objectives, the PhD thesis was composed of 4 application chapters, with Chapter 3 and 4 analysing the dam failure vulnerability for Cătămărăști and Drăcșani lakes using hidraulic modelling principles and software, and Chapter 5 and 6 highlighting the areas susceptible to landslides.

The research and analysis directions presented in this work have achieved the main objective formulated, namely the use of high-resolution data coupled with new calculation

methodologies in order to highlight areas exposed to hydro-geomorphological risks in the Sitna River basin area.

Based on the methodologies described in detail in Chapters 3 and 4, the floods generated by the hypothetical rupture of the Cătămărăști and Sulița dams were highlighted and mapped, and the variables necessary to use the results as decision support or decision-making support by various bodies or institutions with influence in this regard were identified, for planning strategies or directions of action in the event of the imminence of such disasters.

Chapters 5 and 6 detail two methodologies for analyzing and estimating the spatial distribution of landslide susceptibility values. These highlight the areas prone to be affected by landslides, based on a series of determining factors evaluated and taken into account. Both methodologies were validated and the results were consequently represented cartographically, resulting in both situations the areas most prone to be affected by landslide processes.

Cumulatively, the results obtained bring a consistent addition of knowledge both in terms of the typology of risks analyzed and the methodologies by which they can be treated as well as the subsequent highlighting of vulnerable areas. For the study area, except for those already mentioned, the generated results enrich the scientific knowledge necessary for more detailed assessments of the characteristics of the basin, both from a geographical point of view and from the perspective of natural risks and the analysis of their theoretical impact using modern GIS methodologies and at the same time lay the foundations for future research, using more efficient and more precise means than those already applied in this work.