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Compensating the absent or incomplete data required in vulnerability analyses via GIS. A case study on the surface geology and building stock of Iași City, Romania

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Access to comprehensive and updated statistical and spatial databases represents a prerequisite of sound risk, hazard, vulnerability and resilience analyses, which have been advancing in terms of complexity and efficiency for the last 50 years, alongside the development of GIS techniques. Without adequate quantitative and qualitative datasets, research is sensitive to inaccurate and imprecise results, failing to meet the requirements for which it was designed and having zero input to the scientific progress.

Most developing countries - including Romania, face the problem of incomplete, inaccurate or outdated data in many fields of research, including geology-related fields and statistics about the building stock and transport infrastructure. These types of data are fundamental for vulnerability assessments of urban spaces to seismic or landslide hazards. This paper aims to provide a GIS-based methodology for acquiring datasets of the geological surface deposits and of the building stock at the scale of urban settlements, focusing on Iași City in the NE of Romania, respectively on the Țicău area of this city.

The mapping of geological surface deposits relies on automatic image analysis and landforms extraction algorithms that identify and delineate geological deposits based on slope and curvature, using High-resolution DEMs, as well as on cluster analysis. Slope deposits are delineated via watershed segmentation performed by Vision with Generic Algorithms (ViGRA), whereas the Schmidt-Hewitt classification is used to delineate floodplain and ridge deposits. The building stock is extracted from LiDAR point clouds with densities of 4 to 6 points per square meter using various approaches: neural network and deep learning for classification, and bounding rectangles for building boundary extraction. While LiDAR data is not available, high

resolution imagery provided by the Copernicus programme can be used in conjunction with classification and edge detection algorithms to delineate building objects. The results are promising and show how the already available tools can be used to fill in the gaps of the “no-data problem” and overcome such a challenging issue.

The obtained spatial data, namely surface deposits and building stock, become a major asset for the further vulnerability assessments that integrate geotechnical and physical aspects. This may help identify what local scale elements contribute to disaster resilience or, on the contrary, what fuels vulnerability.