AI-DRIVEN URBAN SPATIAL DISASTER RISK ANALYSIS: A MULTIDIMENSIONAL TAXONOMIC PERSPECTIVE

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ABSTRACT

Natural disasters constitute one of the most critical challenges confronting contemporary societies due to their direct impacts on human life, the spatial destruction they cause, and their long-term economic consequences. Urban areas, in particular, face disproportionately severe outcomes as a result of concentrated populations, dense infrastructure systems, and intensified economic activities. Processes such as rapid and uncontrolled urbanization, environmental degradation, and climate change have significantly increased both the frequency and severity of disasters, transforming disaster risks into more widespread, complex, and interdependent phenomena compared to previous periods. This transformation necessitates addressing disasters not merely as extraordinary events requiring post-event response, but as dynamic risk processes that must be systematically analyzed, managed, and mitigated in advance.

Within the pre-disaster phase of disaster management, the identification of risks, the spatial analysis of risk patterns, and the development of risk reduction-oriented policies have become increasingly critical. However, the growing diversity of risks and the complexity of spatial risk configurations have made the limitations of conventional analytical approaches more evident. The processing of large-scale spatial datasets, the modeling of multivariate relationships, and the enhancement of predictive capacity require more flexible and advanced analytical tools. In this context, despite certain methodological limitations, artificial intelligence (AI) technologies offer substantial potential for risk prediction, the analysis of complex interrelations among risk factors, and the production of high-resolution risk maps. Indeed, recent years have witnessed a rapid increase in the use of AI-based approaches in urban disaster risk analysis. The expanding body of literature calls for a comprehensive assessment that reveals methodological trends and research patterns within this field.

Accordingly, this study systematically reviews research focusing on the analysis of spatial disaster risks in urban areas using artificial intelligence algorithms. Studies selected according to predefined criteria are thematically analyzed in terms of risk categories, algorithm preferences, data types, spatial scaling approaches, and validation methods. Based on this analysis, a multidimensional taxonomy is developed for the AI-based assessment of urban spatial disaster risks. The study aims to provide a guiding methodological reference for researchers and to offer an analytical perspective for decision-makers in the fields of planning and disaster management.

KEYWORDS: Artificial intelligence, Disaster risk analysis, Urban spatial risks, Risk mapping