FOSTERING RESILIENCE TO CLIMATE CHANGE – CARMINE PROJECT

Iuliana Maria Pârvu[1], Iuliana Adriana Cuibac[1], Adrian Grigore Pârvu[1], Nicoleta Pârvulescu[1]

[1] *National Center for Cartography, Bd Expoziției 1A, Bucharest, Romania*
e-mail: iuliana.parvu@cartografie.ro

The CARMINE project (Climate-Resilient Development Pathways in Metropolitan Regions of Europe) is funded by Horizon Europe and seeks to enhance the resilience of European metropolitan areas to climate change. By co-developing knowledge-based tools, strategies, and action plans, CARMINE aims to support adaptation and mitigation efforts aligned with the EU's Mission on Climate Change Adaptation for 2030 [1]. The project adopts an interdisciplinary, co-creation approach, fostering collaboration between scientific research, local authorities, civil society, and other key stakeholders to develop actionable knowledge, decision-support tools, and integrated adaptation plans. The main objectives of the project are to: provide knowledge-based Climate Resilient Development Pathways in Metropolitan Regions of Europe, deliver impact-based decision support services and guidance services for increased resilience and adaptive capacity, including early warning systems and disaster risk management and ensure science-based R&I solutions for multi-level climate governance that support local adaptation assessments and plans.

CARMINE will be implemented in eight metropolitan regions across Europe: Prague (CZ), Leipzig (DE), Funen-Odense (DK), Athens (EL), Barcelona (ES), Bologna (IT), Brașov (RO), and Birmingham (UK). This geographical diversity ensures that the findings are transferable across different climate zones, socio-economic contexts, and urban governance systems. The National Center for Cartography (CNC) contributes to various work packages, focusing on climate risk assessments, socio-economic vulnerability evaluations, and the development of a 3D building model to improve resilience in urban governance. The Romanian case study is conducted in Brașov Metropolitan Area, where flood risk assessment is carried out using high-resolution geospatial and meteorological data [2].

The tests derived were performed using four flood scenarios. In this sense, we increased the river water levels with 0.5 m, 1 m, 2 m, and 3 m. The simulations relies on a 2-meter resolution Digital Terrain Model (DTM) and the topographic vector data from the national TopRO5 database. The outputs of this analysis include:

- vector maps of flooded areas under each scenario;
- statistical data on affected areas, categorized by land use class (e.g., residential, industrial, agricultural);
- detailed flood maps for urban and rural zones, providing key inputs for emergency calling and land-use planning.

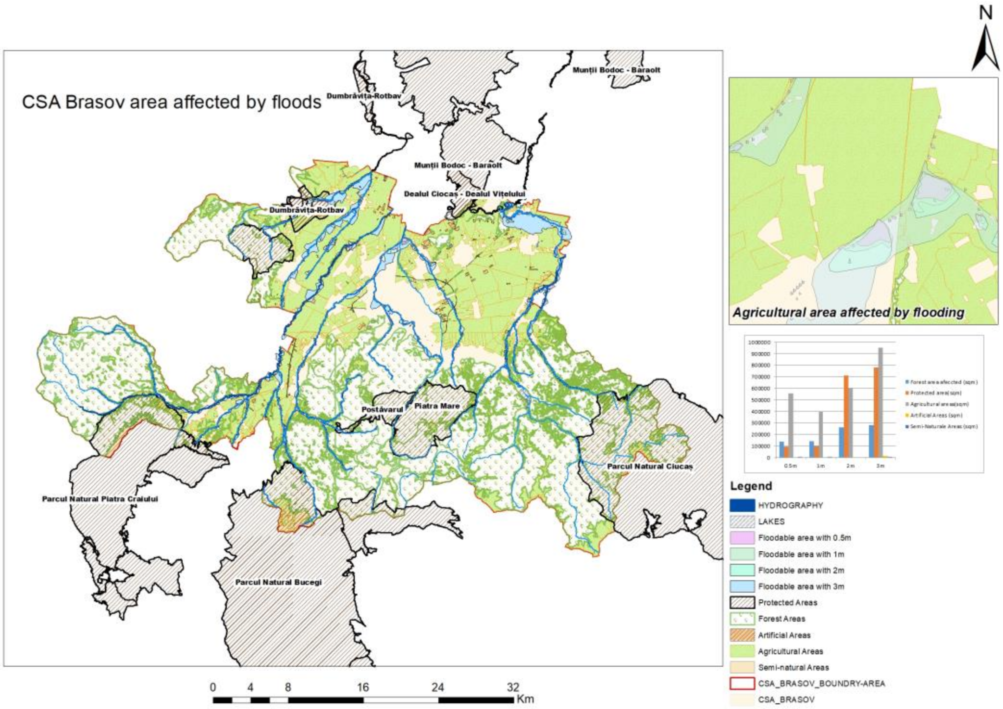

Fig.1. Land use flood area in four scenarios

The analysis done for the area affected by floods displayed by land cover includes classes like: forest, protected areas, agricultural land, artificial surfaces, and semi-natural areas. The study demonstrates that agricultural areas, that occupy most of the rural area, are the most affected by floods when the water level rises by 3 meters. These statistics underscore the critical importance of flood management and land-use planning in the Brașov region, especially concerning agricultural productivity and conservation of natural and protected areas.

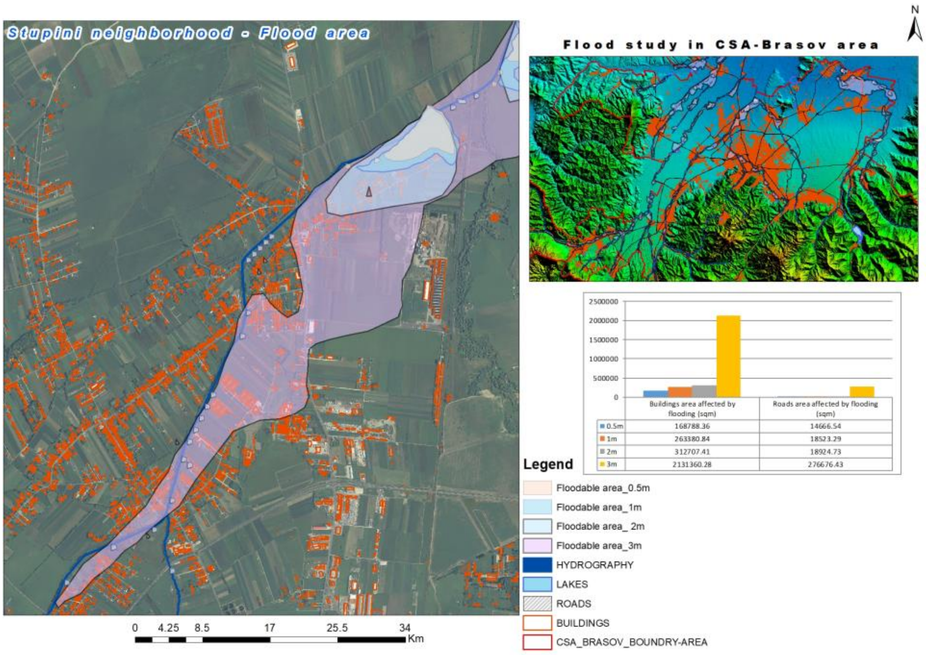

Fig. 2. Flood areas in an urban area

From Fig. 2., we can conclude that the area affected grows exponentially if the water level increases. For the 3 meters increase of the water level the area covered by affected buildings reaches 2 kmp.

To enhance spatial accuracy, 3D building models for the Brașov test area were derived using digitized building footprints extracted from an orthophoto of 8 cm spatial resolution [3].

Fig. 3. Test area for the 3D building models

These models will enable advanced simulation of water propagation and damage estimation at building level. The integration of 3D building models with meteorological data (e.g., rainfall, humidity, and runoff) supports the simulation of urban flood scenarios under different climate conditions. These simulations allow: identification of high-risk areas based on terrain and the storm water pathways, generation of flood risk maps that highlight potential collecting water zones and water flow routes and evaluation of the effectiveness of current drainage infrastructure and green adaptation strategies [4].

By comparing DTM data with forecasted rainfall events, local authorities can proactively plan interventions to reduce the exposure of critical infrastructure and vulnerable populations. These tools also support emergency planning by indicating which buildings and zones are at risk during specific rainfall intensities.

Following this study, authorities and project partners will identify and incorporate nature-based solutions – such as green infrastructure, permeable surfaces, urban wetlands and restoration of natural watercourses – in the decisions plans that will improve the effectiveness of traditional approaches. These solutions not only mitigate flood risks, but also provide corresponding benefits for biodiversity, air quality and urban places.

References:

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