Citizen Science and Spatial Representation of Urban Flooding: A Case Study in Curitiba, Paraná, Brazil

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Abstract The rapid growth of Latin American cities, combined with the increase in extreme hydrological events caused by climate change have intensified urban flooding incidents, especially in areas with inadequate infrastructure. Although Curitiba (Paraná, Brazil) is recognised for its history of urban planning, episodes of recurrent flooding have caused material losses, compromised mobility, and exposed socio-spatial inequalities. The absence of real-time public monitoring systems, updated and georeferenced, limits institutional response capacity and reveals deficiencies in the provision of adaptive urban infrastructure. In this context, citizen science serves as a supplementary and strategic instrument, facilitating the participatory collection of up-to-date, territorially relevant data that is sensitive to local realities. This study aimed to map flood points in the municipality of Curitiba based on voluntary data collected between January and December 2023. A digital form containing 20 questions was widely disseminated via social media (WhatsApp, Instagram, and community groups) and the media, yielding 1,330 responses. After data verification and cleaning, 1,200 valid records were georeferenced individually using specialized tools, allowing the creation of heat maps, neighborhood-based graphs, and integrated cartographic visualizations. The methodology adopted an exploratory and applied approach, based on the principles of citizen science and participatory cartography. The geographical coordinates were validated through visual inspection with the aid of Google Maps and Street View. Official data were geocoded, converted into KML files, and integrated with primary layers in GIS software. Spatial analysis was organised into three blocks: (i) a map of popular perception; (ii) a map of official records. Moreover, (iii) flood risk maps provided by the Municipal Government. The superposition of these layers enabled the identification of convergences, gaps, and critical recurrence areas. The results revealed that this comparative analysis between voluntary and official data showed convergences, reinforcing the reliability of citizen data as a technical resource. Drainage issues are currently recognised as a chronic global problem, and the findings of this study demonstrate how citizen science strategies can disclose hidden patterns of urban water vulnerability, often overlooked by traditional institutional systems. The integration of these data sources, combined with geoprocessing, provides a replicable and effective strategy for improving adaptive city planning in the face of climate change.