INTENSE RAINFALL EVENTS AND FLOODING IN THE IGUAÇU-SARAPUÍ RIVER BASIN, RJ, BRAZIL

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Événements de pluie intenses et inondations dans le bassin de la rivière Iguaçu-Sarapuí, RJ, Brésil

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Introduction

Extreme weather events and the occurrence of hydrometeorological disasters have gained more intense proportions and magnitudes, becoming environmental problems in several Brazilian cities. Zanella and Olímpio (2014) discussed that urban environments are susceptible to major impacts associated with concentrated rainfall, leading to floods.

The intense and rapid urbanization and population agglomeration in cities led to changes in land use and coverage, which consequently led to a gradual reduction in ecosystems and biodiversity, resulting in a significant increase in environmental problems and making large cities more exposed to climate change (Silva, 2019). The study area of this work comprises the Iguaçu-Sarapuí river basin, located in the Metropolitan Region of the State of Rio de Janeiro, Brazil. It is an area with a tropical climate, located between two mountains, with a drainage area of 726 km².This work aimed to evaluate the distribution by months of rainfall events over 100 mm and the impacts associated with the occurrence of floods in the basin area.

1. Data and methodology

The rainfall data were extracted from the information bank of the National Water Agency (ANA) and the Meteorological Database of the National Institute of Meteorology (INMET) – which are Brazilian agencies responsible for collecting rainfall data. After reviewing the sources, 10 rainfall stations were selected, providing daily data (in different periods). For this article, in an attempt to optimize the study, we analyzed the distribution of daily rainfall accumulated above 100 mm. The data extraction utilized the Hidro 1.4 software and the gauges stations used in this study provide data ranging from 1961 to 2022: Xerém INMET (2002-2022); Tinguá (1961-1993); Xerém INEA (1976-2015); Catavento (2008-2021); GBM (2008-2022); Nova Iguaçu (1976-1996); Mendanha (1970-2014); Realengo (1965-2011); Bangu (1961-1998) and Vila Militar (2007-2022).

It is worth mentioning that this work was developed in the context of data from stations with historical series covering different periods (start and end), and presenting data gaps. However, for this initial phase of the study, it was considered pertinent to identify intense rainfall above 100 mm, which consequently caused impacts on the population, such as floods, for example. Up to this point, the analysis of the impacts of the rain events has been based on information collected from the statistical reports of the municipal Civil Defense of Nova Iguaçu – city with more than 50% of its territory in the basin area. The information collected was on the number of floods already recorded and the areas most affected between 2013-2022.

2. Results

The analysis of daily precipitation above 100 mm is conducted for the pluviometric series of the Iguaçu-Sarapuí river basin. It revealed that in total 157 rainfall events above 100 mm were recorded between 1961-2022.The most frequent months of occurrence are November, December, January, February, March and April, being more intense in January and February - corresponding to the summer period in the study area (Fig. 1).

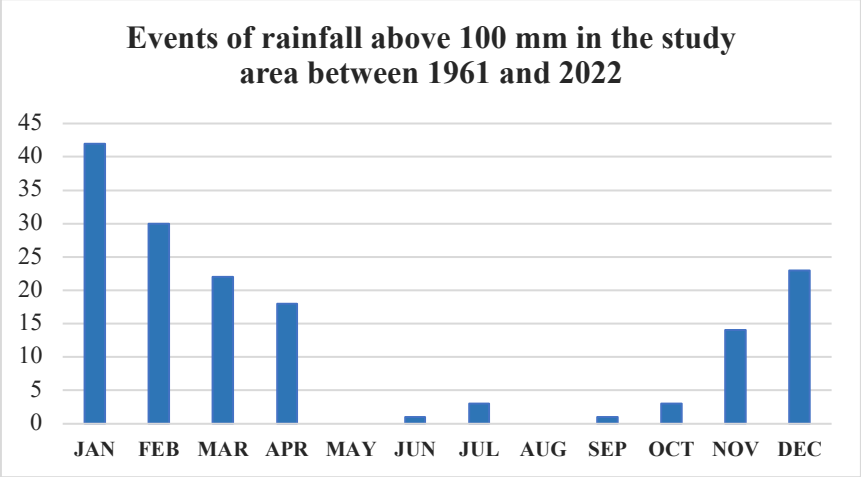

Figure 1. Number of events of rainfall above 100 mm and their distribution by months in the study area

It is important to mention that the annual precipitation regime in the study area is marked by a rainy summer, with reduced precipitation in winter, and the average annual precipitation is around 1700 mm. Through the figure we can see that the accumulations of over 100 mm have been recorded outside of the expected period: for example, in the month of July, a winter and dry period, 3 events above 100 mm were recorded.

Another example that draws attention was observed in the month of April, although this type of accumulation is recurrent. The GBM gauge station on 04/01/2022 recorded an accumulation of 86.4 mm in 1 hour and 228.6 mm in 24 hours, representing 240.6% of the climatological average for April, which is 95 mm. The combination of intense rain with problems of urban drainage and changes in land use and coverage generated various impacts on the population. This includes the occurrence of floods on the Botas River – one of the main rivers in the basin, which reached a maximum level of 5.03 meters, exceeding the overflow quota of 3.7 meters on 04/01/2022. In addition to the Botas River, other rivers in the city of Nova Iguaçu also flooded, and according to the Civil Defense, approximately 500 incidents of flooding were recorded in this event of intense rain on 04/01/2022. This number corresponds to 37% of all episodes of flooding attended between 2013 and 2022.

In a study carried out by Oscar Júnior (2015), it was observed that events with less intensity (between 50 and 60 mm) still caused significant impacts in the municipality of Duque de Caxias (other city in the basin area). This raises concerns about concentrated rain in a short period, raising the hypothesis that the organization of the territory may be a contributing factor for to the occurrence of disasters.

Conclusion

Daily rainfall above 100 mm holds significant potential to trigger flooding events, especially in highly impermeable areas, and many of these events become disasters. For the study area, we have the perspective that the main anthropogenic interventions contribute to the occurrence of disasters, associated with inefficient urban planning, poor management of watersheds, soil sealing, pollution of watercourses, irregular occupation of riverbanks and slopes. To further our investigation, we plan to analyze the events of rainfall introducing new classes (40 – 60 mm, 60 – 80 mm, 80 – 100 mm), and correlate these classes with hydrological impacts in the study area.

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