

Proceeding Paper

The Rainfall in the Municipality of FLORIANÓPOLIS (BRAZIL): The case of December 2022.

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Abstract: The Municipality of Florianópolis is located in the State of Santa Catarina, in South Region in Brazil. The place has experienced several types of disasters. This article, will focus on the flood episode related to precipitation in December 2022. The volume of rainfall for this month was three times higher than the climatologic norm for December. The highest rainfall occurred between the 19th and 20th of December. Despite the flooding, some residents were left homeless. Additionally, an emergency declaration was issued by the Municipal Mayor.

Keywords: Climatology; Disasters; Precipitation; Flood; Santa Catarina; Florianópolis.

1. Introduction

The Municipality of Florianópolis is situated in the State of Santa Catarina (SC) in the South Region of Brazil, specifically in the Mesoregion of Grande Florianópolis. This place is considered the capital of the State or Island of Santa Catarina. According to the census conducted in 2022 for the Brazilian Institute of Geography and Statistics (IBGE) the Municipality had a population of 537.213 habitants, making it the second most populous in the State after Joinville in the North Region.

The Municipality covers a territorial area of 674,844 km², and the economy is based on tourism, featuring several beaches, technological sector, commerce, construction, mariculture, and aquaculture. According to Murara (2012), the average annual rainfall is 1.734 mm. Figure 1 illustrates the geographical location of the Municipality of Florianópolis.

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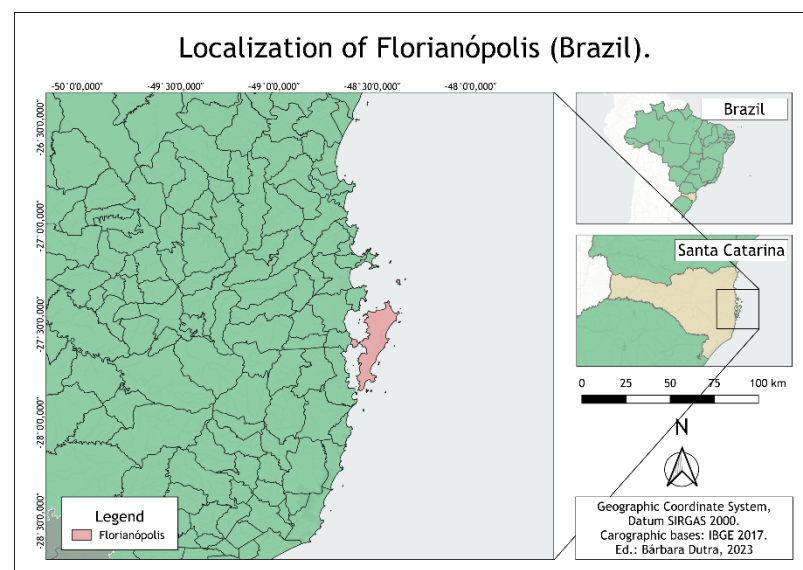


Figure 1. Localization of the Municipality of Florianópolis (Brazil).

The State of Santa Catarina is divided into six Mesoregions such as West, Serrana, Vale do Itajaí, North, South and Grande Florianópolis. According to the census, the state has a population of 7.609.601 habitants, 295 Municipalities and covering a territorial area of 95.739,690 km².

The State of Santa Catarina is recognized for the number of disasters that have occurred over the years, many of which were influenced by precipitation, including floods, droughts, landslides, windstorms, hail, and even the first occurrence of a hurricane in the South Atlantic Ocean, known as Hurricane Catarina. According to Monteiro (2001), Santa Catarina is one of the Brazilian states with the best distribution of precipitation. This is attributed to a series of factors, such as cold fronts, South Atlantic Convergence Zone (ZCAS), mid-level troughs, maritime circulation, tropical convection, cyclonic vortices and relief.

This article aims to analyze and demonstrate the precipitation responsible for the flooding episodes that happened in December 2022 in the Municipality of Florianópolis. Additionally, it aims to compare this with other extremes situations previously recorded.

2. Methods

For the present article, rainfall data and information were collected from the National Institute of Meteorology (INMET) and processed using Excel Software. Additionally, satellite images, data from the Defense Civil website, photographs, and images from state and municipal newspapers were utilized to illustrate the situations in the Municipality. Furthermore, the Atlas of Natural Disasters in the State of Santa Catarina, covering the period between 1980 and 2010 and published in 2014, was consulted.

3. Results and Discussion

In December 2022, the recorded total rainfall reached approximately 477 mm. This was significantly higher than the monthly average of 177 mm, with a rainfall deviation of 299,8 mm. The most intense rainfall occurred at the beginning of December and between the 19th and 20th, with the latter day recording 207 mm in just 24 hours (INMET, 2023).

The precipitation in the South Region of Brazil was attributed to a hot and humid mass of air, especially in the State of Santa Catarina at the beginning of the month. On the 20th, the precipitation was related to a low-pressure system with high humidity levels, resulting in expressive rainfall in the cities of Itajaí and Florianópolis, recording 229,4 and 207 mm, respectively (INMET, 2023).

Figure 2 illustrates the accumulated precipitation throughout the entire Brazilian territory for December 2022, with areas in blue indicating the highest volumes and the areas in yellow/green indicating the lowest volumes. The extreme events in the country were related to the South Atlantic Convergence Zone (SACZ) and humidity levels. The precipitations were observed in almost all of Brazil, from the South and Southeast coast to parts of the central and northern of the North Region. In the State of Santa Catarina, precipitation varied, with the highest indices recorded in the central and northern regions, while the lowest levels observed in the Western Region (INMET, 2023).

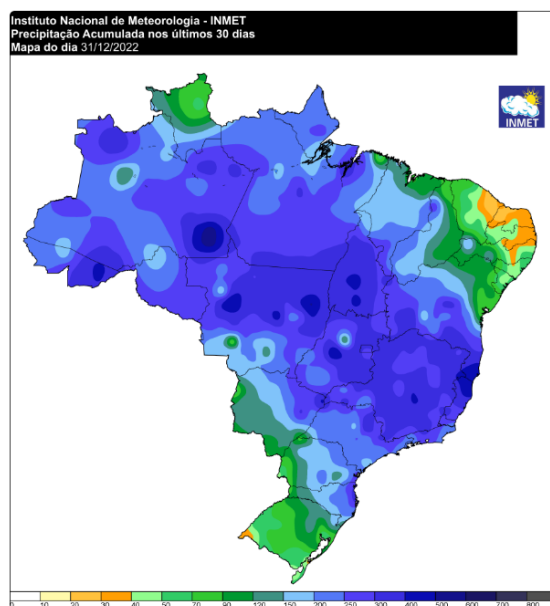


Figure 2. Accumulated rainfall for December 2022 in Brazil. Source: INMET, 2023.

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Figure 3. illustrates the annual rainfall distribution for the Municipality of Florianópolis in 2022. Furthermore, the month of December had the highest rainfall, exceeding 400 mm, followed by March with 242 mm. In December, some days experienced intense precipitations, while on other days, no precipitation was recorded.

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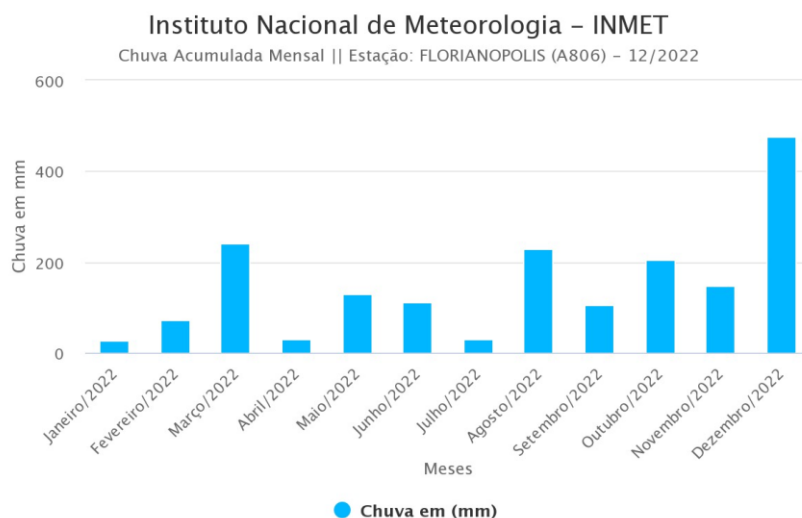


Figure 3. Annual total precipitation for Florianópolis (Brazil) in 2022. Source: INMET, 2023.

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In Figure 4, it is possible to observe the map of Santa Catarina with precipitation alerts for each region. The red area represents alerts for persistent and voluminous precipitations, particularly in regions such as Grande Florianópolis, Baixo Vale do Itajaí and North Littoral. These alerts were issued for the period of December 20th and 21st. During this time, the precipitation was influenced by maritime circulation, resulting in substantial and sometimes intense rainfall, with a very high risk of associated episodes, such as landslides, in the regions of Grande Florianópolis, North Littoral, Baixo, and Médio Vale do Itajaí (CIVIL DEFENSE DEC., 2022).

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Figure 4. Precipitation volume alert in the December 20th and 21st for the State of Santa Catarina. Source: Civil Defense, 2022.

On December 1st, G1 Santa Catarina newspaper, highlighted the incidents of landslides and flooding that occurred in several cities in the State of the Santa Catarina between the November 30th and December 1st. In addition, roadways were interdicted, including the BR-101 at Morro dos Cavalos in the Municipality of Palhoça. In this fact, the Mayor of Florianópolis declared a state of emergency. Due to the episodes, classes and public transportation services, such as buses, were suspended.

On December 21st, the SC Hoje News newspaper emitted a note informing that 90 incidents had already been recorded in Florianópolis as a result of heavy precipitation, leading to landslides and flooding. Furthermore, 15 people were left homeless and 1.600 were displaced, needing to be relocated for parents’ and neighbors’ houses. Additionally, 40 residences were either partially or entirely interdicted due to the risk they represented to the residents.

Figure 5 represents two photographs of the Municipality of Florianópolis. The first one (A) is from December 1st and illustrates the damage caused on a traditional street in the Córrego Grande neighborhood. The second photograph (B) is from December 19th and shows Highway SC-401, which carries hundreds of vehicles every day, and has flooding points, impeding traffic.



Figure 5. Damages caused from the December 2022 rainfall. Source: G1 Santa Catarina.

In addition to the December 2022 flooding event, the Municipality has experienced others significant flood situation in January 2018. This fact tragically resulted in one death and left many residents isolated in Florianópolis, with 500 people becoming homeless across the State. The period which precipitation exceeded climatological average occurred between the 9th and 11th of January, with approximately 400 mm of rainfall. According

to the Civil Defense, this amount of precipitation was almost three times the monthly average, which typically ranges from 150 to 170 mm. In response to the severity of the event, the Mayor declared a state of emergency, and more than 200 streets were affected (TORRES, 2018).

According to Alves and Silveira (2018), the total precipitation for the month reached approximately 625,4 mm at the Carijós Weather Station, located in the Jurerê neighborhood. This precipitation exceeded the previous record of 625 mm, which had been registered in 1997 at the São José Meteorological Station, which has been collecting data since 1913.

According to Herrmann and Alves (2014) in the Atlas of Natural Disasters in the State of Santa Catarina, the Mesoregion of Grande Florianópolis observed a total of 292 flooding facts. Among these, 159 were flash floods, and 133 were gradual flooding events, between the 1980 and 2010 period. Additionally, landslides situations were sometimes associated with heavy rainfall, with the Municipalities of Florianópolis and Blumenau (in Vale do Itajaí) having the highest frequency of these incidents. Among the 21 Municipalities situated in the Grande Florianópolis area, Florianópolis experienced the highest number of flooding episodes, totaling 24.

In the case of previous events, can also cited the 1997 year, which experienced occurrences during the year. Specifically, in January, precipitation deviations were above average, with the influence of South Atlantic Convergence Zone (SACZ). In January, the Municipality of Florianópolis recorded a deviation of 453 mm above the average precipitation. During that summer, there were flash flood and gradual floods, especially in the Grande Florianópolis and Vale do Itajaí Mesoregions, with precipitation exceeding 250 mm. In this case, in terms of precipitation results, 35 Municipalities were affected in January, and 37 were affected in October (Marcelino et al, 2014; Herrmann e Alves, 2014). Additionally, there were other significant events such as December 1995 and November 2008 for the entire State of Santa Catarina.

4. Conclusions

Based in the collected information about the precipitation, it is evident that heavy rainfall occurred during December 2022, exceeding 450 mm and being three times above the historical average. In response to this situation, the Mayor of Florianópolis declared a state of emergency. In addition, the precipitation that affected the Municipality also had adverse effects on other cities located in the North of the State, Baixo and Médio Vale of Itajaí.

Additionally, to the recent event, the Municipality of Florianópolis has experienced other situations during the years, as demonstrated and documented in the Atlas of Natural Disasters in the State of Santa Catarina. Sometimes, heavy and intense rainfall can lead to new incidents, such as landslides and slips.

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