RAINFALL VARIABILITY IN THE SUBTROPICAL CLIMATE OF BRAZIL

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Variabilité des précipitations dans le climat subtropical du Brésil

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Introduction

The sixth report from IPCC Working Group I shows that the world is likely to reach or exceed 1.5°C of warming over the next two decades – sooner than in previous assessments. Consequently, the distribution of rainfall will also be affected.

According to the report (IPCC, 2021), rainfall on the continents has increased globally since 1950, but some regions have registered and are expected to suffer a significant reduction in precipitation. Regional scenarios indicate that changes in rainfall patterns will occur in Brazil, which is essential for agriculture and hydroelectric power generation. In this way, the scenarios suggest that mainly the central region of Brazil and the eastern part of the Amazon will become drier, with a drop of 10% to 20% in precipitation. This will happen in both a 2°C and 4°C global warming scenario.

Brazil is known for its predominant tropical climate. In its southern portion, which covers an area of approximately 576,000 km², formed by the states of Paraná, Santa Catarina, and Rio Grande do Sul, Brazil is characterized by the subtropical climate type. This climate type is responsible for several extreme meteorological events and climatic phenomena that severely affect the region, such as floods, landslides, windstorms, and droughts. Faced with a climate change scenario, this research analyzed rainfall variability for the subtropical climate of Brazil.

1. Methodology

We used daily precipitation datasets from five national networks Agricultural Research and Rural Extension Company of Santa Catarina (EMPRAPA - Brazil), National Meteorological Institute (INMET - Brazil), National Water Agency (ANA - Brazil), Instituto Uruguayo de Meteorología (IUM) and Serviço Meteorológico Nacional da Argentina (SMNA) from the three following countries: Brazil, Argentina, and Uruguay. For Argentina and Uruguay, we have selected 10 weather stations along the border to distribute weather stations better.

Initially, we selected and made analyses for 180 weather stations. After quality control (QC), the number of stations was reduced from 180 to 70 for inhomogeneity, missing data, and closure issues. After QC, we applied the following extreme indices: SDII, CDD, CWD, R95p, R99p, and PRCPTOT to characterize the variability of extreme rainfall patterns. We also carried out a cluster analysis of the hierarchical agglomerative Ward method to identify homogeneity areas for the rain distribution.

2. Results

The results indicated that although the classic literature (Monteiro, 1963; Nimer, 1971) presents the distribution of rainfall as homogeneous in the southern region of Brazil, especially in comparison with the other climate types in the country, it was possible to observe the regional scale that there are differences between the totals of precipitation.

They were characterized by the presence of five distinct regions of Brazil's subtropical climate. In three areas, we identified an increase in annual precipitation by extreme events, while other regions, such as two areas, show a reduction in precipitation values. These last two areas, located in the northernmost portion of the southern region, very close to the tropical climate of Brazil, suggest a possible process of tropicalizing rainfall on the edges of the subtropical climate.

Conclusion

These results, in addition to indicating changes in the rainfall pattern, which is not expected for the subtropical climate type, suggest changes to rainfall extremes. Internal regions in the subtropical climate have higher concentration rates for more rain and others for reduced precipitation. Furthermore, the results suggest that the portion close and tangential to the tropical climate may be associated with the expansion of the tropics, which will be one of the causes of climate change (Yang *et al.,* 2020).

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