THE RELATIONSHIPS BETWEEN EL NIÑO SOUTHERN OSCILLATION AND CLIMATE EXTREMES IN PARANÁ RIVER BASIN, BRAZIL

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1. INTRODUCTION

The Paraná River Basin (PRB) is located in the southeast and center-south of Brazil and in the center-east of South America (Figure 1). It is the second largest hydrographic region of Brazil and it has great importance in the national context, since it concentrates more than 32% of the Brazilian population, and due to the high rate of industrialization, presents the highest energy demand of the country.

The objective of this study is to evaluate the possible influence of the El Niño Southern Oscillation (ENSO) phenomenon in wet and dry events in PRB.

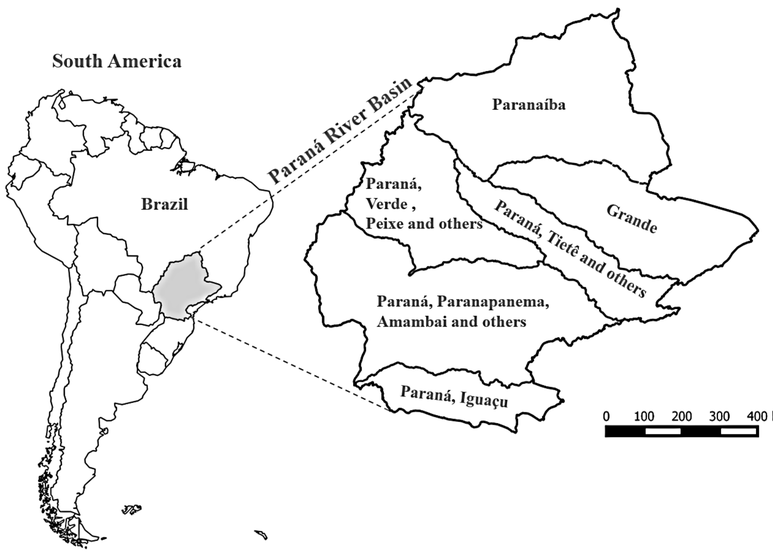

Fig 1. Location of the Paraná river basin (Brazilian part), with emphasis on its sub-basins.

2. MATERIALS AND METHODS

2.1 Datasets

The daily rainfall dataset was obtained from the National Water Agency (Agência Nacional de Águas - ANA) and Department of Water and Electrical Energy (Departamento de Águas e Energia Elétrica - DAEE). 986 stations were found, for the period of 1975 and 2014 with less then 10% missing data.

Sea Surface Temperature (SST) anomalies for the Pacific regions, Niño 1 + 2 (0-10S, 90W-80W), Niño 3 (5N-5S, 150W-90W), Niño 3.4 (5N- 5S, 170-120W) and Niño 4 (5N-5S, 160E-150W) were used. These data were obtained from the Climate Prediction Center (CPC) of the National Oceanic and Atmospheric Administration (NOAA).

2.2 Methods

To characterize the dry and wet events, the Standard Precipitation Index (SPI) was used, developed by McKee et al. (1993). Positive SPI values indicate greater than median precipitation, and negative values indicate less than median precipitation. Thus, the SPI may be used for monitoring both dry and wet conditions. The wet and dry events levels can be classified according to SPI range in Table 1.

Table 1. Wet and dry events levels according to SPI values

SPI Range	Classes
[2.0, +∞)	Extremely wet
[1.5, 2.0)	Severely wet
[1.0, 1.5)	Moderately wet
(−1.0, 1.0)	Near normal
(−1.5, −1.0]	Moderately dry
(−2.0, −1.5]	Severely dry
(−∞, −2.0]	Extremely dry

SPI-3 was used, corresponding to the cumulative rainfall periods of 3 months. The SPI-3 was correlated with the quarterly anomalies of the Niño indices (Niño 1 + 2, Niño 3, Niño 3.4 and Niño 4). For the correlation calculus, it was used the Pearson correlation method and the significance level (of 5%) of the correlation coefficients was defined using the Student's t-test.

3. RESULTS

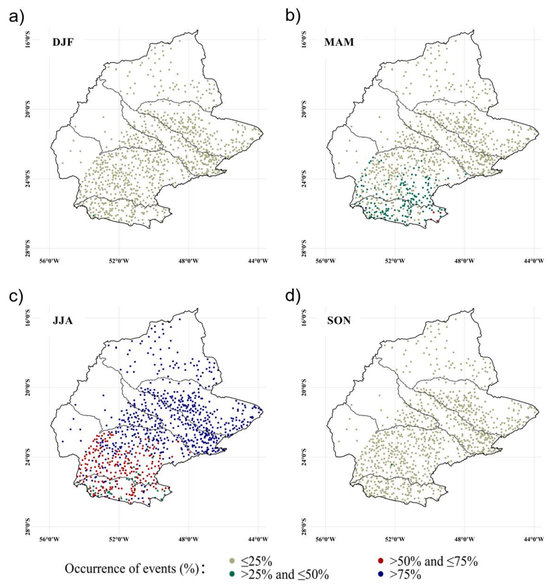

Fig 2. Percentage of the number of dry events (severely and extremely dry) registered in: a) Austral summer, b) Austral autumn, c) Austral winter and d) Austral spring.

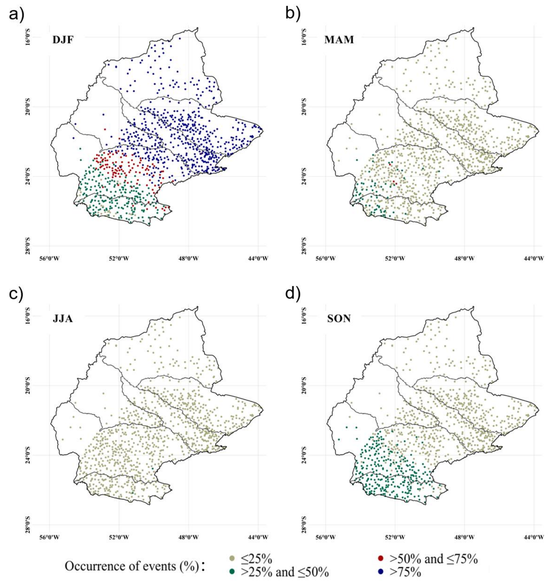

Fig 3 Percentage of the number of wet events (severely and extremely dry) registered in: a) Austral summer, b) Austral autumn, c) Austral winter and d) Austral spring.

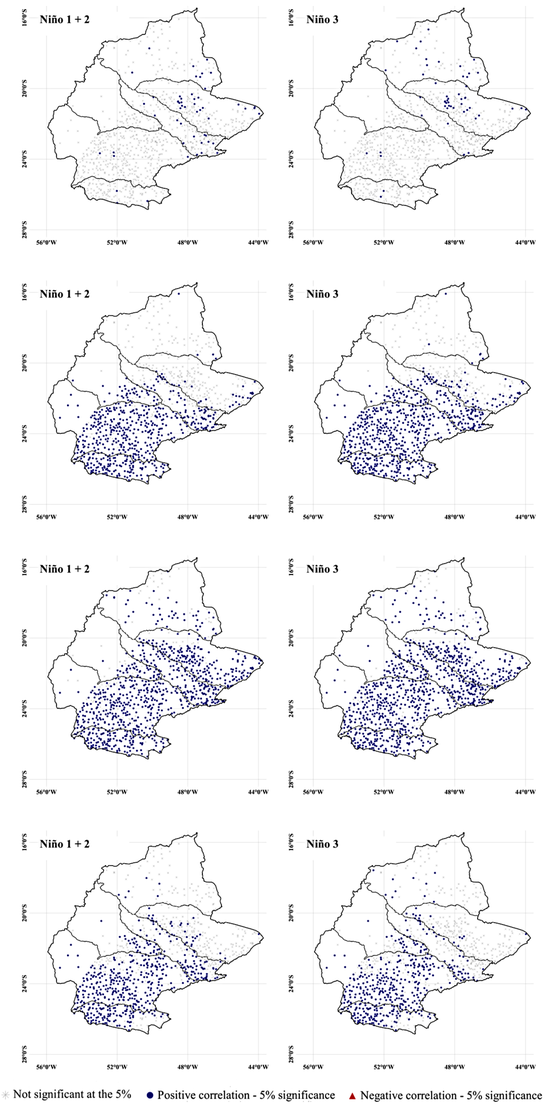

Fig 4. Space correlation among the SPI-3 and the quarterly anomalies of the Niño indices (Niño 1+2 and Niño 3), for the: a) Austral summer, b) Austral autumn, c) Austral winter and d) Austral spring.

4. CONCLUSIONS

- SST anomalies of the Pacific regions play a relevant role on rainfall regime in the PRB, causing increase and / or decrease rainfall, mainly in the autumn and austral winter.
- In the austral summer, period with greater occurrence of wet events in all sub-basins, was not found relationship with ENSO.
- SST anomalies of the Pacific regions were positive (negative) when the SPI were positive (negative)
- El Niño (La Niña) contributes to the excess (lack) of rainfall in the region.

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