CLIMATE CHARACTERIZATION OF SERRA DE MARTINS – RN

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Abstract

The Brazilian Northeast in its largest portion is defined by a Semi-arid climate. However, when analyzing the region on a larger cartographic scale, it is possible to reveal areas that escape this context, being characterized as Areas of Exception or wet enclaves. Thus, this research aimed to characterize the climatic type of Serra de Martins in the period from 1973 to 2002, comparing with the municipality of Antonio Martins, located in the Depression Sertaneja. For the data, rainfall data were made available by EMPARN and temperature data were estimated using a software, following the model of Cavalcanti and Silva (1994), called Estima_T, which provides the averages, maximum and minimum values based on latitude, longitude and altitude. After data tabulation, the climatological water balance was generated, according to the model proposed by Thornthwaite and Mather (1955). For Martins, the rain fall average of 1230 mm and 23 °C was found as a termal average. Antonio Martins, meanwhile, found average precipitation value of 693 mm and its termal average is 26 °C. From the data generated in the water balance, we have the following climacticity pology, B1w2A (Wet Megatherm with water deficit in winter and pring) for Martins and C1dA (Dry Subhumid Megatherm with little or no watersurplus) for Antonio Martins.

Keywords: Climate; Semiarid; Exception Area.

CARACTERIZAÇÃO CLIMÁTICA DA SERRA DE MARTINS – RN

Resumo

A maior parte do Nordeste brasileiro é definido pelo clima semiárido. No entanto, ao analisar a região em escala cartográfica maior, é possível encontrar áreas que fogem a este contexto, caracterizando-se como Áreas de Excepção ou enclave úmidos. Assim, esta pesquisa objetivou uma caracterização climática da Serra de Martins, no período de 1973 a 2002, comparando com o município de Antonio Martins, situado na Depressão Sertaneja. Os dados pluviométricos foram disponibilizados pela EMPARN e os de temperatura foram estimados em software, seguindo modelo de Cavalcanti e Silva (1994), denominado de Estima_T e que disponibiliza as médias, máximas e mínimas com base em dados de latitude, longitude e altitude. Após a tabulação dos dados, o balanço hídrico climatológico foi gerado, conforme modelo proposto por Thornthwaite e Mather (1955). Para Martins encontrou-se a média pluviométrica de 1230 mm e 23 °C como média térmica. Já Antonio Martins o valor médio de precipitação encontrado foi de 693 mm e sua média térmica é de 26°C. A partir dos dados gerados no balanço hídrico, tem-se a seguinte tipologia climática: B1w2A’ (Megatérmico Úmido com déficit hídrico no inverno e na primavera) para Martins e C1dA’ (Megatérmico Subúmido Seco com pequeno ou nenhum excedente hídrico) para Antonio Martins.

Palavras-chave: Clima; Semiárido; Área de Excepção.

CARACTERIZACIÓN CLIMÁTICA DE SERRA DE MARTINS – RN

Resumen

El nordeste de Brasil en su mayor parte se define por un clima semiárido. Sin embargo, al analizar la región una escala cartográfica más grande, es posible revelar áreas que escapan a este contexto, caracterizando como Áreas de excepción e enclave húmedos. Así, esta investigación tuvo como objetivo una caracterización climática de la Serra de Martins, en el período de 1973 a 2002, comparando con el municipio de Antonio Martins, ubicado en la Depresión Sertaneja. Encuanto a los datos, EMPARN puso a disposición los datos de precipitaciones y los datos de temperatura se estimaron mediante software, siguiendo el modelo de Cavalcanti y Silva (1994), llamado Estima_T, que proporciona los promedios, valores máximos y mínimos basados...
em latitud, longitud y altitud. Después de la tabulación de datos, se generó balance hídrico climatológico, de acuerdo con el modelo propuesto por Thornthwaite y Mather (1955). Para Martins, el promedio de precipitaciones de 1230 mm y 23°C se encontró como un promedio térmico. Antonio Martins, por su parte, encontró un valor promedio de precipitación de 693 mm y supremedio térmico es de 26°C. A partir de los datos generado en el balance hídrico, tenemos las siguientes tipología climática, B1w2A 'Megatherm húmedo con déficit hídrico en invierno y primavera para Martins y C1dA' (Megatherm subhúmedo seco con poco o ningún excedente de agua) para Antonio Martins.

**Palabras-clave:** Clima; Semi árido; Area de Excepción.

### 1. INTRODUCCIÓN

El clima de cualquier región es ampliamente definido por el general circulation of the atmosphere, which ultimately results from the differential heating of the globe through solar radiation, the desymmetric distribution of oceans and continents on the Earth's surface and the topographic characteristics over the continents. (FERREIRA; MELO, 2005). Según los autores, dichos factores generan patrones circulatorios que redistribuyen el calor, la humedad y el movimiento en un modo heterogéneo en la Tierra.

Basado en este entendimiento, Mendonça y Danni-Oliveira (2007) definen Brasil como un país tropical, ya que se encuentra en el cinturón tropical, dando lugar a particular aspectos, como la consideración de la belleza del cielo (sol) y las altas temperaturas vinculadas a la lluvia (caliente y húmedo), en uno de los lugares con la mayor energía solar en la superficie del planeta.

En este contexto, el Nordeste brasileño (NEB), en el que se presentan extrema climáticas (cuando se compara con el escenario brasileño), entre las cuales, la bajada de humedad, la escasez de precipitación, la irregularidad en el ritmo de lluvias durante años, la falta de periodos de sequía, la escasez de ríos costeros y otras condiciones climáticas, que son extremadamente limitadas a un corto período, son bien documentados, en promedio, de 2 a 3 años (AB'SABER, 1974; REIS, 1976).

Según Kayano y Andreoli (2009), tres climáticas son tipos reconocidos en la región: Mejor Costa Tropical, Clima Tropical y Semi-Arido Tropical Clima. Este evidenciado diversidad climática depende del clima físico que afecta el área, siendo responsable para la formación y la distribución de las lluvias. Entre los factores principales que determinan este cambio climático variabilidad, podemos mencionar el geográfico, el relieve, el carácter topográfico y el clima systems operating in the region, which have different spatial and temporal scales (MARENGO et al., 2011; FERREIRA; REBOITA; ROCHA, 2019).

Por lo tanto, Ferreira y Mello (2005), indican que en el NEB, la atmósfera ecológica que causa lluvias en el NEB son: el Intertropical Convergence Zone (ZCIT), el cual es responsable para la precipitación que ocurre en el norte del NEB, de febrero a mayo, especialmente en los estados de Ceará, oeste de Rio Grande do Norte e interior de Pará y Pernambuco; el Cold Fronts que causan lluvias en el sur del NEB, desde noviembre a enero; el East Waves, responsable por las lluvias en el NEB este entre mayo y agosto; el High Levels Cyclonic Vortexes (VCANs), que ocurren en primavera, verano e invierno (September to April), con alta frecuencia en la segunda mitad de enero; la Línea de Instabilidad, que causa lluvias, usualmente del tipo cumulonimbus; los Mesoscale Convective Complexes, causan lluvias de fuerte congreso y las estaciones climáticas.

En adición a los factores mencionados, El Niño (EN) es también presente, que según Mendonça y Danni-Oliveira (2007), es un fenómeno climático, debido a la fuerte influencia de condiciones oceánicas, destacando la relación del clima-atmosférico, principalmente de la South Oscillation El Niño (ENOS). En años de EN, el convección equatorial se desvía hacia el este, cambiando la posición del Walker cell, que puede inhibir la formación de nubes y mover el ZCIT hacia el norte, favoreciendo una secuencia de días muy secos.

Orogríferas también juegan un papel importante en el ciclo climático en el contexto de la región, entendido como aquellos que emergen de la acción física del relieve, actuando como barrera para la libre circulación del aire, que es forzado a ascender, lo cual dificulta la generación de nubes. En este sentido, un gran relieve barrial, es identificado en el NEB, el Planalto da Borborema, ubicado en el este del NEB, responsable por la distribución de nubes al norte, responsable por los cambios en el volumen de lluvia en cada parte del monte, mientras interfieren en el funcionamiento de los mecanismos de precipitación.

Barbosa (1998) señala que en las áreas más secas del NEB, con pluvimétricos anuales oscilantes alrededor de 300 mm / año, constituyen valles que se incluyen en el leeward de la barrera topográfica que sube a 1000 m de altura, donde el viento se desvía hacia el este (sin humedad). En el otro lado, el viento del lado del barrer, hay áreas suavemente húmedas, adecuado para la agricultura. Una explicación de este fenómeno se puede encontrar en Mendonça y Danni-Oliveira (2007, p. 71), el humed y el calor, cuando se acercan a las pendientes, se enfrían de manera adiabática (...). El calor favorece la formación de nubes de convección, formando nubes de convección, las cuales, con la continuidad del ascenso, tienden a producir lluvias. Así, el viento de la zona tiende a ser sutil, forzado a desvencer, lo cual dificulta la formación de nubes.

A través de estas discusiones, es esencial reconocer que el entendimiento del clima y su fenómeno es importante para que se entienda y se utilice, de acuerdo a su interés y necesidades. Promoviendo el mercado, el gobierno y la producción social en adición a otras actividades relacionadas con condiciones climáticas y cambios en el comportamiento de los ecosistemas. Las energías, procesos de morfogenia, el régimen de los ríos y actividades...
carried out by man are linked to current atmospheric situations, understood, in this view, as essential to the configuration of the climate (TAVARES, 2004).

In addition to these issues, this work resolves existing gaps in the study of climate change, endowed with information that will serve as a basis for studies in the most diverse areas of knowledge, for the very knowledge of the locality and for future actions of use and management of the territory.

Serra de Martins, despite being geographically located in the semi-arid region of northeastern Brazil, presents climatic peculiarities related to precipitation and temperature, when compared to surrounding areas, inserted in the domains of Country Depression. Considering this reality, the present article aims to develop a climatic analysis for Serra de Martins-RN, aiming to understand how the relief influences the climatic elements temperature and precipitation.

2. METHODOLOGY

The climatic characterization for Serra de Martins was based on a comparison between two different locations, with respect to altitude, Martins and Antônio Martins. The municipality of Martins has altimetric levels above 600 meters, located in the area of the Residual Plateaus and Antônio Martins, located at 270 meters of altitude, is inserted in the Depression Sertaneja (Figure 1).

The data referring to the pluviometric stations, as well as the data used to estimate the temperature were as follows: Martins - latitude: 6° 5’; longitude: 37° 55’; altitude: 645 meters; and Antônio Martins - latitude: 6° 11’; longitude: 37°58’; altitude: 270 meters.

2.1. Data acquisition

The analysis of precipitation was based on rainfall data over a 30-year time series, from 1973 to 2002, provided by the Agricultural Research Corporation of Rio Grande do Norte (EMPARN).

With regard to air temperature, due to the absence of data for the study area and considering the need to work with them, it was decided to work with the data generated from a temperature estimation program for the states of São Paulo, Northeast region, Estima_T, created by the Department of Atmospheric Sciences (DCA) of the Federal University of Campina Grande (UFCG).

Estima_T is a software used to estimate air temperatures in the Northeast Region of Brazil, built from the model proposed by Cavalcanti and Silva (1994), and the coefficients of the quadratic function for minimum temperatures are determined for each desired location, monthly maximum and average, depending on local coordinates (longitude, latitude) and altitude. The estimate of the air temperature time series (average, maximum and minimum) is obtained by adding to the estimated average value the temperature anomaly of the Tropical Atlantic Ocean of the month (ASTM) and year considered.

Cavalcanti et al., (2006) state that the Estima_T model proved to be capable of reconstructing time series of the air temperature with reasonable precision for the entire Northeast of Brazil, from statistically significant correlations at the level of 1%
probability between the air temperatures observed and estimated by the model.

Models of very accurate monthly and annual average temperature estimates, using geographical coordinates and altitude, have been used in different regions of Brazil, as in studies by Cargnelutti Filho et al. (2006) for the state of Rio Grande do Sul, Corraa, Terassi and Galvani (2017) for the hydrographic basin of the Rio Piquiri in Paraná, Capuchinho et al. (2019), for the state of Goiás and Menezes Filho (2020) for the Parnaiba River in Minas Gerais.

The Estima_T program generated, for the municipalities of Martins and Antônio Martins, average monthly temperature data for the period between the years 1950 to 2002, with data from the period from 1973 to 2002 being selected, which now appears as the reference period for this climate analysis, since they comprise the last 30 years of temperature generated by the program. In addition to that, according to the National Institute of Meteorology (1992), the period of 30 years is used for the delimitation of climatological normals, obeying criteria recommended by the World Meteorological Organization (WMO).

### 2.2. Data tabulation, treatment and analysis

The monthly average precipitation and temperature data were transferred and manipulated in a Microsoft Office Excel spreadsheet. The water balance was constructed using the method proposed by Thornthwaite and Mather (1955), using the “BHnorm” program prepared in an Excel spreadsheet by Rolim et al., (1998). As available water capacity (CAD), the value of 100 mm was used for the municipality of Martins and 80 mm for the municipality of Antônio Martins. Rolim et al., (1998) affirm that, for climatological purposes, the determination of the Climatic Water Balance (BHC) only to characterize the regional water availability, it is common to adopt values of Available Water Capacity (CAD) varying from 75 to 125 mm. Potential evapotranspiration (ETP) and real evapotranspiration (ETR) were estimated using the method of Thornthwaite (1948), according to the formula 1:

$$ET_P = 16 \left(\frac{I}{12}\right) \left(\frac{N}{30}\right) \left(\frac{10T_a}{I}\right)^a$$  \hspace{1cm} (1)

One reads:

$ET_P$ - monthly evapotranspiration;

$I$ - average length of the day;

$N$ - number of days of the month;

$T_a$ - average air temperature;

$I$ - heat index;

$a$ - cubic function of $I$.

As a result, the water balance provided estimates of actual evapotranspiration (ETR), water deficiency (DEF), water surplus (EXC) and water availability.

Subsequently, the climatic classification was elaborated using the method proposed by Thornthwaite (1948). Using the water balance data for both locations, the humidity index was initially determined, which is the percentage ratio between excess water and potential evapotranspiration, which is:

$$Im = \frac{(100 . EXC) \text{ annual} - (60 . D) \text{ annual}}{E P}$$

Next, the aridity index, which expresses water deficiency as a percentage of potential evapotranspiration, ranges from 0 to 100. It is calculated using the formula below:

$$I_a = \frac{(D E F) \text{ annual}}{(E T P) \text{ annual}} \times 100$$  \hspace{1cm} (2)

The thermal efficiency index (ETP) is the numerical value of potential evapotranspiration, and is a direct function of temperature and photoperiod. It is presented with a capital letter with an apostrophe and, with or without, a subscript algorithm.

### 3. RESULTS AND DISCUSSION

#### 3.1. Local rainfall characterization

Serra de Martins showed great variations in rainfall, with the values of 2523 mm, maximum rainfall in 1974, and 433 mm, minimum rainfall in 1993, with an annual average of 1230 mm, being identified during the study period. For the town of Antônio Martins, we found a maximum rain precipitation of 1478 mm in 1974, a minimum of 149 mm in 1983, and an average of 693 mm for the analyzed period. By analyzing the rainfall data of the studied municipalities, it was possible to identify the maximum and minimum rainfall found, which correspond respectively to the wetter and drier periods.

Figure 2 shows elements for the understanding that the years 1974, 1977, 1985, 1986 and 2000 are the most expressive in terms of maximum rainfall for the municipalities in question. In the years 1983, 1987, 1990, 1993 and 1998, low rainfall averages were evidenced.

![Historical rainfall series for the municipalities of Antônio Martins and Martins-RN. Source: prepared by the author based on EMPARN data, 2016.](image)

In this sense, the years 1974, 1977, 1983, 1985, 1986, 1987, 1990, 1993, 1998 and 2000 were the most expressive in relation to the extreme events for the series worked on. It should be noted, therefore, that, despite the same behavior found in the two municipalities, both present a contrasting reality when it comes to rainfall values.

It is also important to carry out a more detailed analysis of extreme levels of precipitation and drought, linking them to the performance of current meteorological systems. As for the phenomena of oceanic influence, data can be linked extremes data in their majority, to the performance of El Niño and La Niña.

As for the monthly distribution of rainfall over the period studied (Figure 3), it can be seen that the rains are concentrated in greater quantities in five months of the year, with the rainy season being concentrated in the period from January to May. The driest months comprise the period from July to December, with the critical period being identified in the months of August, September, October and November. The distribution of precipitation during the studied series revealed the presence of a monomodal rainfall regime, that is, with a single peak of the rainy season, in the months of March and April. It is noticed that the municipalities have similar dynamics in terms of the distribution of rainfall throughout the year, concentrating them generally in the first months of the year, a period between the months of January to June. The second semester, from July to December, is characterized by low rainfall.

The dissonance verified between the municipalities occurs in relation to the average values of the pluviometric precipitations, being the data referring to the municipality of Martins greater than the data presented for the municipality of Antônio Martins. The biggest differences are identified in the rainy season, that is, in the period from January to May.

Despite the small geographical distance between the rainfall stations, it is necessary to consider that the climatic dynamics is governed by a close relationship between the elements and the geographical factors of the climate. In this case, the relief acts as a diversifying factor of the climatic pattern, causing greater precipitations with the orographic rains, arising from the physical action of the relief, acting as a barrier to the free advection of the air, which is forced to descend.

Seluchi et al. (2011) and Liebmann et al. (2011) reinforce the understanding of the behavior of areas located windward and leeward at high altitudes, emphasizing that the orographic rains are originated from the influence of the relief, where the air that goes towards the elevated areas, windward slope, is forced to ascend and condense, due to the adiabatic reduction in temperature, with the occurrence of rain of greater intensity and volume in the area being common. When crossing the elevated areas, the air devoid of moisture, descends and heats adiabatically.

In this sense, from the understanding of the precipitation dynamics of the two municipalities inserted in different geographic features, it is understood that the Serra de Martins acts as a physical barrier, presenting favorable conditions for the development of orographic rains, responsible for the contrasts between the volumes of rain identified there (higher rainfall values) and the surrounding areas located in the Depression Sertaneja, represented by the municipality of Antônio Martins, with lower rainfall values).

3.2. Local thermal characterization

The municipality of Martins presented an average air temperature of 23°C. It was evidenced that there is no great oscillation between the temperature data throughout the year, varying from 21°C to 24°C, that is, a difference of 3°C. The June-July-August quarter is characterized by the lowest average air temperatures, around 21°C, thus being the coldest months. The highest averages of air temperature, above 24°C, were verified in the November-December-January quarter, being the hottest months.

In the municipality of Antônio Martins, the average air temperature found was 25.98°C, with the maximum average being 27.90°C in the month of January, which together with the months of February and November, form the hottest months. The average low was 23.83°C in June, which opens the coldest quarter, with averages around 24°C.

It is noticed that the cities of Martins (640 m of altitude) and Antônio Martins (240 m of altitude) have, respectively, average temperatures of 23°C and 26°C, configuring an average vertical gradient of approximately 0.7°C / 100 m (Figure 4).
The municipalities of Martins and Antônio Martins are located within the same latitude, with a difference of only 6 minutes, which represents a small geographical distance between them, around 20 km. In this case, discarding the action of latitude as a geographic factor of the climate, the difference in the temperature gradient is attributed mainly to altitude.

The weather conditions are influenced by several factors, among them, the altitude and relief configuration, added to the geographical position, favoring the occurrence of orographic rains with pluviometric averages higher than the Depressões Sertanejas (MACIEL, 2012; SANTOS; NASCIMENTO, 2017), such as this is the case in the study area.

Tubelis and Nascimento (1984, p. 51) point out that surfaces with different orientations and inclinations receive different amounts of sun radiation, when compared to a horizontal surface, in the same location and time of year. The authors point out that the production of plant matter is conditioned by the availability of solar energy.

Thus, it is clear that vegetation also plays an important role as a temperature regulator for the municipalities in question. The municipality of Martins, according to Medeiros (2016), presents Savanna-Estépica Arborizada, Savana-Estépica Florestalada and Semideciduous Seasonal vegetation, while Antônio Martins, the reality is quite different, limited only to Savanna-Estépica Arborizada. It is understood that vegetation acts as a geographical factor of the climate, with regard to temperature in the municipality of Martins, as the crowns act as a barrier to direct solar radiation, decreasing the availability of energy that heats the air, decreasing the temperature.

3.3. Local water balance

Through the method proposed by Thornthwaite and Mather (1955), it was possible to arrive at the water balance for the municipalities of Martins and Antônio Martins (Figure 5).

The municipality of Martins presented a considerable water surplus in the first semester of the analyzed period, with values ranging from 2 mm to 218 mm, reaching 489 mm. It should be noted that in the first semester there is a gradual decrease in temperature, which significantly decreases from 24ºC in January to 21ºC in June, which contributes to the reduction of potential evapotranspiration. As for rainfall, the period between the months of January to June is characterized by the most significant data.
marked by an increase for the period from January to April and a decline for the months of May and June.

As for the maximum and minimum water surplus values, it is clear that April was the month with the maximum water surplus value (218 mm) and the month of June is characterized by the minimum water surplus value (2 mm). Seeking to establish an association with the climatic elements temperature and precipitation, the month of April is characterized by the most significant rainfall average identified, 294 mm, and the average air temperature of 23º C. The month of June presents an average rainfall of 78 mm, and average air temperature of 21º C, the second lowest average temperature of the analyzed period.

The average water deficit in the period totaled -353 mm, distributed in the second half of the period, with values ranging from -3 mm to -91 mm. It should be noted that the second semester is characterized by high average air temperatures, which gradually increase from 21º C in July to 24º C in December, which enhances potential evapotranspiration. The data referring to the average of pluviometric precipitation for the second semester reveal very modest values that oscillate from 9 mm to 46 mm, what contributes to the water deficit.

As for the relationship between the maximum and minimum deficit values and the climatic elements temperature and precipitation, the following reality exists: the maximum deficit was identified in the month of November (-91 mm) and the minimum value in the month of July (-3 mm). The month of November is characterized by low average rainfall (14 mm) and average air temperature of 24º C, the second highest temperature found in the analyzed period. In July, the situation is as follows: low average precipitation (46 mm) and low average air temperature (21º C).

It is important to highlight the interface period in the water balance that appears in the month of January, explained as a period of water replacement, in which there is no water deficit or surplus.

The real evapotranspiration (ETR) reached 798 mm, being distributed throughout the year. It should be noted that the months of January, February, March and April concentrated around 45% of the total. During this period, high average rainfall is evident, as well as the average air temperature is close to the average of the analyzed period (1973-2002), around 23º C. The lowest ETR values were observed in the months of October and November, being linked to low average rainfall and a slight increase in average air temperature.

Regarding the discussions on water stored in the soil (ARM), whose variation is due to the difference between the water inflows and outflows in the system, it is clear that, in the first six months (January to June), this value was significant, which can be proven from the evaluation of equal values for ETP and ETR. This period was also initially defined as the period in which the highest rainfall averages are concentrated. Otherwise, in the second semester (July to December), the ARM value is not very significant, which, in turn, generates a difference between the ETP and ETR values, the latter being to a lesser extent.

The municipality of Antônio Martins presented water deficit data for almost the entire period analyzed, totaling 811 mm. The only exception noted for the period occurred in the month of April, which presented a water surplus (24 mm) generated from a high rainfall average (165 mm) and an average air temperature of 25 ºC. In view of the water deficit being dominant in this municipality, the discussion will be made from the months of maximum and minimum deficit.

In the period between the months of March to June (04 months), the minimum values of water deficit are evident. The period between the months of July to February (08 months) is configured as a critical period, when it comes to the values of maximum water deficit, reaching up to 127.5 mm. In the period of minimum water deficit, that is, the period from March to June, there are significant rainfall averages, with emphasis on the months of March and April, which had 193 mm and 165 mm, respectively. The average air temperature in these months decreased from 25º C in March to 23º C in June, the latter being the lowest average air temperature identified. As for the months of maximum water deficit, related to rainfall, it should be noted that these were insignificant, with the exception of the months of January and February, which had 67 mm and 91 mm, respectively. The average air temperature for the period presented a gradual growth of 24º C in July until reaching 27º C in February. The interface period appears in the month of March, which is responsible for the replacement of the system, characterized by a month in which there is no water deficit or surplus.

The real evapotranspiration (ETR) in this municipality reached 698.40 mm, poorly distributed throughout the year, concentrating around 75% of the total in the first five months of the year. During this period, high rainfall averages for the municipality and an average air temperature of around 26º C are evident.

The data referring to the water stored in the soil (ARM) show a worrying reality, since only the months of March, April and May were satisfactory (with water surplus), characterized by a quarter in which the values of ETP and ETR presented in the same situation, as well as the rainfall averages were the most significant. However, in the remaining nine months, from June to February, the ETR was lower than the ETP.

3.4. Climatic typology

Applying the data in Figure 4, it can be seen that, considering the average rainfall in the period from 1973 to 2002, the municipality of Martins fits into the Humid climate typology, B1 symbolism, according to the climatic classification of Thornthwaite and Mather (1955), with an Effective Aridity Index of 30%. Through the aridity indices (Ia), the subtype “w2, with water deficit in winter and spring, was determined. As for the thermal factor, it was found that the municipality of Martins is of the Megatérmino type (A’), with an average annual potential evapotranspiration greater than 1150 mm. Thus, the climatic formula for the municipality of Martins is B1w2A’, that is, wet Megathermic type with water deficit in winter and spring.

With respect to the municipality of Antônio Martins, it is classified in the dry Subhumid climate type, C1, according to the climatic classification of Thornthwaite and Mather (1955), presenting an Effective Humidity Index of -30.99%, with subtype d, characterized by small or no water surplus and with type A 'thermal factor, Megatérmino. The municipality of Antônio Martins is characterized by the climatic typology C1dA’, dry sub-humid Megatérmino type with little or no water surplus.
4. CONCLUSION

The municipalities of Martins (640 meters high) and Antônio Martins (240 meters high), in terms of rainfall, are characterized by two seasons: one dry and the other rainy, with average rainfall of 1230 mm and 693 mm, respectively. This contrast is justified by the fact that the Serra de Martins acts as a physical barrier to moisture that rises by convection, causing orographic rains.

The orography and vegetation influence the average temperatures of the municipalities, being verified 23º C in Martins and 26º C in Antônio Martins, which configures an average vertical temperature gradient of approximately 1.2º C / 100 m.

The differences evidenced in the elements precipitation and temperature are directly reflected in the water balance, which, in the municipality of Martins, presents a balance between the months of water deficit and surplus, unlike what occurs in the municipality of Antônio Martins, characterized by water deficit rates throughout the year, with the exception of April alone.

In this sense, it is possible to admit that the Serra de Martins is an Exception Area or humid enclave in the middle of the Semi-arid domain, and can be defined in the perspective of a Brejo de Altitude.

5. REFERENCES


