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BALANÇO HÍDRICO CLIMATÓLOGICO DO ESTADO DO TOCANTINS COMO SUBSÍDIO PARA IRRIGAÇÃO EM ASSENTAMENTOS DO INCRA

RAUANNY BEZERRA PEREIRA [1]; WILKER ALVES MORAIS [1]; MARCONI BATISTA TEIXEIRA [1]; FREDERICO ANTONIO LOUREIRO SOARES [1]; BRUNA EDUARDA LEMES DA COSTA [1] AND LUCAS PERES ANGELINI [1]

[1] Department of Hydraulics and Irrigation, Instituto Federal Goiano, Rio Verde campus, Rodovia Sul Goiana, km 01, Rural Zone, CEP: 75.901-970, Rio Verde - GO, Brazil. rauannypereira@gmail.com ; wilker.ambiental@gmail.com ; marconi.teixeira@ifgoiano.edu.br ; frederico.soares@ifgoiano.edu.br ; brunaeduardalemescosta@gmail.com ; lucas.angelini@ifgoiano.edu.br

1 RESUMO

No Brasil, o balanço hídrico climatológico tem sido amplamente utilizado para a gestão e planejamento dos recursos hídricos, tornando uma ferramenta importante para a análise dos impactos das mudanças climáticas na disponibilidade de água em diferentes regiões do Brasil. O objetivo desse estudo, foi calcular o balanço hídrico climatológico (BHC) mensal dos anos de 2019 a 2020 do estado do Tocantins. Para a execução do mapa foi utilizado o software Rstudio®, utilizando médias mensais de temperatura e precipitação, para calcular a temperatura média mensal do ar no período de 01 de janeiro de 2019 a 31 de dezembro de 2020. O maior período de taxa de armazenamento de água no solo, foram nos meses de janeiro a abril, onde favoreceu o excedente hídrico. Já nos meses de maio a outubro prevaleceu o déficit hídrico.

Palavras-chave: agricultura irrigada, déficit hídrico, desenvolvimento agrário, desenvolvimento sustentável, gestão hídrica.

PEREIRA, RB; MORAIS, WA; TEIXEIRA, MB; SOARES, FAL; COSTA, BEL da; ANGELINI, L.P.

CLIMATOLOGICAL WATER BALANCE AND MANAGEMENT OF WATER RESOURCES IN THE STATE OF TOCANTINS AS A SUBSID FOR IRRIGATION IN INCRA SETTLEMENTS

2 ABSTRACT

In Brazil, the climatological water balance has been widely used for the management and planning of water resources, making it an important tool for analyzing the impacts of climate change on water availability in different regions of Brazil. The objective of this study was to calculate the monthly climatological water balance (BHC) for the years 2019 to 2020 in the state of Tocantins. To construct the map, RStudio® software was used to calculate the average monthly temperature and precipitation during the period from January 1, 2019, to December 31, 2020. The longest period of water storage in the soil occurred from January to April, when the water surplus was favorable. In the months from May to October, water deficit prevailed.

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Keywords: irrigated agriculture, water deficit, agrarian development, sustainable development, water management.

3 INTRODUCTION

The climatological water balance (BHC) is a tool used to evaluate the balance between water inputs and outputs in a given region or river basin. In Brazil, the climatological water balance has been widely used for the management and planning of water resources, especially in regions with a semiarid climate and in irrigation areas.

According to the study by Batista, Pereira and Silva (2021), the BHC is an important tool for analyzing the impacts of climate change on water availability in different regions of Brazil. This study evaluated trends in water balance change in several river basins in the country and concluded that climate change has caused changes in the water regime in these regions.

Furthermore, the BHC has also been used in irrigation management in Brazil. According to the study by Corrêa, Souza and Rocha (2019), the water balance is an important tool for irrigation planning because it allows one to evaluate the water needs of crops and adjust the amount of water to be applied, avoiding waste and optimizing use. of water resources.

Another relevant study on this topic was carried out by Martins *et al.* (2022), who evaluated evapotranspiration and water balance in an area irrigated with sugarcane in the semiarid region of northeastern Brazil. The authors concluded that irrigation was able to meet the crop's water needs, maintain a positive water balance and support the risk of losses due to drought or drought.

The BHC is highly useful for irrigation planning in rural settlements, which are products of agrarian social policies that aim to improve living conditions and generate income for these settlers. According to the INCRA (2022), the state of Tocantins has 352 rural settlements that serve more than 23 thousand families who need to use these properties to generate income. Rural settlement areas form spaces full of stories through which we can uncover different territorialities. Many settled producers have a history of struggle and adaptation to stay on the land.

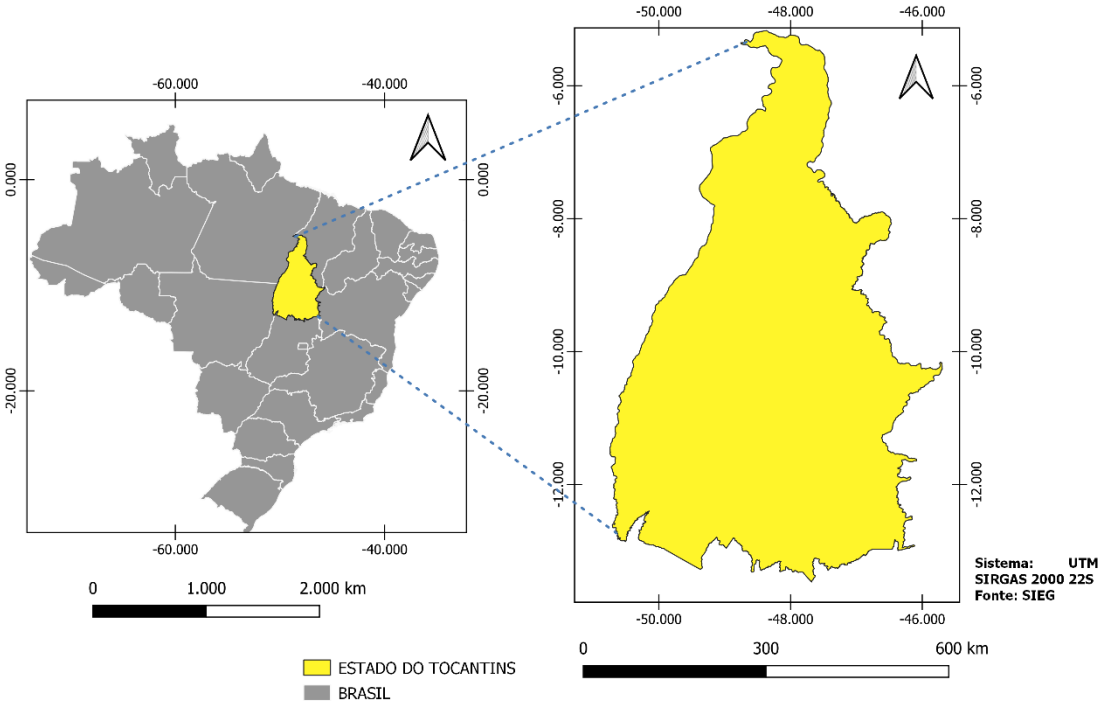
Located in the central region of Brazil, the state of Tocantins is dominated by a semihumid tropical climate, with a dry and rainy season (generally in summer). The climate is classified as Aw – Tropical with humid summers and dry periods in winter according to the Köppen classification (Roldão; Ferreira, 2019; SEAGRO, 2019).

According to ANA (2022), the state of Tocantins has one of the largest river basins in the country, the Araguaia River basin. However, despite the great availability of water, the region faces challenges related to the management of water resources, such as the unequal distribution of water and the lack of investment in infrastructure for the management of water resources. Therefore, the objective of this study was to determine the climatological water balance of the state of Tocantins as a subsidy for irrigation in INCRA settlements.

4 MATERIALS AND METHODS

This work was carried out in the state of Tocantins (Figure 1), located in the northern region of Brazil, with an estimated population of 1.6 million inhabitants in 2021. This region has a territorial area of 277,423,627 km² and a demographic density of 4.98 inhabitants km^{-2} according to data from the Brazilian Institute of Geography and Statistics (2021).

Figure 1. Location map of the state of Tocantins.



Source: SIEG (2021).

To carry out the climatic water balance (BHC) test, RStudio software was used, according to the methodology described by Filgueiras *et al*. (2021). To do this, it was necessary to download the TerraClimate images and then install the package via GitHub.

For this work, the average results of images from the years 2019 and 2020 were used; the area of interest was selected, in this case, the state of Tocantins, and then the rasters were downloaded.

Once we had downloaded images, it was necessary to plot the maps and calibrate the TerraClimate images for Brazilian conditions using all the automatic meteorological stations of the National Institute of Meteorology (INMET-Brazil).

With the calibrated images, it was possible to generate monthly averages of temperature and precipitation that were used to calculate the average monthly air temperature based on the period from January 1, 2019, to December 31, 2020.

With the aforementioned information obtained, it is possible to calculate the water balance parameters based on the available water capacity (AWC), which in this case is 100 mm. This was possible by executing the waterDemand function. This AWC value (100 mm of water per cm of soil) was used because it is normally used for climate classification (Vianello; Alves, 2012).

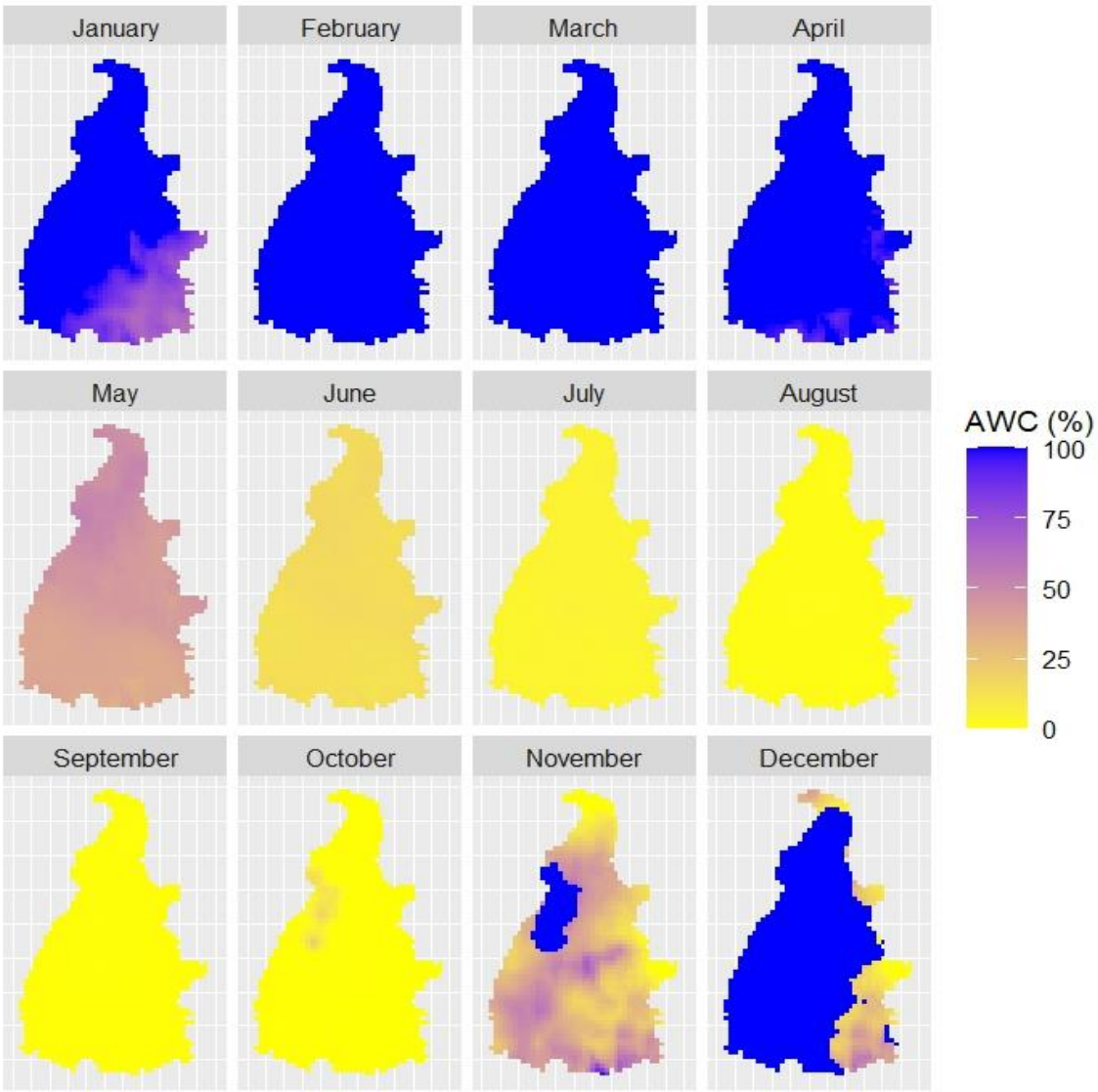
The BHC parameters for this function were ARM - storage; ALT – storage change; ETR – real evapotranspiration; DEF – water deficit; EXC – water surplus; REP – replacement; RET – loss; and AWC – percentage of storage in relation to available storage capacity.

Finally, maps of the results of the climatic water deficit (percentage of storage in relation to available storage capacity) were plotted.

5 RESULTS AND DISCUSSION

The climatological water balance map (BHC) of the state of Tocantins from 2019 to 2020 is shown in Figure 2. The months from January to April presented lower water supply risks in the state, and the month of January in the southeastern region of the state presented a variation in available water capacity between 25 and 75%.

Figure 2. Map of the climatological water balance of the state of Tocantins.



Source: Author.

In the months of February, March and April, the water surplus was above 75%, reaching 100% in some regions. In May, the available water capacity reached 50% in most of the entire state.

In June, July, August, September and October, the climatic risk to the water supply increased to less than 25%, reaching a period of water scarcity throughout the basin in July, August and September. Souza *et al*. (2019), observed through a study of the water deficit in the months of June to September in the state, in which the winter characteristic of the state of Tocantins predominates, a variation of 20 to 33% in the

potential annual evapotranspiration of the entire state.

In November, the available water storage capacity (AWC) varied between 25 and 75% in a large part of the country; however, the northwest region of the country presented a large amount of available water.

In December, the east, southwest and a small part of the north and northeast had lower available water capacities, remaining between 25 and 75%, while the rest of the states in that month had greater water capacities. available.

When studying the climatology of the State of Tocantins, Brazil, Roldão and Ferreira (2019) found that rainfall in the state of Tocantins is concentrated from November to April, totaling an average of 1,404 mm, which is equivalent to 85% of rainfall annually; in January, it was seen as the highest average rainfall in the state, totaling 265.0 mm. These are important months for settlers to be able to implement their crops.

6 CONCLUSIONS

In January, February, May and April, which presented greater water surpluses, the settlers were the most suitable for planting crops.

In the months of May, June, July, August, September and October, water deficits prevailed, highlighting the need for irrigation for crops during the dry season.

It should also be noted that this climatological water balance map generated using the Thornthwaite method is considered a first approximation, as there is no historical series of meteorological data available for the regions of the state of Tocantins. Therefore, as the meteorological database expands, additional research should be carried out to focus on developing a more detailed regionalization of the state.

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