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CLIMATE FLUCTUATIONS IN RELATIVE AIR HUMIDITY AND PRECIPITATION IN BRASILIA – DF

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ABSTRACT

Fluctuations is one of the best known means of climate dynamics, the moment produced by this phenomenon, even within normality, can have significant aspects in human activities. The objective is to ponder the climatic fluctuations in Brasília - DF, focusing on such variations as a means to involve future changes. To carry out this work, data on relative air humidity and monthly and annual rainfall in the period from 1980 to 2012, from the Brasília Meteorological Station - DF belonging to the National Institute of Meteorology, were used. As a result, it can be stated that the relative humidity of the air is decreasing along the studied series, a fact that may be related to the atmospheric fluctuations between so many meteorological elements (temperature, wind, insolation, evaporation, evapotranspiration), causing direct and impact on ecosystems and socioeconomic factors, whose variability results in various impacts, many of them irreversible. Regarding the annual rainfall totals, it is noted that the values are increasing gradually, and this increase may be related to the increase in temperature, which causes greater evaporation and consequently greater precipitation. An anomalous effect of rainfall distribution is observed during the January summers. This climatic factor is known by farmers in the cerrado and cerradão region and in many years is responsible for the fall in agricultural production. The annual total precipitation has been demonstrating a gradual increase in its indices since the 1980s, this increase may be related to the increase in temperature, which causes greater evaporation and consequently greater precipitation. As the relative humidity of the air is proportionally inverse to the temperature, and being a limiting factor for the occurrence of rains with more intensities, it can be clearly seen that since the 1990s a gradual reduction has been occurring in these values. This index may be related to the increase in temperature and consequently to a greater evaporation of water. It should be noted that the relative humidity of the air, in the dry months, has already reached critical levels below 15%, therefore, it can be said that it will influence people's daily lives even more, with aggravation of respiratory problems, drier dry periods and more accentuated, with the possibility of occurrences of fires above normality.

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INTRODUCTION

Variability is one of the best known elements of climate dynamics, the impact produced by this variability, even within normality, can have significant representations in human activities. However, it is worth mentioning that anomalies can disrupt both the environmental and socioeconomic systems. In recent decades, climate change and its consequences for humanity has been one of the biggest concerns of scientists around the world. Mainly with regard to the factors responsible for climate variability, which have been increasing since the mid-twentieth century.

Human activities are, in the view of some researchers, responsible for part of these changes. However, a possible natural climate variability must be taken into account, since the magnitude of the signal associated with it in the existing climate records has not yet been well determined (IPCC, 1996, IPCC 2001). The dynamics of the hydrological cycle in the basins can be better understood by the simple water balance (BHS) or climatological water balance (BHC). According to (VESTENA et al.,(2008) this results from the amount of water that enters and leaves a certain portion of the land (watersheds) in a certain time interval. Studies involving the water balance are used in numerous activities, such as determining irrigation intervals, predicting agricultural productivity, sowing and harvesting time, climate classification, among other activities involving management and planning of water resources. The attempt to identify climate variability in meteorological records is of paramount importance for socioeconomic studies, since trends can be presented, that is, visualize future scenarios for a better understanding of climate dynamics. The visualization of climate change trends in meteorological time series, in addition to representing important scientific data, is a necessity to establish the effect of climate change on climate dynamics, fundamental for future planning of water resources, human health and food production (OBREGON et al., 2007). Studies prepared by the IPCC (Intergovernmental Panel on Climate Change) in 2001 indicate a worrying situation in relation to the buoyancy of precipitation that had increased from 0.5 to 1.0% per decade, until the end of the 20th century. This increase was more significant in the northern hemisphere. In the tropical region, the increase in precipitation was of the order of 0.2 to 0.3%. Studies developed by Pinto et. al., (2003) show that climate variability in Brazil, depending on the region analyzed, can cause continuous changes in meteorological elements (precipitation, winds, air temperature and relative humidity).

Even with the studies undertaken by researchers on climate variability, it should be noted that the climate system is complex in relation to variables that are not yet fully understood. The fact that the instruments and tools used to understand climate variability are deficient to deal with something as complex and dynamic as climate contributes to this. Among researchers, there is a consensus that climate change has a direct and significant impact on ecosystems and on socioeconomic factors, whose variability results in various impacts, many of which are irreversible. This article aims to analyze the climatic fluctuations in Brasília - DF, focusing on such variations as a means to understand future changes. It was chosen to work with the district of Brasília due to the perception, on the part of residents, that the relative humidity of the air and the pluviometric indexes have suffered climatic variability in the last decades. Therefore, a more accurate investigation of the existing data is worth.

CLIMATE FLUCTUATIONS IN CLIMATOLOGY STUDIES

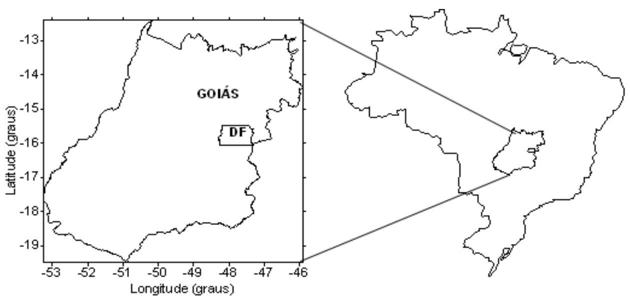
Spatial and temporal fluctuations are attributes of weather and climate. Temporal fluctuation is a characteristic that should be studied with greater particularity and on different chronological scales. Because these studies will allow the knowledge of the climate in the past, present and even make predictions and diagnoses for future climatic situations, from the mathematical models used. Climate variability is considered to be climate variations as a function of the natural conditions of the terrestrial globe and their interactions (TUCCI, 2003). This meteorological variability. Yevjevich (1972) defines trend or variation "as a systematic and continuous change in any parameter of a given sample, excluding periodic or quasi-periodic changes". Hare (1985) apud Nunes et al, (1995) discusses scalar interactions, highlighting the difficulty in detecting eventual changes. It also points out the difficulty of detecting that global processes were affected by facts arising at other scales. Monteiro (1978), Nunes et l, (1995) the modifying action of man would act in an increasing degree of the taxonomic scale (creating the smallest units and changing the averages, when acting on the extensive properties of the climate), even if it did not dominate the intrinsic dynamics of the atmosphere; from which the mechanisms that generate the succession of their states emanate. Some scientists question to different degrees the validity of studies developed on a local scale for the understanding of global variability, but it is through local studies that studies on a regional and global scale can be developed (NUNES et al., 1995). Climate variability is dependent on complex atmospheric dynamics, but also on influences external to the planet such the solar changes. It is a fact that these climatic variability depend on this dynamic, but it is the local and regional scales that will feel the greatest impacts of this climate variability. Gomes (1984) when studying the variability of rainfall for the Alto Tietê hydrographic basin, associated atmospheric systems and local factors that were responsible for producing the prevailing types of weather in the study area.

Marengo et. al. (2007) observed that, in the Southeast and South of Brazil, precipitation had a significant increase in the last 50 years. Haylock et al. (2006) apud Marengo (2007) studied extreme average rainfall in Southeast South America in the period 1960-2000, showing trends towards wetter conditions in southern Brazil, Paraguay, Uruguay and northern and central Argentina. They noted that the Southeast region of South America experienced an increase in the intensity and frequency of days with heavy rain. Therefore, studies of meteorological series, mainly of extreme data, are essential for understanding climate dynamics, whether on a local, regional or global scale. In these series, air temperature, precipitation and relative humidity play a major role. Regarding the temperature and humidity of the air, it is worth noting that "[...] the temperature, humidity and atmospheric pressure, which interact in the formation of the different climates on Earth." (MENDONÇA et al., 2005), that is, the set of these three are the main agents that shape the climate. Still on air humidity and temperature, it should be noted that there is an intrinsic relationship between these two climatic elements, as described by Frota et al, (2003). The great difference that the degree of relative humidity of the air causes in the climatic conditions of a place is in relation to the amplitude of the daily temperature. This is equivalent to saying that the drier the climate, the more accentuated its temperature extremes (minimum and maximum). This phenomenon is due to the water particles suspended in the air having the ability to receive heat from the Sun and heat up. The more humid the air, the greater the amount of water in suspension. These particles, in addition to being heated by the solar radiation they receive, also function, during the day, as a barrier to the solar radiation that reaches the ground and, at night, the heat is dissipated by the soil. (FROTA et al., 2003).

Regarding the use of graphs, Ayoade (2010) states that "the climate of a region is described with the help of graphs of seasonal variations in the values of climatic elements, usually temperature and precipitation". Several studies have been prepared with the theme of variability and its climatic characteristics, so it is still far from reaching a consensus, especially regarding the local influence on global trends. However, studies of local climate variability, mainly on temperature and relative humidity and precipitation are essential to understand the impacts that these variations can bring to the population in general. If the fluctuations are really significant at the local level, these changes could cause socio-economic impacts (eg in agricultural and livestock production), environmental impacts (changes in ecosystems) and social impacts (proliferation of disease vectors).

MATERIALS AND METHODS

LOCATION OF THE STUDY AREA: The Federal District has an area of 5,783 km² and is located within the limits of the State of Goiás, limited by latitudes of 15°30'/16°03'S and longitudes of 47°18'/48°17'W, with the most raised to Colina do Rodeador at 1,349 m, in Brazilândia located 43 km northwest of Plano Piloto (central part of the city). The city of Brasília is located at an average altitude of 1,100 m at latitude 15º50'S and longitude 47º42'W (Figure 1) in the so-called Central Plateau, whose relief is mostly flat, with Cerrado vegetation predominating.



Source: Medeiros (2022).

Figure 1. Location of the Federal District in the state of Goiás and in Brazil

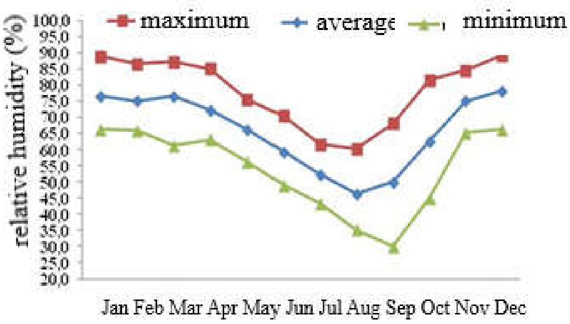
The climate of a given region can be understood as the average atmospheric conditions that act on the region. One of the most used tools to analyze and define the climates of different regions based on the climate classification system (ROLIM et al., 2007). According to the Köppen climate classification (in CODEPLAN 1984), in the Federal District, climates such as: Tropical Aw, Tropical Altitude Cwa and Altitude Tropical Cwb. The average relative humidity varies from 49 to 79% throughout the year, reaching 20% or less during the winter period. The rainy season occurs from October to April, contributing 92.0% (1.540,6 mm) of the annual total. The dry season runs from May to September, and in the driest quarter (June to August) rainfall represents only 2.0% (33.5 mm) of the annual total (Normal Climatológica - 1961 to 1990).

RESULTS AND DISCUSSION

In order to understand the climate variability existing in the Federal Capital, we worked with the meteorological series of relative air humidity and total monthly and annual precipitation, from the period 1980 - 2012, from the Brasília Meteorological Station located at latitude 15º47' of latitude South and 47º56 ' west longitude at an altitude of 1.159,5 m above mean sea level. The station is already being isolated by vertical urbanization and the lack of green areas, as the landscape is practically different from the last three decades. The humidity and precipitation data were made available by the National Institute of Meteorology (INMET). The plotting of the data and the elaboration of the graphs used electronic programs that facilitate such functions. It used the data observed in the synoptic times and applied some statistics in order to obtain the results.

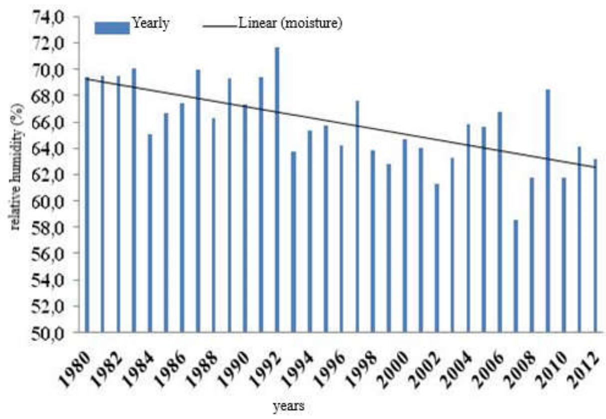
Relative humidity is the ratio between the amount of water in the air (absolute humidity) and the maximum amount that could be present at the same temperature (saturation point). Table 1 shows the representation of the variability of mean relative humidity, monthly and annual absolute maximum and minimum in Brasília - DF, from 1980 to 2012. The relative humidity of the air presents with great daily and monthly oscillations, according to the patterns of the transition regions between cerrado and cerradão. The mean absolute minimum relative humidity varies between 30 and 66% throughout the year. When analyzing the maximum and minimum absolute relative humidity, and their monthly and annual maximum and minimum averages, it is observed that the absolute minimum relative humidity ranges from 30% in the month of September to 66.3% in the months of December and January with an annual rate of 53.9%, with the months from November to April being the months of high absolute minimum relative humidity and the months of May to October the months of low absolute minimum humidity. The maximum average oscillations flow from 46.4% in August to 78.3% in December, with an annual average of 65.9%. In the absolute maximum values, we highlight the months from October to April with high values and from May to September with low values, according to table 1.

In the 1980-2012 recording period, there were three years considered to be humid (1983, 1989 and 1992), with relative humidity rates greater than 72%, and the years 2002 and 203 as relative humidity values. Air less than 62%, being considered of low humidity. This phenomenon may be related to the increase in average temperature in recent decades. Figure 2 has the average relative humidity (RH) fluctuation; absolute maximum and absolute minimum for Brasília – DF. The average relative humidity of the air flows between 46.4 (August) to 78.3% (December) its annual rate is 65.9%, it is noteworthy that in the months of October to March, a time that coincides with the rainy season, the humidity is maximum and in the period from July to September the RH oscillations are minimum. Low RH fluctuations occur in the months of July and August for the maximum recorded relative humidity, in the months of August and September the lowest RH recorded in their averages occur and the record of minimum humidity occurs in the month of September (figure 2).



Source: Medeiros (2022).

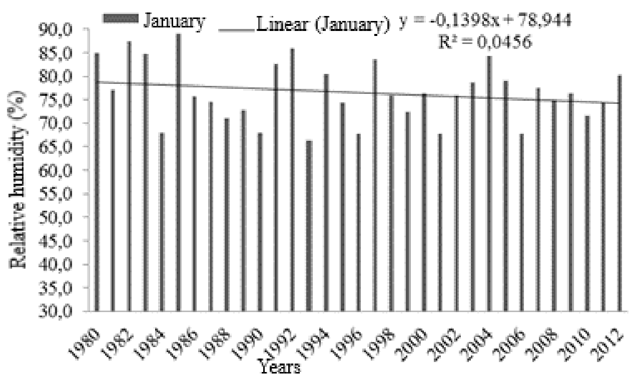
Figure 2. Average relative humidity; absolute maximum and absolute minimum in Brasília – DF from 1980 to 2012



Source: Medeiros (2022).

Figure 3. Relative humidityannual relative humidity in Brasília – DF from 1980 to 2012

Figure 3 demonstrates the variability of the maximum annual relative humidity and its lineares trend, highlighting the years 1983, 1987, 1989, 1991, 1992, 1997, 2004 to 2006, 2011, with higher rates of relative humidity in the ar, and the years 1993, 1999, 2002, 2007, 2008 and 2010 had the lowest rates. Despite the clear division of the relative humidity of the air in two distinct periods: a dry period (June to October) and a humid period (November to April), it is observed in the series that there was a reduction in the relative humidity of the air from the 1990s onwards. 1990. Which, in part, can be explained by the increase in temperature. It can be said, therefore, that this normality of climatic variability is typical of cerrado and cerradão areas, which have only two seasons, one dry and the other rainy. The trend line shows us significant reductions for the relative humidity indices of the air in the studied period. Figure 4 shows the monthly relative humidity from January to December for the period from 1980 to 2012 for Brasília - DF.



Source: Medeiros (2022).

Figure 4. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. January

Table 1. Average relative air humidity, monthly and annual absolute maximums and minimums in Brasília - DF, from 1980 to 2012

Parameters/Months	Average relative humidity	Absolute maximum relative humidity	Absolute minimum relative humidity
January	76.6	88.9	66.3
February	75.0	86.4	66.1
March	76.7	87.2	61.4
April	72.3	85.1	63.2
May	66.4	75.5	56.3
June	59.3	70.4	49.1
July	52.4	61.7	43.3
August	46.4	60.3	35.2
September	49.9	68.1	30.0
October	62.7	81.4	45.0
November	75.1	84.6	65.3
December	78.3	89.3	66.3
Yearly	65.9	78.2	53.9

Source: Medeiros (2022).

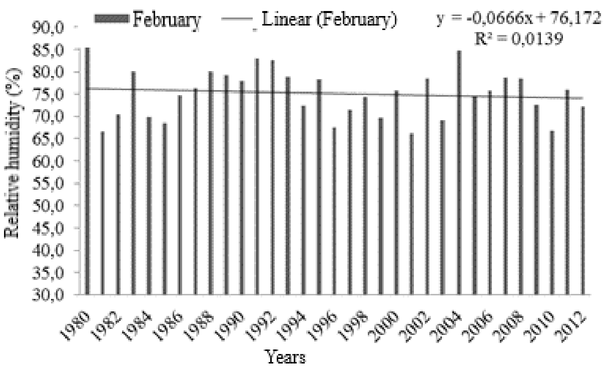
Table 2. Monthly and annual average, maximum and minimum rainfall in Brasília - DF, from 1980 to 2012

Parameters/Months	Average precipitation	Absolute maximum precipitation	Absolute minimum precipitation
January	206.6	398.8	70.6
February	180.6	422.3	37.2
March	212.3	398.6	35.7
April	127.2	375.9	10.2
May	29.7	105.3	0.0
June	4.8	43.8	0.0
July	5.9	95.3	0.0
August	22.6	93.3	0.0
September	43.5	119.2	0.0
October	160.4	526.4	38.3
November	235.1	444.6	87.3
December	239.5	454.6	86.9
Yearly	1468.1	3478.4	366.4

Source: Medeiros (2022).

Figure 4 shows the RH variability for the month of January between the period from 1980 to 2012. The years 1894, 1990 1996, 2001, 2006 the RH indexes flowed below 65%.

The years 1980, 1982 and 1983, 1985, 1992, 1987, 2004 and 2012 oscillated above 80%. It can be observed in figure 5 that the year 1980, and at the end of the 80's and beginning of the 90's, the RH oscillated above 80%, as well as in 2004, 2007 and 2008. In the other years in a study, the RH oscillated below 80%.

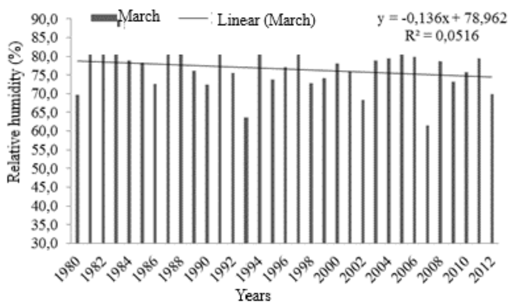


Source: Medeiros (2022).

Figure 5. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. February

Figure 6 shows a negative angular coefficient with R^2 of moderate significance.

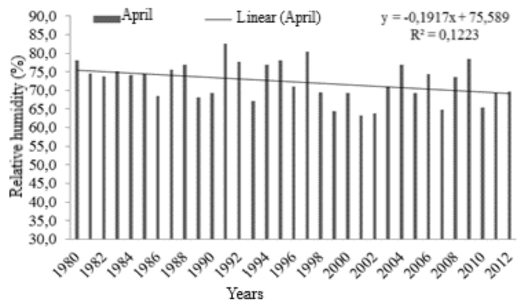
The years 1981, 1985, 1987, 1988, 1991, 1994, 1997, 2004, 2005 and 2011 stand out with RH greater than or equal to 80%, the other years of the month under study their fluctuations were below 75%.



Source: Medeiros (2022).

Figure 6. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. March

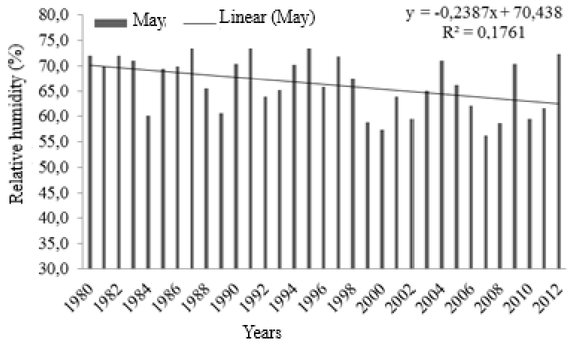
The years 1980, 1987, 1988, 1991, 1992, 1994, 1995, 1997, 2004, 2006, 2008 and 2009 the RH fluctuated from equal to or greater than 75% and in the other years below 75% as shown in figure 7 for the month of April.



Source: Medeiros (2022).

Figure 7. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. April

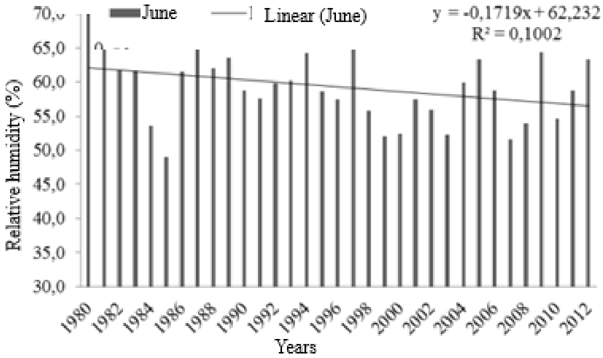
The RH variations in the month of May as shown in figure 8 ranged from 55 to 75%, it has a negative angular coefficient and low significance, the it is the beginning of the dry period, its RH tends to decrease. The years 1980, 1982, 1983, 1987, 1991, 1995, 1997, 2004, 2009 and 2012 the RH fluctuations were above 70%, in the years 1984, 1989, 1999, 2000, 2007 and 2010 the RH fluctuations were below 60%, these fluctuations are interconnected with large-scale phenomena acting on the NEB.



Source: Medeiros (2022).

Figure 8. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. May

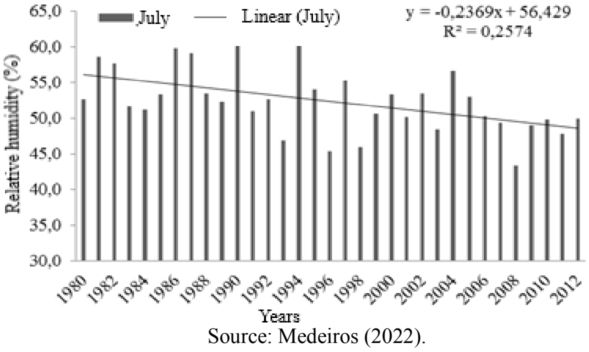
In the month of June, figure 9 of the period 1980-2012 has a negative angular coefficient with R^2 of low significance. In the years 1985, 1999, 2000, 2003, 2007, 2008, 2010 the RH fluctuated from equal to less than 50%. It is also noted that in the years 1980, 1981, 1987 and 1997 the RH flowed above 65%.



Source: Medeiros (2022).

Figure 9. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. June

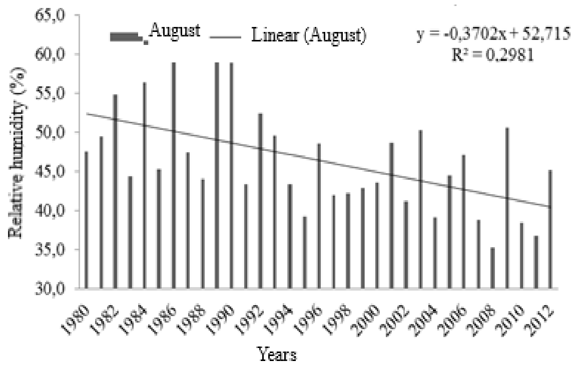
In figure 10 the years 1990 and 1994 stand out with RH flowing above 60% and the year 2008 with a fluctuation of 45%, other months under study the variability of RH fluctuated between 45 and 60% being considered months atypical due to the predominance of regional and local effects.



Source: Medeiros (2022).

Figure 10. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. July

In the month of August figure 11 the years 1982, 1984, 1986, 1989, 1990, 1991 the RH fluctuations were above 50% and in the other months of August the RH oscillated below 50% and its angulares coefficient presented as negative and of low significance.

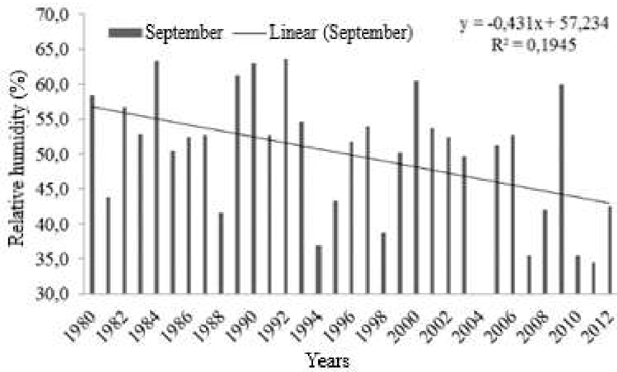


Source: Medeiros (2022).

Figure 11. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. August

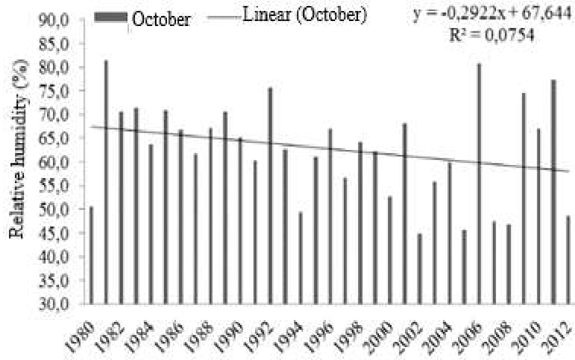
Figure 12 shows the irregularity of the RH during the months of September and the years 2004, 2007, 2010 and 2011 stand out with oscillations below 30%.

With the characterization of the rainy season in November, it is highlighted that the RH oscillations were the ones with the greatest fluctuations for the study period, their fluctuations occur between 65 to 85% except for the years 1984, 1997 and 2002 which the lowest RH was recorded in accordance with figure 13.



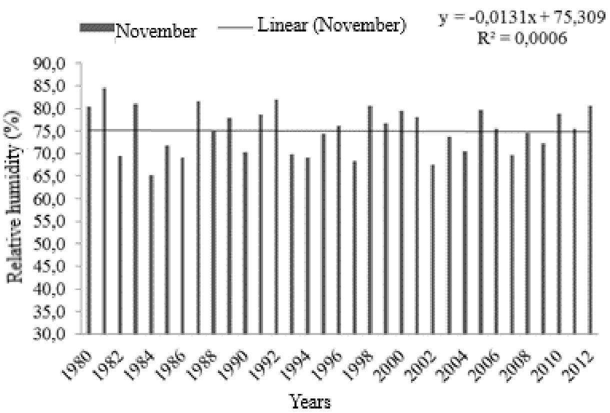
Source: Medeiros (2022).

Figure 12. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. September



Source: Medeiros (2022).

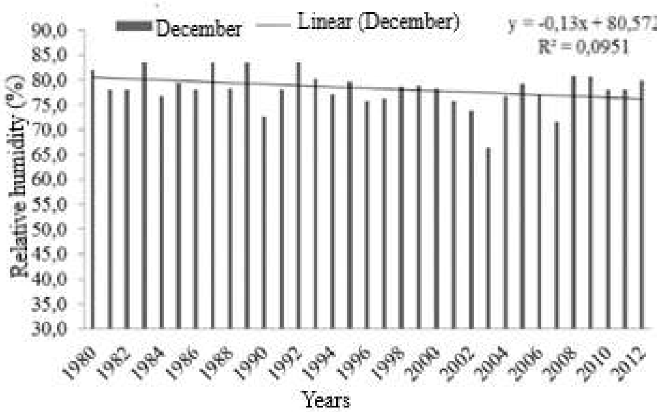
Figure 13. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. October



Source: Medeiros (2022).

Figure 14. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF. November

The RH fluctuation for the months of December (figure 15) was the maximum recorded and its oscillations were equal to and greater than 75%, except for the years 1990, 2003 and 2007, which were 74 and 68% respectively. It is noteworthy that in all months of the period studied the angular coefficients were negative with R^2 of low significance. Low significance values have no probability of occurrence and their oscillations were between 0.006 to 02981.

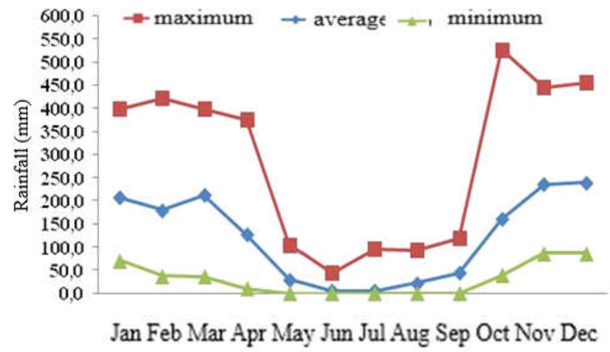


Source: Medeiros (2022).

Figure 15. Monthly representation of the variability of relative air humidity and its trend lines for the period from 1980 to 2012 in Brasília – DF, December

Table 2 There is the variability of mean precipitation, monthly and annual absolute maximums and minimums in Brasília - DF, in the period from 1980 to 2012. The monthly rainfall total is the sum total of rainfall over the course of a month, in millimeters. In the period from 1980 to 2012, it rained irregularly in Brasília - DF with an average of 1.468,1 mm/year. It can be considered the existence of two seasons: one rainy and one dry.

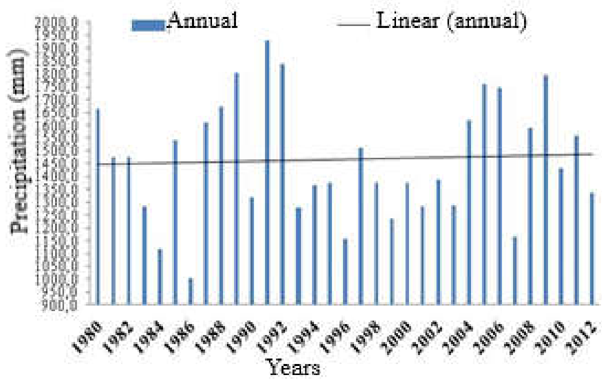
This rainy season (October to April) is responsible for approximately 85% of the rainfall in the municipality. Table 2. Monthly and annual average, maximum and minimum rainfall in Brasília - DF, from 1980 to 2012. Figure 16 shows the oscillation of mean precipitation, absolute maximum precipitation and absolute minimum precipitation from 1980 to 2012, the highest maximum values of precipitation recorded occur between December and April, the same fluctuations are observed in this period of time, which coincide with the start of pre-season rains and their characterization, in the months of May to September the variability of maximum, minimum and average rainfall is insignificant for agriculture and water impoundment. Since the months of December to March concentrate 47% of the annual precipitation. In figure 17 itspossible to observe that the annual rainfall totals have a spatiotemporal distribution with irregularity, highlighting the years 1989, 1991, 1992, 2005, 2006 and 2009 with



Source: Medeiros (2022).

Figure 16. Historical average rainfall, absolute maximum and absolute minimum (anual) rainfall totals

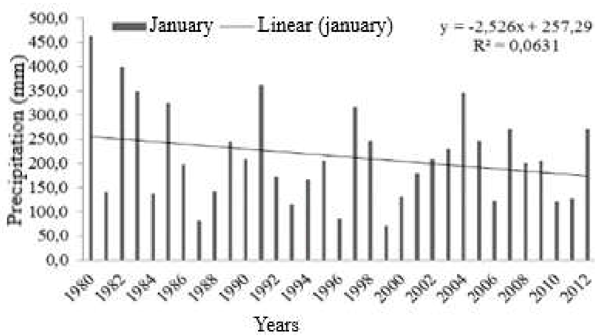
above-normal rainfall, as for the years 1984, 1986, 1996 and 2007 there were below normal rainfall. The trend line shows not very significant increases in rainfall for the period under study. This fact may be related to the increase in air temperature that has been occurring in recent decades. This variability will depend on the meteorological systems operating in the atmosphere, which can lead to rains above or below normality.



Source: Medeiros (2022).

Figure 17. Historical average rainfall, annual rainfall totals in Brasília from 1980 to 2012

It can be observed in figure 18 referring to the months of January that the slope of the line is negative and its tendency is for the rains to be reduced in the referred future months, its correlation levels are 6.3 and 1 .8 showing a low correlation for their monthly indexes.

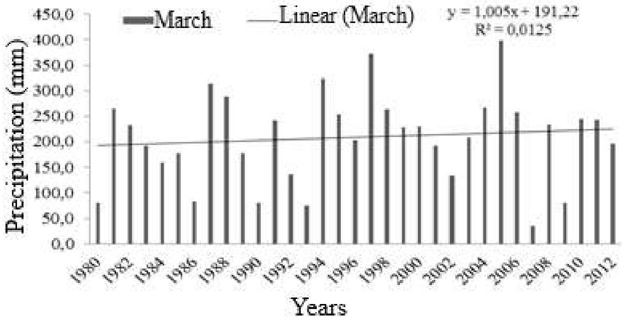


Source: Medeiros (2022).

Figure 18. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF. January

It can be observed in figure 19 referring to the months of February that the slope of the line is negative and its tendency is for the rains to be reduced in the referred future months, its correlation levels are 6.3 and 1 .8 showing a low correlation for their monthly indexes.

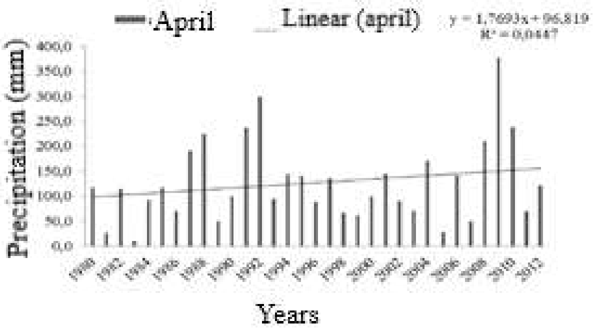
Figures 20 for the month of March show positive slopes of the straight line and with low significance indices, demonstrating that the historical values of precipitation may occur between normality.



Source: Medeiros (2022).

Figure 20. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF. March

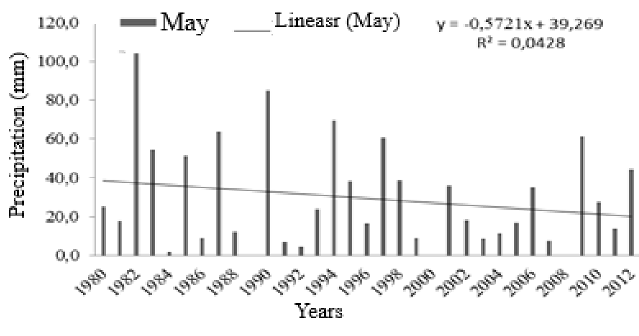
Figure 20 for the months of April show positive slopes of the straight line and with low significance indices, demonstrating that the historical values of precipitation occur between normality.



Source: Medeiros (2022).

Figure 21. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF. April

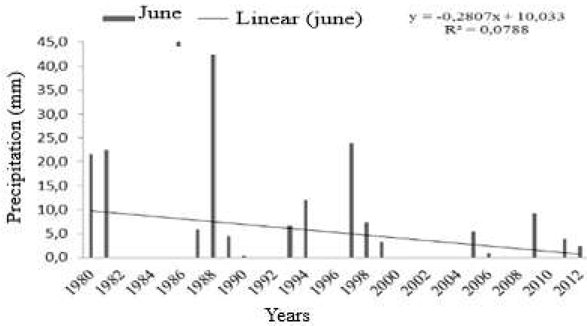
In Figures 22 referring to the month of May, the irregularities of the pluviometric indices between years and their temporal variability that must remain between the climatic normalities are highlighted. In figure 23 referring to the month of June, the irregularities of the pluviometric indices between years and their temporal variability that must remain between the climatic normalities are highlighted.



Source: Medeiros (2022).

Figure 22. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF. May

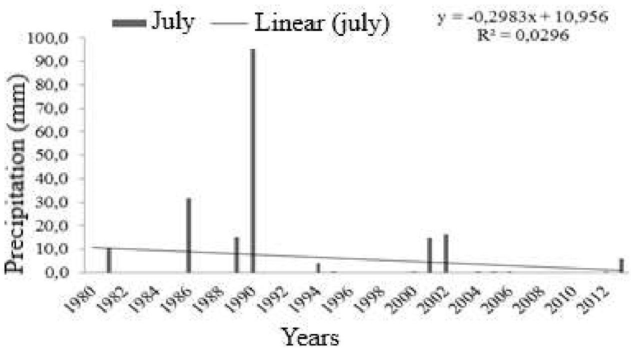
The variability of rainfall in the month of July and August for the period from 1980 to 2012 are represented in figures 24 and 25 which show irregularities between years in the rainfall indices. In the months of September and October the rainfall irregularity persists with occurrences of anomalies in its indexes resulting from the atmospheric factors acting between the years according to figures 26 and 27, with negative and positive trends respectively and with acceptable significance values between normality.



Source: Medeiros (2022).

Figure 23. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF. June

The variability of rainfall in the month of July and August for the period from 1980 to 2012 are represented in figures 24 and 25 which show irregularities between years in the rainfall indices. In the months of September and October the rainfall irregularity persists with occurrences of anomalies in its indexes resulting from the atmospheric factors acting between the years according to figures 26 and 27, with negative and positive trends respectively and with acceptable significance values between normality.



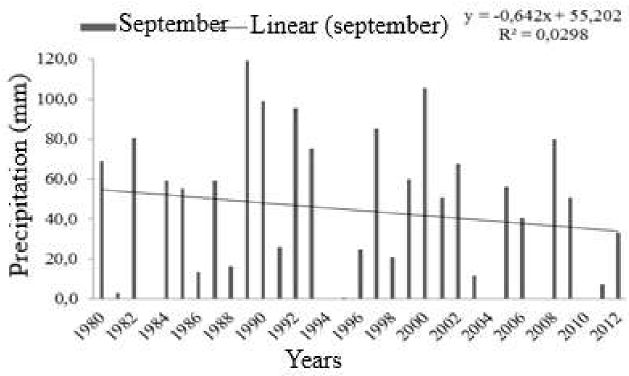
Source: Medeiros (2022).

Figure 24. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF July

The variability of rainfall in the month of July and August for the period from 1980 to 2012 are represented in figures 24 and 25 which show irregularities between years in the rainfall indices. In the months of September and October the rainfall irregularity persists with occurrences of anomalies in its indexes resulting from the atmospheric factors acting between the years according to figures 26 and 27, with negative and positive trends respectively and with acceptable significance values between normality.

Source: Medeiros (2022).

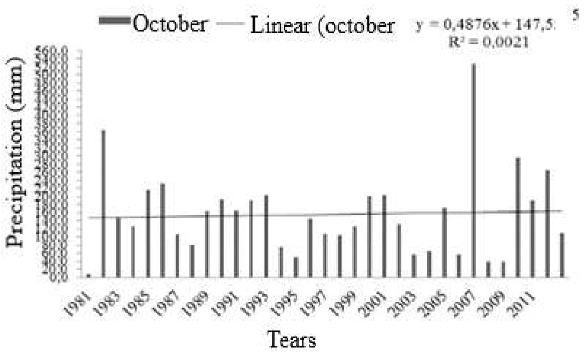
Figure 25. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF. August



Source: Medeiros (2022).

Figure 26. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF. September

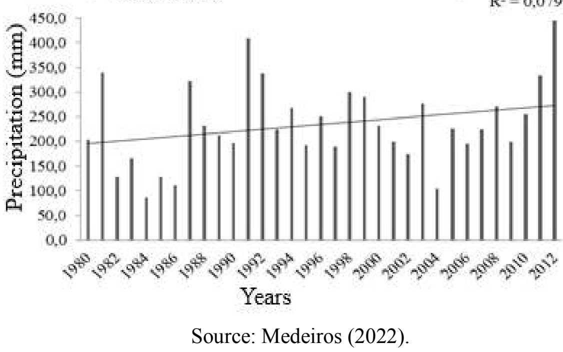
In the month of October the rainfall irregularity persists with occurrences of anomalies in its indexes resulting from the atmospheric factors acting between the years according to figures 27, with negative and positive trends respectively and with acceptable significance values between normality.



Source: Medeiros (2022).

Figure 27. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF October

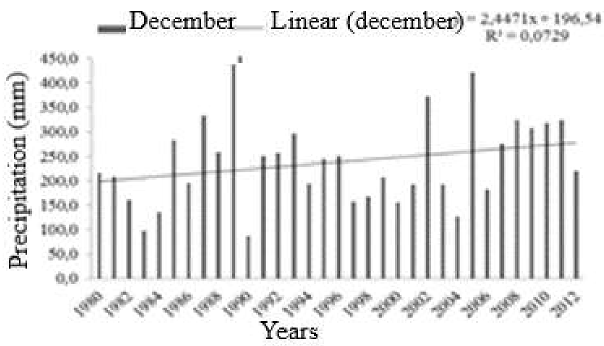
Figure 28 show the monthly distributions of November for the period from 1980 to 2012, with R^2 significance levels accepted and representative of the months under study and demonstrating their interannual irregularities.



Source: Medeiros (2022).

Figure 28. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF. November

Figures 29 show the monthly distributions of December for the period from 1980 to 2012, with R^2 significance levels accepted and representative of the months under study and demonstrating their interannual irregularities.



Source: Medeiros (2022).

Figure 29. Monthly representation of rainfall indices and their trend lines for the period from 1980 to 2012 in Brasília – DF December

FINAL CONSIDERATIONS

The study proceeded to the variability and characterization of the analysis of the evolution of climatic elements, relative humidity and rainfall in Brasília - DF. The results presented, integrated with the information available at the INMET meteorological station, indicate possible climatic variations in the relative humidity of the air and in the precipitation, pointing to a tendency towards warmer and rainy conditions. An anomalous effect of rainfall distribution is observed during the January summers. This climatic factor is known by farmers in the cerrado and cerradão region and in many years is responsible for the fall in agricultural production. The annual total precipitation has been showing a gradual increase in its indices since the 1980s, this increase may be related to the increase in temperature, which causes greater evaporation and consequently greater precipitation. As the relative humidity of the air is proportionally inverse to the temperature, and being a limiting factor for the occurrence of rains with more intensities, it can be clearly seen that since the 1990s a gradual reduction has been occurring in these values. This index may be related to the increase in temperature and consequently to a greater evaporation of water. It should be noted that the relative humidity of the air, in the dry months, has already reached critical levels below 15%, therefore, it can be said that it will influence people's daily lives even more, with aggravation of respiratory problems, drier dry periods and more accentuated, with the possibility of occurrences of fires above normality. The RH presented negative angular coefficients with low significance in all months, and moderate to weak reductions in this variable can be expected. The angular coefficients of the straight lines of precipitation occurred alternating between positive and negative, but in general, reductions in their indices are expected, the possibility of extreme rains in short intervals of time is not discarded. The presented results indicate possible climatic variations, in the relative humidity of the air and in the precipitation, pointing to a trend of warmer conditions and irregularities in their indices.

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