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RESEARCH ARTICLE: Atmospheric

Influence Air Temperature and Precipitation on Climate Change in Baghdad City

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Abstract

Changes in climate indicate both continuity and variability in the regime from year to year. Especially for air temperature (AT) and precipitation in recent years, the climate system has changed very rapidly since the Industrial Revolution. The European Centre for Medium-Range Weather Forecasts (ECMWF), which recently updated the ERA-5 version, was the main source of data and made available as a monthly dataset. The study period of 30 years has been divided into 3 periods: Its results were that AT in the first period had begun to rise linearly(0.18K) while on the contrary for precipitation they decreased significantly(-0.42mm/day), while the second period increased the rise in AT(0.20K) with an increase in precipitation decrease(-0.43mm/day), and 2010 was the year in which AT were recorded the most as(299k) a result of increasing gas emissions and human activity, and this made it the least year for precipitation(4.2mm/day), and the third period was also increasing AT (0.28k)with a decrease in precipitation rates(-0.05mm/day), except 2018 which was a rainy year with a high precipitation rate as(10.3mm/day) a result of sandstorms and thunderstorms in it.

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Keywords: *Climate change, temperature, precipitation, agriculture, Baghdad city*

1. Introduction

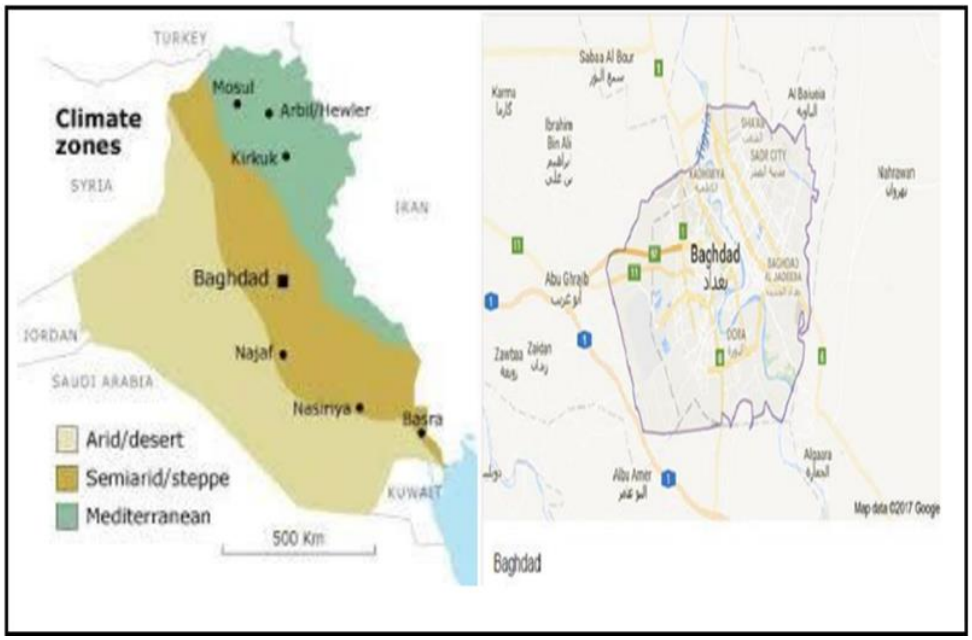
Climate change is defined as a statistically significant variation that lasts for a long time (usually decades or longer) in either the mean state of the climate or its variability.[1] Damage from climate change has been done to agriculture, the environment, and human life. Farmers have observed how climate change affects production costs and yields, in addition to the effects of natural disasters like storms, floods, and droughts on crops. Farmers can better understand the effects of climate change on agriculture and take appropriate action [2]. There was a significant distinction between alterations in the climate brought about by natural and human activity. First, human activity is responsible for 95% of climate change, with the industrial revolution's use of fossil fuels and the release of greenhouse gasses trapped in the atmosphere being the main cause of the most recent significant change in climate. Even though they happen naturally every few thousand or million years, natural climate changes have little effect [3]. It also shows here climate change on crops in the arid environment of Iraq. The results of future precipitation indicate that, on a seasonal basis, most of the regions in Iraq are expected to be wetter in the fall and winter, but most of them are expected to experience a decrease in annual mean precipitation, At the end of the twentieth century [4]. May's highest temperatures (Tmax) indicated a shift toward the summer season, with features more akin to those of June and July. The first era (1970–2017) of the study had May's (Tmax) features, which were similar to those of the spring season. However, the second period (1992–2017) had May's (Tmax). Its features are comparable to those of June and July, and there were positive and negative phases during the study period. The difference was that, in the second study period, the (Tmax) for May climbed by 2 degrees Celsius compared to June's increase of 7.5 degrees Celsius for May and July [5]. The findings demonstrated that rainfall data Expect the Al-Hilla station, all of the data used in the study are uniform and consistent, showing a general downward trend. Expect the Haditha and Samawah stations, the data was random. The investigation revealed that the research region has experienced multiple years of drought in succession. which experienced drought for half of the research period; the

two worst drought periods, from 1997 to 2001 and from 2007 to 2010, were when it was most severe. Everywhere in the research area is experiencing an intense drought [6]. According to a study conducted in Erbil over the previous 20 years, there has been an increase in air temperatures and evaporation, which has resulted in less precipitation and relative humidity. With an average annual temperature of 22 degrees Celsius, an annual evaporation of 2257.59 mm, an annual rainfall of 416 mm, and a relative humidity of 48.74%, Erbil's climate has changed over time, and it's wet and dry climate is now evidence of its impact on global warming.

2. Data and Methodology

Since Iraq, and more specifically Baghdad, is physically located in the range of sub-tropical displays in the northern hemisphere between two longitudes 38.45-48.45 east of the Greenwich meridian and two latitudes 29.5-37.5 north of the equator, it was the focus of the study. Baghdad served as the capital of the Republic of Iraq.

It was one of the major cities in the region and the second-largest city in both Western Asia and the Arab world. It was also recognized as the administrative and commercial center of the country. Located physically, Baghdad is 33.3 latitude north of the equator and 44.4 longitude east of the Greenwich line. The analysis covered the period from 1992 until 2021.



Map1. Iraq's map showed Iraq-Baghdad city [7]

Using datasets in net CDF format, users can plot raster graphics of geo-gridded, or geo-referenced, data using the NASA Goddard Institute for Space Studies' Java application Panoply. Based on the kind of data available, the meteorological department provides a range of display creation choices using Panoply. Net-CDF (NC files) format is used to load files after receiving data from (ECMWF) on air temperature, precipitation, and relative humidity [8]. Use the Panoply program to convert files from the European Center format to the reading data formats that can be read by the Excel application. It is important to note that the linear equation for each of the elements (air temperature, precipitation) has been used in order to know the amount of separation (increase or decrease) that occurs during the years:

$$y=bx+a \quad (1)$$

Where y, x values ,b= Slope, a = The y Intercept (where the line crosses the y axis) ,The slope of a linear function (b) is the proportionality constant between Δx and Δy. That is the fraction:

$$b=\Delta y/\Delta x \qquad (2)$$

Where b slope ,Δy = The difference between the values of y ,Δx = The difference between the values of x

3. Result and discussion:

It is noted that the study period has been divided into three periods (Figure1)air temperature (Figure2)precipitation to clarify each period and what happened in it from the change during the three decades of climatic and this helps us to predict what will happen in the future in the first period (1992-2001) the temperatures were in a state of increasing significantly linearly b(0.18K)in (table1) where 1999 was the highest temperature (299K) recorded at the time and in precipitation was the exact opposite, where in the same period there was a severe decrease in precipitation b(-0.42mm/day) in (table2) where the year 1999 The average precipitation was (4.5mm/day).

Time periods (Years)	a	b
1992-2001	297.0	0.18
2002-2011	298.1	0.20
2012-2021	297.9	0.28
1992-2021(total)	297.7	0.05

Table1: Time series for air temperature for four period (a)cross, (b) slope. for Baghdad city.

Time periods (Years)	a	b
1992-2001	9.56	-0.42
2002-2011	7.8	-0.43
2012-2021	7.34	-0.05
1992-2021(total)	7.76	-0.16

Table2: Time series for precipitation four period (a)cross, (b) slope. for Baghdad city.

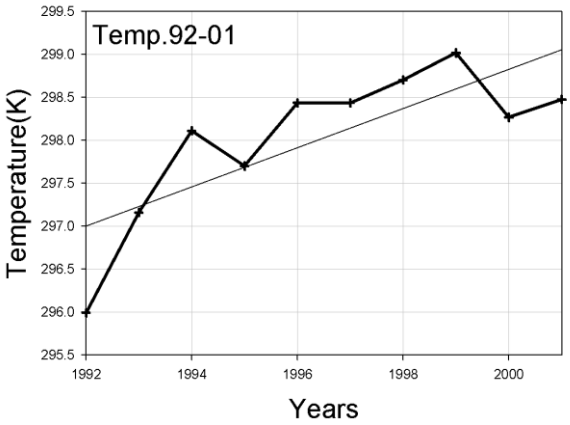
As for the second period (2002-2011) in Figure1 and Figure2, the air temperatures were in a state of fluctuation b(0.20K) and the highest average temperature recorded in 2010 (292.6K), in contrast to which was precipitation for this period b(-0.43mm/day) and that 2010 is the lowest year in precipitation also (4.2mm/day) due to the large emissions of gases, burning fossil fuels, increasing human activity and uprooting trees, all of which helped to increase the rise in temperature and decrease the precipitation.

In the third period (2012-2021) Figure1 and Figure2 there was an increase in air temperatures b(0.28K) with fluctuations in several years, as it decreased in 2013 (297.4K) with an increase in precipitation (8.8mm/day), and then air temperatures begin to increase gradually until they reach 2018, where

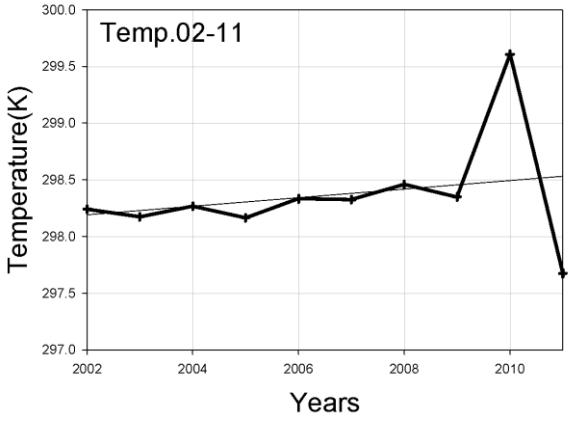
temperatures drop significantly (298.8K) and the precipitation rate for this year was the largest among the past periods (10.3mm/day) It was the result of the large number of thunderstorms and sandstorms that caused this. Then temperatures returned to rise and precipitation decreased with the progress of time, and from this we predict that temperatures in general were subject to increase in the coming years, whatever the reasons, even if human activity decreases or the use of fossil fuels decreases, because the gases trapped inside the atmosphere will increase the earth's temperature and that climate change needs years to change and exit gases into space.

It can also be seen that a in each of the three periods to the air temperatures in (Table1) are approximately the same for the same beginning of each of the three periods a1(297K), a2 (298K) and a3(297K). As for precipitation (Table2) the first period is greater than the other periods a1(9.5mm/day) and the second and third periods are close a2(7.8mm/day), a3(7.3mm/day).

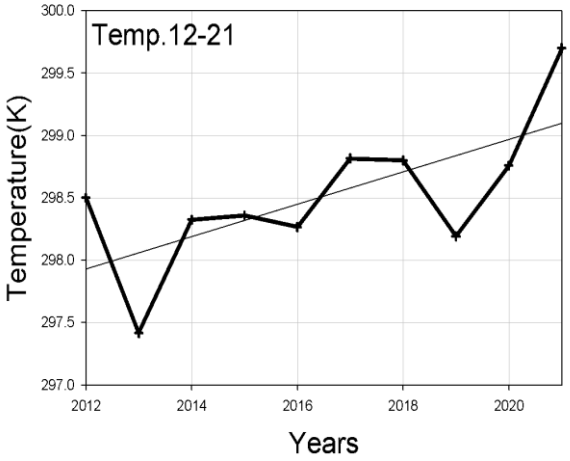
(a)1992 -2001



(b)2002-2011



(c) 2012-2021



(d)1992-2021

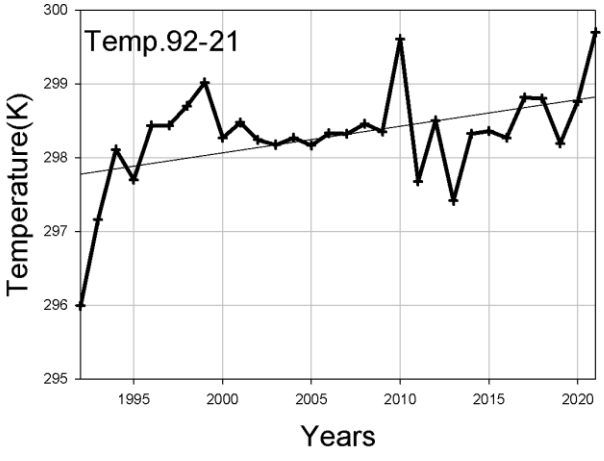


Figure1. Time series if air temperature for four parts a) 1992-2001 b) 2002-2011 c) 2012-2021 and d) 1992-2021(total). The solid line represents slope air temperature for Baghdad city.

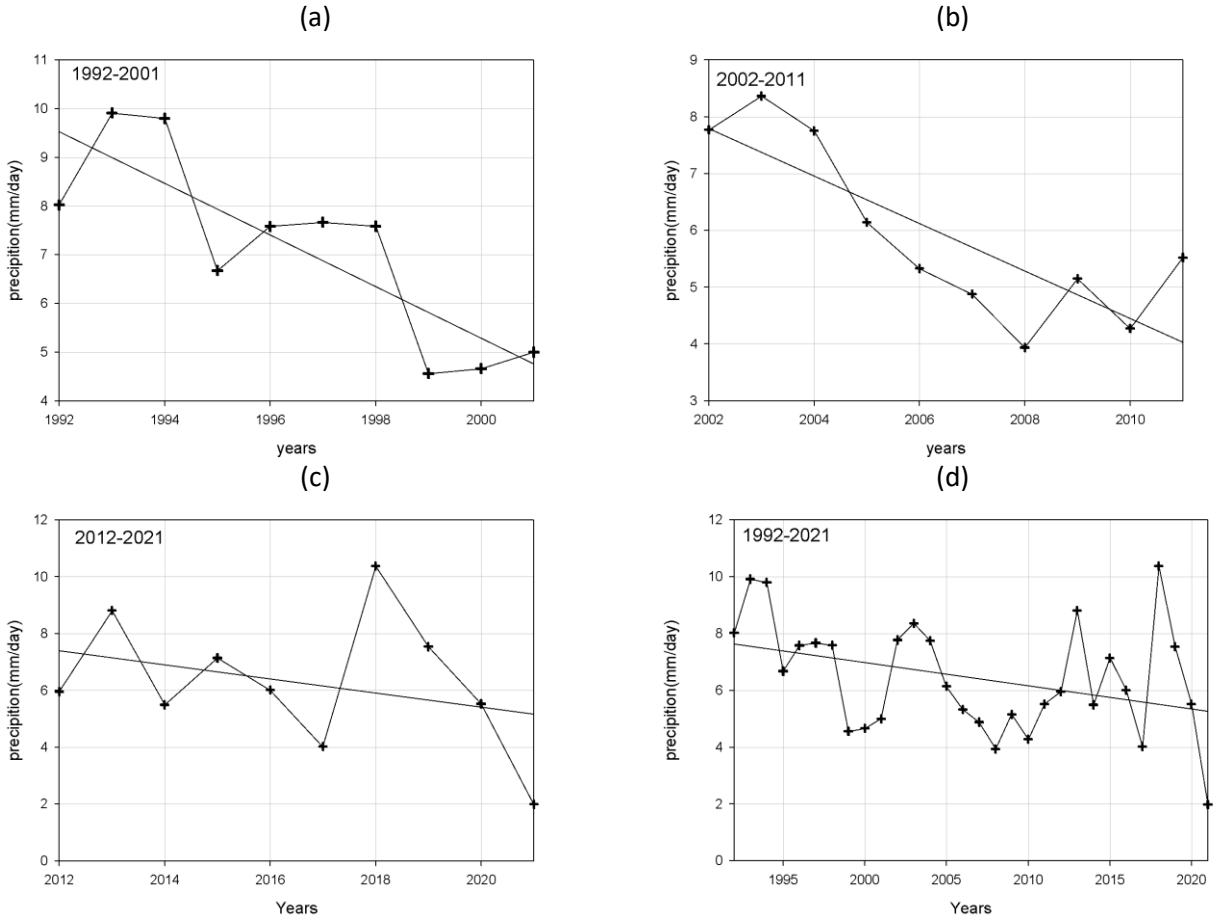


Figure 2. Time series in precipitation for four parts a)1992-2001 b)2002-2011 c)2012-2021 and d)1992-2021(total). The solid line represents slope precipitation for Baghdad city.

4. Conclusion:

The liner regression indicated an increase in the slope of air temperature over the research period and another decrease in the slope of precipitation. The way the air temperature behaved over each period varied, with the first period (1992–2001) starting with low values that resembled exponential functions b(0.18k) and low for precipitation in the same period (-0.42mm/day). and he second period (2002–2011) had very modest changes for air temperature b(0.20k) as more decreased for precipitation b(-0.43mm/day), Expect the notable shift in 2010 where in this year was very high air temperature(299.6k) but in same year was very low precipitation(4.2mm/day). The third period (2012–2021) was higher than the first two in air temperature and included a lot more unformatted data at the slope line b (0.28k) but

precipitation in this period was little, too b(-0.05mm/day) expected 2018 where was highest precipitation (10.3mm/day).

There were years with a great exception during the past three decades, including 2010, which is present in the second period, and it was with high air temperatures (299.6k) and a severe decrease in precipitation (4.2mm/day) due to the large emissions of CO2 gas and some other gases, the increase in human activity and the frequent uprooting of trees, as well as 2018 in the third period here, was the opposite, where the precipitation rate increased significantly (10.3mm/day) and low air temperatures (298.8k) as a result of Thunderstorms and dust storms that occurred frequently during them .

Acknowledgments

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