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CLIMATIC PREDICTION OF THE TERRESTRIAL AND COASTAL AREAS, IRAQ CASE STUDY

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Abstract

Climatic data of four meteorological stations (Mosul, Baghdad, Basra and Rutba) were obtained. Temperature recorded data since 1960 till 2007, rainfall and evaporation recorded data since 1960 till 2008, 1970 till 2008 respectively were used. This study shows a presence of temperature increasing about 5ºC/ 47 years and increasing the evaporation rate with decreasing the rainfall rate. The climatic changes are positively controlled by carbon dioxide gas in the atmosphere.

Basra climate due to its situation, the nearest is expressed as a costal climate has a different behavior from Mosul, Baghdad and Rutba which are expressed as terrestrial climates.

التنبؤ المناخي للاراضي اليابسة والساحلية في العراق

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الكلمات المفتاحية: التغيرات المناخية. التساقط المطري. التبخر. الحرارة.العراق.

المستخلص:

تم الحصول على معلومات مناخية من أربعة محطات أنواء جوية هي الموصل وبغداد واالبصرة والرطبة، وتم إستخدام درجات الحرارة المسجلة منذ عام ١٩٦٠ ولغاية ٢٠٠٧، كما تم إستخدام معلومات الامطار والتبخر منذ عام ١٩٦٠ الى ٢٠٠٨ ومنذ عام ١٩٧٠ الى ٢٠٠٨ على التوالي. بينت هذه الدراسة تزايد درجات الحرارة حوالى ٥ درجة كل ٤٧ سنة، وزيادة معدل التبخر المصاحب لتناقص نسبة الامطار، كما بينت الارتباط الموجب للتغيرات المناخية بغاز ثاني أوكسيد الكربون في الجو.

إن البصرة وبحكم موقعها القريب من البحر فقد اعتبر مناخها ساحلي ذا سلوك مختلف عن مناخات الموصل وبغداد والرطبة والتي اعتبرت مناخات مناطق يابسة.

Introduction

In the last 200 years, through increased utilization of the world's resources, humans have begun to influence the global climate system, primarily by increasing the Earth's natural greenhouse effect (Buchdahl J. 1999**).** Between 1850 and 1990 the global-mean temperature at the surface of the Earth warmed by approximately 0.5°C (about 1°F) (Judith and David, 1996). During the same period, the amount of carbon dioxide measured in the Earth's atmosphere increased by about 25%, as a consequence of our ever-increasing use of fossil fuels. This raises the possibility that the two trends are directly connected, and the climate system responses to human activities (Judith and David, 1996)

Many major and minor types of gases compose the atmosphere, but carbon dioxide (CO_2), the most important of the minor gases in the atmosphere, is involved in a complex global cycle. It is released from the interior of the Earth via volcanic eruptions, and by respiration, soil processes, combustion of carbon compounds and oceanic evaporation. Conversely, it is dissolved in the oceans and consumed during plant photosynthesis. Currently, there are 359 parts per million by volume (ppmv) of CO_2 in the atmosphere (Schimel *et al*., 1995), a concentration which is continuing to rise due to anthropogenic (man-made) emissions from the burning of fossil fuels and forests.

The Iraqi climate characterizes with hot- dry summers and cold- rainy winters. Roughly 90% of the annual rainfall occurs between November and April, most of it in the winter months from December through March. The remaining six months (From May to October), particularly the hottest ones are June, July, and August. The average temperatures in Iraq range from higher than 48ºC (120 Fahrenheit) in July and August to below freezing in January.

Of course, there is considerable difference in temperature between day and night.

The day is hot, whereas the night is colder. Generally, the climate of Mesopotamia is semi-arid with maximium temperature up to 53ºC in July- August and minimum Temperature of -7ºC in January (Saad and Goff, 2006). The annual precipitation is 150mm/year (monthly occurring from November to March), it falls to less than 1000 mm/year toward the desert in the SW causing semi desert to desert climatic condition. The prevailing wind is generally NW and dry for about 300 days of year deviates to SE and humid for about 60 days (Saad and Goff, 2006).

In this study, the CO_2 level that had been gotten from Carbon Dioxide Information Analyses Center (CDIAC) was used in comparison with temperatures of four meteorological stations in Iraq since 1960 till 2007 for evaluating the local climatic warming and predicting the future warming.

The Studying area

Four representative meteorological stations were chosen in order to analyses the general climatic elements. Topography plays an essential role in climate.

Generally, there are four topographic features in Iraq; they are: Mountain in the north, desert in the west, flood plain in the centre extends to the south, and flood plain contains marshes in the south which expresses a costal environment lies near of the delta Arab Shatt. Accordingly, Data were collected from four meteorological stations; they are, Mosul in the north represents the folded belt and foot hills, Rutba in the west represents the desert, Baghdad in the centre represents the Mesopotamia plain, and Basra in the south represents the coastal area (Figure.1).

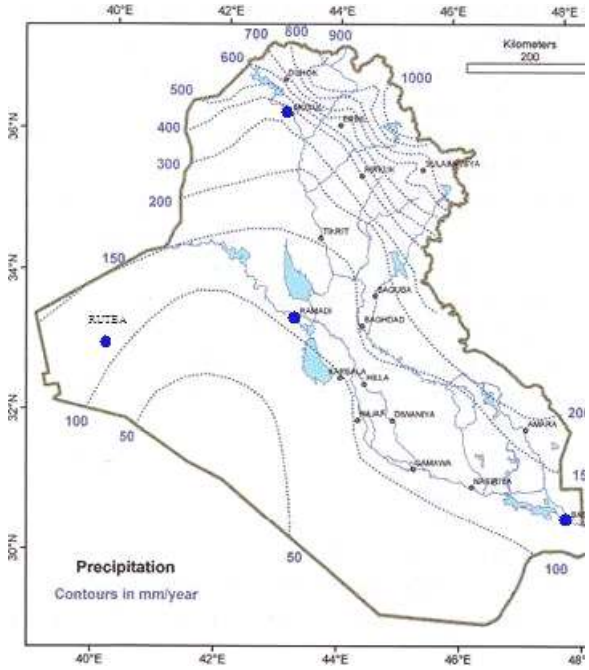

Figure.1: Precipitation map (After Alsam et al.1990 in Jassim and Goff, 2006) displaying the meteorological station as a solid circles.

Distribution of average temperature in Iraq since 1960 to 2007

Since 1960 to 2007, the highest of average temperature has been recorded in Basra throughout year except October that in which a higher temperature was found in Rutba (Figure.2). In the summer season (June, July and August) and September, the temperature in Baghdad and Basra tend to be concordant approximately for years of 1960 to 1970, 1969 to 1973, 1960 to 1975 and 1960 to 1965 respectively, whereas this concordant changed; it was showing Basra warmer than Baghdad for the remnant years (Figure.2). Generally, a tendency of dissimilarity of temperature among the four stations was found. However, there are high contrast between Rutba and Basra throughout year during period extending since 1960 to 2007, except two months, they are: October and November (Figure.2). Rutba appears to have highest temperature on October since 1971 to 2007 (Figure.2). The temperature similarity between Rutba and Mosul since 1960 to 2007 was detected throughout months of year except on October that on which, Rutba was colder than Mosul of about 8ºC (Figure.2).

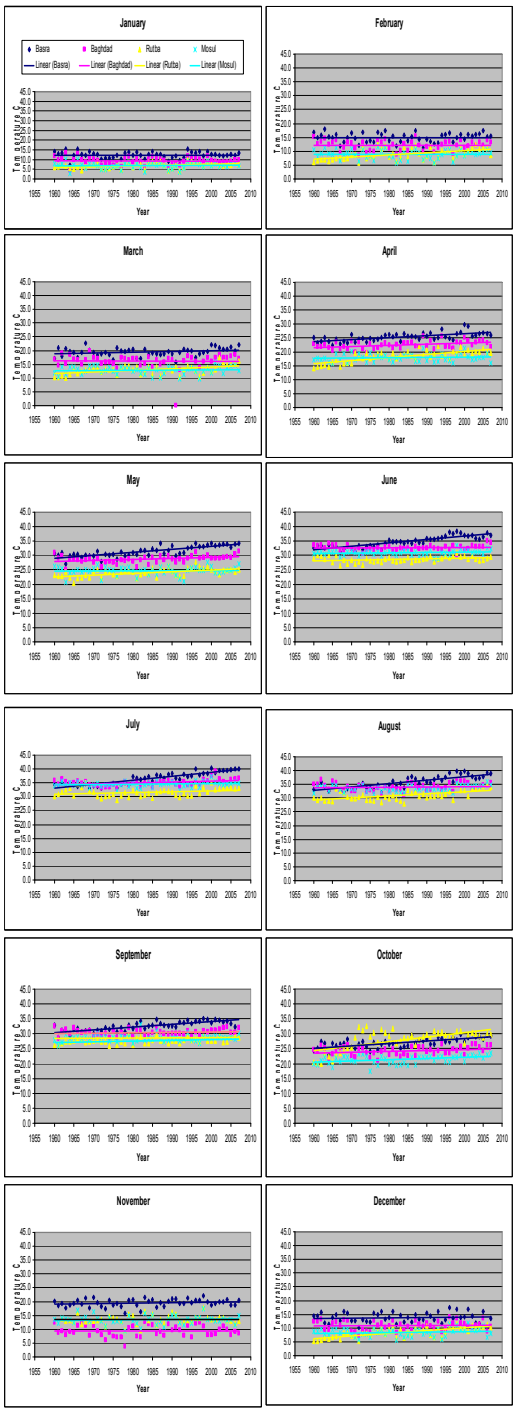

Figure 2: Average monthly temperature of Basra, Baghdad, Mousul and Rutba since 1960 till 2007.

Annual rainfall and evaporation

The higher average rainfall in Iraq since 1960 till 2008 was recorded in Mosul, whereas the lower average rainfall was in Rutba (Figure.3). The relationship between rainfall and time seems to be negative in mosul, Baghdad and Rutba, whereas it appeared constant approximately in Basra (Figure.3). Evaporation in mosul and Baghdad is similar and displays a negative relationship (Figure.4). In Rutba, the climate has highly fluctuated evaporation, there is sudden decreasing in rate of evaporation duration 1990-1995 (Figure.4). In Basra the rate of evaporation is highly increased with time during 1970 till 2008.

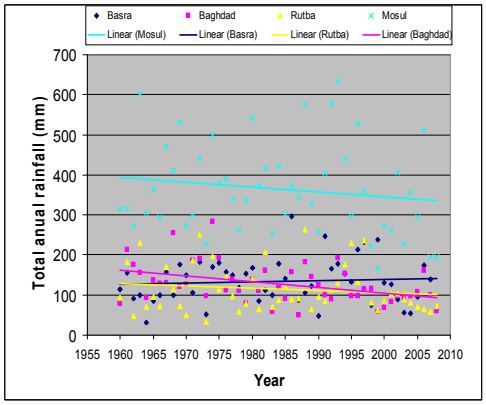

Figure.3: Annual rainfall average of Mosul, Baghdad, Basra and Rutba since 1960 till 2008.

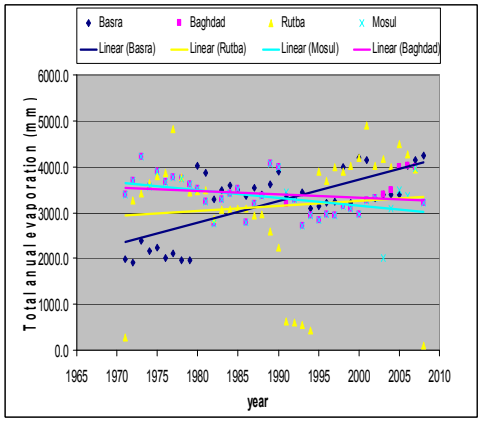

Figure.4: Evaporation average of Mosul, Baghdad, Basra and Rutba since 1970 till 2008.

Level and source of carbon dioxide in Iraq:

According to the data that had been gotten from Carbon Dioxide Information Analyses Center (CDIAC), Carbon dioxide emits from many sources; such as fossil fuel burning (solid, liquid and gas), flaring and cement industry. Since 1957 to 2007, the largest quantity of carbon dioxide emitted from burning of liquid fuel, whereas the lowest quantity of released CO_2 was from burning gas and cement plants (Figure.5).

Flaring was the origin of large CO_2 quantity during the period that had extended from 1964 to 1993 which decreased sharply and reached low level since 1992 to 2007 (Figure.5). The war in March 2003 is responsible for at least 141 million metric tons of carbon dioxide equivalent ($MMTCO_2e$). Between March 2003 and October 2007, the US military in Iraq purchased more than 4 billion gallons of fuel from the Defense Energy Support Center (DESC). The agency is responsible for procuring and supplying petroleum products to the Department of Defense. Burning these fuels has directly produced nearly 39 million metric tons of CO_2 (Reisch N. and Kretzmann, 2008). There is a strong correlation between carbon dioxide content in the atmosphere and temperature was mentioned by (Pelit and Jousel, 1999). Generally, a considerable increasing of CO_2 level since 1950 to 2007 had been obviously detected.

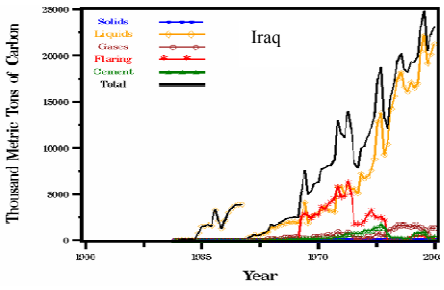

Figure.5: Concentration of carbon dioxide gas in Iraq. (After Carbon Dioxide Information Analysis Center, http//cdiac.ornl.gov).

Discussion and conclusions

The geosphere, consisting of the soils, the sediments and rocks of the earth's land masses, the continental and oceanic crust and ultimately the interior of the Earth itself represent the fifth of final component of the global climate system. Each part of the geosphere plays a role in the regulation and variation of global climate, to a greater or lesser extent, over varying time scales. (Buchdahl J.1999) and (Bridgman and Oliver, 2006). Most desertification takes place far away from desert margins. It is a continuous process that results from the impact of various factors, like climatic variations and human activities. Increasing the temperature and high evaporation with sharp decreasing of rainfall quantity led to expand the desertification that eventually causes reduction of vegetative cover and species diversity, loss of soil structure, decrease in soil fertility, an altered hydrological cycle, and reduced crop yields and livestock production. (Buchdahl J. 1999). In the atmosphere below 25km, the average content of carbon dioxide is 0.035%, also there are 359 parts per million by volume (ppmv) of CO_2 in the atmosphere (Schimel *et al*.,1995). In Iraq, the concentration of CO_2 is positively increased since 1953 till 2005 is essentially emitted from burning of liquid fuel, and from flaring, burning gas fuel and cement industry. (Figure. 5).

Figure.2 displays increasing of temperature during period extended between 1960 and 2007. This refers to that the CO_2 caused a climate warming. During chemical weathering, carbon dioxide is extracted from the atmosphere to react with the decomposing rock minerals to form bicarbonates. These bicarbonates are soluble and can be transported via rivers and other fluvial channels. Then they are deposited on ocean floors as sediment. In essence, carbon dioxide, sequestered from the atmosphere is thereby decreasing the earth's natural greenhouse effect and causing further cooling (Ruddiman & Kutzbach, 1991). The scarcity of rainfall decreased the chemical weathering which is eventually causing further heating. The influence of the Arabian Gulf on the climate of Iraq is very limited, but its effect on Basra climate appears to be clear. Near the gulf, the relative humidity is higher than in the other parts of the country.

This study differentiated many conclusions; these are:

1- Basra has warmer climate than Baghdad, Mosul and Rutba since 1960 till 2007 throughout months except October that in which Rutba appeared to be the colder. The behavior of Basra climate differs from others which is characterized by considerable increasing of temperature and evaporation rate with constant rainfall. The rainfall in Basra looks constant during 38 years ago, while the evaporation increased with rate of 1600 mm/38 years.
2- Mosul and Rutba have similar climate throughout in 1960 to 2007 and they appear to be the colder except October that in which Mosul still colder, but Rutba is warmer.
3- Rainfall in Mosul is higher than all stations and similar in behavior of Baghdad. Rainfall in Mosul and Baghdad decreased of about 70 mm/48 years also the evaporation slightly decreased.
4- Rainfall in Rutba decreased in association with increasing the evaporation.
5- The war in 2003 is responsible for climatic warming and desertification because it directly participated in increasing the CO_2 in the Iraq atmosphere and deforestation.
6- Temperature increases about 5ºC/ 47 years and evaporation rate increases with decreasing the rainfall rate
6- All conclusions above refer to expand and the rapid growth of the desertification.

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