



IMPACT OF CARBON DIOXIDE CONCENTRATIONS ON ATMOSPHERIC TEMPERATURE CHANGES OVER IRAQ AND SOME NEIGHBORING COUNTRIES

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Abstract

Iraq one of the most Middle East countries confronts to climate change, where it faced many environmental challenges the most important of high temperatures above the rate of the natural. The Carbon dioxide (CO_2) gas work on the absorption of part of the heat inside the atmosphere and prevent the leakage into space and this leads to increase temperature of the air and knows this phenomenon of global warming. The aim of this research is to study the effect of CO_2 to increase their concentration in the atmosphere of temperature variation. Where the data was taken from satellites recorded by the European Centre for medium range weather forecasts (ECMWF) and Giovanni reanalysis for NASA. This study choice Iraq and neighbor countries from latitude ($27-37^\circ\text{N}$) and longitude from ($39-50^\circ\text{E}$) for years (2003-2016), where we studied the behavior of CO_2 gas concentration and its relationship with air temperature variation. The result by using correlation coefficient between CO_2 and temperature we found that the relationship is positive in the northern stations, Sulamaniyah (Iraq) +0.5, Mosul (Iraq) +0.3 and weak positive in other regions, as for neighboring countries also be positive in Ahwaz (Iran) +0.5, and Batman (Turkey) +0.4 and weak positive in Jubail (KSA), Amman (Jordan), Aleppo (Syria).

Keywords: Greenhouse gases, Carbon dioxide, ECMWF, Climate change, Iraq.

Introduction

Carbon dioxide is a trace gas in the composition of the Earth's atmosphere, with an average concentration of 400 ppm, according to NOAA measurements on the island of Mona Loa, Hawaii (NOAA, 2018), (Ewald, 2013). The concentration of CO_2 gas varies between areas close to the Earth's surface and high areas, and its concentration varies on a local basis between cities and rural areas, and between industrialized countries and non-industrialized countries. In addition, there is a difference in the concentration of carbon dioxide by months of the year. In the northern half of the Earth, the CO_2 concentration is at its peak in the spring and at its lowest level in the fall, at a repeated annual cycle. Carbon dioxide is released continuously into the atmosphere from natural sources. About 40% of the gas emitted by volcanoes during the eruption is from carbon dioxide (Enting, 1987). It is estimated that volcanoes release between 130 and 230 million tons of CO_2 into the atmosphere each year. However, CO_2 emissions from human activities are about 135 times greater than that of volcanoes. The imbalance in the concentration of atmospheric gases especially in the concentration of gas carbon dioxide because of the activities of human led to enclosure part of the energy in the atmosphere causing alter rates of temperature of the earth's surface and this composition is known as the phenomenon of global warming (Blackstock, 2008).

The Global warming increase in surface temperature medium in the world with increasing the amount of carbon dioxide, methane and other gases in the Atmosphere. These gases are called greenhouse gases because they contribute to the heating of the Earth's surface atmosphere, a phenomenon known as global warming (Baettig *et al.*, 2007). The increase in average air temperature since the middle of the 20th century has been observed as it continues to escalate, with the surface temperature increasing by $0.74 \pm 0.18^\circ\text{C}$ over the last century. The International Committee on Climate Change has concluded that greenhouse gases. The resulting human practices are responsible for most observed temperature rise

since the middle of the twentieth century (Hegel, 2007). while natural phenomena, such as solar eclipses and volcanoes, have a small warming effect since ages before the industry until 1950 and the effect of small cooling thereafter (Amman, 2007), (Howden *et al.*, 2007). The Absorbance and Emissivity Solar Radiation by Clouds, Aerosols and some Atmospheric gases, for this study used data were taken from the satellites of the European Center for Meteorological Forecasts ECMWF, Specifically, the model was used (ERA-interim) (Abood *et al.*, 2018). The employed GIS for mapping that in both Iraq and Jordan the climate should become drier, with reduced growing periods, shifts in climatic zones, and higher temperatures and water requirement than currently (De Pauw *et al.*, 2015). Today's temperature is almost double that of 200 years ago.

The causes of global warming are different; some scientists say pollution is the main cause, while others say it is a change in nature. There are several theories that explain this increase. Global surface temperature is expected to increase by 1.4°C to 5.8°C from 1990 to 2100, and the world surface temperature is now 0.6°C (Nasrallah *et al.*, 2004).

Materials and Methods

The Study Area

Iraq is country in Western Asia spanning most of the northwestern end of the Zagros mountain range, the eastern part of the Syrian Desert and the northern part of the Arabian Desert. The desert is in the southwest and central provinces, along the borders with Saudi Arabia and Jordan and geographically belongs with the Arabian Peninsula. The climate of Iraq is characterized by sub-tropical, continental, arid to semi-arid with dry hot summers and cooler winters. The average annual temperature is varies from 8.5°C to 49°C . The summer temperature range is between 16°C to 49°C , while winter temperature range is between 8.5°C to 14°C . The work was carried with the monthly mean of the years (2003-2016) the CO_2 and Temperature data taken from the

European center medium weather forecasts (ECMWF) specifically model (ERA-interim) (Dee *et al.*, 2011), and CO₂ from Giovanni reanalysis for NASA (Giovanni, 2013). This data is taken over Iraq and neighbor countries where chosen for this work located at the latitude SW (27, 37) °N and longitude NE (39, 50) °E with spatial resolution 2*2.5 degree as shown in Fig. 1 and Table 1.

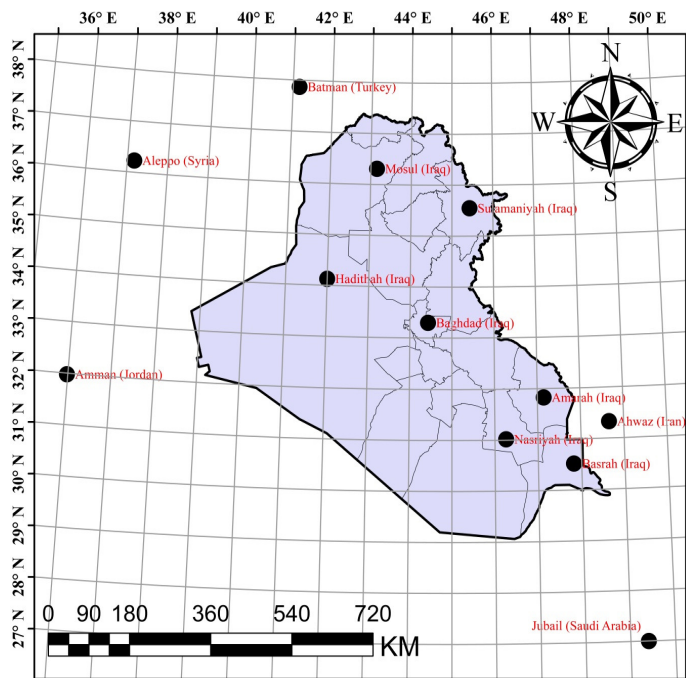


Fig. 1: The study stations.

Results and Discussion

Study the Behavior of Monthly Mean of CO₂ in Study Stations

The Fig. 2 and Fig 3 shows the monthly average of CO₂ on the study region from January 2003 to December 2016. The CO₂ values appear Spatial variation on most parts of Iraq and some neighboring regions with differences in spatial space Patterns for each season, and various seasonal fluctuations depend on Weather conditions and topographic. Carbon dioxide concentrations are constantly increasing due to human activities and huge quantities of fuel burned by industrial facilities, fuel stations and transport engines in transportation, as well as increasing population has a role in increasing the percentage of carbon dioxide because the human activity is the main reason Increase the proportion of the gas. Gas concentrations increase during the summer (June, July and August) during the hot months, with the highest values during the summer in June if the concentration of gas CO₂ 391.3 ppm in Jordan as well as the high gas values in the northern regions (Mosul, Sulaymaniyah), In the southern stations of Basrah, as well as in Baghdad because of the low consumption of gas by plants in the summer, so the proportion of gas in the atmosphere increases because photosynthesis is of lower value.

Carbon dioxide is an essential factor in the process of making Food in plants. During winter (December, January and February), carbon dioxide has less value during the cold months as the plant and tree growth season begins. And less during the spring (March, April) but begin to increase again during the month of May, the end of the spring where in the spring process photosynthesis of the plant is at its greatest value, where the growing season of plants and increase the consumption of carbon dioxide and thus reduce the amount of gas in the atmosphere, Also during the fall (September, October and November), gas concentrations are relatively low because of gas consumption and thus less in the atmosphere. This increase in concentrations of carbon dioxide will lead to negative results in relation to the atmosphere of the Earth where the Earth is exposed because of these imbalance gas concentrations, including carbon dioxide gas to a series of climatic changes and the most important high temperatures than normal. As the CO₂ molecules have a great ability to absorb infrared radiation and increase this gas, the heat gets absorbed as the gas works to absorb the heat and emits it into space and thus increases the temperature of the atmosphere. This increase in carbon dioxide concentrations and the long-term combustion of fossil fuels will lead to a significant increase in the temperature of the atmosphere. This increase in the CO₂ ratio for Iraq and neighboring regions led to an imbalance in the amount of rainfall. Drought and drought caused many in the falling rain as some of the neighboring regions suffered from floods due to the heavy rainfall. This imbalance in the climate system is caused by high temperatures due to the high concentration of CO₂ gas as it is one of the greenhouse gases and causing global warming.

Table 1: Location and Altitude for study stations from north to south.

Stations	Longitude (°E)	Latitude (°N)	Altitude above sea level (meter)
Batman (Turkey)	41.16	37.87	601
Mosul (Iraq)	43.15	36.31	223
Aleppo (Syria)	37.17	36.23	379
Sulamanyah (Iraq)	45.43	35.55	882
Hadithah (Iraq)	42.35	34.13	80
Baghdad (Iraq)	44.43	33.30	34
Amman (Jordan)	35.98	31.98	750
Amarah (Iraq)	47.15	31.83	10
Ahwaz (Iran)	48.66	31.33	21
Nasriyah (Iraq)	46.26	31.02	9
Basrah (Iraq)	47.82	30.52	5
Jubail (Saudi Arabia)	49.4	28.00	7

Statistical Used

Choosing spearman (Rho) from many statistical tests has been selected regression analysis .Using statistical program SigmaPlot to figure out the slope of regression (SigmaPlot, 2013), and p-value simple linear regression way to detect the relationship between the gas concentration and temperature by simple linear regression. And using surfer 13 programs to show gas behavior and GIS program (Surfer, 2013).

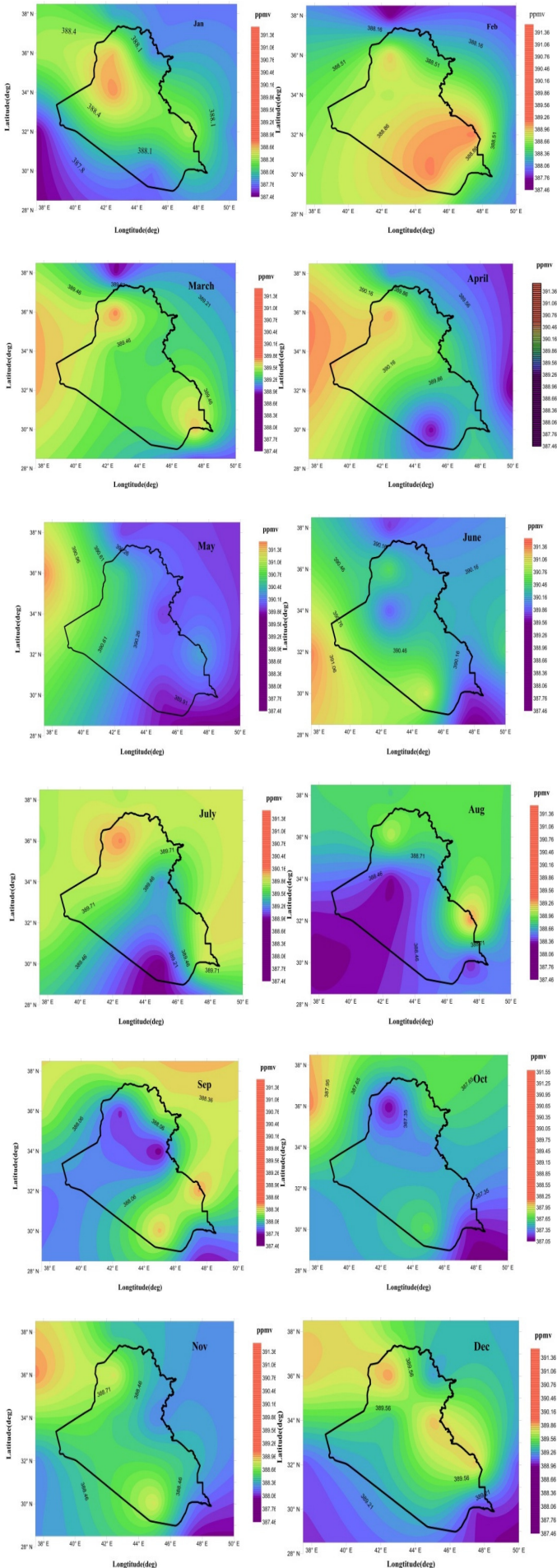


Fig. 2: The behavior of monthly mean of carbon dioxide for the period (2003-2016).

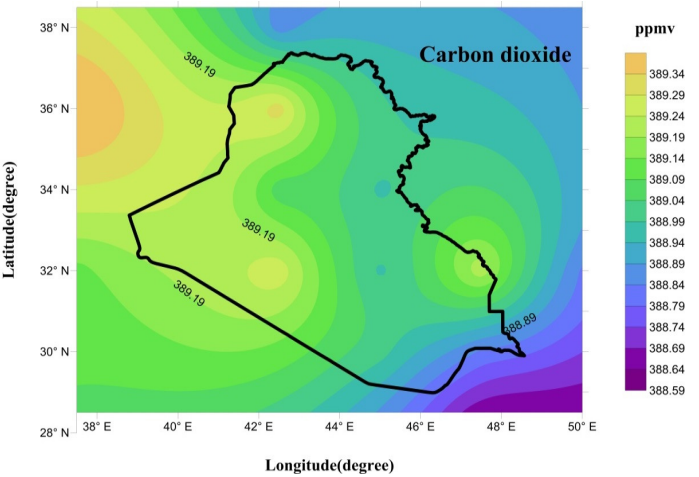
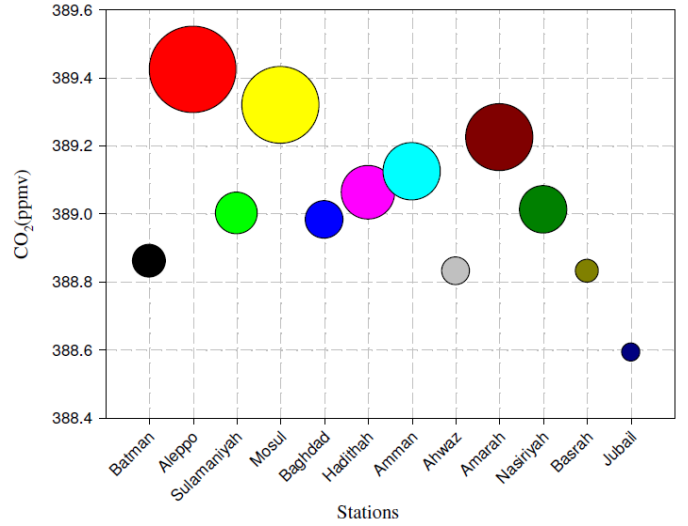


Fig. 3: The spatial variation of total yearly behavior of CO₂ for period (2003-2016)

Study the Behavior of Monthly Mean of Temperature in Study Stations

The Fig. 4 and Fig. 5 showing the behavior of temperature , data of temperature was taken from the European Center Medium Weather Forecasts (ECMWF) ,The program Surfer13 was used to plot the spatial distribution of the rates monthly of temperature of each month of the year during the period of study [2003-2016], this maps as shown in figure (4). during the study it founded that the highest temperature in the southern stations of Iraq in the August, and the lowest temperature in the January, while in the neighbor stations temperature less than Iraqi stations, just Jubail stations in Saudi Arabia has temperature like the southern stations of Iraq, because it has high concentration of greenhouse gases Jubail was industry region therefore has high pollutions. The highest rate of temperature was observed in August in Basrah station in south part of Iraq where the average temperature was 39°C and the lowest temperature during August was in Batman in Turkey where the temperature was 26°C. The lowest rate of temperature was during the month of January where temperature was the lowest -2°C in Batman in Turkey and the highest rate of temperature during the month of January in Byblos in the Kingdom of Saudi Arabia where the temperature was 13°C.

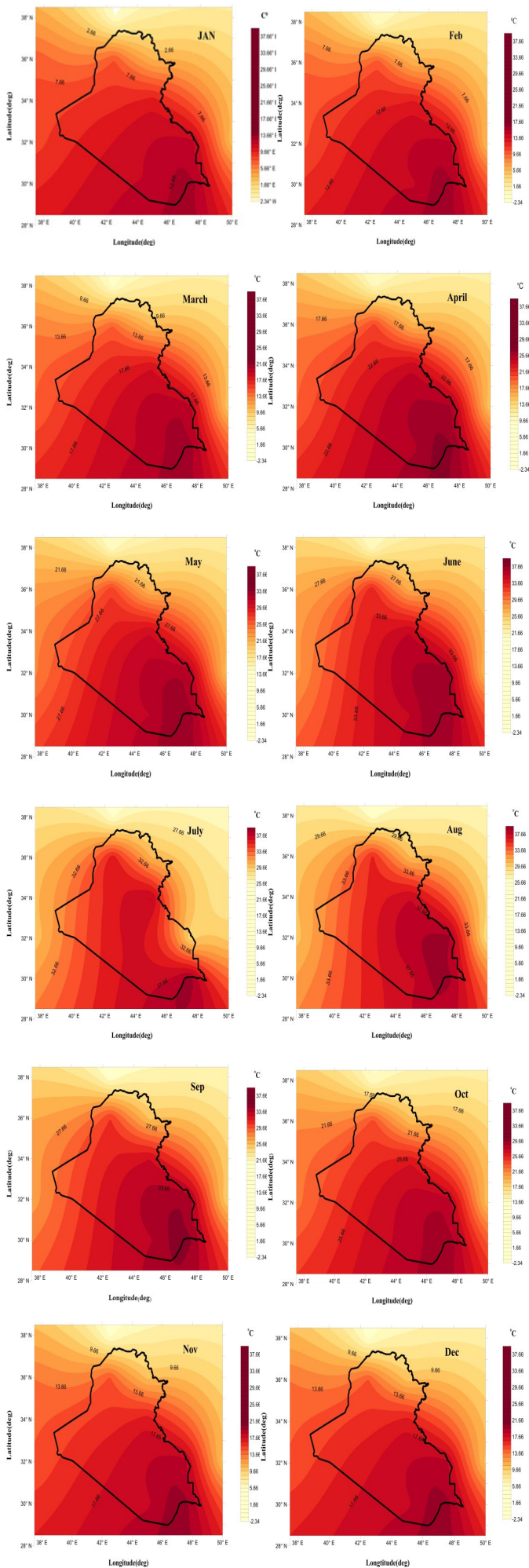


Fig. 4: The behavior of monthly mean of temperature for the period (2003-2016).

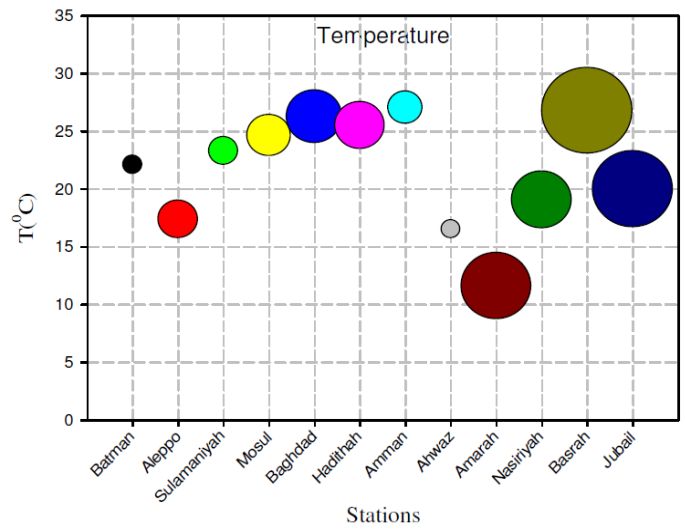
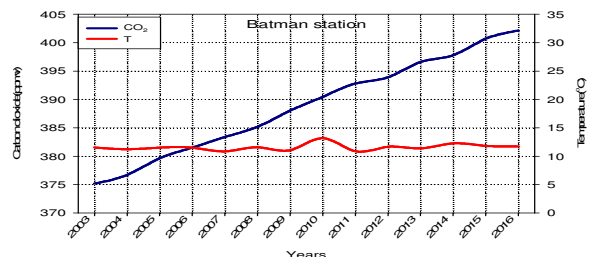


Fig. 5: The spatial variation of temperature behavior in the study stations

Effect of Change in CO₂ on Temperature for Period (2003-2016)

By studying the behavior of carbon dioxide gas by taking yearly averages for the study period (2003-2016), we observe that CO₂ gas is constantly increasing as a result of the increase of fossil fuel combustion, the generation of coal, oil and natural gas mainly, the use of alternative energy and the use of oil and its products. Transportation, aviation and electricity generation. Carbon dioxide is a greenhouse gas that causes high temperature (9-26%). 75% of the increase in carbon dioxide is due to the burning of fossil fuels and the rest is human consumption such as removing trees and leaves. Another factor that plays an important role in this increase is the increase in the population, The highest value of carbon dioxide during the summer and decrease during the winter and the beginning of the plant growth season where the plants withdraw carbon dioxide from the atmosphere through the process of photosynthesis, so the value of CO₂ in the cold months and increase during the summer months warm, see the Fig. 6.



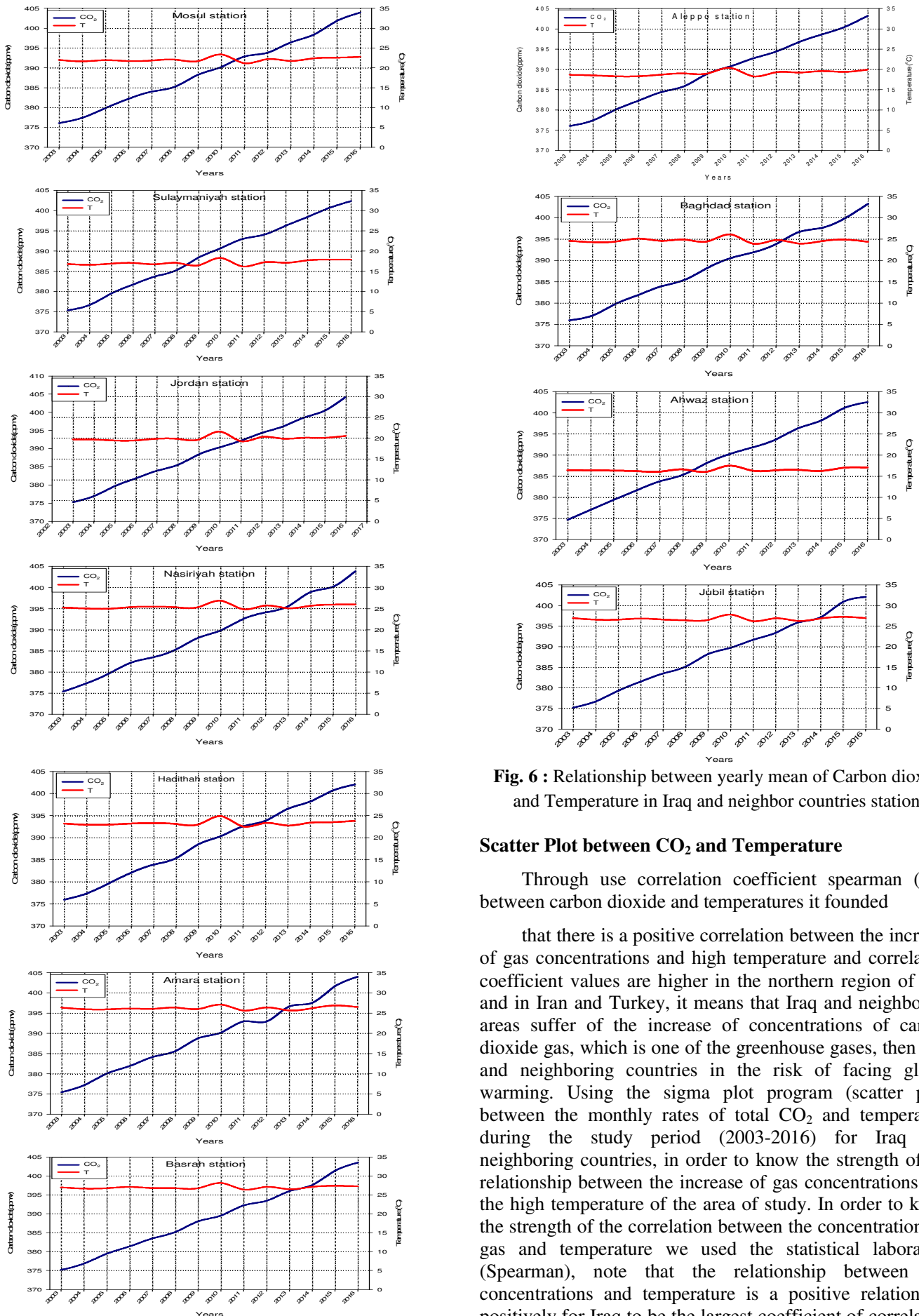


Fig 6 : Relationship between yearly mean of Carbon dioxide and Temperature in Iraq and neighbor countries stations

Scatter Plot between CO₂ and Temperature

Through use correlation coefficient spearman (rho) between carbon dioxide and temperatures it founded

that there is a positive correlation between the increase of gas concentrations and high temperature and correlation coefficient values are higher in the northern region of Iraq and in Iran and Turkey, it means that Iraq and neighboring areas suffer of the increase of concentrations of carbon dioxide gas, which is one of the greenhouse gases, then Iraq and neighboring countries in the risk of facing global warming. Using the sigma plot program (scatter plot) between the monthly rates of total CO₂ and temperature during the study period (2003-2016) for Iraq and neighboring countries, in order to know the strength of the relationship between the increase of gas concentrations and the high temperature of the area of study. In order to know the strength of the correlation between the concentrations of gas and temperature we used the statistical laboratory (Spearman), note that the relationship between gas concentrations and temperature is a positive relationship positively for Iraq to be the largest coefficient of correlation between gas and temperature in Amara where the value of correlation coefficient (+0.4), which lies to the south of Iraq. The greatest value of the coefficient of correlation between the gas and temperature concentrations in the northern regions of Iraq, where the value of the coefficient of

correlation between gas and temperature in the Sulamaniyah station (0.4) and in Mosul station (0.3). For the countries neighboring Iraq, the highest value of the Spearman coefficient is in Ahwaz (Iran) where the coefficient of correlation (+ 0.5) and in Batman (Turkey) the correlation coefficient value (+0.4) Gas and positive grades even if they are lower values, positive value between gas and Temperature means that the high concentration of CO₂ has impact on high Temperature and in result has impact on global warming in study stations, see the **Fig. 7** and **Table 2**.

Table 2: The values of the Spearman coefficient correlate between temperature and CO₂ for period (2003-2016) for study stations

Stations	Spearman rho test		Simple linear regression	
	R	Correlation	P-value	Relationship
Batman	0.4	low	0.2	Linear
Mosul	0.3	low	0.7	Non-linear
Aleppo	0.2	low	0.5	Non-linear
Sulamaniyah	0.4	low	0.2	Linear
Hadithah	0.1	low	0.8	Non-linear
Baghdad	0.1	low	0.8	Non-linear
Amman	0.3	low	0.3	Linear
Amarah	0.4	low	0.4	Non-linear
Ahwaz	0.5	low	0.2	Linear
Nasriyah	0.2	low	0.5	Non-linear
Basrah	0.3	low	0.5	Non-linear
Jubail	0.2	low	0.4	Non-linear

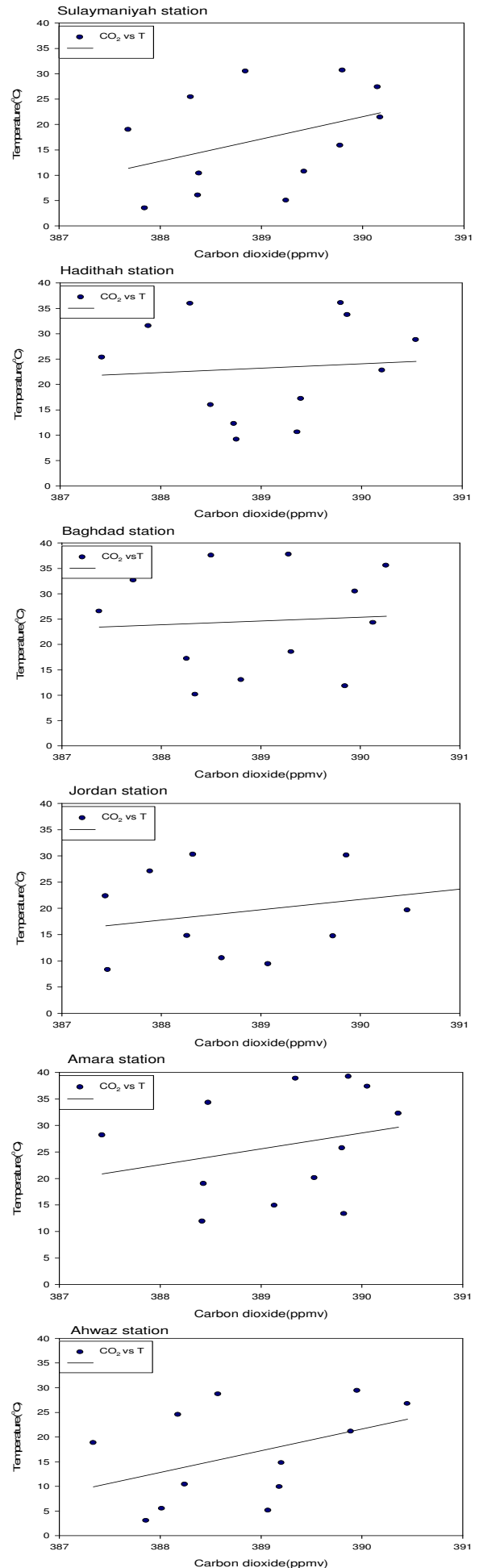
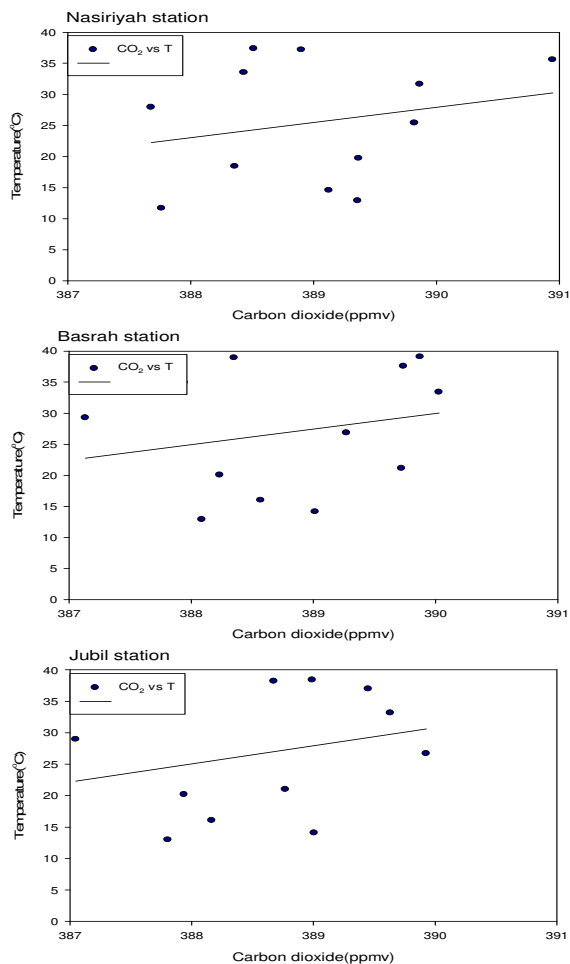


Fig. 7: Relationship between CO₂ and T for period (2003-2016) for study stations



Followed the fig. 7

Conclusions

- The behavior of gas carbon dioxide we note that the in an increase continuous because of the activities of human and natural activities.
- 75% of increasing CO₂ output of burning fossil fuels, oil and natural gas.
- Top of increasing carbon dioxide during summer season and decreasing during winter in the northern hemisphere.
- The temperature increase for rates natural in Iraq and neighboring countries.
- By using the statistical factor spearman correlation coefficient (ρ) find that there positive relationship between increasing gas CO₂ and high temperature.
- Carbon dioxide which is one of greenhouse gases cause increasing high temperature and accompanied of climate changes and cause global warming phenomena.

Acknowledgement

An acknowledgment to the European Center Medium Weather Forecasts (ECMWF) and Giovanni on the data used in this study, and we would also like to thanks Mustansiriyah university for providing scientific support to accomplishing this research.

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