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An Analysis Study on the Effect of Increasing Carbon Dioxide Gas and Climate Change on Temperatures in Libya

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ABSTRACT

Carbon dioxide CO_2 has been increased in the atmosphere and therefore had a significant impact on global warming on the world. Libya had the share of high temperatures in recent years reached 22.6 ^{0}C compared to about 20.9 ^{0}C in1980. It was noted the increase of carbon dioxide over Libya in the time series (1980-2019) has stepped from 338.8 PPM in 1980, to reach 409.6 PPM in 2019. In this study, a statistical analysis of the data to determine the type and strength of the relationship between the two variables, carbon dioxide (CO_2 PPM) and temperature (^{0}C), was performed. It showed that there is a percentage of the effect gas carbon dioxide on the temperature up to 32.6%, and the relationship between the variables is positive, and the correlation coefficient is 0.571. Through analysis of variance to test the significance of the quality of the model, there is a linear relationship between the two variables, and the value of t indicates that there is an effect of carbon dioxide on temperatures.

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دراسة تحليلية حول تأثير زيادة غاز ثاني أكسيد الكربون والتغير المناخي على درجات الحرارة في ليبيا

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ملخص: زاد ثاني أكسيد الكربون(CO_2) في الغلاف الجوي وكان له تأثير كبير على ظاهرة الاحتباس الحراري على العالم ككل. وبلغت حصة ليبيا من درجات الحرارة المرتفعة في السنوات الأخيرة 22.6 درجة مئوية مقارنة بعام 1980 والتي كانت حوالي 20.9 درجة مئوية. لوحظ أن الزيادة في السلسلة الزمنية لثاني أكسيد الكربون فوق ليبيا بلغت قيمتها 338.8 جزء في المليون عام 1980 لتصل إلى 409.6 جزء في المليون في عام 2019. وفي هذه الدراسة أظهر التحليل الإحصائي للبيانات أن هناك نسبة مئوية من تأثير غاز ثاني أكسيد الكربون على درجة حرارة تصل إلى 32.6٪، وكانت العلاقة بين المتغيرين موجبة ، بمعامل الارتباط 0.571.

حيث استخدم ايضا تحليل التباين لاختبار معنوية جودة النموذج ولاحظنا وجود علاقة خطية بين المتغيرين وان النموذج و معادلة خط الانحدار يمكن الاعتماد عليه.

1. INTRODUCTION

Carbon dioxide is Earth's most important greenhouse gas: a gas that absorbs and radiates heat. Unlike oxygen or nitrogen (which make up most of our atmosphere), greenhouse gases absorb heat radiating from the Earth's surface and re-release it in all directions—including back toward Earth's surface. Without carbon dioxide, Earth's natural greenhouse effect would be too weak to keep the average global surface temperature above freezing. By adding more carbon dioxide to the atmosphere, people are supercharging the natural greenhouse effect, causing global temperature to rise. According to observations by the NOAA Global Monitoring Lab, in 2021 carbon dioxide alone was responsible for about two-thirds of the total heating influence of all human-produced greenhouse gases,[1].

Over the 20th century, the atmospheric concentrations of key greenhouse gases increased due to human activities. The stated objective (Article 2) of the United Nations Framework Convention on Climate Change (UNFCCC) is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent "dangerous anthropogenic interference with the climate system [2], and temperatures rose between 0.08 to 0.14 degrees Celsius during the years 1951-2012, and this is the result of the total increase in solar radiation, and carbon dioxide gas is considered the first factor in climate change centered on the rise in temperatures [3], and many reports have confirmed that the basic components The external influence over the past century has been man the rate of anthropogenic input of CO_2 to the atmosphere exceeds the rate at which physicochemical and biological processes remove CO_2. The resulting increase in the atmospheric CO_2 concentration is widely perceived as a major cause of the present increase in global temperatures [4]. The processes that remove part of the additional atmospheric CO_2 is dissolution into water bodies. This results in an increase in dissolved CO_2 and HCO3– concentrations ,and it causes carbonic acid ocean acidification Furthermore [5].

Rising carbon dioxide and associated climate change may significantly affect agricultural production around the world [6] , and land cover changes led to estimated increases in atmospheric CO_2 of between 22 and 43 ppmv.[7], with an increase in temperature for the future, IPCC(2007) estimated that Earth would warm between two and six degrees Celsius over the next century, depending on how fast the carbon dioxide emissions grow. Given the effects of CO_2 have on radiation and climate change, many researchers and policymakers have focused on finding the CO_2 reduction targets to lessen its effects [8].

IPCC defines 'detection' as the process of demonstrating that climate has changed in some statistical sense, which means that the likelihood of occurrence by chance due to internal variability alone is small. Besides statistical analysis of observed data, typically climate models are used to predict the expected responses to external forcing and then the consistency of this response pattern is evaluated with respect to different components of the climate system [9]. And Libya had the share of climate change, which made it more one of the driest countries in the world, where the demand for water is far greater than its renewable supply. Projected temperature increases as well as rise in sea levels and increased incidence of extreme weather events has sparked concerns of depleting water resources, threats to coastal communities and reduced agricultural eases [10].

2. Study objectives

1. Find out the effect of carbon dioxide gas on temperatures in Libya.
2. See some of the results reached by other parties to know the current situation of carbon dioxide gas on temperatures in general.

3. Area study and data

The annual average of both temperatures and carbon dioxide gas was obtained over Libya located between latitudes 20-33^0 and longitudes 10-25^0 ,as shown in figure(1).

during the years 1980-2019,where data temperatures from NASA [11], and carbon dioxide gas at the National Oceanic and Atmospheric Administration (NOAA) [12].

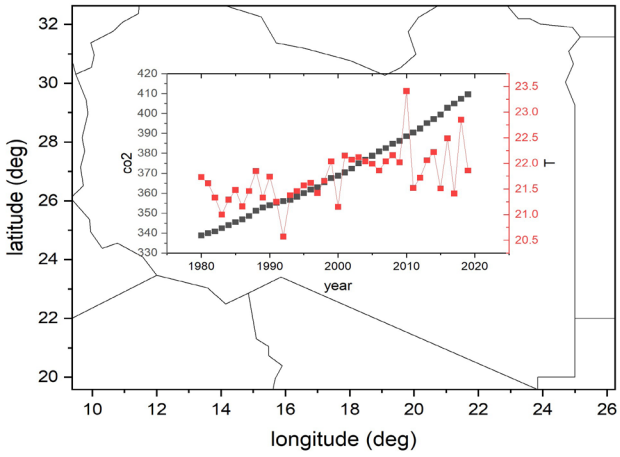

Figure 1. The relationship between temperature and carbon dioxide on the sturdy area.

4. Data analysis and discussion

When analyzing the data, it was found that the temperature over Libya for 1980 was about 21.73 ^{0}C, while the amount of carbon dioxide gas was about 338.8 PPM, and the temperature has

been increasing until the last years reach to 22.85 ^{0}C as well as the amount of CO_2 reach to 407.38 and 409.6 PPM in 2018 and 2019 respectively, while in 2010, which is considered the highest year in temperature rises in the world as a whole, many studies confirm this, including [13], and when analyzing it turns out that 2010 is really high as it reached about 23.41 ^{0}C in Libya.

One of the reasons for the rise in temperatures in the world as a whole is an increase in carbon dioxide levels. In our current study, statistical methods have been used to clarify this rise.

To determine the type and strength of the relationship between the two variables carbon dioxide (CO_2 PPM) and temperature (^{0}C) and it was found to be equal to (0.571), i.e. there is an average direct correlation between CO_2 and temperature ,through the Pearson correlation coefficient formula that has been used in this study and presented as follows:

$$r = \frac{\sum (x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum (x_i - \overline{x})^2 \sum (y_i - \overline{y})^2}} = \frac{s_{xy}}{s_x s_y} \qquad \text{.....(1)}$$

Where S_{xy} covariance xy.

S_x standard deviation x.

S_y standard deviation y.

The terms in that formula are:

x_i: values of the x-variable in the data set (carbon dioxide).

yi : values of the y-variable in the data set (temperature (^{0}C)).

After that, the effect of the increase in carbon dioxide on the temperature was studied by considering carbon dioxide (as independent variable) on the temperature (as dependent variable) analyzing the data of the two variables during the period (1980-2019) using simple linear regression equation:

$$y = a + bx \qquad \text{.....(2)}$$

Spread points between the two variables were plotted as follows:

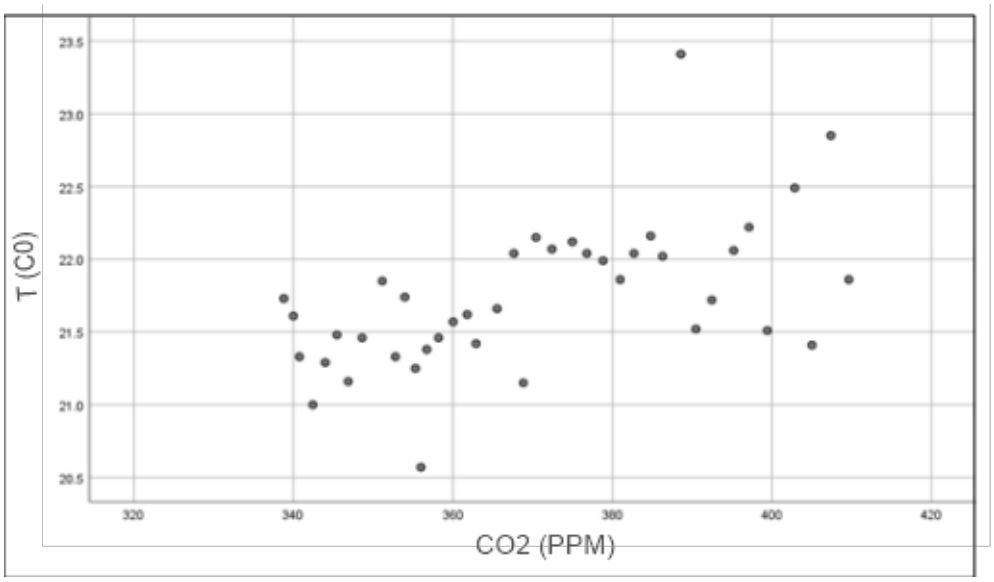

Figure 2. Scatterplot of CO_2 (PPM) and temperature (^{0}C).

Table 1. Additional regression Results for the percentage of influence of CO_2 on temperature

R	R Square	Std. Error of the Estimate
0.571[a]	0.326	0.423
a. Predictors: (Constant), CO_2.		

From the above table, we find that the percentage of the effect of the independent variable CO_2 on the dependent variable Temperature is equal to 0.326, meaning that carbon dioxide affects by (32.6%) the temperature, and the square of the correlation coefficient R is used to find out the percentage of variation in the dependent variable and through it the variable can be predicted independent, explaining the error estimate approx. 0.423.

We depended on the analysis of variance to test the significance of the quality of the model, where we note that there is a linear relationship and that the level of significance for F is less than 0.05, that meaning there is a relationship between the independent variable and the dependent variable and that the regression model is significant, and therefore we reject the null hypothesis and accept the alternative hypothesis that the model is significant statistic and its results can be depend upon, see Table 2.

Table 2. Results of **ANOVA**[a]

	Sum of Squares	df	Mean Square	F	Sig
Regression	3.289	1	3.289	18.407	0.000[b]
Residual	6.790	38	0.179		
Total	10.079	39			
a. Dependent Variable: Temperature (^{0}C), b. Predictors: (Constant),CO_2.					

The following table showed the parameters of the model:

Table 3. Results Coefficients[a]

	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
Constant	16.637	1.191		13.976	0.000
CO_2	0.014	0.003	0.571	4.290	0.000
a. Dependent Variable: Temperature (^{0}C)					

Table 3 shows the value of t indicated to that the effect of CO_2 on temperature cannot reach zero, meaning that there is an effect of CO_2 on temperatures. Through the Table 3, the regression equation can be written, as we obtained the coefficients of the regression line as following:

$$y = 16.637 + 0.014x \quad \text{.....} (3)$$

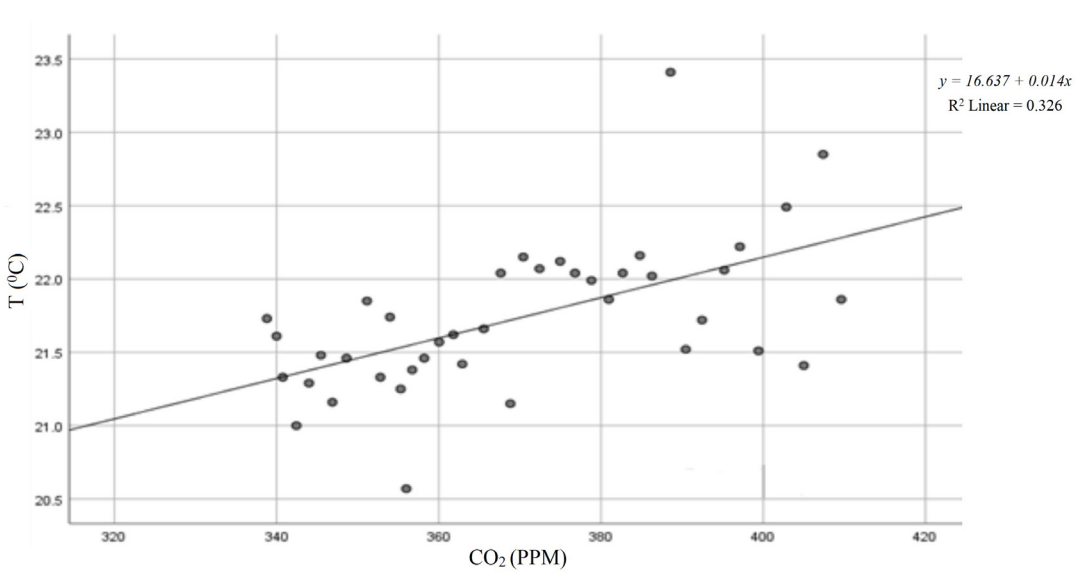

Figure 3. Scatterplot of CO2 (PPM) and temperature (^{0}C).

We also noted that the points approach from the line and that the residuals are distributed according to the normal distribution, which is a condition for applying the regression equation.

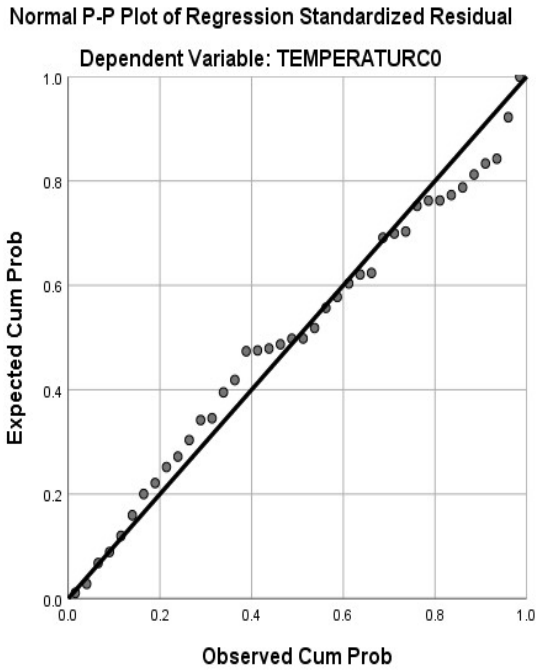

Figure 4. Normal P-P plot of regression residual.

5. Conclusion

Carbon dioxide CO_2 increased in the atmosphere, Libya had the share of high temperatures in recent years reached 22.6 ^{0}C compared to compared to about 20.9 ^{0}C in 1980. It was noted that the increase of carbon dioxide over Libyain the time series (1980-2019) stepped from 338.8 PPM in 1980, to reach 409.6 PPM in 2019. Through this study, the relationship of carbon dioxide gas and

the increase in temperature in recent years was explained by the statistical relationships, shown in the Pearson correlation coefficient, where the correlation coefficient was about 0.571, and the percentage of the effect of carbon dioxide gas on the temperature was about 32.6%.

In addition, a depended study on the analysis of variance to test the significance of the quality of the model was performed. It has been noted that there is a linear relationship and that the level of significance for F is less than 0.05. This means that there is a relationship between the independent variable and the dependent variable and that the regression model is significant, and the value of t indicated that there is an effect of CO_2 on temperatures.

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Data Availability Statement: Publicly available datasets were analyzed in this study. This data can be found here: , https://giovanni.gsfc.nasa.gov ,and https://psl.noaa.gov/gcos_wgsp/Timeseries/Data/co2.
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Conflicts of Interest: The authors declare no conflict of interest

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