

The Study of the Chemical Analysis of Gases (CO, CO₂) and Find A Relationship between Some Meteorological Variables and Concentrations of Gases

[Dr. Osama T. Al-Taai, Dr. Ahmed F. Hassoon and Dr. Luma M. R. Ahmed]

Abstract - The central air oxidizer (with overlapping interactions) where contains many trace gases that could still from the air through oxidative stress, where he found that the effect of unilateral gas dioxide leads to the depletion of ozone gas as hydrocarbons and other gases do. Where it was in this paper the analysis of the behavior of the concentrations of gases Carbon Monoxide and Carbon Dioxide (CO, CO₂) respectively, and the behavior of meteorological variables (Relative Humidity (RH), Temperature (T), Dew Point Temperature (TD) and Wet Bulb Temperature (TW)) every quarter of an hour of the study days 2015 for Al-Hurriya station in Baghdad city.

It was to find a relationship between the meteorological variables and concentrations of gases (CO, CO₂) using simple linear regression (SLR) statistical model, correlation coefficient (R, R²) and standard error, where he found that the relationship between relative humidity and concentrations of gases (CO, CO₂) is inverse and found that the relationship between (temperature, dew point temperature, wet bulb temperature) and concentrations of gases (CO, CO₂) is positive. It was taking into consideration the local and world determinants hourly to concentrations of pollutants (CO, CO₂).

Keywords - Concentrations, Meteorological variables, Chemical analysis, Local determinants, Baghdad.

I. Introduction

We can define Air pollution as the concentrations that cause damage to humans, plant, animal life, human-made materials and structures this known According to US EPA definition [1].

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The United Nations Environment Programmer (UNEP) also says air pollution, resulting from burning oil and aggravated by war, is cause for concern [2]. At the end of the 2003 war, Baghdad's infrastructure was seriously degraded [3]. That of the causes of increased concentrations of pollutant in the air, this is also causing high concentrations of total suspended particles and that was mostly exceeding the specific national proposal and thus increasing the concentrations of heavy metals [4]. Most important processes causes pollutant is combustion of fossil fuels and biomass which produces carbon dioxide (CO₂), carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic compounds (VOCs), black carbon (BC) aerosols, and sulfur oxides (SO_x, comprised of some sulfate aerosols, but mostly SO₂ gas which subsequently forms white sulfate aerosols) [5]. With respect to Urban Air Pollution, the meteorological conditions that effect transport and dispersion take place in the so-called planetary boundary layer, roughly the lower 1000 m of the atmosphere. Within this layer, wind speed and wind direction are influenced by the roughness of the surface and the vertical height of flows [6]. One of the most important objectives of study of air pollution is the development of a methodology capable of predicting the variation of pollutant concentrations under varying meteorological and emission conditions, such a methodology will not only enhance the present understanding of the various physical and chemical processes that take place in atmosphere, but also will provide a tool for federal and local air pollution agencies to use in regional and urban planning [7]. Air pollution monitoring, is scarce and fragmentary for Baghdad City (Capital of Iraq) and its surroundings. On other most of air pollution record by Iraqi ministry of environment in Baghdad is at daytime and data fluctuated and have almost missing in its recorded [8]. Due to the environmental impacts of population activities, this part of research undertook a monitoring campaign aimed at elucidating the role of emission of burring gases inside urban city including electric generator that deterioration air quality in Baghdad spatially after 2003 [9]. Electricity in Iraq is seasonal demand, with the highest peak occurring in the summer months as a result of very high temperatures, during the summer, peak hourly electricity demand could be expected to reach levels around 50% above the average demand level, increasing the gap between grid-based electricity supply (operating at capacity) and demand [10]. The generation providers from household and shared generator. Most of these generators are using diesel engines especially the higher power generators.

Diesel engines yield relatively considerable levels of hydrocarbons (HCs), carbon monoxide (CO), and volatile organic compounds (VOCs). Diesel engines are relatively high emitters of oxides of nitrogen (NO_x) and particulate matter (PM) [11]. Sanchez reported that non-road heavy-duty engines (primarily diesel engines) accounted for approximately 40% of inhalable ambient particulate PM₁₀, and 60–80% of fine particulate PM_{2.5} inventory [12]. Within this campaign the classical gaseous atmospheric pollutants, that observed is carbon monoxide (CO) and carbon dioxide (CO₂). CO is a particularly useful indicator of urban air pollution. It shares many combustion sources with particulate matter and with other urban primary pollutants. For example it is well correlated with NMHC from combustion sources [13]. It tends to show greater spatial homogeneity than many shorter-lived pollutants whose concentration is strongly affected by local sources [14]. In fact, compared to most urban air pollutants, carbon monoxide has a long atmospheric lifetime, from 1.1 to 2.4 months in the tropical boundary layer, and from 2.2 to 3 months in the mid-latitude lower troposphere [15]. The long lifetime has several implications. The gas has often been utilized as a tracer of long distance and intercontinental pollution transport [16]. More importantly, it meant that, on the timescale of its emission and ventilation from urban areas (hours to a day), CO could be treated effectively as an inert tracer. The atmospheric CO₂ concentration was not measured practically or calculated theoretically. This paper will try to estimate the atmospheric CO₂ concentration in north area from center Baghdad city, and compare these results with the source data in some other cities over the world [17].

II. Data and Location

Baghdad city located in the middle–east part of Iraq has a population of more than 8000000 (according to 2010 estimation) [18]. The borders of the municipality of Baghdad encompass fourteen an administrative unit, eight in Rusafa (east of Tigris river) and six in Karkh (west of Tigris river), and area of the municipality of Baghdad (870 km²) its regarded as a urbanized area [19] with several industries, a large number of automobile enter after 2003 (about 885633 in Baghdad only and 2006065 car in all country provinces according to statistic of 2006)[20]. All these cars can across in old and Narrow Streets Baghdad city causes crowded and raised air pollution rates. In addition there is huge number of small and large electric generator, spread in different parts from it, specifically after 2003 where there luck in electric generated, all of these can contribute to the production of local pollutant. In this study we install air quality meter device (AQ-9901SD from LATRON CO.) in suburban region Al-Hurriya (residential) at latitude 33°21'47.32" N, longitude 44°19'13.04" E and 10 meter from surface) see “Fig. 1” and “fig. 2”, to measure CO in (PPM), CO₂ in (PPM), Relative Humidity in (RH%), Temperature in (T°C), Dew Point Temperature in (T_D°C) and Wet Bulb Temperature in (T_W°C), we can define dew point as the temperature to which the ambient air must be cooled to reach 100% relative humidity assuming there is no evaporation into the air; it is the point where condensate (dew) and rain would form., while wet bulb is temperature a parcel of air if it were cooled to saturation RH100% by the evaporation of water into it, with the latent heat being supplied by the parcel[21].

The device is located at the outskirts center of city, in a lightly populated area without any industries and direct influence by anthropogenic emissions. The device is programmed data logger to recorded automatically data every 15 min and all recorded is stored in SD RAM Memory in Microsoft excel extension. The period of study is continuous through 2015 but the recorded data is random, we selected one day from each month to given conditions CO and CO₂ and meteorological variable at this period and season.

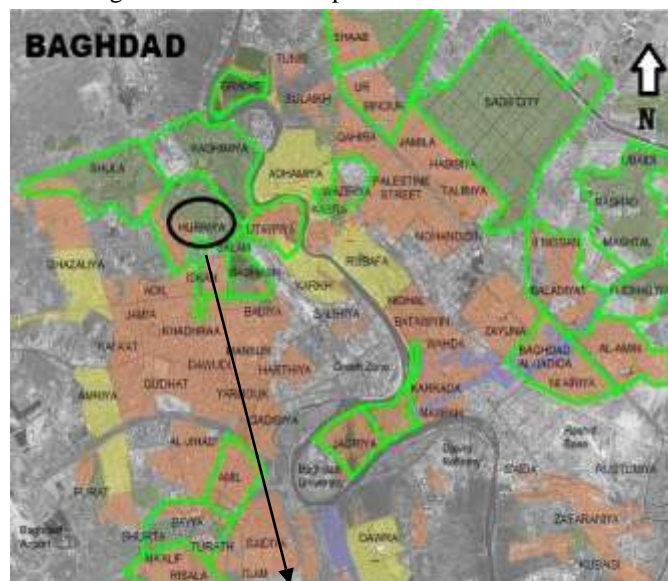


Figure 1. Study area.



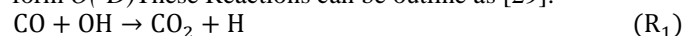
Figure 2. Air Quality Meter Device AQ-9901SD from LATRON CO.

III. Methodology

A. CO Gas

The Environmental Protection Agency (EPA) established the National Ambient Air Quality Standards (NAAQS) and set deadlines for their allowable ambient concentrations and averaging time for certain „criteria air pollutants including CO, its primary and secondary NAAQS for CO, The primary standards specify a level of air quality sufficient to protect public health and secondary standards are intended to protect public safety [22]. The NAAQS for CO are designed to keep COHb levels below 2% in the blood of 99.9% of nonsmoking healthy children and people who belong to probable high-risk groups, and people with coronary artery disease [23]. Godish argues that a significant number of people still be at risk from CO exposure ,even if ambient CO concentrations do not exceed the 8-hour NAAQS for CO [24]. The world health organization (WHO) put guideline for CO exposures its relevant to the discussion above, it's taken average times to exposure with maximum concentrations, as [8-hour for 10 mg/m³ (9 ppm), 1-hour for 30mg/m³,30min for 60 mg/m³ and 15min for 100mg/m³(90ppm)] [25] .Unlike the NAAQS, the guidelines specify maximum concentrations for two shorter time spans (30min and 15min)[26]. WHO's guidelines are intended to prevent blood levels of Carboxyhemoglobin (COHb) from exceeding 2.5–3% in nonsmoking populations even when a person occupies in relatively heavy work [27].

CO gas extracted from many sources, such as fossil fuel combustion and biomass burning from anthropogenic sources, and oxidation of methane. The understanding of the O₃ behavior near surface layers is essential for a study of pollution oxidation processes in urban areas. Usually NO₂ in the atmosphere comes from two sources, either directly from emission sources (primary pollutant) or from chemical reactions in the atmosphere [28]. Nitrogen monoxide (NO), is converted to NO₂ by reactions with proxy radicals (RO₂) or O₃. Proxy radicals are produced mostly by the reactions of hydroxyl radical (OH) with reactive hydrocarbons such as CO and photolysis of aldehydes which have both natural and anthropogenic origins. Nitrogen dioxide is then photolysis in the atmosphere, and the released atomic oxygen O(¹D) combines with molecule O₂ to form O₃ that photolysis later to form O(¹D)These Reactions can be outline as [29]:



The Reaction (R₁₀) regenerates NO and produces an O₃ molecule, which can then go on to photolysis by reactions

(R₁)-(R₃) to produce two additional OH molecules [29]. The sequence of reactions (R₄-R₁₀) is a *chain mechanism* for O₃ production in which the oxidation of CO by O₂ is catalyzed by the HOx chemical family (HOx = H + OH + HO₂) and by NOx. The main sink of CO is oxidation by OH and results in a 2-month mean lifetime; because of this relatively short lifetime, CO is not well-mixed in the troposphere. Concentrations are 50-150 ppbv in remote parts of the world, 100-300 ppbv in rural regions of the United States, and up to several ppmv in urban areas where CO is considered a hazard to human health. In the absence of additional sources OH in atmosphere the hazard gases; CO, CH₄, HCFCs, and other hydrocarbons would accumulate to very high levels in the troposphere, with catastrophic environmental implications [30].

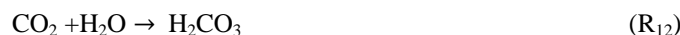
B. CO₂ Gas

The CO₂ concentration in the atmosphere has risen from 290 ppmv to 380 ppmv since Industrial Revolution because of combustion of fossil fuel such as coal and oil and denudation of forest [31]. This increased concentration of CO₂ has now, unambiguously, warmed the Earth. According to the Stefan-Boltzmann. CO₂ gas has a very strong absorption band at ~12 - 15μm, very close to the peak of the Earth's blackbody radiation, and then it is trapping outgoing IR radiation [32].

One of the most important processes in plants is the photosynthesis which depends on two main parameters atmospheric CO₂ concentration and light (solar radiation). A plant's photosynthetic rate can be determined from its assimilation rate of CO₂ [33].



Where CH₂O is composition of biomass material, in other hand the high rates of CO₂ causes problems in gases interaction [34], and to the acid rain (carbonic acid) from interaction with water and water vapor according to interaction [35]:



IV. Statistically Methods

A. Simple Linear Regression (SLR)

Is to predict or estimate the future value of one variable based on the knowledge of the values of the other variable is used in determining the shape of the relationship between two variables mathematically chart of the form of the regression line and the straight line relationship is given by the following equation [36]:

$$\bar{Y} = a + b\bar{X} \quad (1)$$

$$b = \frac{n \sum xy - (\sum x)(\sum y)}{n \sum x^2 - (\sum x)^2} \quad (2)$$

$$a = \frac{\sum y - b \sum x}{n} \quad (3)$$

Where (\bar{X}) is independent variable, (\bar{Y}) the variable or approved, (a) is a steady regression or part of the cut (Y-axis) to the equation (1), (b) is slope of straight line or a slope of regression straight line and (n) is sample size.

B. Probability Value (P-Value)

It is a number used to evaluate metrics statistical, a value shows that the contrast factor it is an influential factor really or is ineffective, as if the value of P-value less than (0.05), the influential factor in the variable that we are trying to study the change, and consider worker effective until the value of P-value equal to (0.1), but if increased from (0.1), it means that the worker should be excluded from the model and therefore is not an influential factor.

C. Standard Error (Std. Error)

The standard error is the standard deviation of the mean. It is the sample standard deviation divided by the square root of the number of samples. For sample standard deviations.

$$\text{Std. Error} = \frac{s}{\sqrt{n}} \quad (4)$$

$$S = \left[\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2 \right]^{0.5} \quad (5)$$

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i \quad (6)$$

Where (\bar{x}) is the mean, (S) is the sample standard deviation.

D. Correlation Coefficient (R and R²)

The quantity R, called the linear correlation coefficient, measures the strength and the direction of a linear relationship between two variables. The linear correlation coefficient is sometimes referred to as the Pearson product moment correlation coefficient in honor of its developer Karl Pearson. The mathematical formula for computing R is:

$$R = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2} \sqrt{n(\sum y^2) - (\sum y)^2}} \quad (7)$$

The value of R is such that $-1 \leq R \leq +1$. The + and – signs are used for positive linear correlations and negative linear correlations, respectively. The coefficient of determination R² is useful because it gives the proportion of the variance (fluctuation) of one variable that is predictable from the other variable. It is a measure that allows us to determine how certain one can be in making predictions from a certain model/graph [37].

- The coefficient of determination is the ratio of the explained variation to the total variation.
- The coefficient of determination is such that $0 \leq R^2 \leq 1$, and denotes the strength of the linear association between x and y.

v. Discuss the Results

A. Analysis Concentrations Trends for CO and CO₂:

In this outlets study we will dell with the effect of chemical interaction and photochemical analysis on the observed concentrations of CO and CO₂ in Al-Hurriya station at the surface layer that is part of the troposphere. This photochemical is may be happened naturally or anthropocentrically by provided abundant of species radical and nonracial from local or regional sources of these species. We will depend on the chain reactions R₁-R₁₀ and other interaction in the interpreted the behavior of concentration CO and CO₂. First we splinted the selected days of year 2015 in to four groups, all of one represent a season, thus we have three days in each season. The selected days 15/12/2015, 1/1/2015 and 15/2/2015 from months December, January and February is consider as the days of winter season. This season in Iraq described as dry and cold, hours number of daytime is less than nighttime. High CO Concentrations that recorded at this period is focused at nighttime, where its reach about 2.5ppm as average in night time but its decreases at daytime to range (0-1) ppm. This decreases at daytime may reflected the abundant founded of OH radicals at this period of day, OH radical reacted with nonracial species such as CO according to R₁, where O (¹D) resulted from photochemical analysis of ozone gas in UV radiation range (wavelength $\lambda < 320 \text{ nm}$ this wavelength is founded in solar radiation passed through the troposphere), according to R₈., see methodology sections of this paper. Atomic Oxygen O (¹D) radical reacted with water vapor and contributed to given two OH radicals according to R₁₀. The behavior of CO gas is overall naturally in this period of year although its concentration is for from the local and international limitations of EPA (35 ppm at 1 hour) but it's over limited relative to WHO (0.078 ppm at 15 minute to exposure) this can specifically at daytime period, see "Fig. 3".

In other hand, CO₂ at this period is decreases at nighttime, while its increases at the daytime to reach an average of about 450 ppm, but at night time its decreases to about less than 400 ppm as average, "Fig. 3". We can interpreted this behavior in the light of photo analysis and the local sources of this gas, where CO₂ concentration in atmosphere depend on the CO concentration and on the OH radical concentration that constructed at daytime according to reaction R₁, thus relationship between CO and CO₂ is inversely proportion (not plotted in this paper) at this period from 24 hour record. This result is interpreted the increases of CO₂ at daytime and decreases at nighttime, although at daytime convection and mixed layer is active to dissipation pollutants such as CO₂. We must remember that the region of location study is residential zone, where the effect of plants is weak on the CO₂ concentration specifically at daytime, plants cover is uptake CO₂ in processes called photosynthesis, this result can also consider relatively the high concentration of CO₂ at daytime. On the other hand, the selected days 1/3/2015,15/4/2015 and 1/5/2015 from months March, April and May is consider as Spring season (this season described as moderated season in weather conditions). The behaviors of CO and CO₂ is the same to the winter season days, see "Fig. 4".

But this last case for concentrations of CO and CO₂ change in summer days 15/6/2015, 1/7/2015 and 15/8/2015 that represented months June, July and August (summer is hot and dry season with temperature range 30-55°C and relative humidity range 5-30%), and there is different behavior for CO and CO₂ concentration in this period. Where frequency of CO concentration at 1ppm is increases to about 90% at daytime and nighttime, and also there is increases in recorded of high concentration of CO specifically at nighttime where its reach to about more than 3 ppm, that is overdose the national limitation of WHO. CO₂ at this period is very high relative to other seasons, its reach to 700ppm at day 1/7/2015 that represent July month, see “Fig. 5”. In this figure we also notes the difference between daytime and nighttime for CO₂ is relatively disappear, there is nearly horizontal homogeny for CO₂ concentration in this period, where the naturally active factors is disable , that coming from photochemical processes for radical OH and nonracial CO, while there is activated the anthropogenic factors. The local anthropogenic sources for CO₂ and also CO increases in this case from the diesel generator for supplied electricity and also huge number cars in old roads since 1960. After the war 2003 the most stations of electricity in Iraq is destroyed through the war and stop to working, after that the national electricity that generated is not suffice to increases need.

Specifically at hot summer season, to treat this problem, hundred thousands of small and moderate of diesel generator is speared in Baghdad Street, and most of them working 24hour specifically at summer period, to cover the luck of electricity in residential regions.

There is other problems may be responsible for this high concentrations of pollutant CO and CO₂ it's the high number of cars in old and street narrow specifically after 2003, its causes continuous crowded in Baghdad streets at daytime but this factor perhaps for to effect directly on the air quality of residential regions that we take observation from it. The operation of this diesel generators in Baghdad roads is continuous to September month at selected day 1/9/2015, (this month can be consider as autumn season that regarded as transient season between summer and winter) where the air temperature is stay very high (reach at daytime to 45°C), see “Fig. 6”, concentrations of CO and CO₂ is also relatively stay high (specifically CO₂). The past case behavior of CO and CO₂ will return to the same condition in winter and spring seasons at the selected days 15/10/2015 and 1/11/2015 that represent October and November months (its consider as autumn season), CO₂ in range 400-450 ppm and CO in 0-3 ppm, relative humidity high at nighttime and low and daytime in range 60-90%, and temperature range 5-25°C.

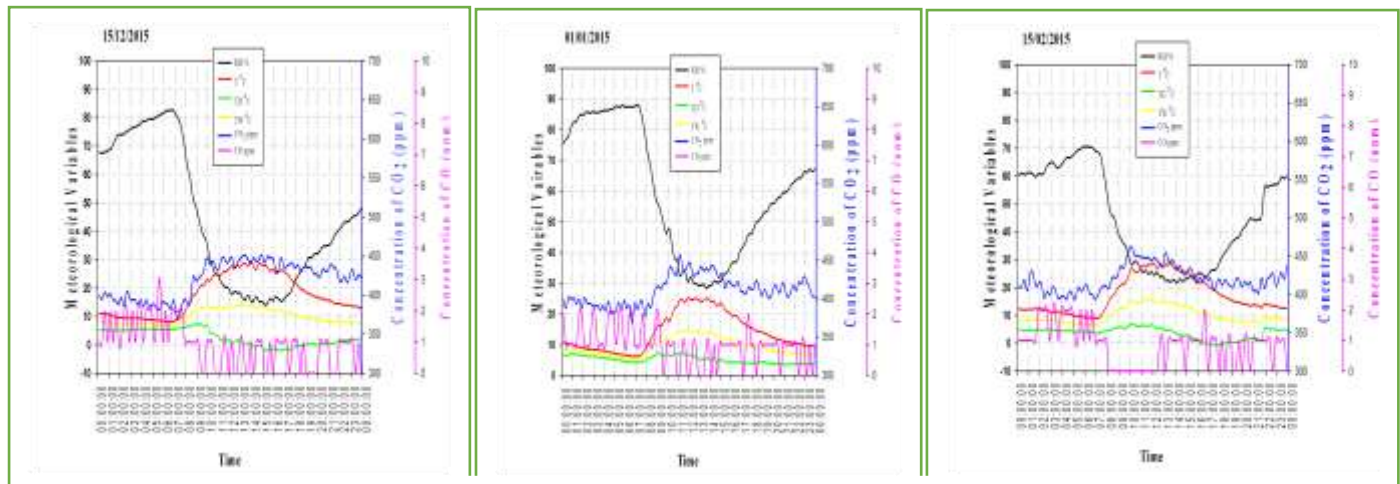


Figure 3. The Temporal variation of concentrations gases (CO and CO₂) and meteorological variables (RH, T, TD and TW) for each 15 minutes at study days of winter season.

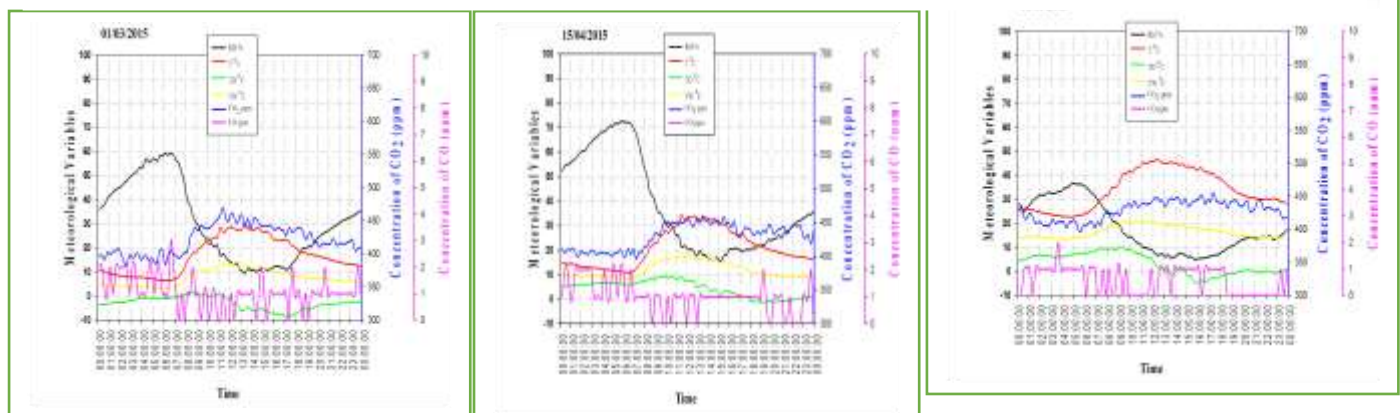


Figure 4. The Temporal variation of concentrations gases (CO and CO₂) and meteorological variables (RH, T, TD and TW) for each 15 minutes at study days of spring season.

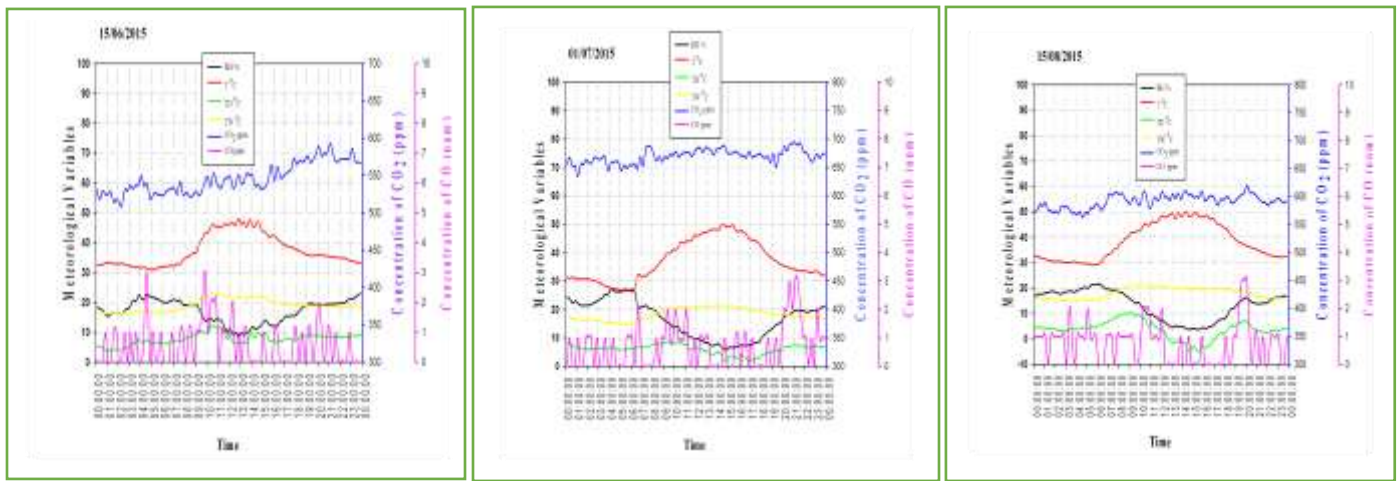


Figure 5. The Temporal variation of concentrations gases (CO and CO₂) and meteorological variables (RH, T, TD and TW) for each 15 minutes at study days of summer season.

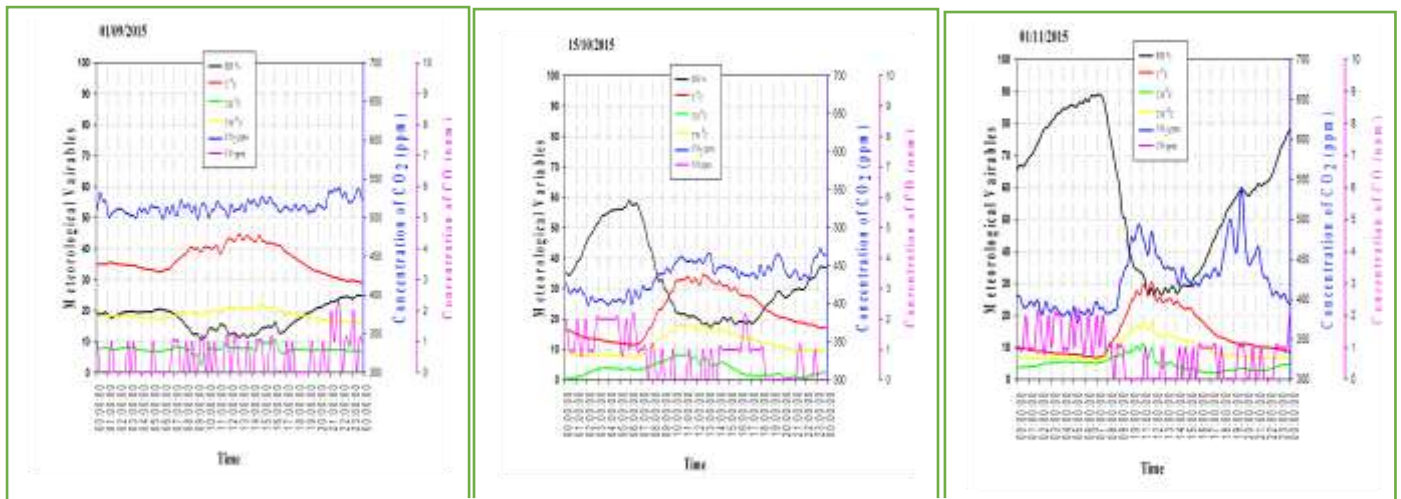


Figure 6. The Temporal variation of concentrations gases (CO and CO₂) and meteorological variables (RH, T, TD and TW) for each 15 minutes at study days of autumn season.

B. Effect of Meteorological Variables on CO and CO₂:

The “Fig. 3”, contains in addition to the time series for CO and CO₂, the temporal variation of meteorological variable, relative humidity RH% , dry air temperature T, dew point temperature TD, and wet bulb temperature TW, that recorded every quarter of an hour for the selected days 15/12/2015, 1/1/2015 and 15/2/2015 (winter season),

The days 1/3/2015, 15/4/2015 and 1/5/2015 (spring season), days 15/6/2015, 1/7/2015 and 15/8/2015 (summer season) and days 1/9/2015, 15/10/2015 and 1/11/2015 (autumn season). We found that there is a clear change in the concentration gases CO and CO₂ during the day, overall there is increases in the average concentration of CO

at middle day about twelve clock and increase of hourly CO concentration at the nighttime and evening period specifically at the selected days that represent season winter, spring, see “fig. 3 and 4”, this change or variation in concentrations of gases is due to several reasons, one of these the effect of meteorological variables (RH, T, TD and TW) that may effect on the behavior of these gases and on measurements in location study Al-Hurriya station, residential area.

The “Fig. 7, 8, 9 and 10” shows the relationship between the meteorological variables (RH, T, TD and TW) and the concentration of the gases (CO and CO₂) respectively for all study days. The “Table 1, 2, 3 and 4” shows the results of statistical operations (SLR, P- Value, Std. Error, R and R²) between the meteorological variables (RH, T, TD and TW) and concentrations of gases (CO and CO₂) respectively.

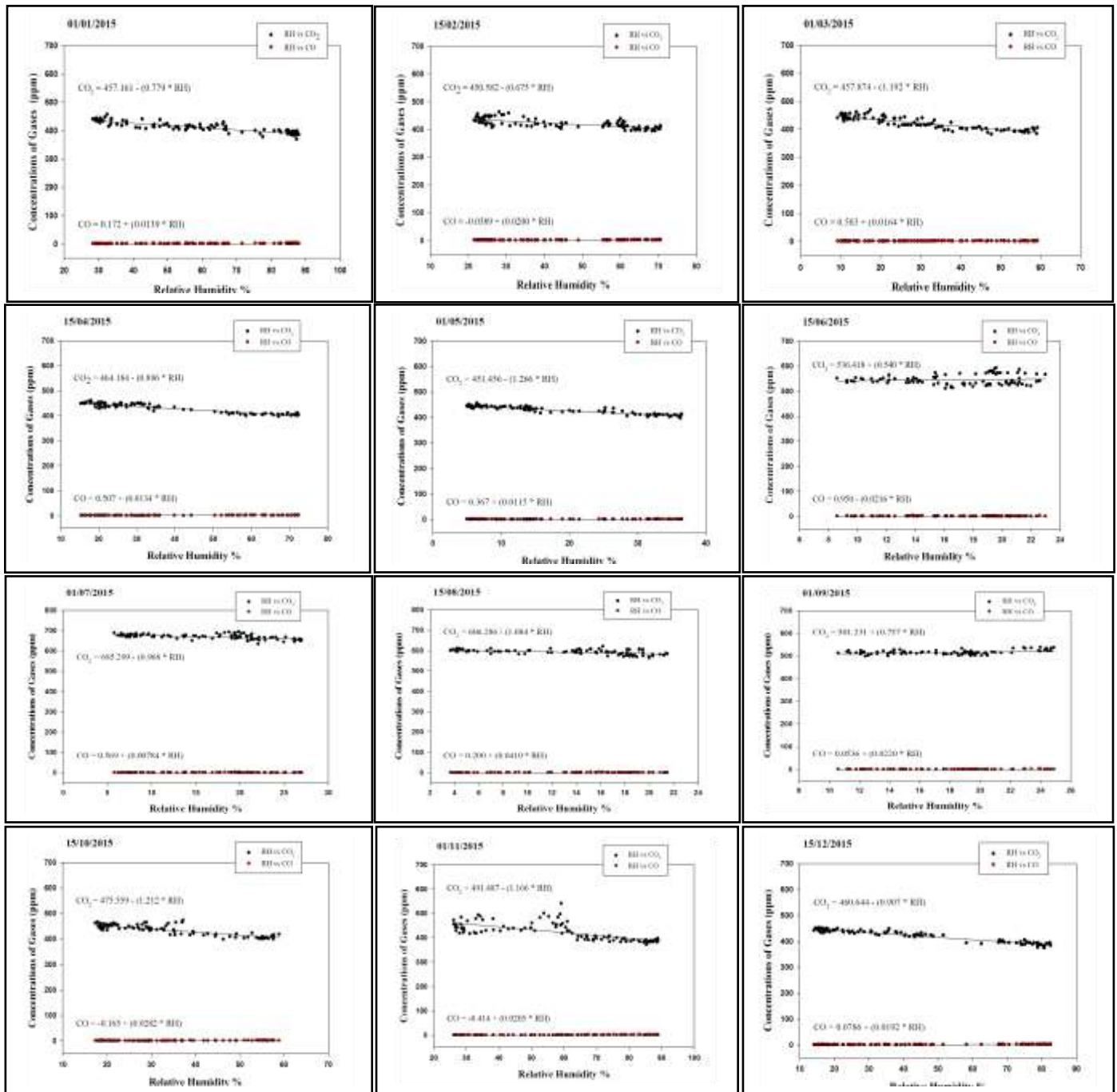
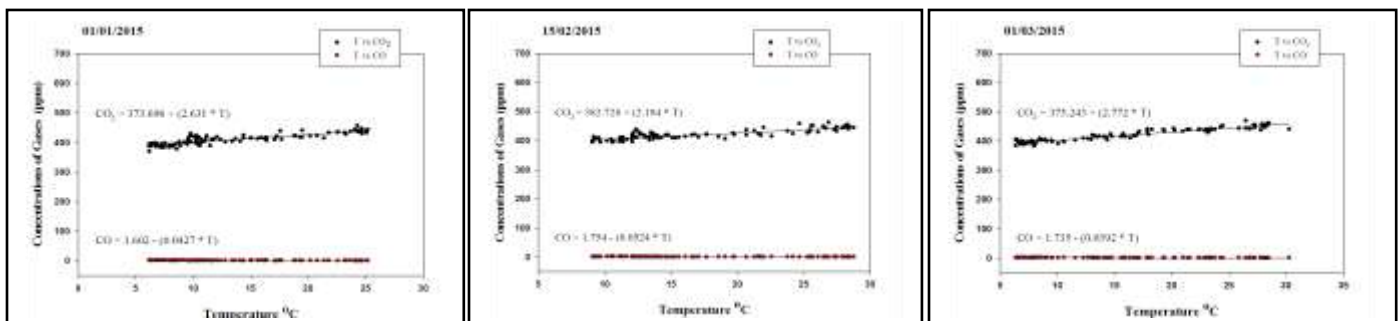


Figure 7. The relationship between Relative Humidity (RH) and concentration of Gases (CO, CO₂) for study days of the year 2015.



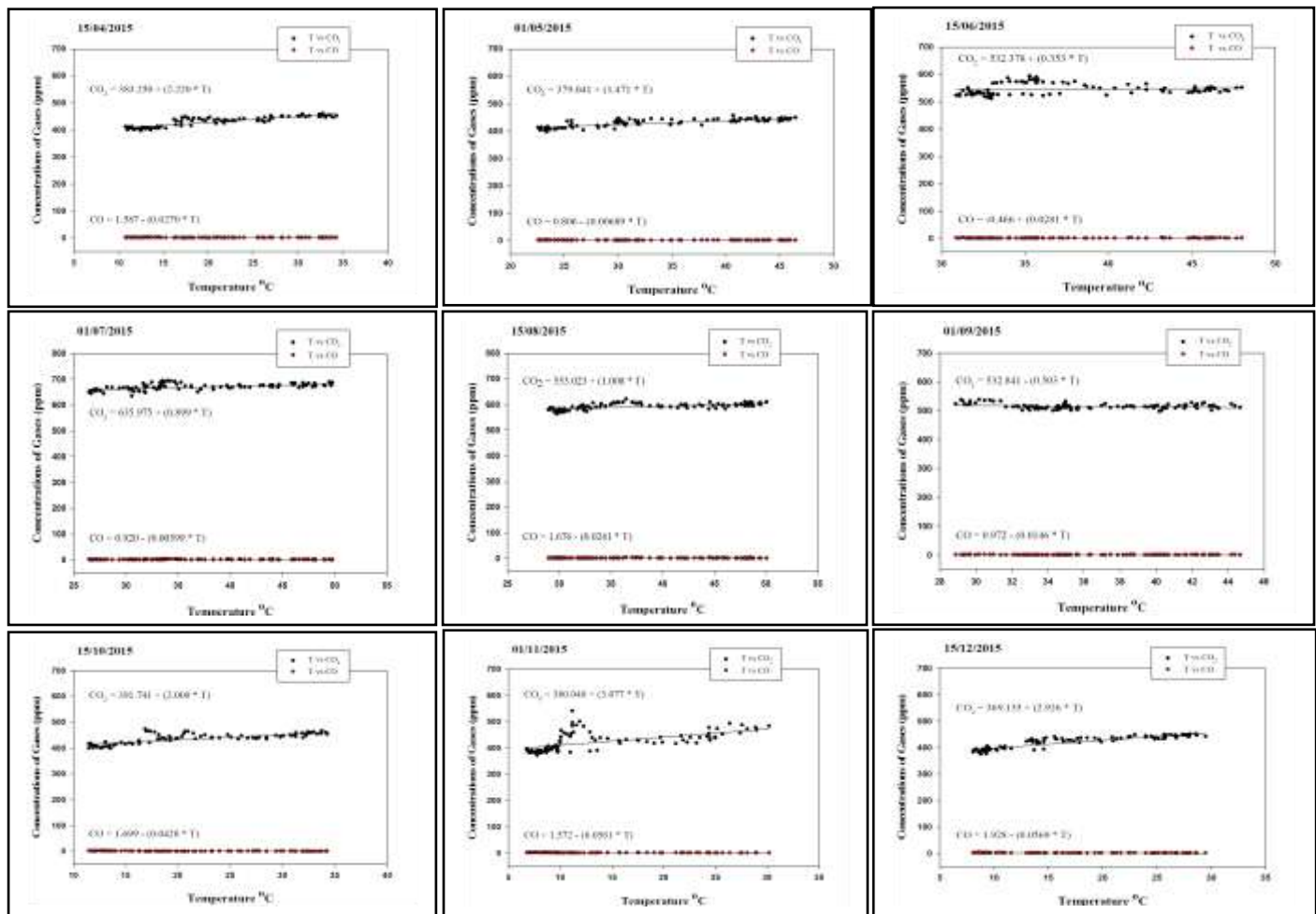
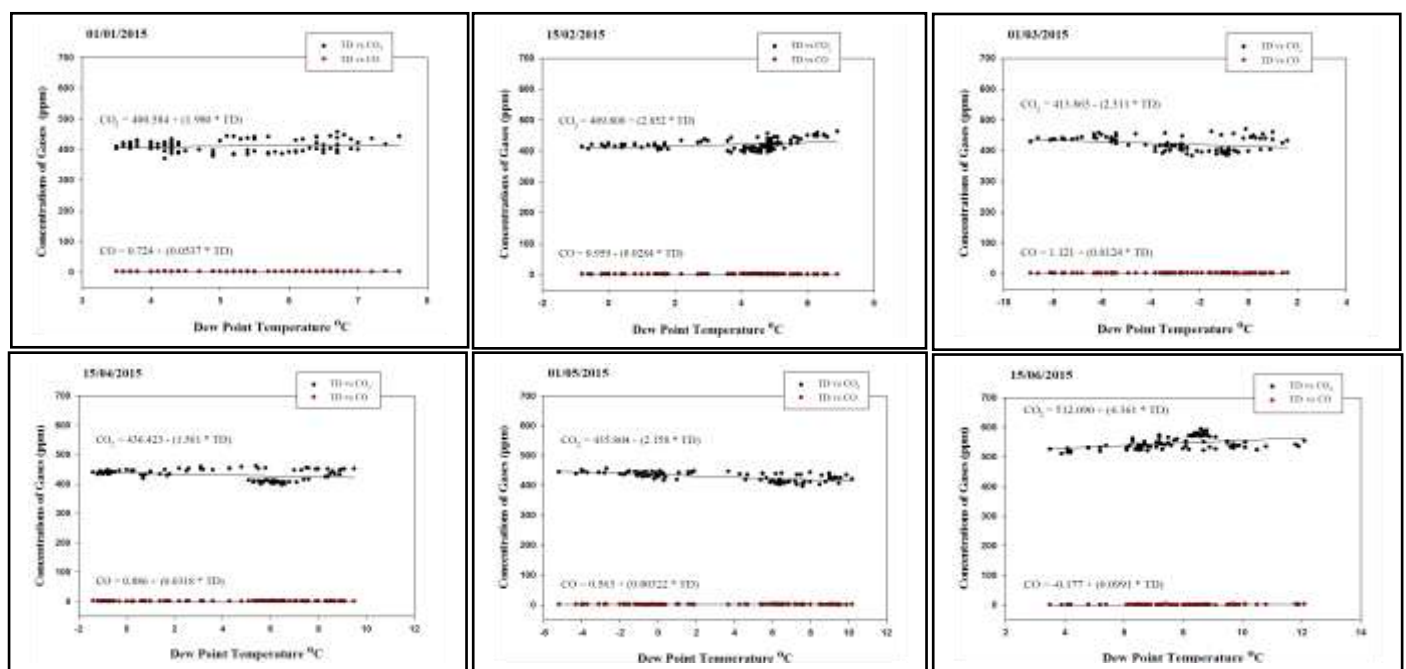


Figure 8. The relationship between Temperature (T) and concentration of Gases (CO, CO₂) for study days of the year 2015.



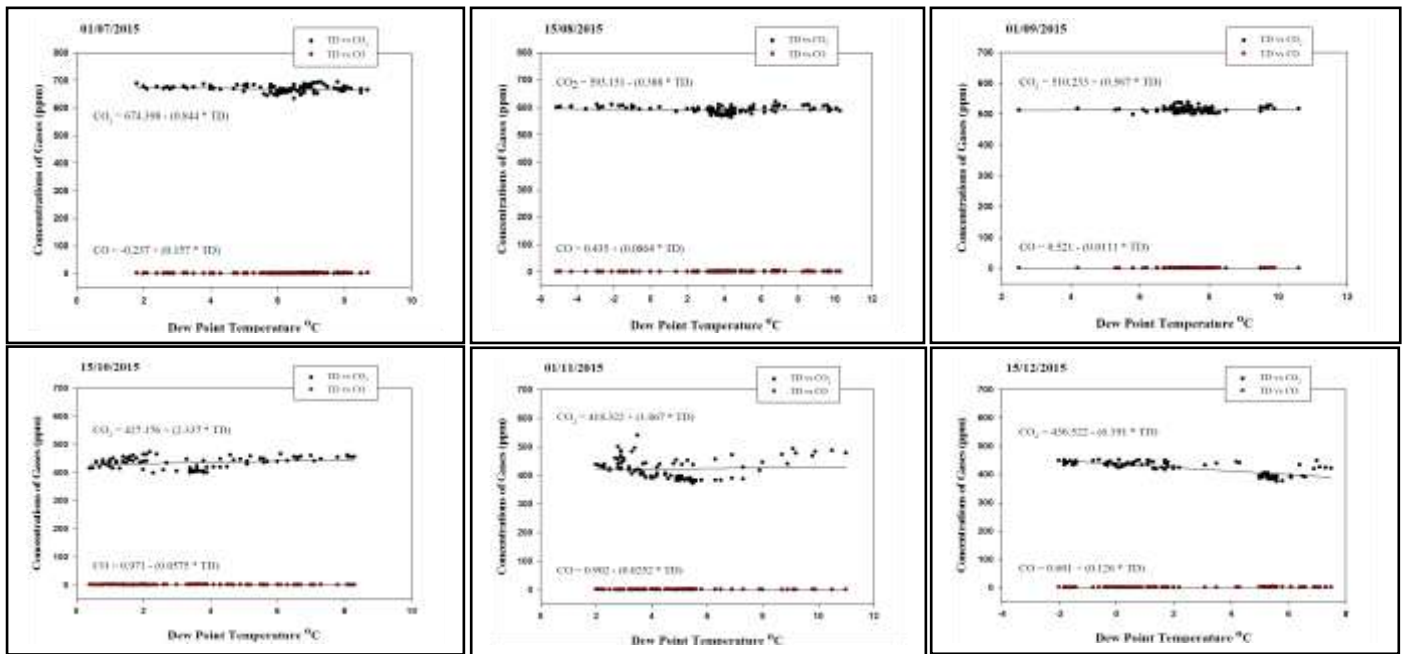
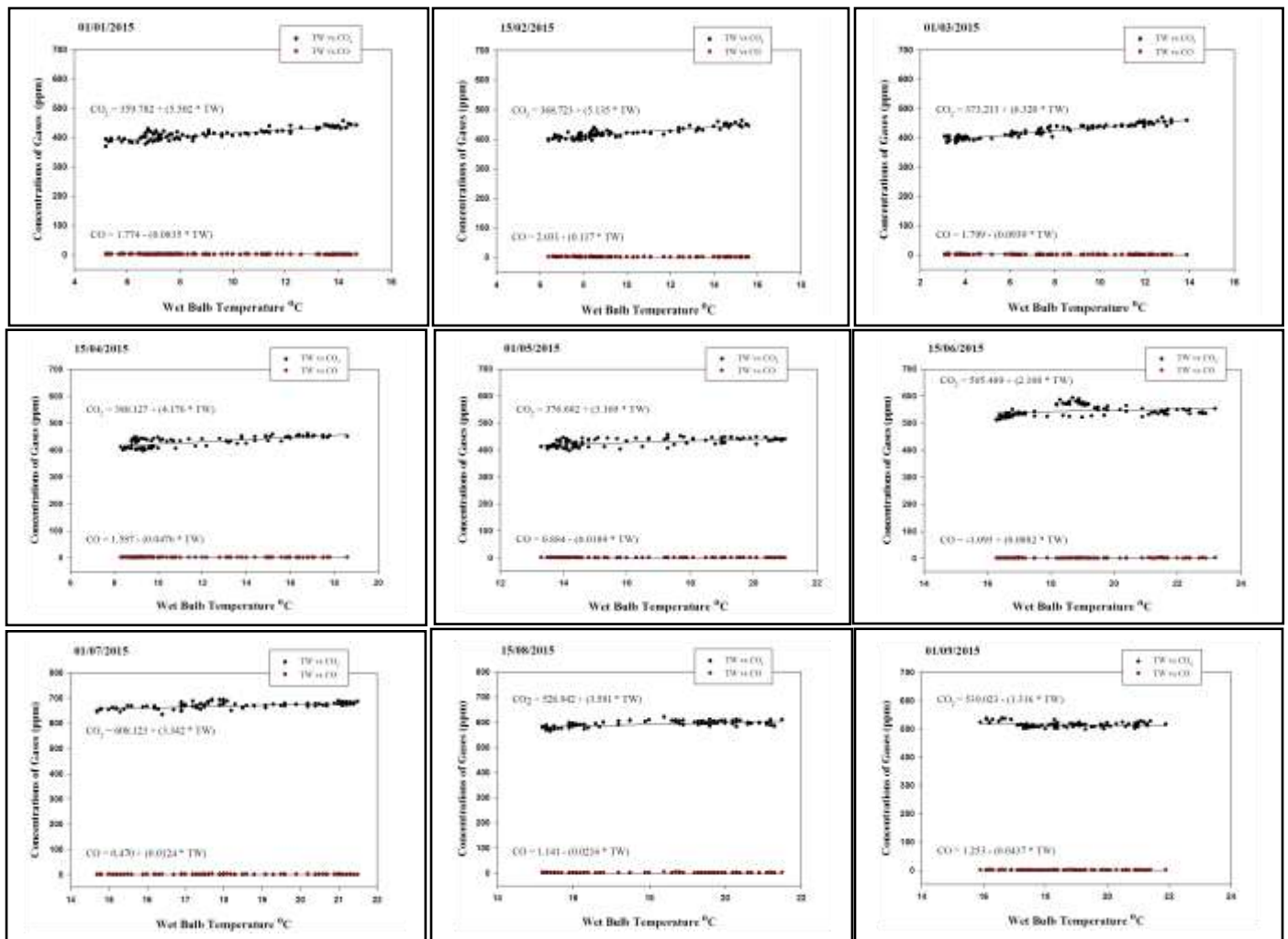


Figure 9. The relationship between Dew Point Temperature (TD) and concentration of Gases (CO, CO₂) for study days of the year 2015.



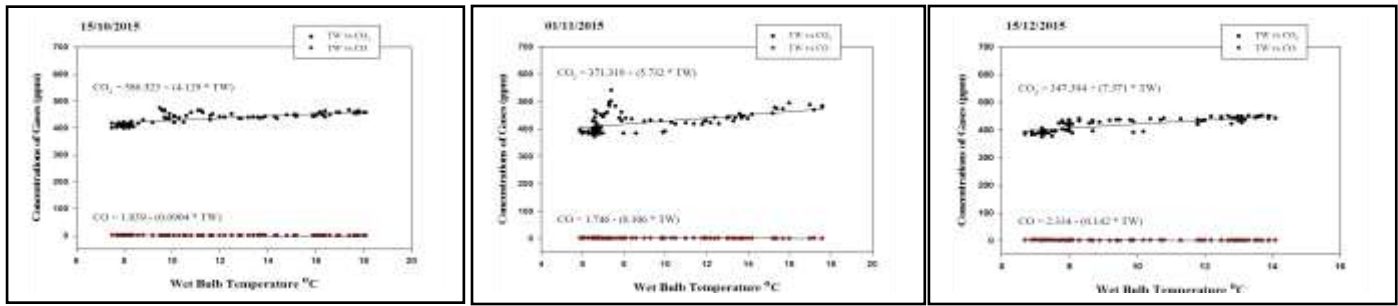


Figure 10. The relationship between Wet Bulb Temperature (TW) and concentration of Gases (CO, CO₂) for study days of the year 2015.

TABLE 1. Results of statistical operations (SLR, Std. Error, R and R²) between Relative Humidity (RH) and concentration of Gases (CO, CO₂) for study days of the year 2015.

	Hours for Days	CO ₂					CO				
		Simple Liner Regression		R	R ²	Std. Error	Simple Liner Regression		R	R ²	Std. Error
		P-value	Relationship				P-value	Relationship			
RH	1/1	0.001	linear	0.877	0.769	0.0440	0.001	linear	0.507	0.257	0.00244
	15/2	0.001	linear	0.697	0.485	0.0717	0.001	linear	0.522	0.273	0.00336
	1/3	0.001	linear	0.880	0.774	0.0664	0.001	linear	0.428	0.183	0.00357
	15/4	0.001	linear	0.928	0.861	0.0371	0.001	linear	0.458	0.210	0.00268
	1/5	0.001	linear	0.921	0.848	0.0553	0.020	linear	0.237	0.0561	0.00486
	15/6	0.326	Non-linear	0.101	0.0102	0.547	0.258	Non-linear	0.117	0.0136	0.0190
	1/7	0.001	linear	0.531	0.282	0.159	0.511	Non-linear	0.0678	0.0046	0.0119
	15/8	0.001	linear	0.518	0.268	0.185	0.001	linear	0.324	0.105	0.0124
	1/9	0.001	linear	0.328	0.108	0.225	0.144	Non-linear	0.150	0.0226	0.0149
	15/10	0.001	linear	0.801	0.641	0.0935	0.001	linear	0.517	0.267	0.00482
1/11	0.001	linear	0.679	0.461	0.130	0.001	linear	0.632	0.399	0.00259	
15/12	0.001	linear	0.962	0.926	0.0264	0.001	linear	0.671	0.450	0.00219	

TABLE 2. Results of statistical operations (SLR, Std. Error, R and R²) between Temperature (T) and concentration of Gases (CO, CO₂) for study days of the year 2015.

	Hours for Days	CO ₂					CO				
		Simple Liner Regression		R	R ²	Std. Error	Simple Liner Regression		R	R ²	Std. Error
		P-value	Relationship				P-value	Relationship			
T	1/1	0.001	linear	0.872	0.761	0.152	0.001	linear	0.459	0.211	0.00853
	15/2	0.001	linear	0.843	0.710	0.145	0.001	linear	0.510	0.261	0.00911
	1/3	0.001	linear	0.948	0.898	0.0964	0.001	linear	0.474	0.224	0.00751
	15/4	0.001	linear	0.875	0.766	0.127	0.001	linear	0.351	0.123	0.00742
	1/5	0.001	linear	0.816	0.667	0.107	0.293	Non-linear	0.108	0.0117	0.00652
	15/6	0.369	Non-linear	0.0928	0.0086	0.390	0.038	linear	0.213	0.0452	0.0133
	1/7	0.001	linear	0.542	0.293	0.144	0.581	Non-linear	0.0570	0.0032	0.0108
	15/8	0.001	linear	0.605	0.367	0.137	0.019	linear	0.239	0.0573	0.0101
	1/9	0.017	linear	0.243	0.0590	0.207	0.279	Non-linear	0.112	0.0124	0.0134
	15/10	0.001	linear	0.745	0.555	0.186	0.001	linear	0.440	0.194	0.0090
	1/11	0.001	linear	0.589	0.347	0.435	0.001	linear	0.570	0.324	0.00835
	15/12	0.001	linear	0.902	0.813	0.145	0.001	linear	0.578	0.334	0.00829

TABLE 3. Results of statistical operations (SLR, Std. Error, R and R²) between Dew Point Temperature (TD) and concentration of Gases (CO, CO₂) for study days of the year 2015.

	Hours for Days	CO ₂					CO				
		Simple Liner Regression		R	R ²	Std. Error	Simple Liner Regression		R	R ²	Std. Error
		P-value	Relationship				P-value	Relationship			
TD	1/1	0.228	Non-linear	0.124	0.0154	1.632	0.290	Non-linear	0.109	0.0119	0.0504
	15/2	0.001	linear	0.346	0.120	0.797	0.397	Non-linear	0.0873	0.0076	0.0334
	1/3	0.003	linear	0.301	0.0905	0.821	0.611	Non-linear	0.0526	0.0027	0.0243
	15/4	0.007	linear	0.275	0.0758	0.562	0.071	Non-linear	0.185	0.0342	0.0174
	1/5	0.001	linear	0.647	0.419	0.262	0.791	Non-linear	0.0274	0.0007	0.0121
	15/6	0.001	linear	0.398	0.158	1.038	0.010	linear	0.260	0.0677	0.0379
	1/7	0.263	Non-linear	0.115	0.0133	0.749	0.001	linear	0.339	0.115	0.0449
	15/8	0.256	Non-linear	0.117	0.0137	0.339	0.001	linear	0.431	0.186	0.0187
	1/9	0.518	Non-linear	0.0668	0.0044	0.873	0.841	Non-linear	0.0207	0.0004	0.0555
	15/10	0.011	linear	0.259	0.0671	0.899	0.085	Non-linear	0.177	0.0313	0.0330
	1/11	0.565	Non-linear	0.0594	0.0035	1.849	0.471	Non-linear	0.0745	0.0055	0.0348
	15/12	0.001	linear	0.760	0.577	0.547	0.001	linear	0.511	0.261	0.0219

TABLE 4. Results of statistical operations (SLR, Std. Error, R and R²) between Wet Bulb Temperature (TW) and concentration of Gases (CO, CO₂) for study days of the year 2015.

	Hours for Days	CO ₂					CO				
		Simple Linear Regression		R	R ²	Std. Error	Simple Linear Regression		R	R ²	Std. Error
		P-value	Relationship				P-value	Relationship			
TW	1/1	0.001	linear	0.842	0.709	0.364	0.001	linear	0.414	0.172	0.0189
	15/2	0.001	linear	0.881	0.776	0.285	0.001	linear	0.509	0.259	0.0204
	1/3	0.001	linear	0.949	0.900	0.217	0.001	linear	0.499	0.249	0.0168
	15/4	0.001	linear	0.708	0.501	0.430	0.009	linear	0.267	0.0711	0.0178
	1/5	0.001	linear	0.556	0.309	0.489	0.364	Non-linear	0.0937	0.0087	0.0207
	15/6	0.038	linear	0.212	0.0448	1.004	0.012	linear	0.255	0.0650	0.0345
	1/7	0.001	linear	0.581	0.337	0.483	0.742	Non-linear	0.0341	0.0011	0.0376
	15/8	0.001	linear	0.640	0.410	0.443	0.537	Non-linear	0.0638	0.0040	0.0348
	1/9	0.031	linear	0.221	0.0486	0.600	0.263	Non-linear	0.115	0.0133	0.0387
	15/10	0.001	linear	0.713	0.508	0.419	0.001	linear	0.433	0.188	0.0194
	1/11	0.001	linear	0.534	0.285	0.936	0.001	linear	0.524	0.275	0.0178
	15/12	0.001	linear	0.801	0.642	0.568	0.001	linear	0.507	0.257	0.0248

VI. Conclusions

- The concentration of CO and CO₂ concentrations is response to the photochemical interaction process, because OH radical that resulted from interaction of atomic oxygen with water vapor is contributed to diluted CO and transfer it to CO₂ Increase the gas concentration (CO₂) for local and world determinants.
- Photosynthesis process is not effected on CO₂ concentration in this residential study location.
- There is increases in the CO₂ concentration at daytime and decreases at night time, in period's winter and spring and part from autumn season of days selected through this study.
- There is nearly inverse proportion between CO and CO₂ concentrations at daytime and night time, in all selected days escape at summer days and September month's day from autumn season, because photochemical interaction process.
- The operations of engines diesel at 24 hour because luck in electricity generation at the hot summer period and part of autumn season is destroyed the behavior of CO₂ and CO in this period, where there is small different in concentrations of these gases between daytime and nighttime at this case.
- The periods of operation diesel generators at summer and part of autumn season raise the concentrations of CO₂ to 500-700ppm through daytime or nighttime, and also raised the frequency concentration at range 1-2 ppm of CO to 90%.
- Diesel generators engine working at high temperature, this insure complete burning of carbon fuel, thus the used of these engines contributed to rise CO₂ but not CO gas.
- Observed CO concentrations at this study is lower than national and international limitations specified by EPA and WHO.
- Relative humidity RH% is effected positively on CO₂ concentrations specifically at winter and spring selected days, but this effected is weak at summer period. Overall the effect of RH% on CO is weak or negative almost.
- Dry air temperature T effected positively on the CO and CO₂ at the days winter, spring, autumn but summer days is negative correlated. CO weakly correlated because the fluctuation in its values at most periods.
- Overall dew point TD has weak effect on CO and CO₂ concentrations.

- Wet bulb TW is positive correlated with CO₂ at most of day's seasons, but CO is negative effected at summer time, and positive in the rest.

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