General Summary and Conclusions

Over MENA, data from Dobson stations have been used to measure long term trends in total ozone, where an accurate instrument is required. The Brewer type spectrophotometer has proven to be one of the world's most accurate ozone-measuring devices. It should be remembered that ground-based instruments give point measurements, while satellite data cover a certain area.

Comparison was held between ground and satellite measurements over Egypt. The maximum, minimum, coefficient of variation and annual variation has been studied at both Cairo and Aswan stations. Also a comparison between Matrouh and Hurghada stations was carried out.

The relationship between surface observed and calculated from satellite may be illustrated and described by the following equations:

<u>Obs = 1.0254 Cal - 4.6744 for Aswan</u>

<u>Obs = 0.9272 Cal + 24.919 Cairo</u>

Where Obs is ozone measured by ground station.

Cal is the ozone value measured and calculated by satellite

From all relations and figures, one can conclude that total ozone is sensitive in location and time cross section.

The variation of total amount of ozone with latitude was approved, then we get equations describe relation between total ozone and latitude in each month. Relationship between total ozone and latitude over each season was also developed.

Satellite Measurement of Total Amount of Ozone over Kuwait has a remarkable decrease, this appear in figures of annual and monthly variations over 1996-2005, and this is due to Iraqi invasion. This may pay attention that satellite data can provide some useful informations about surface activites.

In spite of small proportion of the total atmospheric ozone, it plays an important role in global weather and climate as well as surface ecology. Ozone is an important trace gas which absorbs some of the biologically harmful ultraviolet radiation, therefore preventing them from reaching the earth's surface. An early paper by Molina and Rowland (1974) pointed out the potentially damaging effect that anthropogenic chlorofluorocarbon (CFC) emissions may have on the stratospheric ozone layer.

Both satellite and surface data have documented a process of high stratospheric ozone depletion in the Antarctic environment during spring months (Farman *et al*., 1985; Stolarski *et al*., 1986) [68]. Although this effect cannot be expected to apply in other places to the same extent, more recent studies have indicated that ozone depletion is not confined to Antarctica, but that it has global features (Atkinson et al., 1989; Bojkov *et al*., 1990; Stolarski *et al*., 1991, 1992) [69] [70]. There is some evidence showing that the decreased ozone levels have caused increases of ultraviolet radiation at the surface (Kerr and McElroy, 1993) [71].

Then in chapter 2 the variation of temperature over two periods (1968-1990) and (1990-2007) around the day hour was examined. Two stations studied in this part, Cairo, and Alexandria, which showed an increase in temperature where the real increse is clear in the night and early morning. Also use of annual and monthly variation showed an increase in temperature over two periods (1968-1990) and (1990-2007) around the day hours. This appear the climate change and the rate of change of temperature, and give an idea of the role of Green House Gases. The variation of the total amount of ozone with temperature proved that the decrease in total ozone corresponds to the increase in temperature.

Finally in this chapter Surface Ozone measurements studied and compared using Lagrangian method to interpolate calculation and variation of surface ozone from the behavior of surface ozone over Assekrem and Cap Point stations.

Ground measurements showed variation at South valley, and comparison between interpolation (calculated) and ground measurements over South valley station was also established to be useful to compare annual variation, illustrate the monthly variation over years from 2000, to 2002. From all figures and relations it was found no relation between calculated and observed measurements so get relations page 220.

The total amount of ozone and surface ozone can not be set correlated, due to the very short life time of surface ozone.

One major aim of this study is to provide insight into the CO2 fluxes and concentrations in Cairo, a mega city in an arid environment. In Cairo, with its high traffic density and high percentage of old cars as well as other CO_2 emitters, it was expected to measure higher CO_2 fluxes than in cities of more developed countries.

The third chapter starts with the general profile of atmospheric CO_2 concentrations. The annual trend of variation of CO2 over Al-Jahra, and Um Alheman stations give little increase in values of CO2. Found increase CO2 maximum at Aug. month and minimum at Jul. month also maximum season is Fall but minimum season is winter. Also variation of CO_2 with days over AL-Jahra stations has been studied and get the maximum day is Tuesday and minimum at Friday.

The monthly variation of temperature shows that the temperature is slowly increased with the increase of CO2.

In the second section, we compared between CO2 at Cairo in Egypt during the period Nov 10, 2007 to Feb 26, 2008 Al Jahra data during the interval Nov 10, 2007 to Feb 26, 2007. It was conclude that, first from the week days figure in Cairo, the minimum day is Friday where its values was between 380-420 ppm, and most of the data was less than 350 ppm.

Over this period at Al-Jahra, we found minimum average at Monday and maximum average at Wednesday. This maximum is less than the minimum at Cairo, and provides good results. The variations of CO_2 over each month in this period at Al-Jahra station, shows higher values than the residual months Jan., and Feb. The variation CO and CO_2 over each month in this period at Al-Jahra station, due to human activities, indicated that the amount of CO_2 released into the atmosphere has been rising extensively during the last 150 years. As a result, it has exceeded that the amount sequestered in biomass, the oceans, and other sinks. There has been a climb in carbon dioxide concentrations in the atmosphere of about 280 ppm in 1850 to 364 ppm in 1998, mainly due to human activities during and after the industrial revolution, which began in 1850. Humans have been increasing the amount of carbon dioxide in air by burning of fossil fuels, by producing cement and by carrying out land clearing and forest combustion. About 22% of the current atmospheric CO_2 concentrations exist due to these human activities, considered that there is no change in natural amounts of carbon dioxide.

However, the observed CO2 fluxes and concentrations turned out not to be higher on average than those measured in other cities. This is probably due to the fact that the campus area is a significant part of the source area for the CO2 fluxes and has much less traffic than the area adjacent to the North. Quantification is difficult but it is likely that the CO2 fluxes are underestimated. The direct influence of traffic was not as obvious as it could have been expected based on previous studies; no distinct rush-hour peaks occurred. The influence of traffic, however, became evident on Fridays, when the fluxes were considerably lower compared to the other weekdays.

The CO2 concentrations were clearly influenced by the diurnal course of stability, while the influence of the traffic on the CO2 concentrations was not as obvious.

AL-JAHRA figures showed no specific pattern and the values were more less than the standard value because the artificial activities and the influence of traffic were less than Cairo, but there is a little increase very which may be a result to the Iraq invasion.

Second section in this study is the variation of solar radiation over years using two stations measurements (Al-Jahra, and Mansoria). Solar and UV radiations appears, the decrease in value of solar radiation and increase in the UV radiation values. Then the variation of PM with ratio of UV/Solar radiation over years and months and appear increase and linear proportional between them.

Examining the variation of green house gases (CO2, CO, NOX, NO, NO2, O3, and SO2) with years and temperature were in agreement with the universal model. The variation of GHG concentrations with temperature around years is also studied and gets an increase with temperature.

In Mansoria station long measurements has been carried out during two periods of time (1985-1990) and (1991-2007). It was found some changes in all elements studied during the two periods and this appear is CO, CH_4, NO_X, and temperature climate change happened.

Finally, although the three stations in three different places and different uses but it follow most of measurements.

Chapter 4 deals with the number of dust storm decrease with year over 1962 up to 2009, and the distribution of the number of dust storm in each month over 1962 till 2009. It was found that the dust storms are maximum in July, May, and April months.

The final dust storm cases from our data which measured in more than five years show that the maximum frequency of the number of dust storms occurred in March then May then April. It also was found that maximum dust storms come from North West direction about 80% and the residual come from South West direction and the maximum dust storm occurred in spring about 48 % then summer about 26 % and the dust storms in winter season about 15 % and in the autumn season about 11 %.

The increase in GHG nearly associated with the increase in the PM10 daily, in the days of dust storm, and the same increase GHG with PM10 monthly and then seasonal and the same wind direction. From February to June about 77% NW mainly and SW. April has maximum PM and NOX, CO2, CO, CH4, SO2 and direction NW, except surface ozone O3 about 45% in October, and there were no dust storms in the months January and September. Increasing in value of PM10 with years over 1990-2007 and this give also an increase in the value of PM10.

Thus nearly the increase of GHG accompanied with increase in PM10 means increase with dust storm, so we conclude that dust storms bring some chemical compositions.

Analysis using model NOAA HYSPLIT Model figures back-trajectory from 20 till 47 shows a dominant dust storm loading event over Kuwait show wind direction North West mainly then the residual are SW. We remark some differences in wind direction measurements and Hysplit Model but the most is consistent. It is clear that Shamal dominates the dust source for our region of interest and this is clear from the figures and tables.

We get the source of air to any station is the same where we made all cases in the three stations by back trajectory and get the same plot, also we made monthly comparison between its and get most origin of dust storm from NW.

Comparison between AL-JAHRA station and MANSORIA station was established and then found to be coinciding. The wind direction in the three stations measurements and its results are the most of the wind direction NW in the three stations.

On the other hand we observe a dominant wind pattern following the well known SHAMAL westerly winds .The wind directions observed during dusty days are NW, and SW. However, the major dust wind directions are NW. where the air mass comes from North at Iraq. One can observe that during the wind direction NW, the source of the wind comes from Iraq before reaching Kuwait so it becomes loaded with dust.

Another scenario of these wind direction appears in the back-trajectory (air mass coming from another region has dust such as 24 April, 2006 (SW), which comes from west desert of Saudi as observed in the back-trajectory.

Variation of PM_{10} over Al-Jahra, UM-Alheman stations, we get an increase in the value of PM_{10} with year give our nearly linear relation. Monthly variation of PM_{10} over Al-Jahra, and UM-Alheman stations indicate an increase in the value of PM_{10} with years.

Secondly, monthly variation of dust over Al-Jahra, and UM-Alheman stations nearly has the same relation. Then by applying T-Test we found the difference in measurements in the two stations not significant, and can depend on one station only.

A powerful storm system moved across the Mediterranean Sea and affected Greece on March 17. This system brought gusty winds associated with dust to areas of northern Saudia Arabia, Kuwait, and southern Iraq during the 18-19th [1]. On Tuesday, 25 March a strong dust storm also limited visibility and may be reducing most of all activity over Kuwait.

These dust storms were relatively having been referred to as a *Shamal.* It is unclear whether this event would truly classify as a Shamal as this term is often used to speak about a 40- day low intensity dust event in the Persian Gulf region. A *Shamal* is defined as “a summer northwesterly wind blowing over Iraq and the Persian Gulf often strong during the day but decreasing during the night.” This definition appears linked to heat lows and the intensity of a low-level inversion modulating the winds in the boundary layer. Other, less strict, definitions suggest that the Shamal is a wind and dust storm. They begin in the spring, often defined to begin in February and are at peak intensity during the spring. The more intense in the spring Shamal is an intense low-level jet (LLJ), the interaction with the subtropical jet, and a surface cyclone moving through the region. The longer duration events, which tend to be weaker, appear to be more thermally driven. The event of 25- 27 March 2003 clearly met the loser definition of a *Shamal.* It will be shown that the Shamal of 25-27 March 2003 was associated with a very anomalous surface cyclone that tracked across northern Iraq.

An anomalously strong surface cyclone and accompanying upper level trough swept across SWA on the 25-27 of March 2003. This system, combined with an above normal ridge to the southeast produced anomalously strong low-level southwesterly winds over SWA. These winds resulted in a massive dust storm which impacted many aspects of a lot of Human activity.

Where its value about 22-60 Km/h, meteorologically, many parameters, such as the MSLP, heights, and winds were very anomalous with this system and these anomalies were studied using the NCEP GFS.

From all figures and tables we found we can use only one station for measurements because almost coincidence as Al-JAHRA and Al-MANSORIA stations and most of dust storm come from NW.

In chapter 5 we use RegCM Model to study the effect of increase the emission of carbon dioxide by ratio 20% on meteorological parameters. Where REGCM Model is the Regional Climate Model.

From studied the effect of increase of emission of CO_2 by ratio 20%, we remarked that:

1- The temperature decrease in months Jan. to April by tiny ratios nearly 0.05% to 0.13%, and then an increase in values of temperature from May to December with ratios from 0.27% to 0.55%.

2- The Radiative Forcing (W m^{-2}) of CO_2 due to this increase was found as 1.15 W/m^2. This makes difference in temperature 0.3 % increase as a result of increasing CO_2 emission by ratio 20%, when no feedback exists.

3- The differences in the wind (U) change in all months from January to December by ratios nearly 4 % to 140 %.

4- The wind (V) decrease in most months from May to November and January by ratios nearly 4 % to 140 %, and increase in months February to April and December by ratios nearly 1 % to 56 %, and the ratios of decrease nearly twice the ratios of increase.

5- Remarked differences in Rain values over Mediterranean area.

6- The monthly average of temperature at 500mb, and remarked that the effect of changing CO_2 at 500mb will be opposite to the surface.

7- For the difference of monthly average of incident solar energy flux (W/m^2) before and after changing, and then the difference of monthly average of the net upward LW flux at top of the atmosphere (W/m^2) before and after changing, and all these figures for June 1990 because in the summer the effect of changing appears more obviously than in winter

Thus we conclude from our research that the important of decrease the emission of pollutions and GHG to keep our life.