Plant Archives Vol. 19 No. 2, 2019 pp. 3671-3678 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

AIR QUALITY BEFORE, DURING, AND AFTER DUST STORMS IN BAGHDAD, IRAQ

Hazim H. Hussain Al-Saleem, Nagham T. Ibraheem and Omar L. Khaleed

Atmospheric Sciences Department, College of Science, Mustansiriyah University, Iraq.

Abstract

Dust storms in Iraq have increased dramatically over the last two decades. The Iraqi Ministry of Environment recording 122 dust storms and 283 dusty days in 2014.This research came to study the beaver of air quality values in Baghdad before, during, and after four dust storms occurrence in 2011,by using two different line, the first related to the some chemical gaseous pollutant concentrations and the second related to the concentration of the particulate matter. The results showed that the concentrations of the chemical gaseous pollutants: SO2, NO2 and CO decreased on the day of the dust storm from the day before and the day after it. For example, on the day before the dust storm which occur on 19/1/2011,the concentrations was :(CO=1.5427)(NO_2=0.0364)($SO_{2=}$0.0314) while in the day of the storm : (CO=0.7369) (NO_2=0.0260) ($SO_{2=}$0.0303) and in the day after it : (CO=1.3225)(NO_2=0.0377)($SO_{2=}$0.0457).It was found that the behavior of these gases during the dust storms is due to the impact of wind speed.

Key words : dust storm, air quality, Baghdad, pollutant gases.

Introduction

Dust storms in Iraq have increased over the past 20 years, It is believed that over the next 10 years, Iraq may witness 300 dusty days and dust storms during the year (Daly and Zannetti,2007).

Dust storms carry two types of solid pollutants: sand particles (grint) solid substances that are more than 500μm in diameter and rapidly return to the surface of the earth, and dust particles that are smaller than sand, ranging in diameter from 25 to 200 μm and which are two types, (fall dust) and return to earth after they are launched by gravity, (suspended dust) Its particles remain suspended by air for a while and then dropped by gravity according to its size (Hussain, 2014).

Dust storms passing through Iraq occur for two reasons: the first because of the northern winds resulting from the cyclone based on North Africa to eastern Europe and lead to the formation of monsoons passing by Iraq and southern Iran and Pakistan, The second is the frontal dust storms in the sedimentary plain extending from central Iraq to western and central Iran, and in severe cases may reach northern Iran and the southern coast of the Caspian Sea (Hamidi and Reza ,2013).

Baghdad suffers from the effects of dust almost every year because it is in the course of the frontal storms of the sedimentary plain coming from the Saudi desert, (sources of dust storms). In recent years, the great frequency of SDS has led efforts to give more attention to this problem. Most scientific studies focus on air operations, dust sources, transition paths and changes in concentrations of pollutants (Daly and Zannetti, 2007).

Dust is generally composed of a group of particles, which are divided into three groups (0.5-1.8 μm), which arise as a result of human activities (2-8 μm) and are caused by dust storms (10-20 μm) Is being studied (PM10) (Ning, Zhong *et al.*, 1996), Complex analyzes of temporal and spatial changes for PM10 levels suggest that dust particles reach their highest values 12 hours before PM10 reaches peak and remain for 36 hours (Yang, 2002).

This research come to study the manner of some pollutant gases as one of the most dangerous gases on human health and the environment. These gases are (NO_2) (CO) (SO_2).NO_2 is dangerous to the environment because it contributes to the formation of acid rain in the wet environment, as well as causes heart disease and lung disease and reduces the immunity of the body and

increases the incidence of cancer, and the most prominent sources of transport vehicles and electric generating stations (Warneck, 1999) . While the source of CO is the oxidation of methane due to the decomposition of organic matter as well as caused by vital events in the seas and on land, and the danger to the human being as it combines with blood hemoglobin and cause death without warning (Tiwary and Collis, 2010). The eruption of volcanoes is one of the sources of SO_2, as well as particles resulting from the spray of sulfur springs, resulting in exposure to breathing difficulties such as asthma, lung disease and cough (Jacobson, 2002) , It is known that SO_2 is a substance that is used to treat all mucous membranes in the human body that are exposed to contact, especially for people with respiratory problems and accelerate the development of chronic respiratory diseases (Saide and Pablo, 2011) . produced by fuel combustion in oil refineries and power generation units. Many studies show that the concentration of polluting chemical gases before the dust storm is relatively high because of a strong temperature reversal over the city. But the concentration of these gases during the dust storm is generally reduced due to strong winds while the concentration of PM10 is increased (Fang, YunXie *et al.,* 2003) . Many of polluting chemical gases are absorbed by liquid surfaces such as precipitation or solid surfaces such as soil and vegetation, These gases are absorbed by dust particles in the atmosphere during the dust storm and then drifting by gravity to the surface of the earth by the so-called dry deposition, note that the deposition occurs for particles that have more than 1μm radius (Hemond and Fechner-Levy, 2000) . After the dust storm passes, the percentage of polluting gases begins to rise while the aerosols concentration decreases .

Some studies also suggest that dust storms contain four stages: accumulation of pollutants in the atmosphere, discharge of pollutants, addition of pure dust, dust discharge. Polluted gases and atmospheric plankton show the same four phases, and it is observed that the concentration of the aerosols changes inversely with the concentration of gaseous pollutants (Guo and Rahn , 2004) .

Materials and Methods

Chemical gaseous pollutant concentrations and particulate matter concentration Data were obtained from the Iraqi Ministry of Environment for the city of Baghdad for four storms, (19/1/2011) (22/3/2011) (5/4/2011) (4/7/2011) as shown in Fig. (1-2-3-4) and meteorological data (wind speed components) obtained from European Center for Meteorological Weather Forecasting (ECMWF).

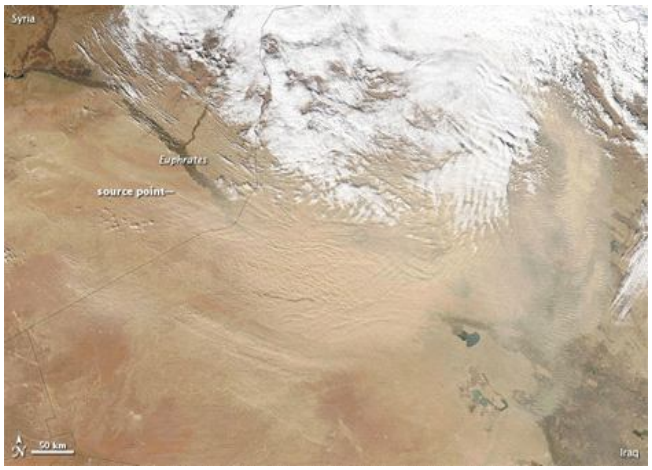

Fig. 1: Meteosat 8 visible image for dust storm occur in 19/1/2011 in Iraq.

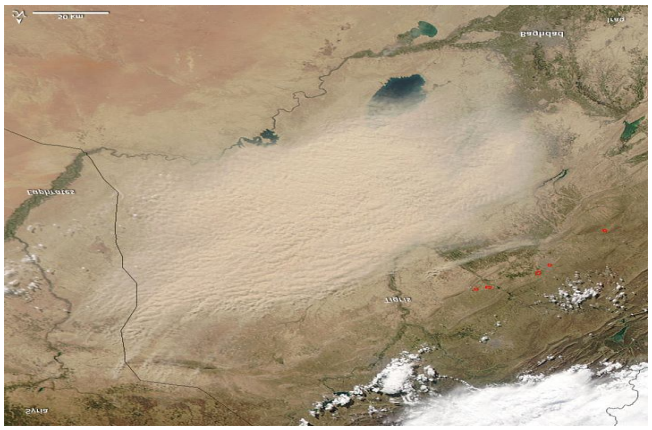

Fig. 2: Meteosat 8 visible image for dust storm occur in 22/3/2011 in Iraq.

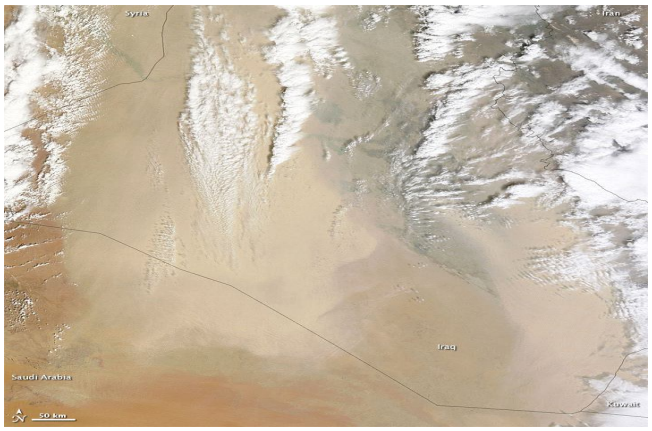

Fig. 3: Meteosat 8 visible image for dust storm occur in 5/4/2011 in Iraq.

Results and Discussion

Data were taken for the dust storms selected for the storm day, one day before and one day later. The data taken are observational data showing the concentration

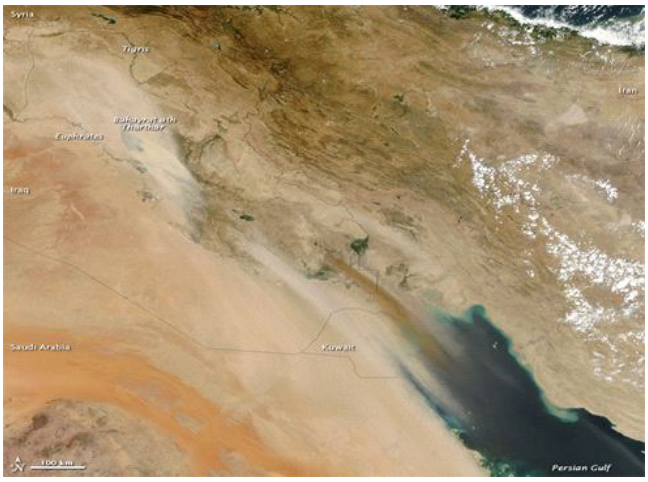

Fig. 4: Meteosat 8 visible image for dust storm occur in 4/7/ 2011 in Iraq.

of polluting gases is high one day before the dust storm, but when it arrives, the concentration of gas is reduced to the lowest value and then rise again in the day after the dust storm and this applies to all Contaminated gases. We also find that the temperature decreases during the dust storm and rises again after the storm, and this is because the aerosol is a barrier that works to reduce the amount of solar radiation reaching the surface of the earth and reduce the temperature, Also, the wind speed increases during the dust storm, increasing the concentration of the aerosol. These winds work to disperse the polluting gases, so the concentration is less concentrated during the dust storm, and when it passes less wind speed increases concentration of gases, this

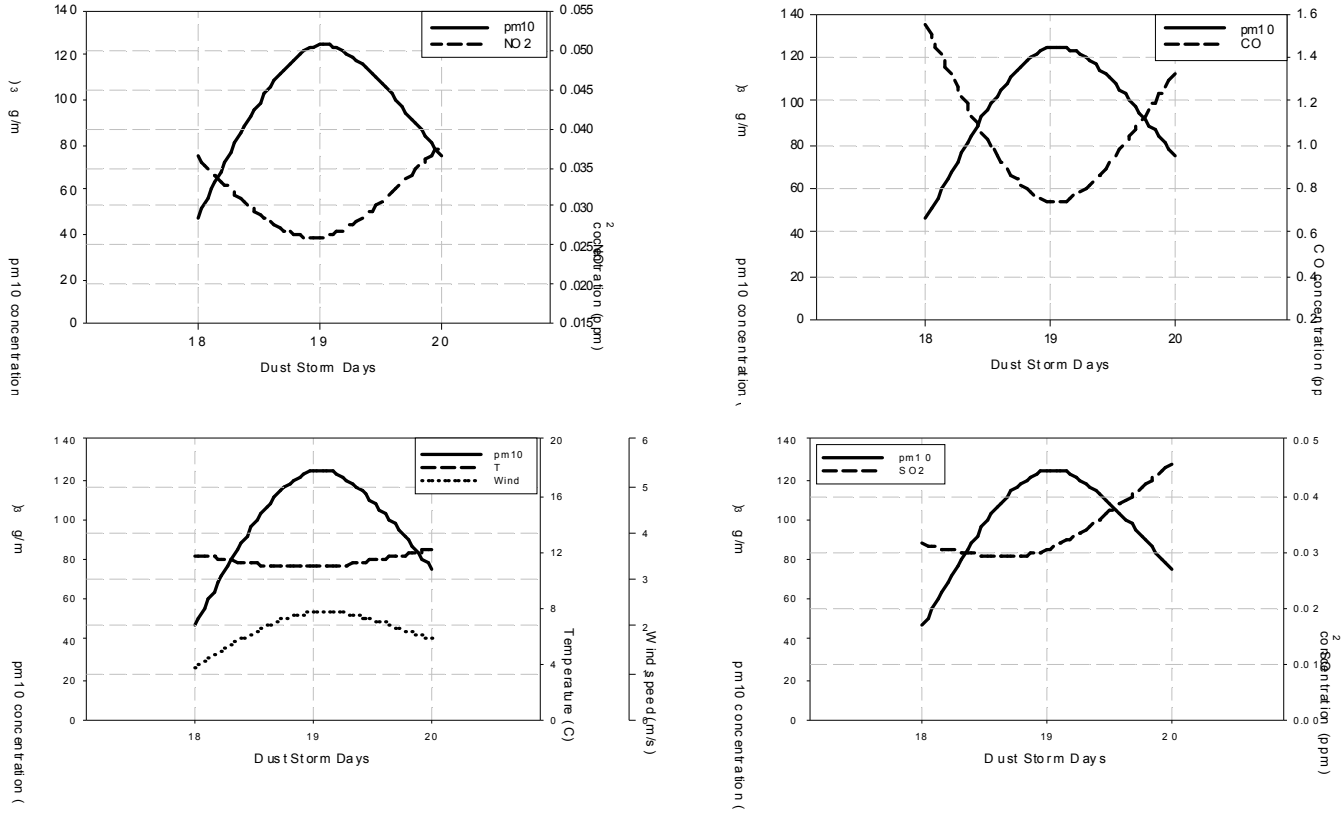

Fig. 5a: dust storm in 19/1/2011

of the aerosols as well as the concentration of (NO_2) (CO) (SO_2) as well as the temperature and wind speed. Drawing the relationships between the variables, the relationship between the concentration of the aerosols and the polluted gases was plotted as well as the relationship between the concentration of the aerosols and the temperature and wind speed for the same days and the result as shown in Fig.(5-a,b,c,d).

Fig.s (5-a,b,c,d) shows the form that the concentration means that the wind speed is the main reason to dispersion of polluted gases concentration, for this reason we studied the effect of horizontal and vertical wind components on the concentration of polluted gases by contour maps of wind components before, during and after the dust storm as in Fig.s (6-a,b,c,d).

The Fig.s shows the absence of the effect of horizontal and vertical wind speed components on the concentration of polluted gases and their values change

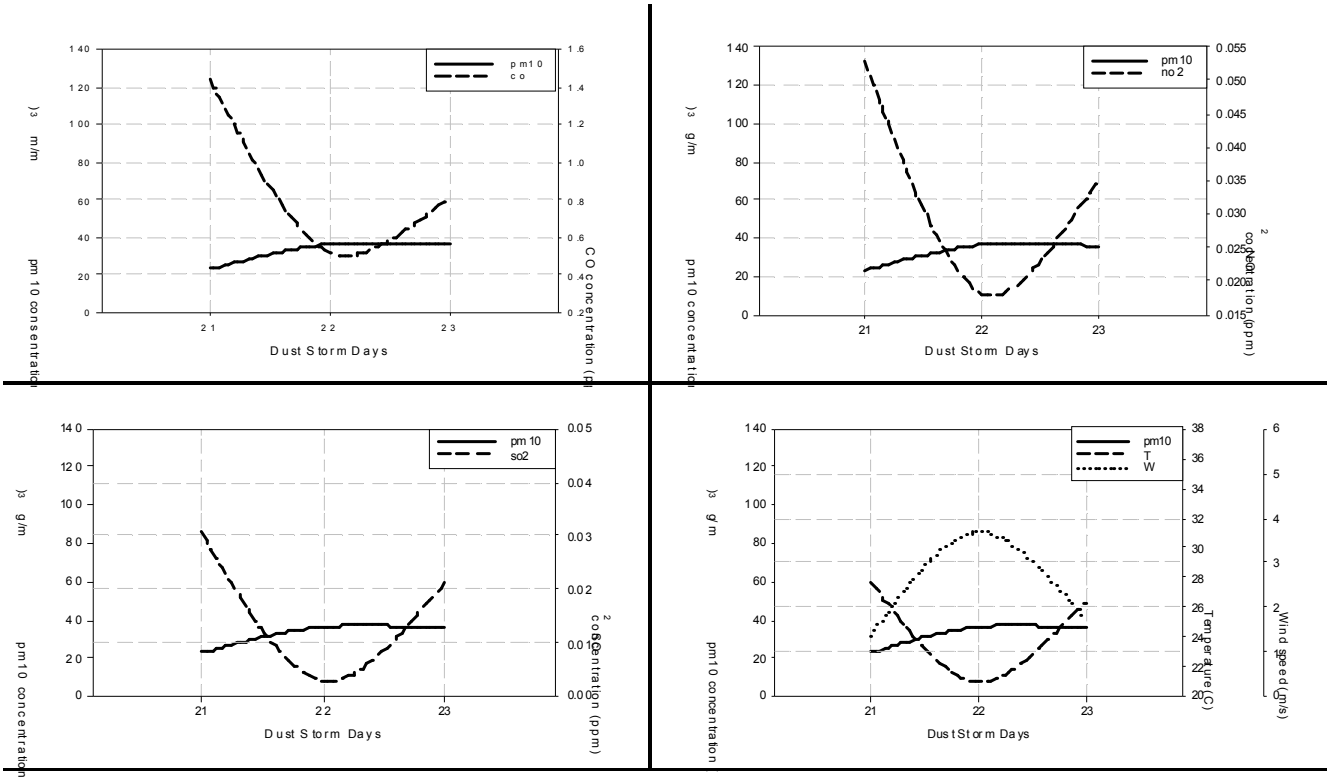

Fig. 5b: dust storm in 22/3/2011

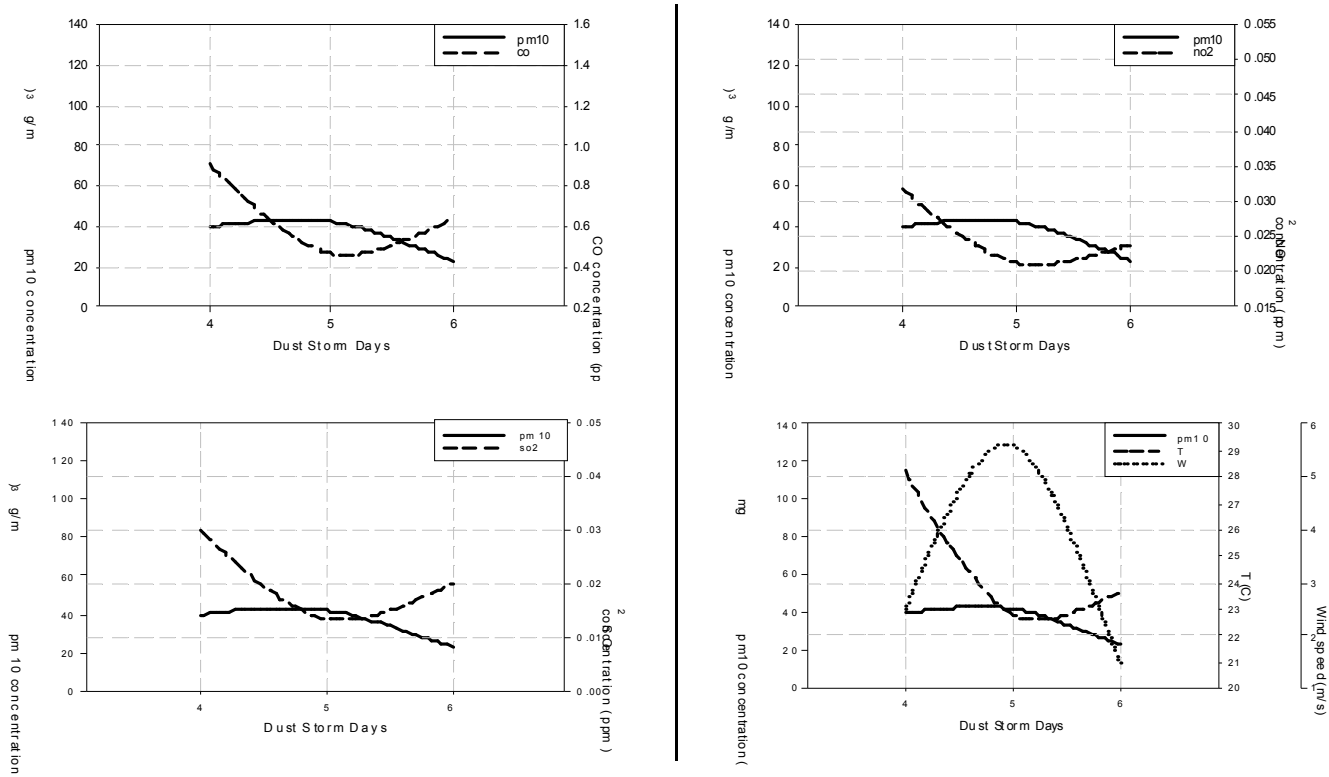

Fig. 5c: dust storm in 5/4/2011

randomly with the concentrations of gases before, during and after the dust storm, reaches maximum values on the day before or after the dust storm while decreased in the storm eliminating their impact on dispersing polluted gases and reducing their concentration. While wind speed is proportional to the concentration of the aerosols (pm10), it is at its highest values during the dust storm and less before and after the storm and this seems clear from the figs. (5-a,b,c,d).

The difference is the concentration of pollutants

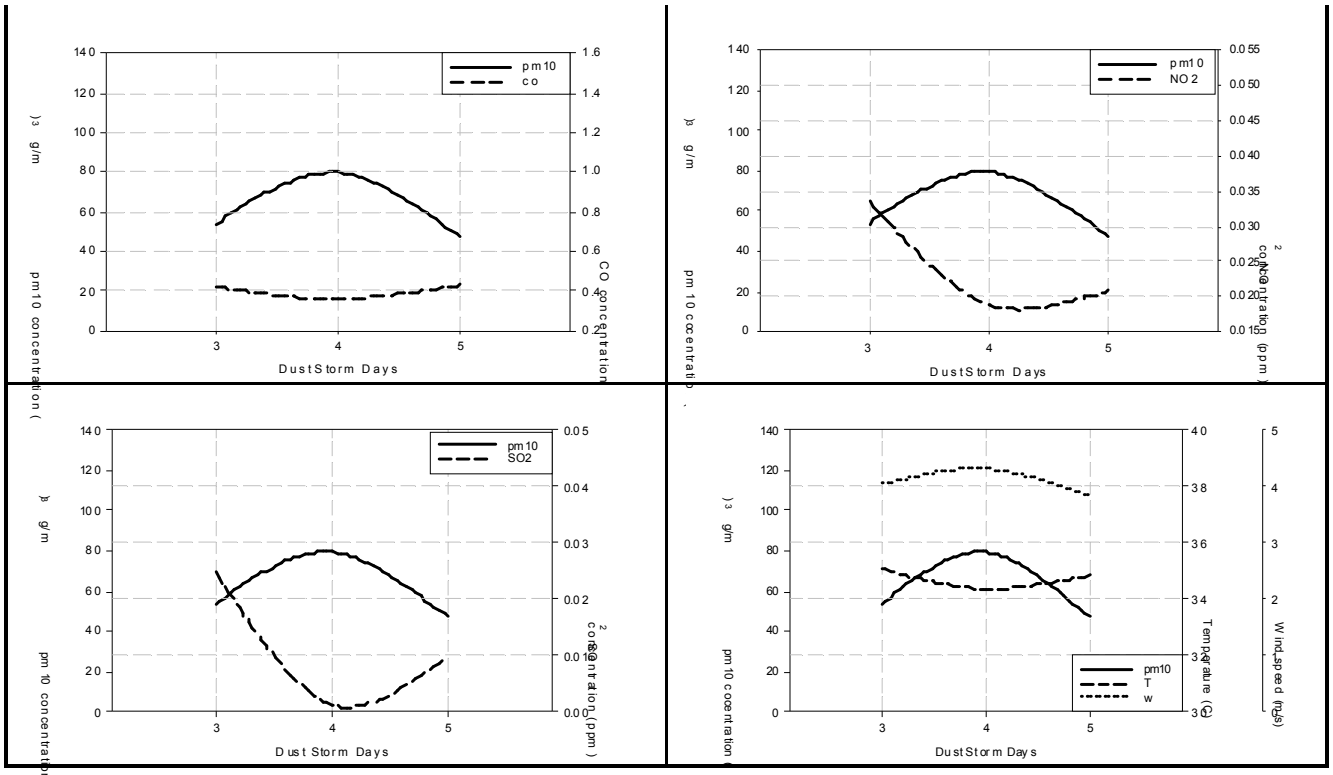

Fig. 5d: dust storm in 4/7/2011

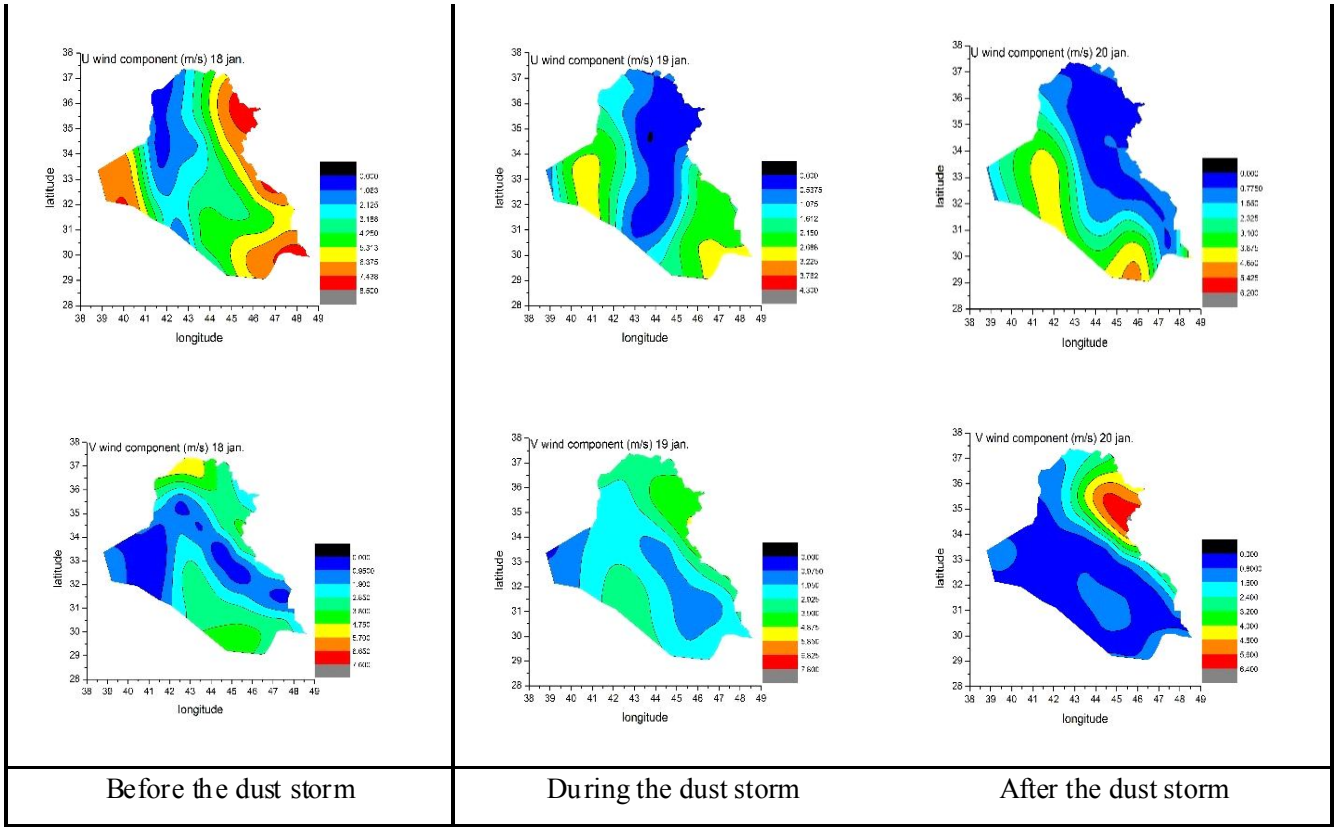

Fig. 6a: Wind speed components for 19/1/2011 Dust Storm.

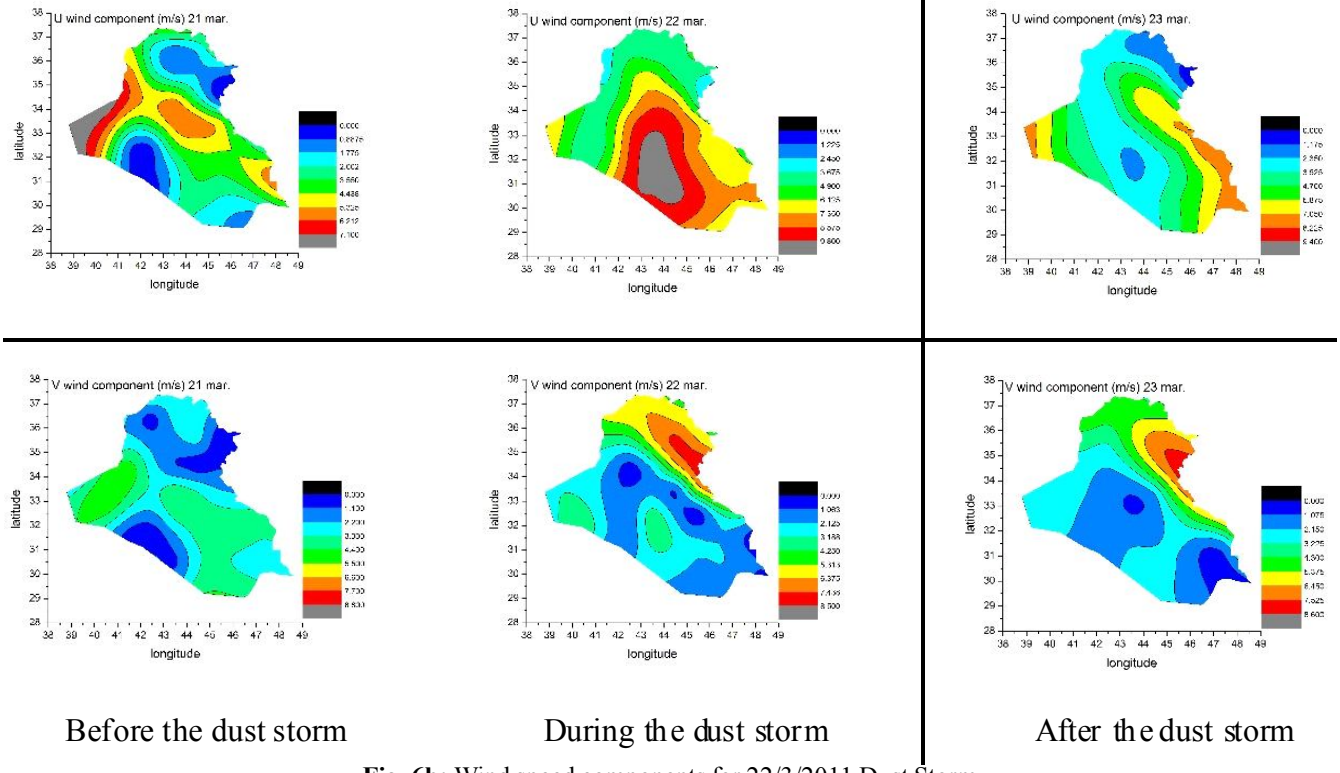

Fig. 6b: Wind speed components for 22/3/2011 Dust Storm.

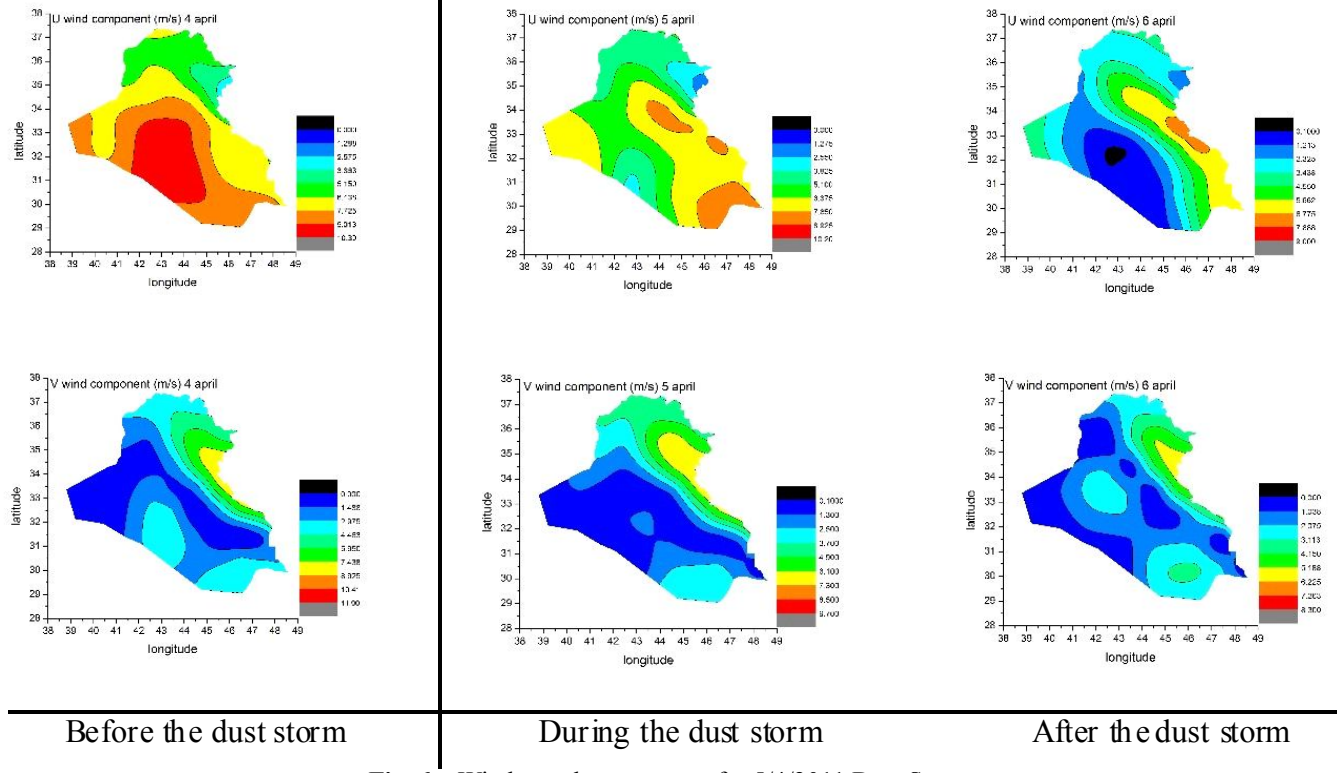

Fig. 6c: Wind speed components for 5/4/2011 Dust Storm.

during the seasons as shown in Fig. 7.

The Fig. shows that the concentration of polluting gases is greater during winter than in the summer, this applies to all polluting gases as shown in Figs. (A, B, C), that means that the concentration of polluting gases is inversely proportional with temperature as shown in Fig. (E). The concentration of the aerosols in the dust storm

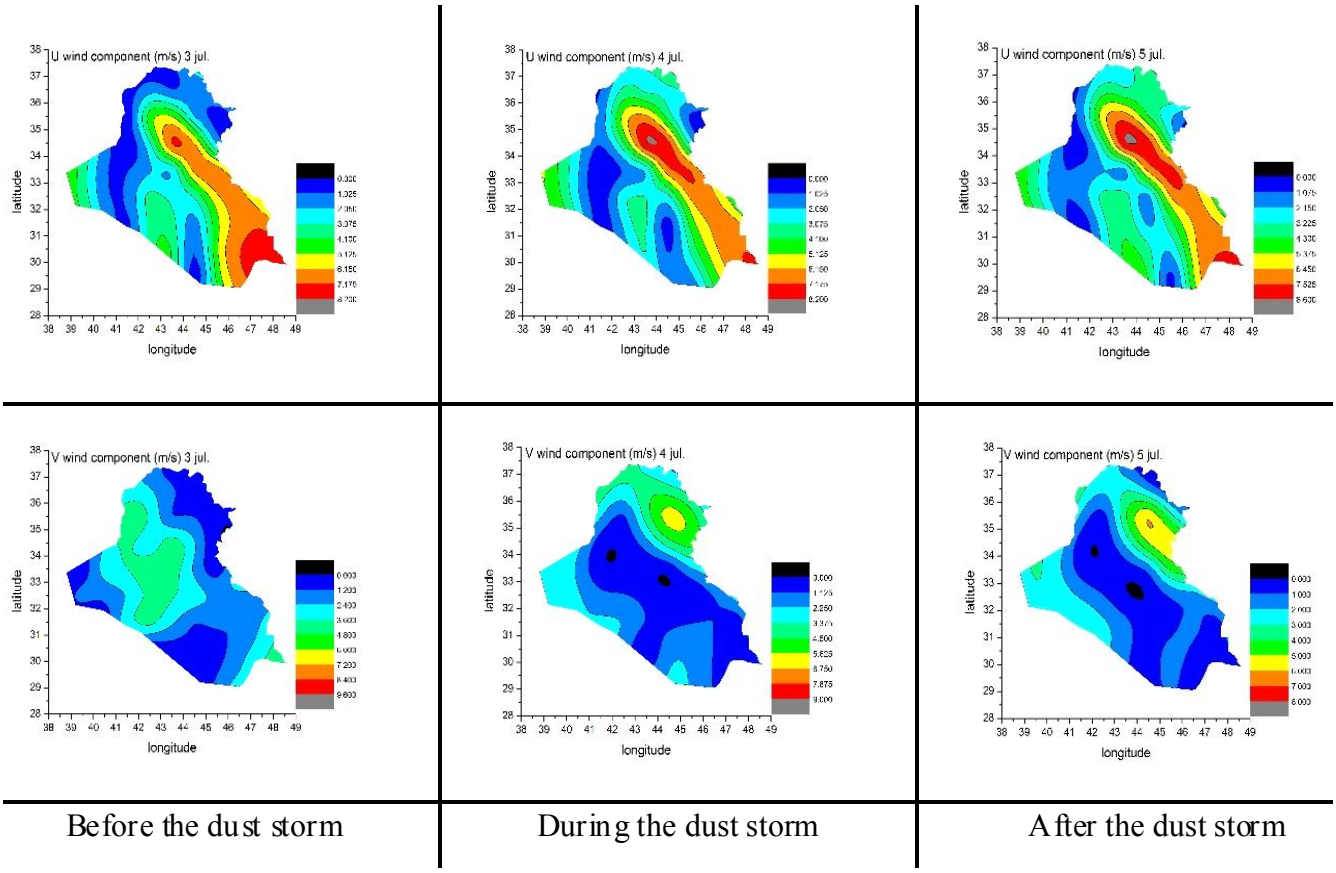

Fig. 6d: Wind speed components for 4/7/2011 Dust Storm.

changes during the seasons depending on the source of the storm and the areas passing through it as shown in fig. (D). This is due to the low wind speed in winter which works for the highest dispersion of contaminants Fig. (F), where the numbers on X-axis refers to the following: 1 (before dust storm), 2 (during dust storm), 3 (after dust storm).

Conclusions

Before the dust storm, the concentration of polluting gases is high in the atmosphere due to traffic and industrial activities, while the concentration of the aerosol is relatively low.

During the dust storm, the concentration of the aerosol increases due to weather system conditions in the study area (low pressure system and blowing wind) and the concentration of polluting gases decreases due to the increasing in the speed of the wind that disperses the pollutants, These polluting gases are absorbed by the dust particles present in the atmosphere during the dust storm and are then deposited to the earth's surface by gravity, which reduces the concentration of these gases in the atmosphere. Also the temperature decreases because the dust acts to block the solar radiation reaching the earth's surface.

After the dust storm passes, the concentration of the aerosol is reduced and the concentration of air pollutants increases due to the low wind speed, which leads to the accumulation of these pollutants near the surface of the earth, and the temperature rises again.

Reference

Daly, A. and P. Zannetti (2007). "Ambient Air Pollution" 2nd Ed., published by the Arab School for Science and Technology (ASST) and the Enviro Comp Institute, USA; 411.

Hamidi, M. and M. Reza (2013). "Synoptic Analysis of Dust Storms in the Middle East". *Asia-Pacific J. Atmos. Sci.*, **49(3) :** 279-286.

Hemond, H.F. and E. J. Fechner-Levy (2000). "Chemical Fate and Transport the Environment", 2nd. edition, Academic press, 290.

Hussain, H.H. (2014). "The efficiency of local dust storm particles as a cloud condensation nuclei". *Journal of Mustansyriya University*, **25(4):** 165-174.

Guo, J.H. and K.A. Rahn (2004). "A mechanism for the increase of pollution elements in dust storms in Beijing". *Atmospheric Environment*, **38:** 855-862.

Jacobson, M.Z. (2002). "Atmospheric Pollution History Science

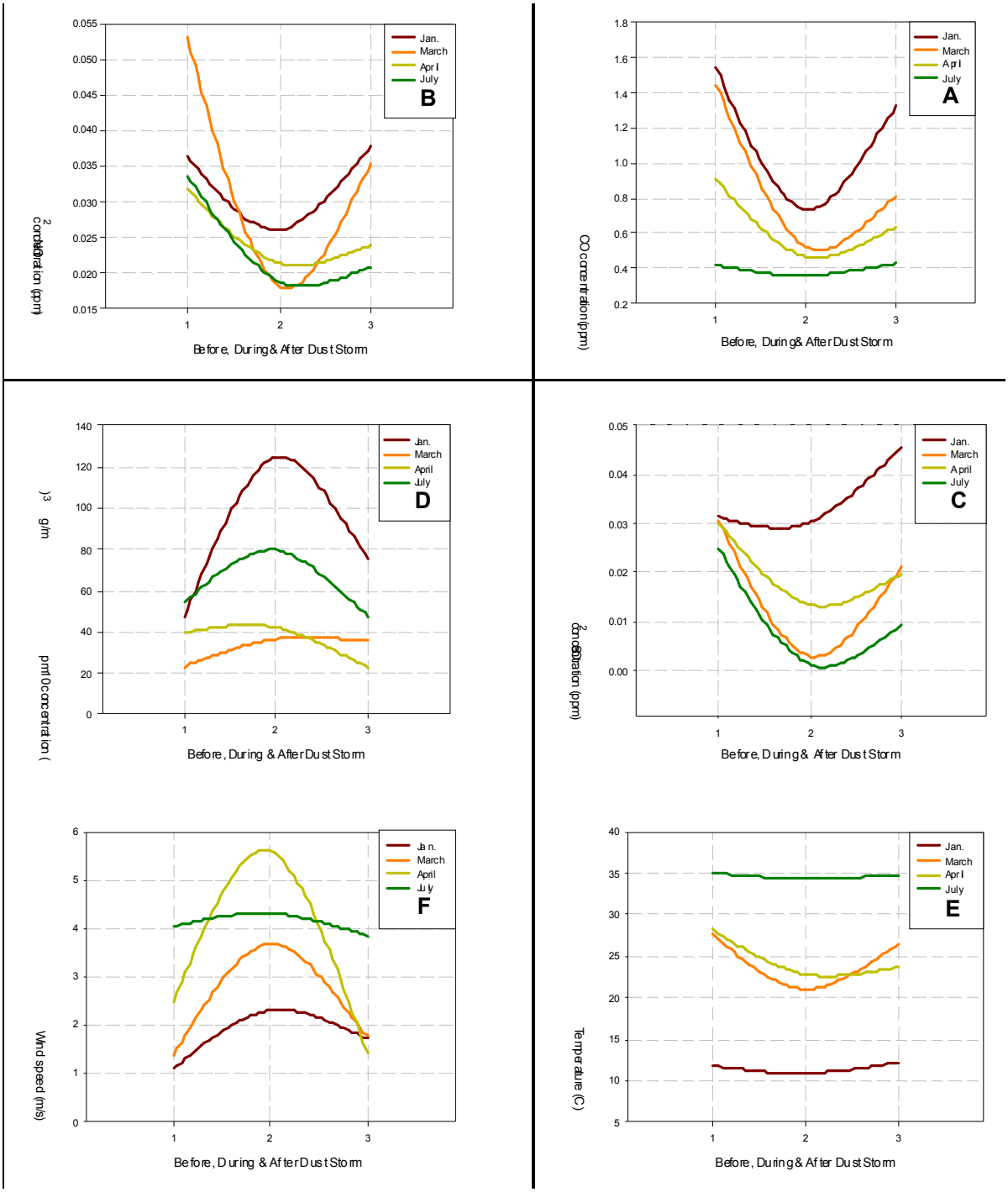

Fig. 7: Aerosol concentrations and contaminants before, during and after the storm.

and Regulations". Cambridge university press, 412.

Fang, X., Y. Xie and L.J. Li (2003). "Effects of Dust storms on the Air Pollution in Beijing", Kluwer Academic Publishers, **3:** 93-101.

Ning, D.T., L.X. Zhong and Y.Chung (1996). "Aerosol size distribution and elemental composition in urban areas of northern China". *Atmospheric Environ.*, **30:** 23-55.

Saide E., Pablo, (2011). "Forecasting urban PM_{10} and $PM_{2.5}$ pollution episodes in very stable nocturnal condition and complex terrain using WRF-CHEM CO tracer model", *Atmospheric Envionment*,**45:** 27-69.

Tiwary, A. and J. Collis (2010). "Air Pollution Measurements modeling and mitigation", 3rd edition, Routledge, 522.

Warneck, P. (1999). "Chemistry of the natural atmosphere", 2nd edition, Academic press, 927.

Yang, K.L. (2002). "Spatial and seasonal variation of PM10 mass concentrations in Taiwan". *Atmospheric Environ.*, **36:** 11-34.