O 16. AIR QUALITY ASSESSMENT IN KONYA CITY CENTER DURING FIRST HALF OF 2020 YEAR

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ABSTRACT: In regions where the industry is very high developed, provincial centers where traffic is heavy and settlements where winter is cold, low-quality fossil fuel consumption affects quality of life especially in people with respiratory diseases. The topographic structure and climatic features of a region are as effective as emission sources in the formation of air pollution. Especially in the winter months, there is no increase in the emission levels as the temperature decreases. However, the negativity caused by meteorological conditions causes lower than expected levels of air quality. Using the data of the existing air quality monitoring station in the Konya city center, it is seen that the air quality increases and then returns to normal levels during the period when curfew is restricted for measures taken due to the covid-19 outbreak. The restrictions that cause the reduction of vehicle exhaust emissions, which are important factors in the formation of some air pollutants, are thought to be effective in improving the air quality. This should not be neglected; as meteorological conditions are effective on the days when air pollution occurs. For this reason, the changes in the air quality should be examined in more detail. It is thought that the reduction in HC, NOx and CO emissions, which can be evaluated as exhaust emissions, will be an effective factor due to the restrictions. In parallel with the decrease in air pollution, the increase in O3 values increased by the sun rays in the atmosphere with the formation of O3 in the clean air. In addition, atmospheric ozone reduces NOx, CO and HC compounds from the air pollutants by oxidizing them with the reactions it creates. It is estimated that the pollutants present in the air before the restriction will cause a decrease in the ozone values, and the increase in the air quality will cause an increase in the ozone values.

Keywords: *Air quality, Ozone, NOx, CO, PM, emissions*

1. INTRODUCTION

Rapid population growth in cities some countries causes many environmental problems including Air pollution (Aroh, 2019). For this reason, the changes in the air quality should be examined in more detail with its sources and related factors. It is thought that the reduction in HC, SO_2, NO_x and CO emissions, which can be evaluated as exhaust emissions, will be an effective factor due to the restrictions (Johnson, 1988). This should not be neglected; as meteorological conditions are effective on the days when air pollution occurs. In addition, atmospheric ozone reduces NO_x, CO and HC compounds from the air pollutants by oxidizing them with the reactions it creates some different compounds. Investigation of Dursun (2019) showed that atmospheric PM levels were increased during could winter period and increasing traffic also evaluated PM levels around residential area. Mankolli *et al*. (2011) detected higher level of reparable size of PM capital city Tiran, because of because of heavy and clogged traffic in city centre. Edun et al (2015) were also show similar explanation for Istanbul city. During rush hours in the morning and evening concentration of PM was extremely increased. As well as the emission sources, many factors have effect on environmental pollution (Ayturan *et al*., 2016).

The rapidly increasing population also increases the need for food production. Natural habitats are transformed into agricultural areas for food production (FAO, 2017; Le Mouël et al., 2018). Occupation of people's natural areas for agriculture, become to contact with non-domestic wild animals and between humans has increased. Natural biodiversity, which helps protect people from zoonotic diseases, this recently is increasingly disappearing. The Covid-19 pandemic is thought to originate from China by human contact with non-domestic animals. The origin of the Covid-19 virus is thought to have spread from the wild animal market in Wuhan, China (https://www.who.int; Md Shah *et al*, 2020). Infectious rates of diseases occur faster than in the past, and the rate of spread increases with increasing human contact. Between beginning January 2020 to middle of July 2020, Covid-19 infections were detected in more than 13 million people worldwide, and about 600 thousand people died (Me & Fu, 2020; Riedel,

2004). Since contact is the most important factor in infection, methods should be developed to reduce it. It has become important to prevent sustainable environment and outbreaks. Covid- 19 infection first detected activity in Turkey is March 15, 2020 and the measures taken in Turkey to reduce the impact of Covidien-19. The causes and possible consequences of the outbreak have not yet been adequately studied. In this investigation, on air quality change due to the Covidien-19 outbreak of Konya was aimed to search. Fort the impact on air quality due to the measures taken were investigated in Konya city centre.

2. MATERIAL AND METHOD

Workspace and features

Konya located in central Anatolia and it has largest surface area in the all provinces of Turkey land (41 thousand km^2; Ceyhan, 2013). Konya is geographically located between 36º 41' and 39º16' north latitudes and 31º41' and 34 º 26' east longitudes (Figure 1). The average height from the sea level is 1016 m and the height, the city center is 1028 m from the level of the sea. As the 2020 census, Konya population is at 2.25 million people, which constitutes 2.7% of Turkey's population of 84 million. When the comparisons made in other provinces of Konya, Turkey's 7th largest city. In terms of area it is the largest city of Turkey. The number of people per km^2 for Konya metropolitan is 55 people (URL-1).

Due to the fact that the annual average rainfall in Konya city is 320 mm, it made it necessary to carry out dry farming. Because summers are hot and dry in the research area; The steppe climate, which has a harsh and snowy winters, is observed. When Konya's long years of data are analysed, the seasonal condition of temperature and precipitation shows a continuous fluctuation according to the years. In the region, these fluctuations have reached extreme values, leading to the development of steppe vegetation. In terms of its land structure, vegetation has the appearance of a plain steppe. Low mountain and high mountain steppe surrounded the plain steppe (Kaya & Aladağ, 2009; Aka, 2007).

Figure 1. Location of investigation area (URL-2)

Konya province has a closed basin structure and the basin consists of wide plain areas and plateaus. The Taurus Mountains cover the south of the basin and there are high mountains to the west, preventing the moist air of the Mediterranean from coming to the region (Dogan & Yılmaz, 2011; Atalay, 2018). Therefore, it has a very arid climate and has an arid feature. With this feature, summer is hot and dry, and winter is cold and snowy. Konya is less rainfall compared to most provinces in Turkey. Although it is known in Turkey as a grain warehouse development, the change of climate and water resources vary this feature. Industrial areas have developed and are developing in the city centre.

Data

Air quality data of PM_{10}, NO_2, CO, SO_2 and O_3 were gathered from four air sampling station of Konya city, via Ministry of Environment and Urbanization of Turkish Republic. Data of the research area were divided in two parts that; Period 1: before the Covid-19 measures were taken to reduce effect of pandemic problem which is between January 1 and March 15 of 2020. Period 2: after the Covid-19

struggle started in Turkey and Covid-19 measures applied which is between March 16 and April 15 of 2020. Daily air pollutant data of 01.01.2020-15.06.2020 compared to see effect of Covid-19 measures. To see effect of seasonal effect on pollution parameters, Same season of 2018 and 2019 were also collected and compared between 2020 and earlier data. Scientific techniques and methods for collecting numerical values collected in a particular area, organizing, statistical analysing, interpreting the collected data, making objective and correct decision should be examined. There are various sampling methods to be used in research. According to the purpose of the research, restrictive conditions such as cost, duration and the characteristics of the audience, the most appropriate among them should be selected. Data analysis covers all the statistical methods required to summarize and evaluate the data collected within the scope of the research. In this study, a comprehensive R-program, an open code statistics program, was used to create the distribution maps of the data.

Covid-19 measures in Turkey

After the occurrence of first infection case in Turkey, it is very quickly becoming measures as a part of the fight against infection with various precaution. In this context, after March 16, 2020 all schools were vacationed then online study was started in the Turkey, as well as Konya city. Mass worship was interrupted in mosques. Quarantine measures were implemented in all metropolitan cities in Turkey. Mobility people has been reduced between the metropolitan cities. Citizens over the age of 65 and then under the age of 20 are forbidden to go out for all cities of Turkey. On the weekends, a curfew measures were introduced for all age groups for all metropolitan. Commercial/touristic flights were cancelled with many countries where the pandemic infection was widespread.

3. RESULTS

Investigation region where Konya metropolitan is one of the highly developed the industry province in Turkey. Provincial living centres has also heavy traffic around settlement roads, settlements region has a very cold winter seasons. When low-quality fossil fuels consumption affects quality of life especially in people with respiratory diseases because emission of incineration. Air pollution is increasing some days due to specific climatic condition occurring via the topographic structure of the region. climatic features of a region are as effective as increasing emission locally in the formation of air pollution. Especially in the winter months, there is increase in the emission levels as the temperature decreases with increasing fuel usage for heating system. However, some days of winter period, the negativity caused by meteorological conditions causes lower than expected levels of air quality.

Figure 2 shows the PM_{10} values of four different air quality sampling station in Konya city centre during first half of 2020 including the period of coid-19 outbreak and Sahara dust effecting periods. Figure 2 shows that PM_{10} levels of four air quality sampling station were significantly lowered by covid-19 outbreak period and were increased with Sahara dust effecting periods than lowered to normal levels again. Results of atmospheric PM_{10} measurement not only affected by the emissions source, but also effected meteorological factors and special situations.

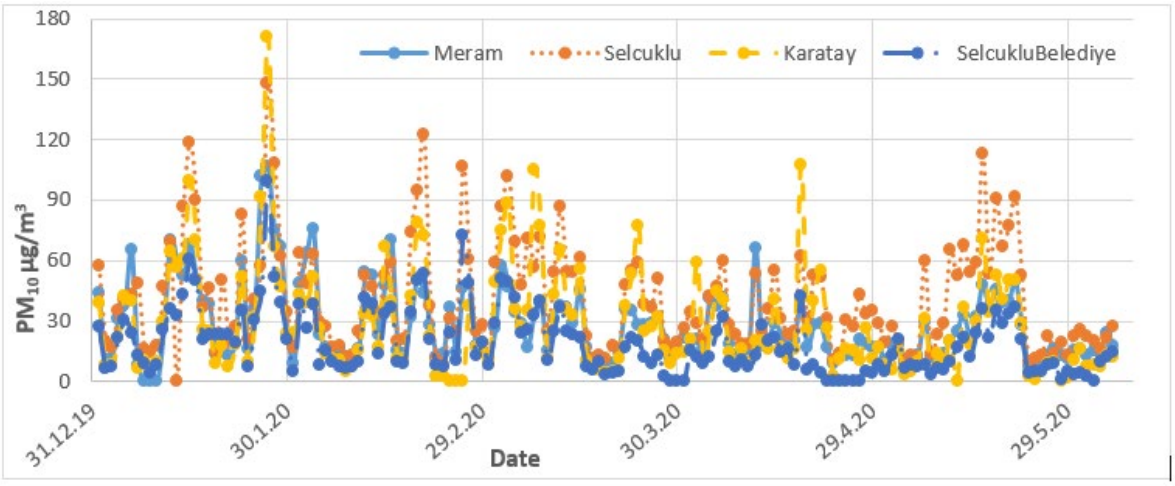

Figure 2. PM_{10} values were being measured at four sampling station in Konya city centre during first half period of 2020 year.

Four air quality parameters of Konya Erenkoy sampling station which are SO_2, CO, NO_2 and O_3 trends are shown in Figure 3. It is clear that the concentrations of gases such as SO_2, NO_2 and CO, shows significant decreased and opposite trend for O_3 values which were increased, during the period of coid-19 outbreak, after March 15, 2020 (Figures 3-6). Figure 3 shows the SO2 concentrations were higher in January and lowered down to10 µg/m³ and after covid-19 outbreak decreased about 5 µg/m³ then turned to normal levels.

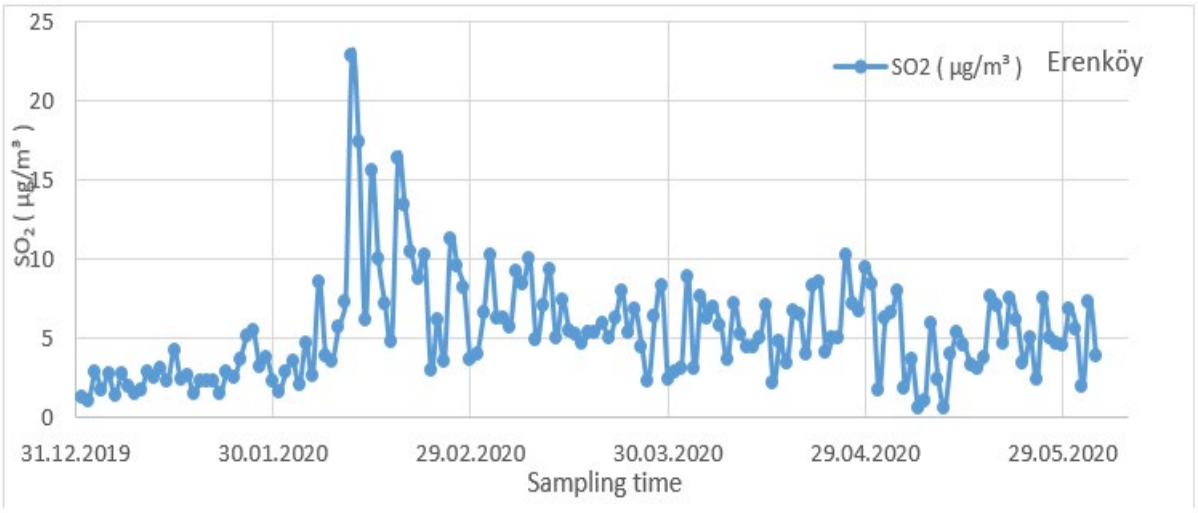

Figure 3.SO_2 values of Erenkoy air quality sampling station in Konya city centre during first half period of 2020 year.

Figure 4 shows the CO concentrations that the highest were again in January about 1700 µg/m³ and lowered down to1000 µg/m³ and after covid-19 outbreak decreased down to 500 µg/m³ then turned to normal levels. More than 200% decrement of CO was seen and possible due to less motor vehicles that emits a lot of CO into the atmosphere and also other sources such as from industrial activities that shut down due to Pandemic Covid-19.

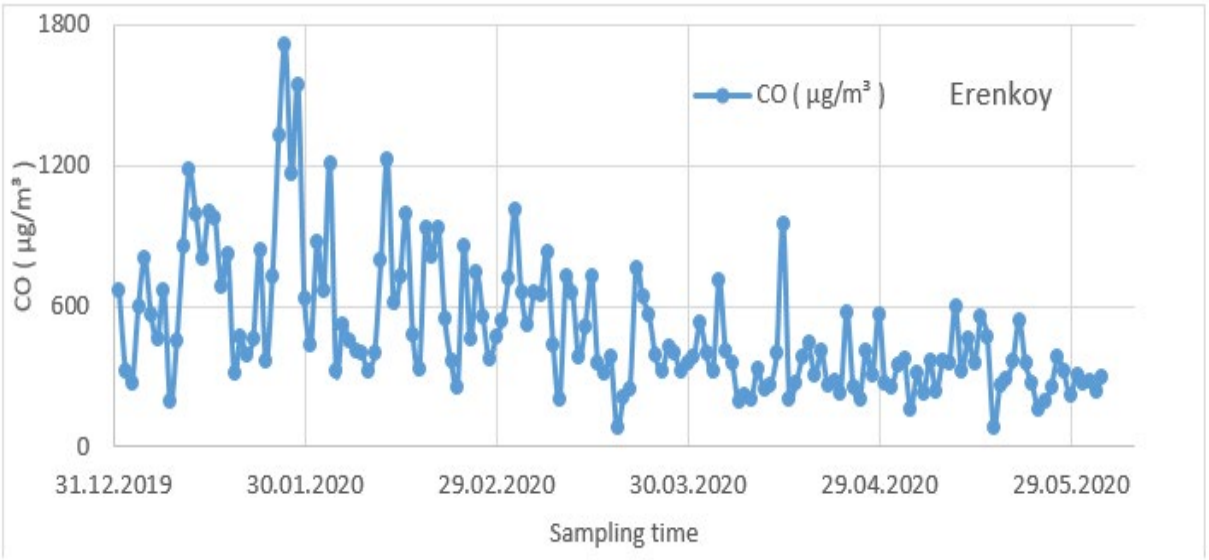

Figure 4. CO values of Erenkoy air quality sampling station in Konya city centre during first half period of 2020 year.

Figure 5 shows the NO_2 concentrations that were generally about 60 µg/m³ and after covid-19 outbreak decreased about 10 µg/m³ then turned to normal levels.

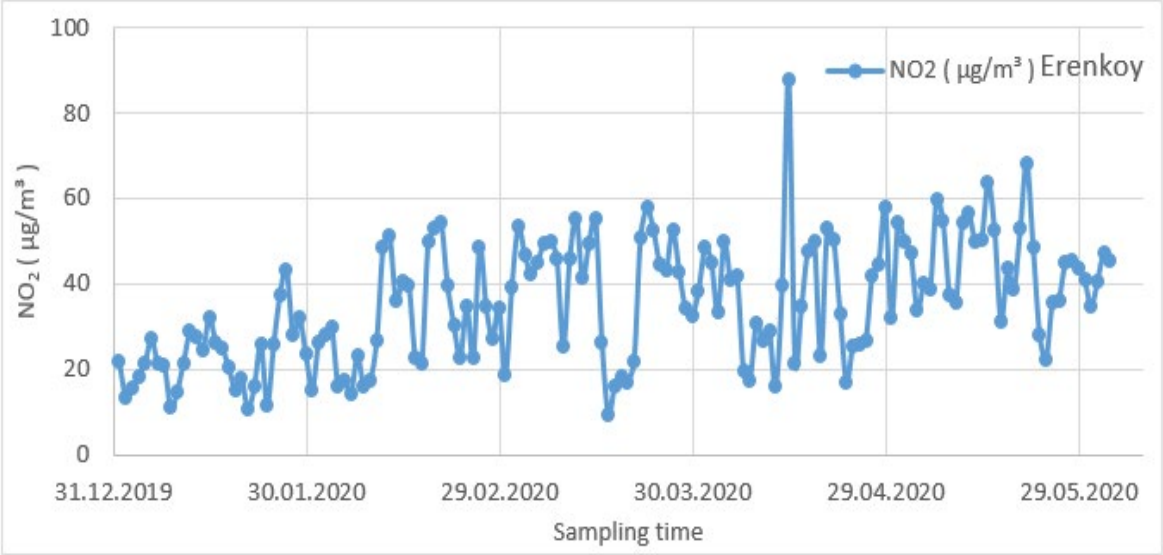

Figure 5. NO_2 values of Erenkoy air quality sampling station in Konya city centre during first half period of 2020 year.

Figure 6 shows the O_3 concentrations that were the lower in January from 15 µg/m³ and increased up to150 µg/m³ then after Sahran dust effect, the concentration of O_3 decreased about 35 µg/m³ then turned to normal levels of 150 µg/m³. The concentrations of O_3 were increased as opposite with the decreasing other air pollution parameters, by the sun rays in the atmosphere with the formation of O_3 in the clean air. It is estimated that the pollutants present in the air during winter period will cause a decrease in the ozone values, and the increase in the air quality will affect an increase in the ozone values.

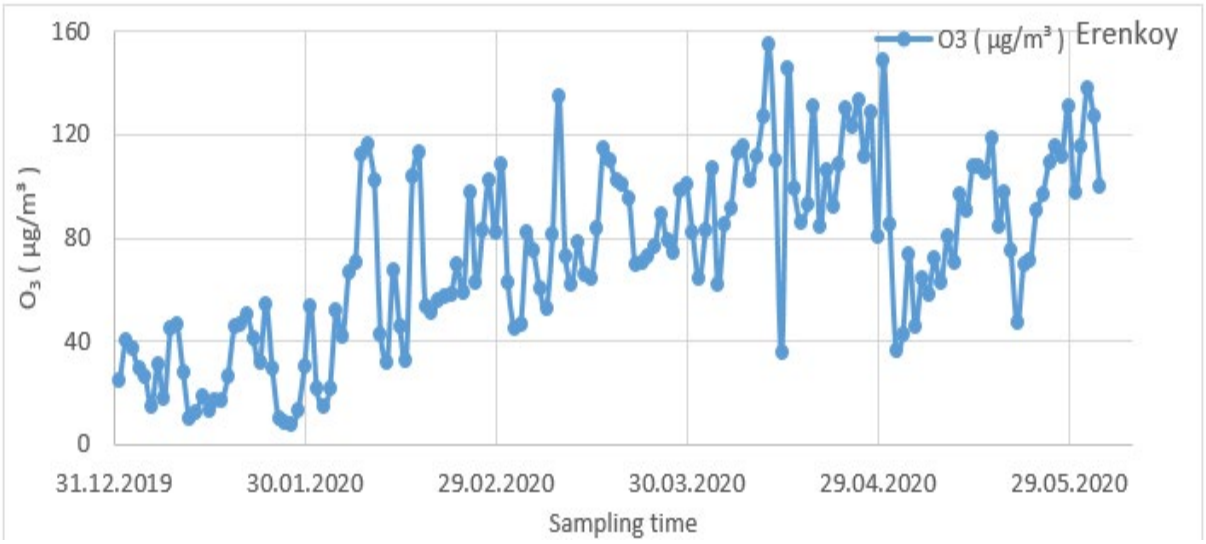

Figure 6. O_3 values of Erenkoy air quality sampling station in Konya city centre during first half period of 2020 year.

Four air quality parameters of Konya Karatay sampling station that are PM_{10}, SO_2, NO_2 and O_3 given following figures. They show that values of all measured parameters similar trend changing for 6 months and O_3 values were also not increased, during the period of coid-19 outbreak period (Figures 7-10). Figure 6 shows that the O_3 concentrations were increasing with an improvement of air quality for Erenkoy air quality sampling station, but for the Karatay sampling station, the increase not seen after

covid-19 outbreak. Karatay sampling station is near the industrial zone so differing from Erenkoy region and coid-19 outbreak did not effected air quality of this region for the investigation tame period.

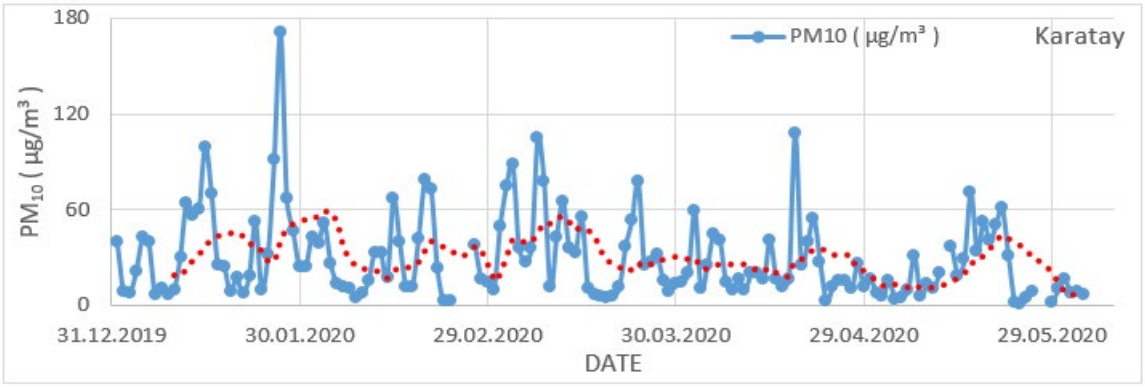

Figure 7.PM values of Karatay air quality sampling station in Konya city centre during first half period of 2020 year.

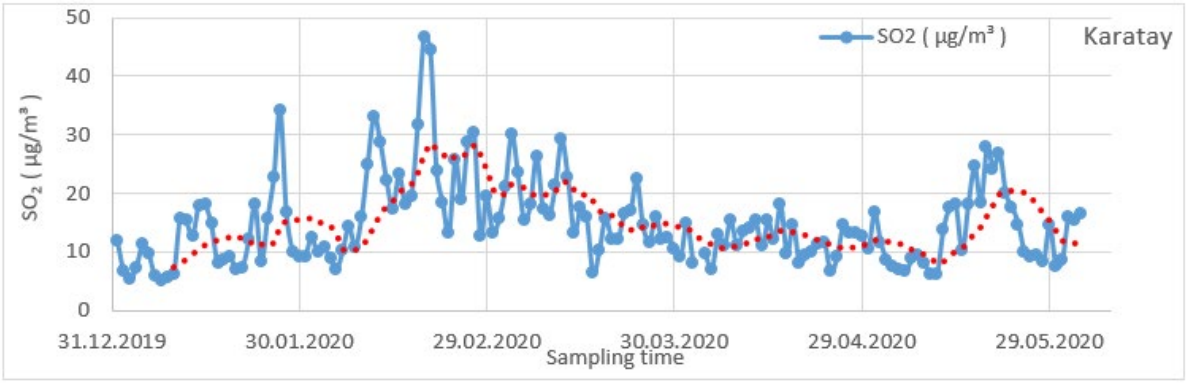

Figure 8.SO_2 values of Karatay air quality sampling station in Konya city centre during first half period of 2020 year.

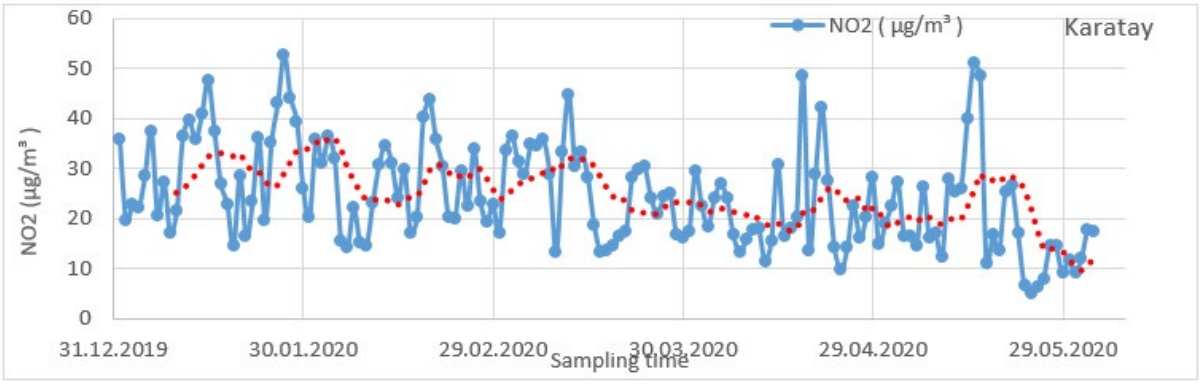

Figure 9. NO_2 values of Karatay air quality sampling station in Konya city centre during first half period of 2020 year.

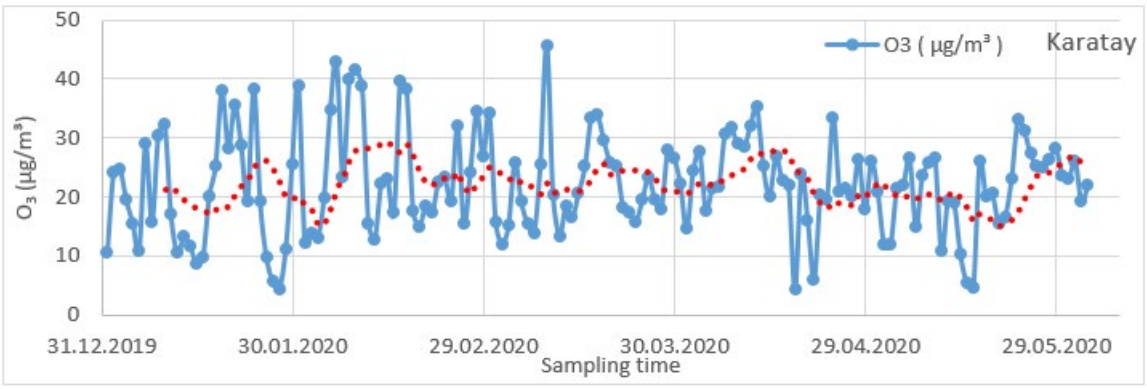

Figure 10. O_3 values of Karatay air quality sampling station in Konya city centre during first half period of 2020 year.

Four air quality parameters of Konya Selcuklu Municipality sampling station that are PM_{10}, SO_2, CO and NO_2, there is not O_3 measurement in this station (Figures 11-14). Results of measurements for 4 pollutant parameters show that that PM_{10} and NO_2 was initially lowered, but other two parameters, SO_2, and CO values were not significantly decreased.

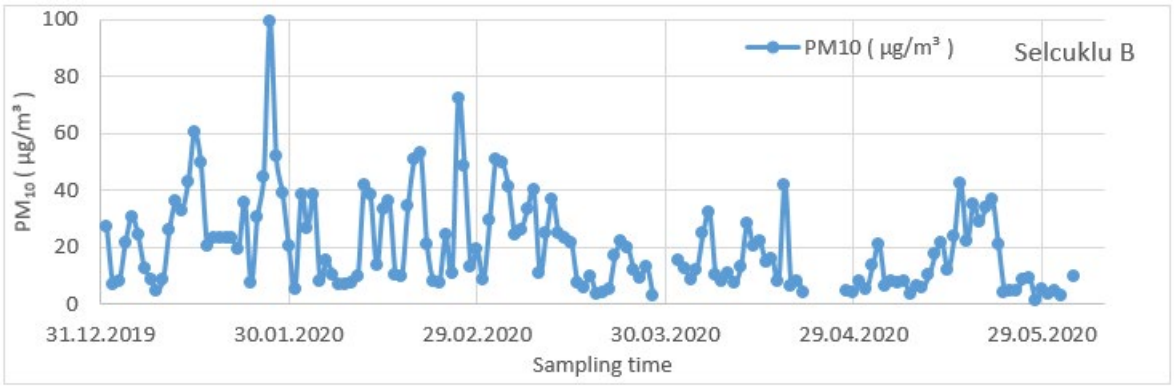

Figure 11. PM_{10} values of Selcuklu Belediye air quality sampling station in Konya city centre during first half period of 2020 year.

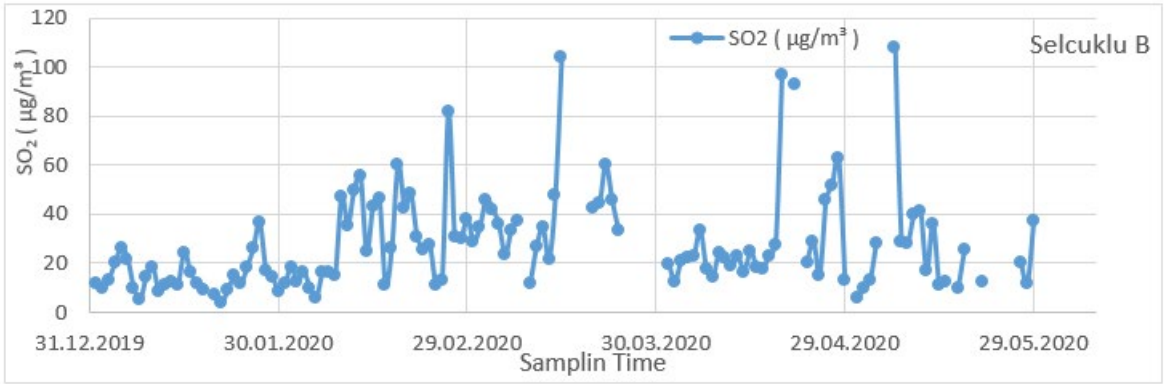

Figure 12. SO_2 values of Selcuklu Belediye air quality sampling station in Konya city centre during first half period of 2020 year.

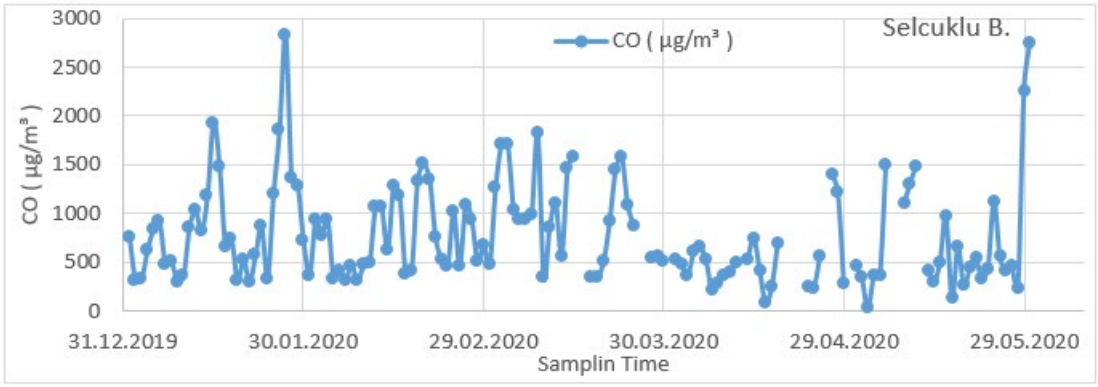

Figure 13. CO values of Selcuklu Belediye air quality sampling station in Konya city centre during first half period of 2020 year.

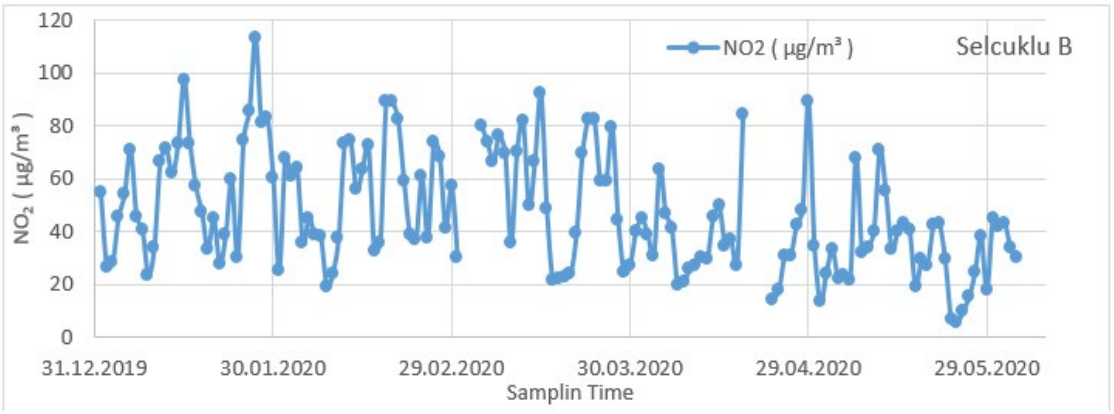

Figure 14. NO_2 values of Selcuklu Belediye air quality sampling station in Konya city centre during first half period of 2020 year.

Figure 15 show the PM_{10} values of three air quality sampling station Selcuklu, Karatay and Selcuklu Belediye in Konya city centre during first half period of 2020 year. Last solid line (—— MAM) show covid-19 outbreak period (01 January 2018, 15 June 2020) and other two are same period 2018 and 2019 years respectively. Dashed line (-----) mean of each year 2018, 2019 and 2020. It can be seen slightly lowering from 2018 to 2019, but lowering rate is more 2020 year. It is clear that reduction of PM_{10} concentrations was lower during covid-19 outbreak period (01 January 2018, 15 June 2020) than before the outbreak and 2018 and 2019 years at same period.

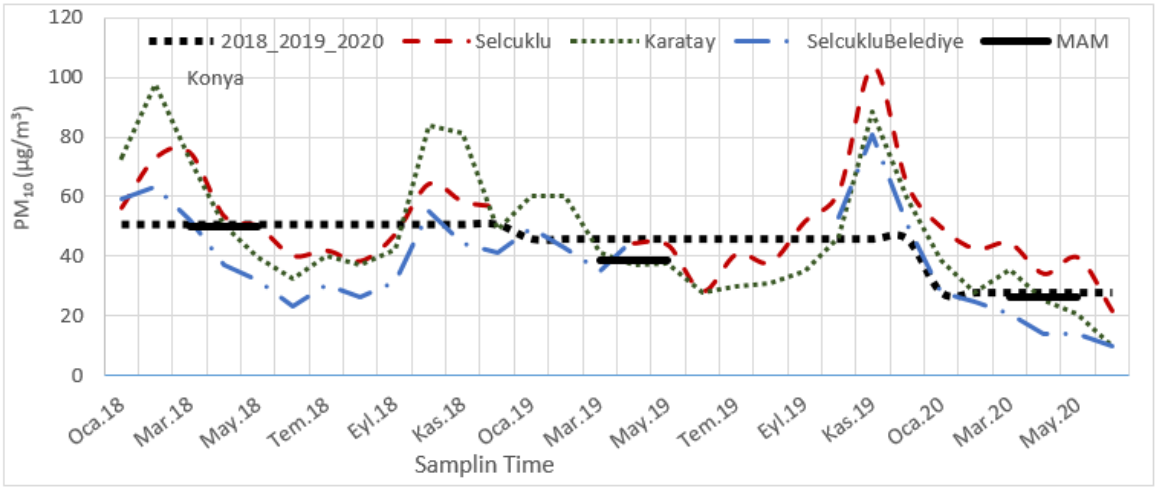

Figure 15. PM_{10} values of three air quality sampling station Selcuklu, Karatay and Selcuklu Belediye in Konya city centre during first half period of 2020 year. Last solid line (—— MAM) show covid-19

outbreak period and other two are same period 2018 and 2019 years respectively. Dashed line (-----) mean of each year 2018, 2019 and 2020

Using the data of the existing air quality monitoring station in the Konya city centre, it is seen that the air quality increases covid-19 outbreak period (01 January 2018, 15 June 2020) and then returns to normal levels during the period when curfew is restricted for measures taken due to the covid-19 outbreak. The restrictions that cause the reduction of vehicle exhaust emissions, which are important factors in the formation of some air pollutants, are thought to be effective in improving the air quality. Four air quality parameters measured in Konya stations are SO_2, NO_2, CO and NO_2 mean of sampling stations to test effect of covid-19 outbreak measures on change of SO_2, NO_2, CO and NO_2 concentration between outbreak time period, with before, 2018 and 2019 period. It is clear that there is a significant decrement on SO_2, NO_2 CO values and but O_3 concentrations pattern were in inversed (Tables 1 - 4). Table 1 – 4 shows the effect of covid-19 concentrations with minus values (-) show decrease and plus (+) values indicates the increment concentrations.

Table 1. Effect of covid-19 outbreak measures on SO_2 concentration ($\mu g/m^3$) for Konya city centre

SO_2 ($\mu g/m^3$)			
	2018	2019	2020
Period 1	21	12	15
Period 2	12	6	12
Period **2/Term1**	**-43**	**-51**	**-24**
Period **2(2020) - Mean** Period **2 (2018,2019)**			**34**

Table 2. Effect of covid-19 outbreak measures on NO_2 concentration ($\mu g/m^3$) for Konya city centre

NO^2 ($\mu g/m^3$)			
	2018	2019	2020
Period 1	**n.a.**	**n.a.**	43
Period 2	**n.a.**	42	33
Period **2/Term1**	**n.a.**	**n.a.**	**-24**
Period **2(2020) - Mean** Period **2 (2018,2019)**			**n.a.**

Table 3. Effect of covid-19 outbreak measures on CO concentration ($\mu g/m^3$) for Konya city centre

CO ($\mu g/m^3$)			
	2018	2019	2020
Period 1	1528	1311	866
Period 2	1311	508	545
Period **2/Term1**	**-14**	**-61**	**-37**
Period **2(2020) - Mean** Period **2 (2018,2019)**			**-40**

Table 4. Effect of covid-19 outbreak measures on O_3 concentration ($\mu g/m^3$) for Konya city centre

O_3 ($\mu g/m^3$)			
	2018	2019	2020
Period 1	7	7	35
Period 2	7	25	53
Period **2/Term1**	**-1**	**248**	**50**
Period **2(2020) - Mean** Period **2 (2018,2019)**			**227**

Figure 16. shows an O_3 values of three air quality sampling station Selcuklu, Karatay and Selcuklu Belediye in Konya city centre during first half period of 2020 year. Last solid line show covid-19 outbreak period and other two are same period 2018 and 2019 years respectively. Dashed line (- - - - -) Slope line of period. Both of increasing ambient temperatures and covid-19 outbreak measures reduced the fossil fuel usage and increased air quality. This situation gave positive effect production of atmospheric ozone production.

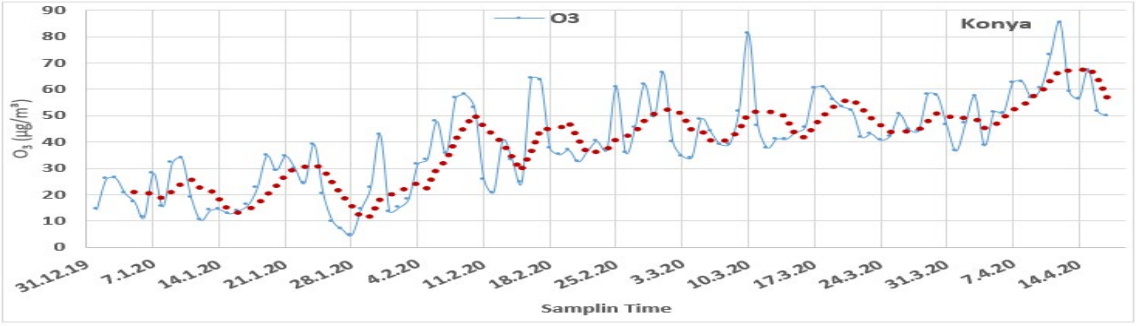

Figure 16. O_3 values of three air quality sampling station Selcuklu, Karatay and Selcuklu Belediye in Konya city centre during first half period of 2020 year. Last solid line show covid-19 outbreak period and other two are same period 2018 and 2019 years respectively. Dashed line (- - - - -) Slope line of period.

4. CONCLUSION

Most of the population (about 70%) living in 31 metropolitans of Turkey. Cities have high population and industrialised that means of increasing air pollution. Konya metropolitan has air pollution potential some days in winter times. Meteorological factor are also may have potential effect on air pollution problem. Air quality of restrictions applied during the Covid-19 pandemic quarantine measures greatly influenced positively decreasing concentration of air pollutants. Some measures taken during the Covid-19 pandemic period may be turn into permanent habits over time. The Covid-19 outbreak may be a turning point in combating global climate change. Especially the improvement in air quality can be considered as the most important gain after the pandemic. Improvements gained through measures should be expanded.

Future recommendations

Air pollution and climate change affect each other through complex interactions in the atmosphere. Emergency measures should be taken and apply strict air quality standards to improve air quality. Reduction of air pollution during the pandemic period on global climate change will be further studied and discussed. For sustainable environmental and air quality, gains from measures should be continued. With the end of the measures, as in many parts of the world, environmental quality decreases.

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