O 22.   ANKARA AIR QUALITY STUDY

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ABSTRACT: In particular, annual amounts of pollutants released from artificial sources reach from a few hundred tons to millions of tons. These produce effects in varying degrees, depending on the area and quantities in which they are formed. The adverse health effects that occur as a result of the inhalation of pollutants (direct exposure) by humans (direct exposure), the mixing of the pollutants accumulated from the air, soil, plants, animals and other environmental environments into the drinking water and food chain (indirect exposure), and the accumulation and absorption of chemicals entering the body. is the important result. Especially in cities, with the increase in air pollution caused by heating, traffic and industry in recent years, there has been an increase in health problems. Air pollution is the release of chemicals, particulate matter or biological materials that harm or disturb humans or other living organisms or harm the natural and artificial environment. The change in the physical, chemical and biological properties of the air affects natural and artificial non-living beings as well as living things. Air pollution occurs when the natural composition of the air changes to a certain extent. Air pollution is the release of chemicals, particulate matter or biological materials that harm or disturb humans or other living organisms or harm the natural and artificial environment. The change in the physical, chemical and biological properties of the air affects natural and artificial non-living beings as well as living things. Air pollution occurs when the natural composition of the air changes to a certain extent. In the calculation of emissions from traffic, data on the length of the roads in the project area, the number of vehicles in the project area and the amount of fuel consumed in the project area have been compiled. From the number of vehicles in our city, the ratio of the number of collecting vehicles was obtained, and from here, the amount of fuel and how much it was used was calculated by proportioning to the fuel types. According to the amount of fuel consumed; Emissions from traffic are calculated using the emission factors of fuels.

Keywords: Air pollution, Ankara city, particle matter, SO_2

INTRODUCTION

Our world has changed in the last 50 years for many reasons, both industrial and technological advances. These differences have led to an increase in the world population, and with the migration in developed cities, the population has increased and the use of energy has also increased. With this situation, in the industrialized world; As a result of energy and heat generation, sulphur dioxide and particulate matter pollution have increased. (Fenger 2009). Due to the increase, the classical way has been followed for environmental protection. In this classic way; first of all, an increase in pollution levels with increased financial comfort, and then to take measures towards reducing pollutants in order to protect public health. Along with the studies, there are important breaks. Environmental pollution problems today are greater than they were in the 1950s. It is especially seen in developing countries with main cities and their environs (Shafik 1994, Fenger 2009). Environmental pollution problems still persist in the industrialized world and are mainly caused by nitrogen oxides, volatile organic compounds and photochemical oxidants associated with increased traffic. Especially, new hazardous compounds from industry have been identified by advanced analytical techniques. As a result; Recently, air pollution has been affecting ecology considerably (Shafik 1994, Fenger 2009). Air quality management in Turkey is carried out by the Ministry of Environment and Urbanization of the Republic of Turkey. EIA, Environmental Permit and License, Industrial Air Pollution Control, Air Quality Assessment Management, Air Pollution Control Due to Heating etc. regulations and measures for air pollution and implementation of mitigation studies are ensured.

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Air pollution is "the presence of one or more types of pollutants in the open air outside the building in an amount that harms human, plant and animal life, commercial or personal belongings, and an environmental quality that can be enjoyed over a certain period of time" (Muezzinoğlu, 2000). Air pollutants can be examined in two groups. The first group consists of CO2, CO, SOX, NOX, hydrocarbons (HC), hydrogen fluoride (HF), hydrogen sulfur (H2S), methane (CH4), chlorofluorocarbon (CFC) and powdered particulate matter. O3, SO3 (sulfur trioxide), H2SO4 (sulfuric acid), acids and photochemical oxidants formed later in the air are added to the second group. (Saracoglu, 2010; 6-7).

The Project for Improving the Air Quality Assessment System in Cities (KENTAIR Project) is a project that started its activities in the field of environmental cooperation between our Ministry of Environment and Urbanization and the Dutch Government National Institute of Environment and Public Health (RIVM). The aim of this project is to determine the air pollution in certain provinces in Turkey (Gaziantep, Adana, Mersin, Samsun, Ankara and Erzurum) and to monitor the air quality in the cities, to prepare the data and action plans by increasing the capabilities of the responsible institutions and organizations at the local scale, and to inform the public about the health effects of air pollution. reinforcement is given.

MATERIAL AND METHOD

Air Quality Measurement Methods
Analysis activities in determining air quality are carried out in two ways. These can be done manually and automatically. The manual is usually done for particulate matter and SO2 determination. A data can be obtained after 24 hours from the manual measurement. The reliability of the measurement information obtained with these systems is low. These systems were used in our country until 2005, but now automatic mechanisms are used. Since 2005, the Ministry of Environment and Forestry has carried out activities to establish an Air Quality Monitoring Network throughout our country, and the National Air Quality Monitoring Network was established by building air quality measurement stations in 36 provinces in 2005, taking into account the cities with high air pollution. At present, air quality measurements are carried out at 116 points by the Ministry of Environment and Urbanization. At the same time, 3 mobile air pollution measurement tools within the structure of the Ministry are dispatched to provinces and districts to measure at a certain time according to the demands. The purpose of establishing measurement stations is to detect air pollution arising from heating.

Limit Values of Pollutants
In our country, to know and determine the air quality objectives in order to stop or reduce the threat of air pollution to ecology and living health, to observe the air quality based on these methods and data, to keep this well-being under control in the regions where the air quality is good and otherwise improve it, to do enough about the pollution. Air Quality Assessment and Management Regulation was published and entered into force in order to obtain data and raise awareness of the society with warning limits. Limit values for pollutants have been introduced within the scope of Annex-1 of the Regulation. (Air Quality Assessment and Management Regulation (HKDYY) 2008.)

Table 1. Limit Values of Air Pollutants in Turkey (Turkish Air Quality Assessment and Management Regulation (HKDYY, 2008.))

Pollutants	Average Duration	Limit Value
SO_2	24 for the hour	125 µg/m³
NOx)	for the hour	200 µg/m³
PM	24 for the hour	50 µg/m³
CO	Daily maximum	10 µg/m³
O_3	8 hourly average	120 µg/m³
Benzene	Annual average	5 µg/m³

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Research Area

There is a lot of air pollution problem during winter period in Ankara. The reason for this is the topography of the city, the use of poor-quality fuel in the heating area, and the misuse of these fuels, the use of poor-quality fuels without improvement, the very low wind speed of the city, exhaust gases, etc. effects accumulate in the city and cause pollution.

There are 8 air quality measurement stations in Cebeci, Demetevler, Dikmen, Bahçelievler, Sıhhiye, Keçiören, Kayaş and Sincan districts affiliated to the National Air Quality Monitoring Network of our Ministry of Environment and Urbanization in order to determine the general situation of air quality in Ankara and to determine measures accordingly. PM2.5, PM10, SO2, NOX, Ozone, CO etc. in stations. Meteorological measurements with pollutants are made for 24 hours.

Figure 1. Representative Locations of Air Quality Stations (THEP, 2019)

Figure 2. Bahçelievler Air Quality Measurement Station (https://ankara.csb.gov.tr/)

Table 2. Coordinates of Air Quality Measurement Stations and Measured Parameters

Sampling Station	COORDINATES		MEASURED AIR CONTAMINANTS							
	Latitude	Longitude	PM_{10}	$PM_{2.5}$	SO_2	NO	NO_2	NO_X	CO	O_3
Bahçeli	39.918546°	32.822268°	+	+	+	+	+	+	-	-
Demetevler	39.896459°	32.840752°	+	+	+	+	+	+	-	-
Dikmen	39.967753°	32.795703°	+	+	+	+	+	+	-	-
Keçiören	39.967254°	32.862833°	+	+	+	+	+	+	-	+
Sıhhiye	39.927317°	32.859416°	+	+	+	+	+	+	+	-
Sincan	39.972019°	32.585109°	+	+	+	+	+	+	-	-

RESULTS

Sulphur dioxide (SO₂)

Sulphur oxides are among the most well-known air pollutants. Sulphur oxide, which is a non-flammable, colourless, suffocating, acidic gas, persists in the atmosphere for 40 days (Incecik, 1994). Sulphur compounds in the structure of coal and fuel-oil combine and burn to form SO₂. Sulphur dioxide producing activities are industrial works, domestic fuels used for heating purposes, thermal power plants and the use of diesel fuelled vehicles. SO2 concentrations are generally high in central areas of cities and industrial areas where coal is used for domestic heating (Akyürek, 2012). While the sulphur dioxide values do not exceed the 24-hour limit values specified in the regulation, they are above the long-term limit values and international limit values. While the values reach very high values in winter months,

they are relatively low in summer months. However, high values can be observed in industrial areas such as Ankara sites. It is attributed to the use of fossil fuels as a source.

Particulate Matter (PM)

Because particulate matter is so heavy and large, they can precipitate quickly in the atmosphere. They are also very small granular solid or liquid particles dispersed in the atmosphere. In terms of particulate matter, quality and quantity; particle sizes, concentration, chemical composition and health effects vary. (Öztürk, 2007). Particulate matter sources consist of anthropogenic and natural sources. While SO_2 and PM_{10} (particles smaller than ten micrometers) are measured in all air quality stations in Turkey, as in many other countries in the world, the measurement of the PM2.5 parameter, due to its chemical properties, has begun to become widespread. Since the particles smaller than ten microns have a high rate of reaching the lower respiratory tract and are important due to their physical/chemical effects, limit values have been set and values have been reduced over time. PM10 values measured at Siteler station after October are thought to be due to industrial activities and the use of fuel for heating purposes in this period. High values in the middle of summer at Demeteveler station can only be explained by a special situation for the region. In general, it is seen that PM10 values are above the limit values.
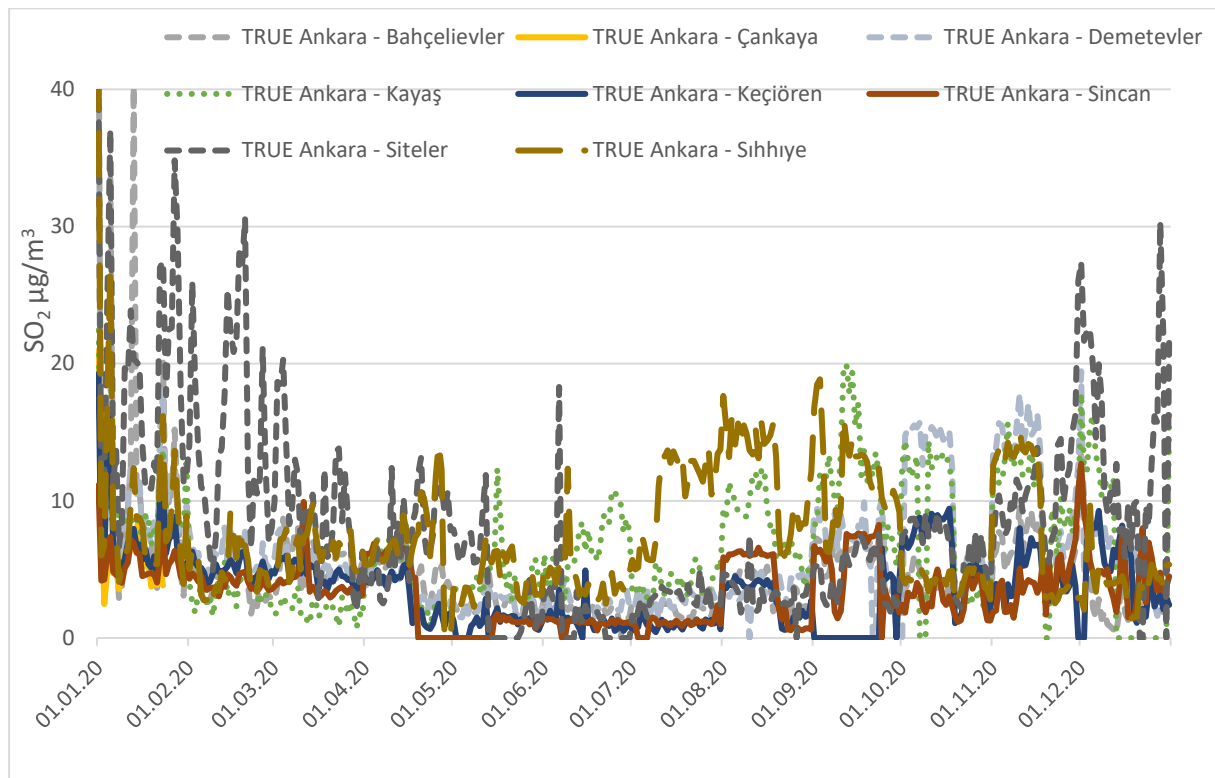

Figure 3. Sulphur dioxide (SO_2) levels 8 air quality station of Ankara Province in 2020
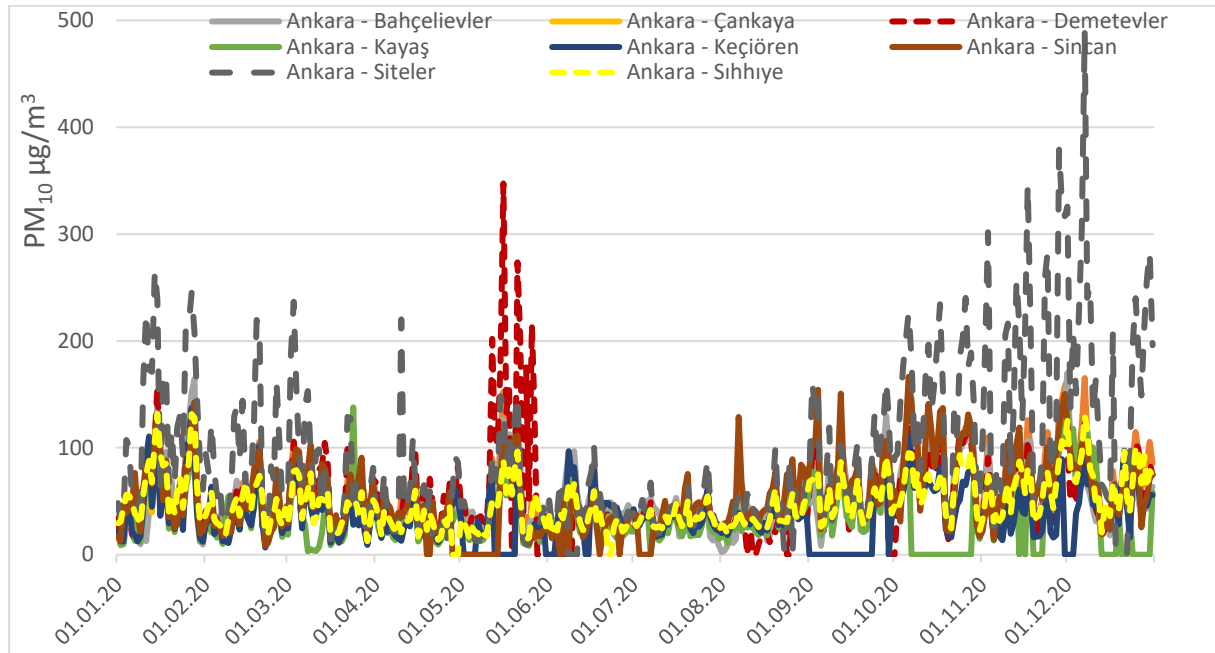
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Figure 4. Particle Matter (PM$_{10}$) levels 8 air quality station of Ankara Province in 2020

Particulate matter Contaminants smaller than 2.5 microns are usually caused by combustion products. Combustion events will be fuel consumption for heating purposes, as well as exhaust gases of transportation vehicles. Meteorological events in the winter months can be a factor in the rise of pollutants. At all stations in Ankara, PM$_{2.5}$ values are observed to be above the limit values in winter months, while the values decrease in summer months. The increase in air temperatures may be a factor in the formation of the pollutant as well as in its distribution (Figure 4).
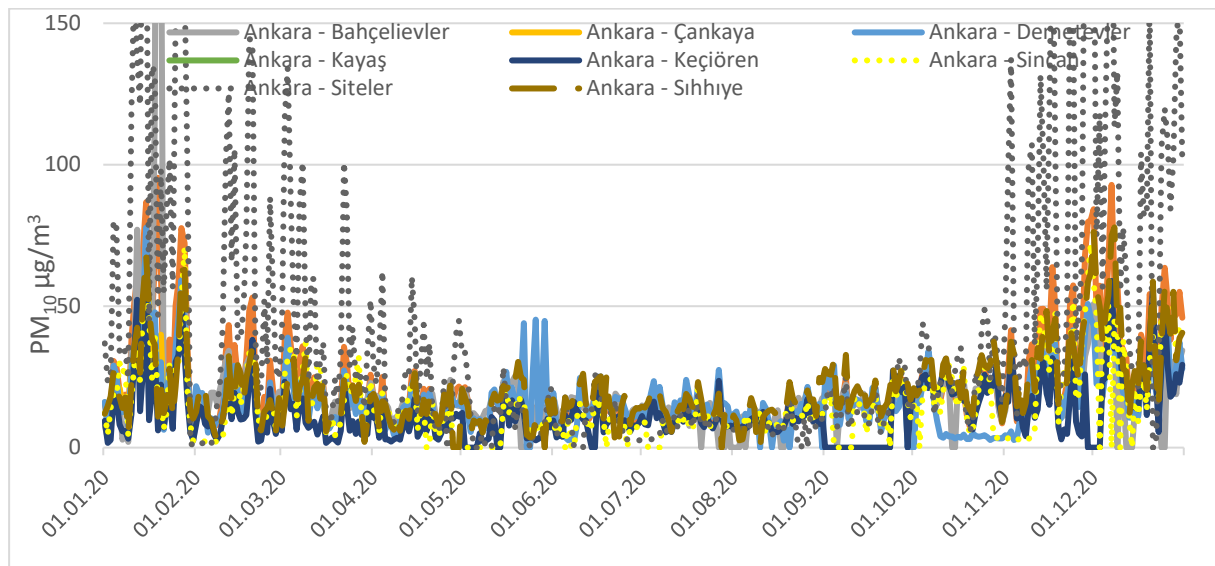

Figure 5. Particle Matter (PM$_{2.5}$) levels 8 air quality station of Ankara Province in 2020

Nitrogen Oxides (NOx)

Nitrogen oxides (NOx) are highly disintegrating gases and most of them are colorless and odorless. In addition, they are insoluble in water and are formed at high temperatures (1200 °C). NOx are formed when solid or liquid fuels are burned at high temperatures. Two important sources are motor vehicles and thermal power plants. Fuel consumption for other industrial plants, commercial and domestic heating are among other sources of NOx. Especially in urban areas, NOx concentrations increase due to the increase in the number of vehicles. Therefore, it causes health problems in the upper respiratory tract

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(Incecik, 1994). Even though SO2 and particulate matter generally decrease in developing countries, NOx emissions increase due to the increasing number of vehicles and industrialization.

Figure 5 shows the NO2 daily grazing values of 8 air quality stations in Ankara for the years 2019-2020. While the general average values are below 100 µg m3, it is seen that the normal values are 3-4 times higher in the last three months of 2019. The explanation of this increase value seems quite complex. If it is not due to measurement errors, this situation needs to be investigated carefully.

Carbon Monoxide (CO)

Carbon is generally formed in fuels when it is not fully combusted. The carbon monoxide (CO) formed is an odorless and colorless gas. CO2 in the urban atmosphere is generated from both vehicles and industry, wood burning and forest fires. CO, together with diffusion in the alveolar-capillary membrane, binds to hemoglobin in the blood and causes carboxy-hemoglobin (COHb). CO is an important indoor air pollutant. And because its affinity for hemoglobin is much higher than that of oxygen, it stops oxygen from binding to hemoglobin. In this way, it prevents the flow of oxygen to the tissues, causing health problems such as headaches and suffocation. Figure 6 shows the average daily CO values measured at 6 stations in Ankara. Although the values are below the annual average values, it is seen that the values reach 5000 µg/m^3 in winter and below 1000 µg/m^3 in June-August. It is thought that this pollutant does not pose a risk for the measured time period and areas.
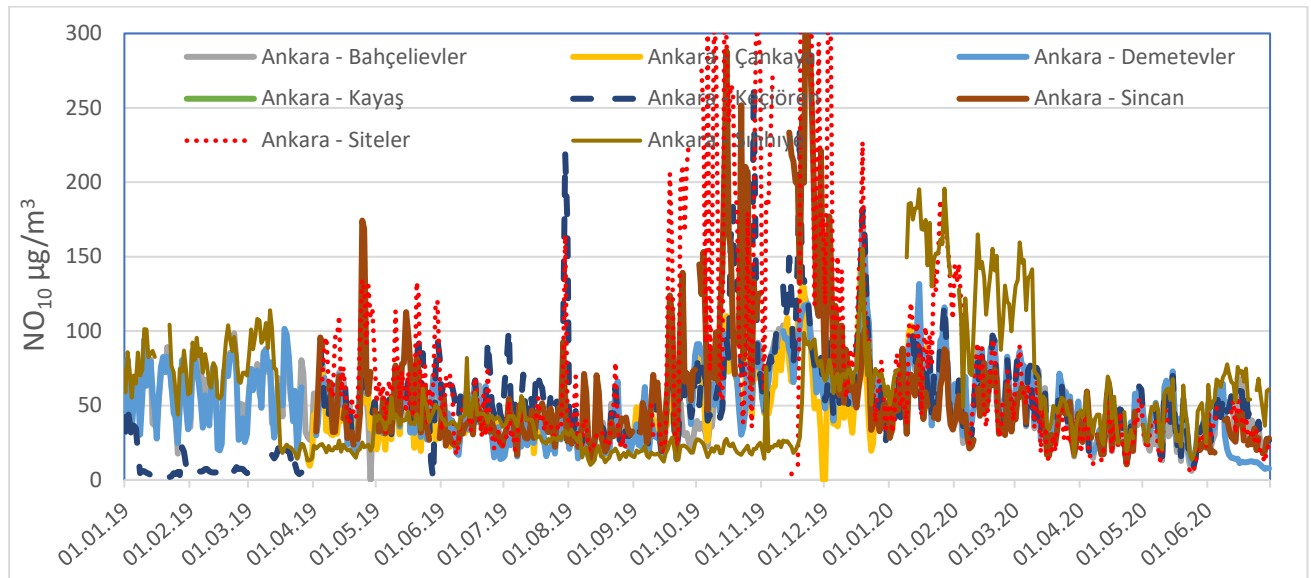

Figure 6. Nitrogen Oxides (NOx) levels 8 air quality station of Ankara Province in 2019-2020
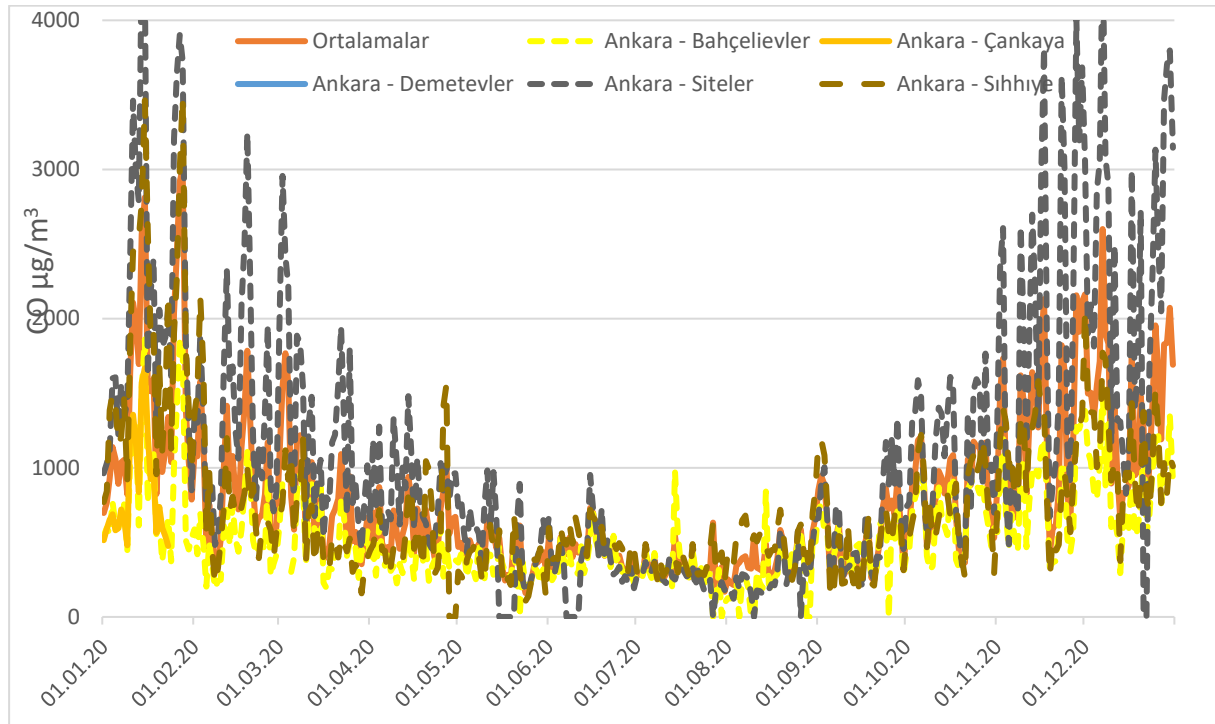
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Figure 7. Carbon Monoxide (CO) levels 6 air quality station of Ankara Province in 2020

Ozon (O₃)

Ozone reaches high concentrations in the stratosphere and is a naturally occurring reactive gas in the atmosphere. In the troposphere, it can be formed as a result of photochemical events from pollutants in anthropogenic sources such as power plants, refineries, chemical factories. (Güler & Akın, 2015). It consists of photochemical processes that take place in the urban and rural atmosphere in the presence of NO_2 and sunlight. It began to be noticed in the atmosphere of Los Angeles in the 1950s. Although transport from the stratosphere also contributes to the increase of O_3 in the atmosphere we live in, it can occur from atropogenic sources to a large extent.

Figure 6 shows the values with the O_3 daily environment for the year 2020, measured at 6 stations in the province of Ankara. While it is observed that the values are below 40 μg/m³ in the winter season, it is observed that the values increase from the summer months and exceed 80 μg/m³ especially in three stations. The number of days when the values exceed the long-term limit values is rare. It is estimated that air pollution is relatively high in regions where ozone value is low in summer months.

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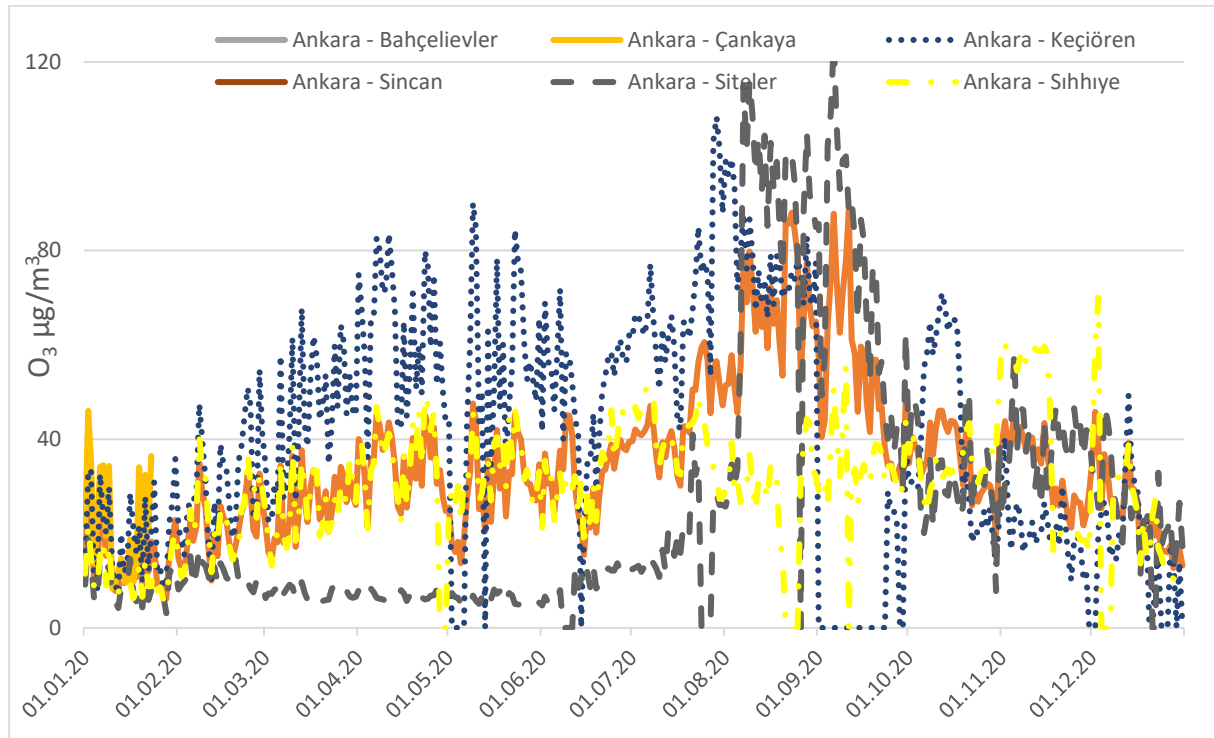
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Figure 8. Ozon (O$_3$) levels 6 air quality station of Ankara Province in 2020

SUGGESTIONS

Diseases arising from air pollution should be declared for public health. Individuals who experience discomfort due to pollution should go to the hospital. Diseases caused by the disease should be investigated in the hospital. At the same time, necessary measures should be taken to reduce the diseases and deaths caused by air pollution. And that's how city plans should go. The absence of unnecessary freedom in thermal power plants will be an important decision in terms of keeping air quality in good condition and reducing it. In order to reduce emissions arising from traffic, which has become the problem of big cities; green wave and smart signalling systems should be used more widely. For patients, children, pregnant women and the elderly, the days and times of temperature reversal should be reported in advance and they should be warned about what to do. Means such as social media and some informing method should be chosen for information. Special precautions should be taken together with the warnings of the measuring stations.

EVALUATION AND CONCLUSION

It was seen that there is a lot of air pollution in Ankara during the winter months. In general, it has been observed that this pollution is caused by traffic, industrialization and rapid population growth. At the same time, the ignorance of the public about air quality accompanies this pollution. Graphs were prepared as a result of the data entered on Excel. By comparing the threshold values determined by the Ministry of Environment and Urbanization, the state of the pollution was determined. In general, it was observed that the pollution increased at Siteler, Demetevler and Bahçelievler stations. This increase will have a great impact on the public health of the society.

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