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ESTIMATION OF THE HEALTH EFFECTS OF EXPOSURE TO PM10 CONTAMINANTS USING THE AIR Q MODEL

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ABSTRACT

According to 1WHO estimates, 800,000 people die of cardiovascular, respiratory and respiratory diseases and airborne lung cancer everywhere in the world, with nearly 150,000 deaths occurring in South Asia. The results of studies on the short-term and long-term effects of hospitalization, referral to the doctor, the number of cases of a specific illness, death and number of years lost in life (YOLL) are reported. The 2Air Q2.2.3 computer model was used to evaluate the effects of exposure to PM10 contaminants on human health in Tabriz metropolitan area. Major sources of emissions are due to human interference with suspended particles of road traffic (10-25%), constant combustion (40- 55%) and industrial processes (15-30%). Materials and methods: In this study, The needs of the Environmental Organization and the Meteorological Organization of Tabriz were gathered. In the next step, the data was processed by Excel software by performing temperature and pressure correction steps, programming, processing (average) and filtering. At the final stage, data processed by Excel was given to the Air Q model. This model is a reliable and reliable tool for estimating the short-term effects of air pollutants by the World Health Organization. The results show that the cases of cardiovascular and respiratory diseases related to atmospheric pollutants during the 10 year period with 4093 and 3353 people, respectively, were %33.10 and %40.7respectively.

Keywords: *Pollutant, PM10, Air Q, Tabriz.*

INTRODUCTION

According to 1WHO estimates, 800,000 people die of cardiovascular, respiratory and respiratory diseases and airborne lung cancer everywhere in the world, with nearly 150,000 deaths occurring in South Asia. The results of studies on short-term and long-term effects are reported as cases of admission, referral to a doctor, number of cases of a specific illness, death and number of lost years of life (YOLL)(Sadat Taghavirad, Davar and Mohammadi, 2014; Delangizan and Jafari Motlagh, 2013).

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Hundreds of thousands of people die each year due to air pollution, of which 90% are in developed countries. In some countries, the number of people who die from the same cause is more than that of road accidents. This mortality is particularly related to asthma, bronchitis, dyspnea and heart attacks, and various respiratory allergies. Air pollution in a variety of ways can have long-term harmful effects on human health. The effect of air pollution varies from one person to another. The vulnerability of some people to air pollution is much higher than others. Young children and the elderly are more vulnerable to air pollution than others. Air pollution is a change in the natural characteristics of the atmosphere due to chemical, dust, or biological agents.

Tabriz is the second most polluted city in Iran and the rate of air pollution in this city is increasing and becoming more severe. The most important cause of air pollution in Tabriz is transportation within the city and the presence of large and mature industries around the city is another factor influencing air pollution in this city. According to a survey conducted in 2010, Tabriz daily produces 1671,558 tons of contaminating material, of which 1,2001,286 tons of large industrial resources, 654, 201 tons of motor vehicles and petroleum products consumed in places Commercial, industrial and residential facilities include 16.7 tons (EPAEAP, 2010).

PM10 particles are Thoracic particles. These particles include particles with an aerodynamic diameter of 10 and less that can pass through the throat (defenses of the body) and deposits in the lung (Kelly and Fussell, 2012). According to the air quality standard in 1996, a 24-hour increase in PM10 increases the risk of an increase in non-accidental deaths by up to 50 (Wark, Warner and Davis, 1998). Suspended particles also cause health effects such as asthma, bronchitis, lung cancer, and cardiovascular disease (Naddafi et al., 2012) With the escalation of vehicle traffic and the increase in polluters such as thermal power plants, petrochemicals and refineries, air pollution has been steadily increasing since the mid-twentieth century. The main environmental threat is now the fissures coming from Iraq and the deterioration of Lake Urmia. The lake has been in crisis since the late 20th century. Reducing the water level, increasing water salinity, and the emergence of large saline islands at its edges are alarming signs of the final drying of this lake. Perhaps in the future wind, salt particles and other salts will be scattered around the lake of Urumieh, especially Tabriz. Making the residents of this city at (Chaudhuri and Sarkar, 1995).

The atmosphere or atmosphere is a natural and dynamic natural gas system that depends on the life of the planet. Understanding the characteristics of this system requires accurate and efficient modeling to consider a set of environmental factors systematically. Then, using few models, estimated the effects of pollutants on a human society. In this research, the necessity to pay attention to the cardiovascular and respiratory health of citizens against air pollutants in the city of Tabriz is modeled. Different zones of the city are extracted in terms of contamination status and the estimation of cardiovascular and respiratory diseases in the form of maps and diagrams, and then in Ultimately, there are some ways to reduce the issues discussed. The hypothesis of this study is as follows:

1. Concentration of air pollutants in Tabriz city has increased in recent years in various urban areas.
2. The number of cardiovascular and respiratory diseases caused by air pollutants in various urban areas has increased in recent years.

3. The number of respiratory diseases caused by air pollutants in different parts of the city has increased in recent years.

THEORETICAL FOUNDATIONS

air pollution

Although minor air pollution was experienced even in 1272 milliard, it was nevertheless proven that in human history, the main issue about this category was significant only in recent years (that is, late in the nineteenth and twentieth centuries). In 1873, when London Maya reported a total of 268 unforeseen deaths from lung related diseases. In December 1930, the industrial area of the Meuse Valley of Belgium experienced a severe three-day famine, in which hundreds of patients and 60 people in that area gradually decreased It found that in 1996 it decreased by 83 times, the highest was 26ppm (for up-to-date quality information South Coast area see http://www.aqmd.gov/Smog/). Inappropriate use of air sources worldwide is observed. Urban air pollution is a growing problem in Latin America and the Caribbean, which is primarily due to The rapid expansion and industrialization of urban communities has contributed to the concentration of pollutants in areas such as Sao Paulo, Brazil, Santiago, Chile and Mexico City, Mexico, consistently exceed the air quality standards of those areas.

The general nature of air pollution issues

Only a small amount of air, soil and water resources is available; with increasing population, the share of these resources is decreasing for each person. In the 1900s, the world's population increased to 1.7 billion. In 1974, the world's population reached 9.3 billion, and in 1993, according to the annual growth rate of 1.6%, the population increased to 6.5 billion. The population of the United States obeyed the same process. In addition, technological advances in agriculture have dramatically reduced the number of jobs in rural areas. Similarly, in other advanced countries, today's two-thirds of the population lives in urban areas that make up about 1 percent of the land. The growth of suburban and large roads has made it possible for more people to reach more distances and reach their cities faster. Therefore, population growth and high living standards lead to a significant increase in the outflow and concentration of air pollutants in the affected areas. For developed or developing countries, there is a close relationship between GDP (GDP) per person and energy consumption per person. According to recent findings, this situation is presented in Table 1 for several countries. These values represent the estimates for the years 1989-91. These data show that the quantity of goods and services used by a citizen is directly related to the amount of energy consumed (directly or indirectly) by that citizen, in other words, the existence and consumption of energy is a standard standard of living. Historically, this increase in consumption Energy has also increased the emission of pollutants to the environment. Our ability to maintain a sustainable environment for the future specifically addresses the efforts of our global efforts to reduce the energy needed to produce products and to find new and improved methods to reduce or eliminate releases of pollutants. Our sources of energy depend on the past Ethical, agricultural and human have found that evacuation of waste products into the atmosphere was more economical than the implementation of waste control methods. In general, the pollution-causing organization or activity did not suffer the consequences of contamination; also, those who benefited from the reduction of air pollution by installing

control equipment, They do not directly bear the cost of equipment. Since the 1960s in the United States, as the community has become increasingly interested in environmental issues, air has also been seen as a source in social areas. Therefore, air pollution is considered as a general problem, and this not only causes concern for people who discharge environmental pollution, but also causes concern for people who may in some way damage their effects. Several other countries have experienced similar developments in the general principles of air pollution. The proper control of air pollution is based on four basic assumptions:
Air is a general category. Such an assumption is essential if air pollution is to be considered as a general issue, which not only causes concern to those responsible for contamination, but also raises concerns for those who suffer from the consequences (Table 1).

Table 1: Energy Consumption Comparison in Different Countries

Country	Energy Consumption (Million Btu/Capita)	(Capita) GDP	GDP/ENERGY
Congo	2	180	90
China	26	370	14
India	9	380	42
Chile	34	2500	73
Russia	191	3220	17
Saudi Arabia	168	5800	35
England	139	15900	114
France	104	18300	176
Canada	281	19400	69
United States	273	19500	71
Japan	111	29774	268

Air pollution is an inevitable part of modern life. There is an inconsistency between our economic and biological inclinations; in the past, this contradiction was marked only after the scourge of air pollution. Therefore, systematic continuous development of policies and programs to preserve the atmosphere is necessary for its biological function.
The scientific recognition of air pollution has been and should be continued for the development of community policy in the past. Although current information on the sources and effects of large-scale air pollution is not complete, this information is not complete. Still, there are many activities to complete effective control strategies, such as prevention, reduction of pollution, continuous improvement, use of control equipment and technologies. However, there is enough information available to further reduce air pollution emissions.
Goodarzi et al. Research in Tehran has accounted for about 6% of total cardiovascular deaths of about 4% and 9% of respiratory deaths due to concentrations of more than 20 10PM (Goudarzi, Naddafi and Mesdaghinia, 2007).
A study by Nadafi and his colleagues was conducted in Tehran in the year 90 in which the results showed that 4.6% of the total death was reported by the PM10 contaminant and caused 2194 deaths of 1367 cases of cardiovascular death and 402 respiratory deaths (Naddafi et al., 2012). Zolghi et al. (2013), Estimation of cardiovascular and respiratory diseases attributable to PM10 contaminants in the air of Tabriz, northwest of Iran, 2011 (using "Air Q" model). The results show that the highest number of cardiovascular diseases (44 people) was in the

concentration range from 70 to 80 micrograms per cubic meter. By increasing 10 micrograms per cubic meter of PM10 concentrations, the risk of cardiovascular diseases in Tabriz increased 0.9 percent, with 68 percent of the respiratory disease on days with A concentration of less than 120 micrograms per cubic meter occurs. By increasing 10 micrograms per cubic meter of PM10 concentration, the risk of respiratory illnesses Each Tabriz increases 0.8 percent (Zolghi et al., 2013).

MATERIALS AND METHODS:

The meteorological station of the synoptic station of Tabriz, the closest meteorological station to the site, was received from the National Meteorological Information Center and the East Azerbaijan Meteorological Organization.

methods:

In summary, using the data of air pollution in Tabriz city, received from the environmental center of Tabriz city and data from the refinery, petrochemicals and industrial towns of Tabriz city, along with data from satellite imagery over a decade (2006-2015), And modeling in the Air Q software platform, is to estimate the small number of patients caused by contaminations such as PM10 in different levels of Tabriz city.

Air Q model:

Cardio respiratory diseases have been used in the Air Q software (World Health Organization, 2004). This application was presented by the Bureau of the European Center for the Environment and Health of the WHO in 2004 and is used to calculate the effects of air pollution. Based on "risk assessment".

The outcomes of the software:

The harmful effects of this software on human health are considered as the following health outcomes:

1. Mortality: The number or the number of deaths (example per 100,000 population) for the specified period of time. This item can include total mortality (all causes except crashes) Total mortality (all causes except accidents (for specific age groups, eg 0-64 years), (over 65 years), (-74 0 years), (Over 75 years), etc; cardiovascular mortality for all ages (ICD9 codes from 410 to 436); mortality from respiratory diseases for all ages (ICD9 codes from 460 to 519).
2. Incidence and prevalence of diseases: the number of cases or ratios (eg, per population unit) for the time period considered. This may include chronic effects or acute effects.

Chronic effects: Hospitalization due to respiratory diseases, hospitalization due to respiratory diseases in special age groups such as (0-14 years), (15-64 years old, (over 65), etc., hospitalization In hospital in special age groups such as (under 15), aged 15-64, admission to hospital due to cardiovascular disease; Hospitalization due to congestive heart in adults.

Acute effects: acute myocardial infarction, acute bronchitis in the group (14-14 years old), asthma attacks in children and adults can be considered.

In this software user should select a parameter as a health consequence. In this software, air pollution is considered to be the following pollutants.

Total suspended particles (TSP)

Black soot (BS)

PM10
Lead (PB)
Benzo AlphaPyrene (BAP)
SO2
NO2
O3

CALIPSO satellite data:

CALIPSO, Satellite Cloud Detector and Aerosol, and Temperature Based on Thermal and Linear Infrared Waves. The satellite is an environmental satellite that was created jointly by the Space Agency of America and France for ground observations. The satellite has been actively and passively monitoring the clouds of clouds and aerosol particles and the vertical temperature of the atmosphere all day long and also has the ability to install on the Aqua, Aura, and CLOUDSAT satellites. In April 2006, the satellite was used to study the effects of clouds and aerosols on the radiation of land and climate. The CALIPSO satellite has the ability to receive data in three levels of led, infrared, and wide-field imaging. The vertical profile of the cloud and aerosol particles is up to 30 km from the ground and their horizontal resolution is 5 km. The satellite is able to capture images from each region at any time of the day, and capture the information in the form of vertical profiles and aerosol particles (vertical profile of the hybrid and aerosol layers, as well as the aerodynamic velocity of the aerial cloud and aerosol particles) and the brightness of the temperature (BT) to users. Vertical profiles are based on linear waves at wavelengths of 532 nm and 1064 nm. If infrared waves, which are the basis for producing glare temperature maps, are propagated in three wavelengths of 8.68 μm and 10 μm and 12 μm / μm (Fig. 1).

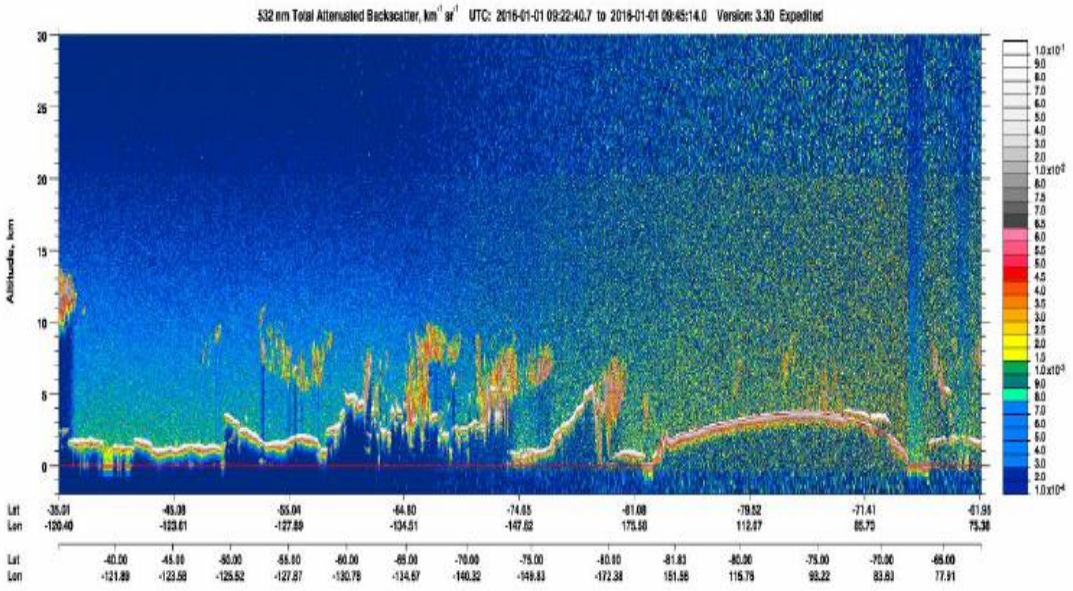

Figure 1: A profile generated from satellite data from CALIPSO

Pollution situation:

The daily traffic of more than 300,000 vehicles in the city and the presence of numerous factories and industries on the border of Tabriz is considered as the main source of air

pollution in the region. According to the studies, the highest contamination in Tabriz air is due to particulate pollutants and carbon monoxide, with the explanation that extra-constructions, the degradation of suburban vegetation and most importantly the activities of industrial complexes, refineries, petrochemicals and industries in the West (region Kojwar (southwest) and the northwest of Tabriz are very effective in exacerbating air pollution in the area.

One of the most important factors producing and exacerbating atmospheric pollutants in Tabriz city, especially in recent years, is:

Increasing motor vehicles and transporting 600,000 vehicles and consuming 1.4 million liters of gasoline per day

Topographic factors and terrestrial complications around the city and lack of green space

Focus on important service centers in the city center

Development of industries and their concentration in the metropolitan suburb of Tabriz

Urban population growth and urban development

Occurrence of dust phenomena and temperature inversion due to climatic conditions

PM10 modeling:

The PM10 gas regimes trend is roughly increasing from the previous states of SO2 (NO2), from the east and west to the central regions, decreasing by 52.1 and 0.205-0.107, on average, the central regions of 1 / 3 µg shows an increase in the concentration of PM10 compared to the eastern and western parts of Tabriz, although there is no particular trend in the north to south direction. Table 2 shows the overall state of the PM10 concentration in the study area.

Table 2: Statistical status of PM10 concentration

Row	Average	Standard deviation	Maximum	Minimum
1	4.91	17.7	115	0.0051

RESULTS

Estimate of contaminated diseases

In this part of the study, based on the available data and modeling, for each year during the 2006 to 2015 statistical period, estimates of the incidence of cardiovascular and respiratory diseases have been reported.

Estimation of Cardiovascular Diseases:

After extracting the amount of pollutants in each block of the city over the past 10 years, using the Air Q model as well as the ArcGIS different areas for determining the cardiovascular disease, as shown below, is presented in Fig. 2. A summary of its information is presented in Table 3.

Table 3: Statistical status of cardiovascular disease attributed to various contaminants

Row	Pollutant	Average	Standard deviation	Maximum	Minimum	Total
1	PM10	0.4	0.3	1.8	0	219.3

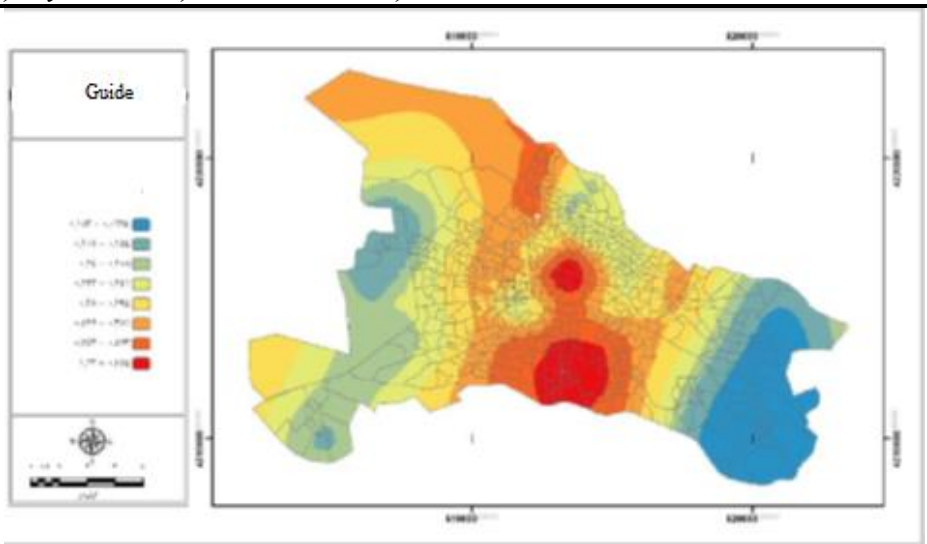

Figure 2: Map of the estimated cardiovascular risk associated with PM10 contamination

Estimation of respiratory diseases

Then, after extraction of the pollutants of each block in the last ten years, using Air Q model and ArcGIS different instruments for assessing respiratory diseases were determined, which is presented in Fig. 3 below. A summary of its information is presented in Table 4.

Table 4: Statistical status of cardiovascular disease attributed to various contaminants

Row	Pollutant	Average	Standard deviation	Maximum	Minimum	Total
1	PM10	0.3	0.2	1.3	0	156.6

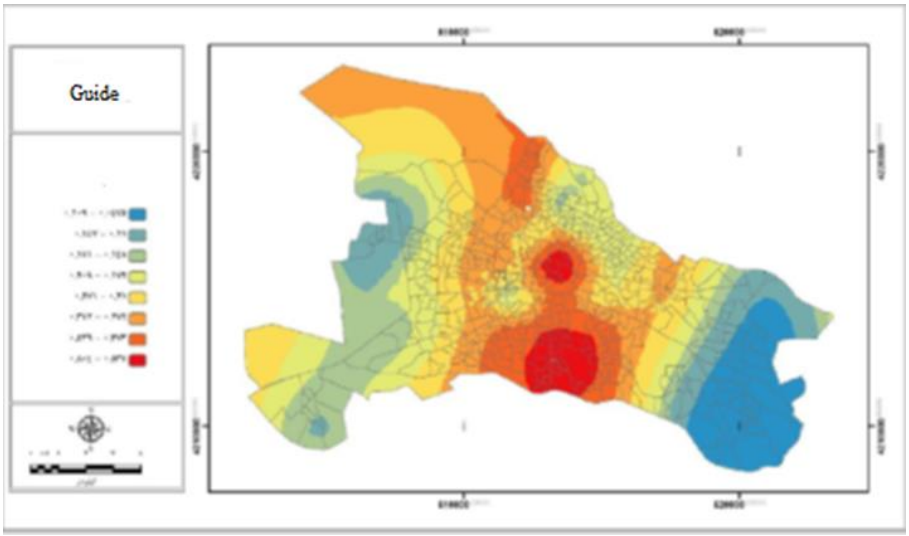

Figure 3: Estimate of respiratory rate associated with atmospheric PM10 contamination

Temperature inversion in Tabriz city

The results of the study showed that the average number of days associated with the temperature inversion phenomenon in Tabriz is 118 days, of which 55% is related to the inversion of the radiant temperature and 45% is related to the inversion of subsidence

temperature. In total, 21 cases of severe temperature inversion during this period, 17 cases were observed in winter, especially in January, with 9 cases and 8 others in late autumn. Figure 18 shows the co-integration profile using Lidar data over the world. Also, in Figure 19 below, the image of Lidar shows above the country and the city of Tabriz.

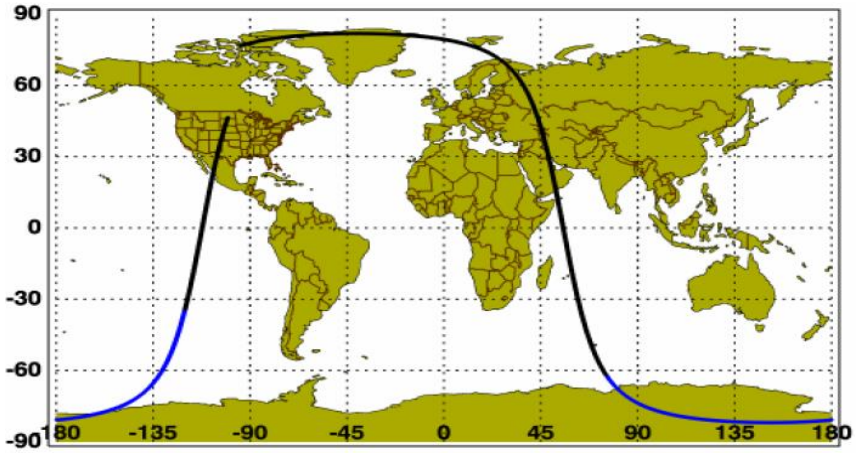

Figure 4: Location and registration of the Lidar for the city of Tabriz

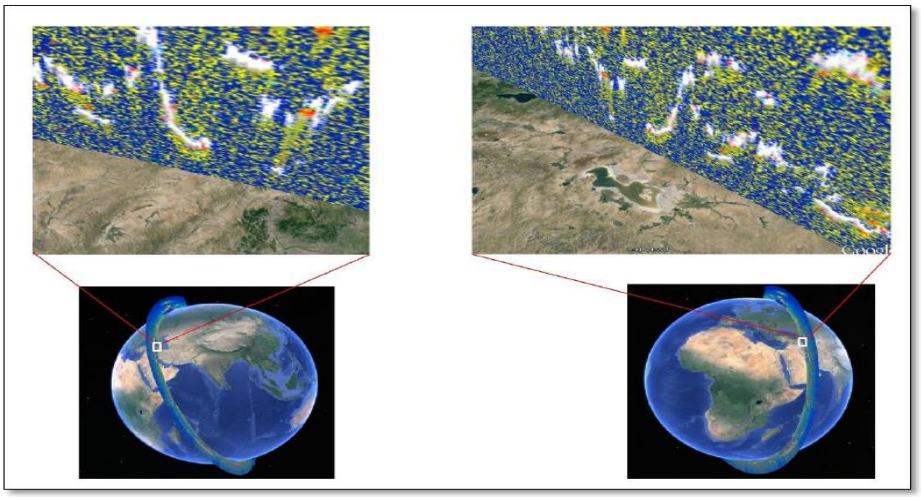

Figure 5: View Grid Profiles in Lidar Data

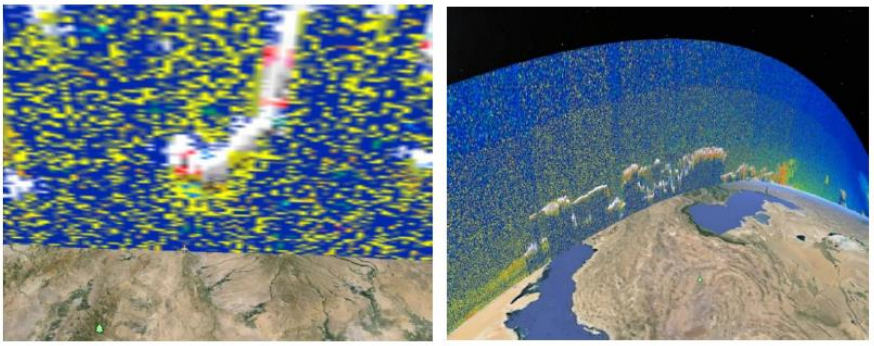

Figure 6: Display of the temperature of the upper atmosphere over 45 degrees of the country (on the right (Tabriz (left)

In general, for some days of the year, especially in recent years, Tabriz has experienced severe infections.

Proof of assumptions

In this section, the research hypotheses are considered and their appropriateness or rejection are measured:

Hypothesis 1: The concentration of air pollutants in Tabriz city has increased in recent years in different parts of the city.

The increasing growth of motor vehicles, increasing population density, concentrating industries around Tabriz, climate change, land use change, etc. have all been affected by the trend of atmospheric pollutants in the center of East Azarbaijan, Tabriz city. The results are different for different pollutants. As shown in Fig. 7, various atmospheric pollutants have always been upswing. CO gas with the highest 25.8 percent increase. It is also second in SO2 gas at 19.4 percent. The concentration of PM10 increased by about 19.05 percent. In the end, NO2 gas has risen by 56.14 percent to a lesser extent than other pollutants. For this reason, the first hypothesis in this study was approved as enhancement of concentration of air pollutants in Tabriz city in different areas of the city in recent years.

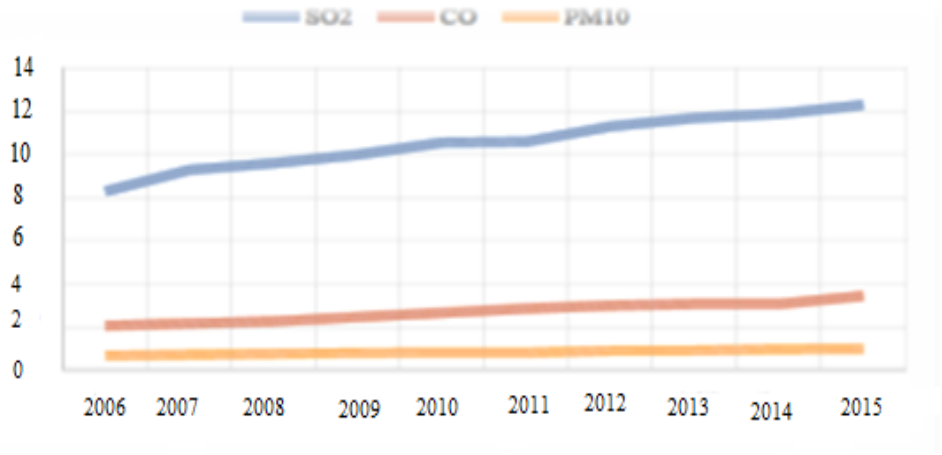

Figure 7: Urban Urban Pollution Process in 2006-2015

Hypothesis 2: The number of cardiovascular and respiratory cases caused by airborne contaminants in different urban areas has increased in recent years.

According to the findings of recent research, the number of patients with cardiovascular disease due to the increase in the amount of atmospheric pollutants has always been increasing. Based on Figure 8, the incidence of patients in the Air Q model in 2006 and 2007 was respectively 29.58 and 17.3084/17 respectively, while in recent years, 2014 and 2015, respectively. , This figure was 4075/67 and 54,4093. Growth of 33.3% indicates an upward trend in the number of cardiovascular patients caused by atmospheric pollutants. For this reason, the second hypothesis in this study confirms the increase in the number of cardiovascular and respiratory diseases caused by airborne contaminants in various urban areas.

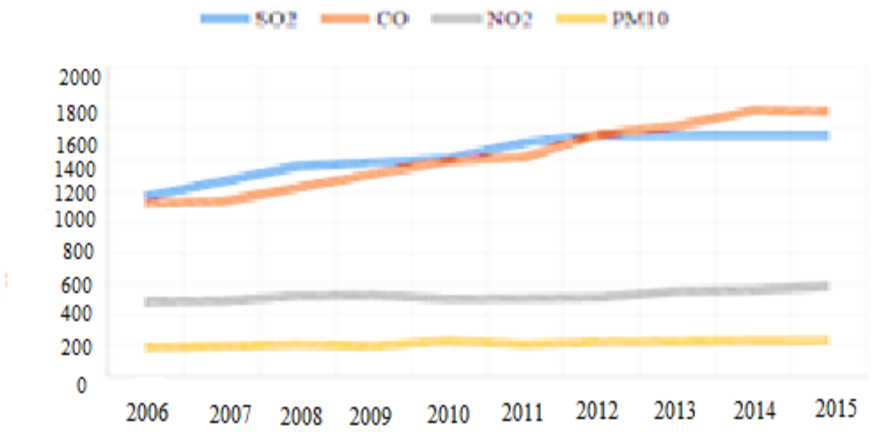

Figure 8: The number of cardiovascular and respiratory illnesses attributed to atmospheric pollutants in 2006-2015

Hypothesis 3: The number of airborne respiratory tract infections in different urban areas has increased in recent years.

According to research findings, in recent years, due to the increase in atmospheric pollutants, the modeling of the number of respiratory illnesses attributed to the pollutants has risen. Based on Figure 9, the incidence of the Air Q model in 2006 and 2007 was 13,889,81 and 44,2709/44, respectively, in recent years, 2014 and 2015 respectively. , This figure was equal to 3205/14 and 3353/04. Growth of 40.7% indicates an upward trend in the number of respiratory cases caused by atmospheric pollutants. For this reason, the third hypothesis in this study is to confirm the increase in the number of respiratory infections due to airborne contaminants in different urban areas.

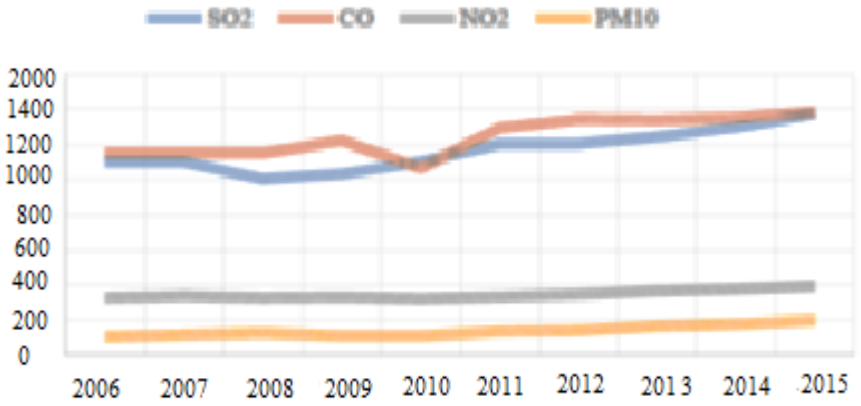

Figure 9: Number of respiratory illnesses attributed to atmospheric pollutants in 2006-2015

DISCUSSION AND CONCLUSION:

Tabriz is the second most polluted city in Iran and the rate of air pollution in this city is increasing and becoming more severe. The most important cause of air pollution in Tabriz is inland transport, and the presence of large and mature industries around the city is another factor influencing air pollution in this city. According to a survey conducted in 2010, Tabriz

daily produces 1671,558 tons of contaminating material, of which 1,2001,286 tons of large industrial resources, 654, 201 tons of motor vehicles, and petroleum products consumed at the sites Commercial, Industrial and Residential Offices include 16.7 Tons (EPAEAP, 2010).

In past research, this is important. Pope research was conducted in the United States in the year. The results of this study showed that, with the increase of PM10 particles, the risk of hospitalization for heart failure patients increases, which is consistent with the current studies (Liu et al., 2007)

Shi et al also investigated the hourly changes in PM2.5 particle concentration in 2008-2007 in Hong Kong. The results showed that various parameters such as ambient temperature, relative humidity, wind speed, wind direction and moderate The pressure level will be effective at concentrations of PM2.5 particles (Shi et al., 2012).With the escalation of vehicle traffic and the increase in polluters such as thermal power plants, petrochemicals and refineries, air pollution has been steadily increasing since the mid-20th century. New threats, such as the explosions from Iraq and the deterioration of Lake Urmia, are very disturbing. The results of this study indicate that PM10 concentration increased by about 19.05%. For this reason, the first hypothesis in this study was approved as enhancement of concentration of air pollutants in Tabriz city in different areas of the city in recent years. Also, cases of cardiovascular and respiratory diseases related to atmospheric pollutants during the 10 year period with 4093 and 3353 people, respectively, were 33.10% and 40.7%, respectively.

Therefore, urban air quality is considered as an effective factor in the health of citizens from the important and new features of the urban environment. Much of the pollution of metropolitan airspace is due to pollutant emissions in the urban transport sector, which highlights the need for more sustainable transport modes such as public transportation.

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