

## Use of GIS and Statistical Analysis to Investigate the Relationship between Atmospheric Pollution and Inversion (A case study: Tehran City)

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**Abstract:** Climate change has a lot of harmful influence on the environment. Tehran is one of the cities in terms of environmental pollution caused by industrial processes and urban activities. Particulate matter concentrations often exceed threshold values at which human health is severely affected. Atmospheric sustainability resulting from inversion is one of the most important reasons for escalation of potential air pollution in big cities in particular Tehran. Tehran being surrounded in an arch-shaped space of western and south eastern currents doesn't have an effective refining quality. Consequently this situation leads to dangerous phenomena called inversion. Inversion is one of the basic factors in studying the pollution of Tehran. In this study, firstly the statistics of Tehran's inversion during months of fall and spring season were provided on a daily basis from 2006 to 2009. for a statistical period using meteorology organization's data. In order to classify the pressure, we used operative analysis model. The results show that, the temperature inversion. Was ongoing in Tehran at the time the research was being done in all the seasons of the same year. the most largest circumference of temperature inversion was seen in fall and winter and the most largest circumference was seen in November and January. In this study we have dealt with identifying the most effective sinoptical patterns of inversion in Tehran as well as increasing the occurrence and the percentage of inversion which has direct relation with increasing the pollution.

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### Introduction:

Tehran is one of the Major cities of the world, which is already suffering from pollution. In some days of the year the amount of pollutant elements increases to the extent that it makes living pretty much difficult to survive. Tehran's geographical position as well as its topographical condition plays some rules in the intensity and frequency of this sustainability and inversion acquired by it. However, inversion occurs in most of the time of the year in Tehran. It's intensity has a direct relation with the dominant sinoptical conditions. (Yonesian, 2000) The air pollution reaches to it's peak when the inversion remains in the air with low altitude and long time makes a static and stable barrier which makes mixing this layer with the upper ones impossible and with the increase of the thickness of the pollutants under it, The air pollution increases. The inversion occurs more than 200 times in Tehran. (environmental engineering magazine 1992, page 14). The least inversion height occurs in the end of fall and at the beginning of winter and the height of the inversion has a negative congruence with its intensity. Carbon mono oxide with the side and the speed of the wind and it's negative congruence and thickness has a direct relation with it's inversion intensity. (Deljoo 1999). In 1987 the margin of ten microns has been determined to the airodynamic diameter of the suspending articles by this committee and particles smaller than this due to the power of penetrating in Aloels received the highest health benefits.

(calcestone, 1987, page 178) Many people lose their lives due to inversion and increasing pollution each year.

In 2009 Alijani studied the synoptical inversion patterns in Mashhad (City located in northern east of Iran) using operative analysis, and investigated different patterns as well as effective patterns in his analysis getting to the conclusion that most of the inversions occur in winter thus they have greatest power and durability. (Alijani 2002). The way of classifying the pressure patterns is the most suitable tool for identifying circulating dominant patterns in a specific time and place. The purpose of this study is to identify possible diversity of having the same pressure patterns of the earth surface during 2006 to 2009, in which the patterns were identified and classified as well as possible time changing as well as identifying and organizing the models which was classified in several different patterns of the models on the basis formation point as follows: In this study we have dealt with identifying the most effective types of inversion in Tehran as well as increasing the occurrence and the percentage of inversion which has direct relation with increasing the pollution.

### Methodology:

In this study, first of all the daily statistics of the inversion in Tehran during fall and winter for the statistical period was prepared from 2006 to 2009 using meteorology organization. the (skew-T) map was prepared of all the days (from which the inversion is identified) and it was compared as well as corresponded with the existing

statistic. The pollution of Teheran's stations was prepared from the preservation of environment organization, to analyze the relationship between inversion and pollution. Since the aim of this study is to identify the synoptic systems, the statistics of the pressure of the sea level at: 00 o'clock of the days that had inversion was received from NCEP (an internet site) in a digital about 20 to 50 north degree till 30 to 70 east degree and a matrix operation was done on them. In the next round, due to frequency of the days of inversion which made the analysis of the map difficult, the daily pressure data was classified in order to categorize the pressure, the operative analysis was employed. With the help of the operative analysis method, we can manage to classify the weather dominating a place for a specific period of time. The operative analysis method is a way that has been mainly created for decreasing the number of variables. The advantage of this method is that not only it decreases the number of variables but also it preserves the initial quantity of existing variance in the main data. (Alijani 2002). The main confluence factors and the pressure data were decreased to a limited number of factors and finally according to the origin of creation and the existing maps and diagrams and existing of high pressure and low pressure on the earth's surface the effective air types in the inversion of Tehran was detected.

### Result and discussion

Having done the study after acquiring the effective patterns on Tehran's inversion which will be shown in the following diagrams we will talk about them:

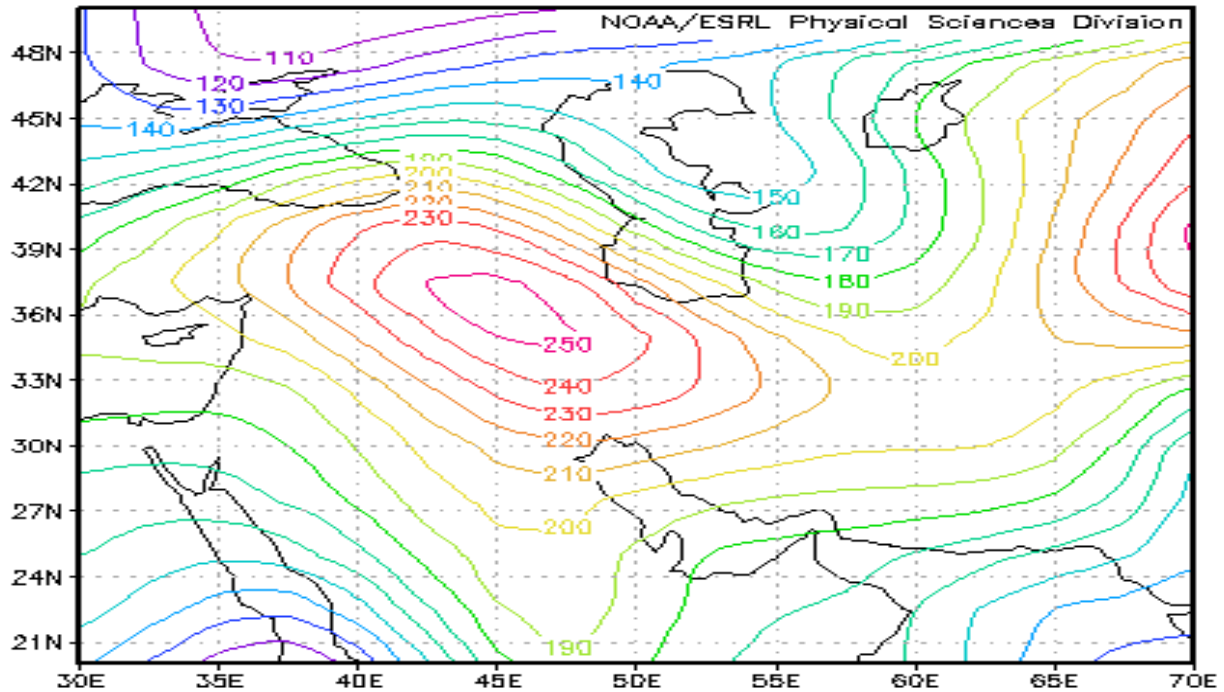
#### The type of high pressure Zagros pattern ( 26 Jun 2007)

In type of pattern, the high pressure one over Zagros is located at the epicenter 1025 and at the other point of middle – east and our country, sparks of the high pressure pattern with the curve of 1023 is dominant over Tehran and causes The short time air sustainability, especially at the beginning of the days and causes the pollution to be collected at the lowest surfaces this sort of pressure distribution occurs in late fall and early winter. When this pattern is dominant over Tehran a very great sustainability is dominant over Tehran so that the amount of this mass is more than 7 days that has caused more concentration of pollution in the lowest layer and increasing the amount of pollutants at most stations of Tehran so that the amount of carbon dioxide has exceeded the critic level at some stations.(Table ,1and Graph 1).

Table:1 The Amounts of pollution of Tehran's Station (26 Jun 2007)

**Table1:** The Amounts of pollution of Tehran's Station (26 Jun 2007)

85/11/06	CO	O3	NO2	SO2	PM-10
<b>Fatemi</b>	130		8		57
<b>Bazar</b>	96		13		
<b>Aqdasiéh</b>	119	15	90	64	86
<b>Mehr-Abad</b>	113	54			
<b>Shahr – rey</b>	84	18	66	68	69
<b>Geophysics</b>	201	8	63		64
<b>Sorkhe - Hesar</b>	33	12	18	22	85
<b>Tajrish</b>	173		82	54	142
<b>Pardisan</b>	199	16	43	53	95
<b>Qolhak</b>	106	18	136	67	
<b>Bahman</b>	125		109	40	98
<b>Azadi</b>	261	8	60	81	115
<b>PSI</b>	137	19	63	56	90



Graph 1: The patterns of sea level pressure (26 Jun 2007)

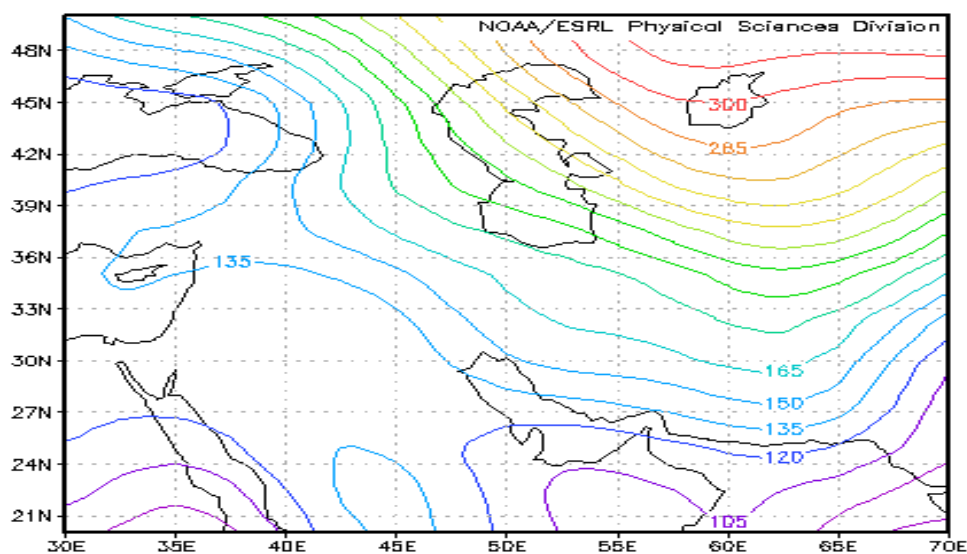
**The type of high pressure Siberia pattern ( 26 Jun 2007):**

In this pattern of high pressure Siberia with 1035 millibars from Siberia ,which enters Iran that carries Siberian cold weather with penetrating the cold weather causes an almost intense air sustainability over Iran.Sparks at this pressure with the pressure of 1018 milibars has been developed over

Tehran and even has reached to Eastern parts of Iran which due to creating inversion and lack of air ventilation in lowest layers, the weather of the region will be entirely sustainable and the pollution will relatively be high, which in graph 2 and table 2, the mount of pollution at some stations for 18 Aban 1388 have been shown.

**Table 2** - the amount of pollutions at Tehran's Stations (9 No, 2009)

88/08/18	CO	O3	NO2	SO2	PM-10
The governer's office	165	10	38	51	68
Aqdasiéh	84	38	37	57	46
Rose park	49	17	19	42	35
Punak	43	47	30	30	31
Geophysics		21	25	13	45
Shahre – rey	99	51	21	28	47
City hall district four	59	9	35	32	74
City hall district 11	52		25	33	87
City hall district 10					
City hall district 16				45	62
City hall district 19	81	30	22	40	67
Golbarg	38	7	15		51
Maweoudieh	30	42	20	23	43
Azadi	179	38	36	90	93
Imam Khomeini					
Bahman	54		65	27	71
Pardisan					
Tajrish	85		31	45	75
Sorkhe – Hesar	18	66	27	14	54
Qolhak	51	55		56	121
PSI	72	33	30	39	63

**Graph: 2-** the pattern of sea level pressure (9 Nov 2009)

**Conclusion:**

In this study we have employed the operative analysis method then arrangements of similar patterns has been classified at the same level and out of these similar patterns of one system for a specific day in which the amount of patterns for that day was prepared and then it was studied and analysed on the basis of dispersion of pressure for dominant types.

The results show that the inversion during the course of study in Tehran has been settled in all seasons and due to qualification the inversion conditions, the temperature sustainability of the earth's surface has been settled and 80 percent of the days of four years was studied under the dominant inversion conditions, but the height of the layer of inversion varies according to changing the seasons, and the greatest circumference of the inversion has been in fall and winter according to the maps of skew-t. and the greatest amount of circumferences has been in November and January. Also out of these pattern types 1,4 and 5 the patterns related to the simultaneous mass above Iran north east over( Aral lake) and north - west and east of Turkey. The pattern related to high- pressure Siberia. It became evident in studies done that usually most of the inversions occur in late fall and winter and winter inversions have more power and continuity.

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