

Study and an investigation of Ternpresture inversion and effective factors in pollution of Tehran with the use of climate statistical analysis and GIS

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Abstract: atmospheric sustainability resulting from temperature inversion is one of the most important reasons for escalation of potential air pollution in big cities in particular Tehran. Therefore inversion is one of the basic factors in studying the pollution of Tehran. Tehran being surrounded in an arch-shaped space of western and south eastern currents doesn't have an effective refining quality, and thus Tehran's weather is still and static and consequently this situation Leads to dangerous phenomena called temperature inversion. 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. 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 in which the most largest circumference of temperature inversion was seen in fall and winter and the most largest circumference was seen in November an January. Also , among the patterns related to the simeltanous mass. Above Iran's north east (above Aral lake) as well as the north west and east of turkey, the pattern related to high pressur zagros had the most intense stability compare to the rest of the other systems and normally out of these systems Siberia's high pressur stability has been greater compare to other systems and when it accompanies the high-pressure part of Iran it's intensity gets greater. [Azadeh arbabi sabzevari and AliReza Jalalzaie. **Study and an investigator of Ternpresture inversion and effective factors in pollution of Tehran with the use of climate statistical analysis and GIS.** *Life Sci J* 2012;9(4):3703-3709]. (ISSN: 1097-8135). <http://www.lifesciencesite.com>. 549

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 it's 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 sinotopical conditions. (Yonesian, 1378)

- 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.

In this study we have attempted to investigate the inversion of Tehran case by case.

For this reason the data of the atmosphere above Tehran's station has been collected during 2006 to 2009 at zero green which and has been studied.

(Ensafi Moghaddam, 1372)

- Therefore, inversion is one of the basic factors in increasing the pollution of Tehran.

Tehran being surrounded in a ach-shape western and south eastern currents, dose not have any refining quality, and thus. Tehran's air in most of the time is static and motionless and as a result this situation will lead to a dangerous phenomena called air or tempretature inversion . (Soltani Nejad 1376).

In winter except for few days of the season, The other days are clean and sunny.

Likewise due to the night radiation and snow on the northern mountains, this kind of radiative inversions as well as movements are usual.

On the other hand, according to the Topographical and Thermodynamical qualities of atmosphere.

The inversion phenomena over Tehran in all seasons, occurring In sinoptical conditions happing in the region and Iran is very strong and

inversions resulting from this condition is synoptical and durable.

In summer inversions adjacent to earth reaches to its peak but they are not very impressive. (Mohseni 1366)

In spring and fall due to domination of instability the number of inversions is not a lot. The inversion occurs more than 200 times in Tehran. (environmental engineering magazine 1371, 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 its negative congruence and thickness has a direct relation with its inversion intensity. (Deljoo 1379)

Nowadays, air pollution is one of the problems major cities and the inversion is one of the basic factors for intensifying this phenomena.

In addition to that, those sources of creating and spreading contamination are very effective in increasing the pollution. (Hall .j. v. and clean, my colleagues and I 1999, page 445)

These material can exist in the state of solid particles Liquid drops, gas or a Mixture of these stuff. (Lais La. 1996, page 287)

The protection of environment committee of the u.s considers the five polluting articles including Mono-oxide Nitrogen dioxide, sulphur dioxide and suspending particles with less than two microns as well as Hydrocarbons among atmospheric pollutants.

In 1987 the margin of ten microns has been determined to the airodinamic 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.

This problem has been of greet concern for officials since the past.

- In 1388 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 1381)
- 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.

The 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. This data was along with the statistical gaps. since the inversion's data cannot be reconstructed the (skew-T) plan of all the days was prepared (from which the inversion is identified) and it was compared as well as corresponded with the existing statistic, and for all the days statistical data reacted to pollution . Of Teheran's stations was prepared form 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 form near 20 to 50 north degree as well as 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 1381)

Then with using the operative analysis.

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.

Studing the sinoptical patterns of inversion in Tehran

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:

A: type pattern (January 2008):

The first graph shows the system arrangements on the ground earth's surface as you see in this pattern a high pressure center with the central pressure of 1022 HECTOPASCAL over 63 degrees east altitude and 41 degrees of north latitude has been formed.

The scope of this high pressure along the north eastern to south western almost covers central and southern Iran, and a high pressure cell in turkey's east 1025 along with the high pressure west soudi Arabia, with

The curve of 1023 has sent it's sparks up to Iran's central parts.

According to the maps available and studies this pattern mostly occur in winter, which has been less that the similar pattern of much pressurized soudi arabia where as the other two patterns play a basic rule in creating inversion of above Tehran.

In the following figure the amount of pollution related to the very day 3 Bahman, 1388 has been shown which according to graph no. I due to making comparative distance of the cold layer and more height of the stations above Tehran The amount of pollutants is much higher in the areas of these stations.

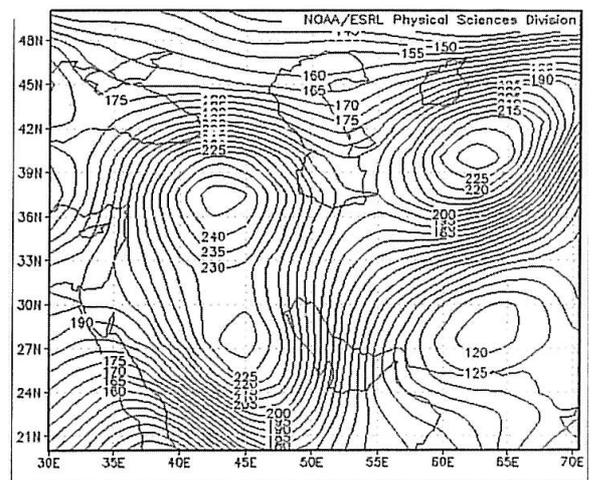
| 88/10/13 | CO | O3 | NO2 | SO2 | PM-10 |
|---------------|-----|-----|-----|-----|-------|
| Bazar | 86 | | | | |
| Aqdasieh | 61 | 125 | #6 | | 36 |
| golbarg | | | | | |
| Shahre rey | | 30 | 25 | 50 | 29 |
| geophysics | 73 | 29 | 32 | 51 | 44 |
| Roz park | 52 | 70 | 55 | 39 | 64 |
| Punak | 64 | 31 | 66 | 58 | 34 |
| Masoudieh | 30 | 29 | | 60 | 28 |
| Imam khomeini | | | | | |
| Sorkhe hesar | 30 | 85 | 16 | 20 | 44 |
| Tajrish | 92 | | 61 | 40 | 77 |
| Pardisan | | | | | |
| Qolhak | 82 | 16 | | 23 | 132 |
| Bahman | | | | | |
| Azadi | 106 | | 22 | 93 | 76 |
| PSI | 68 | 52 | 39 | 48 | 56 |

Chart: 1. The amount of pollution of Tehran's stations (3 january 2008)

Type 2 pattern (11 january 2007)

The type 2 shows a winter pattern which is normally formed over the middle East in winter which is accompanied by the penetration of siberias cold weather into our country.

In this high pressure pattern sparks 1026 milibar has been formed over Northwest of our country. In this pressure distirbating high-pressure 1020 milibars have been stretched up to south of the country thus this sinoptical condition has caused the cold weather to be poured over Tehran and has caused weather sustainability over Tehran.

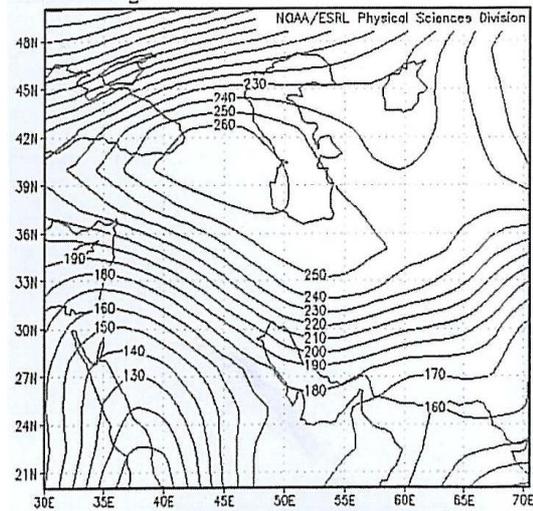


Graph: 1. The pattern of sea level pressure (3 january 2008)

Out of these six categorized patterns this pattern is the most strongest of all and the air condition is much more sustainable. There fore the temperature inversions last longer and following that the weather pollution in the industrial centers and Tehran are much higher compare to other patterns.

For this reason the amount of pollution is much higher in these stations in particular when this pattern is dominant.

| 85/10/21 | CO | O3 | NO2 | SO2 | PM-10 |
|----------------|-----|----|-----|-----|-------|
| Fatemi | 69 | | 5 | | 34 |
| Bazar | 46 | | 6 | | 20 |
| Aqdasieh | 90 | 20 | 31 | 54 | 45 |
| Mehr Abad | 81 | 51 | 22 | | |
| Shahre – rey | 55 | | 27 | 41 | 38 |
| Geophysics | 44 | 13 | 51 | 60 | 28 |
| Sorkhe – Hesar | 13 | 19 | 7 | 17 | |
| Tajrish | 72 | | 39 | 73 | 99 |
| Pardisan | 90 | 13 | 19 | 42 | 67 |
| Qolhak | 77 | 16 | 46 | 59 | 55 |
| Bahman | 70 | | 88 | 27 | 60 |
| Azadi | 119 | 12 | 30 | 69 | 57 |
| PSI | 69 | 21 | 31 | 49 | 50 |



Graph: 2. The Pattern of sea level Pressure (11 jan 2007)

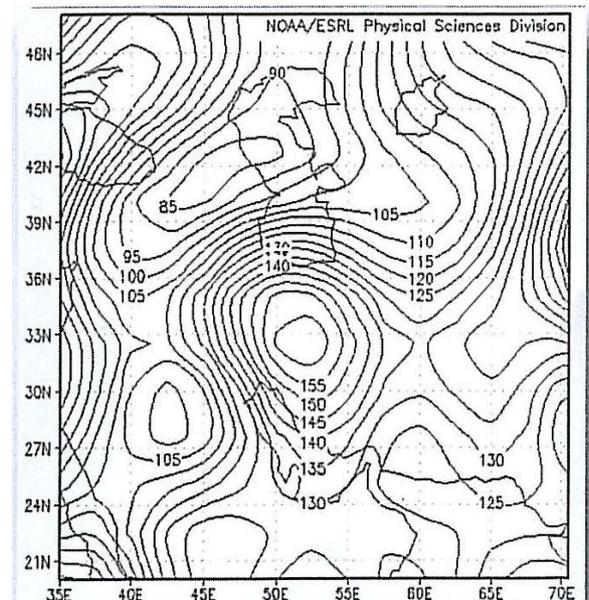
Chart: 2. The amount of pollution of Tehrans station (11 jan 2007)

Pattern 3 (5 Nov 2006)

The Type 3 pattern normally is formed in fall. In this pattern the center of Iran is in the expansion of high pressure pattern with the epicenter of 1016 milibars, and the distance between Caspian sea's Central parts to the east of Turkey is in the stretch of low pressure system of 1008 milibars

in which this state lets it move and it causes the spreading of Iran's Central pressure to the north of the country as well as the air sustainability and lack of ascending currents on the earth's surface Which has been demonstrated in figure 3 of the amount of pollution related to this pattern for 14 Aban 1385.

| 85/8/14 | CO | O3 | NO2 | SO2 | PM-10 |
|----------------|-----|----|-----|-----|-------|
| Fatemi | 124 | | 17 | | 43 |
| Bazar | | | 6 | | 87 |
| Aqdasieh | 84 | | 18 | | 19 |
| Mehr – Abad | 66 | 57 | 21 | | |
| Shahr – rey | 63 | 12 | 38 | 54 | 32 |
| Sorkhe – Hesar | 16 | | 4 | | 21 |
| Tajrish | | | | | |
| Pardisan | 97 | 19 | | 13 | 23 |
| Qolhak | | | | | |
| Bahman | | | | | |
| Azadi | | | | | |
| PSI | 75 | 29 | 17 | 34 | 38 |



Graph: 3- The level pattern of sea level Pressure (5 Nov 2006)

Chart: 3- The amount at pollution of Tehran's stations (5 Nov 2006)

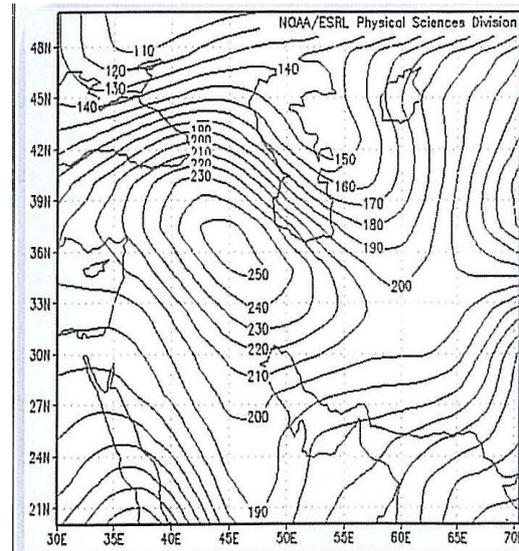
The type 4 pattern (26 Jun 2007)

In type 4 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.

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



Graph: 4- The patterns of sea level pressure (26 Jun 2007)

Chart: 4- The amounts of pollution of Tehran's station (26 Jun 2007)

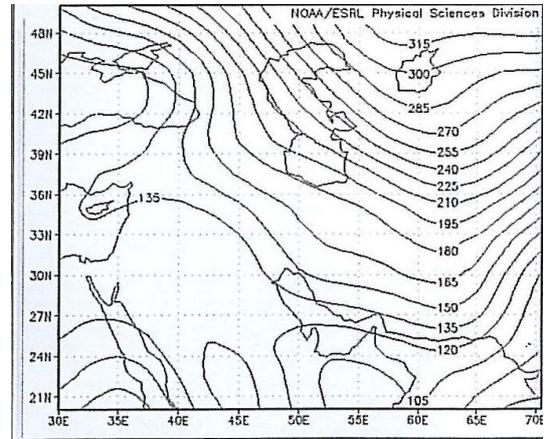
Type 5 pattern:

In this pattern of high pressure Siberia with 1035 millibars from Siberia which enters Iran from north east of Iran that always 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 millibars has been developed over Tehran and

even has reached to Eastern parts of Iran which due to creating temperature 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 5, the amount of pollution at some stations for 18 Aban 1388 have been shown.

| 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 |
| Mawoudieh | 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: 5- the pattern of sea level pressure (9 Nov 2009)

Chart: 5- the amount of pollutions at Tehran's Stations for (9 No. 2009)

Type 6 pattern (10 Nov 2006)

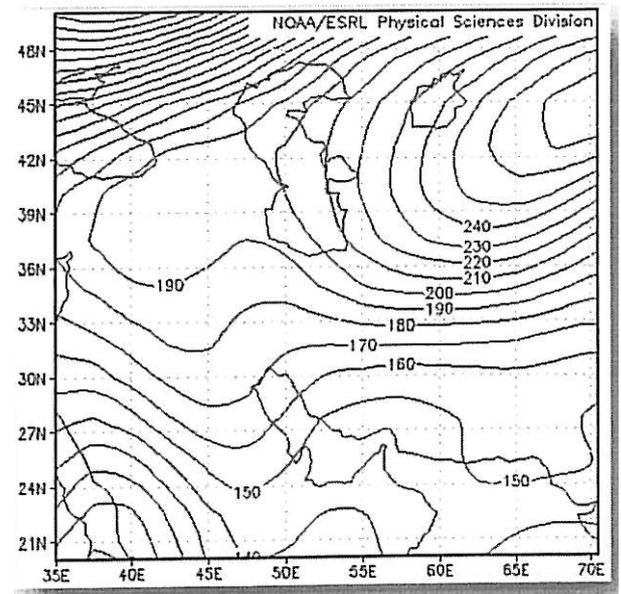
The main controller and dominant system in this pattern in the map of the earth's surface is a high pressure which its origin has been formed on the altitude of 75 degree East and latitude 45 degrees north.

graph 6 shows the quality of the pattern of developing this system on the map of earth's surface.

In this pattern a high pressure curve has entered Iran from the north of Afganistan, and it's western spark has surrounded most parts of Iran in particular central Iran and Tehran with the curve of 1020 milibars.

Therefore entirely sustainable condition has been dominant over Tehran and due to the dynamic quality of dominant system in the region and dynamic decrease of air there is an increased inversion above Tehran so, that, due to more sustainability of this system, there has been more pollution approximately six days from Tehran stations, among which the amount of carbon mono – oxide has been more than the other polluting parameters, whose main reason is combustion failure and fossile fuels.

| 85/8/20 | CO | O3 | NO2 | SO2 | PM-10 |
|----------------|-----|----|-----|-----|-------|
| Fatemi | 96 | | 16 | | 24 |
| Bazar | 56 | | 7 | | 15 |
| Aqdasieh | 130 | | 19 | | 25 |
| Mehr – Abad | 112 | 58 | 20 | | |
| Sahre – rey | 68 | 17 | 30 | 52 | 22 |
| Sorkhe – Hesar | 15 | 4 | | | |
| Tajrish | | | | | |
| Bahman | | | | | |
| Azadi | | | | | |
| PSI | 80 | 26 | 18 | 52 | 22 |



Graph: 6- The pattern of the pressure of sea level for (10 Nov 2006)

Chart: 6- The amount pollutions of stations of Tehran (10 Nov 2006)

Conclusions:

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 temperature 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.

As well as high pressure Zagros has had the most increased sustainability compared to the other systems and normally out of these systems, Siberia's high - pressure sustainability has been higher compared to other systems and when it accompanies Iran's north - west high – pressure it becomes greater in intensity.

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.

Resources:

- Ensafi Moghaddam, Tahereh, 1372 – studying Tehran's pollution in connection with the sustainable and temperature inversion. Tarbiat Modarress masters dissertation.
- Deljoo, Amir Hushang B69- studying temperature inversion and instability on Tehran's pollution. Azad university dissertation, science and research faculty.
- Sultani Nejad, Abdol – Azim 1376 ecological effects of polluting gases from vehicles (based on Tehran's weather) Scientific magazine of environment protection organization , N 04.
- Alijani, Bohlool, Zahra Nick Najafi, 1388, studying synoptical inversion pattern in Mashhad with the use of operative analysis, geography magazine and regional development. No 12, spring and summer
- Zatoallah – mohseni, 1366 – the effect 7 atmospheric agents on Tehran's pollution. Master's dissertation, geophysics faculty of Tehran university.
- Center for studying and programming of Tehran, 1378 research plan of air corridors of Tehran.
- Masoud yonesian 1378, studying the air pollution and causes and fatalities resulting from it in the years 1378, 1388, p.h.d dissertation , Tehran university.
- Hall JV, Kleinman LR et al, 1999, Assessment of the health benefit of improving air quality in Houton, Texas. Final report (Sonoma Technology, Inc, Houston.
- lisella, 2001, What is a temperature inversion and does it affect air quality? Puget sound Clean air Agency.
- Kalkstein, L,S and K.M. Valmont, 1987, Climate effects on human health: E. P.A. Science and advisory committee monograph No. 25389/12252. Washington, D.C, US. Environmental protection Agency.