Upper Air Meteorological Conditions of Acute Air Pollution Episodes (Case Study:Tehran)

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Extended Abstract
In this paper meteorological conditions of some acute air pollution periods for the city of Tehran have been considered. The data used, were obtained from the Air Quality Control Company (AQCC) of Tehran Municipality and from synoptic station of the Institute of Geophysics, university of Tehran. Initially some statistical methods were used to find the episodes for acute air pollution episodes, and then their meteorological conditions were considered.
One suitable method for determining acute air pollution episodes is the use of P parameter which is defined as the number of events in which the air pollution concentrations is 1.5 times (and more than) the averaged seasonal mean. A typical case for this study for P value is shown in figure(1) in which a bubble structure between polar and subtropical jet streams over the area, (see below) has led to large values of showing an acute air pollution episode.

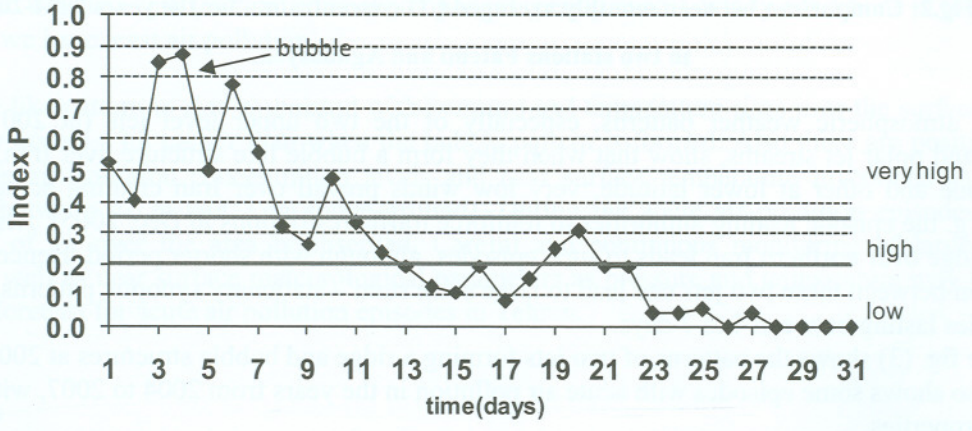

Fig. 1: Variations of P index for CO in Dec. 2005 (the lines for low, high and very high air pollutions are shown)

According to this study statistically, the most abundant levels of the relative air pollution concentration for most pollutant was in the range of 0.5-1.0 and 1-1.5 especially for PM_{10}.
The daily trends for CO in summer and winter show two peaks, one in early morning and the other early at night. Traffic load, small values of urban mixed layer height and static stability at nights and early morning are factors leading to these two peaks. A monthly averaged CO concentration for the monitoring stations shows that usually two peaks are observed during the year.

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Fig. (2) shows comparison of the monthly averaged CO for a period of 3 years in Fatemi's Station, which is situated in about center of Tehran and Aghdasiyeh Station which is located in the north west of Tehran.
The peak for cold season occurs in Nov. or Dec. and the one for warm season occurs in July or August. Usually the peak occurring in cold season is due the persistence of a high pressure system and hence meteorological stable condition which usually occur in cold season in Tehran. However the peak for warm season can be due to nocturnal inversion and lack of precipitation in this period.

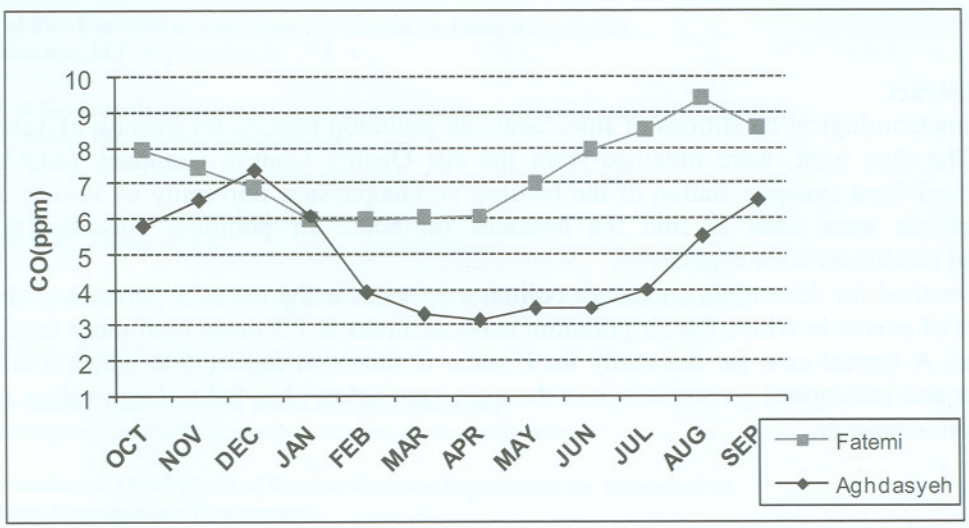

Fig.2: Comparison between monthly averaged CO concentration for the years 2004-2007 in two stations Fatemi and Aghdasyeh.

Large scale atmospheric weather patterns, especially of the two upper level jets (at 200 mb), namely subtropical and polar jet streams, show that when they form a bubble like structure over Iran, i. e. one is at higher latitude and other at lower latitude, very low winds prevail over Iran creating acute air pollution episodes (e. g. the episode leading authorities to reinforce traffic restrictions in Dec. 2005). Also existence of a stagnant ridge over northern Iran leads to such episodes, although with shorter period. Hence we show that an interaction between these two jets can lead to large scale semi – stationary synoptic patterns, creating such acute episodes lasting between 4 to 7 days.
For example fig. (3) shows the patterns of two jets forming a ridge and bubble structures at 200 mb level.
Table (1) also shows some episodes with acute air pollution in the years from 2004 to 2007, with their respective properties.

Table 1: Meteorological characteristics of acute air pollution episodes (* is for the case in which the schools were closed and the odd-even traffic was imposed for Tehran.

ΔT(° C)	P or q average	Period duration	Date of episode	System type
3.3	P = 0.64	7	Dec. 2005 (1-7) *	buble
7.2	q = 1.21	7	Nov. 2006 (1-7)	buble
4	P = 0.42	4	Jan. 2007 (25-28)	buble
6	P = 0.77	4	Mar. 2004(5-8)	ridge
3.4	P = 0.42	4	Jun. 2007 (13-16)	ridge
2.3	P = 0.48	3	Dec. 2006 (19-21)	ridge

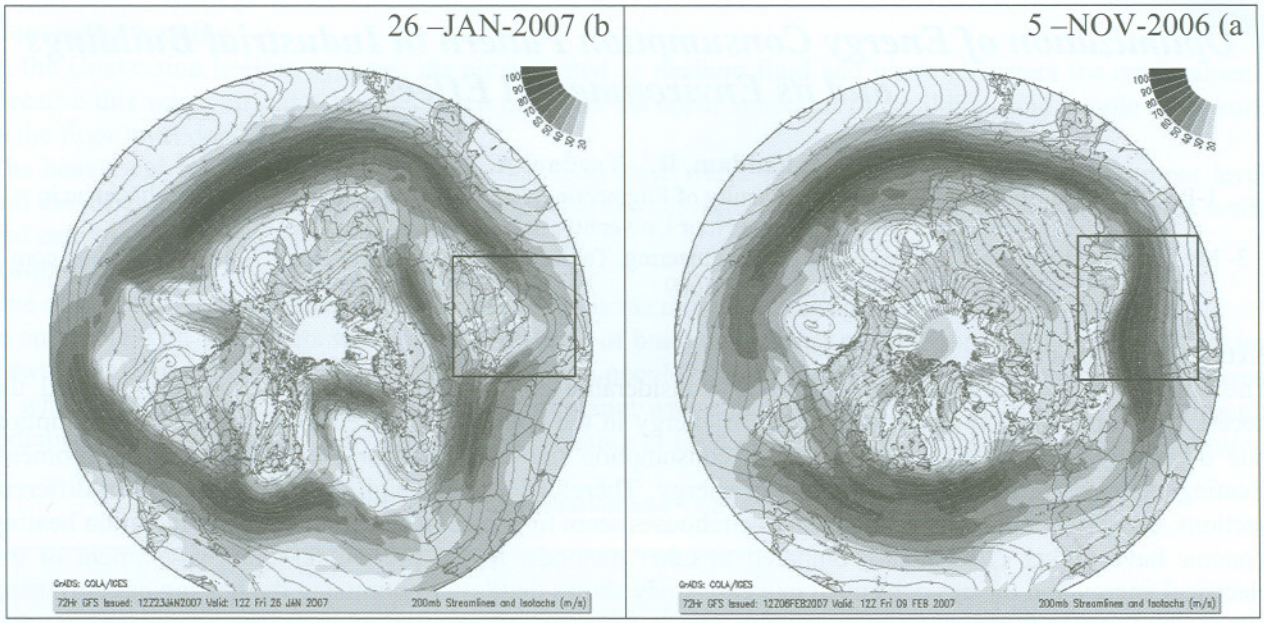

Fig. 3: Hemispheric patterns of waves in subtropical and polar jets a) ridge and b) bubble at 200 mb surface. Wind speed is in m/s and darker regions show higher speeds (Grads)

Usually the case with bubble like structure, especially when the atmosphere is more barotropic in this region, shows a more acute air pollution period which may last longer. Patters other than these especially when the jet are joined together with least meridional component (nearly zonal), windy conditions in the area prevails and hence, we have least air pollution.

The bubble like pattern is also associated with pressure and temperature rises near the surface. The pressure rise usually occurs a bit earlier than when the bubble pattern is formed. Also there are positive correlations between the air pollution concentration levels and near surface temperature inversions (ΔT, temperature difference between 22 m and 2 m above ground). During the acute air pollution episodes, a large scale subsidence of air over the area is observed. Careful and continuous monitoring of large scale weather patterns as well as near surface meteorological parameters as pressure and temperature may be used to give short time forecast for acute air pollution episodes in Tehran.

Key words
Air pollution, meteorological parameters, and acute air pollution episodes, subtropical and polar jet streams