

Temporal Analysis of Particulate Matter Concentration Less than 2.5 Microns (PM_{2.5}) in Mashhad

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Extended Abstract

1. Introduction

According to the World Health Organization (World Health Organization, 2014), one eighth of global deaths is because of exposure to air pollution. This is more than twice the previous estimates and confirm that air pollution is currently the greatest threat to the health of the urban environment in the world.

Particulate matter is one of the major air pollutants. These particles have sizes ranging from 0.000002 to 500 microns, whereas particles smaller than 2.5 microns have significant health and health effects because they are capable of accessing the respiratory system of the human body.

The purpose of this paper is to use statistical methods such as cluster analysis to determine homogeneous time intervals of Particulate matter as the main pollutants of Mashhad. The results can be used by urban planners and decision makers in the discussion of air pollution management, especially planning for the control of air pollution and reducing air pollution.

2. Review of Literature

Concerning the use of statistical methods in air pollution discussion Saksena Joshi and Patil (2002) examined the spatial patterns of air pollution change in New Delhi by cluster analysis method and concluded that there was no statistically significant relationship between pollutant concentration and station type. In another study, Ojeda, Cortina-Januchs, Barrón-Adame, Quintanilla-Domínguez, Hernandez, Vega-Corona, Ruelas and Andina (2010) applied PFCM to clustering algorithm to investigate air pollution in Salamanca, Mexico. Also, air pollution in Bangkok, Thailand, was analyzed using cluster analysis. Using a Geographic Information System (GIS), they mapped air pollution in the area (Prapassornpitaya, Jinsart, & Sanguansintukul 2011).

To reduce costs and better management of air quality stations in the Kanto region of Japan, Iizuka, Shirato, Mizukoshi, Noguchi, Yamasaki and Yanagisawa (2014) performed cluster analysis on air pollution data and found that NOX and O₃ pollutants can be classified into eight clusters. Each cluster has homogeneity in terms of spatial characteristics and temporal behavior.

Ismaili (2018) investigated homogeneous areas of Mashhad air pollution in terms of particulate matter load over a two year period using GIS and cluster analysis

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method. Results of this study identified three separate homogenous regions for Mashhad.

3. Method

In the present study, for the temporal analysis of Mashhad air, 10 air quality stations located in the city of Mashhad were used. Hourly data of suspended particles smaller than 2.5 microns (PM 2.5) were collected and arranged in matrices with temporal and spatial scales. Then a hierarchical cluster analysis was performed. Euclidean distance method and Ward method were used to calculate the degree of similarity. The resulting groups were then shown as a dendrogram.

4. Results and Discussion

The results of cluster analysis on PM2.5 data of Mashhad showed that three clusters or homogenous groups were recognized. The first cluster is distributed throughout the year. The second cluster with a frequency of 113 days is more mid-year. But the third cluster, which represents the highest concentration of suspended particles, often occurs in the second half of the year, with a frequency of 34 days per year.

But on a monthly scale, Shahrivar, Aban and Azar are in the first cluster, and spring months and Mehr in the second cluster. Finally, Tir and Mordad and winter were clustered to the third group.

Weekdays are divided into two main groups, with Friday alone in one cluster and other days of the week in the other group. At a lower level, four homogeneous clusters can be identified. Friday and Sunday are in the first and second clusters, respectively, Tuesday and Thursday in the third cluster and in the fourth cluster are Saturday, Monday, and Wednesday.

5. Conclusion

In this study, particulate matters smaller than 2.5 microns were analyzed using clustering techniques on a scale of days, months, days of a week and hours of a day. The results of hierarchical analysis by Ward's integration method showed that 365 days of the year can be divided into three separate clusters. Also 12 months of the year can be placed in 3 clusters.

Months Azar, Aban and Shahrivar are in one cluster, and spring months and Mehr are in the other cluster. Tir and Mordad and months of winter are in the third cluster.

Days of the week can be grouped into four categories: Friday and Sunday, respectively, the first and second clusters, and the third cluster, including Tuesdays and Thursdays, and finally, Saturdays, Mondays and Wednesdays.

At hourly scale, the results of the study showed that the hours of daylight hours can be divided into homogeneous periods of dawn, morning, evening, and night. The lowest air pollution in the city of Mashhad is in the evening cluster (13-17h). Most of Mashhad air pollution is recorded in the night time, between 18 and 24 hours.

Keywords: Mashhad Air Pollution, Suspended particles smaller than 2.5 microns, Hierarchical clustering, main pollutant

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