Mohammad Hossein Nasserzadeh[1]
Mehdi Doostkamian[2]
Azar Byranvand[3]

An Analysis of the Pattern of Temperature Changes Over the Past Half-Century Iran

Introduction

Climate is a complex system which is changing mainly due to the increase in greenhouse gases. Climate change is slowly expanding across the globe and its impact can be seen on water, agriculture resources and climate parameters in regional scale (Babaian et al., 2009: 136). Climate change is one of the characteristics of the natural cycle of the atmosphere, which is caused by abnormalities and/ or fluctuations in the process of meteorological parameters such as rainfall and temperature. Temperature as important climate variable, causes the most common environmental changes. The effects of temperature changes in the lives of people and other living beings have caused human to face another concern in the real world, which caused a lot of research in this connection in a way that the studies suggest the uniform unchanging temperature in all parts of the world, i.e. the

1- Assistant Professor, Department of Climatology, Faculty of Geographical Sciences, Kharazmi University, Tehran, Iran.
2- PhD Student of Climatology, Climate Change, Zanjan University.
3- Student of Climatology, Zanjan University.

intensity and timing of temperature increase is not the same everywhere (Thuraya et al., 2007). In the world and Iran climatology, numerous studies have been made in the field of climate and its changes in several areas. For example, Lettenmaier et al. (1994, 586-607) in the United States of America, Domonkos and Tar (2003, 131-147) in Hungary, Seleshi and Zanke (2004, 973-983) in Ethiopia, Kumar et al. (2005 , 123-150) in Italy, Qiang et al. (2005, 217-222,) in Egypt, Feriwan Kadioglu (2008, 69-89) in Jordan, Tayanc et al. (2009, 483-502) in Turkey, Mohammadi and Taghavi (2005. 72-115), Azizi and Rowshani (2008, 13-28) in Iran have proven some trends in time series of temperature. In this study, by the using of geo-statistic methods, inter-decadal changes in Iran were reviewed and analyzed.

Materials and Methods

To study the inter-decadal changes of temperature, data resulted from interpolation of daily temperature observations from 663 stations were used in Iran since the beginning of 1961 to December 2004. The data is taken from the Asfezari database. Data spatial resolution of the data is 15 × 15 km, which is written in the picture system of similar conical Lambert. The number of cells across the country is 7187. To enhance the temporal resolution of the data base, daily observations of temperature from 2004 to the end of 2011, using the same method and the same spatial resolution, were interpolated and added to the data base. To analyze the data and to draw maps, programming features of MATLAB software and the GIS software were used, respectively. In order to obtain more detailed information about the temperature of Iran, anomalies and the average (weight average) were studied and analyzed. In the process, the temperature deviations for any climatic normal period happened, using map algebra method. The average of every year in different periods was compared to the average annual values of the same period, and by subtraction

of them, related anomalies were calculated. Average distribution is in fact the center of the spatial distribution, which is defined as follows:

$$(1) \quad \overline{X}_c = \frac{\sum_{i=1}^{n} P_i X_i}{\sum_{i=1}^{n} P_i}$$

$$(2) \quad \overline{Y}_c = \frac{\sum_{i=1}^{n} P_i Y_i}{\sum_{i=1}^{n} P_i}$$

In order to determine the spatial distribution of pattern as a map, Moran cluster analysis and outlier, which is known as the Anserine Local Moran I, have been used. Local Moran's I statistic is calculated as follows (Alijani et al. 2013: 8):

Discussion of Results and Conclusions

Spatial autocorrelation is one of the most useful and important analys tools for research on spatial data. This analysis not only provides in itself useful information about the interrelated effects, but also the results are used for many more complex statistical analyses.

The results of the spatial distribution of temperature anomalies are shown in this study, in which although the studied

in each 5 periods faced concrete changes, the changes are a function of latitude and altitude. Therefore, the center of gravity orientation of temperature in every five periods, which tends to the southeast of the country, confirms the above claim. The results of the analysis of the local Moran's I suggests that all five studied periods of coastal shores of the Persian Gulf and Oman Sea up to a distance of approximately 200 kilometers from the coast are a high cluster model. While some parts of the northeast of the country, northwest of the country (especially Sahand and Sabalan) and along the Zagros Mountains had a low cluster model, or in other words, had negative spatial autocorrelation. The appearance of cluster with positive correlation

in the South Coast, in addition to the impact of the latitude and the exposure of the subtropical high-pressure in this area shows the uniformity of the temperature in this region. As in a cluster a share characteristics of the pixels is required, and due to the heterogeneity of the central regions of the country in terms of altitude, despite the desert areas and high temperatures, these areas are not considered as a part of the cluster with high temperatures. This may be due to temperature differences in desert areas adjacent to moderate temperatures in the high mountains, and cool temperatures. In other words, the existence of maximum temperature in a region in Loot Desert adjacent to areas with relatively cool temperatures at high altitudes cannot lead to the creation of a cluster. The advancement and retreatment of synoptic systems in the general circulation of the atmosphere cause colder or warmer years' experience in the country, in a way that the advancement of polar vortex to the north of the country causes cold air in the region, and the sustainability of the system in the country greatly affect the country's average temperature. Thereby, the retreatment of the vortex provides conditions for entrance of the subtropical pressure in the country. The more the system takes the country's total area, the more average high temperature would be recorded for the country. Finally, the temperature differences in the average temperature of any year are visible in the related expansion zone of each cluster.