Analyzing and Forecasting the Effects of Climate Change on Tehran Metropolitan Air Pollution

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1 Introduction
Climate change is a complex atmospheric-oceanic phenomenon that is affected by global and long-term human activities. This phenomenon is influenced by factors such as solar activity, volcanoes, atmospheres, oceans and greenhouse gases (of natural and human origin) that interact with each other. Atmospheric pollutants have also been shown to be highly concentrated causing damage to Earth's biological cycles. As the largest and most populous city in the country, Tehran is plagued by air pollution and other factors including climate change, fossil fuel consumption from transportation, household energy and energy industries, and rapid population growth and urban development, and they have no lasting impact. Reviewing the studies on the occurrence of climate change at global and national levels and the occurrence of these changes with varying intensity and weakness in our country, this study seeks to study the effects of climate change on the trend of Tehran metropolitan pollutants in the coming years and achieving appropriate and accurate methods for analyzing the relationship between air pollution and climate change in Tehran metropolis and predicting the trend of air pollution caused by these changes in the coming years.

2 Materials and Methods
The case study of the metropolitan area is Tehran. SDSM scenario forecasting method is used to predict and evaluate future climate change in Tehran metropolis and its relationship with Tehran air quality. The regression method then predicts and analyzes its future relationships with Tehran air quality using two optimistic scenarios RCP 2.6 and pessimistic RCP 8.5. The SDSM statistical exponential model is used to simulate climate data at a station in the present and future under the influence of climate change phenomena. The data in this model are daily time series for climate variables such as rainfall, minimum and maximum temperatures and other atmospheric parameters. This model is a kind of transitional function models (regression models) and is able to simulate data from 1 to 100 times per run. To do this, a large-scale exponential
microscope (GCM) was used in this study to produce daily temperature and precipitation data from the output of the HADCM3 model used in this study to produce daily temperature and precipitation data from the output of the HADCM3 model used. For exponential microscopy, SDSM statistical exponential model was also used to simulate Tehran metropolitan climatic data in the present and future conditions. The data used were daily time series for the minimum and maximum temperatures of rainfall climate. This model is a kind of transitional function models (regression models) and is able to simulate data from 1 to 100 times per run. In this study, two absolute mean error criteria were used to evaluate the model performance.

3 Results and Discussion

For forecasting and scenario analysis of indices of Tehran metropolitan air pollutants, first, scenario prediction of minimum temperature, maximum and daily precipitation of selected metropolitan Tehran stations (Mehrabad, Geophysics and Shemiran) was done. Then, by averaging the data (maximum temperature, minimum temperature and precipitation) of the selected stations as mean data of Tehran city and using the mean data of Tehran air pollution indices, we analyze and analyze their correlation and regression relations with mean indices. Air pollution in Tehran was discussed. Behavior of Tehran air pollutants in the coming years was also evaluated through scenario prediction.

Exponential microscopy results of Tehran metropolitan daily minimum temperature showed that according to statistical analysis and exponential scaling results of HADCM3 model data, the mean minimum temperature at all stations increased in the period 2017-2047 and the results showed that based on the two scenarios RCP 2.6 and RCP8.5, the average temperature of Tehran in the period 2047-2017 will reach 13.4 and 13.8 degrees, respectively. However, the RCP8.5 scenario had more pessimistic conditions for each station than the RCP 2.6 scenario. It shows the mean minimum temperature and its standard deviation for the period 2017-2047, and the amount of minimum temperature changes at selected stations over the next thirty years showed an increase in temperature in both RCP 2.6 and RCP8.5 scenarios compared to observational data.

The results of exponential maximal temperature scaling for the selected stations also showed that the air temperature have an increasing trend in the period 2047-2016, based on the two scenarios studied. Exponential scaling of the maximum temperature for different stations has also made it clear that the air temperature will increase over the period 2047-2016, based on the two scenarios considered. Based on the SDSM model outputs from the HADCM3 data scaling model, the average monthly precipitation of the stations under study in the period 202017-2047 under the RCP8.5 scenario (pessimistic conditions) was about 20.9 mm, under the RCP 2.6 scenario (good conditions) is about 22.1 mm. However, the average monthly precipitation in the 1991-2016 observation period was about 25.5 mm, indicating a downward trend over the coming years. Therefore, the daily exponential scaling of the stations under study for the period 2017-2047 also indicates changes in precipitation
values and based on the output of the scenarios, all the stations under study will experience decreasing precipitation in the coming years.

In order to evaluate and analyze the scenario of Tehran air pollutants, according to the results of the average scenario data and the correlation and regression method, the scenario data of dependent variables ie Tehran air pollution indices were generated. To do this, the meteorological parameters were selected according to the statistical bases of pollution indices (since 2006) and daily data and their relationships were analyzed.

4 Conclusion

Analyzing the trend of Tehran air pollution and its relationship with climate elements using SDSM model under two optimistic and pessimistic scenarios RCP2.6 and RCP8.5, showed that the air temperature trend (minimum temperature and maximum month) in subsequent years increased trend. (Calm). This indicates a general warming of Tehran's air in both the RCP2.6 and RCP8.5 scenarios in the coming years. In the case of rainfall, given the downward trend of rainfall in the above scenarios, the increase in air dryness and the decrease in atmospheric precipitation in the coming years are likely. Scenario analysis of Tehran air pollutants also showed that only some air pollutants (i.e. CO2, O3 and PM10 indices) were significantly correlated with meteorological variables (minimum and maximum daily temperature) that regression analysis and scenario prediction indicated. The data showed that the CO2 index will increase in both scenarios, especially the RCP 2.6 scenario in the coming years, but in the O3 and PM10 indices, their value in the optimistic and pessimistic scenarios didnot show any appreciable increase or decrease in the following years.

Therefore, regarding the occurrence of climate change symptoms, especially positive temperature changes in Tehran metropolis, and the positive relationship between climate change conditions, especially temperature parameters with indices of air pollution and its scenario forecasts, it should be said:
- Tehran air pollutants will have an increasing or a constant change in the years to come
- The issue of Tehran's climate change and air pollution and its environmental, social, economic and political consequences should be considered as an important and vital issue for the lives of Tehran's citizens in the planning of Tehran's metropolis as the Iranian capital.

Keywords: Climate Change, Air Pollution, Scenario Forecasting, SDSM Method, Tehran

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