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The Effect of Different Approaches of Distance Between Two Sets on Fractal Downscaling of Temperature in Mashhad

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Introduction: The range of meteorological parameters, such as temperature, are different at different scales. Fractal geometry is a branch of mathematics that has many applications in the field of discrete and continuous domains. Downscaling may be done by different methods, including univariate, multivariate regression functions, splined function and fractal function. Finding the best model for fractal downscaling, is needed to implement the distance between measured and modeled data sets. This distance may be estimated by different methods, including Euclidian. For temporal downscaling, the data are two-dimensional, i.e. time and that of principal variable (e.g. temperatures).In such a case, the dimensionality problem arises in Euclidean space. In these cases, data are usually changed to non-dimensional forms which are referred to standardization, normalization, scaling, or non-dimensionalizing. So, in addition to imbalance of data calculating distance between two sets, we are also considering the impact of standardized data on the number of interpolation points, run time, and accuracy of downscaling the temperature of Mashhad synoptic station.

Materials and Methods: In this paper, fractal model was used for modeling and downscaling temperature datasets for the period of 2007- 2009 at Mashhad Synoptic stations with two approaches of Hasdurf distance to determine the interpolation points (first approach: in first approach original data was used. Second approach: in second approach the data were standardized). We adopted some criteria, such as root mean squared error, correlation, and Akaike information criteria to assess the accuracy of fractal downscaling.

Mashhad is the second most populous city in Iran and capital of Razavi Khorasan Province. It is located in the northeast of the country, close to the borders of Turkmenistan and Afghanistan. It is built-up (or metro) area was home to 2,782,976 inhabitants including Mashhad Taman and Torqabeh cities. It was a major oasis along the ancientSilk Road connecting with Merv in the East. The city is located at 36.20º North latitude and 59.35º East longitude, Mashhad features a steppe climate with hot summers and cool winters. The city only receives about 250 mm of precipitation per year, summers are typically hot and dry, with high temperatures sometimes exceeds 35 °C (95 °F). Winters are typically cool to cold and somewhat humid, with overnight lows routinely dropping below freezing.

At first, fractal method was used to produce daily temperature from daily datasets with two attitude and different interval interpolation (5, 10, 15days). Then the same process was applied to produce 3-hours temperature.

Results and Discussion: Downscaling for daily temperature: In this part, we considered that which standardizing approach and which interval interpolation, will carry the best accuracy for the fractal modeling. Although RMSE, R2, AIC, show that standardized approach is not better, but the difference is not substantial.

Results from fractal modeling from 5-day interval interpolation and 10-day interval interpolation with daily measured temperature in Mashhad compared based on 1:1 line of perfect agreement, and showed acceptable (α=5%) behavior. In both approaches and two interval interpolation with both 5 and 10 days, predicted temperatures imitate the behavior of the measured temperatures. However, simulation with no standardization approach show better results for both distance interpolation compared to the second approach with standardization.

2. Downscaling daily temperature to 3-hour interval: We compared downscaled 3-hour temperature from two standardizing approaches and two timesinterpolation based on daily temperature with 3-hour measured temperature and compared the results with respect to 1:1 line of perfect agreement. It is clear that the results of the three-hour downscaling show the same results with daily downscaling, because temperature shows the fractal behavior. Although both approaches perform well but un-standardizing is better, yet the difference is not pronounced.

Conclusion: Overall, in both approaches, three-hour and daily downscaling is done precisely and with high

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quality. The number of interpolation points was reduced by 30% under the second standardizing approach, which followed by considerable computer runtime. However, the result shows that the first approach had better modeling.

The comparison results of the modeling with 5 intervals interpolation and with 10, the 10 intervals interpolation were more acceptable, such that correlation coefficient was between (first approach: 0.98 and 0.7, second approach: 0.98 and 0.65) while RMSE was between (first approach: 1.33 and 3.27 ° C and second approach: 1.44 and 6.02 ° C), and AICc was between (first approach: 0.55-3.27 and second approach: 2.87-3.51).The intercepts and slopes of regression lines between measured and predicted temperatures were not statistically (5% level of significant) different from 0 and 1, respectively.

Keywords: Downscaling, Housdorf distance, Standardization