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Improve the Accuracy of Imputation Missing monthly rainfall data by Genetic Algorithms and Ant Colony

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Abstract

Precipitation as one of the most important parameters of meteorology and climate, is basic factor in water resource management. This factor has a direct relation with the regional climate. The accuracy of simulating this parameter is very important due to its wide variation. Observation data at Iran's first synoptic stations from 1330 (1951) is available at the Iranian Meteorological Organization website. Old and long-term temperature and monthly precipitation data in five cities of Iran Including Mashhad, measured by the Embassy of the United States and Britain from the Qajar period (around 1880) and recorded in World Weather records. Unfortunately, these data have missing. Monthly missing data are during World War II (1949-1949) and sporadically during the statistical period. Stations from neighboring countries due to the Parity criterion, solidarity and completeness of data in missing periods selected as base stations. Monthly precipitation of Ashgabat Station from Tajikistan and monthly rainfall of Sarakhs, Kooshkah, Bayram Ali, Kerki and Repetek from Turkmenistan were selected as independent variable in the making of Missing Rainfall in Mashhad. Three factors of distance to Mashhad station, correlation and existence of data in missing months were effective in selecting these stations. This research has fitted ten multiple regression models to monthly rainfall of Mashhad station and then the parameters of these patterns are optimized by genetic and Ant Colony algorithm. In statistical modeling, regression analysis is a set of statistical processes for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables (or 'predictors'). Genetic algorithm (GA) is a metaheuristic inspired by the process of natural selection that belongs to the larger class of evolutionary algorithms (EA). Genetic algorithms are commonly used to generate high-quality solutions to optimization and search problems by relying on bio-inspired operators such as mutation, crossover and selection. Ant colony optimization algorithm (ACO) is probabilistic technique for solving computational problems which can be reduced to finding good paths through graphs. This algorithm is a member of the ant colony algorithms family, in swarm intelligence methods, and it constitutes some metaheuristic optimizations.

The repair of the monthly precipitation of Mashhad with these stations has been done with ten regression linear, semi-logarithmic and logarithmic regression models as follows. This was done with programming in the R-Studio environment. The parameters of the five selected patterns were optimized by evolutionary methods (genetic algorithm and anion colony algorithm). Simulation of these methods has been done with the help of MATLAB software 2017. The results showed that the genetic algorithm and Ant Colony methods Ratio of regression methods, dramatically increase the accuracy of estimating

missing rain data. The lowest RMSE regression pattern is 9.79, which is optimized by genetic algorithm to 2.66 and by Ant Colony algorithm to 2.659.

Keywords: data assimilation, Mashhad precipitation, Missing data, Multiple regression, Evolutionary methods.