Daily Pan Evaporation Estimation by Using Artificial Intelligence Techniques in the South of Sistan and Balouchestan Province

Abstract

Nowadays in the world, water resources are the basis for sustainable development. By attention to the limitation of water resources in arid and semiarid regions, the prevention of water loss through evaporation as one of the principal components of hydrological cycle plays an important role in the development and management of water resources. A large number of empirical formulas and methods have been developed to estimate pan evaporation that mostly require a high number of input parameters that are either difficult to access or are expensive and time consuming to measure. In this research, Multi-Layer Perceptron Artificial Neural Network (MLP-ANN) and ANFIS models have been used to estimate pan evaporation under three different climates in Synoptic stations of Iranshahr (warm-dry climate), Chabahar (warm-dry coastal climate), and Saravan (warm-temperate and semi-dry climate). For this purpose, the best combination of model input was chosen by using Gamma Test for all the stations, including the daily data of mean air temperature, mean relative humidity, mean wind speed, sunshine hours and air pressure. The four statistical performance evaluation criteria of the coefficient of determination (R^2), root mean squared error (RMSE), Nash–Sutcliffe efficiency coefficient (d), and mean absolute error (MAE) were employed to evaluate the performances of various models developed. The obtained results indicate the best performance of ANFIS by employing three Gaussian membership functions with R^2=0.993, RMSE=4.21, d=0.998, and MAE=0.299 for Iranshahr station, R^2=0.966, RMSE=3.88, d=0.992, and MAE=0.160 for Chabahar station, and R^2=0.965, RMSE=7.54, d=0.991, and MAE=0.450 for Saravan station. Moreover, the performance of Multi-Layer Perceptron Artificial Neural Network (MLP-ANN) was evaluated in terms of the statistical criteria. The obtained results indicate the best performance of MLP-ANN with R^2=0.993, RMSE=4.28, d=0.998, and MAE=0.376 for Iranshahr station, R^2=0.962, RMSE=4.36, d=0.989, and MAE=0.248 for Chabahar station, and R^2=0.962, RMSE=8.18, d=0.989, and MAE=0.665 for Saravan station. Comparison of the estimated values and measured data indicate that the ANFIS model has a better performance to estimation of daily pan evaporation then the MLP-ANN model.

Key words: Pan evaporation, ANN, ANFIS, Gamma Test, Sistan and Balouchestan province

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