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Correspondence to:
Cahit Gurlek
cgurlek@cumhuriyet.edu.tr

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Tong Seop Kim

Artificial neural networks approach for forecasting of monthly relative humidity in Sivas, Turkey

Cahit Gurlek

Mechanical Engineering Department, Sivas Cumhuriyet University, Sivas 58140, Turkey

Abstract Relative humidity is a crucial parameter for various agricultural and engineering applications and atmospheric dynamics; hence its accurate and reliable estimation is essential. This study aims to predict monthly relative humidity by means of the artificial neural networks (ANNs) method using neighbouring data in Sivas Province, Turkey. Nineteen years (2000-2018) monthly mean relative humidity data of five measurement stations was used for ANN analysis. The prediction accuracy of the ANN models was evaluated with the coefficient of determination (R^2), mean absolute error (MAE), mean absolute percentage error (MAPE) and root mean squared error (RMSE). Contour plot maps were also generated for visual comparison. R^2, MAE, MAPE and RMSE values ranged between 0.952-0.965, 1.916-2.586, 3.422-4.974 and 2.472-3.391, respectively. The results showed that the ANN method provided satisfactory predictions for relative humidity.

1. Introduction

The relative humidity (RH) expresses the ratio of the amount of moisture in the air at a certain temperature to the maximum amount of moisture that air can hold at the same temperature. It is given as a percentage from 0 % (zero moisture content) to 100 % (saturation with moisture) [1]. Relative humidity has a strong significance in a wide variety of areas, such as weather and climate, air pollution, global warming, floods, plant growth, industrial and food processing and storage, human health and comfort, the heating, ventilating, and air conditioning (HVAC) efficiency, etc. [1-4]. Relative humidity depends on several parameters, including air temperature and pressure, wind speed, solar radiation and moisture of air and thus its forecasting is relatively difficult. However, accurate and reliable estimation of relative humidity is crucial due to its importance in the above-mentioned areas.

Chaudhuri and Chattopadhyay [5] designed an ANN model to estimate the maximum surface temperature and relative humidity. It was discerned that the one-hidden-layer neural network is an efficient forecasting tool for estimating maximum surface temperature and relative humidity. Yasar et al. [6] estimated the monthly mean relative humidity for the Aegean Region of Turkey with the artificial neural network (ANN) method. It was concluded that the ANN model gave accurate results for the related region. However, it is also mentioned that alternate models should be developed for the other regions of Turkey because of the different climate and topography. Chronopoulos et al. [7] achieved accurate estimations of the thermal comfort conditions in the mountainous region of Greece using air temperature and relative humidity data with the ANN method. Martínez-Martínez et al. [8] estimated and predicted accurately the spatial and temporal variations of the temperature and relative humidity in the tobacco drying processes using ANN models. Litta et al. [9] used ANN models with six different learning algorithms to predict the surface temperature and relative humidity. The results showed that the ANN model with Levenberg-Marquardt (LM) algorithm well predicted the temperature and humidity during thunderstorm hours. Khatibi at al. [10] investigated the predictability of relative humidity by using genetic expression programming (GEP) and ANN with noisy and missing data. The results