Poll Res. 39 (November Suppl. Issue) : S218-S220 (2020)

ISSN 0257–8050

PREDICTION OF SURFACE OZONE ON A SHORT TERM USING NEURAL NETWORK TECHNIQUE AT THIRUCHIRAPPALI

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(Received 5 July, 2020; accepted 1 September, 2020)

ABSTRACT

Thiruchirappali being a major city in the state of Tamilnadu, plays a very vital role in constituting the economic, health and climatic factors of the state. It thus becomes quite essential to observe and study the characteristics of surface ozone and its relation with its precursor at the study location. Ozone measurements have been carried out for every hour IST. The observation period was from October 2014 to September 2016. In this study, an attempt has been made to utilize neural network schemes in order to predict the surface ozone on a short term.

KEY WORDS : Surface Ozone Concentration, Neural network model, Short term Prediction.

INTRODUCTION

With the advancement in mathematical models, the formation, emission, transport and disappearance of air pollutants have well been described. This has led to a greater understanding of the dynamics of these pollutants. However, the more complex the model, the need for more information for their application is required to have sufficient certainty that the results will have technical or scientific value. The requirement for much information in these deterministic models is not always possible. The data that are available have not always provided successful results upon application of the model, or the cost of obtaining reliable data can be unaffordable. There are other models requiring less information that can be used to study air pollution in some areas. These methods generally make use of statistical techniques such as regression or data data-fitting methods using numerical techniques to establish the respective relationships between the various physicochemical parameters and variables of interest based on routinely-measured historical data. The main objectives of these methods include investigating and assessing trends in air quality, making environmental forecasts and increasing scientific understanding of the mechanisms that govern air quality.

Several studies have been conducted aiming to develop tools and methods capable to achieve a short-term forecast of ozone levels (Kovac-Andric *et al.*, 2009; Chaloulakou *et al.*, 1999). The analysis often aims on investigating whether or not a threshold condition is exceeded. However, this means of analysis can often be exploited by environmental and medical authorities in issuing public warnings.

Among the techniques being examined to relate air quality in a given area to measure physical and chemical parameters, the three that have been used most often are (a) multivariate regression (b) artificial neural networks (ANN) and (c) time series and spectral analysis.

Artificial neural networks have greater flexibility, efficiency and accuracy since they have a large number of features similar to those of the brain that is they are capable of learning from experience, of generalizing from previous cases to new cases, and of abstracting essential features from inputs containing irrelevant information; they use adaptive learning, one of the most attractive features of ANN,

as well as the ability to learn to perform tasks based on training or initial experience. Neural network techniques have recently become the focus of much attention as they can handle the complex and non-linear problems much better than the conventional statistical techniques. It is a simple mathematical input-output model which learns the relationship (linear or non-linear) between the input and output during the training period. Neural network model brings out the maximum information available within the data during the training period and reflects these in the independent period. ANN do not need an algorithm to solve a problem because they can generate their own distribution of the weights of the links through learning and are easily inserted into the existing technology.

AREA AND PERIOD OF STUDY

An intensive field work using portable sensitive gaseous monitor Aeroqual Series 500 monitor which employs GSS sensors was carried out for a period from October 2014to September 2016 with an aim to examine the current scenario of the surface ozone and nitrogen dioxide at Thiruchirapalli (10.7905° N, 78.7047° E), a major tier II city in the Indian state of Tamil Nadu.

METHODOLOGY

As input to the model, the meteorological data (obtained from IMD) and NO_2 dataset is used, whereas the output, ozone concentration is predicted by the model. The network is trained with the past data. By proper choice of training sets, after the learning process, the trained network is capable of predicting the ozone concentrations as an output according to the inputs and internal structure of the network established during the learning period. In the present study, for predicting ozone concentration using neural network, Matlab R2014a has been utilized.

RESULTS AND DISCUSSION

Neural network is one of the vital tools utilized for forecasting or prediction. In this study, Ozone concentration was predicted or forecasted by using the meteorological parameters like temperature and wind speed along with one of the precursors of Ozone namely NO_2 as inputs. The data set is randomly divided into three sets namely training, validation and testing. Training set is the largest set (70%) and the remaining sets are assigned to contain 15% of the samples. The training set is a set of samples used to adjust or train the weights in the neural network to produce desired outcome. The validation set is used to find the best network configuration and testing set is to evaluate the fully trained networks. The most commonly used computational function in air quality modeling is the Log-Sigmoid function $f(x) = 1/(_{1+e-x})$. The model was carried out using Levenberg Markquadrt alogorithm. The neural network model is trained using all the input parameters. Figure 8.1 shows the neural network model. The model gives an R of 0.82062 for all the data points. Figure 8.2 shows the regression of the above model. The model exhibits a good correlation between the actual and predicted data points.

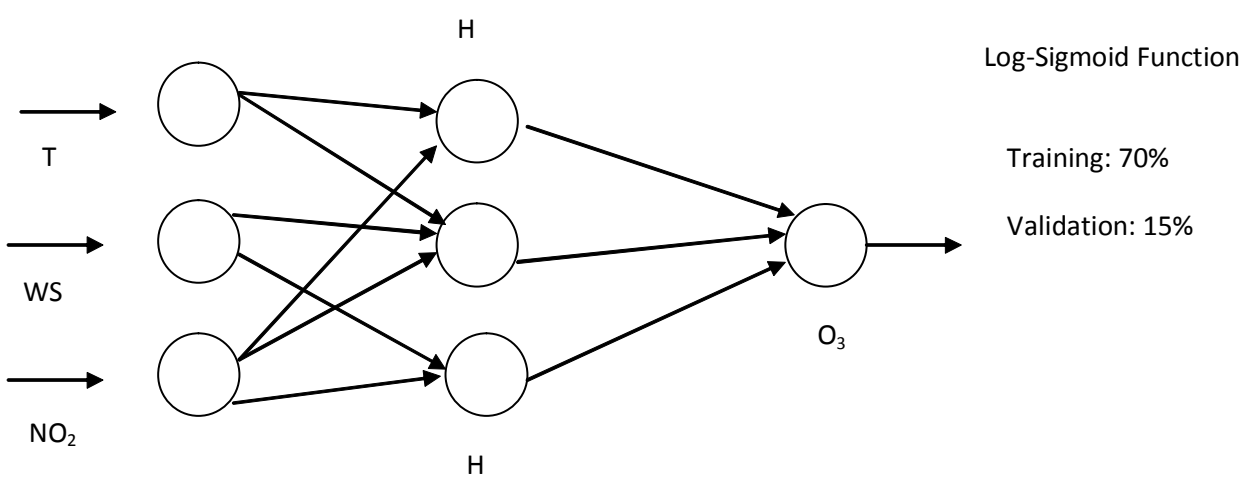

Fig. 1. Neural Network Model

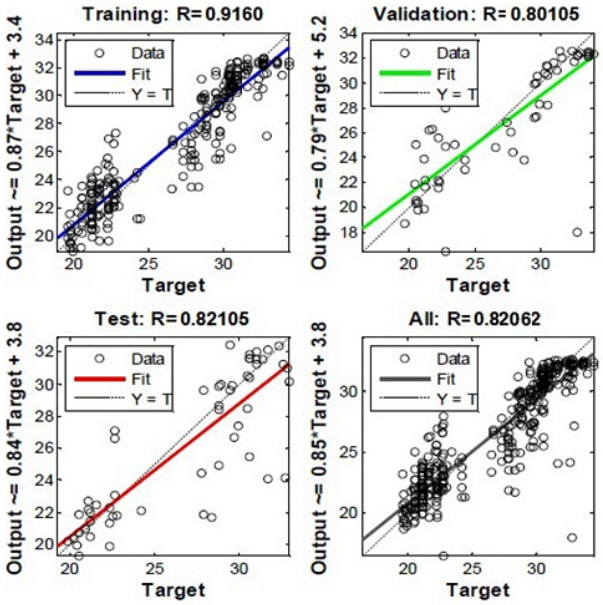

Fig. 2. Scatter plot between actual and predicted data

CONCLUSION

Neural network model was performed to predict the Ozone concentration levels using various inputs. The model gives an R of 0.82062 for all the data points. The model exhibits a good correlation between the actual and predicted data points. This results show that this type of neural network model can be effectively utilized for short term prediction of ozone at the study area.

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