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MODELING OF AMBIENT FOR SOx AND NOx POLLUTANTS THROUGH ARTIFICAL NEURAL NETWORK IN SENSITIVE AREA OF UJJAIN CITY

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ABTRACTS:

This paper aims to analyze the pollutant level of the sensitive area in Ujjain.Application of Artificial Neural Network analyzes the pollutant SO_x and NO_x. Theresult reported pertains to a site successive preliminary air sampling excessive carried out at selected location in Ujjainmahankal temple. The Artificial neural network system was run by giving the inputs of meteorologicaldata's and giving the outputs of concentration of various pollutants and accordingly the estimation of Errors was done by this study. Analysis of consecutive four years of data from the sensitive area through ANN_S has been found, the concentrations of sulphur dioxide (SO_x) =11.133, of nitrogen dioxide (NOx)=11.81. High volume sampler was used to measure the concentration of critical pollutants SOx andNO_x. This model calculates pollution concentrations due to observed traffic, meteorological and pollution data after an appropriate relationship has been obtained empirically between these parameters. The system is made of various devices which haveto be chosen based on the characteristics of the pollutant: aerosol, solid particles, and droplets orgaseous. The chosen framework and facilities depend on the type of the pollutant: aerosol,solid particles, and droplets or gaseous. There are a number of basic parameters which have tobe considered in order to define air pollution control devices. This study represents amodeling of the named parameters which are related to the framework and facilities of airpollution control. In order to set the optimal parameters of a purification device, adeterministic model of the process of purification should be determined.

KEYWORDS: ambient air quality, artificial neural network, sulphur oxide, nitrogen oxide, vehicular exhaust emission (VEE), mean square error (MSE).

1.INTRODUCTION:

Air pollution modeling is a numerical tool used to describe the causal relationship between emissions, meteorology, atmospheric concentration, depositions and other factor. About 60 percent of air pollution in Indian cities is due to automobile exhaust,emission of sulphurdioxides (SO_x) and nitrogen dioxides (NO_x) which has adverse effects on surrounding

ecosystem.Air pollution is a complex issue, fuelled by multiple sources ranging from vehicular exhaust, industrial emissions, emissions from fossil fuels, construction activities to domestic activities. Air pollution may cause pernicious effects on human health, especially in areas with high population density. Forecasting air quality is one of the most sought after topic of research today for urban air pollution studies and specifically for prediction of pollution episodes i.e. high

Pollutants concentration causing adverse health effects.Air quality models play a vital role in all aspects of air pollution control and air quality planning, where prediction isa major component. Air quality forecasts provide the public with air quality information which allows people to take precautionary measures to avoid or limit their exposure to unhealthy levels of air pollution. Hence it is quite essential to predict criteria pollutants. Artificial neural network began with the pioneering work of M_CCulloch and pitts and has its root in rich interdisciplinary history from the early 1993_s (1). The reduction of the number of vehicles circulating and there for fossil fuel consumption decreases emissions and greenhouse gases outcome related to on road traffic sector.(2).

Air pollution in urban centers are associated with sudden occurrence of high concentration of vehicular exhaust emissions (VEEs), which are generally governed by the local meteorology and dispersion mechanism (3). Since the relationship of VEE with the meteorology and traffic characteristic data is highly nonlinear, both deterministic and statistical models under perform in predicting the air quality (3). Monitoring of air pollutants is a prerequisite to air quality control. Their impact on the chemical composition of plants is often used as an indicator of and a tool for monitoring environmental pollution (8, 9, and 7).

The main objectives of these methods include investigatingand assessing trends in air quality, making environment forecasts and increasing scientific understanding of the mechanisms that govern air quality (4).Air pollution is highly correlated with meteorologicalvariable's (5);This is regarded as anintelligent, cost-effective approach and has receivedmuch attention in environmental engineering.

2.0 MATERIALS AND METHOD:

2.1 ARTIFICIAL NEURAL NETWORK (ANN):

An artificial neural network is a mathematical model inspired by biological neural networks. A neural network consists of an interconnected group of artificial neurons, and it processes the information's using a connectionist approach to computation. Neural networks are used to model complex relationships between inputs and outputs or to find patterns in data.

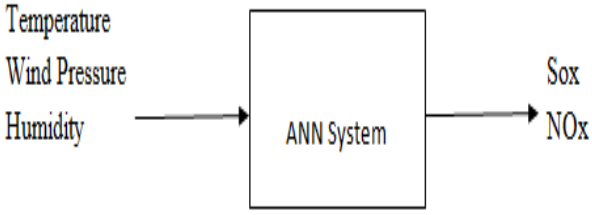

Figure 1. The Artificial Neural Network system

2.2 DATA SETS

The dataused in this study are daily ambient air temperature, relative humidity, wind pressure, rainfall and daily concentration of SO_x and NO_xin Ujjain for 3years period from 2009,2010, and 2012. All of these data were provided by Ujjain (M.P) central pollution control board(CPCB) Department of pollution control (DOPC). The data was divided into two sets which is learning set for Artificial Neural Network training and testing set to verify the efficiency and correctness of the developed model.

2.3 BIO-MONITORING:

Monitoring with the help of biological indicators can sometimes be a simple, cheap and convenient method to evaluate the effect of air pollution on plant. Plant growth characteristics such as leaf area (6), total chlorophyll (10) and total proteins in leaves (11) were recorded to study the impact of air pollutant on plants.

2.4 MEASUREMENT OF SO_X:

Ambient air was continuously drawn into 35ml of sodium hydroxide solution at a flow rate of 2 LPM for 8 hour and Jacobs and Hochhesier method in the laboratory estimated it. Sodium hydroxide solution forms a stable solution of sodium nitrite. The nitrite ion produced during sampling was determined calorimetrically by reacting the exposed absorbing reactant with phosphoric acid, sulphanilamide and N-(1-napthyl ethylene- diamine dihydrochloride producing an azo dye. The absorbance of the color was read at 540 nm. The range of the analysis was between 0.01 and 1.5 µg/ml

2.5 MEASUREMENT OF NO_X:

Ambient air was continuously drawn into 35ml of sodium tetrachloromercurate solution at a flow rate of 1.5 LPM for 8 hour and Sodium tetrachloromercurate method in the laboratoryestimated it.Samples for $SO_x$are collected using high volume sampler in the impinge containing the absorbing reagent, sodiumtetrachloromercurate. After collecting the gas in the absorbent, proper volumes and concentrations of sulphuricacid, formaldehyde, and pararosaniline reagent are added to develop the red=purple colour. The intensity of the colorist measured after half an hour by taking optical density at the wavelength of 560 nm.

3. RESULT AND DISCUSSION:

In this survey and after the experimentation it was found that the air pollutants were greatly affected the selected areas in years 2009, 2010, 2011 and 2012 as shown in figure .

In 2009,As shown in figure 2, the concentration of SOx was 12.4 µg/m^3 and NOx was 11.9 µg/m^3 found as maximum in the month of Octoberand these pollutants were found minimum i.e.

SOx was 10.8 µg/m^3 and NOx was 10.4 µg/m^3 and accordingly due to this the pollution load was high in this area.

In year 2010, As shown in figure 3, the concentration of SOx was 15µg/m^3 and NOx was 12.4 µg/m^3 found as maximum in the month of May and these pollutants were found minimum i.e. Sox was 13.8 µg/m^3 and $NO_{X,}$ was 12 µg/m^3in August.

In year 2011, As shown in figure 4, the concentration of SOx was 12.6 µg/m^3 and NOx was 11.3 µg/m^3 found as maximum in the month of May and these pollutants were found minimum i.e. Sox was 10.2 µg/m^3 and $NO_{X,}$ was 11.8 µg/m^3in August.

In 2012, As shown in figure 5, the concentration of Sox was 13.8 µg/$m^3$and NOx was 12.6 µg/m3 found as maximum in the month of May and these pollutants were found minimum i.e. Sox was 11 µg/$m^3$and NOxwas 10.2 µg/m^3.

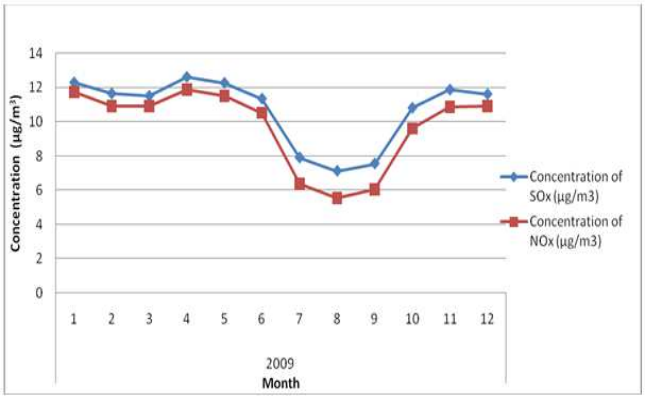

Figure 2 The concentration of SO_X and NO_X in year 2009.

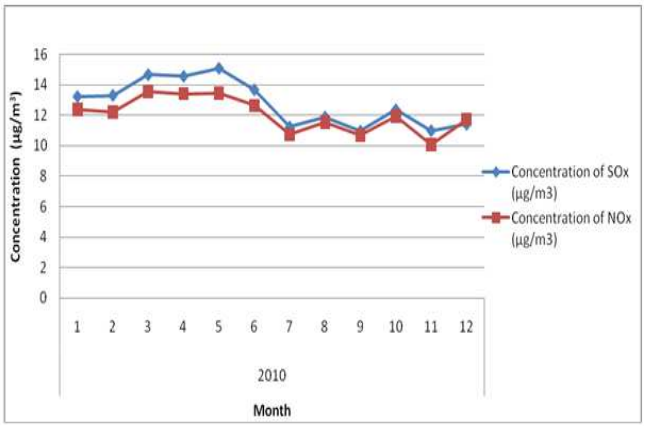

Figure 3 The concentration of SO_X and NO_X in year 2010.

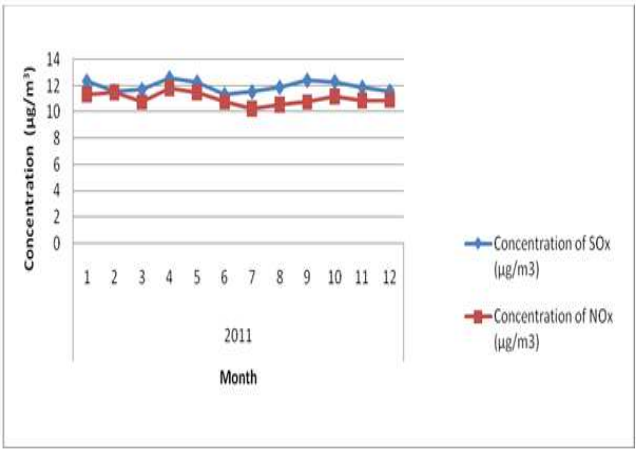

Figure 4 The concentration of SO_X and NO_X in year 2011

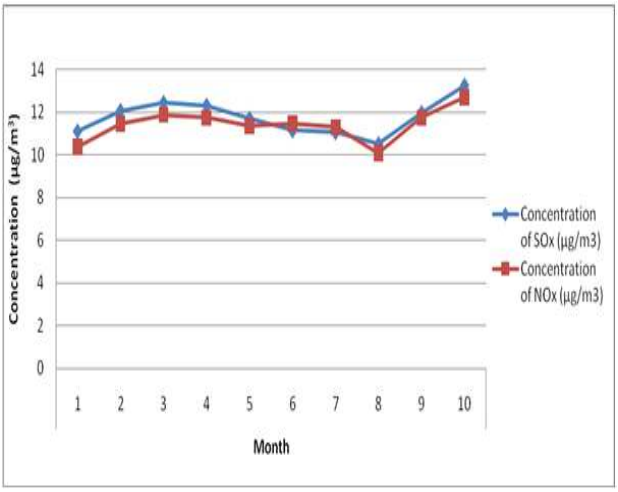

Figure 5 The concentration of SO_X and NO_X in year 2012

Table 1: Result Tabulation

	Year	**2009**	**2010**	**2011**	**2012**
	SOx(min.)	10.8	13.8	11.3	11
Pollutant	(Max.)	12.4	15	12.6	13.8
	NOx (min.)	10.4	12	11.8	10.2
	(Max.)	10.9	12.4	10.2	12.6

4. CONCLUSION:

In this paper, the study was carried out on modeling of air pollutants like SOx, NOx, using Artificial Neural Network. The study was focused at the estimation of the Mean Square Error (MSE) from the inputs and outputs which were given to ANN in the sensitive area of Ujjain City in India. The investigation was carried out by giving inputs of meteorological data's like Temperature, Humidity, wind pressure and rainfall and giving outputs of collected data's of the various concentration of Pollutants from State Pollution Control Board and accordingly the mean square error was found in all cases was in the range of 0.01-0.03. The results shown here are indications that the neural network techniques can be useful tool in the hands of practitioners of air quality management and prediction. The models studied in this study are easily implemented, and they can deliver prediction in real time, unlike other modeling techniques.

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