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Analysis of air temperature variation with atmospheric pollutants and meteorological parameters using SPSS.

Análisis de la variación de la temperatura del aire con contaminantes atmosféricos y parámetros meteorológicos mediante SPSS.

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ABSTRACT

Temperature variation in the atmosphere is closely related to climatic change, environmental pollution and human health. It has become the prime concern of most countries due to the anthropogenic activities and adverse meteorological situations. This temperature variation depends on various factors like the meteorological parameters as well as the air pollutants. The analysis of temperature variation with these factors are done using Geographically Weighted Regression Modelling (GWR) in Statistical Package for Social Sciences (SPSS). This idea is used to study the chronographic change of relationship between a dependent attribute and one or more independent attribute from the output obtained from GWR equation from SPSSS of ware. In this study the variation of air temperature is analyzed with pollutants and meteorological parameters. The studyareas chosen are Vytila, MG Road, Eloor, Methanam, Kalamasserry. The concentration of NO_2, SO_2, Respairable suspended particulate matter (RSPM) and the meteorological parameters like Relative Humidity (RH), precipitation and atmospheric temperature over 2010-2020 were collected. A numerical model is developed using the above data to study the variation of temperature in the selected areas.

Keywords: GWR Modelling, Meteorological parameters, RSPM, SPSS.

RESUMEN

La variación de temperatura en la atmósfera está estrechamente relacionada con el cambio climático, la contaminación ambiental y la salud humana. Se ha convertido en la principal preocupación de la mayoría de los países debido a las actividades antropogénicas y las situaciones meteorológicas adversas. Esta variación de temperatura depende de varios factores como los parámetros meteorológicos y los contaminantes del aire. El análisis de la variación de la temperatura con estos factores se realiza utilizando el modelo de regresión ponderada geográficamente (GWR) en el paquete estadístico para ciencias sociales (SPSS). Esta idea se utiliza para estudiar el

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cambio cronográfico de la relación entre un atributo dependiente y uno o más atributos independientes a partir del resultado obtenido de la ecuación GWR del SPSSS de ware. En este estudio se analiza la variación de la temperatura del aire con contaminantes y parámetros meteorológicos. Las áreas de estudio elegidas son Vytila, MG Road, Eloor, Methanam, Kalamasserry. Se recogieron la concentración de NO2, SO2, partículas suspendidas reparables (RSPM) y los parámetros meteorológicos como humedad relativa (HR), precipitación y temperatura atmosférica durante 2010-2020. Se desarrolla un modelo numérico utilizando los datos anteriores para estudiar la variación de temperatura en las áreas seleccionadas.
Palabras clave: Modelado GWR, Parámetros meteorológicos, RSPM, SPSS.

INTRODUCTION

The noted characteristics of the atmosphere are it sun ceasing temperature change. The annual temperature variation give rise to seasons and climatic changes like shift in summer and winter, the annual temperature ranges vary greatly from place to place. The air temperature variation is generally caused due to the influence of some meteorological parameters and air pollutants likeSOX, NOX, and particulate matters. A growingurban population therefore requires model-based mitigation strategies to have an idea upon the temperature variations that can be introduced. Here the use of SPSS software is done to develop a numerical model for the analysis of air temperature variations. Ramasamy Jayamurugan. Et al (2013) conducted a study addresses the concentration of air pollutants in ambient air as determined by meteorological parameters such as atmospheric wind speed, wind direction, relative humidity and temperature[9]. This study investigated the effects of temperature and relative humidity on SO_2, NO_x, RSPM concentrations around the Indian coastal city of North Chennai during them on soon, post-monsoon, summer and pre-monsoon seasons. They performed are aggression analysis and concluded that SO_2 and NO_2 were negatively correlated with temperature during the summer and monsoons, but positive during the pre-monsoon and post-monsoon periods. The effects of rainfall and humidity on SO_2 and NOx concentrations in summer are small compared to other seasons. The effect of temperature on SO_2 and NOx is much more effective in summer than in other seasons due to the higher heat. As cited in the literature review, the variation of meteorological parameters of atmosphere are dependent on the concentration of atmospheric pollutants

METHODOLOGY

Air pollutant data like NO2, SO2 and RSPM from State pollution control board and meteorological data like temperature, relative humidity and rainfall from meteorological department were the years 2010-2020 of the selected study areas were collected. The study areas chosen are Vytila, MG Road, Eloor, Methanam and Kalamassery. As a sample the data collected from Vytila has to be represented in the table 1:

Table 1. Data Collection from Vytila.

Year	SO_2	NO_2	RSPM	Temp	PPT	RH
2010	17.60	18.10	78.00	26.6	3586.1	78.68
2011	3.90	15.31	46.50	26.5	3601.3	70.77
2012	3.49	11.90	59.87	26.6	2573.3	73.80
2013	2.47	8.57	42.98	26.6	3099.5	74.47
2014	3.00	8.74	65.82	26.7	2853.1	72.92
2015	3.09	9.43	41.00	26.8	2710.1	75.69
2016	2.30	19.23	52.00	26.9	2381.6	75.41
2017	2.71	19.55	50.00	26.7	3011.2	78.39
2018	2.71	19.55	50.00	26.7	3005.2	77.67
2019	2.00	11.99	41.00	27.0	3169.4	77.47
2020	2.00	6.81	33.00	27.0	2868.3	78.32

NUMERICAL MODELLING IN SPSS

SPSS (Statistical Package for the Social Sciences) software-enables the quickly dig deeper into data, making it a much more effective tool than spread sheets, data bases or standard multi-dimensional tools for analysts. SPSS Statistics excels at making sense of complex patterns and associations-enabling users to draw conclusion sand make predictions. Regression analysis using SPSS helps in predicting value of a dependent variable from one or more independent variable. Multiple regression analysis is a statistical technique that can be used to analyses the relationship between a single dependent variable and several independent variables. Here the dependent variable is temperature and independent variables are meteorological parameters like precipitation, relative humidity and concentration of pollutants like NO_2, SO_2 and RSPM. The development of numerical model was carried out consequently in the coefficient tables.

Table 2. Vytila

Model	Unstandardized Coeff.		Standardize Coeff	t	Sig.
	B	Std. error	Beta		
Const.	19.003	2.432		7.814	0.001
SO_2	-0.033	0.026	-0.513	-1.293	0.252
NO_2	-0.025	0.011	-0.413	-2.272	0.072
RSPM	0.016	0.007	0.697	2.187	0.080
PPT	0.000	0.000	-0.343	-1.441	0.209
RH	0.111	0.111	0.929	4.250	0.008

Table 3 M G Road

Model	Unstandardized Coeff.		Standardize Coeff	t	Sig.
	B	Std. error	Beta		
Const.	21.151	1.524		13.875	.000
SO_2	-0.009	0.015	-0.138	-0.588	0.582
NO_2	-0.015	0.011	-0.212	-1.304	0.249
RSPM	0.010	0.003	0.492	3.032	0.029
PPT	0.000	0.000	-0.426	-3.160	0.025
RH	0.085	0.017	0.717	5.025	0.004

Table 4: Eloor

Model	Unstandardized Coeff.		Standardize Coeff	t	Sig.
	B	Std. error	Beta		
Const.	23.314	2.409		9.677	0.000
SO_2	-0.006	0.016	-0.093	-0.381	0.719
NO_2	-0.003	0.007	-0.112	-0.400	0.706
RSPM	0.009	0.005	0.494	1.918	0.113
PPT	0.000	0.000	-0.469	-1.800	0.132
RH	0.057	0.038	0.475	1.504	0.193

Table 5: Methanam

Model	Unstandardized Coeff.		Standardize Coeff	t	Sig.
	B	Std. error	Beta		
Const.	22.758	1.837		12.38	0.000
SO_2	-0.004	0.014	-0.067	-0.295	0.780
NO_2	-0.005	0.006	-0.165	-0.764	0.479
RSPM	0.008	0.003	0.447	2.252	0.074
PPT	0.000	0.000	-0.597	-2.867	0.035
RH	0.070	0.026	0.586	2.671	0.044

Table 6: Kalamassery

Model	Unstandardized Coeff.		Standardize Coeff	t	Sig.
	B	Std.error	Beta		
Const.	23.468	1.918		12.23	0.000
SO_2	0.037	0.019	0.579	2.000	0.102
NO_2	-0.064	0.023	-0.741	-2.749	0.040
RSPM	0.002	0.003	0.159	0.848	0.435
PPT	0.000	0.000	-0.417	-1.93	0.111
RH	0.063	0.022	0.533	12.23	0.034

Multiple linear regression model for temperature obtained from coefficient tables are:

1. Vytila

$$Y=19.003+0.016x_1+0.111x_2$$

2. MGRoad

$$Y=21.151+0.01x_1+0.085x_5$$

3. Eloor

$$Y=23.314+0.009x_1+0.057x_2$$

4. Methanam

$$Y=22.758+0.008x_1+0.07x_2$$

Kalamassery

$$Y=23.468+0.002x_1+0.063x_2+0.037x_3$$

Where,

x_1= RSPM in µg/m³

x_2= RHin%

x_3=SO_2 inµg/m³

Y= Temperature in °C

RESULTS

For the further analysis in numerical modelling, validation is used as a measure off in ding model accuracy between model prediction and real world. The common way for validating numerical result is to compare the existing numerical value with previous correlations on a single graph under the same conditions and variation. The graph obtained for the selected areas are given in the following figures:

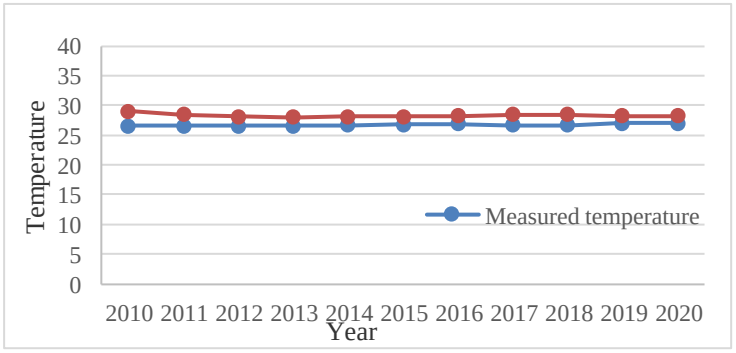

Fig 1: Calculated and measured temperature of Vytila

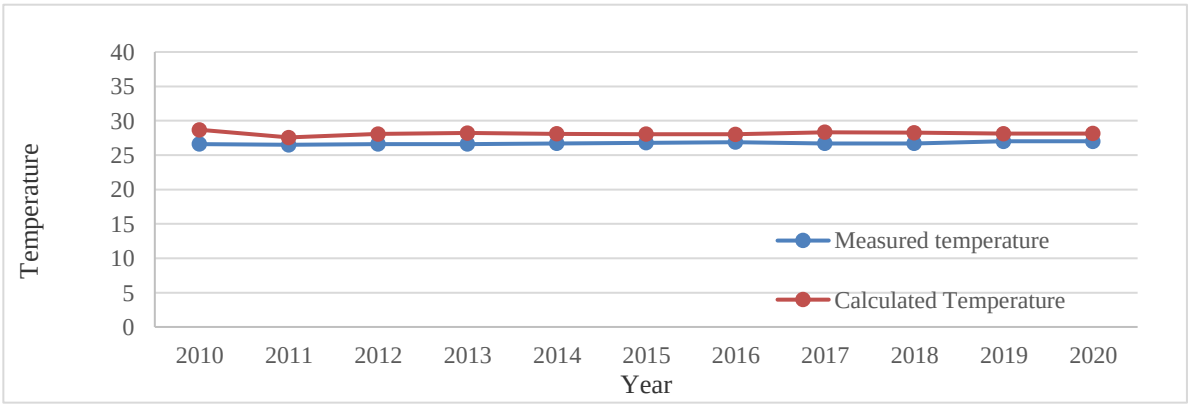

Fig2: Calculated and measured temperature of M G Road

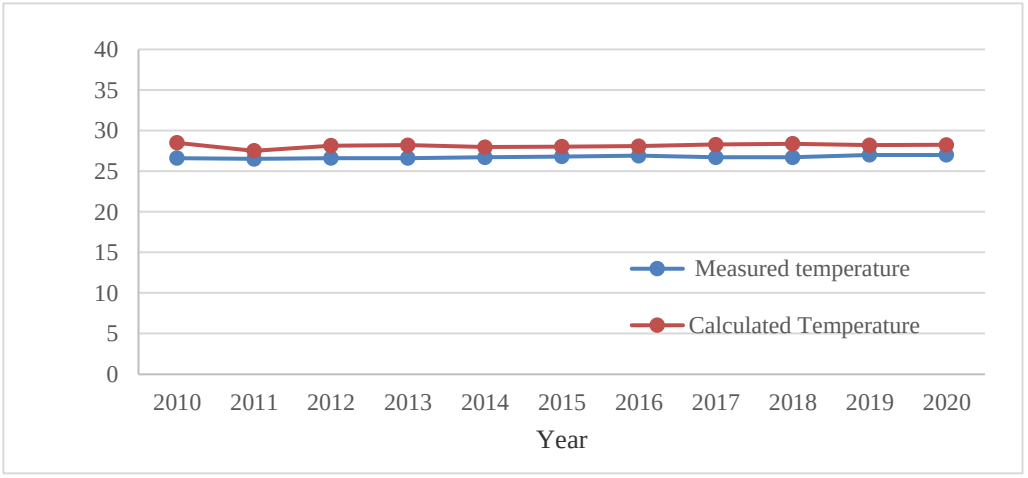

Fig 3: Calculated and measured temperature of Eloor.

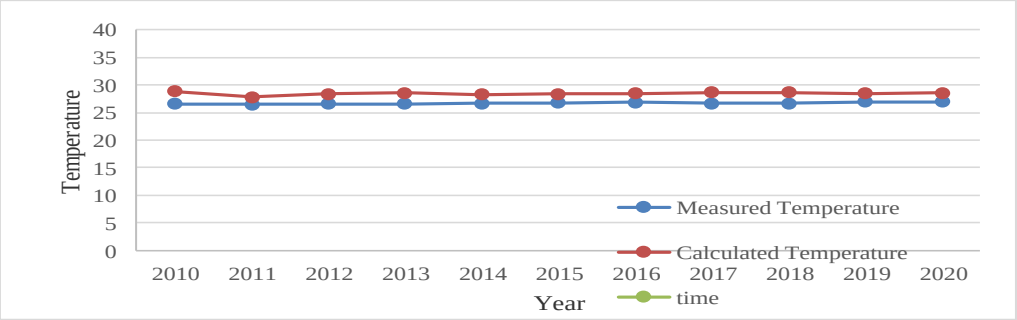

Fig 4: Calculated and measured temperature of Methanam

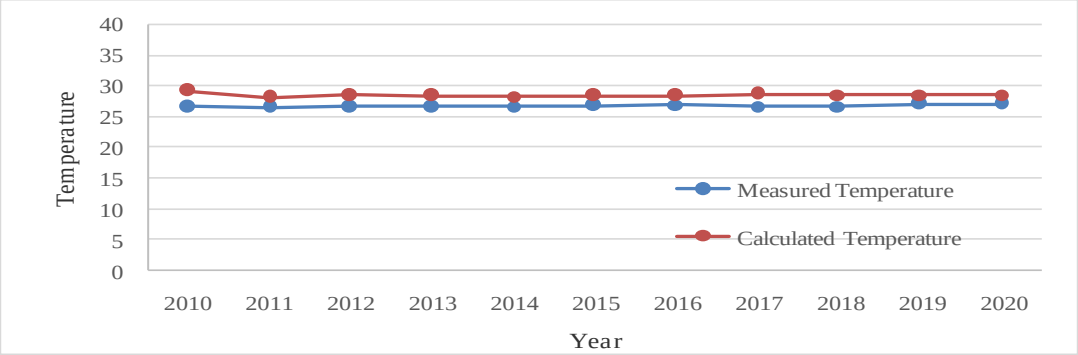

Fig 5: Calculated and measured temperature of Kalamassery

It was observed that the temperature varies with the variation in atmospheric pollutants like SO_2, RSPM and meteorological parameter like RH.

• In the case of Vytila, MG Road, Eloor and Methanam, temperature varies positively with RSPM and RH

• In the case of Kalamassery, temperature varies positively with SO_2, RSPM and RH.

Here the temperature variation with atmospheric pollutants and meteorological parameters were analyzed using the developed numerical equation. From the analysis, it was observed that the temperature is dependent upon the variations in pollutants, as well as the meteorological parameters.

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