Jr. of Industrial Pollution Control 26 (2)(2010) pp 217-220

SPATIAL DISTRIBUTION MAPPING FOR AIR POLLUTION IN INDUSTRIAL AREAS – A CASE STUDY

S.HARINATH[1] AND USHA N MURTHY [2]

[2] Civil Engineering Department, Bangalore University, Bangalore, India

Key words : Air Pollution, Mapping, Spatial map, Geographic Information System (GIS).

ABSTRACT

Air pollution has become a matter of grave concern, particularly in mega-cities and urban areas. Air quality monitoring is necessary in urban and industrial areas for careful planning to facilitate future industrial development. An quality monitoring study has been carried in industrial areas of Bengaluru city for five important parameters for a fixed period and compared with standards. Geostatic modeling technique has been carried out with interpolation method to predict the pollution level in between sampling stations with spatial maps using Arc GIS software. It is observed that most of the predicted pollutants are violating the CPCB norms.

INTRODUCTION

Air pollution is a major problem in developed and developing countries. It causes respiratory diseases and chronic illness (McCubbin and Delucchi, 1999) and effects soil (EI Desouky *et al.* 1998) and forest (Zhang *et al*. 2000).Both human activities and natural environmental processes are our one source of pollution. Seasonal changes (Cheng and Lam, 1997) and chemical reactions contribute to the concentration of the pollutants in the air. Air bone gases and particles were never envisaged as a threat to the ecological balance until the dramatic changes in their concentrations with the advent of industrial era. Anthropogenic emissions from various industrial, domestic and automobile sources have increased manifold and eventually have led to many global problems. Nearly 3000 different anthropogenic air pollutants have been identified, of which most are organic and combustion sources.

The objective of this study was monitoring the air quality for fixed period in selected stations, and also application of GIS technique in the prediction of pollution level in between the sampling stations, thereby to assist to Air Quality Management. Interpolation method is selected according to capability of GIS among various air pollution modeling. The present study represents interpolation method for each pollutant based on theoretical studies approximation leading to better results. The Standards prescribed by CPCB, (Central Pollution Control Board) are given in Table 1.

Table1. Ambient air quality Indian standards ($\mu g/m^3$)

Area	SPM	SO_2	NOx
Industrial	300	80	90
Residential	140	60	60
Sensitive	70	20	20

*** Address for correspondence -** Hari Nath, **Email :** harinath8@yahoo.com

MATERIALS AND METHODS

The present study is carried in Bommasandra industrial, Jigane industrial and Electronic Industrial areas. Each industrial area is divided into three zones to select sampling stations.

Location of sampling points

The method of random sampling was adopted to collect air pollution samples at three stations in and around industrial areas of Bommasandra industrial area, Jigane industrial area and Electronic City Industrial area. The location of sampling station should be such that it should be in the free atmosphere, without interferences from stagnant spaces or large buildings etc. It should be located at a height of minimum 1.5m but not exceeding 15m from the ground level.

The selected parameters are SPM, SO_2, NOx, and CO. The high volume air sampler is used to collect the air samples at each sampling stations as standards, for each different parameters and chosen samples were analysed in the laboratory by following standard methods during the period of Feb 2008 to June 2008.

Site Description

The Bangalore urban and rural parts are located in the south eastern part of Karnataka state between the North latitude 12° 15' and 13° 31' and East longitude 77° 41' and 77° 59'. The climate of the study area is seasonally dry tropical savannah with four Seasons. The dry Season with clear bright weather is from December to February. The summer Season from March to May is followed by the Southwest monsoon season from June to September, October and November Constitute the Post monsoon. The temperature ranges between 33° C in April to 14° C in January. The mean annual rainfall is 950 mm and number of rainy days is about 57, June to September is the principal rainy season.

Preparation of base map

The base map was prepared at a scale of 1: 50,000 by using Bangalore district map, which obtained from the Survey of India Department. The map prepared in Arc GIS 9, the various features like boundaries and road network, sample points were shown in the base maps and spatial distribution of pollutants represented in Figures 1, 2, 3 and 4. The spatial map is prepared with the support of Kriging method. Kriging uses a semivariogram, a measure of spatial correlation between two points, so the weights change according to the spatial arrangement of samples.

GIS is a suitable tool for managing air quality as a high volume of data that depends on time and position. With time-position analyzing and identifying critical pollution, it is possible for manager in different level to decide on localization of new industrial areas, transferring air pollution producer in the way that have the least effect on air pollution areas, creating area which require clean air, identifying region need to creating green space.

RESULTS AND DISCUSSION

The general survey indicates that the industrial areas of Bangalore city are affecting the condition of air due to dust particles. The status of ambient air quality with respect to Suspended Particulate Matter, Sulphur Dioxide, Nitrogen Oxide, Carbon Monoxide and Nitrogen Dioxide etc carried out in different industrial areas of Bangalore city and is summarised in the following Table 2.

The present study shows that Suspended Particulate Matter is higher than standards, prescribed by CPCB. The Suspended particulate matter is high in Bommasandra and Jigane industrial areas and this could be due to stone polishing and cutting industrial activities, due to traffic and due to bad maintenance of roads, and constructional activities therefore the value of SPM and CO is very high.

The value of SPM in the Electronic city is high due to National highway passing closer to sampling station where traffic volume is very high and also due to commercial activities in this area so the distribution particulate matter is high, but no much pollutants emission industries in this area. The Fig. 1 shows graphically the values of different parameters in the selected sampling stations, This graph also shows that the suspended particulate matter is higher than the permissible limit in industrial areas, Carbon monoxide is closer to standard value in all areas. The other parameters are within the permissible limits. Figure 2, 3, 4 & 5, the spatial distribution map has shown and predicted the values of SPM, SO_2, NO_x and CO in the industrial areas by using Arc GIS 9 software. The spatial Map shows that the pollution value is higher in between the selected sampling stations in the industrial areas.

CONCLUSION

The following conclusions were derived the Sus-

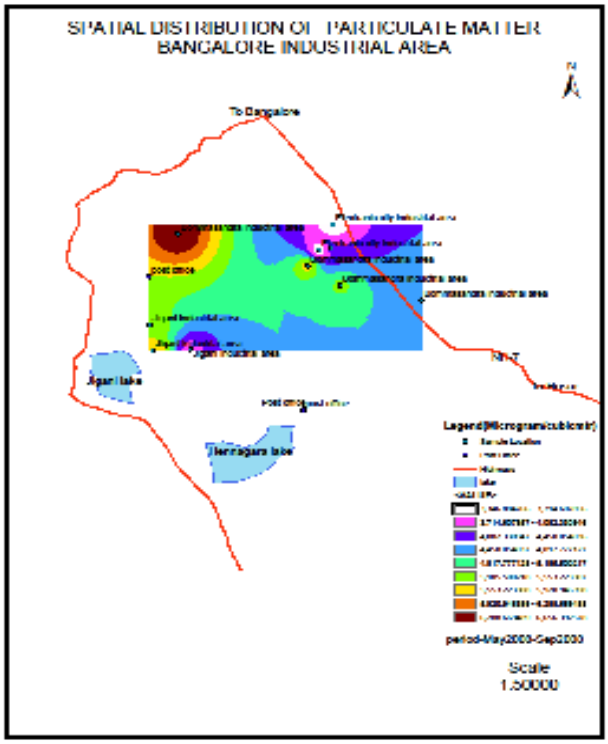

Fig. 1 Levels of Parameter in industrial areas

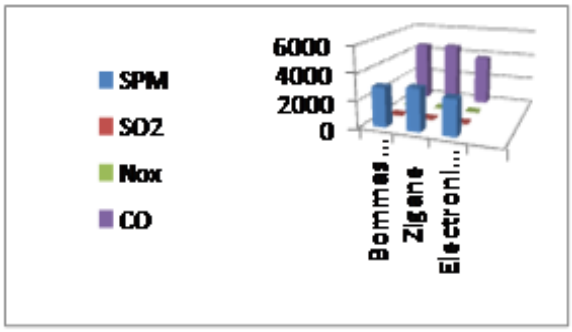

Fig. 2 Spatial Distribution map of SPM

pended Particulates Matter is high in the industrial areas where the traffic movement is more along with industrial activities and reaching a maximum value of 3,178µg/m³ in Jigani industrial area. The results indicate that suspended particulate matter is more in all areas along with carbon monoxide. Use of recent technologies like GIS can be well implemented to study various environmental crises like air pollution by saving time & cost. The predicted air pollution levels necessitate the immediate action to be taken up in order to keep the air pollution level within CPCB limit.

Use of recent technologies like GIS can be well implemented to study various environmental crises like air pollution by saving time and cost.

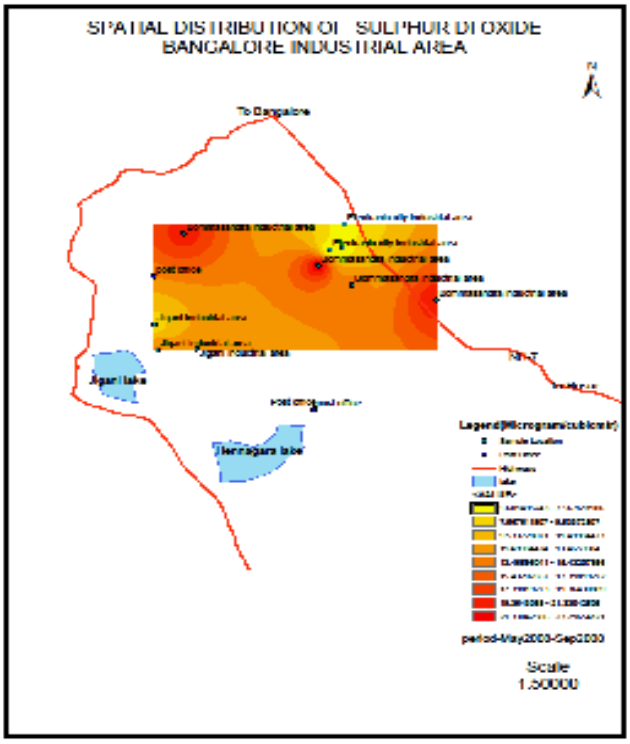

Fig. 3 Spatial Distribution map of SO_2

This study shows how GIS can be used to map the spatial variability of industrial air pollution. The greater spatial detail provided can be used to improve estimates based on interpolation between ground observations and dispersion models.

ACKNOWLEDGEMENT

The authors are thankful to Mr. Arunachalam, Lecturer, Civil Engineering Department, Adhiyamaan Engineering College, Hosur and student M. Mohan and team for providing their help in conduction and preparation of maps.

REFERENCES

Clagget, Michael, Shrock, John, E. Noll, Kenneth 1981. Carbon monoxide near an urban intersection. *Atmospheric Environment*. 15 (9) : 1633-1642.

Chakraborty, J., Schweitzer, L.A. and Forkenbrock, D.J. 1999. Using GIS to assess the environmental Justice consequences of transportation system changes. *Transactions in GIS*. 3 (3) : 239 -258.

Chu, D.A., Kaufman, Y.J., Zibordi, G., Chern, J.D., Mao, J., Li, C. and Holben, B.N. 2003. Global monitoring of air pollution over land from EOS-Terra MODIS. *J. Geophys. Res*. 108 (D21), 4661, doi: 10.1029.

Fig. 4 Special Distribution map of NO_x

Fig. 5 Spatial Distribution map of CO

Table 2. Ambient air quality and predicted values for different industrial areas. (µg/m³)

Sl No	Parameters	Observed Values			Predicted Values in range, between sampling station		
		Bommasandra industrial area	Jigane industrial area	Electronic City industrial area	Bommasandra industrial area	Jigane industrial area	Electronic City industrial area
1.	SPM	3174.62	2965.29	2724.24	4817.77-5553.22	4877.56-5920.94	3346.88 -4082.33
2.	SO_2	11.34	19.58	5.967	17.39 - 23.29	9.53 – 15.43	5.6 -9.53
3.	NO_x	9.52	17.99	4.53	8.09 -18.08	8.90 -12.09	4.10 -6.09
4.	CO	4575.63	4503.51	3768.04	3763.06 – 4317.73	4317.90 – 5149.05	2932.33 – 3209.42

Cheng, S. and Lam, K.C. 1997. Climatic Impact on air pollution concentrations in Hong Kong. Department of Geography, Occasional paper, The Chinese University of Hong Kong, Hong Kong.

Chung, C.E. and Ramanathan, V. 2004. Aerosol loading over the Indian Ocean and its possible impact on regional climate. *Indian J. Marine Sci.* 33 (1) : 40-55

CIESIN (Center for International Earth Science Information Network), Columbia Universit and Centro International de Agriculture Tropical, CIAT) 2004. Gridded Population of the World (GPW), Version 3.

De Nevers, Noel 2000. *Air Pollution Control Engineering*. Singapore: McGraw-Hill

International Edition. Department of Environment 1997. A Guide to Air Pollutant Index in Malaysia (API).

Engel-Cox, J.A., Holloman, C.H., Coutant, B.W. and Hoff, R.M. 2004. Qualitative and quantitative evaluation of MODIS satellite sensor data for regional and urban scale air quality. *Atmos. Environ*. 38 (16) : 2495-2509.

McCubbin, D.R. and Delucchi, M.A. 1999. The health cost of motor vehicle related air pollution. *Journal of Transport Economics and Policy*. 33 (3) : 253 -286.

Zhang Jin Tun, R. Pouyat, J.T. Zhang 2000. Effects of urbanization on the concentrations of heavy metals in deciduous forest floor in a case study of New York City. *Scientia Silvae Sinicae.* 36 (4) : 42-45.