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AIR POLLUTANTS TRANSPORT AND DIFFUSSION AT COASTAL CITY VISAKHAPATNAM – A CASE STUDY

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Abstract: ***The population growth and the increase in vehicular traffic is causing environment pollution in general and air pollution in particular. The pollution load from the industries in the bowl area and traffic volume data clearly points out that not only industry but also traffic is also a source of air pollution. The most important parameter that influence mixing, diffusion and dissipation of pollutants. In the present study an attempt is made to see the implications of air pollution and its effects on the environment of an industrially developed coastal city. A test case chosen here is Visakhapatnam city (17° 42'N: 82°18'E) highly industrialized coastal metropolitan city on the east coast of India. In this paper we took the data of the major pollutant SPM, SO2 and NO2 for the latest warming year 2013 at various locations in Visakhapatnam. The effluent transport of the pollution is studied under different seasons. In this article we observed high concentrations in the month of February and minimum concentrations in the month of April. A season wise comparison revealed that winter season recorded maximum concentrations.***

Keywords: Air pollution, Diffusion, Dissipation and Environment**.**

1. Introduction

A diffusion model for flat terrain was developed to predict the concentrations over the city were discussed by Vittal Murthy et al (1977).Both gaseous and particulate pollutants were monitored regularly in Visakhapatnam city in order to get their spatial and temporal variation and reported by Vittal Murthy et al (1983, 1986).Further in order to evaluate the back ground levels of pollution, rain water samples were collected and analyzed by Vittal Murthy et al (1977).Since then, many researchers like Sadhuram (1982) Sarma (1983),Srinivasa Rao (1983),Venkateswara Rao(1985),I.N.Rao (1992) and Peddiraju and Vittal Murthy(1995) exclusively worked on air pollution problems in this city.Gaussion plume model is modified depending upon the circumstances and requirement and I.N.Rao(1992) developed a multiple source ,multiple receptor complex coastal terrain model (AU GPM) and successfully estimated the ground level concentrations ,but still it is a mathematical once. Krishna et al (2004) applied the ISCST-3model to examine the assimilative capacity and the dispersion of pollutants in the summer and winter seasons due to industrial source in Visakhapatnam bowl area. It is a general observation that the concentration of pollutant at a particular location under the plume depends on the sampling time .The plume will diffuse to larger over longer time periods. The study of Air pollution Monitoring, Modeling and Health Edited by Mukesh Khare. It is well known that the quality of the air in a locale influences the health of the population and ultimately affects other dimensions of that population's welfare and its economy. As a simple example, in cities where pollution levels rise significantly in the summer, worker absenteeism rates rise commensurately and productivity is adversely impacted. Other dimensions of the economy are influenced on "high pollution days" as well. For example, when outdoor leisure activity is restricted this may have serious consequences for the service sector of the economy (Bresnahan et al., 1997). In this paper, we have introduced two measures of environmental quality or air quality as Quality of life factors. A feature of these indices is the fact that these types of pollution are created by some of the very activities that define economic development. The two factors under investigation here are sulfur oxides (Sox) and nitrogen oxides (NOx) (million tons of SO2 and NO2equivalent, respectively). Sulphur oxides, including sulphur dioxide and sulphur trioxide, are reported as sulphur dioxide equivalent, while nitrogen oxides, including nitric oxide and nitrogen dioxide, are reported as nitrogen dioxide equivalent. They are both produced as byproducts of fuel consumption as in case of the generation of electricity. Vehicle engines also produce large proportions of NOx and SOx are primarily produced when high sulphur content coal is burned which is usually in large-scale industrial processes and power generation.

2. Data and Methodology

Unpleasant flumes and odors reduced visibility, injured to human health, crops and forms of vegetation by noxious pollutants and damage to property by dust particles and corrosive gases rank among the major environmental problems of urban and industrialized areas and their surroundings the fact was through with Visakhapatnam (17° 42'N: 82°18'E) a highly industrialized coastal metropolitan city on the east coast of India. Here in this study we taken major air pollutants are SPM (Suspended Particulate Matter), SO2 and NO2 in different regions in the Visakhapatnam urban region those are Mindi (BHPV), IE Marripalem (Industrial), Polis Barracks

(Transportation), Gnanapuram (Industrial area), Veerabahu (INS- Kalinga) and Seetammadhara (Domestic area) in the year 2013. In this article data collected for typical month of the season such as January (winter), April (summer), August (monsoon) and October(post monsoon) for morning wind speeds with Gaussian Flume model (GPM-MWS).

3. Results and Discussions

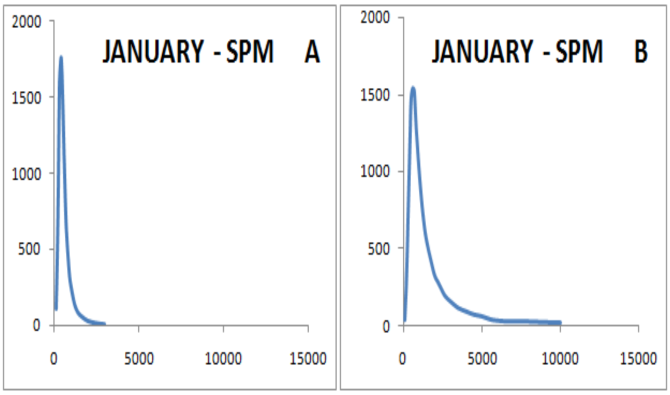
Gaussian Plume Model—Morning (minimum) winds Speeds (GPM-MWS):

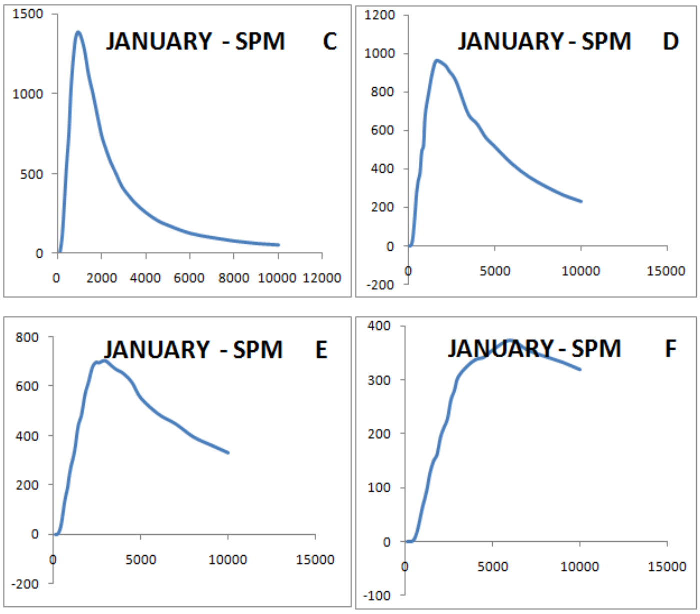
In January in stability A, the concentrations show a very rapid increase followed by a rapid decrease. Where as in stability B, the increase is rapid but the decrease is slow compared to stability A, which is clearly seen in the figure. In other words, the area under the curve increases considerably in stability B. This increase is considerable and well marked .In C, D, E, and F stabilities the area under the curve gradually increases. The main difference in stability from A to F is in the rate of decrease in the decrease in concentrations. The curve under F stability is more or less flat after it showed a peak at 6,000mts.In other words; the concentration is considerable at 10,000 mts, downwind distance in case of F stability. The decrease from peak is sharp in stability A, not so sharp in B, still less in C and D. That is why the concentrations are negligible after 3,000mts in A, in case of B stability also the curve approaches X- axis and one can infer that the concentrations are negligible after 8,000mts.But in case of stabilities C, D, E and F the gap with X- axis increases which means the decrease is not rapid. When a comparison is made within the concentrations, October recorded peak concentration and April recorded minimum value. If a comparison is made as season wise then post monsoon season is recorded maximum concentrations followed by winter season, monsoon and summer season respectively.

4. Summary and Conclusions

Gaussian box model with morning (minimum) wind speeds (GBM-MWS) estimated high concentrations in all the stabilities (A-F) for all the pollutants (SPM,SO2 and NOx) for all the four months .GBM-MWS estimated high concentrations in October and low concentrations in April. Both GBM-MWS and GBM-AWS estimated minimum concentrations in the month of April. A comparison is made between the GPMMWS and GPM-AWS. The former recorded highest concentration in the month of February whiles the latter recorded highest concentrations in the month of October.

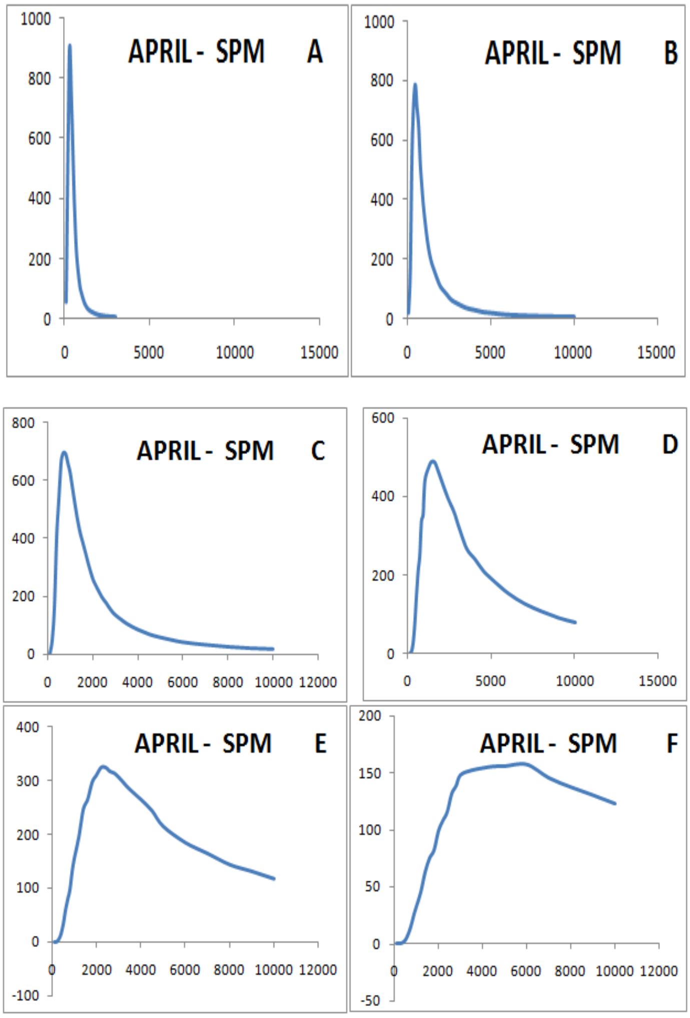
We taken on X- axis downwind distance (mts), on Y-axis Concentration (µg/m3)





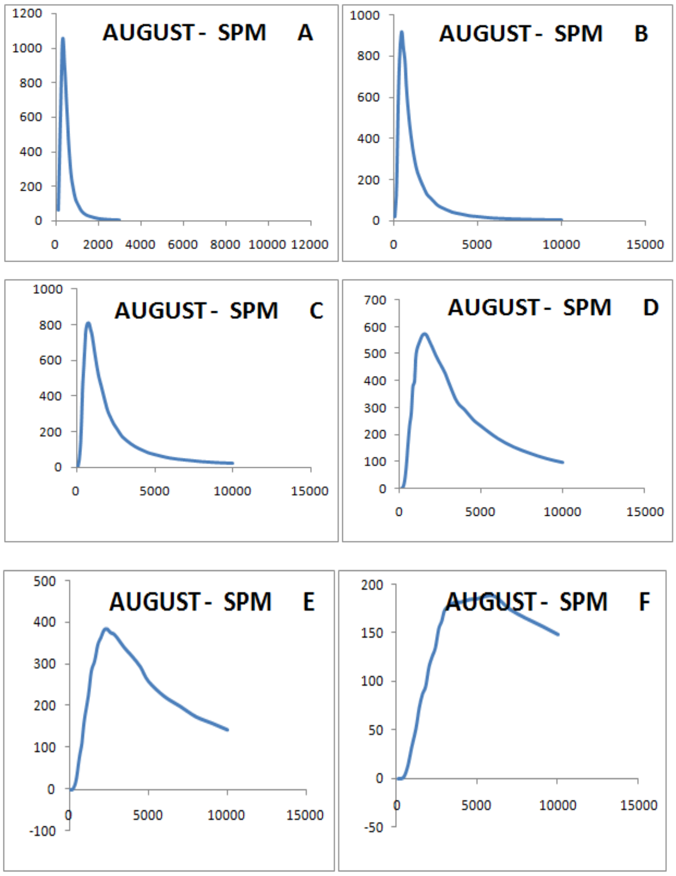
Estimated distribution of pollution concentration of SPM-January

We taken on X- axis downwind distance (mts), on Y-axis Concentration (µg/m3)



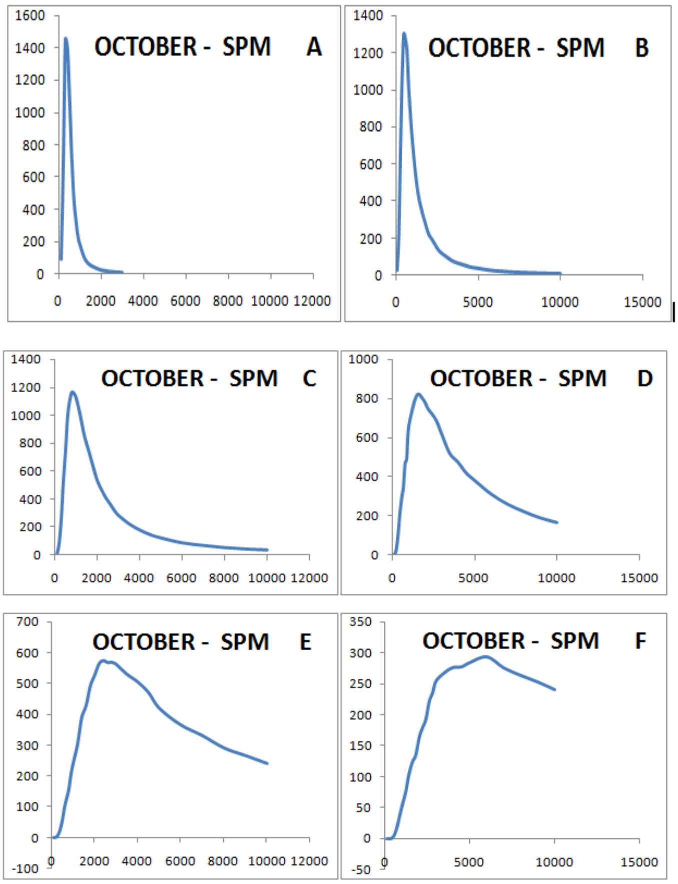
Estimated distribution of pollution concentration of SPM-April.

We taken on X- axis downwind distance (mts), on Y-axis Concentration (µg/m3)



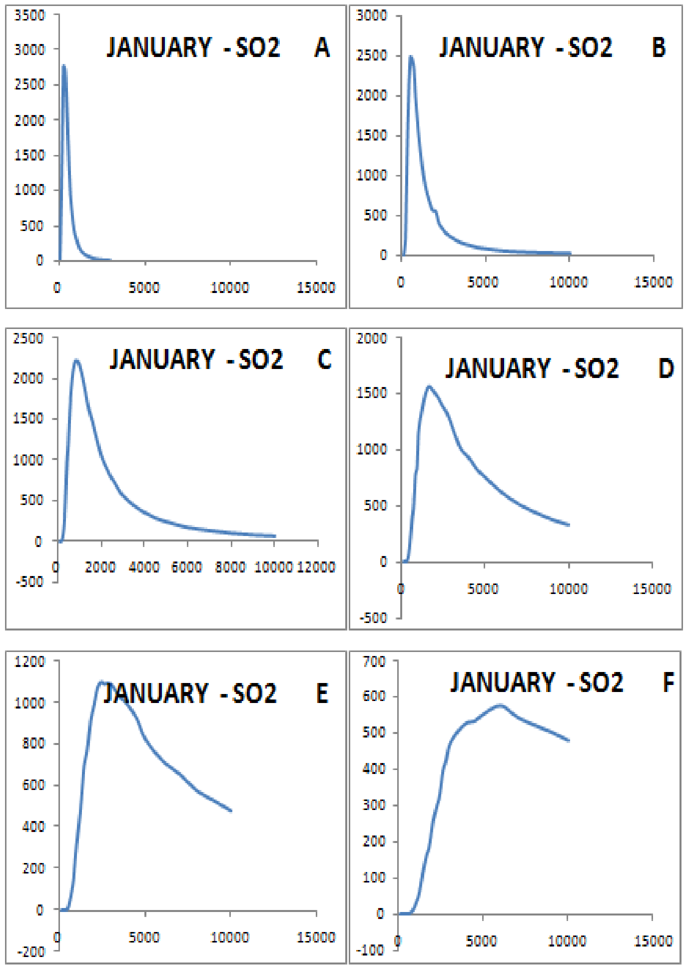
Estimated distribution of pollution concentration of SPM-August.

We taken on X- axis downwind distance (mts), on Y-axis Concentration (µg/m3)



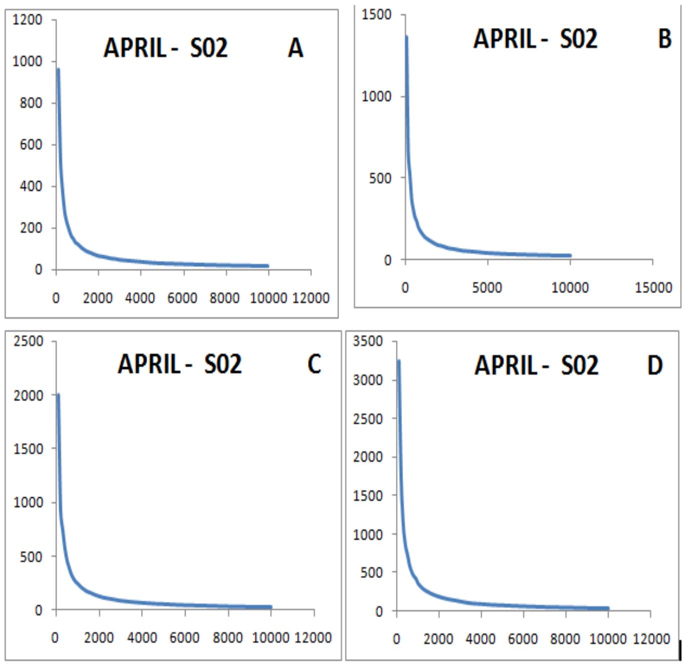
Estimated distribution of pollution concentration of SPM-October.

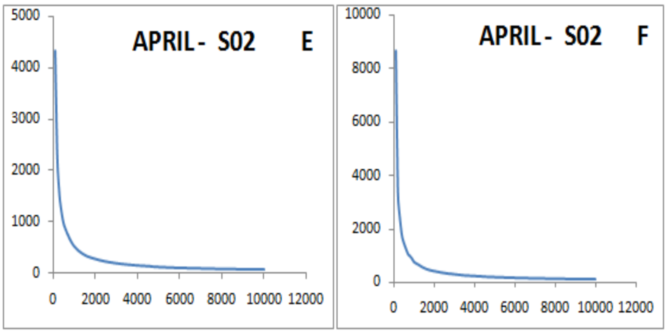
We taken on X- axis downwind distance (mts), on Y-axis Concentration (µg/m3)



Estimated distribution of pollution concentration of SPM-January

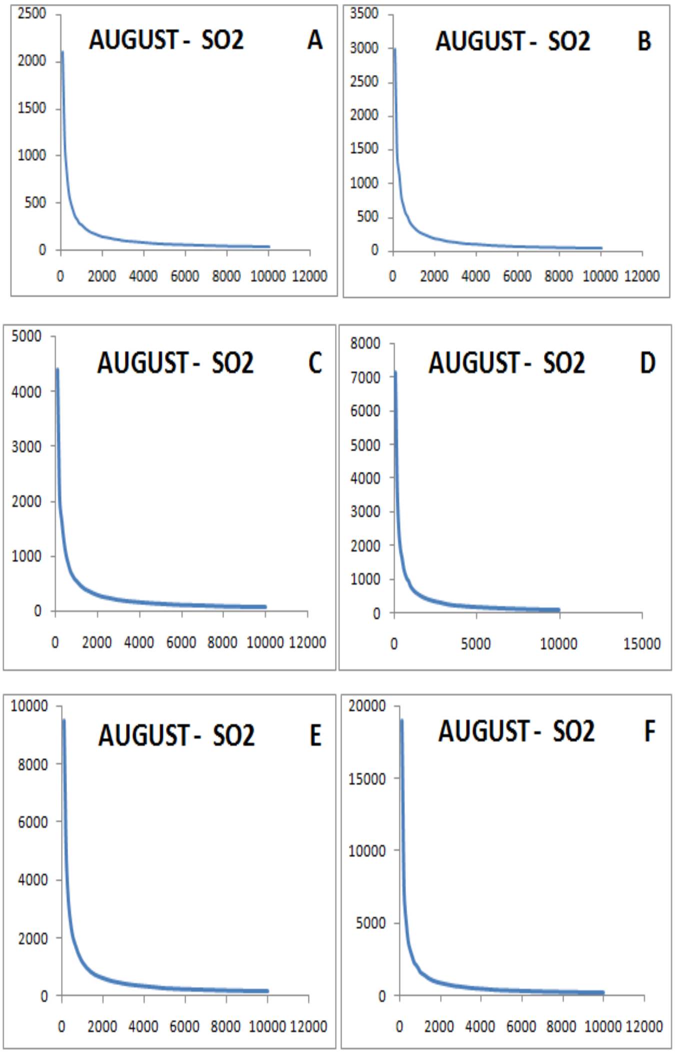
We taken on X- axis downwind distance (mts), on Y-axis Concentration (µg/m3)





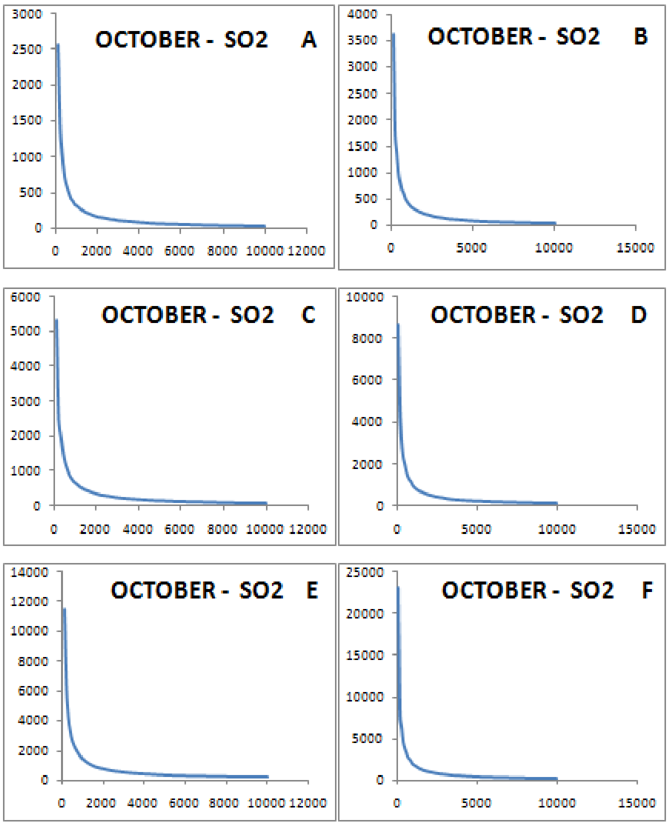
Estimated distribution of pollution concentration of SPM-April.

We taken on X- axis downwind distance (mts), on Y-axis Concentration (μg/m3)



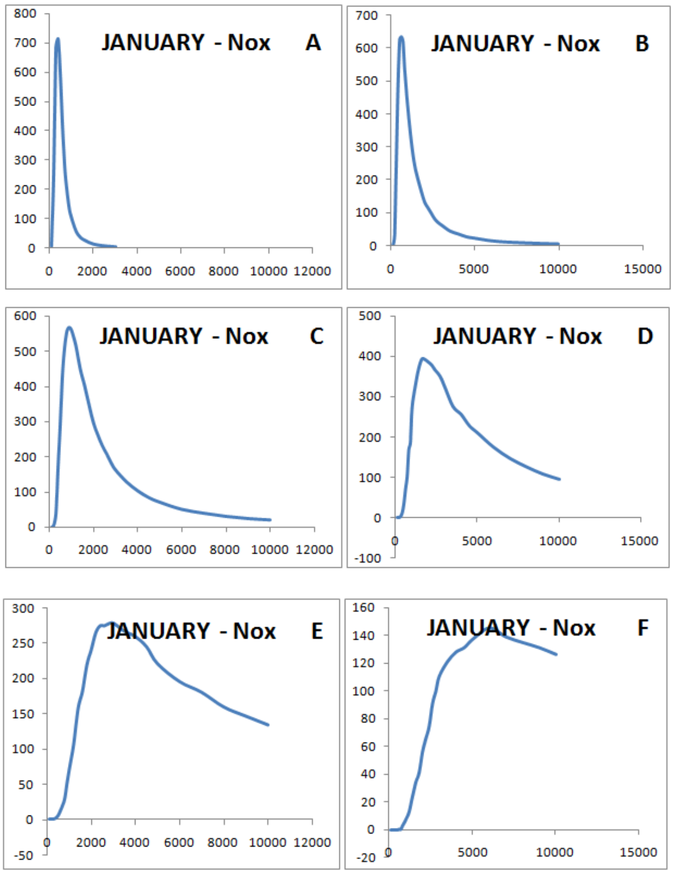
Estimated distribution of pollution concentration of SPM-August.

We taken on X- axis downwind distance (mts), on Y-axis Concentration (μg/m3)



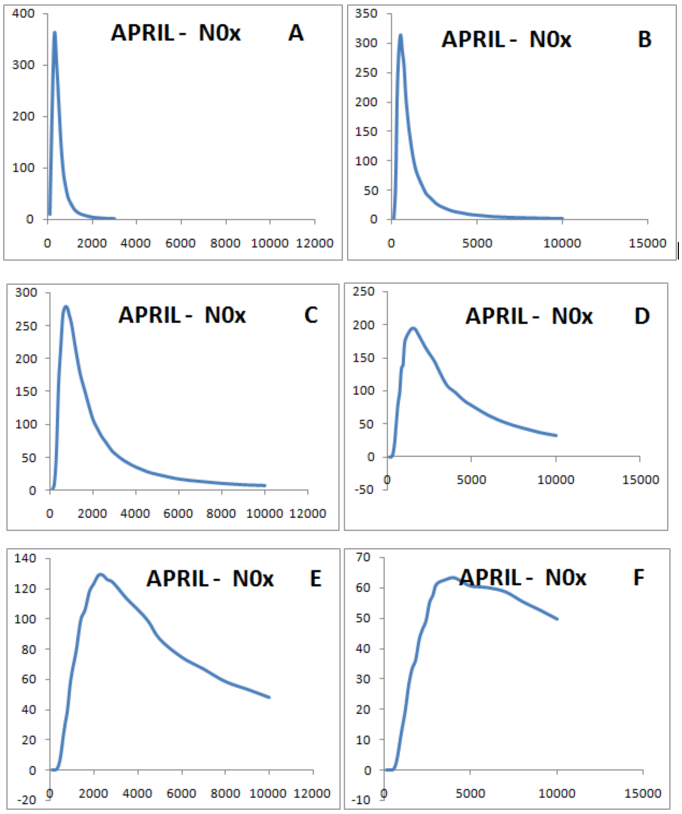
Estimated distribution of pollution concentration of SPM-October.

We taken on X- axis downwind distance (mts), on Y-axis Concentration (μg/m3)



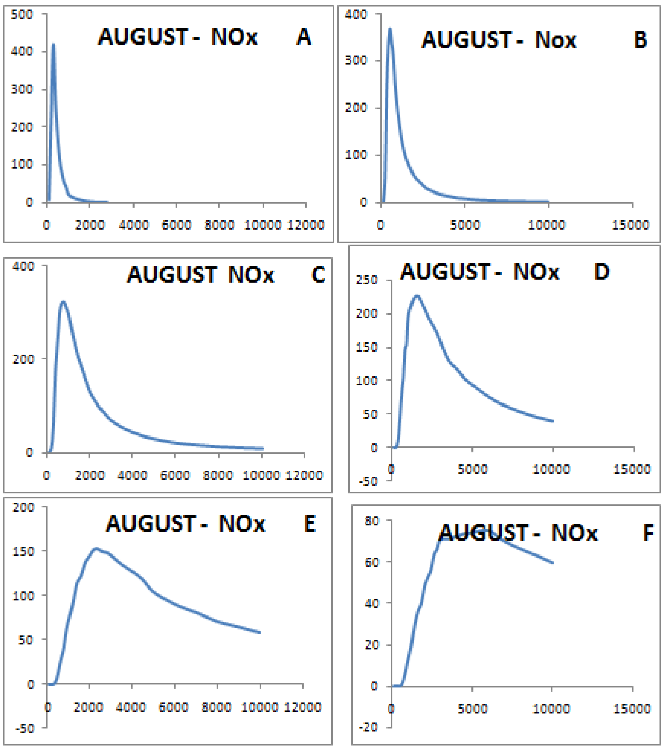
Estimated distribution of pollution concentration of SPM-January.

We taken on X- axis downwind distance (mts), on Y-axis Concentration (μg/m3)



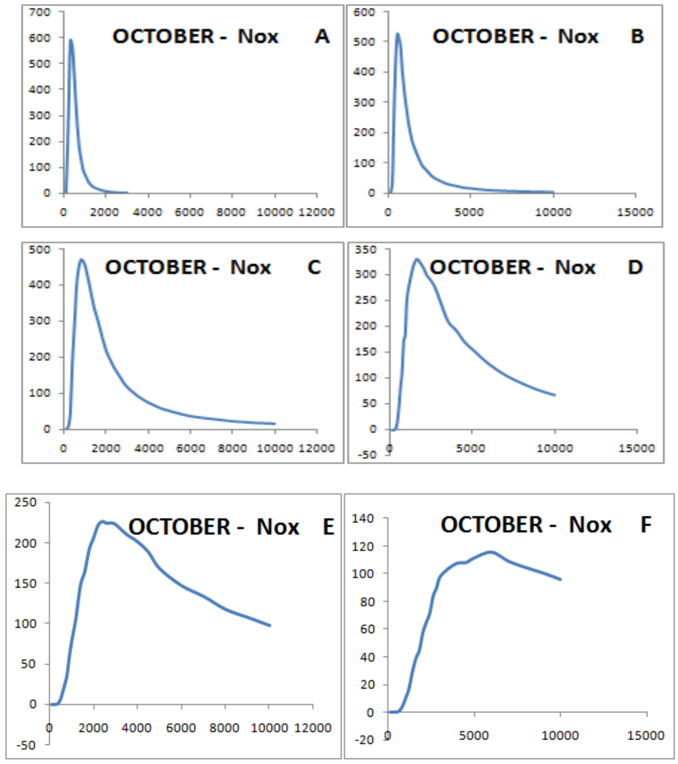
Estimated distribution of pollution concentration of SPM-April.

We taken on X- axis downwind distance (mts), on Y-axis Concentration (µg/m3)



Estimated distribution of pollution concentration of SPM-August.

We taken on X- axis downwind distance (mts), on Y-axis Concentration (µg/m3)



Estimated distribution of pollution concentration of SPM-October.

References

[1] Benkley, C.W. and Bass. A. (1979) Development of mesoscale air quality models, Vol.2.Users guide to MESOPLUME model, NOAA, contract 03-6-02-35254, Env,Res and Tech, Inc., Concord, MA.

[2] Biggs.W.G.and Graves. M.E (1962).A lake breeze index, J.Appl.Meteorol. 1,474.

[3] Burt .E.W.(1977).Valley model users'guide.USEPA, Pub.No.EPA-450/2-77-018.P.112.

[4] Calder. K.L (1977) multiple source plume models of urban air pollution- their general structure, Atoms.Environ. 1,403-413.

[5] Danard M.B.(1972).Numerical modeling of carbon monoxide concentrations near highways,J.Appl.Meteorol.,11,947-957.

[6] Davis Gareth (2005) .The need for air dispersion modeling, Journal of Environment Science & Engineering (June – August, 2005), pp.29-31.

[7] Peddiraju.S.M. and Vittal Murthy.K.P.R.(1995).The concentration of conventional air pollutants in Visakhapatnam

[8] Sadhuram,Y.(1982),A Study of Dispersion of Pollutants over complex Terrain with special Reference to Visakhapatnam City,Ph.D.Thesis,AndhraUniversity, Visakhapatnam.

[9] Sarma.K.S.(1983).Some studies on Suspended particulate Pollution and Metals in the Lower Layers of Visakhapatnam city Ph.D.Thesis,Andhra University.

[10] Srinivasa Rao.B.(1983).Temporal and Spatial Variations of Sulfur Dioxide over a complex Terrain-with Special Reference to Visakhapatnam,Ph.D.Thesis,A U.,Visakhapatnam.