

## **Study of Air pollution in Kolkata with the respect to the monthly spike in the concentration of pollutants for the year 2015**

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Anish Ganguly

*Department of Environmental Science, University of Calcutta*

### **Abstract**

Air pollution in Kolkata is not a result of only the human error and negligence but it is also affected by the meteorological factors like wind. In this rostrum we have simply discussed about the spike in the pollutant level in certain days of the year and have tried to explain the reason with the utilization of Hysplit Backtrajectory and Dispersion model.

**Keywords:** Pollution, Particulate matter, Dispersion Model

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### **Introduction**

In neoteric schedule, lack of stringent government policies and mass clustering of vehicular transports and industrial belt have spiked the concentration of pollutants in major metropolises in Eastern India [1]. Kolkata being both the financial and administrative pivot in the state of West Bengal has in contemporary period saw itself rising gradually up in the ladder for claiming the crown of worst polluted city in India. [2]The spike of pollutants in this city is attributed mainly because of the meteorological phenomenon that transpires through it and altering the chemical composition of its sky [3] While the cardinal static facets of the pollutants are located in the district of Howrah, the dynamic sources are dispersed throughout the city centre and surrounding localities. [3] Wind direction including speed contribute a major change on direction of pollutant outflow and it is observed that their direction is causing a gradual change of pollutant concentration across west to east. Bay of Bengal is a critical factor which plays a strong notion on altering the physical nature of the pollutants through the action of moisture which alters the physical nature of the pollutants through coagulation and precipitation [3]. The blunt of the spike in pollutant concentration is seen during winter season when the concentration spared to an approximate  $170 \mu\text{g}/\text{m}^3$  for  $\text{PM}_{10}$ ,  $293 \mu\text{g}/\text{m}^3$  for  $\text{PM}_{2.5}$ ,  $188 \mu\text{g}/\text{m}^3$  for  $\text{NO}_2$  and  $19 \mu\text{g}/\text{m}^3$  for  $\text{SO}_2$  which is not statistically significant from the mean thus signifying a homogenous distribution of pollutant concentration across the month.

However it's been widely seen that the pollutants also act on each other altering the concentration levels.  $PM_{2.5}$  undergoing coagulation produces  $PM_{10}$  thus increases its concentration while suffers a decrease of its own. While relationship also exists between gaseous and particulate pollutants, it does not have been seen widely. In recent times, further wet laboratory experiments are underway to detect those linkages.

### **Study Area**

One of the bustling cities in the Indo-Gangetic terrain and the administrative hub of Easter India , Kolkata presents us a perfect opportunity for this unique study . The span from December to February encompasses Winter season followed by March to May as Pre-Monsoon season, June to August as Monsoon season and September to November as Post Monsoon season. The study area is under experience of heavy downpour during North –East Monsoon.

### **Methodology**

The collection of the data was done mainly with the utilization of finalised data published at governmental sources and later modified with the help of statistical equations .The pollution levels for Kolkata were extracted from the website of West Bengal Pollution Control Board <http://www.wbpcb.gov.in/> .[4]

Software Analysis were done principally from NOAA (National Oceanic and Atmospheric Administration) analyser Hysplit Back trajectory Modelling employing Langarian dispersion modelling network for the detection of pollutant load arriving from various places towards Kolkata .(Fig 1) [6]The colour trend lines demotes different concentrations with blue and green been unpolluted air and red being the polluted one.

According to Fig 2, it is seen that on the month of January 2015 , the dry air is arriving from the Himalayas but laden with a big amount of pollutants mainly from the districts of Malda and Dinajpurs and dumping them over 24 Parganas and Kolkata before relieving itself to the Bay of Bengal. On 18<sup>th</sup> April 2015, the pollutants mainly arrived through winds which itself found its way right from the dry Deccan Plateau. These factors assisted in a spike in pollutant concentration. Analyzing the wind trajectories of the months of July and October, it is found that they are all following the same tract from the central plateau instead of the Bay of Bengal thus preventing any moisture from diluting the pollutant load particularly particulate matter. Thus these days showed a spike in the concentration despite the overall months showing a near homogenous value especially for the months of Monsoon.

**Results:** Data tabulation and hysplit analysis has revealed the true trajectory of the pollutant laden air across the southern Bengal. It varies with the winds in different season particularly the monsoon winds when they arrive from the southern part of the country

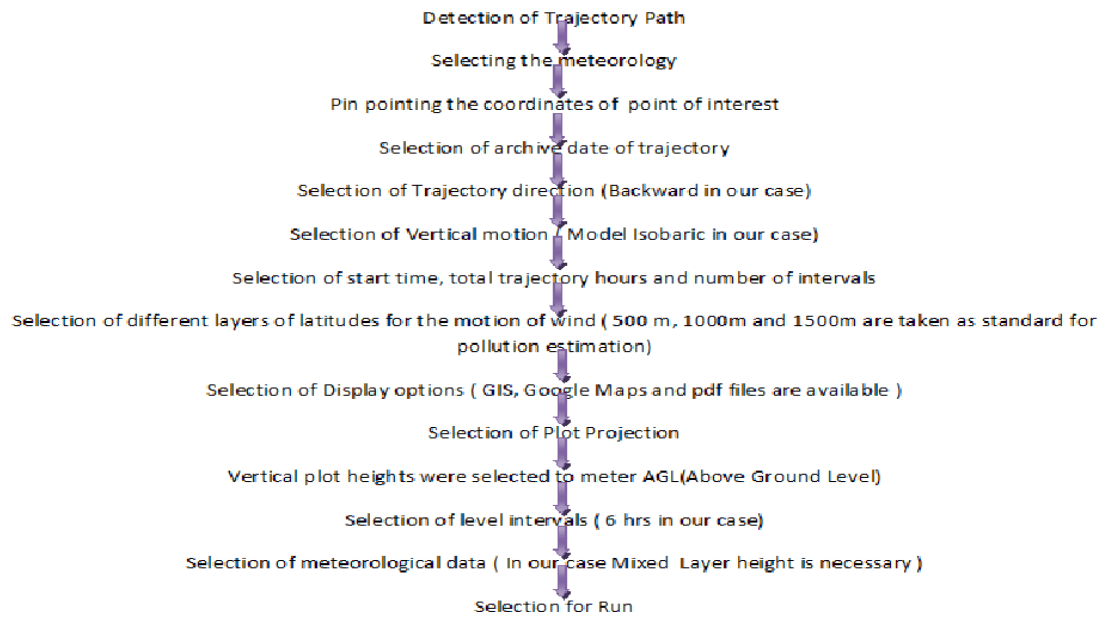


Fig 1: Steps of executing the HYSPLIT back trajectory model

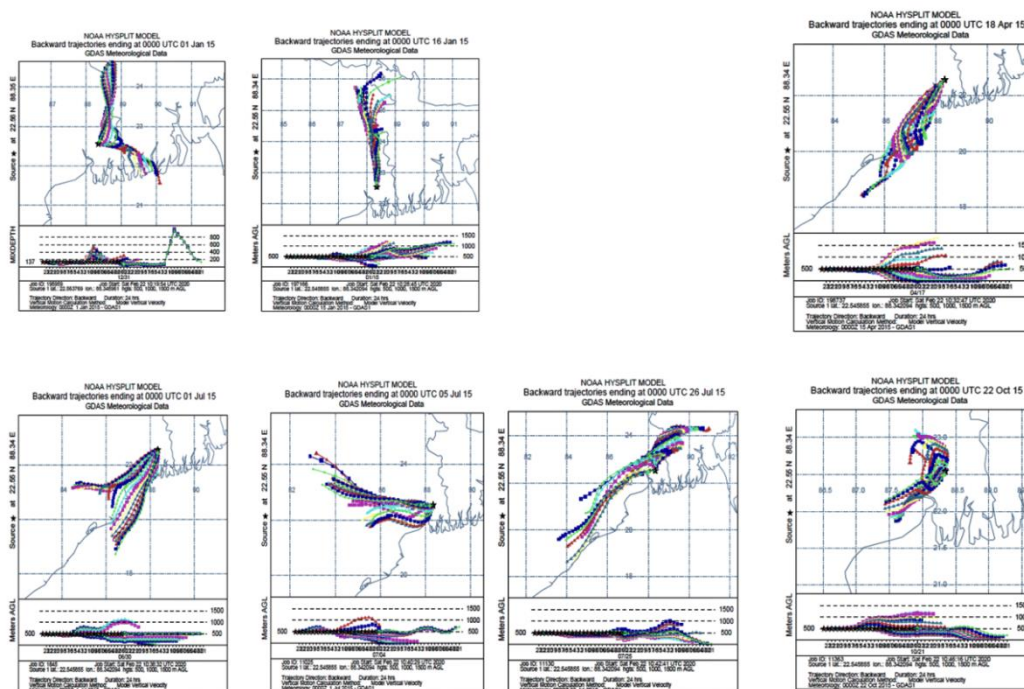


Fig 2: Figures showing the direction of pollutant laden wind from different portion of India especially during days of random spikes

In the Fig 3, we can see different pollutant concentration, deposition and plume dispersion graphs of particulate matter for the month of January. Looking closely, it is seen that the pollutants have dispersed from eastern portion of the area of study to the

western zone before forming a hook with a northward inclination . The dilution of the pollutant increased from 40 km to 20 km within few hours . In the deposition model it is detected that the pollutants are causing widespread deposition on the western flank of the state.

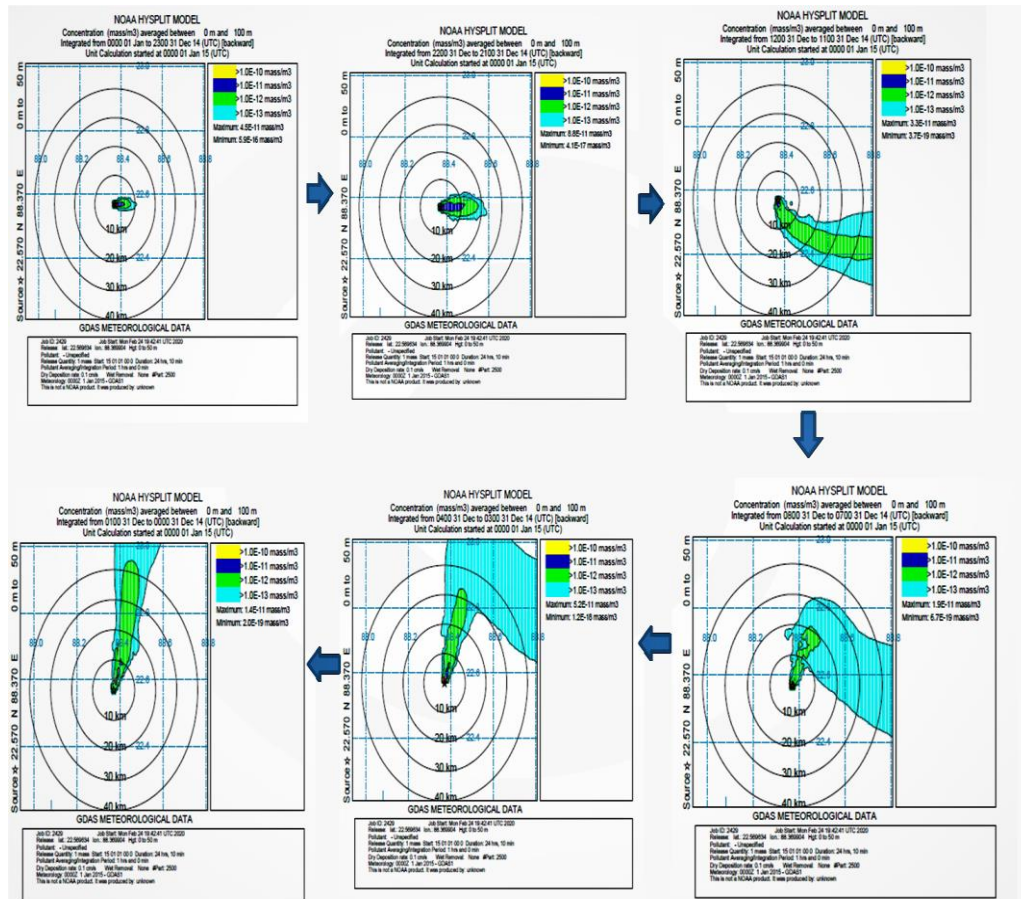


Fig 3: Showing the Dispersion projection of Particulate matters for the month of January

The distribution of pollutant concentration for four different pollutants, which are Particulate matter 2.5, Particulate matter 10, Sulphur Dioxide and Nitrogen Dioxide varies across the months. The maximum concentrations were attained at the winter months with a near homogenous nature. Moderate concentrations were seen on the months of March till October with a heterogeneous distribution of pollutants.

The spike levels are variable at different dates across the year of 2015 with the month of December attaining the highest one followed by January and November and more closely by February and October. (Fig 4)

Statistical analysis of the pollutants has revealed very contradictory consequences which showed that the meteorological conditions are inversely proportional to the pollutant concentrations. Rise in temperature will cause a decrease in pollutant concentration owing to the utilization it caused by increasing vertical dilution and

mixing height. Increase in meteorological parameters denotes a decrease in pollutant concentration through coagulation and precipitation. Increase of wind will always wash out the pollutants.(Fig 5)

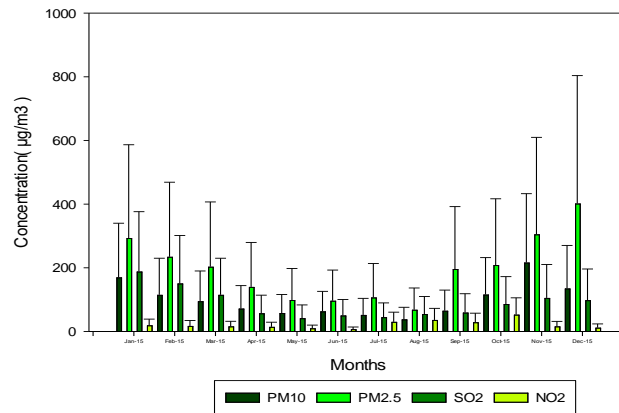


Fig 4: Showing the spikes in pollutant concentrations

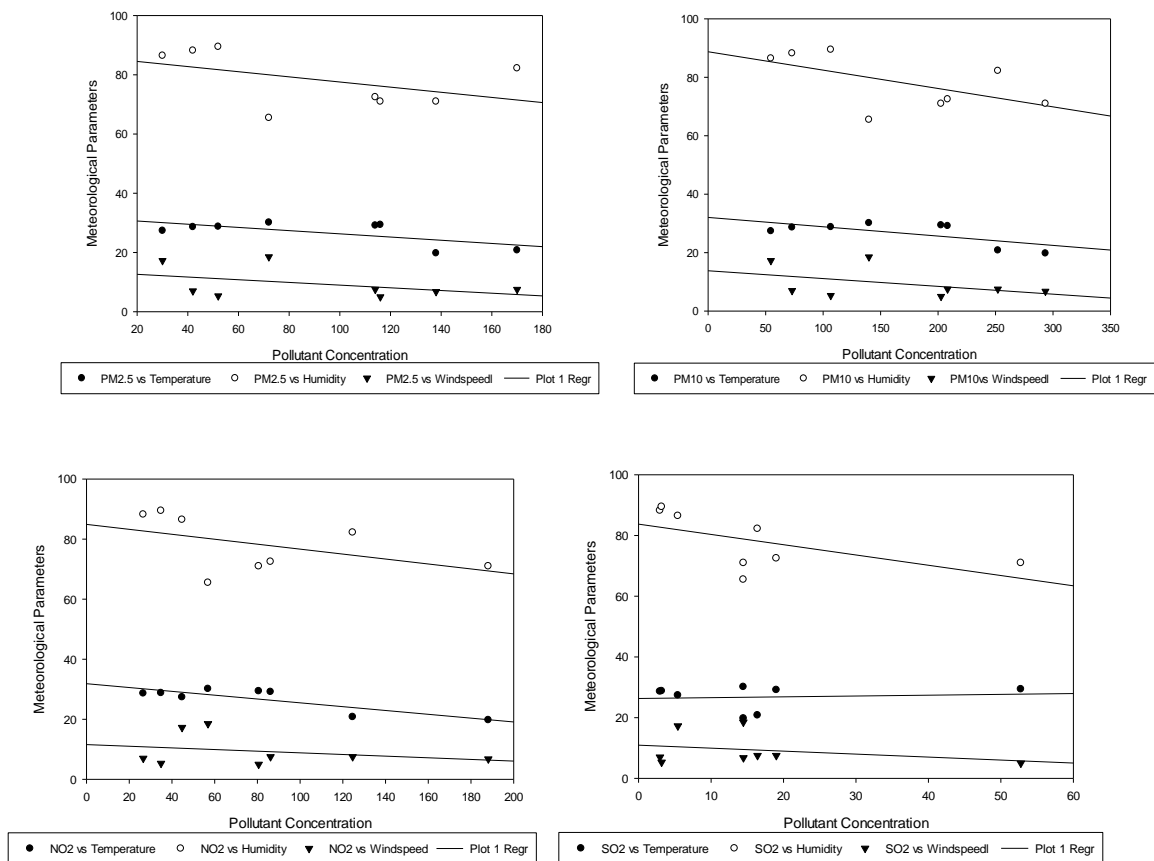


Fig 5: The relationships between Meteorological parameters and Pollutant concentrations

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**Discussion:** After considering the above explanation and findings it can be said that the sudden projection of pollutant loads are mainly due to the meteorological phenomenon. Although human founts can't be ruled out, the blunt of the effort was provided by weather and climate.

**References:**

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