

# ENVIS-IITM NEWSLETTER

Indian Institute of Tropical Meteorology, Pune

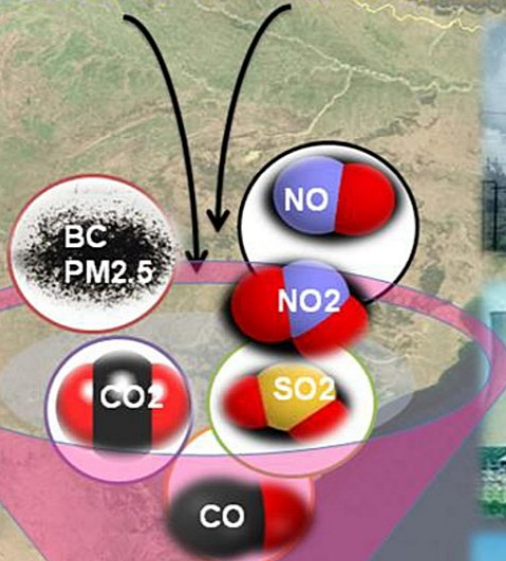
Acid Rain and Atmospheric Pollution

(The project of Ministry of Environment & Forest, Govt. of India)



## Emission & Pollution in India's Capital

EMISSION OF POLLUTANTS



GIS Based statistical Model

SOURCE APPORTIONMENT

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Air can be contaminated by a range of very different particles such as dust, pollen grains, liquid droplets etc. Many of them can harm our health, especially very small particles that can enter deep in to the lunas.

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## EDITORIAL

*The ENVIS - IITM centre deals with acid rain and atmospheric pollution and it is well known fact that our atmosphere is being polluted to an extreme level by human interference. This alteration in the natural atmosphere is due to emissions of various air pollutants as a consequence of burning of fossil fuels, industrial activity, transportation, power generation, agricultural production, waste disposal and so on. It is known fact that Indian cities are hit worst due to air pollution and Particulate pollution is becoming major issue of concern in majority of Indian metropolis specially Delhi. The Delhi Air Quality (AQ) issue needs to be understood in proper scientific perspectives as it is governed by three complex scientific processes namely local emissions, local weather and long to short range transport which are highly coupled and status of AQ especially for Delhi, cannot be understood in isolation by ignoring one over other.*

*The present issue covers how the concentration of Particulate Matter (PM) has been changed during 2010-2014 in India's capital Delhi and what are major factors responsible for observed high particulate levels. It also illustrates major sources of PM emissions in the city and how the emission pattern has changed from year 2010-2014. We hope our attempt to convey scientific information in simple language will help to create awareness amongst the common public which is the first step towards safeguarding our environment.*

— Dr. Gufran Beig

## Air Quality in Delhi

Quality of air depends on three interlinked processes namely local emissions, local weather conditions and long range transport. To understand the air quality in any region one should consider above three processes simultaneously. India first prediction system -System of Air Quality Forecasting and Research "SAFAR" covers all the three aspects through its dense observational network coupled with high resolution (1.67 x 1.67 km) chemistry-transport (CT) forecasting model and emission inventories of pollutants. The results obtained under the project have been discussed in subsequent sections.

## Emission Inventory of Particulate Matter

The pollutants are added to the environment through **emissions** of various natural as well as anthropogenic sources. **Emission Inventory** is a comprehensive listing by sources of air pollutant emissions and amount of air pollutants released into air as a result of a specific process in a particular region during a specific time period. Development of emission inventory is a complex process due to numerous, diverse and widely dispersed emission sources in city like Delhi and its adjacent region and requires huge amount of high resolution activity data, emission factors along with knowledge of fundamental scientific processes. A comprehensive study based on the scientific knowledge has been made to develop the high resolution (1.67 km x 1.67 km) emission inventory of all major air pollutants for a domain of ~65 km x 70 km (~4500 km<sup>2</sup> area) covering Delhi and its adjacent region to facilitate accurate air quality forecasting in 2010 by IITM which has since been updated for each subsequent years as latest as 2013 based on the growth pattern of various sources using GIS based model developed by IITM.

## Identified Air Pollution Sources in the region

*Power (Coal used in all Thermal Power Plants) , Transport (CNG vehicle, diesel, petrol driven vehicles, etc) , Industrial (fuel used in cement, steel, bakery, chemical, metal industries, etc), Slum Cooking (use and type of kerosene, wood, coal, etc), crematorium, etc. , Commercial Cooking (in hotels, restaurants), Street vendor fuel usage survey, Paved /Unpaved Road, Brick Kiln (dust release), Industrial /shop Generator sets (Diesel used), Bio-fuel Burning (dung, crop-residue, wood, bio-mass burning, etc) and open trash burning*

A steady growth of emissions of PM<sub>2.5</sub>, PM<sub>10</sub> and BC from 2010 to 2014 over NCT Delhi resulting in steady increase in Air pollution but erratic weather conditions are responsible for Extreme Pollution events

Transport Sector- Major source of particulate pollution- Delhi has a major road network of nearly 2150 km as compared to minor road network of around 30000 km and it is found that 67% of vehicular density runs on major road.

Above mentioned sources of emissions are categorized in 5 major sectors namely:

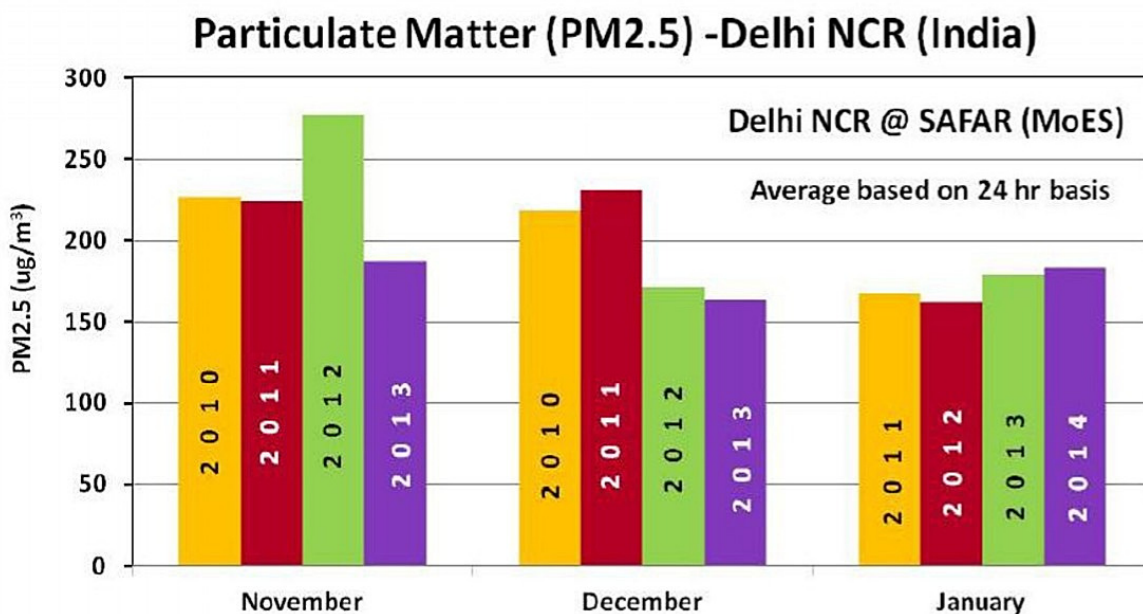
- (1) Power (Coal burning in Thermal Power Plants)
- (2) Industry (all other industries)
- (3) Transport (Fossil fuel-Petrol, Diesel, CNG)
- (4) Bio-Fuel (residential & commercial cooking-wood, coal, kerosene, open bio-mass, street).
- (5) Others (paved and unpaved road, construction activities, brick Kiln, wind-blown, etc)

The estimated total emission of PM<sub>2.5</sub> for Delhi is calculated to be around 94.26 Gg/yr in 2010 which has increased to ~105.12 Gg/yr in 2014, whereas in case of PM<sub>10</sub> it has increased from 235 Gg/year (2010) to 252.25 Gg/year (2014). The growing trend of high emission is found over the Rajiv Chowk, Sansad Bhawan, India Gate, Indira Gandhi International Airport, Okhla Industrial Area, Pragati Maidan, IP-estate, Janakpuri, Meharuli, Lakshmi Nagar, etc. During the period from 2010 to 2014, Growth rate of emissions from transport sector is found to be highest during past 4 years (by ~30%) due to ever increasing vehicle density, whereas the emissions from biofuel sector has shown a marginal decrease as for cooking, more people shifting from wood /kerosene to LPG but open bio-mass burning has slightly increased, especially in winter. The unpaved roads and construction work has high potential of enhancing the PM10 emissions and have shown an increase by around 5% during past few years. Growth rate of emissions of various air pollutants by different sectors as developed by IITM, Pune for the year 2010-2014 in the area of approx.65 km x 70 km covering major parts of National capital region of Delhi is given in Table-1.

| GROWTH RATE-2010-2014 |          |           | Delhi-NCT |
|-----------------------|----------|-----------|-----------|
| Sector                | PM10 (%) | PM2.5 (%) | BC (%)    |
| Power                 | 10       | 3.14      | 0         |
| Industrial            | 0.45     | 5.70      | 10        |
| Transport             | 30       | 30        | 29.9      |
| Biofuels              | -1.3     | -2.94     | -1.68     |
| Other                 | 3.95     | 5         | -         |
| Total                 | 6.95%    | 11.52%    | 17.50%    |

## Concentration of Particulate Matter in Delhi

The results of emission inventory developed under the SAFAR shows that the emissions from local pollution sources has been increased by 10 to 20 % from 2010 (94.26 Gg/Yr) to 2014 (105.12 Gg/yr) from various sectors lead by transport sector but their reflection in concentration level of pollutant is highly non-linear and steady and cannot lead to sudden extremes in pollution. Considering these scientific issues, SAFAR data for 2010-2014 reveals that there is no systematic increasing or decreasing trend in the level of PM<sub>2.5</sub> during past 4 years in Delhi but frequency of extreme pollution events are on increase.



Diagnostic studies using complex CT-model and homogeneous data set of past 3-4 years indicates that unusual meteorological conditions are playing a pivotal role in increased frequency of extreme pollution events dominated by fine particulates, especially in winter and make air quality bad which greatly impact the average concentration. Frequency of these events has increased in recent time. Since two winter characteristics namely- (a) cooler temperature which brings down boundary layer where pollution get trapped near the surface) and (b) calm wind which prevents pollutant to drift and get mixed, have direct effect on air quality processes, winter air quality becomes more venerable in Delhi. One of the extreme events took place in November 2012 which lasted for 12 days and made the average November value highest (275 $\mu\text{g}/\text{m}^3$ ) in 2012 which is higher by ~40% from earlier and

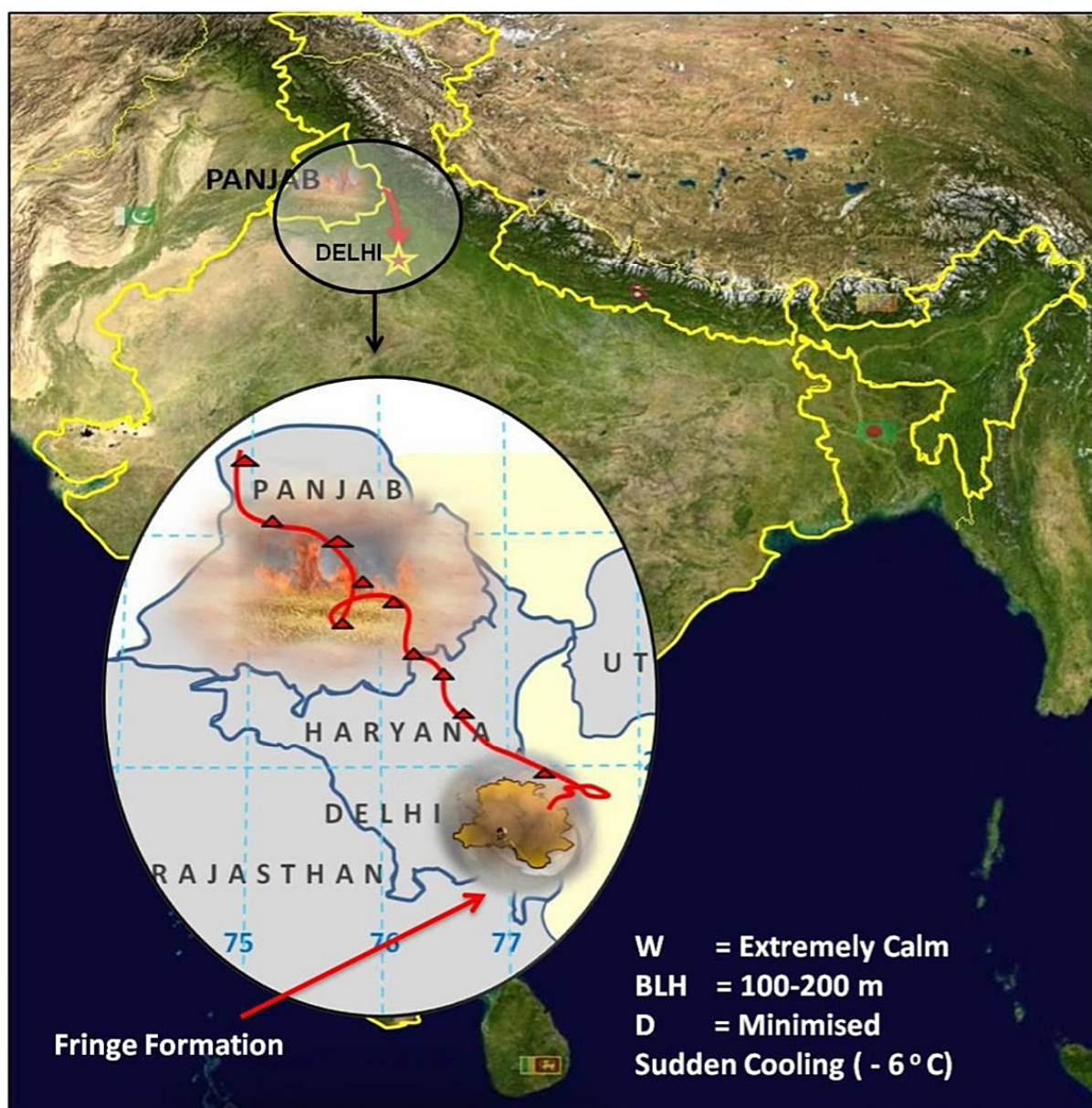
Black Carbon (BC) is important that it plays an important role in climate change as it is one of those rare aerosol particles which act like greenhouse gases and absorb sunlight.

While inferring the impact of air pollution on health or crops, it is crucial to follow standard norms like using 24hr mean value for PM2.5 and PM10. Picking-up the peak (highest) value of the day and comparing it with NAAQS or 24h average of any other country data is misleading.

later years. It was purely due to worst extreme pollution events in the history of Delhi caused due to untimely synoptic weather when western disturbance introduced lot of moisture to Delhi followed sudden fall in temperature by 4-5°C overnight along with dense fog.

### WHAT WAS THE UNIQUE?

A sudden change in wind direction emerging from North instead of usual North-Easterly and directly from crop-residue burn areas which pumped huge amount of fire smoke. Then suddenly calm wind prevailed. This made ventilation coefficient near zero forcing fringe formation enveloping Delhi sky to elevate levels of PM10 and PM2.5 to  $\sim 800\mu\text{g}/\text{m}^3$  and  $\sim 480\mu\text{g}/\text{m}^3$  respectively, the highest 24h mean value of the year lasted for few days followed by Diwali firework on 13th Nov.



## HINTS TO IMPROVE AIR QUALITY

Air pollution can affect our vital systems like hearth, respiratory organs and put all of us at higher risk of strokes and other complications. The effect is more on children's who are active outdoors and adults who have depressed immune system because of aging. The people having asthma or other health complications are at higher risk because of elevated concentration of health hazardous pollutants but after certain limit they have potential to affect healthy persons too. Air pollution is unseen poison which we are inhaling with our every breath and we don't have control over the same.

If we take one simple initiative to reduce emission of various pollutants we can not only help to clear up our air but also we will be a part of improved economy, food security, and water security. In majority of Indian metro cities the major polluting sources are transport activity, coal based thermal power plants, industries which burns lots of fossil fuel, ongoing constructions activities, use of diesel based generator sets during electricity cut off etc. To tackle this challenge of air pollution we have to come together to form a group and take actions at individual level, community level, national level and global level.

- Putting proper equipments in place which will remove the pollutants from fumes coming out of coal based thermal power plants and other industrial units can be the first and most effective step. One can go for installing devises like scrubbers, closed-collection recovery system (through which it is possible to collect the pollutants before they escape in to the atmosphere), the use of dry and wet collectors, filters, electrostatic precipitators etc.
- For any manufacturing industry build higher smoke-stacks which facilitate the discharge of pollutants as far away from the ground as possible.
- The raw material which causes air pollution should be replaced with the material that causes less pollution. Switch to cleaner fuels promote use of CNG, ethanol, methanol, natural gas and electricity.
- Give priority to better supervision and management to reduce particulate pollution which is a biggest threat in India.
- Reach up to grassroots level. Promote use of shegadi instead of chullah in lower income group.

We can't say No to Development as it is our necessity for better life but we can definitely say Yes to Sustainable Development by adopting procedures which will prevent environmental damage and Extreme Pollution events

*If the above factors didn't outrage you, think again and act! Evo Morales has very well predicted our fate: "Sooner or later, we will have to recognise that the Earth has rights, too, to live without pollution. What mankind must know is that human beings cannot live without Mother Earth, but the planet can live without humans."*

### **DO YOU KNOW?**

- *The most hazardous pollutants are released from the air and less from the water and land together.*
- *Air pollution is the fifth most dangerous killer in South-Asia.*
- *Rising levels of air pollution in Beijing has brought a new disease – Beijing cough.*
- *Death rates due to air pollution has increased 100 times from 1995 in New Delhi 1 in every 8 deaths on earth are linked to air pollution, a study says.*
- *Engine exhaust (diesel and gas) contains more than 40 hazardous air pollutants.*
- *The cost of air pollution to the world's most advanced economies plus India and China is estimated to be US \$3.5 trillion per year in lives lost and ill health.*
- *Toxic air pollution poses a greater threat to children, due to their smaller physical size and lung capacity.*

**All queries and feedback regarding this newsletter should be addressed to:**

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