ENVIS NEWSLETTER

Indian Institute of Tropical Meteorology, Pune

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Acid Rain & Atmospheric Pollution

Contents

Editorial

We are happy to bring out the ENVIS newsletter Volume 9 second issue of, July-September 2010. The content of this issue hope towards providing a rapid glance on the overall activities carried out during the launching and dedication of the SAFAR system to nation. The issue covers the topics related with the launching of the system, the assessment of air quality carried out as well as the overall output and knowledge gained from the project.

We thank to all who made valuable suggestions for our newsletters, it would be highly appreciated if you could keep up for our future improvement.

Earth System Science Organization
Ministry of Earth Sciences
Government of India

PRESS RELEASE

The First Ever Air Quality Forecasting System SAFAR designed for NCR, New Delhi successfully utilized for CWG-2010

To understand the air quality management of national capital region Delhi, it is important that we have an integrated system to know the nature and the magnitude of the pollution problem along with its future projections in terms of air quality forecasting system for preventive and mitigation measures. The SAFAR (System of Air quality Forecasting And Research) system of the Ministry of Earth Sciences, Govt. of India which is designed and executed by its constituent Indian Institute of Tropical Meteorology, Pune and earlier dedicated to the nation by MoES Secretary, prior to the Commonwealth Games in September 2010 has successfully been implemented and several interesting results have emerged so far. The SAFAR continues to be operational even after the games as an operational air pollution forecasting service for the citizens of Delhi.

SAFAR provided information to the public services & local people about the current level and forecasted level (24 hours in advance) of air quality at various key locations of CWG through wireless LCD and LED display panels erected at 20 different locations in Delhi. The feedback and response received through volunteers and from the quarry response service of SAFAR web portal is overwhelming. It reflected that Ministry's initiative has increased the awareness among general public regarding the air quality and allowed them to take appropriate preventative measures due to its forecasting ability (see picture-1).

Picture 1: Display of SAFAR Air Quality Forecast

Continuous monitoring and forecasting is done for the major gaseous pollutants namely ozone (O_3), oxides of Nitrogen (NOx), Carbon monoxide (CO), Benzene and other hydrocarbons as well as the particulate matters of 2 different sizes represented as PM_{10}, $PM_{2.5}$, and Black carbon. Out of the above, the forecast for the 5 pollutants namely O_3, NO_2, CO, PM_{10} & $PM_{2.5}$ is displayed in terms

of "Air Quality Index (AQI)" which in a scale of 0-500 and designed to communicate to common man. The AQI is based on the health effects of each of the pollutant defined by the MoES in its report released prior to the games which was based on the extension of the work related to national ambient air quality standards released by Ministry of Environment and Forest in November 2009. Using these MoEF standards and by fixing the break points and applying the mathematical formulations, scientists of MoES have defined the concept of AQI for India which facilitated the easy communication with common audience. The AQI calculation is country specific and exists in almost all those countries where such a prediction system exists. As per this report, the air quality is defined in 4 broad ranges starting from Good (AQI: 0-100), Moderate (100-200), Poor (200-300) and Very Poor (above 300).

OVERALL ASSESSMENT OF AIR QUALITY:

Preliminary scientific evaluation of the data generated from air chemistry transport forecasting model as well as from the dense network of monitoring stations in Delhi has been done by the team of scientists of the Ministry led by Dr. Gufran Beig, Program Director of the project SAFAR from Indian Institute of Tropical Meteorology, Pune for various games venues by classifying the data in 3 time frames namely (i) before (2-3 weeks), (ii) during (3-14 Oct) and (iii) after (2 weeks) the CWG-2010. Air quality is found to be of the mixed nature in the above AQI scale but not as bad as speculated by some quarters prior to the games period (see Figure 3).

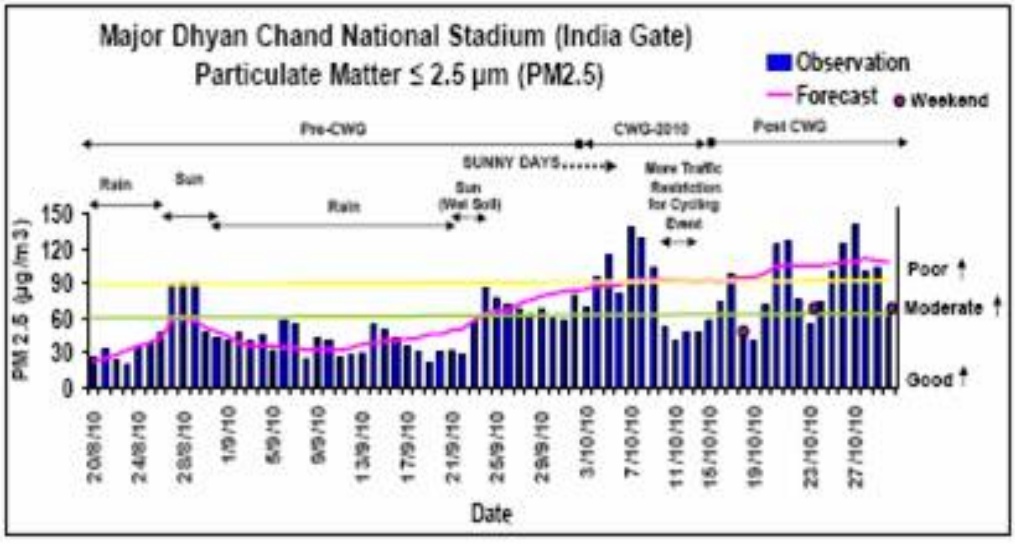

Figure 1. Scenario of fine Particulate matters, before, during and after CWG 2010 at Major Dhyanchand National Stadium Observed and Forecasted by SAFAR System

As per the studies carried out, it is seen that the Air Quality in Delhi from September 2010 until now has hardly touched the "Very Poor" category. The ***overall assessment*** of air quality during September-October 2010 revealed that ***majority of gaseous pollutants were mainly in good range, sometime crossing moderate ranges*** in some venues during peak traffic hours. The air quality related to particulate matters (PM-2.5 and PM-10) was in good to moderate range ***before the games*** until the downpour but as the sun started shining it drifted to moderate. ***During Games period,*** most of the time the Air Quality Index for PM-2.5 was in moderate to poor range whereas PM-10 was mostly in poor category almost at all the monitoring sites except at few venues and during part of night time. The ***Benzene*** is found mainly well within the permissible limit. ***After Games, the overall Air Quality*** slightly deteriorated, especially for particulate matters (in particular PM10) but mainly remained in poor category only which was expected as after the removal of traffic restrictions the wind blown dust from paved and unpaved roads and fossil fuel combustion increased. The wind blown dust mainly affects coarser particles and hence PM 10 is more affected.

SCIENCE BASED ASSESSMENT OF AIR QUALITY IN DELHI:

- **BEFORE GAMES:** The relatively low level of PM-2.5 and PM-10 before games could be attributed to prevailing meteorological condition (heavy rains and cloudy conditions) which minimized the windblown dust emissions and also caused washout of PM-10 and PM-2.5. The dust originating from the construction activities could have deteriorated the PM10 level but excess rain has helped it to settle down quickly. The photochemical formation of ozone was also reduced because of overcast sky conditions in spite of moderately high NO_2 level, keeping ozone level in good range. This is quite satisfactory as surface ozone is one of the most toxic gases which are responsible for majority of the respiratory system related diseases like asthma, chest congestion, etc. This is a well established fact in Delhi as reported earlier by epidemiologist that hospital admissions and OPD visits increases when high ozone emission episodes are noticed.

- **DURING GAMES:** The AQI is found to be mostly in Poor range for particulate matters

and in moderate range for ozone. The increase in the level of particulate matters, especially PM10 during the games period as well as ozone was due to the clear sky and stagnant wind conditions, which lead to accumulation of particular matter in the boundary layer and more photochemical ozone formation. Moreover, due to the dry soil with sunny days, the emission of coarser particles, specially PM-10 has increased significantly through windblown dust from paved and unpaved roads supported by fast moving traffic but contribution of fossil emissions was in check (up to certain extent) due to traffic restrictions as PM2.5 level was relatively better whose main contribution is from fossil fuel. Air quality scenario shows relatively poorer air quality at Major Dhyanchand National Stadium, Talkatora Garden and Commonwealth Games village as compared to some areas like Pusa and NCMRWF (Noida) where long range transport from neighboring states normally plays a vital role but due to calm winds this effect was minimized.

It was interesting to observe that PM10 and PM2.5 suddenly became very high in the night time (between 12 midnight to 3AM) at several venue sites which initially could not be forecasted by the model because it is suspected to be due to the artificial fogging (for insects and mosquitoes) of the area surrounding to the stadiums and purely the localized effect. It disappeared after the games. This fogging was regularly done during the games during the night which has shown unusual impact on the air quality at night.

- **AFTER GAMES:** The level of particulate matters mainly PM-10 has further increased and is more or less staying in the upper limit of poor range during day time probably due to traffic rush hours. Traffic did increase the fossil fuel combustion but it appears that it has more severely affected the windblown dust emissions from paved and unpaved road because the magnitude of PM10 level has increased more significantly than that of PM2.5.

TEST OF FORECASTING ABLITY OF SAFAR:

Most of the time the forecasting capabilities are restricted due to lack of high resolution emission inventories of the pollutants. Hence for the air quality forecasting during CWG-2010, for the first time, a high resolution

gridded emission inventory for 2009-2010 has been developed and released by the Ministry just before the games through its official report. The accuracy and reliability of the above inventories were validated using air quality forecasting model and its validation through monitoring network. The model validation provided a reasonably satisfying result well within the acceptable error for gaseous pollutants baring a few unexpected localized exceptions like the fuming impact in stadium during nights.

In case of particulate matters, when the emission inventory was used without accounting for windblown dust from paved and unpaved road and construction activities, the forecasting model greatly underestimated the observations mainly the PM10 level. It was not used initially because it involves high amount of uncertainty and hardly considered as significant source earlier by any modeler. However, MoES scientists prepared it by collecting the relevant activity data but released separately as supplement to the original report because of its highly uncertain nature where the magnitude of its emissions was calculated to be very close to the sum of all other sector including transport, industry, bio-fuel, etc. However, when forecasting model accounted for this sector, the results of particulate matter were found to reproduce the observed data reasonably well. The air quality forecast from SAFAR system is found to be within 10% to 20% confidence limit of observations. Forecast model is also able to resolve the diurnal pattern quite satisfactorily..

Through this sensitivity test, the preliminary conclusion made is that unnoticed sectors of windblown dust from paved and unpaved roads and construction activities is one of the major contributors in PM and some time even stronger than fossil fuel combustion from transport sector and hence need attention. The calm winds, temperature inversion and formation of relatively stable and persistent boundary layer during and after the CWG games played a vital role in distributing the level of air pollution so far and ***kept the dominance of localized effect and minimized the effect of transport from neighboring states***. The scenario may change with seasons which will be revealed from time to come as SAFAR system of MoES will continue to have pollution watch over NCR Delhi. In addition to emissions, the air quality forecasting is highly influenced by the meteorology and hence the SAFAR system first validated weather parameters obtained from the model with that of AWS

monitoring network of IMD and IITM (35) prior to air quality forecast. **Hence**, the air pollution problem and its forecasting services should be best served by simultaneously dealing with meteorological parameters and its forecast rather than dealing in isolation for planning of scientifically tenable mitigation strategies.

Media Outreach

Diesel gensets draw ire of green activists

TIMES NEWS NETWORK

New Delhi: While the environment department has made elaborate preparations for bringing down air pollution levels for the Commonwealth Games, the organisers are planning to provide a substantial amount of power for the Games through diesel generator sets. While officials justify their decision saying that for certain equipment not even a second can be lost in a power cut, environmentalists are worried about the high emissions this may result in.

The main power source for all audio-visual facilities and certain important equipment like timers and lighting at CWG venues will be through DG sets. "The idea to have gensets as main power source for these equipment is that the switch over time to the secondary source would be much lesser in case of any interruption," said a government official. Experts said switch over time from gensets to secondary power source would be about 2 seconds but if it were the other way around, it would take around 10-12 seconds.

Experts said sportspersons would not tolerate any amount of pollution that is against the specified standards as even a little variation could affect performance. "This will make a difference in the air quality but how far it deteriorates the quality will depend on the kind of DG sets, how long they are run and the quantity of diesel," said Dr Gufran Beig, programme director, air quality monitoring at the Games venues.

Indian Express 29th September 2010

During Commonwealth Games, devices to measure pollution levels

Twenty digital panels in New Delhi will display the Air Quality Index in easy-to-understand colour codes

ANURADHA MASCARENHAS

AS the country gets set for the Commonwealth Games in October this year, scientists at the Indian Institute of Tropical Meteorology (IITM) in Pune have given India an Air Quality Index (AQI) and a System for Air Pollution Forecasting and Research (SAFAR).

Gufran Beig, Project Director of SAFAR and scientist at IITM, was assisted by Sachin Ghude and Aparna Deshpande as they scientifically evaluated existing air quality standards to define the AQI for India.

It couldn't get simpler than this. A green colour code with a value between 0-100 indicates good air quality. But if the colour code is red, beware, it could trigger a health alert, say the scientists. The AQI is primarily a health-related index based on air pollution with descriptor words 'Good' for values of 0-100, 'Moderate' for 101-200, 'Poor' for 201-300, 'Very poor' for 301-400, and 'Severe' for 401-500. Says Beig, "We combined all recent Indian AQI studies and the notification of the new National Ambient Air Quality Standards and proposed an Air Quality Index for criteria pollutants—O3, CO, NO2, PM10, and PM2.5."

The AQI scale helps one understand what the air quality around one means to one's health, says Beig. This concept of AQI is all the more important in India where the common man is not familiar with technical terminology and measuring units (like ppm /ppb/ppt or μg/mg3), he says.

As the curtains go up for the CWG, 20 digital panels in New Delhi will display the AQI. AQIs as suggested by the US Environmental Protection Agency (EPA) are used in many cities to highlight the severity of air pollution and risks of adverse health effects, say the scientists.

This project was taken up while developing SAFAR, says Beig. SAFAR has been developed to measure air quality at a given time and predict what it will be 24 hours later.

AQI sub-index and breakpoint pollution concentration for India

Description	AQI Index	Ozone (8h avg) (ppb)	CO (8h avg) (ppm)	NO2 (24h avg) (ppb)	PM 10 (24h avg.) (μg/m3)	PM 2.5 (24h avg) (μg/m3)
Good	0-100	0-50	0-1.7	0-42	0-100	0-60
Moderate	101-200	51-98	1.8-10.3	43-94	101-150	61-90
Poor	201-300	99-118	10.4-14.7	95-295	151-350	91-210
Poorer	301-400	119 & above	14.8 & above	296 & above	351 & above	211 & above

Good: Air quality good (represented by green colour
Moderate: Air quality acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people. Represented by yellow.
Poor: Members of sensitive groups may experience health-related effects. Represented by orange colour.
Poorer: Triggers health alert, everyone may experience health-related effects. Represented by red colour.

All queries and feedback regarding this newsletter should be addressed to:
Dr. Gufran Beig
ENVIS-Coordinator
Indian Institute of Tropical Meterology,
Dr. Homi Bhabha Road, Pashan,
Pune – 411 008, India
Telephone: + 91-20-25904261 | Fax: +91-20-25893825
Email: pollution@tropmet.res.in | URL: http://envis.tropmet.res.in