



Central Pollution Control Board
Parivesh Bhawan – CBD-cum-Office Complex – East Arjun Nagar – Delhi 110 032 – India
Tel: +91 (0)11 2230 7233 – Fax: +91 (0)11 2230 4948 – E-mail: ccb.cpcb@nic.in – Website: www.cpcb.nic.in



French Ministry of Economy, Finance and Employment

Direction générale du Trésor (DGT)
139, rue de Bercy - Télédéc 230
75572 Paris cedex 12 – France
Tel: +33 (0)1 40 04 04 04
Fax: +33 (0)1 53 18 96 04

French Embassy in India

Regional economic service
André Malraux Marg
2/50 E Shantipath
Chanakyapuri
New Delhi 110 021
Tel: +91 (0)11 2419 6300
Fax: +91 (0)11 2419 6309
Website: www.tresor.economie.gouv.fr/se/inde/
E-mail: newdelhi@dgtrésor.gouv.fr

ARIA Technologies SA

Armand ALBERGEL
8/10, rue de la Ferme
92100 Boulogne-Billancourt
France
Tel: +33 (0)1 46 08 68 60
Fax: +33 (0)1 41 41 93 17
E-mail: aalbergel@aria.fr
Website: www.aria.fr

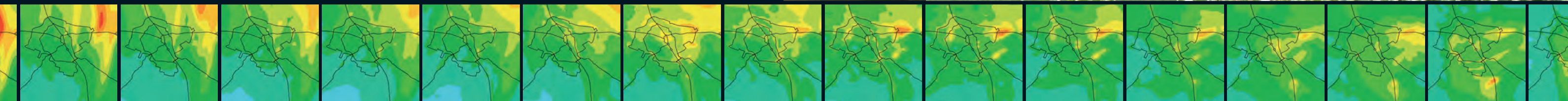
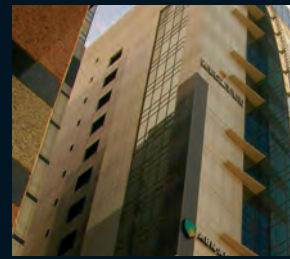


LEOSPHERE

Laurent SAUVAGE
14/16 rue Jean Rostand, 91400 Orsay – France
Tel: +33 (0)1 81 87 05 00 – Fax: +33 (0)1 81 87 05 01
E-mail: info@leosphere.fr – Website: www.leosphere.com



Representative in India:
Microcomm India – B-3 Ansal Chambers
1, 3 Bhikaji Cama Place, New Delhi 110 066 – India.
E-mail: sales@microcommindia.com
Tel: +91 (0)11 2618 1057, 58 – Fax: +91 (0)11 2618 1059



Clean Air for Delhi and beyond

“Clean Air for Delhi 2010 and Beyond”, the pilot program implemented through Indo-French cooperation, allows the Central Pollution Control Board to provide air quality forecasts for the next 48 hours. Now, the citizens of Delhi and the media —

The Commonwealth Games 2010

The Commonwealth Games, an international multi-sport event held once every four years, are the largest sporting event after the Summer Olympic Games and the Asian Games. Participating in the Games are athletes from the 54 member countries of the Commonwealth of Nations, representing 2 billion people or 30% of the world population.

The 19th Commonwealth Games were held in Delhi from 3 to 14 October 2010. It was the first time the Commonwealth Games were held in India, and the third time in a developing country, after Jamaica in 1966 and Malaysia in 1998. Around 6,000 athletes from 71 nations and territories competed in 17 sports over 12 days of competition and ceremonies.

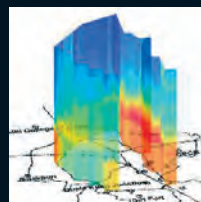
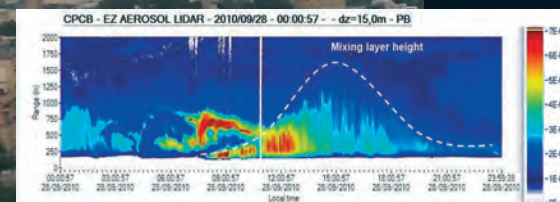
like many in other parts of the world — can check air quality forecasts for their city, just as they do for the weather.

A regional lidar network

Aerosols come from various sources; using light polarization properties, lidars (light detection and ranging) can discriminate between spherical particles (anthropogenic sources or biomass burning) and non-spherical particles (desert dust, etc.).

A network of lidars operated continuously throughout the CWG, and the assimilation of the lidar data into the regional model was tested. Aerosol lidars were then used for urban 3D monitoring studies in the vicinity of the main CWG venues. The 3D maps of PM pollution obtained were used to validate the urban model calculations.

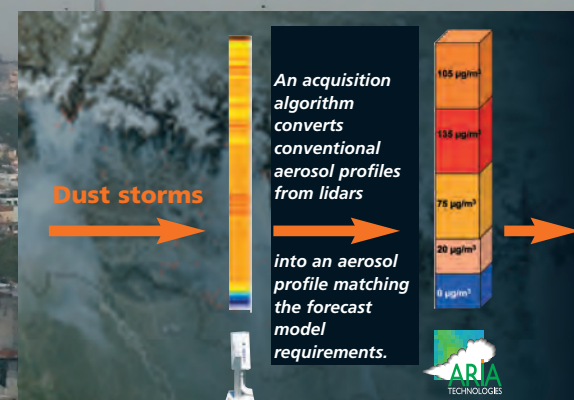
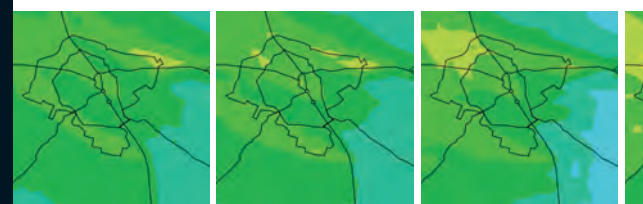
Mobile lidar measurements from a vehicle driven around Delhi during the CWG (5/10/10). In addition to the vertical dynamics of the atmosphere, they provide a unique picture of the density of sources and their dispersion in space.



An advanced notification system on daily air quality has been developed for the public and the media for the National Capital Region (NCR) of Delhi, through the "Clean Air for Delhi 2010 and Beyond" program funded by the French Government. The system was developed by two French firms — Aria Technologies and Leosphere — in technical collaboration with the Central Pollution Control Board (CPCB) in Delhi. The system started operating during the Commonwealth Games in October 2010.

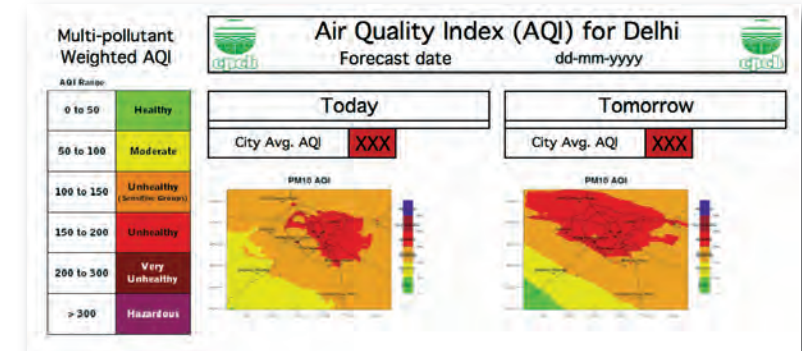
Aria Technologies and Leosphere had previously developed a similar system for Beijing during the Olympic Games in 2008, and are also developing one for Rio de Janeiro (Brazil) as part of the Olympics 2016 preparations.

This program covers 52 x 52 km of the NCR, which means that a forecast is available for every nook and corner of the region, including special points of interest such as the stadiums and venues during the Commonwealth Games.



While the system is based on a model combining the atmospheric physics of weather forecasting and atmospheric chemistry, the inputs include emission intensities from multiple sources contributing to the growing air pollution problem in Delhi: vehicle exhausts and road dust, industrial emissions, residential fuel use, generator sets, garbage burning, etc. A number of surveys were conducted to collect information on these sources and compiled to make an informed forecast of air quality. The data also include information from the existing monitoring network operated by CPCB and a laser-based lidar network deployed in the region to establish horizontal and vertical profiles of particulate

matter (PM), the most harmful of the pollutants to human health. A network of stationary and mobile lidars operated during the Commonwealth Games in October 2010 and the data were utilized to calibrate and validate the modeling system. The “Clean Air for Delhi 2010 and Beyond” program is designed to provide pollution alerts to the public and the media and hopefully minimize the future instances of higher health impacts. As part of the outputs, the air quality index (AQI) ranging between 0 and 500, is also estimated for various parts of the city and published



as a common denominator for multiple pollutants. The system is also utilized for air pollution management by studying scenarios to control pollution and evaluate the impacts of urban projects on air quality. The program relayed 48-hour forecasts of air quality during the Commonwealth Games to the public, the athletes, and the media. The system continues its day to day operations under the leadership of CPCB in Delhi and may be replicated in other Indian cities.

The air quality index which the Central Pollution Control Board is now able to provide daily to the Delhi's citizens.

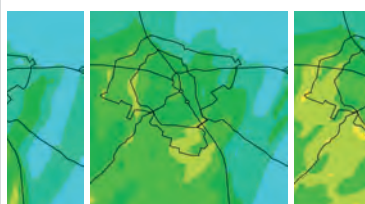
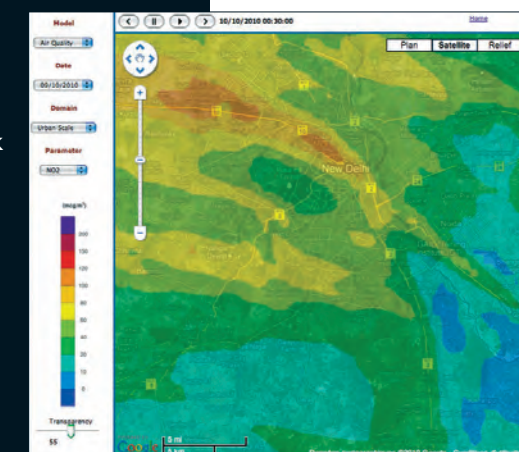
The forecasting system runs on a multi-core platform with 12 CPUs and all the modeling tools are programmed in parallel mode, established with geo-referenced databases, and interlinked with post-processing tools for internet outputs.

An urban air quality forecasting model

Setting up the forecasting model for Delhi took the Indian-French Aria team almost a year and involved the following steps:

- Development of an emissions inventory including transport, industry, residential and tertiary, construction works and agriculture.
- Online estimation of natural sources, such as dust storms, agricultural burning, and forest fires.
- Setting up of a high resolution 3D modelling system which reconstructs detailed meteorological fields and produces concentration maps of pollutants on a hourly basis, covering key pollutants – PM, SO₂, NO_x, CO, hydrocarbons, and ozone.
- Treatment of the urban domain in a nested format into the national and regional scales, providing valuable information on pollution contributions due to long range transport.

The Delhi forecasting system is now interfaced with the monitoring data routinely collected and organized by CPCB. The results from the national scale can be used by the Indian PCBs for the further support of the activities in other cities of India with initial and boundary conditions development.



Delhi is the capital and the second most populated city of India, housing more than 12 million inhabitants, and the largest commercial center in northern India. Industry includes textile manufacturing, engineering, chemical, metallurgical, rubber, plastic goods and power sectors. The per capita consumption of electricity is one of the highest in India. The peak energy demand of Delhi has almost doubled from 2005 to 2010. Rapid urbanization in Delhi has also resulted in a tremendous increase in the number of vehicles and despite stricter norms and the introduction of cleaner fuels like compressed natural gas (CNG) and liquefied petroleum gas (LPG), the air quality of Delhi is still poor, due mainly to the traffic.

The daily averages for RSPM (respirable suspended particulate matter) in Delhi range between 150 and 200 micro-gm/m³, whereas the daily standard prescribed by CPCB is 100 micro-gm/m³, above which there is an increase in the health impact with higher incidence of asthma, acute chronic bronchitis, eye irritations, and even premature death.