A New Era in Air Quality Monitoring in China

The majority of people living in Asian cities are exposed to unhealthy levels of air pollution every day. Seven out of 10 cities in developing Asian countries have unhealthy levels of air pollution, when measured as annual levels of particulate matter with size range of not greater than 10 microns (PM10).[1] The haze episodes have occurred frequently over the past years in developing Asian cities. In China's case, according to statistics from the Ministry of Environmental Protection (MEP), cities in Jing-Jin-Ji, Yangtze River Delta (YRD) and Pearl River Delta (PRD) suffered over 100 haze days in the past three years, with $PM_{2.5}$ concentration two to four times above the World Health Organization (WHO) guidelines levels[2]. These episodes have been a cause of strong public concern because of potentially negative health impacts. Recent estimates from the 2010 Global Burden of Disease (GBD) found that outdoor air pollution is a much more significant public health risk than previously known–contributing annually to 2.1 million premature deaths in Asia.[3] For the first time, outdoor air pollution is among the top 10 risks worldwide and among the top five or six risks in the developing countries of Asia.

"In 2012-2013, Clean Air Asia together with Hong Kong Polytechnic University implemented a project on Air Quality Interventions: Improving Air Quality Monitoring Systems in Asian Cities. This work was supported by the Asian Development Bank."

Author Details:
Wei Wan & Kaye Patdu,
Clean Air Asia
901A Reignwood Building,
No. 8 YongAnDongLi
Jianguomenwai Avenue,
Beijing 100022,CHINA
Tel: +86 10 8528 8381
Email: wei.wan@cleanairasia.org
Web: www.cleanairasia.org

Understanding the status of air quality is an important component of air quality management. This requires setting up and implementing appropriate air quality monitoring systems. However, there are several challenges with air quality monitoring in Asian cities. First, monitoring systems in several cities in developing Asia have a limited scope–either in terms of number of stations or pollutants covered. Secondly, data quality remains a concern with limited technical capacity, unclear monitoring, siting guidelines, quality assurance (QA) and quality control (QC) procedures. Another issue is the lack of linkages between the monitoring data and implementation and monitoring for effectiveness of air pollution control measures and policies. Finally, sustainability of the air quality monitoring systems is a perennial challenge especially with budget constraints.

Clean Air Asia and its partners developed five essential characteristics for a good air quality monitoring system for Asian cities.[4] This builds on international guidelines and good practices and experiences in Asian cities and countries. These include the:

1) Ability to properly plan and implement an AQ monitoring network to a compatible international standard
2) Ability to plan and implement a QA/QC process
3) Ability to disseminate AQ monitoring data and analytical results to stakeholders
4) Ability to utilise the AQ monitoring results to improve AQ control policy
5) Ability to provide manpower and financial resources to sustain the AQ monitoring system

Achieving each of these characteristics is critical in any air quality monitoring system. China is one country which has undergone major developments in air quality monitoring in recent years. It is interesting to assess where China is at in terms of these characterictics and whether there are areas for improvement.

Development and Current Status of Air Quality Monitoring in China

In the last four decades, China has established a comprehensive air quality monitoring system based on the urban air quality monitoring network. China started monitoring air quality in a few cities in the 1970s and set up an initial national monitoring system in the 1980s[5]. In 2000, daily Air Pollution Index (API) based on SO_2, NO_2 and PM_{10} monitoring data was introduced to assess the air quality in 42 cities.

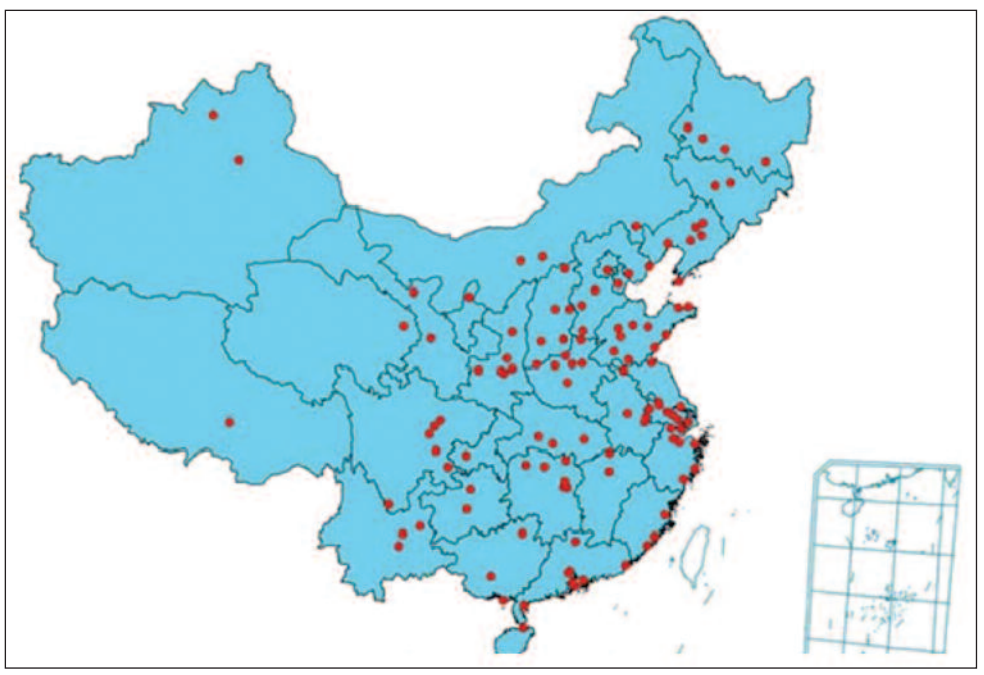

Figure 1: 113 Key Environmental Protection Cities in China
Source: MEP Data Center, 2008

This was further expanded to 113 key environmental protection cities in 2005 (Figure 1).

China's air quality monitoring system consists of a national-level network and a local-level network. Monitoring objectives and settings are similar. Both have four types of stations: (i) monitoring station, (ii) assessment station, (iii) control station and (iv) background station. Each station monitors several air pollutants. The Provincial Environmental Protection Departments (EPDs) are responsible for supervising quality control of urban air quality monitoring stations, while the MEP carries out the spot-checking, flight check and cross-check for quality control.

In 2007, the Ambient Air Quality Monitoring Standards (trial)[6] were issued to provide guidance for the development of air quality monitoring systems, including monitoring objectives, number, type and location of monitoring sites, and QA/QC process. According to this document, data quality assurance and control process based on data quality objectives focuses on data processing. In the same document, it highlights that the objectives of ambient air quality monitoring should be to provide a basis of policy making by measuring:

- High concentration of pollutants in the monitoring area
- Representative concentration of pollutants in monitoring areas
- Compliance of air quality standards
- Impact from key air pollution sources
- Background concentration of pollutants in the monitoring area
- Trends of ambient air quality

Professional and technical personnel are essential to the capacity of AQ monitoring system. An integral manpower system has been built up in major cities in China, including forecasters with atmospheric environment and meteorology expertise, and technical staff for information system development. The air quality monitoring centers and stations are fully supported by the government financial system to sustain the network.

Recent Developments in Air Quality Monitoring Legislation

A milestone in air quality management in China was the amendment of the National Ambient Air Quality Standards (NAAQS) in February 2012 (GB 3095-2012).[7] It prescribes the first-ever limits for $PM_{2.5}$ (particulates with diameter of 2.5 microns or less) and O_3. The standards are comparable to the interim targets (IT) set by the World Health Organisation (WHO). It also planned a three-step for an urban air quality monitoring program: 1) capital cities and key cities in Beijing-Tianjin-Hebei, YRD,PRD start monitoring $PM_{2.5}$ and O_3, and reporting according GB 3095-2012; 2) 113 key environmental protection cities start the same in 2013; 3) and 333 prefectural-level cities which start monitoring and reporting in 2016.

In China, the major plan for air quality management is issued every five years, Five Year Plan on Air Pollution. In the 12th FYP, one key component was to build up a unified air quality monitoring system for regional air pollution, joint prevention and control mechanism in three key regions (Beijing-Tianjin-Hebei, YRD and PRD) and ten city clusters of China. A year following the amendment of the NAAQS and establishment of the timeline for mandatory $PM_{2.5}$ monitoring in the 12th FYP, 74 cities, including municipalities, provincial capitals, cities with independent planning, and cities above prefectural-level in Beijing-Tianjin-Hebei, YRD and PRD, started reporting Air Quality Index (AQI) according to the Technical Guidelines on Air Quality Index (HJ 633-2012)[8] instead of the API, requested by the original Technical Requirements for Urban Air Quality Daily Report. Air Quality Data Real-time Release Platform of the MEP Data Center releases concentration values of six pollutants (SO_2, NO_2, CO, O_3, PM_{10} and $PM_{2.5}$) and the related AQI index, as well as the health advisory (http://113.108.142.147:20035/emcpublish/). The information is from the automatic monitoring data of national operated stations. Figure 2 provides a screen short of the MEP Data Center.

Aside from the data available online, MEP also issues quarterly and annual reports of the analysis results of air quality information at the national level. At the local level, there are primarily three kinds of regularly prepared reports on air quality data. These are: (1) Annual Environment Quality Bulletin; (2) Environmental Quality Report for every five years; and (3) the Environment Statistical Yearbook in some cities.

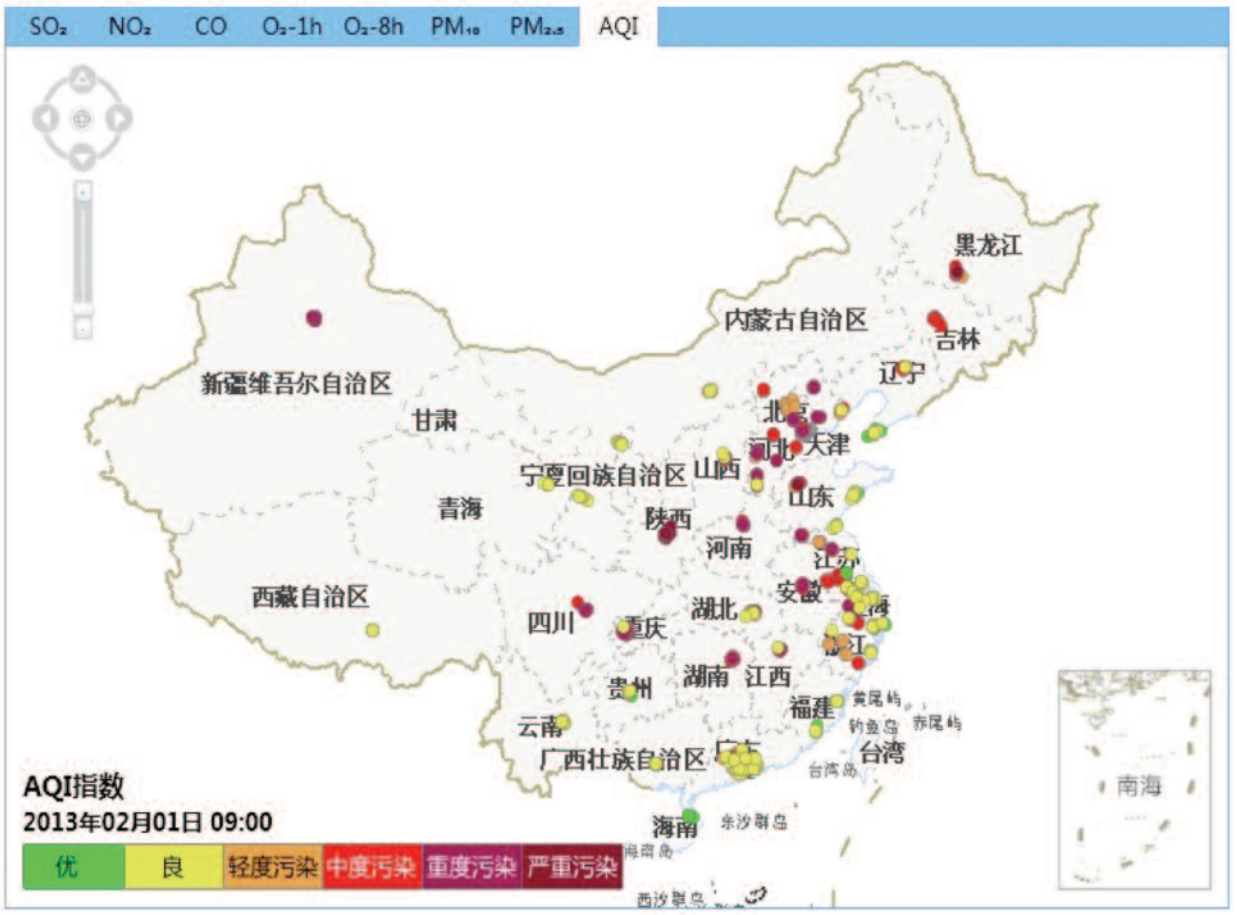

Figure 2: Screen shot of the MEP Data Center. Source: MEP Data Center, 2013

Challenges and Recommendations

China is still facing challenges with air quality monitoring systems, the common issues can be grouped in the following three aspects:

Need to properly plan and implement an AQM network to a compatible international standard

Planning is important because it ensures that design of the project is technically sound. It also enables identification of strategies that maximise the use of resources in achieving the air quality goals. This is particularly relevant in developing countries whose resources are often limited.

In China, the coverage of monitoring stations for the mobile and area sources are still limited. The locations of existing AQ monitoring stations should be reviewed so that they can monitor air quality in various conditions including i) background; ii) roadside traffic; iii) general residential zones; iv) power generating and industrial manufacturing and vii) agriculture activities. Proper AQ monitoring station location identification procedure should be followed.

Ability to disseminate AQM data and analytical results to stakeholders

In communicating air quality to the general public, it is important that the information is translated in a form that is practical, simple and easy to understand. The information should also be shared in a timely manner. Increasing public participation, responsibility and willingness to contribute on an individual level to reduce pollution is important to combat air pollution issues. Lack of knowledge in making decisions will lead to ineffective policies and actions to solve certain issues. It is a challenge to authorities to publicise data that will meet the public demands for various purposes. Collection of raw data is conducted by monitoring departments, and it is quite a challenge for other groups, such as academic institutions and public, to access raw data because the real-time reporting platform does not provide history data base.

Ability to utilise the AQM results to improve AQ control policy

In order to encourage policymakers to address air pollution, it is important that they are given clear and understandable information on air pollution issues. Raw monitoring data, emission inventories, air pollutant concentrations, potential health impacts, and source control measures are not particularly useful unless it is translated into judgments on comparative advantage, or raises these issues in the context of socio-political trends. The information also needs to be brief and concise and presented in a manner that will be easily understandable for policymakers. Further, recommendations on actions and control measures should be clear.

Although sharing of air quality information has been significantly improved in China, the linkage between air quality monitoring and clean air actions is still weak. Shanghai is one city leading in the conduct of source apportionment based on monitoring. Nonetheless, it still has difficulties to identify the regional sources especially the secondary pollutants O_3, $PM_{2.5}$. Additional source apportioning studies can then be followed. With further analysis of data, it is possible to identify causes and sources of air pollution, in particular, hot spots, leading to the development of an abatement strategy and action plans. Stakeholders including academics and NGOs may be engaged to analyse the data and subsequent abatement programs.

There is also a lack of a longer term vision regarding the wider use of the data. Some of the potential uses include:

- Helping to trace the contribution of air pollutants from various pollution sources, including local and trans-boundary ones
- Helping scientists and health practitioners to understand further the interrelationship between air pollution and illnesses
- Building a more accurate regional forecasting system and advance alerting system to tackle the haze issues
- Identifying the formation of the haze and the compositions of the haze which may be a health hazard

1 *Clean Air Asia, 2011. Status and Trends in Air Quality Management.*

2 *Ministry of Environmental Protection, China, 2010-2012. Environmental Statistics Bulletin*

3 *Lim, S., et al., 2012. Lancet, 380:2224 60.*

4 *Clean Air Asia, 2013. Good Practice Guidance on Air Quality Monitoring in Asian Cities. Improving Air Quality Monitoring in Asia : A Good Practice Guidance*

5 *Shuai Wang, 2011. Introduction of Ambient Air Quality Monitoring in China*

6 *Ministry of Environmental Protection, China, 2007. Ambient Air Quality Monitoring Standards (Trial)*

7 *Ministry of Environmental Protection, China, 2012. Ambient air* quality *standards (GB 3095—2012)*

8 *Ministry of Environmental Protection, China, 2012.Technical Regulation on Ambient Air Quality Index (trial)*