SECTOR FOCUS 6

Environmental management

The internet is transforming how policy makers and citizens meet the challenge of environmental management. New technologies have greatly improved monitoring of environmental quality and helped free data from the obscurity of closed government offices, instead making them instantly accessible. This is having profound effects. Not only are these technologies improving the ability of public authorities to monitor pollution, but they are also pushing the boundaries for civic engagement. This is happening in many areas of environmental policy making, including forest monitoring, water quality assessments, identification of natural hazard risk, and air quality management—the emphasis of this sector focus.

Air pollution is a growing threat to health the world over. Exposure to particulates with a diameter of less than 2.5 micrometers ($PM_{2.5}$)—which are capable of penetrating deep into the lungs—increased in all regions between 1998 and 2012, with the exception of North America and Europe. Health risks include heart disease, stroke, lung cancer, and respiratory infections. Exposure to outdoor $PM_{2.5}$ pollution was the ninth leading cause of death and disability worldwide in 2010, accounting for 3.2 million deaths (6 percent of global mortality). There is also growing evidence that $PM_{2.5}$ pollution could harm cognitive functions and contribute to diseases such as Alzheimer's and Parkinson's. The economic costs of deaths and debilitating illnesses related to PM pollution, measured by reduced labor productivity, amount to 4 percent of GDP for some developing countries.[1]

This sector focus was contributed by Chris Sall and Urvashi Narain.

The benefits of the internet in managing air quality

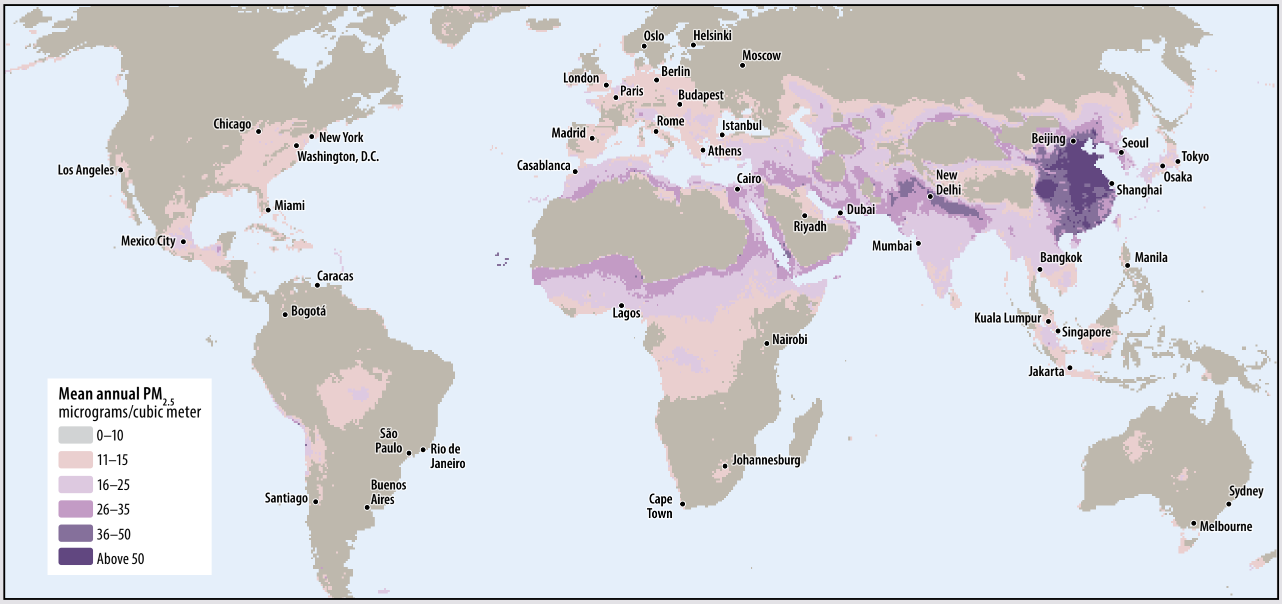
Enabling comprehensive monitoring

Countries now have new tools to monitor the concentration of ambient pollutants, the first critical step in devising an air quality management plan. Ground-level monitoring is common in high-income countries and some middle-income countries such as China, but there are large parts of the globe where monitoring of $PM_{2.5}$ is rare. Barriers include the high cost of installing and maintaining monitoring networks and a shortage of technicians and experts with specialized skills.

New satellite-based sensors measure pollution concentrations from space.[2] In combination with models of particulate movement through the atmosphere, satellite data supplement information provided by sparse ground-level monitors to produce estimates of pollution concentrations over larger areas (map F6.1). In the United States, public agencies are investigating using satellite-based measurements to enhance air quality forecasts for areas where gaps exist in the monitoring network. Remotely sensed data will prove especially helpful for regions where there is currently very little on-the-ground monitoring, such as in Africa.

Personal mobile technologies could also improve pollution monitoring. One California startup has created a wearable monitor primarily intended for developing countries such as China, India, and Mexico. The keychain-size device, called Clarity and costing between US$50 and US$75, uses an optical sensor to measure concentrations of $PM_{2.5}$, nitrogen

Map F6.1 Satellite estimates of average $PM_{2.5}$ concentrations provide global coverage, 2010



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Source: Data from Brauer and others 2012 for the Global Burden of Disease study (Lim and others 2012).

Note: Includes only anthropogenic emissions; concentrations of dust and sea salt are not shown. $PM_{2.5}$ = particulates with a diameter of less than 2.5 micrometers.

oxides, ammonia, and volatile organic compounds. Data will be gathered and analyzed in the cloud so that users can view real-time, crowdsourced maps of pollution in their neighborhood or city.

Improving policy design

Singapore is one of the first cities to pioneer the use of "big data" to help fight congestion and thus reduce pollution from idling vehicles. The city is testing new satellite positioning technologies to improve its existing Electronic Road Pricing (ERP) scheme. The system tracks the exact locations of vehicles and measures their distance traveled on congested roadways. By pinpointing traffic congestion, ERP tariffs can be automatically adjusted to individual driving behavior, providing drivers with incentives to find less congested routes.

Empowering regulators

New, lower-cost sensors and information technologies are reducing the cost to regulators of enforcing limits on emissions from sources such as factories, farms, and energy producers. Sensors can be placed within facilities, at fence lines, or in downwind communities to continuously monitor emissions and transmit data via the internet to regulators. This makes it possible to gauge actual pollution loads (such as kilograms of PM emitted) over time, instead of occasionally sampling gases in smokestacks. Such data support emissions trading schemes and other market-based policies to reduce pollution. An example is the successful sulfur dioxide (SO_2) permit trading system in the United States, which nearly halved SO_2 emissions within a year and saved industries at least US$255 million in annual compliance costs. In India, regulators in the states of Gujarat, Maharashtra, and Tamil Nadu are installing low-cost sensor technologies at industrial facilities for a new pilot trading scheme for PM pollution.

Empowering citizens

Publicly accessible data on pollution concentration levels enable citizens to take preventive measures to reduce their personal risk of exposure and pressure governments to enforce existing emission standards. The AIRNow program of the U.S. Environmental Protection Agency (U.S. EPA) provides hourly, real-time maps and forecasts of air quality. The program illustrates recent changes in data policies. In the early 1990s, local, state, and federal agencies collected air quality data from monitoring stations and sent the data to the U.S. EPA for processing. Concerns over data quality, potential misuse of data, and limited technical capabilities meant that data were released with long delays. Today, AIRNow gathers real-time data from 1,300 ozone and 300 PM monitoring sites, performs automated data quality checks, and provides hourly maps and forecasts of local, regional, and national air quality. Cloud-based computing and mapping, combined with new mobile platforms, make local air quality reports and forecasts accessible to everyone, everywhere. And open data standards allow developers and public interest groups to pull information from AIRNow into their own web services.

Public information disclosure programs that monitor and publicize the environmental performance of firms empower communities to pressure otherwise weak regulatory institutions to enforce environmental standards. These programs now rely on the internet to improve the free flow of information and reduce the cost of data collection and dissemination. Online registries that compile information on pollutant releases by industrial facilities and other sources have been set up in at least 20 nations, including in Japan, the Republic of Korea, Mexico, the United States, and the countries of the European Union. Disclosure programs that rate the environmental performance of firms have also been implemented in about 60 countries. Ratings programs in countries such as India and Indonesia have had a significant, measurable impact in reducing pollution by the worst-performing plants.

China offers an example of how information technologies can leverage mandatory public disclosure programs and expand citizen engagement.[3] Public disclosure of environmental monitoring data in China has expanded rapidly in the last few years in what could be characterized as a virtuous cycle made possible by information technologies. The attention generated by Tweets of air quality data from unofficial monitoring sites in Beijing and other cities prompted programs by public agencies to build official monitoring systems and make the data publicly available in real time. In 2013, the Ministry of Environmental Protection issued rules mandating the disclosure of real-time pollution data by key enterprises and local authorities.

The next year, the Institute of Public and Environmental Affairs (IPE) in Beijing, a public advocacy group, released a free mobile app to put these data directly in the hands of the public. Users of the Pollution Map (*wuran ditu*) app can see current emission levels of local factories and other entities and ascertain whether the readings exceed legal limits. They can share this information on popular social media apps and submit reports and photos of companies that are violating emission limits. According to IPE's founder, Ma Jun, the app gives citizens the hard data they need to put pressure on enterprises and local authorities when environmental standards are being violated. There are already some signs of success. On several occasions in 2014, authorities in the city of Yantai, Shandong Province, publicly responded to social media posts that enterprises in the area were violating emissions limits and resolved the complaints within a few days.

Smart public policy can help make the most of new technologies for monitoring and reducing pollution. Apart from stronger requirements for public disclosure of monitoring data, governments play an important role in setting standards for data collection, reporting, and sharing; offering guidance on best practices for use of technologies; and rating the performance of devices used by consumers. To keep up with the pace of technological change, it is vital for governments to regularly review policies and standards in recognition of new data services. Such policies for encouraging the innovative use of information technology may form an important part of a broader air quality management strategy.

Notes

1. Global Commission on the Economy and Climate 2014.
2. van Donkelaar and others 2015.
3. Li 2011.

References

Brauer, M., M. Amman, R. T. Burnett, A. Cohen, F. Dentener, M. Ezzati, S. B. Henderson, M. Krzyzanowski, R. V. Martin, R. Van Dingenen, A. van Donkelaar, and G. D. Thurston. 2012. "Exposure Assessment for Estimation of the Global Burden of Disease Attributable to Outdoor Air Pollution." *Environmental Science & Technology* 46. doi: 10.1021/es2025752.

Global Commission on the Economy and Climate. 2014. *Better Growth, Better Climate*. New Climate Economy. http://2014.newclimateeconomy.report.

Li, Wanxin X. 2011. "Self-Motivated versus Forced Disclosure of Environmental Information in China: A Comparative Case Study of the Pilot Disclosure Programmes." *China Quarterly* 206. doi: 10.1017/S0305741011000294.

Lim, S. S., and others. 2012. "A Comparative Risk Assessment of Burden of Disease and Injury Attributable to 67 Risk Factors and Risk Factor Clusters in 21 Regions, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010." *Lancet* 380: 2224–60.

van Donkelaar, A., R. V. Martin, M. Brauer, and B. L. Boys. 2015. "Use of Satellite Observations for Long-Term Exposure Assessment of Global Concentrations of Fine Particulate Matter." *Environmental Health Perspectives* 123 (2): 135–43. doi: 10.1289/ehp.1408646.