CityZen Science Policy Brief: Observations

Observational data (determined from measurements, as opposed to estimates from models) provide the basis for our current understanding of air pollution. These data are needed for monitoring of pollution levels, verification of the impact of clean air legislation, and definition of future policy strategies.

Traditionally, pollution levels are measured by standardised instrumentation at monitoring sites that comprise air quality networks.

The air quality networks are complemented by scientific instrumentation operated by research groups that make additional measurements over shorter time scales (e.g., days to 1-2 months). In comparison to data from air quality networks, these measurements provide information on many more species and at higher accuracy.

In addition, measurements from airplanes during flight campaigns allow sampling of air masses not accessible to ground-based instrumentation.

Policy Implications

- Air quality networks remain the backbone of pollution observations.
- Weaknesses in the instrumentation used and stations established need to be addressed, e.g., systematic errors, including interferences, and spatial coverage of networks.
- Emerging observation technologies using remote sensing from the ground should be evaluated for possible inclusion into national and European observation networks.
- Satellite observations already provide useful information on pollutant distributions and patterns on regional scales. As resolution in space and time improve further, integration of satellite data into pollution observation strategies becomes increasingly important.

In recent years, a number of remote sensing techniques from the ground have been developed, which also measure pollutants close to the surface, for example nitrogen dioxide (NO_2) and aerosols. They often provide measurements at several altitudes and therefore can add to the data from air quality networks.

As most of the measurements for monitoring networks are automated, they are more feasible in terms of cost and maintenance for long term observations than scientific measurement campaigns that are more typical of research projects.

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Information from satellite instrumentation on a variety of trace gas species started to become available in 1995. Capability has improved and measurements of a number of pollutants, such as, nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), ammonia (NH_3), and aerosols, are now made. One advantage of these satellite observations is their global coverage in combination with long and consistent time series, extending measurements to regions not covered by air quality networks.

Ground based, in-situ measurements provide measurements of pollutant concentrations at the surface, whereas sensors on satellites measure the entire atmospheric (vertical) concentration over a much larger area. Observations from space provide complementary information to measurement made at ground level and unique information about transport and transformation of pollution, for example for the United Nations Economic Commission for Europe Convention on Long-range Transboundary Air Pollution.

Satellite data has been used to document changes in atmospheric pollution levels over the last 15 years on regional scales. For NO_2, these observations show mostly downward trends over Europe, the US, and Japan, although the downward trend over Europe may have stagnated. Levels over Asia and in particular China have been strongly increasing. The same is true for many large cities in developing countries where increasing population and economic development combine to aggravate air quality problems. Similar studies have been performed for aerosols, also indicating improvements over European hotspots and upward trends over some regions in China.

By combining satellite data with atmospheric models, emission estimates can be made from the observations, and these data can provide unique insights into the effectiveness of clean air measures taken, such as the EU Air Quality Directives, and the accuracy of emission estimates based on statistical data reported to environmental agencies. In addition, natural emissions such as from fires or biological activity can be quantified, which provides important information needed to develop and evolve effective pollution reduction strategies.

The next generation of European satellite instruments will provide much improved spatial resolution and increased frequency of observations to several measurements per day. These data will provide much more useful information for atmospheric models, enabling reliable forecasting of pollution episodes and improvement of emission estimates.

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SEVENTH FRAMEWORK PROGRAMME

prepared by the University of Leicester