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Air Quality Measurements for Science and Policy

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Air quality measurements and the methods used to conduct them are vital to advancing our knowledge of the source-to-receptor-to-health effects continuum[1,2,3]. This information then forms the basis for evaluating and managing air quality to protect human health and welfare. This issue of *Environmental Manager* describes six aspects fundamental to linking science and policy through measurements. These articles include the areas of EPA's Federal reference and equivalent methods (FRM and FEM), EPA's NCore multipollutant network, ultrafine particles (UFP), coarse particles, data needs for air quality modeling, and approaches to community-based monitoring using sensors with data communicated via mobile devices assisted with user friendly 'apps'.

EPA's FRM and FEM research program develops and evaluates the measurement methods used to determine compliance and maintenance with National Ambient Air Quality Standards associated with six 'criteria pollutants'. Those pollutants include carbon monoxide (CO); lead (Pb); ozone (O_3); sulfur dioxide (SO_2); nitrogen dioxide (NO_2), and particulate matter (PM; PM_{10} and $PM_{2.5}$) (http://www.epa.gov/ttn/naaqs/). The FRM/FEM research program is described by Hall et al. (page XX). Standards for coarse particles (i.e., $PM_{10-2.5}$) were under consideration due to health associations observed between coarse particles and respiratory health[4] (http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_cr_cd.html). Although not promulgated in 2006, more evidence is pointing towards adverse health impacts from coarse particles[2]. Relatively strong associations are observed between ultrafine particles and respiratory and cardiovascular health effects[2]. Ultrafine particles are of particular concern with regards to adverse health effects due to their composition and small size that allows them to reach and deposit in the deepest parts of the lungs and to cross the air-lung barrier, allowing intact particles to translocate to other parts of the body[5]. Coarse particles and ultrafine particles are discussed in Fraser and Clements (page XX) and Solomon (page XX), respectively.

EPA's recently implemented NCore multipollutant network, described by Weinstock (page XX), begins to integrate measurements to better understand the true complex mixture that comprises the air we breathe. This network is also a large step towards implementing continuous methods for all critical pollutants across a range of environments from urban to rural, where the previous focus had been in urban areas using integrated measurements. These measurements along with others noted in this issue support air quality modeling, as described by Russell (page XX), which is our current true integrator of air pollution knowledge that allows regulators to develop and test detailed plans to reduce emissions to comply with the NAAQS. The future of air quality monitoring may lie in tiny measurement devices referred to as sensors, as described by White et al. (page XX) that when integrated with current and future communications technology, such as cellphones and associated 'apps', and applied across the internet will allow an unprecedented increase in our understanding of air pollution exposures critical to linking sources/pollutants to health effects. These devices also will allow communities to be actively involved (participatory monitoring) in safeguarding their own health.

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REFERENCES

1. Solomon. P.A.; Hopke, P.K.; Froines, J.; Scheffe, R. Key Scientific and Policy- and Health-Relevant Findings from EPA's Particulate Matter Supersites Program and Related Studies: An Integration and Synthesis of Results; *J. Air Waste Manage.* Assoc. **2008**, *58*, S3-S92.
2. Solomon, P.A.; Costantini, M.; et al. Air Pollution and Health: Bridging the Gap from Sources to Health Outcomes: Conference Summary; *Air Qual., Atmos. Health*. **2012**, *5*, 9–62.
3. Rao, S.T.; Porter, P.S.; Mobley, J.D.; Hubbell B. Understanding the Relationships between Air pollution Levels and Human Health Outcomes. EM (Environmental Manager), Air & Waste Management Assoc., Pittsburgh, PA, USA, May **2011**.
4. Schwarze, P.E.; Ovrevik, J.; et al. Particulate Matter Properties and Health Effects: Consistency of Epidemiological and Toxicological Studies; *Human and Experimental Toxicology* **2006,** *25,* 559-579.
5. Solomon, P.A.; Gehr, P.; et al. Macroscopic to Microscopic Scales of Particle Dosimetry: From Source to Fate in the Body. *Air Qual., Atmos., Health.* **2012.** DOI 10.1007/s11869-011-0167-y.