Green Week 2013

Research Needs for Future Urban Air Quality Monitoring
Research Needs for Future Urban Air Quality Monitoring
(AirMonTech)

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AirMonTech in a nutshell

– Review of recent technologies (approval tests, standard operating procedures, equivalence testing)

– Review of novel promising technologies for automated monitoring or regulated and non-regulated air pollutants

– Data base of air pollution monitoring technologies

– Recommendations and roadmaps for:
  • Enhanced harmonisation and standardisation
  • Adoption of new monitoring devices/strategies
  • New health relevant metrics
  • Research agenda for improved air quality monitoring

– Leading to:
  • More harmonised air pollution monitoring in Europe
  • Contribution to the review of the EU air policy package
  • Contribution to eco-innovation
Trends in instrumentation

- Improved performance by
  - new techniques
  - higher time-resolution
- Miniaturisation
  - Compact monitoring „stations“
  - portable detectors and microchip sensors
- Multi-component detection
  - for gases and particles (elements, solubles, organic matter)
- Open-path monitoring
  - mapping the air quality of a city
- New chemical-physical metrics
New, alternative particle metrics (1)

Photo: IUTA

TSI 3550 (NSAM)

Photo: Chuck Sarnoski & Betsy Frey Delaware DNREC / DAQ
http://www.marama.org/presentations/2012_Monitoring
/frey-sarnoski-ultrafine-mon2012.pdf

Accumulation mode vs. LDSA

UFP vs. LDSA

y = 141,31x + 5476,6
R² = 0,1804

y = 184,01x + 4148,5
R² = 0,6449

01.01.-30.09.2012
(n=5.867)

y = 42,177x - 109,97
R² = 0,6824

y = 40,147x + 20,19
R² = 0,9451

01.01.-30.09.2012
(n=5.867)
**New, alternative particle metrics (2)**

### Black Carbon (BC)

<table>
<thead>
<tr>
<th>Thermochemical Classification</th>
<th>Molecular Structure</th>
<th>Optical Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elemental Carbon (EC)</td>
<td>Graphene Layers (graphitic or turbostratic)</td>
<td>Black Carbon (BC)</td>
</tr>
<tr>
<td>Refractory Organics</td>
<td>Polycyclic Aromatics, Humic-Like Substances, Biopolymers, etc.</td>
<td>Colored Organics</td>
</tr>
<tr>
<td>Non-Refractory Organics (OC)</td>
<td>Low-MW Hydrocarbons and Derivatives (carboxylic acids, etc.)</td>
<td>Colorless Organics (OC)</td>
</tr>
</tbody>
</table>

**MAAP (ThermoFisher)**

**Photoacoustic Extintiometer (DropletMeasurement)**

**Aethalometer (Magee)**

**Graph:**
- Absorption coefficient $[m^{-1}]$
- $b_{abs}(470nm)_w$ for wood burning
- $b_{abs}(950nm)_t$ for traffic

**Equations:**
- $R^2 = 0.7669$
- $R^2 = 0.9183$

**Variations:**
- BC(bf)
- BC(ff)
Trends in instrumentation

• Improved performance by
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• New chemical-physical metrics

• Health effect related proxies

New, exciting technologies, metrics, opportunities and measurement strategies possible
http://db-airmontech.jrc.ec.europa.eu/
The opportunities

monitoring technologies

recommendations for regulatory monitoring
The opportunities

- Monitoring technologies
- Linkages between pollutants
- Recommendations for regulatory monitoring
- Other monitoring
- Network aims
- Health effects
Some key recommendations

The context of the monitoring (1)

The **focus of networks** required by the Air Quality Directive should be broad enough at least to **include the assessment of compliance** with EU standards in background and hotspot sites, **and the assessment of population-based exposure** appropriate for health effect studies.

There should be explicit **supplementary aims** of e.g. addressing scientific questions about **sources, pollution control measures and monitoring** for specific studies on health effects, defined in collaboration with the corresponding scientific communities.
The Roadmap task

- Technologies - where we are
- Technologies – current developments
- Networks and other tools - where we are
- Health effects knowledge - where we are
The Roadmap task

Technologies - where we are

Technologies – current developments

Networks and other tools - where we are

Health effects knowledge - where we are

Where we would like to be

2013  2020
Well chosen and well defined AQ metrics

Roadmap: the destination

Scope for new metrics such as BC, particle number concentration, surface area concentration, ROS
Roadmap: the destination

Scope for multi-laser spectroscopy for gases; low cost sensors for gases; miniature optical particle spectroscopy; particle speciation

Well chosen and well defined AQ metrics

New and better instruments and sensors
Roadmap: the destination

Concept of “supersites” in urban areas; traffic and background

- Well chosen and well defined AQ metrics
- New and better instruments and sensors
- Flexible processes for evaluating new instruments and metrics
Roadmap: the destination

Well chosen and well defined AQ metrics

New and better instruments and sensors

Flexible processes for evaluating new instruments and metrics

Better integration of ambient monitoring, remote monitoring, emissions data, and modelling

Bringing the separate disciplines together synergistically
Roadmap: the destination

Well chosen and well defined AQ metrics

New and better instruments and sensors

Flexible processes for evaluating new instruments and metrics

Better integration of ambient monitoring, remote monitoring, emissions data, and modelling

New and better monitoring strategies addressing defined aims

Making it explicit that national monitoring networks have aims beyond compliance monitoring, such as clarification of health effects, source apportionment, and abatement assessment
Roadmap: the destination

- Well chosen and well defined AQ metrics
- New and better instruments and sensors
- Flexible processes for evaluating new instruments and metrics
- Better integration of ambient monitoring, remote monitoring, emissions data, and modelling
- New and better monitoring strategies addressing defined aims
- Integration of routine AQ and health effects monitoring with other scientific aims

Making health effect monitoring and health impact assessment integral with national AQ monitoring
Roadmap: the destination and philosophy

Coordinated, focussed projects timed to maximise the use of the available expertise and to fit EU funding cycles

- Well chosen and well defined AQ metrics
- New and better instruments and sensors
- Flexible processes for evaluating new instruments and metrics
- Better integration of ambient monitoring, remote monitoring, emissions data, and modelling
- New and better monitoring strategies addressing defined aims
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2013 → 2020
Roadmap

Data acquisition phase

Instrumentation project
Modelling project
Health effects project
Implementation project (support action)

Integration phase
Data integration project
Population exposure project
Full integration project
Combined Ambient Air Quality and Health monitoring

Building on existing knowledge / EU Projects (see Fowler)

➢ to establish a future multipurpose urban AQ and health monitoring network for
  ➢ improved knowledge on AQ and environmental stressors
  ➢ better information of the public
  ➢ better planning
  ➢ improved and efficient abatement strategies
  ➢ …..

➢ ultimately enhancing the quality of life in Europe
Thanks some years gone by