Management Tool for Urban Exposure

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Background

Airborne pollutants are recognized as a major cause of health problems. Many adverse effects come from pollutants that are inhaled in the form of airborne particulate matter (aerosols). Other health risks are due to pollutants where inhalation is combined with either ingestion or dermal absorption. The health risks are not yet fully understood, partly because each microenvironment has its own specific pollutant composition. Up to date, the risks are most often being addressed by legislation for outdoor pollution, work environment and consumer products.

The aim

- To study the human exposure from air-pollution compounds that account for up to two pathways of exposure; inhalation and dermal absorption for particulate matter and chloroform in selected European urban areas.
- The scientific aim is to develop science-based methods for quantification of exposure.
- The environmental and policy-relevant product of the present proposal is the implementation of these methods into an integrated air quality management system.
- Such product will facilitate development of more appropriate public health strategies for mitigation of the adverse effects of air pollutants and drinking water disinfection by-products.

Key Questions

Urban Exposure will provide a tool for users to answer:

- What effect do particle sources outside a building have on the concentrations inside?
- What sources of particles are there inside a building and what concentrations of these are there in indoor air?
- How does the measured concentration translate into exposure experienced by people in the places where they live and work?

Air quality management tool

The computer tool will be made user-friendly and compatible with tools currently in use. To demonstrate the new tool, an existing typical air quality management system is used. An output from such system can typically be in the form of a concentration map (*Fig. 1*). As the system is GIS-based, for each grid square, road segment or a building, one can read off the concentration for a given time interval. Thus one can follow individuals as they move throughout the city.

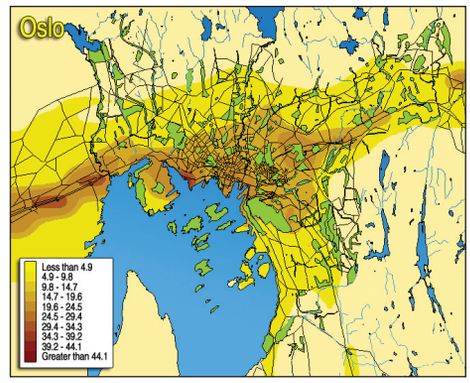

Fig.1 A GIS-generated map of particles in Oslo, Norway, shows that the concentrations follow the main roads.

Indoor concentrations

Most of us spent significant portion of time indoors with numerous pollutants sources. To account for such exposures, the project team employs a physical model that calculates size distributions and particle concentrations indoors. The user can define the most common scenarios (*Fig. 2.*)

Inhalation and dermal absorption

Standard inhalation dosimetry models and PBPK-based dermal absorption models were adapted, tested against experimental data and further verified in stand-alone version before implementation in the tool. *Fig. 3.* illustrates that the dose depends on the particle properties that are different indoors and outdoors.

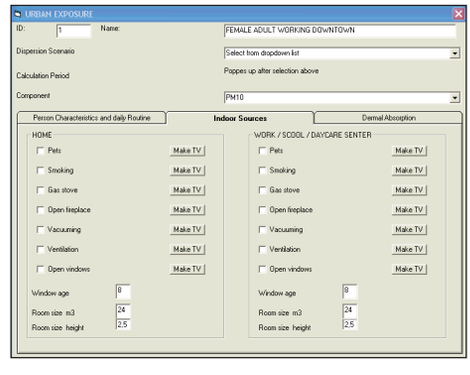

Fig. 2. Scenario definition menu.

Inhalation Dosimetry

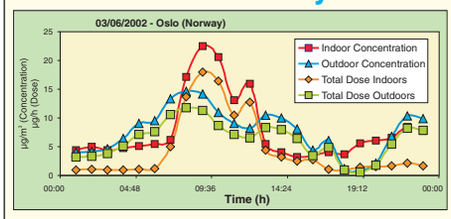

Fig.3. Indoor and outdoor concentrations and inhaled doses for a typical day in Oslo.

Tool design

The intended tool will be able to estimate total exposures and doses, taking into account both outdoor and indoor (micro)environments. It will enable managers to assess differences between exposure scenarios for

- particles, coupling models for outdoor concentrations, models for exposures indoors and finally inhalation models, and
- chloroform, a drinking water disinfection by-product, by coupling together concentrations, a dermal absorption and an inhalation model.

The models can be extended to other pollutants in the future.

Deliverables

The main products will be a computer tool for exposure and dose assessment, and a set of demonstrations to show results for common exposure situations. Emphasis is on inhalation of particles and on inhalation and dermal absorption of chloroform, in typical indoor and outdoor situations. The tool, based on scientific models and real data, is being validated and will be available as an add-on software to air quality management tools in 2005.

Collaborating partners

• **Norwegian Institute for Air Research (NILU)**, Kjeller NO; • **University of Essex**, UK; • **Fraunhofer-Gesellschaft zur Förderung der angewanden Forschung**, Hannover, DE; • **Institute for Ecology of Industrial Areas**, Katowice, PL; • **Institute of Chemical Processes Fundamentals, AS CR**, Prague, CZ; • **"Demokritos" National Centre for Scientific Research**, Athens, GR; • **Technical University of Crete**, GR; • **Technion - Israel Institute of Technology Haifa**, IL; • **Municipality of Oslo**, NO

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