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High-resolution modelling of health impacts from air pollution using the integrated model system EVA

Jørgen Brandt (1), Mikael S. Andersen (1), Jakob Bønløkke (2), Jesper H. Christensen (1), Camilla Geels (1), Kaj M. Hansen (1), Steen S. Jensen (1), Matthias Ketzel (1), Marlene S. Plejdrup (1), Torben Sigsgaard (2), and Jeremy D. Silver (1)

(1) Aarhus University, Department of Environmental Science, Roskilde, Denmark (jbr@dmu.dk, +45-(0)4630-1214), (2) Aarhus University, Institute of Public Health, Aarhus, Denmark

A high-resolution assessment of health impacts from air pollution and related external cost has been conducted for Denmark using the integrated EVA model system. The EVA system has been further developed by implementing an air quality model with a 1 km x 1 km resolution covering the whole of Denmark. New developments of the integrated model system will be presented as well as results for health impacts and related external costs over several decades. Furthermore, the sensitivity of health impacts to model resolution will be studied.

We have developed an integrated model system EVA (Economic Valuation of Air pollution), based on the impact-pathway chain, to assess the health impacts and health-related economic externalities of air pollution resulting from specific emission sources or sectors. The system is used to support policymaking with respect to emission control. In Brandt et al. (2013a; 2013b), the EVA system was used to assess the impacts in Europe and Denmark from the past, present and future total air pollution levels as well as the contribution from the major anthropogenic emission sectors. The EVA system was applied using the hemispheric chemistry-transport model, the Danish Eulerian Hemispheric Model (DEHM), with nesting capability for higher resolution over Europe (50 km x 50 km) and Northern Europe (16.7 km x 16.7 km). In this study an Urban Background Model (UBM) has been further developed to cover the whole of Denmark with a 1 km x 1 km resolution and the model has been implemented as a part of the integrated model system, EVA.

The EVA system is based on the impact-pathway methodology. The site-specific emissions will result (via atmospheric transport and chemistry) in a concentration distribution, which together with detailed population data, are used to estimate the population-level exposure. Using exposure-response functions and economic valuations, the exposure is transformed into impacts on human health and related external costs. In this study we have used a coupling of two chemistry transport models to calculate the air pollution concentration at different scales; the Danish Eulerian Hemispheric Model to calculate the air pollution levels with a resolution down to 5.6 km x 5.6 km and the Urban Background Model to further calculate the air pollution at 1 km x 1 km resolution using results from DEHM as boundary conditions. Both the emission data as well as the population density has been represented in the model system with the same high resolution.

Previous health impact assessments related to air pollution have been made on a lower resolution. In this study, the integrated model system, EVA, has been used to estimate the health impacts and related external cost for Denmark over a 20 year period (1990-2010) at a 1 km x 1 km resolution. Furthermore, a sensitivity study of the health impact using coarse and fine resolutions in the model system has been carried out to evaluate the effect of improved description of the geographical population distribution with respect to location of local emissions.

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