

Spatial mapping of atmospheric pollutants for European scale population exposure assessments

Bruce Denby¹, Jan Horálek², Frank de Leeuw³, Peter de Smet³, Pavel Kurfurst² and Jaraslov Fiala⁴
¹Norwegian Institute of Air Research (NILU), PO BOX 100, 2027 Kjeller, Norway
²Czech Hydrometeorological Institute (CHMI), Prague, Czech
³Netherlands Environmental Assessment Agency (MNP), Bilthoven, The Netherlands
⁴European Environmental Agency (EEA), Copenhagen, Denmark

Ambient air quality still remains an environmental and health problem throughout Europe. Though much has been achieved in the past decades there still remains a number of outstanding problems. In recent years the levels of particulate matter and ozone have not significantly decreased. To provide support to both policy development and public information it is necessary to spatially assess the exposure levels of the European population and its ecosystems to these pollutants.

This paper describes methodologies used to create pollutant maps for all of Europe at a scale of 10 km. The pollutants include PM₁₀, ozone, NO_x and SO₂ but the focus is mainly on PM₁₀ and ozone. These maps do not include local scale hotspots connected to industry or traffic but rather provide a background level for the population exposure calculations. The maps are constructed using both air quality monitoring and air quality modelling data with the inclusion, in some instances, of other spatially distributed supplementary data such as altitude or meteorological parameters. The combination of both monitoring and modelling data provides a robust and an effective description of the spatial distribution, giving complete coverage over all of Europe. Extensive testing of the applied methodologies has been carried out in order to define the best methods. The methods used include multiple linear regression analysis, kriging and co-kriging and residual kriging with linear regression. The monitoring data used in the mapping is provided from the Airbase database and the air quality model used is the EMEP unified model. In addition to producing maps of concentration, or exceedances of limit values, special attention has also been given to the calculation of their associated uncertainty. These uncertainty maps provide extra spatial information concerning the quality of the assessments and can be propagated further into the population exposure calculations to indicate uncertainties in the exposure levels.

The paper includes a preliminary assessment of exposure and impacts of air pollution in terms of population and ecosystems at risk. For example, we calculate the number of Europeans exposed to annual mean concentrations of PM₁₀ above the European limit value of 40 µg/m³ at 5.2% of the total population in 2004. The estimated number of premature deaths calculated, using 2004 as the reference year, is then estimated to be between 246,000 and 327,000, depending on the choice of natural background concentration. The high end of this range is close to the estimates used in the CAFE strategy.

Maps showing concentration levels, concentration uncertainties, population exposure, and their uncertainty, will be provided in the analysis. This is part of ongoing work carried out by the European Topic Centre for Air Quality and Climate Change for the European Environmental Agency.