LINKING ENVIRONMENTAL EFFECTS TO HEALTH IMPACTS – A COMPUTER MODELLING APPROACH

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Objective: To show that it is possible to utilise our knowledge of the health effects of air pollution, gained from time series studies, for the purpose of quantifying the scale of effects that a new industrial source of air pollution might have in the surrounding population.

Background: We know from the remarkably consistent results of many epidemiological studies that there is an association between several health outcomes and exposure to increased concentrations of certain pollutants, notably sulphur dioxide (SO_2) and suspended particulate matter (PM_{10}). The availability of Geographic Information Systems and dispersion models on personal computers makes the application of this knowledge a realistic possibility for quantifying the health effects resulting from the additional air pollution new industrial development might cause. In this case study, we have quantified some of the health effects of a new energy from waste facility on the surrounding population of half a million, in the context of environmental assessment for planning and licensing of the proposal.

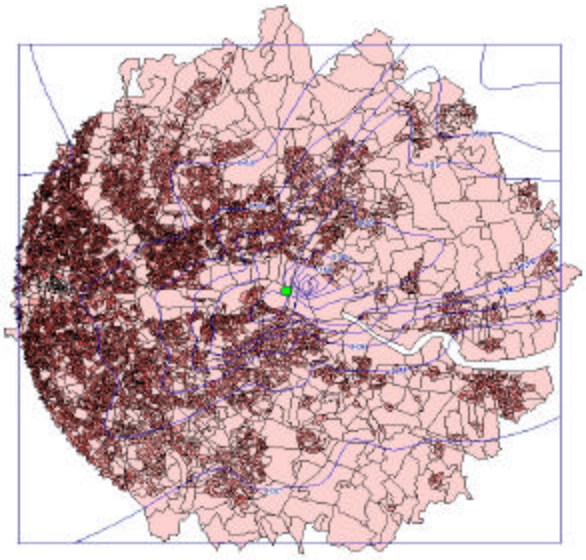
Methods:

The quantification relies on the simple equation:

$$(\Delta)E = \beta \times C \times P \times E,$$

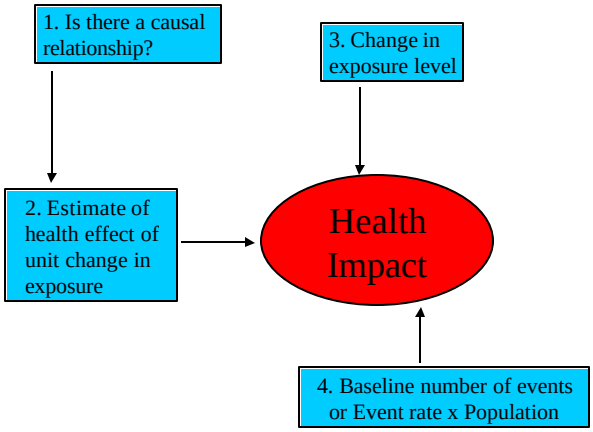
where: $(\Delta)E$ = (change in) background rate of events;
C = change in concentration of pollutant;
P = population exposed;
β = exposure-response coefficient.

The coefficients are derived from epidemiological studies, which show a clear association between increased exposure and increased effects. In this work, we have taken forward those results where the evidence is sufficiently convincing to support a hypothesis of causality. Most obviously, this applies to PM_{10}, where the coefficient β is taken to be a 0.5% increase in all cause mortality for a 10µg m^{-3} increase in concentration. The assumption of no threshold means that the annual average increase in concentration can be used.



To apply the coefficient, we take the 'contours' of additional concentrations for the new source, as generated by a dispersion model, and combine this field with a population database for a 20 km radius. This is done within the GIS, which is set up to calculate the product of the concentration increase with numbers of people exposed at the enumeration district level. (About 100 people within each ED polygon.)

Data on background rates of mortality rates and hospital admissions for several causes are available from the statistics collated by health authorities.



Results and Discussion: Application of the method is able to show that the magnitude of measurable health effects that might result from the increased exposure to PM_{10} is very small – approximately 0.03 deaths each year in a population of 500,000, with 0.04 extra hospital admissions for respiratory disease. Some care must be taken in presenting these results to stress the uncertainties in the numbers and the limitations of the method.

Nevertheless, for planners and other professionals who might be unclear on the scale of possible impacts, the methodology is a useful tool. For the public, context is crucial: for them even one additional death might be seen as an unnecessary burden for a new source.