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Calculating air pollution exposure using an empirical statistical calculation method baserd on ventilation indexes

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Experience from many years of measurements in urban areas in Sweden shows that high concentration of various air pollutant components occur not only in large cities, but also in smaller towns. This is possibly maily due to poor ventilation facilities.

Some years ago IVL developed the so-called URBAN model, an empirical statistical calculation method for air quality assessment. The model has mainly been used as a screening method for estimating the general risk of exceeding different national standard values for air quality in small and medium sized towns in Sweden.

The purpose of this study have been to examine the relevance to use the URBAN model to quantify the general population exposure and exposure assessment in epidemiological air pollution studies of ambient air pollutants on a national level. The calculation of air pollution concentration was performed on a national basis but still with a fairly good resolution (1x1 km). The purpose was to develop a tool useful for exposure as well as for trend and prediction studies.

The required meteorological input parameters for the URBAN model were a ventilation index (V) and a dispersion-adjusting constant (C_d). V and C_d were determined by using mixing height (H) and wind speed (U) which were calculated with the numerical model, TAPM (The Air Pollution Model) at high time and spatial resolution (1 month and 1x1 km (2x2 km for the northern inland)) were obtained.

This study has focused on $NO_2$and PM_{10}, pollutants closely related to traffic emissions and hence to the exposure of air pollution in cities.

At all sites and times where measurements of NO_2 concentrations exist, C_d has been calculated separately at each site and months for the two years. Those calculations have then been used to determine the NO_2 concentration in cities where no measurement data is available, by assuming that C_d is similar for towns with similar V's. A comparison between monthly averages of measured and calculated NO_2 concentrations shows a fair accordance.

PM_{10} calculations were based on a combination of ratio calculations between NO_x/PM_{10} and an established relation between urban- and regional background concentration as a function of the latitude. The ratio method represents the local contribution and the other method shows the national variations of PM_{10} concentration.

The results from the urban modelling show that in 1999 most of the country had rather low NO_2 urban background concentrations, compared to the environmental standard for the yearly mean (40 μg/m^3). Most of the small to medium sized cities has NO_2 concentrations of 10-15 μg/m^3. In the large cities and along the Skåne West Coast the concentration is around 20 μg/m^3.