Combining positional data and real-time environmental modelling techniques for personal exposure estimation

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ABSTRACT

Many studies have proven a strong correlation between spatially distributed air pollutants and health impacts on humans. But as the surveillance of air quality is restricted to a few measurement points per city, and the within-city variance of pollutants can exceed the between-city variance considerably, identifying implications for individual persons is difficult. The positions over the day vary individually, and health studies are most often restricted to using geocoded home and work addresses only. For an individual moving through the city it is impossible to estimate the actual exposure to PM10 or ozone unless the person wears a personal measurement monitor. Spatio-temporal models, based on dispersion dynamics and/or stochastic equations, can help to estimate the exposure at different locations in a city. In the case of PM10 in Münster, 2 public measurement stations are available in the city area, making stochastic interpolation nearly impossible. Running a dispersion model with actual weather conditions on the other hand takes several days, which renders real-time exposure modelling difficult.

On the basis of a pilot study, conducted to estimate the amount of personal PM exposure over the day via GPS diaries and outdoor and indoor modelling, we developed a framework for the combination of multiple data sources. This includes processing of information about the spatio-temporal distribution of pollutants and location based information of individuals to enable a service for real-time information about the concentration at each location in Münster. The pollutant (PM10) model in turn combines information about particle dispersion (from the LASAT model), building models and street maps of Münster, actual meteorological data, and particle concentration measurements at different locations to estimate the real-time pollutant distribution. This model is open to include further data sources if

available, enhancing the quality of the results. Users can send requests from their cell phone or PDA, with their position to this service to obtain information about the actual PM10 concentrations at their location. Positioning works via GPS if available or cell phone-based and will include WLAN positioning in future. Although we combined multiple data sources to improve the estimate of the spatial distribution of pollutant concentrations, we still have many sources of uncertainties. One part of the framework covers the estimation of uncertainty in the model result to give the end-user a confidence interval for the concentration value.