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

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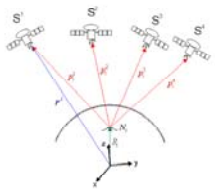
Motivation

Air pollution has an influence on human health. But what does this mean for an individual living in a city? People move through space over time just as air contaminant concentrations can change spatially and temporally. When we are able to match both variables in space and time we can answer the following questions:

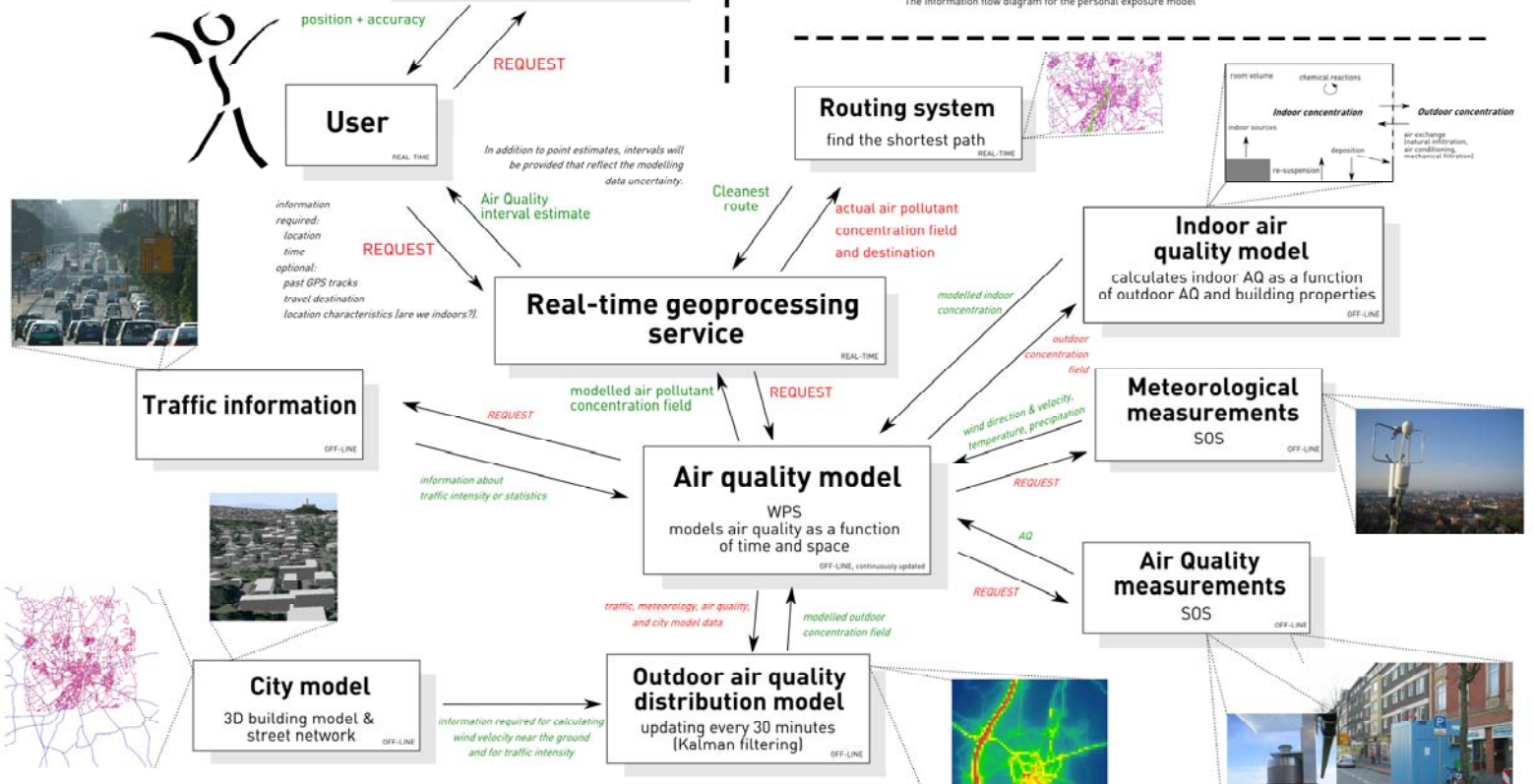
What is the cleanest route home from here?
What is the current air quality at this location?
What was my cumulative exposure over the last week?

Connecting data streams

The plan is to build a generic framework for individual real-time exposure estimation. We will use data and models that already exist and link them to a new applications. The models are "plug-ins", i.e. exchangable for different air pollutants.



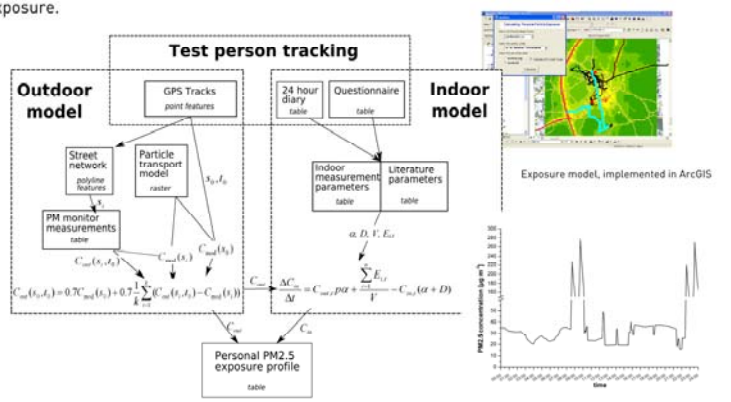
The more information the user provides, the better the estimation can be. Aggregating over time to obtain cumulative exposure also makes the estimate more accurate.



Pilot study:

Estimating individualPM2.5 exposure in Münster

During an initial study on the combination of positional data and modelled concentrations we sampled the time activity patterns of 6 individuals (recorded as GPS tracks and diaries). An outdoor model consisting of a dispersion model and ongoing particle measurements at 4 stations in the city of Münster provided the spatial distribution of particulate matter. A simple mass-balance indoor model was used to estimate the concentrations in buildings. Afterwards the exposure analysis was performed off-line.
The results were promising as the profiles allowed the identification of high exposure situations and a weak correlation between stationary point measurements and the individual exposure.



The information flow diagram for the personal exposure model

Applications

With the overall framework we can build services that answer the questions above:

- A route planner that uses the estimated concentrations as friction maps.
- A Web service for requesting the actual concentration field in a city or at a certain location.
- A Web service for estimating the recent exposure through integrating the ambient concentrations over the user's past positional tracks.

Challenges

The connection of different data sources always comes with interoperability challenges like:

- different measurement techniques and data quality depending on the source
- different spatial and time resolution
- quantification and communication of the uncertainty in all processing steps

that are part of our future research work.