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Assessment of heterogenity of air pollution within an urban canopy

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Air pollution is an important topic within urban areas. Limit values as given in the European Guidelines are introduced to reduce negative effects on humans and vegetation. Exceedances of the limit values are to be assessed using measurements. In case of found exceedances of the limit values, the local authorities need to act to reduce pollution levels. Highest values are found for several pollutants (NOx, NO2, particles) within densely build-up urban areas with traffic emissions being the major source and dispersion being very much impacted by the urban structures. The quality assured measuring network used by the authorities is often too coarse to determine the heterogeneity in the concentration field. Low cost sample devices as employed in several citizen science projects might help to overcome the data sparsity. Volunteers measure the air quality at many sites, contribute to the measurement networks and provide the data on the web. However, the questions arising are: a) Are these data of sufficient high quality to provide results comparable to those of the quality assured networks? b) Is the network density sufficient to determine concentration patterns within the urban canopy layer?
One-year data from a citizen science network, which measures particulate matter (PM10, PM2.5) were compared to measurements provided by the local environmental agency, using two hot-spot areas in the city of Hamburg as an example. To determine how well the measurements agree with each other, a regression analyses was performed dependent on seasonal and diurnal cycles. Additionally, model simulations with the microscale obstacle resolving model MITRAS were performed for two characteristic building structures and different meteorological situations. The model results were used to determine local hot spots as well as areas where measurements might represent the concentration of particles for the urban quarter. The low cost sensor measurements show a general agreement to the city's measurements, however, the values per sensor differ. Moreover, the measurements of the low-cost-sensor show an unrealistic dependence on relative humidity, resulting in over- or underestimations in certain cases. The model results clearly show that only a few sites allow measurements to be representative for a city quarter. The measurements of the citizen science project can provide a good overview about the tendencies of the air quality, but are currently not of sufficient quality to provide measurements calling for legal action.

The model results were used for the project AtMoDat. AtMoDat is an attempt to create a data standard for obstacle resolving models based on the existing Climate and Forecast (CF) conventions. A web-based survey is developed to get information on the requirements for the data standard. The next step is to extend the collection of model characteristics and eventually to

provide a generic scheme.

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