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"Assessment of the in- /outdoor air quality through diffusive sampling and mobile measurements in a school edification - Stuttgart "

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Abstract

It is widely known that one of the pressing environmental problems of major conurbations are the adverse effects of air pollution. With the aim of assessing the in-/outdoor air quality in a German elementary school in Stuttgart; diffusive sampling of NO_X along with mobile measurements of O_3, NO_X, particulate matter, and black carbon were conducted. For the diffusive sampling, 4 sets of triethanolamine absorption-based surfaces located in 23 different strategic points in the school were implemented over a total 7-week time period. The obtained NO_X average values oscillate between 20 to 44 µg/m^3, and 8 to 23 µg/m^3 for NO_2. Eight daily mobile measurements were conducted over a 2-week time period covering all classrooms and halls from the school. Average values between 7 and 17 ppb for NO_2, between 8 and 20 ppb for NO and between 14 to 50 ppb for O_3 were observed. For Particulate Matter, average values were obtained between 2 to 85 µg/m^3 and 1 to 17 µg/m^3 for PM_{10} and $PM_{2.5}$ respectively. Soot average concentration-values were found between 100 and 1700 ng/m^3. In general, peak values are present in forced-ventilated rooms close to the main road and it is noticeable that the pollution levels in and outside the school are not high enough to be considered harmful for the children's health.

Introduction

Reduced lung function, cardiovascular diseases and mental cognitive problems are known as the main consequences of air pollution exposure for children. Hence, evaluation and assessment of air quality in children environments has become one of the most important tasks in environmental appraisal. Some of the pollutants that must be considered as major hazards are:

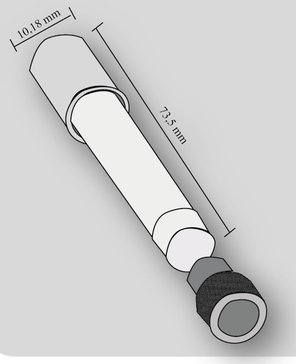
NO_2: Nitrogen dioxide imply and increased risk of respiratory illness for children. This is of concern because repeated lung infections in children can cause lung damage later in life.

O_3: Concentration of ozone above 100 mg/m^3 are shown to have important health effects on children. Symptoms are: significant reduction in lung function, as well as airway inflammation.

Particulate Matter (PM): The range of health effects linked with airborne is broad, but are predominantly to the respiratory and cardiovascular systems. The less diameter the particle has, the more dangerous.

Black Carbon (BC): Present health effects associated to particulate matter exposure. Several studies suggest that BC is a better indicator of harmful particulate substances from combustion sources (traffic).

Methods

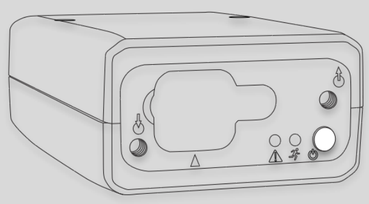


Passive Sampling

Four periods of triethanolamine absorption-based surfaces located in 23 different strategic points in the school were implemented over a total 7-week time period. The diffusive samples were analyzed in the laboratory using the Saltzman reactant and the spectrometer for determining NO_X and NO_2 concentrations. Final average values were computed for every location.

Mobile Measurements

All used instruments and devices were placed together in a cart, which was moved through the classrooms and halls of the school during a 2-week time period. Eight days of measurements were conducted. Night-time measurements were also carried out by leaving the cart in reference rooms in the school.



- A direct absorption-based instrument at 405 nm was used for NO_X measurements (2B Technologies Model 405 nm NO_2/NO/NO_X Monitor™)
- UV-absorption based device in the case of O_3 (2B Technologies Model 202 Ozone Monitor™).
- A light scattering-based device (Portable laser aerosol spectrometer - GRIMM 11A) was implemented for particulate matter measurements.
- Light absorption principle (microAeth® AE51) was used to measure soot concentrations.

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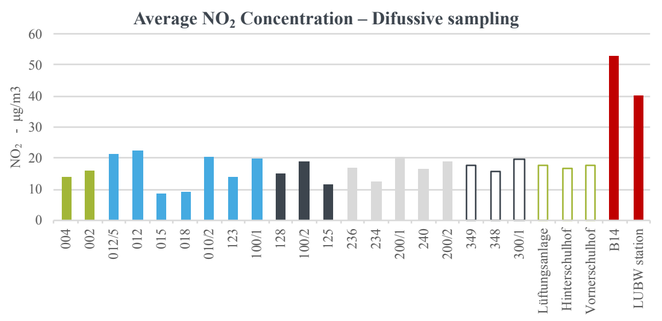
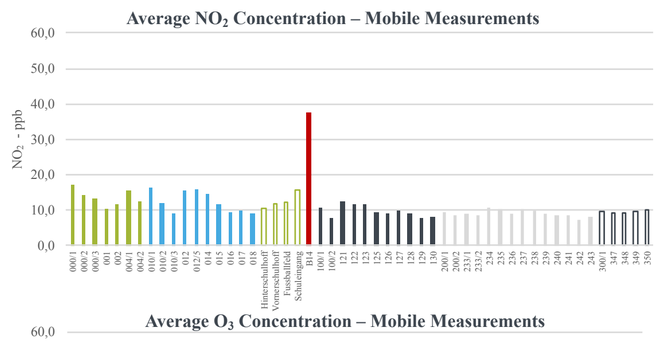
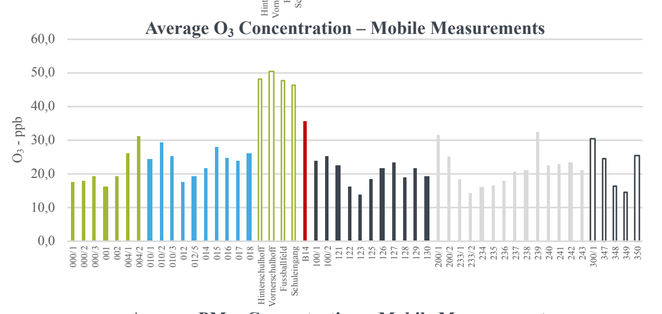
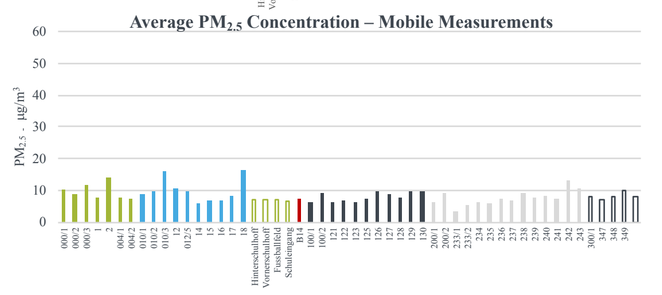
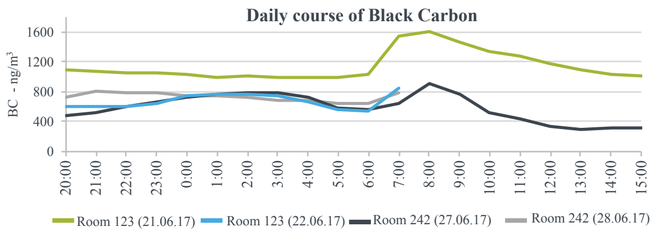
Results

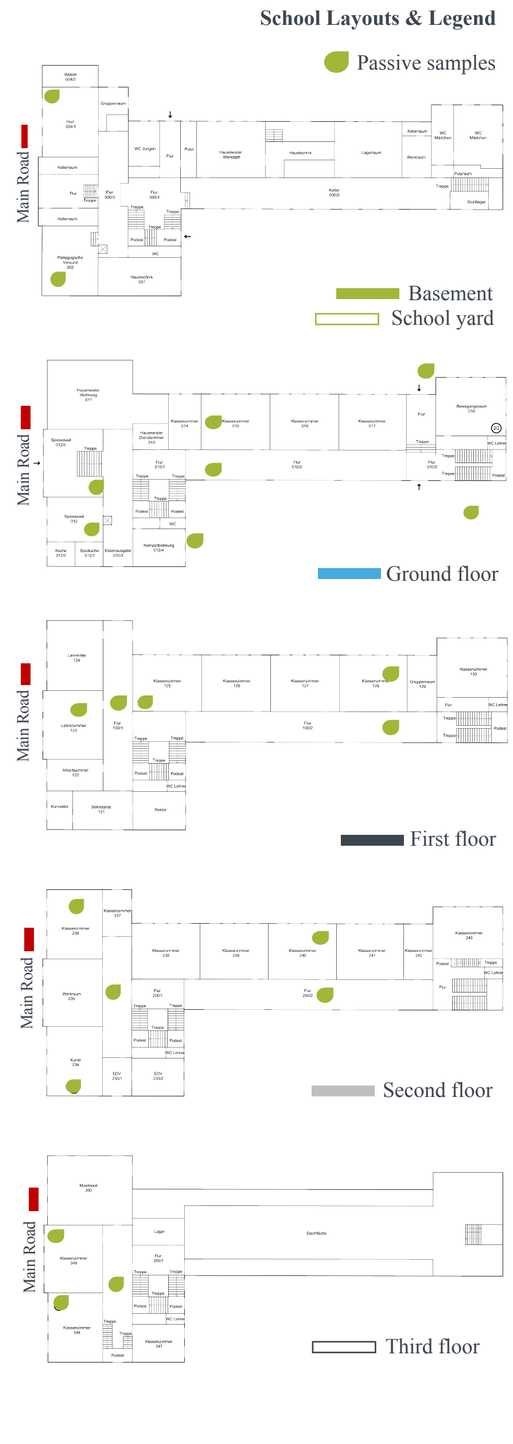












Conclusions

- In general, peak concentration values of pollutants are present in forced-ventilated rooms close to the main road. It is noticeable that the pollution levels in and outside the school are not high enough to be considered harmful for the children´s health.
- The daily course of pollutants shows the clear impact of trafic on contamination levels, which peak during rush hours and drop during night time when trafic is lower.
- It is highly recommended to isolate the classrooms nearby the road by closing the windows and by using the already installed forced-ventilation system.
- It is also suggested to use pollutant-absorbing plants such as *Sansevieria trifasciata* inside the classrooms to minimize the impact of the main road-proximity.

References

[1] Adapted from: "Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide", World Health Organization, Special program on health and environment. European Centre for environment and health, Bonn Office, 2005

[2] Adapted from: "Health effects of black carbon", World Health Organization, Special program on health and environment. European Centre for environment and health, Bonn Office, 2012

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