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# Assessment of urban air quality with mobile measurements using a bicycle (MOBAIR)

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## Abstract

The ambient air quality is a well-known problem for big cities with dense population and high traffic volume. The air quality is usually monitored with measurement stations. However, limited spatial resolution and restricted possibility of mapping spatial distribution of air pollutants is a drawback. To provide high spatial and temporal resolution, mobile measurements are necessary. This study aims to investigate the air quality of an urban city by performing mobile measurements using bicycle (MOBAIR) equipped with devices to measure air pollutants such as nitrogen oxides, ozone, particulate matter, Ultra fine particles and black carbon as well as meteorological parameters such as air temperature, relative humidity, air pressure, wind speed, wind direction and solar radiation. The measurement route covered a big part of the city with high traffic roads as well as side roads and park in order to obtain a broader picture and to identify the contribution of traffic to the air quality.

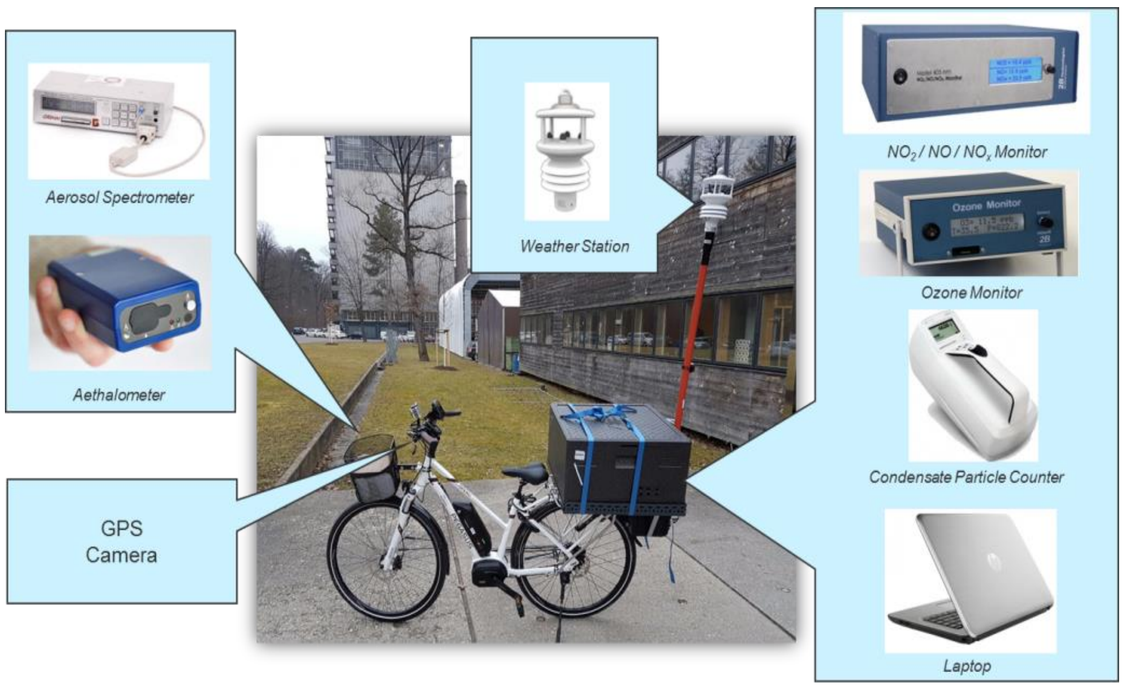
## Introduction

- Low number of air quality measurement stations
- Limited spatial resolution of air quality data
- Restricted possibility of mapping spatial distribution of air pollutants
- Mobile air quality measurements provide the opportunity to investigate high spatial and temporal resolution of air pollutants
- Mobile measurements are an ever-growing trend for the evaluation of urban emissions, local air quality and air pollutant exposure

## Methodology

- Mobile measurements were carried out during summer and winter period of 2017 and 2018
- The measured air pollutants and meteorological parameters are listed in the table along with the instrument used for the measurements
- The bicycle (MOBAIR) along with the devices is shown in the figure

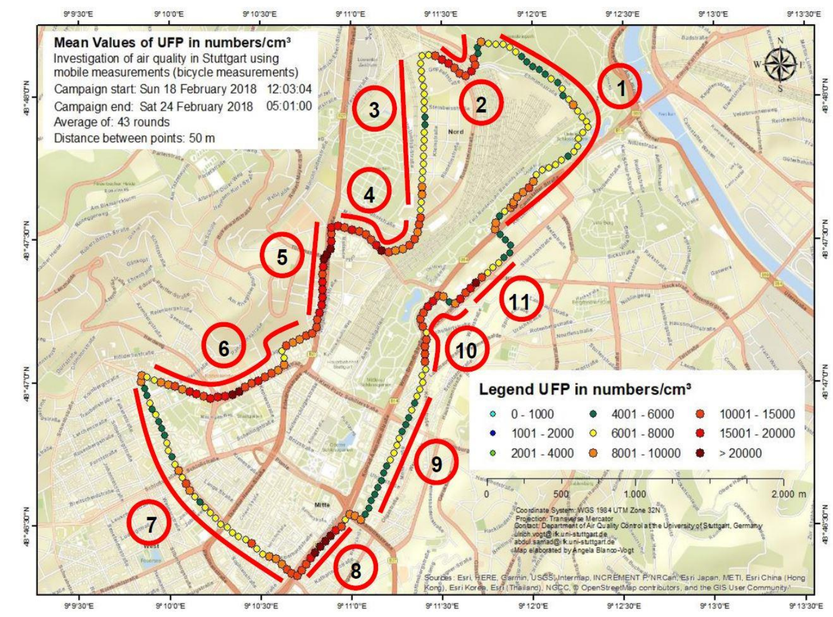
| Measured parameters | Measurement principle | Instrument |
|---|---|---|
| **Particulate Matter (PM) with size range 0.3 – 20 µm** | Light scattering | Grimm 1.108 |
| **Ultrafine Particles (UFP) with size range 0.01 to >1 µm** | Particle condensation | TSI CPC 3007 |
| **Black Carbon (BC)** | Light attenuation | Aethlabs AE 51 |
| **$NO_2$, NO, $NO_X$** | $NO_2$ absorption at 405 nm | 2B technologies 405nm $NO_X$ monitor |
| **$O_3$** | UV absorption at 254 nm | 2B technologies Ozone monitor 202 |
| **Wind speed, Wind direction, Air temperature, Relative humidity, Air pressure and Solar radiation** | Ultrasonic sensors, NTC resistor, Capacitive sensor, MEMS sensor, Pyranometer | Gill GMX 501 |




## Results

- Variation in the pollutant concentrations by factors such as location, traffic volumes, weather, etc.
- Lowest pollutant concentrations in the park
- Identification of two hotspots at construction area
- Higher pollutant concentrations in the study area alongside the main roads with heavy traffic
- Local traffic contributing more than 50% to the pollutant concentrations
- Relatively high pollutant concentrations around the measurement site *Stuttgart "Am Neckartor"*
- The route is divided in 50m segments, the values within this segment are averaged and presented as one circle on the route as shown in figure as an example for UFP results with area description

| Nr. | Description |
|---|---|
| 1 | Park |
| 2 | Construction area |
| 3 | Residential area |
| 4 | Construction area |
| 5 | Federal highway B27 |
| 6 | Road away from B27 |
| 7 | City center area |
| 8 | Federal highway B14 |
| 9 | Road parallel to B14 |
| 10 | Am Neckartor on B14 |
| 11 | Road parallel to B14 |




## Conclusions

- The mobile measurements are a useful tool to locate hot spots in the area under investigation
- The pollutant spatial distribution obtained using mobile measurements provide a clear picture of the air quality of the investigated area
- The traffic being a local source has a dominant influence on the pollutant concentration

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