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Stand-alone low-cost sensor network in the inner city of Munich for modeling urban air pollutants

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Modeling urban air pollutants is a challenging task not only due to the complicated, small-scale topography but also due to the complex chemical processes within the chemical regime of a city. Nitrogen oxides (NOx), particulate matter (PM) and other tracer gases, e.g. formaldehyde, hold information about which chemical regime is present in a city. As we are going to test and apply chemical models for urban pollution – especially with respect to spatial and temporally variability – measurement data with high spatial and temporal resolution are critical.

Since governmental monitoring stations of air pollutants such as PM, NOx, ozone (O_3) or carbon monoxide (CO) are large and costly, they are usually only sparsely distributed throughout a city. Hence, the official monitoring sites are not sufficient to investigate whether small-scale variability and its integrated effects are captured well by models. Smart networks consisting of small low-cost air pollutant sensors have the ability to provide the required grid density and are therefore the tool of choice when it comes to setting up or validating urban modeling frameworks. Such sensor networks have been established and run by several groups, achieving spatial and temporal high-resolution concentration maps [1, 2].

After having conducted a measurement campaign in 2016 to create a high-resolution NO_2 concentration map for Munich [3], we are currently setting up a low-cost sensor network to measure NOx, PM, O_3 and CO concentrations as well as meteorological parameters [4]. The sensors are stand-alone, so that they do not demand mains supply, which gives us a high flexibility in their deployment. Validating air quality models not only requires dense but also high-accuracy measurements. Therefore, we will calibrate our sensor nodes on a weekly basis using a mobile reference instrument and apply the gathered sensor data to a Machine Learning model of the sensor nodes. This will help minimize the often occurring drawbacks of low-cost sensors such as sensor drift, environmental influences and sensor cross sensitivities.

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