Geophysical Research Abstracts
Vol. 19, EGU2017-4765, 2017
EGU General Assembly 2017

Monitoring urban air quality using a high-density network of low-cost sensor nodes in Oslo, Norway.

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Urban air quality represents a major public health burden and is a long-standing concern to citizens. Air pollution is associated with a range of diseases, symptoms and conditions that impair health and quality of life.
In Oslo, traffic, especially exhaust from heavy-duty and private diesel vehicles and dust resuspension from studded tyres, together with wood burning in winter, are the main sources of pollution. Norway, as part of the European Economic Area, is obliged to comply with the European air quality regulations and ensure clean air. Despite this, Oslo has exceeded both the NO_2 and PM10 thresholds for health protection defined in the Directive 2008/50/EC.
The air quality in the Oslo area is continuously monitored in 12 compliance monitoring stations. These stations provide reliable and accurate data but their density is too low to provide a detailed spatial distribution of air quality. The emergence of low-cost nodes enables observations at high spatial resolution, providing the opportunity to enhance existing monitoring systems. However, the data generated by these nodes is significantly less accurate and precise than the data provided by reference equipment.
We have conducted an evaluation of low-cost nodes to monitor NO_2 and PM10, comparing the data collected with low-cost nodes against CEN (European Standardization Organization) reference analysers. During January and March 2016, a network of 24 nodes was deployed in Oslo. During January, high NO_2 levels were observed for several days in a row coinciding with the formation of a thermal inversion. During March, we observed an episode with high PM10 levels due to road dust resuspension.
Our results show that there is a major technical challenge associated with current commercial low-cost sensors, regarding the sensor robustness and measurement repeatability. Despite this, low-cost sensor nodes are able to reproduce the NO_2 and PM10 variability. The data from the sensors was employed to generate detailed NO_2 and PM10 air quality maps using a data fusion technique. This way we were able to offer localized air quality information for the city of Oslo.
The outlook for commercial low-cost sensors is promising, and our results show that currently some sensors are already capable of providing coarse information about air quality, indicating if the air quality is good, moderate or if the air is heavily polluted. This type of information could be suitable for applications that aim to raise awareness, or engage the community by monitoring local air quality, as such applications do not require the same accuracy as scientific or regulatory monitoring.