

Comparative air quality assessment at the street level with a mobile laboratory

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As for many areas in the north of France, the city of Douai (40,000 inhabitants) and its surroundings are recurrently submitted to episodes of altered air, mainly due to high concentrations of airborne particles, which may be directly emitted by local or distant sources but may also be formed through gas-to-particle conversion processes of precursor gases.

Reducing the impact of primary and secondary sources requires to identify, locate and quantify their contribution to the ambient air pollution. This is one of the objectives of the ISARD (Identification of Sources of AeRosols in the Douai area) project, which aims at characterizing the relative influence of the main local sources, *i.e.* traffic and domestic heating, in different neighbourhoods of Douai.

As part of this study, a bicycle was equipped with measurement devices and tested during the five “No-car Saturdays” trial, held by the city of Douai in two shopping streets in October 2015. The roadways, presenting different height-to-width ratios, were each partially closed to cars and left free for pedestrians (Figure 1).

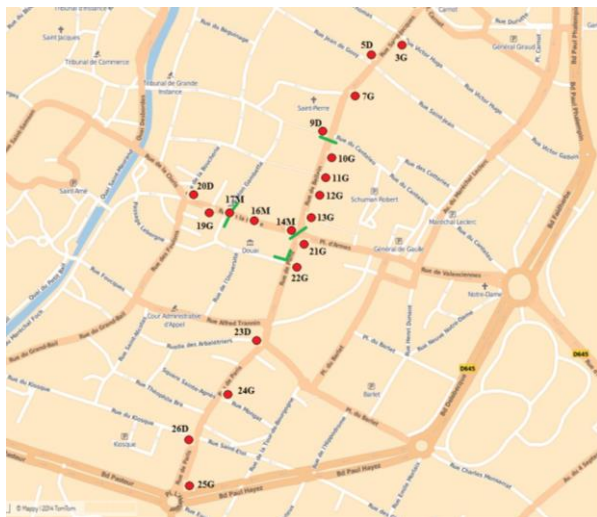


Figure 1. Fixed measurement points in the shopping street area of Douai during the “No-car Saturdays” trial.

The mobile laboratory comprised a mini optical particle counter providing 16 bins over the 0.38 to 17.5 μm diameter range (OPC-N2, Alphasense), five semi-conductor gas sensors (CO_2 , Air Pollutants, Volatile Organic Compounds, Liquefied Petroleum and NO_2 , Figaro and MICS), temperature and humidity sensors (Libelium) and a calibrated particle counter

providing 6 bins over the 0.3 to 10 μm diameter range (Aerotrak 8220, TSI) taken as a reference for particle counting.

Measurements were carried out for 5 minutes at several locations along each street part, alternating both sides of the street to take into account potential wind-related spatial heterogeneity of pollutant concentrations. The same methodology was followed for each of the five investigated Saturdays.

The statistical analysis of measurements was carried out by applying clustering techniques. It shows that both particle number concentrations and gaseous fingerprints behave differently depending on the presence or absence of traffic (Figure 2), with two distinct groups at a distance of ~ 1 .

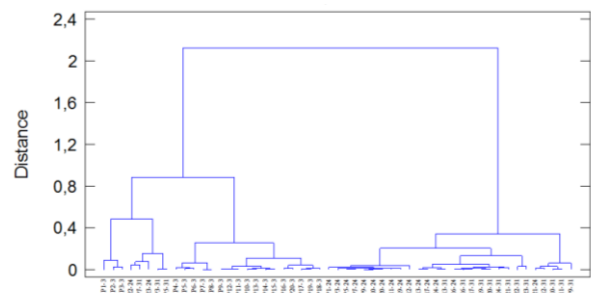


Figure 2. Dendrogram from cluster analysis (Ward's method, Euclidean distance) obtained with Statgraphics Centurion XV.II. The x-axis represents the different gas profiles measured at the different sites for each Saturday.

However the levels of the recorded signals are strongly influenced by weather conditions, following the same trend as the measurements from the nearest air quality monitoring station.

Furthermore, a significant spatial and temporal variability of the particle and gas measurements has been observed at the street level, in relation with the presence of punctual or transient sources of air pollution such as:

- two-wheeled motor vehicles accelerating in the section open to traffic,
- smokers in the pedestrian section,
- food stands (*e.g.* a waffle stall) or restaurant kitchen exhaust systems in the pedestrian section.

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