Super Polluter IDentifiER (SPIDER) – a tool for on-road detection of vehicles that contribute disproportionally to the vehicle fleet emissions

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Traffic is a diverse and disperse source of air pollution. The amount of pollutants emitted depends on vehicle parameters; the engine type and displacement, the exhaust after-treatment system, maintenance status, as well as traffic conditions, topography, driver behavior and the weather conditions. Different statistical analyses and measurement approaches have been employed to evaluate traffic emissions; these vary in complexity in terms of describing traffic activity and emission factor (EF) determination. The EF determination methods performed on-road in real driving conditions have been described as less precise than the dynamometer studies because the tests are not as repeatable due to the absence of standard cycles and additional uncontrolled parameters, such as environmental or traffic conditions, driver behavior or highly transient operations [1]. Their advantage over dynamometer/laboratory measurements is that, over a short period of time, emissions of many different in-use vehicles can be measured and EF distributions for different vehicle categories can be obtained. There have been several studies measuring EF of individual vehicles using different approaches [1-2] and references therein.

We have repeated the on-road measurement campaign using the chasing method as descried in Ježek et al. [2] and determined EF of BC and nitrogen oxides (NO_x) from 435 individual vehicles of different types and particle number (PN) EF of 145 different type vehicles. We have acquired technical data from the national registry information about the measured vehicles and analyzed the data according to vehicle type, age and fuel used. The data-processing method was re-evaluated and optimized, especially from the point of view of background concentration determination, which can represent an important source of uncertainty.

The vehicles were firstly grouped to three categories - diesel cars, gasoline cars and goods vehicles, and then according to age and introduction of new European emission standards. Significant reductions in BC EF with introduction of EURO5 and EURO6 emission standards in diesel cars and goods vehicles groups were observed. The reduction in NO_x EF for diesel cars was small and found only in the EURO6 group. We observed the reduction in NO_x EF in goods vehicles and gasoline cars categories. PN EF were also significantly reduced in all three vehicle categories. We will compare measurement results to the results of Ježek et al. [2] and the contribution of super emitters in the main three vehicle groups. We will demonstrate that the optimized SPIDER method can be used in real-world to determine supper emitters, and the associated reduction of fleet emissions, if these supper emitters were eliminated from the fleet.

[1] Franco, V., et al. (2013). Atmos. Environ., 70, 84–97

[2] Ježek, I., et al. (2015). Atmos. Meas. Tech., 8, 43–55.