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Euro 6 unregulated pollutant characterization and statistical analysis of the impact of aftertreatment devices and driving conditions on recent passenger cars emissions

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This study aims to measure and analyze unregulated compound emissions for two Euro 6 vehicles: one diesel vehicle with a catalysed particulate filter and NO_X trap, and one gasoline vehicle with a direct injection system and propulsion engine. The vehicles were tested on a chassis dynamometer under various driving cycles: Artemis driving cycles (urban, road and motorway) — which are representative of real-world driving conditions, the New European Driving Cycle (NEDC) and the World Harmonized Light-Duty Test Cycle (WLTC) for Europe, and world approval cycles. The emissions of unregulated compounds — such as total particle number (PN) (over 5.6 nm), black carbon (BC), NO_2, BTEX (benzene, toluene, ethylbenzene and xylene), carbonyl compounds and polycyclic aromatic hydrocarbons (PAHs) — were measured with several on-line devices and different samples were collected using cartridges and quartz filters.

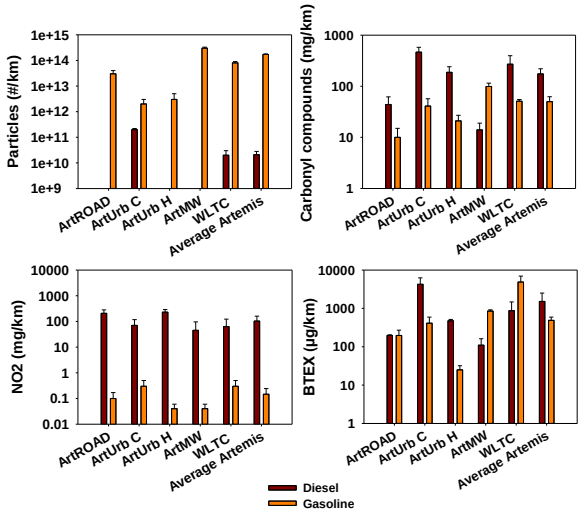

Figure 1. Particles, NO_2, BTEX and carbonyl compounds emission factors for Euro 6 diesel and gasoline vehicles.

Furthermore, a preliminary statistical analysis was performed on eight Euro 4-6 diesel and gasoline vehicles to study the impacts of driving conditions and aftertreatment and engine technologies on emissions of regulated and unregulated pollutants. The results indicate that urban conditions with cold start induce high emissions of BTEX and carbonyl compounds and that urban conditions with hot start induce high emissions of NO_X. Motorway conditions are characterized by high emissions of particle numbers and CO, which mainly induced by gasoline vehicles. Compared with gasoline vehicles, diesel vehicles equipped with catalyzed or additive DPF emit fewer particles but more NOx and carbonyl compounds.

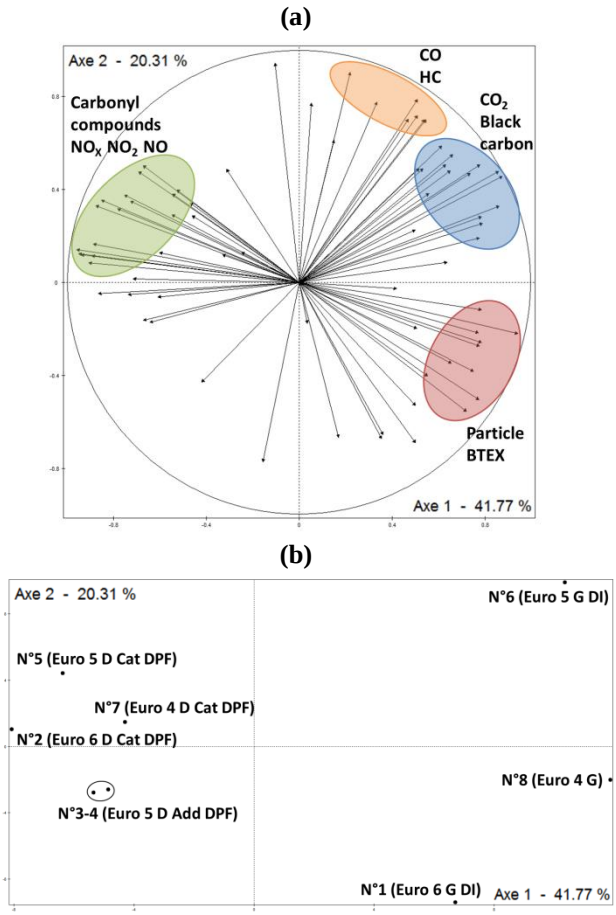

Figure 2. PCA performed for all the driving cycles and all the vehicles, with (a) the projection of emission factors and (b) the projection of vehicles.

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