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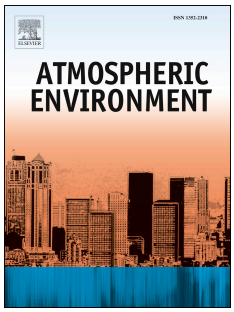

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Primary emissions and secondary organic aerosol formation from the exhaust of a flex-fuel (ethanol) vehicle

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Abstract

Incentives to use biofuels may result in increasing vehicular emissions of compounds detrimental to air quality. Therefore, regulated and unregulated emissions from a Euro 5a flex-fuel vehicle, tested using E85 and E75 blends (gasoline containing 85% and 75% of ethanol (vol/vol), respectively), were investigated at 22 and -7 °C over the New European Driving Cycle, at the Vehicle Emission Laboratory at the European Commission Joint Research Centre Ispra, Italy. Vehicle exhaust was comprehensively analyzed at the tailpipe and in a dilution tunnel. A fraction of the exhaust was injected into a mobile smog chamber to study the photochemical aging of the mixture. We found that emissions from a flex-fuel vehicle, fuelled by E85 and E75, led to secondary organic aerosol (SOA) formation, despite the low aromatic content of these fuel blends. Emissions of regulated and unregulated compounds, as well as emissions of black carbon (BC) and primary organic aerosol (POA) and SOA formation were higher at -7 °C.

The flex-fuel unregulated emissions, mainly composed of ethanol and acetaldehyde, resulted in very high ozone formation potential and SOA, especially at low temperature (860 mg O_3 km^{-1} and up to 38 mg C kg^{-1}). After an OH exposure of 10×10^6 cm^{-3} h, SOA mass was, on average, 3 times larger than total primary particle mass emissions (BC + POA) with a high O:C ratio (up to 0.7 and 0.5 at 22 and -7 °C, respectively) typical of highly oxidized mixtures. Furthermore, high resolution organic mass