



Secondary organic aerosol formation from road vehicle emissions

Simone M. Pieber (1), Stephen M. Platt (1), Imad El Haddad (1), Alessandro A. Zardini (2), Ricardo Suarez-Bertoa (2), Jay G. Slowik (1), Ru-Jin Huang (1), Stig Hellebust (3), Brice Temime-Roussel (3), Nicolas Marchand (3), Luca Drinovec (4), Grisa Mocnik (4), Urs Baltensperger (1), Covadogna Astorga (2), and André S. H. Prévôt (1)

(1) Laboratory of Atmospheric Chemistry, Paul Scherrer Institute, Villigen, CH-5232, Switzerland, (2) Institute for Energy and Transport, EC Joint Research Centre, Ispra, I-21027, (3) Laboratoire Chimie Environment, Aix Marseille Université, Marseille, F-13 331, France, (4) Aerosol d.o.o., SI-1000 Ljubljana, Slovenia

Organic aerosol particles (OA) are a major fraction of the submicron particulate matter. OA consists of directly emitted primary (POA) and secondary OA (SOA). SOA is formed in-situ in the atmosphere via the reaction of volatile organic precursors. The partitioning of SOA species depends not only on the exposure to oxidants, but for instance also on temperature, relative humidity (RH), and the absorptive mass chemical composition (presence of inorganics) and concentration.

Vehicle exhaust is a known source of POA and likely contributes to SOA formation in urban areas [1;2]. This has recently been estimated by (i) analyzing ambient data from urban areas combined with fuel consumption data [3], (ii) by examining the chemical composition of raw fuels [4], or (iii) smog chamber studies [5, 6]. Contradictory and thus somewhat controversial results in the relative quantity of SOA from diesel vs. gasoline vehicle exhaust were observed.

In order to elucidate the impact of variable ambient conditions on the potential SOA formation of vehicle exhaust, and its relation to the emitted gas phase species, we studied SOA formed from the exhaust of passenger cars and trucks as a function of fuel and engine type (gasoline, diesel) at different temperatures (T 22 vs. -7°C) and RH (40 vs. 90%), as well as with different levels of inorganic salt concentrations. The exhaust was sampled at the tailpipe during regulatory driving cycles on chassis dynamometers, diluted (200 – 400x) and introduced into the PSI mobile smog chamber [6], where the emissions were subjected to simulated atmospheric ageing. Particle phase instruments (HR-ToF-AMS, aethalometers, CPC, SMPS) and gas phase instruments (PTR-TOF-MS, CO, CO₂, CH₄, THC, NH₃ and other gases) were used online during the experiments.

We found that gasoline emissions, because of cold starts, were generally larger than diesel, especially during cold temperatures driving cycles. Gasoline vehicles also showed the highest SOA formation. Furthermore, we observed that vehicle emissions and SOA are significantly affected by temperature and RH: doubling the RH in the chamber resulted in significantly increased SOA formation. Primary emissions and secondary aerosol formation from diesel and gasoline vehicles will be compared at different temperature and RH. Also the interaction and influence of inorganics on organics will be discussed.

References: [1] Robinson, A.L., et al. (2007) *Science* 315, 1259. [2] Weitkamp, E.A., et al. (2007) *Environ. Sci. Technol.* 41, 6969. [3] Bahreini, R., et al. (2012) *Geophys. Res. Lett.* 39, L06805. [4] Gentner, D.R. et al. (2012) *PNAS* 109, 18318. [5] Gordon, T.D. et al. (2013) *Atmos. Chem. Phys. Discuss* 13, 23173. [6] Platt, S.M., et al. (2013) *Atmos. Chem. Phys. Discuss.* 12, 28343.