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Sources of SOA gaseous precursors in contrasted urban environments: a focus on mono-aromatic compounds and intermediate volatility compounds

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Among Volatile Organic Compounds (VOC), the mono-aromatic compounds so-called BTEX (Benzene, Toluene, Ethylbenzene, and Xylenes) and the intermediate volatility organic compounds (IVOC) with C>12 are two remarkable chemical families having high impact on health, as well as on the production of secondary pollutants like secondary organic aerosols (SOA) and ozone. However, the nature and relative importance of their sources and, consequently, their impact on SOA formation at urban scale is still under debate.

On the one hand, BTEX observations in urban areas of northern mid-latitudes do not reconcile with emission inventories; the latter pointing to solvent use as the dominant source compared to traffic. Moreover, a recent study by Borbon et al. (2013) has shown an enrichment in the C7-C9 aromatic fraction in Paris atmosphere by a factor of 3 compared to other cities. Causes would be: (i) differences in gasoline composition, (ii) differences in vehicle fleet composition, and (iii) differences in solvent use related sources. On the other hand, many smog chamber studies have highlighted IVOCs as important SOA precursors over the last decade but their origin and importance in urban areas relative to other precursors like BTEX is still poorly addressed.

Here we combined large VOC datasets to investigate sources of BTEX and IVOC in contrasted urban areas by source-receptor approaches and laboratory experiments. Ambient data include multi-site speciated ambient measurements of C2 to C17 VOCs (traffic, urban background, and tunnel) from air quality networks (ie. AIRPARIF in Paris) and intensive field campaigns (MEGAPOLI-Paris, TRANSEMED in Beirut and Istanbul, PHOTOPAQ in Brussels).

Preliminary results for Paris suggest that traffic dominates BTEX concentrations while traffic and domestic heating for IVOC (>70%). In parallel, the detailed composition of the fuel liquid phase was determined at the laboratory for typical fuels distributed in Ile de France region (diesel, SP95, SP95 E10, and SP98) and was used to constraint evaporative emissions in order to predict the headspace vapour composition (Harley and Coulter-Burke, 2000). Modelled and observed compositions are in good agreement (differences up to 20%). Therefore, the implemented model is a relevant tool to test the sensitivity of BTEX and other VOCs ambient composition to evaporative emissions of fuels with regards to their composition. Such analysis will be extended to other target cities and similarities/differences will be presented regarding regional characteristics.

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