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Particle emissions of a Megacity (Paris, France): Results from the MEGAPOLI 2009 summer campaign

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Currently more than half of the world's population is living in a city, and this fraction is continuously growing. Today, 20 cities worldwide qualify as so called Megacities, having more than 10 million inhabitants. The growing number of inhabitants is not only accompanied by logistical problems. Governments also struggle with the adverse health effects on the population caused by the growing (and sometimes, unregulated) emissions within these cities, indicating the need for an investigation of the larger scale impacts of the Megacity emissions.

To evaluate the influence of Megacities on local and regional air quality, two large field campaigns within the framework of the MEGAPOLI project (**M**egacities: **E**missions, urban, regional and **G**lobal **A**tmospheric **POL**lution and climate effects, and **I**ntegrated tools for assessment and mitigation) were carried out in Paris in summer 2009 and winter 2010, each with a measurement period of one month. Here we focus on results of the MEGAPOLI summer campaign, which took place in July 2009. In addition to ground- and aircraft-based mobile measurements, also three stationary sites were installed, monitoring an extensive set of particle and gas phase parameters. Here we report on selected results from these stationary measurements, with a focus on the chemistry of the submicron particle phase as measured by aerosol mass spectrometry.

The locations of the three sites were chosen according to the dominant wind direction during summertime: one site was located in the South-Western suburbia (mostly upwind of Paris), one site was located in the centre of Paris, and one in the North-Eastern suburbia (mostly downwind of Paris). This work focuses on the results of the downwind site, with comparisons to the city- and the upwind site. Different approaches defining the arrival of the emission plume downwind of the city are investigated. The chemical composition, as well as basic physical parameters of the particles within the plume are compared to those values for non-plume events.

Our results indicate that the emission plume of the Paris Metropolitan Area is not the major contributor to the local submicron aerosol mass measured at the suburbia downwind site, but that local emissions (mainly traffic) and long range transport may play a larger role on local air quality. During the MEGAPOLI summer campaign, aerosol mass concentrations in the submicron range were on average very low. Average mass concentrations of submicron, non-refractory aerosol particles were about 5 μg m^{-3}; minimum mass concentrations measured were in the order of only 0.5 μg m^{-3}. Only for very short local events mass concentrations increased to high values, with a maximum mass concentration of up to 330 μg m^{-3} caused by nearby fireworks in the night to July 14. Furthermore, when comparing cases with air masses from different wind directions, the influence of the Paris plume on local air quality in the North-Eastern suburbia does not seem to be very significant. The aerosol mass concentrations during time intervals when the air masses arrived from the city of Paris were lower than 4 μg m^{-3}. In contrast, in cases of North-Eastern wind direction, aerosol mass concentrations were at about 10 μg m^{-3}. At these comparatively high concentrations, the aerosol mass was dominated by very aged organic aerosol particles. No specific major local particle sources were identified in the North-Eastern wind direction, indicating that long range transport, possibly from industrialized regions in Belgium and the Netherlands, are a likely source of these particles.