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Airborne study of photo-oxidant chemistry in Paris plume during MEGAPOLI summer campaign

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Megacities are often characterised by the presence of large emissions of pollutants. Many of these primary compounds are directly toxic to humans, but they can also react in the atmosphere leading to secondary pollutants such as ozone. This latter plays a central role in tropospheric chemistry since it is both a product and an initiator of photochemistry.

Within the FP7 MEGAPOLI project, an intensive field campaign has been conducted in the Greater Paris region during July 2009. One objective of this campaign was to document the oxidant build-up in the plume in order to characterise the photochemical processing of Paris emissions. To reach this goal, high time resolution gaseous measurements were performed into the French research aircraft ATR-42, operated by SAFIRE. 11 flights were designed to study urban plume up to a 200 km distance from the Paris center: several flight legs perpendicular to the wind direction and at increasing distances were performed and gave along and cross plume pollutants gradient in and around the city plume. On board, the instrument MONA was deployed to measure NO, NO2 and NOY. Simultaneously VOCs measurements were performed using a PTR-MS. CO and O3 concentrations were respectively determined by IR and UV absorptions (Thermo Electron).

A specific tracer method was applied to study photo-oxidant build-up as a function of pollution load and photochemical age of air masses. Thus, the plume versus background enhancement of Oxidants (Ox =O3+ NO2) was used as a tracer of this build-up. It was normalised to total pollution load and plume dilution by calculating the quantity Δ[Ox]/Δ[CO]. The increase of this value was related to the photochemical age, which corresponds to cumulative OH exposure of the observed air mass, by using various photochemical clocks. The variability of this term during flights and at different distances from the town center will be presented and discussed. Preliminary results seem to indicate no systematic variability of this ratio within flights, providing valuable information on the integrated VOC reactivity during the first day of plume transport. Experimental results will be compared to model results with the 3D CHIMERE model.