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Measurement of fossil fuel carbon dioxide and other anthropogenic trace gases from MEGAPOLI intensive campaign in Paris during winter 2010.

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The Paris agglomeration is the third biggest megacity in Europe (12 million inhabitants) and according to national emission inventories, is responsible for 15 % of the French anthropogenic CO_2 emissions mainly originating from road transport, and residential and industrial energy consumption. The objective of our feasibility study was to design an efficient monitoring strategy in order to quantify future trends in anthropogenic CO_2 emission in Paris area. During the winter campaign of the European project MEGAPOLI and the French project CO_2-MEGAPARIS, we performed measurements of CO_2 and related trace gases from January to February 2010. The RAMCES (Atmospheric Network for Greenhouse Gases Monitoring) team at LSCE monitored CO_2 and CO mixing ratio with high temporal resolution using instruments based on Cavity Ring Down Spectroscopy (CRDS) in the thirteenth arrondissement of Paris (south). We also sampled air in more than fifty flasks covering three full days at the same place. Flask were analysed in the RAMCES central laboratory with a Gas Chromatograph system for CO_2, CO, CH_4, N_2O, SF_6 and H_2 mixing ratios and also by Mass Spectroscopy for CO_2 isotopic ratios (δ^{13}C and δ^{18}O). In order to quantify the fossil fuel CO_2 (CO_2ff) most flasks were analysed at INSTAAR for Δ^{14}C in CO_2. In addition, $^{13}CO_2$ isotopic ratio and total CO_2 concentration were measured at high temporal resolution ($<$ 1 min) over three days at Paris with the SIMCO instrument developed at LPMAA. In parallel with the Paris measurements, in-situ CO_2, CO and other trace gases were monitored at Gif-sur-Yvette, a semi urban station 20km south west of Paris and also at the Trainou tower, 100 km south of Paris. Similar synoptic variations of $CO_2$and CO mixing ratios were found in Paris and Gif with maximum mixing ratio up to 495 ppm CO_2 and 1000 ppb CO downtown Paris. The mean diurnal variation during this winter period shows a peak to peak amplitude of 15 ppm CO_2 and 150 ppb CO at Paris and 10 ppm CO_2 and 40 CO ppb at Gif station. Using the MEGAPOLI database we will test different tracers (CO, VOCs, NO_x) as possible candidate to quantify CO_2ff (fossil fuel) based on calibration of these tracers against CO_2ff estimates based on D^{14}C. These results from the campaign will be compared to the emission inventories from EDGAR 4.2 (global inventories) and the national ones from CITEPA and AirParif.