Quantifying Paris CO_2 urban dome: a first synthesis of results from the CO_2-Megaparis project (2009-2013)

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About 80% of global CO_2 emissions come from punctual sources such as megacities. Among those, Paris is the third megacity in Europe. However, the estimates of urban CO_2 emissions are based on activity proxies and benchmarked emission factors, leading to uncertainties as high as several tenths of percents in some sectors of bottom-up CO_2 emissions inventories. Since 2009, the CO_2-Megaparis project aims to quantify CO_2 emissions from Paris using a top-down approach based on a synergy between atmospheric observations and modeling. A mini-network of 3 stations was developed by LSCE in Paris agglomeration within the infrastructure of the air quality monitoring agency of Paris region, AIRPARIF, completing 2 other stations from the ICOS network leaded at LSCE. The mean CO_2 concentration dome over Paris in the mid-afternoon over 1 year of data is about 2.2 ppm, and is strongly wind speed and direction dependent. Analysis of correlations between CO_2, CO and 14C02 was carried out and a comparison to available inventories will be presented. Direct modeling of CO_2 at a very fine resolution (2x2 km2, 1h) was performed by CNRM and matched well with observations. Results from inverse modeling will be presented. Furthermore, we conducted a campaign using lidar facilities showing that due to the effect of the urban heat island, the boundary layer height (a key parameter in assessing CO_2 fluxes from the atmospheric approach) is 10 to 40% time higher in Paris than in surrounding rural areas. Also, a sonic anemometer and a 10 Hz CO_2 analyzer were deployed to assess CO_2 fluxes from observations, as well as CO_2 flux analyzers on crops. Using the data from this instrumentation, a mass balance calculation was carried out and allowed the identification and quantification of Paris CO_2 traffic plume to a rural region, about 100 km south of Paris, that matched well with inventories. Finally, an attempt of defining the strengths and weaknesses of the atmospheric approach to quantify urban CO_2 emissions will be presented.