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On the spatial representativeness of NOX and PM10 monitoring sites in Paris, France

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Currently ambient pollutant concentrations are routinely measured by local dedicated networks in Paris, France [https://www.airparif.asso.fr]. These networks, however dense, have a limited spatial representativeness around the monitor site and are not capable to represent the strong horizontal gradients of pollutant concentrations over the urban area. Specific features of the urban landscape, such as topography, land-use, building heights, traffic emissions, act on specific atmospheric processes such as turbulent mixing and pollutant dispersion leading to a high spatial and temporal variability of pollutant concentrations.

On the other hand, high resolution models, such as ARIACity [http://www.aria.fr/aria_city.php], simulate 3D pollution concentration fields at a spatial resolution of a few meters over the urban area. They take into account the advection from various sources, integrate buildings as obstacle to the wind flow by generating vortexes downwind and upwind their location, calculate moist and dry deposition, but do not deal with chemical reactivity. They provide a spatial variability with in the urban environment but are subjected to important uncertainties due to the limited knowledge of emissions and weather conditions.

In the same line of thought as mentioned by the European Commission (Vitali et al., 2016; EC 2011) and discussed in (Vitali et al., 2016; Piersanti et al., 2015; Martin et al., 2014; Santiago et al., 2013; Bobbia et al., 2008) we developed a novel technique that combines AIRPARIF surface measurements and the first layer of ARIACity model simulations to provide an improved description of pollutant concentration spatial gradients over the urban area. Based on specific criteria we define the area of representativeness of the AIRPARIF monitor sites within the city. The selected criteria are (1) a high level of the square correlation coefficient (R2), (2) a low amount of the normalized root mean square error (NRMSE) and (3) simulated concentrations above a threshold with respect to the value at the monitor location. As point of reference to evaluate these criteria we use the simulated concentration at the grid-cell containing the monitor-site (“pseudo-measurement”). Thus, we ensure that the resulting representativeness area is consistent with the pollutant dispersion pattern: criteria thresholds are selected using a sensitivity analysis, and they are applied to compute the area of representativeness of the monitoring sites over a 10-days hourly simulation. The next step consists of spreading the true monitoring station measurements on the obtained representative area using a bayesian approach.