Spatialization of urban airborne particulate matter pollution using magnetic properties of tree bark

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The main sources for urban air pollution are anthropogenic processes, notably particular matter (PM) emissions by heavy traffic and industry. Traditional air pollution/quality monitoring techniques include automatic sampling stations and biomonitoring, followed by chemical analyses. However, as the need increases for spatially detailed data on air pollution dispersion, particle composition, and grain size, the number of monitoring stations as well as the costs for the analyses often becomes a limiting factor. Magnetic methods have proven their efficiency in tracking air and soil contamination both in urban and industrialized zones. They present the advantage of being sensitive, easy to operate, and cost-effective. Recent studies demonstrated that the magnetic properties of tree leaves reliably delineate the distribution and dispersal patterns of anthropogenic airborne PM in urban environments. For this study, we collected plane tree bark in Paris and Toulouse, two French cities with a population of 2 million and 500000, respectively. Both cities are known for their heavy traffic. Magnetic property analyses were performed on ∼400 bark samples. The results suggest that the magnetic PM collected on tree barks consist of a mixture of particle resulting from fuel combustion residuals and the abrasion of disk brakes. High resolution maps of frequency-dependent and mass specific magnetic susceptibility were compiled. Determining factors, such as speed limits, traffic lights, crossings, distance between the tree and the traffic lane influence the concentration and grain size distribution of the magnetic particles detected. The most obvious observation is the contribution of fine magnetic particles to the overall magnetic assemblage that directly correlates to the traffic density on the adjacent road. Our study also points out that the concentration of ultra-fine superparamagnetic particles is higher in plane tree bark situated just behind traffic lights.