Publication

Sources and variability of inhalable road dust particles in three European cities

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Author(s) Amato, F.; Pandolfi, M.; Moreno, T.; Furger, M.; Pey, J.; Alastuey, A.; Bukowiecki, N.; Prevot, A. S. H.; Baltensperger, U.; Querol, X.
Author(s) at UniBasel Bukowiecki, Nicolas ;
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Despite their importance, current scientific knowledge on non-exhaust emissions by road traffic is scarce, severely hampering a reliable description of these particles in atmospheric dispersion models. Consequently, it is still very difficult to convincingly evaluate population exposure to traffic-related components in large cities, especially given the significant variation in traffic-related air pollution concentrations on a small scale (e.g. within 100-1000 m of a busy road). One factor contributing to this uncertainty is the lack of a reliable emission estimate for vehicular non-exhaust emissions. Emissions vary from location to location due to the impact of climate, road surface characteristics and traffic conditions, but the geographical coverage for which Emission Factors are available and the amount of knowledge regarding the variability within a city environment are very limited.The present study investigates the spatial and chemical properties of the strength of the emission source (road dust particles below 10 mu m) in three contrasting European urban environments: two Spanish cities (Barcelona and Girona), and a Swiss city (Zurich). Loadings of road dust <10 mu m from the 8 sites sampled in Zurich ranged from 0.2 to 1.3 mg m(-2), the lowest loadings of the study. The minimum loadings in Girona (Spain) were as high as the maximum in Zurich, with a range of 1.3-7.1 mg m(-2). By far the most polluted site in terms of road dust <10 mu m mass loading is Barcelona (Spain), where a range of 3.7-23.1 mg m(-2) was recorded in the city center samples. Four main sources were found to drive the variability of road dust particles <10 mu m: Mineral (road wear and urban dust generated mostly by construction emissions), Motor Exhaust, Brake wear and Tire wear. Road wear/Mineral is the dominating source in Spanish cities (similar to 60%), but represents only 30% of road dust loadings in Zurich where contributions are more equally distributed among the four main sources of road dust. Regardless of the city categories loadings of OC, EC, Fe, Cr, Mn, Cu, Zn, Mo, Sn, Sb, Cs, Ba, W, Pb and Bi (mu g m(-2)) increase by a factor of 1.2-2.2, from streets with <15 kveh to streets with 15-40 kveh day(-1). At highly trafficked sites (>40 kveh day(-1)) loadings were again increasing by a further factor of 2.6-10.1. Finally, agreement was found between the composition of sampled materials and the composition (available from literature) of PM10 material emitted by vehicles via resuspension (both in Zurich and Barcelona). This permitted to find a relationship, potentially able to calculate emission factors from known amount of deposited pollutants in those cities/environment where no real-world EFs are available from literature.

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