Characterization of fine particles in the near-field of a metallurgy plant: Overview of the NANO-INDUS project

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Industrial areas can be a significant source of particulate pollution and companies are therefore required to measure the particle concentration emitted from stacks. However, the physico-chemical properties of the particles leaving an industrial area are often poorly characterized and there is little information on the evolution of the plume between the source and the surrounding areas. Moreover, air quality monitoring stations are usually located away from industrial areas, because they are not considered as representative. The aim of the NANO-INDUS project was to study the evolution of the physico-chemical properties of industrial fine particles over a short-range distance, before they reach surrounding urban areas. First, measurements were performed directly at the stacks of a plant manufacturing iron-manganese alloy near Dunkirk, France. Then, an intensive field campaign was undertaken at a site located close (<1 km) to the stacks (Figure 1).

Preliminary results obtained during the intensive field campaign are presented here. The concentration of non-refractory submicron particles (NR-PM_1) was 10.2 $\mu g \cdot m^{-3}$ on average during this study. Particles were dominated by inorganic species (67% of the total mass), with organics accounting for 33%. The concentrations of several metallic species (Fe, Mn, V, Cu) were higher than those typically observed at urban environments, and their presence is likely related to industrial activities. However, the concentration and chemical composition of fine particles were subject to dynamic variations, even during periods with constant wind direction. This observation could be due to atmospheric turbulence or to variable emission rates from the plant. The organic fraction was highly oxidized (average O/C ratio = 0.52), which was not expected for this kind of site influenced by industrial and urban emissions. Thus, the sampling site might also be influenced by long-range transport of particles and precursor volatile organic compounds (VOCs), leading to secondary organic aerosol (SOA) formation. The comparison between different air masses shows significant differences in terms of particle concentration, chemical composition and size distribution. Under air masses coming from the industrial area, the particle and gas (CO, CO_2, NO_x, SO_2) concentrations were much higher than during periods dominated by urban or marine emissions. Moreover, the mass size distribution was dominated by submicron particles during periods subject to industrial emissions.

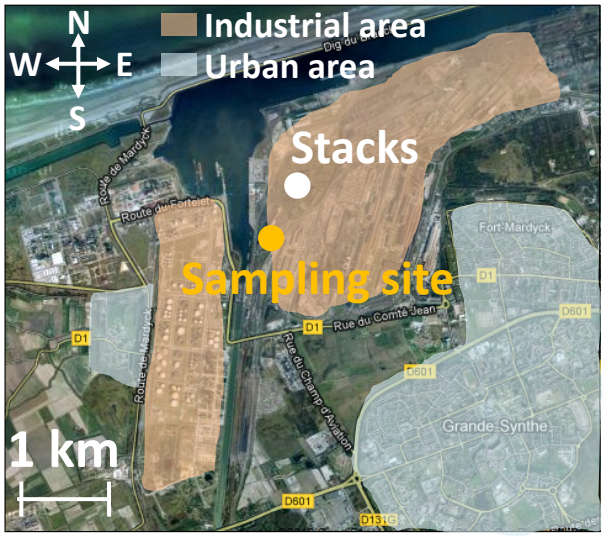

Figure 1. Map of the industrial area of Dunkirk, with the locations of the sampling site and the stacks of the metallurgy plant

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