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Industrial dust deposition in Gravelines (Northern France): first investigations on trace metal contamination of urban soils

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Through the discharge of pollutants, urbanization and industrial activities impact all the compartments of the environment and the ecosystems. Consequently, metal pollution of soils and atmosphere has become a significant problem in urban areas.

In the Dunkirk agglomeration (Northern France), the construction of a large seaport during the 20th century was accompanied by the installation of several metallurgical industries. Dust emissions resulting from their production and storage activities are mainly composed of atmospheric particles of soot, aluminosilicates, silica, calcium or iron. These industrial particles can be associated with specific minor and trace elements : Cr, Cu, K, Mg, Mn, Na, Pb, Ti, Zn or Cl. The composition and the size of the particles determine their fate after emission and influence their toxicity.

This study focuses on sedimentable particles (>20 µm) that cannot penetrate deeply into the respiratory system but can be ingested, especially by children. Due to its location (1 to 2 km South-West of major industries), the city of Gravelines is particularly exposed to dust deposition during North-East windy and dry events.

Among the studies conducted on particles emitted in the Dunkirk area, none was focused on soil matrices. Therefore, the question of the long-term fate of their deposition remains open : what is the influence of these dusts on the chemical quality of the soils of Gravelines ? Which areas of the city of Gravelines are the most affected by metal contamination (potentially associated with dust) ?

Pedological and chemical parameters of topsoils (the first 5 cm) sampled in the city of Gravelines were, first, characterized with the aim to interpret their reactivity to metal inputs. Then, the trace metal concentrations of topsoils and collected dust samples were determined by inductively coupled plasma-mass spectrometry (ICP-MS) to (1) map the areas contaminated by trace metals, (2) assess the levels of environmental pollution, (3) quantitatively characterize the metals associated with dust fallout, and (4) highlight the specific influence of industrial dusts on the potential soil contamination in Gravelines.

The first results on the metal contents measured in the topsoil samples of Gravelines rather reflect

a diffuse metallic contamination. The study of the entire topsoil samples may be questioned because of the dilution of the "dust" signal by the soil matrix. The relative youth of the large seaport of Dunkirk (between 30 and 40 years old), as well as the probable re-mobilization of dust by the winds, may partly explain the moderate contamination measured in soils of Gravelines. However, our results show higher levels of contamination (for some specific metals) and a significant Pollution Load Index (PLI) in the soils located near dust emission sources. Moreover, the combined mapping of metal contents and soil parameters allows the identification of possible differences in metal behavior depending on the nature of the matrix considered. This latter aspect will be discussed in particular according to the use of soils and vegetation (e.g. proximity of the vegetable gardens), in order to highlight areas requiring special attention from an ecotoxicological point of view.