



## Heavy–metals concentration in surface soils of Italian industrialized urban areas

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Many areas of the Italian landscape host settlements with long history of industrial production. These settlements are very different both for the geomorphological context (valley, floodplain and coastal area), for the production processes and for the proximity to urban areas. Therefore they have very different impacts on the surrounding populations.

Aiming at contributing to quantify the exposure to environmental heavy–metals pollution, also in view of assessing manganese and lead neurotoxicity in resident population, and especially in children and elderly people, we investigated the spatial distribution of the surface–soil metal content in three intensively industrialized areas (the town of Bagnolo Mella and the Oglio river valley, namely Valle Camonica, in Northern Italy, and the city of Taranto in Southern Italy), in comparison with data collected around Lake Garda (Northern Italy) considered as background for the little industrial activity.

Bagnolo Mella (85 m a.s.l.) is located in the Po river floodplain and it is characterized by sublitoranean Alpine climate. It hosts two industrial settlements at the Southern edge of the urban centre: a ferro–manganese alloy industry, active from 1974 to 2015, and a steel–producing one, active since 1962. Valle Camonica is a glacial valley in the central range of the Southern Italian Alps, with a transition climate between the sublitoranean Alpine and continental one. The valley, during its long–lasting industrial history, hosted three ferro–manganese alloy industries which operated in the municipalities of Breno (343 m a.s.l., from 1921 to 2001), Sellero (476 m a.s.l., from 1970 to 1985) and Darfo (220 m a.s.l., from 1910 to 1995). Taranto (10 m a.s.l.) is a Ionian Sea coastal city, characterised by Mediterranean climate with continental features. The city hosts one of the largest industrial sites in Europe, with steel and iron foundries, oil refineries, chemical works, army shipyards and cement– and food–processing factories, and for this reason it is listed as one of the Italian National Priority Contaminated Sites.

By means of an extensive field campaign, conducted also in the framework of previous research projects, the total content of many metals (among which Mn, Fe, Ni, Cu, Zn, As and Pb) was measured with a portable X–Ray Fluorescence device (pXRF) at the soil surface. Data were collected in 253 sites in Valle Camonica, 260 sites in Bagnolo Mella, 3463 sites in Taranto and 145 ones in the background area of Lake Garda. Statistical and spatial analyses were performed on all the obtained data, in order to evaluate and compare their distribution, to investigate the presence of spatial patterns and to identify pollution clusters. At this purpose we used Moran's *I* spatial autocorrelation indicator, both in its global and local form. Data were processed both in their raw form and after applying a number of transformation techniques proposed in the literature, i.e. the logarithmic transformation, a Box–Cox transformation (Box & Cox, 1964) and the centered logratio transformation proposed by Aitchison (1986).

Results allowed to identify (pseudo–)statistically significant surface–soil pollution clusters in the areas of Bagnolo Mella, Valle Camonica and Taranto. The hotspot regions vary in position and dimension depending on the considered pollutant.