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Integrating methods to discriminate the soil historical pollution sources and assess the degree of contamination and related health risks in an urban environment: the Commune of Santiago (Chile) case study.

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The Commune of Santiago is an administrative unit belonging to Chile's capital city. It is the central hub for local transportation services and the centre of most national government functions. In 2017, a geochemical survey was carried out focusing on the topsoils of the commune. A total of 121 samples were homogeneously collected across an area of 22.4 sqkm to determine the spatial distribution of potentially toxic elements (PTE) and discover their primary and secondary sources. In the aim of the work, the assessment of human health risk for the local population was also included considering both the direct contact with soils and the breathing of airborne particles as relevant exposure pathways.

The geochemical baseline maps of 15 PTEs were generated using the Multifractal IDW (MIDW) interpolation, and map intervals were determined using a Concentration-Area plot considering the fractal structure of the geochemical data.

The contamination degree of the urban soil and its pattern was also calculated and mapped after developing a new index, named as Cumulative Contamination Degree (CCD), which integrate information about the severity of contamination and its spatial complexity.

A robust multivariate statistical analysis based on Principal Components (RPCA) was carried out considering the compositional nature of the geochemical data. In addition, to highlight the presence and the geochemical patterns depending on different contamination sources, a Sequential Binary Partition (SBP) was used to generate contrasts among those elements considered as proxies of specific processes (Urban traffic, productive settlements, etc.).

A probabilistic approach was chosen to assess the risk due to exposure to soils for the local population. It was based on Monte Carlo simulation to include uncertainty due to spatial variation of data and the relative mobility of people within the borders of the study area.

The results obtained show that the innovation proposed to assess contamination and discriminate

its sources, even when they are of secondary relevance, can generate positive feedback. Using a probabilistic approach in a non-site specific framework can even be considered a more reliable method to assess risks if we want to not underestimate the burden of uncertainty that substantially influences the results.