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Spatial patterns of heavy metal contamination by urbanization

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Source identification is an important step towards predictive models of urban heavy metal (HM) contamination. This study assesses the spatial distribution of enrichment of eight HMs (As, Cd, Cr, Cu, Hg, Ni, Pb and Zn) in the city of Ghent (156.18 km^2; Belgium). A database with HM concentrations measured in the topsoil at 2138 point observations was collected from the Public Waste Agency of Flanders. The degree of anthropogenic HM enrichment was quantified using an urban pollution index (PI). Enrichment of HMs showed high variations throughout the study area due to manifold anthropogenic sources. Topsoil in Ghent was especially enriched with Cu, Ni, Pb and Zn, with median PI's of 1.91, 1.74, 2.12 and 2.02 respectively. Contrastingly, As, Cd, Hg, Cr generally did not exceed expected background concentrations, with median PI values < 1. Stratification of the PI based on land use (agriculture, park and recreation, residential zones, harbor and industry) generally revealed high enrichment of Cu, Ni, Pb and Zn in residential areas linked to housing and traffic, but proved unsatisfactory to capture major trends in urban spatial HM distributions. Moreover, an important control of industrial and traffic emissions is suggested for Ni, Cu, Pb and Zn. Industrial non-airborne point source contaminations were mainly historical, rather than linked to current industrial activities. Results indicated that urban-rural gradients or current land use stratification approaches are inadequate to predict spatial HM distributions in cities with a long history of industrialization.