Spatial distributions of heavy metal concentrations in surface soils of Quezon City, Philippines using geospatial information and regression models

Abstract

Heavy metal pollution is a ubiquitous but largely unmonitored environmental problem especially in urban areas where a growing majority of the human population resides. In a precedent soil survey, heavy metal concentrations (i.e., Cr, Zn, Cu, Ni, Pb) in soils from various urban and peri-urban areas (i.e., watershed, landfill, residential, commercial, urban parks) in Quezon City, Philippines exceed critical thresholds, thereby posing potential risks to surrounding communities and ecosystems (Navarette et al. 2017). In the advent of Geographical Information Systems (GIS), digital soil mapping (DSM) is useful for generating continuous information on soil spatial variability using statistical models, geospatial software, and available environmental datasets. The study explores the predictive performance of multiple linear regression and partial least squares regression in estimating heavy metal concentrations (e.g., Cr, Ni, Zn, Cu, and Pb) in surface soils of Quezon City, and elucidates on the important urban-environmental factors that could influence the spatial distributions of heavy metals in urban soils. Maps are generated with the most suitable models and predictors to locate areas that could have highly polluted soils. This approach in DSM complements point soil survey by considering landscape environmental attributes – including terrain, soil type and parent material, landcover, population size, number of industries, distance to roads and waterways, distance to transportation terminals, solid waste, and management decisions like land-use zoning – to better understand how soil differentiation and environmental risks across the urban land gradient are mediated by human and natural factors especially in increasingly human-dominated systems.