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Local Thinking for Geochemical Data Analysis

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The European Union Commission adopted the EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil' and the Soil Strategy for 2030, aiming to reduce pollution to levels no longer harmful to health and natural ecosystems by 2050. Soil pollution is widely recognized as a severe hazard to both human and soil health. However, due to spatial heterogeneity, identifying the precise sources and status of soil pollution remains challenging, complicating the implementation of the action plan.

With the rapid development of soil databases at regional, national, and international scales, there are now opportunities to analyse data at the local level. This study explores two concepts to promote local thinking: 1) local descriptive statistics and 2) local correlation coefficients. Descriptive statistics are often used to reveal the overall features of environmental data, while correlation analysis is widely used to uncover relationships between two variables. These analyses can be performed locally using moving windows. Geochemical databases from Europe, London in the UK, and Galway in Ireland were used to demonstrate these concepts. The local coefficient of variation effectively reveals spatial variation in metal concentrations in Northern Ireland soils, linked to geological factors. The local correlation coefficient identifies hidden spatial relationships between soil organic carbon (SOC) and elevation in Ireland, SOC and pH in Europe, and lead (Pb) and aluminium (Al) in soils of London and Ireland. These findings suggest that geochemical modelling should be conducted at the local level, incorporating the concept of spatially varying modelling.

In the era of big data, local thinking with these techniques plays a crucial role in uncovering patterns and special features hidden in environmental databases, providing essential decision support for assessing hazards from soil pollution.