



Heavy metals relationship in arable and greenhouse soils of SE Spain using a geostatistical analysis

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This study compares heavy metals contents and the main edaphic parameters in greenhouse soils from the W Almería region one of the most productive agricultural systems in Europe, with agricultural soils (arable soils) in western Andalusia, SW Spain. Heavy metals input in agricultural soils mainly occur through pesticides and phytosanitary control products. The hazardousness of the studied elements (Cr, Ni, Pb, Cu, Zn and Cd) is particularly relevant in soils used for intensive greenhouse farming where such agricultural practices, which centre on maximising production, end up with products that finally enter the human food chain directly. Here we explore a total of 199 greenhouse soils and 142 arable soils, representing two scales of variation in this Mediterranean area. Despite their similar edaphic characteristics, the main differences between arable soils and greenhouse soils lie in nutrients contents (P and K) and in certain heavy metals (Cd, Pb and Zn), which reflect widespread use of pesticides in greenhouse farming. One of the most toxic metals is Cd given its mobility, whose concentrations triple in greenhouse soils, although it does not exceed the limits set by Spanish legislation. We conclude that despite anthropic heavy metals input, the association patterns of these elements were similar on the two spatial variability scales. Cd, Pb and Zn contents, and partly those of Cu, are related with agricultural practices. On the short spatial scale, grouping these heavy metals shows very high contents in greenhouse soils in the central northern area of the W Almería region. On the other hand, the associations of Cr and Ni suggest a lithogenic influence combined with a pedogenic effect on spatial maps. This natural origin input becomes more marked on the long spatial scale (arable soils) where the main Cr and Ni contents are found in the vicinity of the Gádor Mountain Range.