Regionalisation of soil contaminant data in urban areas in the German Ore Mountains (Erzgebirge)

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The German Ore Mountains (Erzgebirge) is an area with a high population density, industrialization and a long history of mining industry. In this region, large areas are contaminated with heavy metals and arsenic, partly with uranium. Soil pollution was caused, on the one hand, by ore-bearing structures, on the other hand by the mining industry, which aggravated the situation considerably (processing plants, smelters, tailing dumps).

In urban areas, the influencing factors on the range of trace elements and the level of pollution are varying in a much smaller pattern than outside the towns. This is caused by the individual history and temporal aspects.

For many tasks of soil protection, information is needed on both spatial distribution and point-related information regarding contamination, e.g. for environmental friendly soil management and for risk evaluation to derivate measures for prevention of hazards, but also to manage changes in land use (e.g. to convert a park into a children´s playground).

Therefore, a complete spatial coverage has to be derived from point information since not all land parcels in urban areas can be sampled. For agricultural lands and forests, methods to generate complete datasets of contaminant contents were developed in North Rhine-Westphalia in the frame of so-called “Bodenbelastungskarten” (Maps of Soil Contamination) (Kerth et al. 2005).

In urban areas, the derivation of a complete data coverage is much more difficult due to differentiated distribution of the contaminants and of their determinating parameters. A number of approaches for urban areas was developed and presented by LANUV (2007), e.g. immission-based, substrate-based and spatial-analytic-approach.

This study provides a review of these approaches to calculate contaminations in two urban test areas (Annaberg and Marienberg) in the Erzgebirge area with both geogenic contamination and mining influence. Maps of contamination are the basis for many tasks. Therefore, the quality of complete spatial coverage must meet highest standards. The focus of this study is on validation of these methods with regard to confidence and assessment of required effort (e.g. density of sampling, additional field and laboratory parameters, workflow in GIS).

As one of the first results it turned out be useful to divide the study area spatially into sub-areas (so-called homogenous spatial units, HSU) classified by land use or different immission processes. These HSU alleviate the statistical and geostatistical data processing. Within the HSU, a continuous spatial change of the study parameters is postulated, whereas along their borders, leaps may occur. Various statistical and geo-statistical methods (e.g. Voronoi-Mosaik, ordinary and universal Kriging, inverse distance weighting, artificial neural networks) were used and evaluated regarding their effectiveness for interpolation of the point data.

References

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