Spatio-temporal stochastic modelling of alluvium soils contaminated by heavy metals

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Abstract

A significant industrial development, associated with a demographic expansion, occurred during the last decades of the XX century, in Loures valley, a region located in the vicinities of Lisbon, the capital city of Portugal. This was accompanied with an important modification of land use and occupation patterns, mainly the decrease of the agricultural land (Silva et al, 2008).

The input of heavy metals in soils of alluvium environment shows high variability in both space and time domains, hence the estimation of the measured elements (Co, Cr, Cu, Ni, V e Zn) should account for either dimension. Furthermore, it is also a non-stationary process, because spatial variability depends strongly on the distance to pollution sources and the amount of precipitation. The variability in time is dependent on the amount of rainfall recorded. Indeed it is a topographically flat area with altitude near zero causing thus a concentration of pollutants, not its leaching. Thus the soils pollution is more pronounced during the wet seasons than during the dry seasons.

The methodology presented herein deals with the application of kriging with external drift as an interpolation procedure (Wackernagel, H., 1995) for the measured heavy metals elements, in a generalised space-time domain. The definition of an auxiliary variable is based on the description of the processes involved (R.Figueira et al, 2000). Kriging with such an external drift yields better estimates of metals concentration at ground level than ordinary kriging does, and such an enhanced performance can be checked out from the cross-validation results as well as from an observation of the corresponding, estimated maps.