Remediation of contaminated soil using geostatistics

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Abstract

Many soil properties are lognormally distributed over a spatial domain of interest, $\mathcal{D}$, including contaminants caused by anthropogenic activity. Remediation of contaminated soil is often made at the block level, where the contaminant is averaged over prespecified spatial regions of $\mathcal{D}$ called blocks. During the period 1954-1963, devices composed of radioactive material were blown apart by chemical explosives at Area 13 of the Nevada Test Site. A consequence of the testing was the contamination of the immediately surrounding soil and vegetation with Americium (`Am`). The concentrations are clearly lognormally distributed, and ex-situ soil remediation requires prediction of average `Am` concentration, averaged over blocks. Recent developments in geostatistical methodology and computation make optimal lognormal block kriging appealing and tractable. In this article, we apply these to obtain an optimal spatial predictor of block-averaged `Am` contamination in soil at the Nevada Test Site. The dataset we analyze has multiple `Am` observations for certain spatial locations, for which we develop non-standard kriging equations that are often unavailable in kriging software. We also show how these multiple observations can be used to obtain an estimate of the measurement error.