

# Geostatistical deconvolution for 2D radiological characterizations

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In the nuclear industry, facility dismantling and decommissioning projects, as well as site remediation projects, are current challenging issues. Precise appraisal of contamination state is a prerequisite. Radiological evaluations have multiple objectives to be considered: determination of average activity levels, to allow the categorization of surfaces or volumes (sorted into different radioactive waste categories); identification of hot spots, i.e., small areas with high activity levels; and estimation of total activity (source term as an accumulation). Besides, there are other considerations according to radiation protection and logistic limitations.

The problem of deconvolution arises from a recurring problem around the input data: the values are not strictly punctual but associated with a measurement or sampling support. Indeed, any measurement results can be seen as the convolution of the point variable by a weighting function. The simplest case is that of the uniform distribution. It corresponds to the regularization of the variable over the length of the samples (mean value). A uniform distribution is compatible with destructive samples, but in situ irradiation measurements (dose rate or in-situ gamma spectrometry in particular) require a better understanding to improve the modeling of radiological contamination. The deconvolution of in situ measurements not only reconstructs the convoluted reality but also serves in optimizing the sampling strategy.

This paper illustrates the necessity of two-dimensional geostatistical deconvolution of radiation characterization on three application cases: (i) outdoor radiation mapping with GPS uncertainties, (ii) multiple-level characterization of contaminated concrete inside a building and (iii) characterization of high active sludges in a tank. Methodological implications are numerous and are addressed one by one: hot spot reduction, multivariate variant, non-linear geostatistics, limited dataset, etc.. At the end, sensitivity analysis is conducted on white noise, background level, weight function (linked with the detector response function and the spatial decrease of radiation levels), sampling density, and its pattern to quantify the impact of each parameter on the characterization results.