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基于Monte Carlo方法的污染场地风险评价及不确定性研究

Quantification of uncertainty in evaluating the health risk of a contaminated site based on Monte Carlo method

关键词: [污染场地](#) [风险评价](#) [不确定性](#) [Monte Carlo模拟](#)

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摘要: 风险评价结果的不确定性直接影响风险管理者的管理和决策,为定量研究污染场地评价过程的不确定性,在系统分析污染场地危害产生过程的基础上,构建了污染场地暴露过程评价的概念模型;提出用概率分布函数表征场地污染参数的不确定性,采用基于过程的污染物运移数值模拟模型以减小模型不确定性的影响,用Monte Carlo方法评估参数不确定性对暴露浓度不确定性的贡献,进而形成暴露点污染物浓度的概率分布函数.在此基础上,基于剂量-效应模型,分别采用暴露点浓度的5%、50%和95%置信区间上限值表示乐观情况下,正常情况下以及最不利情况下的暴露浓度,计算敏感人群的健康风险.研究选择国内西南地区某铬渣污染场地进行案例分析,结果表明,在最乐观情况下六价铬和总铬的非致癌危害商分别是8.98和1.02,正常情况下分别是30.57和2.72;最不利情况下分别是77.95和7.11.研究结果表明该方法能较好的表征各参数不确定性影响下的最终风险,为污染场地的修复和后续管理提供决策支持.

Abstract. Risk assessment is inherently associated with uncertainty, and ignoring the uncertainty will lead to difficulty in decision-making process for risk managers. To quantify the uncertainties and their influences on the health risk of a contaminated site, a conceptual model was built to evaluate the exposure process and the uncertainties. Probability density function was used to describe the parameter uncertainties, and Monte Carlo methods was used to propagate uncertainty from model input to model output to form the probability distribution of contaminants in wellbores. Based on the above results, the widely-used Dose-Effect model was used to calculate the value of human health risk. A Chromium-contaminated site in southwest China was taken as a case study. The results showed that in the optimal case, the hazard quotients of hexavalent chromium and total non-carcinogenic were 8.98 and 1.02, respectively. Under normal circumstances, the hazard quotients were 30.57 and 2.72, respectively, while under the most unfavorable conditions, the hazard quotients increased to 77.95 and 7.11, respectively. The results indicated that this method can be applied to evaluate the health risk and the impact of parameter uncertainties on risk, and can provide strong support for the risk managers' decision-making.

Key words: [contaminated site](#) [risk assessment](#) [uncertainties](#) [Monte Carlo simulation](#)

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