Lecture #3 – Joint use of geostatistics and deterministic models to integrate the dynamic characteristics of physical phenomena in environmental applications.

Geostatistics has been used over the last decades as a tool for pollutant characterization and uncertainty assessment in a wide range of environmental applications, like polluted soil sites, air quality, surface water and groundwater contamination, (geoENV conferences proceedings). Geostatistical models basically share an identical framework, i.e., assuming the variables of interest as spatial, or space-time, stationary random functions. Measures of uncertainty and mean behavior of those variables are determined through local or global conditional distribution functions (cdfs) by using estimation (indicator or multiGaussian kriging) or stochastic simulation algorithms. Cost functions and risk analysis are then derived from these local or global cdfs.

However, more complex phenomena cannot be satisfactorily represented with those common approaches, mostly when they present a determinant dynamic component that is hard to directly account for in geostatistical models as in, for example, the flow of contaminants at the surface, in different soil layers or in deep aquifers, or the dynamics of contaminant plumes in air in industrial or urban areas. Usually, in order to integrate the influence of such dynamic factors, deterministic dynamic simulators are used separately in inverse modeling approaches, such as in groundwater problems, to "calibrate" and update parameters that have been characterized by geostatistical techniques.

This presentation addresses some new proposals to approach such problems. The integration of main dynamic characteristics through hybrid models is presented. This presentation is guided by two real case studies: i) The main vectors of a fluid flow (given by a dynamic simulator), are used to characterize local anisotropy behavior of the phenomenon in the stochastic simulation of the main sediment pollutants in a coastal lagoon (Horta et al, 2010); ii) The results of a Gaussian plume simulation of air pollution emissions of an industrial area are downscaled with multi-scale simulation (Liu and Journel, 2008) by using local point data of monitoring stations and block data from the deterministic model (Pereira, et al., 2010). This algorithm shows to be a nice solution for mitigating the non-exact and coarse scale results of deterministic Gaussian plume simulations, which is a very common practice in air quality characterization.

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