

Content

Chapter 1.	Introduction	1
1.1.	Motivation and objectives	1
1.2.	Thesis organization	2
Chapter 2.	Spatial Variability of Hydraulic Conductivity and Solute Transport Parameters and their Spatial Correlations to Soil Properties.....	5
2.1.	Introduction	6
2.2.	Material and methods.....	9
2.2.1	Description of the study site	9
2.2.2	Soil sampling.....	10
2.2.3	Soil properties characterization	11
2.2.4	Column experiments	12
2.2.5	Transport parameter determination	13
2.2.6	Statistical analysis	14
2.2.7	Geostatistical analysis.....	15
2.3.	Results and discussion.....	17
2.3.1	Average soil properties.....	17
2.3.2	Soil properties statistical analysis.....	17
2.3.3	Statistical analysis of the transport parameters.....	18
2.3.4	Correlation among variables	20
2.3.5	Spatial correlation among variables	24
2.4.	Conclusions.....	27
Chapter 3.	Scale Effect on Hydraulic Conductivity and Solute Transport: Small and Large-Scale Laboratory and Field Experiments	43
3.1.	Introduction	44
3.2.	Materials and methods	46
3.2.1	Soil sampling and characterization.....	46

3.2.2	Large- and small-scale column experiments	47
3.2.3	Field experiments	48
3.3.	Results and discussion	52
3.3.1	Soil characterization	52
3.3.2	Evaluation of the scale dependence in the hydraulic conductivity ..	54
3.3.3	Evaluation of the scale dependence in the transport parameters ...	59
3.4.	Conclusions	66
Chapter 4.	Stochastic Analysis of Three-Dimensional Hydraulic Conductivity Upscaling in a Heterogeneous Tropical Soil	77
4.1.	Introduction	77
4.2.	Hydraulic conductivity upscaling methods	81
4.3.	Characterization of the spatial variability	84
4.4.	Simulation of the hydraulic conductivity random fields	86
4.5.	Groundwater flow numerical modeling at the fine scale.....	87
4.6.	Hydraulic conductivity upscaling	88
4.6.1	Flow equation at the coarse scale	89
4.6.2	Upscaling design	89
4.7.	Results and discussion	93
4.7.1	Reproduction of the flow at the coarse scale	93
4.7.2	Variation of the p-exponent with the block size.....	98
4.8.	Conclusions	106
Chapter 5.	Stochastic Upscaling of Hydrodynamic Dispersion and Retardation Factor in a Physically and Chemically Heterogeneous Tropical Soil	115
5.1.	Introduction	116
5.2.	Upscaled transport model.....	118
5.2.1	Hydrodynamic dispersion upscaling using ADE	119
5.2.2	Upscaling of the retardation factor	120
5.3.	Spatial variability.....	122
5.4.	Numerical simulations.....	124
5.4.1	Simulation of the random fields	124
5.4.2	Flow and transport solutions.....	126
5.5.	Upscaling of flow and transport parameters	128

5.6.	Results and Discussion	131
5.6.1	Hydrodynamic dispersion upscaling	131
5.6.2	Retardation factor upscaling	136
5.6.3	Uncertainty propagation	140
5.7.	Conclusions	143
Chapter 6.	Conclusions	151