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土壤优先流运动的活动流场模型分形特征参数计算

Determining the active region model parameter for modeling preferential flow in unsaturated soil

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中文关键词: 分形 溶质运移 土壤 优先流 活动流场模型 本构方程 染色示踪试验

英文关键词: fractal solute transport soils preferential flow active region model constitutive relation dye staining experiment

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作者	单位
盛 丰	1．长沙理工大学水利学院，长沙 410114；2．水沙科学与水灾害防治湖南省重点实验室，长沙 410114
张仁铎	3．中山大学环境科学与工程学院，广州 510275
刘会海	4．美国劳伦斯伯克利国家实验室，伯克利 94720

中文摘要:

活动流场模型分形特征参数控制着优先流的产生和发展，因此准确获得活动流场模型分形特征参数值对提高模型的模拟预测精度具有重要意义。该研究采用染色示踪方法，将优先流流场从流动背景中显示出来，通过数字图像分析和采样分析获得优先流流场和流场内土壤含水率的分布模式，根据活动流场模型本构方程拟合活动流场模型分形特征参数值；针对3种常见的入渗后染色区内土壤含水率分布模式，分别提供了相应的活动流场模型分形特征参数的计算方法。研究结果显示，1）由于入渗后土壤水重分布的影响，活动流场区域和染色区域在整个入渗深度范围并不完全重合，因此仅可选择活动流场与染色区域相重合深度范围内受土壤初始含水率影响较小的数据来拟合活动流场模型分形特征参数值；2）土壤质地对入渗后染色区内土壤含水率的分布模式有显著影响，细质地土壤中入渗后染色区土壤含水率沿入渗方向逐渐减小，粗质地土壤中入渗后染色区土壤含水率沿入渗方向先增大后减小。

英文摘要:

The active region model (ARM) parameter (γ) controls the generation and development of the preferential flow. Therefore, to obtain an accurate ARM parameter (γ) is essential for getting a precise prediction using ARM. In this study, dye staining methods were used to visualize the preferential flow patterns from their flow background, and the digital imaging procedure and soil sampling were conducted to obtain the distributions of dye stained region and soil water content of stained region, from which the ARM parameter (γ) was estimated by fitting these data according to the constitutive relation of ARM after infiltration. The determination methods for ARM parameter (γ) were presented according to 3 different kinds of distribution patterns of the soil water content of stained region after infiltration. The results indicated that, 1) as a result of soil water redistribution, the active region and the dye stained region might not coincide with each other in the entire infiltrated soil profile, therefore, not all the data (soil water content and fraction of the dye stained region) from the entire infiltrated soil profile but only the data from the soil layer where the soil water contents were under increasing and less affected by the initial soil water contents could be used to determine the ARM parameter (γ); 2) the soil texture generally had obviously significant impacts on the distribution of soil water content after infiltration, making the maximum soil water content of stained region occurred more probably at the soil surface in the fine-textured soil (e.g. silty clay and loam in this research) while making the maximum soil water content of stained region occurred more probably under the soil surface in the coarse-textured soil (e.g. sand in this research).

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